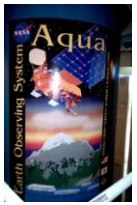
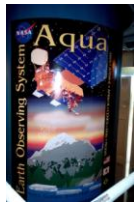


Aqua MODIS Cold FPA Performance and Operation

MODIS Characterization Support Team (MCST)

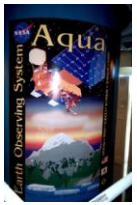
April 16, 2014



Outline

- Introduction
- On-orbit Performance Update
- Observed Impacts
- Mitigation Strategies
- Summary

Introduction

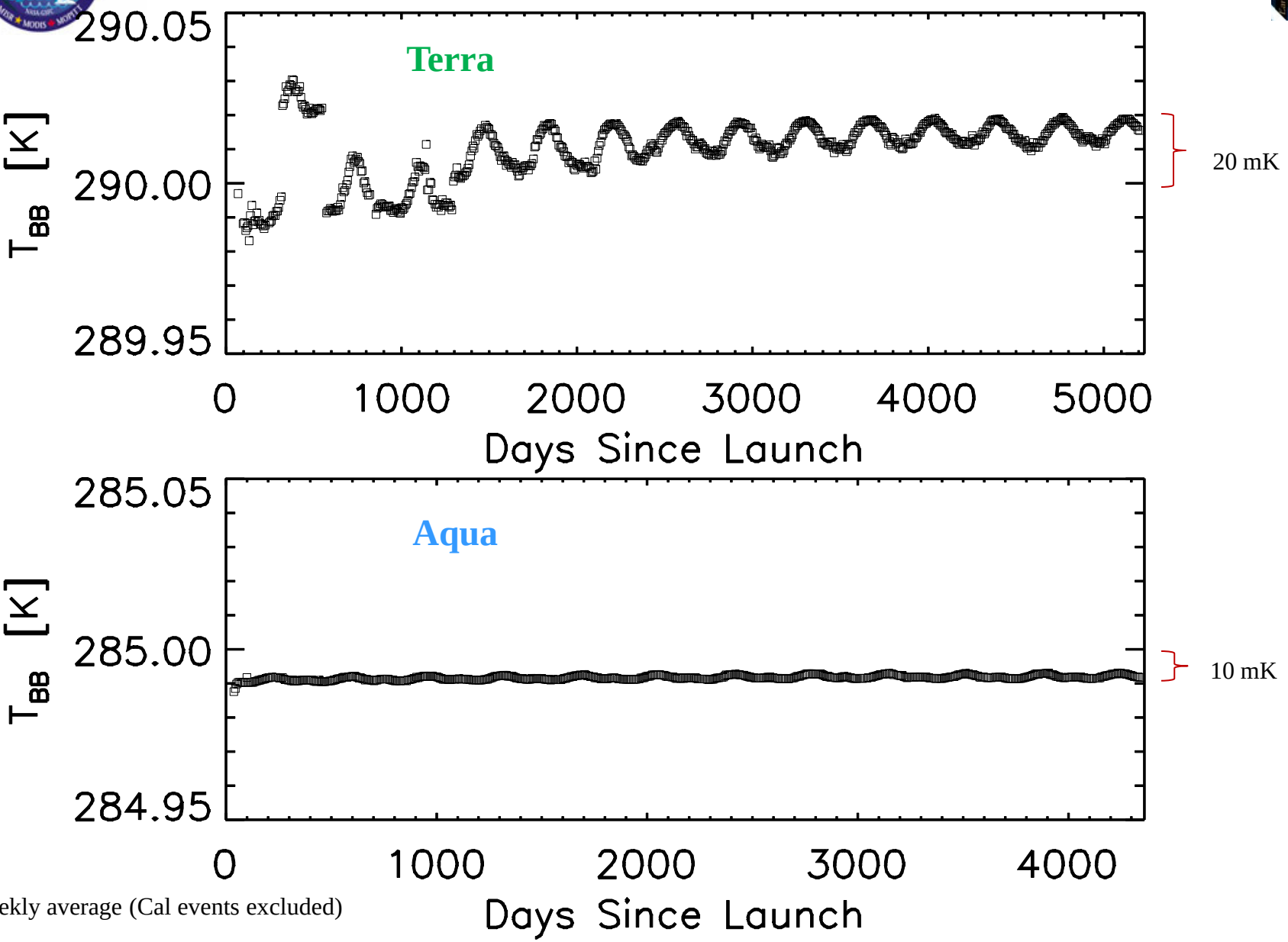


- Aqua MODIS Cold Focal Plane Temperature Control
  - Known issue with decreasing radiative cooler margin
- Prior meetings held to brief science disciplines on status, impacts and possible mitigation strategies
  - 1st meeting on May 7, 2010
  - 2nd meeting on April 25, 2012
  - 3rd meeting on March 17, 2013
- MCST continues to monitor instrument performance
  - Impacts observed that can affect science products
    - Orbital variation in TEB detector gain (PC bands more sensitive)
    - Increased fitting residuals from BB WUCD during a0/a2 derivation
    - Saturation in bands 33, 35-36 EV data during WUCD

