Joint Polar Satellite System (JPSS) National Environmental Satellite, Data, and Information Service (NESDIS) Environmental Satellite Processing Center (ESPC) Requirements Document (JERD) Volume 2: Science Requirements

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U.S. Department of Commerce (DOC)
National Oceanic and Atmospheric Administration (NOAA)
National Environmental Satellite, Data, and Information Service (NESDIS)

Approval

Gregory A. Mandt
Director, Joint Polar Satellite System

Date

Change History Log

This record of changes will be initiated once this document has been signed. This document and subsequent versions of this document are maintained under NOAA JPSS Office (NJO) configuration control. Proposed changes to the body of the document will be presented for review and approval to the PCB.

Revision	Date	Sections Changed	Changed	Author
-	3/31/15	Initial Version	New Document incorporating CCR NJO-2014-033A and CCR NJO-2015-001	B. Reed
1.0	7/02/15	Appendix D	Removed one of the duplicate "Blended Biomass Burning (with VIIRS)" rows from the table. (Administrative Change)	Markus Sorrells
1.0	7/02/15	Appendix A	Per CCR NJO-2014-025, "Reallocation of JPSS Active Fires Algorithm", added "Active Fires (VIIRS), ESPC Product Generation – 15 mins" lines to the latency table.	Markus Sorrells
1.0	7/02/15	Appendix B	Per CCR NJO-2014-025, "Reallocation of JPSS Active Fires Algorithm", added "AF – Active Fires and FRP – Fire Radiative Power" to the list of acronyms in Appendix B.	Markus Sorrells
1.0	7/02/15	Paragraph 3.2.5.36	Per CCR NJO-2014-025, Rev D, "Reallocation of JPSS Active Fires Algorithm", Paragraph 3.2.56 was also added to JERD Vol 2.	Markus Sorrells
1.0	7/02/15	Table of Deviations/Waivers	Per CCR NJO-2014-042, Rev A, "Data Product Science Performance Requirements for JPSS (IDPS B2.0 and NDE 2.0) Priority 3 and 4 EDRs", referenced waiver for science performance requirements for IDPS B2.0 and NDE 2.0 subject to pre-operational verification to the algorithm/data product validation maturity as of the 10/6/2014 NOAA JPSS Program Office Letter JPSS-FY14-09-LTR-D-74	Markus Sorrells

1.0	7/02/15	Section 3.2.5.16	Per CCR NJO-2014-034, Rev A, "Vegetation Health Index Suite Horizontal Cell Size change", added a note to the Vegetation Health Index Suite Requirement section to indicate that "the JPSS Program will now create the product at the Objective horizontal cell size level and that it should be verified at the 1 km requirement now. This higher resolution requirement is based on a National Weather Service (NWS) user request and is approved by the LORWG. This objective horizontal cell size requirement will henceforth be flowed down as the baseline requirement to lower level documents."	Markus Sorrells
2.0	2/3/16	Section 2.0	Per CCR NJO-2015-001, "Add software coding standards document to JERD Vol 2", the following changes were approved and signed by the JPSS Director/PCB Director (with caveats for JERD Vol 2 Version 2) on 9/28/15: Proposed Solution: Add a reference to the SPSRB Software and Coding Standards web page in the "Applicable Document" section of the JERD Volume 2. Also, include a link to the Standards/Best Practices Memo. SPSRB Software and Coding Standards: http://projects.osd.noaa.gov/SPSRB/standards_software_coding.htm Memo on Standards/Best Practices for Application Deployment on ESPC Systems: http://projects.osd.noaa.gov/SPSRB/doc/Stds_Best_Practices_Signed.pdf	Bonnie Reed
2.0	2/3/16	Throughout 3.2.5	Per CCR NJO-2015-018, Rev C, "Reallocation of all Priority 3 & 4 Products to NDE", per 8/20/15 PCB pending approval and 30 Sept 2015 Direction letter from JPSS Director to NASA.	Bonnie Reed
2.0	2/3/16	Appendix D	Per CCR NJO-2015-022, Rev D, "Add ATMS data stream to the blended product: Multiplatform Tropical Cyclone Surface Wind Analysis product and update the JERD Vol 2, which received a pending approval from the 11/30/15 PCB, add Multiplatform Tropical Cyclone Surface Wind Analysis product to JERD Vol 2 (Appendix D).	Markus Sorrells

2.0	2/3/16	Appendix A JPSS Data products allocated to ESPC	Per CCR NJO-2015-033, "Reallocation Administrative Table Updates to the Supplement and JERD", which was recommended by the 11/20/15 ERB to be submitted for OOB PCB Chair Approval Signature, administratively includes table updates with the Priority 3/4 Reallocation CCR to ensure consistency across the documentation. Please see the updated tables as attachments to this CCR where red changes indicate the Priority 3/4 CCR updates. Program Systems Engineering requests that these be included before final PCB approval such that consistency is maintained.	Markus Sorrells
2.0	2/3/16	Appendix D	Per CCR NJO-2016-002, Rev A, "Add AMSR-2 data stream to the blended product: Advanced Dvorak Technique (ADT) and update the Blended Product listing in the JERD Vol 2", add "Advanced Dvorak Technique (with AMSR-2)" to the Blended Products table in the JERD Vol 2 (Appendix D).	Markus Sorrells
2.0	2/3/16	Throughout 3.2.5	Per CCR NJO-2016-004, "Administrative Update for the JERD Vol. 1 and Vol. 2", which was submitted for PCB Chair OOB Approval signature on 1/15/16, adds the OMPS NP and TC requirements into JEDR Vol 2.	Bonnie Reed
2.0	2/24/16	Throughout 3.2.5	Per CCR NJO-2016-006, "Administrative Update for the JERD Vol. 2", was reviewed at 2/19/16 ERB who recommended incorporation of changes into JERD vol 2 version 2.0. No PCB submission recommended (JERD will be approved and signed by JPSS Director). This complements the other administrative changes approved above.	Bonnie Reed
2.0	2/24/16	3.2.5.1	TBD removed and replaced with "5 km."	Bonnie Reed
2.0	3/3/16	3.2.1	Restructured section 3.2.5 to list the EDRs in alphabetical order.	Bonnie Reed
2.0	3/8/16	Paragraph 3.2.5.36	Changed this to Paragraph 3.2.5.3 so that the products were alphabetized in Section 3.2.5	Bonnie Reed
2.0	3/8/16	Paragraph 3.2.5.16	Changed this to Paragraph 3.2.5.27 so that the products were alphabetized in Section 3.2.5	Bonnie Reed
3.0	5/25/16	Waiver	CCR NJO-2016-012, "Flow Down Level 1 Priority 3/4 EDR Performance Relief to the JERD Vol. 2"	Markus Sorrells

3.0	10/11/16	Section 3.1, page 9	Per NJO-2015-015, Rev C, "AMSR2 Data Delivery in Block 2.0 for NDE 2.0 Processing", Edit the following GCOM-W1 and AMSR-2 requirements to match the change for receipt of AMSR2 APID Sorted Data Files delivered from IDPS: JERD-2024	Markus Sorrells
3.0	12/22/16	Waiver	Per NJO-2016-029, Rev A, "Waiver for JERD Vol 2 Requirements 1739 and 2026 to Comply with NetCDF Format (Waiver Effectivity for only 6 months)"	Markus Sorrells
3.0	2/16/17	Waiver	CCR NJO-2017-006, "Waiver for JERD-2335" was approved by 2/16/17 PCB and signed by PCB Chair Waive JERD-2335 for the blended products listed in order to provide sufficient time for STAR development and testing and for OSPO integration, testing, and operationalization. Specifically, defer the verification of the Blended Sea Surface Temperature, Blended Ozone, and Blended Biomass Burning products for one year and waive the verification of the Blended Snow Cover and Blended Land Surface Temperature products indefinitely.	Markus Sorrells
3.0	3/22/17	Section 3.2.5.3, page 11	Per CCR NJO-2016-027, "Waiver of Science Performance Requirements for Land Surface Emissivity" Waive L1RD-S requirement (L1RDS-2475) and JERD requirement (JERD-2043)	Markus Sorrells
3.0	6/15/17	Page 3	Per CCR NJO-2017-011, Rev A, "Admin CCR: Updating JERD Vol 1 and Vol 2 with list of Key Performance Parameters (KPPs)" Modify the text in both volumes of the JERD to KPP language reflected in other JPSS L1 documents.	
3.0	12/13/17	Paragraph 3.2.5 and Appendix A	Per CCR NJO-2016-015, Rev C, "Addition of OMPS Limb Profiler SDR and EDR product requirements for S-NPP" 1) Added the OMPS Limb Profiler SDR description and requirements to the JERD Vol 2 at the end of section 3.2.5. 2) Added the Ozone Limb Profiler EDR description and requirements to the JERD Vol 2 at the end of section 3.2.5 (following the OMPS Limb Profiler SDR section) 3) Added the OMPS Limb Profiler SDR and EDR to the JERD Vol 2 Appendix A, "JPSS Data Products Allocated to ESPC".	Markus Sorrells

3.0	12/14/17	Section 3.2.5.43; Appendix A,;	Per CCR NJO-2016-018, "Addition of ATMS Snowfall Rate product requirements for S-NPP and JPSS" Added new subsection to Section 3.2 EDR Performance and Appendix A.	
3.0	12/14/17	Section 3.2.2,; Appendix A;	Per CCR NJO-2016-021, Rev A, "Removal of Surface Type EDR Requirement from GCOM-W1 L1RD" The word "Surface Type" has to be removed from section 3.2.2, the section 3.2.5.51 AMSR-2 Surface Type has to be removed and from Appendix A, the rows for Surface Type (AMSR 2/3) have to be removed.	
3.0	12/14/17	Section 3.2.5.28; Appendix A,	Per CCR NJO-2016-030, Rev A, "Moving NDE Vegetation Products to GVF Grid" Updates the Vegetation Indices Data Products	
3.0	12/14/17	Section 3.2.5.2;	Per CCR NJO-2017-007, Rev B, "Administrative changes to product documentation-2" Updates the ATMS Imagery description	
3.0	12/14/17	Section 3.2.5.19; 3.2.5.24;	Per CCR NJO-2017-014, "Global Gridded Land Surface Temperature and Albedo Product Suite" Adds requirements to VIIRS Surface Albedo and VIIRS Land Surface Temperature Products Per 3/1/18 discussion with Arron Laynes, decision was made not to include these requirements within this version of the JERD, but to ensure they are captured in STAR's Requirement Allocation Document (RAD)	
3.0 - Cancelled	TBD	ALL	This document was cancelled by 470-CCR-18-0266, which was approved by the JPSS Program ERB on TBD and by the JPSS Program CCB on TBD.	

Table of TBDs/TBRs

Item No.	Location	Summary	Individual/ Organization	Due Date
		TBDs		
1	3.2.2	Note, the following AMSR-2 products are TBD: Snow Cover/Depth, Snow Water Equivalent, Soil Moisture, Sea Ice Characterization	L. Zhou/STAR	April 2015
		TBRs		

Table of Deviations/Waivers

Item No.	Deviation/Waiver	Waiver Approved	Effectivity
1	Waive the science performance requirements for all JPSS-1 Priority 3 and 4 data products and the Ocean Color EDR for IDPS B2.0 and NDE 2.0 subject to pre-operational verification to the algorithm/data product performance represented by the documented S-NPP data product validation maturity as of the 10/6/2014 NOAA JPSS Program Office Letter JPSS-FY14-09-LTR-D-74. Links to the performance artifacts describing the documented validation maturity for each applicable data product are included in the following worksheet.  NJO-2014-042, DD1694 Tab A - IDPS	NOSC Concurred with Waiver on 6/10/15	Three (3) years from the date of IDPS B2.0 and NDE 2.0 transition to operations (TTO). (April 2020)
2	Waive the following JERD Vol. 2 performance requirements applicable to Priority 3 and 4 EDRs and the Ocean Color EDR to their S-NPP performance maturity: JERD-145, JERD-2030, JERD-2031, JERD-2033, JERD-2036, JERD-2038, JERD-2050, JERD-2051, JERD-2052, JERD-2053, JERD-2057, JERD-2058, JERD-2059, JERD-2060, JERD-2061, JERD-2062, JERD-2066, JERD-2067, JERD-2068, JERD-2072, JERD-2073, JERD-2074, JERD-2075, JERD-2079, JERD-2080, JERD-2081, JERD-2082, JERD-2083, JERD-2087, JERD-2088, JERD-2089, JERD-2092, JERD-2093, JERD-2094, JERD-2095, JERD-2099, JERD-2100, JERD-2101, JERD-2105, JERD-2106, JERD-2107, JERD-2108, JERD-2109, JERD-2113, JERD-2114, JERD-2115, JERD-2116, JERD-2128, JERD-2129, JERD-2130, JERD-2131, JERD-2132, JERD-2133, JERD-2134, JERD-2135, JERD-2157, JERD-2158, JERD-2159, JERD-2160, JERD-2164, JERD-2165, JERD-2166, JERD-2167, JERD-2168, JERD-2169, JERD-2173, JERD-2174, JERD-2175, JERD-2176, JERD-2177,	Approved OOB by PCB Chair 5/25/16	Until NDE 2.0 TTO plus three years (April 2020)

	JERD-2178, JERD-2182, JERD-2183, JERD-2184, JERD-2185, JERD-2186, JERD-2187, JERD-2191, JERD-2192, JERD-2193, JERD-2194, JERD-2195, JERD-2196, JERD-2200, JERD-2201, JERD-2202, JERD-2203, JERD-2204, JERD-2205, JERD-2209, JERD-2210, JERD-2211, JERD-2212, JERD-2213, JERD-2214, JERD-2219, JERD-2220, JERD-2221, JERD-2222, JERD-2223, JERD-2224, JERD-2225, JERD-2231, JERD-2232, JERD-2233, JERD-2234, JERD-2235, JERD-2236, JERD-2240, JERD-2241, JERD-2242, JERD-2243, JERD-2244, JERD-2245, JERD-2246, JERD-2247, JERD-2253, JERD-2254, JERD-2255, JERD-2256, JERD-2257, JERD-2258, JERD-2259, JERD-2263, JERD-2264, JERD-2265, JERD-2266, JERD-2267, JERD-2268, JERD-2272, JERD-2273, JERD-2274, JERD-2275, JERD-2276, JERD-2277, JERD-2278, JERD-2282, JERD-2283, JERD-2284, JERD-2285, JERD-2286, JERD-2287, JERD-2291, JERD-2292, JERD-2293, JERD-2294, JERD-2295, JERD-2299, JERD-2300, JERD-2301, JERD-2302, JERD-2303, JERD-2304, JERD-2308, JERD-2309, JERD-2310, JERD-2311, JERD-2312, JERD-2313, JERD-2314, JERD-2315, JERD-2319, JERD-2320, JERD-2321, JERD-2322, JERD-2323, JERD-2324, JERD-2325, JERD-2329, JERD-2330, JERD-2331, JERD-2332, JERD-2333  NJO-2016-012, Pri 3-4 Waiver Flowdowr		
3	Waive JERD-2335 for the blended products listed in order to provide sufficient time for STAR development and testing and for OSPO integration, testing, and operationalization. Specifically, defer the verification of the Blended Sea Surface Temperature, Blended Ozone, and Blended Biomass Burning products for one year and waive the verification of the Blended Snow Cover and Blended Land Surface Temperature products indefinitely.  NJO-2017-006, Waiver for JERD-233 Reference CCR NJO-2017-006	2/16/17 PCB Approved and signed CCR NJO-2017-006 and Waiver	Through December 31, 2017 This waiver is now expired.
4	Waive L1RD-S requirement (L1RDS-2475) and JERD requirement (JERD-2043)  NJO-2016-027, Waiver of Science Pe	NOSC Concurred with Waiver on 3/22/17	Indefinite. An additional CCR is in progress to revise the requirement and correct this inaccuracy for future verification events.

5	Waive JERD-1739 and JERD-2026 in order to provide sufficient time for STAR development and testing and for OSPO integration, testing, and operationalization. Approval of this waiver results in an exception to the L1RD Supplement parent requirement [L1RDS-2261) associated with these two JERD Vol. 2 requirements for JPSS-1/NDE 2.0 verification purposes.  NJO-2016-029, Rev A, NetCDF Complianc	12/22/16: PCB Chair approved and signed associated CCR to this waiver.	Effective for 6 months (until 6/22/17) This waiver is expired.

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1 INTRODUCTION

The Joint Polar Satellite System (JPSS) is the National Oceanic and Atmospheric Administration's (NOAA) next-generation operational Earth observation program that acquires and distributes global environmental data primarily from multiple polar-orbiting satellites. The program plays a critical role to NOAA's mission. The JPSS provides operational continuity of satellite-based observations and products for the Suomi National Polar-orbiting Partnership (S-NPP) satellite, JPSS satellites, and GCOM-W missions.

The JPSS Ground Segment is comprised of the JPSS Ground System (JPSS GS) and the Environmental Satellite Processing Center (ESPC). The JPSS Ground Segment's primary command and control and data processing center will be located at the NOAA Satellite Operations Facility (NSOF) in Suitland, MD. The JPSS alternate command and control and data processing site will be located in the Vertex Center in Fairmont, WV.

The ESPC is the system operated by the Office of Satellite and Product Operations (OSPO) that provides data processing. The JPSS ESPC Requirements Document (JERD), Volumes 1 and 2, is responsive to both the JPSS Program Level 1 Requirements and the JPSS Program Level 1 Supplement.

This document is a level 2 requirements document that allocates and flows down science requirements to the Office of Systems Development/Office of Satellite Ground Services (OSD/OSGS) and the Center for Satellite Applications and Research (STAR). STAR is responsible for science performance verification, with the exception of blended products. Figure 1 below provides an example of where this Level 2 document fits within the JPSS document hierarchy.

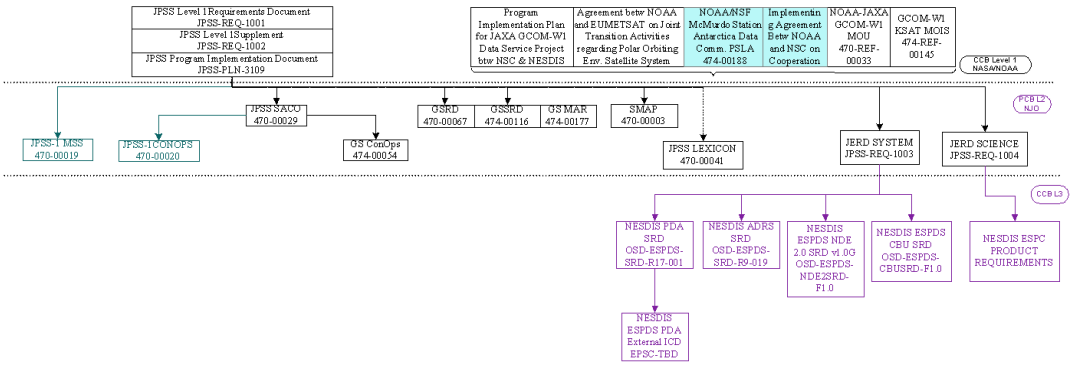

Figure 1. JERD in JPSS Document Hierarchy

1.1 Purpose

The purpose of this document is to identify the science requirements associated with the products allocated to ESPC.

1.2 Scope

This document contains the science requirements for JPSS products that have been allocated to the ESPC as captured in the JPSS Program Implementation Document (PID). The JPSS top level requirements are captured in the JPSS Level 1 Requirements Document (L1RD) and JPSS L1RD Supplement (L1RDS), which is limited to the J1 acquisition baseline. The JPSS ESPC Requirements Document (JERD), a Level 2 document, is responsive to both the JPSS L1RD and L1RDS to allocate and flow down requirements to the ESPC. This document describes the JPSS Environmental Data Records (EDRs) at a high level.

1.3 System Overview

1.3.1 JPSS System Description

The JPSS Program, which constitutes the next series of US civilian polar orbiting environmental sensing satellites, and sensor types that have been flown historically on polar satellites, will implement NOAA's requirements for collection of global multi-spectral radiometry and other specialized meteorological, oceanographic, and solar-geophysical data via remote sensing of land, sea, and atmospheric data. These data will support NOAA's mission for continuous observation of the Earth's environment necessary to understand and predict changes in weather, climate, oceans and coasts, and the space environment that support the Nation's economy, and protect lives and property. The JPSS Program will also provide operational continuity of satellite-based observations and products for NOAA's Polar-orbiting Operational Environmental Satellites (POES) and the NASA Earth Observing System (EOS) satellites.

