# SOCIB, an international **C**oastal **O**cean Observing and Forecasting **S**ystem based in the **B**alearic **I**slands



Joaquín Tintoré and the SOCIB team

SOCIB and IMEDEA (UIB-CSIC) <a href="http://www.socib.eu">http://www.socib.eu</a>













### The ICTS SOCIB approach to sustained Marine RI

To assure the real sustainability of the seas and oceans and of the observing systems, we designed SOCIB:

#### → RESPONDING TO 3 KEY DRIVERS

- Science Priorities
- Strategic Society Needs
- Technology Developments

Similar approach for other Spanish ICTS, UTM (CSIC); PLOCAN













### What is SOCIB?

SOCIB is a Coastal Observing and Forecasting System, a <u>multi-platform</u> <u>distributed</u> and <u>integrated</u> Scientific and Technological Facility (a facility of facilities...)

- providing streams of oceanographic data and modelling services in support to operational oceanography
- contributing to the needs of marine and coastal research in a global change context.

The concept of Operational Oceanography is here understood as general, including traditional operational services to society but also including the sustained supply of multidisciplinary data and technologies development to cover the needs of a wide range of scientific research priorities and society needs.

In other words, SOCIB will allow a quantitative increase in our understanding of key questions on oceans and climate change, coastal ocean processes and ecosystem variability.





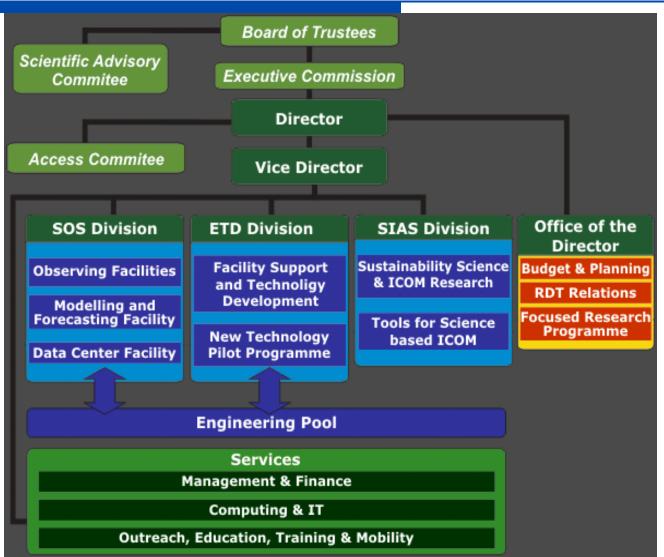








### **SOCIB Structure**















# Systems Operations and Support Division

### 1. Observational Facilities (major elements)

- New Coastal Research Vessel (25 m LOA 1.200 km coastline in the Islands)
- HR Radar
- Gliders and AUV's
- Moorings, tide gages and satellite products
- ARGO and surface drifters
- Nearshore beach monitoring

### 2. Forecasting sub-system

 Ocean currents (ROMS) and waves (SWAN) at different spatial scales, forced by Atmospheric model (WRF) and ecosystem coupling (NPZ)

#### 3. Data Centre

- Quality control and Web access in open source
- Effective data archiving, internationally accepted protocols, delivery and communication













