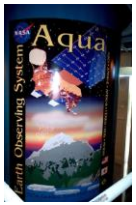
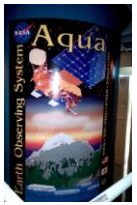


Aqua MODIS Cold FPA Performance and Operation

MODIS Characterization Support Team (MCST)

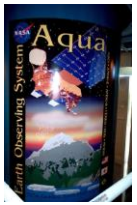
April 22, 2015

Outline



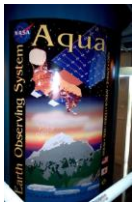
- Introduction
- On-orbit Performance Update
- Observed Impacts
- Mitigation Strategies
- Summary

Introduction



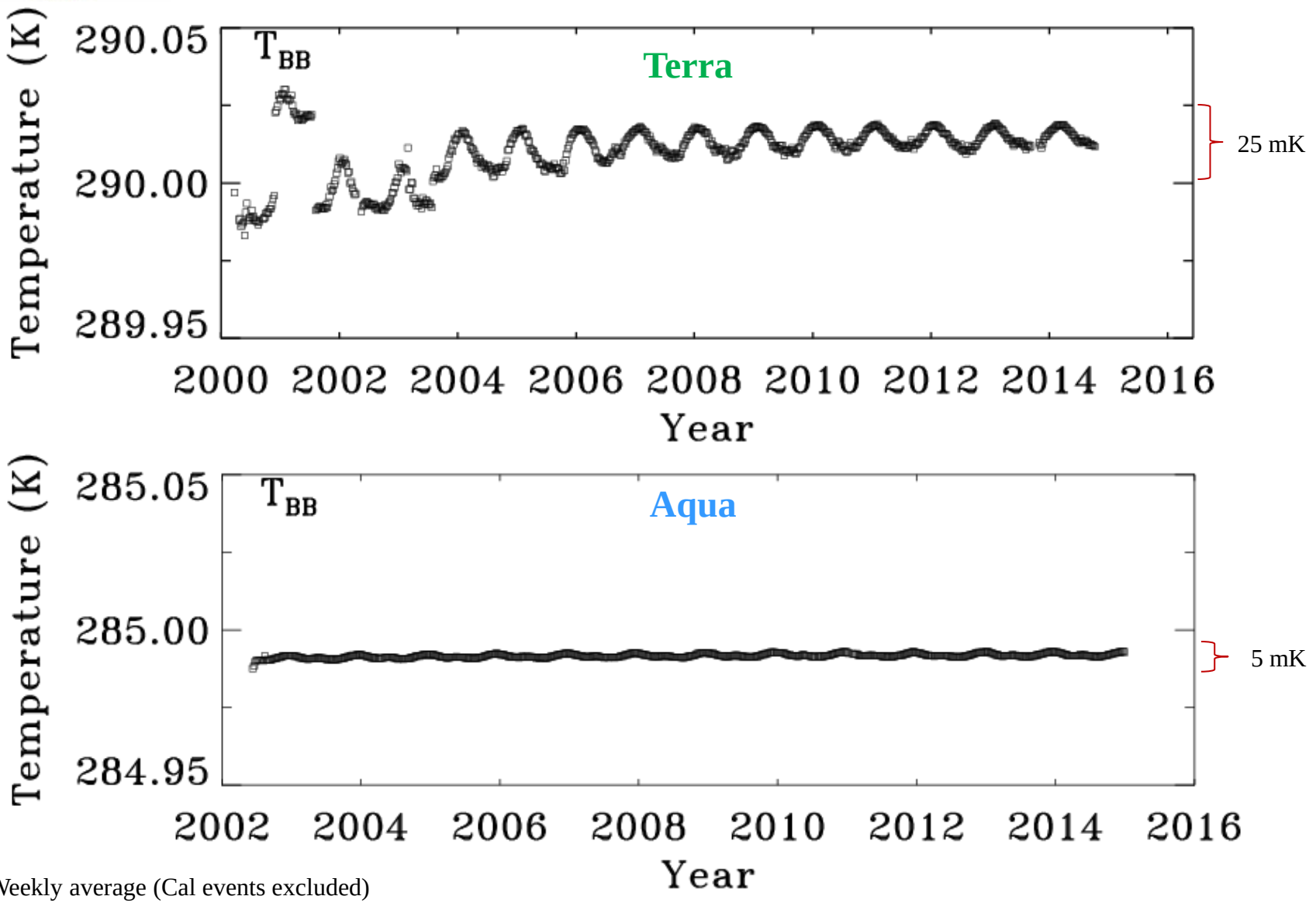
- Aqua MODIS Cold Focal Plane Temperature Control
  - Known issue with decreasing radiative cooler margin
- Prior meetings held to brief science disciplines on status, impacts and possible mitigation strategies
  - 1st meeting on May 7, 2010
  - 2nd meeting on April 25, 2012
  - 3rd meeting on March 17, 2013
  - 4th meeting on April, 16, 2014
- 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



