

RSS GMI Calibration

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Remote Sensing Systems

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GMI Instrument

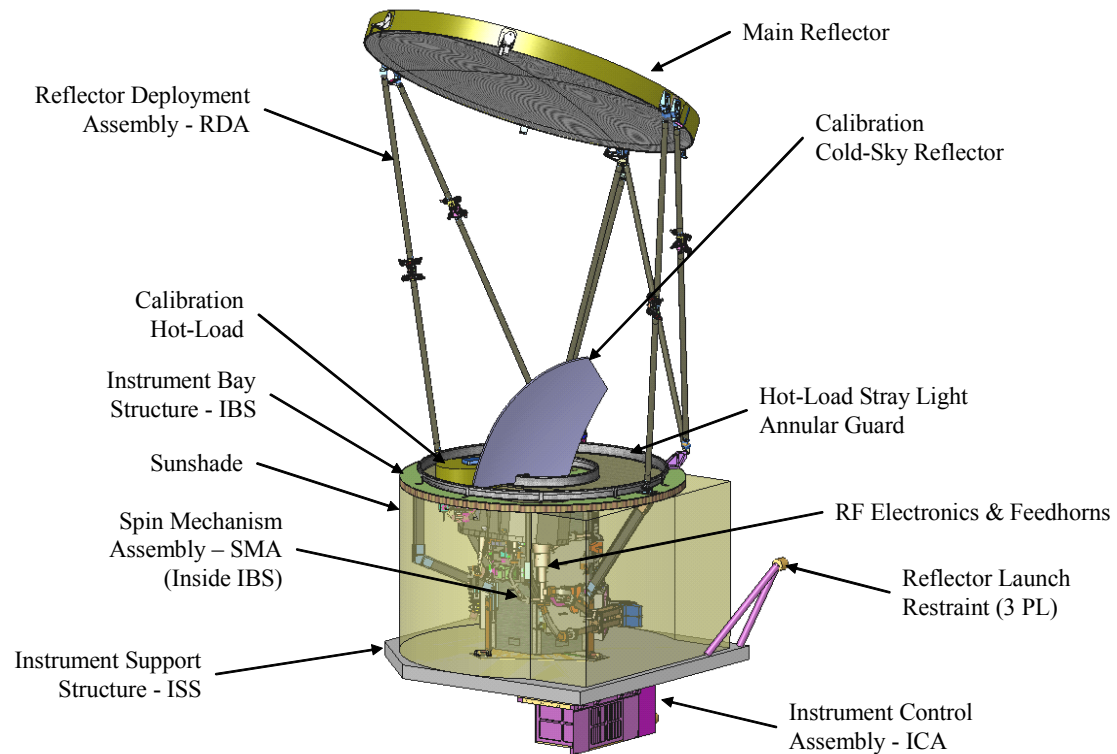


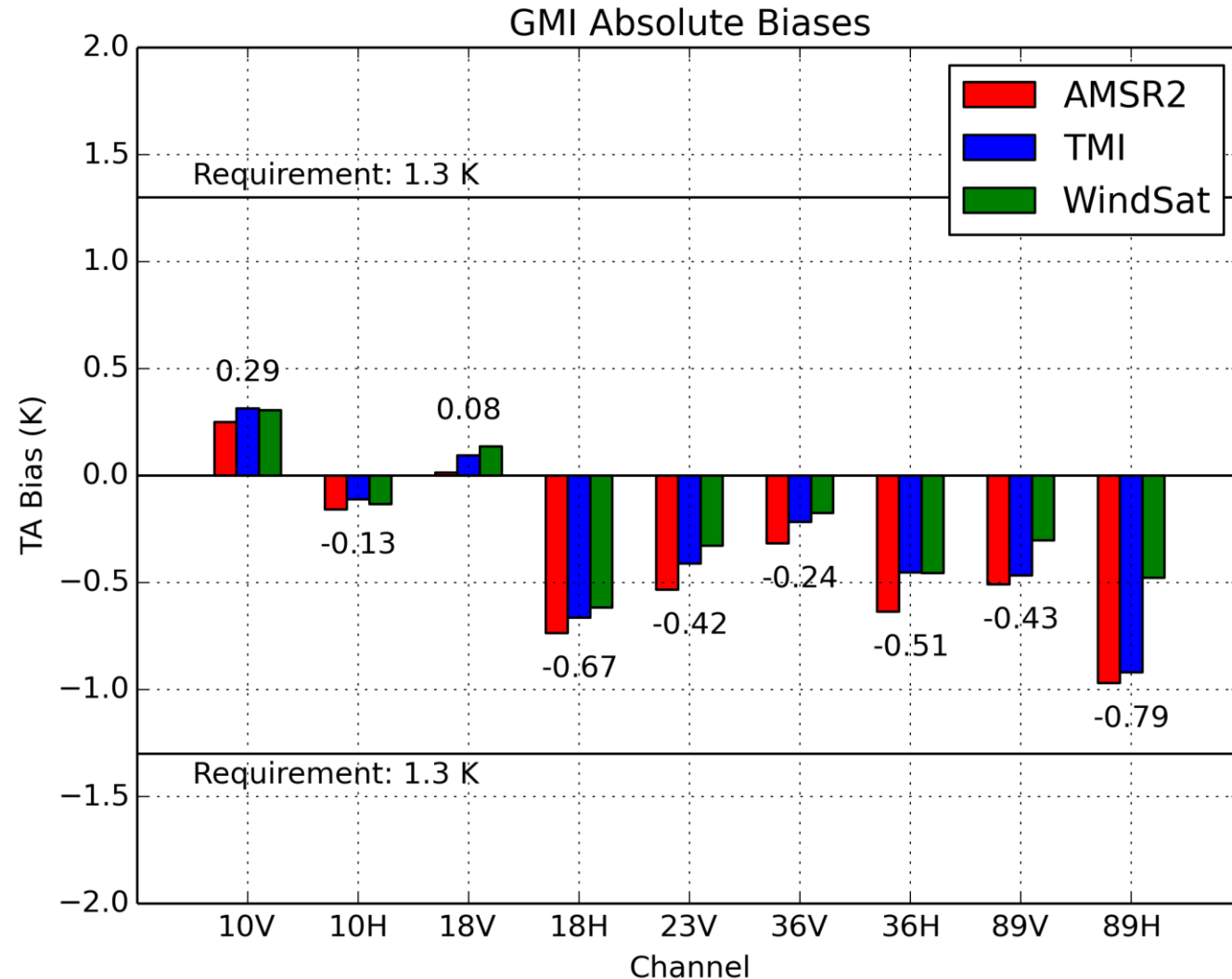
Figure: GMI instrument deployed configuration

- Gain-temperature characteristics are highly stable in time
- 10V and 36V noise diodes exhibited some drift, but appear to be stable
- Hot load shows no anomalous behavior over more than one entire beta angle cycle
- RFI in cold view is addressed by algorithms

