




United Nations  
Educational, Scientific and  
Cultural Organization



Intergovernmental  
Oceanographic  
Commission



**Paradigm change in ocean studies: gliders as key components of new multi-platform observing and forecasting integrated approach in response to science and society needs**

**Joaquín Tintoré, SOCIB - Spain**

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

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

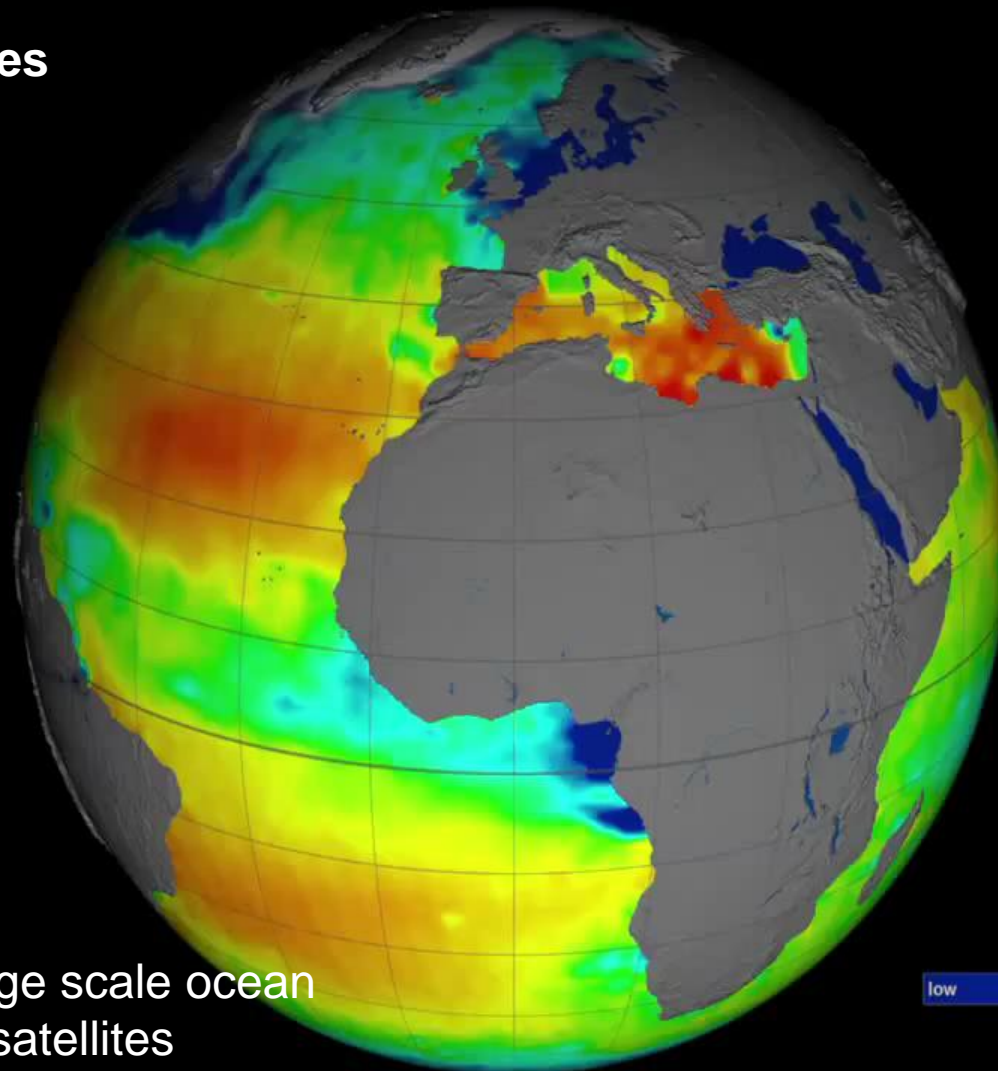
We need:

- 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



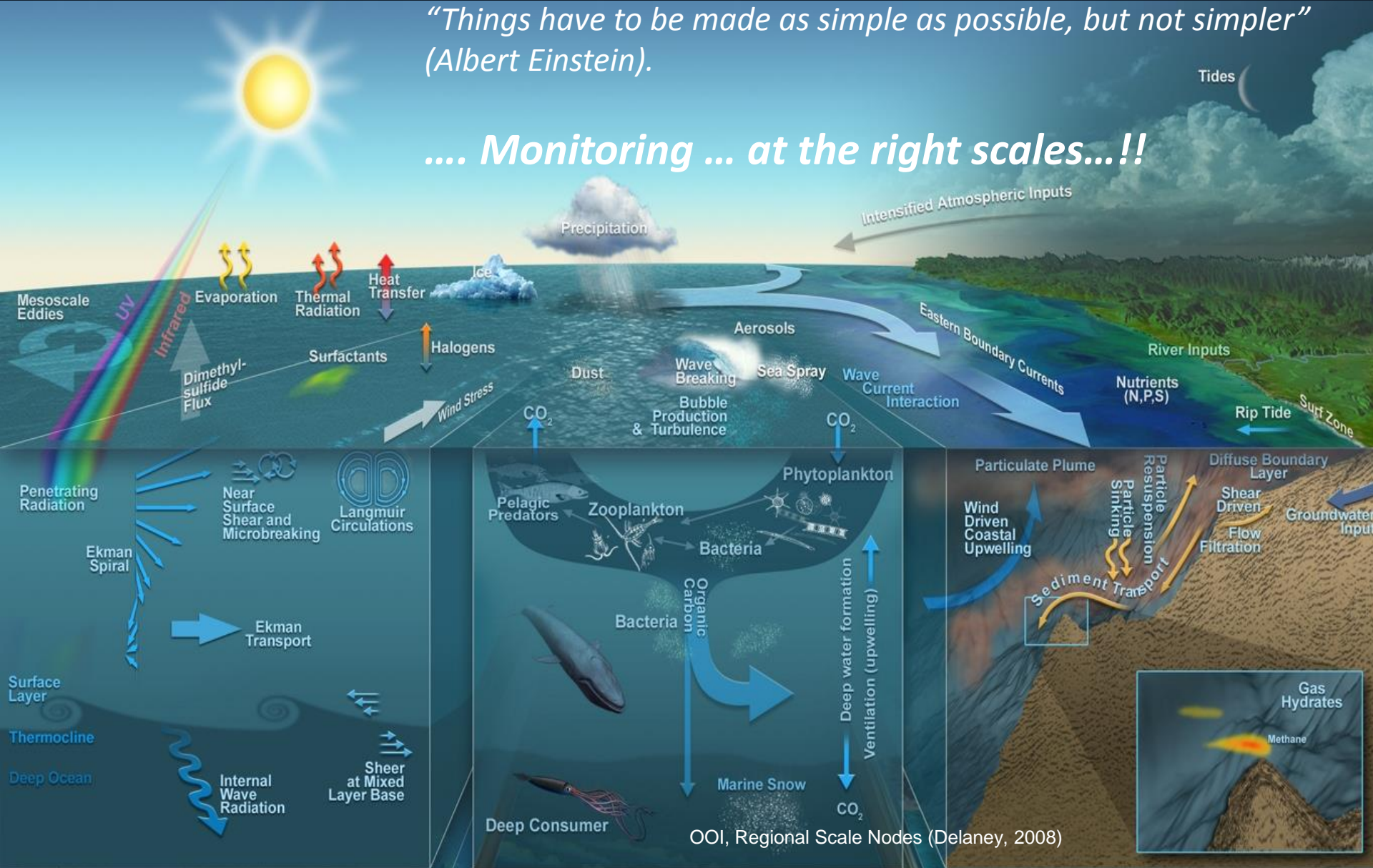
Salinity  
low high



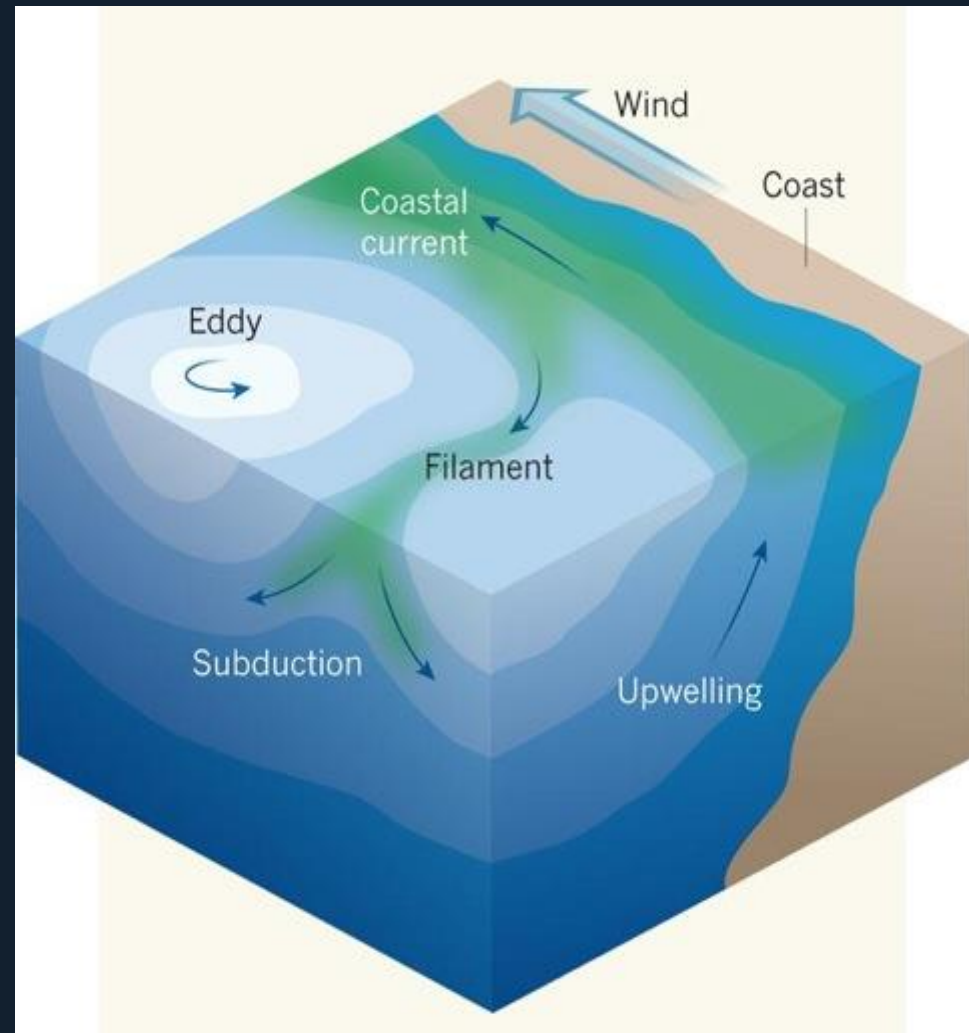
