

Balearic Islands-Spain case study: **SOCIB** contribution to the Observing System of the European Seas and Coasts, in line with Blue Growth initiatives

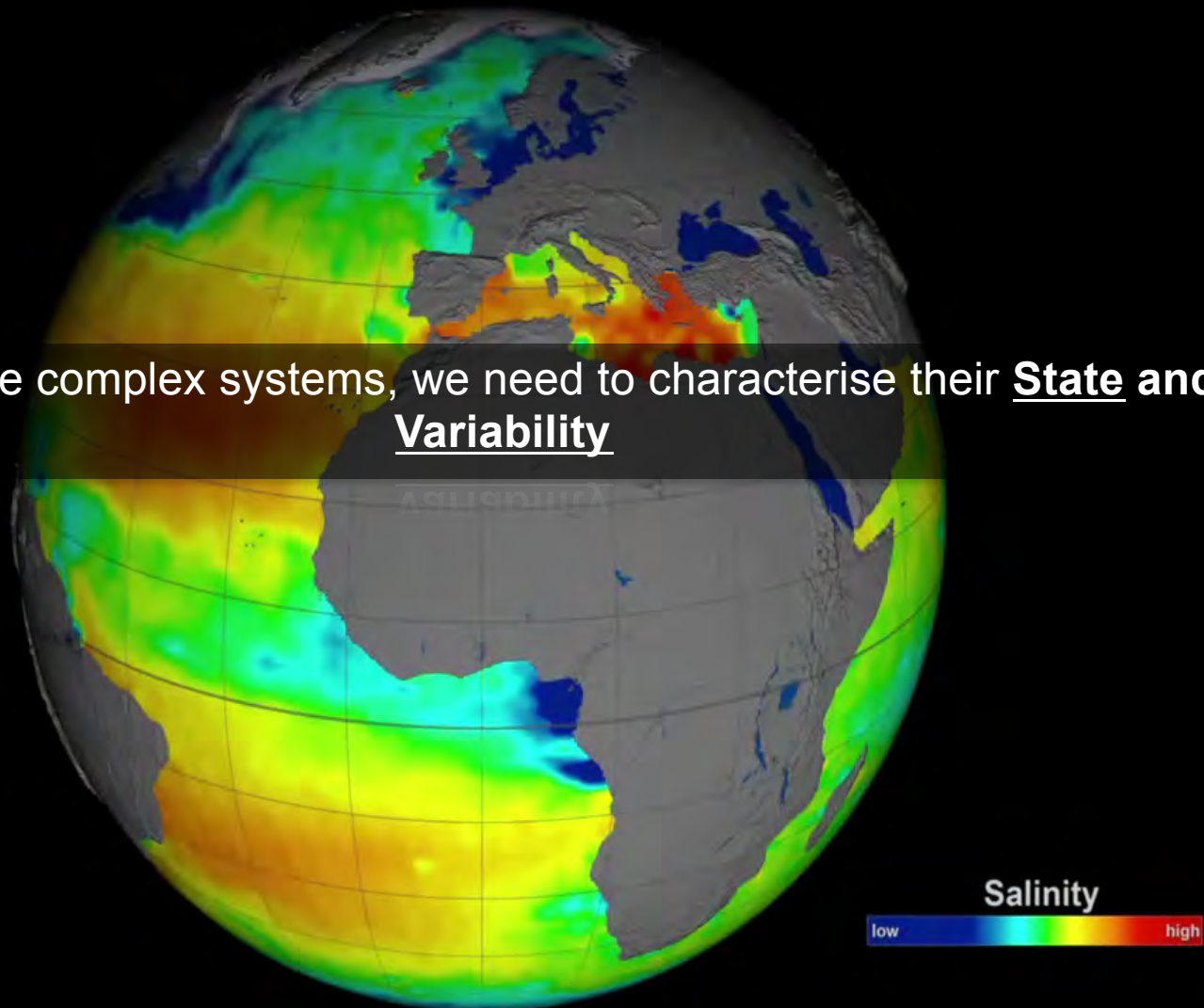
Joaquín Tintoré (Research Prof. CSIC)
SOCIB and IMEDEA (CSIC-UIB)

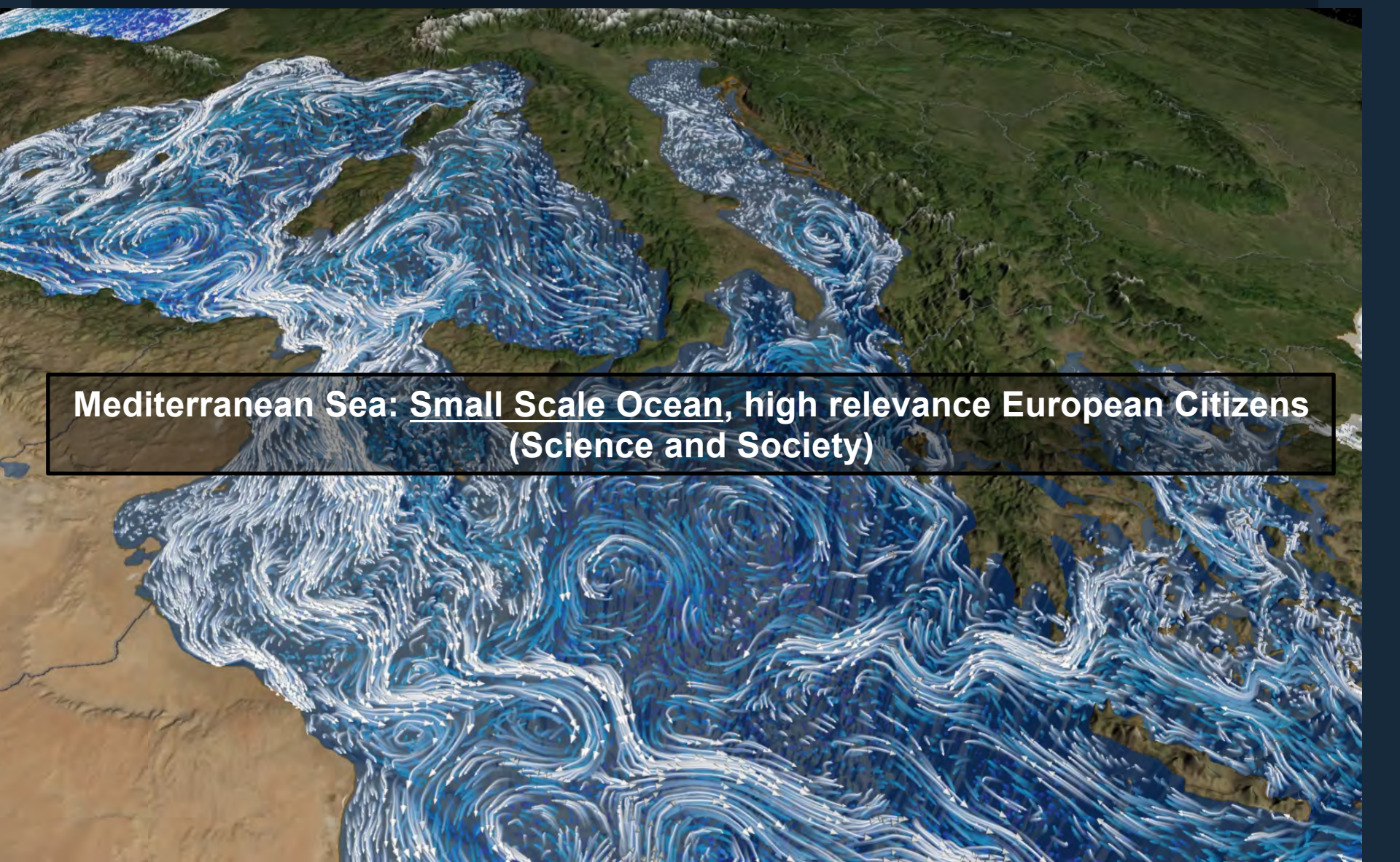
[Workshop on the use of Structural Funds for the construction of distributed e-Infrastructures supporting ESFRI ENV initiatives. May 12, 2014](#)

OUTLINE

1. Balearic Islands: Smart and Sustainable Tourism. Focused, coherent approach to RIS3 Strategies (National/Regional Research and Innovation Strategies for Smart Specialization)
2. Paradigm Change Ocean and Coastal Observation: Multi-Platform Observing Systems and Data Availability
3. SOCIB -and Marine Research Infrastructures in general-: Key Elements to Respond to Science priorities, Enhance Technology Development and Respond to Society Needs by this contributing to Blue Growth EU activities "Turning Data into Jobs..."

Oceans are complex systems, we need to characterise their State and Variability





**Mediterranean Sea: Small Scale Ocean, high relevance European Citizens
(Science and Society)**

New Technologies: Paradigm Shift

→ Ocean Observation

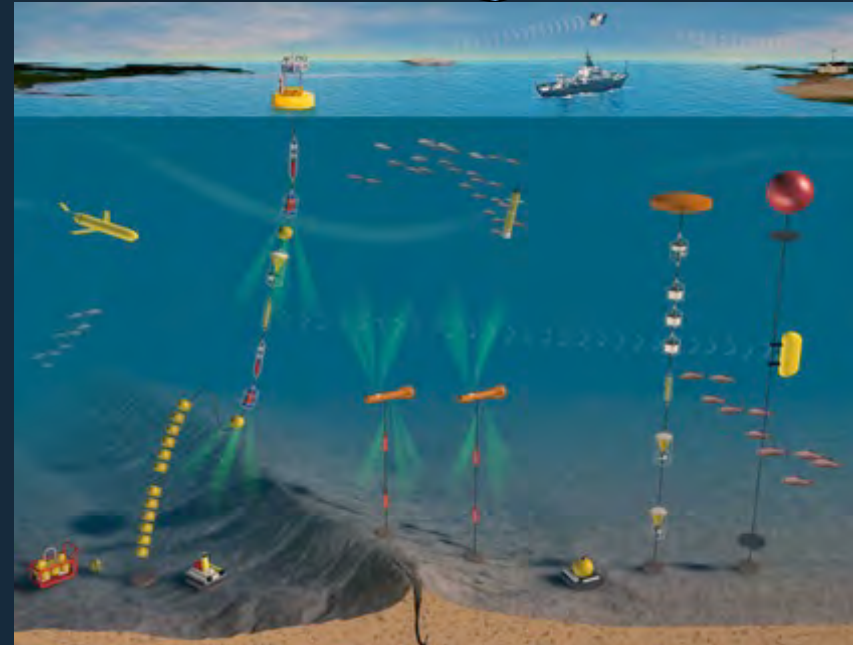
SOCIB

From: Single Platform - Ship based observation

To: Multi-platform observing systems

Network - distributed
Systems

Platform-centric
Systems



(Adapted from Steve Chien, JPL-NASA)

“A single ship can only be in one place at one time. We need to be present in multiple places in multiple times.” ([John Delaney, Nature, Sept. 25, 2013](#))

New Technologies: Paradigm Shift

→ Data Availability

From: Data only available 12-24 months/years after cruises....

