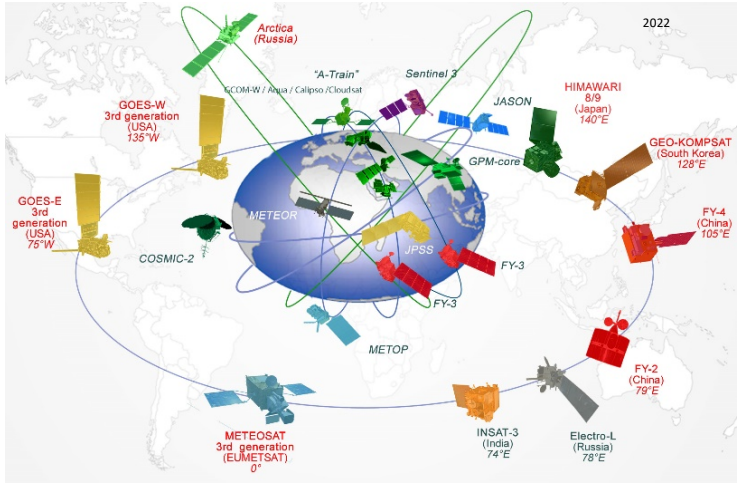


Impacts of Potential Usage of Hyperspectral IR Sounder on Himawari-8/-9 Follow-on Program

Presented to CGMS-48 Plenary, Session: HSIR observations, Agenda item 4.1

Coordination Group for Meteorological Satellites

CGMS

Introduction / Executive Summary

- Future GEO program follow-on to Himawari-8/-9
  - ✓ To be launched by FY 2028, 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)
  - ✓ Two-year (FY 2018-2019) project at JMA
  - ✓ Positive impacts on JMA's Global/Regional (Meso-scale) NWP systems
    - ➢ Reported at domestic/international meetings, published in peer-reviewed paper (Okamoto et al., 2020, *SOLA*, in press)

Method: Reanalysis-based OSSE

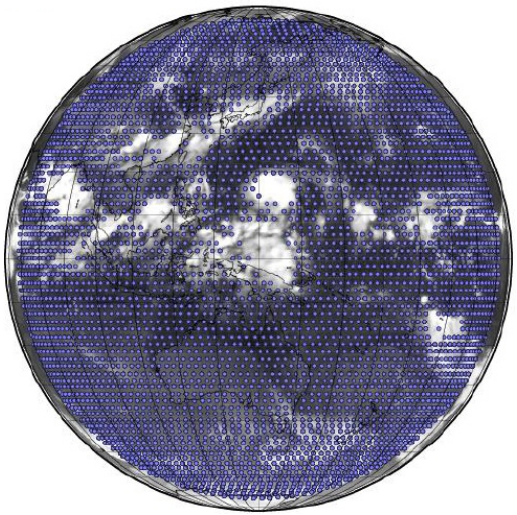
- Candidate instrument: MTG/IRS (700-1210, 1600-2175 cm^{-1})
  - ✓ Located at 140.7 E (same as Himawari-8)
  - ✓ Hourly full-disk observation
  - ✓ Horizontal resolution: 30 km (limitation from reference)
- Reanalysis-based OSSE (RA-OSSE)
  - ✓ Adopt ERA5 (ECMWF Re-Analysis 5) as reference (truth)
    - ➢ No need to simulate existing observations
    - ➢ Assess impacts for cases that actually occurred
      - ➢ Cases are limited that ERA5 better reproduces than JMA

Experimental Settings – Global / Regional Data Assimilations

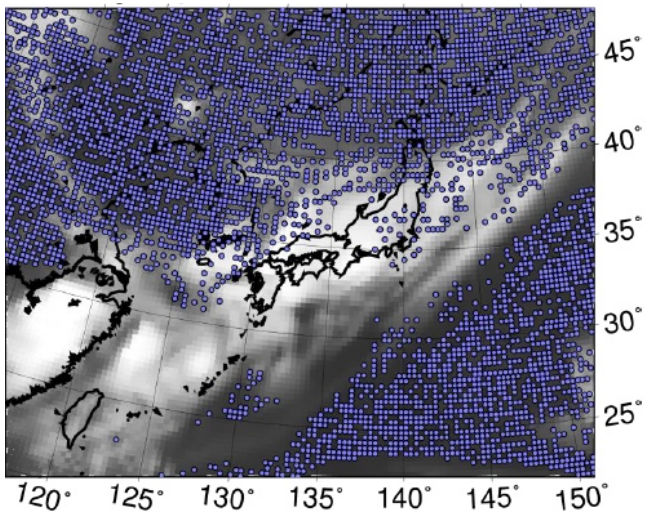
- **Global DA**: assimilation of clear-sky radiance simulated by RTTOV-12.2
  - ✓ 36 Temperature / 25 WV channels, spatial thinning of 200 km
  - ✓ Obs error: similar to the operational IASI setting
- **Regional DA**: assimilation of T/RH vertical profiles in clear-sky scenes
  - ✓ HSS not yet introduced in the operational regional DA system
  - ✓ Spatial thinning of 45 km and 13 (7) layers btw 1000 and 50 (300) for T (RH)
  - ✓ Obs error: 1.5 times the operational RAOB obs error

