Sea level modeling using HYCOM in the bay of Biscay : introduction of atmospheric pressure effects.

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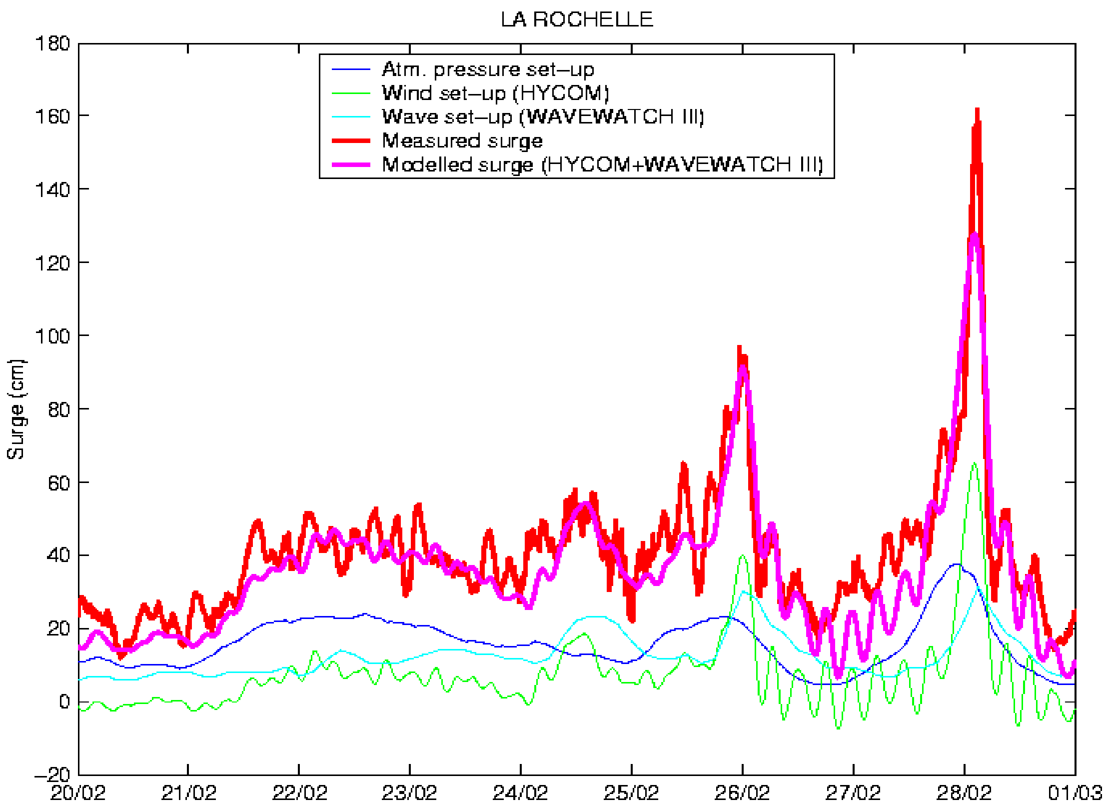
Sea level modeling : Motivations

- Surge
- Tide
- Toward hydrographic accuracy : ~10cm

Storm surge modeling

- « 1 week work » test
- Wind surge : Hycom run without tide
- Wave surge : Wavewatch III run + wave setup estimation
- Atmospheric pressure : inverse barometer estimation

Storm surge modeling

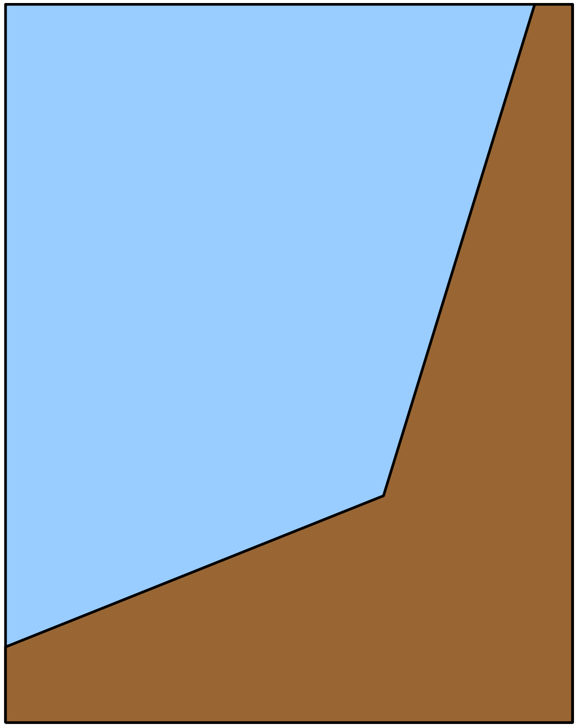


- Long term drift
- No nonlinear effects tide-surge
- No dynamical effects of atmopsheric pressure surge

