

European basin scale perspective: how society around the Mediterranean Sea benefits from ocean observations?

Joaquín Tintoré
SOCIB

Combining Scientific Excellence & Technology Development
with... Impact and Relevance to and for Society

A STORY ON

- **Scientific excellence with Impact on Society in the Mediterranean Sea**
- **Changes in how we do Science & on how we interact with Society: new ocean observatories/infrastructures**
- **The SOCIB case, and some key elements for building EOOS**

Our goal... characterise Ocean State AND VARIABILITY at Different Scales (basin, sub-basin, local & coastal interactions)

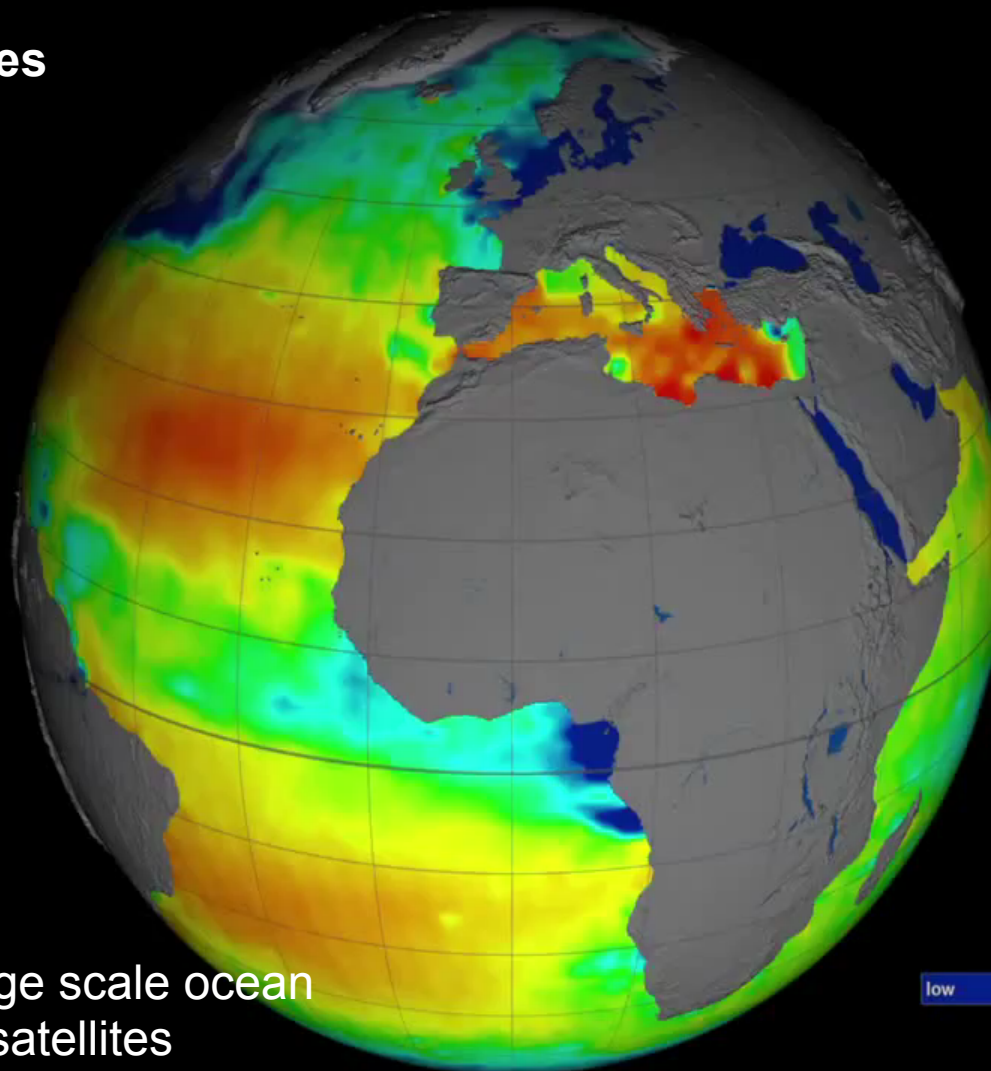
We need:

- Long time series
- Synoptic data

Walter Munk, 2001:
“The last century of
oceanography is
marked by the degree
of under-sampling”.

Carl Wunsch, 2010: “We
need data, ... models
are becoming
untestable”

