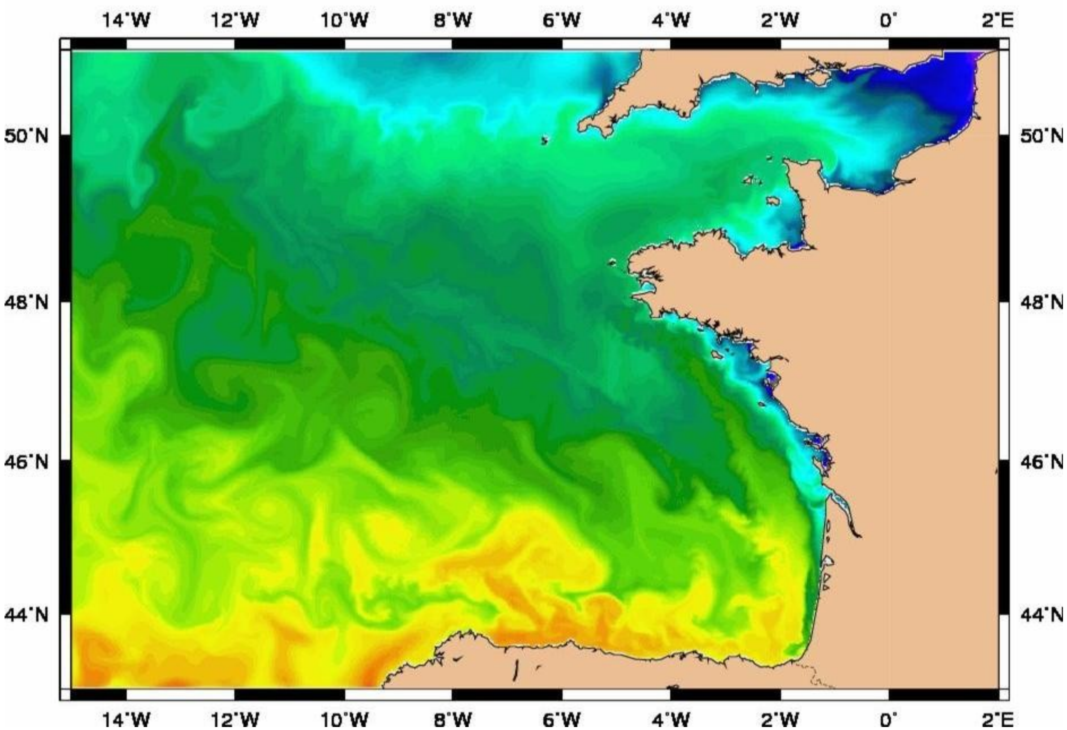
Real time modeling of the bay of Biscay



Stéphanie Louazel, Rémy Baraille, Annick Pichon, Cyril Lathuilière, Yves Morel

LOM2011 Miami 7th -9th February 2011

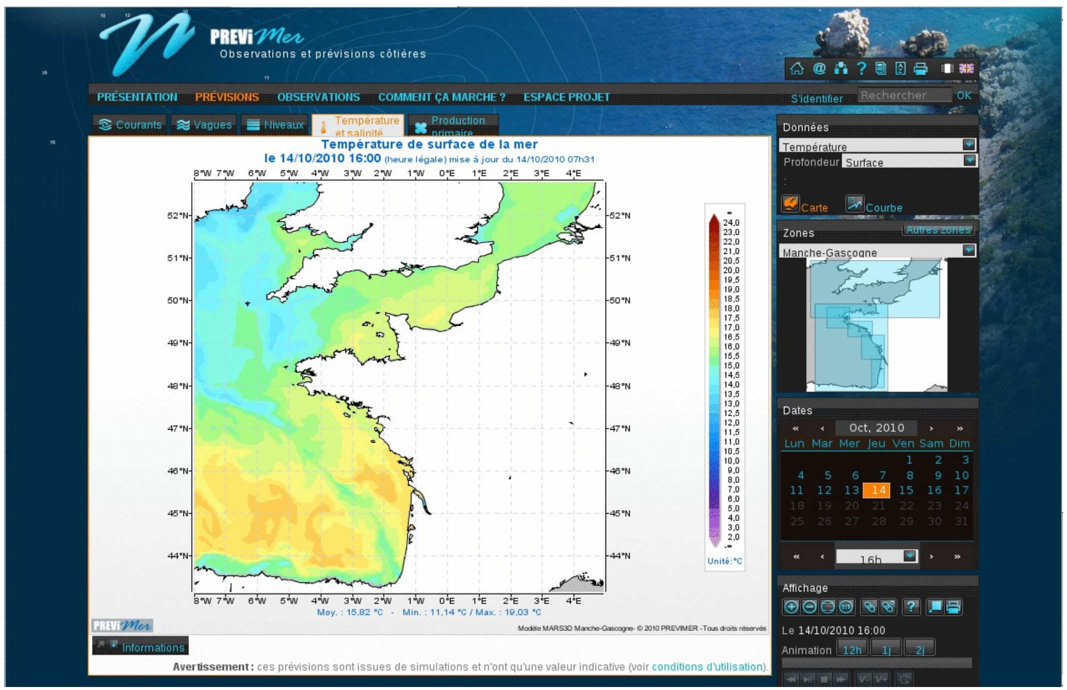
SHOM

L'océan à la carte

Purpose

✔ to include the bay of Biscay model in PREVIMER by this year

✔ to have an operational system that provides data for both civil and military uses



PREVIMER

✔ project managed by Ifremer

✔ SHOM partner

✔ pre-operational system

✔ short-term forecasts about the coastal environment along the french coastlines

✔ observation and modeling data

Outline

1- System description

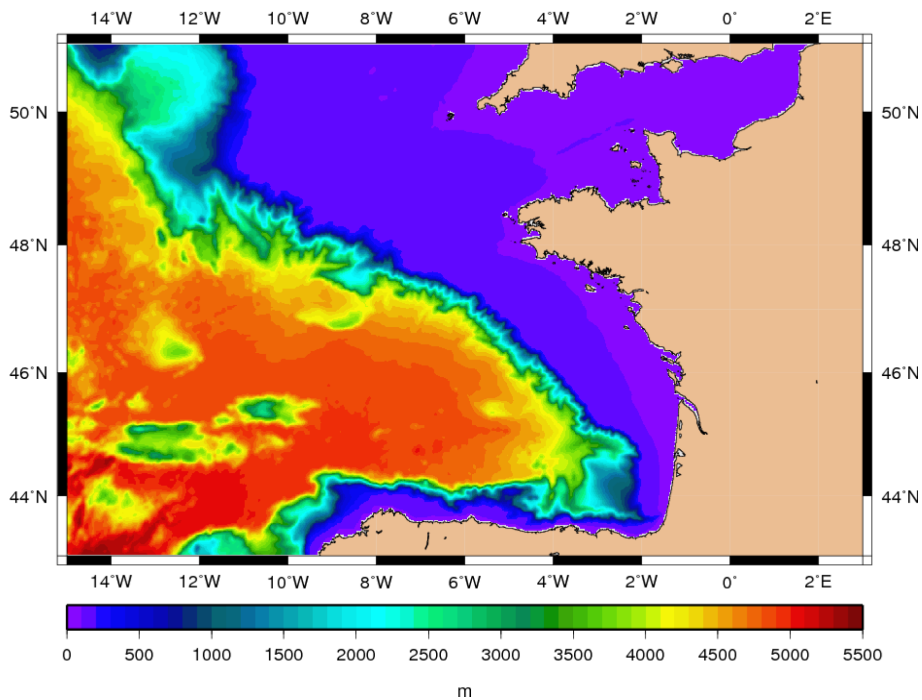
2- Diagnostics

3- Validation

Bay of Biscay HYCOM model

Area : 15°W to 3°E, 43°N to 51°N

Resolution : 1' (720x471), 32 layers



Bathymetry

Configuration :

