

# About altimetry and coastal ocean dynamics

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## Objective :

**to study the ability of different observing scenarios (taking into account present satellites, new technologies and constellations) to observe coastal ocean dynamics**



## The use of altimetry in coastal zones comes up against specific difficulties

- ① Near the coast, altimetric measurements are contaminated by the presence of land in altimeter and radiometer footprints.

→ Need of footprint reduction

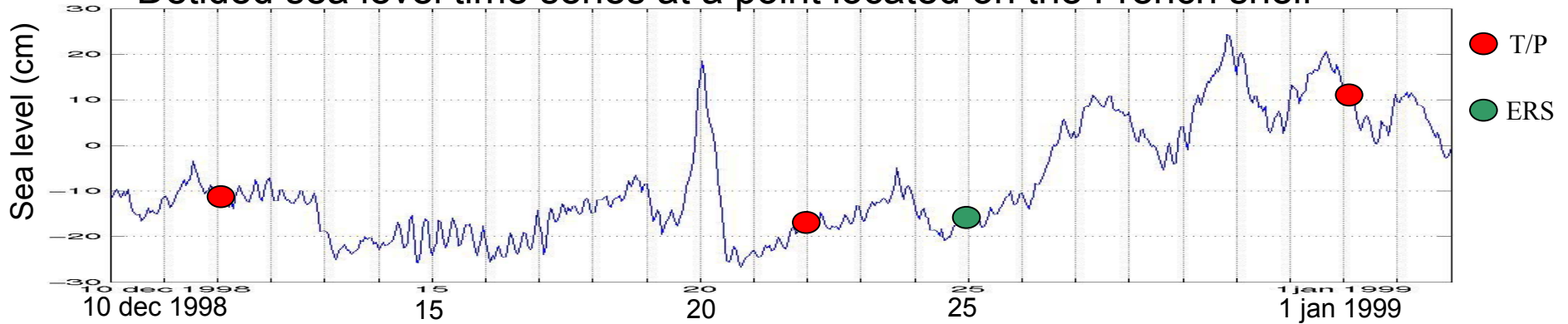
- ② Spatio-temporal scales of dynamical processes are much smaller in coastal zones than in the deep ocean, so that the sampling provided by present altimetric satellites is insufficient in these areas.

→ Need of better space/time resolution

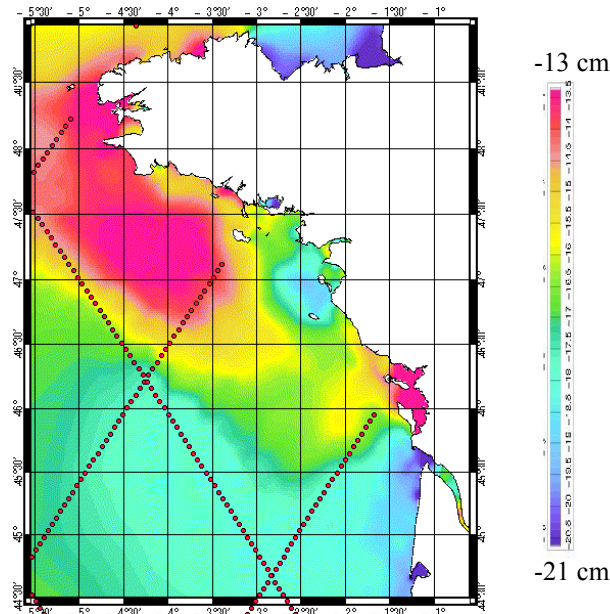


# The sampling provided by present altimetric satellites is insufficient to observe dynamical processes in coastal areas

Detided sea level time series at a point located on the French shelf



Sea level  
22/12/1998 0h



## Our approach

➔ Due to the small spatio-temporal scales of the coastal ocean dynamics, contribution of numerical models is necessary.

But models have uncertainties ! (due to errors on meteorological forcing, on bathymetry, on boundary conditions,...)

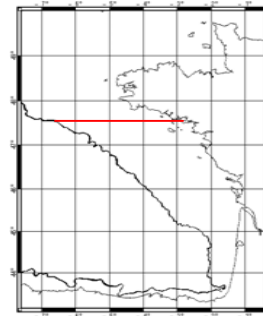
➔ So, the way to get the best estimate of the state of the ocean in these areas is to use models as dynamic interpolators of altimetric observations, both in space and time, with the help of data assimilation techniques.