To: Quasi-real time quality controlled data available

Data available for science and society

- Huge increase in human potential for analysis
- Allowing knowledge based management oceans and coast
- Knowledge based response under emergencies

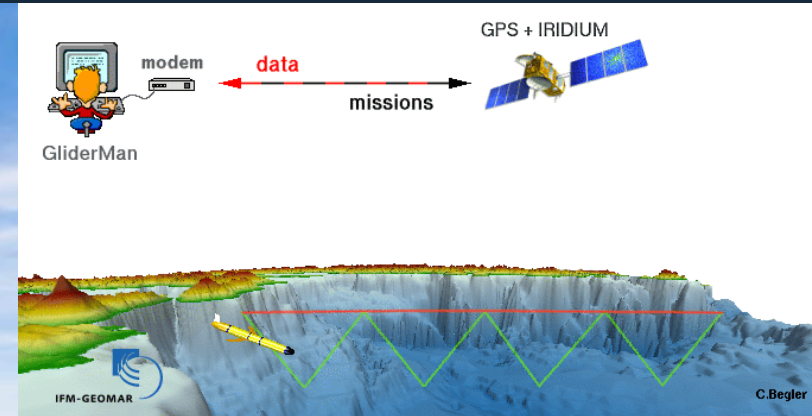
Models / Data inter-comparison

NEW CHALLENGES: Multi-disciplinary, multi-platform integration.

“Le véritable voyage de découverte ne consiste pas à chercher de nouveaux paysages, mais à avoir de nouveaux yeux” – “The real voyage of discovery consists not in seeking new landscapes, but in having new eyes”. (Marcel Proust)

An Example of New Technologies: Autonomous Underwater Gliders

SOCIB



Why Ocean Observatories, why SOCIB, why now?

New Technologies triggered a paradigm change New Approach to Marine and Coastal Research

Allow three-dimensional real time observations, that combined with forecasting numerical models, and data assimilation, ...

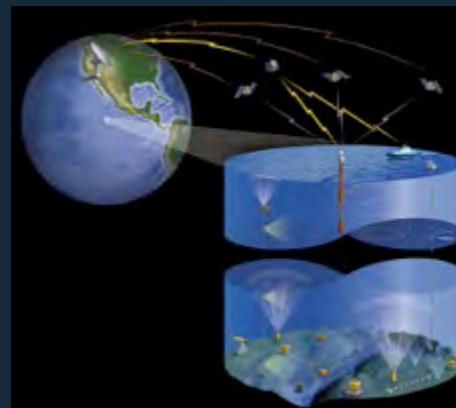
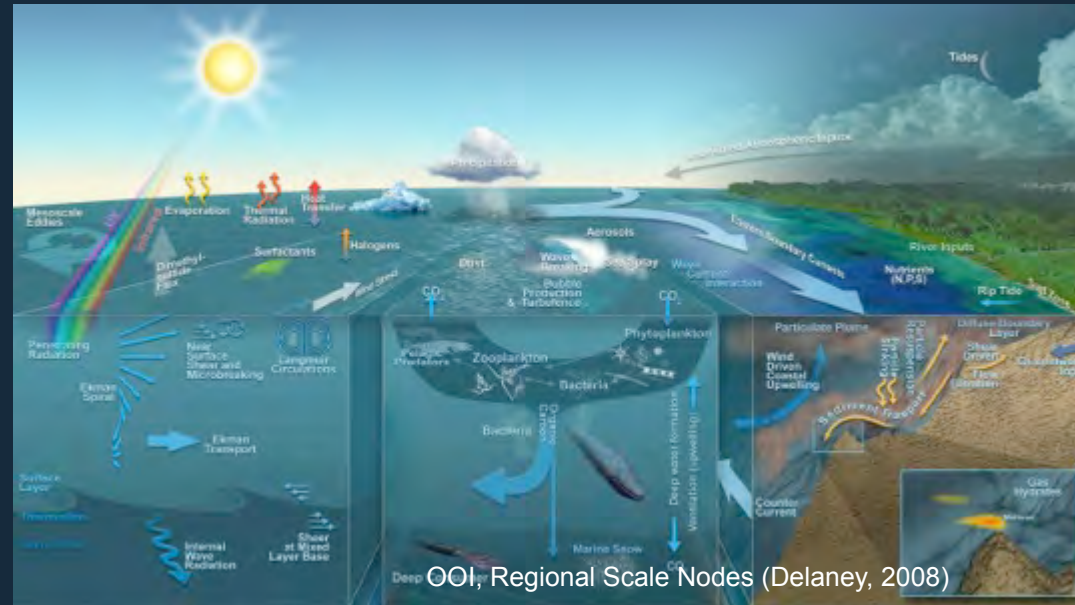


A quantitative major jump, in scientific knowledge and technology development

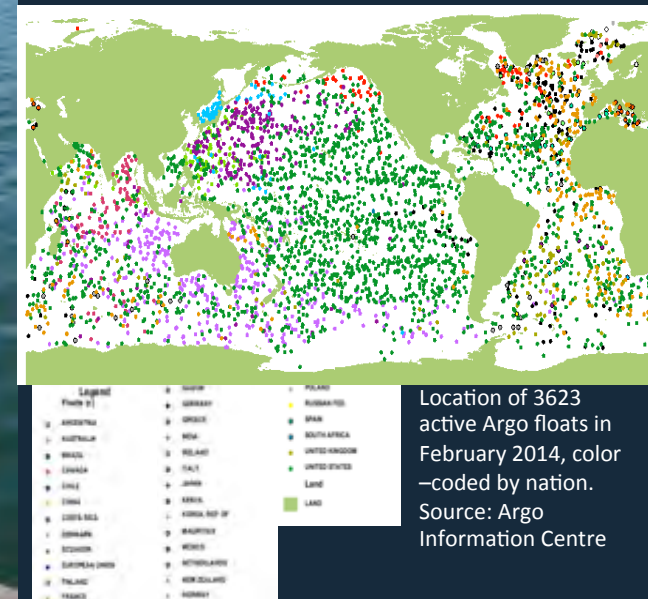
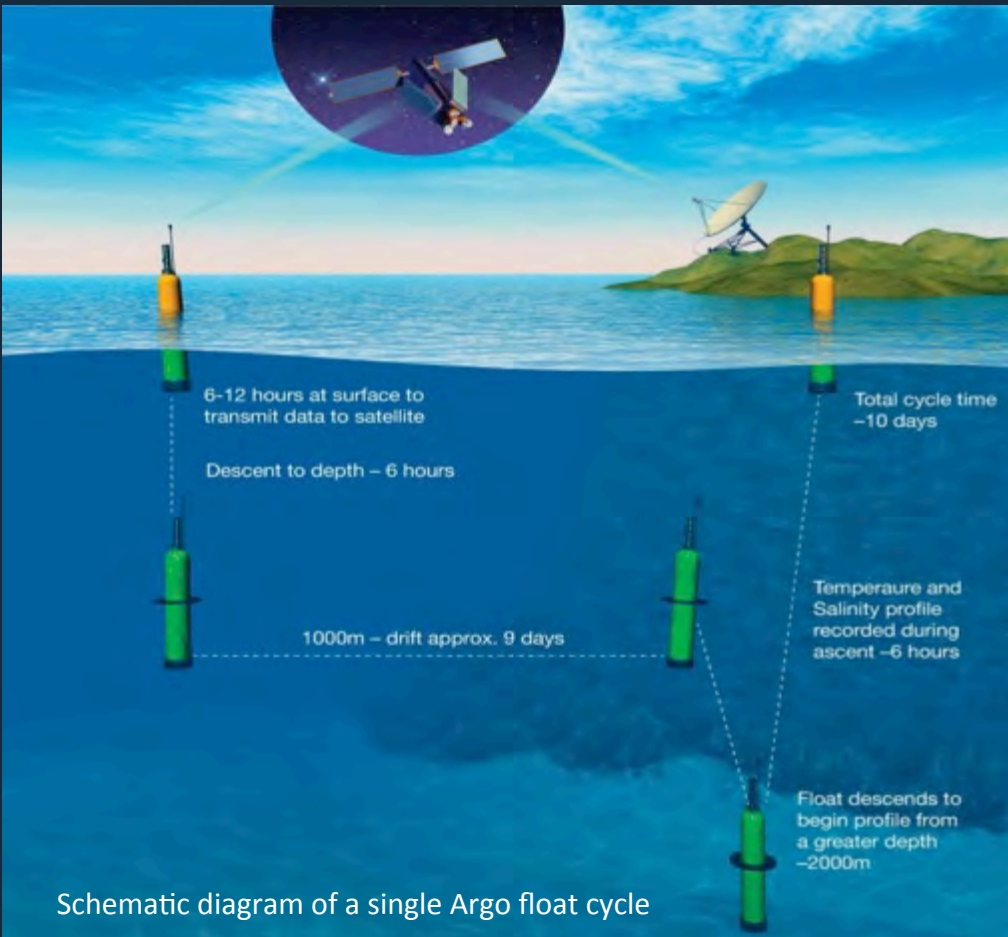


