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Joint Polar Satellite System (JPSS) Program
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Joint Polar Satellite System (JPSS)
JPSS-1 Mission Systems Specification (MSS)

Goddard Space Flight Center
Greenbelt, Maryland

National Aeronautics and
Space Administration

JPSS Review/Approval Page

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Preface

This document is under JPSS Program configuration control. Once this document is approved, JPSS approved changes are handled in accordance with Class I and Class II change control requirements as described in the JPSS Configuration Management Procedures, and changes to this document shall be made by complete revision.

Any questions should be addressed to:

JPSS Configuration Management Office
NASA/GSFC
Code 470
Greenbelt, MD 20771

Change History Log

Revision	Effective Date	Description of Changes
Rev -	April 12, 2012	Initial release per 470-CCR-12-0015, which was approved by the JPSS Program CCB on 04/12/12. All pages affected.
Rev A	June 6, 2013	Incorporates the following CCRs: 470-CCR-13-0037 (approved by JPSS Program CCB on 06/06/13) which contains updates based on JPSS L1RD-Final and L1 Supplement document releases (January 2013). Please refer to "From/To" document in JPSS MIS for complete set of changes. 470-CCR-12-0026 (approved by JPSS Program CCB on 08/30/12), which captures the waiver for JPSS-1 ATMS Beam Efficiency (JPSS-W001 R1). NOTE: The planned updates as per Comment Resolution Matrix document in JPSS MIS: (L2MSSREVA_20130610.xlsx) will be captured in the next revision to the JPSS-1 MSS, which is planned in July 2013.
Rev B	November 7, 2013	Updated document version per 470-CCR-13-0050 (approved by JPSS Program CCB on 11/07/13), which incorporates the comments/updates based on the Comment Resolution Matrix (CRM) file (L2MSSREVB)_20131031. NOTE: The "D3" comments will be captured in the next revision (Rev. C) to the JPSS-1 MSS, which is planned in Jan./Feb. 2014.
Rev C	December 19, 2013	Updated document version per 470-CCR-13-0046 (JPSS-1 OMPS Spatial Resolution Improvement) and 470-CCR-13-0047 (JPSS-1 CrIS Spectral Resolution Improvement), both conditionally program CCB approved on 12/19/13 and ground project approved on 01/08/14.
Rev D	March 27, 2014	Updated document version per 470-CCR-14-0065 (approved by JPSS Program CCB on 03/25/14), which incorporates the comments/updates based on the Comment Resolution Matrix (CRM) file (L2MSSREVD_20140327.xlsx) Updated document version per 470-CCR-14-0072 (approved by JPSS Program CCB on 03/27/14), which incorporates the comments noted in the CCR.
Rev E	September 11, 2014	Updated document version per 470-CCR-14-0084 (Update the JPSS-1 Mission Systems Specification (MSS) - Rev E) which was JPSS Program CCB approved on 09/11/14.

Deviations/Waivers Record

Section # / Requirement	Deviation / Waiver #	CCR #	Date Approved	Title	Mission
4.7.2.5.3 / J1MSS-1704	JPSS-W001 (R1)	470-CCR-12-0026	08/20/12	ATMS Beam Efficiency	JPSS-1
4.7.4.7 / J1MSS-1619		470-CCR-14-0086		VIIRS Absolute Radiometric Calibration Uncertainty	JPSS-1

Table of TBDs/TBRs

Item No.	Location	Summary	Individual/ Organization	Due Date
1	4.7.4.13	J1MSS-1653 The DNB HSR shall not exceed 1.10 (TBR) times the as-delivered HSI in both the track and cross-track direction throughout the scan.	JPSS Flight ISE	

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1 Introduction

1.1 Purpose & Background

The Joint Polar Satellite System (JPSS) is the National Oceanic and Atmospheric Administration (NOAA) next-generation operational low Earth orbiting (LEO) observation program that will acquire and distribute global environmental data, primarily from multiple polar-orbiting satellites. The JPSS plays a critical role in NOAA's continuing mission to understand and predict changes in weather, climate, oceans and coasts in order to support the Nation's economy and protect lives and property. JPSS is NOAA's portion of the restructured National Polar-orbiting Operational Environmental Satellite System (NPOESS) program and will provide operational continuity of satellite-based observations and products from NOAA Polar-orbiting Operational Environmental Satellites (POES) and the Suomi National Polar-orbiting Partnership (S-NPP) mission satellite and ground systems. The JPSS primary program objective is to sustain continuity of and enhance NOAA's Earth observing analysis, forecasting and climate monitoring capabilities from global polar-orbiting observations.

The JPSS program provides satellite missions, including the necessary ground segment elements for the command, control, communications and data product generation and distribution to the user community. The satellite missions include JPSS-1, JPSS-2 and S-NPP, which are configured to provide continuity in environmental sensing from a polar, sun-synchronous orbit and to broadcast environmental data to distributed users. The ground segment consists of the JPSS Ground System, a common ground system supporting the JPSS missions; and elements of NOAA's enterprise data processing ground systems that are part of the NOAA (NESDIS) National Environmental Satellite, Data, and Information Service infrastructure.

The Joint Polar Satellite System-1 (JPSS-1) Mission System Specification (MSS) presents the Level 2 (JPSS Program) functional and performance requirements for the JPSS-1 mission. This document responds to the JPSS Level 1 (NOAA Customer) Requirements Document (L1RD) and JPSS Level 1 Requirements Document Supplement (L1RDS), which together provide the high-level definition and concept for the entire JPSS program, including the fundamental performance requirements that define the objectives for each of the JPSS missions.

1.2 Document Scope & Overview

The JPSS-1 Mission Systems Specification document contains or provides reference to the functional and performance requirements for all mission systems. A traditional mission systems specification contains the mission, flight, ground system and mission data product requirements. In consideration of the JPSS Ground System, which supports the multiple JPSS missions, and the NESDIS Environmental Satellite Processing Center (ESPC) functions in support of JPSS mission, the JPSS program requirement architecture provides for Level 2 requirements in support of the JPSS-1 mission, in both mission systems specification and ground system requirements documents, as follows:

- <u>JPSS-1 Mission Systems Specification (MSS)</u> – contains the high-level mission requirements and the space segment (satellite, spacecraft, instruments, launch vehicle) requirements, and references the location of the ground segment requirements

- JPSS Ground System Requirements Document (GSRD) – contains the ground segment requirements for the JPSS Ground System in support of the JPSS-1 mission, including data product generation and distribution (as appropriate). Volume 1 contains the ground system functional and performance requirements, and Volume 2 contains the data product performance requirements.
- JPSS ESPC Requirements Document (JERD) – contains the ground segment requirements for the ESPC in support of JPSS functions, including additional data product generation and distribution (as appropriate)

This mission systems specification is comprised of five sections. Section 1 provides information regarding the introduction, purpose, scope, requirement management and organization of this document. Section 2 lists the applicable and reference documents. Section 3 describes the overall mission in terms of mission objectives, mission success criteria and mission architecture. Section 4 contains the JPSS-1 Level 2 mission requirements, organized into mission, space segment, launch segment and location of the ground segment requirements. Section 5 contains the requirements verification. Appendix A contains the reference location of the requirements traceability matrix. Appendix B contains the reference location of the requirements verification matrix. Appendix C contains the mission technical performance metrics (TPMs). Appendix D is a list of abbreviations and acronyms. External interface requirements are provided at the appropriate mission-segment level (space, launch, ground).

1.3 Requirements Management

The JPSS Level 1 requirements are developed and managed by the NOAA customer. The JPSS Level 2 requirements are allocated to and managed by NASA and NOAA. The JPSS Level 3 requirements are developed and managed by the NASA JPSS flight and ground projects. All JPSS requirements are managed in a Dynamic Object-Oriented Requirements System (DOORS) database and captured in documents that are under JPSS configuration control.

The following requirements terminology is used throughout this document:

In this document, a specific requirement is identified by *"shall,"* a good practice by *"should,"* permission by *"may"* or *"can,"* and expectation by *"will."*

It should be noted that the JPSS-1 MSS document contains both "shall" and "will" statements within the body of requirements. "Shall" statements are used to identify requirements that are the responsibility of the mission system specification for verification and validation. "Will" statements may be used to provide reference to specific requirements ('shall' statements) that may be found in companion JPSS Level 2 requirement documents (e.g. JPSS GSRD or JERD). For example, in cases where mission-level performance requirements are decomposed into flight and ground system performance requirements (e.g. mission geolocation or mission operational availability), 'will' statements are used to identify the performance decomposition to flight and ground, with pointers to the location of the actual 'shall' statements within the appropriate documents. This approach prevents duplication of 'shall' statements within companion Level 2 requirement documents, which would unnecessarily complicate requirement trace and verification activities.

The term “(TBD),” which means “to be determined”, applied to a missing requirement or missing information means that the JPSS program will work with the corresponding JPSS program/project to identify a plan to provide the necessary information.

The term "(TBS)," which means "to be specified", means that the JPSS program will work with the corresponding JPSS program/project to supply the missing information in time for the next major document revision.

The term “(TBR),” which means “to be refined/reviewed”, means that the requirement is subject to review for appropriateness and subject to revision. The appropriate JPSS program/project is liable for compliance with the requirement as if the “TBR” notation did not exist. The “TBR” merely provides an indication that the value is more likely to change in a future modification than requirements not accompanied by a “TBR."

1.4 Document Hierarchy

Figure 1.4-1 depicts the JPSS-1 Mission Requirements Document organization and illustrates that the JPSS Level 1 requirements captured in the JPSS Level 1 Requirements Document (L1RD) and JPSS Level 1 Requirements Document Supplement (L1RDS) flow into the JPSS Level 2 requirements within the JPSS-1 Mission Systems Specification (MSS), the JPSS Ground System Requirements Document (GSRD Volume 1 and Volume 2) and the JPSS ESPC Requirements Document (JERD). As mentioned earlier, the JPSS-1 MSS contains the traditional mission-level requirements and the flight system requirements specific to the JPSS-1 mission. The JPSS GSRD and JERD contain ground system and data product requirements for all JPSS missions. The JPSS-1 MSS and JPSS GSRD are Level 2 CCB controlled documents at the JPSS program level. The JERD is a Level 2 CCB document controlled by the NOAA JPSS Office (NJO), as the NESDIS ESPC is not completely within the JPSS domain.

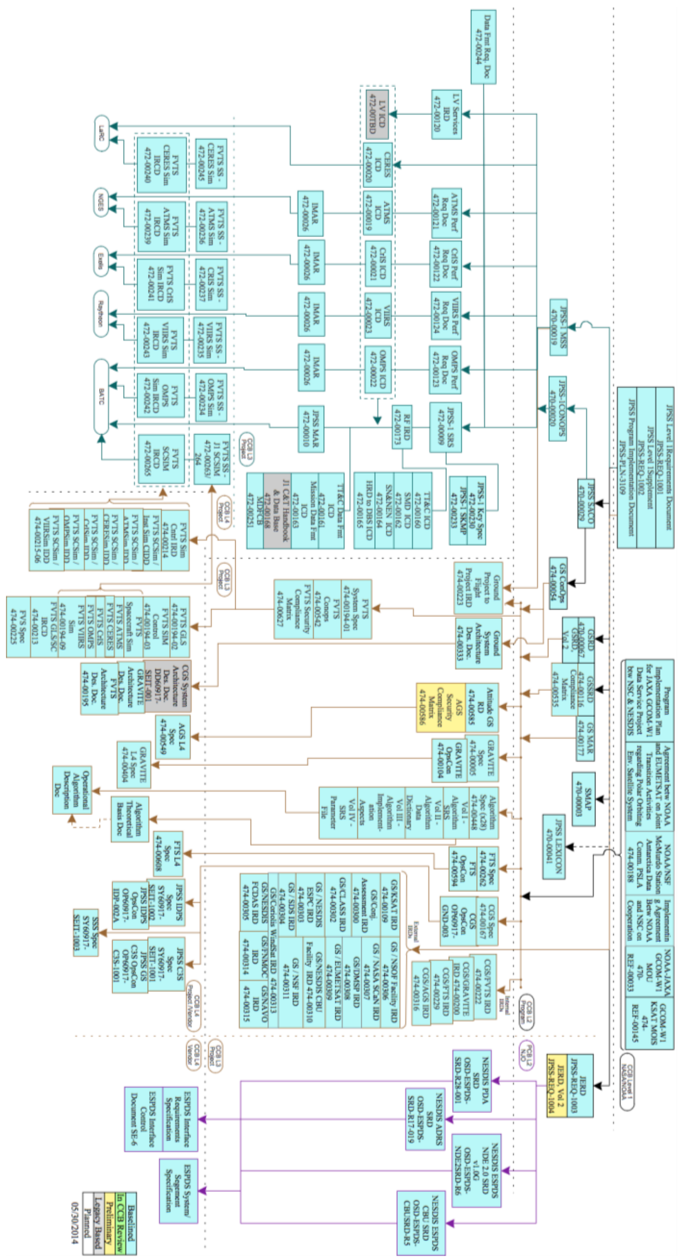

Figure 1.4-1 JPSS-1 Mission Requirements Document Organization

2 Related Documentation

The latest JPSS program and project documents can be found in the JPSS Management Information System (MIS) obtained from URL: https://jpssmis.gsfc.nasa.gov. JPSS documents have a document number starting with 470 (JPSS Program), 472 (JPSS Flight) or 474 (JPSS Ground).

2.1 Applicable Documents

Applicable documents are defined as specific documents that are called out or invoked by requirements in this document. Unless specifically noted, all requirements contained in these documents are applicable to the mission. In the event of a conflict between the following applicable documents and this document, this document will govern.

Reference Number	Document Title
NPR 8705.4	Risk Classification for NASA Payloads
NPR 8715.6	NASA Procedural Requirements for Limiting Orbital Debris
NPD 8610.7	NASA Launch Services Risk Mitigation Policy
NASA-STD-8719.14	Process for Limiting Orbital Debris
GPD 7120.1A	Goddard Space Flight Center Space Asset Protection Policy
470-00067	JPSS Ground System Requirements Document (GSRD)
470-00067-02	JPSS Ground System Requirements Document (GSRD), Volume 2
JPSS-REQ-1003	JPSS NESDIS ESPC Requirements Document (JERD)
NIST FIPS PUB 140-2	National Institute of Standards and Technology Federal Information Processing Standards Security Requirements for Cryptographic Modules
NTIA Redbook	National Telecommunications and Information Administration (NTIA) "Manual of Regulations and Procedures for Federal Radio Frequency Management (Redbook)"
ITU-R	International Telecommunications Union – Radiocommunication Sector

2.2 Reference Documents

Reference documents listed here, although not a part of this Specification, serve to amplify and clarify its contents. The reference documents are:

Reference Number	Document Title
470-REF-0031	JPSS Level 1 Requirements Document (JPSS-REQ-1001)
470-REF-0032	JPSS Level 1 Requirements Document Supplement (JPSS-REQ-1002)
474-00116	JPSS Ground System Security Requirements Document (GSSRD)
470-00029	JPSS System Architecture and Concept of Operations (SACO)
470-00020	JPSS-1 Mission Concept of Operations
474-00054	JPSS Ground System Concept of Operations
474-00333	JPSS Ground System Architecture Description Document (ADD)
470-00041	JPSS Program Lexicon
470-00053	JPSS Program Verification and Validation Plan
470-00051	JPSS Program Plan
470-00002	JPSS Schedule Management Plan
JPSS-PLN-3109	JPSS Program Implementation Document
NPR 7120.5	NASA Program & Project Management Processes & Requirements
NPD 7120.4D	NASA Engineering and Program/Project Management Policy
NOAA_PD_DD	NOAA Data Documentation Procedural Directive (Metadata Standard)

3 Mission Description

The Joint Polar Satellite System-1 (JPSS-1) mission consists of a single satellite, comprised of a spacecraft and complement of environmental sensing instruments, which collects and transmits stored mission data to a ground system that generates and distributes data products to the user community. The JPSS-1 mission is scheduled to succeed the currently operational S-NPP mission, in order to provide continuity of environmental sensing in the 1330 LTAN orbit.

