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Improving Ocean Circulations Using Lagrangian Data Assimilation of Surface Drifters During Grand Lagrangian Deployments

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Accurate forecast of ocean circulation is important in many aspects. A lack of direct ocean velocity observations has been one of the overarching issues in nowadays operational ocean data assimilation (DA) system. Satellite-tracked surface drifters, providing measurement of near-surface ocean currents, have been of increasing importance in global ocean observation system. In this work, the impact of an augmented-state Lagrangian data assimilation (LaDA) method using Local Ensemble Transform Filter (LETKF) is investigated within a realistic ocean DA system. We use direct location data from 300 surface drifters released in the Gulf of Mexico (GoM) by the Consortium for Advanced Research on Transport of Hydrocarbon in the Environment (CARTHE) during the summer 2012 Grand Lagrangian Deployment (GLAD) experiment. These drifter observations are directly assimilated into a realistic eddy-resolving GoM configuration of the Modular Ocean Model version 6 (MOM6) of the Geophysical Fluid Dynamics Laboratory (GFDL). Ocean states (T/S/U/V) are updated at both the surface and at depth by utilizing dynamic forecast error covariance statistics. Four experiments are conducted: (1) a free run generated by MOM6; 2) a DA experiment assimilating temperature and salinity profile observations from World Ocean Database 2018 (WOD18); and 3) a DA experiment assimilating both drifter and the profile observations. The LaDA results are then compared with the traditional assimilation using the drifter-derived velocity field from the same GLAD database. In addition, we evaluate the impact of the LaDA algorithm on different eddy-permitting and eddy-resolving model resolutions to determine the most effective horizontal resolutions for assimilating drifter position data using LaDA.