### SOCIB: the view....















# **Implementation**

	20	009	2010				2011				2012		2013	
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4			Q1/Q2	
Systems, Operations and Support Division		1										ζ-/ ζ	. , .	ζ-/ ζ
Observing Facilities:														
Coastal Research Vessel	CD	CD	PDP	LP	LP	С	С	С	С	С	IOC	OM	FOC	FOC
Coastal HF Radar	CD	CD	PDP	LP	LP	С	С	IOC	FOC	FOC	FOC	FOC	FOC	FOC
Gliders	CD	CD	PDP	LP	IOC	IOC	OM	OM	OM	OM	FOC	FOC	FOC	FOC
Drifters	CD	CD	PDP	PDP	PDP	PDP	LP	IOC	IOC	OM	FOC	FOC	FOC	FOC
Moorings	CD	CD	PDP	LP	С	IOC	OM	OM	FOC	FOC	FOC	FOC	FOC	FOC
Marine and Terrestrial Beach Monitoring	CD	CD	PDP	LP	С	С	С	С	С	С	IOC	FOC	FOC	FOC
Data Centre Facility	CD	CD	CD	PDP	PDP	IOC	IOC	OM	FOC	FOC	FOC	FOC	FOC	FOC
Modelling and Forecasting Facility	CD	CD	PDP	PDP	LP	С	С	IOC	IOC	OM	FOC	FOC	FOC	FOC
Engineering and Technology Development Division														
Facility Support and Technology Development	CD	CD	PDP	LP	IOC	IOC	OM	OM	FOC	FOC	FOC	FOC	FOC	FOC
Near Shore Station	CD	CD	CD	CD	PDP	LP	PDP	С	С	IOC	OM	FOC	FOC	FOC
Ships of Opportunity/Fishing Fleet Monitoring	CD	CD	LP	PDP	IOC	IOC	OM	OM	FOC	FOC	FOC	FOC	FOC	FOC
Strategic Issues and Application to Society Division	CD	PDP	IOC	IOC	OM	FOC	FOC	FOC	FOC	FOC	FOC	FOC	FOC	FOC
Services														
Management & Finance	PDP	IOC	OM	OM	FOC	FOC	FOC	FOC	FOC	FOC	FOC	FOC	FOC	FOC
Computing & IT	CD	С	OM	PDP	LP	С	IOC	OM	FOC	FOC	FOC	FOC	FOC	FOC
Outreach, Education, Training & Mobility	CD	CD	PDP	PDP	PDP	PDP	IOC	IOC	OM	FOC	FOC	FOC	FOC	FOC

#### **Project Stages:**

CD Concept Development
PDP Planning, Design and Pilots
LP Legal Procedure/Purchase
C Construction

OC Achieve Initial Operational Capability

OM Operation and Maintenance FOC Final Operational Capability

Table 2: Implementation Schedule Summary for the major SOCIB elements, detailed schedules are available in Annex 3. All available at

www.socib.es













# Gliders Facility: Science



# Mesoscale – Submesoscale / Vertical motions - biogeo effects

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

Vertical motion in the upper ocean from glider and altimetry data Coastal and mesoscale dynamics characterization using altimetry

Simón Ruiz, Ananda Pascual, Bartolomé Garau, Isabelle Pujol, and Joaquín Tintoré

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

JGR, 2010

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

Jérôme Bouffard, Ananda Pascual, Simón Ruiz, Yannice Faugère, and Joaquín Tintoré<sup>1,3</sup> Iberian Peninsula Menorca Mallorca : Main surface currents 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.









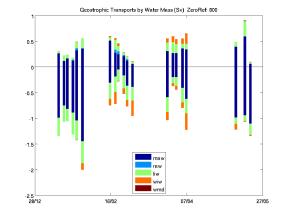




# Gliders Facility: Operational

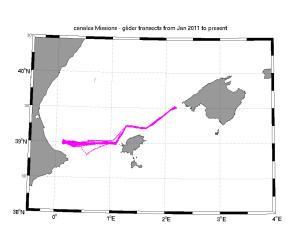
- After 28 glider missions (started in 2006), + 10.000 profiles
- Since January 2011; routine operations in Ibiza and Mallorca Channels (150 miles section)

Major transport changes

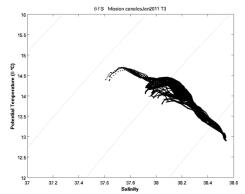


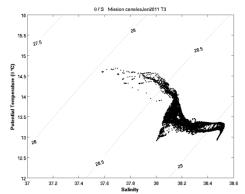


### NEED DEFINE KEY CONTROL SECTIONS EU



## TS diagrams ROMS / Glider

















## SOCIB Glider Facility (Summary)

Gliders (a fleet of ...) ?:

- They allow long term, sustained, multidisciplinary monitoring of the coastal ocean for example at key control sections.
- They are providing new evidences of the complexity of the coastal ocean, by resolving tridimensional mesoscale and submesoscale instabilities never fully observed before, showing the intrinsic dynamical relevance of theses instabilities, their interactions and effects on the mean circulation, and their role on the response of the ecosystem.
  - A major observational breakthrough is appearing upfront. It will trigger theoretical and numerical developments...
  - Examples from Balearic and Alborán Seas have been shown, suggesting the capabilities that will soon arise from monitoring with fleets of gliders, physical variability and ecosystem response at meso and submesoscale...













