

Strategy for Future Marine Operational Systems in the SES ... in line with Blue Growth initiatives

(some examples from SOCIB)

Joaquín Tintoré (Research Prof. CSIC)

SOCIB and IMEDEA (CSIC-UIB)

OUTLINE

1. New Technologies: Paradigm Change Ocean and Coastal Observation. EU international leadership
2. Marine Research Infrastructures, Ocean Observatories: SOCIB, Integrated Science priorities, Technology Development and Society Needs
3. Innovation and Blue Growth: innovation in oceanography - gliders- (multi-disciplinary teams), data availability) and ...
“Turning Data into Jobs...”

Discussion: Are we ready for these changes ? Do we have the framework and right structures to get all the benefits from these changes ? (“to enforce what we think has to be done...”)

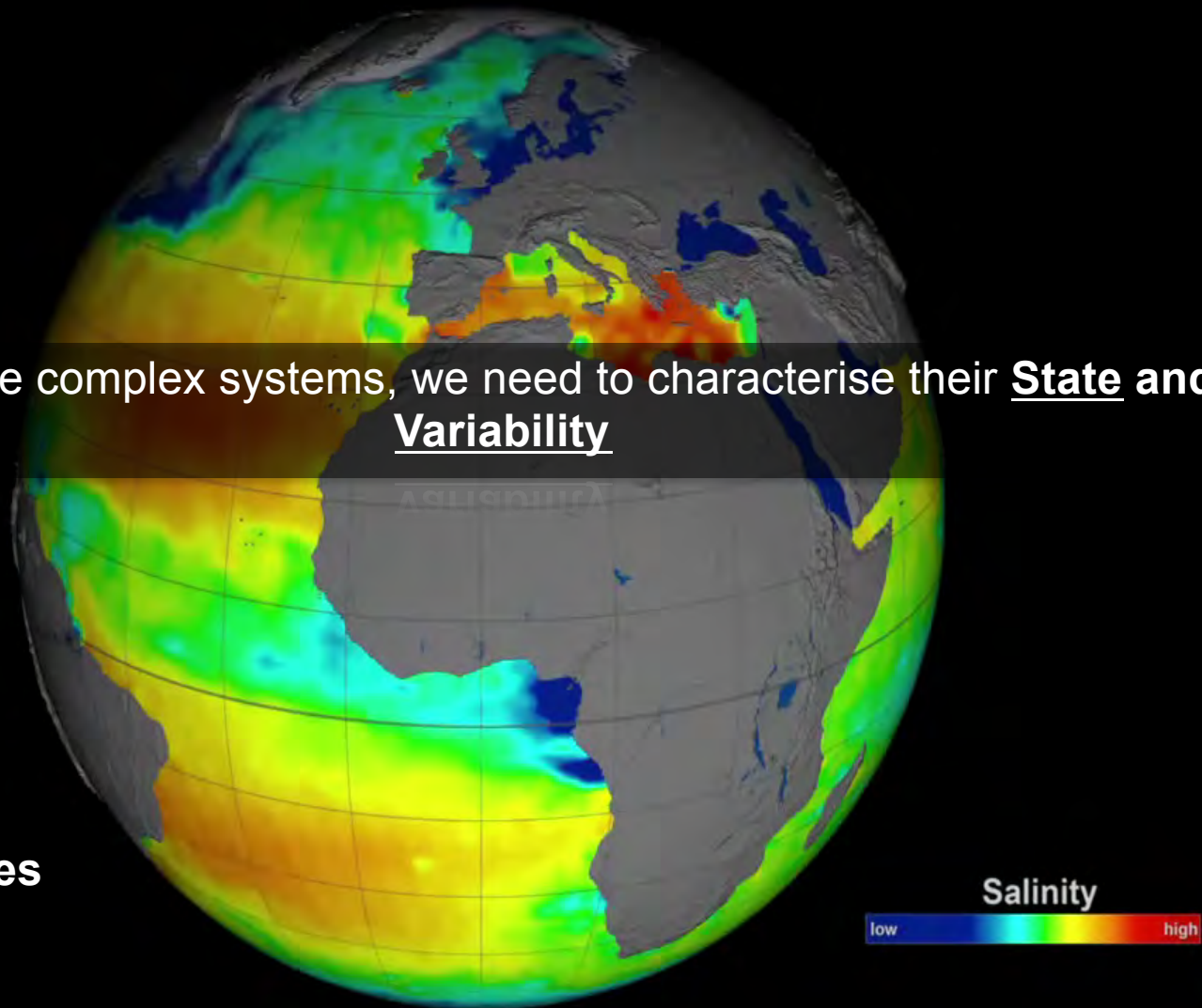
Oceans are complex systems, we need to characterise their State and Variability

We need:

- Long time series
- Synoptic data

• *global data*

NASA's Aquarius salinity, from December 2011 through December 2012





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

New Technologies: Paradigm Shift

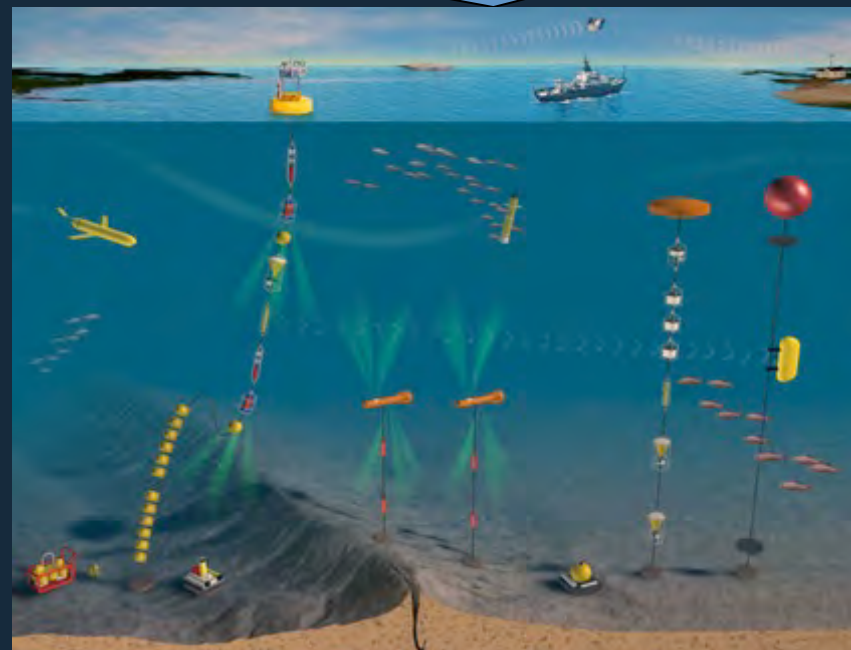
→ Ocean Observation

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

*A 2020 Vision for
Ocean Science*

JOHN R. DELANEY
University of Washington
ROGER S. BARGA
Microsoft Research

Data available for science and society

- Huge increase in human potential for analysis, models/data inter-comparison
- Allowing new science and knowledge based management oceans and coast
- More reliable knowledge based response under emergencies

“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)

NEW CHALLENGES: implies adaptation ... Scientists, Society...

Key words:

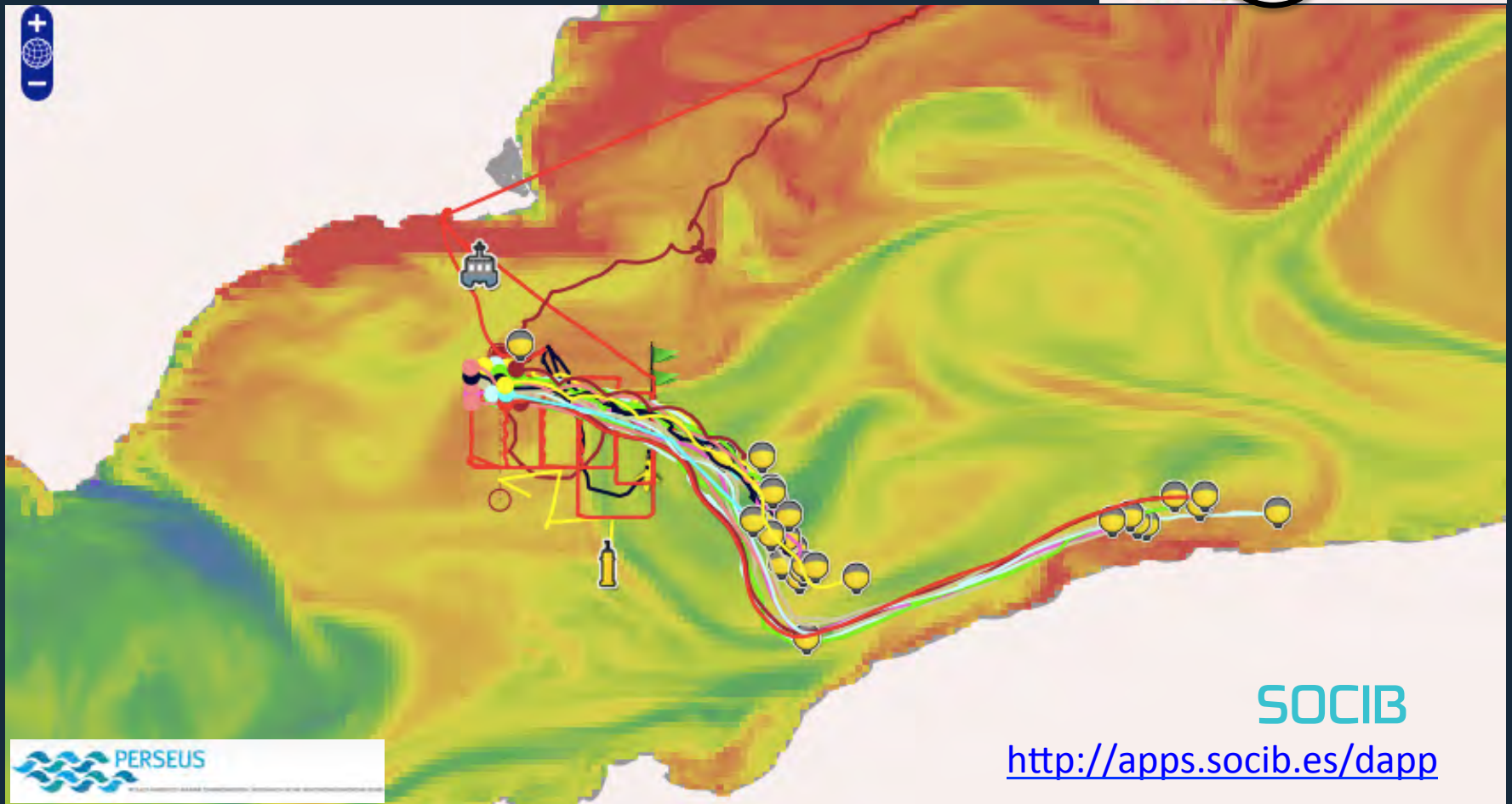
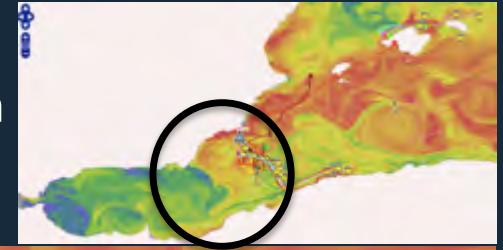
- **Multi-disciplinary. Multi-platform. Free and Open Data. Integration.**
- Scientific career. Students. Science evaluation. Society response.

