

# Visible Infrared Imaging Radiometer Suite (VIIRS) Enterprise Aerosol Optical Depth and Aerosol Particle Size Products User's Guide

Version 1, February 2020

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## 1. Purpose of this Guide

This VIIRS Enterprise Aerosol Products Environmental Data Record (EDR) User’s Guide is intended for users of the Enterprise Processing System (EPS) version of the Aerosol Optical Depth (AOD) and Aerosol Particle Size (APS) EDRs generated from the Visible Infrared Imaging Radiometer Suite (VIIRS) on board the Suomi National Polar-Orbiting Partnership (SNPP) and the Joint Polar Satellite System (JPSS) satellites. It provides a general introduction to the VIIRS instrument, data products, format, and contents. It serves as an introduction and reference to the Algorithm Theoretical Basis Document (ATBD), a more detailed technical document about the VIIRS Enterprise AOD product and algorithm (see Section 6). It should be mentioned that this product is an update of the previous version of VIIRS aerosol EDR product, whose User’s Guide can be assessed from [https://www.star.nesdis.noaa.gov/smcd/emb/viirs\\_aerosol/documents/Aerosol\\_Product\\_Users\\_Guide\\_V2.0.1.pdf](https://www.star.nesdis.noaa.gov/smcd/emb/viirs_aerosol/documents/Aerosol_Product_Users_Guide_V2.0.1.pdf).

## 2. Points of Contact

For questions or comments regarding this document, please contact Istvan Laszlo ([Istvan.Laszlo@noaa.gov](mailto:Istvan.Laszlo@noaa.gov)) and Shobha Kondragunta ([Shobha.Kondragunta@noaa.gov](mailto:Shobha.Kondragunta@noaa.gov)).

## 3. Acronym List

**Table 1.** Acronyms

AOD	Aerosol Optical Depth
AE	Ångström Exponent
APS	Aerosol Particle Size (Ångström Exponent)
ATBD	Algorithm Theoretical Basis Document
AVHRR	Advanced Very High Resolution Radiometer
CLASS	Comprehensive Large Array-Data Stewardship System
EDR	Environmental Data Record
EPS	Enterprise Processing System
IDL	Interactive Data Language
JPSS	Joint Polar Satellite System
MODIS	Moderate Resolution Imaging Spectroradiometer
SNPP	Suomi National Polar-orbiting Partnership
VIIRS	Visible Infrared Imaging Radiometer Suite

## 4. Document Definitions

Aerosol optical depth is a measure of extinction of radiation by aerosols due to absorption and scattering. It depends on the chemical composition and size of aerosol particles, and thus varies with the wavelengths of radiation. It also depends on the amount of aerosol in the atmosphere, and as such it is also a measure of aerosol loading. Mathematically, it is defined as the integrated extinction coefficient over a vertical column of unit cross section, and as such it is unitless.

Aerosol particle size is reported as the Ångström Exponent (AE) (see ATBD for more details), and is used as a proxy for average aerosol particle size. AE characterizes the dependence of AOD on wavelength. This dependence is determined, among others, by the size of aerosol particles (the larger the exponent, the smaller the particles). Mathematically, AE is calculated as the negative slope of aerosol optical depth versus wavelength in log-scale for two pairs of wavelengths. They are reported only over ocean.

## 5. VIIRS Overview

VIIRS is one of five instruments on board the SNPP and JPSS satellites. It is a scanning radiometer with capabilities that are intended to extend and improve upon or continue the heritage of AVHRR and MODIS. VIIRS data are used to measure cloud and aerosol properties, ocean color, sea and land surface temperature, ice motion and temperature, fires, and Earth's albedo. The SNPP and JPSS satellites are on an 824 km sun-synchronous orbit (inclination=98.7°) with a 1:30 pm ascending node. From this orbit they achieve global coverage every day and have a repeat cycle of approximately 16 days. VIIRS has a swath width of 3,040 km with a spatial resolution of ~375 m at nadir in the Imagery (I) Bands and ~750 m at nadir in the Moderate (M) Bands. Through a system of pixel aggregation techniques, VIIRS controls pixel growth towards the edge of scan such that the pixel sizes are comparable to nadir. For more information about this “bow-tie removal” aggregation scheme, look at the SDR User's Guide <https://ncc.nesdis.noaa.gov/documents/documentation/viirs-users-guide-tech-report-142a-v1.3.pdf>.

