Assessment of Suomi NPP VIIRS Vegetation Index EDR

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Introduction

The Visible Infrared Imaging Radiometer Suite (VIIRS) Vegetation Index (VI) Environmental Data Record (EDR) includes the Top of the Atmosphere (TOA) Normalized Difference Vegetation Index (NDVI) and the Top of the Canopy (TOC) Enhanced Vegetation Index (EVI). The VI EDR is an operational product generated by the Interface Data Processing Segment (IDPS) of the Suomi National Polar-orbiting Partnership (S-NPP) ground segment. In this work, we present the results of our quality assessment of the VI EDR product after launch via product inter-comparison to Aqua MODIS and NOAA-18 AVHRR/3 (not shown in this poster). In general, the early VIIRS VI EDR product showed good product integrity and was found radiometrically performing well, while the product still contained some temporal, geographic, and target brightness-dependent biases, and residual contaminations. The VI EDR was promoted to beta maturity status in February 2013, and it is now available to the general public through NOAA's Comprehensive Large Array-Data Stewardship System (CLASS). A series of improvements to the VI EDR product including enhancing the Quality Flags (QF) were proposed and are in the implementation phase. A more comprehensive set of QFs is necessary to allow users to better screen suspicious quality pixels that cannot be screened by the current set of VI EDR QFs. The additional QFs include: snow/ice, cloud shadows, cloud adjacency, and aerosol quantity. The ongoing validation efforts and product improvements will lead to the VI EDR reaching provisional maturity status in the near term.

Vegetation Index EDR Product Description

1. The Vegetation Index EDR provides the Normalized Difference Vegetation Index (NDVI) and the Enhanced Vegetation Index (EVI), and per-pixel quality flags (QFs) at 375 m (imager resolution) on a daily, global basis.
   - The NDVI derived from "Top-of-the-Atmosphere (TOA) I1 and I2 reflectance
     \[ \text{NDVI} = \frac{(\rho_{\text{I1}} - \rho_{\text{I2}})}{(\rho_{\text{I1}} + \rho_{\text{I2}})} \]
   - The EVI derived from "Top-of-Canopy (TOC) I1 and I2, and M3 reflectance
     \[ \text{EVI} = (1 + L) \left( \frac{\rho_{\text{TOC I1}} - \rho_{\text{TOC I2}}}{\rho_{\text{TOC I1}} + \rho_{\text{TOC I2}} - 2 \rho_{\text{TOC M3}}} \right) \]
   - QFs including: (1) Land/Water Mask, (2) Cloud Confidence, (3) Thin Cirrus, (4) Heavy Aerosol Loading, and (5) Day/Night Flag
2. Additional Quality Flags for VI EDR: Additional quality flags are desirable for VI EDR in order to screen suspicious quality pixels that cannot be screened by the current set of VI EDR QFs. The following QFs will be operationally implemented in IDPS build M8x.4 (May 2014)
   - Adjacency clouds (yes or no)
   - Cloud shadow (yes or no)
   - Snow/ice (yes or no)
   - Aerosol quantity (climatological, low, average, high)
3. Current Challenges:
   - The VIIRS NDVI which is derived from TOA reflectance is inherently different from the MODIS NDVI which is derived from TOC reflectance.
   - The VIIRS EVI equation uses a different gain factor from that used in the MODIS equation, requiring an adjustment for compatibility.
   - VI EDR is provided in swath/granule form which is neither geographically projected nor temporally composited.

Spectral bands of polar imagers

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Table 1. Summary statistic VIIRS NDVI and EVI and reflectance at 375 m.

VIIRS VI-EDR Global 16-Day Composites (January 9-24, 2014)

Daily VIIRS vs. MODIS VI Product December 18, 2013

VI-EDR Time Series

Match-up Analysis

Near-simultaneous nadir observations. Global mosaic comparisons with Aqua MODIS

VIIRS Vegetation Index APU Metrics: 2013 261-266 (SNPP VIIRS minus Aqua MODIS)

Summary

- This analysis is based on data from VIIRS, MODIS and AERONET.
- MODIS 8-biome land cover mask was used to quantify variations in VI product performance as a function of surface type.
- Cal/Val activities include:
  - Evaluation of VIIRS VI-EDR using MODIS and AVHRR (not shown in this poster) VI products
  - Evaluation and validation of VIIRS VI-EDR using the AERONET-based Surface Reflectance Validation Network (ASRVN) data stream at a limited number of sites.
  - Evaluation and validation of VIIRS VI-EDR using tower-based reflectance networks, Including PEN, BSRN, and FLUXNET (not shown in this poster). Cross-sensor compatibility analysis among VIIRS, AVHRR, and MODIS for the NDVI, EVI, and E12
  - Differences between VIIRS-EVI and MODIS-EVI are caused by: different gain factor (VIIRS = 2 and MODIS = 2.5) and differences in the spectral response functions, specifically the blue band.
  - The Visible Infrared Imaging Radiometer Suite (VIIRS) sensor on Suomi NPP has been successfully collecting satellite data that is regularly used by our customers, the weather forecasting and science communities, as a critical weather prediction tool. VIIRS provides valuable data for accurately monitoring global and long-term weather patterns.
  - The Joint Polar Satellite System (JPSS) is committed to the successful operation of the Suomi NPP satellite launched in 2011, the successful and timely launch of the next polar weather satellite, the Polar System-1 (2017), as well as the development and launch of the subsequent polar-orbiting weather satellite, known as JPSS-2 (2022).

Acknowledgements and Disclaimer

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