The NOAA JPSS Risk Reduction System
External User Manual (EUM)

Version 1.2
October 29, 2020

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National Environmental Satellite, Data, and Information Service (NESDIS)
Office of Satellite Products and Operations (OSPO)
TITLE: The NOAA JPSS Risk Reduction System External Users Manual

AUTHORS:

John Lindeman

APPROVAL SIGNATURES:

______________________________________________
Hanjun Ding (OSPO)                        Date
Land Product Lead
The Document Revision Log identifies the series of revisions to this document since the baseline release. Please refer to the above page for version number information.

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1. PRODUCTS

This is an external user’s manual document describing the Joint Polar Satellite System (JPSS) Risk Reduction (RR) products and output files. The JPSS Risk Reduction product system was developed at the Center for Satellite Applications and Research (STAR) and will be implemented into operations at the NOAA NPOESS Data Exploitation (NDE).

The intended users of the External Users Manual (EUM) are end users of the output products and files, and the product verification and validation (V&V) teams. The purpose of the EUM is to provide product users and product testers with information that will enable them to acquire the product, understand its features, and use the data. External users are defined as those users who do not have direct access to the processing system.

1.1. Product Overview

The NOAA JPSS RR System produces a total of 26 products in four different product areas: Clouds, Aerosol, Cryosphere, and Land Surface. The products generated from the Suomi NPP (National Polar Orbiting Partnership) Visible Infrared Imaging Radiometer Suite (VIIRS) Scientific Data Records (SDR) will be used as risk reduction assessment for a cost effective implementation of common NESDIS algorithms for the JPSS program. The output products are intended for operational and scientific users.
1.1.1. Product Requirements

The requirements are to develop a production system to demonstrate that common algorithm approach for new NPP VIIRS satellite products created from upgraded GOES-R algorithms. It is expected to demonstrate a cost effective algorithm development, implementation, transition to operations, and maintenance process for NOAA JPSS products on future JPSS satellites.

1.1.2. Product Team

The VIIRS JPSS RR Development product team consists of members from STAR. The roles and contact information for the different product team members are identified in Table 1-1.

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1.1.3. Product Description

The NOAA JPSS RR products will be used as a risk reduction assessment for a cost effective implementation of common NESDIS algorithms for the JPSS system. The system was designed to run within the NPOESS Data Exploitation (NDE) production environment.
The output products are intended for operational and scientific users. Table 1-2 provides information on the algorithms and products.

**Table 1-2: JPSS RR Algorithms and Products**

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<td></td>
<td></td>
<td>Cloud Liquid Water Path</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cloud Ice Water Path</td>
</tr>
<tr>
<td>Aerosol</td>
<td>- Aerosol Detection</td>
<td>Aerosol Detection</td>
</tr>
<tr>
<td></td>
<td>- Aerosol Optical Depth</td>
<td>Aerosol Optical Depth</td>
</tr>
<tr>
<td></td>
<td>- Volcanic Ash</td>
<td>Aerosol Particle Size</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Volcanic Ash Mass Loading</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Volcanic Ash Height</td>
</tr>
<tr>
<td>Cryosphere</td>
<td>- Snow Cover</td>
<td>Snow Cover</td>
</tr>
<tr>
<td></td>
<td>- Ice Concentration</td>
<td>Snow Fraction</td>
</tr>
<tr>
<td></td>
<td>- Ice Thickness and Age</td>
<td>Ice Concentration and Cover</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ice Surface Temperature</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ice Thickness/Age</td>
</tr>
</tbody>
</table>
1.1.4. Product History

The algorithms in the JPSS products are modified or upgraded versions of GOES-R algorithms adapted to run on S-NPP VIIRS (except for Snow Cover which is GOES heritage). The result of this implementation is to have just one set of algorithm software that will need to be maintained for generating products from both the GOES-R Advanced Baseline Imager and the JPSS VIIRS instruments. It is expected that instruments onboard future VIIRS satellites will also use these algorithms. This risk reduction project supports the common algorithm approach for new satellite products.

1.2. Product Characteristics

VIIRS is a 22-band imaging radiometer that, in terms of features, is a cross between MODIS and AVHRR, with some characteristics of the Operational Linescan System (OLS) on Defense Meteorological Satellite Program (DMSP) satellites. Several unique characteristics of VIIRS will impact the VIIRS JPSS RR products, which include

- a wider swath,
- high spatial resolution,
- constrained pixel growth: better resolution at edge of swath,
- a visible day-night band (DNB).

1.3. Product Access

All JPSS RR output data files will be made available by the NDE DHS on the NDE data distribution server at ESPC in a near real time manner. For access to this server, information about data files, and associated documentation, the JPSS PAL should be contacted (see Table 1-1).
The NESDIS’ Policy on Access and Distribution of Environmental Data and Products is provided at: http://www.ospo.noaa.gov/Organization/About/access.html.

Users need to fill out the Data Access Request Form located on this site and submit to the PAL with a copy to nesdis.data.access@noaa.gov. This address provides the OSPO Data Access Team a copy of the correspondence. The process is defined in the following diagram. Once the request is approved by the OSPO management the data will be delivered by the Data Distribution System (DDSProd) currently distributing the ESPC data products and later by the Product Distribution and Access (PDA) system. The ESPC Data Distribution Manager, Donna McNamara (donna.mcnamara@noaa.gov) should be contacted for any data accessibility and data distribution problems.

The products are in netCDF format and undergo compression while being processed. Table 1-3 lists the JPSS RR output files and their formats. Tables 1-4 to 1-14 show the detailed content of the output files.

Table 1-3: JPSS RR Output File Names: NetCDF4

<table>
<thead>
<tr>
<th>JPSS RR Product Algorithm Names</th>
<th>NetCDF4 PPSS RR product filenames</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerosol Detection</td>
<td>JRR-ADP_v1r2_npp_sYYYYMMDDHHMMSS0_eYYYYMMDDHHMMSS0_cYYYYMMDDHHMMSS0.nc</td>
</tr>
<tr>
<td>Aerosol Optical Depth</td>
<td>JRR-AOD_v1r2_npp_sYYYYMMDDHHMMSS0_eYYYYMMDDHHMMSS0_cYYYYMMDDHHMMSS0.nc</td>
</tr>
<tr>
<td>Volcanic Ash</td>
<td>JRR-VolcanicAsh_v1r2_npp_sYYYYMMDDHHMMSS0_eYYYYMMDDHHMMSS0.cYYYYMMDDHHMMSS0.nc</td>
</tr>
<tr>
<td>Cloud Mask</td>
<td>JRR-CloudMask_v1r2_npp_sYYYYMMDDHHMMSS0_eYYYYMMDDHHMMSS0.cYYYYMMDDHHMMSS0.nc</td>
</tr>
<tr>
<td>Cloud Height</td>
<td>JRR-CloudHeight_v1r2_npp_sYYYYMMDDHHMMSS0_eYYYYMMDDHHMMSS0.cYYYYMMDDHHMMSS0.nc</td>
</tr>
<tr>
<td>Cloud Phase</td>
<td>JRR-CloudPhase_v1r2_npp_sYYYYMMDDHHMMSS0_eYYYYMMDDHHMMSS0.cYYYYMMDDHHMMSS0.nc</td>
</tr>
<tr>
<td>Daytime Cloud Optical and</td>
<td>JRR-CloudDCOMP_v1r2_npp_sYYYYMMDDHHMMSS0_eYYYYMMDDHHMMSS0.cYYYYMMDDHHMMSS0.nc</td>
</tr>
<tr>
<td>Microphysical Properties</td>
<td></td>
</tr>
<tr>
<td>(DCOMP)</td>
<td></td>
</tr>
<tr>
<td>Nighttime Cloud Optical and</td>
<td></td>
</tr>
<tr>
<td>Microphysical Properties</td>
<td></td>
</tr>
</tbody>
</table>
| Microphysical Properties (NCOMP) | CloudNCOMP_v1r2_npp_sYYYYMMDDHHMMSS0_eYYYYMMD
DHHMSS0_cYYYYYMMDHHHMSS0.nc |
|----------------------------------|--------------------------------------------------------------------------------|
| Cloud Base                       | JRR-CloudBase_v1r2_npp_sYYYYMMDDHHMMSS0_eYYYYMMDDH
HMSS0_cYYYYYMMDHHHMSS0.nc         |
| Ice Thickness and Age            | JRR-IceAge_v1r2_npp_sYYYYYMMDDDHHMMSS0_eYYYYYMDDHHHM
SS0_cYYYYYMMDHHHMSS0.nc           |
| Ice Concentration                | JRR-IceConcentration_v1r2_npp_sYYYYYMMDDDHHMMSS0_eYYYYYMMDDHHHM
SS0_cYYYYYMMDHHHMSS0.nc           |
| Snow Cover                       | JRR-SnowCover_v1r2_npp_sYYYYYMMDDDHHMMSS0_eYYYYYMDDH
HMSS0_cYYYYYMMDHHHMSS0.nc         |
| Land Surface Temperature         | LST_v1r4_npp_sYYYYYMDDHHMMSSS_eYYYYYMMDDDHHMM
SSS_cYYYYYMMDHHHMSSS.nc           |
|                                 | LST_v1r4_j01_sYYYYYMDDHHMMSSS_eYYYYYMMDDDHHMM
SS_cYYYYYMMDHHHMSSS.nc            |
| Land Surface Albedo              | SURFRAD_v1r4_npp_sYYYYYMDDHHMMSSS_eYYYYYMMDDHH
HMSSS_cYYYYYMMDDDHHHMSSS.nc       |
|                                 | SURFRAD_v1r4_j01_sYYYYYMDDHHMMSSS_eYYYYYMMDDHH
HMSSS_cYYYYYMMDDDHHHMSSS.nc       |

Where,

- \( v1r2, v1r4 \) – version number
- \( npp \) – satellite name is NPP
- \( j01 \) – satellite name is JPSS01(NOAA20)
- \( YYYY \) – 4 digit year
- \( MM \) – 2 digit month
- \( DD \) – 2 digit day
- \( HH \) – 2 digit hour
- \( MM \) – 2 digit minute
- \( SS \) – 2 digit second
- \( SSS \) – Decimal seconds to the 1/10 precision (e.g. “103” = 10.3 seconds)
- \( s \) – start
- \( e \) – end
- \( c \) – creation time

Note that the *.nc product data files undergo level 2 compression. While the other JPSS products have the ‘JRR’ prefix, land surface file names begin with the product names. The land surface products version number is v1r4, while the other JPSS RR products are v1r2.
In addition to the ancillary products required to generate the JPSS RR products, the land surface temperature and albedo products also require offline components (albedo and emissivity) that are determined separately outside of the framework. Brief descriptions of the offline components can be found among the ancillary products in section 2.3.16.