## 6. VIIRS Enterprise Aerosol Algorithm

The VIIRS Enterprise Aerosol Algorithm retrieves AOD at the 750-m pixel level for the nominal wavelength of 550 nm using radiances from 11 VIIRS channels (412, 445, 488, 555, 672, 746, 865, 1240, 1378, 1610, and 2250 nm). The current version of the algorithm does not retrieve aerosol properties in cloud-affected pixels, over snow/ice surface and sunglint water, or at night. The AOD is calculated separately for land and ocean using a lookup table of pre-computed values for several atmospheric parameters to simplify radiative transfer calculations. Pixel level AE is then calculated from AOD at two pairs of wavelengths (555 vs. 865 nm and 865 vs. 1610 nm) over water. Compared with the previous version of the VIIRS aerosol algorithm, the algorithm updates include: (1) the retrieval over bright land surface; (2) extended range of AOD at 550 nm to [-0.05, 5.0]; (3) updated internal tests to detect unfavorable conditions (cloud;

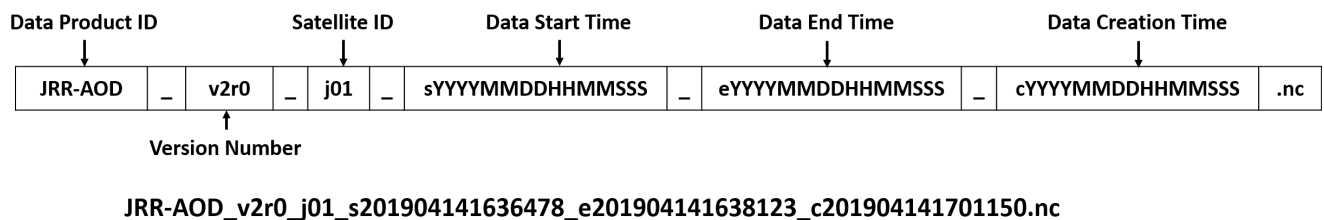
cirrus, snow/ice; ephemeral and shallow water); (4) aerosol models used in the MODIS dark-target algorithm; (5) a new set of spectral land surface reflectance relationships; and (6) an update of the land algorithm by adding an alternative choice of spectral combination. In-depth descriptions of the algorithms are available in the ATBD

([https://www.star.nesdis.noaa.gov/jpss/documents/ATBD/ATBD\\_EPS\\_Aerosol\\_AOD\\_v3.0.1.pdf](https://www.star.nesdis.noaa.gov/jpss/documents/ATBD/ATBD_EPS_Aerosol_AOD_v3.0.1.pdf)).

## 7. VIIRS Aerosol Products

The VIIRS aerosol data products are available on a granule basis and distributed in NetCDF4 format. Each granule has 48 scan lines, or approximately 86 seconds in length, and the pixel-level M-band (0.75km at nadir) resolution data is contained in 768 x 3200 arrays. Due to the relatively short granule length and the data resolution, users should expect a total of approximately 550 granule files for global coverage in the daytime (sizes are ~20-25 MB each) each day.

Figure 1 describes the file naming convention of the VIIRS EPS AOD products. The satellite ID uses “npp” for SNPP and “j01” for NOAA-20.



**Figure 1** Enterprise VIIRS AOD filename fields and an example.

Note that the version number in the filename refers to the version of the entire EPS system, not the version of AOD product or the algorithm. Even though this system-wide version number has changed since the start of EPS AOD retrievals, the AOD algorithm has not changed as of February 2020.

The VIIRS Enterprise aerosol output file contains the pixel-level (750m nominal resolution) primary products of AOD at 550 nm (AOD550), overall quality flag (QCALL), and Angstrom Exponents over water (AngsExp1 and AngsExp2); along with the geolocation (Longitude and Latitude) and other extended and diagnostic data. The full list and description of the output variables is in Table 2. There are numerous quality flags (Table 3) which are in 8-bit integer format. Finally, the NetCDF4 file contains all the metadata for the granule, which include the averaged granule all-quality and high-quality AOD550, as well as the percentage of all-quality and high-quality retrievals. Table 4 and Table 5 list the criteria used to assign the retrieval quality over water and land. It is recommended that the high-quality AOD be used for the quantitative analysis, while the “top2” (high plus medium) quality data be used for qualitative applications.

