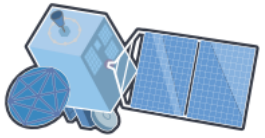
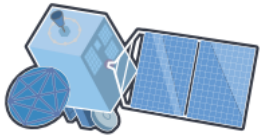
Observation System Simulation Experiments for a Hyperspectral Infrared Sounder Onboard a Geostationary Satellite

OWADA Hiromi

Satellite Program Division

Japan Meteorological Agency

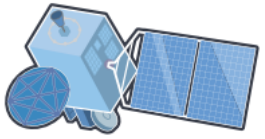




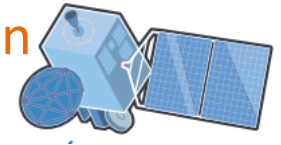
Introduction / Executive Summary

HSIR: Hyperspectral infrared sounder

- Future GEO program follow-on to Himawari-8/-9
  - ✓ To be launched by FY2028, and operation will be started in FY2029 (Basic Plan on Space Policy, Japan)
  - ✓ HSIR: one of the potential payloads, recommended in Vision for WIGOS in 2040
- Assessment of potential impacts of GEO HSIR (GeoHSS) on JMA NWPs by reanalysis-based OSSE (RA-OSSE)
  - ✓ Positive impacts on JMA's Global/Regional (Meso-scale) NWP systems
  - ✓ Both of global and regional data assimilation systems are based on our recent operational NWP systems



- Forecast Sensitivity Observation Impact (FSOI) of GeoHSS
  - ✓ FSOI (Ishibashi 2018) is implemented in the Global NWP system of JMA (operational system as of Dec. 2019)
  - ✓ Large positive impact of GeoHSS was confirmed in the investigation

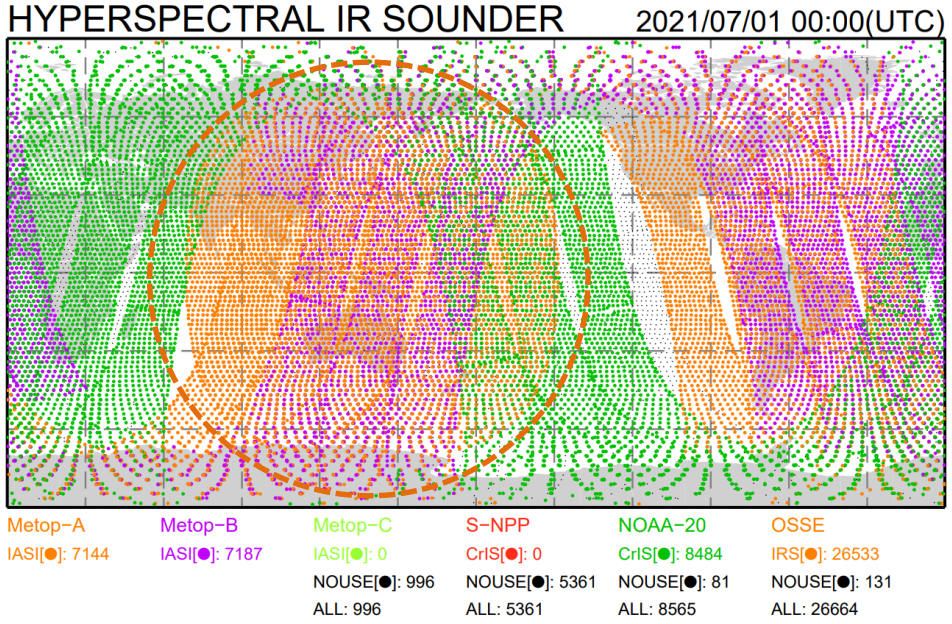


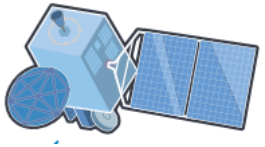
Experimental Settings – Global Data Assimilation (Global DA)

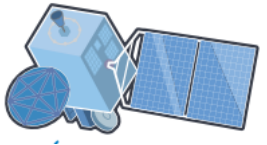
- Assimilation of clear-sky radiance simulated by RTTOV-12.2
- 36 Temperature / 25 WV channels, spatial thinning of 200 km
- Forecast periods of experiments
  - ✓ 201908 (Summer): 21 July 2019 to 11 September 2019
  - ✓ 202001 (Winter): 21 December 2019 to 11 February 2020

