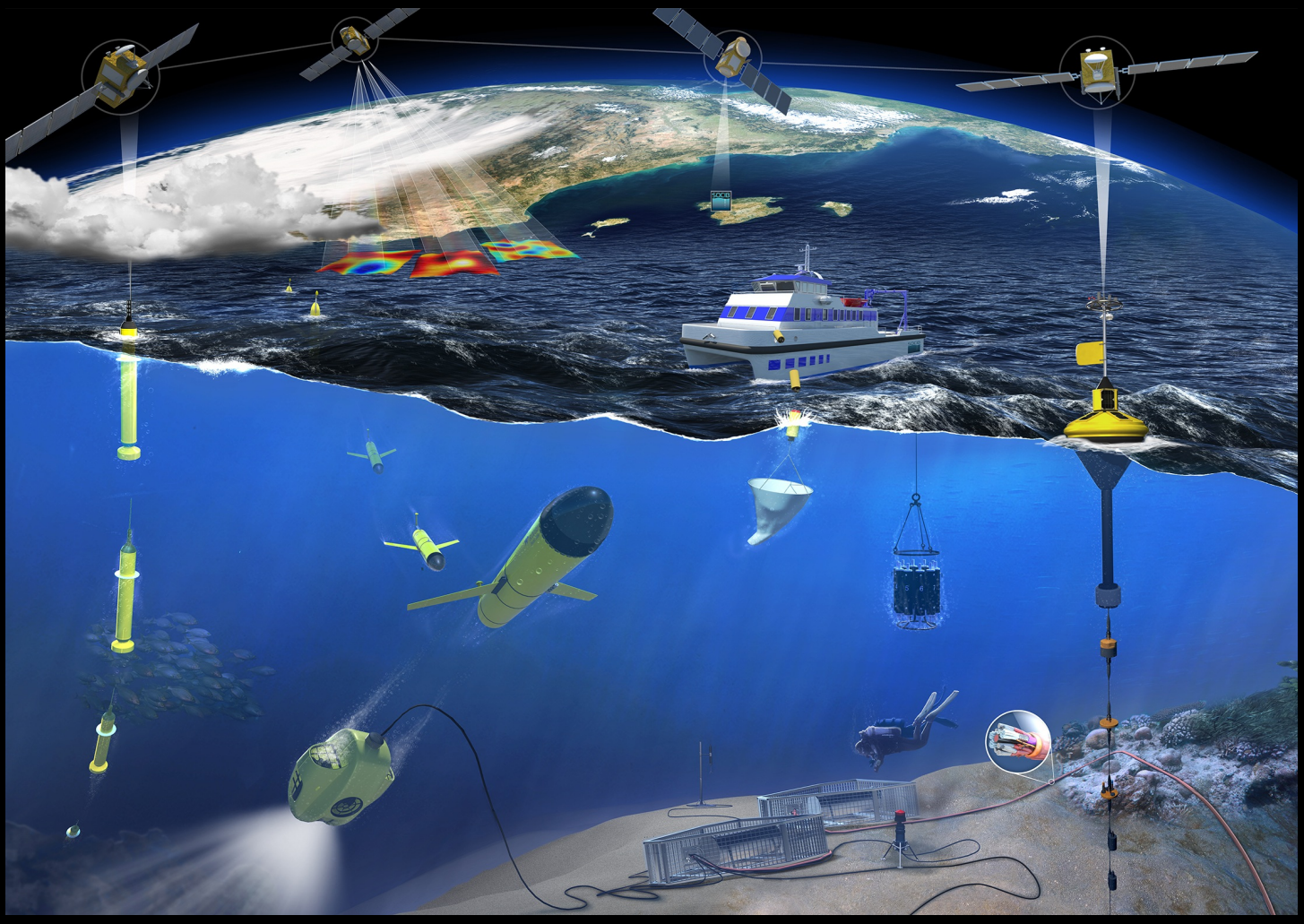
ICTS SOCIB

Strategic Plan 2013-2016



SOCIB Balearic Islands Coastal Observing and Forecasting System

Multi-platform Coastal Ocean Observing and Forecasting System

Towards a sustainable development of coastal areas based on scientific knowledge and technology development

June 30, 2013

Govern de les Illes Balears

GOBIERNO DE ESPAÑA

MINISTERIO DE ECONOMIA Y COMPETITIVIDAD

SOCIB Balearic Islands Coastal Observing and Forecasting System

1 EXECUTIVE SUMMARY

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BACKGROUND

New monitoring technologies are being progressively implemented in the world oceans leading a better description of the oceans state and to major changes in our understanding of the oceans variability. For example, over the last decade the sustained Argo monitoring program has significantly contributed to our understanding of large-scale open ocean circulation. Now, new cost effective monitoring technologies are starting to provide the capability to characterise, at smaller time and spatial scales, not only the ocean circulation but also its variability, in many cases in near real time and both in the open and coastal oceans.

Multi-platform integrated observing systems – also called ocean observatories or marine research infrastructures – that integrate both new and more traditional ocean observing platforms, are therefore progressively being established in the world oceans, in particular at the interface between the open-ocean and the coastal seas (European Commission Report, 2013). **These new observing systems respond to a twofold change of paradigm in ocean observations** (Delaney and Barga, 2009). The first is that the observation of the oceans has evolved from being centred on a single platform, the oceanographic ships, to an observation based on multi-platform and integrated systems relying on buoys, gliders, AUV's, HF radars, drifters, Argo profilers and satellites, to name only some of the potential platforms. The second paradigm change is related to the amount of data and data availability. Historically, only the teams directly involved in data collection had access to the datasets. Today, much data can be quality controlled and available in near real time, and direct access to the data can be provided to all scientists and to society in general. This greatly enlarges the user community and offers the potential to better respond to society needs, with the development of tools for reliable and independent decision support and science based, sustainable ocean and coastal management. This crucial paradigm change in ocean observation is aided by the integration, into the observing systems, of powerful modelling tools, giving rise to new multiplatform observing and forecasting systems that can help us to describe the three-dimensional oceanic structures and understand the underlying physical and biogeochemical processes of multiple interacting spatial and temporal scales that characterise the variability of our oceans and their interactions with the coast.

SOCIB STRUCTURE

SOCIB, the Balearic Islands Coastal Ocean Observing and Forecasting System, is one such system, a new multiplatform observing and forecasting system, a facility of facilities, extending from the nearshore to the open sea. SOCIB is unique in the context of these new observing systems in that its mission responds to three key drivers: science, technology and society.

SOCIB is included in the **Large Scale Infrastructures Programme** from the Spanish Ministry of Economy and Competitiveness (MINECO), and is providing streams of oceanographic data and modelling services to support operational oceanography at a national, European and international level. In line with EuroGOOS, operational oceanography is here understood in a wide sense, including both the systematic long-term measurements of the seas and their interpretation and dissemination, and also the sustained supply of multidisciplinary data to cover the needs of a wide range of scientific research and societal priorities. This will allow a quantitative increase in our understanding of key questions on oceans and climate change,

coastal ocean processes, ecosystem variability, sea level rise, etc. and will also drive us towards a more science based coastal and ocean management.

The **Mediterranean Sea** is a well-known reduced scale ocean, an ideal natural laboratory to study this type of processes, their non-linear interactions as well as the medium and long-term response of the ecosystem. SOCIB takes advantage of the strategic location of the Balearic Islands, at an important Atlantic/Mediterranean transition area and biodiversity 'hot spot', to implement a long-term multi-platform and integrated ocean monitoring system that can support the study in the Mediterranean of ocean processes of global relevance. A well know example of this global to local approach is the study of meso and submesoscale variability, mean flow interactions and ecosystem response, topics where significant contributions have been established along the years, all key contributions of global implication for the understanding of ocean variability.

SOCIB was officially incorporated in April 2008 when the statutes were published (BOE No. 83, April 2008). The Director was appointed in December 2008 and in December 2009 the SOCIB office was opened in the Technological Parc in Palma de Mallorca (ParcBit) with 6 employees. The SOCIB **Design Phase** spanned from early 2009 to July 2010, when the IP2010 was approved by SOCIB Board of Trustees and was just followed by the **Construction Phase** that ended in December 2012 when most of the multi-platform systems were constructed, in place and operational. The **Operational Phase** then commenced in January 2013 when the different facilities started to provide operational data and modelling services through the THREDDS catalogue of SOCIB Data Centre. The seven major Observing and Forecasting Facilities are now operational, supplying data from the nearshore to the open ocean, data are quality controlled following international standards and are all available for visualization, download, etc.

SOCIB ACTIVITIES AND STRATEGIC PLAN 2010-2014

The development and activities of SOCIB as a coastal ocean observing and forecasting system was laid out in the 2010-2014 Implementation Plan (hereafter IP2010), formally approved in June 2010 and available for download from www.socib.es. Over the last 3 years, the construction of SOCIB has for the most part followed the IP2010, both in timescale and budgetary terms. This is a considerable success given the range of the eight facilities constructed and now operational, the relatively short timescale, the size of the SOCIB team and the funding allocated. We are especially proud of the achievements made above and beyond what was foreseen in the IP2010, the success of our partnerships with other regional and national institutions, our scientific contributions and the fact that SOCIB has become a European leader in ocean monitoring and data management. Each facility and service has contributed to this success.

SOCIB in line with IP2010 is in **June 2013 operational** and has reached FOC (Final Operational Capability) of the different facilities and services. It is therefore an established and internationally recognised ocean observing and forecasting system, as described in detail in **Tintoré et al., (2013), see Annex 1**. Formally, as an ICTS, we are in a pre-operational phase, pending official recognition by the Large Scale Installations Spanish Board (CAIS), and this 2013-206 Strategic Plan is a key component for achieving this official status.

SOCIB STRATEGIC PLAN 2013-2016

We are now at an exciting stage of our development, the Operational Phase where we will focus on encouraging the broad use of our data, leveraging the investment made in this monitoring system and bringing the data closer to society through products and services designed to answer issues and support the decisions we are facing with regard to our relationship with the marine environment in the Balearic Islands and the Mediterranean but in a global change context. We will encourage broad use of our data and open access platforms in the scientific community, and seek interact with regional marine and coastal **stakeholders** including for example, policy makers, leisure and commercial marine users, environmental agencies (e.g., responsible of EU Directives implementation) and/or SAR facilities. We will encourage the use of this data through existing and new partnerships and seek to activate the development of additional new society-orientated data based products and services, for example through links with entrepreneurial groups and universities at national and international level. At the same time we will seek to maintain our leading edge as an observing network through selectively extending our observational capability with new technologies, by employing and supporting a core team of data experts, and by seeking a critical international perspective by engaging in international meetings and from the overview and guidance of our Scientific Steering Committee. One of the real challenges for ocean observing systems in the next decades is the integration of new technologies to monitor the variability at small scales and through integration into multiplatform observing and forecasting systems to advance from small to large scales. Another key challenge we face is activating the use of data by stakeholders and decision makers in line with well-established international collaborations (e.g., through EU funded projects).

Our success is driven by our vision (developed back in 2006) to respond to **3 key drivers**; science, society and technology, and by our people. This focus is now progressively being adopted internationally (e.g., Horizon 2020). Into the future we strongly feel that we have an important role to play in providing the long term, regularly sampled, quality controlled and freely available ocean data now required to confront pressing issues associated with ocean use and climate change, for the benefit of both Spanish and European society in a key environment such as the Mediterranean Sea.

The structure of this SOCIB Strategic Plan 2013-2016 follows the structure and contents formally requested in the MINECO letter from February 27, 2013. We first present a general overview and describe the major elements and structure of SOCIB, and next present and describe in detail the developments and advances of SOCIB from July 2010 to June 2013, the facilities constructed and placing our operations within a national and international scientific and society context and within the existing socio-economic frame. The major achievements from the different facilities are highlighted as well as some examples of recent scientific results, also discussing the resources and the data, products and services developed and available. A detailed critical analysis has been carried out and is discussed. Finally we outline the objectives, strategies and the specific actions planed for the development of SOCIB facilities and services from 2013 to 2016. The report closes with a section that presents the Directors view/conclusions.

References:

Delaney J. R., R. S. Barga: 2009: A 2020 Vision for Ocean Science. pp. 27-38. In “The Fourth Paradigm”. Microsoft Research.

European Commission, 2013: Towards European Integrated Ocean Observation. Expert Group on Marine Research Infrastructures. Final Report. 96 pp. ISBN978-92-79-27319-3. doi: 10.2777/29343.

Tintoré, J., Vizoso, G., Casas, B., Heslop E., Pascual, A., Orfila, A., Ruiz, S., Martínez-Ledesma, M, Torner, M., Cusí, S., Diedrich, A., Balaguer, P., Gómez-Pujol, L., Álvarez-Ellacuría, Gómara S., Sebastian K., Lora, S., Beltrán, J.P., Renault L., Juzà, M., Álvarez, D., March, D., Garau, B., Castilla, Cañellas, T., C., Roque, D., Lizarán I., Pitarch S., Carrasco M.A., Lana, A., Mason E., Escudier R., Conti, D., Sayol, J.M., Barceló, B., Alemany, F., Reglero, P., Massuti, E., Velez-Belchí, P., Ruiz, J., Gómez, M., Álvarez, A., Ansorena L., Manríquez, M., 2013: SOCIB: the Balearic Islands Observing and Forecasting System responding to science, technology and society needs. Mar. Tech. Soc. J., Vol. 47, N. 1. 17 pp.

SOCIB Balearic Islands Coastal Observing and Forecasting System

2 ICT SOCIB: DESIGN, CONSTRUCTION AND PRESENT STATUS

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2.1 ICTS SOCIB VISION AND MISSION

Vision

Our vision is to advance on the understanding of physical and multidisciplinary processes and their non-linear interactions, to detect and quantify changes in coastal systems, to understand the mechanisms that regulate them and to forecast their evolution and/or adaptation under, for example, different IPCC scenarios. Specifically addressing the preservation and restoration of the coastal zone and its biodiversity, through the analysis of its vulnerability to climatic change and through considering new approaches, such as the SOCIB Bluefin Tuna multidisciplinary study and in the near future connectivity studies and Marine Protected Areas optimal design, to advance and progressively establish a more science based sustainable management of the ocean and coastal areas.

SOCIB aspires to become an internationally recognized coastal observing and forecasting system, a reference facility, contributing to scientific excellence, technology transfer and knowledge dissemination, capable of adapting and responding to society's needs and by this contributing to narrow the 'science-policy' gap[1].

Mission

To develop a coastal ocean observing and forecasting system, a scientific and technological infrastructure that provides free, open, quality controlled and timely streams of oceanographic data, in order to: (1) Support research and technology development on key internationally established topics such as: the role of the ocean in the climate system at an inter-annual scale, the interaction between currents and eddies, addressing vertical exchanges and physical and ecosystems variability, the variability in nearshore morpho-dynamics and the sea level variability in response to climate change. (2) Support (on a longer term) strategic needs from society in the context of global change: sustainable management, science-based mitigation and adaptation strategies and also policy development and operational tools for decision support. (3) Consolidate operational oceanography in the Balearic Islands, in Spain and Europe, contributing to the establishment of a well-structured center of excellence in an international frame (e.g., GOOS, EuroGOOS, MONGOOS).

[1] in line with Lubchenco and Sutley (2010, *Science)* and following the work of Economy Nobel Price, Elinor Orstom, 2012*: The Future of the Commons; Beyond Market Failure and Government Regulation*. *The Institute of Economic Affairs*.

2.2 ICTS SOCIB STRUCTURE

SOCIB, following the IP2010, is composed of three Divisions, supported by three cross Division Services and the Office of the Director, which is responsible for managing the divisions, services, governance issues and strategic direction.

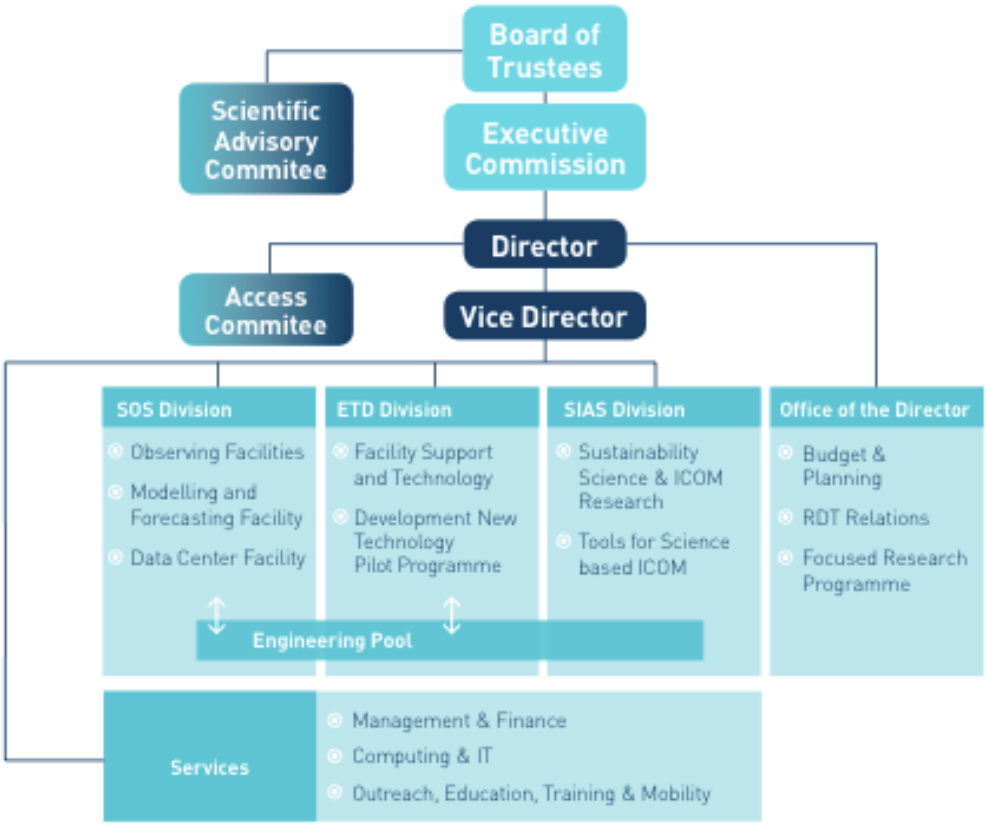


Figure 2.2a: SOCIB Structure

The Divisions are organised into the Systems Operation and Support Division (SOS), essentially the observing and forecasting facility division, the Engineering and Technology Development Division (ETD), a technical division that manages technical resources and deploys new technology, and the Strategic Issues and Applications for Society Division (SIAS), that seeks to understand and bridge the gaps between society, policy, science and observations. The central support services are the Management and Finance Service, the Computing & IT Service and the Outreach and Education Service.

In summary:

- The SOS Division: composed of 8 facilities, the Coastal Ocean Research Vessel Facility, HR Radar Facility, Glider Facility, Mooring Facility, Drifter Facility and Beach Monitoring Facility, the Forecasting and Modelling Facility and the Data Centre Facility.

- The ETD Division: provides the engineering and technological backbone to develop and operate the Observing Facilities network and is responsible for the practical integration of new and emerging technologies.

- The SIAS Division: develops applications and operational tools for science-based management of the coastal and marine environment, within the context of sustainability science.

- Management and Finance Service: manages the financial and human resources aspects of SOCIBs operation

- Computing and IT Service: manages the essential IT and computing infrastructure

- Outreach and Education Service: manages the creation of the SOCIB visual identity and and the communication of SOCIB news and activities across different media and sectors

- The Office of the Director: responsible for planning, overall management, and communication with stakeholders and governing bodies.

This structure was designed in order to respond effectively to the key SOCIB mission and drivers, that is to provide oceanographic data to support research and technology development on key internationally established topics, to support the strategic needs of society in the context of global change, and to consolidate operational oceanography and associated marine technology development in the Balearic Islands and in Spain. Some minor adjustments have been made in the initially foreseen structure, as SOCIB needs evolved and the administrative constraints regarding new contracts changed.

Integrated into the SOCIB infrastructure, through partner agreements, are key regional, national and international research institutions with which SOCIB shares resources (see section 2.6) and experiences, in order to maximise the advancement of marine and coastal research and promote the most efficient use of public funds. Important agreements have been reached with CSIC, IEO, Puertos del Estado, Ports de les Illes Balears, Instituto Hidrográfico de la Marina, Mercator Ocean, MONGOOS, among others.

2.3 ICTS SOCIB OVERVIEW OF DEVELOPMENT AND ACHIEVEMENTS FROM CONSTRUCTION TO OPERATIONAL CAPABILITY (2010-2013)

In just three years the SOCIB team has worked towards a common goal in constructing an internationally recognised, leading edge coastal ocean monitoring and forecasting facility; a facility of facilities, capable of observing the ocean state from the nearshore to the open ocean, streaming and visualising data real time through the SOCIB data portals and capable of supporting open access for teams of outside scientists.

The hard work and dedication of the SOCIB team and many others in our key partner organisations has developed an organisation that not only meets the vision we expressed in IP2010 but also provides Spain with a lean, agile, leading edge ocean observing structure to support science based coastal and open ocean management. An organisation both capable and ready for the new challenges both of science and society ocean research needs.

KEY HIGHLIGHTS

- The eight facilities comprising the SOS Division have been implemented and are now all considered to have reached Final Operational Capability (FOC), providing real time and delayed mode streams of oceanographic and meteorological data.

The Coastal Research Vessel Facility R/V SOCIB is a fast 24 m catamaran, equipped for modern, multi-discipline ocean science, and capable of sustained operations of up to 5-7 days at sea. She was delivered to Palma de Mallorca, on budget, in December 2012 after sea trials and has already completed initial IEO and SOCIB cruises. She is a regional and European asset, available for external users as part of the Spanish oceanographic fleet (COCSABO), offering labs, a suite of oceanographic equipment at a lower daily cost than larger vessels. She is formally managed with the participation of IEO and CSIC.

The R/V Facility achieved FOC in early 2013.

The **Coastal HF Radar Facility** operates in the Ibiza Channel at 13.5 MHz and provides hourly surface current maps with a spatial resolution of approximately 3 km and a range reaching up to 40 miles offshore. It has required considerable and sustained interventions from both SOCIB and the manufacturer during a 9-month installation and set-up period in 2012. However the facility now provides detailed real time 24/7 data that can be fully exploited by the Modelling Facility and other regional and international users.

The Coastal HF Radar Facility reached FOC in Oct 2012 when the calibration of the antennas was carried out, with a new calibration more recently in April 2013.

The Glider Facility is a leading European operation and a flagship facility for both SOCIB and Spain. The SOCIB glider fleet consists of 7 gliders (including in-kind support from IMEDEA with 3 gliders), with 2 technology platforms supported (Slocum and Seaglider). A leading monitoring resource in a Mediterranean context, the Glider Facility has the potential to offer a national capability. The facility maintains one sustained and semi-permanent endurance line in the Ibiza and Mallorca channels in order to understand spatial and temporal variability in the Mediterranean circulation and also supports open access to the platforms for more focused process studies, thus enabling outside scientific groups to access this new platform for

oceanographic research. The open access capacity is for 90 glider days at sea and a first open access mission was successfully carried out during 45 days (Febuary – March).

The Glider Facility reached FOC in Jan 2013.

The Lagrangian Facility manages the deployment strategy for Argo floats and surface drifters, which form a significant part of the Spanish contribution to the international Argo network and the Global Drifter Program respectively. Through the annual deployment of 2-3 Argo floats and 8 drifters SOCIB directly contributes over the long term to maintaining a consistent spatial coverage in the north western Mediterranean, intended to meet the needs of, amongst other users, global climate models. The facility has an automated QC protocol and data available through SOCIB website and the regional Argo GDAC.

The Lagrangian Platforms Facility has been at FOC since Oct 2012.

The Fixed Stations Facility is becoming a key regional service for the operation of fixed oceanographic stations. The facility streams data in real time data from 4 networks of ocean and weather sites (11 platforms), providing continuous timeseries of essential water and weather variables that can be incorporated into a broad range of applications for science and society. The Facility is marked by its successful and supportive partnerships with local institutions. In June 2013, a new Met-Ocean deep-water instrumented buoy was moored in the Ibiza Channel location (inside the HF radar coverage area) and will assume responsibility for additional damaged or under-funded oceanographic stations as requested by the Balearic Islands harbours regional authority. Thus becoming a true regional data hub for essential continuous timeseries of water variables.

The Fixed Stations Facility has reached FOC in June 2013, with the installation of the Ibiza channel met-ocean deep buoy.

The **Beach Monitoring Facility** is a technology leader in the monitoring of the short to long-term evolution of beach morphology. Its system of beach installations and associated field campaigns is unique and delivers data streams to meet science needs at cost level that is sustainable, and is being adopted by the Spanish Coastal Research Community and institutes internationally as reference system. Specific societally focused data products, such as for the tourism sector, are foreseen.

The Beach Monitoring Facility reached FOC in Feb 2012.

The **Modelling Facility** has implemented three different operational systems: a high-resolution ocean current forecasting system (WMOP), a wave forecasting system (in collaboration with Puertos del Estado) and a meteotsunamis forecasting system (pre-operational). These systems are continually improved and tested through specific process studies, thus contributing to both enhancing our scientific understanding and our modelling skills and capabilities. The ocean currents forecasting system (WMOP) is now providing predictions in the Balearic Islands and adjacent sub-basins and the wave forecasting system in the region South of Mallorca is also operational, in collaboration with *Puertos del Estado*.

The Modelling & Forecasting Facility reached FOC in June 2012.

The **Data Center Facility** takes streams of data from the SOCIB Observing and Modelling Facilities and some SOCIB Partners, applies automatic data specific and internationally established quality controls, then archives and streams the data for display through SOCIB and

other web portals. It is the data hub of the SOCIB structure. The Archived data is made available over the long term for search and discovery in a (THREDDS) catalogue system and this data access capability will be expanded in the future to encompass advanced data combination and user specific applications. The infrastructure, technology development and knowledge required to achieve this level of data management is non trivial and the Data Center Facility could provide regional/national marine data services in the future (as expressed by the Board of Trustees of SOCIB in 2012).

The Data Center moved to FOC as data streams from each of the 6 observational facilities became incorporated, it can be considered to have reached a final FOC in January 2013 with the incorporation of the first datasets from the SOCIB R/V Facility.

IN ADDITION:

- SOCIB has earned a strong international profile, as a leading edge ocean observing and forecasting system, formed along international lines, innovative in its focus on society needs and a European leader in glider and data management operations
- Open Access to the SOCIB Facilities was initiated in 2013, with the first open access glider mission
- Important resource sharing partnership agreements have been signed with CSIC, IMEDEA (CSIC-UIB), IEO and Puertos del Estado, Ports de les Illes Balears, etc. providing for a vital interchange of resources and the efficient use of public funds within the regional and national context
- SOCIB has achieved or contributed to a significant scientific output, in terms of papers in peer-reviewed journals, participations in meetings, conferences, workshops, projects and invited lectures.
- R/V SOCIB was delivered on budget and on time and has now successfully completed several missions.
- Data from each Facility is displayed in near real time through a facility specific web page and is sent to key European marine data portals, such as Coriolis, SeaDataNet and EGO, amongst others.
- The creation of SOCIB applications for modern web browsers and mobile platforms, for example the SOCIB App for Smartphones, and the Beamon (beaches) or SaCosta viewers

All the facility development been made possible through the strong cross facility support provided by the ETD Division, and Services. The ETD Division providing field and engineering operational support, the Outreach and Education Service in creating a strong and appealing visual identity across different media and sectors, and the Management and Finance Service and Computing and IT Services providing a strong and well-managed infrastructure. In addition, some SOCIB Facilities have been supported by strong regional in-kind contributions from IMEDEA (CSIC-UIB) and IEO, in terms of personnel and infrastructure.

SUMMARY OF MAIN DIFFERENCES IN FOC WITH RESPECT TO THE IP2010

ICTS SOCIB has developed remarkably in-line and on time with respect to the plans as outlined in the SOCIB Implementation Plan of 2010 (hereafter IP2010). The IP2010 anticipated a January 2010 start date, however as the plan was formally approved in June 2010, a 6-month delay should be considered when comparing the schedule outlined in the IP2010 with the

subsequent and actual ICTS SOCIB development schedule. The IP2010 outlined 3 phases of development:

- **Design Phase (completed June 2010)**
- **Construction and Equipment Phase (completed December 2012)**
- **Operational Phase (commenced in 2013)**

The Design Phase was completed with the approval of the IP2010 in June 2010 and the Construction and Equipment Phase was completed in December 2012, when all 8 of the SOCIB Facilities (as outlined above) reached Final Operational Capability (FOC). Overall this is some 6 months behind the schedule outlined in the IP2010, however that some facilities reached full operational capability on time, despite the delays. This is a significant achievement, considering the number of facilities that have reached FOC and is a credit to the hard work and determination of the SOCIB team.

The IP2010 also foresaw the development of forecasting tools and the staged release of SOCIB data products and services, much of which has been achieved, see specific Section 2.5 Data, Products and Services for details. In addition key partnership agreements were to be established and again this has been achieved, see Section 2.6 Access and Coordination.

In summary, SOCIB has successfully completed the design and construction phases and is fully operational since the start of 2013 and in general as anticipated in the IP2010, this is in great part due to the hard work of all the members of SOCIB team, the governance boards and many others in our key partner organisations. We are now excited about further development in the operational phase

Another important element foreseen in IP2010 was the consolidation of the dispersed SOCIB locations (much of the technical space is provided in-kind by IMEDEA (CSIC-UIB)) into a single combined technical and office location (2,500 m^2: 600 m^2 offices and 1,400m^2 of labs and warehouses). This has been a focus for the Office of the Director during the last 9 months (since September 2012). Currently, June 2013, a specific proposal is being discussed with *Autoridad Portuaria de Baleares* (APB).

As would be expected there are some differences in the configuration of the SOCIB Facilities and the achievement of FOC with respect to that as outlined in the IP2010. The detailed differences between the operational SOCIB of today and that as foreseen in 2010 are provided in the detailed per Facility, Division and Service description provided in Section 2.4, below. In these details it can be seen that in certain aspects the IP2010 was over ambitious in its aims, in what could be achieved in the timescales, with limited personnel and with un-anticipated events, such as storm damage and manufacturer problems. In addition, delays in the release of funds[2] allocated for SOCIB operations and personnel has meant that some investments were postponed in order to maintain sufficient levels of financial liquidity (as discussed in Section 2.7 Resources), which delayed development for some facilities. The national freeze in the hire of public sector personnel, commencing in 2012 and still on going, combined with the national freeze in public sector salary levels, has combined to make replacing personnel, who left for higher remuneration internationally, difficult (this is discussed in Section 2.7 Resources). This has also delayed the development plans of some facilities and caused significant difficulties in the day-by-day workload for the remaining employees.

[2] given the general finantial situation the two SOCIB Consirtium partners and funders, the Balearic Government and the Ministry of Economy and Competitiveness, have been at times in 2011 and 2012 unable to release on time the comitted funding for reasons not under their control; the situation in June 2013 is improving.

However, at the same time, it should be noted that SOCIB has responded to new opportunities and adapted to reflect the changing needs of society, and, in doing so created new elements that were not foreseen in the IP2010, but which are very much in line with our mission, vision and objectives.

Below is a summary of the main differences in the development of SOCIB as compared to the IP2010, with a note as to the cause, as discussed above the details are in the detailed development descriptions in Section 2.4:

- The Glider Facility has purchased 4 of the 6 gliders anticipated in the IP2010; although authorised in 2012, the purchase of the 2 final SOCIB gliders has not yet been made due to uncertainty regarding funding (mostly due to delays in the reception of partners contribution). This in turn has affected our ability to support the second endurance line foreseen in IP2010. However it is anticipated that the glider purchases will go ahead in 2013 and the second endurance line can then be initiated.
- The Beach Monitoring Facility has 3 beach monitoring sites, 1 less than anticipated. The Ibiza site for the beach monitoring has not yet been made due to uncertainty regarding funding (same as above). The Bay of Palma monitoring system has been expanded and is now a unique system worldwide.
- The New Technology Implementation/Pilot Programme Unit, ETD Division, has not been developed, as the investment in equipment has not been made due to the uncertainty regarding funding.
- The Fixed Station Facility has not yet deployed one of the moorings foreseen in the IP2010, due to uncertainly in the funding situation and in part due to over optimism in the IP2010 with regard to the availability of ETD resources. The installation of this final mooring (Formentera/Eivissa natural park) has been delayed, until the funding situation is more stable. However the Fixed Station Facility will be taking on additional stations not anticipated in the IP2010 for the Balearic Islands Harbour Authority.

In summary the main differences are caused by a) the IP2010 being overly optimistic and b) the recent economic uncertainty, which has led to delays in the payment of SOCIB operational funding and a freeze in public sector employment contracts and salaries. The delays in payments have had a significant impact on the final stages of the facilities development causing SOCIB to delay investments (see Section 2.5) and experience delays in the recruitment of key personnel.

2.4 ICTS SOCIB DETAILED DEVELOPMENT AND ACHIEVEMENTS BY FACILITY DIVISION AND SERVICE (2010-2013)

In this section we provide the important detailed development of each Facility, Division and Service from 2010 through to June 2013. This section is important; it is the work of the individual teams responsible, which is evident from the differing content and focus of each. However it is also one of the strengths of SOCIB that this individual focus on excellence and goals within the different facilities and services, all clearly work towards the common SOCIB vision, mission and objectives. As can be seen in the collective achievements, the critical analysis (specifically the SWOT and the socio economic impact) and finally in the future plans, which clearly show that the actions of the individual facilities, Divisions and services, in combination, contribute across the key strategy lines identified for the next period 2013 – 2016.

For each one, we first present a short description, followed by the aims for the 2010-2013 period, the major achievements and the difficulties faced and overcome. Where relevant the scientific contributions is also noted and a SWOT is provided.

2.4.1 COASTAL OCEAN RESEARCH VESSEL FACILITY

2.4.1.1 Description

The SOCIB Coastal Ocean Research Vessel, R/V SOCIB, is a modern, fast catamaran of 24 m length, fully equipped for coastal and open ocean oceanographic operations, able to operate for up to 7 days continuously, with wet and dry labs available (see following page for the R/V SOCIB catamaran Fact Sheet). This is an important new oceanographic platform for the Balearic Islands, cost effective and modern she will enable greater flexibility in operations at sea and support new oceanographic research initiatives for both scientists and engineers at the regional oceanography related institutions; SOCIB, IMEDEA, COB IEO, and UIB, as well as national/international groups on application.

Delivered in August 2012 and completing scientific sea trials in Palma in Dec 2012, she has now already successfully completed initial operational cruises for both IEO and SOCIB, and has several others are planned in 2013. She is currently managed by IEO, under a partnership agreement between IEO and CSIC and available for open access through COCSABO, as part of the SOCIB Open Access Program. She will also form an important platform for educational outreach activities. It is also worth noting that the R/V SOCIB was delivered to time and to budget.

A brochure is in preparation to advertise the capabilities of R/V SOCIB (see initial version SOCIB R/V Poster enclosed below).

R/V SOCIB characteristics

A micro-documentary on the R/V SOCIB construction process, displaying the different phases of the construction was released on October 26, 2012 and is available through the SOCIB web site as well as images and photos of labs and activities of operations at sea.

Specific requests from the offshore and survey industry sectors are already reaching SOCIB and a first charter is envisioned for August 2013.

2.4.1.2 Aims 2010 – 2013

The SOCIB R/V has been one of the major objectives since the inception of SOCIB. The idea has been to create a new type of coastal ocean research vessel, well equipped, versatile for multidisciplinary operations, rapid in terms of ability to respond to emergencies, and efficient in terms of time and fuel consumption. With this vessel, a gap in the oceanographic capability in the Balearic Islands and the Western Mediterranean is covered.

The IP2010 envisioned 150 days at sea available for oceanographic operations per annum, of which 60 were related to SOCIB monitoring operations and 90 available for external access.

It was intended from the outset that the vessel would be an example of good practice in the sense that different public organisations would participate in the development, use and management of the vessel. CSIC, IEO and SOCIB itself are the principal organisations to be part of this system, that will use the vessel in a highly efficient manner, sharing expertise in their respective fields (both scientific and management) and setting an example for future use of public research resources. Charter for external companies is also envisioned.

2.4.1.3 Achievements and review current status of the facility (2010 – April 2013)

During 2010 the primary task was to establish the detailed characteristics of the catamaran, in line with IP2010. The major elements were reviewed and established, including all the details on interior space, deck space, laboratories, accommodation, crew, propulsion, fuel and water consumption, etc. At the same time, detailed analyses of the projected operating costs were also carried out addressing different scenarios of operation (8 hour or 24 hour days for example).

Finally, on December 12, 2010, SOCIB published the tender for the construction of a 24 m coastal oceanographic catamaran. The details can be found on the SOCIB web pages (Contractor Profile section). The contract was finally awarded to Rodman Polyships, SAU, based in Vigo.

The construction started in September 2011. To monitor construction, and to assess that construction was progressing well in accordance to all the technical specifications, SOCIB had the support of two CSIC members of staff with more tan 30 years of experience in the shipping industry. Mr. Mario Manriquez, formally from CSIC-UTM in Barcelona, visited the shipyard weekly and reported monthly on the advances in the construction to the Director of SOCIB. Mr. Manriquez was assisted in this work by Mr. Luis Ansorena (CSIC-UTM) based in Vigo, who maintained an almost daily record of activities and progress.

Finally, on August 31, 2012 the catamaran was delivered to SOCIB in Vigo. Between September and November, tests of navigability and general operation of the catamaran and its scientific equipment were carried out.

One of the difficulties at that time was that due to delays in receiving the 2011 and 2012 funds, the crew could not be hired, therefore these tests had to be carried out with support from CSIC crews based in Vigo, and at a later stage (mid October 2012), with support from IEO who provided a Captain for the catamaran. It was also at this later stage that SOCIB committed funds to contract a chief engineer.

The tests were completed and on November 29, the catamaran sailed from Vigo to Palma, arriving in Palma 5 days later. A berth in Palma harbour was obtained from APB (*Autoridad Portuaria de Balears*) and the primary task for December 2012 was to implement the computer facilities on board, including telecommunications and the data network. For this, we again had the collaborative support of CSIC (UTM and IMEDEA).

Given the difficult financial scenario, the SOCIB Office of Director prepared an agreement for the management and operation of the catamaran to assure the operations during 2013 even if SOCIB funds would not be received. It was considered, given the economic scenario across Spain and Europe and in the continued absence of SOCIB funding for 2011 and 2012, that a close coordination between SOCIB, IEO and CSIC, would be the best way to manage this first phase of commissioning of the catamaran. Each of these three institutions would contribute with their own strengths, sharing capabilities and thus avoiding duplication. After several meetings, an agreement was finally reached, by which IEO would provide the crew and operate the catamaran, while CSIC would be providing technical support for the operation of scientific equipment. The agreement was finally signed on January 1st, 2013.

This agreement also established that the SOCIB catamaran is incorporated into the IEO fleet, and that ship time requests by external users will be through COCSABO, the Spanish Ministerial Commission for Ship Time request and coordination. Internationally, the SOCIB

R/V has been included in EurOcean, the European initiative that coordinates ERVO, the European Research Vessels Operators where SOCIB is formally included since 2012. It is expected that international requests for ship time will step by step be received from both the public and private sectors. TNA agreements with EU funded projects will be encouraged.

In summary, the catamaran was ready for operation by early February 2013. A fact sheet was prepared and is available on the Web.

For 2013, SOCIB had initially estimated (in IP2010 and Action Plan 2012) to use a maximum of 60 days of operation, including routine monitoring campaigns in the Balearic Sea, and the maintenance of buoys and moored equipment around the various islands. Subsequently, as a result of the financial situation already explained above, and the excellent joint commitments with IEO in the monitoring programme of the Balearic channels, as well as the convergent interests in EC funded projects such as PERSEUS, the SOCIB Office of Director decided that there would have to be a significant reduction in SOCIB's R/V activities for 2013. However, it is expected that this situation will be back to 60 days of operation in 2014.

From February 13 to June 30 2013, the catamaran successfully completed 7 oceanographic cruises with a total of 74 days at sea (mostly from IEO), 12 days at Cartagena for work and maintenance and 6 days of transit between Palma and Cartagena. In July and August, 23 days at sea are planned. This indeed shows that the R/V SOCIB is being nicely used in its first year of operation, above the initial expectations described in IP2010 (page 46) where 115 days were indicated for the first year.

HUMAN RESOURCES

In order to supervise the construction of the vessel and weekly inform the Director, SOCIB had the collaboration of two expert technicians from CSIC during this phase: Mario Manriquez and Luis Ansorena, both from UTM CSIC.

Also from the UTM CSIC, two IT engineers, together with SOCIB personnel, dedicated a significant number of days in order to install and test the IT system on board, this system has the capacity to store and transfer data very efficiently.

As for the crew, once the vessel was delivered at the end of 2012, an agreement with IEO for the management of the vessel was signed, including the provision of the crew for normal 8 h operations; a captain, a chief engineer, and a mate/cook. Depending on the length of any specific campaign, this crew is complemented by a number of extra marine staff up to 8 (including since June 2013 an electronic engineer responsible for scientific equipment operation and data management in coordination with SOCIB Data centre).

INVESTMENTS

The construction of the vessel was published for a total amount of 4,128,000 €. The major scientific elements on board are the following: MOCNESS (153,301€), CTD (280,388€), salinometer (46,987€), ADCP (69,926€), continuous surface water analysis (36,838€), on top of which there were numerous other minor components.

ACHIEVEMENTS NOT ANTICIPATED IN THE IP2010

It is worth mentioning that after discussion with the Balearic Islands Government and the Ministry of Economy and Competitiveness of the possibility of having European regional funds (FEDER) to finance the construction of the vessel emerged. Both parties agreed with the potential to access to this source of finance and, after an evaluation of the project, the vessel was favourably looked upon and financed to 50% through this route. A press release was prepared in November 2012. After an evaluation meeting in Palma with EU officials in June 2013 visiting the R/V SOCIB, we have just known that they have considered including the construction of R/V SOCIB as an example of Best Practices for EU funding.

SWOT

Weaknesses	Strengths
• Management of the crew is undertaken by SOCIB (although this is also a strength in terms of efficient regional cooperation)	• Collaboration with regional institutions • Designed in consultation with regional stakeholders to meet the regional organisations needs • Low fuel consumption at 12-14 knots (in line with estimations) which make it an efficient platform • Robust performance in poor weather conditions • Proven platform for existing monitoring operations (e.g. RADMED) • Modern equipment for oceanographic research, data archiving and transmission
Threats	**Opportunities**
• Current economic situation	• Rapid response capacity • Open access (nationally) through COCSABO, interest has already been expressed by scientists in the national system and internationally • New science missions in the Balearic islands • Commercial interest in use of vessel

AREAS OF MAJOR IMPACT IN THE NEXT 5 YEARS: SCIENTIFIC, TECHNOLOGICAL AND SOCIETAL

The R/V SOCIB has just started operations but we are convinced that this new type of R/V will be contributing to scientific priorities, technology developments and also will increase our capabilities to respond to society needs. Also important, it will drive innovation and increasing collaboration between the public and private sector in the islands.

2.4.2 COASTAL HF RADAR FACILITY

2.4.2.1 Description

The HF Radar facility has been installed on the West coast of Ibiza, at the Puig of Galfi, and on the West coast of Formentera Island (Figure 2.4.a.) to monitor the currents in the Ibiza Channel, a well-known biodiversity hot spot. The system is formed by two CODAR antennas, handled and installed by Qualitas S.A. The two antennas named GALF and FORM, respectively, are 34 km apart. The system is completed by a storage and processing server at SOCIB. The antennas transmit and receive the reflected signal, scattered by the rough surface of the ocean. The signal reflection is caused by waves and allows us to calculate the surface currents.

The Ibiza HF Radar has a signal of 13.5 MHz transmission, which gives surface current maps with a spatial resolution of approximately 3 km, hourly, and a range reaching up to 40 miles offshore. The system is in place and data are available from June 2012. An in situ calibration field experiment was carried out in September 2012 when 2 surface drifters were used. Results obtained during 2012 were only partially acceptable and discussions with the supplier of the HF Radar antennae, Qualitas S.A., were frequent during this period to improve coverage and the percentage of good data.

The HF radar data will be essential in establishing the variability of the surface conditions in the Ibiza channel, including specifically the characterization of the intensification of the north-eastward inflow of recently Modified Atlantic Waters. The data are also important for the validation of numerical ocean models, WMOP in particular (and more generally MyOcean), and in the longer term, for assimilation to improve forecasting skill.

Figure 2.4.a. Position of the HF Radar Antennas (Ibiza and Formentera).

2.4.2.2 Aims 2010 – 2013

As indicated in IP2010 they are:

2010-2012:

- Construction of Ibiza Channel HF Radar site
- Integration of data streams and data available at SOCIB Data Centre Facility (June 2012)
- Quality Control procedures developed and implemented across the datasets.
- Statistical procedures developed to complete the gaps produced in the HF Radar coverage. Integration of the data into the SOCIB data portal.
- Initial products tested.

2013-2014:

- Filtered data will be integrated into the SOCIB data portal (2013-2014).
- Standardize HF Radar data validation with drifter and moored ADCP data (2013-2014)
- Standardize WMOP SOCIB validation with HF Radar data

2.4.2.3 Review current status of the facility (2010 – April 2013)

ACHIEVEMENTS

- Contract awarded ..... May 2011
- Construction of the first HF Radar site, Formentera ..... Dec 2011
- The negotiations with the Local Authorities in Ibiza and Formentera regarding site permissions, telecommunications and power were completed and sites constructed. Final completion of the Formentera site was at the end of 2012.
- Completed construction and installation of GALF and FORM antennas..... June 2012
- SOCIB Web Observing and Data Access Facilities NetCDF data available... Aug 2012
- HF Radar layer in the Dapp application ..... Aug 2012
- HF Radar section on the SOCIB web site..... Oct 2012
- HF Radar data visualization in the Lw4nc2 application ..... Oct 2012
- Antenna Pattern Measurement (APM) calibration at GALF and FORM ..... Sept 2012
- TOSCA cruise; Med TOSCA project drifters were launched for the HF Radar data (Figure 2.2b) validation ..... Oct 2012
- Measurements of the receiver antenna pattern are required to determine the direction of arrival of the ocean echo. Determining the distortions from the ideal response functions is necessary to accurately calculate the radial current fields; these distortions are determined and corrected for by carrying out a suitable APM survey. The APM survey requires a boat (supported by SOCIB), a transponder (supported by Qualitas S.A.) and a GPS receiver. An APM calibration should be performed periodically in order to maintain HF Radar data quality. ..... Dec 2012
- HF Radar Course given by Qualitas S.A. staff. The objective was to provide an introduction to HF Radar measurements ..... Jan 2013
- SOCIB Participation at the National HF Radar meeting ..... Mar 2013
- Antenna Pattern Measurement calibration at GALF ..... Apr 2013

- Drifters launched in the GALF area to provide surface current data for the validation of the HF Radar data ..... Apr 2013

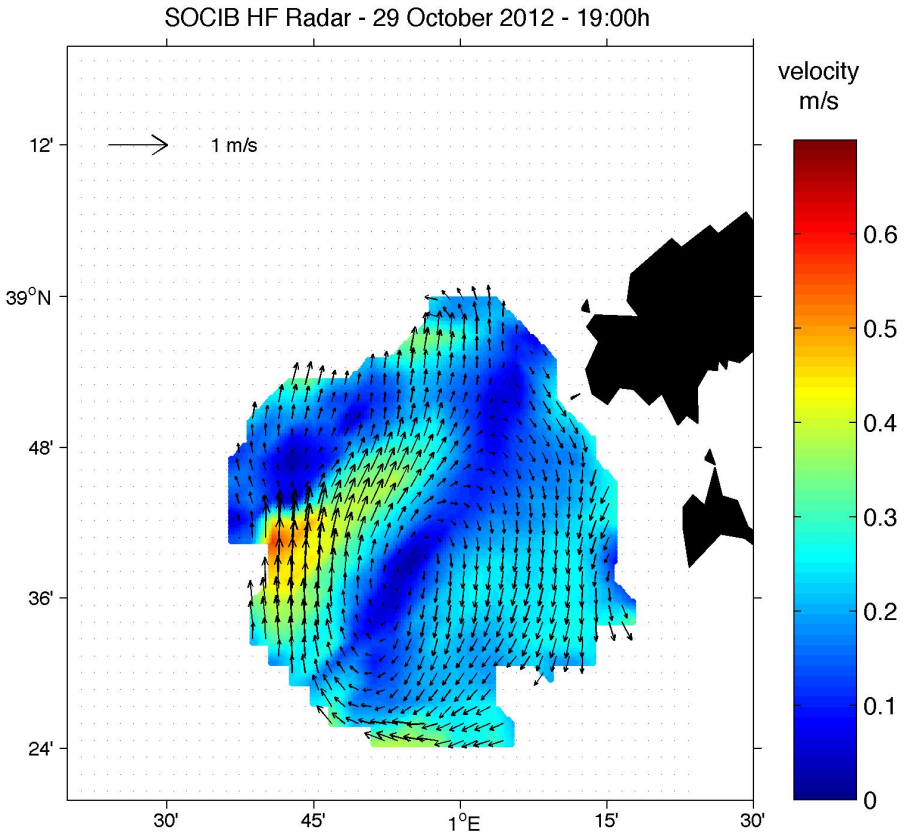


Figure 2.4.b. HF Radar data during the Med TOSCA experiment.

SCIENTIFIC CONTRIBUTION

It is too early to present any specific scientific contribution. Specific contributions are expected in terms of the variability of the northward inflow of Modified Atlantic Waters in Ibiza channel, as well as a key support validation and later assimilation element for operational modelling (WMOP; MyOcean, etc.). SOCIB participated at the HF National Radar Meeting, with a presentation entitled: 'SOCIB HF Radar. Ibiza and Formentera' (linked to the SOCIB web page: **http://RedNacionalHFRadar.pdf).** The meeting was organized by Puertos del Estado in Madrid in March 2013.

2.4.2.4 Current status with reference to IP2010

Overall the IP2010 program has been delayed by 12 months (FORM) and 16 months (GALF). This was caused in part by the initial 7 months delay in approval of the IP2010, followed by an additional 6 months delay at the contract stage, when the nature of the tender required formal publication in the official state bulletin (BOE) and the award of the contract was consequently contested.

The system was delivered in June 2012. However, during 2012 and at the beginning of 2013 different problems with the antennae produced a total spatial coverage below our initial expectations (see Figure 2.4.b, 2.4.c and 2.4.d. for HF Radar spatial and temporal coverage). In particular, the following problems were encountered:

- FORM power cut.
- GALF fault, due to humidity in the cables.
- GALF fault, due to issues with the Mac Mini computer installed at the station.
- GALF damaged by a storm, which resulted in a loss of the HF Radar data between the 5th February 2013 and its repair on the 20th March 2013.
- Changes in the GALF antenna configuration required a new APM calibration (April 2013).

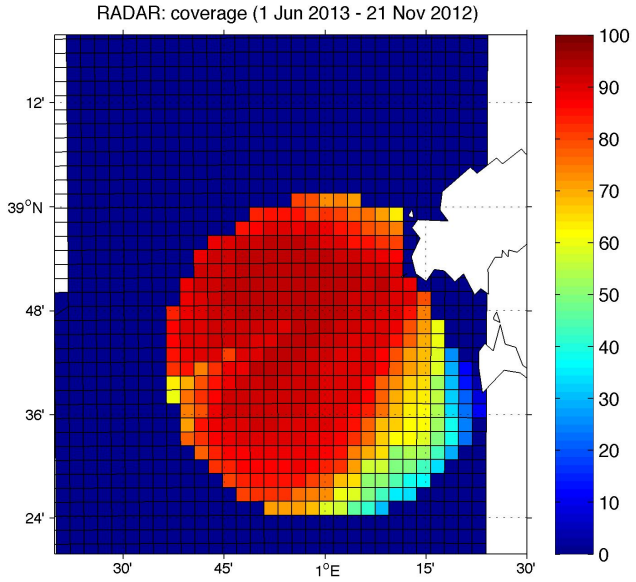


Figure 2.4.c HF Radar coverage. Percentage of the total coverage.

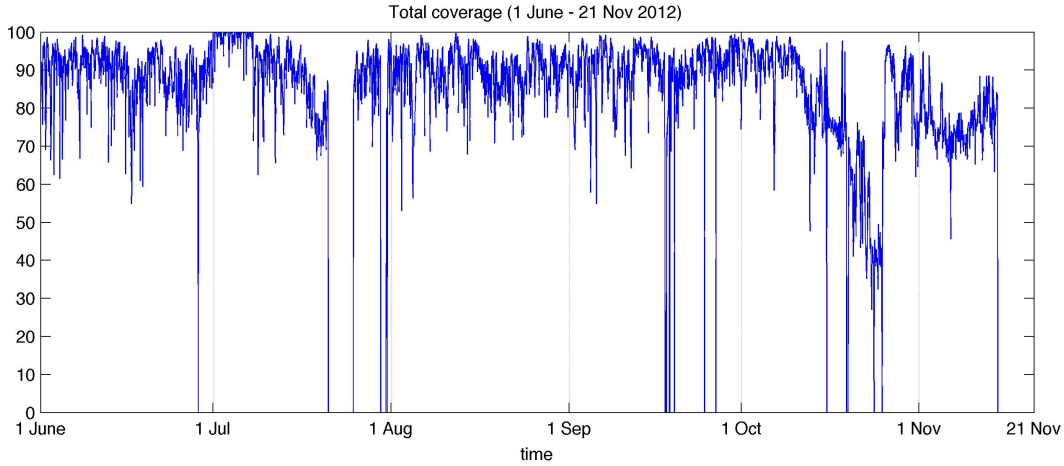


Figure 2.4.d. Temporal evolution of the total coverage.

HUMAN RESOURCES

Unfortunately, the present funding scenario (with frozen public contracts) has not allowed SOCIB to contract the required engineers to adequately operate and maintain the HF Radar Facility. This would be needed as soon as the situation redresses, at least to establish the routine procedures for Quality Control, Validation and interaction with other facilities (in particular, data assimilation with Modelling Facility) and stakeholders.

We have been fortunate that other SOCIB personnel have been able to provide support. In particular past and ongoing activities are: ETD provides support for installation, maintenance and technology development of the HF Radar system. The Data Center Facility provides the computing and IT and data management support. Modelling provides validation support. The Office of the Director supported the contract negotiations and general coordination. Support from IMEDEA has been also provided (in-kind): During 2011 and 2012 important technical support was provided (Guillermo Vizoso). Later in 2012, scientific direction and data quality assurance is provided by IMEDEA's Marine Technologies, Operational Oceanography and Sustainability Department, specifically Arancha Lana (Post Doc), Alejandro Orfila (Scientist) and Juan Manuel Sayol (PhD Student).

2.4.2.5 Critical analysis

SWOT

Weaknesses	**Strengths**
• Constant need for supervision of equipment and data quality • Need to maintain calibration and validation • No specific personnel assigned	• Surface currents monitored at scientific hotspot for example, delivers information on the coastal currents, critical to local ecology; fish larvae, phytoplankton, jelly fish blooms, etc. • Large user base • Complements data from other SOCIB Facilities, • Important for model validation / assimilation • Increases our presence within European / International HF Radar network
Threats	**Opportunities**
	• Potential to provide critical current information for SAR or following pollutant discharge. • Development of statistical tools for user needs

AREAS OF MAJOR IMPACT IN 5 YEARS: SCIENTIFIC, TECHNOLOGICAL AND SOCIETAL

Scientific topics

- The HF radar facility will monitor both long and short-term circulation variability off Ibiza. This will support our observation and understanding of Mediterranean and Atlantic water exchanges. Ultimately this will provide an invaluable resource for the validation of WMOP model currents; we also expect to improve the WMOP forecasting skill through HF radar data assimilation.

Technology topics

- Cross-validation of drifters and HF Radar current data will help to optimize drifter design and deployment to fill observational gaps.

Strategic and society needs

- The HF radar provides an important component of the strategy needed by society for real-time current monitoring; to improve the efficient response to oil spill pollution and the mitigation of risks in both preventing its occurrence and resulting clean up operations, and to support the accurate targeting for search and rescue operations in the Mediterranean. The relation with the Bluefin Tuna project is also important and developments are expected in the forthcoming years in this new line.

2.4.3 GLIDER FACILITY

2.4.3.1 Description

Gliders are a new and fast developing technology for autonomous ocean observation; navigating between surface waypoints they efficiently 'glide' through the water column, sampling temperature, salinity and other biogeochemical variables to a maximum depth of 1000m (current capability), and can stay at sea for months at a time, powered by internal battery packs and almost unaffected by surface weather conditions. Gliders enable high resolution sampling, showing the existence of new features, such as submesoscale eddies that are characterised by strong horizontal gradients and intense vertical motions. These structures interact with the underlying mean flow and topography and can be temporally highly dynamic; they can block the general circulation and/or give rise to intensified upper ocean biogeochemical exchanges. These scientific discoveries, of global importance in a climate change context, are examples of where glider monitoring offers a real advance in our understanding of ocean processes and their impact.

The SOCIB GF can be regarded as one of Europe's leading glider observatories in terms of the size of the fleet, its experience, its maintenance of operations and the variety of platforms. The data from the routine glider monitoring is automatically incorporated into the SOCIB data portal in near real time (NRT) and is also forwarded to ocean and glider data portals at a European level, such as MyOcean (Coriolis) and EGO (Everyone's Glider Observatory). In addition the SOCIB Glider team contribute to several EU FP7 projects including, PERSEUS, GROOM and JERICO.

The SOCIB Glider Facility (GF) is responsible for the sustained and routine monitoring of the Western Mediterranean and the Balearic sub-basin; in particular a quasi-permanent monitoring of the Ibiza and Mallorca Channels began in January 2011. This endurance line[3], at a key biodiversity hotspot, is now fully operational in 2013, where a maximum of a one-month gap between missions is the objective. The GF also provides a number of days per year of open access to gliders for outside institutions. The first of these external missions started in 2012 under the Trans-National Access (TNA) agreement of the JERICO project where CNR IAMC (Italy) requested a monitoring experiment of the Menorca-Sardinia section.

SOCIB's GF operates 7 gliders from two different manufacturers: Teledyne Webb Research Slocums and iRobot Seagliders[4]. Six of the gliders are rated for 1000 m depth missions and one is rated to 200 m depth, suitable for shelf process monitoring. Three of the gliders (Telydyne Slocums, 1 purchased in 2005 and 2 purchased in 2009) are provided as an in kind contribution from IMEDEA (CSIC-UIB). These 3 gliders have been refurbished and are maintained and operated by the SOCIB GF; four gliders (2 Seagliders and 2 Slocums), were acquired by SOCIB in 2011. All the gliders are equipped with Seabird CTDs, Wetlabs fluorometers, and AADI oxygen sensors. New laboratory facilities have also been established at IMEDEA, including a 1000 m depth pressure chamber. At present, two full time glider engineers, with partial support from an electronics engineer from IMEDEA, maintain and operate the SOCIB glider fleet; additional support for glider deployment and recovery is provided by ETD technicians, the Data Centre Facility (DCF) provides archive, management and visualisation of the glider data, and IMEDEA also provides scientific support in kind to the GF.

2.4.3.2 Aims 2010 – 2013

The aims, noted below, of the GF for 2010-2013 were described in SOCIB's IP2010 and are presented here for completeness:

- Maintain 2 Endurance Lines (EL) for monitoring with 2 gliders, 12 months per year (planned from July 2012 onwards). One for the North-South exchanges (Balearic channels) and one for the Balearic front along satellite tracks (Balearic sea).
- Provide gliders for re-locatable, Open Access (OA) operations (from October 2012). 6 months every year.
- Develop systems and procedures for glider fleet management, training, service and maintenance, pressure testing, sensor validation and calibration against water samples, satellite data communications, web based glider command/control and a real time data delivery system.

It quickly became evident (by July 2011) that these objectives were over ambitious with respect to the status of the development of the technology and the reliability of the glider platform. In the next sections we will highlight the achievements and then discuss the difficulties encountered and the actions taken to overcome these issues and demonstrate how, in 2013, we are now close to matching the objectives originally foreseen in the IP2010.

[3] Endurance lines are developing as a cross European concept within the glider community to indicate important monitoring transects, monitored by gliders, on a regular basis, over a long period of time. For example these could be key transects crossing basin scale circulation to monitor variability

[4] Note that iRobot has recently sold its rights to commercialise the Seaglider technology to Kongsberg (http://www.km.kongsberg.com/ks/web/nokbg0238.nsf/AllWeb/4F8991D0FDDC143DC1257B6D004CB89A?OpenDocument)

2.4.3.3 Review current status of the facility (2010 – April 2013)

ACHIEVEMENTS

In this section we present the major achievements obtained from 2010 to 2013 in six major categories: Endurance Lines, Open Access, Facility Development, Data Development, and Outreach and Human Resources.

- **EL: Endurance Lines (shown in green Figure 2.2.e. and 2.2.f.)**

2011 - 6 months of semi-continuous glider operations were achieved using gliders provided as support in-kind by IMEDEA, for the North-South Exchange Endurance Line. From January to June 2011, 6 successful missions were completed, achieving 24 transects of the Ibiza Channel, 5 transects of the Mallorca Channel, with over 4,350 profiles of the water column obtained. The major scientific discovery was the very high frequency (days – weeks) of variability in significant flows and transports of water masses (Heslop et al., 2012).

2012 - 8 months of semi-continuous glider operations were achieved using both IMEDEA and SOCIB gliders, collecting over 4,370 profiles and achieving 17 transects of the Ibiza channel and 9 transects of the Mallorca channel.

2013 - (January to June) - 6 months of semi-continuous glider operations have been achieved, with a maximum allowable gap of one month between missions. Over 2,400 profiles have been collected, achieving 12 transects of the Ibiza channel and 3 transects of the Mallorca channel.

A total cost of 30 € per profile has been estimated for the SOCIB glider missions, this is in line with estimations independently obtained by another well established international team at the University of Washington (personal communication from Charlie Eriksen).

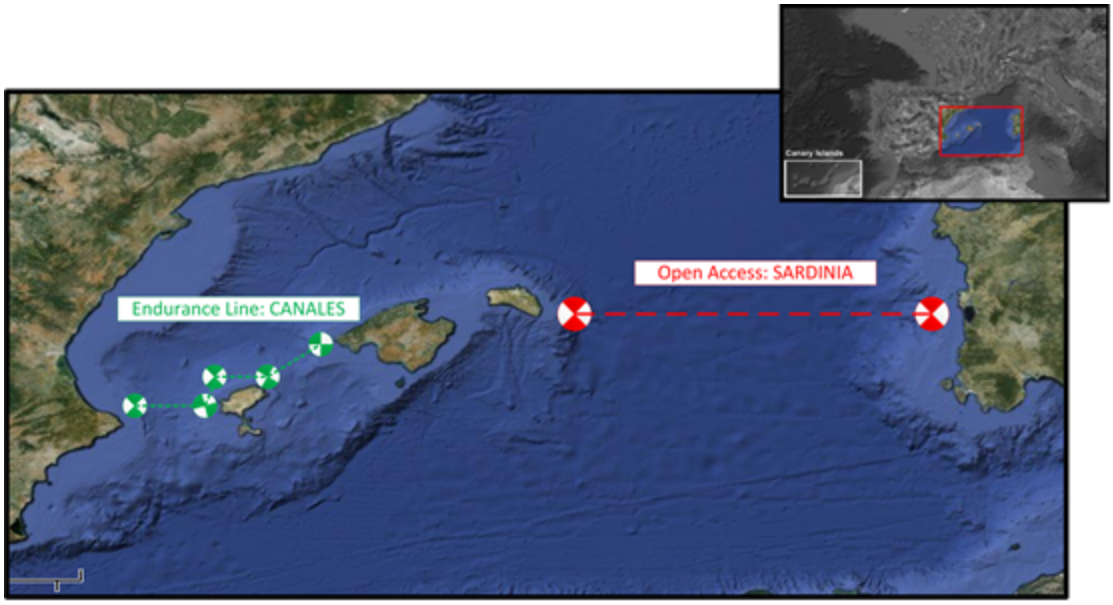


Figure 2.4.e: SOCIB's EL (Endurance Line) and OA (Open Access) Waypoints and Routes

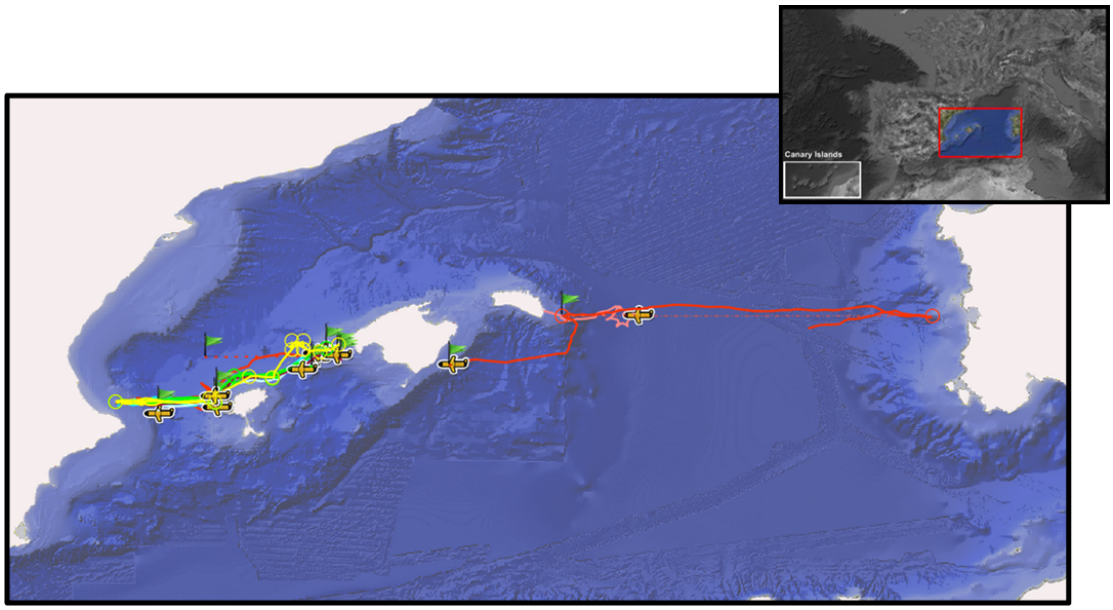


Figure 2.4.f: SOCIB's EL (Endurance Line) and OA (Open Access) tracks for missions undertaken in 2010-2013

- **OA: Open Access (shown in red Figure 2.2.e and 2.2.f)**

January-March 2013 – the first OA glider mission was undertaken. This mission covered 2 transects of the Menorca-Sardinia section over 45 days, collecting 452 data profiles with an iRobot glider. The mission was undertaken for CNR (Italy) under the JERICO TNA agreement. This was the first OA glider mission carried out under this new European framework. A first version of the report (44 pages) is available at SOCIB Ramada repository[5].

- **FD: Facility Development**

Major developments in the Glider Facility, are highlighted below (with a detailed explanation provided later).

- First glider mission to 1000m depth ..... Dec 2010
- Initiation of glider monitoring (IMEDEA support in-kind gliders) ..... Jan 2011
- Purchase of 4 new deep gliders (2 Slocum, 2 Seagliders) ..... Mar 2011
- Glider lab renewal completed ..... Jun 2011
- Training in USA for 2 glider operators (Slocum and Seaglider) ..... Jul 2011
- Delivery of 4 new deep gliders ..... Sept 2011
- Backup location system for Seagliders (Argos tags) ..... Jan 2012
- First water tests with new Slocum gliders ..... Jan 2012
- First water tests with new Seagliders ..... Feb 2012
- Implementation of RUDICS communications for Slocums ..... Mar 2012
- Pressure chamber installed and operational ..... May 2012
- First use of Zodiac Hurricane RIB for glider launch /recovery ..... May 2012

5 http://repository.socib.es/repository/entry/get/Top/Public/SOS%20Division/Glider%20Facility/Mission%20Reports/GF-MR-0013_sdeep03_jerico_tna_sardinia_feb13.pdf?entryid=14ff4dd3-3bd6-466d-bbe7-2f0e26594dbe

- Implementation of new glider storage system (custody cage, lift truck, lithium closet, industrial horizontal shelving) ..... Jun 2012
- Implementation of RUDICS communications for Seagliders ..... Jul 2012
- Use of Maritime Traffic Maps (AIS) for mission planning ..... Sept 2012
- Creation of internal wiki documenting most of the critical procedures related to gliders (initial versions) ..... Dec 2012
- Repair/maintenance program for the Slocum fleet until 100% availability 2012
- Insurance obtained for JERICO TNA Seaglider mission ..... Jan 2013
- Mobile lab (SOCIB's van) fully operational ..... Mar 2013
- Training in USA, (2 glider technicians) for, iRobot battery refurbishment .... Apr 2013

o **DD: Data Development**

- Integration of NRT (near real-time) glider data streams ..... Mar 2011
- Glider App. available on SOCIB web site ..... Jun 2011
- Mobile App. available for iOS ..... Jul 2011
- Gliders missions displayed real-time in the Dapp tracking webpage6 ..... Mar 2012
- Gliders metadata introduced in SOCIB's Instrumentation ..... Apr 2012
- NRT data sent to EGO Network ..... Sep 2012
- NRT data sent to Coriolis Data Centre ..... Sep 2012
- Scripts for Seaglider and Slocum data representation and analysis..... Dec 2012
- NetCDF files of glider data available for NRT/Delayed-Mode..... Apr 2013

o **HR: Human Resources Development**

- Hiring and training of 2 glider operators ..... Sept 2010
- Hiring of glider technician for support in glider operations ..... Dec 2011

o **OR: Outreach**

- Participation in documentary about gliders in Thalassa TV show (TV3), "The glider revolution" ..... Oct 2010
- Participation as jury and sponsor in the International Glider Design Competition (UPM-Madrid) ..... Dec 2011
- Interview on Balearic radio show "Ones de mar" of (IB3) ..... Apr 2012
- SOCIB glider micro-documentary released ..... Sept 2012
- Glider Facility in TVE "La Fábrica de Ideas" ..... Sept 2012
- Article Colaboration: "Magazine Océano nº6" (magazineoceano.com)..... Apr 2013

o **PP: Project Participation**

- The SOCIB glider facility has actively participated in several EC funded initiatives such as the JERICO, eCOST Action, and GROOM projects. In particular, participation in the JERICO FP7 project has allowed SOCIB to become part of the glider TNA procedure, by which external access to the platform for non-glider users was given. Participation in the eCOST Action and in the GROOM project, has allowed the SOCIB glider team to be involved in project workshops and working visits (e.g to the centralised French glider facility in 2012) with substantial benefits in terms of Glider Facility development.

[6] http://apps.socib.es/

SCIENTIFIC CONTRIBUTION

Scientific Publications

Pascual, A.; Bouffard, J.; Ruiz, S.; Buongiorno Nardelli, B.; Vidal-Vijande, E.; Escudier, R.; Sayol, J.M.; Orfila, A., 2013: *Recent improvements in mesoscale characterization of the western Mediterranean Sea: synergy between satellite altimetry and other observational approaches*, Scientia Marina **77**, 19 – 36

Ruiz, S.; Garau, B.; Martinez-Ledesma, M.; Casas, B.; Pascual, A.; Vizoso, G.; Bouffard, J.; Heslop, E.; Alvarez, A.; Testor, P.; Tintore, J., 2012: *New technologies for marine research: Five years of glider activities at IMEDEA [Nuevas tecnologías para la investigación marina: 5 años de actividades de gliders en el IMEDEA],* Scientia Marina 76, 261 – 270

Ruiz, S.; Renault, L.; Garau, B.; Tintoré, J., 2012: *Underwater glider observations and modelling of an abrupt mixing event in the upper ocean*, Geophysical Research Letters 39, L01603

Bouffard, J.; Renault, L.; Ruiz, S.; Pascual, A.; Dufau, C.; Tintore, J., 2012: *Sub-surface small-scale eddy dynamics from multi-sensor observations and modelling*, Progress in Oceanography 106, 62 - 79

Pascual, A.; Bouffard, J.; Ruiz, S.; Nardelli, B.; Vidal-Vijande, E.; Escudier, R.; Sayol, J.M.; Orfila,A., 2012: *Recent advances on mesoscale variability in the Western Mediterranean Sea: Complementary between satellite altimetry and other sensors*, Marine Geodesy 0, 0 -

Heslop, E.; Ruiz, S.; Allen, J.; López-Jurado, J.L.; Renault, L.; Tintoré, J., 2012: *Autonomous underwater gliders monitoring variability at "choke points" in our ocean system: A case study in the Western Mediterranean Sea*, Geophysical Research Letters 39, agu -

Garau, B.; Ruiz, S.; G. Zhang, W.; Pascual, A.; Heslop, E.; Kerfoot, J.; Tintoré, J., 2011: *Thermal Lag Correction on Slocum CTD Glider Data*, Journal of Atmospheric and Oceanic Technology **28**, 1065 – 1071

Bouffard J.; Pascual A.; Ruiz S.; Faugere Y.; Tintore J., 2010: *Coastal and mesoscale dynamics characterization using altimetry and gliders: A case study in the Balearic Sea*, Journal of Geophysical Research-Oceans 115, 0 - 0

Pascual A.; Ruiz S.; Tintore J., 2010: *Combining new and conventional sensors to study the balearic current*, Sea Technology 51, 32 – 36

Congress communications – presentations

Glider monitoring reveals high sub-seasonal variability at a key 'choke' point in the thermohaline circulation of the Western Mediterranean, *E. E. Heslop, S. Ruiz, J. Allen, J-L López-Jurado, J. Tintoré* . Congress: European Geosciences Union General Assembly April 8, 2013 - April 12, 2013 Austria (AUT), Vienna

ICTS SOCIB and the Glider Facility, *Cusí Van Dooren, S., Torner Tomas, M., Roque Atienza, D., Martínez Ledesma, M., Heslop, E., Ruiz Valero, S., Casas Pérez, B., Beltran, J.P., Tintoré Subirana, J.* Congress: V Jornadas de AUTOMAR. December 19, 2012 - December 21, 2012 Spain (ESP), Girona

Operational use of gliders at ICTS SOCIB, *Torner Tomas, M., Cusí Van Dooren, S., Roque Atienza, D., Martínez Ledesma, M., Heslop, E., Ruiz Valero, S., Casas Pérez, B., Vizoso Miquel del Solà, G., Tintoré Subirana, J.* Congress: Encuentro Oceanografía Física Española November 14, 2012 - November 16, 2012 Spain (ESP), Madrid

Gliders at ICTS SOCIB, *Cusí Van Dooren, S., Torner Tomas, M., Roque Atienza, D., Martínez Ledesma, M., Heslop, E., Ruiz Valero, S., Casas Pérez, B., Beltran, J.P., Tintoré Subirana, J.* Congress: 2nd Field Training Workshop on Underwater Robotics Intervention (FP7 Trident). October 1, 2012 - October 5, 2012 Spain (ESP), Port de Sóller

Recent advances on mesoscale variability in the Western Mediterranean Sea: complementarity between satellite altimetry and other sensors, *Pascual, A., Bouffard, J., Ruiz, S., Buongiorno Nardelli, B., Escudier, R.* Congress: European Geosciences Union General Assembly 2012. April 23, 2012 - April 28, 2012 Austria (AUT), Vienna

Recent advances on mesoscale variability in the Western Mediterranean Sea: complementarity between satellite altimetry and other sensors, *Pascual, A., Bouffard, J., Ruiz, S., Buongiorno Nardelli, B., Escudier, R.* Congress: European Geophysical Union General Assembly. April 22, 2012 - April 27, 2012 Austria (AUT), Vienna

Recent Advances on Mesoscale Variability in the western Mediterranean sea: complementarity between satellite altimetry and other sensors, *Pascual, A., Bouffard, J., Ruiz, S., Buongiorno Nardelli, B., Escudier, R., Vidal-Vijande, E.* Congress: European Geophysical Union General Assembly. April 3, 2011 - April 8, 2011 Austria (AUT), Vienna

Mesoscale characterization using altimetry and glider: methodology and error budget assessment, *Bouffard, J, Pascual,A, Renault, L, Ruiz, S, Faugère, Y, Dufau, Larnicol, G, Tintoré, J.* Congress: Ocean Surface Topography Science Team (OSTST) October 20, 2010 - October 22, 2010 Portugal (PRT), Lisbon

How to combine altimetric techniques with gliders in order to monitor 3D coastal mesoscale and submesoscale processes., *Bouffard, J, Pascual,A, Renault, L, Ruiz, S, Faugère, Y, Dufau, Larnicol, G, Tintoré, J.* Congress: Coastal Altimetry Workshop October 14, 2010 - October 15, 2010 Portugal (PRT), Lisbon

New technologies for marine research: 4 years of glider activities at IMEDEA-TMOOS, *Ruiz, S, Garau, B, Martínez-Ledesma, M, Casas, B, Vizoso, G, Llodrá, J, Testor, P, Pascual, A, Alvarez, A, Bouffard, J, Tintoré, J.* Congress: Encuentro Oceanografía Física Española October 13, 2010 - October 15, 2010 Spain (ESP), Barcelona

Synergy between Envisat satellite altimetry and glider data: case study in the Balearic Sea, *Pascual,A, Bouffard, J, Ruiz, S, Garau, B, Faugère, Y, Tintoré, J.* Congress: ESA Living Planet Symposium June 28, 2010 - July 2, 2010 Norway (NOR), Bergen

Synergy Between Glider and Coastal Altimetry: Examples Along Envisat, Jason-1 and Jason-2 Tracks, *Pascual, A., Bouffard, J., Ruiz, S., Faugère, G.,Larnicol, G., Tintoré, J.* Congress: Ocean Sciences Meeting February 22, 2010 - February 26, 2010 United States (USA), Portland

Vertical Velocities Combining Glider and Altimetry Data: a Case of an Intense Density Front in the Eastern Alboran Sea, *Ruiz, S., Pascual, A., Garau, B., Pujol, I., Tintoré, J.* Congress: Ocean Sciences Meeting- February 22, 2010 - February 26, 2010 United States (USA), Portland

Congress communications - invited conferences

High resolution multi-sensor experiments to diagnose vertical motion in the upper ocean, Pascual, A, Ruiz, S, Bouffard, J, Buongiorno- Nardelli, B, Larnicol, G, Le Traon, P.Y, Tintoré, J. Congress: Towards High-Resolution of Ocean Dynamics and Terrestrial Surface Waters from Space Workshop. October 21, 2010 - October 22, 2010 Portugal (PRT), Lisbon

On the combination of satellite and in-situ observations to better understand (sub)mesoscale dynamics, Pascual, A., Ruiz, S., Bouffard, J., Fauguère, Y., Buongiorno-Nardelli, B., Larnicol, G., Le Traon, P.Y., Tintoré, J. Congress: Scientific Assembly of the Committee on Space research. July 18, 2010 - July 25, 2010 Germany (DEU), Bremen

Coastal and mesoscale dynamics characterization combining glider and altimetry: case study over the Western Mediterranean Sea, Bouffard, J, Pascual, A, Ruiz, S, Pujol, M.I, Faugère, Y, Larnicol, G, Tintoré, J. Congress: Scientific Assembly of the Committee on Space research. July 18, 2010 - July 25, 2010 Germany (DEU), Bremen

Synergy between satellite and in-situ observations to monitor mesoscale variability: review of recent studies and new proposals for the research station Jaume Ferrer, Pascual, A, . Congress: Ad Hoc Working Group for Developing the Scientific Programme of the Coastal Marine Research Station Jaume Ferrer. May 24, 2010 - May 26, 2010 Spain (ESP), Maó

Congress communications – posters

High resolution simulations and glider observations in the eastern Alboran Sea (Mediterranean Sea): implications for vertical velocity estimates, Mason, E., Pascual, A., McWilliams, J. C. Congress: EGU General Assembly. April 7, 2013 - April 12, 2013 Austria (AUT), Vienna

Recent advances on mesoscale variability in the Western Mediterranean: complementarity between altimetry and other sensors, Pascual, A., Bouffard, J., Ruiz, S., Buongiorno Nardelli, B., Escudier, R., Tintore, J. Congress: 20 years of progress in Radar Altimetry . September 24, 2012 - September 29, 2012 Italy (ITA), Venice

Glider observations and modelling of an abrupt mixing event in the Western Mediterranean, Ruiz, S., Renault, L., Garau, B., Tintoré, J. Congress: European Geosciences Union General Assembly 2012 . April 22, 2012 - April 27, 2012 Austria (AUT), Vienna

SOCIB, a new internationally open glider infrastructure in the Balearic Islands, Ruiz, S, Tintoré, J, Heslop, E, Garau, B, Casas, B, Torné, M, Simó, C, Vizoso, G, Renault, L, Pascual, A. Congress: The Future of Operational Oceanography . October 25, 2011 - October 27, 2011 Germany (DEU), Hamburg

Glider observations and modelling of an abrupt mixing event in the upper ocean, S. Ruiz, L. Renault, B. Garau, A. Pascual, J. Tintoré. Congress: HYdrological cycle in the Mediterranean EXperiment . May 17, 2011 - May 19, 2011 Spain (ESP), Sant Lluís

Glider observations of an abrupt mixing event in the upper ocean, Ruiz, S, Renault, L, Garau, B, Bouffard, J, Pascual, A, Tintoré, J. Congress: Maritime Rapid Environmental Assessment Conference . October 18, 2010 - October 22, 2010 Italy (ITA), Lerici

Mesoscale characterization using altimetry and glider: methodology and error budget assessment, Bouffard, J, Pascual,A, Renault, L, Ruiz, S, Faugère, Y, Dufau, Larnicol, G, Tintoré, J. Congress: Ocean Surface Topography Science Team (OSTST) . October 18, 2010 - October 22, 2010 Portugal (PRT), Lisbon

Synergy between Envisat satellite altimetry and glider data: case study in the Balearic Sea, Pascual,A, Bouffard, J, Ruiz, S, Garau, B, Faugère, Y, Tintoré, J. Congress: ESA Living Planet Symposium. June 28, 2010 - July 2, 2010 Norway (NOR), Bergen

Contributions to international conferences

- Participation of 2 SOCIB glider operators in EOF2012 congress in Madrid .. Nov 2012
- Participation of 1 SOCIB glider operator in the AUTOMAR conference in Girona. Dec 2012

Participation in EC funded project meetings

- Participation of 2 glider operators and 2 scientific collaborators to EGO meeting and glider school in the Canary Islands ..... Mar 2011
- 5 day visit, of 1 glider operator, to the glider division of DT-INSU (IFREMER) in Toulon (France) ..... Mar 2012
- Participation of SOCIB's director, 2 glider operators, 2 scientists and 2 data centre technicians in JERICO/GROOM/COST Workshop, Mallorca ..... May 2012
- Participation of 2 glider operators and 1 technician in the TRIDENT workshop in Mallorca ..... Oct 2012
- Participation of 2 glider operators in the GROOM workshop in Cyprus ..... Jan 2013

2.4.3.4 Current status with reference to IP2010

The glider facility is evolving and setting strong foundations for continuous monitoring across key transects in the Western Mediterranean Sea. The IP2010 was possibly too optimistic regarding glider technology and reliability and the failure of all available gliders in August 2011 led to a period of 8 months without observations in the Ibiza and Mallorca Channels. Final Operational Capability (FOC) for the GF was originally foreseen for the start of 2012; instead the GF should be considered to have reached FOC at the start of 2013[7]. Taking into account the initial 6 month delay (IP2010 approved in June 2010), FOC for the glider facility is some 6 months behind target. It was anticipated that there would be one year of Operation and Maintenance (OM) in 2011 before reaching FOC to allow for development and consolidation of operational practices and technology.