Last decade: ok large scale ocean
circulation –Argo & satellites

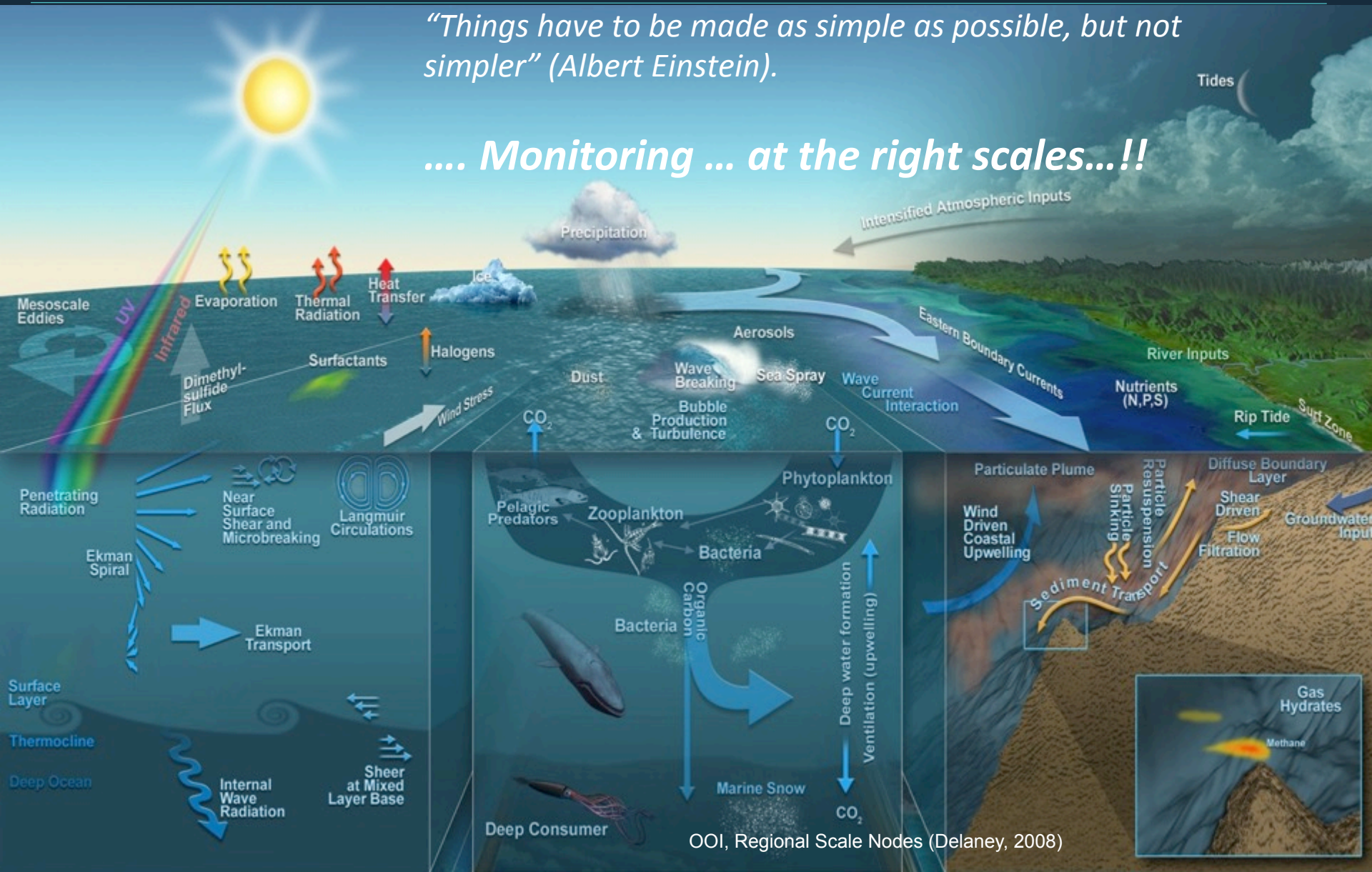


Salinity
low high

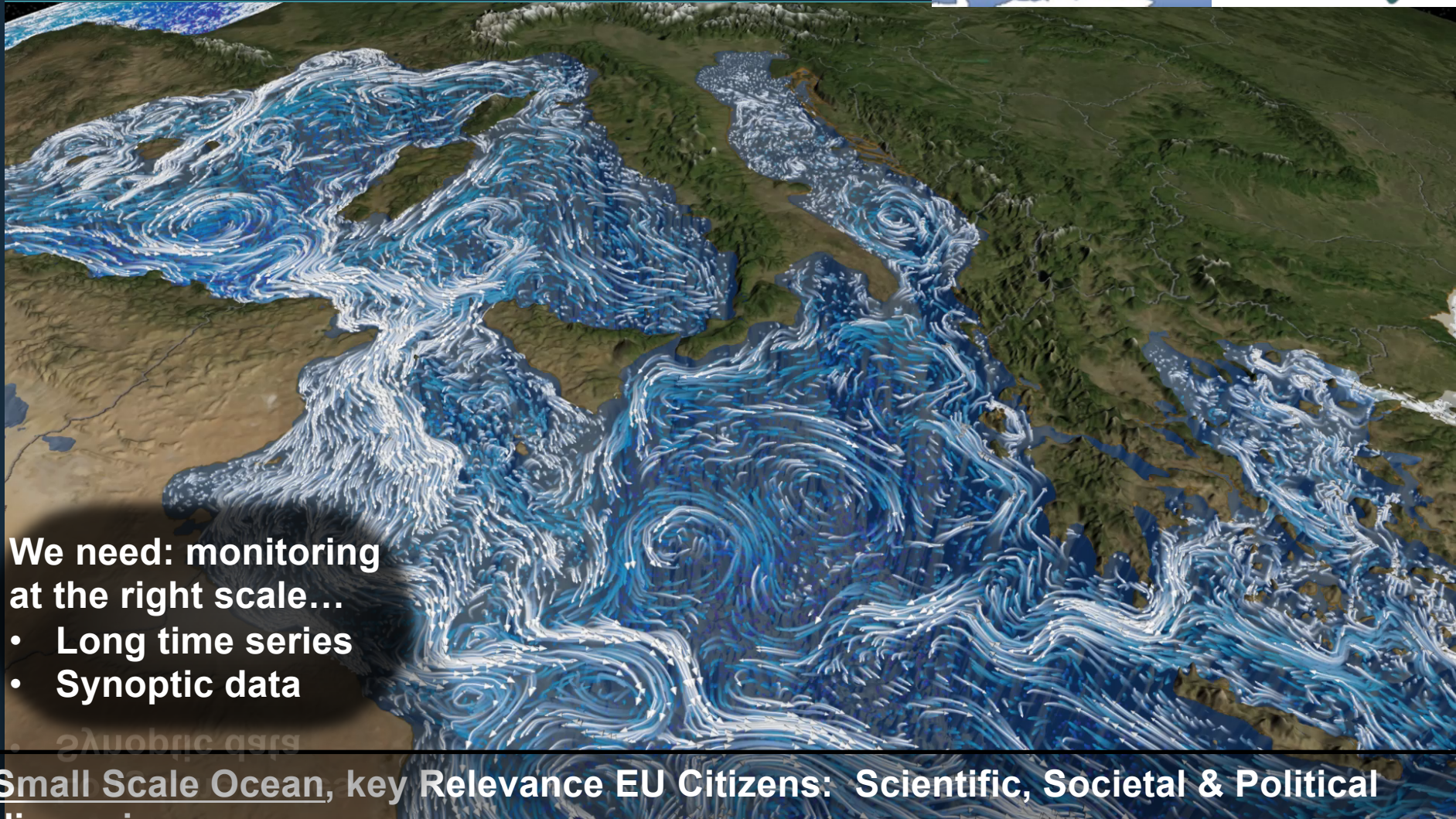
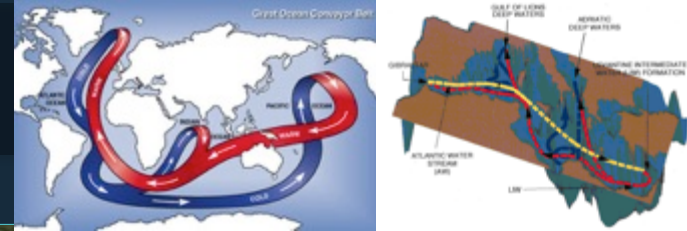
Oceans and coastal interactions. Scales interactions. Management is needed. No oversimplification

“Things have to be made as simple as possible, but not simpler” (Albert Einstein).

.... Monitoring ... at the right scales...!!



The Mediterranean Sea



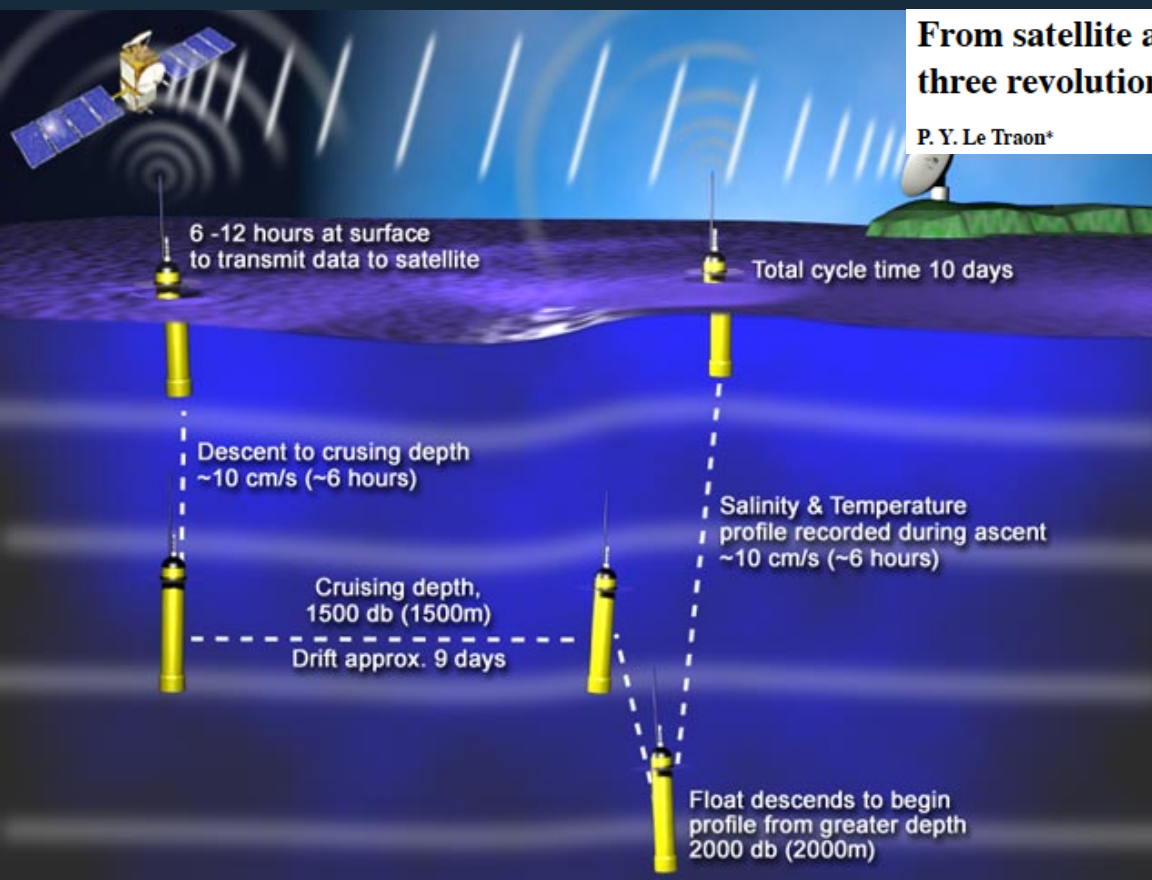
**We need: monitoring
at the right scale...**

- Long time series
- Synoptic data

Small Scale Ocean, key Relevance EU Citizens: Scientific, Societal & Political dimensions

Mediterranean leadership in Europe, for 25 years: EC triggered with MTP.

Last decade: characterization of the State of Large Scale open ocean circulation; Euro-Argo / ESFRI...

