

# Status of satellite data assimilation in Meteorological Service Singapore



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## SINGVDA: TROPICAL CONVECTIVE SCALE DATA ASSIMILATION SYSTEM

- ❖ Tropical version of the Unified Model with 3 hourly-cycling DA using 3D-VAR FGAT. LBCs from ECMWF deterministic run
- ❖ Horizontal resolution of 1.5km, with 80 vertical levels up to 38.5km
- ❖ Blends large-scale ECMWF analysis/forecast winds with SINGVDA
- ❖ Variational Bias Correction (VarBC) used for satellite radiances assimilation
- ❖ After HPC migration, SINGVDA (vn5.1) underwent a technical upgrade (vn5.2). OPS/VAR 2016 with RTTOV9 => OPS/VAR 2020 with RTTOV12



### Observations assimilated operationally in SINGVDA

	Satellite radiances	
	Infrared	Microwave
AIRS	AQUA	
CrIS	Suomi NPP	
IASI	Metop A/B	
AHICSR	Himawari-8 Himawari-9*	
Geocloud <sup>§</sup>	Himawari-8 Himawari-9*	
ATMS	Suomi NPP	
AMSU-B/MHS	Metop-A Motop-B NOAA-18/19	
SAPHIR	Megha-Tropiques	
GMI <sup>†</sup>	GPM	