1.3.2 JPSS Context Diagram

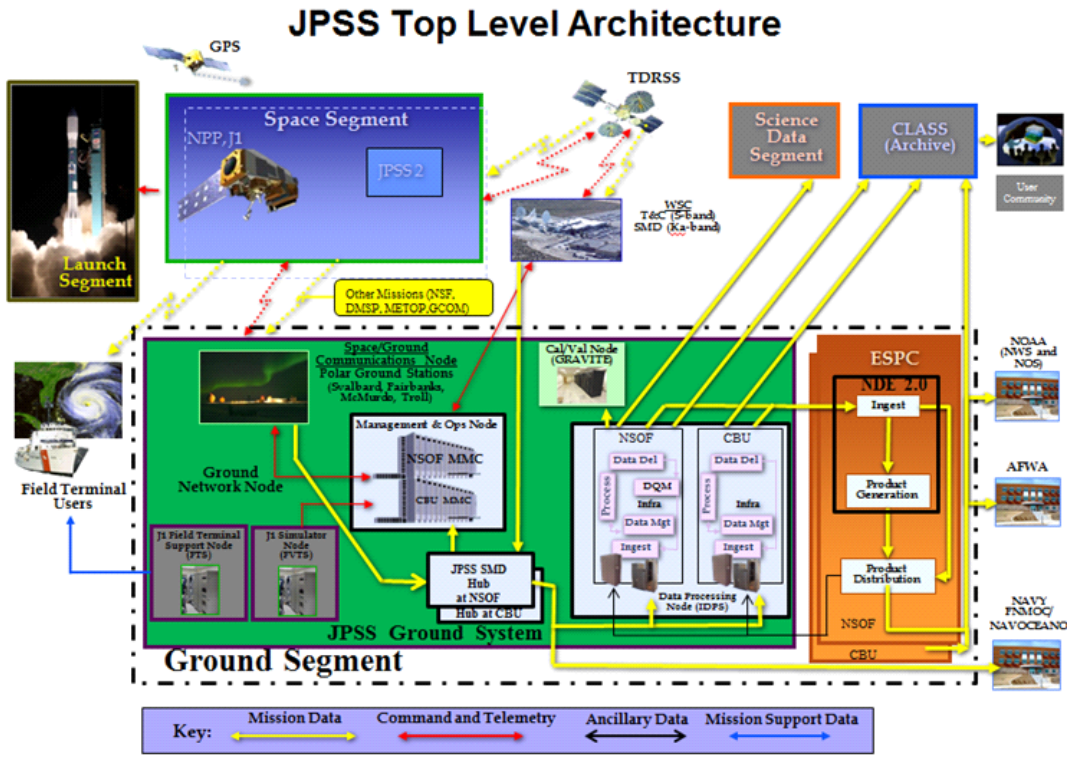

Figure 2. JPSS 1 Context Diagram

1.3.3 JPSS System Architecture

The Joint Polar Satellite System is comprised of the JPSS missions and other missions that support the fulfillment of the requirements in the JPSS L1RD Supported Missions. The JPSS missions utilize the JPSS Space Segment, JPSS Launch Support Segment, JPSS Ground System, and the JPSS Ground Segment.

JPSS will provide a variety of environmental observations from the 1330 Local Time of the Ascending Node (LTAN) orbit. The users will depend on the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT)'s Metop satellites to provide data in the 2130 LTAN orbit (0930 Descending Node). Additionally, the JPSS will acquire and process data from the Japanese Aerospace Exploration Agency (JAXA)'s Global Change Observation Missions (GCOM). Collectively, these missions are designed to fulfill the EDR requirements specified in the NOAA L1RD and the L1RDS. KPPs are system attributes that represent those minimum capabilities or characteristics considered most essential to achieve an effective system. Failure to meet a KPP attribute threshold may result in a reevaluation of the program. The JPSS KPPs are:

- ATMS Temperature Data Records (TDRs)
- CrIS Sensor Data Records (SDRs)

- For latitudes greater than 60oN in the Alaskan region, VIIRS Imagery EDRs at 0.64 µm (I1), 1.61 µm (I3), 3.74 µm (I4), 11.45 µm (I5), 8.55 µm (M14), 10.763 µm (M15), 12.03 µm (M16), and the 0.7 µm Near-Constant Contrast (NCC) EDR
- 87 minute data latency for the ATMS and CrIS SDRs and the VIIRS Imagery EDR channels specified above

1.3.4 JPSS Space Segment

Capitalizing on the success of Suomi National Polar-orbiting Partnership (S-NPP), the JPSS-1 spacecraft will also host the five instruments currently manifested on S-NPP: Visible Infrared Imaging Radiometer Suite (VIIRS); Cross-track Infrared Sounder (CrIS); Advanced Technology Microwave Sounder (ATMS); Ozone Mapper and Profiler Suite-Nadir (OMPS-N) and the Clouds and Earth's Radiant Energy System (CERES). JPSS-1 is scheduled to launch in early 2017. JPSS-1 will take advantage of the successful technologies developed through the Suomi S-NPP satellite. JPSS-1's design life is seven years, and it is scheduled to launch aboard a Delta-II Launch Vehicle. JPSS-2 is scheduled to be launched in 2021. The same instruments currently hosted on JPSS-1 will be hosted on JPSS-2. JPSS-2 will provide accommodations for the Radiation Budget Instrument (RBI) and OMPS OMPS-Limb (OMPS-L) if agreement is reached with NASA.

1.3.5 JPSS Ground Segment

The JPSS Ground Segment is a shared ground infrastructure consisting of multiple subsystems that support a heterogeneous constellation of polar-orbiting satellites, both JPSS Missions and JPSS Supported Missions, through a comprehensive set of services.

1.3.5.1 JPSS Ground System

The services provided by the JPSS Ground System include Enterprise Management and Ground Operations, Flight Operations, Data Acquisition, Data Routing, Data Product Generation, Data Product Calibration and Validation, and Direct Readout Support. Traditional NOAA systems and facilities that form a part of the JPSS Ground Segment include the NOAA Satellite Operations Facility (NSOF), the Consolidated Back Up (CBU) facility, and the Environmental Satellite Processing Center (ESPC). The NOAA Comprehensive Large Array-data Stewardship System (CLASS) is not a part of the JPSS Ground Segment.

1.3.5.2 Environmental Satellite Processing Center (ESPC)

The ESPC is NOAA's primary data-processing system for the Nation's environmental satellite data; the ESPC primary location is at the NSOF in Suitland, MD. The ESPC ingests, processes, and distributes environmental data and information received from all of NOAA's satellites, several foreign countries' satellites and the Department of Defense's Defense Meteorological Satellite Program (DMSP) satellites. The ESPC includes the operational satellite data distribution network that provides NESDIS'' customers access to real-time/near real-time environmental data and information on a continuous (24 hours per day/7 days per week) basis.

The primary product applications are near real-time imagery, interactive products, and automated products.

The ESPC consists of four primary segments: Ingest, Product Generation, Product Distribution, and Infrastructure.

Ingest Segment

The Ingest Segment receives (ingests) satellite data from the NOAA geostationary and polar satellites, selected NASA and DoD satellites, and foreign government environmental satellites by a variety of methods ranging from direct receipt via an antenna on the roof of NSOF to file transfers from other organizations. The ESPC system will receive data products from the JPSS Ground System and ancillary/auxiliary data from external, non-ESPC sources. Ancillary data is critical to the processing and generation of many ESPC products. This data includes but is not limited to Numerical Weather Prediction (NWP) models produced by the National Weather Service, surface observations from the Automated Surface Observing System (ASOS) network, observations from upper-air soundings from radiosondes, and in situ observations from ships, buoys, and aircraft.

Product Generation Segment

The Product Generation Segment processes and packages mission data to meet user requirements. The ESPC will process JPSS and Global Change Observation Mission (GCOM) mission data into sensor and environmental data products, repackage sensor and environmental data products received from the JPSS Ground System, and provide data compression services to meet user requirements.

Product Distribution Segment

The Product Distribution Segment exchanges mission data, data products, and ancillary and auxiliary data between ESPC internal processing systems and external users systems mission data, data products, and ancillary and auxiliary data. It includes a user service function that provides an automated interface enabling authorized users to search and request data products (subscription and ad hoc) and provides status on the request. The ESPC provides a "push/pull" data transfer capability to make xDRs and data available to users.

Infrastructure Segment

The Infrastructure Segment provides common services that support the other segments, including communications network, data storage, resource management and security functionality to communicate between all ground segment and external entities. It consists of communication servers equipment (e.g., switches, routers), distributed Local Area Networks, Wide-Area Network, point-to-point copper and fiber connections, Network Attached Storage, Storage Area Networks, and network security systems (e.g., firewalls, intrusion detection and

prevention, system logging, and account management). The ESPC provides some of these capabilities. Additional capabilities are provided as a part of the facility (e.g., NSOF), or by other users.

2 DOCUMENTATION ORGANIZATION

Section 1 provides information regarding the scope, purpose, background and organization of this document.

Section 2 lists applicable and reference documents that were used as sources of information for this document or that provide additional background information to aid understanding of the requirements. Applicable documents are documents from which this document was derived. Reference documents are documents that amplify or clarify the information contained in this document.

Section 3 contains the NESDIS science performance requirements that apply to the JPSS only. This section identifies the JPSS data product performance requirements from the JPSS L1RDS that are allocated to the ESPC.

The appendices contain JPSS products allocated to ESPC, Acronym Lists, and Definitions.

2.1 Applicable Documents

The ESPC must be compliant with the following documents:

JPSS-REQ-1001 JPSS Level-1 Requirements Document Version 1.8, June 25, 2014

JPSS-REQ-1002 JPSS Level-1 Requirements Document Supplement Version 2.10, June 25, 2014

JPSS-PLN-3109 JPSS Program Implementation Document (PID) (JPSS-PLN-3109) version 1.9 May 23, 2013

Joint Polar Satellite System (JPSS) Ground System to National Environmental Satellite, Data, and Information Service (NESDIS) Environmental Satellite Processing Center (ESPC) Interface Requirements Document (474-00303) Volume 1

Joint Polar Satellite System (JPSS) Common Ground System to National Environmental Satellite, Data and Information Service (NESDIS) Environmental Satellite Processing Center (ESPC) Interface Control Document (474-00411)

ISO 19115 Metadata Standard for Geographic Information ISO 19115 effective May 1, 2003

ISO 19115-2 Metadata Standard for Geographic Information, Part 2: Extensions for Imagery and Gridded Data effective April 7, 2008

SPSRB Policy on NetCDF, January 14, 2009
(http://projects.osd.noaa.gov/SPSRB/standards_docs/SPSRB_NetCDF_Policy.pdf)

Standards for Algorithm Delivery and Integration Using Delivered Algorithm Packages (DAPs), ESPDS-DAP-WA2-DOC-1.4

NetCDF Climate and Forecast (CF) Metadata Conventions, Version 1.6, 5 December 2011

SPSRB Software and Coding Standards (http://projects.osd.noaa.gov/SPSRB/standards_software_coding.htm):

- General Programming Principles and Guidelines, Version 2.0, September 2010.
- Standards, Guidelines and Recommendations for Writing Fortran 77 Code, Version 2.0, September 2010.
- Standards, Guidelines and Recommendations for Writing Fortran 90/95 Code, Version 2.0, August 2010.
- Standards, Guidelines and Recommendations for Writing C Code, Version 1.0, September 2010.
- Standards, Guidelines and Recommendations for Writing C++ Code, Version 1.0, December 2011.

Memo on Standards/Best Practices for Application Deployment on ESPC Systems, January 28, 2013: http://projects.osd.noaa.gov/SPSRB/doc/Stds_Best_Practices_Signed.pdf

2.2 Reference Documents

The following documents provide additional information:

470-00067-02 Joint Polar Satellite System (JPSS) Ground System Requirements Document (GSRD) Volume 2 – Science Products Specification Rev-A, March 27, 2014

470-00019 Joint Polar Satellite System (JPSS)-1 Mission System Specification Rev-E, September 24, 2014

470-REF-00033 Memorandum of Understanding (MOU) Between National Oceanic and Atmospheric Administration (NOAA) and Japanese Aerospace Exploration Agency (JAXA) in Relation to the Cooperation for the GCOM-W1 Rev- 7/18/11

JPSS Common Data Format Control Book (CDFCB) Volumes I through VI (474-00001-01 Rev C, 6/21/12, 474-00001-02 Rev D, 6/21/12, 474-00001-03 Rev C, 6/21/12, 474-00001-04 This has many parts. Part 01 is Rev A, 11/30/11, 474-00001-05 Rev C, 6/21/12, 474-00001-06 Rev B, 6/21/12) (Note: These CDFCB references are applicable to the pre-B2.0 ground system)

Environmental Satellite Processing and Distribution System (ESPDS) Development Global Change Observation Mission – Water (GCOM-W1) System Requirements Document Rev- 30 April 2012 (included in Project Plan)

Department of Commerce IT Security Program Policy and Minimum Implementation Standards

The Memorandum of Agreement for Data Acquisition, Processing and Exchange (DAPE) Rev- 24 Sep 2008

Initial Joint Polar System (IJPS) Memorandum of Agreement (MOA)

MOA between NOAA and EUMETSAT for Joint Transition Activities (JTA).

ESPDS-DAP-WA2-DOC-1.0, Standards for Algorithm Delivery and 254 Integration Using Delivered Algorithm Packages (DAPs)

IETF RFC 2460 Standards for Internet Protocol routing as defined in accordance with IETF RFC 2460 – Internet Protocol. Ipv6 compatibility is required in accordance with US Executive Order 893, effective June 2010

474-REF-00151 Global Change Observation Mission Water (GCOM-W1) AMSR2 Level 1 Product (A, B, and R) Format Specification for the GCOM-W1 Rev- 10/8/2011

470-00041 Joint Polar Satellite System (JPSS) Program Lexicon Rev A

3 REQUIREMENTS

This document contains the ESPC science performance requirements that apply only to the Joint Polar Satellite System (JPSS) and blended products generated within the ESPC using JPSS and GCOM-W data. This document does not apply to other missions which the ESPC supports.

3.1 General Requirements

JERD-2022 The science products shall be designed to be integrated into the ESPC.

JERD-2023 The science products shall use ancillary data available through Product Distribution and Access (PDA).

JERD-2024 The science products shall use data (xDRs and ASD files) from the Infrastructure Segment and the Interface Data Processing Segment (IDPS).

JERD-2025 All science products shall be produced in NetCDF4 format.

JERD-1739 The science products shall include metadata that are compatible with the NetCDF Climate and Forecast (CF) Metadata Conventions.

JERD-2026 The science product geolocation latitude and longitude shall comply with the NetCDF Climate and Forecast (CF) Metadata Conventions.

JERD-2027 The science algorithm along with the NDE 2.0 IT resources shall produce products within the latency identified in Appendix A.

Note: the requirement above is a shared requirement between the NDE 2.0 IT resources and the science algorithm performance.

3.2 Science Products Performance

3.2.1 Normal Conditions

JERD-145 The science products (EDRs) produced by the NESDIS ESPC shall meet the data product performance requirements as specified in the JPSS Level-1 Requirements Document-Supplement unless an exclusion or degradation condition occurs.

JERD-2030 The EDR Accuracy, Precision, Uncertainty (APU) and Probability of Correct Typing (PCT) performance shall be assessed and validated against their requirements using correlative data.

JERD-2031 APU and PCT requirements shall apply only within the specified Measurement Range.

3.2.2 Quality Flags

JERD-2033 The science products shall include a quality flag describing the quality of the retrieval, with the exception of those products listed below:
- Green Vegetation Fraction
- Ocean Color/Chlorophyll

Note, the following AMSR-2 products are TBD: Snow Cover/Depth, Snow Water Equivalent, Soil Moisture, and Sea Ice Characterization.

3.2.3 Degraded Conditions

JERD-2036 Retrieved values within a product that are described by Degradation Conditions shall be identified.

3.2.4 Excluded Conditions

JERD-2038 Unless otherwise indicated for an EDR and where possible, retrieved values that are described by Exclusion Conditions shall be identified.

3.2.5 EDR Performance

The following requirements apply to all environmental data derived from the JPSS data stream and made available via the external interfaces to JPSS data consumers and users. See Appendix A for a table of JPSS Data Products allocated to NDE 2.0.

3.2.5.1 ATMS Cloud Liquid Water

Cloud Liquid Water is defined as the equivalent amount of water within a cloud in a specified segment of a vertical column of the atmosphere.

JERD-2087 The algorithm shall produce a cloud liquid water product that has a horizontal cell size of 15 km at nadir.

JERD-2088 The algorithm shall produce a cloud liquid water product that has a measurement precision of 0.08 mm over sea.

JERD-2089 The algorithm shall produce a cloud liquid water product that has a measurement accuracy of 0.03 mm over sea.

3.2.5.2 ATMS Imagery

The ATMS image is a limb-corrected nadir view of the ATMS TDR. The nadir view images enable weather forecaster to obtain the information content about severe weather such as the warm core structure of tropical cyclones.

JERD-2079 The algorithm shall produce an imagery product under all weather conditions.

JERD-2080 The algorithm shall produce an imagery product at each channels highest native resolution.

JERD-2081 The algorithm shall produce an imagery product where all channels are vertically and horizontally polarized.

JERD-2082 The algorithm shall produce an imagery product that has a horizontal reporting interval of 15 km at nadir.

JERD-2083 The algorithm shall produce an imagery product that has a mapping uncertainty (3 sigma) of 5 km.

Notes:
1. Imagery EDRs are brightness temperature data from each microwave channel displayed at the original TDR resolution

3.2.5.3 ATMS Land Surface Emissivity

Land Surface Emissivity is the relative ability of the land surface to emit energy by radiation.

JERD-2043 The algorithm shall produce a land surface emissivity that has a horizontal cell size of 15 km at nadir.

JERD-2045 The algorithm shall produce a land surface emissivity that has a measurement precision of:
3.0% for 23.8 GHz (V-pol),
3.0% for 50.3 GHz (H-Pol), and
4.0% for 165.5 GHz (H-Pol).

JERD-2046 The algorithm shall produce a land surface emissivity that has a measurement accuracy of:
2.0% for 23.8 GHz (V-pol),
1.5% for 50.3 GHz (H-Pol), and
1.5% for 165.5 GHz (H-Pol).

Notes:
1. Those performances are relative to a derived analytical emissivity based on the Global Data Assimilation System (GDAS) products.
2. The emissivity performance is for snow-free land surfaces.
3. The reported emissivity properties are a composite performance over all the ATMS zenith angles (-65 to 65 deg).
4. The described performances include the Microwave Integrated Retrieval System (MiRS) algorithm performance, as well as the collocation error, the instrument noise and the errors inherent to the reference used to measure the performances.
5. This performance assessment does not include precipitating cases, but does include cloud contaminated points.
6. Refresh, coverage and horizontal size are all dependent on the refresh, coverage and horizontal size of the brightness temperatures measurements. The MiRS algorithm outputs characteristics will reproduce the brightness temperature (TB) characteristics of these factors.

3.2.5.4 ATMS Land Surface Temperature

Land Surface Temperature (LST) is defined as the sensor-facing skin temperature of the land surface. It includes the aggregate temperature of objects comprising the land surface, including any open water, in the cell. Surface temperature information is needed for NWP and hydrological modeling, automated cloud analysis, and for general operations (i.e., wind chill temperatures and heat stress factors). LST is also used to support rescue operations.

JERD-2072 The algorithm shall produce a land surface temperature product that has horizontal reporting interval of 15 km at nadir.

JERD-2073 The algorithm shall produce a land surface temperature product that has a measurement precision of 7.0 K in clear and cloudy conditions.

JERD-2074 The algorithm shall produce a land surface temperature product that has a measurement accuracy of 4.0 K in clear and cloudy conditions.

JERD-2075 The algorithm shall produce a land surface temperature product that has a measurement uncertainty of 8.0 K in clear and cloudy conditions.

Notes:
1. Those performances are relative to the European Centre for Medium-Range Weather Forecasts (ECMWF) model.
2. The described performances include the MiRS algorithm performance, as well as the collocation error, the instrument noise and the errors inherent to the reference used to measure the performances.
3. Refresh, coverage and horizontal size are all dependent on the refresh, coverage and horizontal size of the brightness temperatures measurements. The MiRS algorithm outputs characteristics will reproduce the TB characteristics of these factors.

3.2.5.5 ATMS Moisture Profile

An Atmospheric Vertical Moisture Profile (AVMP) is a calculation of the mixing ratio at specified points along a local vertical. The mixing ratio of a sample of air is the ratio of the mass of water vapor in the sample to the mass of dry air in the sample.

For requirements in which both a percentage value and an absolute value of the mixing ratio are supplied, the requirement is to be interpreted as the greater of the values. The horizontal and vertical cell sizes indicate the dimensions of three-dimensional cells over which the ground truth environmental parameters are averaged for verification.

Atmospheric profiles of moisture provide very important information for weather forecasting. Moisture profiles are used to determine the vertical and horizontal extent of clouds, to confirm NWP output, and to determine atmospheric stability condition.

JERD-2050 The algorithm shall produce a moisture profile that has a horizontal reporting interval of 15 km at nadir.

