VIIRS Aerosol Optical Thickness (AOT) and Aerosol Particle Size Parameter (APSP)
IP/EDR Release, Validated Stage 1 Data Quality
May 2014
Read-me for Data Users

The JPSS Algorithm Engineering Review Board (AERB) released the **VIIRS Aerosol Optical Thickness** and Aerosol Particle Size Parameter Intermediate Product (IP) and **Environmental Data Record (EDR) to the public with a Stage 2 Validation level maturity with an effectivity date of January 23, 2013.** This assessment is based on both qualitative and quantitative analysis of the VIIRS aerosol EDR. The VIIRS AOT EDR has been compared with MODIS aerosol products and with AERONET and MAN products and observations. Comparisons include direct collocations using various match-up criteria, and assessments of monthly statistics without the benefit of direct collocation. **APSP is at Stage 1 validation level with the caveat that using APSP over land is not recommended.**

Validated Stage 1 quality is defined as:

- Using a **limited** set of samples, the algorithm output is shown to meet the <u>threshold</u> performance attributes identified in the **JPSS Level 1 Requirements Supplement with the exception of the S-NPP Performance Exclusions**

Validated Stage 2 quality is defined as:

- Using a **moderate** set of examples, the algorithm output is shown to meet the <u>threshold</u> performance attributes identified in the **JPSS Level 1 Requirements Supplement with the exception of the S-NPP Performance Exclusions.**

The Board recommends that users be informed of the following product information and characteristics when evaluating the VIIRS Aerosol Optical Thickness (AOT) and Aerosol Particle Size Parameter (APSP) IP/EDR.

1. The VIIRS aerosol IP contains AOT at 550 nm and Angstrom Exponent. This is a pixel level (~750 m) retrieval that is stored in 768 X 3200 floating point array.

2. AOT is a unitless value. The APSP is reported as Angstrom Exponent.

3. The VIIRS Aerosol EDR contains the AOT for eleven wavelengths ranging from 0.412 to 2.250 microns as well as the Angstrom Exponent. These values are stored as 96 x 400 arrays of 16-bit integers with the corresponding scale and offset stored separately in the granule.

4. The VIIRS Aerosol EDR is derived from IPs for 8 x 8 moderate resolution (750 m) pixels. Note that pixel resolution can be slightly larger at the edge of scan.

5. There is a significant difference in quality between APSP over ocean and that over land. The APSP over land data has no quantitative value; however the overall VIIRS Aerosol EDR product is still declared Validated Stage 2 because:

   a. AOT and APSP are contained within the same product; the quality of APSP over land should not prevent users from obtaining AOT.

b. Users have dealt with this shortcoming for MODIS as the MODIS Aerosol Team has stated that Angstrom Exponent over land from MODIS has no quantitative value, even though historically it was available in the same product file with AOT.

6. Users are strongly recommended to use only the **high quality** IP/EDR products.

7. The VIIRS aerosol IP/EDR AOT (over ocean and land) and APSP (over ocean only) is meeting the JPSS Level 1 requirements. This conclusion is based on over a year of evaluation against corresponding values from AERONET, the Maritime Aerosol Network (MAN) and MODIS. The full year allows testing the product over the entire seasonal cycle, which gives confidence in the measured accuracy, precision and uncertainty.

8. The following are known issues with the VIIRS Aerosol IP/EDR:

    a. There are regional biases that do not show up in the global evaluation.

    b. VIIRS tends to be lower than the MODIS Dark Target AOT over arid land regions.

    c. VIIRS tends to be higher than MODIS Dark Target AOT over vegetated land areas.

    d. There is an artificially high AOT in the snow melt region. This problem is understood. Revisions to snow/ice tests that will minimize AOT data artifacts in snow melt regions in high latitudes are ready for operational implementation.

    e. There are missing data in the bowtie deletion region.

    f. Snow and ice are present in unexpected areas. Internal tests to identify the presence of snow/ice, bright pixel, ephemeral water etc. need further evaluation to determine performance. Revisions to tests for bright pixel and ephemeral water are ongoing.

    g. The "Bad SDR Data" quality flag is set even if a band that is not used in the AOT retrieval algorithm is bad. If the AOT quality flag indicates "high" quality retrieval the "bad SDR flag" should be ignored.

    h. In heavy dust/smoke plume regions, AOT could be flagged as out of range.

    i. IP AOT could be cloud contaminated when VIIRS cloud mask identifies clear sky but the scene is actually cloudy. Based on comparisons with CALIPSO, it is determined that this occurs for ~13% of the pixels.

9. The next steps in the VIIRS Aerosol IP/EDR validation process, to move the product to Stage3 (AOT) and Stage 2 (APSP) validation maturity, include the following:

    a. Monitor the effect of latest changes to the VCM, and adapt aerosol Processing Coefficient Table (PCT) and code to these changes, if necessary;

    b. Investigate and implement spatially and seasonally varying surface reflectance band ratios;

    c. Test and expand valid range of land and ocean AOT retrievals from 2 to 5 at the high end and from zero to small negatives at the low end;

    d. Implement new internal snow/ice mask based on a Normalized Difference Snow Index, brightness temperature and spatial variability;

    e. Remove internal ephemeral water mask;

    f. Evaluate and test land retrieval that identifies and compensates for red soils;

g. Evaluate choice of aerosol models, land and ocean, in terms of covering adequate solution space and consequences for retrieving.

More information about VIIRS and VIIRS aerosol products can be found at the following websites, where users can find the Algorithm Theoretical Basis Document (ATBD), Operational Algorithm Description (OAD) document, Common Data Format Control Book (CDFCB), and product examples:

http://www.star.nesdis.noaa.gov/smcd/emb/aerosols/index.php
http://npp.gsfc.nasa.gov/science/documents.html

Additionally, the VIIRS Sensor Data Record (SDR) provisional quality Read-me document is available at:
http://www.nsof.class.noaa.gov/saa/products/welcome

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