The development of a new form of Integrated Coastal and Ocean Management, based on recent scientific and technological achievements,...

on a global change context (where climate change is one of the most important, but not the only one...), and following sustainability principles



Why now?: Last decade, successful Argo international programme, Euro-Argo

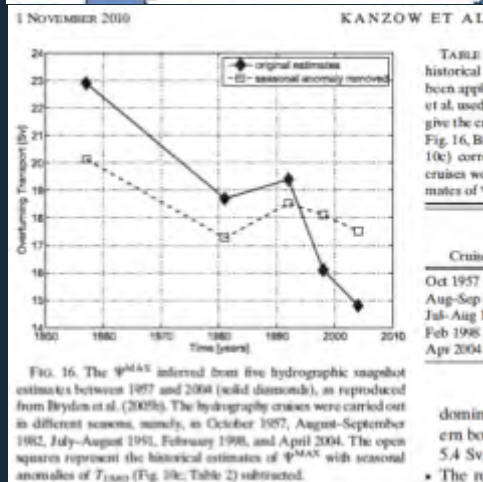


<http://www.euro-argo.eu>

Argo Programme -combined with satellite altimetry- allowed characterisation

STATE OF LARGE SCALE OCEAN CIRCULATION

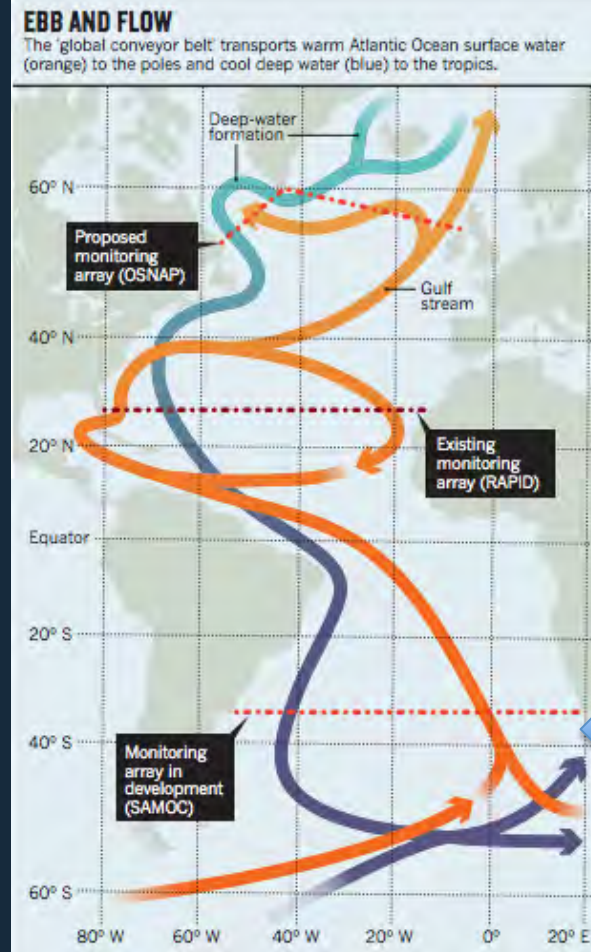
Why now?: The real challenge today is Ocean Variability AND at key scales (mesoscale)



An Example: AMOC, Atlantic Ocean Meridional Circulation

2005: decline.

2010: seasonal biases correction



AMOC recent key milestones:

- 2005
- 2010
- 2012
- 2013

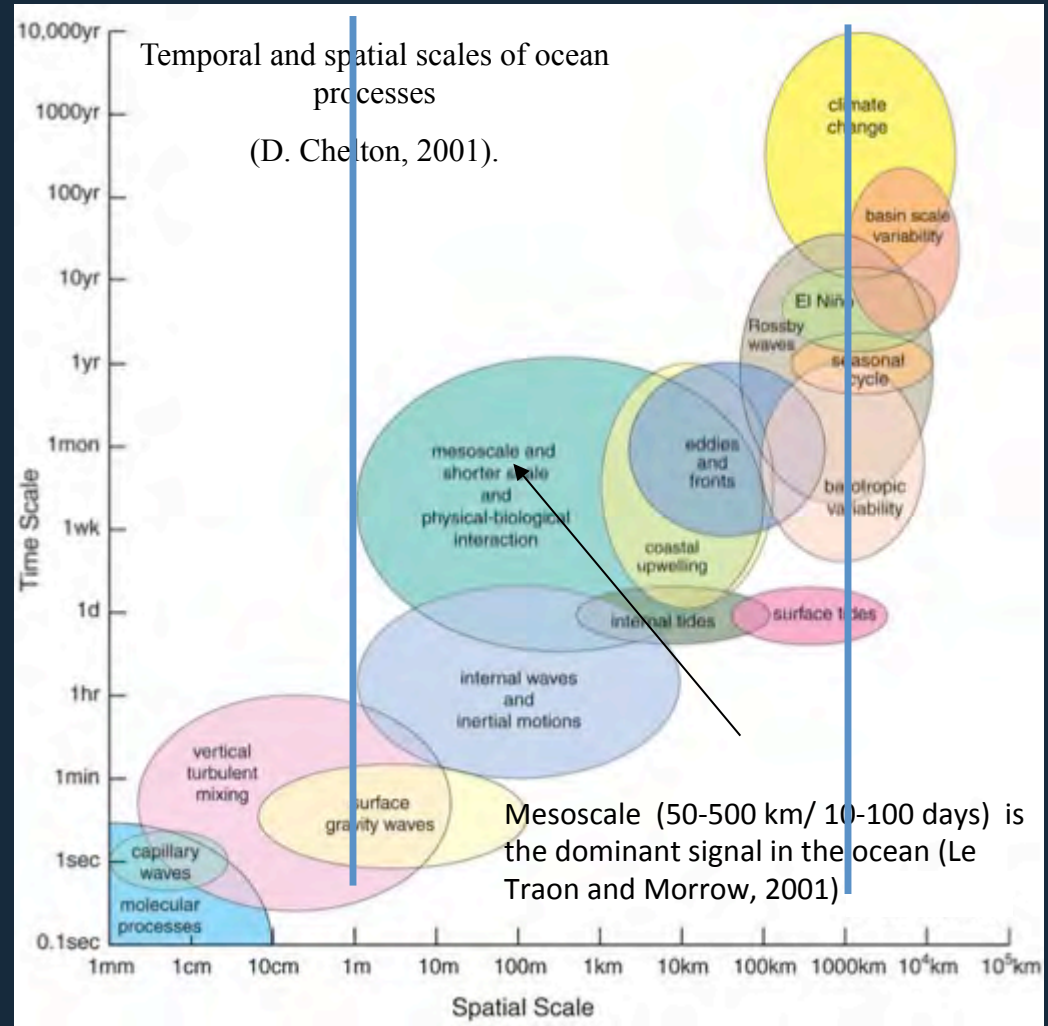
In April 2009, the array recorded a 30% drop in average current strength that persisted for a year, reducing the amount of heat transported to the North Atlantic

Why focus on Variability at Mesoscale and Coastal interactions?

Theory and observations have shown that there is a maximum energy at the mesoscale (include fronts and eddies ~10-100km),

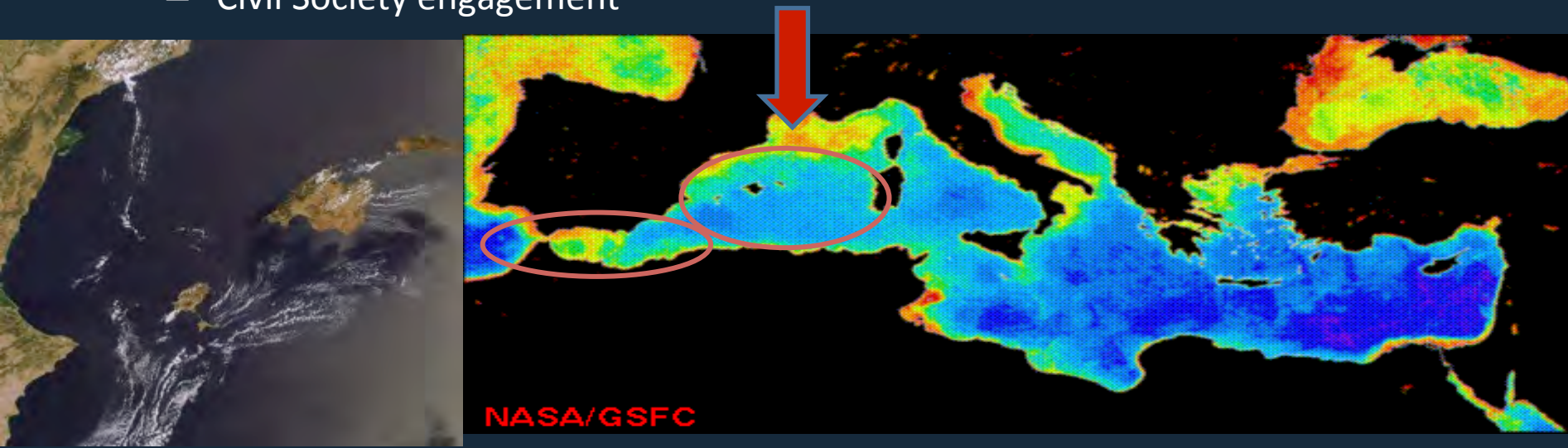
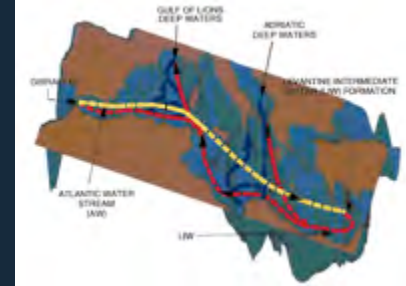
SOCIB focus: mesoscale & submesoscale and their interactions with general circulation and their effects on vertical motions, impact on ecosystem variability.

