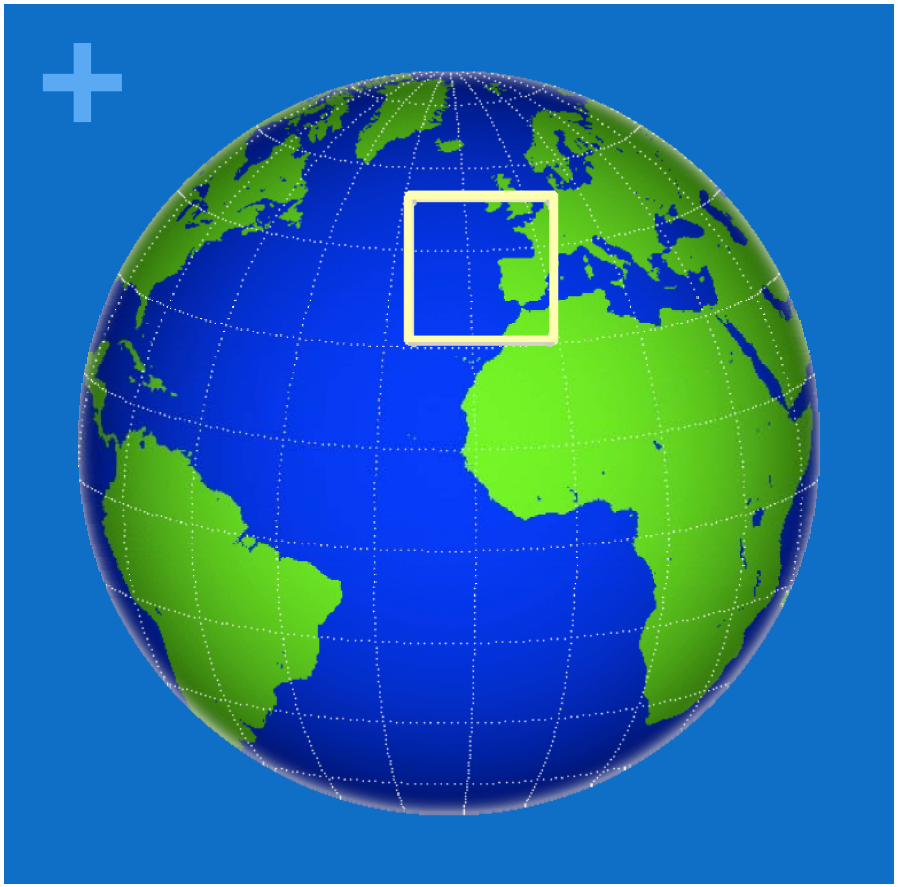


MODELLING THE NORTH-EASTERN ATLANTIC SHELF

HYCOM

Luis QUARESMA (HIDROGRÁFICO)

R. BARAILLE, A. PICHON, S. LOUAZEL, Y. MOREL (SHOM) S.CORRÉARD (GEOSCIENCES) S.CASITAS (ACTIMAR)

MODELLING THE NORTH-EASTERN ATLANTIC SHELF WITH HYCOM

Object:

To model EUROPE's SW coastal-margin:

Channel, Bay of Biscay,

West Portugal and gulf of Cadiz.

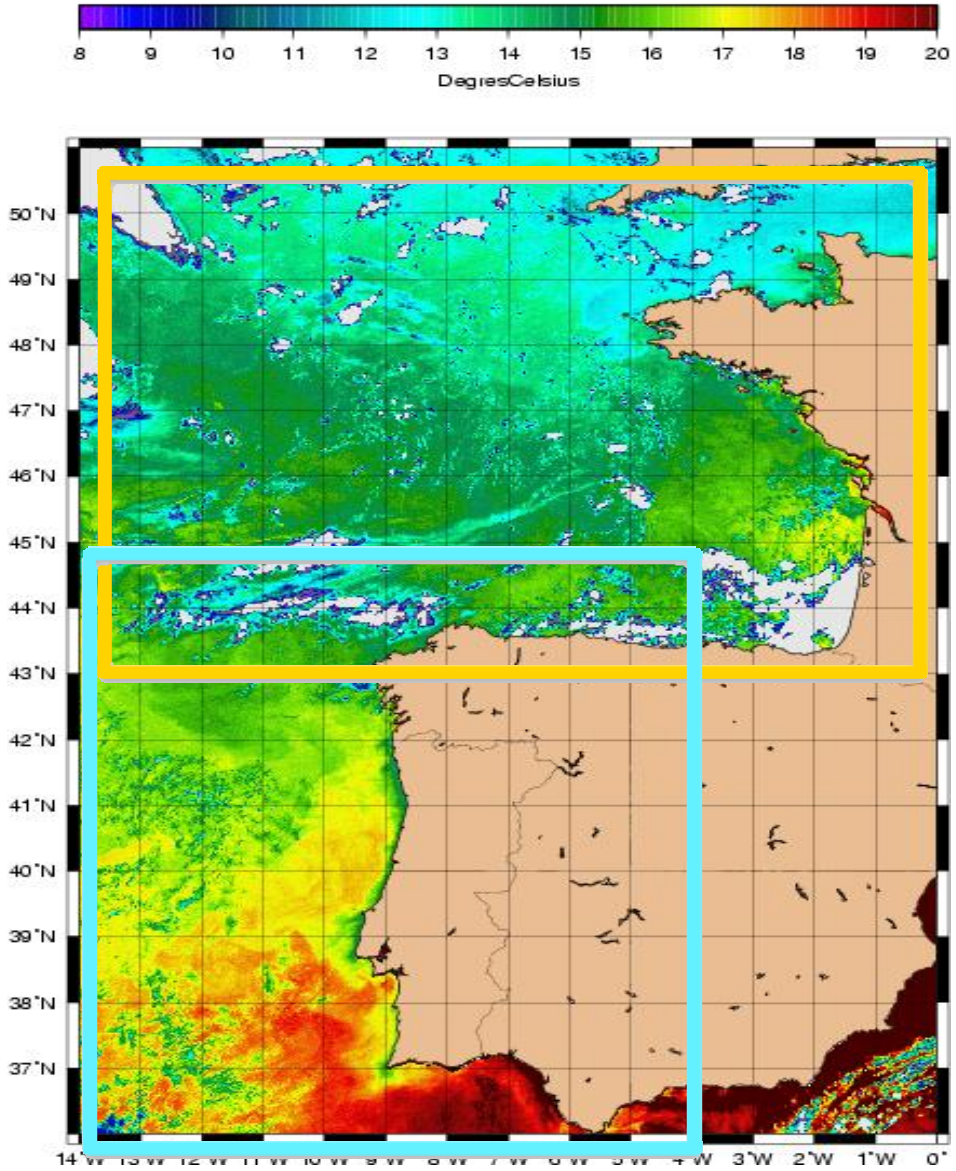
Sub-domains division:

1. Golfe de Gascogne
2. **West-Iberian**

Project:

Started as a **SHOM** operation program MOUTON (2001-2008) PROTEVS (2009-2017) EPIGRAM(2008-2012);

Partnership with **HIDROGRAFICO** at the south Sub-domain (MITIC (2009-2011);



Modelling improvements to approach accuracy

NUMERICAL DEVELOPMENTS

- Wetting drying version of HYCOM
- New boundary conditions (based on flux control)
- Time varying mixed layer scheme for (manage seasonnal thermocline)
- New time stepping for the slow part of barotropic fields (4th order advection scheme for momentum; conservative scheme)

BATHYMETRY UPGRADING

- SHOM and HIDROGRAFICO made available high resolution data, to construct a new DTM of the study region.

FORCING STEP UP

- Establish better Initial State and Boundary Conditions for each involved oceanic process:

MERCATOR (mean circulation) ;

GDEM (mediterranean boundary);

MOG2D vs OTIS (tide);

ARPEGE vs ALADIN (wind)

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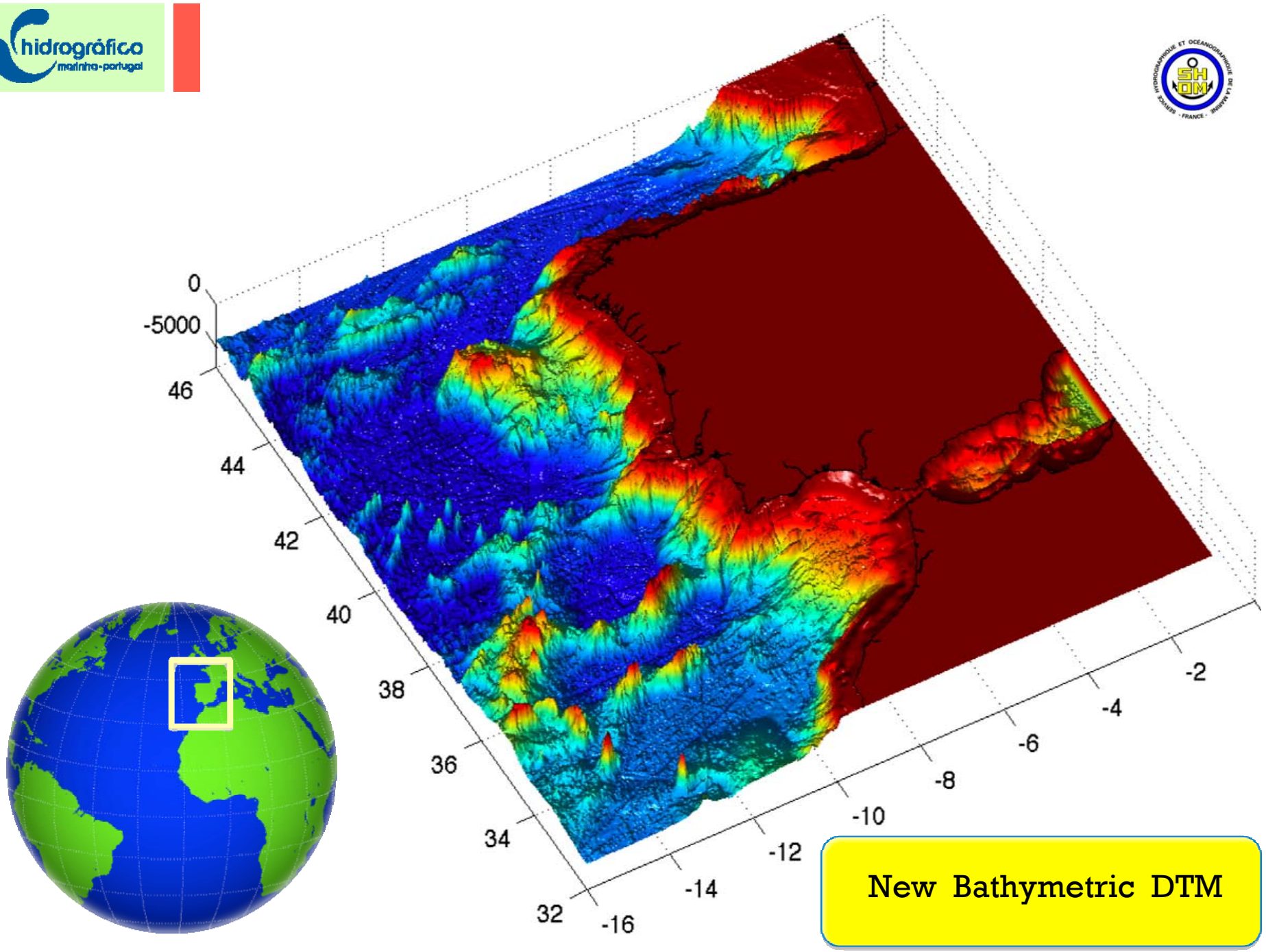
0
-5000
46
44
42
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38
36
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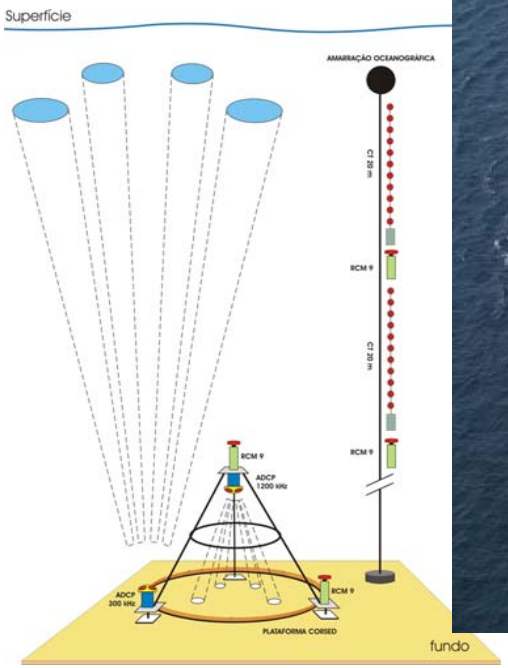
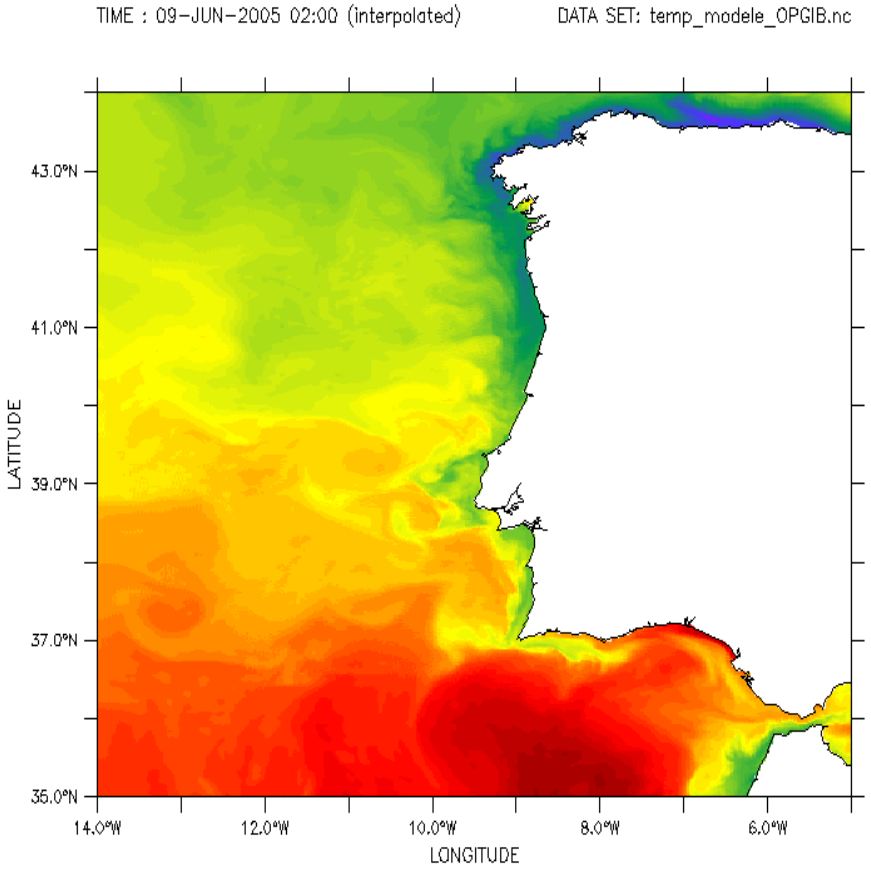
32
-16
-14
-12
-10
-8
-6
-4
-2
New Bathymetric DTM

