UTILIZING BRIGHTNESS TEMPERATURE HISTOGRAMS FOR MICROWAVE RADIOMETER HIGH FREQUENCY (150-183 GHZ) CALIBRATION

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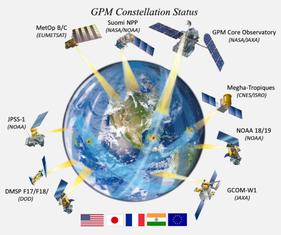
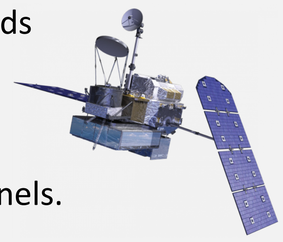
Introduction

On-orbit calibration of spaceborne microwave radiometers is necessary to correct for:

- Solar intrusions
- Attitude offsets
- Calibration drifts
- Scan obstructions
- Intercalibration

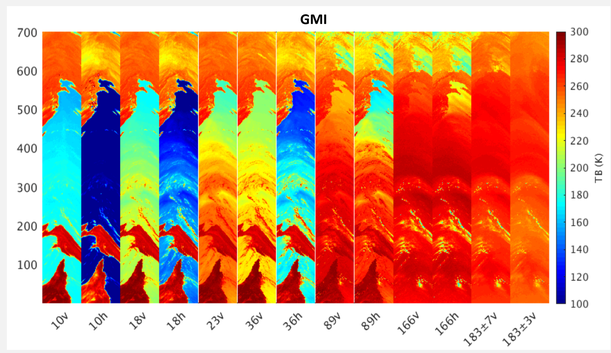


Utilizing several unique methods for on-orbit calibration give confidence to results. This presentation describes a new method for 150-183 GHz channels.



Background

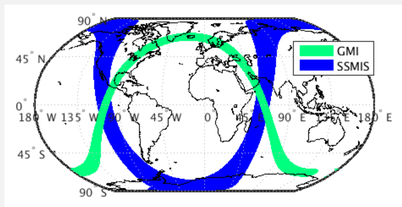
Microwave frequencies from 10 to 183 GHz see very different Earth scenes



On-orbit calibration methods may vary for different microwave frequencies due to the relative sensitivity to the surface or atmosphere

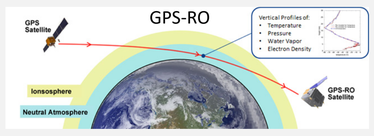
Current calibration methods for 150-183 GHz