New Technologies: Paradigm Shift

→ Data Availability

ALBOREX, May 30, 2014 situation (1040h)

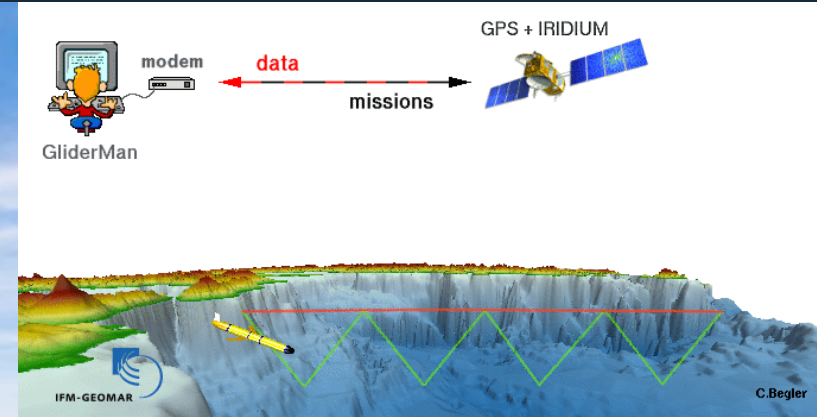
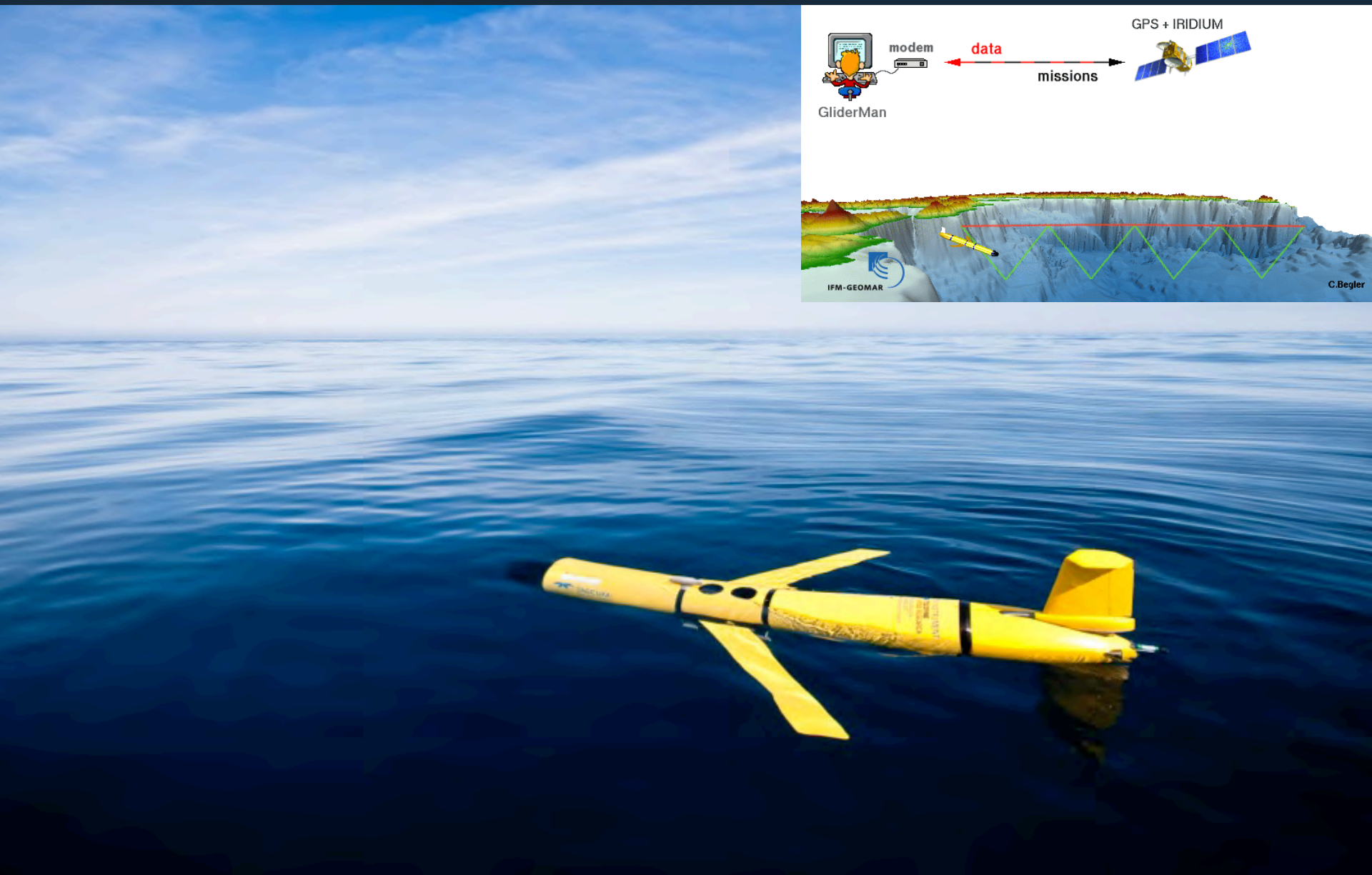
Ruiz et al., 2013: Anchovy landings x 10 related to Alboran gyre location...



SOCIB

<http://apps.socib.es/dapp>

An Example of New Technologies: Autonomous Underwater Gliders



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, ...

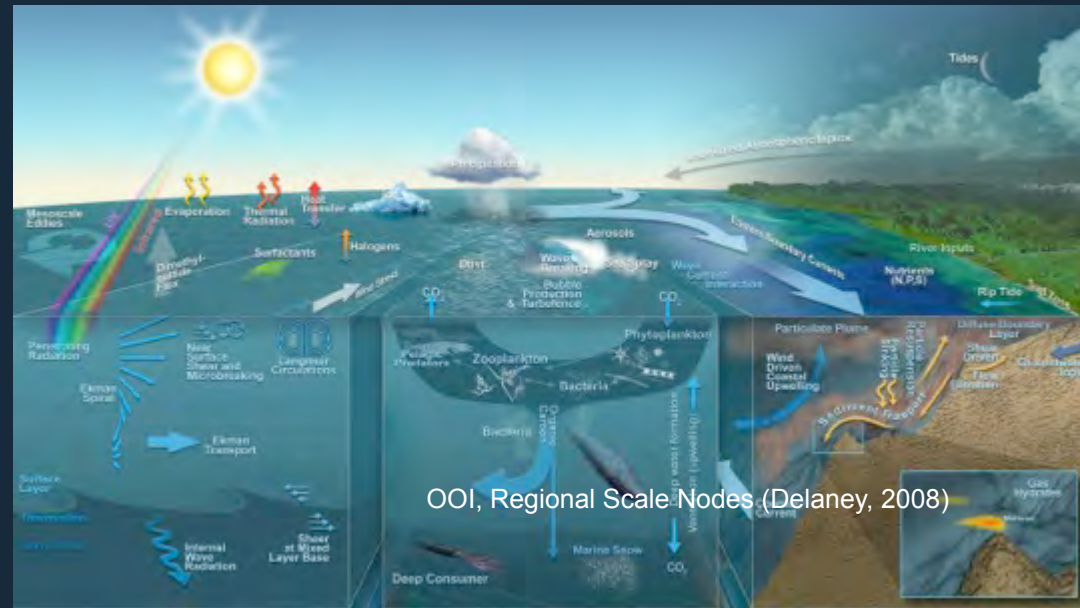


A quantitative major jump, in scientific knowledge and technology development



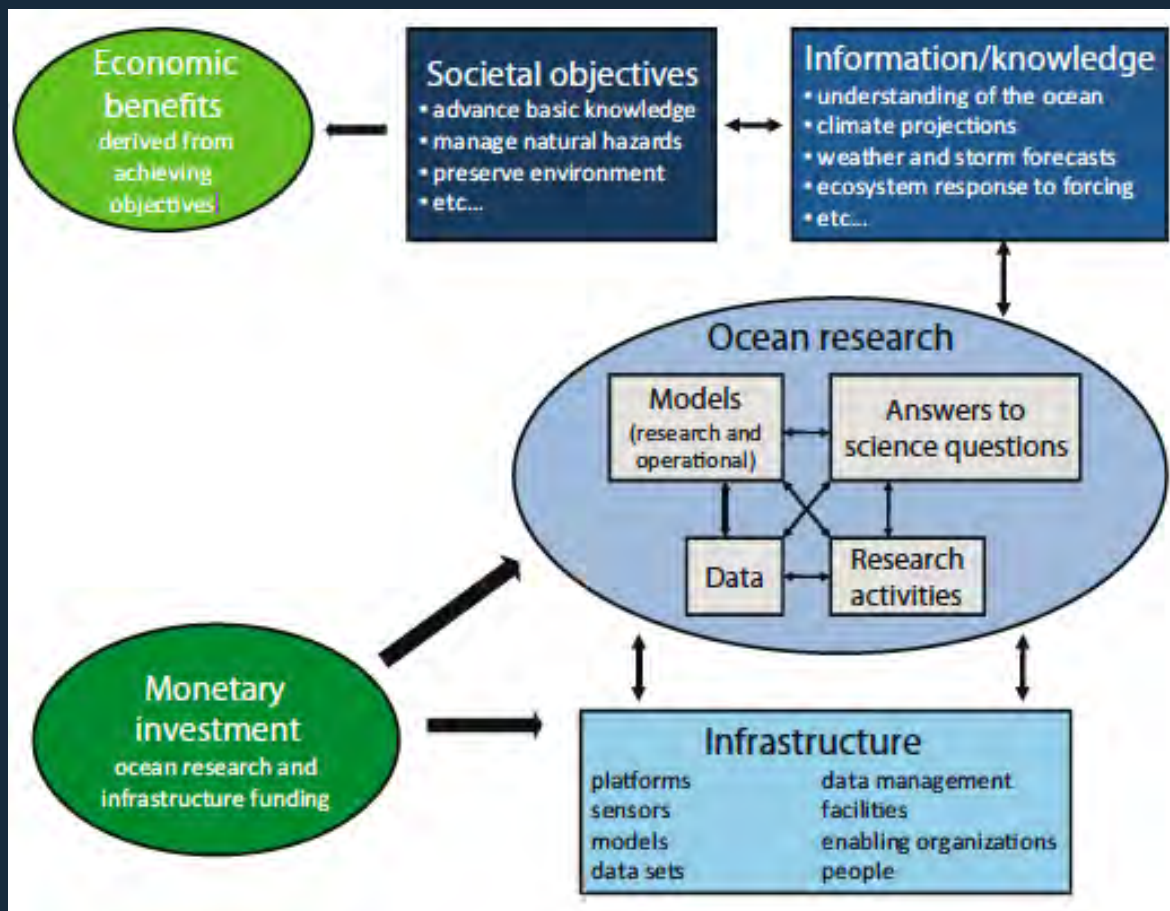
The development of a new form of Integrated Coastal and Ocean Management

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



Are we ready for these changes?
We need to open our minds, adapt scientific and educational structures, management procedures

Ocean Observatories, Marine Research Infrastructures: International Frame



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

SOCIB: MRI International Framework

Europe

- POSEIDON, Cosyna, MONGOOS, among others ...
- ESFRI –

EEUU

- OOI (NSF research)
- IOOS (inter-agency operational)

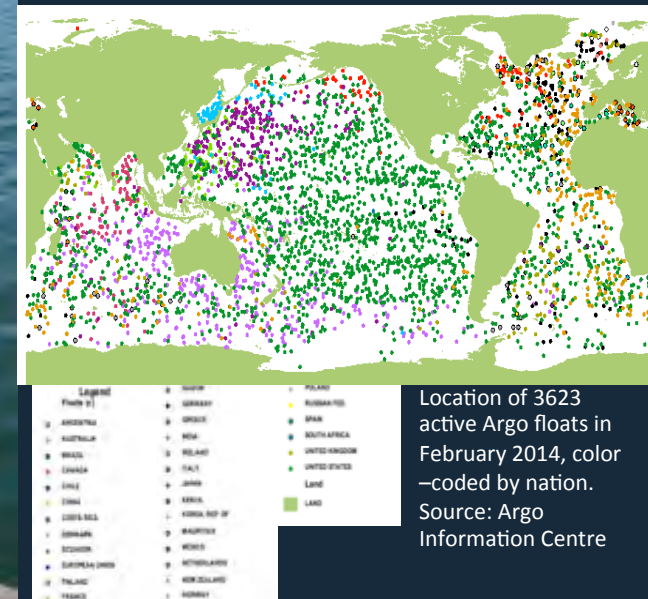
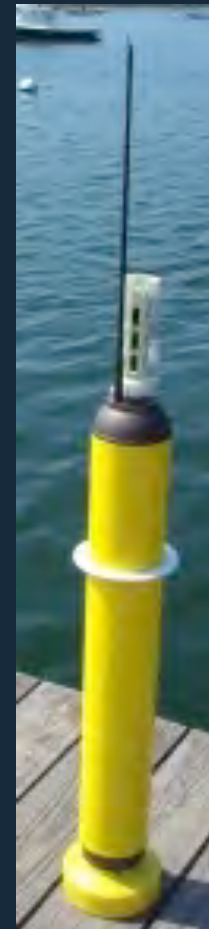
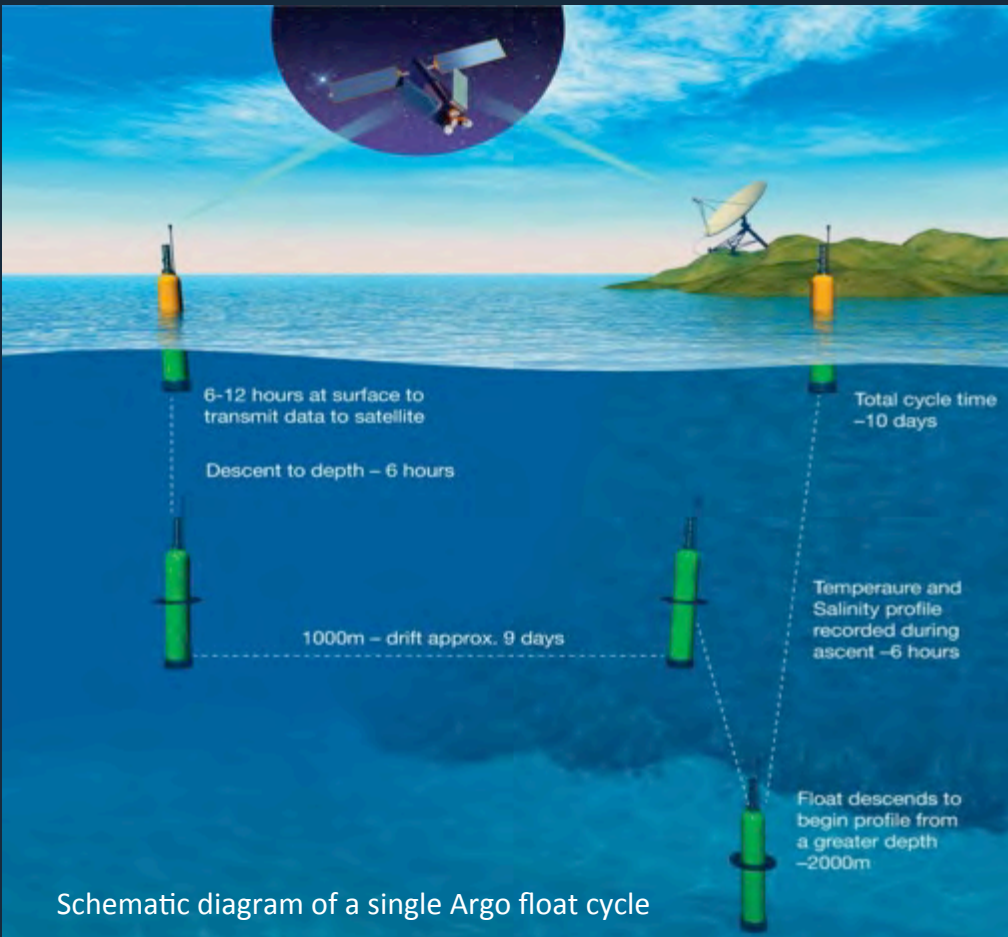
Canada