Current Status

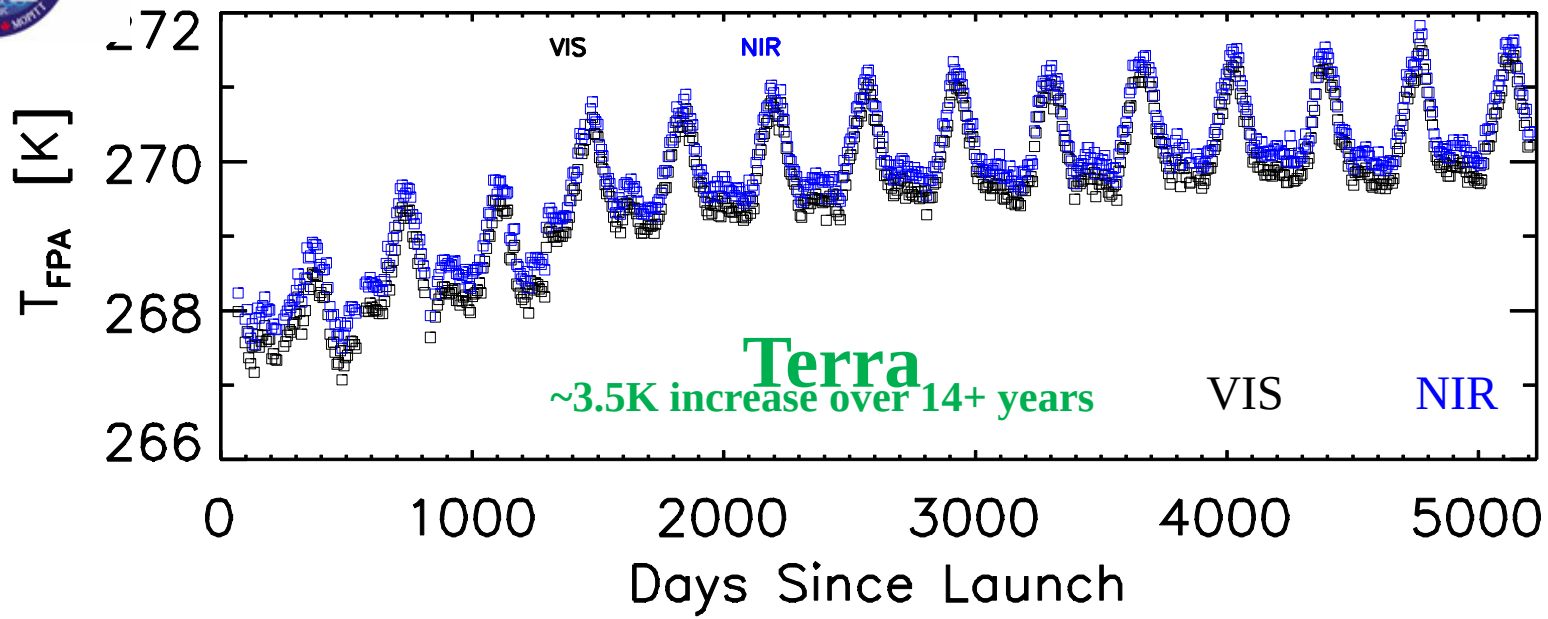
- CFPA temperature peak during summer months with maximum ~83.7 K in mid-2013.
- CFPA orbital/seasonal oscillation – max/min difference ~0.8 K
- Radiative cooler margin lost for CFPA setpoint of 83 K during intermittent periods through annual cycle.
- Majority of impacts on L1B products occur during BB Warmup/Cooldown activities

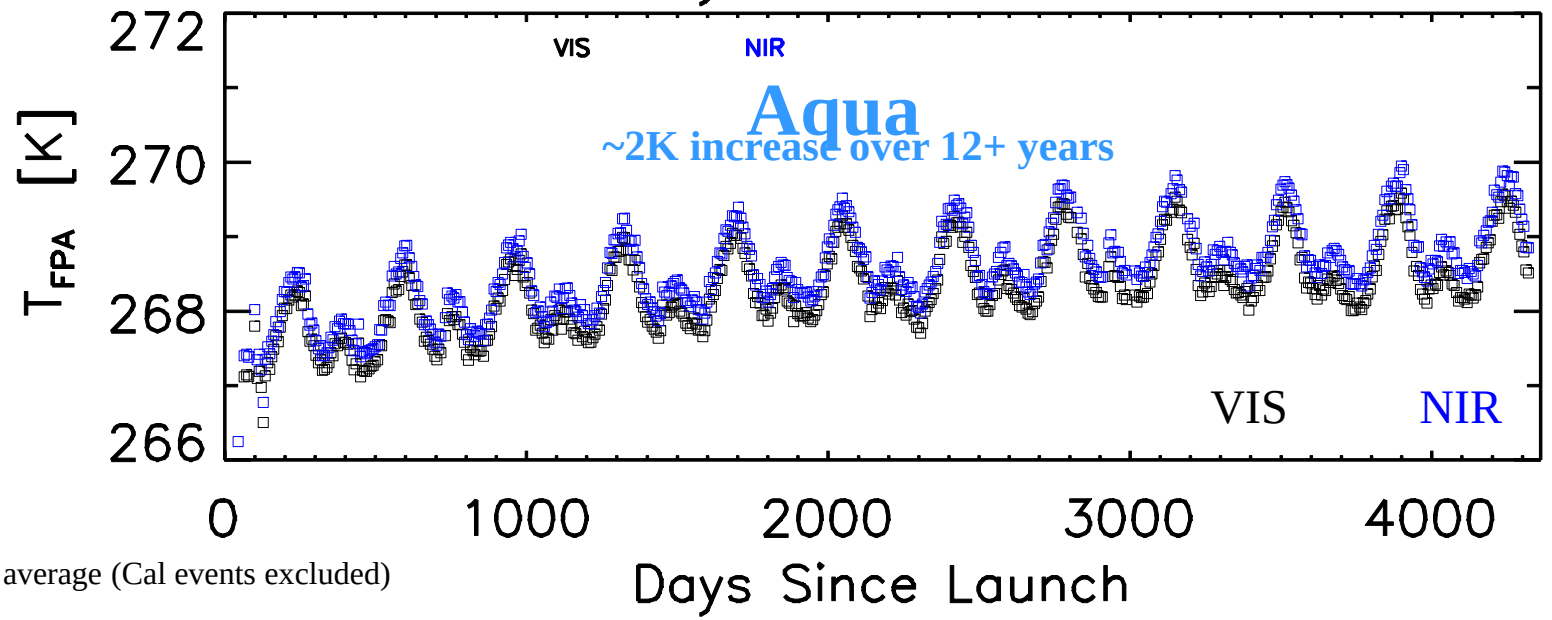
BB Temp Trends



Weekly average (Cal events excluded)