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**Table 2.** VIIS EPS AOD and APSP algorithm outputs

<b>Output Variable Name</b>	<b>Description</b>	<b>Dimension</b>
<b><i>Geolocation</i></b>		
Longitude	Longitude of each pixel	pixel (xsize, ysize)
Latitude	Latitude of each pixel	pixel (xsize, ysize)
<b><i>Primary Outputs</i></b>		
AOD550	Retrieved aerosol optical depth at 550 nm	pixel (xsize, ysize)
AngsExp1	Ångström Exponent calculated from AOD at M4 and M7 over ocean	pixel (xsize, ysize)
AngsExp2	Ångström Exponent calculated from AOD at M7 and M10 over ocean	pixel (xsize, ysize)
QCAII	Overall quality flag for aerosol retrieval: 0: high quality; 1: medium quality; 2: low quality; 3: no retrieval	pixel (xsize, ysize)
<b><i>Extended Outputs</i></b>		
AOD_channel	Retrieved aerosol optical depth in sensor channels M1 to M11	pixel (xsize, ysize) x 11
QCExtn, QCInput, QCtest, QCPath, QCRet	Detailed input and output quality and critical path flags (see Table 3)	pixel (xsize, ysize) for each flag
AerMdl	Aerosol model selected from prescribed models during the retrieval; 0: oceanic aerosol; 1: dust over land; 2: generic aerosol over land; 3: urban aerosol over land; 4: smoke over land.	pixel (xsize, ysize)
FineMdlIdx	Index of fine mode for the selected oceanic aerosol model	pixel (xsize, ysize)
CoarseMdlIdx	Index of coarse mode for the selected oceanic aerosol model	pixel (xsize, ysize)
FineModWgt	Fine mode weight over ocean	pixel (xsize, ysize)
<b><i>Diagnostic Outputs</i></b>		
SfcRefl	Surface spectral reflectance of land and ocean	pixel (xsize, ysize) x 11
Residual	Retrieval residual of the best solution	pixel (xsize, ysize)
SpaStddev	3 by 3 standard deviation of TOA reflectance at M1/M11 (land/ocean)	pixel (xsize, ysize)
AOD550LndMdl	Retrieved AOD at 550nm for each candidate land aerosol model	pixel (xsize, ysize) x 4
ResLndMdl	Retrieval residual for each candidate land aerosol model	pixel (xsize, ysize) x 4

**Table 3** Detailed input and output quality and critical path flags

Name	Bits	Quality Flag Name	Meaning
QCExtn	0,1	Input cloud mask	0: confidently clear; 1: probably clear; 2: probably cloudy; 3: confidently cloudy
	2	Input snow mask	0: no; 1: yes
	3	Input cloud shadow mask	0: no; 1: yes
	4	Input fire mask	0: no; 1: yes
	5	Input glint mask	0: no; 1: yes
	6	Input heavy aerosol mask	0: no; 1: yes
QCInput	0	Input location	0: good; 1: bad - if 1. longitude beyond [-180°,180°] 2. latitude beyond [-90°,90°]
	1	Input geometry	0: good; 1: bad - if 1. zenith angle beyond [0°,90°] 2. azimuth angle beyond [-360°,360°]
	2	Input ancillary data	0: good; 1: bad - if 1. TPW beyond [0,20] cm 2. ozone beyond [0,1] atm-cm 3. surface pressure beyond [500,1500] mb 4. wind speed beyond [0,100] m/s 5. wind direction beyond [0°,360°]
	3	Input reflectance and brightness temperature	0: good; 1: bad - if 1. M1-M11 reflectance beyond [0,1] 2. M15 or M16 brightness temperature beyond [200,350] K 3. M6 reflectance is saturated
QCTest	0	Cloud test	0: no; 1: yes
	1	Cirrus test	0: no; 1: yes
	2	Thin cirrus test	0: no; 1: yes
	3	Inhomogeneity test	0: no; 1: yes
	4	Snow/ice test	0: no; 1: yes
	5	Ephemeral water test	0: no; 1: yes
	6	Shallow water test	0: no; 1: yes
QCPath	7	Heavy aerosol test	0: no; 1: yes
	0	Retrieval over water	0: no; 1: yes
	1	Bright land surface	0: no; 1: yes
	2	Sunglint over water	0: no; 1: yes
	3	SWIR scheme over dark land	0: no; 1: yes
	4	SWIR scheme over dark land	0: no; 1: yes
5	Retrieval over bright land	0: no; 1: yes	