The main difference between the FOC achieved in 2013 and that envisioned by the IP2010 is that we have one endurance line regularly monitored and not the two originally, and perhaps rather over-optimistically, proposed. Given the actual (rather than advertised) stability of the glider technology and the financial crisis of 2012, we would suggest this is an acceptable compromise. The ability to operate two endurance lines was also affected by the number of gliders in the facility. We have purchased 4 gliders and the purchase of 6 was originally planned, the funds for the additional 2 gliders have been approved; however as detailed in Section 2.5 (Financial Summary) this purchase has been delayed due to funding issues. Procedures to purchase the 2 new gliders are being initiated in 2013 and monitoring of an additional endurance line (EL2) is planned for late 2014 or early 2015.

Reviewing the three main objectives of IP2010:

- **Endurance Lines (EL):** Having 2 endurance lines operating for 12 months of the year was and still is the aim of the SOCIB GF. However, supporting 12-24 glider months per year (allowing a 1 month gap limit) requires a level of reliability in platform technology and continuous operational support; the GF is on track to achieve this in early 2015. Currently, no glider group in Europe consistently maintains this level of activity, although the new centralised French glider facility comes close, but to do so it has more than twice the SOCIB investment in gliders, labs and personnel.

  Continuous monitoring with 2 gliders over 2 endurance lines was planned in the IP2010 from July 2012 onwards. We achieved continuous monitoring (maximum 1 month gap) for one endurance line from July 2012.

- **Open Access (OA):** Open access operations were planned in the IP2010 to start in October 2012 for 6 months. We achieved 51 days in the period November 2012-March 2013 under the JERICO Trans National Agreement. 45 days are planned later in 2013 (very likely in October). We are therefore close to being on track for this objective.

- **Facility Development (FD):** Much work has been undertaken in the GF to develop robust, efficient, cost effective, quality controlled and safe procedures for glider operation, to optimise performance and maximise the return on investment in the GF. In this context, and as mentioned before, the GF has been focused on developing strong foundations on which to grow and maintain continuous monitoring operations. The development of the facility has in general proceeded according to IP2010, with only calibration procedures and a web based

[7] With stable monitoring of one endurance line transect and successful open access to the platform achieved

glider command-control tool yet to be completed. These 2 components are currently under development and in planning, respectively.

A full description of the glider facility development is listed below divided into key areas, a summary of this was provided above under achievements:

1) IS: International Standards

- Created a new Slocum glider compass error calibration tool to simplify the measurement of the internal compass deviations
- Incorporated the use of AIS (Automatic Identification System that tracks most of the large boats) data in mission planning, in order to define areas of high marine traffic to help avoid the risk of collision.
- Created internal documentation to count the number of profiles/days in water of a specific sensor in order to determine when a sensor calibration is needed.

2) GL: Glider Lab

- Redesigned the glider lab. to enable more efficient glider preparation.
- Installed glider lab pressure chamber to increase the efficiency of the pre-mission tests (in lab) and the probabilities of completing a mission without leaks..
- RUDICS communications adopted to increase reliability and transfer rates, optimising mission costs.
- Use of new RIB (Zodiac Hurricane), which doubles the number of operations (deployment or recovery) that can be made in a given period of time, and allows for fast emergency recovery operations.
- Created new storage system, which allows better and safer glider/battery storage. The Seaglider cart has been adapted to this new system as well.
- Configured and installed a new reception computer for Slocum gliders and a backup (dockserver) in order to minimize possible communication loss.
- Developed new scripts to help check scientific and technical data during and after the mission. This helps verify data integrity, improve gliders' flight paths, optimize battery consumption and improves our knowledge of the technology.
- Purchased and verified an underwater acoustic transponder (Benthos) used to locate the Seagliders in case of failure at sea.

3) KH: Know How

- Developed new procedures and checklists for glider preparation and maintenance. The missions have been broken down into independent tasks, so that they can be completed by different operators in order to improve mission efficiency and quality control.
- Performed the first tests and missions with Seagliders to improve the knowledge of this new platform.
- Completed a Seaglider battery refurbishment course, which enables the operators to refurbish the Seagliders in-house, so that they do not need to be sent to the USA every time the batteries need replacing, optimising costs and increasing glider availability.
- Learned advanced Seaglider piloting techniques such as the transmission of selected dives, in order to optimise the energy consumption and costs related to the transmission of glider data using the satellite communication link.

4) FL: Fleet

- Insured SOCIB Seaglider 541 (first time a glider has been insured) to perform the TNA mission. Insurance covered loss and third party damages.

- Introduced an Argos transponder on the Seaglider antenna mast to have a secondary communication system to locate the glider in case of failure.
- Purchased selected spares of glider components, such as an entire science bay for the Slocum glider, to increase efficiency in refurbishment and calibration of sensors and components.

5) DC: Data Centre

- Developed web based tracking applications such as *Gapp* (Glider Application) and *Dapp* (Deployment Application) to provide pilots with a convenient way to monitor the glider's position and vital technical parameters about the mission.
- Added glider sensors to the centralised instrumentation database, developed by the Data Centre Facility, which allows easy mission setup, displays sensors automatically in the *Dapp* application, and is crucial for the glider data processing and quality control.
- Designed and developed a new glider data processing chain to improve on earlier processing protocols and which is able to receive and process NRT (Near Real Time) and DM (Delayed Mode) data from the glider platforms. The Data Center Facility, in direct collaboration with the GF team, created the glider data processing chain. The routine for Slocum gliders (both generation 1 and 2) is 90% complete whilst the routine for Seagliders is under test.
- Introduced the glider NRT data forwarding to key European Data Portals, EGO and MyOcean (Coriolis), as a requirement for every mission. This gives SOCIB's glider missions a broad visibility.

HUMAN RESOURCES

- Coordinator: responsible for coordination of the GF, reports and general management (20% of year, support in-kind from IMEDEA).
- Two Glider Pilots: one primarily responsible for the Slocum glider technology and acting as first pilot for Slocum gliders and backup pilot for Seagliders, and one responsible for the Seaglider technology, acting as first pilot for Seagliders and backup pilot for Slocum gliders. Duties also include deployment, recovery, reports, glider ballasting and preparation, pressure chamber management, internal documentation and scripts for Seaglider data visualization.
- Technician: providing technical support for Slocum ballasting, Slocum preparation, pressure chamber maintenance, Seaglider tests, deployment, recovery, scripts for Slocum data visualization, verification of CTD casts (this role was temporary, to assist with the intensive period Jan 2012 – Dec 2012).
- Additional facility support: The glider facility is supported by the ETD Division, primarily for glider recovery and support, by the Data Centre Facility, with which there has been particularly strong collaboration in 2012, and two scientists in-kind from IMEDEA (CSIC-UIB), providing support specifically with regard to data quality, data processing and scientific objectives from two scientists. The Office of the Director also supports the GF, with regard to resource allocation, mission planning and international cooperation.

Below are details of the persons and man months (MM) for 2010 – 2012.

2010	Task	MM	Dates
M. Torner, SOCIB, GF	Glider Operator	01:00	09/10 – 12/10
S. Cusi, SOCIB, GF	Glider Operator	01:00	09/10 – 12/10
S. Ruiz, IMEDEA	Scientific support	02.00	01/10 – 12/10
M. Martinez, IMEDEA	Glider Coordinator	03:00	09/12 – 12/12

E. Heslop; IMEDEA	Scientific support/data processing	06.00	07/10 – 12/10
J. Tintoé; SOCIB OoD	Scientific team leader	01.00	01/10 – 12/10
ETD; SOCIB/IMEDEA	Technicians, deployment/recovery support	01.00	07/10 – 12/10

2011	Task	MM	Dates
M. Torner, SOCIB, GF	Glider Operator	12:00	01/11 – 12/11
S. Cusi, SOCIB, GF	Glider Operator	12:00	01/11 – 12/11
D. Roque, SOCIB, GF	Glider Technician	01:00	12/11 – 12/11
S. Ruiz, IMEDEA	Scientific support	03.00	01/11 – 12/11
E. Heslop; IMEDEA	Scientific support/data processing	09.00	01/11 – 12/11
J. Tintoré; SOCIB OoD	Scientific team leader	01.00	01/11 – 12/11
ETD; SOCIB/IMEDEA	Technicians, deployment/recovery support	02.50	01/11 – 12/11
Data Centre Facility; SOCIB	Data archive, processing and display	03.00	01/11 – 12/11

2012	Task	MM	Dates
M. Torner, SOCIB, GF	Glider Operator	12:00	01/12 – 12/12
S. Cusi, SOCIB, GF	Glider Operator	12:00	01/12 – 12/12
D. Roque, SOCIB, GF	Glider Technician	12:00	01/12 – 12/12
M. Martinez, IMEDEA	Glider Coordinator	10:00	03/12 – 12/12
S. Ruiz, IMEDEA	Scientific support	01.00	01/12 – 12/12
E. Heslop; IMEDEA	Scientific support/data processing	09.00	01/12 – 12/12
J. Tintoré; SOCIB OoD	Scientific team leader	02.00	01/12 – 12/12
ETD; SOCIB/IMEDEA	Technicians, deployment/recovery support	02.50	01/12 – 12/12
Data Centre Facility; SOCIB	Data archive, processing and display	10:00	01/12 – 12/12

INVESTMENTS

- Pressure Chamber (to test the resistance of the glider hulls against external water pressure to 1000 m depth) purchased and installed in 2011
- 2 Slocum gliders were purchased in 2011 and initially operated in Nov 2012
- 2 Seagliders were purchased in 2011 and initially operated in May 2012
- Authorization for the purchase of 2 more gliders was requested and obtained (Executive Commission) in early 2012. However, the current financial situation has meant that it has been necessary to reserve these funds to guard against defaulting on the monthly salary payments. It is our intention to purchase the gliders as soon as the operational funds that are still owed to SOCIB are received.

DIFFICULTIES OVERCOME

In 2011 after 6 months of very successful missions, the glider facility faced a series of technical problems with the glider fleet, both with the older (IMEDEA supplied) gliders and the newly purchased (SOCIB) gliders, including mechanical wear, communications issues and

manufacturing faults. This lead to a gap in the data from the North-South Exchange endurance line missions launched during this period, which were aborted due to the various technical issues.

In light of the number of problems being encountered and a growing gap in the data record, a significant effort was put into the GF in early 2012; the initial plan was revised, decreasing the number of missions and establishing a new and detailed test program so as to allow for intensive checks at sea for every glider (at least one week at sea and to 1,000 m) prior to missions. At the same time the GF was re-organized, setting a firm base for a robust operational unit. SOCIB decided that it was critical to strongly reinforce the facility with new personnel that could improve the glider procedures and tests, both in the lab and at sea. As a result, a new Coordinator was appointed to manage the GF (a transfer as support in kind from IMEDEA) and a technician was also hired to support the more routine tasks of glider preparation, ballasting, and to help with the set-up and testing of new instruments and gliders. A clear focus during this period was in getting the newly purchased gliders into service. During this period, 11 test deployments were carried out, with a total of 66 days at sea, so that the total number of missions (scientific and technical) undertaken during 2012 was 20 deployments, 205 days at sea and more than 7,000 profiles obtained.

It should be made clear that a number of the problems experienced were external to the GF and beyond the team's control, particularly problems with communications in the new gliders. Nevertheless, this period, although disappointing with regard to data, served to consolidate the GF operationally and much was learnt about the technical and operational capability of the glider platform, as shown by the teams' subsequent track record. During this period, the addition of new infrastructure, required for the efficient running of a larger operational glider facility, such as the pressure chamber and glider storage rack, also improved the reliability and efficiency of operations. For example, using the pressure chamber, gliders can be tested to 1000 m without the cost in both time and resources of undertaking the sea trials. Endurance line monitoring restarted in July 2012 and the objectives for 2013 are close to those envisioned in the IP2010. The SOCIB GF actively participates in European projects aiming to define best practice in glider operations and glider data management (PERSEUS, GROOM, JERICO).

ACHIEVEMENTS NOT ANTCIPATED IN THE IP2010

The OA glider mission, under the JERICO TNA Agreement, was an achievement of relevance not anticipated in the IP2010, as although OA was anticipated, the added complexity of doing so under a European Project was not. This experience has placed SOCIB GF as a leading facility in the context of international facilities exchange programs. The full EU TNA procedure is complex, administratively, scientifically, in setup, and in operation and data management. The mission was completed successfully in January 2013 (an initial attempt in Dec 2012 was aborted due mechanical failure) as recognized by the beneficiaries of this first JERICO TNA mission, IAMC – CNR (Oristano, Sardinia), during their visit to the SOCIB labs and facilities in April 2013.

2.4.3.5 Critical analysis

SWOT

Weaknesses	Strengths
• Gliders are a developing technology, platform reliability is still an issue • Piloting a glider requires 24 hour attention during a mission, a significant responsibility for glider pilots operating the long term monitoring of endurance lines • The level of technical and operational expertise required to successfully run a long term monitoring program is frequently underestimated • Salaries are limited and personnel will have to increase as soon as possible.	• Experience in maintaining semi-continuous monitoring operations • Experience in maintaining two different types of glider design and a large operational fleet, e.g. robust internal procedures • Good working relationships with glider manufacturers • In-house web based tracking for glider operations real-time, which also provides the public with real time viewing of glider missions • Unique and leading glider data processing chain • SOCIB is a major European glider observatory, in terms of glider missions, days in the water, experience, facilities, etc. • Experience in delivering true open platform access (transnational) • Excellent working relationship with ETD • Excellent working relationships with scientists using glider data – improves mission planning • Exposure to latest glider related information and developments through involvement in main glider related European FP7 projects • Large and well equipped facilities, e.g. pressure chamber
Threats	**Opportunities**
• General economic situation in Spain may affect national funding • Availability of personnel required to reach the objectives, glider operations are expanding across Europe/world • Potentially increases in cost of facility, gliders seem likely to increase in importance as monitoring tools	• High platform potential, glider are a developing technology, e.g. deep gliders, thermal gliders • New sensor technology developing for gliders, acoustic and biogeochemical • SOCIB could be a regional (WMED) glider port and data processor • Data can be assimilated into regional models • Support regional society and policy concerns related to tourism and sustainable through monitoring water quality and other MFSD indicators • Innovation in science through open platform access • Attract European funding for monitoring infrastructure

AREAS OF MAJOR IMPACT IN 5 YEARS: SCIENTIFIC, TECHNOLOGICAL AND SOCIETAL

Scientific topics

- Characterisation of variability of the circulation system, on seasonal and sub seasonal timescales and how this affects our longer term view of circulation variability
- Characterisation of regional water mass variability (seasonal, sub-seasonal and interannual) and the impact of this on circulation, inter-basin exchanges and ecosystem response
- Mesoscale and submesoscale eddy characterization, interactions with the general circulation, and ecosystem response

Technology topics

- Over the longer term, the operation of endurance lines will include the development of automated procedures for navigation

Strategic and society needs

- Contribution to MSFD descriptors and in the longer term to better understand and establish the role of the ocean in climate change

2.4.3.6 GLIDER FACILITY INTERNAL DOCS AND PROCEDURES (ELECTRONIC ACCESS)

SOCIB Glider Facility has developed internal procedures (Section 6, Annex 2) and document templates to allow tracking of the tasks carried out, the processes established and know how acquired. These written resources mainly provide: (1) a compilation of methodologies (Wikis and Checklists) to aid glider facility operations and (2) a set of files (forms and sheets) to organize and maintain information for future review.
All these documents are available for public access, through SOCIB's repository, at : http://repository.socib.es/repository/entry/show/Top/Public+-+Strategic+Plan+2013+-+2016/Glider+Facility?entryid=b6c19c20-3bba-4778-b281-cb001ef824e0

1. SOCIB Glider Facility Templates

Developed to document internal processes and events of the Glider Facility activities. The aim is to organize and maintain the information for later revision, check and analysis. These documents are sub-organized as follows:

Index	Name	Description
1.1	Sheets and Forms	PDF and DOC forms for each key process within the facility
1.1.a	SUB-VERSIONS	Repository of early versions. Used to keep track of changes
1.1.b	PDF	Forms were initially written in PDF versions. This format was discontinued in favor of MS Word's since it is considered more flexible and handy
1.1.c	MD Mission	Mission Documentation (not anymore used). Primitive collection of

	Documentation_July2012	sheets initially created to document key processes executed during the preparation of a glider mission. It eventually yielded to "mission_folder_template" (see 1.2), which is now used.
1.1.d	administrative	Example Set of the initial notification emails and faxes sent to officially announce a forthcoming glider mission to involved authorities (see 1.2 for the evolution of these documents). Incorporated now in "mission_folder_template" (see 1.2).
1.1.e	.dotx-.txt files	Collection of the current versions of sheets and forms. DOT files contain the form itself with the acronym coded in the filename. TXT files explain the meaning of these acronyms
1.1.f	EXAMPLE	EXAMPLE_20120305_IS_243_emergency_recovery_DephTests_final.pdf
1.2	Mission_folder_template[8]	Latest documentation structure used to establish procedures on different stages of a mission preparation. Conceived to create a detailed record of the actions taken to support a glider mission. It also serves as a comprehensive checklist to guarantee sound and safe glider deployments Currently used for SLOCUMs only although there are concrete plans to extend its usage to SeaGlider operations
1.2.a	README	Detailed explanation of the 16 'Stage Folders' to be fulfilled when preparing a mission
1.2.b	0-GPR-...	Pre-mission report and other 'mission definition' documents
1.2.c	1-GPC1-...	Hardware checklist to assure the glider's integrity
1.2.d	2-GPC2-...	Communications checklist to assure the glider's ability to call home
1.2.e	3-GPC3-...	Battery checklist to assure the glider's energetic supply
1.2.f	4-GBS-...	Record of the results after equilibrating the vehicle in salt tank
1.2.g	5-GFS-...	Checklist guiding through the final assembly before deployment
1.2.h	6-GMS-...	Set of files to configure the glider to execute the mission properly
1.2.i	7-GTP-...	Checklist to assure all the material is loaded and transported to port
1.2.j	8-GNF-...	Notification FAX's template. Used to notify the mission to authorities
1.2.k	9-GCC-...	(under development). It will list the steps of the final general check at port
1.2.l	10-GDS-...	Deployment sheet to keep a record of the deployment fieldwork

[8] provides a good synthesis of all tasks for mission preparation, execution, post mission and summary.

1.3	**Mission_ folder_ template_ SEAGLIDER_UnderDevelopment**	• **Latest documentation structure used to establish procedures on different stages of a Seaglider mission preparation. It is a provisional structure (Seagliders were incorporated just 2 years ago and their operation scheme is not yet stable) that needs to be gradually adapted to the Slocum one.** • **Main differences are ballasting (not existant for Seaglider so far, contained in Pre-Mission report) and checklist (all steps in one document for Seaglider).** • **In this folder, documents generated for last Seaglider TNA mission (GF-MR-0013) are shown as example.**
1.2.m	11-GMB-...	Mission Blog to record all the relevant events happened during the mission
1.2.n	12-GRS-...	Recover sheet to keep a record of the recovery fieldwork session
1.2.o	13-GMC-...	(under development). Checklist to systematize the actions to undertake when the mission is over (downloading files from glider, notifications, storage...)
1.2.p	14-GFR-...	Post-mission report which contains all the interesting information regarding preparation, execution and conclusions of the glider mission
1.2.q	15-UPI-...	Holds the 'Intervention Sheets' generated at any of the previous stages
1.2.r	EXAMPLE	MISSION_FOLDER_EXAMPLE_GR-MR-0014_20121125_canov243

1.3.a	0-GPR-...	Pre-mission report and other 'mission definition' documents
1.3.b	1-GPC-...	All checks done to the glider, from pre-mission to post-mission
1.3.c	2-GNF-...	Notification FAX's template. Used to notify the mission to authorities
1.3.d	3-GDS-...	Deployment sheet to keep a record of the deployment fieldwork session
1.3.e	4-GMB-...	Mission Blog to record all the relevant events happened during the mission
1.3.f	5-GRS-...	Recover sheet to keep a record of the recovery fieldwork session
1.3.g	6-GFR-...	Post-mission report which contains all the interesting information regarding preparation, execution and conclusions of the glider mission
1.3.h	7-UPI-...	Holds the 'Intervention Sheets' generated at any of the previous stages

2. Glider Wikis

Compilation of documents containing description of the internal procedures executed within the Glider Facility which, in most cases, are requested and/or mentioned in the checklists and forms listed as Custom Templates (see previous entry).

Current format is WORD's .doc although the idea is to rebuild them as online Wiki Pages in RAMADDA. (See '2a. Online Wiki Pages Index')

Index	Name	Description
2.1	COMO HACER PREMISSION REPORT	PDF and DOC forms for each key process within the facility
2.2	CHECKLIST WIGGLE SOCIB v1.1	Describing the procedure for complete mechanical check
2.3	CHECKLIST COMMS CALANOVA SOCIB v1.1	Describes how to verify checklist 1.2.k
2.4	CHECKLIST MECANICO SOCIB v1.1	More general mechanical checklist
2.5	Camara presion SOCIB v1.1	Pressure Vessel testing
2.6	CALIBRACIONES COMPAS SOCIB v1.1	Error measurement before compass calibration
2.7	Ballasting SOCIB v1.1	Describing the process of equilibrating the glider in ballast tank to adapt it to expected critical conditions in navigated waters
2.8	ALMACENAMIENTO DE GLIDERS Y BATERIAS SOCIB v1.1	Storage of gliders and batteries
2.9	DAPP SOCIB v1.1	Sign-in of new missions in web-based tracking tool (apps.socib.es/dapp)
2.10	EXCEL DROPBOX SOCIB v1.1	Instruction on how to fill a registry of the usage and last calibration of the science sensors of the glider fleet
2.11	SHELF-TEST SEAGLIDER SOCIB v1.1	
2.12	NOTIFICACIONES SALIDASENTRADAS DE MISIONES v1.1	Description of the notifications to be sent during stage 8-GNF (see 1.2.j)
2.13	MISIONES EN LA WEB DE EGO-NETWORK	How to subscribe a glider mission in www.ego-network.eu

2.14	MATLAB POSTMISION SOCIB v1.1	How to process raw glider files with a custom developed script
2.15	MANTENIMIENTO BASE DE DATOS GLIDERS v1.1	How to keep Instrumentation DDBB up-to-date
2.16	HOW TO CONFIGURE CALLBOOK FOR SLOCUM FREEWAVE	(Freewave is the local radio link used by Slocums)
2.17	FTP SOCIB v1.1	
2.18	EXTRACCION DE DATOS GLIDERS SLOCUM SOCIB v1.1	How to download raw data files from the glider during post mission stage (see 1.2.o)
2.19	Tareas realizadas por David Roque_v2	Conclusion summary list of the tasks developed by one of the Glider Technicians who worked at SOCIB during year 2012

2a. Online Wikis Pages Index

(Under development). This repository contains references to all the On-line Wiki Pages created by all the facilities at SOCIB including the Glider F. It is meant to canalize searches of Wikis to ease the process of accessing them.

3. Mission Reports

Set of reports written to summarize glider missions. Newer versions of the report's templates are being written for both Slocum and Sea Glider models. Filenames are pretty much self-explanatory and follow this format:

GF[=Glider Facility]-MR[=Mission Report]-####[=identifier]_[Unit Name]_keywords

4. Image Portfolio

Compilation of all pictures taken related to the activities developed by the Glider Facility. This is an internal repository accessible by SOCIB Staff exclusively; mainly due to the fact that most of the pictures are related to the glider technology which is protected by international patents and copyright clauses. Therefore, a snapshot is offered to show the general structure of this graphical documental resource (see Picture_Portfolio_Glider_Facility.jpg)
Pictures are grouped depending on the event to which they are related and therefore stored in folders in a folder name to allow easy access and identification:

YYYYMMDD_IP[=Image Portfolio]_keywords

5. Glider Status Chart

SLOCUM Coastal

Unit 050 icoast00	Sent to TWR for repair

SLOCUM Deep

Unit 184 ideep00	Returning from manufacturer after refurbishment
Unit 131 ideep01	Missing since 17/05/2011
Unit 132 ideep02	Leak issues. Needs to be checked
Unit 243 sdeep00	On Mission ENL Canales May2013
Unit 244 sdeep01	Ready for preparation. Stored in the shelf

Seaglider EBE

Unit 538 sdeep02	Sent to iRobot for battery refurbishment and sensor calibration
Unit 541 sdeep03	Ready for preparation. Stored in the shelf

This table is updated every time a significant change affects the status of a glider unit.
It is meant to offer punctual information about the availability of the vehicles or the a estimation on when they will be.

It is an internal resource. The original is not in this Public folder of RAMADDA so the information displayed here may not be up-to-date at the moment of its visualization

2.4.4 LAGRANGIAN PLATFORMS FACILITY

2.4.4.1 Description

The Lagrangian Facility (LF) uses drifting platforms to provide a quantitative description of the changing state of the upper ocean (0 - 2000 dbar) on a regional scale. The facility, built in 2011 following IP2010, currently runs two different but complementary types of platform, Argo profiling floats and surface velocity drifters. The Argo floats provide repeated profiling of the upper ocean, with hydrographic (temperature, salinity and pressure) measurements in the upper 2000 dbar, while the drifters provide a record of near surface currents. Additionally the Argo floats can be used as drifters at their parking depth of ~700 dbar.

The goal of SOCIB's LF is to build and maintain an array of 8 Argo profiling floats and 16 surface drifters in the western Mediterranean Sea (Figure 2.2.g.), ensuring the coverage outlined by international and regional initiatives like Euro-Argo, PERSEUS and JERICO, amongst others. The LF's program contributes to the coverage needs identified for the Mediterranean Sea and within a regional context, providing information on the balance of Atlantic vs. Mediterranean waters in the Balearic basin, supporting the Bluefin Tuna project, modelling for oil spill trajectories and WMOP model validation.

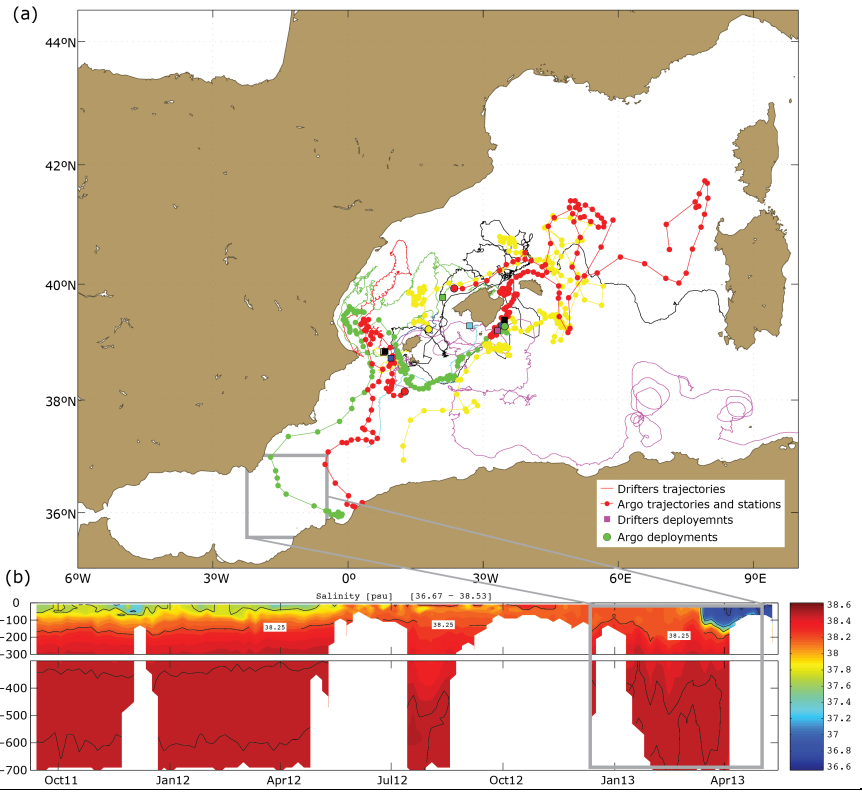


Figure 2.4.g. (a) Trajectories of all Argo floats (6) and surface drifters (9) deployed in the period 2011-2013. (b) Example of a Salinity vertical section (0-700metres) from Argo float 6900660, showing the strong salinity gradient crossing the Almeria-Oran front.

2.4.4.2 Aims 2010 – 2013

The LF contributes to the general SOCIB objectives at different levels: scientific, technology, service to society, outreach and education, and international collaboration. As described in the IP2010 the aims during the implementation phase were:

- To contribute to the understanding of the exchange of heat and mass between the northern and the southern Mediterranean and also to the knowledge of the circulation at basin and sub-basin scale. This knowledge is necessary to understand the local ecosystem, including the highly productive tuna fishery.
- To help to build up a database of upper ocean observations, including hydrographic (Temperature and Salinity) data and surface and mid-ocean velocities.
- To contribute to the SOCIB objectives by developing a knowledge base for deploying, maintaining and processing the data from a fleet of Argo floats and drifters.
- To contribute to education and outreach by facilitating access to upper ocean information, including products and services that would be useful to students, policy makers and the general public.
- To constitute the Spanish contribution to the Global Drifter Program in this region of the western Mediterranean and play an important part in the Spanish contribution to the Argo network. SOCIB activities are actually described and included in the DoW E-AIMS (Euro-Argo Improvements for the GMES Marine Service), EC funded project and in DoW PERSEUS, EU FP7 Project.

2.4.4.3 Review current status of the facility (2010 – April 2013)

ACHIEVEMENTS

During the 2010-2013 period the facility was built, becoming fully operative during the latter stages of the period. All the platforms are deployed; the data is processed at the Data Centre Facility and made publically available within 24 hours after a QC protocol. Data from the LF facility are part of the Argo and Global Drifter Program data sets.

The main achievements related to scientific objectives are:

- Design of the deployment strategy based on general scientific questions ..... Sep 2010

The main achievements related to technological objectives are:

- Tender and purchase for 4 Argo floats and 8 drifters ..... Oct 2010
- Preparation of Argo floats for deployment ..... Dec 2010
- Initial Argo deployments ..... Jan-Sep 2011
- Initial Drifter deployments ..... Jan-Sep 2011
- Data integrated into Data Centre Facility ..... Jan 2011
- Real-time data sent to Argo GDAC ..... Jan 2011
- QC protocol for Drifters implemented ..... Jan 2011
- Tender and purchase for 4 Argo floats and 8 drifters ..... Dec 2011
- Initial Argo deployments ..... Jul-Dec 2012
- Initial Drifter deployments ..... Jan-Dec 2012

The main achievements related to education and outreach:

- Data publically available in 24 hours ..... Jan 2011
- Creation of a Lagrangian platform Data visualizer (Figure 2.2.g) ..... Dec 2011

The main achievements related to international collaboration and dissemination:

- Agreement with the Global Drifter Program (GDP) office – SOCIB LF data included in the GDP data stream ..... Jan-Sep 2011
- Notification of Argo deployments to the international office..... Jan-Sep 2011
- Initial Drifter deployments..... Jan-Sep 2011

SCIENTIFIC CONTRIBUTION

The SOCIB contribution is evident in the Western Mediterranean Sea as shown in Figure 2.2.g. During the period 2011-2013, the total number of Argo hydrographic profiles in the area was 1577, sampled by 18 Argo floats. The SOCIB LF was responsible for 30 % of this data, 477 profilers sampled by 6 Argo floats.

All deployments of surface drifters in the area were made by the SOCIB LF, or associated with experiments where the SOCIB LF cooperated. It is worth mentioning than the only drifters deployed in the area as a contribution to the Global Drifter Program were those deployed by the LF during the period 2011-2013.

Papers:

Vélez-Belchí, Pedro, Alonso Hernández-Guerra, Eugenio Fraile-Nuez, Verónica Benítez-Barrios, 2010: Changes in Temperature and Salinity Tendencies of the Upper Subtropical North Atlantic Ocean at 24.5°N. J. Phys. Oceanogr., 40, 2546–2555.

Participation in meetings and workshops:

2011, Data Buoy Cooperation Panel. SOCIB Lagrangian facility: contribution to the Global Drifter Program. DBCP- Geneva, Switzerland, 26-30 September 2011.

PRODUCTS AND SERVICES

Instruments – techniques	Frequency	Products	Services
Surface Drifter - Trajectory diagrams - Sea Surface Temperature	 Bi-Hourly Bi-Hourly	- Weekly spaghetti diagrams - Mean circulation	- Real time data and graphs exploration - Data available at thredds
Argo Profilers - Temperature section - Salinity section	 5 days 5 days	- Monthly spaghetti diagrams - Mean circulation	- Real time data and graphs exploration - Data available at thredds

2.4.4.4 Current status with reference to IP2010

The Lagrangian Facility is fully operational, being able to deploy, maintain, process and publish the data from 8 Argo floats and 16 surface drifters. The size of the required fleet is adapted to the coverage of other programs (Argo and GDP) in the area.

HUMAN RESOURCES

As was already pointed out for the HF radar facility, to specific dedicated personnel is assigned to the LF. In kind contributions from IEO has been essential (P. Velez, scientific leadership and coordination) as has been the support from SOCIB ETD engineers and technicians. A part time contract will have to be established as soon as possible.

2010	Task	MM
P. Velez, IEO	Scientific team leader	1.0
B. Casas, ETD	Fieldwork & instruments maintenance	0.5

2011	Task	MM
P. Velez, IEO	Scientific team leader	0.5
B. Casas, ETD	Fieldwork & instruments maintenance	0.5
C. Castilla, ETD	Fieldwork & instruments maintenance	0.5
K. Sebastian, DC	Real time processing	0.25
S. Lora	Data delivery	0.25
G. Vizoso, IMEDEA	Lagrangian data viewer	1.0

2012	Task	MM
P. Velez, IEO	Scientific team leader	0.5
B. Casas, ETD	Fieldwork & instruments maintenance	0.5
C. Castilla, ETD	Fieldwork & instruments maintenance	0.5
K. Sebastian, DC	Real time processing	0.25
S. Lora	Data delivery	0.25
G. Vizoso, IMEDEA	Lagrangian data viewer	1.0

2013	Task	MM
P. Velez, IEO	Scientific team leader	1.0
B. Casas, ETD	Fieldwork & instruments maintenance	0.25
C. Castilla, ETD	Fieldwork & instruments maintenance	0.25
K. Sebastian, DC	Real time processing	0.15
S. Lora	Data delivery	0.15

INVESTMENTS

The major investments are the Lagrangian platforms themselves. Maintaining an operating fleet of 8 Argo floats and 10 surface drifters requires replacing the platforms at the same rate as the lifetime of the platforms. During the period 2010-2013, the major investments were:

- 2010 - Acquisition of 4 Argo profiling floats, provided with one-way satellite communication (Argos). Acquisition of 4 drifters, with Argos satellite communication.
- 2012 - Acquisition of 4 Argo profiling floats, provided with two-way satellite communication (iridium) and reprograming capabilities. Acquisition of 8 drifters, with Argos3 satellite communication, and including a sensor to monitor the drogue. 4 of these drifters had enhanced tethering.
- 2013 - Acquisition of 4 Argo profiling floats, provided with two-way satellite communication (iridium) and reprograming capabilities. Acquisition of 8 drifters, with

Argos3 satellite communication, and including a sensor to monitor the drogue. 4 of these drifters had enhanced tethering.

DIFFICULTIES OVERCOME

The main difficulty faced during the implementation phase was the shortening of the lifetime of the Lagrangian platforms. This shortening was not due to technical problems but to the dynamics of the western Mediterranean Sea that result in the platforms beaching on the shoreline in a period that ranges from ~1.5 years for the Argo profilers to ~6 months for the Surface Drifters. In consequence, the operational fleet has been reduced to half of the one established in the implementation plan, although during the 2011-2013 period the coverage in the area was complemented by other programs. To optimize the size of the fleet, two different actions will have to be implemented for the 2013 – 2016 plan as discussed later. Additionally the LF data viewer, web page development and data stream analysis has required more human resources than previously envisioned.

2.4.4.5 Critical analysis

SWOT

Weaknesses	**Strengths**
• Lack of a full time technician for coordination and to fully exploit facility. • Lack of a long-term data series in LF mission, means contribution cannot yet be fully assessed, requires decadal scale data sets. • In the Mediterranean floats beach more often, this requires a rapid response to prolong the life of the platforms.	• Skills to develop and maintain a fleet of Lagrangian platforms and to make the data publically available in real-time. • Only facility in Spain to operate and make Lagrangian platform data available real-time, an done of only a few in Europe. • Long term objectives and funding mean that skills base expands. Strong international relationships, integrated with international efforts and well coordinated with other Mediterranean observing systems.
Threats	**Opportunities**
• Institutional and financial difficulties. • Not enough ownership for inevitable difficult decisions.	• ESRF and EU Marine Directives identify monitoring the upper ocean as a key issue. • Integrating upper ocean observations (Lagrangian, Radar and Mooring) with modelling to improve forecasting.

AREAS OF MAJOR IMPACT IN 5 YEARS: SCIENTIFIC, TECHNOLOGICAL AND SOCIETAL

Scientific topics

- North-South Mediterranean Exchange
- Shelf-break circulation in the western Med.
- Interaction Algerian gyres - circulation in the Balearic Basin
- Precondition of deep-water mass formation.
- Cross-validation of model results with lagrangian observations

Technology topics

- Adaptive technique to modify the sampling using Argo floats.

Strategic and society needs

- Tools for real-time upper-ocean monitoring in the Western Mediterranean Sea.

2.4.5 FIXED STATIONS FACILITY

2.4.5.1 Description

The SOCIB Fixed Station Facility (FSF) is an infrastructure composed of different fixed measurement networks aimed at providing routine point monitoring to scientists, environmental managers, public authorities, etc. The FSF produces long-term time-series data of different parameters, both physical and biogeochemical. These data are then available through SOCIB's Data Centre Facility to guide environmental policy decisions, support scientific research and validate and constrain forecast models.

The spatial distribution and type of SOCIB monitoring stations were designed to:

- Extend the number of marine observations available in the Balearic Islands, complementing existing monitoring networks belonging to other agencies like Ports IB (regional ports authority), Puertos del Estado, etc.
- Create new types of observational networks.
- Increase met-ocean data recording in terms of variables, temporal distribution and geographical context.

In June 2013 the FSF infrastructure comprises four networks of operational stations:

- Sea Level network – 3 stations
- Moored buoy network – 2 stations[9]
- Coastal station network – 1 station
- Weather station network – 6 stations

See Figure 2.4.h.

[9] The Ibiza channel mooring has just been installed in June 2013 and, although the data are already available through SOCIB web, it will not be described here until the present test phase ends.

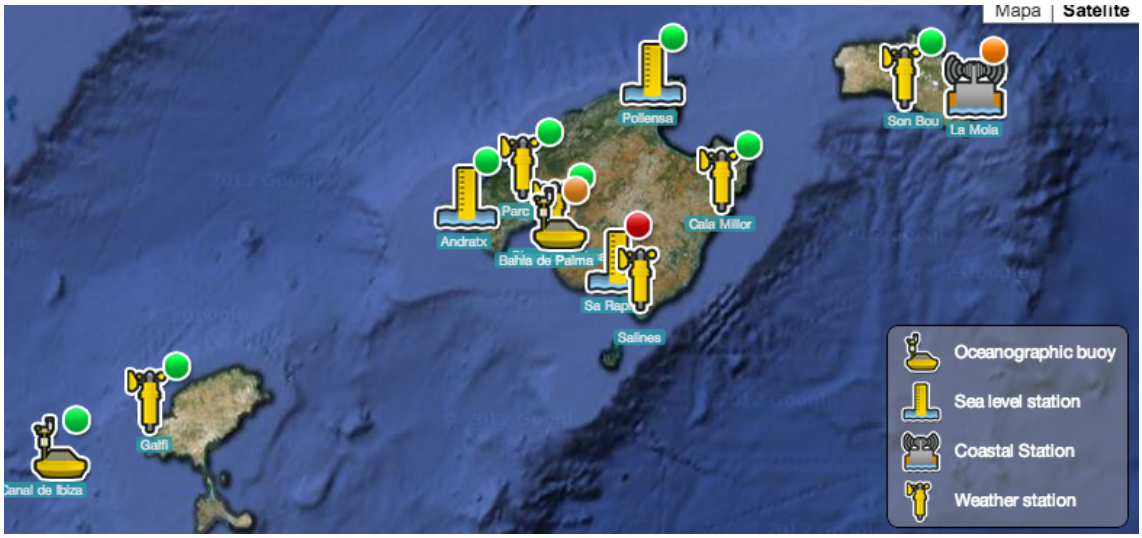


Figure 2.4.h. The FSF network, as visible real time on the facility web page, (http://www.socib.es/?seccion=observingFacilities&facility=mooring)

2.4.5.2 Aims 2010 – 2013

The aim of the Mooring Facility is to provide the Balearic coast with instruments for time-series observations of physical, biological and chemical properties with respect to their long term variability.

2.4.5.3 Review current status of the facility (2010 – April 2013)

ACHIEVEMENTS

- Installation of sea level station Andratx, Mallorca ..... Jun 2009
- Installation of sea level station Pollensa, Mallorca..... Jul 2009
- Installation of coastal station La Mola, Menorca ..... Oct 2010
- Installation of weather station MOBIMS Cala Millor, Mallorca..... May 2011
- Installation of sea level station SaRapita, Mallorca ..... Jul 2011
- Installation of weather station MOBIMS Son Bou, Menorca ..... Oct 2011
- Incorporation of real-time data streams into the SOCIB data portal ..... Oct 2011
- Installation of weather station MOBIMS, Playa de Palma ..... Nov 2011
- Incorporation of real-time data streams into the SOCIB iPhone App ..... Nov 2011
- Receipt of AXYS buoys in Palma ..... Dec 2011
- Replacement of Aanderaa buoy by coastal AXYS buoy bay of Palma ..... May 2012
- Geo-referencing Sea Level Stations ..... Jan 2012
- Installation of weather station ParcBit, Mallorca ..... Jul 2012
- Installation of weather station Galfi, Ibiza..... Nov 2012

2.4.5.4 Current status with reference to IP2010

In this section a review of the stations that are currently (as at December 2012) providing data to SOCIB through its FSF is presented.

Sea Level Network

1. **Andratx Station:**

Instrument type	Manufacturer	Model
Wave and Tide Recorder	SeaBird	SBE26
Atm. Pressure Sensor	Vaisala	PBT330

Station output variables: Sea level (Δt 60 s), water temperature (Δt 60 s), atmospheric pressure (Δt 30 s).

2. **Pollensa Station**:

Instrument type	Manufacturer	Model
Wave and Tide Recorder	SeaBird	SBE26 +
Atm. Pressure Sensor	Vaisala	PBT330

Station output variables: Sea level (Δt 60 s), water temperature (Δt 60 s), atmospheric pressure (Δt 30 s).

3. **Sa Rapita Station**:

Instrument type	Manufacturer	Model
Wave and Tide Recorder	SeaBird	SBE26 +
Atm. Pressure Sensor	Vaisala	PBT330

Station output variables: Sea level (Δt 60 s), water temperature (Δt 60 s), atmospheric pressure (Δt 30 s).

Moored Buoy Network

1. **Buoy "Bahía de Palma":**

Instrument type	Manufacturer	Model
Oceanographic Buoy	AXYS	Watch Mate
Current profiler	Sontek	
Current meter	FSI	
CT recorder	SeaBird	SBE37
Wave recorder	AXYS	TriAXYS
Multiparametric probe	YSI	6600

Station output variables: wind speed (Δt 10 minutes), wind direction (Δt 10 minutes), wind gust (Δt 10 minutes), air temperature (Δ t 10 minutes), atmospheric pressure (Δt 10 minutes), relative humidity (Δt 10 minutes), net solar radiation (Δt 10 minutes), dew point (Δt 10 minutes), wave sig. height (Δt 1 hour), wave direction (Δt 1 hour), water temperature (Δt 10 minutes), water salinity (Δt 10 minutes), water turbidity (Δt 10 minutes), water ph (Δt 10 minutes), water chlorophyll concentration (Δt 10 minutes), water oxygen concentration (Δt 10 minutes), current speed and direction profile from the surface to the bottom (30 m) in 2m intervals (Δt 1 hour).

Coastal Station Network

1. **Station La Mola**:

Instrument type	Manufacturer	Model
Current profiler	Nortek	Aquadopp 1MHz
Water CT recorder (21m)	SeaBird	SBE37
Water CT recorder (12m)	SeaBird	SBE37
Atm. Pressure Sensor	Vaisala	PBT330

Station output variables: atmospheric pressure (Δt 30 s), water temperature at 12 m depth (Δt 60 s), water temperature at 21 m (Δt 60 s), water salinity at 12 m (Δt 60 s), water salinity at 21m (Δt 60 s), current speed and direction profile from the surface to the bottom in 2 m intervals (Δt 60 s).

Weather Station Network

Some of the weather station sites are co-located with the Beach Monitoring Facility MOBIMS sites and HF Radar sites, in order to provide atmospheric variables for these Facilities' datasets.

1. **MOBIMS Cala Millor:**

Instrument type	Manufacturer	Model
Weather Station	Vaisala	WXT520

Station output variables: Air temperature, wind speed, wind direction, wind gust, atmospheric pressure, relative humidity, and rainfall volume all collected at a sampling interval Δt of 60 seconds.

2. **MOBIMS Playa de Palma:**

Instrument type	Manufacturer	Model
Weather Station	Vaisala	WXT520

Station output variables: Air temperature, wind speed, wind direction, wind gust, atmospheric pressure, relative humidity, and rainfall volume all collected at a sampling interval Δt of 60 seconds.

3. **MOBIMS Son Bou:**

Instrument type	Manufacturer	Model
Weather Station	Vaisala	WXT520

Station output variables: Air temperature, wind speed, wind direction, wind gust, atmospheric pressure, relative humidity, and rainfall volume all collected at a sampling interval Δt of 60 seconds.

4. **Station Galfi:**

Instrument type	Manufacturer	Model
Weather Station	Vaisala	WXT520

Station output variables: Air temperature, wind speed, wind direction, wind gust, atmospheric pressure, relative humidity, and rainfall volume all collected at a sampling interval Δt of 60 seconds.

5. **Station ParcBit:**

Instrument type	Manufacturer	Model
Weather Station	Vaisala	WXT520

Station output variables: Air temperature, wind speed, wind direction, wind gust, atmospheric pressure, relative humidity, and rainfall volume all collected at a sampling interval Δt of 60 seconds.

6. **Station Salines:**

Instrument type	Manufacturer	Model
Weather Station	Aanderaa	AWS2700

Station output variables: Air temperature (Δt 5 minutes), wind speed (Δt 5 minutes), wind direction (Δt 5 minutes), wind gust (Δt 5 minutes), atmospheric pressure (Δt 5 minutes), and relative humidity (Δt 5 minutes)

HUMAN RESOURCES

B. Casas Perez takes the planning and coordinating role for the Fixed Platform Facility. The operational support for the facility is provided from the ETD Division and is estimated for normal operations at approx. 6 man months (MM) per year, and encompasses; installations of new stations (Sea Level, Coastal, Deep, Weather), initiating and maintaining data flow to the Data Center, regular service schedule for fixed station sites, instrument calibration schedule. No specific personnel is therefore formally assigned to this facility.

2010	Task	MM	Dates
B. Casas, IMEDEA	Coordination, fieldwork & instruments maintenance	05.0	01/12 – 12/12

2011	Task	MM	Dates
B. Casas, IMEDEA	Coordination, fieldwork & instruments maintenance	05.0	01/11 – 12/11
C. Castilla, ETD	Fieldwork & instruments maintenance	03.0	05/11 – 12/12

2012	Task	MM	Dates
B. Casas, IMEDEA	Coordination, fieldwork & instruments maintenance	05.0	01/12 – 12/12
C. Castilla, ETD	Fieldwork & instruments maintenance	04.0	01/12 – 12/12
I. Lizarán, ETD	Fieldwork & instruments maintenance	04.5	01/12 – 12/12
D. Roque, ETD	Fieldwork & instruments maintenance	01.0	01/12 – 12/12

INVESTMENTS

The major equipment investment carried out during 2010- 2013 period was the acquisition of 2 AXYS buoys (427,160 €). Other important investments for this facility included the purchase of sensors to complement the Sea Level Stations (4 barometers), instruments and submarine communication cables for La Mola Station and, finally, a pool of backup instruments to guarantee the reliable operation of the data network. In order to provide accurate sea level data, precise georeferencing for the Sea Level Stations (Andratx, Pollença and Sa Rapita) was carried out.

DIFFICULTIES OVERCOME

As a result of logistical problems, environmental problems, delays in the acquisition process and/or over optimistic planning, a few actions in the IP2010 were not achieved or were/will be achieved later than planned. The following table illustrates this in detail:

Station	Status	Reason	Planning
Buoy "Canal de Ibiza"	Just moored in June 2013. Test Phase.	Delay in the acquisition process. Delay in the availability of R/V SOCIB	This buoy will reach FOC approx.. in two months.
Buoy "Cabrera" (from Parques Nacionales Authority).	Lost	In May 2011, a storm broke the mooring line of the buoy, and communication with the platform was lost	In 2012 Parques Nacionales (owner of the buoy) started a procedure to purchase a new buoy to replace the one lost at Cabrera
Buoy "Formentera"	Ready to be moored, but not installed	A lack of security in funding (due to delays in SOCIB receiving its annual funding contributions) places a large risk factor on FSF's ability to the maintain this buoy once in-situ. It has therefore been decided to delay the deployment indefinitely.	Not scheduled

ACHIEVEMENTS NOT ANTICIPATED IN THE IP2010

It is important to point out that apart from the technical procedures carried out in establishing theses sites, in most cases specific agreements with stakeholders have also been negotiated to obtain permissions for the installation of the different sensors. This has had the advantage of contributing to a bilateral transfer of knowledge between SOCIB and local stakeholders.

2.4.5.5 Critical analysis

SWOT

Weaknesses	Strengths
• Lack of exclusive facility staff, leading to compromised priorities • Lack of a full time dedicated computer technician • Low non competitive salaries	• Strong support from IMEDEA • Developed symbiosis with other monitoring institutions in order to extend the data network coverage
Threats	**Opportunities**
• Institutional and financial difficulties	• Extensive network of deployed stations

AREAS OF MAJOR IMPACT IN 5 YEARS: SCIENTIFIC, TECHNOLOGICAL AND SOCIETAL

Scientific topics

- Identifying and understanding marine responses to climate change.
- Model validation, and forecast model constraint through data assimilation

Technology topics

- Beach wave modelling and forecasting
- Leading improvements in new communication technologies

Strategic and society needs

- Tools to provide scientific information at the right level for decision makers.
- Tools for wave height and security alerts
- Met-Ocean data presentation and access for the society benefit

2.4.6 BEACH MONITORING FACILITY

2.4.6.1 Description

The Beach Monitoring Facility (BMF) employs different types of high-resolution sensors to continuously monitor coastal and nearshore processes; data are acquired automatically and continuously from systems that combine large coverage observation (low frequency, large area and surface processes) with in situ monitoring systems (high frequency, point measurements and process-based observations).

Monitoring is carried out using the Modular Beach Integral Monitoring System (MOBIMS), which consists of a video monitoring system, an Acoustic Doppler Current Profiler (ADCP) and a program of bathymetric surveys and sediment sampling. This enables the autonomous and sustained collection of physical data on nearshore hydrodynamics and sediment transport.

The BMF has implemented MOBIMS at three sites, Cala Millor and Platja de Palma in Mallorca and Son Bou in Menorca. The system provides images and meteorological data streams, combined with annual bathymetries and semi-annual beach profiling surveys as well as in situ ADCP data. These data are combined with analytical tools developed at SOCIB providing information on the evolution of the 3 beaches, increasing our understanding of the hydrodynamics and sediment transports at different scales, and also contributing to the modelling and forecasting of beach response to global change scenarios. The BMF is also developing products and services (such as wave propagation analyses at the 3 sites) that can be used by researchers, beach managers, lifeguards and the beach using public.

2.4.6.2 Aims 2010 – 2013

The BMF contributes to the SOCIB objectives as described in the IP 2010 at different levels: scientific, technology, society service, outreach, education and international collaboration:

- Regarding the scientific scope there are two dimensions in which BMF contributes to IP2010. First, on the long term, BMF aims to build up a continuous and coherent database on beach morphology, sediment budgets and waves for addressing the role of climate variability and its trend on beach evolution. Second, at short-time scale, BMF provides datasets and diagnostic indicators for understanding and modelling these natural systems and to unravel specific coastal processes (i.e. bar displacement, rips).
- From a technological point of view, the SOCIB BMF is developing new coastal video-monitoring tools (i.e. video-monitor image processing and coastline analysis tools, etc.) and providing resources for coastal management (wave beach propagation, beach users alert tools, etc.).
- In contributing to society the BMF seeks to generate products and services that can be useful to coastal managers and related government departments, especially in those issues related to beach management and beach safety.
- The BMF also aims to contribute to education of students interested in coastal variability, hydrodynamics and coastal management; facilitating the understanding of beach processes and making the information more accessible to the undergraduate community and society in general.
- Regarding international collaboration the main goal of the SOCIB BMF is contributing to reinforce the Spanish position in the international frame of coastal monitoring observatories.

2.4.6.3 Review current status of the facility (2010 – April 2013)

ACHIEVEMENTS

The main achievements related to technological objectives are:

- Training in AZTI of 1 BMF technician Nov2010
- Purchase of equipment and MOBIMS' components ..... Dec 2010
- Laser granulometer installed ..... Apr 2011
- Integration of real-time beach images data streams (BEAMON apps) ..... May 2011
- Integration of weather station data streams ..... Jun 2011
- 3 MOBIMS sites installed and fully operative ..... Oct 2011
- Integration of zabbix and remote control tools at SIRENA stations ..... Jun 2012
- Development of semi-automatic coastline extraction tools ..... Sep 2012
- Implementation of a beach wave propagation model ..... Sep 2012
- Integration of near real-time wave and currents data streams (AWAC) ..... Nov 2012
- Implementation of a wave-forecasting tool for the Balearic Sea (with PE) .... Mar 2013

The main achievements related with scientific objectives are:

- Initiation of biannual beach survey and sediment sampling CLM ..... May 2011
- Initiation of biannual beach survey and sediment sampling SNB ..... Oct 2011
- Initiation of biannual beach survey and sediment sampling PDP ..... Feb 2012
- Weekly coastline extraction from video monitoring images ..... Dec 2012
- Analysis of coastline and bar evolution ..... Sep 2012
- Study of seagrass banquette accumulation and beach erosion..... Jan 2013

The main achievements related to society service are:

- Collaboration agreement with Melia International Hotels ..... Oct 2011
- Development of a map-server with historical datasets for coastal management Feb 2012
- Dissemination of video monitoring images to beach sport users ..... Nov 2012

The main achievements related to outreach and education are:

- Organization in Palma of 1st Spanish Coastal Video monitoring Workshop.. Mar 2011
- Supervision of a MSc (UIB) thesis using SOCIB's beach images ..... Oct 2011
- Supervision of a French Internship BSc student for 6 months ..... Mar 2012
- BSc final project on video monitoring issues ..... Nov 2012
- Supervision of two Dutch Internship BSc students for 2 months ..... Apr 2013
- Supervision of one training MSc (UIB) student for 6 months ..... May 2013
- Development and publication of a video documentary on BMF (web access) Dec 2012

The main achievements related to international collaboration and dissemination:

- Participation in 6th Spanish Coastal Geomorphology Meeting, Tarragona .... Sep 2011
- Participation in 33rd Int. Conference in Coastal Engineering, Santander ..... Jul 2012
- Participation in 32nd International Geographical Congress, Köln ..... Aug 2012
- Presentation of BMF activities and datasets to Rutgers Coastal Facility
- Geomorphology Lab and discussion on survey protocols (Dr. Psuty) ..... Aug 2012
- Participation in 12th International Coastal Symposium, Plymouth..... Apr 2013

SCIENTIFIC CONTRIBUTION

Papers:

Nieto, M.A., Garau, B., Balle, S., Simarro, G., Zarruk, G.A., Ortiz, A., Tintoré, J., Álvarez-Ellacuría, A., Gómez-Pujol, L., Orfila. A. 2010. An open source, low cost video-based coastal monitoring system. Earth Surface Processes and Landforms, 35: 1712-1719.

Álvarez-Ellacuría, A., Orfila, A., Gómez-Pujol, L., Simarro, G., Obregón, N. 2011. Decoupling spatial and temporal patterns in short-term beach shoreline response to wave climate. Geomorphology, 128: 199-208.

Gómez-Pujol, L., Orfila, A., Álvarez-Ellacuría, A., Tintoré, J. 2011. Controls on sediment dynamics and medium-term morphological change in a barred microtidal beach (Cala Millor, Mallorca, Western Mediterranean). Geomorphology, 132: 87-92.

Ponce de León, S., Orfila, A., Gómez-Pujol, L., Renault, L. Vizoso, G., Tintoré, J. 2012. Assessment of wind models around the Balearic Islands for operational wave forecast. Applied Ocean Research, 34: 1-9.

Gómez-Pujol, L., Orfila, A., Álvarez-Ellacuría, A., Terrados, J., Tintoré, J. 2013. *Posidonia oceanica* beach-cast litter in Mediterranean beaches: a coastal videomonitoring study. Journal of Coastal Research SI65: 1768-1773.

Gómez-Pujol, L., Roig-Munar, F.X., Fornós, J.J., Balaguer, P., Mateu, J. 2013. Provenance-related characteristics of beach sediments around the island of Menorca, Balearic Islands (western Mediterranean). Geo-Marine Letters, 33: 195-208.

Participation in meetings and workshops:

2011, 1st Spanish Coastal Video monitoring Workshop. Sistemas de Observación Coastera en las Islas Baleares. Oral communication.

2011, 6th Spanish Coastal Geomorphology Meeting, La infraestructura de monitorización de playas del SOCIB. Poster.

2012, 33rd International Conference on Coastal Engineering, Intermediate states transitions in a low energy microtidal beach. Poster.

2012, 32nd International Geographical Congress, Design and development of a large and high-resolution beach-monitoring program at Balearic Islands Coastal Observing and Forecasting System. Oral communication.

2013, 12th International Coastal Symposium, Posidonia oceanica beach-cast litter in Mediterranean: a coastal video monitoring study. Oral communication.

PRODUCTS AND SERVICES

Instruments – techniques	Frequency	Products	Services
Video-monitoring stations - Snap shots - Mean images - Variance images - Time stacks	 Hourly Hourly Hourly Hourly	- Weekly shorelines - Beach users statistics* - Run-up and beach flooding* - Rips presence* - *P. oceanica* banquettes dynamics and accumulation	- Report on shoreline evolution - Web-based beach images repository for coastal managers and beach users
		- Weather timeseries	- Real time weather

Weather station - Atmospheric pressure - Humidity - Rainfall - Temperature - Wind velocity - Wind direction	1 min 1 min 1 min 1 min 1 min 1 min		station data and graphs exploration - Data available at thredds
Wave and current profilers - Wave height - Wave period - Wave direction - Velocities across de water column	20 min 20 min 20 min 20 min 20 min	- Biannual wave timeseries	- Wave data and graph exploration application - Data available at SOCIB Thredds
Beach Monitoring Program - Beach survey - Profile survey - Sediment survey	1 year 2 year 1 year	- Beach DTM - Beach profiles - Sediment properties	- Reports on sediment budgets - Beach profile equilibrium - Beach sediment characterization -Mapserver with monitoring program and historical beach data

- Potential products

2.4.6.4 Current status with reference to IP2010

HUMAN RESOURCES

2010	Task	MM	Dates
A. Orfila, IMEDEA	Scientific team leader	04.00	01/10 – 12/10
A. Álvarez; BMF	Technician BMF	04.00	01/10 – 12/10
M.A. Nieto; BMF	Technician BMF SIRENA tools	01.00	01/10 – 12/10

2011	Task	MM	Dates
A. Orfila, IMEDEA	Scientific team leader	04.00	01/11 – 12/11
L. Gómez-Pujol, BMF	Technician BMF, coordinator	08.00	04/11 – 12/11
A. Álvarez; BMF	Technician BMF	12.00	01/11 – 12/11
M.A. Nieto; BMF	Technician BMF SIRENA tools	05.00	01/11 – 12/11
B. Casas, ETD	Fieldwork & instruments maintenance	01.00	01/11 – 12/11
C. Castilla, ETD	Fieldwork & instruments maintenance	01.50	01/11 – 12/11
I. Lizarán, ETD	Fieldwork & instruments maintenance	01.50	01/11 – 12/11
G. Vizoso, IMEDEA	Apps *BEAMON* design	00.50	01/11 – 12/11
J. Brunet, DC	Appes *BEAMON* development	01.50	01/11 – 12/11
J. Llodrá, DC	BMF web implementation	00.50	01/11 – 12/11
K. Sebastian, DC	Apps instrumentation	00.50	01/11 – 12/11
S. Gomara, DC	Systems management	01.00	01/11 – 12/11

2012	Task	MM	Dates
A. Orfila, IMEDEA	Scientific team leader	04.0	01/12 – 12/12
L. Gómez-Pujol, BMF	Technician BMF, coordinator	12.0	01/12 – 12/12
A. Álvarez; BMF	Technician BMF	12.0	01/12 – 12/12
M. Dupuy; BMF	Internship coastal modelling	06.0	02/12 – 08/12
A. Campos, BMF	BSc final project UIB	06.0	03/12 – 09/12
B. Casas, ETD	Fieldwork & instruments maintenance	00.5	01/12 – 12/12
C. Castilla, ETD	Fieldwork & instruments maintenance	02.0	01/12 – 12/12
I. Lizarán, ETD	Fieldwork & instruments maintenance	02.5	01/12 – 12/12
D. Roque, ETD	Fieldwork & instruments maintenance	00.1	06/12 – 06/12
G. Vizoso, IMEDEA	Beach GIS viewer, *SAPO*	01.0	01/12 – 12/12
J. Vallespir, Freelance	External contract for Beach GIS viewer	02.00	01/12 – 02/12
S. Gomara, DC	Systems management	01.00	01/12 – 12/12
J. Llodrá, DC	BMF web implementation	00.50	01/12 – 06/12
K. Sebastian, DC	Apps instrumentation	00.50	01/12 – 12/12
S. Lora	Apps *Beamon*	00.50	01/12 – 12/12

2013	Task	MM	Dates
A. Orfila, IMEDEA	Scientific team leader	04.0	01/13 – 12/13
L. Gómez-Pujol, BMF	Technician BMF, coordinator	12.0	01/13 – 12/13
A. Álvarez; BMF	Technician BMF	12.0	01/13 – 12/13
R. Borgman, BMF	Internship Coastal management	02.5	01/13 – 12/13
M. Siegfrid, BMF	Internship Coastal management	02.5	01/13 – 12/13
J. Font, BMF	Santander Grant Sch. Beach GIS	03.00	01/13 – 12/13
B. Casas, ETD	Fieldwork & instruments maintenance	00.25	01/13 – 12/13
C. Castilla, ETD	Fieldwork & instruments maintenance	02.0	01/13 – 12/13
I. Lizarán, ETD	Fieldwork & instruments maintenance	02.5	01/13 – 12/13
P. Balaguer, ETD	Fieldwork & instruments maintenance	02.0	01/13 – 12/13
S. Gomara, DC	Systems management	01.50	01/13 – 12/13
B. Frontera, DC	BMF web implementation	02.00	01/13 – 12/13
K. Sebastian, DC	Apps instrumentation	00.50	01/13 – 12/13
S. Lora	Apps Beamon	00.50	01/13 – 12/13

INVESTMENTS

In 2010 and 2011, the major equipment and technology investments carried out were fully in line with the IP2010; a laser granulometer, RTK, computers, cameras, ADCP's, etc. They were purchased for 3 sites instead of 4 as initially planned, due to lack of available funds in 2012 (related to the delays in receiving the annual contributions). As a result, the Ibiza beach system is still pending.

In 2012, the major investments have been related to the acquisition of video monitoring station components (i.e. hardware components, optics, filters etc.) and Awac batteries. Other investments included replacement of RTK elements, as well as replacement of laboratory and sediment sampling consumables (bags, markers etc.).

DIFFICULTIES OVERCOME

The Beach Monitoring Facility is fully operational although initial implementation locations have been changed due to the lack of adequate sites (i.e. buildings high enough for installing video-monitoring stations or the availability of suitable power or broadband communication access). The installation at the Ibiza study site has been cancelled due to budget reductions.

The set up of the MOBINS sites has required a higher level of work than previously envisioned; discovering the sites (hotels and private housing) that have provided the protected locations, power supply and broadband access, required. Additionally GIS Beach viewer, BMF web page development and stream data analysis has also required more human resources and work time than originally expected. For this reason the BMF team was increased in size by hiring a new technician with facility coordination responsibilities.

ACHIEVEMENTS NOT ANTICIPATED IN THE IP2010

SOCIB's IP2010 did not consider the development of wave modelling tools. However, the demand to provide services to society and coastal managers with these kinds of tools, persuaded the SOCIB BMF to assume this responsibility.

2.4.6.5 Critical analysis

SWOT

Weaknesses	**Strengths**
• Lack of a full time computer technician to improve the robustness of the SIRENA video monitoring software and hardware (important as system is adopted nationally and internationally) • Requirement for long-term data series in BMF mission to achieve monitoring objectives means that its impact cannot yet be fully evaluated • Low competitive salaries	• Unique infrastructure in terms of technology and capabilities in the Mediterranean and in Europe • Largest such infrastructure in Spain and among largest in Europe • International relationships and education • Commercial collaborations and service to society needs
Threats	**Opportunities**
• Institutional and financial difficulties do not enable us to fully exploit the facility	• ESRF and EU Marine Directives identify coastal and near-shore environments as key issues, implying an expansion of coastal monitoring • Regional social and political concern for sustainable development • Exportable knowledge and skills for coastal video-monitoring and beach monitoring in Spain and the Mediterranean

AREAS OF MAJOR IMPACT IN 5 YEARS: SCIENTIFIC, TECHNOLOGICAL AND SOCIETAL

Scientific topics

- Short-time vs. long-time shoreline variability
- The role of *Posidonia oceanica* in Mediterranean beach morphodynamics
- Bar dynamics and detection by means of video monitoring techniques

Technology topics

- Beach wave modelling and forecasting
- Coastal video monitoring tools development

Strategic and society needs

- Tools for beach managers, wave and security (rips) alert
- Historical repositories on coastal datasets for coastal managers and government agencies
- Real-time web-based server on coastal images, weather stations, and wave data at different beaches.

2.4.7 MODELLING FACILITY

2.4.7.1 Description

The numerical Modelling & Forecasting Facility (M&FF) combines operational goals with research oriented process studies to enhance the capabilities of operational systems. The Balearic Islands are a key biodiversity hotspot in the western Mediterranean and this is largely related to the importance of thermohaline processes of global ocean relevance that are not yet fully understood.

These processes take place in sub-basins adjacent to the Balearic Islands and the M&FF takes full advantage of the ideal conditions of the western Mediterranean (sometimes referred to as a laboratory ocean) and of the observational and data facilities of SOCIB to contribute to global ocean problems. Two specific examples of theses processes are: (a) Water Mass Interactions and Instabilities: at sub-basin scale (mostly east of the Alborán Sea/south of the islands), interaction between recently Modified Atlantic Waters (MAW) and Mediterranean Waters (MW). (b) Water masses Formation: at sub-basin scale also (Gulf of Lion/north of the islands). As a result of theses processes, fronts and eddies (meso and submesoscale structures) develop and modify both the large basin scale circulation and the local coastal waters, in both cases with significant effects on the ecosystem variability. Accordingly, one of the main objectives of the M&FF is, taking advantage of the proximity of the Gulf of Lion to the Balearic Islands, to efficiently study processes of global ocean interest (Bryden et al., 2012[10]).

In summary, the general objectives of the M&FF at SOCIB are to advance on the understanding of physical and multidisciplinary processes and their nonlinear interactions, to detect and

[10] Bryden H., C. Robinson, G. Griffiths, 2012: Changing currents: a strategy for understanding and predicting the changing ocean circulation. Phil. Trans. R. Soc., A2012, 370, doi: 10.1098/rsta.2012.0397.

quantify changes at different spatial and temporal scales, to understand the mechanisms that regulate them and to forecast their evolution under different scenarios for the region around the Balearic Islands and adjacent sub-basins from the nearshore to the open ocean. This science to operational systems approach from the M&FF at SOCIB is a logical evolution of the science based pre-operational systems approach developed since the beginning of last decade (around 2001-2002) at IMEDEA (CSIC-UIB) and mutual interactions and benefits remain active.

OPERATIONAL SYSTEMS

The following **operational systems** and tools are now, April 2013, in place and available for science, decision making support, and society (including outreach) on the SOCIB website:

- **Western Mediterranean OPerational (WMOP) model**: forecasting oceanic conditions, in the Balearic Islands and adjacent sub-basins, in the frame of the MyOcean2 and MONGOOS agreement. This provides pre-operational services related to SAR, oil spill, or larvae tracking for example in relation to the Bluefin Tuna sustainable fisheries. Validation is carried out at daily/operational and seasonal/inter-annual scales.
- **Wave forecast for Palma Bay** (in collaboration with the *Puertos del Estado, SAPO system*). SAPO is a wave forecasting system developed by Puertos del Estado (The Spanish holding of harbours) to predict waves at the coast and is run twice a day with a forecasting horizon of 72 h. This system is driven by wind fields supplied by the Spanish Meteorological Service from the HIRLAM model.
- **Meteotsunamis pre-operational system; Balearic RIssaga Forecasting System (BRIFS)**: contributing to the forecast of Meteotsunamis in Ciutadella harbour (Minorca, Spain), presently carried out qualitatively by AEMET (Spanish Meteorological Agency).
- **Oil Spill trajectories Lagrangian tool**: tools to determine Lagrangian trajectories are being developed. Some of them are ready to use in case of emergency (oil spill, rescue, etc.).
- **Satellite derived products**: SST, ocean colour and altimetry products are available for visualization at SOCIB web site from 2012. Coastal altimetry products are validated using the new tide gages deployed, as described in Fixed Stations facility. These satellite products are contributing to the characterization of the variability in the Western Mediterranean/ Balearic Sea and are also used for WMOP model validation (specific tool derived).

PROCESS ORIENTED RESEARCH AREAS

At the same time, the **specific research areas** and process studies in which we have concentrated our efforts have been:

- **Ocean-Atmosphere-Wave coupled studies:** to improve the parameterisation of air-sea interactions, in operational models. SOCIB's M&FF aims to resolve detailed water mass formation in the WMOP operational system by achieving a better representation of ocean-atmosphere exchanges and interactions.
- **Mesoscale/submesoscale eddy interactions and 3D dynamics**: a three-year WMOP hindcast (2009-2011) study was initiated to understand the 3D circulation at the meso and submesoscale as well as the role and interaction of water masses at basin and sub-basin scales. In the Alborán Sea sub-basin, a detailed study on the key role of eddies and sub-mesoscale processes, both in modifying the physical dynamics and the associated biogeochemical processes, was carried out. These basin and sub-basin scale process studies were ultimately oriented towards understanding the effects of climate change scenarios in

the circulation of the Mediterranean and the expected impacts on biodiversity at the sub-basin scale.

- **Bio-Physical Coupling, biogeochemical fluxes and ecosystem response** (using 'simple' NPZD models): (i) to understand the Bio-Physical interactions primarily driven by the interaction and juxtaposition of Atlantic and Mediterranean water masses, the relation to fish larvae trajectories and accumulation, with a focus (in the long term) on Bluefin tuna spawning areas and connectivity with MPA (Marine Protected Areas) design and conservation, and (ii) to study the eddy induced vertical motion relationship with phytoplankton size structure and biogeochemical exchanges.
- **Meteotsunami studies:** mostly related to the validation of the existing system, and advance towards an operational forecasting model.
- **Data assimilation;** very preliminary studies on the assimilation of glider data from the Ibiza Channel Endurance line. To establish the importance of adequate constraint on water masses and 3D structure present in the models for forecasting the north-south exchanges in this channel (both northward flow of MAW and southward flow of MW).

A summary of the conceptual structure and actions of the M&FF can be seen in Figure 2.4.i.

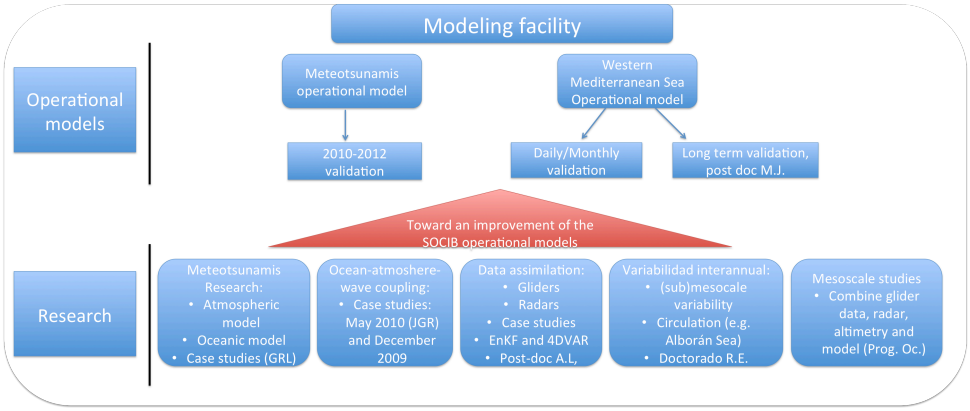


Figure 2.4.i: Conceptual structure of M&FF

2.4.7.2 Aims 2010 – 2013

The M&FF has maintained the research and operational objectives that were originally established in the SOCIB Implementation Plan approved in 2010. They are briefly outlined below for completeness, to show that progress has been consistent and in phase with the original objectives.

It is clear though, that the objectives established in 2010 were over-ambitious and that the human resources allocated to the M&FF have been small compared to other facilities at SOCIB. It is also fair to say that a lot of baseline work from IMEDEA (CSIC-UIB) existed when the M&FF started (both in terms of model setup, data management, tools and understanding of Mediterranean key features and processes) and this obviously facilitated the implementation, development and results achieved by M&FF from 2010 to 2013.

Scientific objectives

- Develop a regional circulation oceanic hindcast model to study the Western Mediterranean Sea variability.

- Carry out mesoscale/submesoscale processes studies.
- Assess ocean-atmosphere-wave interaction parameterisations.
- Assimilate observational data including those from new platforms such as gliders.
- Study meteotsunamis from numerical models and observations.
- Coupled physical-biological modelling process studies.
- Investigate sediment transport modelling.

Specific objectives for operational models and tools

- To provide ocean current forecasts from a regional ocean circulation model.
- To use regional atmospheric model atmospheric forcing for the ocean forecast model.
- To constrain the oceanic operational model through observational data assimilation.
- To develop a regional wave modelling capability, to forecast wave conditions for the Balearic Sea.
- To develop a meteotsunami pre-operational forecasting system based on a regional atmospheric model.
- To develop particular user required added value applications and products for oil spill and SAR trajectory forecasting, and predicting Jellyfish trajectories for example.
- To disseminate results and new applications through the SOCIB website.

2.4.7.3 Review current status of the facility (2010 – April 2013)

We firmly believe that one of the successes of the M&FF is the combination of science, operations and technology, leading to the development of a unique modelling system for the Balearic Basin, with coincident scientific advancement (20 publications), and the development of new products and services, e.g. the Oil Spill tracking system, Meteotsunami forecasting system, and ocean wave and current forecasts.

ACHIEVEMENTS OPERATIONAL SYSTEMS

The WMOP forecasting system: WMOP (Western Mediterranean sea OPerational system) is the forecasting subsystem component that has been implemented at SOCIB. WMOP is a local configuration of the Regional Oceanic Model System (ROMS, www.myroms.org; Shchepetkin & McWilliams, 2005) to forecast ocean currents. The model domain was implemented over an area extending from the Gibraltar strait to Corsica and Sardinia (from 6°W to 9°E and from 35°N to 44.5°N), including the Balearic Sea and Gulf of Lion. The grid is 631 × 539 points with a resolution of ~1.5km, which allows good representation of mesoscale and submesoscale features. This is of key relevance in this region because of the known dynamical interactions between eddies and the mean currents (further details can be found at SOCIB Modelling Facility web site). Development of science based ocean forecasting systems at global, regional, sub-regional and local scales affords better management of the marine environment and these tools can also be used for better testing and enhancing our understanding of ocean dynamical processes. In this context, the WMOP system, based on scientific studies, is the forecasting subsystem component that has been implemented at SOCIB and it has been running continuously since April 2012, although some gaps exist in the simulation timeseries.

Online validation procedures based on inter-comparison of model outputs against observing systems and reference models such as MFS and Mercator are used to assess at what level WMOP reproduces the features observed from in-situ systems and remote sensing. The intrinsic three-dimensional variability of the coastal ocean and open-ocean exchanges imply the need of

multi-platform observing systems covering a variety of scales. Fixed moorings provide a good temporal resolution but poor spatial coverage, while satellite products provide a good spatial coverage but just on the surface layer. Gliders can provide a reasonable spatial variability in both horizontal and vertical axes. Thus, inter-comparison with products from different types of sources provides a good view of how well the model is performing and reproducing the dynamics of the basin.

Daily validation procedures based on intercomparison of model outputs against observations (in situ and satellite) are being used. These are comparable to those of previous modelling studies in the area (Onken et al., 2008) and the present MyOcean2 project standards to assess what level the numerical models are able to reproduce the features observed from in situ systems or remote sensing.

Some of the results obtained[11] suggest a strong sensitivity to the basin scale model used. Accordingly, the next step for the second part of 2013 will be to compare the results obtained at sub-basin scale in the Balearic Sea when WMOP is nested to the different basin scale models existing, basically Mercator and MFS.

Additionally, WMOP simulations are quantitatively assessed against complementary observational databases, i.e. to identify well-simulated physical features and to characterize the structure of model biases. The simulations are evaluated against hydrographic observations (temperature/salinity profiles from the ENACT-ENSEMBLES database, buoys, gliders) and high resolution satellite products (Sea Surface Temperature, Sea Level Anomaly). During 2013, we are comparing various simulations (WMOP, MFS, Mercator) to quantify the impact of the (sub)mesoscale on the large scale circulation.

At the same time, **different types of indicators** (SST, SSS, KE, MLD, HC [0-150m], transport) are provided for the WMOP domain and also over the Alborán Sea, Gulf of Lion and Balearic Sea sub-basin regions. The main results show WMOP is characterized by a mean sea surface temperature bias by 0.5 degrees (by comparing to satellite and in situ data) and is able to reproduce the main variability and processes of the Western Mediterranean Sea (such as the Alboran gyres dynamic, the water masses formations, etc.). The next step consists to improve the validation procedure by incorporating monthly reports. This work is directly related to the seasonal validation hindcast described below. Theses recent results of WMOP were presented at the EGU meeting in Vienne in 2013 (poster).

The Balearic RIssaga Forcasting System (BRIFS): based on the Meteotsunamis research described above, an operational model has been implemented and run during summer 2011 and 2012. Daily, during the summer, the BRIFS system provides a high spatio-temporal resolution of the atmosphere that forces the oceanic models every 2 minutes. Main results show, under certain conditions, the forecasting system is able to predict with a temporal lag of a few hours, the presence of Meteotsunamis into the Ciutadella harbour (Figure 4). The next step consists to validate other forecasted events (Renault et al., 2013).