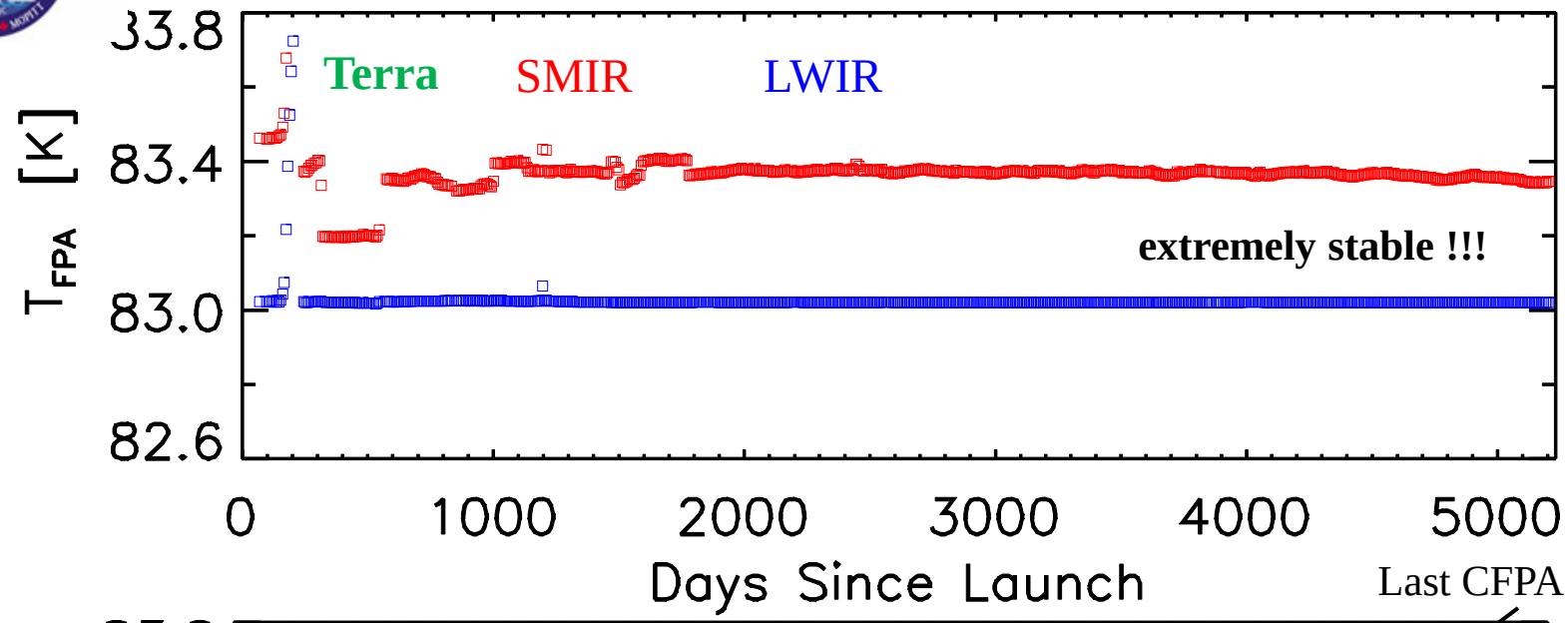
Warm FPA Temperatures

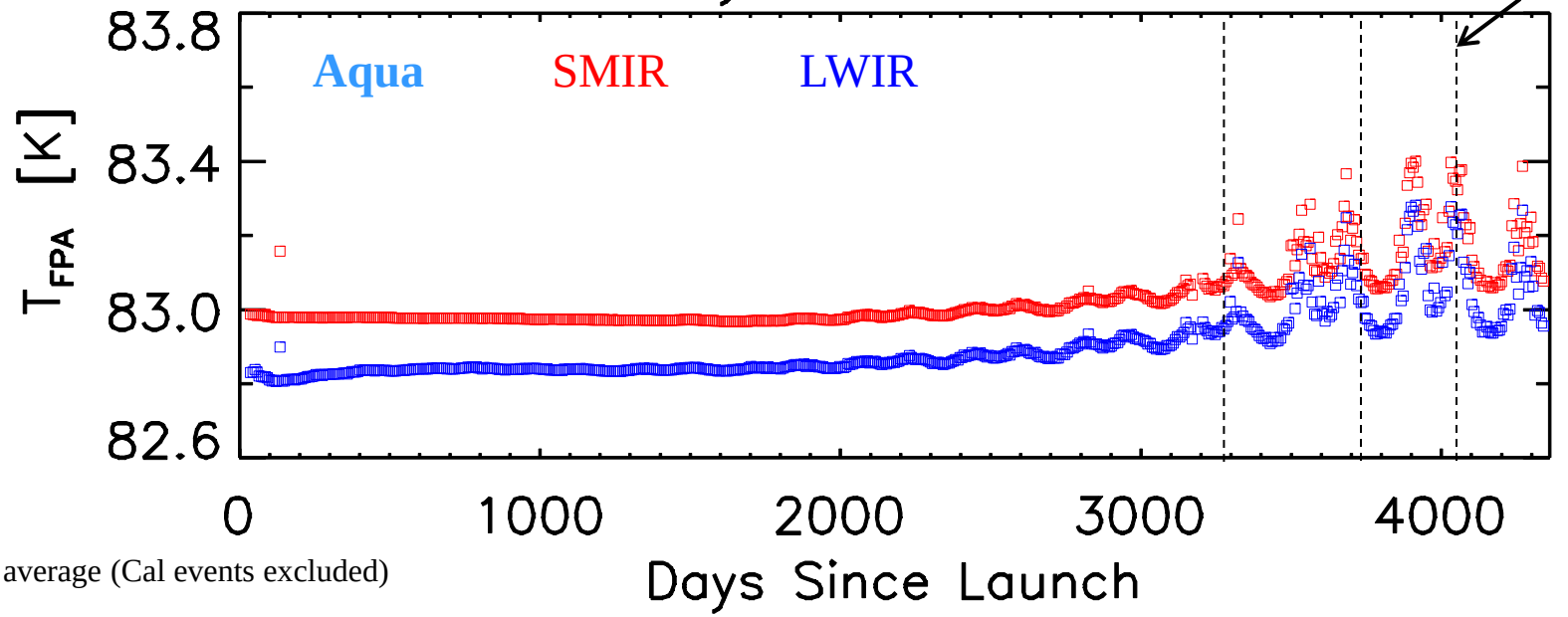




Weekly average (Cal events excluded)