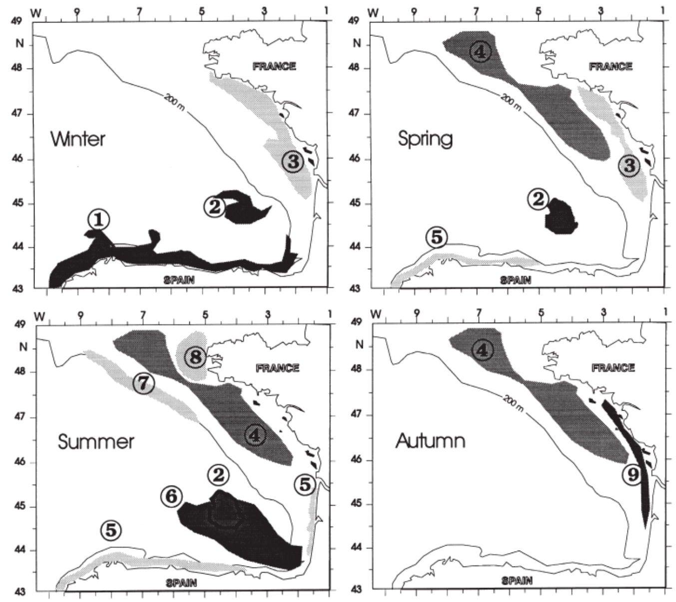
- ✔ no assimilation
- ✔ meteorological forcing : Météo-France (0.5°)
- ✔ tide : MOG2D (Legos lab)
- ✔ boundary conditions : Mercator outputs
- ✔ rivers outflows

A few characteristics

- ✔ KPP mixing
- ✔ non-linear barotropic equations
- ✔ monthly target densities

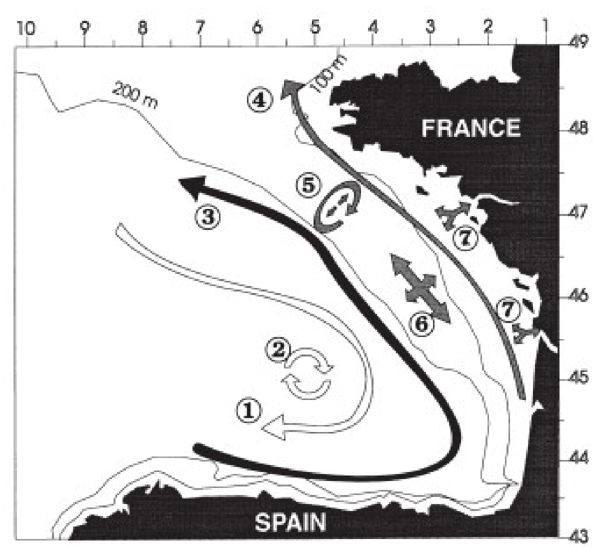
Processes in the bay of Biscay

Main hydrological structures



1 winter warm current (Navidad)
2 swoddies
3 river plumes
4 cold water masses
5 upwellings
6 warm water of the bay
7 slope fronts
8 tidal fronts
9 warm water tongue

Circulation and currents



1 general oceanic circulation
2 eddies
3 slope current
4 shelf residual circulation
5 tidal currents
6 wind induced currents
7 density currents