Data and Methodology

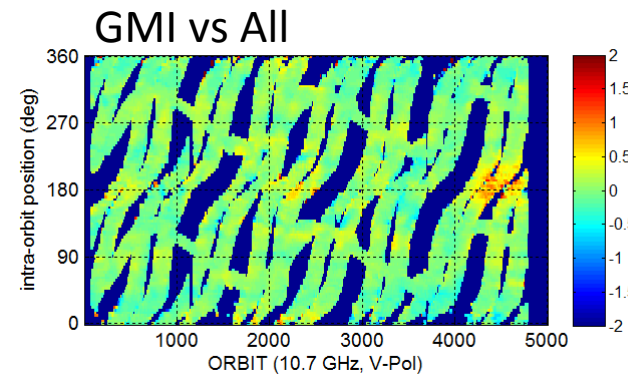
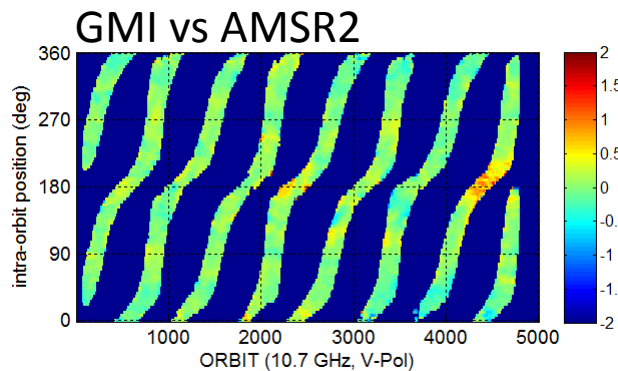
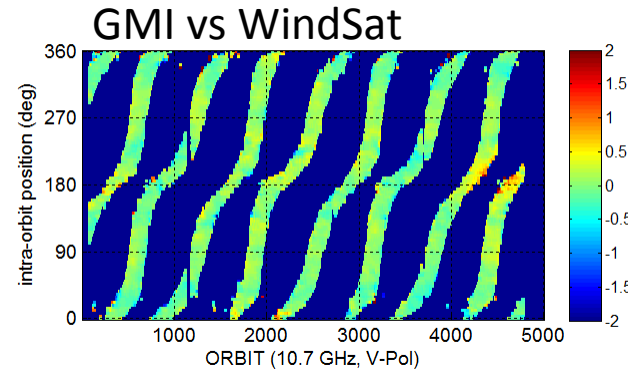
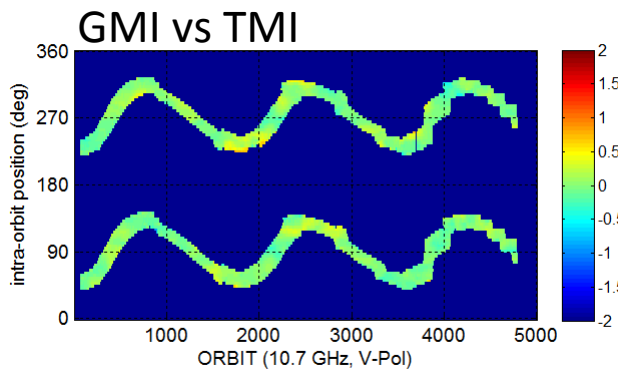
- Time period of GMI data used: March 4, 2014 through December 31, 2014
- Goddard GMI data is from 1Base-RSS.GPM.GMI files
- Calibration is Ball/RSS Version 3B
- Methodology: Minimize GMI measured minus RTM antenna temperature differences
- RSS Version 7 ocean parameters
 - AMSR2, TMI, and WindSat
 - Wind speed, water vapor, cloud liquid, and rain (flag)
 - Require: data within 1 hour and 25 km
- Reynolds OI SST
- NCEP GDAS wind direction
- RTM gives TB, use GMI antenna pattern matrix to get TA
 - Reference: *RSS ATBD GMI Calibration Algorithm and Analysis, Version G, April 2012*
 - Assumed main reflector emissivity is zero
- Verified results with deep space calibration and Amazon calibration

GMI Absolute Calibration



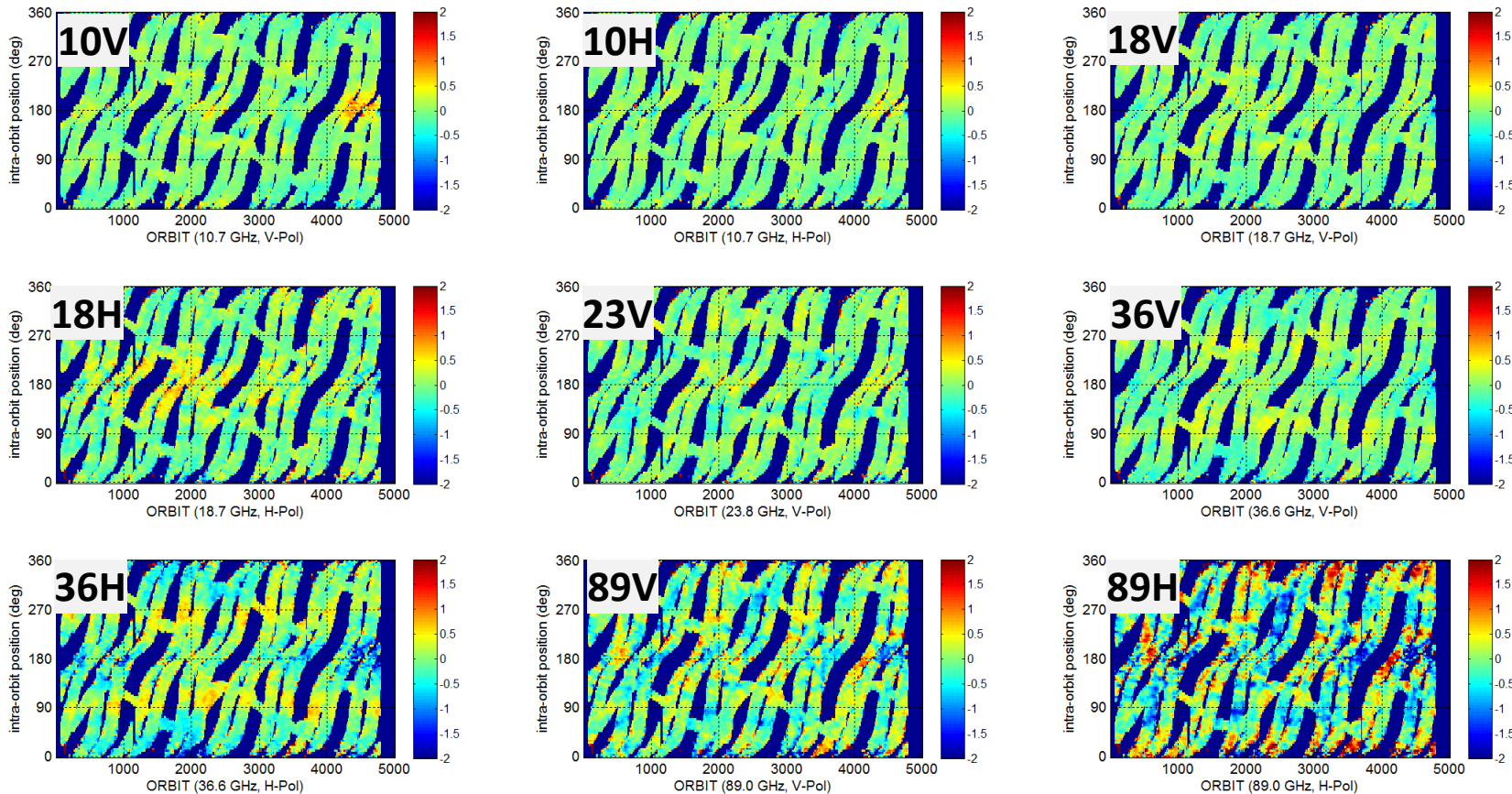
- Figure: GMI TA minus RTM
 - AMSR2 (red)
 - TMI (blue)
 - WindSat (green)
- Biases are within the 1.3 K requirement, and are generally less than 0.5 K
- GMI biases tend to be slightly cool compared with other satellites
- 18H bias is consistent with cold sky results
- Results are consistent within 0.2 K among sensors, except at 89H

