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Using Ensemble Adjustment Kalman Filter to assimilate Argo profiles in a coastal OGCM

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An ensemble adjustment Kalman filter system is developed to assimilate Argo profiles into the Northwest Pacific MASNUM wave-circulation coupled model, which is based on the Princeton Ocean Model (POM). Some numerical tests are carried out to check the performance of the system: one for checking the ensemble spread and another for the performance of assimilation of the Argo data in 2005-2009. The checking of ensemble spread shows that the ensemble system performs well and these samples can well presents the probabilities of the real ocean states. The spatial distributions of the correlation between model grids and a fixed observation location showed that there is a strong local correlation under the ensemble samples, but there is still some correlation at locations far from the observation location. The result shows the necessary of performing the localization for ensemble samples in order to increase the accuracy of Kalman filtering and reduce the computational cost.
Assimilation experiments are carried out to compare with the simulation without data assimilation which serves as the reference experiment (CTL). Different experimental results are compared with data set of the satellite sea surface temperature (SST) and the Global Temperature-Salinity Profile Program (GTSPP). The comparison with SST shows that modeled SST errors are reduced after assimilation; the SST error reduction percentage after assimilation of Argo profiles is about 10% on average. The comparison against GTSPP profiles which are dependent with Argo profiles shows the improvements in both temperature and salinity. In different layers of the ocean, the maximum error reduction is appeared in the subsurface of the ocean. In the top layers of the ocean shallower than 500m, the error reduction of temperature is about 10%. However, the error reduction percentage in the layers of 500-1000m of the ocean is around 50%. The error reduction percentage in the rest deeper layers of the ocean is averaged on 35% that is a little smaller than the subsurface. The subsurface region is the active part in vertical because of the existence of the upper ocean mixing layer. Therefor these results also indicated that the simulation of top ocean mixing layers is improved after the assimilation of Argo profiles.