JERD-2051 The algorithm shall produce a moisture profile that has a vertical reporting interval from the surface to 0.01 mb.

JERD-2052 The algorithm shall produce a moisture profile that has a measurement precision of (Note 6):
60% at 400 mb, 60 % at 500 mb, 50% at 700 mb, and 30 % at 900 mb for clear sea scenes.
60% at 400 mb, 65 % at 500 mb, 60% at 700 mb, and 30 % at 900 mb for cloudy sea scenes.
60% at 400 mb, 60 % at 500 mb, 50% at 700 mb, and 50 % at 900 mb for both clear and cloudy land scenes.

JERD-2053 The algorithm shall produce a moisture profile that has a measurement accuracy of (Note 6):
30% at 400 mb, 20 % at 500 mb, 20% at 700 mb, and 20 % at 900 mb for clear sea scenes.
30% at 400 mb, 20 % at 500 mb, 10% at 700 mb, and 20 % at 900 mb for cloudy sea scenes.
30% at 400 mb, 10 % at 500 mb, 10% at 700 mb, and 20 % at 900 mb for both clear and cloudy land scenes.

Notes:
1. Those performances are relative to the GDAS.
2. The performances are for all non-rainy conditions, including clear and cloudy.
3. The performances are for individual layers (not averaged vertically).
4. The pressure values are averaged layer values.
5. The described performances include the MiRS algorithm performance, as well as the collocation error, the instrument noise and the errors inherent to the reference used to measure the performances.
6. Sea performances are assumed ice-free and Land performances are assumed over snow-free land.
7. Refresh, coverage and horizontal size are all dependent on the refresh, coverage and horizontal size of the brightness temperatures measurements. The MiRS algorithm outputs characteristics will reproduce the TB characteristics of these factors.

3.2.5.6 ATMS Rainfall Rate

Rainfall Rate is defined as the amount of rainfall during a period of time. The required Rainfall Rate products provide the instantaneous rainfall rate during the time of observation in mm/hour. Satellite-derived rainfall rate data provides information on the severity and evolution of rainfall events, especially in geographic areas without surface-based radar coverage.

JERD-2057 The algorithm shall produce a rain rate product that has a horizontal cell size of 15 km at nadir.

JERD-2058 The algorithm shall produce a rain rate product that has a measurement precision of 1.0 mm/h over sea and 1.5 mm/h over land.

JERD-2059 The algorithm shall produce a rain rate product that has a measurement accuracy of 0.10 mm/h over sea and 0.05 mm/h over land.

JERD-2060 The algorithm shall produce a rain rate product that has a probability of detection of 50% over sea and 50% over land.

JERD-2061 The algorithm shall produce a rain rate product that has a false alarm rate of 5.0% over sea and 6.0% over land.

JERD-2062 The algorithm shall produce a rain rate product that has a Heidke Skill Score (HSS) (-1 - +1) of 0.30 over sea and 0.30 over land.

Notes:
1. The described performances include the MiRS algorithm performance, the collocation error, the instrument noise and the errors inherent to the reference used to measure the performances, as well as the errors due to differences in the footprint size of the collocated ATMS and the reference measurements (beam filling effect).
2. Over ocean performances are relative to the Tropical Rainfall Measuring Mission's (TRMM) Microwave Imager (TMI) Level 2A Hydrometeor Profile Product Version 7. For the comparisons, 3 min and 7.5 km were used as the time and space collocation thresholds, respectively. This assessment is over the +/- 38 deg. latitudes.
3. Over land performances are relative to the hourly National Centers for Environmental Prediction (NCEP) Stage IV precipitation analysis over the CONUS. The Stage IV precipitation analysis product is much more of an integrated hourly estimate, while the satellite-based MiRS precipitation estimation products represent an instantaneous observation. Because of that, during the comparison, it has been assumed that the Stage IV rainfall rate is a constant amount for an entire hour and is compared with the MiRS precipitation estimates that had occurred within that hour. Stage IV rainfall rate is approximately 4 km resolution. For the comparisons, 3 min and 7.5 km were used as the time and space collocation thresholds, respectively.
4. For the computation of precision and accuracy rainfall rate values equal to zero were included.
5. For the purpose of computing the probability of detection (POD), false alarm rate (FAR) and HSS the definition of rain is where the rainfall rate is greater than 0.6 mm/hr.
6. Refresh, coverage and horizontal size are all dependent on the refresh, coverage and horizontal size of the brightness temperatures measurements. The MiRS algorithm outputs characteristics will reproduce the TB characteristics of these factors.

3.2.5.7 ATMS Sea Ice Concentration

Sea Ice Concentration is defined as the areal extent of sea ice relative to the total at a given location in the ocean. It is empirically derived using the natural variation in the emissivity of ice and water in the microwave frequencies between 23 and 50 GHz.

JERD-2066 The algorithm shall produce a sea ice concentration product that has a horizontal reporting interval of 15 km at nadir.

JERD-2067 The algorithm shall produce a sea ice concentration product that has a measurement precision of 25%.

JERD-2068 The algorithm shall produce a sea ice concentration product that has a measurement accuracy 10%.

Notes:
1. Performances are relative to the F17 Special Sensor Microwave Imager Sounder (SSMIS) near real time product (NASA Team Algorithm).
2. The described performances include the MiRS algorithm performance, the collocation error, the instrument noise and the errors inherent to the reference used to measure the performances, as well as the errors due to differences in the footprint size of the collocated ATMS and the reference measurements (beam filling effect).
3. Refresh, coverage and horizontal size are all dependent on the refresh, coverage and horizontal size of the brightness temperatures measurements. The MiRS algorithm outputs characteristics will reproduce the TB characteristics of these factors.

3.2.5.8 ATMS Snow Cover

JERD-2092 The algorithm shall produce a snow cover product that has a horizontal cell size of 15 km at nadir.

JERD-2093 The algorithm shall produce a snow cover product that has a probability of detection (0 – 1) of 0.80.

JERD-2094 The algorithm shall produce a snow cover product that has a false alarm ratio (0 – 1) of 0.10.

JERD-2095 The algorithm shall produce a snow cover product that has a Heidke Skill Score (-1 - +1) of 0.55.

Notes:
1. Those performances are relative to the NASA AMSR-E product during Northern Hemisphere cold season (Nov-Mar).
2. The described performances include the MiRS algorithm performance, as well as the collocation error, the instrument noise and the errors inherent to the reference used to measure the performances.
3. For the purpose of computing the POD, FAR and HSS the snow water equivalent threshold is 0.01 cm.
4. Refresh, coverage and horizontal size are all dependent on the refresh, coverage and horizontal size of the brightness temperatures measurements. The MiRS algorithm outputs characteristics will reproduce the TB characteristics of these factors.

3.2.5.9 ATMS Snow Water Equivalent

Snow-Water Equivalent (SWE) is the product of snow depth and snow relative density (with respect to the density of liquid water), a measure of the amount of water stored in a snowpack per unit area; it is expressed in units of length (e.g., cm or inches), being a quantity of type surface density, normalized by water density. It is the depth of water in the snowpack, if the snowpack were melted. SWE is extremely useful to the hydrological community to estimate runoff and stored water.

JERD-2099 The algorithm shall produce a snow water equivalent product that has a horizontal cell size of 15 km at nadir.

JERD-2100 The algorithm shall produce a snow water equivalent product that has a measurement precision of 6.0 cm.

JERD-2101 The algorithm shall produce a snow water equivalent product that has a measurement accuracy of 3.0 cm.

Notes:
1. Those performances are relative to the NASA AMSR-E product during Northern Hemisphere cold season (Nov-Mar).
2. The described performances include the MiRS algorithm performance, as well as the collocation error, the instrument noise and the errors inherent to the reference used to measure the performances.
3. Those performances are dependent on the grain size assumed in the retrieval. For MiRS, this quantity is part of the retrieved state vector.
4. Refresh, coverage and horizontal size are all dependent on the refresh, coverage and horizontal size of the brightness temperatures measurements. The MiRS algorithm outputs characteristics will reproduce the TB characteristics of these factors.

3.2.5.10 ATMS Temperature Profile

The AVTP is a calculation of temperatures at stated intervals throughout the atmosphere. Sampling of temperature at stated intervals throughout the atmosphere is used to predict a variety of weather elements such as thunderstorms, cloud cover, and winds. NOAA's weather forecast offices use AVTP information to help predict severe weather events.

JERD-2113 The algorithm shall produce a temperature profile product that has a horizontal reporting interval of 15 km at nadir.

JERD-2114 The algorithm shall produce a temperature profile product that has a vertical reporting interval from the surface to 0.01 mb.

JERD-2115 The algorithm shall produce a temperature profile product that has a measurement precision of:
2.0 K at 100 mb for clear sea scenes;
2.0 K at 300 mb for clear sea scenes;
2.0 K at 500 mb for clear sea scenes;
3.0 K at 900 mb for clear sea scenes;
2.0 K at 100 mb for cloudy sea scenes;
2.5 K at 300 mb for cloudy sea scenes;
2.0 K at 500 mb for cloudy sea scenes;
3.0 K at 900 mb for cloudy sea scenes;
2.5 K at 100 mb for rainy sea scenes;

2.5 K at 300 mb for rainy sea scenes;
2.5 K at 500 mb for rainy sea scenes;
3.5 K at 900 mb for rainy sea scenes;
2.0 K at 100 mb for clear and cloudy land scenes;
2.0 K at 300 mb for clear and cloudy land scenes;
2.5 K at 500 mb for clear and cloudy land scenes;
5.5 K at 900 mb for clear and cloudy land scenes;
2.5 K at 100 mb for rainy land scenes;
2.5 K at 300 mb for rainy land scenes;
3.0 K at 500 mb for rainy land scenes;
5.5 K at 900 mb for rainy land scenes.

JERD-2116 The algorithm shall produce a temperature profile product that has a measurement accuracy of:
0.2 K at 100 mb for clear sea scenes;
0.5 K at 300 mb for clear sea scenes;
0.2 K at 500 mb for clear sea scenes;
1.5 K at 900 mb for clear sea scenes;
0.8 K at 100 mb for cloudy sea scenes;
0.8 K at 300 mb for cloudy sea scenes;
0.6 K at 500 mb for cloudy sea scenes;
2.0 K at 900 mb for cloudy sea scenes;
1.0 K at 100 mb for rainy sea scenes;
1.5 K at 300 mb for rainy sea scenes;
2.0 K at 500 mb for rainy sea scenes;
2.0 K at 900 mb for rainy sea scenes;
0.5 K at 100 mb for clear and cloudy land scenes;
0.8 K at 300 mb for clear and cloudy land scenes;
0.2 K at 500 mb for clear and cloudy land scenes;
2.5 K at 900 mb for clear and cloudy land scenes;
1.5 K at 100 mb for rainy land scenes;
1.0 K at 300 mb for rainy land scenes;
0.5 K at 500 mb for rainy land scenes;
2.5 K at 900 mb for rainy land scenes.

Notes:
1. Those performances are relative to the GDAS.
2. The performances are for all non-rainy conditions, including clear and cloudy.
3. The performances are for individual layers (not averaged vertically).
4. The pressure values are averaged layer values.
5. The described performances include the MiRS algorithm performance, as well as the collocation error, the instrument noise and the errors inherent to the reference used to measure the performances.
6. Refresh, coverage and horizontal size are all dependent on the refresh, coverage and horizontal size of the brightness temperatures measurements. The MiRS algorithm outputs characteristics will reproduce the TB characteristics of these factors.

3.2.5.11 ATMS Total Precipitable Water (TPW)

Total Precipitable Water is defined as the total column amount of water vapor available in a vertical atmospheric profile. The required Total Precipitable Water data products are derived from an integration of the vertical water vapor profile (mm). Total Precipitable Water data provides information on moisture advection in the atmosphere and precipitation intensity potential for quantitative precipitation forecasts.

JERD-2105 The algorithm shall produce a TPW product that has a horizontal cell size of 15 km at nadir.

JERD-2106 The algorithm shall produce a TPW product that has a measurement precision of:
2.5 mm for clear and cloudy scenes over the sea,
2.0 mm for clear and cloudy scenes over sea ice,
5.5 mm for clear and cloudy scenes over land, and
2.0 mm for clear and cloudy scenes over snow.

JERD-2107 The algorithm shall produce a TPW product that has an accuracy of:
1.5 mm for clear scenes over the sea,
0.5 mm for cloudy scenes over the sea,
2.0 mm for both clear and cloudy scenes over sea ice,
2.5 mm for both clear and cloudy scenes over land, and
0.5 mm for both clear and cloudy scenes over snow.

JERD-2108 The algorithm shall produce a TPW product that has a measurement uncertainty of:
2.5 for both clear and cloudy scenes over the sea,
2.5 for both clear and cloudy scenes over sea ice,
5.5 for both clear and cloudy scenes over land, and
2.0 for both clear and cloudy scenes over snow.

JERD-2109 The algorithm shall incorporate fill and quality flag conditions including degraded, excluded or other applicable quality conditions.

Notes:
1. Those performances are relative to the GDAS.
2. The described performances include the MiRS algorithm performance, as well as the collocation error, the instrument noise and the errors inherent to the reference used to measure the performances.
3. The spatial distribution of the assessment data is global, encompassing the natural variability of the different geophysical conditions.
4. Refresh, coverage and horizontal size are all dependent on the refresh, coverage and horizontal size of the brightness temperatures measurements. The MiRS algorithm outputs characteristics will reproduce the TB characteristics of these factors.

3.2.5.12 CrIS Greenhouse Gases – Carbon Dioxide (CO_2)

Retrievals of column and total carbon dioxide, calibrated by the users with ground-based measurements, of stated precision needed to afford deduction of long-term variations and trends.

NOTE: Carbon dioxide and methane-column data are required by NOAA to accomplish its climate mission and are useful to meet the long-term stability requirements for temperature and moisture from an infrared sounder. Measurement quantities are given in parts-per-million by volume (ppmv) for CO2 and parts-per-billion by volume (ppbv) for methane. This measure implies that the volume of air sampled by the observation is known (usually by determination of molecules of dry gas in the atmosphere through knowledge of surface pressure and quantity of atmospheric moisture). In order for climate models to predict the concentrations of these trace gases in the troposphere, the sources and sinks of these gases need to be understood. For species with long atmospheric lifetimes (CO2 is ~ 100 years, CH4 is ~ 12 years), this requires very precise total column data. Values of the absolute accuracies of these gases needed for adequate predictions would not be as strict as the precision requirements due to the availability of supporting ground-based measurements. Long-term trends and inter-annual variations in the amounts of these gases in the atmosphere are almost certainly addressed best by carefully calibrated ground-based measurements. The satellite retrievals allow for important assessments of the global geographical distribution of patterns or gradients in the trace gas concentrations that are not feasible otherwise.

JERD-2173 The algorithm shall produce a CO_2 product that has a vertical coverage of the total column.

JERD-2174 The algorithm shall produce a CO_2 product that has a horizontal resolution of 100 km.

JERD-2175 The algorithm shall produce a CO_2 product that has a mapping uncertainty (3 sigma) of 25 km.

JERD-2176 The algorithm shall produce a CO_2 product that has a measurement range of 300 to 500 ppmv (Note 1).

JERD-2177 The algorithm shall produce a CO_2 product that has a measurement precision of 0.5% (2 ppmv) (Note 2).

JERD-2178 The algorithm shall produce a CO_2 product that has a measurement accuracy of +/-1% (4 ppmv) (Note 3).

Notes:
1. Measurement range is extended to 500 ppmv (17,800 μmoles) to cover potential increases of CO2 concentration during mission life.
2. Measurement precision of 20 μmoles/cm2 is equivalent to 1.4 ppmv (0.37%). Simulations and experience with AIRS suggest the CrIS instrument should be able to achieve 2 ppmv (0.5%) precision.
3. Simulations and experience with AIRS suggest the CrIS instrument should be capable of 4 ppmv (1%) accuracy.

3.2.5.13 CrIS Greenhouse Gases – Carbon Monoxide (CO)

Measure of the carbon monoxide in a specified volume of air.

Note: Carbon monoxide is a short-lived gas (≈1 month) in the troposphere and has air-quality, atmospheric chemistry, and climate applications. It has applications in monitoring of combustion products (e.g., forest fires, biomass burning, and industrial pollution) and is a cause of tropospheric ozone production. It has potential as a tracer of atmospheric transport of pollution and could be used as a proxy for fossil fuel emissions. Knowledge of the carbon monoxide concentration is also useful in the determination of sources and sinks for CO2 and CH4 through partitioning of combustion sources relative to other natural and anthropogenic sources and through its interaction with the hydroxyl radical which is the primary sink for both carbon monoxide and methane in the upper troposphere.

JERD-2164 The algorithm shall produce a CO product that has a vertical coverage of the total column.

JERD-2165 The algorithm shall produce a CO product that has a horizontal resolution of 100 km.

JERD-2166 The algorithm shall produce a CO product that has a mapping uncertainty (3 sigma) of 25 km.

JERD-2167 The algorithm shall produce a CO product that has a measurement range of 0 to 200 ppbv.

JERD-2168 The algorithm shall produce a CO product that has a measurement precision of 15%.

JERD-2169 The algorithm shall produce a CO product that has a measurement accuracy of 5%.

Notes:
1. 7 µmoles is equivalent to 200 ppbv.
2. With existing CrIS short-wave resolution (0.2 cm Optical Path Difference (OPD)), the carbon monoxide measurement can barely improve beyond background variability. Simulations suggest precision of 35% and accuracy of 25% are achievable.
3. With full resolution CrIS short-wave resolution (0.8 cm OPD), precision and accuracy improves to 15% and 5%, respectively.

3.2.5.14 CrIS Greenhouse Gases – Methane (CH_4)

Measure of the amount of methane contained in a specified volume of air.

Note: Carbon dioxide and methane column data are required by NOAA to accomplish its climate mission and are useful to meet the long-term stability requirements for temperature and moisture from an infrared sounder. Measurement quantities are given in parts-per-million by volume (ppmv) for CO_2 and parts-per-billion by volume (ppbv) for methane. This measure implies that the volume of air sampled by the observation is known (usually by determination of molecules of dry gas in the atmosphere through knowledge of surface pressure and quantity of atmospheric moisture). In order for climate models to predict the concentrations of these trace gases in the troposphere, the sources and sinks of these gases need to be understood. For species with long atmospheric lifetimes (CO_2 is ≈100 years, CH_4 is ≈12 years), this requires very precise total column data. Values of the absolute accuracies of these gases needed for adequate predictions would not be as strict as the precision requirements due to the availability of supporting ground-based measurements. Long-term trends and inter-annual variations in the amounts of these gases in the atmosphere are almost certainly addressed best by carefully calibrated ground-based measurements. The satellite retrievals allow for important assessments of the global geographical distribution of patterns or gradients in the trace gas concentrations that are not feasible otherwise.

JERD-2182 The algorithm shall produce a CH_4 product that has a vertical coverage of the total column.

JERD-2183 The algorithm shall produce a CH_4 product that has a horizontal resolution of 100 km.

JERD-2184 The algorithm shall produce a CH_4 product that has a mapping uncertainty (3 sigma) of 25 km.

JERD-2185 The algorithm shall produce a CH_4 product that has a measurement range of 1100 to 2250 ppbv (Note 1).

JERD-2186 The algorithm shall produce a CH_4 product that has a measurement precision of 1% (~ 20 ppbv) (Note 2).

JERD-2187 The algorithm shall produce a CH_4 product that has a measurement accuracy of +/-4% (~ 80 ppbv) (Note 3).

Notes:
1. 40 µmoles is equivalent to 1100 ppbv (a more common unit).
2. Experience with Atmospheric Infrared Sounder (AIRS) and CrIS simulations suggest we can achieve 1% precision.
3. Experience with AIRS suggests we can achieve an accuracy of 4%.

3.2.5.15 CrIS Infrared Ozone Profile

The CrIS instrument is sensitive to ozone in the 10 micron region of its spectrum. This allows retrieval of ozone in both daytime and nighttime conditions. This retrieval is only possible when

cloud clearing is successful (the partly cloudy condition of AVTP and AVMP), otherwise a climatological first guess is reported. The sensitivity of the 10 micron channels is mostly located in the lower stratosphere and under the right conditions (e.g., stratosphere-troposphere exchange) has some sensitivity in the upper troposphere.

Ozone is derived principally because it can improve other CrIS-derived products (e.g., determination of temperature and moisture and trace gases) since ozone affects CrIS radiances over broad spectral regions. This product complements ozone products derived from other instruments (e.g., OMPS) due to its unique ability to be derived both day and night and because, as a thermal sounder, CrIS has enhanced sensitivity above the tropopause due to knowledge of the thermal structure coming from the AVTP product.