Name	Bits	Quality Flag Name	Meaning
QCRet	0	Retrieval failed	0: no; 1: yes 1. Missing critical channel reflectances (M3/5/11 over dark land; M1/2/3/5 over bright land; M6 over ocean) 2. Cannot calculate NDVI and redness ratio over dark land 3. Missing ancillary surface reflectance dataset over bright land 4. Arithmetic error (divide by 0)
	1	Low sun	0: no; 1: yes (solar zenith angle > 80°)
	2	Barren land cover type	0: no; 1: yes
	3	Extrapolation	0: no; 1: yes
	4	Large residual	0: no; 1: yes Larger than 0.5 over land; 0.3 over ocean
	5	NDVI <sub>SWIR</sub> out-of-range	0: no; 1: yes Beyond [-0.1,0.8] over land
	6	Redness ratio out-of-range	0: no; 1: yes Beyond [0.4,1.6] over land
	7	Adjacent to cloud or snow	0: no; 1: yes

**Table 4** Criteria used for assigning retrieval quality over water.

Quality Level	Criteria
No Retrieval	1) Cloudy: external cloud mask is probably or confident cloudy and any internal cloud, cirrus or inhomogeneity test fails; 2) Sea ice (external mask or internal test); 3) Shallow water (internal test); 4) Sunlint (external mask or internal test) 5) Retrieval failed due to missing inputs or numeric error.
Low	1) Out of AOD range (-0.05, 5.0); 2) Solar zenith angle > 80°; 3) Fail internal cloud test (but external cloud mask is clear); 4) Fail internal cirrus test (but external cloud mask is clear); 5) External cloud mask is cloudy (but pass internal tests, not heavy aerosol); 6) $\sigma_{M1}^{3 \times 3} > 0.008$ ; 7) Retrieval residual > 0.3
Medium	1) Cloud shadow (external mask); 2) Thin cirrus (internal test); 3) Adjacent to cloudy pixel; 4) Adjacent to snow pixel (within 3-pixel distance) 5) $\sigma_{M1}^{3 \times 3} > 0.002$ ; 6) Retrieval residual > 0.25

Quality Level	Criteria
High	Remaining retrievals

**Table 5.** Criteria used for assigning retrieval quality over land.

Quality Level	Criteria
No Retrieval	<ol style="list-style-type: none"> <li>1) Cloudy: input cloud mask is probably or confident cloudy and any internal cloud, cirrus or inhomogeneity test fails;</li> <li>2) Snow/ice (input mask or internal test);</li> <li>3) Ephemeral water (internal test);</li> <li>4) Fire (input mask)</li> <li>5) Retrieval failed due to missing inputs, missing land surface reflectance data over bright pixels, or numeric error.</li> </ol>
Low	<ol style="list-style-type: none"> <li>1) Out of AOD range (-0.05, 5.0);</li> <li>2) Solar zenith angle &gt; 80°;</li> <li>3) Fail internal cloud test (but input cloud mask is clear);</li> <li>4) Fail internal cirrus test (but input cloud mask is clear);</li> <li>5) External cloud mask is cloudy (but pass internal tests, not heavy aerosol);</li> <li>6) Coastal area (input land/water mask);</li> <li>7) Extrapolation to positive AOD is involved ;</li> <li>8) <math>\sigma_{M1}^{3 \times 3} &gt; 0.008</math>;</li> <li>9) Retrieval residual &gt; 0.5;</li> </ol>
Medium	<ol style="list-style-type: none"> <li>1) Cloud shadow (input mask);</li> <li>2) Thin cirrus (internal test);</li> <li>3) Adjacent to cloudy pixel;</li> <li>4) Adjacent to snow pixel (within 3-pixel distance)</li> <li>5) Land cover type is barren or sparsely vegetated;</li> <li>6) TOA NDVI<sub>SWIR</sub> is out of range (-0.1, 0.8);</li> <li>7) TOA redness ratio is out of range (0.4, 1.6);</li> <li>8) <math>\sigma_{M1}^{3 \times 3} &gt; 0.004</math>;</li> <li>9) Retrieval residual &gt; 0.4</li> </ol>
High	Remaining retrievals

