Impact of Megha-Tropique's SAPHIR humidity profiles in the Unified Model Analysis and Forecast System

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Outline

1. **Megha-Tropiques Mission : Overview**

2. **SAPHIR Microwave Humidity Sounder : characteristics**

3. **Bias correction – SAPHIR Radiances**

4. **SAPHIR radiance assimilation –**
   - **(i) Impact on other observations**
   - **(ii) Verification of analysis and forecast**

5. **Conclusions**

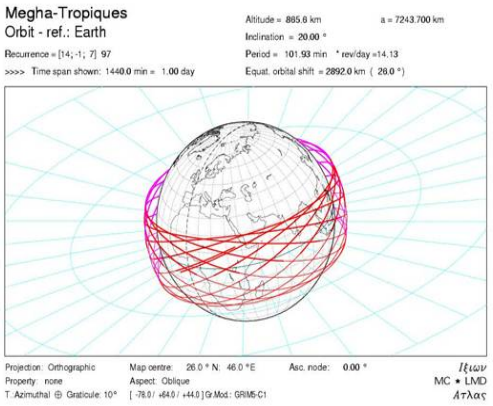
Megha-Tropiques: Overview

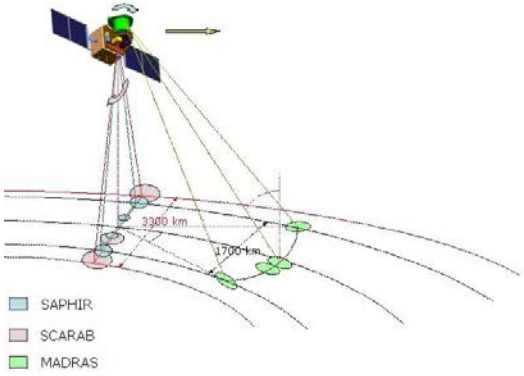
The Megha Tropiques (MT), a joint Indo-French satellite, was launched by the Indian launch vehicle, PSLV-C18 on 12 October 2011.

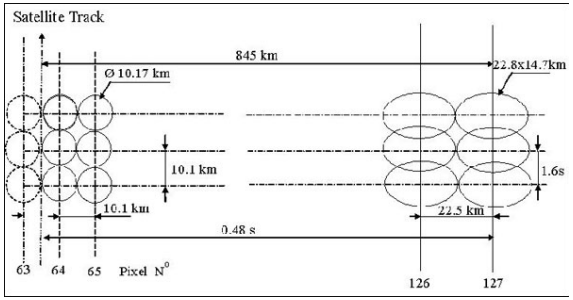
MT is positioned in a highly inclined equatorial plane of 20°at a height of 867 km above the Earth so as to orbit the tropical region (30°S to 30°N) nearly 14–15 times per day.

The four payloads on-board MT consisting of a microwave radiometer(MADRAS), a microwave humidity sounder (SAPHIR), a radiation budget instrument (SCARAB) and a radio-occultation sounder (ROSA) are important for the study of tropical convective systems and hydrological cycle

SAPHIR and SCARAB have across-track scanning, MADRAS has conical scanning. SAPHIR and SCARAB images are distorted at the Edge of the Swath, MADRAS images are not.

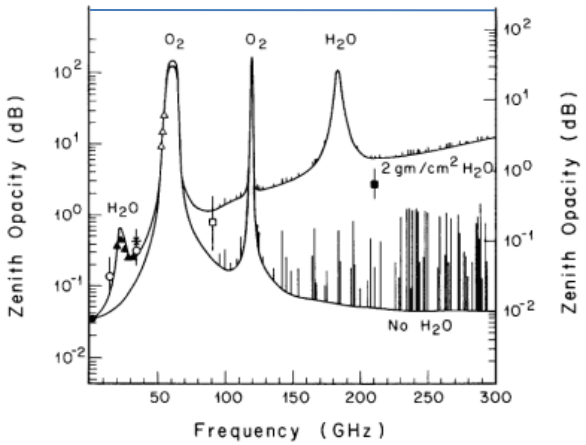


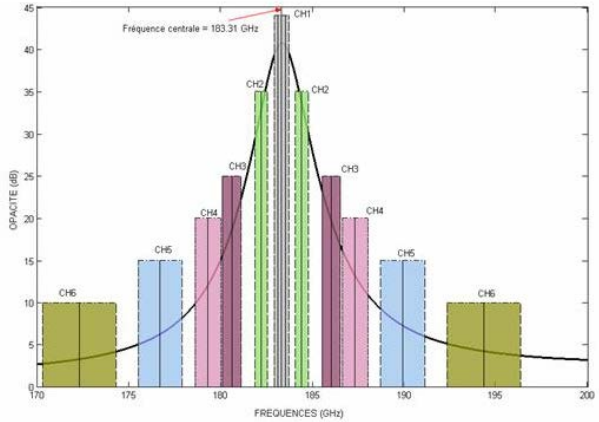


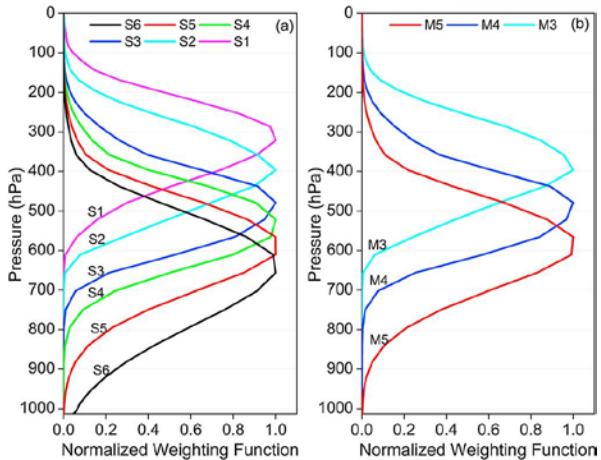


Assimilation of SAPHIR radiances in the Unified Model of MetOffice, UK - which is also being used at National Centre for Medium Range Weather Forecasting (India) for NWP - is the focus of this study

SAPHIR: Characteristics







Saphir Channels	Central Frequencies (GHz)	Channel Bandwidth (MHz)
S1	183.31±0.2	200
S2	183.31±1.1	350
S3	183.31±2.8	500
S4	183.31±4.2	700
S5	183.31±6.8	1200
S6	183.31±11	2000

amsu-b Channels	Central Frequencies (GHz)	Saphir equivalent channel
amsub-3	183.31±1.0	S2
amsub-4	183.31±3.0	S3
amsub-5	183.31±7.0	S5

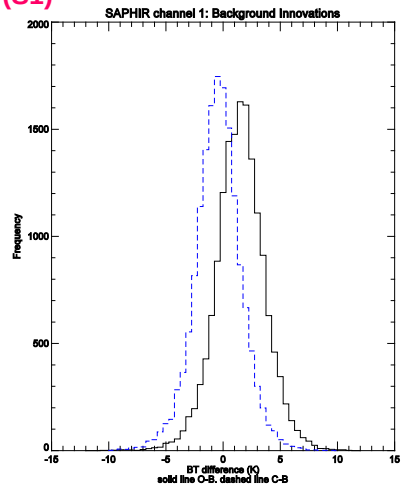
ATMS channels	Central Frequencies (GHz)	Saphir equivalent channel
atms-18	183.31±7.0	S5
atms-19	183.31±4.5	S4
atms-20	183.31±3.0	S3
atms-21	183.31±1.8	
atms-22	183.31±1.0	S2