Our first experiment for winter in the Northern Hemisphere

Data coverage of hyperspectral IR sounder used at one analysis.
OSSE means GeoHSS

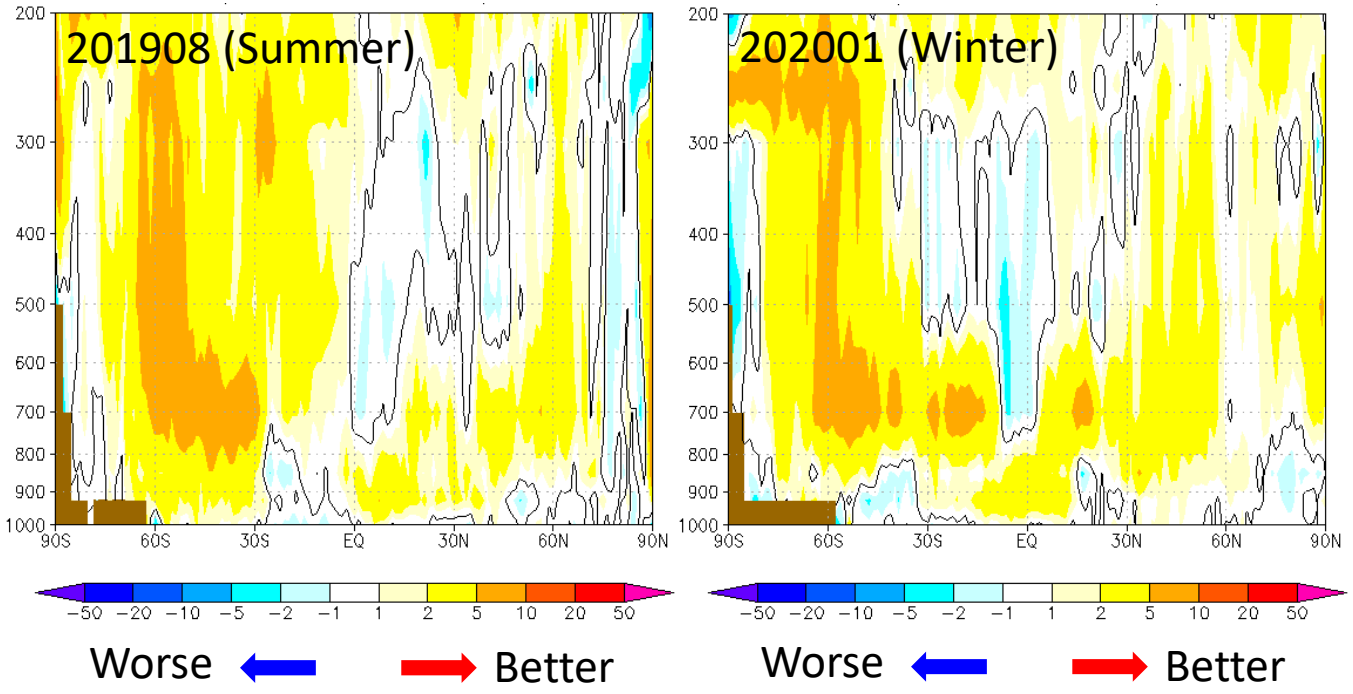


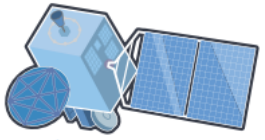


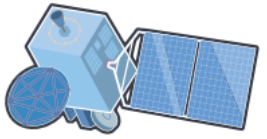


Global Data Assimilation Experiment – Results

- These figures are zonal means of average relative differences (%) in temperature forecasts at 24 h between EXP (with GeoHSS) and CNT (without GeoHSS) for root mean square errors (RMSEs) verified against ECMWF initials. EXP is better than CNT and the seasonal differences are small
- EXP also shows improved accuracy in east-west wind forecasting (next slide)

