Suomi NPP VIIRS Calibration Knowledgebase

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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/validation of VIIRS, a comprehensive knowledgebase has been developed at NOAA and made available online. This poster introduces the key components of the knowledgebase and its use for data quality assurance, anomaly investigation, and EDR applications.

The calibration knowledgebase has a number of features, including daily orbital prediction, simultaneous nadir overpass (SNO) and SNO extension to low latitude (SNOx) predictions, VIIRS event log database, image gallery, radiometric time series at validation sites, instrument information, and publication references. It has been used extensively for the VIIRS calibration/validation. For example, the event log database contains the monthly lunar calibration events through maneuver from 2012 to current. The database provides the lunar data date and time, location, spectral bands, and event type for users to search the lunar data from the database. This provides important support for lunar data analysis which allows us to independently verify the stability of the VIIRS calibration.

The VIIRS calibration knowledgebase has become an important component for supporting the VIIRS SDR data calibration/validation, 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 needs for high quality satellite data.

The URL for the calibration Knowledge Base is https://cs.star.nesdis.noaa.gov/NCC/VIIRS

Calibration Knowledge Base Components

VIIRS Event Log Database

The Event log database contains all events that occurred to Suomi NPP VIIRS since launch. This includes major events such as sync loss, single event upset outage, as well as planned events such as lunar maneuvers, blackbody warm-up cool-down (WUCD), star tracker realignment, etc. The event log database is very useful for instrument diagnoses, time series trending and analysis, and future reanalysis and recalibration. We have used the Event log database to collect lunar maneuver data which has been used for the lunar band ratio analysis. It is also used to correlate the time and location of the single event upset outage in instrument anomaly and diagnosis.

Figure 1 shows the distribution of the SBC lockup events from the database and its correlation with the SAA. The event log database is powered by MySql and was initially designed by a summer intern from the Computer Science Department, University of Maryland.

While the current database only includes instrument related events, the ground processing related events such as MX updates will be added in the near future.

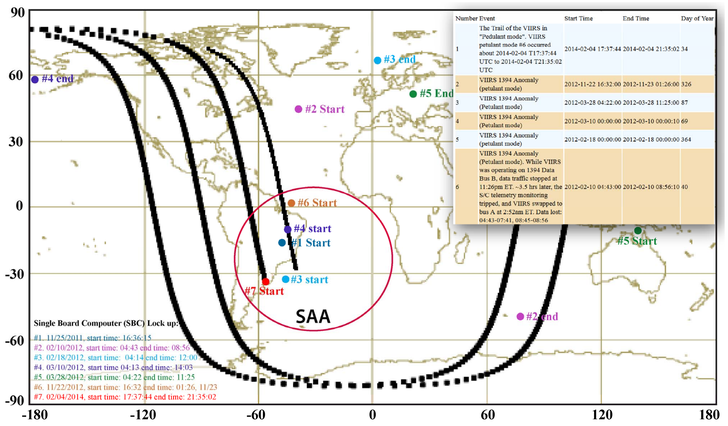

Figure 1. SBC lockups and other events from the event log database

VIIRS Image Gallery

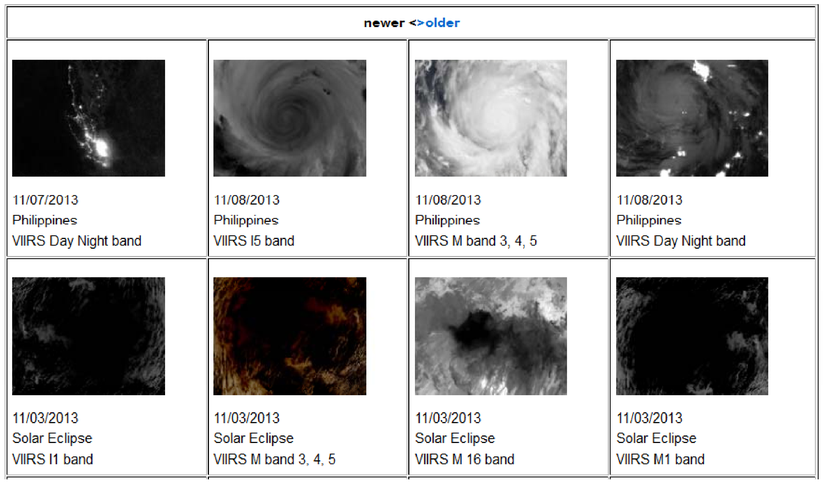

Figure 2. Sample images from the image gallery

The VIIRS image gallery is one of the early features developed for the calibration knowledge base shortly after Suomi NPP launch. The sample images has a collection of observations of major events such as the Hurricane Sandy, Super Typhoon, solar eclipse, and first light images. The DNB sample imagery shows that the quality has improved significantly since launch, with the calibration improvements by updating the look up tables, and with the stray-ligth correction implementation. Figure 2 shows that the Super Typhoon was over the Phillipines on November 8, 2013.