With inputs from 'both sides'....
(nearshore and coastal ocean and also seasonal/inter-annual and decadal variability)



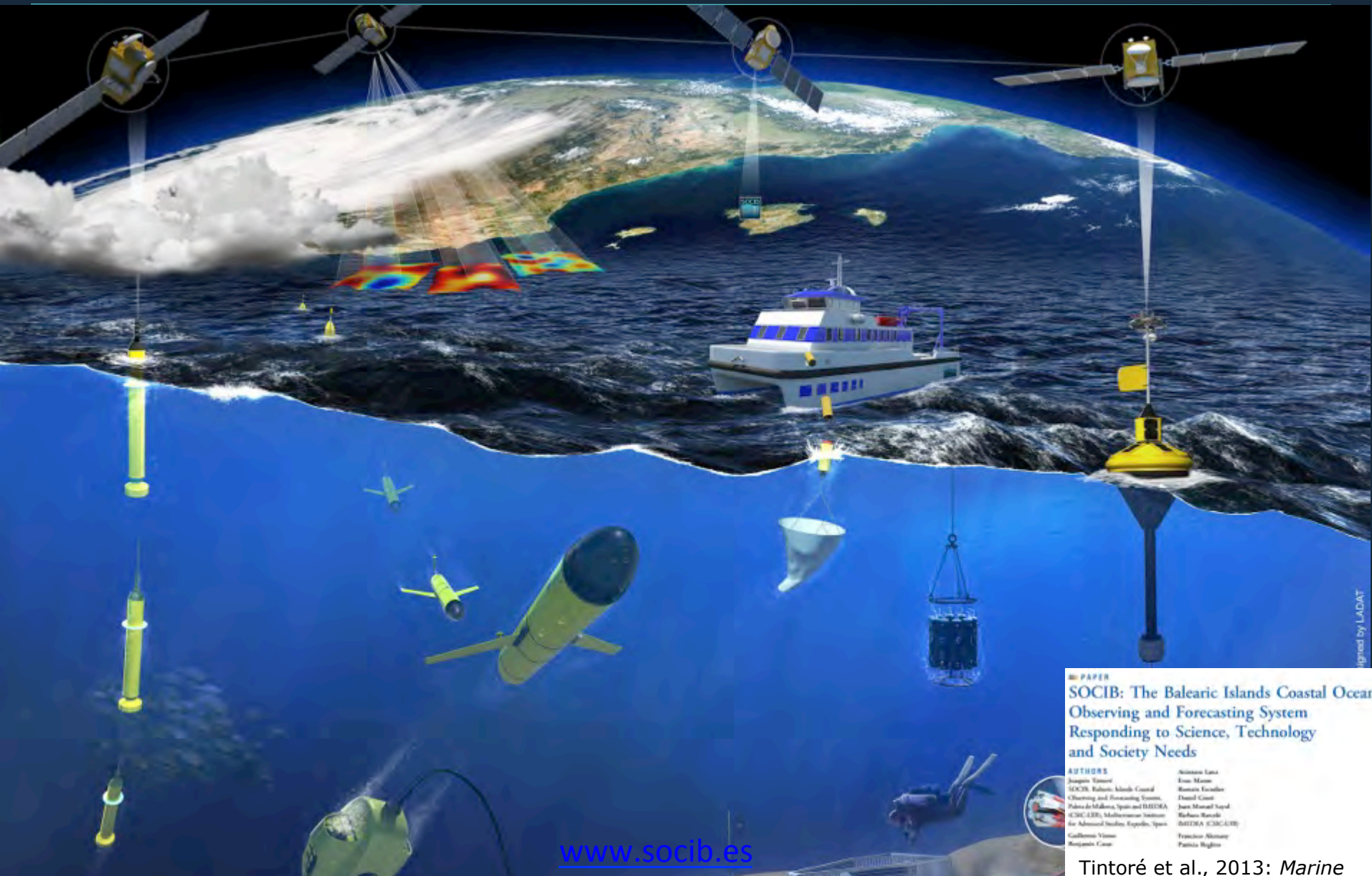
Why Mediterranean and why SOCIB, ?

- Mediterranean
 - Scientific relevance as small scale ocean, THC; (e.g., Malanote-Rizzoli et al., 2014).
 - Society relevance: European citizens
 - Leading ocean science, new technologies, data management, society response
- Balearic Islands
 - Know-how and infrastructures: leading EU and international science
 - Government lead and unified joint support (MINECO and Balearic Gov)
 - Civil Society engagement



What is SOCIB? A multi-platform observing system, from nearshore to open-ocean in Mediterranean

SOCIB



Agreed by LADAT

PAPER

SOCIB: The Balearic Islands Coastal Ocean Observing and Forecasting System Responding to Science, Technology and Society Needs

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www.socib.es

Tintoré et al., 2013: *Marine*

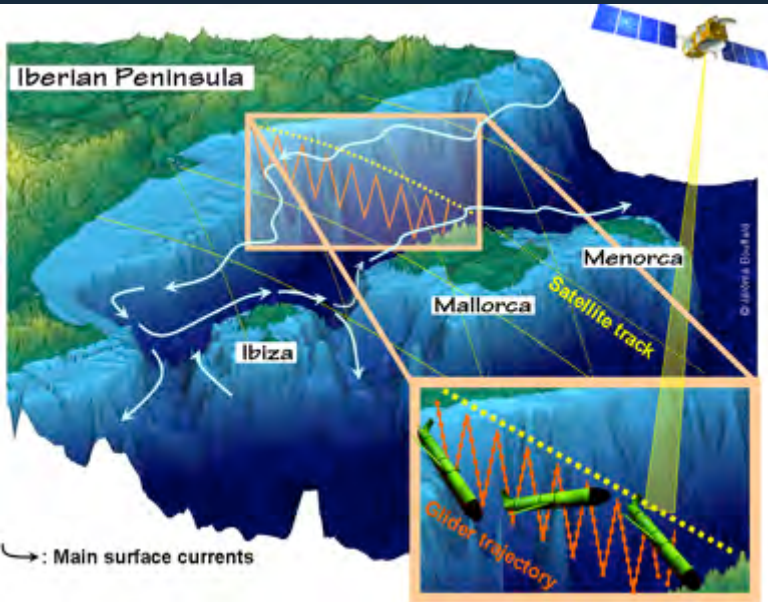
What is SOCIB? A multi-platform observing system, from nearshore to open-ocean in Mediterranean

SOCIB

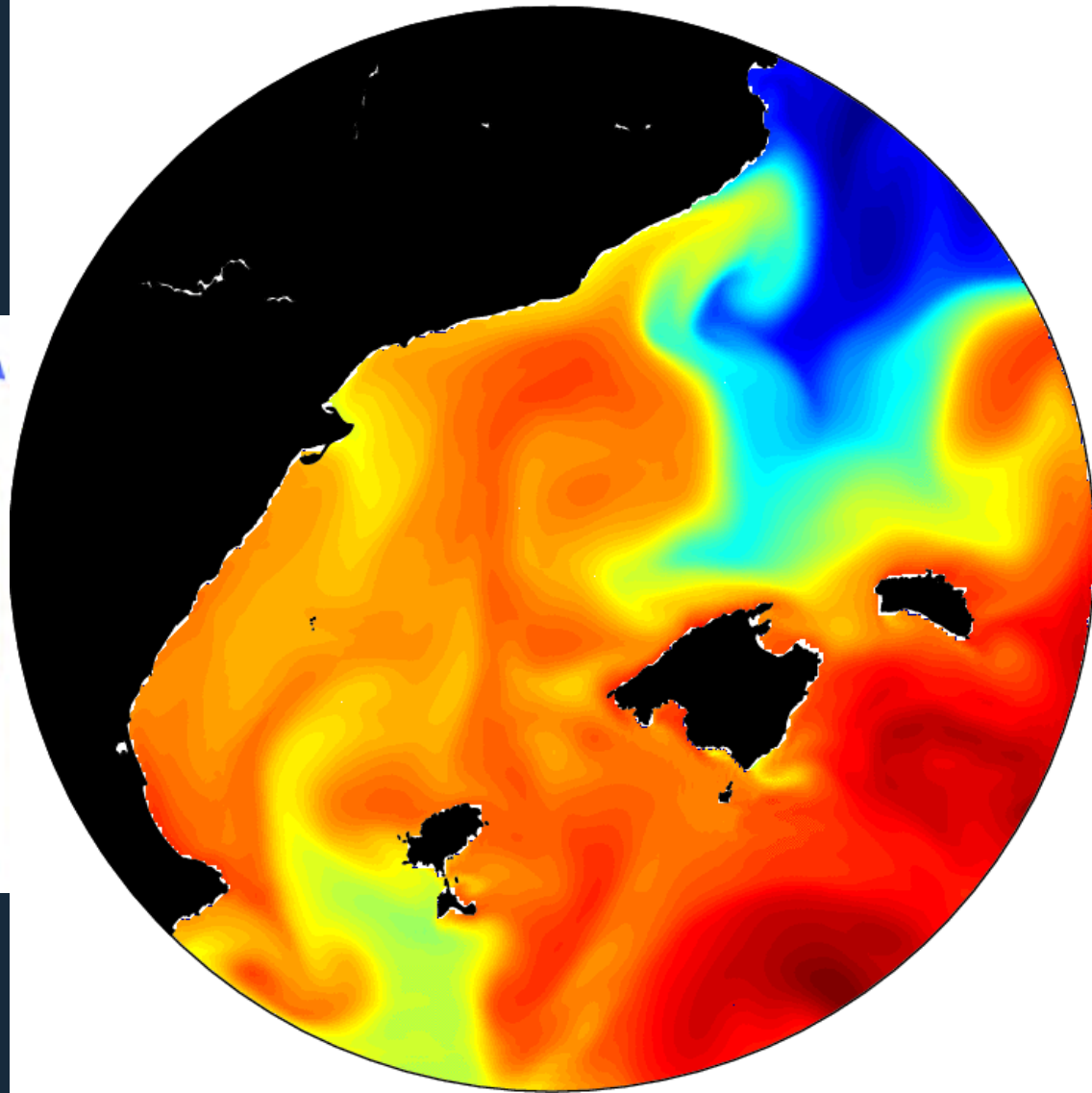
The screenshot displays the SOCIB website interface. At the top, the logo and name 'SOCIB Balearic Islands Coastal Observing and Forecasting System' are visible, along with logos for the Government of the Balearic Islands and the Spanish Government. A navigation bar includes links for home, about us, facilities, news, multimedia, job opportunities, and competitive access. The main content area features a large video player showing a diver underwater, with the caption 'Fixed Stations facility'. To the right, a 'latest news' section lists three recent updates: SOCIB's participation in the EMODnet MedSea Checkpoint Project (08-05-2014), a presentation at the EGU conference (05-05-2014), and a visit to the SOCIB Glider Facility (15-04-2014). Below the news, there are social media icons for Facebook, Twitter, LinkedIn, RSS, YouTube, and Flickr. The 'facilities' section is a horizontal row of icons representing different observation platforms: COASTAL, COASTAL HF, GLIDER, LAGRANGIAN, FIXED STATIONS, BEACH, OCEAN, and DATA CENTER. The 'direct links' section at the bottom contains a grid of links to various resources: SACOSTA (Environmental Sensitivity of the Coastline), ICTS Map (Spanish Large Scale Facilities Map), contractor profile, Wave forecast (collaboration with Puertos del Estado and Aut. Portuaria IB), Dapp (real-time deployment monitoring application), Satellite (Satellite observations), Seaboard (Dashboard visualizations of real-time and forecast ocean data), Follow the glider (Educational web developed by CEFAS, IMEDEA (CSIC-UIB) and SOCIB), and LW4NC2 (Web application to visualize NetCDF data interactively).

