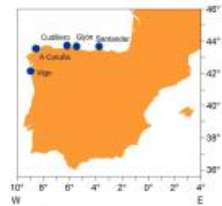
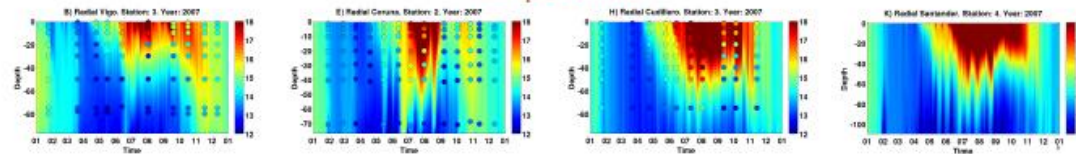


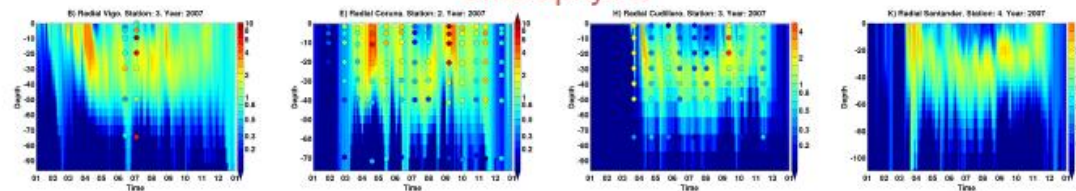
The IEO coastal observatory: understanding variability of coastal circulation and ecosystem response off North and North West Iberia



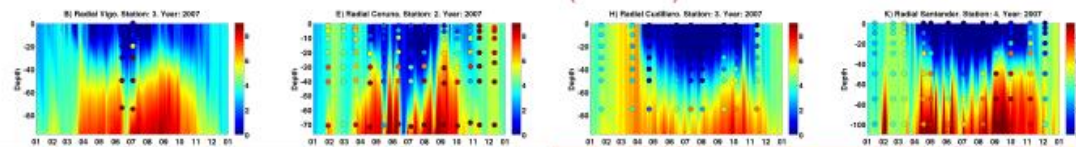
Temperature



Chlorophyll-a



Nutrients (Nitrate)



Manuel Ruiz Villarreal, Luz García, Marcos Cobas
Instituto Español de Oceanografía, A Coruña Oceanographic Center
manuel.ruiz@co.ieo.es



INSTITUTO ESPAÑOL DE OCEANOGRAFÍA



IEO tasks and duties

- To carry out **scientific research** in the fields of oceanography and sea sciences.
- To **advise the government** in terms of fishing and marine policies.
- To **represent Spain** in international organizations that have to do with fisheries and marine sciences (like ICES)
- To **promote cooperation** in terms of marine research among regional, national and international organizations.
- To **train marine researchers** and disseminate oceanographic knowledge.

RADIALES (1989- ...)

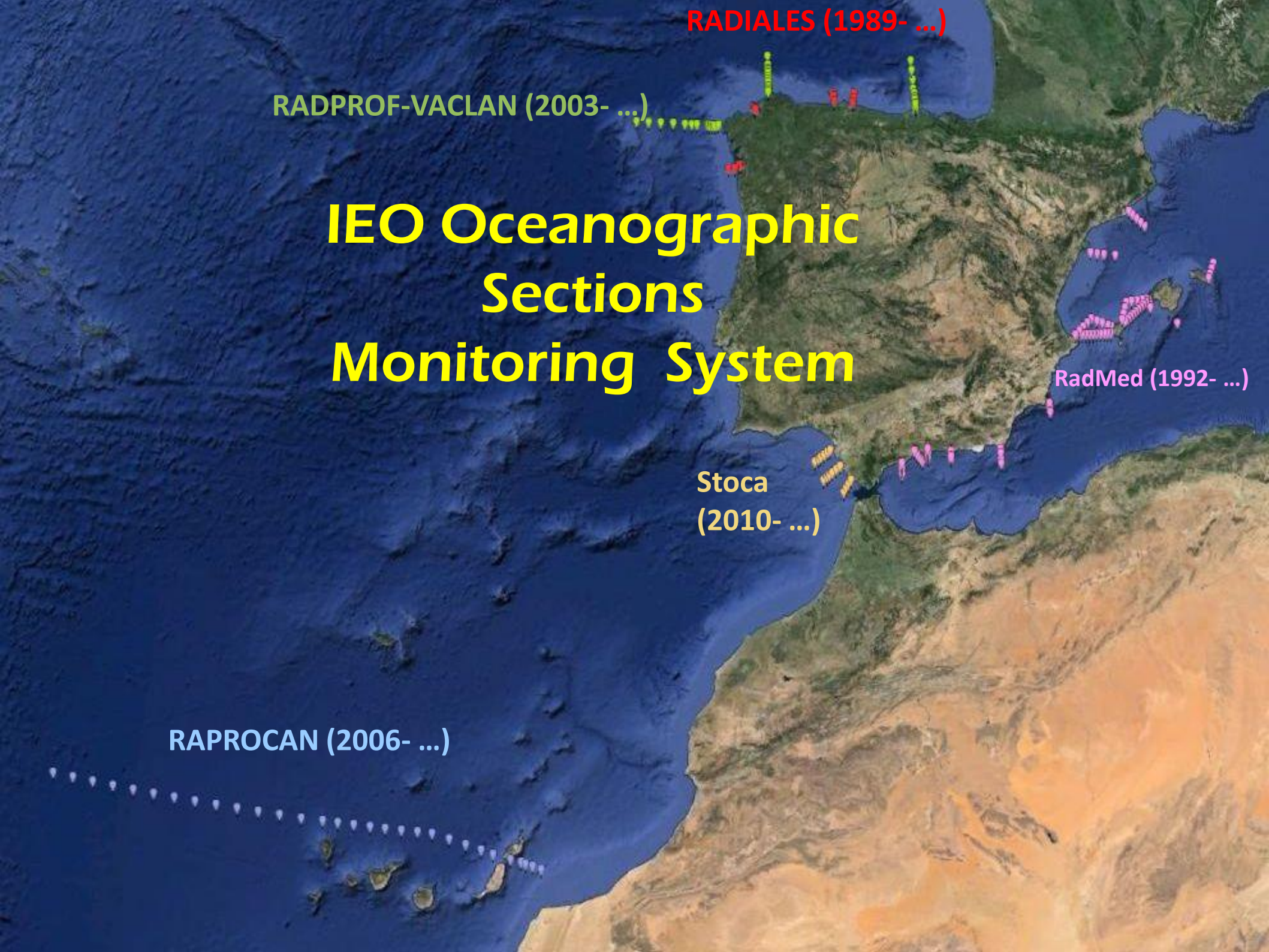
RADPROF-VACLAN (2003- ...)

IEO Oceanographic Sections Monitoring System

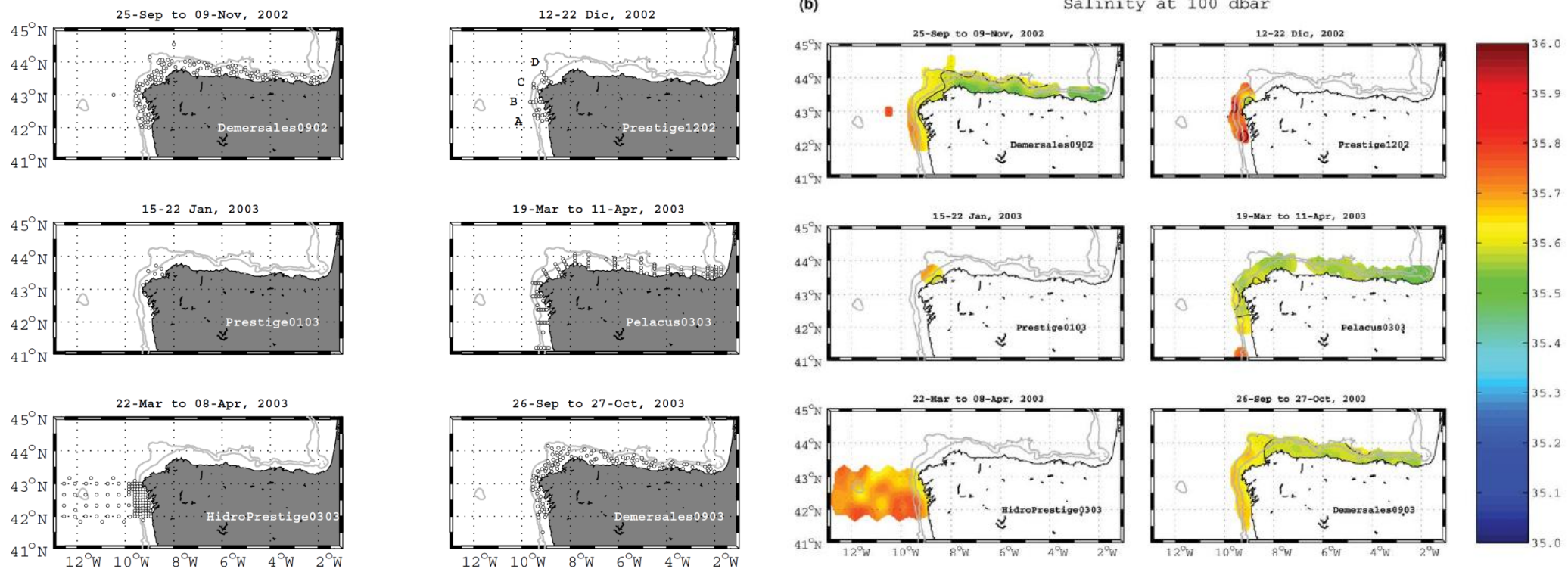
RadMed (1992- ...)

Stoca
(2010- ...)