- NEPTUNE, VENUS,

Australia

- IMOS: Integrated Marine Observing System

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: monitoring at the right scales

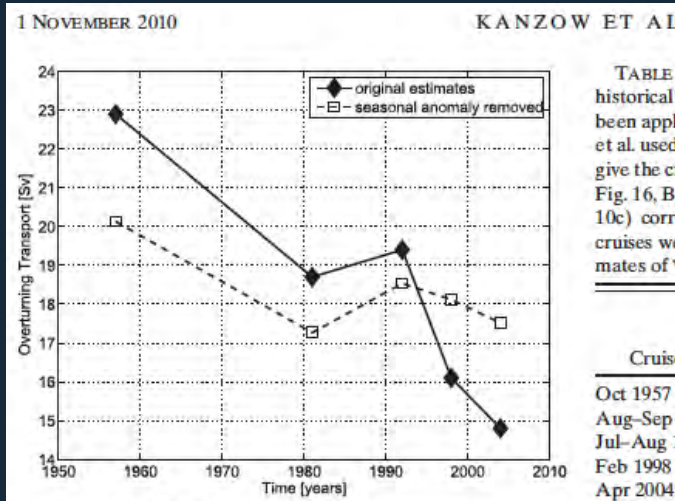
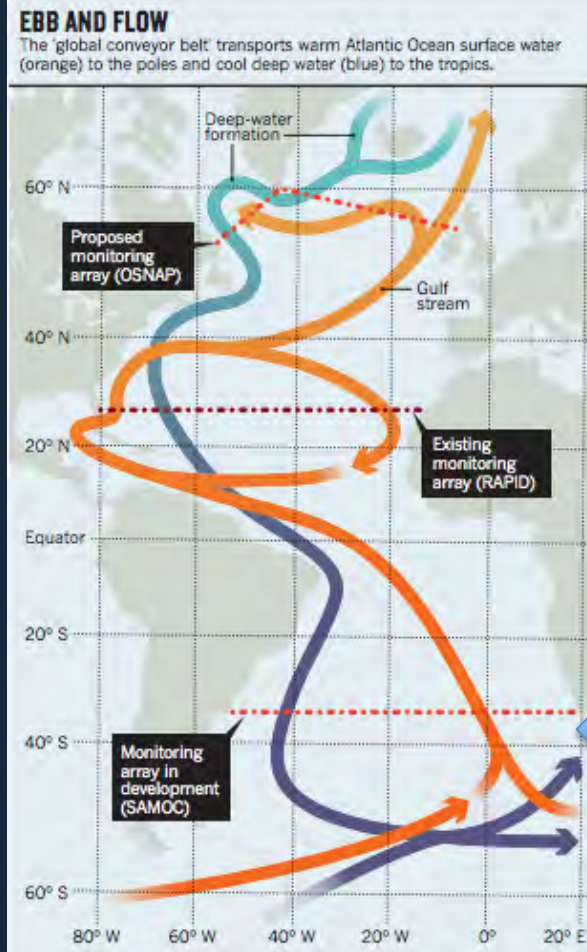


TABLE 1
historical estimates of Ψ^{MAX} have been applied to the hydrography cruises used in this study to give the corrected estimates of Ψ^{MAX} (Fig. 16, Bryden et al. 2005b). The 10c) corrected estimates of Ψ^{MAX} were obtained by subtracting the seasonal anomalies of T_{UMO} (Fig. 10c; Table 2) from the original estimates of Ψ^{MAX} .

Cruise	Season
Oct 1957	Oct 1957
Aug-Sep 1982	Jul-Aug 1982
Feb 1998	Feb 1998
Apr 2004	Apr 2004

FIG. 16. The Ψ^{MAX} inferred from five hydrographic snapshot estimates between 1957 and 2004 (solid diamonds), as reproduced from Bryden et al. (2005b). The hydrography cruises were carried out in different seasons, namely, in October 1957, August–September 1982, July–August 1991, February 1998, and April 2004. The open squares represent the historical estimates of Ψ^{MAX} with seasonal anomalies of T_{UMO} (Fig. 10c; Table 2) subtracted.

dominant mode of variability in the Atlantic Ocean is the AMOC. The re



AMOC recent key milestones:

- 2005
- 2010
- 2012
- 2013

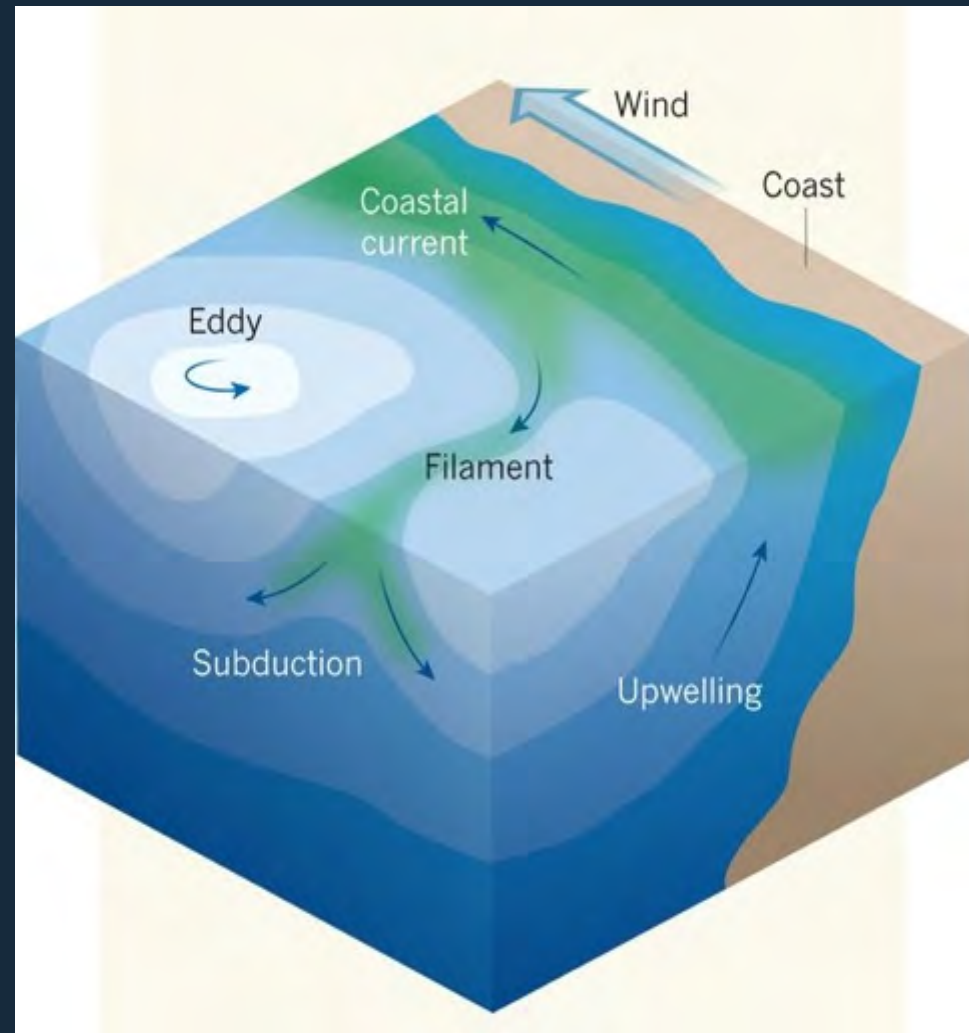
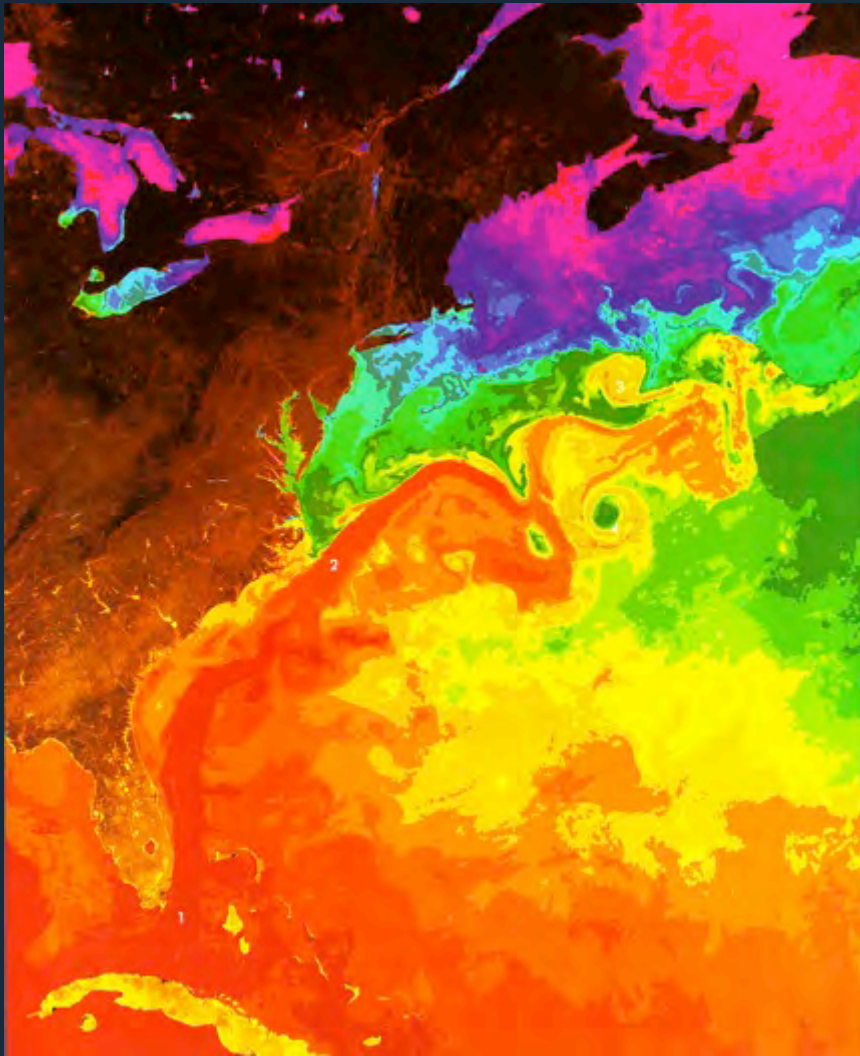
In April 2009, the array recorded a 30% drop in average current strength that persisted for a year, reducing the amount of heat transported to the North Atlantic

An Example: AMOC, Atlantic Ocean Meridional Circulation

2005: decline.