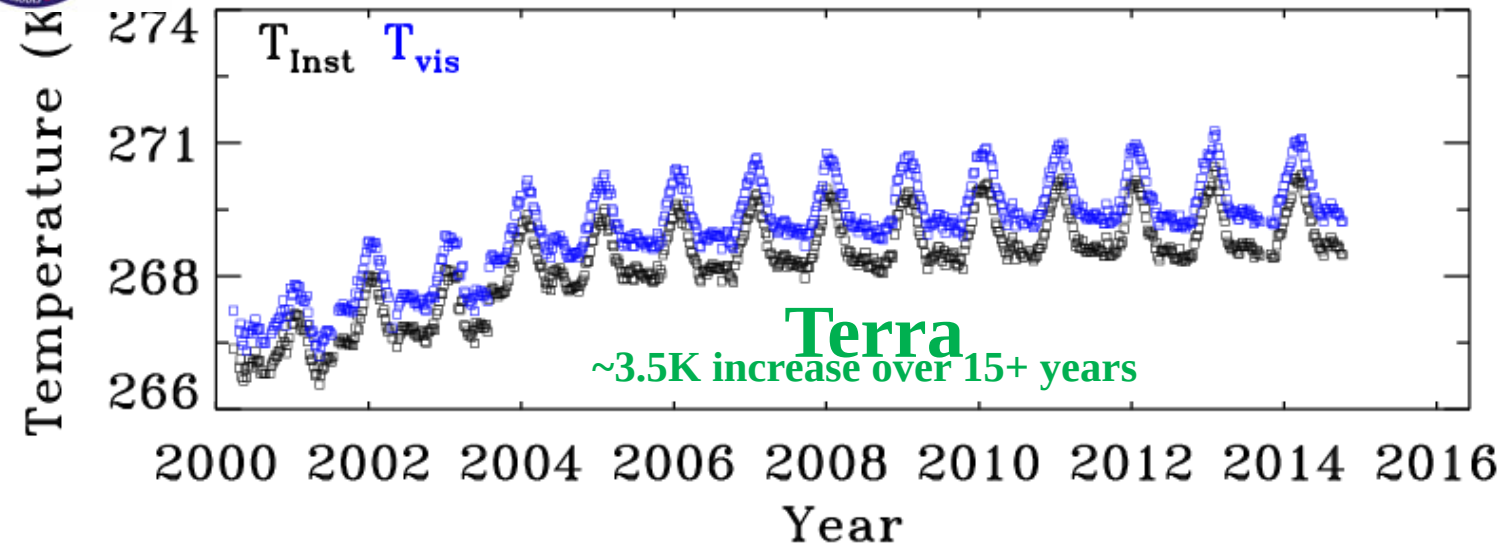
- CFPA temperature peak during summer months with maximum ~83.7 K in mid-2013.
- Peak temperature has decreased in 2014 and 2015
- CFPA orbital/seasonal oscillation – max/min difference ~0.4 K
- Radiative cooler margin lost for CFPA setpoint of 83 K during intermittent periods through annual cycle.
- Majority of impacts on L1B products occur during BB Warmup/Cooldown activities

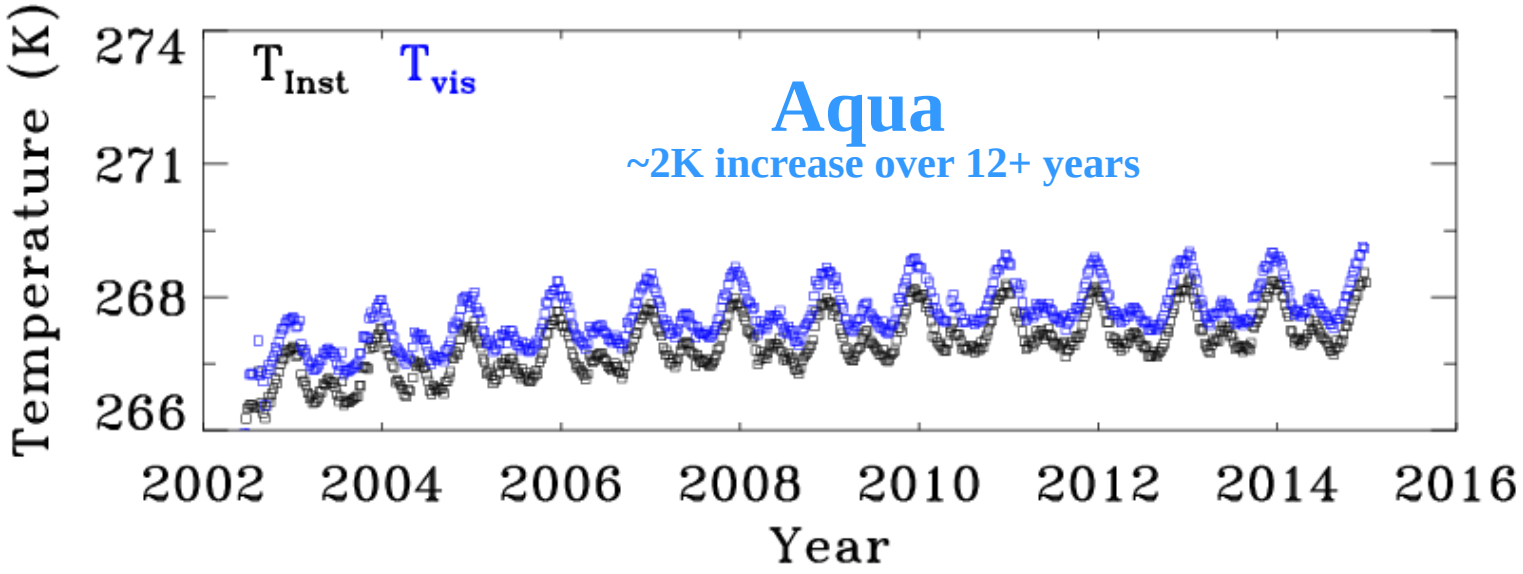
BB Temp Trends



Weekly average (Cal events excluded)