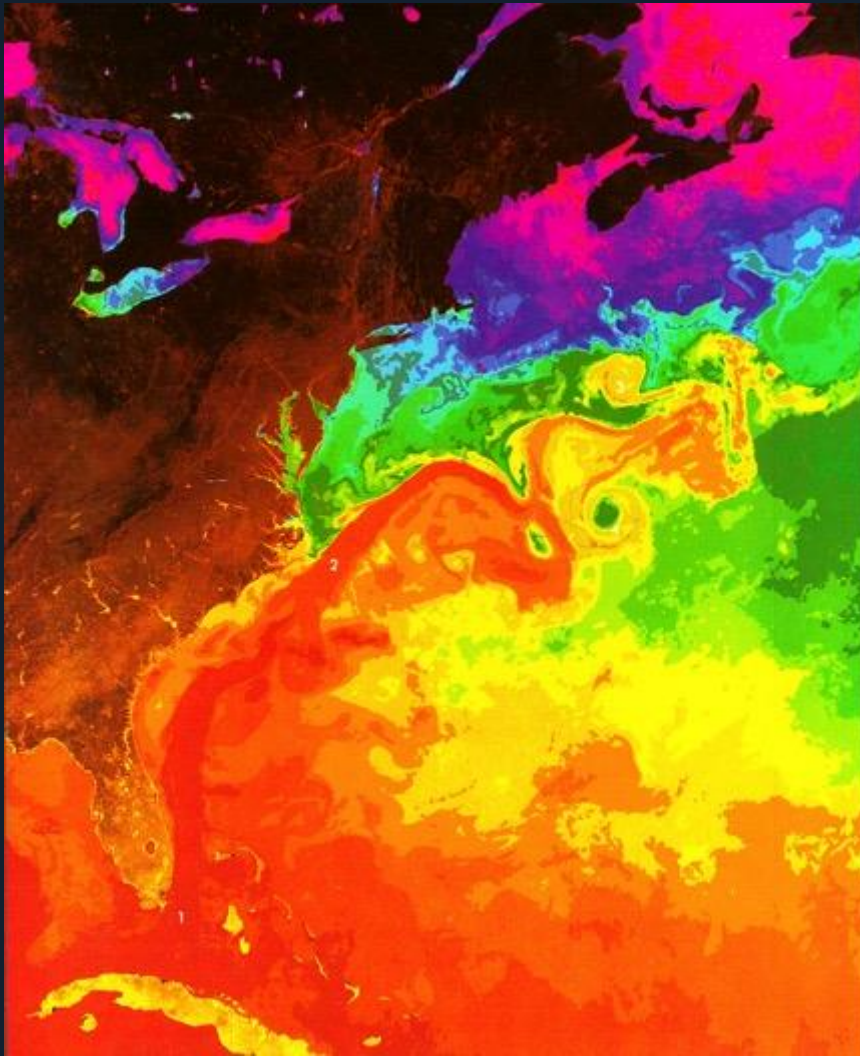
# Oceans and coastal interactions at different scales. Management is needed. No oversimplification.