## Multi-platform integration: altimeter - tide gauge

**OBJECTIVE:** Assess the benefit of combining tide gauge measurements with altimetry (Saraceno

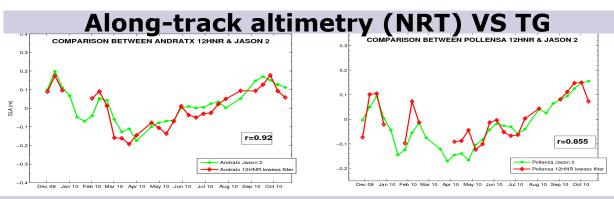
et al 2008) to improve surface currents estimation along the Balearic coast.

Data and methodology



Altimetry: JASON 1/2

SSH corrected by HIRLAM (20 days Filtered) AVISO (NRT) at nearest points

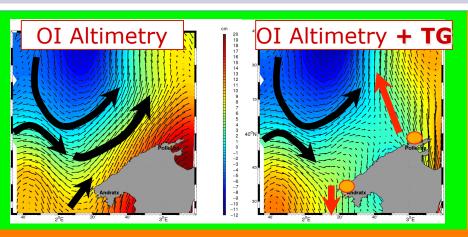


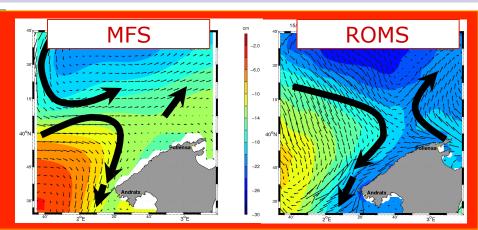
Good TG-altimetry agreement (corr >0.8 with J1/J2)...

# **OPTIMAL INTERPOLATION**Several tests (Grid definition, Spatial / temporal correlation

scales, error covariances ...)

### **Gridded currents VS models**





Preliminary results show good qualitative agreements with numerical

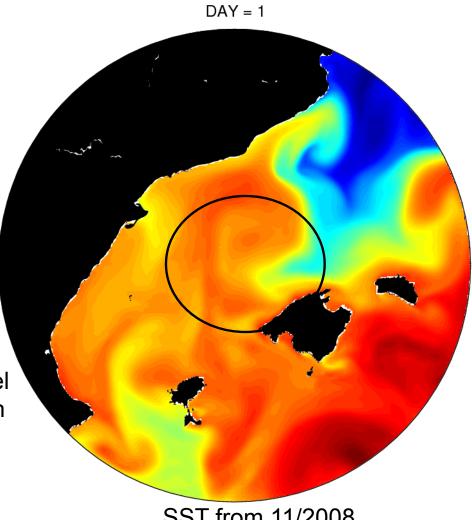
### Modelling Facility

**Operational Modeling: ROMS**, 2km To reproduce and maintain mesoscale features, interactions. In collaboration with GKSS and Univ. Rutgers, in the frame MFS/MOON.

**WRF** Atmospheric Model Also **SWAN** for coastal ocean wave Dynamics and Habors (with PE)

#### The aim:

- Validate the model with the measurement (gliders, ...)
- From the available data and the model simulation (5 years), study the formation of mesoscale structures.
- Understand impact on the ecosystem

















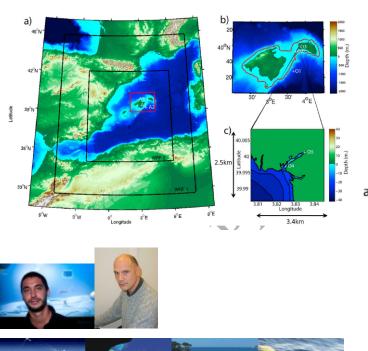


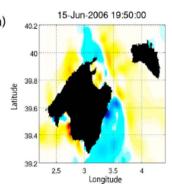


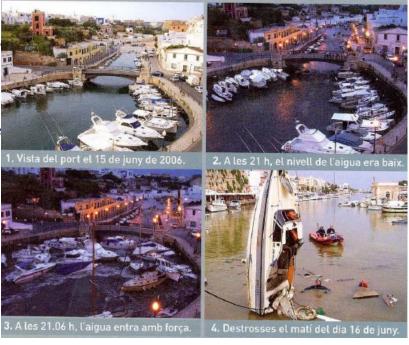
# Modelling Facility; Meteotsunamis forecasting