The product is made available on 100 layers so that users can compute total column and layer column densities on their vertical gridding; however, in reality this product only has one to two degrees of freedom. Therefore, most of the vertical structure in the profile is derived from the climatological first guess. The horizontal and vertical cell sizes indicate the dimensions of three-dimensional cells over which the ground truth environmental parameters are averaged for verification.

JERD-2191 The algorithm shall produce an infrared ozone profile product that has a horizontal cell size of 50 km at nadir.

JERD-2192 The algorithm shall produce an infrared ozone profile product on the native retrieval reporting interval (usually the forward model's vertical grid) such that users can vertically remap the product without the loss of vertical information content.

JERD-2193 The algorithm shall produce an infrared ozone profile product that has a mapping uncertainty (3 sigma) of 10 km.

JERD-2194 The algorithm shall produce an infrared ozone profile product that has a measurement precision of:
20% from 4 hPa to 260 hPa (6 statistic layers) and
20% form 260 hPa to the surface (1 statistic layer).

JERD-2195 The algorithm shall produce an infrared ozone profile product that has a measurement accuracy of:
10% from 4 hPa to 250 hPa (6 statistic layers) and
10% from 260 hPa to the surface (1 statistic layer).

JERD-2196 The algorithm shall produce an infrared ozone profile product that has a measurement uncertainty of:
25% from 4 hPa to 250 hPa (6 statistic layers) and
25% from 260 hPa to the surface (1 statistic layer).

Notes:
1. Ozone retrievals only exist when the CrIS radiances are used in the retrieval (i.e., "partially cloudy" condition in the AVTP and AVMP requirements). For "cloudy" conditions the first guess is reported. Users must use QC to determine if retrieval was performed.
2. CrIS measurements are most accurate near the tropopause and statistic layers used to compute performance must mimic standard Umkehr reporting layers of ~5 km per layer (recommend statistic layers = 4-8, 8-16, 16-32, 32-66, 66-125, 125-260 hPa).
3. Lower layer statistic is computed on a single thick layer of variable thickness due to surface pressure variability.

3.2.5.16 CrIS Outgoing Longwave Radiation (OLR)

Outgoing Longwave Radiation is the instantaneous radiative energy emitted by the Earth-atmosphere system at the Top of the Atmosphere (TOA) to space into a hemisphere.

JERD-2200 The algorithm shall produce an OLR product during daytime and nighttime, regardless of sky conditions.

JERD-2201 The algorithm shall produce an OLR product that has a horizontal cell size of 25 km at nadir.

JERD-2202 The algorithm shall produce an OLR product that has a mapping uncertainty (3 sigma) of 5 km at nadir.

JERD-2203 The algorithm shall produce an OLR product that has a measurement range of 0 to 500 W/m^2.

JERD-2204 The algorithm shall produce an OLR product that has a measurement precision of 12 W/m^2.

JERD-2205 The algorithm shall produce an OLR product that has a measurement accuracy of 5 W/m^2.

Notes:
1. OLR is now an infrared product produced from CrIS, rather than CERES data.

3.2.5.17 CrIS/ATMS Atmospheric Vertical Moisture Profile

See ATMS Moisture Profile for a description.

JERD-2219 The algorithm shall produce the AVMP product under Day and Night conditions.

JERD-2220 The algorithm shall produce the AVMP product under cloud-free, partly cloudy, and cloudy conditions.

JERD-2221 The algorithm shall produce the AVMP product that has a horizontal cell size of 50 km at nadir (Note 1).

JERD-2222 The algorithm shall produce the AVMP product that has a vertical reporting interval of:
20 mb from surface to 850 mb and
50 mb from 850 mb to 100 mb.

JERD-2223 The algorithm shall produce the AVMP product that has a mapping uncertainty (3 sigma) of 5 km.

JERD-2224 The algorithm shall produce the AVMP product that has a measurement uncertainty (expressed as a percent of average mixing ratio in 2 km layers) of:
Greater of 20 % or 0.2 g/kg for cloud-free to partly cloudy, surface to 600 mb (Note 2);
Greater of 35 % or 0.1 g/kg for cloud-free to partly cloudy, 600 mb to 300 mb (Note 2);
Greater of 35 % or 0.1 g/kg for cloud-free to partly cloudy, 300 mb to 100 mb (Note 2);
Greater of 20 % or 0.2 g/kg for cloudy, surface to 600 mb (Note 3);
Greater of 40 % or 0.1 g/kg for cloudy, 600 mb to 400 mb (Note 3); and
Greater of 40 % or 0.1 g/kg for cloudy, 400 mb to 100 mb (Note 3).

JERD-2225 The algorithm shall produce the AVMP product that incorporates fill and quality flag conditions including degraded, excluded or other applicable quality conditions.

Notes:
1. JPSS will process one sounding per FOR for a clear or cloudy resolution of better than or equal to ~50 km at Nadir; all 9 CrIS FOVs are used in the processing step to produce one FOR sounding.
2. Partly cloudy conditions are those where both the infrared and microwave retrievals are used and are typically scenes with less than or equal to 50% cloudiness.
3. Cloudy conditions are those where only the microwave retrievals are used and are typically scenes with greater than 50% cloudiness.

3.2.5.18 CrIS/ATMS Atmospheric Vertical Temperature Profile (AVTP)

See ATMS Temperature Profile for a description.

Restricting the Measurement Uncertainty to “over ocean” enables CrIS/ATMS to meet the Global average requirement. Over land and ice mass, the Uncertainty is 1.7 K due to the state of the science of the land emissivity knowledge within the temperature sounding algorithm.

JERD-2209 The algorithm shall produce the AVTP product under Day and Night conditions.

JERD-2210 The algorithm shall produce an AVTP product under cloud-free, partly cloudy, and cloudy conditions.

JERD-2211 The algorithm shall produce an AVTP product that has a horizontal cell size of 50 km at nadir (Note 1).

JERD-2212 The algorithm shall produce an AVTP product that has a vertical reporting interval of:
20 mb from the surface to 850 mb;
50 mb from 850 mb to 300 mb;
25 mb from 300 mb to 100 mb;
20 mb from 100 mb to 10 mb;
2 mb from 10 mb to 1.0 mb, and
0.2 mb from 1.0 mb to 0.5 mb.

JERD-2213 The algorithm shall produce an AVTP product that has a mapping uncertainty (3 sigma) of 5 km.

JERD-2214 The algorithm shall produce an AVTP product that has a measurement uncertainty expressed as an error in layer average temperature of:
1.6 K per 1 km layer for cloud-free to partly cloudy, surface to 300 mb over ocean (Note 2);
1.5 K per 3 km layer for cloud-free to partly cloudy, 300 mb to 30 mb (Note 2);
1.5 K per 5 km layer for cloud-free to partly cloudy, 30 mb to 1 mb (Note 2);
3.5 K per 5 km layer for cloud-free to partly cloudy, 1 mb to 0.5 mb (Note 2);
2.5 K per 1 km layer for cloudy, surface to 700 mb (Note 3);
1.5 K per 1 km layer for cloudy, 700 mb to 300 mb (Note 3);
1.5 K per 3 km layer for cloudy, 300 mb to 30 mb (Note 3);
1.5 K per 3 km layer for cloudy, 30 mb to 1 mb (Note 3); and
3.5 K per 5 km layer for cloudy, 1 mb to 0.5 mb (Note 3).

Notes:
1. JPSS will process one sounding per Filed of Regard (FOR) for a clear or cloudy resolution of better than or equal to ~50 km at Nadir; all 9 CrIS Field of Views (FOVs) are used in the processing step to produce one FOR sounding.
2. Partly cloudy conditions are those where both the infrared and microwave retrievals are used and are typically scenes with less than or equal to 50% cloudiness.
3. Cloudy conditions are those where only the microwave retrievals are used and are typically scenes with greater than 50% cloudiness.

3.2.5.19 Ozone Nadir Profile (Ozone-NP)

The Ozone Nadir Profile is an EDR created from measurements made by the OMPS Nadir Profiler and the OMPS Nadir Mapper sensors. This product will continue the heritage ozone profile products made by the POES SBUV/2. These products have vertical resolution between 7 and 10 km in the middle and upper stratosphere.

When an OMPS Limb Profiler instrument is present, the OMPS measurements can be used to make (limb) ozone profile EDRs with high vertical resolution (< 3 km) throughout the stratosphere. The detailed vertical structure of lower stratospheric ozone (12 to 25 km altitude region) has been shown to be a useful contributor to extended range (beyond 1 week) forecast skill in global models. It is also a key region for monitoring interactions between the expected ozone recovery and climate change.

Applicable Conditions:
1. Clear, daytime only (Note 3)

JERD-2422 The algorithm shall produce an ozone nadir profile product that has a horizontal cell size of 250 x 250 km (Note 1).

JERD-4063 The algorithm shall produce an ozone nadir profile product that provides atmospheric vertical ozone profiles with a vertical cell size of 5 km.

JERD-2445 The algorithm shall produce an ozone nadir profile product that has a vertical cell size of:
10-20 km below 30 hPa,
7-10 km from 30-1 hPa, and
10-20 km above 1 hPa.

JERD-2446 The algorithm shall produce an ozone nadir profile product that has a mapping uncertainty (3 sigma) of < 25 km.

JERD-2447 The algorithm shall produce an ozone nadir profile product that has a measurement range of 0.1-15 ppmv for 0-60 km.

JERD-2448 The algorithm shall produce an ozone nadir profile product that has a measurement precision of:
Greater of 20% or 0.1 ppmv below 30 hPa,
Greater of 10% or 0.1 ppmv at 30 hPa,
5% - 10 % from 30 – 1 hPa, and
Greater of 10% or 0.1 ppmv above 1 hPa. (Note 2)

JERD-2449 The algorithm shall produce an ozone nadir profile product that has a measurement accuracy of:
Greater of 10% or 0.1 ppmv below 30 hPa,

5% - 10 % from 30 – 1 hPa,
Greater of 10% or 0.1 ppmv at 1 hPa, and
Greater of 10% or 0.1 ppmv above 1 hPa. (Note 2)

Notes:
1. The SVUV/2 has a 180 km X 180 km cross-track by along-track FOV. It makes its 12 measurements over 24 samples (160 km of along-track motion). The OMPS Nadir Profiler is designed to be operated in a mode that is able to subsample the required HCS.
2. The OMPS Nadir Profiler performance is expected to degrade in the area of the South Atlantic Anomaly (SAA) due to the impact of periodic charged particle effects in this region.
3. All OMPS measurements require sunlight, so there is no coverage in polar night areas.

3.2.5.20 Ozone Total Column (Ozone-TC)

Ozone Total Column (also called Atmospheric Ozone) is defined as the amount of ozone in a vertical column of the atmosphere measured in Dobson Units (milli-atm-cm). All threshold values for ozone total column/profile are based on national climate requirements as detailed by the Workshop on NPOESS Ozone Measurements Requirements.

Applicable Conditions:
1. Threshold requirements only apply under daytime conditions with Solar Zenith Angles (SZA) up to 80 degrees.
2. The EDR shall be delivered for all SZA.

JERD-2423 The algorithm shall produce an ozone total column product that has a horizontal cell size of 50 x 50 km^2 at Nadir.

JERD-2450 The algorithm shall produce an ozone total column product that has a vertical cell size of 0-60 km.

JERD-2451 The algorithm shall produce an ozone total column product that has a mapping uncertainty, 1 sigma, of 5 km at Nadir.

JERD-2452 The algorithm shall produce an ozone total column product that has a measurement range of 50-650 milli-atm-cm.

JERD-2453 The algorithm shall produce an ozone total column product that has a measurement precision of:
6.0 milli-atm-cm for $X<0.25$ atm-cm,
7.7 milli-atm-cm for $0.25 < X < 0.45$ atm-cm, and
2.8 milli-atm-cm + 1.1% for $X>0.45$ atm-cm.

JERD-2454 The algorithm shall produce an ozone total column product that has a measurement accuracy of:

9.5 milli-atm-cm for X<0.25 atm-cm,
13.0 milli-atm-cm for 0.25 < X < 0.45 atm-cm, and
16.0 milli-atm-cm + 1.1% for X>0.45 atm-cm.

3.2.5.21 VIIRS Active Fires

The Active Fires product is based on the detection and analysis of the radiative signature of natural or anthropogenic surface fires as received by the sensor. The product includes the geolocation and Fire Radiative Power (FRP) of pixels for which fires are detected, and a full mask consisting of a two-dimensional array of values representing the fire and other relevant thematic classes (e.g., cloud) of each pixel in a swath data granule.

JERD-2406 The algorithm shall produce an Active Fires product with a horizontal cell size of 0.80 km at nadir.

JERD-2407 The algorithm shall produce an Active Fires product with a horizontal reporting interval of 0.80 km at nadir.

JERD-2408 The algorithm shall produce an Active Fires product globally (Note 2).

JERD-2409 The algorithm shall produce an Active Fires product with a mapping uncertainty, 3 sigma, of 1.5 km.

JERD-2410 The algorithm shall produce an Active Fires Radiative Power product with a measurement range of 1.0 MW to 5.0 $(10)^3$ MW (Note 3).

JERD-2411 The algorithm shall produce an Active Fires Radiative Power product with a measurement uncertainty of 50%.

Notes:
1. NOAA has endorsed the inclusion of an Active Fires EDR based on strong community interest in providing continuity of validated MODIS-based fire products (geolocation of fire detections, FRP, and a full fire mask) consistent with the recommendations of the NOAA-NASA Land Science Team. This change proposes the institution of Active Fires as an EDR with threshold requirements based on the demonstrated capabilities of the VIIRS F1 sensor and S-NPP spacecraft.
2. The requirement of global coverage is based on user community stated intentions to extend Active Fires product capabilities to non-land based targets (e.g., offshore gas flares).
3. The high end of the FRP Measurement Range threshold requirement (5000 MW) is based on current design capabilities (i.e., the present 634 K saturation specification for the M13 Band on VIIRS) and the recommendation of the NOAA-NASA Land Science Team.

3.2.5.22 VIIRS Aerosol Detection

Aerosol Detection (including Smoke and Dust) is a summary map that indicates the extent of smoke/aerosol coverage and a measure of smoke albedo indicates relative intensity. The detection is above a nominal level that can vary depending on conditions. For reference this product is used for verifying operational smoke forecasts and documenting trends in biomass burning and urban aerosols and to estimate the impact of biomass burning on human health, ecology, and climate.

Applicable Conditions:
1. Aerosol Detection includes dust/sand, and smoke at any altitude.
2. Clear, for Aerosol Optical Depth (AOD) greater than 0.15, daytime only.

JERD-2424 The algorithm shall produce an aerosol detection product that has a horizontal cell size of 0.8 km at Nadir (Note 2).

JERD-2455 The algorithm shall produce an aerosol detection product that has a vertical cell size of the total column.

JERD-2456 The algorithm shall produce an aerosol detection product that has a mapping uncertainty (3 sigma) of 3 km.

JERD-2457 The algorithm shall produce an aerosol detection product that has a measurement range of:
Detect suspended matter (dust/sand and smoke) (Note 1) of dust/sand and smoke and Smoke plume column concentration of 0 to 2000 $\mu g/m^2$.

JERD-2458 The algorithm shall produce an aerosol detection product that has a probability of correct typing (Note 2) of:
80% for suspended matter,
80% for Dust, and
70% for Smoke

Notes:
1. DOC has a responsibility for analyzing areas of volcanic ash, blowing dust, and smoke. There is therefore a requirement that the AOD algorithm identify instances of multiple types of aerosols at the same location and not to merely provide a single aerosol type with the highest concentration or probability.
2. Probability of correct typing performance will be verified and validated for an aggregated 3 km horizontal cell to provide for adequate comparability of performance across the scan.
3. Volcanic ash detection will be reported in SM output file but information will come from a separate volcanic ash algorithm and refer to volcanic ash requirement table.

3.2.5.23 VIIRS Aerosol Optical Depth

Aerosol Depth is a measure of the fine solids suspended in the air including dust, sand, volcanic ash, smoke, and urban/industrial aerosols. Aerosol Optical Depth characterization will consist of elements of aerosol optical depth and fine particulate matter. The fine particulate matter will be derived from the aerosol optical depth translated to mass concentration in the observed vertical path (microgram per cubic meter), where translation to concentration depends on particle type and vertical location of the aerosols and determined in regions where aerosols have been detected above a nominal level that can vary depending on conditions.

Applicable Conditions:
1. Clear, daytime only
2. Zenith angles less than or equal to 80 degrees (Note 3).

JERD-2425 The algorithm shall produce an aerosol optical depth with a vertical coverage of the total column.

JERD-2459 The algorithm shall produce an aerosol optical depth with a horizontal cell size of:
0.8 km at Nadir and
1.6 km at the edge of scan.

JERD-2460 The algorithm shall produce an aerosol optical depth with a vertical cell size of the total column.

JERD-2461 The algorithm shall produce an aerosol optical depth with a mapping uncertainty (3 sigma) of 4 km (Note 2)

JERD-2462 The algorithm shall produce an aerosol optical depth with a measurement range from -0.05 to 5 (Note 5).

JERD-2463 The algorithm shall produce an aerosol optical depth with a measurement accuracy of:
0.08 (Tau < 0.3) and 0.15 (Tau >= 0.3) over ocean (Notes 1, 2, 3, and 4) and
0.06 (Tau < 0.1), 0.05 (0.1 <= Tau <= 0.8), and 0.2 (Tau > 0.8) over land (Notes 1, 2, and 4).

JERD-2464 The algorithm shall produce an aerosol optical depth with a measurement precision of:
0.15 (Tau < 0.3) and 0.35 (Tau >= 0.3) over ocean (Note 1, 2, 3, and 4) and
0.15 (Tau < 0.1), 0.25 (0.1 <= Tau <= 0.8), and 0.45 (Tau > 0.8) over land (Notes 1, 2, 3, and 4).

Notes:
1. Tau is the true observed AOD from ground-based measurements. A single linear regression equation for the dependency of accuracy and precision on Tau cannot be used to cover the dynamic range for Tau (-0.05 to 5).
2. For the stratified AOD ranges that are based on ground-based measurements, JPSS VIIRS AOD product accuracy and precision are to be determined by comparing it to ground-based measurements with specific matchup criteria: The VIIRS AODs from pixels within a radius of 27.5 km from ground-based measurements are averaged and compared to the hourly average of ground-based measurement AOD; a minimum of five best quality VIIRS AOD retrievals and two ground-based observations must be available within these spatial and temporal constraints. Ground-based measurement AOD data, if observed at wavelengths other than 550 nm, should be interpolated to 550 nm using the best available methodologies. Product evaluation should include the entire dynamic range, all aerosol types over all seasons.
3. Applies to total column optical depth.
4. See Appendix C - Glossary for the definition of Tau (τ)
5. AOD Measurement Accuracy and Precision requirements are applicable and should be verified only at 550 nm and only over this Measurement Range 0 – 2.

3.2.5.24 VIIRS Aerosol Particle Size

The Aerosol Particle Size provides a measure of the bimodal size distribution of the aerosol population in terms of the effective radius re and effective variance ve of each mode. The effective radius is the ratio of the third moment of the aerosol size distribution to the second moment. The effective variance characterizes the width of the size distribution. The aerosol particle size is determined in regions where aerosols have been detected above a nominal level that can vary depending on conditions.

Applicable Conditions:
1. Clear, daytime and ocean only

JERD-2426 The algorithm shall produce an aerosol particle size product with a horizontal cell size of 0.8 km at Nadir and 1.6 km at the edge of scan.

JERD-2465 The algorithm shall produce an aerosol particle size product with a vertical cell size of the total column.

JERD-2466 The algorithm shall produce an aerosol particle size product with a mapping uncertainty (3 sigma) of 4 km.

JERD-2467 The algorithm shall produce an aerosol particle size product with a measurement range of -1 to +3 alpha units (Note 2).

JERD-2468 The algorithm shall produce an aerosol particle size product with a measurement precision of 0.6 alpha units over ocean (Note 2).

JERD-2469 The algorithm shall produce an aerosol particle size product with a measurement accuracy of 0.3 alpha units over ocean (Note 2).

Notes:
1. Reserved.
2. To meet the Climate requirements specified in the IORD for the Aerosol Particle Size EDR, an Aerosol Polarimetry Sensor is needed. Since an APS is not going to be flown on JPSS, the APS Climate requirements have been deleted from the Supplement.
3. EDR performance is dependent on the accuracy of model-based ancillary data for this parameter.

3.2.5.25 VIIRS Cloud Cover/Layers

Cloud cover is the fraction of a given area of the earth's horizontal surface that is masked by the vertical projection of clouds. Layers refer to three predefined layers and one layer that spans the entire atmosphere.

Applicable Conditions:
1. Requirements apply whenever detectable clouds are present.
2. Cloud Cover shall be computed and reported at each separate, distinct layer, as well as for the total cloud cover.

JERD-2427 The algorithm shall produce a cloud cover/layers product that has a horizontal cell size of 10 km.