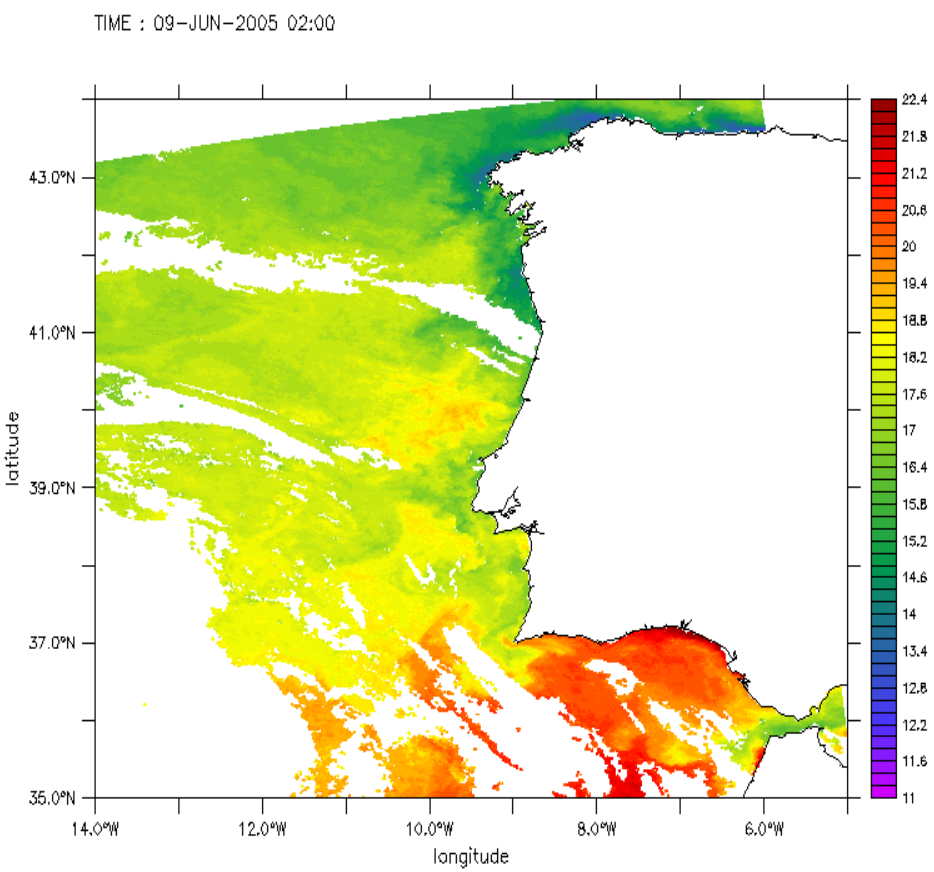
Observation campaigns at sea to validate and improve numerical results



Satellite images to validate numerical results

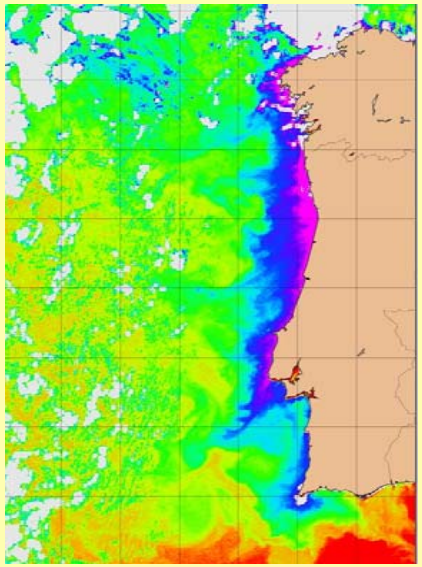


SST hycom (degC)

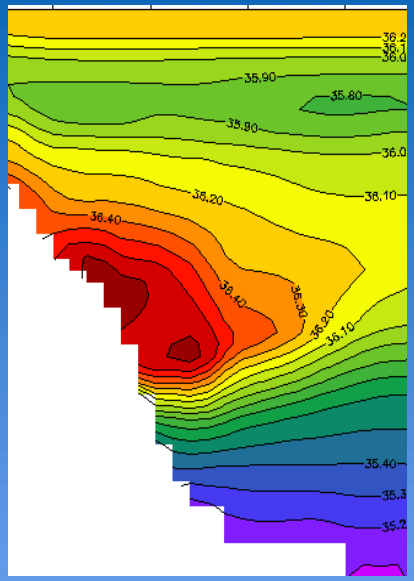


SST image (degC)

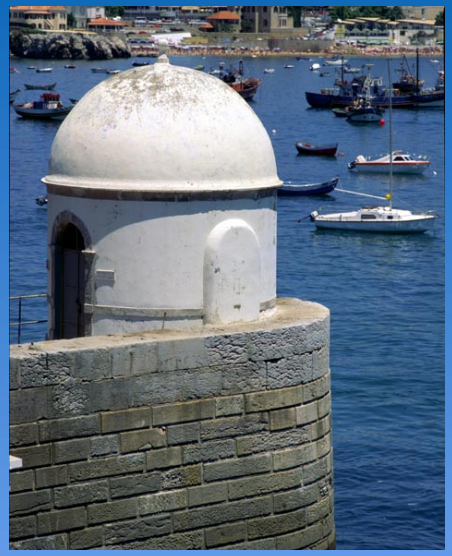
Modelling 3 important oceanic processes



UPWELLING



MEDITERRANEAN OUTFLOW



TIDE
(internal tide)

HYCOM SETUP

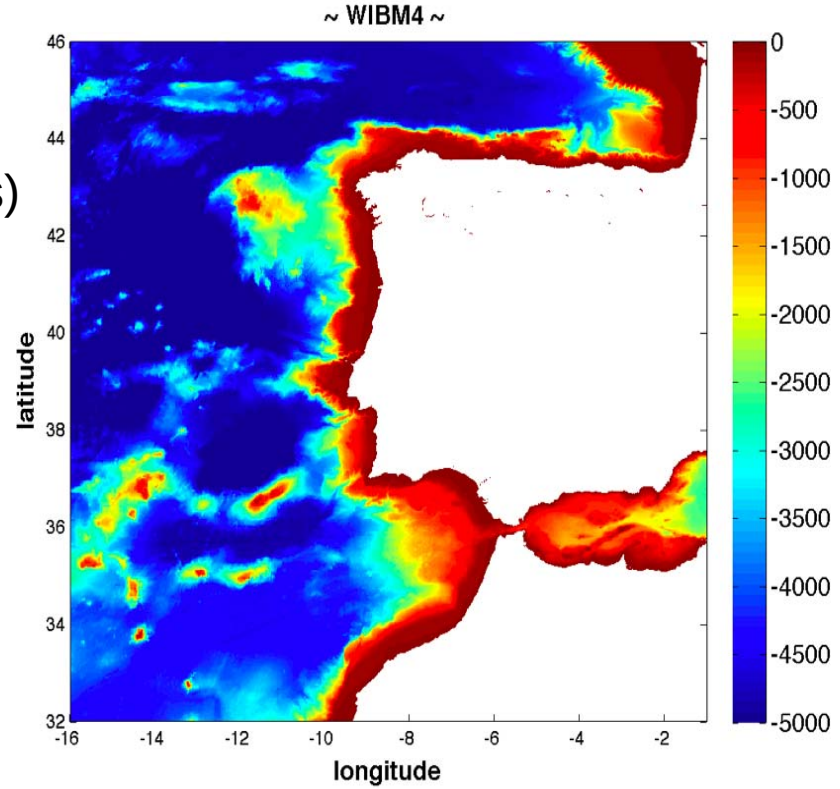
1. Vertical structure: **32 vertical levels (sigma2)**

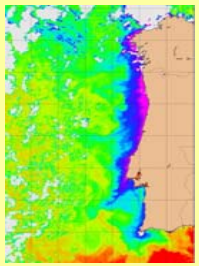
1. Spatial resolution: **~ 1.8 km (Mercator projection)**

2. Initial state and boundary conditions forced by:

   Stratification: **MERCATOR** (every 7 days)

   Wind: **ARPEGE** (every 6 hours)

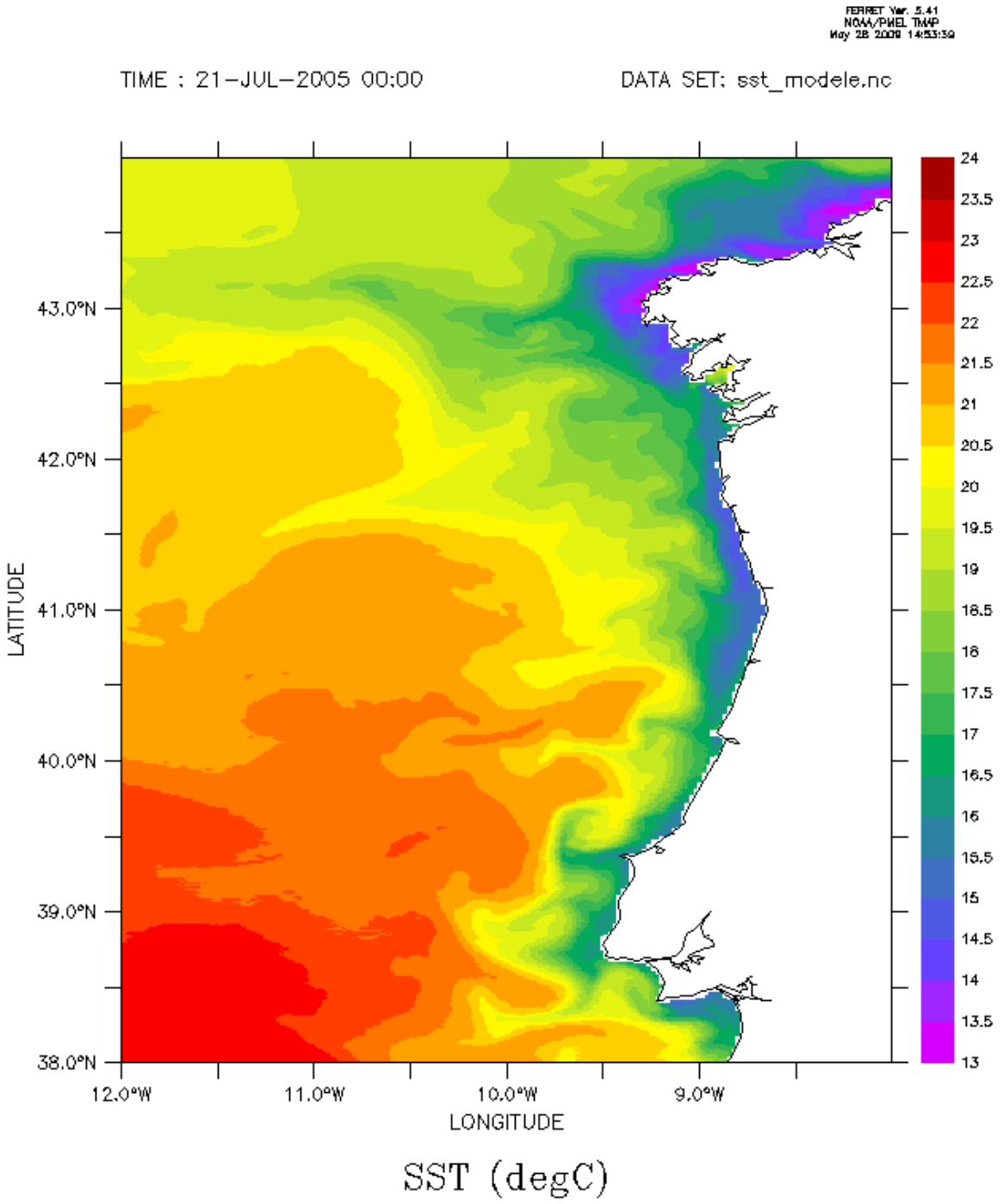




UPWELLING

4. **Free run** (no assimilation, no correction of atmospheric fluxes)

5. Time period : **2005**


FERRET Ver. 5.41
NOAA/PMEL TMAP
May 28 2009 14:53:59
TIME : 21-JUL-2005 00:00
DATA SET: sst_modele.nc
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42.0°N
41.0°N
40.0°N
39.0°N
38.0°N
LATITUDE
12.0°W
11.0°W
10.0°W
9.0°W
LONGITUDE
24
23.5
23
22.5
22
21.5
21
20.5
20
19.5
19
18.5
18
17.5
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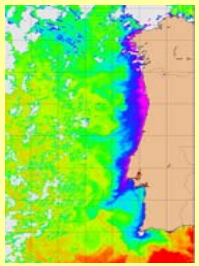
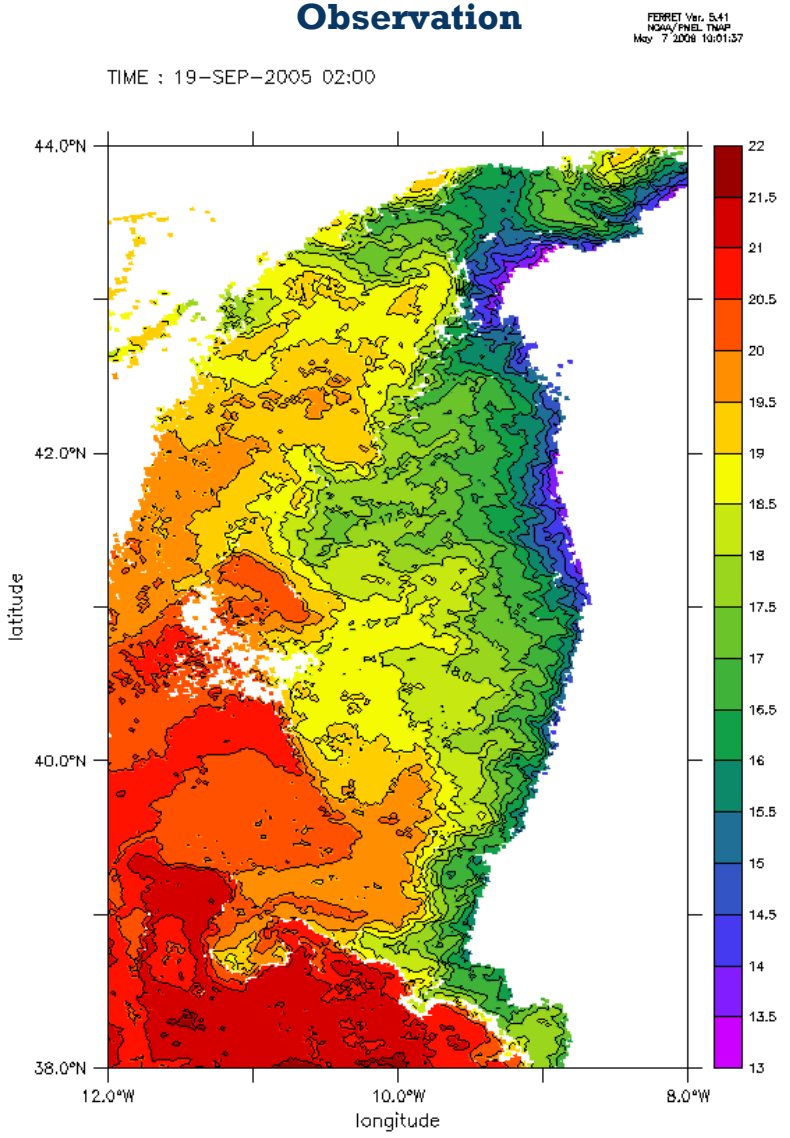
16.5
16
15.5
15
14.5
14
13.5
13
SST (degC)