2010: seasonal biases correction

Ocean currents, eddies and instabilities: the mesoscale, the oceanic weather



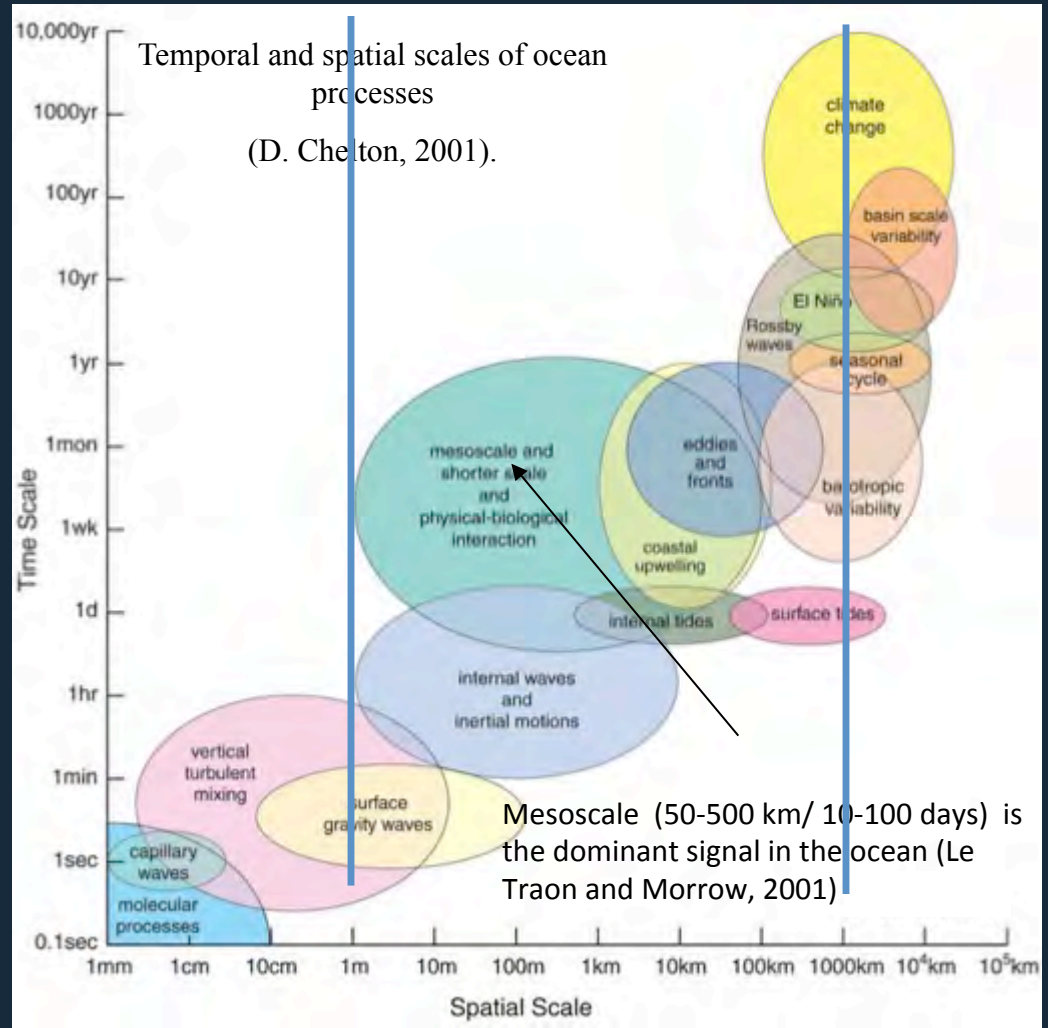
Mahadevan (Nature, 2014)

Why and how to focus on Variability at Mesoscale and Coastal interactions?

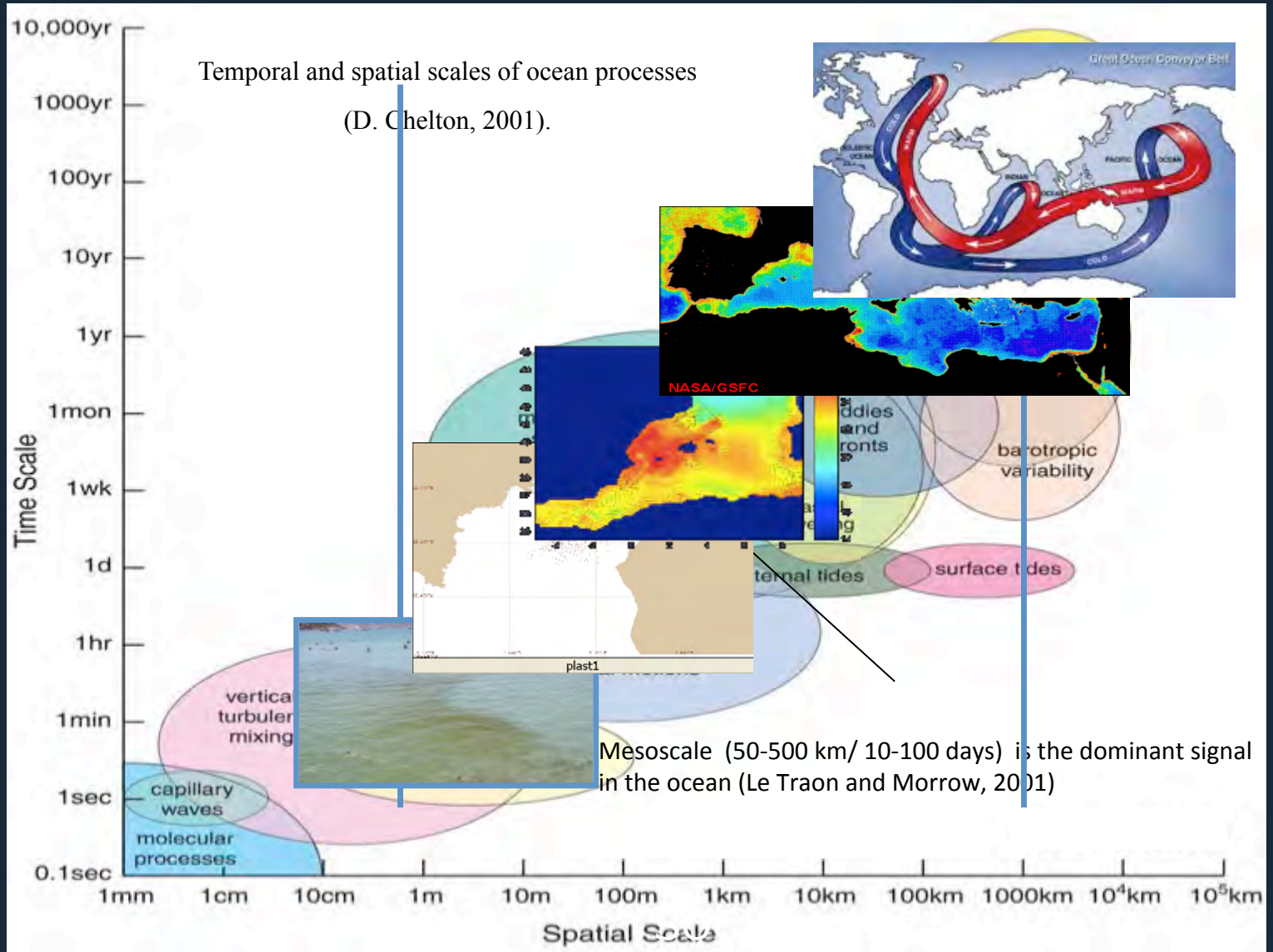
Theory and observations have shown that there is a maximum energy at the mesoscale (include fronts and eddies ~10-100km),

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

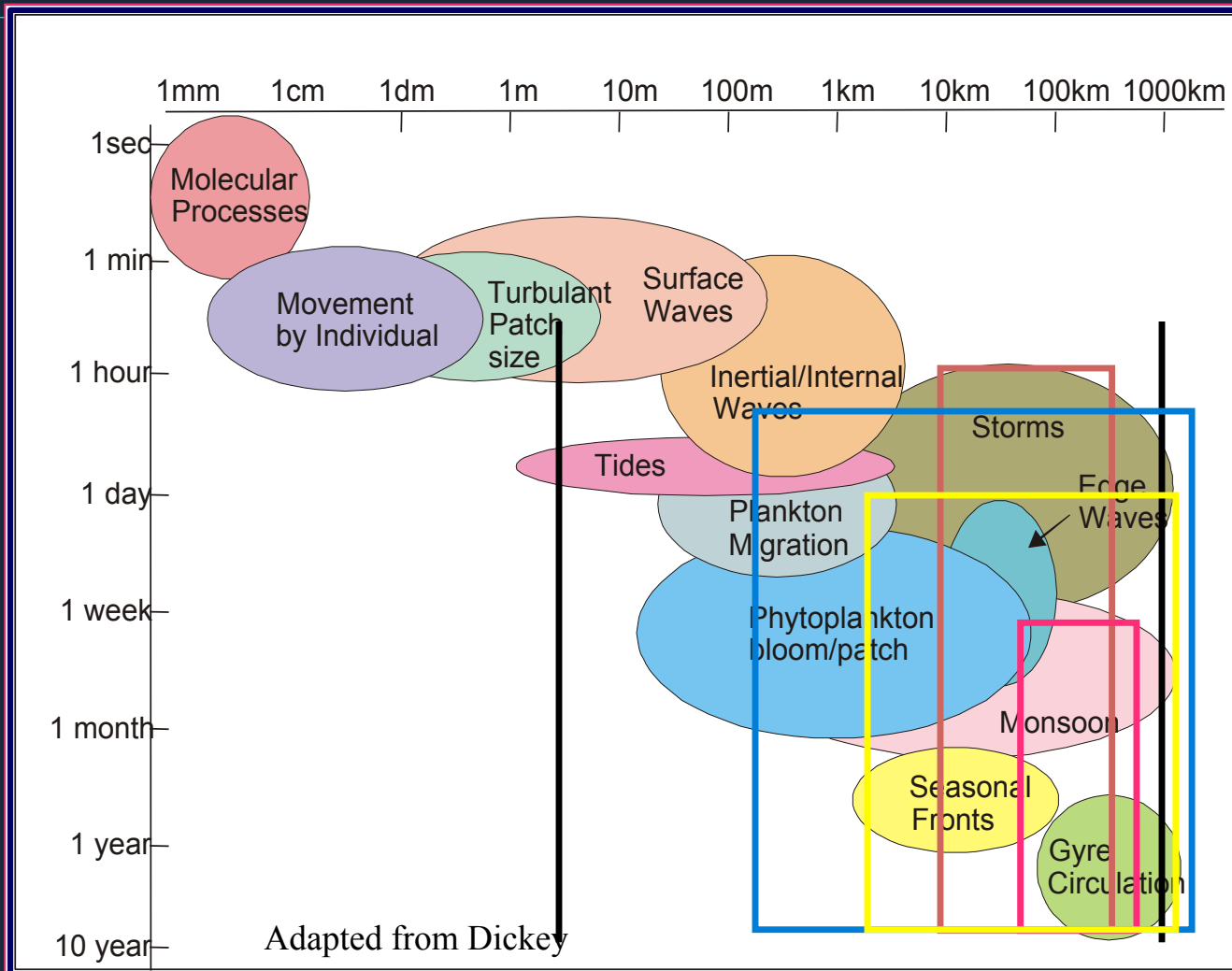
With inputs from 'both sides'....
(nearshore and coastal ocean and also seasonal/inter-annual and decadal variability)



Why and how to focus on Variability at Mesoscale and Coastal interactions?