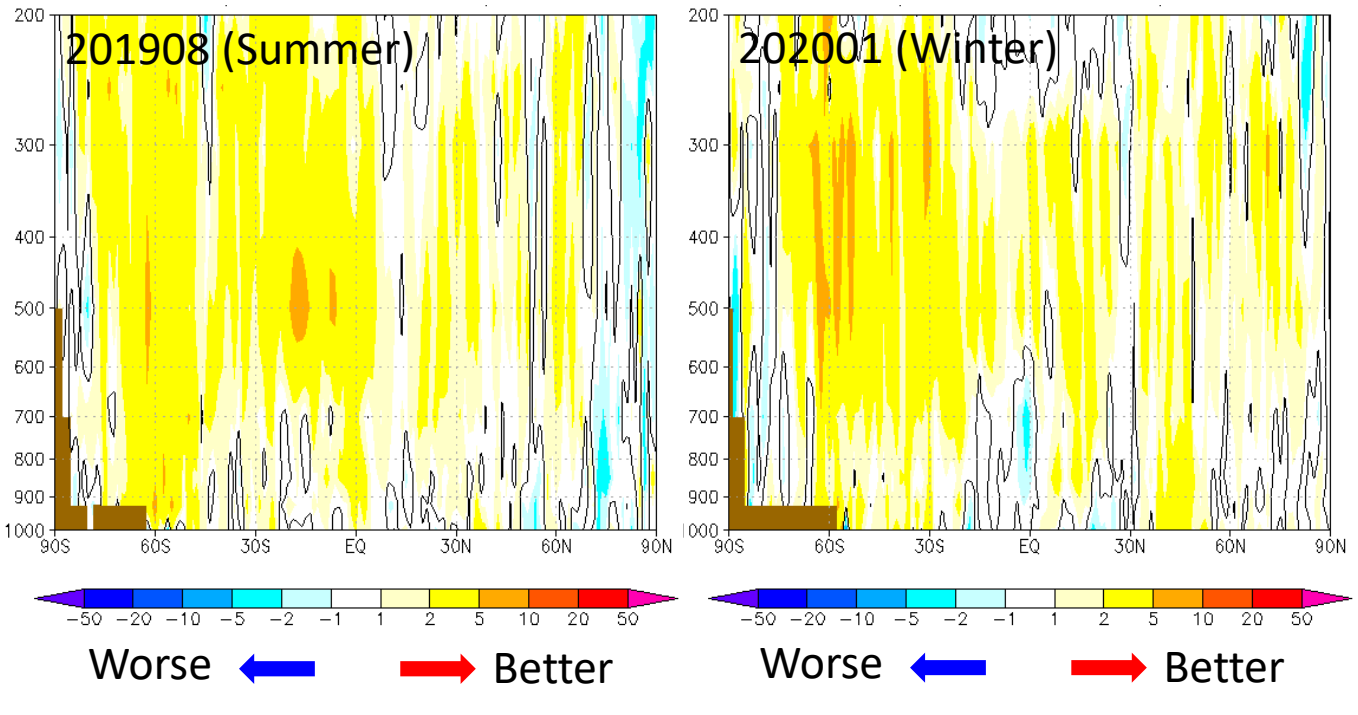






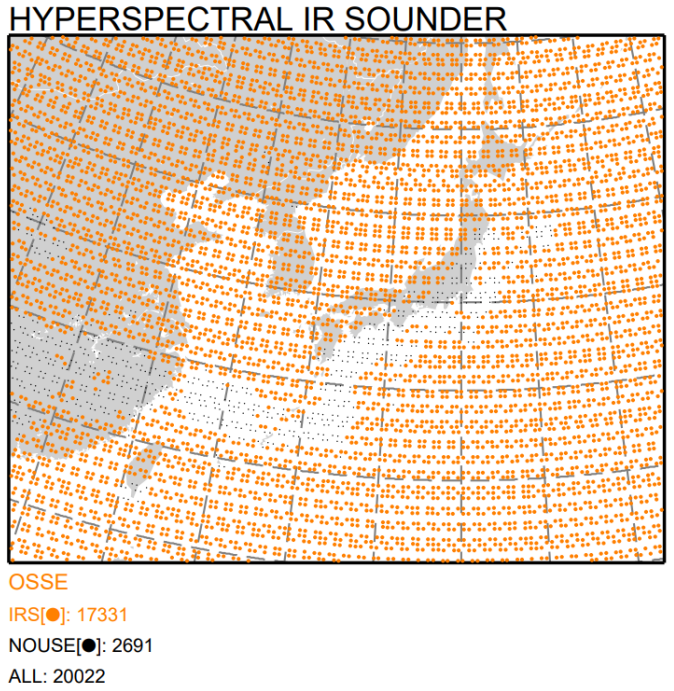
Global Data Assimilation Experiment – Results

