

This study focuses on the multi-platform assessment of the high resolution Western Mediterranean OPERational model (WMOP) developed at the Balearic Islands Coastal Observing and Forecasting System (SOCIB) and the impact of downscaling in comparison with the larger scale model CMEMS Mediterranean Sea Reanalysis (CMEMS Med Rea) used to constrain the WMOP simulations. Specifically, model-glider comparisons in the Ibiza Channel allow a new evaluation of the variability of water mass transports in this choke point of the Western Mediterranean Sea (WMS).

## 1 Multi-platform perspective

### Observations

**Gliders:** transects through Ibiza channel (black line, Fig. 1b). Temp & Salinity

**HF radar:** Ibiza Channel (Fig. 1b). U, V, from Jun-2012

**Satellite altimetry:** SLA product in WMS from CMEMS (1/8°, ~12km, daily)

**Moorings:** 6 locations (red dots, Fig. 1a). U, V, Temp & Salinity, from 2008

### Numerical models:

**CMEMS Med Rea** [Simoncelli et al., 2014]

- Spatial resolution: 1/16° (~6 km)
- Assimilation of SLA and T-S profiles

...downscaling

**WMOP** [Juza et al., JOO, 2016]

- Spatial resolution: 1/50° (~2 km)
- Free run 2009-2015 simulation without data assimilation
- Initial & boundary conditions from CMEMS Med Rea
- Surface forcing: from AEMET HIRLAM model (3h-5km)

