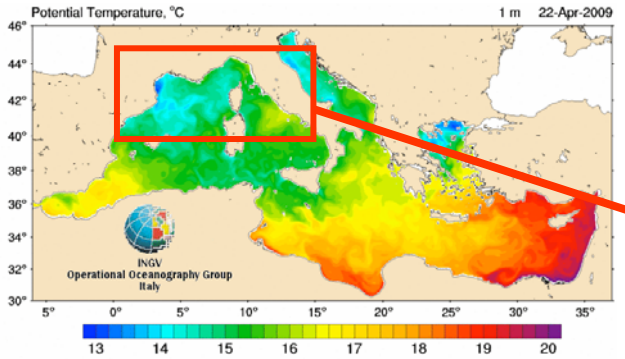
An experiment of Spectral Nudging : application to the Mediterranean Sea

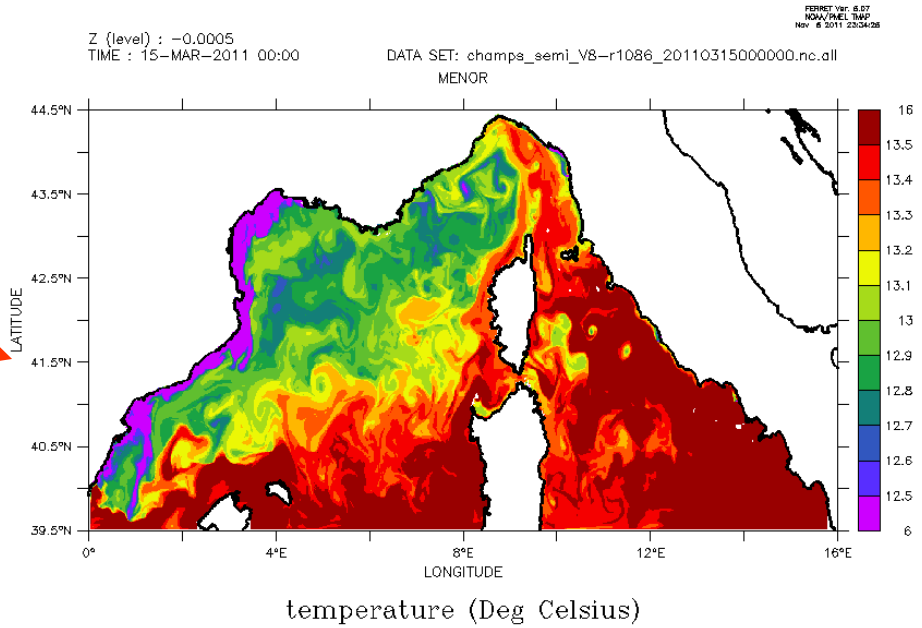
Preliminary results

Pïerre Garreau , Valérie Garnier

(IFREMER Brest)

The MENOR configuration of Mars3d

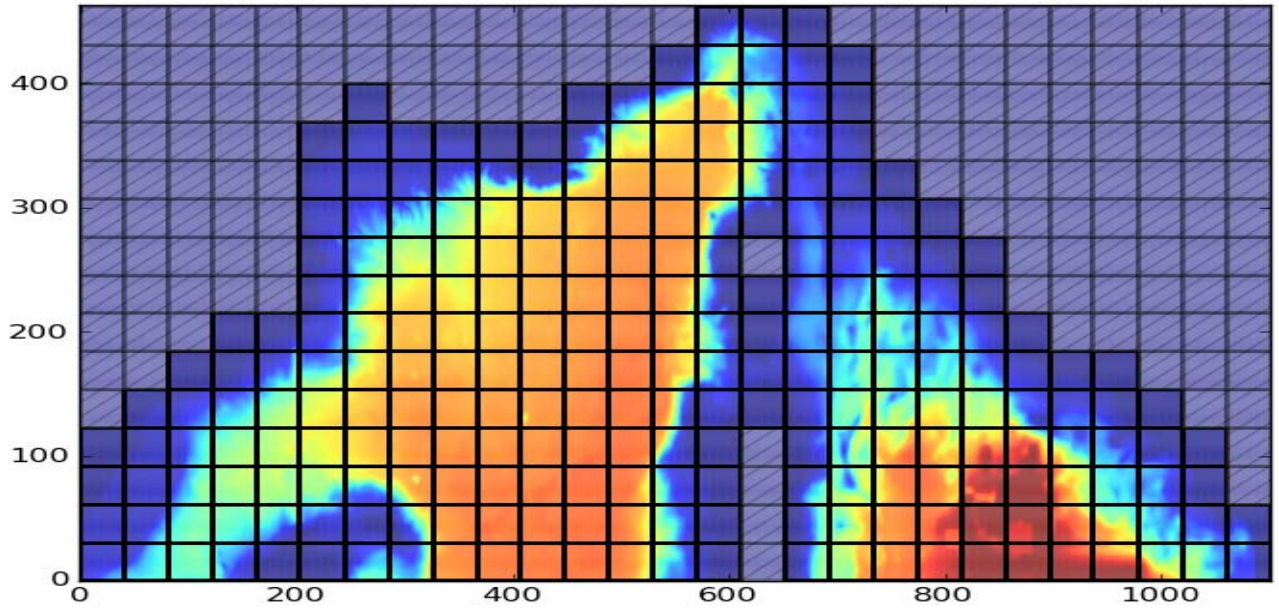




- North from 39.5°N
- Forced by OGCM : INGV-MFS SYS3a2 SYS4 ou Mercator
- Atmospheric forcing is a zoom of MM5 model embbeded in NCEP
- Free run
- Resolution about 1.2 km /30 sigma levels
- **Operational Purpose** : PREVIMER / (ANR CLARA II)
- **Research purpose** : Physics (mesoscales procresses), Biology/Contaminants (ANR COSTAS /eco3m), halieutics (SARDONE EU-PROJECT), Climatology (fondation Total /CLIMCARE), Downscaling, spectral nudging (PPR Mercator).

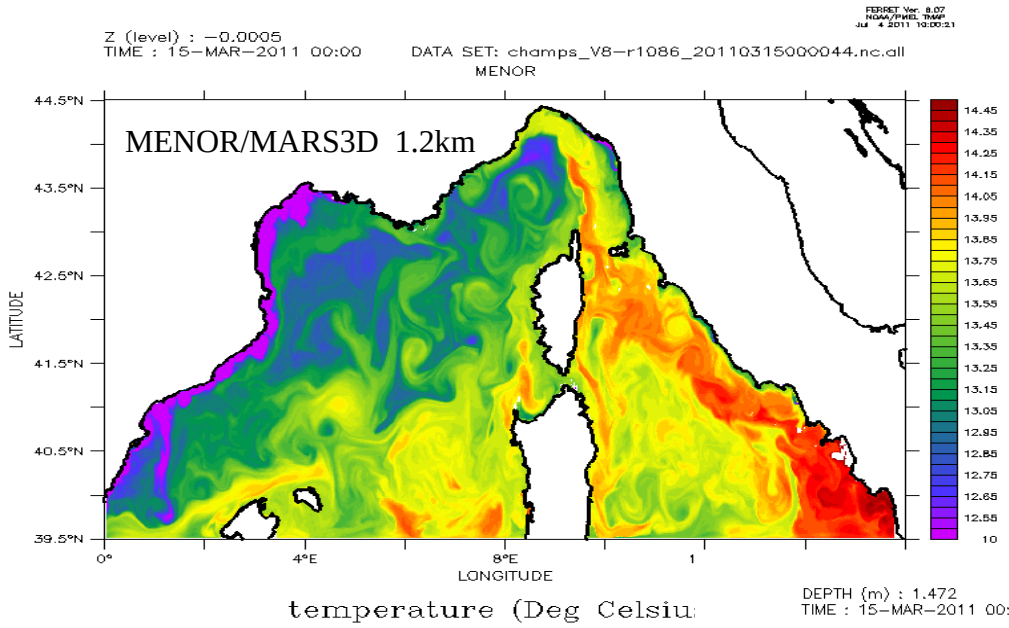
The MENOR configuration of Mars3d

This configuration is parallelised

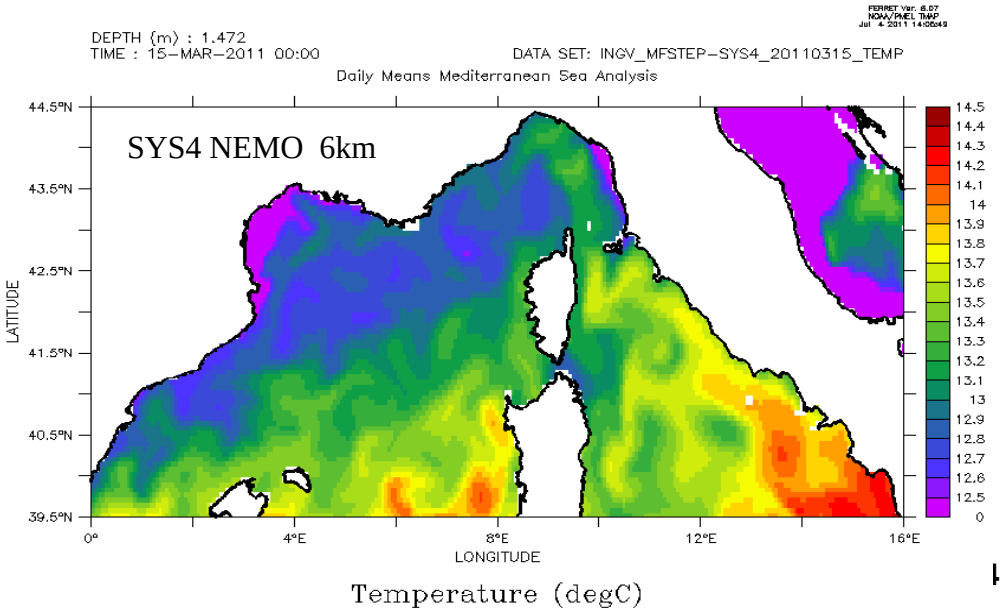


- Matrix is 1100*460*30
- Paralelization MPI 256 CPU
- 1 day simulated in 3 mn elapsed.