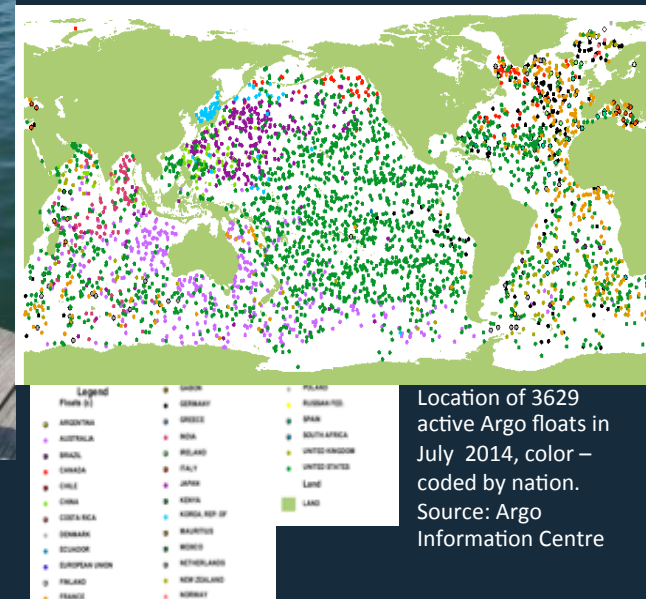


Schematic diagram of a single Argo float cycle

From satellite altimetry to Argo and operational oceanography: three revolutions in oceanography

P. Y. Le Traon*

Ocean Sci., 9, 901–915, 2013



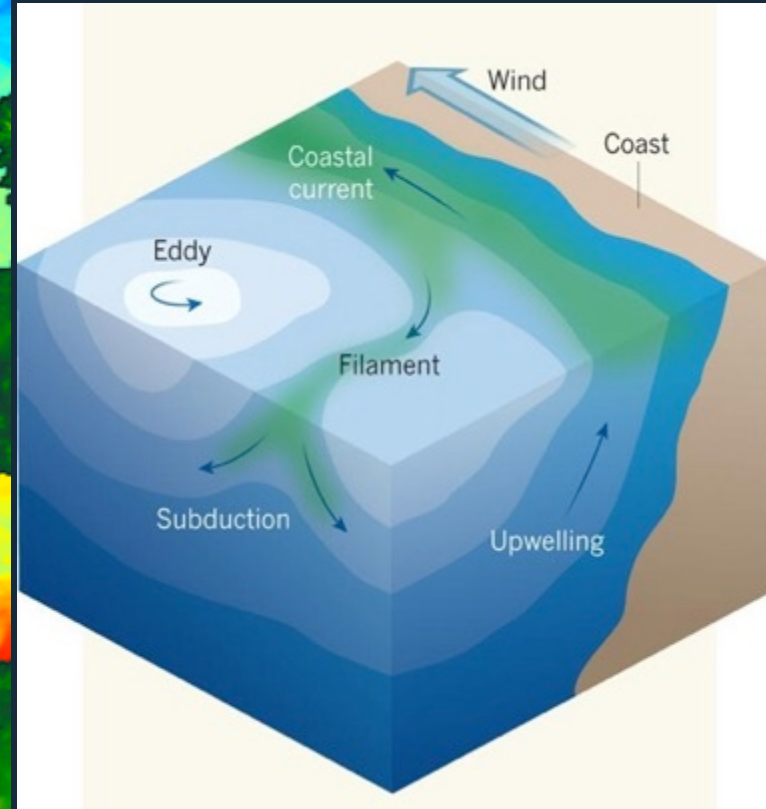
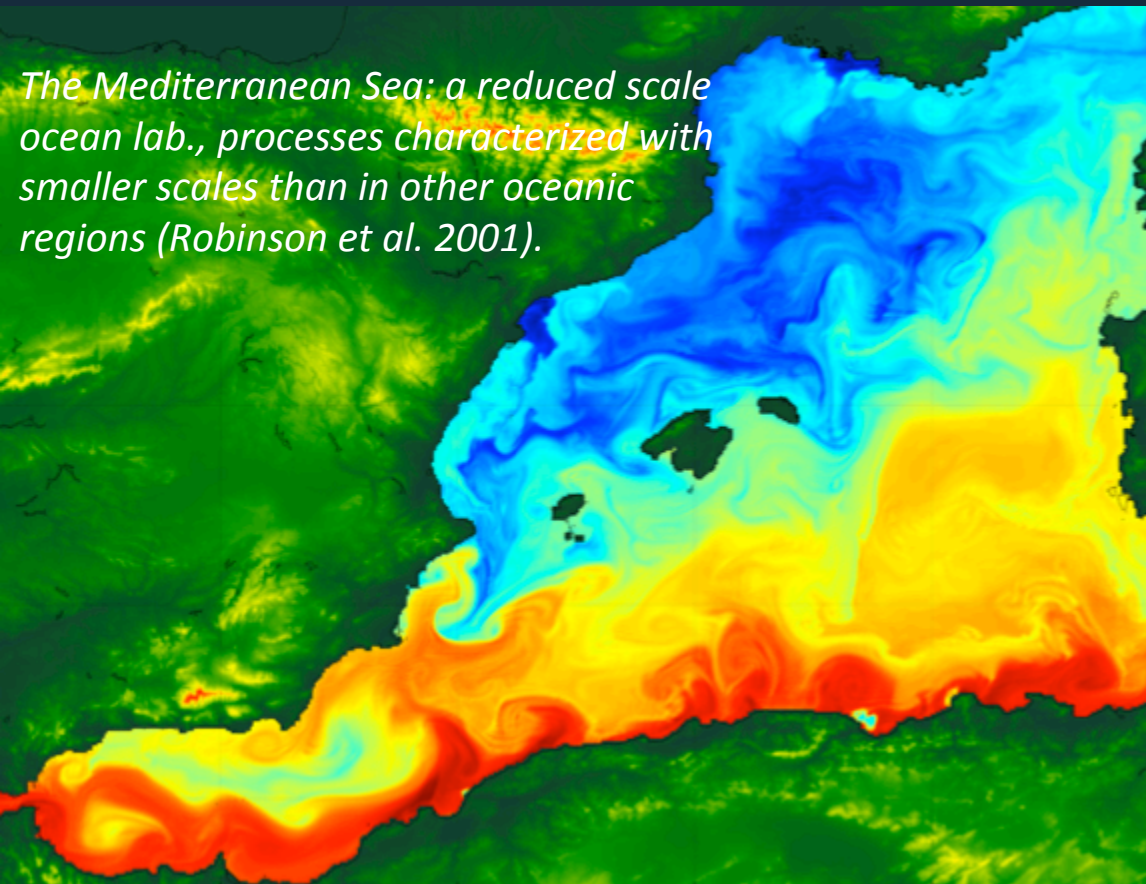
<http://www.euro-argo.eu>

262 floats with biogeochemical sensors
638 European floats (18%)

Argo programme and satellite altimetry allowed characterisation of the state of the large scale open ocean circulation

Successful international cooperation programme...

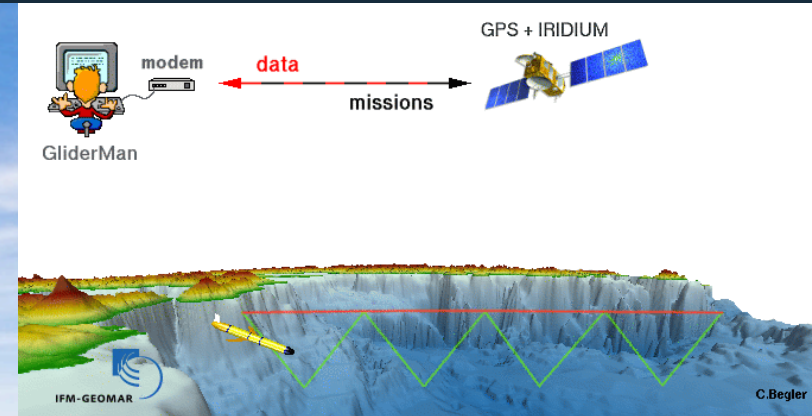
Next decade... Ocean Variability and ... at the right scale... meso & sub-mesoscale



Theory and observations have shown a maximum energy at the mesoscale/fronts & eddies ~10-100km

Mahadevan (Nature, 2014)

New Technologies: drivers of change.... (gliders just an example)



New Technologies: Paradigm Shift

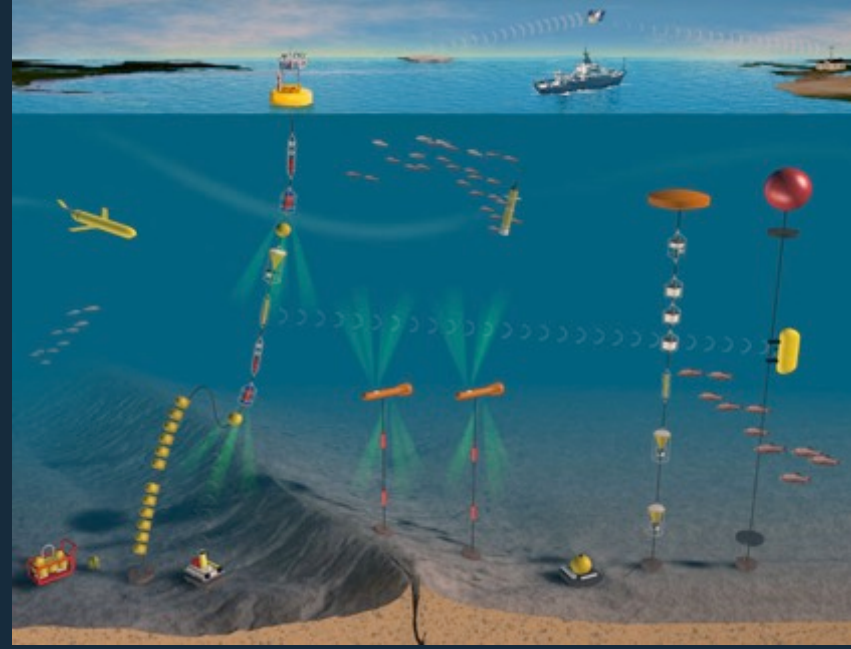
→ Ocean Observation

From: Single Platform - Ship based observation

To: Multi-platform observing systems

Network - distributed
Systems

Platform-centric
Systems



(Adapted from Steve Chien, JPL-NASA)