Wave Forecasting System: the Puertos del Estado SAPO coastal wave operational system has been established for the Southern coast of Mallorca and the Palma Harbour entrance using SWAN, a well-established coastal ocean wave model. The system provides on an hourly basis, wave fields and timeseries estimates of wind, significant wave height, and other parameters in the area with a 72-h horizon. It is updated twice daily. The model is forced by wind forecasts from the HIRLAM model provided by the Spanish met office (AEMET) and the deep ocean

[11] Rapport MERCATOR-SOCIB; internal report - September 2012. (in Dropbox – Modelling Fac)

Mediterranean wave model from Puertos del Estado. This system also includes a validation procedure with near real- time measurements registered by the oceanographic buoys located at Bay of Palma and Dragonera (South of Mallorca).

The SAPO system was develop in 1996 to offer a local predictions to the Spanish harbours, were the wave transformations due to bottom and coast line would need to be taken into account. SOCIB signed a collaboration agreement with Puertos del Estado in 2009 for the collaboration between institutions to share data and generate new information. Since 2010 Puertos del Estado sends wave and wind conditions twice a day, with a forecast horizon of 72 hours for the area of Palma Bay, and since October 2012 information of the complete Balearic Sea is also received.

Early 2011, SOCIB started with the implementation of SAPO operational system for the Southern coast of Mallorca. From May 2011, daily forecasts of the Palma Bay are available in the database of SOCIB (http://www.socib.es/sapo/d.sapo/sapo.html), these data can also be seen in SOCIB and the SAPO web[12].

Since December 2012 SAPO domain has been extended and now runs on a high resolution grid of the whole Balearic sea. Three nested grids have been also established, one for each island, Mallorca, Menorca and Ibiza. Theses new SAPO configurations will be available in the SOCIB dataset and the Spanish Harbours web once validated, around summer 2013.

The major phases of development have been:

- Training of a SOCIB technician in the Spanish Harbours Authority ..... Feb 2010
- Definition of the Palma Bay grid for SWAN model ..... Mar 2010
- SAPO settlement in Palma Bay, first executions ..... Apr 2010
- Results available through Internet ..... May 2010
- Operational maintenance of SAPO/SOCIB system ..... Jun 2010 – Dec 2012
- Balearic Sea and Islands grids new forecast ..... Dec 2012

Oil spill/SAR trajectory modelling system: our first approach was based on the ROMS internal Lagrangian trajectory tools. As an application, the possible trajectory of a met-ocean buoy lost on the 12th December 2010, close to the Mallorca Island (Cabrera Island National Park) was simulated using WMOP outputs. Then, within the framework of TOSCA, a more complex operational model for tracking surface objects in the ocean has been developed. Contrary to most of traditional Lagrangian Particle Tracking Algorithms, the presented approach computes the probability density function from the final position of a set of neutrally buoyant particles deployed in the flow providing the area of accumulated probability. This requires daily predictions of ocean surface currents, winds and waves provided by WMOP and Hirlam, and integrates the Eulerian velocities to obtain the trajectory of each particle forward in time. A random walk term is added to simulate numerical diffusivity. Several tests are performed in order to determine the optimal numerical scheme as well as the computational time step. To show the performance of the model we simulate the trajectories of a set of SVP-drifters deployed in the Balearic Sea. For these experiments, the final position of the drifters laid within the modelled contour of 50% of accumulated probability for the first 24 h forecast. See Figure 2.4.j.

[12] http://www.puertos.es/sites/default/files/contenidosExternos/Sapo/index.html

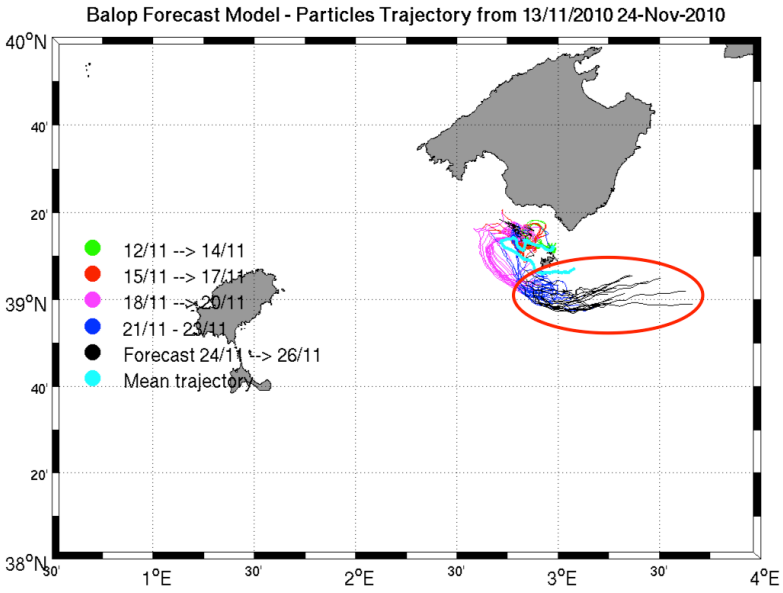


Figure 2.4.j: Trajectories of SVP drifters and the contour for 50% predicted probability of position after 24 hours.

Satellite derived products: The aim of the SOCIB satellite imaging section is to collect heterogeneous satellite data from different institutions and missions in a single place, and to generate descriptive images for selected domains like Western Mediterranean and Balearic Islands. These datasets are useful in the context of operational geography for applications like data assimilation or sea surface monitoring due to their high spatial and temporal resolution.

The satellite products are available for internal operational and external use (images only). Images include maps of sea surface temperature, absolute dynamic topography (sea surface height) and geostrophic currents, and chlorophyll-a concentration.

More specifically, SOCIB has concentrated in the last two years on the altimetry data from which a new Mean Dynamic Topography for the Mediterranean Sea (SOCIB-CLS MDT) has been computed. The new Mean Dynamic Topography takes profit of improvements made possible by the use of extended datasets and refined processing. The updated dataset spans the 1993-2012 period and consists of: drifting buoy velocities provided by OGS, altimetry data provided by CLS, hydrological profiles provided by EN3, IMEDEA (CSIC-UIB), SOCIB and IEO and model data provided by INGV. The methodology is similar to the previous MDT Rio et al (2007).

However, in Rio et al (2007) no hydrological profiles were considered. This has required the development of dedicated processing. A number of sensitivity studies have also been carried out to obtain the most accurate MDT as possible. The main results from these sensitivity studies are:

- Moderate impact to the choice of correlation scales but almost negligible sensitivity to the choice of the first guess (model solution).
- A systematic external validation to independent data has been made to evaluate the performance of the new MDT. Compared to previous version, SOCIB-CLS MDT features smaller scale structures, which results in an altimeter velocity variance closer to the observed velocity variance and, at the same time, gives better Taylor skills.

A poster was presented at the EGU conference in Vienne in May 2013. The SOCIB-CLS MDT is provided on a 1/16º degree grid. The data are in NetCDF. The data will be accessible from September 2013 onwards.

ACHIEVEMENTS PROCESS ORIENTED STUDIES

Process oriented studies that are conducted under the SOCIB IP2010 umbrella follow an approach that lies at the heart of EU priorities and responds to key international research and operational questions (e.g. as found within EU projects such as PERSEUS, MyOcean, etc.). They demonstrate relevance from the outset to similar research problems linked ultimately to operational oceanography, sustainable fisheries, climate change and seasonal forecasting, good environmental status and eutrophication, and the development of tools for science based decision support, etc.

The WMOP hindcast studies: The WMOP system has been validated through seasonal variability validations using 3 years simulation (2009-2011). The objective of this activity (both process oriented and operational), which started during in January 2012, is to assess hindcast simulations from WMOP and improve them, thereby developing the forecasting skill of the M&FF. In general M&FF is seeking to understand oceanic processes such as water mass interactions and the role of mesoscale structures, and also to develop a better understanding of large inter-annual to decadal climatic variability. More specifically, attention is centred on the evaluation of the impact of submesoscale dynamics on simulations at different model resolutions (different WMOP versions) and under different model configurations (MFS/Mercator).

The hindcast simulations are assessed using available observations such as satellite products (Sea Level Anomaly, Sea Surface Temperature) and *in situ* data (temperature and salinity from Argo floats, CTD, XBT, fixed moorings, drifters and gliders). A quantitative comparison of the hindcast simulations against observations is necessary to determine the well-simulated physical processes, to quantify the possible simulation biases, to characterize their structure and to determine their origins. The simulations are also compared between themselves to determine the impact of different model parameters (atmospheric forcing, resolution, numerical scheme, parameterizations etc.) on the realism of the model and thus to improve them. Improving hindcast simulations will enable us to better forecast the ocean system, to study and to understand ocean physical processes in well simulated regions and to address climate studies. First, the model outputs are collocated at the same time and space observation positions for quantitative comparisons with observations and between themselves. Then, adequate statistics are developed to assess the simulations over several spatial and temporal scales, in different dynamical sub-regions (Alboran Sea, Balearic Sea, Gulf of Lion, Algerian and Algero-Provencal basins), in different depth boxes (coastal areas, shelves and "open" sea), in key sections (Balearic Channels, Corsica Channel) and in case studies (events). This work is presently in progress and promising results are foreseen.

Significant work during 2012 was focused on examining water mass formation in the WMOP. It has shown its capacity to reproduce relatively realistically the ocean conditions, the main characteristics of the Western Mediterranean Sea variability and water masses, in particular the Winter Intermediate Water (WIW) (see Figure 1). The fully sampled WMOP simulation is thus used to study ocean processes, such as the formation and spatio-temporal evolution of WIW in the Western Mediterranean Sea and its impact on the general circulation (Juza et al., 2013, submitted). Currently, the capability of the WMOP to represent mesoscale structures has also been studied, in particular relating to features observed during a cruise in October 2012 in the

Ibiza channel under the TOSCA project to which SOCIB M&FF provided support (Orfila et al., 2012, results under preparation). The main results have been presented at numerous international meetings (see conferences e.g., EGU 2013, EOF 2013, FOO 2012).

Mesoscale process studies: The study of mesoscale and submesoscale hydrodynamic features is essential to understand thermal and biogeochemical exchanges between coastal regions and the open ocean. During summer 2008, the combined use of modelling and multi-sensor observational data revealed the baroclinic structure of the Balearic Current and the Northern Current and a small-scale anticyclonic eddy observed northeast of the Mallorca coast (current ~ 15 cm/s, < 30 km in extent and > 180 m deep). This mesoscale structure, partially intercepted by a glider and along-track altimetric measurements, is marked by relatively strong salinity gradients and not, as is more typical, temperature gradients.

The use of the observationally assessed simulation also shows that the geostrophic component of this small-scale eddy is controlled by sub-surface salinity gradients. We hypothesize that this structure contains recently modified Atlantic water arriving from the strait of Ibiza due to a northerly wind, which strengthens the northward geostrophic circulation (see Bouffard et al., 2012 and conference OSST).

Ocean-Atmosphere-Wave coupling: The coastal areas of the North-Western Mediterranean Sea are exposed to severe storm events that are of short duration. During these events, significant air-sea interaction with strong winds driving high sea-states can have catastrophic consequences on coastal communities. To investigate these air-sea interactions and the oceanic response to such events, we implemented the Coupled Ocean-Atmosphere-Wave-Sediment Transport Modelling System (Warner et al., 2008) simulating a severe storm in the Mediterranean Sea that occurred in May 2010 (see associated publication Renault et al., 2012). Comparisons with available atmospheric and oceanic observations (Figure 2.4.k.) showed that the use of the fully coupled system provides the most skilful simulation. The next step is to assess another case study using glider data (see Ruiz et al., 2012 and Renault et al., 2013, to be submitted). Such case studies may lead towards an operational coupled forecasting system in the longer term.

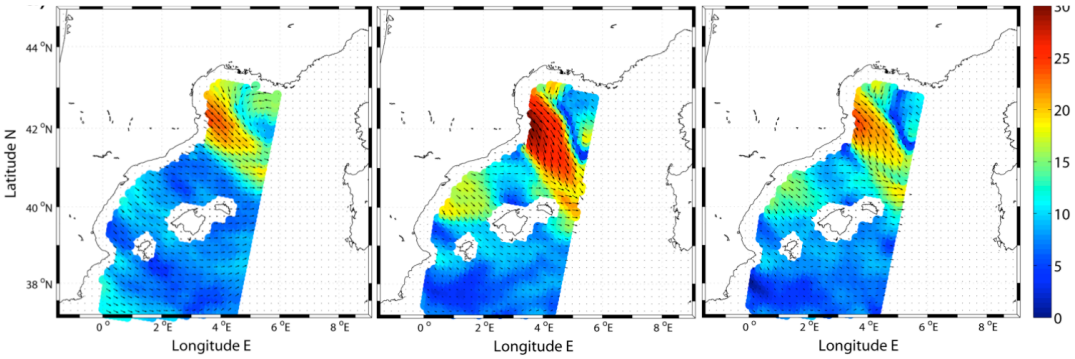


Figure 2.4.k: From the left to the right, 10 meter wind speed and direction during the storm, simulated ten meters wind speed without ocean-atmosphere-wave coupling, and with full coupling.

Data assimilation: Initial work on data assimilation was also started during 2012-2013, profiting from international collaborations in particular the visit to SOCIB of Dr. Baptiste Moure (NURC). The aim was to improve the initial conditions for the forecasting system by assimilating the glider data from the SOCIB Endurance line in the Ibiza channel. To this end, a

reduced configuration of the WMOP model covering the Balearic Sea and the Gulf of Lion for a case study period of 6 months beginning in January 2011, during the near continuous SOCIB glider missions, was implemented. An ensemble of simulations was carried out perturbing initial conditions, open boundary conditions and atmospheric forcing. Finally, using an ensemble Kalman Filter, the glider data available during January 2011 along the Ibiza channel were assimilated. Although such studies are on going, preliminary results show the benefits of using glider data assimilation to constrain the operational model, which is an important result with implications for regional model assimilation strategies (Figure 2.4.l.). In particular, the results indicate that gliders deployed in the Ibiza channel may be crucial to simulate realistically the main Western Mediterranean Sea circulation and the exchange of water masses through the Ibiza channel. Data assimilation will be continued in the forthcoming years, 2013-2014 and is expected to consider the assimilation of SOCIB HF radar derived surface current data, available from June 2012.

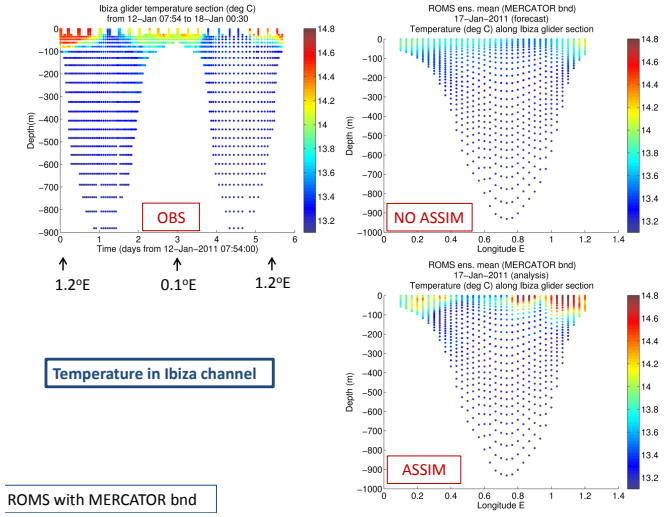


Figure 2.4.l: Data assimilation using Ensemble Kalman Filter from the glider observations and snapshots from ROMS simulations without and with assimilation of the glider data.

Meteotsunami studies: Meteotsunamis are oceanic waves that possess tsunami-like characteristics but are meteorological in origin. They occur in oceans all over the world, usually under their local names such as the "Rissaga" (Ramis and Jansá, 1983; Tintoré et al., 1988; Gomis et al., 1993), and in a regional context in Ciutadella harbour (Menorca, Spain). The sea level oscillation during a Rissaga event corresponds to the oceanic response to atmospheric gravity waves (Ramis and Jansá, 1983; Monserrat et al., 1991a) and/or convective pressure jumps (Jansá, 1986; Monserrat et al., 2006). In the western Mediterranean, travelling atmospheric pressure oscillations generate long oceanic surface waves that can become amplified and produce strong seiche oscillations inside harbours.

For the first time, based on a regional configuration of the WRF model (Skamarock et al., 2008) and a regional configuration of the ROMS model (Shchepetkin & McWilliams, 2005), a Meteotsunami has been simulated throughout its cycle life, from atmospheric origin to oceanic response, in Ciutadella harbour. The selected event was the 2006 extreme event (see Renault et al., 2011). Results show that the atmospheric and oceanic models used were able to realistically simulate the chosen case study (Figure 2.4.m.). In particular, the atmospheric model reproduced the development of a convective system leading to the atmospheric pressure disturbance and the oceanic model reproduced the different resonances inducing sea level oscillations into

Ciutadella harbour. On-going studies aim to assess Meteotsunami cases characterized by the formation of atmospheric internal gravity waves (Renault et al., 2013).

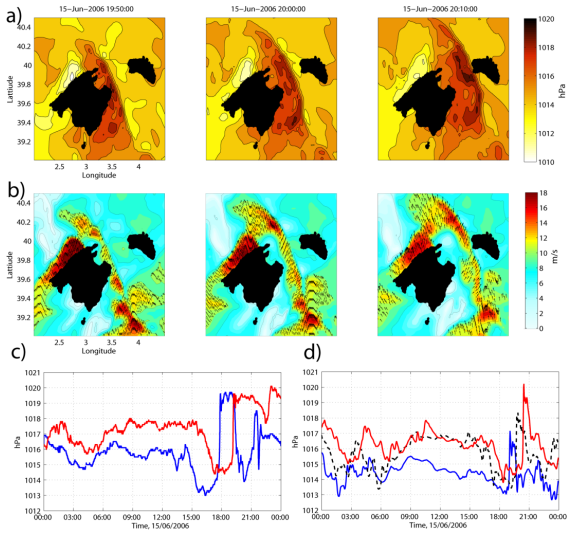


Figure 2.4.m: (a) SLP snapshots each 10 minutes from 1950 UTC 15 June 2006. (b) The same as Figure 2.4.m.(a) for the surface wind speed and direction. The colour fields represent the wind speed and the arrows the wind direction (only wind >12 m/s). (c) Temporal evolution of the measured sea level pressure at Palma de Mallorca and Ciutadella (lines blue and red). (d) Temporal evolution of the simulated sea level pressure at the points Palma de Mallorca, middle of Minorca channel and Ciutadella (lines blue, black and red).

Physical-biological coupling: As indicated above, another primary objective has been to advance the modelling of the ecosystem response to physical variability in the different sub-basins of the Western Mediterranean: with the background longer term goal of creating an operational coupled physical-biological model.

Under the objectives of the IP2010 there were three primary topics that have been addressed during the period 2010-2013. **Firstly, to investigate the biological response of different characteristic dynamical regimes**, for example, the highly productive coastal upwelling zones (e.g. the northwestern Alborán coast), the oligotrophic conditions developed in the anticyclonic Alborán gyres, and the mesotrophic conditions in cyclonic regions (e.g. the Catalan basin).

To understand the underlying processes and the coupled dynamics we used a 'simple' one-dimensional version of the coupled physical and intermediate-complexity biochemical model (NPZD model). One particular feature of the biological model is that we extended the previous model (with single-species plankton structure) to the multi-species case and therefore distinguished the mesotrophic and oligotrophic conditions and the deep chlorophyll maximum layer structure more realistically.

The biological model therefore comprise two size groups (small and large) of phytoplankton and zooplankton, two dissolved inorganic nitrogen (ammonium and nitrate) compartments, and the particulate organic nitrogen (detritus) compartment. It also explains the importance of the zooplankton grazing parameterization for a realistic representation of the annual plankton structure. It also incorporates explicit parameterizations of the vertical and horizontal advective nutrient fluxes in a one-dimensional modelling context, which is generally missing in majority of the one dimensional models. Therefore, it enables the reproduction of different ecological

conditions of the Alborán and Balearic/Catalán Seas by altering the upwelling velocity and vertical and horizontal nitrate fluxes, thereby demonstrating the sensitivity of regional food web structures to the regional physical conditions.

The coupled physical-biochemical model provided a systematic assessment for the relative roles of bottom-up and top-down controls in different ecological conditions. An important finding of this modelling study is to document sensitivity of the lower trophic food web structure to different forms of the zooplankton grazing parameterization, in other words, importance of the choice of the zooplankton grazing parameterization for a realistic representation of the annual plankton structure. Otherwise, the model illustrated development of spurious lower trophic level food web structures for some range of values of the fish predation rate. The study also explained how to avoid such spurious solutions. These are the important findings that make the study a broad and general international relevance.

This study led to a journal publication entitled "*Controls of plankton production by pelagic fish predation and resource availability in the Alborán and Balearic Seas*" *by Temel Oguz, Diego Macias, Lionel Renault, Javier Ruiz, Joaquin Tintoré (2013) published in a highly prestigious scientific journal called "Progress in Oceanography*".

Secondly we aimed to elucidate the dominant spatial and temporal modes of variability and their interactions and feedbacks in a complex dynamical region such as the Alborán Sea. This sub-basin is known to be a highly dynamic system and a well studied example of a semi-enclosed sea. Through analysing 936 weekly absolute dynamic topography (satellite altimetry) derived surface geostrophic current maps for 1993-2010, two distinct semi-annual signals were revealed representing the predominant variability of the data. The winter-spring phase is characterized by two stable basin scale features, namely the western anticyclonic gyre (WAG) within the western sub-basin and a central cyclonic gyre (CCG) occupying the central and eastern parts of the Alborán Sea sub-basin. This single anticyclonic gyre regime apparently develops under moderate ranges of net transport through the strait of Gibraltar. The more well known double anticyclonic gyre regime forms a stable circulation system in the summer and autumn period, under relatively strong upper layer transport through the Gibraltar Strait. In this latter case, the CCG is narrower and displaced closer to the WAG. Apart from some transient changes on weekly-monthly time scales, they undergo little inter-annual variability and are robust at the decadal time scale. They therefore represent two stable states of the system, whereas the short-term changes reflect small perturbations on these stable states. This study led to a journal publication called "Bistable annual mode of the Alborán Sea circulation" by L. Renault, T. Oguz, A. Pascual, G. Vizoso, J. Tintoré (2012), that was published another highly prestigious journal "Journal of Geophysical Research - Oceans".

Thirdly we sought to follow-up our second topic described above to fully test the hypothesis that the dual character of the upper layer circulation regime is regulated by the changing Gibraltar transport rates, when all other forcing mechanisms are either excluded or kept invariant. To accomplish this, we developed a high-resolution (~ 3 km horizontal grid) circulation model of the Alborán Sea and the strait of Gibraltar system and investigated forcing different upper layer transports with respect to a relatively constant lower layer transport through the strait. These model runs supported the hypothesis and indeed showed that both the WAG and EAG exist in the case of a sufficiently strong net transport into the Mediterranean, and that only the WAG exists in the case of a moderate net transport. The development of a filamentary structure from the coastal jet along the curved African coastline is suggested as a possible EAG formation mechanism in the case of sufficiently strong coastal current regime. Its geometric/topographic control may explain why it is always observed in the form of a coastally attached structure and thus its eastern periphery forms the Almeria - Oran front.

This study is to be extended by embedding the one dimensional biological model described earlier into the circulation model. During 2013-2014 our objective is to investigate the biological importance of the coastal upwelling zone along the north-western Alborán Sea, the input of nutrients and phytoplankton cells transported by the Atlantic surface waters through the strait of Gibraltar, and the intermittent biological production episodes by transient mesoscale cyclonic eddies on the Alborán Sea. This study is in the process of publication in a scientific journal. Pre-print versions are available upon request from SOCIB.

ACHIEVEMENTS OUTREACH

The modelling facility website has been developed during over the period 2010-2013. This includes the availability of interfaces for the visualization of the wave model, the WMOP ocean currents model and the Rissaga meteotsunami forecast model. Additionally, wave and ocean current model outputs are daily and operationally validated by comparing model outputs to available observations.

Scientific Contribution

Publications

Renault L. et al. (2013): Oceanic response and wave-current interactions during a storm event over the Balearic Sea (Western Mediterranean Sea) from coupled simulations, in preparation

Renault L., Jansa A., Juza M. and J. Tintoré (2013): Forecasting Meteotsunamis over the Balearic Islands (Spain), validation and assessment from observations and numerical models. To be submitted to Special issue of Natural Hazard, April/May 2013.

Juza M., Renault L., Ruiz S. and J. Tintoré (2013): Origin and pathways of Winter Intermediate Water in the Northwestern Mediterranean Sea using observations and numerical simulation. To be submitted to JGR Oceans, April/May 2013.

Sayol J. M., Orfila A., Simarro G., Conti D., Renault L. and A. Molcard (2013): A Lagrangian model for operational ocean surface tracking in the probability domain, (in preparation).

Macías D., Castilla, D., del Hoyo, J.J., Navarro, G., Catalán, I., Renault, L., Ruiz, J. (2012): Fishing anchovy in the Alboran Sea: A socioeconomic activity under threats by future environmental scenarios, accepted, Journal of Marine Systems.

Oguz T., D. Macias, L. Renault, J. Ruiz, J. Tintoré (2012): Controls of plankton production by pelagic fish predation and resource availability in the southwestern Mediterranean Sea, accepted, Progr. Oceanogr.

Heslop, E. E., S. Ruiz, J. Allen, J. L. López-Jurado, L. Renault, and J. Tintoré (2012): Autonomous underwater gliders monitoring variability at “choke points” in our ocean system: A case study in the Western Mediterranean Sea, Geophys. Res. Lett, 39, L20604, doi:10.1029/2012GL053717.

Renault, L., J. Chiggiato, J. C. Warner, M. Gomez, G. Vizoso, and J. Tintoré (2012): Coupled atmosphere-ocean-wave simulations of a storm event over the Gulf of Lion and Balearic Sea, J. Geophys. Res., 117, C09019, doi:10.1029/2012JC007924.

J. Bouffard, L. Renault, S. Ruiz, A. Pascual, C. Dufau, J. Tintoré (2012): Sub-surface small-scale eddy dynamics from multi-sensor observations and modelling, Progress in Oceanography, ISSN 0079-6611, 10.1016/j.pocean.2012.06.007.

Renault, L., T. Oguz, A. Pascual, G. Vizoso, and J. Tintore (2012): Surface circulation in the Alborán Sea (western Mediterranean) inferred from remotely sensed data, J. Geophys. Res., 117, C08009, doi:10.1029/2011JC007659.

Renault, L., B. Dewitte, P. Marchesiello, S. Illig, V. Echevin, G. Cambon, M. Ramos, O. Astudillo, P. Minnis, and J. K. Ayers (2012): Upwelling response to atmospheric coastal jets off central Chile: A modelling study of the October 2000 event, J. Geophys. Res., 117, C02030, doi:10.1029/2011JC007446.

Ruiz, S., L. Renault, B. Garau, and J. Tintoré (2012): Underwater glider observations and modelling of an abrupt mixing event in the upper ocean, Geophys. Res. Lett., 39, L01603, doi:10.1029/2011GL050078.

S. Ponce de León, A. Orfila, L. Gómez-Pujol, L. Renault, G. Vizoso, J. Tintoré (2012): Assessment of wind models around the Balearic Islands for operational wave forecast, Applied Ocean Research, Volume 34, Pages 1-9, ISSN 0141-1187, 10.1016/j.apor.2011.09.001.

M. Tonani, J. A. U. Nilsson, V. Lyubartsev, A. Grandi, A. Aydogdu, J. Azzopardi, G. Bolzon, A. Bruschi, A. Drago, T. Garau, J. Gatti, I. Gertman, R. Goldman, D. Hayes, G. Korres, P. Lorente, V. Malacic, A. Mantziafou, G. Nardone, A. Olita, E. Ozsoy, I. Pairaud, S. Pensieri, L. Perivoliotis, B. Petelin, M. Ravaioli, L. Renault, S. Sofianos, M. G. Sotillo, A. Teruzzi, and G. Zodiatis (2012): Operational evaluation of the Mediterranean Monitoring and Forecasting Centre products: implementation and results, Ocean Sci. Discuss., 9, 1813-1851, 2012

Tintoré, J., G. Vizoso, B. Casas, S. Ruiz, E. Heslop, L. Renault, T. Oguz, B. Garau, A. Pascual, M. Martínez-Ledesma, L. Gómez-Pujol, A. Álvarez-Ellacuría, A. Orfila, F. Alemany, D. Álvarez-Berastegui, P. Reglero, E. Massuti, P. Vélez-Belchí, J. Ruiz, M. Gómez, E. Álvarez, M. Manriquez (2012): SOCIB the impact of new marine infrastructures in understanding and forecasting the Mediterranean Sea. pp 99-118. In CIESM: Designing Med-SHIPS: a Program for repeated oceanographic surveys. N. 43 CIESM Workshops Monographs (F. Briand Ed.), 164 pages, Monaco.

Renault, L., G. Vizoso, A. Jansá, J. Wilkin, and J. Tintoré (2011): Toward the predictability of meteotsunamis in the Balearic Sea using regional nested atmosphere and ocean models, Geophys. Res. Lett., 38, L10601, doi:10.1029/2011GL047361.

Dewitte, B., S. Illig, L. Renault, K. Goubanova, K. Takahashi, D. Gushchina, K. Mosquera, and S. Purca (2011): Modes of covariability between sea surface temperature and wind stress intraseasonal anomalies along the coast of Peru from satellite observations (2000–2008), J. Geophys. Res., 116, C04028, doi:10.1029/2010JC006495.

Communications:

Conference “Blue Growth in the Mediterranean:perspectives of Spain”, May 2013, Palma de Mallorca: Juza, M., and SOCIB’s team (2013): Science, forecasting systems and tools over the Western Mediterranean Sea: response to society needs, talk.

EGU 2013, Vienna: Renault, L., M. Juza, T. Garau, A. Orfila, J,M. Sayol, and J. Tintoré (2013): WMOP: the SOCIB Western Mediterranean sea Operational system, poster.

EGU 2013, Vienna: Juza, M., L.Renault, S. Ruiz, and J. Tintoré (2013): Origin and pathways of Winter Intermediate Water in the Northwestern Mediterranean Sea, poster.

EGU 2012, Vienna: S. Ruiz, L. Renault, B. Garau, and J. Tintoré (2012): Underwater glider observations and modelling of an abrupt mixing event in the upper ocean, poster.

MyOcean, Athenes, 2012: Renault L., J. Tintoré and collaborators (2012): WMOP: an operational model of the Western Mediterranean Sea, talk.

Ocean Sciences, Salt lake City, 2012: Renault L., J. Chiggiato, J.C. Warner, M. Gomez, G. Vizoso, J. TIntore (2012): Coupled Atmosphere-Ocean-Wave simulations of a storm event over the Gulf of Lion and Balearic Sea, poster.

Gordon congress, 2011: Renault L., J. Chiggiato, J. Warner, M. Gomez, G. Vizoso, J. TIntore (2011): Coupled Atmosphere-Ocean-Wave simulations of a storm event over the Gulf of Lion and Balearic Sea, poster. Renault L., Vizoso G., A. Jansa, Wilkin J., Tintore J.

(2011): Toward the predictability of meteotsunamis in the Balearic Sea using regional nested atmosphere and ocean models, poster.

Hymex workshop, Minorca, 2011: Renault L., Vizoso G., A. Jansa, Wilkin J., Tintore J. (2011): Predictability of meteotsunamis in the Balearic Sea using regional nested atmosphere and ocean models, poster. Ruiz S., L. Renault, G. Bartolomé, Bouffard J., A . Pascual and J. Tintoré (2011): Glider Observations of an abrupt mixing process, poster.

5th EGO, Canarias, 2011: Ruiz S., L. Renault, G. Bartolomé, Bouffard J., A . Pascual, J, Tintoré (2011): Glider Observations of an abrupt mixing process, talk.

Future of Operational Oceanography, Hamburg, 2011: Renault L., T. Garau G. Vizoso, and J. Tintoré (2011): WMOP: The SOCIB Western Mediterranean Sea operational forecasting system. FOO,Hamburg, poster. Renault L., J. Chiggiato, J. Warner, M. Gomez, G. Vizoso, J. TIntoré (2011): Storm event over the Gulf of Lion and Balearic Sea, poster. Renault L., Vizoso G., A. Jansa, Wilkin J., Tintore J. (2011): Toward the predictability of meteotsunamis in the Balearic Sea using regional nested atmosphere and ocean models, poster.

Maritime Rapid Environmental Assessment Conference (MREA10): S. Ruiz, L. Renault, B. Garau, J. Bouffard, A. Pascual, J. Tintoré (2010): Glider observations of an abrupt mixing event in the upper ocean, poster. Renault L., J. Chiggiato, et al. (2010): Ocean-atmosphere-wave coupling extreme event analysis forecast and effects in the Mediterranean Sea, May 2010, talk.

4th Coastal Altimetry Workshop, 14-15 October 2010, Porto, Lisbon: Bouffard, J, A. Pascual, L. Renault, S. Ruiz, Y. Faugère, C. Dufau and J.Tintoré (2010): How to combine altimetric techniques with gliders in order to monitor 3D coastal mesoscale and submesoscale processes?,talk

OSTST meeting and workshop towards higher resolution remote sensing of ocean dynamics and terrestrial surface waters, Lisbon 2010: Bouffard, J, A. Pascual, L. Renault, S. Ruiz, Y. Faugère, C. Dufau, G Larnicol and J. Tintoré (2010): Mesoscale characterization using glider and altimetry : Methodology and budget error assessment, talk.

Encuentro de la oceanografía española Barcelona, 2010: Renault L., J. Zavala and collaborators (2010): A 4Dvar data assimilation experiment: toward a regional operational system, talk. Vizoso g., L. Renault and collaborators (2010): Resonant coupling of oceanic gravity waves forced by traveling atmospheric disturbances with destructive effect in harbors: meteotsunamis in the Balearic Sea, talk. Ponce de León Álvarez S., L. Renault, L. Gómez Pujol, G. Vizoso, J. Tintoré and A. Orfila (2010): An assessment of realistic winds for the Balearic Islands wave forecast. S. Ruiz, B. Garau, M. Martínez-Ledesma, B. Casas, J. Bouffard, G. Vizoso, L. Renault, J. Jodrá, P. Testor, A. Pascual, A. Alvarez y J. Tintoré: New tecnologies for marine research: 4 years of glider activities at IMEDEA-TMOOS

S/TOM Users Workshop, University of Hawaï, Honolulu,, US, 5-8th of April, 2010: Renault L., B. Dewitte, V. Echevin, S. Illig,(2010): Impact of atmospheric coastal jet off central Chile: A numerical study for the October 2000 event, poster. Renault L., G. Vizoso, J. Wilkin and J. Tintoré (2010): Resonant coupling of oceanic gravity waves forced by travelling atmospheric disturbances with destructive effects in harbors: meteo-tsunamis in the Balearic Sea, talk.

2.4.7.4 Current status with reference to IP2010

Major highlights:

- Developing and bringing to operational status the Western Mediterranean OPerational system (WMOP) current forecast model, and its validation and resulting peer-reviewed publications demonstrating the international standard of this model.
- Initiating process modelling studies with WMOP, resolving the mesoscale and water mass formation, helped us to improve our knowledge of mesoscale processes.

- Developing the Balearic Rissaga Forecasting System (BRIFS) for pre-operational meteotsunami events prediction.
- Establishing bio-physical coupling models, based on the development of the N2P2Z2D coupled model, with significant results at sub-basin scale in oligotrophic and eutrophic conditions.
- Development of the South of Mallorca wave forecasting system.

HUMAN RESOURCES

The human resources of the M&FF can be summarized as follows: initially, during 2010, only a post-doctoral modeller was employed full-time within the M&FF, with part-time in-kind support from an IMEDEA (CSIC-UIB) physicist (2010-2011 for ROMS/WMOP, 2012 for Waves/SWAN/SAPO) and with additional support from Puertos del Estado). This modeller had been responsible for the initial setup of some of the modelling activities prior to the preparation of their contract for the post-doctorate post. In January 2011 a full-time visiting professor was contracted for the implementation of the bio-physical coupling models. As a result of the uncertain financial situation this became a part-time contract (50%) in September 2012. Finally, from December 2012 a new post-doctoral engineer has been contracted to increase the model validation capabilities for WMOP. During 2013, the wave modelling work has been centralized at SOCIB as an inter-Facility collaboration between the M&FF and the BMF.

INVESTMENTS

Investments have been made in computing power and storage and backup under the Computing and IT Service.

DIFFICULTIES OVERCOME

The operational and process study approach taken by SOCIB involves close cooperation between operations and research interests, which has required developing a new internal model for collaboration, however the benefits of this multi-disciplinary approach are now visible across a range of activities within the Modelling Facility. Recognition for operational.

ACHIEVEMENTS NOT ANTICIPATED IN THE IP2010

It is clear that the number of papers in scientific international reviews has exceeded any initial estimate. This points to the excellent capabilities of the SOCIB environment and the adequacy of the historical science based operational approach. The Wave-atmosphere-ocean coupling study and COWAST model implementation was not anticipated and is also a major achievement.

2.4.7.5 Critical analysis

SWOT

Weaknesses	Strengths
• Insufficient personnel to achieve objectives • The balance between applied and research led modelling can be hard to achieve • Uncompetitive salaries make it difficult to compete with other countries in attracting the best modellers	• Multidisciplinary scientific activity • Close collaboration with IMEDEA • Scientific productivity • Access and use of new data sets such as glider and radar for validation/assimilation
Threats	**Opportunities**
• Political, institutional and financial uncertainty	• Capacity to respond to societal needs • Creating product/applications, e.g. the pre-operational Meteotsunami forecasting system and oil spill trajectory tool

AREAS OF MAJOR IMPACT IN 5 YEARS: SCIENTIFIC, TECHNOLOGICAL AND SOCIETAL

Scientific topics

- Ocean-atmosphere-wave coupling: Such studies improve significantly our understanding of air-sea interactions and may also help us to increase our predicting capacity.
- Glider and HF radar data assimilation into the WMOP model. Such data are quite new and SOCIB is one of the leading team providing such data. Assimilate them into an oceanic may greatly improve both hindcast and forecast.
- Mesoscale studies by combining high-resolution numerical simulations and new data such as gliders and radar.
- Meteotsunamis: for the first time, numerical simulations reproduce from the early begin of life to the harbour resonance a Meteotsunamis. On-going research will help to improve our understanding on both atmospheric and oceanic sides.

Technology topics

- The website developed may contain innovations for stakeholder consultation of the results.

Strategic and society needs

- Operational forecasting system: Meteotsunamis forecasting system (BRIFS) for decision makers
- Wave, currents and oil spill model may be very useful for regional agencies and as an example at European/international level

References

Calvo, E., Simó, R., Coma, R., Ribes, M., Pascual, J., Sabatés, A., Gili, J. M., Pelejero, C. (2011). Effects of climate change on Mediterranean marine ecosystems: the case of the Catalan Sea. Clim. Res. 50, 1–29.

Criado-Aldeanueva, F., Soto-Navarro, F. J. and Garcia-Lafuente J. (2010) Seasonal and interannual variability of surface heat and freshwater fluxes in the Mediterranean Sea: budgets and exchange through the Strait of Gibraltar. Int. J. Climatol., DOI: 10.1002/joc.2268.

Mellor, G.L. (1996) User's guide for a three dimensional, primitive equation, numerical ocean model. Program in Atmospheric and Ocean Science Report, Princeton UNiversity Press, Princeton, NJ, 40pp.

Mellor, G.L., Yamada, T. (1982) Development of a turbulence closure model for geophysical fluid problems. Reviews of Geophysics and Space Physics, 20, 851-875.

Mellor, G.L., Oey, L.Y., Ezer, T. (1998) Sigma coordinate pressure gradient errors and the seamount problem. Journal of Atmospheric and Ocean Technology, 15, 1122-1131.

Oguz, T., Macias, D., Renault, L., Ruiz, J., Tintoré, J. (2013) Controls of plankton production by pelagic fish predation and resource availability in the Alboran and Balearic Seas. Prog. Oceanogr., http://dx.doi.org/10.1016/j.pocean.2013.03.001.

Renault, L., Oguz, T., Pascual, A., Vizoso, G., Tintoré, J. (2012) Surface circulation in the Alborán Sea (Western Mediterranean) inferred from remotely sensed data, J. Geophys. Res., 117, doi:10.1029/2011JC007659.

Shchepetkin, A.F., McWilliams, J.C. (2004) The Regional Ocean Modelling System (ROMS): a split-explicit, free-surface, topography-following-coordinate ocean model. Ocean Modelling, 9, 347-404.

2.4.8 DATA CENTRE FACILITY

2.4.8.1 Description

The Data Centre is at the core of SOCIB. The general goal of the SOCIB Data Centre is to provide users with a system to locate and download the data of interest (near real-time and delayed mode) and to visualize and manage the information. Following SOCIB principles, the data need to be (1) discoverable and accessible, (2) freely available, and (3) interoperable and standardized. In consequence, SOCIB's Data Centre Facility (DCF) is developing and implementing a general data management system to guarantee international standards, quality assurance and interoperability.

The variety of sources and types of data (timeseries, profiles, trajectories, grids/meshes, images, acoustic data, etc.) requires appropriate methods to ingest, catalogue, display, and distribute the information. The main data managed by SOCIB's DCF comes from its own observation platforms (e.g., HF radar, gliders, drifters, ARGO profilers, fixed stations, buoys, etc.), numerical models (waves and currents) and information generated from the activities of its SIAS Division. In addition, the DCF also manages data coming from external data providers through various collaborations, for example, the harbour authorities (e.g., Puertos del Estado) or research groups (e.g., IMEDEA).

SOCIB's DCF is therefore responsible for the different stages of data management, ranging from data acquisition to distribution and visualization through web applications. The implemented system relies on open source solutions, following other architectures adopted

within the context of marine spatial data infrastructures. In other words, the core DCF system components are:

- An instrumentation application: developed at SOCIB to manage all platforms, and centralized in a database through a web interface.
- A processing application: developed at SOCIB to deal with all collected platform data and performing data calibration, derivation, quality control and standardization.
- A THREDDS catalogue: implemented at SOCIB to archive and distribute data through services such as OPeNDAP, OGC services, HTTP and ncISO.
- A layer of RESTful web services: developed at SOCIB to ease the development of both internal and external applications, such as web or mobile applications.
- A set of tools for data visualization and real time monitoring: developed at SOCIB.

The general structure and some of the components are illustrated in Figure 2.4.n. and some specific examples of visualization developments are illustrated in Figure 2.4.o

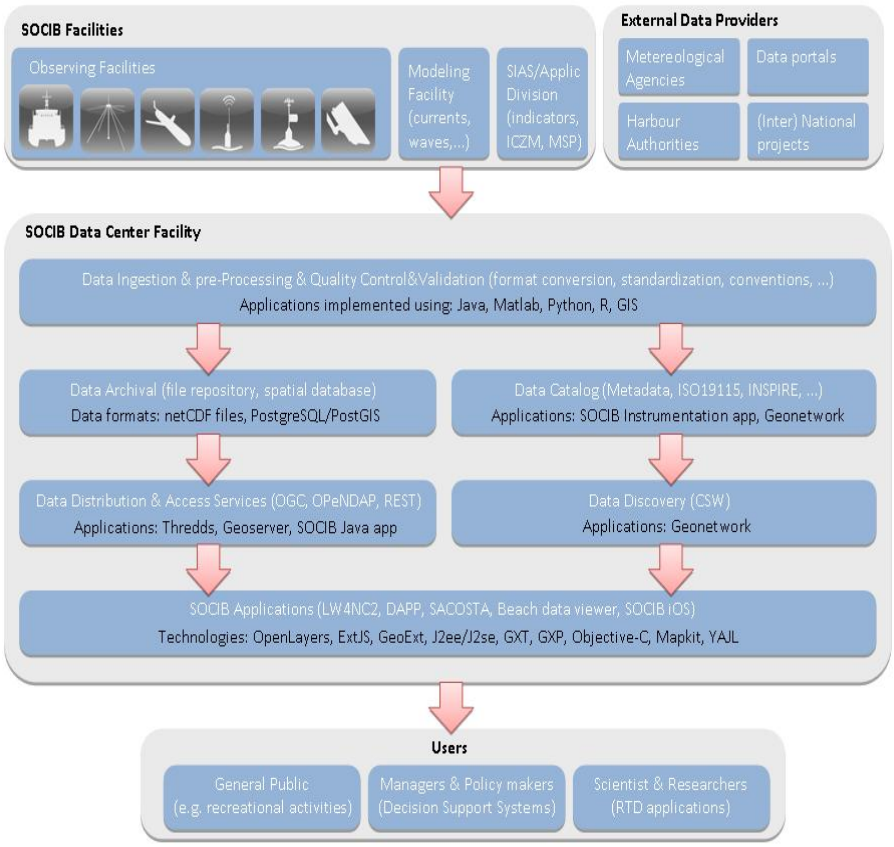


Figure 2.4.n: Data Center Conceptual Structure and SOCIB developed applications

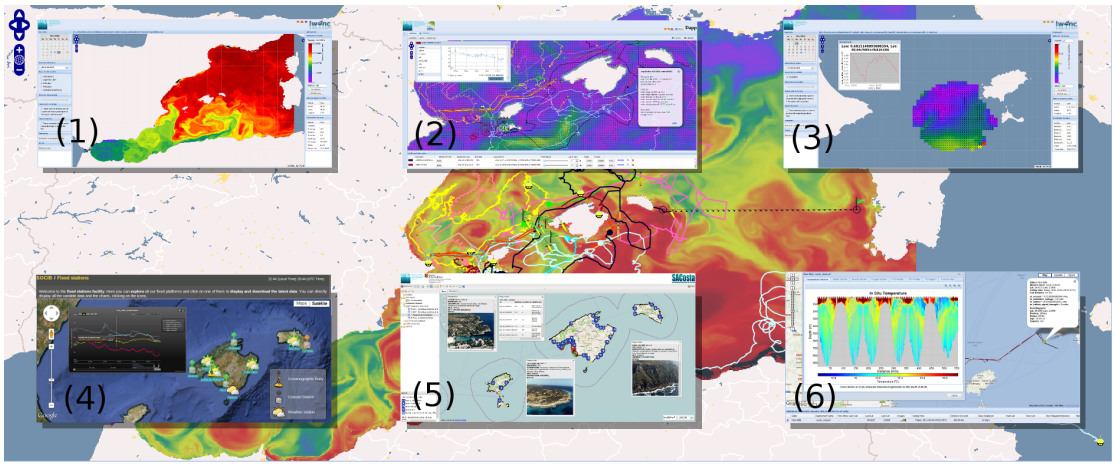


Figure 2.4.o: Data and applications developed at SOCIB: (1) web-based map viewer for numerical models output; (2) web application for mobile platforms (e.g. gliders, Argo profilers, drifters, etc.); (3) HF radar output; (4) fixed stations web section; (5) web-based map viewer for cartographic data, ESI, etc.; (6) glider real-time monitoring tool.

2.4.8.2 Aims 2010 – 2013

The SOCIB DCF hosts, manages and archives the data (raw and processed, model and observational) from all the SOCIB facilities; it provides the standards, protocols and systems to integrate the data and related information into a number of frameworks and the tools to allow appropriate end users to access and use the data.

To accomplish the full lifecycle data management, in 2009 SOCIB's DCF initially defined the following seven components for the Data Management Process (as detailed in the Implementation Plan; approved in July 2010 and available at www.socib.es):

- Platform Management and Communication: This first step involves the data transfer from the platform to an accessible computer. It is the most platform dependent step because the data transmission is dependent on the system in place for each platform.
- Quality Control Assurance: quality control assurance is one of the main goals of data management in SOCIB, quality control (QC) routines have to be developed and implemented following existing standards or new developments in line with EU activities such as the MyOcean project.
- Metadata Aggregation: all data available from SOCIB will have the metadata necessary to allow its discovery by powerful search tools. Initially the DCF follows the OceanSites Metadata directives and the ISO 19115/19139 w[4] standard for a second stage, in order to support the INSPIRE directive.
- Data Archive: SOCIB will provide a Network Storage system to enable the archiving of data, and also a File Naming convention ensuring a well organized data archive. Initially the common data format is the self describing CF-convention NetCDF. At a second stage we will add Geospatial information using OGC standards wherever possible.
- Data Search and Discovery: A catalogue with all metadata will be created allowing search and discovery of all data. The metadata aggregation is standard, to allow searching by key text, by location, by parameter, by platform, etc.
- Data Policy and Distribution: the data policy is defined for each dataset and is further described in the Data Policy section. The distribution methods are OPeNDAP, HTTP, WMS, and NetCDFSubset.

- Data viewing: SOCIB will provide a practical view of the SOCIB Data available from anywhere at anytime. Specific visualization tools will be developed to allow the visualization of all data types: timeseries, trajectories, grid data and general data. Finally, these tools will be merged to create a data portal capable of supporting the visualization of all data types.

The data management process was to be implemented in three phases that are briefly presented here. In the first phase, we focused on the initial development of the instrumentation and processing applications and procedures needed to collect and assimilate data from the different platforms. In the second phase, the main goal was the development of visualization tools and auxiliary services to display and manage the collected data. During the third stage we developed and implemented extended data distribution capabilities such as advanced search and discovery tools. The timetable of each one of these 3 phases is outlined in the following table:

	2010	2010	2011	2011	2012	2013	2014
Phase 1	D	D	O	M	M	M	M
Phase 2		D	D	O	M	M	M
Phase 3				D	D	O	M

D: Definition, O: Operational, M: Maintenance

2.4.8.3 Review current status of the facility (2010 – April 2013)

ACHIEVEMENTS

The following list summarizes the main achievements for each component of the data management process described above:

Platform Management and Communication

An instrumentation application has been developed to keep track of all platform inventories and their state. In addition, data acquisition mechanisms have been implemented for each platform. Processing procedures have also been developed and adopted for most of the platforms. Finally, the state of the platforms is monitored and presented, in real time, on SOCIB's web site.

- Initial version of Instrumentation application ..... Feb 2011
- SOCIB platform data acquisition: fixed stations (Jun 2011), drifters (Sep 2011), glider (Mar 2012), HF radar (Aug 2012), and R/V SOCIB (Jan 2013).
- Integration of data from external providers: buoy data from Puertos del Estado and Meteofrance (Feb 2011), flowmeter data from CHE (Nov 2011), satellite data from CLS and NASA (Dec 2011), Mercator, MyOcean, MFS2
- Real time platform monitoring tool available on the web ..... Apr 2011

Quality Control Assurance

Data quality control is mostly handled through a central processing application, according to well-defined international conventions where available. It should be noted that the quality control policies for some platforms are still 'work in progress' both at SOCIB and in the science community at large.

- Definition and implementation of quality control tests ..... Feb 2011
- Timeseries quality control support ..... Feb 2011
- Trajectory data quality control support ..... Nov 2011
- Timeseries profile data quality control support ..... Jan 2012

Metadata Aggregation

Platform and instrument metadata are stored and managed through the instrumentation application. The metadata are fully in line with international conventions and standards. The processing application uses these metadata to properly describe the final datasets produced.

- Initial version of the SOCIB metadata definitions according to international metadata proposals such as Ocean Sites, IMOOS and ISO 19115 ..... Dec 2010
- Support for defined metadata following SOCIB conventions in the instrumentation and processing applications ..... Feb 2011
- Installation of Geonetwork catalogue to perform metadata discovery of GIS data Feb 2012
- Integration between the THREDDS catalogue and Geonetwork by using ISO 19115 specification in the testing stage ..... Jun 2012

Data Archive

Collected data are stored in a file system composed of mainly NetCDF files and some other file formats. A THREDDS layer is laid on top of it providing a catalogue presentation and some services for those files. In addition, some data are archived in a separate database with GIS support (PostgreSQL/PostGIS).

- Migration of the mooring dataset generated at TMOOS ..... Oct 2010
- Creation of the file system archive for NetCDF ..... Feb 2011
- Adaption of already existent data to the new archival structure ..... Oct 2011
- First installation of PostGIS support database ..... Jan 2012
- Adopted general archival procedures for all the observing and forecasting platforms: fixed stations (Feb 2011), currents forecasting Feb 2011, drifters (Nov 2011), beach monitoring images (Mar 2011), RT glider data (Mar 2011), HF radar (Aug 2012), R/V SOCIB (Feb 2013)

Data Search and Discovery

Partial support for data search and discovery is provided to each SOCIB facility through SOCIB's website. In addition, some other web based applications and web services provide limited data discovery capabilities. A data search solution based on a version of Geonetwork catalogue is presently under evaluation.

- Implementation of facilities' web sections and web applications: fixed stations v1.0 (Apr 2010), glider application (Nov 2010), beach monitoring application (May 2011), fixed stations v2.0 (Nov 2011), deployments application (Jun 2011), drifter (Jan 2012), glider (May 2012), beach monitoring (Jul 2012), HF radar (Oct 2012), R/V SOCIB (Mar 2013)
- Implementation of SOCIB Data Discovery Services layer (Nov 2011)
- Evaluation of existent solutions to provide extended data discovery and search capabilities such as Geonetwork, ERDDAP and RAMADDA (May 2012)

Data Policy and Distribution

Data collected are distributed in the form of product files for direct download or through web services such as OPeNDAP, OGC Services, and some custom RESTFul services, according to international standard formats and conventions like the CF conventions, the specification ISO 19115, and the GeoJSON specification. Data access is generally free of charge, according to the principles of the Open Data initiative and also in line with the SOCIB policies (see Data Policy Section for details).

- Enabling of the THREDDS based distribution services: OGC services (WMS and WCS), OPeNDAP, ncISO and direct download (Oct 2010)
- RESTFul distribution services for fixed stations, drifters, gliders (tracking information) and vessel (Nov 2011)

- GIS data distribution through OGC services (WMS, WFS and WCS) using Geoserver (Jan 2012)

Data viewing

Custom web applications have been developed to fulfil the visualization requirements of each facility and to provide a practical view of the data available, from anywhere at anytime.

- *jwebChart*: Timeseries data viewer integrated with the THREDDS catalogue (December 2010)
- *lw4nc2*: Grid data viewer for WMS based services such as model outputs and HF radar (December 2010)
- *gapp*: Glider web application to visualize glider tracking data (November 2010)
- *beamon*: Beach monitoring web application to visualize image products from the Sirena suite (May 2011)
- *dapp*: Deployment web application to visualize glider, drifter and vessel tracking data (June 2011)
- Created specific data views in each facility web section (November 2011)
- *SaCosta*: GIS data viewer to visualize ESI, Environmental Sensitivity of the Coastline (February 2012).
- *Beach data viewer*: GIS beach data viewer is an application to show beach data collected, such as seafloor, coast lines, bathymetric profiles and topographic points, among others (May 2012)

In addition, as part of the common support that the DCF provides to SOCIB and its other divisions and facilities, the following achievements are noteworthy:

- Writing and approval of the DCF plan for inclusion in the Implementation Plan 2010
- Collaboration with national and international groups (CSIC-UTM, IEO, MeteoGalicia, CESGA, UPCT, OOCMUR, SARTI/UPC, UdG, MBARI, IMOS-eMarineII, Ifremer-Coriolis, USGS)
- Data center physical infrastructure installation including the visualization system (January 2010)
- Creation of the initial version of the SOCIB corporate web site (September 2010)
- Installation of the general content Management System RAMADDA (April 2010)
- Support to specific tasks of SOCIB: ForoTec (2009 and 2010), Fira de la Ciència (2010 and 2011), SAPO implantation in the modelling facility (February 2011), wireless point-to-point in the beach monitoring facility (April 2012)
- SOCIB web site maintenance, updates and monitoring. From June 2010 until now (March 2013) there has been a continuous increase in audience web site visitors. SOCIB started with ~800 visits per month and now SOCIB has ~2000 visits per month, this represents an increase of 150% (Figure 3). The total visits during 2010_2013 is ~50.000. Other important metrics are the page-views (the total number of pages viewed) and visit duration (Figure 4). SOCIB started with ~3500 page-views per month and now has ~7000 page-views per month, this represents a 100% increase and ~4 pages/visit. The average visit duration is 3 minutes, 20 seconds.

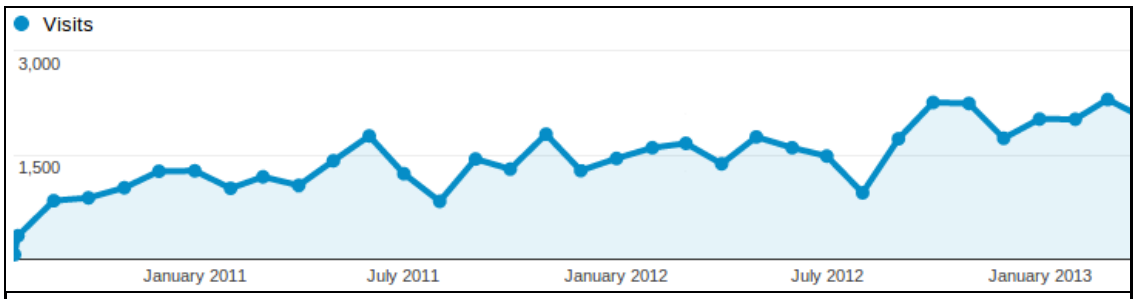


Figure 2.4.p: Outside visitors and internal users web site visits

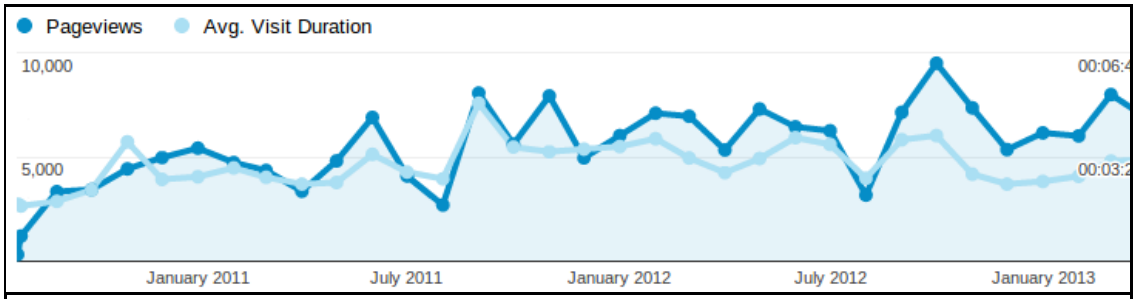


Figure 2.4.q: Outside visitors and internal users page-views and average visit duration

SCIENTIFIC CONTRIBUTION

Even though the SOCIB DCF activities are not oriented to scientific research, it provides key support not only to SOCIB activities but also to research projects and conferences, such as TOSCA, JERICO, MyOcean, GROOM, Bluefin, IMDIS, KnowSeas and PERSEUS, amongst others. This has resulted in mutual benefits and is the result of sound cooperation between IMEDEA, IEO, and SOCIB.

Additionally the DCF contributes to international conferences, such as, the International Marine Data and Information Systems (IMDIS) 2013, where the Data Center has submitted an abstract and will make a presentation relating the SOCIB data infrastructure and the *Jornadas Ibéricas de las Infraestructuras de Datos Espaciales* (JIIDE) 2012. Furthermore, the DCF was involved in the recent publication of a SOCIB article in the Marine Technology Society Journal.

It is also important to note that the SOCIB DCF visualization screens are frequently used to explain the SOCIB concept of multi-platform data monitoring and visualization, capturing significant attention during visits to the SOCIB offices in Palma de Mallorca.

The SOCIB DCF has contributed to filling gaps in the data management process, either by improving third party developed tools such as the THREDDS catalogue or the RAMADDA content management system, or by developing new components including format conversion tools such as *NC2KML* and *NCDUMP-JSON*, and processing tools like the glider processing toolbox, both in its original version (2011) and its improved version (2013).

Since gliders are a relatively recent technology in the field of operational oceanography, the development of a glider processing toolbox has been part of a wider effort to establish a set of well defined glider data management and operation procedures. This effort included significant contributions related to some of the components of the data management process as follows:

- **Platform Management and Communication**
  An operational glider data processing system is a common goal in the international glider community. A prototype version developed in TMOOS and SOCIB used to process Slocum glider data interactively has been refactored to make it a flexible operational tool, ready to be deployed, with the following features (some of them in testing stage):

  - flexibility to connect to any glider deployment information database
  - support to retrieve files from multiple remote base stations
  - improved Slocum raw data acquisition and loading
  - support for Seaglider raw data acquisition and loading (under development)
  - extended available derivations and corrections
  - allows the whole configuration of every processing stage
  - two separated working modes for real time and delayed mode are provided
  -

- **Quality Control Assurance**
  Only very preliminary control quality tests were applied to glider data by the previous processing version, and SOCIB is closely following the definition of the standard quality control procedures for glider data, which is a major topic in the international community. Current proposals are under evaluation and the processing toolbox has been designed to easily allow for their adoption when they become available.

- **Metadata Aggregation**
  The IMEDEA/SOCIB glider fleet has been added to SOCIB's Instrumentation application, and deployment metadata is registered there. The stored metadata is in accordance with the guidelines currently drafted in the EGO Glider Data User Manual. The new processing chain can retrieve any desired deployment metadata from virtually any database, and metadata parameters may be set in the search configuration. This metadata is included in the self-describing glider data products generated by the toolbox.

- **Data Archive**
  A well-defined private archive of glider deployment snapshots has been designed and is maintained by the glider team. Raw data source files and any other outputs and figures produced by the processing chain, are stored in another well defined configurable private archive. Finally three standard data products with different processing levels are stored in NetCDF format in SOCIB's catalogue:
  - L0: raw/preprocessed glider data, as it comes from the glider, except for some unit conversions in reference coordinate variables.
  - L1: processed glider data; sequences of data from raw measurements along the glider trajectory, possibly interpolated, filtered and/or with applied conversions or corrections. Also, new timeseries derived from existing ones.
  - L2: postprocessed glider data, L1 data interpolated to produce regular vertical instantaneous profiles at selected locations along the glider trajectory.

- **Data Search and Discovery**
  The glider facility web page shows a map of current deployments and a table of all the deployments providing links to data products. Both active and completed glider deployments may also be found in the deployment client application *DAPP*, which provides links to tracking data products too.

- **Data Policy and Distribution**
  Free of charge public access to both real time and delayed mode glider data is provided through the SOCIB public THREDDS catalogue and its companion services. Real time tracking NetCDF products are available at SOCIB's public catalogue for both Slocum and Seaglider data, and a migration process to upgrade the real time processing NetCDF products from the legacy chain to both the real and delayed mode ones from the new processing chain is ongoing.

- **Data viewing**
  Glider deployments have been integrated in the deployment client application *DAPP*, a viewer for both active and past deployments that shows their trajectories and figures from real time data processing, and provides links to the data products.

2.4.8.4 Current status with reference to IP2010

During the period 2010-2013, the data center developments followed quite closely the actions described in SOCIB IP2010, also along the lines of the three phases described above, but with a delay of several months. By the end of 2010 the first data samples were collected and processed, and the core applications became operational in June 2011, handling data for the facilities that were operational at that time. The second stage became operational in the first semester of 2012, when specific visualization tools were released. The third stage is ongoing work, evaluating and defining the solutions for advanced data search and discovery requirements and improving the existing data distribution mechanisms.

HUMAN RESOURCES

The human resources structure of the DCF is composed of the following roles:
- Team leader
- Data processing developers
- Data visualization developers

At the end of 2010 the DCF team was composed of 1 team leader, 2 data processing developers and 2 data visualization developers.

At the beginning of 2011 a third data processing developer was hired to fulfil all the workload needs. However, by the end of 2012 the data center was composed of just the 3 data processing developers due to the unexpected resignation of 3 members of the team during the first half of 2012.

INVESTMENTS

There are no current planned investments for the DCF, as the Computing Service provides the IT infrastructure.

ACHIEVEMENTS NOT ANTICIPATED IN THE IP2010

In addition to the achievements derived from the tasks described in the IP2010, the SOCIB DCF has also carried out development and management tasks that were not initially foreseen. Amongst others, the following are especially noteworthy:

- Support for centralized invoice management as an extension of the instrumentation application (April 2011)
- Tools to aid glider mission planning as an extension of the instrumentation management application (August 2012)
- SOCIB mobile native application for iOS platforms (iPhone and iPad) (November 2012)
- SOCIB mobile native application for Android platforms (April 2013)

2.4.8.5 Critical analysis

SWOT

Weaknesses	**Strengths**
• Under staffed • Insufficient dynamic prioritization. A wide diversity of facilities results in a complex array of problems requiring great flexibility of DCF staff • Uncompetitive salaries	• Fast response to facility requirements • Development based on free and open source solutions, strong commitment to Open Data access principles • Development according to community standards, access to a wide user group • IT infrastructure design, suitable for data management challenges • Strong and regular interaction with network of ocean scientists • Demonstrated ability to develop applications and technical capacity for knowledge transfer to society • Expertise in, advanced data visualization, app. design, support and implementation, data processing, QC, integration of data from different platforms
Threats	**Opportunities**
• Institutional and financial difficulties	• Visibility of our work e.g. through Ramadda, Unidata, • Exposure to leading edge ocean data management and the definition of new standards in EU projects such as MyOcean, GROOM, JERICO, PERSEUS, etc… • Potential for further applications for SOCIB data streams

2.4.9 ENGINEERING AND TECHNOLOGY DEVELOPMENT (ETD) DIVISION

2.4.9.1 Description

The Engineering and Technology Development (ETD) Division constitutes a pool of specialized engineers and technicians (mechanical technicians, electronic technicians, boat handlers and

divers) that provide support for the Observing Facilities and develop new technologies to improve observing systems and data transmission.

The work of the ETD Division encompasses the maintenance, calibration, testing, preparation and operation of all SOCIB's instruments, the planning of routine maintenance, support for scientific surveys and the operation of equipment at sea, new data analysis tools and visualization elements. A core of well trained, multi-disciplinary, technicians coordinate the activities of the ETD Division with the existing base of marine and technology development initiatives in the Balearic Islands. At the same time the ETD Division is responsible for directing and coordinating the support, maintenance and operations of the Observing Facilities, managing instruments, laboratories and SOCIB's warehouses. The activities of the ETD Division are largely carried out at IMEDEA (CSIC-UIB) laboratories and warehouses, as the initial SOCIB offices at ParcBit are only suitable for office work.

2.4.9.2 Aims 2010 – 2013

The ETD Division is responsible for directing and coordinating the support to the Observing facilities, managing instruments, labs and warehouses, as well as directing the operations of SOCIB R/V.

2.4.9.3 Review current status of the facility (2010 – April 2013)

ACHIEVEMENTS

The main achievements related to ETD activities were:

- Acquisition of SOCIB van ..... Mar 2011
- Incorporation of first SOCIB technician ..... Mar 2011
- Acquisition of Zodiac Hurricane ..... Apr 2011
- Installation of pressure chamber ..... May 2012
- Incorporation of second SOCIB technician ..... Jan 2012
- Installation of a workshop in SOCIB van ..... Jul 2012
- Installation of SOCIB R/V scientific equipment & data infrastructure ..... Dec 2012

2.4.9.4 Current status with reference to IP2010

The tasks assigned to ETD fall into two main groups as follows:

Background Responsibilities

- Maintenance of the SOCIB vehicle and RIB (SOCIB van and Zodiac Hurricane)
- Management of SOCIB installations: the pressure chamber and laboratories, etc.
- Installation of new facilities and stations
- Maintenance, calibration, testing, preparation and operation of all instruments, planning of routine maintenance, support for scientific surveys and operation of equipment at sea.

Specific support for SOCIB's facilities

- Equipment maintenance on the **Coastal Research Vessel Facility**
- Support in the calibration and maintenance of the **Coastal HF Radar Facility** stations
    - 2 Radar HF stations in Ibiza and Formentera

- Support for the deployment and recovery operations of **Glider Facility** (boat handling and deployment technicians)
- Support for the **Lagrangian Platforms Facility** in the deployment and recovery of drifters and floats
- New installations and equipment maintenance of the **Fixed Stations Facility**:
  - 3 Sea Level Stations
  - 1 Oceanographic buoy
  - 1 Coastal Station
  - 3 Weather Stations
- Support for the **Beach Monitoring Facility** in bi-annual samplings and BEAMON stations maintenance
  - 3 BEAMON Stations; 2 in Mallorca and 1 in Menorca

New Technology Pilot Programme

This was not developed due to resource issues, funding uncertainties and personnel (see below and Section 2.5).

HUMAN RESOURCES

ETD is June 2013, staffed by the following SOCIB technicians with skills as noted below:

- One professional diver, boat handler and oceanographic instrumentation technician
- Two boat handler and oceanographic instrumentation technicians

The ETD also has the in-kind coordination and support from IMEDEA an oceanographic instrumentation technician, professional diver and boat handler.

DIFFICULTIES OVERCOME

The ETD division is, and has been since the start, working at maximum capacity. It is well organised around its schedule of tasks and responsibilities, with no space in its timetable or duplication of effort. Whilst commendable this lean efficiency breaks down when unforeseen problems occur, for a real example equipment failure as a result of storm damage. Clearly such emergencies have to be addressed quickly and immediately, and inevitably this creates a gap in the routine responsibilities and tasks, which subsequently become delayed and places a higher than acceptable risk on SOCIB's monitoring data collection. This situation should ease with the planned hiring of additional ETD team technicians, until this happens the risk to routine monitoring data streams remains and some pre-defined level of prioritisation is the only available option.

The ETD has been at FOC with regard to Facility Support and Technology Development since January 2012. However the Technology Implementation/Pilot Programme, the second line of ETD Division activities, was simply too ambitious a program to undertake simultaneously with the facility construction, given the number of technicians, storm and other natural damage, equipment/installation problems (to be expected during set-up of new equipment). More recently issues associated with financial constraint and staff recruitment have prevented the initiation of the two programs envisioned in the IP2010. The Fishing fleet program has been cancelled, although SOCIB has links with an initiative that sees a different system (VMS) operational in the Balearics through PERSEUS.

2.4.9.5 Critical analysis

SWOT

Weaknesses	Strengths
• Insufficient personnel to cope with ETD workload • More dedicated IT expertise would help with the maintenance of remote stations	• ETD technicians' multidisciplinary skills and personal motivation to use these skills fully • ETD facilities and tools • Strong support from IMEDEA
Threats	**Opportunities**
• Political, institutional and financial uncertainty, restricting the development of some actions	•

2.4.10 SIAS DIVISION

2.4.10.1 Description

The sustainable management of coastal and marine ecosystems is a significant international challenge, which is becoming increasingly urgent with the prevalence of global change on the decision-making agenda. There is no panacea for solving sustainability problems, rather, there is a need for scientific research aimed at developing innovative, adaptive approaches to understanding and managing complex socio-ecological systems. New approaches such as sustainability science have emerged in order to address this need; these approaches are necessarily interdisciplinary, participative, and problem orientated. At the policy level, frameworks such as Integrated Coastal Zone Management and Marine Spatial Planning (within our group we refer to these collectively as Integrated Coastal and Marine Management) have been proposed as ways to link scientific assessment, monitoring, and prediction with environmental decision-making.

Integrated Coastal and Marine Management (ICMM) can be an effective process for advancing towards sustainability; promoting conservation and preservation of ecosystems, equitable use of coastal and marine resources (natural, socio-economic, and cultural), and integration among users, sectors, and administrative zones. Coastal and marine zones in the Mediterranean, especially islands, which are particularly vulnerable, continue to show evidence of negative environmental impacts; with governments and society expressing the need to address sustainability challenges with increasing urgency. This need is reflected in an increase in scientific research related to ICMM.

Globally, the effective integration of science into decision-making and policy development (i.e. science-policy gap) has, in many cases, been largely ineffective in supporting the implementation of ICMM. We believe that in order to achieve success in ICMM, there is a need for research and innovation, which is truly relevant and applicable to management and decision-

making and adaptable to different social-ecological scenarios. This is the type of research and activity that we have carried out in SIAS over the period 2010-2013: interdisciplinary, focused on the development of tools and methodologies, defined by the problems it addresses, requiring collaboration with society and convinced of the importance of addressing governance issues to assure we are able to close the science to society loop, and thereby contributing to reduce the science-policy gap.

ICZM activities in the Balearic Islands started in 2005 and the initial phases to 2010 were reviewed in Diedrich et al., (2011) and will not be repeated here. The continuation of these actions in SOCIB was a specific mandate from the Board of Trustees in 2010.

The mission of this research division is to advance sustainability science to support the implementation of European policies such as the Integrated Maritime Policy (IMP) or the Marine Strategy Framework Directive (MSFD) through conducting research at local, regional, and international scales. We aim to increase knowledge and understanding of human-environment interactions in coastal and marine zones and provide practical solutions to solving sustainability problems.

Specific research objectives are:

- To develop and evaluate science-based decision-making tools and methods to support ICMM and related frameworks, with particular emphasis on the integration of social and ecological dimensions,
- To identify and implement indicators to assess, monitor, and predict limits to growth and critical thresholds,
- To integrate research with environmental governance and management systems and to transfer science to society.

The activities have responded to theses objectives and are briefly summarised here. An important effort of balancing science and society needs ended after more than 4 years of intense studies to the development of sustainability indicators for ICZM in the Balearic Islands (Diedrich et al., 2010). Theses indicators were initially implemented in Menorca Island and at present, theses activities are being refocused towards a more clear convergence with EC Directive descriptors and indicators and other EC driven initiatives such as Marine Knowledge, IMP, MSFD, Blue Growth, etc. (see SOCIB news at www.socib.es in May 2013 for a recent update on this). A review of theses activities and major results, oriented towards the Balearic Islands stakeholders, was published (in Catalan) in 2011 in the Bulletin of Economic Conjuncture from the Directorate General of Economy and Statistics of the Balearic Islands Government.

The development of tools for real support to ICMM has lead to results that are interesting for sustainable and science based management in the Balearic Islands, in areas such as beach management and recreational boating. In particular, we developed a general methodology for applying the limits of acceptable change processes to the management of recreational boating on a specific beach (Diedrich et al., 2011) and also studied the relationship between the availability of space for anchoring and the pressure exerted upon that space, taking into account ecological consequences (i.e. impacts on benthic habitats). This lead to a study of recreational boating in Mallorca, as a first key step for marine spatial planning (MSP) in the islands (Balaguer et al., 2011). Some internal reports along this line have also been produced (e.g., for MSP in the bay of Palma). The importance of taking quantitative perception data into consideration for identifying pragmatic environmental management measures in coastal recreation scenarios was later addressed in Diedrich and Tintoré (2012).

Another active area for the development of tools in SIAS has been related to oil spill response at the coast, and the development and implementation of an Environmental Sensitivity Index (ESI) following the guidelines from the NOAA restoration and response division. The ESI has been updated and validation was carried out during 2011-2012. A new version is presently available on the SOCIB website.

All these studies point to the importance of multidisciplinary work carried out under science excellence based studies and carefully listening to societal needs from the start, which in many cases requires a significant time devoted to understanding and knowledge transfer in both directions, from science to society and from society to science.

2.4.10.2 Aims 2010 – 2013

The objective of this Division, as expressed in the IP 2010, was to develop applications related to Coastal Operational Oceanography and Integrated Coastal and Ocean Management (ICOM), within the general framework of sustainability science.

The Division combines research at the forefront of sustainable coastal zone management, with data from the observing platforms and with local Balearic concerns and pressure points, which strongly reflect global issues, to develop tools for the practical application of best practice to help local, national, and European coastal and marine environmental managers. The output from this division will ultimately provide key science-based decision support tools and sustainable policy insight. This area of activity is again a good example of cooperation and development between local institutions (Economic and Social Council); work in this area was initiated in 2005 at IMEDEA (CSIC-UIB) and is continued at SOCIB as requested by the Board of Trustees in 2009-2010.

Since 2013, the activities have been more focused concentrating on the science to policy needs for sound knowledge based implementation of European Directives directly affecting our oceans and coasts such as for example, the Marine Strategy Framework Directive.

2.4.10.3 Review current status of the facility (2010 – April 2013)

The SIAS division is at present (as of April 2013) under re-organisation since the departure in late 2012 of SIAS Post Doc. Dr. Amy Diedrich for a permanent position in Australia. This again points to the weakness of the personnel structure at SOCIB with an internationally un-competitive salary structure. In line with this re-organization, Dr. Pau Balaguer has been re-assigned to ETD, with only 10-20% of his time now being devoted to SIAS activities (mostly related to ESI).

There is at present strong collaboration between SIAS and some research projects at IMEDEA (CSIC-UIB) such as KnowSeas and PERSEUS, where policy oriented, science based, approaches and tools are being developed. This includes both David March and Beatriz Morales (IMEDEA), and Joaquín Tintoré, who initiated theses activities in 2005, and has again become responsible for them after the departure of Dr. Diedrich. Funding from EC sources will be sought for the near future, and re-focusing, as already indicated in actions related to the implementation of, for example, the MSFD.

ACHIEVEMENTS

The main achievements related with the SIAS Division were:

- Sustainability Indicators 2010

- ESI revision 2011-2012
- Recreational boating in Mallorca 2012
- SACOSTA tool 2012

In this section we provide, for the research areas already presented, the specific scientific contributions of the different activities For details of research areas and access to publications see http://www.socib.es/?seccion=siasDivision.

Major milestones achieved since the initial ICZM activities in the Balearic Islands

Indicators for Integrated Coastal Zone Management

2006 First meeting between IMEDEA (CSIC-UIB) and CES to propose a partnership to develop a system of indicators for ICZM in the Balearic Islands

2007 Formal presentation of the System of Indicators for ICZM in the Balearic Islands (*CES Dictamen* 5/2007) to the Government of the Balearic Islands and the Insular Councils

2008 Diedrich, A, Tintoré, J, Navinés, F, Tur, V, Tortosa, E. 2008. System of Indicators for Integrated Coastal Zone Management in the Balearic Islands.Dictamen 5/2007 of the Economic and Social Council of the Balearic Islands. Palma de Mallorca: CES. Publication of the Dictamen in English, Spanish and Catalán.

2010 Publication of a scientific article on the indicators project. Diedrich, A, Tintoré, J and Navinés, F. 2010. Balancing Science and Society through Establishing Indicators for Integrated Coastal Zone Management in the Balearic Islands. Marine Policy 34: 772-781.

2010-2011 Implementation of the system of indicators through a pilot project in Menorca in collaboration with IBESTAT and OBSAM. Espeja, S., Diedrich, A, Navinés, F, Crespí, J, Balaguer, P, Tintoré, J. 2010. Implementación del Sistema de Indicadores para la Gestión Integrada de la Zona Costera en las Illes Balears: estudio piloto en Menorca. Technical Report. Palma de Mallorca.

2011 Publication of a monograph of the indictors project. Espeja, S, Navinés, F, Diedrich, A, Carreras, D, Tintoré. 2011. Integrated Management Strategies for Sustainability in the Balearic Islands, Integrated Coastal Zone Management (Monograph in Catalan). Economic Bulletin of the Balearic Islands (tri-annual), July 2011, pp 58 – 64.

2011 Inclusion of the System of Indicators in the Balearic Islands Statistics Plan.

2012 Finalization and review of coastal sustainability indicators which have been applied as a pilot study in Menorca. The indicators can be consulted on the SOCIB web pages for the SIAS Division: http://www.socib.es/?seccion=siasDivision&facility=indicators

Coastal and Marine Spatial Planning/Recreational boating studies

2009 Inventory and analysis of space available for recreational boating (including pressure upon that space) in the Balearic Islands. Balaguer, P, Diedrich, A, Sardá, R, Fuster, M, Cañellas, T, Tintoré, J. 2011.Spatial Analysis of Recreational

Boating Activity as a Key Step for Marine Spatial Planning in Mallorca (Balearic Islands, Spain). Ocean and Coastal Management 54: 241-249.

2010

Implementation of a social ecological study of recreational boaters (including adjacent beach users) in CalaXinxell, Illetas. Diedrich, A, Balaguer, P, Tintoré, J. 2011. Methodology for Applying the Limits of Acceptable Change Process to the Management of Recreational Boating in the Balearic Islands, Spain (Western Mediterranean). Ocean and Coastal Management 54: 341-351. Diedrich, A, Tintoré, J. 2012.Multi-method approach to exploring social-ecological dimensions in a Mediterranean suburban beach setting. Coastal Management40:301-311.

2011

Spatial characterization of Bahía de Palma (Mallorca, Balearic Islands) (*Caracterización Espacial de la Bahía de Palma*).Implementation of boundary delimitation of the coastal area of the Bay of Palma according with an initiative of Integrated Coastal and Marine Management (ICMM).This study is an internal technical report of SOCIB. (In Spanish) Available on-line:
http://repository.socib.es/repository/entry/get/caracterizacion_espacial_badia_palma.pdf?entryid=0321c338-5461-4e59-9b59-afa0a2290872

2011

Implementation of a social ecological study on perceptions of mooring buoys in Cala Blava. Diedrich, A, Terrados, J, Arroyo, L, Balaguer, P. (in review). Modelling the influence of attitudes and beliefs on the use of mooring buoys in a Mediterranean Marine Protected Area. Ocean and Coastal Management.

Environmental sensitivity of the coastline

2011

Environmental Sensitivity of the coastline of the Bay of Palma (Mallorca, Balearic Islands) (*SensibilidadAmbiental de la Bahía de Palma*). Exhaustive inventory of the coastline of de Bay of Palma according to their environmental sensitivity (include geomorphological, bio-ecological and human-use resources characteristics of the coastline of the Bay of Palma).This study is an internal technical report of SOCIB. (In Spanish) Available on-line:
http://repository.socib.es/repository/entry/get/sensibilidad_costa_badia_de_palma.pdf?entryid=0fe3990e-3e08-4851-adf8-0cd32e10e89d

2011
2012

Updating the cartographic data related to environmental sensitivity index regarding to the three main components (geomorphological, bio-ecological and human-use resources).