Objectives

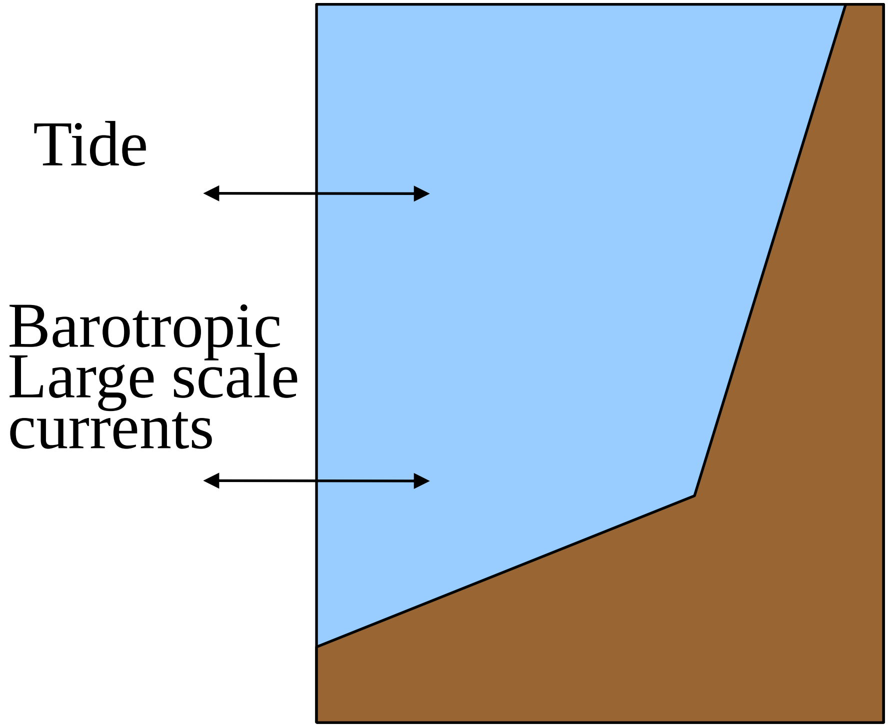
- Revisit the barotropic open boundary conditions to remove any ''long term'' drift
- implement the atmospheric pressure
- Study the ''inverse barometer paramaterization'' biais during transitory phases (storm)
- Get a tool to study the non-linear relationships between tide and surges

Sources of sea level variations



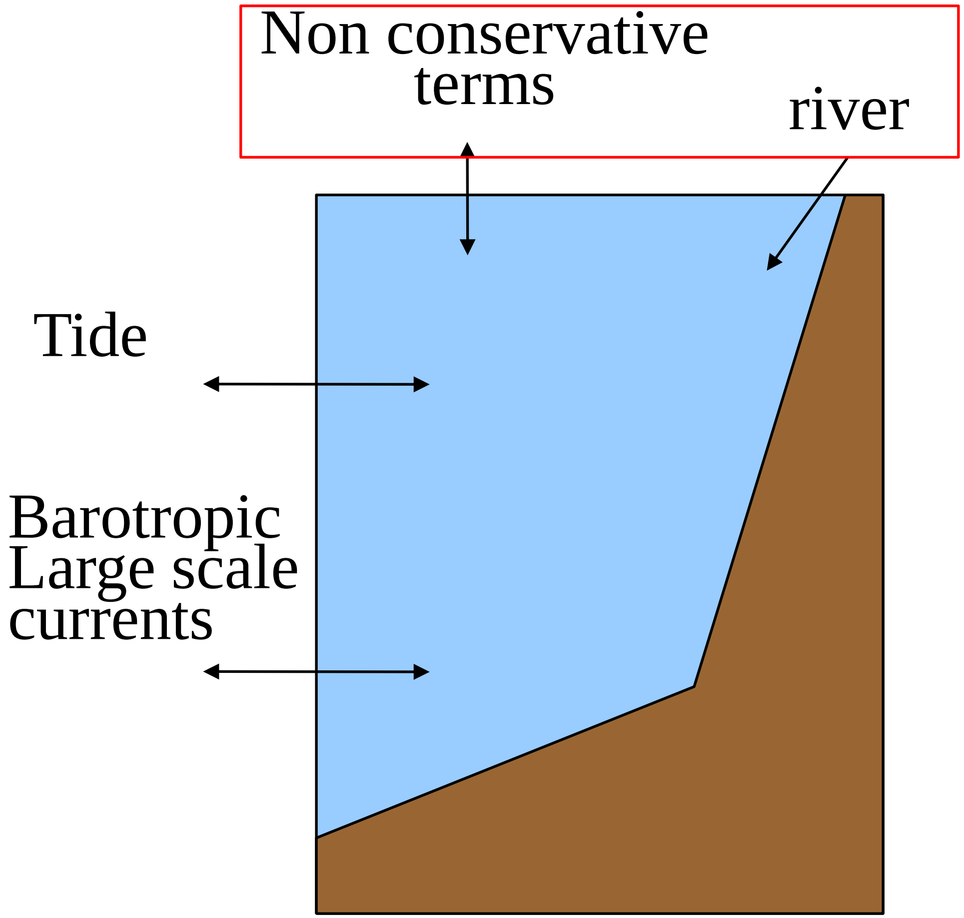
- Tides
- Barotropic large scale currents
- rivers
- Steric effect
- Non conservative terms