➔ To what extent can altimetric observations correct models errors and improve their accuracy ?

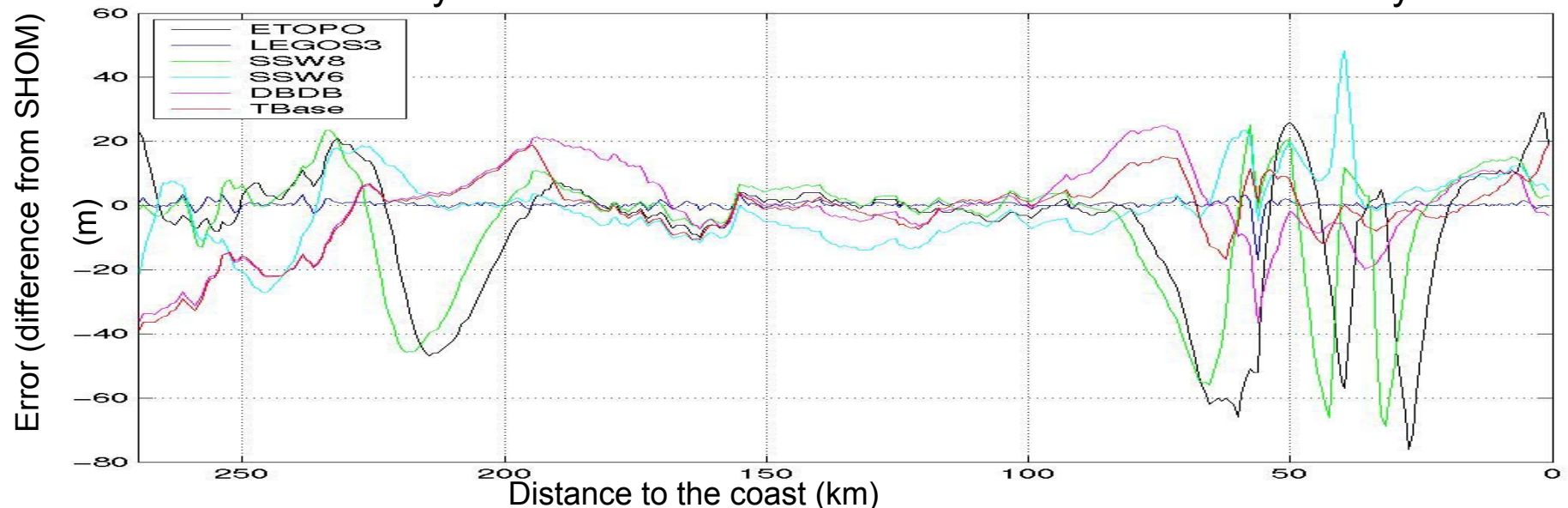
## Here, preliminary results of this work :

- presentation of an application on the European shelf simulated with a barotropic nonlinear model (MOG2D)
- focus on errors due to uncertainties on bathymetry