C. Koutsikopoulos and B. Le Cann (1996)

Scenario

✔ the system is run daily from D-2 to D+5,

✔ 3 steps

Pre-processing

✔ nesting

✔ meteorological forcing

✔ rivers outflows

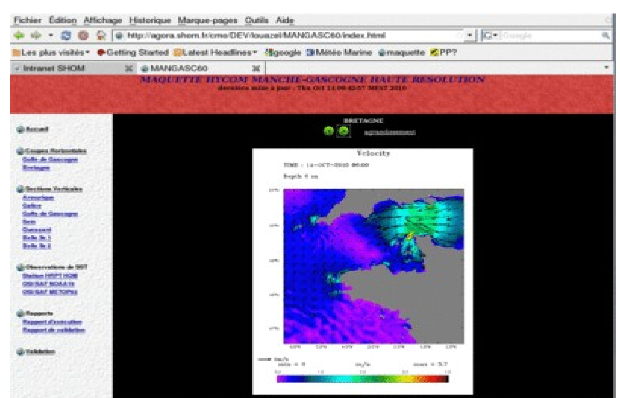
→ **HYCOM run** →

Post-processing

✔ diagnostics

✔ validation

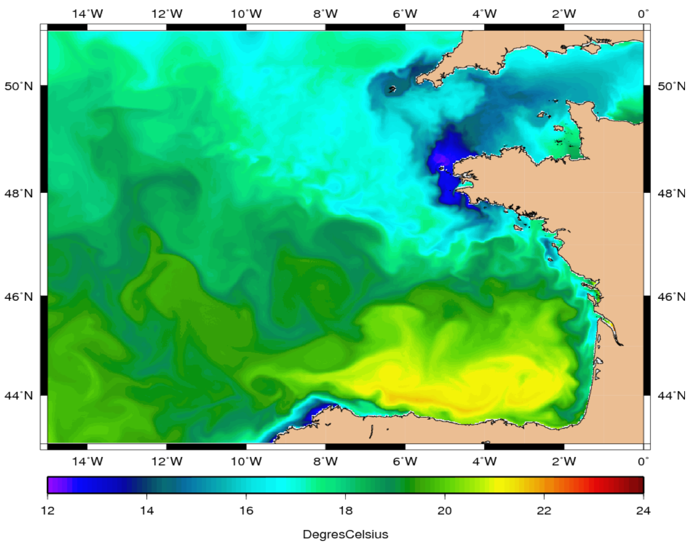
✔ intranet website daily updated



Maps

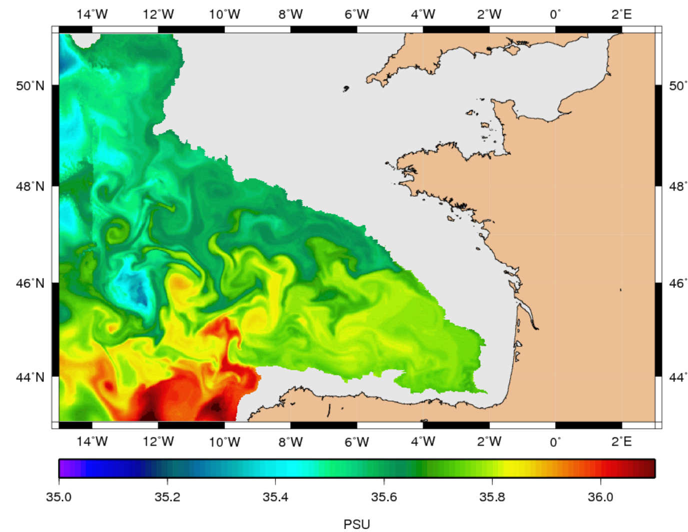
Temperature

Date : 2010/08/16 00:00 TU Layer 1



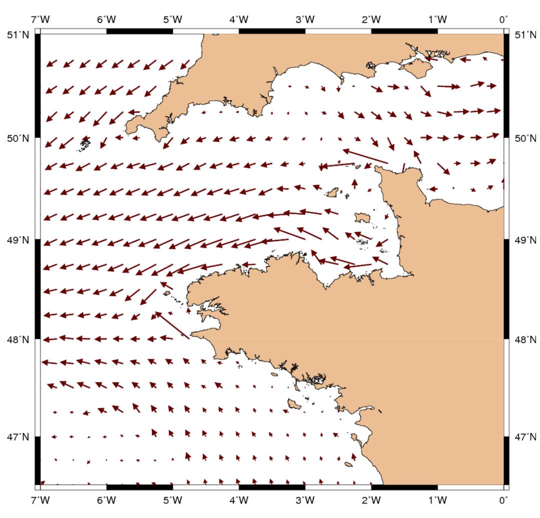
Salinity

Date : 2011/01/26 03:00 TU Depth 1000.00 m



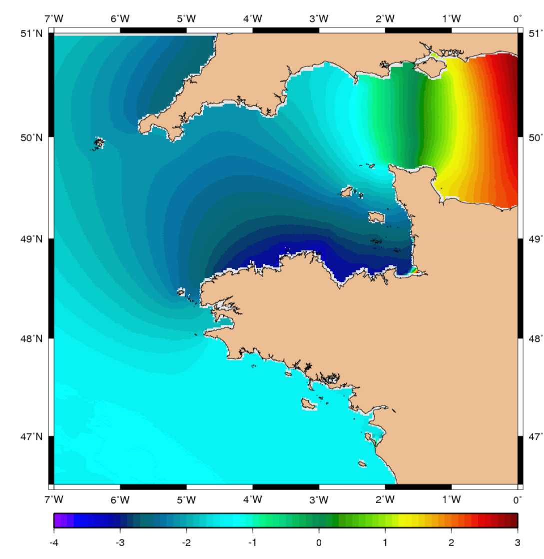
Current

Date : 2010/12/10 01:00 TU Layer 1



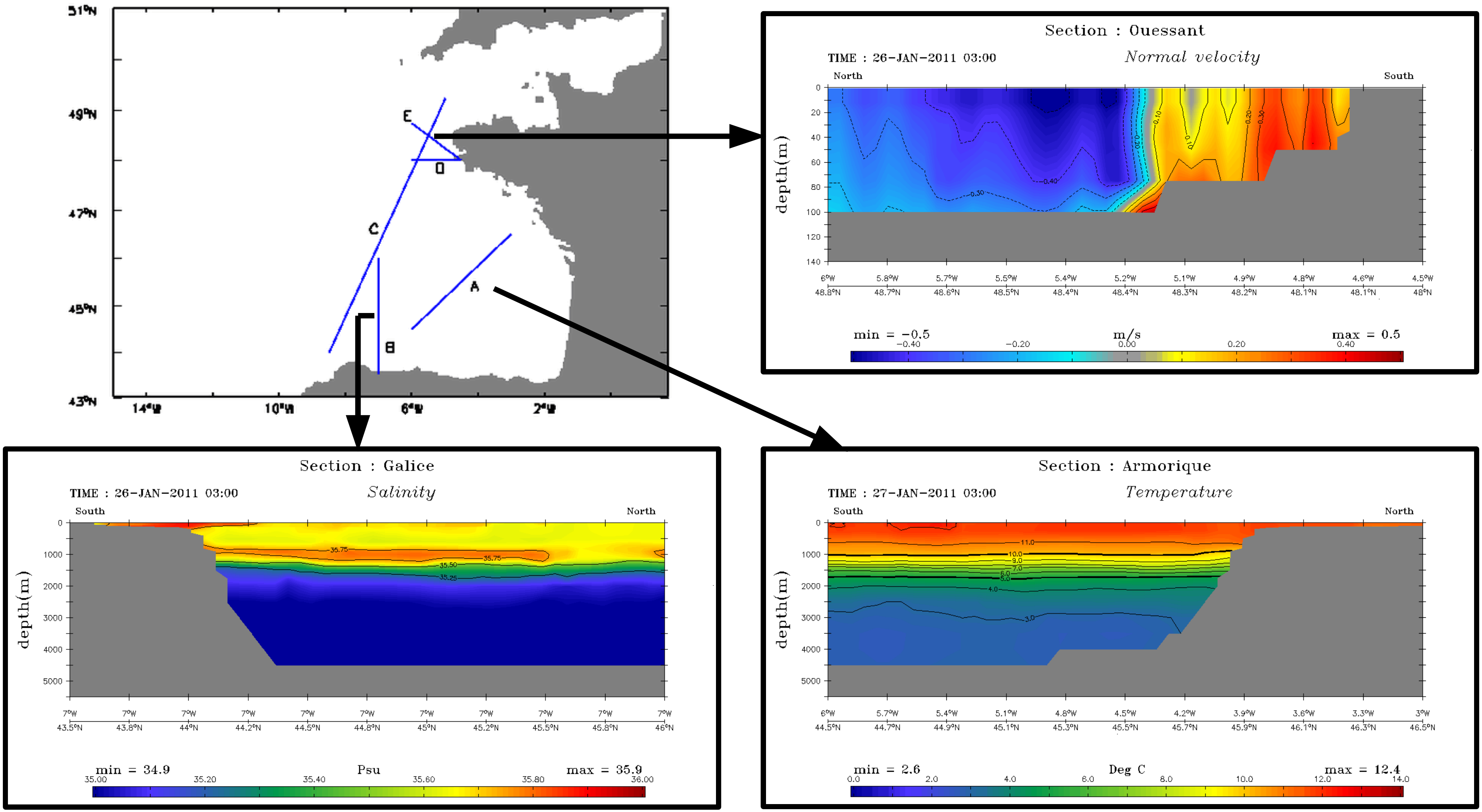
SSH

Date : 2010/12/10 01:00 TU



2- Diagnostics

Vertical sections



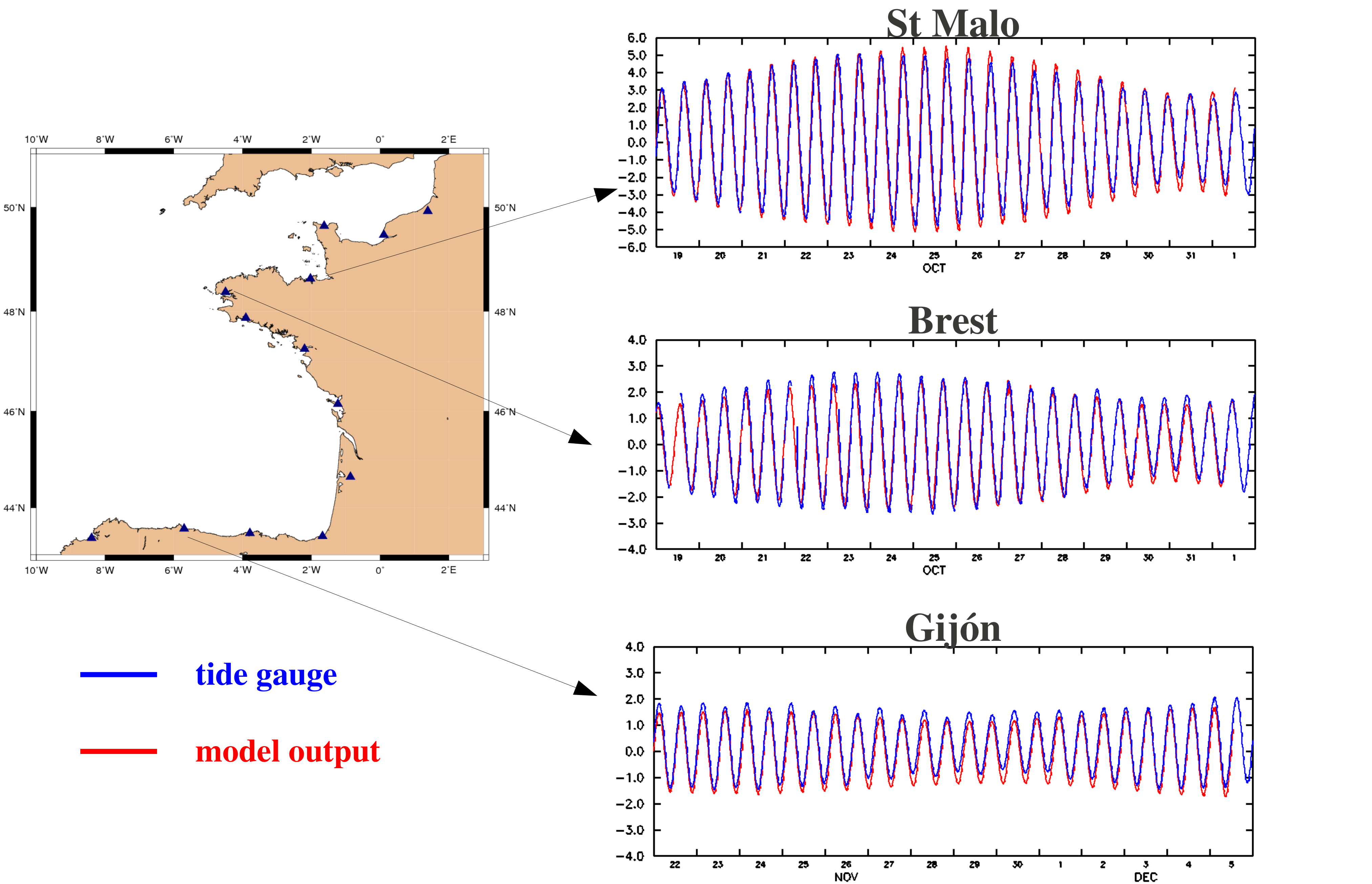
