

HF RADAR OCEAN SURFACE CURRENT OBSERVATIONS IN THE IBIZA CHANNEL: DESCRIPTION AND MODEL-DATA COMPARISONS

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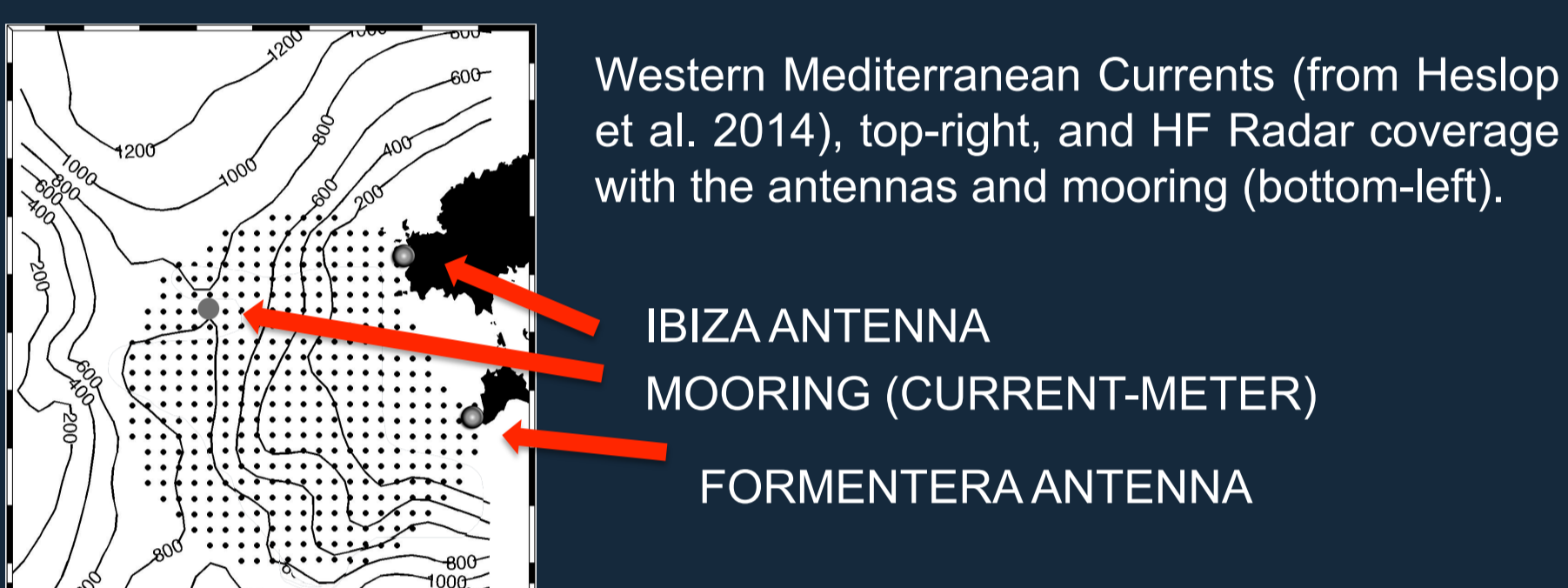
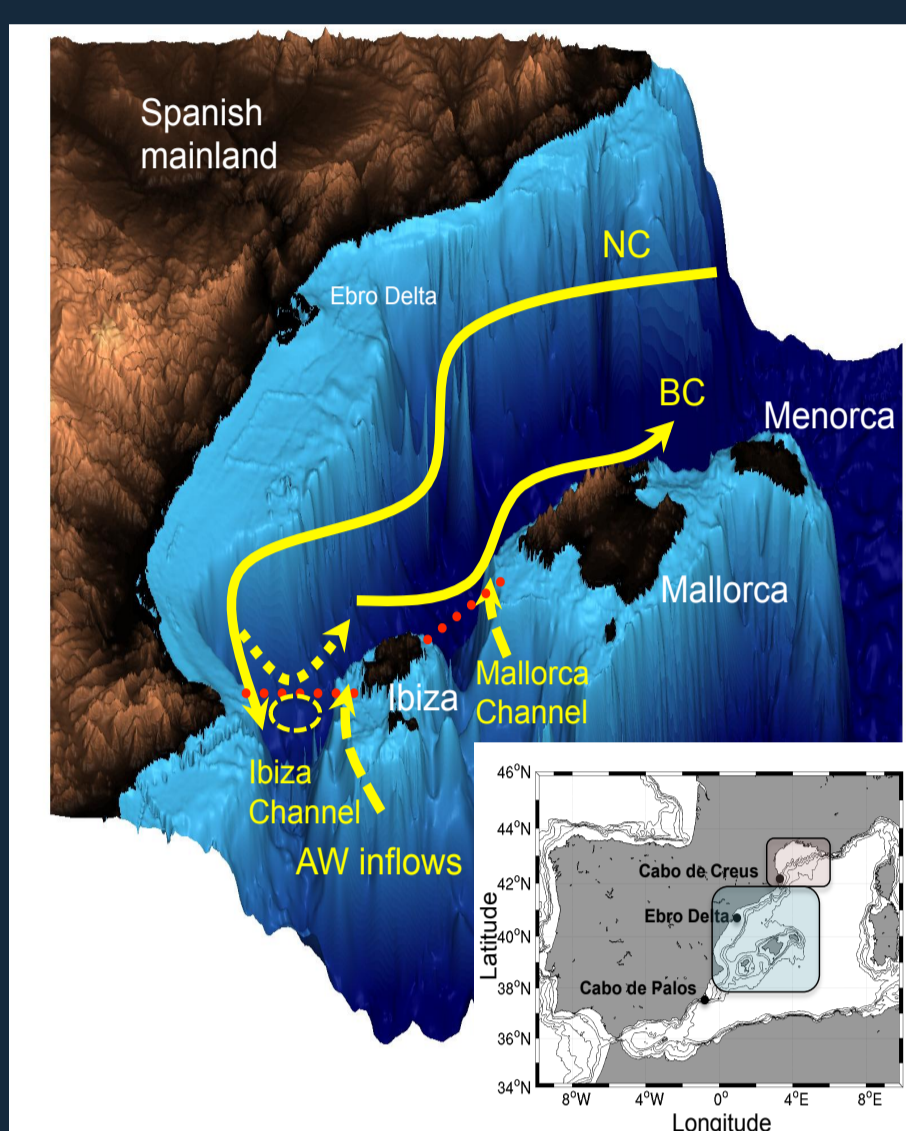
01 ABSTRACT

