



Calibration Performance Assessment of MODIS and VIIRS Thermal Emissive Bands

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Contributions:

NASA MODIS/VIIRS Characterization Support Team (MCST/VCST)
NOAA S-NPP and JPSS VIIRS SDR Calibration Team

Outline

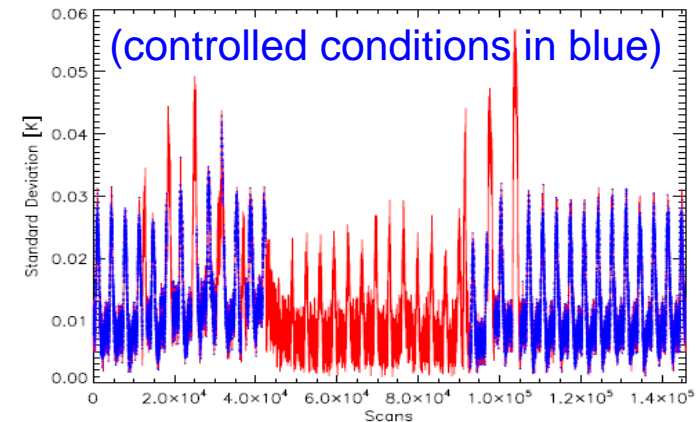
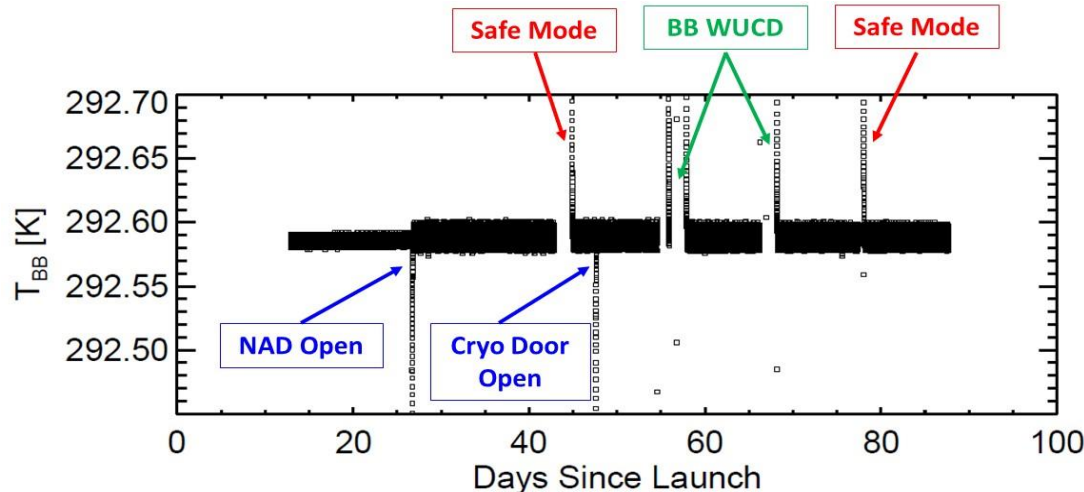
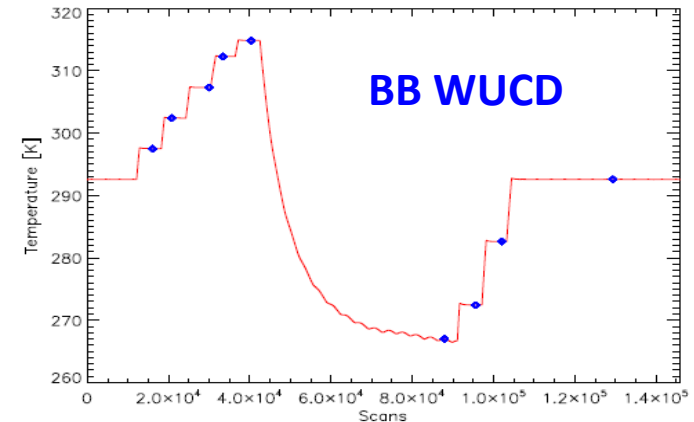
- **MODIS and VIIRS TEB On-orbit Calibration**
- **Instrument Performance**
 - Changes in Spectral Band Responses
- **Calibration Inter-comparisons**
- **Summary (Future Work)**

MODIS and VIIRS TEB On-orbit Calibration

- A quadratic calibration algorithm with detector gains updated on a scan-by-scan basis
- Reference to an on-board blackbody nominally controlled at a fixed temperature (plus quarterly BB warm-up and cool-down operation)



Examples from N20
BB operation and
performance

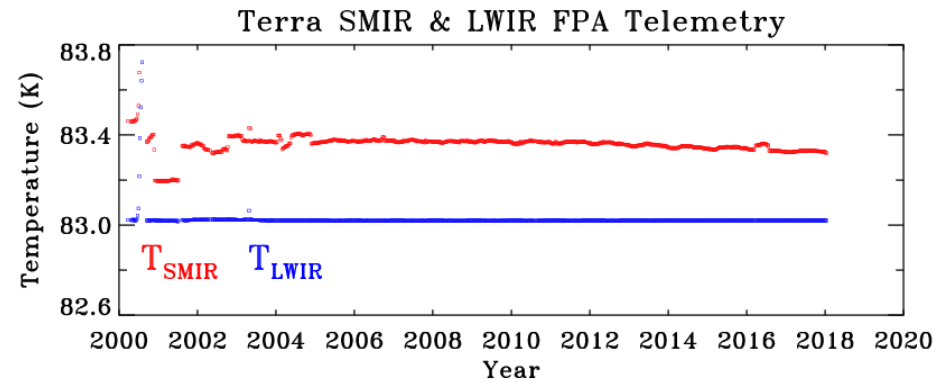


Instrument Performance (TEB)