Processes detection

Criteria have been defined to automatically detect in the model output the following dynamical processes :

- ✔ Ushant front (tidal front)
- ✔ upwelling
- ✔ warm water tongue
- ✔ cold water masses
- ✔ winter warm current
- ✔ mediterranean water

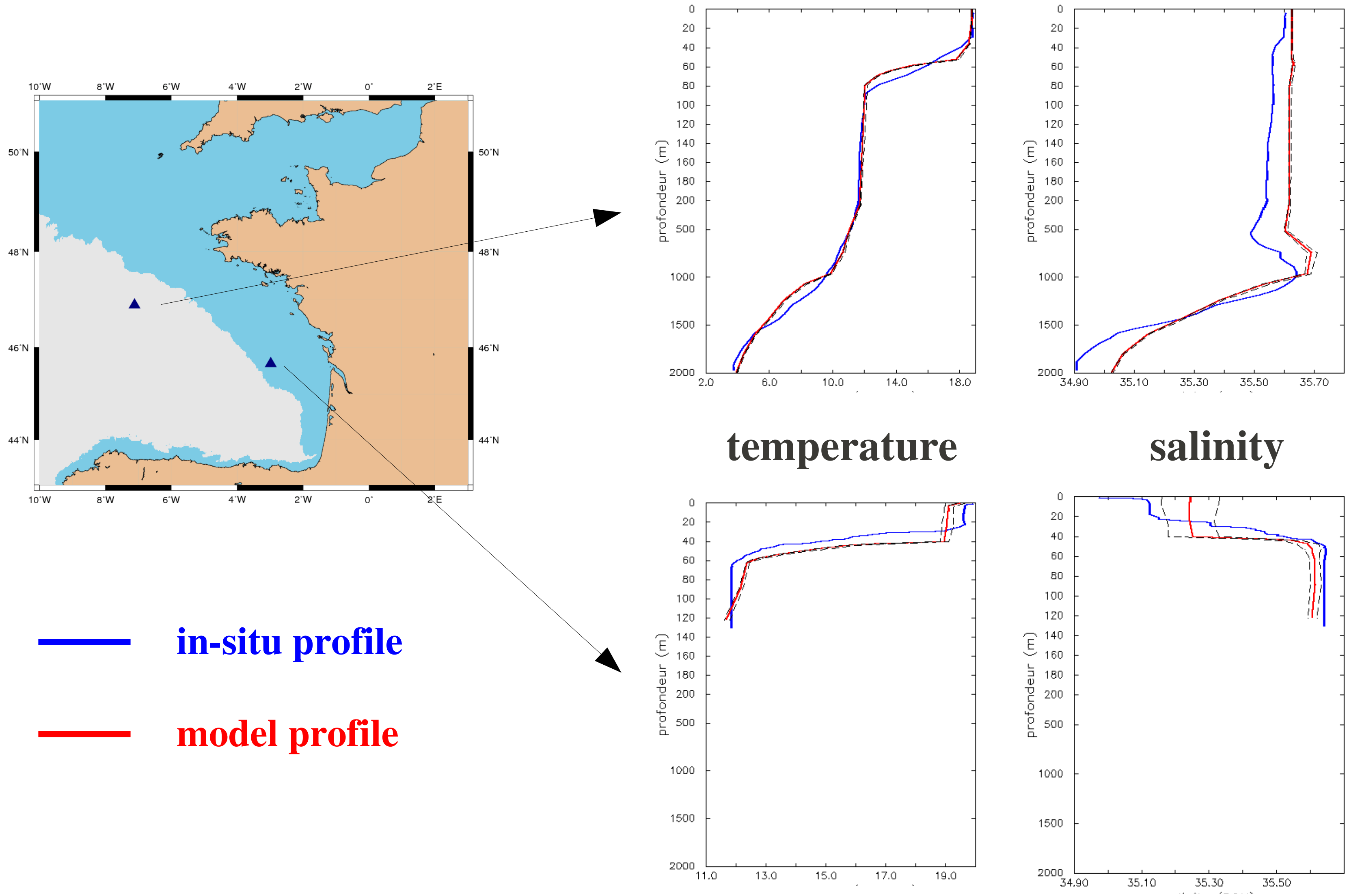
Front Ouessant	✔	• Sur la zone Ouest, le gradient vertical des moyennes des valeurs negatives inferieures a -1.80 (3 valeurs • Sur la zone Est, le gradient vertical des moyennes d valeurs absolues faibles inferieures a 0.80 (13 valeu • L'ecart entre les moyennes de temperature de surfa 2.00 (2.90)
Up welling des Landes	—	• ⚠ Moyenne des temperatures de la zone en bord de • Moyenne des temperatures de surface de la zone au • Moyenne des temperatures au large, a 50m de prof • Moyenne de la ssh au large (-6.32) doit etre superi
Langue d'eau chaude sur le plateau	—	• Moyenne des temperatures de surface sur la zone d • ⚠ Amplitude de la temperature le long de la coupe • La valeur du quantile a 80pourcent est comprise da la langue : [16.50 - 20.50] (18.88)
Bourrelet Froid	✔	• Moyenne des temperatures de surface sur la zone d • Moyenne des temperatures a 65m sur la zone doit e • Ecart-type des temperatures a 65m doit etre inferi
Navidad	—	• Moyenne des temperatures de surface sur la zone d • Moyenne des temperatures a 50m sur la zone doit e • ⚠ Le courant de surface doit etre oriente a l'Est, v surface= 146.46°) • ⚠ Le courant a 50m doit etre oriente a l'Est, valeu 179.86°) • Vitesse moyenne du courant doit etre superieure a
Eau mediterraneenne	✔	• Salinite moyenne a 1000m de profondeur doit etre

