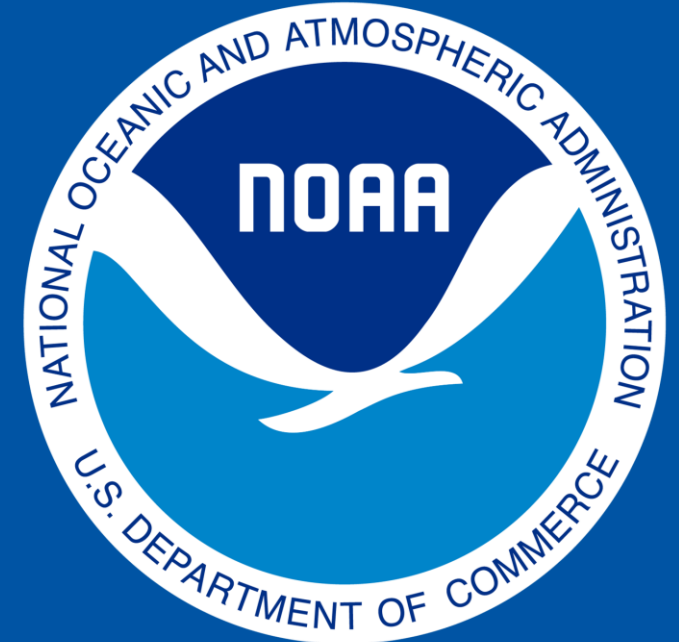




Status of Joint Polar Satellite System (JPSS) and Low Earth Orbit (LEO) Satellite Products and Data Access



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Introduction

Over the past 10 years, the Joint Polar Satellite System (JPSS) mission has provided high-quality data products for environment forecasting and monitoring through the current Suomi National Polar-orbiting Partnership (S-NPP), NOAA-20, and NOAA-21 satellites, which launched on October 18, 2011, November 18, 2017, and November 10, 2022, respectively. The sensor data record (SDR) and the derived environmental data record (EDR) products from the Visible Infrared Imaging Radiometer Suite (VIIRS), the Cross-track Infrared Sounder (CrIS), the Advanced Technology Microwave Sounder (ATMS), and the Ozone Mapping and Profiler Suite (OMPS) offer unprecedented opportunities for weather forecasting and earth observing. This paper will provide an update of the latest status of the JPSS products with highlights of the NOAA-21 data products post launch validation results. The schedule and status of JPSS/LEO algorithms migrating to the NESDIS Common Cloud Framework (NCCF), and the further enhancement of JPSS/LEO data access will be presented. The planned science improvements and enhancements for JPSS/LEO products through user engagement and via the newly established NESDIS Product Portfolio Management (PPM) process, will also be briefed.

NOAA-21 data products post launch validation

Major differences for NOAA-21 compared to NOAA-20 are:

- OMPS Nadir Mapper (NM) improved horizontal resolution
 - 12 x 10 km for JPSS-2 vs. 50 x 17 km for NOAA-20
- OMPS Limb Profiler (LP)
 - No OMPS-LP on NOAA-20 (but was flown on S-NPP)
- Spacecraft Diary
 - Spacecraft Diary data changed from 1 Hz to 10 Hz

Pre-launch updates have been incorporated in the system and fully tested before launch