The higher resolution of the regional model allows the modelling of mesoscale processes Not present in the OGCM

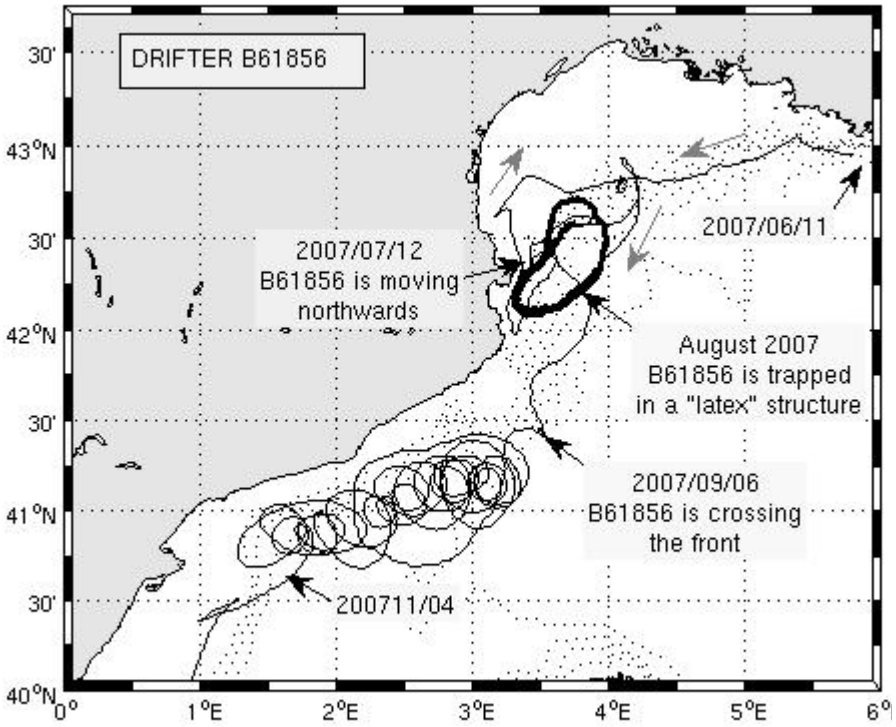


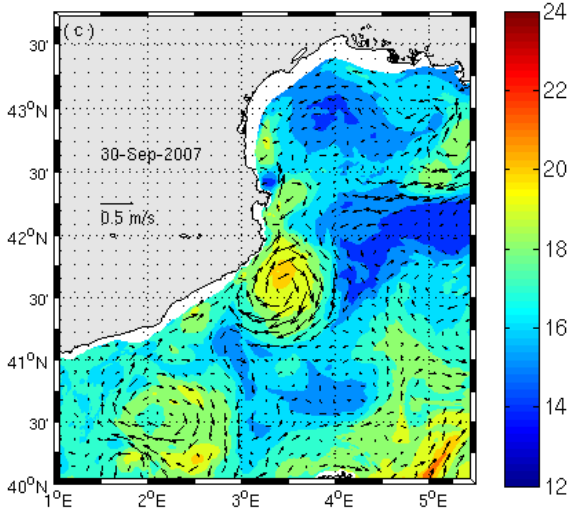
Differences after 2.5 months of spin-up

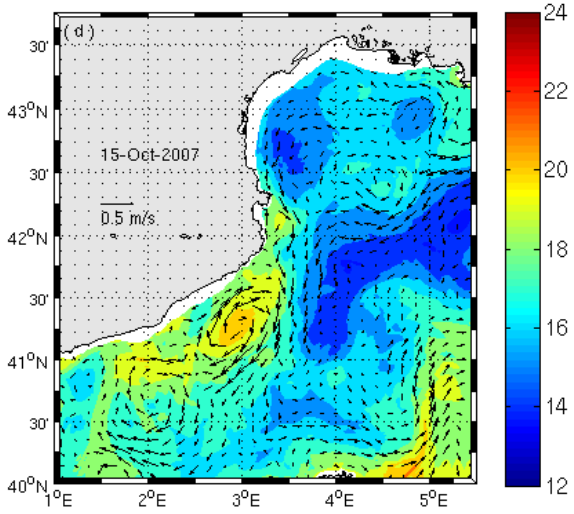


Sub – mesoscale processes and atmospheric forcing

Modelling Catalan eddies

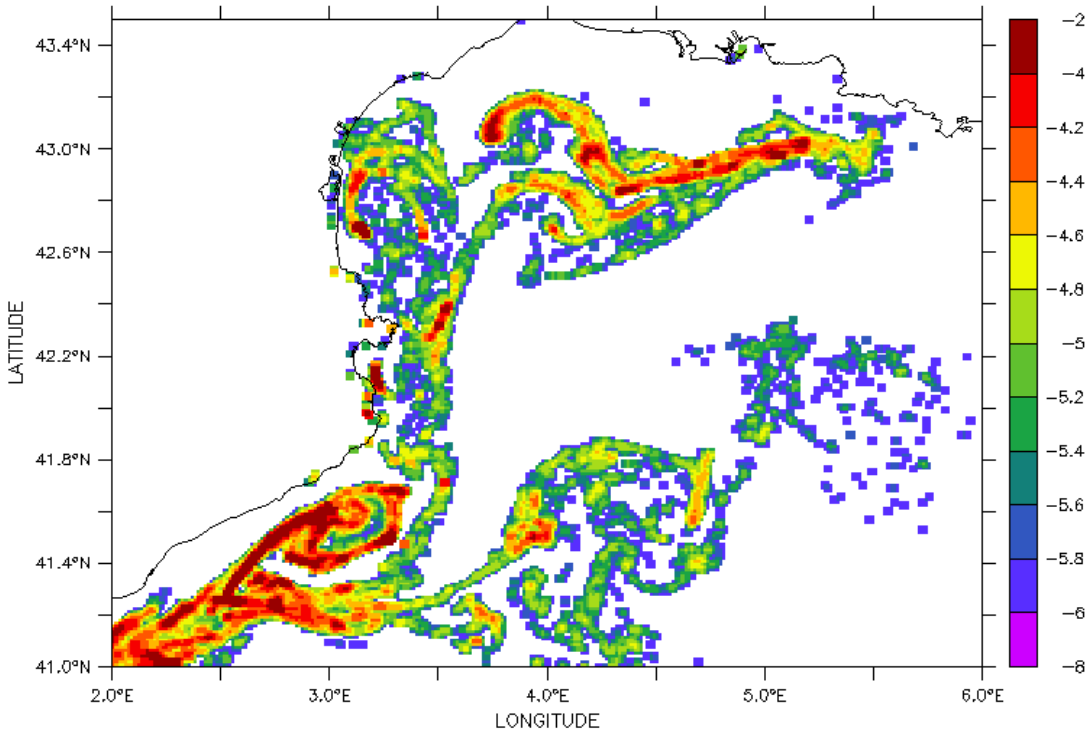






Garreau et al. 2011
Schaeffer et al. 2011
Schaeffer et al. 2011

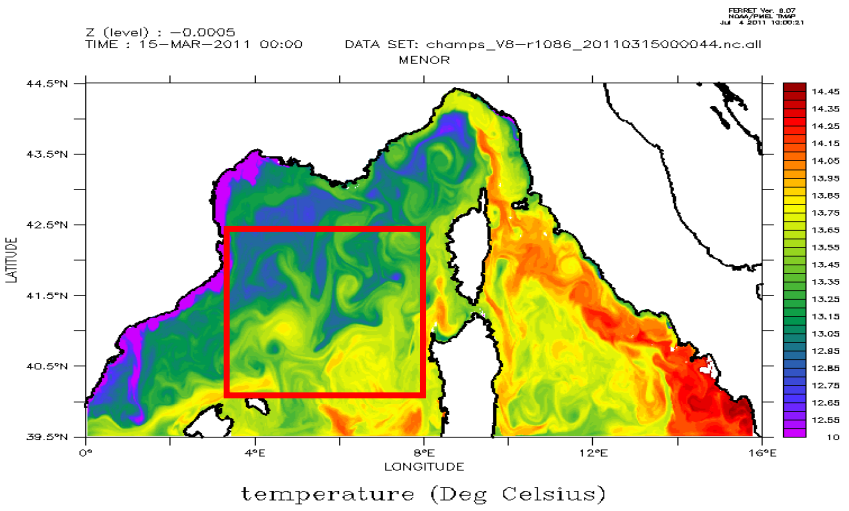
Recruitement of small pelagic eggs and larvae transportation

