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Assimilation of high-frequency radar currents in the Ligurian Sea

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The circulation in the Ligurian Sea is dominated by strong currents, namely the Western Corsican Current and the East Corsican Current, which jointly form the Northern Current. A high mesoscale activity, including meanders and eddy formation, is associated to those energetic currents. The non-linear instability processes and apparently chaotic behavior of this current system make this region a challenging testbed for data assimilation.

High-frequency radar surface currents have been measured by the NATO Undersea Research Centre (NURC), La Spezia, Italy from two sites at the Italian Coast (Isola Palmaria and San Rossore). Each of those sites measures the radial currents relative to the position of the radar system. This WERA system captures well the general circulation and mesoscale flow features.

The present study shows an application of the assimilation of those measurements in a nested model configuration of the Ligurian Sea. It is assumed that the error in the model surface currents comes primarily from uncertainties in the lateral boundary conditions and surface wind fields. The objective of this study is to reduce the uncertainty in these forcing fields by data assimilation. An ensemble of 100 perturbed lateral boundary conditions and surface wind fields is created to take the uncertainty into account. Using an ensemble-smoother technique described in Barth et al, 2010 (Ocean Science) and Barth et al, 2010 (Ocean Dynamics, in press), improved estimates of the wind forcing and boundary conditions are obtained. By rerunning the model with the updated forcing fields, it is verified that the analyzed model solution is closer to the observed HF radar currents. This technique is similar to 4D-Var, but since it is based on the ensemble covariance between forcing fields and observations, it does not require the formulation of an adjoint.