### Bathymetric errors (1)

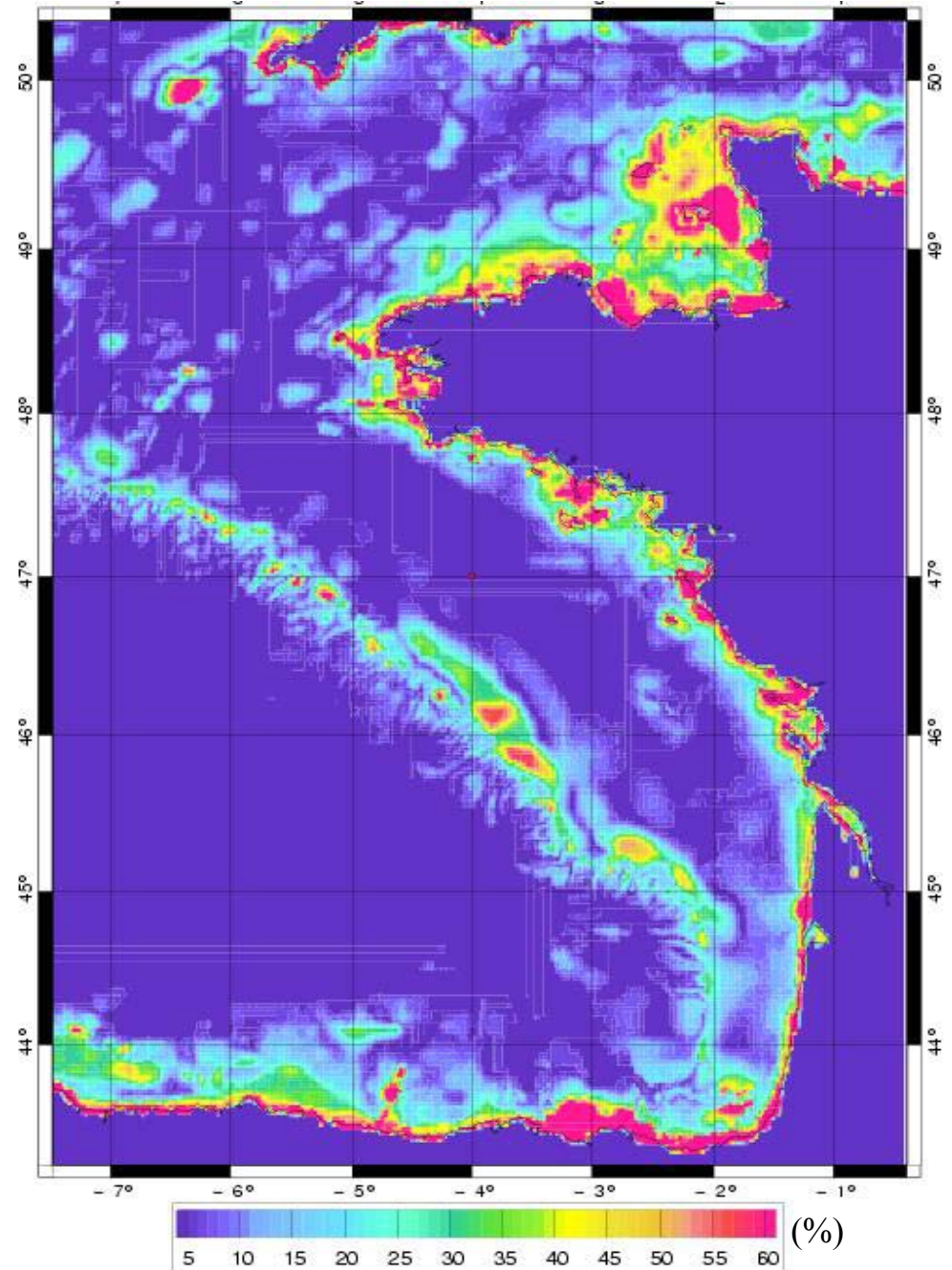


Section of bathymetric errors on the French shelf for 6 different bathymetries



## Bathymetric errors (2)

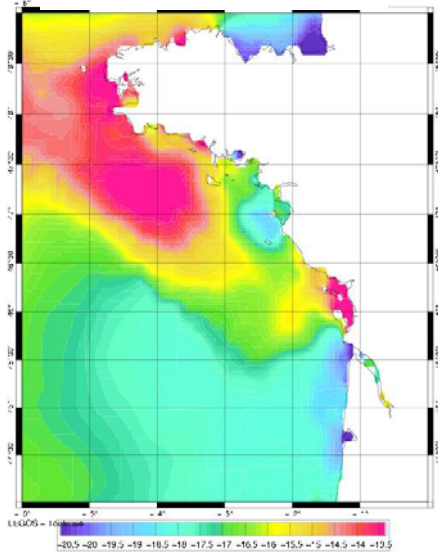
Rms dispersion of gravity wave speed ( $\sqrt{gH}$ ) estimates corresponding to the 6 previous bathymetries



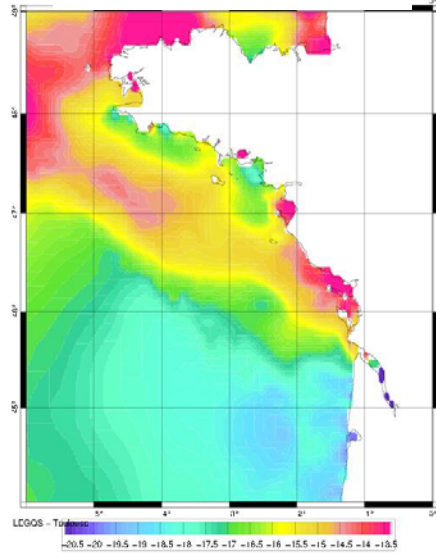
# Impact of bathymetric errors on the model (1)