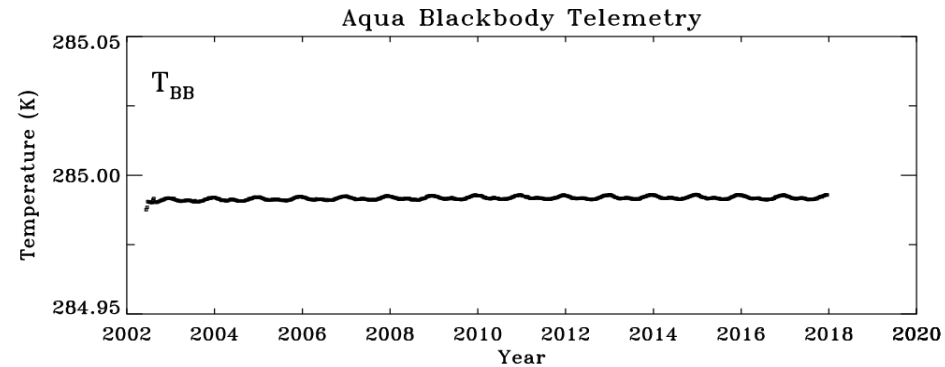
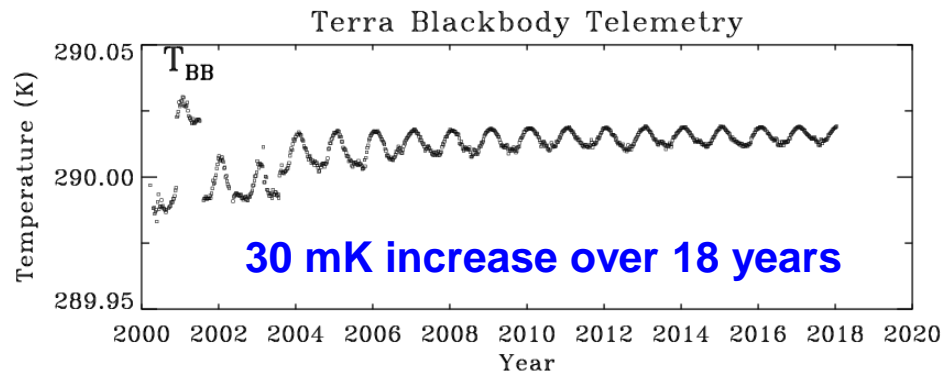
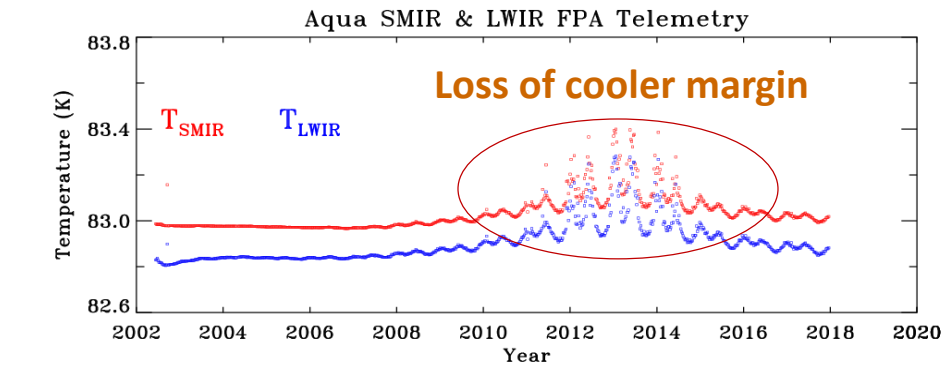
- **MODIS**
 - Instrument temperatures: stable for both Terra (less than 3.5 K over 18 years) and Aqua (less than 2.0 K over 16 years)
 - BB temperatures: Aqua MODIS (controlled at 285 K) is more stable than Terra MODIS (controlled at 290 K)
 - CFPA temperatures: more stable in Terra (with an outgassing performed earlier in the mission to recover the cooler margin)
- **VIIRS**
 - TEB overall performance is more stable and better than MODIS
 - Minor issue during BB WUCD (T_BB uniformity) – correctable
- **JPSS-1 (N20) VIIRS**
 - Results at mission beginning showed larger than expected LWIR response degradation
 - Outgassing performed recently to mitigate the effect likely caused by the ice water buildup