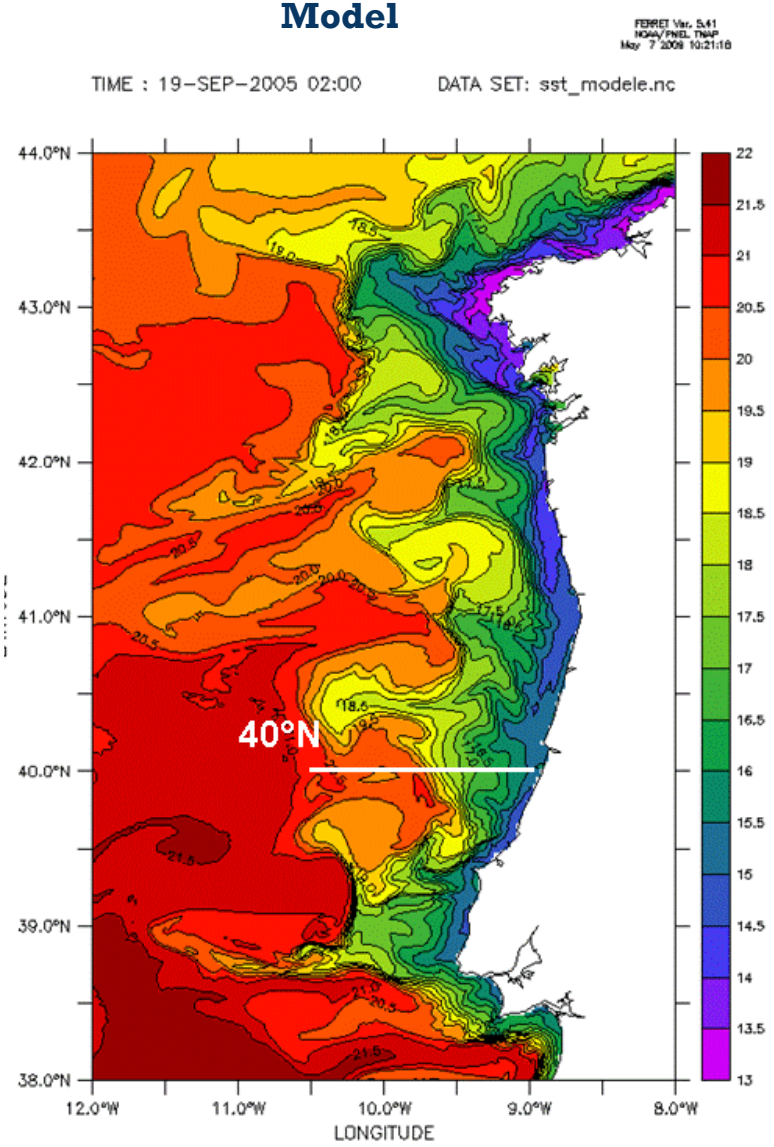
UPWELLING

Observation

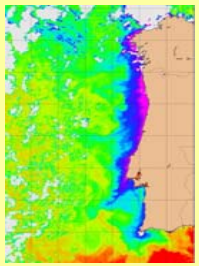


SST image (degC)

Model

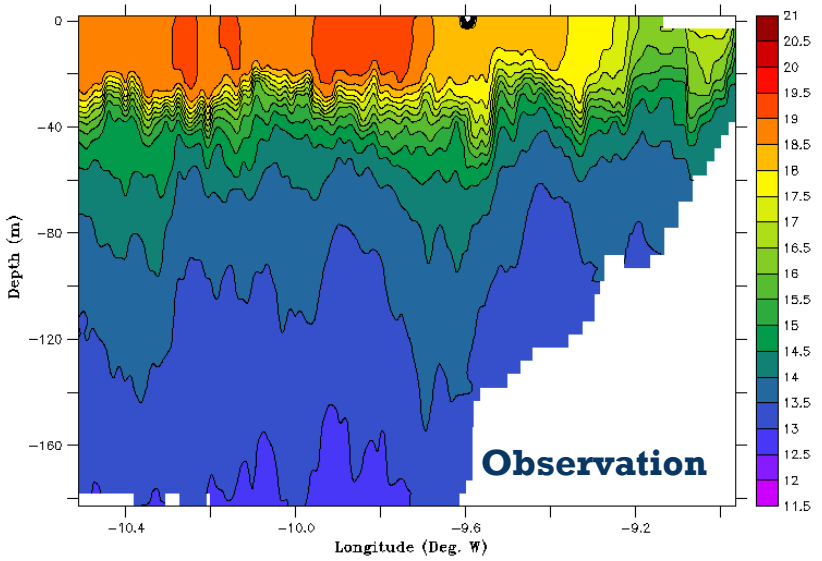


SST hycom (degC)

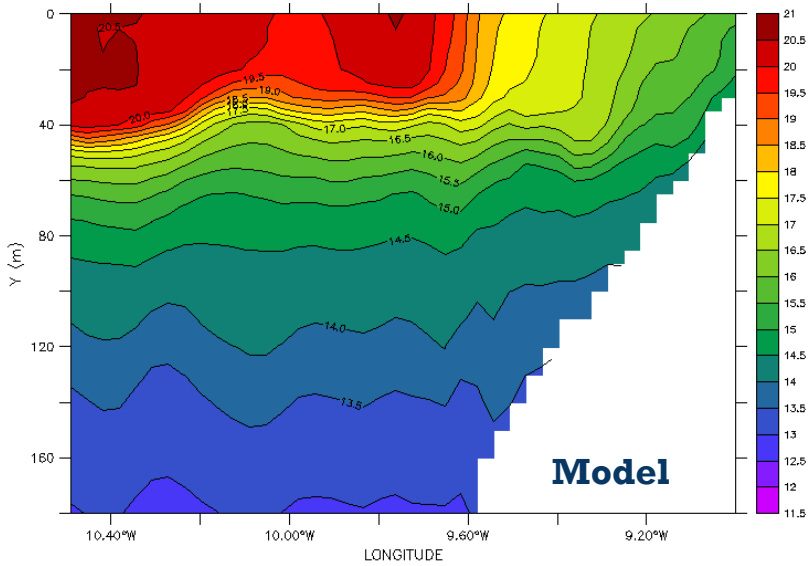


UPWELLING

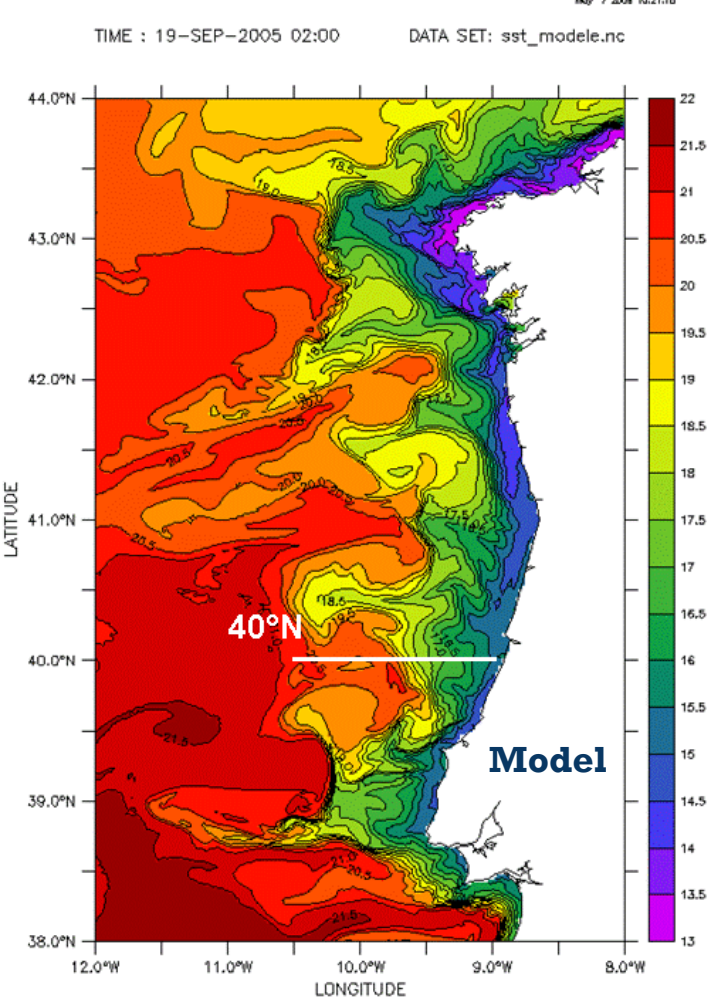
Temperature



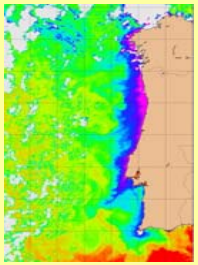
radiale40N-leg3.txt Temperature(090) (Deg. C.)



Temperature HYCOM – EXP2

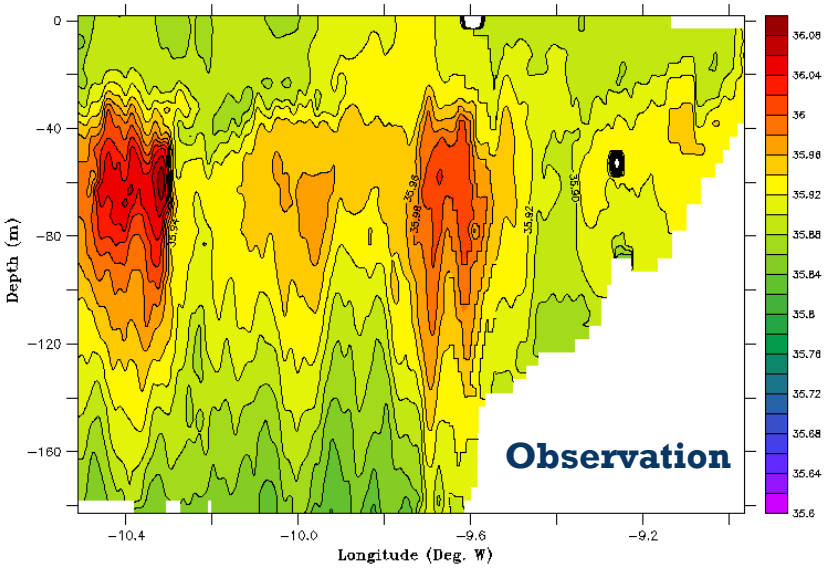


SST hycom (degC)

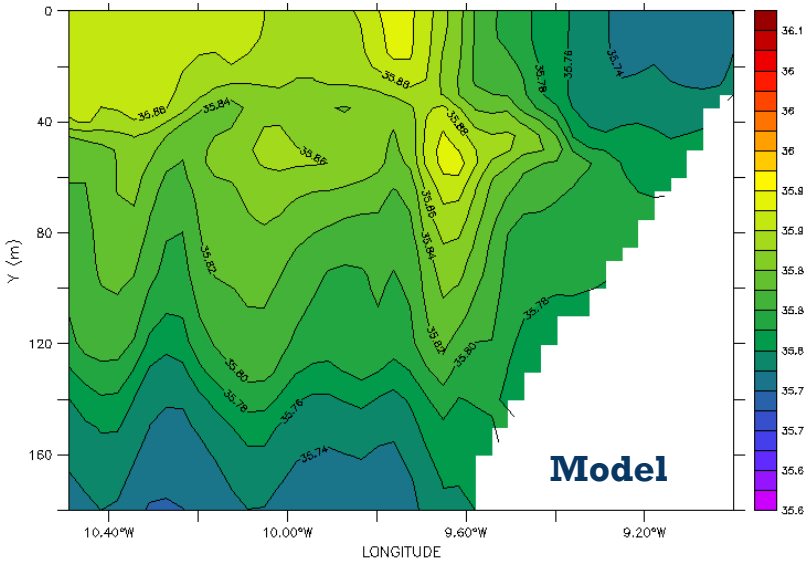


UPWELLING

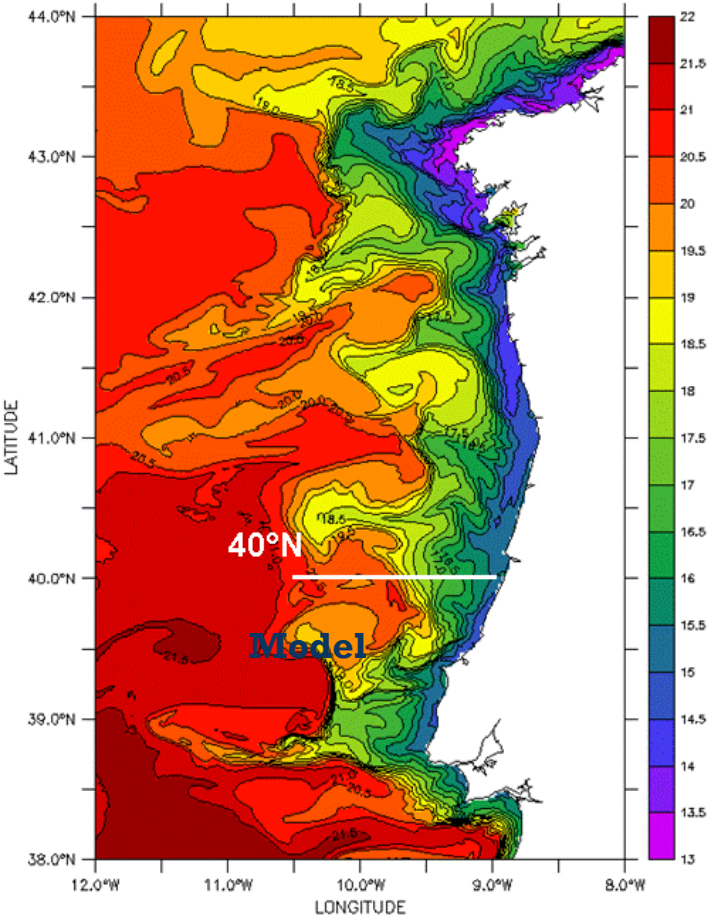
Salinity



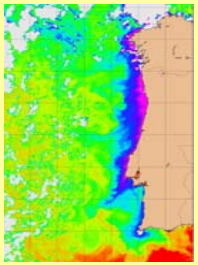
radiale40N-leg3.txt Salinity(0) (psu)



Salinite HYCOM – EXP2

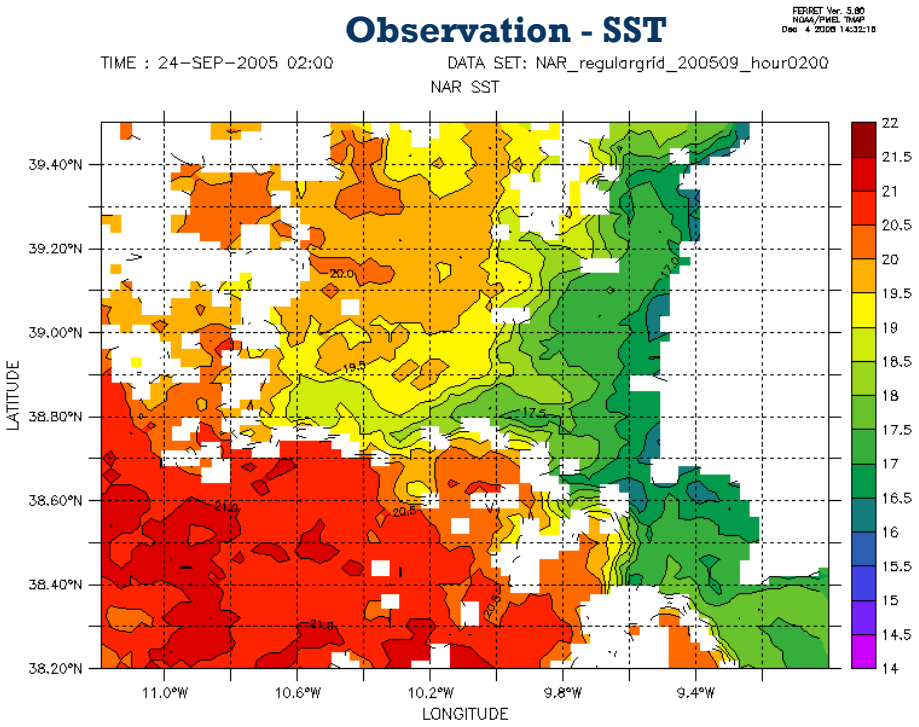


SST hycom (degC)

