Operational Use of NOAA-20 ATMS and CrIS Radiance Data in JMA's Global NWP System

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1. Introduction

- JMA began to assimilate NOAA-20 ATMS and CrIS clear-sky radiance data in JMA's Global NWP System on 5 March 2019.
- Suomi-NPP radiance data have been assimilated since 29 March 2017.
- This poster outlines the configurations of the ATMS and CrIS data assimilation, and the impacts of NOAA-20 in the JMA's Global NWP system.

2. Radiance assimilation configurations of ATMS and CrIS

- Configurations of NOAA-20 ATMS and CrIS radiance assimilation are basically same as those of Suomi-NPP. ATMS configurations are in line with AMSU-A and MHS, and CrIS configurations are in line with other Hyperspectral Infrared Sounders (AIRS, IASI).
- The details of the configurations are listed in the table below.

Configurations	ATMS	CrIS
Assimilated Channels	Temperature ch: 06-09 Humidity ch: 18-22	Temperature ch: 27 channels around 15μm. Channel selection is based on Entropy Reduction.
Radiance Data, Thinning	SDR data. Noise reduction filter applied (by AAPP). Omit both end FOVs (1,2,95,96). Thinning: 250 km, taking into account satellites overlap (Suomi-NPP, NOAA-20)	FSR data set (delivered 431 selected channels out of 2211 channels). Omit corner and center FOVs (1,3,5,7,9). Thinning: 200 km, taking into account satellites overlap (Suomi-NPP, NOAA-20, Metop-A, Metop-B, Aqua)
Static Bias correction (ScanBC)	Estimated from O-B statistics	Estimated from O-B statistics
Variational Bias Correction (VarBC) Predictors	IWLR (Integrated Weighted Lapse Rate), Ascending/Descending flag, Surface Temperature, Total Precipitable Water (Temperature channels only), Satellite Zenith angle (1/cosZ), Constant	Thickness Z1-Z10hPa, Z5-Z50hPa, Z50-Z200hPa, Z300-Z850hPa, Constant
Rain/Cloud detection	Cloud: CLW (Weng et al. 2002) >100 (g/m2) Rain: Tb16-Tb17>3(K) or CLW > 300 (g/m2)	Cirrus: Split window Cloud height: CO2 slicing
Surface/Cloud Condition Availability of clear-sky channels depends on the surface/cloud condition.	Sea Clear, Sea Cloud, SeaIce, Land, Mix (Land/Sea), Rain. (See Figure 1(a))	Sea Clear, Sea Cloud, Sea Cirrus, Land. (See Figure 1(b))
Observation error, inflation	Estimated from O-B statistics, Inflation: x1.5 (Temperature ch), x4.5 (Humidity ch) (See Figure 2)	Estimated from O-B statistics, Inflation: x3.0

Figure 1. Surface/Cloud condition as a result of quality control at 2019.10.14 18UTC. (a) NOAA-20/ATMS, (b) NOAA-20/CrIS.

Figure 2. O-B standard deviation statistics and observation error setting. (a) ATMS, (b) AMSU-A.

3. Observation System Experiments (OSE)

- Impacts of NOAA-20 ATMS and CrIS in JMA's Global NWP system were investigated by OSEs.
- Improvements of first-guess (FG) field by assimilating NOAA-20 were confirmed to be similar to (or better than) Suomi-NPP against Baseline experiments (without both satellites) (Figure 3).
- Improvements of FG field by assimilating NOAA-20 ATMS and CrIS against the latest NWP system (i.e. before assimilating NOAA-20; CNTL) were confirmed. The improvements observed with MHS and AMSU-A tropospheric channels were mainly attributed to ATMS, and those with AMSU-A stratospheric channels were mainly attributed to CrIS (Figure 4).
- Improvement of Forecast field in geopotential height was found in the experiment assimilating NOAA-20 ATMS and CrIS (TEST) against the CNTL experiment, especially for the mid-latitudes (Figure 5).