T/A MODIS Instrument Performance

T-MODIS CFPA and BB Temperatures

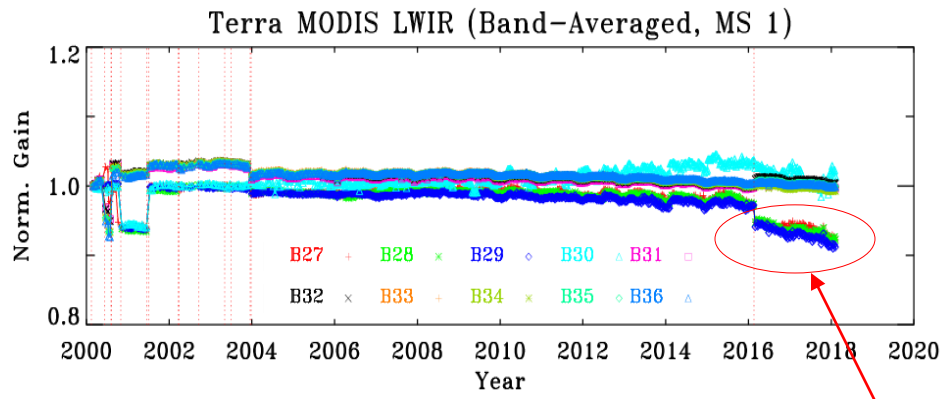


A-MODIS CFPA and BB Temperatures

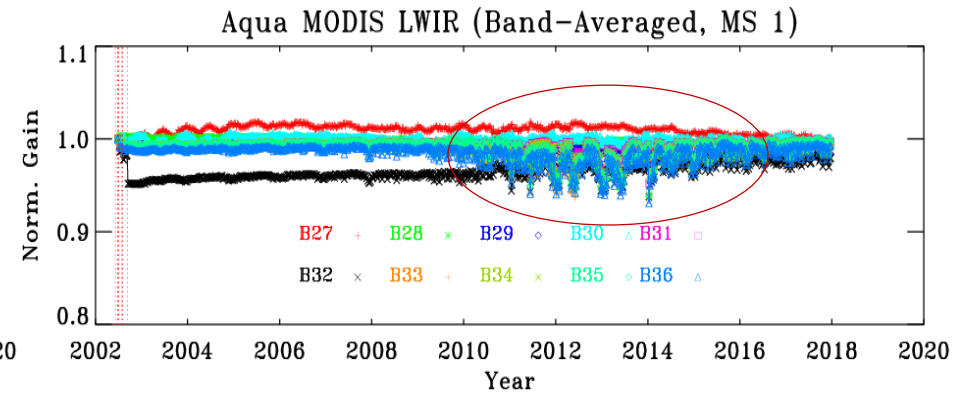


T/A MODIS Detector Gains and NEdT

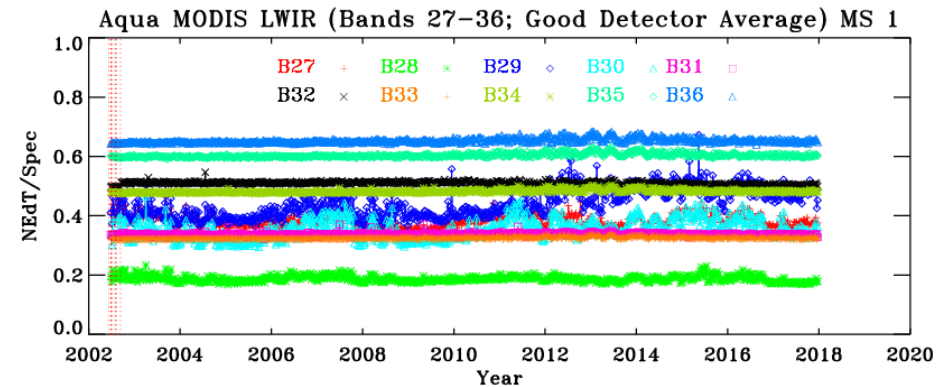
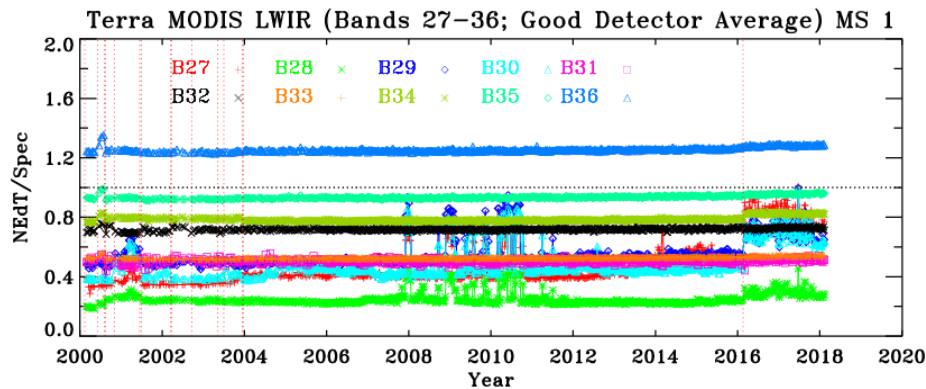
T-MODIS LWIR Gains and NEdT



A-MODIS LWIR Gains and NEdT



SC safe mode => changes in crosstalk

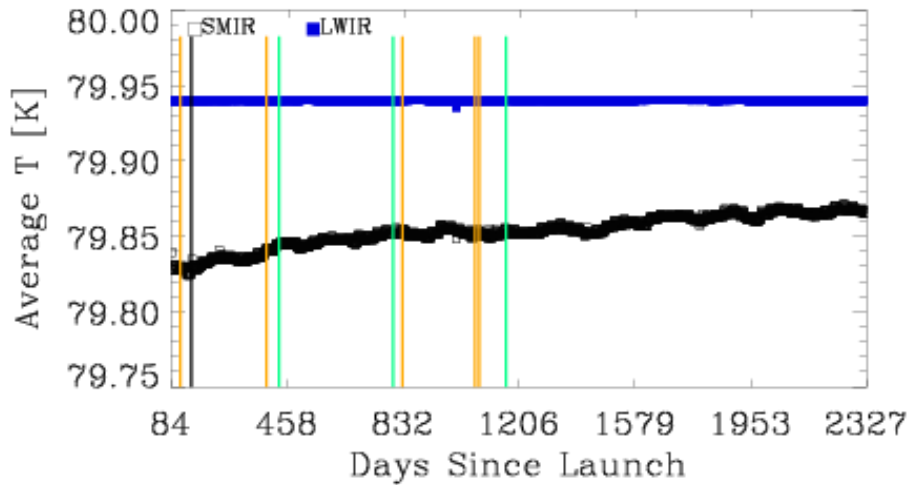


MWIR spectral bands performance is more stable than LWIR

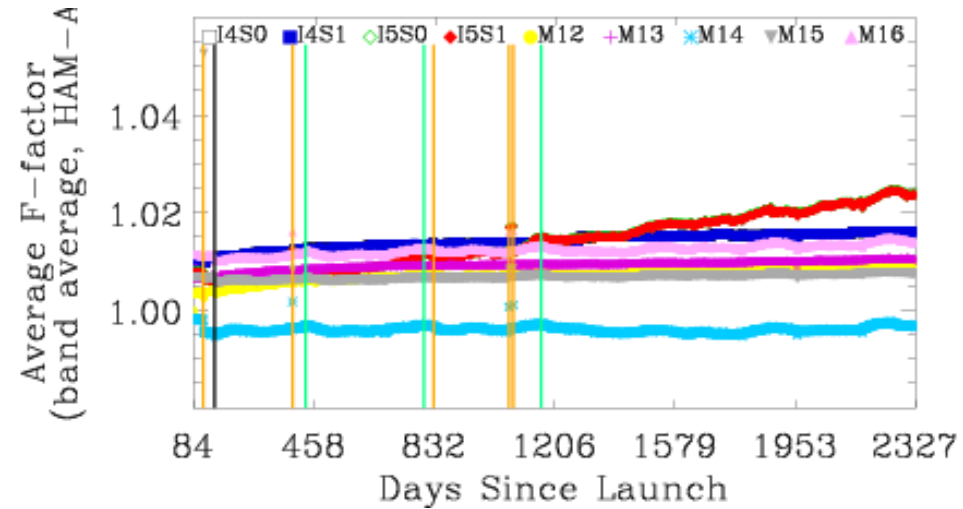
Noise detectors identified (most in Terra LWIR PV bands) are not included in band average