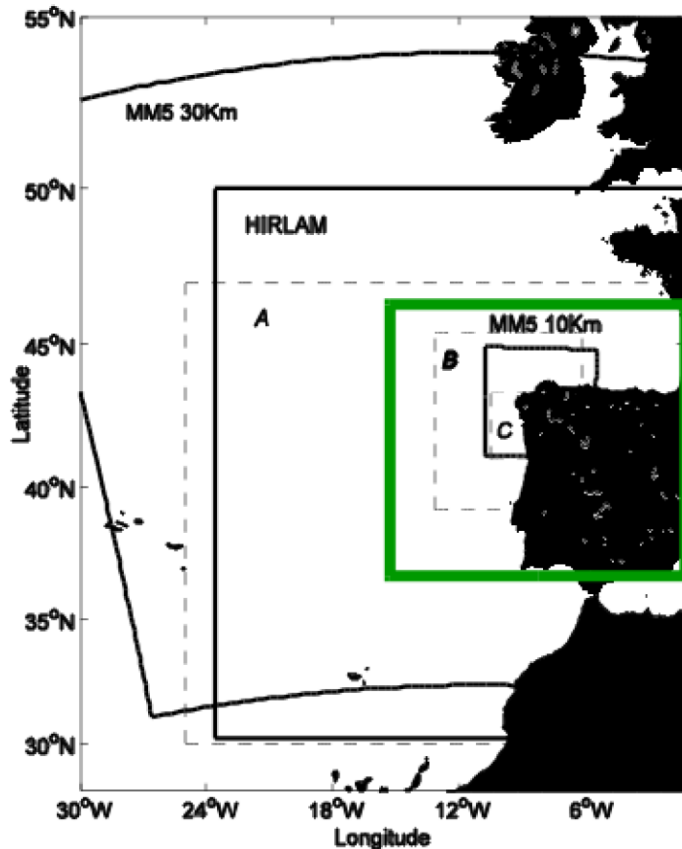
RAPROCAN (2006- ...)



Characterization of oceanographic conditions with monitoring cruises



OB: MERCATOR PSY2V2



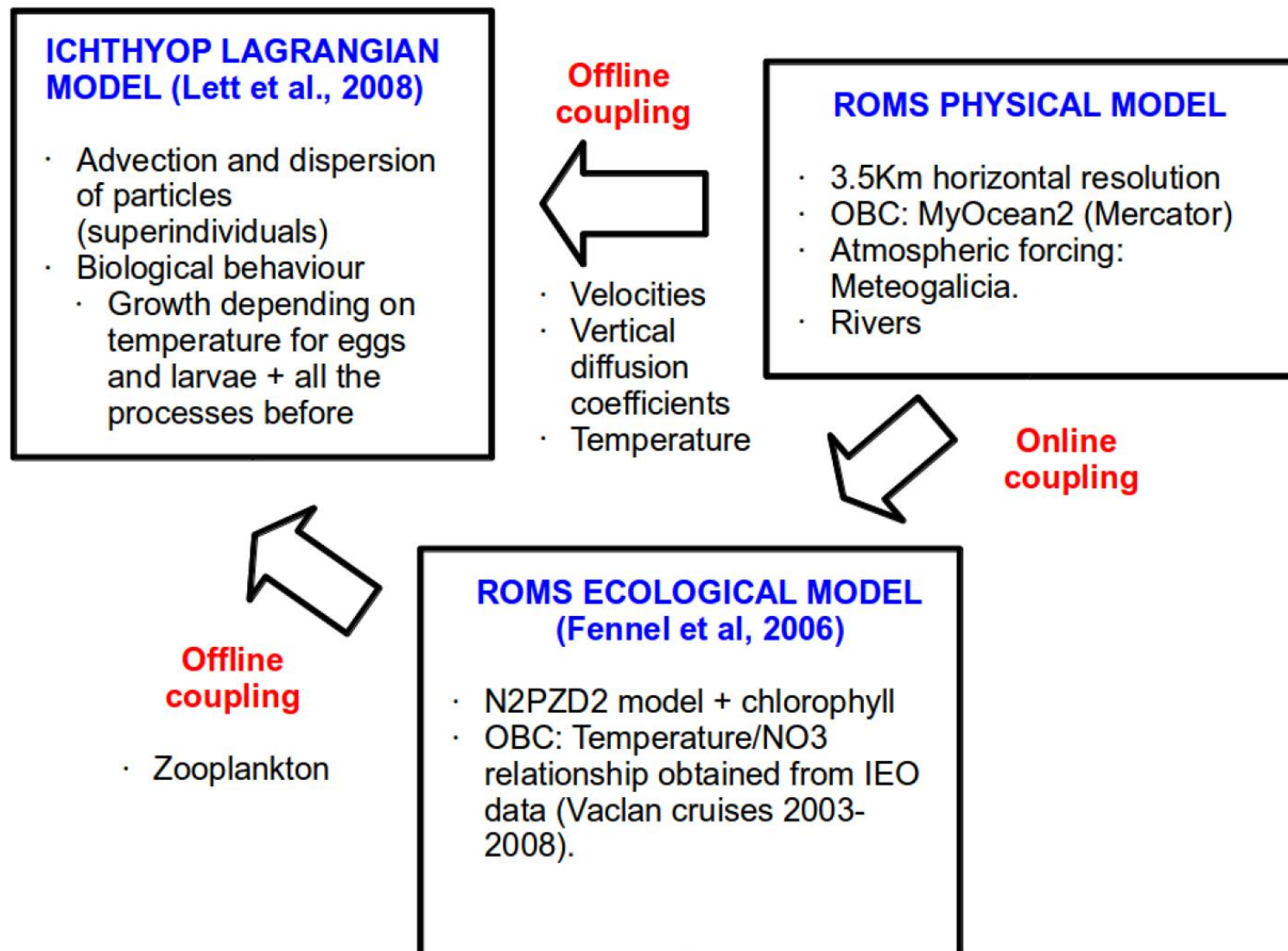
Hydrodynamics+Biogeochemistry

- ROMS Rutgers version 3.5
- 30 vertical levels
- 3.5km horizontal resolution.
- Rivers
- Simulated period: 2005-**2006-2007** and 2012-2013

Only hydrodynamics

- Operational model
 - Roms Agrif
 - One way nesting
 - Simulated period: from 2009 till January 2014
- New operational model
 - Roms Rutgers 3.7
 - ~~One way nesting~~
 - Simulated period: from January 2014-now

Modeling approach



The LTL model

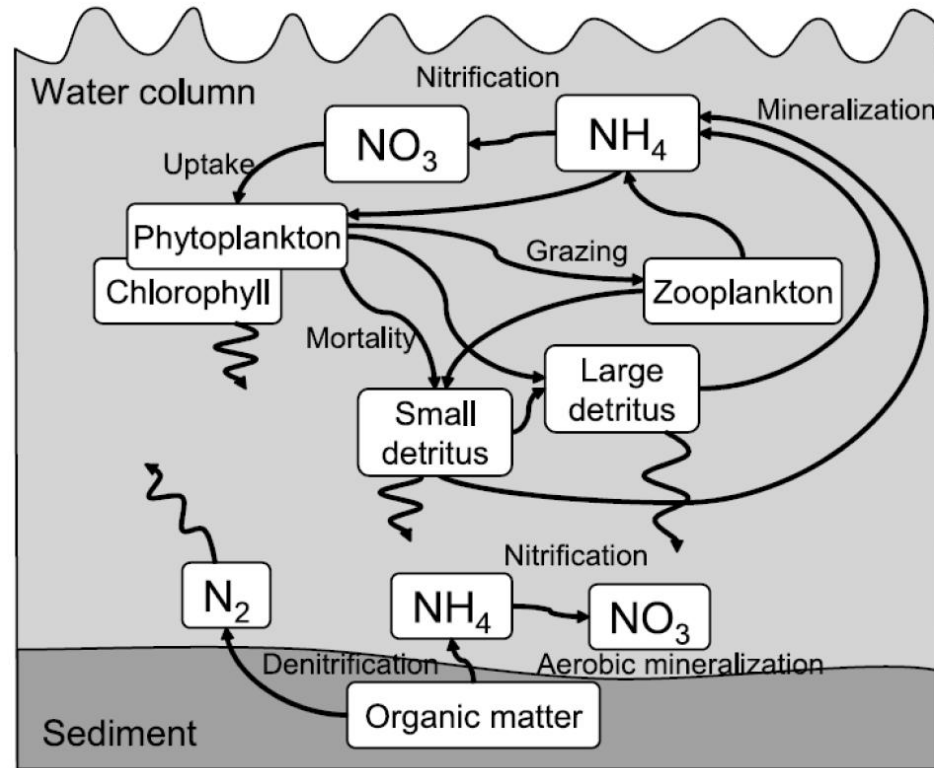


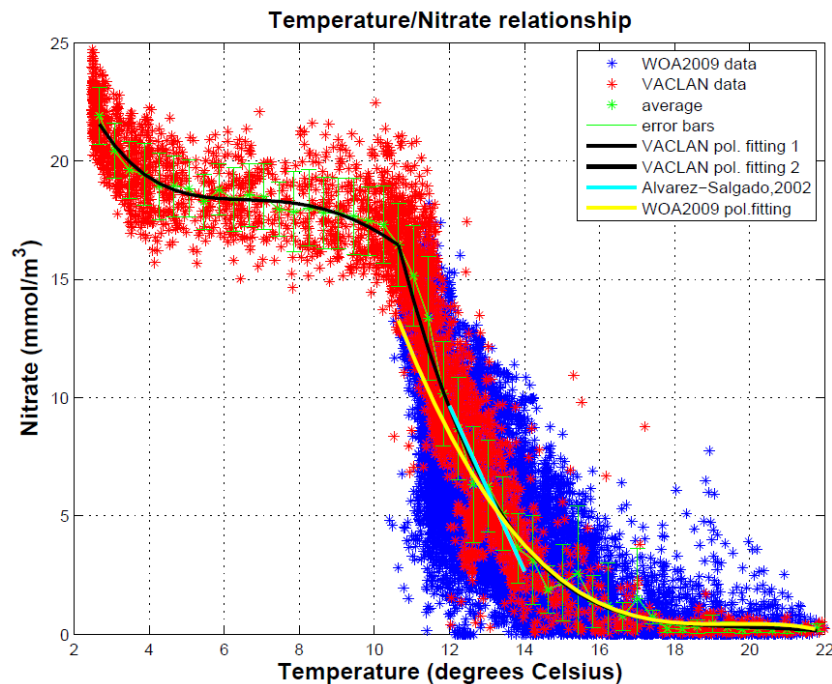
Figure 1. Biological model schematic.