Mission Plots for Each Satellite



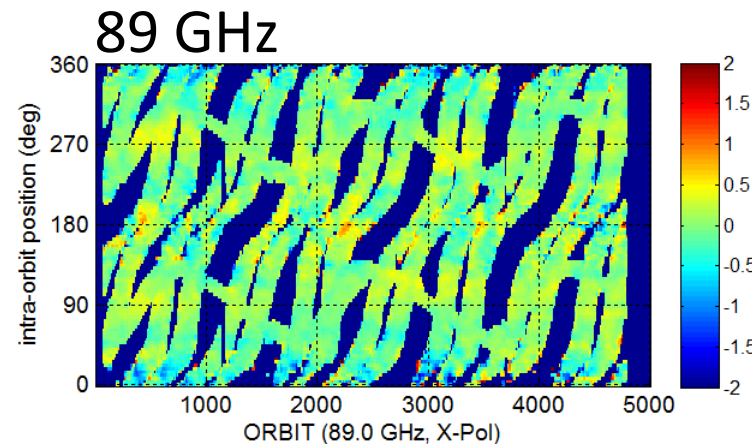
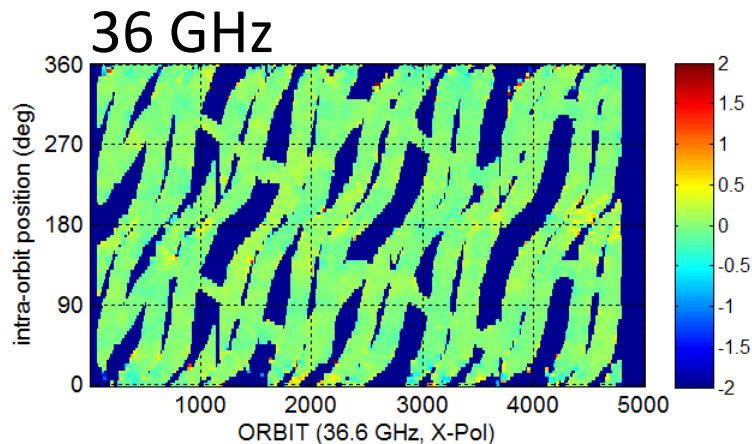
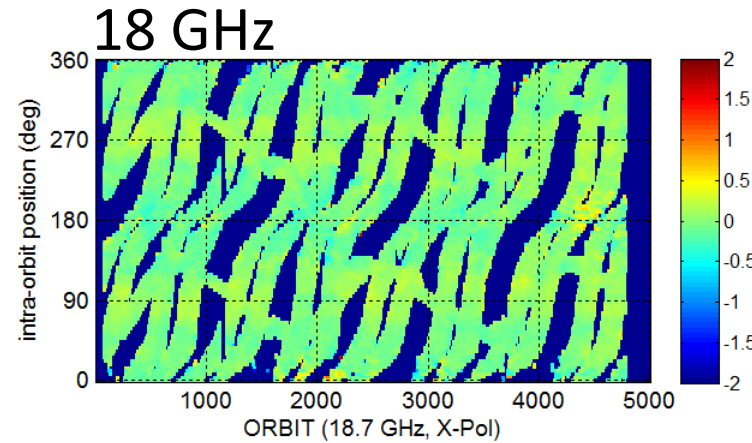
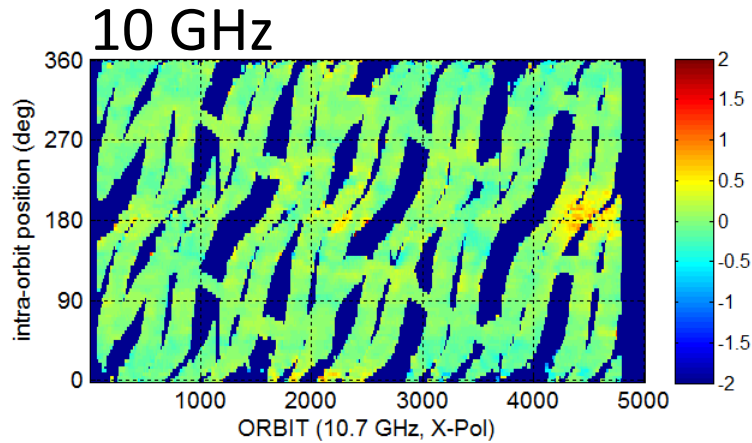
- Figure: GMI minus RTM TA versus orbit number and position within orbit for 10V channel
- Intra-orbit position:
 - 0° position = 65°S
 - 180° position = 65°N
- Color scale: +/- 2 K
- Collocations with TMI have preferred latitudes that vary slowly with time
- TMI, WindSat, and AMSR2 find consistent results
- Differences of 0.5-1.0 K present in 10V during December 2014

Mission Plots for Each Channel



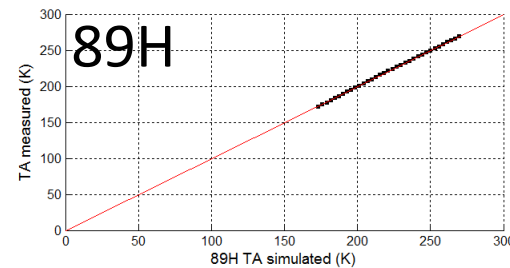
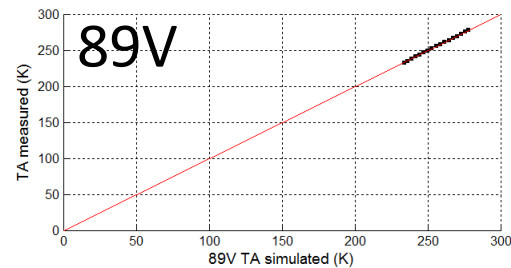
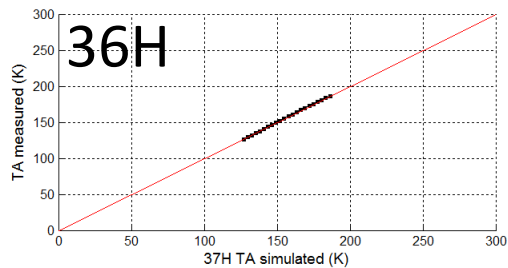
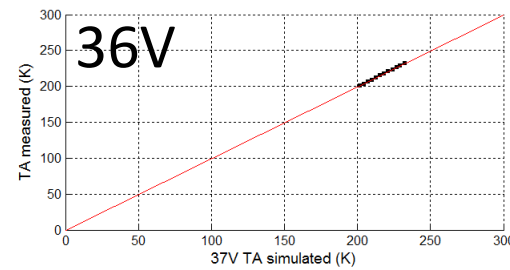
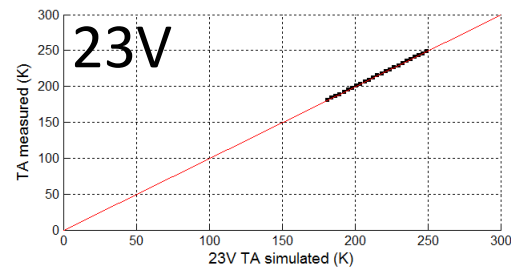
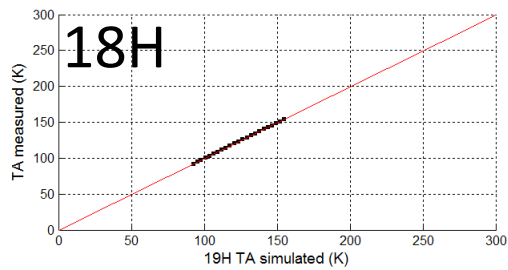
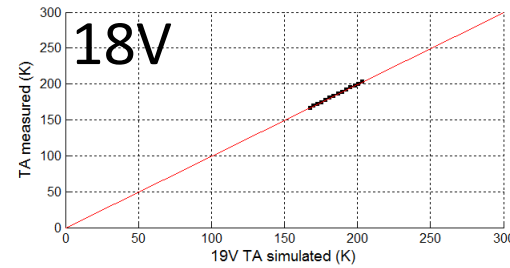
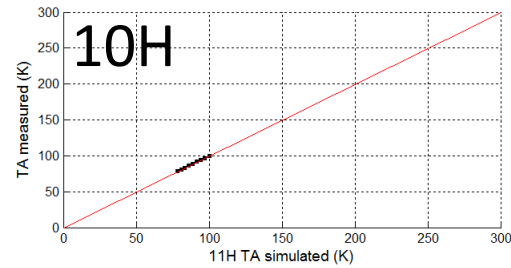
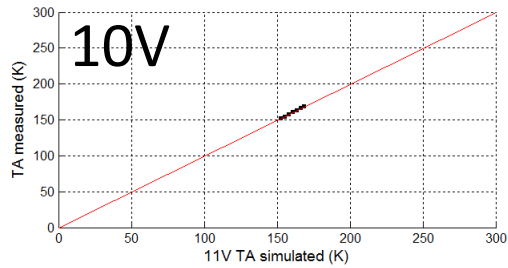
- Figure: GMI minus RTM TA versus orbit number and position within orbit
- Separate satellite mission plots in backup slides
- High-latitude northern hemisphere warm biases 0.5 - 1.0 K in 10V in December 2014 and in 18H in June 2014
- Those differences are most obvious in AMSR2, but also in WindSat; too far north for TMI
- 36 and 89 GHz have 0.5 K and larger differences through tropics, likely due to atmosphere