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

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



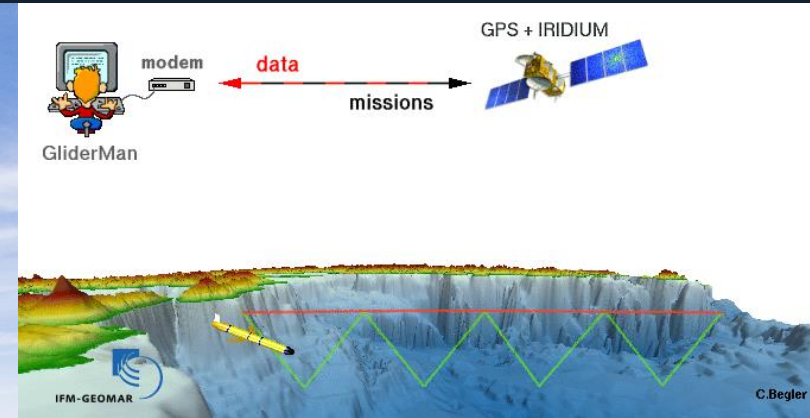
# Eddies and instabilities: the mesoscale (sub-mesoscale) characterize ocean 'weather'



Mahadevan (Nature, 2014)



# New Technologies: drivers of change.... (gliders a clear example)



## SOCIB Glider Facility: 05/2006-06/2015

- 56 missions, days in water 960, 10.850 nm
- 26.885 profiles (30 Euros/profile)
- Bi-monthly routine operation (since 01/2011)

# New Technologies: Paradigm Shift

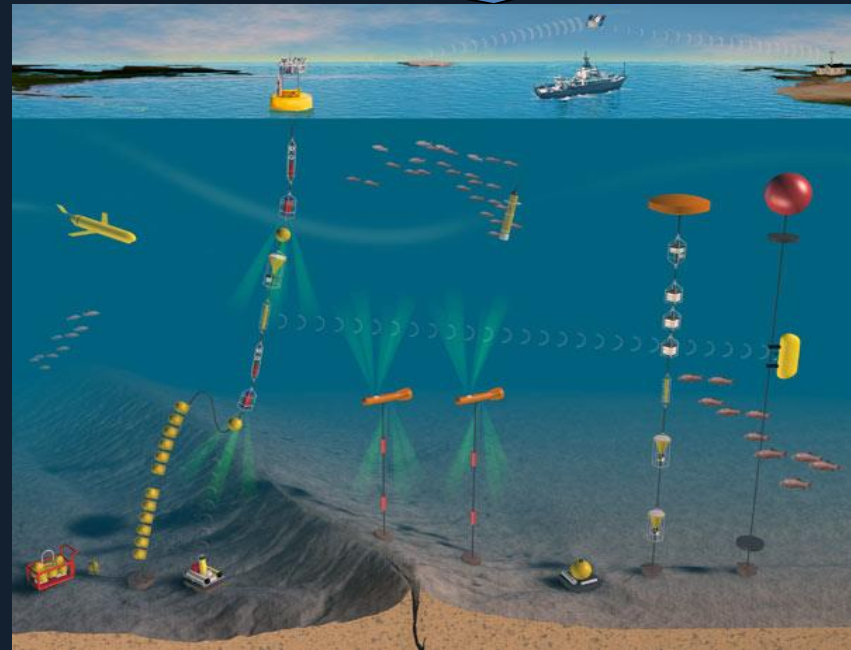
## → Ocean Observation

From: Single Platform - Ship based observation

To: Multi-platform observing systems

Network - distributed  
Systems

Platform-centric  
Systems

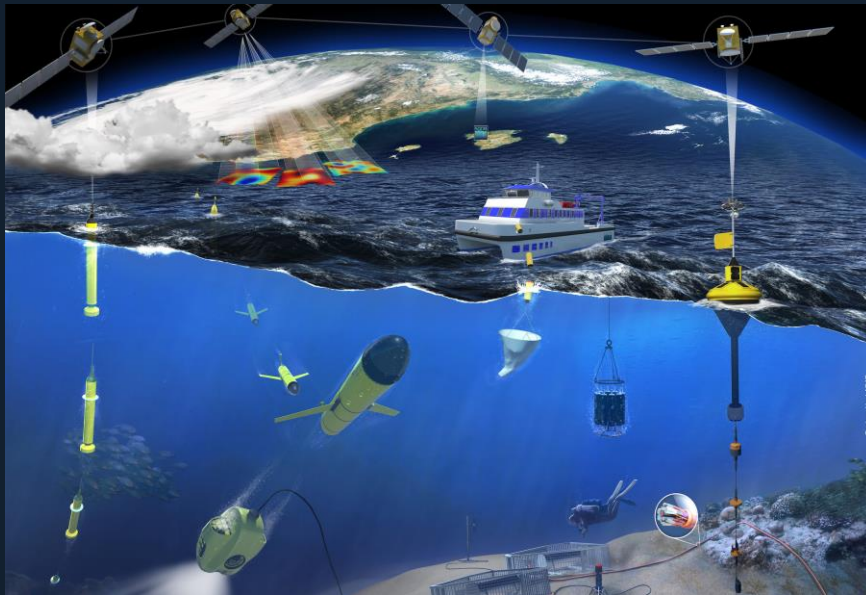


(Adapted from Steve Chien, JPL-NASA)

