Validation of NOAA-16/ATOVS products from AAPP and IAPP packages over Korea and its vicinity

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Abstract

Operational production of the 'vertical' products using the NOAA-16/ATOVS has been done since June 2001 at the Korea Meteorological Administration. The operational production utilizes the AAPP (ATOVS and AVHRR Processing Package) of EUMETSAT and IAPP (International ATOVS Processing Package) of the University of Wisconsin. For the initial guess profiles, we use the predicted fields from the NOAA/NCEP global aviation model. Using the advanced microwave sensor (AMSU - Advanced Microwave Sounding Unit), accuracy of the ATOVS products is expected to be better than previously, especially for cloudy conditions. Indeed, preliminary results from a validation study with the collocated radiosonde data during 7-month period, from June to December 2001, show much greater accuracy of ATOVS products for cloudy skies than for the TOVS, especially for higher altitudes. The RMS (Root Mean Square) difference between ATOVS products and radiosonde data is about 1.3 °C for both clear and cloudy conditions, except for near the surface and at higher altitudes, around 200 hPa. There is no significant temporal variation of the error statistics at any of the pressure levels considered.

Introduction

Since May 2001, the Korea Meteorological Administration (KMA) has operationally produced NOAA-16/ATOVS products using the AAPP and IAPP. Figure 1 shows the overall flow chart for operational ATOVS processing. For the first guess and boundary data, the NOAA/NCEP Aviation model outputs are used. Based on several months' comparison with collocated radiosonde data, we found the products using the model first guess are better than products using the regression algorithm. The current study shows the validation results for temperature and water vapor mixing ratio derived from the AAPP version 3 and IAPP version 2 for the period May to December 2001.

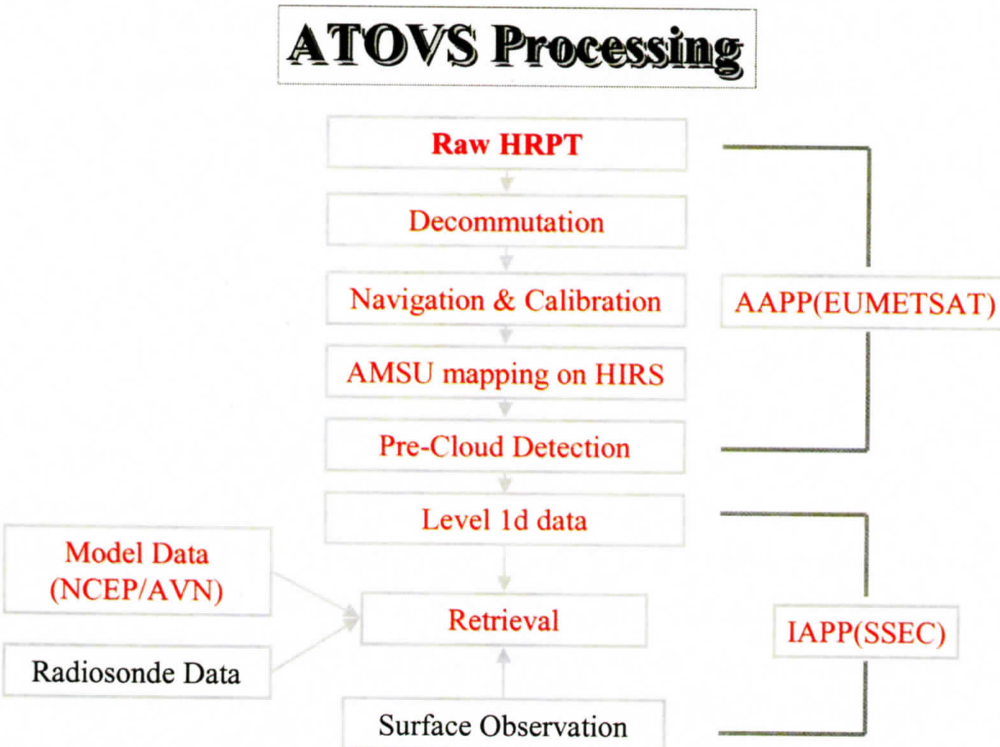
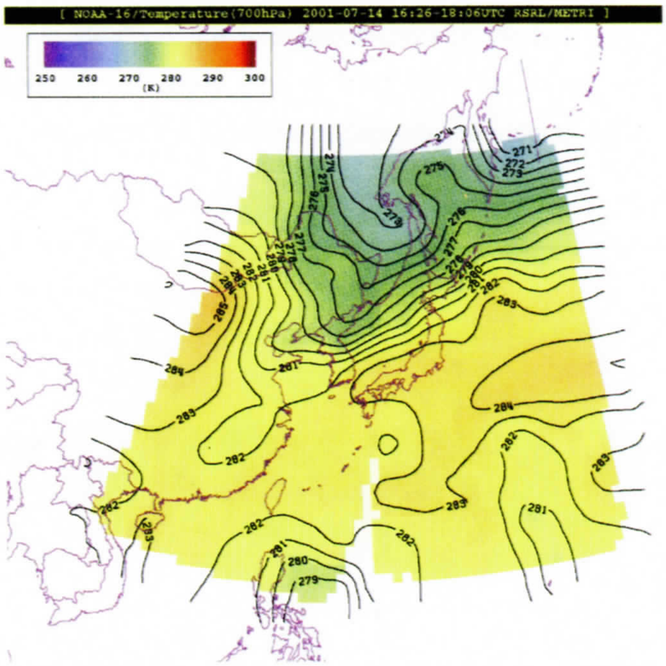