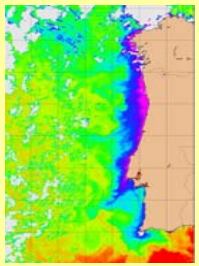


UPWELLING

Observation - SST

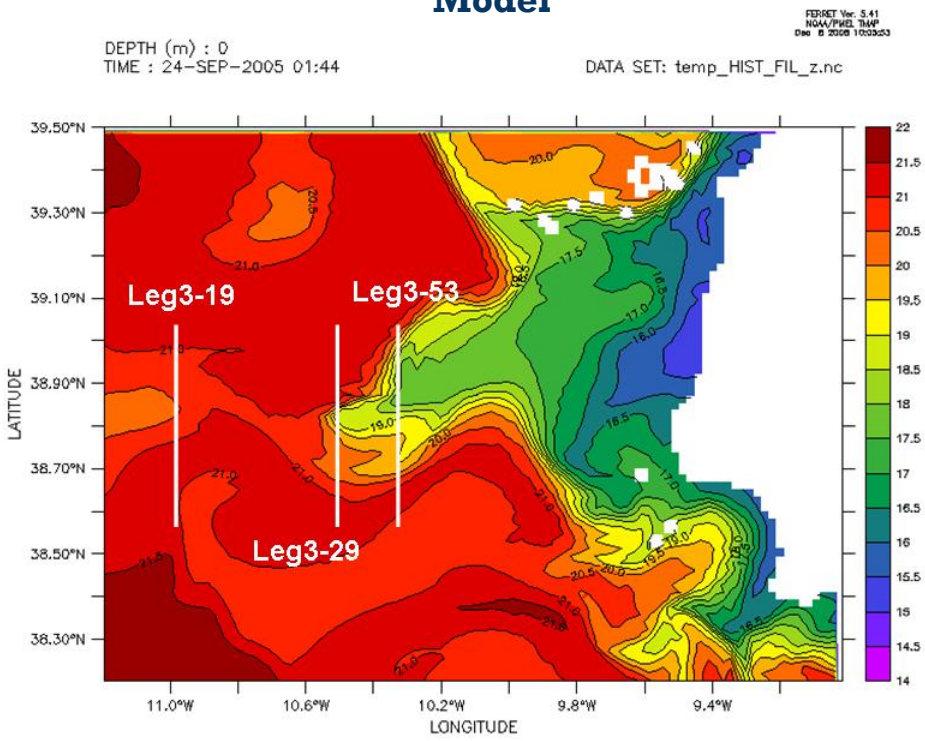


Temperature de surface (degC)



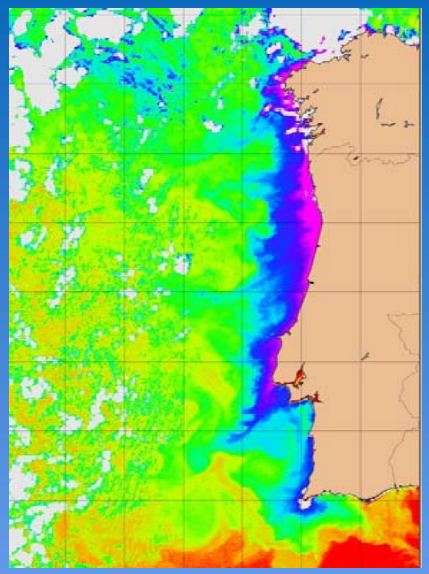
UPWELLING

Model

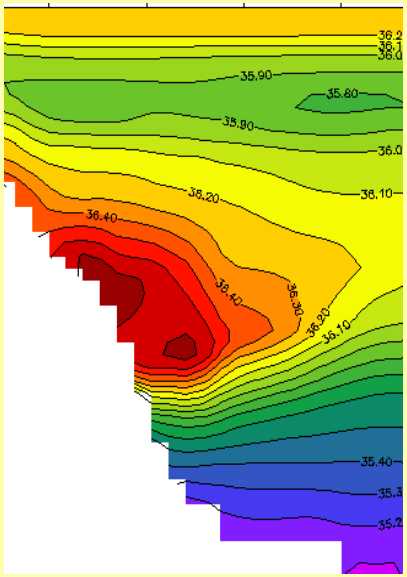


Temperature HYCOM – EXP2

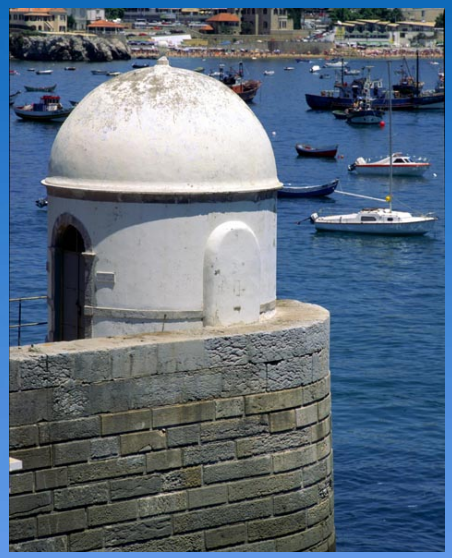
Modelling 3 important oceanic processes



UPWELLING



MEDITERRANEAN OUTFLOW



TIDE
(internal tide)

HYCOM SETUP

1. Vertical structure: **32 vertical levels (sigma2)**

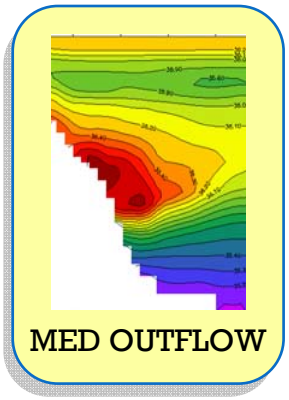
1. Spatial resolution: **~ 1.8 km (Mercator projection)**

2. Vertical mixing: **KPP + Xu et al. (2006) for gravity current**

3. Initial state and boundary conditions forced by:

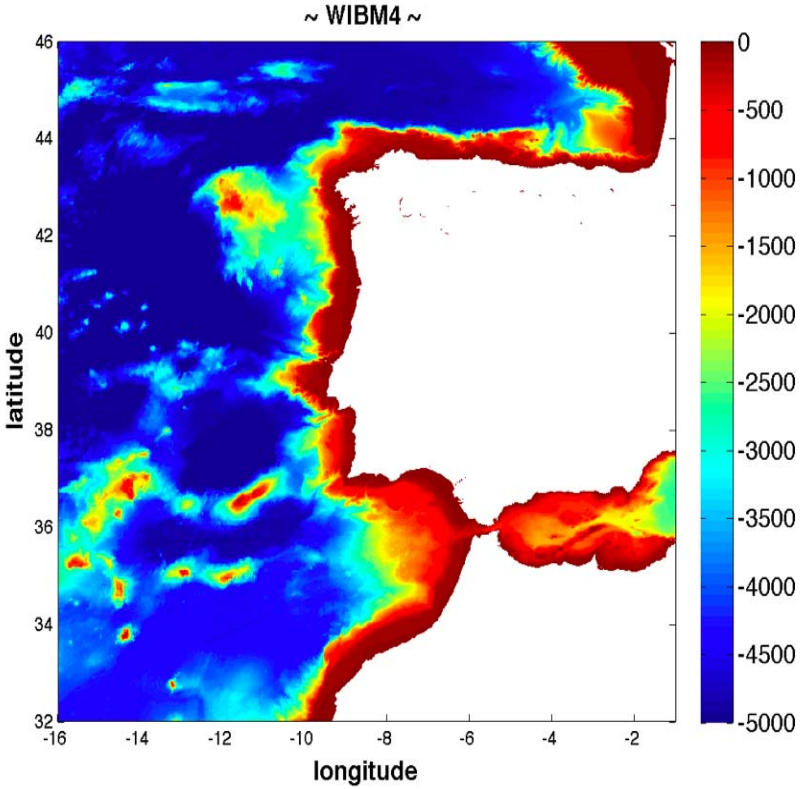
Stratification: **MERCATOR** (Atlantic)
GDEM (Mediterranean)

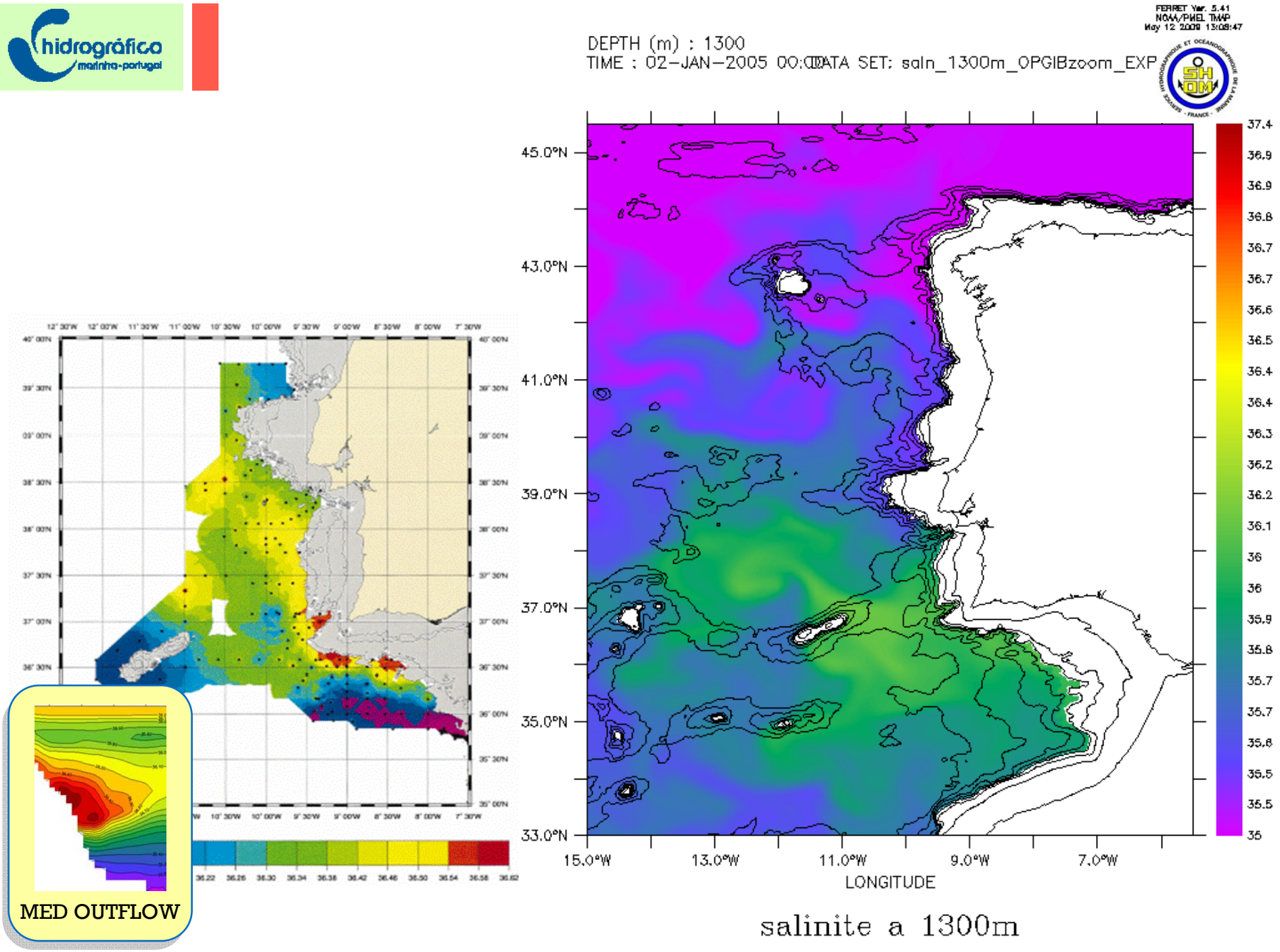
Wind: **ARPEGE**



5. **Free run** (no assimilation, no correction of atmospheric fluxes)