Sources of sea level variations SHOM 2009 code



- Tides : corrected every period
- Barotropic large scale currents : corrected for each readed field
- Rivers
- Steric effect
- Non conservative terms

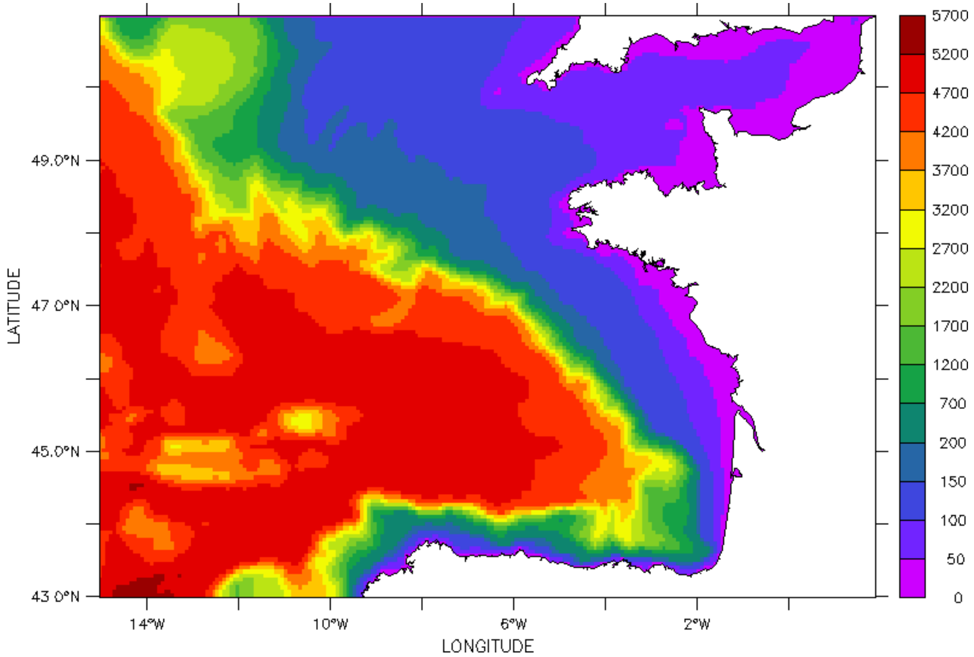
Sources of sea level variations SHOM 2011 code



- Tides
- Barotropic large scale currents
- rivers
- Steric effect
- Non conservative terms

- A unique correction for all terms
- Computes the difference between the modeled and expected volume variations

Channel/Biscay configuration



Bathymetry (m)

- Low resolution (5.5 km)
- A good configuration for tests
- Tides, rivers, open boundaries