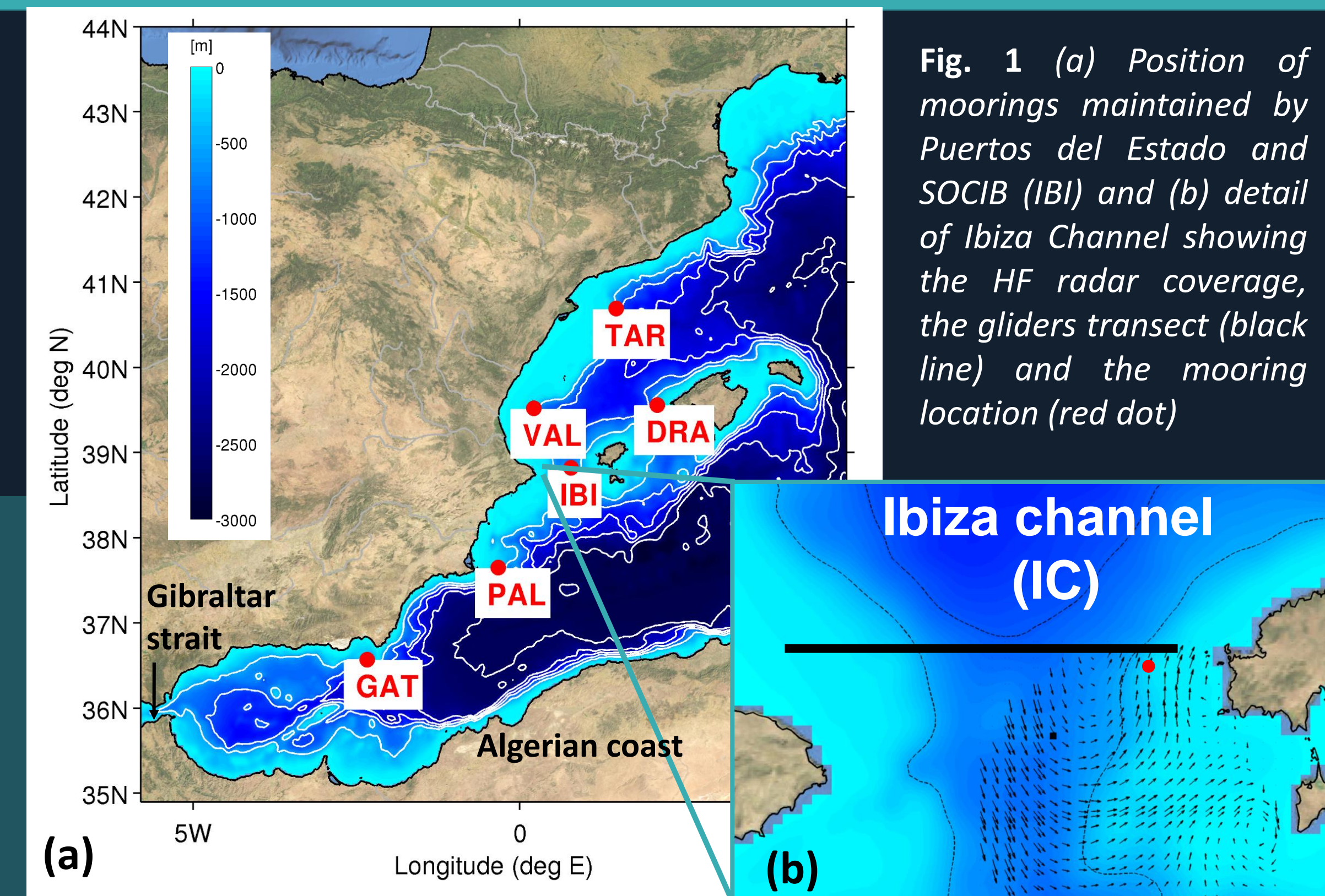


Fig. 1 (a) Position of moorings maintained by Puertos del Estado and SOCIB (IBI) and (b) detail of Ibiza Channel showing the HF radar coverage, the gliders transect (black line) and the mooring location (red dot)

## 2 Model assessment

### 2.1 Main axis of ocean current variability

- Good agreement between moorings, both models and altimetry in terms of the main axis of variability, in the northern positions and in GAT
- WMOP shows discrepancies respect to the other datasets in PAL and IBI