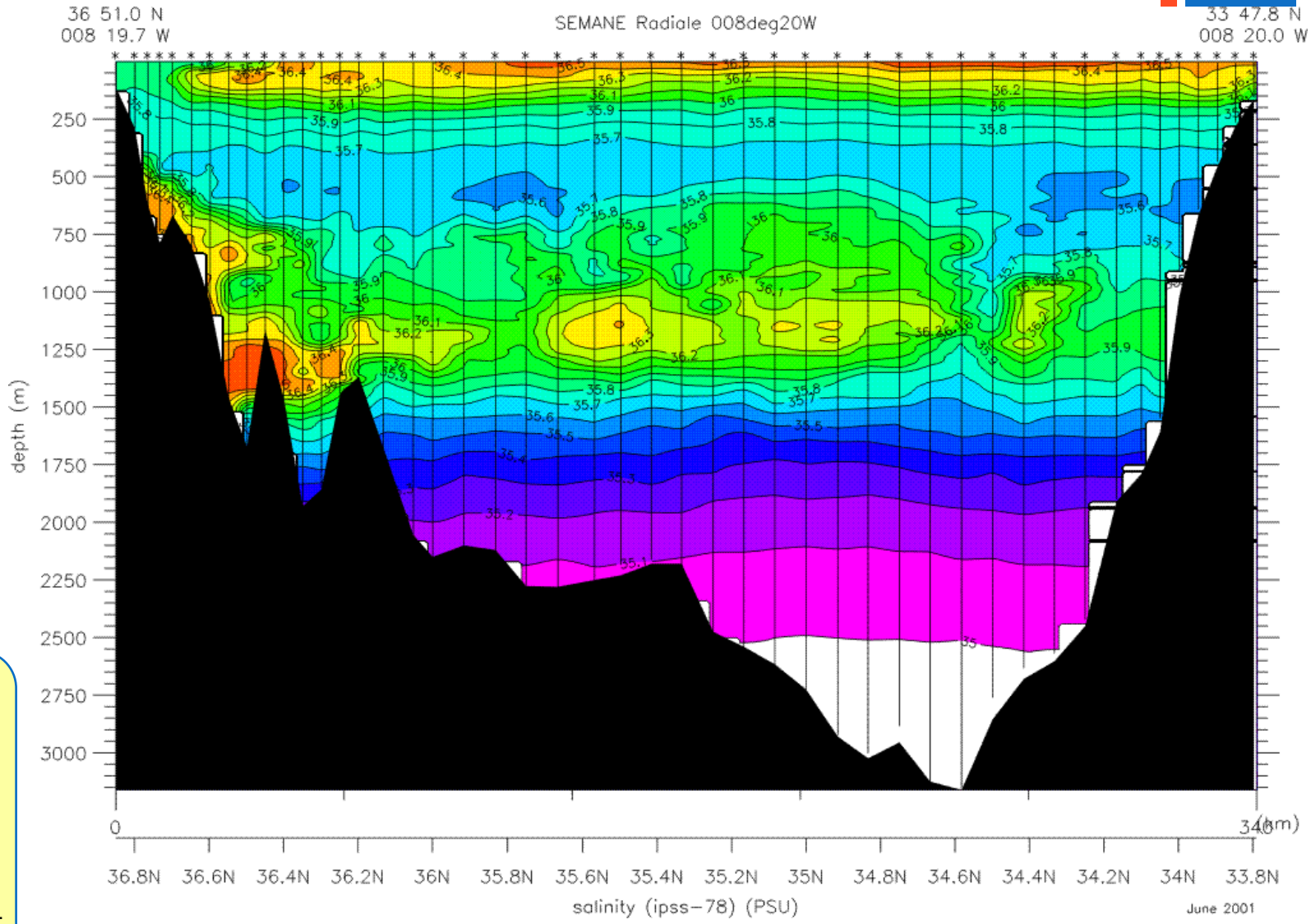
6. Time period : **2005**

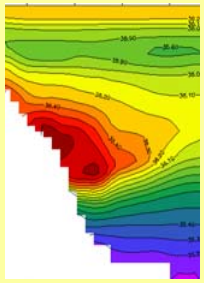




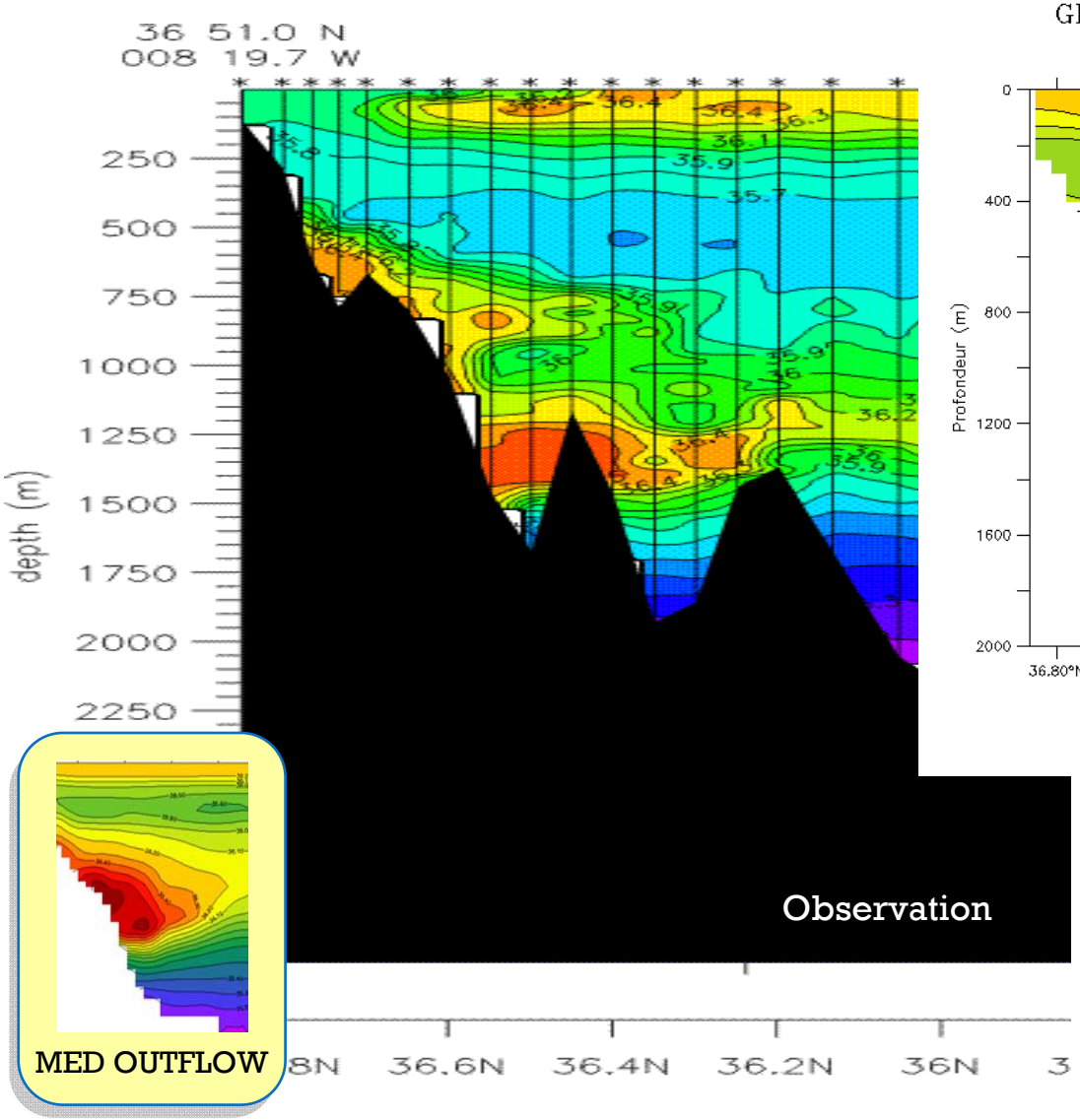
salinite a 1300m

SEMANE PROJECT

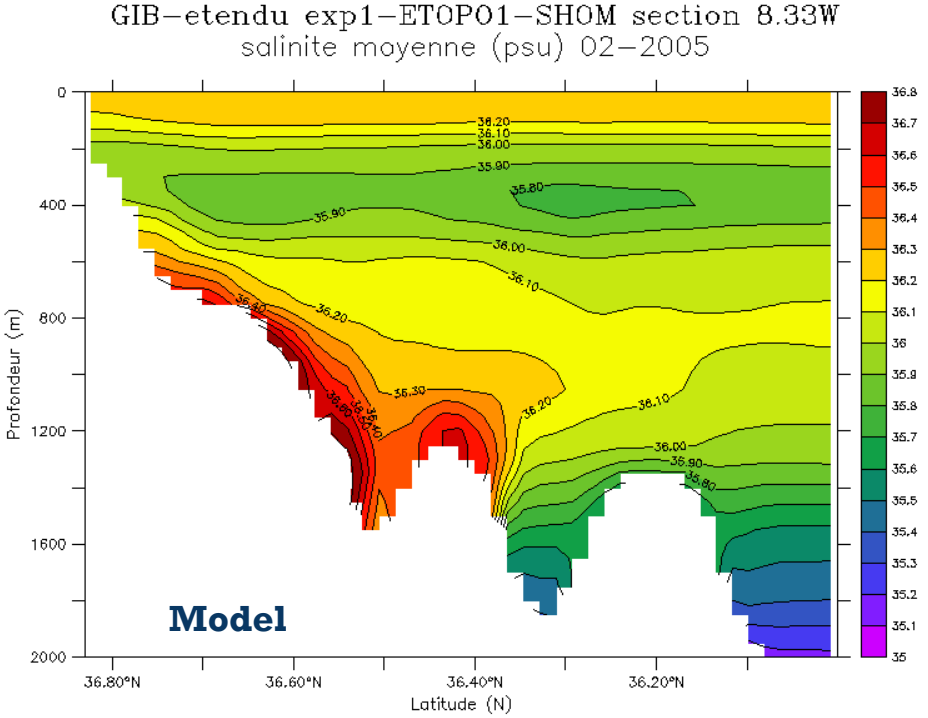




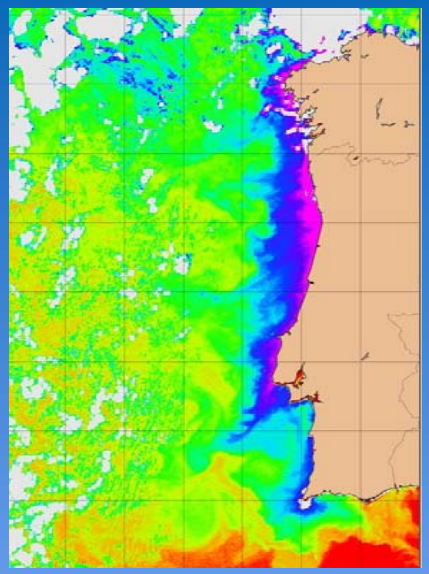
MED OUTFLOW


36 51.0 N
008 19.7 W
depth (m)
250
500
750
1000
1250
1500
1750
2000
2250
36.6N
36.4N
36.2N
36N
Observation

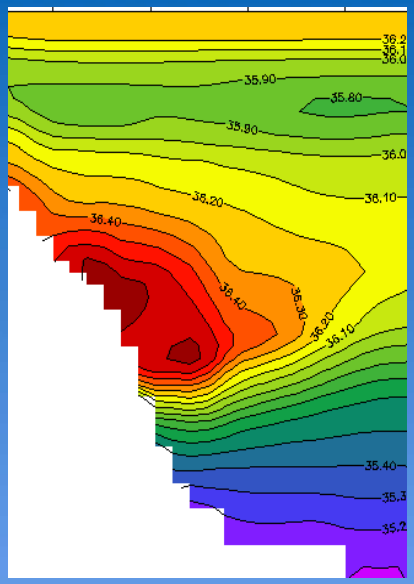
MED OUTFLOW


GIB-etendu exp1-ETOPO1-SHOM section 8.33W
salinite moyenne (psu) 02-2005
Profondeur (m)
0
400
800
1200
1600
2000
36.80°N
36.60°N
36.40°N
36.20°N
Latitude (N)
Model

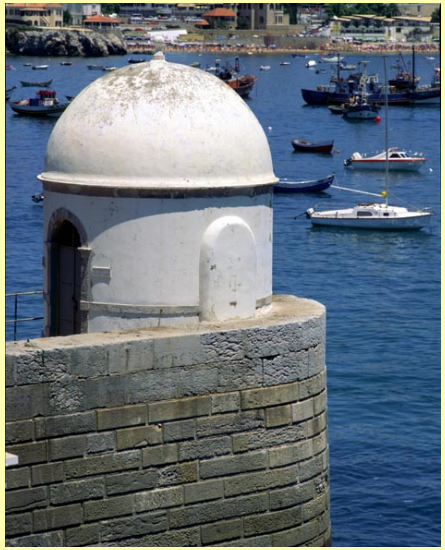
Modelling 3 important oceanic processes



UPWELLING



MEDITERRANEAN OUTFLOW



TIDE
(internal tide)

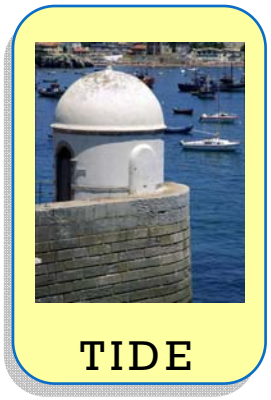
HYCOM SETUP

1. Vertical structure: **Barotropic (1 homogeneous level)**

1. Spatial resolution: **~ 1.8 km (Mercator projection)**

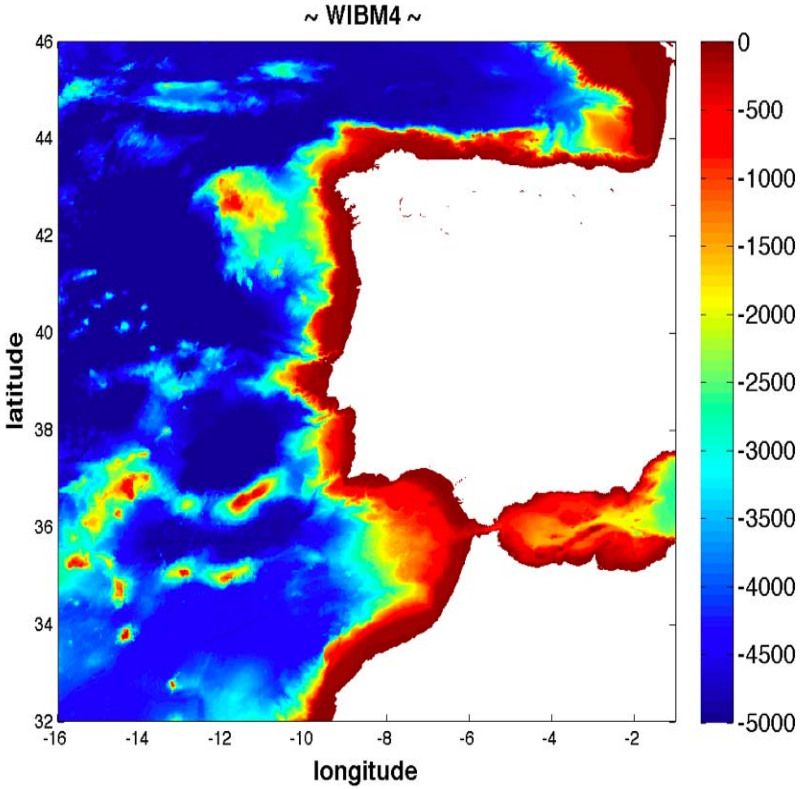
2. Initial state and boundary conditions forced by:

   Tide: **MOG2D** (LEGI spectral model)**,** by the main semi-diurnal tidal harmonics (M2, S2,N2,K2).



4. **Free run** (no assimilation),

5. Time period : **2004**



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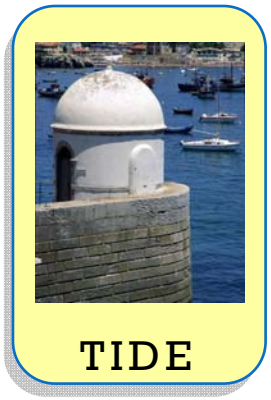
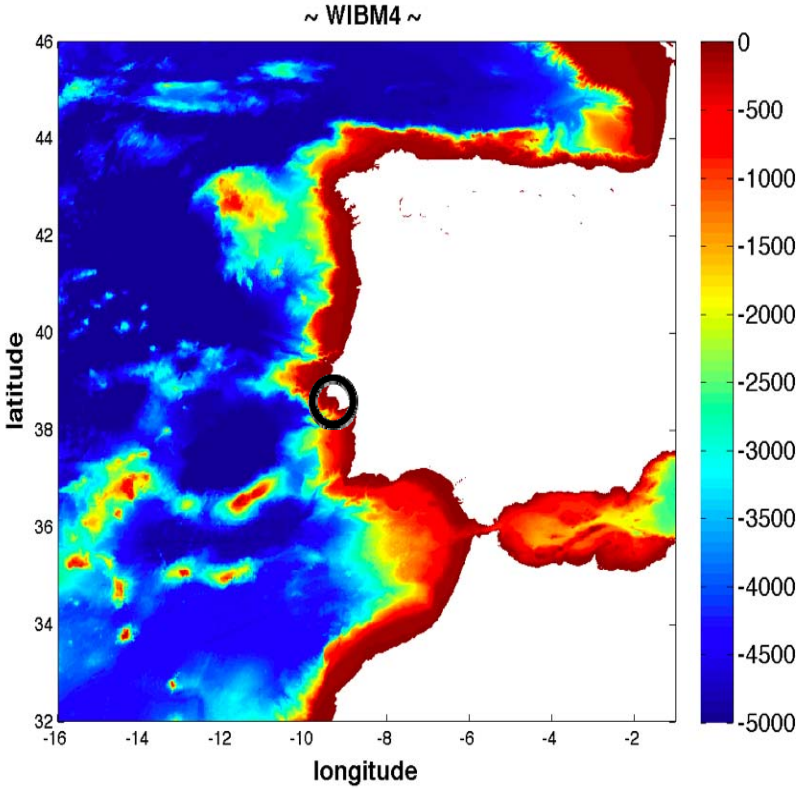
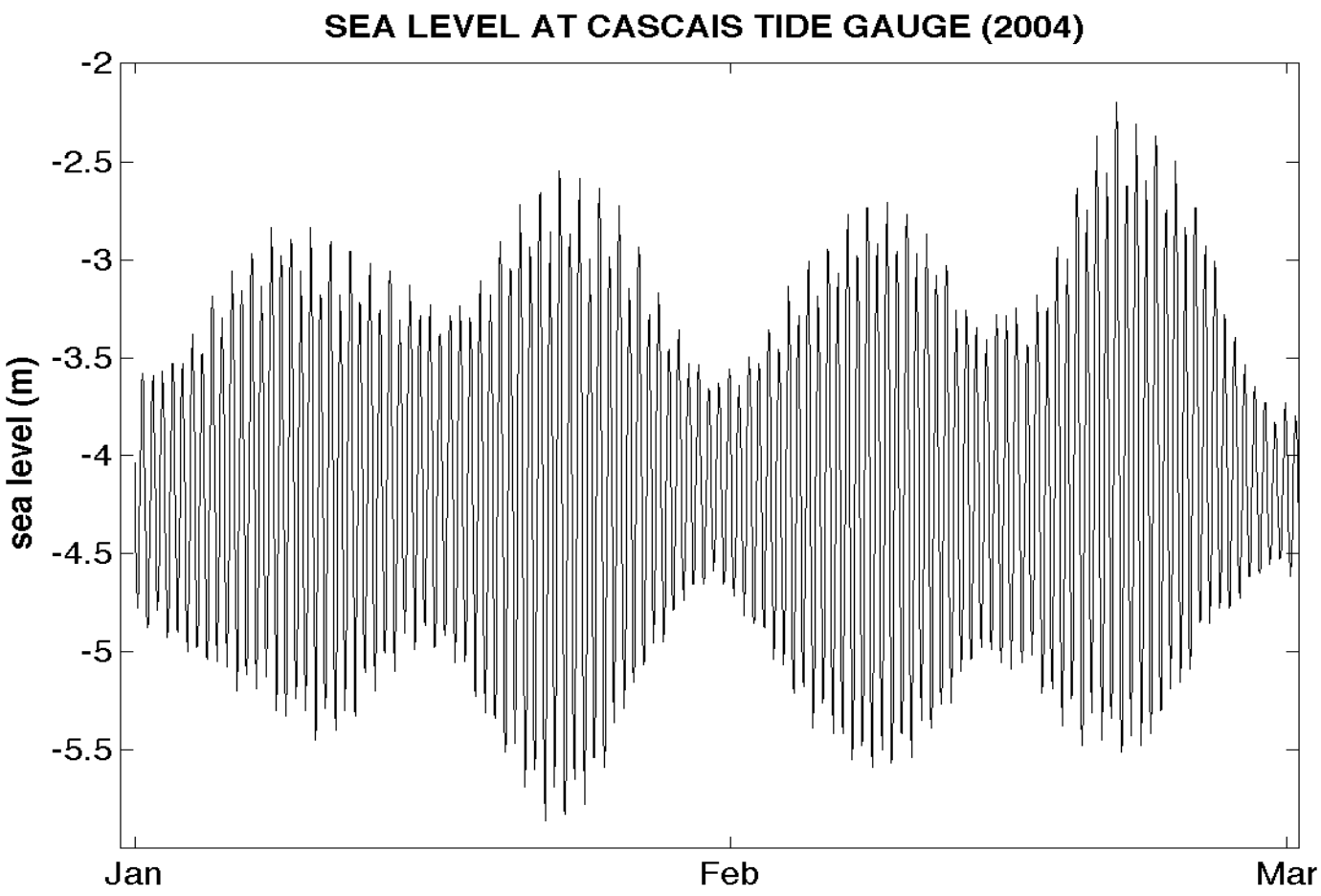


