Monitoring of a quasi-stationary eddy by means of satellite, in situ and model data

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ÎLE DE RÉ

Introduction & Objective

- Stationary eddies in the **world ocean**:
  - Northeastern Indian Ocean (between the Cuvier basin and the Exmouth Plateau), Iceland Basin **> 9 months**, the California Current System…
  - In some cases, eddies are affected by **deep topographic features**, modifying their characteristics and avoiding their migratory tendency: e.g.: California Current System, where **~500 m high nearly-cylindrically-symmetrical seamount** other topographic disturbances, may either generate and/or trap (Huppert & Bryan, 1976) some of offshore eddies.

The *objective* of this study is to analyze the **interannual** variability of the 4ºW eddy in the southeastern Bay of Biscay (around 43-45ºN and 1-4.5ºW), as well as to look for the **area of generation** and the subsequent **retention or migration**.

  - This kind of eddy appeared during years of **strong winter slope current** (1989, 1982, 1990, 1996; within a period from 1979 to 2000) (Garcia-Soto et al., 2002).
  - It has been observed a relationship between eddies and the survival of **fish larvae** (Bakun, 2006). Some studies focused in the Bay of Biscay, relate eddies with the distribution of hake larvae (Sánchez & Gil, 2000) and with anchovy (Irigoien et al., 2008).

- Nevertheless little is known about 4ºW eddies:
  - Forcing, retention processes, inter annual variability, transport…

DATA: In situ and remote measurements

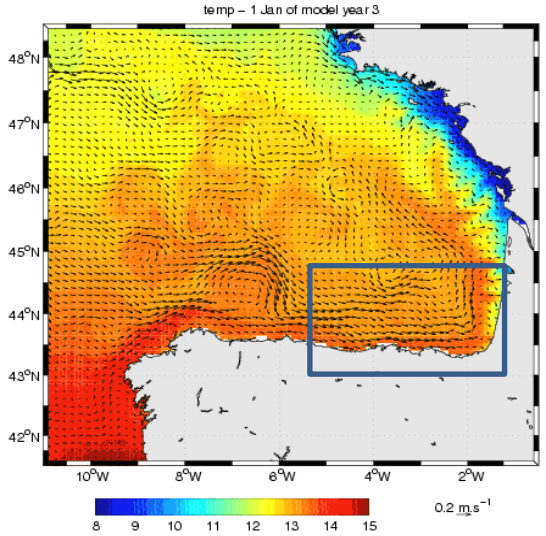
- Satellite altimetry
  - Sea Level and Geostrophic Currents Anomaly maps (SLA, GCA).
  - Source: AVISO Ssalto/Duacs http://www.aviso.oceanobs.com/
  - Spatio-temporal resolution: 0.33ºx0.33º and weekly.
  - Time period: 2003-2010
  - Multimission & UPDATED >= 3 satellites

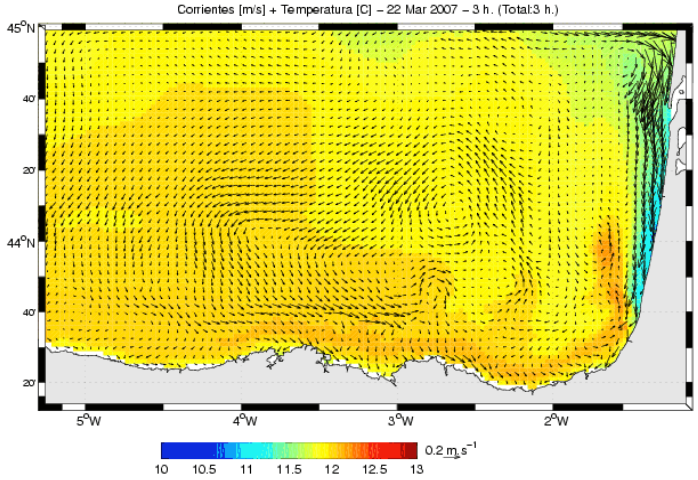
- Level 2 SST images: AVHRR (~1 km resolution), Chl-a images MERIS (~1 km resolution) (NEODAAS, http://www.neodaas.ac.uk/data/)
- AGL (IEO) and Matxitxako oceanic-meteorological buoys, (2850 and 550 meters water depth, respectively
- Drifters (G. Charria)

DATA: Model Simulations

Numerical Model Simulations:

- Two Grids:
  - REGIONAL (Horizontal resolution of 6.6 km)
  - SUBREGIONAL (2.2 km)
- 32 terrain-following vertical levels
- Atmospheric forcing: NCEP re-analysis data (~2º, 6-hour data)
- Open Boundary Conditions: ECCO (1º, 10-day data)
- Period: 2000-2010, (2-year spin-up: 1998-2000)





METHODS: Eddy tracking

- Wavelet-based utility (Doglioli et al., 2007, Rubio et al. 2009)
- 2D decomposition into wave packets (position localized in space). Then, reconstruction and identification using the first (most energetic) wavelets (18-20%) *
- Eddies tracked in time (in successive weekly maps) using a research radius of 80 km for weekly altimetry maps and 30 km for daily model outputs

