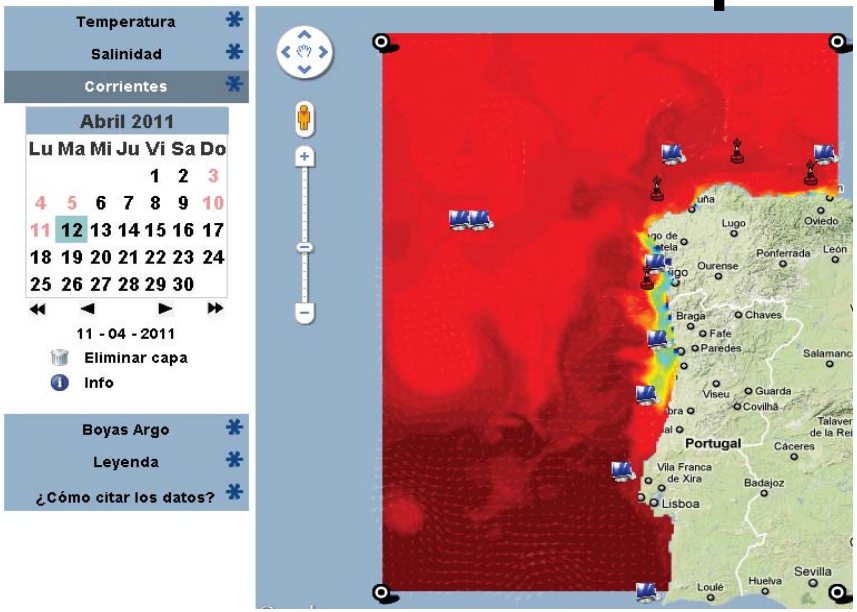
Modelado aplicado a acuicultura y pesquerías



Manuel Ruiz Villarreal
Instituto Español de Oceanografía, A Coruña

INSTITUTO ESPAÑOL DE OCEANOGRAFÍA

IEO tasks and duties

- To carry out **scientific research** in the fields of oceanography and sea sciences.
- To **advice 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 diseminate oceanographic knowledge.

ICHTHYOP LAGRANGIAN MODEL (Lett et al., 2008)

- Advection and dispersion of particles (superindividuals)
- Biological behaviour
  - Growth depending on temperature for eggs and larvae + all the processes before

Offline coupling

- Velocities
- Vertical diffusion coefficients
- Temperature

ROMS PHYSICAL MODEL

- 3.5Km horizontal resolution
- OBC: MyOcean2 (Mercator)
- Atmospheric forcing: Meteogalicia.
- Rivers

Online coupling

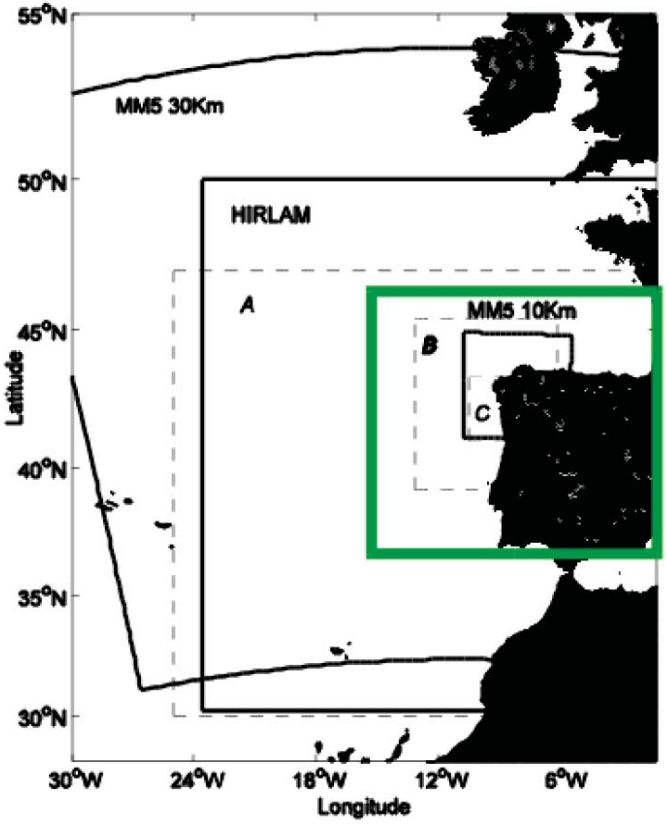
Offline coupling

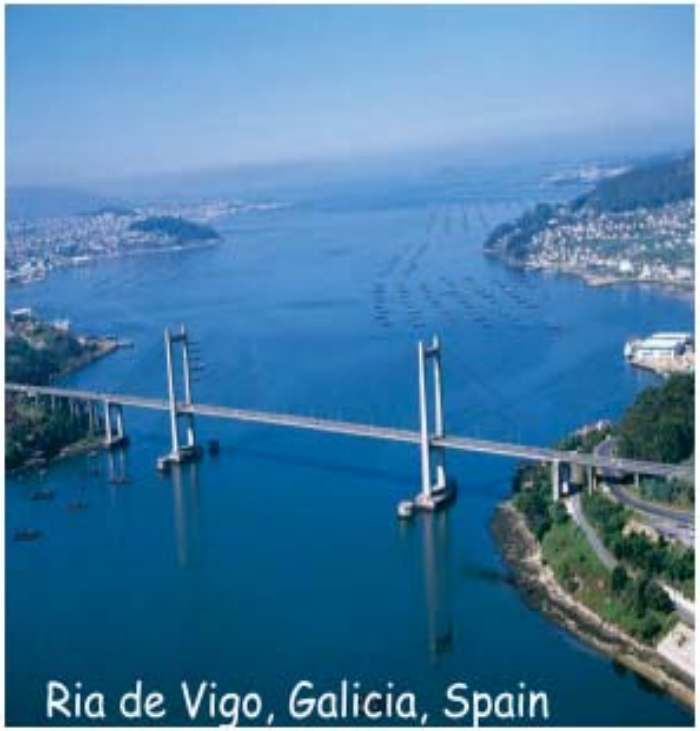
Zooplankton

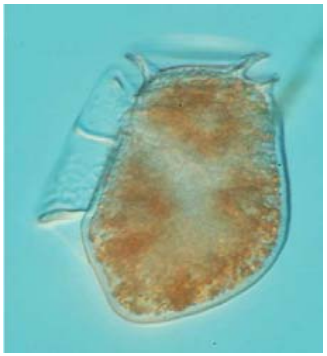
ROMS ECOLOGICAL MODEL (Fennel et al, 2006)

- N2PZD2 model + chlorophyll
- OBC: Temperature/NO3 relationship obtained from IEO data (Vaclan cruises 2003-2008).

