NOAA STAR ICVS LTM – Suomi NPP VIIRS WEB PAGE

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http://www.star.nesdis.noaa.gov/icvs/status_NPP_VIIRS.php

Abstract

The Visible Infrared Imaging Radiometer Suite (VIIRS) is one of the key instruments onboard the Suomi National Polar-Orbiting Partnership (Suomi NPP) spacecraft, which was successfully launched on October 28, 2011.

To support the post-launch calibration and validation of VIIRS, the Integrated Calibration / Validation System Long-Term Monitoring (ICVS-LTM) was developed at NOAA STAR and made available online. This poster introduces the scope of the user friendly STAR ICVS web page, which extends to anomaly detection and future sensor improvements.

The quality of satellite radiances is essential for direct radiance assimilation in numerical weather prediction models, for retrievals of various geophysical parameters, and for climate trend studies. It is also a measurement of the success of the engineering and science efforts of our operational satellite program. Past efforts in post-launch calibration and validation took a piecemeal approach, focusing on onboard calibration, with much less attention paid to the quality of radiance data of earth observations. Many instrument related artifacts were left to the users to discover and evaluate the impacts. The lack of on-orbit calibration standards and methodology for radiance verification also aggravated the problem. In order to meet the challenge of the increasing demand for better satellite data quality, an integrated system that incorporates pre-launch, post-launch, onboard sensor calibration and long-term monitoring, as well as forward calculation of radiances are needed.

The STAR ICVS – VIIRS LTM has become an important tool for monitoring VIIRS data quality and instrument performance. It provides critical support for producing the products of sea surface temperature, ocean color, cloud imagery, vegetation, aerosols, and others, which will improve product quality to meet the growing need for high quality satellite data.

Introduction

Parameters	Descriptions	Dimensions	Measurement
Global True Color Image	Global image from VIIRS M3, M4, and M5 bands	1 map	Cloud distribution, Solar eclipse detection
Global Single Band Image	VIIRS broad spectral coverage for observing the Earth	M1-16, I1-5, Day and Night DNB 23 maps	Atmosphere, land, ocean characteristics
Global SDR Quality Map	Global overall VIIRS SDR quality map	M1-16, I1-5, DNB 22 maps	Daily global data quality
Lunar Intrusion Map	Moon in the Space View	1 band represents all M & I bands	Data contaminated by the Moon
Instrument Temperature	BB, RTA, cavity, HAM, FPA, cooler, Mainframe, Circuit Card Assembly	19 temperature	Electromagnetic radiation
Instrument Status	In flight instrument health status	20 parameters	Voltage, current and motor errors
F factors and H factors	Degradation of Solar bands based on SD signal and SDSM	9 bands	Degradation of reflective solar bands
Solar Diffuser Counts	VIIRS observation delta N of solar diffuser for band I1~I3, M1~M11, DNB over band average	21 bands	Degradation trends
Solar Diffuser NE∆N	Noise NE∆N for solar diffuser signal of solar bands	17 bands	Signal to noise ratio
Detector Solar Diffuser Counts	VIIRS observed DN of Solar diffuser from bands I1~I3, M1~M13 over detector average	16 bands	degradation from detector uniformity
SDSM signal	SDSM signal of solar diffuser and the Sun in every orbit	7 bands	SDSM trends
Space View Counts	VIIRS observation Space view DN for I1-I5, M1-M16 bands	21 bands	Background signal
Space View Count NE∆N	Dark Noise NE∆N for space view signal for I1 to I5, M1 to M16 bands	21 bands	Dark noise signal
Blackbody Counts	VIIRS observation blackbody DN for I1 to I5, M1 to M16 bands	21 bands	IR gain derivation
Blackbody Counts NE∆N	Noise NE∆N for black body signal for I1 to I5, M1 to M16 bands	21 bands	IR NEDT derivation

Goals and Objectives

Goals - Build a site that can easily be edited to house an evolving set of metrics for each satellite instrument. Our goal was to build a site that was maintainable, extensible, and simple for instrument monitoring teams to populate and manage.