S-NPP VIIRS Instrument Performance

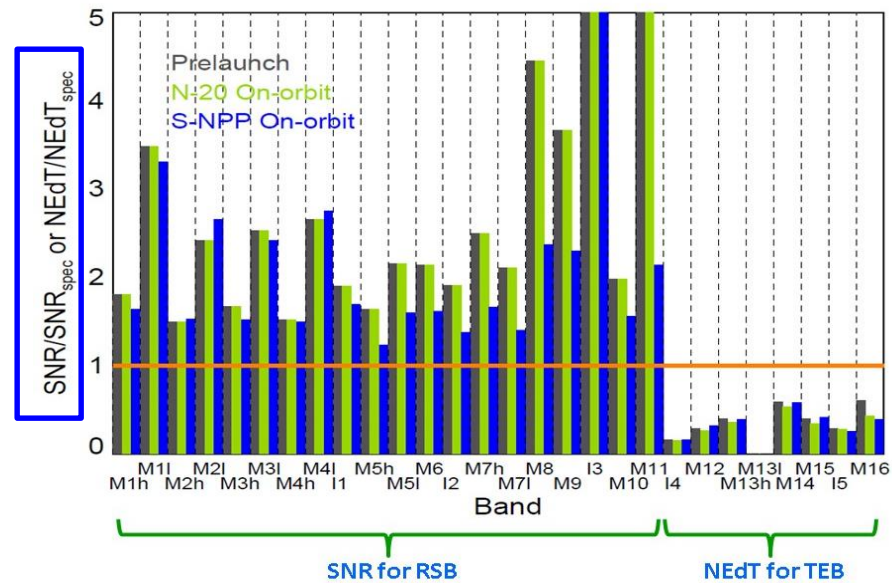
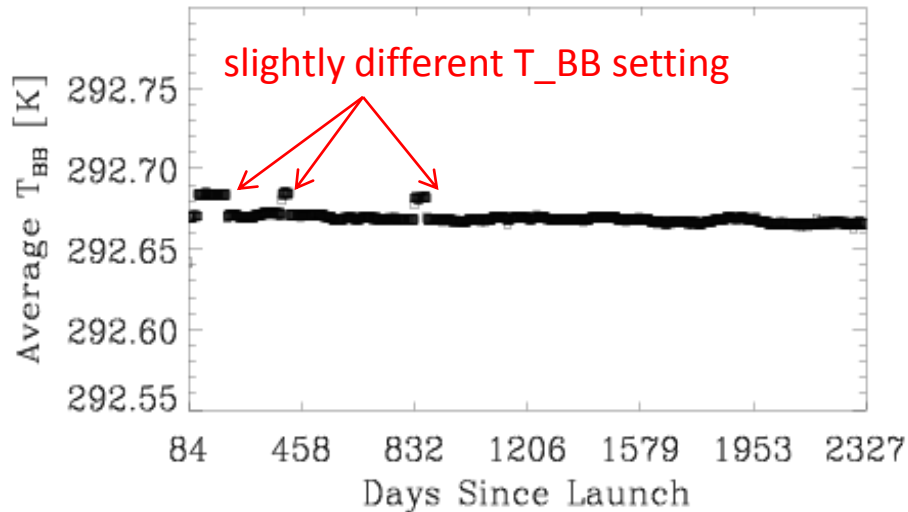
CFPA Temperature



