Multi-platform validation of a high-resolution model in the Western Mediterranean Sea: insight into spatial-temporal variability

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1 Motivation

This study focuses on the validation of the high resolution Western Mediterranean Operational model (WMOP) developed at SOCIB, the Balearic Islands Coastal Observing and Forecasting System. This assessment uses multi-platform observations from moorings, gliders and satellite altimetry. A hindcast simulation is evaluated over the period 2009-2015.
The main spatial patterns of variability are then described using the EOF analysis of sea level anomaly (SLA) maps from WMOP in two different regions

2 Multi-platform perspective

1 Moorings: 6 stations from Puertos del Estado and SOCIB (Fig. 1a). Hourly surface currents, temperature & salinity

2 Satellite altimetry: SLA product in the Western Mediterranean Sea (WMS) from CMEMS (1/8º, daily)

3 Gliders: 3 points extracted from SOCIB transect in Ibiza Channel (W, C, E; Fig. 1b). Temperature & salinity.
[Heslop et al., GRL, 2012]

4 Numerical model -WMOP (ROMS):
[Juza et al., JOO, 2016]

- Regional configuration of ROMS in the WMS
- Spatial resolution: 1/50º (~2 km)
- Initial & boundary conditions from CMEMS MED-MFC (1/16º)
- Surface forcing: from AEMET HIRLAM model (3h-5km)
- Free run without data assimilation (2009 - 2015)

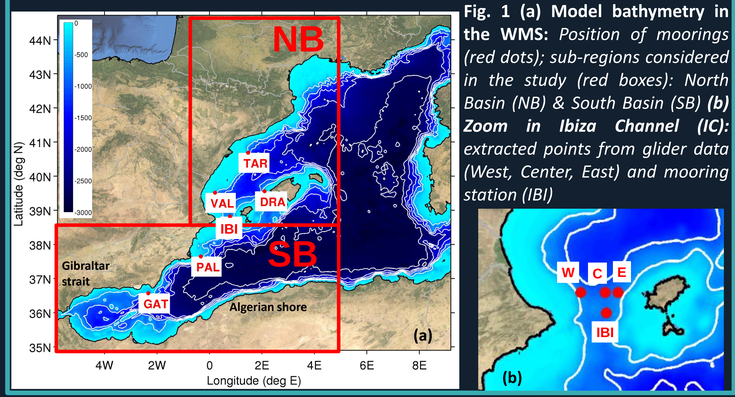


Fig. 1 (a) Model bathymetry in the WMS: *Position of moorings (red dots); sub-regions considered in the study (red boxes): North Basin (NB) & South Basin (SB)* ***(b) Zoom in Ibiza Channel (IC):*** *extracted points from glider data (West, Center, East) and mooring station (IBI)*

3 Model validation

1 Main axis of ocean current variability

- Good agreement among the model, the moorings and altimetry in terms of the main axis of variability
- TAR, PAL and GAT are located in areas of marked mean currents
- The principal axis is parallel to local isobaths at all stations

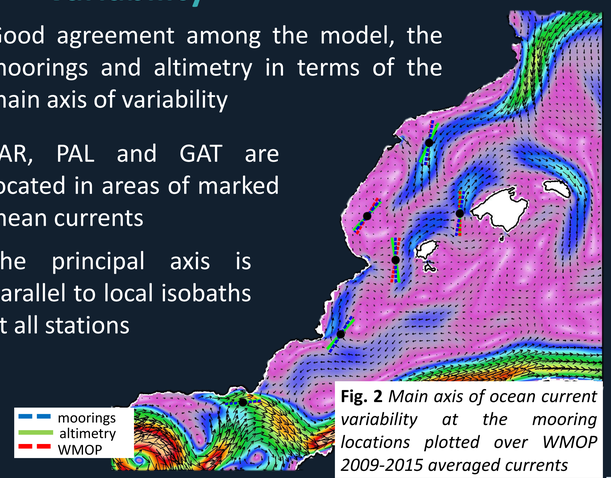


Fig. 2 *Main axis of ocean current variability at the mooring locations plotted over WMOP 2009-2015 averaged currents*

2 Inter-annual changes of the surface flows

- The intense and anomalous southward flow during 2014 captured by 3 moorings (TAR, PAL, GAT) and gliders in the western part of IC (W), is reproduced by the model
- According to glider data, the central point of IC does not capture the main southward flow occurring in the Western part