www.socib.es

Ocean Circulation Variability, an example in the Balearic Sea (biodiversity hotspot)



DAY = 1



Ocean Circulation Variability – ubiquitous mesoscale signal – an example Indian Ocean...

How can ocean currents help with finding a missing plane? (April, 2014)

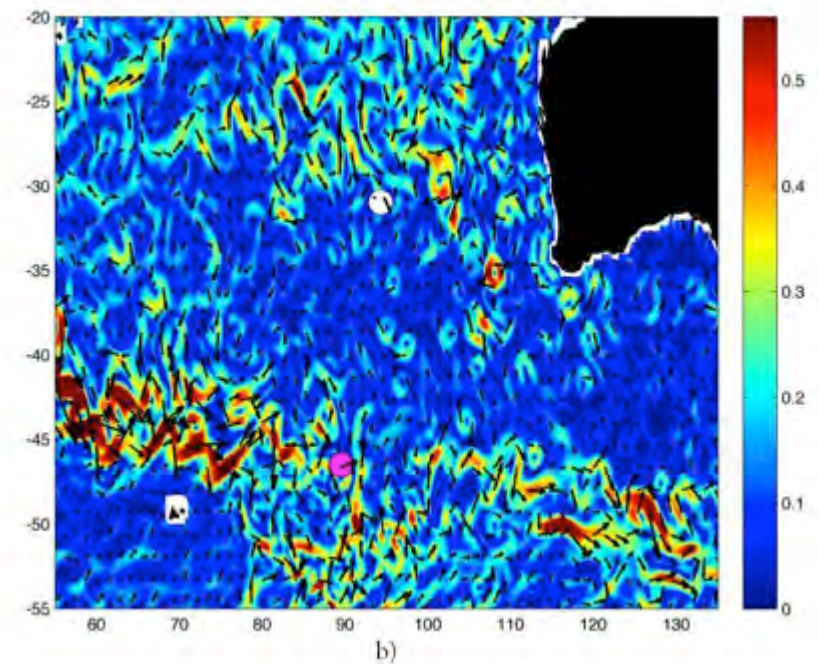
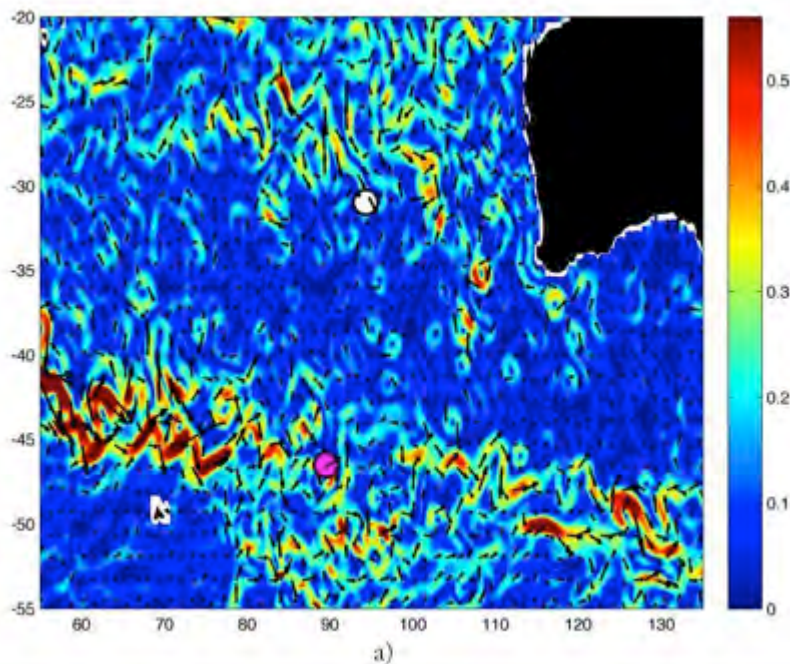


Figure 1. OSCAR ocean surface currents (m/s) on a) 23 March 2014 and b) 28 March 2014. The pink dot denotes the center of the search area on 27 March 2014 and the white dot denotes the center of the search area on 31 March 2014.

What is SOCIB? A multi-platform observing system, from nearshore to open-ocean in Mediterranean

SOCIB

OBSERVING FACILITIES



Research vessel



HF Radar



Gliders



Lagrangian platforms



Fixed stations

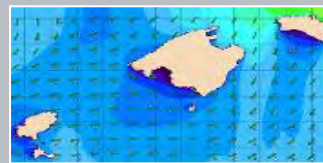


Beach Monitoring

MODELLING FACILITY



Currents (ROMS)



Waves (SWAN)

STRATEGIC ISSUES & APPLICATIONS FOR SOCIETY



Integrated Coastal Management



Marine Spatial Planning

DATA CENTER



Data access – Data Repository – Applications
Spatial data infrastructure – Real time monitor

What is SOCIB? A multi-platform observing system, from nearshore to open-ocean in Mediterranean

SOCIB

3 Drivers

- Science priorities
- Enhance Technology Development
- Respond Society Needs

Mission

Ocean Variability, focus on meso & sub-mesoscale

- “Oceanic weather”-
- From nearshore to open ocean
- 2013 Start operational phase, data, products and services

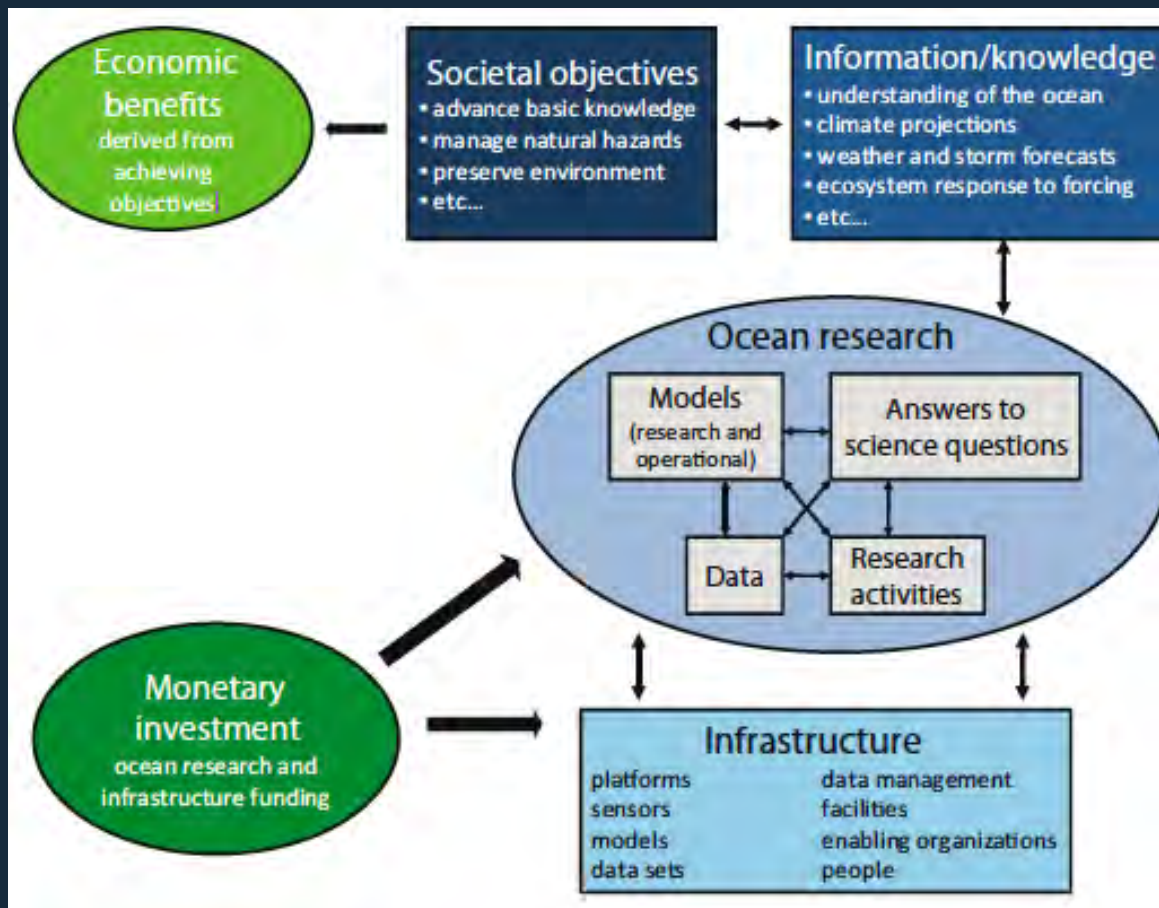
Results

Yes, already from the 3 drivers...

