The CMEMS Iberia-Biscay-Ireland (IBI) configuration: assessment of the model's capacity to reproduce regional dynamics

K. Guihou(1-2), P. Lorente(1-2), M. G. Sotillo(1-3), A. Amo-Baladrón(1-2), R. Aznar(1-2), A. De Pascual(1-2), B. Levier(3), J. C. Sanchez-Garrido(4), G. Reffray(3), S. Sammartino(4), C. Toledano(1-2), E. Álvarez-Fanjul(1)

(1) Puertos del Estado, Spain; (2) NoLogin Consulting S.L., Spain; (3) Mercator Ocean, France; (4) GOFIMA, Spain

Iberia-Biscay-Ireland (IBI): A CMEMS service

The CMEMS (Copernicus Marine Environment Monitoring Service) European service provides free forecasting and reanalyis simulations, at global and regional scales. **IBI (Iberia-Biscay-Ireland)** is the regional configuration of CMEMS for the Western European Shelf area extending from the Canary Islands to Ireland, at $1/36°$.

The IBI Monitoring and Forecast Centre (MFC) provides ocean analysis and forecast of physics, waves and bio. IBI-PHY produces outputs of T, S, SSH, velocities, and mixed layer depth for the two following products:

IBI-PHY-NRT (Analysis & 5-day forecasts): daily 3D, hourly 2D, coastal hourly 3D
IBI-PHY-REA (Reanalysis, 1992-2017): hourly, daily, monthly outputs

http://marine.copernicus.eu

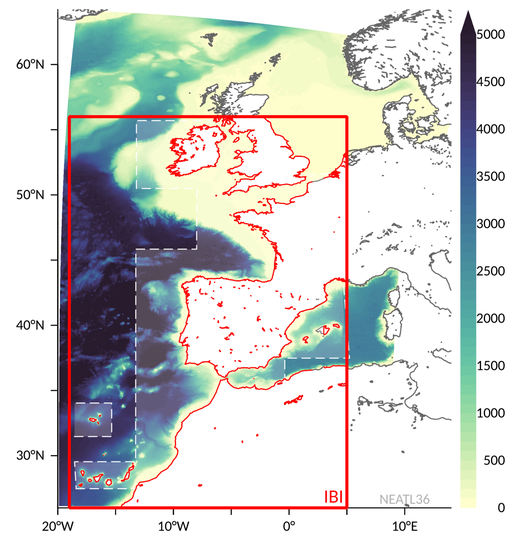

Figure 1: The IBI domain (red), embedded in NEATL36. White area delimits the region of 3D hourly outputs forecasts.

IBI-PHY-NRT (Near Real Time)

- $1/36°$ (2 km) horizontal resolution
- 50 geopotential levels
- Nested into $1/12°$ CMEMS Global forecasting system
- Forced with 3-h $1/8°$ atmospheric fields (ECMWF)
- Data assimilation of SST, SLA and Argo T, S.

IBI-PHY-REA (Reanalysis)

- Same as IBI-PHY-NRT but at $1/12°$

From global to regional: How IBI-PHY-NRT improves the solution in 3 examples

The validation of IBI against independent measurements is routinely conducted to evaluate model's veracity and prognostic capabilities. Noticeable efforts are done to define meaningful skill scores and statistical metrics, to quantitatively assess the quality and reliability of the IBI model solution. IBI products are also regularly compared against other model solutions on overlapping areas at diverse timescales. $\longrightarrow$ **The constant efforts to validate and assess IBI's capacity help us to identify the strengths and weaknesses of the model.**

Here we show 3 examples on how IBI compares against observations (buoy, HF radars) and models: CMEMS GLOBAL (NEMO, $1/12°$) and SAMPA (MITgcm, Gibraltar strait area, 300-500m rés.).

Freshwater plume

A buoy detected an **abrupt decrease in SSS and SST** on the Galician coast in march 2018, due to freshwater discharge from the Miño river. The global configuration could not reproduce this event, but IBI was able to catch the drop in salinity and temperature.

