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Assimilation of Sea Surface Temperature into a Global Hybrid Coordinate Ocean Model

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The Hybrid Coordinate Ocean Model (HYCOM) uses different vertical coordinate choices in different regions. In HYCOM, the prognostic variables include not only the seawater temperature, salinity and current fields, but also the layer thickness. All prognostic variables are usually adjusted in the assimilation when multivariate data assimilation methods are used to assimilate sea surface temperature (SST). This paper investigates the effects of SST assimilation in a global HYCOM using the Ensemble Optimal Interpolation multivariate assimilation method. Three assimilation experiments are conducted from 2006–08. In the first experiment, all model variables are updated during the assimilation process. In the second experiment, the temperature alone is updated in the entire water column. In the third experiment, a vertical localization technique that confines the effect of SST observations to the mixed layer is used. For comparison, a control experiment without assimilation is also conducted. The three assimilation experiments yield notable SST improvements over the results of the control experiment. Additionally, the experiments in which all variables are adjusted and the temperature alone in all model layers is adjusted, produce significant negative effects on the subsurface temperature. Also, they yield negative effects on the subsurface salinity because it is associated with temperature and layer thickness. The experiment adopting a vertical localization technique yields positive effects and outperforms the other experiments. The heat content in the upper 300 m and 300–700 m layers further suggests that it yields the best performance among the experiments. The results imply that the vertical localization is very important, especially for the SST assimilation. Moreover, attention should be paid to SST assimilation by ensemble-based multivariate assimilation methods. The ensemble used in the assimilation is usually taken from model outputs. However, model errors can give rise to improper correlations between the SST and other variables, which can lead to the improper adjustment of variables in the assimilation. In particular, when a specific variable is dominent (e.g., the layer thickness variable in HYCOM), its incorrect adjustment can generate an extensive negative impact on the other variables.