Bias Correction

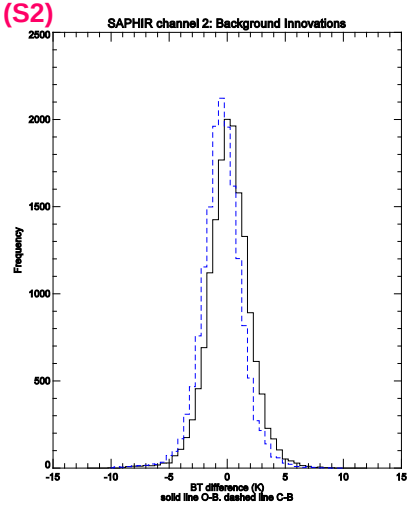
----------before Bias correction

---------- after bias correction

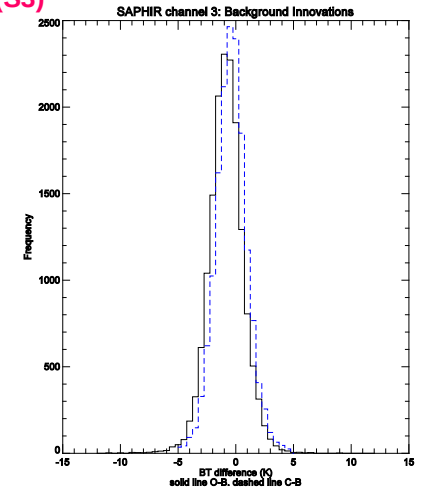
Ch1 (S1)



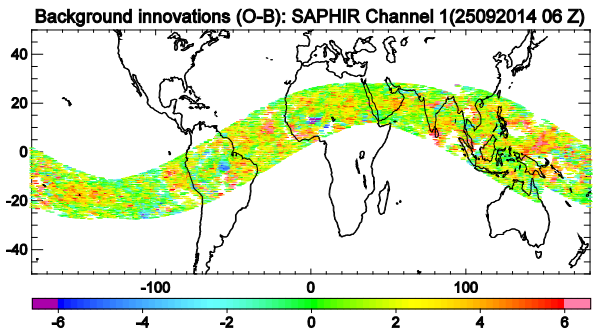
Ch2 (S2)

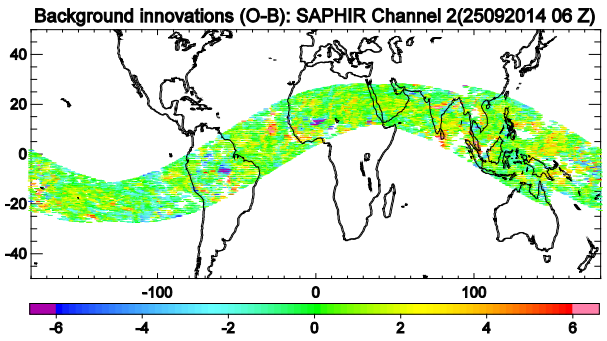


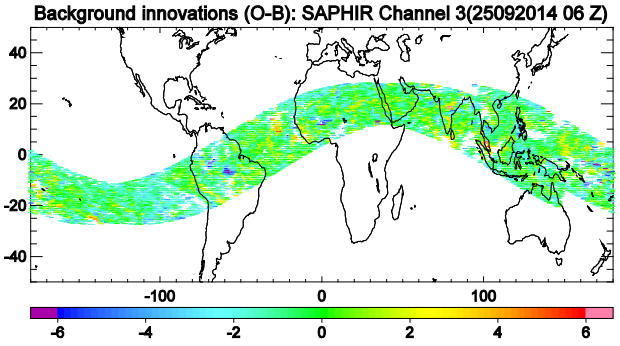
Ch3(S3)



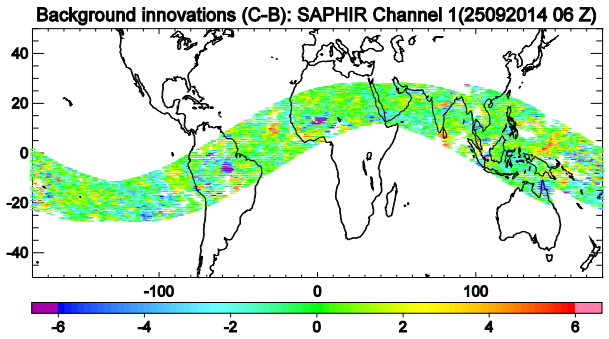
O - B

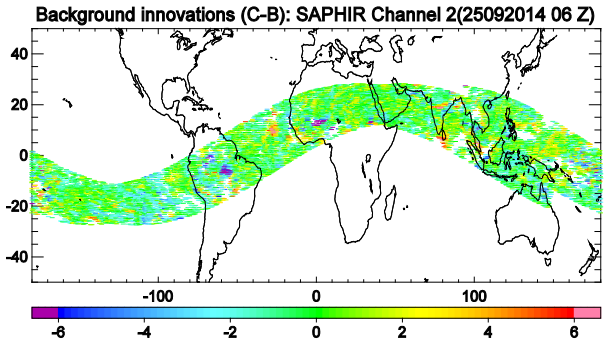


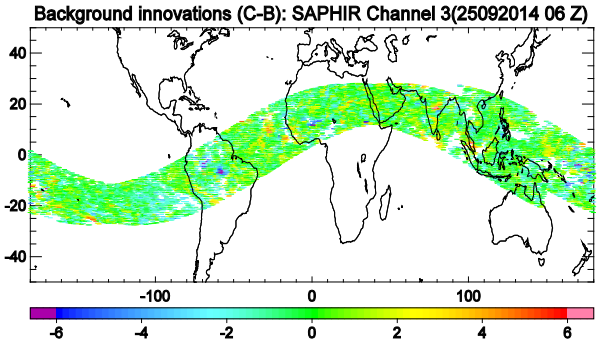




C - B



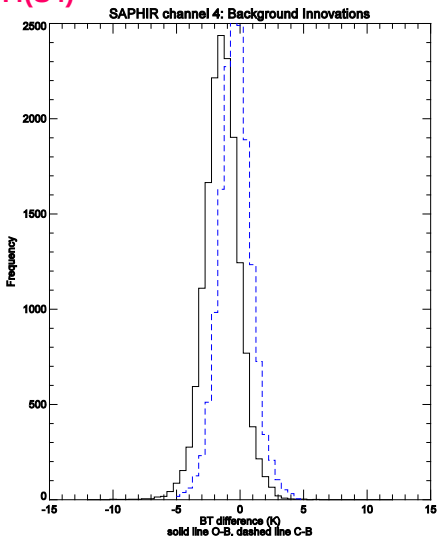




Bias Correction: contd...