Cross-over points



Comparisons with RTM

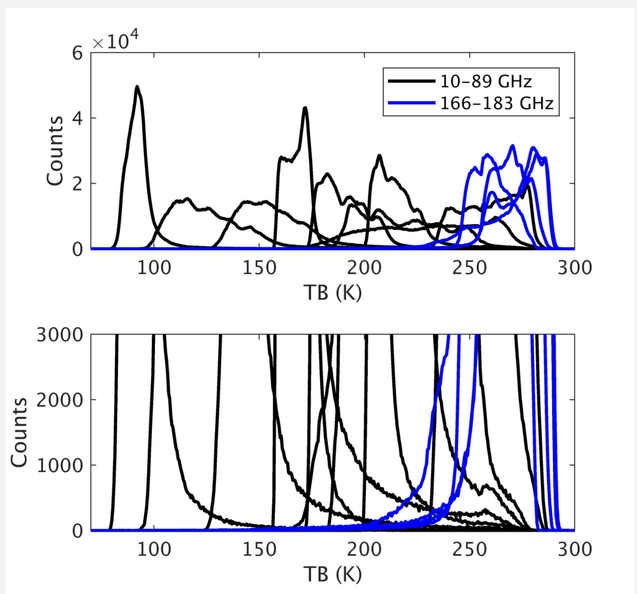
Natural Targets



New method described here uses brightness temperature (TB) histograms

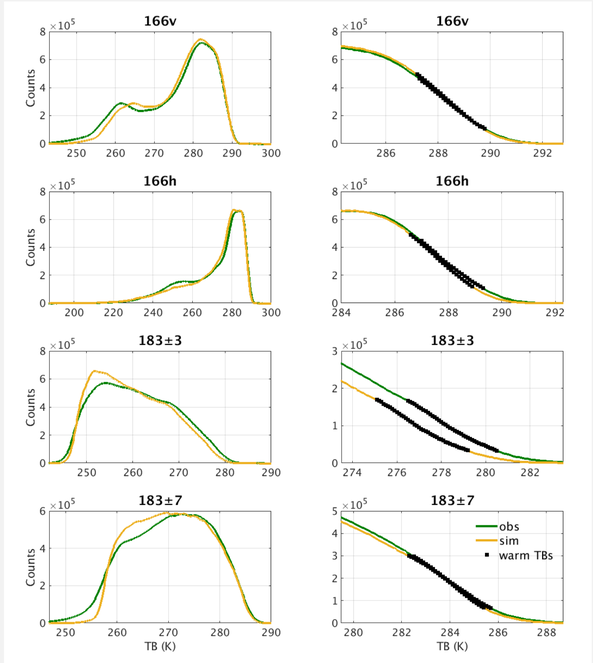
Method

GMI TB histograms for one month of observations



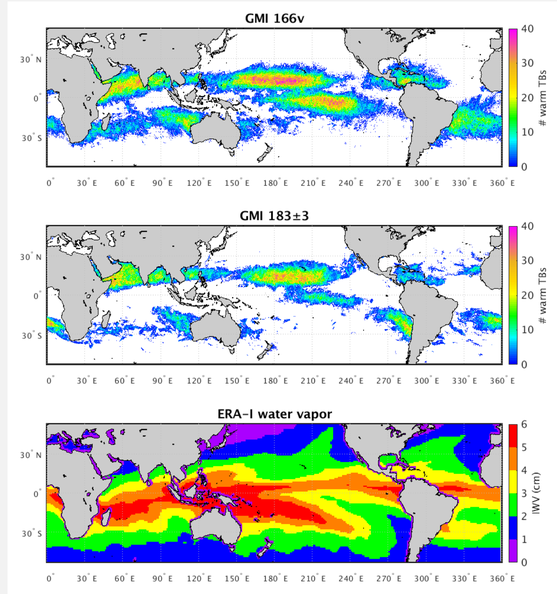
10-89 GHz: cold side of histogram has sharp edge
166-183 GHz: warm side of histogram has sharp edge

GMI observed (obs) and simulated (sim) histograms



- Shapes of obs and sim histograms similar at warm end
- Black dots indicate portion of histogram used for calibration
- Use single difference (SD: obs – sim) to analyze radiometer calibration

Where do the warm TBs occur?

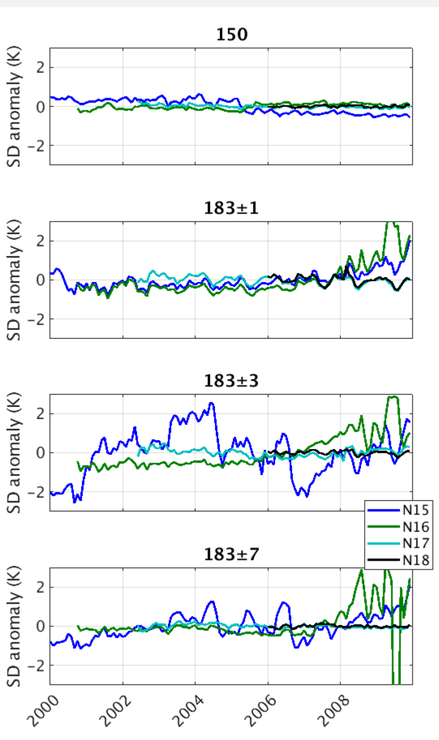


Warm TBs occur in tropical regions with minimal water vapor

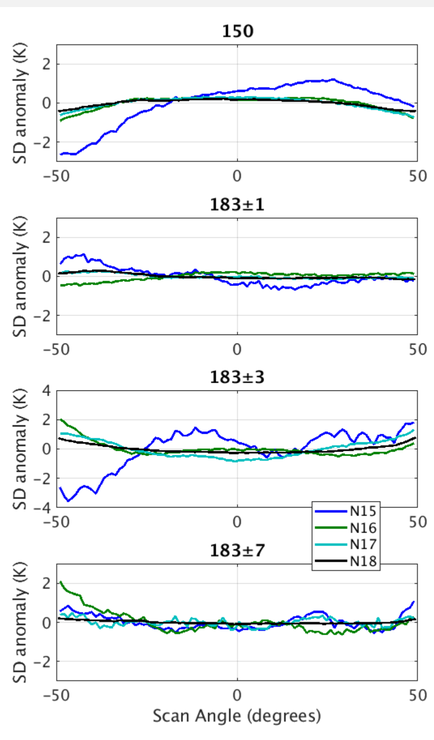
Results

AMSU-B and MHS

Time Series



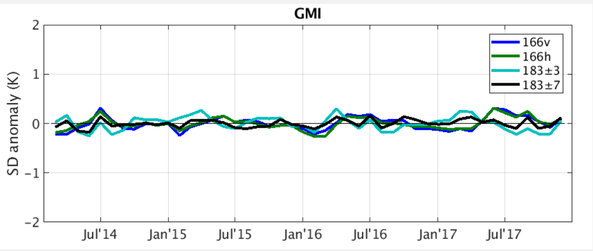
Scan Bias



N15 and N16 AMSU-B have significant calibration drifts and scan biases. N17 AMSU-B and N18 MHS are relatively stable.

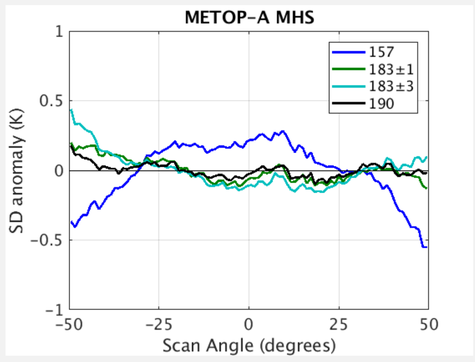
GMI

Time Series



GMI shows no evidence of a calibration drift.

RTM Uncertainty



Cross-track biases for METOP-A MHS. 157 GHz biases most likely due to RTM uncertainty.

Summary

New on-orbit calibration method is presented for microwave radiometer 150-183 GHz channels

- Utilizes the shape of brightness temperature histograms
- Can be used in combination with other methods to corroborate results
- Does not require cross-overs between satellites or observations of a specific region
- Application to cross-track sounders and conical imagers show promising results

Future Work

- Mitigate impact of RTM on sounder cross-track scan biases
- Improve intercalibration of similar but different channels (e.g. 150 with 166 GHz)

References

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