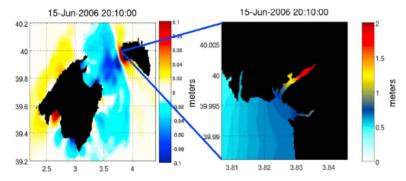
GEOPHYSICAL RESEARCH LETTERS, VOL. 38, LXXXXX, doi:10.1029/2011GL0

- 1 Toward the predictability of meteotsunamis in the Balearic Sea
- 2 using regional nested atmosphere and ocean models
- 3 Lionel Renault, 1 Guillermo Vizoso, 2 Agustin Jansá, 3 John Wilkin, 4 and Joaquin Tintore
- 4 Received 4 March 2011; revised 29 March 2011; accepted 30 March 2011; published XX Month 2011.



















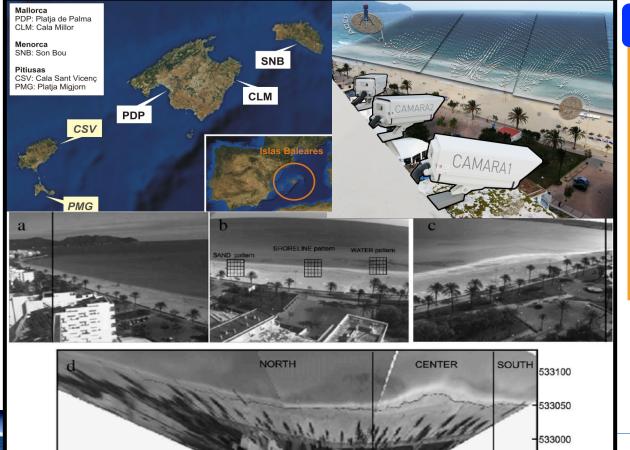




## Marine and Terrestrial Beach Monitoring Facility

TMTBMF is a MODULAR SYSTEM designed to monitor continuously and in an autonomous way short and long term physical beach hydrological and morphological parameters.





#### **MOBIMS**

Beach videomonitoring (SIRENA)

Waves and currents (ADCPs)

Bathymetry and beach profiles surveys

Sediment parameters

PRODUCTS & SERVICES FOR BEACH MORPHODYNAMICS RESEARCH, BEACH SAFETY & COASTAL MANAGEMENT





4383500







4383200

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4382800

# Data Center process







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
- Data Archive
- 5. Data Search and Discovery
- 6. Data Policy and distribution
- 7. Data Viewing















# Data Centre. Technologies

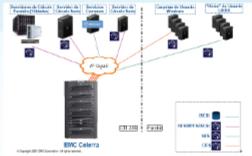
The main technologies used are: OPeNDAP/THREDDS server hosting CF-compliant NetCDF; the open-source RAMADDA as a content management system and collaboration services for Earth Science data. Those technologies permit the distribution, cataloging and discovery over the oceanographic data.

#### 1. Multi Platform Management



Alredyavailable:glidersdrifters,moorings,ad cp, beach monitoring cameras, ... Real time monitoring and wide descriptions of data sets (standardscompliant).

#### 2. Data Archive



**Informatic infraestructure:** to securely archive data and metadata and retrieve them on demand.

#### 3. Distribution



OPeNDAP, WCS, WMS, HTTP, FTP, ... to access the data in an interoperable manner from client applications.

#### 4. Catalog



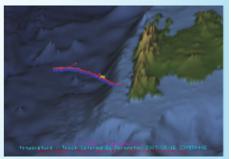
THREDDS to organize data and Metadata to automatic harvesting.

#### 5. Discovery



RAMADDA to search for and find data sets of interest for human interaction.

#### 6. Analisis and Visualization



IDV, own Web Aplications, GODIVA, LAS,... capability to provide an integrated viewing service.









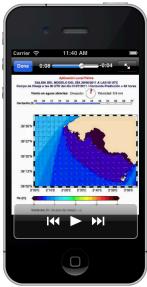


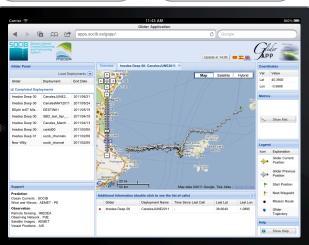




## Data Centre (example of Apps)





















## SOCIB Strategic Issues and Applications for Society

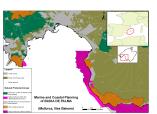
#### Sustainability Science and Integrated Coastal and Marine Management, MSP

#### We are

- Developing and evaluating science-based decision-making tools and methods to support ICMM, with particular emphasis on the integration of environmental and social dimensions
- Identifying and implementing indicators to assess, monitor, and predict limits to growth and critical thresholds,
- Integrating research with environmental governance and management systems to assure sound transfer two sides science to society and back!.







