Comparisons between measured and modeled brightness temperatures at 183 GHz

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Introduction

- The GMI passive radiometer will include **high frequency channels** not present on the TMI radiometer – three channels around the 183 GHz water vapor line and one at 166 GHz. These channels can be used for sensing of frozen hydrometeors.
- GPM mission concept will rely on a **constellation of satellites** to derive consistent precipitation estimates with global coverage and high sampling frequency.
- **Radiometer intercalibration is a critical component of obtaining accurate precipitation retrievals from satellite constellations**, and removing intersatellite differences will be of vital importance for the success of the GPM mission.

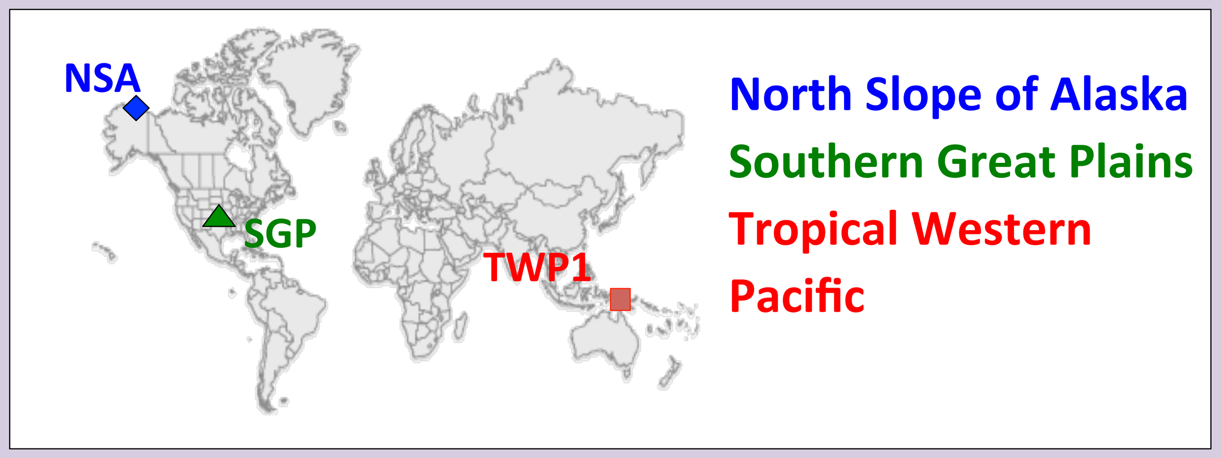
Work to date has focused on comparisons between the 183 GHz channels of the MetOp MHS, NOAA-18 MHS, NOAA-17 AMSU-B, NOAA-16 AMSU-B and NOAA-15 AMSU-B instruments for one year of data (2008). The approach adopted here was to compare measurements from each of these instruments with radiative transfer model simulations using the radiosonde-based "Merged Sounding" product for the specification of the atmospheric state over DoE ARM sites located in the Southern Great Plains (SGP), Oklahoma, the Tropical Western Pacific (TWP1) and the North Slope of Alaska (NSA). An important feature of our approach is the use of well-validated radiative transfer modeling tools, using up-to-date water vapor spectroscopy to accurately model the water vapor absorption.

Approach

Aim for "reference" calculations.

Goal is to use best available input to the RTM in order to minimize the uncertainties in calculated TBs.

Avoid surface influence:
Use channel-dependent total column H_2O thresholds



North Slope of Alaska
Southern Great Plains
Tropical Western Pacific

Temperature, H_2O profiles: Merged Sounding product (MS) from DoE ARM sites
Sophisticated interpolation of radiosonde profiles
1 minute temporal resolution
Attempts to correct for **known radiosonde biases**
Assume MS are our **best estimate of "truth"**

- Monochromatic Radiative Transfer Model (MonoRTM)
- Developed at AER
- Publicly available: http://rtweb.aer.com

Surface Properties

Atmospheric State

Radiative Transfer Model

Spectroscopic input:
- Line parameters, line mixing, continuum absorption
- Carefully validated against high-quality, ground-based measurements

•Cadeddu et al., 2007, Payne et al., 2008, Payne et al., 2011

Spectroscopic Line Parameters, Continua

Satellite TBs

COMPARE

One year of measurements: 2008
Cross-track radiometers
–MetOp-A MHS
–NOAA-18 MHS
–NOAA-17 AMSU B
–NOAA-16 AMSU B
–NOAA-15 AMSU B
Satellite Tb data obtained via NOAA CLASS site
– Data supplied **without antenna pattern correction**
"Clear-sky" measurements where footprint center within 8 km of an ARM site

GPM concept:

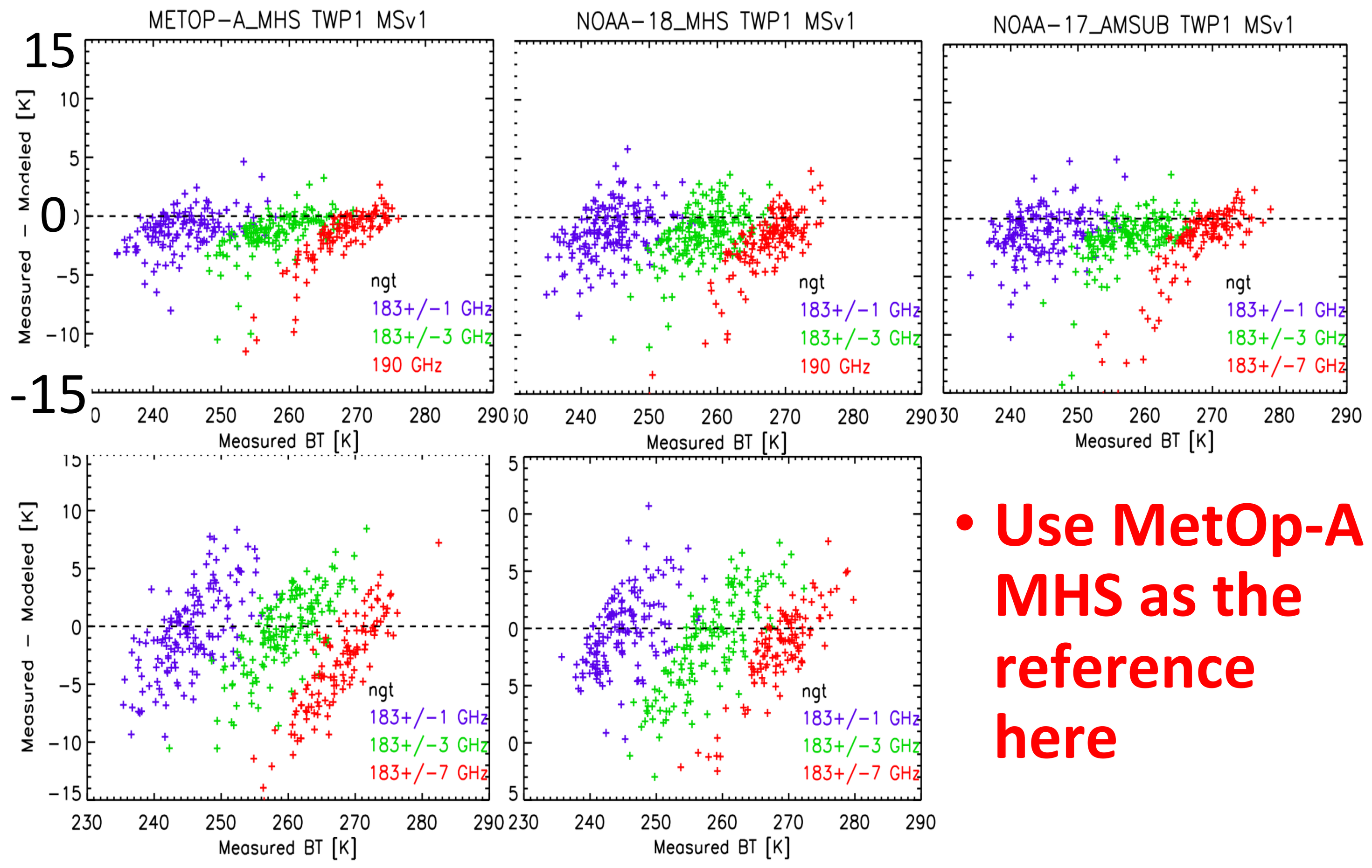
- **Sensors referenced to GPM core satellite**
- Goal for 183 GHz channels:
  - Inter-instrument differences < **~1 K**

Single differences

- D_A = $Measurement_A$ – $Calculation_A$
- D_B = $Measurement_B$ – $Calculation_B$

Double difference = D_B – D_A

Single differences at the TWP1 site, SZA>90. All scan angles.