SOCIB Principles

- Scientific and technological excellence through peer review
- Science, technology and society driven objectives
- Support to R&D activities in the Balearic Islands (existing and new ones)
- Systems integration, multiplatform and multidisciplinary coordination
- Sustained, systematic, long term, monitoring, addressing different scales
- **Free, open and quality controlled data streams**
- **Baseline data in adherence to community standards**
- **Partnership** between institutions

SOCIB in the Spanish, EU and International Frame



[Committee on an Ocean Infrastructure: Strategy for U.S. Ocean Research in 2030. NRC \(2011\)](#)

SOCIB Data Centre: Real Time, Free Access & Download, Quality Controlled, Interoperable Data

SOCIB



SOCIB Data Centre

DATA CENTER FACILITY

- Manage all multi-platform SOCIB Data
- Allow users to discover, gather, visualize and download
- Immerse in the international framework and EU funded projects

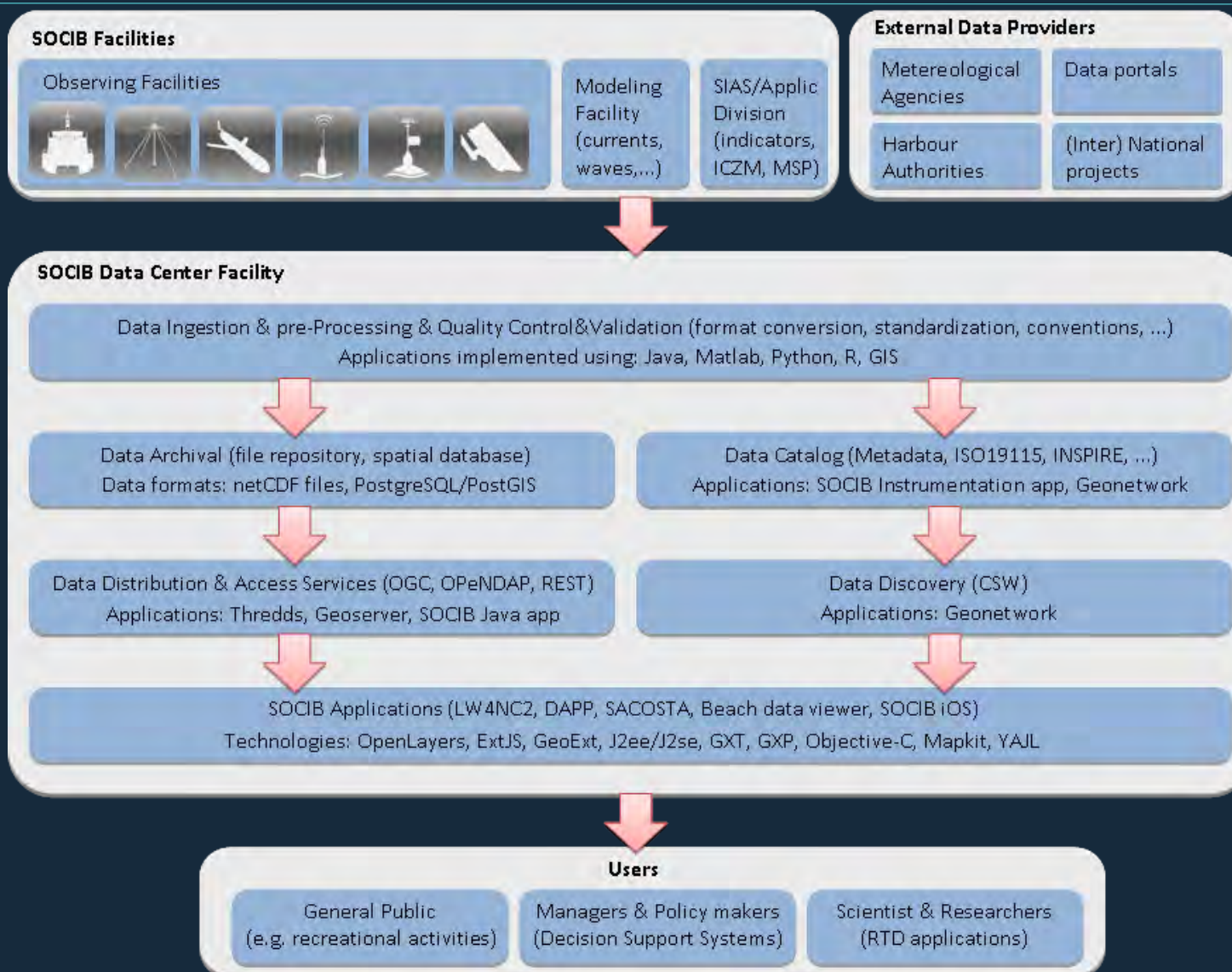
OPEN DATA PRINCIPLES

- Discoverable and accessible
- Freely available
- Interoperable, standardized and quality controlled



**Turning DATA INTO JOBS (US - NOAA)....
Blue Growth**

SOCIB Data Centre: Lifecycle of data



Gliders Facility: Science



**Mesoscale – Submesoscale /
Vertical motions - biogeo effects**

**Eddy/mean flow interactions –
Blocking effects General Circulation**

GEOPHYSICAL RESEARCH LETTERS, VOL. 36, L14607, doi:10.1029/2009GL038569, 2009

Vertical motion in the upper ocean from glider and altimetry data

Simón Ruiz,¹ Ananda Pascual,¹ Bartolomé Garau,¹ Isabelle Pujol,² and Joaquín Tintoré¹

JGR, 2010

**Coastal and mesoscale dynamics characterization using altimetry
and gliders: A case study in the Balearic Sea**

Jérôme Bouffard,¹ Ananda Pascual,¹ Simón Ruiz,¹ Yannice Faugère,²
and Joaquín Tintoré^{1,3}

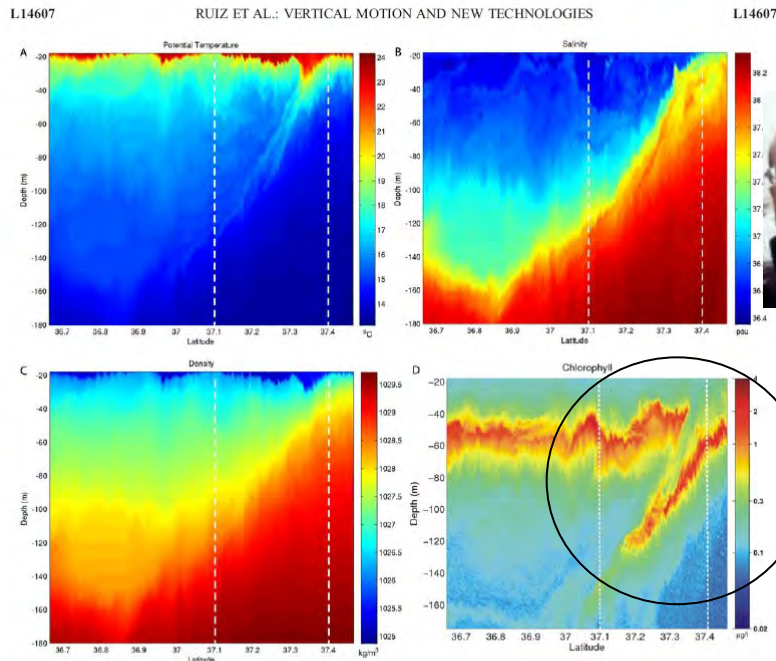
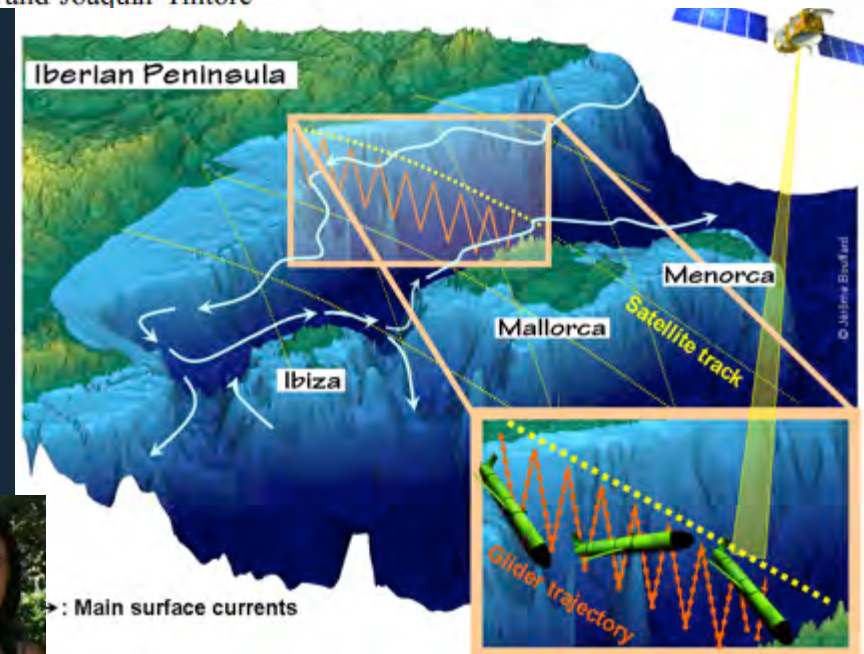
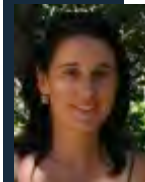


Figure 2. Vertical section of temperature (°C), salinity (PSU), density (kg/m³) and chlorophyll (µg/l) from glider section 2 (dashed magenta in Figure 1). White dashed lines define sub-section in the northern part of the domain.