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

### 2.2 Water masses meridional transports

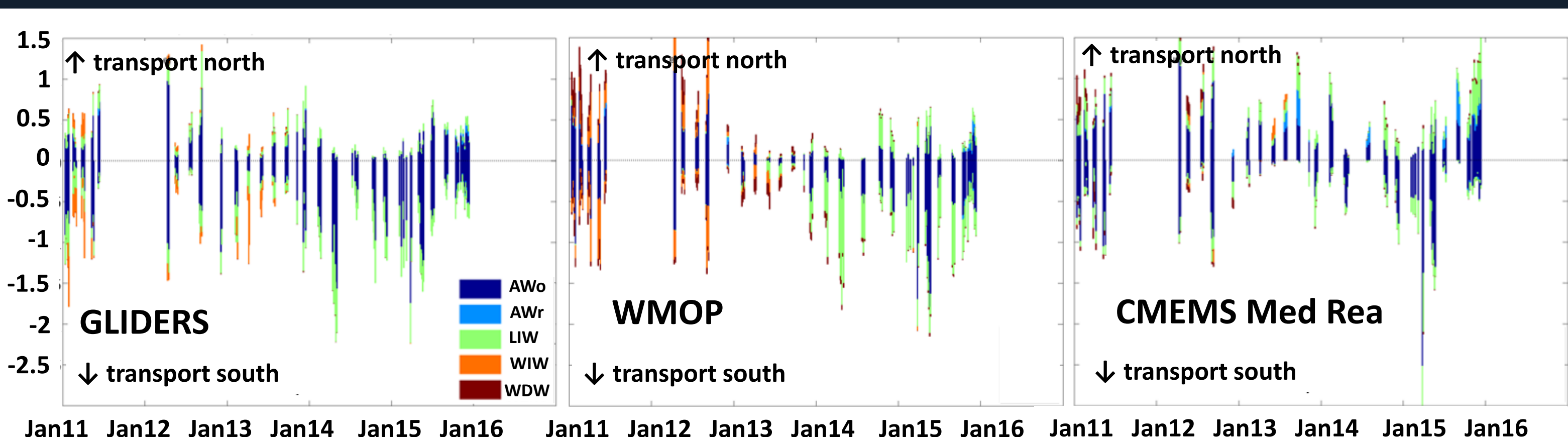
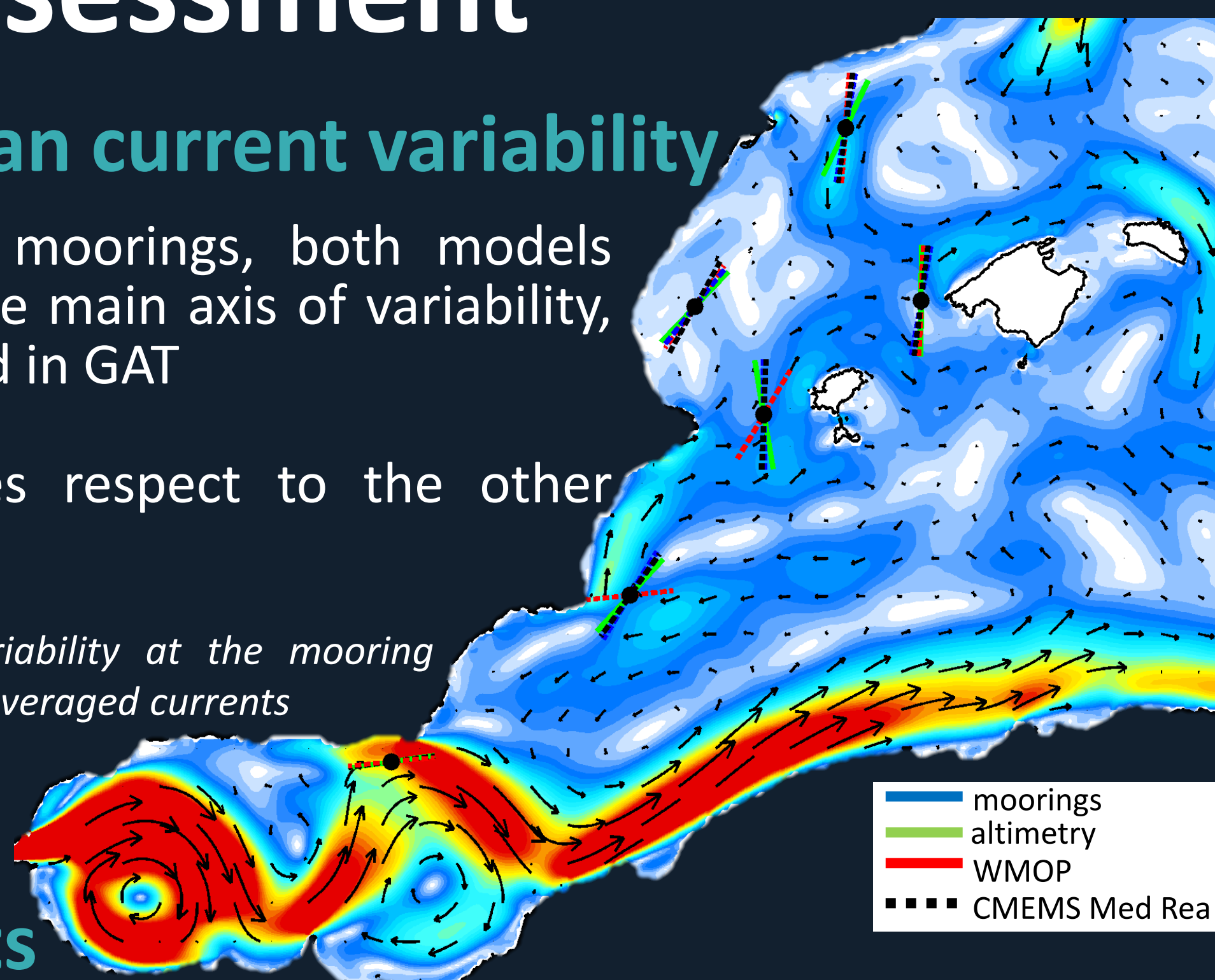


Fig. 3 Geostrophic velocity transport (Sv) by water mass from gliders, WMOP (to be updated) and CMEMS Med Rea

- 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
- CMEMS Med Rea underestimates WIW in the Channel and shows a northwards biased net transport [Juza et al., JMS, 2015]

### 2.3 Surface current spatial variability

- The meridional surface flow reversal described by gliders, HF radar and altimetry is well reproduced by WMOP but not by CMEMS Med Rea
- Downscaling improves the representation of the average surface circulation in the HF area [Lana et al., OcDyn, 2016] in comparison to CMEMS Med Rea