3.1 Mission Objectives

The JPSS-1 mission objectives are to provide environmental sensing from a polar sun-synchronous orbit, generate calibrated/validated/geo-located mission data products that serve the meteorological and global climate change communities, and provide real-time broadcast of environmental data to the distributed user community.

The JPSS-1 mission data products are derived from the JPSS Level 1 requirements which provide the data products for the JPSS missions. These data products consist of Raw Data Records (RDRs), Sensor Data Records (SDRs), Temperature Data Records (TDRs) and Environmental Data Records (EDRs) all of which are generated by the ground system using the spacecraft and instrument science data provided within the downlinked data packets. The production and timely distribution of the mission data products is critical to meeting the mission success criteria described in Section 3.2. The complete set of mission data products are identified and organized in Table 5.1 in Section 5.

3.2 Mission Success and Mission Critical Criteria

3.2.1 Mission Success Criteria

Mission success is the ability of the mission system to provide the mission data necessary to meet the mission objectives. The JPSS-1 mission defines the mission success criteria in terms of full mission success and minimum mission success, based on the approach provided in the JPSS Level 1 Requirements Document.

Full mission success requires all JPSS-1 mission data and associated data products to meet the necessary requirements contained or referenced within this document, using a mission system which meets the necessary requirements, over the mission lifetime.

- All mission-specific data records (reference Table 5.1) produced to the functional and performance requirements in the JPSS Ground System Requirements Document (GSRD) and JPSS NESDIS ESPC Requirements Document (JERD)
- Mission system that meets the mission-level operational availability, data availability and data latency performance requirements in Section 4.5 (Mission System Performance Allocations) of this document
- Distribution of all requisite data to the user community, including direct broadcast, as per the requirements in Section 4.3.1 (Data Products) of this document

Minimum mission success requires all performance attributes identified as Key Performance Parameters (KPPs) listed below to be met. KPPs are those polar system capabilities that if they cannot be met, would compromise NOAA’s weather mission to provide essential warnings and forecasts to protect lives and property. For the JPSS-1 mission, the KPPs associated with the minimum mission success criteria (reference Table 5.1) are as follows:

- ATMS & CrIS Sensor Data Record (SDR) production to the functional and performance requirements in the JPSS Ground System Requirements Document (GSRD)
- VIIRS Imagery Environmental Data Records (EDRs) at 0.64µm (I1), 3.74µm (I4), 11.45µm (I5), 8.55 µm (M14), 10.763 µm (M15), and 12.03 µm (M16) for latitudes greater than 60ºN in the Alaskan region, to the functional and performance requirements in the JPSS Ground System Requirements Document (GSRD)
- 96 minute data latency for the ATMS and CrIS SDRs and the VIIRS Imagery EDR channels specified above.
- Distribution of KPP data to the user community, as per the requirements in Section 4.3.1 (Data Products) of this document.

3.2.2 Mission Critical Criteria

The NOAA customer has identified the need to mitigate the risk of an operational data gap in providing continuity of critical microwave and infrared instrument data from polar satellites to obtain global temperature and moisture measurements necessary for accurate, consistent and high-confidence extended (3-7 day) weather forecasting. This need has resulted in the identification of mission critical criteria for the JPSS missions, which is a set of mission capabilities considered necessary to mitigate this risk. As opposed to the mission success criteria, which establishes technical performance metrics to evaluate the mission system performance once the JPSS-1 satellite is operational on-orbit, the mission critical criteria may be used during the mission development phases leading up to launch in order to assist the JPSS program and projects in the identification of which mission capabilities are critical and which may be considered for potential deferral or descope.

The mission critical criteria for the JPSS missions are the mission capabilities needed to:

- Support the launch and on-orbit commissioning of the JPSS satellites
- Perform the on-orbit initial calibration/validation of the CrIS and ATMS instruments and associated Sensor Data Records (SDRs)
- Process and distribute the CrIS and ATMS SDRs in support of operational weather forecasting

3.3 Mission Architecture

The JPSS-1 mission consists of a space segment, launch segment, ground segment and external interfaces. The space segment includes the spacecraft and instruments that are integrated to form the satellite, the launch segment includes the launch vehicle and associated launch services, and the ground segment includes the facilities and resources necessary to support the mission operations and data product generation. External interfaces include data consumers, data providers and support systems that provide resources required to support the JPSS-1 mission objectives, but are not necessarily controlled by the JPSS program. Requirements for external interfaces are captured at the mission-segment levels (space, launch, ground). Figure 3.3-1 provides a diagram that illustrates the JPSS-1 mission system elements and Figure 3.3-2 provides a diagram that illustrates the JPSS-1 mission architecture. Additional details on the JPSS-1 mission elements and architecture are located in the JPSS System Architecture and Concept of Operations Document (470-00029) and the JPSS Ground System Architecture Description Document (474-00333).

3.3.1 Space Segment

The space segment consists of the spacecraft and the instruments, which are integrated together to form the satellite, and the pre-launch ground support equipment (GSE). The JPSS-1 mission instrument complement includes the Visible Infrared Imaging Radiometer Suite (VIIRS), the Cross-Track Infrared Sounder (CrIS), the Advanced Technology Microwave Sounder (ATMS), the Ozone Mapping Profiler Suite-Nadir sensor (OMPS-N), and the Clouds and the Earth's Radiant Energy System (CERES). Instrument data are acquired continuously, stored on-board the spacecraft, and subsequently downlinked within data packets to a ground network for capture, preprocessing, and routing to data product processing and distribution centers. Additionally, a continuous real-time direct broadcast capability is provided for transmitting instrument data from the JPSS-1 satellite to ground users equipped to receive these data at field terminals (FT) and direct readout (DR) stations.

3.3.2 Launch Segment

The launch segment provides those assets and services associated with the launch vehicle (LV) and the payload integration necessary to place the JPSS-1 satellite into the mission orbit. Included along with the LV are all ground support equipment, property, and facilities to integrate the satellite with the LV, verify their integration, and conduct pre-launch testing with the ground system.

3.3.3 Ground Segment

The ground segment consists of the JPSS Ground System being developed and managed by the JPSS Ground Project and elements of NOAA’s enterprise data processing ground systems that are part of the NOAA NESDIS (National Environmental Satellite, Data, and Information Service) infrastructure. These systems together provide capabilities for mission planning and scheduling; spacecraft and payload operations; data acquisition, communication and processing; data product generation and distribution; data product calibration and validation; flight vehicle simulation; system sustainment; and Field Terminal (FT) user community support.

The JPSS Ground System supports the JPSS-1 mission with mission planning, spacecraft control, satellite command and telemetry, mission data acquisition, data routing, data product processing, distribution and calibration/validation, as follows:

- Primary mission management, product processing and distribution are located at the NOAA Satellite Operations Facility (NSOF) in Suitland, Maryland with an alternate site located at the NOAA Consolidated Backup Facility (CBU) in Fairmont, West Virginia. Primary space to ground communications for the transmission of the stored mission data utilize ground station sites at Svalbard (Norway) and McMurdo (Antarctica), with alternate ground station sites at Fairbanks (Alaska) and Troll (Antarctica). Primary telemetry and commanding for mission operations utilizes the ground station site at Svalbard (Norway), with an alternate ground station site at Fairbanks (Alaska). Backup space-to-ground communications for the transmission of the stored mission data, as well as for command and telemetry during post-launch activation and for contingencies throughout the mission lifetime, utilize the NASA Space Network (SN) interface (SMD transmission uses TDRS-W and TDRS-E only).

- Data processing elements and software are responsible for the generation of the observational data products, following ingest of raw instrument data and telemetry in the form of Application Packets (APs), received from the communication systems ground network. The artifacts from the communication routing are removed, providing the mission data products, consisting of Raw Data Records (RDRs), which are subsequently processed to create Sensor Data Records (SDRs), Temperature Data Records (TDRs) and Environmental Data Records (EDRs). Production of EDRs includes production of intermediate-level processed data files (IPs), as needed.
- JPSS-1 mission data products will be delivered to the NOAA Comprehensive Large Array-data Stewardship System (CLASS) for archival storage and to the NOAA National Environment Satellite, Data, and Information Service (NESDIS) Environmental Satellite Processing Center (ESPC) for additional processing and distribution to users.
- The JPSS Ground System also provides for an operational level of calibration and validation of the algorithms and the performance of the satellite instruments. The Government Resource for Algorithm Verification, Independent Testing, and Evaluation (GRAVITE) provides the technical infrastructure to conduct Calibration and Validation (Cal/Val) activities, and is located at the NOAA Satellite Operations Facility (NSOF) in Suitland, MD.

The NOAA enterprise data processing system elements in support of JPSS functions are part of the Environmental Satellite Processing Center (ESPC), whose primary facilities are at the NOAA Satellite Operations Facility (Suitland, MD) and alternate facilities planned for at the NOAA Consolidated Backup Facility (Fairmont, WV).

- 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 satellites to NOAA’s operational and climate communities.
- The ESPC utilizes the NESDIS Office of Satellite & Product Operations (OSPO) 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 ESPC primary product applications are near real-time imagery, interactive products, and automated products.
- The ESPC consists of four primary segments in support of JPSS functions: Ingest (ING), Product Generation (PG), Product Distribution (PD) and Infrastructure (INF).

3.3.4 External Interfaces

External interfaces include data consumers, data providers and support systems that provide resources required to support the JPSS-1 mission objectives, but are not necessarily controlled by the JPSS program, and include the following:

Data Consumers –

NOAA National Weather Service (NWS) – component of NOAA whose mission is to provide weather, water, and climate data, forecasts and warnings for the protection of life and property and enhancement of the national economy.

Air Force Weather Agency (AFWA) - located on Offutt Air Force Base (AFB) in Bellevue, NE, the Air Force Weather Agency (AFWA) is the global operations center of Air Force Weather. The center provides worldwide weather support to Air Force and Army war fighters, unified commands, national programs, and the National Command Authorities. This is a primary data processing center that uses JPSS data products and other data to produce environmental products for their customers. The processing, archiving and dissemination of these data are their responsibility. The JPSS data products are provided to AFWA from NOAA ESPC.

Fleet Numerical Meteorology and Oceanography Center (FNMOC) - located in Monterey, CA, FNMOC is the principal global Numerical Weather Prediction (NWP) center within the DoD. In particular, FNMOC is well known for its long and productive track record of implementing, evaluating, operating, maintaining and improving complex NWP models specifically to meet the needs of the Department of Defense (DoD). This is a data processing center that uses JPSS data products and other data to produce environmental products for their customers. The processing, archiving and dissemination of these data are their responsibility. FNMOC is slated to receive JPSS data packets and software support to enable local processing of their own products.

Naval Oceanographic Office (NAVOCEANO) - located at Stennis Space Center, Mississippi, NAVOCEANO is primarily responsible for the collection, processing, and distribution of oceanographic, hydrographic, and other geophysical data and products to all elements of DoD and to civilian users as appropriate. NAVOCEANO is the Navy's primary processing facility for NOAA polar-orbiting satellite data and is nationally recognized for satellite-derived global sea-surface temperature and satellite altimeter-derived sea-surface topography and wave height. This is a data processing center that uses JPSS data products and other data to produce environmental products for their customers. The processing, archiving and dissemination of these data are their responsibility. NAVOCEANO is slated to receive JPSS application packets and software support to enable local processing of their own products.

Field Terminal Users – refers to users who use their own equipment (Field Terminals) to acquire and process the JPSS-1 mission real-time data broadcast over its Field Of View (FOV) for near real-time generation of data products to support regional operations. This community will be provided with the necessary data processing software and documentation to enable users to use their own hardware to receive the JPSS-1 mission High Rate Data (HRD) broadcast to produce data products.

NASA Science Data Segment (SDS) - used to support the NASA requirements for JPSS mission data. The SDS will interface with the work request system. SDS generated work requests may include: instrument command loads for the NASA provided instruments; recommendations for instrument calibration operations; and recommendations for spacecraft maneuvers for instrument characterization and calibration. The SDS will make data quality assessments and algorithm improvements developed by the NASA Science Team available to the JPSS Science Team and the JPSS Program. The SDS will interface with the JPSS Ground System for rapid access to the data especially those needed to process the data from the NASA provided instruments.

Data Providers –

NOAA’s Comprehensive Large Array-data Stewardship System (CLASS) – provides a data archival storage and distribution system for NOAA’s environmental data. CLASS data drops are located at the NSOF and CBU in order to transfer data products and system components used in the generation of the JPSS data products.

Support Systems –

NASA Space Network – used for spacecraft communications during the JPSS-1 mission launch and early orbit activities, and for anomaly support throughout the mission lifetime. Provides backup stored mission data (SMD) downlink capability from satellite to ground network, specifically using only the TDRS-W and TDRS-E satellites. Through the NASA-SN White Sands Complex (WSC) and Tracking and Data Relay Satellite System (TDRSS) satellites, the JPSS-1 mission will receive real-time telemetry and SMD, as well as transmit commands.

NASA Flight Dynamics Facility (FDF) - used for mission analysis support during JPSS-1 mission launch and early orbit, nominal and contingency operations. FDF will provide satellite tracking, orbit determination and spacecraft sensor calibration, and other services as needed.

NASA Conjunction Assessment and Risk Analysis (CARA) – provides analysis support throughout the mission lifetime, including necessary maneuvers, in order to avoid satellite collision with other space objects.