Mass splitting vs volume splitting

Version 2009

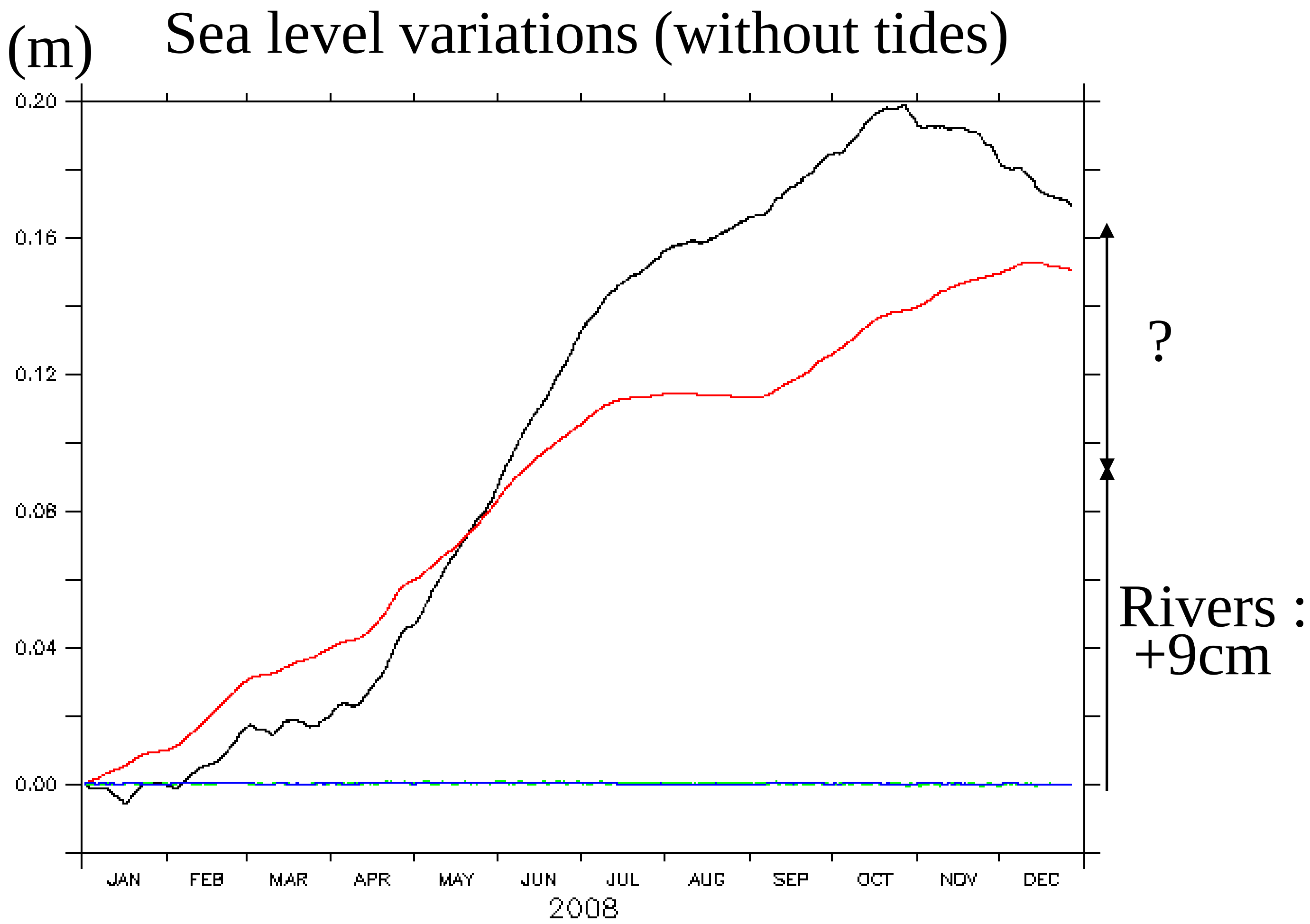
— mass-splitting

— volume-splitting

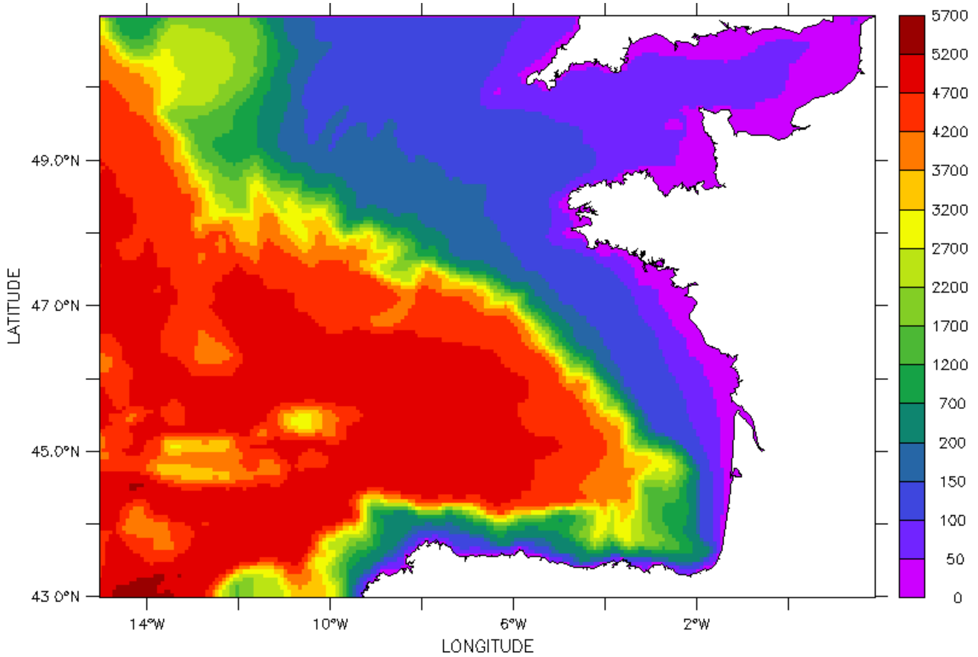
Version 2011