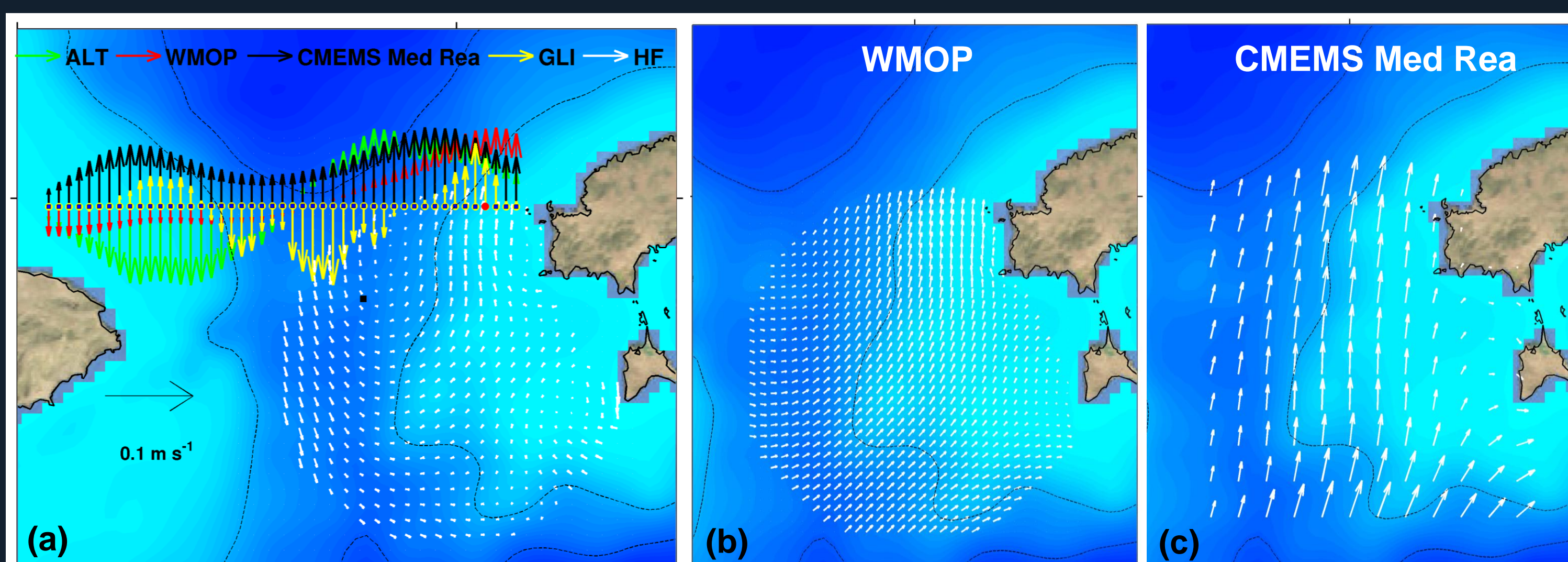


Fig. 4 Mean meridional surface flows (Jun2012-Dec2015) from Gliders, Altimetry, WMOP and CMEMS Med Rea and surface mean velocity from HF radar (a), WMOP (b) and CMEMS Med Rea (c).

### 2.4 Inter-annual changes of the surface circulation

- Northward circulation bias in CMEMS Med Rea seen at TAR and corrected in WMOP
- Intense northward flow at PAL during 2013 noted in all the datasets, except in WMOP and erroneous intense WMOP eastward flow in GAT during 2012-2013.
- Discrepancies due to the difficulty to correctly reproduce the size and location of eddies.

