# Office of Satellite and Product Operations
# Environmental Satellite Processing Center


# JPSS Risk Reduction Land Surface Albedo System Maintenance Manual

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**U.S. Department of Commerce**
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**Office of Satellite and Product Operations**

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# Approval Page

## Environmental Satellite Processing Center

## JPSS Risk Reduction Land Surface Albedo System Maintenance Manual

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# Changes/Revisions Record

This system maintenance manual is changed as required to reflect system, operational, or organizational changes. Modifications made to this document are recorded in the Changes/Revisions Record below. This record will be maintained throughout the life of the document.

| Version Number | Date | Description of Change/Revision | Section/Pages Affected | Changes Made by Name/Title/ Organization |
|---|---|---|---|---|
| 1.0 | 01/2023 | Original Version | All | Lindeman |
| 1.1 | 09/2024 | Updated to reflect recent changes in software | All | Hardy |
| 1.2 | 11/2024 | Updated for NCCF; Added links to NCCF SMM; Added links to Product monitoring and visualization; Added data flow diagrams | All; 1.3, 2.1, 2.2, 4.2.2, 4.2.3, 4.4.1, 5.2-5.3, 6.1-6.3; 5.1.1; 7.1 | Augenbaum |
| 1.3 | 11/07/2024 | Transfer contents to latest template, perform minor copyediting and formatting | All | Hannah Bowie, Technical Writer, ERT |
| 1.3 | 11/07/2024 | Quality Assurance | All | Clint Sherwood, Quality Assurance Manager, ERT |

# Preface

This document comprises the National Oceanic and Atmospheric Administration (NOAA) National Environmental Satellite, Data, and Information Service (NESDIS), Office of Satellite and Product Operations (OSPO), publication of this JPSS Risk Reduction (JRR) Land Surface Albedo (LSA) System Maintenance Manual (SMM). This document reflects current operations for the DOC/NOAA/NESDIS Environmental Satellite Processing Center (ESPC) (NOAA5045) information technology systems. This document describes the established ESPC procedures for JRR LSA system maintenance in accordance with Federal, DOC, NOAA, NESDIS and OSPO requirements.

Future updates and revisions to this document will be produced and controlled by DOC/NOAA/NESDIS for ESPC information technology systems.

The published version of this document can be found at the OSPO SharePoint Products Library.

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# Executive Summary

This is a System Maintenance Manual (SMM) document describing the JPSS Risk Reduction (JRR) Land Surface Albedo (LSA) processing system, which includes the primary clear albedo and improved albedo products. These products are included in a single NetCDF output file for the LSA algorithm. These algorithms are part of the Joint Polar Satellite System (JPSS) Risk Reduction (RR) system. In this document, 'JPSS RR' is often referred to as 'JRR'.

The Land Surface Albedo system was designed to run within the NESDIS Cloud Common Framework (NCCF) production environment. All of the output product files will be archived at National Centers for Environmental Information (NCEI).

The processing requirement for LSA products is for them to be made available to users (e.g. on the distribution server) within 3 hours (maximum 6 hours) of observation.

The LSA Development product team consists of members from Office of Common Services (OCS) and Center for Satellite Applications and Research (STAR). The roles and contact information for the different product team members are identified in Table 0-1.

**Table 0-1 - Product Team Members**

| Team Member | Organization | Role | Contact Information |
|---|---|---|---|
| Walter Wolf | OCS | OCS Product Management Division Chief | walter.wolf@noaa.gov |
| Yunyue (Bob) Yu | OCS | Science Team Lead | yunyue.yu@noaa.gov |
| Jingjing Peng | OCS | Science Team | jingjing.peng@noaa.gov |
| Hanjun Ding | OSPO | OSPO PAL | hanjun.ding@noaa.gov |
| Shuang Qiu | OSPO | OSPO PAL | shuang.qiu@noaa.gov |
| Changyi Tan | OSPO | OSPO PAL | changyi.tan@noaa.gov |
| Jena Kent | OCS | PPM | yunhui.zhao@noaa.gov |
| Jen (Jianbin) Yang | OCS | PIB | jianbing.yang@noaa.gov |
| Priyanka Roy | OCS | ASSISTT Management Team | priyanka.roy@noaa.gov |
| Michael Walters | OCS | ASSISTT Regression Testing | michael.walters@noaa.gov |
| Michael Butler | OCS | ASSISTT Framework Integration Team Lead(s) | michael.butler@noaa.gov |
| Yuxiang He | OCS | ASSISTT Framework Integration Team | luke.he@noaa.gov |
| Tianxu Yu | OCS | ASSISTT Framework Integration Team | tianxu.yu@noaa.gov |
| Yunhui Zhao | OCS | ASSISTT Configuration Management Team Lead | yunhui.zhao@noaa.gov |
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| Eric Buzan | OCS | ASSISTT R2O Team | eric.buzan@noaa.gov |
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| Brandon Laufer | OCS | ASSISTT R2O Team | brandon.laufer@noaa.gov |
| Mark Hardy | OCS | ASSISTT Technical Writer | mark.hardy@noaa.gov |
| Tracey Dorian | OCS | ASSISTT Lifecycle QA Team Lead | tracey.dorian@noaa.gov |
| Mingming Yao | OCS | ASSISTT Lifecycle QA Team | mingming.yao@noaa.gov |

| Team Member | Organization | Role | Contact Information |
|---|---|---|---|
| Hua Xie | OCS | ASSISTT Science QA Team Lead | hua.xie@noaa.gov |

The low-level code within the Land Surface Albedo processing system is written in Fortran 90 and C++. This low-level code performs all data processing, scientific computation, reading/writing, reformatting, and opening/closing of files. All high-level code within the LSA processing system is written in Python. The high-level code performs tasks such as file management, system management, making system calls, and error trapping from the lower-level processing. The driver script will manage the software and call any necessary unit scripts. The system consists of only one unit that handles all of the LSA processing. This unit will, therefore, produce all expected output product files.