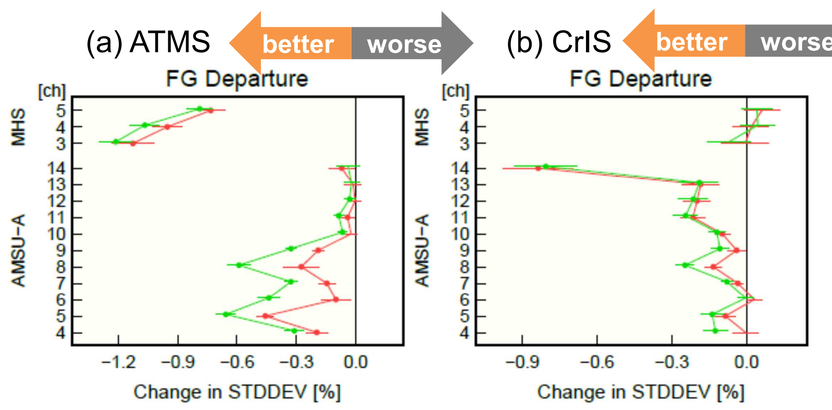

Figure 3. Normalized changes in the standard deviation (STDDEV) of the FG departure of AMSU-A and MHS, resulting from assimilation of Suomi-NPP (red) and NOAA-20 (green) against Baseline experiments with regard to (a) ATMS and (b) CrIS.
Validation period: 2018/08/01-10/31 (92 days).

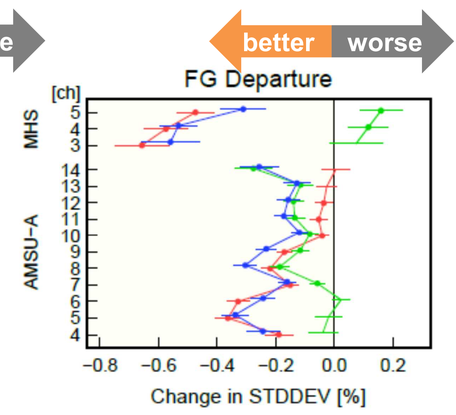

Figure 4. Normalized changes in STDDEV of the FG departure of AMSU-A and MHS resulting from assimilation of NOAA-20 ATMS (red), CrIS (green) and both (blue).

4. Summary

- Operational use of NOAA-20 ATMS and CrIS clear-sky radiances in JMA's Global NWP System was started on 5 March 2019.
- Positive impact of assimilating NOAA-20 ATMS and CrIS were confirmed in the study.

5. Future plans

- ATMS: Stratospheric channels (ch10-15) are not assimilated due to the inconsistency with corresponding AMSU-A channels in FG field. The bias correction scheme to be reconsidered. Optimization of observation error setting is also considered.
- CrIS: Currently only small number of temperature channels are assimilated. Additional channels are considered to be selected. Cloud detection scheme for lower cloud is considered to be improved.

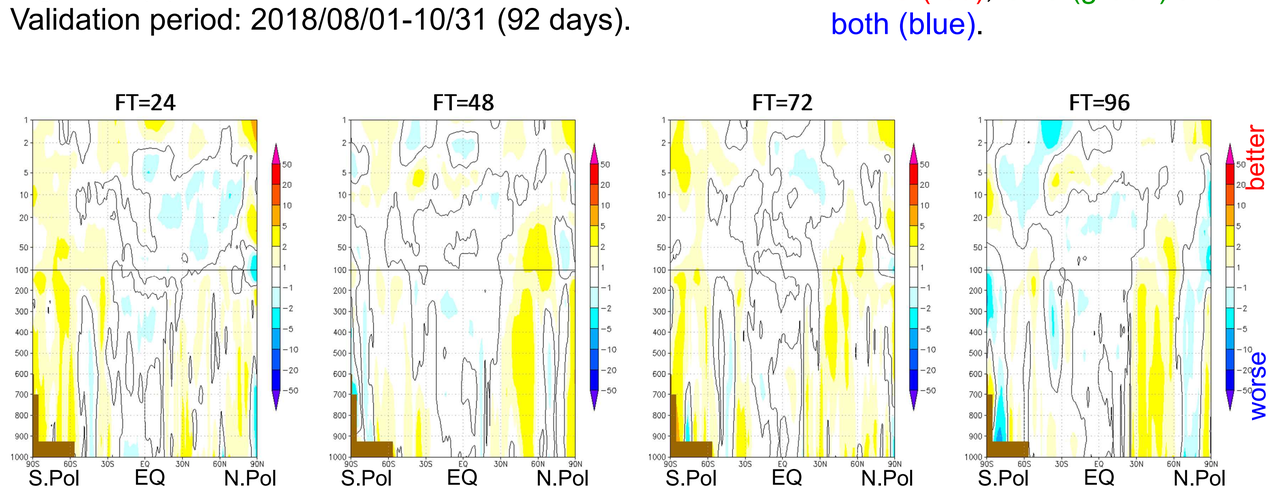

Figure 5. Zonal mean of the relative improvement rate [%] in the TEST experiment (with NOAA-20/ATMS and CrIS) relative to the CNTL experiment (without NOAA-20/ATMS and CrIS) in RMS error against own analysis of each experiment for geopotential height forecast. Warm colors indicate forecast error reduction. Validation period: 2018/08/01-10/31 (92 days).

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