Objectives –

1) Search engine optimization - Better chart metadata and consistent labeling for satellite and instrument names has made the ICVS system very 'discoverable' via web search tools.
2) Compliant with Section 508 - STAR ICVS web page is compliant with Section 508 accessibility standards and other requirements associated with a properly compliant government website
3) Animation capability - use "Slide Show of All Charts for Selected Date" button
4) Browsers and devices support - IE8 and newer; Firefox; Safari; Opera, iPhone and Android mobile devices
5) Access to metrics across S-NPP's entire operational history through the calendar
6) Intelligent error handling by listing missing files and providing contact e-mail for communication

Detailed Activity Schedule Load Detection

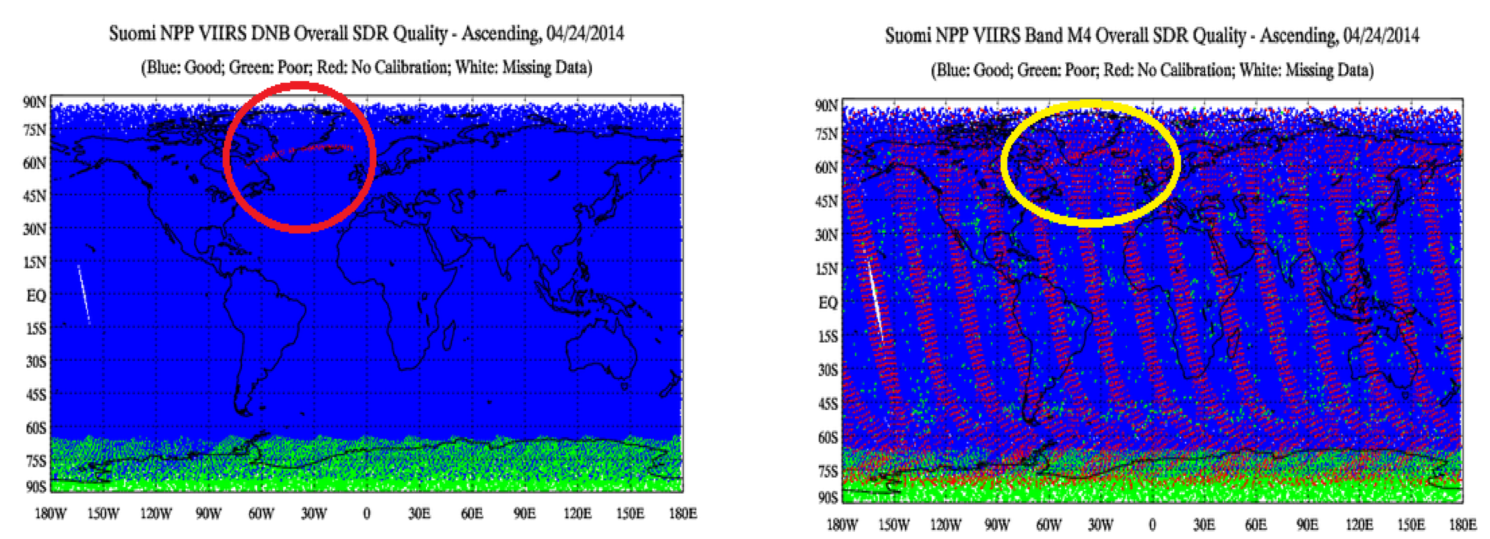

Figure 1. Suomi NPP VIIRS detailed activity schedule (DAS) were uploaded during contact for orbit number 12900 at 15:00 UTC on 24th April. This activity was observed on the VIIRS overall SDR quality map for all bands. A red streak which means no calibration data passed south of Greenland over the North Atlantic Ocean. This is the result of missing thermistor data which is required for calibration processing.