The file contents are shown in Table 1-4 to Table 1-14.

### Table 1-4: Aerosol Detection Output File

<table>
<thead>
<tr>
<th>Variable</th>
<th>Type</th>
<th>Description</th>
<th>Dim</th>
<th>Units</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ash</td>
<td>Byte</td>
<td>Volcanic Ash Flag: 1 = yes, 0 = No</td>
<td>2</td>
<td>1</td>
<td>0,1</td>
</tr>
<tr>
<td>AshConfidHighPct</td>
<td>Float</td>
<td>Percent of high confidence ash</td>
<td>0</td>
<td>Percent</td>
<td>0, 100</td>
</tr>
<tr>
<td>AshConfidLowPct</td>
<td>Float</td>
<td>Percent of low confidence ash</td>
<td>0</td>
<td>Percent</td>
<td>0, 100</td>
</tr>
<tr>
<td>AshConfidMediumPct</td>
<td>Float</td>
<td>Percent of medium confidence ash</td>
<td>0</td>
<td>Percent</td>
<td>0, 100</td>
</tr>
<tr>
<td>AshPct</td>
<td>Float</td>
<td>Percent of good ash retrieval</td>
<td>0</td>
<td>Percent</td>
<td>0, 100</td>
</tr>
<tr>
<td>Byte1</td>
<td>Byte</td>
<td>Quality Flag Byte 1</td>
<td>2</td>
<td>1</td>
<td>-128,127</td>
</tr>
<tr>
<td>Byte2</td>
<td>Byte</td>
<td>Quality Flag Byte 2</td>
<td>2</td>
<td>1</td>
<td>-128,127</td>
</tr>
<tr>
<td>Byte3</td>
<td>Byte</td>
<td>Quality Flag Byte 3</td>
<td>2</td>
<td>1</td>
<td>-128,127</td>
</tr>
<tr>
<td>Byte4</td>
<td>Byte</td>
<td>Quality Flag Byte 4</td>
<td>2</td>
<td>1</td>
<td>-128,127</td>
</tr>
<tr>
<td>Byte5</td>
<td>Byte</td>
<td>Quality Flag Byte 5</td>
<td>2</td>
<td>1</td>
<td>-128,127</td>
</tr>
<tr>
<td>Cloud</td>
<td>Byte</td>
<td>Cloud Flag: 1 yes, 0 no</td>
<td>2</td>
<td>1</td>
<td>0,1</td>
</tr>
<tr>
<td>DAll</td>
<td>Float</td>
<td>Dust Aerosol Index</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Dust</td>
<td>Byte</td>
<td>Deep blue dust flag: 1 yes, 0 no</td>
<td>2</td>
<td>1</td>
<td>0,1</td>
</tr>
<tr>
<td>DustConfidHighPct</td>
<td>Float</td>
<td>Percent of high confidence dust</td>
<td>0</td>
<td>Percent</td>
<td>0, 100</td>
</tr>
<tr>
<td>DustConfidLowPct</td>
<td>Float</td>
<td>Percent of low confidence dust</td>
<td>0</td>
<td>Percent</td>
<td>0, 100</td>
</tr>
<tr>
<td>DustConfidMediumPct</td>
<td>Float</td>
<td>Percent of medium confidence dust</td>
<td>0</td>
<td>Percent</td>
<td>0, 100</td>
</tr>
<tr>
<td>DustPct</td>
<td>Float</td>
<td>Percent of good dust retrieval</td>
<td>0</td>
<td>Percent</td>
<td>0, 100</td>
</tr>
<tr>
<td>Latitude</td>
<td>Float</td>
<td>Pixel latitude in field latitude</td>
<td>2</td>
<td>Degrees north</td>
<td>-90., 90.</td>
</tr>
<tr>
<td>Longitude</td>
<td>Float</td>
<td>Pixel longitude in field longitude</td>
<td>2</td>
<td>Degrees east</td>
<td>-180., 180.</td>
</tr>
<tr>
<td>NDAI</td>
<td>Float</td>
<td>No Dust Aerosol Index</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Variable</td>
<td>Type</td>
<td>Description</td>
<td>Min</td>
<td>Max</td>
<td></td>
</tr>
<tr>
<td>--------------------------------</td>
<td>----------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-----</td>
<td>-----</td>
<td></td>
</tr>
<tr>
<td>NUC</td>
<td>Byte</td>
<td>None, Unknown, Clear sky Flag: 1 Yes, 0 No</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>NUCConfidHighPct</td>
<td>Float</td>
<td>Percent of high confidence NUC</td>
<td>0</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>NUCConfidLowPct</td>
<td>Float</td>
<td>Percent of low confidence NUC</td>
<td>0</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>NUCConfidMediumPct</td>
<td>Float</td>
<td>Percent of medium confidence NUC</td>
<td>0</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>NUCPct</td>
<td>Float</td>
<td>Percent of good NUC retrieval</td>
<td>0</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>NoAshPct</td>
<td>Float</td>
<td>Percent of ash not determined (bad)</td>
<td>0</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>NoDustPct</td>
<td>Float</td>
<td>Percent of dust not determined (bad)</td>
<td>0</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>NoNUCPct</td>
<td>Float</td>
<td>Percent of NUC not determined (bad)</td>
<td>0</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>NoSmokePct</td>
<td>Float</td>
<td>Percent of smoke not determined (bad)</td>
<td>0</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>NumOfGoodAshRetrieval</td>
<td>Long</td>
<td>Number of Good Ash Retrievals</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>NumOfGoodDustRetrieval</td>
<td>Long</td>
<td>Number of Good Dust Retrievals</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>NumOfGoodNUCRetrieval</td>
<td>Long</td>
<td>Number of Good NUC Retrievals</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>NumOfGoodSmokeRetrieval</td>
<td>Long</td>
<td>Number of Good Smoke Retrievals</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>NumOfQualityFlag</td>
<td>Long</td>
<td>Number of quality flag</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>NumOfSatZenAngLess60</td>
<td>Long</td>
<td>Number of pixel with satellite zenith angle less 60 degree</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>NumOfSolZenAngLess60</td>
<td>Long</td>
<td>Number of pixel with solar zenith angle less 60 degree</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Smoke</td>
<td>Byte</td>
<td>Deep Blue Smoke Flag: 1 Yes, 0 No</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>SmokeCon</td>
<td>Float</td>
<td>Smoke Concentration</td>
<td>2</td>
<td>ug/m^3</td>
<td></td>
</tr>
<tr>
<td>SmokeConfidHighPct</td>
<td>Float</td>
<td>Percent of high confidence smoke</td>
<td>0</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>SmokeConfidLowPct</td>
<td>Float</td>
<td>Percent of low confidence smoke</td>
<td>0</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>SmokeConfidMediumPct</td>
<td>Float</td>
<td>Percent of medium confidence smoke</td>
<td>0</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>SmokePct</td>
<td>Float</td>
<td>Percent of good</td>
<td>0</td>
<td>%</td>
<td></td>
</tr>
</tbody>
</table>
### Table 1-5: Aerosol Optical Depth Output File

<table>
<thead>
<tr>
<th>Variable</th>
<th>Type</th>
<th>Description</th>
<th>Dim</th>
<th>Units</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>AOD550</td>
<td>Float</td>
<td>Aerosol optical depth at 550 nm</td>
<td>2</td>
<td>1</td>
<td>-0.05, 5.0</td>
</tr>
<tr>
<td>AOD550LndMdl</td>
<td>Float</td>
<td>Retrieval AOD550 for each land aerosol model: dust, generic, urban, smoke</td>
<td>3</td>
<td>1</td>
<td>-0.05, 5</td>
</tr>
<tr>
<td>AOD_channel</td>
<td>Float</td>
<td>Aerosol optical depth in selected channels</td>
<td>3</td>
<td>1</td>
<td>0, 12</td>
</tr>
<tr>
<td>AerMdl</td>
<td>Byte</td>
<td>Aerosol model: 0-oceanic, 1-dust, 2-generic, 3-urban, 4-heavy smoke</td>
<td>2</td>
<td>1</td>
<td>0, 4</td>
</tr>
<tr>
<td>AngsExp1</td>
<td>Float</td>
<td>Angstrom exponent for M4 vs M7 over ocean</td>
<td>2</td>
<td>1</td>
<td>-1, 3</td>
</tr>
<tr>
<td>AngsExp2</td>
<td>Float</td>
<td>Angstrom exponent for M7 vs M10 over ocean</td>
<td>2</td>
<td>1</td>
<td>-1, 3</td>
</tr>
<tr>
<td>CoarseMdIdx</td>
<td>Byte</td>
<td>Retrieved coarse aerosol model index over ocean</td>
<td>2</td>
<td>1</td>
<td>1, 5</td>
</tr>
<tr>
<td>FineMdIdx</td>
<td>Byte</td>
<td>Retrieved fine aerosol model index over ocean</td>
<td>2</td>
<td>1</td>
<td>1, 4</td>
</tr>
<tr>
<td>FineModWgt</td>
<td>Float</td>
<td>Retrieved ratio of fine mode optical depth at 0.55 micron over ocean</td>
<td>2</td>
<td>1</td>
<td>0, 1</td>
</tr>
<tr>
<td>Variable</td>
<td>Type</td>
<td>Description</td>
<td>Min</td>
<td>Max</td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>--------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-----</td>
<td>-----</td>
<td></td>
</tr>
<tr>
<td>HighQualityPct</td>
<td>Float</td>
<td>Percent of high quality retrievals</td>
<td>0</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Latitude</td>
<td>Float</td>
<td>Pixel latitude in field latitude</td>
<td>2</td>
<td>-90, 90.</td>
<td></td>
</tr>
<tr>
<td>Longitude</td>
<td>Float</td>
<td>Pixel longitude in field longitude</td>
<td>2</td>
<td>-180, 180.</td>
<td></td>
</tr>
<tr>
<td>MeanAOD</td>
<td>Float</td>
<td>Mean AOD at 550 nm</td>
<td>0</td>
<td>1</td>
<td>-1, 5</td>
</tr>
<tr>
<td>QCInput</td>
<td>Byte</td>
<td>Flags for input data (0-valid/1-invalid): bit 0: geolocation; bit 1: geometry; bit 2: ancillary model data; bit 3: reflectance</td>
<td>2</td>
<td>0, 15</td>
<td></td>
</tr>
<tr>
<td>QCPath</td>
<td>Byte</td>
<td>Flags for retrieval path (0-No/1-Yes): bit 0: retrieval over water; bit 1: over bright land; bit 2: over glint water; bit 3: retrieval with SW scheme over land; bit 4: retrieval with SWIR scheme over land; bit 5: retrieval over bright-land algorithm</td>
<td>2</td>
<td>0,31</td>
<td></td>
</tr>
<tr>
<td>QCRet</td>
<td>Byte</td>
<td>Flags for retrieval (0-No/1-Yes): bit 0: retrieval failed; bit 1: low sun; bit 2: dark barren land surface type; bit 3: extrapolation involved; bit 4: Heavy aerosol</td>
<td>2</td>
<td>-128,127</td>
<td></td>
</tr>
<tr>
<td>Variable</td>
<td>Type</td>
<td>Description</td>
<td>Dim</td>
<td>Units</td>
<td>Range</td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------</td>
<td>--------------------------------------------------</td>
<td>-----</td>
<td>---------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Latitude</td>
<td>Float</td>
<td>Pixel latitude in field latitude</td>
<td>2</td>
<td>Degrees north</td>
<td>-90., 90.</td>
</tr>
<tr>
<td>Longitude</td>
<td>Float</td>
<td>Pixel longitude in field longitude</td>
<td>2</td>
<td>Degrees</td>
<td>-180., 180.</td>
</tr>
</tbody>
</table>