2012

Website of SOCIB. New section regarding Environmental Sensitivity of the coastline of the Balearic Islands providing information through several PDF documents.

Applications and products:

- Atlas of Environmental sensitivity of the coastline of the Balearic Islands (2007), scale 1/50,000. Internal report.
  http://www.socib.es/?seccion=siasDivision&facility=applicationandproductsvertidos&language=en_GB#atlas
- Decision-making support during the sinking of Don Pedro (Ibiza, July 2007).
  http://www.socib.es/?seccion=siasDivision&facility=applicationandproductsvertidos&language=en_GB#donpedro

- Field survey review of the coastal sensitivity of Bay of Palma (Mallorca) and specific modifications of classification of the Balearic Islands. This subsection includes 1) an inventory of Environmental Sensitivity of the coastline of the Bay of Palma (internal report with detailed cartography included) and 2) pwp presentation (pdf) of advantages of field survey for studies based on ESI: http://www.socib.es/?seccion=siasDivision&facility=applicationandproductsvertidos&language=en_GB#fieldsurvey_bayofpalma
- Methodological review of the environmental sensitivity classification for the Balearic Islands: http://www.socib.es/?seccion=siasDivision&facility=applicationandproductsvertidos&language=en_GB#methodologicalchanges
- Relationship between Environmental Sensitivity and Integrated Coastal and Marine Management (ICMM). Example of Bay of Palma (Mallorca). Include abstract of communication and poster presented at 1st Iberoamerican Congress on Integrated Coastal Zone Management. This subsection also shows the utility of environmental sensitivity faced to floating solid wastes (pictures slides): http://www.socib.es/?seccion=siasDivision&facility=applicationandproductsvertidos&language=en_GB#iczmmvses
- Characteristics of Coastal Habitats of Balearic Islands. Choosing Spill Response Alternatives: http://www.socib.es/?seccion=siasDivision&facility=applicationandproductsvertidos&language=en_GB#coastalhabitat
- Sheets providing information and spill response alternatives for each type of coast of the Balearic islands (internal report PDF): http://repository.socib.es/repository/entry/get/FICHAS_HABITATS_CARACTERISTICOS_IB_SOCIB.pdf?entryid=e0a89906-5a26-4959-8362-e725917d4873
- Web-based Map Viewer of the shoreline sensitivity of the Balearic Islands. This subsection also has been included in the next paragraph corresponding to Spatial Data Infrastructures to support MSP and MSFD: http://www.socib.es/?seccion=siasDivision&facility=applicationandproductsvertidos&language=en_GB#webbasedmaps

Spatial Data Infrastructures to support MSP and MSFD

2012 Launch of SACOSTA (Environmental Sensitivity of the Coastline) is a web-based map viewer which displays cartographic data related to the environmental sensitivity of the coastline of the Balearic Islands. Continuous updating of cartographic data related to environmental sensitivity of the coastline of the Balearic Islands. Accessible at: http://gis.socib.es/sacosta

2012 Launch of GIS-SEAS, a web mapping application that displays environmental and socio-economic information to support the MSFD and MSP. This application is based on SACOSTA and was developed to support the KnowSeas project in cooperation with IMEDEA. Accessible at: http://knowseas.socib.es/lion

SCIENTIFIC CONTRIBUTION

Academic Journals (refereed)

Cinnirella S, March D, O'Higgins T, Murciano C, Sardà R, Albaigés J, Pirrone N. 2012. A multidisciplinary Spatial Data Infrastructure for the Mediterranean to support

implementation of the Marine Strategy Framework Directive. International Journal of Spatial Data Infrastructures Research, vol. 7, p. 300-322

Diedrich, A, Tintoré, J. 2012.Multi-method approach to exploring social-ecological dimensions in a Mediterranean suburban beach setting. Coastal Management40:301-311.

Diedrich, A, Upham, P, Levidow, L, van den Hove, S. 2011. Framing environmental sustainability challenges for research and innovation in European policy agendas. Environmental Science and Policy 14: 935-939.

Diedrich, A, Balaguer, P, Tintoré, J. 2011. Methodology for Applying the Limits of Acceptable Change Process to the Management of Recreational Boating in the Balearic Islands, Spain (Western Mediterranean). Ocean and Coastal Management54: 341-351.

Balaguer, P, Diedrich, A, Sardá, R, Fuster, M, Cañellas, T, Tintoré, J. 2011.Spatial Analysis of Recreational Boating Activity as a Key Step for Marine Spatial Planning in Mallorca (Balearic Islands, Spain).Ocean and Coastal Management 54: 241-249.

Diedrich, A, Tintoré, J and Navinés, F. 2010. Balancing Science and Society through Establishing Indicators for Integrated Coastal Zone Management in the Balearic Islands. Marine Policy 34: 772-781.

Balaguer, P, Sardá, R, Ruiz, M, Diedrich, A, Vizoso, G, Tintoré, J. 2008. A Proposal for Boundary Delimitation for Integrated Coastal Zone Management Initiatives.Ocean and Coastal Management 51: 806-814.

Books

Doménech, J, Sanz, F, Jiménez, L, de Carvalho, C, Antonio, J, Díaz, M, Carballo, A, Bernabéu, A, Sardá, R, Sebastián, C, Molina, A, García, C, Fernández-Palacios, Y, Tintoré, J, do Carme, M, Diedrich, A. 2010. Guide for the Implementation of a System of Integrated Coastal Zone Management in Spain (in Spanish). Study Collection Num.2. Coastal Observatory of La Coruña. La Coruña: Netbiblo.

Diedrich, A, Tintoré, J, Navinés, F, Tur, V, Tortosa, E. 2008.System of Indicators for Integrated Coastal Zone Management in the Balearic Islands. Dictamen 5/2007 of the Economic and Social Council of the Balearic Islands. Palma de Mallorca: CES.

Book chapters

Diedrich, A, Balaguer, P, Tintoré, J. 2011. Concepts, methods, and tools to support science-based decision-making in Integrated Coastal and Ocean Management: Examples from the Balearic Islands. In ICZM as an Evolution of Territorial Planning and Governance (Joaquín Farinós, ed.).Valencia: University of Valencia, pp-89-110.

Balaguer, P. 2012. Implicaciones de la Geomorfología en las Iniciativas de Gestión Integrada de la Zona Costera. En: Rodríguez-Perea, A., Pons, G.X., Roig-Munar, F.X., Martín-Prieto, J.Á., Mir-Gual, M. y Cabrera, J.A. (eds.). La gestión integrada de playas y dunas: experiencias en Latinoamérica y Europa: Mon. Soc. Hist. Nat. Balears, 19: 45-60. ISBN: 978-84-616-2240-5. Palma de Mallorca.

Non-refereed publications and reports

International Council for the Exploration of the Sea (ICES).Report of the Study Group on the Socio-economic Dimensions of Aquaculture. Amy Diedrich, May 2011 (member of the study group).

International Council for the Exploration of the Sea (ICES) Report of the Working Group for Marine Planning and Coastal Zone Management, April, 2011 (contributed to annual reports as member of the working group since 2007).

Espeja, S, Navinés, F, Diedrich, A, Carreras, D, Tintoré. 2011. Integrated Management Strategies for Sustainability in the Balearic Islands, Integrated Coastal Zone Management (Monograph in Catalan). Economic Bulletin of the Balearic Islands (tri-annual), July 2011, pp 58 – 64.

Tintoré, J, Diedrich, A, Vizoso, G and Pitarch, S. 2007. Knowledge-based Integrated Coastal Zone Management: An Essential Element of Sustainable Tourism (in Spanish). In Towards a new paradigm in tourism – Sustainability in Spain (ed. F Prats). Report prepared for the 2020 Strategic Horizontal Plan for Tourism in Spain, pp 199 – 203.

Conferences (national and international)

Dec 2012 *Cumulative pressuresmapping as a tool for the assessment of the MSFD: the case study of the Gulf of Lions*. KnowSeas Fourth Scientific Workshop. Bruges, Belgium.

Jan 2012 *A Spatial Data Infrastructure for the Mediterranean to support implementation of the Marine Strategy Framework Directive*. EuroGEOSSConference. Madrid, Spain

Jan 2012 1er Congreso Iberoamericano de Gestión Integrada de Áreas Litorales (GIAL). Universidad de Cádiz (UCA). Cádiz. Topic: Spatial characterization of the Bahía de Palma & Relationship between ICMM and environmental sensitivity index of the coastline.

Dec 2011 *SDI for the Mediterranean*.KnowSeasThrird Scientific Workshop. Helsinki, Finland

Sep 2011 VI Jornadas de geomorfología Litoral. Universitat Rovira y Virgili (Tarragona). Topic: Application of sea level rise scenarios of IPCC and storm surges in Son Bou Beach.

Jul 2011 Method for linking environmental and social science data to support the management of coastal recreational use.*6th International Conference on Environmental Futures: Interdisciplinary Progress in Environmental Science and Management*, Newcastle, UK.

Jun 2011 The Design and Implementation of a System of Indicators for ICZM in the Balearic Islands. *II Economic Conference of the North-West Mediterranean*. Hosted by the Institute of European Studies, Barcelona, Spain (invited).

Jun 2011 Bridging the science-policy gap. *International Workshop on New Practices of Participative Planning to Face New Environmental, Economic and Territorial Challenges*, hosted by the University of Valencia, Spain (invited).

Apr 2011 Integrated Coastal Zone Management and coastal governance in the Balearic Islands. *Special Session on Coastal Governance and ICZM in the Mediterranean*, hosted by the MAREMED Project, Valencia, Spain (invited).

Nov 2010 *New ways of doing Research which address Societal Challenges* (invited expert in open discussion). Participatory seminar hosted by the European Commission DG Research (Science, Economy and Society), Brussels, Belgium.

Sep 2010 Socio-economic and cultural objective setting for supporting the effective use of indicators for integrated management of marine and coastal ecosystems.*ICES Annual Science Conference*, Nantes, France.

Apr 2010 International Conference on Coastal Conservation and Management (ICCCM 2010). Estoril. Topic: Spatial analysis of recreational boating in the island of Mallorca (Balearic Islands).

Feb 2010 Balancing science and society through establishing indicators for Integrated Coastal Zone Management in the Balearic Islands.*Workshop on Geospatial Risk Characterization: Tools for Ecosystem-based Approaches to Support Integrated Decision Making*, hosted by the Department of Fisheries and Oceans, Government of Canada, Bedford Institute of Oceanography, Canada (invited).

Working groups

- *Study Group on the Socio-economic Dimensions of Aquaculture*, International Council for the Exploration of the Sea (ICES)
- *Working Group on Marine Planning and Coastal Zone Management*, ICES.
- *Interdisciplinary Dialogue across Science Panel*, MARCOM+ Initiative towards an Integrated Marine and Maritime Science Community, European Commission FP7 Programme.

2.4.10.4 Current status with reference to IP2010

HUMAN RESOURCES

As already indicated above the facility has evolved along the lines foreseen in IP2010. Some major changes and adaptation will necessarily happen by the end of 2013, once the financial situation has been clarified and new competitive recruitments can be made.

INVESTMENTS

No major investments have been carried out and are not either foreseen in the near future in the SIAS Division.

DIFFICULTIES OVERCOME

Key personnel left in 2012, which was without doubt an important loss of SOCIB. However at the same time this has provided us with the opportunity to additionally focus the Divisions activities towards providing science and monitoring expertise for the determination of descriptors and indicators needed to implement European Directives, without neglecting the original focus on management problems that affect the coastal zone of the Balearic Islands (both the natural physical and biotic environments and the society users).

ACHIEVEMENTS NOT ANTICIPATED IN THE IP2010

Achievements not anticipated in the IP20The knowledge gained since 2012 in European Directives and the importance of the monitoring programs that need to be in place before during 2014 are a clear example of an important achievement that was not anticipated in 2010.

2.4.10.5 Critical analysis

SWOT

Weaknesses	Strengths
• Uncompetitive salaries	• Well coordinated and committed team • Knowledge base • Balearic base, where there is pressure on a unique marine and coastal environment and need from society for science based information and tools
Threats	**Opportunities**
• Financial difficulties at SOCIB level	• Creation of advanced tools for society ICOM • Creation of advanced tools for MFSD

AREAS OF MAJOR IMPACT IN 5 YEARS: SCIENTIFIC, TECHNOLOGICAL AND STRATEGIC AND SOCIETY NEEDS

Strategic and society needs

There are two principle issues emerging over the next few years:

- Firstly, the EU's Marine Strategy Framework Directive (MSFD) will involve monitoring programs and the development of metrics to support the writing of marine management plans.
- Secondly, there will be new initiatives and directives such as Blue Growth and the new proposals for directive for ICM and MSP

2.4.11 OUTREACH SERVICE

2.4.11.1 Description

The role of SOCIB's Outreach service is to create awareness, visibility and to enhance the understanding of SOCIB's mission, products and services, and through this process contribute to expanding the stakeholder exploitation of SOCIB products and services to fill the science-policy gap.

Outreach activities are undertaken through the dissemination of information via multiple channels of communication, including traditional media, conferences, workshops etc. and new media channels, such as web access, Facebook, twitter etc. Targeted end users include the scientific community, coastal residents, educators and students, administrators involved in coastal and ocean management (implementing EU Directives such as the Marine Strategy Framework Directive), the tourism sector, recreational coastal zone users, marine workers and the public at a regional, national and international level. Collaboration with the Computer

Animation and New Technologies Group from UIB (http://www.ladat.es) has been established, contributing to the dissemination of the SOCIB vision through high quality 3D animations.

2.4.11.2 Aims 2010 – 2013

The objectives of Outreach and Education work are summarised as follows:

- Spreading knowledge about the ICTS SOCIB – national, international scientific community, society
- Make the science and technology development accomplished by SOCIB interesting and approachable for society
- Attract young students into the world of science in order to maintain a continued base of quality scientists and researchers
- Position SOCIB as one of the leading coastal ocean observing and forecasting systems, at a national / European level.

2.4.11.3 Review current status of the facility (2010 – April 2013)

ACHIEVEMENTS

Major achievements are presented below following the general categories of the activities in the Outreach Service:

Web

- Initial concept of SOCIB's web structure, including design and the back-office support organisation – ..... Feb 2010
- Established SOCIB's social media profiles (Facebook, Twitter, LinkedIn, Flickr, YouTube, Vimeo) Jun2011
- Final version of SOCIB's web structure, including the back office support infrastructure ..... Jul 2010
- SOCIB's web content and structure updated for the different facilities (example) ..... During 2012
- SOCIB's iOS application for mobile platforms released, lead by the Data Center Facility
- Creation of multimedia content and the multimedia tab ..... During 2012 and updated in early 2013.
- Creation of the glider Educational Tool ..... To be released in May 2013.

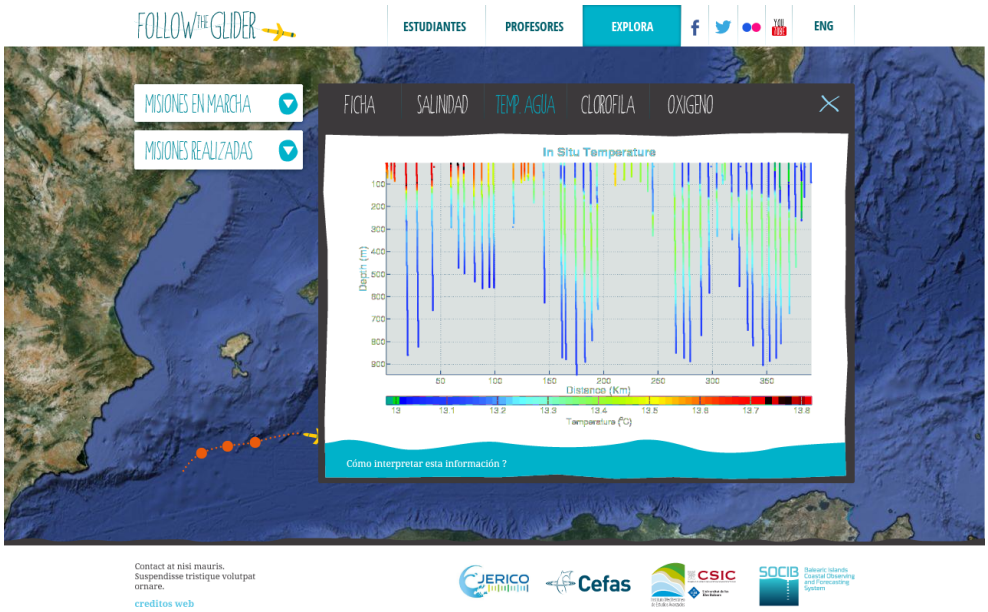


Figure 2.4.r: Follow the Glider Project, work in progress detail

SOCIB web Statistics (period Nov. 2010 – Apr. 2013):

- Visits 47942
- Unique Visitors 15680
- Page views 209880
- Visits per Month ..... Over 2000
- Top 10 traffic sources – Facebook, Red ICTS Marinas, Totalwind (public forum), CSIC, LinkedIn, Oceandrivers, IMEDEA, ParcBit, B/O García del Cid and La taberna del Puerto (public forum).

Social network statistics (period Nov. 2010 – Apr. 2013):

- YouTube 3737 plays, most viewed video "Rissagues and Meteotsunamis".
- Vimeo 3264 plays, most viewed video "R/V SOCIB Design & Construction".
- Twitter..... 190 followers.
- Facebook ..... 161 followers.

Outreach material

Documentaries (in chronological order):

- Documentary "The Glider Revolution" by Thalassa TV3, – January, 2011 – Duration: 18'15".
- Short documentary "SOCIB's Facilities: Research Vessel Construction" – November, 2011 – Duration: 3'44". Available through SOCIB web.
- Short documentary "SOCIB's Facilities: Gliders" – August, 2012 – Duration: 5'19". Available through SOCIB web.
- Short Documentary "SOCIB's Facilities: Beach Monitoring" – December, 2012 – Duration: 5'12". Available through SOCIB web.

Edited SOCIB material & brochures:

- SOCIB's implementation plan – January, 2012. Edited and available through the SOCIB web site.
- SOCIB's brochure – March, 2012. Edited and available through the SOCIB web site.

Dissemination of SOCIB activities:

Publications (all available on the SOCIB web site)

- International Innovation – Issue October, 2012
- Marine Research Infrastructures experts group – January, 2013
- Marine Technology Society Journal, Volume 47, Issue 1, pp. 101-117(17) - February, 2013

Press (all available on the SOCIB web site)

- NAUTA360 website – Short documentary "R/V design & construction" – December 15th, 2012.
- NAUKAS website – Short documentaries "SOCIB's facilities" December 23rd, 2012.
- Diario de Ibiza – "Eivissa, el grifo del Mediterráneo" January 4th, 2013.
- Baleópolis – El Mundo – "SOCIB, el mar en tiempo real" January 29th, 2013.
- Última Hora – "El Nuevo catamaran oceanográfico del SOCIB surca las aguas de Baleares" February 17th, 2013.
- Baleópolis – El Mundo – "El surfer de las Corrientes marinas" February 26th, 2013.
- Mallorca Zeitung "Der neue star der Meeresforcher" March 14th, 2013.
- Magazine Océano "SOCIB: Sistema de Observación y Predicción Costera de las Islas Baleares", num. 4 April 8th, 2013.

Figure 2.4.s: Cover detail of 2 different publications

LADAT coordination:

- SOCIB's poster final version v. 1.0 ..... Aug 2010
- Rissaga 2-D animation. Available at SOCIB's Youtube ..... May 2011
- SOCIB's poster final version v. 2.0 ..... Dec 2012
- Rissaga 3-D animation project first draft ..... Dec 2012
- Rissaga 3-D release planned for June, 2013. Duration: 3' aprox.

3D simulation of the "Rissaga" phenomenon, work in progress

SOCIB news

SOCIB's Outreach Service periodically releases short news articles about our activities, including glider missions, scientific campaigns, visits to SOCIB's HQ, congress attendance, etc. Major milestones to report are as follows:

- Initial operational capability (IP2010) achieved ..... May 2010
- Final operational capability (IP2010) achieved ..... Dec 2011
- Publication of 184 news articles in 28 months

SOCIB participation in general public events

SOCIB's Outreach Service attended and organized various public events where SOCIB displayed the latest activities and general information about our mission, vision and objectives.

- Forotec ..... Nov 2010
- Balearic Science Fair ..... Apr 2011
- Forotec ..... Nov 2011
- Mareostra ..... May, 2012

SOCIB participation in radio programs

- SOCIB's Director attended IB3's "Balears fa Ciència" ..... Jan 14th, 2012
- SOCIB's Director attended IB3's "Al Dia" ..... Feb 2nd, 2012
- SOCIB glider engineer attended IB3's "Ones de Mar" ..... Mar 31st, 2012
- SOCIB's Director attended IB3's "Balears fa Ciència" ..... Jan 19th, 2013

Participation in scientific campaigns

- Bluefin Tuna ..... Jun 2011

R/V SOCIB operations, during the installation of a met-ocean buoy in the Bay of Palma

2.4.11.4 Current status with reference to IP2010

Outreach Service has accomplished the initial three aims as laid out in the IP2010, the final aim that of attracting young students into the world of science has been initiated through SOCIB attendance at events like science fairs, however now SOCIB has reached full operational status this area can now being further activated, with initiatives such as the 'Follow the Glider' web educational tool.

HUMAN RESOURCES

One person part-time has undertaken all the Outreach work outlined above.

INVESTMENTS

No significant investments foreseen and none made.

DIFFICULTIES OVERCOME

The Outreach Service did not detect major difficulties in the working strategy, except the existence of time periods with unduly heavy workloads, due to the coincidence of several important tasks at the same time.

ACHIEVEMENTS NOT ANTICIPATED IN THE IP2010

The short documentaries were not anticipated and have been very successful, in that they are used for many public outreach occasions (e.g. Maremostra, SOCIB visitors) and featured in external websites (e.g. Naukas) and in the science sections of national newspapers (e.g. El Mundo, Ultima Hora). In addition creating the as the 'Follow the Glider' web educational tool which was not foreseen in the IP2010 and is now being tested in local schools.

2.4.11.5 Critical analysis

SWOT

Weaknesses	**Strengths**
• Develop greater flexibility in work pattern as occasionally inundated if several events take place at once	• Design ability across a range of media • Network of skilled contacts for areas of non expertise
Threats	**Opportunities**
• Public not fully understand the importance of SOCIB activities	• Increasing importance placed upon communicating and engaging with the public

AREAS OF MAJOR IMPACT IN 5 YEARS: SCIENTIFIC, TECHNOLOGICAL AND SOCIETAL

Strategic and society needs

- Spreading knowledge and awareness of marine related issues and the important role that can be played by science in the policy making and policy implementation process.
- Our capability to translate complex scientific information into concepts that can be easily understood by society, from school children to the interested public and professional users of our data services and products.

2.4.12 COMPUTING AND IT SERVICE

2.4.12.1 Description

The SOCIB Computing and IT service comprises a full set of physical systems, computational and network services, which provides the technical IT infrastructure behind both personnel' and Facilities' computing needs. It supports all of SOCIB's requirements in terms of the total data lifecycle, including data collection, archiving, discovery, download, distribution, modelling and visualization.

The SOCIB Computing and IT Service provides support to intensely IT dependent Facilities such as the Data Centre Facility (DCF) and the Modelling and Forecasting Facility, and equally provides the general infrastructure to support staff and administrative functions. In addition, the Computing and IT Service encourages collaboration with other institutions, like UIB and IMEDEA, in terms of sharing computing resources and space to increase joint computing capabilities, storage resources and network communications. More specifically the main infrastructures in place are:

- DCF Infrastructure: a centralized storage and automated backup for all the data obtained by the different facilities, including observational data as well as numerical models outputs. Data are stored in a separated shared file system, allowing concurrent and distributed access.
- Forecasting and Modelling Facility Infrastructure: a HPC infrastructure to run operational forecasting models as well as specific process studies.
- General Infrastructure (personnel and administrative functions): a centralized storage and automated backup for administrative data. It also provides a platform where centralized databases and management applications are executed. Data are kept on a shared file system, allowing concurrent and distributed access. Communications support an adequate interconnection between systems and ensure data availability.

The Computing and IT service consists of 5 main components: communications, storage (including backup), general services, processing services and parallel computing. In addition, it also provides support to the oceanographic research vessel IT facilities.

Communication. From the main office, the communication to the outside is accomplished through a 1 Gbps monomode optical fiber connection with UIB; in addition, there is another monomode optical fibre link between IMEDEA and UIB. In fact, UIB is the local node of the RedIRIS Spanish National Research and Education Network (NREN), which services over 370 institutions, including all Spanish universities and the main public research entities. Internally,

SOCIB communications work over a 100 Mbps LAN network, handling around 50 network points, two separated wireless networks, a PABX and several switches at different speeds.

Storage and backup. The total storage space capacity is around 100 TB for storage and 80 TB for backup. This storage is geographically distributed between the two data centers but forms a unified storage system. Independent file systems provide a hierarchical storage system, organised into 4 main components: data (both observational and numerical), users (Windows, Mac OS and Linux users), general services (virtual machines, applications and databases) and HPC (both serial and parallel computing). NFS and CIFS provide the ability to share centralized file systems between different users and servers, while an iSCSI service stores server OS and configurations for the virtualization environment. The backup system consists of various external storage systems, for backup up of all scientific and staff data, applying proper archiving policies. Both storage and backup systems implement different levels of RAID technology (RAID 5 or RAID 6) in order to offer a high availability fault tolerant storage solution. Storage and backup policies ensure storage data compliant with current legislation and provide a suitable recovery system.

General Services. The IT system currently comprises 4 general purpose servers, sharing the same architecture and characteristics and implementing a virtualization environment. Virtualization brings substantial cost savings, increased IT capacity and business continuity. Different virtual machines handle different responsibilities, jointly defining a solid, safe and reliable system. The main services are provided by separated virtual machines, such as a data server (THREDDS, RAMADDA, etc.), a data processing server, a web server, a GIS server or a database server. Additionally, a centralized management platform provides the flexibility and expandability for this virtual infrastructure, extending virtualization capabilities over the whole IT facility.

Processing. Two additional servers offer serial computing capabilities, for batch processing of serial jobs, running processes that require a large amount of shared memory with a sequential code. Most of the facilities benefit from these servers as they allow data processing for observations as well as model inputs and outputs.

HPC. A computer cluster provides an enhanced platform for parallel computing. It provides the Forecasting and Modelling Facility with the necessary infrastructure to deploy modelling applications. Waverider is a SGI computing cluster system, running SUSE Linux Enterprise Sever release 10.1 and offers 8 homogeneous computing nodes based on the dual-socket hexa-core Intel Xeon processor architecture running at 2.8 GHz and offering 24 GB of main system memory (2GB per core). An administration node offers login and serial processing capabilities; it is based on the dual-socket quad-core Intel Xeon processor running at 2.26 GHz and offers 24 GB of main system memory. The computing system implements a double interconnection network topology, where all nodes are doubly interconnected by a Gigabit Ethernet Network and a QDR Infiniband Network, offering a low-latency and high throughput connection up to 40 Gbps.

Research vessel IT. The catamaran integrates an on-board data center service in order to satisfy the computational needs, for collecting, archiving and distributing the observational data collected during research campaigns. It integrates a real-time data monitoring service, for on-board visualization, and a data synchronization mechanism between the vessel IT system and the central office facility. The vessel has 5 general purpose servers: a data server (management, processing, synchronization, archiving and distribution), 2 laboratory servers (real-time data and delayed data), a visualization server (monitoring camera systems, data visualization and navigation) and a data probe server. Collected data is archived in a unified RAID array data

storage system, and a Network Time Server (NTP) ensures time-synchronization. External communications are achieved by a dual communication system: a 3G router with mobile phone coverage (near-shore) and a VSAT satellite system. In terms of internal communications on board, three CISCO switches interconnect all systems establishing a 1 Gbps LAN and three wireless routers provide internal wireless Internet access.

The objectives and developments of SOCIB Computing and IT infrastructure followed the activities and previous experience developed at the TMOOS Department from IMEDEA (CSIC-UIB), which certainly provided a very useful guideline. There is a good level of coordination between SOCIB and IMEDEA Computing and IT Departments.

2.4.12.2 Aims 2010 – 2013

The July 2010 Implementation Plan described the computational plan to fully support the data management system. The system was planned to be implement in three phases: installation of core services (communications and storage), first IT stage (computing and backup system) and second IT stage (computing and backup system).

- The first phase comprised the installation of the main system: communications (outer and inner), installation of the storage system and general service computers, and the initial establishment of the office local area network (LAN).
- In the second phase, the main goals were the purchasing and installation of a high performance computing system and the installation of a data backup system.
- During the third phase, further acquisitions were planned fot the installation of a second stage for the backup system and the HPC system. At the moment, this third phase has been postponed indefinitely, for financial reasons. The temporal scale of these phases is outlined in the following table:

	1st mid 2010	2nd mid 2010	1st mid 2011	2nd mid 2011	1st mid 2012	2013	2014
Phase 1: core system	D	O	M	M	M	M	M
Phase 2: first IT stage	D	D	D	O	O	M	M
Phase 3: second IT stage				D	D / O (?)	D / O (?)	O (?)

D: Definition, O: Operational, M: Maintenance

2.4.12.3 Review current status of the facility (2010 – April 2013)

ACHIEVEMENTS

Throughout the period 2010 - 2013, the core IT infrastructure system has been implemented and consolidated, providing a system that ensures data availability and reliability. This is fully in line with its main goal of efficiently servicing and supporting the whole SOCIB organization,

including users, services and facilities. During this period, computing resources such as storage, communications and computing capacity, required by the users have been established.

In line with the Implementation Plan approved in 2010, the activities accomplished by this service can be categorized as:

- A critical study of initial IT requirements and a full resource analysis
- Systems architecture design, following an Initial service definition, ensuring support to the whole data management process lifecycle
- Installation and start-up of the acquired initial solution. Configuration of the storage service, computing services and networking (internal and external communications)
- Define system upgrades (storage and services)
- Operation, monitoring and maintenance of the IT facilities, including local work stations and remote facilities
- Define and maintain data synchronization services between remote locations and the Data Centre
- Management of IT resources within the organization (equipment, applications, networking)
- Study and evaluation of alternative IT solutions. Knowledge and awareness of new technologies and solutions
- Help-desk and user support (all personnel including scientists)
- Support and maintenance of business software (office software, anti-virus, inventory software, data repository etc.) and scientific software (MATLAB, THREDDS etc.)

The following paragraphs summarise the main achievements accomplished by the Computing and IT Services, organized in two main components: installed infrastructure and provided services.

Infrastructure

A core data centre has been established at the corporate offices, interconnected with the diversity of remote stations (HF Radar, Beach monitoring, ETD) and with IMEDEA facilities. The first stage consisted of the design and composition of the data center location, including the acquisition, installation and configuration of a suitable power and cooling system. In addition, an environmental monitoring system ensures the core data centre infrastructure is protected against adverse environmental conditions. Once the data center foundations were laid, during 2010, the core systems were setup. Communications systems were established, including both internal and external communications, a wireless network system and the office telephone system. The installation and configuration of the unified storage system and the initial deployment of the general services servers, defining a virtualization environment, was completed. At the same time, the first stages of the HPC system (waverider) and of the backup system were deployed. Through 2011 and 2012, the data center infrastructure was expanded with the acquisition and installation of an extension to the storage system and with the integration of an additional general services server. Furthermore, the computing services were extended with the acquisition and installation of a serial computing system (erebus). At the end of this period, the Computing and IT Service carried out the design and installation of the IT infrastructure for the Research Vessel Facility.

Services

SOCIB's Computing and IT Service offers a full set of services to support the operational requirements of the different facilities, mainly the Data Centre Facility and the Modelling and Forecasting Facility. The following list summarizes the main services provided by the Computing and IT Service in order to guarantee the suitable performance of the whole system.

- Unified Storage System:
  - Installation and configuration of a main RAID array storage system (tetis)
  - Installation and configuration of a secondary storage system at IMEDEA (nas02-nas03)
  - Definition of an independent file systems hierarchy
  - Setup write access for management and user quotas

- Backup System:
  - Installation and configuration of a local backup and disaster recovery system (IMEDEA and SOCIB). Backup of three main components: data (user, observational, models), applications configurations and server configurations.
  - Installation and configuration of the first stage of the remote backup system, between IMEDEA and SOCIB facilities.

- Virtualization Environment:
  - Installation and configuration of a virtualization system environment (VMware). Configuration of a central management platform (VCenter). Main servers:
    - Database Server
    - Data server
    - Data Processing Server
    - Web Server
    - DHCP, DNS and NTP Server
    - Active Domain Server and LDAP Server
  - Implementation of the GIS system. A two-tier architecture system: a database server and an application server.

- Serial Processing Servers / Modelling Servers:
  - Installation and configuration of the serial HPC system. Installation and configuration of applications, compilers and libraries (erebus).
  - Implementation of the operational wave system (WAVE)
  - Implementation of the SAPO system
  - Implementation of the dedicated server for extended SAPO service (SAPO2)

- High Performance Computing (waverider):
  - Installation and configuration of the HPC system (compilers, applications and libraries).
  - Benchmarking and establishing a user-friendly computing environment (modular system)
  - Installation and configuration of a monitoring tool (Ganglia)
  - Installation and configuration of a portable batch system (PBS Torque)

- Remote resource management:
  - Management of remote beach monitoring stations (beamon)
  - Integration, management and monitoring of the remote HF Radar Stations
  - Management of a remote real-time monitoring system for the construction of the Oceanographic Research Vessel SOCIB
  - Configuration and management of a dual dockserver high availability system (Glider Facility)

- Monitoring services:
  - Installation and configuration of a centralized monitoring system (Munin, Zabbix), managing both local and remote stations
  - Installation of application and service monitoring tools (Awstats, Javamelody)

- User services:
  - Email service (contacts, calendars, distribution lists)
  - UIB user services (e-mail, wireless)
  - Help-desk and configuration of user environments (Windows, Linux, MacOS)
  - Study and evaluation of a videoconferencing system. Acquisition of two VoIP web-systems (Skype, WebEX)
  - Installation and maintenance of project and issue tracking software (Atalassian JIRA)

- Additional management services:
  - Management of the data centre environmental monitoring system
  - Management of the office telephone system
  - Network inventory management
  - IT resources management. Inventory management
  - Scripting for data management (meteofrance, gis server)

- External coordination:
  - CTI-UIB
  - IMEDEA

- Courses:
  - EMC training course (Celerra NS-120)
  - AENOR Auditing Information Security Management System (ISMS)

2.4.12.4 Current status with reference to IP2010

HUMAN RESOURCES

Since early 2010, one full time employee computer engineer is responsible for the system management. This is obviously a strong limitation.

INVESTMENTS

The following table summarizes the main investments made by the Computing and IT Services during the period 2010-2012.

Date	Equipment	Components	Invoice (€)
18-08-2009	CPD Conditioning	Rack 19" 42 U SAI MGE-APC Rack 10KVA Air-conditioning Environmental Monitoring System	10713,12
10-11-2009	Video wall	6 x LCD Samsung 46"	19126,08

		Stand + wiring + adapters	
22-01-2010	Storage: tetis	EMC Celerra NS-120 EMC Software	51400,76
12-04-2010	Networking	Office networking deployment	8591,84
25-06-2010	HPC: waverider	16 x Intel Xeon HexaCore X5660 2 x Intel Xeon QuadCore E5620 54 x 4 GB RAM DDR3 8 x 500 GB SATA & 2 x 750 SATA Infiniband & Gigabit Ethernet networking Software: SLE 10 + SGI Software	59999,83
26-10-2010	General Servers	3 x PowerEdge R710 Intel Xeon E5550 3 x 24 GB RAM 2 x VMware 4.0 U1 Standard Edition	11321,34
30-10-2010	General Servers	2 x VMware 4 Advanced 1 x VMware vCenter 4 Foundation	9004,72
30-05-2011	Storage: nas02 + nas03	SIE Ladon NAS/iSCSI 24 TB E610S 32 TB Open-E Software (unlimited) Infiniband controller	23800,60
9-11-2011	Research Vessel: Cameras + Access Points	2 x Axis Camera P1347 3 x Access Point CISCO Axis Software	8183,30
2-12-2011	Serial Computing Server: erebus	1 x PowerEdge R710 Intel Xeon X5687 64 GB RAM	6844,00
4-04-2012	Research Vessel: Racks	1 x Rack Retex 19” 36U 1 x Rack Retex 19” 18U	5165,32
12-04-2012	Research Vessel: Domo Camera	1 x Camera Axis P55 HDTV Monitoring system	3455,60
14-05-2012	Research Vessel: SAI	3 x SAI 300 VA Rack 19”	4124,10
16-05-2012	Research Vessel: servers	3 x Rack Server Supermicro (4GB RAM, 2 x 500 GB HD) 1 x Rack Server Supermicro (4GB, 500 GB HD) 1 x Rack Server Supermicro (8 GB, 2 x 500 GB HD)	8572,70
20-06-2012	Research Vessel:	NTP Server + GPS Antenna	6291,76

	NTP + 3G Router	UMTS/3G Router + UMTS Antenna	

DIFFICULTIES OVERCOME

From the initial start-up phase, the Computing and IT service has had to address the main difficulty of not having a suitable physical space for the Data Centre at SOCIB headquarters. Therefore, it was necessary to carry out essential modifications to the initial designated location, starting with low-level technical details (power-supply systems, cooling system, etc.) and ending with the redistribution of some IT equipment. In addition, the Computing and IT service has put significant effort into transparently providing a unified global system, despite working with a geographically distributed infrastructure, composed of the SOCIB Data Center, the IMEDEA Data Center, the Oceanographic Research Vessel and the distributed remote stations (Beach Monitoring, HF Radar, ETD).

The establishment of the operational HPC environment has been another major milestone for the Computing & IT Service, providing an affordable operational environment for the Modelling and Forecasting Facility, providing a suitable platform for their numerical models. It has been necessary to adapt the numerical models in order to efficiently operate over the new HPC infrastructure, achieving the necessary application and performance requirements.
The implementation of the second stage of the backup and recovery system has been delayed, and the fully remote backup system is currently being redefined. Additionally, the public call for bids for the second stage of the HPC system has been postponed due to financial constraints as mentioned earlier.

2.4.12.5 Critical analysis

SWOT

Weaknesses	Strengths
• Insufficient personnel to achieve objectives • Uncompetitive salaries • Over reliance on resources offered by partners leads to complex management and communications • Career structure for research technicians poorly defined • Poor structural funding for purchasing and maintaining computing systems • Significant dependency on commercial software solutions, with high license cost	• Well trained, talented, technical team • Unique infrastructure capabilities and IT resource • Installation based on open source solutions • Close relations with other facilities • Strong commitment to open data access principles • Expertise in computing and IT services • Provision of resources by major institutes (IMEDEA, UIB) provides high availability infrastructure

Threats	Opportunities
• Political will for sustainability science may be overcome by economic pressures • Lack of resources to meet present and future objectives • Uncertainty in SOCIB's location	• Great cooperation with external institutions, provides added knowledge transfer

2.4.13 MANAGEMENT AND FINANCE SERVICE

Description

Since SOCIB started its activity, the Management and Finance Service (MFS) has taken into account all the activities related to supplies, contact with suppliers, public announcements, tenders, annual budget preparation, payments and the general management of finance and personnel.

Another major role of the MFS is the preparation of the extensive collection of documents required for the meetings of the Executive Commission (2-4 per year usually), the Board of Trustees (2-3 per year) and the Financial Commission (1-2 per year).

During 2010, 2011, and 2012 the MFS was also responsible for the personnel contracts, including the significant number of new recruitments and departures.

ACHIEVEMENTS

The MFS has been instrumental in the development of SOCIB. In 2011, the contracts were signed, the acquisitions arrived between 2011 and 2012 and the technical team was then able to test the equipment and start operations. A peak of 27 staff was reached in 2012 followed by a decline in 2013 reaching now 23 persons.

In 2011 the big investment in infrastructures was made. Before that, at the end of 2010, the tenders were published in the Spanish Official Journal (BOE), and in all but one of the cases, in the European Commission Official Journal (DOUE).

The major announcements for these infrastructures were also available through the SOCIB web pages, specifically:

- HF Radar System for measuring surface currents, to be installed in the Ibiza Channel
- CTD system, including frame, auxiliary sensors and oceanographic sample bottles
- Rigid Inflatable Boat (RIB)
- High-tech version of the MOCNESS sampling net for plankton and meroplankton sampling
- 2 gliders (underwater autonomous vehicles) for routine autonomous monitoring
- 2 gliders (underwater autonomous vehicles) for mesoscale eddy studies
- Oceanographic research catamaran

HUMAN RESOURCES

A manager and an administrator, with the occasional collaboration of the Office of the Directors team, provide the MFS service.

2.4.14 OFFICE OF THE DIRECTOR

2.4.14.1 Description

The Office of the Director is responsible for the overall coordination of SOCIB strategy and planning, communication with external bodies, open access procedures and the Focused Research Program, including the current Bluefin Tuna Project. In general terms, the activity of the Office of the Director can be summarised as:

- Planning the general strategy of SOCIB
- Communication with the different government agents, at all levels, regional, state, and European
- Developing agreements with national and international institutions
- Budget reporting and planning
- Management of the Focused Research Programme: Bluefin Tuna Project

2.4.14.2 Aims 2010 – 2013

The major aim for the 2010-2013 period has been the construction and setup of SOCIB. So the major role of the OD has been to create a strategy, develop budgets and manage annual planning processes with Division Managers.

The IP2010 was presented and approved by the Board of Trustees meeting, in April 2010. Since then, all the efforts have been directed to accomplish the steps specified in IP2010. This included the start-up of all the facilities activities; opening employment positions, publishing the call for tenders, purchasing all the major and minor infrastructures, and developing good public relations. Specifically SOCIB has made a big effort to explain its objectives, both societal and scientific, for many different audiences, from society, to politicians, technicians, and scientists. Also, there has been significant activity in discussing and forming agreements and collaborations with a large number of organisations with similar interests to those of SOCIB.

2.2.14.3 Review current status of the facility (2010 – April 2013)

ACHIEVEMENTS

Brief summary of 2010

During 2010 the ICTS SOCIB, completed the 'Design Phase', as outlined in the IP2010 and commenced the construction phase of the various, multi-platform observing, forecasting and data management systems. The original objectives and milestones that were established with the approval in April of the SOCIB Implementation Plan have largely been met, including (a) the investments made and committed in scientific equipment both for the laboratory and for in situ monitoring, (b) the incorporation of 14 people to the ICTS (c) the start of activity in some of the

systems, and the creation of the base structure for the start of those that would be implemented during 2011 and (d) the signature of agreements and institutional arrangements that provide structural guarantees to the activity.

Brief summary of 2011

The most important development in 2011 was the approval, by the Executive Commission, of 7 important contractor calls, all published in the BOE and/or DOUE. These were:

- Construction of an oceanographic research catamaran
- Radar HF System to measure superficial currents, to be installed at the Ibiza Channel
- CTD, auxiliary sensors and oceanographic bottles
- Zodiac boat
- High-tech version of the sampling net MOCNESS for plankton and meroplancton sampling
- 2 GLIDERS (underwater autonomous vehicles) for deep sampling and long autonomy
- 2 GLIDERS (underwater autonomous vehicles) for mesoscale studies

All of these calls, except the research vessel construction, were completed during 2011. The vessel was constructed in 2011 and completed on schedule at the end of 2012.

On the 3th of June 2011, the Executive Commission additionally approved the following contractor profiles: AUV (826.000 €); High Performance Computing (354.000 €); 1 profound glider (177.000 €); and 1 glider for mesoscale studies (177.000 €). However, although SOCIB had the authorization by the Executive Commission to publish these in the BOE and/or DOUE, the Office of the Director decided to postpone publication due to the economic uncertainty in Spain at this time.

Also in 2011 a number of important **agreements** were made between SOCIB and local, national and European organisations, including:

- Agreement with the Instituto Español de Oceanografía to collaborate in the research and technological development of the marine science
- Specific Agreement with the Instituto Español de Oceanografía, to develop a modelling programme of the nesting variability areas and the population dynamics of the Blue Fin Tuna in the Mediterranean
- Agreement with Sol Melia Group to install a coastal video monitoring system in Son Bou (Menorca)
- Addenda number 3 to the Agreement with Organismo Público Puertos del Estado in order to interchange data and collaborate in the development of operational oceanography systems
- Agreement with Ports de les Illes Balears in order to interchange data and collaborate in the development of operational oceanography systems
- Agreement with IEO and Grupo Balfegó to study nesting areas and population dynamics of the Blue Fin Tuna in the Mediterranean

SOCIB hosted the following visits:

- Prof. Lorenzo Cianelli (Oregon State University, EEUU) for 3 weeks to collaborate on the BluefinTuna Project, in order to determine the principle hydrographical variables that allow nesting sites.

- Dr. Reiner Onken (COSYNA, Germany) visited SOCIB from 7th to 11th of February, in order to collaborate in the updating of HOPS operational model and to establish glider quality control procedures.
- The Counsellor of Justice and Internal Affairs, together with the Sub-secretary of State for Tourism and Innovation of the Mexican Government; Chief Executive of CEIM (Centre of Enterprise and Innovation of Madeira) together with the General Director for Research of the Balearic Islands Government.

SOCIB participated in various regional, national and international meetings:

- 4-6 April SOCIB sponsored the second support action from the FP7 MARCOM: Panels for Interdisciplinary Dialogue across Science and Research Infrastructure Development
- 10th April SOCIB presents the Wave Prediction System for the Puerto de Palma and the South of Mallorca, at the Autoridad Portuaria in Palma
- 11-14 May Joaquín Tintoré was invited to the Workshop CIESM Workshop, number 43, in Croatia
- 18-19 May Joaquín Tintoré was invited to participate in the seminar: Monitoring the Marine Environment. Organismo Parques Nacionales, in Cabrera National Parc
- 28 June - 1 July International Symposium, Brest, France: "The future of the 21st Century Ocean. Marine Sciences and European Research Infrastructures"
- 14-15 November Joaquín Tintoré presented SOCIB at the 7th Marine Infrastructures Expert Working Group of the EU, in Brussels
- 25 November Participation in Forotec 2011. Institutional stand and conference (J. Tintoré): the big research infrastructures, as a knowledge engine, technological transfer, and management technology for the public and private sectors. Talk of J. Tintoré in FOROTEC: Las grandes infraestructuras de investigación, motor de conocimiento, de transferencia de productos tecnológicos y de tecnologías de gestión para el sector público y privado
- Working Groups of the Red de ICTS Marinas
- Balearic Science Fair 2011, preparation and participation
- The Director of SOCIB officially presented SOCIB in Ibiza, in a press conference in the Consell the Ibiza and Formentera, together with the Counsellor of Inner Affairs, Innovation and Justice.

It is also important to note that SOCIB was invited to various conferences, meetings or international panels of European and international relevance, in particular with reference to our mission, responding to scientific, technological and strategic (in response to societal needs) objectives, our strong commitment to new sampling platforms such as gliders / AUV 's, and the relevance of the data centre.

Brief summary of 2012

During 2012 SOCIB has gradually moved into the operational phase. This means that it is well established and consolidated and apart from HF Radar, which has been adjusted and will be soon fully accessible, and the coastal catamaran, that was undergoing local sea trials at the end of 2012, all facilities were fully operational by the end of 2012. With most facilities reaching this milestone on time. In 2012, SOCIB has also developed a higher profile as an institution, in the Balearic Islands, nationally and internationally. SOCIB has appeared in different media, both specialised and mass media, and regularly hosted visitors from different institutions, both governmental and scientific.

SOCIB made the following technological advances:

The pressure chamber was fully installed and started to operate; the ZODIAC was built in Zodiac facilities in Vancouver and delivered to SOCIB; an Iridium Lagrangian buoy was built together with IMEDEA TMOOS and was tested successfully at the sea, sending data that can be followed from SOCIB page; the catamaran was completed in Polyships Rodman shipyard in Vigo, and delivered to SOCIB; a Met new AXIS Ocean buoy has been installed in the Bay of Palma, fully equipped with sensors; two mini buoys are designed, built and launched in the Ibiza channel, together with Albatros Marine Technologies: the HF Radar to monitor Ibiza Channel currents was installed in Formentera and Ibiza, and tested with drifters, and this facility is already providing current maps which are available on the website of SOCIB.

SOCIB signed the following agreements with important institutions:

- A cooperation agreement between the Ministry of Economy and Competitiveness and SOCIB, in which it was specified the cooperation of FEDER founds to cofound up to 50% of the costs of the catamaran construction.
- A collaboration agreement with Ports de les Illes Balears to promote and regulate scientific and technical activities that will help improve the prediction models, especially in relation to the phenomenon of "rissaga". Through this agreement, SOCIB and Ports de les Illes Balears will exchange real-time data of their observing networks for its subsequent use and dissemination. IB Ports and SOCIB agreement also aims to expand the Balearic coastline observing networks to contribute to the improvement of port activities and navigation, and jointly develop research projects that aim to the progress of the prediction models of oceanographic conditions.
- An agreement with the Navy (Ministry of Defence) through the Naval Hydrographic Institute, to establish the basic lines of collaboration between the Navy and SOCIB.

SOCIB appeared in the following media publications and programmes:

'Balears fa Ciencia' IB3 Radio Program; 'Al Dia' IB3 Radio Program; presentation of SOCIB at the forum of European Economic and Social Council; roundtable to present the project Bluefin Tuna in the Ocean International Film Festival -Maremostra-; informative article in the October issue of the International Innovation Journal; presentation at the meeting of the Open Days organized by the Department of the Presidency of the Government of the Balearic Islands. Also, SOCIB has been mentioned and recognized for his work in the Green Paper of the European Commission: Marine Knowledge 2020.

SOCIB developed the following brochures and internal documentaries:

Gliders of SOCIB; documentary on the catamaran SOCIB; documentary on the Beach Monitoring facility; the web-based map Sacosta (Coastline Environmental Sensitivity map); a corporate brochure.

SOCIB presented/attended the following scientific forums and conferences:

Oral presentation at the First Iberoamerican Congress on Integrated Coastal Management (January 25 to 27, Cadiz); oral presentation at the II Economic Conference of the North-Western Mediterranean (March 13, Barcelona); Seminar of the International Commission for the Scientific Exploration of the Mediterranean Sea-CIESM-(March 15, Roma); keynote speaker, Joaquin Tintoré, in the 2nd ICES / PICES Conference for Early Carreer Scientists Ocean of Changes (24-27 April, Mallorca); SOCIB organized jointly with IMEDEA TMOOS, a

workshop in the framework of European projects and EGO Jerico and GROOM Cost Action, entitled "Glider Operations in Europe: scientific, technical and operational challenges" (May, Mallorca); SOCIB organized a workshop on marine data interoperability standards with the Geospatial Open Consortium (June, Mallorca); SOCIB presentation in the Australia-European Union Research Infrastructure Second Workshop (26-27 June, Brussels); presentation at the International Conference on Coastal Engineering (1-6 July, Santander); presentation of the Beach Monitoring facility at the 32nd International Geographical Congress (26-30 August, Cologne); presentation at the 4th Argo Science Workshop (September, Venice); presentation of the Project results SOCIB Bluefin Tuna in the V Scientific Meeting organized by Balfegó Group (October, Ametlla de Mar); presentation of spatial data infrastructure in the III SOCIB Iberian Conference on Spatial Data Infrastructures (17 - October 19, Madrid); SOCIB presentation in the Marine and Sub-marine Infrastructures Symposium (13-15 November, Toulon).

SOCIB hosted the following visits:

Counsellor of Education, Culture and Universities of the Balearic Islands Government; the Vice President of Economy, innovation and Employment; CYTMAR; INNOVAMAR; Counsellor of Tourism and Sports; JPI Oceans Director; Director of EACI –Executive Agency for Competitiveness and Innovation-; Director of Science, Research and Environment of the La Caixa Foundation; South Coria Ambassador in Spain; the President of the Balearic Islands Government; European Investment Bank Delegation. Also, it was very satisfactory for SOCIB having the visit during 4 days, of the winners of the Underwater Gliders Design Context for engineering students (Escuela Técnica Superior de Ingenieros Navales) organized by the Universidad Politécnica de Madrid.

Brief summary of 2013

2103 has started with a significant level of achievements, both in terms of technological advancement and societal repercussion of SOCIB activities (projects, visits, meetings, media publications, etc.).

SOCIB made the following technological advances:

A major highlight is the successful 44-day glider campaign, completed in the framework of the second call for transnational (TNA) access to JERICO's (Towards a Joint European Research Infrastructure network for Coastal Observatories) EU funded project infrastructures. The glider mission started on Thursday January 31st, 2013, and ended on the 8th of April, with a deep glider mission from Menorca to Sardinia in the Western Mediterranean Sea. The first R/V SOCIB oceanographic cruise was carried out in the Balearic Sea from February 12 to 19th 2013, leaded by PI Benjamín Casas from IMEDEA (CSIC-UIB) and with a multidisciplinary team of scientists and engineers from a variety of international organizations. The cruise was part of the initial tests of the SOCIB new R/V and was also a contribution to PERSEUS FP 7 funded project. The objective of this cruise was to establish the variability in the Balearic channels and the associated ecosystem response, also visiting a deep offshore station South of Cabrera Island.

SOCIB appeared in the following media publications and programmes:

January 19th, SOCIB's Director was interviewed on the radio programme "Balears fa Ciència" from IB3. Joaquín Tintoré presented the ICTS SOCIB and the present on-going work, and he also explained the importance of SOCIB's paradigm shift in ocean observation (from large scale campaigns with oceanographic vessels to integrated multi-platform observing and forecasting

systems) and SOCIB's leadership in this change. Internationally, the most important media publication has been in the May issue of "The Parliament Magazine", (Issue 369, pages 30-31), with SOCIB as en example of a solid foundation for multi-platform oceanic research, which is revolutionizing the understanding of key questions on ocean processes, climatic change and ecosystem variability. SOCIB was mentioned in the frame of EU initiatives such as Blue Growth strategies, etc.

As for press releases SOCIB appears in 2013 in different national media:

- Mallorca Zeitung - "Der neue Star der Meeresforscher" 14/03/2013
- El Mundo - Baleópolis - "El Surfer de las Corrientes Marinas" 26/02/2013
- Última Hora - "El nuevo catamarán oceanográfico del SOCIB surca las aguas de Balears" 17/02/2013
- El Mundo - Baleópolis - "SOCIB, El Mar en Tiempo Real" 29/01/2013
- Diario de Ibiza - "Eivissa, El Grifo del Mediterráneo" 04/01/2013

SOCIB presented/attended the following scientific forums and conferences:

SOCIB actively participated in the important "Blue Growth in the Mediterranean, perspectives of Spain" meeting hosted in Palma de Mallorca, 2-3, May 2013. Mélanie Juza presented the on-going activities of the SOCIB Modelling Facility in Workshop 1 (Maritime Security and integrated management of emergencies, threats and maritime risks prevention). In Workshop 2 (Marine Research: Contribution to science, industry and needs of society, support elements for IMP), David March from IMEDEA presented the on-going activities related to PERSEUS and KNOWSEAS EC funded projects, well in line with SOCIB activities from the SIAS Division. Finally, Joaquin Tintoré presented the paradigm change in Ocean Observation that is at the origin of the multi-platform approach of SOCIB as well as recent developments associated with the monitoring and the descriptors needed for the implementation of the Marine Strategy Framework Directive (MSFD), the marine pillar of Integrated Maritime Policy.

SOCIB hosted the following visits:

SOCIB had two principal visits during the first months of 2013. The 9th of April, a delegation from the Brazilian Government, visited SOCIB. These included the Secretary of Science and Technology of the Prefecture of Rio de Janeiro, Franklin Dias Coelho and Deputy Secretary of Science and Technology, Jardim Maria Helena Cautiero Huerta, accompanied Balearic Islands authorities. The 9th of May, the Spanish Government Delegate, MmeTeresa Palmer, visited SOCIB. SOCIB's Director and all the team presented the on-going activities with particular emphasis on the role of science, technology development, and innovation (development of tools for decision support) to advance towards knowledge based management of our oceans and coasts.

SCIENTIFIC CONTRIBUTION

In this section we have only included the results from SOCIB as a multi-platform system presented at key scientific meetings. The contributions focused on specific processes or results from a Facility, Service or Project, can be found in the relevant sections above.

Thesis

Alvarez-Ellacuria, A.2010: Nearshore hydrodynamics and shoreline evolution in the Balearic Islands, UIB. Advisors: A. Orfila; R. Medina.

Cañellas; B., 2010: Wave climate in the Balearic Sea: characterization, variability and prediction, UIB. Advisor: A. Orfila.

Martínez Ledesma, M.; Alvarez Diaz, A.; Segura Fuster, J.;, Electronic Engineering Master Thesis: Development of an oceanographic drifter with Iridium bi-directional communication capability, Alvarez Díaz, Alberto.

Invited conferences

The impact of new information infrastructures in understanding and forecasting the coastal ocean: some examples from the Balearic Islands, Tintoré, J, Congress: Ocean Sciences Meeting February 22, 2010 - February 26, 2010 United States (USA), Portland, Oregon

Integrated Maritime Policy in the Mediterranean and Black Sea in practice, Tintoré, J, Congress: European Maritime Day May 18, 2010 - May 21, 2010 Spain (ESP), Gijón

Synergy between satellite and in-situ observations to monitor mesoscale variability: review of recent studies and new proposals for the research station Jaume Ferrer, Pascual, A,

Congress: Ad Hoc Working Group for Developing the Scientific Programme of the Coastal Marine Research Station Jaume Ferrer May 24, 2010 - May 26, 2010 Spain (ESP), Maó , Menorca

Las grandes infraestructuras de investigación, motor de conocimiento, de transferencia de productos tecnológicos y de tecnologías de gestión para el sector público y privado, Tintoré, J, Vizoso, G, Casas, B, Renault, L, Garau, B, Ruiz, S, Heslop, E, Torner, M, Cusi, S, Martinez-Ledesma, M, Pascual, A, Escudier, R, Orfila, A, Sayol, J.M, Gómez-Pujol, L, Alvarez, A, Diedrich, A, Balaguer, P, Espejo, S, Gómara, S, Sebastian, K, Brunet, J, Llodrá, J, Lora, S, Castilla, C, Lizarán, I, Vidal, E, Cañelles, B, Ponce-de-León, S, Congress: Innovación y Transferencia de Conocimiento. Consejo General de Cámaras de Comercio, Industria y Navegación de España October 20, 2011 - October 21, 2011 Spain (ESP), Madrid, CONSEJO SUPERIOR DE LAS CÁMARAS DE COMERCIO. INDUSTRIA Y NAVEGACIÓN DE ESPAÑA. C/ Ribera del Loira 12, MADRID

SOCIB: the role and impact of new multi platform sustained observing and forecasting systems, Tintoré, J, Vizoso, G, Casas, B, Renault, L, Ruíz, S, Garau, T, Pascual, A, Martinez-Ledesma, M, Gomez-Pujol, LL, Orfila, A, Congress: Variability of the Eastern and Western Mediterranean Circulation and Thermohaline Properties: Similarities and Differences, November 7, 2011 - November 9, 2011 Italy (ITA), Roma

Marine and Coastal Research Infrastructures: drive knowledge increase, transfer of technological products and management technologies for the public and private sector, Tintoré, J, Vizoso, G, Casas, B, Renault, L, Garau, B, Ruiz, S, Heslop, E, Torner, M, Cusi, S, Martinez-Ledesma, M, Pascual, A, Escudier, R, Orfila, A, Sayol, J.M, Gómez-Pujol, L, Alvarez, A, Diedrich, A, Balaguer, P, Espejo, S, Gómara, S, Sebastian, K, Brunet, J, Llodrá, J, Lora, S, Castilla, C, Lizarán, I, Vidal, E, Cañelles, B, Ponce-de-León, S, Congress: Meeting of the Expert Group on Marine Research Infrastructure November 14, 15 2011 Belgium (BEL), Brussels

From Large to Small scales, the new challenges in ocean research, Tintoré, J., Congress: 2nd ICES/PICES Conference for Early Career Scientists September 28, 2012 - September 28, 2012 Spain (ESP), Palma de Mallorca

The impact of new multi-platform observing systems in science, technology development and response to society needs; from small to large scales, Tintoré, J., Congress: EUROCAST, February 10, 2013 - February 15, 2013 Spain (ESP), Las Palmas de Gran Canaria, Museo Elder de la Ciencia y la Tecnología

Oral presentations in 2011

SOCIB as an example of an innovative approach to generating science that responds to the needs of society, Tintoré, J, Congress: Meeting of the EU Panel for Interdisciplinary

Dialogue across Science and Research Infrastructure Development. April 4, 2011 - April 6, 2011 Spain (ESP), Palma de Mallorca, Hotel Isla de Mallorca in Palma

The impact of new marine infrastructures in understanding and forecasting the Mediterranean Sea: some examples from the Balearic Islands, Tintoré, J, Congress: Planning repeated basin-wide surveys for climatic studies in the Mediterranean Sea May 11, 2011 - May 14, 2011 Croatia (HRV), Brac Island

Publications – book chapters, journals, proceedings

Tintoré, J.; Vizoso, G.; Casas, B.; Ruiz, S.; Heslop, E.; Renault, L.; Oguz, T.; Garau, B.; Pascual, A.; Martínez-Ledesma, M.; Gómez-Pujol, L.; Álvarez-Ellacuría, A.; Orfila, A.; Alemany, F.; Álvarez-Berastegui, D.; Reglero, P.; Massuti, E.; Vélez-Belchí, P.; Ruiz, J.; Gómez, M.; Álvarez, E.; Manriquez, M.; , 2012: SOCIB the impact of new marine infrastructures in understanding and forecasting the Mediterranean Sea. pp 99-118. In CIESM: Designing Med-SHIPS: a Program for repeated oceanographic surveys. N. 43 CIESM Workshops Monographs (F. Briand Ed.), 164 pages, Monaco.

Malanotte-Rizzoli, P.; 2012: PAN-MED Group; Pascual, A. ; Tintoré, J.;, Physical forcing and physical/biochemical variability of the Mediterranean Sea: A review of unresolved issues and directions of future research, Report of the Workshop "Variability of the Eastern and Western Mediterranean circulation and thermohaline properties : similarities and differences".

Tintoré, J.; Vizoso, G.; Casas, B.; Ruiz, S.; Heslop, E.; Renault, L.; Oguz, T.; Garau, B.; Pascual, A.; Martínez-Ledesma, M.; Gómez-Pujol, L.; Álvarez-Ellacuría, A.; Orfila, A.; Alemany, F.; Álvarez-Berastegui, D.; Reglero, P.; Massuti, E.; Vélez-Belchí, P.; Ruiz, J.; Gómez, M.; Álvarez, E.; Manriquez, M.;, Forecasting System responding to science, technology and society needs.,

2.4.14.4 Current status with reference to IP2010

The Office of the Director has for the most part achieved the objectives as set out in the IP2010, as noted from the description of the development of SOCIB. There are two elements that are not yet achieved:

- Securing unique location for a combined SOCIB technical/office space
- Commencing the annual/bi-annual SCC committee meetings

At present, in June 2013, we are intensively working on both elements. We expect to advance on the first one very soon, after more than 10 months of interactions with the Palma Harbor Port Authority. This is a major issue of the highest priority for the consolidation of SOCIB. The SSC meetings, as already indicated before in this 2010-2013 report, where not carried out due to the uncertainties in the funding situation in 2011-2012. Given the present better state, we foresee a meeting before the end of 2013.

HUMAN RESOURCES

Throughout the period 2010 - 2013 the work of the Office of the Director has been carried out by one person, Joaquín Tintoré, the Director of SOCIB, well supported by an assistant to the Office of the Director. In the IP2010 it was envisaged that a Vice-Director would be hired to enable to Director to concentrate on raising the international profile of SOCIB and to developing new initiatives such as graduate educational program. However due to the current economic climate, both financial uncertainty and restrictions over hiring staff, the work of the

Office of the Director has continued to be undertaken by the Director with support from the Assistant to the Office of the Director.

INVESTMENTS

The investments made have been those specified both in the original agreement for the creation of SOCIB and in the IP2010.

DIFFICULTIES OVERCOME

The difficulties have been those related to the creation of such a diverse infrastructure, composed of many different facilities and wide ranging equipment, the recruitment of a number of personnel in such a short period, and all the necessary administrative steps. In addition it is inevitable that the EU economic crisis has had consequences in SOCIB's performance. We believe we have managed this crisis well and minimized the number of affected. However, there have been some unavoidable delays; for example, in 2011 the Board of Trustees approved the call of tenders for the provision of three gliders, but the OD was forced to postpone this in order to protect existing commitments (mostly in relation to maintaining personnel contracts).

2.4.14A BLUEFIN TUNA PROJECT – A FOCUSED PROJECT UNDER OFFICE OF THE DIRECTOR

2.4.14a.1 Description

The SOCIB focused research Project BLUEFIN TUNA started in 2010 in line with the Implementation Plan approved in July 2010. The main objective is to understand the inter-annual variability of Bluefin Tuna spawning sites and use this knowledge to develop models useful for the conservation and management of tuna species in the Balearic Sea. The achievement of this overall objective is tackled through the development of specific operational tools to assess and forecast the location and suitability of BFT spawning grounds in the Balearic Sea using different SOCIB observing and forecasting systems and R/V cruises. This project is developed as a joint partnership between SOCIB, IEO and IMEDEA (CSIC-UIB).

From the detailed study of CTD profiles, gliders, hydrodynamic models, satellite and in-situ biological data, one of the main results emerging from this project, is the tight relation found between the Bluefin Tuna spawning ecology and the regional oceanography. Specifically, the preference shown by the tuna to reproduce close to an oceanic front at the interface between the inflowing surface Atlantic Waters and the resident Mediterranean waters. Previous studies have established the high variability of the regional and local oceanography (Heslop et. al., 2012; Pinot et al., 2002) and the inter-annual differences in the position of the salinity front (Balbin et al., 2013). Therefore, in order to progressively implement an ecosystem based sustainable management of this species; it would be necessary to link the tuna ecology with the real time conditions of the environment. The change towards ecosystem based approaches for the conservation of threatened species in the marine environment is demanded today by multiple international organizations including the United Nations Environmental Program-Mediterranean Action Plan (UNEP/MAP) derived from the Barcelona Convention and the International Commission for the Conservation of Atlantic Tunas (ICCAT). The application of operational oceanography to support ecosystem based fisheries management is now the subject of an ICES (International Council for Exploration of the Seas) working group WGOOFE (Working Group on Operational Oceanographic Products for Fisheries and Environment).

2.4.14a.2 Aims 2010 – 2013

The specific objectives established in the framework of the BLUEFIN TUNA project in 2010 were:

1) To carry out an Identification of spawning site location and assessing the dependency on the oceanographic scenarios.
2) To determine the influence of environmental factors on larval survival rates
3) To make forecasts of tuna spawning location (spawning habitat) based on environmental variability

During the first three years of this project, activities (described in detail in section 2) have been designed to advance these particular objectives. These activities have mainly focused on data collection from various sources (field work campaigns, historical, remote sensing and numerical models) and the analysis of how local oceanography drives the spatial distribution of the Bluefin tuna spawning grounds. During this period, the development of technology has been a requirement and therefore, to make the most of this development within the scientific community, one additional objective has been included in the 2010-2013 period:

4) To encourage the research community and industry towards the adoption of operational oceanography in fisheries management and disseminating the acquired knowledge to other projects related to the sustainable exploitation of living resources.

2.4.14a.3 Review current status of the facility (2010 – April 2013)

ACHIEVEMENTS

The activities to accomplish the general project objectives during the 2010-1013 period have involved five major tasks:
T.1 In-situ collection of larvae and hydrographic data on research cruises
T.2 Compilation of historical data sets and development of the technology required to study the Bluefin tuna spawning distribution
T.3 Analysis of the relationship between the temporal and spatial spawning of Bluefin tuna and the regional sub-basin scale variability in the Balearic sea circulation.
T.4 Providing scientific assessment in relation to the environmental effects on the survival of Bluefin tuna larvae hatched within transport cages located offshore.
T.5 Transfer of knowledge to other studies to promote the application of operational oceanography to the study of marine living resources to improve sustainable exploitation, and thereby strengthening the collaboration with research teams of other national and international institutions.

The specific activities carried out and associated with each one of the major tasks are further described below.

T.1. In-situ collection of larvae and hydrographic data on research cruises

Tuna fish larvae have been collected on five surveys carried out during the first triennium of the BLUEFIN TUNA project. Three surveys at different times during 2011 provided data to resolve the temporal spawning window of Bluefin (Field surveys Bluefin_05_2011, Bluefin_06_2011, Bluefin_07_2011). Two surveys spatially observing the salinity fronts provided data to address the relationship between the horizontal and vertical spatial distribution of tuna larvae and the environmental variables (Field surveys Bluefin 06_2011 and ATAME-BLUEFIN_07_2012). This activity addresses objectives 1 and 2 that links environmental scenarios with the location of

spawning sites and larval survival and provides the temporal window of interest for the forecasting model (objective 3).
Additionally, Bluefin tuna larvae were sampled around a pelagic cage to study the potential of spawning events in captivity to increase the larvae nearby (Field survey GABIES_2010). This is a particular question requested by the tuna fisheries and farming sector and is related to objective 4; the application of operational oceanography to fisheries management. The dates of each survey together with particular objectives, area sampled, type of data collected and number of stations are summarized below.

Photo: Enrique Vidal.

Field Work campaign: GABIES_2010

Dates: 18/06/2010-23/06/2010

Sampling strategy: Adaptive sampling of fishing tows located at positions that maximize the probability of larvae drifting from an adult Bluefin tuna off-shore cage. Locations were selected from the information provided by CTD data, hydrodynamic models and real-time data from drifting buoys

Sampled area: South Formentera near a pelagic cage and Mallorca channel.

Type of data collected: CTD profiles, plankton tows (bongo 90 and bongo 20).

Number of sampled stations: 49

Field Work campaign: BLUEFIN_05_2011

Dates: from 14/05/2011 to 17/05/2011

Sampled area: South Mallorca and Ibiza channel

Sampling strategy: Icthyoplankton survey to analyse the temporal evolution of the Bluefin tuna spawning season and characterization of the hydrographic scenario in the study area. Stations were located to maximize the probability of finding Bluefin tuna larvae in the Balearic Sea.

Type of data collected: CTD profiles, plankton tows (bongo 90 and bongo 20).

Number of sampled stations: 18

Field Work campaign: BLUEFIN_06_2011

Dates: from 19/06/2011 to 25/06/2011

Sampled area: South Mallorca, Mallorca channel, South and North Ibiza.

Sampling strategy: Obtaining data to analyse the temporal evolution of the Bluefin tuna spawning activity. Vertically resolving samples were collected to estimate the vertical

distribution of the larvae. The hydrographic scenario in the study area was characterized and the data obtained will be used for the further validation of the operational products.
Type of data collected: CTD profiles, plankton tows (bongo 90 and bongo 20).
Number of sampled stations: 88

Field Work campaign: BLUEFIN_07_2011
Dates: 10/07/2011 to 17/07/2011
Sampled area: South Mallorca, Mallorca channel, Ibiza and Ibiza channel.
Sampling strategy: Icthyoplankton survey to analyse the temporal evolution of the Bluefin tuna spawning season and characterization of the hydrographic scenario in the study area. Stations were located to maximize probability of finding Bluefin tuna larvae in the Balearic Sea.
Type of data collected: CTD profiles, plankton tows (bongo 90 and bongo 20).
Number of sampled stations: 26

Field Work campaign: ATAME-BLUEFIN_07_2012
Dates: From 20th June to 14th July 2012
Sampled area: South Mallorca
Sampling strategy: Obtain data for the analysis of the spatial distribution of Bluefin tuna larvae near a frontal zone at high spatial resolution. Analysis of the size/extent of larvae patches. Estimation of the vertical distribution of different larval sizes within the patch and the advection dynamics associated with the currents in the front. Tuna fish larvae were collected at stations located in a regular grid of 10 by 10 nautical miles and additional stations were sampled following drift buoys from larvae patch locations.
Type of data collected: Vertical distribution of larvae (MOCNESS and MULTINET samples), characterization of hydrographic scenarios (CTD profiles), plankton tows (Bongo 90 and Bongo 20).
Number of sampled stations: 76

T.2 Compilation of historical data sets and development of technology for study the Bluefin tuna spawning distribution

Operational oceanography provides a wide range of products giving information about the marine environment. The compilation of the products from remote sensing (as sea surface temperature, chlorophyll-a or geostrophic currents) and from numerical models (as sea surface salinity and currents) best suited to achieve the proposed objectives has been one main task during the first steps of the BLUEFIN TUNA project. Specific data bases have been designed to handle the data of Bluefin tuna larvae obtained during icthyoplankton cruises and, historical data sets have been standardized to be merged with the recent collected data.
The data bases developed allow the combining of biological information with the compiled oceanographic data to accomplish objectives related to the study of the relationship between the tuna spawning ecology and the environment (Objectives 1 and 2).

T.3 Analysis of the relationship between the temporal and spatial spawning distribution of Bluefin tuna and the regional oceanography of water masses/frontal variability.

The spawning habitats of most large pelagic predators are poorly known. This lack of knowledge hampers conservation efforts that are aimed at identifying critical habitats for the spawning of these species. We hypothesize that phylogenetically related species with contrasting migration strategies show different adaptations and respond differently to environmental or geographical cues for when and where to spawn. We tested this hypothesis from the Balearic Islands region (Mediterranean Sea), targeting the early larval stage of three

abundant species of tuna: Bluefin tuna, a large migratory species, albacore, resident in the Mediterranean, and bullet tuna confined to more coastal areas. This activity completes objective 1 linking environmental scenarios with the location of spawning sites and sets the basis for addressing objectives 2 and 3 regarding forecasting models for tuna spawning and recruitment indices incorporating environmental variability.

T.4 Assessing the viability of Bluefin tuna spawning events in offshore cages located in a priory favourable larval habitat

Most of the Atlantic Bluefin tuna caught by the purse-seine fleet in the Mediterranean Sea are transferred alive into transport cages and towed to coastal facilities where they are fatted. This major fishery is targeting aggregations of reproductive Bluefin tuna that continue spawning within the transport cages. This study has been the first attempt to assess the viability of the spawning events within transport cages placed offshore in a-priory favourable locations for larval survival (Reglero et al 2013-a submitted). The study area is located in the Balearic Sea, one main spawning area for Bluefin tuna in the Mediterranean. This activity addresses objective 4 regarding the application of operational oceanography to fisheries management.

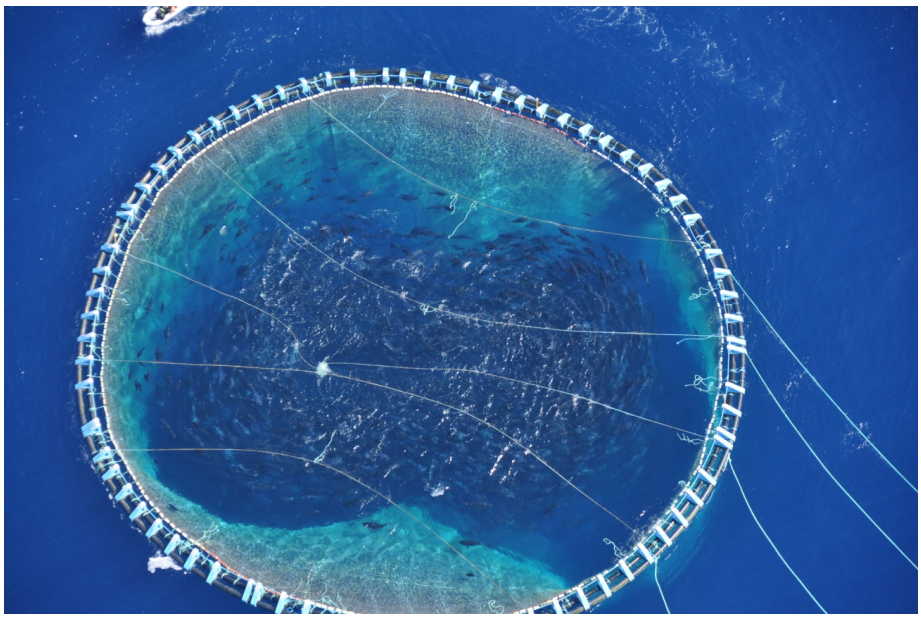


Photo: Joan Mikel Sorell. Balfego Grup.

T.5 Transfer of knowledge to other studies to promote the application of operational oceanography to the study of marine living resources to improve sustainable exploitation, and thereby strengthening the collaboration with research teams of other national and international institutions.

Transferring the experience gained during the Bluefin project to other studies will promote the implementation of operational oceanography for fisheries management in other species. This activity is specifically addressing objective 4 on how to transfer the acquired know-how to other projects. For this purpose, the BLUEFIN project is interacting through the inter-change of data and tools with other research projects in the same study area. These projects focus on the larval ecology of different taxonomic groups (project BALEARES CTM2009- 07944 (subprogram MAR) and the evaluation of the Atlantic Bluefin tuna population that reproduces in the Western Mediterranean (project ATAME: CTM2011-29525-C04-02).

Relevant results of this project are also emerging from existing international collaborations. Research developed with NOAA teams allowed testing the possibility of evaluating the stock of Bluefin from larvae data. These techniques provide an evaluation of the Bluefin spawning stock biomass (SSB) independently of the fisheries data. In addition, researchers from IEO and SOCIB visited Oregon State University in Corvallis (USA), where together with NMFS/NOAA researchers, they analyzed the differences and similarities of the spawning ecology of Atlantic Bluefin tuna in the Balearic Sea and in the Gulf of Mexico, the two most prevalent spawning grounds for the species. Results obtained within the Bluefin project and emerging from collaborations with other projects are being presented in several scientific forums to ensure quality, knowledge transfer and feedback.

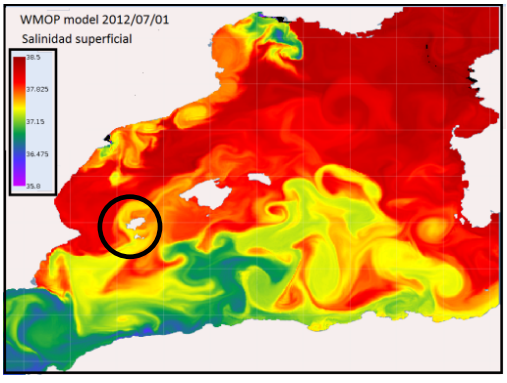
Major Results

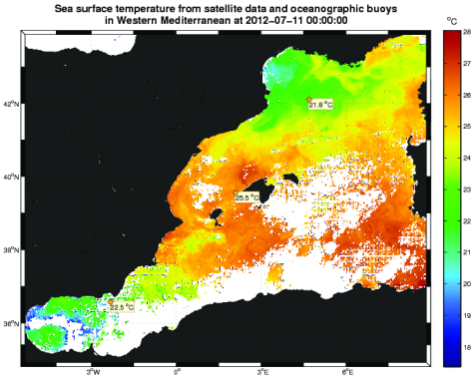
Analysis of oceanographic operational products demonstrated that sea surface temperature from remote sensing and hydrodynamic models present a good agreement with in situ data in the study area. Considering that near infrared remote sensing images are frequently affected by meteorological conditions, hydrodynamic models were seen as the best source for the application of this product for the study of Bluefin tuna spawning ecology in the Balearic Sea. Other products such as sea surface salinity or sea surface currents did not present such good agreements and therefore further research and development should be carry on to improve product accuracy. In this line SOCIB has developed a research project that is providing improved geostrophic currents from satellite data (SOCIB-MDT).

Technology developed for data management and exploration, data compilation and standardization enabled the merging of nine years (eleven fieldwork campaigns) of biological data coming from different sampling instruments measuring the distribution of larvae abundances and sizes. This has been a core activity allowing the assessment of relationships between the spawning ecology of Bluefin tuna and the environment (Objectives 1 and 2).

The results obtained from the combination of biological and hydrographic data have demonstrated a tight relationship between the distribution of spawning areas for the large-migratory Bluefin tuna and the regional oceanography (Reglero et al, 2012). The spawning activity of other resident tuna species, such as albacore or bullet tuna, are less dependent on the oceanographic scenarios, but show some dependency with quasi-permanent frontal structures. Our first studies on the environmental factors that influence larval survival rates has shown that the oligotrophic nature of the study area can result in food limitation, especially in older larvae, and therefore higher mortality rates (Reglero et al. 2011).

Therefore, applying operational oceanographic products to forecast sea surface temperature, salinity and currents are needed to assess the location of the spawning grounds of Bluefin tuna in the Balearic Sea. The value of these sources of information was evident during the field campaigns carried out in 2011 and 2012. The application of real time data from the modelling, drifters and satellite facilities during these two years has been the key to find locations, associated with the Modified Atlantic water inflows, where thousands of larvae and eggs of Bluefin Tuna were found. These larval densities had never been reported in any other place in the world for this species. (Fig.2.4.t, Fig.2.4.u).





Figures 2.4.t and 2.4.u: Sea surface salinity from the SOCIB Wmop prediction model of 01/07/2012 and sea surface temperature from satellite data of 11/07/2012 showing the inflow of Atlantic waters through the Ibiza channel, where abundance records of Bluefin Tuna larvae were measured during the 2012 campaign.
(http://www.socib.es/index.php?seccion=detalle_noticia&id_noticia=191).