The coastal HF Radar is a key observing facility from the **Balearic Islands Coastal Observing and Forecasting System** (SOCIB, Tintoré et al. 2013), a multi-platform system that provides streams of oceanographic data and modelling services. The **HF radar** derived currents have been **quantitatively validated against both moored current-meter and Lagrangian drifters**. The analysis of the low-frequency circulation patterns shows that the **southward** flow in the channel is characterized by a marked seasonal cycle.

The SOCIB **Western Mediterranean Operational Forecasting System** (WMOP) provides high-resolution model outputs in the Ibiza Channel. A comparison exercise was performed between the model surface currents and the radar observations, allowing to evaluate the simulated surface velocities over the radar coverage.

02 IBIZA CHANNEL

Complex oceanographic processes affect the circulation in this area, influenced by the Northern (NC) and Balearic (BC) currents. NC provides old Mediterranean water masses from the Gulf of Lion, with strong current flow during winter and weaker during summer months. The NC through the Ibiza Channel can turn eastward probably due to a temporary blocking anticyclonic structure, or can continue southward to the Algerian Sea. The main patterns are highly influenced by density, strongly affected by the shallow topography, and by wind events. There is a high current variability in the area which makes it a challenge for oceanographic studies (Mason and Pascual, 2013).



Related posters:

WMOP general presentation -> Mourre et al.
WMOP-glider data comparisons -> Heslop et al.
SOCIB Data Centre -> Troupin et al.
and SOCIB presentation:
Tintoré et al.