SSH: comparison with tide gauges



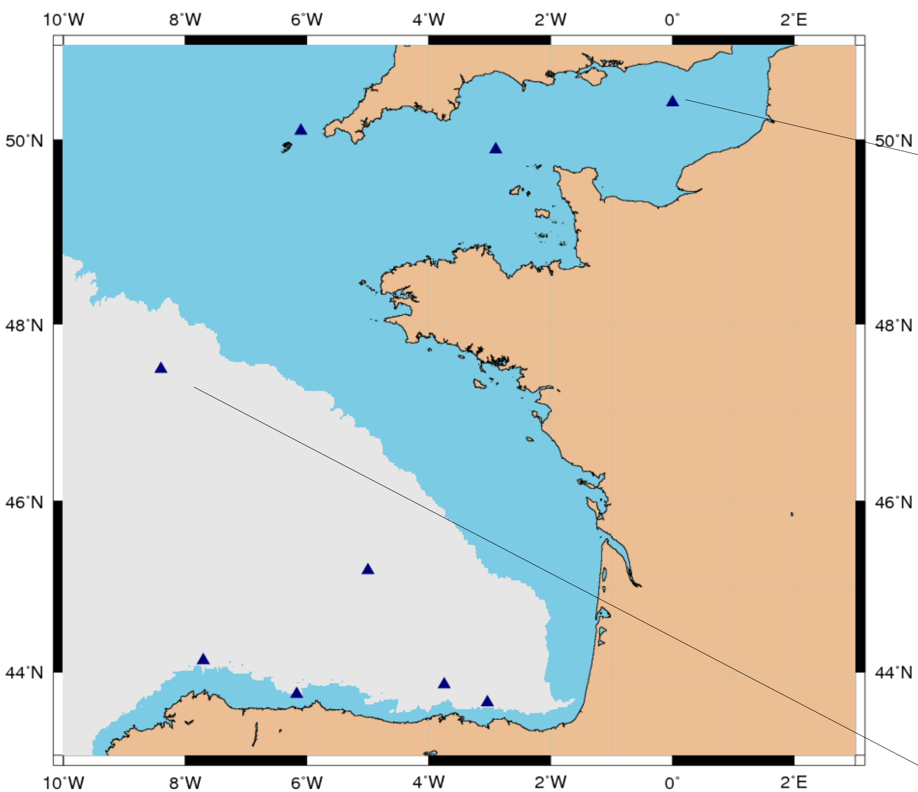
3- Validation

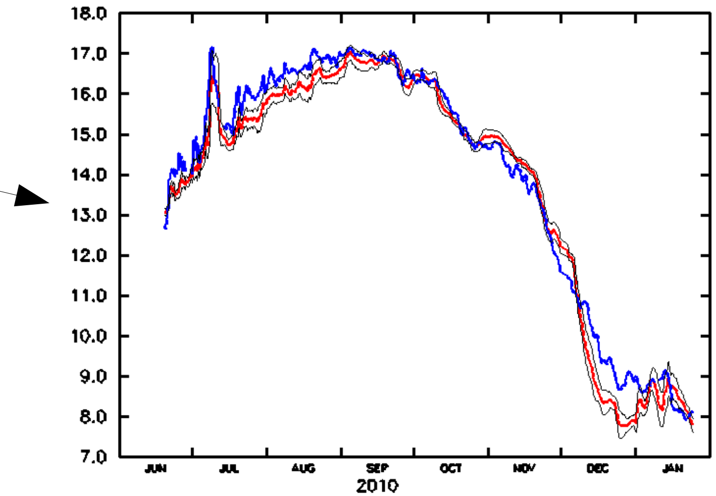
Temperature and salinity: comparison with in-situ profiles

