Assimilation of HF radar data in a regional model of the Ligurian Sea

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An ensemble of ROMS models with 1/60 degree resolution, covering the Ligurian Sea, and nested in the Mediterranean Forecasting System, is coupled with two WERA high-frequency radars run by the NATO Undersea Research Center (now CMRE).

The following perturbations are applied to the members of the ensemble: the wind forcing field, the open sea boundary conditions, and a supplementary term in the momentum equation.

An ensemble Kalman (EnKF) filter is then used to assimilate hourly-averaged radial currents into the model. A observation operator extracts the corresponding model radial currents from the model currents, then smooths them in the azimuthal direction as a function of distance to the radar. The observations are spatially dense, and not uncorrelated to one another, which is approximated in our experiment by increasing the observation error variance.

Different cases are run, with the estimation vector containing the model state (in which case it is called the state vector) or multiple model states at different time steps. In the latter case, the filter is closely related to the Ensemble Smoother and the Asynchronous EnKF.

The impact of different parameters is studied: the correlation length of the localization function, the (experimentally determined) total observational error, the stochastic perturbation in the momentum equation, the assimilation window length, etc.

The update vector generated by the data assimilation scheme is analyzed to examine whether inertial oscillations are present and corrected.

The model surface temperature is also compared with satellite images in order to assess the impact of assimilating one variable (surface currents) on another one (surface temperature).