----------before Bias correction
---------- after bias correction

Ch4(S4)



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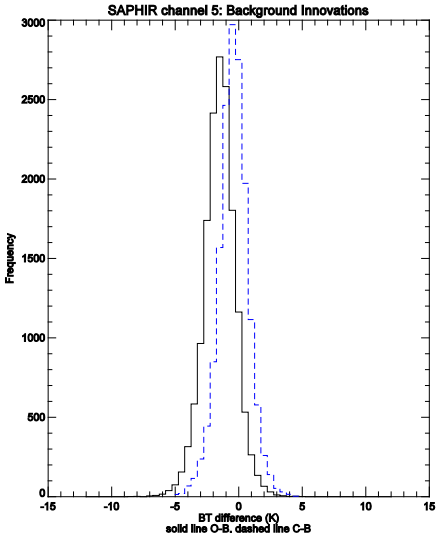
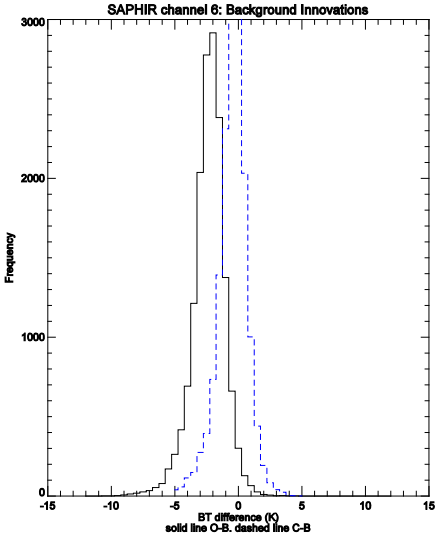


Ch6(S6)



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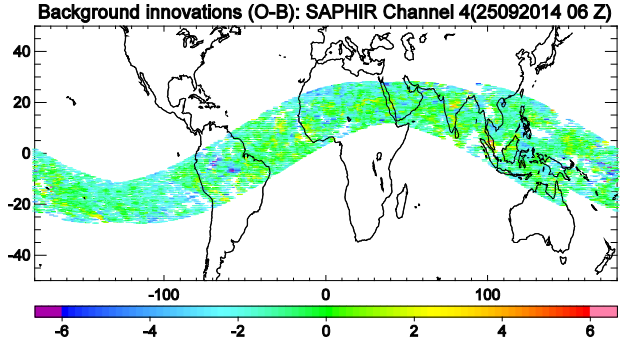
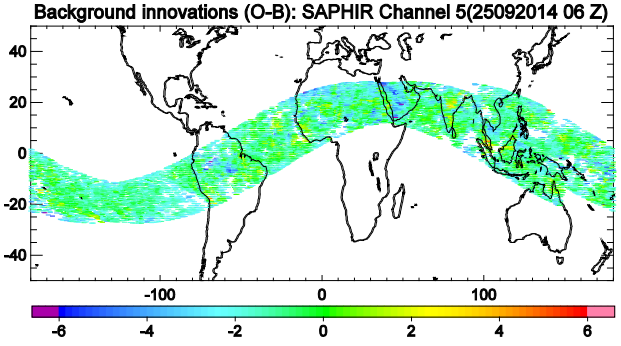
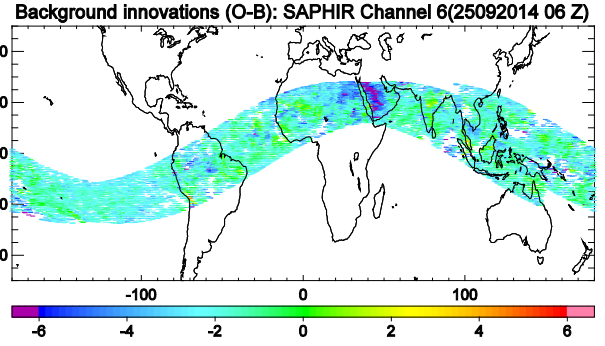
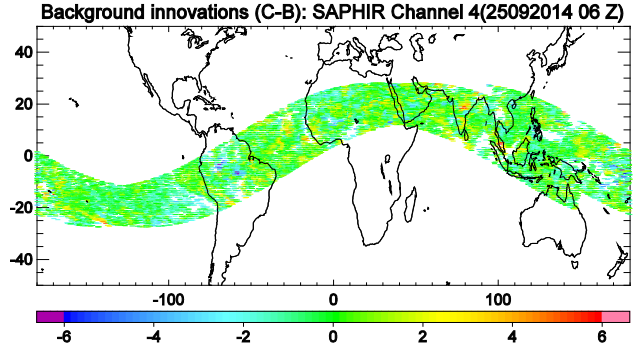
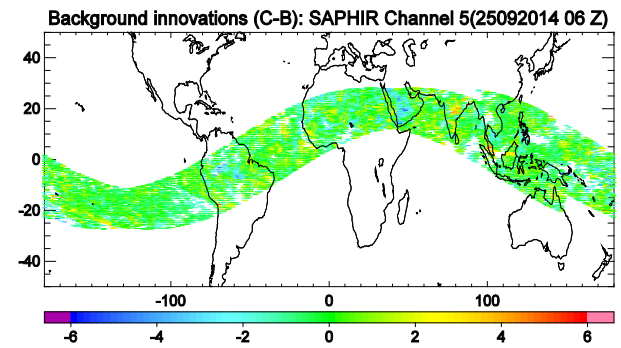