Key results of this project are emerging from the existing international collaborations. Research developed with the National Oceanic and Atmospheric Administration (NOAA) from EEUU teams tested the possibility of evaluating the stock of Bluefin tuna from larval data from the Balearic sea research surveys (Ingram et al. 2012). These techniques provide an evaluation of the Bluefin spawning stock biomass independent of the fisheries data and offer a framework for the application of oceanography in fisheries management. The main results were presented at the 18th Special Meeting of the International Commission for the Conservation of Atlantic Tunas, (ICCAT). This commission is that responsible for the conservation of tunas and tuna-like species in the Atlantic Ocean and its adjacent seas.

Other results in the framework of the Bluefin project comparing the ecology of Bluefin tuna spawning dependencies in the Balearic sea and in the Gulf of Mexico revealed similarities in how oceanic fronts and the location of different water masses determine the location of the spawning grounds (Muhling et al, 2013). These results demonstrated that technology developed for operational products predicting the spawning of Bluefin tuna are of interest for applications in other geographical areas.

Knowledge about the dependency of Bluefin tuna spawning preferences on regional oceanography were applied for assessing the viability of Bluefin tuna spawning events in off-shore cages located in *a-priori* determined favourable larval habitats. The location of two transport cages was chosen based on the situation of the chlorophyll front using satellite imagery as a proxy for the salinity front between resident surface waters and those of recent Atlantic origin. The results showed that despite Bluefin tuna eggs being spawned almost every day within the two cages (Gordoa, personal comment regarding observations), the sampled larval densities were below that expected. The trajectories of the eggs after hatching estimated from a particle tracking model using observed geostrophic currents and a drifter deployed adjacent to the cage suggested that larvae were likely to be caught close to the walls of the cages within the sampling period, within the designed sampling area. Some hypotheses, about potential predation exerted on the Bluefin offspring from the cages by jellyfishes, are being tested now. It implies that more research and analysis are needed, as is a deeper understanding of the biological factors implied in larval survival, to evaluate the usefulness of maintaining transport cages for larval survival as a management measure to minimize the impact of purse-seine fishing activity on tuna.

Results from the BLUEFIN project and collaborations with other institutions are providing tools directly applicable to optimize the decision making processes of fishermen, the study of Atlantic Bluefin tuna ecology and other species in the Balearic Sea and in other geographical areas, and designing innovative approaches for stock management for relevant fishing councils such as the International Commission for the Conservation of Atlantic Tunas (ICCAT).

SCIENTIFIC CONTRIBUTION

A list of the most relevant publications in international peer reviewed journals, reports and working documents includes:

Reglero P., Ciannelli L., Alvarez-Berastegui D., Balbín R., Lopez-Jurado J.L., Alemany F., 2012, Geographically and environmentally driven spawning distributions of tuna species in the western Mediterranean Sea, Journal: Marine ecology progress series, Volumen: 463:273-284 pp

Ingram G.W., Jr., Alemany F., Alvarez D. and García A., 2012, Development of indices of larval bluefin tuna (Thunnus thynnus) in the western Mediterranean sea. DOC: SCRS/2012/164, Report of the 2012 Atlantic Bluefin tuna stock assessment session, 2012 SCRS: BFT Stock Assess. Meeting Report, Madrid, Spain – September 4 to 11, 2012

Rodriguez a M., I. Alvarez, J.L. Lopez-Jurado, A. Garcia, R. Balbín, Alvarez-Berastegui D., F. Alemany, Environmental forcing and the larval fish community associated to the Atlantic bluefin tuna spawning habitat of the Balearic region (Western Mediterranean), in early summer 2005, 2012, Deep Sea Research, In press

Reglero P, Balbin R, Ortega A, Alvarez-Berastegui D, Gordoa A, Torres AP, Moltó V, Pascual A, Alemany F. First attempt to assess the viability of bluefin tuna spawning events in off-shore cages located in a priory favorable larval habitat, 2013, Scientia Marina, Accepted with major changes, March 2013

Barbara A. Muhling, Patricia Reglero, Lorenzo Ciannelli, Diego Alvarez-Berastegui, Francisco Alemany, John T. Lamkin, Mitchell A. Roffer, A comparison between environmental characteristics of larval bluefin tuna (Thunnus thynnus) habitat in the Gulf of Mexico and western Mediterranean Sea, Marine Ecology Progress Series, Accepted , May, 2013

Contributed communications and attended international scientific meetings

Reglero P, Ciannelli L, Alvarez-Berastegui D, Balbin R, Lopez-Jurado JL, Alemany F (2012) Geographically and environmentally driven spawning distributions of tuna species in the western Mediterranean Sea. 36th Larval Fish Conference, Bergen Norway. Submitted as oral presentation.

Hidalgo M., P. Reglero, D. Álvarez-Berastegui, A. P. Torres, I. Álvarez, J. M. Rodriguez, A. Carbonell, N. Zaragoza, A. Tor1, A. Goñi, S. Mallol, R. Balbín, F. Alemany.Hydrographical and biological components of seascape shape mixed assemblages of a meroplankton community, ICES CM 2013/M. Accepted as oral presentation.

2.4.14a.4 Current status with reference to IP2010

The tasks developed during the period 2010-2013 (as presented earlier T1-5), objectives to which they are related (as presented earlier under Aims 2010 - 2013), the current status of each task and a short summary of the major results are presented in the following table.

Task	Related objective	Status	Major results (short summary)
T.1	1,2,3	On going	Five sampling campaigns providing hydrographic and biological data
T.2	1,2	Finished	Nine years of in situ data compiled. Databases developed for merging biological and environmental data. Software developed for statistical modelling.
T.3	1,2,3	Finished	Main relations between local oceanography and Bluefin tuna spawning location analysed.
T.4	4	Finished	Viability of larvae from-off shore cages analysed
T.5	3,4	On going	Collaboration with other research projects at national and international levels

In situ data collection (T1) has been successfully carried out to provide data for the validation of spatial distribution models and developing individual base models of Bluefin tuna larvae, activities that are related to objectives 2 and 3. Fieldwork campaigns will be also carried out in the future to advance the assessment of the viability of the Atlantic Bluefin tuna larvae in different oceanographic scenarios (objective 3) and improve the skill of spatial distribution models of Bluefin tuna spawning grounds (objective 2), as well as to validate them.

Historical data compilation, standardization and development of tools for data management and analysis (T2) have been achieved in 2012. Results from this task allowed the disentangling of relations between the location of Bluefin tuna spawning areas and the oceanographic scenarios (T3), achieved in 2013. These results allowed significant advancement towards the development of models to assess larvae survival (objective 2) and the development of an operational forecast model of spawning areas (objective 3).

Assessing the viability of Bluefin tuna spawning events in offshore cages located in *a-priori* determined favourable larval habitat (T4) was completed in 2012 and allowed direct contact with the fishing industry sector (objective 4). Collaboration and knowledge transfer (T5) is an open task that is being addressed throughout the project (objective 4). Collaboration with experts for the application of specific data analysis, and comparisons of ecological strategies for Bluefin tuna in the Mediterranean and in other areas has provided high quality results in the framework of the BLUEFIN TUNA project.

Completed and ongoing tasks have advanced successfully towards the achievement of the overall objectives of the BLUEFIN TUNA Project. Objective 1 (Identification of spawning sites location and assessing the dependency with the oceanographic scenarios.) and 4 (transferring the acquired know-how to other projects) have been 100% completed. Objectives 2 (Determine the influence of environmental factors on larval survival rates) and 3 (Forecasting of tuna spawning location (spawning habitat) based on environmental variability), are still in development and are part of the activities planned for the 2013-2016 period on the basis of the knowledge and techniques developed during the first three years of the project.

HUMAN RESOURCES

In the table below are listed the personnel provided in-kind by IEO to work on the Blue BLUEFIN TUNA Project. In addition the project is coordinated under the SOCIB under the Office of Director (approximately 0.5 MM per year).

Person	Professional Category	% Time	Time (months/year)
Diego Alvarez	Project Leader	100%	12
José Luis López-Jurado	Senior Technician	5%	0.5
Mariano Serra	Technical Specialist	10%	1
Alberto Aparicio	Senior Technical Specialist	20%	2
Rosa Balbín	Researcher	20%	2
Francisco Alemany	Researcher	20%	2
Patricia Reglero	Researcher	20%	2
Tomeu Calafat	Assitant technician	50%	4.5
Asvín Perez	Doctoral felloship	10	1

INVESTMENTS

Apart from human resources above, there were no major investments in the period 2010-2013.

DIFFICULTIES OVERCOME

The biggest difficulty for the project was a lack of well-validated hydrodynamic model data for the early years of the 21st century, i.e. 2001-2005. A greater focus has been placed on combining operational oceanographic observing with fisheries studies, to mechanistically understand the habits of Bluefin tuna spawning, and therefore the expected impact of variability in circulation patterns.

ACHIEVEMENTS NOT ANTICIPATED IN THE IP2010

There have been three significant unexpected achievements of this project since 2010. Firstly the testing of the application of a larvae index in the Balearic sea, where unprecedented larval densities were discovered associated with Modified Atlantic Water inflows. Secondly, being able to quantitatively assess the viability of Bluefin tuna spawning events in offshore cages located in *a-priori* favourable larval habitats. Thirdly the level of knowledge transfer afforded to other studies to promote the application of operational oceanography to the study of marine living resources and thereby improving sustainable exploitation; and thus strengthening the collaboration with research teams of other national and international institutions.

2.2.15a.5 Areas of major impact in the next 5 years: societal

STRATEGIC AND SOCIETY NEEDS

The Spanish fishing sector related to the exploitation of tuna species is one of the most important of the national fisheries. Recent estimations reveal an annual value of almost 1,120 million euros and a total number of direct and indirect jobs above 62.000 (Source: Europa azul Nº 132, 2012). This sector involves fisheries based in all oceans around Spain and targeting different tuna species. Among them, Atlantic Bluefin tuna is the one with the highest total economic value even though the capture volumes are not as high as for other species.

In the Mediterranean, the most prevalent fishing ground for this species alongside the Gulf of Mexico, the total catch of Atlantic Bluefin tuna in 2006 ascended to 23.153 Tonne, acquiring a market value of 226,810,000 dollars. This economic activity provides more than 17.000 jobs. The Spanish fishing sector operating in this area reported, that year, a total catch of 2689 Tonne with an economical value of 26,259,000 dollars and supporting more than 600 jobs (Data source: Sumaila and Huang, 2010). Since then, the annual fishing quota established by ICCAT at global, European and national levels have been decreasing drastically in response to the impact of the fisheries on the reproductive stock (See Figure 2.4.b.). The suspension of the fishery was pending on 2010-2012 statistics (Mylonas et al. 2010). In 2013 ICCAT recommended a small increase of the quota for the EU, as the Bluefin tuna population has now shown the first signs of recovering (ICCAT, 2012, "Recommendation by ICCAT Amending the Recommendation by ICCAT to Establish a Multi-annual Recovery Planfor Bluefin Tuna in the Eastern Atlantic and Mediterranean", 2012/-03/REC/, Group:BFT, http://www.iccat.int/).

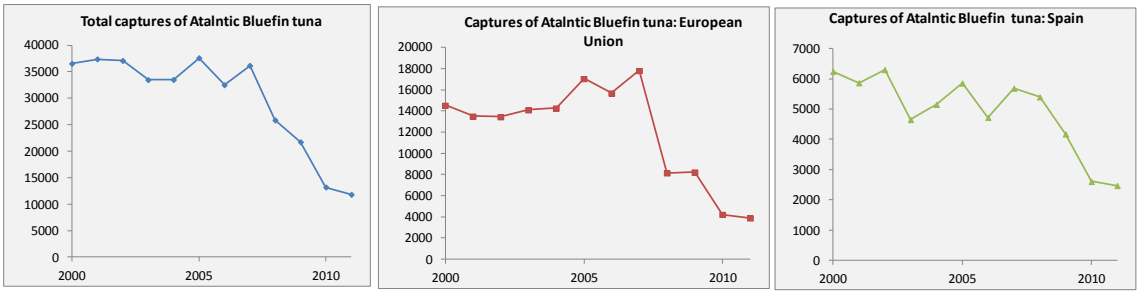


Figure 2.4.v Temporal evolution of Northern Bulefin tuna catches (mtn) since 2000 at three scales, Global, European Union and Spanish fleets (Source data: ICCAT).

Even though sport fishing of Bluefin tuna is now forbidden in Spanish waters the recreational fishing sector targeting other species also plays a relevant role in the local economies. Statistical reports from 2000-2003 (Tragsatec 2005) showed a total number of recreational fishing licenses of 110,733, a total of 143,332 recreational boats and a total value of that sector around the 549,034,586 Euro (expenses associated with fishermen and boat maintenance). In the Balearic Islands the number of sport licenses is around 50,000 (Coll, 2013) and in spite of the fact that the number of sports fishermen targeting other tuna related species is below 4% of the total (Morales-Nin iFOP), this type of fishing is the one presenting higher investments on fishing trips and equipment with an estimation of 13,336 Euro per year per boat (Source Gordoa et al. 2004, SFITUM project).

Within this socio-economic context and the decrease of the Bluefin tuna stocks over the last few years, the scientific committee from the ICCAT highlights the importance of science-based management (ICCAT 2012). Other marine management institutions such as NOAA, FAO, UNEP/MAP and non-governmental organizations such as the WWF, demand new management approaches that take into account the dependences of the species on their environment to address an ecosystem based fisheries management (Pikitch et al. 2004). But how to implement this type of approaches is in many cases still an open question (Agardy 2011). The Bluefin project is a practical application showing how operational oceanography can be applied for the management of Bluefin tuna and related species. Predictive information of spawning locations should serve to establish functional ocean zoning for the protection of species, to provide estimation of offspring survival, and to improve the estimation of stock assessment from larval indices.

Results from the Bluefin project are published in relevant international scientific journals but the dissemination of these results is not restricted to the academic or scientific environment. Communication with management institutions and the fishing sector to ensure knowledge transfer to society is a goal within the framework of the Bluefin project. Different outreach channels have been used to ensure that goal, among them, publication on social networks, establishing collaboration agreements with companies from the fishing industry, and presenting communications in tuna fisheries sector forums, as the 5th Bluefin Scientific Conference, a meeting point between different sectors, especially public authorities, associations of producers, consumers and researchers.

Cited references:

Derived from the project and already included in section 4

Muhling B. A., Patricia Reglero, Lorenzo Ciannelli, Diego Alvarez-Berastegui, Francisco Alemany, John T. Lamkin, Mitchell A. Roffer, A comparison between environmental

characteristics of larval bluefin tuna (Thunnus thynnus) habitat in the Gulf of Mexico and western Mediterranean Sea, Marine Ecology Progress Series, Accepted , 2 may, 2013

Reglero P, Balbin R, Ortega A, Alvarez-Berastegui D, Gordoa A, Torres AP, Moltó V, Pascual A, Alemany F. First attempt to assess the viability of bluefin tuna spawning events in off-shore cages located in a priory favorable larval habitat, 2013, Scientia Marina, Submitted March 2013

Reglero, P., Urtizberea, A., Torres, A.P., Alemany, F. & Fiksen,Ø. 2011. Cannibalism among size classes of larvae may be a substantial mortality component in una. Mar. Ecol. Prog. Ser. 433 : 205–219.

Reglero P., L. Ciannelli, D. Alvarez-Berastegui, R. Balbín, J.L. Lopez-Jurado, F. Alemany, Geographically and environmentally driven spawning distributions of tuna species in the western Mediterranean Sea, Journal: Marine ecology progress series, Volumen: 463:273-284 pp.

Other cited references in the document not included in section 4 (Not derived from the Bluefin project).

Agardy, T., 2011,Approaching EBM via an Ecosystem Approach, Marine Ecosystems and Management Vol. 4, No. 6, June - July 2011

Balbín R., Lopez Jurado, J.L., Flexas M.M., Reglero P., Velez Velchí, P., Gonzalez Pola C., Rodríguez J.M., García A., Alemany A., Interannual variability of the early summer circulation around the Balearic Islands: driving factors and potential effects on the marine ecosystem, Journal of Marine Systems, Submitted, February 2013.

Coll J., 2013. Avaluació dels esculls artificials i de les reserves marines com a eines de gestió dels recursos íctics litorals a les Illes Balears. Ph. D. Thesis. Universitat de les Illes Balears. 218 pp.

Gordoa et al, 2004, Sport Fishing: an informative and economic alternative for tuna fishing in the Mediterranean (SFITUM). EC Project 02/C132/11/41

Heslop E., Ruiz S., Allen J., Tintoré J., High sub-seasonal variability in water volume transports, revealedthrough a new ocean monitoring initiative using autonomous gliders, Geophysical Research Abstracts Vol. 14, EGU2012-3494, 2012, EGU General Assembly 2012

ICCAT 2012, 2012 Annual ICCAT Meeting Press Release. http://www.iccat.int/Documents/Meetings/COMM2012/PRESS-REL-2012_ENG.pdf

Ingram G.W., Alemany F., Alvarez D. and García A., 2012, Development of indices of larval bluefin tuna (Thunnus thynnus) in the western Mediterranean sea. DOC: SCRS/2012/164, REPORT OF THE 2012 ATLANTIC BLUEFIN TUNA STOCK ASSESSMENT SESSION, 2012 SCRS: BFT Stock Assess. Meeting Report, Madrid, Spain – September 4 to 11, 2012

Morales-Nin B., Moranta J., García, C., Cardona L., López D., Cerdà M., Grau A.M., Riera F., Bosch, T. and Martino, S. (2004). SEGUIMIENTO DE LA PESCA RECREATIVA EN LAS ISLAS BALEARES. DETERMINACIÓN DEL ESFUERZO Y DE LAS CAPTURAS, (Projecto IFOP ES/R/BAL.5.1.3). II Document TËcnic de Pesca. Conselleria díAgricultura i Pesca, Palma.

Mylonas,C.C., F.De La Gandara, A.Corriero, and A.B.Rios. 2010. Atlantic Bluefin Tuna (Thunnus Thynnus) Farming and Fattening in the Mediterranean Sea. Reviews in Fisheries Science 18:266-280.

Pinot, J.M., Lopez-Jurado, J.L., Riera,M.,2002.The CANALES experiment (1996-1998).Interannual, seasonal and mesoscale variability of the circulation in the Balearic Channels. Prog. Oceanogr. 55, 335–370.

Pikitch E. K., C. Santora, E. A. Babcock, A. Bakun, R. Bonfil, D. O. Conover, P. Dayton, P. Doukakis, D. Fluharty, B. Heneman, E. D. Houde, J. Link, P. A. Livingston, M. Mangel, M. K. McAllister, J. Pope, and K. J. Sainsbury, Ecosystem-

Based Fishery Management, Science 16 July 2004: 305 (5682), 346-347. [DOI:10.1126/science.1098222]

Sumaila, U. R., & Huang, L. (2010). Managing Bluefin tuna in the Mediterranean Sea. Economic Research Forum, Working paper No.576

ICCAT, REPORT OF THE 2012 ATLANTIC BLUEFIN TUNA STOCK ASSESSMENT SESSION, 2012 SCRS: BFT Stock Assess. Meeting Report, ICCAT, Madrid, Spain – September 4 to 11, 2012

TRAGSATEC (2004). Estudio del impacto socioeconÛmico de la pesca recreativa en el Mediterraneo Español, SecretarÌa General de Pesca Marítima, Ministerio de Agricultura, Pesca y Alimentación, Madrid, 47 pp.

2.5 ICTS SOCIB DATA, PRODUCTS AND SERVICES

As outlined in the IP2010 the delivery of timely, accessible, appropriate and easy to use products and services to the end user is an important objective for ICTS SOCIB. The initial users targeted for our data products were scientists, marine and coastal managers (government or private), the public, educators and students.

2.5.1 DATA POLICY

The SOCIB Data Policy follows similar open information policies from around the world, IMOS (Australia), Neptune (Canada) and the OOI ocean observatory initiative or IOOS in the US for example. Archiving and disseminating observed and modelled marine data is at the core of the SOCIB mission. Dissemination implies timely, generally free and largely unrestricted access to all data, associated metadata and products generated by ICTS SOCIB.

The SOCIB Data Centre Facility (DCF) has the responsibility for implementing the SOCIB data policy. The DCF with its close ties to European and international programmes, is implementing and driving international activities related to multi-platform data integration and visualization. Including the life-cycle management of the data (from observation to archive) and in terms of developing technically innovative ways to handle the large quantities of interrelated datasets that are available through the SOCIB coastal ocean observing and forecasting system.

Delivery is achieved through systems and processes for data and information management developed by the Data Centre Facility and through international portals for oceanic observations to which SOCIB contributes (e.g. PERSEUS, MyOcean). Full recognition of the use of SOCIB data is strongly encouraged, that is to say that the use of SOCIB data requires that ICTS SOCIB, and any specific research team involved, must be acknowledged by the researcher or other third party making use of the data.

In addition some monitoring datasets may be the result of research experiments designed by SOCIB or SOCIB partners that make use of SOCIB facilities. These datasets are also part of the ICTS SOCIB Data Policy and SOCIB will strongly encourage the use of co-authorship in the use of this data by third parties, in order that the input of the research experiment designers and ICTS SOCIB is explicitly recognised.

SOCIB fully supports the international progress towards a common strategy for good practice in data access, data life cycle management, and data usage, driven by SCOR[13] and IODE[14] of the UN's IOC[15] (EOS, vol. 90, No. 50, 15 December 2009). SOCIB also supports and is keen to seek to promote the accession, DOI, numbering and publication of data sets being pioneered by a number of leading environmental journals. The flow diagram (Figure 2.5.a.) for SOCIB's data policy fits well with the proposed SCOR/IODE flow diagram (figure 1 in the aforementioned EOS article). SOCIB's data policy is also fully in-line with leading European data policies as envisaged within the MyOcean programme (SeaDataNet2-MyOcean2, 2nd Joint Meeting on Products, Cork, 15th April 2013 – Report figure 1)

[13] Scientific Committee on Oceanic Research, http://www.scor-int.org/
[14] International Oceanographic Data and Information Exchange, http://www.iode.org/
[15] International Oceanographic Commission, UNESCO, UN, http://ioc-unesco.org/

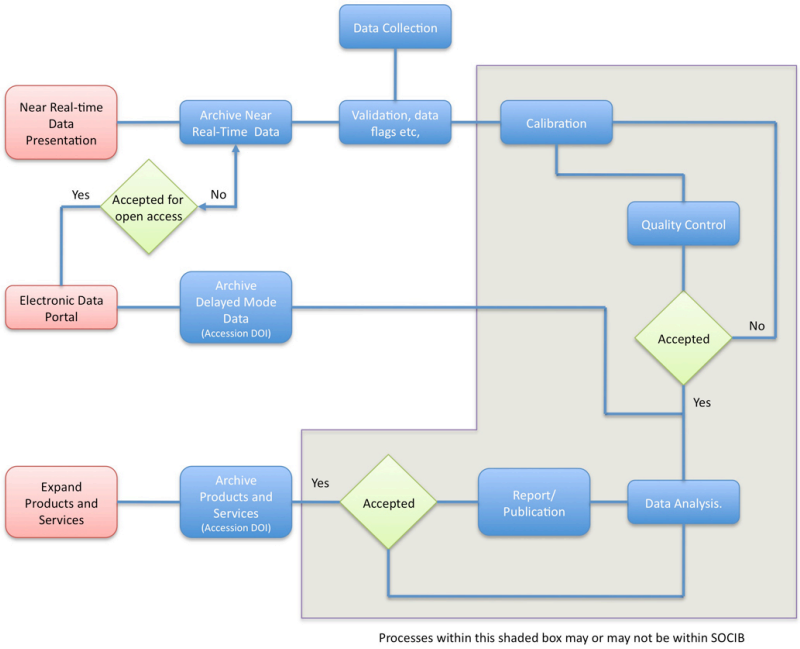


Figure 2.5.a: Flow diagram for SOCIB's data policy

SOCIB's data policy considers data in three different ways (Figure 2.5.a.), which naturally derive from the SOCIB mission and its resultant focus on the data lifecycle:

Near real-time data

A principle component of SOCIB's mission is the monitoring and dissemination of observations from the coast and seas around the Balearic Islands. To facilitate this, data collected by SOCIB are presented as images in as close to real-time as possible, near real time (NRT), on the SOCIB website. In general the NRT data will also pass to the electronic data portal for open access to all for download as NetCDF files. It should be noted that in order to provide access to data in NRT mode, only a basic level of automated data quality control can be applied, for example to ensure that the instruments are still operating correctly.

In some circumstances there may be a limited delay in the availability of NRT data, for example, where data is critical to specific post-graduate studies, or where data collection has been commercially supported and the organisation that has provided the support requires a period of embargo, or where the data requires considerably more quality control and may only be useful in delayed mode.

Delayed mode data

Following detailed calibration, validation and quality control, the data are made available as delayed mode data from the SOCIB electronic data portal and are also sent to oceanographic portals such as for example SeaDataNet. The delayed mode (DM) data are stored in the SOCIB electronic data portal and are available through the SOCIB website for delivery to the requester as NetCDF files. Following the policy clearly stated in the SOCIB mission, these data are freely available, however as DM data contains significant added value funded by the Spanish and Balearic Islands government grants, there are some exceptions to this policy particularly for external commercial use. This is discussed more fully later under charges and intellectual property. SOCIB actively encourages the timely availability of the DM data, this is usually

several months after the initial real-time dissemination in order to allow for the careful calibration, validation and quality control of these important datasets.

In exceptional circumstances SOCIB allows researchers to retain exclusive rights to delayed mode data for a predetermined and limited period following archiving, in order to expedite the publication of scientific papers, degree theses and commercial reports. Typically this additional period of delay is not expected to exceed 90 days, but case-by-case flexibility does exist.

The SOCIB DCF is also keenly aware of the importance of both model forecasts and the analysis of observational data to assist in the protection and sustainable management of fish stocks, aquaculture and bio-diversity. SOCIB is currently actively seeking to expand its biogeochemical data calibration and validation skill sets so that the delayed mode data have a greater multi-disciplinary coverage

Data Products and Services

Further use of near real time and delayed mode data come from the interpretation, multidisciplinary combination, development of applications and high level derived analysis of the various data types, such as the solving of fluid dynamic equations, the correlation of biological samples with water properties or the assimilation of real-time observational data into model forecast data sets. Broadly these are termed data products and services.

In addition, scientific publications, further degree theses, and commercial reports all generally rely on the products of complex combinations of multi-instrument and often multi-platform data sets. The results of these publications take scientific knowledge and the application of scientific knowledge forward, so that many of these publications will lead to new services for stakeholders to responsibly exploit the Balearic marine environment.

The close historical links between SOCIB and the EU MyOcean and MyOcean2 programmes have helped to focus the Data Centre Facility and its data policy around the needs of users. The near real-time open access policy is ideal for search and rescue (SAR) support and up to the minute environmental information for oil spill response teams. Sea-state, forecasts and hindcasts of surface currents, sea surface temperatures data and meteorological analyses are all key factors in predicting surface drifting, and likely survival periods in the case of SAR. These data and forecasts provide the information required to minimise the time spent in response to an emergency, minimise the risk to the response crews, and maximise the probability and scale of success.

Data Charges

The data streams, data products and data services, discussed above, from the nationally supported SOCIB infrastructure are currently accessible to all users through the SOCIB website. SOCIB principles of timely, open access, with acknowledgement of the data as sourced from SOCIB will be adhered to wherever possible. Near real-time image data will remain freely available to all, through electronic access tools. Ordinarily, delayed mode data will remain freely available, through electronic access tools, to SOCIB stakeholders, scientists and scientific institutions; where SOCIB stakeholders includes all Spanish and Balearic Islands tax payers. Stakeholders also include those involved in promoting and ensuring maritime safety, those involved in unlocking marine resources for the benefit of the Balearic Islands, those involved in protecting the coastal and marine environment and those providing open access weather, seasonal and/or climate forecasts. Prospective users requesting delayed mode data who are not included in the above descriptions, or users that require a faster track access to calibrated and

validated data, may be expected to contribute a fee, or in kind support for the SOCIB infrastructure, to reflect some proportion of the work associated with the added value contained in delayed mode data.

Intellectual Property

Intellectual Property Rights (IPR) associated with SOCIB raw data lie with the SOCIB consortium. Any IPR associated with SOCIB value-added products, produced under the auspices of SOCIB, also lie with the SOCIB consortium. SOCIB will issue an automatic non-exclusive licence to any user of near real time or delayed mode data for downstream IPR, provided the user registers it's details and interests with the SOCIB data centre facility, a process which will be fully electronic in the future. This allows the IPR of value-added products or services, not produced under the auspices of SOCIB but which use SOCIB data, to rest with the agency that produces that product or service, with no restriction other than that set out below. Any pre-existing IPR at the commencement date of SOCIB is still recognised and respected and data affected by this can only be used as authorised by the owner of the IPR or as permitted under Law. Except where otherwise negotiated with the Office of the Director and agreed by the governing bodies, any users (including re-packaging) of SOCIB data, data products and services are required to clearly and prominently acknowledge the source of the material derived from SOCIB, together with (where relevant) a reference/link to the related metadata record. Re-packagers of SOCIB data should include a statement that information about data quality and lineage is available from the metadata record and a statement that data, products and services from SOCIB are provided "as is" without any warranty as to fitness for a particular purpose. SOCIB's Terms and Conditions will be available on the Data Facility's web pages for this purpose.

In addition to registering their interests for the purposes of supporting SOCIB's reporting statistics and demonstration of SOCIB's socio-economic presence, users downloading data from the SOCIB Data Centre Facility will be explicitly reminded of their ethical obligation to contact SOCIB prior to publication, and offer acknowledgement and/or co-authorship, where appropriate.

Terms and Conditions

Any person or institution downloading data from the SOCIB web site will accept the Terms and Conditions, as published on the Data Facility's web pages. These Terms and Conditions are currently under construction, they will encompass the SOCIB Intellectual Property Rights, Use and Dissemination of Data Rules, and the SOCIB Data Policy, and will follow established examples such the MONGOOS Agreement, which covers the exchange of oceanographic and modelling data in the Mediterranean, to which SOCIB is a signatory (http://www.moon-oceanforecasting.eu/) and/or other similar agreements currently under development, such the PERSEUS IPR and data policy.

The SOCIB data policy supports the SOCIB mission in coastal and marine monitoring. It both promotes and seeks to lead in the continued development of the EU's Marine Strategy Framework Directive. The open access policy implemented by the Data Centre Facility provides monitoring data for use in environmental impact assessment (EIA) studies both to provide a baseline assessment and post development monitoring for new developments. For legacy developments, SOCIB's monitoring data provide a basis for trend analyses and advanced warning to support timely mitigation intervention. The life-cycle data approach of the SOCIB data policy recognizes the importance of good practice in long-term data archiving for re-

analysis products of the future. As scientific marine forecasting skill grows, so too will the requirement to re-examine historical observations and model analyses.

2.5.2 DATA AVAILABILITY AND PRODUCTS

SOCIB's public presence begins at its highly creative website, www.socib.es. Without sacrificing an efficient menu driven information portal, the user is only one mouse click away from interactive graphics displaying automatically updating maps of glider, lagrangian floats or research vessel positions for example. The invitation to acquire more information through further mouse clicks is tempting, and the website encourages curiosity and fosters a degree of enthusiasm that drives the education of users, simply because it is fun to explore. The important news items and per facility data access is again just one mouse click away, as are connections to all the principal social networking tools.

Each facility has a web section through which users can visualise and download the real time (current deployments) and archived (previous deployments) data variables, see Table 2.5 b for a list of the data variables available by facility. The data variables from multiple platforms and multiple deployments can be visualised through the DAPP application.

In addition to data download and visualisation, SOCIB has developed some initial data-based products and services:

- Ocean currents and waves forecasting subsystem at a regional scale, Balearic Sea waters and a local scale, Balearic littoral waters
- Meteotsunamis, long waves and resonant seiches in the Balearic Sea, analysis and potential forecasting system
- Real-time operational forecasting systems for environmental emergency response e.g. decision support tools for spill trajectory forecasting and coastal ocean impact oil spills
- Tools for coastal ocean decision makers, managers and policy makers, based on sustainability science, developed from SIA Division ICOM and Sustainability Science applied research
- GIS Beach Data Viewer, combining data from all historical beach monitoring surveys in the region in an easy to use web based application
- SOCIB Apps for iPhone, iPad, Android platforms, which enable the user to view all the fixed station and glider data in real time and from archive. The data from the Beach Monitoring Facility and the Lagrangian Platforms Facility will soon be added.

In Figure 2.5 c there is an updated version of the IP2010 SOCIB Value Chain and from this it can be seen that many of the initially planned data platforms, variables, models, products and value elements are underway or already completed. The SOCIB strategy for developing future data products and services has now evolved to take into account, the evolution of societal needs since the creation of the IP2010, such as the rising profile of MFSD indicators, new technology developments and our evolving capability. This strategy is described in Section 4.2.2.

SOCIB recently signed an important agreement with MONGOOS (2012), the new MOON/GOOS Mediterranean operational oceanography network, which establishes the procedures for the inter-network exchange of observational and model outputs. This means that SOCIB data follows to internationally recognised standards and can therefore be automatically incorporated into new marine data portal initiatives such as EMODnet Physical. Currently SOCIB data can be visualized through the following marine data portals:

- EGO (Everybody's Glider Organisation)
- Coriolis
- PERSEUS

Based on the success of SOCIB's life-cycle approach to data archive, management and dissemination, other research institutions (e.g. TMOOS-IMEDEA (CSIC UIB), Puertos del Estado), universities and agencies may want to utilise the existing SOCIB infrastructure to provide their marine data through the same data management process. SOCIB's data policy objective, in line with the request from the Board of Trustees in 2012, has expanded to include the provision of a blue print for marine data management in Spain, hosting additional datasets and ensuring interoperability with similar services internationally; although, clearly it is acknowledged that some additional resources may be needed to achieve this longer term objective.

Standard name	Category	Coastal R/V	Coastal HF Radar	Glider	Lagrangian Platforms	Fixed Stations	Beach Monitoring	Modelling	Satellite
air_pressure	Atmosphere Dynamics	PD PV				PD PV			
air_temperature	Atmosphere Dynamics	PD PV				PD PV			
dew_point_temperature	Atmosphere Dynamics					PD PV			
wind_from_direction	Atmosphere Dynamics	PD PV				PD PV		ID PV	
wind_speed	Atmosphere Dynamics	PD PV				PD PV		ID PV	
wind_speed_of_gust	Atmosphere Dynamics	PD PV				PD PV			
rain_accumulation	Atmosphere Dynamics					PD PV			
rain_duration	Atmosphere Dynamics					PD PV			
rain_intensity	Atmosphere Dynamics					PD PV			
rain_peak_intensity	Atmosphere Dynamics					PD PV			
relative_humidity	Atmosphere Dynamics	PD PV				PD PV			
650nm_scattering_in_sea_water	Biogeochemistry			PD PV					
colored_dissolved_organic_matter_in_sea_water	Biogeochemistry			PD PV					
mass_concentration_of_chlorophyll_in_sea_water	Biogeochemistry	PD PV		PD PV		PD PV			
turbidity_of_sea_water	Biogeochemistry	PD PV		PD PV		PD PV			
sea_water_ph_reported_on_total_scale	Biogeochemistry					PD PV			
fractional_saturation_of_oxygen_in_sea_water	Hydrology			PD PV		PD PV			
mass_concentration_of_oxygen_in_sea_water	Hydrology	PD PV		PD PV		PD PV			
oxygen_reduction_potential	Hydrology					PD PV			
sea_water_density	Hydrology			PD PV				PD PV	
sea_water_sigma_t	Hydrology	PD PV							
sea_water_electrical_conductivity	Hydrology	PD PV		PD PV		PD PV			
sea_water_pressure	Hydrology	PD PV		PD PV	PD PV				
sea_water_practical_salinity	Hydrology	PD PV		PD PV	PD PV			PD PV	
sea_water_temperature	Hydrology	PD PV		PD PV	PD PV	PD PV		PD PV	
speed_of_sound_in_sea_water	Hydrology					PD PV			
water_volume_transport_into_sea_water_from_rivers	Hydrology					ID IV			
direction_of_sea_water_velocity	Ocean Dynamics	ID	PD PV	PD PV		PD PV		PD PV	
sea_water_speed	Ocean Dynamics	ID	PD PV	PD PV		PD PV			
total_dissolved_solids	Ocean Dynamics					PD PV			
upward_sea_water_velocity	Ocean Dynamics	ID				PD PV			
surface_net_downward_radiative_flux	Radiation	PD PV				PD PV			
altimeter_range	Surface			PD PV					
height_above_sea_floor	Surface			PD PV					
sea_floor_depth_below_sea_surface	Surface			PD PV					
sea_surface_temperature	Surface								ID PV
sea_surface_height_above_geoid	Surface								ID PV
surface_geostrophic_eastward_sea_water_velocity	Surface								ID PV
surface_geostrophic_northward_sea_water_velocity	Surface								ID PV
sea_surface_wave_from_direction	Surface					PD PV	ID IV	ID PV	
sea_surface_wave_max_height	Surface					PD PV	ID IV		
sea_surface_wave_maximum_period	Surface					PD PV	ID IV		
sea_surface_wave_mean_directional_dispersion	Surface					PD PV			
sea_surface_wave_mean_height	Surface					PD PV			
sea_surface_wave_mean_period	Surface					PD PV			
sea_surface_wave_mean_period_from_variance_spectral_density_second_frequency_moment	Surface					PD PV			
sea_surface_wave_peak_direction	Surface					PD PV			
sea_surface_wave_peak_period	Surface					PD PV		ID PV	
sea_surface_wave_period_at_variance_spectral_density_maximum	Surface					PD PV			
sea_surface_wave_period_at_wave_energy_peak	Surface					PD PV			
sea_surface_wave_significant_height	Surface					PD PV		ID PV	
sea_surface_wave_significant_period	Surface					PD PV			
sea_surface_wave_to_direction	Surface					PD PV			
beach_image_hourly	Coastal						PD PV		
shoreline_derived	Coastal						ID IV		
breach_bathymetry	Coastal						ID		
beach_topography	Coastal						ID		
sediment_grain_size	Coastal						ID		
ocean_color_image	Remote sensed								ID PV
platform_speed_wrt_ground	Platform	PD PV		PD PV	PD PV				

Table 2.5.b: SOCIB list of data variables available for public and/or internal visualisation and/distribution. PD = Public distribution, ID = Internal distribution, PV = Public visualisation, IV = Internal visualisation. **Note this table does not include data variables from bluefin tuna**

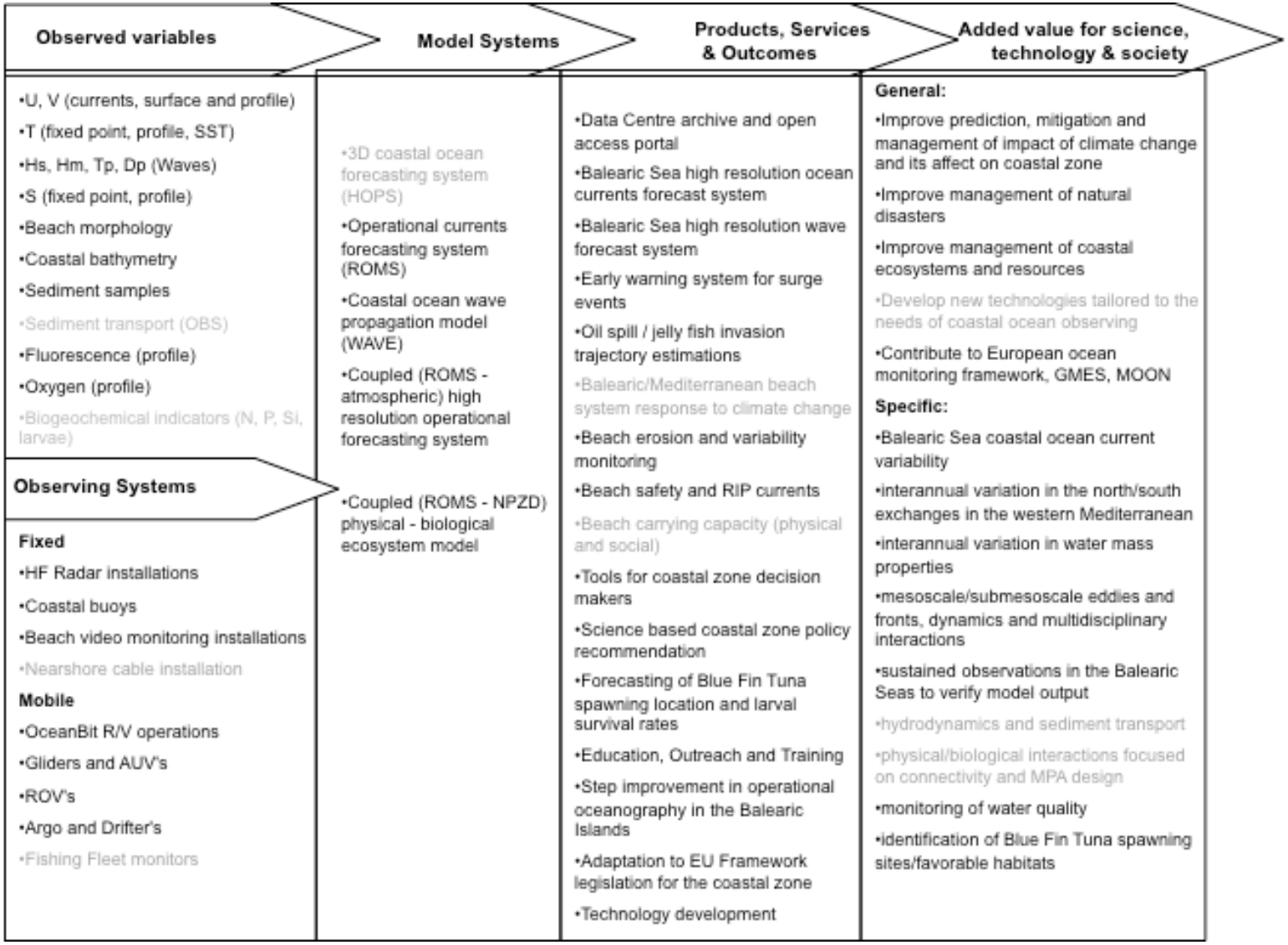


Figure 2.5.c: SOCIB Value Chain, updated from IP2010. From this it can be seen that the many of the planned data variables, models, products and value elements are completed, in black, those not yet completed are in grey.

2.6 ICTS SOCIB COORDINATION AND ACCESS

2.6.1 COORDINATION

SOCIB has developed a network of partnerships and collaborations at regional, national and international level. These can be grouped into three broad categories:

- Coordination with other marine activities in the Balearic Islands and in Spain
- Coordination with stakeholder/societal groups
- Coordination with EU/international marine infrastructure

Coordination with other marine activities in Spain
This coordination is at a regional to national level and includes ICTS SOCIB key partners and other national marine facilities such as, among others, ICTS PLOCAN, the Commission responsible for Coordinating Ship Time (COCSABO), organizations such as the Spanish Meteorological Agency (AEMET), Search and Rescue Organizations (SASEMAR and SAR Squadron 801 with base in Palma) and governmental bodies associated with stewardship of the marine environment.

SOCIB key partners are organisations with which we have a close relationship, sharing infrastructure, equipment, personnel and data for mutual benefit. Through these partnerships scarce regional resources are coordinated and used efficiently, in that each partner is able to focus on their own strategic direction whilst sharing resources supported through a partnership agreement. In particular, fruitful and specific collaborations have been established with: IMEDEA (CSIC-UIB), IEO, UIB, AEMET, Puertos del Estado, Ports de les Illes Balears, Instituto Hidrográfico de la Marina, at scientific and operational level, resulting in multidisciplinary approaches and more efficient operations.

Coordination with marine focused activities in Spain leads to a more efficient use of public resources, promotes the advancement of marine science in Spain and aids in the coordination of the Spanish presence at an international level, with regard to marine issues. A brief description of the main partnership and collaboration agreements is provided below:

CSIC and IMEDEA (CSIC-UIB): in 2008, SOCIB signed a *Convenio de Colaboración* with CSIC (Consejo Superior de Investigaciones Científicas) by which CSIC would be providing in kind contributions to SOCIB (in particular with the endorsement of prof. Tintoré as Director of SOCIB)[16]. Later, in December 2010, SOCIB and CSIC (through IMEDEA -Mediterranean Institute for Advanced Studies- signed a new *Convenio de Colaboración* through which IMEDEA provides support in the form of infrastructure, e.g. lab space (around 250 m^2), and personnel, e.g. engineers and scientists and SOCIB provides support in terms of equipment, trained engineers and technicians, data services, etc. IMEDEA researchers are actively involved with the development of several of the Facilities. Finally a new *Convenio de Colaboración Especifica* was signed in January 2013 between SOCIB-IEO-CSIC regarding the operation of the R/V SOCIB, by which CSIC would be providing in kind support in the form of technical support for R/V equipment operations and maintenance.

[16] SOCIB actually originates from IMEDEA, Dept. of Marine Technologies, Operational Oceanography and Sustainability (TMOOS) 2010-2013 Strategic Plan.

IEO: SOCIB has developed an important partnership with IEO-COB (Instituto Español de Oceanografía - Centre Oceanogràfic de Balears) under a general *Convenio de Colaboración*, signed in February 2011 to collaborate in the research and technological development of marine science. In addition there are two specific agreements, firstly regarding the Blue Fin Tuna Project (see Section 3.2.14a) where a *Convenio de Colaboración Específica between IEO, SOCIB and Balfegó Tuna S.L* has been signed to share data from the project and to develop a modelling program to forecast the spatial distribution of Bluefin tuna spawning locations and assess larval survival in relation to environmental scenarios in the Mediterranean. A second *Convenio de Colaboración Específica* was signed in January 2013 between SOCIB-IEO-CSIC regarding the operation of the R/V SOCIB (just referred to in previous paragraph. Under this agreement IEO has management responsibility for the crew of the R/V SOCIB and the ships operational timetable is coordinated at a national level by COCSABO. This is an interim agreement developed in order to maintain the initial operational schedule for the Research Vessel Facility until issues regarding the operational funding are resolved.

Puertos del Estado: SOCIB signed in 2009 a *Convenio Marco de Colaboración* with Puertos del Estado, which provides support for data and modelling activities in operational oceanography (specifically with two addenda: one for currents/ESEOMED/WMOP and the second for waves/SWAN/SAPO). A 3rd addendum was signed in 2011 to collaborate in AIS processing in relation to maritime traffic and safety of for example glider operations.

Ports de les Illes Balears: SOCIB signed in 2011 a *Convenio Marco de Colaboración* with Ports de les Illes Balears for the exchange of data and collaborate in operational oceanography activities. An addendum is being at present (June 2013) planned to respond to the request to SOCIB to incorporate to our fixed stations network the sea level tide gauges from Ports de les Illes Balears, providing maintenance, operation and real time data from these fixed stations.

Instituto Hidrográfico de la Marina: SOCIB signed in July 2012 a *Convenio de Colaboración* with the Ministry of Defence to collaborate with IHM (Instituto Hidrográfico de la Marina) in marine environmental issues and the education of engineers in July 2012. Through this agreement, SOCIB provides also data and predictions for at sea operations during the annual navy exercises (Mine Counter Measures) in the Bay of Palma, usually in March/April.

Other collaborations:
ICTS PLOCAN: intensive collaboration exists with ICTS PLOCAN. Common elements for coordination include:

- Collaboration for the training of personnel
- Collaboration in the promotion of internships
- Exchange of technical information and information related to operational costs
- Collaboration in the promotion of services
- Mutual technical assistance, in particular in glider operation
- As appropriate, the sharing or borrowing of equipment
- Collaboration on publications, in particular technical publications

COCSABO: The R/V SOCIB is part of the national fleet and access to the vessel can be requested through COCSABO (Comisión de Coordinación y Seguimiento de las Actividades de los Buques Oceanográficos).

Coordination with stakeholder/societal groups
In addition SOCIB is developing a wide range of collaborations with the public and private sector companies, also with charities and trade associations. This coordination is at a regional

to national level and again is for mutual benefit, concentrated around themes such as gaining broad use of use of SOCIB data and products, increasing public awareness of current marine issues, integrating external points of view into SOCIB and to exchange expertise that SOCIB has/does not have, access to our infrastructure or to contribute to the development of operational oceanography and sustainable marine resources and technologies. These collaboration agreements are summarised below.

Fundació La Caixa: Agreement for the creation of a multimedia marine educational tool and associated activities, April 2013.
UIB (LADAT): *Convenio de Colaboración* agreement with UIB (University Iles Baleares, Laboratoti d'animacío technologie audiobvisual) in July 2010. The agreement encompasses the production of multimedia/animation products.
SolMelia: *Convenio de Colaboración,* agreement for the installation of beach monitoring system at SolMelia Hotel in Son Bou Beach, Menorca, October 2011.
IDimar: Agreement with the Balearic Nautical Association regarding design and innovation in order to enhance the marine sector, May 2012.
Balfegó Tuna S.L: Agreement IEO and SOCIB to share data from the Bluefin Tuna Project, December 2011.
Innovamar: collaboration during 2012 in a working group to define the major scientific and technological priorities to help defining a Spanish Marine and Maritime Strategy

Coordination with EU/international marine infrastructure
Finally we are well coordinated with national and European projects, especially those concerned with provision of oceanographic data and coordination of infrastructure. This is at an international level and includes for example SOCIB involvement in EU FP7 Projects and European marine data portals. This supports SOCIB and Spanish presence at the leading edge of ocean observation and Spain's response to important EU policy such as Horizon 2020. For SOCIB it ensures that we provide our data to a broad audience as possible, that our data adheres to international standards for data distribution and QC, through contributing we develop an international reputation for SOCIB, and maintain our leading edge. For example SOCIB researchers and engineers participates in several European FP7 Projects, including JERICO, PERSEUS and GROOM and through our participation, amongst other things, aids in the development of glider standards and the glider platform as a robust and cost effective tool for oceanographic research monitoring. Also SOCIB provides data to data portals for marine observations, such as MyOcean (Coriolis), EGO (Everybody's Glider Observatory) and SeaDataNet. These collaboration agreements are summarised below:

MERCATOR: Agreement regarding operational oceanography, ROMS Models and WRF atmospheric datasets, August 2009, with annual revision up to 2013.
MONGOOS: Agreement with MONGOOS (was MOON) for oceanographic data and model data exchange at a Mediterranean level, signed in May 2012.
MyOcean 2 (Coriolis): Collaboration and provision of data.
JERICO (EU FP7 Project): Collaboration and provision of data.
PERSEUS (EU FP7 Project): Collaboration and provision of data. SOCIB being explicitly mentioned in the DoW.
E-AIMS (EU FP7 Program 2 Project): Collaboration and provision of data. SOCIB being explicitly mentioned in the DoW.
MedShips: SOCIB is included in the proposal.

Figure 2.6.a. below provides an overview of the SOCIB partners and collaborators network indicating the benefits for science and society is delivered by SOCIB and also through our network

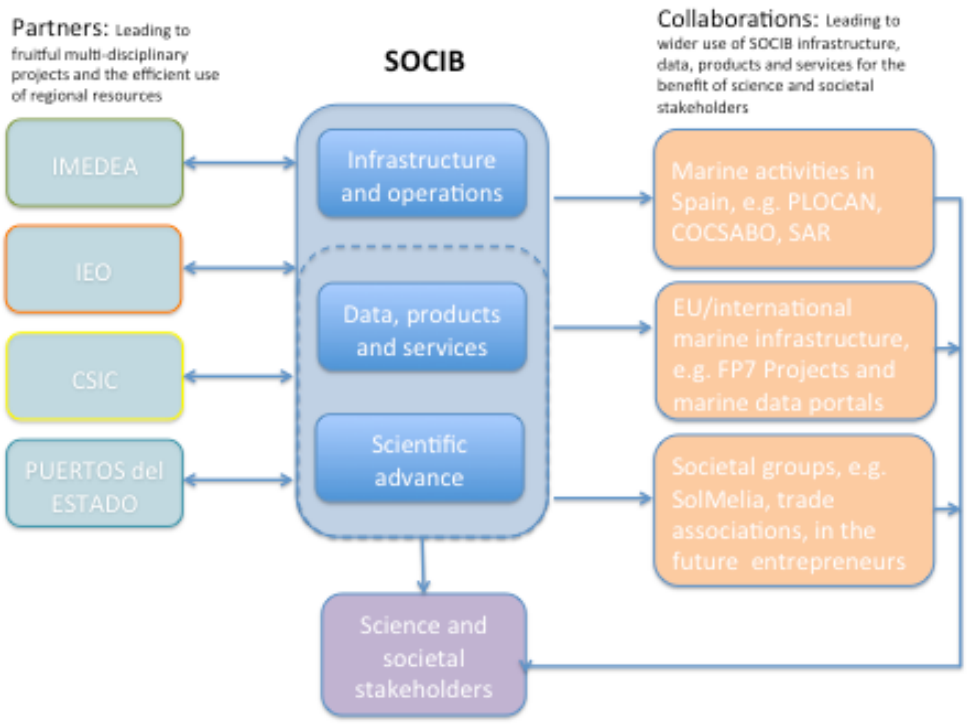


Figure 2.6.a: SOCIB Partnership and Collaboration network: the elements within dashed lines can be created by SOCIB or by our partners and collaborators.

2.6.2 ACCESS

SOCIB's operational observing system offers open access to platforms and facilities, for periods of time specifically requested, to fully exploit its capacity and enable a broad user base for key research infrastructure. The IP2010 provided details of the initial deployment of the permanent and dynamic/re-locatable Observing Facility infrastructure. Now, in full operation and ready for additional users, we present in this section the open access policy and details of how that access may be obtained.

The SOCIB Open Access Policy follows similar open access policies from IMOS (Australia), Neptune/Venus (Canada) and OOI in the US. As a leading member of the EU JERICO Project, access to SOCIB facilities is entirely compatible with JERICO principles and rules of the European Commission Trans-National Access (TNA) Programme. The principles of SOCIB's open access policy are:

- Contributing to the development of long-term co-operation between national, European and international scientific bodies and SOCIB, its partners and supporters. This will include facilitating staff exchange and scientific collaboration where appropriate.

- Capacity building; developing a Balearic facility for science dedicated to innovative technology and world-class society relevant science.
- Promoting knowledge-exchange from SOCIB and its partners to and from scientific users and their institutions. A clear objective here is to play a front-line role in the international harmonization of methods, quality control and good practice in coastal observing and forecasting.

It is important to take into consideration that SOCIB is a new type of infrastructure at international level, similar to other Marine Research Infrastructures internationally since the data from the different multi-platform systems are already all of them accessible in quasi-real time. Apart from this, two types of infrastructures are available for open access:

Dynamic/re-locatable Infrastructure

SOCIB offers open calls for the use of its dynamic/re-locatable facilities in research projects. These facilities include the SOCIB catamaran R/V *SOCIB*, the rigid inflatable boat (RIB) and trailer, and its fleet of gliders, both Teledyne Webb Research Slocum gliders and iRobot Seagliders[17]. Calls for access to these facilities are subject to a scientific peer review process to ensure equality in access and scientific merit in the use of publicly funded ICTS SOCIB resources. Proposals can be made unsolicited for access to this infrastructure, providing the proposal is consistent with the marine observing objectives of the ICTS SOCIB, either directly to SOCIB or though the national structures in which SOCIB participates.

Permanent Infrastructure

Not all permanent infrastructure is suitable for open access, however SOCIB can, under certain circumstances, provide access to some moorings, laboratories and equipment. SOCIB has a system of moorings and bottom mounted tide/pressure gauges, designed to support and prioritize the long-term focused monitoring of critical parameters to constrain and validate forecast models. The moorings are generally only equipped to measure the parameters critical to the identified long-term objectives of the integrated marine observing system. Where appropriate, however, researchers are encouraged to suggest and request the opportunity to use the permanent facilities infrastructure for the deployment of additional and/or experimental specialist instrumentation. Different researchers have recently contacted SOCIB Office of the Director to request the possibility of using the Ibiza Channel mooring as a basis for specific process studies and are being examined and discussed. Consideration will not ordinarily be given to proposals that create any significant risk to existing instrumentation supporting the monitoring objectives of SOCIB. In addition, SOCIB can provide access to tripod mounted littoral zone self-contained acoustic Doppler current profiler instruments (SC-ADCP) and sediment (sand) grain size analysis equipment for proposer applications.

Modes of Access

Generally, access to a specific infrastructure (or a specific installation that is part of an infrastructure) by a user is intended as a concession granted to use the infrastructure to collect specific data following a specific agreed plan of action between the user and SOCIB. A written contract and/or agreement between SOCIB and the user defines the actions to be undertaken, the resources that will need to be allocated, the period of planned user stays or training (if any), and the period of facility use. It will also define the rights and obligations of all the parties involved,

[17] IRobot has recently sold its rights to commercialise the Seaglider technology to Kongsberg (http://www.km.kongsberg.com/ks/web/nokbg0238.nsf/AllWeb/4F8991D0FDDC143DC1257B6D004CB89A?OpenDocument)

including provisions for early termination of the conferred access or extensions if requested by a user and mutually acceptable to SOCIB.

The requested access to SOCIB facilities and their available infrastructure can follow three modes:

- **remote**: the measuring system is implemented by SOCIB and/or its partners and the presence of the user is not required
- **partially remote:** the presence of the user is required for some period at some stage (e.g. installing and un-installing, or training of SOCIB personnel)
- **in-situ**: the presence of the user group is necessary during the whole access period.

In all instances potential users are encouraged to consult with the SOCIB Office of the Director prior to any proposal development. This supports cost savings on both sides; for example aligning the start and end of an access interval to coincide with times scheduled for ordinary maintenance of an installation, or to coincide with the point of departure or arrival of a vessel or glider, can introduce significant financial savings. Direct communication also affords a better understanding of the feasibilities of the proposed projects by the very parties who will be working together if they are approved, whilst also fostering closer cooperation between them in addressing practical concerns and developing a proposal.

Internet based information regarding open access and an application form will be made available later in 2013 and will follow a common format for all platforms, see Annex 3, for example.

Application for Access

Direct application for Facility Access will be through the SOCIB Office of the Director, and during 2013 a web based information and standard form will be made available to facilitate this process. Consideration is given to all proposals; clearly those that have been subject to scientific peer review or which can easily demonstrate a novel hypothesis of societal or scientific importance will be given priority. In some years or for some clearly advertised period of time, SOCIB may also give preference to proposals that fit with an emergent opportunity. Such an opportunity may be natural, for example the opportunity to study an active under-sea volcano or a forecast meteotsunami event, or relational, acknowledging the timing of a consortium project like the JERICO Project in 2013 for example, where there is an opportunity for the overall achievement to be much greater than simply the sum of the individual proposals. All proposals to use permanent or dynamic/relocatable facilities are reviewed by a committee of 4 members from the SOCIB external Scientific Advisory Committee with a final decision made by the SOCIB Director's Office. For all infrastructure applications, proposals must obviously meet logistical and operational costs in excess of those covered by SOCIB and its partners' monitoring objectives, although where possible SOCIB will help proposers to reduce their costs through co-operational planning and avoiding any duplication of effort. The current price list for access to SOCIB platforms is provided in Annex 3 and a summary of currently available platforms and methods of access in Annex 4.

2.7 ICTS SOCIB RESOURCES (2010-2013)

2.7.1 FINANCIAL

SOCIB is financially well managed. In this section we present the financial information and discuss the resources used in the construction phase (2010-2012), the difficulties phased and overcame, under the following 3 general topics: investments, personnel and operations. Below is a table summarising the total annual investments and funds received from 2008-2012.

DATOS ECONÓMICOS							
INVERSIÓN INICIAL PARA LA CONSTRUCCIÓN/ADQUISICIÓN DE LA INFRAESTRUCTURA ***(Hasta 2007)*****:**	Inversiones tecnológicas - €		Otras inversiones - €		Periodo realización	Año inicio	Año fin
AÑO	**Anterior a 2008**	**2008**	**2009**	**2010**	**2011**	**2012**	**TOTAL**
INVERSIONES SIGNIFICATIVAS DE MEJORA O AMPLIACIONES	**- €**	**2,428.04 €**	**241,230.88 €**	**752,997.65 €**	**4,907,397.07 €**	**2,598,733.05 €**	**8,502,786.69 €**
Adquisiciones de Activos Tecnológicos	0.00	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	
Otras inversiones	0.00	**2,428.04**	**241,230.88**	**752,997.65**	**4,907,397.07**	**2,598,733.05**	
Breve descripción (Nota 1)							
GASTOS	**0.00**	**9,799.02**	**410,399.72**	**862,027.25**	**1,388,479.30**	**1,389,604.74**	**4,060,310.03**
Personal	**0.00**	**0.00**	**263,155.42**	**556,575.54**	**1,002,296.89**	**925,999.83**	
Operación y mantenimiento	**0.00**	**9,799.02**	**147,244.30**	**305,451.71**	**386,182.41**	**463,604.91**	
Otros	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**		
INGRESOS SEGÚN ORIGEN DE LA FINANCIACIÓN	**0.00**	**5,759,375.85**	**3,073,133.83**	**3,175,947.97**	**2,302,751.12**	**4,396,101.11**	**18,707,309.88**
Patronos	**0.00**						
Subvenciones Nacionales	**0.00**	**3,750,000.00**	**1,500,000.00**	**1,500,000.00**	**912,650.00**	**956,250.00**	
Subvenciones CCAA	**0.00**	**1,978,715.00**	**1,429,715.00**	**1,426,215.00**	**1,114,615.00**	**1,130,964.00**	
Subvenciones UE	**0.00**						
FEDER	**0.00**					**2,241,469.52**	
Fondos Privados	**0.00**						
Mecenazgo	**0.00**						
Otros	**0.00**	**30,660.85**	**143,418.83**	**249,732.97**	**275,486.12**	**67,417.59**	
INGRESOS SEGÚN FINALIDAD	**0.00**	**5,759,375.85**	**3,073,133.83**	**3,175,947.97**	**2,302,751.12**	**4,396,101.11**	**18,707,309.88**
Para explotación - gestión ordinaria	**0.00**	**823,885.00**	**574,885.00**	**571,385.00**	**1,922,436.00**	**1,982,386.00**	
Para inversiones	**0.00**	**4,904,830.00**	**2,354,830.00**	**2,354,830.00**	**104,829.00**	**2,346,297.52**	
Para proyectos y acciones	**0.00**						
Otros	**0.00**	**30,660.85**	**143,418.83**	**249,732.97**	**275,486.12**	**67,417.59**	

Table 2.7.a: Financial summary 2010 - 2012

Investments:

Investments have been made on schedule, with minor exceptions and generally to the budget foreseen in the IP2010. The most notable of these being the successful delivery of the R/V SOCIB under to contract for 4 million euros as per budget in the IP2010 (planned 4,050,000, actual 4,128,230€, 2% above budget). During the last 18 months (2012 – 2013) investments have slowed, as the construction phase is close to an end, and also due to the financial uncertainty that SOCIB has faced in 2012. As detailed below this financial uncertainty, is specifically but not only, due to delays in the release of funds, has necessitated that SOCIB adopt a financially prudent strategy (delaying some investments) in order to safeguard the on going functioning of the organization. This **prudent financial strategy** has been endorsed throughout 2012 and 2013 by SOCIB governing bodies (Executive Commission and Board of Trustees).

The actual cost of **the major investments is close to the planned budget (IP2010)** and this is an important achievement and credit to both the sound financial management and careful planning that underpins SOCIB success. None of the major investments were more than 2% over-target and savings have been made through the competitive process of tender publication, effective use of the new customs warehouse (allowing now no VAT costs on certain offshore items), etc.

The investments to date total 8,502,786 €, a summary of the major items is provided below.

- R/V SOCIB construction – 4,128,230€.
- R/V SOCIB oceanographic equipment – 698,309€.
- HF Radar Installations – 560,500€.
- 4 Gliders – 595,000€.
- 2 Coastal Buoy (AXYS) - 405,802€.
- Zodiac RIB – 353,929€.
- Beach Monitoring Equipment – 230,686€.
- Storage and high performance computing – 135,199€.

Additionally, on the 3th of June 2011, the Executive Commission additionally approved the following investments (as per the budgets outlined in the IP2010):

- AUV – est. 847.000€
- High Performance Computing - est. 363.000€
- 2 gliders - est. 363.000€

However, in line with the prudent financial strategy adopted during 2012-2013 (and already previously mentioned), the Office of the Director decided to postpone this investment until the financial situation stabilised in order to maintain sufficient levels of financial liquidity to meet SOCIBs monthly commitments. As the economic climate stabilises, anticipated during 2013, and as outlined in the Section 4 of this report, SOCIB will publish the calls for these outstanding and very much needed investments. In 2014 we anticipate that we will be close to the cumulative investment anticipated in the IP2010.

Personnel: With regard to the budget for personnel, although SOCIB today is close to the level of personnel foreseen in the IP2010, we are still **under budget (approximately by 15%) and under staffed (as compared to IP2010)**. The reason for this is that number of staff in SOCIB was and remains frozen to 2011 levels as demanded by the Spanish Government regulations for public sector. This has meant we could not complete our recruitment during the construction phase, which had the effect of increasing the workload for SOCIB team. However, now that the operational phase has started, this is beginning to have an additional serious impact on our ability to fully exploit and deliver value of the investment made, and to leverage and fully exploit our observational platforms and datasets (for science and society) as detailed in section 4.

In addition, SOCIB is loosing annually key personnel at least in part due the salary levels in SOCIB (which as indicated above were frozen to 2011 figures, in our case these were for many staff initial starting salaries that were due to be revised after one year). Another extra difficulty has been that due to the difficulty in getting new contracts accepted (even to replace staff, the acceptance from the Board of Trustees is requested) and the frozen salary levels (which makes SOCIB offers not attractive internationally), we have not been able to easily replace staff that left.

As an example, for the year 2012, SOCIB personnel costs were less than anticipated, which is due to the loss during 2012 of several members of the team and the accompanying delays in re-recruitment. Overall however the personnel costs anticipated and approved for 2013 are of the order of 1,002,000€ which are close to those anticipated in the IP2010, with a shortfall of approximately 135,000€.

Operations: With regard to the cost of operations we are currently under budget with regard to the IP2010. This shortfall in operational spending has two sources, firstly the delay in approval

of the IP2010 means that SOCIB is some 6 months behind the operational schedule anticipated. Secondly, delays in the release of SOCIB operational funding (3,000,000€ is delayed) have, as with investments, had the affect of delaying operational spending, in line with previously mentioned approved prudent financial strategy.

For example, the 2012-2013 employment of the crew and cruising schedule for the R/V SOCIB is a case in point and the largest contributor to this shortfall in operations expense. In the IP2010 it was envisioned that the employment of the ships crew would be jointly financed by IEO and SOCIB, under a formal agreement, as the two main users of this key regional resource. Currently IEO, under an agreement between IEO/CSIC/SOCIB signed in June 2012, has full responsibility for the vessels crew. This was a temporary solution, sought by the three parties to the agreement to ensure the operation of the vessel in 2012 – 2013. It is anticipated that, as the financial situation further stabilises and in line with auditors request to consider annual amortization of this investment, a new agreement will be developed under which SOCIB will likely take responsibility for the vessel with an IEO commitment to partially fund the operation of the vessel as commensurate with their use. In addition the SOCIB cruise schedule is more limited than originally foreseen for 2013, again pursuing the agreed prudent financial strategy, but that SOCIB will commence a full schedule of SOCIB vessel operations in 2014 (see future actions in Section 4). Other delays in operational spend included a delay of several months in the installation of the deep ocean mooring in the Ibiza Channel, this is however now completed.

Once the delayed operational funding is received, the operations budget is predicted to be slightly below the levels anticipated for the Operational Phase (IP2010).

In summary, SOCIB has faced some difficult decisions in the years 2011 – 2012 as a result of the on-going economic crisis. Accordingly, a balance has been maintained between assuring the construction and achieving SOCIB long-term objectives, maintaining momentum and managing month-to-month fiscal liquidity. SOCIB has been and is well managed financially. Also important is that this general financial strategy has been annually endorsed since 2010 by the Financial Commission, the external auditors, the Executive Commission and the Board of Trustees.

2.7.2 PERSONNEL

In this section we provide present a brief outline of the annual evolution. During **2011 there were 26 persons employed by SOCIB**, excluding in-kind contributions from IMEDEA (CSIC-UIB) and other external collaborations from CSIC.

In particular:

- SOCIB contracted a well-known international researcher to introduce a biogeochemical modelling system, as envisaged in the IP2010.
- Employment of the Beach Monitoring Facility Manager/Team Leader, who has accelerated significantly the beach monitoring of those areas planned in the Implementation Plan.
- ETD gained staff allowing them to accomplish all the planned campaigns of the different Facilities.
- Other facilities also employed new personnel, 6 persons in total.

In 2012, only replacements were partially allowed and SOCIB lost some key personnel for the reasons already explained above, this resulted in SOCIB suffering a contraction in staff numbers

in 2012 - 2013, which is hard to explain given the fact that SOCIB needed people to complete the construction phase and to activate the data sets during the beginning of operations.

In November 2012, the Executive Commission approved the new staff for 2013 (i.e. contracts due to start during 2013). This **implies hiring 4 new people** (see details in Section 4) most of which will replace staff lost in 2012. These positions are already offered in the SOCIB web page and through other employment calls, and one of the four positions has already been recruited. The present situation is that SOCIB staff levels reached a low level of 19 persons in May 2013 (see Table 2.3.b). The Modelling and Forecasting Facility Team Leader left in early May, however the recent Board of Trustees meeting (end of June), allowed for the replacement of this contract. Thus, by the end of 2013 we anticipate again being 23 persons.

SOCIB Personnel	**May 2013**
Financial Manager	1
Team Leader	1
Office of the Director Coordinator	1
Engineer	6
Technician (advanced)	4
Technician (standard)	4
Scientific Expert	1
Administration Assistant	1
TOTAL	**19**

Table 2.3.b: SOCIB employees as of May 2013

However it should be made clear that although SOCIB numbers will increase that reinforcement of key areas of SOCIB is still critically needed for a period of 3 years (2014 - 2016), employing for this **seven new non permanent contracts,** to support activities from the different facilities. A detailed analysis of this need is presented later in Section 4, Strategic Plan 2013-2016.

2.8 GOVERNANCE

SOCIB is formally a consortium with its own legal entity created through a joint agreement between the Government of the Balearic Islands (CAIB) and the Spanish Ministry of Science and Innovation (MICINN) and with funds approved into 2021. The governance of this consortium is managed through the Board of Trustees, Executive Commission and an External Scientific Committee. The SOCIB Director is appointed by the Board of Trustees and is responsible for the overall development and administration of SOCIB. The SOCIB Director reports to the Board of Trustees and the Executive Commission. The Board of Trustees meets twice a year in order to approve the annual accounts and the Budget and Activities Plan for the forthcoming year. The Executive Commission is second to the Board of Trustees and meets once per quarter to discuss and approve the annual Activities Plan and the associated annual budgets to be put forward to the Board of Trustees. It also approves the salary structure proposed by the Director. The 17th meeting of the Board of Trustees took place on June 26, 2013 and the 17th meeting of the Executive Commission took place on June 21st, 2013. The number of meetings that have taken place in the 2009-2013 period is an indication that SOCIB development has been continuously monitored and evaluated, and that SOCIB is well supported by the governing bodies.

The External Scientific Committee is composed of ten senior scientists of international standing in marine science. The External Scientific Committee meets in principle once a year to advise the SOCIB Director with regard to SOCIB strategic objectives and also reviews proposals for access to SOCIB facilities as a result of the open call process. The External Scientific Committee was established in 2010 and a first meeting was planned in late 2011. However, given the very difficult financial situation at that time and the associated frequent changes of scenarios (very difficult to explain and/or understand for non directly involved experts), the Director did not considered appropriate to make a formal meeting. The situation has not changed during 2012 when delays in payments and incapacity to increase the initial salaries to which most of SOCIB personnel were contracted in 2010-2011 have again produced a difficult situation with frequent changing scenarios. Accordingly, SOICB Director has maintained frequent personal and/or Skype meetings with the different members of the External Scientific Committee but not formal meeting has yet taken place. Now in 2013, it appears that the situation is recovering and a formal meeting is now being planned to take place towards the end of 2013, to present the present Strategic Plan and discuss priorities and actions. In the future, one meeting per year will be planned, with personal presence or through WebEx.

SOCIB Balearic Islands Coastal Observing and Forecasting System

CRITICAL ANALYSIS 3

3: Critical Analysis

As presented in the previous section, SOCIB is a facility of facilities, and each of SOCIB's divisions, facilities and services have a key role to play in ensuring SOCIB achieves its overall objectives. In fulfilling these roles the divisions, facilities and services have their own specific objectives, as presented in Section 2, together with the individual facility SWOTs. The combination of these analyses is reflected in any critical analysis of SOCIB as a whole. In this section we present a critical analysis of ICTS SOCIB.

3.1 GENERAL ICTS SWOT ANALYSIS

WEAKNESSES

Short track record

SOCIB has been setup following its implementation plan and largely on time and budget. SOCIB is now operational, delivering data and already some products and services; as such it has a suitably ambitious yet sensitively conservative strategic plan for 2013-2016, as presented in this document. However, being new, small and efficiently dynamic carries the caveat that its track record is inevitably shorter and less immediately impressive than other ICTS. SOCIB must present its track record in proportion to its size and youth, in doing so it will appear more impressive than other ICTS. SOCIB must strive for its rightful accreditation and citation by its partners and collaborators, and it will exploit its dynamic efficient structure to drive its outputs; ambitious early career researchers are eager to develop their careers and take ownership of applications, products and services

Lack of a well-defined career progression path for technicians

Across all European research establishments there is a common problem related to motivation for talented technical staff, there is no well-defined track for promotion of well-trained and motivated technicians. A clear progression path for the technical job family would give SOCIB a distinct advantage in maintaining the success and expansion of its research activities; and make SOCIB an international role model for investment in staff. Being aware of this issue (general problem in Spain), the Office of the Director will prepare a specific proposal to be discussed by the boards in early 2014.

SOCIB can be dominated by larger ICTS

As a small and recent facility, SOCIB can be easily dominated by the views and wishes of larger more historically established ICTS in regional or national decision making issues. The concept of SOCIB, as a Facility of Facilities, is not always easily understood by others. The SOCIB Office of the Director must seek to present SOCIB's views as not just those of SOCIB ICTS but also those of the stakeholder society that has been at the heart of the SOCIB mission since the beginning.

Low Salaries compared to other ICTS

SOCIB salaries where established in 2010 and 2011 at starting levels, low salaries that it was planned to increase after an initial training period. This increase has not been possible and accordingly SOCIB personnel now have low to very low salaries compared with their experience and their peers in other ICTS.

Not in control of all resources

During the development and early construction phase it has been beneficial to SOCIB to utilize existing labs and warehouse space through in kind agreements with IMEDEA. However, we are now operational (24/7, 365 for data) and not being in full control of the different resources can lead to difficulties over time. In addition, we loose time and efficiency in operations being spread across multiple sites.

THREATS

Sustainability in politically uncertain times

Given the difficult worldwide economic situation, there is a risk that financial cuts and austerity measures could have a disproportionate impact on SOCIB. SOCIB's budget is lean and even small cuts in public funding as an emergency measure could reduce the funding to below the critical level required to sustain the user facilities. The SOCIB Office of the Director need to be alert during these times, presenting the stakeholder society led nature of SOCIB, and the exceptional value for money presented to the public by such a small, low overhead, highly dynamic unit dedicated to user requirements and services.

Poor salaries make losses of key personnel frequent and recruitment of the most talented engineers and researchers difficult

SOCIB workplace is generally attractive to highly qualified scientists and technicians, however, its salaries are poor and whilst Palma, Mallorca is very attractive as a place to live it is expensive in comparison to many other parts of Spain and Europe as a whole. This can be a deal breaker when it comes to the final cold decisions that a talented scientist, engineer or technician has to make. SOCIB needs to recognize the needs of the prospective staff it wishes to recruit and maintain, and the possible variety of their domestic situations. Sometimes there may be more flexibility regarding the total employment package rather than around just the salaries themselves; for example support towards relocation, employment opportunities for partners, child care options etc.

Loss of IP to partners and/or competitors

SOCIB has significant intellectual property (IP), invested in its monitoring and forecasting services and products. The free and open access policy to its services and infrastructure inevitably exposes some of this IP to others who, perhaps without intention, may adopt this IP without providing SOCIB with the credit and citation that it justly deserves. Another route for the unaccredited loss of IP from SOCIB lies in the short-term contract nature of the employment at SOCIB and the previously discussed weak salaries and career structure. When an employee leaves for a more competitive employment offer elsewhere, the intellectual skills that they brought to SOCIB inevitably go with them as do the ideas that were created as part of the SOCIB 'team'. The SOCIB Office of the Director must continue to seek to maximize the profile or image of SOCIB in both the science and user community, such that citing SOCIB is a desirable for other organizations as say citing IMOS, Neptune or OOI. Forging and maintaining good working relationships with world leading marine organizations is a prime example of SOCIB activities that support its growing profile.

SOCIB Balearic Islands Coastal Observing and Forecasting System

STRENGTHS

Small and dynamic, young and enthusiastic, organisation

SOCIB has a highly qualified team of young technicians, researchers and administrators; all highly motivated towards developing their careers and reputations within a dynamic organization focused around a responsible mission, notwithstanding the issues of salaries. This creates a working environment where problems are solved not raised and where ideas are encouraged and discussed with enthusiasm. SOCIB is an organization that knows where it is going and whose members want to own a part of that achievement.

Stakeholder, science and society focus since the outset

User relevance for marine products and services from observations, monitoring and forecasting has been the core subject of SOCIB's vision and mission since SOCIB itself was little more than a good idea. This immediately places SOCIB in a leading position in both Spain and Europe as an innovator in making marine science available to society. SOCIB's customers and financial supporters are closely involved in the design of the products that they require, and SOCIB is poised to present new applications of scientific information in a manner that is relevant and understandable, and free from the complex scientific and technical concepts that lie behind them.

Unique infrastructure, capabilities and equipment

SOCIB owns, and through its partners has access to, unique infrastructures and equipment. Among them, SOCIB has access to mechanical and electronic workshops. Observational equipment includes CTDs, ADCPs, RTK, video and moored instrumentation. SOCIB's observational platforms, include a fleet of 7 gliders, permanent coastal moorings off shore of the Balearic coastlines, a 'Zodiac' RIB rigid and the R/V SOCIB.

Internationally highly recognized leadership

SOCIB team is at present recognised not only for its previous scientific contributions but also for the work carried out since 2010 in implementing the different observing and forecasting systems. Recent publication of SOCIB paper in February 2013 issue of the Marine Technology Society Journal is a clear example of this.

International recognition as a major glider operator

In the eyes of a number of EU funded projects, MERSEA, ECOOP, SESAME, JERICO, SOCIB is recognized as a leading international team in the use of the emerging autonomous 'glider' platforms. With highly enthusiastic and well trained technical and scientific personnel, the availability of established facilities such as mechanical and electronics laboratories, pool, ballasting facility, and pressure chamber, experience gained since 2010, the data Facility's tools developed for data management and dissemination, and both a leading edge coastal research vessel and a 'Zodiac' RIB.

SOCIB Balearic Islands Coastal Observing and Forecasting System

OPPORTUNITIES

Growth through partnership and dynamic vision

SOCIB is small and efficient. Its mission and its existence arose out of the vision of the founding partners IMEDEA, CSIC and IEO and its supporters, the Balearic and Spanish governments. SOCIB continues to develop and grow through maintaining existing partnerships and enticing new partnerships and working relationships where opportunities exist for the development of new ideas, products and services. Through its compact size and lean management overhead it can respond very quickly to opportunities and change direction according to user requirements.

Little historical inertia

The young, enthusiastic and highly motivated technicians and scientists at SOCIB have very little historical inertia. They are equally keen to adapt to and embrace changing requirements as they are to learn and develop from experience: research and development at SOCIB references and acknowledges sound scientific and engineering principals but its Facility teams are not afraid to think out of the box and embrace revolutionary rather than evolutionary solutions when they occur.

International relationships are easy to forge

There are no barriers to SOCIB, its employees or partners, to forming intellectual friendships and working relationships either corporate or personal. SOCIB poses no obvious business threat to outside organizations or institutions. Partly this is because it is small and designed to work with expert knowledge and experience elsewhere rather than attempt to recruit or absorb this expert knowledge and experience within its own entity. Partly it is because SOCIB and its office of the director present the organization as a monitoring hub for the Balearic Islands that is an opportunity on which to attach spokes to other organizations and expertise elsewhere to create a rolling programme of collaborative development of user driven responsive marine observing for sustainable management and exploitation of the marine environment under global and climatic pressure.

Expanding science

Broad data distribution can lead to more studies and greater science impact.

Education courses

Education, the ability to develop an operational oceanography and technology course will give SOCIB access to new talent and also invest in developing potential in the Balearic islands.

Expand funding base

SOCIB may have the potential to diversify funding base and attract EU infrastructure funding for ocean observing, Horizon 2020

Stakeholders/end users, companies-spin off potential:

Creation of new end-user products that could have broad application and/or spin off potential, ICTS is now under MINECO.