MOG2D  
Sea level  
22/12/1998 0h

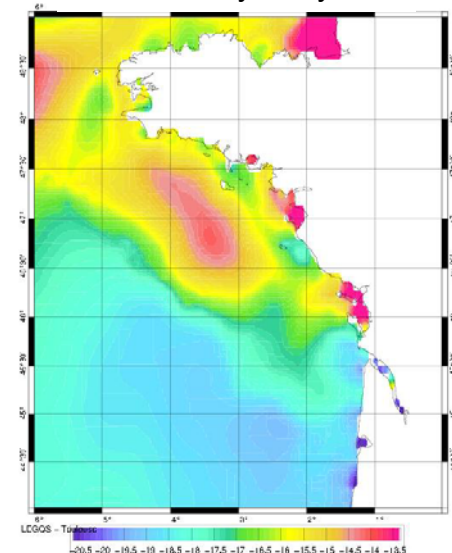
SHOM bathymetry



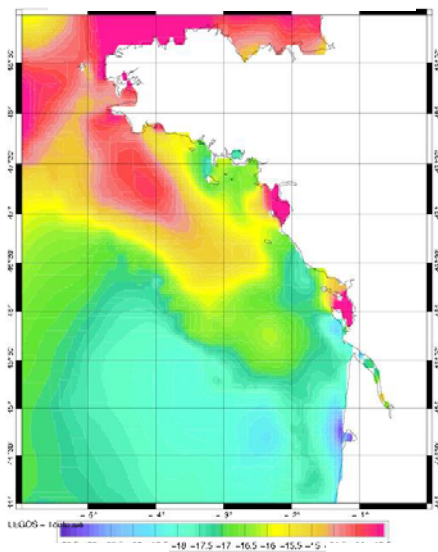
ETOPO bathymetry



DBDB bathymetry

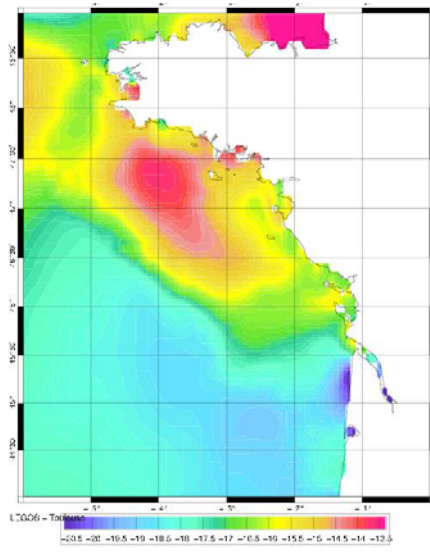


SMITH&SANDWELL



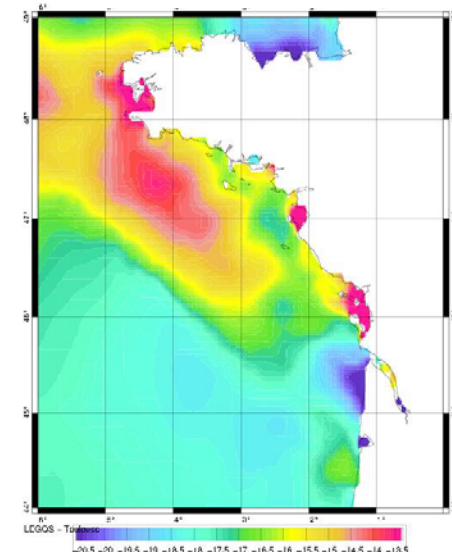
-21 cm

TERRAIN BASE bathymetry



-13 cm

LEGOS bathymetry



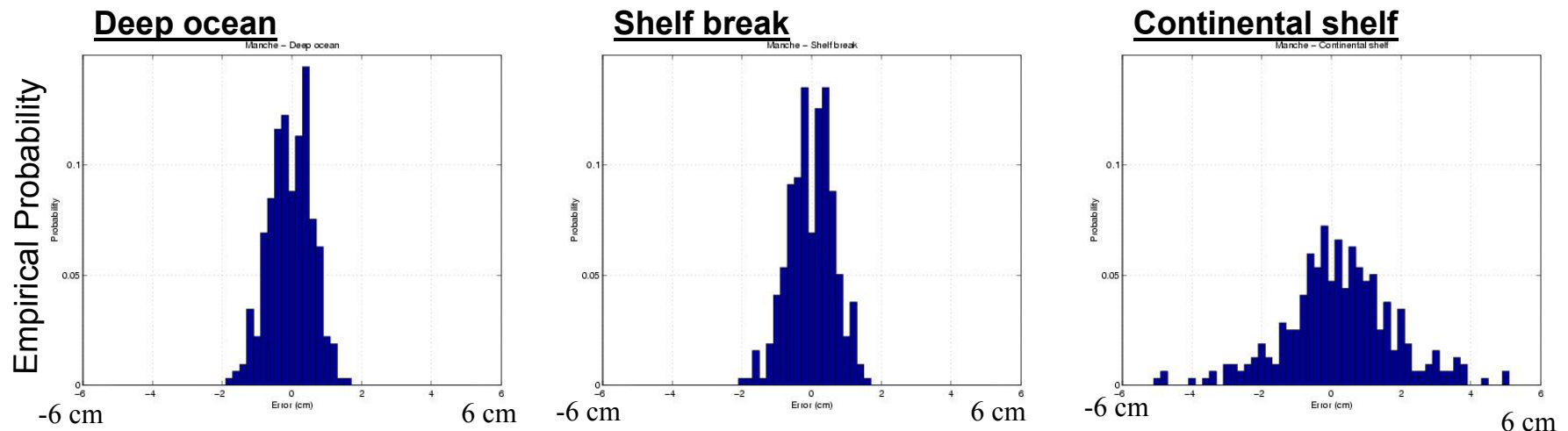
# Impact of bathymetric errors on the model (2)

➔ Data assimilation experiments require a specification of error statistics in the model

➔ Done with ensemble methods (empirical statistics are computed with a number of perturbed ensemble members)  
*Evensen JGR 1994 ; Echevin et al. JPO 2000*

➔ As a first cut : ensemble of 210 realizations generated from 6 simulations made with 6 different bathymetries, each simulation sampled at 35 « independent times » during a given meteorological regime

Error statistics at 3 locations :