— mass-splitting

— volume-splitting

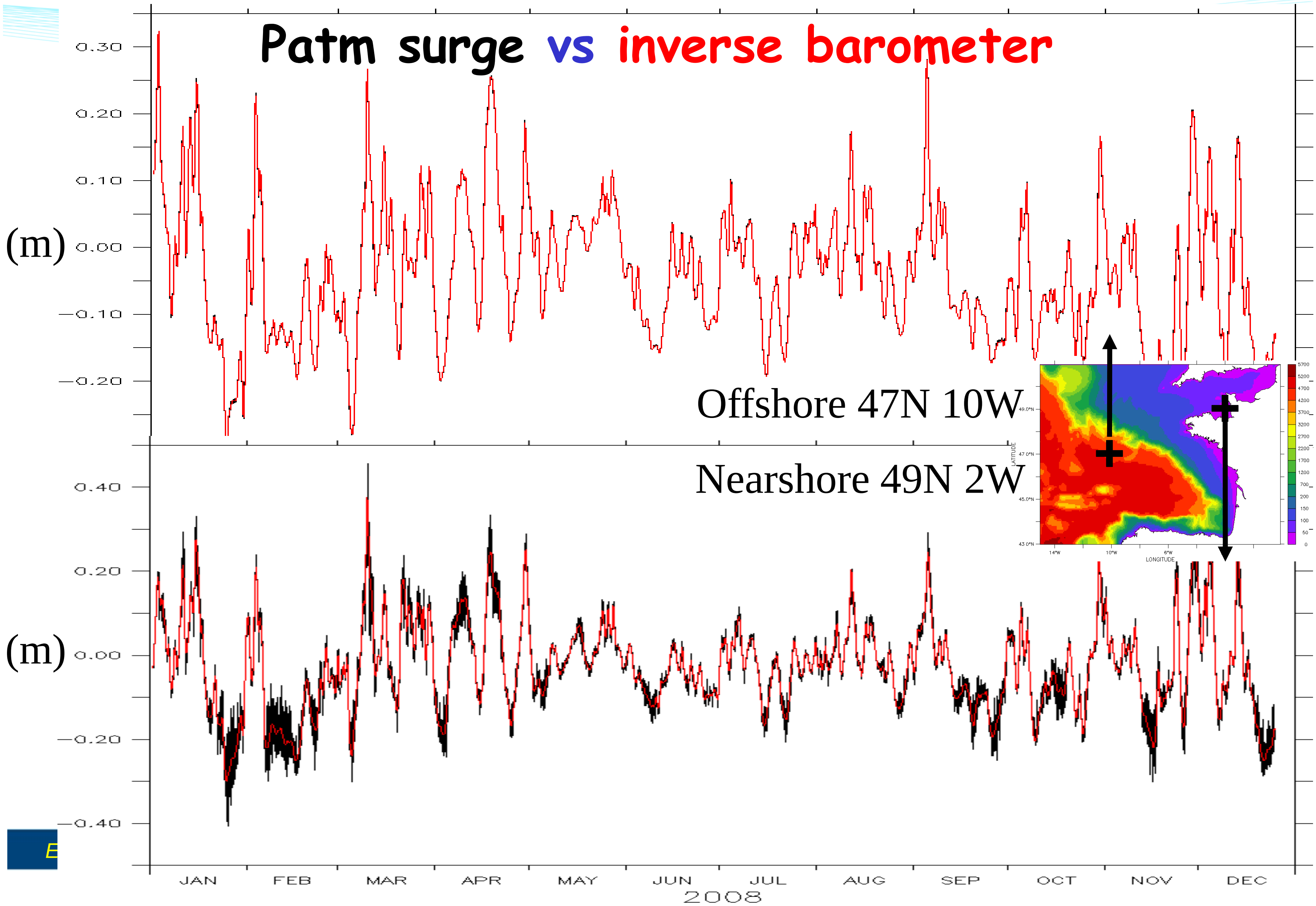


Tests of simulations including atm. pressure



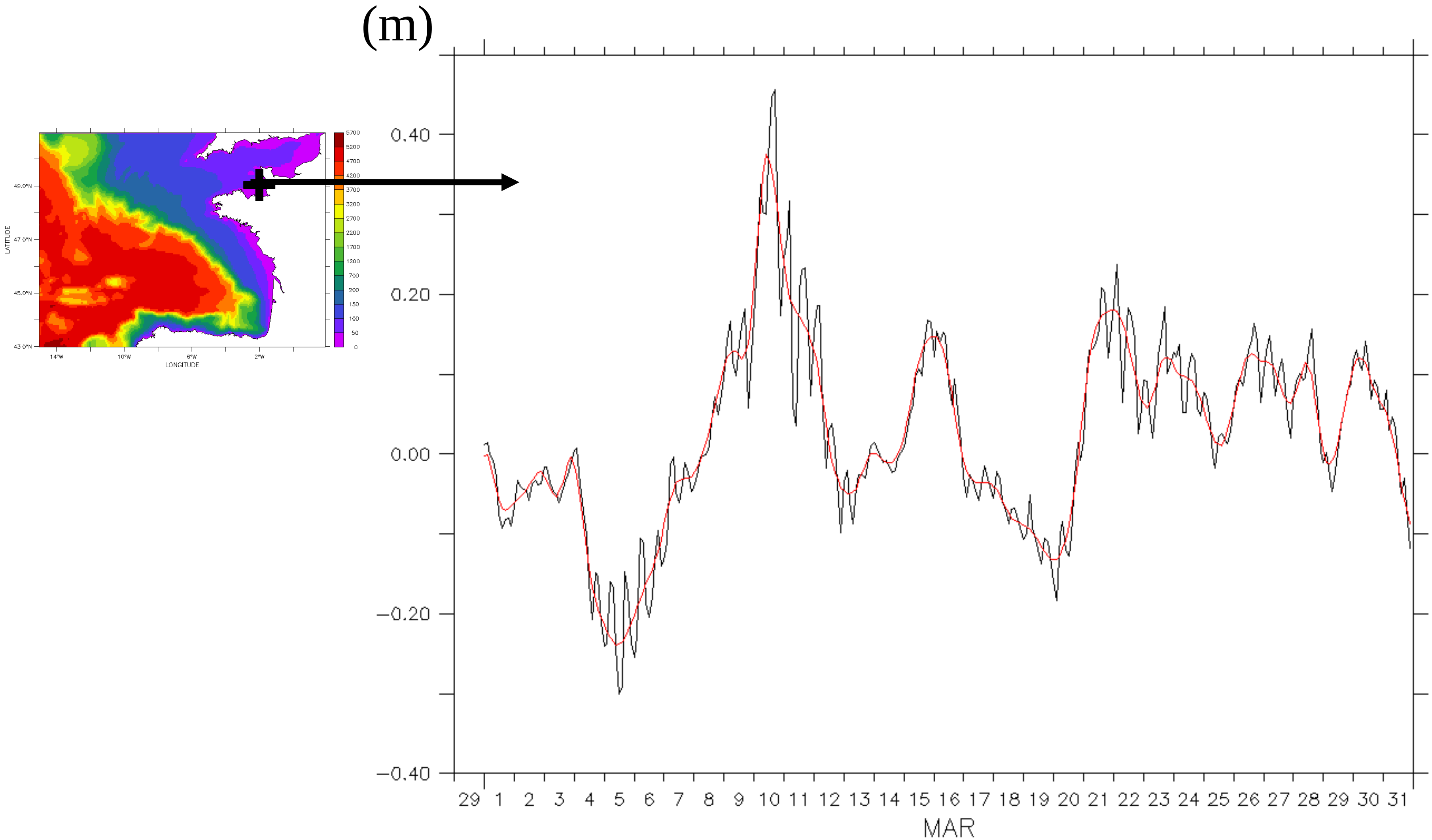
Bathymetry (m)