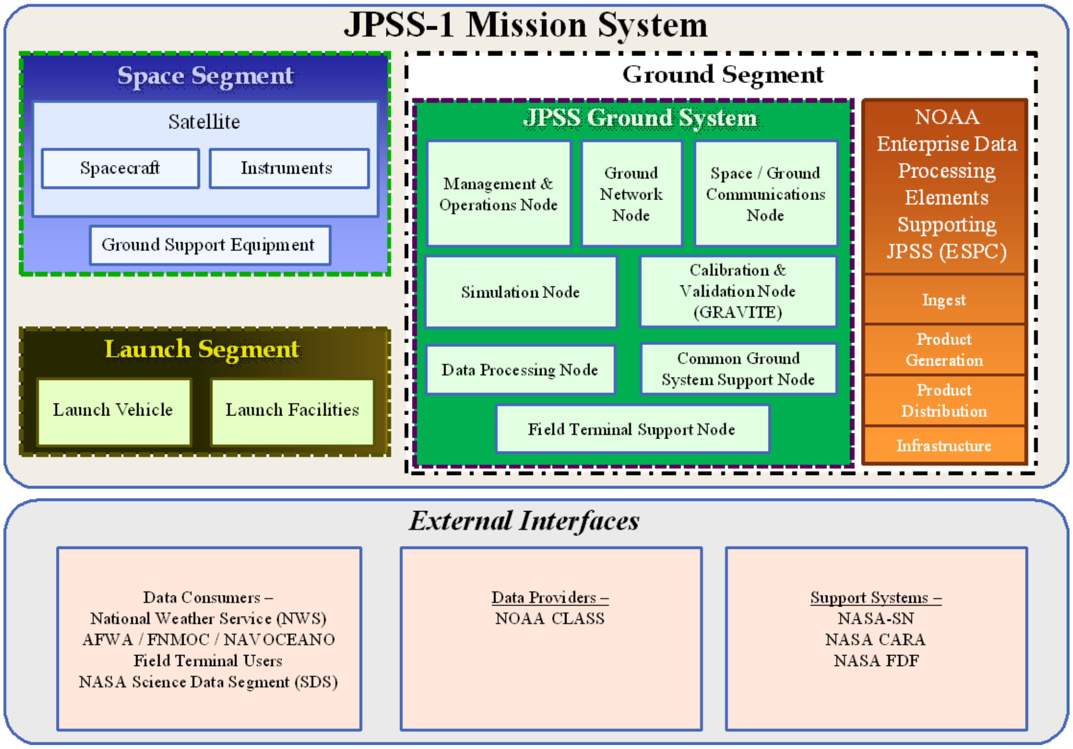

Figure 3.3-1 JPSS-1 Mission System

Note: This figure intentionally does not contain the other missions that may or may not use the JPSS ground system as it is intended to represent only the JPSS-1 mission system.

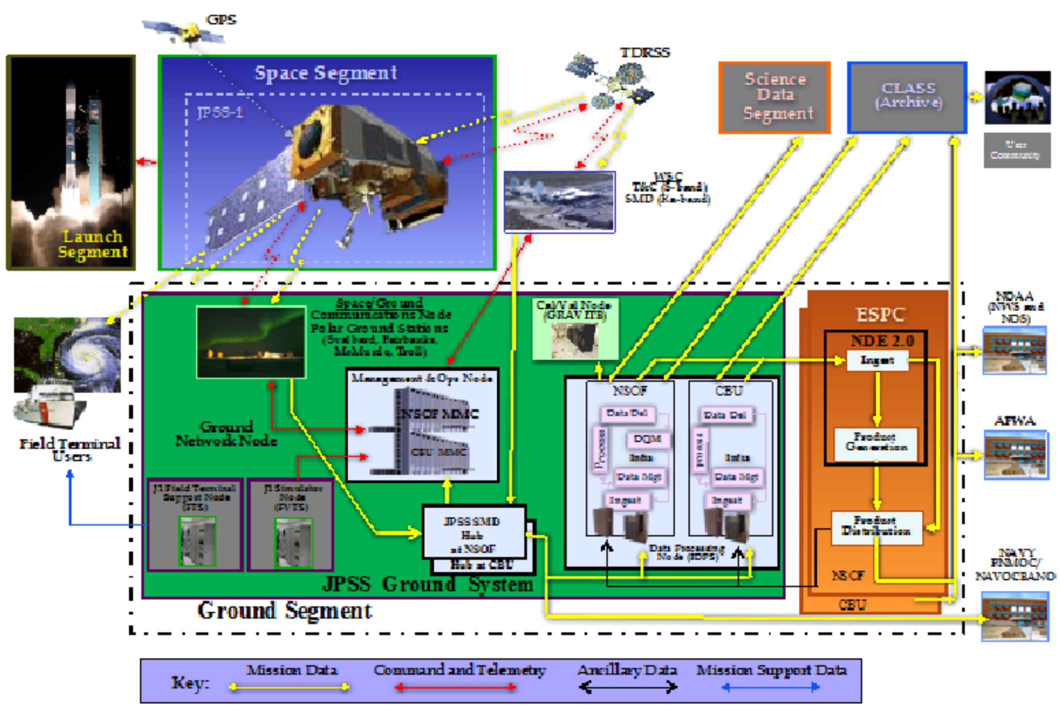

Figure 3.3-2 JPSS-1 Mission Architecture

4 Mission System Specification Requirements

4.1 General Requirements

4.1.1 Mission Risk Classification

J1MSS-107 The JPSS-1 mission risk classification shall be Class B, as per NPR 8705.4 Risk Classification for NASA Payloads.

Rationale: Direct flowdown from JPSS L1RD 6.1.1.5. This guideline will define and apply the appropriate management controls, systems engineering processes, mission assurance requirements, and risk management processes.

4.1.2 Mission Lifetime

J1MSS-115 The JPSS-1 mission shall be designed for a Mission Lifetime of at least 7 years, including Mission On-Orbit Checkout and Mission Initial On-Orbit Calibration & Validation.

Rationale: Direct flowdown from JPSS L1RD 6.1.1.1. The Mission Lifetime starts at launch (L+0 days) and includes the on-orbit satellite checkout during the first 90 days (L+90 days) and the initial on-orbit calibration and validation of the mission instruments and data products which may take up to 1 year (L+365 days). This requirement defines the time period that the JPSS satellite will need to be operational on-orbit, but not necessarily fully-calibrated and meeting all mission performance requirements. CERES FM6 is not included in this mission Lifetime requirement.

4.1.3 Reserved

4.1.4 Mission On-Orbit Checkout

J1MSS-111 The JPSS-1 mission on-orbit checkout shall be complete within 90 days following launch.

Rationale: After launch, the JPSS-1 spacecraft and instruments will undergo functional checkout to ensure that all systems have survived launch. The JPSS program will formally transfer mission operational responsibility to NOAA once the satellite and ground system operations demonstrate nominal functional performance within the 90 days following launch. The timeframe is established in the JPSS Program Implementation Document (PID), JPSS-PLN-3109, Table B-1, JPSS Program Major Milestones.

4.1.5 Mission Initial On-Orbit Calibration & Validation

J1MSS-113 The JPSS-1 mission initial on-orbit calibration and validation shall be complete within 1 year following launch.

Rationale: Following launch and insertion into the mission orbit, the JPSS-1 mission instruments will require on-orbit calibration and validation in order to meet the data product performance requirements for the JPSS-1 mission. Up to 1 year is required to account for the seasonal influences on data product performance.

4.1.6 Mission Time Convention and Coordinate Systems

J1MSS-119 The JPSS-1 mission shall use Coordinated Universal Time (UTC), including the leap second convention.

Rationale: UTC is the time format distributed and utilized worldwide and can be readily obtained from the Global Positioning Satellites (GPS).

J1MSS-319 The JPSS-1 mission shall maintain on-board absolute correlation of time to within 1 millisecond to Coordinated Universal Time (UTC).

Rationale: Accurate time correlation is necessary for data product time-tagging.

J1MSS-120 The JPSS-1 mission on-orbit coordinate system shall use a right-hand, orthogonal, body-fixed XYZ coordinate system as follows: the +Z axis is downward towards nadir, the Y-axis is along the orbit normal plane (+Y is opposite the orbital angular momentum), and the X-axis is along the spacecraft velocity vector (+X toward the direction of spacecraft travel).

Rationale: Common reference frame necessary for JPSS flight system that is consistent with heritage coordinate systems (e.g. SNPP) for Earth-observing spacecraft.

J1MSS-121 The JPSS-1 mission shall use the J2000 inertial coordinate system for attitude knowledge.

Rationale: Reference frame knowledge is required for accurate data geolocation.

J1MSS-122 The JPSS-1 mission shall use the WGS84 geodetic reference system for environmental data geolocation.

Rationale: JPSS ground system processing of the instrument data requires the definition of a geodetic reference frame. The GPS uses WGS84 geodetic reference system. The usage of a geodetic reference system reduces the incident angle variation on conically scanning instruments.

4.1.7 Spectrum Management

J1MSS-126 The JPSS-1 mission shall comply with all applicable sections of national (National Telecommunications and Information Administration -NTIA) and international (International Telecommunications Union - ITU) Radio Rules, Regulations and Recommendations, including but not limited to compliance with: NTIA Certifications of Spectrum Support; and, applicable Recommendations and Resolutions issued by the Space Frequency Coordination Group (SFCG).

Rationale: Compliance with NTIA and ITU Rules, Regulations, and Recommendations are mandatory to avoid any potential on-orbit, or space to ground/ground to space interference. The SFCG Recommendations and Resolutions provide additional coordination guidelines. Compliance with the above will be accomplished via necessary NOAA filings for the Program as well as NOAA national and international negotiations when and where needed.

4.1.8 Space Asset Protection

J1MSS-1531 The JPSS-1 mission shall encrypt the uplink commands using a NIST FIPS 140-2 certified AES algorithm uplink security system that uses 256 bit keys.

Rationale: GPD 7120.1A (GSFC Space Asset Protection Policy) establishes the policy for the protection of GSFC-managed space missions. The command link design (encryption and authentication) should not be susceptible to contact from sources other than the JPSS mission operations control centers.

J1MSS-1532 The JPSS-1 mission shall source authenticate all real-time commands to the satellite.

Rationale: GPD 7120.1A (GSFC Space Asset Protection Policy) establishes the policy for the protection of GSFC-managed space missions. The command link design (encryption and authentication) should not be susceptible to contact from sources other than the JPSS mission operations control centers.

4.2 Mission Orbit Management Requirements

4.2.1 Operational Orbit

J1MSS-129 The JPSS-1 mission shall operate for the Mission Lifetime in a polar sun-synchronous orbit with the following characteristics:

Nominal Altitude: 824 km +/- 17 km
Ground Track Repeatability Accuracy: +/- 20 km at the equator
Ground Track Repeat Cycle: 16 days
Nominal Ascending Equator Crossing Time: 1330 (local time) +/- 10 min.

Rationale: Direct flowdown from JPSS L1RD (JPSS-REQ-1001) - 6.1.1.4. Defined mission orbit provides data continuity at desired altitude with repeat cycle providing global coverage, as the JPSS-1 mission is designed to succeed the SNPP mission. Explicit ground track repeat cycle of 16 days versus the <20 days value in JPSS L1RD 6.1.1.4 ensures the same value as the SNPP mission orbit requirement. Failure to maintain the defined mission orbit will result in degraded mission capabilities.

J1MSS-134 The JPSS-1 mission shall lead the S-NPP mission by no less than a 20 min along-track separation in the similar mission orbit.

Rationale: This requirement provides the placement of the JPSS-1 satellite into mission constellation with the S-NPP mission. Both missions are flown in a similar LTAN orbit in order to provide similar lighting conditions for nadir observations. The time separation between both missions is necessary to avoid ground station contact conflicts and facilitate mission operations activities. Along-track separation assumes similar LTAN between missions.

4.2.2 Orbit Maneuver Activities

J1MSS-138 The JPSS-1 mission shall predict and perform maneuvers to avoid orbital debris that poses a credible threat to mission success.

Rationale: GSFC-managed missions are required to support collision avoidance based on asset protection assessment per GPD 7120.1A and the risk classification of this mission.

J1MSS-2459 The JPSS-1 mission shall perform orbit maintenance maneuvers to maintain the mission orbit.

Rationale: Inclination and drag makeup adjustments are required to maintain the mission orbit throughout the mission lifetime. It is desired to maintain the JPSS-1 and SNPP missions at the same relative LTAN, such that the instrument coverage pattern offsets between the missions remain similar.

J1MSS-233 The JPSS-1 mission shall perform the sensor calibration maneuvers in Table 4.2.2-1 upon ground command, non-simultaneously, without imposing unrecoverable impacts on the spacecraft or sensors, maintaining command and telemetry links throughout each maneuver, and returning to nominal satellite Earth-pointing orientation upon completion.

Rationale: Sensor calibration maneuvers are necessary throughout the mission lifetime in order to maintain data product performance.

Table 4.2.2-1 JPSS-1 Sensor Calibration Maneuvers

Instrument	*Maneuver Type*	*Rationale*
ATMS	*Roll Offset*	*Obtain Earth/Space-view equivalency and side-lobe characteristics*
ATMS	*Pitch Offset*	*Obtain knowledge of non-uniformities/biases in instrument antenna field*
CERES	*Pitch Offset*	*Determine magnitude of scan-dependent offsets*
CERES	*Yaw Offset*	*Determine stray light contamination impacts on solar calibration*
OMPS	*Yaw Offset*	*Validate solar diffuser goniometric calibration*
VIIRS	*Roll Offset*	*Lunar Calibration for instrument responsivity degradation trending*
VIIRS	*Pitch Offset*	*Validate consistency of Earth/Space-view radiometry and response vs. scan angles*
VIIRS	*Yaw Offset*	*Determine radiometric/scattered light performance of solar diffuser, solar diffuser stability monitor and solar diffuser screen on-board calibration system*

4.2.3 Mission Orbital Debris

J1MSS-137 The JPSS-1 mission shall comply with the NASA Procedural Requirements for Limiting Orbital Debris (NPR 8715.6).

Rationale: NPR 8715.6 invokes NASA-STD-8719.14 (Process for Limiting Orbital Debris). This requirement ensures that the JPSS-1 mission has the capability to perform collision avoidance maneuvers during the mission lifetime, and limits orbital debris generation throughout mission activities, including disposal.

4.2.4 Mission Controlled Reentry

J1MSS-140 The JPSS-1 mission shall be capable of performing a controlled reentry, per the requirements of NASA-STD-8719.14 Process for Limiting Orbital Debris, from the mission orbit anytime up to 7 years from launch, when initiated by ground procedures.

Rationale: Controlled re-entry systems are required on missions that present a risk to the public above specific thresholds during re-entry at end of mission, as per NASA-STD-8719.14: Process for Limiting Orbital Debris. Controlled re-entry systems are necessary for safe exit from the planned mission constellation configuration.

4.3 Mission System Operations Requirements

4.3.1 Data Products

The JPSS-1 mission data products and associated data product performance requirements are identified in the JPSS L1RD and JPSS L1RDS, and are flowed directly to the JPSS Level 2 data product performance requirements in the JPSS GSRD and JERD. For reference, the complete set of JPSS-1 mission data products and mapping to the data product performance requirements in the JPSS GSRD and JERD is provided in Table 5.1 of this document. The JPSS-1 mission instrument performance requirements in support of meeting the data product performance requirements are found in Section 4.7 of this document. As mentioned earlier in Section 1.3, this section contains 'will' statements that provide the location of the actual 'shall' statements in companion JPSS Level 2 requirements documents.

4.3.1.1 Data Product Production

J1MSS-145 The JPSS-1 mission will produce the mission-applicable data products specified in the JPSS Ground System Requirements Document (GSRD), 470-00067-02, and in the JPSS NESDIS ESPC Requirements Document (JERD), JPSS-REQ-1003.

Rationale: All of the mission-specific data product requirements are contained in the JPSS GSRD (470-00067-02), and the JERD (JPSS-REQ-1003). This document does not contain any specific data product performance requirements, but only provides the reference to the appropriate documents (reference Table 5.1).

J1MSS-146 The JPSS-1 mission shall generate metadata used by data stakeholders to identify, evaluate, extract, employ and manage the data and data products from JPSS-1.

