Improvements of ATOVS radiance-bias correction scheme at JMA

Masahiro Kazumori, Hiromi Owada, Kozo Okamoto
Numerical Prediction Division, Japan Meteorological Agency
1-3-4 Otemachi, Chiyoda-ku, Tokyo 100-8122,JANAN

email: kazumori@met.kishou.go.jp,
howada@naps.kishou.go.jp ,okamoto@npd.kishou.go.jp

1. Introduction

JMA has started operational use of ATOVS radiances in the global data assimilation on 28 May 2003. ATOVS radiances replaced retrievals of ATOVS from NOAA/NESDIS and that of GMS-5. The effect of direct assimilation of ATOVS radiances was dramatic. The temperature profiles in the upper stratosphere and global humidity field in the troposphere were improved compared with retrieval assimilation. As for forecast skills, positive impacts were found for the geopotential height at 500 hPa especially in the Southern Hemisphere and in the tropical region. The improvement of forecast skill in short-term forecasts was remarkable, and better results on the typhoon track prediction were also found. JMA has achieved considerable progress in ATOVS data assimilation, but some un-preferable features are still seen: anomalous profile of temperature at some levels in the stratosphere. To solve this problem, we continue to carry out some experiments with an improved bias correction scheme of ATOVS brightness temperature.

2. Upgrade of radiance-bias correction

JMA radiance-bias correction scheme is based on radiosonde observation (Kazumori et al. 2003). Due to lack of radiosonde data (temperature in stratosphere and moisture in troposphere), six-hour forecasts were used to make up the profile to calculate radiance in a radiative transfer model (RTTOV-6, Saunders 1998). In the current ATOVS radiance assimilation system at JMA, radiance-bias correction is not employed for AMSU-A upper stratosphere channels 12, 13, 14 and AMSU-B moisture channels 3, 4, 5, and HIRS/3 moisture channels 11, 12, because there are some biases in stratospheric temperatures and tropospheric moisture in the JMA global model.

It is well known that raw radiances from satellite have instrumental biases and there are some biases in the radiative transfer model. Through the operational use of ATOVS radiances at JMA, anomalous changes of temperature at some levels in the stratosphere have been detected. To remove stratospheric temperature biases in analysis field, an improved radiance bias correction scheme was applied to the upper stratosphere channels and the moisture channels. To make the scheme reliable, a period of collocation of radiosonde and satellite was extended from one year to two years. Besides a scan bias correction was implemented in moisture channels of AMSU-B.

3. Results

To confirm the effect of upgrade of the bias-correction scheme, cycle experiments were carried out for December 2002. Low-resolution system of T106L40 3D-Var and the JMA Global Spectral Model was used. The experimental configuration is as follows,

Test: Improved radiance-bias correction scheme.

Cntl: Operational radiance-bias correction scheme.

Figure 1 shows the global mean temperature profile of analysis field at 00UTC 31 December 2002. Cooling bias in stratosphere from 10hPa to 2hPa was reduced and temperature profile was improved particularly in the upper stratosphere compared with Cntl run. Figure 2 shows time sequences of difference of the background temperature and radiosonde temperature observations in the Northern Hemisphere for December 2002. Clear improvements of BIAS and RMSE were found at stratosphere temperature from 30 hPa to 10 hPa. As for forecast skill, positive impact was found in the 500 hPa geopetential height.

Furthermore, we are going to carry out experiments for two seasons using JMA full resolution data assimilation system to confirm the forecast impacts. This new radiance-bias correction will be implemented in the JMA operational global data assimilation system in 2004.

References

Kazumori, M., K. Okamoto, and H. Owada, 2003: Operational use of ATOVS radiances in global data assimilation at the JMA, *Tech. Proc. of 13th International TOVS Study Conference, Quebec, Canada 29 Oct. -4 Nov. 2003.* (Submitted)

RTTOV-6 SCIENCE AND VALIDATION REPORT 2000. Available from the NWP SAF web site.[1]

Saunders, R., M. Matricardi and P. Brunel, 1998: An improved fast radiative transfer model for assimilation of satellite radiance observations. *Q. J. R. Meteorol. Soc.*, **125**, 1407-1425.

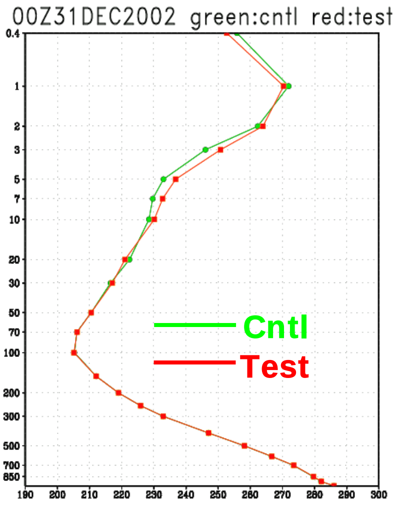

Fig. 1: Global mean temperature profile of analysis field at 00UTC 31 December 2002. Red line is temperature profile of Test run, and green line is that of Cntl run.

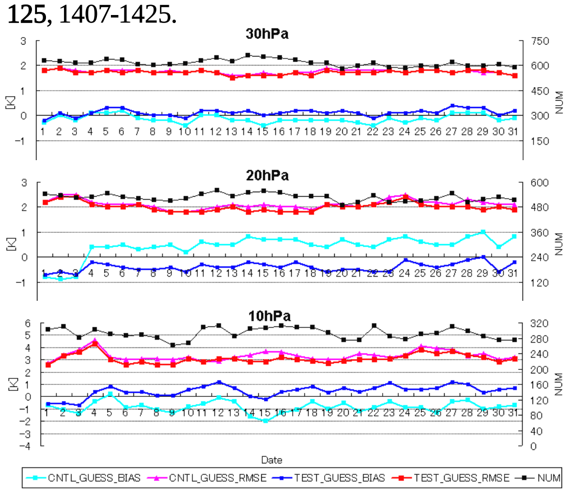

Fig. 2: Time sequence of difference between the background temperature and radiosonde observations in the Northern Hemisphere for December 2002. Upper panel is for 30 hPa, middle for 20 hPa, and lower for 10 hPa. (Test: Red line is RMSE and blue line is BIAS, Cntl:Light red line is RMSE and light blue is BIAS. Black line is number of sampled data for each experiment.)

1 < http://www.met-office.gov.uk/research/interproj/nwpsaf/rtm/d81svr.pdf >