Table 1-6: Volcanic Ash Output File
<table>
<thead>
<tr>
<th>Field Name</th>
<th>Type</th>
<th>Description</th>
<th>Length</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>AshConfidence</td>
<td>Float</td>
<td>Ash Confidence</td>
<td>2</td>
<td>None</td>
</tr>
<tr>
<td>AshConfidenceMulti</td>
<td>Float</td>
<td>Ash Confidence Multi</td>
<td>2</td>
<td>None</td>
</tr>
<tr>
<td>AshDetectionQPI</td>
<td>Byte</td>
<td>Ash Detection Product Quality Information</td>
<td>3</td>
<td>None</td>
</tr>
<tr>
<td>AshDetectionQF</td>
<td>Byte</td>
<td>Ash Detection Quality Flag</td>
<td>2</td>
<td>None</td>
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**Table 1-7: Cloud Height Output File**
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Table 1-8: Cloud Mask Output File
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### Table 1-9: Daytime and Nighttime Cloud Microphysics Output File

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NitCat06Pct  |  Float  |  No retrieval: minimum error model for water = 0 |  0  |  Percent  |  0, 100 |
NitCat07Pct  |  Float  |  No retrieval: minimum error model for ice = 0 |  0  |  Percent  |  0, 100 |

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<th><strong>Description</strong></th>
<th><strong>Dim</strong></th>
<th><strong>Units</strong></th>
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### Table 1-12: Ice Concentration Output File

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Table 1-13: Snow Cover Output File

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<td>Fraction of land pixels of all pixels in the granule</td>
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<td>Fraction of snow pixels of all pixels in the granule</td>
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<td>None</td>
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<td>Fraction of cloud pixels of all pixels in the granule</td>
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<td>Dim</td>
<td>Units</td>
<td>Range</td>
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**Table 1-14: Cloud Base**

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<th>Dim</th>
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<th>Range</th>
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Table 1-15: Land Surface Temperature

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<td>Degrees north</td>
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<td>Value 2</td>
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<td>emis_bbe</td>
<td>Float</td>
<td>Emissions</td>
<td>2</td>
<td>?</td>
<td>NA</td>
</tr>
<tr>
<td>emis_m15</td>
<td>Float</td>
<td>Ch15 emissions</td>
<td>2</td>
<td>?</td>
<td>NA</td>
</tr>
<tr>
<td>emis_m16</td>
<td>Float</td>
<td>Ch16 emissions</td>
<td>2</td>
<td>?</td>
<td>NA</td>
</tr>
</tbody>
</table>

* Product level monitoring metadata
### Table 1-16: Land Surface Albedo

<table>
<thead>
<tr>
<th>Variable</th>
<th>Type</th>
<th>Description</th>
<th>Dim</th>
<th>Units</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>AlbOff</td>
<td>Float</td>
<td>VIIRS LSA Albedo offset</td>
<td>0</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>AlbScl</td>
<td>Float</td>
<td>VIIRS LSA Albedo Scale Factor</td>
<td>0</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>CldCnfCld</td>
<td>Long</td>
<td>VIIRS LSA Cloud Condition: Confidently Cloudy</td>
<td>0</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>CldCndClr</td>
<td>Long</td>
<td>VIIRS LSA Cloud Condition: Confidently Clear</td>
<td>0</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>CldProbCld</td>
<td>Long</td>
<td>VIIRS LSA Cloud Condition: Probably Cloudy</td>
<td>0</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>CldProbClr</td>
<td>Long</td>
<td>VIIRS LSA Cloud Condition: Probably Clear</td>
<td>0</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>DataQualityFlag</td>
<td>Byte</td>
<td>VIIRS LSA 2-bit High-Quality Flag</td>
<td>2</td>
<td>None</td>
<td>0, 2</td>
</tr>
<tr>
<td>Latitude</td>
<td>Float</td>
<td>Pixel latitude in field</td>
<td>2</td>
<td>Degrees</td>
<td>-90, 90.</td>
</tr>
<tr>
<td>Longitude</td>
<td>Float</td>
<td>Pixel longitude in field</td>
<td>2</td>
<td>Degrees</td>
<td>-180, 180.</td>
</tr>
<tr>
<td>OnFltFltd</td>
<td>Long</td>
<td>VIIRS LSA Online Filter: Online Filtered</td>
<td>0</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>OnFltNoFlt</td>
<td>Long</td>
<td>VIIRS LSA Online Filter: No Online Filter</td>
<td>0</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>OvQltyHghQltyRtr</td>
<td>Long</td>
<td>VIIRS LSA Overall Quality: High Quality Retrieval</td>
<td>0</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>OvQltyNoRtr</td>
<td>Long</td>
<td>VIIRS LSA Overall Quality: No Retrieval</td>
<td>0</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>OvQltyRtr</td>
<td>Long</td>
<td>VIIRS LSA Overall Quality: Retrieval</td>
<td>0</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>ProductQualityInformation</td>
<td>Short</td>
<td>VIIRS LSA 2-byte Quality Flag</td>
<td>2</td>
<td>None</td>
<td>0, 32767</td>
</tr>
<tr>
<td>RtrPthDst</td>
<td>Long</td>
<td>VIIRS LSA Retrieval Path: Desert</td>
<td>0</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>RtrPthGen</td>
<td>Long</td>
<td>VIIRS LSA Retrieval Path: Generic</td>
<td>0</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>RtrPthNoRtr</td>
<td>Long</td>
<td>VIIRS LSA Retrieval Path: No Retrieval</td>
<td>0</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>RtrPthSI</td>
<td>Long</td>
<td>VIIRS LSA Retrieval</td>
<td>0</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>Path: Sea Ice</td>
<td></td>
<td>VIIRS LSA Retrieval Path: Snow</td>
<td>0</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>---------------</td>
<td>---</td>
<td>---------------------------------</td>
<td>----</td>
<td>------</td>
<td>----</td>
</tr>
<tr>
<td>RtrPthSnw</td>
<td>Long</td>
<td>VIIRS LSA Solar Zenith Angle: Favorable SZA</td>
<td>0</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>SZAFav</td>
<td>Long</td>
<td>VIIRS LSA Solar Zenith Angle: Very Large SZA</td>
<td>0</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>SZALge</td>
<td>Long</td>
<td>VIIRS LSA Temporal Filter Flag: Degraded Retrieval</td>
<td>0</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>TFDegRtr</td>
<td>Long</td>
<td>VIIRS LSA Temporal Filter Flag: High-Quality Retrieval</td>
<td>0</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>TFHghRtr</td>
<td>Long</td>
<td>VIIRS LSA Temporal Filter Flag: No Retrieval</td>
<td>0</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>VIIRS_Albedo_EDR</td>
<td>Short</td>
<td>Improved VIIRS Land Surface Albedo</td>
<td>2</td>
<td>None</td>
<td>0, 10000</td>
</tr>
<tr>
<td>VIIRS_Albedo_IP</td>
<td>Short</td>
<td>Primary VIIRS Land Surface Albedo Clear</td>
<td>2</td>
<td>None</td>
<td>0, 10000</td>
</tr>
<tr>
<td>VZAFav</td>
<td>Long</td>
<td>VIIRS LSA View Zenith Angle: Favorable VZA</td>
<td>0</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>VZALge</td>
<td>Long</td>
<td>VIIRS LSA View Zenith Angle: Very Large LZA</td>
<td>0</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>MaxLSA*</td>
<td>Float</td>
<td>Max LSA</td>
<td>0</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>MinLSA*</td>
<td>Float</td>
<td>Min LSA</td>
<td>0</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>MeanLSA*</td>
<td>Float</td>
<td>Mean LSA</td>
<td>0</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>StdLSA*</td>
<td>Float</td>
<td>Std. deviation of LSA</td>
<td>0</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>PercentHighQuality*</td>
<td>Float</td>
<td>Percentage of high quality retrievals over all valid retrievals</td>
<td>0</td>
<td>Percent</td>
<td>[0,100]</td>
</tr>
<tr>
<td>PercentFilteredPixel*</td>
<td>Float</td>
<td>Percentage of filtered pixels over all valid retrievals</td>
<td>0</td>
<td>Percent</td>
<td>[0,100]</td>
</tr>
<tr>
<td>PercentLandPixels*</td>
<td>Float</td>
<td>Percentage of land pixels</td>
<td>0</td>
<td>Percent</td>
<td>[0,100]</td>
</tr>
<tr>
<td>PercentSeaicePixels*</td>
<td>Float</td>
<td>Percentage of seaice pixels</td>
<td>0</td>
<td>Percent</td>
<td>[0,100]</td>
</tr>
<tr>
<td>PercentClearPixels*</td>
<td>Float</td>
<td>Percentage of clear</td>
<td>0</td>
<td>Percent</td>
<td>[0,100]</td>
</tr>
</tbody>
</table>
PercentLargeVZAPixels* | Float | Percentage of large view zenith angle pixels | 0 | Percent | [0,100]
PercentLargeSZAPixels* | Float | Percentage of large solar zenith angle pixels | 0 | Percent | [0,100]

* Product level monitoring metadata

Note that four additional nc files will be generated along with the Cloud Mask output files. These files, one navigation and three L1b channel band files, will be used as input for the VIIRS polar wind product suite.