Mission Plots for V-H/2



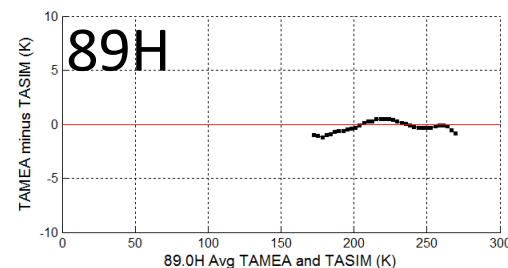
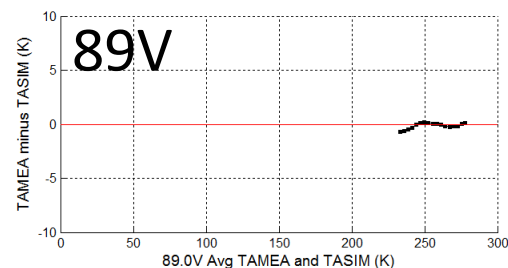
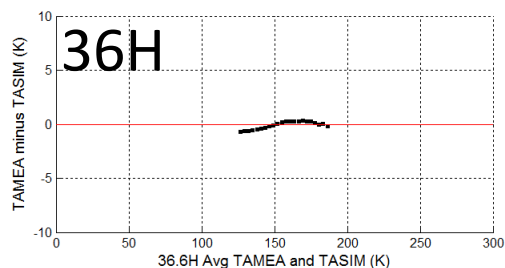
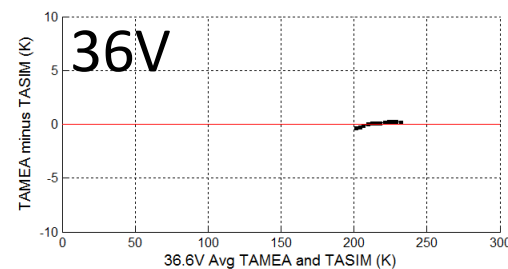
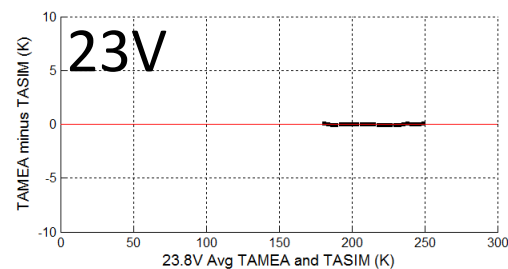
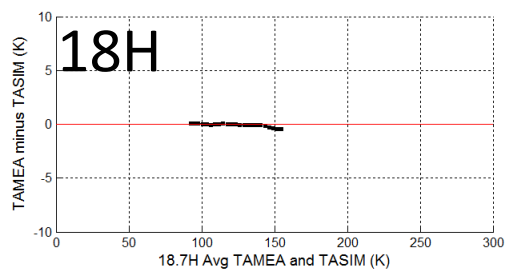
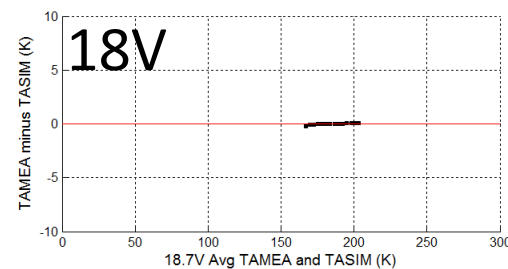
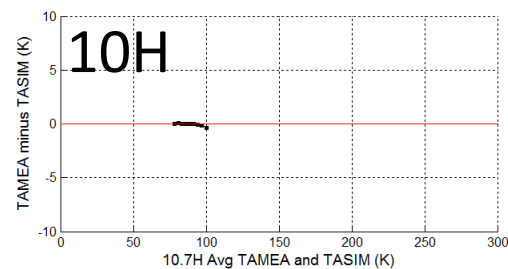
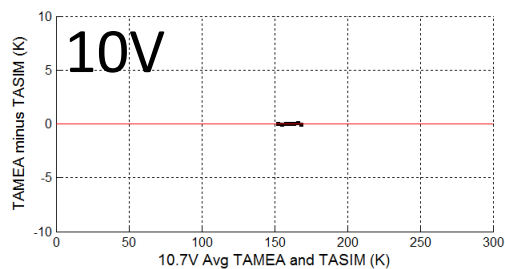
- Figure: GMI minus RTM TA versus orbit number and position within orbit
- V-H/2 combination minimizes atmospheric effects
- 10 GHz anomaly still present, but gone from 18 GHz
- 36 GHz differences well below 0.5 K
- Largest 89 GHz differences are about 0.5 K

