Validation of HF radar ocean surface current observations in the Ibiza Channel using lagrangian drifters, moored current meter and underwater gliders

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QA/QC

SOCIB High Frequency (HF) radar is one component of the multi-platform system located in the Baleric islands and made up of Lagrangian platforms (profilers and drifting buoys), fixed stations (sea-level, weather and coastal), beach monitoring (camera), gliders, a research vessel as well as an ocean forecast system (waves and hydrodynamics).

The HF radar system overlooks the Ibiza Channel, known as a “choke point” where Atlantic and Mediterranean water masses mix and where meridional exchanges of water mass properties between the Baleric and the Algerian sub-basins take place. In order to determine the reliability of surface velocity measurements in this area, a quality assessment of the HF Radar is essential.

We present the results of several validation experiments performed in the Ibiza Channel in 2013 and 2014. Of particular interest is an experiment started in September 2014 when a set of 13 surface drifters with different shapes and drogue lengths were released in the area covered by the HF radar. The drifter trajectories can be examined following the SOCIB Deployment Application (DAPP): http://apps.socib.es/dapp. Additionally, a 1-year long time series of surface currents obtained from a moored surface current-meter located in the Ibiza Channel, inside the area covered by the HF radar, was also used as a useful complementary validation exercise.

System validation

In order to ensure the highest quality of HF Radar data, comparison exercises were performed with the use of lagrangian drifters, the moored current meter (MCM) and HF Radar system (operating at a frequency of 13.5 MHz) measures an average of the first meter depth of the water column.

Lagrangian drifters are highly influenced by wind effect. The 13 drifters used in this study (September 2014) carried different kinds of drogues, in order to assess the effective depths of the HF radar. Three different kinds of drogues, being different both in shape (i.e. windage exposure effect) and the drogue shape: 1) Four Max-Dec Ocean DECE oceanographic surface drifter with drogues ranges between 50 and 100 cm deep, long life battery and low wind-exposure. 2) Five MD35b: with surface current tracker, flexible and rigid drogues and low wind-exposure, 3) OD1 drifter with a small 5 kg weight drogue, high wind-exposure.

Moored current meter validation

The closest radar grid point has been selected to compare total HF Radar velocities with the current meter. The mean distance between the drifters and the closest Radar node is ~140 m. We have chosen the period from 10th October 2013 until 30th Sept 2014 (1 year of data) to perform the total vs. current radar node correlation exercise. Note however that there is a general tendency of the North-south velocity except for the month of February 2014 where Radar and Current meter have reverse points of rotation. The variation of the correlation index was between 0.58 and 0.84 for U-component, and between 0.4 and 0.72 for V-component. Generally, U-component has a better correlation than V-component; this must be due to the fact both radars are closer to the X-axis.

Underwater glider validation

The glider sampled, during the G-AltiKa mission, the whole water column with a high-resolution, especially in the coastal area (the last 20 km of the track). The depth-averaged absolute (DAV) velocities retrieved from the GPS glider positioning were used to correct the surface geostrophic current, following the method described in Bouffard et al. (2012). The estimated depth-averaged velocity (DAV) ranges from 2 cm/s in the southernmost part of the glider trajectory to 10 cm/s at the end point, with a preferred northeast-westward orientation. The difference between the relative depth-averaged geostrophic currents (computed from DH) and the absolute DAV (computed from GPS) constitutes a reliable estimation of the absolute geostrophic current at the reference level. The dynamic height (DH) is obtained by integrating the density calculated from the glider temperature and salinity, between a level of reference and the surface. The HF radar data and the filtered glider DH show consistencies, as they have a zero-crossing at about 38.65ºN and flow to the west north of that latitude. The glider has the unique capability of profiling the water column with an horizontal resolution below 1 km. The HF radar system has the unique capacity to combine an extended spatial coverage (more than 70 km offshore) with a temporal resolution of 1 h. In spite of the difference, this initial validation/inter-comparison exercise is of particular value in assessing the quality of SA-RAL/AltiKa data in the coastal band. It also emphasizes the relevance of cross-platform approaches in the study of the coastal ocean dynamics and of the additional sources of validation for the currents (details at Trupin et al., 2015).

Conclusions

The study of oceanographic mesoscale processes using high resolution observations constitutes a new challenge in oceanography, and this challenge has to be tackled by a multi-platform approach. However, the comparison between different measuring systems is not straightforward since each system measure currents over different temporal and spatial scales. In this study the use of different instruments to compare/validate the HF radar currents shows promising results to assure the high quality of the surface ocean measurements:

- Thirteen drifters were launched in the exercise, with different shapes and drogues and at different positions of the coverage area. The radial components show good agreement with the correlations coefficients between 0.5 and 0.8 for Ibiza antenna, and between 0.4 and 0.8 for Formentera antenna. The lower values are generally associated with high radial angels, or areas with very low number of data.

- The total current vectors measured by the moored buoy and total vector at the closest radar grid point compared to the general result for the whole year show a good agreement with correlation coefficients of 0.67 and 0.57 respectively for U and V components.

- The comparison between the underwater glider and the HF radar currents is a challenge since the along-track data of the glider do not allow a two-dimensional description of the HF radar. However, according to the result, it is an interesting exercise to examine different ways to obtain current data.