Figure 1. Overall flow chart for the operational ATOVS processing in KMA

Data

Figure 2 shows an example of NOAA-16 products on 14 July 2001 when a flash flood occurred over central Korea. The 700 hPa temperature filed shows a well-developed trough located northwest of the central Korean Peninsula, while the dew point temperature shows a high moisture level band over central Korea. With the strong southwestly flow of moist air into the Peninsula, heavy rainfall caused a severe flash flood over the central Peninsula. As upper air observational data at the 18 UTC time slot is not readily available, profiles derived from NOAA-16 play an important role in short-range forecasting.

(a)



(b)

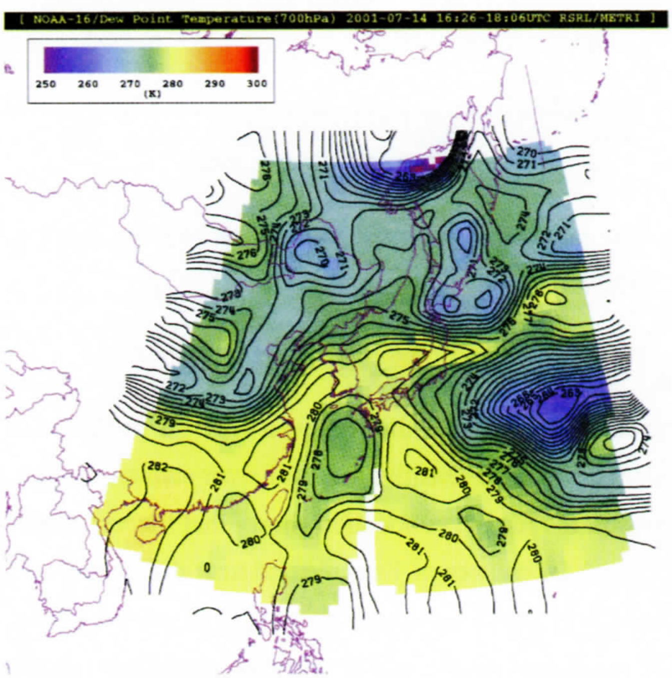


Figure 2. ATOVS retrieved temperature (a) and dew point temperature (b) at 700 hPa on July 14, 2001 when heavy rainfall caused a severe flash flood over the central Korean Peninsula.

The usual number of orbits for each morning and afternoon pass is two. The time series of number of profiles retrieved for the morning and afternoon orbits for the study period is shown in Figure 3. The average number of profiles retrieved for each morning and afternoon orbit is about 1,300 points, while some cases exceed more than 1,500 points when the number of orbits received are 3. Considering that the available number of radiosonde observation data for the 0600 and 1800 UTC is only about 20, the satellite derived data provides an increase in the amount of information available to the models.