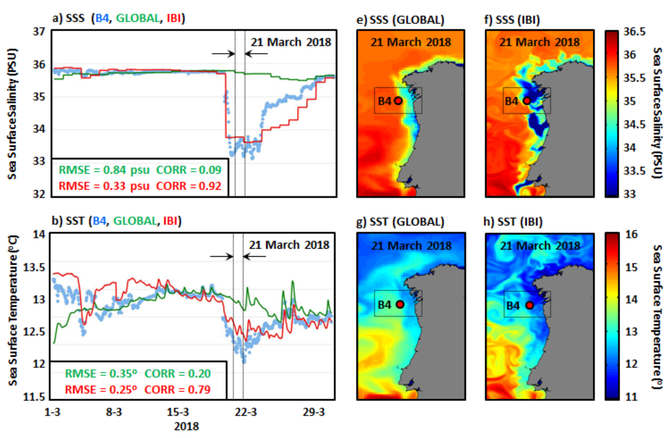

Figure 2: Left panels: timeseries of SSS (up) and SST (down) from buoy, GLOBAL, and IBI in 2018. Right panels: surface SSS (up) and SST (down) from GLOBAL and IBI.

Mesoscale: surface coastal currents and eddies

An HF radar captured a **coastal eddy** off the Ebro delta in the Mediterranean. (Summer 2016). IBI has a sufficient resolution to reproduce this pattern at the right time and place, whereas the global cannot resolve it.

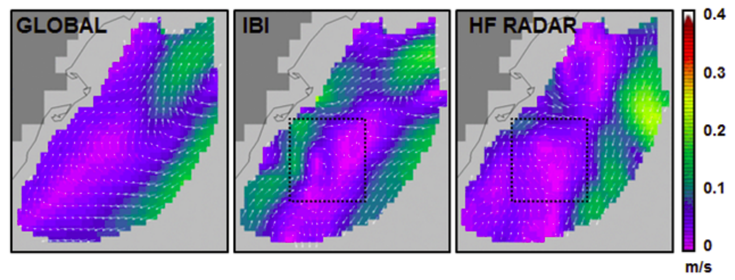

Figure 3: Surface currents off the Ebro delta. From left to right: Global, IBI, HF radar. 3-month average (JJA)

Exchange through the strait of Gibraltar

The **Atlantic Jet (AJ) inflow** dynamics is catched by an HF radar. The higher the resolution, the better the representation of the speed and direction of the jet. IBI correctly simulates the AJ eastward flow, however only the coastal model captures the AJ reversals.

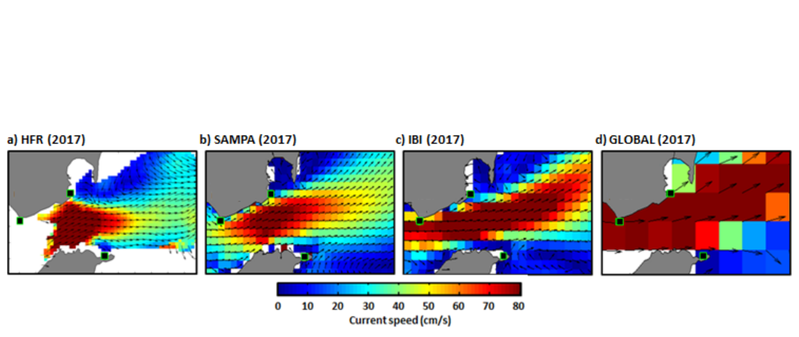

Figure 4: Left panel: Annual mean circulation pattern in the Strait of Gibraltar for 2017, derived from hourly estimations provided by (from left to right): HFR, SAMPA coastal model, IBI regional model, GLOBAL model. Right panel: Annual (2017) scatter plot of hourly AJ current speed versus direction (angle measured clockwise from the North); estimations provided by (from left to right): HFR, SAMPA coastal model, IBI regional model, GLOBAL model

Ongoing developments of IBI-PHY-NRT

Validation and sensitivity tests are carried out to investigate the impact of the two following developments on the IBI-PHY-NRT system regional dynamics:

$\longrightarrow$ Update of the tidal forcing (TPXO7.1 $\rightarrow$ FES2014)

$\longrightarrow$ Sensitivity study of an upgrade of the bathymetry, from GEBCO08 to EMODnet.

Bathymetry

A modification of the coastline and small-scale topographic features are expected to impact greatly the **tidal solution**, the **current position** and the **exchange and transport of water masses between the Mediterranean and the Atlantic** through the Strait of Gibraltar. The feasibility of an upgrade from GEBCO08 to EMODnet is currently assessed.