- These figures are zonal means of average relative differences (%) in east-west wind forecasts at 24 h between EXP (with GeoHSS) and CNT (without GeoHSS) for root mean square errors (RMSEs) verified against ECMWF initials.

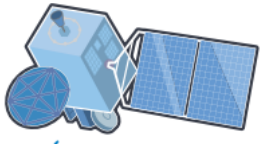


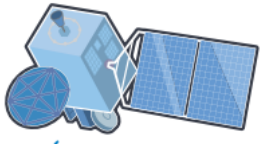
Experimental Settings – Regional Data Assimilation (Regional DA)

- Assimilation of clear-sky radiance simulated by RTTOV-12.2
  - ✓ HSIR is not yet assimilated in our operational regional NWP
- 3 Temperature / 24 WV channels, spatial thinning of 45 km
  - ✓ Regional DA has a low model top, assimilation is performed only with channels sensitive to the troposphere from those used in global DA
- Forecast period of experiments
  - ✓ 27 July 2021 to 11 September 2021
  - ✓ To monitor precipitation forecasts, mainly for linear precipitation belts
- Global DA has also been performed to give boundary condition for regional DA



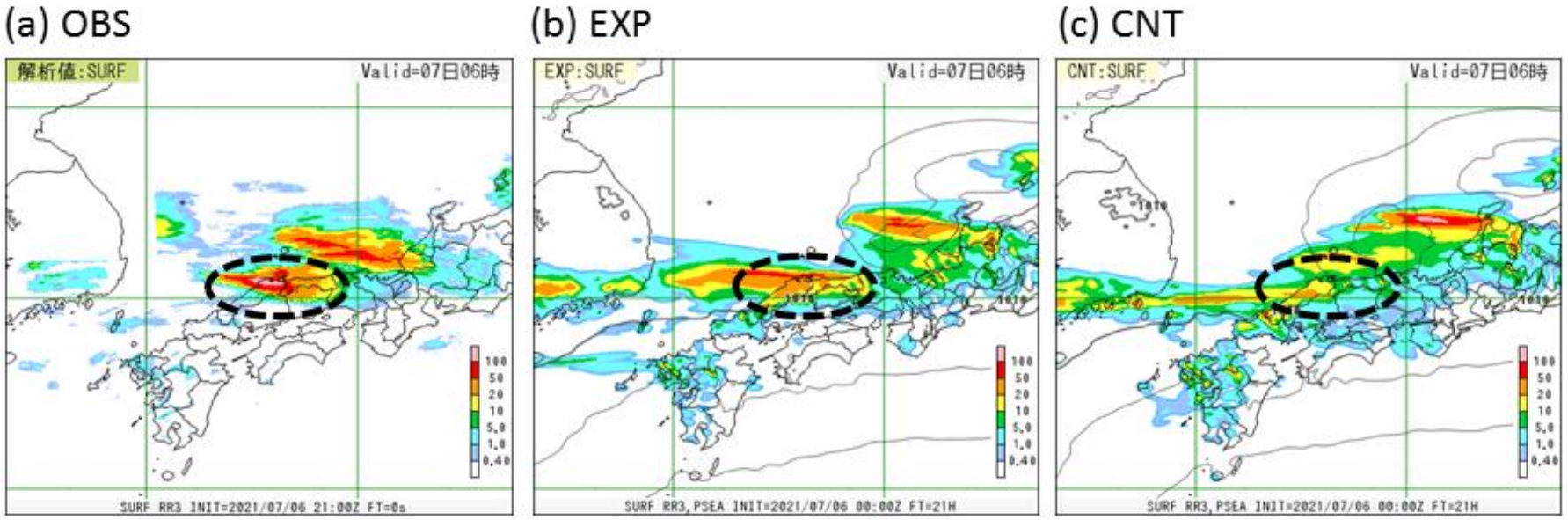
Data coverage of hyperspectral IR sounder used at one analysis.
OSSE means GeoHSS