Details about the Land Surface Albedo algorithm can be found in its VIIRS LSA Algorithm Theoretical Basis Document (ATBD).

The NESDIS' Policy on Access and Distribution of Environmental Data and Products is provided at: http://www.ospo.noaa.gov/Organization/About/access.html.

The JRR Land Surface Albedo products will be used as a risk reduction assessment for a cost- effective implementation of common NESDIS algorithms for the JRR system. The OCS Algorithm Scientific Software Integration and System Transition Team (ASSISTT), integration, and python development teams have prepared for its implementation into the NESDIS Cloud Common Framework (NCCF). LSA is run operationally by Office of Satellite and Product Operations (OSPO) on NCCF for JPSS satellites. The output products are intended for operational and scientific users. Table 0-2 provides information about the algorithms and products.

**Table 0-2 - JRR LSA Algorithms and Products**

| Product Category | Algorithm | Product |
|---|---|---|
| JRR Land Surface Products | Land Surface Albedo | • Primary Clear Albedo<br>• Improved Albedo |

# 1. Introduction

## 1.1. Product Overview

LSA is defined as the ratio between outgoing and incoming irradiance at the earth's surface, which is a key component of surface energy budget. The VIIRS LSA product applies a two-step approach to produce a new daily granule and gap-filled product based on VIIRS data, which is implemented here. This LSA product is a granule-based product, containing albedo parameters over land and sea-ice surfaces. A direct estimation algorithm was developed to estimate daily mean blue-sky albedo from clear-sky VIIRS observations over land pixels. The direct estimation algorithm uses Top of Atmosphere (TOA) spectral reflectance data [known as VIIRS Sensor Data Record (SDR)] of nine VIIRS bands (M1, M2, M3, M4, M5, M7, M8, M10, and M11) as major inputs. A VIIRS cloud mask Intermediate Product (IP) helps to exclude cloudy-sky pixels. Land cover data, VIIRS ice concentration EDR, and snow mask EDR are used to determine the LUT type deployed on each pixel. There are four land type specified LUTs included in the algorithm: General, Desert, Snow, and Sea-ice. The VIIRS albedo granule data have been validated using field measurements. The accuracy is comparable to existing satellite albedo products.

The CCAP consists of 3 processing units that generate L2 LSA. An algorithm package can be divided into processing units. The rules cover the required input, how to run the driver scripts, and the expected output.

LSA runs in a cycle between the online unit and offline units. The online unit produces level 2 LSA from VIIRS L1B data (Suomi-NPP, NOAA-20, and NOAA-21) and several upstream algorithms. The offline unit runs once per day using LSA data from the previous 9 days to generate a set of filtered LSA tile data. These filtered tiles are used by the online unit to generate an improved LSA product.

The VIIRS LSA process consists of two components. The granule albedo is estimated online from a combination of the directly estimated albedo and a historical temporally filtered gap-free albedo; the historical albedo is derived offline using granule albedo previously obtained. The online direct estimation approach, which has been widely used for estimating land surface albedo from a variety of satellite data, is initially used to estimate daily mean blue- sky land surface albedo from clear-sky VIIRS data of TOA spectral reflectance. The offline statistical temporal filter is then applied to combine information from the albedo retrieved with observations of the current day (if existing) and the adjacent days as well as historical climatology to generate a gap-free and noise-reduced albedo data set.

## 1.2. Algorithm Overview

The implementation of the gridded VIIRS albedo product consists of two major steps: direct retrieval and temporal filtering. The direct retrieval procedure is granule-driven and employs the improved direct estimation algorithm to generate daily mean albedo granule from VIIRS clear-sky SDR data. The albedo granule directly retrieved from the first step will then be gridded and converted to a sinusoidal map projection. The gridded data will serve as the input of the temporal filtering step. The temporal filtering process is tile-driven and executed at the end of each day, which mainly implements a statistical temporal filter algorithm to combine albedo from the current and temporally neighboring days and climatology information to generate a gap-filled and noise-reduced albedo product.

The direct retrieval and temporal filtering algorithms are implemented into two separate modules in the software development. The online processing part employs the direct retrieval algorithm to generate Primary Surface Albedo ("VIIRS_Albedo_IP") from VIIRS clear-sky observations. Data gaps in the clear-sky albedo granule are then filled using the historical albedo information, which come from the temporal filtering algorithm (the offline processing part). The gap-filled albedo granule is also known as Improved Surface Albedo ("VIIRS_Albedo_EDR").

The offline processing part mainly implemented the temporal filtering algorithm with the albedo tiles gridded from Primary Surface Albedo during a 9-day window (precedent 8 days plus the current day) as the main input. The offline processing updates the historical albedo data that are used in the online processing part.