Hypothetical GeoHSS obs. after quality control and thinning

Global DA
Ch. 3
(14.260 µm)



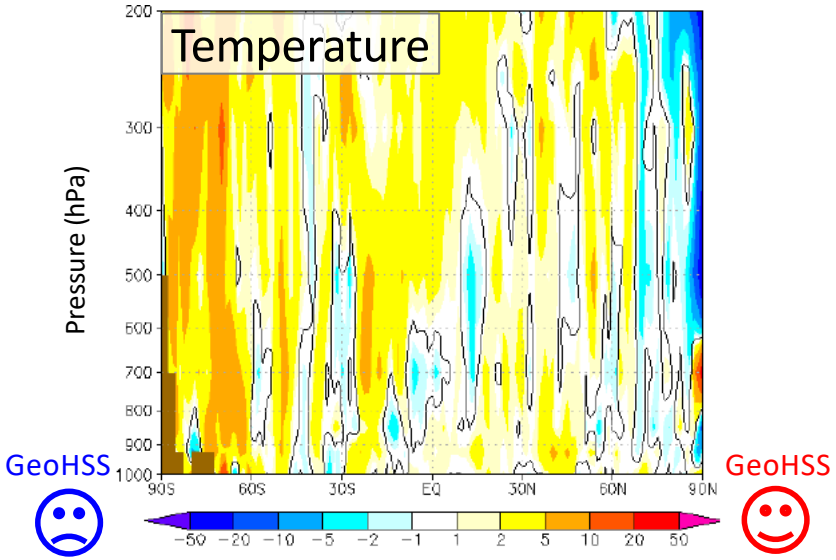
Regional DA
Temperature
150 – 250 hPa



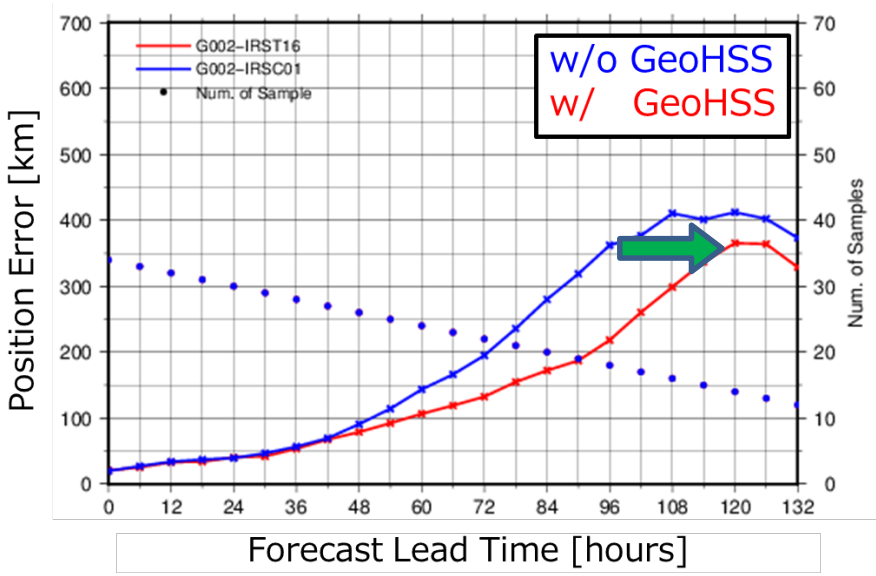
Global Data Assimilation Experiment – Results

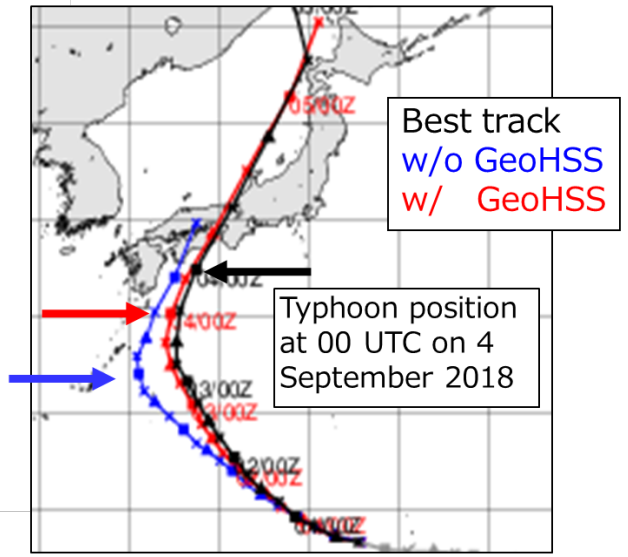
- Reduction of RMSEs in all altitudes and latitudinal bands, except in northern high latitude
- Reduction of typhoon position error (e.g., 5-d forecasts w/ GeoHSS ≈ 4-d forecasts w/o GeoHSS) by better representation of large-scale field