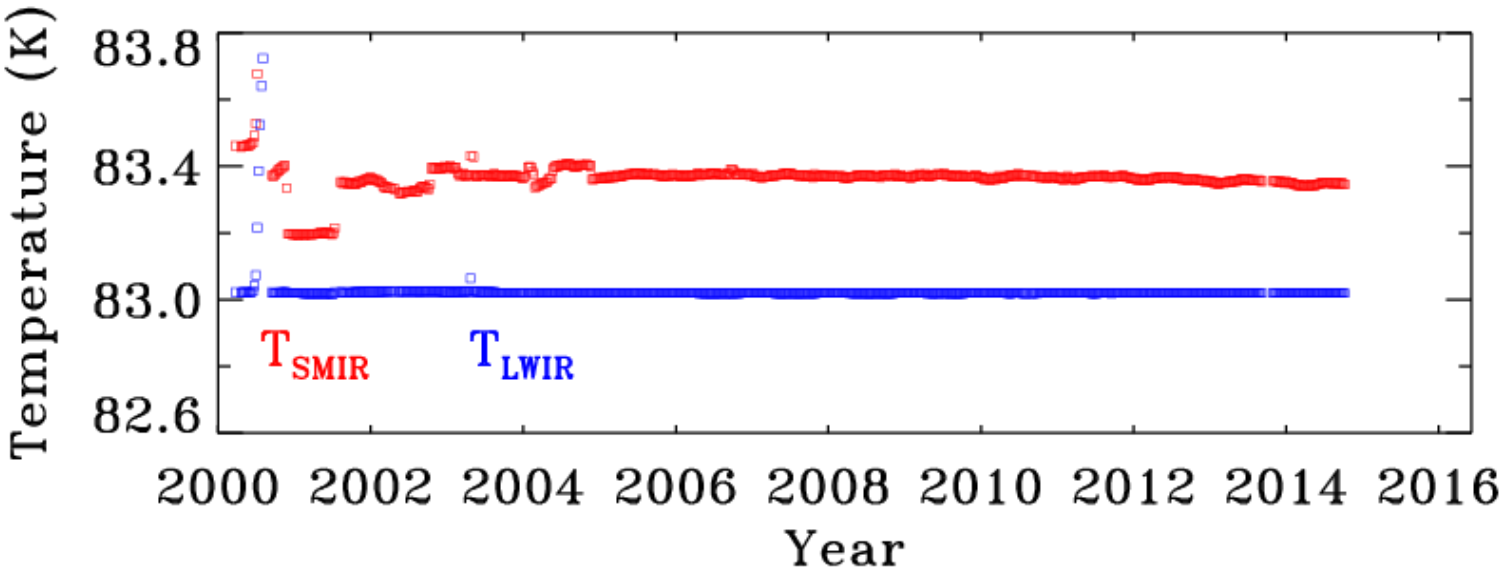
Warm FPA Temperatures



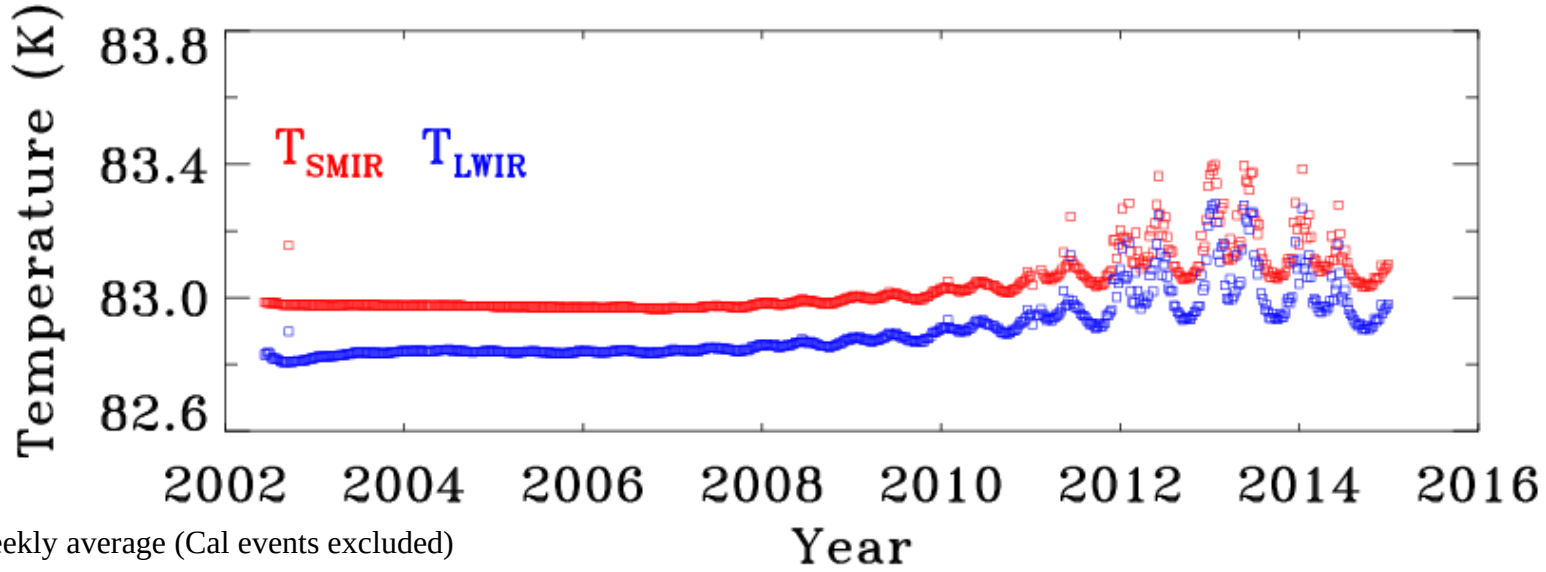


Weekly average (Cal events excluded)

