USE OF TMI AND SSM/I DATA IN THE JMA OPERATIONAL MESO ANALYSIS

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The Japan Meteorological Agency has been operating a Meso-Scale Model (MSM) with 4D-VAR data assimilation system (Meso 4D-VAR). This model is utilized for very short range rainfall forecast to mitigate natural disasters. Although the Meso 4D-VAR brought considerable improvement in the precipitation forecasts of MSM, it still does not have enough accuracy to predict heavy rainfall quantitatively. It needs not only to improve MSM and Meso 4D-Var but also to introduce new observations.

An observational system experiment (OSE) for both rain rates (RR) and total column precipitable water (TCPW) retrieved from Tropical Rainfall Measuring Mission (TRMM) Microwave Imager (TMI) and Special Sensor Microwave/Imager (SSM/I) was performed. To retrieve both RR and TCPW, the method developed by Takeuchi and Kurino (1997) was employed.

A result of the OSE is shown in Fig. 1. The analysis date is 00UTC 25 Aug. 2003. Without TCPW assimilation, a water vapor concentrated area was analyzed over the East China Sea (Fig.1b). However TCPW observation did not show the concentration (Fig 1a). With TCPW assimilation, the high humid area was removed (Fig.1c) and the analyzed field showed good correspondence with the observation. Forecast experiments using MSM from these initial conditions were performed in this case. Radar observation showed that torrential rain occurred at the northern part of Kyushu Island after 18 hours (Fig 1a'). Without TCPW assimilation, a convective system was developed over the East China Sea right after the start of forecast and it moved toward the southern part of Kyushu Island (Fig.1b'). With TCPW, development of the convective system was delayed and heavy rain was predicted at the northern part of Kyushu Island (Fig.1c'), corresponding with the radar observation.

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To estimate the total effect of the RR and TCPW, an OSE was performed for two weeks starting from 3 Jun. 2003. Considering the real time operation, TMI and SSM/I data received after the cut-off time were not used in the OSE. Meso Analysis was performed cyclically using those additional data. Forty eight forecasts were performed and compared with operational ones, in which the satellite data were not assimilated.

The threat scores of weak (1mm/3hour) and moderate (10mm/3hour) rain over Japan are shown in Fig. 2. The both threat scores showed positive impact in the rainfall forecast after 12 hours forecast, while they were showed almost neutral up to 9 hours forecast. This result can be explained by that the water vapor field over ocean was improved with the additional data and it needed time to flow over Japan islands. In the operational Meso Analysis, radar data are used and they adjust rainfall field to radar observations. Therefore, no remarkable differences are seen in the threat scores in the first half of the forecast period.

The RMSEs for 500 hPa height (Z500) and 850 hPa temperature (T850) against upper air sounding data are shown in Fig. 3. RMSE for Z500 was slightly improved after 12 hours forecast and T850 was improved from the initial time. RR and TCPW assimilation may affect initial condition of thermodynamical field. Besides the modification of water vapor field changes the location where convection develops, and improved the dynamical field. Undoubtedly, the introduction of those data brought positive effect in MSM forecast.

With the results, JMA decided to use the data in operational Meso Analysis. It has started from 00UTC 15 Oct. 2003.

References:

Takeuchi, Y and T. Kurino, 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.

