Assimilation of SSM/I and TMI Total Column Precipitable Water Data into the JMA Global 3D-Var Assimilation System

Toshiharu Tauchi*, Yoshiaki Takeuchi, Yoshiaki Sato
Numerical Prediction Division, Japan Meteorological Agency
1-3-4 Otemachi, Chiyoda-ku, Tokyo 100-8122, JAPAN
e-mail:ttauchi@naps.kishou.go.jp

In order to improve global water circulation forecast, it is essential to prepare accurate model initial fields, especially for water vapor. The Japan Meteorological Agency (JMA) has been trying to introduce total column precipitable water (TCPW) data, which can be retrieved from Microwave Radiometer, into the global 3D-Var assimilation system.

An observation system experiment (OSE) for TCPW from SSM/I on DMSP -13, 14 and 15 and TRMM/TMI was conducted. Predetermined look-up tables for SSM/I and TMI were used to retrieve TCPW (Takeuchi and Kurino 1997). Some biases between the satellites were corrected before OSE.

In the preliminary experiment, excessive precipitation was appeared in the tropics due to systematic difference between the retrieved TCPW and the guess TCPW of the JMA global model (GSM) as shown in Fig. 1a. To remove the undesirable difference, a bias correction was applied to the retrieved TCPW (Fig. 1b).

With the bias corrected TCPW, an OSE was performed for the period of 1-31 July 2003. Fig. 2a shows the difference in monthly mean analyzed TCPW fields between the test with TCPW assimilation and control. The monthly mean TCPW increased mainly over Indonesia and Northern Atlantic Sea, and decreased over the Arabian Sea. It affected lower layer temperature (Fig. 2b). Figure 3 shows the RMSE for 850 hPa temperature (T850) forecast against radio-sonde observation in the tropical region (20S-20N). The decrease of RMSE up to 4 days forecast is remarkable.

Although the T850 score against radio-sonde observation was improved, a model-originated cooling bias in the lower troposphere (Nakagawa 2003) resulted in the degradation of forecast scores against initial field. To solve the problem, we are investigating the detail mechanism of the forecast degradation in the TCPW assimilation.

References:

Takeuchi, Y and Kurino, T, 1997: “Document of algorithm to derive rain rate and precipitation with SSM/I and AMSR,” Algorithm description of PIs for SSM/I and ADEOS-II/AMSR, 2nd AMSR Workshop, 61-1 - 61-9.

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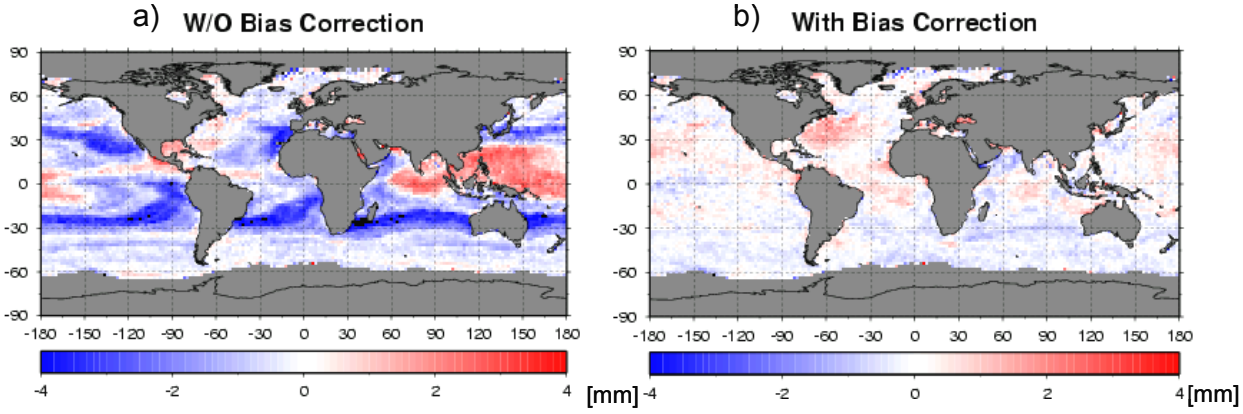

Fig.1: Monthly mean TCPW difference between the guess of global model and the retrieval, a) Without the bias correction and b) With the bias correction. The period is 1-31 July 2003.

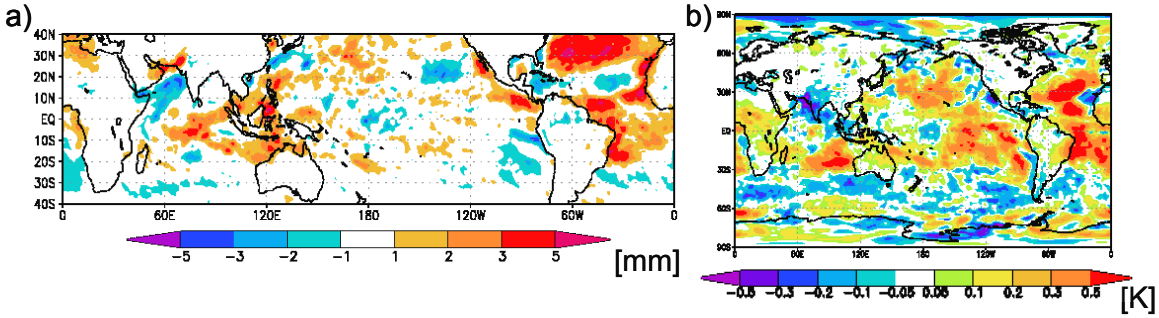

Fig. 2: a) Difference of monthly mean analyzed TCPW between the test with TCPW assimilation and the control. b) Same as is a) but for temperature at 850 hPa. The period is 1-31 July 2003.

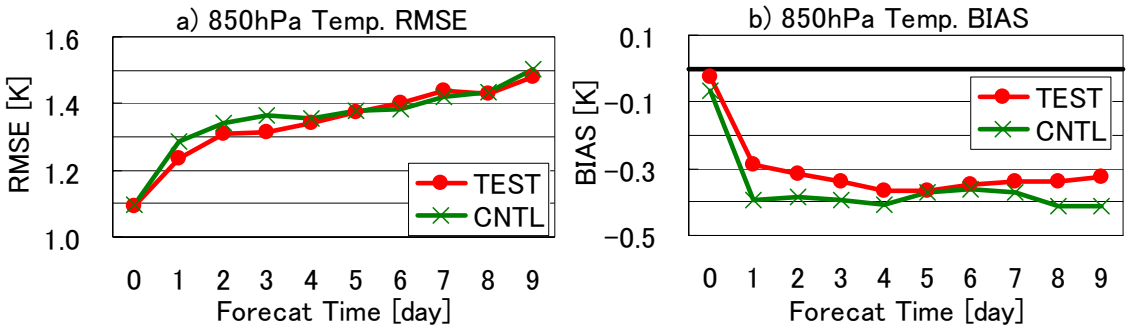

Fig. 3: a) RMSE for 850 hPa temperature forecast in tropical area against radio-sonde observation. b) Same as is a) but for mean error.