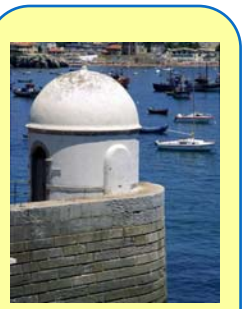
4. **Free run** (no assimilation),

5. Time period : **2004**

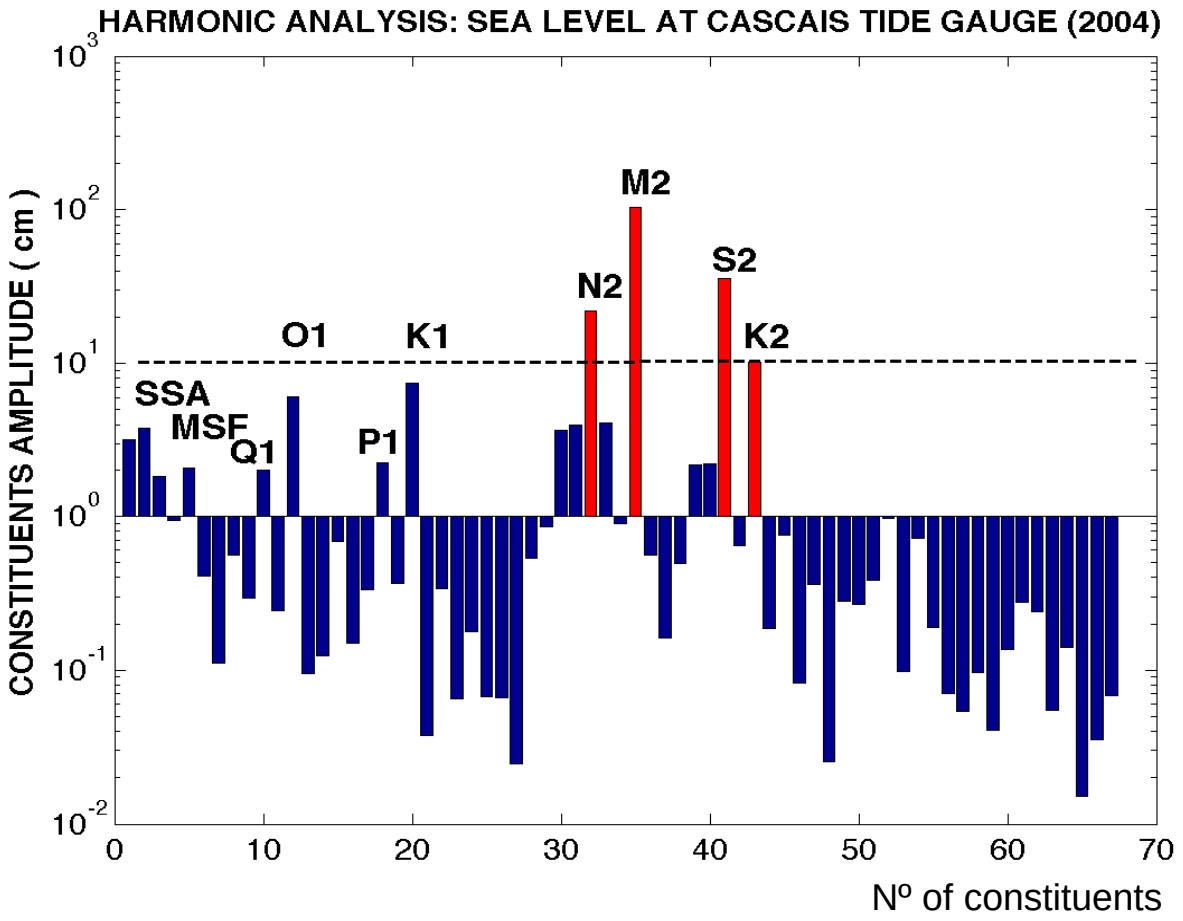


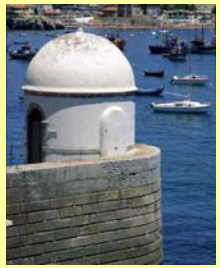
Along the Iberian coast the TIDE is mainly Semi-diurne





TIDE

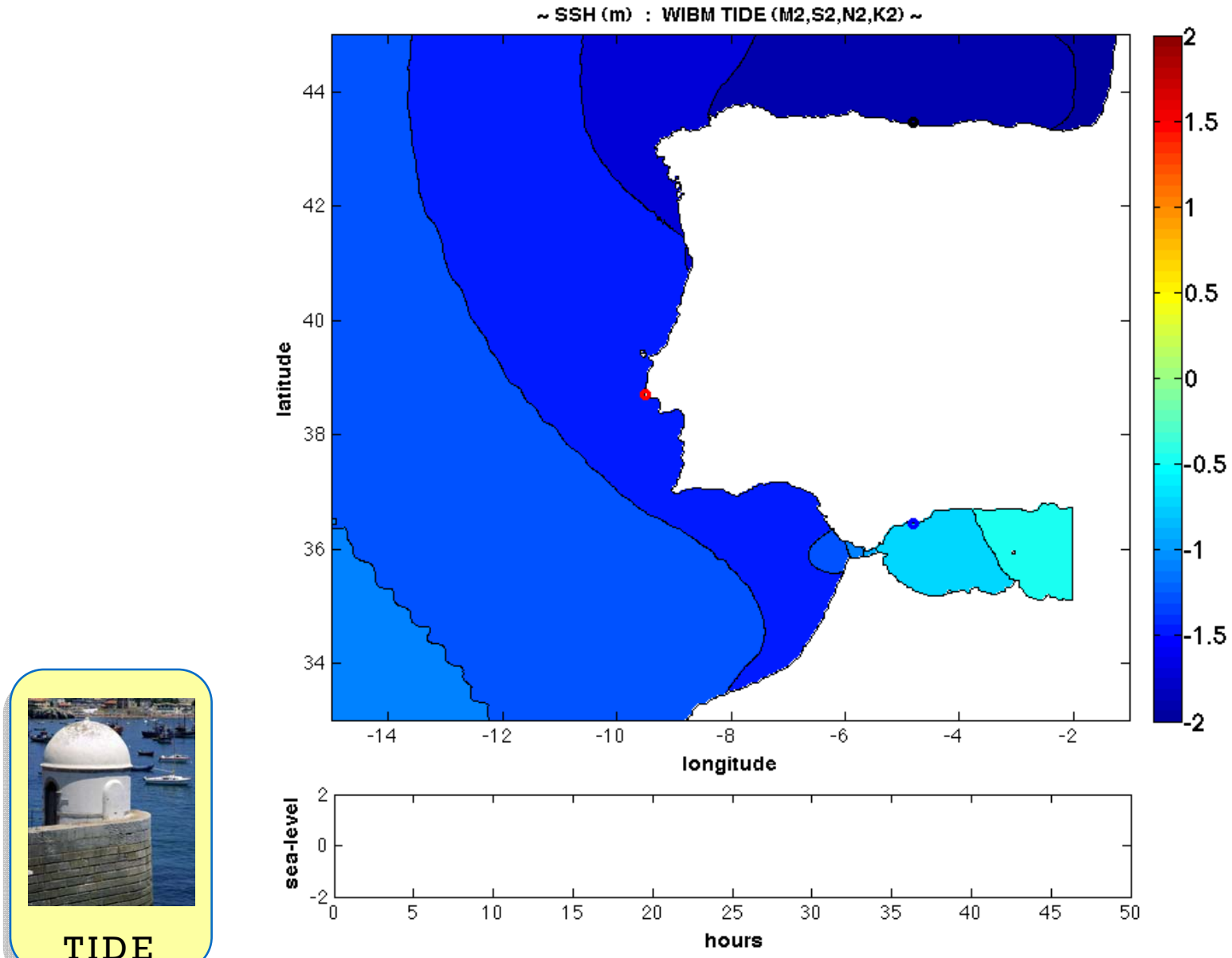




TIDE

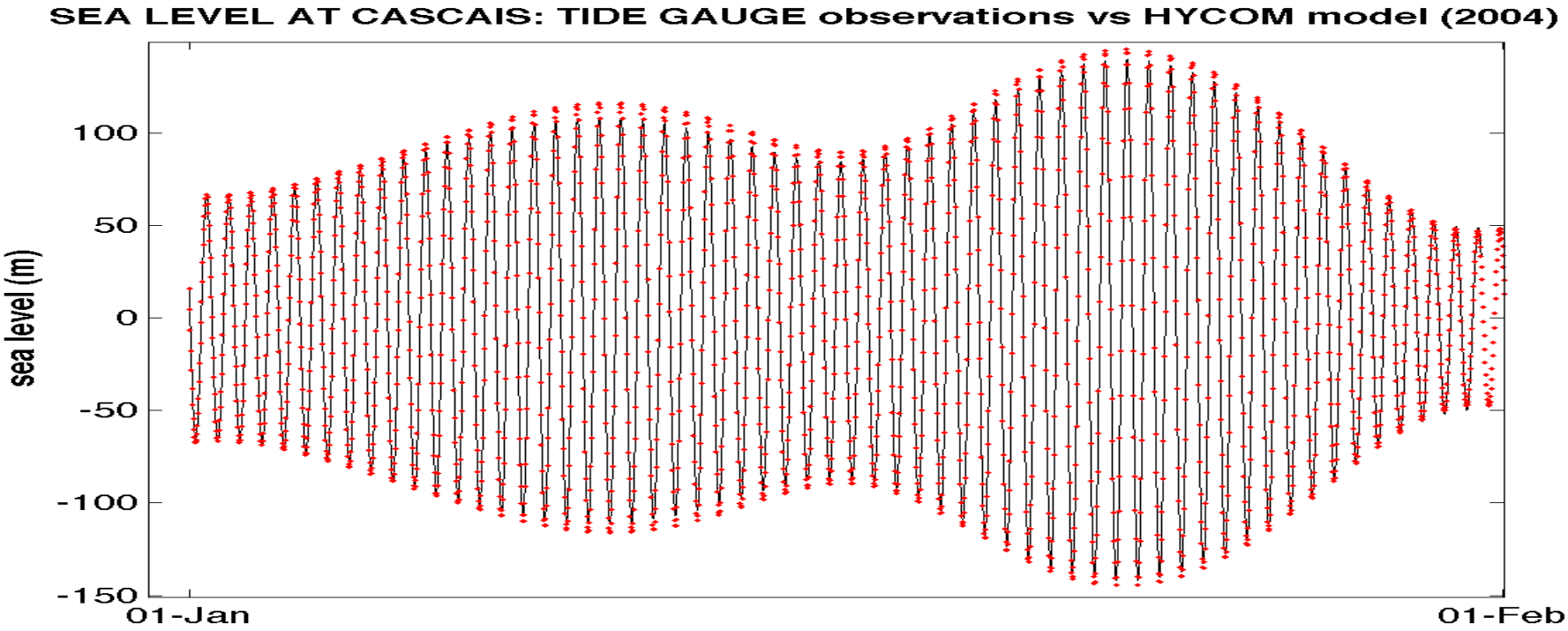
The 4 main semi-diurne constituents represent more than **75%** of the Tidal amplitude

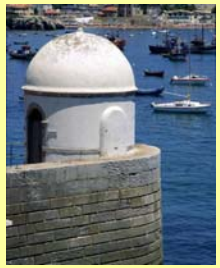
The 4 main semi-diurne **+** 4 main diurne constituents represent more than **82%** of the Tidal amplitude


~ SSH (m) : WIBM TIDE (M2,S2,N2,K2) ~
latitude
longitude
sea-level
hours

TIDE

Semi-diurne tidal wave modelling



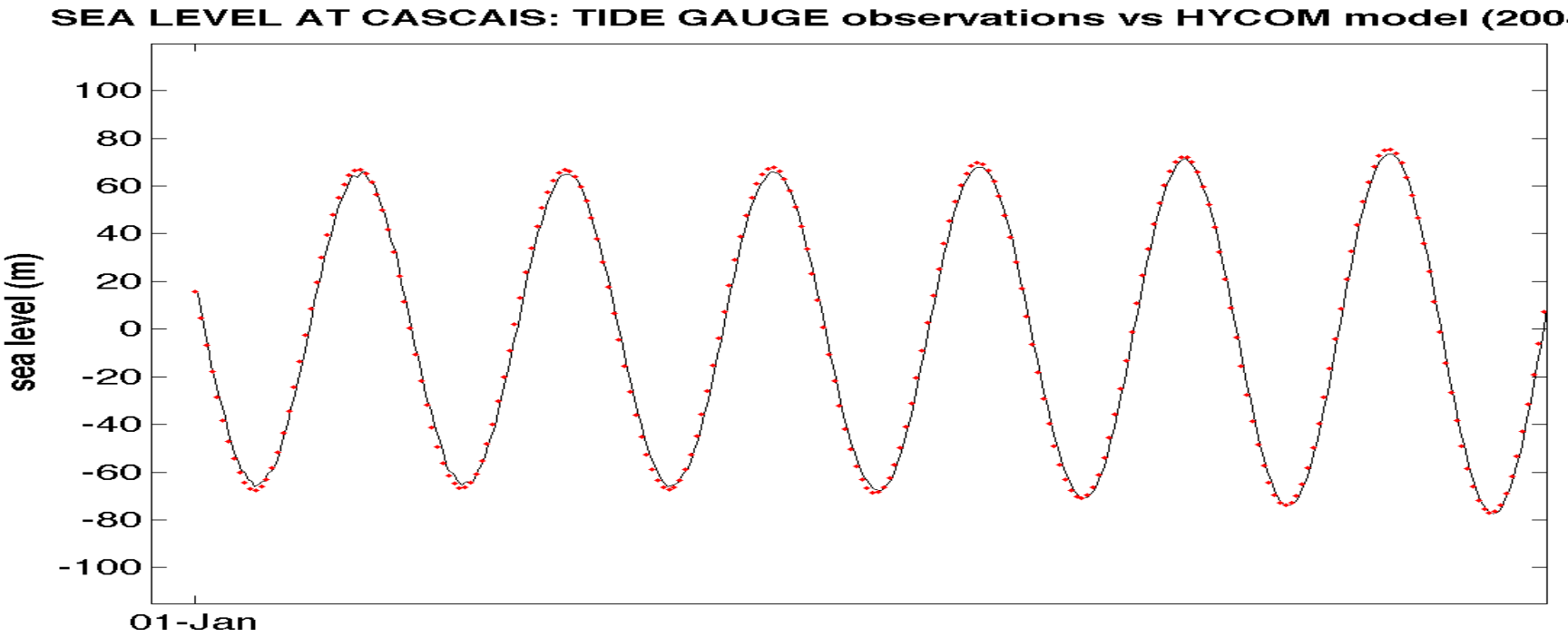


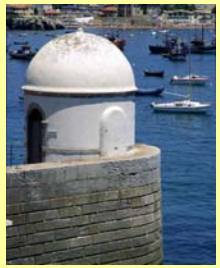
TIDE

Line = HYCOM model (M2, S2, N2, K2)