JERD-2470 The algorithm shall produce a cloud cover/layers product that has a vertical reporting interval of cloud cover in 3 predefined layers and total cloud cover in the column.

JERD-2471 The algorithm shall produce a cloud cover/layers product that has a mapping uncertainty (3 sigma) of 4 km.

JERD-2472 The algorithm shall produce a cloud cover/layers product that has a measurement range from 0 to 1.0 horizontal cell size (HCS) area.

JERD-2473 The algorithm shall produce a cloud cover/layers product that has a measurement uncertainty of 15%.

Notes:
1. Predefined layers are high = 0 - 350 hPa, middle = 350 - 642 hPa and low = 642 to 1100 hPa. These are high/middle/low boundaries used by NOAA NWP models.

3.2.5.26 VIIRS Cloud Height (Top and Base)

Cloud height (top and base) is defined for each cloud-covered earth location as the set of heights above mean sea level of the tops and bases of the cloud layers overlying the location.

Applicable Conditions:
1. Requirements apply whenever detectable clouds are present.

JERD-2428 The algorithm shall produce a cloud height product that has a horizontal cell size of 0.8 km.

JERD-2474 The algorithm shall produce a cloud height product that has a vertical reporting interval of top and base of highest cloud in the column.

JERD-2475 The algorithm shall produce a cloud height product that has a mapping uncertainty (3 sigma) of 4 km.

JERD-2476 The algorithm shall produce a cloud height product that has a measurement precision of:
For Cloud Top Height:
1.0 km for COT >= 1 and
2.0 km for COT < 1 (Note 1)
For Cloud Base Height:
2.0 km for COT >= 1 and
3.0 km for COT < 1 (Note 2).

JERD-2477 The algorithm shall produce a cloud height product that has a measurement accuracy of:
For Cloud Top Height:
1.0 km for COT >= 1 and
2.0 km for COT < 1 (Note 1)
For Cloud Base Height:
2.0 km for COT >= 1 and
3.0 km for COT < 1 (Note 2).

Notes:
1. COT, expressed in units of "Tau", is also referred to as "Optical Thickness" or "Optical Depth.
2. CBH specifications only apply for clouds where the CTH met its specifications.

3.2.5.27 VIIRS Cloud Mask

Cloud Mask describes the area of the earth’s horizontal surface that is masked by the vertical projection of detectable clouds.

Applicable Conditions:
1. Requirements apply whenever detectable clouds are present.
2. Cloud Mask shall be computed and reported for the total cloud cover.

JERD-2429 The algorithm shall produce a cloud mask product that has a horizontal cell size of 0.8 km at Nadir.

JERD-2478 The algorithm shall produce a cloud mask product that has a horizontal reporting interval the same as the cloud mask horizontal cell size.

JERD-2479 The algorithm shall produce a cloud mask product that has a mapping uncertainty, (3 sigma) of 4 km.

JERD-2480 The algorithm shall produce a cloud mask product that has measurement range of cloudy/not cloudy.

JERD-2481 The algorithm shall produce a cloud mask product that has a probability of correct typing of:
87% Globally,
92% Ocean, Day,
90% Ocean, Night,
90% Snow-free Land, Day,
88% Snow-free Land, Night,
85% Desert, Day,
85% Desert, Night,
88% Snow-covered land, Day,
85% Snow-covered land, Night,
82% Sea-Ice, Day,
72% Sea-Ice, Night,
80% Antarctica and Greenland, Day, and
70% Antarctica and Greenland, Night.

Notes:
1. Attribute (a) (Horizontal Cell Size) shows the Cloud Map HCS as 0.8 km which is approximately the VIIRS M band Nadir pixel size.
2. Cloud Optical Thickness (COT) is defined as the extinction (scattering plus absorption) per unit length, integrated over each and every distinguishable cloud layer in a vertical column and all distinguishable cloud layers in aggregate, in a vertical column of the atmosphere.

3.2.5.28 VIIRS Cloud Optical Depth

Cloud Optical Depth (COD) is defined as the optical thickness of the atmosphere due to cloud droplets, per unit cross section, integrated over each and every distinguishable cloud layer and all

distinguishable cloud layers in aggregate, in a vertical column above a horizontal cell on the Earth's surface. The term "Cloud Optical Thickness" is often used synonymously.

Applicable Conditions:
1. Requirements apply whenever detectable clouds are present.

JERD-2430 The algorithm shall produce a cloud optical depth product that has a horizontal cell size of 0.8 km.

JERD-2482 The algorithm shall produce a cloud optical depth product that has a mapping uncertainty (3 sigma) of 4 km.

JERD-2483 The algorithm shall produce a cloud optical depth product that has a measurement range of
0.3 – 64 (Day) and
0.3 – 8 (Night).

JERD-2484 The algorithm shall produce a cloud optical depth product that has a measurement precision of
greater of 30% or 3.0 Tau (Day) and
greater of 30% or 0.8 Tau (Night).

JERD-2485 The algorithm shall produce a cloud optical depth product that has a measurement accuracy of
Liquid phase: 20% (Day), 30% (Night);
Ice phase: 20% (Day), 30% (Night).

3.2.5.29 VIIRS Cloud Particle Size Distribution

Cloud particle size distribution reports the width or effective variance (ve) of a single mode particle size distribution having effective radius (re). The effective radius is the ratio of the third moment of the size distribution to the second moment.

Applicable Conditions:
1. Requirements apply both day and night and whenever detectable clouds are present.

JERD-2431 The algorithm shall produce a cloud particle size distribution product that has a horizontal cell size of 0.8 km.

JERD-2486 The algorithm shall produce a cloud particle size distribution product that has a mapping uncertainty (3 sigma) of 4 km.

JERD-2487 The algorithm shall produce a cloud particle size distribution product that has a measurement range of
2 to 50 µm (day),
2 to 32 µm for water (night), and

2 to 50 µm for ice (night).

JERD-2488 The algorithm shall produce a cloud particle size distribution product that has a measurement precision of
greater of 4 µm or 25% for water and
greater of 10 µm or 25% for ice.

JERD-2489 The algorithm shall produce a cloud particle size distribution product that has a measurement accuracy of
Greater of 4 µm or 30% for water and
10 µm for ice.

Notes:
1. Reserved
2. The vertical reporting level was struck because cloud effective particle size distribution is only derived at cloud top, not multiple cloud layers.

3.2.5.30 VIIRS Cloud Phase

Cloud Phase is derived from Cloud Type and is the primary phase of the cloud (clear, liquid, supercooled, mixed, ice, and unknown) product.

Applicable Conditions:
1. Requirements apply whenever detectable clouds are present.

JERD-2432 The algorithm shall produce a cloud phase product that has a horizontal cell size of 0.8 km.

JERD-2490 The algorithm shall produce a cloud phase product that has a mapping uncertainty (3 sigma) of 4 km.

JERD-2491 The algorithm shall produce a cloud phase product that has a measurement accuracy of
60% Correct Classification (Cloud Type) and
80% correct classification (Cloud Phase).

3.2.5.31 VIIRS Cloud Top Pressure

Cloud top pressure is defined for each cloud-covered earth location as the set of atmospheric pressures at the tops of the cloud layers overlying the location.

Applicable Conditions:
1. Requirements apply whenever detectable clouds are present.

JERD-2433 The algorithm shall produce a cloud top pressure product with a horizontal cell size of 0.8 km.

JERD-2492 The algorithm shall produce a cloud top pressure product with a vertical reporting interval of tops of up to four layers.

JERD-2493 The algorithm shall produce a cloud top pressure product with a mapping uncertainty (3 sigma) of 4 km.

JERD-2494 The algorithm shall produce a cloud top pressure product with a measurement precision of:
100 hPa for COT >= 1 and
200 hPa for COT < 1.

JERD-2495 The algorithm shall produce a cloud top pressure product with a measurement accuracy of:
100 hPa for COT >= 1 and
200 hPa for COT < 1.

Notes:
1. Detectable clouds are defined as clouds with optical depths greater than 0.3.

3.2.5.32 VIIRS Cloud Top Temperature

Cloud top temperature is defined for each cloud-covered earth location as the set of atmospheric temperatures at the tops of the cloud layers overlying the location.

Applicable Conditions:
1. Requirements apply whenever detectable clouds are present.

JERD-2434 The algorithm shall produce a cloud top temperature product with a horizontal cell size of 0.8 km.

JERD-2496 The algorithm shall produce a cloud top temperature product with a vertical reporting interval of tops of highest cloud in the column.

JERD-2497 The algorithm shall produce a cloud top temperature product with a mapping uncertainty (3 sigma) of 4 km.

JERD-2498 The algorithm shall produce a cloud top temperature product with a measurement precision of:
6 K for COT >=1 and
12 K for COT <1.

JERD-2499 The algorithm shall produce a cloud top temperature product with a measurement accuracy of:
6 K for COT >=1 and
12 K for COT <1.

Notes:
1. Detectable clouds are defined as clouds with optical depths greater than 0.3.

3.2.5.33 VIIRS Green Vegetation Fraction (GVF)

Green Vegetation Fraction (GVF) is the fractional green vegetation cover within a specific grid cell. The retrieval algorithm uses VIIRS red (I1), near-infrared (I2) and blue (M3) surface reflectance bands centered at 0.640 μm, 0.865 μm, and 0.488 μm, respectively, to calculate the Enhanced Vegetation Index (EVI) and derive GVF from EVI.

JERD-2120 The algorithm shall produce a GVF product that has a horizontal cell size of 16 km.

JERD-2121 The algorithm shall produce a GVF product that has a mapping uncertainty (3 sigma) of 4 km.

JERD-2122 The algorithm shall produce a GVF product that has a measurement precision of 15% globally and regionally.

JERD-2123 The algorithm shall produce a GVF product that has a measurement accuracy of 12% globally and regionally.

JERD-2124 The algorithm shall produce a GVF product that has a measurement uncertainty of 17% globally and regionally.

3.2.5.34 VIIRS Ice Age/Thickness

The Ice Age/Thickness EDR provides ice age classes. Sea ice age is defined as the time that has passed since the formation of ice on the surface of sea water. Ice age is related to ice thickness.

JERD-2435 The algorithm shall produce an ice age/thickness product that has a vertical coverage of the ice surface.

JERD-2500 The algorithm shall produce an ice age/thickness product that has a horizontal cell size of 1.0 km in clear conditions.

JERD-2501 The algorithm shall produce an ice age/thickness product that has a mapping uncertainty (3 sigma) of 1 km at Nadir for clear pixels.

JERD-2502 The algorithm shall produce an ice age/thickness product that has a measurement range of:
Ice free, New/Young Ice, all other ice for Ice Age

JERD-2503 The algorithm shall produce an ice age/thickness product that has a measurement uncertainty of 70% for Ice Age probability of correct typing (Notes 1, 2, 3).

JERD-2504 The algorithm shall produce an ice age/thickness product in all ice-covered regions of the global ocean.

Notes:
1. VIIRS produces sea ice characterization in clear sky conditions only.
2. Performance Exclusion Conditions:
    a. VCM cloud confidence: confidently cloudy and probably cloudy.
    b. Sun glint regions
    c. Slant path 550 nm aerosol optical thickness > 1
3. Performance Degradation Conditions:
    a. Cloud shadow region: cloud shadows identified by VCM cloud shadow flag
    b. Night and terminator region: SZA > 85 deg
    c. Low thermal contrast region: ice/water tie point thermal contrast < 1.5
    d. Melt ponded ice region: ice tiepoint temperature or surface temperature IP temperature > 271.1 K

3.2.5.35 VIIRS Ice Concentration

Ice concentration is defined as the fraction of a given area of sea water covered by ice. The concentration of sea ice varies within the ice pack due to deformation, new ice development, melting, and motion. Total concentration includes all stages of development that are present.

JERD-2436 The algorithm shall produce an ice concentration product that has a vertical coverage of the ice surface.

JERD-2505 The algorithm shall produce an ice concentration product that has a horizontal cell size of 1.0 km in clear conditions.

JERD-2506 The algorithm shall produce an ice concentration product that has a mapping uncertainty (3 sigma) of 1 km at Nadir for clear pixels.

JERD-2507 The algorithm shall produce an ice concentration product that has a measurement range of 0 – 100%.

JERD-2508 The algorithm shall produce an ice concentration product that has a measurement accuracy of 10% (Notes 1, 2, 3).

JERD-2509 The algorithm shall produce an ice concentration product that has a measurement uncertainty of 25% (Notes 1, 2, 3).

JERD-2510 The algorithm shall produce an ice concentration product in all ice-covered regions of the global ocean.

Notes:
1. VIIRS produces sea ice concentration in clear sky conditions only.
2. Performance Exclusion Conditions:
    a. VCM cloud confidence: confidently cloudy and probably cloudy.
    b. Sun glint regions
    c. Slant path 550 nm aerosol optical thickness > 1
    d. Cloud adjacency exclusion (more than 15% confidently cloudy pixels within a tie point collection window)
3. Performance Degradation Conditions:
    a. Cloud shadow region: cloud shadows identified by VCM cloud shadow flag
    b. Night and terminator region: SZA > 85 deg
    c. Low thermal contrast region: ice/water tie point thermal contrast < 1.5
    d. Melt ponded ice region: ice tiepoint temperature or surface temperature IP temperature > 271.1 K

3.2.5.36 VIIRS Ice Surface Temperature

IST is the radiating, or "skin", temperature at the ice surface. It includes the aggregate temperature of objects comprising the ice surface, including snow and melt water on the ice. Inland water bodies and coastal ice temperatures will be obtained from the LST EDR.

As an objective, the Ice Surface Temperature EDR should measure the atmospheric temperature 2 m above the surface of the ice.

Applicable Conditions:
1. Clear, only

JERD-2437 The algorithm shall produce an ice surface temperature product with a sensing depth of the ice surface.

JERD-2511 The algorithm shall produce an ice surface temperature product with a horizontal cell size of 1 km at Nadir and 1.6 km at worst case.

JERD-2512 The algorithm shall produce an ice surface temperature product with a mapping uncertainty (3 sigma) of 1 km at Nadir and 1.6 km at worst case.

JERD-2513 The algorithm shall produce an ice surface temperature product with a measurement range of 213-275 K.

JERD-2514 The algorithm shall produce an ice surface temperature product with a measurement uncertainty of 1 K.

JERD-2515 The algorithm shall produce an ice surface temperature product with a geographic coverage of ice-covered oceans (Note 1).

Notes:
1. The horizontal coverage of this EDR is limited to Ice-covered oceans since the Chesapeake, Delaware, and Great Lakes are covered under the Land Surface Temperature EDR which provides temperature measurements for inland (navigable waters) and coastal waters.

3.2.5.37 VIIRS Land Surface Temperature

Land Surface Temperature (LST) is defined as the sensor-facing skin temperature of the land surface. It includes the aggregate temperature of objects comprising the land surface, including any open water, in the cell. Surface temperature information is needed for NWP and hydrological modeling, automated cloud analysis, and for general operations (i.e., wind chill temperatures and heat stress factors). LST is also used to support rescue operations.

Applicable Conditions:
1. Clear only.

JERD-2438 The algorithm shall produce a land surface temperature product with a horizontal cell size of 0.80 km.

JERD-2516 The algorithm shall produce a land surface temperature product with a mapping uncertainty (3 sigma) of 1 km at Nadir.

JERD-2517 The algorithm shall produce a land surface temperature product with a measurement range of 213 – 343 K.

JERD-2518 The algorithm shall produce a land surface temperature product with a measurement precision (1 sigma) of 2.5 K (Note 1).

JERD-2519 The algorithm shall produce a land surface temperature product with a measurement accuracy (bias) of 1.4 K (Note 1).

Notes:
1. Accuracy and precision performance will be verified and validated for an aggregated 4 km horizontal cell to provide for adequate comparability of performance across the scan.

3.2.5.38 VIIRS Ocean Color/Chlorophyll (OC/C)

Ocean color is the amount of light exiting the water column (excluding specular reflection at the air-water interface), specifically the outgoing radiant flux per solid angle and surface area at multiple wavelengths, e.g. normalized water-leaving radiance (nLw), and is estimated from top-of-atmosphere radiances. Geophysical quantities of interest, such as the concentration of the phytoplankton pigment (chlorophyll-a) and inherent optical properties (absorption and backscattering) of near surface waters are derived from these nLw values or equivalent, i.e., remote sensing reflectance. This EDR provides continuity of observations with a selected subset of observations from heritage ocean color missions (e.g., MODIS and SeaWiFS).

Open Ocean is defined as waters where phytoplankton and their derivative products play a dominant role in determining the optical properties and where the water depth is 30 m or greater. Blue Band indicates that the associated requirements apply to retrievals derived from measurements using the visible band centered at or near 0.445 μm and prescribe demonstrating that nLw errors in the contributing sensor bands are spectrally correlated as observed in heritage data. Measurement ranges applicable to individual, contributing sensor bands may vary from the stated EDR ensemble Measurement Range requirements as dictated by the expected natural variability of nLw in each band. Satisfaction of the Measurement Accuracy, Precision, and Long Term Stability threshold requirements will require application of vicarious calibration techniques and spacecraft calibration maneuvers similar to those used in heritage ocean color missions. The application of system design capabilities in the coastal ocean environment is considered an objective requirement for this EDR.

JERD-2128 The algorithm shall produce an OC/C product during clear conditions.

JERD-2129 The algorithm shall produce an OC/C product during daytime conditions.

JERD-2130 The algorithm shall produce an OC/C product that has a horizontal cell size of 0.75 km at nadir (worst case of 1.6 km).

JERD-2131 The algorithm shall produce an OC/C product that has a mapping uncertainty (3 sigma) of 0.75 at nadir (worst case 1.6 km).

JERD-2132 The algorithm shall produce an OC/C product that has a measurement range of
0.1 – 50 W/m2/um/sr for ocean color,
4.6/(10)2 to 1.0/m for optical properties – absorption,
4.0/(10)4 to 1.1/(10)2/m for optical properties – backscattering, and
0.01 to 100 mg/m3 for chlorophyll.

JERD-2133 The algorithm shall produce an OC/C product that has a measurement precision (open ocean, blue band) of:
10% operational (5% science quality) for ocean color,
20% for optical properties,
30% for chlorophyll at Ch1 < 1 mg/m3
30% for chlorophyll at 1.0 mg/m3 < Ch1 < 10 mg/m3, and
50% for chlorophyll at Ch1 > 10 mg/m3.

JERD-2134 The algorithm shall produce an OC/C product that has a measurement accuracy (open ocean, blue band) of:
10% operational (5% science quality) for ocean color,
35% operational (25% science quality) for optical properties,
35% operational (25% science quality) for chlorophyll at Ch1 < 1 mg/m3
30% operational (25% science quality) for chlorophyll at 1.0 mg/m3 < Ch1 < 10 mg/m3, and
40% operational (30% science quality) for chlorophyll at Ch1 > 10 mg/m3.

JERD-2135 The algorithm shall produce an OC/C product that demonstrates that nLw errors in the contributing sensor bands are spectrally correlated as observed in heritage data.

Notes:
1. These requirements are based on studies of these data in the NASA vetted and culled validation archive (NOMAD v2) and modeling using the baseline S-NPP inherent optical properties (IOP) algorithms. The threshold requirements reflect the baseline S-NPP system capability. The objective requirements reflect the full range of observed in-situ values in NOMAD.
2. The required range is pursuant to a recommendation by the JPSS L1RD Ocean Color Attributes Team to accommodate coastal region ocean waters that may have higher observed levels of biological activity.
3. Heritage requirements dictated that APU requirements be satisfied equally in all contributing VIIRS bands with regard for the variability of naturally occurring reflectances between bands. The Open Ocean, Blue Band qualifier has been recommended by the ocean community and endorsed by the JPSS L1RD Ocean Color Attributes Team to make the application of APU requirements more realistic in the absence of band-specific requirements. This qualifier necessitates the demonstration that sensor nLw errors will be spectrally correlated as observed in heritage data, a prescription that has been explicitly added to the leading paragraph for this EDR. This qualifier also provides for the exclusion of optically complicated waters where algorithm assumptions are no longer viable.

3.2.5.39 VIIRS Polar Winds

Polar (Tropospheric) winds are derived by tracking cloud features in VIIRS infrared channel imagery. Wind speed, direction, and height are measured throughout the troposphere, pole-ward of approximately 70 degrees latitude, in cloudy areas only. Vertical and horizontal coverage is not uniform. For quality control, winds are derived using three consecutive orbits. Wind vectors

are assigned the time of the middle image of the orbit triplet, thereby adding 101 minutes to the latency.

JERD-2139 The algorithm shall produce a polar winds product that has vertical coverage from the surface to the tropopause.

JERD-2140 The algorithm shall produce a polar winds product that has a horizontal resolution of 10 km.

JERD-2141 The algorithm shall produce a polar winds product that has a vertical reporting interval at cloud tops.

JERD-2142 The algorithm shall produce a polar winds product that has a mapping uncertainty (3 sigma) of 5 km.

