VIIRS SDR Release: Validated Data Quality

March 1, 2014

Recommended Cautions for Data Users

The JPSS Algorithm Engineering Review Board (AERB) has released the VIIRS Sensor Data Record product to the public with a validated data quality attribute. Validated quality is defined in Table 1 below:

Table 1. Validated definition and assessment

Validated Definition	Explanation for Maturity Assessment
On-orbit sensor performance characterized and calibration parameters adjusted accordingly	Both radiometric and geospatial performance of VIIRS have been characterized. Both noise and accuracy meet specifications for all bands except M11 (waiver). Minor issues are on-track to be resolved. Calibration parameters have been fine-tuned and routinely updated. However, the goal of sub-percent radiometric accuracy and stability for Ocean Color is challenging.
There may be later improved version	Improvements are still being made, in such areas as RSB Autocal, RSB calibration stability, and some LUT fixes. Striping is being investigated which may lead to improved algorithms in the future.
There will be strong versioning with documentation	Code change controlled by AERB and IDPS build (currently Mx8.3). LUT changes monitored by AERB. Procedure well established for testing and version control.
Ready for use in applications and scientific publication	VIIRS SDR data are available on CLASS for public access. The VIIRS SDR team has been responding to inquiries and QA issues from users worldwide. Users are in general satisfied with the quality of the VIIRS SDR data.

The Suomi NPP SDR Science and Validated Product Maturity Review was held on December 18-20, 2013 at the NOAA Center for Weather and Climate Prediction (NCWCP) in College Park, Maryland, hosted by NOAA/NESDIS/STAR. The VIIRS SDR team members presented progress since the Provisional maturity review, and EDR users also offered their independent assessments of data product quality based on their analyses. After a thorough review, the VIIRS SDR team, EDR users, and the review panel members reached consensus that overall the VIIRS SDR

product has reached the validated status and therefore was recommended to be approved by the AERB, and made available to the public and for the operational use, starting at the time MxI1.5.08.03 (Mx 8.3) transferred to operations. This occurred at 18:38 UTC on March 18, 2014.

VIIRS Validated SDR Product Caveats:

- DNB stray-light correction is implemented in the SDR production software; it requires periodic updates to processing coefficients: currently, the coefficients are updated monthly
- RSB Autocal input parameters are being tuned to optimize performance of the automated RSB calibration before the RSB Autocal becomes fully operational (planned for Spring 2014)
- Although the VIIRS RSB calibration accuracy meets the 2% requirements, it may not be optimal for ocean color applications where sub-percent accuracy and stability is needed. This issue will be further addressed by the VIIRS SDR team, working together with the ocean color community. Along this line, seasonal discrepancies between lunar and solar calibrations for bands M1-M3 need to be resolved.
- Polarization sensitivity is strongly detector dependent in VIIRS: polarization effects and impact on products will be further quantified
- Low-level striping may be present in both RSB and TEB products: root causes are under investigation
- Infrequent SDR data degradation during the WUCD and lunar calibrations, as well as during an RTA/HAM synchronization loss, is now indicated by the quality flags: users should use the flags to filter out the invalid data
- Additional methods, such as lunar calibration, will be investigated to improve M13 low-gain calibration
- A small cold scene bias exists for M15: it will be further characterized and potentially reduced by adjusting calibration coefficients
- Geo-location during and shortly after spacecraft maneuvers may not be as accurate.
- In all single-gain bands, unaggregated pixels may be saturated, but if the final aggregated pixel is unsaturated, there is no flag to indicate any saturation issue. Therefore any affected pixels will underestimate the total radiance of the aggregated pixel. See e.g. https://ncc.nesdis.noaa.gov/documents/documentation/viirs-users-guide-tech-report-142a-v1.2.pdf page 8 for illustration of pixel aggregation." Note this effect is independent of radiance error due to saturation foldover

The Collection Short Names (CSNs) are:

- VIIRS-DNB-SDR
- VIIRS-I(1-5)-SDR
- VIIRS-M(1-16)-SDR
- VIIRS-MOD-GEO

- VIIRS-MOD-GEO-TC
- VIIRS-IMG-GEO
- VIIRS-IMG-GEO-TC
- VIIRS-DNB-GEO

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More information about VIIRS SDR is available from the following website: https://cs.star.nesdis.noaa.gov/NCC/VIIRS, where users can find the user's guide, algorithm theoretical basis documents (ATBD), on-orbit instrument performance data, sample codes to read the VIIRS SDR data, conference presentations, and image gallery. In addition, the following journal publications contain information about the VIIRS performance:

Cao, C., F.J. De Luccia, X. Xiong, R. Wolfe, F. Weng, Early On-Orbit Performance of the Visible Infrared Imaging Radiometer Suite Onboard the Suomi National Polar-Orbiting Partnership (S-NPP) Satellite, *IEEE Transactions on Geoscience and Remote Sensing*, **52** (2014) 1142-1156, doi:10.1109/TGRS.2013.2247768

Cao, C., X. Xiong, S. Blonski, Q. Liu, S. Uprety, X. Shao, Y. Bai, F. Weng, Suomi NPP VIIRS sensor data record verification, validation, and long-term performance monitoring, *Journal of Geophysical Research: Atmospheres*, **118** (2013) 11,664-11,678, doi:10.1002/2013JD020418

Xiong, X., J. Butler, K. Chiang, B. Efremova, J. Fulbright, N. Lei, J. McIntire, H. Oudrari, J. Sun, Z. Wang, A. Wu, VIIRS On-orbit Calibration Methodology and Performance, *Journal of Geophysical Research: Atmospheres*, in press, doi:10.1002/2013JD020423

Wolfe, R., G. Lin, M. Nishihama, K. P. Tewari, J. C. Tilton, A. R. Isaacman, Suomi NPP VIIRS prelaunch and on-orbit geometric calibration and characterization, *Journal of Geophysical Research: Atmospheres*, **118** (2013) 11,508-11,521, doi:10.1002/jgrd.50873

Liao. L.B., S. Weiss, S. Mills, B. Hauss, Suomi NPP VIIRS Day-Night-Band On-Orbit Performance, *Journal of Geophysical Research: Atmospheres*, **118** (2013) 12,705-12,718, doi:10.1002/2013JD020475

Rausch, K. S. Houchin, J. Cardema, G. Moy, E. Haas, F.J. De Luccia, Automated Calibration of the Suomi National Polar-Orbiting Partnership (S-NPP) Visible Infrared Imaging Radiometer Suite (VIIRS) Reflective Solar Bands, *Journal of Geophysical Research: Atmospheres*, in press, doi:10.1002/2013JD020479

Uprety, S., C. Cao, X. Xiong, S. Blonski, A. Wu, X. Shao,: Radiometric Intercomparison between Suomi-NPP VIIRS and Aqua MODIS Reflective Solar Bands Using Simultaneous Nadir Overpass in the Low Latitudes, *Journal of Atmospheric and Oceanic Technology*, **30** (2013) 2720-2736, doi:10.1175/JTECH-D-13-00071.1

Cao, C., X. Shao, S. Uprety, Detecting Light Outages After Severe Storms Using the Suomi-NPP/VIIRS Day Night Band Radiances, *IEEE Geoscience and Remote Sensing Letters*, **10** (2013) 1582-1586, doi:10.1109/LGRS.2013.2262258

Liu, Q., C. Cao, F. Weng, Assessment of Suomi National Polar-Orbiting Partnership VIIRS Emissive Band Calibration and Inter-Sensor Comparisons, *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, **6** (2013) 1737-1748, doi:10.1109/JSTARS.2013.2263197

Liu, Q., C. Cao, F. Weng, Striping in the Suomi NPP VIIRS Thermal Bands through Anisotropic Surface Reflection. *Journal of Atmospheric and Oceanic Technology*, **30** (2013) 2478–2487, doi:10.1175/JTECH-D-13-00054.1