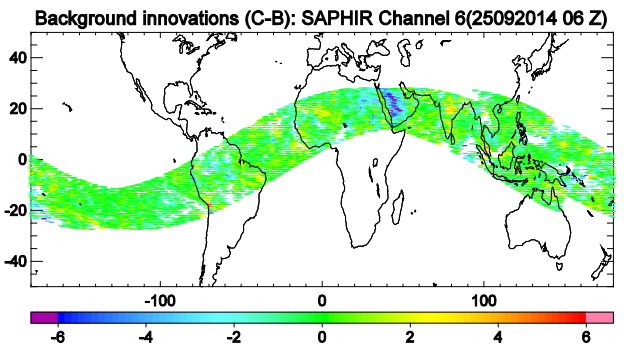


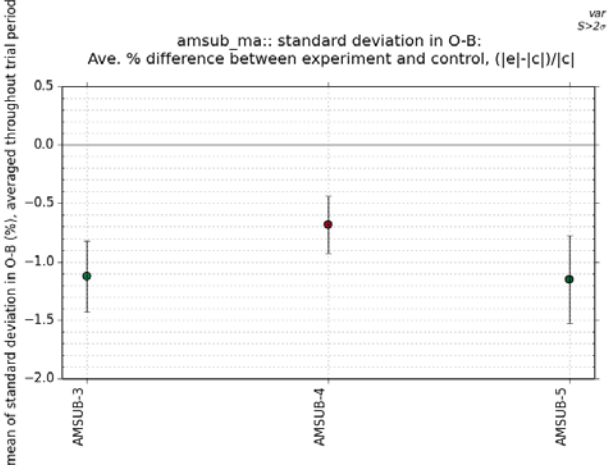


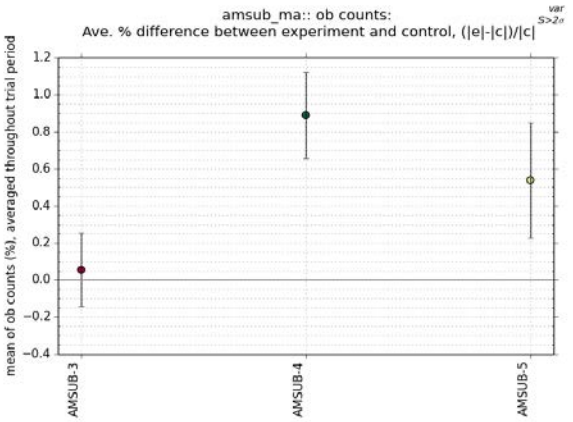
C - B



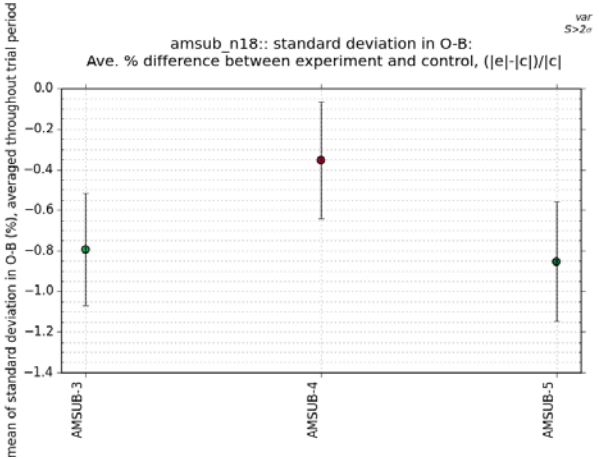


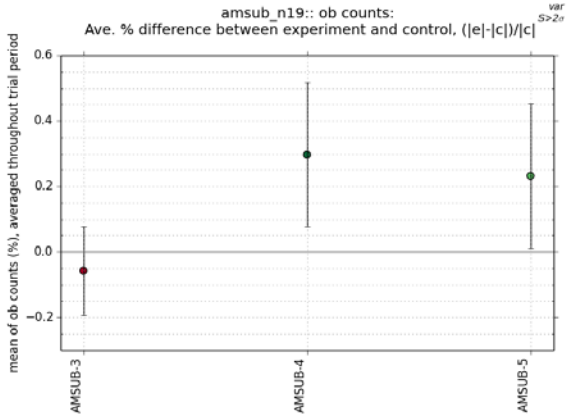


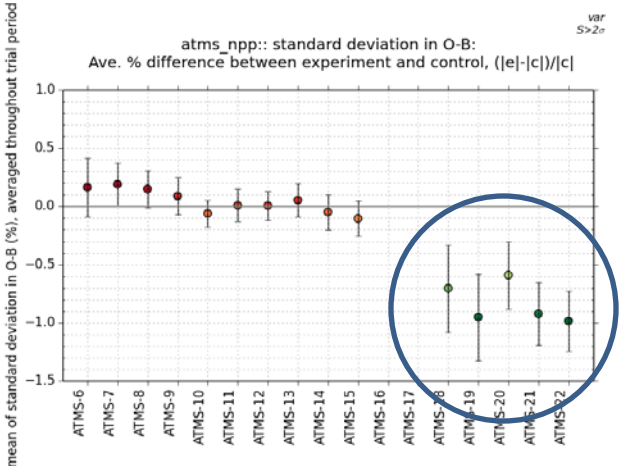


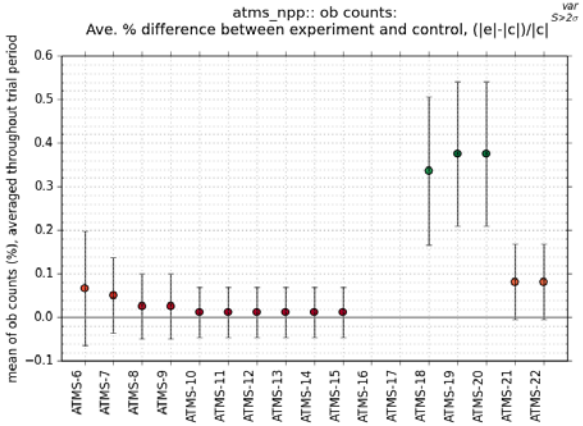


VARSTATS: Impact of SAPHIR on the assimilation of other microwave humidity sounder data

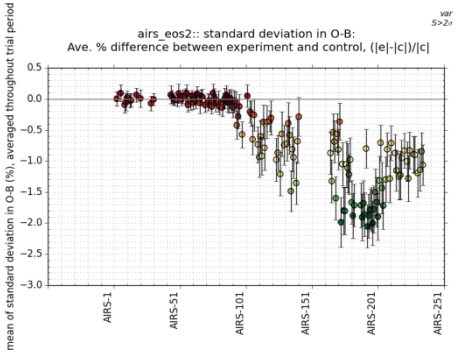


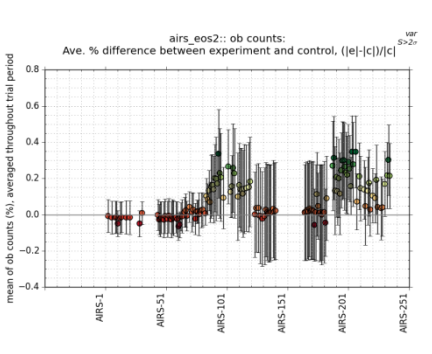


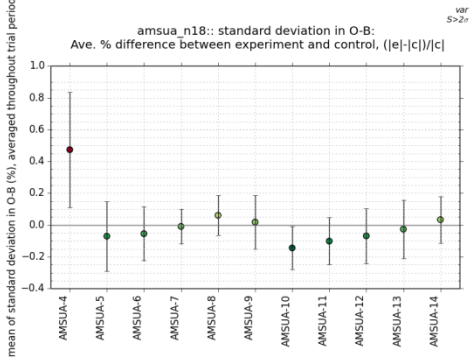


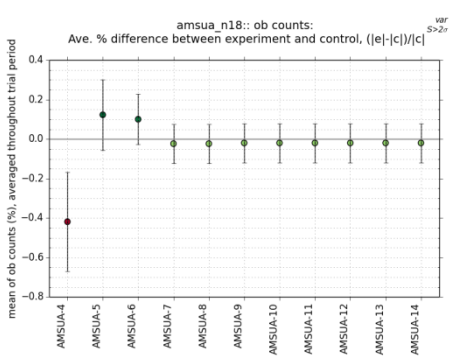


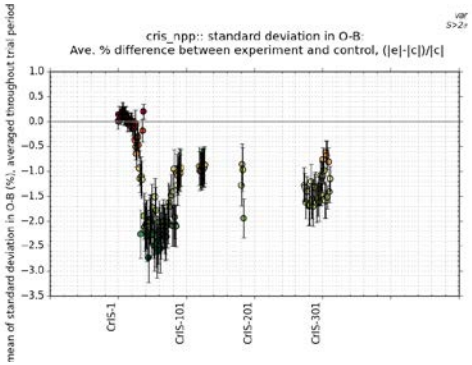
Assimilation of SAPHIR radiances reduced the biases of radiances from other satellites, in similar MW frequencies (eg. Some of the channels in ATMS of NPP satellite).