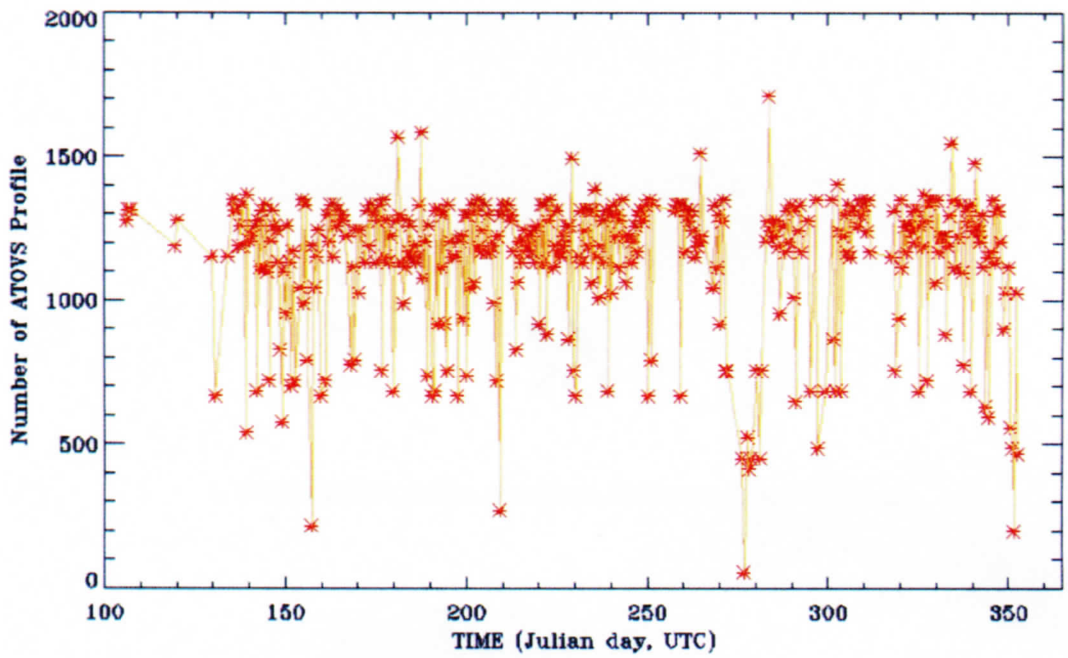


Figure 3. Time series of the number of retrieved points from NOAA-16/ATOVS data received at KMA since May 4, 2001.

Validation results

For the validation, we collocated the retrieved ATOVS profile with the radiosonde observation for the study period. The sensitivity test of error statistics to the several different spatial and temporal constraints for the collocation shows that the variation of error statistics are not significant for spatial differences of 1 degree and time differences of 3 hours. Also for the comparison with the IAPP products, which are at a fixed pressure level, the radiosonde data was interpolated if necessary. As the radiosonde data often fails to report data at higher altitudes, the current study shows results only for altitudes lower than 100 hPa.

Figure 4 shows vertical profiles of bias (radiosonde-ATOVS) and RMS difference of temperature between collocated ATOVS and radiosonde observations. As the NOAA-16 passes over Korea at around 06 and 18 UTC, while the regular radiosonde observation is made at 00 and 12 UTC, the number of collocated data is only about 450 for the 8 month period. The bias is less than 1° C at all altitudes with smaller values at lower altitudes (about

0.5° C). Figure 4 also shows that clear sky cases have less bias than for cloudy condition. The RMSE shows better than 1.5° C at most altitudes except near the ground, where it is more than 2 ° C. Although clear sky conditions give a slightly better RMSE, the difference is not significant.