SOCIB scales and monitoring tools



Gliders

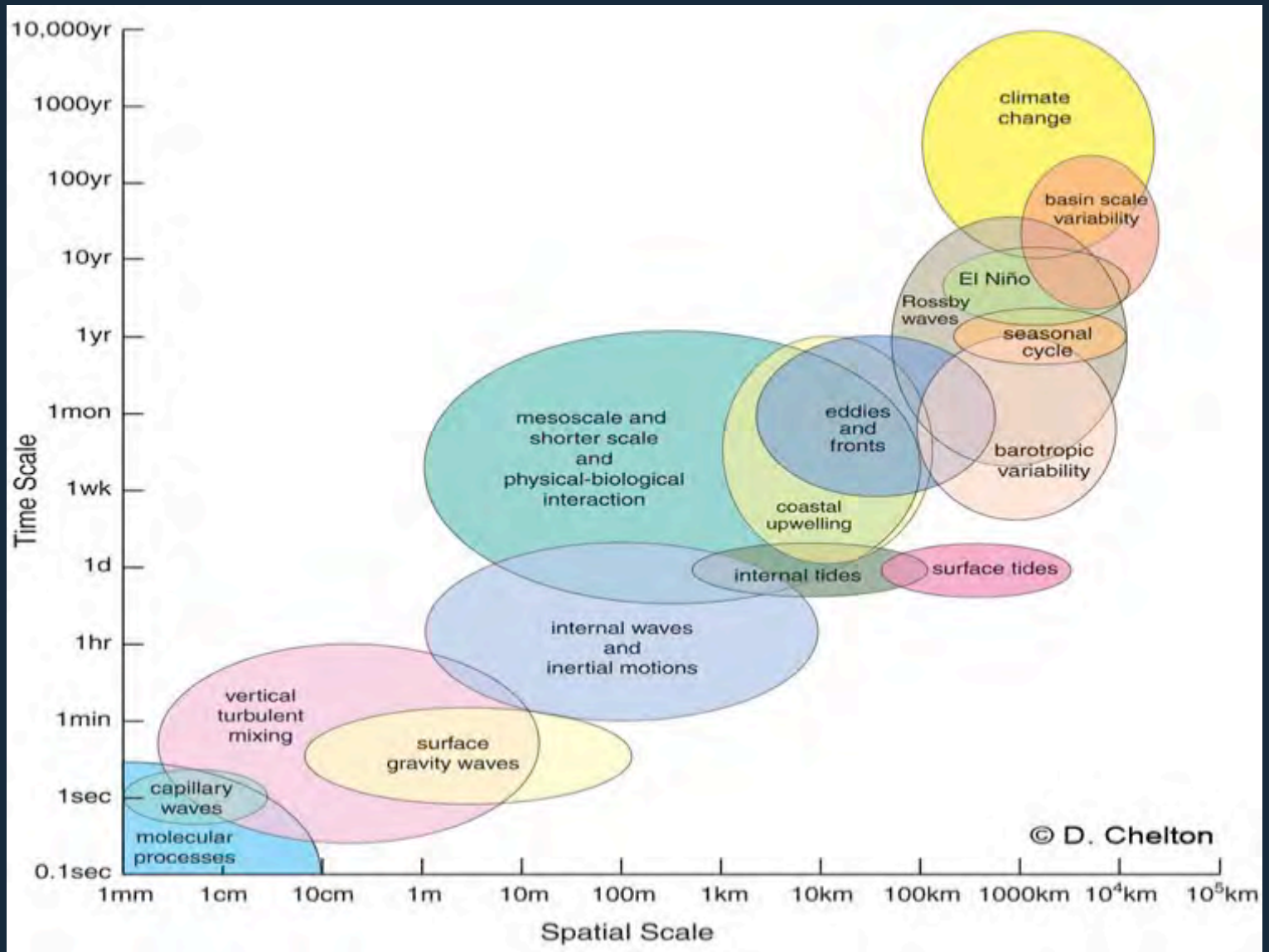
**Fixed
Platforms**

HF radar

**24 m R/V
Catamaran**

Satellite

Why and how to focus on Variability at Mesoscale and Coastal interactions?



OUTLINE

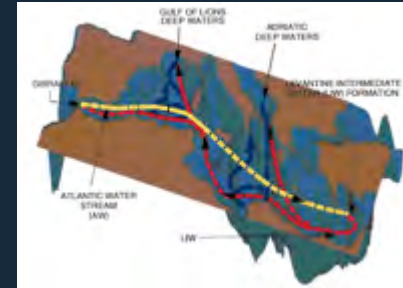
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Why Mediterranean and why SOCIB, ?

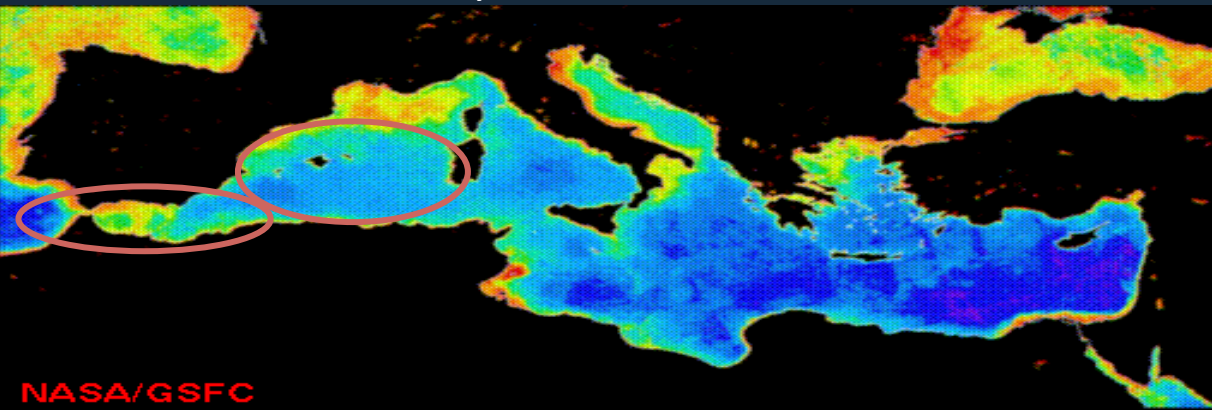
Mediterranean

- 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

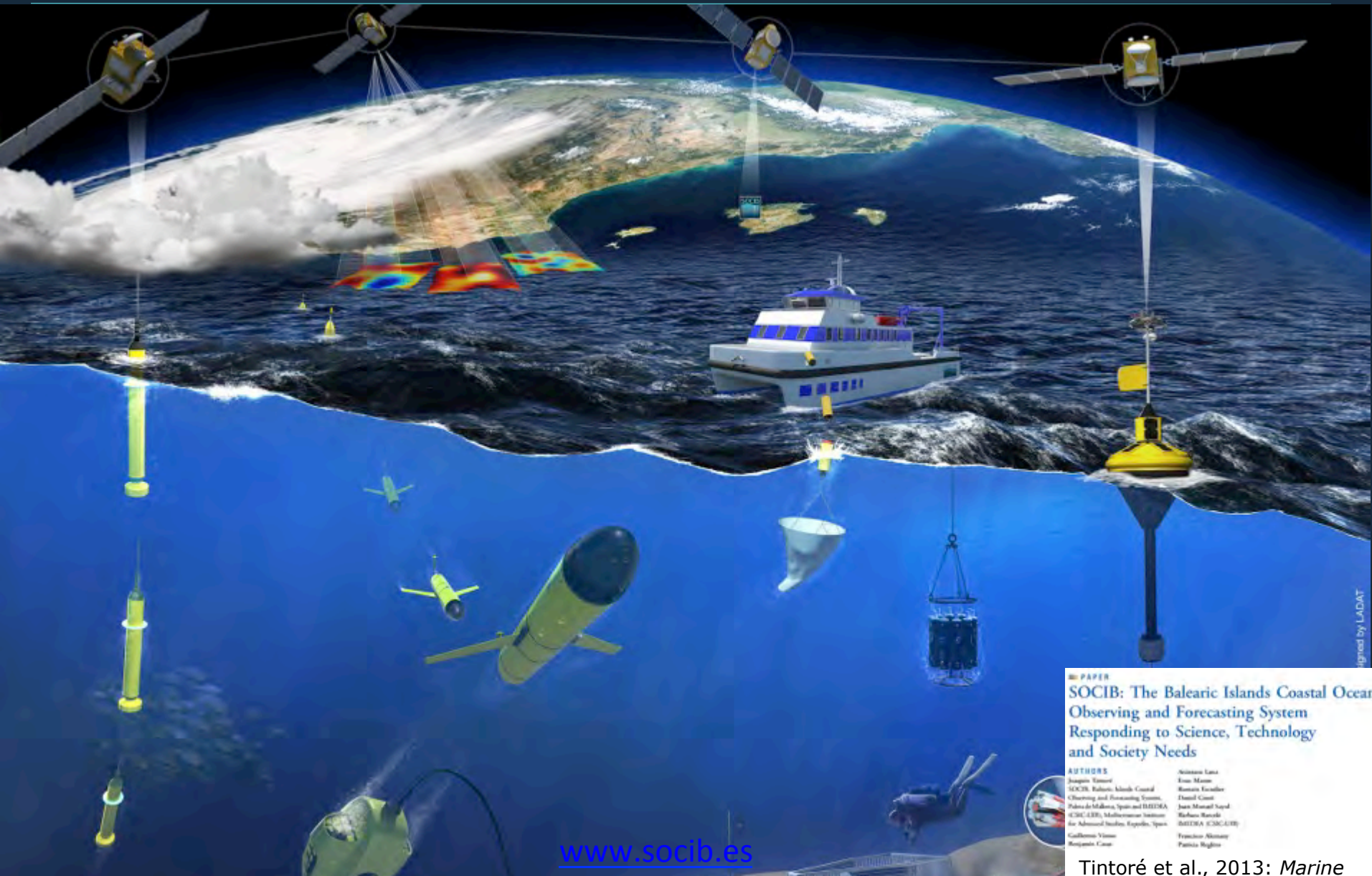


Balearic Islands ... after 25 years...

- Scientific know-how and technological infrastructures: leading international science
- Governmental unified joint support (MINECO and Balearic Gov); RIS3 Smart and Sustainable Tourism
- Civil Society endorsement



What is SOCIB? A multi-platform observing system,



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

OBSERVING FACILITIES



Research vessel



HF Radar



Gliders



Lagrangian platforms



Fixed stations

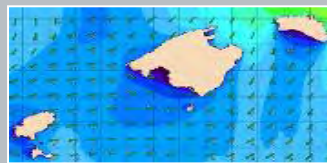


Beach Monitoring

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

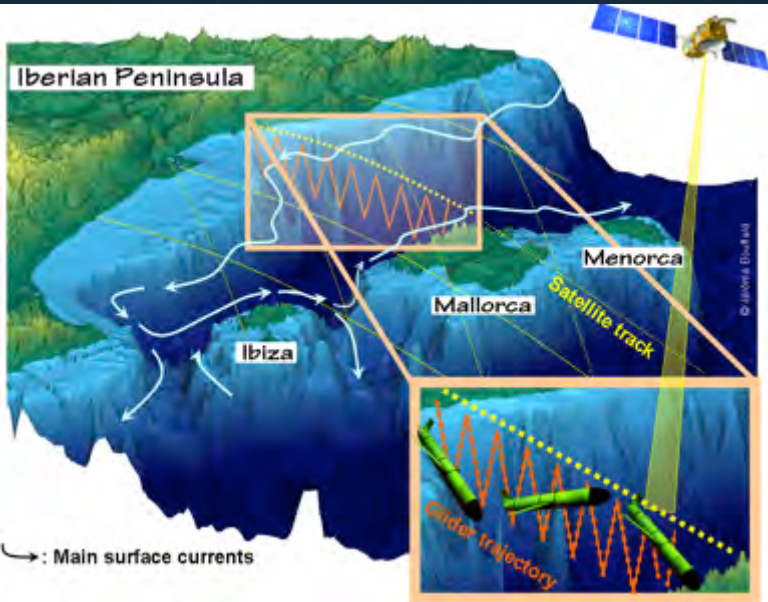
What is SOCIB? A multi-platform observing system, from nearshore to open-ocean in Mediterranean

The screenshot shows the SOCIB website interface. At the top, the browser address bar displays 'www.socib.es'. The website header includes the SOCIB logo and navigation tabs for 'home', 'about us', 'facilities', 'news', 'multimedia', 'job opportunities', and 'competitive access'. The main content area features a large image of a research vessel with the caption 'SOCIB RV Information'. To the right, the 'latest news' section lists three articles: '25 French entrepreneurs meet SOCIB; science and society' (dated 27-05-2014), 'SOCIB, invited speaker at GreinSus 2014' (dated 12-05-2014), and 'SOCIB participates in the EMODnet MedSea Checkpoint Project' (dated 06-05-2014). Below the news section is a 'facilities' row with icons for COASTAL OBSERVATION, COASTAL HF RADAR, GLIDER, LAGRANGIAN PLATFORM, FIXED STATIONS, BEACH MAPPING, OCEAN FORECAST, and DATA CENTER. The 'direct links' section at the bottom contains a grid of links to various services and data sources, including SACOSTA, ICTS Map, contractor profile, Wave forecast, Dapp, Satellite, Seaboard, Follow the glider, and LW4NC2.