3.2 ANALYSIS OF ICTS SOCIB AGAINST OTHER SIMILAR SYSTEMS IN EXISTENCE OR PLANNED, WITHIN A NATIONAL AND INTERNATIONAL CONTEXT

National and international context for analysis

Oceanographic and coastal information, combined with integrated predictive models, is increasingly needed to manage national coastal and ocean areas, to understand and depict the state of the ocean today, next week and in the next decade. In order for example to increase the efficiency of shipping, to mitigate storm damage and flooding of coastal areas, to enable sustainable fisheries, to protect important ecosystems from degradation, to develop science based management of marine and coastal environments, and to improve our seasonal and climate forecasting in response to global change.

The ocean however changes continuously, and it therefore must be observed continuously. This, combined with the understanding that we have a responsibility to maintain healthy, resilient and sustainable coasts and oceans, and with the ongoing curiosity driven advancement in knowledge and in technology, is the foundation for new ocean observing networks.

Ocean observing networks are being adopted as an important component of marine strategy by most countries that are both advanced in marine science research and that have economically significant coastal areas, such as for example the US, Canada, Australia and also within the EU. These new ocean observatories, such as IMOS, OOI, IOOS, Neptune/Venus, COSYNA, MOOSE, and Poseidon, among others, are incorporating long term, multiplatform, marine observations with data management and distribution capabilities. SOCIB is one such observatory, however SOCIB is also unique among them in responding to 3 key drivers: science, society and technology.

The importance and the need of ocean and coastal observations to address **state of the art scientific priorities** is universally accepted and the arguments will not be therefore repeated here. It is however interesting to mention two main ideas behind a recent review on UK ocean strategies for the next 20 years by Bryden et al., (2012). This emphasized firstly the need to combine sustained observations and process studies, a concept that is fully in line with the origins of SOCIB (as found in the IP2010) and with the scientific strategies adopted by Balearic Islands in researchers over the last 10 years. Further Bryden et al., (2012) note that although observations over the last decade have allowed us to establish the main characteristics of the world ocean circulation, that recent observations of the MOC from the RAPID array in the Atlantic show a decrease of 30% in the mean MOC from winter April 2009 – March 2010 (McCarthy et al. 2012), a clearly significant signal that had not been previously observed or modelled. These and other more local observations (Heslop et al. 2012) make it clear that the ocean circulation is much more variable on seasonal to inter-annual time scales than previously thought, and that accordingly, the challenge for the next decade is to establish how the ocean circulation varies on inter-annual to decadal time scales.

To do this, more detailed and sustained monitoring is required, combined with process studies to understand physical and biogeochemical processes that drive ocean variability and ecosystem response. In summary, the SOCIB approach, initiated 10 years ago (Tintoré et al., 2013)[18], encompassing both these elements, is now fully endorsed by the main international strategies for ocean observations.

[18] SOCIB paper published in 2013 February issue of Marine Tech. Soc. J.

In parallel to theses evident scientific needs, in the last 3 years there has been an increasing emphasis on **linking ocean science to strategic societal needs**, both in the EU (initiatives such as Horizon 2020 or Clean Seas by 2020 or more specifically the recent report from the Marine Infrastructures Working Group (European Commission, 2013) and also in the US where an excellent review of the science and society challenges in 2030 was carried out by the Committee on an Ocean Infrastructure Strategy for U.S. Ocean Research in 2030 (2011). More recently (April 2013) the National Strategy for Earth Observations was presented in the US, which was followed in May by the announcement of a significant increase in funds for ocean observing systems in 2014[19].

The SOCIB vision already anticipated this need to harness the investment in ocean monitoring infrastructure to meet the needs of both science and society, covering from the nearshore to the open ocean (therefore with close similarities with NANOOS off the US northwest coast) and so in this context SOCIB is a leader in the field of ocean and coastal observing systems (Tintoré et al., 2013).

The US Strategy for Earth Observations identifies 13 societal benefit areas (SBA), many of which are pertinent to the ocean, for example biodiversity, climate, disasters, ocean resources, and ecosystems. These SBAs are inter-connected, share observational requirements and the societal benefits inform scientific research, policy, and decision-making (see diagram below from Committee on an Ocean Infrastructure Strategy for U.S. Ocean Research in 2030 (2011)).

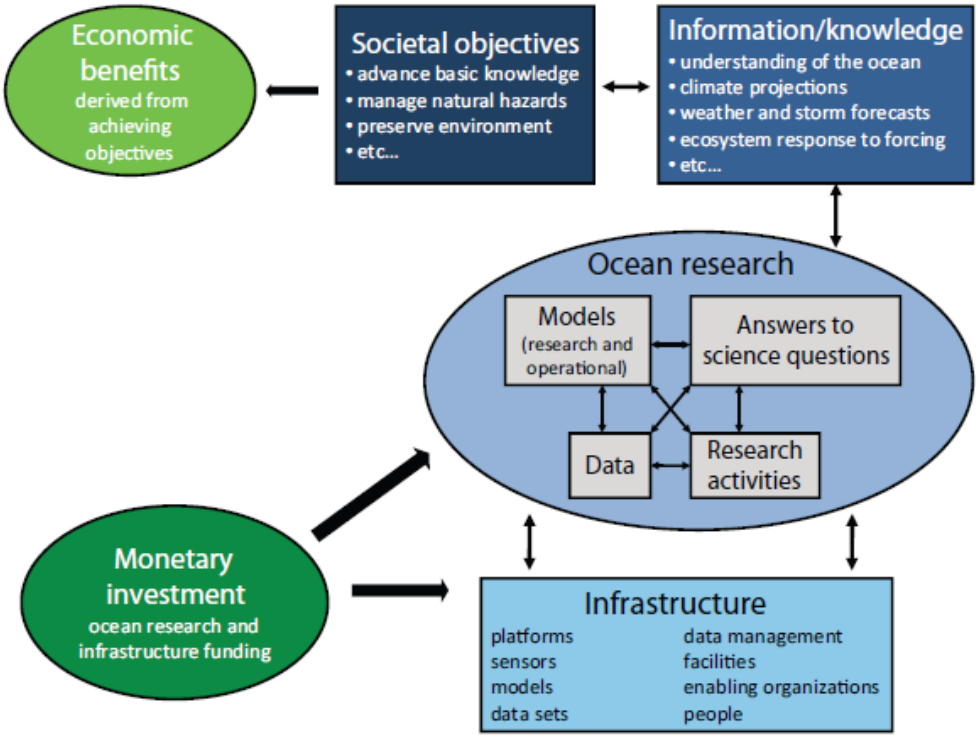


Figure 3.2.a: Conceptual diagram illustrating links between ocean infrastructure, scientific research, relevant societal objectives, and benefits associated with achieving these objectives.

[19] US Government in May 2013 announced an increase in funding the U.S. Integrated Ocean Observing System (IOOS) of 50% (to $34.5 million) part of an overall 11% increase in the proposed funding for the National Oceanic and Atmospheric Administration (NOAA), fiscal year 2014.

In Europe**,** a key societal driver is the information required for the implementation of the European Marine Strategy Framework Directive (MSFD), a key pillar of the Integrated Maritime Policy (IMP) in Europe. More specifically, the implementation of the MSFD requires (1) an Initial Assessment of the present status (carried out in 2012) to guarantee the achievement of (2) Good Environmental Status by means of specific actions that include (3) Monitoring Programs (to be implemented in 2014) and detailed (4) Programs of management measures (2014). Also important is that IMP promotes the Blue Growth by a sustainable use of marine resources and in consequence, one of the aims of IMP is to offer a more coherent approach to maritime and marine affairs and an improved coordination between relevant actors and sectors, by this contributing to establish the potential of the seas and oceans for growth and jobs. Blue economy needs to consider the interactions between human activities and their potential effects on marine environment and biodiversity

In this general scientific and societal context, new ocean observatories are increasingly being relied upon to deliver the information required to inform policy with regard to current human pressure on the marine environment and future climatic change and multi-platform systems, such as SOCIB, by integrating different types of monitoring platforms, at different scales, they directly contribute to providing ocean observations that can be combined to answer questions that are relevant to society, and thus contributing directly to responding, amongst other things, to the MSFD pressures and states indicators.

Analysis of ICTS SOCIB as compared to other ocean observing systems

SOCIB is designed around science for society, it is not the re-focus of a previous organisation, neither is it a department of a larger organisation. SOCIB covers the marine environment from the deep ocean, through the littoral zone and right up to the head of the beaches and the users. SOCIB is a facility of facilities exploiting the a whole range of instrument and platform technologies currently available for marine observation, from weather protected video cameras to sea-bed mounted pressure gauges, and from world class research vessel sampling to leading edge autonomous glider vehicles, not forgetting moorings and lagrangian drifters. SOCIB's high resolution modelling programme extends from waves to currents and extreme meteotsunamis. In addition to modelling and observing the maritime environment, SOCIB serves data and products and SOCIB develops user friendly interfaces for society access. This envelope makes the SOCIB effort unique, not just in the Mediterranean, not just in Europe, but globally. Now SOCIB is implemented, the people of the Balearic Islands have a better opportunity to sustainably exploit and sensitively manage their marine environment than anyone else; provided the investment is safeguarded.

Let us take a brief look at SOCIB's as compared to other national and international observing systems:

The PLOCAN observing laboratory in the Canary Islands is SOCIB's only obvious national counterpart. This is an extensive laboratory facility and glider/mooring facility. SOCIB is now fully implemented despite a similar if not slightly lower implementation budget. Most importantly however, the objectives are clearly different and direct comparison could be misleading as could be misleading also a direct comparison of land based infrastructures. SOCIB has a much larger envelope of facilities and actions than its Canary Island relative. PLOCAN has neither the modelling nor the data centre actions at its core, In addition, whilst its data gathering from shelf to open ocean is expected to be world standard like that of SOCIB, PLOCAN does not have the same remit to either connect this through the littoral zone or to

serve a suite of public information and education products. PLOCAN has an important focus on alternative energies, which is not among present SOCIB objectives.

SOCIB's closest example is NANOOS, the Pacific northwest ocean observing system of IOOS (Integrated Ocean Observing System). Based predominantly on the Washington and Oregon coasts, NANOOS was the principal inspiration for the SOCIB concept. Having been in existence for approximately three times the age of SOCIB, NANOOS is considerably larger and has access to a very much bigger budget. But just like a younger brother, SOCIB has benefitted from following closely the ideas and concepts of NANOOS; SOCIB has been able to develop more rapidly, and it has some of its own ideas, NANOOS does not take monitoring to the beach head yet, possibly because tourism and the interests of hotels may be a bigger driver in the Balearic Islands.

COSYNA and MOOSE are SOCIB's European counterparts. MOOSE is a French observation network to monitor the NW Mediterranean and has clearly followed the model of a regional component of a global ocean observing system (GOOS), driven largely by global change and scientific interests with little focus on user services and products. COSYNA on the other hand is a German observing and modelling system of much greater similarity to SOCIB. Predominantly focussed on the southern North Sea, COSYNA has a similar array of monitoring platforms to SOCIB, and is also working to assimilate the data into wave and current forecasting models of the region.

POSEIDON is the Greek monitoring, forecasting and information system based at the Hellenic Centre for Marine Research. It comprises a network of typically 3 observing buoys gathering meteorological and oceanographic surface information and an operational centre where these data are used to validate atmospheric and oceanographic forecast models for the Mediterranean Sea, with a higher resolution focus on the Aegean and Black Seas. At two of the moored buoy sites, water column information for salinity, temperature, chlorophyll, Oxygen, water currents and irradiance are also obtained. The buoy data are supplemented by a ferrybox system mounted in the F/B Olympic Champion, which transits the route between Herakleion, Crete, and Piraeus, Athens daily.

The Australian Integrated Marine Observing System (IMOS) is probably the worlds largest observing and monitoring network, covering the seas and oceanic regions around the entirety of Australia and Tasmania. The Observing systems include, AUVs, gliders, HF radar, moored platforms, Argo floats, experimental cruises, animal tagging, ferryboxes and ships of opportunity observations. The IMOS facilities are served by the Australian Ocean Data Network (AODN) for data archiving, data access policy and an electronic data portal, which provides model outputs for coastal marine forecasting and the Oceanic region around Tasmania in particular. Although its sheer size makes a comparison with SOCIB difficult, it is clear that IMOS does not have the same socio-economic focus on monitoring; IMOS has a more conventional science research focus spread across 5 principal themes, climate variability and weather extremes, multi-decadal ocean change, major boundary currents and inter-basin flows, continental shelf processes, and ecosystem responses. IMOS was established in 2007 and received a major increase in funding two years later in 2009.

Europe: Within Europe SOCIB is clearly a leading coastal ocean observing system; the multiplatform science to society approach covering from the nearshore to the open ocean makes SOCIB a unique infrastructure, specifically we are leaders in:

- Multi-platform data archive, management, integration and visualization
- Glider operations, we operate one of the main glider labs in Europe

- Linking observations and modelling at a regional level
- Being driven by the needs of science, society and technology
- Extending from nearshore to open ocean

National: we are an agile and relatively young ICTS for ocean and coastal observation, our structure provides a blue print for a future network of regional ocean observing systems in Europe and we play an important role in responding EU MFSD requirements for Clean Seas by 2020. We serve science and society through providing free and open access to our data and in line with other ICTS, such as PLOCAN, we provide open access to our ocean observing platforms, including the R/V SOCIB and Glider Facility. In the future our Data Centre Facility will have the capacity to offer data archive, management and visualisation services to other national marine institutes, in line with the request of the Board of Trustees in 2012. We also anticipate that as ocean-atmosphere modelling develops that through partnerships, such as with the Puertos del Estado, our data will be assimilated into models to contribute the national seasonal forecasting capability. Finally, SOCIB is also collaborating in the definition of the Integrated Maritime Policy in the Mediterranean (IMP-MED), an important initiative from the EC DG MARE, for example through participation in the Blue Growth meeting, Palma de Mallorca May 2013.

Regional: We play an important role in the local Balearic community, providing emergency response capacity through our re-locatable observing platforms and knowledge. For example, when in 2007 the Don Pedro ferry sank outside Ibiza Town harbour the current core team of SOCIB scientists and engineers were involved in forecasting currents and providing information on the regional coastline to better organize the installation of the anti-pollution barriers at the coast. This system has now been updated by SOCIB and is a tool available at the DG Emergencies of the Balearic Islands Government. SOCIB has also actively participated in local marine related policy and public events since 2010 (for example the annual science fairs, Forotec meetings, and the more recent Maremostra Ocean Film festival), and is developing an online educational tool for gliders that will be tested in local schools. SOCIB also aims to develop marine science open days on the R/V SOCIB. At a general level we support the development of marine research expertise in the islands, investing in the development of marine engineers, scientists and data management experts, and respond to regional marine issues as they arise (for example, government concern related to 2013 jelly fish blooms and tourism impact).

References:

Bryden H., C. Robinson, G. Griffiths, 2012: Changing currents: a strategy for understanding and predicting the changing ocean circulation. Phil. Trans. R. Soc., A2012, 370, doi: 10.1098/rsta.2012.0397.

Committee on an Ocean Infrastructure Strategy for U.S. Ocean Research in 2030; National Research Council; 2011: Critical infrastructure for ocean research and societal needs in 2030. National Academies Press. 98 pp. ISBN 978-0-309-18603-2.

European Commission. 2013. Towards European Integrated Ocean Observation. Expert Group on Marine Research Infrastructures. Final Report. 96 pp. ISBN978-92-79-27319-3. doi: 10.2777/29343.

McCarthy, G., E. Frajka-Williams, W. E. Johns, M. O. Baringer, C. S. Meinen, H. L. Bryden, D. Rayner, A. Duchez, C. Roberts, and S. A. Cunningham (2012), Observed interannual variability of the Atlantic meridional overturning circulation at 26.5°N, Geophys. Res. Lett., 39, L19609, doi:10.1029/2012GL052933.

3.3 ANALYSIS OF SOCIB COMPETITIVE ADVANTAGES

SOCIB Team - skilled and experienced staff, areas worth highlighting include; the Data Center team with a broad range of skills extending from infrastructure, to data archive, search and visualization, to oceanographic data QC, and data product development, the Glider team with operational glider experience, the beach monitoring team a European centre of excellence in design of systems and the ETD Division where our experienced staff mean that we are naturally evolving into a regional hub, and experienced staff with business skills.
Our End-to-End concept – from observations to stakeholders, coastal to open ocean, encompassing data collection, QC and validation, products and services, this is end-to-end vision is embodied at the core of SOCIB in our mission statement, enables us to not just provide data but to see the evolution of this data through to end users which enables us to react and adapt our network and services in line with real and evolving societal needs.
Intellectual Property – to deliver our unique concept we have developed and are developing in-house tools and solutions that have application for other organisations.
Potential to create commercial spin-offs – we are at the forefront of combining and delivering marine data to stake holders, using new technology and people experienced in multimedia. This is one example of a potential area for spin-offs
International network of contacts – developed initially through the Office of the Director, however also now though the involvement of SOCIB Facilities at an international level in their specific areas, we have and continue to develop a strong national and international network
Strong national and international reputation – through our work and advocacy SOCIB has developed a strong national and international profile as a good example of a observing and forecasting system, with a strong focus on societal needs.
Agile organisation – capable of responding to change

3.4 ANALYSIS OF SOCIB SOCIO-ECONOMIC IMPACT

3.4.1 INITIAL IMPACT

It is too early to allow a full assessment of SOCIB socio-economic impact, we are just completing the construction phase and the success of the infrastructure can only be more fully assessed once we are operational. In addition a number of the issues that we seek to resolve scientifically, e.g. variability in the circulation system, upper ocean variability, beach monitoring erosion and change, require datasets of at least 10 years to fully resolve natural vs. anthropogenic influences. SOCIB was designed as a long term monitoring system and the full value of our data will continue to increase as the data timeseries lengthen. Notwithstanding we can point to a number of early successes.

Inline with other international observing systems we understand the societal areas on which we expect to an impact and some of our next steps include the development of specific products and services to meet the needs of defined end-user stakeholders within these sectors. These end user stakeholders lie below major areas of current societal and marine policy needs, such as those defined by Expert Group on Marine Research Infrastructures (Final Report 2013 - Towards Integrated Ocean Observation):

- Stewardship of the marine environment
- Understanding ocean/climate interactions to predict and adapt to climate change impacts
- Supporting the maritime economy
- Marine safety

These are the major areas that we anticipate having an increasing socio-economic impact on over the coming years as outlined in the future plans (Section 4), however we can already demonstrate this impact, for example through the work of the SIAS Division, Outreach Service and the Bluefin Tuna project.

3.4.2 ANTICIPATED IMPACT: KEY SCIENCE, SOCIETY AND TECHNOLOGY TOPICS ON WHICH ICTS SOCIB WILL HAVE A MAJOR IMPACT OVER THE NEXT 5 YEARS

In Table 3.4.a we list the technical, scientific and society driven key topics that SOCIB envisages addressing over the next 5 years. This represents a synthesis of the key research plans of the SOCIB facilities and divisions presented in Section 2.4. Those Facilities and Divisions are also given in the table below, as is the area (science, technology or society) to which their input is addressed. In the final column we have mapped the relevant 'big questions' that were presented in the 2011 report of the Committee on an Ocean Infrastructure Strategy for U.S. Ocean Research in 2030 of the US National Research Council. Nearly half of their questions map easily to the SOCIB topics, showing how internationally relevant the SOCIB mission is. The other questions were predominantly related to atmospheric, polar, geo-engineering and geological etc. issues, and therefore out of SOCIB's remit.

Topic	Science	Technology	Society	Mapping these to US infrastructure 2030 big questions[20]
Understanding seasonal-multi-decadal variability, climate/global change	HF Radar GF BMF FSF			How Will Ocean Circulation and the Distribution of Heat in the Ocean and Atmosphere Respond to Natural and Anthropogenic Drivers? How Will Alterations in the Global Water Cycle Influence the Ocean?
Improving forecast model skill	HF Radar LF FSF MF	BMF	BlueFin	How Can the Effects of Ocean and Atmosphere Interactions be Better Parameterized?
Optimising the design and deployment of advanced technologies		HF Radar GF LF BMF	BMF	
Avoiding/mitigating for oil spill/pollutant risks			HF Radar MF	What Advances Will Be Made in Prediction and Mitigation of Oil Spills and Industrial Accidents in the Ocean?
Supporting extreme event forecasting, wave height/rip current security, and search and rescue	MF		HF Radar BMF MF	How Will Coastal Ecosystems and Communities Respond to Multiple Stressors? How Can Understanding and Prediction of the Path and Intensity of Severe Storms Be Improved?
Understanding water mass exchanges, formation and their ecosystem response	GF LF BMF		LF BlueFin	How Will Climate Change Influence Cycles of Primary Production ? How Will Marine Ecosystem Structure, Biodiversity, and Population Dynamics Be Shaped by a Changing Ocean Environment?
Quantifying the role of dynamic ocean processes in the marine system	GF LF BMF MF			How Will Changes at Coastal Boundaries Alter Physical and Geochemical Processes ? What Processes Dominate Mixing in the Ocean and on What Space and Time Scales?
Developing metrics for effective MSFD activities	BMF		GF SIAS BlueFin	What Is the Role of Coastal Pollutants and Pathogens on Human and Ecosystem Health?
Supporting Integrated Coastal Ocean Management (ICOM)		MF	BMF MF SIAS Outreach OD	How Can Humanity Ensure Sustainable Food Production in the Ocean? How Can Humanity Maximize Energy and Mineral Resource Extraction, While Minimizing Adverse Environmental Impacts?
Education			Outreach OD	

Table 3.4.a. Anticipated impact: key science, society and technology topics on which ICTS SOCIB will have a major impact over the next 5 years

[20] Committee on an Ocean Infrastructure Strategy for U.S. Ocean Research in 2030, 2011: Critical infrastructure for ocean research and societal needs in 2030. National Research Council. National Academies Press. 98 pp. ISBN 978-0-309-18603-2.

3.5 ANALYSIS OF THE ANNUAL CAPACITY OF THE INSTALLATION, ITS OPENNESS TO USERS AND THE LIMITING FACTORS OF USE

The use SOCIB annual capacity by its 'users' has two main components:

- use of its data; the coastal and ocean observations and forecasts
- use of its infrastructure; the observing and forecasting facilities and ETD Division

The openness SOCIB data to its users is enshrined in our mission statement - *to develop a coastal ocean observing and forecasting system, a scientific and technological infrastructure that will provide free, open, quality controlled and timely streams of oceanographic data* - and described in detail in the section on Data Policy (Section 2.5). Essentially access to our data sets is free, open and timely, except under certain specific circumstances, as described in the Data Policy Section. However, we believe that the openness of data access to users has an additional dimension that of making the data easy to use. Part of the work of the SOCIB Operational Phase is to extend this easy to use concept, however the building blocks are already there. SOCIB has developed a sophisticated and leading edge website (as previously described in Section 2.5 Data, Products and Services and under Section 2.4.8 Data Center Facility) with the ability to visualize and download almost all of our current data sets. A now and even more sophisticated data visualization interface is currently under development, the release of which is one of the key milestones for 2013. This will give scientists, citizen scientists, educators and other users the tools to quickly and easily visualise data in a variety of ways, from all the observing facilities. In addition with its 3 fold commitment to science, society and technology has always had in mind to bring the data closer to society through end user appropriate products and services. The initial products and services are described in Section 2.5 Data, Products and Services and the on going plans to develop this capability to open/enable further exploitation of our datasets by the development of products and services for targeted end user groups is laid out in Section 4 SOCIB Strategy 2013 – 2016.

The openness SOCIB infrastructure to its users is through provision of open access to our facilities where appropriate (see Section 2.6) and under specific agreements to provide support for observing infrastructure owned by other organisations, for the benefit of both organisations and the for the efficient use of public funds. For example the SOCIB regional capability has meant that sea level gauges purchased by Puertos del Estado, were installed, and are maintained by the SOCIB ETD Division and the data streams managed by the SOCIB Data Center Facility. The open access to our facilities is described in Section 2.4.3 Facility Access and encompasses:

- Coastal Ocean Research Vessel Facility – days at sea through COCSABO
- Glider Facility – days at sea through application and EU transnational access programs
- Beach Monitoring Facility – specialist equipment through application
- RIB - days at sea through direct application through application

Some facilities are more appropriate to external access than others, for example it is possible to provide days at sea access to external users for platforms like the Coastal Ocean Research Facility and the Glider Facility, however it would not generally be feasible to re-locate the Coastal HF Radar Facility. Notwithstanding requests received for external use of facilities not included in the general open access list or other requests for use of infrastructure will be given due consideration, as long as they do not compromise SOCIB long-term objectives.

The limiting factors for the use of SOCIB data and infrastructure are 3 fold: funding levels, budgetary autonomy and efficiency related to multi-site operations. The capacity to increase the range of observations (platforms, sensors and monitoring locations) is primarily limited by funding. The ability to offer open access to facilities is again primarily limited by funding. For example if more glider access was see as important then this would imply the purchase and support of additional gliders, and similarly if the Data Center were to expand its operations to support marine data from external sources, as requested by the Executive Commission, this again would require an expansion in resources. The ability of SOCIB to develop products and services for targeted end users groups is limited in part by funding levels and in part by the constraints regarding budgetary autonomy, in that SOCIB constitutionally has the right to budgetary autonomy with respect to how it spends its funding, given that he budgets are approved by the Executive Commission and Board of Trustees, however in practice this has not been the case. This lack of budgetary autonomy means that SOCIB is unable to allocate scarce resources to where they can be utilised most effectively, in particular this limits the employment of specific skilled personnel for projects such as end-user product creation. Finally operating as a multi site operation, although initially efficient in terms of utilising existing space, is now becoming a limiting factor in the efficiency of operating some facilities and inter-facility communications. A single location for management, computing and technical work would now bring rewards for the SOCIB team in terms of increasing the efficiency of operations across facilities and SOCIB as a whole and making SOCIB more attractive for external use and investment.


SOCIB
Balearic Islands
Coastal Observing
and Forecasting
System

SOCIB Balearic Islands Coastal Observing and Forecasting System

SOCIB STRATEGIC PLAN 2013-2016

4

4 SOCIB Strategic Plan 2013-2016

The SOCIB Coastal Ocean Observing and Forecasting System has been set up following the IP2010, is almost entirely operational and many of the deadlines have been met on schedule or without significant delay. One of the key values of the infrastructure investment is its integrated nature; the coordinated deployment of a wide range of 'state of the art' multi-platform monitoring technologies, deriving critical data sets, which are the essential base for research and stakeholder knowledge at climate, seasonal and weather scales. During, and in preparation for, the SOCIB implementation phase, extensive consultation with local, regional and international research institutions and government bodies resulted in a 'community' view of the priorities for the SOCIB observing infrastructure (see Annex A6 - ICTS SOCIB Research Themes). This was a critical foundation stone for creating an integrated and sustainable marine observing system that addresses the needs and wishes of the people of the Balearic Islands and Spain as a whole, in a European and international context. The design, acquisition and deployment of the SOCIB observing and forecasting infrastructure grew logically out of the SOCIB scientific, technological and societal objectives that support the SOCIB mission to provide a 'coastal ocean observing and forecasting system'. In the operational phase the value of a multi-platform observational approach can be seen in the number of cross facility actions initiated, by this, further developing and strengthening a truly integrated observing and forecasting system.

4.1 DESCRIPTION OF OBJECTIVES

SOCIB is unique in that it is designed to support and prioritize a sustained approach to ocean and coastal monitoring that is responsive **to three key drivers, science, technology and society**.

In 2013 we are commencing the **Operational Phase**, during which it was anticipated that there would be an increase in use of the data, products and services by the identified SOCIB user groups and indeed this is one of the key elements of the SOCIB strategy for 2013 – 2016. In addition, the initial focus in the development of SOCIB has been on physical variables, however progressively more biogeochemical variables will be incorporated into the SOCIB observing network, reflecting both the present state of sensor technology and the importance of the impact of physical processes on driving biogeochemical fluxes and ecosystem response.

In this section we describe the 2013-2016 objectives (updated versions of the IP2010 objectives) and in Section 4.2 we present the four key strategy lines that SOCIB will follow in order to achieve these objectives. The detailed actions per Facility, Division and Service are provided in Section 4.3.

The core scientific and technology objectives from IP2010 (objective numbers 1, 2 and 5, below) remain relatively unchanged. However the objectives focused on supporting the strategic needs from society and broadening the use of SOCIB data (objectives 3, 4 and 6 below) are now coming into focus and we have now evolved and expanded upon these objectives.

Over the longer term SOCIB will continue to test and adapt its system, products and services to the changing needs through consultation with stakeholders.

SOCIB General Objectives 2013 – 2016

The objectives for 2013-2016 are detailed below. To facilitate comparison and analysis, we have maintained the numbering from the IP2010, and updated when deemed necessary.

1. **To support peer reviewed research along three internationally established research lines that have particular relevance to the oceanography and societal needs of the Balearic region, see Section 6, Annex A6 for details on the research lines, namely understanding:**

- The role of the oceans in our climate system, climate impact and climate variability effects in the Mediterranean Sea
- The interaction between major Mediterranean currents and the shelf environments and their influence on biogeochemical cycles and ecosystem variability
- The nearshore morpho-dynamics and sea level variability in response to climate change

2. To contribute to the development of operational oceanography technologies, specifically:

- To develop new products, sensors, tools and systems to enhance the real-time capabilities of observational facilities and numerical modelling
- To expand SOCIB operational oceanography activities; adding new, complementary platforms, techniques and processes, in response to identified science, technology or society needs
- To progressively improve the observed information, adding new variables, increasing the range of spatial-temporal scales

3. To support the strategic needs from society in the context of global change, in particular contributing to EU Integrated Maritime Policy (IMP) and EU Horizon 2020 Program in line with RIS3 Strategies and Blue Growth actions, opportunities for marine and maritime sustainable growth:

- By facilitating sustainable management of the oceans through the development of operational tools for decision support and knowledge transfer, and
- Through the development of science based coastal and ocean management, in the general frame of sustainability science and contributing in particular responding to MSFD (Marine Strategy Framework Directive), the marine pillar of the EU IMP
- To develop additional products and services in response to stakeholder needs

4. To support and encourage the broad use of SOCIB data, services and facilities through:

- Open, well designed and easy to use data access systems
- Partnership with external research organisations
- Transfer of knowledge, through outreach, education, training and mobility activities, increasing the bi-directional transfer from science to society and from society to science
- Encouraging use of available open access to SOCIB facilities

5. To develop and maintain an international perspective, in order to increase the international visibility of the ICTS, to attract the participation of the best researchers from around the world, and over the medium term to advance towards participation within the European ESFRI framework.

6. To support SOCIB participation and recognition through publications made in collaboration with key Balearic research institutions, such as IMEDEA (CSIC-UIB), COB-

IEO and UIB, and other national and international partners and collaborators (including recognition for SOCIB data, data products and access provided under open access policy).

4.2 SOCIB STRATEGY 2013-2016

Four Strategy Lines are outlined below, that in combination, will enable SOCIB to achieve its objectives for the period 2013-2016.

4.2.1 GENERAL STRATEGY LINES

1. Maintain and enhance the SOCIB operational observing and forecasting network; to meet the evolving needs of science and society. This will encompass for example:

- Identifying regional observational gaps, through our work and participation in different international projects, and seeking to fill these gaps, for example additional glider endurance lines
- Increasing the number and use of biogeochemical sensors, for example to support observations for MFSD indicators
- Expanding the Data Center Facility for the hosting of regional/national marine data streams (provided there are additional resources)
- Studying process oriented topics, for example upper ocean exchanges, physical/biological coupling, submesoscale dynamics, of key relevance to increasing our operational model skills and in response to key worldwide scientific priorities.

2. Increase the use of SOCIB data by key societal stakeholders. To bridge the gap between data collection and data use by. This strategy line is an important part of leveraging the value of the observational data collected and therefore of the operational phase. It is envisioned that this will encompass the components summarised below and expanded on in Section 4.2.2 Focused strategy towards products, services and end user stakeholders:

- Outreach activity to key stakeholders/end users, including dialogue with regional end users about data products and services
- Redesigning the website to emphasise end user focused access to data, products and services
- In-house development of end user focused products and services
- Exploring partnerships with private/creative sector to develop new products and services
- Expand use data streams for assimilation into seasonal forecasting models
- Potential expansion of the Data Center to support additional marine data from outside institutions

3. Maintain and expand SOCIB international collaborations, in particular in relation to:

- Gaining new competitive EU Horizon 2020 funding
- Increasing the profile of SOCIB data and modelling facilities
- Increasing international collaborations with US, Canada and Australia

4. Develop and implement a new SOCIB oriented education program to develop and attract new talent. This strategy line is essential for the long-term success of SOCIB to train and attract new talent. A need to increase the education of marine scientists and engineers was also identified in the recent EU and US strategy documents (Marine Infrastructures Working Group, European Commission, 2013 and US Marine Strategy for Ocean Infrastructure Strategy for U.S. Ocean Research in 2030). To drive this strategy the responsibility for Education,

originally part of the Outreach Service, will move to the Office of the Director and will be carried out hand by hand with UIB. This will encompass:

- Development of a masters program with UIB/CSIC in Operational and Coastal Oceanography and Marine Technology
- Development of ship based open days for schools and university students.

4.2.2 FOCUSED STRATEGY TOWARDS, DATA, PRODUCTS AND SERVICES FOR END USER STAKEHOLDERS

One of the most important elements of the Operational Phase is to gain wider use of data, by science and society, Strategy Line 2. More specifically, there is an increasing need for oceanographic data to underpin science-based decisions regarding sustainable management of our marine and coastal environment. We have therefore developed a detailed and focused plan for this important Strategy Line.

Oceanographic data can be used in many ways and over a variety of timescales. For example over the longer term oceanographic data are useful for answering questions related to climate change, and in the short term (real time) data can be used in an operational sense for oil spill response, environmental hazards (jellyfish) and SAR, or over intermediate timescales applications range from ocean circulation to coastal erosion, and from seasonal weather to rip current forecasting and ecosystem predictions. This approach is fully consistent with European approach as show by the recent "Navigating the Future IV[21]", position paper from the European Marine Board just present on June 20, 2013. Along the same line, the US, in its National Strategy for Earth Observations[22] from April 2013, has identified as many as 32 Key Research Areas and 13 Key Societal Benefit Areas (SBA) for earth observing systems, many of which are associated with marine observations. These SBAs operate across different timescales, with longer-term scientific questions and immediate operational uses of marine observations. Users include amongst others, scientists, policy makers, models and forecasting, marine economic activities, marine environmental managers, marine tourism and recreational activities amongst others. Although the questions and potential users are many, they have overlapping observational requirements and therefore an integrated coastal ocean observatory with an intelligent data delivery system can provide streams of data that can be used across a range of science and societal applications.

SOCIB cannot predict all the potential uses for our data and therefore our open data policy (see Section 2.5) and data archive, search and discovery technologies (Section 2.4.7 Data Center Facility) are the cornerstone of our strategy to maximise the use of our datasets in 2013 – 2016, within the scientific community and beyond. We want to take the activation of SOCIB data one step further and develop products and services for specific societal end users. We are convinced that to try to develop services for all end users and sectors could result in failure to develop products that are used (as reflected in the MyOcean User Conference, Copenhagen, April 2013). Along this line, as the potential applications for these datasets is broad, the EU Strategy for marine and maritime research infrastructures (as published in January 2013, with significant participation of SOCIB) has identified four broad areas of societal needs; blue growth, good environmental status of the seas (stewardship), adaptation to climate change and marine/coastal safety. SOCIB will focus on developing useful products for specific end-user stakeholders within theses areas. The strategy for developing our data applications in this way needs to be

[21] http://www.marineboard.eu
[22] http://www.whitehouse.gov/sites/default/files/microsites/ostp/nstc_2013_earthobsstrategy.pdf

targeted so as to bring relevant data to relevant societal end users in a form (product, service, tool or package) that they can use.

Therefore a two-fold approach is adopted; **creating awareness of data availability** to attract data oriented users, and **creating targeted products and services** for end-user societal stakeholders. There are three phases to this strategy:

PHASE 1 (current 2013)

1. Raise awareness of our data availability in the scientific community, both directly from our web site and indirectly through European ocean data portals. An important component of this is the Agreement signed with MONGOOS, which means that SOCIB data streams will be made available following recognized international standards.

- Specific activities of the Outreach Service to attract research and citizen scientists to make maximum use of the data sets available
- On going national and international interactions of the individual facilities with other scientists

2. Develop initial products for testing and use: A web developer has recently been hired and is developing initial targeted products:

- A Beach monitoring web tool – combining real-time video from the beach monitoring system, with the atmospheric variables and other useful information (e.g. local weather forecast) to create an interface that can be placed in the participatory hotels to satisfy the interest of the touristic sector. A specific version to include HF Radar in Ibiza channel is being also developed.
- An advanced oceanographic data real time visualisation tool - a sophisticated web interface where data sections and profiles from any of the ocean observing facilities can be selected and investigated by scientific and non scientific users

Other developments currently under way include:

- Create a web service for recreational and touristic marine users, e.g. yachts, marinas, ports, based on the SOCIB data sets and using an outside specialist web developer
- Upgrade of the SOCIB App (iPhone/iPad and Android –to be released in July 2013-), to include glider and fixed station data in real time and for archived missions as well as at a later stage HF radar and Modelling.

3. To define our target end user stakeholders for Phase 2 data, product and service development, with input from all the facilities and SIAS Division, these targets will be in line with our observational datasets, societal needs and national interest

4. Study success and learn from other initiatives, such as the products developed by Meteo Galicia and MyOcean

PHASE 2 (2014-mid 2015)

1. To continue to raise awareness of our data availability in the scientific community, in particular:

- Ensuring that our datasets are available through developing systems such as that being defined by the GROOM FP7 Project for glider data and the EMODnet Physical marine data portal
- Partnerships to enable the assimilation of our data into seasonal forecasting models.

2. Host dedicated workshops or meetings with the target end user stakeholder groups to introduce SOCIB datasets and potential products and services:
- Outreach Service to organise meetings/workshops
- SIAS Division and some facilities may also participate or organise meetings/workshops

3. Creation of new societal end user products and services, for example an App for professional and recreational divers

PHASE 3 (mid 2015-2016)

1. Continue to develop awareness of the SOCIB data availability, for example in line with future EU initiatives regarding ocean observatories.

2. Broaden our offer to end user stakeholders, by integrating additional ocean data variables based on user needs and feedback and/or potentially expanding the role of the Data Center Facility to integrate additional data streams from other regional or national marine data sources

3. Encouraging commercial or entrepreneurial interest in product creation. There is some opportunity to provide tools with a specific focus for say data pertaining to MSFD indicators, compliance with specific marine based legislation or policy related to environmental monitoring

The **end user stakeholders** for our data products and services include the following:
- Scientists – individuals, institutions, regional, national, international
- Recreational marine sector – leisure, tourism and sports users, for example divers and surfers are already users of the SOCIB data portal
- Marine planners, policy and decision makers, marine safety, water quality, etc. – this is a fragmented group dispersed across many departments, institutions, projects and activities related to stewardship and sustainable management of the marine environment. Many responding to EU driven directives such as WFD and/or MSFD.
- Blue Growth – representing sustainable commercial activity in the marine environment is again a diverse sector, for example renewable energy, aquaculture, commercial fishing, etc.
- General public – interest, citizen scientists
- Education - schools and universities
- National ocean and seasonal forecasting and modelling facilities
- SAR and environmental response – responding to oil spill, HAB's, etc.

In the next section we present the detailed objectives, strategies and actions planned to reach the objectives for 2013-2014. At present, given the general financial situation the detailed planning of activities for 2015 and 2016 seems very risky and we have considered that 2014 is a actually a good template for the activities to be carried out by each facility in 2015 and 2016, in line with the general stakeholders/end users priority.

4.3 SPECIFIC ACTIONS PER FACILITY, DIVISION AND SERVICE

4.3.1 COASTAL OCEAN RESEARCH VESSEL FACILITY

4.3.1.1 Objectives 2013 – 2016

Representing a significant regional investment in ocean science, the SOCIB R/V Facility was designed for open access and as a shared regional infrastructure, as described in the IP2010. Under this design ICTS SOCIB itself has access[23] to only part of the annual capacity of this facility (days of operations at sea per year). The other part of the annual capacity is reserved for a) our regional partner IEO, and b) open access by either commercial operations (e.g. water quality monitoring, habitat or bathymetry surveys) or outside funded research projects (e.g. EU funded projects).

Today, 2013, the SOCIB R/V Facility is operationally maintained by IEO under a signed agreement, this was a short term measure introduced to cover funding gaps (as previously described) and will be revised this year.

For 2013 the objectives are:

- Establish the operational costs and revise the agreement with CSIC and IEO regarding the management of the vessel. The current agreement is a new example of its kind and functions very well, however some improvements can be made. Discussions will take place in the forthcoming months regarding developing a new version of the agreement. Explicit consideration of the yearly amortization will need to be included as an explicit SOCIB contribution, following request from the auditors
- To secure convenient berthing arrangements in the Port of Palma de Mallorca. The vessels current mooring is only provisional
- To develop an efficient system of Open Access to the vessel for national and international scientists

From 2014 the primary objective of the SOCIB Costal Ocean Research Vessel Facility will be to achieve 50 SOCIB operational days at sea per annum, distributed across 3 areas of scientific operation:

- Monitoring schedule (approx. 32 days/RADMED type cruises)
- Support for other facilities, e.g. the maintenance of buoys (approx. 8 days)
- Specific technologies test at sea and process studies (approx. 10 days)

Other objectives are to:

- Support the Open Access Program, including creating awareness of availability of the platform, managing applications for use and managing the logistics of accepted projects
- Ensure that the vessel is efficiently managed and well maintained
- Initiate outreach activities with schools and UIB

[23] and operational funds

4.3.1.2 Strategies and actions to achieve objectives

In 2013 we will develop a proposal for a SOCIB R/V Facility monitoring program for 2014 and beyond, in coordination with the other facilities, specifically the Glider Facility activities. We have as a first priority for monitoring operations the maintenance of the existing RADMED monitoring program. This monitoring program was initiated by IEO in 1990 and is an important regional time series. Designed to monitor variability at seasonal scales the RADMED cruises are repeated 4 times a year, the SOCIB monitoring program will provide support as a priority, to maintain integrity of this existing time series.

4.3.1.3 Resources

The R/V Facility requires a new ships computing technician to manage the ships oceanographic instrumentation and computing systems, one of their primary tasks will be to maintain the operation of all scientific systems on R/V SOCIB, including maintaining the IT network and the instrumentation for continuous measurements, including managing the onboard data acquisition and archive procedures and integrating these with the DCF both in real-time and in delayed mode. This ships computing technician will work closely with the ETD Division and with the DCF.

In addition the R/V Facility requires support from a new DCF engineer to manage and maintain the QC and validation for the R/V Facility data. The work with the R/V Facility would be part-time, this new resource will be shared across all the facilities and will unite the QC and validation processes, see DCF for details.

4.3.1.4 Timeline

- IEO RADMED Cruise ..... Jun-Jul 2013
- Advertise Open Access capability through COCSABO ..... Jul –Sep 2013
- Hire new technician for ships equipment and data ..... Sep 2013
- IEO RADMED Cruise ..... Oct-Nov 2013
- Create R/V Open Access page for SOCIB web site ..... Nov 2013
- Create plan SOCIB annual monitoring activity ..... Nov 2013
- Revise the agreement with IEO and CSIC..... Dec 2013
- Secure permanent berthing in Palma de Mallorca ..... Mar 2014
- Commence SOCIB R/V annual monitoring activity 2014
- Develop SOCIB R/V outreach for schools and UIB 2015

4.3.2 COASTAL HF RADAR FACILITY

4.3.2.1 Objectives 2013 – 2016

- *To carry out in-situ validation of the HF Radar:* the installed HF Radar system requires in situ validation. With this objective comparative analysis of Lagrangian drifters and data from fixed current measurement stations with the HF Radar derived current data will be carried out within the Radar range.

- *To develop Quality Control Procedures:* the real-time HF Radar data requires quality control. Many factors can affect the radar signal and these require continuous oversight, and correction by the SOCIB DCF.
- *To examine small-scale features:* The Ibiza Channel is a highly dynamic area with small scale variability affected by different processes. The study of the Radar data through Lyapunov exponents will allow us to examine the small-scaled Lagrangian features, which can block the general circulation patterns in the channel.
- *To begin Data Assimilation:* The assimilation of HF Radar data will drive an improvement in the constraint, forecasting and evaluation of the model outputs.

4.3.2.2 Strategies and actions to achieve objectives

ONGOING ACTIONS

- HF Radar validation with the drifter trajectories.
- Quality Control applied to post-processed HF Radar data.
- Lyapunov exponent analyses of the HF Radar data to improve understanding of the small-scale dynamics in the HF Radar coverage area. Evaluation of the HF Radar variability and coverage.
- Use of different methods to avoid the HF Radar coverage gaps.

NEW ACTIONS

- **VALRAD Project.** ***VALidation - RADAR data.*** A new fixed station open ocean mooring will be installed in the Ibiza Channel by SOCIB (Fixed Platform Facility) at depths close to 600 m, with ADCP sensors mounted near surface. This together with SVP surface drifters will allow comparison and validation of the HF Radar data. In addition, an innovative project using two gliders in the HF radar area is under consideration for late 2013/early 2014.
- **VARIB Project.** ***Intra-annual variability Ibiza Channel.*** The study of the interannual variability of surface currents will be improved by the HF Radar data analyses. These data overcome previous difficulties in supplying *in situ* and continuous measurements in such a dynamic area with high current variability.
- **LAVA-bal Project.** ***Correction by lagrangian multipliers (IMEDEA, SOCIB, U. Toulon, U. Miami).*** LAVA is an algorithm based on a variational approach, which provides the optimal velocity field with the combination of radar and drifter data. The drifter trajectory will provide valuable measurements to improve the surface current data measured by the HF Radar.
- **Project RADMod. Radar Data Assimilation in the ROMS-Wmop.** ***Comparison and analysis (IMEDEA, SOCIB, U. Liege)***. The WMOP modelling and operational forecasting system at SOCIB, is based on the ROMS numerical model. This project will assimilate HF Radar data into the model to improve forecasting skill. The HF Radar data is continuous and real-time, and has high spatial and temporal resolution, thus it provides an ideal input to constrain the model and improve forecast accuracy. The improvement of the prediction of oceanographic currents in coastal areas will be a key objective of this work.
- International/national collaboration with research centers that perform the same type of studies will be sought, the options to visit other HF Radar installation, to compare tools, and increase our knowledge as well as to inform collaborative projects will be assessed.

4.3.2.3 Resources

Currently the Data Center Facility provides data management, easy web access and data visualization. In addition the HF Radar facility works in close collaboration with ETD Division to develop field campaigns for the validation and calibration experiments, together with other facilities such as the coastal ocean research vessel and gliders etc. Finally, the Modelling and Forecasting Facility provides the computer server and the modelling skills necessary for the development of the data assimilation within the WMOP.

A new Post Doc position is required, however, to fully exploit the data and the capabilities of this excellent investment and the integration of this with the Modelling and Forecasting Facility.

4.3.2.4 Timeline

Activity No.	Activity	Phase	Duration (months)	Start	End
1	Analysis of annual variability, QC of data, and validation				Aug 2013
2	Analysis of different processes used to fill HF Radar coverage		2		Sep 2013
3	Evaluation of small scale structures according to filled data and drifter validation		1		Oct 2013
4	Programming gliders and drifters validation		1		Nov 2013
5	Integration of filled data method as operational process in the web page		3		Nov 2013
6	Use of LAVAL algorithm		3		Jan 2014
7	Pre-processing Quality Control		3		Mar 2014
8	HF Radar validation – Drifters lauched		1		2014
9	Re-processing data and new pattern HF Radar data evaluation		1		2014
10	Re-processed HF Radar data tests and validation		1		2014
11	Test experiment: Evaluation of Glider use as dirigible surface drifter		1		2014
12	Analysis of the drifter and SeaGlider validation		2		2014
13	Analysis of QC and LAVAL result		2		Jun 2014
14	Integration of QC method as operational process		2		Aug 2014
15	Integration of LAVAL method as operational process		2		Oct 2014
16	Data assimilation at WMOP		4		Jan 2015
17	Validation and comparation of the first experiments carried out with a control run of Data Assimilation results		6		Jun 2015
18	Assess the impact of the assimilation of the HF Radar data in the model circulation and the representation of water mass transports		6		Jan 2016

19	Implementation of the data assimilation in the operational system WMOP		6		Jun 2016

4.3.3 GLIDER FACILITY

4.3.3.1 Objectives 2013 – 2016

In this section we present the general objectives of the glider facility for 2013-2014 that are in line with the description presented above. They are in essence:

- Maintain endurance lines, increasing capacity in terms of temporal coverage and initiating a second EL (likely late 2014 or early in 2015) and specific process oriented studies
- Provide 90 days of Open Access per annum (to date in 2013 we have completed 45 days)
- Initiate Facility automation projects, including autopilot, automatic pressure chamber, and automatic report generation
- Continue QC and V development, including finalising the NRT and DM data processing chains and implementing automated QC and V procedures for glider missions

4.3.3.2 Strategies and actions to achieve objectives

Year 2013 is an important year for the Glider Facility, the remaining elements of the working scheme for continuous monitoring operations, data management, glider management and documentation, need to be completed and formalized. 2014 will focus on automating the piloting, pressure chamber testing and report generation in order to increase efficiency and support the operation of a second endurance line.

ONGOING ACTIONS

To accomplish Endurance Lines, process studied and Open Access objectives
Lithium Battery Usage on SOCIB's Slocum G2 gliders: To accomplish anticipated 2014 time coverage, lithium batteries need to be used in Slocum G2 gliders. With lithium batteries, Slocum gliders can stay 4 times longer in the water, thus increasing the coverage of endurance lines and increasing efficiency by minimising the number of operations that a mission implies: glider ballasting, glider preparation (different tests), launch and recovery. The May-June 2013 Endurance Line mission has used for the first time lithium batteries on a G2 Slocum glider, with very successful results in terms of consumption. A process oriented multi-platform experiment is planed in Alborán Sea for June 2014 in the frame of PERSEUS EU funded project.

Attract national/international Open Access projects: SOCIB, with the first JERICO TNA mission in February 2013, has proved that its gliders can reliably perform missions for other institutions. To receive further scientifically applications for the 3 months per annum of Open Access missions available in 2015-2016, SOCI promotes its GF Open Access Program both nationally and internationally, through congress participation, projects and networking.

Purchase 2 new gliders: Two new gliders will be needed to support the additional endurance line and OA missions, the purchase of which has already been approved by the Executive Commission. Refurbishment of G1 gliders is also considered in 2013. Furthermore calibration

standards currently under development in the GROOM Project will require increased regular calibration of sensors which means that gliders will be sent to the US, or European facility if developed.

To accomplish Facility Development objectives
NRT and DM data processing chain: The data processing chain is in an advanced stage for the Slocum glider data type and is now incorporating the Seaglider data format. The Data Centre Facility and the Glider Facility have already worked together on this during 2012 and by the end of 2013 standard data products (NetCDF) will be available in NRT and DM for both glider models. The processing chain, however, will need updating as international standards, such as those under development in the GROOM FP7 Project, emerge.

NEW ACTIONS

To accomplish Endurance Lines and Open Access objectives
Hire an additional Glider Operator – likely 2014: The large increase in the number of planned missions and ambitious GF development projects will require an additional qualified glider operator.

To accomplish Facility Development objectives
Glider Compass Calibration and Error Measurement Procedures – 2013: A precisely calibrated compass and a controlled deviation ensure that gliders measure Depth Averaged Currents properly. This is a very important variable and special attention will be paid to implement procedures to verify the compass every mission. Nowadays a basic system with two degrees of freedom (heading and roll) allows for compass deviation measurement for Slocum gliders. In 2013 this tool will be used systematically every mission. In 2014 a stand will be built to ease compass calibration and allow calibration with three degrees of freedom (heading, roll and pitch) for both Slocum and Seaglider platforms.

Calibration and verification of payload sensors – 2014: Payload sensors (CTD, Fluorescence and Oxygen etc.) will be sent to the manufacturer for calibration according to the GROOM standards. New procedures to verify their correct behaviour will be developed and applied systematically.

Auto Pilot System – 2014: SOCIB GF will look at evaluating existing systems and then implementing or developing a SOCIB autopilot for both Slocum and Seaglider. The French national glider facility (INSU/CNRS) has already developed an autopilot system, which supports them in maintaining high levels of glider activity; the GROOM project is also planning to use this tool. In addition glider manufacturers have some interest in providing piloting services. SOCIB will evaluate the options and if required will develop an autopilot for its gliders.

Automated Pressure Chamber System – 2014: SOCIB GF will look at developing a pressure chamber system, to automate the test procedure (remote control) and to provide more precise pressure measurements.

Automated mission report generation – 2014: As the number of missions increase, reporting could become a bottleneck. In collaboration with the Data Centre Facility and using the data introduced in the central database for the deployment, reports could be generated semi-automatically with automatic plot generation, using the Glider Data Processing chain tools.

YEARS 2015-2016

During this period, the facility is expected to be routinely operating glides along two endurance lines. Open Access missions will also cover 3 months a year. As such, SOCIB will be one of the most active glider groups in Europe and will have strongly contributed to defining the new standards for glider observations (JERICO, GROOM, MyOcean2, etc.).

4.3.3.3 Resources

To accomplish the IP2010 and the specific objectives identified above, the following investments will be made:

- A new glider operator is required. An engineer capable of piloting gliders but also providing new knowledge to help with the automation development that will assist with increased operational capacity and new planned work.
- The GF requires support from a new DCF engineer to manage and maintain the QC and validation for the GF data. The work with the GF would be part-time, this new resource will be shared across all the facilities and will unite the QC and validation processes, see DCF for details.
- Two new gliders to support the additional endurance line and open access missions and the refurbishment of the existing Slocum G1 gliders.

4.3.3.4 Timeline

Activity No.	Activity	Phase	Duration (months)	Start	End
1	EL-EL1: Mission with alcaline batteries	IOC	1	Jan 2013	Feb 2013
2	OA: Mission TNA ½	IOC	1,5	Feb 2013	Mar 2013
3	EL-EL1: Mission with alcaline batteries	IOC	1	Mar 2013	Apr 2013
4	FD-DC: Integration of SG and Slocum in same data processing chain	IOC	12	Jan 2013	Dec 2013
5	FD-KH: Seaglider battery refurbishment course in USA	OM	0,1	May 2013	May2013
6	EL-EL1/IS: Mission with lithium batteries and measure of Compass deviation	IOC	1	May 2013	Jun 2013
7	FD-GL: Install pressure chamber new digital manometer	OM	1	Jun 2013	Jun 2013
8	FD-GL: Put into service Seaglider server (Basestation)	OM	1	Jun 2013	Jun 2013
9	FD-GL: Update Slocum server (Dockserver)	OM	1	Jun 2013	Jun 2013
10	EL-EL1/IS: Mission with lithium batteries and measure of Compass deviation	IOC	1	Jul 2013	Jul 2013
11	OA: Study new projects for 2014	PDP	5	Jul 2013	Nov 2013
12	FD-IS/KH: Visit to NURC	OM	0,75	Aug 2013	Aug 2013
13	EL-EL1/IS: Mission with lithium batteries and measure of Compass deviation	IOC	1	Aug 2013	Sep 2013
14	FD-GL: Autopilot concept design	CD	6	Aug 2013	Dec 2013
15	FD-GL: Setup Glider Control Room	FOC	1	Sep 2013	Sep 2013
16	OA/IS: Mission TNA 2/2 and measure of Compass deviation	IOC	1,5	Sep 2013	Oct 2013

17	FD-GL: Unify Slocum and Seaglider preparation and maintenance procedures and documentation	IOC	3	Sep 2013	Nov 2013
18	FD-GL: Automated Pressure Chamber concept design	CD	3	Sep 2013	Dec 2013
18	EL-EL1/IS: Mission with lithium batteries and measure of Compass deviation	IOC	1	Oct 2013	Oct 2013
20	OR: Martech workshop presentations	FOC	0,1	Oct 2013	Oct 2013
21	EL-EL1/IS: Mission with alcaline batteries and measure of Compass deviation	IOC	1	Nov 2013	Dec 2013
22	FD-DC: Glider data Processing Chain operative in NRT and DM	FOC	1	Dec 2013	Dec 2013
23	FD-GL: Same procedures and documentation for Seaglider and Slocum achieved (checklists, reports, interventions,..)	FOC	1	Dec 2013	Dec 2013
24	HR: Hire new glider operator (engineer)	LP	2	Jan 2014	Feb 2014
25	OA: Mission and measure of Compass deviation	IOC	3	Jan 2014	Dec 2014
26	FD-IS: Implement new verification systems for Payload sensors, especially CTD, Fluorometer and Oxygen. In line with GROOM.	IOC	12	Jan 2014	Dec 2014
27	EL-EL1/IS: Mission with lithium batteries and measure of Compass deviation	FOC	3	Jan 2014	Mar 2014
28	FD-FL: Purchase 2 deep gliders lithium capable (G2 or SG)	LP	6	Jan 2014	Jun 2014
29	FD-IS: Design new stand for easy and complete compass deviation measurement and calibration	CD	6	Jan 2014	Jun 2014
30	FD-GL: Design and implementation of Automated Pressure Chamber	PDP	10	Jan 2014	Oct 2014
31	EL-EL2: Study viability for 2015-2016	PDP	11	Jan 2014	Nov 2014
32	FD-DC: Semi-Automatic mission report generation	PDP	11	Jan 2014	Nov 2014
33	FD-GL: Autopilot design, engineering and programming	PDP	8	Jan 2014	Aug 2014
34	EL-EL1/IS: Mission with lithium batteries and measure of Compass deviation	FOC	3	Apr 2014	Jun 2014
35	EL-EL1/IS: Mission with lithium batteries and measure of Compass deviation	FOC	3	Jul 2014	Nov 2014
36	FD-IS: Manufacturing of new compass deviation measurement and calibration stand	OM	5	Jul 2014	Nov 2014
37	FD-GL: Autopilot test in real mission and fine tuning	IOC	3	Set 2014	Nov 2014
38	EL-EL1/IS: Mission with lithium batteries and measure of Compass deviation	FOC	3	Oct 2014	Dec 2014
39	FD-GL: Automated Pressure Chamber put into service	IOC	1	Nov 2014	Nov 2014
40	FD-IS: New compass deviation measurement and calibration stand operative	FOC	1	Dec 2014	Dec 2014
41	FD-GL: Automated Pressure Chamber operative	FOC	1	Dec 2014	Dec 2014
42	FD-GL: Autopilot operative	FOC	1	Dec 2014	Dec 2014
43	FD-DC: Semi-Automatic mission report generation	FOC	1	Dec 2014	Dec 2014
44	EL-EL1: Continuous monitoring missions	FOC	24	2015 (12)*	2016 (12)*
45	EL-EL2: Continuous monitoring missions	FOC	18	2015 (6) *	2016 (12) *
46	OA: Project driven missions 6 months/year	FOC	6	2015 (3) *[24]	2016 (3) *
47	FD-IS: Regular attendance to GROOM workshops	FOC	2	2015	2016
48	FD-IS: Regular glider sensor calibration according to GROOM	FOC	2	2015	2016

* Duration of missions in months per year

4.3.4 LAGRANGIAN PLATFORMS FACILITY

4.3.4.1 Objectives 2013 – 2016

There are three main objectives for the period 2013-2016. The first one is to maintain the full operational capability of the LF, revising and updating the data gathering and data dissemination protocols. The second one is to further exploit the data, both for scientific and society requirements. The third objective is to improve the support provided by Lagrangian platform data to the modelling facility through validation measures. Specific objectives are:

The specific technical objectives are:

- To update QC controls to allow regional specifications
- To update the protocol for daily monitoring of Argo and surface drifters
- To develop a delayed Mode Quality control to improve salinity measurements
- To develop a protocol to modify sampling strategy to avoid beaching of the Argo floats

The specific scientific objectives are:

- To use ensemble velocities measured by Argo floats to describe the mid water circulation in the Western Mediterranean
- To use ensemble velocities measured by the surface drifters to upgrade the description of the surface circulation in the Western Mediterranean.
- To cross-validate surface current measurements in the Ibiza channel, where the HF radar is installed
- To validate model results from the Modelling facility and to help quantify uncertainty in model predictions

Regarding outreach and education:

- To establish agreements with academic institutions in order to facilitate the enrolments in BSc and MSc training schedules or internship visits and offer, on an annual basis, training projects at different academic institutions in subjects related to SOCIB's LF projects
- Publication of research and technological works in appropriate forums and scientific-technological journals
- Develop a policy of data dissemination to end-users to assure users exploit the full capabilities of the facility

Regarding the International collaboration and dissemination aims:

- Strengthen the Spanish contribution to the international Argo network by joining the Euro-Argo European Research infrastructure, as would be requested by the present coordinating Institution, IEO.

4.3.4.2 Strategies and actions to achieve objectives

ONGOING AND NEW ACTIONS

Forecasting Facility provides the computer server and the modelling skills necessary for the development of the data assimilation within the WMOP. SOCIB's LF is engaged in different actions to achieve its objectives. There are two different types of actions: the core actions (CA) that are related with the operational tasks of upper ocean monitoring and imply a long-life time.

The specific actions (SS) are focused on particular experiments, to answer scientific questions or provide upgrades to the core actions.

Project	Goal	Description	Start – End
CA LADAT	Make data publically available in 24-hours	Maintenance and updating of LF data management protocols and visualization applications	01/13 – 12/13
CA LADEP	Maintain a fleet of 8 Argo floats and 10 surface drifters in the Western Mediterranean.	Purchase, deploy, recover and maintain platforms to achieve the fleet goal.	01/13 – 12/13
CA LAMON	Maintain a fleet of 8 Argo floats and 10 surface drifters in the Western Mediterranean.	Monitor the performance of the Lagrangian platforms	01/13 – 12/13
SA LAVEL	Increase the services provided by the LF	Ensemble surface and mid-depth velocities, to be included in *CPLADAT*	01/14 – 07/14
SA LARAD	Increase the services provided by the LF	Cross validation of surface velocities with data from the HF radar.	07/15 – 12/15
SA LAREC	Optimization of the Lagrangian fleet	Establish a protocol to recover Argo and surface drifters, to be included in *CPLADEP*	07/14 – 12/14
SA LASAM	Optimization of the Lagrangian fleet	Establish a protocol to modify Argo sampling strategy, to be included in *CPLADEP*	01/15 – 07/15
SA LARIC	Expand the international dimension of SOCIB.	Coordinate with the IEO the participation in Euro-Argo in order that Spain becomes a full member of this European infrastructure	05/13-12/13

	LF Core actions			LF Specific Actions				
	LADAT	LADEP	LAMON	LARIC	LAVEL	LAREC	LASAM	LARAD
Jan'13								
Apr'13								
Jul'13								
Oct'13								
Jan'14								
Apr'14								
Jul'14								
Oct'14								
Jan'15								
Apr'15								
Jul'15								
Oct'15								
Jan'16								
Apr'16								
Jul'16								
Oct'16								

4.3.4.2 Resources

INVESTMENT

The annual purchase of Argo profilers and surface drifters, estimated as: 3 Argo = 3 x 20,000 = 60,000 Euros and 8 SVP = 8 x 2,000 = 16,000 Euros
Total per annum: 76,000 Euros

PERSONNEL

Currently the facility has 1 leading scientific researcher from IEO, 1 technician support from ETD, and support from DCF technicians for data management and visualisation.

In addition, the LF requires support from a new DCF engineer to manage and maintain the QC and validation for the LF data. The work with the LF would be part-time, this new resource will be shared across all the facilities and will unite the QC and validation processes, see DCF for details.

SPACE

Currently considered is the use of a warehouse for equipment storage (provided in-kind by IMEDEA) and use of a laboratory for testing and maintenance (also provided in-kind support by IMEDEA).

4.3.5 FIXED STATIONS FACILITY

4.3.5.1 Objectives 2013 – 2016

- To maintain the current infrastructures, and as far as possible, incorporate new measurement stations
- To integrate all data collected by different stations operated by other organisations (e.g. Puertos del Estado) in the SOCIB DCF's databases
- To revise and update the QC procedures for all variables, with particular attention to the biogeochemical parameters
- To incorporate in the FSF the instrumentation and stations from the "Rissagues Monitoring System" belonging to PortsIB
- Create new products (internet and smart phone interfaces etc.) specifically designed to encourage the "end users" (sailors, fisheries, environmental managers, surfers, etc.) to access the information coming from FSF's stations

4.3.5.2 Strategies and actions to achieve objectives

ONGOING ACTIONS

Maintenance

The FSF currently has three working sea level stations, six weather stations, one oceanography/meteorology buoy and one shore station. To guarantee the accuracy of all the instrumental data from these stations, it is necessary to follow a periodic maintenance protocol. Depending on the type of station, the maintenance consists of:

- **Sea Level Network:** Every six months the different components of each station are cleaned (including submerged components). At the same time all data are locally downloaded from the instruments. All the installed sensors are calibrated bi-annually
- **Moored Buoy Network**: The buoys require periodic cleaning of the installed sensors (every 2 months and more often during summer). This operation is done *in situ* by scuba divers, and can be carried out from a small boat, commonly SOCIB`s Zodiac Hurricane is used. Once per year it is necessary to release the buoys from the mooring point, take them to harbour for a more thorough maintenance of all components (including cleaning of all mechanical parts, a data upload, local checking of all instruments, antifouling paint, etc.). All the installed sensors are calibrated bi-annually
- **Coastal Station Network**: Every six months the different components of each station are cleaned (including the submerged components). At the same time all data are locally downloaded from the instruments. Annually, submerged instruments are brought to the coast for a complete inspection, checking and cleaning. All the installed sensors are calibrated bi-annually
- **Weather Station Network**: An annual maintenance is performed. This includes cleaning of the components, checking the correct operation of sensors with a reference weather station and a local data download**.** Once again, all the installed sensors are calibrated bi-annually

Coordination with other networks

Currently, the FSF is working to incorporate the data coming from Sea Level stations and buoys in Puertos del Estado's data centre. This is scheduled to begin with the incorporation of sea level data in the PORTUS system (second trimester of 2013) and subsequently to incorporate data from the buoys (fourth trimester of 2013). To fully achieve this integration it will be

necessary to check that the measurement procedures and quality controls of SOCIB and Puertos del Estado's systems are compatible. In return, SOCIB will be able to present, through its website, the data collected by the Puertos del Estado network.

NEW ACTIONS

PortsIB (regional ports authority) have contacted SOCIB to establish an agreement to make SOCIB become the new "Rissagues System" operator (currently operated by PortsIB). This system is a part of the infrastructure created during the construction of the new Ciutadella harbour (Menorca) and its mission was to create an alarm system to predict and warn of possible "Rissagues" events. The system comprises several sea level stations (Ciutadella, Colonia de Sant Pere, Cala Ratjada and Porto Cristo), various barometric stations (Ibiza Island), and models. The models are responsible for creating the "Rissagues" warnings and are driven by the collected station data. This is an ideal opportunity for the FSF to respond to a clear stakeholder request, to extend its sea level network by integrating the "Rissagues" system, and to demonstrate the development of a new SOCIB product for society.

For the period 2013-2016 the following actions are scheduled:

- Complementing the Sea Level Network with the:
  - Installation of a station at the port of Sant Antoni (Ibiza). Fourth trimester 2013
  - Incorporation of the "Rissagues" system from PortsIB. This system includes Sea Level Stations in Cala Ratjada, Porto Cristo and Colonia de Sant Pere. Third trimester 2013
- Complementing the Buoys Network with the:
  - Installation of Buoy "Canal de Ibiza". Second trimester 2013
  - Incorporation of the replacement Buoy "Cabrera" from Parques Nacionales. Fourth trimester 2013
  - Incorporation of Buoy "Canal de Menorca" in agreement with Ports IB. First trimester 2015
  - Deployment of the Buoy Formentera has been delayed indefinitely, as mentioned above, however it is noted here for completeness and is in grey in the resources section.
- Complementing the Coastal Stations with the:
  - Installation of a Ciutadella Coastal Station. This station will be focused on the study of the "Rissagues" phenomenon. The station will be equipped with a current profiler and a sea level sensor in the old harbour and one tide gauge outside the port (in a depth of ~ 20 m). Second trimester 2013

4.3.5.3 Resources

INVESTMENT

Most of the expenditures requested for the period 2013-2016 arise through the acquisition of components (sensors, instrumentation, submarine cables and CPU, etc.) to replace broken, irreparable, or lost components on the stations. Some investments are dedicated to acquire duplicate sensors to allow sensors to be swapped-out whilst being sent for factory calibration and thereby ensure the continuity of a timeseries will not be affected. Note that for completeness the Buoy "Formentera" is included in the investments below (marked in grey), however under the current financial conditions it has been decided to indefinitely delay the deployment of this buoy.

	Elements	Investment
Components for Sea Level Stations	1 SBE26+, spares, cables	25 000 €
Components for Buoys	1 SBE37, 1YSI 6600, meteorological set, spares	50 000 €
Components for Coastal Stations	1 Nortek Aquadopp, submarine cable, spares	30 000 €
Components for Weather Stations	1 Vaisala VTX520, spares	5 000 €
	TOTAL	110 000 €

The Buoy "Canal de Menorca" that will be transferred from PortsIB to SOCIB is the replacement of an old one, lost because of a mooring line failure. This buoy was seriously damaged when it reached the coast and requires repair and some components will have to be replaced. This represents an investment of 60 000€ in 2014.

Maintenance and operations

SEA LEVEL STATIONS								
Station	**Activity**	**Act. per year**	**Unitary budget**	**2013**	**2014**	**2015**	**2016**	**Total 2013-2016**
Station Andratx	Full maintenance	0	0 €	0 €	0 €	0 €	0 €	**0 €**
	Insitu maintenance	2	300 €	600 €	600 €	600 €	600 €	**2 400 €**
	Insurance	0	0 €	0 €	0 €	0 €	0 €	**0 €**
	Calibrations	0.5	2 000 €	2 000 €	0 €	2 000 €	0 €	**4 000 €**
	Incidentals		900 €	900 €	900 €	900 €	900 €	**3 600 €**
	Total Annual			**3 500 €**	**1 500 €**	**3 500 €**	**1 500 €**	**10 000 €**
Station Pollença	Full maintenance	0	0 €	0 €	0 €	0 €	0 €	**0 €**
	Insitu maintenance	2	300 €	600 €	600 €	600 €	600 €	**2 400 €**
	Insurance	0	0 €	0 €	0 €	0 €	0 €	**0 €**
	Calibrations	0.5	2 000 €	0	2 000 €	0 €	2 000 €	**4 000 €**
	Incidentals		900 €	900 €	900 €	900 €	900 €	**3 600 €**
	Total Annual			**1 500 €**	**3 500 €**	**1 500 €**	**3 500 €**	**10 000 €**
Station Sa Rapita	Full maintenance	0	0 €	0 €	0 €	0 €	0 €	**0 €**
	Insitu maintenance	2	300 €	600 €	600 €	600 €	600 €	**2 400 €**
	Insurance	0	0 €	0 €	0 €	0 €	0 €	**0 €**
	Calibrations	0.5	2 000 €	2 000 €	0 €	2 000 €	0 €	**4 000 €**
	Incidentals		900 €	900 €	900 €	900 €	900 €	**3 600 €**
	Total Annual			**3 500 €**	**1 500 €**	**3 500 €**	**1 500 €**	**10 000 €**
Station Porto Cristo	Full maintenance	0	0 €	0 €	0 €	0 €	0 €	**0 €**
	Insitu maintenance	2	300 €	300 €	600 €	600 €	600 €	**2 100 €**
	Insurance	0	0 €	0 €	0 €	0 €	0 €	**0 €**
	Calibrations	0.5	2 000 €	0 €	2 000 €	0 €	2 000 €	**4 000 €**

	Incidentals		900 €	900 €	900 €	900 €	900 €	**3 600 €**
	Total Annual			**1 200 €**	**3 500 €**	**1 500 €**	**3 500 €**	**9 700 €**
Station Cala Ratjada	Full maintenance	0	0 €	0 €	0 €	0 €	0 €	**0 €**
	Insitu maintenance	2	300 €	300 €	600 €	600 €	600 €	**2 100 €**
	Insurance	0	0 €	0 €	0 €	0 €	0 €	**0 €**
	Calibrations	0.5	2 000 €	2 000 €	0 €	2 000 €	0 €	**4 000 €**
	Incidentals		900 €	900 €	900 €	900 €	900 €	**3 600 €**
	Total Annual			**3 200 €**	**1 500 €**	**3 500 €**	**1 500 €**	**9 700 €**
Station Sant Pere	Full maintenance	0	0 €	0 €	0 €	0 €	0 €	**0 €**
	Insitu maintenance	2	300 €	300 €	600 €	600 €	600 €	**2 100 €**
	Insurance	0	0 €	0 €	0 €	0 €	0 €	**0 €**
	Calibrations	0.5	2 000 €	0 €	2 000 €	0 €	2 000 €	**4 000 €**
	Incidentals		900 €	900 €	900 €	900 €	900 €	**3 600 €**
	Total Annual			**1 200 €**	**3 500 €**	**1 500 €**	**3 500 €**	**9 700 €**
Station Sant Antoni	Full maintenance	0	0 €	0 €	0 €	0 €	0 €	**0 €**
	Insitu maintenance	2	1 000 €	1 000 €	2 000 €	2 000 €	2 000 €	**7 000 €**
	Insurance	0	0 €	0 €	0 €	0 €	0 €	**0 €**
	Calibrations	0.5	2 000 €	2 000 €	0 €	2 000 €	0 €	**4 000 €**
	Incidentals		900 €	900 €	900 €	900 €	900 €	**3 600 €**
	Total Annual			**3 900 €**	**2 900 €**	**4 900 €**	**2 900 €**	**14 600 €**
							TOTAL	**73 700 €**

BUOYS								
Station	**Activity**	**Act. per year**	**Unitary budget**	**2013**	**2014**	**2015**	**2016**	**Total 2013-2016**
Buoy “Bahía de Palma”	Full maintenance	1	2 000 €	2 000 €	2 000 €	2 000 €	2 000 €	8 000 €
	Insitu maintenance	3	500 €	1 500 €	1 500 €	1 500 €	1 500 €	6 000 €
	Insurance	1	12 000 €	12 000 €	12 000 €	12 000 €	12 000 €	48 000 €
	Calibrations	0.5	10 000 €	0 €	10 000 €	0 €	10 000 €	20 000 €
	Incidentals	-	5 000 €	5 000 €	5 000 €	5 000 €	5 000 €	20 000 €
	Total Annual	**-**	**-**	**20 500 €**	**30 500 €**	**20 500 €**	**30 500 €**	**102 000 €**
Buoy “Canal de Ibiza”	Full maintenance	1	10 000 €	10 000 €	10 000 €	10 000 €	10 000 €	40 000 €
	Insitu maintenance	3	1 000 €	1 000 €	3 000 €	3 000 €	3 000 €	10 000 €
	Insurance	1	12 000 €	12 000 €	12 000 €	12 000 €	12 000 €	48 000 €
	Calibrations	0.5	10 000 €	0 €	0 €	10 000 €	0 €	10 000 €
	Incidentals	-	8 000 €	8 000 €	8 000 €	8 000 €	8 000 €	32 000 €
	Total Annual			**31 000 €**	**33 000 €**	**43 000 €**	**33 000 €**	**140 000 €**
Buoy “Formentera”	Full maintenance	1	10 000 €	0 €	10 000 €	10 000 €	10 000 €	30 000 €
	Insitu maintenance	3	1 000 €	0 €	1 000 €	3 000 €	3 000 €	7 000 €
	Insurance	1	8 000 €	0 €	8 000 €	8 000 €	8 000 €	24 000 €
	Calibrations	0.5	10 000 €	0 €			10 000 €	10 000 €

	Incidentals	-	8 000 €	0 €	8 000 €	8 000 €	8 000 €	24 000 €
	Total Annual	-	-	**0 €**	**27 000 €**	**29 000 €**	**39 000 €**	**95 000 €**
Buoy "Cabrera"	Full maintenance	1	5 000 €	5 000 €	5 000 €	5 000 €	5 000 €	20 000 €
	Insitu maintenance	3	800 €	0 €	2 400 €	2 400 €	2 400 €	7 200 €
	Insurance	0	0 €	0 €	0 €	0 €	0 €	0 €
	Calibrations	0.5	0 €	0 €	0 €	0 €	0 €	0 €
	Incidentals	-	2 500 €	2 500 €	2 500 €	2 500 €	2 500 €	10 000 €
	Total Annual	-	-	**7 500 €**	**9 900 €**	**9 900 €**	**9 900 €**	**37 200 €**
Buoy "Canal de Menorca"	Full maintenance	1	10 000 €	0 €	0 €	10 000 €	10 000 €	20 000 €
	Insitu maintenance	3	1 000 €	0 €	0 €	3 000 €	3 000 €	6 000 €
	Insurance	1	12 000 €	0 €	0 €	12 000 €	12 000 €	24 000 €
	Calibrations	0.5	10 000 €	0 €	0 €		10 000 €	10 000 €
	Incidentals		8 000 €	0 €	0 €	8 000 €	8 000 €	16 000 €
	Total Annual	-	-	**0 €**	**0 €**	**33 000 €**	**43 000 €**	**76 000 €**
							TOTAL	**450 200 €**

COASTAL STATIONS								
Station	**Activity**	**Act. per year**	**Unitary budget**	**2013**	**2014**	**2015**	**2016**	**Total 2013-2016**
Station La Mola	Full maintenance	1	1 800 €	1 800 €	1 800 €	1 800 €	1 800 €	9 000 €
	Insitu maintenance	1	1 500 €	1 500 €	1 500 €	1 500 €	1 500 €	7 500 €
	Insurance	0	0 €	0 €	0 €	0 €	0 €	0 €
	Calibrations	0.5	4 000 €	4 000 €	0 €	4 000 €	0 €	12 000 €
	Incidentals		3 000 €	3 000 €	3 000 €	3 000 €	3 000 €	15 000 €
	Total Annual			10 300 €	6 300 €	10 300 €	6 300 €	33 200 €
Station Ciutadella	Full maintenance	1	1 800 €	0 €	1 800 €	1 800 €	1 800 €	7 200 €
	Insitu maintenance	1	1 500 €	0 €	1 500 €	1 500 €	1 500 €	6 000 €
	Insurance	0	0 €	0 €	0 €	0 €	0 €	0 €
	Calibrations	0.5	4 000 €	0 €	0 €	0 €	4 000 €	8 000 €
	Incidentals		3 000 €	0 €	3 000 €	3 000 €	3 000 €	12 000 €
	Total Annual			0 €	6 300 €	6 300 €	10 300 €	22 900 €
							TOTAL	**56 100 €**

WEATHER STATIONS								
Station	**Activity**	**Act. per year**	**Unitary budget**	**2013**	**2014**	**2015**	**2016**	**Total 2013-2016**
Station Galfi	Full maintenance	0	0 €	0 €	0 €	0 €	0 €	0 €
	Insitu maintenance	1	1 000 €	1 000 €	1 000 €	1 000 €	1 000 €	4 000 €

	Insurance	0	0 €	0 €	0 €	0 €	0 €	0 €
	Calibrations	0.5	1 000 €	0 €	1 000 €	0 €	1 000 €	2 000 €
	Incidentals		2 000 €	2 000 €	2 000 €	2 000 €	2 000 €	8 000 €
	Total Annual			3 000 €	4 000 €	3 000 €	4 000 €	14 000 €
Station ParcBit	Full maintenance	0	0 €	0 €	0 €	0 €	0 €	0 €
	Insitu maintenance	1	200 €	200 €	200 €	200 €	200 €	800 €
	Insurance	0	0 €	0 €	0 €	0 €	0 €	0 €
	Calibrations	0.5	1 000 €	0 €	0 €	1 000 €	0 €	1 000 €
	Incidentals		400 €	400 €	400 €	400 €	400 €	1 600 €
	Total Annual			600 €	600 €	1 600 €	600 €	3 400 €
Station Salines	Full maintenance	0	0 €	0 €	0 €	0 €	0 €	0 €
	Insitu maintenance	1	300 €	300 €	300 €	300 €	300 €	1 200 €
	Insurance	0	0 €	0 €	0 €	0 €	0 €	0 €
	Calibrations	0.5	0 €	0 €	0 €	0 €	0 €	0 €
	Incidentals		600 €	600 €	600 €	600 €	600 €	2 400 €
	Total Annual			900 €	900 €	900 €	900 €	3 600 €
							TOTAL	**21 000 €**

PERSONNEL

Currently the FSF has a technical expert, provided in-kind by IMEDEA (CSIC-UIB), to coordinate and manage of the FSF network in close cooperation with the ETD Division for installation and maintenance activities. The DCF provides support for data management and visualisation, and the Office of the Director for agreements and overview of development.

In addition, the FSF requires support from a new DCF engineer to manage and maintain the QC and validation for the FSF data. The work with the FSF would be part-time, this new resource will be shared accross all the facilities and will unite the QC and validation processes, see DCF for details.