Bias vs Scene Temperature



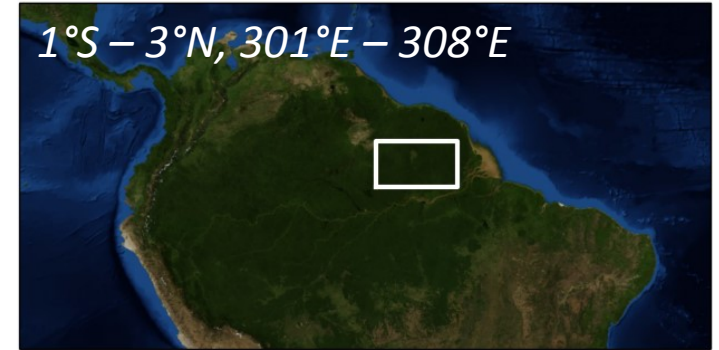
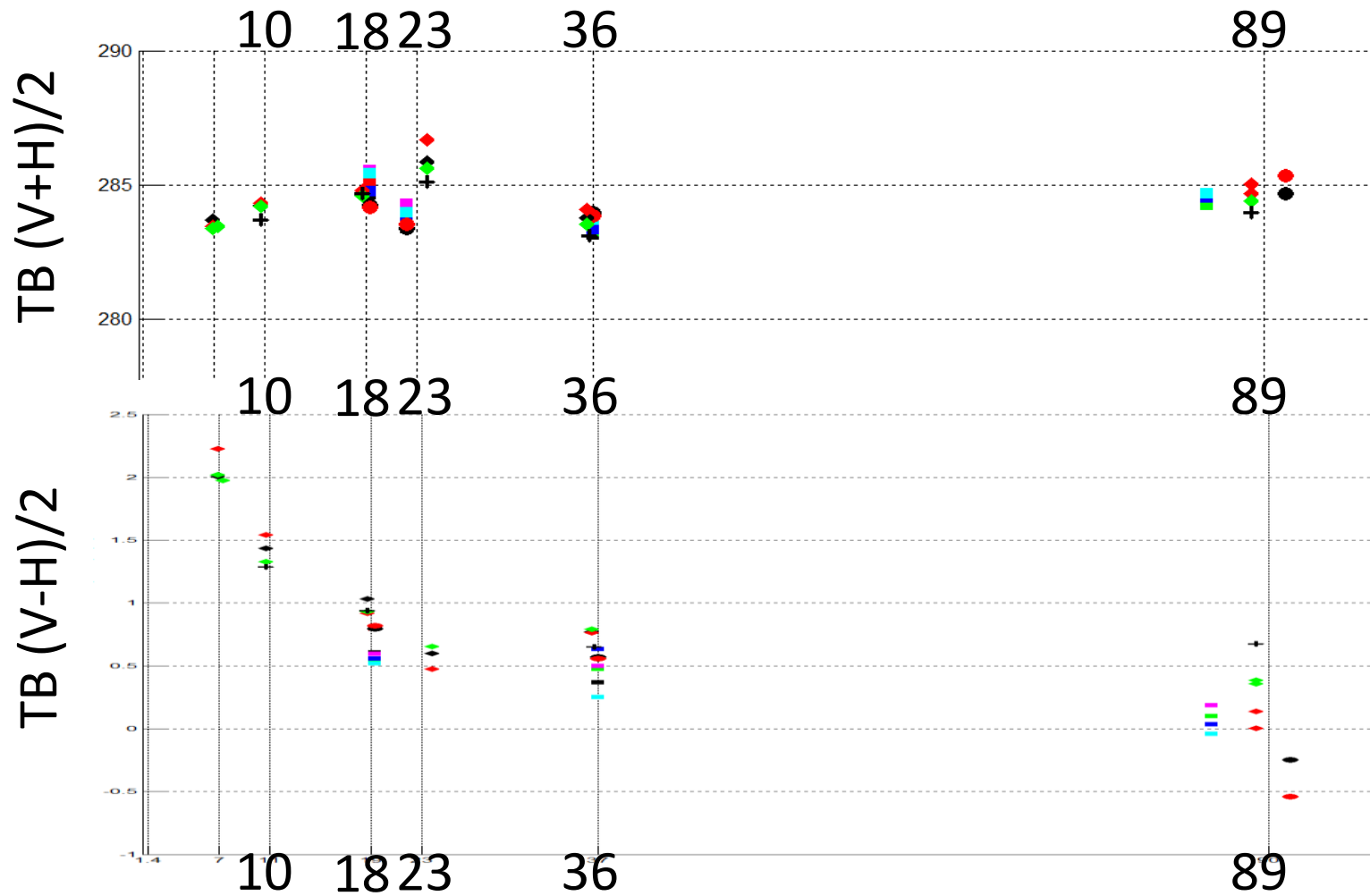
- Figure: GMI TA versus RTM TA
- This is after performing non-linearity correction (*ATBD 2012*)
- The feel good slide

Bias vs Scene Temperature



- Figure: GMI-RTM TA bias as a function of average TA scene temperature (average of measured and rtm TA)
- This is after performing non-linearity correction (*ATBD 2012*)
- Below 36 GHz curves are flat and zero
- Differences at most 0.5 K for 36 GHz and 1.0 K for 89 GHz

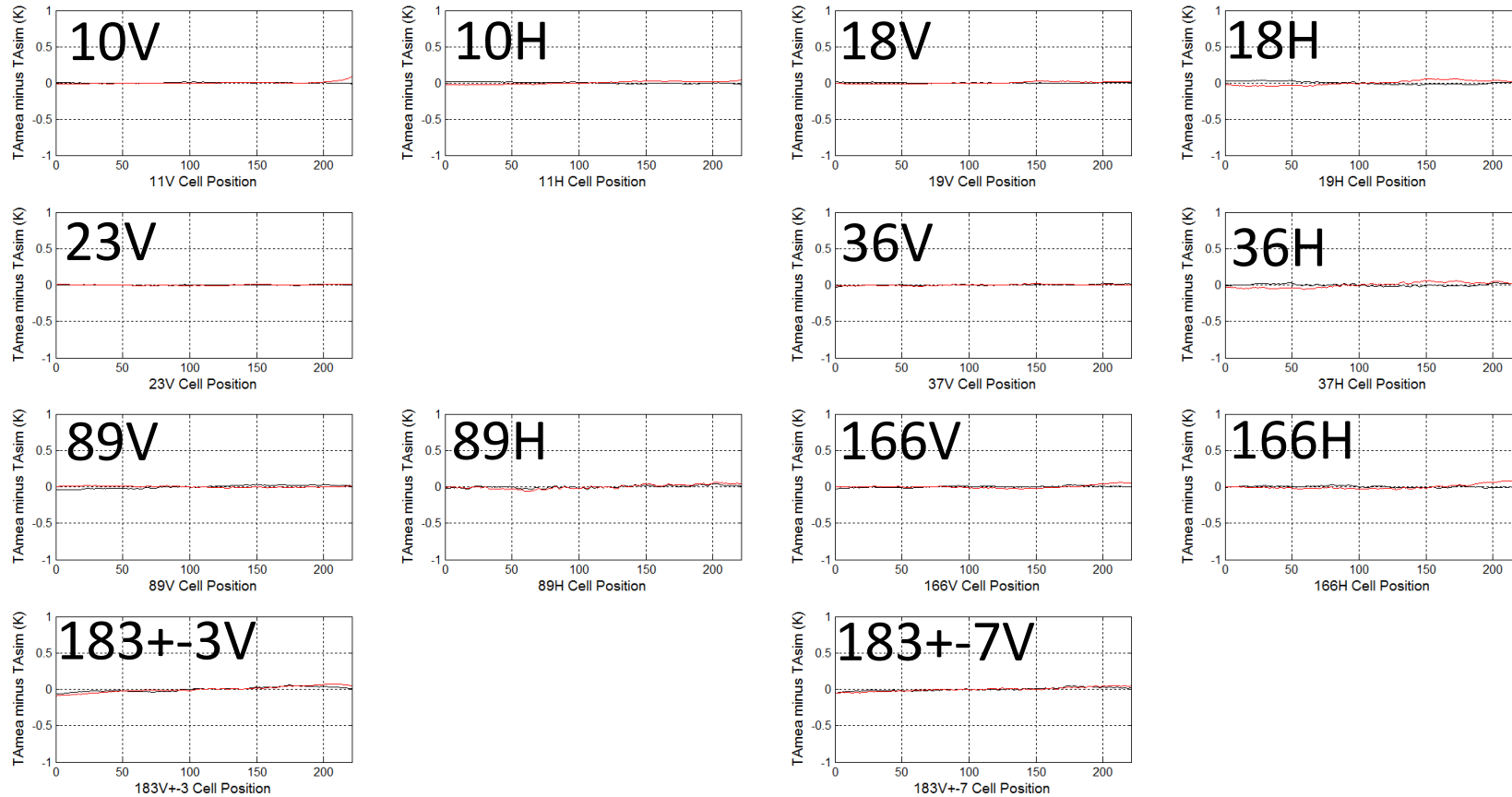
Amazon Calibration



- Figure: day/night average of TB, 1st (top) and 2nd (bottom) Stokes
- GMI: black cross
- Others: WindSat (black diamond), AMSR-E (red diamond), AMSR2 (green diamond), F16 (black circle), F17 (red circle), SSMI (squares)
- Calibration is to rain-free ocean scenes, if response function is linear and physical calibration model is corrected, should be no need for separate land calibration
- Assumption of linearity is good to at least 1 K

