

Terra MODIS Safe Mode Recovery Summary

Terra spacecraft entered safe mode (2016/049: 14:33:17Z) during an IAM. This caused MODIS to enter safe mode as well. The nadir and the space-view doors were closed as expected. The solar diffuser door was left open (since the anomaly from July, 2003). On 2016/053, the Terra FOT successfully recovered the Terra spacecraft from Safe-Mode back to Normal mode. Below is a brief description of the MODIS recovery timeline:

- MODIS transitioned to Standby Mode at 2016/054 16:41:52.
- MODIS preformed Outgas procedure from 2016/054 17:34:43 until 2016/055 19:19:40 (Total Outgas duration: 25:44:57).
- Space View Door opened at 2016/055 19:22:52.
- MODIS transitioned to Science Mode at 2016/055 19:26:34.
- Blackbody was turned on (290K) at 2016/055 19:59:21

The key telemetry temperatures (instrument, and focal plane) stabilized after day 2016/058. Onboard SDSM and black body calibrations were scheduled to monitor the instrument's performance after this recovery.

Reflective Solar Bands (RSB) performance:

Special Solar Diffuser Stability Monitor (SDSM) calibrations were performed on a daily basis for few days after the recovery. The Solar Diffuser (SD) degradation trending did not show any out-of-family behavior. The SD calibration is available every orbit for Terra MODIS and hence the gain for all RSB was tracked on a routine basis. All the RSB detectors continue to function nominally after the safe-mode recovery; however there has been a gain change for most detectors. On average, the VIS/NIR bands showed a gain change within 0.5% and the SWIR bands showed a change of up to 2%. A calibration look-up-table update is necessary to account for these gain changes. Consequently, a LUT (6.1.20.14) was delivered to SDST on 03/10/2016 (2016/070). A companion C5 LUT update (5.0.48.14) was also prepared at the same time and was delivered on 03/17/2016 (2016/077) along with the TEB and QA LUT.

Thermal Emissive Bands (TEB) performance:

Initial assessment indicated that the PV-LWIR bands (bands 27-30) were most impacted by this event. A gain change of up to 25% was observed for some detectors along with increased noise levels. A warm up cool down (WUCD) calibration was scheduled on 2016/062 to perform a comprehensive assessment of the performance of the TEB. This data was also necessary to derive updated calibration LUT parameters (a0, a2). Results confirmed the gain changes as well as the increased noise levels for these bands. The following QA changes were initiated to maintain the quality of the L1B as well as the downstream products.

Band 27: Flag detectors: 9 and 10 (product order) as noisy (detectors 1, 2, 3, 6 and 8 are already flagged noisy)

Band 30: Additional noisy detector: 6, (based on NEdT). Change status of noisy detector 8 to inoperable (based on NEdT and EV-imagery)

With these QA changes and updated calibration coefficients (a0, a2), the C6 LUT was delivered to SDST on 03/10/2016 (2016/070).

Deriving the updated calibration coefficients for band 30 in C5 showed unexpected behavior. Using updated a_0 and a_2 coefficients, derived from the 2016/062 WUCD calibration, Band 30 detectors after the safe-mode recovery resulted in a negative gain (b_1) coefficients that manifested as fill values in the L1B product. To overcome this, the C6 methodology was adopted to derive the C5 LUT for band 30 (using $a_0 = 0$). On 03/16/2016, the science team representatives were briefed via MsWG and after their approval, a LUT was delivered on 03/17/2016.

Increased noise in the band 27 detectors (1, 2, 9, and 10) has an impact at low radiance earth-scene images resulting in a fill value.

No observable impact in the on-board and the earth-view measurements was observed for the remaining TEB.

An initial assessment of the derived L1B was performed using continued ground measurements from Dome Concordia (Dome C) site. The brightness temperature (referenced to 11 μm channel) was evaluated to confirm consistency of the trends after the safe-mode recovery.

Information and updates regarding L1B data production after the safe-mode recovery can be found here: <http://ladsweb.nascom.nasa.gov>