Dots = TIDAL FORECAST (M2, S2, N2, K2) from harmonic analysis of Tide gauge data

Neap tide phase



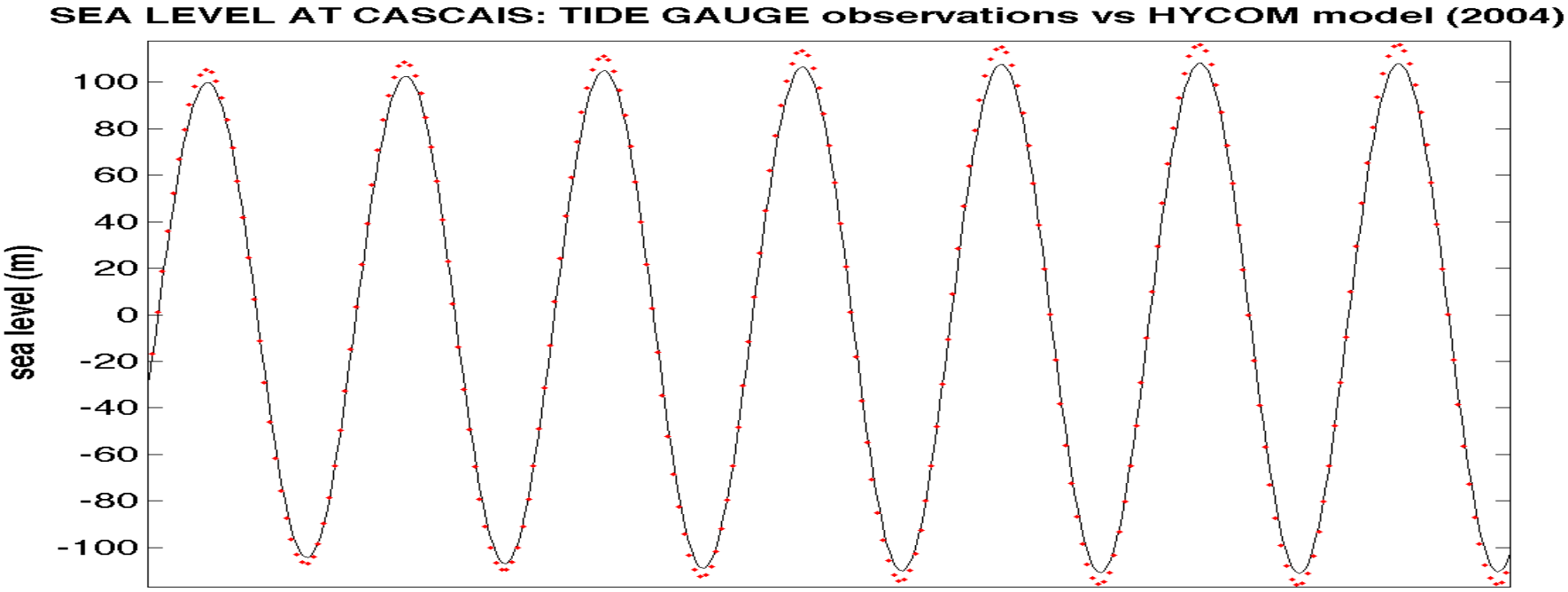


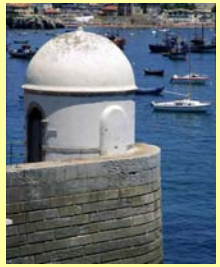
TIDE

Line = HYCOM model (M2, S2, N2, K2)

Dots = TIDAL FORECAST (M2, S2, N2, K2) from harmonic analysis of Tide gauge data

Spring tide phase



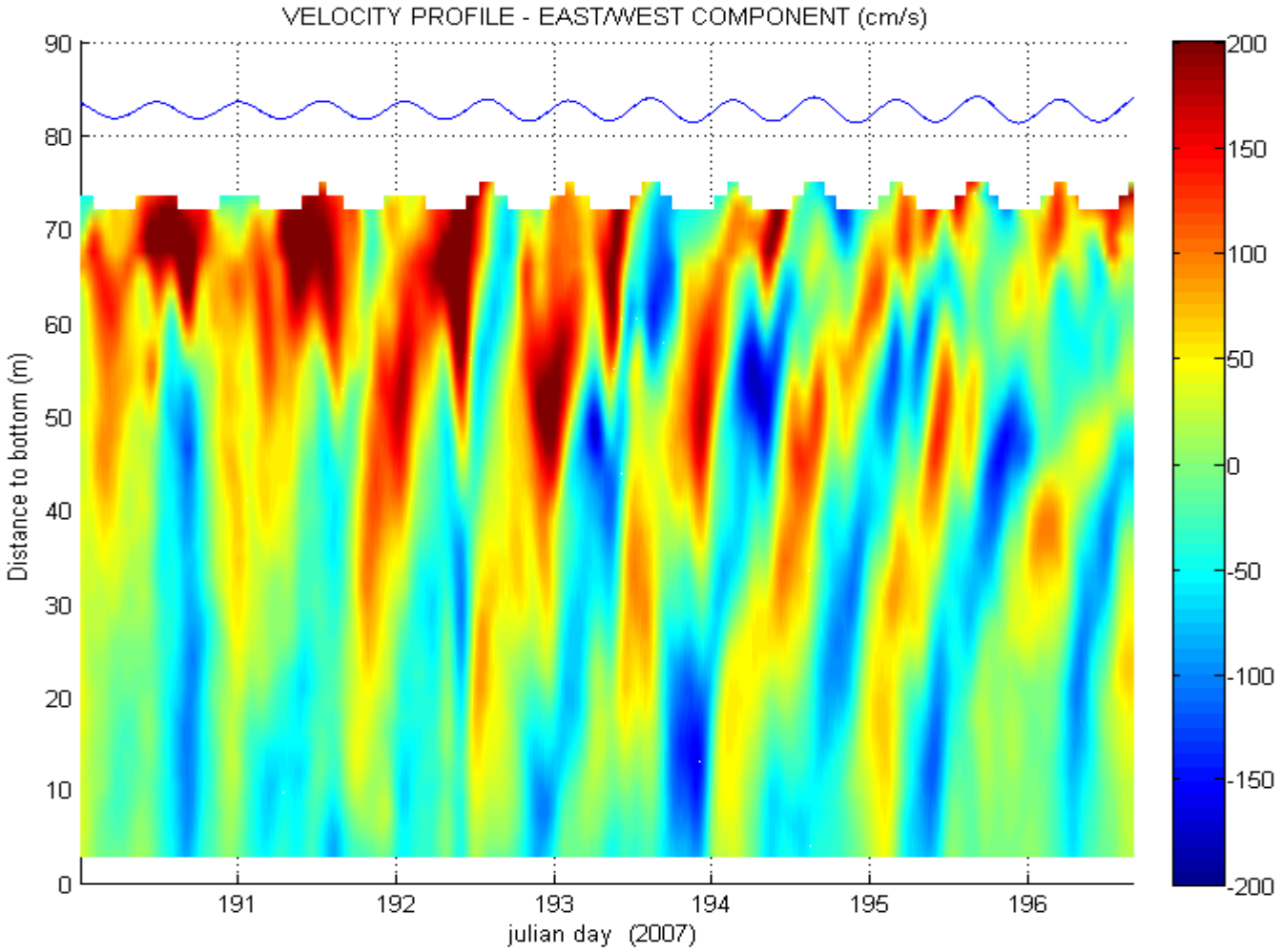


TIDE

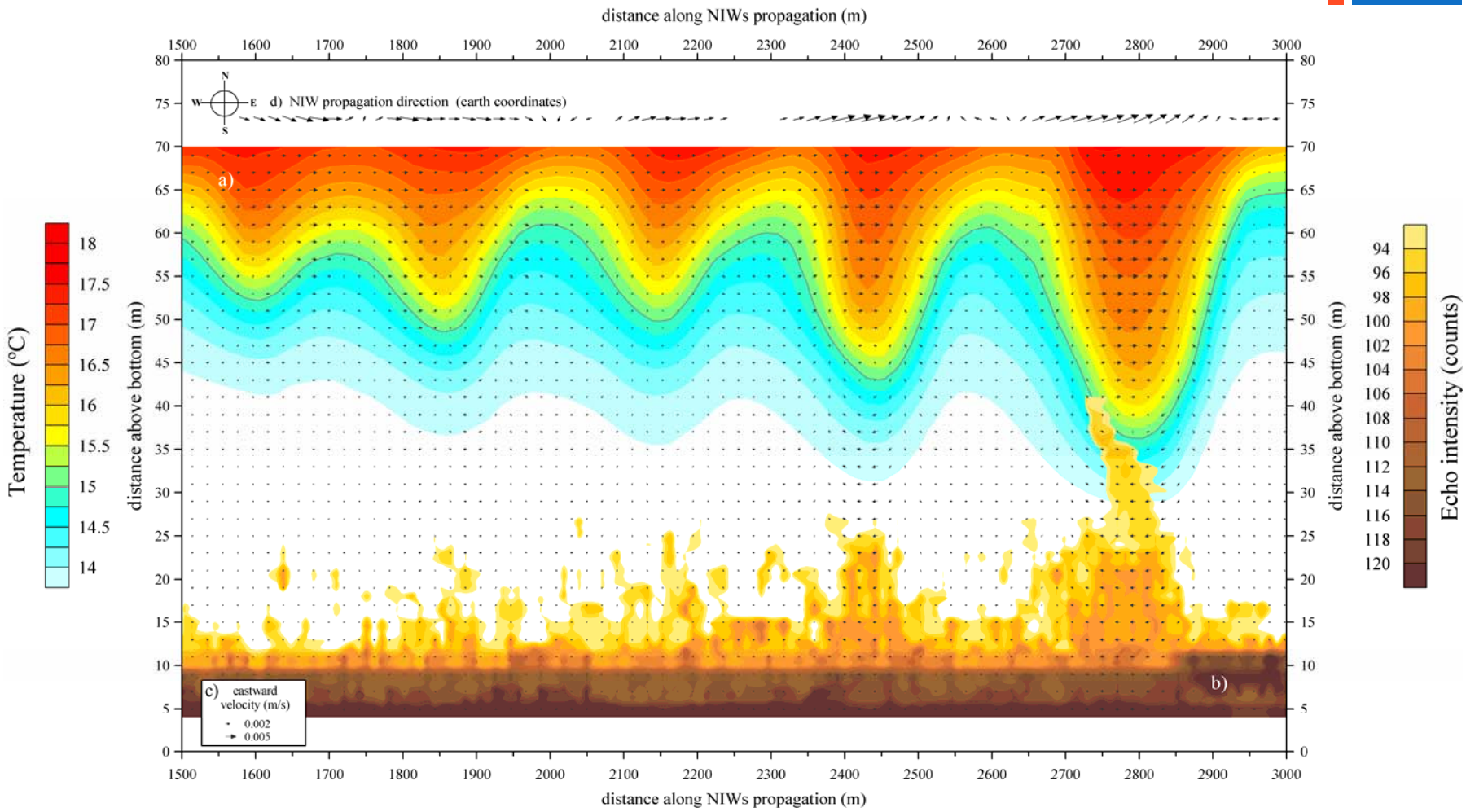
Line = HYCOM model (M2, S2, N2, K2)

Dots = TIDAL FORECAST (M2, S2, N2, K2) from harmonic analysis of Tide gauge data

Internal tide over the shelf (observation)