Spectral Band Responses

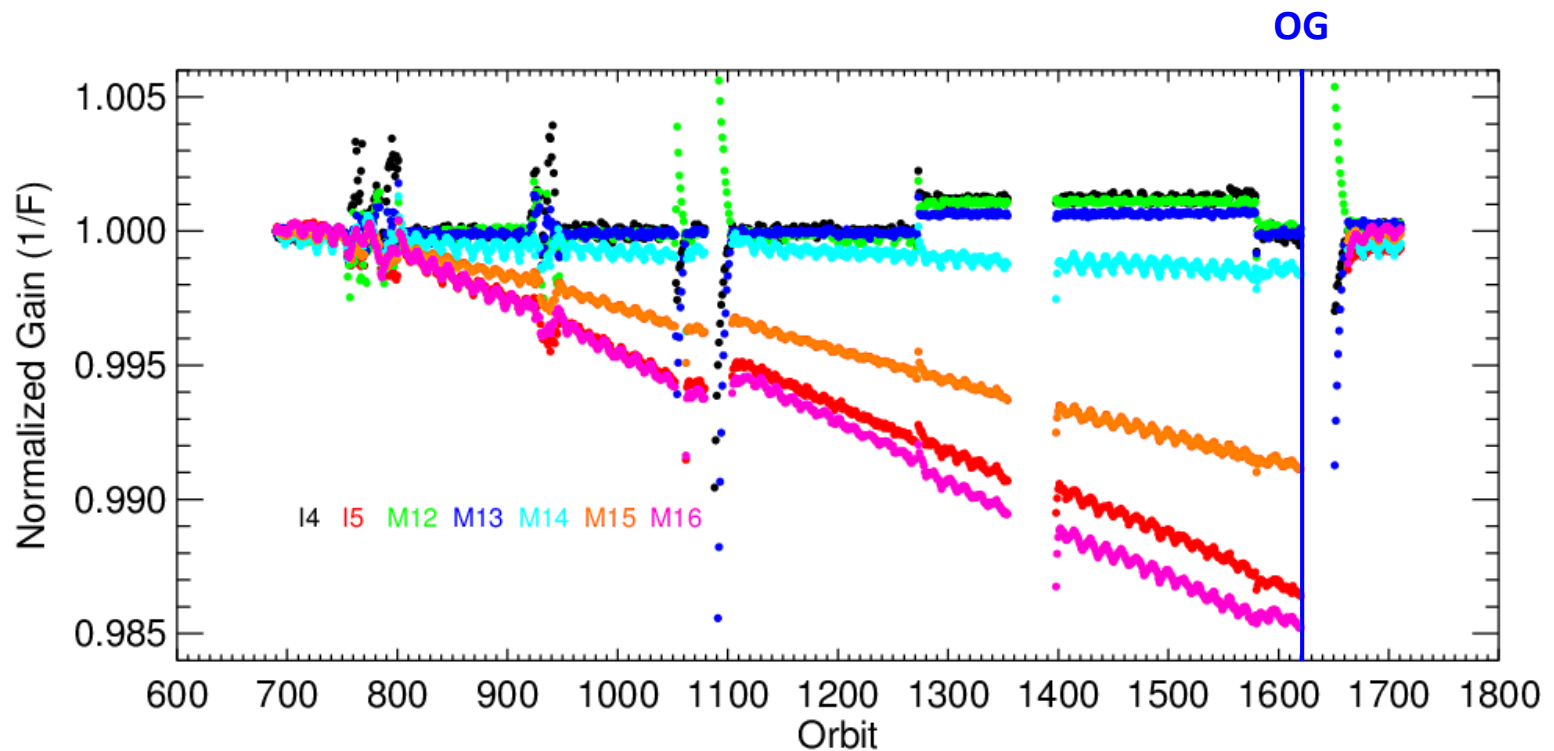


BB Temperature



N-20 VIIRS Instrument Performance

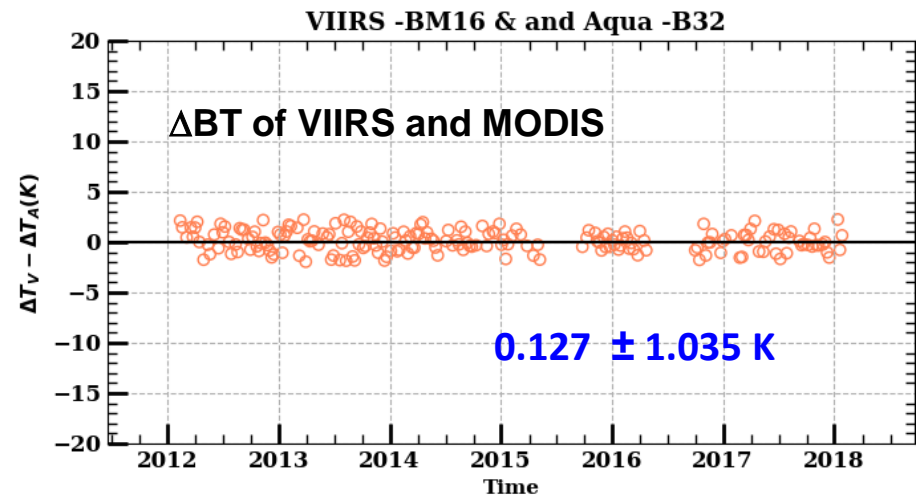
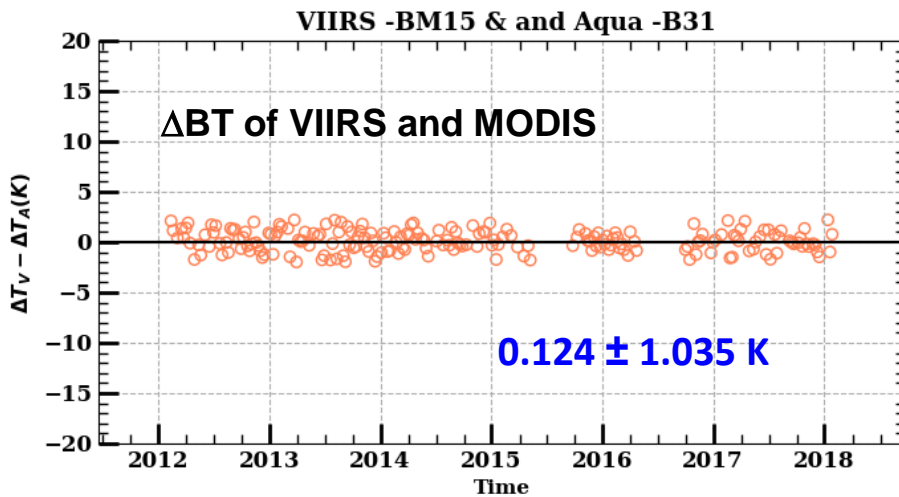
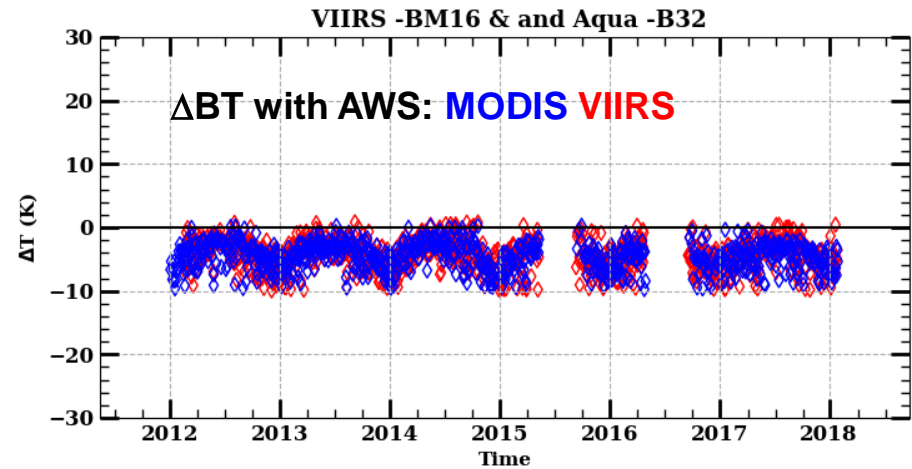
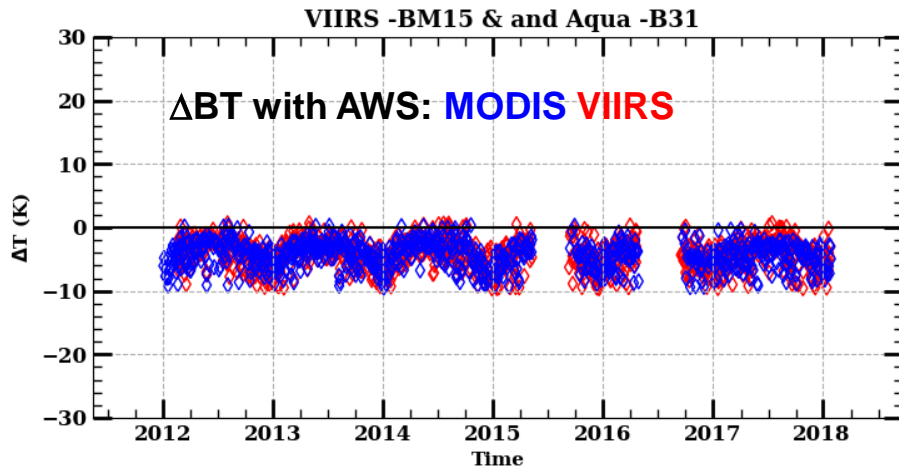
- Larger than expected changes in LWIR detector responses (potentially due to ice water buildups)
- Investigation underway to identify and help to reduce, if not completely remove, the impact (outgassing performed recently)



