Operational use of Himawari-8 CSR data of band 9 and 10 in JMA's local NWP system

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1. Introduction

The Japan Meteorological Agency (JMA) began to use Himawari-8 surface-sensitive band 9 and 10 (6.9 and 7.3 μm) clear-sky radiance (CSR) data in its local NWP system on July 29, 2020 in addition to Band 8 (6.2 μm) CSR data (Ikuta 2017). Experiments indicated that this assimilation with a new radiative transfer (RT) calculation method for JMA's global NWP system (Okabe 2019) had positive impacts on water vapor (WV) field first-guess (FG) and precipitation forecast scores for heavy rain in the local NWP system. The results are reported here.

2. Methodology

The new RT calculation method is the same as that of the global NWP system (Okabe 2019). The land surface emissivity atlas of Wisconsin University (Borbas and Ruston 2010) and retrieved land surface temperatures from window band 13 (10.8 μm) CSR observation data are used in the calculation.

3. Assimilation Experiment

The control experiment performed (referred to here as CNTL) had the same configuration as the operational JMA local NWP system as of March 2020. The test experiment (TEST) was as per CNTL, but surface-sensitive CSRs from Himawari-8 (band 9 and 10) were additionally assimilated. The experiment periods were from June 27 to July 8, 2018 (referred to as summer) and from January 16 to 27, 2018 (referred to as winter).

4. Impacts on the NWP System

Figure 1 shows normalized changes in the standard deviation (STDDEV) of the FG departure (difference between observations and FG) for microwave sounder, microwave imager data and radiosonde observations, which contain information on WV and temperature in the troposphere. The reductions seen indicate improved fitting between FG and other observations, implying improved FG field accuracy.

Figure 2 shows bias scores, threat scores, false alarm ratios and undetected error rates for three-hour cumulative precipitation forecasts in the summer experiment. Although there were only slight differences between TEST and CNTL, false alarm ratio and undetected error rate values were reduced for heavy-rain thresholds (25 mm or more), and slight improvements were seen in threat scores.

5. Summary

JMA began to assimilate surface-sensitive CSRs from Himawari-8 (bands 9 and 10) in the local NWP system on July 29, 2020, and the new RT calculation method used in JMA's global NWP system was applied. Positive impacts from these CSRs on WV and temperature field accuracies for the first guess in the local NWP system were shown in the assimilation experiment, which also revealed improved precipitation forecasting scores for heavy rain.

References

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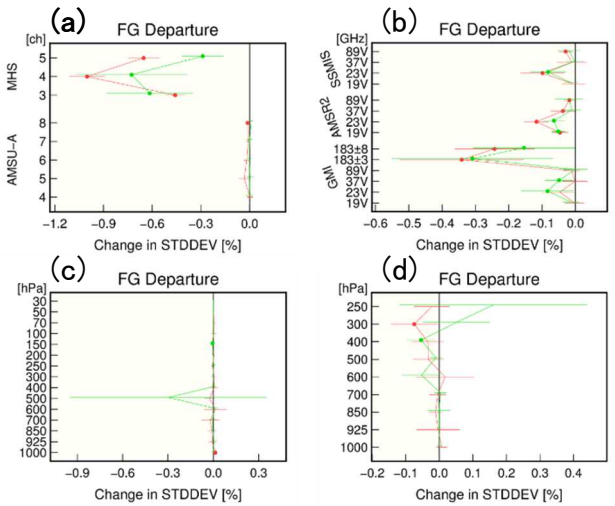

Figure 1. Normalized changes in standard deviation (STDDEV) for first-guess departures in microwave sounding data for individual channels [ch] (a), microwave imager data for individual channels [ch] (b), radiosonde observations indicating temperature (c) and relative humidity (d) for individual pressure heights [hPa]. The validation periods are from June 27 to July 8 2018 (red dots) and from January 16 to 27, 2018 (green dots).

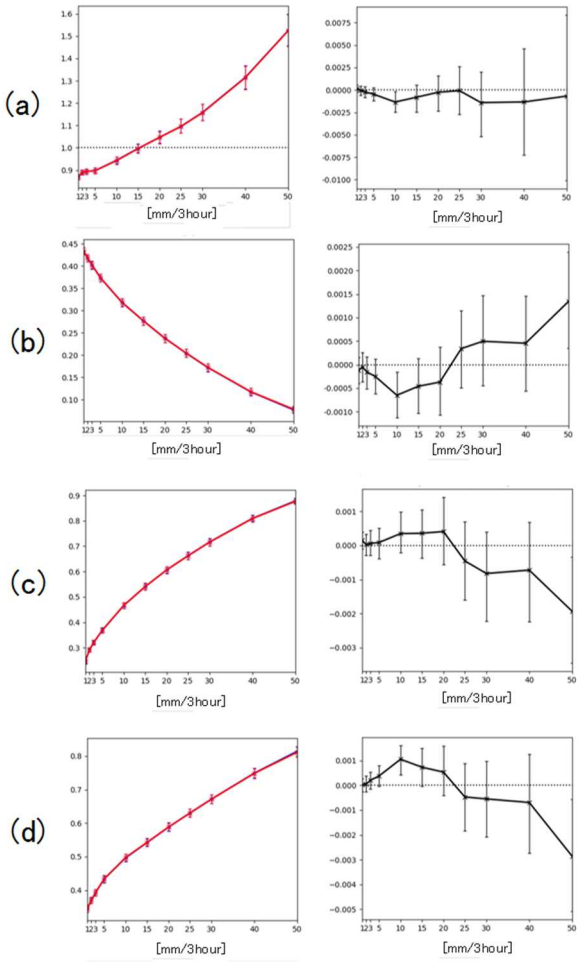

Figure 2. Bias scores (a), threat scores (b), false alarm ratios (c) and undetected error rates (d) for three-hour cumulative precipitation forecasts with different thresholds (x axis). Red lines are scores for TEST and black lines are for CNTL (left panels). The panels on the right show differences between TEST and CNTL scores (TEST - CNTL). The validation periods are from June 27 to July 8, 2018.