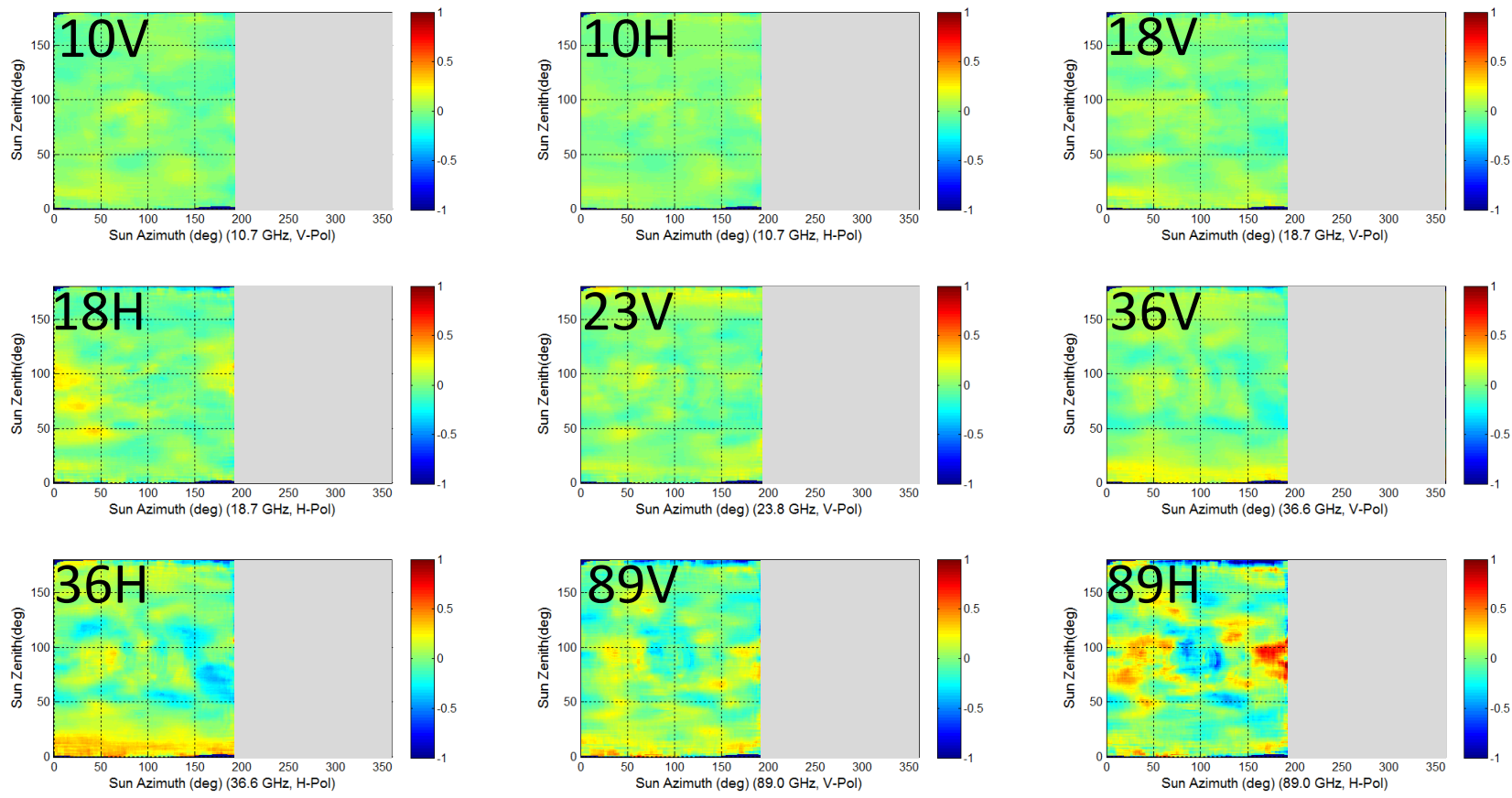
Note: These results are from V03A for first 3 months.

Biases vs Scan Position



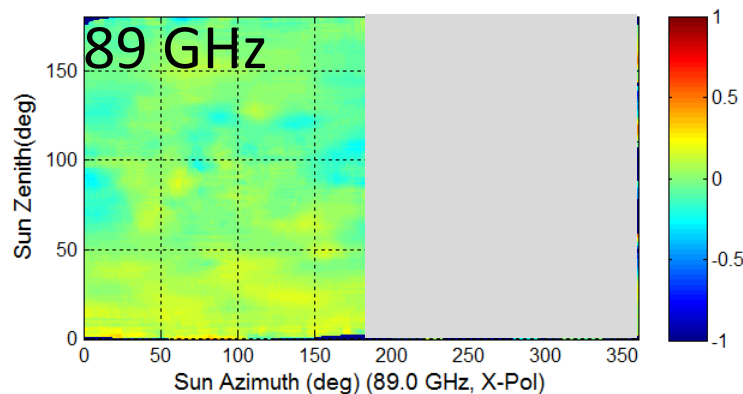
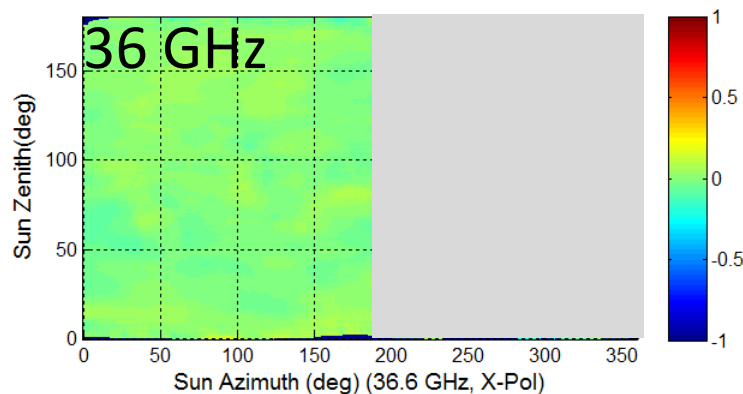
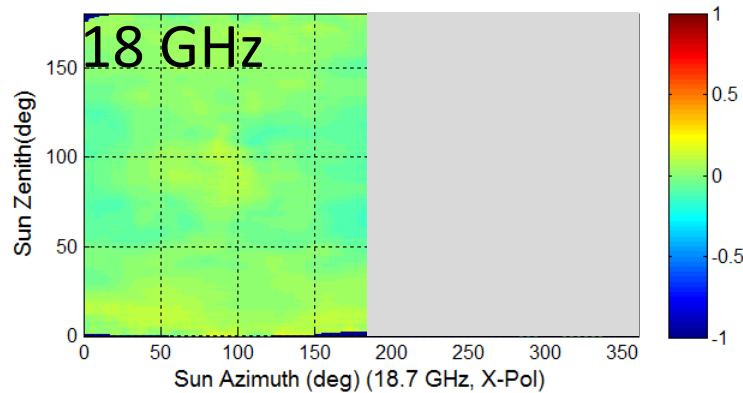
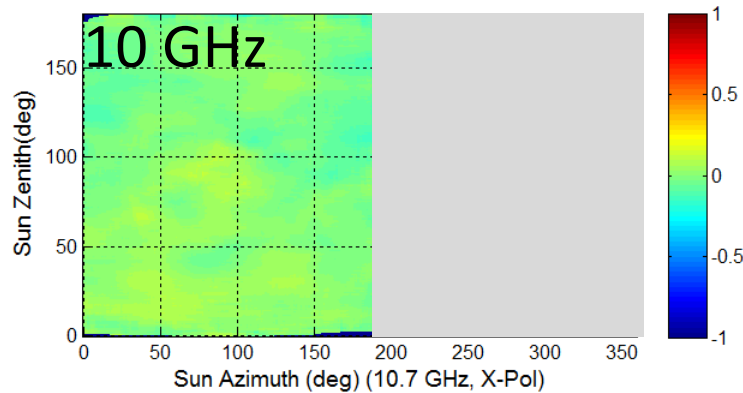
- Figure: TA difference versus cell position within Earth view sector
 - Ascending (black)
 - Descending (red)
- The 0° and 180° yaws are combined
- GMI: 221 cell positions across swath for Earth observations
- Vertical scale: +/- 1 K
- Along-scan differences are 0.1 K or less
- Improved over previous results, particularly at 10 GHz