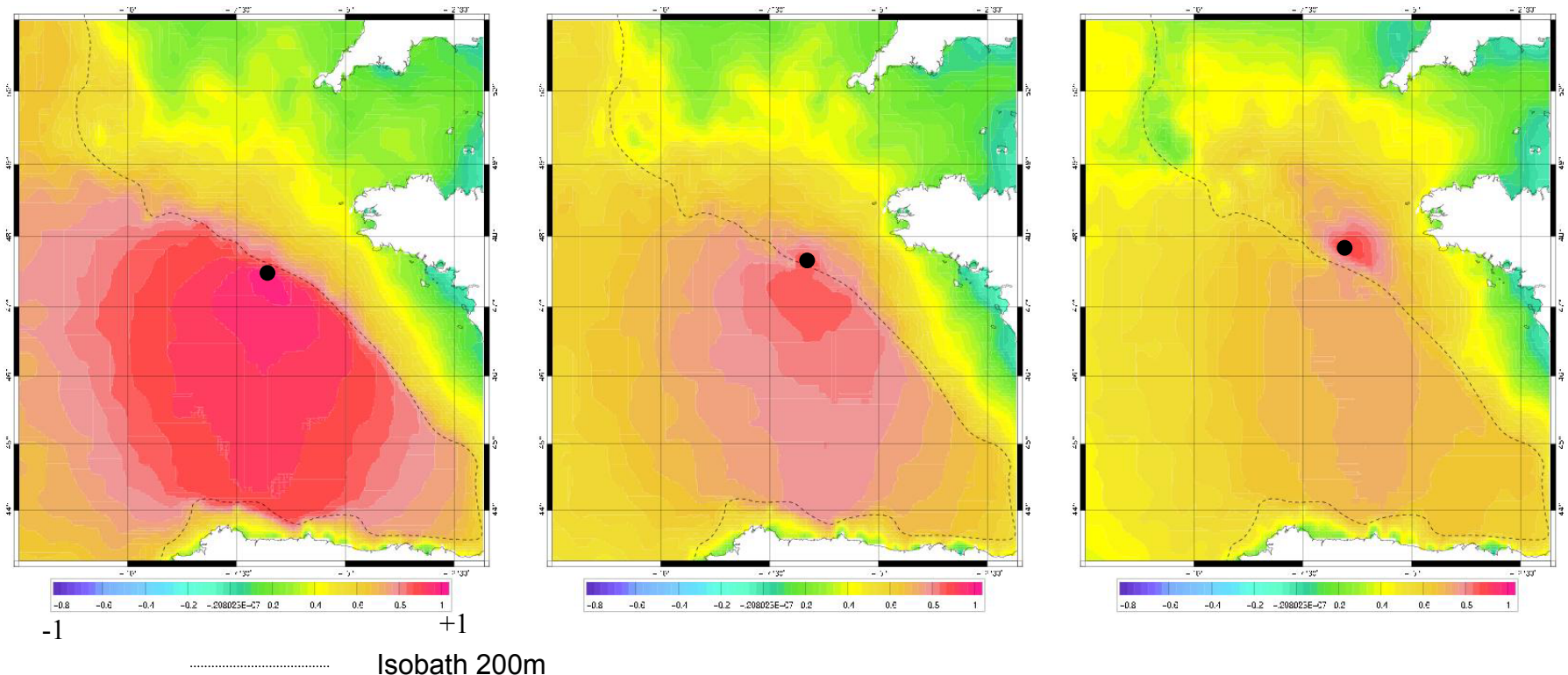


# A representer method

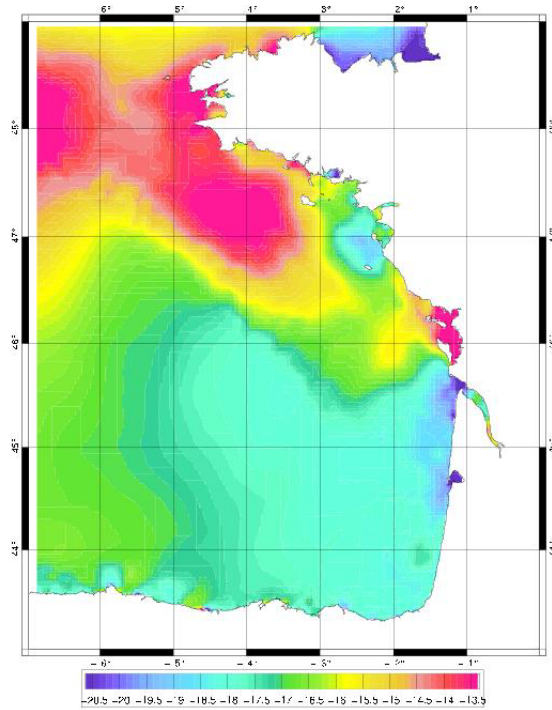
(Echevin et al. JPO 2000)

- ➔ model correction due to observations = linear combination of the « representers » of these observations
- ➔ 1 representer defines the «function of influence» of an observation (in space, time and across variables)

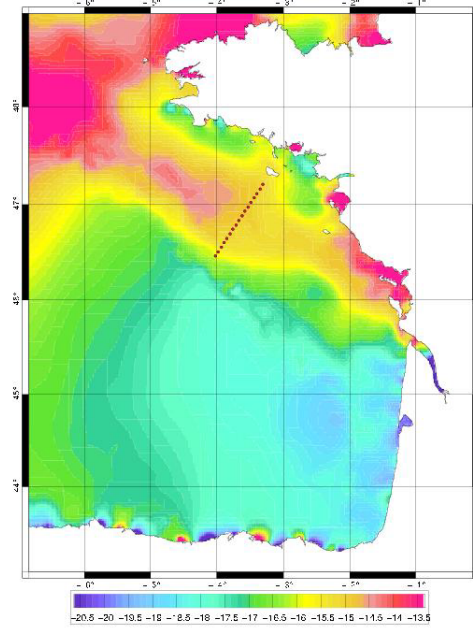
Representers (sea level) at 3 locations on both sides of the shelf break