Discontinuities: due to different instrument operation/calibration events

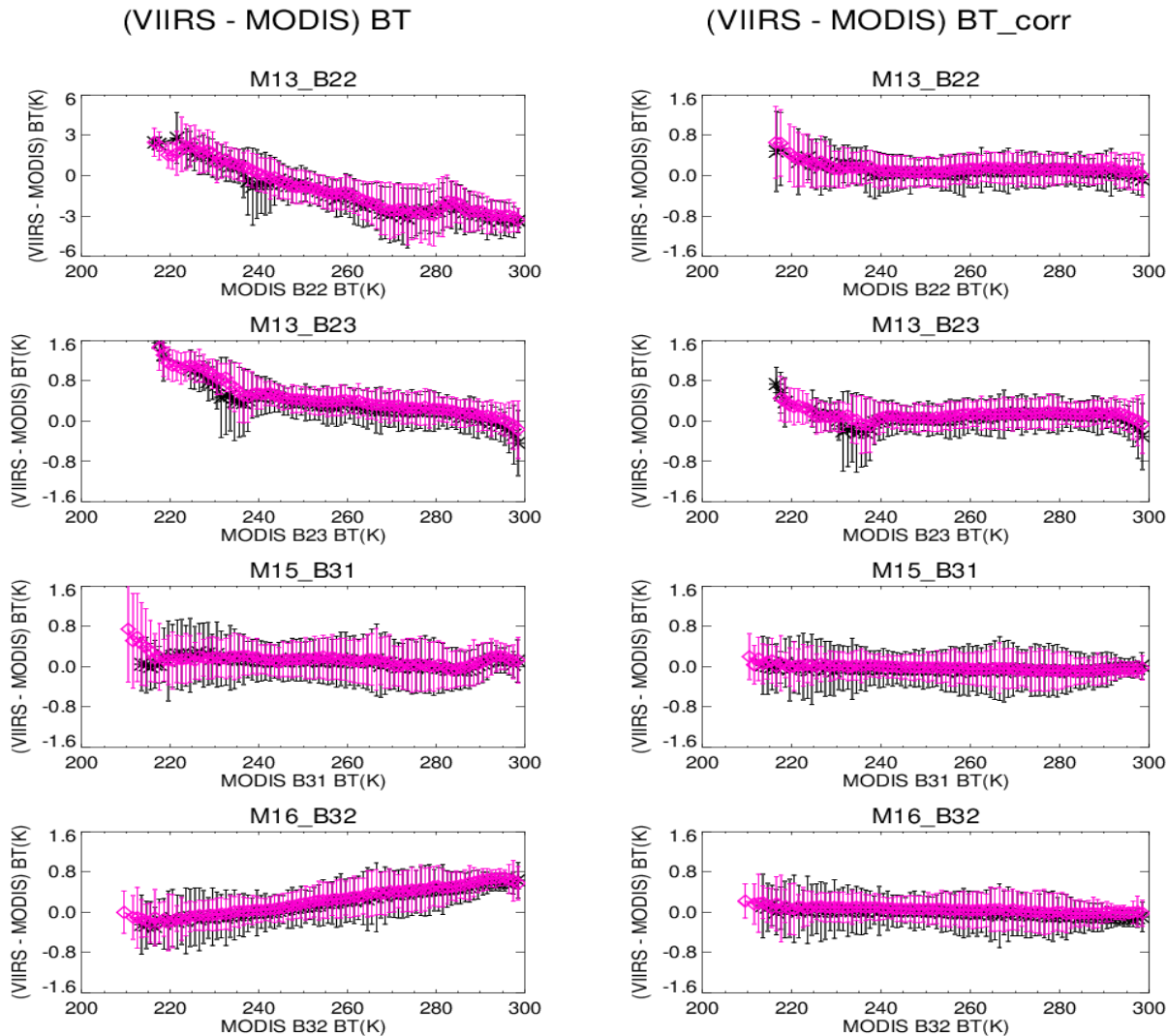
Calibration Inter-comparison: A-MODIS and S-NPP VIIRS

Dome C: Aqua MODIS and S-NPP VIIRS 11 and 12 μm channels



Same approach applied for calibration inter-comparison of T- and A-MODIS
Ocean targets also used for similar calibration inter-comparisons