03 HF RADAR AND WMOP MODEL

3.1 HF RADAR QA/QC AND VALIDATION

QA/QC procedures - additionally to CODAR QC, based on international references, MARACOOS (Roarty et al., 2012) and UCSB (Emery and Washburn). Radial parameters selected as system performance quality:

- Signal to Noise Ratio
 - Total number of Radial Vector solutions
 - Averaged Bearing of all radial vectors
 - Comparison between radial ideal and measured Bearing
- QC flags have been adapted based on SeaDataNet project.

VALIDATION - Total and radial currents have been compared against a surface current-meter and an ADCP located at the mooring in the Ibiza Channel. This comparison give a good correlation for the period from October 2013 to March 2015 except for some bad functioning periods. An intensive drifter validation exercise was performed in September 2014 (when the current meter and the Radar HF have a correlation of 0.8 for U and 0.54 for V and RMSD of 3.08 and 4.57 cm/s respectively). For Ibiza antenna, the correlations coefficients vary between 0.74 and 0.85, and for Formentera antenna between 0.63 and 0.78.

HF Radar system:

- Two Tx-Rx antennas situated at Ibiza and Formentera
- Tx Central Frequency: 13.5 MHz,
- Bandwidth: 90 kHz
- Radial Resolution: 1.5 km, angular resolution: 5 deg
- Radial Range ~ -80 Km
- Temporal Coverage: 75 min, moving average, hourly data
- Grid resolution: 3 km

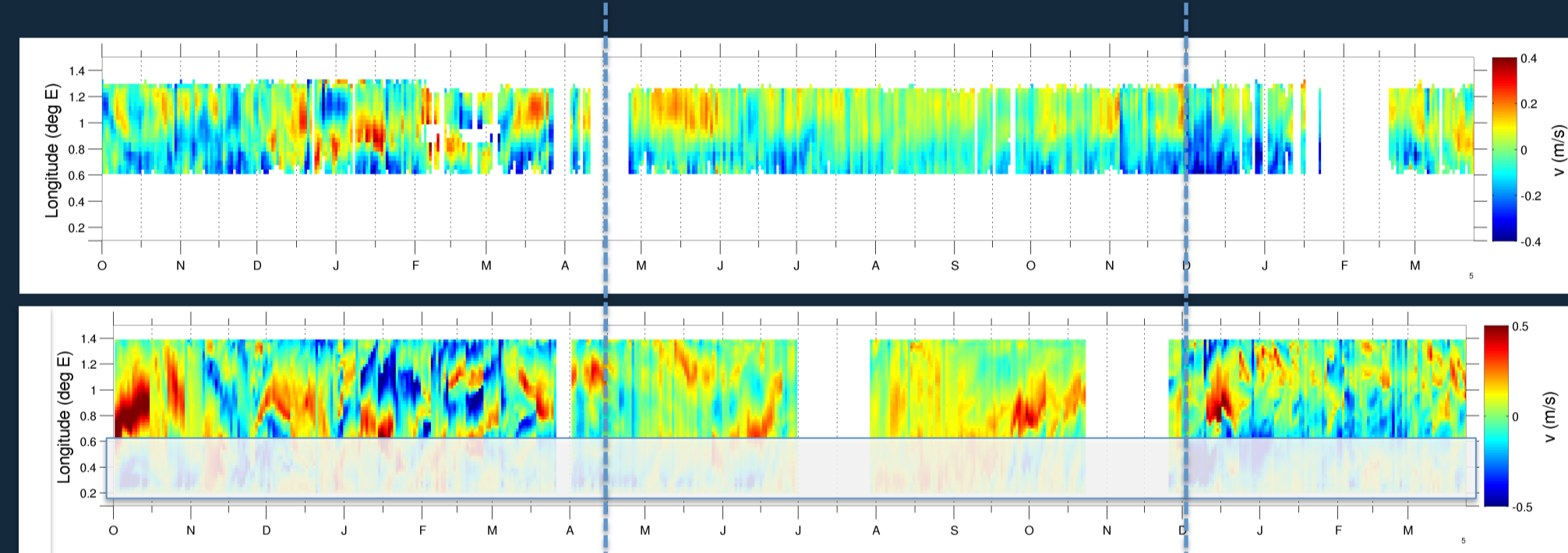
3.2 WMOP MODEL

WMOP configuration:

- ROMS
- From Gibraltar to Sardinia (6°W-9°E, 35°N-44.5°N)
- Spatial resolution: 1.8 to 2.2 km
- Vertical grid: 32 sigma levels
- Boundary conditions from MFS
- Atmospheric forcing from HIRLAM (3 h, 1/20°)
- Rivers runoffs
- Weekly model reinitialization from the outputs of a 3-week spinup simulation initialized from MFS

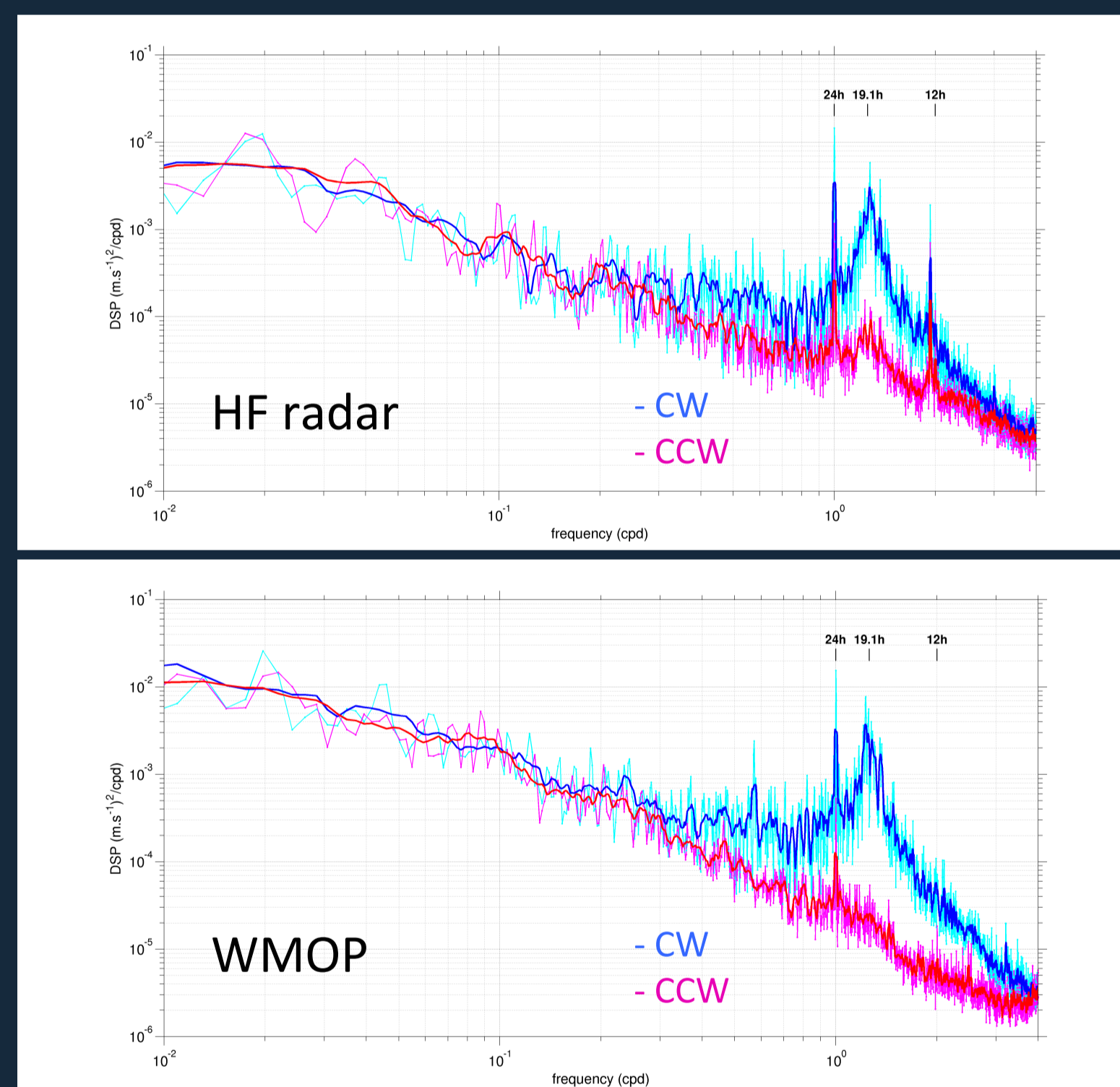
04 COMPARING HF RADAR WITH WMOP MODEL

4.1 HÖVMOLLER DIAGRAMS (38.7°N):



- A seasonal variability appears for both data sets (high variability in winter, low variability in summer). No permanent and synoptic patterns appear in this area.
