Coupled Assimilation of both Atmospheric and Oceanic Observations for ENSO Prediction Using an Intermediate Coupled Model

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The initial surface and subsurface temperature fields are important for ENSO prediction due to the ocean's long memory. As a result, most ENSO predictions are initialized by ocean data assimilation. However another key for the development of an ENSO event is the wind anomalies in the western Pacific associated with air-sea coupled tropical convection systems. Therefore the assimilation of both atmospheric and oceanic observations should be taken into account for ENSO prediction. However one difficulty is that the atmosphere has relative short memory on its initial conditions. This can be even worse if one uses the intermediate coupled models in which the atmospheric components are statistical and slavery to ocean components. In this case, the atmospheric models do not have any memory on its initial conditions and the adjustment of the atmospheric state made by assimilation cannot impact on model forecast. In this study we use the coupled covariance to assimilate both atmospheric and oceanic observations based on ensemble Kalman filter with an intermediate coupled model. The coupled covariance enables the assimilation of atmospheric observations to adjust the ocean states and can overcome the above mentioned difficulty technically. By a series of experiments using both simulated and realistic observations, we found that the assimilation of atmospheric observations (i.e., wind in this study) can help to improve the surface and subsurface currents in ocean because the correlation between the wind and ocean currents is stronger than that between ocean temperature and ocean current in the equatorial Pacific. Finally we demonstrate that initialized by the coupled assimilation the prediction lead time with useful skills can reach up to two years.