## 8. Data Availability

The SNPP data are available from July 6, 2017 and the NOAA-20 data from March 7, 2019. As noted above, even though the product version number shown in the filename has changed since the start of production, there has been no change in the aerosol algorithm.

The primary source of access for the VIIRS Enterprise aerosol products is through NOAA's Comprehensive Large Array-data Stewardship System (CLASS) web interface ([www.class.noaa.gov](http://www.class.noaa.gov)).



Once at the CLASS webpage, follow the steps below to order the VIIRS EPS AOD files (Figure 2 and Figure 3),

1. If you have not already done so, register to become a user of CLASS.
2. Login with your username and password.
3. Set “User Preferences”. It is recommended to (1) check “No” on the “Package Geolocation with JPSS Data Products” option since the AOD file contains the longitude and latitude; (2) check “Yes” on the “De-aggregate JPSS Data Products” for the 86-second-granule-level files.
4. From the drop-down product search list, select “JPSS VIIRS Products (Granule)(JPSS\_GRAN)”, and click the “>>GO” button on the right.
5. Once on the “Search – JPSS\_GRAN” page, select the spatial domain of your interest by drawing a rectangle on the map, or by specifying the longitude and latitude domains on the right.
6. Select the time period by changing the “Start/End Date/Time”.
7. Select the “VIIRS Aerosol Optical Depth and Aerosol Particle Size EDRs” datatype from the “Advanced Search” list (you may need to expand the list by clicking the + button)
8. Select the satellite, either “S-NPP” or “NOAA-20”.
9. Click “Quick Search & Order” or “Search” button to order the data.

The “Search” option is useful if you would like to view the inventory listing of the data available within your search parameters and select a small number of specific files. If you are confident in your search parameters, you may use the “Quick Search and Order” button that will skip the inventory list. Once the ordered data are ready, you will get an email instructing you how to download the data via anonymous FTP. For larger order sizes, you can request Block Orders through the CLASS helpdesk ([class.help@noaa.gov](mailto:class.help@noaa.gov)). Since these must be manually pulled from the tape library, CLASS handles the bulk order requests on a best effort basis. Finally, subscriptions are also available to users who require regular data access ([https://www.avl.class.noaa.gov/release/system\\_help/subs/index.htm](https://www.avl.class.noaa.gov/release/system_help/subs/index.htm)).

Please note beginning on April 11, 2018, the VIIRS Enterprise AOD data are available in CLASS as TAR files containing several individual granules (NetCDF files) corresponding to roughly 10 minutes of VIIRS scans. This change was made to allow for easier access to the data since CLASS order limits are restricted by file counts (500 maximum). Daily TAR files of the products for the most recent 90 days are available via anonymous FTP download at <ftp://ftp-npp.bou.class.noaa.gov/>.

To order the previous version of the VIIRS AOD data retrieved using the IDPS algorithm, search for “JPSS Visible Infrared Imaging Radiometer Suite Environmental Data Record (VIIRS\_EDR)” and check the “VIIRS Aerosol Optical Thickness (AOT) EDR (VAOOO)” and [Back to Table of Contents](#)

the corresponding geolocation data “VIIRS Aerosol (aggregated) EDR Ellipsoid Geolocation (GAERO)”.