OB: MERCATOR PSY2V2

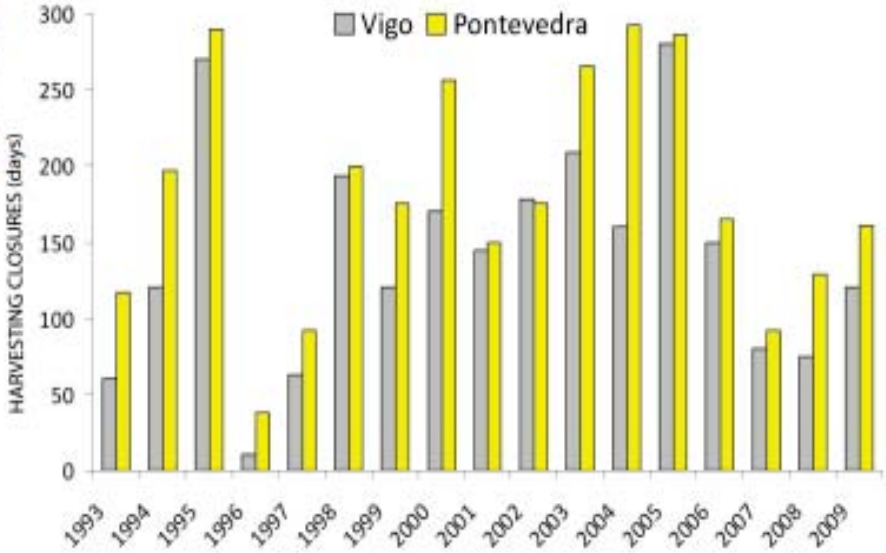


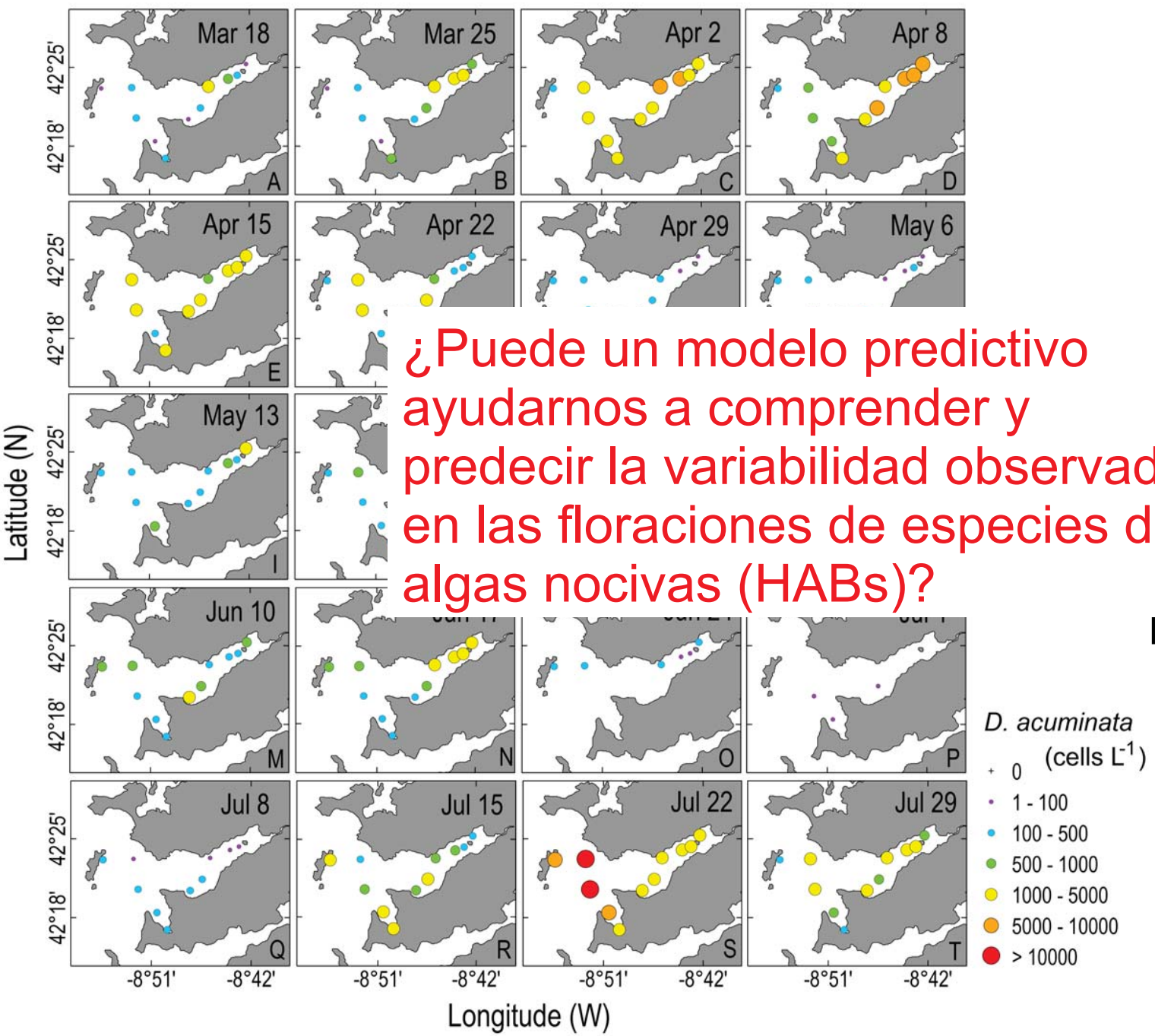




Dinophysis spp.

Días de cierre por toxina diarreica en polígonos bateeiros de la Ria de Vigo y de la Ria de Pontevedra (Datos de INTECMAR www.intecmar.org)





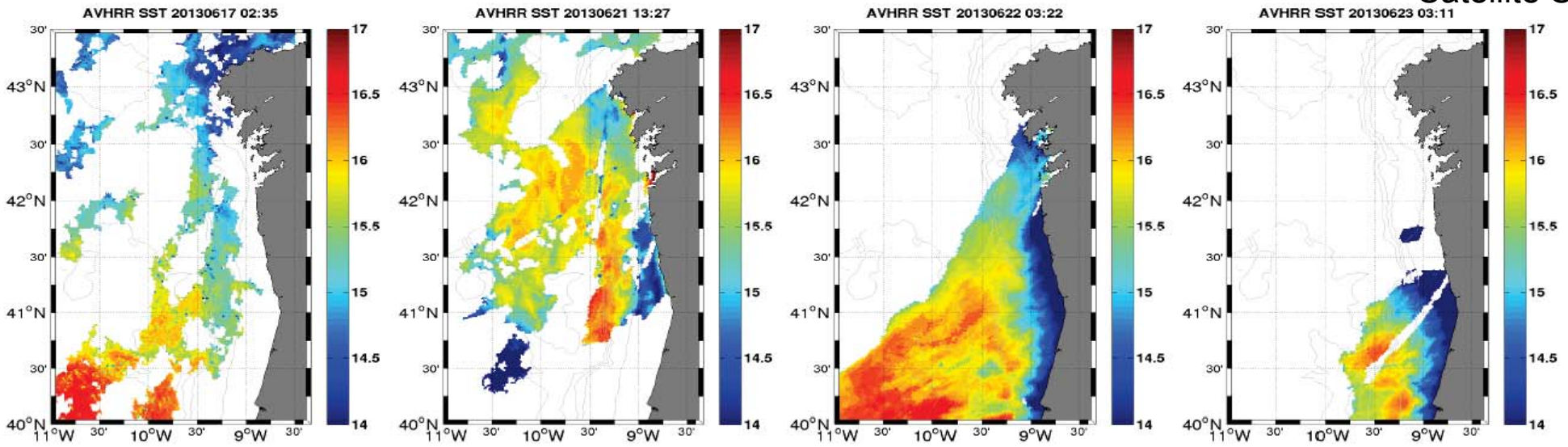
¿Puede un modelo predictivo ayudarnos a comprender y predecir la variabilidad observada en las floraciones de especies de algas nocivas (HABs)?

Ría de Pontevedra

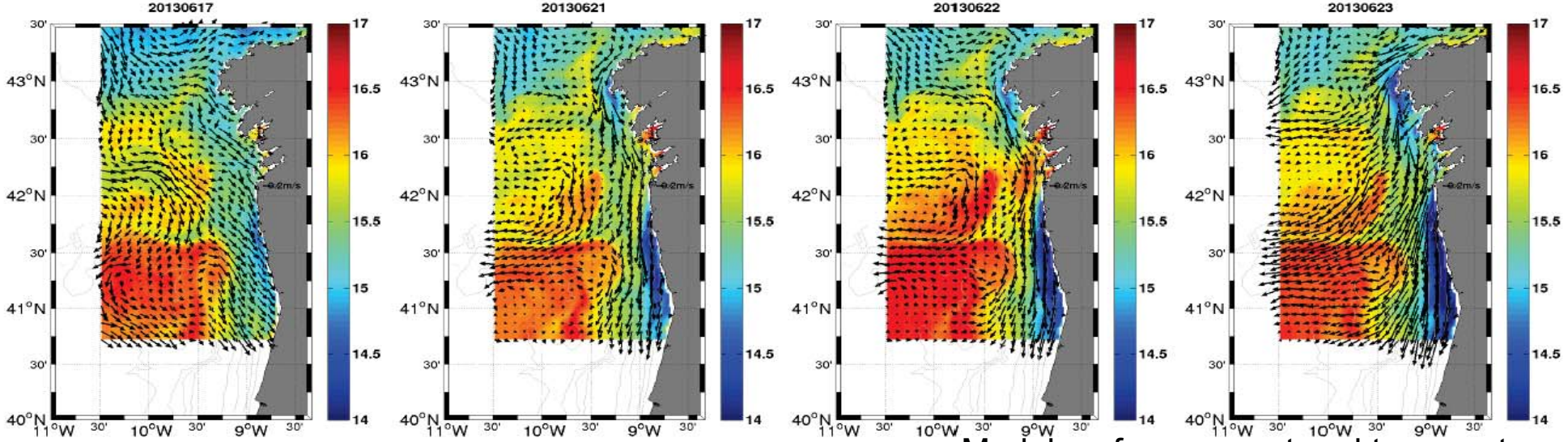
Dinophysis acuminata concentrations in weekly monitoring stations
(Data from INTECMAR, Xunta de Galicia)

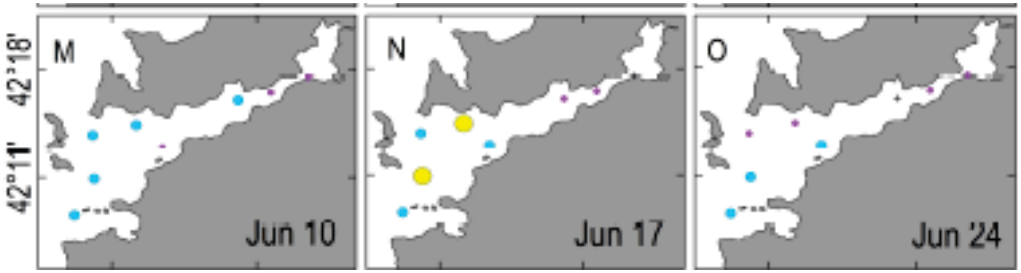
Spring 2013: variability in *D. acuminata* vs. variability in oceanographic conditions

Satellite SST



Model surface current and temperature



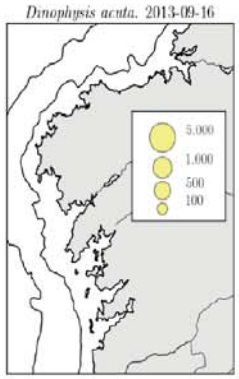


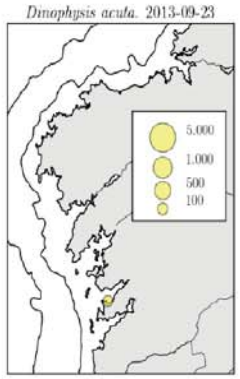
Upwelling pulse
Water renewal in the ria

Autumn 2013: High *D. acuta* (and *D.acuminata*) concentrations (prolonged closures)