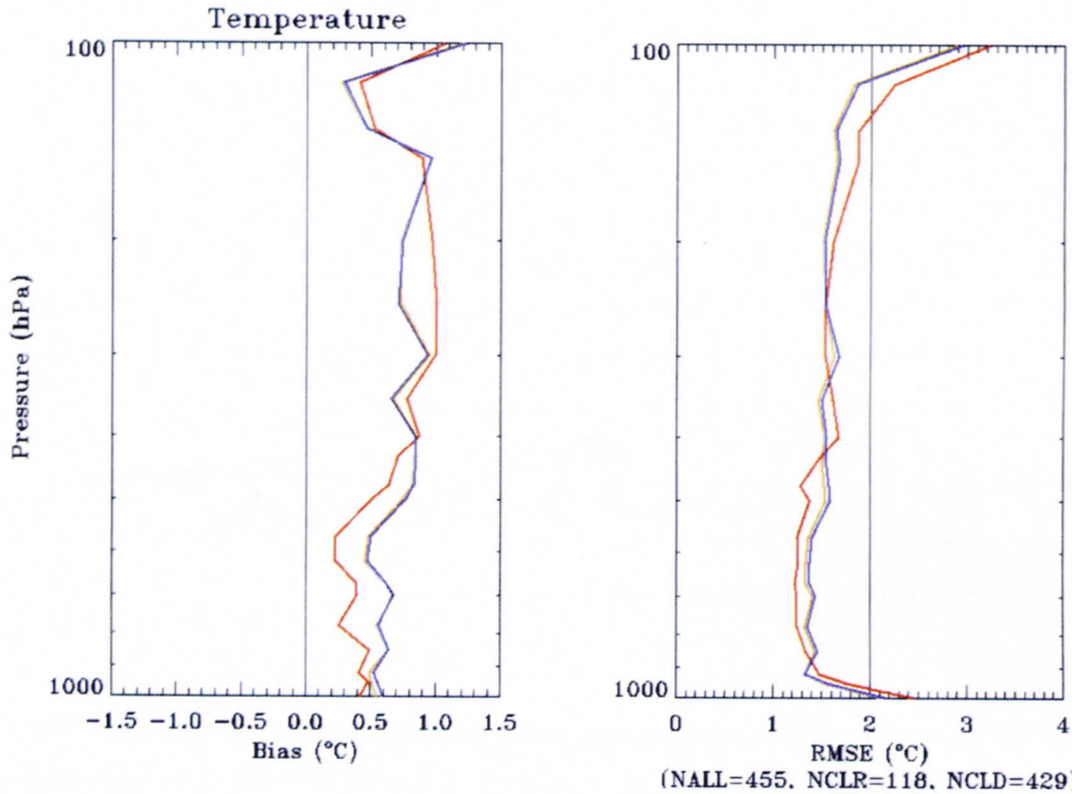


Figure 4. Vertical distribution of bias and RMSE of the ATOVS retrieved temperature compared to the radiosonde observation. Red, orange, and blue lines are for clear, cloudy, and all sky conditions, respectively. The total number of data points is 118 and 429 for clear and cloudy condition, respectively. At lower altitude, say below 500 hPa, the clear sky bias is a bit less than for the cloudy sky, while it is almost the same or a bit worse at higher altitudes. Overall, bias is smaller at lower altitudes, about 0.5° C, and larger in the higher troposphere, at around 0.8° C. On the other hand, RMSE is almost the same for different sky condition and altitude, except at the altitude near the tropopause. The overall value is better than 1.5° C at most altitudes, except near the ground.

Figure 5 shows validation results for water vapor mixing ratio. In contrast to the temperature profile, there is a clear separation between clear and cloudy sky conditions. The overall results are much better for clear skies than for cloudy conditions.

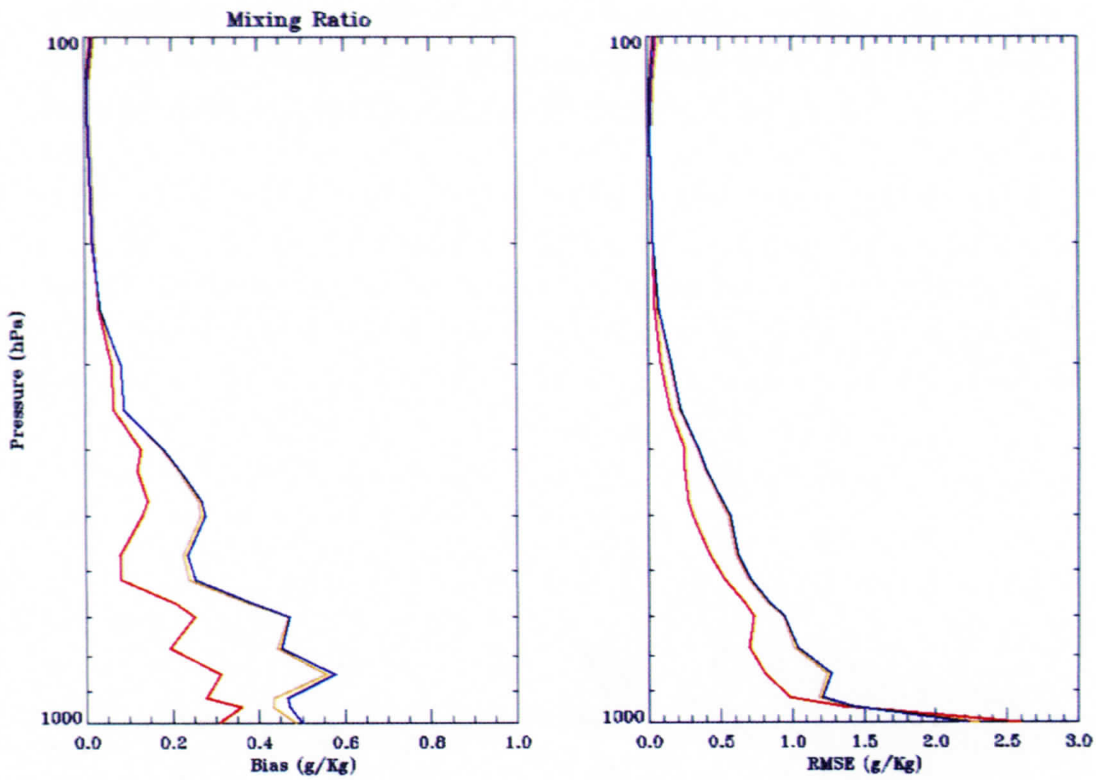


Figure 5. Same as figure 4 but for water vapor mixing ratio.

Conclusions

The operational ATOVS products have been produced in KMA since June 2001. The NOAA-16/ATOVS products are found to be valuable, even for nowcasting by providing upper air information for the time when ground-based data are missing. The temperature and water vapor mixing ratio products derived from the direct readout data at KMA were validated against the radiosonde data. Validation results show that the retrieved temperature shows a positive bias with RMSE of about 1.5° C.

Acknowledgement

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