JERD-2143 The algorithm shall produce a polar winds product that has a measurement range of:
3 to 100 m/sec for speed and
0 to 360 degrees for direction.

JERD-2144 The algorithm shall produce a polar winds product that has a measurement precision mean vector difference of 3.8 m/sec.

JERD-2145 The algorithm shall produce a polar winds product that has a measurement accuracy mean vector difference of 7.5 m/sec.

3.2.5.40 VIIRS Sea Surface Temperature (SST)

In context of retrievals from VIIRS, sea surface temperature (SST) is defined as a measurement of the skin temperature of the ocean surface, following the internationally accepted definition used by Group for High-Resolution SST (GHRSST) and the Committee on Earth Observation Satellites (CEOS) Virtual Constellation for SST. Satellite retrievals of SST provide the majority of ocean data that are assimilated into ocean circulation, climate, and mesoscale atmospheric numerical models, by providing real time constraints on ocean surface boundary conditions. SST is needed for many applications including operational weather and ocean forecasting (including ocean circulation and tropical storm trajectory and intensity forecasts), military and defense operations, validating or forcing ocean and atmospheric models, ecosystem assessment, tourism, coastal zone management, crew safety/ditching at sea, fisheries, climate variability, and seasonal forecasting. Satellite skin temperatures will enhance the emerging coupled ocean-atmospheric models that require both air and sea temperatures. Improvements in SST resolution, accuracy and uncertainty beyond legacy JPSS threshold values will enable significantly improved applications. Many users need temperature profiles, which can be derived by running models of the ocean upper layer, and using skin SST as a constraint. This “skin-to-bulk” inversion will be external to the SST EDR product described here, which only represents atmospheric and surface emissivity correction applied to top-of-atmosphere VIIRS brightness temperatures, and estimates the skin temperature of the ocean surface. Note that the derived skin

SST product will automatically meet similar specifications for bulk SST required by the bulk SST users community.

JERD-2148 The algorithm shall produce a SST product that has a horizontal cell size of 1.6 km (Note 1).

JERD-2149 The algorithm shall produce a SST product that has a mapping uncertainty (3 sigma) of 2 km (Note 1).

JERD-2150 The algorithm shall produce a SST product that has a measurement range of 271 K to 313 K.

JERD-2151 The algorithm shall produce a SST product that has a measurement accuracy of 0.2 K.

JERD-2152 The algorithm shall produce a SST product that has a measurement precision of 0.6 K.

JERD-2153 The algorithm shall produce a SST product that has a geographic coverage of global cloud and ice-free ocean – excluding lakes and rivers.

Notes:
1. Worst case scenarios corresponding to swath edge; both numbers are ~1km at nadir
2. Represent global mean bias and standard deviation validation statistics against quality-controlled drifting buoys (for day and night, and in full VIIRS swath and range of atmospheric conditions). Better performance is expected against ship radiometers.

3.2.5.41 VIIRS Snow Cover

The snow cover product contains two products: a fractional snow cover (FSC) and a binary snow cover (BSC) mask. The fractional snow cover is defined as the fraction of a given area of the earth's horizontal surface that is masked by snow. The binary snow/no-snow mask provides a mapping of snow covered areas as either containing or not having snow.

Applicable Conditions:
1. Clear Daytime, only

JERD-2439 The algorithm shall produce a snow cover product that has a horizontal cell size of 1.6 km (edge of scan) for clear pixels.

JERD-2520 The algorithm shall produce a snow cover product that has a measurement range, snow cover, of:
0-100% area fraction;
0 or 1 binary mask.

JERD-2521 The algorithm shall produce a snow cover product that has a mapping uncertainty (3 sigma) of 3 km for clear pixels.

JERD-2522 The algorithm shall produce a snow cover product that has a measurement uncertainty of
20% snow fraction,
90 % probability of correct snow/no-snow classification for clear pixels (Notes 2, 3).

Notes
1. A microwave instrument is needed to provide the cloudy measurement capability.
2. The probability of correct snow/no-snow detection applies only to climatologically snow-covered regions.
3. These requirements apply only to the viewable snow area, i.e., the portion of the land surface which is seen as snow covered by the satellite sensor. They do not include the effect of snow masking by forest cover or by topographic shading.

3.2.5.42 VIIRS Surface Albedo

Surface albedo is defined as the total amount of solar radiation in the 0.4 to 4.0 micron band reflected by the Earth's surface into an upward hemisphere (sky dome), including both diffuse and direct components, divided by the total amount incident from this hemisphere, including both direct and diffuse components. Both narrow- and broad-band albedo are important variables in determining the radiative balance at the surface (how much incident energy goes toward surface heating versus how much is reflected back to space). Albedo is also of use in determining surface type and as a background against which to detect and screen out clouds.

Applicable Conditions:
1. Daytime, clear, only.

JERD-2440 The algorithm shall produce a surface albedo product with a horizontal cell size of 0.80 km.

JERD-2523 The algorithm shall produce a surface albedo product with a mapping uncertainty (3 sigma) of 1 km at Nadir.

JERD-2524 The algorithm shall produce a surface albedo product with a measurement range of 0 to 1.0 (albedo units).

JERD-2525 The algorithm shall produce a surface albedo product with a measurement precision of 0.05 (albedo units). (Note 1)

JERD-2526 The algorithm shall produce a surface albedo product with a measurement accuracy of 0.08 (albedo units). (Note 1)

JERD-2527 The algorithm shall produce a surface albedo product with geographic coverage of global, including land ocean and ice surface conditions.

JERD-2528 The algorithm shall produce a surface albedo product with spectra coverage of broad band values from 0.4 to 4.0 microns.

Notes:
1. Accuracy and precision performance will be verified and validated for an aggregated 4 km horizontal cell to provide for adequate comparability of performance across the scan.

3.2.5.43 VIIRS Surface Reflectance

Surface Reflectance (SR) is defined as spectral (narrowband) bidirectional (dependent on the view geometry) reflectance that would be measured with the atmosphere removed. Surface Reflectance is a product of atmospheric correction removing effects of scattering and absorption of sun light by atmospheric gases and aerosols. SR is a derivative product dependent on performance of cloud detection and aerosol algorithms. The threshold and objective requirements support the derived requirements for the downstream products: V egetation Indices and Land Surface Albedo

Applicable Conditions:
1. Clear, daytime only (Note 1)

JERD-2441 The algorithm shall produce a surface reflectance product with a horizontal cell size of 0.80 km for radiometric and 0.40 km for imagery bands.

JERD-2529 The algorithm shall produce a surface reflectance product with a mapping uncertainty, 3 Sigma, of the VIIRS SDR pixel geolocation uncertainty.

JERD-2530 The algorithm shall produce a surface reflectance product with a measurement range of 0-1.

JERD-2531 The algorithm shall produce a surface reflectance product with a measurement Accuracy $0.005+0.05\rho$. (Note 1)

JERD-2532 The algorithm shall produce a surface reflectance product with a measurement Precision of $0.005+0.05\rho$. (Note 1)

Notes:
1. The symbol ρ denotes the retrieved surface reflectance. The APU metrics are applicable in conditions of low-to-moderate atmospheric turbidity (AOT (0.55μm) x m <1) where m is the air mass. The performance is degraded for the SR at wavelengths lower than 0.55μm by at least a factor 2. The SR errors may also be higher under partly cloudy and snow conditions.

3.2.5.44 VIIRS Surface Type

Surface Type is defined as the predominant type of one of the seventeen International Geosphere Biosphere Program (IGBP) classes (Table 1) in a given area. Surface type information is required as input to weather, climate, hydrological and agricultural models supporting various U.S. Government and academic customers.

Table 1. Land Cover Classifications

Land Cover Class	Definition
1. Evergreen Needleleaf Forests	Lands dominated by woody vegetation with a percent cover > 60% and height exceeding 2 meters. Almost all trees remain green all year. Canopy is never without green foliage.
2. Deciduous Needleleaf Forests	Lands dominated by woody vegetation with a percent cover > 60% and height exceeding 2 meters. Consists of seasonal, needleleaf tree communities with an annual cycle of leaf-on and leaf-off periods.
3. Evergreen Broadleaf Forests	Lands dominated by woody vegetation with a percent cover > 60% and height exceeding 2 meters. Almost all trees and shrubs remain green all year. Canopy is never without green foliage.
4. Deciduous Broadleaf Forests	Lands dominated by woody vegetation with a percent cover > 60% and height exceeding 2 meters. Consists of broadleaf tree communities with an annual cycle of leaf-on and leaf-off periods.
5. Mixed Forests	Lands dominated by woody vegetation with a percent cover > 60% and height exceeding 2 meters. Consists of tree communities with interspersed mixtures or mosaics of the other four forest types. None of the forest types exceeds 60% of landscape.
6. Closed Shrublands	Lands with woody vegetation less than 2 meters tall and with shrub canopy cover > 60%. The shrub foliage can be either evergreen or deciduous.
7. Open Shrublands	Lands with woody vegetation less than 2 meters tall with shrub canopy cover between 10-60%. The shrub foliage can be either evergreen or deciduous.
8. Woody Savannas	Lands with herbaceous and other understory systems, and with forest canopy cover between 30-60%. The forest cover height exceeds 2 meters.
9. Savannas	Lands with herbaceous and other understory systems, and with forest canopy cover between 10-30%. The forest cover height exceeds 2 meters.
10. Grasslands	Lands with herbaceous types of cover. Tree and shrub cover is less than 10%.
11. Permanent Wetlands	Lands with a permanent mixture of water and herbaceous or woody vegetation. The vegetation can be present in either salt, brackish, or fresh water.
12. Croplands	Lands covered with temporary corps followed by harvest and a bare soli period (e.g., single and multiple cropping systems). Note that perennial woody crops will be classified as the appropriate forest or shrub land cover type.
13. Urban and Built-Up	Land covered by buildings and other man-made structures.
14. Cropland/Natural Vegetation Mosaics	Lands with a mosaic of croplands, forests, shrubland, and grasslands in which no one component comprises more than 60% of the landscape.
15. Snow and Ice	Lands under snow/ice cover.
16. Barren	Lands with exposed soil, sand, rocks or snow and never had more than 10% vegetated cover during any time of the year.
17. Water Bodies	Oceans, seas, lakes, reservoirs, and rivers. Can be either fresh or salt-water bodies.

Applicable Conditions:

1. Both clear and partly cloudy sky conditions.

JERD-2442 The algorithm shall produce a surface type product with a horizontal cell size of 1 km at Nadir.

JERD-2533 The algorithm shall produce a surface type product with a mapping uncertainty (3 sigma) of 5 km.

JERD-2534 The algorithm shall produce a surface type product with a measurement range of 17 IGBP classes specified in Table 1.

JERD-2535 The algorithm shall produce a surface type product with a measurement accuracy of 70% correct for 17 types.

3.2.5.45 VIIRS Vegetation Health Index Suite

Vegetation Condition Index (VCI), Temperature Condition Index (TCI) and Vegetation Health Index (VHI) were developed to characterize land surface conditions/health. VCI, produced from NDVI, characterizes such indicators as greenness (dependent on chlorophyll contents) and vigor (dependent on moisture content). TCI, produced from infrared radiance, characterizes thermal conditions of land cover. VHI, a weighted combination of the VCI and TCI, characterizes the integrated effects of greenness, moisture and temperature on vegetation health. The data processing include comprehensive calibration of radiances, complete removal of high, medium and low frequency noise, calculation of special climatology (following three bio-physical lows) and anomalies. The indices are produced in real time at the end of each week for each 4*4 km land surface. In the past, these indices were validated in 26 countries based on health conditions of such major crops as wheat, corn, soybeans, sorghum and rice, pasture conditions, precipitation and temperature anomalies and sea surface temperature.

JERD-2157 The algorithm shall produce a vegetation health index product that has a horizontal cell size of 0.036° (4 km). (Note 3)

JERD-2158 The algorithm shall produce a vegetation health index product that has a mapping uncertainty (3 sigma) of < 0.036° (<4 km).

JERD-2159 The algorithm shall produce a vegetation health index product that has a measurement precision of 4.0% (for the range 0-100%).

JERD-2160 The algorithm shall produce a vegetation health index product that has a measurement accuracy of 1%.

Notes:

1. Three VH indices are produced: VCI- Vegetation condition index, TCI – Temperature conditions index, VHI – Vegetation health index. They characterize moisture (VCI), thermal (TCI) and total vegetation health (VHI) conditions.
2. Latency: At the end of each 7-day period the data are available between 2 and 3 am (on the 7th day). 4 hours later (7 am the latest) the products are ready to use. The US main users (Climate Prediction Center and United States Department of Agriculture) will have the products by the time they come to work. These arrangements we confirmed with users.
3. The JPSS Program will now create the product at the Objective horizontal cell size level and that it should be verified at the 1 km requirement now. This higher resolution requirement is based on a National Weather Service (NWS) user request and is approved by the LORWG. This objective horizontal cell size requirement will henceforth be flowed down as the baseline requirement to lower level documents.

3.2.5.46 VIIRS Vegetation Indices

Vegetation Indices (VIs) are used to monitor and characterize terrestrial landscapes; VIs are related to absorption of photosynthetically active radiation by vegetation and correlate with biomass or primary productivity. The Vegetation Indices Product Suite consists of three vegetation indices: the Top-of-Atmosphere (TOA)-Normalized Difference Vegetation Index (NDVI), Top-of-Canopy (TOC)-Enhanced Vegetation Index (EVI) and TOC-NDVI. The TOA-NDVI is defined as the ratio of the difference of the NIR and Red band reflectance values as received by the sensor (i.e., TOA bands I1 and I2) divided by their sum. The EVI product relies on reflectances that are atmospherically-corrected (TOC, surface reflectance bands I1, I2 and M3) and has improved sensitivity in high biomass regions. The TOC-NDVI is defined as the ratio of the difference of the NIR and red reflectance values (TOC bands I1 and I2) divided by their sum.

Applicable Conditions:
1. Clear, land (not ocean), daytime only.

JERD-2443 The algorithm shall produce a daily vegetation indices product with a horizontal cell size of 4 km global and 1 km regional. (Note 3).

JERD-2536 The algorithm shall produce a daily vegetation indices product with a mapping uncertainty (3 sigma) of 4 km. (Note 3)

JERD-2537 The algorithm shall produce a daily vegetation indices product with a measurement range of:
-1 to +1 for $NDVI_{TOA}$, -1 to +4 for EVI (Note 1), and -1 to +1 for $NDVI_{TOC}$. (Note 3)

JERD-2538 The algorithm shall produce a daily vegetation indices product with a measurement accuracy of 0.05 NDVI units for $NDVI_{TOA}$. (Note 2) (Note 3)

JERD-2539 The algorithm shall produce a daily vegetation indices product with a measurement precision of 0.04 NDVI units for $NDVI_{TOA}$. (Note 2) (Note 3)

JERD-2540 The algorithm shall produce a daily vegetation indices product with a measurement accuracy of 0.05 NDVI units for EVI. (Note 2) (Note 3)

JERD-2541 The algorithm shall produce a vegetation indices product with a measurement precision of 0.04 NDVI units for EVI. (Note 2)

JERD-2542 The algorithm shall produce a daily vegetation indices product with a measurement accuracy of 0.05 NDVI units for $NDVI_{TOC}$. (Note 2) (Note 3)

JERD-2543 The algorithm shall produce a daily vegetation indices product with a measurement precision of 0.04 NDVI units for $NDVI_{TOC}$. (Note 2) (Note 3)

JERD-4064 The algorithm shall produce a weekly vegetation indices product with a horizontal cell size of 4 km global and 1 km regional. (Note 4)

JERD-4065 The algorithm shall produce a weekly vegetation indices product with a mapping uncertainty (3 sigma) of 4 km. (Note 4)

JERD-4066 The algorithm shall produce a weekly vegetation indices product with a measurement range of:
-1 to +1 for $NDVI_{TOA}$, -1 to +4 for EVI (Note 1), and -1 to +1 for $NDVI_{TOC}$. (Note 4)

JERD-4067 The algorithm shall produce a weekly vegetation indices product with a measurement accuracy of 0.05 NDVI units for $NDVI_{TOA}$. (Note 2) (Note 4)

JERD-4068 The algorithm shall produce a weekly vegetation indices product with a measurement precision of 0.04 NDVI units for $NDVI_{TOA}$. (Note 2) (Note 4)

JERD-4069 The algorithm shall produce a weekly vegetation indices product with a measurement accuracy of 0.05 NDVI units for EVI. (Note 2) (Note 4)

JERD-4070 The algorithm shall produce a weekly vegetation indices product with a measurement precision of 0.04 NDVI units for EVI. (Note 2) (Note 4)

JERD-4071 The algorithm shall produce a weekly vegetation indices product with a measurement accuracy of 0.05 NDVI units for $NDVI_{TOC}$. (Note 2) (Note 4)

JERD-4072 The algorithm shall produce a bi-weekly vegetation indices product with a measurement precision of 0.04 NDVI units for $NDVI_{TOC}$. (Note 2) (Note 4)

JERD-4073 The algorithm shall produce a bi-weekly vegetation indices product with a horizontal cell size of 4 km global and 1 km regional. (Note 5)

JERD-4074 The algorithm shall produce a bi-weekly vegetation indices product with a mapping uncertainty (3 sigma) of 4 km. (Note 5)

JERD-4075 The algorithm shall produce a bi-weekly vegetation indices product with a measurement range of:
-1 to +1 $NDVI_{TOA}$, -1 to +4 for EVI (Note 1), and -1 to +1 for $NDVI_{TOC}$. (Note 5)

JERD-4076 The algorithm shall produce a bi-weekly vegetation indices product with a measurement accuracy of 0.05 NDVI units for $NDVI_{TOA}$. (Note 2) (Note 5)

JERD-4077 The algorithm shall produce a bi-weekly vegetation indices product with a measurement precision of 0.04 NDVI units for $NDVI_{TOA}$. (Note 2) (Note 5)

JERD-4078 The algorithm shall produce a bi-weekly vegetation indices product with a measurement accuracy of 0.05 NDVI units for EVI. (Note 2) (Note 5)

JERD-4079 The algorithm shall produce a bi-weekly vegetation indices product with a measurement precision of 0.04 NDVI units for EVI. (Note 2) (Note 5)

JERD-4080 The algorithm shall produce a bi-weekly vegetation indices product with a measurement accuracy of 0.05 NDVI units for $NDVI_{TOC}$. (Note 2) (Note 5)

JERD-4081 The algorithm shall produce a bi-weekly vegetation indices product with a measurement precision of 0.04 NDVI units for $NDVI_{TOC}$. (Note 2) (Note 5)

Notes:
1. EVI can produce faulty values over snow, ice and residual clouds (EVI>1).
2. Accuracy and precision performance will be verified and validated for an aggregated 4 km horizontal cell to provide for adequate comparability of performance across the scan.
3. After a 24-hour compositing period, the daily global and regional gridded products will be updated in 6 hours.
4. After a 7-day compositing period, the weekly global and regional gridded products will be updated daily.
5. After a 16-day compositing period, the bi-weekly global and regional gridded products will be updated daily.

3.2.5.47 VIIRS Volcanic Ash Detection and Height

Volcanic ash detection and height maps the location and concentration of volcanic ash after an eruption and dispersion by the wind. The top height of the ash is detected at a minimum in regions where aerosols have been detected above a nominal level that can vary depending on conditions.

Applicable Conditions:
1. Clear, AOD > 0.15

JERD-2444 The algorithm shall produce a volcanic ash detection and height product that has a horizontal cell size of 0.8 km.

JERD-2544 The algorithm shall produce a volcanic ash detection and height product that has a vertical coverage of the total column.

JERD-2545 The algorithm shall produce a volcanic ash detection and height product that has a mapping uncertainty (3 sigma) of 3 km.

JERD-2546 The algorithm shall produce a volcanic ash detection and height product that has a measurement accuracy of 2 tons/km^2, 3 km height (Note 1).

JERD-2547 The algorithm shall produce a volcanic ash detection and height product that has a measurement precision of 2.5 tons/km^2 (Note 1).

Notes:
1. Accuracy and precision requirements only apply to actual pixels that contain volcanic ash as the highest cloud layer.

3.2.5.48 AMSR-2 SDR

AMSR-2 SDRs (Level-1 Brightness Temperatures) will be generated at NOAA using Japan Aerospace Exploration Agency (JAXA) provided processing code and look-up tables. Level-2 products will then be generated using algorithms and processing code provided by STAR. The resultant Level-1 and Level-2 products will be distributed to NOAA's real-time operational users, employing NOAA distribution servers. More detail on the AMSR-2 Level-1 data can be found in the Global Change Observation Mission Water AMSR2 Level 1 Product (A, B, and R) Format Specification for the GCOM-W1.

