Development of weakly coupled atmosphere-ocean data assimilation system and the evaluation of the coupled reanalysis in JMA/MRI

*Yosuke Fujii[1], Chiaki Kobayashi[1], Toshiyuki Ishibashi[1], Yuhei Takaya[1]

1. Meteorological Research Institute, Japan Meteorological Agency

JMA/MRI have developed a weakly-coupled Data Assimilation (DA) system, MRI-CDA1, based on JMA's operational systems. MRI-CDA1 is composed of the global atmosphere Four-Dimensional Variational (4DVAR) system for numerical weather predictions, the global ocean Three-Dimensional Variational (3DVAR) system for seasonal predictions, and the coupled atmosphere-ocean model for seasonal predictions. The coupled atmosphere-ocean model is adopted as the outer model of the atmospheric 4DVAR routine although the uncoupled atmospheric model is used as the inner model. While the atmospheric 4DVAR analysis is performed every 6 hours, the oceanic 3DVAR analysis is performed every 10 days and the oceanic analysis increments are applied in the integrations of the outer (coupled) model.

Coupled reanalysis experiments based on MRI-CDA1 are conducted for the period from November 2013 to December 2015. In the coupled reanalysis the excess rainfall found in the tropics in Japanese 55-year Reanalysis (JRA-55) is effectively suppressed, particularly in the Intertropcal Convergence Zone (ITCZ) in the Pacific. We also confirmed that the coupled DA system properly reproduces the lagged-correlated variations of Sea Surface Temperature (SST) and precipitation in the far western tropical North Pacific which is not reproduced by a regular uncoupled DA system. The variation of the precipitation is improved in the coupled reanalysis over the uncoupled one when only conventional data and oceanic data are assimilated. But the coupled DA system adjusts SST to the change of precipitation, instead of correcting the precipitation field, when atmospheric data from satellite are additionally assimilated. We also conducted another coupled reanalysis experiment in which the atmospheric observation error variances set larger than the original, and found that the variation of the precipitation in the tropics is roughly improved over the original coupled reanalysis.

Keywords: coupled data assimilation, coupled analysis, Subseasonal-to-seasonal prediction, sea surface temperature, precipitation

