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Assimilation of float positions in general circulation and regional scale ocean models

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Because of the increase in the realism of ocean models and in the coverage of Lagrangian data sets in most of the world's oceans, assimilation of Lagrangian data emerges as a natural avenue to improve ocean state forecast with many potential practical applications such as environmental pollutant transport, biological and naval-related problems. In this study, we provide an overview of recent work performed by the authors (Molcard et al., 2003; Ozgokmen et al. 2003; Molcard et al., 2005; Taillandier et al., 2005), where a Lagrangian data assimilation method for particle position is developed, implemented in a hierarchy of models, and tested using the twin-experiment approach.

The first and main step consists of using the Lagrangian data to correct the Eulerian model velocity in the same layer where the data are collected. This is done by minimizing the distance between observed positions and positions of synthetic floats simulated by the model. The corrections obtained in a single layer are then projected to other layers using statistical correlations. In idealized double-gyre multi-layer models, mass variables are also corrected using a dynamical balancing technique based on geostrophy and mass conservation. An extensive set of twin experiments indicates that the assimilation is effective provided that the data sampling period Dt is smaller than the Lagrangian time scale TL. The performance of the Lagrangian assimilation technique is also compared to that of conventional methods of assimilating drifters as moving current meters, and assimilation of Eulerian data, such as fixed-point velocities. Overall, the results are very favorable for the assimilation of Lagrangian observations to improve the Eulerian velocity field in ocean models.

Applications to realistic regional flows have also been performed, further improving the method using an adjoint formulation to extend the Eulerian velocity corrections to a sequence of time intervals. The influence of higher frequency motion such as inertial motion on the assimilation performance has also been studied, considering a sensitivity study to the sampling interval Dt.