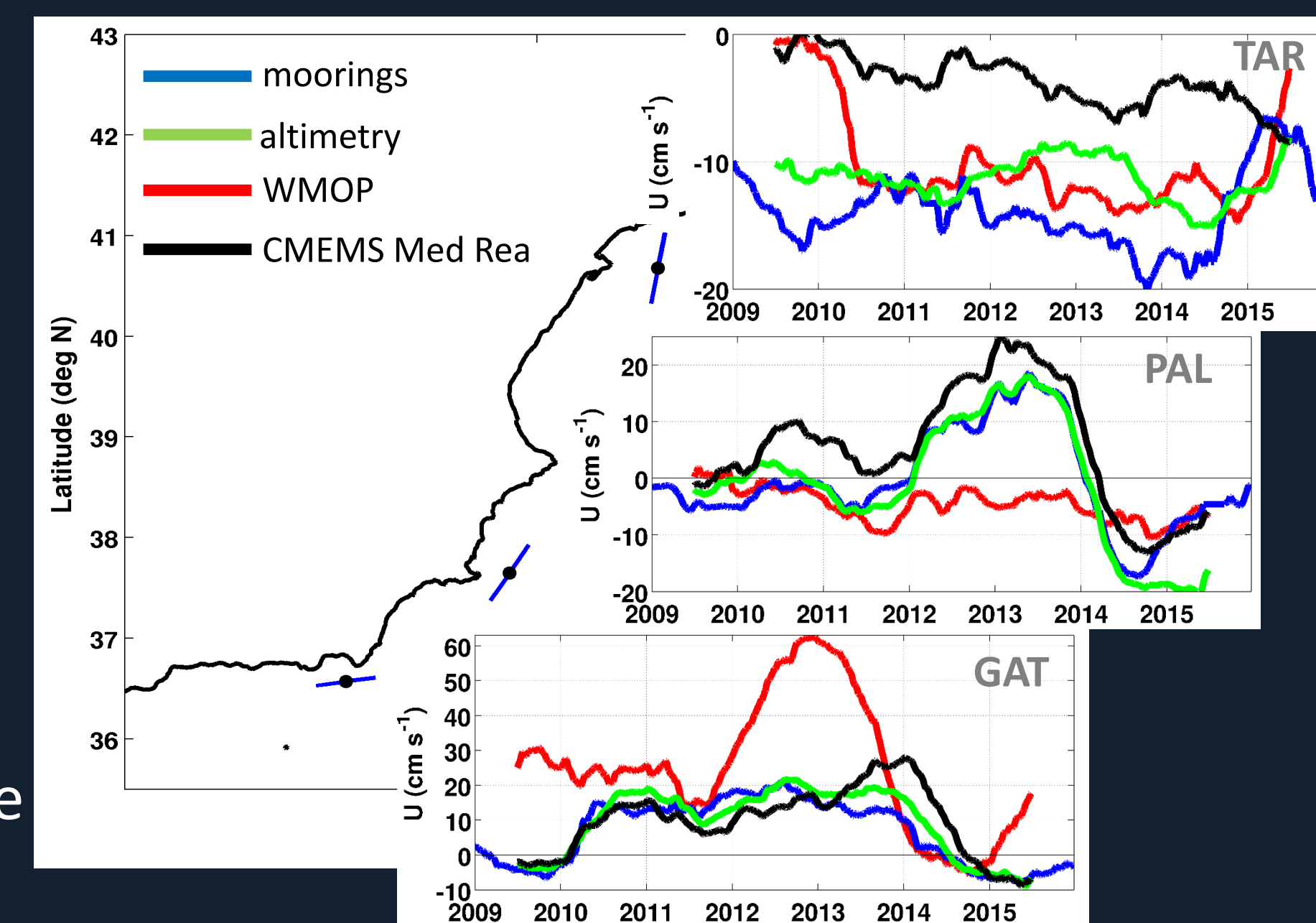


Fig. 5 Inter-annual velocities along the main axis at TAR, PAL and GAT moorings locations

### 2.5 Propagation of mesoscale eddies in the Algerian sub-basin

[Escudier et al., JGR, 2016]