SPACE / WORKSHOP

To develop its activities, the FSF has access to the following facilities:

- The Oceanographic Instrumentation Laboratory for instrument and computer setup, provided as support in-kind by IMEDEA (CSIC-UIB)
- Two warehouses for equipment storage, one provided as support in-kind by IMEDEA (CSIC-UIB) in Esporlas and the other at SOCIB´s offices in the ParcBit
- Additional facilities are available at Calanova, provided as support in-kind by IMEDEA (CSIC-UIB), for operations with buoys and other big platforms

4.3.6.4 Timeline

The maintenance tasks and the incorporation of new stations are shown in the following table:

SOCIB Balearic Islands Coastal Observing and Forecasting System

		TR1 /2013	TR2 / 2013	TR3 /2013	TR4 / 2013	TR1 /2014	TR2 / 2014	TR3 /2014	TR4 / 2014	TR1 /2015	TR2 / 2015	TR3 / 2015	TR4 / 2015	TR1 /2016	TR2 / 2016	TR3 / 2016	TR4 / 2016
BUOYS	Buoy Bahía de Palma	1dM	1wM	1dM	1dM	1dM	1wM	1dM	1dM	1dM	1wM	1dM	1dM	1dM	1wM	1dM	1dM
	Buoy Canal de Ibiza			I	1dM	1dM	1dM	1wM	1dM	1dM	1dM	1wM	1dM	1dM	1dM	1wM	1dM
	Buoy Formentera							I	1dM	1dM	1dM	1wM	1dM	1dM	1dM	1wM	1dM
	Buoy Cabrera				I	1dM	1dM	1dM	1wM	1dM	1dM	1dM	1wM	1dM	1dM	1dM	1wM
	Buoy Canal de Menorca									I	1dM	1dM	1dM	1wM	1dM	1dM	1dM
SEA LEVEL	Station Andratx		1dM		1dM		1dM		1dM		1dM		1dM		1dM		1dM
	Station Pollensa		1dM		1dM		1dM		1dM		1dM		1dM		1dM		1dM
	Station Sa Rapita		1dM		1dM		1dM		1dM		1dM		1dM		1dM		1dM
	Station Porto Cristo			Inc		1dM		1dM		1dM		1dM		1dM		1dM	
	Station Cala Ratjada			Inc		1dM		1dM		1dM		1dM		1dM		1dM	
	Station San Pere			Inc		1dM		1dM		1dM		1dM		1dM		1dM	
	Station San Antonio				I		1dM		1dM		1dM		1dM		1dM		1dM
COASTAL	Station La Mola		1wM		1dM		1wM		1dM		1wM		1dM		1wM		1dM
	Station Ciutadella						I		1dM		1wM		1dM		1wM		1dM
WEATHER	Station Galfi				1dM				1dM				1dM				1dM
	Station ParcBit				1dM				1dM				1dM				1dM
	Station Salines				1dM				1dM				1dM				1dM

1dM	One day maintenance
1wM	Large (harbour) maintenance
I	Installation
Inc	Incorporation to FSF

4.3.6 BEACH MONITORING FACILITY

4.3.6.1 Objectives 2013 – 2016

The main objective for the period 2013-2016 is to maintain the Full Operational Capability (FOC) of the SOCIB BMF revising and updating it as required; for example, revising and updating QC procedures established across datasets, integration of the data into the SOCIB data portal and incorporating new camera sensors and optics where required.

New initiatives for this period involve the development of tools and applications and encouraging wider use of the datasets by stakeholders (i.e. academic, hotel companies, beach security services, etc.). Specific objectives under this are:

Specific scientific and technological objectives:

- In the long term, to maintain and explore the variability and trends in sediment budget analysis and beach profile evolution.
- In the short term, to maintain and explore weekly shoreline evolution as well as characterize bar position and displacement, and beach cross-shore sediment transport.
- To address the integration and effects of local winds in beach wave forecasting models and incorporate these effects in tools related to beach wave forecasting.
- The development of tools related to the Beach Wave Forecasting System (SIPOP2) capabilities (information on waves at the Balearic Islands' Beaches, Safety Forecasting Alerts, etc.).
- The updating of products from the different dissemination platforms (thredds, NCfiles, GIS Beach viewer)

Specific society objectives:

- To develop a data dissemination policy for end-users and stakeholders that ensures users exploit the full capabilities of the facility
- To develop web-based applications related to beach users security and risk forecasting in collaboration with Conselleria d'Interior from the Balearic Islands Government
- To develop open-access services offered through the availability of SOCIB BMF equipment and related human resources; principally through advertising on the BMF web pages an open-access services list (laser granulometer, expertise in video monitoring, etc.)
- To disseminate the society focussed BMF advances and results to beach-coastal stakeholders and the general public

Specific international collaboration objectives:

- To establish agreements with academic institutions in order to incorporate the SOCIB BMF in BSc and MSc training; including offering internship visits to the BMF and offer, on an annual basis, projects at different academic institutions related to the SOCIB BMF mission.
- To participate in the relevant coastal meetings and littoral zone conferences; creating a high national and international visibility for SOCIB and its BMF's products, tools and services
- To collaborate with other leading institutions thereby maintaining the BMF's awareness of the latest technologies and the internationally recognized standards and protocols.
- To publicise research and technology works in appropriate forums and scientific-technological journals

4.3.6.2 Strategies and actions to achieve objectives

ONGOING ACTIONS

The SOCIB BMF mission is organized in different projects in order to achieve the former aims. During 2013 it deals with two different types of projects: the frame projects (FP) that relate to the main, long-life time span tasks of coastal video monitoring and MOBIMs products, and the specific projects (SP) which are punctual actions or projects. Additionally there are some actions (DA), related to outreach and education issues.

Project	Description	Start – End
FP MANPLAT	Maintenance and updating of SIRENA components	01/13 – 12/13
FP MANEC	Maintenance and updating of moorings and survey instruments	01/13 – 12/13
FP MANTOOLS	Maintenance and updating of BMF data management and visualization applications	01/13 – 12/13
FP C_imaging	Coastline extraction and analysis of coastline variability	01/13 – 12/13
FP C_morpho	Sediment budget and profile extraction and analysis of the beach evolution	01/13 – 12/13
FP BDM	Integration of Beach Data Management in Beach Data Viewer	01/13 – 12/13
SP TUCOAST	Improving scripts and codes used by BMF in data exploitation	07/12 – 12/13
SP RISKBEACH	Intensive field campaign on rips dynamics and bar displacement and sediment transport characterization.	08/12 – 12/13
SP SIPOP2	Development of a system of beach wave forecasting	01/13 – 07/13
SP CM10	Monograph on 10 years of data on Cala Millor Beach	04/13 – 12/13
DA MANAG_In	BMF introduction to Government Coastal Managers	01/13 – 07/13
DA COLAB_In	BMF introduction to collaborating entities and users	01/13 – 07/13
DA BMF telf apps	Developing a mobile phone BMF application	01/13 – 07/13
DA FARO	Workshop on beach morhphodynamics	07/13 – 12/13

NEW ACTIONS

Bearing in mind the current financial uncertainties in Spain and indeed Europe as a whole the BMF has conservative plans regarding growth in monitoring but ambitious plans to develop specific analyses and tools to maximize the exploitation of the current monitoring facilities. This includes continued development of open-access equipment services and the development of user (society) orientated products. If the financial situation improves it will be a simple matter to consider the installation of an additional MOBIMS at Santa Eulària (Ibiza) and the corresponding beach monitoring campaigns, as these are essentially already planned.

BMF envisages:

- Maintaining and expanding, if funds permit, the operational platform
- New work on the analysis of the datasets generated by specific projects
- Initiation of new specific projects, as a continuation of 2013 projects
- Developing an offer for open-access to selected facilities equipment
- Developing products aimed at local stakeholders

During the period 2014-2016 we plan to expand the analyses and services resulting from the 2013 projects**:**

- RISKBEACH#2. This action will consist of the analysis and exploitation of datasets on bar position and rip current dynamics, including sediment transport patterns obtained in the field experiment RISKBEACH to be carried out in the last trimester of 2013.
- SIPOP#3. Development of a web-based wave and beach safety risk forecasting tool for the Balearic Islands, in collaboration with the Conselleria d'Interior, CAIB.
- DRIPS, (Dynamics of Rips). This action will consist of the validation of wave data from the beach wave forecasting system and addressing the role of winds in this system. Additionally different bathymetric surveys and coastal modelling will be developed for unravelling rip current dynamics.

4.3.6.3 Resources

INVESTMENT

The acquisition of a multi-beam echosounder for improved bathymetric surveys, in order to reduce the sampling and bathymetry campaign time and increase the spatial resolution of depth data. The estimated cost for a multi-beam echosounder is 150,000 Euros.

For maintenance and operations there will need to be an ongoing acquisition of computers, camera optics, hardware components, AWAC batteries and other small elements integrated into the MOBIM modules. The estimated annual operations expenses are 58,000 Euros (not including insurance of moored equipment).

PERSONNEL

Currently the BMF has 1 leading scientific researcher provided in-kind by IMEDEA (CSIC-UIB) and 2 coastal morphodynamics research technicians. The BMF is also supported by ETD and DCF technicians.

As mentioned in the BMF SWOT a new computing engineer is required by the BMF to upgrade and update the video monitoring tools in order to guarantee the ongoing data acquisition and maintain the BMF international leadership with the SIRENA system. This is in addition an investment for the future of the SIRENA system as a potential spin off 'product', the system has already been adopted by other research facilities and a robust SIRENA system has some commercial potential for global beach monitoring systems.

SPACE

The BMF currently uses a hydrodynamics laboratory, provided in-kind by IMEDEA (CSIC-UIB), and a warehouse for field equipment and samples storage, again provided in-kind by IMEDEA (CSIC-UIB).

4.3.5.4 Timeline

	BMF FRAME PROJECTS						BMF SPECIFIC PROJECTS						
	MANPLAT	MANEC	MANTOOLS	C_imaging	C_morpho	BDM	TUCOAT	RISKBEACH	SIPOP#2	CM10	RISKBEACH#2	SIPOP#3	DRIPS
Jan'13													
Apr'13													
Jul'13													
Oct'13													
Jan'14													
Apr'14													
Jul'14													
Oct'14													
Jan'15													
Apr'15													
Jul'15													
Oct'15													
Jan'16													
Apr'16													
Jul'16													
Oct'16													

4.3.7 MODELLING FACILITY

4.3.7.1 Objectives 2013 – 2016

The situation at the M&FF changed in March 2013 when the post doctorate responsible for leading the operational modelling resigned to take up a new position, at Scripps Institute, University of California, USA. In the near term we are re-structuring the planned activities around the current personnel, until we have secured the approval of the Board of Trustees (end of June 2013) to seek a replacement M&FF Team Leader, anticipated for end of June 2013, and we are planning to maintain (1) the operational systems and (2) the on going research activities.

As part of the **SOCIB engagement with the MONGOOS/EuroGOOS Science Advisory Working Group (leader Paolo Oddo)**, the following research and development topics and challenges for modelling and observing systems were prepared in early 2013. These will provide a basis for the future R&D activities of the MF&F in 2013-2016, once the go ahead to hire new personnel has been agreed, and are therefore included here for completeness.

Leveraging the observing platforms: We need to consider the opportunities to capitalise on the new multi-platform Observing System. These observing platforms are providing near-real time capabilities to characterize the ocean state and ocean variability. In particular at key control choke points. (e.g. Heslop et al,, 2012); Therefore we will be looking to adopt and develop new techniques for multivariate model validation, and in the longer term model constraint through data assimilation. This includes HF Radar, surface drifters, Argo float profiles, gliders, the R/V SOCIB observational programme, fixed moorings and satellite data. Similarities with NANOOS, IMOS, COSYNA, Poseidon, and IOOS, for example, will be examined closely, taking direction and leading the way where appropriate.

The main challenge for next decade is to integrate new technologies to:

- Monitor the variability at small scales, e.g. the mesoscale (10-100 km) and days to weeks.
- Resolve the sub-basin seasonal and inter-annual variability and by this
- Establish the decadal variability, understand the associated biases and correct for them

The SOCIB strategy:

- Select key control sections in the coastal ocean, from coast to open ocean, for routine monitoring ‘choke or control points’ to characterise coastal and ocean variability
- Evaluate the relevance of mesoscale activity and shelf/slope exchanges on coastal ocean state and ocean variability, and the impacts on exchanges with the open ocean

Modelling will play a key role in responding to this challenge, for example in Observing Systems Simulation experiments to optimise sampling strategies for routine monitoring.

The modelling challenges are:

- To examine how well the different sampling platforms contribute to (a) characterizing the regional ocean state and (b) its variability
- To establish its interactions with and impacts on the global ocean and the coastline
- To understand factors that influence or control the accuracy of the reconstruction of the ocean state

The SOCIB modelling strategy:

- Observation system simulation experiments (OSSE) that will sub-sample pseudo oceanic fields in model experiments to quantify errors in the reconstructions of the ocean state from just those 'observations', and to study factors that control these errors.

Encompassing the aims above the **specific MF&F objectives** include:

- Maintain the **WMOP operational system**, reinforcing the current validation system, both with the quasi-real time operationally available data and with the monthly to seasonal validation.
- Determine **optimal initial and boundary conditions**: it is well know the realism of the downscaling depends strongly on the initial and open boundary conditions (OBC). Nowadays, for the Mediterranean Sea, there are three main OBC available: MFS, MFS2 and Mercator. As a background to the WMOP, we propose to hindcast the period 2011-2013 with the different OBCs. The analysis from these different models will be compared to all the available observation data (including SOCIB glider data and probably HF radar data). Results will determine which OBC provides the most optimal conditions to force the WMOP forecasting system.
- **Validate the BRIFS** Meteotsunamis forecasting system: Renault et al. (2011) assess an extreme Rissaga event generated by a strong convective system. Another study will assess a Rissaga generated by Atmospheric Internal Gravity Waves (AIGWs) and forecasted by the BRIFS system; the BRIFS predictions being compared to the available data. Such a study will aim to fully validate the BRIFS system across the two known mechanisms for setting up a meteotsunami.
- **Data assimilation:** due to the employment difficulties cited above, this objective has been delayed. Nevertheless, as highlighted by preliminary results, it still remains a key point for an operational model. In particular, the SOCIB glider data could improve significantly the oceanic forecast. To achieve this goal, it is planned to reinforce the collaborations (in particular with NURC, La Spezia). The recruitment of a specialized post-doctorate in data assimilation may become a critical requirement to achieve this aim.
- Maintain and extend the **wave model** to all the islands, updating QC procedures established across datasets and data integrated into the SOCIB data portal. An important extension is planned related to the development of tools related to a Beach Wave Forecasting System (SIPOP2); this work is in collaboration with the beach monitoring facility, and in particular it will focus on considering the inclusion of the sea breeze in the atmospheric forcing.
- **Bio-Physical coupling and ecosystem response:** In order to advance towards a solid and science based modelling of the ecosystem response to the physical variability in the different sub-basins of the Western Mediterranean (and as a result advance towards an operational coupled physical-biological model) the basic question we wish to elaborate on is related to the impacts of mesoscale and gyral scale dynamics on the control of regional plankton production characteristics in two sub-basins of the western Mediterranean; (1) the north-western Mediterranean Sea above 38ºN latitude covering the Catalano-Balearic Sea and Liguro-Provencal Sea, and (2) the south-western Mediterranean Sea (below 38oN latitude covering the Alborán and Algerian Seas.
  Because several different mechanisms (e.g. topographic steering, vortex stretching, barotropic-baroclinic instability, downstream propagation of eddies, cross-frontal circulation, modulation by the fluctuating winds and cooling/warming, etc.) are likely acting together or separately in controlling nutrient enrichment and plankton distribution,

the individual role of these likely processes are being examined and their relative roles and importance will be assessed using numerical model simulations along with remote sensing observations. The formation and evolution of these eddies and their role on the regional biology has not been studied in detail before either in the context of circulation dynamics or in conjunction with primary production.
Another interesting subject worthy to include into our modelling strategy is to study the effects of "Extreme events" on the physical system and their likely bio-geochemical impacts. Such extreme events particularly gained scientific attention in relation to the accelerating adverse impacts of global anthropogenic changes on the atmospheric and oceanic systems. The ongoing multi-platform observational facilities run by SOCIB provide a unique opportunity to trace such events and explore hypotheses and mechanisms to elaborate their occurrence. Other specific questions may be listed as follows:
1) What are the relative roles of the Northern Current and the fresh water induced coastal currents provided by the Ebro and Rhone Rivers to the buoyancy-induced boundary current system along the Catalano-Balearic (C-B) coast?
2) How and to what level do the frontal dynamics of this current system modulate the interior basin circulation of the C-B Sea under different atmospheric and other external forcings?
3) What are the main sources of nutrients and physical processes that support plankton production along the C-B coast?

To resolve these scientific questions, the MF coupled physical-biological model is implemented to the domain that extends from the northern Algerian basin (38oN latitude) in the south to the northern coast, and from the Catalan and French coasts on the west to the meridional section at 6.4oE longitude (Fig. 1). It is configured by an eddy resolving rectangular grid of 0.04º (3150 m) in the zonal direction and 0.025º (2775 m) in the meridional direction. In the vertical, the model grid has 29 non-uniformly-spaced vertical levels. The same model is then implemented to the south-western Mediterranean basin extending from the Gibraltar Strait to the 6oE longitude and from the African coast to 38ºN latitude.

Our present vision for the process modelling studies during 2015-2016 covers the integration of two sub-basin scale models into one single entity and to obtain a mesoscale resolving physical-biological model for the entire western Mediterranean to the west of 6ºE longitude. This model will therefore include dynamically and biologically very different sub-basins including Gibraltar Strait, Alborán Sea, Algerian Sea, Catalano-Balearic Sea, Iberian Shelf, Liguro-Provencal Sea and the Gulf of Lions.

Recent studies, based on the available long-term data, suggest a general warming trend in response possibly to anthropogenic-induced global warming (Criado-Aldenueva et al., 2010; Calvo et al., 2011). Although it is a very challenging modelling task to explore likely transformation of the physical and biological properties of the Western Mediterranean water masses, we plan to tackle this question, and run the entire WestMed circulation model, starting from the early 1970s and extend the simulation for a decade ahead for the 2020s.

4.3.7.2 Strategies and actions to achieve objectives

ONGOING ACTIONS

- New validation of the WMOP operational model using data such as gliders and HF Radar
- Validation of the WMOP operational model using data from the TOSCA cruise in the Ibiza Channel, October 2012. During such campaigns, an eddy formation has been monitored and relatively well simulated by WMOP. On going study aims to validate the WMOP outputs with the data and to understand the eddy formation using both data and numerical simulations
- Meteotsunamis assessment: a summer 2012 case study aims to deeply validate the simulations.
- Bio-Physical coupling (see above).
- The wave modelling related activities will be carried out step by step, assuring always the maintenance of the operational system.

NEW ACTIONS

Implement new computing power for sole operational needs.

- New data cruise (MEDES) will provide new data and good opportunities to validate the WMOP model.
- Inter-comparison between Mercator, MFS and MFS2 by using classical data and new data from SOCIB.
- Collaboration with Mercator-Ocean and the MFS group.
- Upgrade the computing infrastructure to support Modelling Facility objectives

4.3.7.3 Resources

INVESTMENT

A robust computer system is needed to support the forecasting systems and the current system requires upgrading with the addition of:

- A direct-attached storage system (DAS) exclusively dedicated for storing numerical models. 15,000 €
- A secondary login node for the HPC system, providing high availability system architecture. 5,000 €

PERSONNEL

Hire a new Post Doc to lead the facility, as approved in the Board of Trustees meeting (June 2013).

4.3.7.4 Timeline

Activity No.	Activity	Phase	Duration (months)	Start	
8	Maintain WMOP operational model	FOC	ongoing		
9	Maintain BRIEFS		ongoing		
10	Maintain Waves / PE		ongoing		
11	Extend Wave modelling operational system	FOC	6		July 2013
12	Seasonal hindcast WMOP Assessment	IOC	12		Dec 2013
13	Bio-Physical coupling, eddies impact regional circulation	IOC	12		Dec 2013

4.3.8 DATA CENTER FACILITY

4.3.8.1 Objectives 2013 – 2016

During the period from 2013 to 2016 the SOCIB DCF will continue with the development of phases 1 and 2, and will develop phase 3 (develop and implement extended data distribution capabilities) during the first semester of 2014, FOC in 2016. Accordingly, the main objectives are:

- Maintain and update the existing SOCIB infrastructure of data management
- Continue with the development of new data visualization solutions
- Implement the SOCIB Data Policy and make information available to data users who visit the SOCIB web site
- Develop web based information for the open access to selected SOCIB Facilities
- On-going improvement to the quality control procedures to respond to continued developments in scientific community good practice, some of which can be expected to be led by SOCIB
- Satisfy all the data distribution requirements specified in the Strategic Plan, including improving the initial work on data distribution, search, and discovery, providing solutions required by all groups of users

4.3.8.2 Strategies and actions to achieve objectives

ONGOING ACTIONS

Maintenance and update data management (OM)

- OM1 Define and implement of the workflow between the DCF and the other divisions and facilities
- OM2 Add support for CTD data received from the R/V SOCIB facility and it's oceanographic campaigns
- OM3 Continue support for the instrumentation needs derived from the activity of the facilities and ongoing or future projects
- OM4 Release of the improved version of the glider processing toolbox, adding support for both Seaglider and Slocum gliders
- OM5 Complete comprehensive documentation about the DCF architecture and the data management process, covering: software, technologies, tools, etc.

- OM6 Complement the DCF documentation with teaching material such as online tutorials, screencasts, and examples of use
- OM7 Add support for AIS data

Data visualization solutions (ODV)

- ODV1 Develop a new solution to visualize CTD data
- ODV2 Develop a web based application for oil spill emergency support
- ODV3 Provide a visualization solution to respond to the request from tourism partners for the display of beach monitoring products
- ODV4 Provide a visualization solution for AIS data

Quality Control procedures (OQC)

- OQC1 Produce a technical report describing the current state of the quality control procedures applied at SOCIB. Identifying deficiencies and new requirements from scientific and technical feedback received from the other SOCIB divisions, the international community and international conventions.
- OQC2 Implementation of the new proposals for Quality Control procedures according to the technical report

Data distribution (ODD)

- ODD1 Evaluate the viability of exploiting existent solutions in data discovery and distribution field such as: Geonetwork, Gi-cat, RAMADDA, ERDDAP, Esri Geoportal, Sextant
- ODD2 Participate actively in the international framework of projects
- ODD3 Implement the SOCIB Data policy

NEW ACTIONS

Maintenance and update data management (NM)

- NM1 Complement the DCF documentation with teaching material such as online tutorials, screencasts and examples of use

Data visualization solutions (NDV)

- NDV1 Implement an improved version of the SOCIB DCF web section. This section will include the previously discussed documentation about the DCF itself, teaching material, and data statistics.
- NDV2 Design and develop a data portal
- NDV3 Release a new version of the SOCIB corporate web site

Quality Control procedures (NQC)

- NQC1 Implementation of the new proposals for Quality Control procedures according to the technical report

Data distribution (NDD)

- NDD1 Provide data solutions for society specific sectors whose social and economic activities are related with oceanography and/or the marine environment.
- NDD2 Collaborate with other institutions in order to improve the interoperability and sharing of oceanographic data

4.3.8.3 Resources

PERSONNEL

During 2013 DCF will hire one web developer (already incorporated) and one team leader. The major duties of the web developer will be:

- Maintain the applications and web sites that are currently running at SOCIB
- Design, develop and provide new web solutions for the challenges proposed by the Data Center and the other SOCIB facilities

The major duties of the team leader will be:

- Manage the SOCIB DCF team of engineers to maintain and evolve the whole data management process lifecycle, from data ingestion to data visualization
- Coordinate the workflow between the DCF and the other SOCIB facilities.
- Take Responsibility for the definition, implementation, development and maintenance of the applications related to the data management process

The integration of the data collected by the 7 SOCIB facilities has meant that the DCF needs to hire 1 engineer to manage and maintain the QC and validation across these data sets. This work would be integrated with and across the different facilities, for example 40% GF data, 20% LF data, 20% R/V Facility data (in conjunction with the ships technician), 10% FSF data and 10% other facility data. This will unite the QC and validation processes across SOCIB and enable a centralised management of data QC protocols compliant with existing and emerging EU standards for oceanographic data.

4.3.8.4 Timeline

The following table describes, in general, all the work to be done by the DCF to achieve the SOCIB objectives; this information is public and can be downloaded at https://docs.google.com/document/d/1xArF_fR1GSA25e5vmCUn6hTN9FUaV2Vzb-knTHZw_-0.

Activity No.	Activity	Due time
	On going actions	
1	OQC1	1st trimester 2013
2	OM2	2nd trimester 2013
3	OM4	2nd trimester 2013
4	ODV1	2nd trimester 2013
5	ODV3	2nd trimester 2013
6	OQC2	3d trimester 2013
7	ODD1 and ODD3	3d trimester 2013
8	OM5	3d trimester 2013
9	OM6	3d trimester 2013
10	ODV2	4th trimester 2013
11	OM1	4th trimester 2013
12	OM7	1st trimester 2014
13	ODV4	1st trimester 2014
	New actions planned	
12	NM1	2nd trimester 2014
13	NDV1	3th trimester 2014

14	NDV3	1st trimester 2015
15	NDV2	2nd trimester 2015
16	NQC1	3d trimester 2015
	Permanent activities	
17	OM3	
18	ODD2	
19	NDD1	
20	NDD2	

4.3.9 ENGINEERING AND TECHNOLOGY DEVELOPMENT DIVISION

4.3.9.1 Objectives 2013 – 2016

- To continue providing an optimum service to SOS
- To support the Facilities in their operations and major developments, including the increases in the Fixed Station network

4.3.9.2 Strategies and actions to achieve objectives

ONGOING ACTIONS

The tasks that are the responsibility of the ETD currently are:

Background Responsibilities

- Maintain all instrument sensors in a calibrated and fit for purpose state
- Maintain all SOCIB vehicles in optimum conditions
- Give support to equipment and instrumentation on R/V SOCIB

Specific support to facilities

- Participate in glider launching and recovery missions
- Deployment and control of SVP and ARGO drifters
- Participate in SOCIB cruises (R/V SOCIB)

Station maintenance

- Sea Level Stations: Bi-annual maintenance of 3 stations (Andratx, Pollença and Sa Rapita)
- Buoys: Bi-monthly in-situ maintenance of Bahía de Palma Buoy and yearly buoy maintenance in harbour
- Coastal Station: Semi-annual maintenance of La Mola Coastal Station
- Weather Station: annual maintenance of 3 stations (Galfi, ParcBit and Ses Salines)
- MOBIMS: Participate in semi-annual campaigns in 3 locations (Cala Millor, Playa de Palma and Son Bou)
- Radar Stations: Semi-annual maintenance and biannual calibration of 2 radar HF stations (Ibiza and Formentera)

Support for other unforeseen incidents

NEW ACTIONS

New acquisitions and actions

- Update the 'Rissaga stations' from PortsIB (Porto Cristo, Colonia de Sant Pere, Cala Ratjada and Ciutadella) to SOCIB Sea Level Station's system.
- Installation of San Antonio Sea Level Station
- Installation of ocano-meteorological buoy (AXYS watchMate) in Ibiza Channel
- Installation of ocano-meteorological buoy (AXYS watchMate) in Formentera
- Incorporate the new instrument/platform acquisitions in the ETD maintenance schedule

4.3.9.3 Resources

INVESTMENT

The major expenditures for the period 2013-2016 cover the acquisition of elements for the maintenance and renewal of existing equipment and the calibration of instrument sensors.

	Investment
New SOCIB small van	30 000 €
Tools updating	10 000 €
Equipment updating	20 000 €
RIB maintenance	30 000 €
Sensors calibration	50 000 €
Instrument update & maintenance	80 000 €
	220 000 €

PERSONNEL

The work of the ETD Division is currently undertaken by a team of 3 ETD technicians and coordinated by a senior technician, provided in-kind by IMEDEA (CSIC UIB. The technicians have a range of instrumentation expertise that provides support for the maintenance of SOCIB's fixed stations, HF Radar location infrastructure, glider deployment and recovery, BMF field campaigns and beach monitoring stations and who collaborate in measurement campaigns on board the R/V SOCIB. The new ships technician to be hired for the R/V Facility will be a part of the ETD technical team and will also work closely with the DCF. This technician will have a background that includes oceanographic instrumentation issues, and also a good knowledge of computer systems; one of their primary tasks will be to maintain the operation of all scientific systems on R/V SOCIB, including maintaining the IT network and the instrumentation for continuous measurements etc.

SPACE / WORKSHOP

Space for the ETD Workshop is currently provided in-kind by IMEDEA, ETD will move when SOCIB has developed its own technical space/workshops.

4.3.9.4 Timeline

The work of ETD Division is primarily driven by supporting the observing Facilities and thus by their timelines.

4.3.10 SIAS DIVISION

4.3.10.1 Objectives 2013 – 2016

- To provide science based support for implementation of the MSFD
- To maintain and develop tools for ICCM.
- To connect these activities with appropriate regional stakeholders

4.3.10.2 Strategies and actions to achieve objectives

ONGOING ACTIONS

- In the short term a paper or short communication will be dedicated to the work done related to environmental sensitivity in the coast line of the Balearic Islands, work that was started in the year 2004
- A scientific work about marine pollutant risk, linking it to: a) AIS data (Automatic Identification System) of the big ships, showing areas of high probability of maritime accidents, b) information of the and c) currents and waves
- SIAS Division Web page will be further developed with details on current work and projects, especially those sections indicated as "in construction"
- Two papers will be shortly submitted to a special issue of 'Ecology and Society' about the implementation of the MSFD and MSP. In preparation within the context of SOCIB's collaboration with the FP7 project KnowSeas.

NEW ACTIONS

- Digital atlas of the marine and coastal zone (Coastal Atlas) and a new cartographic visor with socioeconomic, bio-ecologic and geomorphologic information, related to the ICMM.
- A cumulative pressure assessment in Alcudia Bay as a pilot case study to support the implementation of the Marine Strategy Framework Directive and the new proposal of a Directive on Marine Spatial Planning and Integrated Coastal Management
- An integrated study of maritime traffic using AIS data in order to evaluate the capabilities of this system to provide new indicators related to the MSFD and MSP Directives
- Spatial characterization of the main hubs or hotspots of the coastal area of the Balearic Islands (e.g. Bay of Palma, Bay of Alcudia – Pollença, coasts of Mahón, Southeastern and Western coast of Ibiza, Formentera, etc.)
- Solving of specific problems affecting environmental and economic sustainability of the coastal area of the Balearic Islands

4.3.10.3 Resources

No major investments are foreseen for SIAS, however a dedicated scientist will have to be hired to lead the Division, replacing the science lead who left in 2012.

4.3.10.4 Timeline

For the period 2013-2016 the SIAS will be reorganized and additional external funding will be secured.

4.3.11 OUTREACH

4.3.11.1 Objectives 2013 – 2016

The main objectives of 2013 focus firstly on providing continuity to activities that require constant updating such as: news, social networking, the SOCIB Newsletter and translations etc. Secondly on specific actions such as participation in the Science Fair and Forum, participation in the International Ocean Film (Maremostra), tracking SOCIB's 2013 campaigns (Bluefin, installation of new instruments, etc.) and in each case providing new content and outreach material, mainly for SOCIB's Web site.

In addition, during 2013 we plan an improvement to SOCIB's web design, including the development of new multimedia content generated during the science campaigns and the integration of SOCIB's YouTube video channel in the multimedia tab. A proposal for the design and publication of a new HTML Newsletter will be presented and discussed; this effort is to develop the users mailing list and an automated subscription service. A new 2nd version of the Newsletter will be supplied directly through news published on the Web site to enable greater efficiency and convenience for our readers.

More specifically, a special effort will be undertaken by Outreach SOCIB to present SOCIB facilities, services and products in the form of posters and/or micro videos to different key stakeholders. Amongst others, the tourism sector (HF radar and beach monitoring facilities in particular), and the importance of science for sustainable 'blue' growth in the Balearic Islands.

4.3.11.2 Strategies and actions to achieve objectives

ONGOING AND NEW ACTIONS

A list of the Outreach Services future activities and key milestones is presented below:

- Update content and design of SOCIB's website
- Continue News publication
- Develop a specific Outreach section on the SOCIB web site including an outreach archive
- Generate specific Micro-Documentaries for the SOCIB facilities. Examples: SOCIB's Research Vessel operations and specific campaigns, fixed stations facilities, a Bluefin Tuna documentary, etc.
- Attendance at future technological forums and science fairs. Examples: Forotec 2013, Science week 2013, etc.
- Public presentation of the "Glider Educational Tool" – June, 2013. Engagement of schools though a focused website with adapted outreach material for both teachers and students
- CosmoCaixa 2013 "Mediterranean", presentation of a specific multimedia application – October 2013

- Meteo-tsunamis 3d animation / Rissagues (3d animation with LADAT). Release planned for June 2013. Duration: 3' approx.
- Engagement with specific sectors: fishermen, marine sports, marinas, tourists, etc.
- Target different categories of stakeholders, in order to engage them in SOCIB's mission and activities and promote SOCIB's stakeholder/society relevant products as developed by the Facilities
- Increase the number of visitors to SOCIBs web site, within scientific, general public interest and specific society groups

4.3.11.3 Resources

No major resources requirements are foreseen for the Outreach Service.

4.3.11.4 Timeline

Activity	Duration (months)	Start	End
Update WEB content	12	Jan 2013	Dec 2013
Upgrade WEB design and implementation of a Multimedia Tab	3	Jan 2013	Mar 2013
Maintain SOCIB news	12	Jan 2013	Dec 2013
Micro-Documentaries – SOCIB & Bluefin Tuna	6	Jun 2013	Dec 2013
Newsletter (V1 -> V2)	6	Mar 2013	Sep 2013
Forotec 2013 (to be confirmed)	1	Nov 2013	Nov 2013
Produce the Glider Educational Tool	6	Jan 2012	May 2013
LADAT Coordination Tasks	6	Jan 2012	Jun 2013
Social Network Updates	12	Jan 2013	Dec 2013
Cataloging and improvement of SOCIB's Graphic Archive – Phase II, Metadata inclusion	12	Jan 2013	Dec 2013

4.3.12 COMPUTING AND IT SERVICE

4.3.12.1 Objectives 2013 – 2016

The primary objective of the Computing and IT service is to ensure that all data (raw data, processed data, derived data) are managed and stored in a proper way following good practice and a duty of care, allowing its wider and further access into the future. The main objectives of the Computing & IT Service are:

- Store and organize data, making them accessible and available for further retrieval and users. Archiving of historical and current datasets in an appropriate format and service as demanded, ensuring both effective data archiving and access

- Establish a high performance computing system allowing the execution of complex numerical models to simulate oceanographic and meteorological processes. Providing information such as analyses and forecasts of different environmental variables
- Support the other facilities
- Ensure affordability, efficiency and longevity of the computing system
- Effective management of IT resources
- Ensure broad accessibility, from all set of users and systems
- Data circulation and availability for end-users

4.3.12.2 Strategies and actions to achieve objectives

ONGOING ACTIONS

- Implementing a cloud backup system
- An external placement for the backup system will be implemented to improve data safety in case of a catastrophic event destroying the main storage system
- Establish a full operating R/V computing system

NEW ACTIONS

- Develop a mechanism to obtain feedback from researchers and technicians
- Expand redundant and parallel communication pathways to critical systems in order to avoid dependencies on a single infrastructure external provider (e.g. UIB)
- Create the Computing & IT site for the SOCIB webpage
- Upgrade the HPC system with an additional login node for pre and post-processing tasks.
- Define a new data policy (data access and distribution). Study different alternatives for controlling user access.
- Establish additional web services: wiki, personal pages (blog), etc.

4.3.12.3 Resources

No major investment requirements are foreseen for the Computing and IT Service, however the hire of an additional IT engineer to support the work of the Computing and IT Service is needed.

4.3.12.4 Timeline

This table summarizes the main actions to achieve through 2013 from the Computing and IT service.

Activity	Duration (months)	Start	End
Establish R/V computing system	**8**	**Jan 2013**	**Aug 2013**
Cloud Backup System	**4**	**May 2013**	**Aug 2013**
External Backup System	**6**	**May 2013**	**Oct 2013**
Implement user feedback	**3**	**Sep 2013**	**Nov 2013**
Redundant parallel communication pathway	**6**	**Nov 2013**	**May 2014**
Computing & IT site	**3**	**Aug 2013**	**Oct 2013**
Upgrade the HPC System	**6**	**Jun 2013**	**Dec 2014**

Data policy and user access	**12**	**May 2013**	**Oct 2014**
Establish web additional services	**12**	**Jan 2013**	**Dec 2014**

4.3.13 MANAGEMENT AND FINANCE SERVICE

4.3.13.1 Objectives 2013 – 2016

The objectives for the Management and Finance Service for the period 2013 remains the same; the management of the purchasing process, including specific rules governing the spending of public funds, management of suppliers and associated contracts, tender processes and public calls, inventory and management of installations; the general finance which includes managing financial budgets and annual accounts, auditing and public accountability, and creation of financial statements.

The Management and Finance Service will also remain responsible for the creation of annual accounts (Balance sheets, statement of losses and gains, and retained earnings) and management reports; specifically the management of contracts, social security payments and compliance with health and safety at work legislation (prevención de riesgos laborales), and finally the fiscal duties, which includes the management of financial assets and the timely payment of all relevant taxes.

4.3.13.2 Strategies and actions to achieve objectives

Ongoing actions as required to fulfil the above management and financial objectives.

4.3.13.3 Resources

No major resources requirements are foreseen for the Management and Finance Service.

4.3.14 OFFICE OF THE DIRECTOR

4.3.14.1 Objectives 2013 – 2016

OD aims to steer/develop strategy for the new operational phase, whilst improving and strengthening areas as required. The key elements of this strategy are outlined in the previous section and the focus of the Office of the Director will be on achieving this with the following Office of the Director specific objectives:

- Education: Initial steps have been made to provide specific educational courses, ideally at the level of an MSc. This will be carried out in collaboration with the University of the Balearic Islands (UIB).

- Expand internationally: enhancing the multi-platform SOCIB approach, key elements are the EC's Horizon 2020 Program, the Blue Growth Strategy, and ESFRI. Further away, more effort will be dedicated to integrate or create links with similar ocean observing initiatives such as those in the USA, Canada and in Australia.

- New building: seek agreement for a new SOCIB combined technical/office space, effort will be devoted in this direction over the next few months.

- Negotiations regarding operational funding: the OD will dedicate more effort to finding new sources of funding, and widening the funding portfolio. Also key is to address and solve the frozen salaries situation in 2013 as well as the needs for new seven positions.

- Initiating the annual/bi-annual SCC Meetings, first planned for Nov-Dec 2013

- Ensuring SOCIB data gains the correct recognition and SOCIB Data Policy principals are upheld within external data portals

- Improve and develop a career trajectory within SOCIB, in particular to provide adequate recognition for technical and engineering work

4.3.14.2 Resources

No major investment requirements are foreseen for the Office of the Director, however additional sources of funding will be sought by the office of the Director for SOCIB infrastructure and operations.

A new senior scientist support will be hired to help support work of the Office of the Director, including co-ordinating and managing a multidisciplinary observational science programme, and to support the development of a highly attractive PhD programme that encourages the brightest graduates from within Europe and worldwide. This position is currently published (June 2013).

A new scientist to support multi-platform facilities integration will be hired to work on the data exploitation and synergies from the different facilities (initially, gliders and R/V) and to support knowledge transfer activities between SOCIB and its governmental, policy-advising, public and private stakeholders,

4.3.14.3 Timeline

- Official operational status as an ICTS Jul 2013
- Hire of senior scientist facilities support and international coordination Sep 2013
- Hire scientist multi-platform integration, glider data exploitation and response to stakeholders needs Nov-Dec 2013
- First Scientific steering committee meeting Nov-Dec 2013
- Revise R/V Agreement Dec 2013
- Develop proposal for SOCIB technical career path Jan 2014
- Secure agreement for new centralised office and technical location Dec 2014
- Education program agreement with UIB end 2014
- Education program start UIB Sep 2016

4.3.14A THE BLUEFIN TUNA PROJECT – FOCUSED PROJECT UNDER OFFICE OF THE DIRECTOR

4.3.14a.1 Objectives 2013 – 2016

Ob.1. To develop an operational model for the location of Bluefin spawning areas in the Balearic Sea: An operational model showing the spatial probability of the location of Bluefin tuna spawning grounds will be developed based on sea surface temperature and geostrophic currents. Studies developed during this project (Reglero et al. 2013) have shown the relevance of these two variables on the spatial distribution of the Bluefin tuna spawning grounds. Operational data from remote sensing and hydrodynamic models providing this environmental information will be used as input to statistical models for near real time assessment of the location of the spawning areas

Ob.2. To assess the viability of the Atlantic Bluefin tuna larvae in different environmental scenarios in the Balearic Sea: The relationship between the viability of Bluefin Tuna larvae to reach the post-flexion stage, as a proxy for recruitment, and the environmental conditions will be analysed. This analysis will consider the growth of the Bluefin tuna larvae, the oceanographic scenarios and the spatial overlap of Bluefin tuna larvae with their potential prey and predators. Results will be applied to assess the larval survival rates in the Balearic Sea.

Ob.3. To collect in situ data for the validation of operational models assessing the location of spawning areas and larvae dispersal: Fieldwork campaigns will be continued to obtain in situ data for addressing objective 2. Plankton tows and hydrographic data will be collected following two different sampling strategies: sampling stations located in a standard grid used in previous campaigns and sampling stations near frontal areas with high abundance of Bluefin tuna larvae.

Ob.4. To analyse the relevance of mesoscale oceanographic features on the spawning ecology of Bluefin and other tuna species in a broad geographical context: The relationship between the spawning distribution of Atlantic Bluefin Tuna and the local oceanography has been demonstrated in the Balearic Sea and the Gulf of Mexico. These results show the importance of operational oceanography for the study and management of this species. We will assess if this relationship is relevant also for other tuna species and other spawning areas at the global scale. This analysis will be based on data provided by operational oceanography data servers across the globe and literature searches providing information about the location of tuna species spawning areas around the world.

4.3.14a.2 Strategies and actions to achieve objectives

ONGOING AND NEW ACTIONS

A.1. Development of an operational model to estimate the location of Bluefin spawning areas in the Balearic Sea.

A.1.1 Process timeseries of altimetry remote sensing data with most recent algorithms developed for the Balearic Sea. Build timeseries of sea surface data from recent reanalysis of hydrodynamic models.

A.1.2 Development of statistical models relating the location of spawning grounds and the environmental conditions obtained from satellite and hydrodynamic models.
A.1.3 Apply the models developed in 1.2 with near real time operational data.
A.1.4 Development of software tools to produce an operational system based on 1.3

A.2. Assess the viability of the Atlantic Bluefin tuna larvae in different environmental scenarios in the Balearic Sea.
A.2.1 Analysis of the vertical distribution of Bluefin tuna larval abundance in relation to hydrographic variables. This analysis will be conducted using data collected with the MULTINET and MOCNESS samplers and the CTD profiles.
A.2.2 Evaluation of how environmental scenarios drive the spatial overlap of Bluefin tuna larvae with their potential prey and predators.
A.2.3 Estimation of the trajectories of the Bluefin tuna larvae after hatching from a particle tracking model to assess the viability of the larvae in different environmental scenarios.
A.2.4 To develop an Individual Based Model able to simulate larval survival rates in relation to biotic and abiotic factors. The parameterization should consider data available from bibliography, our own field observations, and rearing experiments.
A.2.5 To develop a model combining the information provided by activities 2.2, 2.2, 2.3 and 2.4 useful for assessing the viability of the larvae in different environmental scenarios.

A.3. Collection of in situ data for the validation of operational models forecasting the location of spawning areas and larvae dispersal.
A.3.1 Conduct field sampling campaigns during summer 2013 and 2014 to collect Bluefin tuna larvae and hydrographical data in the Balearic Sea using the standard sampling grid used in previous years.
A.3.2 Process hydrographical data from sampling campaigns
A.3.3 Process biological data (species identification, abundance and size distributions) from sampling campaigns.
A.3.4 Comparison of data from the field and operational model predictions to evaluate the reliability of the models

A.4. Examine the relevance of mesoscale oceanography on the spawning ecology of Bluefin and other tuna species in a broad geographical context.
A.4.1 Compile larval presence-absence data of tuna species at a global scale from scientific bibliography and fisheries reports.
A.4.2 Compile environmental data of sea surface conditions (sea surface temperature and eddy kinetic energy) at a global scale from public data servers.
A.4.3 Development of statistical models to analyse the effects of mesoscale oceanography on the location of the spawning ground of different tuna species at this global scale.

	2013		2014		2015		2016	
Activity	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half
A.1.1	X	X	X	X				
A.1.2					X	X		
A.2.1		X	X	X				
A.2.2		X	X	X				
A.2.3		X	X	X				
A.2.4	X	X	X					
A.2.5		X	X	X	X			

A.3.1		X		X				
A.3.2		X		X				
A.3.3		X	X	X	X	X		
A.4.1	X	X	X					
A.4.2	X	X						
A.4.3		x	x					

Results obtained along the activities 1 to 4 will be disseminated among relevant stakeholders related to the Atlantic Bluefin Tuna management, exploitation, research and conservation. Scientific results will be presented in forums related to the fishing industry, submitted to international research journals and presented to managers on the Standing Committee on Research and Statistics (SCRS) from the International Commission for the Conservation of Atlantic Tuna, responsible for the conservation of tunas and tuna-like species in the Atlantic Ocean and the Mediterranean.

4.4 RESOURCES REQUIRED AND ANTICIPATED

4.4.1 FINANCIAL

The SOCIB funding levels for 2013-2016 are currently set in line with the general funding agreement for SOCIB (that goes in principle until 2021); (see Table 4.4.a. below):

ANNUAL CONTRIBUTIONS TO SOCIB: 2013-2016				
(Ref. BOE 83, 5 April 2008)			2015	2016
OPERATIONS AND PERSONNEL	2,020,636.00 €	2,059,652.00 €	2,099,446.00 €	2,140,038.00 €
INVESTMENTS	104,828.00 €	104,828.00 €	104,828.00 €	104,828.00 €
TOTAL	2,125,464.00 €	2,164,480.00 €	2,204,274.00 €	2,244,866.00 €

Table 4.4.a: Funding levels for 2013 - 2016

The funds for operations increase by a small, predetermined amount each year (approximately 40,000€ for example operational funds rise to 2,059,652€ for 2014) and cover both personnel and operations.

SOCIB has some investment funds reserved for already approved purchases:

- AUV – est. 847.000€
- High Performance Computing - est. 363.000€
- 2 gliders - est. 363.000€

SOCIB will seek to broaden our funding base, through for example securing EU funding and/or exploiting our IP through commercial opportunities and partnerships, however this will take time to develop and is possibly beyond the 2016 horizon of this document. Therefore the strategic plan for 2013-2016 is envisioned under the financial future outlined above, that is to say our objectives will be achieved within the same levels of funding that we currently receive, which means in real terms, once inflation is taken into consideration, achieved under an overall decline in funding from 2013-2016.

4.4.2 PERSONNEL

Approval has already been given for the hire of 5 new people in 2013 (Executive Commission Nov 2012 and Board of Trustees June 2013), all of which will be replacing personnel who left in 2012. The new personnel are:

- Informatics engineer for the DCF to lead web based product and service development, already commenced May 2013, replacing the engineer who left in September 2012.
- Data Centre Manager to lead the DCF, replacing the engineer who left April 2012.
- Senior ships technician to manage oceanographic equipment on board the R/V SOCIB, replacing a technician who left in January 2013.
- Modelling Facility Team Leader to further define and lead the ongoing development of the Modelling Facility, replacing the postdoc who left in May 2013.

- Facilities Coordinator and Project manager. A new role directly linked to the Operational Phase, to coordinate advancements across the SOICB facilities and services, this post is already published on the SOCIB web site.

In addition in the Operations phase, the actions foreseen for 2014 – 2016, will require the ongoing recruitment of the following 7 personnel:

- A scientist to support multi-platform integration and stakeholders response.
- A technician for the GF to support glider operations and monitoring of a second endurance line
- A postdoc for the HF Radar Facility
- An engineer for central data QC and validation role in the DCF
- A computing engineer for the BMF
- A scientist to lead the SIAS division (replacing the scientist who left in 2012)
- An engineer to support the work of the Computing and IT Service

SOCIB Personnel	End 2013	End 2014
Financial Manager	1	1
Team Leader	4	5
Office of the Director Coordinator	1	1
Engineer	6	9
Technician (advanced)	4	6
Technician (standard)	4	4
Scientific Expert	1	1
Scientist	0	2
Administration Assistant	1	1
TOTAL	**23**	**30**

The tight restrictions with regard to personnel salaries, due to the current economic situation in Spain, mean that SOCIC faces real recruitment issues. Although we offer a flexible working environment, training opportunities and the rapid career development and early responsibility that exists within a small, developing organisation, the fact remains that SOCIB currently finds it difficult to hire the highly skilled personnel (intellectual capital) it requires to develop a leading edge organisation. As the skilled team members that SOCIB seeks do not match the salaries that we are authorised to offer and frequently we are not competitive in the employment market place.

4.4.3 SPACE

The IP2010 described the need for a new building with sufficient space to hold the laboratories, warehouses, offices and the Data Center of SOCIB, all of which are currently spread across several different buildings (ParcBit and IMEDEA). Work is currently being undertaken in the Office of the Director with Autoridad Portuaria de Balears (Palma harbour) to secure a location for a combined SOCIB office/technical space (with 600 m2 and 1.400 m2 respectively).

Refurbishment of the building is likely to be considered and for this, regional European Funds (FEDER) will be needed. Discussions with the Balearic Government are well advanced and the RIS3 Strategies frame also provides good opportunities. At this stage however the negotiations are not yet far enough advanced to provide details.

4.5 TIMELINE AND MAJOR MILESTONES

This is a timeline for the major milestones foreseen across SOCIB Facilities, Divisions, Services and Office of the Director:

- Focus Strategy phase 1 ..... Jan 2013-Dec 2013
- Focus strategy phase 2 ..... Jan 2014-Jun 2015
- Focus strategy phase 3 ..... Jul 2015-Dec 2016

1) Deploy Canal de Ibiza deep mooring ..... Jun 2013
2) Launch new BMF hotel/tourism sector product ..... Jul 2013
3) BMF introduction to stakeholders meetings (coastal managers) ..... Jul 2013
4) Launch of a new data visualisation tool ..... Jul 2013
5) SOCIB to gain official operational status as an ICTS ..... Jul 2013
6) Hire new technician for ships equipment and data ..... Sep 2013
7) Hire Data Center Facility team leader ..... Sep 2013
8) Hire senior scientist ..... Oct 2013
9) Initiate outreach campaign to increase SOCIB web visitors ..... Oct 2013
10) Update computing system for M&FF ..... Oct 2013
11) Second GF Open Access project (JERICO TNA 2nd Call) ..... Oct 2013
12) Hire scientist to enhance cross platform exploitation of data sets ..... Oct 2013
13) Hire M&FF Team Leader (postdoc) ..... Nov 2013
14) Advertise R/V SOCIB Open Access capability COCSABO/SOCIB web ..... Nov 2013
15) Upgrade to SOCIB App (GF, FSF and BMF data) ..... Nov 2013
16) Integration of PortsIB 'Rissagues System' ..... Nov 2013
17) First Scientific Steering Committee meeting ..... Nov 2013
18) Call for 2014 glider days at sea open access ..... Nov 2013
19) Revise R/V Agreement (SOCIB, IEO, CSIC) ..... Dec 2013
20) Update Beach Data Viewer to include current BMF data ..... Dec 2013
21) Development of web based wave and beach safety tool ..... Dec 2013
22) Hire new data QC and validation engineer (DCF) ..... Dec 2013
23) Bio-Physical coupling modelling development ..... Dec 2013
24) Launch Oil Spill application ..... Dec 2013
25) Two-way coupling with Puertos del Estado network ..... Dec 2013
26) Coordinate, with IEO, the Spanish participation in Euro-Argo ..... Dec 2013
27) Secure agreement for new centralised office and technical location ..... Dec 2013
28) Annual purchase and deployment of lagrangian drifters 2014
29) Annual purchase and deployment Argo Profilers 2014
30) Hire of new postdoc to exploit and integrate HF Radar data 2014
31) Hire computing engineer for the BMF video tools 2014
32) Hire science lead for SIAS Division 2014
33) Launch web site for marine recreational users (FSF data) 2014
34) Purchase 2 new gliders ..... Jan 2014
35) Hire new glider operator ..... Jan 2014
36) Increase monitoring level along first endurance line, EL1 ..... Jan 2014
37) Commence SOCIB annual R/V monitoring activity ..... Jan 2014
38) Integration of biogeochemical data in FSF web page ..... Mar 2014
39) Local stakeholder meetings (in conjunction with facilities) ..... Mar 2014

40) Integrate QC for biogeochemical data sets ..... Mar 2014
41) Data Center Facility phase 3 operational ..... Mar 2014
42) HF Radar glider/drifter validation experiment..... Mar 2014
43) Analysis of HF Radar QC/LAVAL Project ..... Sept 2014
44) Trials of automated glider piloting system ..... Nov 2014
45) Call for 2015 glider days at sea open access..... Nov 2014
46) SOCIB/UIB Education program agreement ..... end 2014
47) Secure additional funding for SIAS 2015
48) Annual purchase and deployment of lagrangian drifters 2015
49) Annual purchase and deployment Argo Profilers 2015
50) Unravelling RIP Current dynamics..... 2015
51) Develop SOCIB R/V outreach for schools and UIB..... 2015
52) Test protocol to modify Argo sampling strategy ..... Jan 2015
53) Initiate second glider endurance line, EL2..... Jan 2015
54) Commence HF Radar data assimilation in WMOP ..... Jan 2015
55) Release updated SOCIB web site, with focused end user access ..... Mar 2015
56) Develop commercial data product project ..... Sep 2015
57) Call for 2016 glider days at sea open access..... Nov 2015
58) Model to estimate spawning grounds of BFT ..... Dec 2015
59) Annual purchase and deployment of lagrangian drifters 2016
60) Annual purchase and deployment Argo Profilers 2016
61) Operational implementation of data assimilation in WMOP..... Jun 2016
62) Commence SOCIB/UIB MSc Education Program ..... Sep 2016

SOCIB Balearic Islands Coastal Observing and Forecasting System

5 DIRECTORS VIEW / CONCLUSIONS

5. Directors view/conclusions

New monitoring technologies are key components of recent ocean observatories or observing systems being progressively implemented in many areas of the world oceans. As a result, new capabilities to characterise the ocean state and its variability at small scales exists today in many cases in quasi-real time.

SOCIB, the Balearic Islands Coastal Ocean Observing and Forecasting System, is one such ocean observatory, a new multiplatform observing and forecasting system, a facility of facilities extending from the nearshore to the open sea. The SOCIB proposal, fully in line with Nature ed., Vol. 450, Issue 7171, 6 Dec. 2007, was submitted to the Spanish Large Scale Infrastructures Programme in 2006 and was later approved in 2008. SOCIB is unique among the new observing and forecasting systems in that its mission and objectives are science, technology and society driven. Together with NANOOS in the US, it is one of the few examples that run from the coastline to the open ocean.

The SOCIB Design Phase spanned from 2009 to 2010 and was followed by the Construction Phase that formally ended in December 2012. Simultaneously, t**he Operational Phase commenced in 2012** when the different facilities have started to provide operational data and modelling services through the SOCIB THREDDS catalogue[25]. In June 2013 eight major facilities are now operational at SOCIB, from the open ocean waters to the Balearic beaches: a new coastal catamaran (24 m LOA), a 12 MHz long range HF radar system in the Ibiza channel, coastal and open ocean gliders, Lagrangian platforms (Argo and drifters), Fixed stations (moorings and coastal stations), Beach Monitoring, Modelling and Forecasting and the essential and core Data Centre. A recent description of activities and results can be found in Tintoré et al., (2013).

The real challenge for the next decade is the integration of theses technologies and multiplatform observing and forecasting systems to (a) routinely monitor the variability at small scales (e.g. mesoscale/weeks) in order (b) to resolve the sub-basin/seasonal and inter-annual variability and by this (c) establish the decadal variability, understand the associated biases and correct them. In other words, the challenge is to advance from small to large scales since the new observing and forecasting systems now allow this major change in our focus of ocean observation.

The strategy for this implies selecting key control sections (Heslop et al., 2012) in coastal/open ocean regions, major straits or channels (e.g. Drake passage (Meredith et al., 2011), Atlantic MOC monitoring Rapid Array and Rapid Watch at 26 N (Matei et al., 2012; MaCarthy et al., 2012) for routine monitoring of these control or choke points to establish ocean state and variability, evaluating for example the relevance of mesoscale activity, shelf/slope exchanges, etc.

The optimal design of an observational network in the world oceans is also a challenge that will need to combine the sound and relatively well established key ocean areas (the hot spots of ocean dynamics and ecosystem response), with existing and or relocatable systems. The new capabilities of Observing Systems Simulation Experiments (OSSE) will be most helpful in (1) establishing how well the different platforms contribute to characterize coastal ocean state and variability, (2) examining the interactions and impacts between coastal and open ocean and (3) studying the processes and factors that control the accuracy of the

[25] http://thredds.socib.es/thredds/catalog.html

reconstruction of the oceanic state. The strategy would imply using OSSE to subsample the oceanic fields in order to quantify the errors in the reconstruction of the ocean state and the ocean variability.

Responding to society needs. It is also important to mention the impact of theses new multi-platform systems or marine infrastructures on society driven objectives. An excellent review of the science and society challenges in the US in 2030 can be found in Committee on an Ocean Infrastructure Strategy for U.S. Ocean Research in 2030 (2011) and in Europe, in the recent report from the Marine Infrastructures Working Group (European Commission, 2013). An example of this society driver is the monitoring needed by the implementation of the Marine Strategy Framework Directive (MSFD), the marine pillar of the Integrated Maritime Policy in Europe. One of the aims of IMP is to offer a more coherent approach to maritime and marine affairs and an improved coordination between relevant actors and sectors, by this contributing to establish the potential of the seas and oceans for growth and jobs. More specifically, the implementation of the MSFD requires (1) an Initial Assessment of the present status (carried out in 2012) to guarantee the achievement of (2) Good Environmental Status by means of specific actions that include (3) Monitoring Programs (to be implemented in 2014) and detailed (4) Programs of management measures (2014). Multi-platform systems, by integrating different types of monitoring platforms at different scales, and by this, providing data and tools, contribute to MSFD pressures and states indicators.

Finally, the development of tools for routine analysis of the results from these new multiplatform observing and forecasting systems is also a real challenge. The impact of these new systems cannot be overlooked and it is important we face and prepare ourselves and the forthcoming generations.

To conclude, SOCIB is a major achievement executed in budget and following the detailed IP2010. There are however two issues that will need to be addressed satisfactorily in the very near future, now that the Operational phase is reached and that all data are available. (a) New building: the consolidation of the dispersed SOCIB locations into a new combined technical and office location. A specific proposal is being discussed and its success is of outmost importance. (b) Personnel salaries and new personnel: again, the consolidation of the excellent SOCIB team that has made it possible to reach the present stage is a critical requirement. For this, salaries need to be increased to reach similar levels to other ICTS in operation. At the same time, some specific project based new staff are also needed for the 2014-2016 period to undertake the crucial development of products and services for stakeholders.

In summary, SOCIB is now part of a new type of marine infrastructures worldwide, new multi-platform systems that are establishing new ways of international cooperation that will lead to major science breakthroughs, innovations in oceanographic instrumentation and new ways of science based coastal and ocean management.

References:

Committee on an Ocean Infrastructure Strategy for U.S. Ocean Research in 2030, 2011: Critical infrastructure for ocean research and societal needs in 2030. National Research Council. National Academies Press. 98 pp. ISBN 978-0-309-18603-2.

European Commission. 2013. Towards European Integrated Ocean Observation. Expert Group on Marine Research Infrastructures. Final Report. 96 pp. ISBN978-92-79-27319-3. doi: 10.2777/29343.

Heslop E., Ruiz, S., Allen J., Lopez-Jurado, J.L., Renault L., Tintoré, J: 2012: Autonomous underwater gliders monitoring variability at “choke points” in our ocean system: a case study in the Western Mediterranean Sea. Geophys. Res. Lett. . VOL. 39, L20604, doi:10.1029/2012GL053717.

Matei D., Baehr J., Jungclaus J.H., Haak H., Muller W.A., Marotzke J., 2012: Multiyear Prediction of Monthly Mean Atlantic Meridional Overturning Circulation at 26.5°N. Science. 335, 76-79.

McCarthy, G., E. Frajka-Williams, W. E. Johns, M. O. Baringer, C. S. Meinen, H. L. Bryden, D. Rayner, A. Duchez, C. Roberts, and S. A. Cunningham, 2012. Observed interannual variability of the Atlantic meridional overturning circulation at 26.5_N, Geophys. Res. Lett., 39, L19609, doi:10.1029/2012GL052933.

Meredith, M. P., et al., 2011: Sustained monitoring of the Southern Ocean at Drake Passage: Past achievements and future priorities, Rev. Geophys., 49, RG4005, doi:10.1029/2010RG000348.

Tintoré, J., Vizoso, G., Casas, B., Heslop E., Pascual, A., Orfila, A., Ruiz, S., Martínez-Ledesma, M, Torner, M., Cusí, S., Diedrich, A., Balaguer, P., Gómez-Pujol, L., Álvarez-Ellacuría, Gómara S., Sebastian K., Lora, S., Beltrán, J.P., Renault L., Juzà, M., Álvarez, D., March, D., Garau, B., Castilla, Cañellas, T., C., Roque, D., Lizarán I., Pitarch S., Carrasco M.A., Lana, A., Mason E., Escudier R., Conti, D., Sayol, J.M., Barceló, B., Alemany, F., Reglero, P., Massuti, E., Velez-Belchí, P., Ruiz, J., Gómez, M., Álvarez, A., Ansorena L., Manríquez, M., 2013: SOCIB: the Balearic Islands Observing and Forecasting System responding to science, technology and society needs. Mar. Tech. Soc. J., Vol. 47, N. 1. 17 pp.

SOCIB Balearic Islands Coastal Observing and Forecasting System

ANNEXES

6

6. Annexes

6.1 A1: Journal of Marine Technology Society Paper

(see Tintoré et al., 2013, enclosed pdf)

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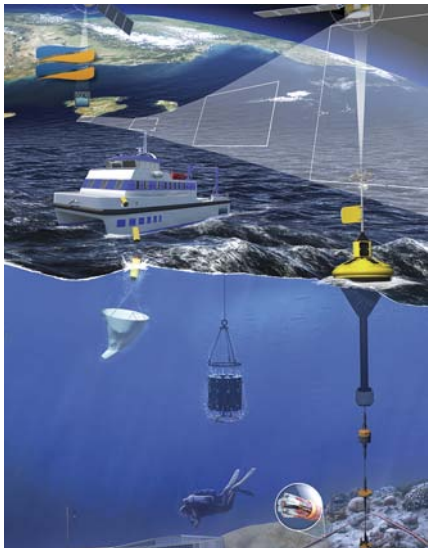
Volume 47 Number 1 January/February 2013

The Breadth of the Marine Technology Society



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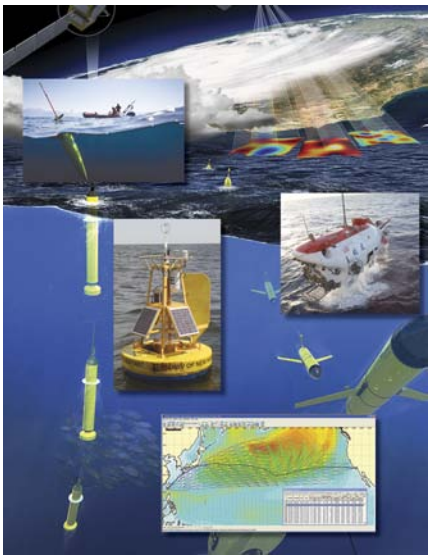

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The Breadth of the Marine Technology Society

In This Issue

In This Issue

PAPER

SOCIB: The Balearic Islands Coastal Ocean Observing and Forecasting System Responding to Science, Technology and Society Needs

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ABSTRACT

New monitoring technologies are being progressively implemented in open-ocean and coastal observatories. The Mediterranean Sea is a well-known, reduced-scale ocean, an ideal natural laboratory to study global ocean processes, in particular those associated with meso- and submesoscale variability, interactions with mean flows and associated ecosystem response. SOCIB, the Balearic Islands Coastal Ocean Observing and Forecasting System, is one of such observatories, a multi-platform distributed and integrated system, a facility of facilities that extends from the nearshore to the open sea. SOCIB profits from the strategic position of the Balearic Islands at the Atlantic/Mediterranean transition area, one of the "hot spots" of biodiversity in the world's oceans, and also of societal needs in islands where preservation of the environment is essential to assure both residents' welfare and the competitiveness of the tourist sector. SOCIB is unique in that, from peer-reviewed excellence, its mission and objectives are science-, technology-, and society-driven. These types of new marine infrastructures, because of their critical mass and sustained funding, are presently establishing new ways of international cooperation, leading to major science breakthroughs, innovations in oceanographic instrumentation, and new ways of more efficient and science-based coastal and ocean management. We describe the major elements and structure of SOCIB and present some recent scientific, technological, and society-related results that are of relevance at a global ocean scale.

Keywords: ocean observatories, paradigm change on ocean observation, multi-platform integrated observing and forecasting system, science, technology and society driven mission and objectives, scientific excellence and response to society needs

International Context and Paradigm Change in Ocean Observation

Oceanographic information, combined with integrated predictive models, are increasingly needed to manage national coastal and ocean areas; to portray the state of the ocean today, next week and for the next decade; to increase the efficiency of shipping; to mitigate storm damage and flooding of coastal areas; to sustain fisheries; to protect important ecosystems from degradation; to develop science-based sustainable management of marine and coastal areas; and to improve climate forecasting in response to global change, among other direct applications. However, the ocean changes continuously, and therefore, the ocean must be observed continuously to deliver accurate and reliable ocean services. This, combined with the understanding that we have a responsibility to maintain healthy, resilient and sustainable coasts and oceans and together with the curiosity-driven advancement of knowledge and technology, is the foundation for new ocean observing networks.

The establishment of such ocean observing systems is being adopted as an important component of marine strategy by the European Commission (2010, 2012, 2013) and by most countries that are advanced in marine science research and with economically significant coastal areas (Committee on an Ocean Infrastructure Strategy for U.S. Ocean Research in 2030, 2011). These new observatories, such as Integrated Marine Observing System (IMOS) in Australia, the Ocean Observing Initiative (OOI) and different regional components of the Integrated Ocean Observing System (IOOS) in the United States, Neptune and Venus in Canada, Coastal Observing System for Northern and Arctic Seas (Cosyna) Project in Germany, and Poseidon in Greece, are today discovering new insights into the oceans' variability. These discoveries will in turn trigger new theoretical developments, increasing our understanding of coastal and nearshore processes and contributing towards a more science-based and sustainable management of the coastal area.

SOCIB, the new Balearic Islands Coastal Ocean Observing and Forecasting System (Tintoré, 2010) is one such system, a new facility of facilities, open to international access. SOCIB is a multiplatform, distributed and integrated system (Figure 1) a scientific and technological infrastructure, which since early 2012 has delivered free, open, quality-controlled and timely streams of oceanographic data and modeling services to support operational oceanography in a Mediterranean and international framework. It contributes to the needs of marine and coastal research

FIGURE 1

SOCIB, a new multiplatform observing and forecasting system located in the Balearic Islands (Western Mediterranean).

in the context of global change. In line with EuroGOOS (www.eurogoos.org), operational oceanography is here understood in a wide sense, including both systematic long-term measurements of the seas and their interpretation and dissemination and the sustained supply of multidisciplinary data to cover the needs of a wide range of scientific research and societal priorities. This will allow a quantitative increase in our understanding of key questions on oceans and climate change, coastal ocean processes, sea level rise, and ecosystem variability, among others.

SOCIB responds to a twofold change of paradigm in the observation of our oceans and coasts (Delaney & Barga, 2009). First, the observation of the oceans has evolved from being centered on a unique platform, the oceanographic ship, to today's multiplatform and integrated systems (using satellites, ships, gliders, HF radar, drifters, ARGO profilers, moorings and fixed platforms, etc.; Figure 2). There is however a second paradigm change related to data deluge and data availability. Historically, just the teams directly involved in data collection had access to the data and were involved in the analysis. Today, many different kinds of data are quality controlled and available in quasi real time. As a result, scientists and society have direct access to huge amounts of data, by this enlarging the community that supports improved science-based decisions.

New tools for this data analysis are being developed in order for these two paradigm changes to become really effective. This will reenforce a science-technology-society system and a science-to-society transfer as a loop can now be established from new scientific breakthroughs and new scientific questions (presently not yet foreseen, but that we will be prepared to address in the future, e.g., with background baseline data) to new technologies development and to the development of tools for more knowledge-based decision support. The result is a more science- and ecosystem-based ocean and coastal management, with continuous feedback between the three key elements, science, technology development, and society.

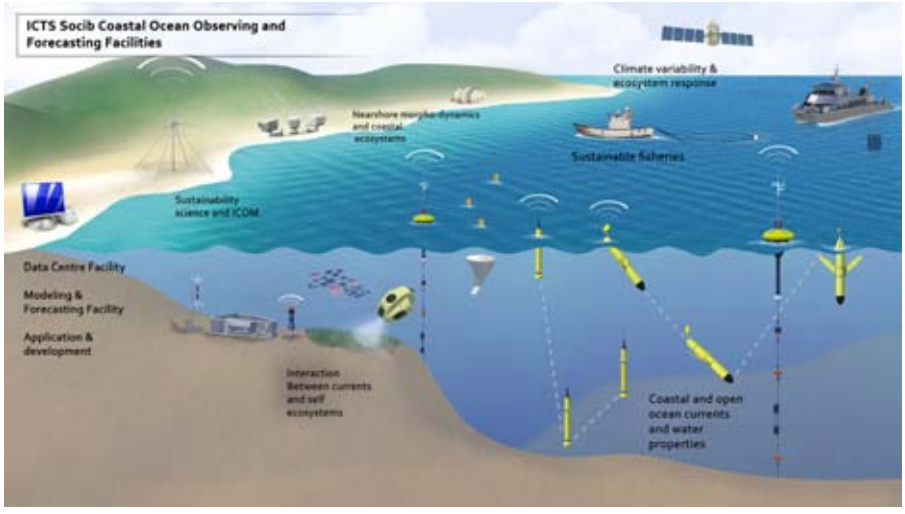
The change in paradigms is now widely recognized and is at the origin of the key drivers identified by SOCIB back in 2009: (1) science priorities, (2) technology development, and (3) response capacity to society needs. Again, this is fully in line with today's approach of the new European Union Horizon 2020 program.

From the initial Board of Trustees meeting in December 2008, there have been three consecutive phases in SOCIB: the Design phase covered from 2009 to July 2010, when the Implementation Plan (2010-2014) was approved. This was followed by the Construction phase, during which the different observing and forecasting systems were established and that ended in December 2012. The Operational phase started during 2012, and several facilities have already started to provide operational data and modeling services that are available through the SOCIB THREDDS catalog (see below). SOCIB activities are funded until 2021 and are included in the Spanish Large Scale Scientific Infrastructures Program (from the Ministry of Economy and Competitiveness) and in the Balearic Islands Regional Research and Innovation Plan.

In this paper, we present SOCIB, the drivers, objectives, and major components and also briefly describe some of the major achievements reached during 2012, focusing on the observing, modeling, and data center facilities. The reader more interested in technology developments and/or applications and tools for coastal and ocean management is referred to SOCIB reports and publications available at www.socib.es (Figure 3).

FIGURE 2

SOCIB major components (adapted from IMOS).



Mission, Drivers, Objectives, and Vision

SOCIB mission is to develop an observing and forecasting system, a scientific and technological infrastructure that provides free, open, quality-controlled, and timely streams of data

FIGURE 3

SOCIB Web page, www.socib.es, multiplatform integrated facilities.

to achieve three missions: (1) Support research and technology development on key internationally established topics such as the role of the oceans in the climate system at interannual scale, interaction between currents and eddies, vertical exchanges and physical and ecosystems variability, variability of nearshore morphodynamics, and sea-level variability in response to climate change. (2) Support longer-term strategic needs from society in the context of global change such as sustainable management, science-based mitigation and adaptation strategies and also policy development and operational tools for decision support. (3) Strengthen operational oceanography in the Balearic Islands and in Spain, contributing to the establishment of a well-structured center of excellence in an international frame.

More specifically, SOCIB objectives are driven by state-of-the-art international scientific and technological priorities but also, by specific interests from the European, Spanish and Balearic Islands societies. The general objective is accordingly twofold: (1) to contribute to address and respond to international scientific, technological and strategic challenges in the coastal ocean and (2) to enhance operational oceanography research and technology activities being carried out in the Balearic Islands, contributing to the consolidation of a well-structured center of excellence.

In the long term, our vision is to advance the understanding of physical and multidisciplinary processes and their nonlinear interactions, to detect and quantify changes in coastal systems, to understand the mechanisms that regulate those coastal systems, and to forecast their evolution and or adaptation under, for example, different International Panel on Climate Change scenarios.

SOCIB specifically addresses the preservation and restoration of the coastal zone and its biodiversity and the analysis of its vulnerability under global change. It also considers new approaches such as science-based sustainable fisheries and/or connectivity studies and marine-protected area's (MPA's) optimal design to advance and progressively establish a more knowledge-based and sustainable management of the oceans and coastal areas.

Strategic Location in the Western Mediterranean

SOCIB activities are largely centered in the western Mediterranean, with focus in the Balearic Islands and adjacent sub-basins (specifically the Algerian and Alborán/Gibraltar) and covering the nearshore, the coastal ocean and the blue open ocean waters and their associated processes. SOCIB takes advantage of the strategic position of the Balearic Island at the Atlantic/Mediterranean transition area, one of the "hot spots" of biodiversity in the world's oceans research, and also a region where mesoscale and submesoscale dynamics are of particular relevance (Internal Rossby Radius, Ri = 10km). Thus physical mechanisms can be more easily monitored in this "ocean basin", contributing to the advancement of knowledge of physical interactions and biogeochemical coupling at nearshore, local, sub-basin and global scales. In this context, coastal ocean research and technology development in the Balearic Islands have significantly contributed to our understanding of different oceanographic problems of worldwide interest over the last 20 years (see, for example, the TMOOS 2010–2013 Strategic Plan at www.imedea.uib-csic.es/tmoos).

The oceans and coastal areas of the Balearics provide jobs, food, resources, recreation and tourism opportunities and play a critical role in transportation, economy, trade and security and so management of this resource is of

strategic societal interest in this region. The Balearics dependence on marine activities (maritime traffic, fishing, tourism) places Balearic society at the forefront of confronting issues related to sustainability management of the coastal zone, and this is a strategic location for the development and implementation of new ICOM-based tools and applications. In addition, the existence of the Cabrera Island National Park (Figure 4), areas of barely disturbed marine ecosystems such as Menorca and areas with sensitive habitats and special interest ecosystems, such the NE of Mallorca, North and South of Menorca, Menorca channel and South Cabrera, or Natural Parks of Ibiza and Formentera, are of great interest for the analysis of natural variability in and human interaction with pristine and threatened systems.

Guiding Principles and Operational Scope

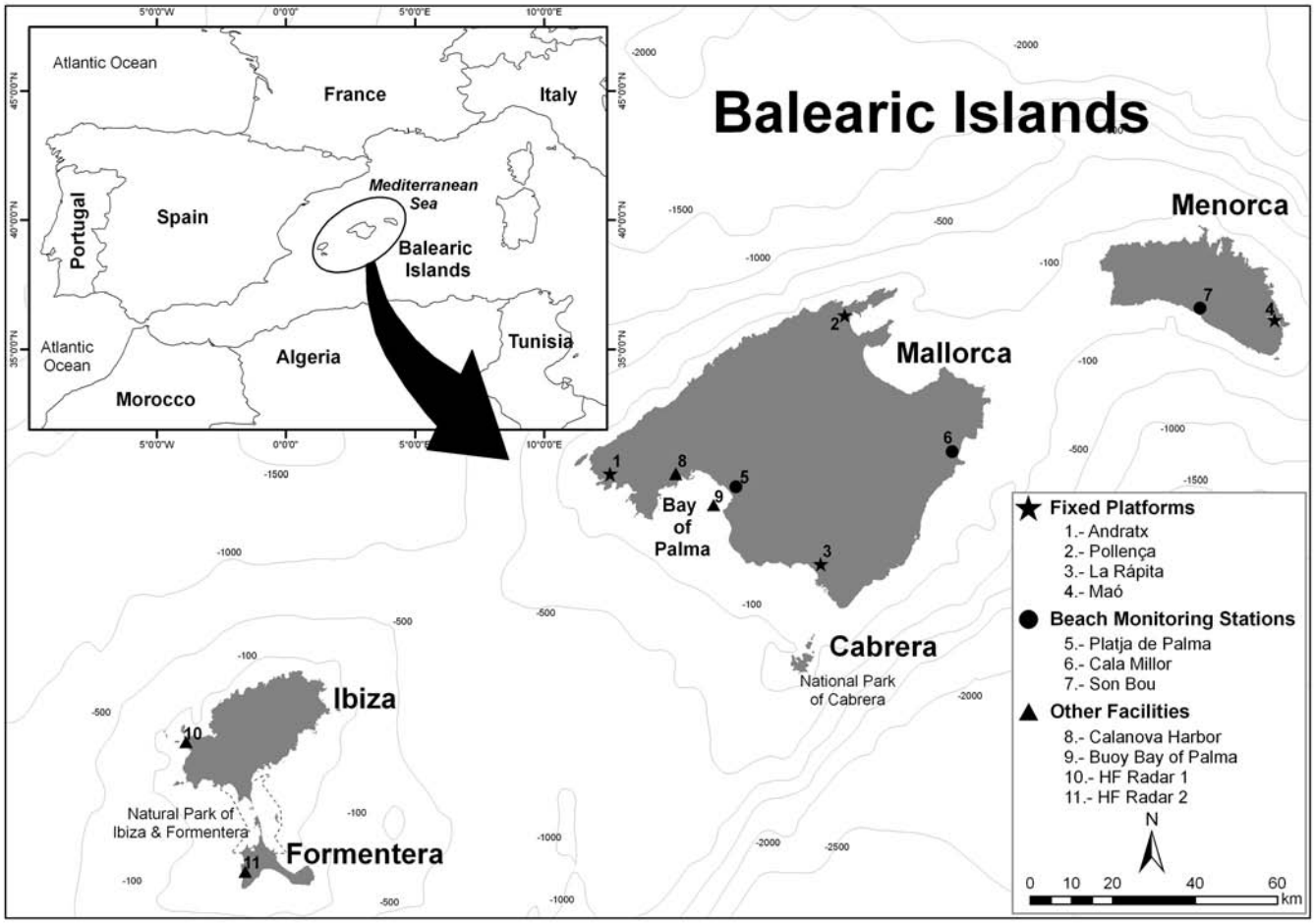
In line with IMOS, a number of well-defined principles have been established from the very beginning. These principles guide the development, decision-making and interaction with SOCIB partners, users and other collaborating institutions. They are:

- scientific and technological excellence through peer review,
- science, technology and society driven objectives,
- support to R&D activities in the Balearic Islands,
- integrated, coordinated multiplatform,
- multidisciplinary and sustained monitoring,
- partnership between institutions, and
- free, open and quality controlled data streams, with data in adherence to scientific community standards.

SOCIB was designed to support a sustained approach to ocean monitoring to address state-of-the-art science priorities, enhance technology development

FIGURE 4

The Balearic Islands (Mallorca, Menorca, Ibiza, and Cabrera) in the Western Mediterranean Sea.



and that would be also capable to respond to society needs. Curtin and Belcher (2008) analyzed the conditions for radical innovations to occur in oceanography. They showed the importance of scientific leadership, close work with engineers and sustained funding, very close to the founding elements of SOCIB.

The initial focus in the development of SOCIB is on physical variables and progressively later some biogeochemical variables, reflecting both the present state of sensor technology and the importance of the impact of physical processes on driving biogeochemical and ecological responses. New biogeochemical sensor technologies are advancing rapidly and will be incorporated into the SOCIB observing network that will enhance the long term sustained monitoring of chemical and biological properties.

SOCIB Structure, Major Components, and Facilities

SOCIB is unique among coastal ocean observatory systems in that our mission, vision, and structure respond to three main drivers: state-of-the-art research priorities, implementation and development of new technologies, and response to the strategic interests of Spanish and Balearic Islands society. In other words, SOCIB is science, technology and society driven. A secondary uniqueness of SOCIB is that it extends from the beach and the nearshore to the open ocean (similar to NANOOS, the IOOS regional system on the northwest U.S. coast).

As with other international ocean observing systems, SOCIB has three major infrastructure components: (1) a distributed multiplatform observing system with appropriate instruments and technologies, (2) a numerical forecasting system with different types of predictive models, and (3) a data management and visualization system. The combination of the three elements enables real-time monitoring of the state of the ocean and the coastal zone and the prediction of its spatial and temporal evolution.

SOCIB structure is original in that, apart from the observing, modeling, and data center facilities that respond to science-driven objectives, it is also addressing technology and society-driven needs. Accordingly, SOCIB functional structure (Figure 5) has been established into three main divisions and three services. In this section, we present a brief outline of this general functional structure.

The observing, forecasting, and data center components configure the *Systems Operation and Support Division (SOSD)* that will be described in further detail in the next section.

