A study on the optimal data assimilation system for the whole neutral atmosphere

Dai KOSHIN[1], Kaoru SATO[1], Kazuyuki MIYAZAKI[2], and Shingo WATANABE[2]

[1] *Department of Earth and Planetary Science, Graduate School of Science, The University of Tokyo, Tokyo, Japan*

[2] *Japan Agency for Marine-Earth Science and Technology, Yokohama, Japan*

Observations in the mesosphere are sparser than those in the troposphere, and the model predictability is not sufficient to simulate behaviors of the real atmosphere. Thus, global data including the mesosphere estimated by the data assimilation system is a key for quantitative evaluation of the momentum budget, although it has not yet been common. The purpose of this study is to develop the assimilation system and to make global data for a wide height range from the ground to the lower thermosphere. A conventional observation data set called PREPBUFR and the satellite temperature retrieval data from Aura MLS were used.

We adopted the 4-D Local Ensemble Transform Kalman Filter (4D-LETKF) developed by Miyoshi and Yamane (2006) and examined relevant values of the parameters which should be given for the data assimilation system. Before the parameter examination, the model performance was improved by modifying the vertical profile of the horizontal diffusion coefficient and the source intensity in the gravity wave parameterization. Tuned parameters for the assimilation are the number of ensemble members, the localization length, the assimilation window, and the covariance inflation coefficient. The parameters regarding the treatment of observation data were also examined: the subtraction of the MLS observation bias using a bias table as a function of time, latitude, and height, made from less-biased SABER data which were not always obtained globally; the super-observation adjusting the density of observation data to the model resolution; the inflation of observation error during the startup time; and the degree of the gross error check. The data assimilation was performed for the time period from 10 January to 20 February 2017.

Next, the assimilation with the best parameter setting was performed. It was confirmed that the obtained analysis data were plausible by comparing with the MLS observation, and with MERRA-2 data for the available height region. The analysis data were examined using theoretical framework of the Transformed-Eulerian-Mean equations from a viewpoint of the difference between before and after the sudden stratospheric warming.

Key words: data assimilation, satellite, middle atmosphere

References

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