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Report on NWP Utilization of ATOVS Data at KMA

This paper reports on utilization of ATOVS data in KMA's NWP system.

Utilization of ATOVS Data in KMA's NWP System

The Korea Meteorological Administration (KMA) updated the ATOVS usage in its NWP system

1. Current Status

TOVS data has been assimilated in global model since 1999 using the 1dVar technique. Currently, the ATOVS level 1d radiance data is assimilated in global 3dVar. Based on the monitoring results, only the AMSU data is assimilated currently.

The upper most level of the global model is extended up to 0.4 hPa from 10hPa and the impact of ATOVS data is proved to be quite stronger because the ATOVS data is the only observation available above the troposphere.

(1) Bias correction

The bias correction of ATOVS data is based on the regression scheme. The scan angle and air mass dependency are removed using the channel predictors and the regression coefficients are updated every analysis cycle with the one month accumulated innovation data set.

(2) Observation error

ATOVS observation error is calculated from the innovation and the background error. The background error is calculated from the so-called NMC method. The global averaged error is used and error correlation between channels is not treated yet.

(3) Quality Control

Rouge QC is performed. Cloud top pressure and cloudiness information is used to assimilate cloudy radiance data, but if the innovation is large at the window channel all the channels are rejected. Therefore some useful information at the upper troposphere and stratosphere is rejected.

2. Plans

KMA tests FGAT (First Guess at Appropriate Time) for the ATOVS direct assimilation since 2005 and plan to operate it at the end of this year. The regional 3dVar and global 3dVar will be merged into the unified 3dVar and will be in operation at 2007. The ATOVS data assimilation in the unified 3dVar is updated in several aspects.

(1) FGAT

In order to account for the time difference between ATOVS observation and background, FGAT is adopted in the global 3dVar. With the FGAT, the number of assimilated ATOVS data is increased about 9 % compared to the operation. As the error caused by the time difference between background and observation is decreased, lots of

ATOVS data pass the quality control and compel the background near the observation. It results in the diminished innovation and the cost function at 1st iteration is getting smaller than that of the operation.

The FGAT impact on the global forecast is evaluated for the summer and winter season in 2005 (Fig. 1). The overall impact is positive but not significant and some degrade are shown in the tropics in the summer season. However, as the performance of FGAT strongly depends on the quality of NWP model forecast, the positive impact of the FGAT will be stronger as the forecast quality upgrades in future.

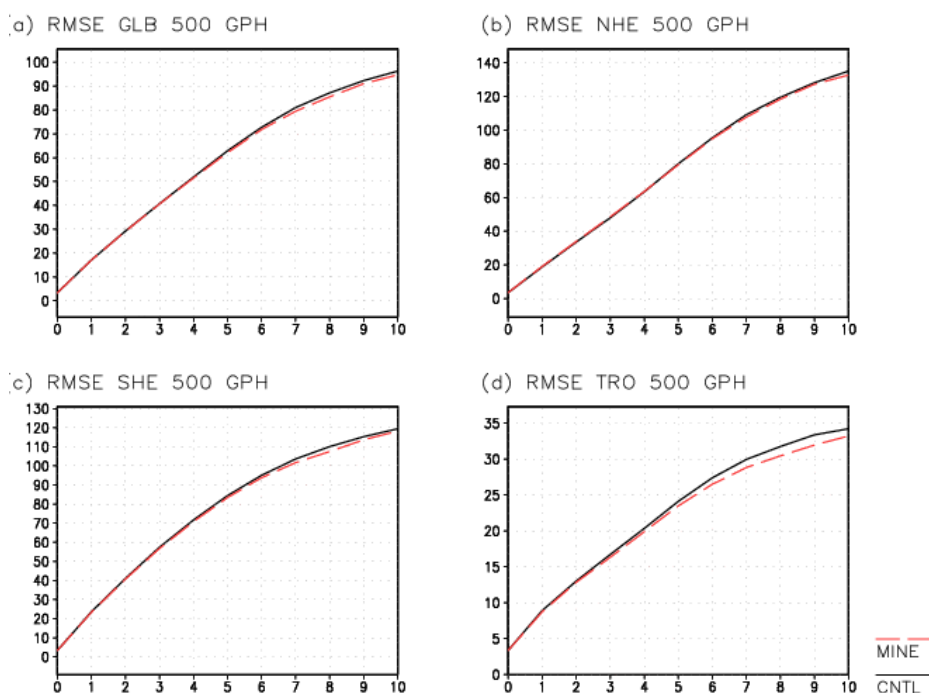


Figure 1. The 500hPa geopotential height RMSE for the winter season 2005. Solid lines are operation and dashed lines are FGAT results. a) is global averaged, b) is the Northern Hemisphere, c) is the Southern Hemisphere, and d) is the Tropics.

(2) Unified 3dVar

The unified 3dVar is developed in KMA based on the WRF 3dVar to merge the regional and global 3dVar. The unified 3dVar has some upgrade in its ATOVS assimilation technique.

In the unified 3dVar, the quality control will be done with the 1dVar just like the operation. The comparison of the quality control is shown in table 1. In the unified 3dVar, the quality control depends on the channels. For example, even in the rainy condition, stratospheric channels can pass the quality control. And over the land, the stratospheric channels and upper tropospheric channels are assimilated. The radiance observation operator (i.e. radiative transfer model) is upgraded to the RTTOV Version 8.5 from RTTOV Version 7. For the bias correction, model variables are used as predictors.

Further upgrade of the ATOVS data assimilation is planned. The adaptive bias

correction scheme will be implemented in the unified 3dVar to account for the model bias. The quality control process done by the 1dVar will be merged into the 3dVar quality control processes and it can make the code simple and easy to maintain.

Table.1 Comparison of the quality control between operation global 3dVar and the unified 3dVar

KMA 1DVAR	OLD	NEW
BG	P-Coor. Latitude : 90 ~ -90 Longitude : 0 ~ 360	Sigma-Coor. Latitude : -90 ~ 90 Longitude : -180 ~ 180
OBS	Level 1d	Level 1d Level 1b
Bias correction	Correction with observed TBB	Correction with first guess fields
BG error	Calculated in 1DVAR	Calculated in 3dVar
Channel	Fixed channel number And channels Over all obs. points	Selected channel number And channels Over each obs. point