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JMA has been operationally using the clear-sky radiances of the water vapor channel (WV CSRs) from MTSAT-1R in the JMA global four dimensional variational (4DVAR) data assimilation system since 7 June 2007. WV CSRs are generated by averaging radiances of cloud-free pixels in 16 x 16 pixels (60 km x 60 km at nadir). WV CSRs have information on the middle and upper tropospheric humidity.

Several quality control procedures are applied to WV CSR data before the assimilation in 4DVAR. The data are thinned to 2.0 degrees horizontally and every two hours temporally. Those having a low percentage of clear pixels, a large standard deviation of brightness temperature, or a large departure (observation minus first-guess) are excluded. A variational bias correction scheme (Sato 2006) is applied in the 4DVAR system.

Observing System Experiments were carried out to evaluate the impacts of WV CSR on both analysis and forecast quality in August 2006 and January 2007. Adding WV CSR slightly reduced dry biases of the first-guess and analysis with respect to the radiosondes in the mid troposphere in the Tropics and the Southern Hemisphere. In the boreal summer experiment, the root mean square errors (RMSEs) of forecasts were reduced by assimilating WV CSR with respect to the analyses for the 500 hPa geopotential height in the Tropics and the Northern Hemisphere, and for the 850hPa temperature in the Tropics and South Hemisphere (Fig. 1). The cold temperature biases at 850hPa in the global areas were also improved (Fig. 2). Typhoon track forecast errors were clearly reduced (Fig. 3). In the boreal winter experiment, the RMSEs were reduced for the 500 hPa geopotential height and the 850hPa zonal wind velocity in the Tropics (data not shown).

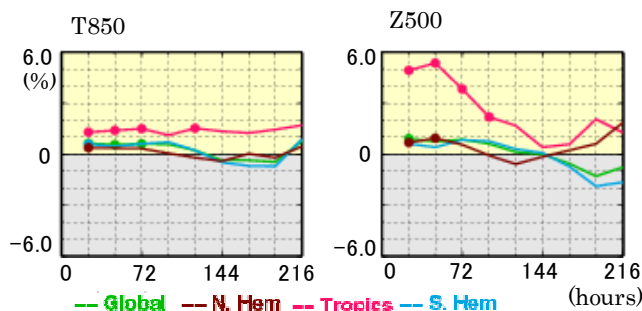


Fig.1. Improvement Rate of RMSE of Forecast (IRRF) for 850hPa temperature and 500hPa geopotential height. IRRF is defined as follows:

$$IRRF = (RMSE_{ctrl} - RMSE_{test}) / RMSE_{ctrl}$$

Dots on these score lines represent statistical significance.

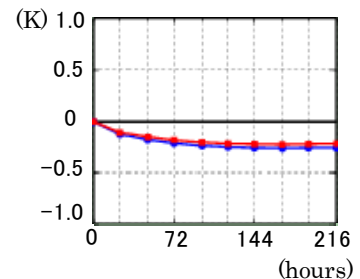


Fig.2. Temperature biases at 850hPa in the global areas for the cases with WV CSR (red line) and without WV CSR (blue line).

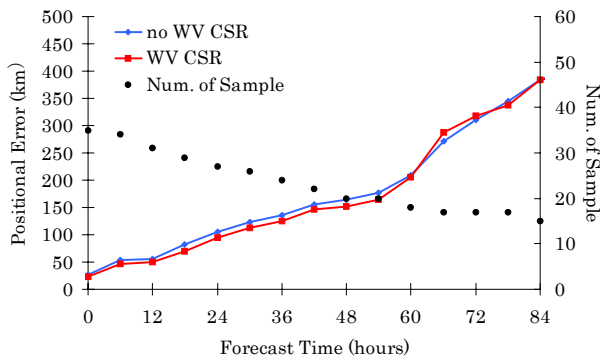


Fig.3. Typhoon track forecast errors of the run with WV CSR (red line) and without WV CSR (blue line) in August 2006. The dots represent the sample size.

Reference:

Sato, Y, 2006: Introduction of variational bias correction technique into JMA global data assimilation system. *CAS/JAC WGNE Research Activities in Atmospheric and Oceanic Modelling*, **37**, 1-19.