Fennel, K. et al. (2006): Nitrogen cycling in the Middle Atlantic Bight: Results from a three-dimensional model and implications for the North Atlantic nitrogen budget. *Global Biogeochemical Cycles*, 20

Nitrate: the limiting nutrient in the area

- ~~CLIMATOLOGY: NODC World Ocean database 2009 (WOA2009)~~
- **T/NO₃ relationships. We want to include nutrient variability through the boundaries!!!**



NW Iberia upwelling system

- Reliable characterization of the Eastern North Atlantic Central Water (ENACW).



Álvarez-Salgado et al., 2002

- IEO-VACLAN data
- WOA2009 data

Role of convective winter mixing on nutrient availability.



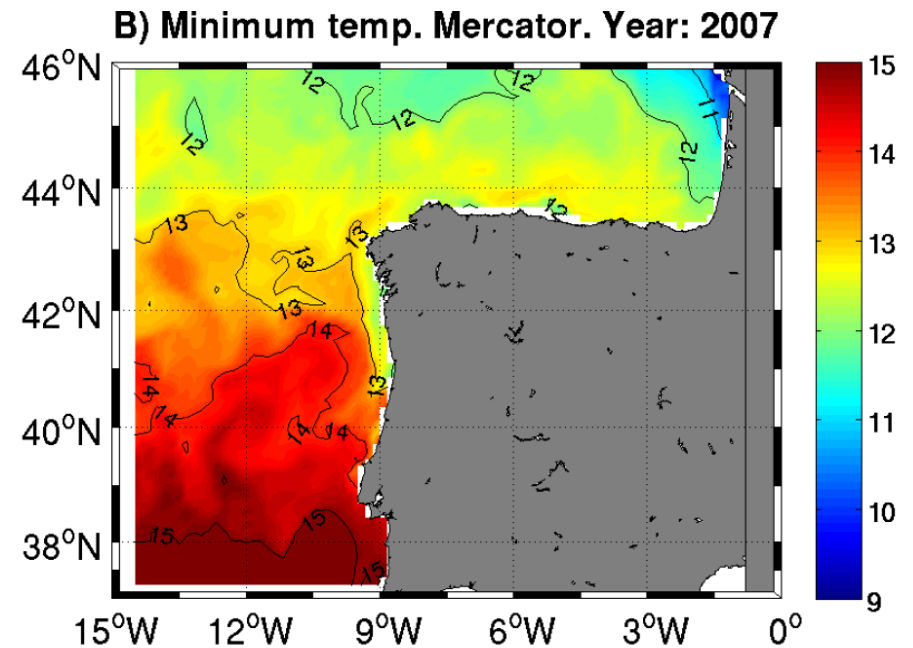
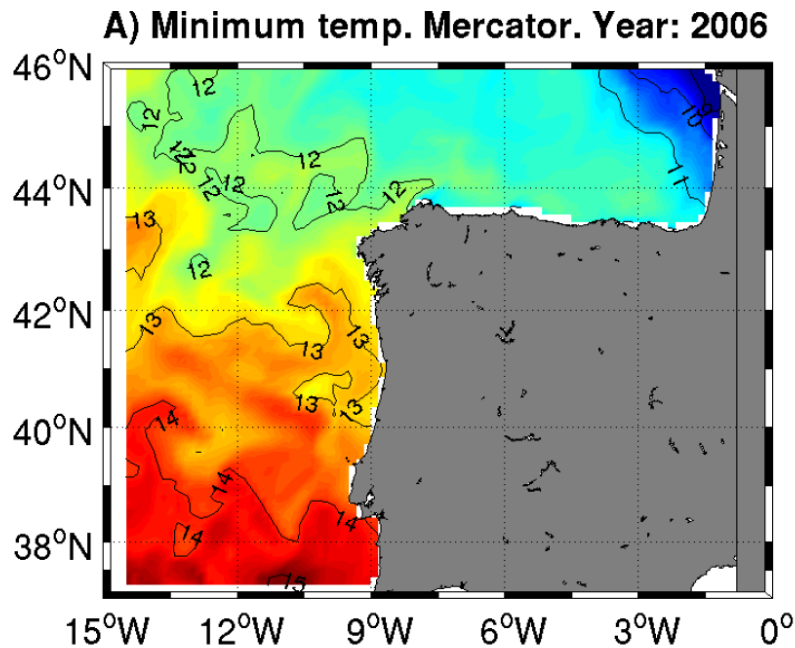
Hartman et al., 2010



Hartman et al., 2012

Inter annual variation in mixed layer depth (MLD) and Productivity (NCP) assessed using oxygen data

Year	MLD ARGO 0.5°C (m)	NCP _{mlD(DO)} (Mol C m ⁻²)
2005/2006	469	20.91
2006/2007	212	10.07
2007/2008	285	10.53
2008/2009	439	19.91
2009/2010	476	16.91



Role of convective winter mixing on nutrient supply.



Hartman et al., 2010

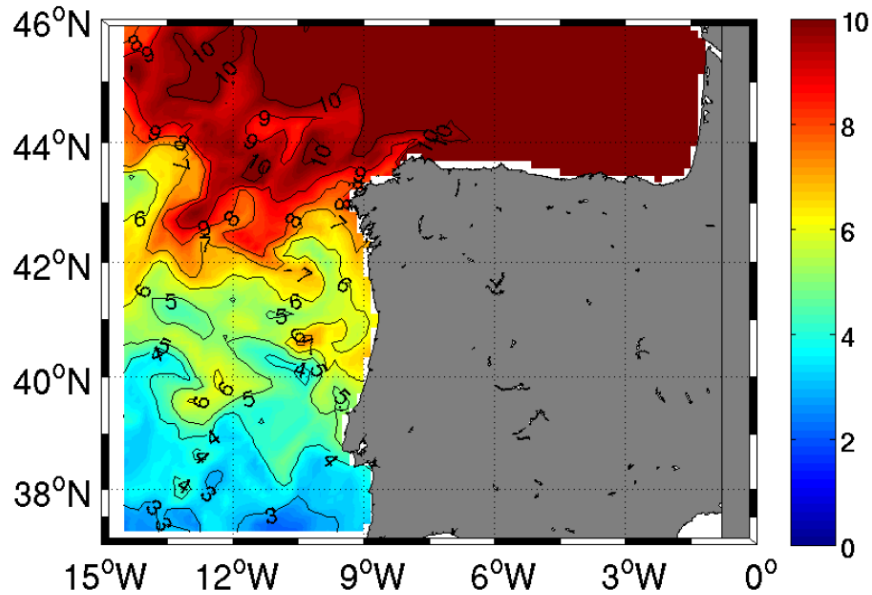


Hartman et al., 2012

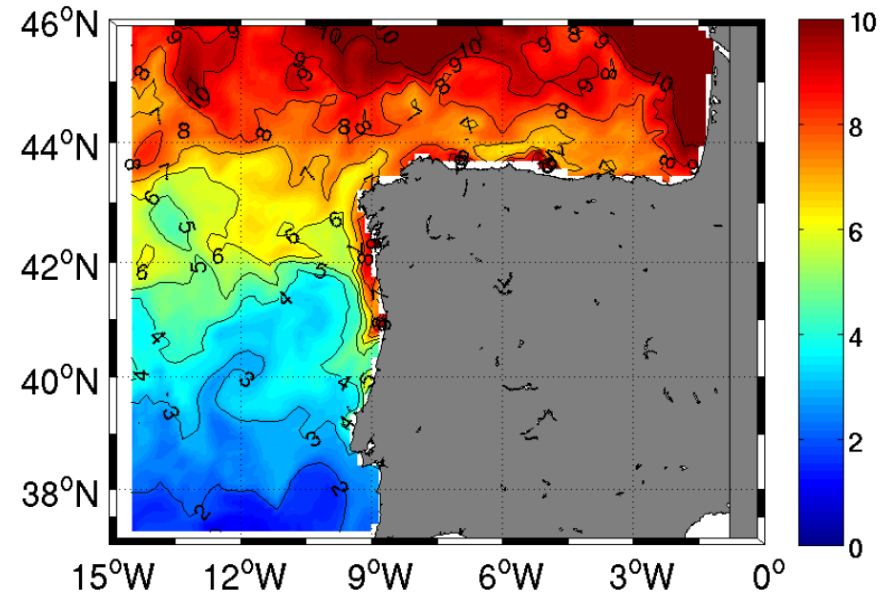
Inter annual variation in mixed layer depth (MLD) and Productivity (NCP) assessed using oxygen data

Year	MLD ARGO 0.5°C (m)	NCP _{mid(DO)} (Mol C m ⁻²)
2005/2006	469	20.91
2006/2007	212	10.07
2007/2008	263	10.53
2008/2009	439	19.91
2009/2010	476	16.91