Gliders Facility: Operational

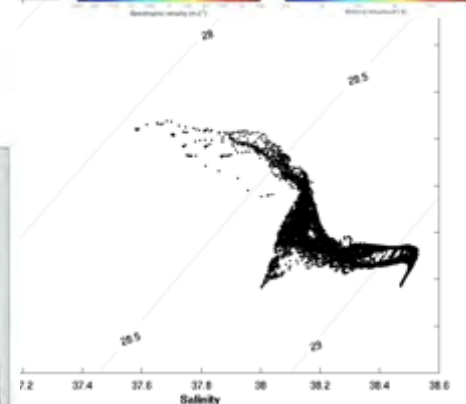
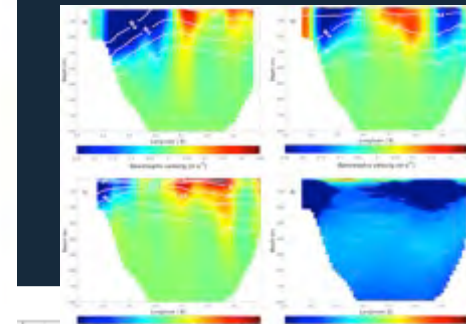
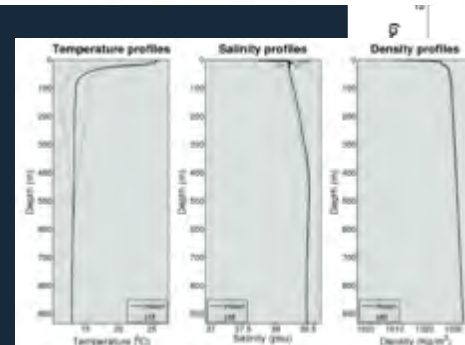
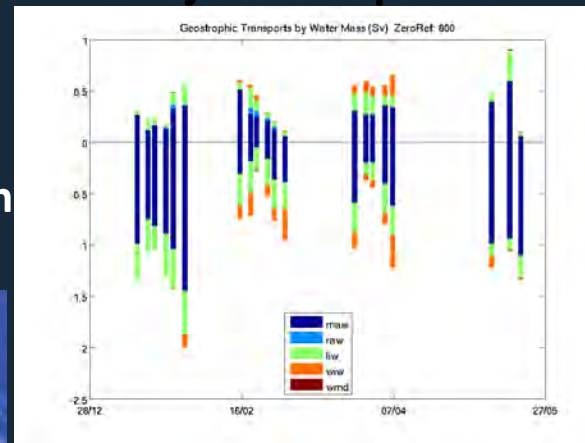
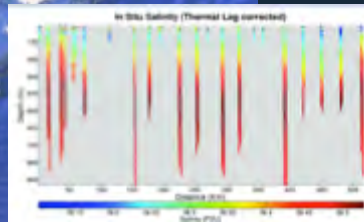
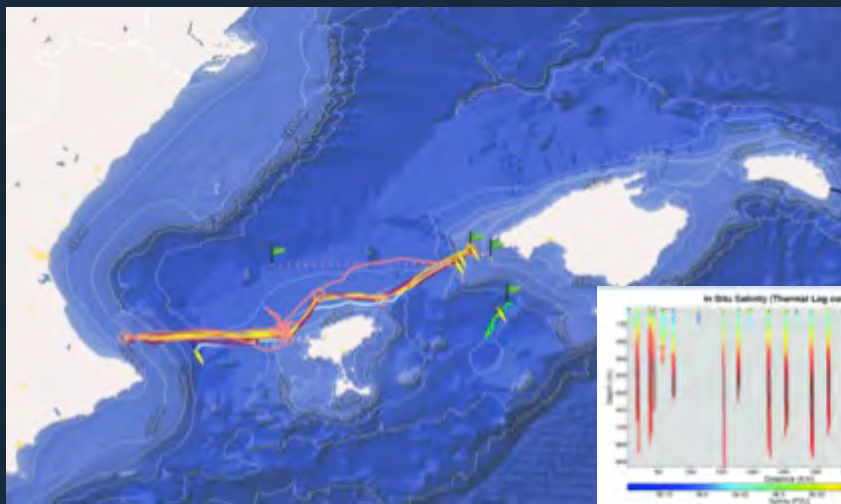
GEOPHYSICAL RESEARCH LETTERS, VOL. 39, L20604, doi:10.1029/2012GL053717, 2012

Autonomous underwater gliders monitoring variability at “choke points” in our ocean system: A case study in the Western Mediterranean Sea

Emma E. Heslop,¹ Simón Ruiz,¹ John Allen,^{2,3} José Luís López-Jurado,⁴ Lionel Renault,⁵ and Joaquín Tintoré^{1,5}

Major transport changes

- After 32 glider missions (started in 2006), + 17.000 profiles (30 Euros/profile)
- Since January 2011; routine operation



Gliders Facility: Outreach

ESTUDIANTES

PROFESORES

EXPLORA



ENG

FOLLOW THE GLIDER



EXPLORA

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volutpat ornare.

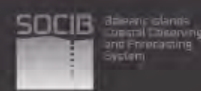
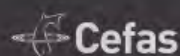


<http://followtheglider.com>

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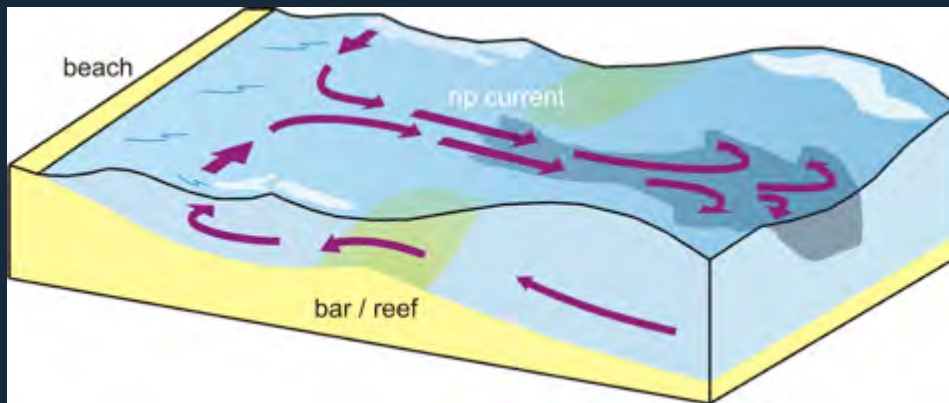
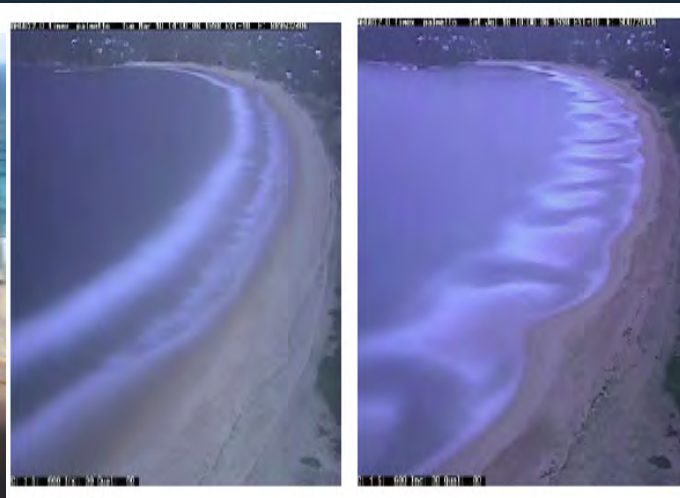
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Technology Development: Rip Currents and Beach Safety

SOCIB



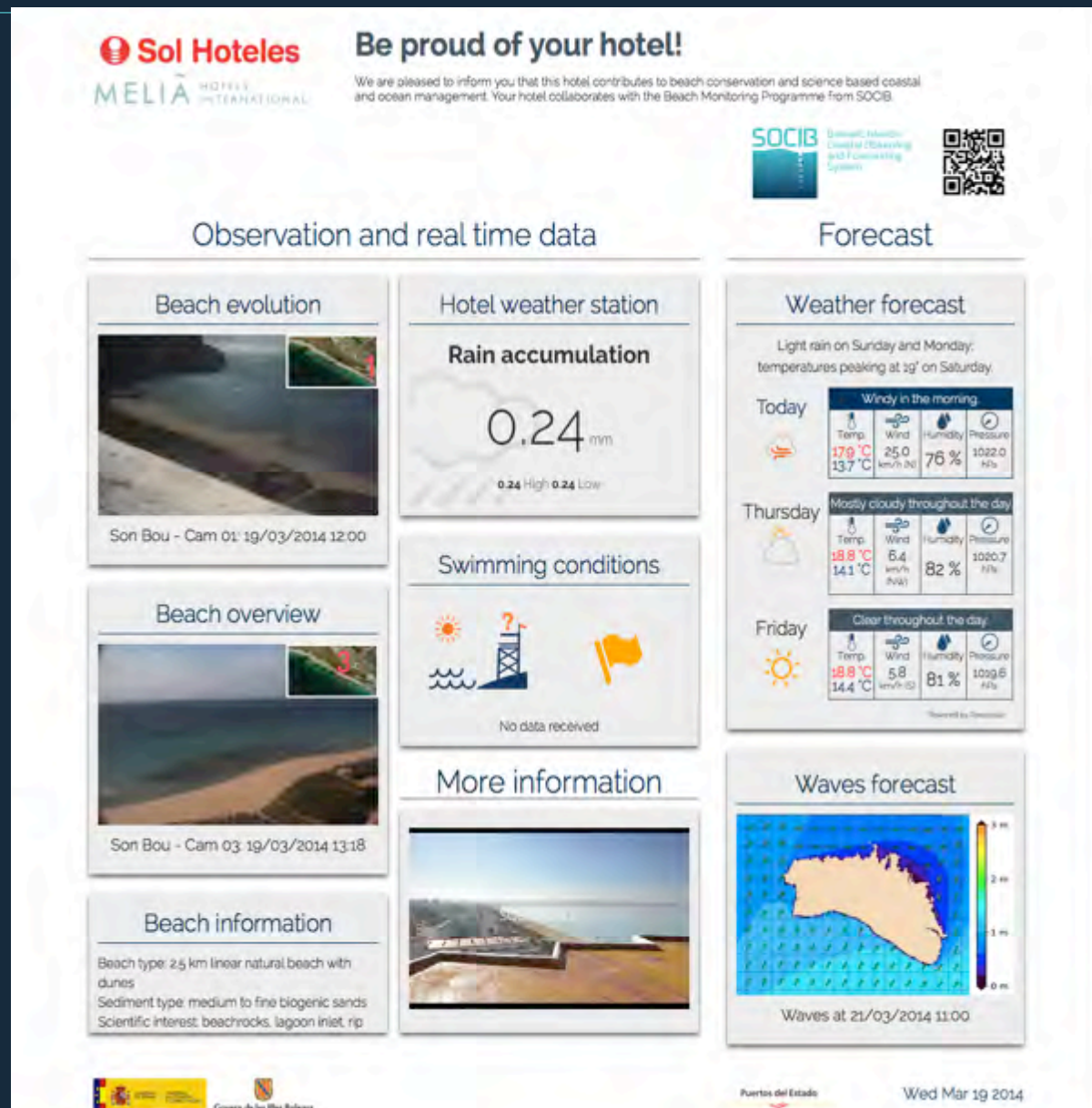
Beach monitoring using cameras, breakers, rips, bathymetry changes, etc.