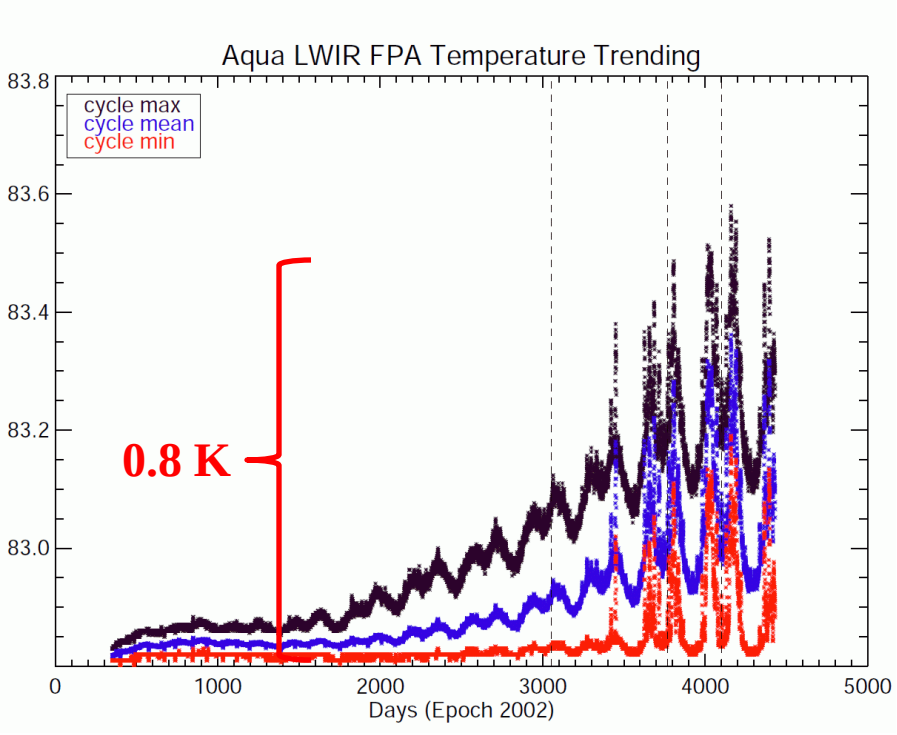
Cold FPA Temperatures

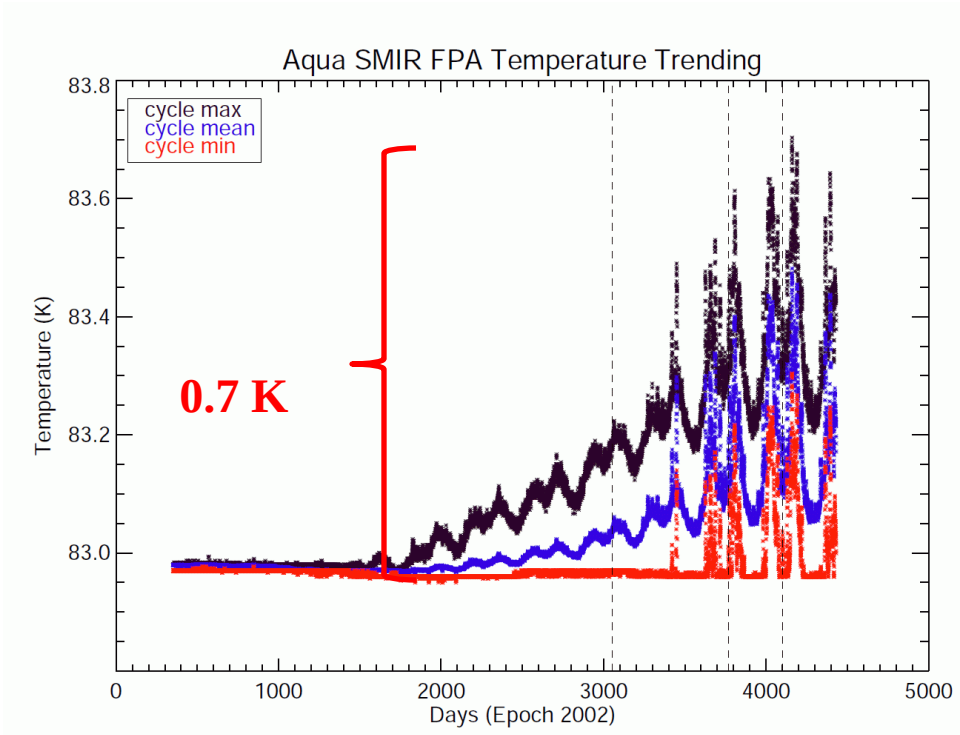




Weekly average (Cal events excluded)