C) Maximum NO₃ from Mercator temp. Year: 2006



D) Maximum NO₃ from Mercator temp. Year: 2007



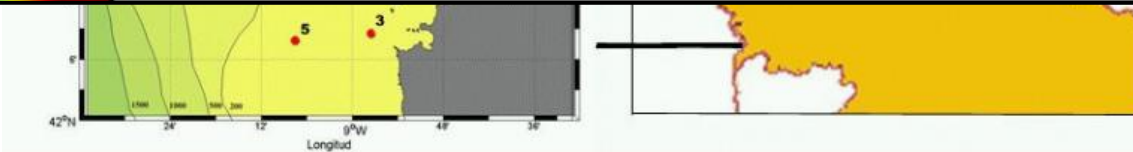
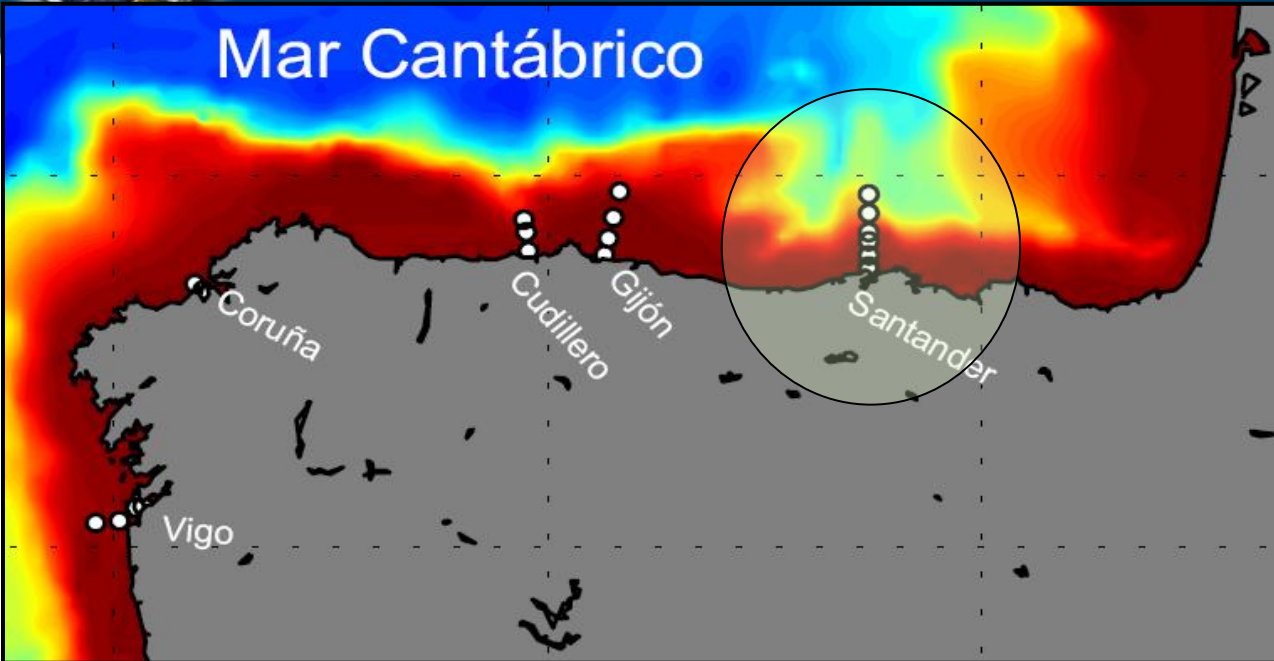
The Radiales Program

Scientific origin, late 80`s

Systematic sampling (hydrographical and biological) in 5 standard sections in Spanish N and NW Atlantic Waters

Monthly sampling in the Galician-Cantabrian area.

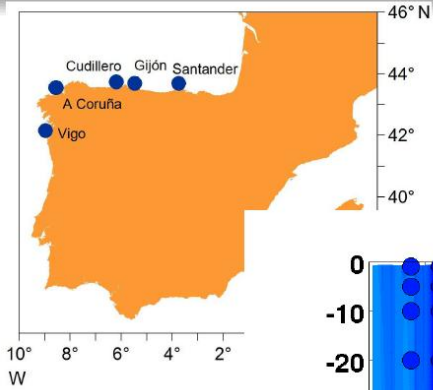
Mar Cantábrico



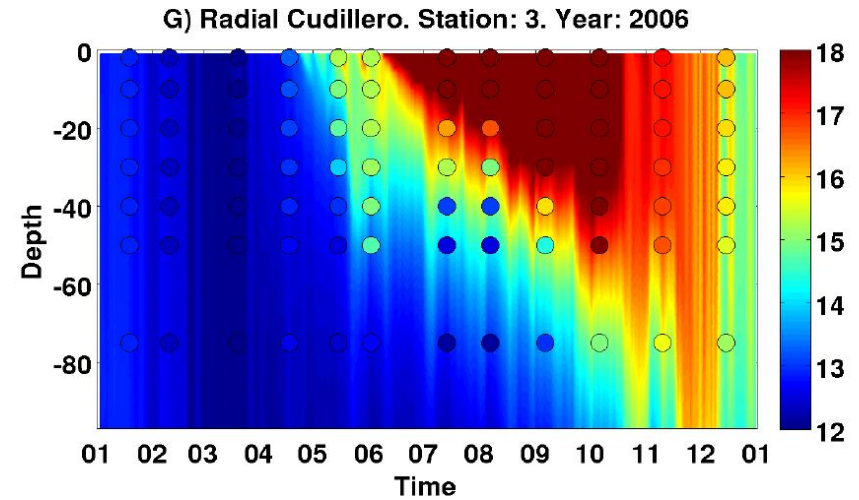
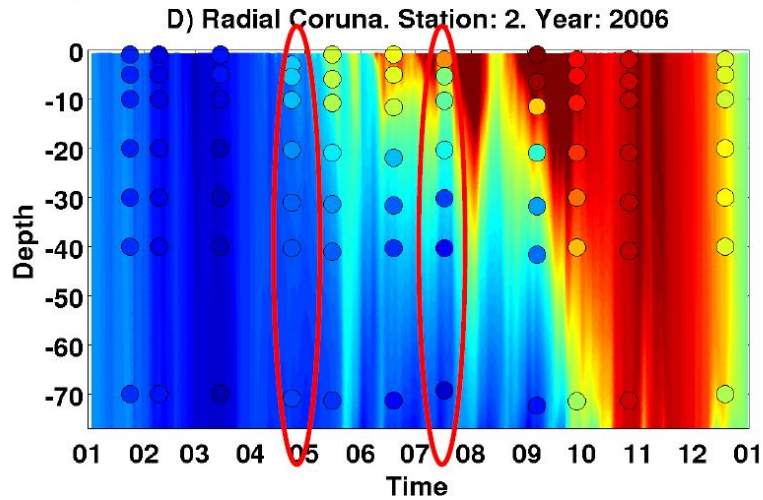
Santander Section. 7 stations, 1 in the shelf break, two over the deep ocean (2400 and 2800)

<http://www.seriestemporales-ieo.net/>

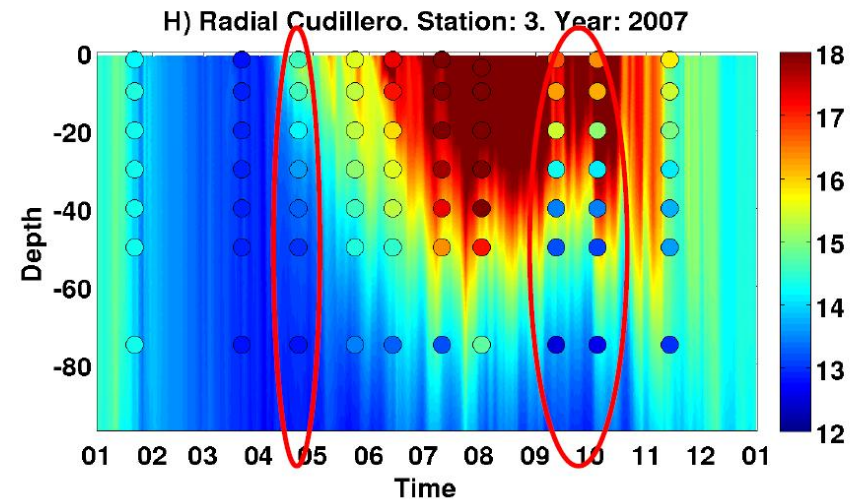
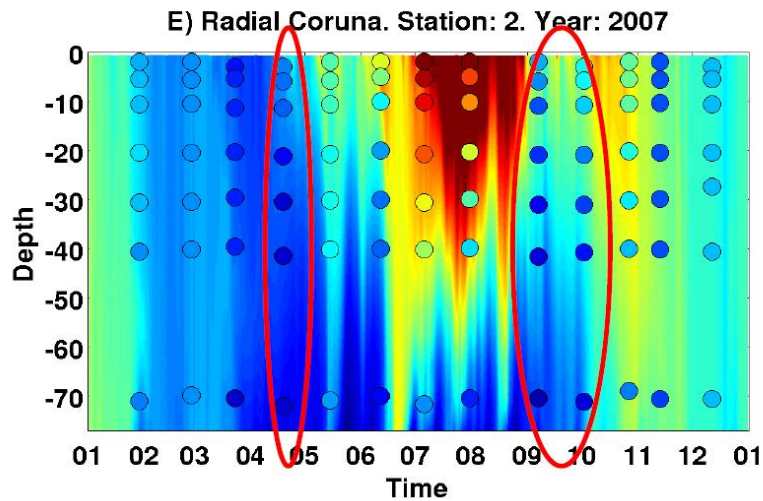
Temperature: Radiales (IEO) vs. model