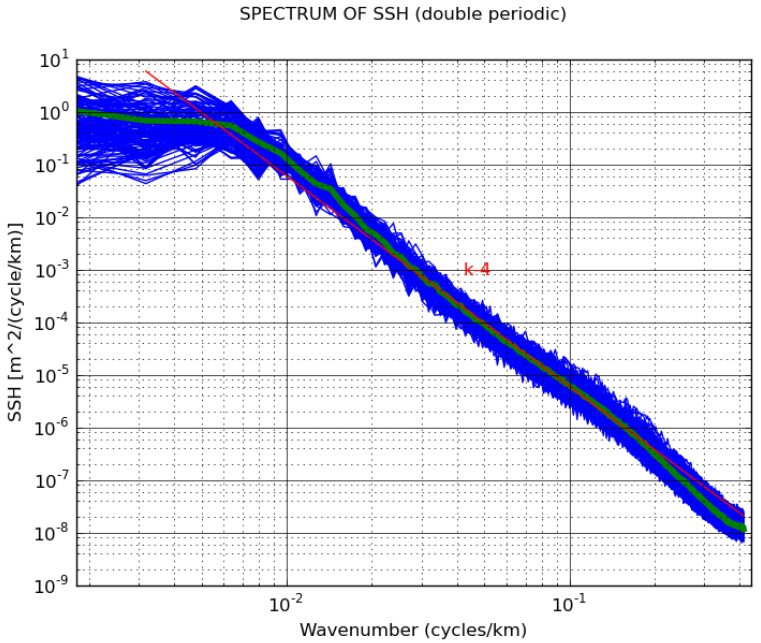


Dispersion des larves d'anchois après un mois

Nicolle et al. 2009

EKE spectrum from SSH

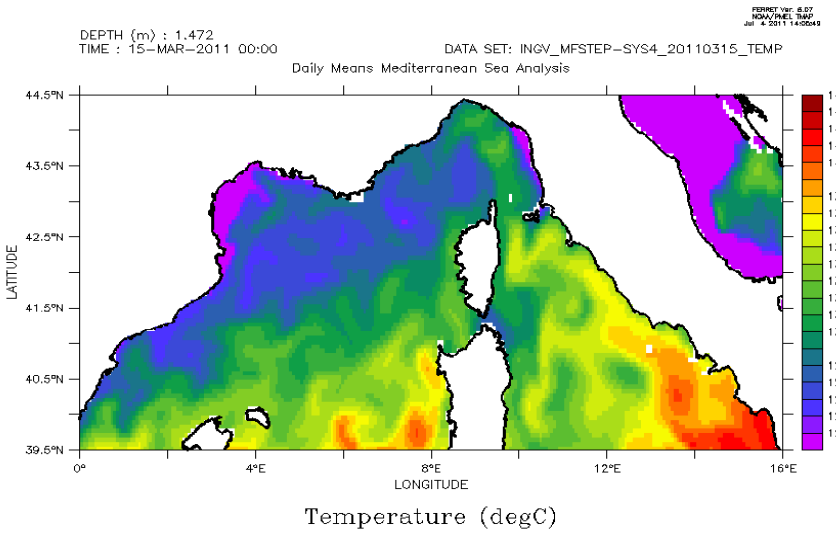


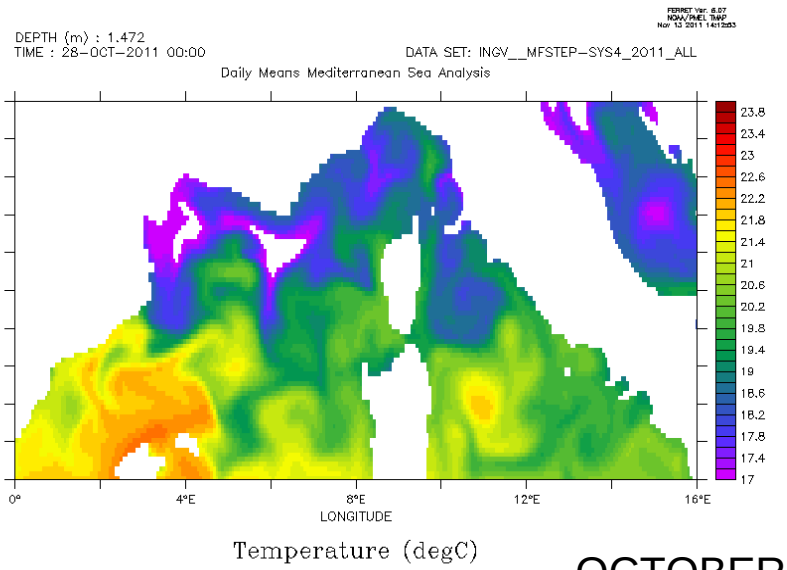


The cascading in k-4 in agreement with recent development in very high resolution model (Capet ,Klein 2008)