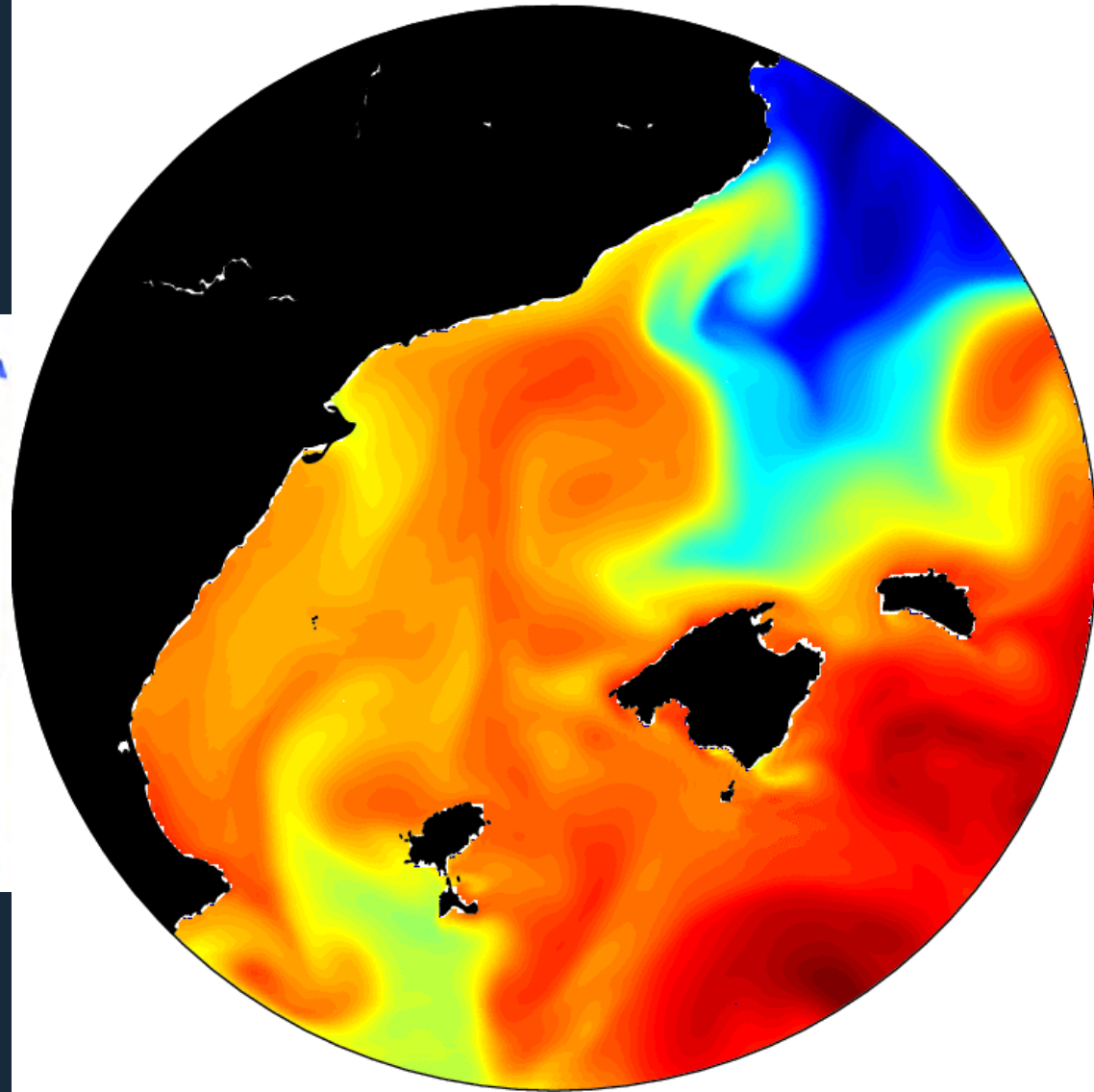
3 Drivers

- Science priorities
- Technology Dev.
- Society Needs

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



DAY = 1



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

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



MedSea Portal

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

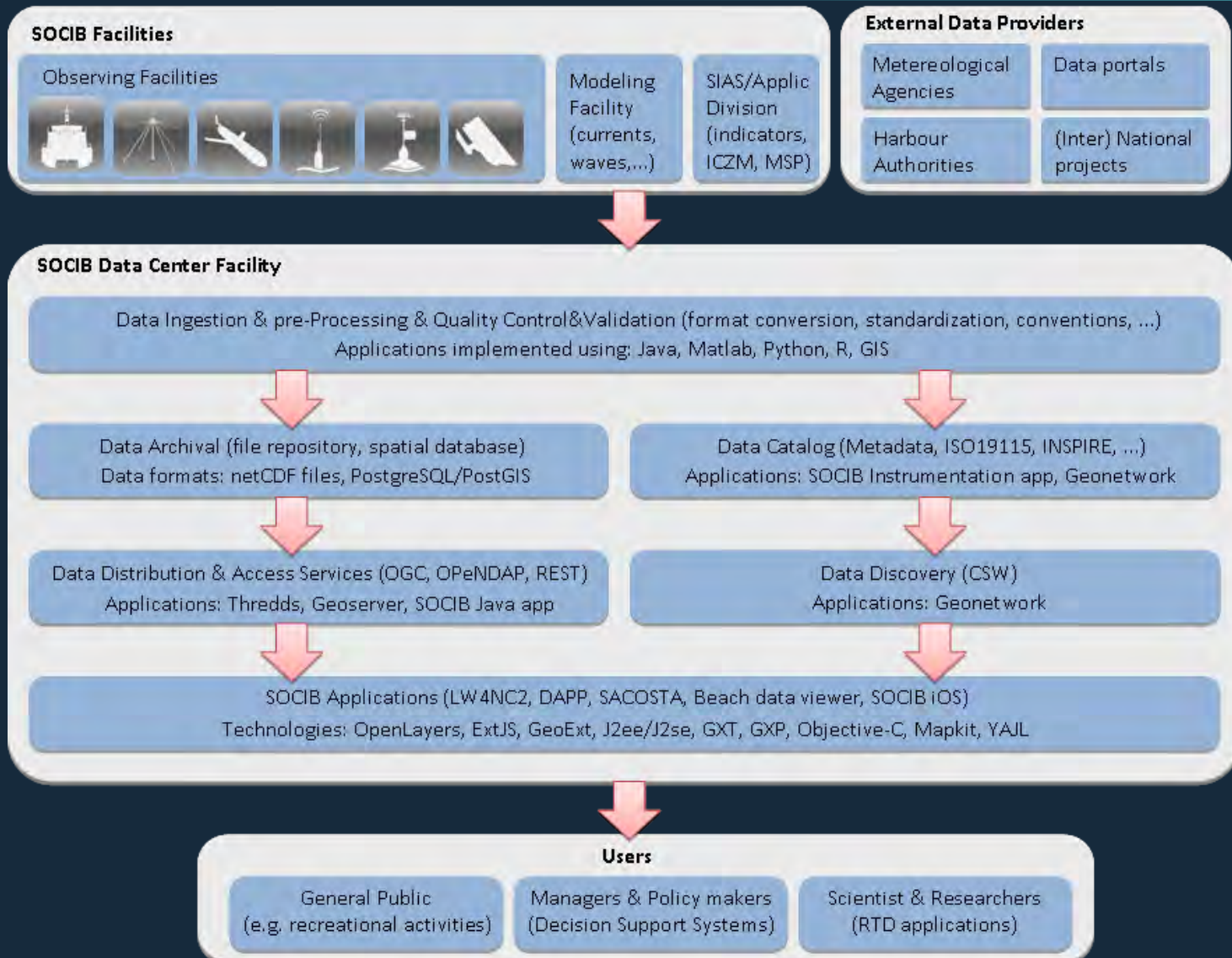
OPEN DATA PRINCIPLES

- 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

JGR, 2010

Vertical motion in the upper ocean from glider and altimetry data Coastal and mesoscale dynamics characterization using altimetry and gliders: A case study in the Balearic Sea

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

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

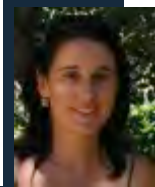
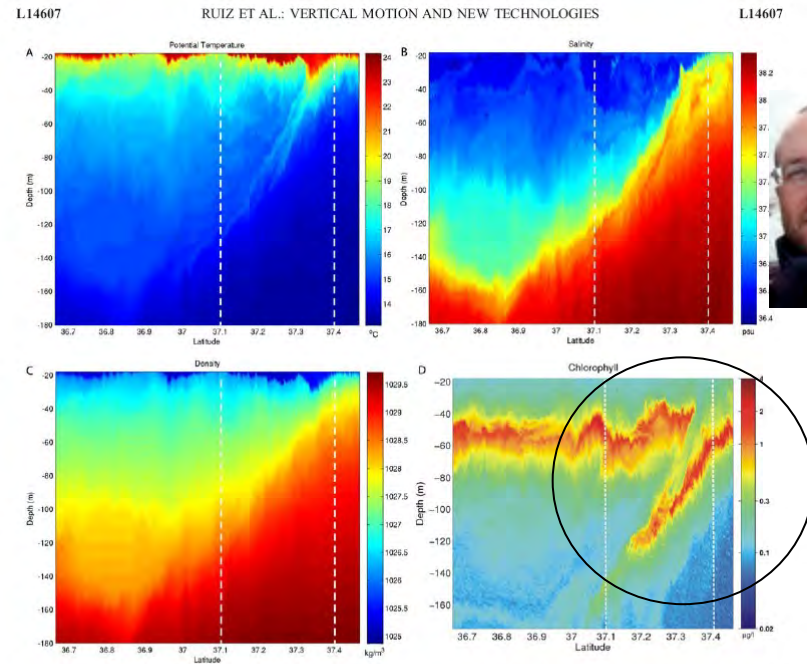
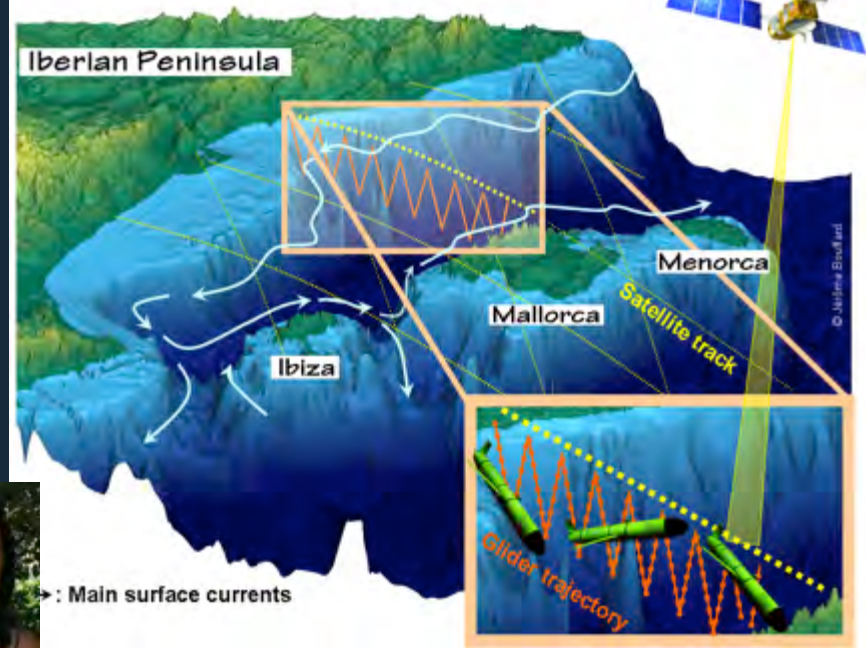
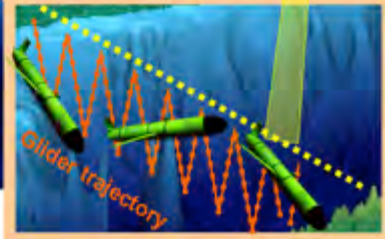


Figure 2. Vertical section of temperature (°C), salinity (PSU), density (kg/m³) and chlorophyll (µg/l) from glider section 2 (dashed magenta in Figure 1). White dashed lines define sub-section in the northern part of the domain.