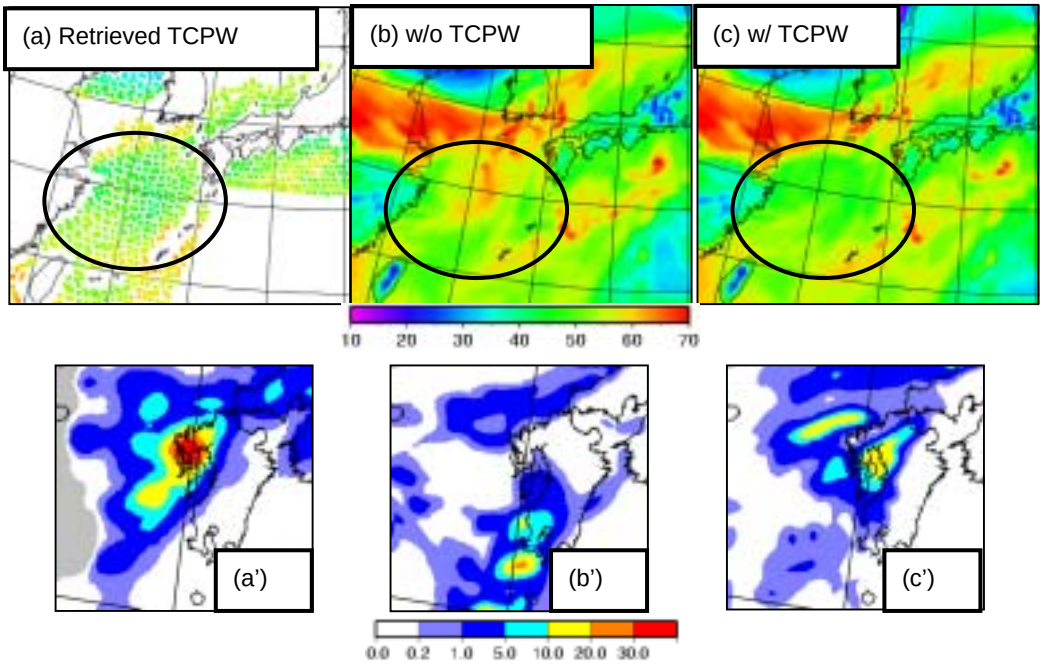

Fig.1 (a) Retrieved TCPW at 00UTC 25 Aug. 2003 from TMI and SSM/I. (b) Analyzed TCPW field at the same time without assimilating TCPW data. (c) Same is in (b) but with TCPW assimilation. (a') 3-hour rain at 18UTC 25 Aug. 2003 estimated by radar observation. (b') 3-hour rain forecast after 18 hours from the initial condition (b). (c') Same is in (b') but from the initial condition (c).

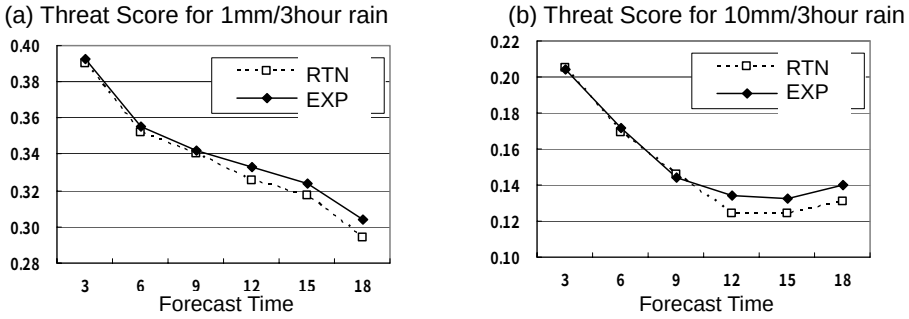

Fig. 2 The threat scores for weak (1mm/3hour) and moderate (10mm/3hour) rainfall forecasts in the two weeks starting from 3 Jun. 2003. RTN means the operational forecast and EXP means the OSE forecast.

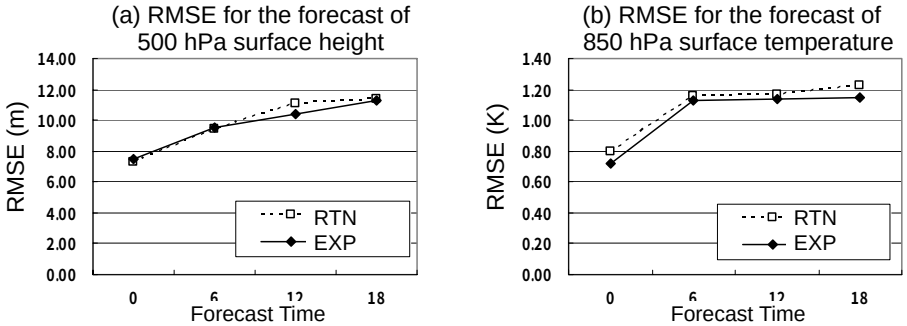

Fig. 3 RMSE of the operational (RTN) and OSE (EXP) forecast against upper air sounding data in the two weeks starting from 3 Jun. 2003.