Zonal mean of RMSE diff. on 3-d forecast (%), verified against initials of UKMO



Typhoon track forecast for JEBI (1821)

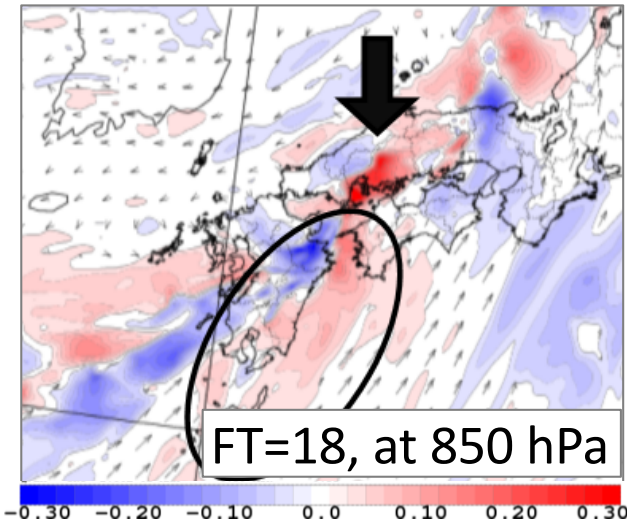




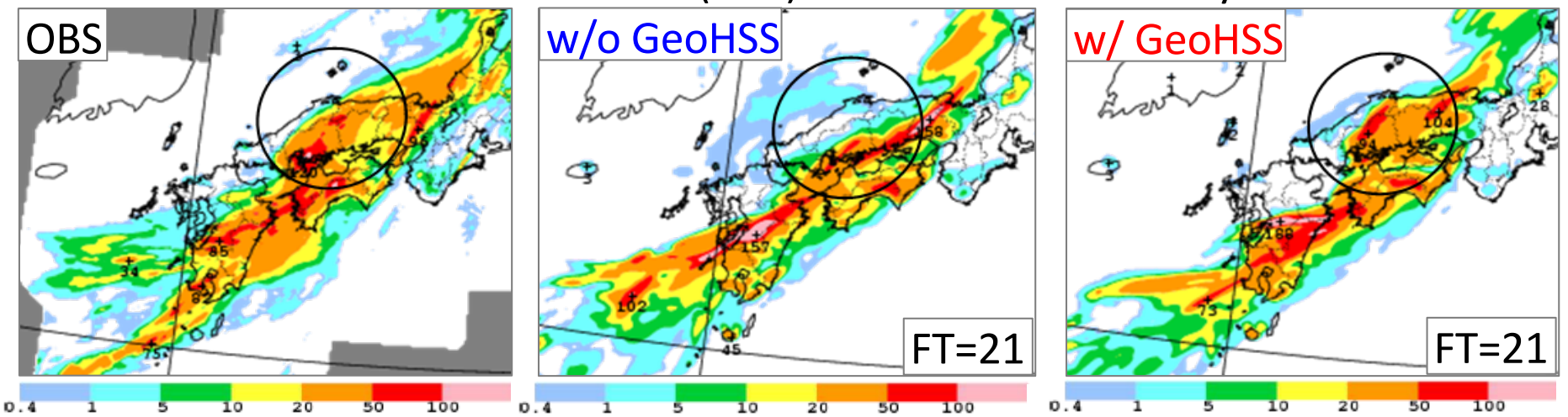
Regional (Meso-Scale) Data Assimilation Experiment – Results

- Better fit of analysis and forecast for T and winds to RAOB (not shown)
- Better prediction of heavy rainfall due to increased southwesterly moisture flux
  - ✓ Propagation of analysis improvement in clear-sky regions through data assimilation cycles

Moisture flux diff. (kg m^{-2} s^{-1})
(w/ GeoHSS − w/o GeoHSS)



3-hour accumulated rainfall (mm) at 0000 UTC on 06 July 2018



Key issues of relevance to CGMS/for consideration:

- Impacts of GeoHSS were assessed using a reanalysis-based OSSE to discuss Himawari-8/-9 follow-on program
  - Assimilation experiments clearly demonstrate value of GeoHSS for the prediction of heavy rainfall event and large-scale system such as typhoon
- Recommendations for CGMS members
  - To publish and discuss their HSIR OSSE/OSE assessment results for weather/environment applications
  - To share the information on HSIR such as instrument developments, observation performance, data processing, operation, and applications
  - To promote the public awareness of the socioeconomic benefits of the HSIR