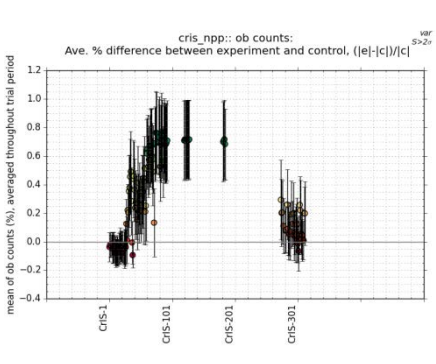


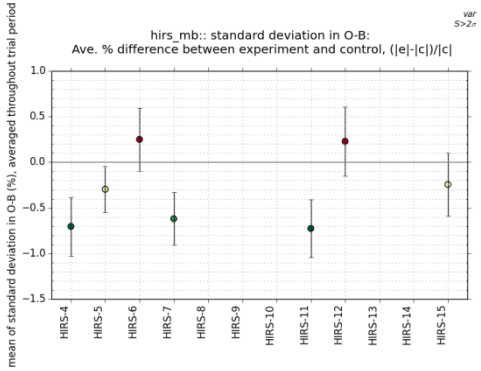


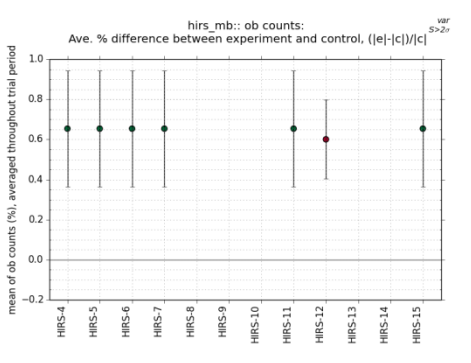


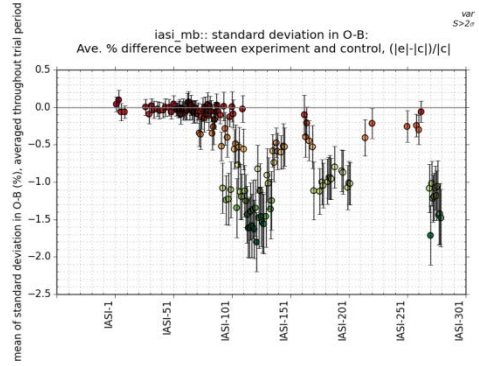


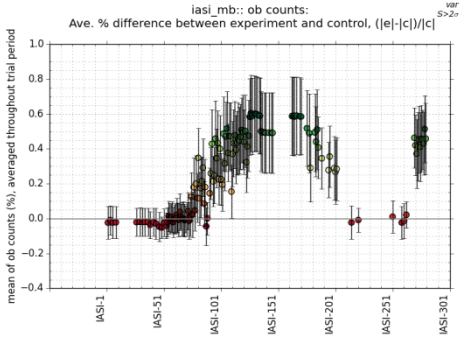






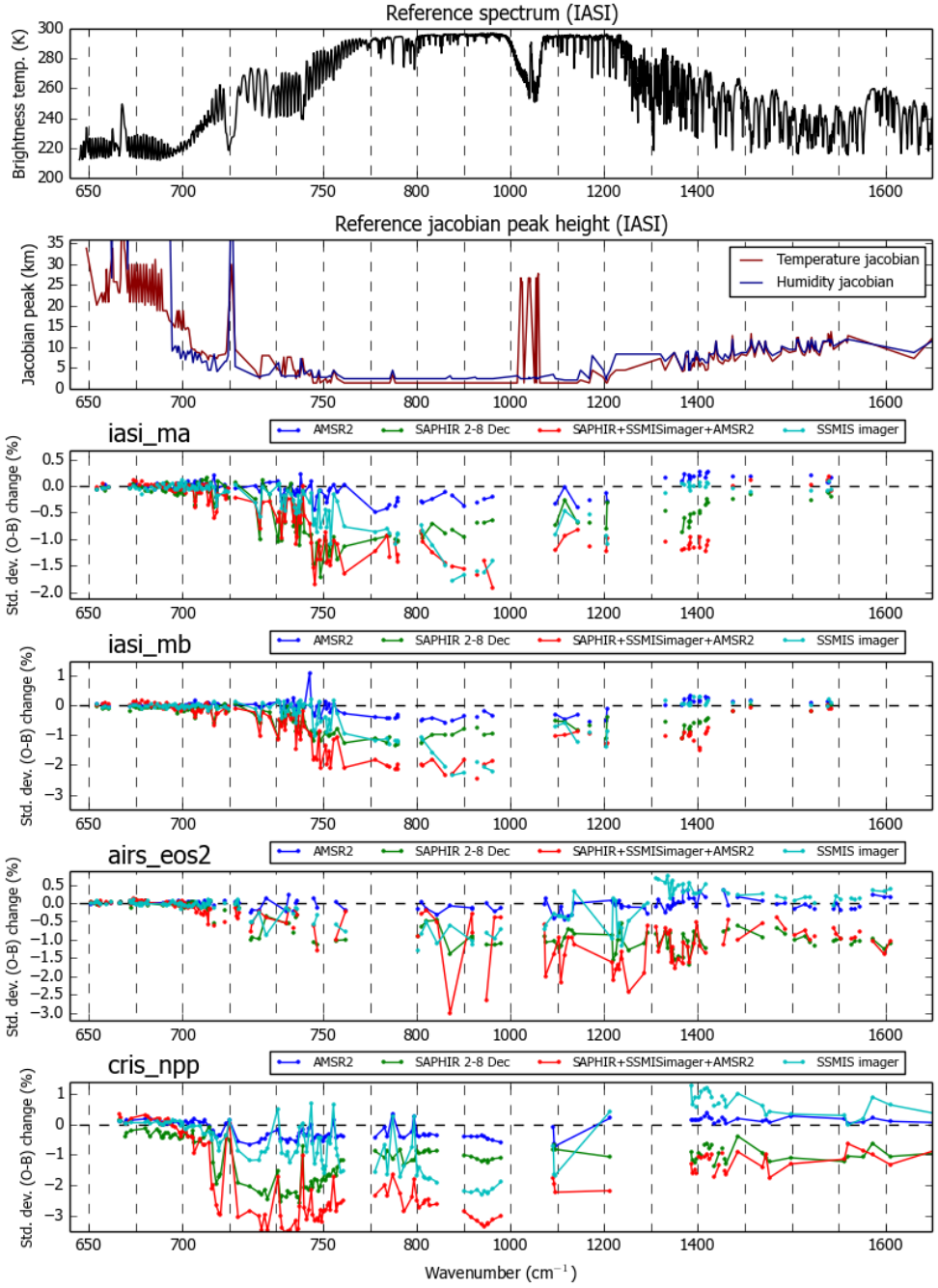






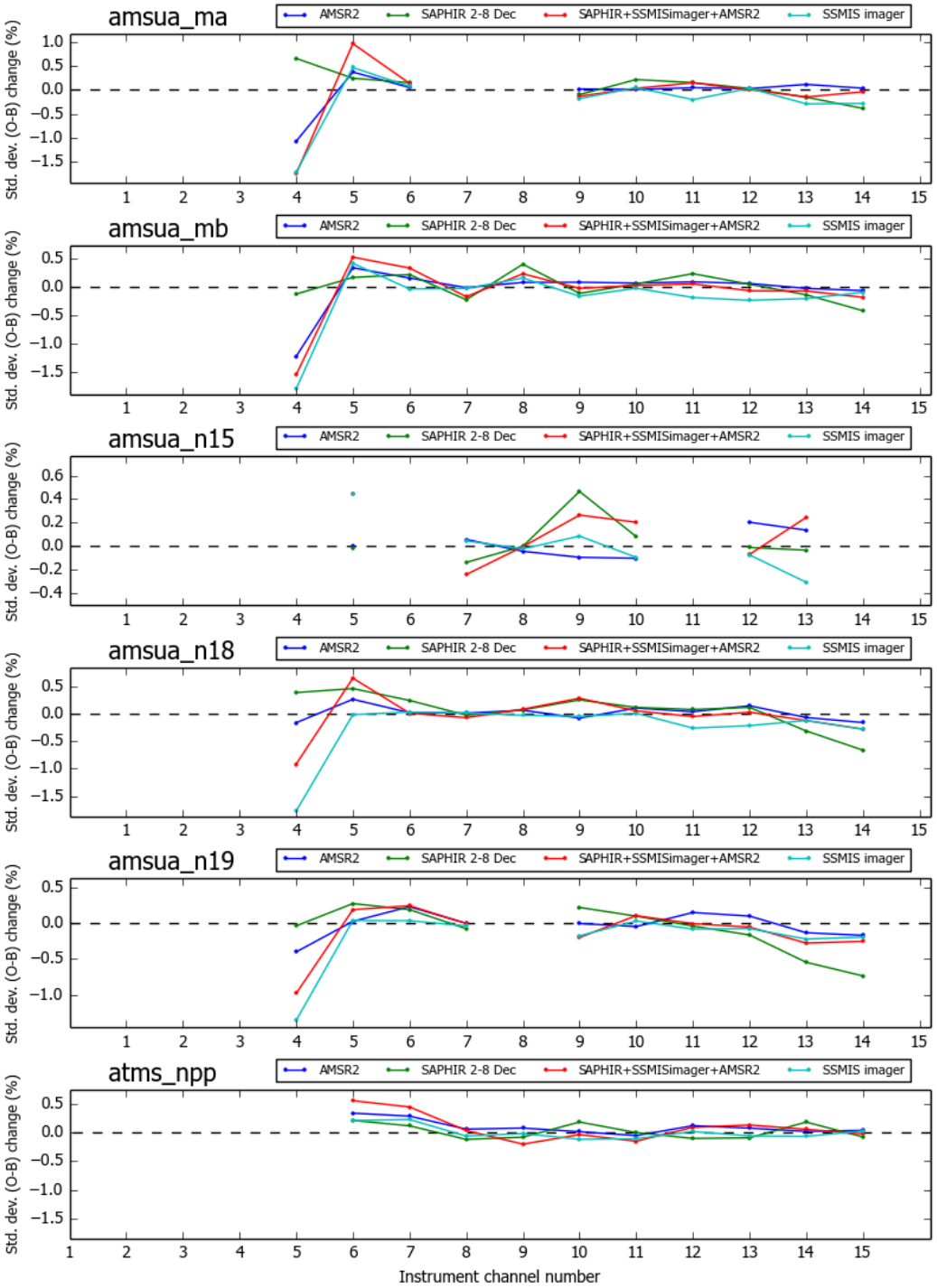
VARSTATS:
Impact of SAPHIR data assimilation on IR, WV and hyperspectral radiances from other satellites

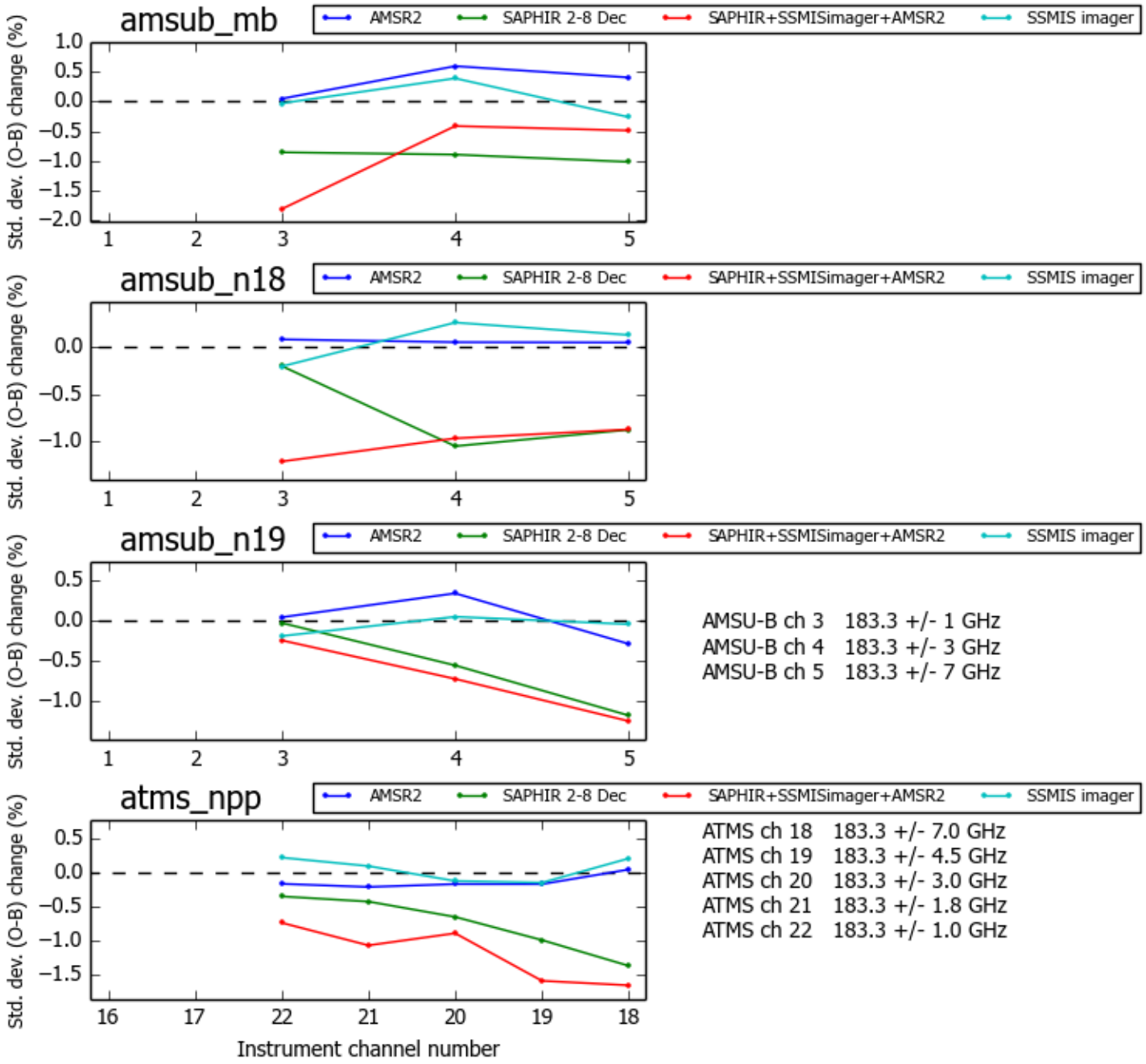
Combined effect of SAPHIR, AMSR2 and SSMIS



- The improved humidity information from the imagers combined with the high resolution SAPHIR data in the vertical would improve on the performance of the imagers.