Cold FPA Temperatures



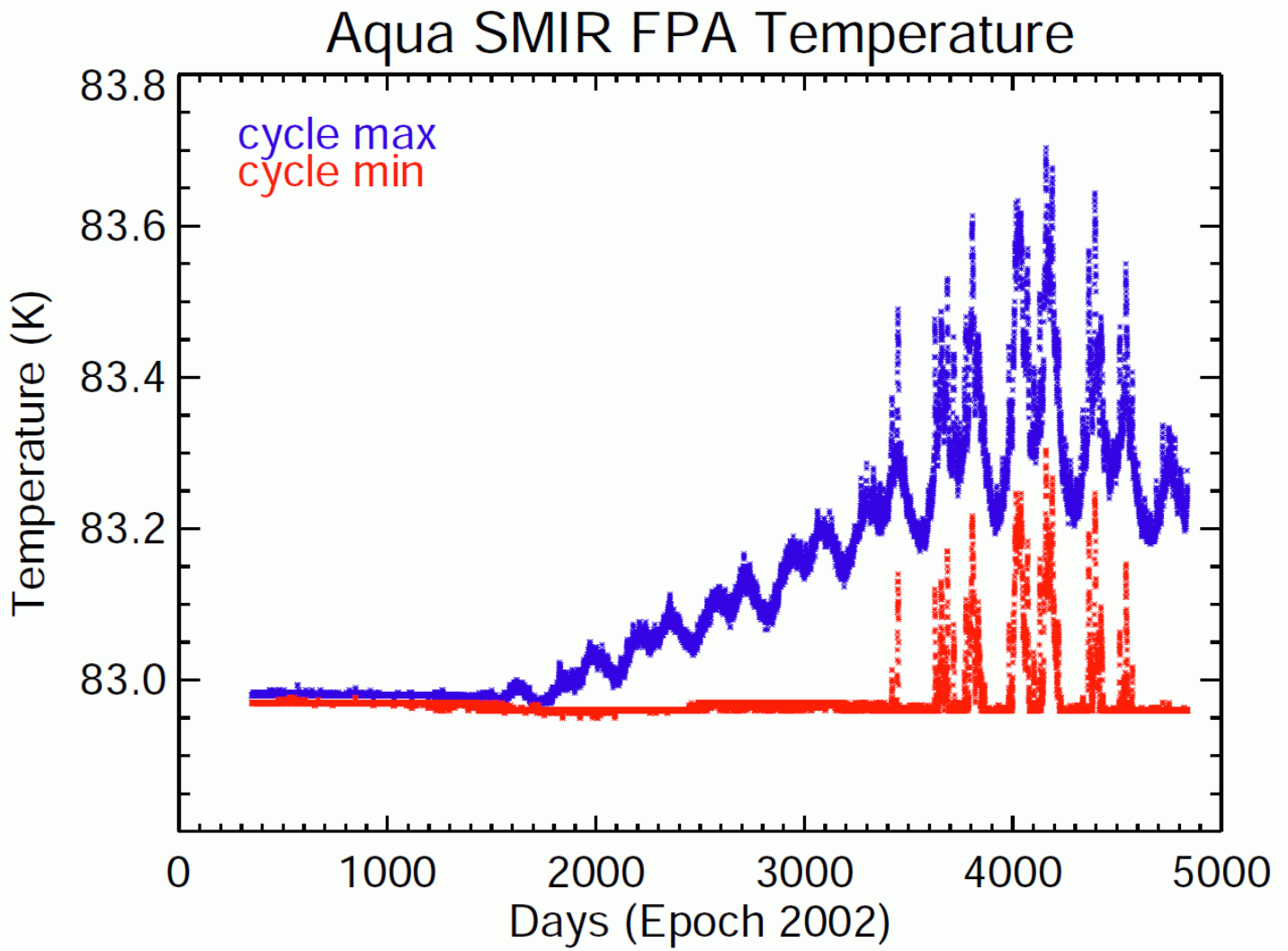
Terra



Aqua