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



→ Main surface currents



Gliders Facility: Operational

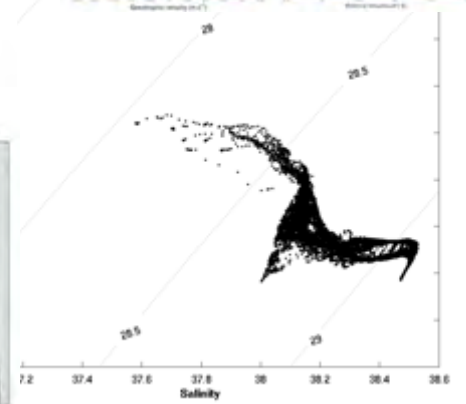
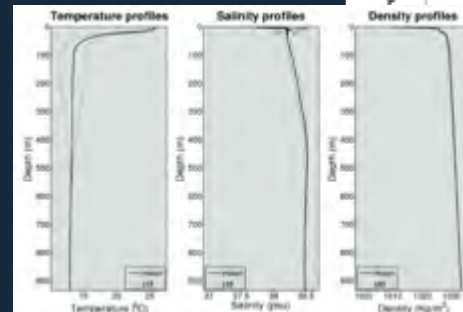
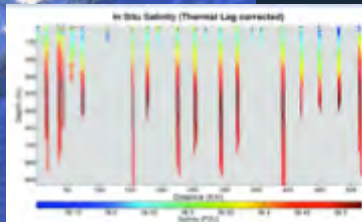
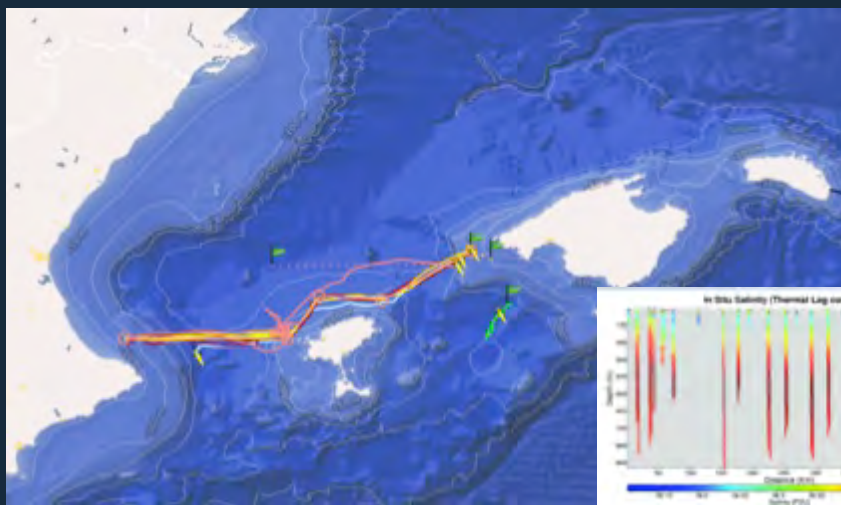
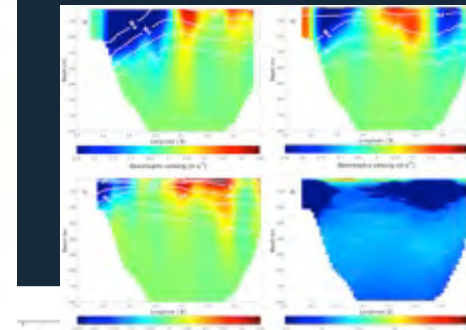
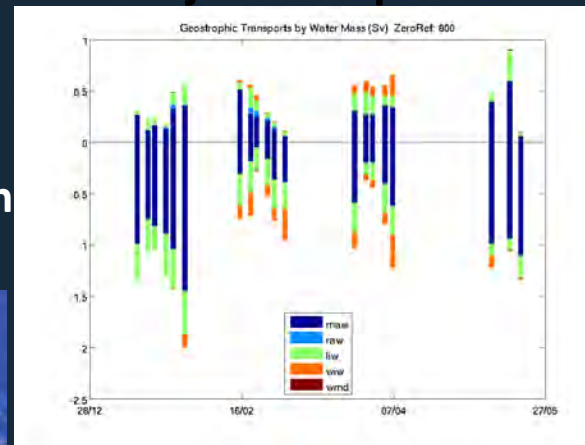
GEOPHYSICAL RESEARCH LETTERS, VOL. 39, L20604, doi:10.1029/2012GL053717, 2012

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

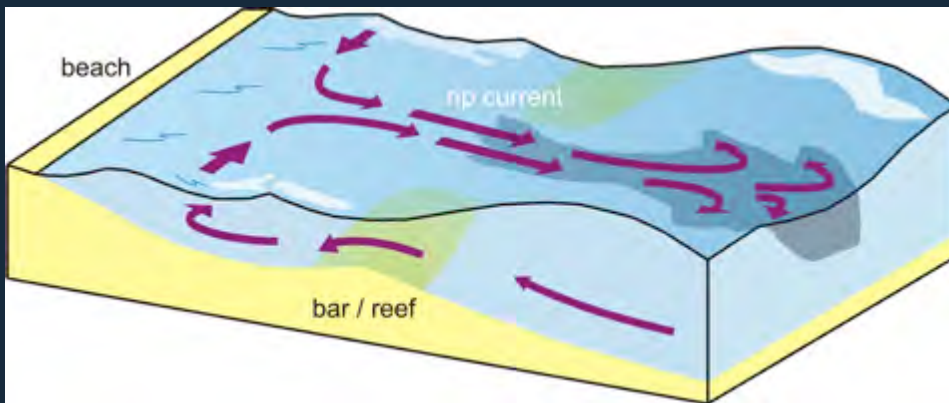
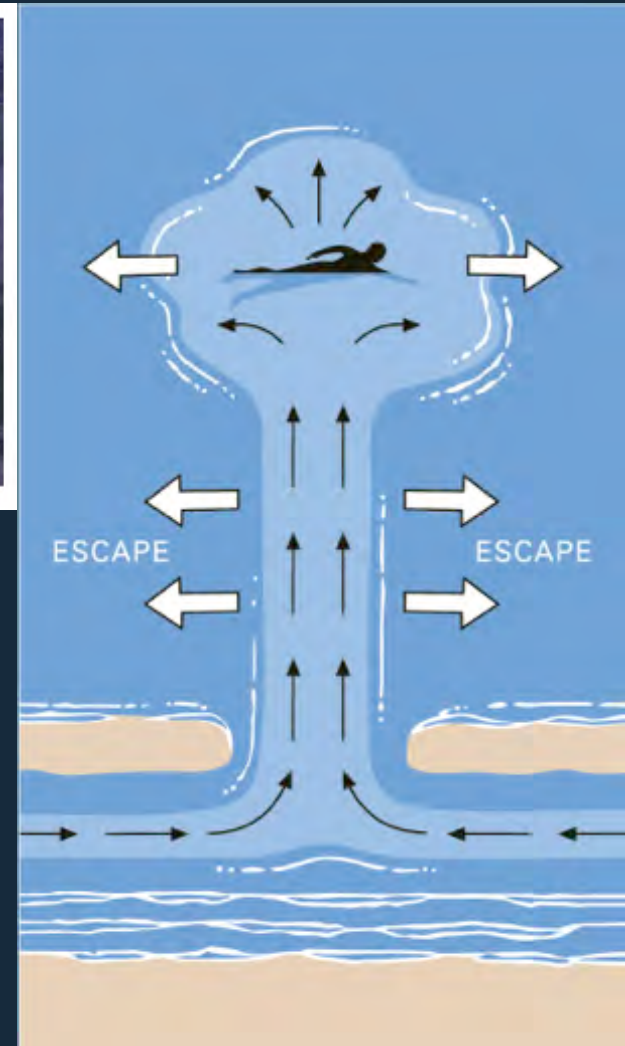
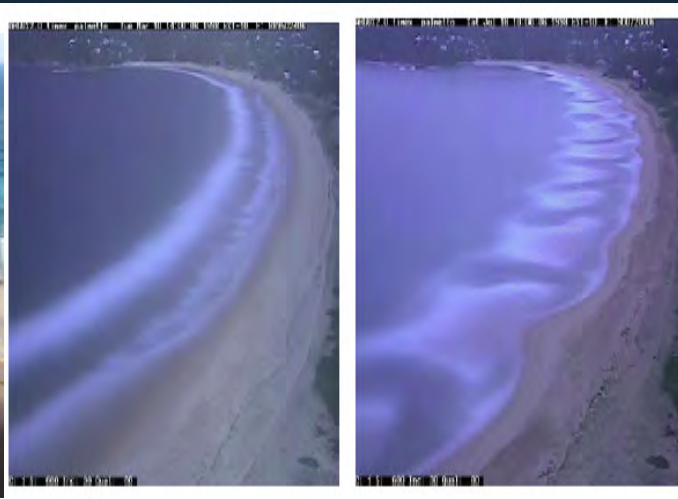
Emma E. Heslop,¹ Simón Ruiz,¹ John Allen,^{2,3} José Luís López-Jurado,⁴ Lionel Renault,⁵ and Joaquín Tintoré^{1,5}

Major transport changes

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



SOCIB Technology Development & Applications: Beach Safety -Rip Currents-



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

SOCIB Developments and Applications: Mobile Apps



900 downloads



300 downloads

SOCIB Developments and Applications: Touristic sector



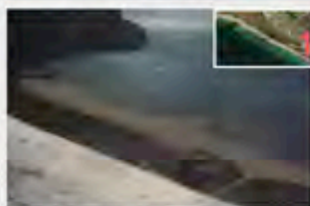
Be proud of your hotel!

We are pleased to inform you that this hotel contributes to beach conservation and science based coastal and ocean management. Your hotel collaborates with the Beach Monitoring Programme from SOCIB.



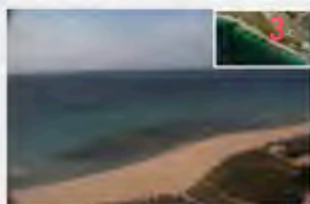
Observation and real time data

Beach evolution



Son Bou - Cam 01: 19/03/2014 12:00

Beach overview



Son Bou - Cam 03: 19/03/2014 13:18

Beach information

Beach type: 2,5 km linear natural beach with dunes
 Sediment type: medium to fine biogenic sands
 Scientific interest: beachrocks, lagoon inlet, rip

Hotel weather station

Rain accumulation

0,24 mm

0.24 High 0.24 Low

Swimming conditions



No data received

More information



Forecast

Weather forecast

Light rain on Sunday and Monday; temperatures peaking at 29° on Saturday.

Today

Windy in the morning.			
Temp	Wind	Humidity	Pressure
17.9 °C 13.7 °C	25.0 km/h (20)	76 %	1022.0 hPa

Thursday

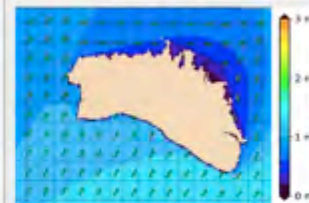
Mostly cloudy throughout the day			
Temp	Wind	Humidity	Pressure
18.8 °C 14.1 °C	6.4 km/h (4)	82 %	1020.7 hPa

Friday

Clear throughout the day			
Temp	Wind	Humidity	Pressure
18.8 °C 14.4 °C	5.8 km/h (4)	81 %	1020.6 hPa

*Powered by Thomson

Waves forecast



Waves at 21/03/2014 11:00

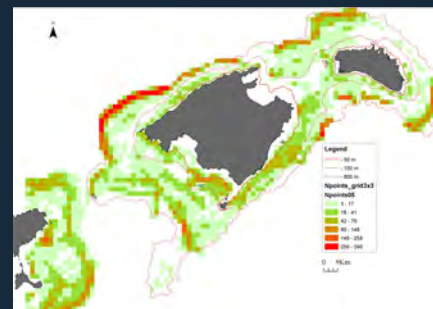
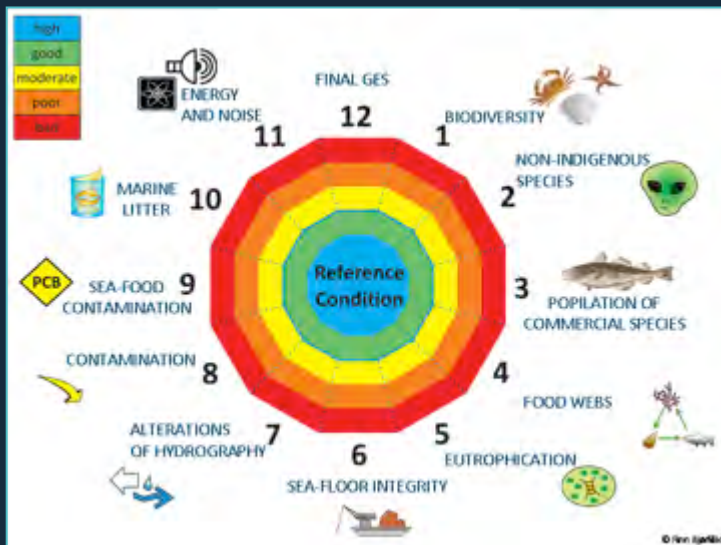
SOCIB Developments and Applications: Contribution to IMP, e.g., MSFD. Strong science for wise decisions.

MSFD A KEY SOCIETAL DRIVER:

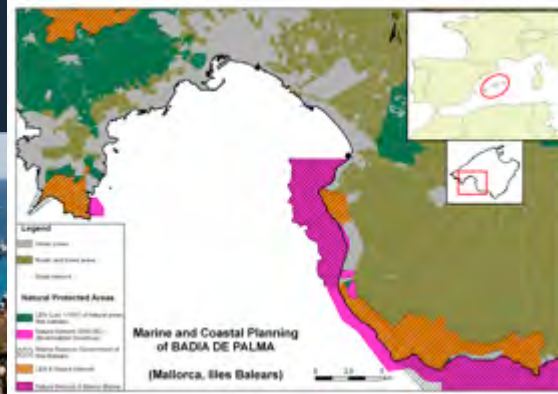


"What we measure affects what we do. If we have the wrong measures, we will strive for the wrong things"
(Joseph Stiglitz, 2010)

"Bridging the science-policy gap is arguably the biggest current challenge to achieving sustainability"
(Lubchenco and Sutley, 2010, Science).