The screenshot shows the NOAA CLASS website interface. At the top, there is a navigation bar with links for NOAA HOME, WEATHER, OCEANS, FISHERIES, CHARTING, SATELLITES, CLIMATE, RESEARCH, COASTS, and CAREERS. The main header features the NOAA logo and the text "COMPREHENSIVE LARGE ARRAY-DATA STEWARDSHIP SYSTEM (CLASS) NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION". Below the header, there is a navigation menu with links for CLASS Home, Login, Register, Help, About CLASS, and RSS. A search bar is located on the right side of the navigation menu, with the text "CLASS Help" and "All NOAA" next to it. The search bar contains the text "JPSS VIIRS Products (Granule)(JPSS\_GRAN)" and a "GO" button. A red circle highlights the "GO" button, and a red arrow points to it from the search bar. The left sidebar contains a menu with links for "Around CLASS" (Home, Search for Data, Upload Search, Search Results, Shopping Cart, Order Status, Help), "User Account" (User Profile, User Preferences), "Advanced Options" (Download Keys, FTPS Instructions), and "Release Info" (Version 8.1.8.1, February 13, 2020). The main content area features a large image of a satellite orbiting Earth, with the text "Image source: GOES-16 and S-NPP" below it. To the right of the image is a "SEARCH FOR DATA" section with a list of data types: Environmental Data from Polar-orbiting Satellites, Environmental Data from Geostationary Satellites, Defense Meteorological Satellite Program (DMSP), Joint Polar Satellite System (JPSS), Sea Surface Temperature data (SST), RADARSAT, Altimetry / Sea Surface Height Data (JASON), Global Navigation Satellite Systems (GNSS), and Other - Miscellaneous products in CLASS. Below this list is a "SEARCH COLLECTION METADATA" section with a search bar and a "GO" button. The "User Preferences" link in the sidebar is circled in red. The "GO" button in the search bar is also circled in red. A red arrow points from the search bar to the "GO" button. The "JPSS VIIRS Products (Granule)(JPSS\_GRAN)" text in the search bar is also circled in red. The "CLASS" logo in the image is also circled in red.

Figure 2. Searching VIIRS Enterprise AOD data from NOAA’s CLASS web page.

NOAA HOME WEATHER OCEANS FISHERIES CHARTING SATELLITES CLIMATE RESEARCH COASTS CAREERS

**NOAA** COMPREHENSIVE LARGE ARRAY-DATA STEWARDSHIP SYSTEM (CLASS)  
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

» CLASS Home » Logout » Help » About CLASS » RSS CLASS Help All NOAA SEARCH

JPSS VIIRS Products (Granule)(JPSS\_GRAN) GO

### Search - JPSS\_GRAN

#### Data Description

JPSS VIIRS Products (Granule) (JPSS\_GRAN) - Visible Infrared Imaging Radiometer Suite (VIIRS) sensor data records and intermediate products from the Joint Polar Satellite System (JPSS) have been used to generate these VIIRS Level 2 granule products. The products were developed by the NOAA NESDIS Center for Satellite Application and Research (STAR) and were produced within a near real-time environment at the NOAA NESDIS Office of Satellite and Product Operations (OSPO). The archived products are distributed in the netCDF-4 file format with metadata attributes included. Please expand "Details - Metadata, Documentation" section below for more details. Individual product (Datatype) description, documentation, and possible bulk access options are available under the "Product Details" link.

#### Details - Metadata, Documentation

#### Notes

(Posted 3/13/2018) Please note: Beginning on April 11, 2018 many of the datatypes below will begin flowing into CLASS as roughly 10 minute TAR files to allow for easier access to the data since the order limits are restricted by file counts. Each TAR file will contain several granules. Please plan accordingly.

(Posted 12/06/2017) Daily tar files of the products for the most recent 90 days are available via anonymous FTP download at <ftp://ftp-npp.bou.class.noaa.gov/>.

#### Spatial

75.94  
-139.22 -26.72  
0  
Max Area

-18.98, -1.41

#### Temporal

(maximum range is 366 days)