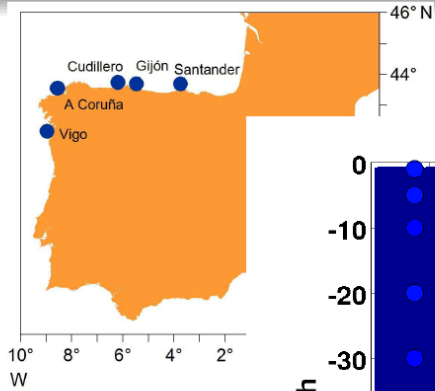
2006



2007

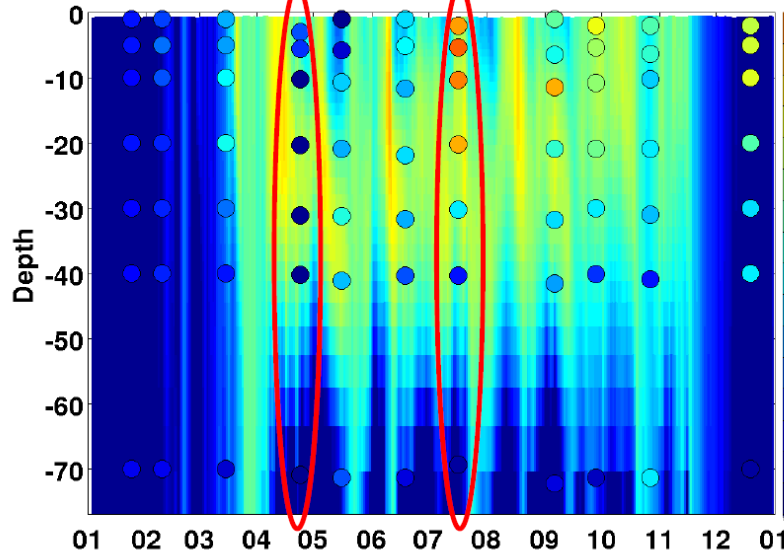


Chlorophyll: Radiales (IEO) vs. model

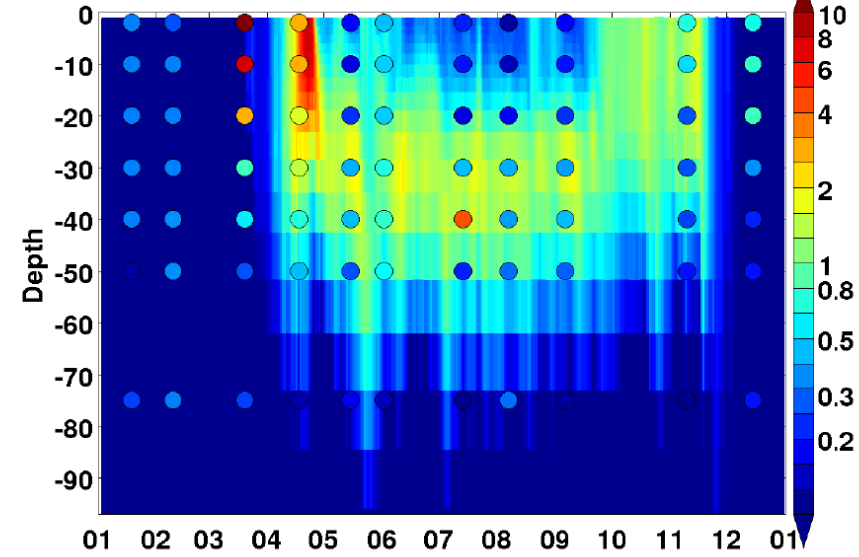


2006

D) Radial Coruna. Station: 2. Year: 2006

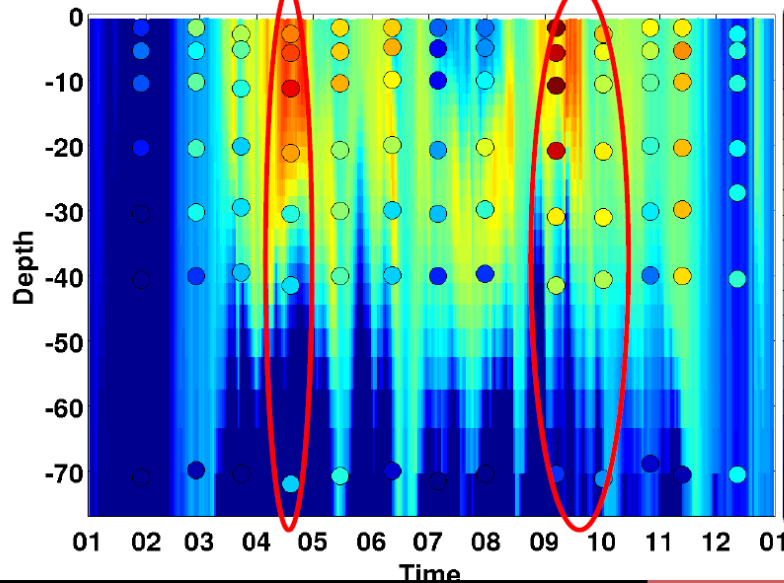


G) Radial Cudillero. Station: 3. Year: 2006

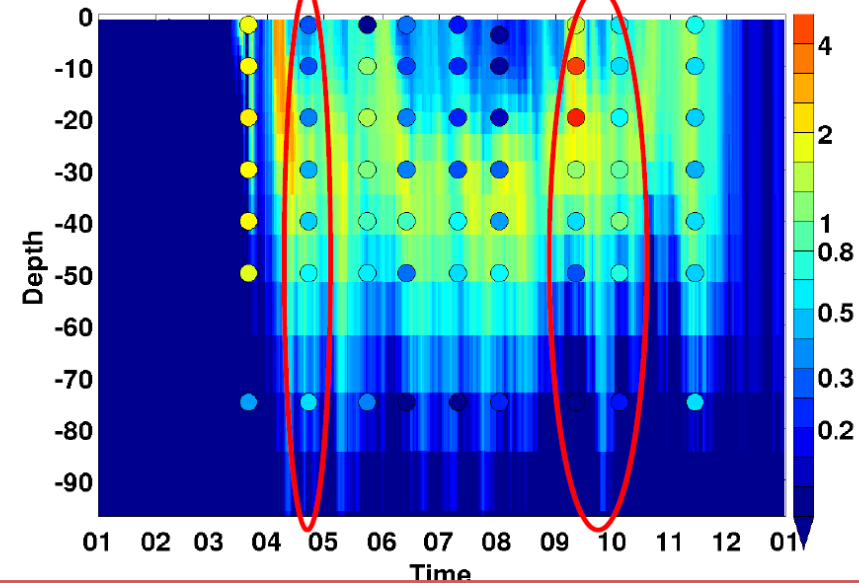


2007

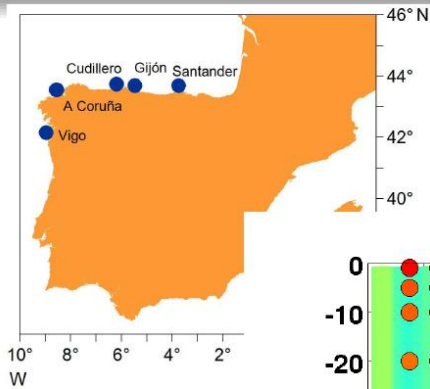
E) Radial Coruna. Station: 2. Year: 2007



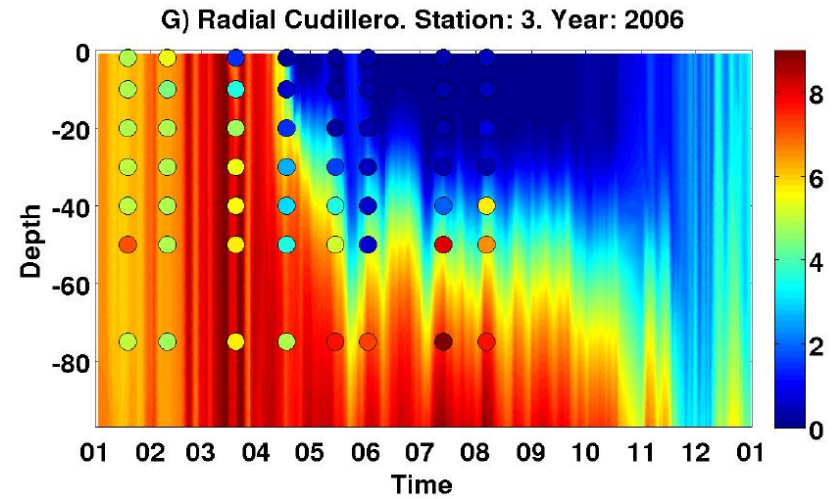
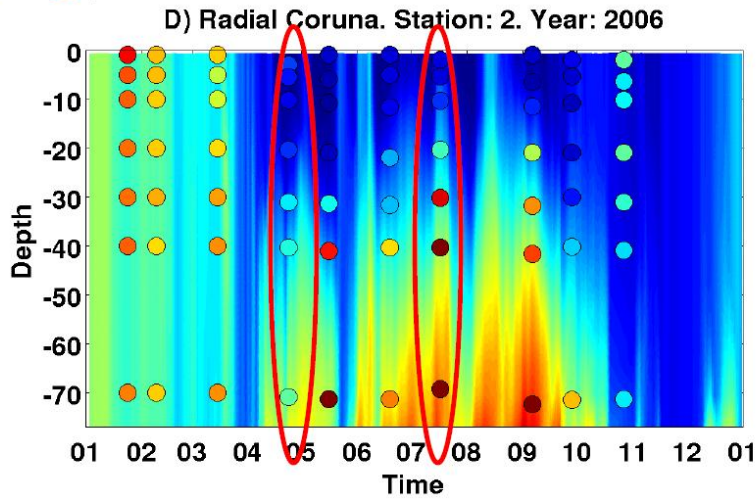
H) Radial Cudillero. Station: 3. Year: 2007