Comparison MOON/MFS OGCM vs MENOR

SYS4 NEMO 6km

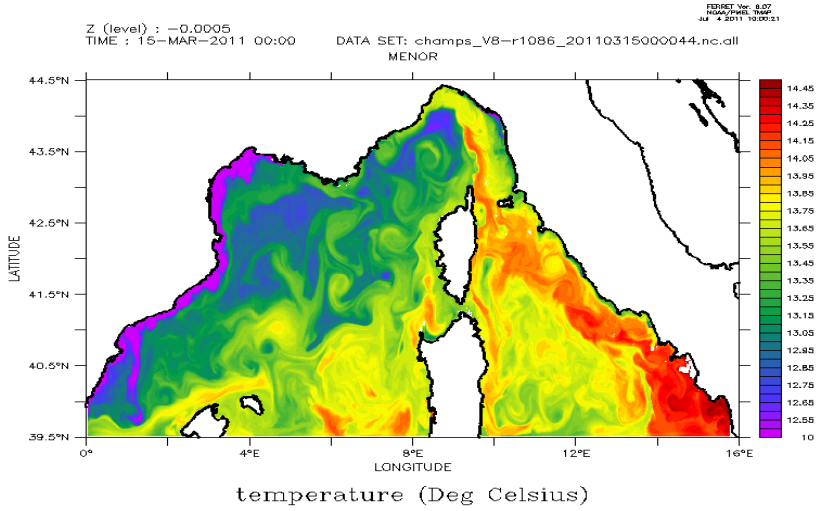


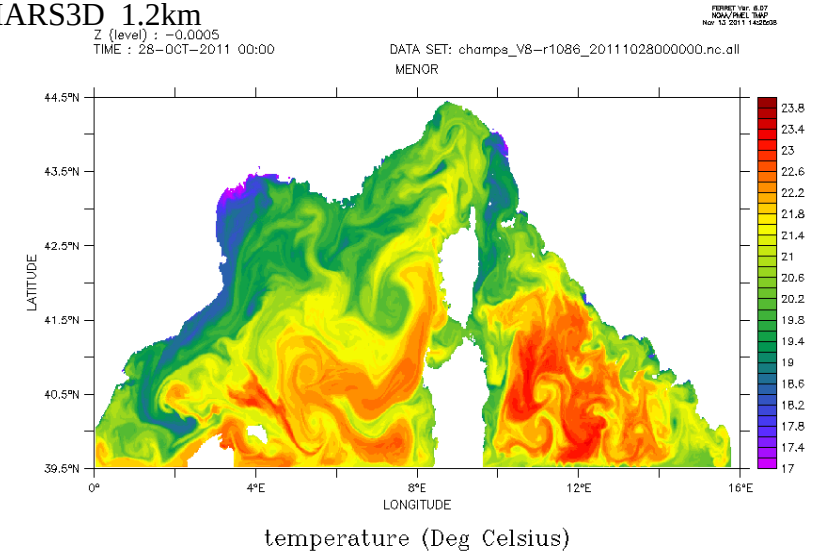


Mid march

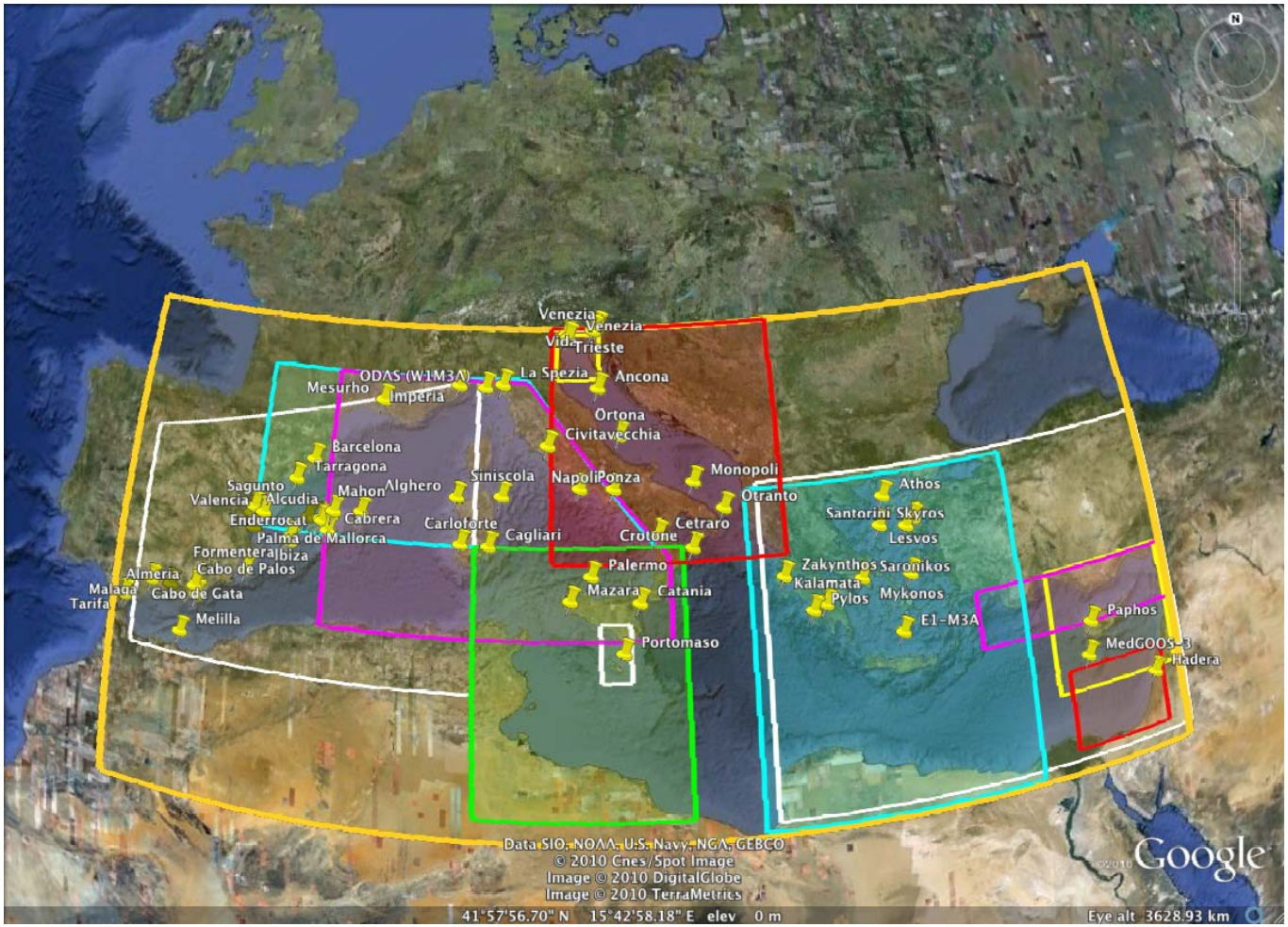
OCTOBER

MENOR/MARS3D 1.2km





MOON modelling network



Menor is used for operational oceanography (PREVIMER)

http://www.previmer.org

In Mediterranean Sea local and regional models are embeded in a global one.

How to be consistent between the OGCM and the REGIONAL or LOCAL models ?

The OBC, IC , methods currently use in the MOON community are

- Restart (re-initialisation) from OGCM every weeks or months

-Use of a variational method (VIFOP) to avoid the shock (and decrease the spin-up time)

- MENOR is totaly free run

Spectral nudging

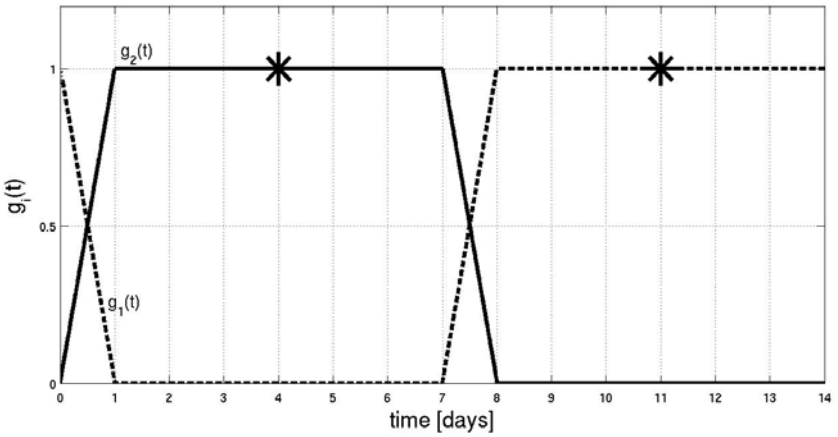
Largely used in the atmospherical modeling
Already tested in ocenographic modeliing (Thomson 2006)

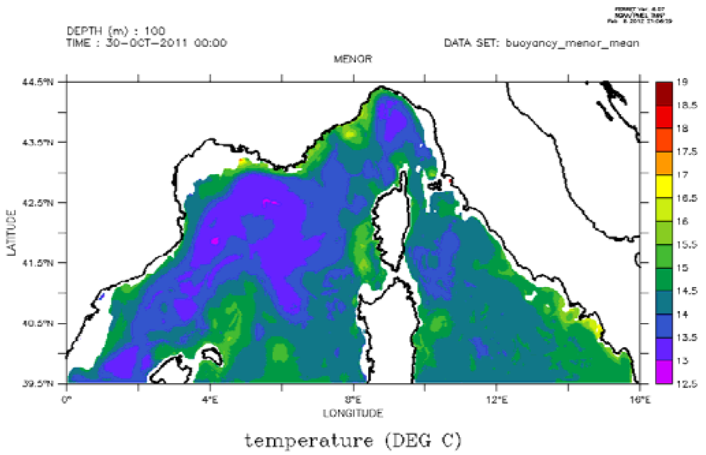
$$X(t+1) = X(t) + dt\,\{M(t) + INC_X(i_cycle)\},\ t0 < t < t0+T$$

→ 7 days

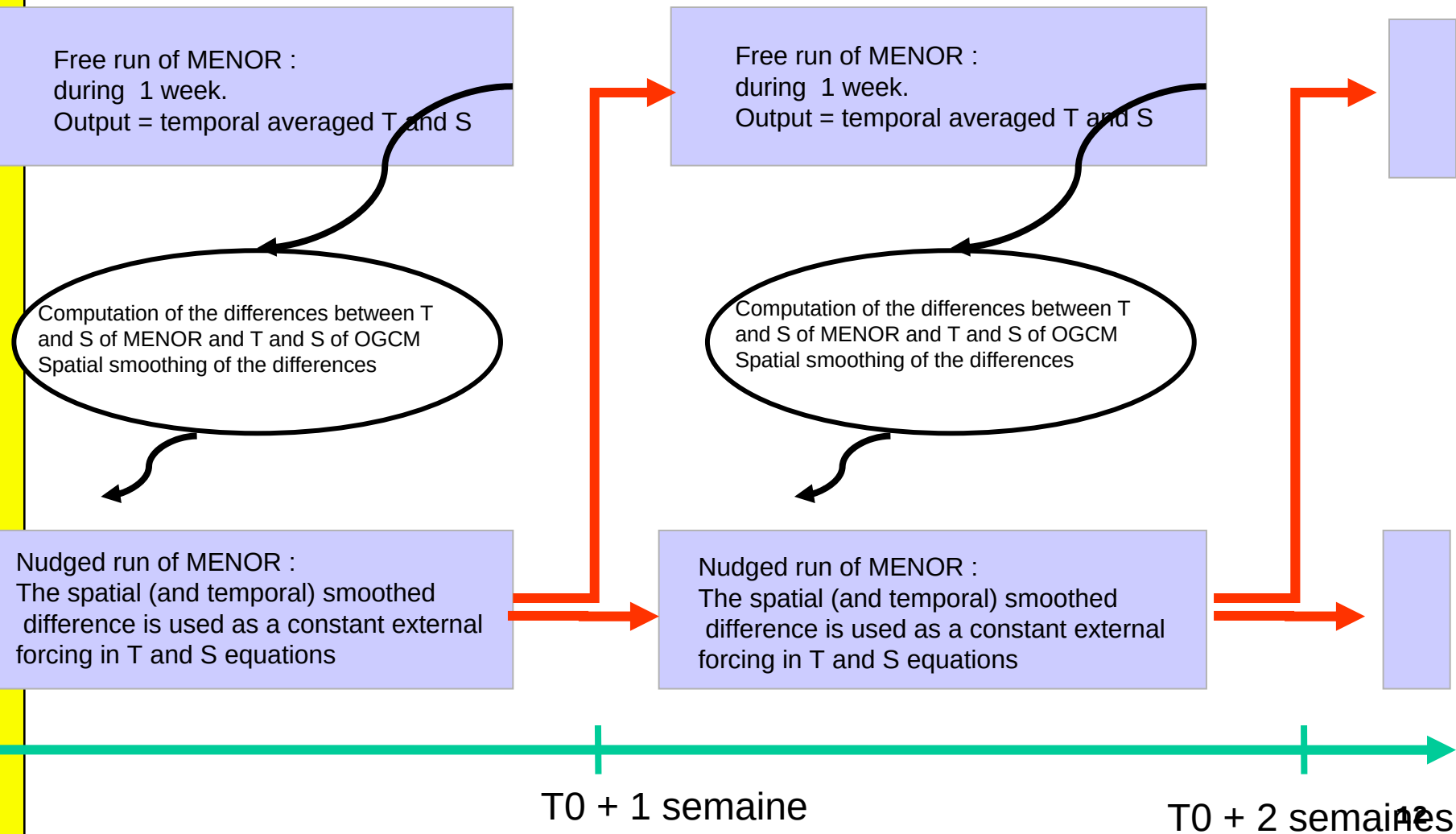
$$INC_X(i_cycle) = g(t)\, f(x,y,z)\, \langle \delta X \rangle$$