Biases vs Solar Angle



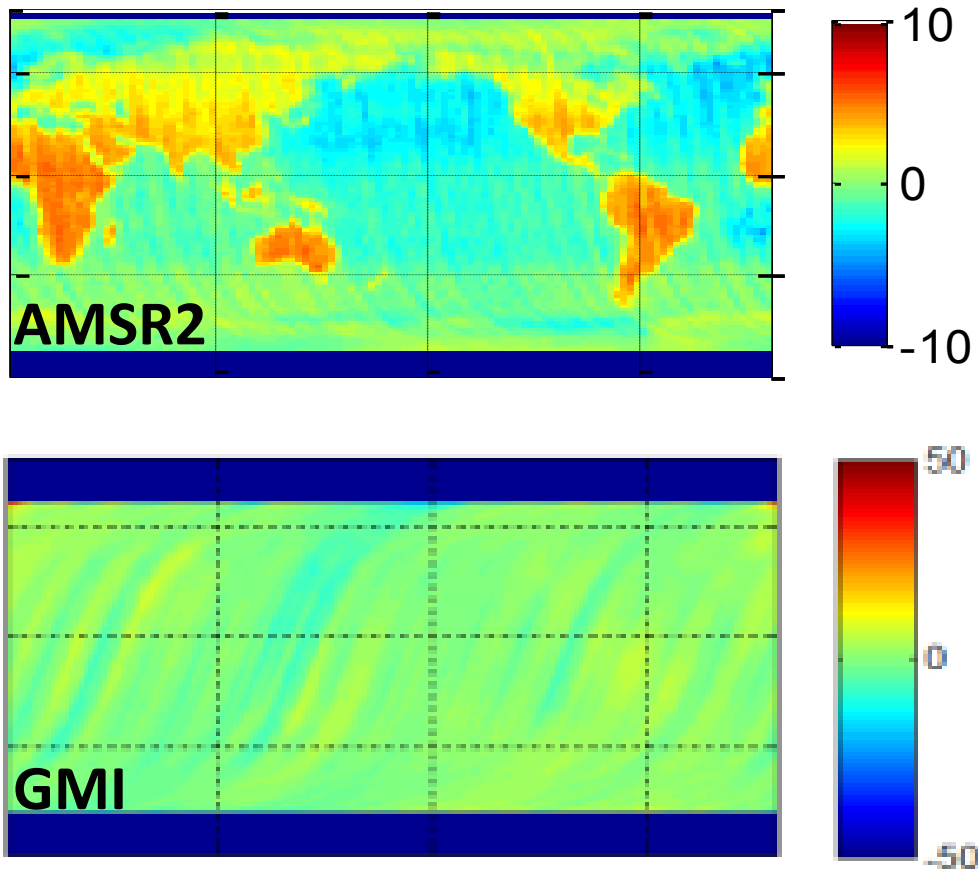
- Figure: TA difference versus sun azimuth and zenith angles
- Color scale: +/- 1 K
- Grey area are angles not observed due to solar geometry
- No obvious patterns of solar intrusion as observed by SSMIS and WindSat
- Patterns in 36 and 89 GHz due to atmosphere

Biases vs Solar Angle



- Figure: same as previous but for V-H/2
- Combination minimizes atmospheric effects
- Color scale: +/- 1 K
- Grey area are angles not observed due to solar geometry
- No obvious patterns of solar intrusion as observed by SSMIS and WindSat

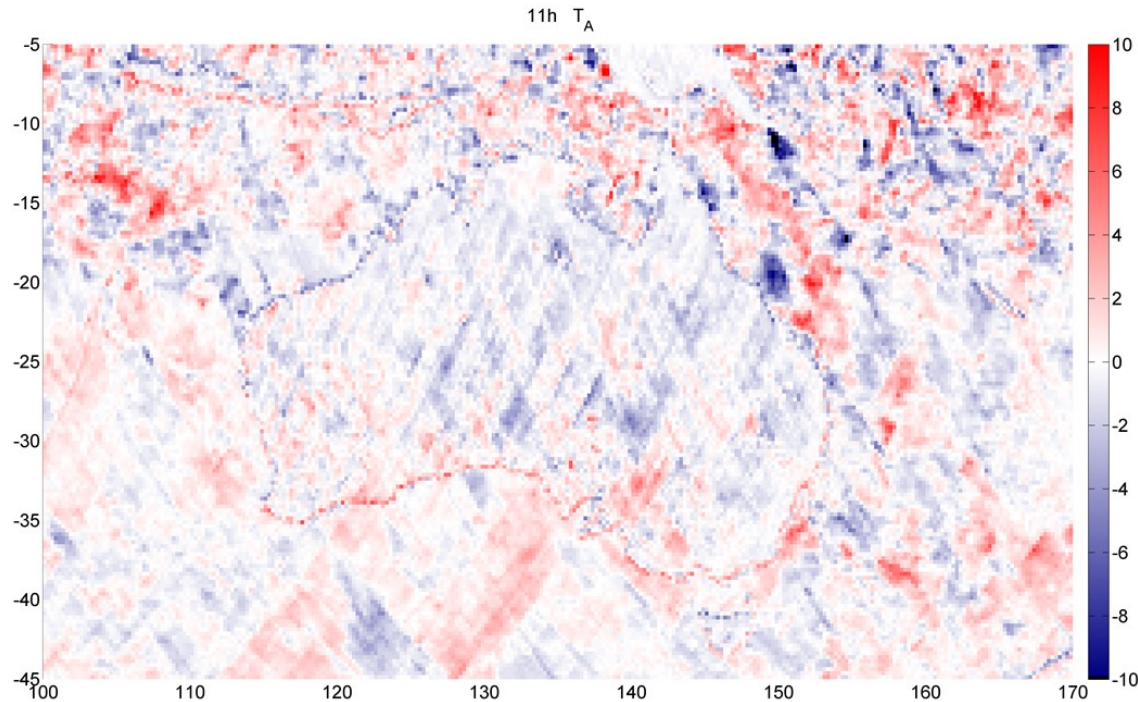
Check for Earth Intrusion into CSV



- Figure: average cold counts on latitude-longitude Earth grid
 - Top: AMSR2 6V ascending
 - Bottom: GMI 10V descending
- AMSR2 spillover 0.35% for two lowest frequencies
- Found geostationary-originating RFI in 19 GHz for GMI when cold mirror boresight crosses Equator; Goddard implemented median filter to remove

Note: These results from V03A for first 3 months.

GMI Pointing is Accurate to 0.1°

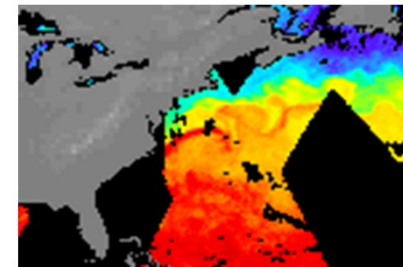


- Figure: ascending minus descending TA for 10H over Australia
- Coastlines are explained with 0.1° change in nadir angle offset or pitch offset
- Other channels (18, 23, 36, 89) show no evidence of pointing problems
- Thus, unlikely to be s/c attitude misspecification

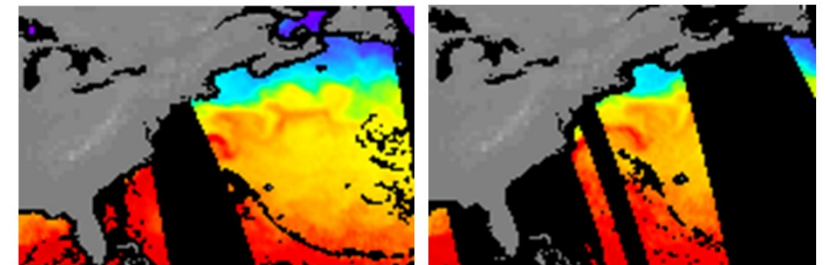
Conclusions

- Absolute biases are within requirement
- Biases within 0.5 K, except for 18H and 89H
- Time varying bias in 10V and 18H in N. Hem.
- GMI response function is linear
- Along-scan biases are very small
- No indication of solar intrusion
- No Earth intrusion in CSV
- GMI pointing accurate to 0.1°

GMI is providing highest resolution SST and rain rates available!