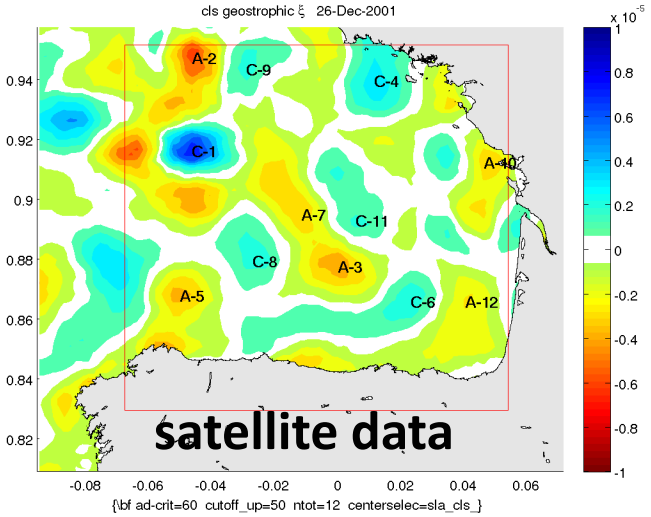
Daily model outputs

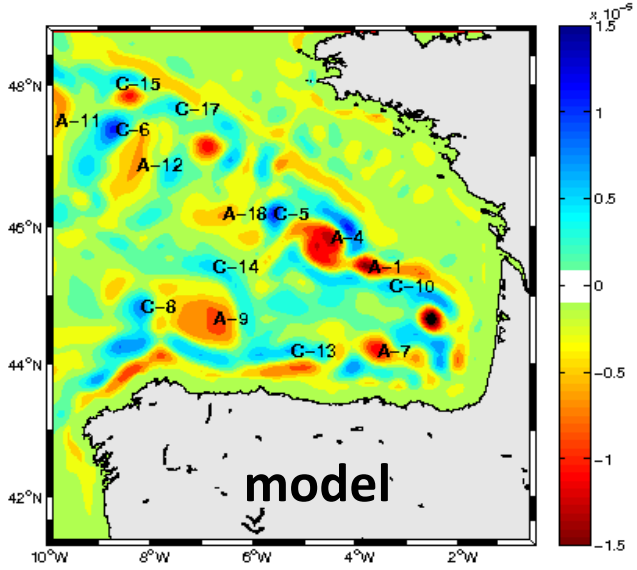
> 30 km DIAMETER > 8 WEEKS LIFETIME

Weekly altimetry maps

> 80 km DIAMETER > 8 WEEKS LIFETIME

SURFACE RELATIVE VORTICITY fields

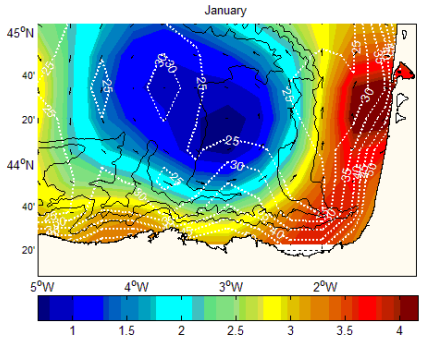


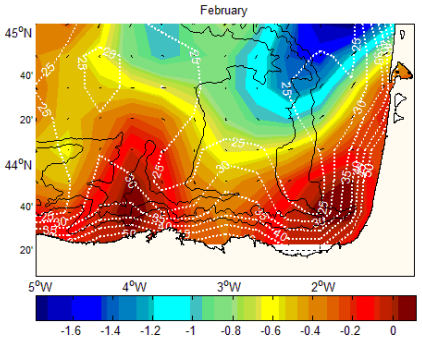


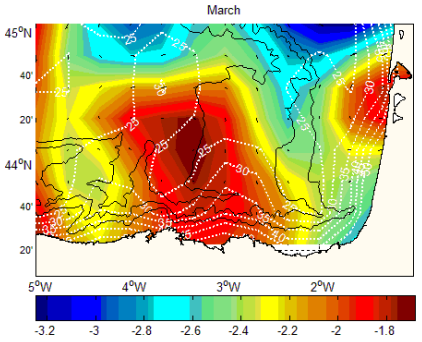
* The eddy tracking method has been developed by B. Blanke and N. Grima of the LPO laboratory (Brest, France).