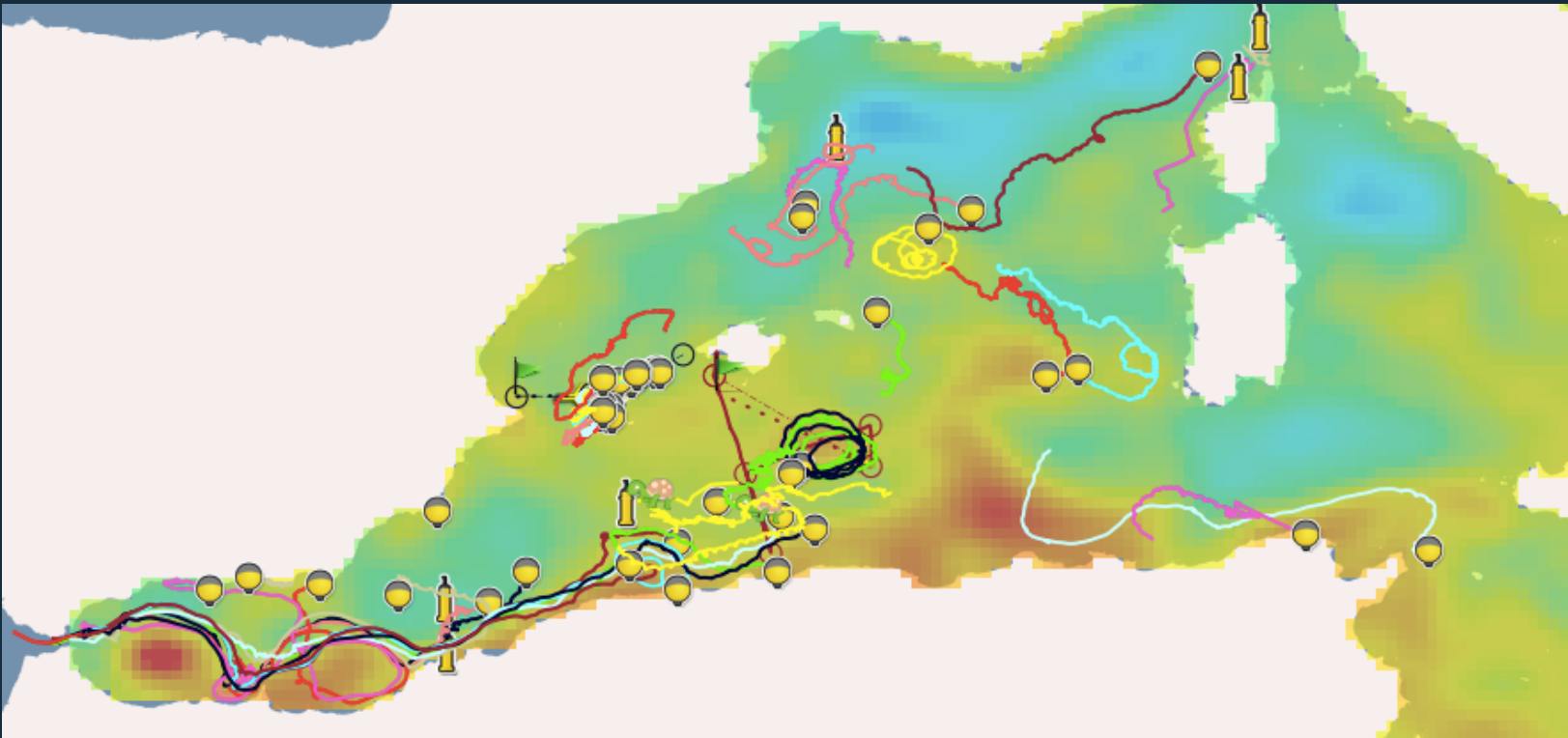
“A single ship can only be in one place at one time. We need to be present in multiple places in multiple times.” ([John Delaney, Nature, Sept. 25, 2013](#))

New Technologies: Paradigm Shift

SOCIB

➔ Data Availability (Real time and QC 'at one click')

Dapp SOCIB: multi-platform real time data available: 40 surface drifters, 4 Argo profilers, 2 sea-turtles, 2 gliders, 2 fixed moorings, 7 tide gages, 3 real time beach monitoring systems). **REALLY ALL AVAILABLE** (not just on paper...)



- ➔ SOCIETAL IMPLICATIONS: Alborán Gyres position and fisheries: (Ruiz et al., 2013: Anchovy landings x 10)
- ➔ SCIENCE IMPLICATIONS: adaptive sampling with gliders...



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

Why Integrated Coastal 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, ...