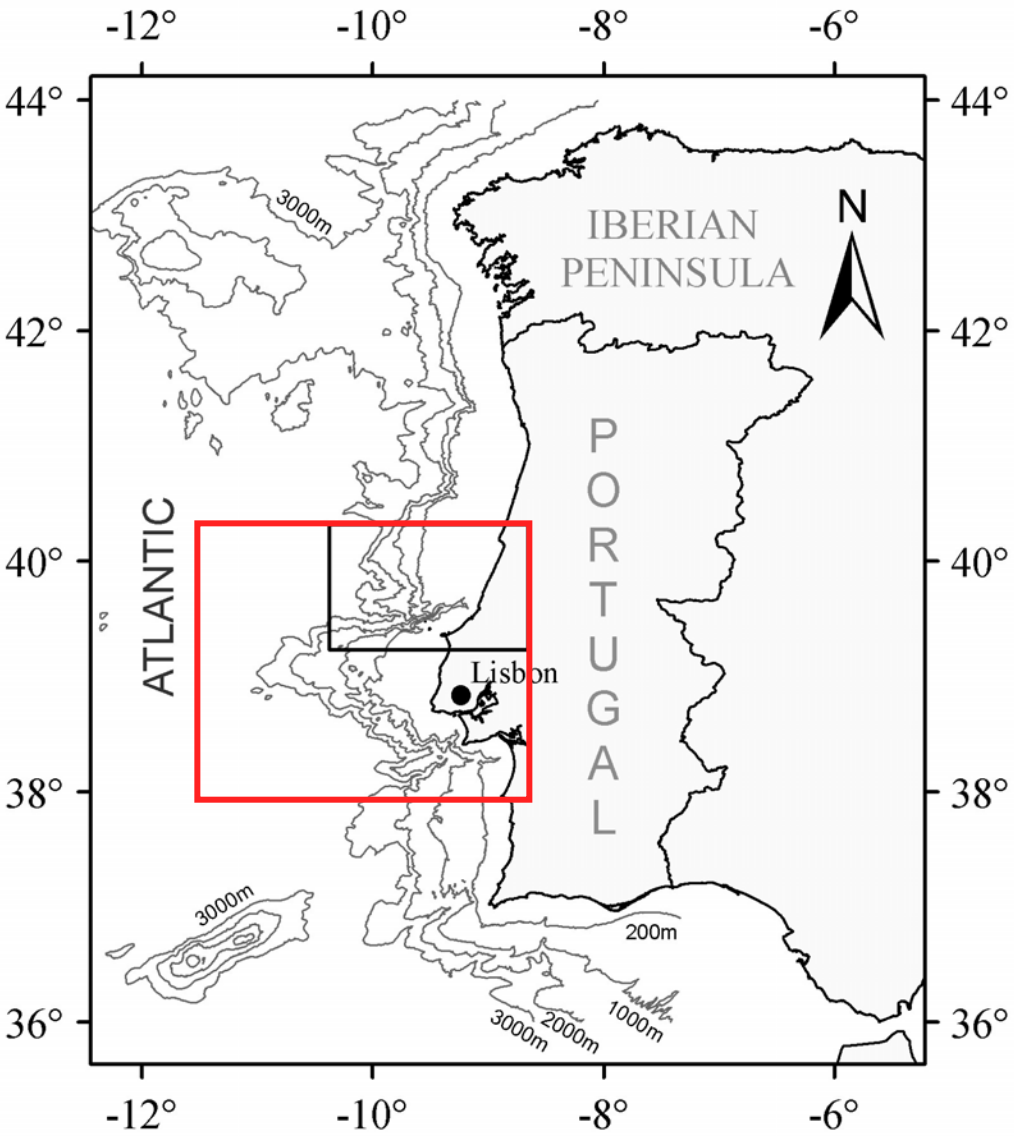


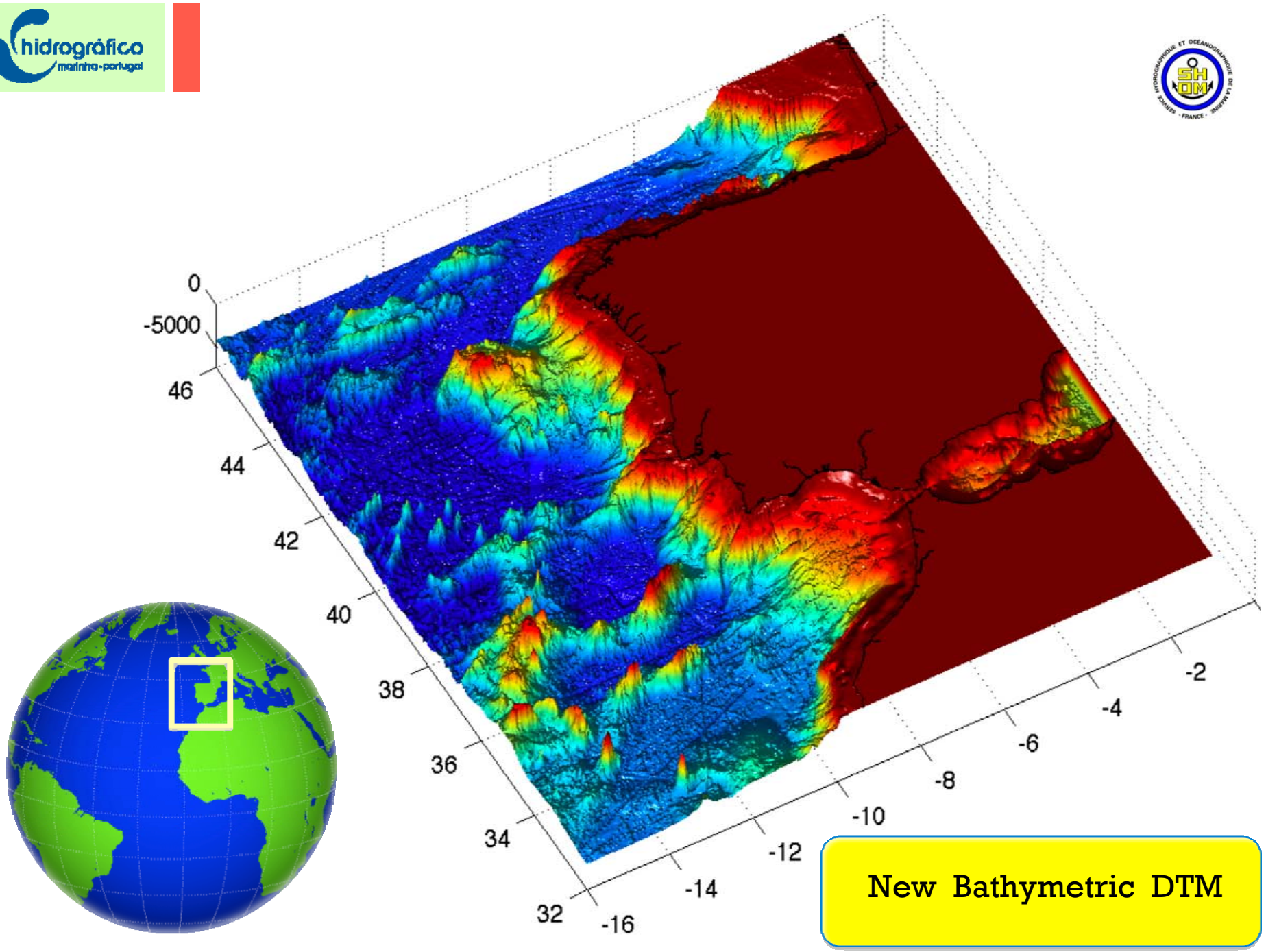
Internal tidal solitons over the shelf (observation)



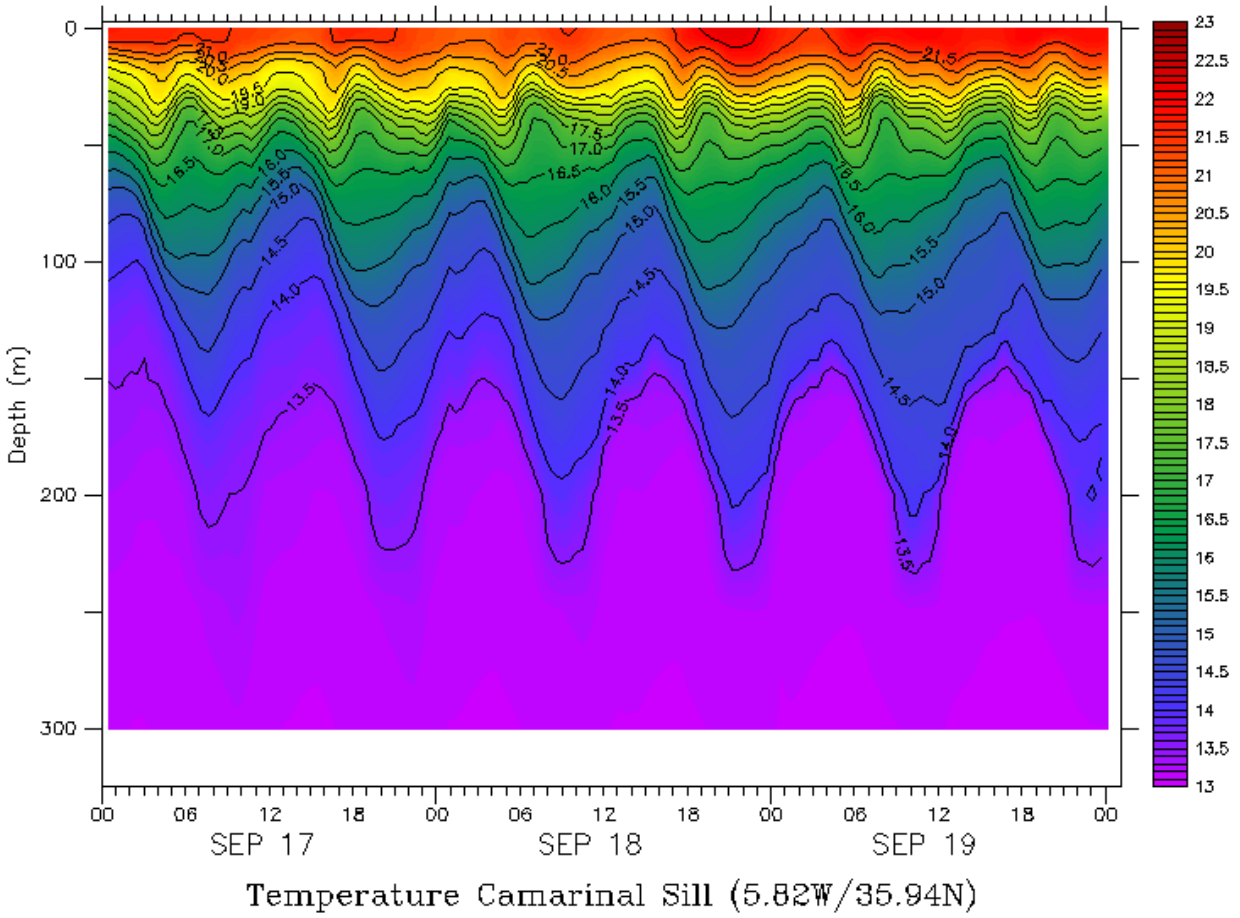
Quaresma 2007, Evidence of sediment resuspension by non-linear internal waves on the western Portuguese mid-shelf, ***Marine Geology*** 246, 123-143.

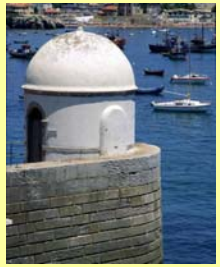
Future work: High resolution coastal model




0
-5000
46
44
42
40
38
36
34
32
-16
-14
-12
-10
-8
-6
-4
-2
New Bathymetric DTM

Internal tide at Gibraltar strait



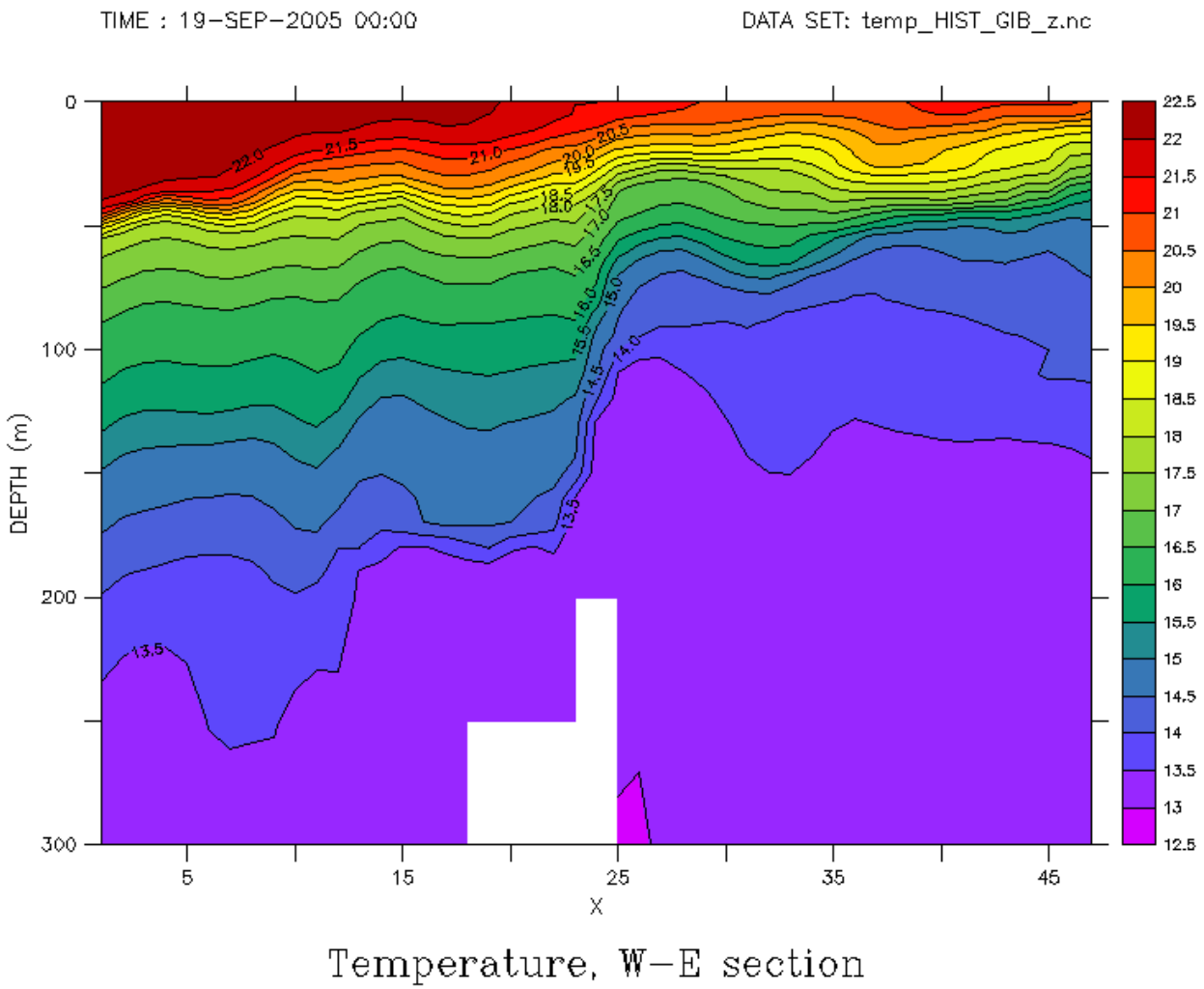


TIDE

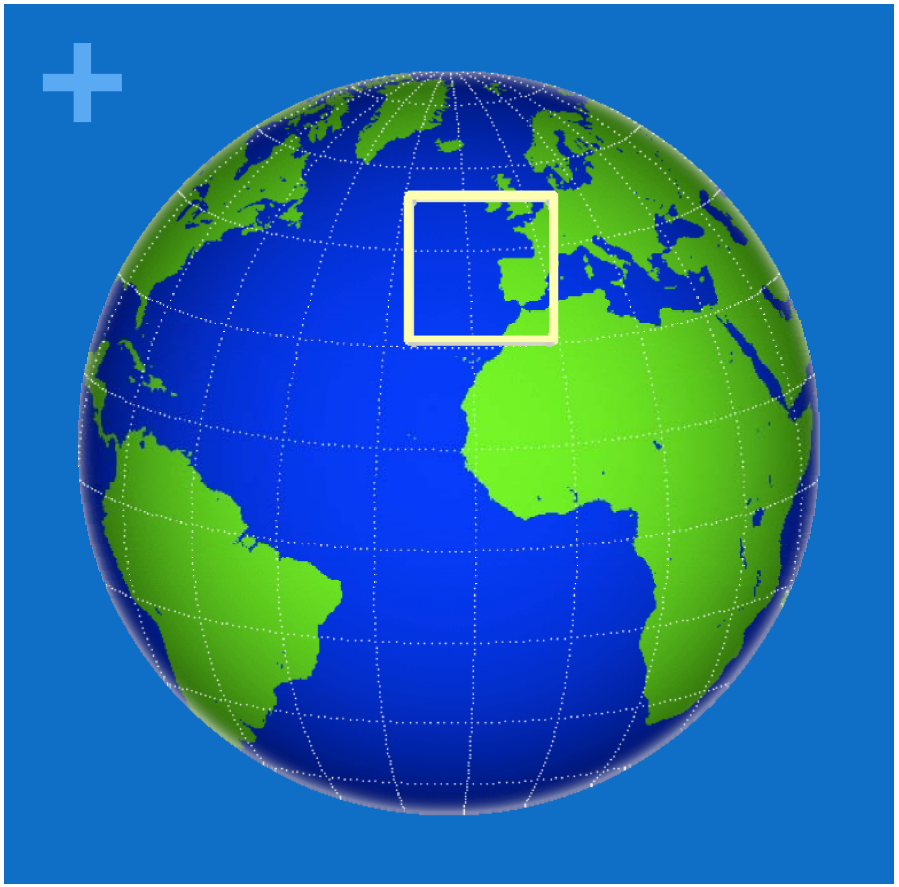
1. Vertical structure: **32 vertical levels (sigma2)**
1. Spatial resolution: **~ 1.8 km (Mercator projection)**
1. Initial state and boundary conditions forced by:

   Tide: **MOG2D** (M2, S2,N2,K2).

Internal tide at Gibraltar strait



Temperature, W-E section



MODELLING THE NORTH-EASTERN ATLANTIC SHELF

HYCOM

Luis QUARESMA (HIDROGRÁFICO)

R. BARAILLE, A. PICHON, S. LOUAZEL, Y. MOREL (SHOM) S.CORRÉARD (GEOSCIENCES) S.CASITAS (ACTIMAR)