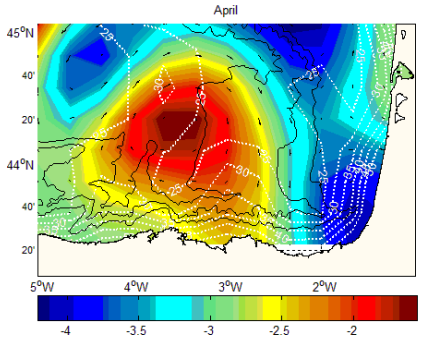
RESULTS

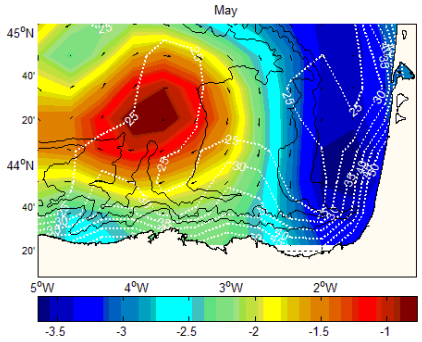
2003-2010 MONTHLY CLIMATOLOGIES

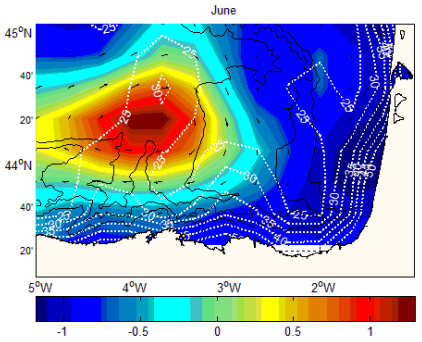


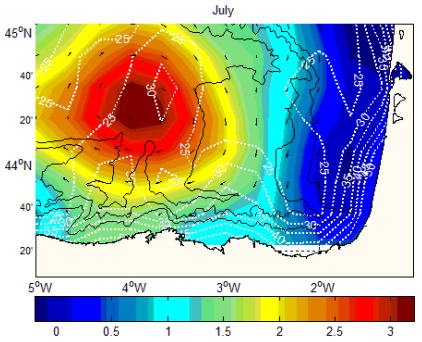


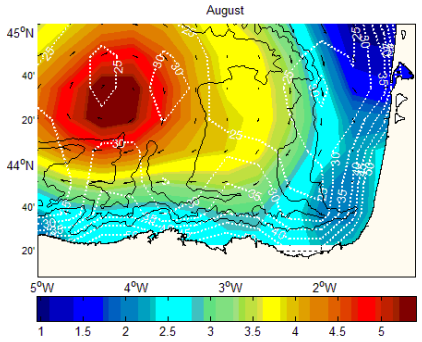


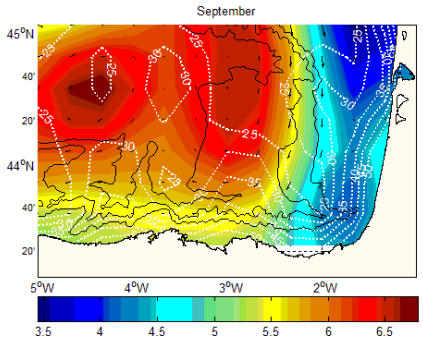


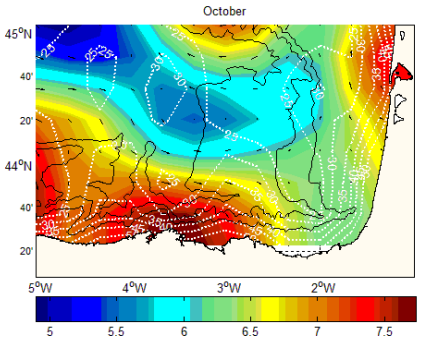


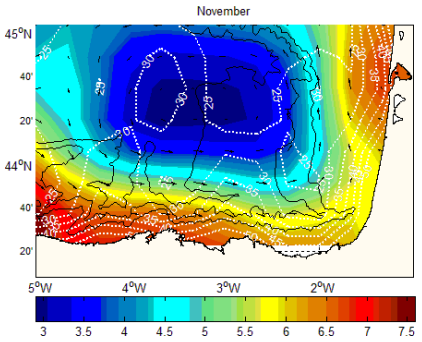