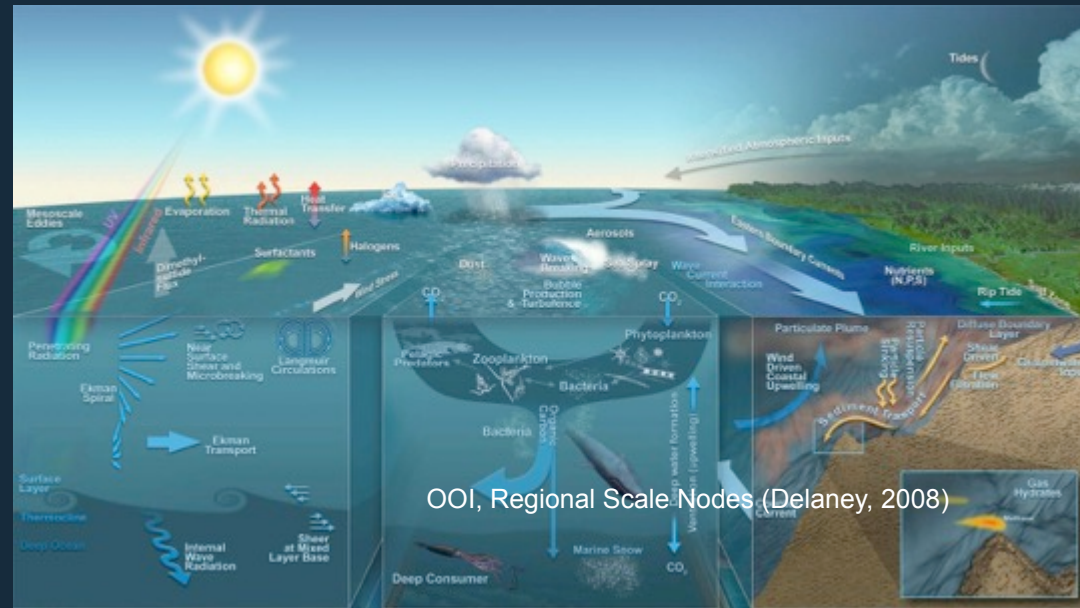


A quantitative major jump, in scientific knowledge and technology development



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

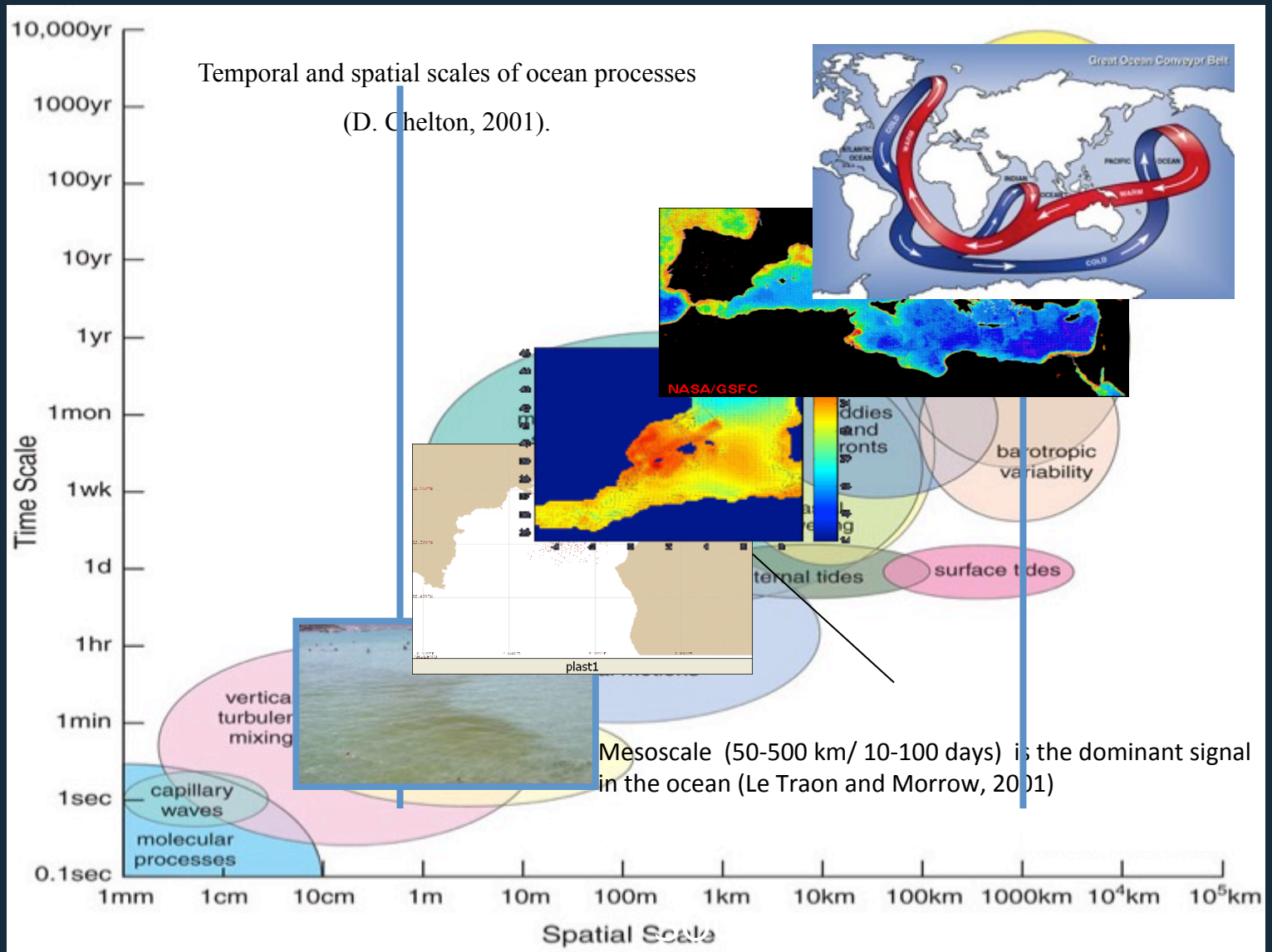
on a global change context (where climate change is one of the most important, but not the only one...), and following sustainability principles



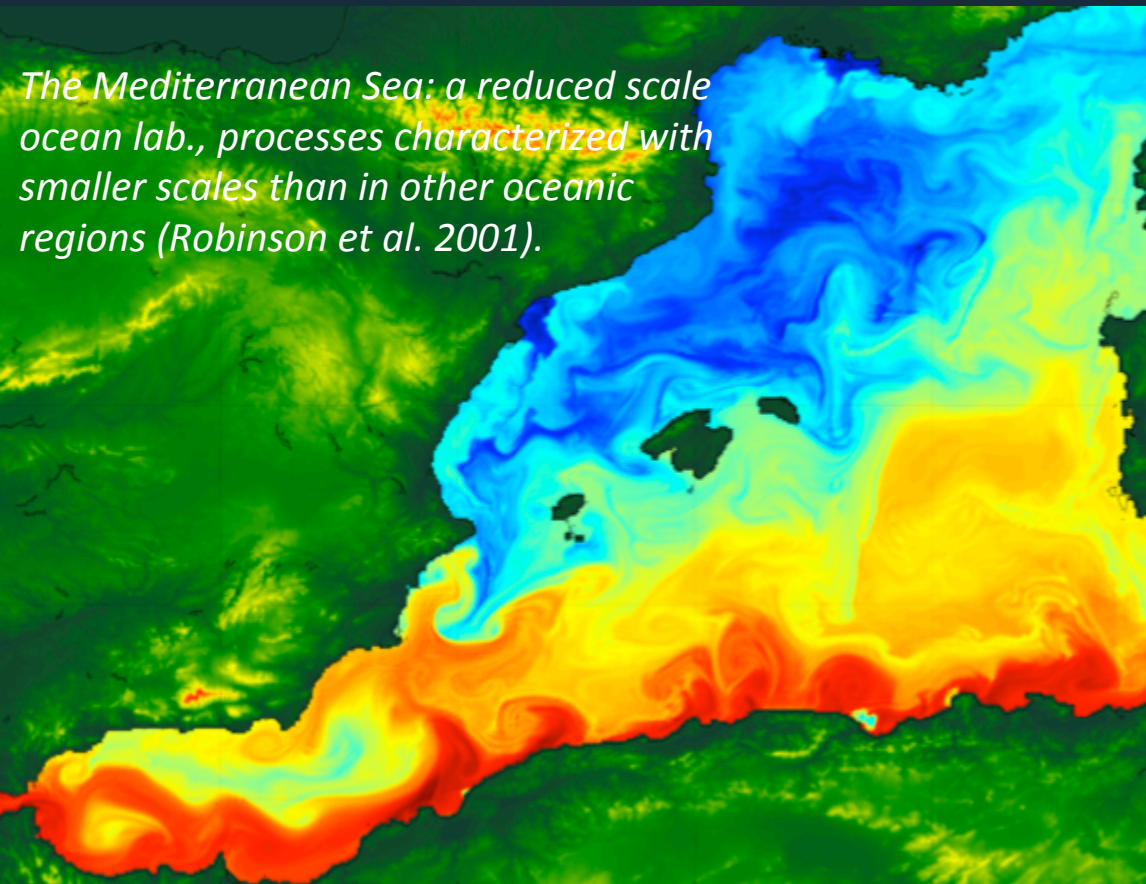
- Are we ready for these changes?

We need to open our minds, adapt scientific and educational structures, management procedures

The scientific challenge: oceanic scales, non-linear interactions and implications on variability & forecasting

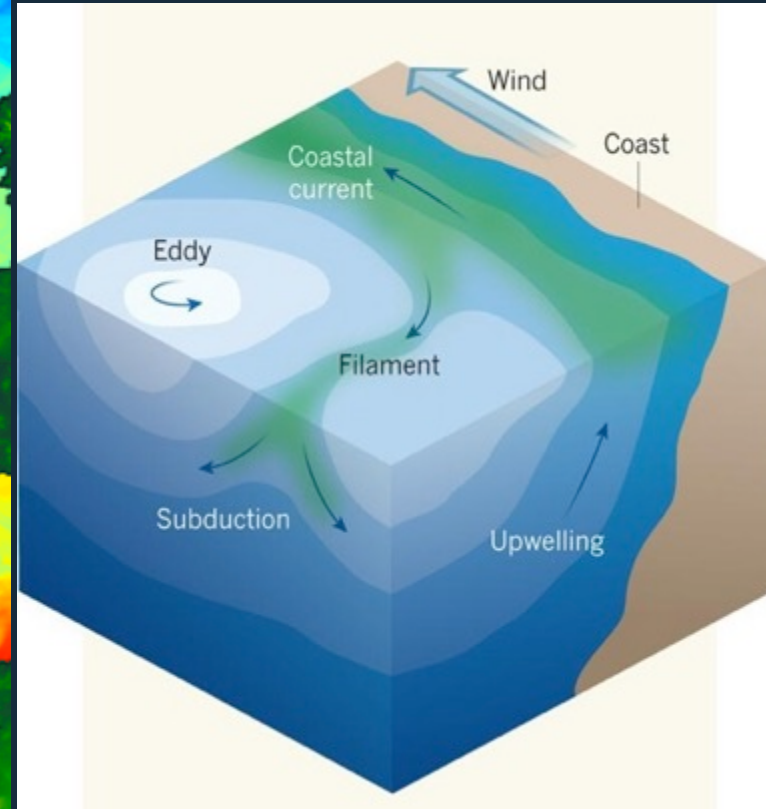


Next decade... Ocean Variability and ... at the right scale... meso & sub-mesoscale



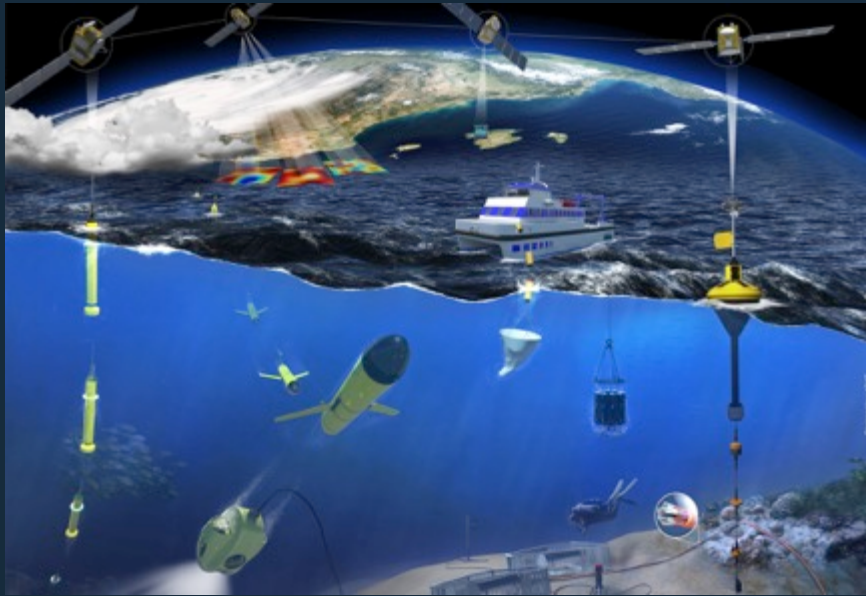
The Mediterranean Sea: a reduced scale ocean lab., processes characterized with smaller scales than in other oceanic regions (Robinson et al. 2001).