3.2.5.49 AMSR-2 Cloud Liquid Water

Cloud Liquid Water is defined as the equivalent amount of water within a cloud in a specified segment of a vertical column of the atmosphere.

JERD-2240 The algorithm shall produce the cloud liquid water product under all-weather conditions.

JERD-2241 The algorithm shall produce the cloud liquid water product that has a horizontal cell size of 10 km (37 GHz FOV size); 10 km sampling (Note 1).

JERD-2242 The algorithm shall produce the cloud liquid water product that has a vertical reporting interval of the total column.

JERD-2243 The algorithm shall produce the cloud liquid water product that has a mapping uncertainty (3 sigma) of 5 km.

JERD-2244 The algorithm shall produce the cloud liquid water product that has a measurement uncertainty of 0.05 mm over ocean and best efforts over land.

JERD-2245 The algorithm shall produce the cloud liquid water product that has a measurement accuracy of 0.01 mm.

JERD-2246 The algorithm shall produce the cloud liquid water product globally over ice-free oceans.

JERD-2247 The algorithm shall produce the cloud liquid water product that has a range of 0.005 – 1 mm.

Notes:
1. Horizontal Cell Size (HCS) is consistent with 36 GHz SDR product HCS.
2. This Refresh requirement is consistent with the AMSR-2 Cross-track Swath Width design of 1450 km for a single orbit plane.

3.2.5.50 AMSR-2 Imagery

Microwave Imagery is the brightness temperature data from each microwave channel displayed at the native resolution.

JERD-2231 The algorithm shall produce the imagery product under all-weather conditions.

JERD-2232 Each channel shall be provided at its highest native resolution.

JERD-2233 All channels shall be vertically and horizontally polarized.

JERD-2234 All channels shall be sampled at 10 km except 89 GHz, which shall be sampled at 5 km.

JERD-2235 The algorithm shall produce the imagery product that has a horizontal sampling interval (Note 1) of 10 km except 89 GHz which is at 5 km (Note 2).

JERD-2236 The algorithm shall produce the imagery product that has a mapping uncertainty (3 sigma) of 5 km.

Notes:
1. "Horizontal Sampling Interval" better reflects the way the data is to be taken rather than specifying "Horizontal Spatial Resolution" (HSR) which is used for other EDRs. The Sampling Interval does not necessarily equal the HSR.
2. All channels are sampled at 10 km except 89 GHz, which is at 5 km. All channels V & H polarization. The native resolutions for each channel are as follows:
   a) GHz - 35 x 62 km
   b) GHz - 35 x 62 km
   c) 10.65 GHz - 24 x 42 km
   d) 18.7 GHz - 14 x 22 km
   e) 23.8 GHz - 15 x 26 km
   f) 36.5 GHz - 7 x 12 km
   g) 89.0 GHz - 3 x 5 km
3. This Refresh requirement is consistent with the AMSR-2 Cross-track Swath Width design of 1450 km for a single orbit plane.

3.2.5.51 AMSR-2 Precipitation (Type/Rate)

Precipitation Rate is defined as the amount of rainfall during a period of time. The required Precipitation Rate products provide the instantaneous rainfall rate during the time of observation in mm/hour. Satellite derived precipitation rate data provides information on the severity and evolution of rainfall events, especially in geographic areas without surface-based radar coverage.

JERD-2253 The algorithm shall produce a precipitation type/rate product under all-weather conditions.

JERD-2254 The algorithm shall produce the precipitation type/rate product that has a horizontal cell size of 5 km over land (89 GHz FOV) (Note 1); 5 km over ocean (37 GHz FOV size); 5-10 km sampling.

JERD-2255 The algorithm shall produce the precipitation type/rate product that has a mapping uncertainty (3 sigma) of < 5 km.

JERD-2256 The algorithm shall produce the precipitation type/rate product that has a measurement range of 0-50 mm/hr.

JERD-2257 The algorithm shall produce the precipitation type/rate product that has a measurement precision of 0.05 mm/hr.

JERD-2258 The algorithm shall produce the precipitation type/rate product that has a measurement uncertainty of:
2 mm/hr over ocean and
5 mm/hr over land.

JERD-2259 The algorithm shall produce the precipitation type/rate product that has a precipitation type of stratiform or convective.

Notes:
1. The HCS is consistent with the 89 GHz SDR product HCS.
2. This Refresh requirement is consistent with the AMSR-2 Cross-track Swath Width design of 1450 km for a single orbit plane.

3.2.5.52 AMSR-2 Sea Ice Characterization

Sea Ice Characterization constitutes the sea ice properties derived from all-weather imagery. Sea ice age is defined as the time that has passed since the formation of the surface layer of an ice covered region of the ocean. The content of the sea ice age EDR is the typing of areas of sea ice by age. The National Ice Center monitors sea ice globally to estimate sea ice growth and decay. This information is used to protect mariners, support military and civilian operations, and assess potential global climate changes since Polar Regions are more likely to exhibit early signs of global warming.

JERD-2308 The algorithm shall produce a sea ice characterization product under all-weather conditions.

JERD-2309 The algorithm shall produce the sea ice characterization product that has a vertical coverage of the ice surface.

JERD-2310 The algorithm shall produce the sea ice characterization product that has a horizontal cell size of 10 km.

JERD-2311 The algorithm shall produce the sea ice characterization product that has a mapping uncertainty (3 sigma) of 5 km.

JERD-2312 The algorithm shall produce the sea ice characterization product that has a measurement range of:
1/10 – 10/10 for ice concentration and
ice free, first-year, multiyear ice for ice age classes.

JERD-2313 The algorithm shall produce the sea ice characterization product that has a measurement uncertainty of 10% for ice concentration.

JERD-2314 The algorithm shall produce the sea ice characterization product that has a probability of correct typing of 70% for typing of Ice Age Classes.

JERD-2315 The algorithm shall produce the sea ice characterization product that has a geographic coverage of all ice-covered regions of the global ocean.

Notes:
1. This Refresh requirement is consistent with the AMSR-2 Cross-track Swath Width design of 1450 km for a single orbit plane.

3.2.5.53 AMSR-2 Sea Surface Temperature (SST)

See the VIIRS SST Section for a description of SST.

JERD-2319 The algorithm shall produce the SST product under all-weather conditions.

JERD-2320 The algorithm shall produce the SST product that has a horizontal cell size of 40 km (Note 1).

JERD-2321 The algorithm shall produce the SST product that has a mapping uncertainty (3 sigma) of 5 km.

JERD-2322 The algorithm shall produce the SST product that has a measurement range of 271 K to 313 K (Note 2).

JERD-2323 The algorithm shall produce the SST product that has a measurement accuracy, skin and bulk, of 0.5 K.

JERD-2324 The algorithm shall produce the SST product that has a measurement uncertainty of 1.0 K.

JERD-2325 The algorithm shall produce the SST product that has a geographic coverage of the global oceans (Note 4).

Notes:
1. This HCS requirement is consistent with the 6 GHz SDR product HCS.
2. For all weather, 301 K is the AMSR-E limit. 307 K is the realistic upper limit (Objective) per the Microwave Operational Algorithm Team (MOAT).
3. This Refresh requirement is consistent with the AMSR-2 Cross-track Swath Width design of 1450 km for a single orbit plane.
4. Note that MW instruments cannot retrieve within ~50-100 km of land due to contamination of the side-lobe, so coastal waters are problematic. Also, geographic coverage is limited to global ice free oceans.
5. The characterization of errors for each retrieval is a MW SST user community requirement ((e.g.) GHRSST L2P format). Although not defined in this document, such error characteristic will be defined for the AMSR-2 SST product as an objective requirement

3.2.5.54 AMSR-2 Sea Surface Wind Speed

Sea Surface Winds (SSW) is the measure of atmospheric wind speed/direction at the sea/atmosphere interface in clear sky and cloudy conditions. Winds indicate global and local circulation patterns, force ocean surface circulation (surface currents), determine sea state, influence water levels along the coast, help to determine surface height, produce storm surge, and drive the motion of the lower layers of the atmosphere.

JERD-2272 The algorithm shall produce a sea surface wind speed product under all-weather conditions.

JERD-2273 The algorithm shall produce the sea surface wind speed product that has a horizontal cell size of 33 km (10.7 GHz FOV size) (Note 3); 10 km sampling.

JERD-2274 The algorithm shall produce the sea surface wind speed product that has a mapping uncertainty (3 sigma) of 5 km.

JERD-2275 The algorithm shall produce the sea surface wind speed product that has a measurement range (speed) of 2 – 30 m/sec.

JERD-2276 The algorithm shall produce the sea surface wind speed product that has a measurement uncertainty (speed) of greater of 2.0 m/sec or 10%.

JERD-2277 The algorithm shall produce the sea surface wind speed product that has a measurement accuracy of 0.5 m/sec (Note 4).

JERD-2278 The algorithm shall produce the sea surface wind speed product that has a geographic coverage of global ice-free oceans.

Notes:
1. There is no SSW capability on JPSS.
2. There is no SSW - Direction capability on GCOM (AMSR-2).
3. This HCS is consistent with the 10 GHz SDR product HCS.
4. Accuracy requirements apply for Cloud Liquid Water up to 2mm.
5. This Refresh requirement is consistent with the AMSR-2 Cross-track Swath Width design of 1450 km for a single orbit plane.

3.2.5.55 AMSR-2 Snow Cover/Depth

Snow Cover is defined to be the horizontal extent of snow cover. It does not include snow hidden by vegetation or other obstructions when viewed from above. Snow cover data at specified values are required to determine background conditions for electro-optical sensors. Forecasts of weather, trafficability, river stage, flood, air rescue conditions, and other phenomena also utilize snow cover information.

JERD-2282 The algorithm shall produce a snow cover/depth product under all-weather conditions.

JERD-2283 The algorithm shall produce the snow cover/depth product that has a sensing depth of 0 – 60 cm.

JERD-2284 The algorithm shall produce the snow cover/depth product that has a horizontal cell size of 10 km.

JERD-2285 The algorithm shall produce the snow cover/depth product that has a mapping uncertainty (3 sigma) of 5 km.

JERD-2286 The algorithm shall produce the snow cover/depth product that has snow depth ranges of 5 – 60 cm.

JERD-2287 The algorithm shall produce the snow cover/depth product that has a measurement uncertainty (Note 1) of:
80% probability of correct snow/no snow classification – snow depth: 20 cm (30 cm if forest cover exceeds 30%) for clear scenes and
80% probability of correct snow/no snow classification – snow depth: 20 cm for cloudy scenes.

Notes:
1. Uncertainty requirements do not apply to (1) mountainous areas (2) melting snow condition. Formulated uncertainty requirements are based on past results of validation of other snow depth products derived from the data of SSMI and AMSR-E. Retrievals with algorithms utilizing only satellite data (no Radiative Transfer (RT) model involvement) were considered.
2. This Refresh requirement is consistent with the AMSR-2 Cross-track Swath Width design of 1450 km for a single orbit plane.

3.2.5.56 AMSR-2 Snow Water Equivalent

Snow-Water Equivalent (SWE) is the product of snow depth and snow relative density (with respect to the density of liquid water), a measure of the amount of water stored in a snowpack per unit area; it is expressed in units of length (e.g., cm or inches), being a quantity of type surface density, normalized by water density. It is the depth of water in the snowpack, if the snowpack were melted. SWE is extremely useful to the hydrological community to estimate runoff and stored water.

JERD-2291 The algorithm shall produce a snow water equivalent product under all-weather conditions.

JERD-2292 The algorithm shall produce the snow water equivalent product that has a horizontal cell size of 10 km.

JERD-2293 The algorithm shall produce the snow water equivalent product that has a mapping uncertainty (3 sigma) of 5 km.

JERD-2294 The algorithm shall produce the snow water equivalent product that has a measurement range of 10 – 200 mm.

JERD-2295 The algorithm shall produce the snow water equivalent product that has a measurement uncertainty (Note 1) of:
20 mm or 50% for shallow to moderate snow packs (10-100 mm) and
70% for high snow accumulation (above 100 mm).

Notes:
1. Uncertainty requirements do not apply to (1) mountainous areas (2) melting snow condition. Relaxed accuracy requirement should be specified for densely forested areas. Formulated uncertainty requirements are based on past results of validation of other SWE products derived from the data of SSMI and AMSR-E. Retrievals with algorithms utilizing only satellite data (no RT model involvement) were considered.
2. This SWE Refresh requirement is consistent with the AMSR-2 Cross-track Swath Width design of 1450 km for a single orbit plane.

3.2.5.57 AMSR-2 Soil Moisture

Soil Moisture is moisture within the surface soil layer to the depth where microwave emission or reflection signals can be sensed by satellite sensors. Numerical weather prediction, climatic, and hydrological forecast models require soil moisture for model initialization and estimation of land-atmosphere water, carbon, and energy exchanges. Soil moisture information is also needed in crop production forecasts, agricultural and urban water management, and other societal applications (e.g. vector disease forecasts).

JERD-2299 The algorithm shall produce a soil moisture product under all-weather conditions.

JERD-2300 The algorithm shall produce the soil moisture product that has a sensing depth of surface to -0.1 cm (skin layer).

JERD-2301 The algorithm shall produce the soil moisture product that has a horizontal cell size of 40 km.

JERD-2302 The algorithm shall produce the soil moisture product that has a mapping uncertainty (3 sigma) of 5 km.

JERD-2303 The algorithm shall produce the soil moisture product that has a measurement uncertainty of 6% volumetric RMSE (goal), with VWC < 1.5 kg/m^2 or GVF < 0.5 and < 2 mm/hr precipitation rate.

JERD-2304 The algorithm shall produce the soil moisture product that has a measurement range of 0 – 50% (Note 1).

Notes:
1. The threshold measurement range is given as 0-50% which is appropriate. However, the objective is given as 0-100%. A 0-100% range in absolute soil moisture only makes sense if you are including some fraction of standing water in the total of what you are calling "soil moisture" since soils will saturate at an absolute soil moisture level of 40-50%. The community often converts % soil moisture into absolute units (for ex., 50% = 0.50 cm3/cm3) to avoid confusion. The later approach would not include standing water in the units of soil moisture since the "per cm3" volume referred to is the soil volume at and below the soil surface and would not include anything sitting on top of the surface like puddles of water.
2. This Refresh requirement is consistent with the AMSR-2 Cross-track Swath Width design of 1450 km for a single orbit plane.

3.2.5.58 AMSR-2 Total Precipitable Water

TPW is the total equivalent water of unit cross-sectional area between any two specified levels, including the total atmospheric column. This EDR is derived from imagery, atmospheric sounding data, and microwave observations.

JERD-2263 The algorithm shall produce the TPW product that has a horizontal cell size of 10 km (21 GHz FOV sampling) (Note 1).

JERD-2264 The algorithm shall produce the TPW product that has a mapping uncertainty (3 sigma) of 5 km.

JERD-2265 The algorithm shall produce the TPW product that has a measurement range of 1 – 75 mm.

JERD-2266 The algorithm shall produce the TPW product that has a measurement uncertainty of 2 mm or 10%; whichever is greater.

JERD-2267 The algorithm shall produce the TPW product that has a measurement accuracy of 1 mm.

JERD-2268 The algorithm shall produce the TPW product that has a coverage of ice-free global ocean.

Notes:
1. This HCS consistent with the 23 GHz SDR product HCS.
2. This refresh requirement is consistent with the AMSR-2 cross-track swath width design of 1450 km for a single orbit plane.
3. The spatial distribution of the assessment data is global, encompassing the natural variability of the different geophysical conditions.
4. Refresh, coverage and horizontal size are all dependent on the refresh, coverage and horizontal size of the brightness temperatures measurements. The MiRS algorithm outputs characteristics will reproduce the TB characteristics of these factors.

3.2.5.59 OMPS Limb Profiler SDR

The OMPS Limb Profiler (LP) SDR is comprised of calibrated radiances [mW/(m2 sr nm)] from three vertical fields of View (FOV) as viewed through two different diameter apertures with two different integration times. The 12 measurements sets are provided for wavelength channels as selected by instrument sample tables with consideration of signal and noise levels requirements of the retrieval algorithm. The nominal set of channels is [290, 293, 296, 299, 302, 310, 320, 347, 353, 400, 490, 500, 514, 525, 575, 602, 616, 632, 675, 750, 860, and 1020] nm. The records also contain error estimates, applicable quality flags, metadata, and the associated geolocation (latitude, longitude and altitude) and pointing information. The OMPS LP SDR requirements facilitate satisfaction of the ozone EDR and performance necessary for exploitation of these data in near-real-time applications and external Climate Data Record production.

JERD-4085 The OMPS LP SDR shall satisfy the Threshold performance characteristics as given in Tables omps-lp-1, omps-lp-2a, omps-lp-2b, and omps-lp-2c for all scenes with solar zenith angles less than 80 degrees and all Fields of View.

JERD-4086 The OMPS LP SDR shall produce OMPS LP SDR products globally.

Parameter	**Requirements**	**Comments**
Wavelength range	290 nm to 1020 nm	Ozone and path length range, aerosol dependence, stray light monitoring, solar features for wavelength scale, RSAS pointing
Bandwidth	1.5 nm to 40 nm	Distinguish Solar lines and O_3 absorption features.
Samples /FWHM	≥ 2	λ-shifts, gridding
Number of channels	32 (for 12 images with 80 vertical pixels)	Gridding/interpolation, Multiple pairs and triplets for O_3, reflectivity, aerosols, RSAS pointing
Horizontal cell size	125 km along track	Stratospheric features
Horizontal coverage	3 Nadir FOVs ±250 km	4 day global coverage
Signal to noise ratio (SNR)	See tables	Precision, pixel bin factor of 1, 19-S integration
Polarization	< 3 %	Accuracy

Parameter	Requirements	Comments
sensitivity		
λ-registration	< 0.01 pixels	O_3 Absorption features and solar registration
Albedo calibration	2%	Accuracy and stability
Pixel to pixel calibration	0.5% max.	Accuracy
Albedo deviation error	< 1%	Accuracy and stability between weekly solar
Stray Light	< 10%	Accuracy (Instrument performance before SDR correction)

Table omps-lp-2a Signal-to-noise ratio allocations to the limb sensor channels as a function of wavelength and altitude.

	290 nm		293 nm		296 nm		299 nm		302 nm	
	snr	mr	snr	mr	snr	mr	snr	mr	snr	mr
61-65 km	65	4.45	70	4.33	75	4.20	70	3.47	80	3.67
53-60 km	75	5.43	85	5.33	n/a	5.22	n/a	4.36	n/a	4.63
50-53 km	105	8.1	125	9.0	145	9.89	145	9.05	170	10.0
47-50 km	n/a	7.1	n/a	8.45	145	9.8	170	11.6	200	13.4
45-47 km	n/a	6.67	n/a	7.83	n/a	8.99	170	11.6	220	16.0
43-45 km	n/a	6.34	n/a	7.38	n/a	8.42	160	10.6	240	17.2
38-43 km	n/a	5.74	n/a	6.62	n/a	7.49	n/a	9.17	n/a	17.4
28-38 km	n/a	5.0	n/a	5.73	n/a	6.45	n/a	7.78	n/a	14.3
15-28 km	n/a	4.42	n/a	5.04	n/a	5.66	n/a	6.8	n/a	12.5
Trop-15 km	n/a	4.0	n/a	4.55	n/a	5.11	n/a	6.14	n/a	11.3

Table omps-lp-2b Signal-to-noise ratio allocations to the limb sensor channels as a function of wavelength and altitude.

	310 nm		320 nm		347 nm		353 nm		400 nm	
	snr	mr	snr	mr	snr	mr	snr	mr	snr	mr
61-65 km	95	3.87	135	5.08	150	4.76	150	4.69	90	4.31
53-60 km	n/a	4.91	n/a	6.46	180	6.05	180	5.97	110	5.48
50-53 km	n/a	11.0	n/a	14.8	300	14.1	300	13.9	190	12.7
47-50 km	n/a	15.3	n/a	21.1	360	20.3	360	20.0	240	18.3
45-47 km	n/a	20.5	n/a	29.6	460	29.1	460	28.7	300	26.4
43-45 km	320	23.8	440	36.9	500	37.1	500	36.7	360	33.7
38-43 km	320	25.6	500	45.1	500	47.5	500	46.9	400	43.3
28-38 km	n/a	20.9	500	67.0	500	88.8	500	87.7	500	82.3
15-28 km	n/a	18.1	n/a	69.6	500	315	500	312	500	317
Trop-15 km	n/a	16.4	n/a	69.1	n/a	568	n/a	570	n/a	829

Table omps-lp-2c Signal to noise ratio allocations to the limb sensor channels as a function of wavelength and altitude.