Aqua CFPA Oscillations
Long-term trend

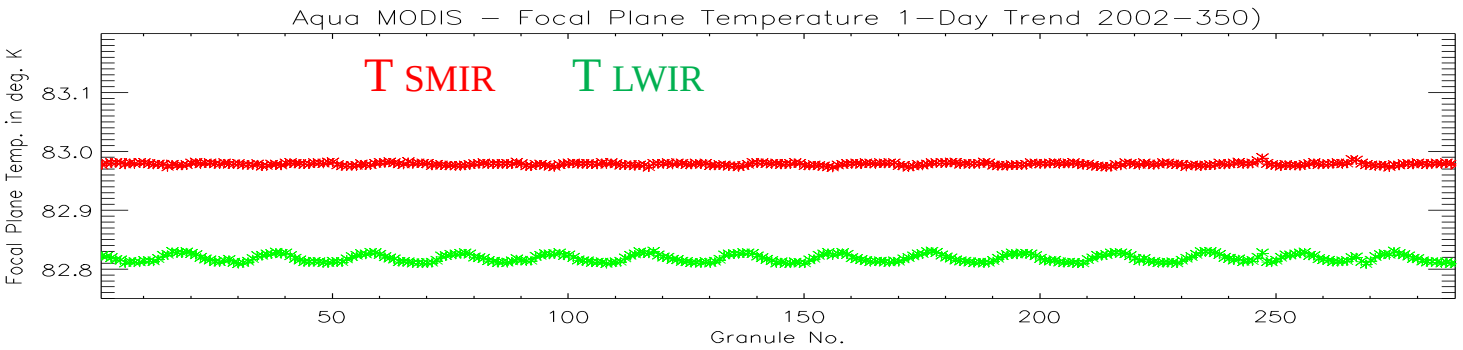




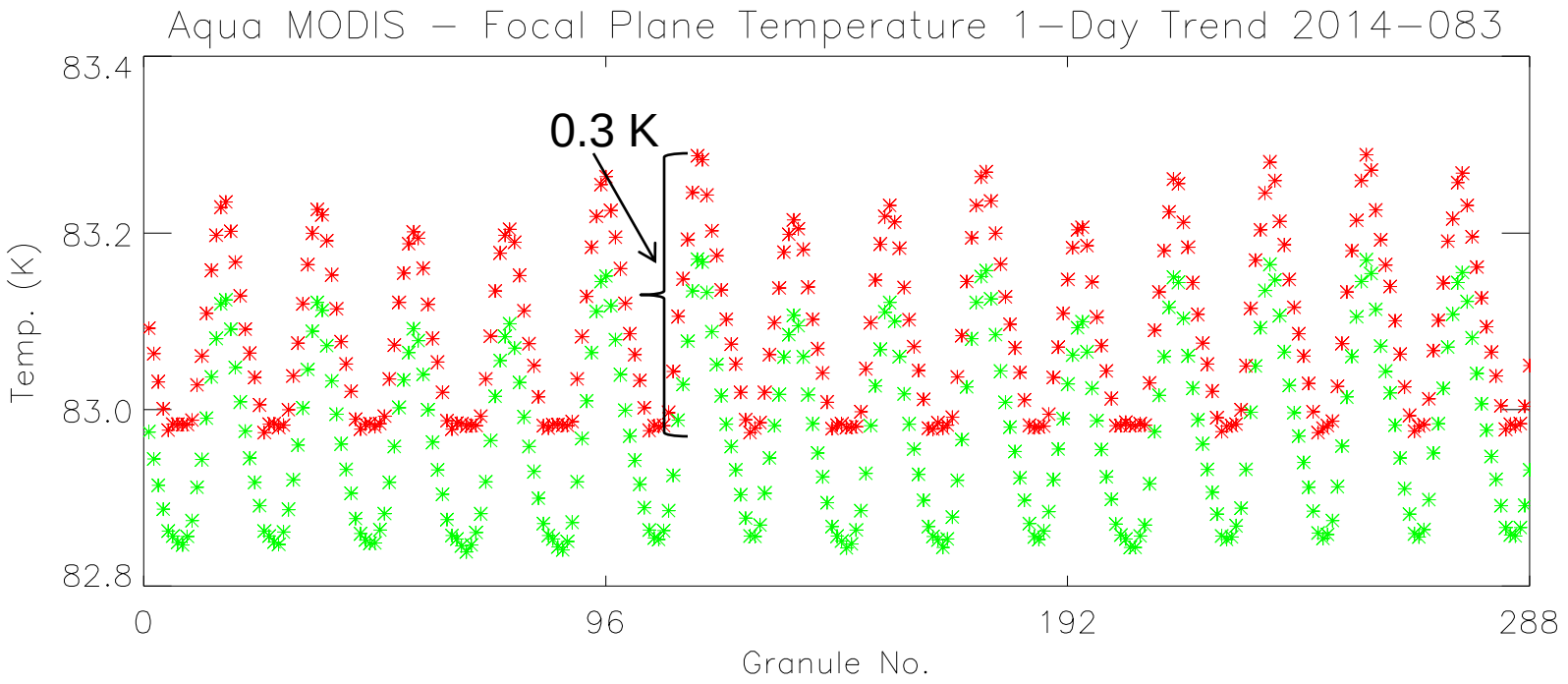
Dashed vertical lines indicate time of last three CFPA meetings.