Lastly, all JPRR RR product output files contain three types of NDE-required metadata. The first type is collection-level metadata, which is static with respect to each NUP NOAA Unique Product). The second type is granule-level metadata that is granule-dependent and thus is dynamic with respect to the observations. The third type is swath geographic metadata, which is the satellite’s native geolocated observation. The NDE metadata can be found in the global-attributes section of the output files. A list of metadata variables is shown in Table 17.

Table 17 - NDE Level Metadata

<table>
<thead>
<tr>
<th>Collection Level Metadata</th>
<th>Attribute Name</th>
<th>Data Type</th>
<th>Description / Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventions</td>
<td>Conventions</td>
<td>string</td>
<td>“CF-1.5”</td>
</tr>
<tr>
<td>Metadata_Conventions</td>
<td>Metadata_Conventions</td>
<td>string</td>
<td>“CF-1.5, Unidata Dataset Discovery v1.0”</td>
</tr>
<tr>
<td>standard_name_vocabulary</td>
<td>standard_name_vocabulary</td>
<td>string</td>
<td>“CF standard Name Table(version 17, 24 March 2011)”</td>
</tr>
<tr>
<td>project</td>
<td>project</td>
<td>string</td>
<td>“S-NPP Data Exploitation”</td>
</tr>
<tr>
<td>institution</td>
<td>institution</td>
<td>string</td>
<td>“DOC/NOAA/NESDIS/NDE -&gt; S-NPP Data Exploitation, NESDIS, NOAA, U.S. Department of Commerce”</td>
</tr>
<tr>
<td>naming_authority</td>
<td>naming_authority</td>
<td>string</td>
<td>“gov.noaa.nesdis.nde”</td>
</tr>
<tr>
<td>satellite_name</td>
<td>satellite_name</td>
<td>string</td>
<td>“NPP”</td>
</tr>
<tr>
<td>instrument_name</td>
<td>instrument_name</td>
<td>string</td>
<td>“VIIRS”</td>
</tr>
<tr>
<td>Attribute Name</td>
<td>Data Type</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>------------------------</td>
<td>----------------</td>
<td>-----------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>title</td>
<td>string</td>
<td>Set to the NUP product short name (SURFRAD / LST)</td>
<td></td>
</tr>
<tr>
<td>summary</td>
<td>string</td>
<td>Brief description of the product</td>
<td></td>
</tr>
<tr>
<td>history</td>
<td>string</td>
<td>Provides the algorithm name and version used to produce the NUP (v1r0)</td>
<td></td>
</tr>
<tr>
<td>processing_level</td>
<td>string</td>
<td>“NOAA Level 2”</td>
<td></td>
</tr>
<tr>
<td>references</td>
<td>string</td>
<td>Published or web-based references describing the data or methods used to produce the product</td>
<td></td>
</tr>
</tbody>
</table>

**Granule Level Metadata**

<table>
<thead>
<tr>
<th>Attribute Name</th>
<th>Data Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>string</td>
<td>Each product team can implement a unique identifier, approved by NESDIS data center representative</td>
</tr>
<tr>
<td>metadata_link</td>
<td>string</td>
<td>This attribute lists the unique NUP product file name</td>
</tr>
<tr>
<td>start_orbit_number</td>
<td>int</td>
<td>This attribute is a sequential whole number set by the S-NPP / JPSS Ground System in the xDR metadata. Orbits are incremented on the northward equatorial node.</td>
</tr>
<tr>
<td>end_orbit_number</td>
<td>int</td>
<td>This attribute is a sequential whole number set by the S-NPP / JPSS Ground System in the xDR metadata. Orbits are incremented on the northward equatorial node.</td>
</tr>
<tr>
<td>day_night_data_flag</td>
<td>string</td>
<td>This attribute should be set to “day”, “night”, or “both” depending on sunlight conditions for observation</td>
</tr>
<tr>
<td>ascend_descend_data_flag</td>
<td>int</td>
<td>This attribute indicates whether the satellite is moving northward or southward. The center time of an observation is used. This attribute should be set to 0 (ascending or northward) or 1 (descending or southward)</td>
</tr>
<tr>
<td>time_coverage_start</td>
<td>string</td>
<td>This attribute is set to the UTC start time of an observation as “YYYY-MM-DDTh:mm:ssZ”, where YYYY is the four digit year, MM is the two digit month, DD is the two digit day, hh is the UTC hour, mm is the UTC minute, and ss is the UTC second</td>
</tr>
<tr>
<td>time_coverage_end</td>
<td>string</td>
<td>This attribute is set to the UTC end time of an observation as “YYYY-MM-DDTh:mm:ssZ”, where YYYY is the four digit year, MM is the two digit month, DD is the two digit day, hh is the UTC hour, mm is the UTC minute, and ss is the UTC second</td>
</tr>
<tr>
<td>date_created</td>
<td>string</td>
<td>This attribute is set to the UTC time the NUP file was created as “YYYY-MM-DDTh:mm:ssZ”, where YYYY is the four digit year, MM is the two digit month, DD is the two digit day, hh is the UTC hour, mm is the UTC minute, and ss is the UTC second</td>
</tr>
</tbody>
</table>

**Swath Geographic Metadata**

<table>
<thead>
<tr>
<th>Attribute Name</th>
<th>Data Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>cdm_data_type</td>
<td>string</td>
<td>This attribute describes the geographic category the NUP data represents. This should be “swath” for native 2-D satellite swath data</td>
</tr>
</tbody>
</table>
These attributes describe the four point geolocated latitude and longitude (polygon) that describes the geographic context for the NUP observation. Latitude values include -90 (south) to 90 (north) degrees and longitude values include -180 (west) to 180 (east).

These attributes should be "degrees_north"

This attribute should be "degrees_east"

This attribute describes a closed polygon of N (N>3) latitude and longitude vertices. The last latitude/longitude pair must be identical to the first pair. Latitude values include -90 (south) to 90 (north) degrees and longitude values include -0 (west) to 180 (east). This should be "POLYGON((lon1 lat1, lon2 lat2, ..., lonN latN, lon1 lat1))"

2. ALGORITHM

2.1. Algorithm Overview

The JPSS RR products are generated from the Cloud, Aerosol, Cryosphere, and Land Surface algorithms located within the framework. The Cloud algorithms include Cloud Mask, Cloud Phase, Cloud Height, Daytime Cloud Optical and Microphysical Properties (DCOMP), and Nighttime Cloud Optical and Microphysical Properties (NCOMP). The Aerosol algorithms include Aerosol Detection, Aerosol Optical Depth, and Volcanic Ash. The Cryosphere algorithms include Snow Cover, Ice Concentration, and Ice Thickness and Age. The land surface products include the Land Surface Temperature and Albedo.
These algorithms run inside a system of supporting software. This is the AIT-Framework system or the GOES-R Algorithm Working Group (AWG) Product Processing System Framework. The Framework has been developed to be plug-and-play system for GOES-R and VIIRS scientific algorithms enabling the development and testing of the Level 2 GOES-R and VIIRS products within a single system. Many of the VIIRS products originated as GOES-R products but have been adapted for the VIIRS satellites. The system has been created to run products and store them in memory to be used as inputs for other products: i.e. product precedence. Common ancillary data has been used by the algorithms and the ancillary data is also stored in memory and treated as precedence for the products. Within the Framework system, the RR algorithms have flexible interface designs that allow the different types of instruments/satellite data sets. Therefore the RR algorithms are the same for GOES-R products and corresponding JPSS RR products.

### 2.1.1 Pre-Processing Steps

For JPSS RR, there are two steps in order to generate the VIIRS products: The pre-processing step and main-processing step. The main purposes of the preprocessing are to do the data gap filling and HDF5-to-NetCDF4 conversion.

During Preprocessing steps, JPSS RR software first reads in the system PCF file. Next JPSS software converts the HDF5 format VIIRS data to NetCDF4 format and performs data gap filling, then generates/writes out Framework output of SDR data and ancillary products by calling the Framework program. For detailed information about the preprocessing steps, please refer JPSS RR System Maintenance Manual.

### 2.2. Input Data Files

This section describes the input data files required by the JPSS RR system, including the satellite data, the ancillary data required by the AIT-framework to generate the products, as well as the algorithm specified coefficient files, etc. All of these files are defined in the system PCF files through the File-Handle-Name (the left side of the equal sign in the PCF file).
The JPSS RR system requires AIT-framework configuration files (CFG) and process control files (PCF) in text format.

An AIT-framework CFG file is required to run the AIT-framework program and in the CFG file, a number of AIT-framework PCF files are specified. The data is passed to the AIT-framework program through the Framework-CFG and Framework-PCF files by specifying the data files in these Framework-CFG and PCF.

2.2.1. Satellite Data Files

To generate JPSS RR products, VIIRS satellite pixel files in NetCDF4 format are required. It only uses whichever I or M band data is required to run the JPSS RR system. They are VIIRS Science Data Records (SDR) Moderate Resolution Band 01-16 SVM01-16, Terrain Corrected Geolocation data GMCTO, VIIRS SDR Imagery Bands 01-05 SVI01-05, and VIIRS Image Bands SDR Terrain Corrected Geolocation data GICTO. The Bayesian CloudMask algorithm uses I band 1/4/5 resolution to produce the dust mask. These data files are the VIIRS input to the JPSS RR system. All of these files are in HDF5 format and are generated by the IDPS system at NDE. The details of the File-Handle-Name in the system’s PCF and the corresponding satellite data files are listed in JPSS RR System Maintenance Manual.