Theory and observations have shown a maximum energy at the mesoscale/fronts & eddies ~10-100km



Mahadevan (Nature, 2014)

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



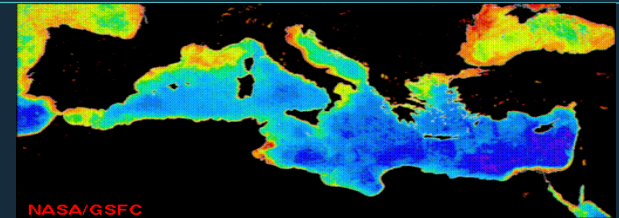
Tintoré et al., 2013: *Marine Tech. Soc. J.*, Vol. 47, N. 1, pp. 101-117

3 DRIVERS

- Science priorities
- Technology Development
- Society Needs

OPEN DATA PRINCIPLES

INTERNATIONAL FRAMEWORK



www.socib.es

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



Charles Troupin



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**

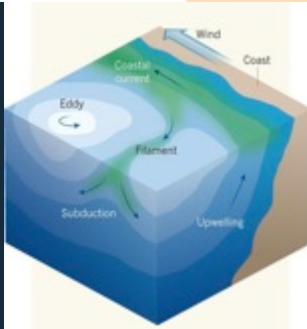
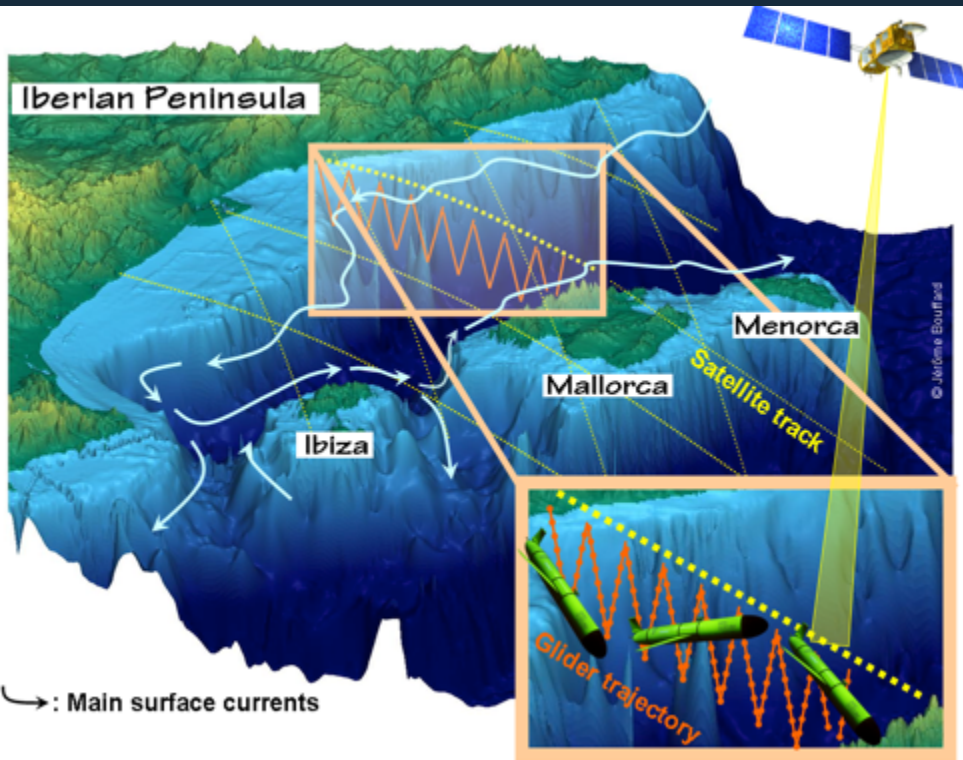
SOCIB Developments and Applications: Mobile Apps



**Turning DATA & APPS INTO JOBS (US – NOAA).
EU - Blue Growth / Ocean Innovation...**

New ocean observing systems for science and society

The Mediterranean Sea.... Ideal lab to study global ocean problems



Mesoscale – Submesoscale / Vertical motions - biogeo effects

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

Vertical motion in the upper ocean from glider and altimetry data

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

L14607

RUİZ ET AL.: VERTICAL MOTION AND NEW TECHNOLOGIES

L14607

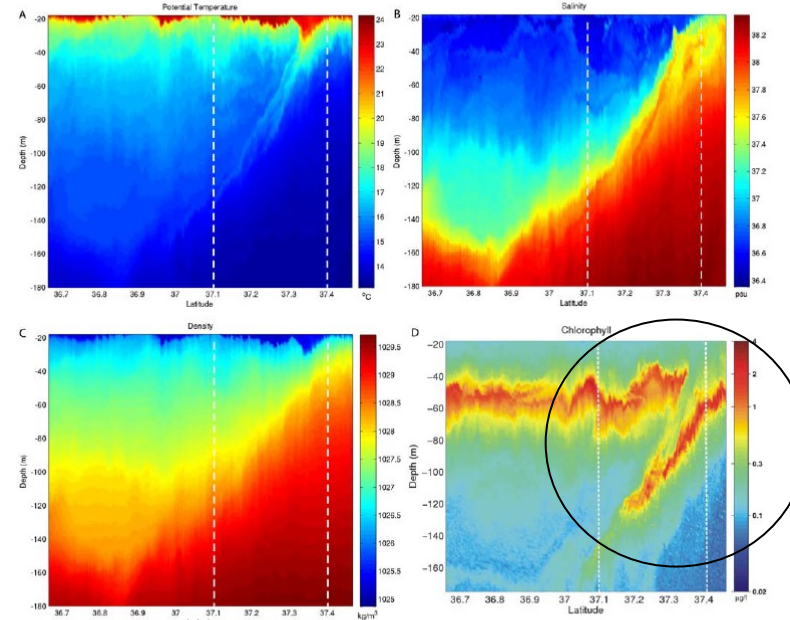


Figure 2. Vertical section of temperature ($^{\circ}\text{C}$), salinity (PSU), density (kg/m^3) and chlorophyll ($\mu\text{g/l}$) from glider section 2 (dashed magenta in Figure 1). White dashed lines define sub-section in the northern part of the domain.

In 2010, the Mediterranean basin suffered a **Portuguese Man-of-War** explosion: was it a permanent jellyfish invasion?



The 2009-2010 winter presented an anomalous intensity of westerly winds

Physalia physalis colony density did not increase inside the basin after 2010

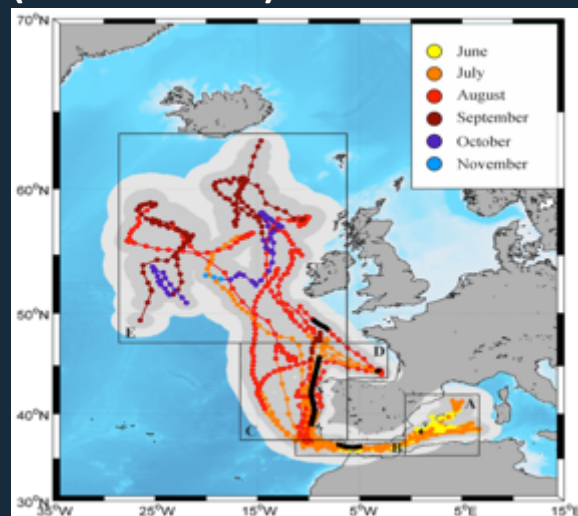
Bluefin Tuna: linking ocean variability & species ecology to improve population stock assessment



Alvarez-Berastegui D.