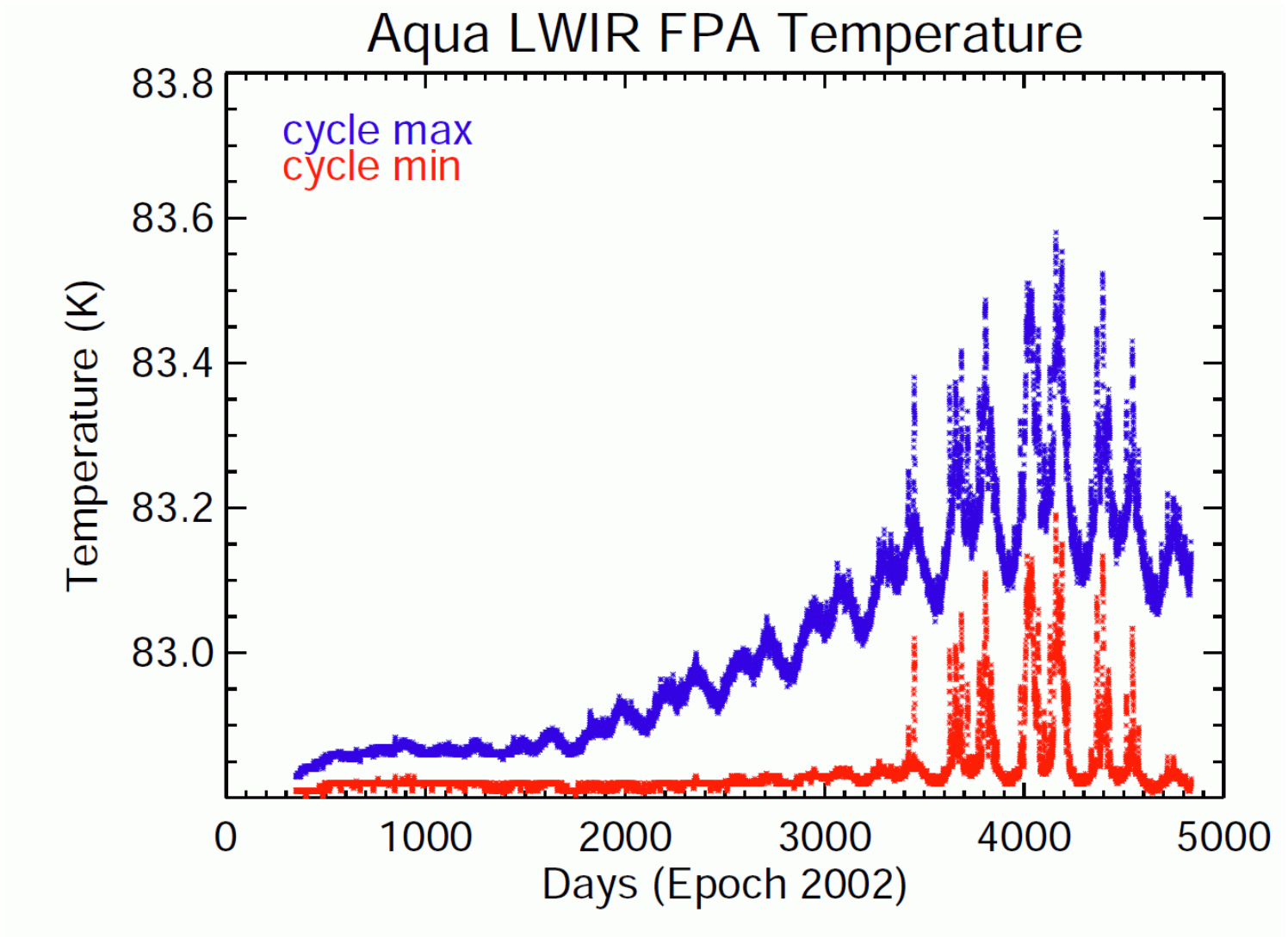
Weekly average (Cal events excluded)