2.3. Ancillary Data Files Required by AIT-framework

The ancillary files are in NetCDF format, except for the CRTM coefficient files, which are in binary format. Each of the three product categories requires some ancillary files. The Cloud products require NWP GFS data, NWP Snow Mask, 1km NASA Land Mask, 1km NASA Coast Mask, Desert Mask, AVHRR Surface Type, 1km Surface Elevation, Seebor Surface Emissivity, Surface Albedo Composite, Pseudo Emissivity, OISST, and CRTM. The Aerosol products require 1km NASA Land Mask, Desert Mask, NWP GFS data, and NWP Snow Mask. The Cryosphere products require Land Mask, Surface Elevation, and Climatic LST. In addition, all of the products require ancillary data for the VIIRS SDR reader. These ancillary products are described below. The land surface products require the land surface emissivity, which is currently being calculated offline and treated as an ancillary product.
2.3.1. Land Mask

The land mask is derived from the NASA EOS project supplied static dataset as well as World Vector Shoreline data and DTED DEM data provided by NIMA (then DMA) and bathymetric data provided by the oceanographic community. The original global binary file, version 3, produced in 2003 by Robert Wolfe, was converted to NetCDF and HDF for usage in the framework. Resolution: The land/ocean mask is stored in a 1 km geographic (geodetic) projection.
Filename: lw_geo_2001001_v03m.nc
Origin: Created by SSEC/CIMSS based on NASA MODIS collection 5
Size: 890 MB.
Static/Dynamic: Static
Values:
0 = Shallow ocean
1 = Land (Nothing else but land)
2 = Ocean coastlines and lake shorelines
3 = Shallow inland water
4 = Ephemeral water
5 = Deep inland water
6 = Moderate or continental ocean
7 = Deep ocean

2.3.2. Coast Mask

The coast mask is created from the land/water mask and differentiates coast at resolutions ranging from 1 – 10 km. It is produced by searching for heterogeneity in concentric boxes 3x3 (1 km) up to 21x21 (10 km) of pixels centered on any given pixel. Resolution: The coast mask is stored in a 1 km geographic (geodetic) equal area projection.
Filename: coast_mask_1km.nc
Origin: Created by SSEC/CIMSS based upon NASA MODIS collection 5.
Size: 890 MB.
Static/Dynamic: Static
Values: A value of 1 means that the pixel 1km away is a water/land transition or is a water/land transition. 0 is considered the fill value of the coast mask.
2.3.3. NWP Snow Mask

The NWP Snow Mask ancillary algorithm generates the Snow Mask from the following ancillary products: GFS NWP Data (section 2.3.10), Land Mask (section 2.3.1), and OISST Daily Data (section 2.3.11).

Note that the LST algorithm will switch to a snow cover mask ancillary dataset in a future update.

2.3.4. Calculated Desert Mask

The Calculated Desert Mask uses two ancillary products to generate the desert mask: Land Mask (section 2.3.1), and Surface Type (section 2.3.7). A value of 0 means no desert, 1 is wooden grass, closed shrubs, open shrubs, grasses, or cropland, and 2 is bare surface.

2.3.5. Surface Elevation Mask

The digital surface elevation is Global Land One-km Base Elevation (GLOBE) Project 1km database global file converted into a file format readable by the framework.

Resolution: The surface elevation is stored as meters in a Plate Carrée projection at 30 arc-second (1km) resolution.

Filename: GLOBE_1km_digelev.nc
Origin: NGDC
Size: 1843.2 MB
Static/Dynamic: Static

2.3.6. Climatic LST

The Climatic Land Surface Temperature (LST) product is monthly-averaged mean surface temperatures over the globe at 2.5 degree resolution. The data is from the International Satellite Cloud Climatology Project (ISCCP). Data is interpolated between two consecutive months to arrive at an average of the date of the satellite data. The temperature is in degrees K, and the twelve input NetCDF datasets are in the following format: climatic_lst_month_XX.nc, where XX is the two digit number of the month (01 to 12). Each file is 47 K in size.
2.3.7. Surface Emissivity SEEBOR

The surface IR emissivity for ABI bands from UW-Madison baseline fit database. This is a global database of monthly (001-031, 032-059, etc.) IR land surface emissivity derived from the Moderate Resolution Imaging Spectroradiometer (MODIS) operational land surface emissivity product (MOD11). Emissivity is available globally at ten wavelengths (3.6, 4.3, 5.0, 5.8, 7.6, 8.3, 9.3, 10.8, 12.1, and 14.3 μm). Monthly emissivities have been integrated into the ABI spectral response functions to match the ABI bands. The SEEBOR emissivity training set was interpolated over the spectral response function for a given channel at each data point. These are then output to a static file for usage in the framework. For the production of the test dataset, the ABI SRFs, provided by the Imagery AWG, were used to produce the static emissivity dataset.

Resolution: 0.05 degree (5km) spatial resolution
Filename: global_emiss_intABI_YYYYDDD.nc where, YYYYDDD = year plus Julian day
Origin: UW Baseline Fit, Seeman and Borbas (2006).
Size: 693 MB x 12
Static/Dynamic: Dynamic
Values: The emissivities are fractional values scaled with a scale factor of 0.001 and have fill value of -9999. Generally, the data points that are the fill value are ocean or water pixels.

Surface emissivity at 5km resolution (climatologically monthly), required by AIT Framework is listed in Table 2-1.

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
<th>Size (MB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>global_emiss_intABI_2005001.nc</td>
<td>SEEBOR data for January</td>
<td>693</td>
</tr>
<tr>
<td>global_emiss_intABI_2005032.nc</td>
<td>SEEBOR data for February</td>
<td>693</td>
</tr>
<tr>
<td>global_emiss_intABI_2005060.nc</td>
<td>SEEBOR data for March</td>
<td>693</td>
</tr>
<tr>
<td>global_emiss_intABI_2005091.nc</td>
<td>SEEBOR data for April</td>
<td>693</td>
</tr>
<tr>
<td>global_emiss_intABI_2005121.nc</td>
<td>SEEBOR data for May</td>
<td>693</td>
</tr>
<tr>
<td>global_emiss_intABI_2005152.nc</td>
<td>SEEBOR data for June</td>
<td>693</td>
</tr>
<tr>
<td>global_emiss_intABI_2005182.nc</td>
<td>SEEBOR data for July</td>
<td>693</td>
</tr>
<tr>
<td>global_emiss_intABI_2005213.nc</td>
<td>SEEBOR data for August</td>
<td>693</td>
</tr>
<tr>
<td>global_emiss_intABI_2005244.nc</td>
<td>SEEBOR data for September</td>
<td>693</td>
</tr>
<tr>
<td>global_emiss_intABI_2005274.nc</td>
<td>SEEBOR data for October</td>
<td>693</td>
</tr>
</tbody>
</table>
### 2.3.8. Surface Type Mask

A global land cover classification collection created by The University of Maryland Department of Geography. Imagery from the AVHRR satellites acquired between 1981 and 1994 was used to distinguish fourteen land cover classes and was updated in 2001. The original binary file is available at:

**Resolution:** This product is available at 1 km resolution in a 1 km geographic (geodetic) equal area projection.

The data are arranged with the upper left hand corner having a latitude/longitude of 90.0, -180.0 and lower right corner with a latitude/longitude of 90S, 180.0.

**Filename:** gl-latlong-1km-landcover.nc

**Origin:** University of Maryland

**Size:** 890 MB

**Static/Dynamic:** Static

**Values:**

- 0 = Water
- 1 = Evergreen Needleleaf Forest
- 2 = Evergreen Broadleaf Forest
- 3 = Deciduous Needleleaf Forest
- 4 = Deciduous Broadleaf Forest
- 5 = Mixed Forests
- 6 = Woodland
- 7 = Wooded Grassland
- 8 = Closed Shrubland
- 9 = Open Shrubland
- 10 = Grasslands
- 11 = Cropland
- 12 = Bare Ground
- 13 = Urban and Built-Up
2.3.9. CRTM Coefficients

CRTM coefficient files for VIIRS data, required by AIT Framework, are shown in Table 2-2. Note that the coefficient files are for CRTM v2.1.3, and not v2.0.2 which was previously used by the framework.

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
<th>Size (MB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AerosolCoeff.bin</td>
<td>Aerosol Coeff data for CRTM</td>
<td>5.5</td>
</tr>
<tr>
<td>CloudCoeff.bin</td>
<td>Cloud Coeff data for CRTM</td>
<td>1.6</td>
</tr>
<tr>
<td>EmisCoeff.bin</td>
<td>Emissivity Coeff data for CRTM</td>
<td>1.9</td>
</tr>
<tr>
<td>viirs-m_npp.SpcCoeff.bin</td>
<td>Space Coeff data for NPP VIIRS-M</td>
<td>472 Bytes</td>
</tr>
<tr>
<td>viirs-m_npp.TauCoeff.bin</td>
<td>Tau Coeff data for NPP VIIRS-M</td>
<td>104 KB</td>
</tr>
</tbody>
</table>

2.3.10. Ancillary Data for VIIRS SDR Reader

These two files contain NPP VIIRS 16 M-band and I-band channel information, Planck coefficients and spectral ranges. It is used by the framework SDR Data Readers.

File Name: npp_viirs_ancil.Ibands.nc
Size: 2240 KB

File Name: npp_viirs_ancil.Mbands.nc
Size: 2258 KB

Ancillary data contains information such as channel mapping.

File Name: npp_viirs_ancil.nc
2.3.11. NWP Data - GFS GRIB2 Forecast Files

These are GFS 6-hour global forecast data files at 0.5 degree resolution in GRIB2 format from NCEP.

File Name: gfs.t${Hour}z.pgrbf${Forecast}.YYYYMMDD
Size: 51~52 MB

2.3.12. Desert Mask

The desert mask uses the NASA 1km land mask and 1km surface type ancillary algorithms to calculate the desert mask. A value of ‘0’ denotes no desert, ‘1’ refers to wooden grass, closed shrubs, open shrubs, grasses, or croplands, and ‘2’ is desert. There are no external files associated specifically with this algorithm.

2.3.13. Surface Albedo Composite

The surface albedo (**not to be confused with the JPSS RR land surface albedo product***) provides a global estimate of the cloud-clear white sky reflectance from 2004 MODIS data. This product is used for the Clouds products. The albedo is an averaged value over a seventeen day period. There are three wavelengths, 0.659 um, 1.64 um, and 2.13 um.

Filenames:
AlbMap.WS.c004.v2.0.2004.DDD.0.659_x4.nc
AlbMap.WS.c004.v2.0.2004.DDD.1.64_x4.nc
AlbMap.WS.c004.v2.0.2004.DDD.2.13_x4.nc

Where DDD is the Julian day of the year, which ranges from 001 to 353 in increments of 17. There are a total of 66 files. Each file is 28 MB in size.