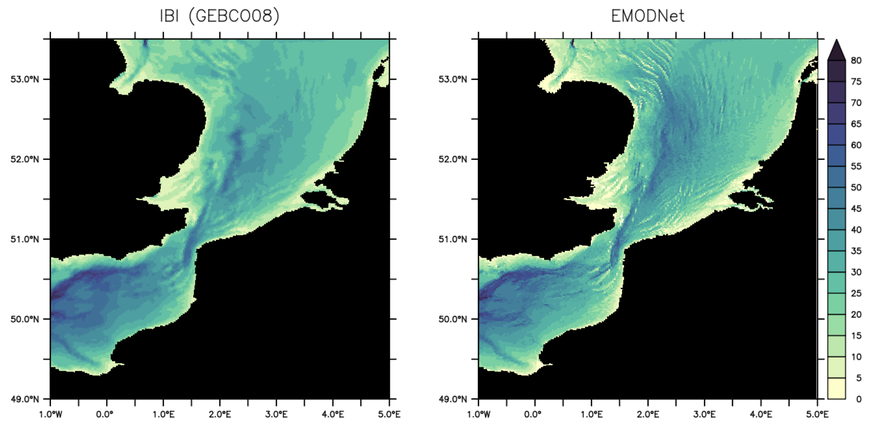

Figure 5: Bathymetry (m) of the English Channel. Left: the current IBI bathymetry, derived from GEBCO08; right: The EMODNet bathymetry, interpolated on IBI grid.

Tidal Forcing

The tidal forcing will soon be updated from the existing TPX07.1 to the LEGOS model (FES2014). The **number of tidal harmonics** is expected tol be increased from 11 to 19, and sensitivity tests are performed to check the impact of adding the **Self Attraction and Loading (SAL)** effect.

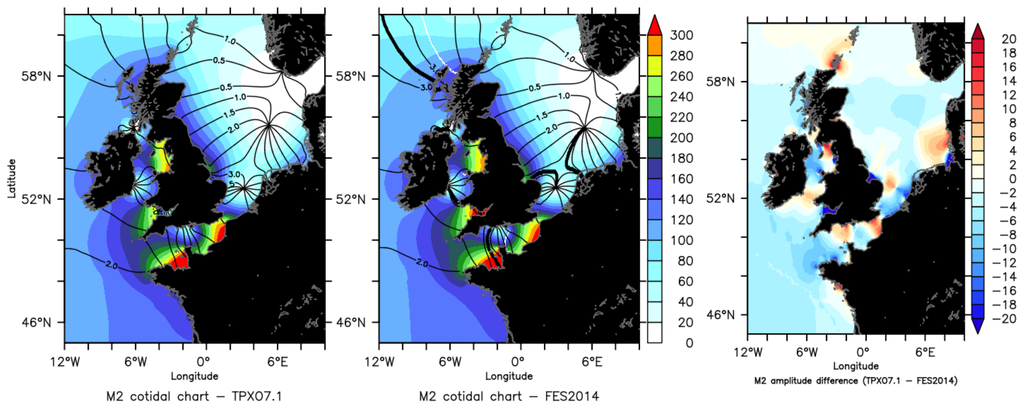

Figure 6: From left to right: Cotidal charts of M2 component from TPXO7.1 (current IBI forcing) and FES2014 + SAL (new forcing), and difference of amplitude between both datasets (TPXO7.1 - FES2014). Amplitude is in cm.

Future improvements of IBI-PHY-NRT planned to be achieved by the end of CMEMS Phase 2 (2021)

- Increase of the vertical resolution from 50 to 75 levels (this improvement will be linked to the update of the CMEMS GLO $1/12°$
- Improvement of the Data Assimilation (new scheme + new observational data)
- Coupling with waves solution (offline 2-way coupling with IBI-WAV)
- Increase of the resolution of the reanalysis (from $1/12°$ to $1/36$ **)**
- Developement of tools to check system anomalies, and Ocean Monitoring Indicators (OMIs)

And, if the sensitivity tests are conclusive:

- Improve the runoffs (LAMBDA project $\rightarrow$ more rivers, switch from climatology to model)
- Improve the MED dynamics (new BDY forcing, barotropic component,. . .)

Contact: karen.guihou@nologin.es