Multi-platform coastal model assessment and impact of downscaling in the Western Mediterranean Sea

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This study focuses on the assessment 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 coastal observations from moorings, gliders and HF radar, as well as satellite altimetry. A hindcast simulation is evaluated over the period 2009-2015. The large scale model used as initial and boundary conditions is also evaluated using the same set of metrics to provide indications about the impact of model downscaling.

1 Multi-platform perspective

1. **Moorings:** 6 locations (red dots, Fig. 1a). U, V, Temp & Salinity
2. **Gliders:** transects through Ibiza channel (black line, Fig. 1b). Temp & Salinity.
3. **HF radar:** Ibiza Channel (Fig. 1b). U, V
4. **Satellite altimetry**

Numerical models:

WMOP (ROMS)
[Juza et al., JOO, 2016]
- Spatial resolution: 1/50° (~2 km)
- Free run without data assimilation
- Initial & boundary conditions from CMEMS MED-MFC
- Surface forcing: from AEMET HIRLAM model (3h-5km)

MED-MFC (NEMO)
[Tonani et al., 2014]
- Spatial resolution: 1/16°
- Assimilation of SLA and T-S profiles

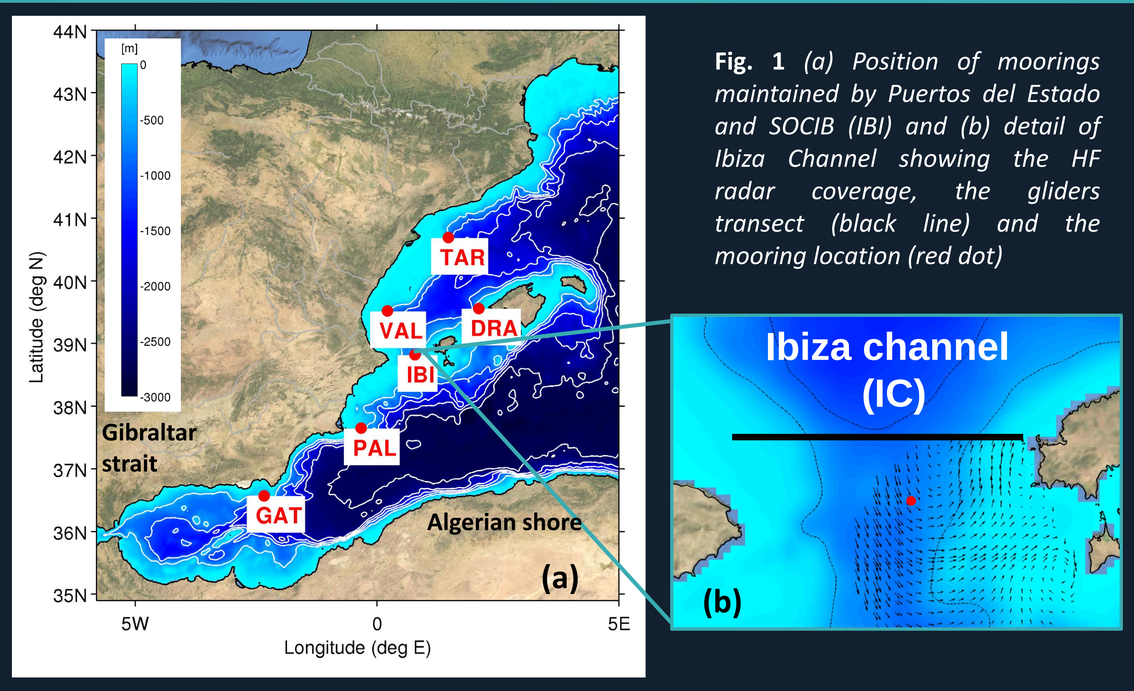

Fig. 1 *(a) Position of moorings maintained by Puertos del Estado and SOCIB (IBI) and (b) detail of Ibiza Channel showing the HF radar coverage, the gliders transect (black line) and the mooring location (red dot)*

2 Model assessment

1 Main axis of ocean current variability

- Good agreement between moorings, the two models and altimetry in terms of the main axis of variability
- TAR, PAL and GAT are more representative of the mean currents than the other moorings
- The principal axis is parallel to local isobaths in all cases