Rationale: Direct flowdown from JPSS L1RDS (JPSS-REQ-1002) L1RDS-2261. Metadata is data about the content, quality, condition and other characteristics of data. Metadata is descriptive information that employs a common set of terms and definitions to characterize and describe data. For example, metadata is associated with each data item in the IDPS internal archive, and is used to locate and interpret the data. The metadata standards are referenced in https://www.nosc.noaa.gov/EDMC/documents/EDMC_PD-DD_transmittal_v1.pdf.

J1MSS-147 The JPSS-1 mission shall provide the software, documentation and periodic updates to the field terminal community necessary to generate data products from the High Rate Data (HRD) direct broadcast.

Rationale: Direct flowdown of JPSS L1RD (JPSS-REQ-1001) - 6.2.13. JPSS provides the software resources necessary for the field terminals to generate the data products from the HRD direct broadcast. JPSS is not responsible for the field terminal hardware or field terminal operations.

4.3.1.2 Data Product Format

J1MSS-149 The JPSS-1 mission shall provide the formatting of mission data in support of data products, auxiliary data, data quality flags and associated metadata between the flight and ground system.

Rationale: Flight product data format is necessary for ground product data formatting, processing and distribution.

4.3.1.3 Data Product Availability

J1MSS-151 The JPSS-1 mission will make available Application Packets (APs), Raw Data Records (RDRs), Sensor Data Records (SDRs), Temperature Data Records (TDRs), Intermediate Products (IPs) and Environmental Data Records (EDRs) as specified in the JPSS Ground System Requirements Document (GSRD), 470-00067-02, and in the JPSS NESDIS ESPC Requirements Document (JERD), JPSS-REQ-1003.

Rationale: These documents indicate which of the mission-specific data products are made available by either the JPSS ground system and/or the NOAA ESPC.

4.3.2 Mission Communications

J1MSS-154 The JPSS-1 mission shall use five paths for space-ground communications: a direct ground path for command and telemetry, a direct ground path for Stored Mission Data, a direct ground path for High Rate Data direct broadcast, a backup relay satellite path for command and telemetry and a backup relay satellite path for Stored Mission Data, as specified in Table 4.3.2-1.

Rationale: This requirement defines the necessary set of communication links required to support the JPSS-1 mission, including telemetry and commanding (T&C), stored mission data (SMD) downlink and high rate data (HRD) direct broadcast.

Table 4.3.2-1 JPSS-1 Mission Space-Ground Communication Links

Spacecraft to Ground Links	**Function**
S Band – Telemetry & Commanding (T&C)	Real-time telemetry & commanding
Ka Band – Stored Mission Data (SMD)	Science data downlink
X band – High Rate Data (HRD)	Direct broadcast of science data
Spacecraft to NASA-SN to Ground Links	**Function**
S Band – Telemetry & Commanding (T&C)	Real-time telemetry & commanding
Ka Band – Stored Mission Data (SMD)	Science data downlink

J1MSS-216 The JPSS-1 mission shall collect, monitor and archive telemetry relevant to the health, safety and performance of the JPSS-1 flight and ground systems for the mission lifetime.

Rationale: It is necessary to characterize the flight and ground system health and safety and provide ground system status reporting throughout the mission.

J1MSS-220 The JPSS-1 mission shall provide real-time telemetry during all mission-critical events, including 1) following launch vehicle separation and establishment of safe attitude, 2) spacecraft component activation and deployments, and 3) during all planned propulsive maneuvers.

Rationale: It is not permitted to conduct critical mission operations without direct visibility into satellite performance and command verification.

J1MSS-280 The JPSS-1 mission shall provide spacecraft telemetry and ground system status reporting to conduct diagnostics and troubleshooting procedures without interrupting the operational mode of the system.

Rationale: All operational modes should provide the necessary information to support diagnostics and troubleshooting of the operational system, without needing reconfiguration.

4.3.2.1 Command Link

J1MSS-159 The JPSS-1 mission shall be capable of generating, sending, receiving and processing all satellite processor commands and memory loads.

Rationale: The command link needs to support all of the planned operational capabilities for the JPSS-1 mission.

4.3.2.2 Simultaneity of Uplink and Downlink Data Transmission

J1MSS-163 The JPSS-1 mission shall be capable of simultaneously transmitting the following:

a. Real-time telemetry in S-Band
b. Playback telemetry in S-Band
c. Stored Mission Data in Ka-Band
d. HRD direct broadcast data in X-Band
e. Command uplink in S-Band

Rationale: The JPSS-1 mission must support simultaneous data uplink and downlink operations to meet data delivery requirements.

4.3.2.3 Real Time & Playback Telemetry

J1MSS-169 The JPSS-1 mission shall be capable of processing and displaying real-time housekeeping and playback telemetry during scheduled ground contact commanding of the JPSS-1 satellite.

Rationale: Real-time telemetry is required during any scheduled ground contact time for satellite commanding, in order to avoid commanding in the blind.

4.3.2.4 Stored Mission Data

J1MSS-176 The JPSS-1 mission shall provide a stored mission data (SMD) downlink that contains the mission data necessary for data product generation.

Rationale: This requirement defines the functional purpose and planned content of the operational SMD downlink.

J1MSS-178 The JPSS-1 mission shall recover retransmitted stored mission data (SMD) without impacting the delivery of SMD that can still meet data latency requirements.

Rationale: The intent of this requirement is to recover missing data without impacting the nominal collection of data.

4.3.2.5 High Rate Data

J1MSS-180 The JPSS-1 mission shall provide a continuous, near real-time broadcast that contains instrument science and engineering data, and spacecraft auxiliary data necessary for the production of mission data records.

Rationale: This requirement defines the functional purpose and planned content of the operational HRD downlink.

4.3.3 Data Handling

4.3.3.1 Data Compression

J1MSS-187 The JPSS-1 mission shall use lossless data compression, when data compression is utilized in the mission science downlinks.

Rationale: Data compression of the mission science data is necessary in order to manage the content of the mission science downlinks. The JPSS ground system recommends the utilization of lossless compression techniques, when compression is utilized.

4.3.3.2 Data Packets

J1MSS-173 The JPSS-1 mission shall be capable of selecting which data packets are transmitted in the mission downlinks.

Rationale: The mission downlinks (R/T telemetry, playback telemetry, SMD downlink and HRD downlink) should be configurable. Application packets can only be specified based on Application Process IDs (APIDs).

4.4 Mission Maintenance Requirements

4.4.1 Fault Handling Capability

J1MSS-223 The JPSS-1 mission shall provide the capability for resolving flight and ground hardware and software faults and anomalies.

Rationale: The JPSS-1 mission flight and ground systems will be designed such that they are single-fault tolerant, and provide the capability to resolve and recover operations after faults.

4.4.2 Mission Continuity

J1MSS-283 The JPSS-1 mission shall operate continuously using primary or alternate facilities, to ensure data continuity for the Mission Lifetime.

Rationale: Consolidated Backup Facility (CBU) at Fairmont, WV provides alternate facilities for mission operations, data product generation and distribution as a backup to the primary facilities at the NSOF (Suitland, MD).

4.5 Mission System Performance Allocations

4.5.1 Mission Operational Availability

J1MSS-2305 Excluding on-orbit failures, the JPSS-1 mission shall maintain an operational availability of greater than or equal to 98% over any 30 day period after the Satellite Operational Handover to NOAA.

Rationale: Direct flowdown of JPSS L1RD (JPSS-REQ-1001) - 6.1.1.3. Operational availability refers to the mission elements (flight and ground) necessary to meet the minimum mission success criteria in Section 3.2, once the satellite is declared operational, nominally at launch + 90 days. This requirement intentionally excludes on-orbit failures, which are defined as the unplanned permanent or temporary loss of a function provided by the spacecraft and/or instruments necessary to meet the minimum mission success criteria (e.g. functional loss of an entire ATMS instrument or recoverable spacecraft fault). The suballocation of performance to flight and ground is provided in the JPSS L1RDS (JPSS-REQ-1002), Section 3.1.2.3 (L1RDS-2279, 2280, 2281).

4.5.1.1 Reserved

4.5.1.2 Reserved

4.5.1.3 Satellite Scheduled Operational Outage

J1MSS-2311 The JPSS-1 satellite scheduled operational outages shall be less than or equal to 2 hours over any 30 day period after the Satellite Operational handover to NOAA.

Rationale: Derived from JPSS L1RDS (JPSS-REQ-1002) L1RDS-2281. Satellite scheduled operational outages consist of planned activities (e.g. calibration maneuvers, collision avoidance, orbit maintenance) that are necessary to sustain satellite performance to meet the minimum mission success criteria.

4.5.2 Mission Data Latency

J1MSS-305 Over any 30-day period, the JPSS ground system shall meet the JPSS-1 mission-specific data latency requirements in the JPSS GSRD (470-00067), at least 95% of the time for data collected by the primary operational sensors.

Rationale: Based on JPSS L1RD (JPSS-REQ-1001) - 6.2.6, which is flowed as a requirement to the JPSS ground system in the JPSS GSRD (470-00067). Data latency is the period from the time of observation of all requisite data by the satellite until the data product produced from those data is available to the user at the system/user interface. Mission data latency is part of the mission success criteria.

4.5.2.1 NESDIS ESPC Data Latency

J1MSS-2365 Over any 30-day period, the NESDIS ESPC shall meet the JPSS-1 mission-specific data latency requirements in the JPSS NESDIS ESPC Requirements Document (JERD), JPSS-REQ-1003, for data collected by the primary operational sensors.

Rationale: Based on JPSS L1RD (JPSS-REQ-1001) - 6.2.6, which is flowed as a requirement to the NOAA ESPC in the JERD (JPSS-REQ-1003). ESPC latency is defined as the period of time starting when the ESPC receives the input data and ending with delivery to the user interface, including the ESPC processing time, reformatting time if necessary, and making the data available to the end user interface.

4.5.3 Mission Data Availability

J1MSS-313 Over any 30-day period, the JPSS-1 mission shall deliver at least 99% of the stored mission data collected from the operational sensors to the JPSS ground system data processing node.

Rationale: Direct requirement from JPSS L1RD (JPSS-REQ-1001) - 6.1.1.11. Data availability is the capability of the JPSS-1 satellite to provide the stored mission data (SMD) to the ground system data processing node, such that data gaps are minimized. This requirement is verified by analysis of the end-to-end data collection process in order to ensure that there are no single point failures that can result in permanent loss of data.

4.5.4 Mission Geolocation

J1MSS-1538 The JPSS-1 mission shall perform geolocation of the mission-specific data records as per the performance specified in the JPSS Ground System Requirements Document (GSRD), 470-00067.

Rationale: All mission-specific data product requirements (e.g. mapping uncertainty) from the JPSS L1RDS are captured in the JPSS (GSRD), 470-00067-02.

J1MSS-2276 The known pointing of the VIIRS instrument boresight, referenced to the center of the effective field of view for any channel, shall be within 375 m (3 sigma) at nadir, on the WGS84 reference ellipsoid, at any time during nominal JPSS-1 operations.

Rationale: Performance is derived for each mission instrument based on the related JPSS L1 data product performance requirement attribute (mapping uncertainty). Satisfaction of VIIRS data product geolocation performance requirements dictates on-orbit calibration techniques to remove at least 96% of the static instrument boresight line-of-sight errors.

4.5.4.1 Flight Geolocation

J1MSS-2273 The known pointing of the ATMS instrument boresight, referenced to the center of the effective field of view for any channel, shall be within 1.50 km (3 sigma) at nadir, on the WGS84 reference ellipsoid, at any time during nominal JPSS-1 operations.

Rationale: Performance is derived for each mission instrument based on the related JPSS L1 data product performance requirement attribute (mapping uncertainty).

J1MSS-2274 The known pointing of the CrIS instrument boresight, referenced to the center of the effective field of view for any channel, shall be within 1.50 km (3 sigma) at nadir, on the WGS84 reference ellipsoid, at any time during nominal JPSS-1 operations.

Rationale: Performance is derived for each mission instrument based on the related JPSS L1 data product performance requirement attribute (mapping uncertainty).

J1MSS-2275 The known pointing of the OMPS instrument boresight, referenced to the center of the effective field of view for any channel, shall be within 15.00 km (3 sigma) at nadir, on the WGS84 reference ellipsoid, at any time during nominal JPSS-1 operations.

Rationale: Performance is derived for each mission instrument based on the related JPSS L1 data product performance requirement attribute (mapping uncertainty).

J1MSS-2984 The known pointing of the VIIRS instrument boresight, referenced to the center of the effective field of view for any channel, prior to on-orbit calibration shall be within 1200 m (3 sigma) at nadir, on the WGS84 reference ellipsoid, at any time during nominal JPSS-1 operations.

Rationale: Performance is derived for each mission instrument based on the related JPSS L1 data product performance requirement attribute (mapping uncertainty).

J1MSS-2277 The known pointing of the CERES instrument boresight, referenced to the center of the effective field of view for any channel, shall be within 2.50 km (3 sigma) at nadir, on the WGS84 reference ellipsoid, at any time during nominal JPSS-1 operations.

Rationale: Based on the heritage mission geolocation requirements for CERES climate data products produced by the NASA Langley Research Center's CERES Project and providing traceability to the pointing and alignment requirements contained in the CERES-to-JPSS-1 Interface Control Document (472-00020 Rev D) and the CERES FM6 Performance Specification (SY13-0001 Rev G).

4.5.4.2 Reserved

4.6 Launch Segment Requirements

J1MSS-364 The JPSS-1 flight launch vehicle shall be Risk Category 2 (medium risk) or a Category 3 (low risk), per NASA Policy Directive (NPD) 8610.7.

Rationale: Direct flowdown from JPSS L1RD (JPSS-REQ-1001) - 6.1.1.6. This policy applies to all NASA-owned or NASA-sponsored payloads/missions designed for orbital launch and/or for other Government- sponsored payloads for which NASA is responsible for launch service acquisition and management.

J1MSS-1540 The JPSS-1 satellite shall be launched with a Delta II 7920-10 launch vehicle utilizing the 6915 Payload Attach Fitting.

Rationale: The satellite needs to be compatible with the identified launch vehicle.

4.7 Space Segment Requirements

4.7.1 Satellite Functional Requirements

J1MSS-369 The JPSS-1 satellite instrument payload shall consist of ATMS, CrIS, VIIRS, OMPS-N, and CERES.

Rationale: Direct flowdown from JPSS L1RD (JPSS-REQ-1001) - 6.1.1.7. The payload has been defined as to provide continuity of necessary capabilities of the JPSS missions.

J1MSS-2514 The spatial and radiometric performance of the JPSS-1 satellite instruments shall be characterized and documented prior to launch.

Rationale: Direct flowdown from JPSS L1RDS (JPSS-REQ-1002) L1RDS-11. It is necessary to characterize the pre-launch performance in order to ensure that the instruments have survived the launch environment.

J1MSS-1541 The JPSS-1 satellite shall be capable of operating all subsystems and instruments simultaneously and continuously.

Rationale: The nominal operational mode of the JPSS-1 satellite is to have all instruments and spacecraft subsystems operating at the same time.

J1MSS-215 The JPSS-1 satellite shall be capable of remaining operational without additional satellite commanding for a period of 48 hours minimum.

Rationale: The satellite should be capable of continuing nominal mission operations while it is operating out of a stored command load, in the absence of real-time ground commanding.