“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](#))



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



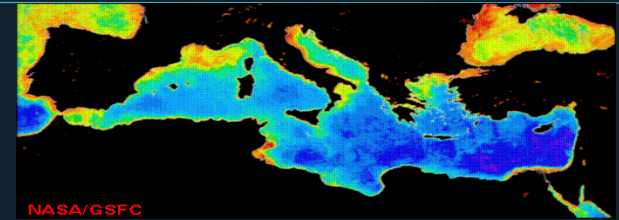
Tintoré et al., 2013: *Marine Tech. Soc. J.*, Vol. 47, N. 1, pp. 101-117

## 3 DRIVERS

- Science priorities
- Technology Development
- Society Needs

## OPEN DATA PRINCIPLES

## INTERNATIONAL FRAMEWORK



[www.socib.es](http://www.socib.es)

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SOCIB Balearic Islands Coastal Observing and Forecasting System

homs about us facilities news multimedia job opportunities competitive access

latest news

25 French entrepreneurs meet SOCIB: science and society [27-05-2014]

SOCIB, invited speaker at GReNSus 2014 [12-05-2014]

SOCIB participates in the EMODnet MedSea Checkpoint Project [08-05-2014]

facilities

COASTAL COASTAL HF GLIDER LAGRANGIAN FIXED STATIONS BEACH OCEAN DATA CENTER

direct links

SACOSTA Environmental Sensitivity of the Coastline

ICTS Map Spanish Large Scale Facilities Map

contractor profile Contractor's contractual activity is made available on the Internet

Wave forecast waves in collaboration with Puertos del Estado and Aur. Portuaria IB

Dapp Our real-time deployment monitoring application

Satellite Satellite observations

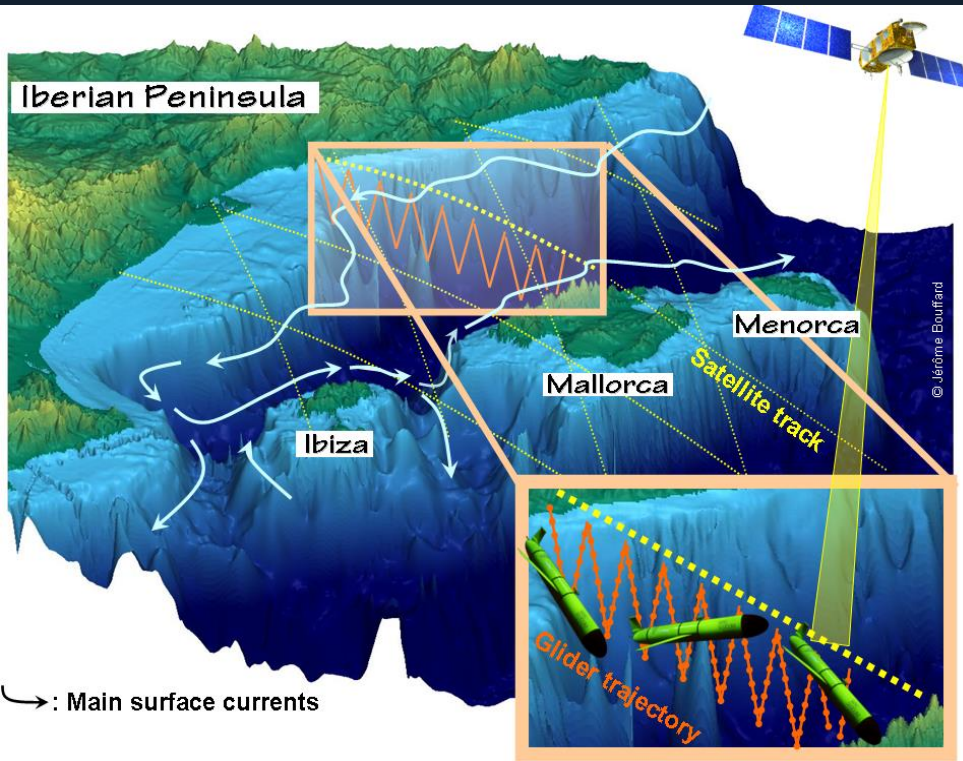
Seaboard Dashboard visualizations of the real time and forecast ocean data cur...