→ **spatial and temporal Filtering**

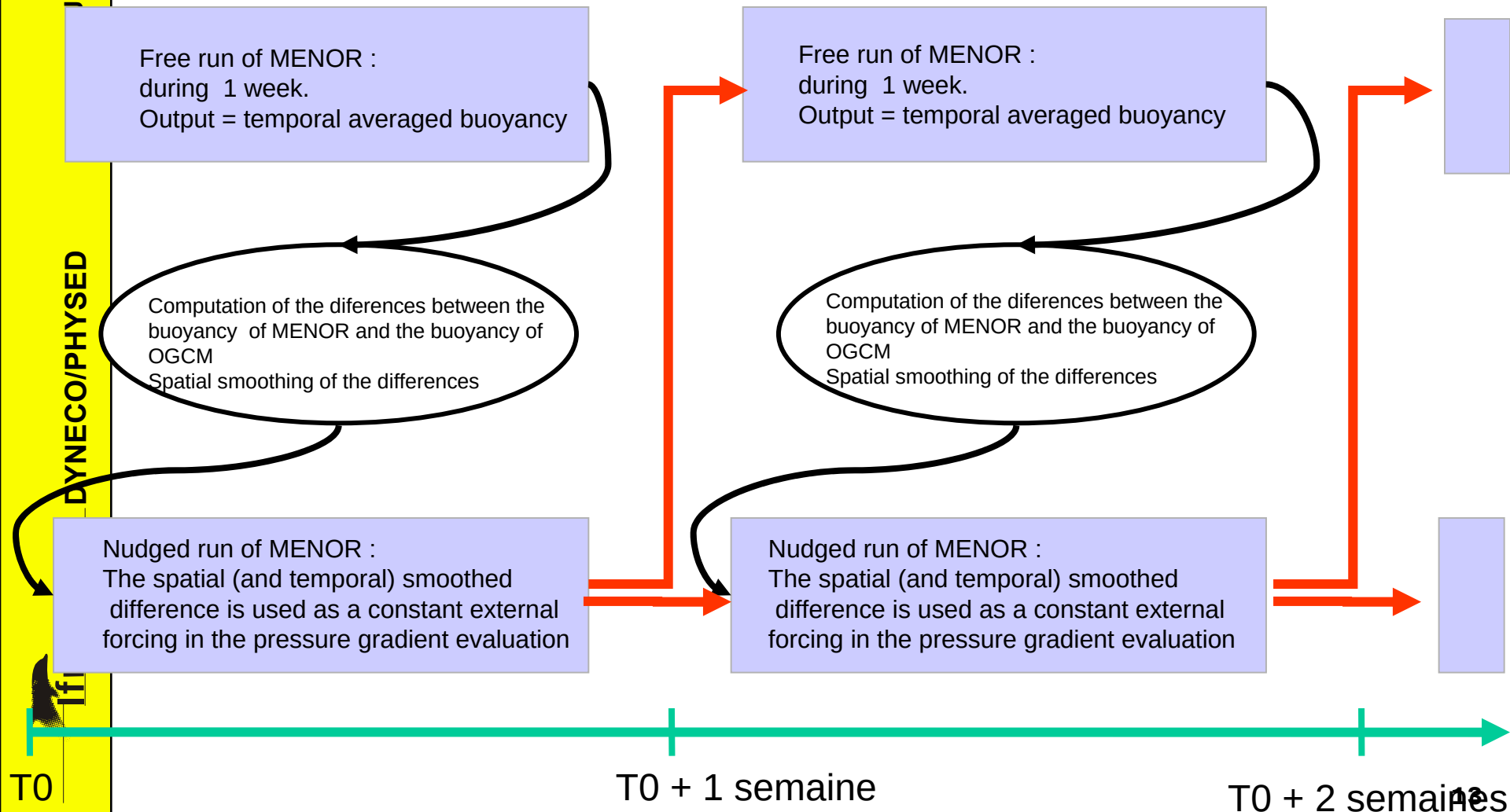




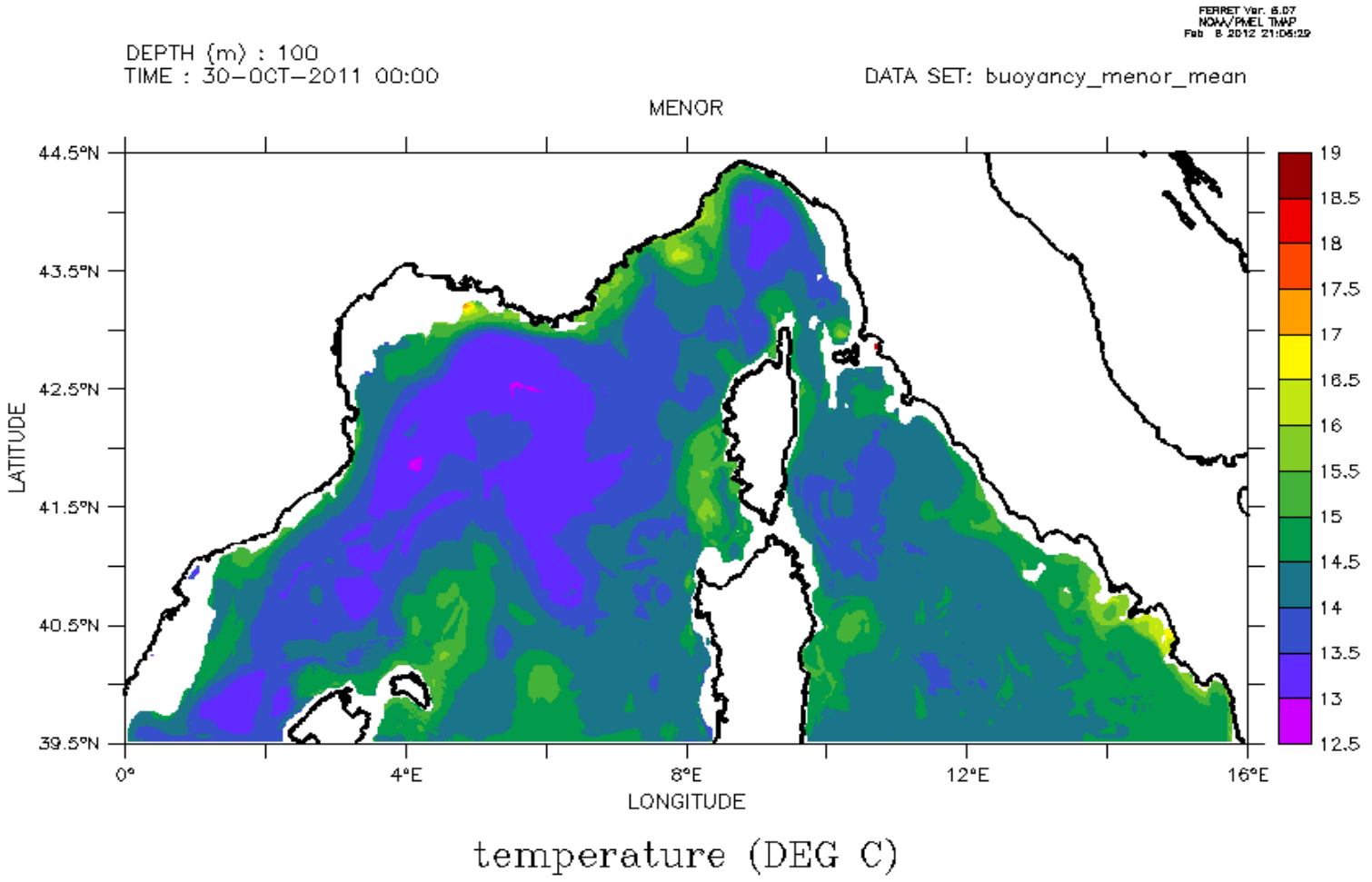
Flow chart of spectral nudging method in T and S