Dinophysis acuta | *Dinophysis acuminata*

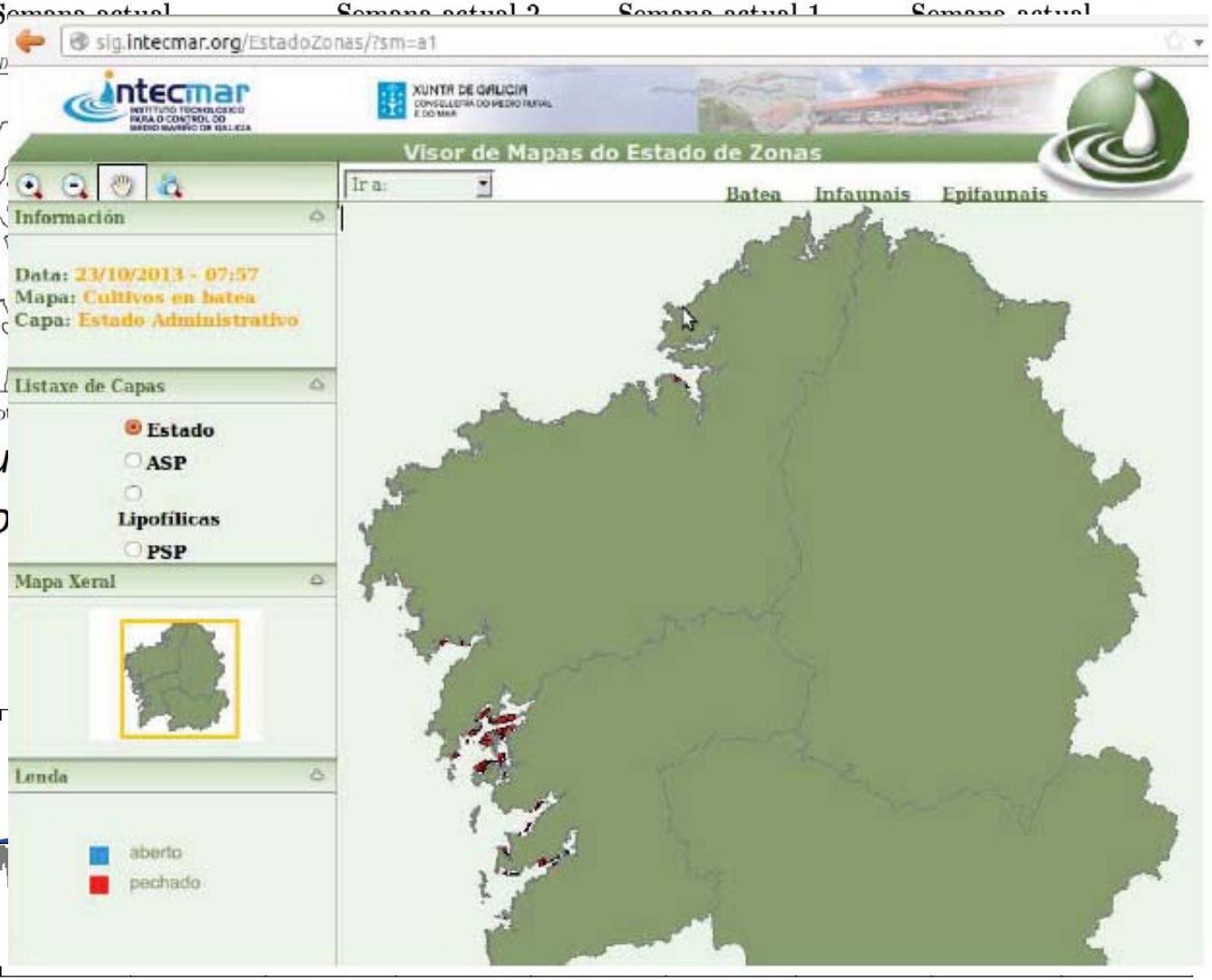
Semana actual-2 | Semana actual-1 | Semana actual | Semana actual-2 | Semana actual-1 | Semana actual





*Os datos de concentración de especies tóxicas (en células/l) son ob

Figure 12: Cell counts of D. Acu monitoring cruises of the two Intecmar)



Autumn 2013: Dynophysis acuta and Along-shore transport

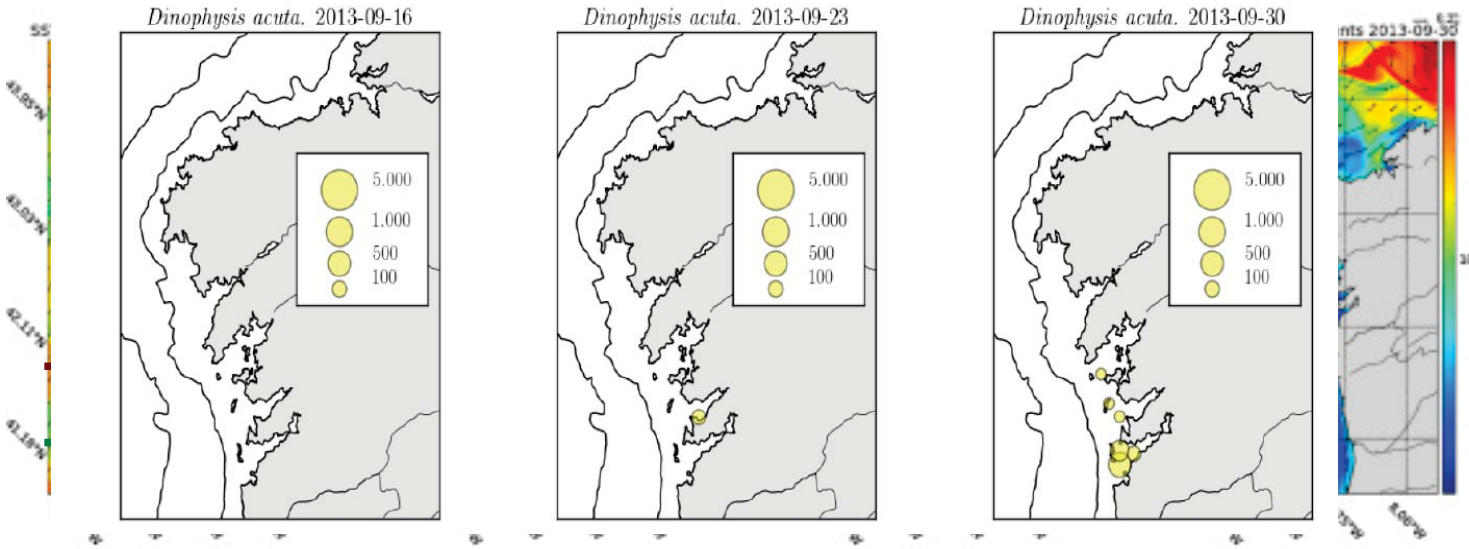
PILOT BULLETIN

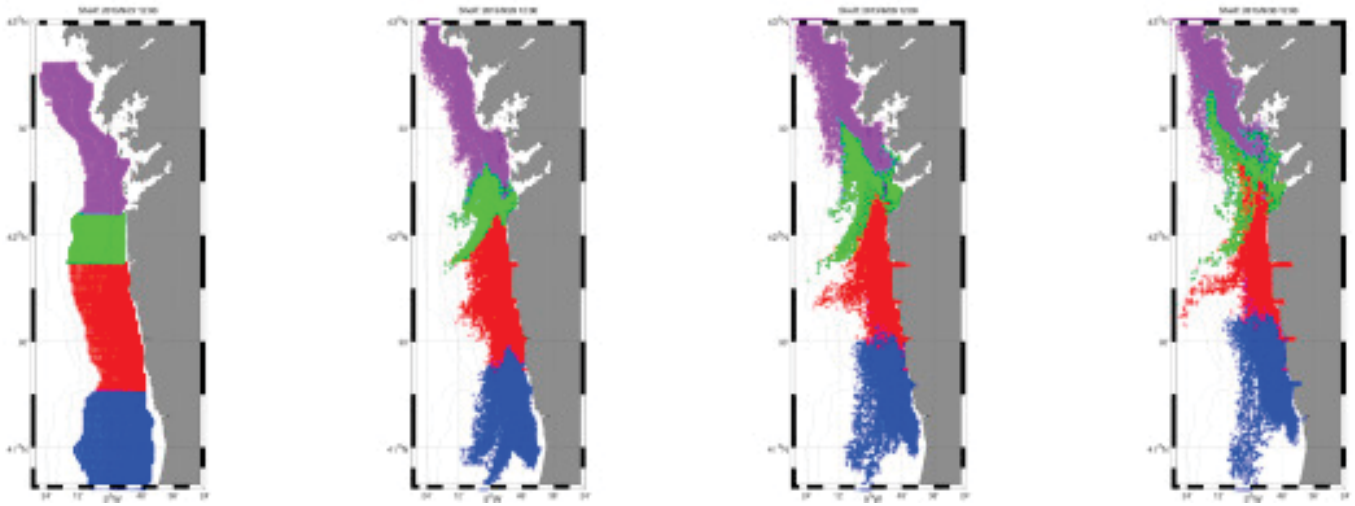
ASIMUTH

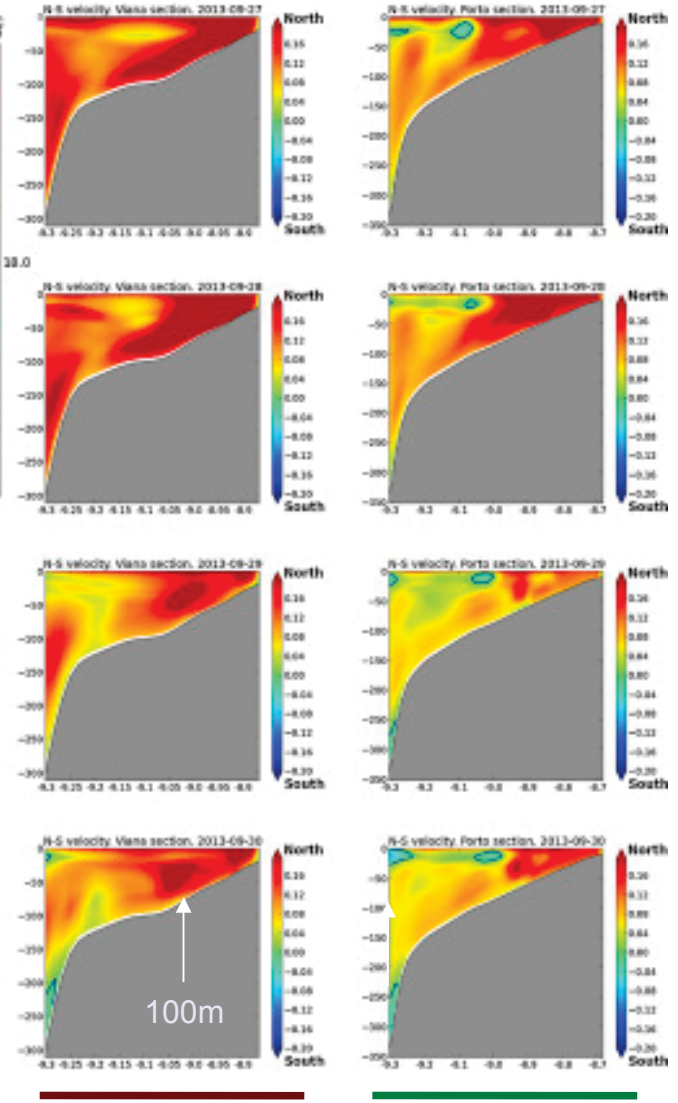
1. Models: surface temperature and currents. Shelf circulation