2.3.14. Pseudo Emissivity

The pseudo emissivity uses the Plank function to calculate the channel 7 emissivity. There are no external files associated with this algorithm.
2.3.15. OISST Daily Data

It is the Reynolds OISST daily analysis at 0.25 degree resolution from NCDC

File Name: avhrr-only-v2.YYYYMMDD_preliminary.nc
Size: 8.0 MB

2.3.16. Offline Land Surface Emissivity and Albedo

The offline land surface emissivity and albedo are not technically ancillary products, but are included here because they are used for the online LST and LSA products, respectively. More information for both offline products can be found in the JRR ARR (Algorithm Readiness Review) documentation (2018). Table 2-3 shows information about the output offline LSE and LSA products that are used by their online counterparts.

The LST EDR algorithm processing requires dynamic emissivity data. The daily offline LSE algorithm implementation produces high-resolution gridded global emissivity data using near real-time vegetation fraction and snow fraction data. The gridded LSE data is interpolated to VIIRS pixel level to be used in the retrieval of LST EDR processing. Offline LSE output is used as online LST EDR processing for the next day.

The VIIRS LSA EDR algorithm processing requires a dynamic global albedo map. This is achieved using the daily offline LSA algorithm implementation at NDE which produces the gridded temporal filtered global LSA tiles. The filtered LSA tiles are used in the retrieval of the improved LSA EDR product – VIIRS Albedo EDR. As the offline processing is very time consuming, filtered LSA tiles from 2 days ago are utilized in LSA EDR processing.

Table 2-3 - LSE and LSA Offline Output Products

<table>
<thead>
<tr>
<th>Interface Item</th>
<th>Notes</th>
<th>Format</th>
<th>Source</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIIRS gridded Land Surface Emissivity (LSE)</td>
<td>4 variables, each of grid (xsize=40000, ysize=20000)</td>
<td>NetCDF4</td>
<td>VLPS</td>
<td>VIIRS LSE offline product file containing (8 – 13.5 um) broadband emissivity, M15, M16 emissivities, and quality flag S-NPP.VIIRS.LSE.yyyymmdd.v2p1.nc</td>
</tr>
</tbody>
</table>
Filtered LSA Tiles  | ~2400 files per day  | NetCDF4  | NDE  | Filtered LSA Tiles for (day+2) LSA processing

where yyyy is the year and jjj is the Julian date.

3. PERFORMANCE

3.1. Product Testing

3.1.1. Test Data

Description of all JPSS RR test data (input, output, and intermediate) used in unit and system tests is provided in the JPSS RR Algorithm Readiness Review and Test Readiness Document (NESDIS/STAR, 2015). These are available by contacting the JPSS RR Product Area Lead (PAL) at OSPO.

3.1.2. Test Plans

Description of all JPSS RR test plans used in unit and system tests is provided in the JPSS RR Algorithm Readiness Review and Test Readiness Document (NESDIS/STAR, 2014). These are available by contacting the JPSS RR Product Area Lead (PAL) at OSPO.

3.2. Product Accuracy

3.2.1. Test Results

Description of all JPSS RR test results from the unit and system tests is provided in the JPSS RR Algorithm Readiness Review and Test Readiness Document (NESDIS/STAR 2014). These are available by contacting the JPSS RR Product Area Lead (PAL) at OSPO.

3.2.2. Product Accuracy

JPSS RR products have been validated against observations. The accuracy and precision of the JPSS RR products fall well within the accuracy and precision specifications. The detailed validations are available at Algorithm Readiness Review by contacting the JPSS RR Product Area Lead (PAL) at OSPO.
3.3. Product Quality

Quality flags are expected to be zero, which means no error. Each failure is associated with a unique “flag” value that is saved in the JPSS RR output files. These values are shown in Table 3-1 to Table 3-15 for the algorithms.

Table 3-1: Cloud Mask Failure Codes.

<table>
<thead>
<tr>
<th>QC_Flag</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Good</td>
</tr>
<tr>
<td>1</td>
<td>Invalid pixel due to space view</td>
</tr>
<tr>
<td>2</td>
<td>Invalid pixel due to being outside of sensor zenith range</td>
</tr>
<tr>
<td>3</td>
<td>Invalid earth pixel due to bad data (bad or missing 11mm BT or bad/missing clear sky 11 mm BT)</td>
</tr>
<tr>
<td>4</td>
<td>Reduced quality Cloud mask (bad 3.9mm pixel)</td>
</tr>
<tr>
<td>5</td>
<td>Reduced quality 0.64mm tests</td>
</tr>
<tr>
<td>6</td>
<td>Reduced quality due to other bad channels (excluding 0.64, 3.9, or 11 mm)</td>
</tr>
</tbody>
</table>

Table 3-2: Cloud Phase/Type Quality Flags

<table>
<thead>
<tr>
<th>Bit</th>
<th>Definition</th>
<th>Bit Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Overall cloud phase product quality flag – the overall quality will be set to “low quality” if any of the more specific quality flags listed below are set to “low quality”</td>
<td>0 = high quality 1 = low quality</td>
</tr>
<tr>
<td>2</td>
<td>L1b quality flag – this will be set to “low quality” if any of the spectral data used in the algorithms is of low quality, based on L1b calibration flags</td>
<td>0 = high quality spectral data 1 = low quality spectral data</td>
</tr>
<tr>
<td>3</td>
<td>Beta quality flag – this will be set to “low quality” if $\beta_{\text{stropo}}(12/11\mu m)$, $\beta_{\text{sopaque}}(12/11\mu m)$, $\beta_{\text{stropo}}(8.5/11\mu m)$, or $\beta_{\text{sopaque}}(8.5/11\mu m)$ fall outside of the 0.1 – 10.0 range</td>
<td>0 = high quality beta calculation 1 = low quality beta calculation</td>
</tr>
</tbody>
</table>
Ice cloud quality flag – this will be set to “low quality” if the cloud phase was determined to be ice and the $\varepsilon_{\text{stropo}}(11\,\mu m) < 0.05$

Surface emissivity quality flag – this will be set to “low quality” if the result of the Low Surface Emissivity (LSE) Test is TRUE and the result of the Overall Opaque Cloud (OOC) Test is FALSE

Satellite zenith angle quality flag – this will be set to “low quality” if the cosine of the satellite zenith angle is less than 0.15 (~82 degrees)

### Table 3-3: Cloud Height Failure Codes

<table>
<thead>
<tr>
<th>QC_Flag</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Good</td>
</tr>
<tr>
<td>1</td>
<td>Invalid pixel due to space view</td>
</tr>
<tr>
<td>2</td>
<td>Invalid pixel due to being outside of sensor zenith range</td>
</tr>
<tr>
<td>3</td>
<td>Invalid earth pixel due to bad data (bad or missing 11mm BT or bad/missing clear sky 11 mm BT)</td>
</tr>
<tr>
<td>4</td>
<td>Invalid due to cloud mask being clear or probably clear</td>
</tr>
<tr>
<td>5</td>
<td>Invalid due to missing cloud type</td>
</tr>
<tr>
<td>6</td>
<td>Failed retrieval</td>
</tr>
</tbody>
</table>

### Table 3-4: DCOMP Quality Flag Specification

| Aerosol Quality Control Codes |
### Table 3-5: DCOMP Failure Codes

<table>
<thead>
<tr>
<th>Quality Flag Name</th>
<th>Bit</th>
<th>F&lt;sub&gt;1&lt;/sub&gt;</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCOMP_PRC_S_FLAG</td>
<td>0</td>
<td>1</td>
<td>0 - not processed; - processed</td>
</tr>
<tr>
<td>DCOMP_QF_COD_VALID</td>
<td>1</td>
<td>2</td>
<td>0 – valid retrieval; 1 – not valid</td>
</tr>
<tr>
<td>DCOMP_QF_REF_VALID</td>
<td>2</td>
<td>4</td>
<td>0 – valid retrieval; 1 – not valid</td>
</tr>
<tr>
<td>DCOMP_QF_COD_DEGRADED</td>
<td>3</td>
<td>8</td>
<td>0 – no; 1 - degraded</td>
</tr>
<tr>
<td>DCOMP_QF_REF_DEGRADED</td>
<td>4</td>
<td>16</td>
<td>0 – no; 1 - degraded</td>
</tr>
<tr>
<td>DCOMP_QF_CONVERGENCY</td>
<td>5</td>
<td>32</td>
<td>0 – convergent; 1 - not</td>
</tr>
<tr>
<td>DCOMP_QF_GLINT</td>
<td>6</td>
<td>64</td>
<td>0 – no glint; 1 - glint</td>
</tr>
</tbody>
</table>

### Table 3-6: Cloud Phase/Type Quality Flags

<table>
<thead>
<tr>
<th>NCOMP Control Codes</th>
<th>Bit</th>
<th>Quality Flag Name</th>
<th>Cause and effect</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Angle restriction flags</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>QC_CYCLE_VZA</td>
<td>Viewing Zenith Angle &gt;= 72.0</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>QC_CYCLE</td>
<td>Solar Zenith Angle &lt; 82.0</td>
<td></td>
</tr>
<tr>
<td><strong>Ancillary Data Flags</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>QC_CYCLE_NO_CLOUD</td>
<td>Cloud Type indicates it is not a cloud</td>
<td></td>
</tr>
</tbody>
</table>
4 QC_CYCLE_CLOUDTYPE Cloud Type has an unknown value
5 QC_CYCLE_TCLOUD Cloud Temperature is < 0.0

No Retrieval Flags
6 QC_MINERR_WATER_0 No retrieval: Minimum error model for water = 0
7 QC_MINERR_ICE_0 No retrieval: Minimum error model for ice = 0

Valid Retrieval Flags
8 QC_TWILIGHT_ 82.0 <= Solar Zenith Angle < 90.0
9 QC_CTWATER_NCOMPICE Cloud Type = water, NCOMP preferred phase = ice
10 QC_CTICE_NCOMPWATER Cloud Type = ice, NCOMP preferred phase = water
11 QC_CTMIX_NCOMPWATER Cloud Type = mixed, NCOMP preferred phase = water
12 QC_CTMIX_NCOMPICE Cloud Type = mixed, NCOMP preferred phase = ice
13 QC_NCOMPWATER Cloud Type = supercooled, NCOMP preferred phase = water
14 QC_NCOMPICE Cloud Type = supercooled, NCOMP preferred phase = ice