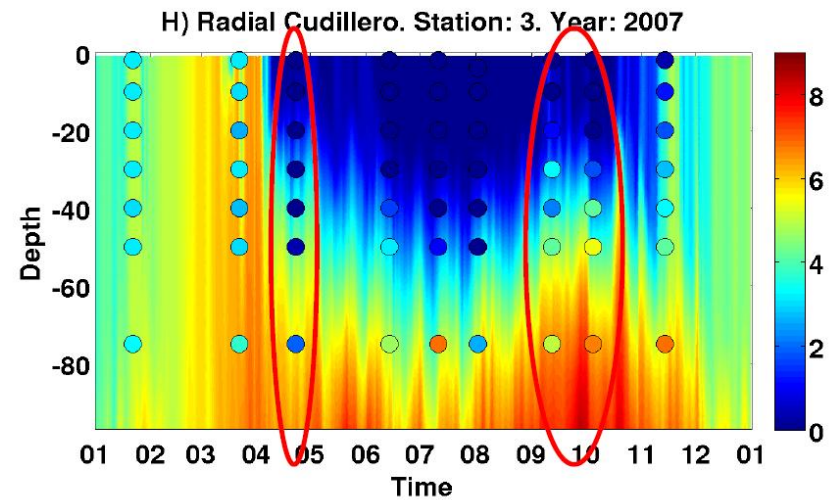
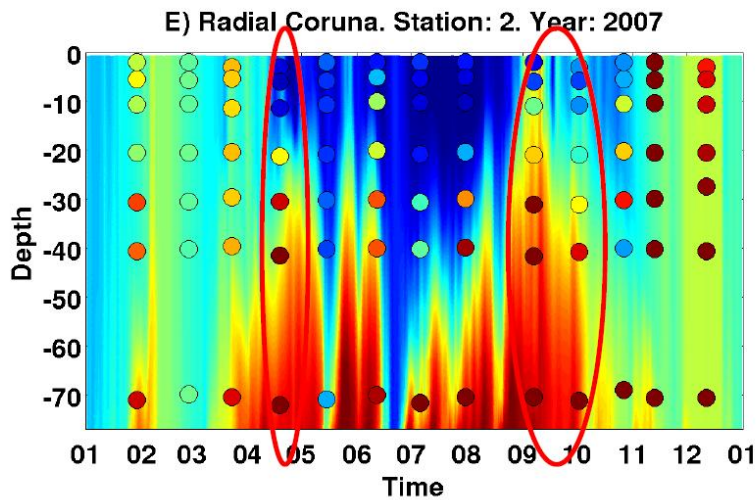
Nitrate: Radiales (IEO) vs. model



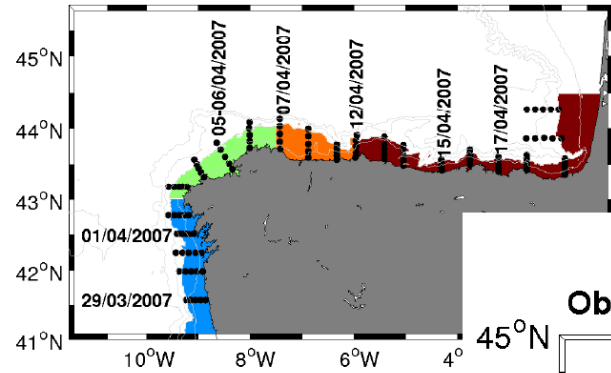
2006



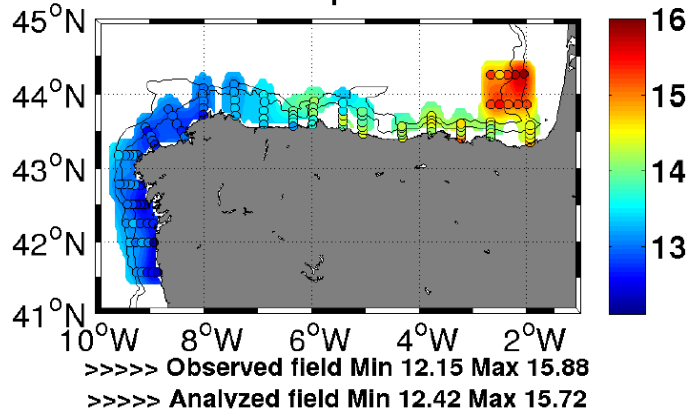
2007



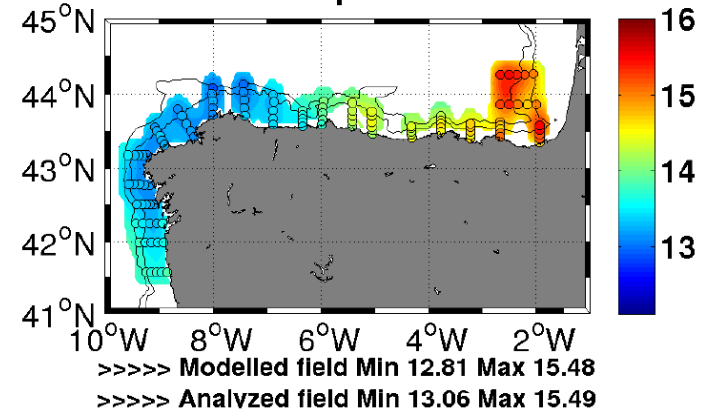
Pelacus cruise 2007: 27th of March 2007 to 23rd of April 2007



