



MEMORANDUM FOR: The JPSS Program Record
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SUBJECT: NOAA-21 Snow Cover Product Validated maturity status
DATE: 01/25/2024

Validated maturity status declaration for Snow Cover Product (JPSSRR-SNOWCOVER)

Maturity Review Date: 01/25/2024
Effective Date: 05/01/2023
Operational System: NCCF, V3R2

The JPSS Algorithm Maturity Readiness Review Board approved the release of the NOAA-21 Snow Cover Product to the public with a Validated maturity level quality as of 05/01/2023, based on JPSS Validation Maturity Review held on 01/25/2024.

1. Validated Maturity Definition

Product performance has been demonstrated over a large and wide range of representative conditions (i.e., global, seasonal). Comprehensive documentation of product performance exists that includes all known product anomalies and their recommended remediation strategies for a full range of retrieval conditions and severity level. Product analyses are sufficient for full qualitative and quantitative determination of product fitness-for-purpose. Product is ready for operational use based on documented validation findings and user feedback. Product validation, quality assurance, and algorithm stewardship continue through the lifetime of the instrument.

<http://www.star.nesdis.noaa.gov/jpss/AlgorithmMaturity.php>

2. Snow Product and Algorithm Description

The NOAA-21 Spacecraft with the Visible Infrared Imaging Radiometer Suite (VIIRS) was successfully launched on November 10, 2022. With 22 spectral bands covering wavelengths from 0.41 to 12.5 μm , VIIRS provides operational information on the land surface, atmosphere, and ocean for weather, climate and other environmental applications. The Snow Cover EDR is among a number of cryosphere products generated with VIIRS data. The Snow Cover EDR (JPSSRR-SNOWCOVER) includes two products, the Binary Snow Map and the Snow Fraction.

The binary snow map is generated with reflectances and brightness temperatures observed in VIIRS bands I1, I2, I3 and I5. The technique to identify snow cover in VIIRS pixels utilizes a decision-tree threshold-based image classification algorithm for preliminary snow identification followed by a series of consistency tests. The latter are used to eliminate spurious snow and no-snow identifications and mask out scenes where snow identifications may not be sufficiently reliable. An externally generated

cloud mask is applied to limit snow identifications to clear sky pixels. Snow retrievals are performed only in daytime conditions.

The snow fraction is derived in VIIRS pixels which were identified as snow-covered in the binary snow map. The snow fraction retrieval algorithm implements a linear unmixture technique. It incorporates VIIRS observations in one, visible spectral band I1 and two endmembers representing the reflectance of a completely snow free land surface and the reflectance of snow. The values of both endmembers have been established empirically and are adjusted with changing viewing and illumination geometry of observations.

Both binary and fractional snow cover are derived at the VIIRS imagery (375m) spatial resolution. The snow product EDR contains two data objects (binary snow and fractional snow) and corresponding two 8-bit quality flags. The Snow Cover EDR output file format is NetCDF4.

3. Product Requirements/Exclusions

VIIRS Snow Cover product requirements and exclusions are documented in the Joint Polar Satellite System (JPSS) Ground Segment Data Product Specification (GSegDPS), 474-01543, Revision G, Effective Date: February 11, 2022 https://www.nesdis.noaa.gov/s3/2022-03/474-01543_JPSS-GSegDPS_A.pdf. The document requires that the binary snow algorithm ensures at least 90% probability of correct snow/no-snow classification and the fractional snow cover algorithm produces the snow fraction with the maximum uncertainty of 20%.

4. Product evaluation/validation

The quality of the NOAA-21 VIIRS Snow Cover EDR has been evaluated during the time period from April 20, 2023 to January 15, 2024. Thus, at the time of this report the product dataset available for evaluation included around ten months of daily data.

Product Availability/Reliability

NOAA-21 VIIRS Snow Product has been available almost continuously since the end of April 2023. The collected dataset covers the larger part of the year including the first half of the winter season and therefore is sufficient for an extensive validation of the product.

Algorithm Performance Dependence

The quality of the NOAA-21 VIIRS Snow Product is critically dependent on the quality of the input VIIRS SDR data (reflectance and brightness temperature) as well as on the accuracy of geolocation information. It is also dependent on the accuracy and performance of the VIIRS cloud mask which is an input product to the VIIRS snow retrieval algorithms.

Known errors/issues/limitations



Read-me for Data Users

No errors have been found in the snow algorithm implementation for NOAA-21 VIIRS. Some inaccuracies have been found in the cloud mask which adversely affect the snow cover product. Noticed inaccuracies in the cloud mask are mostly confined to alpine areas and coastal areas.

Changes since last maturity stage

None

Review board recommendations

Based on our evaluation, the Binary and the Fractional Snow Cover Products of NOAA-21 VIIRS Snow Cover EDR meet all requirements for the validated level of maturity. Although some issues still exist, our evaluation shows that both products are reasonably accurate and well agree to other remote-sensing based products and *in situ* measurements. We conclude that NOAA-21 VIIRS Binary and Fractional Snow Cover Map Products as part of the VIIR Snow Cover EDR have reached the validated maturity level and thus can be made publicly available. The validated maturity effectivity date is May 1, 2023.

Path Forward/Future Plans

Evaluation of the product will continue. More detailed quantitative estimates of the snow product accuracy over various land surface cover types and topography will be established over the Northern Hemisphere using the data accumulated during the 2023-2024 winter season.

Additional Items to note

Additional information is available in the JPSS Snow Cover Product algorithm theoretical basis document (ATBD) and validation maturity review briefing, which can be accessed at:

<http://www.star.nesdis.noaa.gov/jpss/Docs.php>

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