# Simple analysis experiments (1)

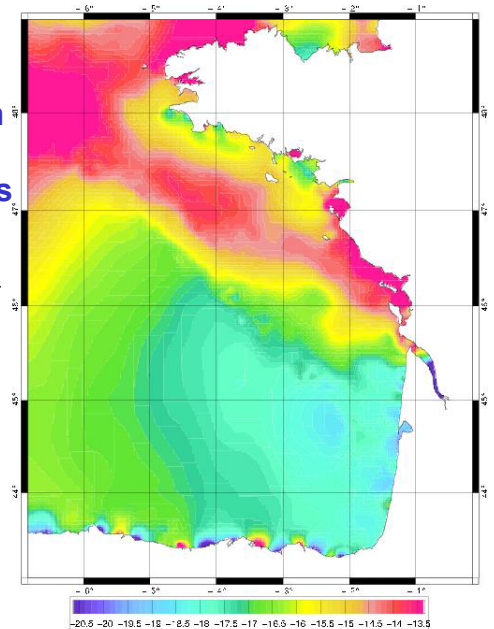


« True state »

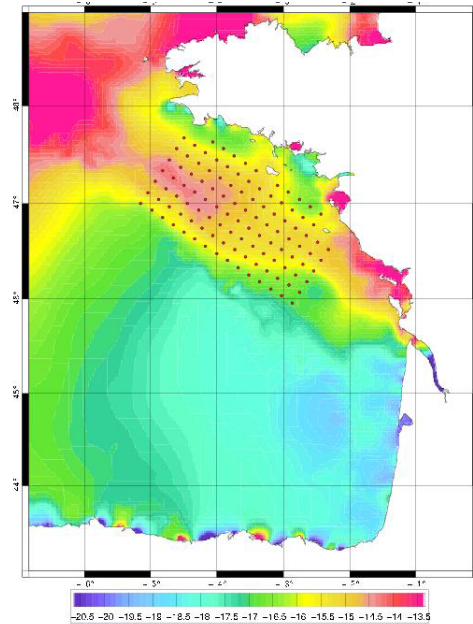


« Model prediction »

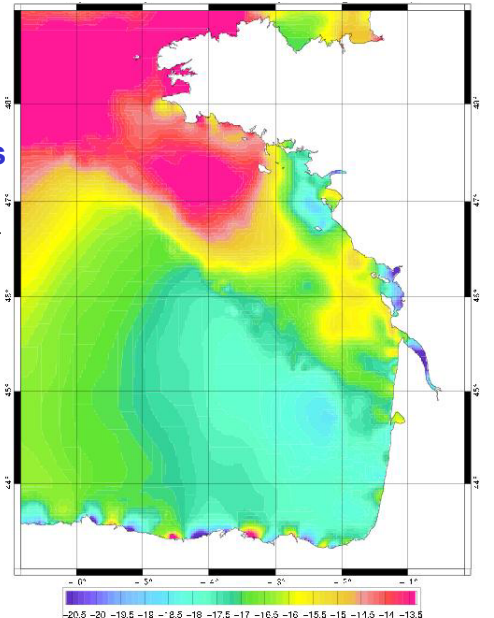
Assimilation of « Jason » observations



« Analysed state »

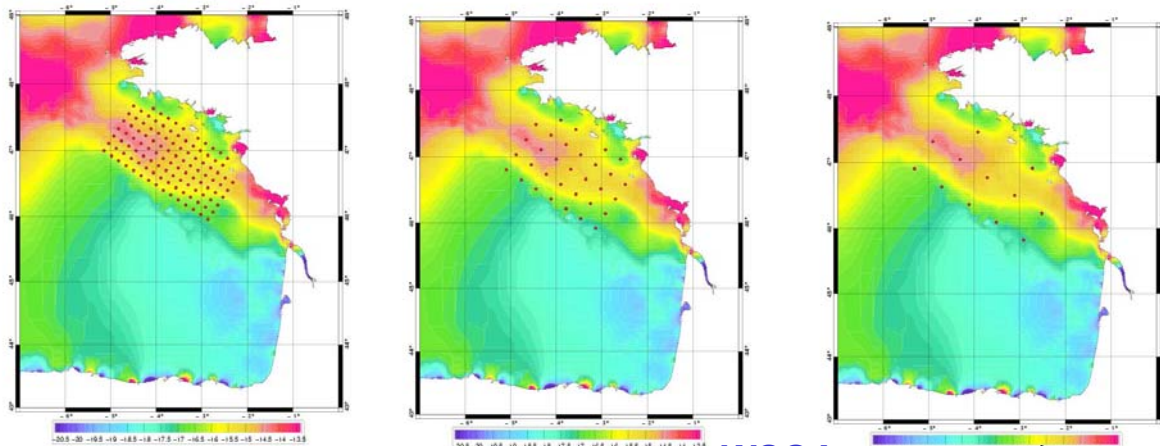


Assimilation of « WSOA » observations



# Simple analysis experiments (2)

« Model prediction »