6

Start Date (format YYYY-MM-DD) 2020-02-17

End Date (format YYYY-MM-DD) 2020-02-18

Start Time (UTC) (format HH:MM:SS) 00:00:00

End Time (UTC) (format HH:MM:SS) 23:59:59

Specify the range of the times for:  Each Day Or  The Entire Range Of Days

#### Advanced Search

7

Datatype

- VIIRS Active Fires EDR
- VIIRS Aerosol Optical Depth and Aerosol Particle Size EDRs
- VIIRS Volcanic Ash Detection and Height EDRs
- VIIRS Aerosol Detection EDR
- VIIRS Albedo (Surface) EDR
- VIIRS Cloud Base Height EDRs
- VIIRS Cloud Top Height EDR
- VIIRS Cloud Mask EDR
- VIIRS Cloud Phase EDR
- VIIRS Daytime Cloud Optical and Microphysical Properties (DCOMP) EDRs
- VIIRS Ice Concentration and Ice Surface Temperature EDRs
- VIIRS Ice Thickness and Age EDRs
- VIIRS Land Surface Temperature EDR
- VIIRS Nighttime Cloud Optical and Microphysical Properties (NCOMP) EDRs
- VIIRS Snow Cover EDR
- VIIRS Surface Reflectance EDR

8 Satellite

NOAA-20  
S-NPP

9

Quick Search & Order to place large order without reviewing inventory or granule (file) metadata.

Search to place small order after reviewing inventory and granule metadata, including browse images when available.

Save Criteria Load Criteria Dataset Name View Reset

Figure 3. Ordering VIIRS Enterprise AOD data from NOAA's CLASS web page.

## 9. Known Issues to Date

The VIIRS Aerosol team has identified the following data quality problems that the user should be aware of:

- Before Feb 13, 2018 16:09 UTC, the overall quality flag (QCAL) value of the S-NPP EPS AOD products had a different definition: 0-no retrieval; 1-low; 2-medium; 3-high quality.
- Retrieval over Africa and Indian continent tends to underestimate the AOD at high value cases.
- Extended and diagnostic products (aerosol model, surface reflectance, etc.) have not been extensively evaluated, so they are not recommended for applications. It appears that the current algorithm selects the dust and smoke aerosol models over land at an unrealistically high proportion.
- The internal tests are designed to screen out pixels unfavorable for retrievals, however, the associated flags should not be interpreted literally. For example, the internal cloud test based on the reflectance value might identify snow/ice as cloud.
- Retrieval is subject to the error of the upstream inputs (e.g., cloud mask, snow mask, etc.).
- Some internal tests (heavy aerosol, etc.) are still under evaluation and will be updated in the near future.
- There are negative 550 nm AODs (AOD550), as low as -0.05, in the product. It is recommended to replace these with small positive values before assimilating them in models.
- Neither the S-NPP nor NOAA-20 Enterprise AOD product is usable during the two-day period of 1/16 – 1/17/2020 because of the incorrect solar vector calculations in the VIIRS sensor data record.

## Appendix: Helpful Tools for Working with VIIRS AOD Files

### A. NetCDF Tools

For users unaccustomed to working with NetCDF4 formatted files, please visit the website <https://www.unidata.ucar.edu/software/netcdf/> for information.

### B. Panoply Data Viewer

The Panoply NetCDF, HDF and GRIB Data Viewer developed by NASS GISS is a convenient tool for visualization the EPS AOD outputs. Please visit the website <https://www.giss.nasa.gov/tools/panoply/> for more information about this software.

### C. IDL Tools

IDL has a built-in library of commands for NetCDF4 files. Documentation can be found online at [https://www.harrisgeospatial.com/docs/NCDF\\_Overview.html](https://www.harrisgeospatial.com/docs/NCDF_Overview.html) or using IDL Help.

Also, Michael Galloy has written a particularly helpful IDL program to read HDF5 (also works for NetCDF4) arrays into IDL. It is available at [http://docs.idldev.com/idllib/hdf5/mg\\_h5\\_getdata-code.html](http://docs.idldev.com/idllib/hdf5/mg_h5_getdata-code.html). Examples for reading in fields from the VIIRS Aerosol EDR and Aerosol Geolocation are shown below.

*Extracts Latitude and Longitude:*

```
IDL> Latitude = mg_h5_getdata(EPS_AOD_FileName, 'Latitude')
```

```
IDL> Longitude = mg_h5_getdata(EPS_AOD_FileName, 'Longitude')
```

*Extracts AOD550 and overall quality:*

```
IDL> AOT = mg_h5_getdata(EPS_AOD_FileName, 'AOD')
```

```
IDL> AOT_Factors = mg_h5_getdata(EPS_AOD_FileName, 'QCALL')
```