MODELLING THE NORTH-EASTERN ATLANTIC SHELF

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

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)
Modelling improvements to approach accuracy

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  - ARPEGE vs ALADIN (wind)
New Bathymetric DTM
Observation campaigns at sea to validate and improve numerical results
Satellite images to validate numerical results

TIME: 09 JUN 2005 02:00  DATA SET: temp_modes_0PO18.nc

SST hycom (degC)  SST image (degC)
Modelling 3 important oceanic processes

- **UPWELLING**
- **MEDITERRANEAN OUTFLOW**
- **TIDE** (internal tide)
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)

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

5. Time period: 2005
Observation

Model

Temperature

radiale40N-leg3.txt Temperature(080) (Deg C.)

Model

SST hycom (degC)

Temperature HYCOM - EXP2
Salinity

**Observation**

**Model**

**UPWELLING**

**SST hycom (degC)**

Salinity HYCOM – EXP2

TIME: 19-SEP-2005 02:00  DATA SET: sst_models.nc
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

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

5. Time period: 2005
Modelling 3 important oceanic processes

- **UPWELLING**
- **MEDITERRANEAN OUTFLOW**
- **TIDE** (internal tide)
1. Vertical structure: **Barotropic (1 homogeneous level)**

1. Spatial resolution: $\sim 1.8 \text{ km (Mercator projection)}$

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

1. Spatial resolution: $\sim 1.8 \text{ km} \ (\text{Mercator projection})$

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**
Along the Iberian coast the TIDE is mainly Semi-diurne.

**SEA LEVEL AT CASCAIS TIDE GAUGE (2004)**

-2
-2.5
-3
-3.5
-4
-4.5
-5
-5.5

sea level (m)

Jan  Feb  Mar

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
Semi-diurne tidal wave modelling

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

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

**LINE** = HYCOM model (M2, S2, N2, K2)

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

**SEA LEVEL AT CASCAIS: TIDE GAUGE observations vs HYCOM model (2004)**

- **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)

Future work: High resolution coastal model
New Bathymetric DTM
1. Vertical structure: **32 vertical levels (sigma2)**

1. Spatial resolution: \(~1.8 \text{ km} \) (Mercator projection)

1. Initial state and boundary conditions forced by:

   Tide: **MOG2D** (M2, S2, N2, K2).
Internal tide at Gibraltar strait

TIME: 19-SEP-2005 00:00

DATA SET: temp_HIIST_GIB_z.nc

Temperature, W-E section
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HYCOM

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