- Short spatial and temporal scales in winter in both model and radar, with poor pattern correspondence.
- General overestimation of the current intensity in the model (maximum values aprox. 30% higher).

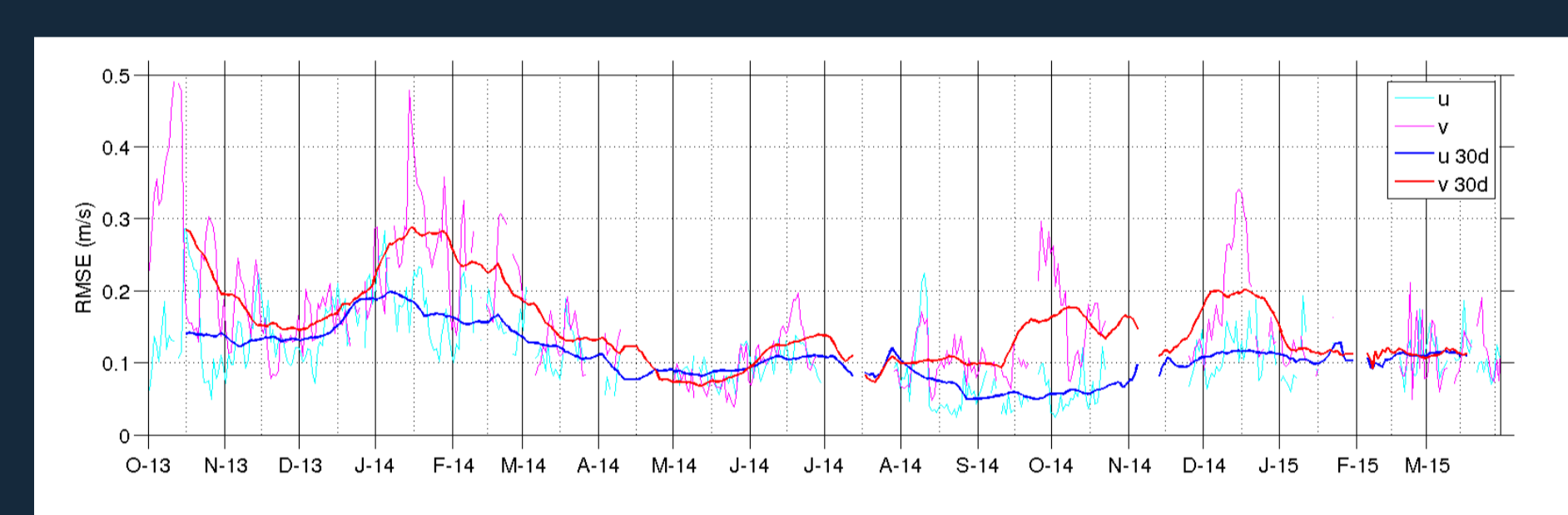
4.2 ROTATORY SPECTRUM ANALYSIS:



Rotatory power spectra sketches for HF radar and WMOP:

- clockwise circulation is dominant
- the inertial frequency (around 19h in this area).
- diurnal frequency (mainly S1)
- semidiurnal frequency at M2 for the HF radar data (tidal forcing is not included in the model)