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

Northwards shelf current







Ruiz-Villarreal et al. 2016 Harmful Algae

Viana

Porto

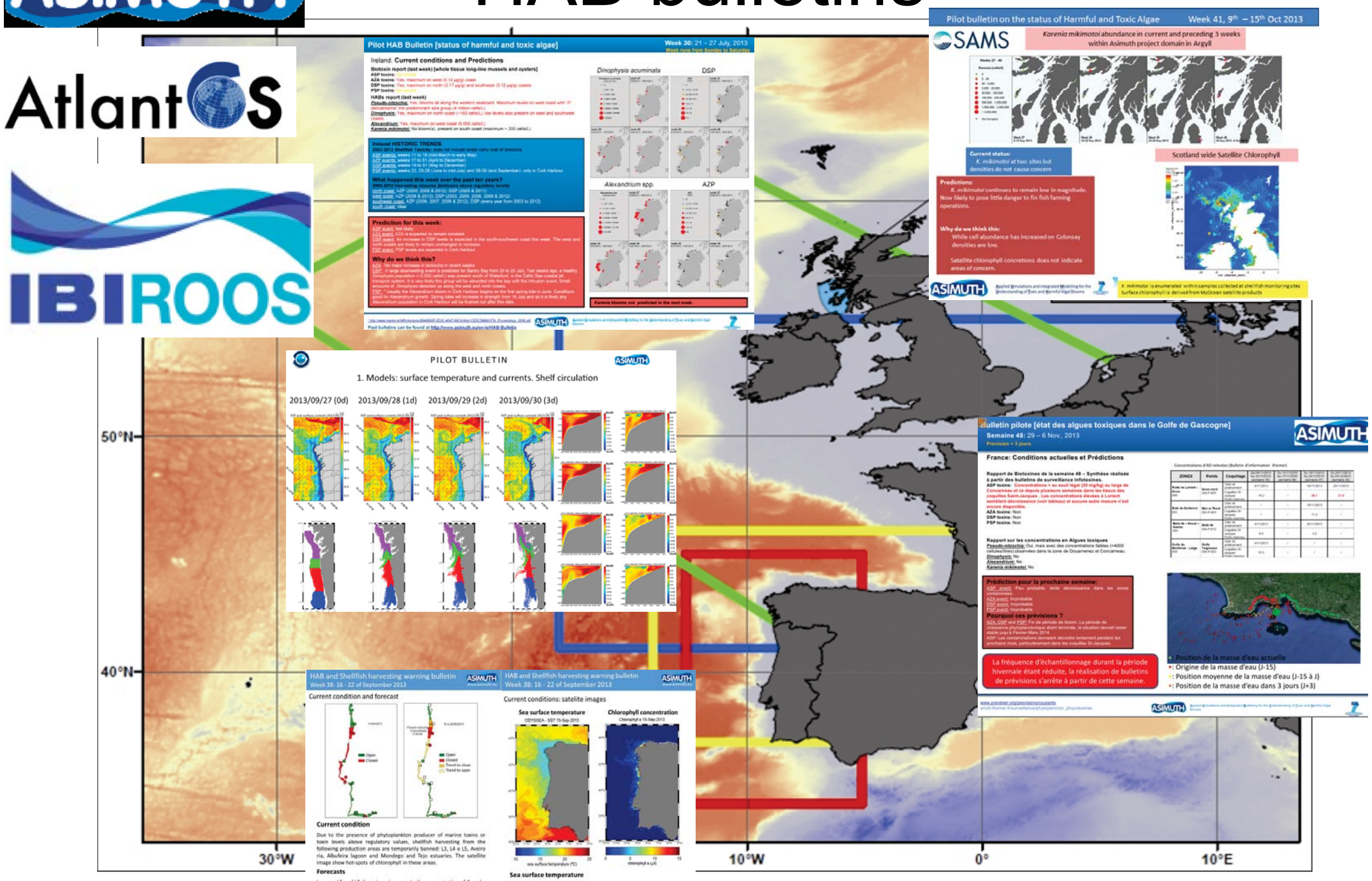
Es posible "predecir" el riesgo de los eventos de HABs (especialmente DSP) en Galicia?

El modelo de circulación proporciona información del transporte de los blooms de *Dinophysis spp* entre rías y de la retención y exportación hacia y desde las rías. El acoplamiento entre mareas y eventos de viento (afloramiento y hundimiento), al que está acoplado el ciclo de vida de Dinophysis spp., pueden describirse con modelos numéricos de circulación que representan la variabilidad del sistema.

Durante los blooms de otoño de *D. acuta,* las predicciones de advección a lo largo de la costa y hacia y desde la costa constituyen una herramienta para la predicción del riesgo de cierres de polígonos marisqueros

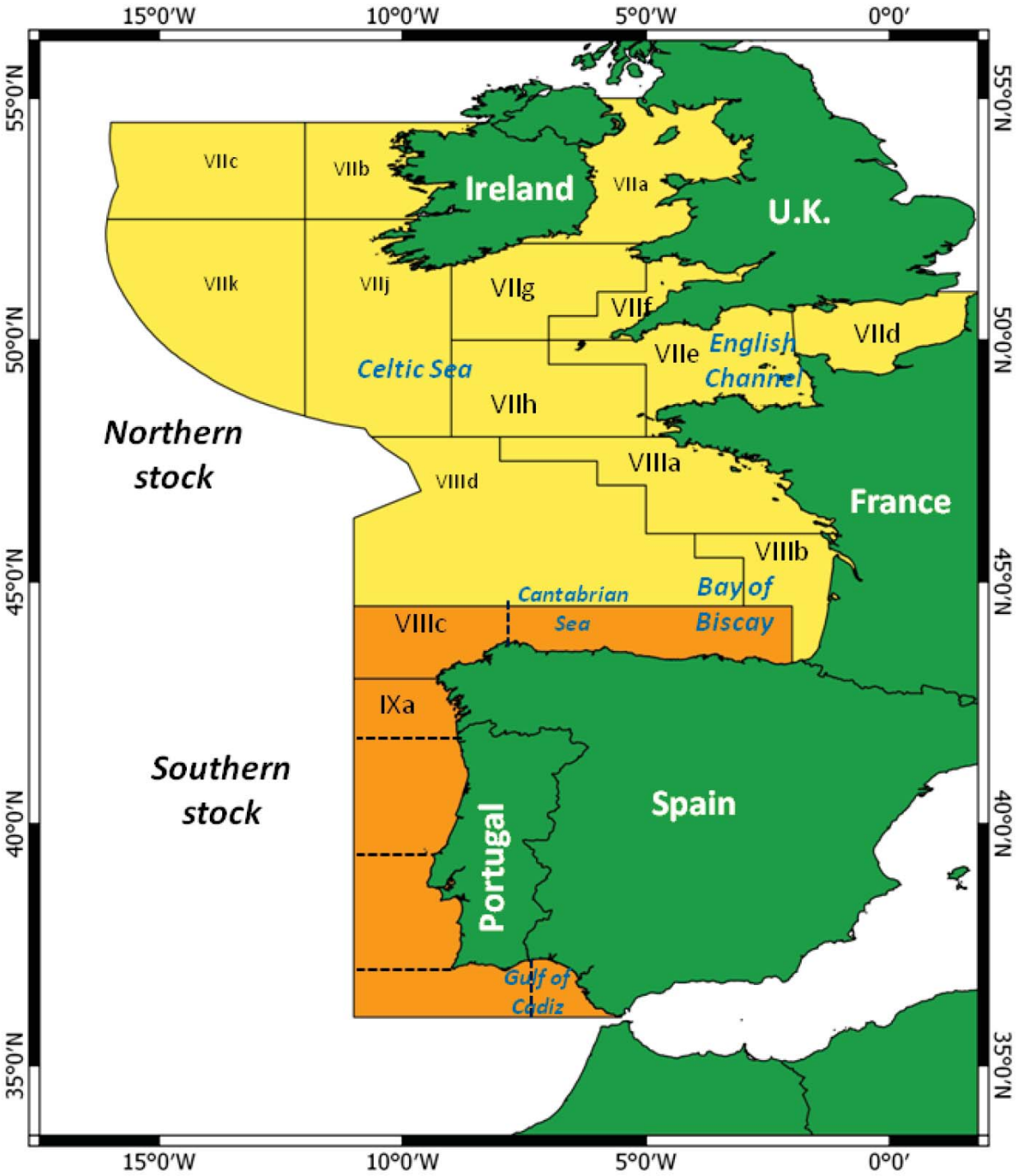
Ruiz-Villarreal et al. 2016, Harmful Algae