## 1.3. Interfaces Overview

Before reviewing this System Maintenance Manual (SMM), please request the live **master NCCF SMM** (refer to ***System Maintenance Manual - NESDIS Common Cloud Framework (NCCF)***) from the OSPO PALs in Table 1-2. The NCCF system overview is described in the **master NCCF SMM: NCCF Description and Overview (or Document Object: 4,5)**.

# 2. Hardware

## 2.1. Hardware Description

The hardware is described in the **master NCCF SMM: NCCF Description and Overview (or Document Object: 4,5): Infrastructure.**

## 2.2. Operating System

The NCCF operating system description can be found in the **master NCCF SMM: Operating System (or Document Object: 64).**

## 2.3. System Requirements

The system requirements and timing information are listed in the following two tables:

**System Requirements:**

| | |
|---|---|
| **Memory** | 2 GB |
| **CPU** | 1 |

**Timing Information:**

| Processing Unit | User Time |
| --- | --- |
| LSA Offline | 1 Hour |
| LSA Online | 20 Seconds |

### 2.3.1. Storage Requirements

Unpacking the tar files included with the delivery will require about 86.2GB of storage space. Sizes of individual files used or created by Offline/Online LSA are shown in Table 2-1. Note that large numbers of these files will be required for running LSA, such as up to 2988 Filtered LSA Tile files generated each day by Offline LSA.

**Table 2-1 - Offline and Online LSA File Sizes**

| File | Approximate Size per File |
| --- | --- |
| JRR Cloud Mask | 35 MB |
| Snow Mask | 40 MB |
| Offline LSA Tiles (filtered and original) | 1-10 MB |
| L1b VIIRS GMTCO | 28 MB |
| L1b VIIRS SVM## | ~5-10 MB |
| Online LSA SURFALB output product | 10 MB |
| Log | < 5 KB |

### 2.3.2. Computer Resource Requirements

- Ensure that GCC 8.3 or the Intel 19.0.5 compilers are available in your PATH.
- Set the location of the required libraries using environment variables. By default, OTS_HOME should be set to the root directory of these libraries, and each library is contained in the following subdirectories:
    - zlib - $OTS_HOME
    - szip = $OTS_HOME
    - hdf5 - $OTS_HOME/hdf5
    - netCDF - $OTS_HOME/netcdf4
    - Jasper - $OTS_HOME/jasper
    - ecCodes - $OTS_HOME/eccodes
    - CRTM - $OTS_HOME/crtm_v2.3.0
    - Boost - $OTS_HOME/boost
- The location of each library can be customized with the variables ZLIB_HOME, SZIP_HOME, HDF5_HOME, NETCDF4_HOME, JASPER_HOME, ECCODES_HOME, CRTM_HOME, or BOOST_HOME.

- Enter the CODE/src/online_LSA directory and run the following commands to build the Framework executable used for the online unit:
    - ./build_alg clean
    - ./build_alg -j12
- Enter the CODE/src/offlone_LSA directory and run the following commands to build the executables used for the online units:
    - ./build_alg

These libraries and utilities must be present within the package to allow processing to run successfully. Without these libraries and utilities, the expected output files cannot be produced properly.

### 2.3.3. Communication Needs

The target system for the Land Surface Albedo package is the NESDIS Common Cloud Framework (NCCF). There are no special bandwidth or communication issues associated with LSA. The communication needs of the processing system must be sufficient to meet the processing requirements described throughout this document.

# 3. Software

## 3.1. Software Description

The VIIRS LSA algorithm consists of 3 processing units that generate L2 Land Surface Albedo (LSA). An algorithm package can be divided into processing units. The rules cover the required input, how to run the driver scripts, and the expected output.

LSA runs in a cycle between the online unit and offline units. The online unit produces level 2 LSA from VIIRS L1B data (Suomi-NPP, NOAA-20, and NOAA-21) and several upstream algorithms. The offline unit runs once per day using LSA data from the previous 9 days to generate a set of filtered LSA tile data. These filtered tiles are used by the online unit to generate an improved LSA product.

## 3.2. Directory Description

The CCAP consists of four gzip'd tar files:

- LSA_CCAP_CODE_v1-3_20240712.tar.gz
- LSA_CCAP_DATA_v1-3_20240712.tar.gz
- LSA_CCAP_DATA_CLIMATOLOGY_v1-1_20240306.tar.gz
- LSA_CCAP_DOCS_v1-3_20240712.tar.gz

One way to unpack the algorithm package involves running the following command:

```
tar -xvzf < tarfile_name >
```

where tarfile_name is the name of the tarfile you wish to unpack.

Text files explaining the directory tree structure are located within the LSA code tar file (code_tree.txt) and the LSA data tar file (data_tree.txt).

The following is an abridged list of the files and directories that includes important files and directories:

```
├── CODE
│   ├── bin
│   │   ├── GriddingMain.exe
│   │   ├── LSAConnectMain.exe
│   │   └── LSAOffMain.exe
│   ├── docker
│   │   ├── Dockerfile
│   │   ├── eccodes_definitions.tgz
│   │   └── fw.tgz
│   ├── scripts
│   │   ├── ccap_utils
│   │   ├── common_utils
│   │   ├── jpssrr_application.py
│   │   ├── launch_docker.py
│   │   ├── lsa_offline_final.py
│   │   └── lsa_offline_preliminary.py
│   ├── src
│   │   ├── offline_LSA
│   │   └── online_LSA
│   │       ├── algorithms.exe
│   │       └── Config
│   └── templates
├── DATA
│   ├── ancillary_data
│   │   ├── algorithm_ancillary
│   │   ├── framework_ancillary
│   │   └── mod_alb_clim_nc
│   ├── sample_yamls
│   └── test_cases
```

```
│        ├── logs
│        ├── NOAA20_final
│        ├── NOAA20_LSA
│        ├── NOAA20_prelim
│        ├── NOAA21_final
│        ├── NOAA21_LSA
│        ├── NOAA21_prelim
│        ├── NPP_final
│        ├── NPP_LSA
│        ├── NPP_prelim
│        └── output
└── DOCS
    ├── JPSS-LSA_v1-3_DeliveryMemo_20240712.docx
    ├── JPSS-LSA_v1-3_ProductionRules_20240712.docx
    └── JPSS-LSA_v1-3_README_20240712.docx
```