Max/Min of 4 orbits

Aqua CFPA Oscillations
Short Term (1day) trend



2002

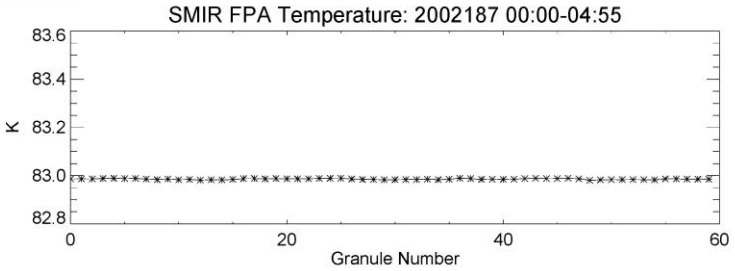


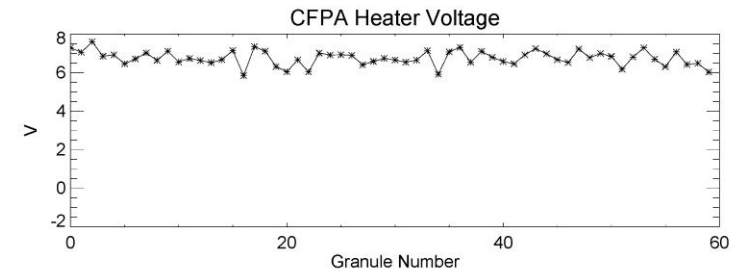
2014

Granule average

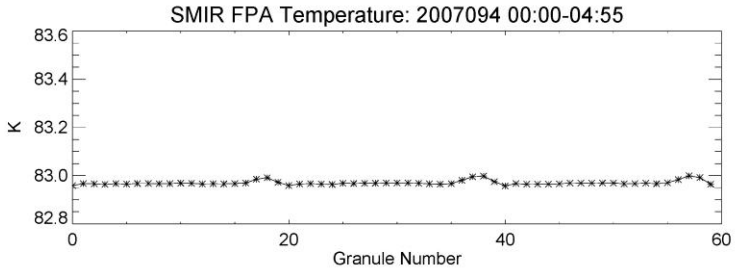
Aqua CFPA Heater Voltage

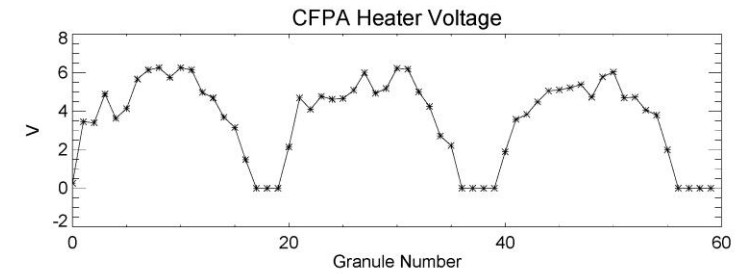
2002



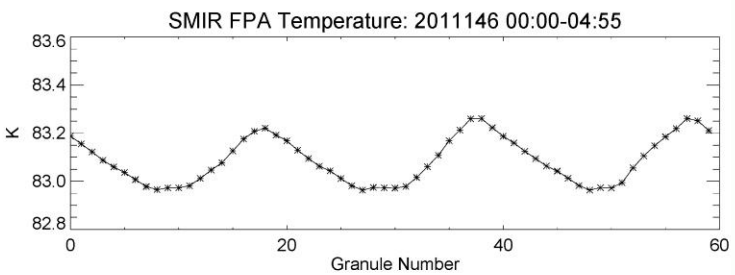


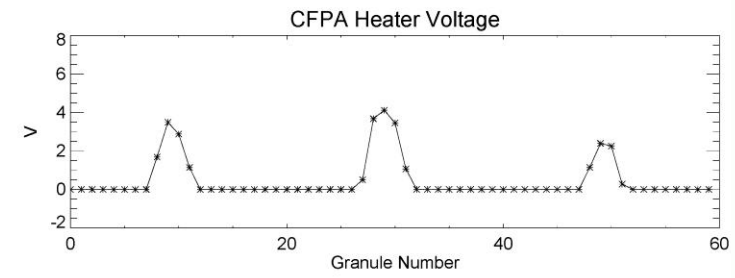
2007



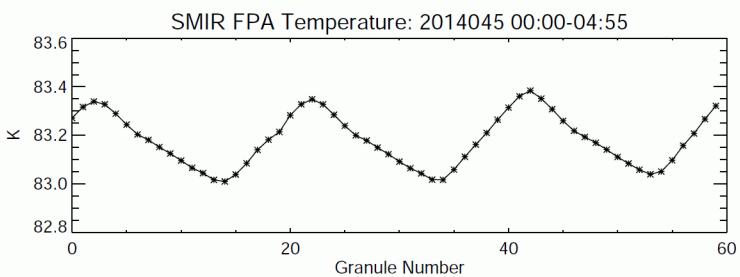


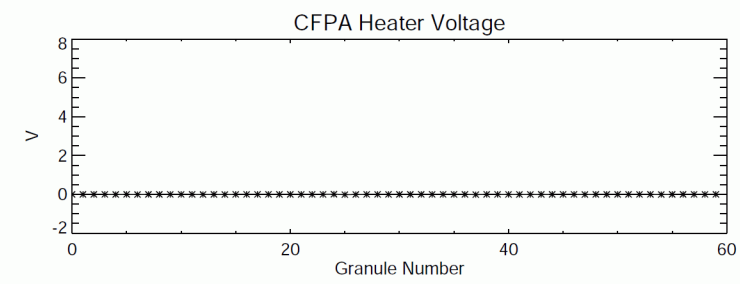
2011





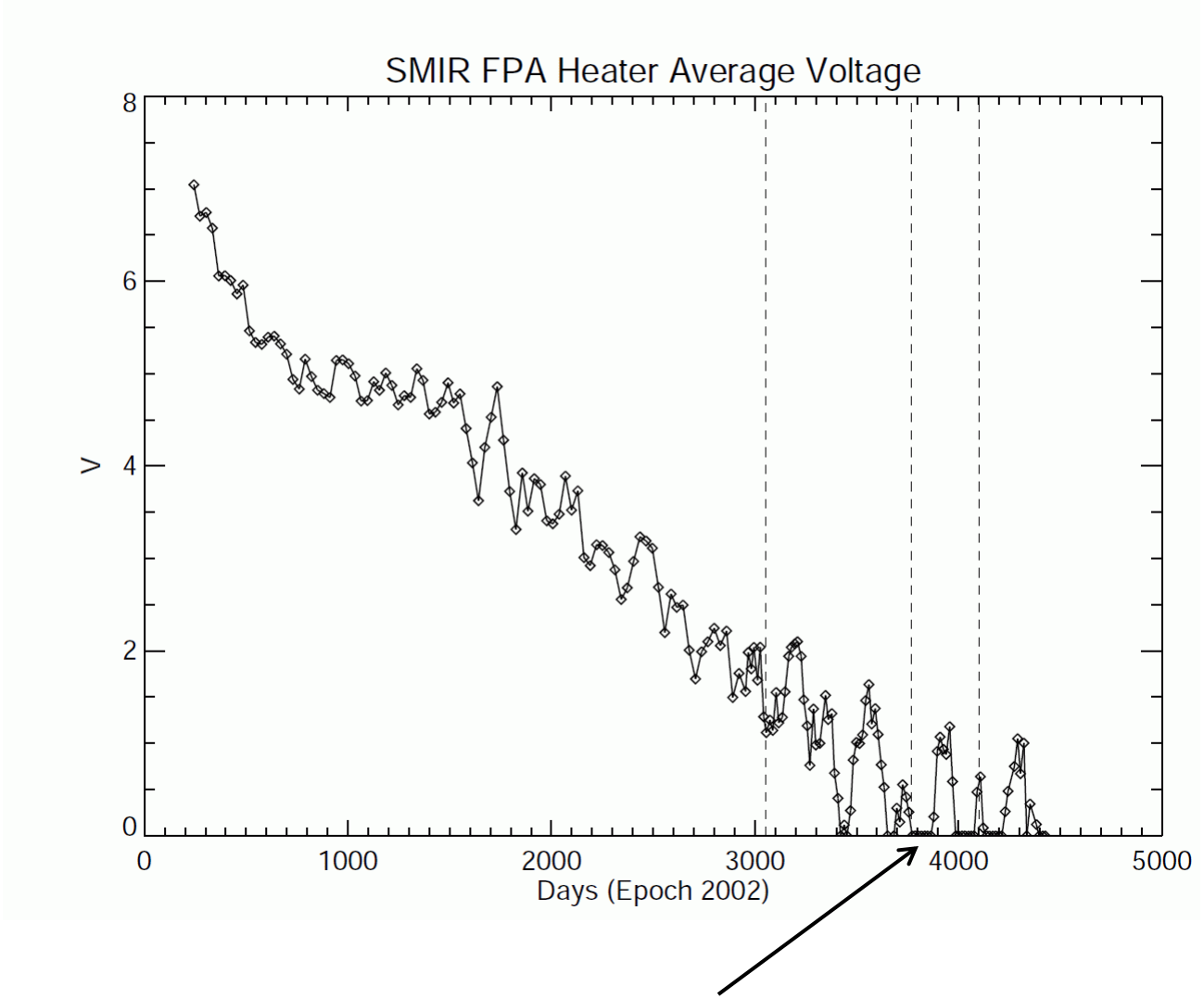
2014





Granule average

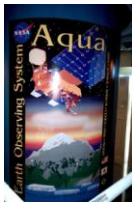
Heater Voltage Trend



CFPA temperature not controlled for intermittent periods

1 orbit average

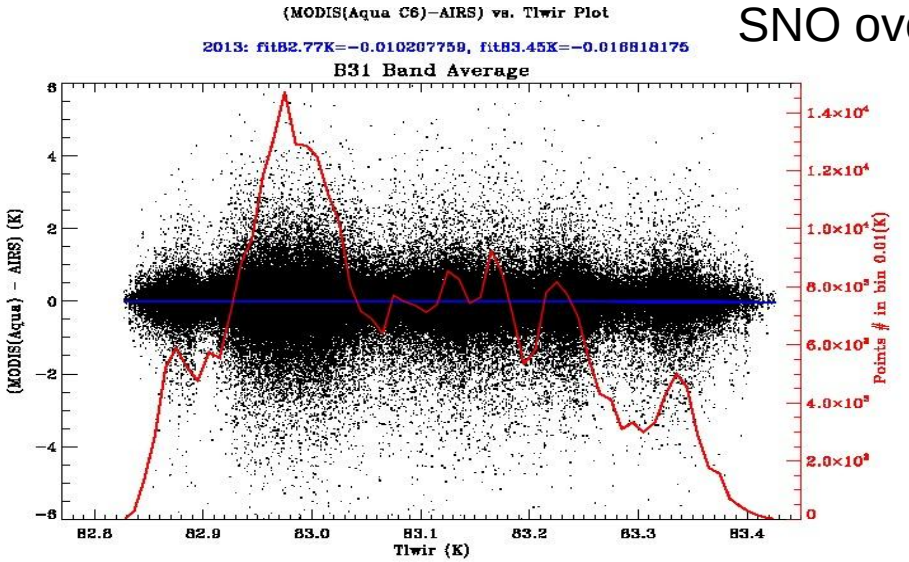
Observed Impacts

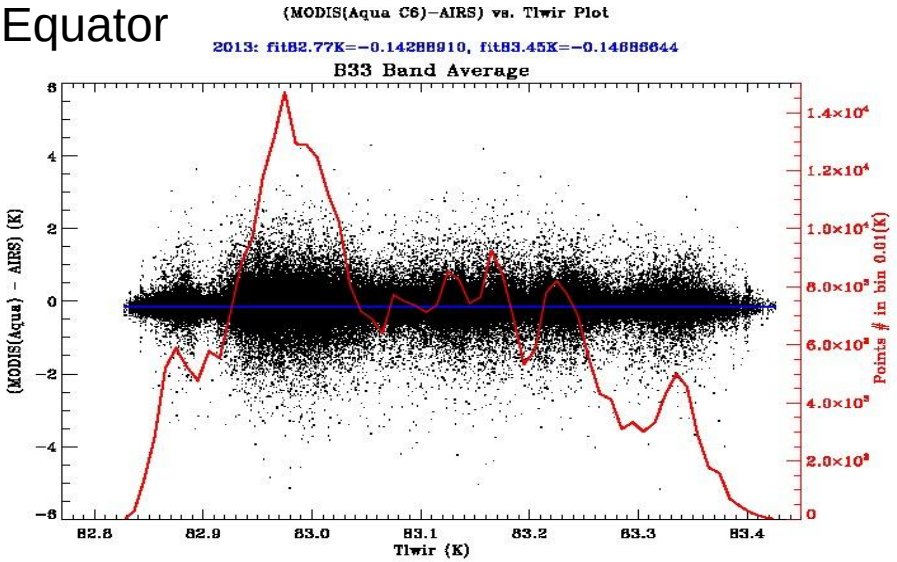


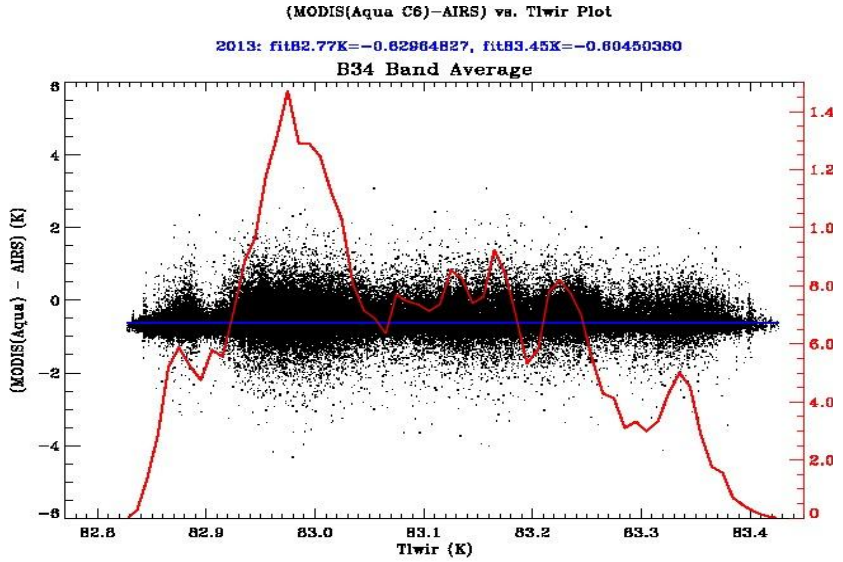
- No major changes since last meeting
- Gain variation with CFPA temperature
  - captured by scan-by-scan calibration
  - PC bands show largest effect
  - Linear relationship between gain and CFPA Temp
- BB Warmup-Cooldown Activities
  - Larger residuals for a2 derivation (a0 = 0 for PC bands)
    - Temperature correction for a0/a2 analysis implemented in C6
  - Bands 33, 35 & 36 T_{BB} Saturation
    - Increased instances of EV saturation
      - Currently cumulative saturation during WUCD: B33 ~180 min, B35 ~100 min, B36 ~50 min
    - FPA temperature dependent default b1 algorithm implemented for C6

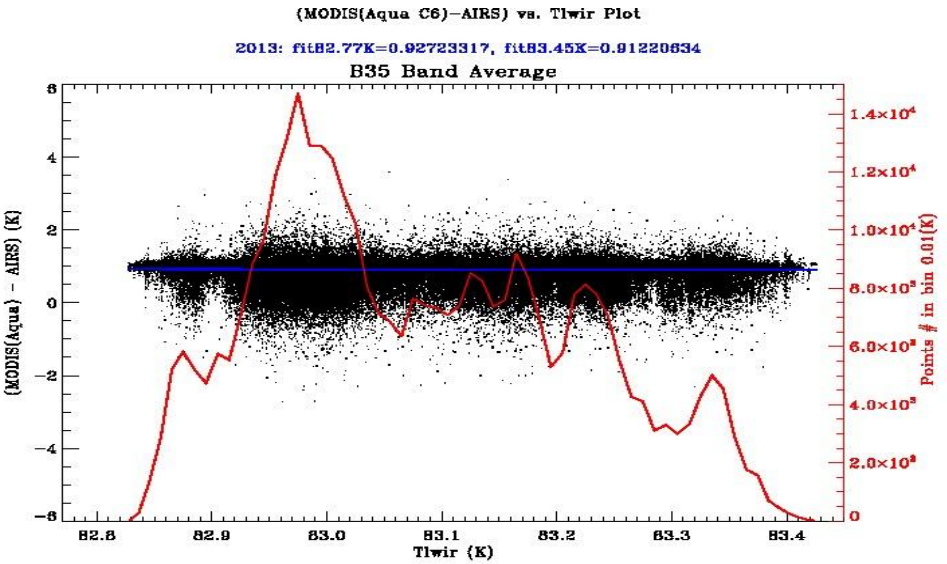