Follow the glider Educational web developed by CEFAS, IMEDEA (CSIC-UIB) and

LW4NC2 Web application to visualize NetCDF data interactively

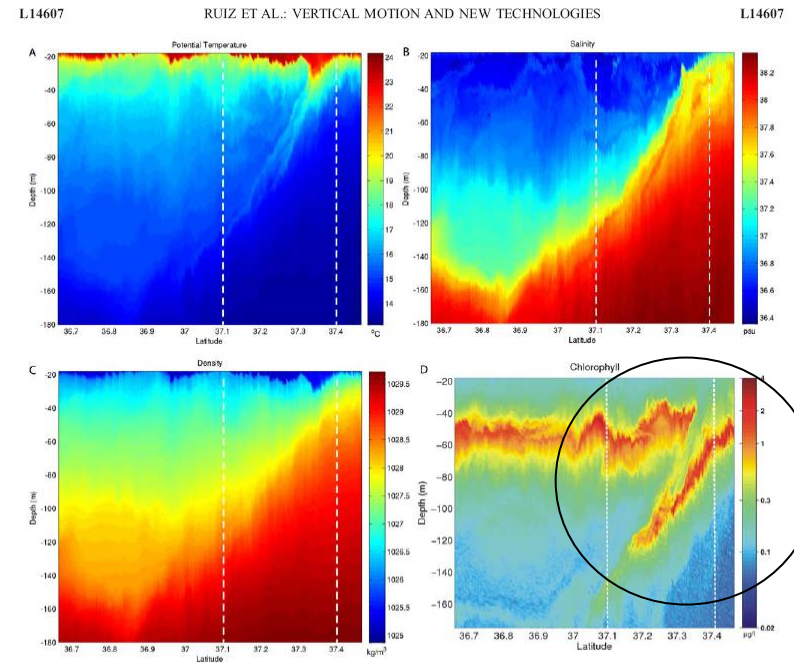
# Gliders key components of new ocean observing systems for science and society

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

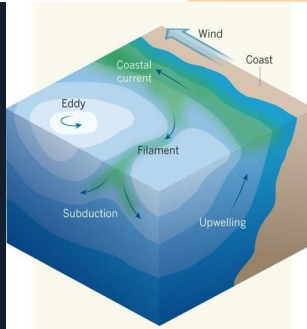


## Mesoscale – Submesoscale / Vertical motions - biogeo effects

EOPHYSICAL RESEARCH LETTERS, VOL. 36, L14607, doi:10.1029/2009GL038569, 2009  
 Vertical motion in the upper ocean from glider and altimetry data  
 Ramón Ruiz,<sup>1</sup> Ananda Pascual,<sup>1</sup> Bartolomé Garau,<sup>1</sup> Isabelle Pujol,<sup>2</sup> and Joaquín Tintoré<sup>1</sup>