HAB bulletins



Atlantic Area Project: PRIMROSE

Map 2: Delimitation of the Northern and Southern sardine stocks



Sardine in the Southern stock: VIIIc and IXa

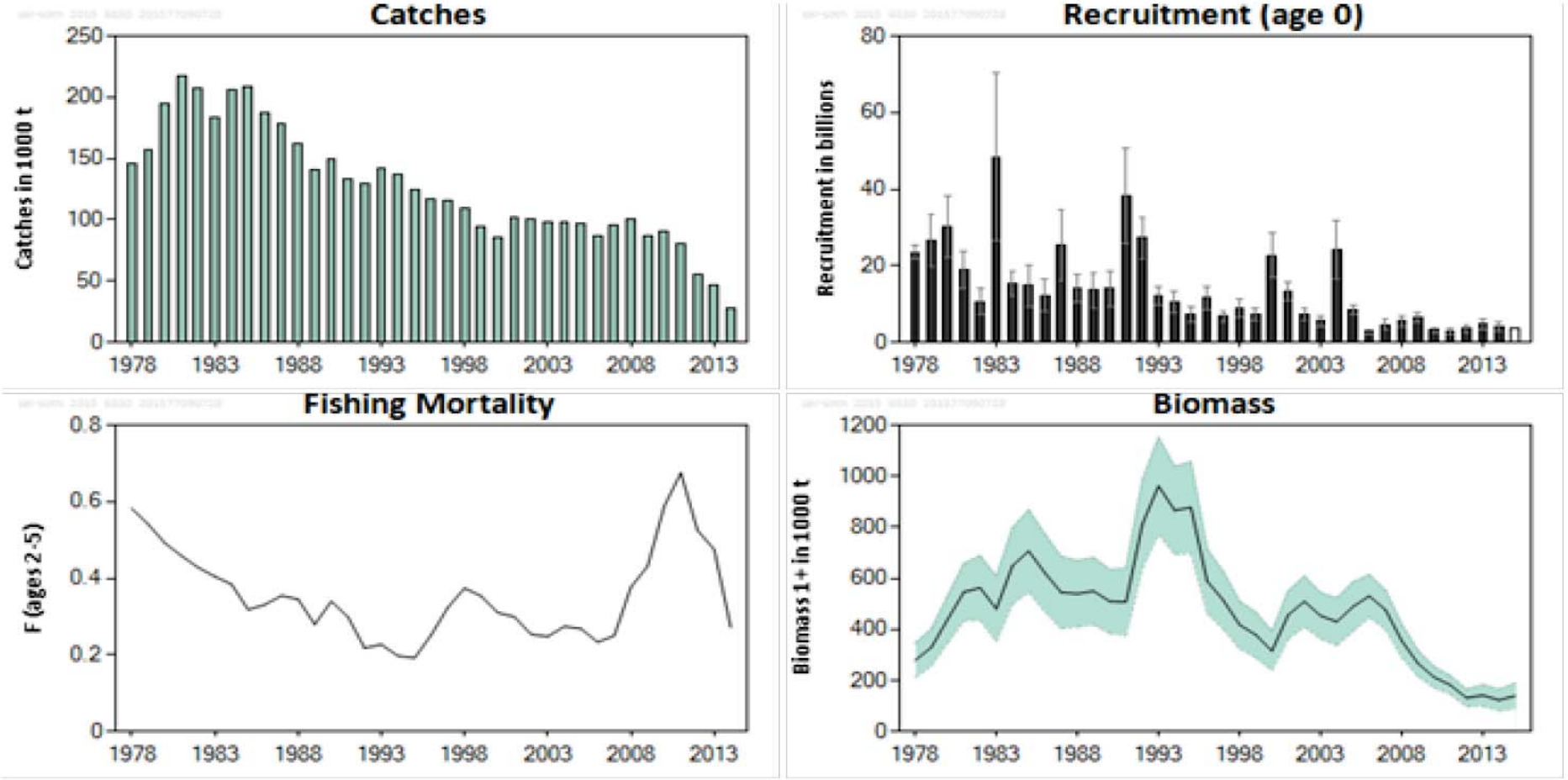
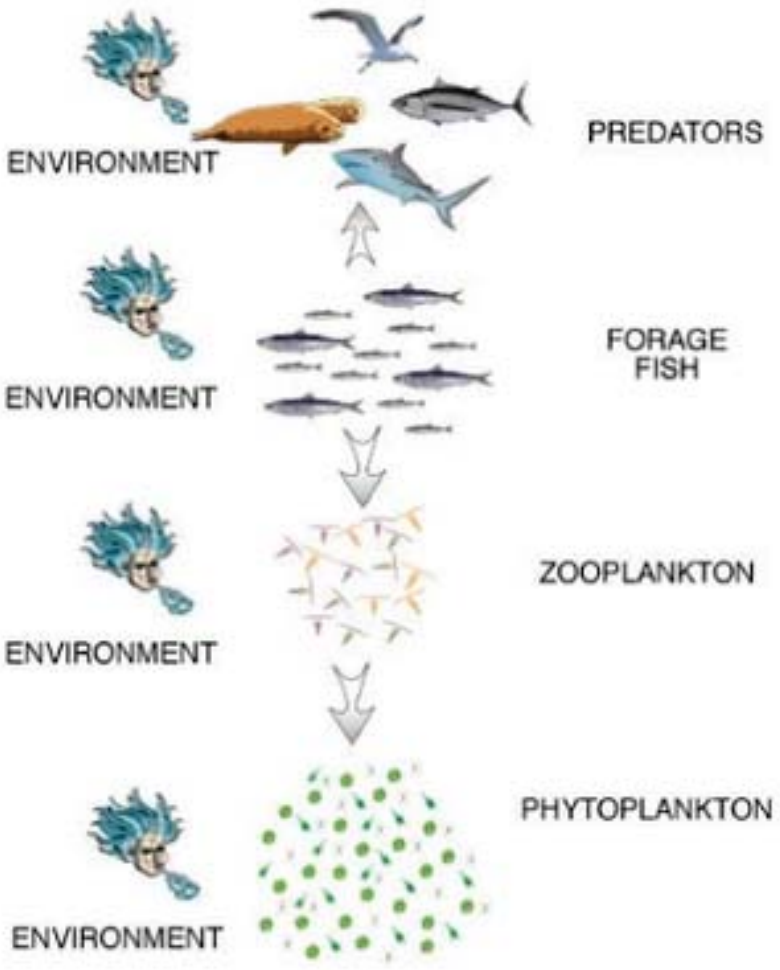


Figure 7.3.27.1 Sardine in Divisions VIIIc and IXa. Summary of stock assessment (weights in thousand tonnes). Predicted values are not shaded.

Sardine Fisheries: Resource assessment and social and economic situation
By Silva et al. (IPMA, IEO, USC, CESAM, Ifremer)
Document requested by the European Parliament's Committee on Fisheries, 2015

Modelos biofísicos aplicados a pesquerías



- Environment represented by climate - hydrodynamic ocean models
- Lower, intermediate and upper trophic levels represented by modules

Taken from Miguel Bernal presentation “Climate to fish to fishers”, Sete 2011

ICHTHYOP LAGRANGIAN MODEL (Lett et al., 2008)

- Advection and dispersion of particles (superindividuals)
- Biological behaviour
  - Growth depending on temperature for eggs and larvae + all the processes before

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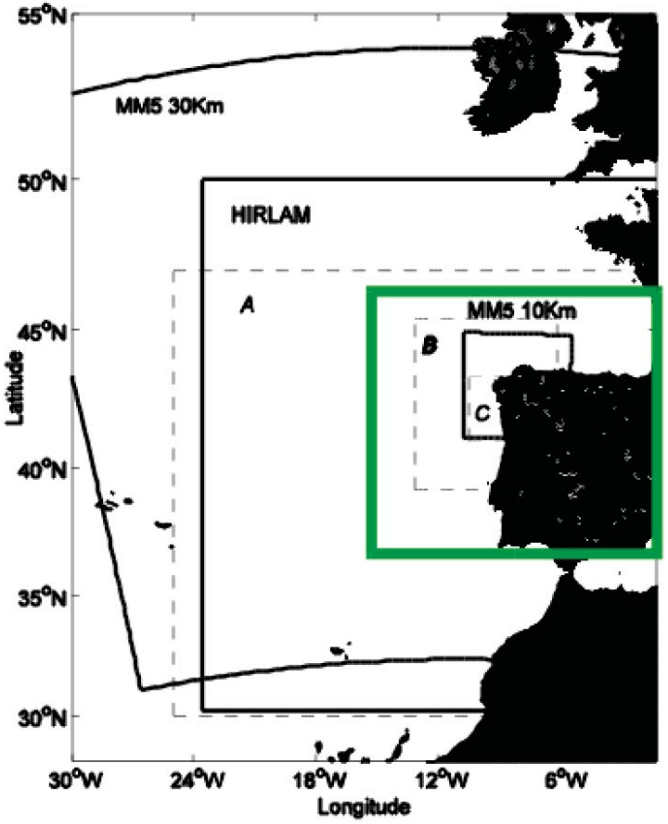
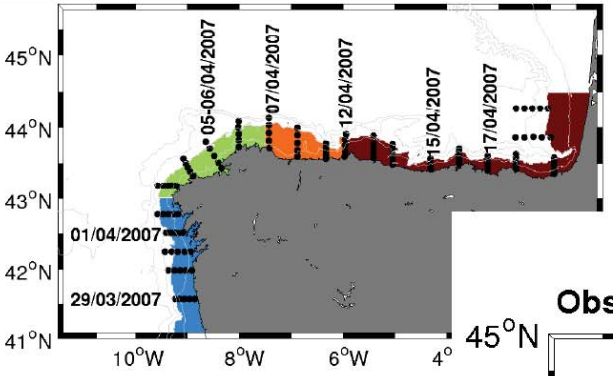
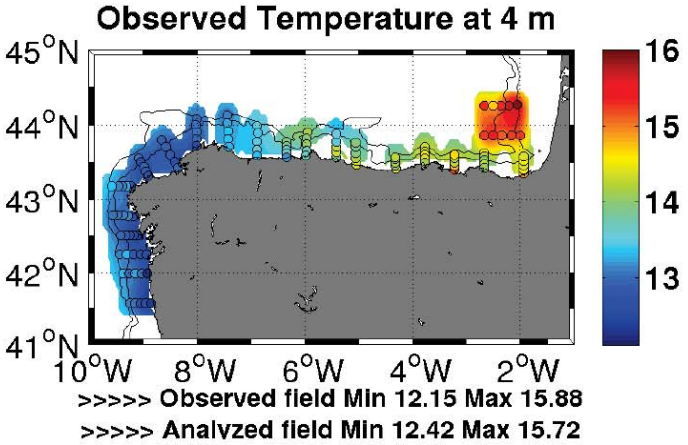


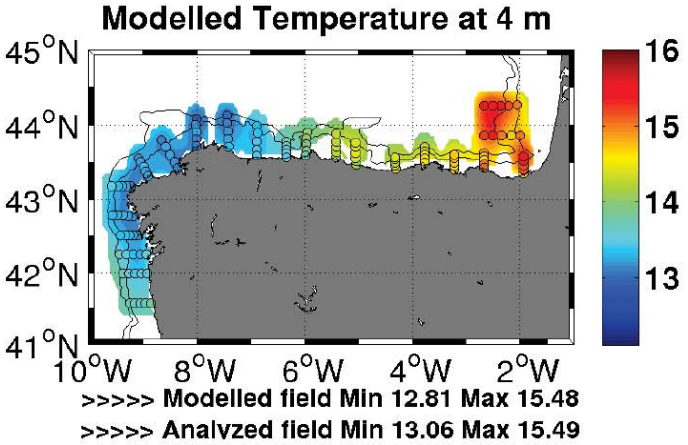
Environment: variability in spring during Pelacus cruises