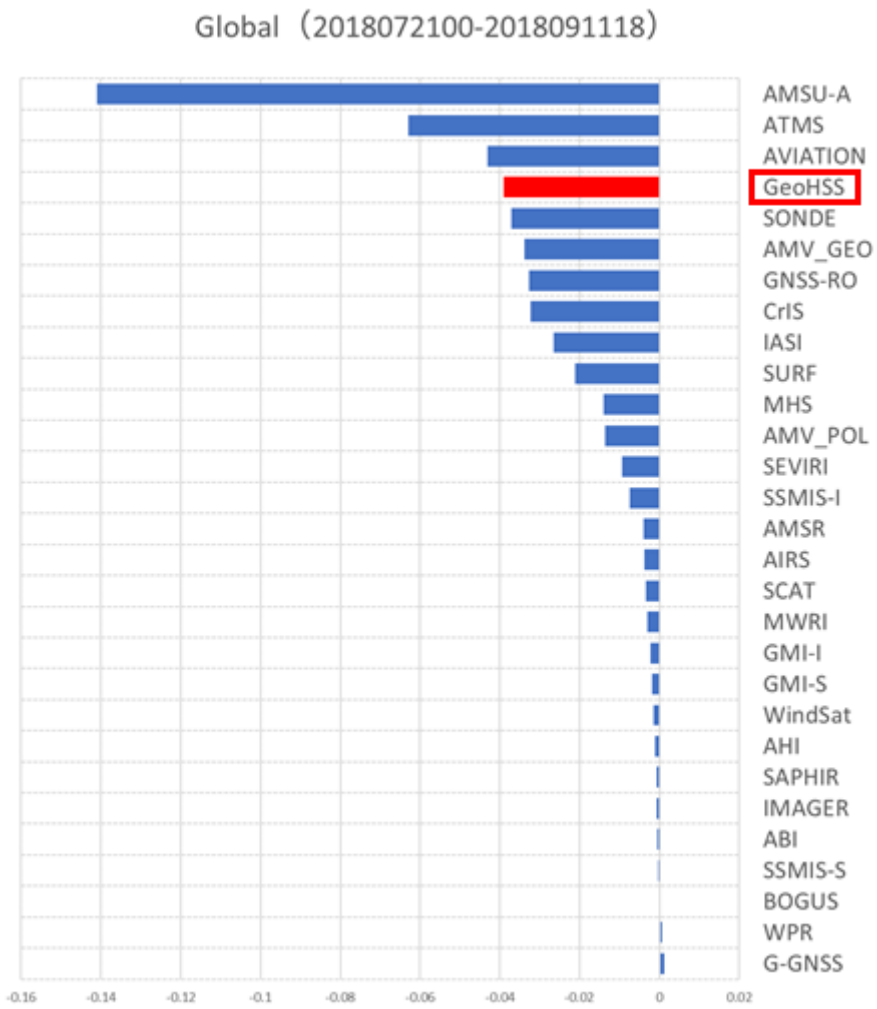
Regional (Meso-Scale) Data Assimilation Experiment – Results

