Introduction of spaceborne microwave imager radiance data into the JMA global data assimilation system

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The brightness temperature (TB) data from spaceborne microwave imagers, such as DMSP/SSM/I, TRMM/TMI, and Aqua/AMSR-E, have been introduced into the JMA global data assimilation (DA) system in May 2006 with variational bias correction technique (VarBC, Derber and Wu 1998).

Those data are used over the clear sky or thin cloudy ocean with sea surface temperature (SST) higher than 5 degree Celsius. Thick cloudy and rainy areas are masked by using TB based parameters, such as the ratio of horizontal polarized TB to vertical one. The data are thinned by 200 x 200 km grid box for each time slot to neglect the spatial error correlation. The assimilated channels are vertical polarized channels of SSM/I and corresponding channels of TMI and AMSR-E. The channels and observation error settings are summarized in Table 1. The observation errors are set to 4 times the errors estimated in the preparatory analysis. Figure 1 shows an example of the assimilated data distribution.

Radiative transfer model RTTOV7 (Saunders et al 2002) is employed for TB calculation. Bias of the observations is corrected by using VarBC. Bias correction predictors for the VarBC are total column precipitable water, SST, square of SST, surface wind speed, secant of the satellite zenith angle, and unity (constant).

Observation system experiment with the MWR TB data (TEST) was carried out and compared with control experiment (CNTL). The study period was August 2004 and January 2005. Results of the experiment showed positive impact on the typhoon track forecast (Fig. 2). The position error against JMA best track data was reduced especially in the forecast time from 36 to 60 hour. The rainfall amount distribution of 24-hour forecast (R24) was also improved. The evaluation was made by using GPCP monthly averaged daily rainfall data (Adler et al 2003). The correlation coefficient of R24 against GPCP product in August 2004 for CNTL was 0.881 and it for TEST was 0.891. The coefficient in January 2005 for CNTL was 0.835 and it for TEST was 0.841. Figure 3 shows R24 of TEST and CNTL, and GPCP product in August 2004. The rainfall over Arabian Sea and west coast of India was much suppressed in TEST. The impact on forecasts of the 500 hPa geopotential height was almost neutral.

Table 1. Assimilated channels and the observation error settings (Unit: K).

Freq. and Pol.(H/V)	DMSP13	DMSP14	DMSP15*		TRMM		Aqua
	SSM/I				TMI		AMSR-E
19V	9.28	9.68	9.48	19V	10.00	18V	8.20
22V	14.60	15.44	15.04	21V	14.80	23V	13.80
37V	8.64	8.72	8.56	37V	8.40	36V	8.60
85V	11.28	11.24	10.92	85V	10.40	89V	11.80

*DMSP15/SSM/I data assimilation has been discontinued from Aug 2006, because of the US navy's activation of a radiation/calibration beacon.

References:

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Derber, J. C., and W. -S. Wu 1998: The use of TOVS cloud-cleared radiances in the NCEP SSI analysis system. *Mon. Wea. Rev.*, **126**, 2287-2299.

Saunders, R., 2002: RTTOV-7 Users Guide. Eumetsat, 21pp. available from http://www.metoffice.com/research/interproj/nwpsaf/rtm/rttov7_ug.pdf

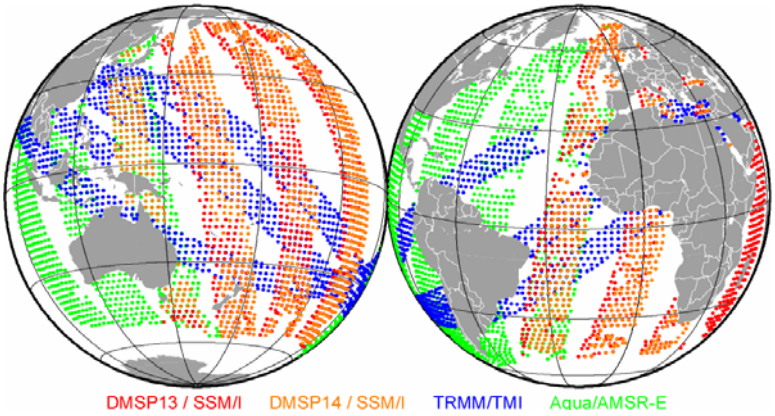

Figure 1. Sample of the assimilated data distribution in the JMA global DA system at 06UTC, 15 Nov 2006. Red symbol shows DMSP13/SSM/I, orange DMSP14/SSM/I, blue TRMM/TMI and green Aqua/AMSR-E.

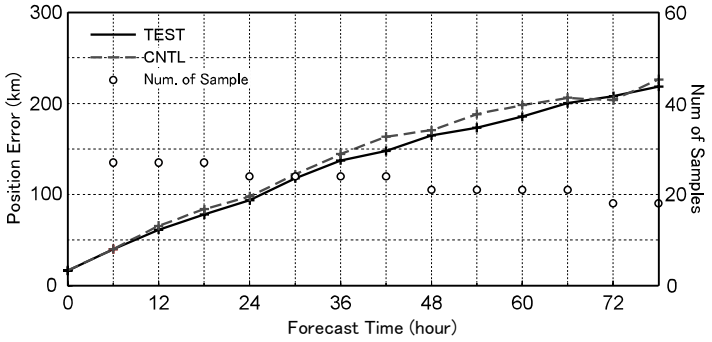

Figure 2. Time sequence of the typhoon position error against JMA best track data. Solid line shows TEST and dashed line shows CNTL

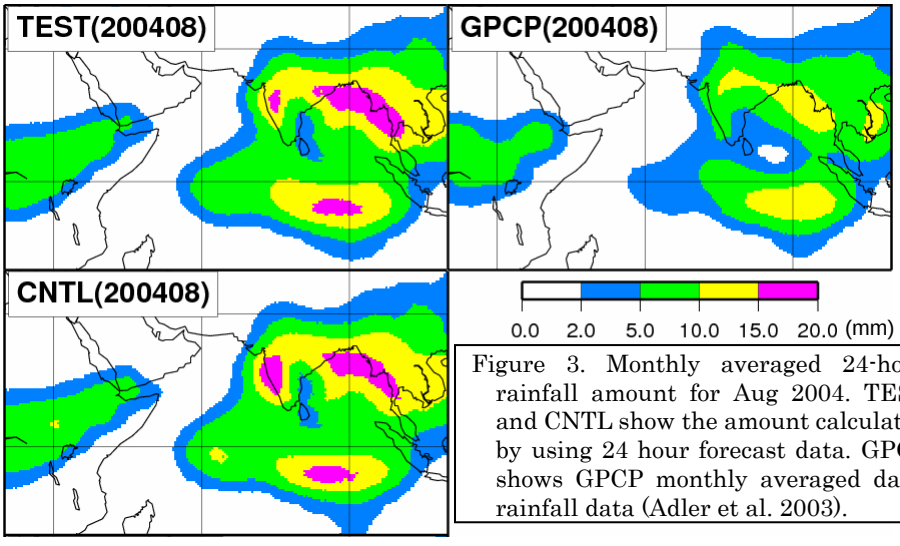

Figure 3. Monthly averaged 24-hour rainfall amount for Aug 2004. TEST and CNTL show the amount calculated by using 24 hour forecast data. GPCP shows GPCP monthly averaged daily rainfall data (Adler et al. 2003).