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

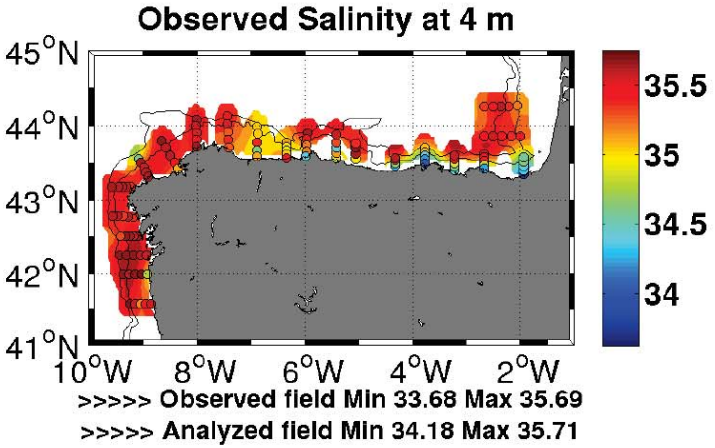




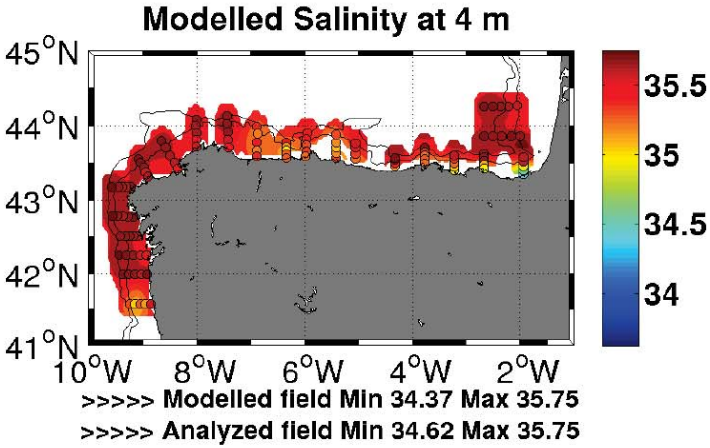
>>>>> Observed field Min 12.15 Max 15.88
>>>>> Analyzed field Min 12.42 Max 15.72



>>>>> Modelled field Min 12.81 Max 15.48
>>>>> Analyzed field Min 13.06 Max 15.49

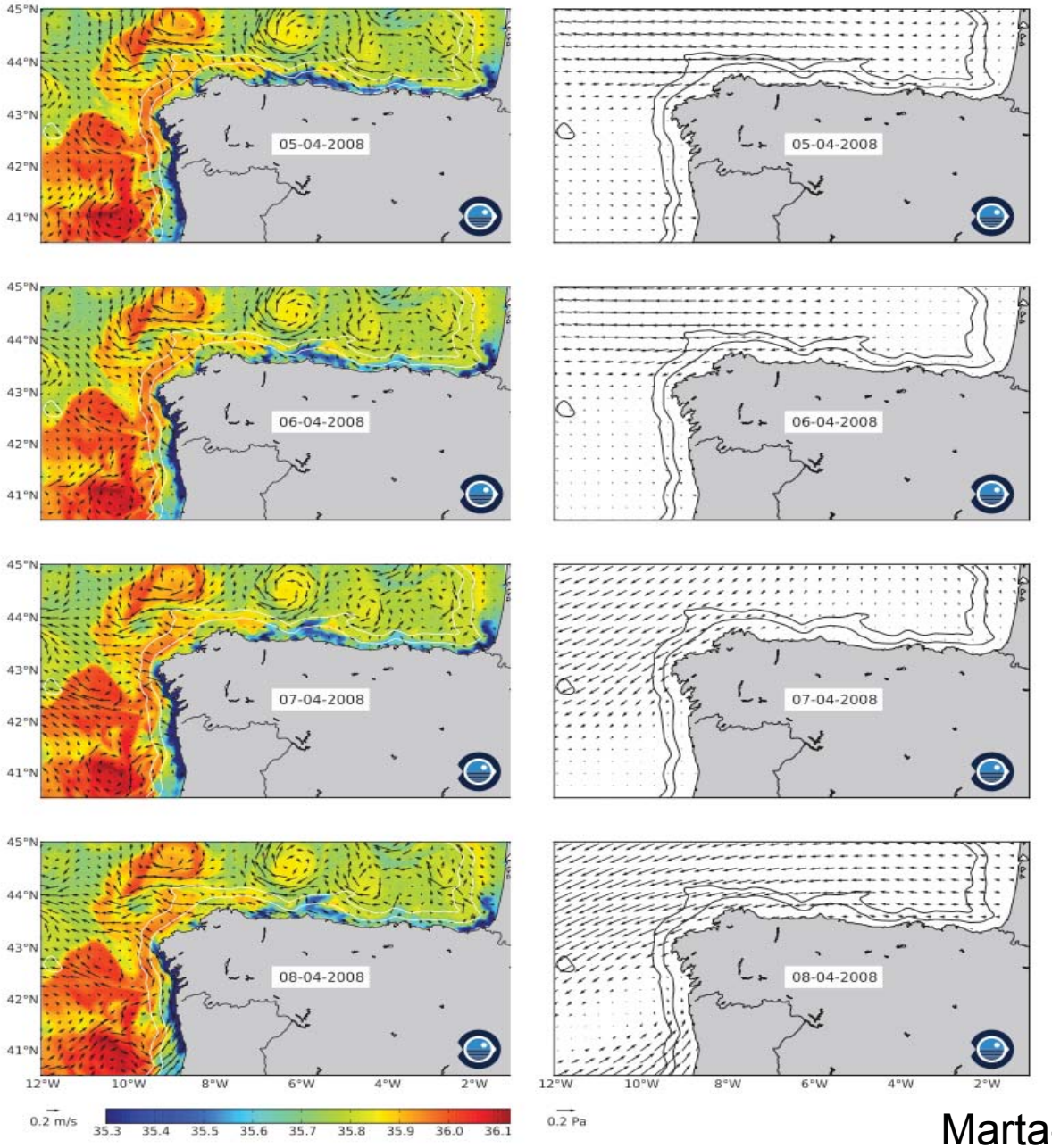


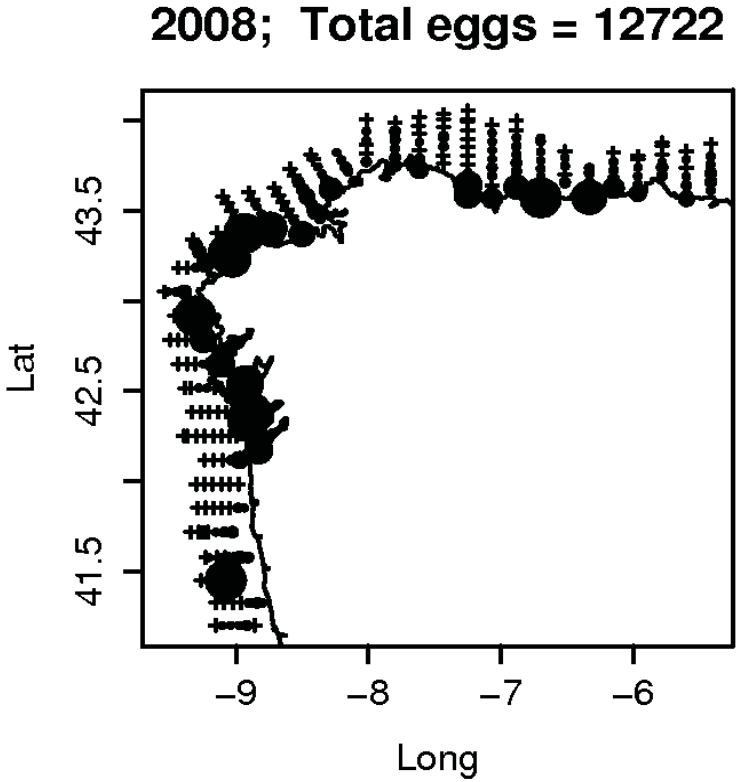
>>>>> Observed field Min 33.68 Max 35.69
>>>>> Analyzed field Min 34.18 Max 35.71



>>>>> Modelled field Min 34.37 Max 35.75
>>>>> Analyzed field Min 34.62 Max 35.75

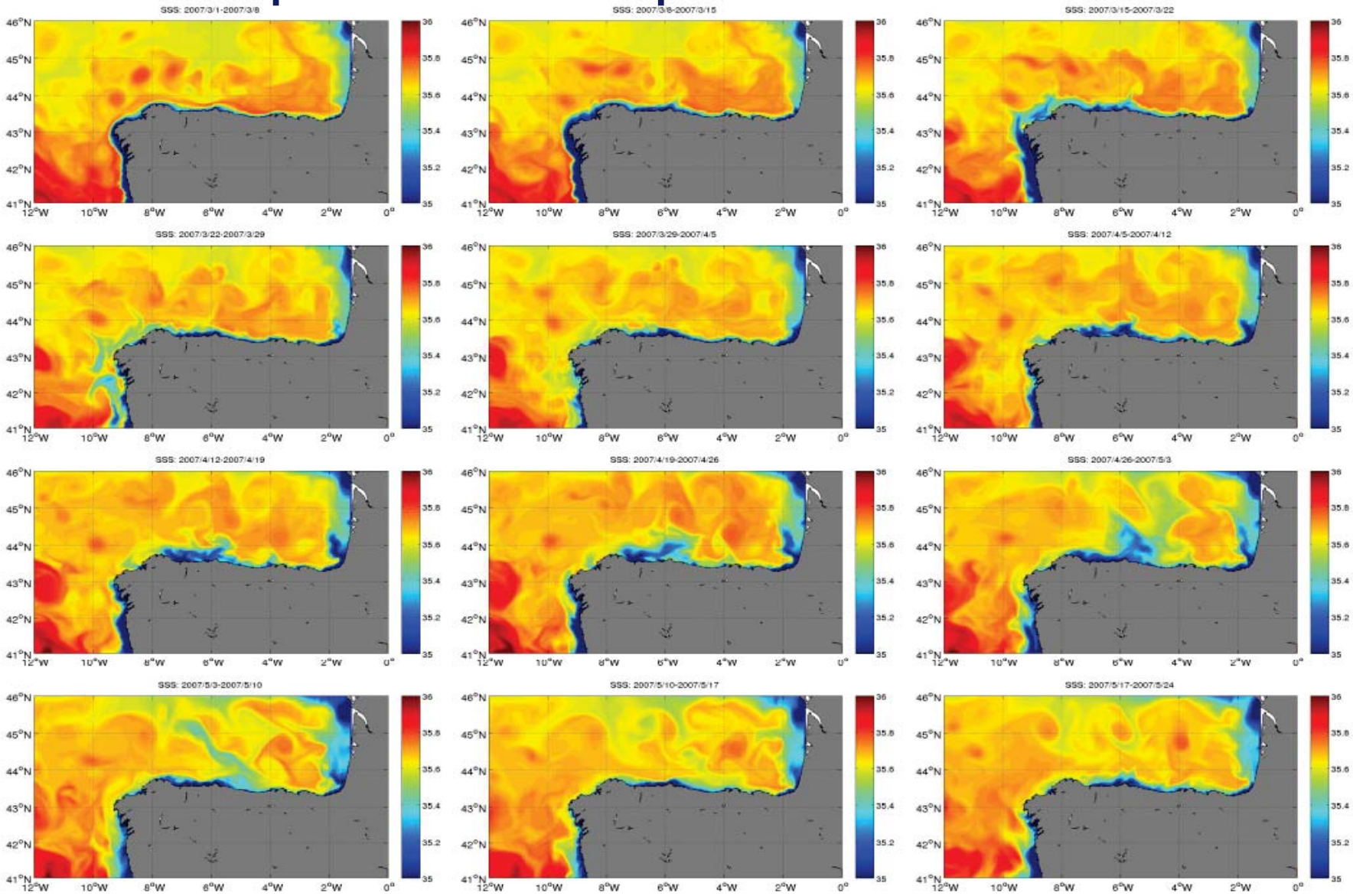
Respuesta a eventos de viento en primavera 2008