NOAA-21 POST LAUNCH UPDATES		
Instrument	Purpose	Operational Date
ATMS	NOAA-21 ATMS PCT update to suppress instrument health status quality flag	2/13/23
ATMS	Software update to correct instrument health status quality flag	Mx8 TTO (7/13/2023)
ATMS	NOAA-21 ATMS PCT update for Validated Maturity	5/12/23
ATMS	NOAA-21 ATMS PCT update to turn off SDR quality flag QF-1	8/24/23
CrIS	First Calibration Table upload EP (Eng. Packet) v210 with Vinst, PGA gain, TVAC param (ILS and Nonlinearity), and Geolocation parameters (adjusted for in-track zero position)	2/21/23
CrIS	Second Calibration Table Upload EP v211 with optimized Nonlinearity, Geolocation and ILS parameters	3/23/23
CrIS	Third Calibration Table Upload EP v212 with optimized Nonlinearity, Geolocation and Spectral parameters	9/20/23
CrIS	NOAA-21 CrIS PCT update for validated maturity, with optimized Polarization Correction	9/26/23
VIIRS	post-lunch mounting matrix: GEO LUTs update to reduce geolocation errors observed on orbit	1/12/23
VIIRS	Start of NOAA-21 Monthly Day-Night-Band Offsets and Gains Fast-Track Look Up Table updates	3/9/23
VIIRS	Start of NOAA-21 stray light correction LUT updates, will deliver 12 LUTs, then re-use the tables	3/30/23
VIIRS	NOAA-21 VIIRS SDR DELTA-C LUT Update for TEB Cold FPA Temperature Setpoints change	3/30/23
VIIRS	NOAA-21 VIIRS SDR RVF LUT Update (TEB LWIR only, using s/c "backflip" pitch maneuver)	6/7/23
VIIRS	Re-initialized RSBAutoCal calculations	6/8/23
VIIRS	NOAA-21 VIIRS RSBAutoCal LUTs Update (prepare for SWIR automated calibration)	7/31/23
VIIRS	NOAA-21 VIIRS SDR CAL-AUTOMATE LUT Update to Automate SWIR-Band Calibration	8/18/23
F-PREDICTED LUT updates (Calibration scaling coefficients):		
VNIR only		
Adds SWIR		
Adds SWIR degradation correction		
Adds SWIR bias corrections for I3, M8, M10, M11, 3/4/2023 and 5/1/2023 measurements		
Using 4/1/2023 and 5/22/2023 measurements		
Adds SWIR bias correction for M9, using 5/1/2023 and 6/12/2023 measurements		
Using 6/1/2023 and 7/16/2023 measurements		
VIIRS		7/27/23
OMPS	NOAA-21 OMPS TC code change and OMPS-TC MACROPIX and EV-SAMPLE tables update	Mx8 TTO (7/13/2023)
OMPS	Start of NOAA-21 OMPS TC & NP Weekly Dark Fast-Track Look Up Table updates	2/2/23
OMPS	Start of NOAA-21 OMPS NP SDR OSOL and WAVELENGTH LUTs bi-weekly update	3/23/23
OMPS	Wavelength shifts from ground to flight; Fixing the NM radiance 3-pixel-shift-error	3/9/23
OMPS	NOAA-21 OMPS-NM and NOAA-21 OMPS-NP show significant/unacceptable discrepancies in albedo coefficients. This updated coefficients will fix the discrepancies	3/9/23
OMPS	Fixing the 85th cross track wavelength shift discrepancies	4/13/23
OMPS	Applied stray light correction; doppler shift; wavelength shift	6/23/23
OMPS	OMPS NP Solar intrusion stray light correction - code change	Mx10 TTO
OMPS	NOAA-21 OMPS NP Solar intrusion stray light correction - fast track	11/9/23
OMPS	NOAA-21 OMPS-NP flight and IDPS sample table update to fix the bad CCD pixel issue	1/5/24

All JPSS data products are available for worldwide users through:

- NOAA Comprehensive Large Array-data Stewardship System ([CLASS](#))
- NOAA Open Data Dissemination (NODD) System: [NOAA-21](#); [NOAA-20](#); [S-NPP](#)
- Google Storage: [NOAA-21](#); [NOAA-20](#); [S-NPP](#)