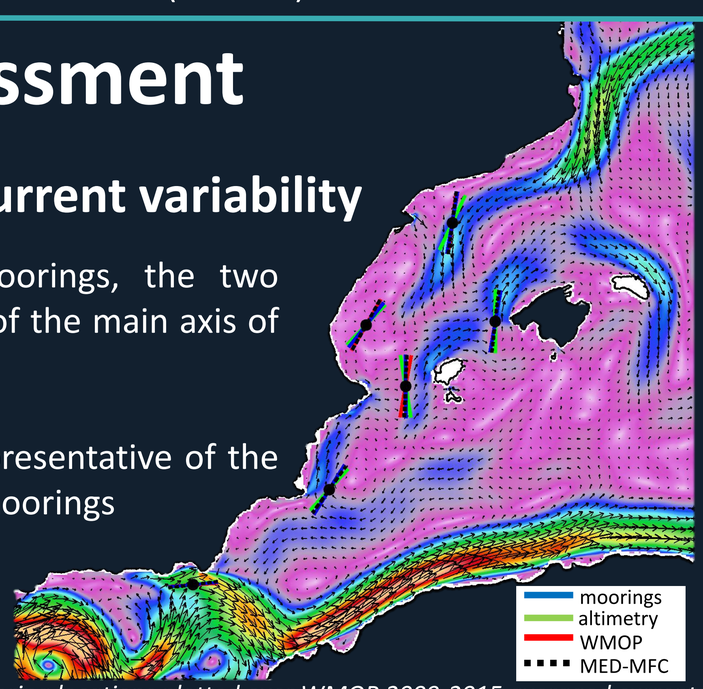

Fig. 2 *Main axis of ocean current variability at the mooring locations plotted over WMOP 2009-2015 averaged currents*

2 Water masses meridional transports

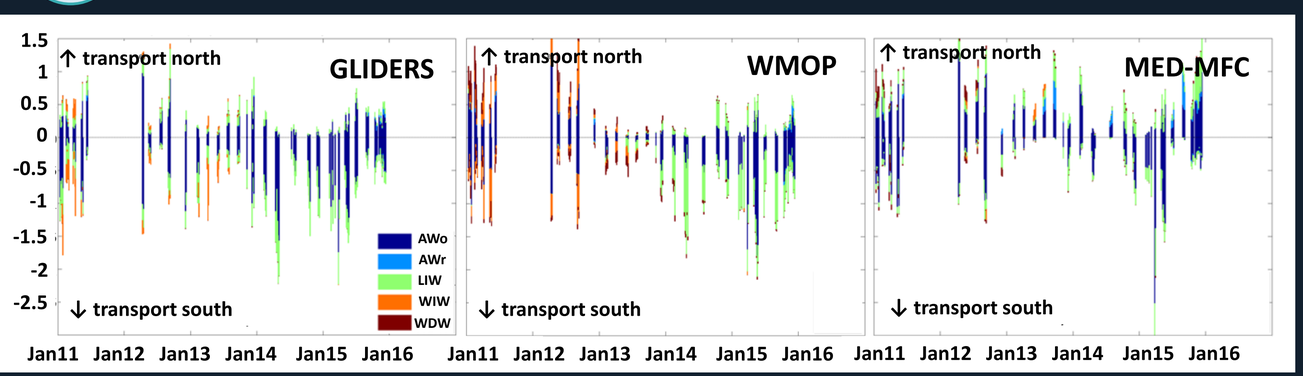

Fig. 3 *Geostrophic velocity transport (Sv) by water mass from gliders, WMOP and MED-MFC*

- WMOP represents the water mass transport variability [Heslop et al., GRL 2012] across the Ibiza Channel
- In particular, WMOP is able to generate and propagate Winter Intermediate Water (WIW) during the winters 2011, 2012, and 2013
- MED-MFC underestimates WIW in the Channel and shows a northwards biased net transport [Juza et al., JMS, 2015]

3 Surface current spatial variability

- WMOP improves the representation of the average surface circulation [Lana et al., OcDyn, 2016] with comparison to MED-MFC
- The meridional surface flow reversal associated with the Northern Current recirculation and described by gliders, HF radar and altimetry is well reproduced by WMOP but not by MED-MFC

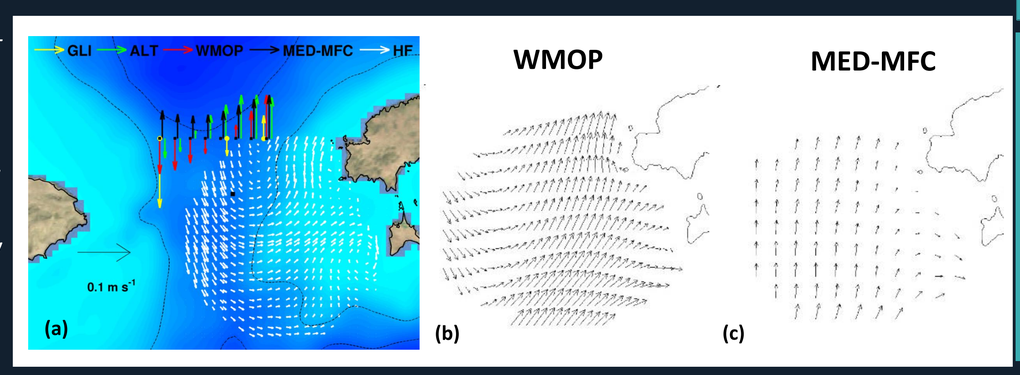

Fig. 4 *(a) Mean (Jan11-Dec15) meridional surface flows from Gliders, Altimetry, WMOP and MED-MFC and surface mean (Jun12-Aug14) velocity from HF radar, (b) WMOP, and (c) MED-MFC*

4 Inter-annual changes of the surface circulation

- Intense and anomalous southward flow during 2014 noted in the three moorings (also in temperature and salinity) and reproduced in the models
- Erroneous intense northward flow in 2010 in WMOP
- Northward circulation bias in MED-MFC seen at TAR and corrected in WMOP