Assessment of Aqua CFPA temperature anomaly impact on L1B using AIRS

2013 MODIS/AIRS
SNO over Equator









Mitigation Strategies

- Scan-by-scan calibration captures much of the impact of the CFPA variation.
  - CFPA temperature dependent default b1 algorithm implemented in C6
- Options under consideration to address temperature fluctuations
  1. No change – continue operations in current configuration
  2. Change CFPA set point to 85K
  3. Perform Outgas
  4. Reduce frequency of WUCD activities
  5. Upload modified DCR table for bands 33, 35 & 36 (reduce saturation during WUCD)

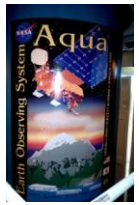
Option 2 – Change CFPA Set Point to 85K

- S/C needs to be in “nominal mode” for this activity
- Ensure that CFPA heater B is in the ON state
- Send the following commands:

  SET_RC_CFPA_TEMP TO 1/2/3

  MOD_SET_PM_RC_CFPA_TEMP(‘T2’)
- Monitor telemetry to ensure that the CFPA temperature adjusts accordingly (real time until it stabilizes)

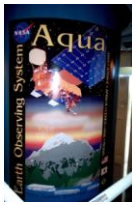
- Advantages:
  - Gain stably controlled
  - EV saturation during WUCD decreased
  - Increase in dynamic range for some TEB
- Concerns:
  - Majority of pre-launch LUT tables based on 83 K set point
  - DCR table for 85 K
  - Decreased radiometric resolution for some TEB
  - Increased detector noise



Option 3 - Outgas

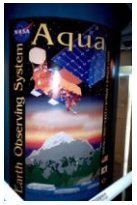
- An outgas without an anomaly requires transitioning MODIS from science mode to standby mode and then to outgas mode