\* Under development

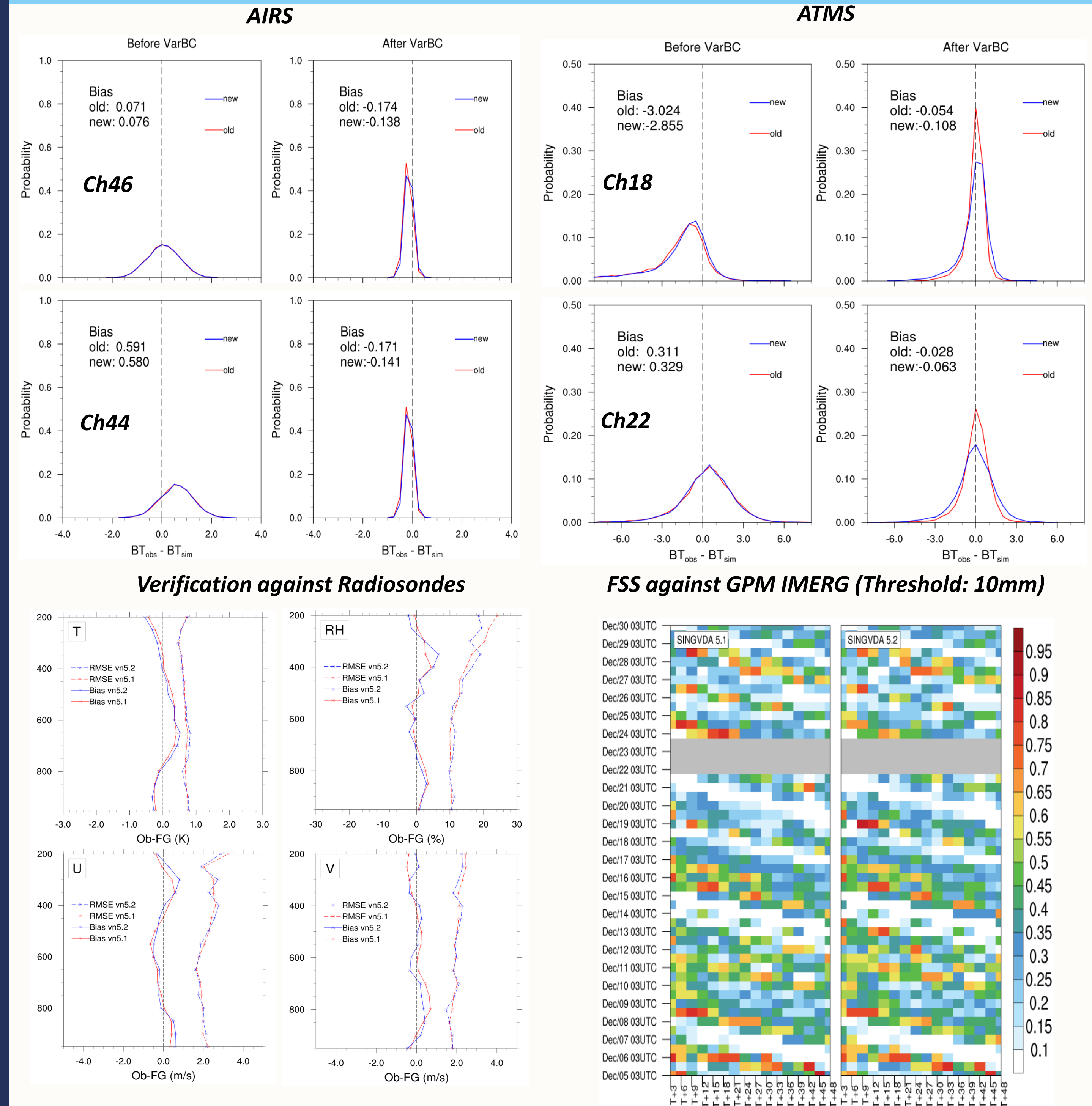
† In the planning/evaluation phase

§ 1DVar retrieved parameters over cloudy region

Conventional	
Surface	Automatic/Manual land SYNOP
	METAR
	SHIP
Sonde	Land TEMP
	Land PILOT
Aircraft	AMDAR
	AIREP
	MODE-S*
	TAMDAR*