J1MSS-332 The JPSS-1 satellite shall acquire and store at least 3 orbits of Stored Mission Data.

Rationale: The means of getting the satellite data to the ground is through transmission of the stored mission data on the data recorder to the ground system. The satellite data recorder must be sized to account for single-point failures in the ability to downlink the stored mission data.

4.7.2 ATMS Performance Requirements

This section contains the ATMS instrument performance requirements in support of the ATMS sensor data record (SDR) performance requirements located in the JPSS Ground System Requirements Document (GSRD), Volume 2. Table 5.2 in this document provides the mapping of instrument performance requirements to the SDR performance requirements.

4.7.2.1 Definitions

The term "Beam Position" means the position of a "Beam-Center," which is defined as the position of the beam (electrical boresight) at the mid-point of the integration time.

The beam electrical boresight is defined as the mid-point between the half-power points of the instantaneous antenna pattern.

The term "cell" refers to the segment from the start to the end of the integration time.

4.7.2.2 Global Coverage

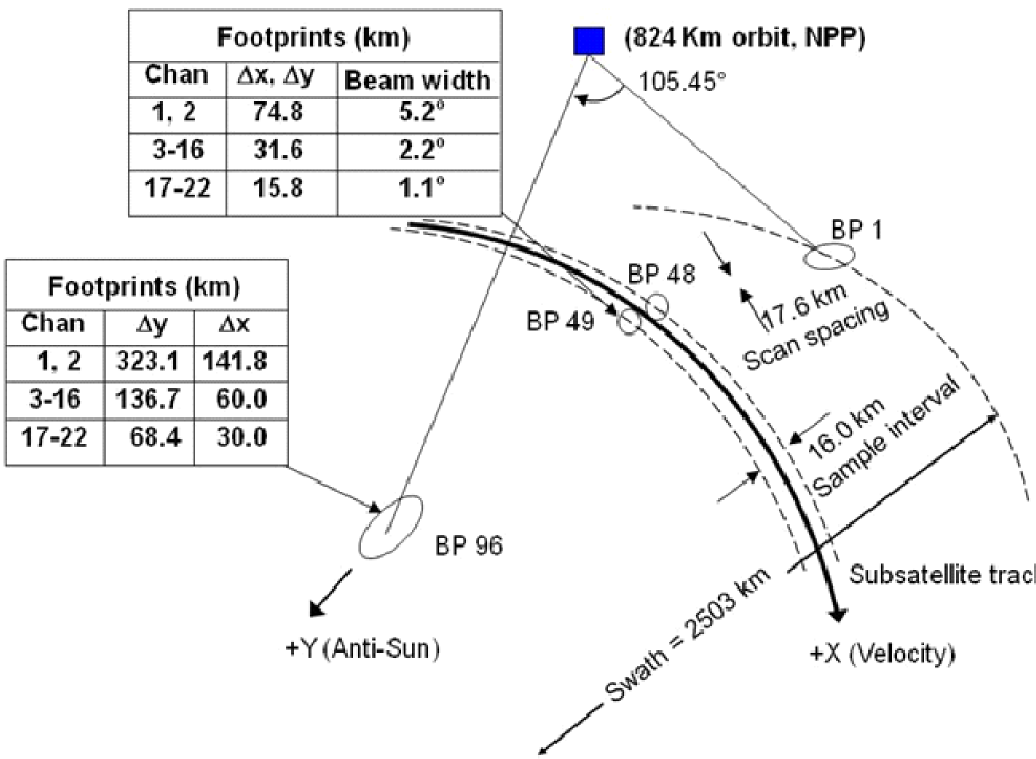

Figure 4.7.2.2-1 ATMS Footprint

J1MSS-1670 The ATMS Scan swath shall be a minimum of 2200 km. The typical ATMS scan width for an 824 km altitude sun-synchronous orbit is depicted in Figure 4.7.2.2-1.

Rationale: To provide at least 90% coverage of the globe every 18 hours (monthly average).

4.7.2.3 Footprint

J1MSS-1672 The ATMS Effective Field of View (EFOV) shall be as given in Table 4.7.2.3-1, with a tolerance of 10%. Note that Instantaneous Field of View (IFOV) and Horizontal Cell Size (HCS) are given for reference only.

Rationale: To meet measurement resolution requirements for derived products.

Table 4.7.2.3-1 ATMS Footprint

	Chan 1,2			Chan 3-16			Chan 17-22		
	Down-Track	Cross-Track	Geom Mean	Down-Track	Cross-Track	Geom Mean	Down-Track	Cross-Track	Geom Mean
IFOV (degr)	5.2	5.2	5.20	2.2	2.2	2.20	1.1	1.1	1.10
EFOV (degr)	5.2	6.3	5.72	2.2	3.3	2.69	1.1	2.2	1.56
HCS (km, at nadir)	74.78	90.60	82.31	31.64	47.46	38.75	15.82	31.64	22.37

The typical ATMS footprint is depicted in Figure 4.7.2.2-1.

4.7.2.4 Scan and Position Sensor Boresight

J1MSS-1679 ATMS shall scan and position the sensor boresight to enable measurement of scene radiance at specified locations.

Rationale: To make measurements to meet the accuracy, a scan method is required.

4.7.2.4.1 Scan Method

J1MSS-1681 All main beam axes of ATMS shall be coincidental, i.e., they shall be pointing in the same direction (subject to the pointing accuracy requirements) at the same time for any given beam position.

Rationale: Some channels are window channels for others. Coincidental reduces required ground processing and increased accuracy for ATMS-only products.

4.7.2.4.2 Scan Profile

J1MSS-1684 ATMS shall have an Earth-viewing sector containing a total of 96 Earth-viewing beam positions.

Rationale: The Earth Viewing Scan Angle divided by the Footprint gives the required number of beam positions for continuous cross-track coverage. The ATMS implementation is 96 beam positions driven by the G-Band. The current implementation is Level 2 requirement to support algorithm development. Within a sector, the beam center position for all channels is separated from the adjacent beam position along the scan direction by 1.11 degrees.

J1MSS-1686 There shall be provisions, in response to specific commands, to point and hold the ATMS sensor boresight to any given beam position, in the Earth-viewing, cold calibration, or hot-calibration sectors.

Rationale: Used for special on-orbit calibration and validation procedures.

4.7.2.4.3 Scan Period

J1MSS-1688 The ATMS total scan period shall be 8/3 seconds +/-0.35 msec (subject to the CrIS Synchronization Accuracy requirement).

Rationale: For the smallest beamwidth, this scan period is required to achieve continuous ground-track coverage. This scan period also provides the necessary synchronization of scan with CrIS every 8 seconds.

4.7.2.4.4 Synchronization with CrIS

J1MSS-1690 The ATMS instrument beams shall scan cross-track to the satellite motion.

Rationale: Chosen implementation to provide synchronization with CrIS scanning.

J1MSS-1691 The ATMS instrument scan direction shall be from sun to anti-sun.

Rationale: Chosen implementation to provide synchronization with CrIS scanning.

J1MSS-1692 ATMS shall synchronize its scan start time with a timing signal it receives from the spacecraft bus.

Rationale: Needed for co-geolocation for CrIMSS producing atmospheric soundings in all cloud conditions.

J1MSS-1693 The time difference between the start of beam position number one of the ATMS scan and the corresponding intended time indicated by the spacecraft bus timing signal, plus a programmable offset, shall be no greater than 25 msec.

Rationale: Needed for repeatability of relative geolocation for CrIMSS producing atmospheric soundings in all cloud conditions.

4.7.2.5 Beam Characteristics

4.7.2.5.1 General Definitions

Each channel of ATMS is considered to form a beam.

In the following sections, if only one beam is discussed it is inferred to represent any and all beams.

4.7.2.5.2 Beamwidth

Beamwidth is defined as the width between the half-power points, or half power beam width (HPBW).

J1MSS-1700 The ATMS beamwidth in any plane containing the main beam axis (electrical boresight axis) shall be within plus or minus 10% of the specified value.

Rationale: Width-symmetry of beam contributes to measurement accuracy or derived data products.

J1MSS-1701 The ATMS beamwidth variation among channels that have the same specified beamwidth shall be no greater than 10% of the specified beamwidth.

Rationale: Beamwidth differences of beam contribute to measurement accuracy of derived data products.

4.7.2.5.3 Beam Efficiency

Beam efficiency is defined as the ratio of the energy received within the main lobe, including cross-polarized energy, to that of the total energy received by the antenna in a radiometrically isotropic environment. The main lobe is defined as the region equal to 2.5 times the half power beam width (HPBW).

J1MSS-1704 ATMS antenna beam efficiency shall be no less than 95.0% at all frequencies and all beam positions.

Rationale: Significant contributor to measurement accuracy.

4.7.2.5.4 Beam Polarization

ATMS Quasi-horizontal and -vertical polarizations are defined as follows:

Quasi Horizontal Polarization (QH): ELECTRIC FIELD VECTOR Normal to scanning plane

Quasi Vertical Polarization (QV): ELECTRIC FIELD VECTOR Parallel to the scanning plane

4.7.2.5.5 Channel Specific Beam Characteristics

J1MSS-1708 The beam characteristics for each channel produced by ATMS shall be as given in Table 4.7.2.5.5-1.

Rationale: Beamwidth and Polarization contribute to measurement accuracy and algorithms to process or derived data products. While there are no Polarization Angle requirement tolerance or uncertainty (knowledge) for JPSS-1, characterization is being performed since it also contributes to measurement accuracy for some channels data products.

Table 4.7.2.5.5-1 ATMS Channel Specific Beam Characteristics

Channel	Static Beamwidth B (Deg)	Quasi Polarization	Channel	Static Beamwidth B (Deg)	Quasi Polarization
1	5.2	QV	12	2.2	QH
2	5.2	QV	13	2.2	QH
3	2.2	QH	14	2.2	QH
4	2.2	QH	15	2.2	QH
5	2.2	QH	16	2.2	QV
6	2.2	QH	17	1.1	QH
7	2.2	QH	18	1.1	QH
8	2.2	QH	19	1.1	QH
9	2.2	QH	20	1.1	QH
10	2.2	QH	21	1.1	QH
11	2.2	QH	22	1.1	QH

4.7.2.6 Channel Spectral Characteristics

Table 4.7.2.6-1 ATMS Channel Spectral Characteristics

Channel	Center Frequency (GHz)	Maximum Bandwidth (GHz)	Center Frequency Stability (MHz)	Temperature Sensitivity (K) NEΔT
1	23.8	0.27	≤10	0.70
2	31.4	0.18	≤10	0.80
3	50.3	0.18	≤10	0.90
4	51.76	0.40	≤ 5	0.70
5	52.8	0.40	≤ 5	0.70
6	53.596 ±0.115	0.17	≤ 5	0.70
7	54.40	0.40	≤ 5	0.70
8	54.94	0.40	≤10	0.70
9	55.50	0.33	≤10	0.70
10	57.290344	0.33	≤ 0.5	0.75
11	57.290344 ±0.217	0.078	≤ 0.5	1.20
12	57.290344 ±0.3222 ±0.048	0.036	≤ 1.2	1.20
13	57.290344 ±0.3222 ±0.022	0.016	≤ 1.6	1.50
14	57.290344 ±0.3222 ±0.010	0.008	≤ 0.5	2.40
15	57.290344 ±0.3222 ±0.0045	0.003	≤ 0.5	3.60
16	88.2	2.0	≤ 200	0.50
17	165.5	3.0	≤ 200	0.60
18	183.31±7	2.0	≤ 30	0.80
19	183.31±4.5	2.0	≤ 30	0.80
20	183.31±3	1.0	≤ 30	0.80
21	183.31±1.8	1.0	≤ 30	0.80
22	183.31±1	0.5	≤ 30	0.90

4.7.2.6.1 Center Frequency

Each channel of ATMS is considered to form a beam.

J1MSS-1716 The ATMS channel data products shall have 22 channels of the Center Frequencies provided in the Table 4.7.2.6-1.

Rationale: Physics of the Earth's Atmosphere.
- Channels 1 and 2 measure the surface emissivity and moisture
- Channels 3 and 4 measure the surface temperature
- Channels 5-15 measure atmospheric temperature in specific vertical layers
- Channels 16 and 17 provide surface and moisture characterization
- Channels 18-22 measure atmospheric moisture in specific vertical layers

4.7.2.6.2 Passbands

The number of pass-bands per channel, listed in the "Center Frequency" column of the table, is the maximum allowed. Fewer pass-bands may be used, provided that both the Temperature Sensitivity requirements are met and symmetry is maintained with respect to the absorption peak for that channel. For example, Channel 18 lists two pass-bands centered at (183.31 + 7) = 190.31 GHz and (183.31-7) = 176.31 GHz. The channel may be implemented using only one of these passbands, provided the temperature sensitivity value of no greater than 0.8 K is achieved; however, if only one passband is used and the symmetry with respect to the 183.31 GHz atmospheric absorption peak is not maintained, then errors or changes in Local Oscillator frequency will introduce a science bias and the specification for center frequency stability may need to be tightened to compensate.

4.7.2.6.3 Bandwidth

Channel bandwidth is defined as the spectral width between the half-power points per pass-band.

J1MSS-1721 The bandwidths of the 22 ATMS instrument channels shall be no greater than the values listed in Table 4.7.2.6-1.

Rationale: Bandwidth is a significant contributor to measurement accuracy of data products.

4.7.2.6.4 Center Frequency Stability

Channel center frequency stability is defined as the maximum deviation from the channel center frequency for both long-term and short-term periods over the operational life of the instrument.

J1MSS-1724 The center frequency stability of the 22 ATMS instrument channels shall comply with the values listed in Table 4.7.2.6-1.

Rationale: Center Frequency Stability is a contributor to meeting the calibration data product accuracy requirements.

4.7.2.6.5 Temperature Sensitivity

Temperature sensitivity (Noise Equivalent Delta Temperature or NEDT) is defined as the standard deviation of the radiometer output in kelvins (K) brightness temperature incident at the antenna collecting aperture, when the antenna is viewing a 300 K uniform and stable target.

J1MSS-1727 The temperature sensitivity of the 22 ATMS instrument channels shall be no greater than the values listed in Table 4.7.2.6-1.

Rationale: Flowdown of Level 1 Measurement Uncertainty.

4.7.2.6.6 Outputs Per Channel

J1MSS-1729 All ATMS instrument channels, regardless of the number of passbands, shall have only one output per channel.

Rationale: Each channel is to provide one measurement of desired temperature/moisture. Ground algorithms are designed to accept only one data input for each channel.

4.7.2.6.7 Channel Gain

4.7.2.6.7.1 Gain Definition

Passband gain is defined as the overall gain of ATMS system from the antenna aperture to the instrument output, averaged over the passband bandwidth.

4.7.2.6.7.2 Gain Stability

J1MSS-1734 The band center gain of each passband shall vary no more than +/- 2 dB over the operating temperature range and life of the ATMS instrument.

Rationale: Contributes to Calibration accuracy and Long Term Stability of measurements. Ensures operation within desired dynamic range, to meet accuracy and sensitivity requirements.

4.7.2.6.8 Channel Dynamic Range

J1MSS-1736 The dynamic range of the ATMS instrument radiometer system shall be from 3 to 330 K.