  - Doors are closed, except SV door is moved to outgas position
  - This operation/action may require approval from HQ
- An outgas requires a set of commands and takes 2-3 days to complete (heaters are turned on in specific sequence)
  - CFPA will be back to ambient temperature during outgas operation
- Potential impact on SWIR (band 6 in particular) detector operability
- IOT prepared for and has approval to perform an outgas in the event of spacecraft anomaly resulting in a safe mode transistion.

Option 5 – Modify DCR Table



- CFPA setpoint remains at 83 K
- DCR table for bands 33, 35 & 36 modified and uploaded
- Expected to reduce EV saturation during WUCD
- Can be performed by IOT as a regular table upload to MODIS.

Summary



- Aqua MODIS continues to operate nominally
  - A decrease in radiative cooler margin has been observed since ~2007.
  - CFPA temperature not able to be stably controlled at set point of 83 K
    - Orbital and seasonal variations observed
  - Scan-by-scan calibration captures much of the impact of the CFPA variation
  - Collection 6 includes an improved default b1 algorithm and temperature correction to the a0/a2 analysis.

- EV saturation for bands 33, 35 & 36 during WUCD activities has increased.

- MCST continues monitoring of CFPA performance and is prepared to implement any of the proposed mitigation strategies in the event of increasing adverse impacts on science data products