Derived winds	
Geostationary AMV	Himawari-8
Scatterometer winds	Metop-A ASCAT

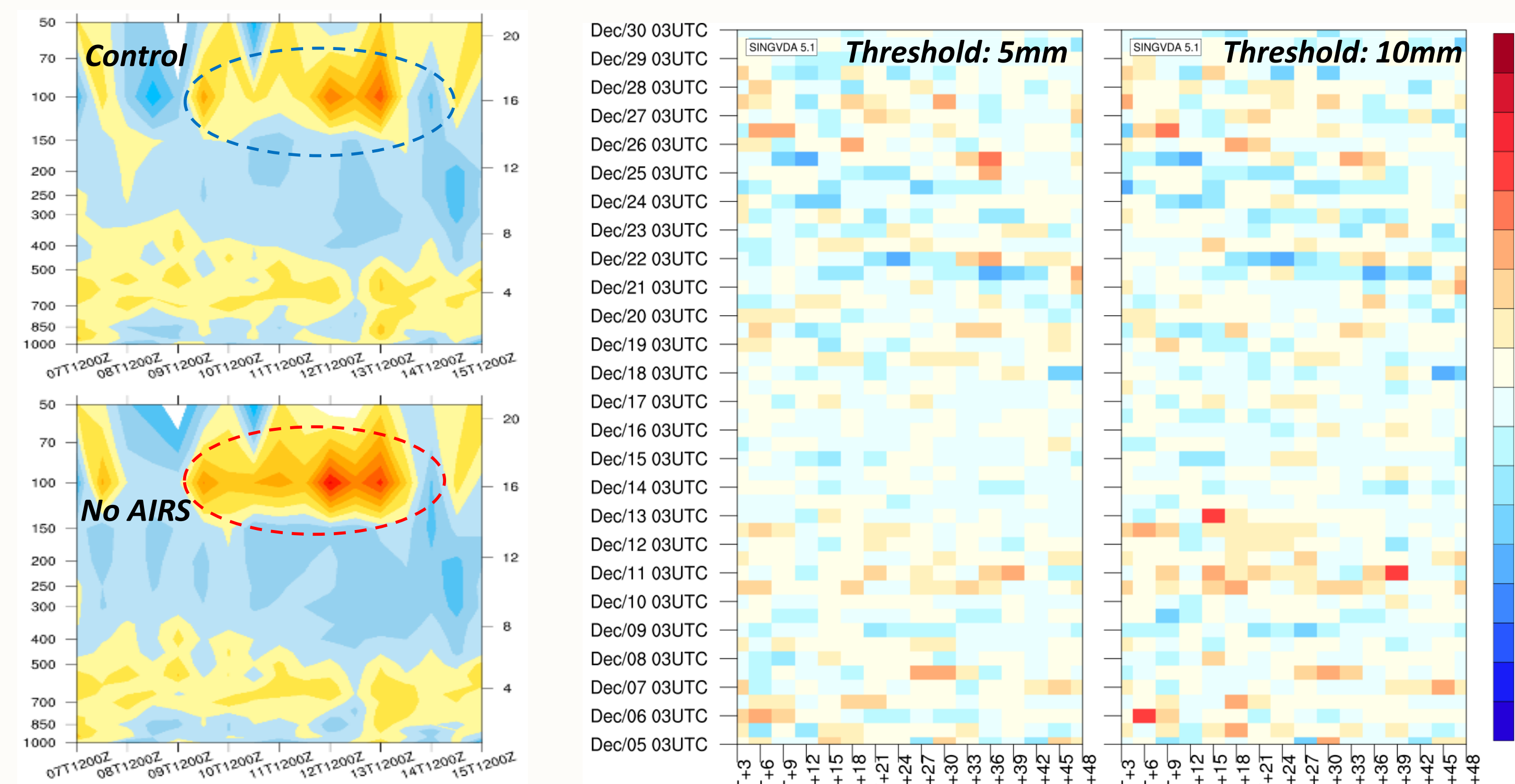
## VERIFICATION: SINGVDA vn5.1 vs vn5.2



Some differences are observed in the humidity errors in the higher atmospheric levels (~200-450hPa). Forecast skill also improved when verified against Radiosondes after the technical upgrade. This is hypothesized to be the result of the change in VarBC coefficients which was affected by the RTTOV version upgrade.

## DATA DENIAL AND SENSITIVITY STUDIES

Given the variety of satellite observations assimilated into SINGVDA, it is very crucial to monitor these observations and their impacts. Observing System Experiments (OSE) are used to assess the impact of different microwave/infrared observations.

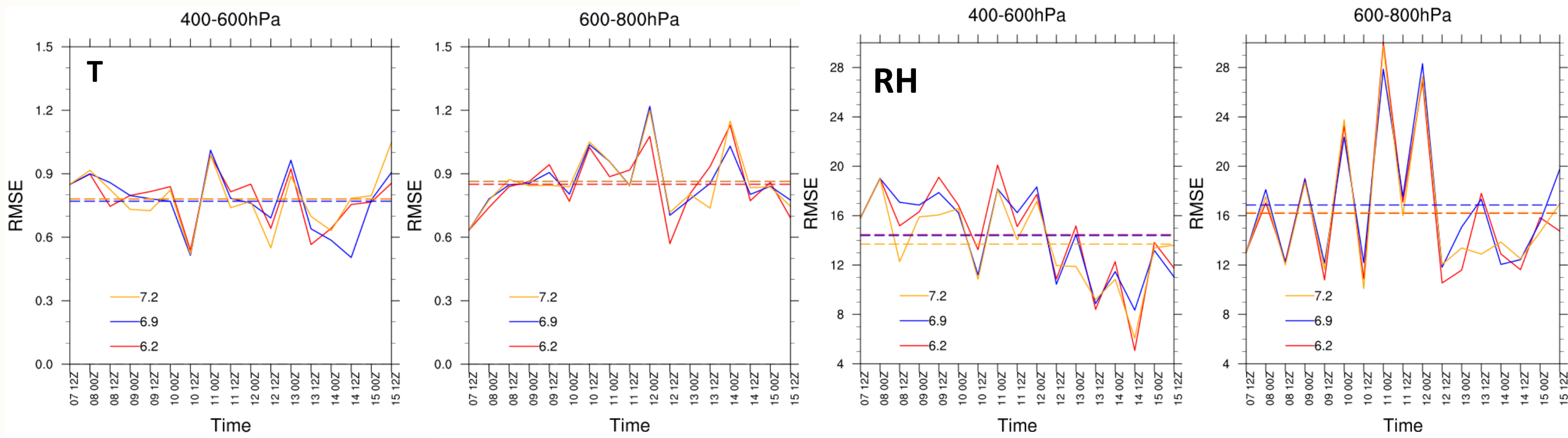


Initial results from OSE for AIRS comparing domain average O-B against Sonde observations