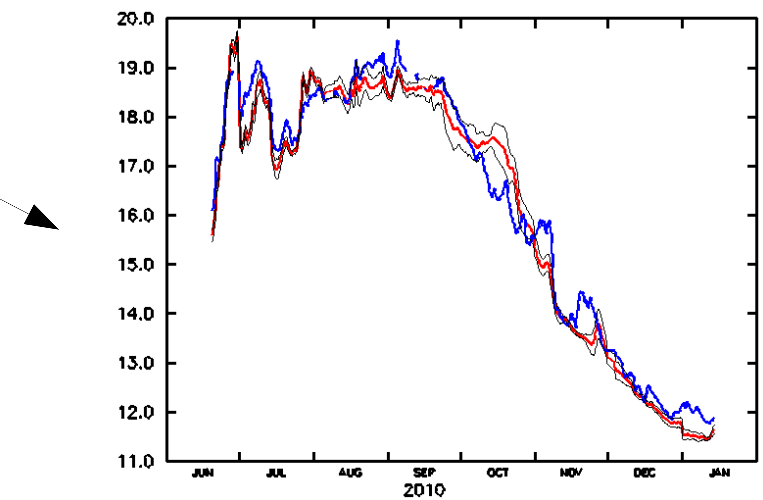


3- Validation

SST: comparison with permanent mooring data







mooring data

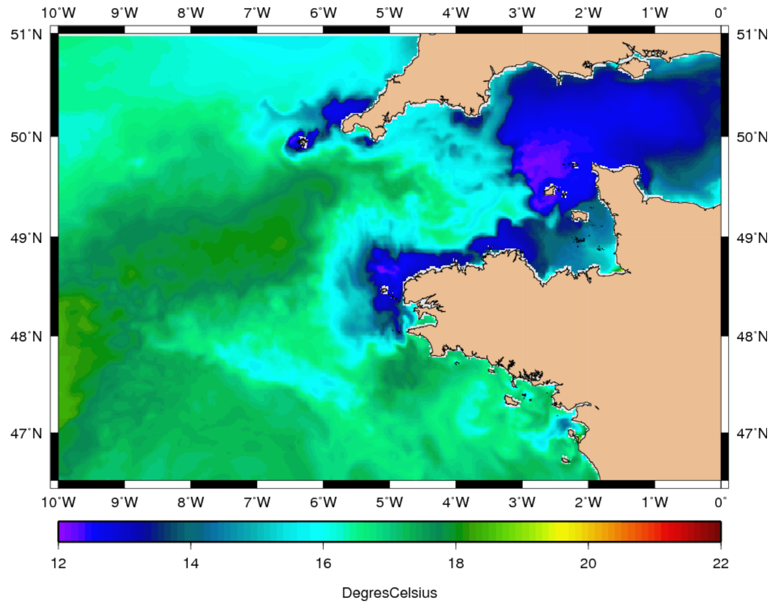
model output

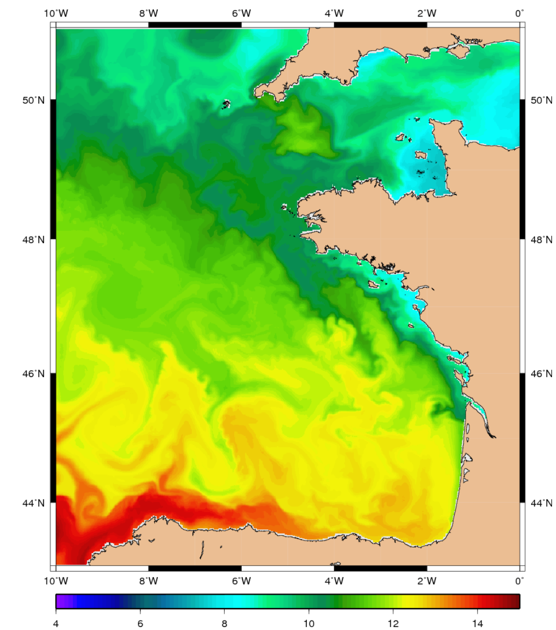
3- Validation

SST: comparison with satellite data

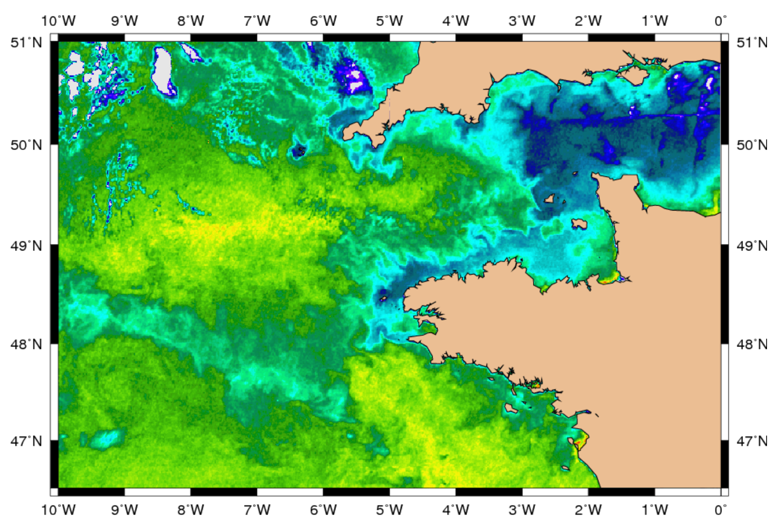
06/25/2010 **01/09/2011**

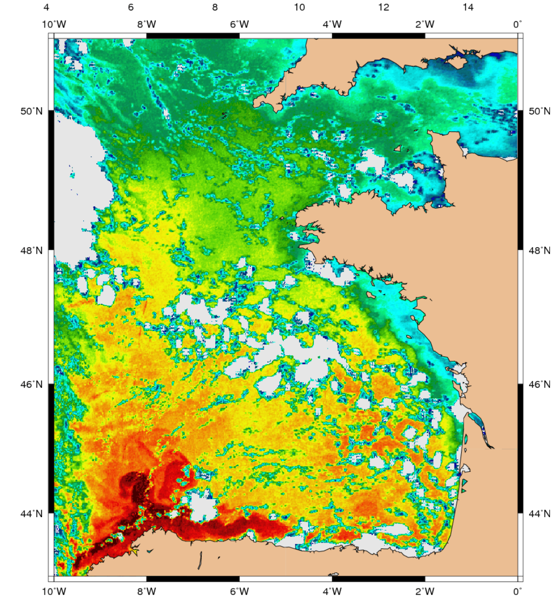
Model





Satellite

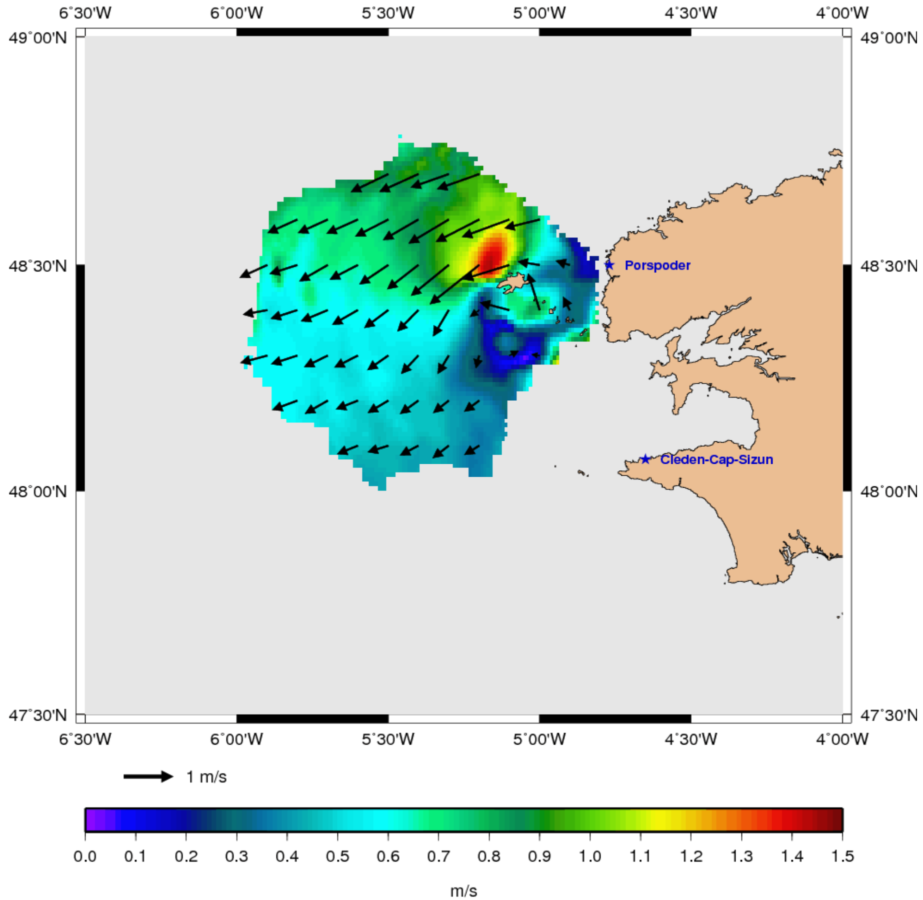




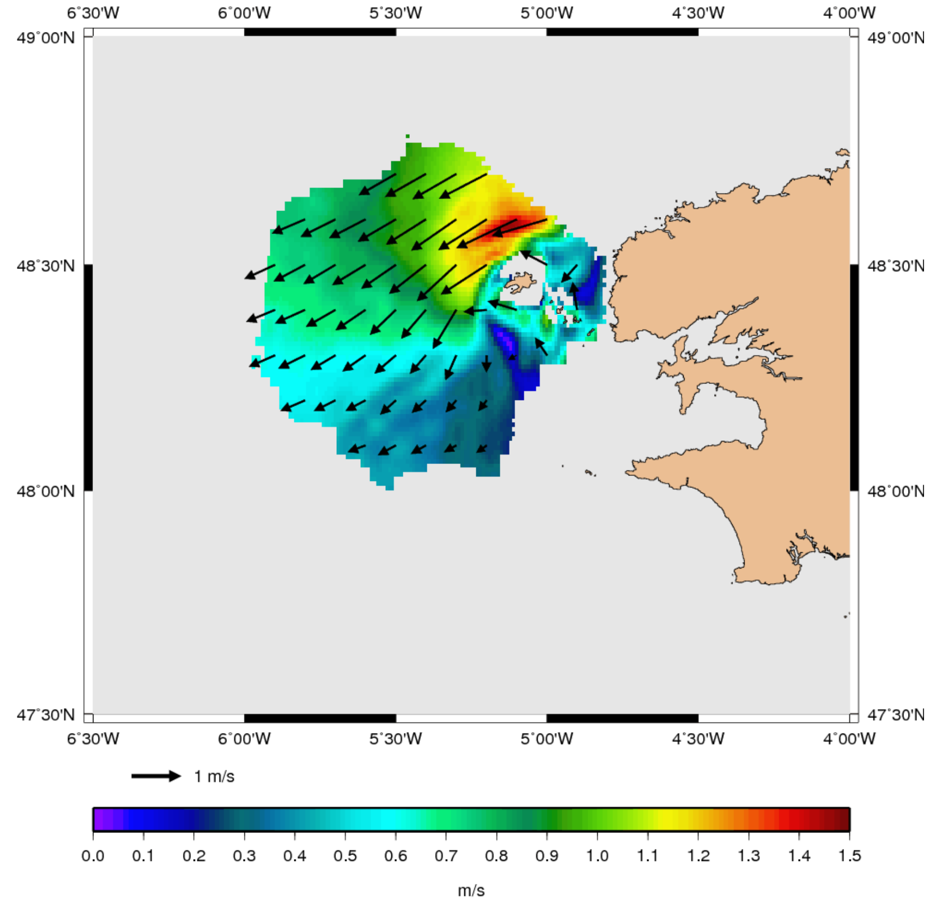
Surface currents: comparison with HF radars data