Aqua CFPA Oscillations
Long-term trend



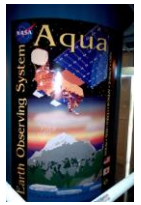
Max/Min of 4 orbits

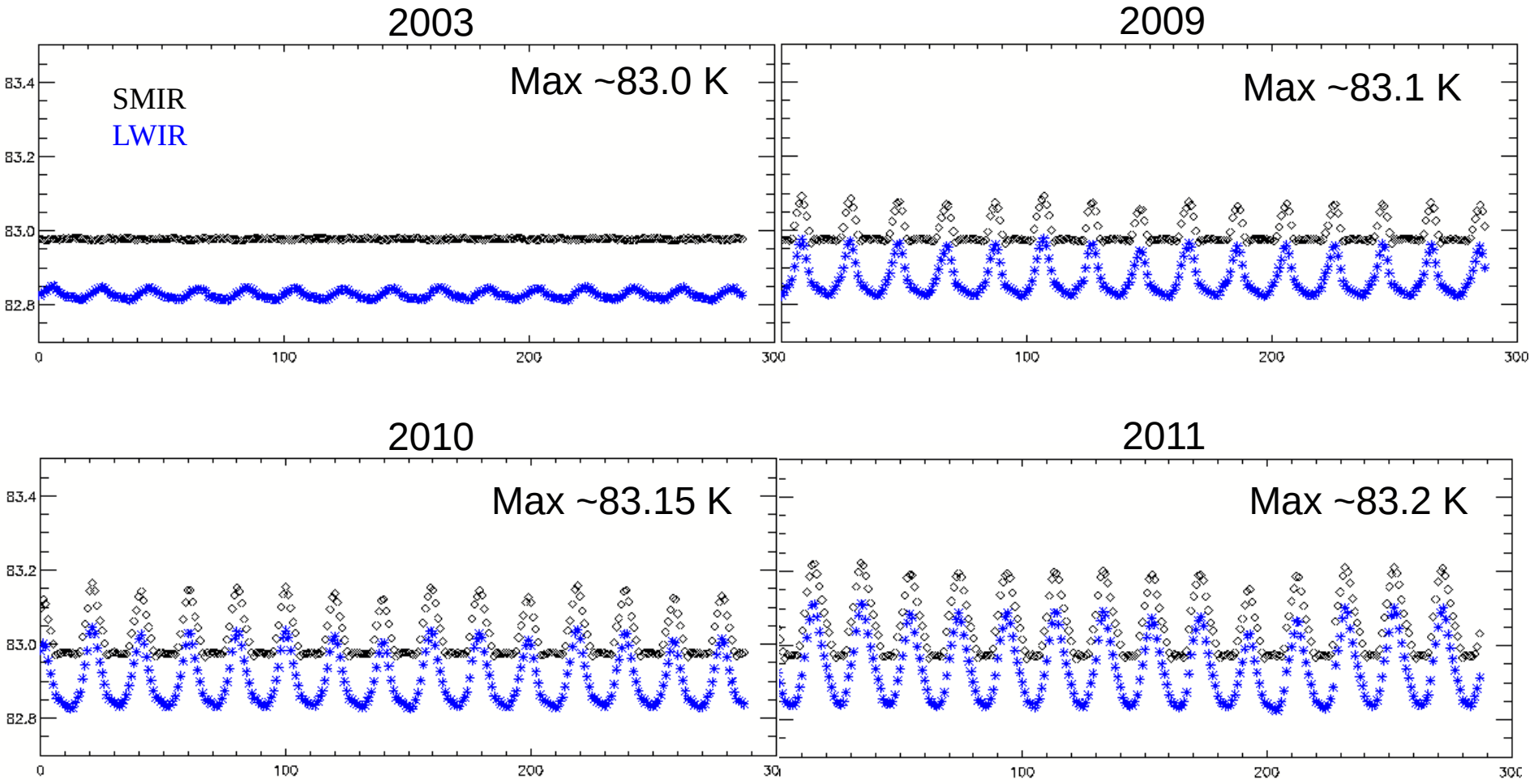
Aqua CFPA Oscillations
Long-term trend



Max/Min of 4 orbits

Aqua CFPA Oscillations
Short Term (DOY 100) trend

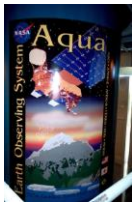




Granule average

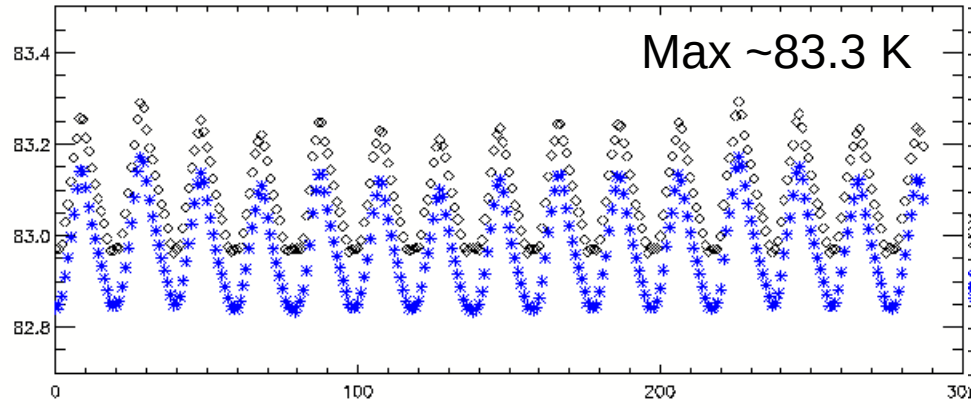
x-axis = granule #

Aqua CFPA Oscillations
Short Term (DOY 100) trend

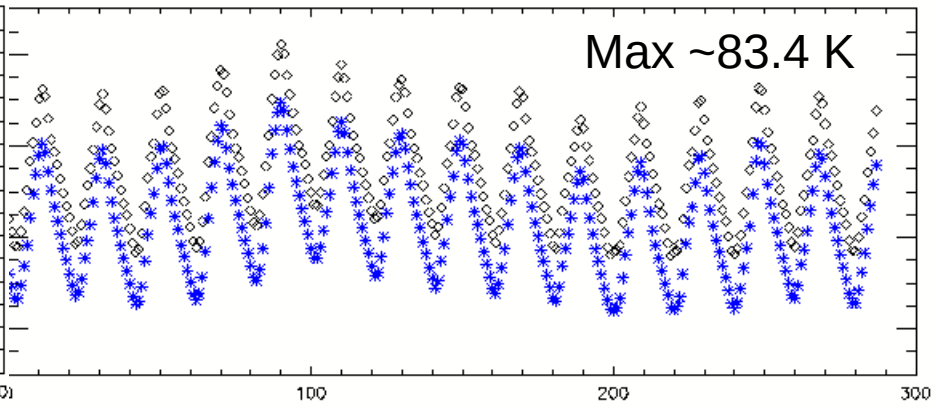


SMIR
LWIR

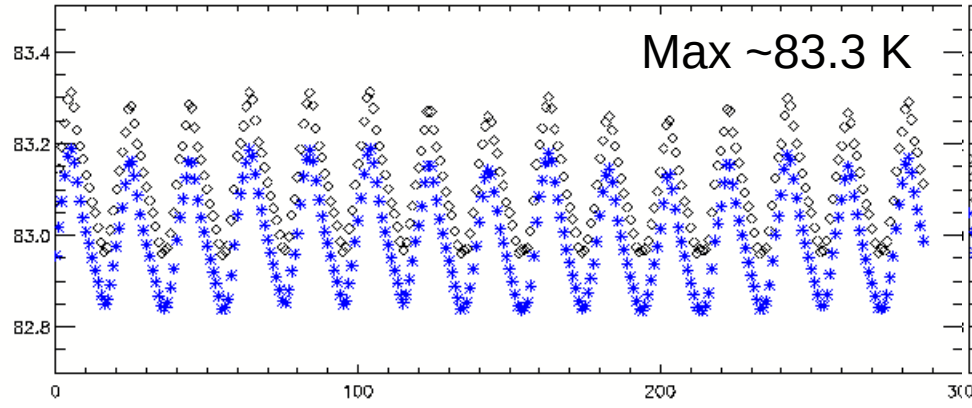
2012



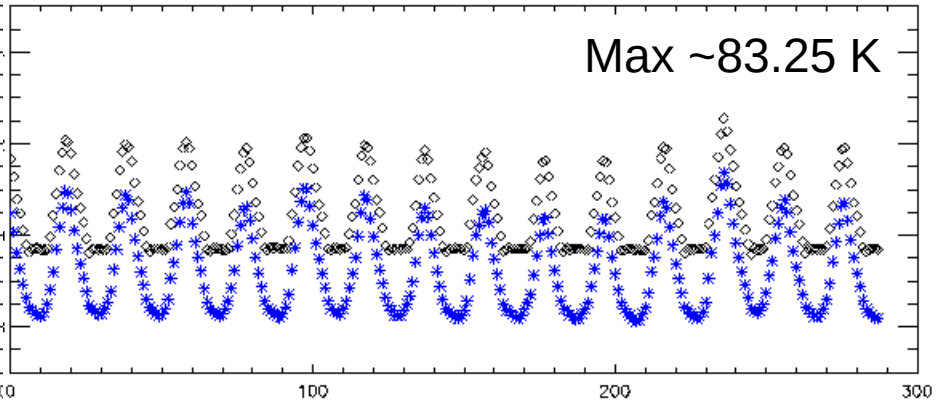
2013



2014

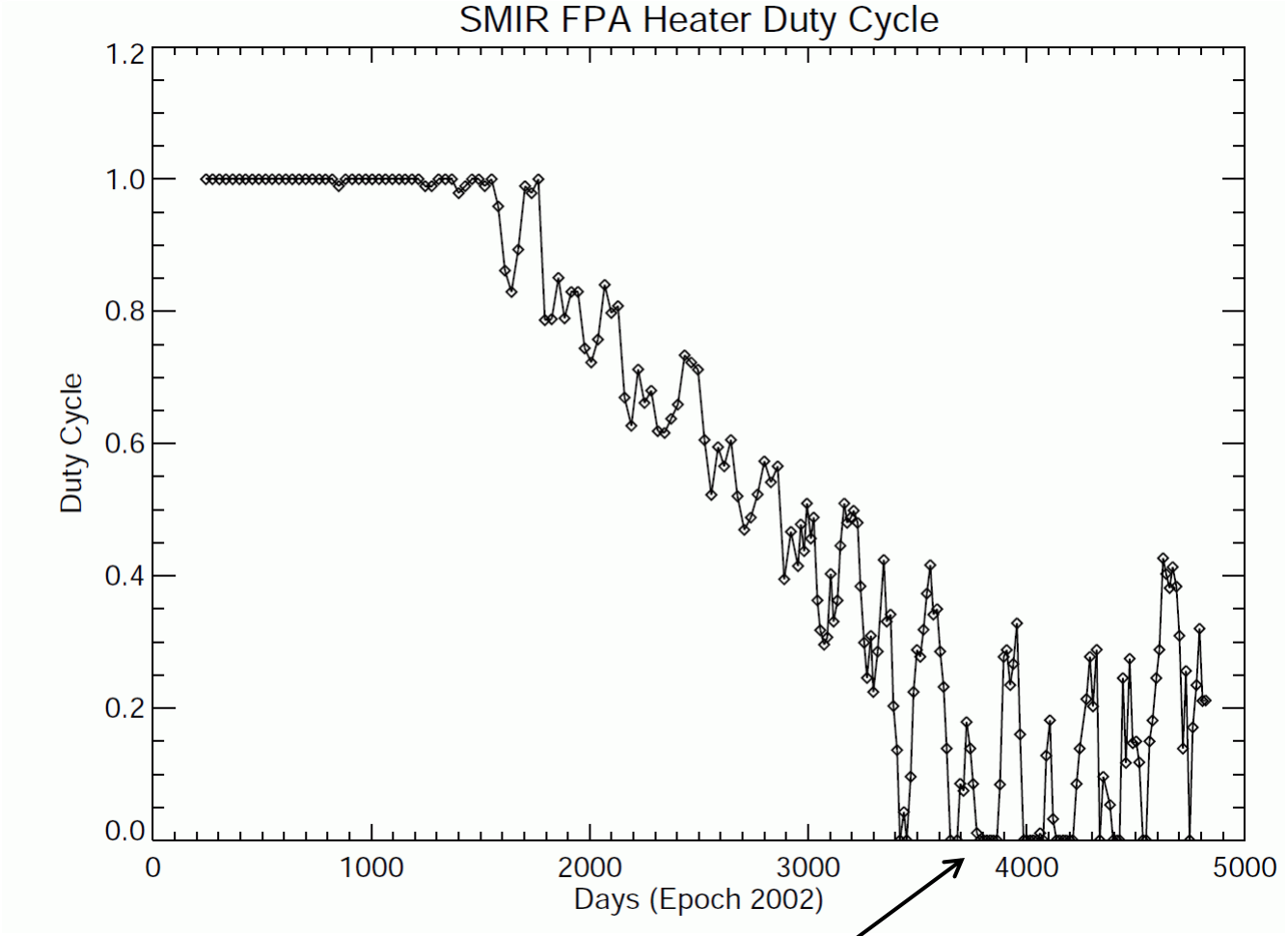


2015



Granule average

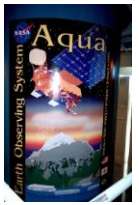
Heater Voltage Trend



CFPA temperature not controlled for intermittent periods

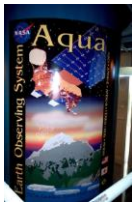
1 orbit average

Observed Impacts



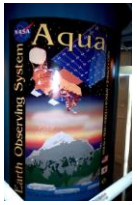
- Improved temperature performance since last meeting
- Gain variation with CFPA temperature
  - captured by scan-by-scan calibration
  - PC bands show largest effect
  - Linear relationship between gain and CFPA Temp