GMI

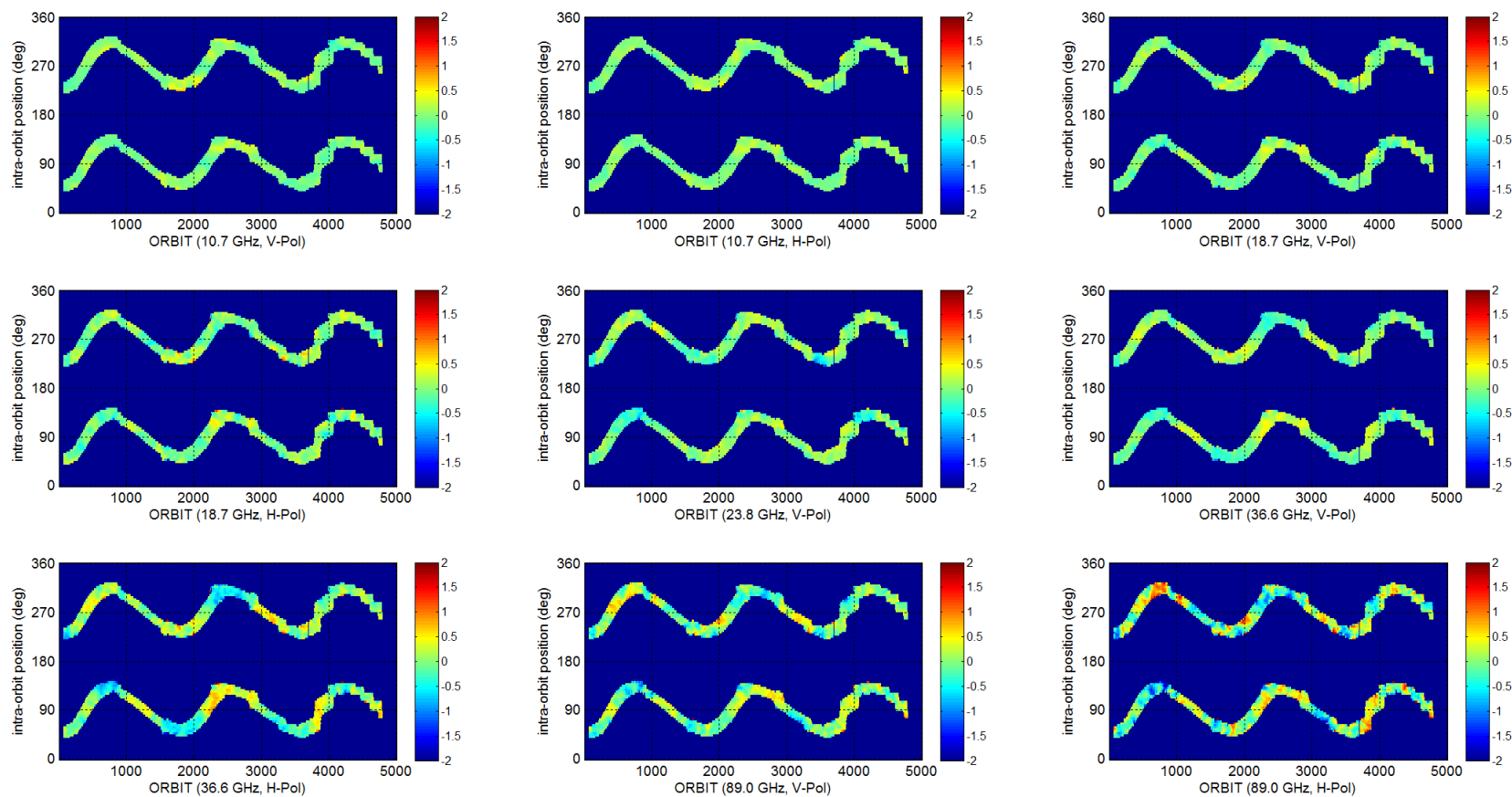


AMSR2

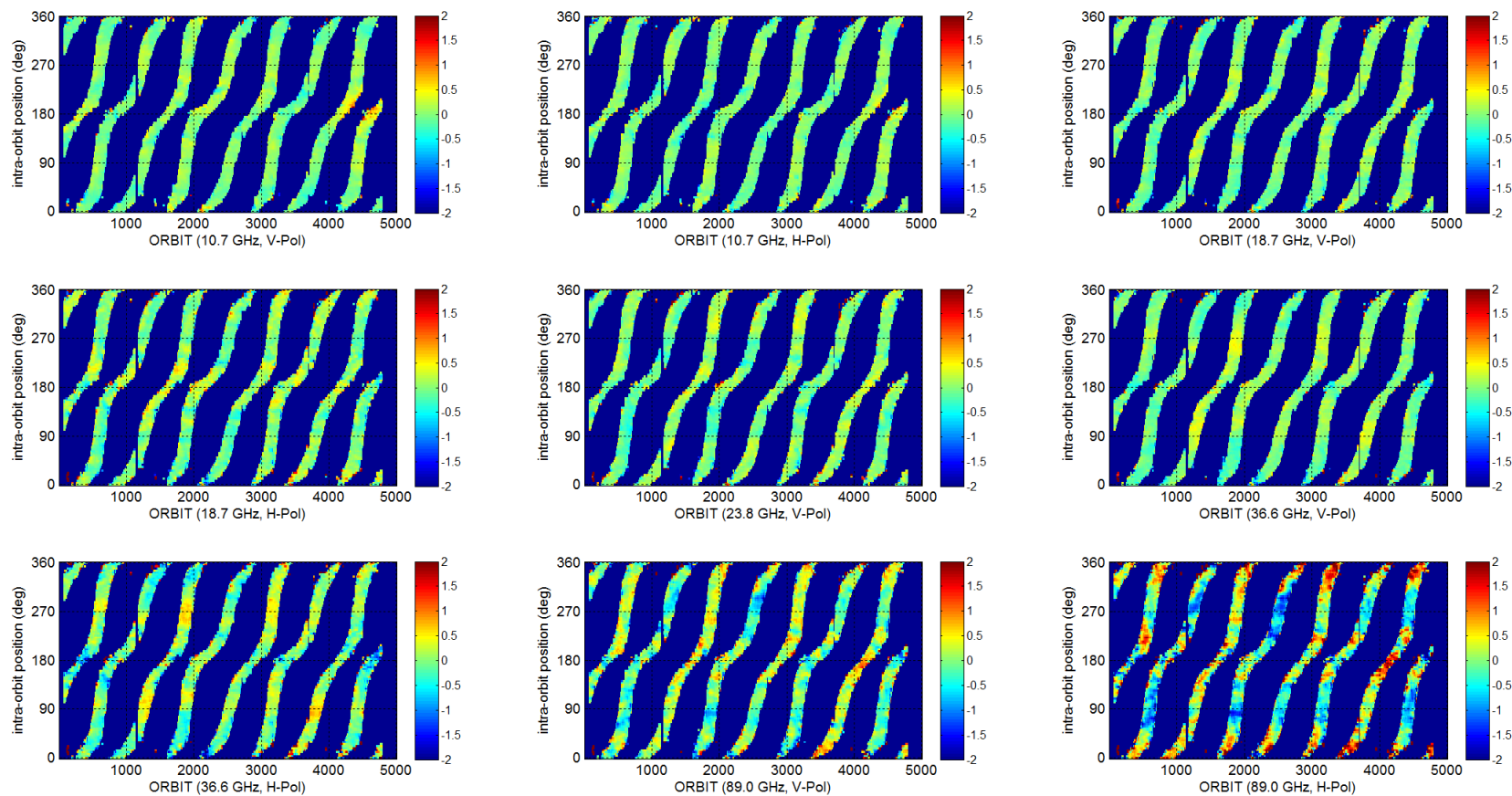
WindSat

Figure: Gulf Stream on 2014-05-15

Backup: Mission Plots for GMI vs TMI



Backup: Mission Plots for GMI vs WindSat



Backup: Mission Plots for GMI vs AMSR2