Rationale: Range required for space calibration (most accurate cold calibration) and upper limit of Internal Hot Calibration Target.

4.7.2.7 Provide Radiometric Calibration

J1MSS-1743 ATMS shall perform in-flight calibration for all channels.

Rationale: Needed for long-term stability as well as improves accuracy conversion of a radiometric data (digital counts) to units of brightness temperature.

4.7.2.7.1 In-Flight Calibration Types

J1MSS-1745 There shall be two types of ATMS instrument in-flight calibration measurements during each scan period: a "hot" calibration and a "cold" calibration.

Rationale: Calibration over the full dynamic range is optimal.

4.7.2.7.2 Calibration Accuracy

Calibration accuracy is defined as the difference (error) between the brightness temperature inferred from the microwave radiometer (referred to the antenna collecting aperture) and the actual brightness temperature of a blackbody test target directly in front of the antenna. Calibration accuracy is the average error over a time scale longer than 24 hours. Calibration accuracy predictions are computed as the sum of worst-case static (bias) errors and the root-sum-square (RSS) of the standard deviations of dynamic (time-variable) errors.

J1MSS-1748 The ATMS instrument calibration error accuracy for each channel shall be no greater than the values listed in Table 4.7.2.8.2-1.

Rationale: Calibration accuracy contributes directly to measurement accuracy.

Table 4.7.2.7.2-1 ATMS Calibration Accuracy

Channel	Calibration Accuracy (K)	Channel	Calibration Accuracy (K)
1	1.00	12	0.75
2	1.00	13	0.75
3	0.75	14	0.75
4	0.75	15	0.75
5	0.75	16	1.00
6	0.75	17	1.00
7	0.75	18	1.00
8	0.75	19	1.00
9	0.75	20	1.00
10	0.75	21	1.00
11	0.75	22	1.00

4.7.3 CrIS Performance Requirements

This section contains the CrIS instrument performance requirements in support of the CrIS sensor data record (SDR) performance requirements located in the JPSS Ground System Requirements Document (GSRD), Volume 2. Table 5.2 in this document provides the mapping of instrument performance requirements to the SDR performance requirements.

4.7.3.1 Sensitivity (Noise Equivalent Radiance Difference (NEdN))

J1MSS-1583 The predicted CrIS on-orbit noise equivalent radiance difference (NEdN) for each field of view (FOV) in the field of regard (FOR) shall be less than or equal to the values illustrated in Figures (4.7.3.1-1) through (4.7.3.1-3) for the nominal equivalent blackbody earth scene temperatures expected to be viewed by the instrument.

Rationale: These values are based on the reduced spectral resolution as described in J1MSS-1585.

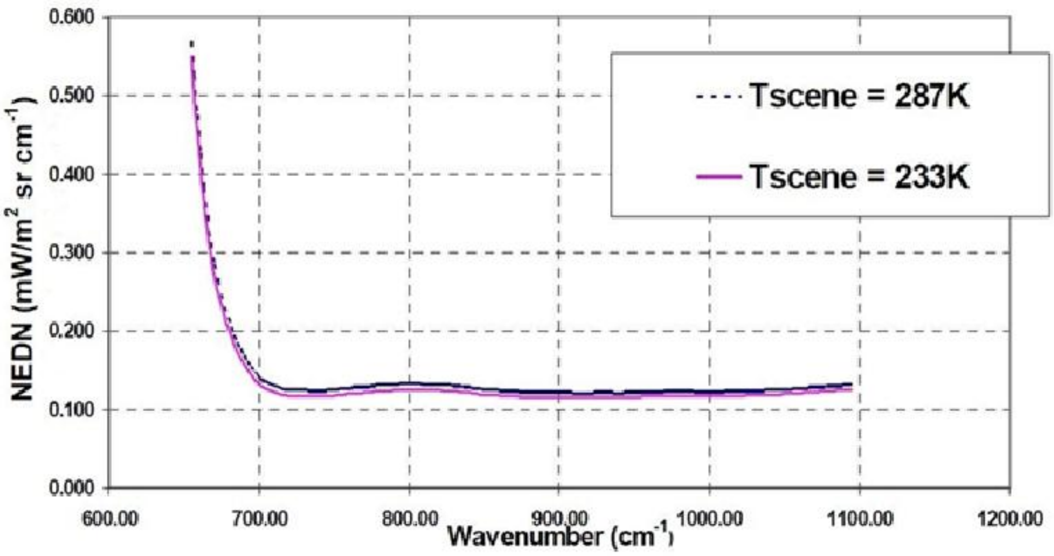

Figure 4.7.3.1-1 CrIS LWIR Maximum NEdN

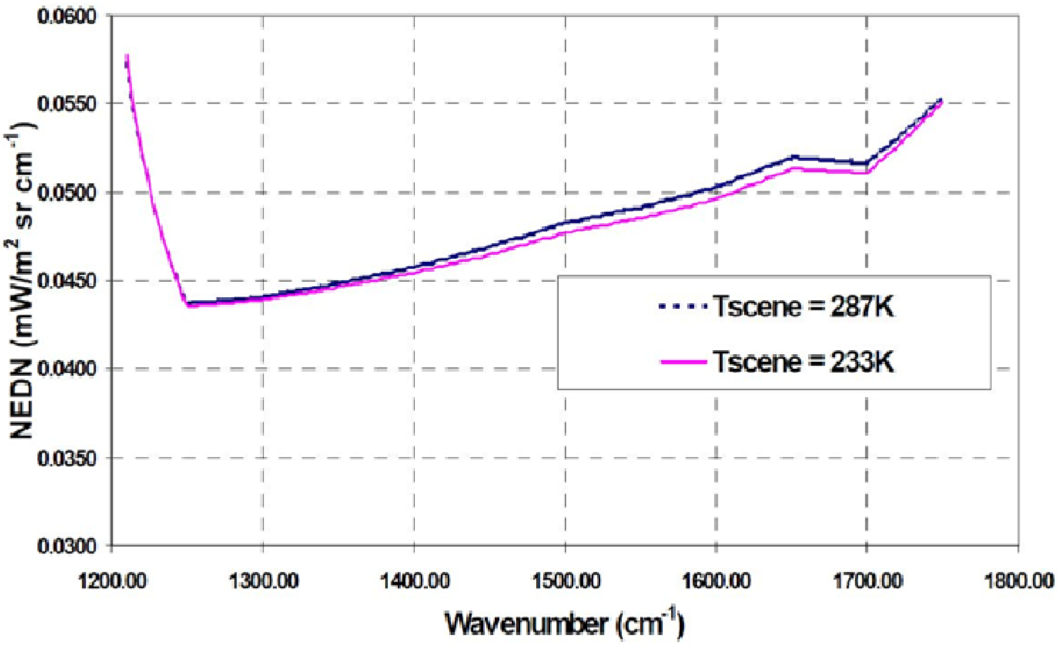

Figure 4.7.3.1-2 CrIS MWIR Maximum NEdN

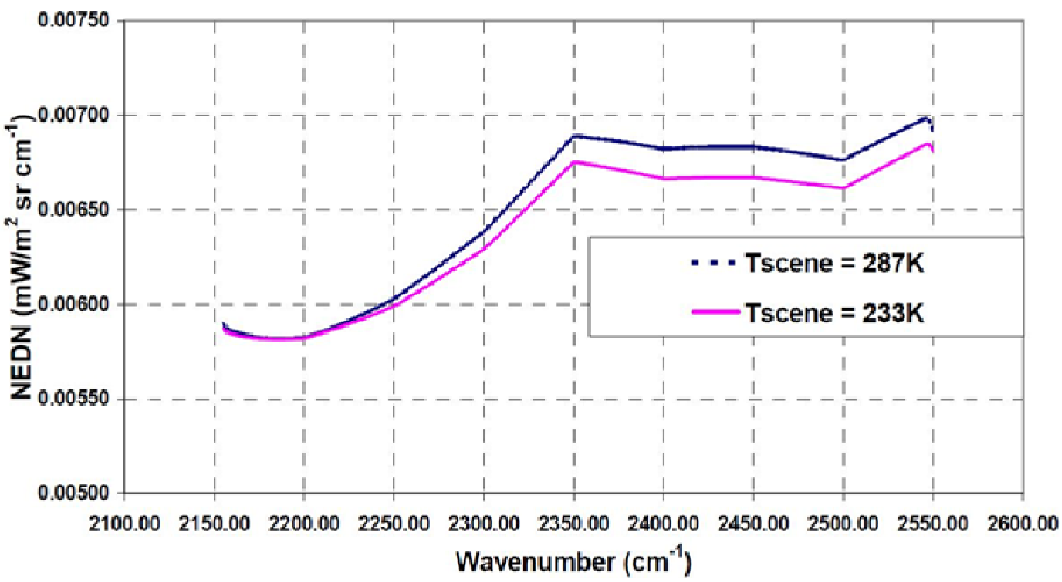

Figure 4.7.3.1-3 CrIS SWIR Maximum NEdN

4.7.3.2 Absolute Radiometric Uncertainty

J1MSS-1584 The CrIS absolute radiometric uncertainty shall be less than or equal to 0.45%, 0.58%, and 0.77%, on a spectral bin-by-bin basis, relative to the radiance of a 287 K blackbody target, for the LWIR, MWIR, and SWIR bands, respectively.

4.7.3.3 Spectral Resolution

J1MSS-1585 The CrIS on-axis, unapodized spectral resolution shall be less than or equal to 0.625 cm^{-1}, 1.25 cm^{-1} and 2.5 cm^{-1} for the LWIR, MWIR, and SWIR bands, respectively.

J1MSS-2440 The CrIS instrument shall be capable of outputting interferograms which have an on-axis, unapodized spectral resolution of less than or equal to 0.625 cm^{-1} for each of the spectral bands (LWIR, MWIR, and SWIR).

4.7.3.4 Infrared Radiation Measurements

J1MSS-1586 CrIS shall measure infrared radiation in the spectra range of 9.13-15.38 micrometers, 5.71-8.26 micrometers, and 3.92-4.64 micrometers for the LWIR, MWIR, and SWIR bands, respectively.

4.7.3.5 Spectral Uncertainty

J1MSS-1587 The spectral uncertainty of the CrIS data shall be less than or equal to 10 ppm for each band over the life of the mission.

4.7.3.6 Timing Synchronization with ATMS

J1MSS-1588 CrIS shall use the timing signal it receives from the Spacecraft to synchronize its scan start with ATMS.

4.7.3.7 Swath Width Measurements

J1MSS-1589 The system shall provide CrIS measurements over a swath width that extends at least ±49.5 degrees from nadir to the center of the far corner FOV at the edge of swath.

J1MSS-1590 CrIS measurements shall be of sufficient geometry to provide a horizontal cell size at the Earth's surface that is less than or equal to 15 km at nadir.

4.7.3.8 Radiometric Stability

J1MSS-1592 The CrIS long term radiometric stability shall be less than or equal to 0.40%, 0.50%, and 0.64%, on a spectral bin-by-bin basis, relative to the radiance of a 287 K blackbody target, for the LWIR, MWIR, and SWIR bands, respectively.

4.7.4 VIIRS Performance Requirements

This section contains the VIIRS instrument performance requirements in support of the VIIRS sensor data record (SDR) performance requirements located in the JPSS Ground System

Requirements Document (GSRD), Volume 2. Table 5.2 in this document provides the mapping of instrument performance requirements to the SDR performance requirements.

4.7.4.1 Sensor Capability

J1MSS-1608 VIIRS shall meet its capability requirements, over operational conditions including life and scan angle, when flown in the nominal JPSS orbit.

4.7.4.2 Dynamic Range

J1MSS-1609 VIIRS shall be able to measure scene spectral radiance for the single gain reflective bands between the minimum radiance (L_{min}) and the maximum radiance (L_{max}) and for the dual gain reflective bands between the High Gain L_{min} and the Low Gain L_{max} radiances as given in Table 4.7.4.2-1.

Table 4.7.4.2-1 Dynamic range requirements for VIIRS Sensor reflective bands

Band	Center Wavelength (nm)	Gain Type	Single Gain		Dual Gain			
					High Gain		Low Gain	
			Lmin	Lmax	Lmin	Lmax	Lmin	Lmax
M1	412	Dual	-	-	30	135	135	615
M2	445	Dual	-	-	26	127	127	687
M3	488	Dual	-	-	22	107	107	702
M4	555	Dual	-	-	12	78	78	667
M5	672	Dual	-	-	8.6	59	59	651
M6	746	Single	5.3	41.0	-	-	-	-
M7	865	Dual	-	-	3.4	29	29	349
M8	1240	Single	3.5	164.9	-	-	-	-
M9	1378	Single	0.6	77.1	-	-	-	-
M10	1610	Single	1.2	71.2	-	-	-	-
M11	2250	Single	0.12	31.8	-	-	-	-
I1	640	Single	5	718	-	-	-	-
I2	865	Single	10.3	349	-	-	-	-
I3	1610	Single	1.2	72.5	-	-	-	-
Notes: Spectral radiance (Lmin and Lmax) has units of watt m^{-2} sr^{-1} μm^{-1}.								

J1MSS-1611 The VIIRS Day-Night Band (DNB) shall have a dynamic range from an Lmin that is less than or equal to 3.0E-5 W m^{-2} sr^{-1} to an Lmax that is greater than or equal to 200 W m^{-2} sr^{-1}.

4.7.4.3 Reflective Band Sensitivity

J1MSS-1612 The VIIRS reflective bands shall meet the sensitivity requirements given in Table 4.7.4.3-1.

Table 4.7.4.3-1 Sensitivity requirements for VIIRS Sensor reflective bands

Band	Center Wavelength (nm)	Gain Type	Single Gain		Dual Gain			
					High Gain		Low Gain	
			Ltyp	SNR	Ltyp	SNR	Ltyp	SNR
M1	412	Dual	-	-	44.9	352	155	316
M2	445	Dual	-	-	40	380	146	409
M3	488	Dual	-	-	32	416	123	414
M4	555	Dual	-	-	21	362	90	315
M5	672	Dual	-	-	10	242	68	360
M6	746	Single	9.6	199	-	-	-	-
M7	865	Dual	-	-	6.4	215	33.4	340
M8	1240	Single	5.4	74	-	-	-	-
M9	1378	Single	6	83	-	-	-	-
M10	1610	Single	7.3	342	-	-	-	-
M11	2250	Single	1.0	90	-	-	-	-
I1	640	Single	22	119	-	-	-	-
I2	865	Single	25	150	-	-	-	-
I3	1610	Single	7.3	6	-	-	-	-

Notes:
The units of spectral radiance for Ltyp are watt m^{-2} sr^{-1} μm^{-1}.
The SNR column shows the minimum required (worst-case) SNR that applies at the end-of-scan. Elsewhere in the scan, aggregation will yield a larger SNR.
Within the same gain setting, at radiances larger than Ltyp, the SNR will be larger than what is specified in this table.

4.7.4.4 Emissive Band Dynamic Range

J1MSS-1614 VIIRS shall be able to measure scene temperatures for the single gain emissive bands between the minimum temperature (T_{min}) and the maximum temperature (T_{max}) and for the dual gain emissive bands between the High Gain Tmin and the Low Gain Tmax temperatures as given in Table 4.7.4.4-1.