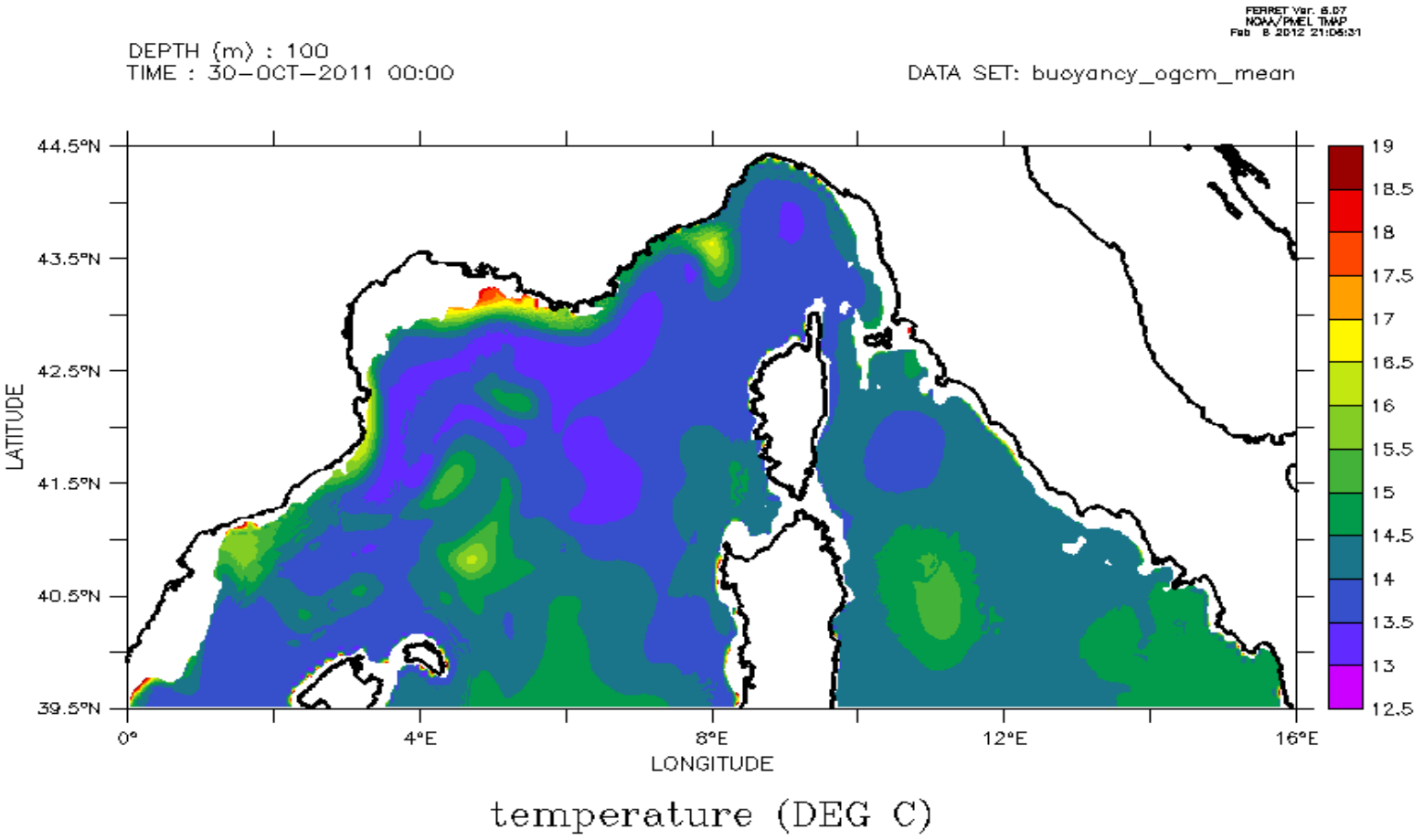
Flow chart of spectral nudging method
Semi-prognostic method



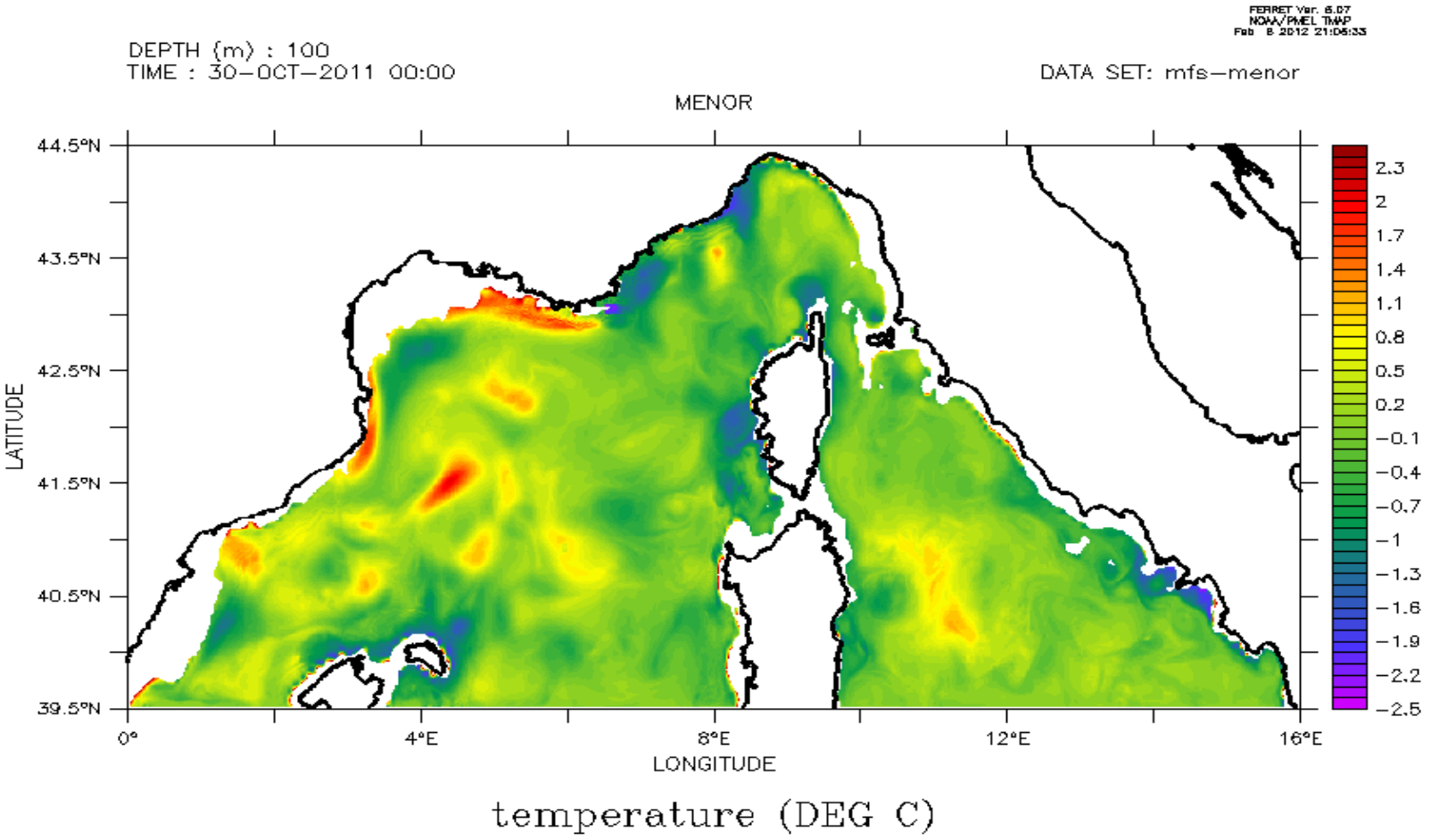
Compute the time averaged temperature (and salinity) of the free run (in a part of the domain i.e. abyssal plain)



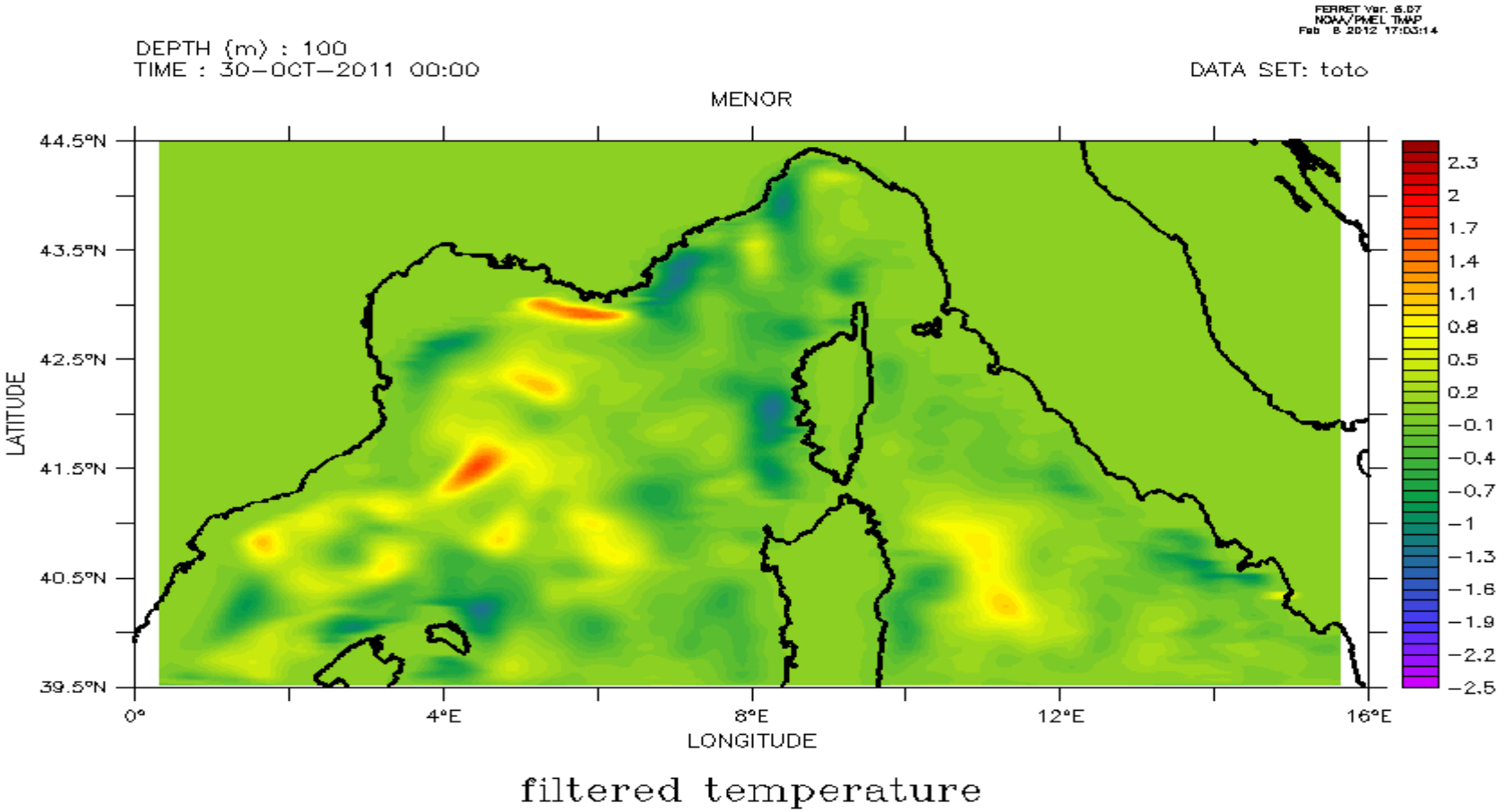
Evaluate the time averaged temperature (or salinity) on the same domain in OGCM