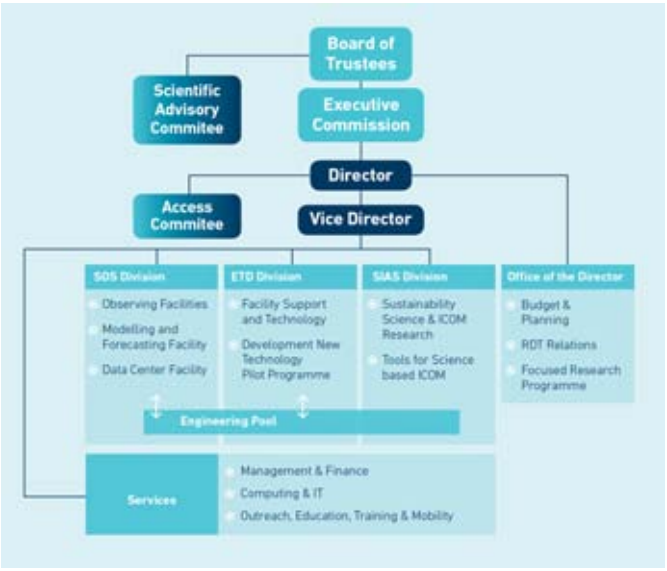
The Engineering and Technology Development Division (ETD Division) provides the engineering and technical backbone to develop and operate the facilities of the Systems Operation and Support Division and is also responsible for the application, development, and testing of new technologies for future observing systems and for developing new analytical tools for the effective management of new, high volumes, of observational data and modeling output.

The Strategic Issues and Applications for Society (SIAS Division) is designed to develop applications and operational tools for science-based management of the coastal and marine environment, within the general frame of sustainability science, thus supporting the development and transfer of strategic knowledge to meet the needs of society in the context of global change.

The sustainable management of coastal and marine ecosystems is a significant international challenge, which is becoming increasingly urgent with the prevalence of global change. There is

FIGURE 5

SOCIB structure.



no panacea for solving sustainability problems, rather, there is a need for scientific research aimed at developing innovative, adaptive approaches to understanding and managing social-ecological systems with variable, complex, and multidimensional attributes. New scientific approaches such as sustainability science have emerged to address this need and are more interdisciplinary, participative, and problem orientated than before. At the policy level, frameworks such as Integrated Coastal Zone Management and Marine Spatial Planning (we refer to these collectively as Integrated Coastal and Marine/Ocean Management) have been proposed as ways to link scientific assessment, monitoring, and prediction with environmental decision-making.

These science-to-society multidisciplinary activities were initiated in 2005 at the Mediterranean Institute for Advanced Studies (IMEDEA) of the Consejo Superior de Investigaciones Científicas (CSIC) and the University of the Balearic Islands (UIB). They are continued at SOCIB as requested by the Board of Trustees in 2008. This area of activity is again a good example of the capacity of excellent peer-reviewed science to respond to society needs and of cooperation with regional and local institutions.

The output from this division will ultimately provide science-based decision support tools and sustainable policy insight for Balearic, Spanish, and International ICOM managers in the marine and coastal environment. As an example, the development of science-based but society-endorsed (Social and Economic Council, CES) indicators for sustainable management of the coastal zone is among the most significant achievements (Diedrich et al., 2010, 2011). Also important is the application of new methodologies for coastal zone delimitation and marine spatial planning to well-identified problems such as recreational boating (Balaguer et al., 2008, 2011; Diedrich et al., 2011; Diedrich & Tintoré, 2012).

The establishment of the environmental sensitivity of the coasts of the Balearic Islands is also an important and continuous task at SOCIB. It started in 2004 and is based on the recognition of the different types of coasts of the Islands based on geomorphological, bioecological and socioeconomic characteristics defined in Balaguer et al. (2008), following the coastal sensitivity typologies and ESI (Environmental Sensitivity Index) proposed by the U.S. National Oceanographic and Atmospheric Administration (NOAA) and applied in the Mediterranean by Adler and Inbar (2007) on the coasts of Israel. The maps that have been developed (e.g., Figure 6) cover the entire coastline of the Balearic Islands (around 1,700 km) and comprise approximately 4,500 segments. The adaptation of the standard proposed by NOAA differentiated eight types of shorelines (according to geomorphological sensitivity, divided into 15 subtypes). The establishment of the sensitivity of the coast of the Balearic Islands is an important decision support tool that follows the work described in Beagle-Krause et al., (2010) for responding to oil spill events (Jordi et al., 2006; Balaguer et al., 2011). This tool has been transferred to the government of the Balearic Islands (Directorate General of Emergencies), who actually used it with beneficial results in July 2007 to respond to an oil spill that occurred off the coast of Ibiza.

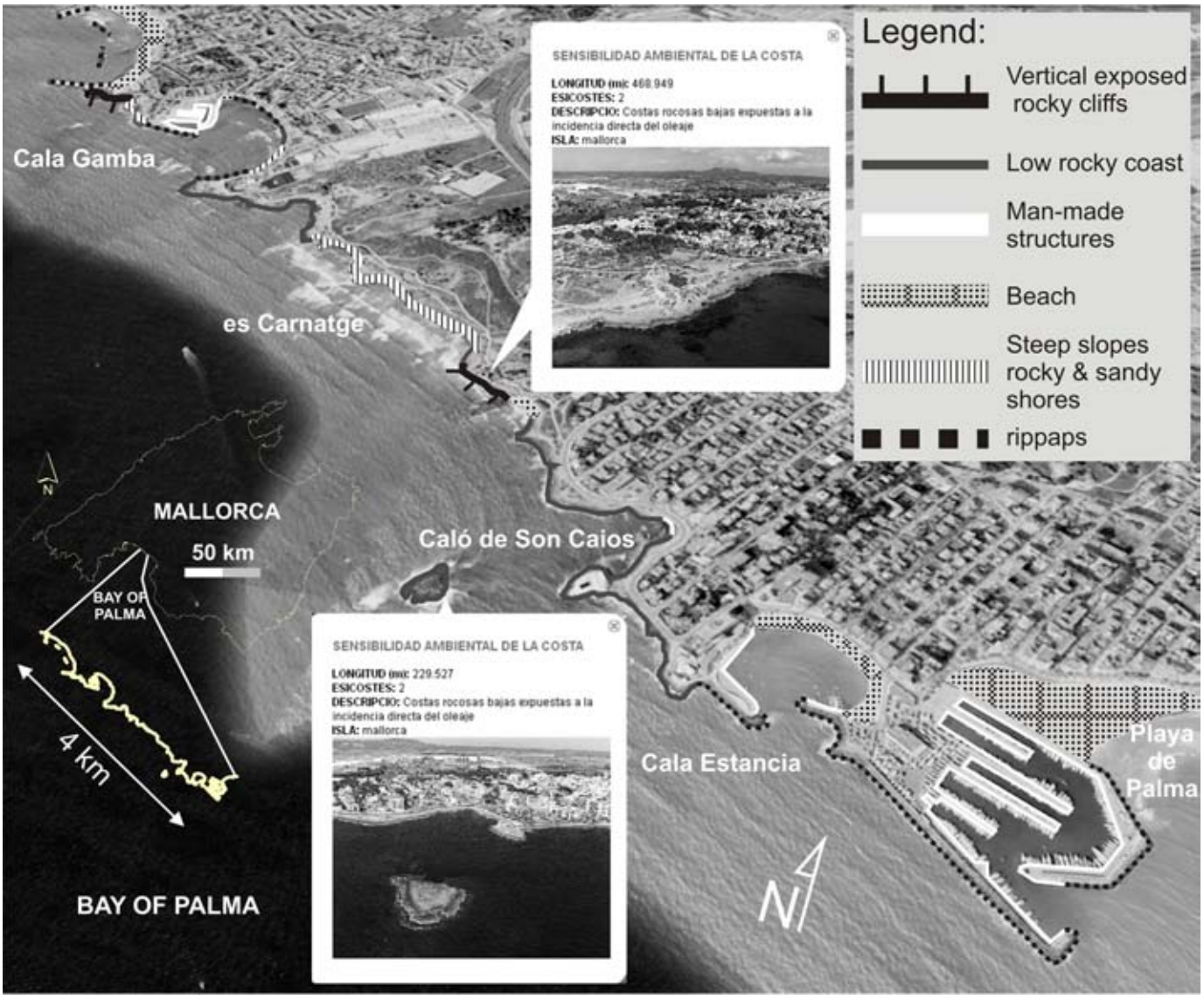
The three "horizontal" SOCIB Services that support the Divisions are Management and Finance; Computing and Information Technology; and Outreach, Education, Training and Mobility (OETM). They are all located at SOCIB offices in the Technological Park (Parc Bit).

Finally, the Office of the Director is responsible for SOCIB strategic direction, budget planning and communication with the consortium's governing bodies. In addition the Office of the Director manages the Atlantic Bluefin Tuna focused program (ABT), led by IEO (Instituto Español de Oceanografía). The Balearic Islands constitute one of the main spawning grounds of ABT eastern stock, the one that spawns in Mediterranean Sea. The ABT SOCIB program started in 2010 in line with previous studies from Alemany et al. (2010) and Reglero et al. (2011). It has focused on the sustainable use of marine living resources, studying the impact of the physical and biogeochemical variability on ABT spawning grounds and population dynamics. Several interdisciplinary cruises have been already carried out from 2010 to 2012 and will be continued in forthcoming years, combining *in situ* monitoring with satellite data (SST, Color, Altimetry) and numerical models.

This ABT Program is another example of the regional problem-solving approach at SOCIB, addressing state-of-the-art problems with global worldwide relevance. One of the main conclusions so far is that the different ABT spawning areas present common features, since all of them are highly oligotrophic, located in the vicinity of islands, and present complex hydrodynamic scenarios resulting from the interaction of different water masses, which in the Balearic Sea consist of the convergence between recent low salinity Modified Atlantic Waters (MAW) with more saline Mediterranean Waters (MW) and the existence of significant mesoscale and submesoscale variability that appears to play a key role in the Bluefin Tuna spawning strategies worldwide. Therefore, most of the

FIGURE 6

An example of environmental sensitivity index characterization of the Balearic Islands coastline.



results obtained in the Balearic Sea could be extrapolated at the regional level. Moreover, under the Integrated Marine Biogeochemistry and Ecosystem Research/Climate Impacts on Oceanic Top Predators (IMBER/CLIOTOP) initiative (www.imber.info/cliotop), the ABT team is working in close coordination with the research teams of the NOAA Southeast Fisheries Science Center in the USA and Fisheries Research Agency in Japan, which are also carrying out similar projects in the main western ABT stock and Pacific Bluefin tuna spawning areas, Gulf of Mexico, and Nansei Islands, respectively.

Systems Operations and Support Division

The SOSD is responsible for operating the observational, numerical, and data management facilities, and we describe below each one of the existing facilities that conform a sustained, spatially distributed, heterogeneous, potentially relocatable and dynamically adaptive network, integrated through data management and numerical methodologies.

Six major observing facilities were in place in 2012: a new coastal catamaran research vessel (strongly needed in the Islands with more than 1.200 km of coastline); HF radar at the Ibiza channel; a fleet of gliders (both Slocum and Seagliders); Lagrangian platforms including Argo profilers and surface drifters (SVP); Fixed stations (including

open ocean moorings, coastal moorings and coastal stations); and a Beach Monitoring facility.

Coastal R/V *Catamaran* Facility

The SOCIB R/V *Catamaran* (Figure 7) was delivered in September 2012 by Rodman Polyships (Vigo) and is presently undergoing sea trials. She is a modern and fast catamaran (an evolution from the NOAA R/V *Manta*) with 23.76 m LOA, 9.00 m beam and 1.75 m draught, that sails at an optimal and fuel efficient cruising speed of 18 knots (total fuel-diesel consumption around 330 L/h for the 2 × 1.622 HP; 500 miles autonomy), allowing rapid transit times between the different Islands and survey sites. She has two labs (wet and dry, with an area of 27 m^2) and can accommodate up to 16 persons for missions of duration between 1 and 5 days (7 crew and 8 scientists for 24-h operations and a reduced crew of 3 for 8-h operations). This R/V *Catamaran* brings new and cost-effective opportunities to both scientists/engineers and the different key oceanography-related institutions in the islands (IMEDEA, IEO, UIB) but also in adjacent regions.

HF Radar Facility

Surface currents are identified as a high-priority product for coastal ocean observing systems. Shore-based high-frequency (HF) radars that broadcast and then observe back-scattered radio signals from the ocean's surface are now a mature technology that has been implemented and is routinely operating in numerous locations worldwide. The HF radar system (13.5 MHz) was delivered to SOCIB in July 2012 (one station in Ibiza and the second in Formentera islands) and is presently undergoing extensive calibration and validation actions. At present hourly surface velocity fields in the Ibiza Channel (Figure 8) are available through the SOCIB data center.

Glider Facility

A new glider facility for routine glider operations is operational at SOCIB and has been run in strong collaboration and in-kind support from IMEDEA (CSIC-UIB) since 2010, following the research activities and associated glider developments at IMEDEA (CSIC-UIB) since 2005 (Ruiz et al., 2009a, 2009b, 2009c). SOCIB has improved the existing glider infrastructures by providing new glider units, new electronics, ballasting and operations labs, a new 1,000-m pressure chamber, and a 9.2-m Hurricane Zodiac rigid inflatable boats (RIB) for glider deployment and recovery. The present SOCIB glider fleet (three-in-kind from IMEDEA) consists of five Slocum gliders and two iRobot Seagliders (Figure 9). Additionally, the IMEDEA facilities at Calanova Harbor (Bay of Palma) include a warehouse and coastal laboratory available to support glider operations.

Twenty-eight glider missions have been performed, collecting ~17,000 hydrographic and biogeochemical profiles, which gives a cost estimate of around 30 Euros/glider profile. Gliders combined with satellite altimetry have specifically contributed to better understanding of mesoscale and submesoscale process (1–20 km) in the upper ocean (Pascual et al., 2009b, 2010; Ruiz et al., 2009a), including the coupling between the physical and biogeochemical process of the marine ecosystem (see Ruiz et al., 2012a, for recent revision). Multiplatform experiments combining drifters, ships, gliders and satellites have been also carried out. Bouffard et al. (2010, 2012) and Ruiz et al. (2012b) showed the benefits of this multiplatform approach for characterization of the variability in the coastal ocean. Different types of tools, such as path planning tools (Garau et al., 2009) and thermal lag correction tools, have been also developed (Garau et al., 2011).

Since January 2011, the glider operations have focused on the routine

FIGURE 7

SOCIB coastal catamaran 24 m LOA.

FIGURE 8

Ibiza channel (between Ibiza and the mainland) HF radar coverage and surface currents.

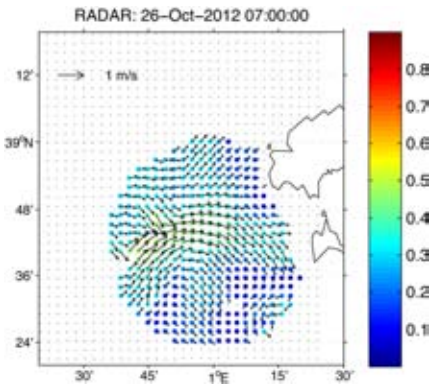


FIGURE 9

Launching a glider off the southern cost of Mallorca.

and sustained operational monitoring in the Ibiza Channel. Heslop et al. (2012) reported a new view of the temporal and spatial variability of the Atlantic and Mediterranean N/S exchanges through the channel. This Ibiza channel glider track will be maintained on a routine basis and additional permanent glider sections will be progressively considered in the Balearic, Algerian, and Sardinian sub-basins in strong collaboration with international partners. The relevance of the choke points concept will be further exploited.

Fixed Stations Facility

The Fixed Stations Facility is also already operating with one AXIS buoy located in the Bay of Palma and four Coastal Stations that include sea level gages and barographs at key harbors (Andratx, Pollensa, La Rápita, and Maó). Intensive work has been carried out during on the setup of the coastal stations, including quality control procedures. A new deep-water mooring (800 m depth) will be established in the Ibiza channel with physical and biogeochemical sensors in 2013 when a coastal buoy will be installed in the Ibiza-Formentera Natural Park. The data can be visualized in quasi real time from the new SOCIB iPhone App available from the Apple Store.

Lagrangian Platforms Facility

The first four SVP surface drifters were released in September 2011 in collaboration with Med Project TOSCA, where SOCIB was participating. This was followed with four releases in 2012. The plan is to deploy four to eight SVP drifters annually. All the surface drifters are part of the international Global Drifter Program. It is interesting to note that significant speeds higher than 50 cm/s can be estimated from the drifter trajectories at different times, such as for example off the western coast of Ibiza, along the slope, where sustained velocities around 50 and 60 cm/s where registered by IME-SVP003 (WMO 37572) during the first week of November 2011.

Argo profilers permit the observation of long-scale and interannual variability (Vélez-Belchí et al., 2010) and therefore are also a key element in SOCIB. The first three profilers were deployed in 2011, and three additional ones were deployed in 2012. The plan is to release four Argo profilers annually. This activity is part of the Argo-Spain initiative, led by IEO as part of the EuroArgo EC cofunded Infrastructure and the new E-Aims project. The first Argo profilers show interesting features, such as the seasonal flow of Atlantic waters through the Ibiza channel (WMO 6900661) or the flow of the alternative Levantine Intermediate Water (LIW) path at the southern shelf break of Mallorca (WMO 6900660). The evolution, visualization and data for the Argo profilers and SVP drifters are accessible from the SOCIB web.

Beach Monitoring Facility

Balearic Islands' beaches are a major tourist attraction for the 12.3 millions of tourists that visit the archipelago (population is roughly multiplied by 10 in summer), a classical Mediterranean sun and beach destination. Therefore beach dynamics, sea-level rise, flooding and erosion, as well as users' safety risk issues and beach management associated with recreational and leisure activities are of relevant interest for the Balearic Islands society given the importance to the environmental and socioeconomical context (Tintoré et al., 2009).

The Beach Monitoring Facility is also operational and develops three different activities: real-time data, periodic surveys and historical data (Figure 10). Real-time and continuous monitoring of coastline evolution and nearshore hydrodynamics, using both coastal video monitoring and Acoustic Doppler Current Profilers (ADCP) is at present carried out in three beaches: Cala Millor (May 2011) and Platja de Palma (September 2011) in Mallorca and Son Bou in Menorca (October 2011). The second group of activities relates to a biannual monitoring program of bathymetric surveys and sediment sampling in the former beaches. Finally, the last type of activity concerns the compilation of historical data on shoreline position, sediment features, bathymetries, beach profiles from research projects and publications. The ultimate aim of all these actions is to establish a database from which to obtain baselines to support scientific research and public-private coastal management (Alvarez-Ellacuría et al., 2011 and Gomez-Pujol et al., 2011).

Together with the SOCIB Data Centre, a specific web-based visualizing tool has been established for visualization and discovery of weather stations data and video monitoring products. A map server based on GIS technology enables access to historical and beach data survey program data. All these data sources have in mind meeting the potential uses by public-private beach managers and scientific research or educational purposes.

From a technological point of view, the Beach Monitoring Facility, operated jointly with IMEDEA (CSIC-UIB), has developed an open-source coastal video-monitoring system—SIRENA (Nieto et al., 2010)—and different tools for video-monitoring products management (errors analyses; image geo-referencing) and coastline extraction among others.

FIGURE 10

Nearshore data flow from the different platforms and surveys of the Beach Monitoring Facility (from data capture to dissemination).

Modeling Facility

We describe here only the operational and/or preoperational systems implemented at SOCIB during 2011–2012. The scientific results also obtained (e.g., Renault et al., 2012a, 2012b, following Warner et al., 2010) can be found and are described at the SOCIB web site.

Regional Modeling: The activities formally started in 2010 with the development and implementation of the WMOP current forecasting system that is a regional configuration of the Regional Oceanic Model System (ROMS, www.myroms.org; Shchepetkin & McWilliams, 2005) to forecast ocean currents. The model domain was implemented over an area extending from Gibraltar strait to Corsica/Sardinia (from 6°W to 9°E and from 35°N to 44.5°N), including the Balearic Sea and Gulf of Lion. The grid is 631 × 539 points with a resolution of ~1.5km, which allows good representation of mesoscale and submesoscale features of key relevance in this region because of the dynamical effects and interactions with the mean currents (further details can be found at SOCIB Modeling Facility web site).

WMOP has been running continuously since April 2012. Validation procedures based on intercomparison of model outputs against observations (*in situ* and satellite) are being used. These are comparable to those of previous modeling studies in the area (Onken et al., 2008) and the present MyOcean project standards to assess what level the numerical models are able to reproduce the features observed from *in situ* systems or remote sensing. At the same time, different types of indicators (SST, SSS, KE, MLD, Hc [0-150m], transport) are provided for the WMOP domain and also over the Alborán Sea, Gulf of Lion and Balearic Sea sub-basin regions.

Meteotsunami Preoperational System: Meteotsunamis are long-period oceanic waves that possess tsunami-like characteristics but are meteorological in origin. They occur all over the world, and in the Balearic Sea they are particularly intense in the Ciutadella Harbor (Menorca Island) where they are known as "Rissaga" (Tintoré et al., 1988; Gomis et al., 1993). The sea level oscillation during a Rissaga event corresponds to the oceanic response to some atmospheric gravity waves (Monserrat et al., 1991) and/or to convective pressure jumps (Jansá, 1986; Monserrat et al., 2006). The Meteotsunami forecasting system (Renault et al., 2011) is known as BRIFS (Balearic RIssaga Forecasting System) and makes use of a high-resolution configuration of the Weather Research Forecast (WRF; Skamarock et al., 2007) atmospheric model that has been implemented over the Western Mediterranean to have high-resolution, redundant and self-sufficient atmospheric forcing fields. This configuration is able to reproduce reasonably well the atmospheric pressure perturbations and their propagation from initial synoptic conditions. The oceanic response is then forecasted both over the shelf and inside Ciutadella Harbor using a simple ROMS configuration. The model is able to reproduce the main processes and in particular the harbor oscillations driven by the atmospheric disturbance. The predictive capability of BRIFS was tested during summer 2011 and 2012 (the system started in July 2011). Preliminary results show that the forecast is able to reproduce, in relatively good agreement, both atmospheric pressure oscillations (wave train or pressure jump) and oceanic response into the Ciutadella Harbor, but there are also conditions where the forecast needs to be improved

and work is in progress along these lines.

Coastal Wave Modeling: The *Puertos del Estado* coastal wave operational system has been established for the Southern coast of Mallorca and the Palma Harbor entrance using SWAN, a well-established coastal ocean wave model. The system provides on an hourly basis, wave fields and time series estimates of wind, significant wave height, and other parameters in the area with a 72-h horizon. It is updated twice daily. The model is forced by wind forecasts from the HIRLAM model provided by the Spanish met office (AEMET) and the deep ocean Mediterranean wave model from *Puertos del Estado*. This system also includes a validation procedure with near real-time measurements registered by the oceanographic buoys located at Bay of Palma and Dragonera (South of Mallorca).

Remote Sensing: Following the implementation plan, the data are integrated in the Modeling Facility to facilitate the development and integration with model outputs. SOCIB web site facilitates easy access to in house generated products and visualization of ocean remote sensing thematic products. Various satellite data products (altimetry, SST, and ocean color) are acquired and processed by SOCIB, operationally providing data visualization products through a dedicated web portal. The SST and ocean color products are acquired, processed and visualized, both at delayed and real-time lags. Swath and gridded data will be progressively considered at different spatial (1–4 km) and temporal (1–8 days) resolutions. These data will contribute an important data stream that produces high-quality regional 1- to 2-km resolution near real-time forecasts. Altimetry data and products will benefit from the expertise of IMEDEA researchers in developing improved and tailored satellite altimetry products for coastal and mesoscale applications (Pascual et al. 2007, 2009a; Bouffard et al. 2010; Escudier et al. 2011).

Data Center Facility

The Data Centre is the core of SOCIB. Through it, SOCIB is developing and implementing a general data management system to guarantee international standards, quality assurance and interoperability. The combination of different sources and types of information (time series, profiles, trajectories, grids/meshes, images, acoustic data, etc.) requires appropriate methods to ingest, catalogue, display, and distribute this information. The general goal of the SOCIB Data Centre is to provide users with a system to locate and download the data of interest (near real-time and delayed mode) and to visualize and manage the information. Following SOCIB principles, data need to be (1) discoverable and accessible, (2) freely available, and (3) interoperable and standardized (Tintoré et al. 2012). These principles are in line with the challenges and opportunities of Open Data (European Commission 2010; Reichman et al., 2011; Urban et al., 2012).

To accomplish the full lifecycle data (from the modeling and observing systems ingestion up to the user), the data center has defined seven steps for the Data Management Process: (1) platform management and communication, (2) quality control assurance, (3) metadata aggregation and standardization, (4) data archive, (5) data search and discovery, (6) data policy and distribution, and (7) data viewing.

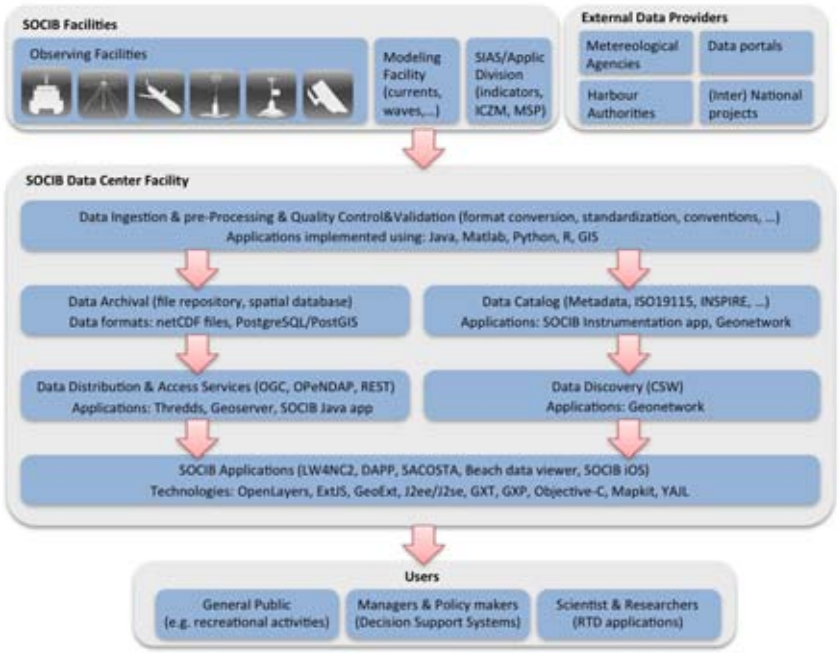
The Data Centre of SOCIB is therefore responsible for directing the different stages of data management, ranging from data acquisition to its distribution and visualization through web applications (Figure 11). The implemented system in the Data Centre relies on open source solutions, following other architectures adopted within the context of marine spatial data infrastructures (Cinnirella et al. 2012).

The main data managed by SOCIB comes from its own observation platforms (e.g., HF radar, gliders, drifters, buoys), numerical models or information generated from the SIAS Division. In addition, the Data Centre also performs the management of data coming from external data providers through various collaborations, for example, with harbor authorities (e.g., Puertos del Estado) or with research groups (e.g., CSIC).

Data processing involves managing different processes such as standardization and data conversion, as well as data validation. Processes include data ingestion, quality controls, generation of new products, and data archival. The generation of metadata follows interoperable and international standards in order to facilitate data discovery, while adopting the European Directive INSPIRE (European Commission, 2007). Data Centre uses different applications for data processing; these include Java, Matlab, R, Python and Geographic Information System (GIS). Data from observation platforms and numerical models are stored in netCDF repositories, while vector data are stored in spatial databases implemented with PostGIS. The management of metadata is done through two main tools. On the one hand, all metadata coming from the SOCIB observation platforms are managed by an internal application. On the other hand, the rest of the metadata is edited and stored using the application Geonetwork.

FIGURE 11

Data Centre Conceptual Structure and SOCIB developed applications.



The distribution and access to data is done through web services (i.e., OGC, REST). THREDDS and Geoserver are used to generate OGC services from the netCDF repository and PostGIS databases, respectively. In addition, the Data Centre has implemented a REST web service, which is called data discovery. These services allow that data generated by SOCIB could be integrated into applications developed by the Data Centre itself or by third parties, thus providing system interoperability. The OGC catalogue service (CSW) is currently implemented with the Geonetwork catalogue. However, further developments are currently underway to harvest the THREDDS catalogue by Geonetwork to integrate all the metadata in a single catalogue service (CSW).

Finally, the SOCIB Data Center also develops specific tools for the different facilities when required. As a result, several web applications have been implemented, responding to interests from a wide range of users. As an example, some applications are designed to manage the instrumentation platforms by the researchers, while other applications are directed to stakeholders and general public by providing a general view of the data produced at SOCIB. These applications have been developed using different technologies (e.g., OpenLayers, KML, iOS). All of them use the web services described above, and some of them can incorporate OGC services provided by external organizations.

Some specific examples of developments are as follows (Figure 12):

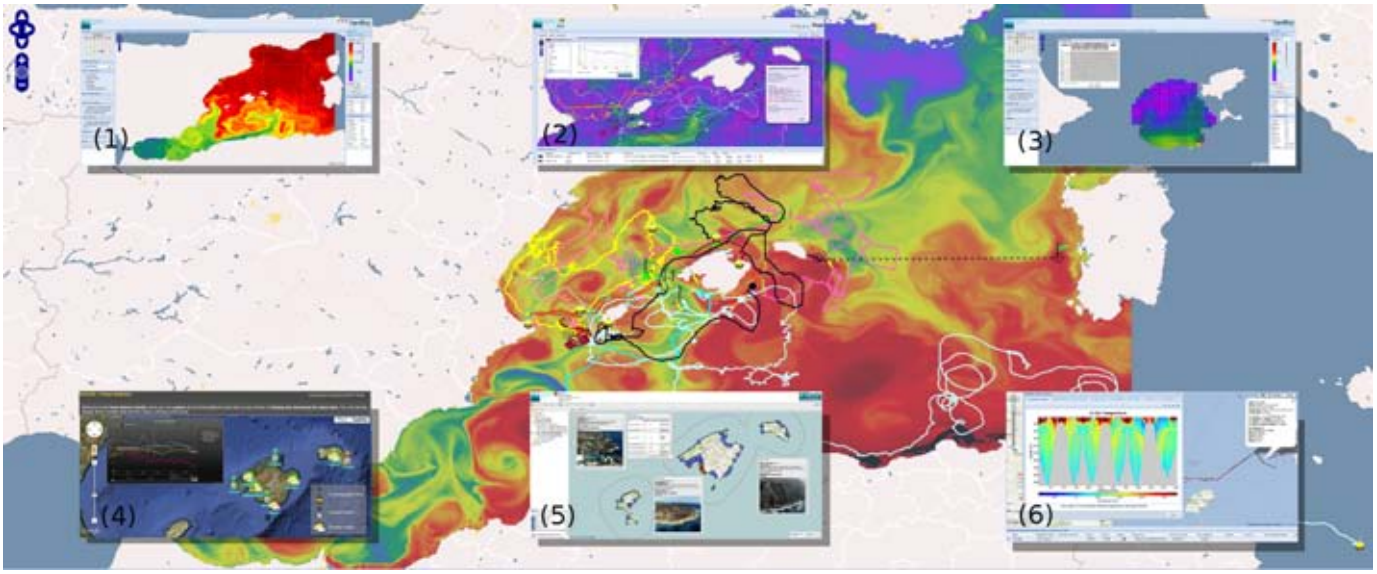
- SACOSTA: web-based map viewer for cartographic data such as environmental sensitivity of the coastline (http://gis.socib.es/sacosta).
- LW4NC2: web application for multidimensional data from netCDF files usually from numerical models (http://thredds.socib.es/lw4nc2).
- BEACH DATA VIEWER: web-based map viewer to display historical and beach survey data (http://gis.socib.es/viewer)
- DAPP: web application to display information related to trajectories from mobile platforms (e.g., gliders, drifter buoys, ARGO profilers; http://apps.socib.es/dapp/)
- SOCIB iOS app for real-time data from fixed stations (oceanographic buoys, sea level stations and coastal weather stations, etc.) and glider trajectories. Available for iPhone and iPad at: http://itunes.apple.com/us/app/socib/id482542716?mt=8

SOCIB Funding and Governance

SOCIB is part of the Spanish Large Scale Infrastructure Facilities (ICTS). Formal agreement between the Spanish Government (Ministry of Science and Innovation) and the Balearic Islands Regional Government (Ministry of Economy, Finance and Innovation) was reached in 2008 to establish in the Balearic Islands this new Consortium, with legal entity, following a proposal submitted in 2006. Funding up to 36 million Euros was approved, including 13.5 million Euros for scientific equipment and facilities and 2 million Euros/year of running costs through the year 2021. Activities formally started in 2009 with the preparation of the detailed implementation plan that was finally approved in July 2010 and the formal participation in the Consortium of key partners in the Balearic Islands, such as CSIC, IEO, and UIB. Strong and active involvement and partnership between all key players is essential for the success of this

FIGURE 12

Data and applications developed at SOCIB: (1) Web-based map viewer for numerical models output; (2) Web application for mobile platforms (e.g., gliders, Argo profilers, drifters, etc.); (3) HF radar output; (4) fixed stations web application and SOCIB iOS app; (5) web-based map viewer for cartographic data, ESI, etc.; (6) glider real-time monitoring tool.



initiative. Cooperative agreements with national, regional or international institutions have been also established (Puertos del Estado, Ports de les Illes Balears, IHM, MERCATOR, MONGOOS, among others) and will continue.

SOCIB is a new way to fund R&D activities and represents a very significant change in marine and coastal observing in the Balearic Islands (and also at European level), moving to an oriented, strategic regional approach with a view to establishing a sustained marine and coastal system. It is a pilot initiative at regional level that will be later extended at national and/or European level. SOCIB is a specific contribution to MONGOOS and has many similarities with Australia's IMOS in particular, OOI and IOOS initiatives in the United States and several other observational and forecasting systems existing or being designed at present (e.g., Liverpool Bay Coastal Observatory, COSYNA in Germany, MOOSE-Mediterranean Ocean Observation on Environment in France). It is also strongly linked to ongoing EC-funded research projects such as JERICO, TOSCA, PERSEUS, GROOM, MyOcean2, MEDES4MS, and E-AIMS.

Conclusion

SOCIB is an example of a new type of sustained multiplatform and operational marine and coastal infrastructure. These infrastructures, combining new technology developments and careful scientific analysis, are already allowing new ways of international cooperation leading to major science breakthroughs and new ways of science based coastal and ocean management.

Acknowledgments

This paper, describing SOCIB, its components, and initial results, is the result of more than 15 years of oceanographic and coastal zone scientific and technological activities in the Balearic Islands (mostly described in the IMEDEA TMOOS 2010–2013 Strategic Plan). As a result, many research projects are at the origin of this activity and should be acknowledged, including EU-funded projects, *Grups Competitius* from the Balearic Government, and the Spanish National Plan for research. JT also kindly acknowledges the invitation from the MTS OOS Committee Chair that gave the opportunity to prepare this manuscript and deeply thanks Reiner Onken for carefully reviewing the manuscript and the MTSJ editor for useful editing and suggestions.

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References

Adler, E., & Inbar, M. 2007. Shoreline Sensitivity to oil spills, the Mediterranean coast of Israel: Assessment and analysis. Ocean Coast Manage. 50:24-34. http://dx.doi.org/10.1016/j.ocecoaman.2006.08.016.

Alemany, F., Quintanilla, L., Velez-Belchí, P., García, A., Cortés, D., Rodríguez, J.M., … López-Jurado, J.L. 2010. Characterization of the spawning habitat of Atlantic bluefin tuna and related species in the Balearic Sea (western Mediterranean). Prog Oceanogr. 86(1-2):21-38.

Álvarez-Ellacuría, A., Orfila, A., Gómez-Pujol, L., Simarro, G., & Obregon, N. 2011. Decoupling spatial and temporal patterns in short-term beach shoreline response to wave climate. Geomorphology. 128:199-208. doi:10.1016/j.geomorph.2011.01.008.

Balaguer, P, Sardá, R, Ruiz, M, Diedrich, A, Vizoso, G, & Tintoré, J. 2008. A proposal for boundary delimitation for integrated coastal zone management initiatives. Ocean Coast Manage. 51:806-14. http://dx.doi.org/10.1016/j.ocecoaman.2008.08.003.

Balaguer, P, Diedrich, A, Sardá, R, Fuster, M, Cañellas, T, & Tintoré, J. 2011. Spatial analysis of recreational boating activity as a key step for marine spatial planning in Mallorca (Balearic Islands, Spain). Ocean Coast Manage. 54:241-9. http://dx.doi.org/10.1016/j.ocecoaman.2010.12.002.

Beegle-Krause, C.J., Allen, A., Bub, F., Howlett, E., Gleen, S., Kohut, J., … Tintoré, J. 2010. Observations as Assets in Decision Support. In Proceedings of OceanObs'09: Sustained Ocean Observations and Information for Society (Vol. 2), Venice, Italy. 21–25 September 2009, Hall, J., Harrison, D.E., & Stammer, D., Eds., ESA Publication WPP-306. doi:10.5270/OceanObs09.cwp.03

Bouffard, J., Pascual, A., Ruiz, S., Faugere, Y., & Tintoré, J. 2010. Coastal and mesoscale dynamics characterization using altimetry and gliders: A case study in the Balearic Sea. J Geophys Res. 115:C10029. doi:10.1029/2009JC006087.

Bouffard, J., Renault, L., Ruiz, S., Pascual, A., Dufau, C., & Tintoré, J. 2012. Sub-surface small-scale eddy dynamics from multi-sensor observations and modeling. Prog Oceanogr. 106:62-79. http://dx.doi.org/10.1016/j.pocean.2012.06.007.

Cinnirella, S, March, D., O'Higgins, T., Murciano, C., Sardà, R., Albaigés, J., & Pirrone, N. 2012. A multidisciplinary spatial data infrastructure for the Mediterranean to support implementation of the marine strategy framework directive. Int J Spatial Data Infrastructures Res. (in press).

Committee on an Ocean Infrastructure Strategy for U.S. Ocean Research in 2030; National Research Council; 2011: Critical infrastructure for ocean research and societal needs in 2030. National Academies Press. 98 pp. ISBN 978-0-309-18603-2

Curtin, T.B., & Belcher, E.O. 2008. Innovation in oceanographic instrumentation. Oceanography. 21(3):44-3. http://dx.doi.org/10.5670/oceanog.2008.34

Delaney, J.R., & Barga, R.S. 2009. A 2020 vision of ocean sciences. pp. 27-38. In Earth and Environment. The Fourth Paradigm. Microssoft Corporation.

Diedrich, A., Tintoré, J., & Navinés, F. 2010. Balancing Science and Society through establishing indicators for integrated coastal zone management in the Balearic Islands. Mar Policy. 34: 772-81. http://dx.doi.org/10.1016/j.marpol.2010.01.017.

Diedrich, A., Balaguer, P., & Tintoré, J. 2011. Methodology for applying the limits of acceptable change process to the management of recreational boating in the Balearic Islands, Spain (Western Mediterranean). Ocean Coast Manage. 54: 341-51. http://dx.doi.org/10.1016/j.ocecoaman.2010.12.009.

Diedrich, A., Balaguer, P., & Tintoré, J. 2011. Concepts, methods, and tools to support science-based decision-making in Integrated Coastal and Ocean Management: Examples from the Balearic Islands. In ICZM as an Evolution of Territorial Planning and Governance (Joaquín Farinós, ed.). Valencia: University of Valencia. pp. 89-110.

Diedrich, A., & Tintoré, J. 2012. Multimethod approach to exploring social-ecological dimensions in a Mediterranean suburban beach setting. Coastal Manage. 40:301-11. http://dx.doi.org/10.1080/08920753.2012.677636.

European Commission. 2007. Directive of the European Parliament and the Council establishing an Infrastructure for Spatial Information in the European Community (INSPIRE).

European Commission. 2010. Marine Knowledge 2020 marine data and observation for smart and sustainable growth. COM (2010) 461:1-13.

European Commission. 2012. Green Paper-Marine Knowledge 2020—from seabed mapping to ocean forecasting. 23 pp. ISBN 978-92-79-25350-8. doi:10.2771/4154.

European Commission. 2013. Towards European Integrated Ocean Observation. Expert Group on Marine Research Infrastructures Final Report. 96 pp. ISBN 978-92-79-27319-3, doi: 10.2777/29343.

Escudier, R., Pascual, A., Bouffard, J., Sayol, J.M., & Orfila, A. 2011. High resolution altimeter gridded fields for coastal and regional studies: Applications in the Western Mediterranean. Coastal Altimetry Workshop. (USA) San Diego.

Garau, B., Bonet, M., Alvarez, A., Ruiz, S., & Pascual, A. 2009. Path planning for autonomous underwater vehicles in realistic oceanic current fields: Application to gliders in the Western Mediterranean Sea. J Mar Res. VI(II):5-22.

Garau, B., Ruiz, S., Zang, G.W., Heslop, E., Kerfoot, J., Pascual, A., & Tintoré, J. 2011. Thermal lag correction on Slocum CTD glider data. J Atmos Ocean Technol. 28:1065-71. DOI: 10.1175/JTECH-D-10-05030.1.

Gómez-Pujol, L., Orfila, A., Alvarez-Ellacuria, A., & Tintoré, J. 2011. Controls on sediment dynamics and medium-term morphological change in a barred microtidal beach (Cala Millor, Mallorca, Western Mediterranean). Geomorphology. 132:87-98. http://dx.doi.org/10.1016/j.geomorph.2011.04.026.

Gomis, D., Monserrat, S., & Tintoré, J. 1993. Pressure forced seiches of large amplitude in inlets of the Balearic Islands. J Geophys Res. 95(C8):14,437-45.

Heslop, E., Ruiz, S., Allen, J., Lopez-Jurado, J.L., Renault, L., & Tintoré, J. 2012. Autonomous underwater gliders monitoring variability at "choke points" in our ocean system:

A case study in the Western Mediterranean Sea. Geophys Res Lett. 39:L20604. doi:10.1029/2012GL053717.

Jansá, A. 1986. Marine response to mesoscale-meteorological disturbances: The June 21, 1984, event in Ciutadella (Menorca). Rev Meteorol. 7:5-29.

Jordi, A., Ferrer, M.I., Vizoso, G., Orfila, A., Basterretxea, G., Casas, B., Álvarez, A., … Tintoré, J. 2006. Scientific management of Mediterranean coastal zone: A hybrid ocean forecasting system for oil spill and search and rescue operations. Mar Pollut. 53(5-7):361-8. http://dx.doi.org/10.1016/j.marpolbul.2005.10.008.

Monserrat, S., Ibberson, A., & Thorpe, A.J. 1991. Atmospheric gravity waves and the "rissaga" phenomenon. Quart J Roy Met Soc. 117:553-70.

Monserrat, S., Vilibić, I., & Rabinovich, A.B. 2006. Meteotsunamis: Atmospherically induced destructive ocean waves in the tsunami frequency band. Natural Hazards Earth Syst Sci. 6:1035-51. http://dx.doi.org/10.5194/nhess-6-1035-2006.

Nieto, M. A., Garau, B., Balle, S., Simarro, G., Zarruk, G.A., Ortiz, A., … Orfila, A. 2010. An open source, low cost video-based coastal monitoring system. Earth Surf Proc Land. 35:1712-9. http://dx.doi.org/10.1002/esp.2025.

Onken, R., Alvarez, A., Fernandez, V., Vizoso, G., Tintore, J., Haley, P., & Nacini, E. 2008: A forecast experiment in the Balearic Sea. J Mar Syst. 71:79-98. http://dx.doi.org/10.1016/j.jmarsys.2007.05.008.

Pascual, A., Pujol, M.I., Larnicol, G., Le Traon, P.Y., & Rio, M.H. 2007. Mesoscale mapping capabilities of multisatellite altimeter missions: First results with real data in the Mediterranean Sea. J Mar Syst. 65(1-4):190-211. http://dx.doi.org/10.1016/j.jmarsys.2004.12.004.

Pascual, A., Boone, C., Larnicol, G., & Le Traon, P.-Y. 2009a. On the quality of real-time altimeter gridded fields: Comparison with in situ data. J Atmos Ocean Technol. 26:556-69. http://dx.doi.org/10.1175/2008JTECHO556.1.

Pascual, A., Bouffard, J., Escudier, R., Ruiz, S., Garau, B., Martínez-Ledesma, M., … Tintore, J., 2009b. A multi-sensor approach towards coastal ocean processes monitoring. In Proceedings of OceanObs'09: Sustained Ocean Observations and Information for Society (Vol. 2), Venice, Italy. 21–25 September 2009. Hall, J., Harrison, D.E., & Stammer, D., Eds., ESA Publication WPP-306.

Pascual, A, Ruiz, S, & Tintoré, J. 2010. Combining new and conventional sensors to study the balearic current. Sea Technol. 51(7):32-6.

Reglero, P., Urtizberea, A., Torres, A.P., Alemany, F., & Fiksen, Ø. 2011. Cannibalism among size classes of larvae may be a substantial mortality component in tuna. Mar Ecol Prog Ser. 433:205-19. http://dx.doi.org/10.3354/meps09187.

Reichman, O.J., Jones, M.B., & Schildhauer, M.P. 2011. Challenges and opportunities of open data in ecology. Science. 331:703-5. http://dx.doi.org/10.1126/science.1197962.

Renault, L., Vizoso, G., Jansá, A., Wilkin, J., & Tintoré, J. 2011. Toward the predictability of meteotsunamis in the Balearic Sea using regional nested atmosphere and ocean models. Geophys Res Lett. 38(L10601):7. doi:10.1029/2011GL047361.

Renault, L., Oguz, T., Pascual, A., Vizoso, G., & Tintore, J. 2012a. Surface circulation in the Alborán Sea (Western Mediterranean) inferred from remotely sensed data. J Geophys Res.117:19. doi:10.1029/2011JC007659.

Renault, L., Chiggiato, J., Warner, J.C., Gomez, M., Vizoso, G., & Tintoré, J. 2012b. Coupled atmosphere-ocean-wave simulations of a storm event over the Gulf of Lion and Balearic Sea. J Geophys Res. 117:C09019. doi:10.1029/2012JC007924.

Ruiz, S., Pascual, A., Garau, B., Pujol, I., & Tintoré, J. 2009a. Vertical motion in the upper ocean from glider and altimetry data. Geophys Res Lett. L14607. doi:10.1029/2009GL03856.

Ruiz, S., Garau, B., & Martinez-Ledesma, M. 2009b. Monitoring the Eastern Alborán Sea using high resolution glider data. Sea Technol March issue, 29-32.

Ruiz, S., Pascual, A., Garau, B., Faugere, Y., Alvarez, A., & Tintoré, J. 2009c. Mesoscale dynamics of the Balearic front integrating glider, ship and satellite data. J Marine Syst. 78:S3-S16. doi:10.1016/j.jmarsys.2009.01.007.

Ruiz, S., Garau, B., Martinez-Ledesma, M., Casas, B., Pascual, A., Vizoso, G., Tintoré, J. 2012a. New technologies for marine research: 5 years of glider activities at IMEDEA. Sci Mar. 76S1:261-70. DOI:10.3989/scimar.03613.19D.

Ruiz, S., Renault, L., Garau, B., & Tintoré, J. 2012b. Underwater glider observations and modeling of an abrupt mixing event in the upper ocean. Geophys Res Lett. 39:L01603. doi:10.1029/2011GL050078.

Shchepetkin, A.F., & McWilliams, J.C. 1998. Quasi-monotone advection schemes based on explicit locally adaptive dissipation. Mon Wea Rev. 126:1541-80. http://dx.doi.org/10.1175/1520-0493(1998)126<1541:QMASBO>2.0.CO;2.

Shchepetkin, A.F., & McWilliams, J.C. 2005. The regional oceanic modeling system (ROMS): A split explicit, free-surface, topography-following-coordinate oceanic model. Ocean Model. 9:347-404. http://dx.doi.org/10.1016/j.ocemod.2004.08.002.

Skamarock, W.C., & Klemp, J.B. 2007. A time-split nonhydrostatic atmospheric model for research and NWP applications. J Comp Phys, special issue on environmental modeling. 3465-85.

Tintoré, J., Gomis, D., Alonso, S., & Wang, D.P. 1988. A theoretical study of large sea-level oscillations in the Western Mediterranean. J Geophys Res. 93:10797-803. http://dx.doi.org/10.1029/JC093iC09p10797.

Tintoré, J. 2010. OceanBIT/SOCIB: An International Coastal Ocean Observing and Forecasting System based in the Balearic Islands. in Proceedings of OceanObs'09:

Sustained Ocean Observations and Information for Society (Annex), Venice, Italy, 21–25 September 2009, Hall, J., Harrison, D.E., & Stammer, D., Eds., ESA Publication WPP-306. doi:10.5270/OceanObs09.

Tintoré, J., Medina, R., Gómez-Pujol, L., Orfila, A., Vizoso, G. 2009. Integrated and Interdisciplinary scientific approach to sustainable coastal management. Ocean Coast Manage. doi:10.1016/j.ocecoaman.2009.08.002.

Tintoré, J., Vizoso, G., Casas, B., Ruiz, S., Heslop, E., Renault, L., … Manriquez, M. 2012. SOCIB: The impact of new marine infrastructures in understanding and forecasting the Mediterranean Sea. CIESM Workshop Monographs. 43:99-118.

Urban, E., Leadbetter, A., Moncoiffe, G., Pissierssens, P., Raymond, L., & Pikula, L. 2012. Pilot projects for publishing and citing ocean data. EOS. 93(43).

Vélez-Belchí, P., Hernández-Guerra, A., Fraile-Nuez, E., & Benítez-Barrios, V. 2010. Changes in Temperature and Salinity Tendencies of the Upper Subtropical North Atlantic Ocean at 24.5°N. J Phys Oceanogr. 40:2546-55. doi: http://dx.doi.org/10.1175/2010JPO4410.1

Warner, J. C., Armstrong, B., He, R., & Zambon, J.B. 2010. Development of a Coupled Ocean-Atmosphere-Wave-Sediment Transport (COAWST) modeling system. Ocean Model. 35:230-44. http://dx.doi.org/10.1016/j.ocemod.2010.07.010.

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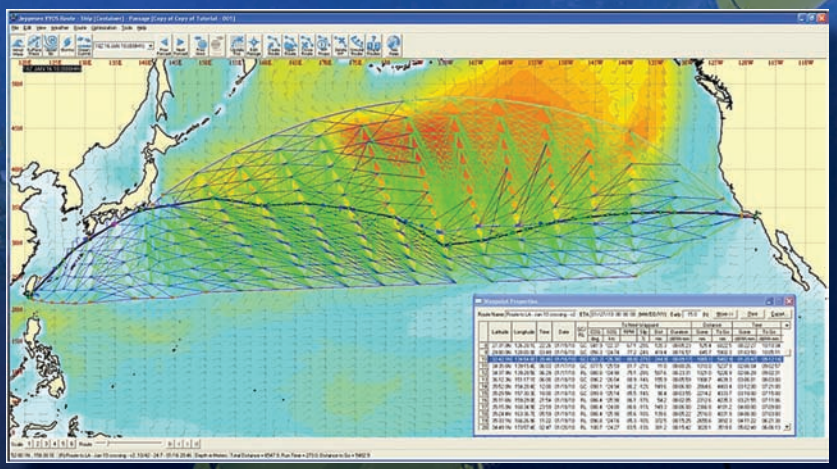


6.2 A2: SOCIB digital internal resources (manuals and procedures, in facility folders/Ramada)

SOCIB Facilities internal documents, check-lists and procedures established (2010-2012)

SOCIB Facilities have made an important effort during the Construction and initial Operations Phases (2010-2012) to develop internal procedures to document tasks carried out and results or products obtained following international standards. As a result, we have developed internal procedures and document templates to allow tracking of the tasks accomplished, the processes established and know how acquired.

These written resources mainly provide: (1) a compilation of methodologies (Wikis and Checklists) to SOCIB Facility operations and (2) a set of files (forms and sheets) to organize and maintain information for future review.

Examples of these documents for the different facilities are available for review through SOCIB's repository, at: http://repository.socib.es/repository/entry/show/Top/Public+-+Strategic+Plan+2013+-+2016?entryid=3918a838-d273-4929-8136-d18074666089

6.3 A3: SOCIB Facilities Open Access Application Form

Infrastructure requested (availability table on the back page of this form):
Catamaran R/V *SOCIB*, Glider facility (GF), Fixed Station Facility (FSF), Beach Monitoring Facility (BMF), Data Centre Facility (DCF), SOCIB RIB (SRIB)

Organisation / Nationality / Web Site:

Contact Scientist Name / Address /Telephone/ Email:

Scientific Track Record / e.g. Research programmes, publication list etc.

Description of Proposed Research / Previous Similar Projects (if appropriate):

Location of Proposed Research / Diagram or Chart (if appropriate):

Duration of Proposed Research:

Facility Supplied Instrumentation Requested / Usage (e.g. number of stations, volume of water, Maximum Water Depth etc.) :
***R/VSOCIB*:** CTD/12 water bottles, VM-ADCP, Thermosalinograph
GF: CTD, Flourimeter
FSF: CTD

BMF: Cameras, SC-SDCP, Sediment size analysis
DCF: Glider data processing
SRIB: N/A

User Supplied Equipment / Usage Required (e.g. number of stations, volume of water, Maximum Water Depth etc.) :
Indicate clearly if this has been discussed with the SOCIB Office of the Director previously.

Source of Funding:

Funding Granted / Speculative:

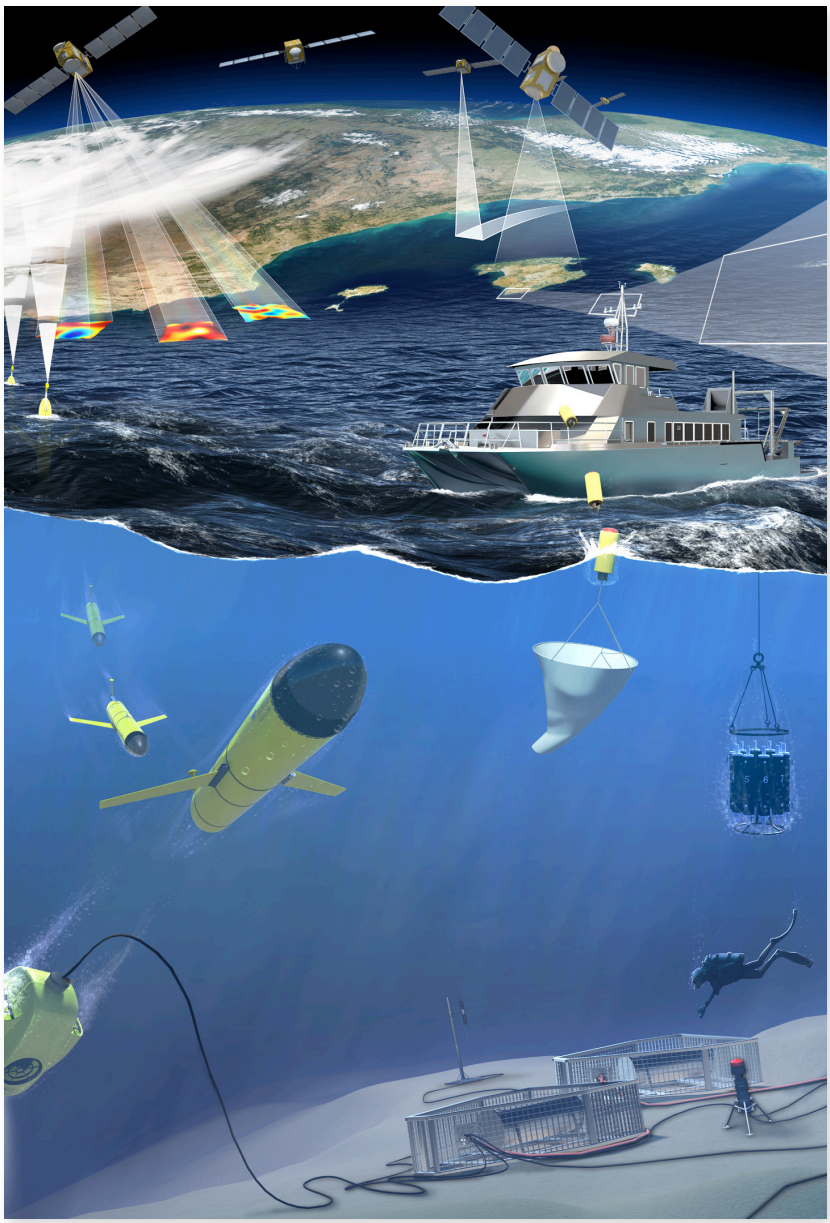
For What Start Date is the Facilty Requested / What Flexibilty is Acceptable:

6.4 A4: Price list for access to SOCIB Platforms

(see enclosed pdf)


SOCIB
Balearic Islands
Coastal Observing
and Forecasting
System

SOCIB



TARIFICACIÓN DE SERVICIOS DE LA ICTS SOCIB

1) INTRODUCCIÓN

SOCIB es una ICTS que mantiene un conjunto de plataformas que observan sistemáticamente el medio marino en el Mediterráneo Occidental. Los datos que se generan con estas plataformas son públicos, abiertos y gratuitos. Esta es el objetivo principal de SOCIB.

La ICTS SOCIB también ofrece la posibilidad de permitir que usuarios externos usen alguna de las plataformas de SOCIB para poder obtener datos en zonas diferentes a las monitorizadas sistemáticamente por SOCIB.

Los estatutos del SOCIB (BOE número 83, de 5 de abril de 2008) establecen varios aspectos relativos al acceso de usuarios externos a las infraestructuras del SOCIB. Así, en el artículo 3, se establece que *el SOCIB constituirá una plataforma en la que los centros de investigación y en general toda la comunidad científica y tecnológica nacional se podrá apoyar para el estudio de distintos aspectos relativos a las ciencias y tecnologías marinas y de las interacciones entre los procesos físicos, químicos, biológicos y geológicos que configuran la variabilidad de las aguas costeras, con una resolución espacial y temporal sin precedentes. El SOCIB estará al servicio de toda la comunidad científica y tecnológica nacional y abierta a la colaboración internacional y se insertará de pleno en las iniciativas, actuales y futuras, de coordinación y colaboración europeas en este campo.*

En el artículo decimotercero, relativo a las competencias de la Comisión Ejecutiva, se especifica en la letra i) *Aprobar, modificar o suprimir las tarifas o precios de los diferentes servicios que preste el SOCIB.*

Asimismo, en el artículo decimoséptimo, relativo a recursos económicos, se determina, en el punto 3, que entre los recursos económicos del SOCIB se cuentan *los ingresos que pueda obtener por sus actividades, así como los rendimientos de su patrimonio.*

La ICTS SOCIB ha puesto en marcha una serie de infraestructuras y de servicios que quiere poner a disposición de usuarios externos.

Los servicios e infraestructuras ofertados por SOCIB a usuarios externos se coordinaran con las actividades operacionales del SOCIB en línea con el Plan e Implementación aprobado en abril de 2010.

Para la elaboración de las siguientes tarifas, se han tenido en cuenta:

- El coste del personal, en función de cada categoría profesional
- El coste de la amortización de los equipos
- El coste, si los hubiere, de servicios similares en entidades nacionales o internacionales
- Los costes indirectos

2) SERVICIOS OFERTADOS POR EL SOCIB

- Embarcación ZODIAC Hurricane
- Gliders
- Diferentes servicios englobados en la Beach Monitoring Facility

A continuación, se desglosa cada una de las infraestructuras o servicios ofertados.

3) EMBARCACIÓN ZODIAC HURRICANE

Características de la embarcación: se trata de un embarcación profesional semi-rígida, con el casco construido en aluminio y equipada con dos motores intraborda, capaz de navegar en condiciones extremas de viento y mar, con la máxima resistencia y fiabilidad.

Eslora total: 9.20 m
Manga total: 3.20 m
Puntal casco: 0.65 m
Peso máximo con motores y depósito de combustible completo: 3800 Kg
Flotador Neopreno hinchable
Volumen del flotador: 5000 l
Capacidad: 6 personas
Velocidad: 30 – 35 nudos
Motores: 2 diesel intraborda
Potencia: 2 x 225 HP

Precios de uso:

Se establece un precio diario de 125 euros por día, más 25 euros por hora de navegación.

(Se trata de un precio equivalente al precio ofertado por el CSIC-IMEDEA para servicios

similares). El personal de SOCIB mínimo para el uso de la embarcación por parte de usuarios externos es de un titulado medio. El precio hora de esta persona es de 21,3 €.

Se establece un precio de medio día, siendo el mínimo de tiempo por el que se puede alquilar la embarcación (hasta 4 horas), de 300 euros, y un precio diario, equivalente a 8 horas, de 495 euros.

Precio medio día, máximo 4 horas (€)	Precio de un día, máximo 8 horas (€)
300	495

4) GLIDERS

Características de la facility:

Los planeadores tienen la capacidad de:

- Realizar misiones de largo alcance (al menos 200 millas náuticas) de observación.
- Mantenerse operativo en campañas de larga duración (al menos 20 días) de observación.
- Alcanzar una velocidad moderada (al menos 35 cm/s).

· Realizar perfil de trayectoria vertical en diente de sierra.
· Hacer apariciones superficiales intervalos regulares.
· Incorporar navegación GPS.
· Establecer comunicaciones bidireccionales entre el glider y una estación remota en tierra mediante telefonía satelital.
· Alcanzar una profundidad de 1000 m

Tratamiento de datos

Durante la realización de las misiones, los gliders recogen datos de temperatura, conductividad y profundidad de forma continua. Además puede integrar otros sensores adicionales, y los datos recogidos pueden ser tratados de forma análoga a los mencionados.

Precios de uso:

Las tarifas para el uso de los gliders, teniéndose en cuenta que se trata de una tecnología innovadora que no se ofrece actualmente en el mercado, se han establecido en base al proyecto europeo JERICO (TOWARDS A JOINT EUROPEANRESEARCH INFRASTRUCTURE NETWORK FOR COASTAL OBSERVATORIES) y en concreto al TNA (Trans National Acces Costs). Se pueden consultar los detalles en el Anexo 1.

- La tarifa diaria para el uso de los gliders es de 1.538 euros.
- El mínimo tiempo para poder ser contratado su uso es de 3 semanas.
- Esta tarifa incluye el seguro, y el personal necesario para su funcionamiento y el procesamiento de datos, siguiendo los estándares del Data Center de SOCIB.
- No incluye el transporte hasta el lugar de lanzamiento y recogida.

Estos precios son equivalentes a los de la ICTS PLOCAN.

5) Beach Monitoring Facility

Características de la facility: Los productos de la Infraestructura de Monitorización de playas consisten en servicios en tiempo de real de imágenes de la playa y datos meteorológicos, así como datos periódicos de oleaje, sedimentos y morfología de playa.

El objetivo de la infraestructura de monitorización de playas consiste en obtener una base de datos de alta resolución, continua y dilatada en el tiempo con la que contribuir a la caracterización y gestión del litoral, especialmente en el ámbito de las Islas Baleares. Para ello, se parte de un sistema modular de monitorización integral de playas (MOBIMS) que integra sistemas de videomonitorización, perfiladores de corrientes y oleaje (ADCP), así como un completo programa de batimetrías y caracterización de sedimentos.

La videomonitorización costera es una técnica que permite la obtención autónoma y contínua de imágenes digitales de alta resolución de la costa, así como su análisis y almacenamiento. Dichas imágenes pueden utilizarse para la observación y cuantificación de un amplio espectro de fenómenos costeros. El sistema de videomonitorización costera SIRENA, desarrollado en el Instituto Mediterráneo de Estudios Avanzados (IMEDEA, CSIC-UIB) constituye el elemento clave de la infraestructura de monitorización de playas de SOCIB.

Precios de uso:
Esta facility puede ofrecer una serie de servicios que se detallan a continuación, estableciéndose las tarifas siguientes:

SERVICIOS	PERSONAL	INVERSIONES Y/O OPERACIÓN	TOTAL EUROS
01. Instalación y operación estación SIRENA (5 cam)**	2.277	5.723	8.000
02. Mantenimiento estación SIRENA*	2.736	764	3.500
03. Administración y gestión de datos de SIRENA*	5.880	1.020	6.900
04. Explotación datos SIRENA (línea de costa, usuarios, etc)*	3.000	0	3.000
05. Informes evolución anual datos SIRENA*	1.710	290	2.000
06. Alquiler AWAC*	998	7.502	8.500
07. Alquiler estación meteo*	784	2.716	3.500
08. Batimetría**	1.583	4.417	6.000
09. Alzamiento topográfico**	912	588	1.500
10. Muestreo de sedimentos (30 muestras)**	1.062	938	2.000
11. Procesado batimetría**	335	0	300
12. Procesado topografía**	228	0	300
13. Procesado sedimentos (30 muestras)**	456	0	450
14. Informe batimetría**	684	316	1.000
15. Informe topografía**	684	316	1.000
16. Informe sedimentos**	684	316	1.000
17. Informe datos AWAC**	684	316	1.000
18. Informe datos meteo**	684	316	1.000
19. Estudio histórico evolución playa y clima marítimo**	3.420	580	4.000
* precio anual; ** precio por unidad			

6) ANEXO 1. COSTE DE USO DE LOS GLIDERS DE LA ICTS SOCIB

A. Descripción de los costes elegibles en la vida útil de los gliders de la ICTS SOCIB			**Costes elegibles (€)**
Costes de mantenimiento (sensores, fungible, etc.)			225.000
Viajes y transportes para el mantenimiento			15.000
Costes de telecomunicaciones			135.000
Calibración de sensores			60.000
Seguros			60.000
Tratamiento de residuos			2.000
Coste de Procesamiento de Datos			66.840
Formación de personal técnico de operaciones			34.128
		Total A	**597.968**
B. Niveles del Personal (científicos y técnicos solamente)	**Número de horas (1)**	**Precio hora (2)**	**(3) = (1) x (2)**
Ingeniero Jefe Departamento	4.500	40,89	184.005
Ingeniero electrónico	3.600	40,89	147.204
Ingeniero informático	2.340	40,89	95.682,6
Técnico	4.600	21,51	98.946
Científico Senior	2.400	35,47	85.128
Científico	2.400	35,47	85.128
		Total B	**696.094**
C. Costes indirectos = 7% x (A+B)			90.584,34
D. Costes elegibles totales = A+B+C			1.384.646,34
E. Cantidad de acceso (días) a usuarios totales (internos y externos) durante la vida del glider (4 años)			900
F. Fracción del coste que se cargará			100,0%
G. Coste diario estimado = F x (D/E)			1.538

6.5 A5: ICTS SOCIB Open Access availability and method of access (June 2013). research lines

Facility	Available	What is available?	Access National/ International	Fees	Mechanism	Details/Notes
R/V *SOCIB*	Yes	Order 150 days /yr	National/(International)	Yes	COCSABO (Nat access)	Direct application for commercial and international requests (Int),
GF	Yes	90 days/yr	National/International	Yes	EU/TNA, Direct Application	Fees for comms, batteries and launch/recovery operations
FSF	Yes	Additional sensors to current stations	National/(International)	No	Direct Application	Clearance may be required from Int. applications
BMF	Yes	Tripod mounted ADCP. Sediment grain size analysis	National/International	Direct negotiation	Direct Application	
DCF	To be implemented	Processing of glider data.	National/International	Yes	Direct Application	
SRIB	Yes	RIB	National	Yes	Direct Application	


SOCIB
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6.6 A6: ICTS SOCIB research lines

(see enclosed pdf)

Annex 6: ICTS SOCIB Research Lines

The summary of the research lines below is taken from the Memoria científica del proyecto ICTS-SOCIB presented to the SOCIB Board of Trustees on 18/12/2007.

1. Summary

The project raises ambitious but realistic scientific objectives, related to the study of physical and multidisciplinary processes in the coastal ocean (and its interactions) directly related to advances in science and technology for the coastal zone[57] operational oceanography, through the use of observations and numerical modelling.

These objectives are in line with the established international priorities in operational oceanography, adapted to the specific capacities and interests in the Balearic Islands, and considering the need to progressively address the variability prediction of ecosystems.

The scientific objectives have been focused on a one specific area, the coastal ocean, looking to unify and maximize the cooperation possibilities for scientists assigned to SOCIB. It is imperative to be aware of the complexity of the coastal ocean as a system of study, both for its intrinsic multidisciplinary nature, and by the nonlinear interactions (between different scales, the sea floor, the coast and the atmosphere) and its direct influence on major international challenges of the next decade as well as coastal vulnerability or global change. Research in the coastal ocean ("coastal ocean" is a nomenclature which has been internationally adopted to describe the region comprised between the wave break and the external limit of the continental shelf slope) is in fact a specific international priority in the United States, United Kingdom, France, Germany, etc. The scientific objectives will be addressed in a systematic manner by combining the studies of ❶ processes ❷ with numerical simulations and ❸ observations, in line with the research philosophy of IMEDEA's Physical Oceanography Group over the last 15 years.

The specific scientific objectives are related to the study of:

2. Hydrodynamics and morphodynamics of the nearshore area, wave-current interactions and sediment transport

The nearshore[58] marine medium is generally subjected to constant anthropogenic disturbance. The deterioration of the marine medium in these areas will depend on the more or less pernicious nature of the deposited detritus as well as the dispersion capacity of the existing residue in that medium. Therefore, the study and quantification of dispersive processes in this coastal strip is of great relevance for environmental management. Hydrodynamic processes in the coastal zone require the knowledge of the boundary conditions in external waters and the diffusion processes of the receptive waters. From the perspective of the specific study of dispersive processes, the starting hypothesis is that these can be simulated combining the information from high resolution circulation models in shallow waters and wave break areas. The boundary conditions must necessarily come from autonomous system in-situ measurements and nesting in regional oceanographic models. In other words, in the nearshore area, modelling of hydrodynamic processes must be performed by means of 3D circulation and wave models to study the relative importance of each of the processes (waves

57. Including both the studies on the role of the coastal ocean on climate and the impacts of global change (and climate change as a part of global change) on the coastal zone.

58. nearshore, from the coastline -including the emerged beach zones- until depths shallower than 50 m –generally located at around 500 m from the coast.

and currents). In SOCIB, the starting hypothesis is the need to develop a tool that will allow the inclusion, through radiation tensors, and the influence of wave action on coastal hydrodynamics thereby providing a unique tool for prediction that is properly validated by the observations also obtained by SOCIB.

The lines of research needed to address the observational and numerical development of a new numerical tool in the coastal zone are consistent with the international scientific challenges posed by the scientific community in this area, and are structured in four main action axes:

Coastal zone hydrodynamics

a. **Wave propagation from deep waters to the coast:** knowledge of the wave action in the shallow zone is essential to tackle any study on coastal morphodynamics and hydrodynamics. This requires propagation models that allow studying the different processes experienced by the waves (refraction, diffraction, reflection and shoaling) as they travel from deep waters towards shallow waters. With the moored instrumentation in the SOCIB framework, the necessary information will be available to initialize and validate these models.

b. **Modelling of currents in the coastal zone:** coastal circulation models make up one of the main challenges in modern oceanography. The energy variations at the coast occur in a much-reduced scale than in the open ocean. To this must be added the complexity of the bathymetry, irregular coastline and the energetic inputs from both the open ocean and the continental zone. In addition, the task of obtaining an operational is difficult since they currently do not exist for large areas of the coastline.

c. **Wave-current interactions:** the non-lineal interaction between waves and currents is at the moment one of the hottest research topics in coastal oceanography and is still not fully understood. The wind induced circulation or density gradients modify waves as they travel towards the coast and these, at the same time, provide momentum to the currents. The pursuit of a model to study and predict this interaction is one of the challenges for the scientific community in the next years and is one of the objectives of SOCIB.

d. **Spill impact numerical models.** Coastal vulnerability against potential spills will be studied through the development of a mathematical model of advection and dispersion of pollutants from which the models described above will study and analyze the spill trajectories to take appropriate measures with a reasonable response time.

Sediment transport and boundary layer

a. **Current-flux interactions:** sediment transport is the result of complex interactions that occur in the bottom boundary layer and the sediments found there. Waves provide this process with enough energy to re-suspend the sediment while the current causes its redistribution. One of the SOCIB objectives in this context is the study of these processes at the boundary layer level in order to achieve a mathematical model for their study. This requires addressing the fundamental mechanics studies by installing a set of Doppler current meters (ADV) in the shallow zone (surf zone).

b. **Energy dissipation by the sea floor.** Posidonia seabeds play an important role in marine hydrodynamics that is still not fully understood. The study through intensive monitoring of these areas at the core of SOCIB will generate the necessary information to be able to formulate the appropriate mathematical models to study these effects.

Beach morphodynamics

a. **Tilting / erosion of beaches and variability.** Beach erosion on all coastlines of the planet is a matter of great importance in the context

of climate change. Completely understanding the sand inputs during "calm" periods where the submerged sand bar feeds, the loss of sand during storms, the tilting of beaches and the passing through different morphodynamic characteristics along different periods (reflective, dissipative or intermediate) is of great importance in order to take the appropriate measures for a proper management of them. This section involves fieldwork in which periodic measurements must be taken of topo-bathymetric data, sediment granulometry and the characteristics of maritime climate, which will provide the instruments for the platform in real time.

b. **Rip currents and security.** Rip currents are one of the phenomena which cause more deaths on beaches around the world. These highly variable currents are a consequence of many factors, amongst which we find the position of the submerged sand bars, infragravitatory waves or the interactions between the incident waves and the wind-generated current. The study of these factors and subsequent modelling will allow the collection of risk indices and safety profiles for the areas likely to have such currents.

Slope / coastal zone coupling

a. **Two-way nesting of the coastal zone (h<50m) and slope.** The two-way coupling between the slope (next objective) and the coastal zone with waters shallower than 50 meters is fundamental for the diagnostic and prognostic system that is being proposed. At the moment in these areas, the nesting between models occurs only in one direction (from deep to shallow areas) and it is assumed that forcing happens in only one direction. However, for a more complete analysis of this complex area, information must be transferred simultaneously between both models. Within the SOCIB framework we intend to obtain the necessary data to validate the physical and mathematical approximations that will be developed.

3. Oceanography in the coastal zone, shelf/slope and marine resource sustainability

The marine areas of our country, including both the continental shelves as well as their interaction with the coast (estuaries, bays, etc) or the open ocean (beyond the continental shelf slope) represent areas of great scientific, technological and socio-economic interest. These are areas that contain some of the greatest assets in terms of biodiversity, are characterized by ecosystems of great importance and variability, and also play a crucial role in large-scale ocean and climate processes. The sustainable management, protection and preservation of these areas require sound advances in the knowledge of processes and their interactions, to be able to understand and be able to predict both the natural variability (initially in the physical environment but gradually in a multidisciplinary way) as well as the response and variability in response to changes due to human activity and due to climate change.

In this context, we present **three main lines of action** that could be addressed through the new observational, prediction and data management systems available through SOCIB and therefore with multidisciplinary research focused on:

Coastal ocean variability and advances in operational oceanography at a regional and local level

a. **Characterization and monitoring of the variability of the coastal zone of the Balearic Islands:** the variability of the coastal zone of the islands is not well known, nor in many cases the processes and interactions that lead to this variability, an essential element to understand the natural or anthropogenic variability of the ecosystems, even more in a global change context taking into account the geo-strategic location of the Balearic Islands in the Mediterranean. It is also essential to incorporate the generated knowledge into the new regional and local operational oceanography systems of SOCIB, which,

nested in larger scale[59] systems, will allow both the study of this variability and associated processes (also in a second phase), to predict their response to different types of forcing.

b. **Coastal zone satellite oceanography:** one of the great global challenges in the coming years lies in evaluating and improving the performance of satellite[60] sensors, in particular in coastal zones. In particular, priority will be given to the study and improvement of the current limitations of altimetry in the coastal zone, as well as the introduction of these improvements and results into the SOCIB operational oceanography systems through real-time data assimilation into the implemented numerical models. It will also be considered significant to perform re-analyses of historical time series mainly of SST, with the goal of establishing and defining the possible circulation states in the Western Mediterranean.

c. **Regional Operational Oceanography System:** real-time spatial and temporal variability: the achievement of the two previous objectives evolves naturally into the third; to establish and operate a system, which in real-time, will provide the variability of the system (and the ecosystem in a second phase) and also add a retro-feedback, allowing the study of specific processes and their impact on the obtained results, thus enabling an effective and continuous monitoring of progress.

Mesoscale and front dynamics: processes, interactions, observations and modelling

a. **Characterization of the Balearic Front, its variability and role in the North-South exchanges in the Mediterranean:** the slope front located over the SW-NE Balearic coastal shelf is a key oceanographic element in the physical aspects related to the local currents and the blocking of the general circulation as well as of the Island's ecosystem variability and living marine resources. Here there is evidence of its relation with the fisheries (for example, pelagic —red tuna— and demersal —hake and prawn—) and the proliferation of species such as jellyfish. The Ibiza and Mallorca channels are areas of special importance within this objective and therefore observational efforts will be increased in these areas.

b. **Characterization and variability of shelf/open ocean exchanges:** the coastal zone over the continental shelf represents (from a theoretical perspective) a domain isolated from the open ocean. It is well known however, that exchange processes exist between these two areas, processes that for example give rise to water, larvae and residue exchanges, and which are necessarily induced by the instabilities of a slope front, or wind-associated transitory phenomena, etc. Both the mentioned oceanographic conditions occur in the Islands, the Balearic (SW-NE) slope front, the slope and the shelf areas to the S and NE of Mallorca where, despite a steep slope there is no permanent slope front with a dynamical signature (significant density gradient). It is essential to understand these exchanges, the phenomena which cause them and their effects on the marine ecosystem and its living resources. It is of special interest to maintain and expand, in space and time, the monitoring conducted by the COB (IEO) of the areas South of Mallorca in the Radiales Project framework. Furthermore, particular emphasis will be placed on exchanges in the deep canyon areas with the goal of advancing towards a sustainable management of the exploited deep ecosystem resources.

Protected Marine Areas and Global Change

a. **Design and management of new protected marine areas based on connectivity studies:** the more than 1,100 km of coastline

59. For example, through MOON and MERCATOR with whom a stable and lasting relationship is maintained.

60. Allow to obtain quasi-synoptic, in large coastal areas, variables such as temperature, salinity (soon with SMOS although at low resolution), colour, altimetry, etc.

of the Balearic Islands requires a new method of design and management of new protected marine areas, which in line with the scientific advances of the last years, can allow a biomass recovery over the next 50 years. Particularly, studies of the connectivity between the coastal marine populations in the Caribbean have shown that their distribution depends both on the characteristics of the larval phases and the coastal currents that determine their distribution. Amongst these larval characteristics it is essential to know where they are located (far away or close to the coast), when (autumn-winter, spring-summer), and how for long the planktonic phase lasts. This is because the effects of the currents can change depending on those larval characteristics, conditioning the real dispersion capacity of each species. The detailed knowledge of these aspects, together with the comprehensive study of the population's genetic structure will allow the definition of the connectivity scale or exchange between populations, as well as their degree of vulnerability. Furthermore, it will help to determine the necessary improvements for the existent reserve network, both with respect to their size, their number and geographical location. The intention is to conduct a detailed study of the mean trajectories of the different types of larvae in relation to their lifespan, etc. to create an optimized map of the "mean free paths" of the larvae and the location and types of new protected marine areas. It is also important to know the demersal ecosystems in these areas.

b. **Global change in the coastal areas of the Balearic Islands:** the protected areas constitute ideal zones for the characterization of oceanic variability and also for changes at the deep oceanic levels, as for example those found a few miles south of the Cabrera National Park reaching over 2,000 meters in depth. Therefore, special emphasis will be placed on the study of the variability in these areas and observational efforts will be concentrated with the aim of having a new time series (which must be reliable, sustained over time and available in real-time for researchers and citizens) that allows an adequate response to this objective.

4. Impacts of climate and climate variability (natural or anthropogenic) on the Mediterranean Sea, variability of the regional circulation (sub-basin) and variability of the ecosystem

The third scientific axis of SOCIB aims at concentrating the knowledge obtained over the last 20 years into a topic of maximum scientific and socio-economic interest containing issues such as the impact of climate and climatic variability on the Balearic Islands and its surrounding areas. In this context, two main aims are set, which are also of international scientific interest.

Determination of global change scenarios on the Mediterranean circulation and their impact of the interannual variability of the ecosystems using high-resolution observations (including underwater gliders) and models

a. **Scenarios or states of the Western Mediterranean circulation:** identification of the past (from a reanalysis of the circulation over the last 40 years - maximum reliably obtainable) and future scenarios (based of IPCC scenario predictions), and assess (understand, resolve and potentially parameterize) the interactions resulting from the convergence between recent incoming Atlantic water, less dense ($S < 36$), and the denser ($S > 37$) resident Mediterranean water in the western Alboran Sea, the resulting instabilities and their relation with the north/south heat transport and exchanges in the western Mediterranean. All this is of key relevance to the ecosystem and fisheries variability.

b. **Scenarios and ecosystem variability:** analysis of the ecosystem changes in specific coastal areas through their short term

integration, focusing on specific problems such as the proliferation of jellyfish and algal blooms (HABs), assessing in both cases, the coastal inputs and exchanges with the open ocean. All of this in the context of global change.

Mesoscale and submesoscale processes and their contribution to the 3D interannual variability of the surface layer in the Mediterranean

Specifically considering the relevance of the vertical movements caused by eddies and the ocean-coast exchange processes, using process, observations and modelling studies.

a. **Mesoscale variability and scales of variability,** determination or parameterization, for every identified scenario, characterizing the mesoscale variability and establishing the importance of mesoscale and submesoscale eddies on the surface layers of the ocean.


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