SOCIB: examples of recent products...

SOCIB Mobile Apps



SOCIB examples of recent products...

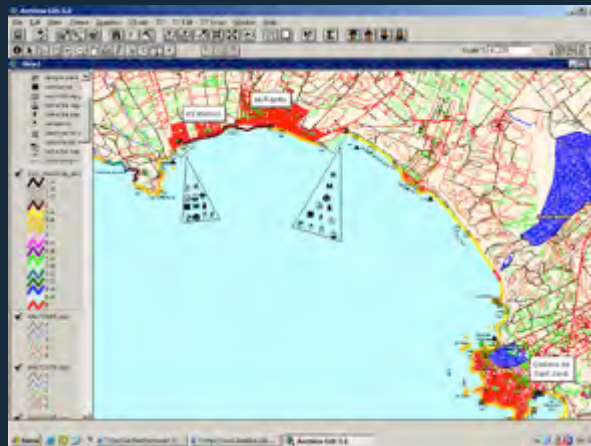


SOCIB tools for decision support under oil spill: ESI for all Balearic coast (1.200 km coastline)

SOCIB

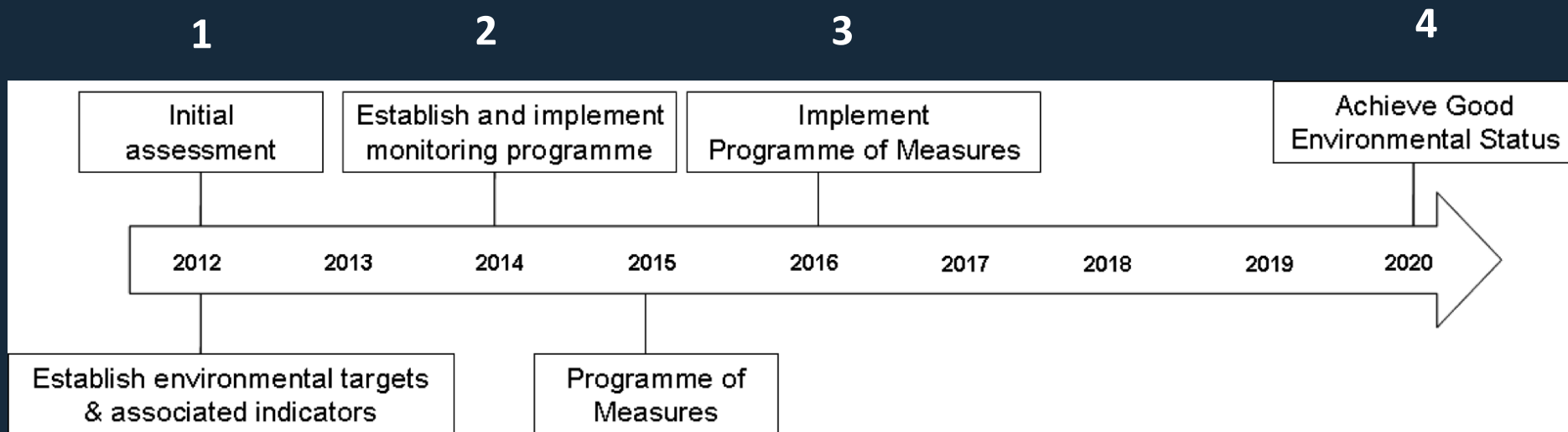
This system incorporates all the available information and identifies resources at risk, establishing protection priorities and identifying appropriate response.

ESI (Environmental Sensitivity Index)



SOCIB (contribution to IMP, e.g., MSFD)

- **MSFD A KEY SOCIETAL DRIVER:** requires (1) An Initial Assessment present status to guarantee achievement of (2) Good Environmental Status by means of actions that include (3) Monitoring Programs and detailed (4) Programs of management measures.



Marine Research Infrastructures: key elements of **SOCIB** Blue Growth & IMP, increase Horizon 2020 competitiveness & implementation RIS3 SS Strategies

Why Ocean Observatories, why SOCIB and why now?

- New technologies allow crucial **change of paradigm** ocean observation: from ship based observation to multi-platform observing system. SOCIB, 2006 proposal based scientific excellence.

- International trend: **towards new observing systems**/MRI, Europe response to this challenge, EC, JPI Ocean

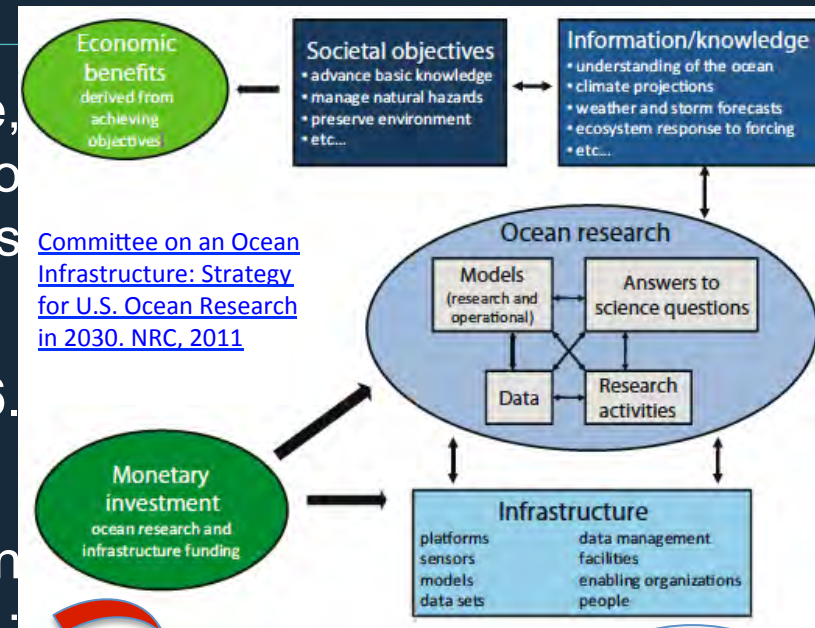
- SOCIB: one of the leading elements of European response: a **multi-platform distributed and integrated facility of facilities**, open to international access that provides free, open, quality controlled and timely streams of data & forecasting products and services. ICTS MINECO.



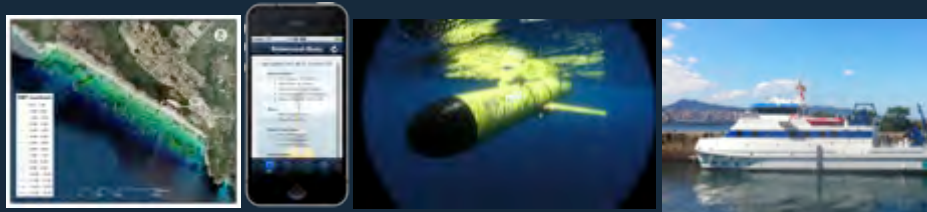
Marine Research Infrastructures: key elements of **Blue Growth & IMP**, increase **Horizon 2020** competitiveness & implementation **RIS3 SS Strategies**

SOCIB

- **SOCIB drivers & singularities:** science, technology development and capacity to respond to strategic society needs. Extends from nearshore to open ocean.
- Initial proposal from IMEDEA: in 2006. Formal start: 2009 (CSIC-Board Trustees).
- [Implementation Plan](#) 7/2010. Design 2009-2010; Construction 2010-2102; Operations 2012-2021. Strong Partnership, both in Europe -[Marine Res. Infrastructures](#)- and internationally IMOS, OOI-IOOS, Neptune-Venus, NANOOS, etc.



[Committee on an Ocean Infrastructure: Strategy for U.S. Ocean Research in 2030. NRC, 2011](#)



The role of new marine research infrastructures on Blue Growth, Horizon 2020, RIS3

➔ SOCIB is an example of Critical Mass and Capability to...:
RESPOND TO THE 3 KEY DRIVERS (in line with H2020)

- Science Priorities – (ok!)
- Strategic Society Needs (more listening!, policy makers&managers endorsement), MSFD (GES); Energy, Tourism, etc.
- New Technology Developments (companies, social society endorsement)

Ocean Observatories/Marine Research Infrastructures are particularly well placed (mission, vision, critical mass, etc.)

AND → Need to define a **JOINT STRATEGY** at European level, more than coordination, **Partnership**..., for...Horizon 2020, RIS3 Strategies, etc.

SOCIB, MRI, Structural Funds and Blue Growth

Two messages

- Smart and Sustainable Tourism ; RIS3 Strategy in the Balearic Islands; well focused, based on solid grounds, with critical mass (science-society-gov), political endorsement and strong cooperation other EU and Spanish regions similar interests.
- Technology and paradigm changes ocean observation; Ocean Variability, with shift from Large Scale to Mesoscale and Coasts: SOCIB.

SOCIB, new ocean and coast observing system, real time open data, ... “Turning data into jobs”

- SOCIB is a key component of the Balearic Islands RIS3 Strategy (presented by President Bauzá, January 2014).
- Key role of Observing Systems in Europe in Blue Growth initiatives (Marine Knowledge 2020; **EU Communication May 8, 2014:** [EU eyes oceans innovation as source of sustainable growth;](#)



Thanks for your attention

www.socib.es