Docker Information:

- Files, Libraries, and Off-The-Shelf (OTS) Software Present in the Docker Image
    - HDF5
    - NetCDF
    - zlib
    - szlib
    - ecCodes
    - wgrib2
    - CRTM
    - Python 3.7.3 with the following libraries:
        - Numpy
        - Urllib3
        - netCDF4
        - h5py
        - pykdtree
        - pyyaml
        - pyresample
        - sortedcontainers
    - Docker Image Information
        - Base Image: assistt-centos7-python3-fw2
        - Image Size: 975 MB
        - Repository Name: 754153872510.dkr.ecr.us-east-1.amazonaws.com

- Tag Name: v3.0

## 3.3. Source Code Description

The source code associated with the Land Surface Albedo system is similar to the source code that supports the JPSS Risk Reduction (RR) system. The framework processing system is currently the AIT-Framework system version 2, or the GOES-R Algorithm Working Group (AWG) Product Processing System Framework. The JPSS RR system contains many programs, functions, subroutines, and scripts. These files are written multiple coding languages including Fortran 77/90/95, C/C++, and Python. The source code can be found in the Framework Algorithms subdirectory.

Due to the size and content of the processing system, details about the source code are not described in this document.

All three units of LSA processing is performed by running the following command from the script's directory:

- python launch_docker.py /path/to/docker_config.yaml

This script launches a Docker container then executes the main driver script for the desired unit.

Two configuration files in YAML format are used for LSA processing. One contains information used to launch the Docker container, and the other contains information to run LSA processing.

# 4. Normal Operations

## 4.1. System Control

Several YAML and python scripts are responsible for the execution of both Offline and Online LSA. The scripts begin the process by setting up the parameters, deciding what gets processed, and runs the algorithm.

### 4.1.1. System Control Files

There must be at least one YAML file present in the algorithm package responsible for guiding the inner script as it chooses what processing or preprocessing steps will occur, which granule will be processed, and which span of time will be observed. For convenience, all items in the file that have a possibility of variation or are system specific will be located at the top of the YAML file as anchors. Each of these arguments are listed below.

**Table 4-1 - LSA YAML Unit File Application Information**

| Key | Description of Value |
| --- | --- |
| production_site | Production site info added to product metadata |
| production_environment | Production environment info added to product metadata |
| satellite | Satellite name: NOAA20, NOAA21, or NPP |

### 4.1.2. Processing Controls

There must be at least one YAML file present in the algorithm package that contains information concerning the setup of the Docker run command. For convenience, all items in the file that have a possibility of variation or are system specific will be located at the top of the YAML file as anchors. Each of these arguments are listed below.

#### LSA Offline YAML Files

The **Offline YAML docker file** has the following parameters (Table 4-2).

**Table 4-2 - Offline LSA Docker YAML File Parameters**

| Key | Description of Value |
|---|---|
| application_yaml | Full path of the application config YAML |
| output_dir | Full path of the output directory |
| log_dir | Full path of the log output directory |
| scripts_dir | Full path of the scripts directory containing lsa_offlne_preliminary.py |
| gridding_bin | Full path of the gridding executable GriddingMain.exe |
| connect_bin | Full path of the connect executable LSAConnectMain.exe |
| gridding_cfg_template | Full path of the config template file used by the gridding step |
| connect_cfg_template | Full path of the config template file used by the connectstep |
| lsa_input_dir | Full path of the directory containing the previous day’s LSA files |

**Table 4-3 - Offline LSA Application YAML File Parameters**

| Key | Description of Value |
|---|---|
| application_yaml | Full path of the application config YAML |
| output_dir | Full path of the output directory |
| log_dir | Full path of the log output directory |
| scripts_dir | Full path of the scripts directory containing lsa_offlne_final.py |
| final_bin | Full path of the gridding executable LSAOffMain.exe |
| final_cfg | Full path of the config template file used by the final step |
| albedo_climatology_dir | Full path to the climatology ancillary data directory |
| tile_input_dir | Full path to the directory containing 9 days of Primary LSA Tile data |

### LSA Online YAML Files

The **Online YAML docker file** has the following parameters (Table 4-4).