Table 4.7.4.4-1 Dynamic range requirements for VIIRS Sensor emissive bands

Band	Center Wavelength (nm)	Gain Type	Single Gain		Dual Gain			
					High Gain		Low Gain	
			Tmin	Tmax	Tmin	Tmax	Tmin	Tmax
M12	3700	Single	230	353	-	-	-	-
M13	4050	Dual	-	-	230	343	343	634
M14	8550	Single	190	336	-	-	-	-
M15	10763	Single	190	343	-	-	-	-
M16	12013	Single	190	340	-	-	-	-
I4	3740	Single	210	353	-	-	-	-
I5	11450	Single	190	340	-	-	-	-

4.7.4.5 Emissive Band Sensitivity

J1MSS-1616 The VIIRS emissive bands shall meet the sensitivity requirements given in Table 4.7.4.5-1.

Table 4.7.4.5-1 Sensitivity requirements for VIIRS Sensor emissive bands

Band	Center Wavelength (nm)	Gain Type	Single Gain		Dual Gain			
.	.	.	.	.	High Gain		Low Gain	
	.	.	Ttyp	NEdT	Ttyp	NEdT	Ttyp	NEdT
M12	3700	Single	270	0.396	-	-	-	-
M13	4050	Dual	-	-	300	0.107	380	0.423
M14	8550	Single	270	0.091	-	-	-	-
M15	10763	Single	300	0.070	-	-	-	-
M16	12013	Single	300	0.072	-	-	-	-
I4	3740	Single	270	2.500	-	-	-	-
I5	11450	Single	210	1.500	-	-	-	-

4.7.4.6 Reflective Band Sensitivity

J1MSS-1618 At the low end of the VIIRS dynamic range, the DNB shall have a Signal-To-Noise Ratio (SNR) of at least 6 at scan angles less than 53 degrees off nadir and a SNR of at least 5 at scan angles greater than or equal to 53 degrees.

4.7.4.7 Calibration Uncertainty

J1MSS-1619 For the VIIRS Moderate Resolution reflective bands, the calibration uncertainty of the spectral reflectance shall be less than 2% for a uniform scene of typical spectral radiance (L_{typ}) as given in Table 4.7.4.3-1.

J1MSS-1620 For the VIIRS Imagery Resolution reflective bands, the calibration uncertainty of the spectral reflectance shall be less than 2% for a uniform scene of typical spectral reflectance (L_{typ}) as given in Table 4.7.4.3-1.

J1MSS-1621 For the VIIRS Moderate Resolution emissive bands, the absolute radiometric calibration uncertainty of spectral radiance shall be less than or equal to the percentages given in Table 4.7.4.7-1.

Table 4.7.4.7-1 Absolute radiometric calibration uncertainty of spectral radiance for VIIRS moderate resolution emissive bands

Band	λc (µm)	Scene Temperature				
		190K	230K	270K	310K	340K
M12	3.7	N/A	7.0%	0.7%	0.7%	0.7%
M13	4.05	N/A	5.7%	0.7%	0.7%	0.7%
M14	8.55	12.3%	2.4%	0.6%	0.4%	0.5%
M15	10.763	2.1%	0.6%	0.4%	0.4%	0.4%
M16	12.013	1.6%	0.6%	0.4%	0.4%	0.4%

J1MSS-1623 For the VIIRS Imagery Resolution emissive bands, the calibration uncertainty of the spectral radiance shall be as given in Table 4.7.4.7-2 for a uniform scene of brightness temperature of 267K.

Table 4.7.4.7-2 Radiometric calibration uncertainty for VIIRS imaging emissive bands

Band	Center Wavelength (nm)	Calibration Uncertainty
I4	3740	5.0%
I5	11450	2.5%

J1MSS-1625 For the VIIRS DNB, the radiometric calibration uncertainty of the effective, in-band radiance (W m^{-2} sr^{-1}) for a uniform scene shall be as follows: at Low Gain State, 5 percent at one-half of maximum radiance and 10 percent at the minimum radiance; for Medium Gain State, 10 percent at the maximum radiance and 30 percent at the minimum radiance; for High Gain State, 30 percent at the maximum radiance and 100 percent at the minimum radiance.

J1MSS-1626 Given the angular distances to a VIIRS bright target provided in Table 4.7.4.7-3, the amount of scattered radiance as a fraction of typical scene radiance shall be less than or equal to the values given in Table 4.7.4.7-3. The near field scatter from Lbrt target shall be characterized for all the bands in the table above, including those with requirements listed as N/A.

Table 4.7.4.7-3 VIIRS structured scene requirements

Band	Center Wavelength (nm)	Angular separation from bright target (milliradian)	Maximum allowed ratio of scattered radiance to typical radiance	L_{brt} (W/m2 sr μm) or T_{brt} (K)
M1	412	6	0.01	162
M2	445	6	0.01	180
M3	488	6	0.01	160
M4	555	6	0.01	160
M5	672	6	0.01	115
M6	746	12	0.02	147
M7	865	6	0.01	124
M8	1240	6	0.01	57
M9	1378	N/A	N/A	N/A
M10	1610	6	0.01	86.1
M11	2250	6	0.01	1.2
M12	3700	3	0.005	295
M13	4050	3	0.004	321
M14	8550	N/A	N/A	N/A
M15	10763	3	0.001	318
M16	12013	3	0.001	318
DNB	700	N/A	N/A	N/A
I1	640	6	0.01	115
I2	865	6	0.01	124
I3	1610	6	0.01	86.1
I4	3740	N/A	N/A	N/A
I5	11450	N/A	N/A	N/A

J1MSS-1628 For the VIIRS DNB, the radiance of the bright target shall be half the maximum radiance for the DNB low gain state, and the response of a detector 6 milliradians away shall be not more than the response of that detector to a radiance 0.002 times the bright target radiance.

J1MSS-1629 For all VIIRS bands except the DNB, when the steady-state radiance on the senders is changed from 0 to Lmax, the corresponding change in signal on the receiver shall be less than or equal to the larger of 0.002 Ltyp or 0.5 the measured NedL of the receiver when the sender radiance is 0.

J1MSS-1630 For the VIIRS DNB, when the steady-state radiance on the senders is changed from 0 to Lmax, the change in signal on the receiver shall be less than or equal to the larger of 0.002 Lin or 0.5 the measured NEdL of the receiver when the sender radiance is 0, where Lin is equal to 0.5 * Lmax.

4.7.4.8 Polarization Sensitivity

J1MSS-1631 The linear polarization sensitivity of the visible and near-infrared VIIRS bands shall be less than or equal to the values indicated in Table 4.7.4.8-1 for scan angles less than 45 degrees off Nadir.

Table 4.7.4.8-1 VIIRS polarization sensitivity requirements

Band	Center Wavelength (µm)	Maximum Polarization Sensitivity
M1	0.412	3%
M2	0.445	2.5%
M3	0.488	2.5%
M4	0.555	2.5%
I1	0.640	2.5%
M5	0.672	2.5%
M6	0.746	2.5%
I2	0.865	3%
M7	0.865	3%

4.7.4.9 Stray Light Rejection

J1MSS-1633 For the spacecraft in an operational, nadir-facing attitude, the VIIRS response to any stray light striking the sensor on any surface (except the entrance aperture and within the sensor FOV) from any angle shall be less than one percent of the response to the specified typical spectral radiances and temperatures.

J1MSS-1634 For the spacecraft in an operational, nadir-facing attitude, the VIIRS DNB response to any stray light striking the sensor on any surface except direct sunlight striking the primary mirror shall be less than 0.1 times the response to a radiance of Lmin.

4.7.4.10 Spectral Band Optical Requirements

J1MSS-1635 The system shall provide VIIRS Imagery Resolution, Moderate Resolution, and DNB spectral band measurements with the bandpass and wavelength characteristics as given in Table 4.7.4.10-1.

Table 4.7.4.10-1 VIIRS Spectral band optical requirements

Band	Center Wavelength (nm)	Tolerance on Center Wavelength (± nm)	Bandwidth (nm)	Tolerance on Bandwidth (± nm)	OOB Integration Limits (lower, upper) (nm)	Maximum Integrated OOB Response (%)	Characterization Uncertainty (nm)
M1	412	2	20	2	≥376, ≤444	1.0	1
M2	445	3	18	2	≥417, ≤473	1.0	1
M3	488	4	20	3	≥455, ≤521	0.7	1
M4	555	4	20	3	≥523, ≤589	0.7	1
M5	672	5	20	3	≥638, ≤706	0.7	1
M6	746	2	15	2	≥721, ≤771	0.8	1
M7	865	8	39	5	≥801, ≤929	0.7	1.3
M8	1240	5	20	4	≥1205, ≤1275	0.8	1
M9	1378	4	15	3	≥1351, ≤1405	1.0	1
M10	1610	14	60	9	≥1509, ≤1709	0.7	2.3
M11	2250	13	50	6	≥2167, ≤2333	1.0	1.9
M12	3700	32	180	20	≥3410, ≤3990	1.1	3.7
M13	4050	34	155	20	≥3790, ≤4310	1.3	3
M14	8550	70	300	40	≥8050, ≤9050	0.9	11
M15	10763	113	1000	100	≥9700, ≤11740	0.4	10.8
M16	12013	88	950	50	≥11060, ≤13050	0.4	6
DNB	700	14	400	20	≥470, ≤960	0.1	1
I1	640	6	80	6	≥565, ≤715	0.5	1
I2	865	8	39	5	≥802, ≤928	0.7	1.3
I3	1610	14	60	9	≥1509, ≤1709	0.7	2.3
I4	3740	40	380	30	≥3340, ≤4140	0.5	3.7
I5	11450	125	1900	100	≥9900, ≤12900	0.4	20

[1] The values given under "OOB Integration Limits" are the specified limits on the 1% relative response points.
[2] The OOB integration limits will be the 1% response points determined during sensor characterization.

4.7.4.11 Spatial Requirements

J1MSS-1637 VIIRS shall scan the Earth about the x-axis over an angle of ±56.063 degrees ±0.4% relative to the VIIRS +Z (nadir) axis.

J1MSS-1638 For the VIIRS Moderate Resolution bands and the DNB, the Dynamic Field Of View (DFOV) shall not differ from the value given in Table 4.7.4.11-1 by more than ± 5% in either dimension.

J1MSS-1639 For the VIIRS Imagery Resolution bands except the DNB, the DFOV shall not differ from the value in Table 4.7.4.11-1 by more than ± 5% in the track dimension and ± 10% in the scan dimension.

Table 4.7.4.11-1 VIIRS Dynamic Field Of View (DFOV) requirements

Band	DFOVTrack milliradians	DFOVScan milliradians
Moderate	0.891	0.393
DNB	0.424 - 0.891	0.163 - 0.891
Imagery	0.445	0.123

J1MSS-1641 VIIRS detector data shall be transmitted and aggregated as a function of scan angle as given in Table 4.7.4.11-2.

Table 4.7.4.11-2 VIIRS cross-track aggregation factors and detectors transmitted

Scan Angle (φ)	Number of values to aggregate in scan	Detectors Transmitted-Bands M1-M16	Detectors Transmitted-Bands I1-I5
$\|\varphi\| < 31.59°$	3	1-16	1-32
$31.59° < \|\varphi\| < 44.82°$	2	2-15	3-30
$\|\varphi\| > 44.82°$	1	3-14	5-28

4.7.4.12 Horizontal Sampling Interval

J1MSS-1643 For VIIRS single-gain Moderate Resolution bands, the horizontal sampling interval (HSI) in the scan and track directions shall be within 5% of the values listed in Table 4.7.4.12-1.

Table 4.7.4.12-1 VIIRS HSI requirements for single-gain moderate resolution bands

Scan angle (degrees relative to nadir)	HSI_{track} (km)	HSI_{scan} (km)
0	0.742	0.776
10	0.755	0.805
20	0.797	0.903
30	0.876	1.111
40	1.018	1.033
50	1.289	0.899
55.84	1.600	1.579

J1MSS-1645 For VIIRS dual-gain Moderate Resolution bands, the HSI in the scan and track directions shall be within 5% of the values listed in Table 4.7.4.12-2.

Table 4.7.4.12-2 VIIRS HSI requirements for dual-gain moderate resolution bands

Scan angle (degrees relative to nadir)	HSI_{track} (km)	HSI_{scan} (km)
0	0.742	0.259
10	0.755	0.268
20	0.797	0.301
30	0.876	0.370
40	1.018	0.516
50	1.289	0.899
55.84	1.600	1.579

J1MSS-1647 For VIIRS Imagery Resolution bands with the exception of the DNB, the HSI in the scan and track directions shall be within 5% of the values listed in Table 4.7.4.12-3.

Table 4.7.4.12-3 VIIRS HSI requirements for imaging bands

Scan angle (degrees relative to nadir)	HSI_{track} (km)	HSI_{scan} (km)
0	0.371	0.388
10	0.378	0.403
20	0.398	0.452
30	0.438	0.555
40	0.509	0.516
50	0.644	0.449
55.84	0.800	0.789

J1MSS-1649 For the DNB, the HSI shall be within 7% of 750 m in the scan direction and 5% of 760 m in the track direction throughout the scan.

4.7.4.13 Image Quality

J1MSS-1650 The Modulation Transfer Function (MTF) of the VIIRS Moderate Resolution bands shall equal or exceed the values given in Table 4.7.4.13-1 in the along-track and cross-track dimensions.

Table 4.7.4.13-1 VIIRS moderate resolution band MTF requirements

Fraction of Nyquist Frequency	Modulation Transfer Function
0.00	1.0
0.25	0.9
0.50	0.7
0.75	0.5
1.00	0.3

J1MSS-1652 The VIIRS Imagery Resolution bands, with the exception of the DNB, shall achieve a Horizontal Spatial Resolution (HSR) of less than or equal to 0.4 km at nadir and less than or equal to 0.8 km worst case throughout the scan.

J1MSS-1653 The DNB HSR shall not exceed 1.10 (TBR) times the as-delivered HSI in both the track and cross-track direction throughout the scan.

4.7.4.14 Geometric Performance Requirements

J1MSS-1655 At least 99.7% of corresponding VIIRS pixel samples shall be coregistered so that the product of (1-Δtrack) and (1-Δscan) is greater than or equal to 0.8 for any pair of bands within the following groups: (1) Imagery Resolution Bands I1, I2, I3, I4, and I5; (2) Moderate Resolution Bands M9, M12, M13, M14, M15, and M16; (3) Moderate Resolution Bands M5 and M7.

J1MSS-1656 At least 99.7% of corresponding VIIRS pixel samples of Moderate Resolution Bands M3, M5 and M11 shall be coregistered so that the product of (1-Δtrack) and (1-Δscan) shall be greater than or equal to 0.7.

J1MSS-1657 At least 99.7% of corresponding VIIRS pixel samples of all other pairs of Moderate Resolution Bands shall be coregistered so that the product of (1-Δtrack) and (1-Δscan) shall be at least 0.64.

J1MSS-1658 At least 99.7% of the VIIRS pixel samples for all Moderate Resolution Bands shall be coregistered with corresponding pixel samples of all Imagery Resolution bands so that the product of (1-Δtrack) and (1-Δscan) shall be at least 0.64.