- Low resolution (5.5 km)
- Tide, rivers, open boundaries
- Atm. forcing 0.5 /6 hours
- Implementation of the atmospheric pressure
  - Add the pressure gradient in barotp
  - Add the inverse barometer in the expected volume variations
- Patm surge : SSH(run with Patm) - SSH(run without Patm)



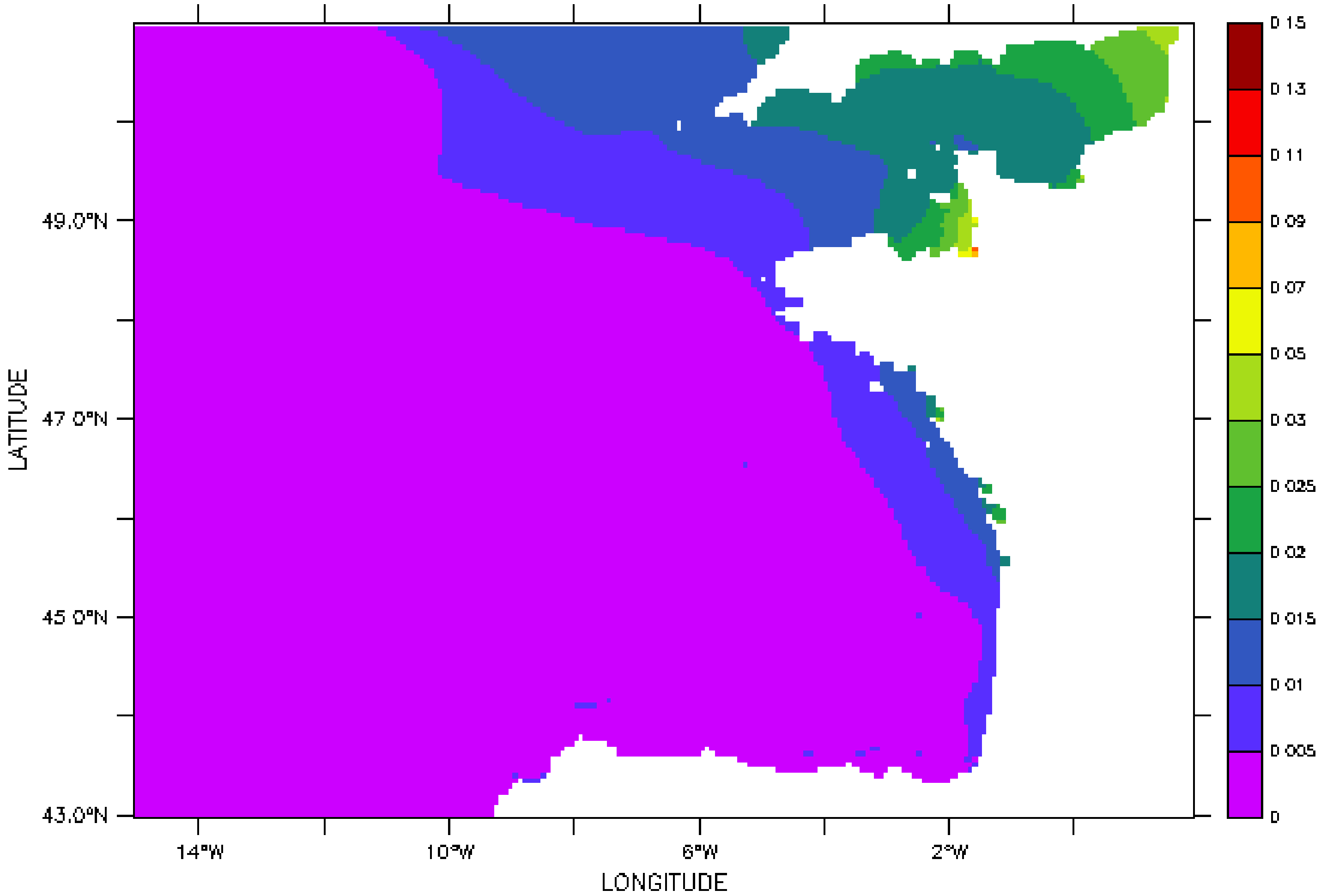
Patm surge vs inverse barometer
(m)
0.30
0.20
0.10
0.00
−0.10
−0.20
Offshore 47N 10W
Nearshore 49N 2W
(m)
0.40
0.20
0.00
−0.20
−0.40
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
2008
LATITUDE
LONGITUDE