- BB Warmup-Cooldown Activities
  - Larger residuals for a2 derivation (a0 = 0 for PC bands)
    - Temperature correction for a0/a2 analysis implemented in C6
  - Bands 33, 35 & 36 T_{BB} Saturation
    - Increased instances of EV saturation
      - Cumulative saturation during WUCD:
        2004/203 - B33: 0 min., B35: 0 min, B36: 0 min
        2009/123 – B33: 7 min, B35: 13 min, B36: 0 min
        2013/174 - B33: 200 min, B35: 95 min, B36: 37 min
        2015/032 - B33: 161 min, B35: 105 min, B36: 37 min
    - FPA temperature dependent default b1 algorithm implemented for C5/C6

Mitigation Strategies



- 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 (requires NASA HQ approval)
  4. Reduce frequency of WUCD activities
  5. Upload modified DCR table for bands 33, 35 & 36 (reduce saturation during WUCD) – may impact dynamic range for bands

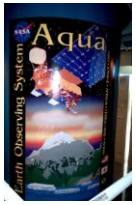
Summary



- 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
  - Maximum SMIR temperature reached in mid-2013, temperature performance has improved since then
  - 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.

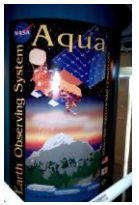
- EV saturation for bands 33, 35 & 36 during WUCD activities continues.

- MCST continues monitoring of CFPA performance. No reports received of adverse impacts on science products.
  - MCST Recommendation: Option 1 – No change in operation status



Backup Slides

Option 2 – Change CFPA Set Point to 85K



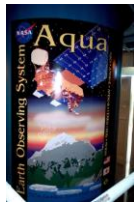
- S/C needs to be in “nominal mode” for this activity
- Ensure that CFPA heater B is in the ON state
- Send the following commands:

  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)

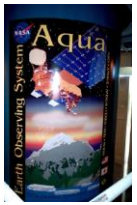
- Advantages:
  - Gain stably controlled
  - EV saturation during WUCD decreased
  - Increase in dynamic range for some TEB
- Concerns:
  - Majority of pre-launch LUT tables based on 83 K set point
  - DCR table for 85 K
  - Decreased radiometric resolution for some TEB
  - Increased detector noise

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 transition.

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.