**Table 4-4 - Offline LSA Docker YAML File Parameters**

| Key | Description of Value |
|---|---|
| application_yaml | Full path of the application config YAML |
| output_dir | Full path of the output directory |
| log_dir | Full path of the log output directory |
| scripts_dir | Full path of the scripts directory containing jpssrr_application.py |
| algorithm_ancillary | Full path of the log algorithm_ancillary directory |
| framework_ancillary | Full path of the log framework_ancillary directory |
| gfs_dir | Full path to the directory containing GFS files. If no GFS files are used, this should be set to "none". |
| cmc_sst_dir | Full path to the directory containing CMC SST file. If no CMC SST files are used, this should be set to "none". |
| snow_mask_dir | Full path to the directory containing IMS/SSMI Snow Mask file. |
| l1b_dir | Full path to the directory containing satellite L1B files (GMTCO, SVMxx) |
| upstream_dir | Full path to the directory containing output from upstream directories (Cloud Mask) |
| lsa_tile_dir | Full path to the directory containing filtered LSA tiles from offline processing |
| framework_exe | Full path to the Framework executable algorithms.exe |
| framework_config_dir | Full path to the Framework config directory |

## 4.2. Installation

### 4.2.1. Installation Items

For more information concerning the installation items associated with the LSA processing system, please refer to section 3.2.

### 4.2.2. Compilation Procedures

1. Ensure that GCC 8.3 or the Intel 19.0.5 compilers are available in your PATH.
2. Set the location of the required libraries using environment variables. By default, OTS_HOME should be set to the root directory of these libraries, and each library is contained in the following subdirectories:
    a. zlib - $OTS_HOME
    b. szip = $OTS_HOME

   c. hdf5 - $OTS_HOME/hdf5
   d. netCDF - $OTS_HOME/netcdf4
   e. Jasper - $OTS_HOME/jasper
   f. ecCodes - $OTS_HOME/eccodes
   g. CRTM - $OTS_HOME/crtm_v2.3.0
   h. Boost - $OTS_HOME/boost
3. The location of each library can be customized with the variables ZLIB_HOME, SZIP_HOME, HDF5_HOME, NETCDF4_HOME, JASPER_HOME, ECCODES_HOME, CRTM_HOME, or BOOST_HOME.
4. Enter the CODE/src/online_LSA directory and run the following commands to build the Framework executable used for the online unit:
   a. ./build_alg clean
   b. ./build_alg -j12
5. Enter the CODE/src/offlone_LSA directory and run the following commands to build the executables used for the online units:
   a. ./build_alg

### 4.2.3. Installation Procedures

## 4.3. Configuration Procedures

Please refer to the README document included with this delivery package.

See the **master NCCF SMM: Installation Procedures (or Document Object: 77).**

### 4.3.1. Production Rules

The Preliminary Offline LSA unit runs once per day after all the previous day's L2 LSA products are available for one satellite: NPP, N20, or N21. The output from the offline units is not needed until the following day, so the unit may start at any time as long as enough time is given for both offline units to complete before midnight.

## 4.4. Operations Procedures

### 4.4.1. Normal Operations

Please refer to the master NCCF SMM: Procedures for Normal Operations (or Document Object 10).

## 4.5. Distribution

### 4.5.1. Data Transfer/Communications

Please refer to the master NCCF SMM: Data Transfer/Communications and Data Preparation (or Document Object 73, 81).

### 4.5.2. Distribution Restrictions

There are no restrictions on the distribution of LSA products.

### 4.5.3. Product Retention Requirements

No specific requirement for this product.

### 4.5.4. External Product Tools

There are no external product tools supplied with the LSA package. The LSA output files are in NetCDF4 format. External users can choose their own tools to display and analyze these output files.

# 5. Monitoring and Maintenance

## 5.1. Job Monitoring

### 5.1.1. Product Monitoring and Visualization

Product quality is monitored using the NCCF Product Monitoring Tool at https://nccf.espc.nesdis.noaa.gov/mtool/index.html.

Users can use this page to monitor summaries of the LSA quality based on parameter thresholds determined by the PAL.

The NCCF Products Visualization Page is located at https://origin-east-01-www-ospo.woc.noaa.gov/products/land/lsa/.

LSA products are generated daily.

## 5.2. Data Signal Monitoring

## 5.3. Product Monitoring

### 5.3.1. Unit Test Plans

### 5.3.2. Internal Product Tools

There are no internal product tools supplied with the LSA processing system. The output product files are NetCDF4 files. External users can choose their own tools to display and analyze these output files.

### 5.3.3. Performance Statistics

### 5.3.4. Product Monitoring

### 5.3.5. Product Criticality

## 5.4. Maintenance

### 5.4.1. Monitoring and Maintenance

See the **master NCCF SMM: Maintenance Utilities (or Document Object: 84).**

#### 5.4.1.1. Ingest Monitoring

See the **master NCCF SMM: Data Transfer/Communications and Data Preparation (or Document Object: 73).**

#### 5.4.1.2. Production Job Monitoring

#### 5.4.1.3. Product Distribution Monitoring

### 5.4.2. Science Maintenance

Product quality monitoring is performed by the OSPO Product Quality Monitoring System and the OCS developers. OCS and OSPO personnel communicate regularly to discuss any potential data quality issues, formulate updates to the code, and schedule updates to the package's science code.

### 5.4.3. Library Maintenance

See the **master NCCF SMM: Library Maintenance (or Document Object: 71).**

### 5.4.4. Special Maintenance Procedures

No special maintenance procedures are required for the algorithm.

See the master NCCF SMM: Special Maintenance Procedures (or Document Object: 72).

### 5.4.5. Maintenance Utilities

## 5.5. Program Backup Procedures

See the **master NCCF SMM: Data Recovery Procedures and Program Recovery Procedures (or Document Object: 89, 90)**.