SOCIB Developments and Applications: Sustainability indicators; Science and Society




Marine Policy 34 (2010) 772–781

Contents lists available at ScienceDirect

Marine Policy

journal homepage: www.elsevier.com/locate/marpol

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

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 Spain

ABSTRACT

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 Balearic Indicators Project. This initiative reflects a series of compromises considered necessary to achieve the objective of generating an indicator system that is scientifically viable, comparable 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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New tools: MSP, ICOM Social and Economic Council.

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Integrated and interdisciplinary scientific approach to coastal management.

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ARTICLE INFO


ABSTRACT

Coastal zones and beach management practices, regulatory demands, and land use planning activities along coastal zones have historically been made with insufficient information concerning the dynamic coastal environment. In this study we address and propose an interdisciplinary scientific approach to Coastal Management in a scenario where lack of information has resulted in the alteration of the natural dune system of the beach of Cala Millor (Mallorca, Balearic Islands, Spain) and also in the penetration of the beach area and in a parallel loss of the tourism resources. In this work a detailed analysis on beach micro-phenomena have been developed as a basis for integrating proper beach management, beach natural dynamics, and local users and economic agents interests. From this point of view a set of solutions are considered as the basis for a management policy that links beach science and beach use as a sustainable resource.

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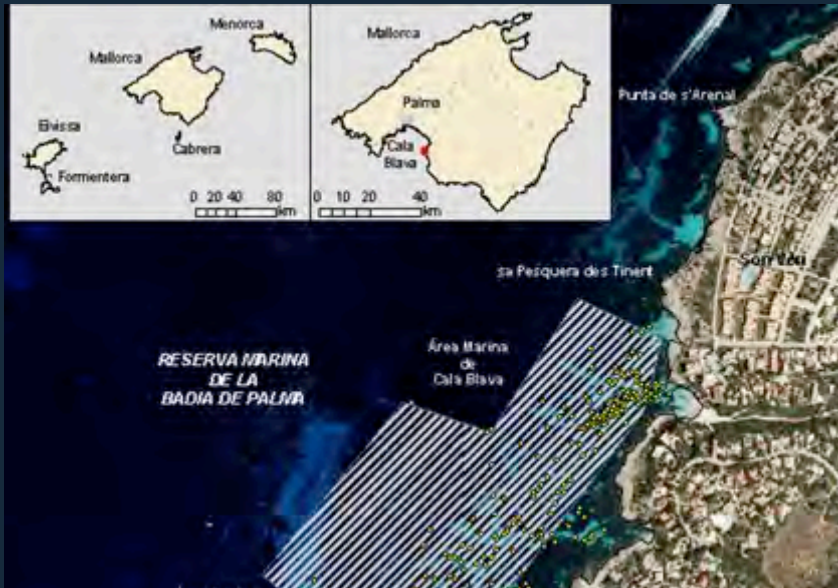
SYSTEM OF INDICATORS

for Integrated Coastal Zone Management in the Balearic Islands



Official Opinion 5/2007 of the Economic and Social Council of the Balearic Islands

SOCIB Developments and Applications: Socio-environmental studies carrying capacity beaches



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Multi-Method Approach to Exploring Social–Ecological Dimensions in a Mediterranean Suburban Beach Setting

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SOCIB Developments and Applications: Outreach

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DISCOVER THE OCEAN'S SECRETS WITH UNDERWATER GLIDERS

The image shows a browser window with the URL 'followtheglider.socib.es/en/'. The page features a navigation bar with 'STUDENTS', 'TEACHERS', and 'EXPLORE' links, and social media icons for Facebook, Twitter, and YouTube. The main content area has a large graphic with the text 'FOLLOW THE GLIDER' and 'EXPLORE' in a white, hand-drawn font. A yellow glider is shown flying over a blue ocean with a ship in the distance. Below the waterline, a red seabed is depicted with a crab, coral, and an octopus. The text 'DISCOVER THE OCEAN'S SECRETS WITH UNDERWATER GLIDERS' is written in a white, hand-drawn font at the bottom left. A URL 'http://followtheglider.com' is displayed in blue text in the lower right.

OUTLINE

1. New Technologies: Paradigm Change Ocean and Coastal Observation. EU international leadership
2. Marine Research Infrastructures, Ocean Observatories: SOCIB, Integrated Science priorities, Technology Development and Society Needs
3. **Innovation and Blue Growth: innovation in oceanography - gliders- (multi-disciplinary teams), data availability) and ...**
“Turning Data into Jobs...”

Discussion: Are we ready for these changes ? Do we have the framework and right structures to get all the benefits from these changes ? (“to enforce what we think has to be done...”)

Innovation in oceanographic instrumentation

3 elements:

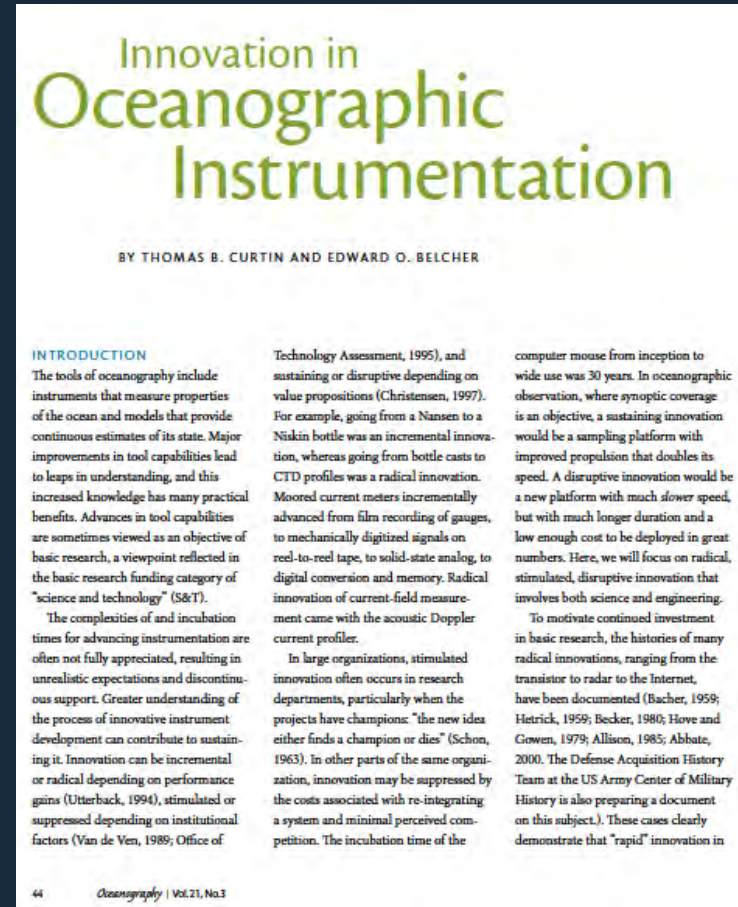
- Oceans complexity imply and drive a need for improvement of instrumental capacities

- The innovation process, complexity and incubation time:

• Incubation time: 15-30 years (computer mouse, 30 years).
Gliders 10 years. WHY?

- The key to success

3



(Curtin and Belcher, TOS, 2008)

The innovation process (for advancing instrumentation)

3 key decision centres:

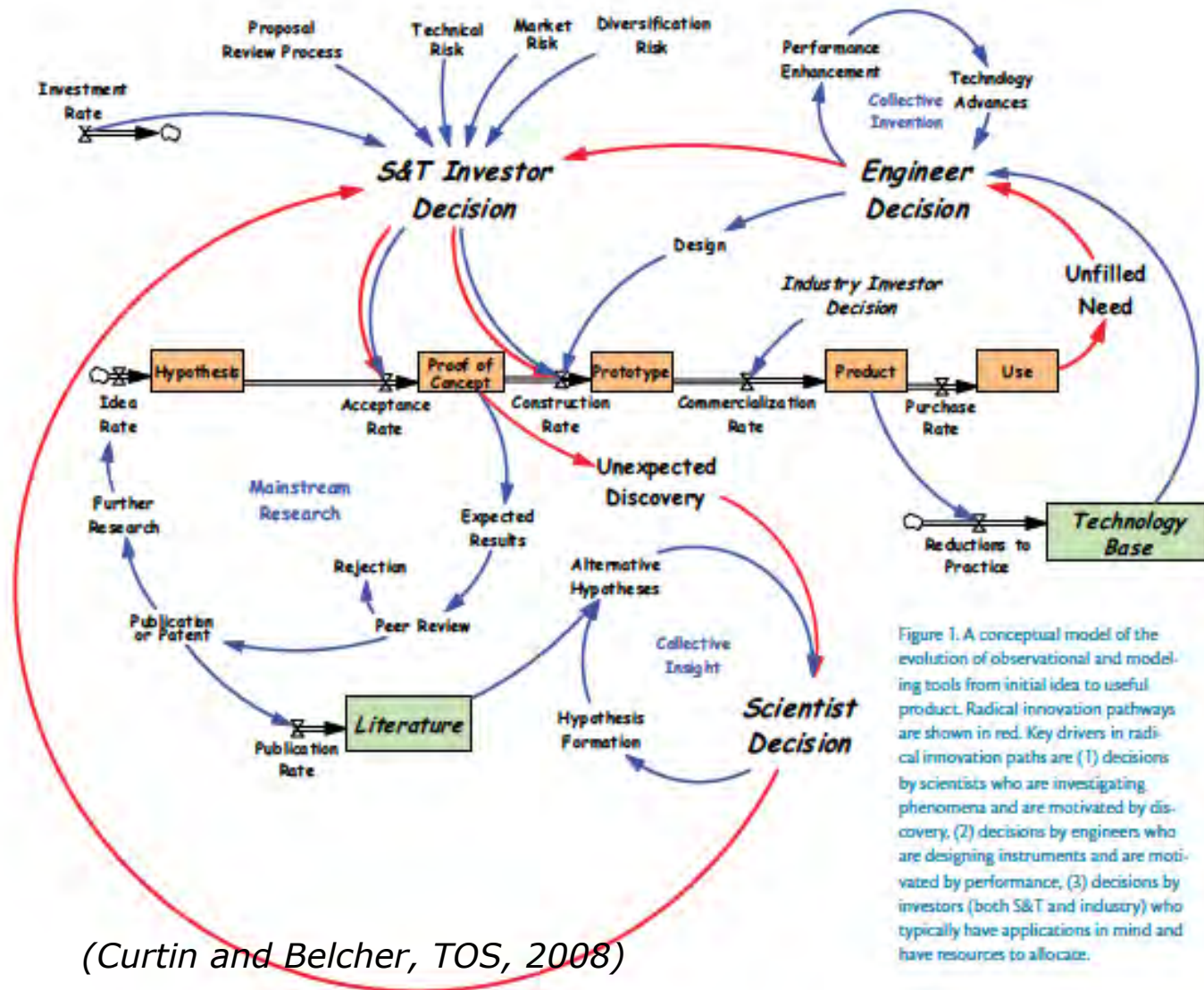


Figure 1. A conceptual model of the evolution of observational and modeling tools from initial ideas to useful product. Radical innovation pathways are shown in red. Key drivers in radical innovation paths are (1) decisions by scientists who are investigating phenomena and are motivated by discovery, (2) decisions by engineers who are designing instruments and are motivated by performance, (3) decisions by investors (both S&T and industry) who typically have applications in mind and have resources to allocate.

The key to success for radical innovation in oceanographic instrumentation

1. Visionary leadership
2. Close coupling between science and engineering
3. A coherent investment strategy based on distributed, coordinated resources
4. Effective processes for communication, feedback, and contingency planning.
5. Incentive to assume responsibility for risky instrumentation development projects without undue career jeopardy.

In summary: work in collaborative, multidisciplinary teams, be tenacious and focused on long term objectives while producing short-term success, and find creative champions among funding agencies and investor organizations.

- MULTI-DISCIPLINARY APPROACH
- INTEGRATION

Data Availability....

OPEN DATA PRINCIPLES

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

EU FRAMEWORK

- MARINE KNOWLEDGE 2020;
- EU COM May 8, 2014;

[EU eyes oceans innovation as source of sustainable growth;](#)



Turning DATA INTO JOBS (US - NOAA)....

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.

SUMMARY; 2 messages

1. New technologies and paradigm change Ocean Observation: Ocean Variability, with shift from Large Scale to Mesoscale and Coasts: SOCIB.
2. Marine Research Infrastructures/Observing Systems in Europe; Key elements in Blue Growth initiatives (**EU Oceans Innovation COM**) because of:
 - Critical mass
 - Multi-disciplinary approach and
 - Integration capabilities of Science/Technology/Society

EXACTLY ... What we need for successful innovation!.

 **New observing systems with real time open data**

“Turning data into jobs” initiative...

So... now... we need to establish a framework to bring together the 3 pillars from H2020...

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