Patm surge vs inverse barometer



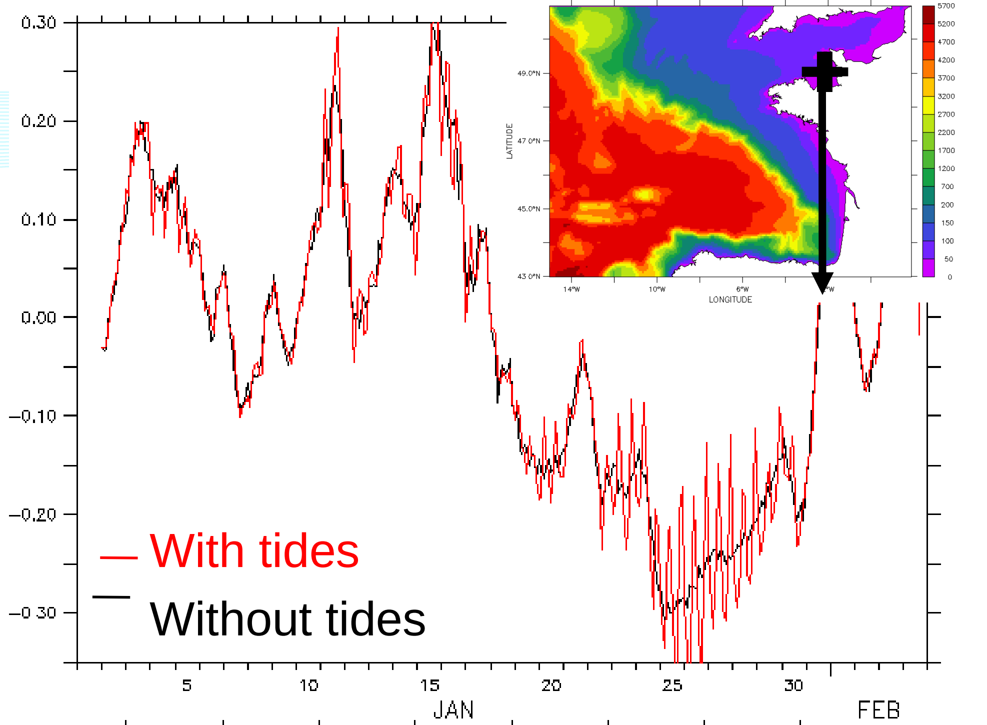
Patm surge vs inverse barometer

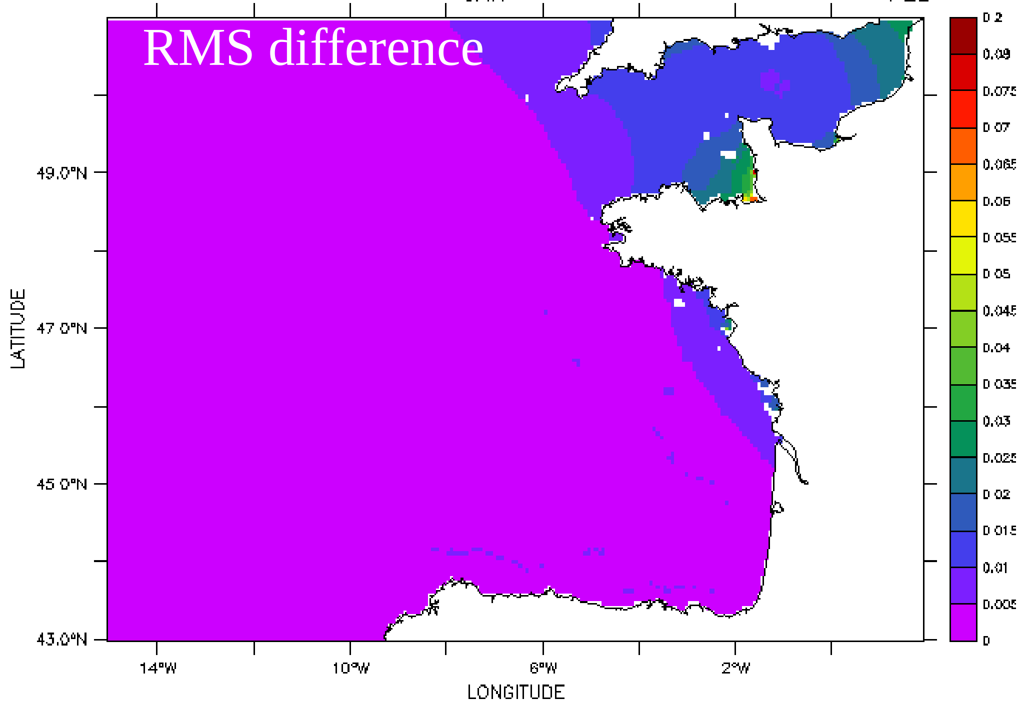
☯👎SSH-(Patm-Pref)/g.ρ]RMS



Non linear interactions

- Compare atm. Pressure surge in absence/presence of tides
- Impact 1-6 cm



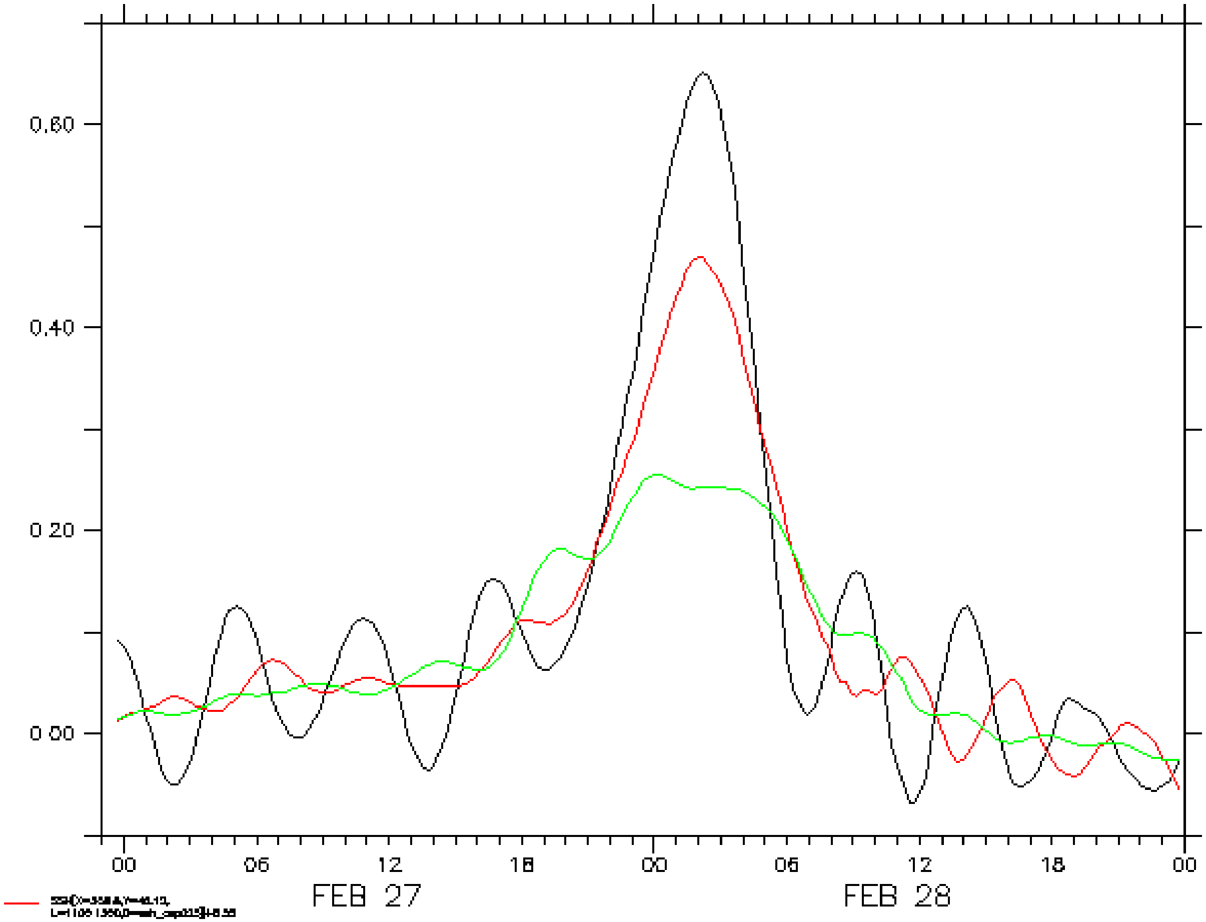


Sensitivity to resolution

Wind surge at La Rochelle (m)

Wind stress resolution

- (green) 0.5 /~12 hours
- (red) 0.5 / 6 hours
- (black) 0.25 / 3 hours



➢ Similar sensitivity to atmospheric pressure resolution?

Conclusion

- Modification of open boundary conditions in order to ''conserve'' the volume
- Implementation of the atmospheric pressure
- Small differences with the ''inverse barometer parameterization''
- But low resolution : higher differences expected with the high resolution configuration

Next steps

- Validation in the high resolution configuration (1.7km)
- Comparison with tide gauges
- Need to increase the temporal/spatial resolution of atmospheric forcings.
- Focus on some interesting events (storms).

Related projects

- Develop a case study to validate the implementation of tides and surges (open boundary conditions).
- Improve the accuracy of sea level modeling
- New observations in Iroise sea (nov 2012-mar 2013)