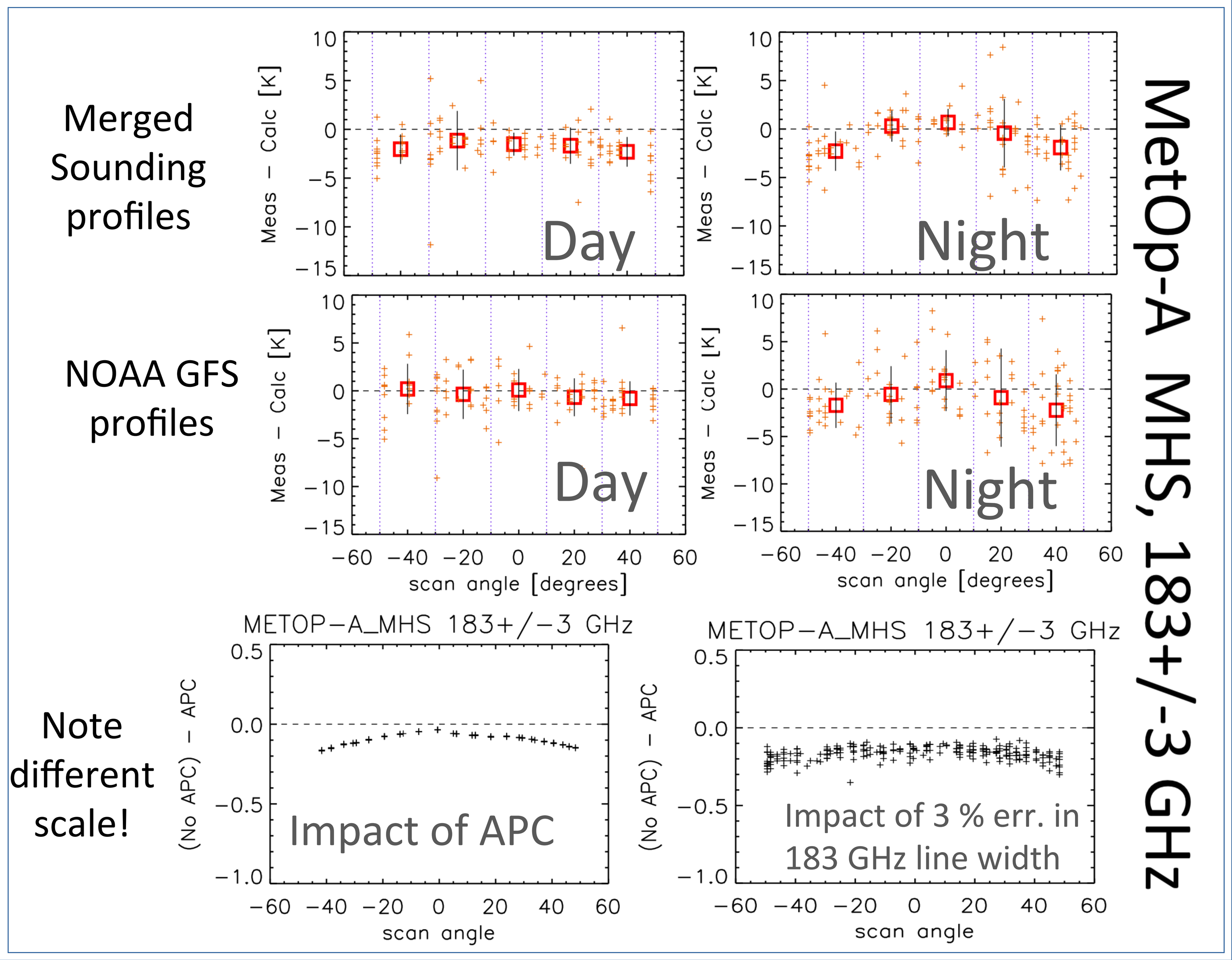


- **Use MetOp-A MHS as the reference here**

How good is the reference sensor?

All AMSU-B/MHS instruments and channels show **scan angle dependence** in the model/measurement differences at all three sites.
Scan angle dependence is stronger in night-time comparisons.

Antenna pattern correction? Too small
Uncertainty in spectroscopic input? Too small
Effect of antenna slidelobes on measured TBs?
Systematic errors in humidity profiles used as input to the RTM?

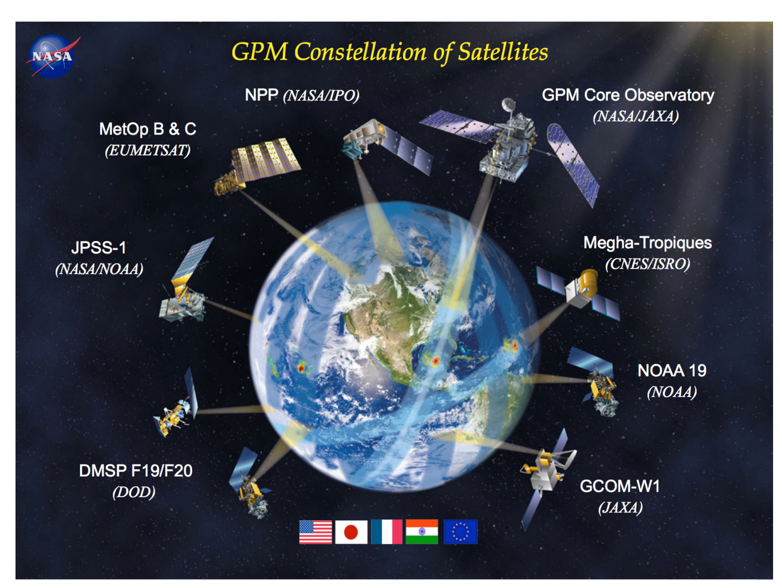


Future work

Using approach described here, we will quantify model/measurement differences, based on best available inputs, for 183 GHz sensors for the GPM era, in readiness for launch of the GPM core satellite.

GPM-era sensors:
- MHS on the MetOp satellite series
- MHS on NOAA-19
- SAPHIR on Megha-Tropiques
- ATMS on NPP
- ATMS on the JPSS satellites
- SSMIS instruments on DMSP satellites

We will continue to quantify intersatellite differences based on this approach and compare with results from other approaches utilized within the GPM Cross-Calibration (XCAL) Working Group.



http://pmm.nasa.gov/GPM/constellation-partners

Also see talk at 4.10 pm on Wednesday!