The experiments of direct assimilation of ATOVS radicances in the JMA 3D-Var system

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1. Introduction

Since 1982, the Japan Meteorological Agency (JMA) has been operationally using the temperature profile data retrieved by NOAA/NESDIS. Currently, there are few observed information of atmospheric humidity in the JMA global analysis. The JMA uses radio-sonde-observed humidity profiles and statistically derived profiles from the Geostationary Meteorological Satellite (GMS-5) brightness temperature.

In 2000, the JMA operational system introduced a 1D-Var scheme of TOVS data in the 3D-Optimum Interpolation. In September 2001, the JMA introduced a 3D-Var data assimilation system in the operational global analysis. By using the 3D-Var assimilation system and a radiative transfer model, satellite radiances data can be assimilated directly without any conversion to analysis variable such as temperature or relative humidity.

2. Setting of experiments

In the experiments, ATOVS radiances were assimilated directly in place of retrievals, and no statistical humidity retrievals from GMS-5 were used. As the fast radiative transfer model, RTTOV-6 developed at ECMWF was used. The experiments were performed for December 2001 and July 2002. A new cumulus parameterization scheme of JMA global model (Nakagawa 2003) was used jointly.

3. Results

The experiments have demonstrated some positive impacts on forecast skills for the geopotential height at 500 hPa in the southern hemisphere and in the tropical region (Fig.1). The improvement of forecast skill in the former part of forecast period was remarkable. The forecast scores of the temperature at 850 hPa, wind speed at 250 hPa and sea level surface pressure were similarly good. The temperature profiles in the upper stratosphere and the global humidity field in the troposphere were also improved. The accuracy of initial fields of temperature and humidity were confirmed against the total precipitable water from SSM/I (Fig.2) and radio-sonde observation. We also got better results on the typhoon track prediction and the global monthly mean 24-hour rainfall. However, the anomalous change of temperature at some levels in the stratosphere and the concentration of rainfall in 6-hour forecast were seen. To solve these problem, we have some plans to improve the global model and bias correction scheme of ATOVS

brightness temperature.

This direct assimilation scheme of ATOVS radiances will be implemented in the JMA operational global data assimilation system in April 2003.

References

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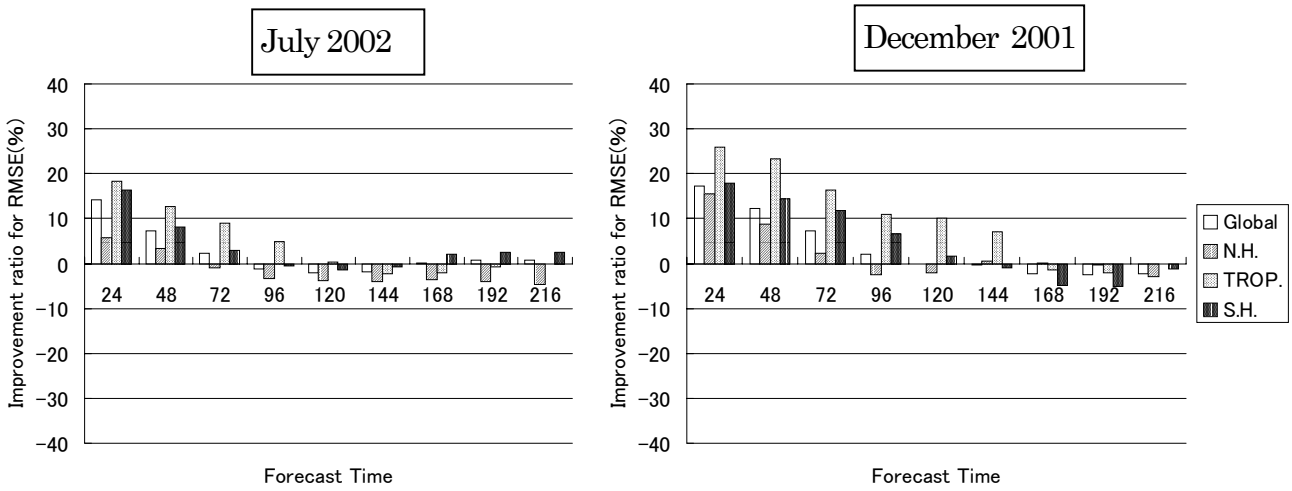

Fig.1: Improvement ratio for RMSE (%). Jul. 2002 (left) and Dec.2001 (right). Horizontal axis means forecast time in hours.

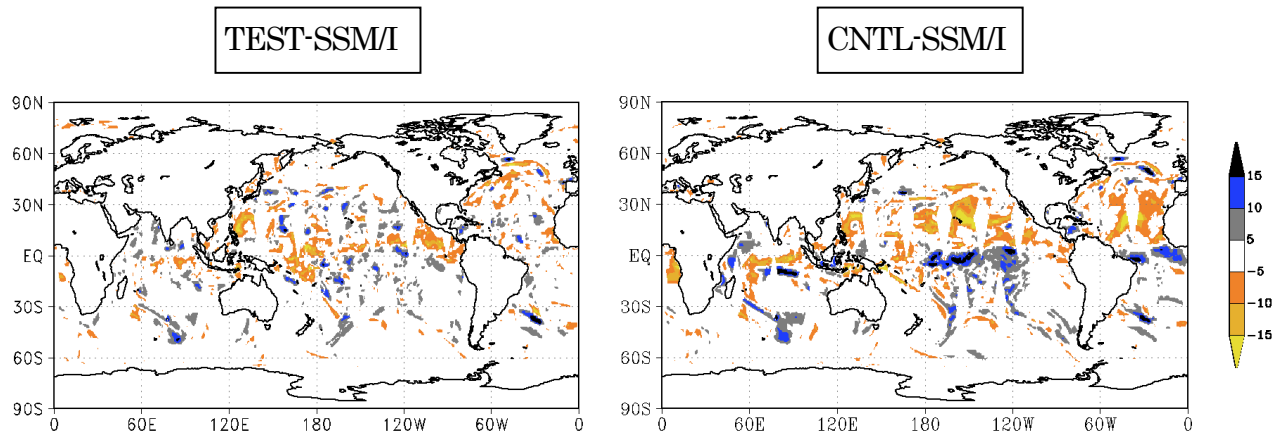

Fig.2: Differences of total precipitable water between the analyzed fields at 12UTC 1 July 2002 and SSM/I observation which is no assimilated. TEST-SSM/I (left). CNTL-SSM/I (right).