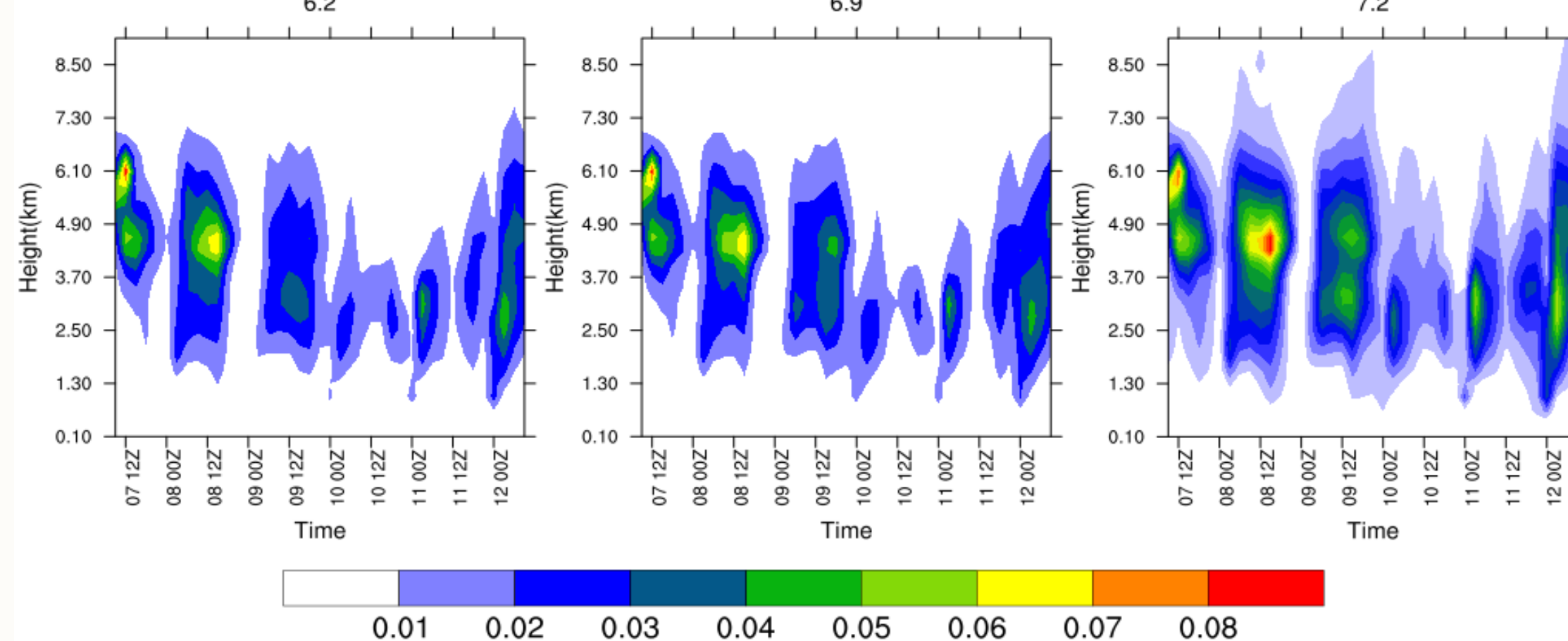
FSS differences (FSS control - FSS no MW) comparing the control which mimics the operational setting with OSE denying all microwave observation. The benefit of adding MW observations is more evident at higher rainfall thresholds (red indicates the improvement from MW).

Himawari-8 AHI offers high spatial and temporal resolution observations of the atmosphere over the Maritime Continent. Understanding the sensitivity of tropical precipitation to different AHI WV channels will 1) help us understand the role of moisture in tropics and 2) decide which tropospheric levels should be better observed in order to get a better forecast skill.