Marta-Almeida, Ruiz-Villarreal et al. MPB, 2013

Medias semanales modeladas de salinidad superficial en primavera 2007

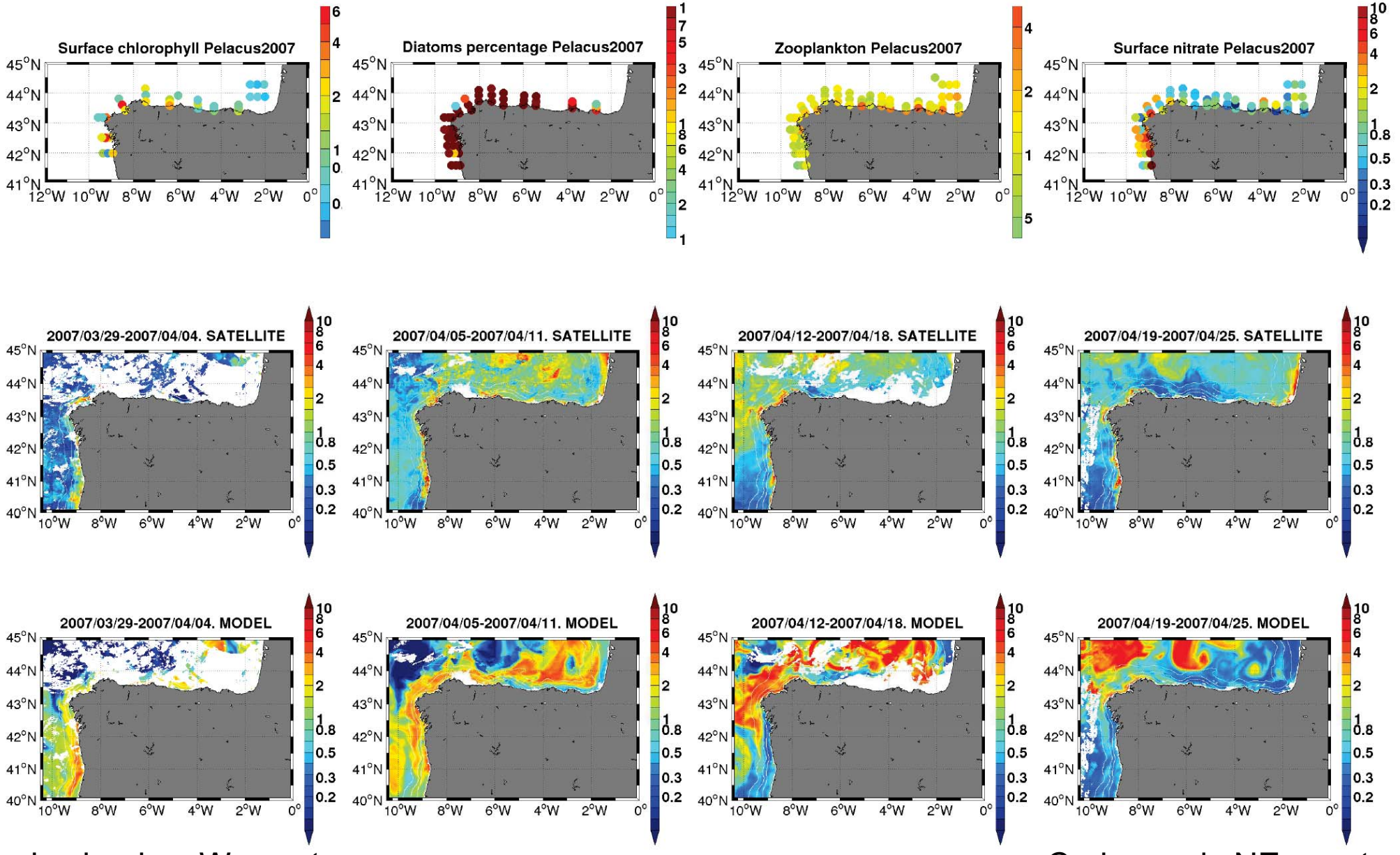


INSTITUTO ESPAÑOL DE OCEANOGRAFÍA 1914

MINISTERIO DE EDUCACIÓN Y CIENCIA

Variability in the plankton:
Temporal and spatial variability of the spring bloom.

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



Cruise begins: W coast

Cruise ends NE coast

Zooplankton distribution (model) at the position of late sardine larvae (29 days after spawning)

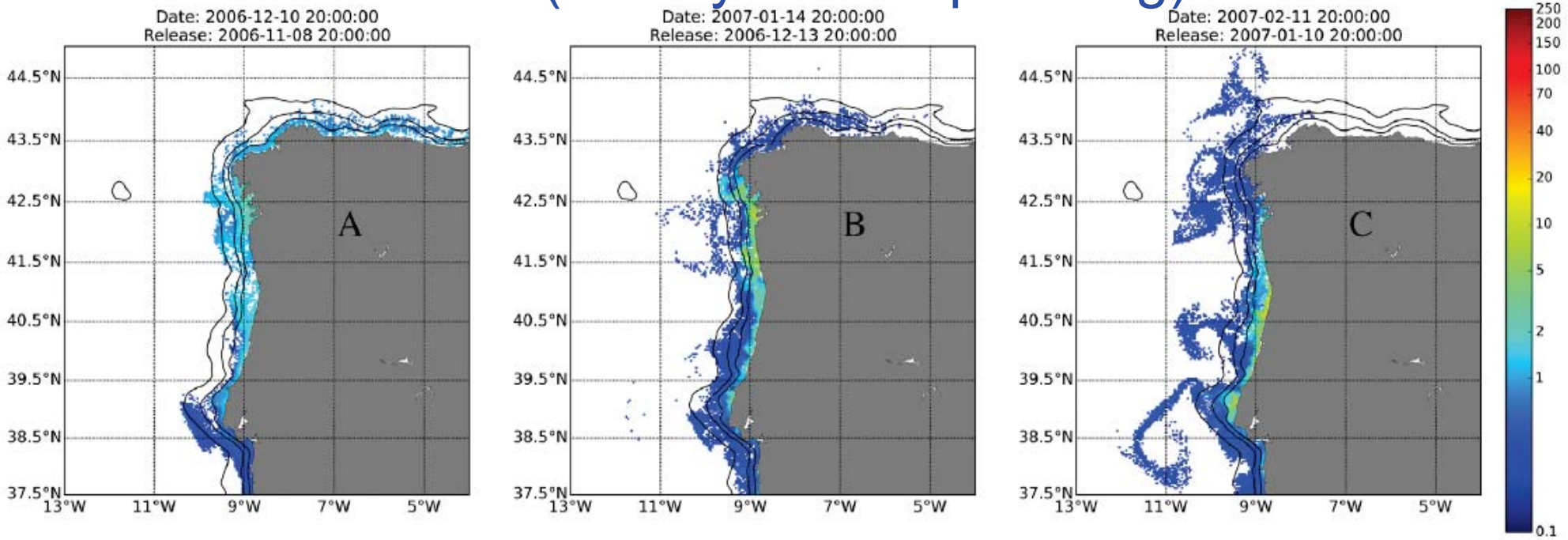


Fig. 14. Maps showing snapshots of the zooplankton distribution (in mg C/m^3) at the particle positions obtained 29 days (late larvae) after being spawned at the Portuguese coast at the dates indicated in each figure.