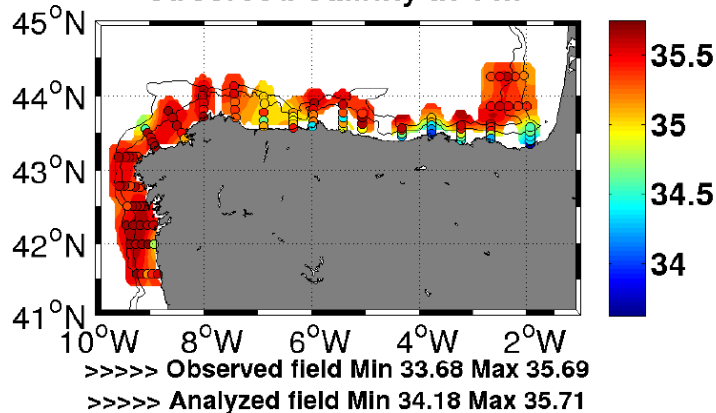
Observed Temperature at 4 m



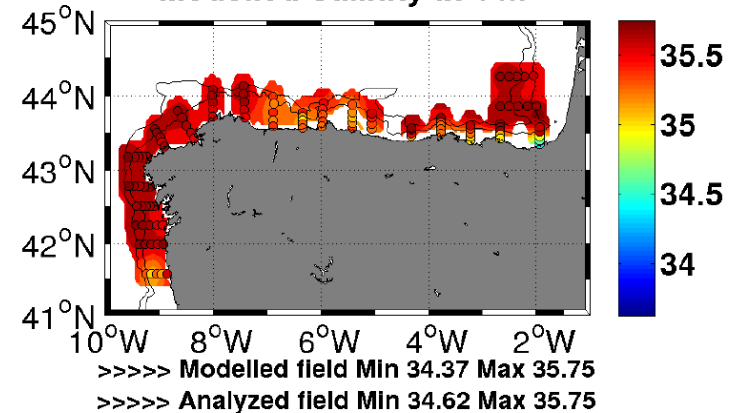
Modelled Temperature at 4 m



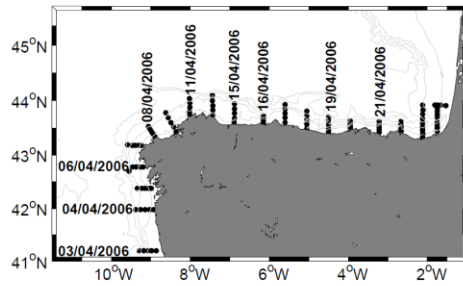
Observed Salinity at 4 m



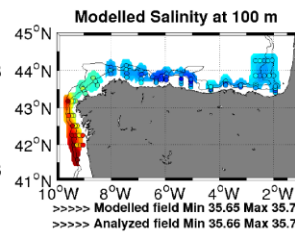
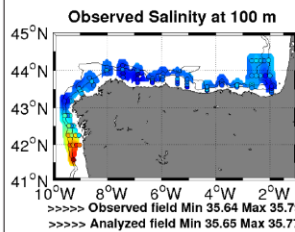
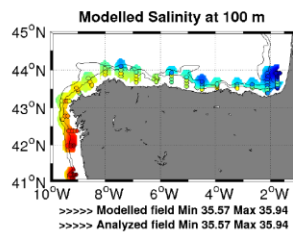
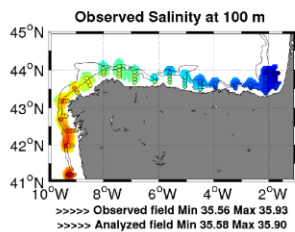
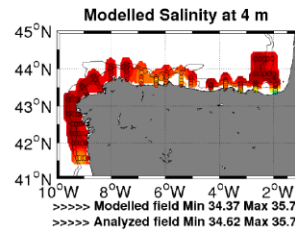
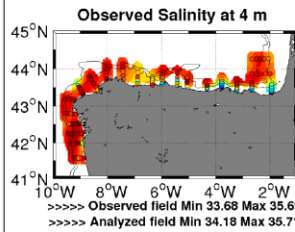
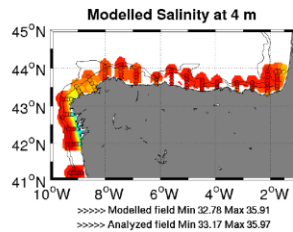
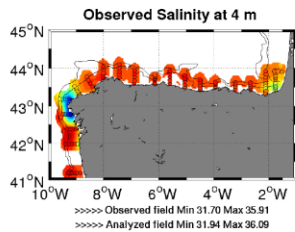
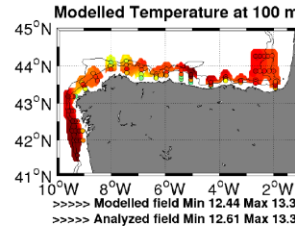
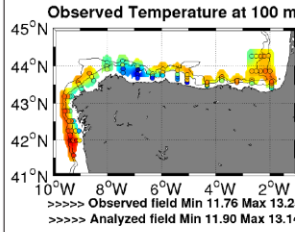
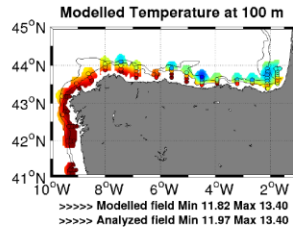
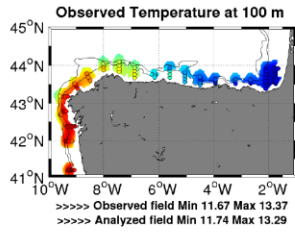
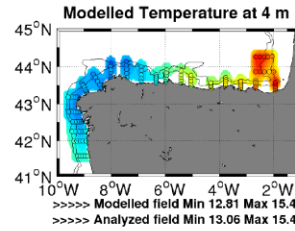
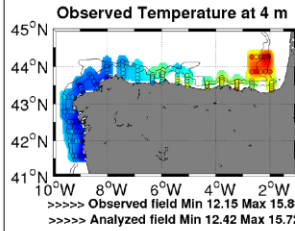
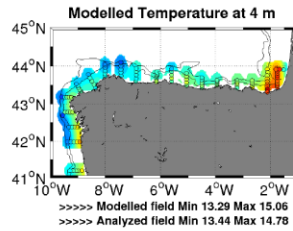
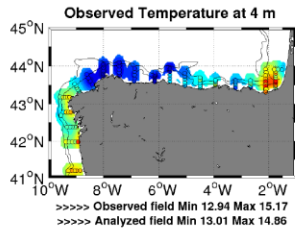
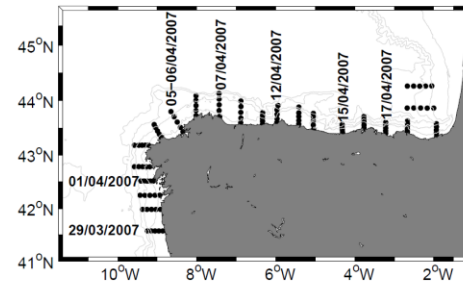
Modelled Salinity at 4 m



2006



2007



Variability of oceanographic conditions in response to wind events during Pelacus spring cruises

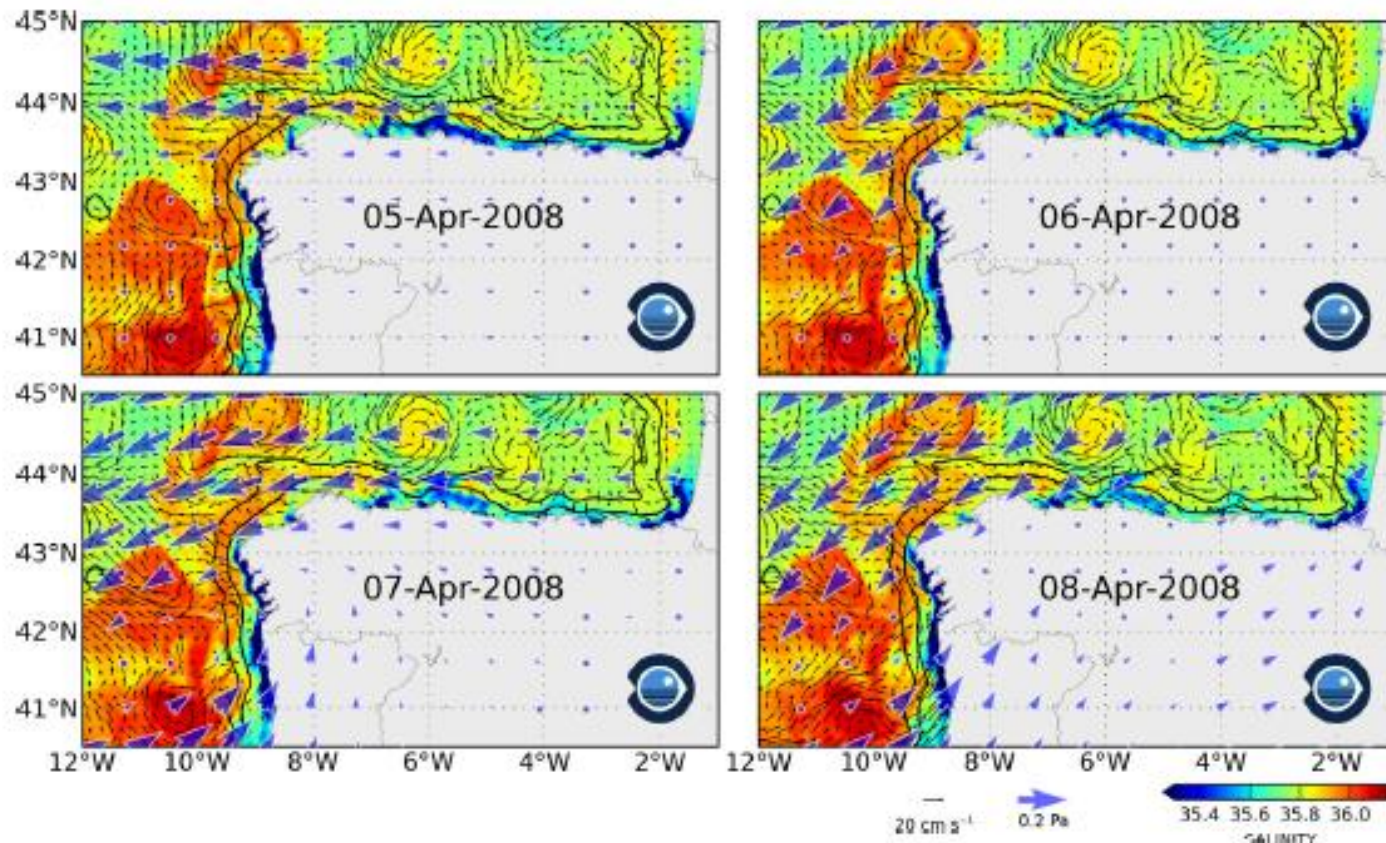
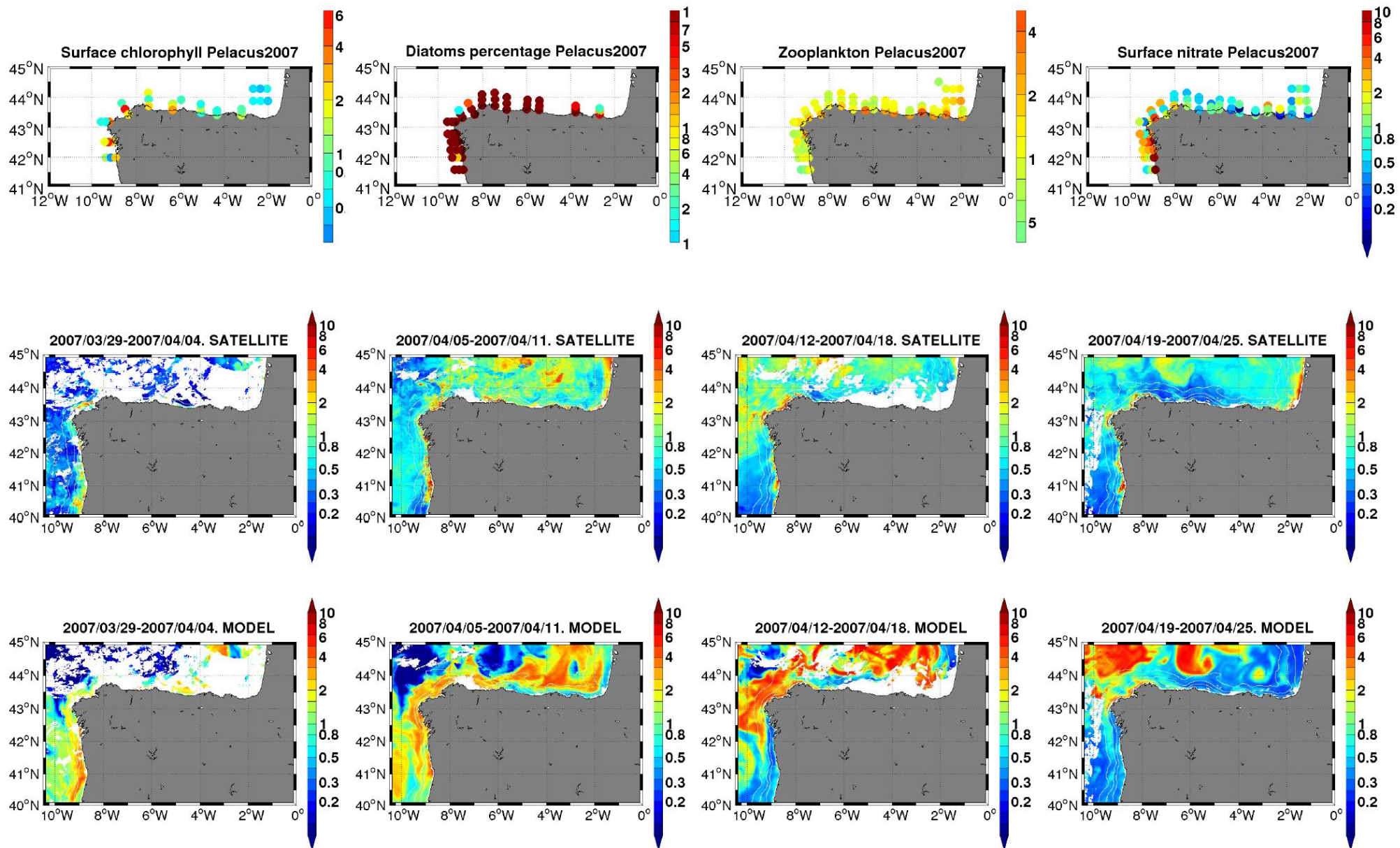
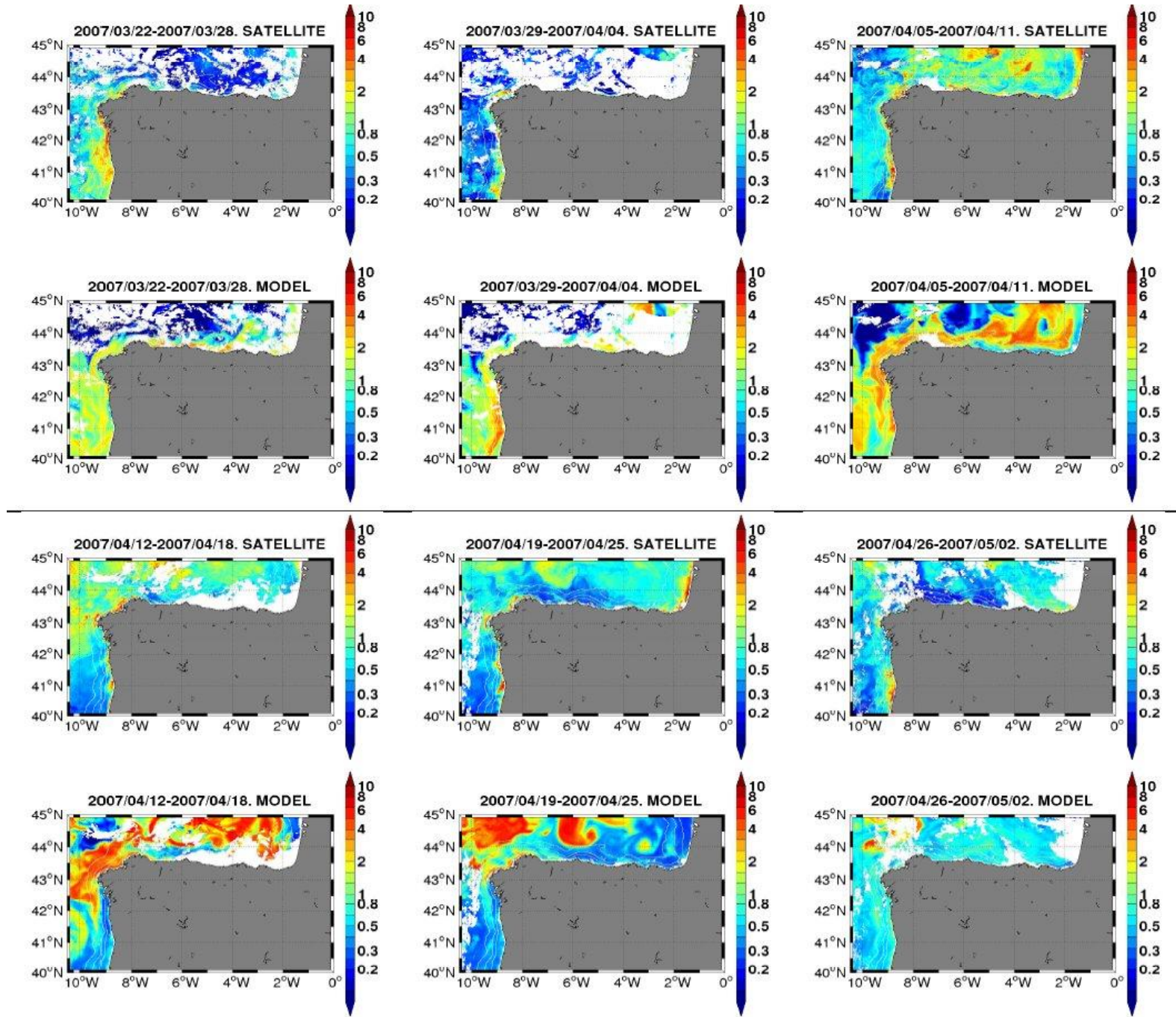