Cross Reference VIIRS SDR Teamwork

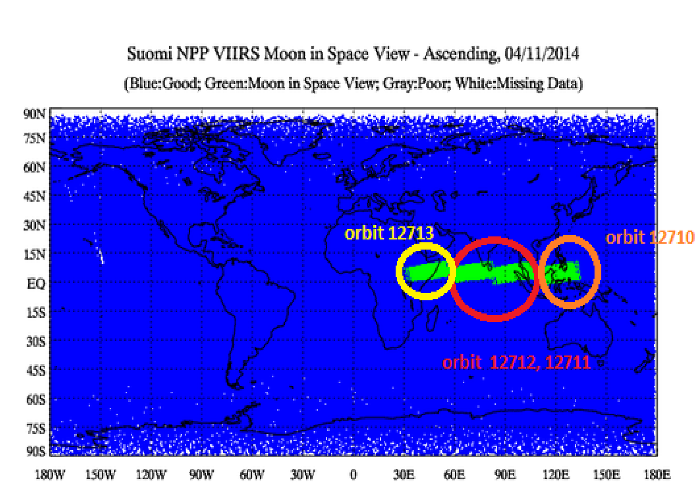

Figure 2. False Suomi NPP VIIRS Lunar Intrusion observed on 11th April -
The VIIRS lunar intrusion was expected for two orbits: orbit 12711 from 07:02:52 to 07:03:07 and orbit 12712 from 08:44:37 to 08:44:52 on April 11, 2014. We received good geo-location data for the day. Quality flag two for orbit 12711 (t0701585_e0703227_b12711), which is the right middle rectangle of the four green rectangles, and 12712 (t0844241_e0845483_b12712), which is the left middle rectangle of the four green rectangles, in the above time frame showed the Moon has corrupted the space view. Besides the two predicted lunar intrusion orbits, the adjacent orbits are also contaminated with lunar intrusion. The unpredicted lunar intrusion was observed on the VIIRS Lunar Intrusion map for orbit numbers 12710 (t0048094_e0049336_b12650) and 12713 (t0410080_e0411322_b12652). North Grumman team is aware of the extra lunar intrusion issue and they are working on a solution to fix it.

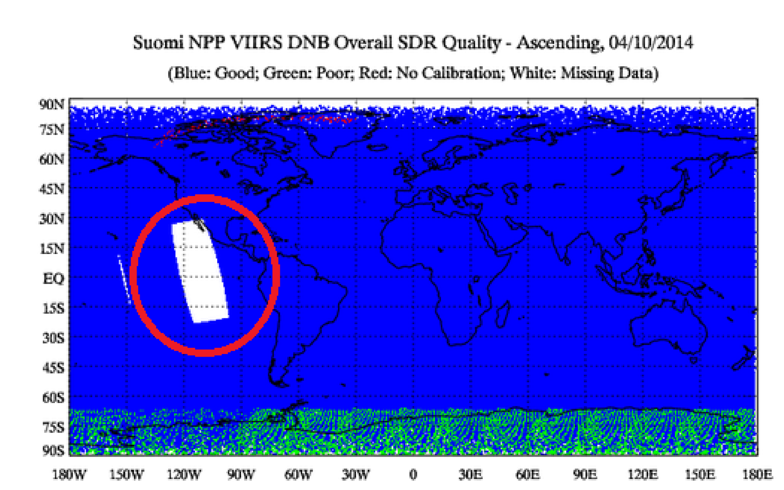

Figure 3. Suomi NPP VIIRS Lunar Calibration Maneuver on 10th April -
Suomi NPP VIIRS performed a maneuver for lunar calibration on orbit 12704 with VIIRS sector rotation (encoder offset) to allow the Moon image to be captured in the middle of Earth view sector (target time 20:53:17 UTC). This includes thirteen minutes of sector rotation, from 20:47:46 to 21:00:47 UTC, which impacted VIIRS SDR and EDR data quality and twelve minutes of geo-location pointing off nadir, i.e. maneuver, from 20:48:16 to 21:00:16 UTC. We received good geo-location data for the day, but the geo-location data received from 20:47:46 to 21:00:50 are not useful (filled values) -- which is the white area on the map where lunar calibration was performed

Monitoring VIIRS Instrument Degradation

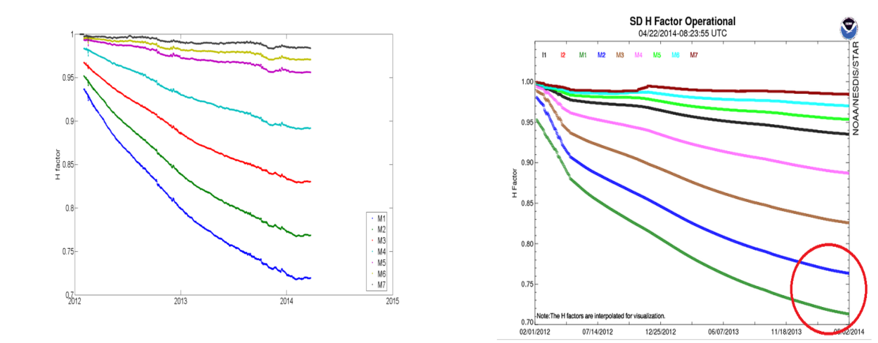

Figure 4. Suomi NPP VIIRS H-Factor trending showed discrepancies from the Aerospace H-Factor trends. The H-Factor from Aerospace (left figure) showed flattened curves in February and March of 2014, especially in the M1 and M2 bands, while the H-factor from ICVS (right figure) showed decreasing curvature in 2014.