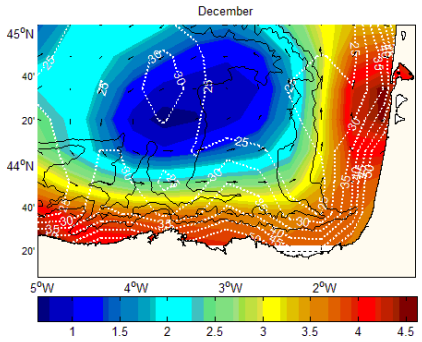






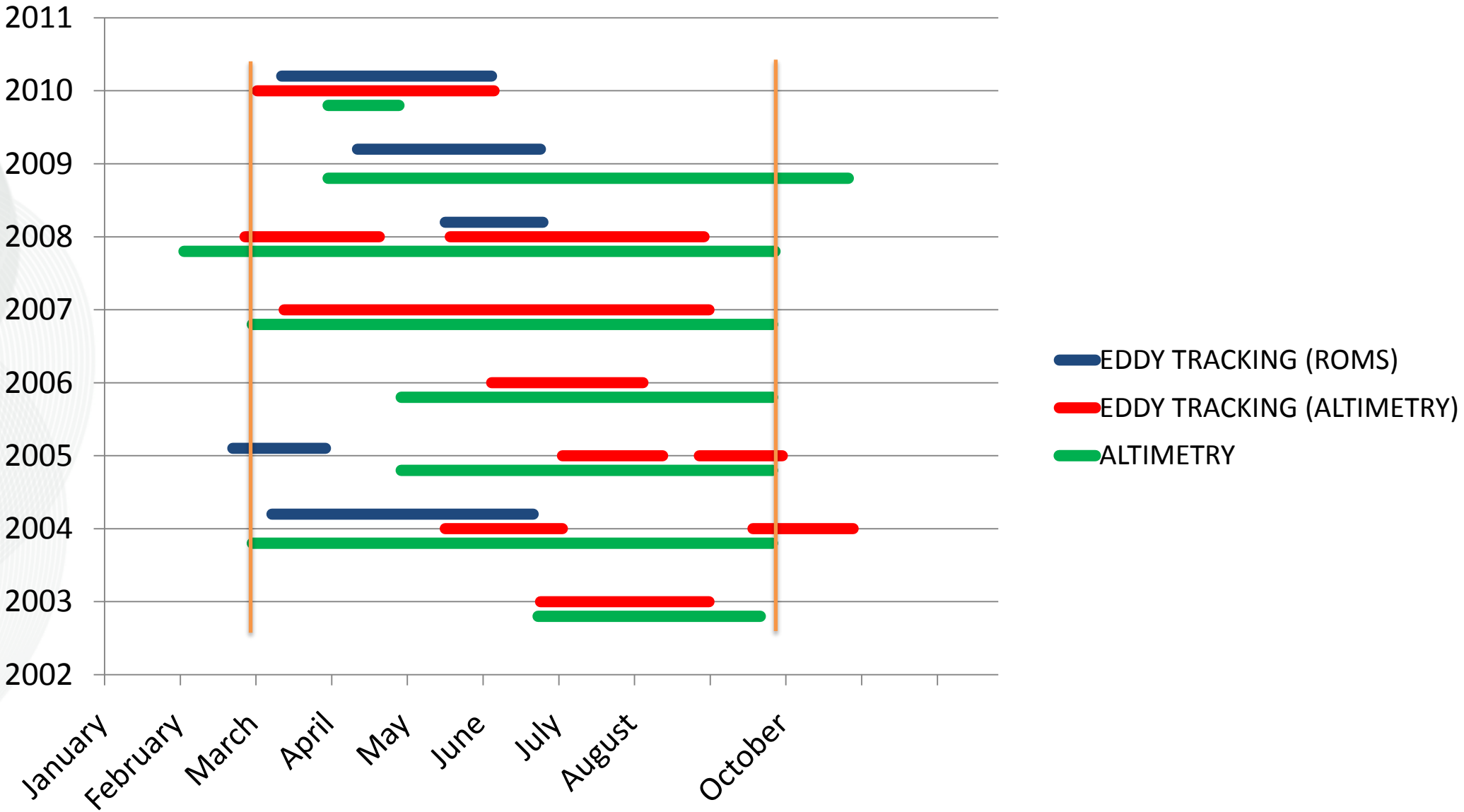






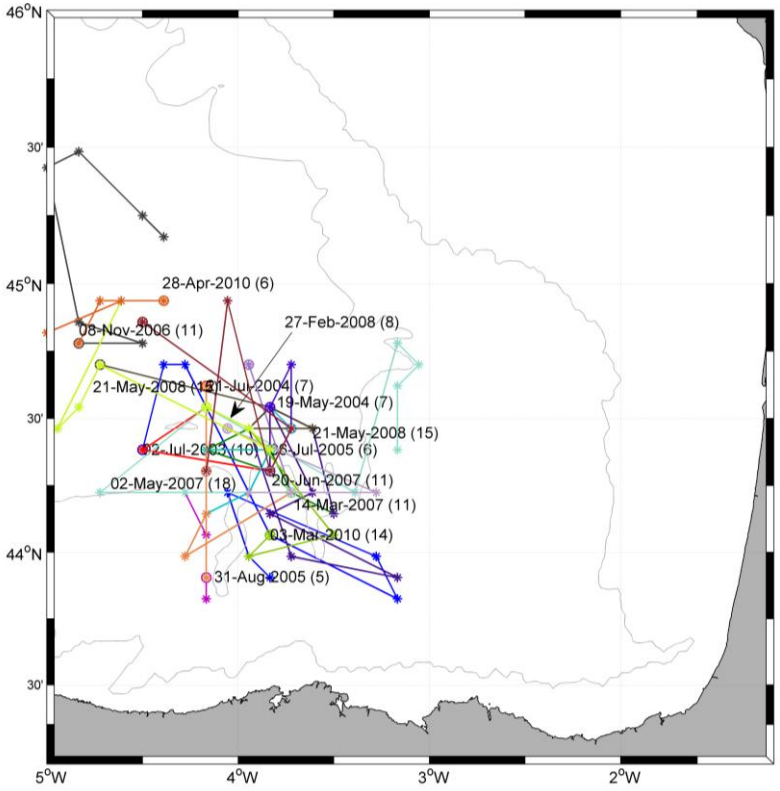
RESULTS

2003-2010 OBSERVATIONS-SIMULATIONS

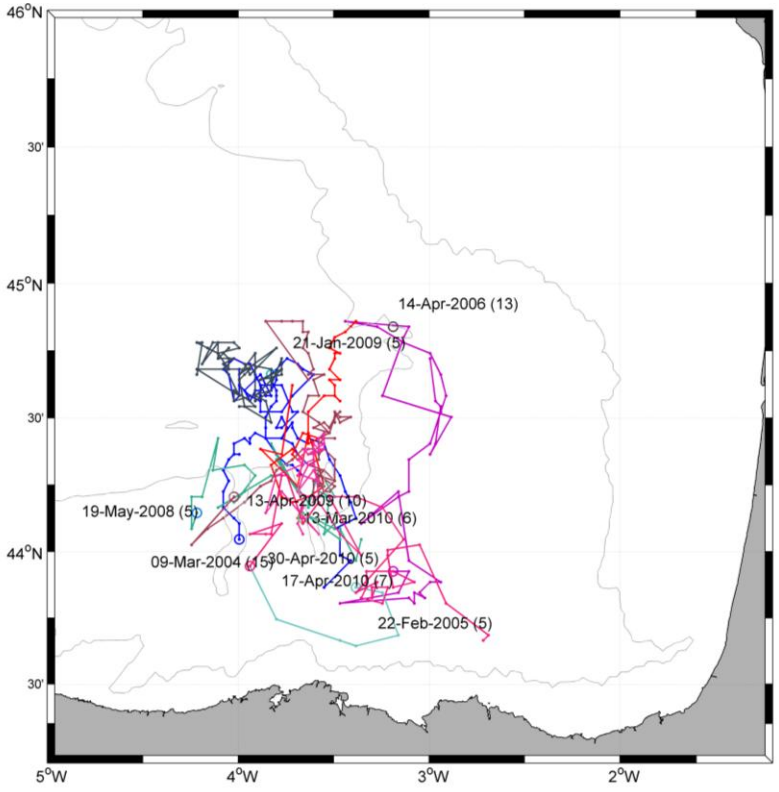


2003-2010 OBSERVATIONS-SIMULATIONS

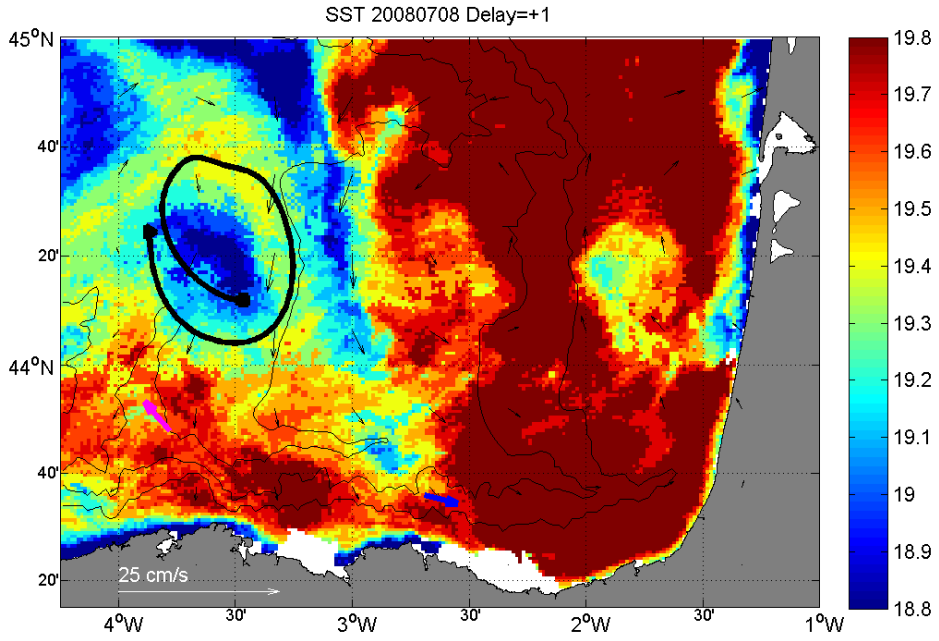
ANTICICLONIC EDDIES
EDDY TRACKING: ALTIMETRY