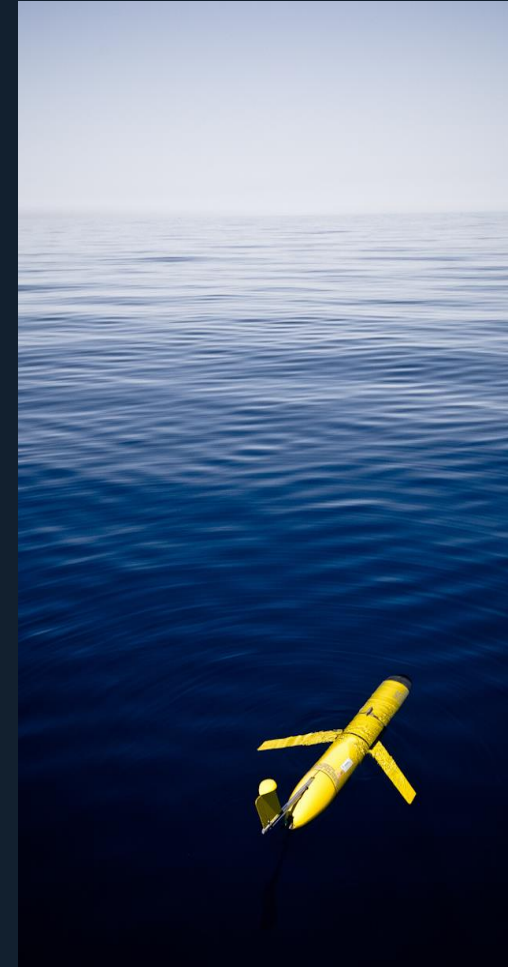
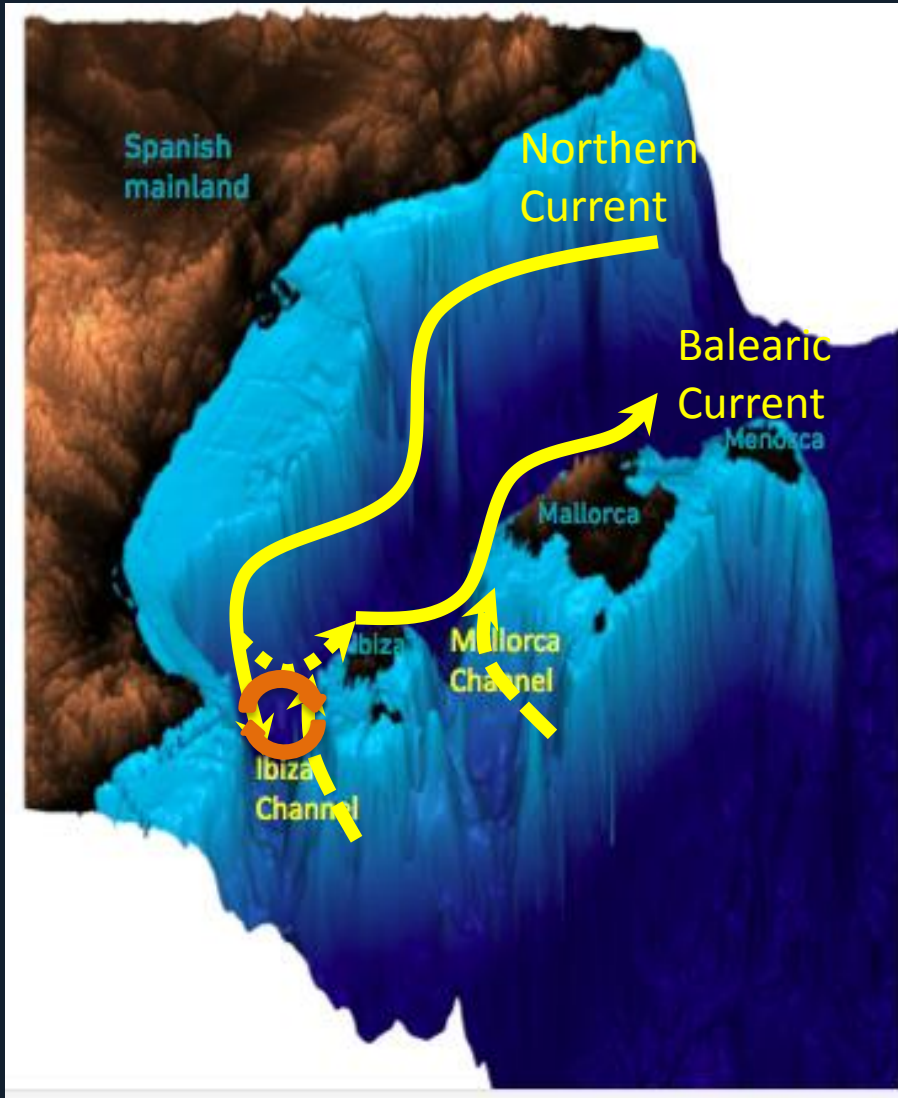
**Figure 2.** Vertical section of temperature (°C), salinity (PSU), density (kg/m<sup>3</sup>) and chlorophyll (µg/l) from glider section 2 (dashed magenta in Figure 1). White dashed lines define sub-section in the northern part of the domain.





# Gliders allow definition control sections or choke points for Science & Society: Ibiza Channel

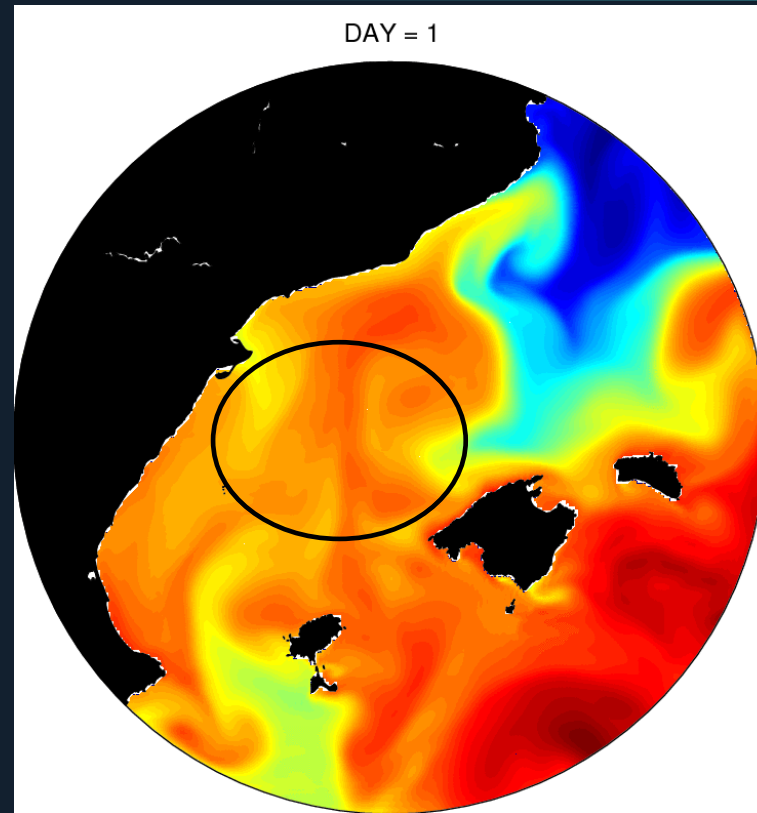
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>> a quiet revolution