### Verification against Radiosondes

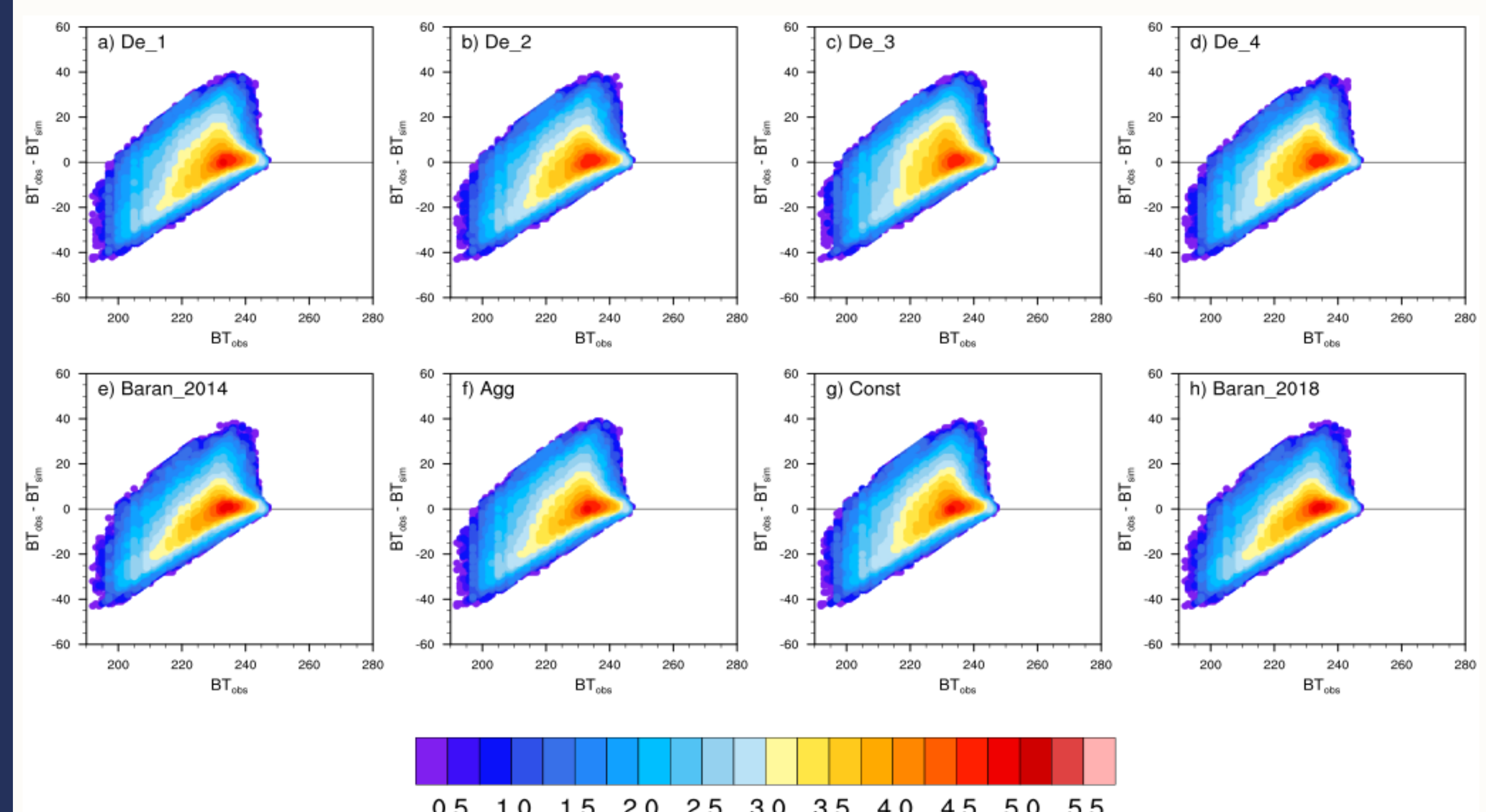


Average vertical profiles of cloud liquid water over the eastern coast of Sumatra.



## ALL-SKY IR RADIANCE DA

Currently, evaluation of the all-sky AHI GEO-IR radiance simulation capability in SINGVDA vn5.2 underway. The goal of this study is to understand the biases in the forward RTTOV simulation of cloud affected IR radiances in the tropics. Future plan is to test the all-sky radiance DA in the hybrid DA framework.



Number of 6.2 micrometer observations (in color) plotted as a function of different bins of observed BT and first-guess departure values with a bin size of 1K for various choice of ice scattering property parameterizations.

## SUMMARY & FUTURE PLANS

- ❖ The tropical convective scale DA system at MSS utilizes a wide variety of satellite observations. The operational system underwent a technical upgrade which included the upgrade to RTTOV12 from RTTOV9. Evaluation of this upgrade showed improvements in the humidity and precipitation forecasts.
- ❖ Several OSEs are being carried out to investigate/understand the sensitivity of tropical precipitation to various infrared/microwave radiances. The initial results from some of these experiments have revealed some interesting results.
- ❖ Major tasks for this year include 1) major scientific (RAL3) upgrade to the core UM model. 2) operationalizing Himawari-9 and 3) updating the SINGVDA system to use observations from new satellite platforms.