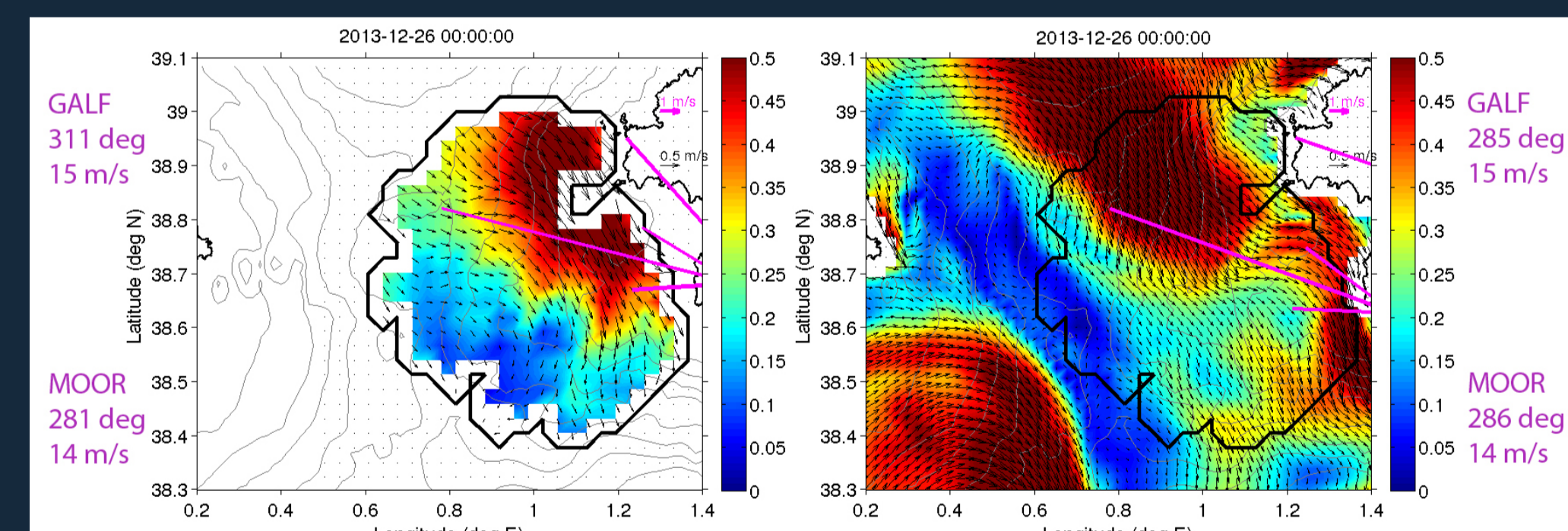
4.3 ROOT-MEAN SQUARE DEVIATION:



- In general RMSD are higher for V-component.
- Seasonal variability appears, with higher RMSD in wintertime and lower RMSD in summertime.
- This variability is related to the seasonal variability of the current data (higher in winter, lower in summer).