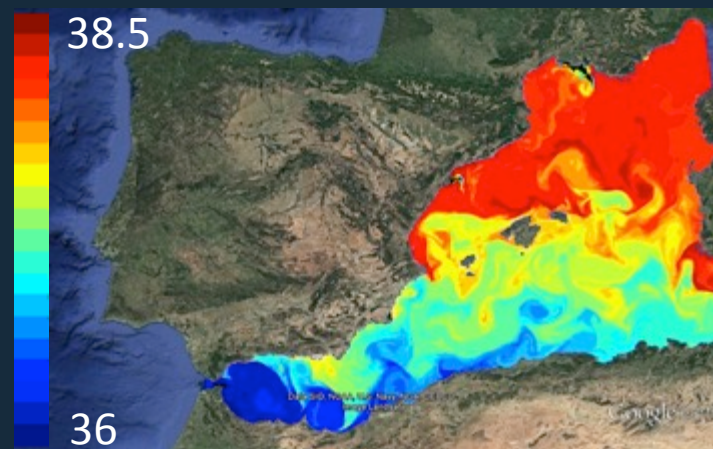
Migration patterns along the year
(Eastern Stock)



Aranda et al, Pone 2013



Sea Surface salinity (06/2016)

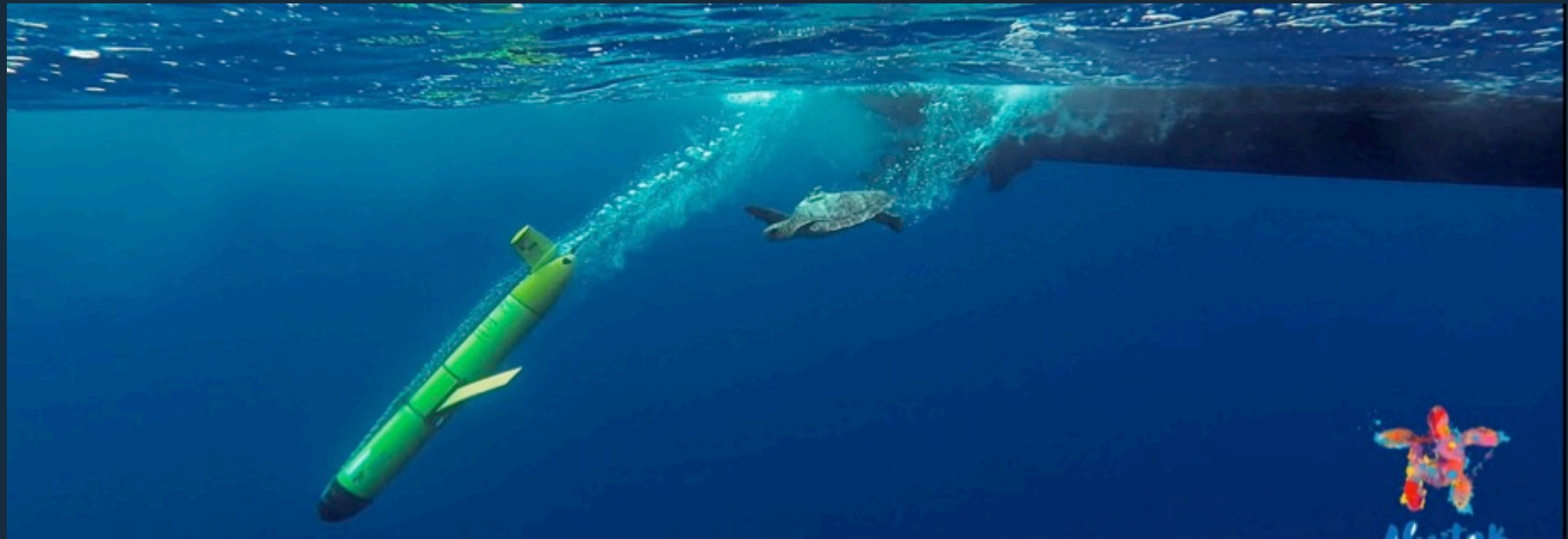


Alvarez-Berastegui et al. (ICES
JMSc. 2016)

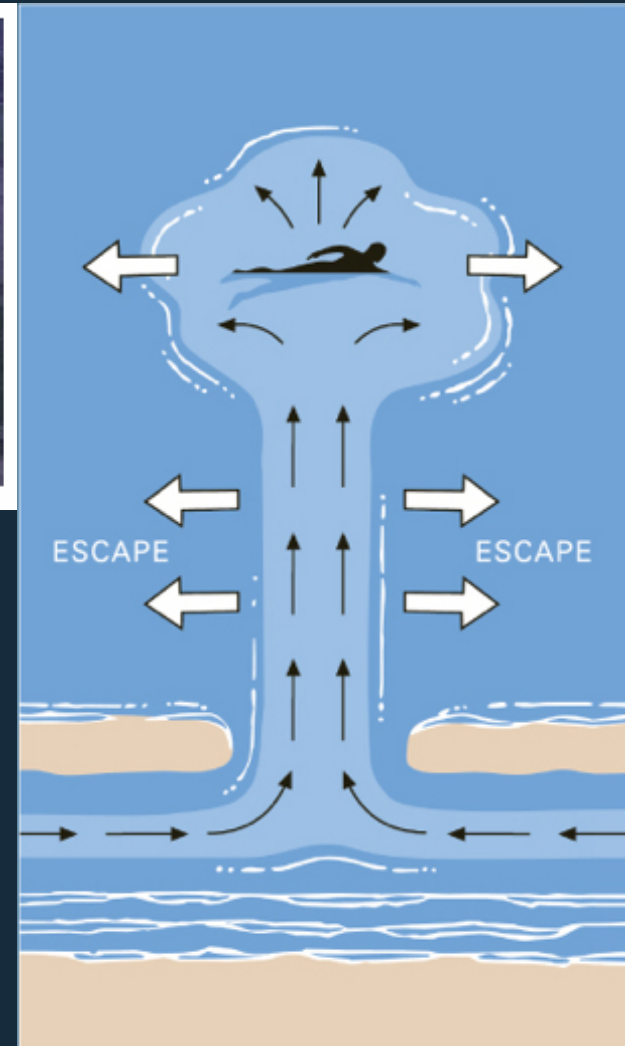
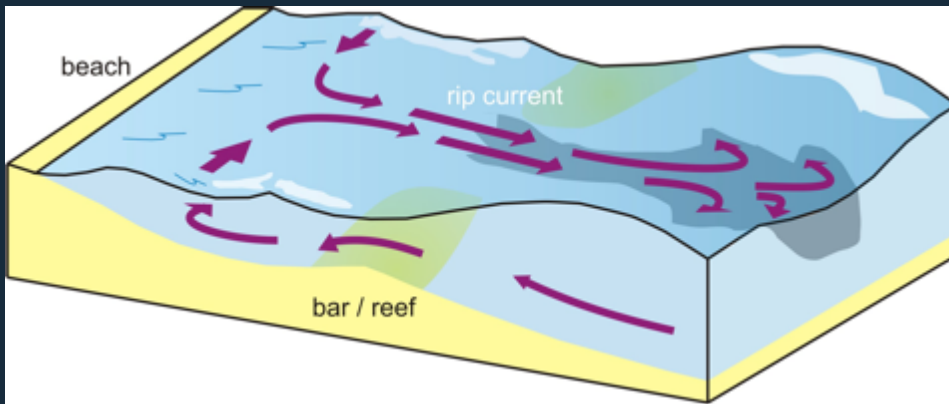
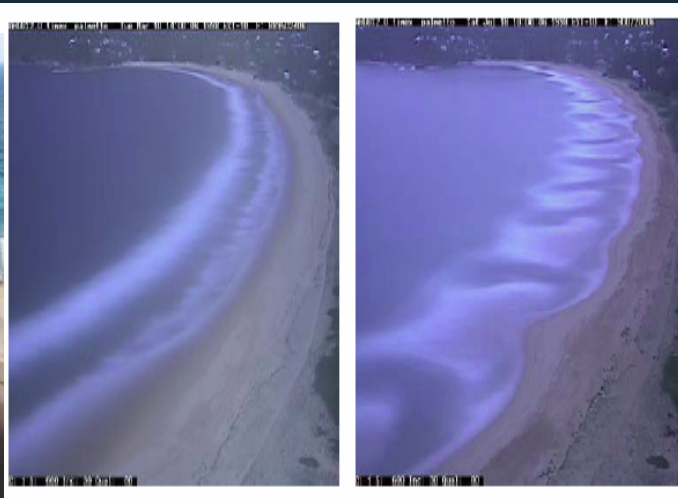
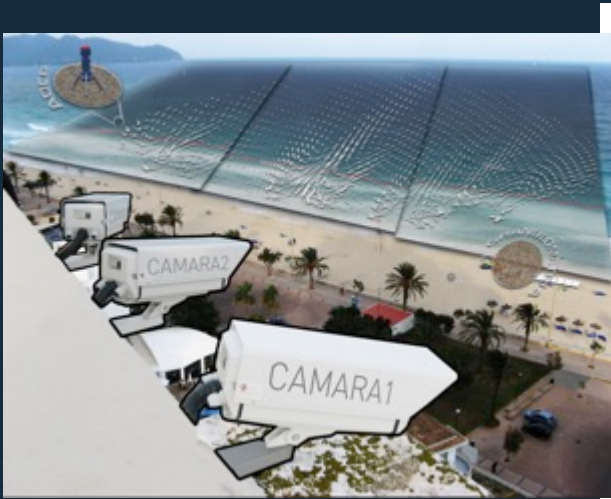


Seaturtles: Animal-Borne Instruments in Operational Ecology for Dynamic Ocean Management

<http://seaturtle.socib.es/en/turtle-viewer/#>



Technology Development & Applications: Beach Safety -Rip Currents-



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

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 19° on Saturday.