Calibration Inter-comparison: A-MODIS and S-NPP VIIRS



Before correction

After correction

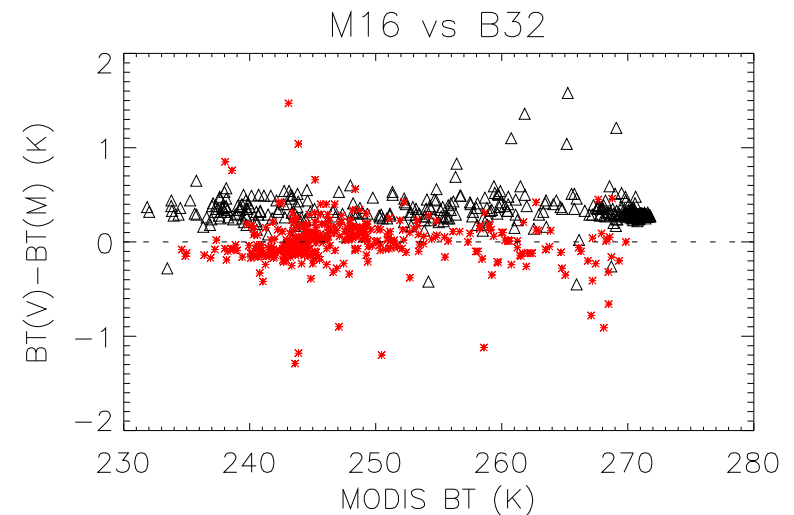
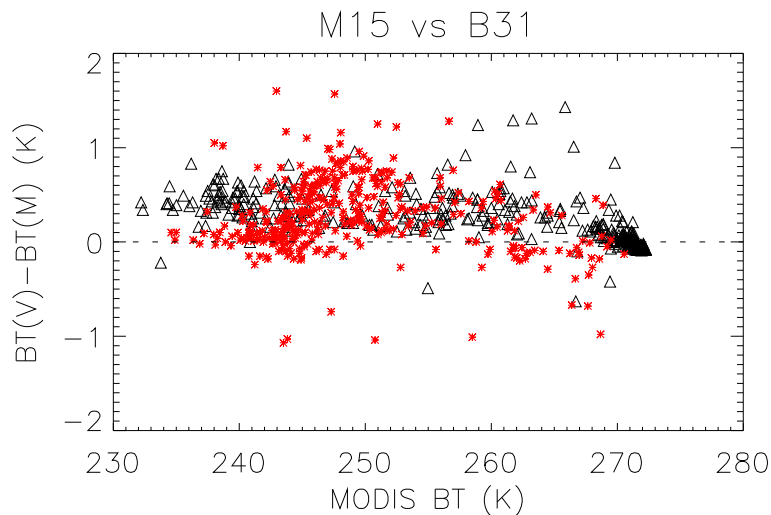
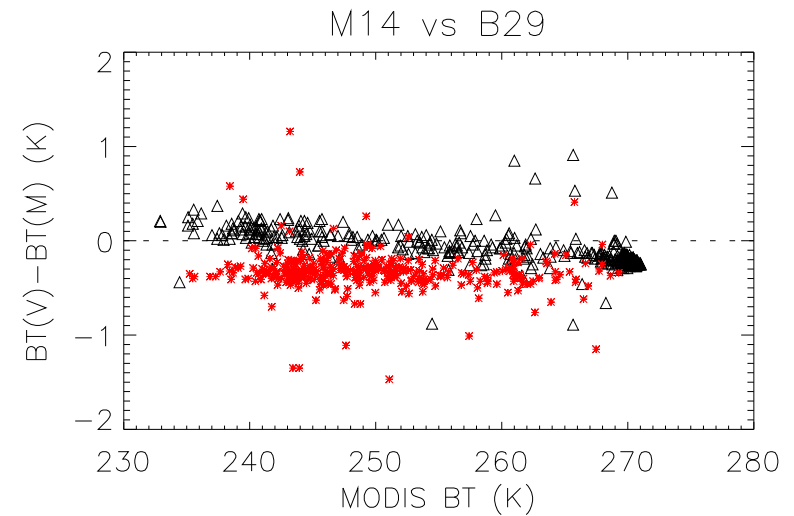
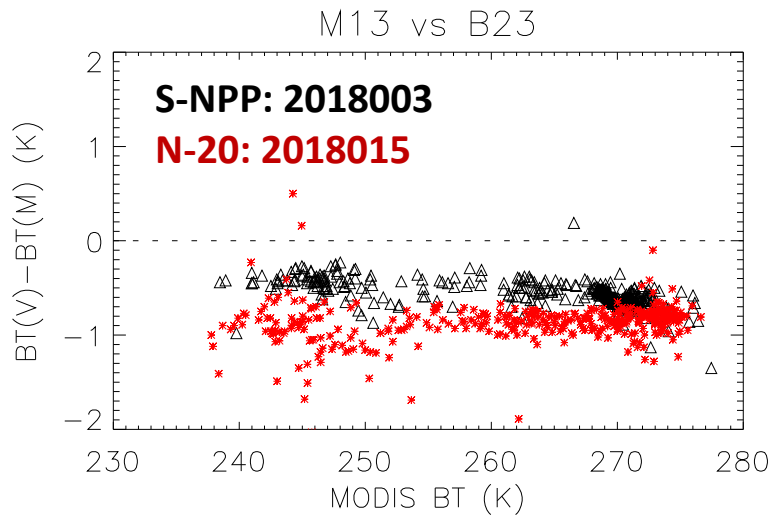
SNOs of Aqua and S-NPP (2014-2016)

Black: from AIRS-MODIS SNO FOV, find collocated VIIRS pixels; SBAF derived using AIR spectral to account for the difference between MODIS and VIIRS RSR.

Pink: from CrIS-VIIRS SNO FOV, find collocated MODIS pixels; SBAF derived using CrIS spectral to account for the difference between MODIS and VIIRS RSR.

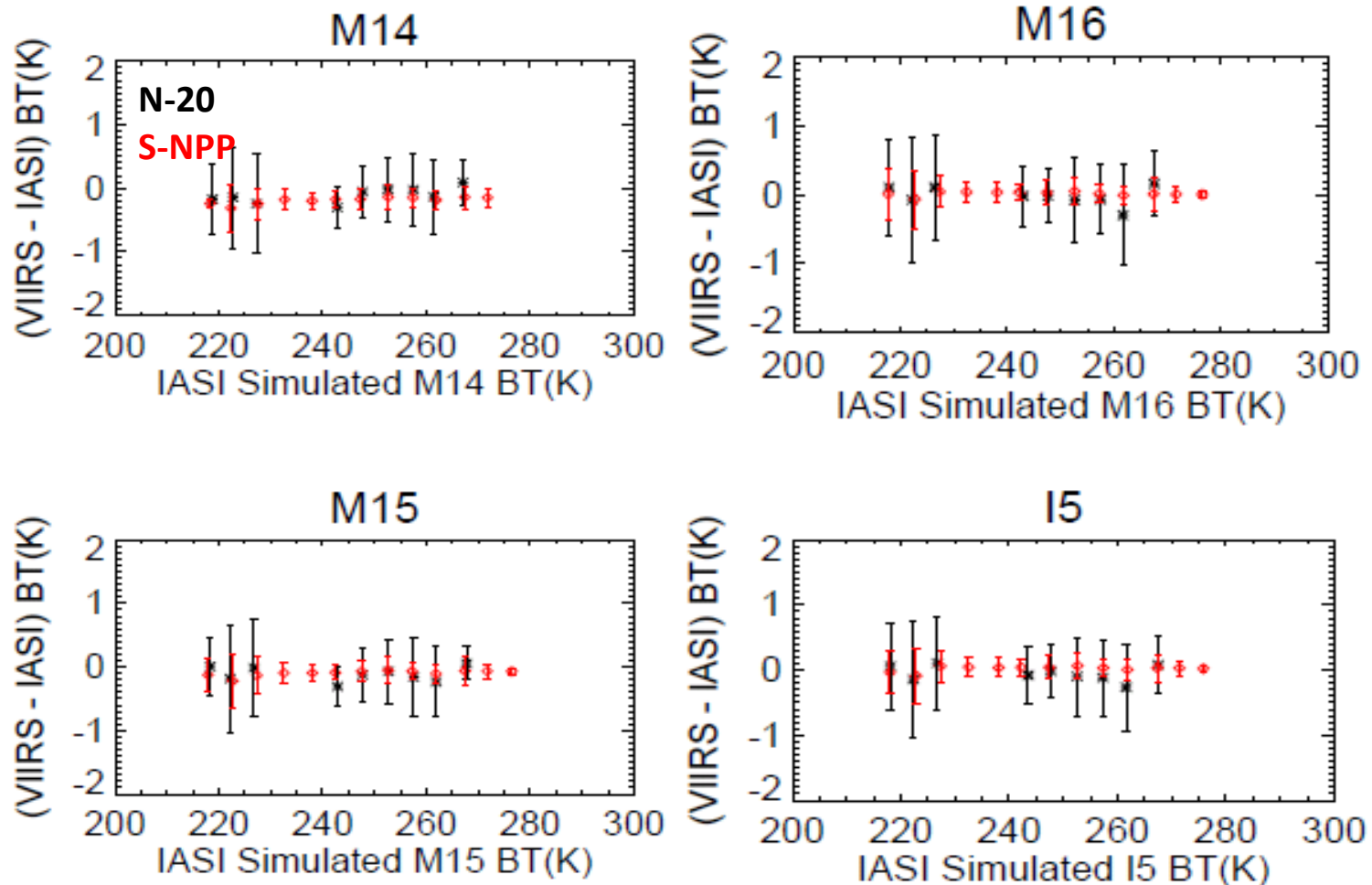
Calibration Inter-comparison: S-NPP and N-20

