Geophysical Research Abstracts
Vol. 19, EGU2017-18569, 2017
EGU General Assembly 2017

Model velocities assessment and HF radar data assimilation in the Ibiza Channel

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High Frequency Radar (HFR) provides continuous and high-resolution surface current measurements over wide coastal areas, enabling the observation of dynamic processes at the atmosphere-ocean interface, where a lot of momentum and heat exchange takes place, which is still not fully understood. Furthermore, HFR data provide critical information to improve numerical model predictions through data assimilation. However, the routine assimilation of HFR surface current data in operational models is still a challenge from both the methodological and computational points of view.

Since 2012, SOCIB, the Balearic Islands Coastal Observing and Forecasting System, operates two coastal HFR sites with the purpose of monitoring the surface currents of the Ibiza Channel (Western Mediterranean Sea). It is an area characterized by important meridional flow exchanges with significant impacts on ecosystems. The circulation in the Ibiza Channel results from the complex interaction of different water masses under strong topographic constraints. This makes the area very challenging from the point of view of numerical modeling. Indeed, models are generally found to represent erroneous flows across this section.

In this work, we perform the first steps to evaluate the potential of HFR data to improve the model circulation in the Ibiza Channel area with data assimilation. A multimodel Ensemble Optimal Interpolation scheme has been coupled to the SOCIB Western Mediterranean Operational Model (WMOP) to assimilate multiplatform observations, including the HFR surface velocities. WMOP is a 2-km resolution configuration of the ROMS model using CMEMS numerical products as initial and boundary conditions and high-resolution surface forcing from the Spanish Meteorological Agency.

To evaluate whether the model properly captures the main dynamical features observed in the Ibiza Channel (which is a prerequisite for a successful data assimilation), comparison of spatial empirical orthogonal function (EOF) patterns from HFR observations and from model results have been performed. Results show good agreement between the two first modes of variability of both data sets, which explain the north-south and east-west flows, respectively.

The comparison with ADCP data in the HFR coverage area shows also good agreement with the main vertical modes of the model at the first 120 m.

In our approach, model error covariances are estimated by sampling three long-run simulations of the WMOP system with different initial/boundary forcing and mixing parameters. Vertical correlations in the HFR coverage area are validated using ADCP measurements at the mooring. As expected, correlations decrease with depth both in the model as well as with the ADCP data. The agreement is found to vary with the season and the velocity component under consideration.

The first results of multiplatform data assimilation experiments using this modelling setup and including HFR, SST, SSH and in situ profiles will then be presented.