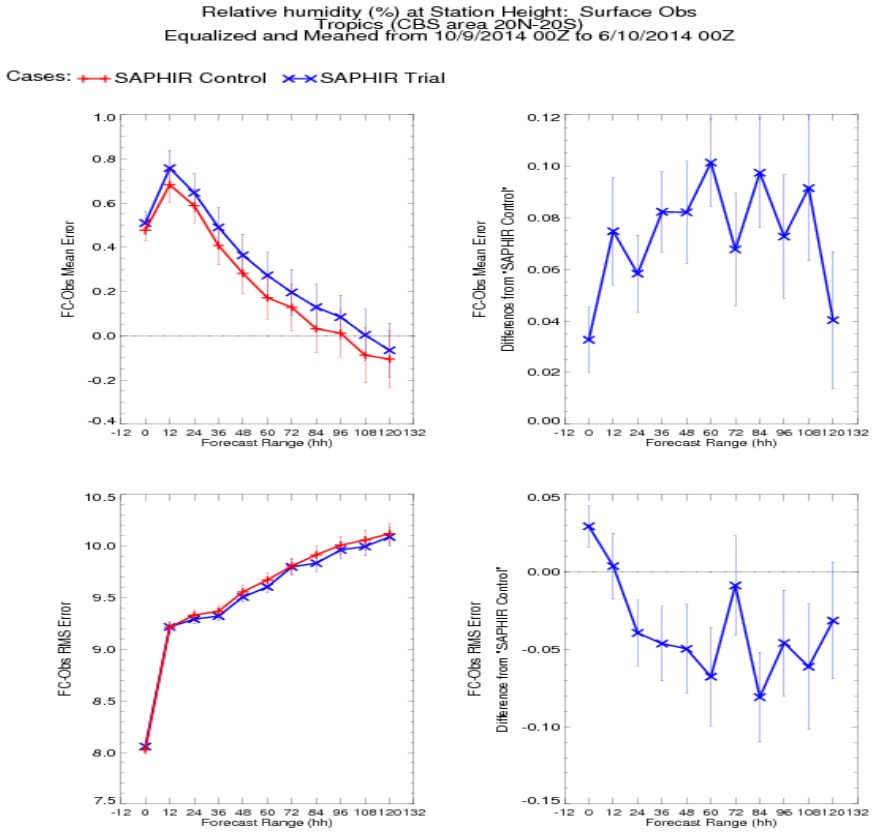
- Combining them improved on SAPHIR's performance too.


amsua_ma
amsua_mb
amsua_n15
amsua_n18
amsua_n19
atms_npp
AMSR2
SAPHIR 2-8 Dec
SAPHIR+SSMISimager+AMSR2
SSMIS imager
Std. dev. (O-B) change (%)
Instrument channel number

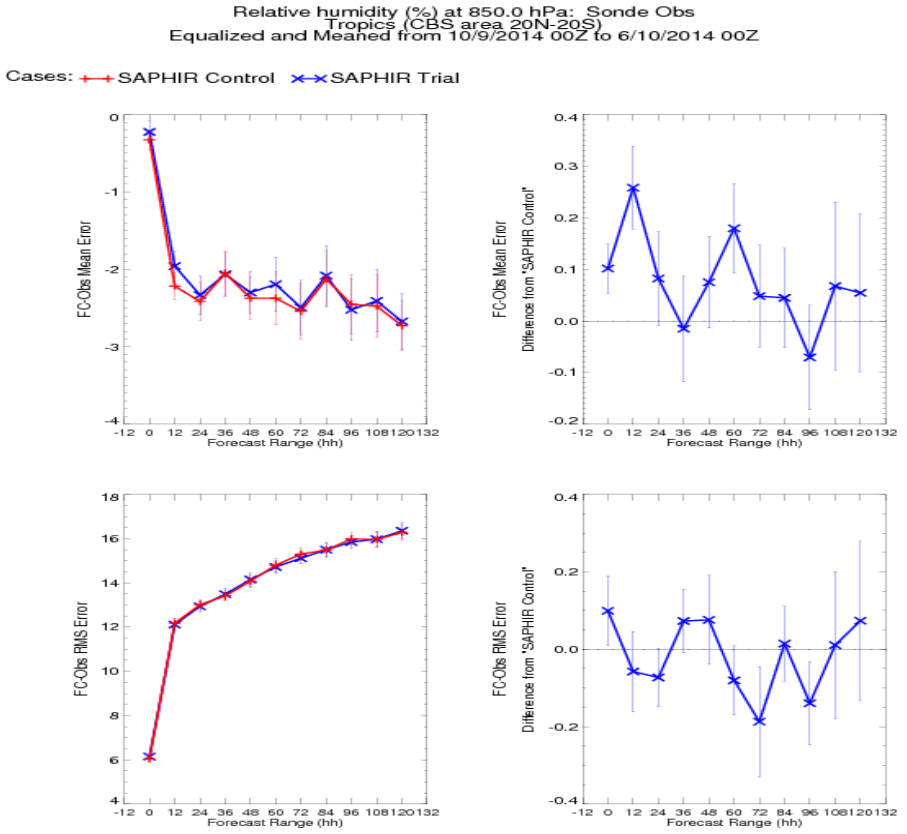

amsub_mb
AMSR2
SAPHIR 2-8 Dec
SAPHIR+SSMISimager+AMSR2
SSMIS imager
Std. dev. (O-B) change (%)
amsub_n18
amsub_n19
atms_npp
Instrument channel number
AMSU-B ch 3 183.3 +/- 1 GHz
AMSU-B ch 4 183.3 +/- 3 GHz
AMSU-B ch 5 183.3 +/- 7 GHz
ATMS ch 18 183.3 +/- 7.0 GHz
ATMS ch 19 183.3 +/- 4.5 GHz
ATMS ch 20 183.3 +/- 3.0 GHz
ATMS ch 21 183.3 +/- 1.8 GHz
ATMS ch 22 183.3 +/- 1.0 GHz

Verification of Analysis (with SAPHIR) against conventional Observations: Over Tropics