Fig. 4. Output of DOF_c at IEO-A Coruña during the PELACUS cruise in spring 2008. The panels show surface salinity, currents and wind forcing between 5th and 8th of April 2008, when PELACUS sections on the northwestern and northern Galician coast (north from 43°N between 9.5°W and 7°W) were occupied. Easterly winds on the north coast on April 5th were associated with upwelling and offshore surface currents in the northern coast. During the relaxation of easterly wind and veering to northeasterly wind, surface flow turned mainly westwards in the northern Galician coast. Black solid lines represent the 200 and 1000 m isobaths.

Pelacus cruise 2007: 27th of March 2007 to 23rd of April 2007



Temporal and spatial variability of the spring bloom.



Autumn 2013: *Dinophysis acuta* (HAB species, DSP toxin) and Along-shore transport

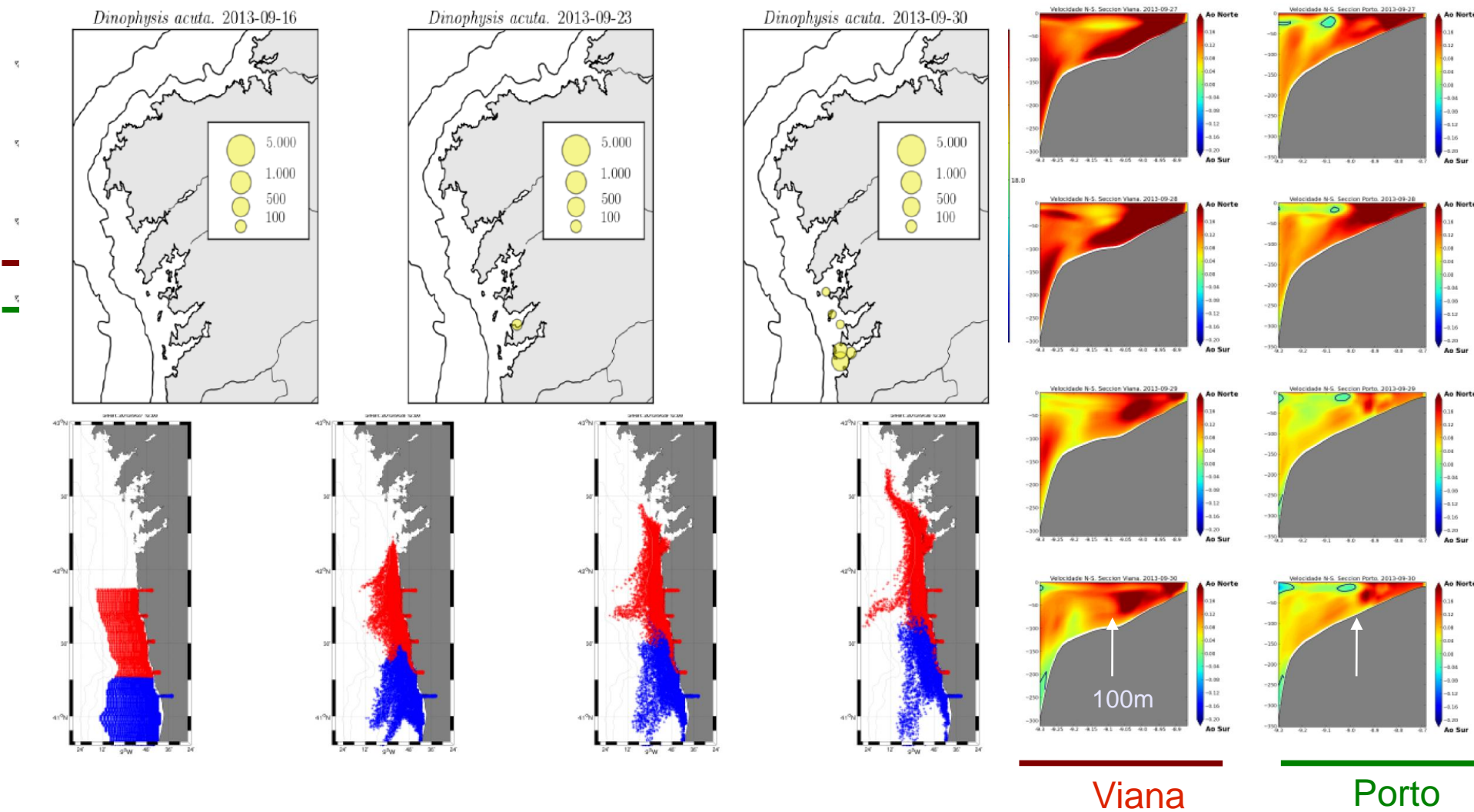


BOLETÍN PILOTO



1. Modelos: temperatura e correntes superficiais. Circulación na plataforma

2013/09/27 (0d) 2013/09/28 (1d) 2013/09/29 (2d) 2013/09/30 (3d)



Conclusions

- The IEO observing system in N-NW Iberia characterizes variability of hydrodynamics and of the ecosystem
- A modelling system is validated by the observing system at different scales (wind events, seasonal, interannual)
- Products for fisheries and aquaculture sectors are developed based in numerical model combined with observations

Instituto Español de Oceanografía Founded in 1914



Odón de Buen
Founder of IEO



1916: Launching a plankton net on a cruise on board the Spanish Navy gunboat Hernán Cortés, 1916, in the coastal waters of northwest Spain

“Changes in ocean variables obey laws and cycles that must be known, it is necessary to gather data for a very long time...as a means to forecast the weather at sea to the advantage of seafarers and farmers”

Odón de Buen, as cited in Parrilla, 18(4) Oceanography, 2005