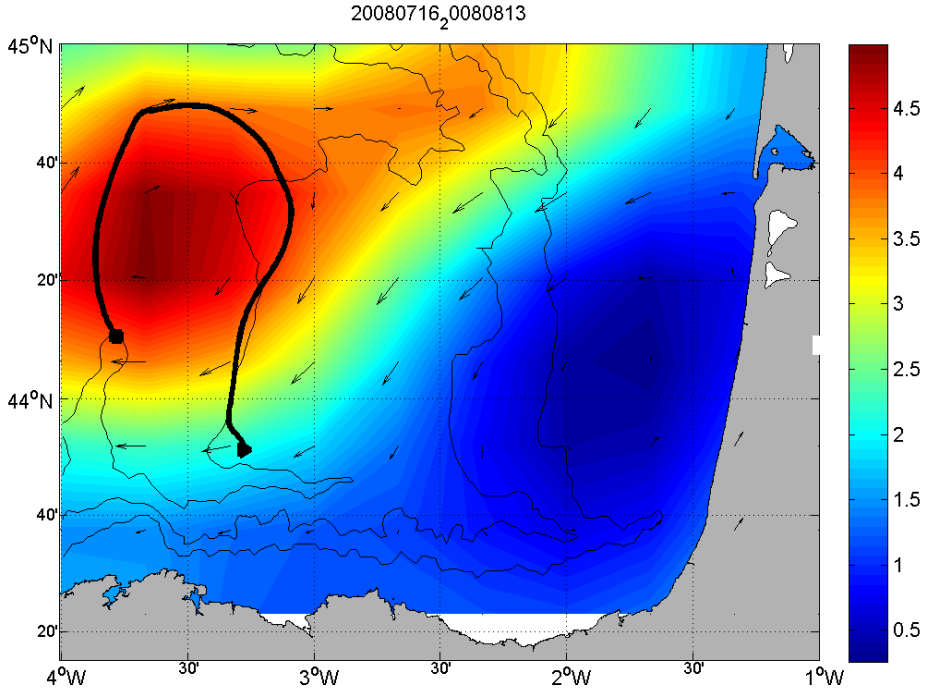


ANTICICLONIC EDDIES
EDDY TRACKING ROMS



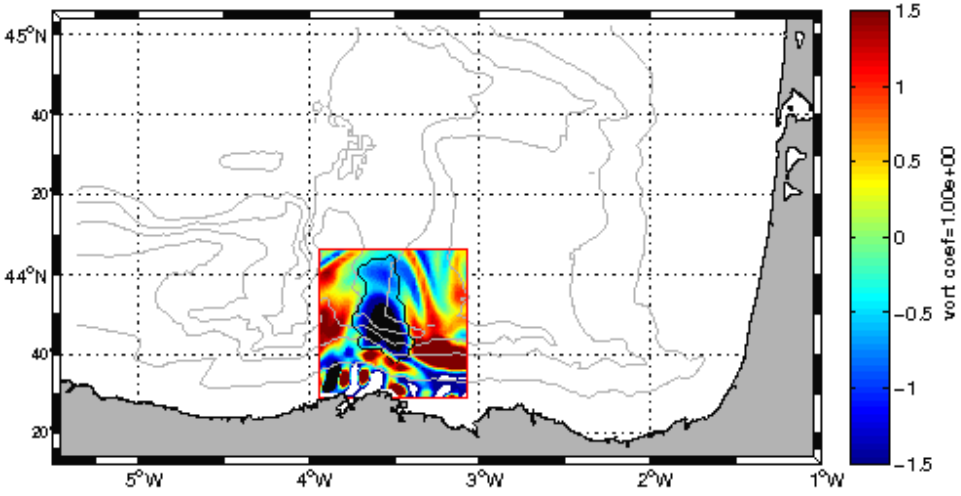
RESULTS: 2008

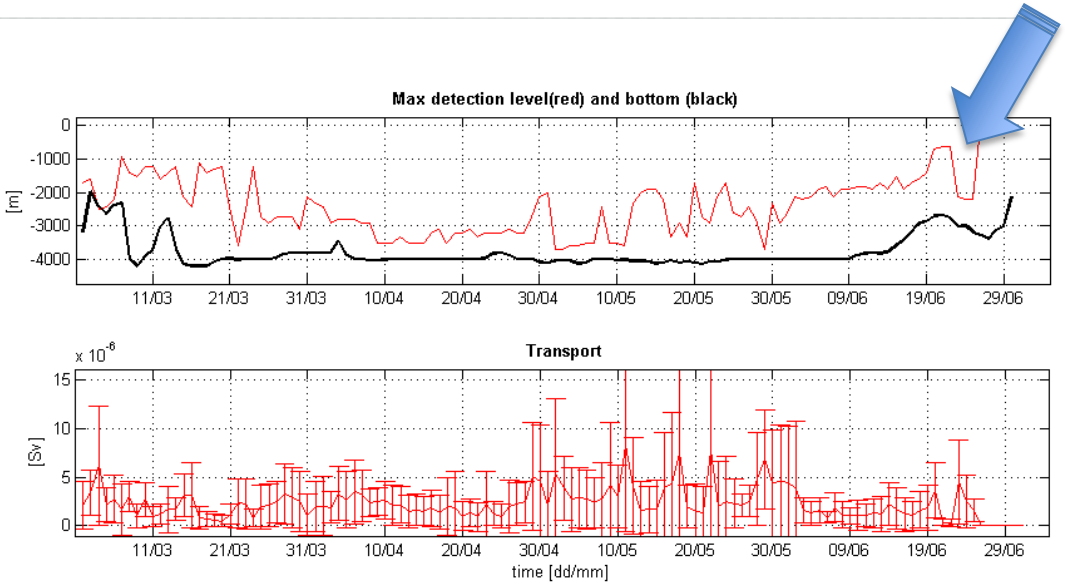


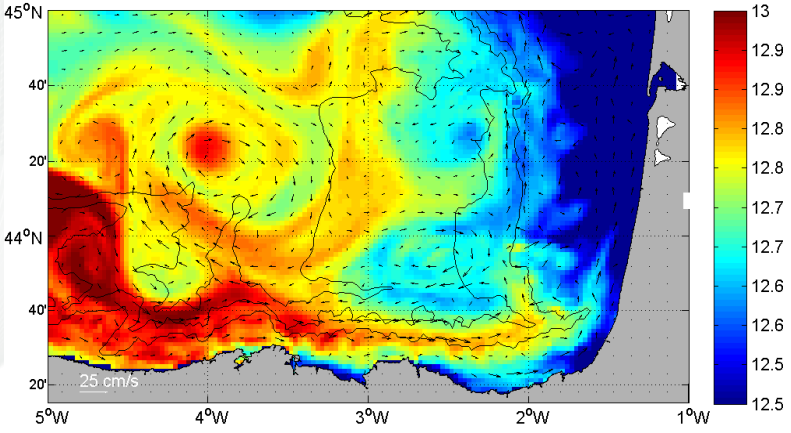


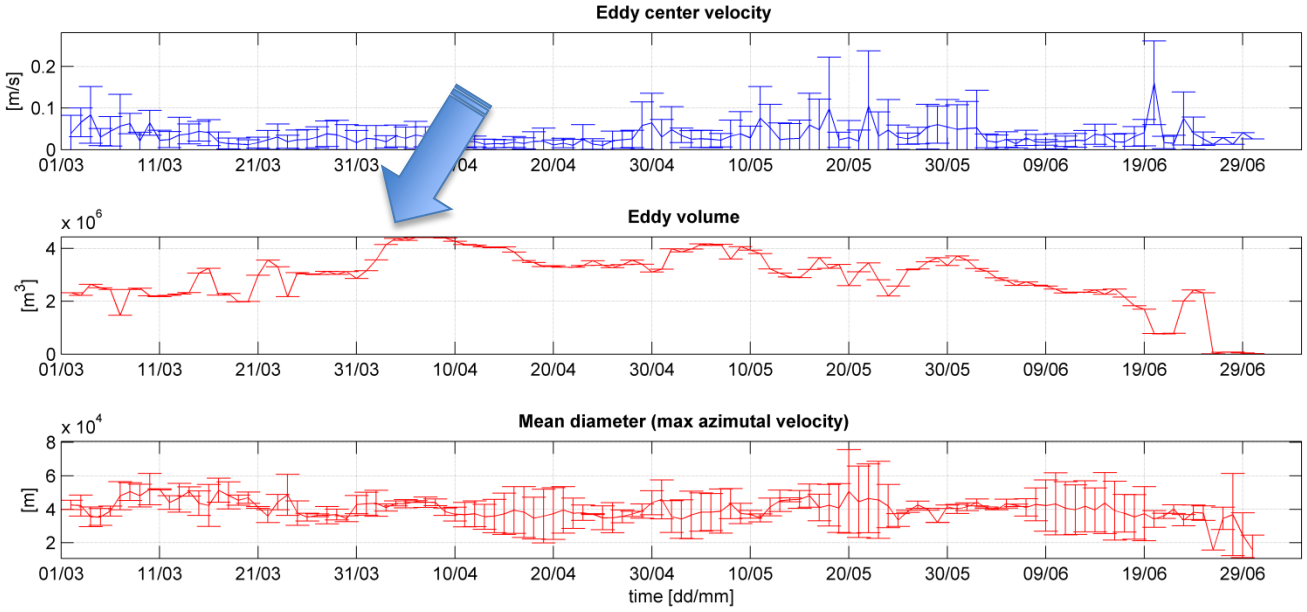
Results

MARCH 2004



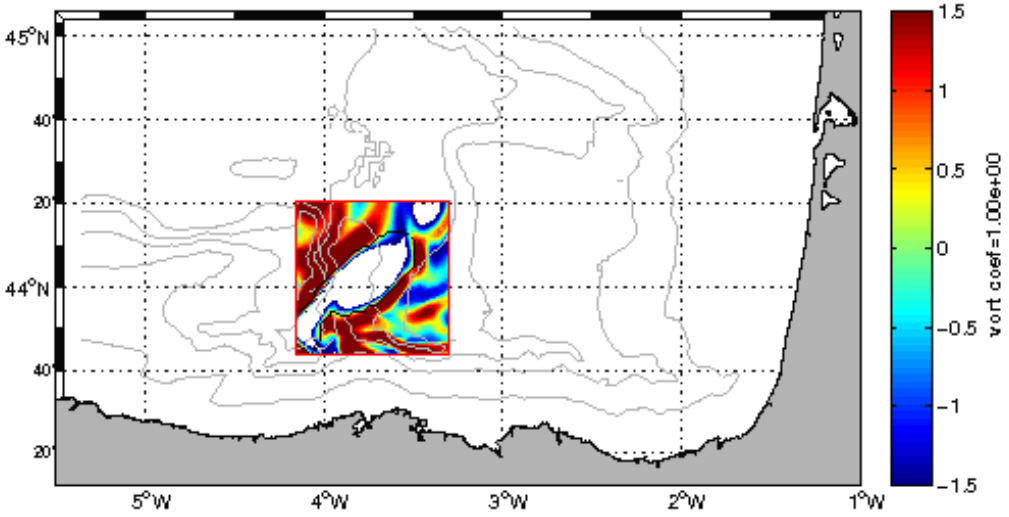


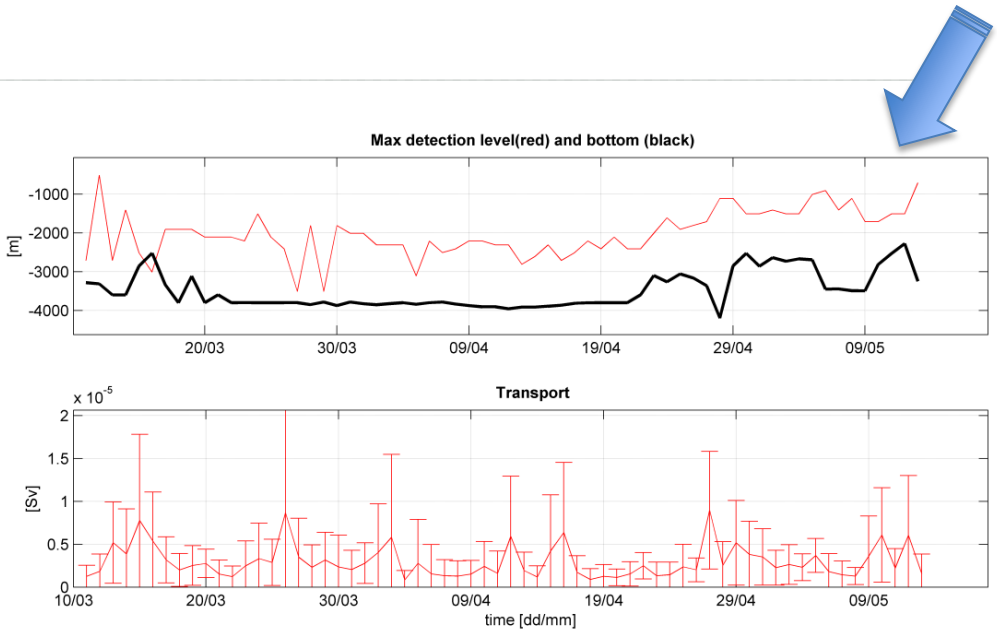


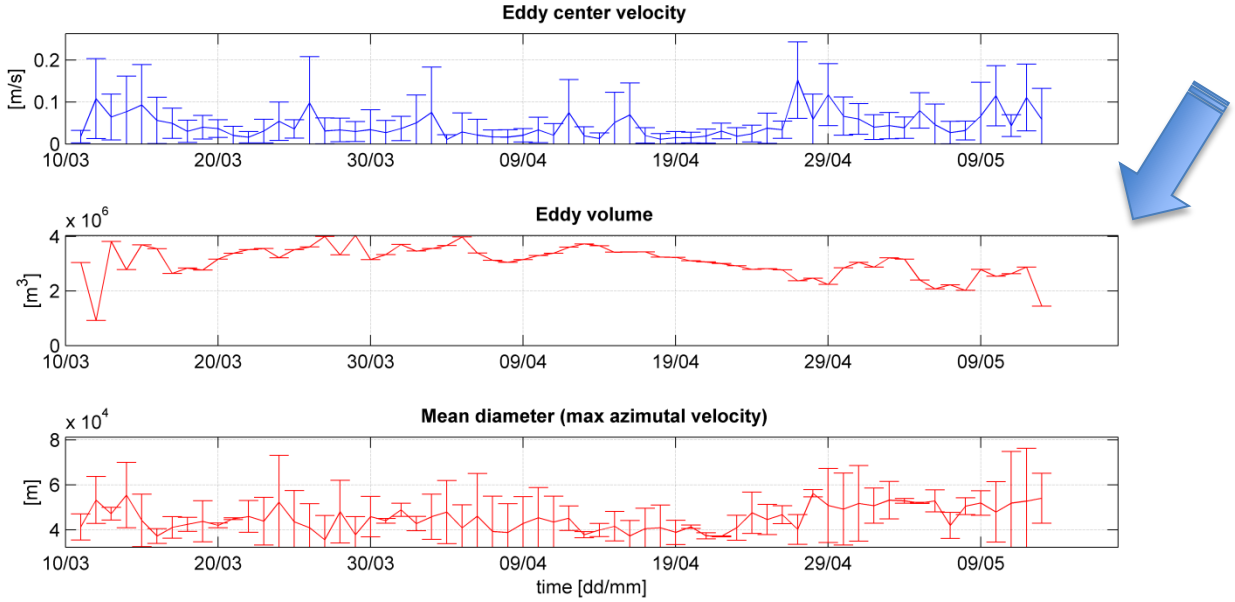


Results

MARCH 2010

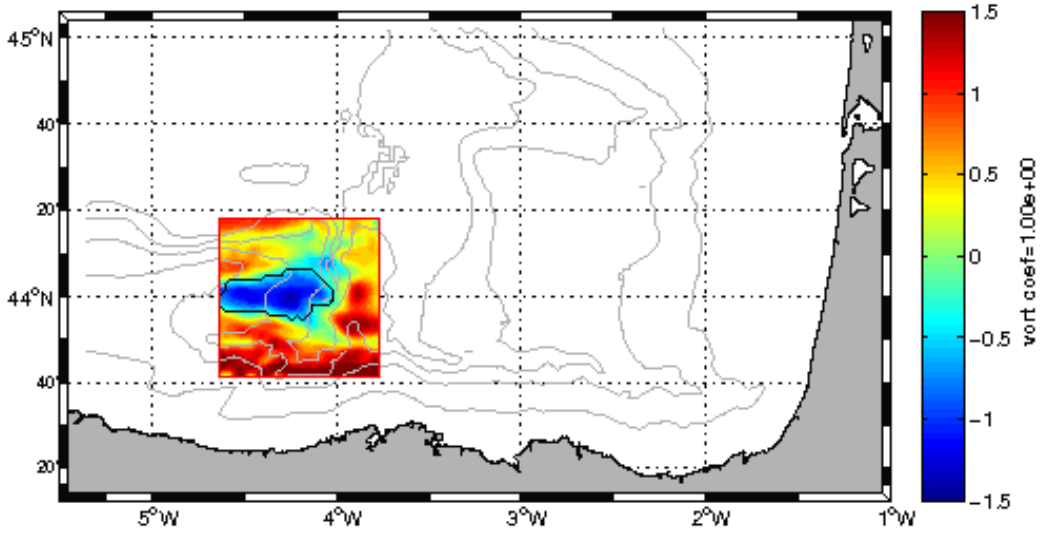


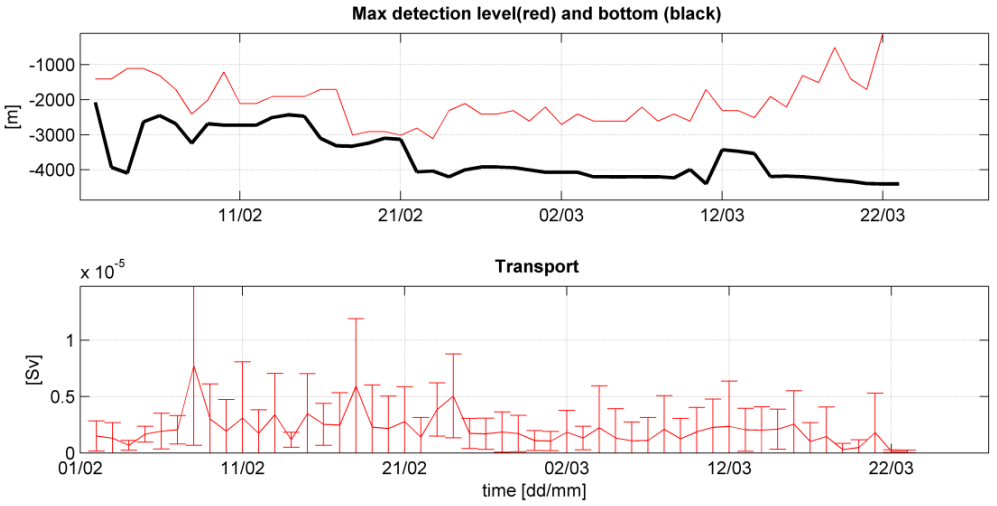