2007

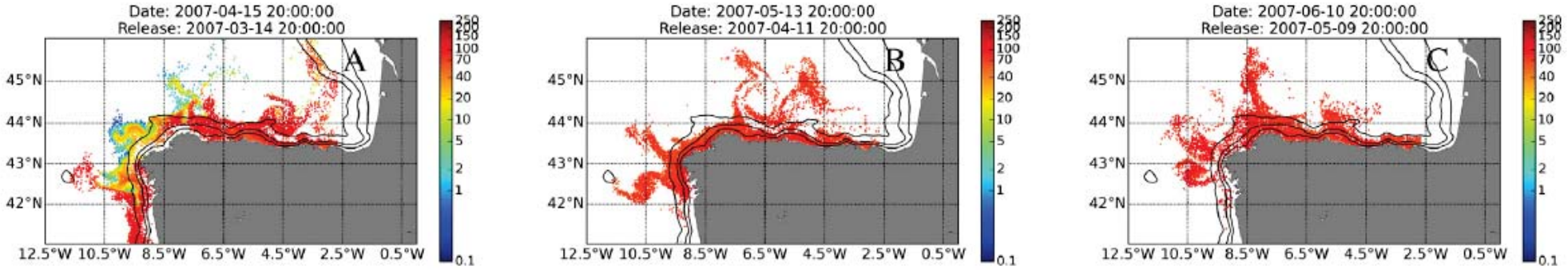
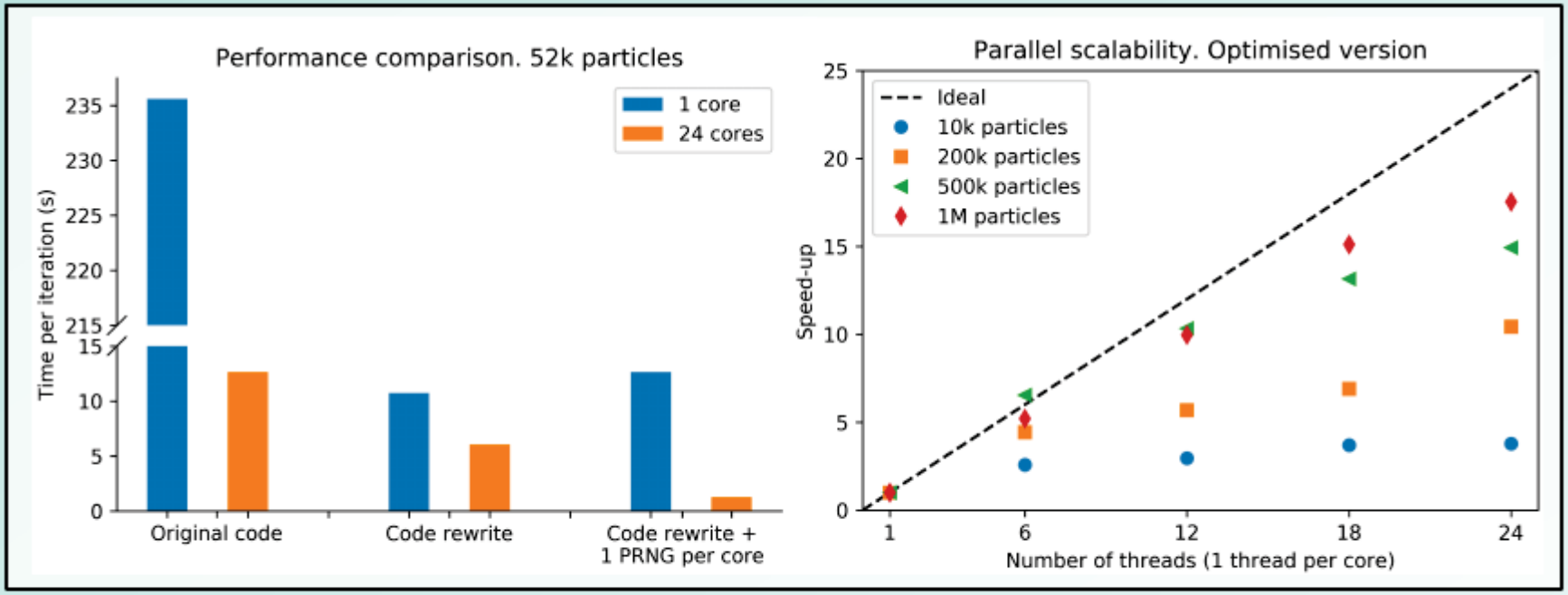


Fig. 16. Maps showing snapshots of the zooplankton distribution (in mg C/m^3) at the particle positions obtained 29 days (late larvae) after being spawned at the Cantabrian Sea coast at the dates indicated in each figure.

García-García & Ruiz-Villarreal, A biophysical model for simulating early life stages of sardine in the Iberian Atlantic stock, Fisheries Research, 2016

Off-line lagrangian particle tracking: Efficient implementation of a Vertical Dispersion algorithm

Ignacio Vidal-Franco[(1)], Manuel Ruiz-Villarreal[(2)], Andrés Gómez-Tato[(3)]



Finisterrae II cluster: 2x Intel(R) Xeon(R) CPU E5-2680 v3 @ 2.50GHz

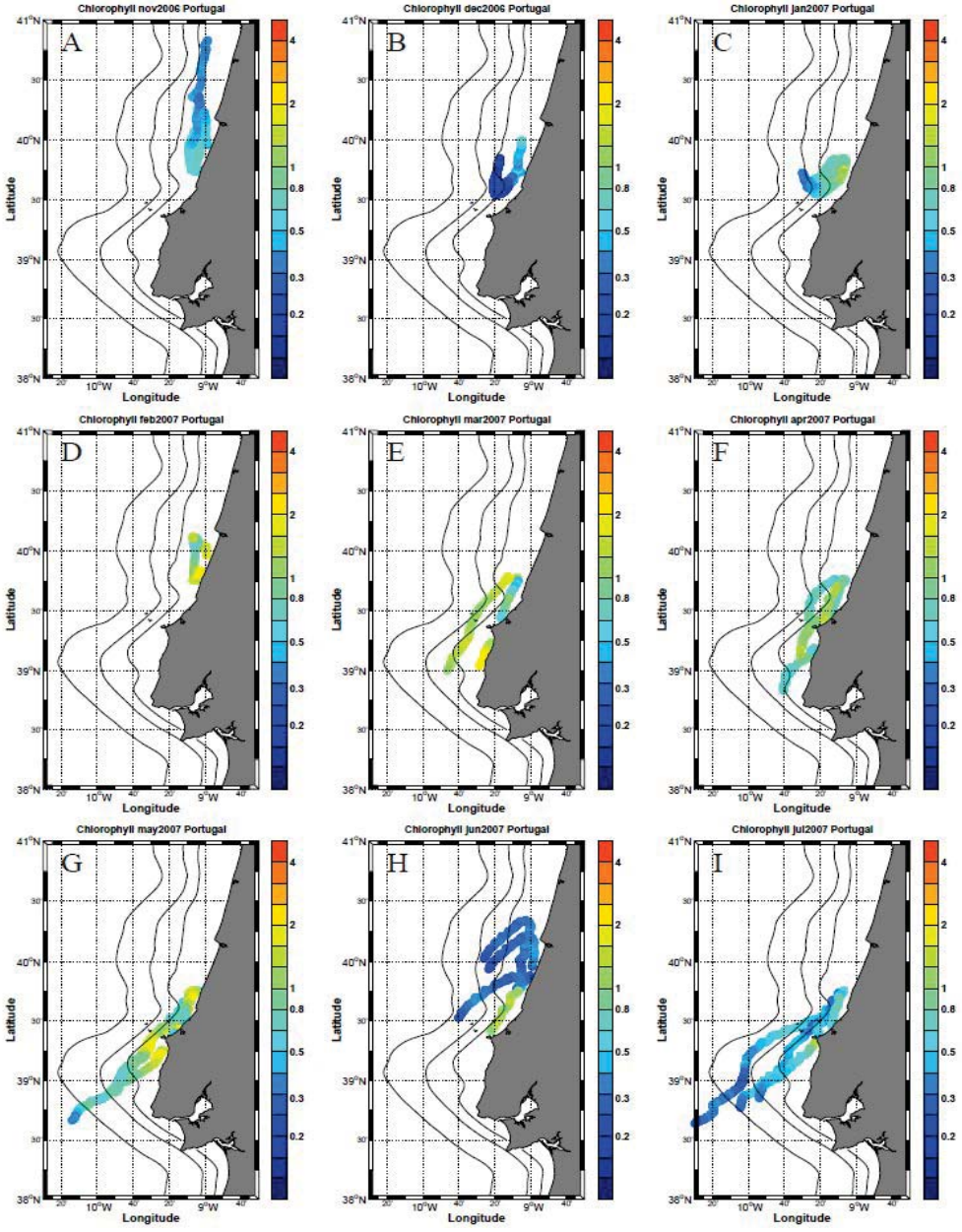
Java Hotspot 64 bit Server VM, 1.8.0_121-b13

Optimization of the numerics of the offline Lagrangian model (vertical diffusion)

Optimization of the code for running in Finisterrae II:
more particles, more frequency of release,more years THEREFORE
simulations more representative of interannual variability sardine recruitment

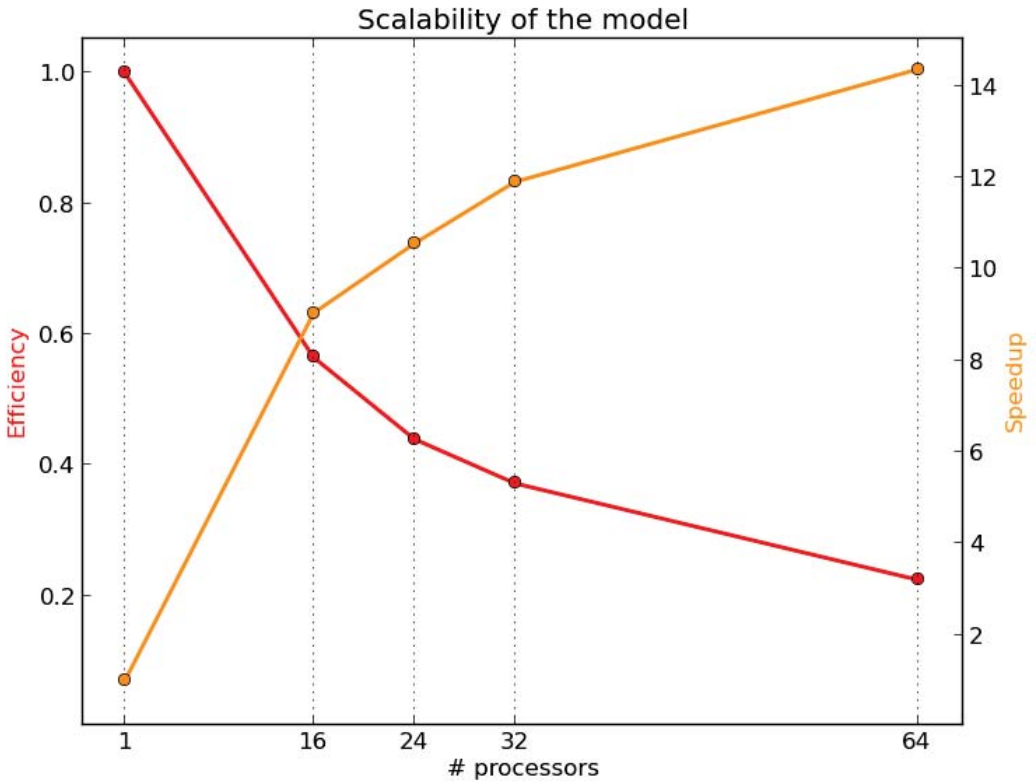
Products for marine resources: Decadal simulation (2000-)

- Hydrodynamical model coupled with ecological model:
  - Reanalysis using the Mercator analysis product for the Global ocean at 1/12º (PSY4V2R2).
- Use of CESGA (Galician Supercomputing Center).
- Biophysical modelling
- **Aim:** fisheries (egg and larval drift, recruitment), HAB hindcasts (understanding the effect of circulation on HAB development and advection)



HPC supporting ocean services

Computing



Speed-up of simulations
Dedicated processor time for improving model configuration
Decadal simulations of the ecosystem requires scalable model

Storage

Around 54 Tb at CESGA for:
- output of interannual simulations of hydrodynamics + ecosystem
- forcing of offline Lagrangian models