Today



Windy in the morning.

Temp	Wind	Humidity	Pressure
17.9 °C	25.0 km/h (SE)	76 %	1022.0 hPa
13.7 °C			

Thursday



Mostly cloudy throughout the day

Temp	Wind	Humidity	Pressure
18.8 °C	6.4 km/h (NW)	82 %	1020.7 hPa
14.1 °C			

Friday



Clear throughout the day

Temp	Wind	Humidity	Pressure
18.8 °C	5.8 km/h (SE)	81 %	1019.6 hPa
14.4 °C			

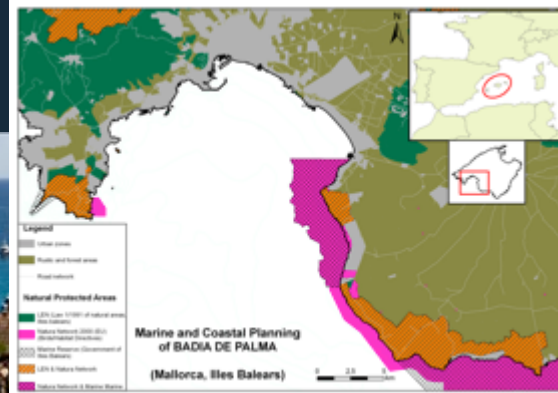
Powered by Forecast.io

Waves forecast



Waves at 21/03/2014 11:00

SOCIB Developments and Applications: Sustainability indicators; Science and Society-Blue Growth



New tools: MSP, ICOM
Social and Economic Council.



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

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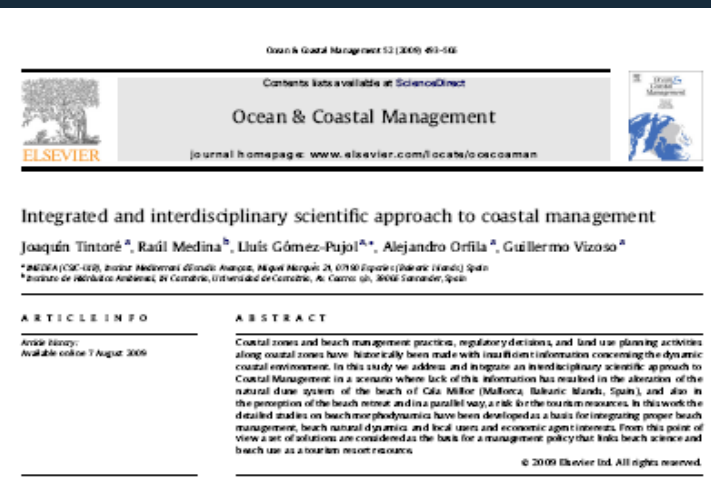
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ABSTRACT

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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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 Innovation and BG: i.e. jobs since 2005...



<http://www.albatrosmt.com>



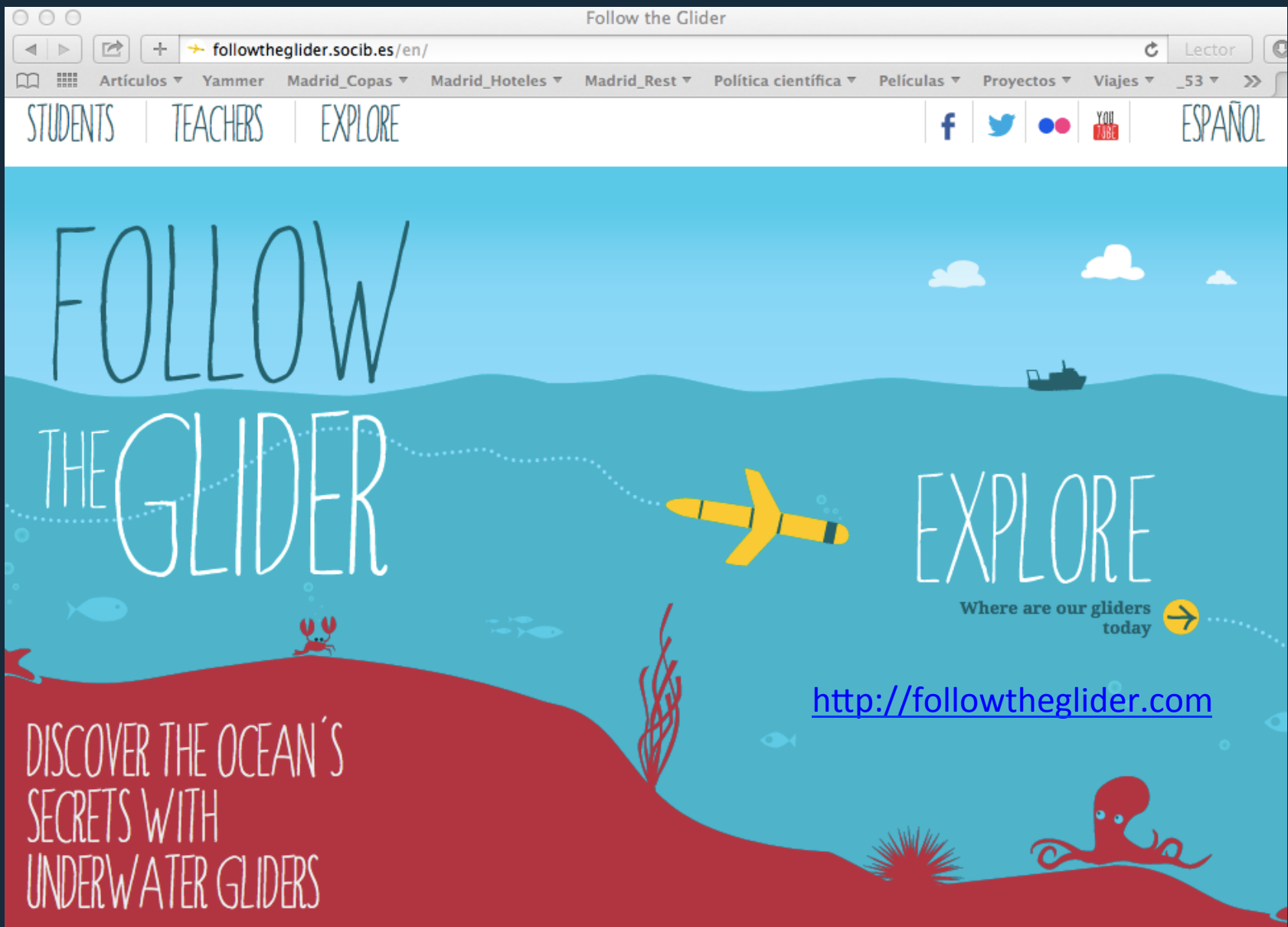
“The Blue Economy is a knowledge based economy looking to the sea, not really for extraction of natural goods but for data to address societal challenges and inspire solutions” (R. Spinrad, EOS, August 1, 2016).

SOCIB Outreach and Education; MEDCLIC



NEW PHASE COMMUNITY ENGAGEMENT; *“We are entering a new phase of community engagement in which scientists and society, educators, are encouraged to use the data, provide feedback on data access ease and quality and in the process, expand our knowledge on the coastal oceans”* — Fulweiler, Gawarkiewicz, Davis, OOI, EOS, August 1st, pag. 9, 2016)


SOCIB Outreach and Education; MEDCLIC



Building EOOS: from Mediterranean 'ocean' perspective

1. Paradigm change Ocean Observation
2. Marine Research Infrastructures -SOCIB ex-: key elements in building EOOS: international leadership in the Mediterranean, & key elements in Blue Growth initiatives (**EU Oceans Innovation COM**) because their:
 - Well focused critical mass
 - Multi-disciplinary approach
 - Integration capabilities of Science, Technology, Society

In other words: ...



EOOS & New observing systems with real time open data are key elements for science based ocean & coastal management (SDG'14) & real innovation initiatives "Turning data into jobs"

Building EOOS. Sound combination Excellent Science with IMPACT ON SOCIETY: SCIENCE with & for SOCIETY