# SOCIB Societal Applications: Glider Facility & Ocean Forecasting, e.g., Search and Rescue.

SST from 11/2008



Collaboration:  
Search and Rescue  
801 Squadron  
and local authorities

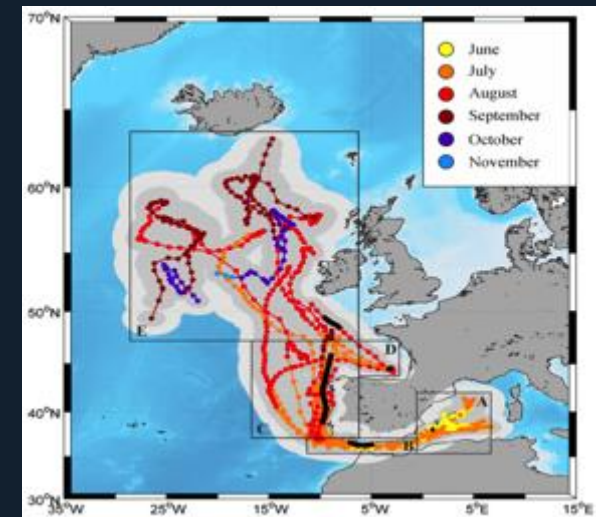




# SOCIB Societal Applications: Bluefin Tuna spawning habitat in the Mediterranean



Migration patterns along the year  
(Eastern Stock)



Aranda et al, PONE 2013



# SOCIB Education

Follow the Glider

followtheglider.socib.es/en/

Artículos ▾ Yammer Madrid\_Copas ▾ Madrid\_Hoteles ▾ Madrid\_Rest ▾ Política científica ▾ Películas ▾ Proyectos ▾ Viajes ▾ \_53 ▾ >>

STUDENTS | TEACHERS | EXPLORE

f | | | YOUTUBE

ESPAÑOL

# FOLLOW THE GLIDER

# EXPLORE

Where are our gliders today →

<http://followtheglider.com>

DISCOVER THE OCEAN'S SECRETS WITH UNDERWATER GLIDERS

The graphic features a yellow glider flying through a blue ocean. The seabed is red and includes illustrations of a crab, coral, an octopus, and various fish. A dotted line tracks the glider's path from the left side of the page towards the right.



# Summary: why Ocean Observatories, why gliders, 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, ...**

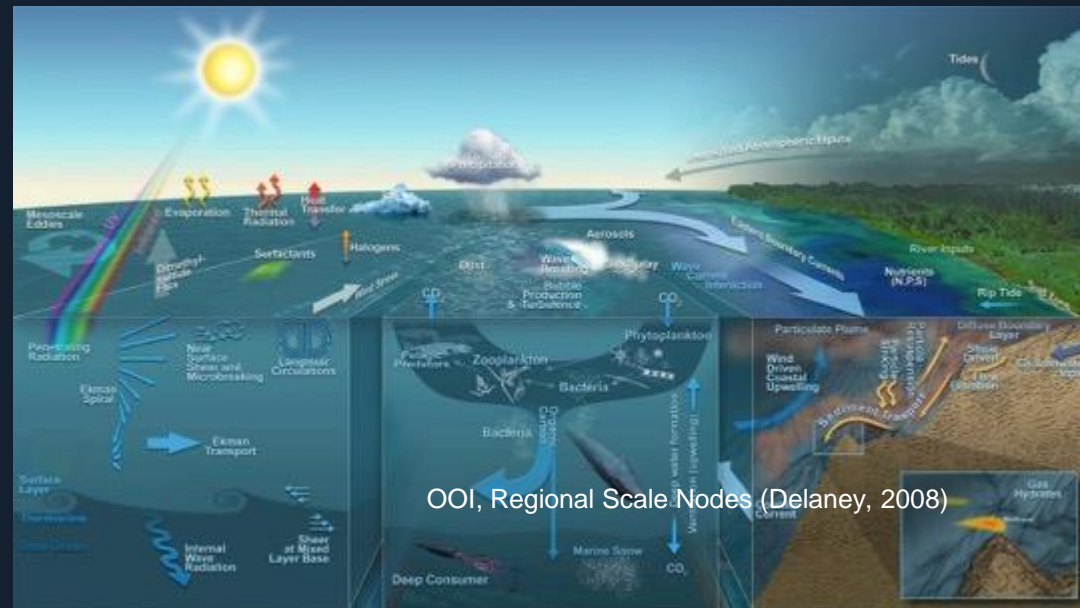


**A quantitative major jump, in scientific knowledge and technology development**



**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

# Gliders, .... a quiet revolution...

Thank you

“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)