Relative Humidity



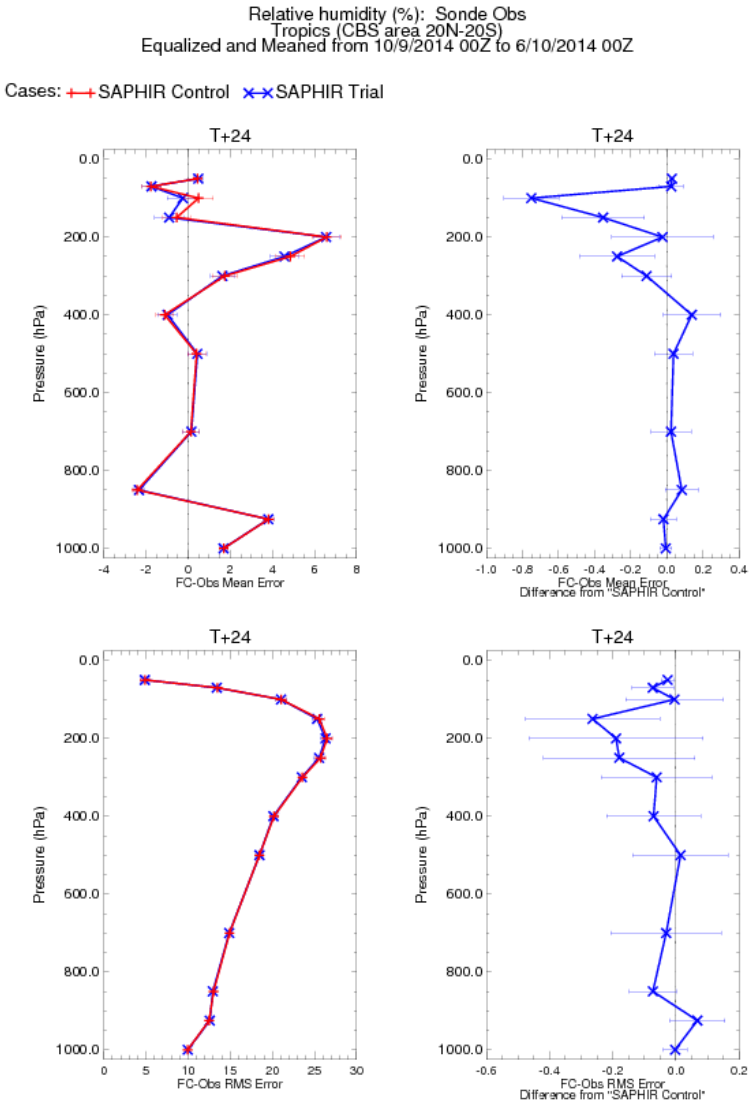
RMSE decreased



Bias decreased

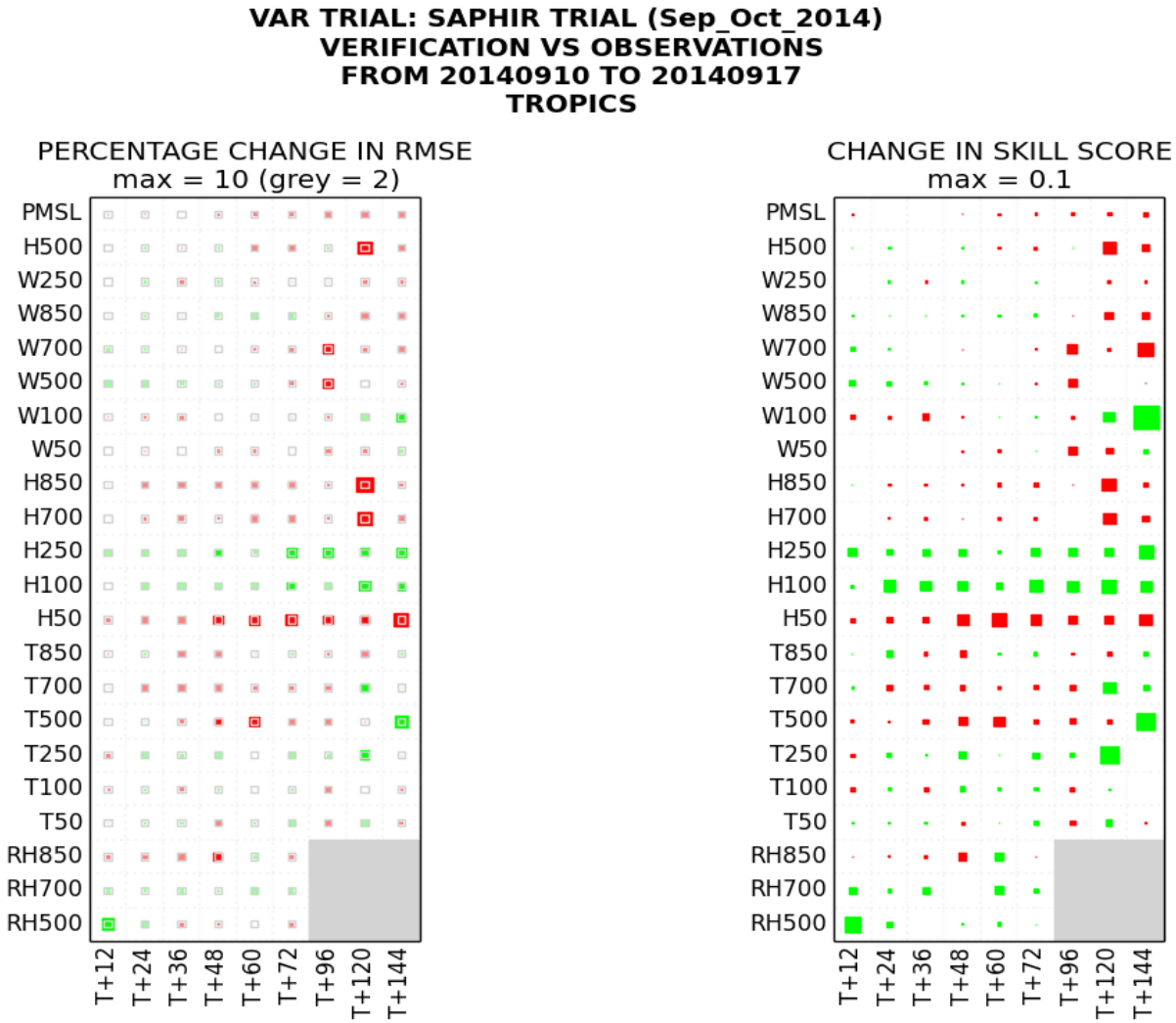
Verification against Observations: Tropics

Relative Humidity: Profiles



Both bias and RMSE decreased

SAPHIR: UK Index (Met Office, UK)



SAPHIR Assimilation changed t he NWP-Index by 1.82%.
Changes are visible in RH, Temperature and Height

Conclusions

Initial test run (assimilation and forecast) shows positive impact of SAPHIR Microwave Radiances in Unified Model (UM) Assimilation-Forecast System.

Inclusion of SAPHIR radiances in the UM Data Assimilation system reduced the standard deviation of radiances from MW, IR and WV instruments onboard other satellites.

SAPHIR Assimilation - NWP index improved 0.367% and UK Index improved 1.82% over Tropics.

Improvements are clearly visible in RH, Temperature and Height fields

Acknowledgements

National Monsoon Mission (NMM) program of Ministry of Earth Sciences (Government of India) funded my visit to Met Office, UK .

THANKS