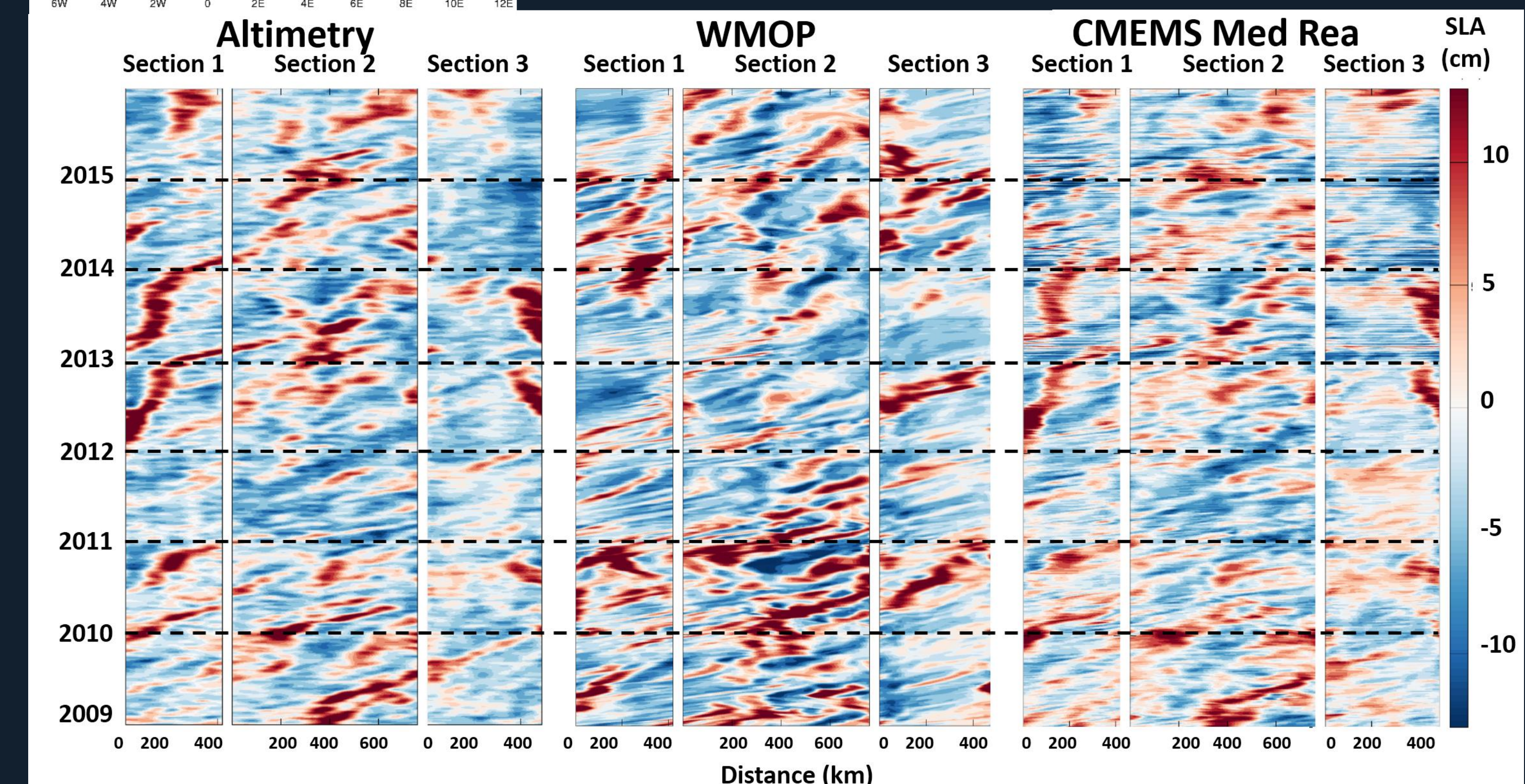
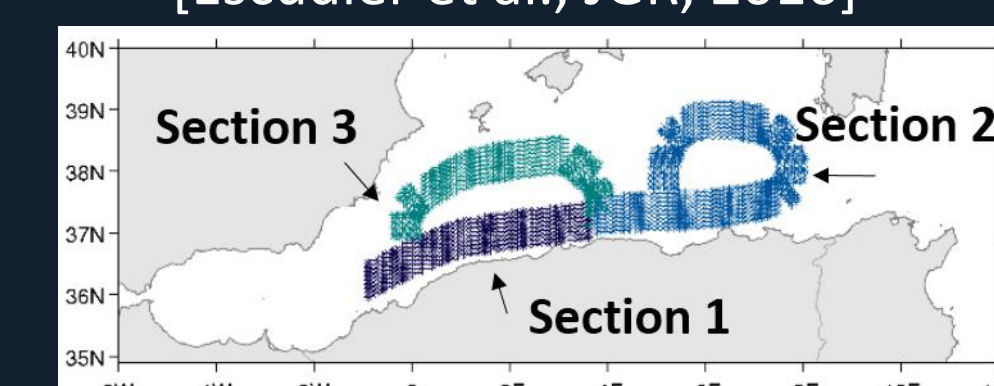


Fig. 6 Hovmöller diagrams obtained from altimetry, WMOP and CMEMS Med Rea data along the 3 sections represented in the insert.

## 3 Conclusions

- ✓ Downscaling improves (a) the surface circulation in the northern part of the Western Mediterranean Sea, (b) the variability of water mass transports, and (c) the meridional circulation in the Ibiza Channel in comparison to CMEMS Med Rea although the absence of data assimilation.
- ✓ WMOP is not able to reproduce the inter-annual temporal variability at mooring locations. Complementary analysis (not shown) suggest that this issue comes from the difficulty to correctly position the eddies. Data assimilation is then required, at least in the southern part of the domain.
- ✓ The generation of Algerian eddies needs to be constrained by data assimilation of satellite altimetry and is better represented in CMEMS Med Rea.