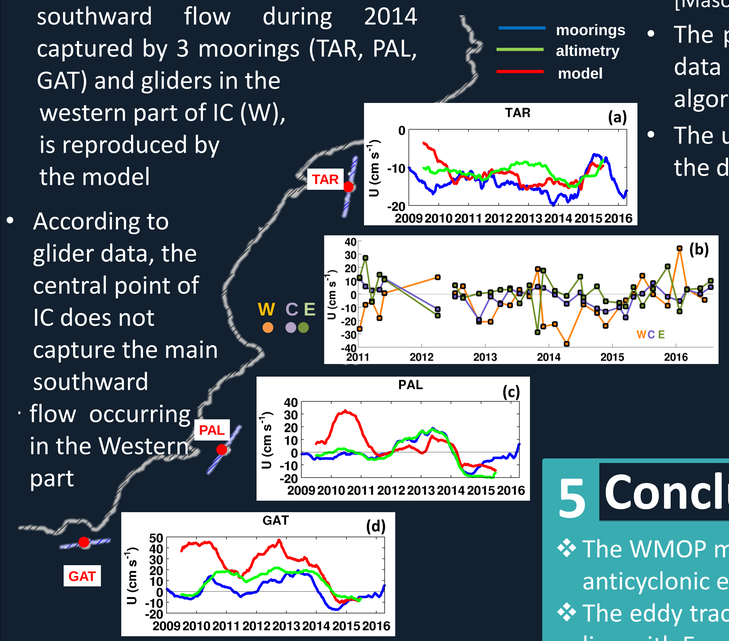
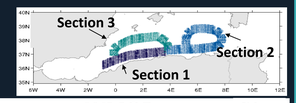


Fig. 3 *Low-frequency filtered (365 d) velocities at TAR, PAL and GAT locations from moorings, altimetry and model data (a, c, d) and at Ibiza channel from gliders in W, C and E points (b).*

3 Propagation of mesoscale eddies in the Algerian sub-basin

[Escudier et al., JGR, 2016b]

- WMOP generates and propagates Algerian eddies but these are not synchronous with observations



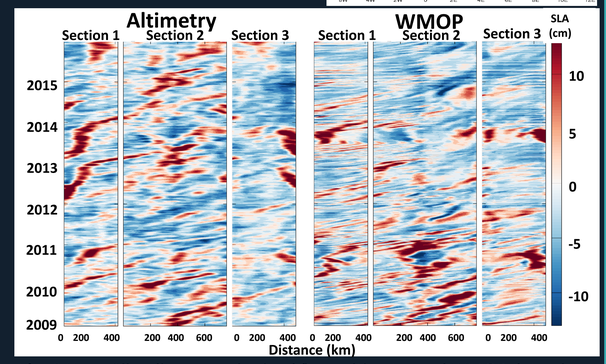


Fig. 4 *Hovmöller diagrams obtained from altimetry and WMOP data along the 3 sections represented in the insert.*

4 Statistical properties of eddies

- Radius of eddies were calculated from WMOP and altimetry SLA maps using an eddy tracker algorithm [Mason et al., JAOT, 2014]
- The prevalence of small radius eddies using WMOP data and its relation to the parameters of the algorithm still need to be understood
- The use of SLA and/or SSH in WMOP is irrelevant for the detection algorithm

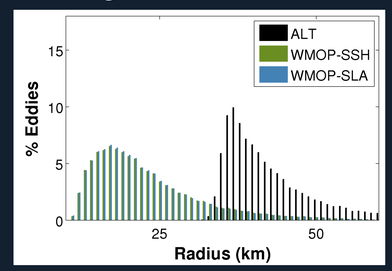


Fig. 5 *Radius of eddies detected from altimetry and WMOP (SLA and SSH) data using the eddy tracker algorithm*

4 Patterns of variability

- EOF analysis was applied to the SLA maps from WMOP in 2 different regions of WMS
- The first mode has a strong seasonal variability and explains more variability in the NB than in the SB
- Inter-annual variability in amplitude
- First EOF in NB also describes the intense southward flow produced during 2014
- Inter-connection between basins?
  - ✓ The intensification of the Northern Current (NC) in the NB is generally associated with minimums in the activity of eddies in the SB
  - ✓ The high activity of eddies in the SB is generally associated with a weakening of the Northern Current (NC) in the NB
  - ✓ There is generally a lag of few weeks between minimas/maximas in NB and SB. This lag does not always occur in the same direction.

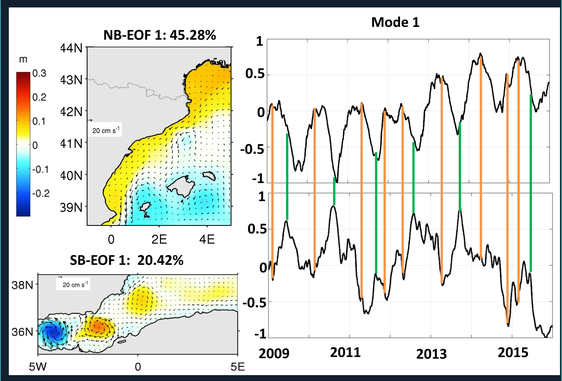


Fig. 6 *Spatial patterns and temporal evolution of the first mode of EOF analysis of SLA*

5 Conclusions

- ❖ The WMOP model reproduces the intensification of the southward flow in IC and the generation and evolution of anticyclonic eddies in Algerian basin.
- ❖ The eddy tracker algorithm applied to WMOP provides structures with a smaller radius compared to altimetry, in line with Escudier et al., JGR, 2016a. This point is object of ongoing research.
- ❖ The circulation in the northern and southern sub-basins have a marked seasonal cycle. Further analysis of model fields and forcings is needed to establish the interconnection between both sub-regions

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