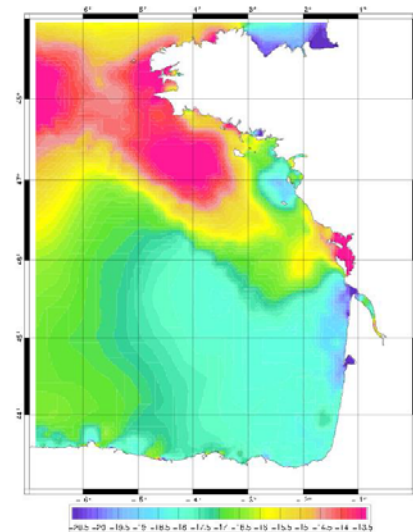


WSOA  
15 km

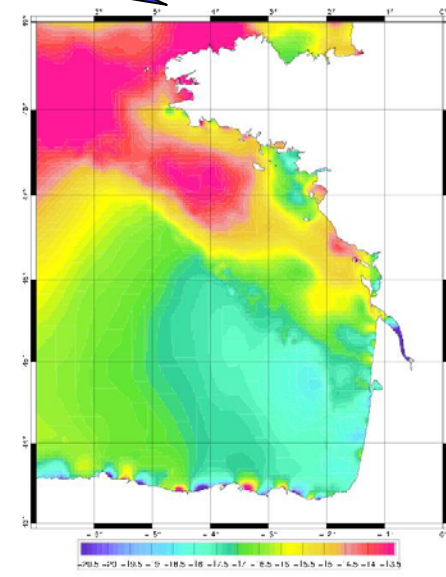
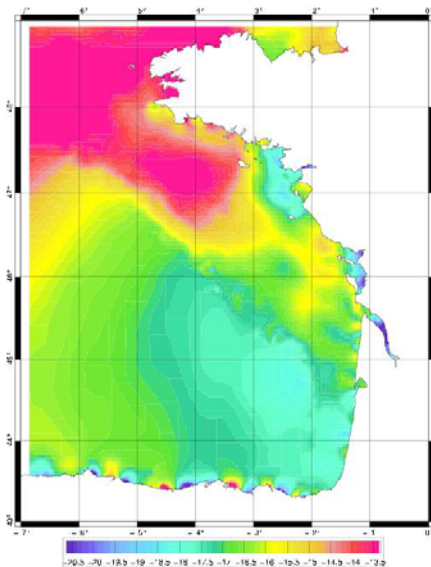
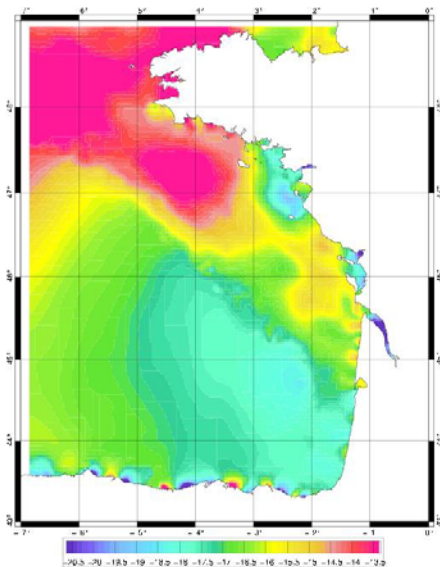
WSOA  
30 km

WSOA  
55 km

« True state »



« Analysed state »



## CONCLUSIONS

- ➔ **This approach is going to make it possible**
  - **to test the ability of different configurations of altimetric satellites to improve models accuracy in coastal zones**
  - **and therefore to bring some recommendations for future missions**
- ➔ **But a lot of work is still to be done : consideration of the time dimension, study of other sources of errors such as meteorological forcing or boundary conditions, application to different coastal areas, ...**