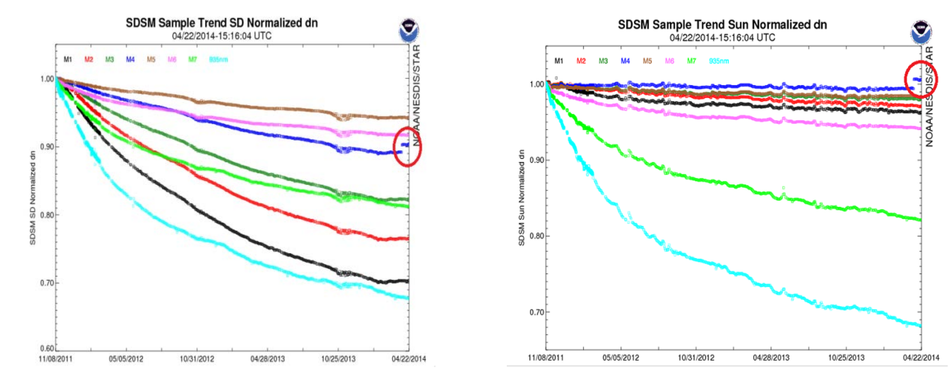

Figure 5. Suomi NPP VIIRS SDSM SD and SDSM Sun Normalized DN showed discontinuity for the M4 band. The discontinuity started on 4th April.

Astronomical Activity Detection

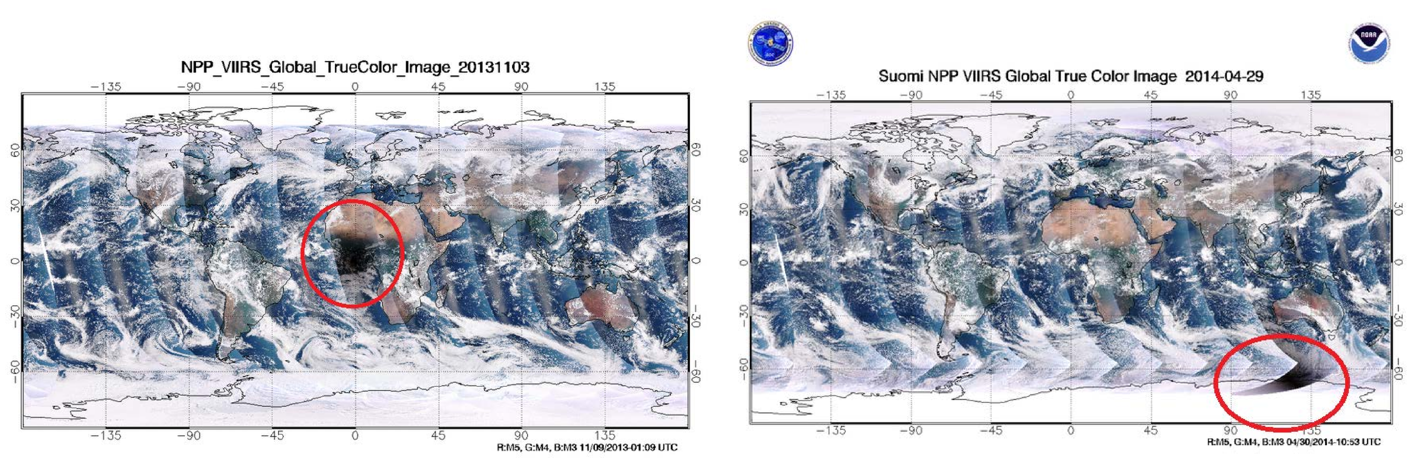

Figure 6. Suomi NPP VIIRS Global Image Captures the Solar Eclipse on the 3rd November 2013 and the 29th April 2014