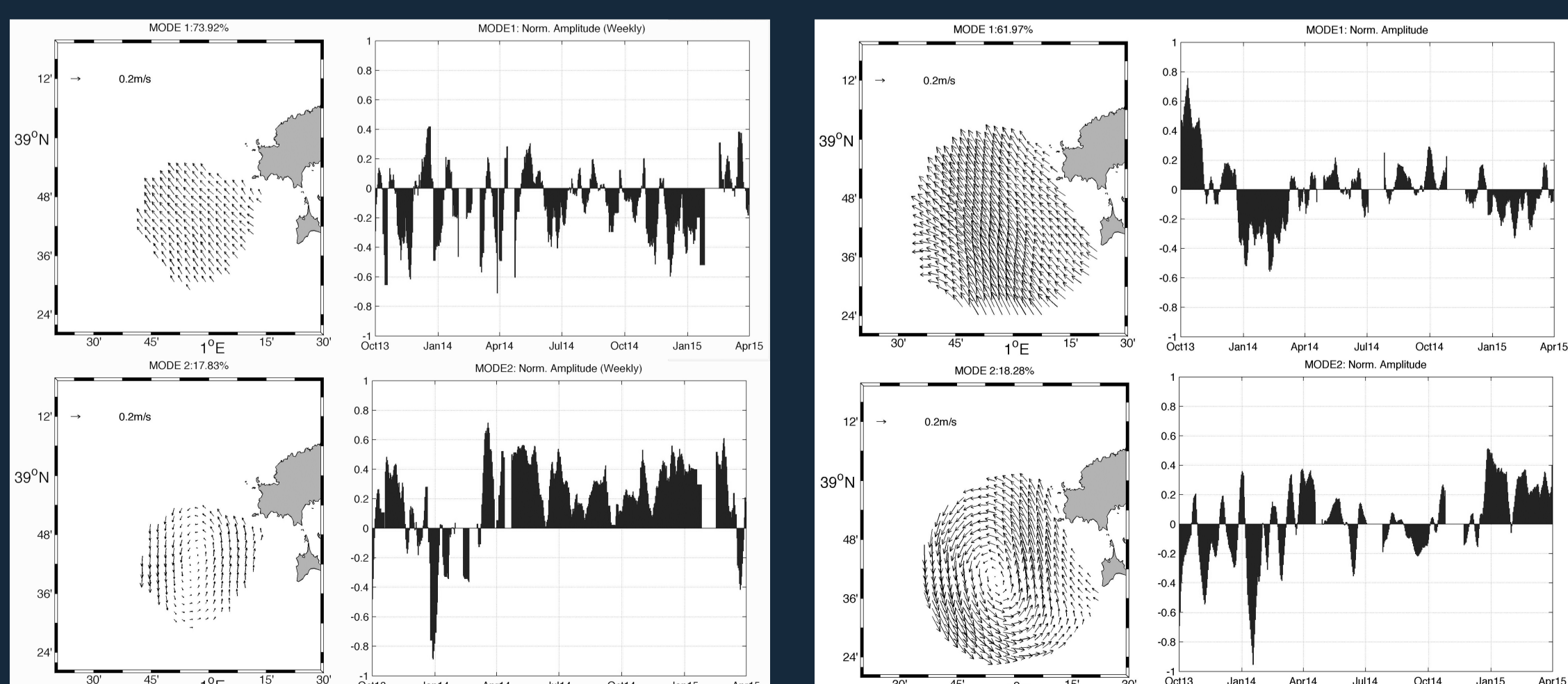
4.3 WIND EVENT SNAPSHOTS:

Generally good agreements between model and radar surface currents are found during strong wind events.



05 PRINCIPAL MODES OF VARIABILITY IN BOTH WMOP AND RADAR

An EOF analysis has been applied to HF radar data (October 2013 to April 2015), to study the temporal evolution of the main large scale and mesoscale circulation features. Radar grid nodes with more than 80% of hourly data are considered in the dataset. For each radar node, there is a continuous time series of 332 days. The observed and simulated modes 1 and 2, which explain 90 and 80% of the total variability respectively, have similar patterns. However, there are discrepancies in the time amplitude evolution.



HF radar (left) and WMOP current data (right) modes 1 and 2 with their temporal evolution amplitudes.

References:

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- Emery and Washburn, "Evaluation of SeaSonde Hardware Diagnostic Parameters as Performance Metrics", UCSB, technical Report.
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06 SUMMARY AND CHALLENGES

- HF radar is a valuable tool to validate WMOP surface currents in the Ibiza Channel.
- An automated QC/QA procedure, based on the system performance, is implemented in SOCIB HF radar facility.
- A drifter validation exercise was performed in September 2014, together with a continuous validation against a moored current meter in the Ibiza Channel to ensure the quality of the Radar data.
- WMOP overestimates by about 30% of the surface current intensity with respect to the radar observations in the Ibiza Channel.
- There is a good agreement in the spatial structures between WMOP model and HF radar data for periods of very high wind events.
- EOF analysis shows similar patterns, however, there is a discordance between amplitude time evolution.
- HF radar data assimilation is expected to improve WMOP surface currents in the Ibiza Channel.