



S-NPP VIIRS Significant Events in 2014 Monitored by NOAA ICVS Web-page



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Abstract

- As a part of post-launch Cal/Val, NOAA STAR developed and has maintained the Integrated Calibration and Validation System (ICVS) for Long-Term Monitoring (LTM) of the sensor performance. The Visible Infrared Imaging Radiometer Suite (VIIRS) is the one of the key instruments onboard the Suomi National Polar orbiting Partnership (S-NPP) satellite, which was successfully operational since its launch on October 28, 2011.
- This poster is focused on significant VIIRS significant anomalous events in year 2014 that were identified and analyzed through the ICVS LTM webpage. Firstly, the Single Board Computer (SBC) lock-up events randomly occurred four times in last year. It was caused by the cosmic high energy particle hits and the improved design was applied to the next J1 VIIRS. During the SBC lock-up events, there were unrecoverable data losses. The second event affected reflectance (or radiance) in the Reflective Solar Band calibration. The sudden SD degradation LUT (H-factor) changes were occurred on June 28th and July 11th of 2014, which had ripple effect on F-factors. The H/F-factor changes affected VIIRS radiometry up to 1.5 percent approximately especially in band M1. Thirdly, the calibration coefficients (C0) were updated on May 9th to be zero mostly affecting I3 approximately 1 percent drop in F-factor. Lastly, other operational anomalies such as 'Night Time Day Mode' and 'Sync Loss' events are explained in detail.
- The VIIRS ICVS LTM webpage has provided in-depth instrument monitoring information with very simple web-interface from imagery analysis to radiometric calibration. The calendar based browsing capability also provided excellent accessibility to locate the timing of the anomalous events. The VIIRS ICVS LTM webpage will be improved to meet the growing needs for the high quality satellite data providing essential information on the satellite performance.

Introduction

- STAR Integrated Cal/Val System (ICVS) Long-Term Monitoring (LTM) system
 - Turn instrument measurements into accurate environmental parameters.
 - Ensure high-quality satellite imagery for forecasts
 - e.g., hurricane tracking and monitoring.
 - Deliver accurate products for weather forecasts and environmental monitoring.
 - Ensure the integrity of the climate data records from broader satellite instruments.
- VIIRS ICVS LTM webpage provides (as shown in Figure 1)
 - Imagery Analysis (Global true color image, VIIRS single band image, VIIRS overall SDR quality)
 - Calibration factor trending plots (RSB/TEB F factors, H factor)
 - Solar Diffuser Stability Monitor (SDSM) related trending results
 - Solar Diffuser (SD) related plots per band, Blackbody (BB) related plots per band, Space View (SV) related plots per band.
 - Instrument health, Volt and current trending plots, Instrument/Focal Plane/Circuit Card Assembly/Scan Cavity temperatures.



Figure 1. ICVS LTM Webpage with VIIRS sensor at http://www.star.nesdis.noaa.gov/icvs/status_NPP_VIIRS.php

Significant Events in Year 2014

Single Board Computer (SBC) Lock-Up Events

- Data loss occurred during the SBC Lock-Ups in Figure 1 on October 9th.
- Caused by high energy particle hits and improvements are implemented to the next J1 [1].
- The staring locations and orbits were varying for all the events as shown in Table 1.
- SV counts were reset to higher values because of the new DC restore values in Figure 2.
- SD counts were also moving along with the SV, the bias corrected SD responses remained in stable levels in Figure 2.
- The SBC lock-up didn't affect the Reflective Solar Band (RSB) calibration
- No huge impact on TEB calibration, since the blackbody (BB) temperature was immediately went back to the normal temperature of 292.66K as shown in Figure 3.

Table 1. Detailed information on S-NPP VIIRS SBC lock-up events in 2014.

SBC lock-up event #	Date	Time	Duration	Starting Location	orbit
6	2/4/2014	17:38 - 21:35	3 hours 37 minutes	South America	Day
7	8/8/2014	14:20 - 18:50	4 hours 30 minutes	East Australia	Night
8	9/26/2014	18:25 - 18:35	10 minutes	Arctic near America	Day
9	10/9/2014	17:22 - 19:31	2 hours 9 minutes	South America	Day

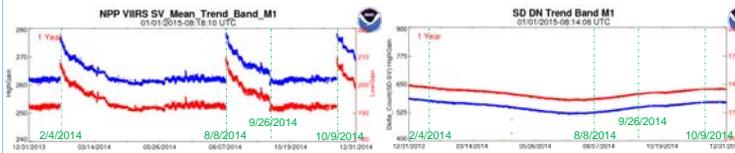


Figure 2. VIIRS SV and bias corrected SD trending results along with the SBC lock-up events in 2014.

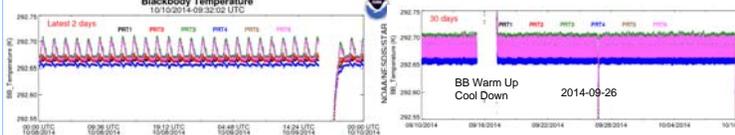


Figure 3. VIIRS BB temperature trending near the 8th and 9th SBC lock-up events..