Table 3-7: Cloud Base Quality Flag

<table>
<thead>
<tr>
<th>Cloud Base Quality Control Codes</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>QC_Flag</td>
<td>Definition</td>
</tr>
<tr>
<td>0</td>
<td>Valid retrieval</td>
</tr>
<tr>
<td>1</td>
<td>Invalid due to the upstream input being invalid or clear</td>
</tr>
<tr>
<td>2</td>
<td>Out of range due to CBH lower than terrain (set to TBH = terrain)</td>
</tr>
<tr>
<td>3</td>
<td>Out of range due to CBH &lt; minCBH (0 km) or CBH &gt; maxCBH (20 km)</td>
</tr>
<tr>
<td>4</td>
<td>Invalid due to CBH &gt;= CTH</td>
</tr>
</tbody>
</table>
### Table 3-8: Aerosol Detection Failure Codes

<table>
<thead>
<tr>
<th>Byte/Bit</th>
<th>Quality flag name</th>
<th>1bit: 0 (default)</th>
<th>2bit: 00 (default)</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>QC_SMoke_DETECTION</td>
<td>0 (default)</td>
<td>01</td>
<td>Determined (good)</td>
</tr>
<tr>
<td>1</td>
<td>QC_Dust_DETECTION</td>
<td>1 (default)</td>
<td>11</td>
<td>not Determined (bad)</td>
</tr>
<tr>
<td>2-3</td>
<td>QC_SMoke_CONFIDENCE</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>4-5</td>
<td>QC_Dust_CONFIDENCE</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>6</td>
<td>SPARE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>SPARE</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 3-9: Aerosol Quality Flags

<table>
<thead>
<tr>
<th>Quality Flag Name</th>
<th>Variable Type</th>
<th>Value</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>QC_EXT_SNOW</td>
<td>LONG</td>
<td>2</td>
<td>External input mask for snow</td>
</tr>
<tr>
<td>QC_EXT_SHADOW</td>
<td>LONG</td>
<td>3</td>
<td>External input mask for cloud shadow</td>
</tr>
<tr>
<td>QC_EXT_FIRE</td>
<td>LONG</td>
<td>4</td>
<td>External input mask for fire</td>
</tr>
<tr>
<td>QC_EXT_Glint</td>
<td>LONG</td>
<td>5</td>
<td>External input mask for the glint angle</td>
</tr>
<tr>
<td>QC_EXT_HYyaER</td>
<td>LONG</td>
<td>6</td>
<td>External input mask for heavy aerosols</td>
</tr>
<tr>
<td>QC_INPUT_LOC</td>
<td>LONG</td>
<td>0</td>
<td>Input mask for loc</td>
</tr>
<tr>
<td>QC_INPUT_Geo</td>
<td>LONG</td>
<td>1</td>
<td>Input mask for geo</td>
</tr>
<tr>
<td>QC_INPUT_ANC</td>
<td>LONG</td>
<td>2</td>
<td>Input mask for ancillary</td>
</tr>
<tr>
<td>QC_INPUT_REF</td>
<td>LONG</td>
<td>3</td>
<td>Input mask for reference</td>
</tr>
<tr>
<td>QC_CLOUDY</td>
<td>LONG</td>
<td>0</td>
<td>Cloud – fail reflectance test</td>
</tr>
<tr>
<td>QC_CIRRUS</td>
<td>LONG</td>
<td>1</td>
<td>Cirrus test</td>
</tr>
<tr>
<td>QC_THIN_CIRRUS</td>
<td>LONG</td>
<td>2</td>
<td>Thin cirrus test</td>
</tr>
<tr>
<td>QC_INHOMO</td>
<td>LONG</td>
<td>3</td>
<td>Spatially inhomogeneous test</td>
</tr>
<tr>
<td>QC_SNOWICE</td>
<td>LONG</td>
<td>4</td>
<td>Snow/ice test</td>
</tr>
<tr>
<td>QC_EPHEMERAL_WATER</td>
<td>LONG 5</td>
<td>Over land only test</td>
<td></td>
</tr>
<tr>
<td>QC_SHALLOW_WATER</td>
<td>LONG 6</td>
<td>Over water only test</td>
<td></td>
</tr>
<tr>
<td>QC_HVYEAR</td>
<td>LONG 7</td>
<td>Heavy aerosols test</td>
<td></td>
</tr>
<tr>
<td>QC_RET_WATER</td>
<td>LONG 0</td>
<td>Retrieval water path</td>
<td></td>
</tr>
<tr>
<td>QC_OVER_BRIGHT_LAND</td>
<td>LONG 1</td>
<td>Retrieval path over bright land</td>
<td></td>
</tr>
<tr>
<td>QC_OVER_GLINT_WATER</td>
<td>LONG 2</td>
<td>Retrieval path over glint water</td>
<td></td>
</tr>
<tr>
<td>QC_LAND_SW</td>
<td>LONG 3</td>
<td>Retrieval path over short-wave land</td>
<td></td>
</tr>
<tr>
<td>QC_LAND_SWIR</td>
<td>LONG 4</td>
<td>Retrieval path over land short-wave IR</td>
<td></td>
</tr>
<tr>
<td>QC_LAND_BRT</td>
<td>LONG 5</td>
<td>Retrieval path over land brightness temp</td>
<td></td>
</tr>
<tr>
<td>QC_FAILED</td>
<td>LONG 0</td>
<td>Failed retrieval</td>
<td></td>
</tr>
<tr>
<td>QC_LOWSUN</td>
<td>LONG 1</td>
<td>Low sun angle retrieval</td>
<td></td>
</tr>
<tr>
<td>QC_DARK_BARREN</td>
<td>LONG 2</td>
<td>Dark barren land retrieval</td>
<td></td>
</tr>
<tr>
<td>QC_EXTRP</td>
<td>LONG 3</td>
<td>Extrapolation retrieval</td>
<td></td>
</tr>
<tr>
<td>QC_RESIDUAL</td>
<td>LONG 4</td>
<td>Residual retrieval</td>
<td></td>
</tr>
<tr>
<td>QC_NDVI</td>
<td>LONG 5</td>
<td>NDVI retrieval</td>
<td></td>
</tr>
<tr>
<td>QC_REDR</td>
<td>LONG 6</td>
<td>REDR retrieval</td>
<td></td>
</tr>
<tr>
<td>QC_ADJ</td>
<td>LONG 7</td>
<td>ADJ retrieval</td>
<td></td>
</tr>
<tr>
<td>QC_HIGH</td>
<td>LONG 0</td>
<td>Overall quality high</td>
<td></td>
</tr>
<tr>
<td>QC_MEDIUM</td>
<td>LONG 1</td>
<td>Overall quality medium</td>
<td></td>
</tr>
<tr>
<td>QC_LOW</td>
<td>LONG 2</td>
<td>Overall quality low</td>
<td></td>
</tr>
<tr>
<td>QC_NORET</td>
<td>LONG 3</td>
<td>Overall quality no return</td>
<td></td>
</tr>
</tbody>
</table>

**Table 3-10: Aerosol Optical Depth Failure Codes**

<table>
<thead>
<tr>
<th>Aerosol Optical Depth Quality Control Codes</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input Geometry Quality Flag</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Byte</td>
<td>Bits</td>
<td>Quality Flag Name</td>
</tr>
<tr>
<td>------</td>
<td>------</td>
<td>-------------------</td>
</tr>
<tr>
<td>0</td>
<td>QC_INPUT_LON</td>
<td>0: valid longitude (-180 - 180°)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1: out-of-range longitude</td>
</tr>
<tr>
<td>1</td>
<td>QC_INPUT_LAT</td>
<td>0: valid latitude (-90 - 90°)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1: out-of-range latitude</td>
</tr>
<tr>
<td>2</td>
<td>QC_INPUT_ELEV</td>
<td>0: valid elevation (-2 – 10 km)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1: out-of-range elevation</td>
</tr>
<tr>
<td>3</td>
<td>QC_INPUT_SOLZEN</td>
<td>0: valid solar zenith (0 - 90°)&lt;br&gt;1: out-of-range solar zenith</td>
</tr>
<tr>
<td>4</td>
<td>QC_INPUT_SATZEN</td>
<td>0: valid satellite zenith (0 - 90°)&lt;br&gt;1: out-of-range satellite zenith</td>
</tr>
<tr>
<td>5</td>
<td>QC_INPUT_SOLAZI</td>
<td>0: valid solar azimuth (0 - 180°)&lt;br&gt;1: out-of-range solar azimuth</td>
</tr>
<tr>
<td>6</td>
<td>QC_INPUT_SATAZI</td>
<td>0: valid satellite azimuth (0 - 180°)&lt;br&gt;1: out-of-range satellite azimuth</td>
</tr>
</tbody>
</table>

2: Input Ancillary Data Flag

| 0 | QC_INPUT_TPW | 00: constant TPW data (2.0 cm)<br>01: valid TPW data from ABI retrieval (0-20 cm)<br>10: valid TPW data from model (0-20 cm) |
| 1 | QC_INPUT_OZONE | 00: constant ozone data (0.35 atm-cm)<br>01: valid ozone data from ABI retrieval (0.0 – 0.7 atm-cm)<br>10: valid ozone data from model (0.0 – 0.7 atm-cm) |
| 2 | QC_INPUT_PRES | 0: valid model surface pressure (500 – 1500 mb)<br>1: constant surface pressure (1013 mb) |
| 3 | QC_INPUT_HGT | 0: valid model surface height (-2 – 10 km)<br>1: constant surface height (0 km) |
| 4 | QC_INPUT_WSP | 0: valid model surface wind speed (0 – 100 m/s)<br>1: constant surface wind speed (6 m/s) |
| 5 | QC_INPUT_WDR | 0: model surface wind direction (0° – 360°)<br>1: fixed surface wind direction (90°) |

3: Input Reflectance Data Flag

| 0 | QC_INPUT_REFL_CH1 | 0: valid ABI reflectance in band 1 (0 – 1)<br>1: out-of-range ABI reflectance in band 1 |
| 1 | QC_INPUT_REFL_CH2 | 0: valid ABI reflectance in band 2 (0 – 1)<br>1: out-of-range ABI reflectance in band 2 |
| 2 | QC_INPUT_REFL_CH3 | 0: valid ABI reflectance in band 3 (0 – 1)<br>1: out-of-range ABI reflectance in band 3 |
| 3 | QC_INPUT_REFL_CH5 | 0: valid ABI reflectance in band 5 (0 – 1)<br>1: out-of-range ABI reflectance in band 5 |
| 4 | QC_INPUT_REFL_CH6 | 0: valid ABI reflectance in band 6 (0 – 1)<br>1: out-of-range ABI reflectance in band 6 |

