Ocean Data Assimilation Using Temperature, Salinity, and Sea Surface Height Observations, and Its Impacts on El Niño Prediction

Masayoshi Ishii*, Kenji Sakamoto, and Masahide Kimoto*****

** Climate Prediction Division, Japan Meteorological Agency; ishii@naps.kishou.go.jp*
*** Climate Prediction Division, Japan Meteorological Agency; k-sakamoto@met.kishou.go.jp*
**** Center for Climate System Research, University of Tokyo; kimoto@ccsr.u-tokyo.ac.jp*

A three-dimensional variational ocean data assimilation system using temperature, salinity, and sea surface height (SSH) observations was developed, and the impacts of the data assimilation on El Nño prediction by a coupled ocean-atmosphere model was studied.

In ocean model integration without data assimilation, atmospheric forcing plays essential roles in reproducing seasonal and interannual variations, but it also causes sizable biases in temperature and salinity fields. By data assimilation, these biases are significantly reduced and the intraseasonal variations appear to be well reproduced. In case of salinity assimilation, its outputs have been verified using TRITON-buoy observation. Introduction of SSH observation to data assimilation makes variability of model temperature and salinity larger by a factor of 1.5−2.0 in data sparse regions, e.g., the Indian and equatorial Atlantic Oceans, than a case without SSH data assimilation.

El Niño prediction experiments were carried out using several types of ocean initial condition; temperature (T) and salinity (S) assimilation (TSAS), T, S, and SSH assimilation (TSHAS), and T assimilation with/without climatological salinity constraint (TAS+Sclim/TAS+Sfree). Figure 1 shows anomaly correlation skill (ACC; %; upper) and root-mean-square error skill (RMSE; ˚C; bottom) with a function of lead time (days) for Niño-3.4 sea surface temperature (SST) anomalies predicted from 83 initials in 1993 – 1999. Large differences in skill are found between prediction with TAS+Sfree (dashed) and the others. Initially, salinity of TAS+Sfree is far different from climatology and the errors of predicted SSTs grow rapidly rather than those of the other predictions. Small improvement of prediction skill using TSAS and TSHAS initials may be owing to sparseness of salinity observation and incompleteness of an SSH assimilation scheme adopted in the system, although further investigations are necessary.

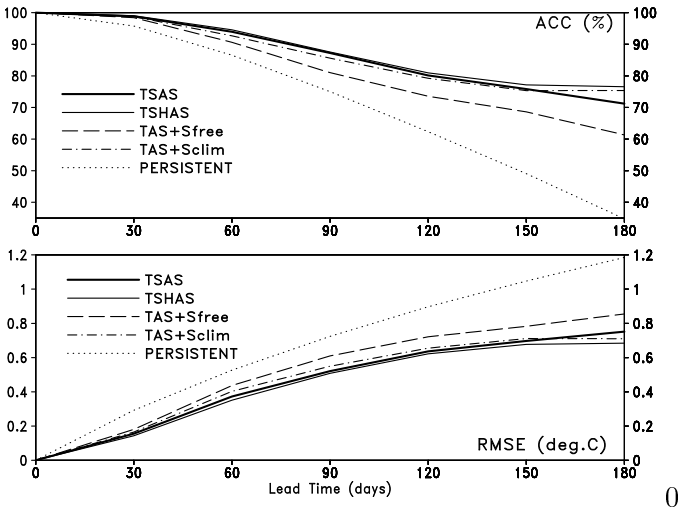

Fig. 1.

In future, the system will be equipped with a current update scheme by which model currents are adjusted to updated density fields, as well as an revised dynamical model and improved data assimilation schemes. In addition, data impacts on El Niño prediction will be reexamined.