

VIIRS VIIRS-Surf-Refl-IP, Beta Data Quality
Last Updated: 22 March 2013
Read-me for Data Users

The Joint Polar Satellite System (JPSS) Algorithm Engineering Review Board approved the release of the Visible Infrared Imager Radiometer Suite Surface Reflectance Intermediate Product (VIIRS-Surf-Refl-IP) to the public with a Beta level quality as of November 28, 2012. Beta quality is defined as:

- Early release product
- Initial calibration applied
- Minimally validated and may still contain significant errors (additional changes are expected)
- Available to allow users to gain familiarity with data formats and parameters
- Product is not appropriate as the basis for quantitative scientific publications, studies and applications

The Board recommends that users be informed of the following product information and characteristics when evaluating the VIIRS-Surf-Refl-IP.

- 1. Product status:** The VIIRS-Surf-Refl-IP represents continuity with NASA EOS MODIS and NOAA POES AVHRR surface reflectance products. VIIRS-Surf-Refl-IP is the basis for various VIIRS EDRs including vegetation index, snow/ice products and others. Based on extensive MODIS user base, this product will be used by real-time resource and disaster management; ecosystem monitoring; climate studies etc., provided its elevation to the status of EDR (the motion is underway). The current VIIRS-Surf-Refl-IP was designed to satisfy derived requirements from the downstream EDRs and the proposed L1RD EDR requirements are compliant with the derived requirements.

The algorithm, based on a heritage MODIS C5 atmospheric correction algorithm, removes atmospheric scattering and absorption effects in cloud-free daytime conditions in VIIRS VIS SWIR bands, assumes a lambertian reflectance model and uses aerosol climatology over bright surfaces. It requires the following ancillary data: VCM; aerosol properties (AOD and model); DEM; NCEP Ozone and WV; Land-Water Mask, and Snow/Ice Mask. M-band and I-band QFs are coded together while being at a different resolution, implying that the QF is only provided at the M-band resolution.

- 2. Product evaluation:**

This validation assumes that the VIIRS SDR is calibrated. Pre-beta and beta versions of SDR have been used to help algorithm and instrument assessments during EOC and the early stages of ICV. The Surface Reflectance Team provided feedback to SDR team to assess the impact of the post-launch calibration degradation in the Red-NIR bands due to mirror coating problem.

Overall, performance of the Suomi NPP VIIRS-Surf-Refl-IP is good. Visual evaluation of VIIRS-Surf-Refl-IP was accomplished in different world regions using data from both Land PEATE (NASA) and IDPS (NOAA). The results from both systems were found to be in agreement. As the quality of VIIRS-Surf-Refl-IP is a function of performance of the VIIRS Cloud Mask (CM) and aerosol algorithms, the joint analysis of the three products VCM, AOD and VIIRS-Surf-Refl-IP was conducted for a number of scenes.

Quantitative validation was based on the AERONET-based Surface Reflectance Validation Network (ASRVN). An APU analysis of VIIRS-Surf-Refl-IP was conducted for many AERONET sites for M1, M2, M4, M5, M7, M8, M10 and M11. Generally, VIIRS-Surf-Refl-IP algorithm underestimates surface reflectance showing negative bias in visible bands. The bias is spectrally dependent, generally being largest in the blue band and reducing with wavelength. This result agrees with analysis of aerosol team which reported overestimation of AOD over land.

3. Known errors:

- a) "Cloud leakage" is observed where VIIRS-Surf-Refl-IP CM (Cloud Confidence) disagrees with VCM (Cloud Confidence + Cirrus Flag). The Cirrus Flag combines "Cirrus" and "Brightness Temperature" tests, the latter detecting small and less bright clouds. Currently, the Cloud Confidence flag does not include Cirrus flag which causes the observed CM discrepancies and VIIRS-Surf-Refl-IP errors. We provided the input to VCM team (T. Kopp) which is currently tuning the CM thresholds over land to resolve this issue.
- b) AOD is reported for the exclusion conditions (under clouds);
- c) The "Overall quality SR" (QF) does NOT show exclusion conditions such as clouds;
- d) AOT is correlated with the surface brightness; relatively high AOT values appear over urban centers and major roads. This known deficiency of the aerosol retrieval algorithm is correctly masked in the QF;
- e) In certain regions, VIIRS-Surf-Refl-IP CM marks many more land pixels as water as compared to the VCM.

The following two changes are recommended for future code updates to significantly improve VIIRS-Surf-Refl-IP data quality and QF "friendliness":

- (1) add exclusion conditions (e.g. clouds, high AOD) into the "Overall quality of SR" bit; and
- (2) Include Cirrus Flag into Cloud Confidence Flag which can then be considered as a "summary" VCM flag .

The main observed artifact of spectral distortions (usually over brighter surfaces and snow) will be further investigated and corrected.

Additional information on VIIRS and Land Surface Reflectance algorithm theoretical basis document (ATBD) are available at

<http://www.star.nesdis.noaa.gov/jpss/ATBD.php>

The VIIRS SDR Read-me for Beta Data Quality is also available at the CLASS Homepage.

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