Reflective Solar Band (RSB) F and H factor Trend Changes

- Due to flattening anomaly in SD degradation in 2014, there were two times of sudden updates in SD degradation, i.e. the H-factors on May 23rd and July 11th, 2014.
- The flattening anomaly started approximately from Feb 4th to May 19th as shown as red dotted lines in Figure 4.
- To compensate the flattening effects, two sudden H-factor updates were applied in operational H factor in blue dotted lines.
- Figure 5 show significant F-factor discontinuities directly affected radiometric calibration especially in M1-M4 bands.

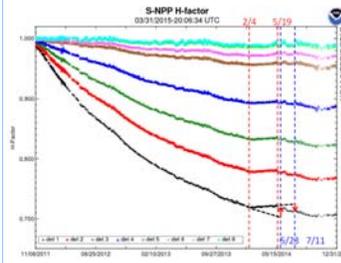


Figure 4. SD degradation flattening start dates (in red) and update dates (in blue).

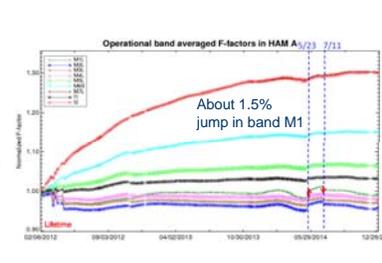


Figure 5. operational F-factors affected by H-factor updates on May 23rd and July 11th in 2014

Delta C₀=0 Coefficient Update

- The C coefficients represent thermal responses of the detectors and electronics.
- The C0 values were set to zero for all RSB bands and the C2 values were derived by the prelaunch test results starting from May 9th.
- Changes were < 0.5% in most of the RSB bands, but I3 had approximately 1% change in Figure 6.

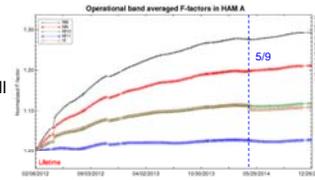


Figure 6. VIIRS delta C0=0 coefficient update on May 9th, 2014.

Night Time Day Mode Anomaly

- Day mode collections (Op_day) were reversed to night mode operation (Op_night) approximately between 15:00 and 21:00 on June 12th.
- Operational team quickly recovered the anomaly. RSB SDR data are missing except bands M7, M8 and M10.
- Figure 7 shows quality flag images and the quality flags were reversed responses during the anomaly periods.

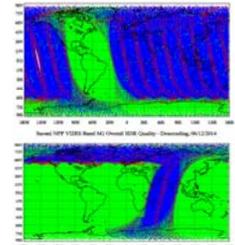


Figure 7. Night time day mode anomaly capture by the global quality flag images.

VIIRS RTA and HAM Synchronization Loss (Sync Loss)

- The root cause of this event is accumulation of charges in the Scan Control Electronics assembly (SCE) [2].
- The improved design was applied to J1.
- There were 5 Sync Loss events during 2014 as listed in Table 2.
- Figure 12 shows global image of quality flag in band M2 on 4/2/2014.

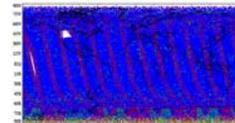


Figure 7. The global quality flag captured the Sync Loss event on 4/02/2014. The white patch indicates the data loss during the Sync Loss event from 20:14:21 to 20:15:52 UTC.

Table 2. Detailed information on the Sync Loss in 2014.

Sync Loss #	Date	Starting Time	Ending Time	Duration
36	3/8/2014	16:29:26	16:31:06	1 min 40 sec
37	3/12/2014	03:15:53	03:17:32	1 min 39 sec
38	4/2/2014	20:14:21	20:15:52	1 min 31 sec
39	5/20/2014	07:53:39	07:55:19	1 min 40 sec
40	11/8/2014	15:09:51	15:11:30	1 min 39 sec

Summary

- The NOAA ICVS LTM webpage for VIIRS sensor is continually providing critical global images, quality flags and calibration related trending plots.
- Indicating sensor status and data coverage.
- The S-NPP VIIRS related significant events in year 2014 are summarized here such as, Single Board Computer (SBC) Lock-Up Events, RSB F and H factor trend changes, delta C₀=0 coefficient update, night time day mode anomaly, RTA and HAM synchronization loss events.
- The VIIRS ICVS LTM team is ready to apply current system to next J1 trending.

References

- Changyong Cao, "JPSS STAR Science Team Annual Meeting: VIIRS SDR Team Report," 2014 STAR JPSS Annual Meeting, May 12-16, 2014, College Park, MD.
- Robert Wolfe, et al., "Suomi NPP VIIRS prelaunch and on-orbit geometric calibration and characterization," JOURNAL OF GEOPHYSICAL RESEARCH: ATMOSPHERES, VOL. 118, 11,508-11,521