Validation Site Radiometric Time Series

Although VIIRS has onboard calibration for all channels, it is important that the calibrated SDR are independently validated. A major effort towards this end is the development of the world-wide validation site radiometric time series. The goal is to construct the time series for the entire period of the mission over about 30 vicarious sites to monitor the stability of the VIIRS calibration (Figure 3). Many of these sites are endorsed by the Committee on Earth Observation Satellites (CEOS) Working Group on Calibration/Validation (WGCV). Legacy sites such as MOBY are also included. The time series has already been used for diagnoses for the recent H and F factor trend changes. In addition to the ground based sites, the time series also includes the Deep Convective Cloud time series, and the Lunar Band Ratio Time Series.

If any calibration trend is found in the onboard calibration, the vicarious time series will be used to validate the trend. Conversely, if the time series over the vicarious sites show trends, the information will be used for the onboard calibration performance analysis.

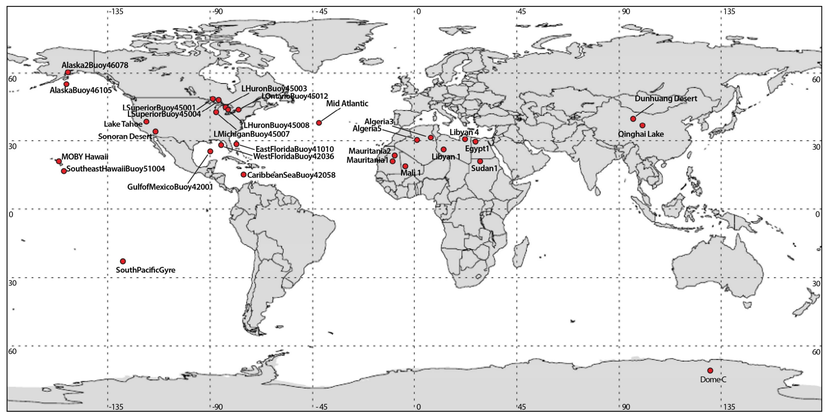

Figure 3. Over thirty validation sites included worldwide

Daily Orbital Track & SNO Predictions

The Suomi NPP orbital ground track has been made available since launch. The prediction is based on the latest SGP4 model and TLEs. This information is used to locate specific data on a daily basis by image analysts (Figure 5).

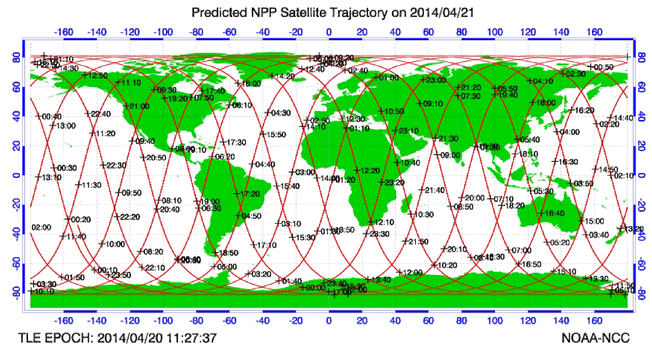

Figure 5. Daily orbital track

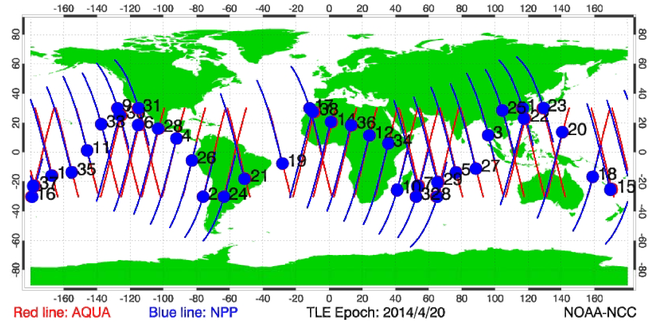

Figure 6. SNOx in the low latitudes.

Similarly, the SNO prediction information has been used for intersatellite comparisons with MODIS and other instruments by VIIRS SDR as well as other SDR teams.

Summary

The Suomi NPP calibration knowledge base provides important information for both VIIRS SDR and EDR users. It has become an indispensible part of the cal/val tool for the postlaunch verification and validation of VIIRS SDR. The event log database keeps track of what happened to the VIIRS in its history of operations, while the validation time series tells us how VIIRS is performing over time. The image quality can be analyzed using the sample data from the image gallery and through comparisons with other instruments at the SNOs.

For additional information about the Calibration Knoledge Base, such as calibration parameters, spectral response functions, publications, documentation, data format, software, as well as links to VIIRS applications, please visit the website at https://cs.star.nesdis.noaa.gov/NCC/VIIRS.

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