# 6. Troubleshooting

## 6.1. Program Diagnosis and Recovery

See the **master NCCF SMM: Problem Diagnosis and Recovery Procedures (or Document Object: 82).**

### 6.1.1. Quality Control Output

The retrieval process of albedo will be monitored and the retrieval quality will be assessed. A set of quality flags and metadata will be generated with the albedo product for retrieval diagnostics. These flags will indicate the retrieval conditions as well as the data quality. The QC flag is located within the Online LSA output file as the variable ProductQualityInformation.

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 LSA output files. The output files have a number of failure codes. Table 6-1 describes the control codes of the quality flags for the products.

**Table 6-1 - LSA Product Quality Information QC Variable**

| byte | bit | Flag description | Meaning |
|---|---|---|---|
| 0 | 0-1 | Overall quality of product | 00=high quality retrieval, 01=retrieval, 10=no retrieval |
| | 2-3 | Cloud condition | 00=confidently clear, 01=probably clear, 10=probably cloudy, 11=confidently cloudy |

| byte | bit | Flag description | Meaning |
|---|---|---|---|
| | 4 | SDR quality | 0=normal, 1=bad data (VIIRS bad, missing, or not calibrated) (GOES bad, missing, or out of space) |
| | 5 | Solar zenith angle flag | 0=favorable SZA, 1=SZA larger than 60 deg |
| | 6 | View zenith angle flag | 0=favorable VZA, 1=VZA larger than 60 deg |
| | 7 | Spare | |
| 1 | 0-2 | Retrieval path | 000=generic, 001=desert, 010=snow, 011=sea ice, 100=no retrieval |
| | 3-4 | Temporal filter quality flag | 00=high-quality retrieval, 01=degraded retrieval, 10=no retrieval |
| | 5 | Online filter flag | 0=non-filtered, 1=filtered |
| | 6-7 | Spare | |

#### 6.1.2. Error Correction

See the **master NCCF SMM: Error Correction – Warnings and Messages for Systems and Error Codes, Menus and Navigation (or Document Object: 43,44,45).**

#### 6.1.3. Problem Diagnosis and Recovery Procedures

See the **master NCCF SMM: Problem Diagnosis and Recovery Procedures (or Document Object: 82).**

##### 6.1.3.1. High-Level Errors

##### 6.1.3.2. Low-Level Errors

#### 6.1.4. Data Recovery Procedures

See the **master NCCF SMM: Data Recovery Procedures (or Document Object: 89)**.

#### 6.1.5. Program Recovery Procedures

### 6.2. Application Shutdown and Restart

See the **master NCCF SMM: Program Recovery Procedures (or Document Object: 90).**

#### 6.2.1. Application Shutdown Procedures

See the **master NCCF SMM: Application Shutdown Procedures (or Document Object: 94).**

#### 6.2.2. Application Restart Procedures

See the **master NCCF SMM: Application Restart Procedures (or Document Object: 92).**

### 6.3. System Shutdown and Restart

See the **master NCCF SMM: Reboot Procedures, Restart Procedures and Shutdown Procedures (or Document Object: 83, 93, 95).**