Evaluate the differences between the OGCM and the regional model

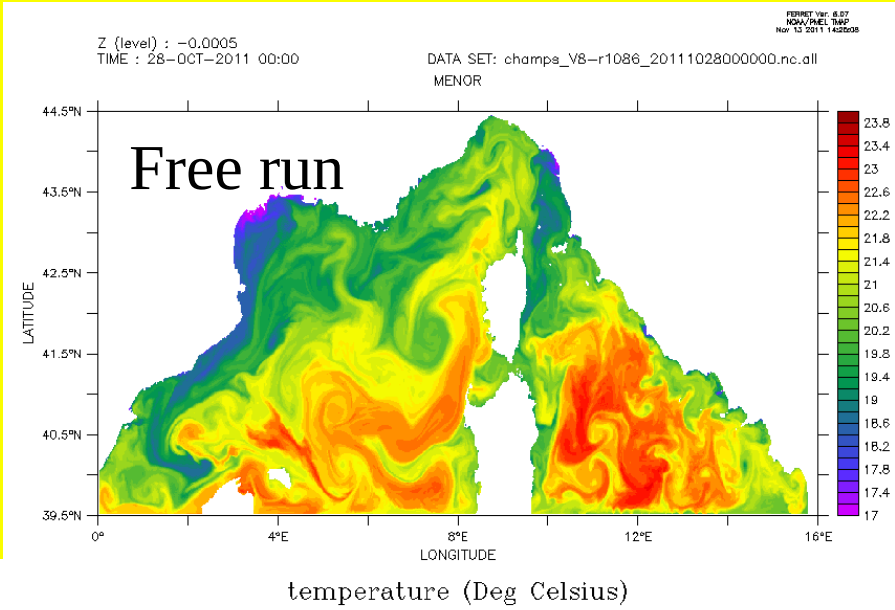


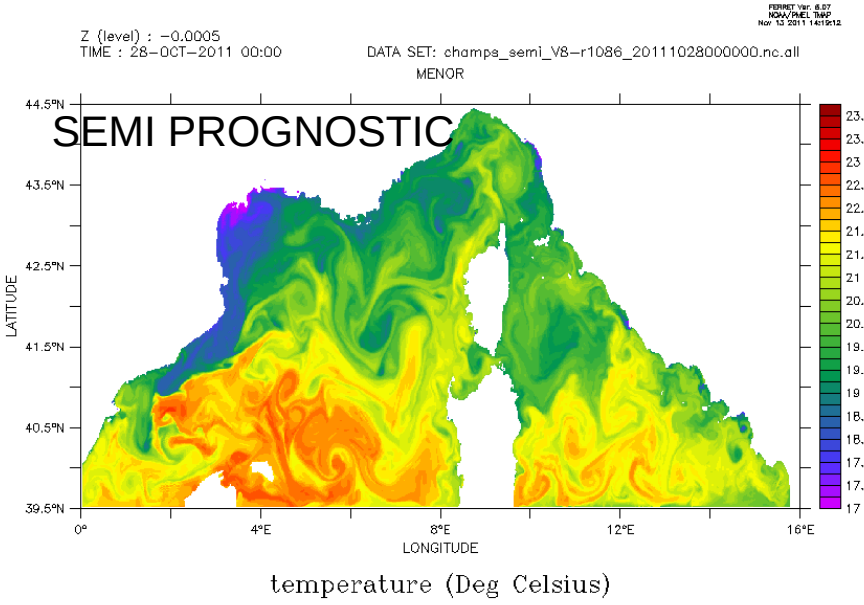
Smoothing (filtering) the difference (here an Hanning filter has been used) (box of 50 km)