Total current 12/25/2010 01.00 PM

HF radars



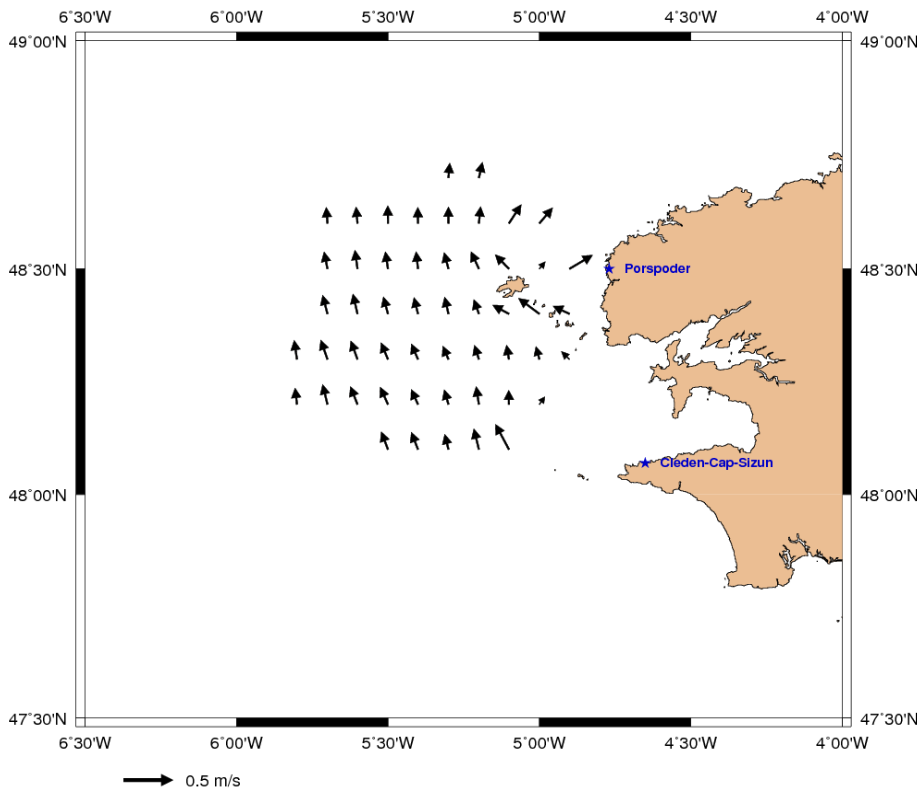
Model



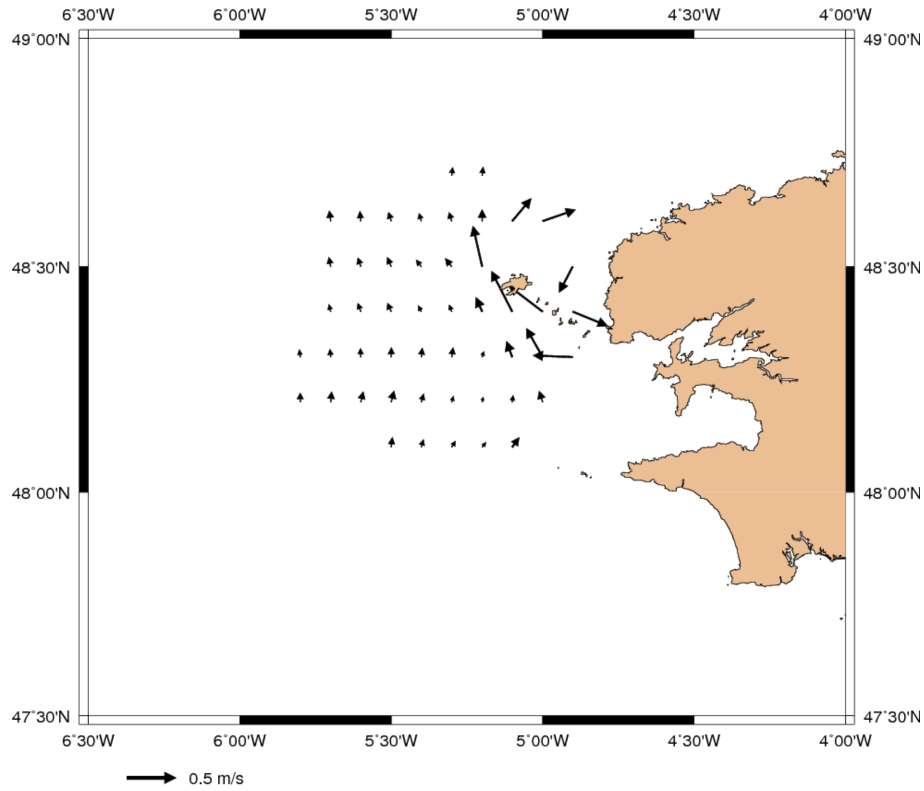
Surface currents: comparison with HF radars data

Residual current 12/26/2010 12.00

HF radars



Model



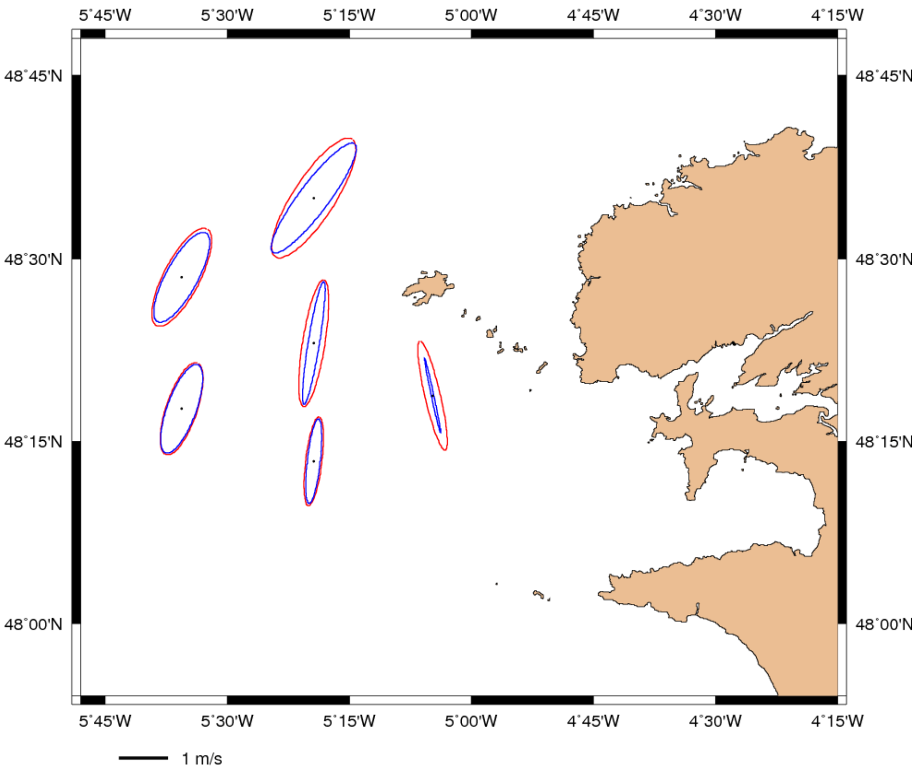
What can explain these differences ?

- small signal compared to the total current
- Stokes drift absent in the model
- smoothed HF radars data
- signal very sensitive to the rough bathymetry

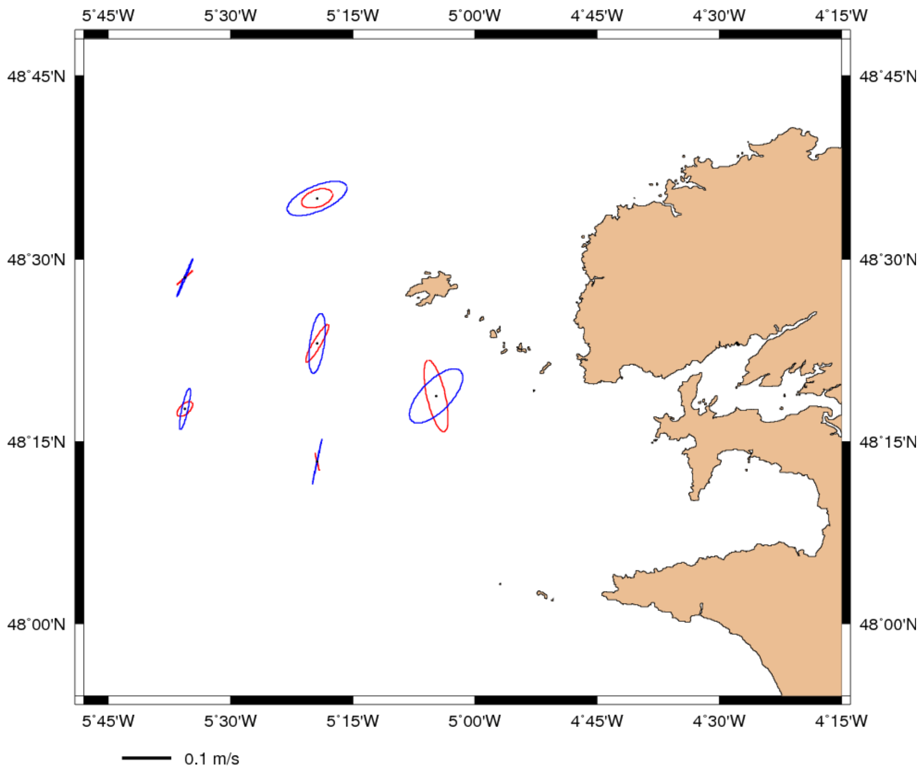
Surface currents: comparison with HF radars data

Tidal current ellipses

M2 constituent



M4 constituant



Model — HF radars

Problems : bottom friction, bathymetry ?

Conclusion

Real time system is continuously evolving

Validation tools

- ✔ to be improved
- ✔ quantitative indicators need to be developped

Model evolutions

- ✔ data assimilation
- ✔ introduction of atmospheric pressure effects
- ✔ AGRIF implementation to make zooms
- ✔ coupled to a wave model