SNO: BT differences with Aqua MODIS (no RSR correction)



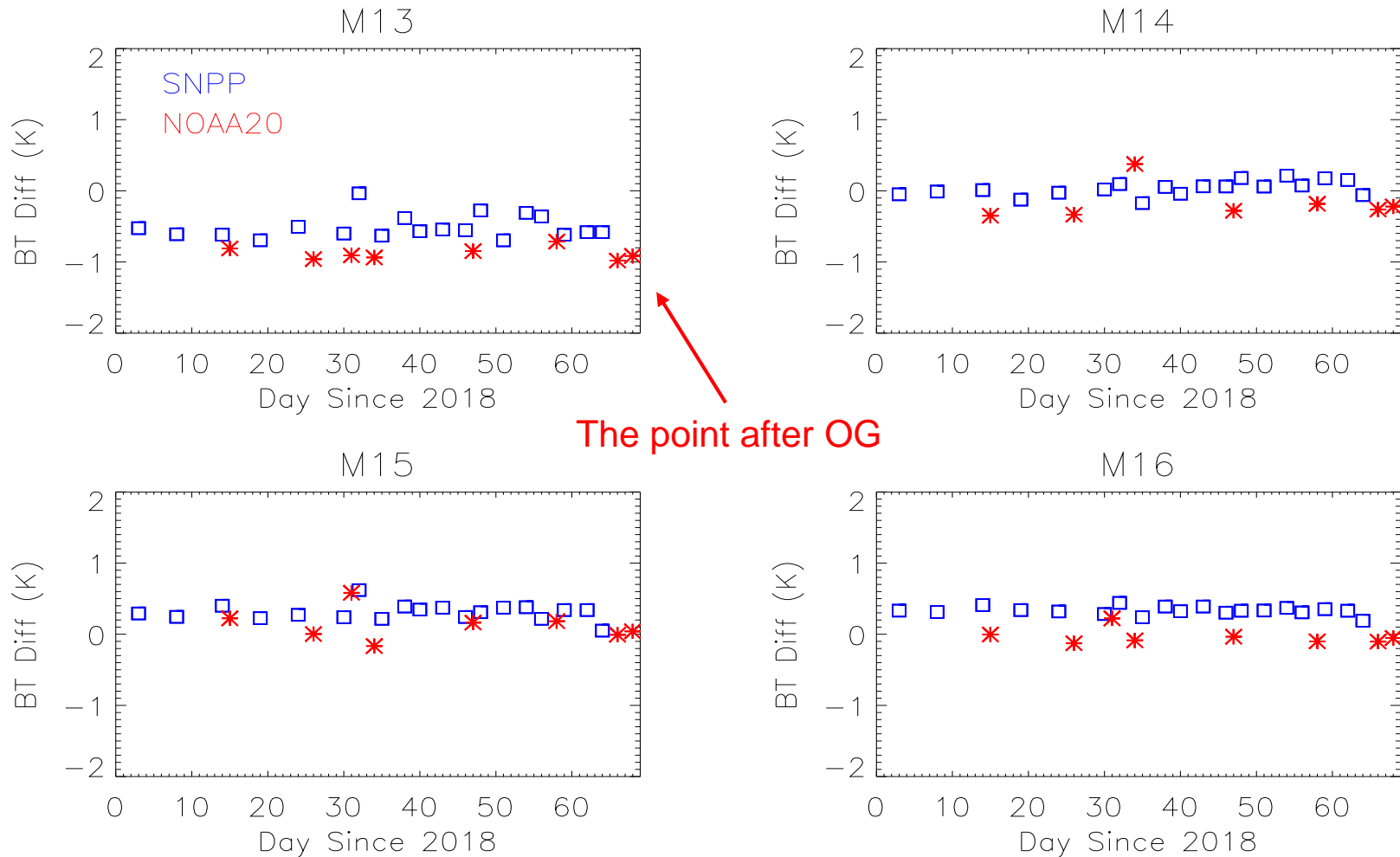
Calibration Inter-comparison: S-NPP and N-20

SNO: BT differences with IASI (no RSR correction)



Calibration Inter-comparison: S-NPP and N-20

BT differences with Aqua MODIS (from SNO, no RSR correction)



Preliminary results used to assess N-20 TEB on-orbit performance

Summary (Future Work)

- **MODIS and VIIRS TEB on-orbit performance has been constantly monitored and remains satisfactory**
- **Different approaches have been developed and applied to assess calibration performance and to evaluate calibration differences between sensors**
- **Future work to address existing and new challenging issues and to continue improving sensor on-orbit calibration**
 - Terra MODIS LWIR PV crosstalk and noisy detectors
 - Aqua MODIS CFPA temperature variation (getting better now)
 - MODIS and VIIRS calibration consistency and impact on science products (long-term data records)
 - *Community effort, including science support, and interagency collaboration (working closely with NOAA SDR team)*