4: Critical Path Flag

| 0 | QC_CLOUD_MASK | 0: clear sky<br>1: cloudy sky |
| 1 | QC_RET_SCENE | 0: over-land algorithm is used<br>1: over-water algorithm is used |
| 2 | QC_LAND_TYPE | 0: vegetation<br>1: soil |
| 3 | QC_LAND_BRISFC | 0: dark surface<br>1: bright surface |
| 4 | QC_LAND_SNOW | 0: no snow contamination<br>1: with snow contamination |
| 5 | QC__WATER_GLINT | 0: no sunglint contamination<br>1: with sunglint contamination |

5: AOD Product

| 0 | QC_RET | 0: AOD is retrieved<br>1: AOD is not retrieved |
| 1 | QC_RET_EXTRP | 0: interpolation within LUT AOD range |
Table 3-11: Volcanic Ash Detection Quality Flags

<table>
<thead>
<tr>
<th>Byte</th>
<th>Bit</th>
<th>Name</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Overall QF</td>
<td>0 – High Quality</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 – Low Quality</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>Invalid Data QF</td>
<td>0 – High Quality</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 – Low Quality</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>Local Zenith Angle QF</td>
<td>0 – High Quality</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 – Low Quality</td>
</tr>
<tr>
<td>1</td>
<td>4-6</td>
<td>Ash Single Layer Confidence QF</td>
<td>0 – High</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 – Moderate</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 – Low</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3 – Very Low</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4 – Not-Ash</td>
</tr>
<tr>
<td>1</td>
<td>7-8</td>
<td>Spare</td>
<td>n/a</td>
</tr>
<tr>
<td>2</td>
<td>1-3</td>
<td>Ash Multi Layer Confidence QF</td>
<td>0 – High</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 – Moderate</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 – Low</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3 – Very Low</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4 – Not-Ash</td>
</tr>
</tbody>
</table>

Table 3-12: Volcanic Ash Retrieval Quality Flags

<table>
<thead>
<tr>
<th>Byte</th>
<th>Bit</th>
<th>Name</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1-2</td>
<td>Retrieval Status</td>
<td>0 - Successful</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 - Failed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 - Not Attempted</td>
</tr>
<tr>
<td>1</td>
<td>3-4</td>
<td>T_{dd} QF</td>
<td>0 – High Quality</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 – Medium Quality</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 – Low Quality</td>
</tr>
<tr>
<td>1</td>
<td>5-6</td>
<td>ε_{dd} QF</td>
<td>0 – High Quality</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 – Medium Quality</td>
</tr>
</tbody>
</table>
Table 3-13: Snow Cover Retrieval Quality Flags

<table>
<thead>
<tr>
<th>Bit</th>
<th>Name</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>no-data value in band data</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>missing data in band data</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>modeled cloudy</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>water</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>solar zenith angle less than 0 or greater than MAX_SOLAR_ZENITH_ANGLE</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>sensor zenith angle less than 0.0 or greater than MAX_SENSOR_ZENITH_ANGLE</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>bad metadata or ancillary data</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</table>

Table 3-14: Ice Concentration Retrieval Quality Flags

<table>
<thead>
<tr>
<th>Ice Concentration Retrieval Quality Control Codes</th>
<th>Quality Flag Name</th>
<th>Variable Type</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>QC_Flags</td>
<td>LONG</td>
<td>Quality Control Flags</td>
<td></td>
</tr>
<tr>
<td>Tot_QACat01</td>
<td>LONG</td>
<td>Total number of pixels with QA category 1</td>
<td></td>
</tr>
</tbody>
</table>
### Table 3-15: Ice Thickness And Age Retrieval Quality Flags

<table>
<thead>
<tr>
<th>Quality Flag Name</th>
<th>Variable Type</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>QC_Flags</td>
<td>LONG</td>
<td>Quality Control Flags</td>
</tr>
<tr>
<td>Tot_QACat01</td>
<td>LONG</td>
<td>Total number of pixels with QA category 1 (Normal or optimal)</td>
</tr>
<tr>
<td>Tot_QACat02</td>
<td>LONG</td>
<td>Total number of pixels with QA category 2 (Uncertain or suboptimal)</td>
</tr>
<tr>
<td>Tot_QACat03</td>
<td>LONG</td>
<td>Total number of pixels with QA category 3 (Non-retrievable)</td>
</tr>
<tr>
<td>Tot_QACat04</td>
<td>LONG</td>
<td>Total number of pixels with QA category 4 (Bad data)</td>
</tr>
</tbody>
</table>

### Table 3-16 - VIIRS LST Quality Flags

<table>
<thead>
<tr>
<th>LST Algorithm Quality Flags (2 bytes)</th>
<th>bit</th>
<th>Flag</th>
<th>Source</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0-1</td>
<td>LST quality</td>
<td>LST</td>
<td>00=high, 01=medium, 10=low, 11=no retrieval</td>
</tr>
<tr>
<td></td>
<td>2-3</td>
<td>Cloud condition</td>
<td>Cloud mask</td>
<td>00=confidently clear, 01=probably clear, 10=probably cloudy, 11=confidently cloudy</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>SDR quality</td>
<td>SDR</td>
<td>0=normal, 1=bad data (bad quality or missing or out of space)</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Aerosol optical thickness at 550nm (slant path)</td>
<td>AOD</td>
<td>0=within range (AOD&lt;=1.0), 1=outside range (AOD&gt;1.0)</td>
</tr>
<tr>
<td>byte</td>
<td>bit</td>
<td>Flag description</td>
<td>Meaning</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-----</td>
<td>---------------------------------------</td>
<td>----------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0-1</td>
<td>Overall quality of product</td>
<td>00=high quality retrieval, 01=retrieval, 10=no retrieval</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2-3</td>
<td>Cloud condition</td>
<td>00=confidently clear, 01=probably clear, 10=probably cloudy, 11=confidently cloudy</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>SDR quality</td>
<td>0=normal, 1=bad data (VIIRS bad, missing, or not calibrated) (GOES bad, missing, or out of space)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Solar zenith angle flag</td>
<td>0=favorable SZA, 1=SZA larger than 60 deg</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>View zenith angle flag</td>
<td>0=favorable VZA, 1=VZA larger than 60 deg</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>Spare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0-2</td>
<td>Retrieval path</td>
<td>000=generic, 001=desert, 010=snow, 011=sea ice, 100=no retrieval</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 3-17 - VIIRS LSA Quality Flags (2 bytes)**
<table>
<thead>
<tr>
<th>3-4</th>
<th>Temporal filter quality flag</th>
<th>00=high-quality retrieval, 01=degraded retrieval, 10=no retrieval</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Online filter flag</td>
<td>0=non filtered, 1=filtered</td>
</tr>
<tr>
<td>6-7</td>
<td>Spare</td>
<td></td>
</tr>
</tbody>
</table>

No external product tools are supplied. External users can choose their own tools to display and analyze these output files.

4. PRODUCT STATUS

4.1. Operations Documentation

NESDIS/STAR (2018), Enterprise Land Surface Emissivity Algorithm Theoretical Basis Document (ATBD)

NESDIS/STAR (2018), VIIRS NDE Surface Albedo Algorithm Theoretical Basis Document (ATBD)


NESDIS/STAR (2018), JPSS Risk Reduction: Uniform Multi-Sensor Land Surface Temperature and Surface Albedo for Consistent Products Algorithm Readiness Review (ARR)

NESDIS/STAR (2017), JPSS Risk Reduction: Uniform Multi-Sensor Land Surface Temperature and Surface Albedo for Consistent Products Unit Test Readiness Review (UTRR)

NESDIS/STAR (2013), JPSS VIIRS Land Surface Temperature Algorithm Theoretical Basis Document (ATBD)

NESDIS/STAR (2014), JPSS VIIRS Surface Albedo Algorithm Theoretical Basis Document (ATBD)
NESDIS/STAR (2017), AWG Cloud Base Algorithm (ACBA), Algorithm Theoretical Basis Document


NESDIS/STAR (2014), JPSS Risk Reduction: Uniform Multi-Sensor Cryosphere Algorithms for Consistent Products Unit Test Readiness Review


NESDIS/STAR (2012), JPSS Risk Reduction: Requirements Allocation Document


NDE (2013), Standards for Algorithm Delivery and Integration Using Delivered Algorithm Packages (DAPs), Version 1.4


NPOESS(2009), NPOESS Common Data Format Control Book, Version D.

### 4.2. Maintenance History

### 5. APPENDIX A: Algorithm Status

#### Table 5-1 – JPSS RR Algorithm Status

NOTE: the following chart is out-of-date.

<table>
<thead>
<tr>
<th>JPSS RR Algorithms</th>
<th>Algorithm Code is integrated in Framework?</th>
<th>Algorithm is hooked up w. Bayesian CM and bit flags?</th>
<th>NDE Metadata is added?</th>
<th>Ready to run in NRT?</th>
<th>Integrator</th>
<th>Has been set up in NR run*? (by Hua)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cloud Mask</td>
<td>Yes</td>
<td>N/A</td>
<td>Yes</td>
<td>Yes</td>
<td>Roy</td>
<td>Yes</td>
</tr>
<tr>
<td>Cloud Phase</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Roy</td>
<td>Yes</td>
</tr>
<tr>
<td>Cloud Height</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Roy</td>
<td>Yes</td>
</tr>
<tr>
<td>NCOMP</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Roy</td>
<td>Yes</td>
</tr>
<tr>
<td>DCOMP</td>
<td>Yes</td>
<td>N/A</td>
<td>Yes</td>
<td>Yes</td>
<td>Mike</td>
<td>Yes</td>
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<tr>
<td>AOD</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Roy</td>
<td>Yes</td>
</tr>
<tr>
<td>ADP</td>
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<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Tianxu</td>
<td>No</td>
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<tr>
<td>VolAsh</td>
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<td>Yes</td>
<td>Yes</td>
<td>Mike</td>
<td>No</td>
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<td>Ice Concentration</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Alex/Aiwu</td>
<td>Yes</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Alex/Aiwu</td>
<td>Yes</td>
</tr>
<tr>
<td>SnowCover/Fraction</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Alex</td>
<td>No</td>
</tr>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Alex</td>
<td>No</td>
</tr>
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</table>
END OF DOCUMENT