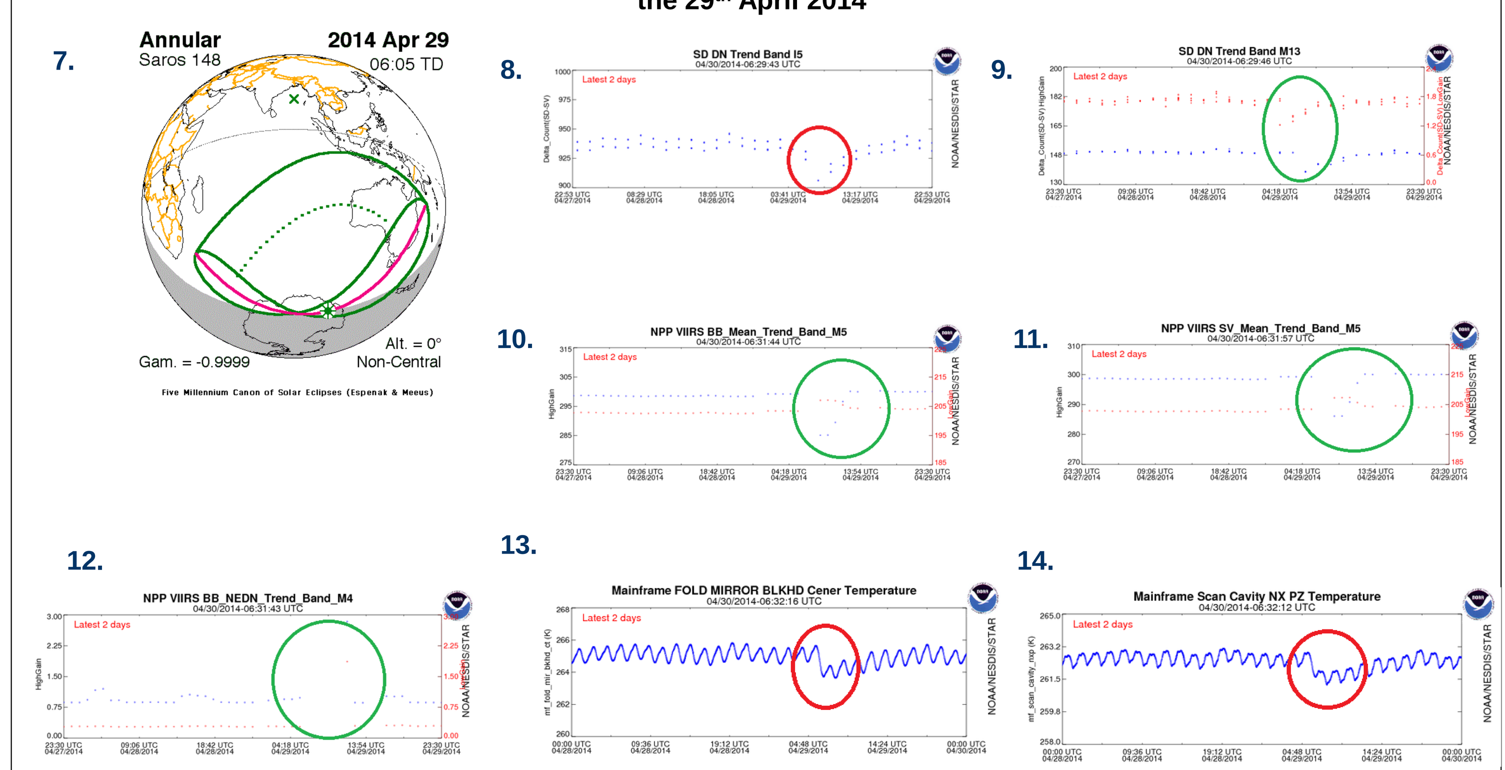

Figure 7. Solar eclipse event on 29 April 2014 - The northern edge of the shadow first touches down in Antarctica at 05:57:35 UTC. The instant of greatest eclipse occurs six minutes later at 06:03:25 UTC the event last seventeen minutes.
Figures 8 and 9. VIIRS solar diffuser count for M12 to 16, I4 and I5 bands showed decreased SD count at 5:00 - 7:00 UTC;
Figures 10 and 11. VIIRS high and low gain of M4 and M5 bands switch position for blackbody count and space view count after the solar eclipse;
Figure 12. VIIRS blackbody count NE delta N for M4, M5 showed data missing during and after the solar eclipse;
Figures 13 and 14. VIIRS mirror, telescope, and mainframe scan cavity temperature declined during the solar eclipse.

Future Development

We are looking for anomalies daily through the NOAA STAR ICVS VIIRS web page. The convenience of the NOAA STAR ICVS VIIRS SDR database allows all the scientists to flip through the calendar and find the parameters of interest for their research projects. We received very positive user feedback. The need of VIIRS RDR data monitoring is in high demand in order to find the root causes of instrument malfunction. NOAA STAR ICVS VIIRS team is developing a tool to monitor VIIRS RDR data.