	500 nm		525 nm		575 nm		602 nm		675 nm		1000 nm	
	snr	mr	snr	mr	snr	mr	snr	mr	snr	mr	snr	mr
61-65 km	n/a	2.88	n/a	1.44	n/a	1.11	n/a	0.786	n/a	0.416	n/a	0.0414
53-60 km	n/a	3.66	n/a	1.84	n/a	1.42	n/a	0.999	n/a	0.528	n/a	0.0527
50-53 km	n/a	8.5	n/a	4.26	n/a	3.29	n/a	2.32	n/a	1.23	n/a	1.22
47-50 km	n/a	12.2	n/a	6.12	n/a	4.72	n/a	3.32	n/a	1.76	n/a	0.122
45-47 km	n/a	17.6	n/a	8.79	n/a	6.78	n/a	4.76	n/a	2.53	n/a	0.253
43-45 km	440	22.5	320	11.2	320	8.63	280	6.06	220	3.23	25	0.322
38-43 km	500	28.8	360	14.4	360	11.1	320	7.74	260	4.14	30	0.414
28-38 km	500	54.8	500	27.3	500	20.9	460	14.4	360	7.89	55	0.793
15-28 km	500	210	500	103	500	76.0	500	49.1	500	31.4	180	3.42
Trop-15 km	500	619	500	410	500	269	500	129	500	196	440	32.5

Notes for Tables 2a, 2b, and 2c: mr = minimum radiance, 10-4 W/m2/sr/nm; trop = tropopause, 8-15 km depending on latitude; reference = 61-65 altitude averaged

3.2.5.60 – Ozone Limb Profiler EDR

The OMPS Limb Profiler, in conjunction with the OMPS Nadir Profiler and OMPS-Nadir Mapper instruments, provides global ozone observations at high vertical resolution (< 3 km). This EDR provides a measurement of ozone concentration within a specified volume. Since the OMPS Limb instrument is not flown on JPSS-1, the Ozone Limb Profiler EDR requirement only apply to S-NPP.

Applicable Conditions:
1. Clear, daytime only, solar zenith angles less than 80 degrees

JERD-4087 The algorithm shall produce an ozone limb profile product that has a horizontal cell size of 250 km.

JERD-4088 The algorithm shall produce an ozone limb profile product that has a horizontal reporting interval of 150 km.

JERD-4089 The algorithm shall produce an ozone limb profile product that has a vertical coverage of TH to 60 km. (Note 1)

JERD-4090 The algorithm shall produce an ozone limb profile product that has a vertical reporting interval of 1 km.

JERD-4091 The algorithm shall produce an ozone limb profile product that has a vertical resolution of:
N/A from 0 to TH (Note 1),
5 km from TH to 25 km Note 1),
5 km from 25 to 60 km.

JERD-4092 The algorithm shall produce an ozone limb profile product that has a mapping uncertainty (1 sigma) of <25 km.

JERD-4093 The algorithm shall produce an ozone limb profile product that has a measurement range of:
N/A for 0 to TH (note 1),
0.1 to 15 ppmv for TH – 60 km.

JERD-4094 The algorithm shall produce an ozone limb profile product that has a measurement precision of:
N/A for 0 to TH (Note 1),
Greater of 10% or 0.1 ppmv from TH to 15 km, (Note 1),
Greater of 3% or 0.05 ppmv from 15 to 50 km,
Greater of 10% or 0.1 ppmv from 50 to 60 km.

JERD-4095 The algorithm shall produce an ozone limb profile product that has a measurement accuracy of:
N/A for 0 to TH (Note 1),
Greater of 20% or 0.1 ppmv from TH to 15 km,
Greater of 10% or 0.1 ppmv for 15 to 60 km.

JERD-4096 The algorithm shall produce an ozone limb profile product that has a refresh of at least 75% coverage of the globe every 4 days (monthly average). (Note 2)

JERD-4097 The algorithm shall produce an ozone limb profile product that has long term stability of 2% over 7 years.

Notes:
1. TH is Tropopause Height or 8 km, whichever is greater as determined by ancillary data.
2. All OMPS measurements require sunlight, so there is no coverage in polar night areas. With three limb curtains (each with a Vertical FOV of ~ 1.85°) positioned at Nadir and 250 km (+/- 4.3 degrees) on each side, the measurements are taken to give a good representation of the ozone profile in the central 750 Km of the orbital track. With a 4-day repeat cycle in the orbital tracks, this will yield a 4-day revisit time (approximately) for 30,000 km out of 40,000 km equator.

3.2.5.61 – ATMS Snowfall Rate (SFR)

Snowfall rate is the water equivalent snowfall rate estimate. SFR is generated from passive microwave radiometer ATMS. It requires measurements from both “window” channels and water vapor/temperature sounding channels. The product can be generated at near real-time to

satisfy time-sensitive applications such as weather forecasting. It also benefits users from such fields as hydrology, cryosphere, and climate studies etc.

JERD-4113 The algorithm shall produce a snowfall rate product that has a horizontal cell size of 15 km at nadir.

JERD-4114 The algorithm shall produce a SFR product that has a measurement precision of: 1.0 mm/hr

JERD-4115 The algorithm shall produce a SFR product that has an accuracy of: ±0.3 mm/hr

JERD-4116 The algorithm shall produce a SFR product that has a measurement uncertainty of: 1.0 mm/hr

JERD-4117 The algorithm shall incorporate fill and other condition flags including degraded, excluded or other applicable conditions.

3.3 Blended Products

JERD-2335 The NESDIS ESPC shall incorporate JPSS and GCOM-W data into the blended satellite products identified in Appendix D.

Appendix A JPSS Data Products allocated to ESPC

Note: "Latency Allocated to NDE 2.0" is shared between the IT system performance and the algorithm performance.

Product/Parameter	Latency Allocated to NDE 2.0 (min)
Active Fires (VIIRS)	
ESPC Product Generation	15
AMSR-2/3 Calibrated Sensor Data	
ESPC Product Generation	15
Aerosol Detection (VIIRS)	
ESPC Product Generation	15
Aerosol Optical Depth (VIIRS)	
ESPC Product Generation	15
Aerosol Particle Size (VIIRS)	
ESPC Product Generation	15
Albedo (Surface) (VIIRS)	
ESPC Product Generation	15
Atmospheric Vertical Moisture Profile (CrIS/ATMS)	
ESPC Product Generation	15
Atmospheric Vertical Temperature Profile (CrIS/ATMS)	
ESPC Product Generation	15
Carbon Dioxide (CO2) (CrIS)	
ESPC Product Generation	15
Carbon Monoxide (CO) (CrIS)	
ESPC Product Generation	15
Cloud Cover/Layers (VIIRS)	
ESPC Product Generation	15
Cloud Height (Top and Base) (VIIRS)	
ESPC Product Generation	15
Cloud Liquid Water (AMSR-2/3)	
ESPC Product Generation	15
Cloud Liquid Water (ATMS)	
ESPC Product Generation	15
Cloud Mask (VIIRS)	
ESPC Product Generation	15
Cloud Optical Depth (VIIRS)	

Product/Parameter	Latency Allocated to NDE 2.0 (min)
ESPC Product Generation	15
Cloud Particle Size Distribution (VIIRS)	
ESPC Product Generation	15
Cloud Phase (VIIRS)	
ESPC Product Generation	15
Cloud Top Pressure (VIIRS)	
ESPC Product Generation	15
Cloud Top Temperature (VIIRS)	
ESPC Product Generation	15
Green Vegetation Fraction (VIIRS)	
ESPC Product Generation	23hr 59min
Ice Age/Thickness (VIIRS)	
ESPC Product Generation	15
Ice Concentration (VIIRS)	
ESPC Product Generation	15
Ice Surface Temperature	
ESPC Product Generation	15
Imagery (AMSR-2/3)	
ESPC Product Generation	15
Imagery (ATMS)	
ESPC Product Generation	15
Infrared Ozone Profile (CrIS)	
ESPC Product Generation	15
Land Surface Emissivity (ATMS)	
ESPC Product Generation	15
Land Surface Temperature (ATMS)	
ESPC Product Generation	15
Land Surface Temperature (VIIRS)	
ESPC Product Generation	15
Methane (CH4) (CrIS)	
ESPC Product Generation	15
Moisture Profile (ATMS)	
ESPC Product Generation	15
Ocean Color/Chlorophyll (VIIRS)	

Product/Parameter	Latency Allocated to NDE 2.0 (min)
ESPC Product Generation	30
OMPS-L SDR	
ESPC Product Generation	15
Ozone Limb Profiler (OMPS-L)	
ESPC Product Generation	15
Outgoing Longwave Radiation (CrIS)	
ESPC Product Generation	15
Ozone Nadir Profile (OMPS-N)	
ESPC Product Generation	15
Ozone Total Colum (OMPS-N)	
ESPC Product Generation	15
Polar Winds (VIIRS)	
ESPC Product Generation	116
Precipitation (Type/Rate) (AMSR-2/3)	
ESPC Product Generation	15
Rainfall Rate (ATMS)	
ESPC Product Generation	15
Sea Ice Characterization (AMSR-2/3)	
ESPC Product Generation	15
Sea Ice Concentration (ATMS)	
ESPC Product Generation	15
Sea Surface Temperature (AMSR-2/3)	
ESPC Product Generation	15
Sea Surface Temperature (VIIRS)	
ESPC Product Generation	15
Sea Surface Wind Speed (AMSR-2/3)	
ESPC Product Generation	15
Snow Cover/Depth (AMSR-2/3)	
ESPC Product Generation	15
Snow Cover (ATMS)	
ESPC Product Generation	15
Snow Cover (VIIRS)	
ESPC Product Generation	15
Snowfall Rate (ATMS)	
ESPC Product Generation	15

Product/Parameter	Latency Allocated to NDE 2.0 (min)
Snow Water Equivalent (AMSR-2/3)	
ESPC Product Generation	15
Snow Water Equivalent (ATMS)	
ESPC Product Generation	15
Soil Moisture (AMSR-2/3)	
ESPC Product Generation	15
Surface Reflectance (VIIRS)	
ESPC Product Generation	15
Surface Type (VIIRS)	
ESPC Product Generation	15
Temperature Profile (ATMS)	
ESPC Product Generation	15
Total Precipitable Water (AMSR-2/3)	
ESPC Product Generation	15
Total Precipitable Water (ATMS)	
ESPC Product Generation	15
Vegetation Indices – Daily (VIIRS)	
ESPC Product Generation	23 hr 59 min
Vegetation Indices – Weekly (VIIRS)	
ESPC Product Generation	23 hr 59 min
Vegetation Indices – Bi-Weekly (VIIRS)	
ESPC Product Generation	23 hr 59 min
Vegetation Health Index Suite (VIIRS)	
ESPC Product Generation	15
Volcanic Ash Detection and Height (VIIRS)	
ESPC Product Generation	15

Appendix B Acronyms

AFWA	Air Force Weather Agency (now identified as the 557th Weather Wing)
AIRS	Atmospheric Infrared Sounder
AMSR	Advanced Microwave Scanning Radiometer
APC	Alternate Processing Center
APU	Accuracy, Precision, and Uncertainty
ASD	AMSR2 APID Sorted Data
ASOS	Automated Surface Observing System
ATMS	Advanced Technology Microwave Sounder
AVMP	Atmospheric Vertical Moisture Profile
AVTP	Atmospheric Vertical Temperature Profile
C3	Command, Control and Communications
CBU	Consolidated Back Up
CCB	Configuration Control Board
CEOS	Committee on Earth Observation Satellites
CERES	Clouds and the Earth's Radiant Energy System
CF	Climate and Forecast
CH_4	Methane
CLASS	Comprehensive Large Array-Data Stewardship System
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CORL	Consolidated Observing Requirements List
CrIS	Cross-track Infrared Sounder
DOC	U.S. Department of Commerce
DoD	Department of Defense
DMSP	Defense Meteorological Satellite Program
DUS/O	Deputy Under Secretary of Commerce for Oceans and Atmosphere for Operations
ECMWF	European Centre for Medium-Range Weather Forecasts
EDR	Environmental Data Record
EOS	NASA Earth Observing System
ESPC	Environmental Satellite Processing Center
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FAR	False Alarm Rate
FNMOC	Fleet Numerical Meteorology and Oceanography Center
FOR	Field of Regard
FOV	Field of View
FRP	Fire Radiative Power
FT	Field Terminal
GCOM	Global Change Observation Mission
GCOM-W	GCOM-Water
GDAS	Global Data Assimilation System
GHRSST	Group for High-Resolution SST
GVF	Green Vegetation Fraction
HCS	Horizontal Cell Size
HSPD	Homeland Security Presidential Directive
HSR	Horizontal Spatial Resolution
IDPS	Interface Data Processing Segment
IOP	Inherent Optical Properties

ISO	International Organization for Standardization
JAXA	Japanese Aerospace Exploration Agency
JERD	JPSS ESPC Requirements Document
JPSS	Joint Polar Satellite System
JPSS GS	JPSS Ground System
KPP	Key Performance Parameter
L1RD	Level 1 Requirements Document
LEO	Low-Earth orbiting or orbit
LST	Land Surface Temperature
LTAN	Local Time of the Ascending Node
MOAT	Microwave Operational Algorithm Team
MODIS	Moderate Resolution Imaging Spectroradiometer
MOU	Memorandum of Understanding
MiRS	Microwave Integrated Retrieval System
NAO	NOAA Administrative Order
NASA	National Aeronautics and Space Administration
NAVO	Naval Oceanographic Office
NCEP	National Centers for Environmental Prediction
NDE	NPP Data Exploitation
NESDIS	NOAA Satellite and Information Service
NetCDF	Network Common Data Form
NIST	National Institute of Standards and Technology
NJPO	NOAA JPSS Program Office
nLw	Normalized water-leaving radiance
NOAA	National Oceanic and Atmospheric Administration
NPD	NASA Policy Directive
NPP	National Polar-orbiting Partnership
NPR	NASA Procedural Requirement
NSOF	NOAA Satellite Operations Facility
NSPD	National Security Presidential Directive
NWP	Numerical Weather Prediction
NWS	National Weather Service
OC/C	Ocean Color/Chlorophyll
OLR	Outgoing Longwave Radiation
OMPS	Ozone Mapping and Profiler Suite
OMPS-L	OMPS Limb
OPD	Optical Path Difference
OSD	Office of Systems Development
OSPO	Office of Satellite and Product Operations
PCT	Probability of Correct Typing
PDA	Product Distribution and Access
PID	Program Implementation Document
POD	Probability of Detection
POES	Polar-orbiting Operational Environmental Satellites
RBI	Radiation Budget Instrument
RDR	Raw Data Record
RT	Radiative Transfer
SDR	Sensor Data Record
SDS	Science Data Segment
SeaWiFS	Sea-Viewing Wide Field-of-View Sensor

SN	NASA Space Network
S-NPP	Suomi NPP
SSMIS	Special Sensor Microwave Imager Sounder
SST	Sea Surface Temperature
SWE	Snow Water Equivalent
SSW	Sea Surface Winds
STAR	NOAA's Center for Satellite Applications and Research
SWE	Snow-Water Equivalent
TB	Brightness Temperature
TBD	To Be Determined
TBR	To Be Reviewed
TBS	To Be Specified
TCI	Temperature Condition Index
TDR	Temperature Data Record
TMI	TRMM Microwave Imager
TPW	Total Precipitable Water
TRMM	Tropical Rainfall Measuring Mission
USAF	United States Air Force
VCI	Vegetation Condition Index
VHI	Vegetation Health Index
VIIRS	Visible Infrared Imager/ Radiometer Suite
xDR	Data Record

Appendix C Glossary

The following terms are used in this requirements document. For a complete listing of JPSS related terms, see the Joint Polar Satellite System Program Lexicon.

Algorithm: The software and all associated data files that translates science data into an environmental parameter.

Blended Products: A data product that is dependent on direct measurements from sensors on more than one satellite

CERES: The Clouds and the Earth's Radiant Energy System. Part of NASA's EOS, CERES products include both solar-reflected and Earth-emitted radiation from the top of the atmosphere to the Earth's surface. Cloud properties are determined using simultaneous measurements by other EOS instruments such as the Moderate Resolution Imaging Spectroradiometer (MODIS).

Comprehensive Large Array-data Stewardship System (CLASS): CLASS is an IT system that supports the NOAA Data Center's mission to archive data and other artifacts from its polar and geostationary satellites and from in situ sources.

Data: A discrete set of logical records containing information in a digital format that includes, but is not limited to, Level 1b, Level 2 and higher Level products created by operational systems, subsets and aggregates of operational products, as well as ancillary data, instrument calibration data and spacecraft navigation data.

Data Quality: The accuracy and correctness of the content and meaning of the data.

Data Receipt: Last bit of incoming data has been received at the system receive point, and for data that arrives directly at PDA from a source outside of ESPC security boundaries, a virus scan has completed.

Data Server: Source of data that is to be distributed.

Data Set: A logical grouping of data sharing a common attribute, such as data source or data type.

Data Type: A specific category of data with common characteristics.

Delivery Timeliness: A threshold of time specified within a subscription that defines how recently the data needs to have been created in order to be delivered to the user. Delivery Timeliness is meant to prevent the transfer of data that is not useful to a user due to the age of the data.

Environmental Data: Environmental data as used in this document is also termed mission data and refers to all data (atmospheric, oceanographic, terrestrial, space environmental and climatic) being sensed and collected by the spacecraft.

Environmental Data Record (EDR): Data record produced when an algorithm is used to convert Sensor or Temperature Data Records (SDRs, TDRs) to geolocated geophysical parameters (including ancillary parameters, e.g., cloud cleared radiation, etc.).

Interface Data Processing System Segment (IDPS): The IDPS is a subsystem of the NESDIS ESPCJPSS Common Ground System that receives raw data the polar satellites and processes

these data into RDRs, SDRs, TDRs and EDRs and makes these products available to the user community.

Imagery: Two-dimensional array of numbers, in digital format, each representing the brightness of a small elemental area.

Key Performance Parameter: A parameter so significant to the user community that all designated requirements must be met to achieve minimal mission success.

Objective: Objectives represent an improved performance level above and beyond the threshold requirements that would better meet user needs and which are realistically achievable with current technology.

OMPS: Ozone Mapping and Profiler Suite collects data to permit the calculation of the vertical and horizontal distribution of ozone in the Earth's atmosphere. OMPS consists of separate nadir and limb sensors. The OMPS Nadir sensor consists of Mapper and Profiler components.

Operational Satellite: A spacecraft containing an operational sensor/instrument that is providing useful data to meet or supplement one or more of the JPSS observational data or service requirements.

Operations: The staff necessary to operate a system and the recurring costs necessary to keep the operation active (for example, facilities, networks, utilities, software licensing, and hardware maintenance).

Raw Data Record (RDR): Full resolution digital sensor data, time referenced and earth located, with absolute radiometric and geometric calibration coefficients available, but not applied, to the data. Aggregates (sums or weighted averages) of detector samples are considered to be full resolution data if the aggregation is normally performed to meet resolution and other requirements. Sensor data must be unprocessed with the following exceptions: time delay and integration, detector array non-uniformity correction (i.e., offset and responsivity equalization), and data compression are allowed. Lossy data compression is allowed only if the total measurement error is dominated by error sources other than the data compression algorithm. All calibration data will be retained and communicated to the ground without lossy compression.

Sensor Data Record (SDR): Data record produced when an algorithm is used to convert Raw Data Records (RDRs) to geolocated calibrated brightness temperatures, radiances, or reflectances with associated ephemeris data.

Threshold: Threshold requirements represent the minimally acceptable level of performance that must be achieved.

Temperature Data Records (TDRs): Data records that are geolocated antenna temperatures with all relevant calibration data counts and ephemeris data to revert from T-sub-a into counts. The existence of the SDRs provides reversible data tracking back from the EDRs to the Raw data.

VIIRS: The Visible Infrared Imager/Radiometer Suite collects visible and infrared radiometric data of the Earth's atmosphere, ocean, and land surfaces. Data types include atmospheric parameters, clouds, Earth radiation budget, land/water and sea surface temperature, ocean color, and low light imagery.

Appendix D ESPC Blended Satellite Products

Blended Product	Priority
Blended Sea Surface Temperature (with VIIRS)	Critical
Blended Sea Surface Temperature (with AMSR2)	Critical
Blended Biomass Burning (with VIIRS)	Supplemental High
Blended Snow Cover (with VIIRS)	Supplemental High
Blended Snow Cover (with AMSR2)	Supplemental High
Blended Rainfall Rate (with ATMS)	Supplemental High
Blended Rainfall Rate (with AMSR2)	Supplemental High
Blended Total Precipitable Water (with ATMS)	Supplemental High
Blended Total Precipitable Water (with AMSR2)	Supplemental High
Blended Ozone (with OMPS NP)	Supplemental High
Blended Ozone (with OMPS CrIS)	Supplemental High
Blended Soil Moisture (with AMSR2)	Supplemental High
Blended Land Surface Temperature (with VIIRS)	Supplemental Low
Blended Tropical Cyclone Surface Wind Analysis (with ATMS)	Supplemental High
Advanced Dvorak Technique (with AMSR-2)	Supplemental High