#### SYSTEM OF INDICATORS

for Integrated Coastal Zone Management in the Balearic

Marine Policy 34 (2010) 772-781



#### Contents lists available at ScienceDirect Marine Policy journal homepage: www.elsevier.com/locate/marpo



Balancing science and society through establishing indicators for integrated coastal zone management in the Balearic Islands

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\*IMEDEA (CSIC-UIB), Mediterranean Institute of Advanced Studies, Calle Miquel Marqués, 21, 07190 Esportes, Mallorca, Balearic Islands, Spain b CES, Economic and Social Council of the Balearic Islands, Palau Reial, 19, 07001 Palma, Mallorca, Balearic Islands, Spain

ARTICLE INFO

Received 24 November 2008 Received in revised form 18 January 2010 Accepted 18 January 2010

Indicators **ICZM** Science-policy gap Balearic Island

This paper explores the process by which indicators may be developed as tools for communicating science to decision-makers using the participatory approach demonstrated by the Balaric Indicators Project. This initiative reflects a series of compromises considered necessary to achieve the objective of generating an indicator system that is scientifically viable, comparative internationally yet locally relevant, and to facilitate its implementation. The article highlights questions regarding the utility of science for addressing current global issues related to sustainability and why science often fails to promote change at the societal level.

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Count & Guard Management 53 (2009) 493-500



Contents lists available at ScienceDirect

Ocean & Coastal Management

lournal homeosos: www.elsevier.com/locate/ocscoaman



Integrated and interdisciplinary scientific approach to coastal management

Joaquín Tintoré ", Raúl Medina b, Lluís Gómez-Pujol ", Alejandro Orfila ", Guillermo Vizoso " \* MECEA (CSC-169), brains Medierman d'étade Avanços, Migrél Morquée 21, 0750 Españo (Métado Hando) Spain \* Businso de Résidates Ambienet, Si Corndele, l'internidad de Cornellio, As Carros (p., 2006 Saromées, Spain

ARTICLEINFO

Countal zones and beach management practices, regulatory decisions, and land use planning a along countal zones have historically been made with insufficient information concerning the countal environment. In this study we address and integrate an interdisciplinary scientific approach to the perception of the beach retreat and in a parallel way, a risk to rithe tourism resources. In this work the detailed studies on beach morphodynamics have been developed as a basis for integrating proper beach management, beach natural dynamics and local users and economic agent interests. From this point or when a set of solutions are considered as the basis for a management policy that finite beach science and













# Summary

### THE FACTS: Oceans and Coasts, Research, Research Infrastructures

- •The Oceans; a complex system, changing, under-sampled (Walter Munk-2001- "The last century of oceanography is marked by the degree of under-sampling", cited by Chris Barnes/NEPTUNE yesterday; Carl Wunsh 2010: "We need data, ... models are becoming untestable" and examples from Martin Visbeck Atlantic Ocean meridional circulation yesterday), but that still needs to be managed...
- Scientists have a role but...
  - Recognize GAPS in data and in knowledge, but also in GAPS in procedures such as in some cases data availability, optimization of resources, etc.
  - Recognize we are part of society, managing and understanding the oceans is a global enterprise: we need more than just coordination --- > Partnership
- •Marine Infrastructures can help and must help to fill theses gaps and Governing bodies should adapt to the new global situation.

But we have another BIG GAP: .... "The Science-Policy Gap"













# Summary

To assure the real sustainability of the oceans and of the observing systems, we need to address **the Science – Policy GAP**.

### HOW?

#### → RESPONDING TO THE 3 KEY DRIVERS

- Science Priorities (ok!)
- Strategic Society Needs (more listening!, policy makers&managers endorsement)
- New Technology Developments (social society endorsement)

This implies deep structural changes of 'our' scientific system. Changes imply risk, but we cannot probably avoid it if we want endorsement from Society.

<u>AND</u> → **DEFINING A JOINT STRATEGY** (European/national level in the international framework, more than coordination, <u>Partnership</u>...)

It is time for action. Are we ready? YES!!!!













# Gracias!