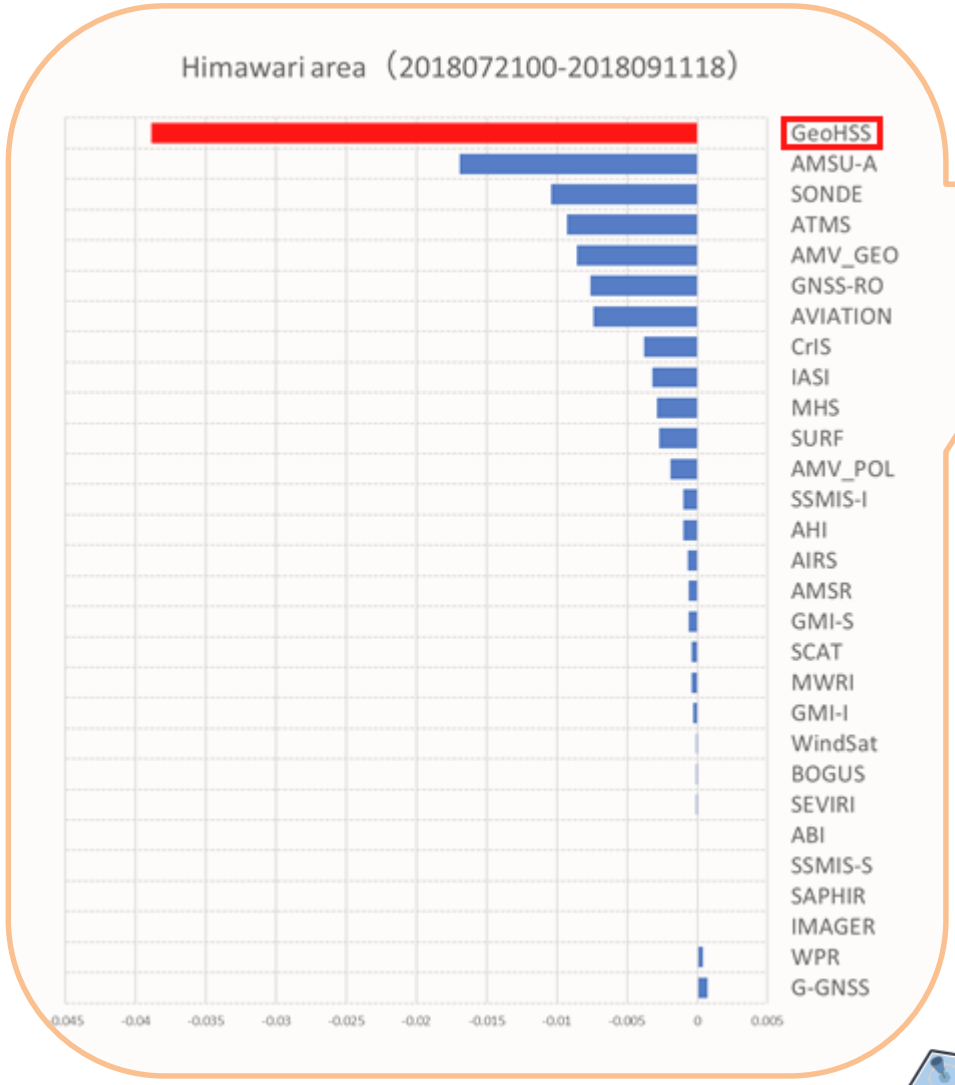
- 3-hour accumulated rainfall forecast at 21 h initialized at 0000 UTC on 6 July 2021. CNT (without GeoHSS) failed to predict the location of the heaviest rain area. Meanwhile, EXP (with GeoHSS) better predicted the location

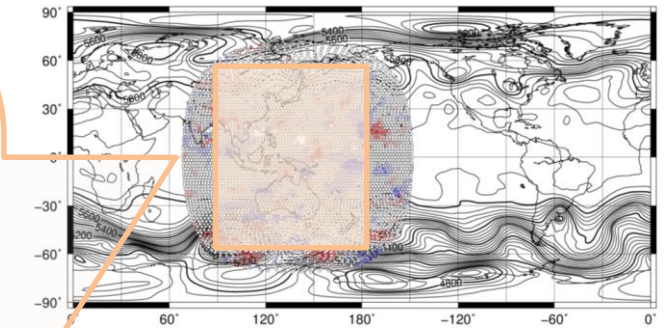


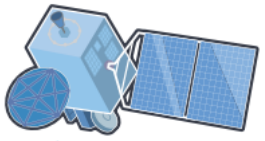
Three-hour accumulated rainfall (mm) valid at 2100 UTC 06 July 2021

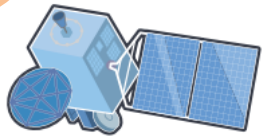
Forecast Sensitivity Observation Impact (FSOI)











Results from one cycle experiment for August 2018.

Summary

- OSSEs have been performed to assess potential impacts of GeoHSS technology on JMA's operational NWP systems. We confirmed the positive impacts of GeoHSS in NWP by OSSEs.
- Results of a cycle experiment for FSOI show that GeoHSS has large impact even in targeting the global area. In Himawari targeting area, it has the largest impact compared to other instruments.