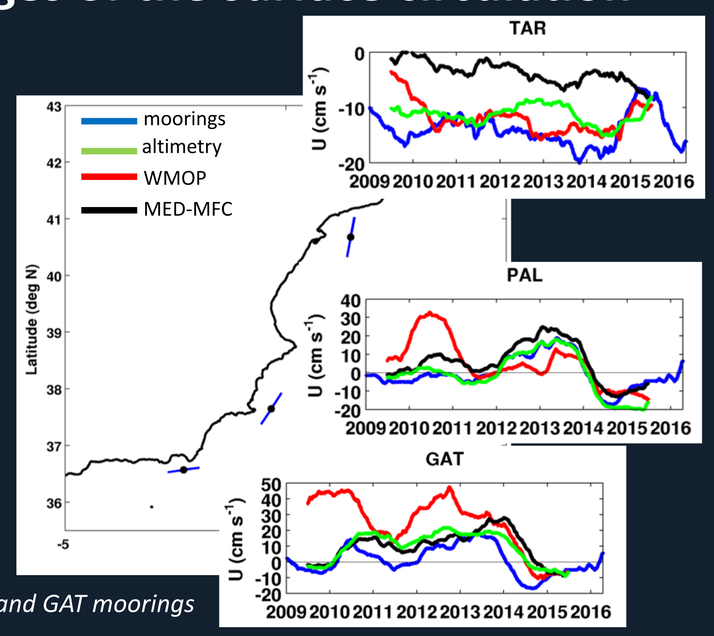

Fig. 5 *Inter-annual velocities at TAR, PAL and GAT moorings*

5 Propagation of mesoscale eddies in the Algerian sub-basin

- WMOP generates and propagates Algerian eddies but these are not synchronous with observations
- MED-MFC is in better agreement with altimetry due to SLA data assimilation

[Escudier et al., JGR, 2016]

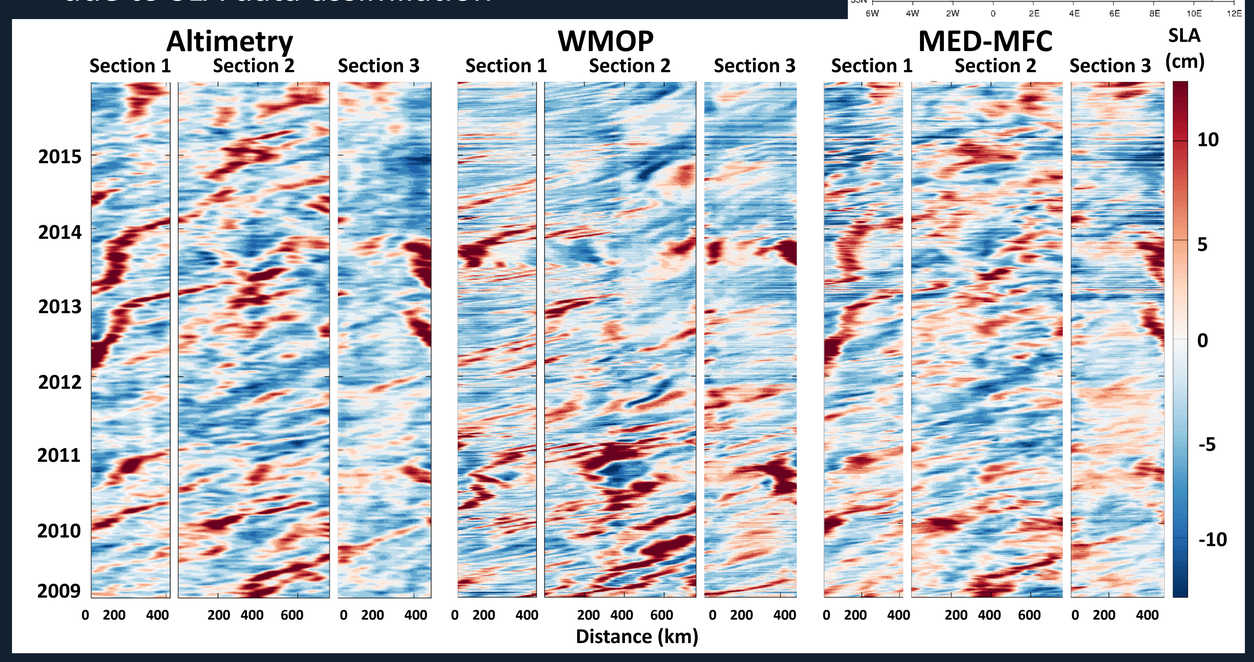

Fig. 6 *Hovmöller diagrams obtained from altimetry, WMOP and MED-MFC data along the 3 sections represented in the insert.*

3 Conclusions

✓ WMOP improves (a) the surface circulation in the northern part of the Western Mediterranean Sea, (b) the variability of the water masses transport, and (c) the meridional flow reversal in the Ibiza Channel with comparison to MED-MFC and even in the absence of data assimilation.

✓ The generation of Algerian eddies needs to be constrained by data assimilation of satellite altimetry and is better represented in MED-MFC.