#### 6.3.1. System Shutdown Procedures

#### 6.3.2. System Restart Procedures

#### 6.3.3. System Reboot Procedures

# 7. Appendix – Data Description

## 7.1. Data Flow

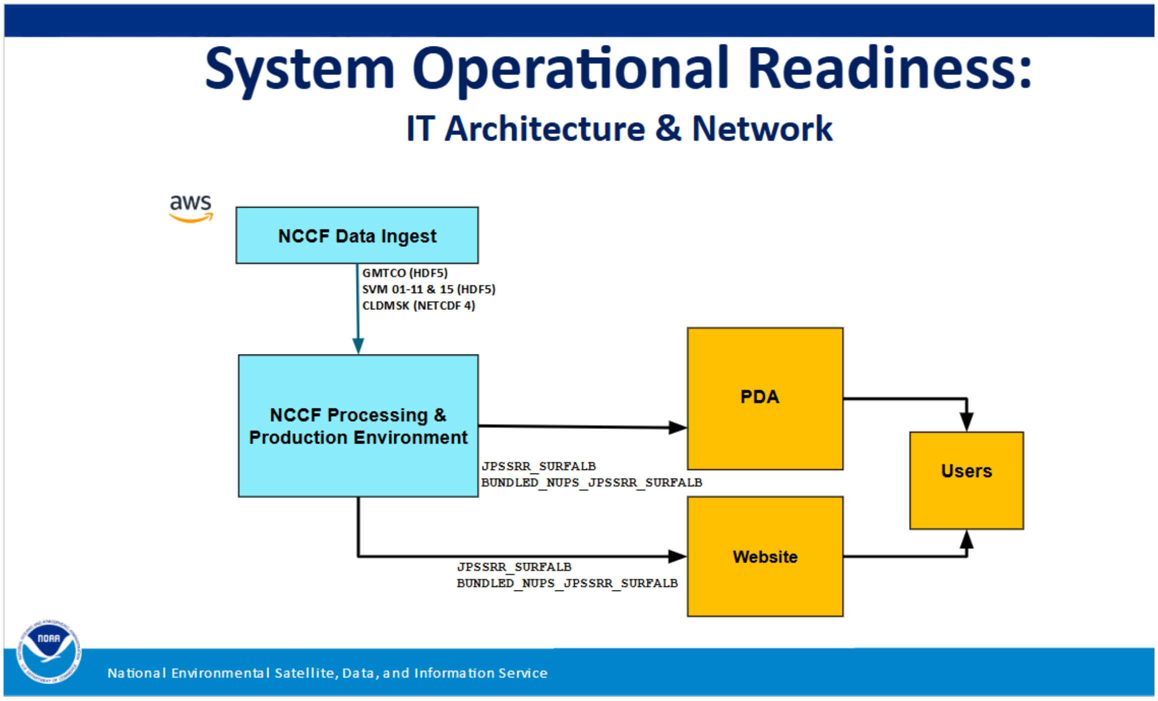


**Figure 7-1 - IT Architecture & Network**

## 7.2. Input Data Files

The input data sources differ between the Offline and Online LSA components. This is further complicated by the fact that the Offline component uses Online output files from previous days, and the Online component requires the output files from the Offline component. The Offline output files are technically intermediate files, as their purpose is to provide input data for Online LSA.

**Table 7-1 - LSA Input Data Files**

| Type of File | File Naming Conventions |
|---|---|
| LSA | SURFALB_<version>_<sat>_s<yyyymmddHHMMSSs>_e<yyyymmddHHMMSSs>_c<yyyymmddHHMMSSs>.nc |
| VIIRS L1B | GMTCO_<sat>_d<YYYYMMDD>_t<HHMMSSs>_e<HHMMSSs>_b<orbit>_c<yymmddHHMMSSssssss>_noac_ops.h5<br><SVMxx>_<sat>_d<YYYYMMDD>_t<HHMMSSs>_e<HHMMSSs>_b<orbit>_c<yymmddHHMMSSssssss>_noac_ops.h5 |
| Cloud Mask | JRR-CloudMask_<version>_<sat>_s<yyyymmddHHMMSSs>_e<yyyymmddHHMMSSs>_c<yyyymmddHHMMSSs>.nc |

| **Type of File** | **File Naming Conventions** |
|---|---|
| IMS/SSMI Snow Mask | snow_map_4km_<YYMMDD>.nc |
| GFS | gfs.t<hh>z.pgrb2.0p25.f<fff>.<YYYYMMDD> |
| CMC SST | <YYYYMMDD>120000-CMC-L4_GHRSST-SSTfnd-CMC0.1deg-GLOB-v02.0-fv03.0 |

Where:

| | | |
|---|---|---|
| <version> | → | Product file version, currently v2r2 for LSA and v3r2 for Cloud Mask |
| <sat> | → | Satellite ID: j01, j02 (L1B data), n21 (product data), or npp |
| <tilesat> | → | Satellite name: NOAA20, NOAA21, or NPP |
| <yyyymmddHHMMSSs> | → | Timestamp with day/time to the nearest tenth of a second |
| <yyyyjjj> | → | Year and day of year |
| <YYYYMMDD> | → | Date with year/month/day |
| <HHMMSSs> | → | Time to the nearest tenth of a second |
| <YYMMDD> | → | Date with 2-digit year |
| <SVMxx> | → | L1B Channel ID, where xx is 01-11 or 15 |
| <hxxvxx> | → | Tile grid ID, where xx are two-digit numbers |
| <hh> | → | GFS model run hour |
| <fff> | → | GFS forecast hour |

## 7.3. Ancillary Data Files

The LSA Offline component does not require any dynamic ancillary data files.

The Online LSA requires a snow mask input file. The preferred snow mask is IMS/SSMI Snow Mask. If this is not available, the executable can generate NWP Snow Mask from SVM15, GFS, and CMC SST data.

If IMS/SSMI Snow Mask is used, data from the same day as the granule is preferred, but data from the previous day is acceptable. If the files needed for NWP Snow Mask are also provided, they will be ignored.

If NWP Snow Mask is generated, SVM15 and GFS are required; CMC SST is not required but will result in a degraded product if missing. Two GFS files are needed with specific forecast and model times; see the appendix for the description of which files are needed. The CMC SST file that is provided should be the most recently available file within the past 7 days.

**Table 7-2 - LSA Online Dynamic Ancillary Data**

| File Name | File Naming Convention |
|---|---|
| IMS/SSMI Snow Mask | snow_map_4km_<YYMMDD>.nc |
| GFS | gfs.t<hh>z.pgrb2.0p25.f<fff>.<YYYYMMDD> |
| CMC SST | <YYYYMMDD>120000-CMC-L4_GHRSST-SSTfnd-CMC0.1deg-GLOB-v02.0-fv03.0 |

Where:

| | | |
|---|---|---|
| <YYYYMMDD> | → | Date with year/month/day |
| <hh> | → | GFS model run hour |
| <fff> | → | GFS forecast hour |
| <YYMMDD> | → | Date with 2-digit year |

## 7.4. Look Up Tables (Static Ancillary Data)

Both the LSA Offline and Online components use static data that is provided with the delivery package. Offline LSA requires climatological albedo data, and online LSA uses framework and algorithm static ancillary data.

The final offline LSA unit uses climatology data. These static ancillary data are located in the following directory:

- DATA/ancillary_data/algorithm_ancillary/mod_alb_clm_nc

The static ancillary data needed for the Online LSA unit are located in the following directories:

- DATA/ancillary_data/algorithm_ancillary
- DATA/ancillary_data/framework_ancillary

## 7.5. Intermediate Data Set Description

The offline filtered LSA tiles output files are technically intermediate files since they are used as input for Online LSA processing.