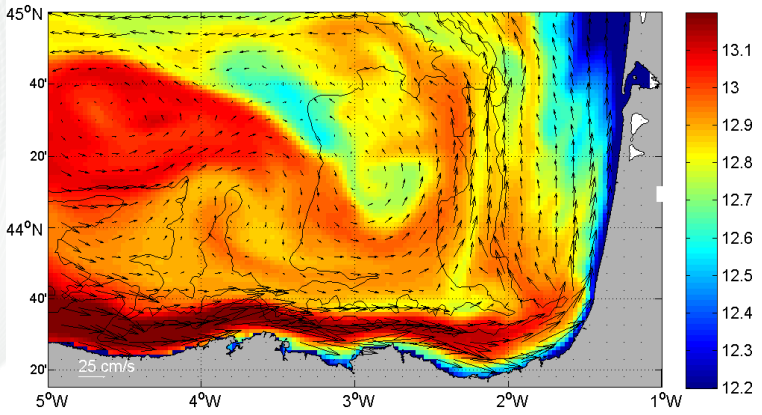


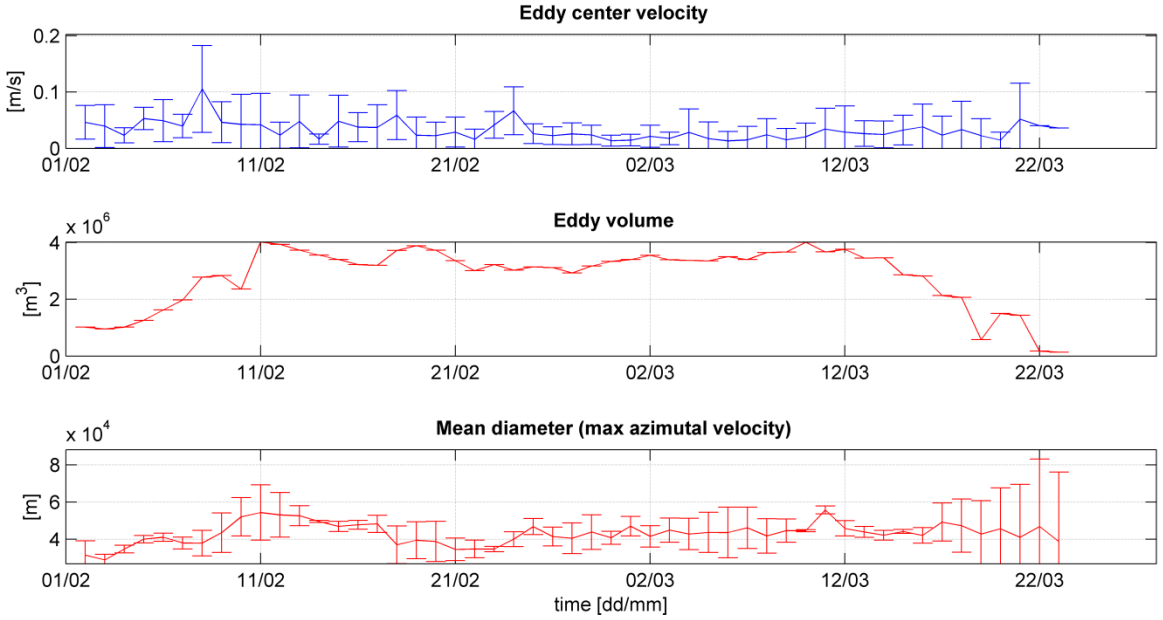
Results

FEBRUARY 2008



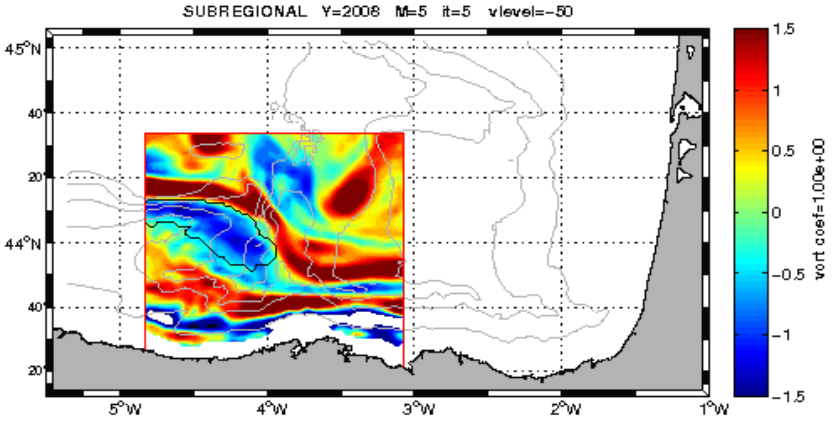


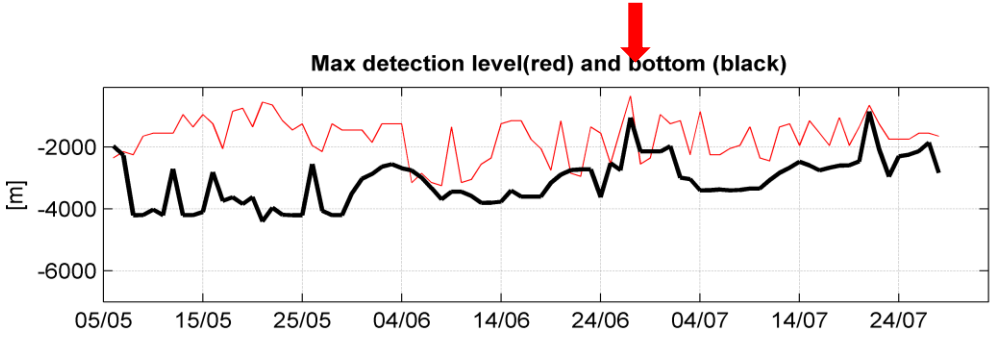


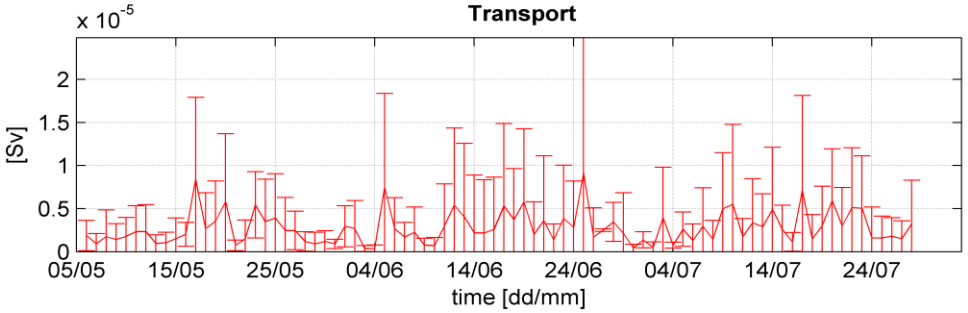


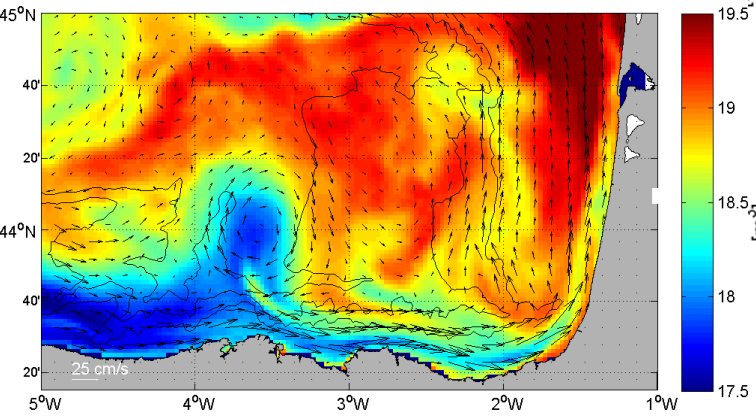
Results

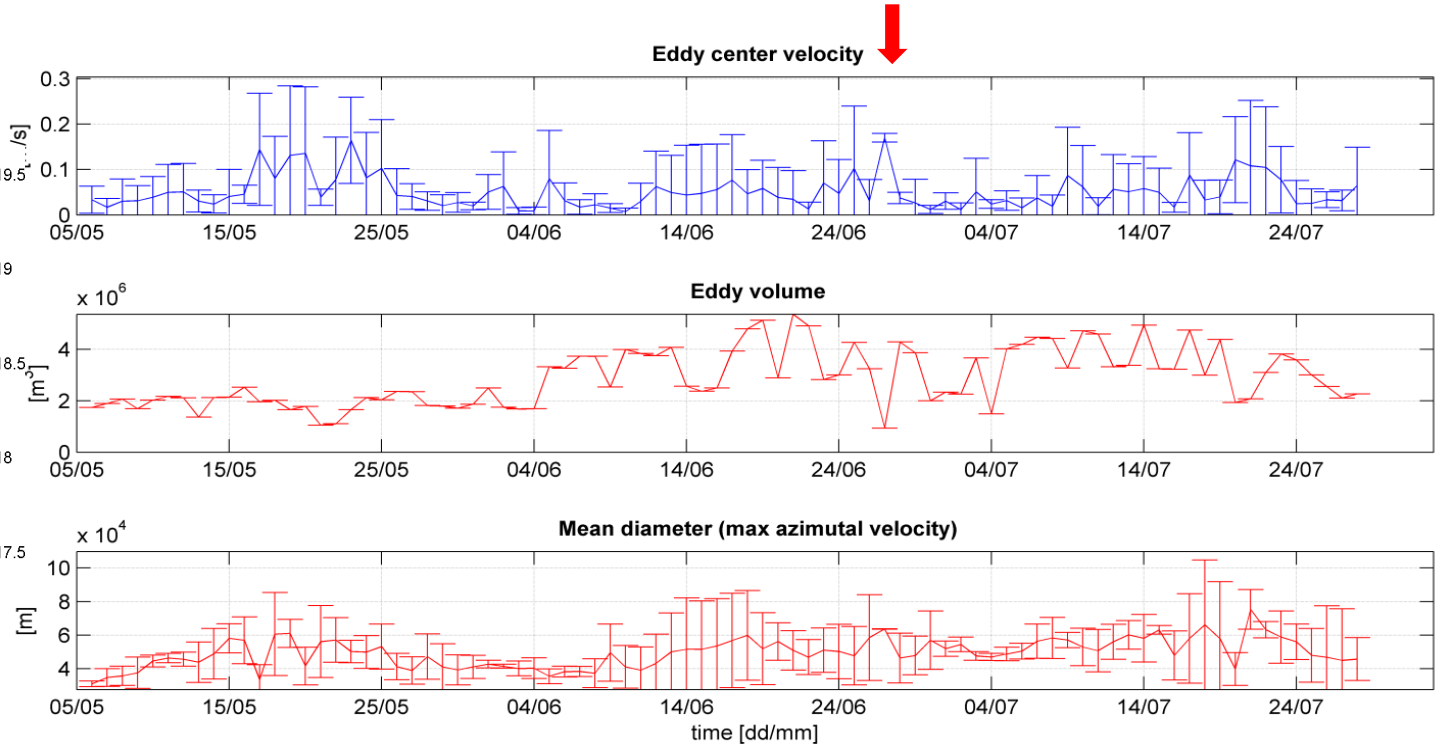
MAY 2008











CONCLUSIONS

- From 8 years of remote sensing derived data and numerical model outputs, a **recurrence** of anticyclonic eddies near 44ºN 4ºW has been observed.
- These structures are observed near the same position during months, from the **end of winter to the beginning of autumn**, depending on the year.
- The generation areas of these structures have been observed near **Cape Breton and Torrelavega canyons** from model simulations (different years) and satellite derived SST images (2008).
- These anticyclones tend to interact with **cyclones**, changing their characteristics (volume, energy, dynamics…).
- The simulated anticyclones extend from the surface until more than **3000 m** depth in some cases.
- The origin of these structures appeared to be the instabilities of the slope current near these topographic irregularities. Nevertheless, which are the specific **conditions** of this current (speed, direction, depth, …) that lead to the generation as well as the **retention** of these structures, remain unanswered.
- The IR and visible satellite images suggest that these structures contribute to the SST and chlorophyll distribution in the area of study and consequently can also contribute in other **biological** species.

Merci beacoup!