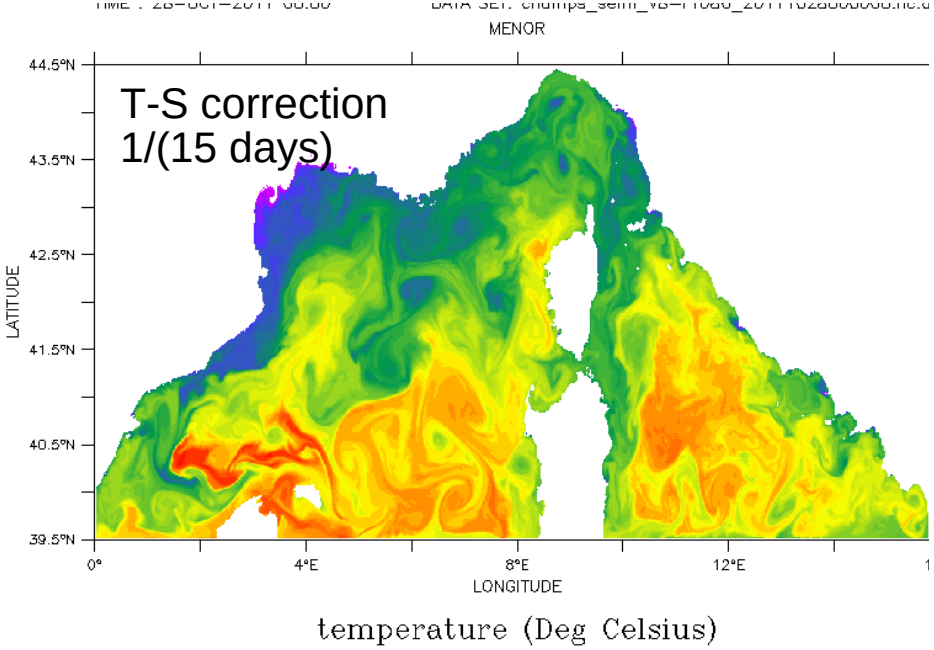


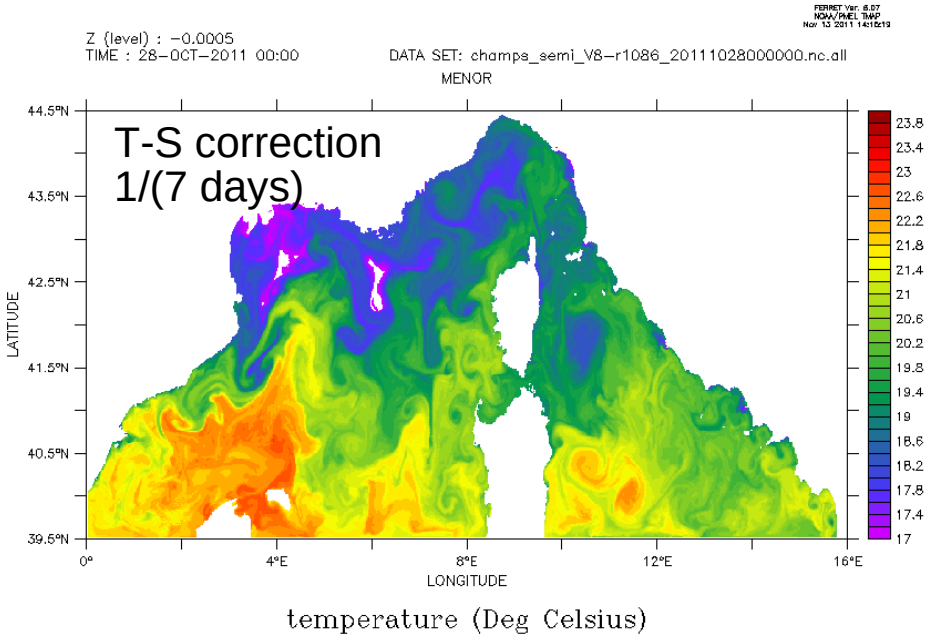
filtered temperature

Comparison after 10 months of spectral nudging

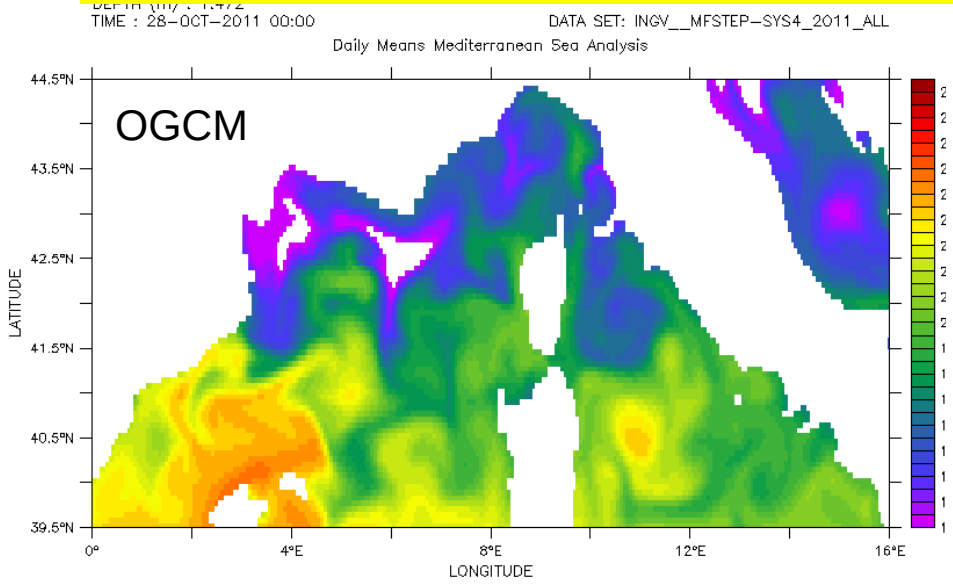


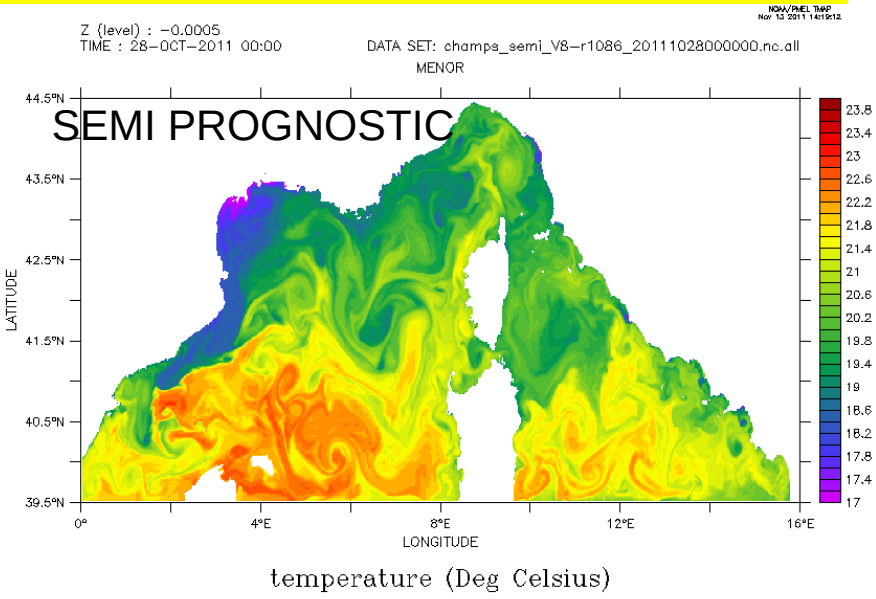


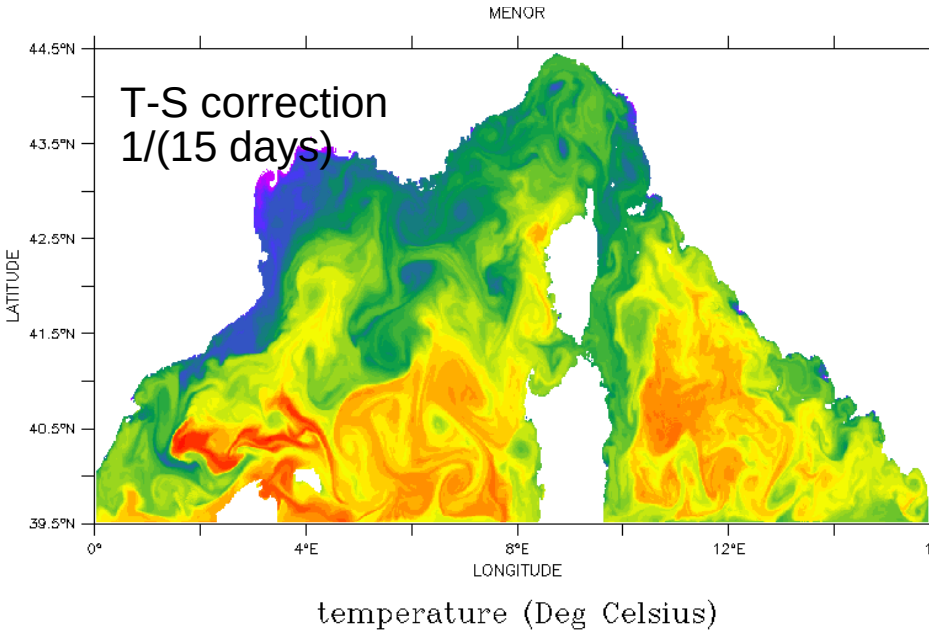


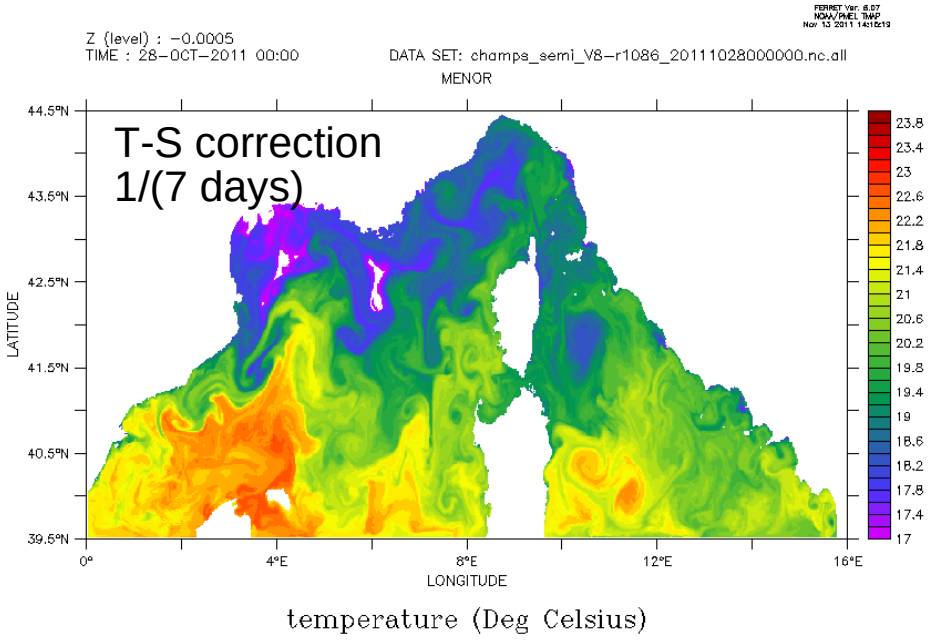


Comparison after 10 months of spectral nudging

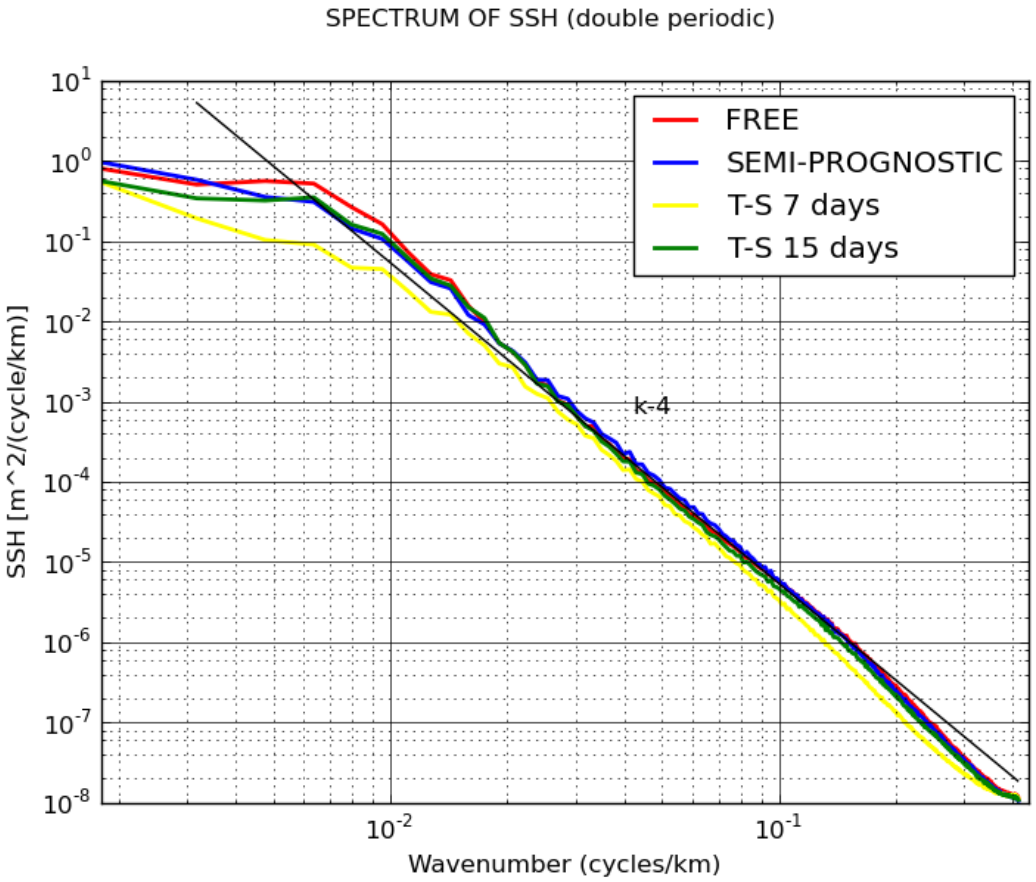








EKE spectrum from SSH



The nudging has low impact on energy cascading

CONCLUSION

- Spectral nudging is not intrusive in the code and easy to manage in an operational chain.
- Take advantage of the data assimilation done in OGCM.
- Usefull for regional modelling of the climate change (the regional model need to follow the heat and salt content of the OGCM)
- We have to continue the diagnostic of the nudged model.
- To be added in the Previmer chain