**Table 7-3 - LSA Intermediate Data File Naming Conventions**

| File Name | File Naming Convention |
|---|---|
| LSA Primary Tile | <tilesat>_VIIRS_LSA_<yyyyjjj>_<hxxvxx>.nc |
| LSA Filtered Tile | <tilesat>_VIIRS_LSA_<hxxvxx>_<yyyyjjj>_FLT.nc |

Where:

| | | |
|---|---|---|
| <tilesat> | → | Satellite name: NOAA20, NOAA21, or NPP |
| <yyyyjjj> | → | Year and day of year |
| <hxxvxx> | → | Tile grid ID, where xx are two-digit numbers |

## 7.6. Output Data Set Description

The LSA Online component produces the output files listed in Table 7-4.

**Table 7-4 - Online LSA Output Files**

| Type of File | LSA Product Filename |
|---|---|
| **Land Surface Albedo** | SURFALB_<v#r#>_<sat>_s<YYYYMMDDHHMMSSS><br>_e<YYYYMMDDHHMMSSS>_c<YYYYMMDDHHMMSSS>.nc |

Where:

| | | |
|---|---|---|
| s<YYYYMMDDHHMMSSs> | → | the start time in 4-digit year, 2-digit month, 2-digit day, 2-digit hour, 2-digit minute, 2-digit second, 1-digit tenths of a second format associated with the file |
| e<YYYYMMDDHHMMSSs> | → | the end time in 4-digit year, 2-digit month, 2-digit day, 2-digit hour, 2-digit minute, 2-digit second, 1-digit tenths of a second format associated with the file |
| c<YYYYMMDDHHMMSSs> | → | the creation time in 4-digit year, 2-digit month, 2-digit day, 2-digit hour, 2-digit minute, 2-digit second, 1-digit tenths of a second format associated with the file |
| <v#r#> | → | the 1-digit version number and release number |
| <sat> | → | satellite identifier; can be npp, j01, or n21 |

An example of an output filename is:
SURFALB_v2r2_n21_s202312111130155_e202312111131402_c202403192050340.nc

## 7.7. Archive Data Files

The JPSS Risk Reduction products will be archived to CLASS/NCEI archive.

## 7.8. References

NESDIS/STAR (2023), The JRR Land Surface Albedo System Maintenance Manual

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

NESDIS/STAR (2022), The NOAA JPSS Risk Reduction (JPSSRR) System - External Users' Manual (EUM) v3.1

NESDIS/STAR (2022), The NOAA JPSS Risk Reduction (JPSSRR) System - System Maintenance Manual (SMM) v3.1

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

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

NESDIS/STAR (2013), JPSS Risk Reduction: Uniform Multi-Sensor Cloud Algorithm for Consistent Products Critical Design Review

NESDIS/STAR (2020), GOES-R Advanced Baseline Imager (ABI) Algorithm Theoretical Basis Document for Surface Albedo

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END OF DOCUMENT

# 8. Acronyms

| Acronym | Definition |
|---|---|
| ABI | Advanced Baseline Imager |
| ASSISTT | Algorithm Scientific Software Integration and System Transition Team |
| ATBD | Algorithm Theoretical Basis Document |
| AVHRR | Advanced Very High-Resolution Radiometer |
| AWG | Algorithm Working Group |
| CLASS | Comprehensive Large Array-data Stewardship System |
| DMSP | Defense Meteorological Satellite Program |
| DNB | Day-Night Band |
| DOC | Department of Commerce |
| ERT | Earth Resources Technology, Inc. |
| ESPC | Environmental Satellite Processing Center |
| EUM | External Users' Manual |
| GFS | Global Forecast System |
| GOES | Geostationary Operational Environmental Satellite |
| IMS | Interactive Multisensor Snow and Ice Mapping System |
| IP | Intermediate Product |
| JPSS | Joint Polar Satellite System |
| JPSSRR | JPSS Risk Reduction |
| JRR | JPSS Risk Reduction |
| LSA | Land Surface Albedo |
| MODIS | Moderate Resolution Imaging Spectroradiometer |
| NCCF | NESDIS Common Cloud Framework |
| NCEI | National Centers for Environmental Information |
| NESDIS | National Environmental Satellite, Data, and Information Service |
| NetCDF | Network Common Data Form |
| NOAA | National Oceanic and Atmospheric Administration |
| NWP | Numerical Weather Prediction |
| OCS | Office of Common Services |
| OLS | Operational Linescan System |
| OMS | Operations, Maintenance, and Sustainment |
| OSPO | Office of Satellite and Product Operations |
| OTS | Off-the-Shelf |
| PAL | Product Area Lead |
| PDA | Product Distribution and Access |
| PIB | Product Implementation Branch |
| PPM | Project Portfolio Management |
| QA | Quality Assurance |
| QC | Quality Control |
| R2O | Research to Operations |
| RAD | Requirements Allocation Document |
| RR | Risk Reduction |
| SA | Science Algorithm |
| SDR | Science Data Record |
| SDR | Sensor Data Record |
| SMM | System Maintenance Manual |
| S-NPP | Suomi National Polar-orbiting Partnership |
| SSMI | Special Sensor Microwave Imager |
| SST | Sea Surface Temperature |

| Acronym | Definition |
|---|---|
| STAR | Center for Satellite Applications and Research |
| SVM | Support Vector Machines |
| TOA | Top of Atmosphere |
| V&V | Verification and Validation |
| VIIRS | Visible Infrared Imaging Radiometer Suite |