NOAA-21 Science Product Validation & Readiness for Operations

	Beta	Provisional	Declares Ready for Operations	Validated	S-NPP/NOAA-20 NCCF Migration
Level 1 Sensor Data Products					
ATMS Temperature Data Record (TDR)*	Nov-30-2022	Dec-03-2022	Dec-15-2022	Jun-22-2023	#
ATMS Sensor Data Record (SDR)	Nov-30-2022	Dec-03-2022	Dec-15-2022	Jun-22-2023	#
CrIS SDR*	Feb-23-2023	Mar-23-2023	Mar-30-2023	Sep-28-2023	#
VIIRS SDR	Feb-23-2023	Mar-30-2023	Mar-30-2023	Aug-03-2023	
OMPS Total Column and Nadir Profile SDRs	Feb-23-2023	Apr-13-2023	Apr-19-2023	Mar-2024	
VIIRS Level 2 Products					
VIIRS Imagery*	Feb-23-2023	Mar-30-2023	Mar-30-2023	Aug-03-2023	##
Cloud Mask	Jun-2023	Oct-2023	Oct-2023	Mar-2024	NCCF OPS
Cloud Phase/Type, Cloud Top Property	Oct-2023	Oct-2023	Oct-2023	Mar-2024	NCCF OPS
Cloud Base Height, Cloud Cover Layer	Oct-2023	Oct-2023	Nov-2023	Mar-2024	NCCF OPS
Daytime/Nighttime Cloud Optical and Microphysical Properties (DCOMP and NCOMP)	Nov-2023	Nov-2023	Nov-2023	Mar-2024	NCCF OPS
Aerosol Optical Depth and Particle Size Parameter	Jun-2023	Jun-2023	Jul-2023	Jun-2024	NCCF OPS
Aerosol Detection (ADP)	Aug-2023	Aug-2023	Sep-2023	Jun-2024	NCCF OPS
Volcanic Ash	Aug-2023	Aug-2023	Sep-2023	Mar-2024	NCCF OPS
Ice Surface Temperature (IST)	Jul-2023	Oct-2023	Nov-2023	Feb-2024	NCCF OPS
Sea Ice Concentration	Jul-2023	Oct-2023	Nov-2023	Feb-2024	NCCF OPS
Sea Ice Thickness/Age	Jul-2023	Jan-2024	***Nov-2023	Feb-2024	NCCF OPS
Snow Cover (Binary Map & Snow Cover Fraction)	Jul-2023	Jan-2024	Mar-2024	Jul-2024	NCCF OPS
Active Fire	Jun-2023	Jun-2023	Sep-2023	Jul-2024	NCCF OPS
Land Surface Temperature (LST)	Jul-2023	Jan-2024	Mar-2024	Jan-2025	PI-16
Land Surface Albedo (LSA)	Jul-2023	Jan-2024	Mar-2024	Jul-2024	PI-16
GST (Global Gridded Surface Type)**	Jun-2024	Jun-2024		Sep-2024	
Land Surface Reflectance	Jul-2023	Jan-2024	***Oct-2023	Jan-2025	NCCF OPS
Green Vegetation Fraction (GVF)	Jul-2023	Jan-2024	Mar-2024	Jan-2025	PI-15
Vegetation Index (VI)	Jul-2023	Jan-2024	Mar-2024	Jan-2025	PI-14
Vegetation Health (VH)	Sep-2023	Sep-2023	Jun-2024	Apr-2025	PI-16
Ocean Color	Feb-2024	Feb-2024	Jun-2024	Jul-2025	PI-16
Sea Surface Temperature (SST)	Apr-2023	Aug-2023	Feb-2023	Aug-2024	PI-14
VIIRS Polar Winds (VPW)	Jan-2024	Jan-2024	Mar-2024	Mar-2024	PI-14
VIIRS Flood Mapping (VFM)	Aug-2023	Aug-2023	Dec-2023	Jan-2025	NCCF OPS
CRIS/ATMS Level 2 Products					
NUCAPS: AVTP, AVMP, OLR	Jun-2023	Jan-2024	Feb-2024	Mar-2024	NCCF OPS
NUCAPS: Ozone, Trace Gas (CO, CO2, CH4)	Jun-2023	Jan-2024	May-2024	Jun-2024	NCCF OPS
ATMS Level 2 Products					
MiRS Products	Apr-2023	Jun-2023	Jul-2023	Oct-2024	NCCF OPS
SnowFall Rate (SFR)	Apr-2023	Feb-2024	Apr-2024	May-2025	PI-14
OMPS Level 2 Products					
Ozone EDR: NP (V8Pro)	Apr-2023	Oct-2023	Feb-2024	Mar-2024	PI-14
Ozone EDR: TC (V8TOz)	Apr-2023	Aug-2023	Sep-2023	Mar-2024	NCCF OPS
Ozone LP (SDR & EDR)	Feb-2024	Feb-2024	Mar-2024	Sep-2024	PI-17

Calibration/Validation Maturity Levels	Not Validated	Beta Maturity	Provisional Maturity	Validated Maturity	Ready for Operations (NCCF Operational Schedule)	Declares Ready for Operations	
*	Key Performance Parameter (KPP)				#	ATMS & CrIS BUFR (KPP)	PI-14 Jan 15 - Apr 05, 2024
**	Global Surface Type is an annual product produced offline at STAR				##	Tailored VIIRS Imagery EDR	PI-15 Apr 08 - Jun 29, 2024
***	Data Products at Beta-Access Level						PI-16 Jul 01 - Sep 20, 2024
	Product quality documentation available: https://www.star.nesdis.noaa.gov/jpss/AlgorithmMaturity.php						PI-17 Sep 23 – Dec, 2024

Planned Improvements and Enhancements

Enhanced Capabilities: VIIRS Radiance Cluster Analysis within CrIS
Project Science Lead: Dr. Likun Wang CISES/ESSIC, UMD

Algorithm R20 Status:

- 06/23/22: The science codes for VIIRS radiances cluster implemented.
- 12/12/23: The long-term CrIS VIIS Cluster data from 10/18/22 to 01/31/23 was processed to test the software for operational transition.
- 06/29/23: Preliminary delivery of the VIIRS Radiance Cluster algorithm CCAP
- 08/16/23: The second version of VIIRS cluster analysis codes was delivered to deal with missing files and collocation errors
- **Target operation in NCCF - Jan 2024**

The results are very similar, while details are a little different

7 clusters, the pixels in the same cluster are indicated by the same color

- CrIS uses **K-means clustering**
 - Centroid-based clustering
 - Need a fixed number (k) of the cluster
 - Fast
- IASI uses **Hierarchical clustering**
 - Connectivity-based clustering
 - Need to build hierarchical tree structures
 - Slow

Enhancing CrIS data with VIIRS Cluster Information Supporting NWP Data Assimilation

Enhanced Capabilities: Understanding Upper Troposphere Trending of Trace Gases with CrIS/LEO Hyperspectral IR Soundings

AIRS V7 IR-only CH₄ (lower left) and CrIS CH₄ (lower right) Trends vs Latitudes Compared w GML's in situ (top)

References: Nisbet et al., 2019; 2020
Zhou, Warner, et al., 2022

CrIS CH₄ (ppbv) monthly mean at 400 hPa

In Process to bring it to NESDIS Operation -- Expect to be in Ops Q1 2024!

LEO Continuity: AMSR3/AMSR2 NOAA Unique Algorithms
Science Narratives

The "Global Change Observation Mission" (GCOM)-W1/Advanced Microwave Scanning Radiometer 2 (AMSR2) Algorithm Software Processor (GAASP) produce products including:

- Microwave Brightness Temperature (MBT)
- Total Precipitable Water (TPW)
- Cloud Liquid Water (CLW)
- Sea Surface Temperature (SST)
- Sea Surface Wind Speed (SSW)
- Precipitation Type/Rate (PT/R)
- Snow Cover/Depth (SC/D)
- Snow Water Equivalent (SWE)
- Sea Ice Characterization (SIC)
- Soil Moisture (SM)

AMSR3 has additional channels, primarily geared for cold season precipitation (following GMI heritage):

- NOAA and NASA SME's assisted JAXA in channel specifications
- AMSR-2 (6-9-89 GHz); AMSR-3 (165, two bands at 183 GHz)
- New development work will be required to exploit new channels and improve current product performance

POC: paul.s.chang@noaa.gov (NOAA STAR)

Tropical Storm Iba - March 25, 2019

GCOM AMSR2 Sea Surface Wind Speeds shows winds in excess of 50 knots near the center of the storm.

Sustainment and Enhancement: Prepare to evolve GCOM AMSR2 Algorithm Software Processor (GAASP) to the GOSAT-GW AMSR3 Algorithm Software Processor (GAASP)

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Research to Operation: VIIRS BRDF Product

Parameters	Requirements
Environmental parameter	• 16-day gap filled-snow cleared BRDF albedo at each wavelength • 16-day Gap filled-snow cleared BRDF parameters at each wavelength • 16-day Gap filled-snow cleared BRDF NBAR at each wavelength
Geographical coverage	Global 1 km
Measurement range	0 to 1 km
Measurement accuracy	Required: Shortwave Albedo of 0.05, Nadir reflectance of 0.08 (mean of channels) Expected: Shortwave Albedo of 0.03, Nadir reflectance of 0.05 (mean of channels)
Measurement precision	Required: Albedo of 0.08, Nadir reflectance of 0.1 (mean of channels) Expected: Albedo of 0.05, Nadir reflectance of 0.08 (mean of channels)
Data Latency	72 hours or shorter
Frequency	Weekly or Bi-weekly
Format	NetCDF4

VIIRS BSA map from v2 BRDF data

VIIRS BSA maps for November 20, 2019, March 5, 2021, June 5, 2021, and August 14, 2021.

Shortwave BSA

Shortwave BSA maps for November 20, 2019, March 5, 2021, June 5, 2021, and August 14, 2021.

Users' Feedback:

- NESDIS provided a weekly 1 km BRDF and albedo climatology using VIIRS (S-NPP and NOAA20)
- Processed and re-gridded to 3 km for comparison to current version in UFS-Aerosols
- Improves Middle East Africa and Eastern Asia compared to GEFsV12 and GEFs

New Products for improving the dust model forecasts and vegetation monitoring