4.7.4.15 Sensor Stability

J1MSS-1660 The system shall provide VIIRS measurements with a response to input radiance that does not vary by more than 0.1 % for the emissive bands and 0.3 % for the reflective bands during the time between successive acquisitions of on-orbit calibration data.

4.7.5 OMPS-N Performance Requirements

OMPS-Nadir (OMPS-N) provides calibrated measurements of Earth-atmosphere reflected solar radiance and solar irradiance at the top of the atmosphere necessary for deriving the distribution of atmospheric ozone, while operating from the nominal JPSS orbit. The OMPS-N is consisted of two instruments, a Nadir Total Column Mapper (NM) and a Nadir Profiler (NP), which provide global ozone observations at high vertical resolution (<3 km).

This section contains the OMPS instrument performance requirements in support of the OMPS sensor data record (SDR) performance requirements located in the JPSS Ground System Requirements Document (GSRD), Volume 2. Table 5.2 in this document provides the mapping of instrument performance requirements to the SDR performance requirements.

4.7.5.1 Calibration Accuracy

J1MSS-1560 OMPS shall provide an albedo calibration accuracy that is less than or equal to 2 % (λ-independent) and less than or equal to 0.5% (λ-dependent) at all measured wavelengths.

4.7.5.2 Radiometric Accuracy

J1MSS-1562 OMPS shall provide measurements with an absolute radiometric accuracy for all measured wavelengths that is less than or equal to the following values (measurement, absolute accuracy):
a. Earth scene radiance, 8 %.
b. Solar irradiance, 7 %.

4.7.5.3 Sensor Dynamic Range

J1MSS-1563 The OMPS nadir total column mapper shall provide measurements over a radiance range that has a minimum of 8.0E11 photons s^{-1} cm^{-2} sr^{-1} nm^{-1} at 308.5 nm and a maximum of 7.3E13 photons s^{-1} cm^{-2} sr^{-1} nm^{-1} at 377 nm.

J1MSS-1564 The OMPS nadir profile spectrometer shall produce RDRs for input radiance signals over a SZA range from 0 to 88 degrees and across the spectrometer wavelength range of 252 to 305.87 nm.

4.7.5.4 Sensor Sensitivity

J1MSS-1565 The OMPS nadir total column mapper shall provide measurements with a signal-to-noise ratio that is greater than or equal to 1.0E3.

J1MSS-1566 The OMPS nadir profiler shall provide measurements with a signal-to-noise ratio that is greater than or equal to the following values for the given reference wavelengths (reference wavelength, SNR): a. 252 nm, 35. b. 274 nm, 100. c. 283 nm, 200. d. 288 nm, 260. e. 292 nm, 400. f. 306 nm, 400.

4.7.5.5 Polarization Sensitivity

J1MSS-1567 OMPS shall provide measurements with linear polarization sensitivity that is less than or equal to 5 %.

4.7.5.6 Stray Light Rejection

J1MSS-1568 OMPS shall provide measurements with a ratio of the combined out-of-band and out-of-field signal to the expected signal in a band that is less than or equal to 2 % for all specified bands.

4.7.5.7 Interchannel Accuracy

J1MSS-1569 OMPS interchannel accuracy shall be less than or equal to 0.5% for the nadir sensor, except for the 252 nm channel.

J1MSS-2983 OMPS nadir profile signal correction accuracy shall be less than or equal to 2.5% for the 252 nm channel using the nominal measured instrument throughput and mean radiances and less than or equal to 0.5% for all other solar backscatter ultraviolet radiometer (SBUV) V6 ozone algorithm channels.

4.7.5.8 Minimum Number of Channels or Bands

J1MSS-1570 The OMPS nadir total column mapper shall provide measurements between 300 nm and 380 nm sampled at 0.42 +/-10 %.

J1MSS-1571 The OMPS nadir profiler shall provide measurements between 250 nm and 310 nm sampled at 0.42 +/-10 %.

4.7.5.9 Bandpass Limits

J1MSS-1572 OMPS shall provide measurements with bandpass limits for points on the spectral response function as follows (point on response function, bandpass (full width)):

a. 50 %, less than or equal to 1
b. 10 %, less than or equal to 1.9
c. 1 %, less than or equal to 3.1

4.7.5.10 Calibration Source

J1MSS-1573 OMPS shall provide on-orbit wavelength calibration to an accuracy that is less than or equal to 0.01 nm.

4.7.5.11 Horizontal Sampling Interval

J1MSS-1574 The OMPS nadir total column mapper shall provide measurements sampled along-track at a frequency and shape sufficient to achieve a horizontal cell size on the ground of less than or equal to 50 km.

J1MSS-1575 The OMPS nadir total column mapper shall provide measurements sampled over the cross-track field of view at an interval and shape sufficient to achieve a horizontal cell size on the ground of less than or equal to 50 km at Nadir.

J1MSS-1576 The OMPS nadir profiler shall provide measurements sampled at a frequency sufficient to achieve a horizontal cell size on the ground of 250 km.

J1MSS-1577 The OMPS nadir total column mapper shall provide measurements over a cross-track field of view that is greater than or equal to 110 degrees.

4.7.5.12 Calibration Source Monitoring

J1MSS-1579 OMPS shall measure the rate of efficiency change in the spectral reflectivity of the solar calibration diffuser, relative to a reference diffuser, to an accuracy of less than or equal to 0.1 %/year over the spectral range of the instruments.

J1MSS-1580 OMPS shall provide measurements with stability between successive on-orbit calibrations that is less than or equal to 1 %.

4.7.5.13 Instrument Data Compression

J1MSS-2524 The OMPS shall provide the capability for configurable lossless data compression internal to the OMPS instrument.

Rationale: Data compression furthers optimizes the capability to improve the spatial resolution performance.

4.7.6 CERES Performance Requirements

4.7.6.1 Radiance Measurements

J1MSS-1544 CERES shall make radiance measurements over the following range: Total channel 0 to 500 W/m^2-sr, Longwave channel 0 to 180 W/m^2-sr, Shortwave channel 0 to 425 W/m^2-sr.

Rationale: CERES Performance Specification, SY13-0001 Rev. G, FM6SR1:4.1.3.1 CERES FM6 shall make radiance measurements over the following range: Total channel 0 to 500 W/m2-sr, Longwave channel 0 to 180 W/m2-sr, Shortwave channel 0 to 425 W/m2-sr.

4.7.6.2 Radiometric Accuracy

J1MSS-1545 The CERES total channel absolute radiometric accuracy threshold requirement shall be the larger of 0.7W/m^2-sr or 0.7% (1 sigma).

Rationale: CERES Performance Specification, SY13-0001 Rev. G, FM6SR1:3.5 The CERES systematic error bounds specified above are for the nominal Earth-viewing radiances: Total channel; Total radiance = 115 W/m2-sr. For all Earth-viewing radiances, the scanner systematic error bound is, for the minimum requirement: Total channel, + the larger of 0.575 W/m2-sr or 0.5 percent of PT.

J1MSS-1546 The CERES shortwave channel absolute radiometric accuracy threshold requirement shall be the larger of 1.6W/m^2-sr or 1.7% (1 sigma).

Rationale: CERES Performance Specification, SY13-0001 Rev. G, FM6SR1:3.5 The CERES systematic error bounds specified above are for the nominal Earth-viewing radiances: Shortwave channel; SW radiance = 38 W/m2-sr. For all Earth-viewing radiances, the scanner systematic error bound is, for the minimum requirement: SW channel, + the larger of 0.75 W/m2-sr or 1.0 percent of PR.

J1MSS-1547 The CERES longwave channel absolute radiometric accuracy shall be the larger of 0.38W/m^2-sr or 0.5% (1 sigma).
Note: The threshold requirement for radiometric stability is included as part of the allocation for radiometric accuracy as follows: 0.33% for the longwave channel, 0.6% for the total channel, and 1.6% for the shortwave channel, to be met over a 5 year period.

Rationale: CERES Performance Specification, SY13-0001 Rev. G, FM6SR1:4.1.3.4 The CERES FM6 systematic error bounds are specified at a nominal longwave radiance level of 76 W/m2-sr. For radiance levels less than the nominal, the error shall be less than 0.38 W/m2-sr. For radiance levels greater than or equal to nominal, the error shall be less than 0.5% of PE.

4.7.6.3 Radiometric Precision

J1MSS-1548 The CERES total channel radiometric precision shall be (0.2 W/m^2-sr + 0.1% of measured radiance) (3 sigma).

Rationale: CERES Performance Specification, SY13-0001 Rev. G, FM6SR1:3.5 The instrument precision requirements are as follows: Total (Pt) - Range: 0 to 500 W/m^2-sr, Precision (3 sigma): +/-0.2 plus +/-0.1% of Pt.

J1MSS-1549 The CERES shortwave channel radiometric precision shall be (0.3 W/m^2-sr + 0.1% of measured radiance) (3 sigma).

Rationale: CERES Performance Specification, SY13-0001 Rev. G, FM6SR1:3.5 The instrument precision requirements are as follows: Shortwave (Pr) - Range: 0 to 425 W/m^2-sr, Precision (3 sigma): +/-0.3 plus +/-0.1% of Pr.

J1MSS-1550 The CERES longwave channel radiometric precision shall be (0.45 W/m^2-sr + 0.1% of measured radiance) (3 sigma).

Rationale: CERES Performance Specification, SY13-0001 Rev. G, FM6SR1:4.1.3.5 The CERES FM6 Longwave channel precision requirements are as follows: Longwave (PE), Range = 0 to 180W/m2-sr, Precision Requirements = ±0.45W/m2-sr plus ±0.1% of PE.

4.7.6.4 Channel Linearity

J1MSS-1551 The CERES total channel, shortwave channel, and longwave channel linearity shall be 1.5 W/m^2-sr, 1.28 W/m^2-sr, and 0.54 W/m^2-sr, respectively.

Rationale: CERES Performance Specification, SY13-0001 Rev. G, FM6SR1:3.3.4 Each channel of the CERES instrument shall be end-to-end linear within 0.3 percent of the channel's maximum value of radiance as stated in Section 4.1.3.1, Ranges. Such linearity shall be defined as the maximum difference in output between a calibration curve over the complete range and a straight line through the end points. Linearity shall apply to that portion of the instrument from the power absorbed by the detector to the output of that channel.

4.7.6.5 Spectral Range

J1MSS-1552 The CERES shortwave channel spectral range shall be from 0.3 to 5.0 µm.

Rationale: CERES Performance Specification, SY13-0001 Rev. G, FM6SR1:3.2.2.1 The shortwave channel shall have a bandpass from 0.3 to 5.0 µm, as defined below.

J1MSS-1553 The CERES longwave channel spectral range shall be from 5.0 to 50+ µm.

Rationale: CERES Performance Specification, SY13-0001 Rev. G, FM6SR1:4.1.2.3.1 The spectral response of the CERES FM6 longwave bandpass channel filter shall have a nominal bandpass of 5 to >50 µm as described in Section 4.1.2.3.2.

4.8 Ground Segment Requirements

The ground segment requirements for the JPSS-1 mission are found in the JPSS Ground System Requirements Document (GSRD) and the JPSS NESDIS ESPC Requirements Document (JERD).

The JPSS Ground System Requirements Document (GSRD) contains the Level 2 functional and performance requirements allocated to the JPSS Ground System. Since the JPSS Ground System supports multiple missions (e.g. SNPP, JPSS-1, JPSS-2, etc.), the approach taken is to provide mission effectivity for each requirement. The JPSS GSRD Volume I contains requirements grouped by each functional node of the JPSS Ground System, whereas the JPSS GSRD Volume 2 contains the performance requirements associated with the mission data products.

The JPSS ESPC Requirements Document (JERD) contains all Level 2 requirements for the NESDIS ESPC. These include functional and performance requirements allocated to the ESPC in support of the JPSS mission for ingest, processing, and distribution of real-time/near real-time environmental data and information. However, these requirements are not applicable to the legacy polar missions supported by the ESPC. All JPSS requirements for ESPC are maintained in a DOORS database which links the Level 2 requirements to the program Level 1s and provides consistency in management with other applicable JPSS ground segment development.

5 Requirements Verification

Appendix B presents the reference location of the requirements verification matrices for the JPSS-1 mission requirements. Identified within the matrix, is the verification method for each JPSS-1 mission requirement.

At the mission level, the verification process must consider the true "intent" of the requirement, budget, availability and schedule. It should be noted that some requirements have been allocated multiple verification methods. In some instances, the cost of performing a test may be prohibitive and alternative methods including analysis and demonstration may be implemented in order to reach the desired level of verification for a particular requirement.

Consideration would also be made to leverage the verification of Level 2 requirements against lower level requirement verification.

Four standard verification methods are utilized for JPSS-1. These methods and associated examples are included below.

Analysis

Analysis utilizes proven analytical techniques or mathematical modeling to assess the requirements verification. It is the interpretation, interpolation or extrapolation of analytical, empirical, or test data, to show theoretical compliance with a stated requirement. This method also applies to requirements to perform an analysis, or that specify how an analysis is to be performed.

Inspection

Inspection is used to verify compliance with requirements through visual examination. Inspection can include a visual check or review of project documentation such as vendor drawings, specifications, software versioning or code. Inspection also includes the visual examination of a physical attribute such as a dimension, weight or color. This includes:

A. Certain requirements verified by simple mechanical measurements that do not require the item to be powered or operated.

B. Hardware implementation constraints (such as required or prohibited materials or processes)

C. Software implementation constraints (such as coding standards) – verified by examination of source code.

D. Requirements for documentation and other requirements that are verified by the examination of documentation. The documentation must be configuration controlled at time of inspection.

Verification by Design is not an acceptable verification method. Generally requirements that contained verification by design should be defined as Inspection of configuration controlled design documentation, such as drawings or software.

Demonstration

Demonstration assesses compliance with requirements when either there is no quantitative measurement or detailed data gathered (example: item x is within reach of the operator), or when verification is accomplished by using a similar unit but not the actual system being verified (pyro units, strength assessment of metal to be used on end units, etc.).

Test

Test assesses compliance with functional or performance requirements by measuring output responses to a known stimuli (in a controlled condition that is real or simulated). These verifications require use of special test equipment and sensors to obtain quantitative data for analysis as well as qualitative data derived from displays and indicators inherent in the item(s) for monitor and control. The Test method includes examination of output data from the unit under test that has been collected and/or processed by special test equipment. This also applies to requirements to perform a test, or that specify how a test is to be performed. Whether the test assesses all combination or uses a subset to assess compliance is defined in the specific test plan.

The JPSS-1 mission verification and validation is defined in the JPSS Program Verification and Validation Plan, which documents the approach and structure for planning, execution, and management of the V&V activities. The JPSS Program Verification and Validation Plan provides the definitions of the verification methods, the roles and responsibilities of the V&V end-to-end, and the documentation hierarchy of the individual V&V plans. For the JPSS-1 mission, the space and ground segment requirements will be verified pre-launch. Following launch, the spacecraft and instruments will undergo testing to verify that they have survived the launch environment and are ready to proceed with the mission. Table 5-1 contains the complete set of JPSS-1 mission data products derived from the JPSS Level 1 Requirements Document (L1RD) and JPSS Level 1 Requirements Document Supplement (L1RDS). This table also includes mapping of the data products to the location of the actual performance requirements in the JPSS GSRD and JERD.

Table 5-1 JPSS-1 Mission Data Products

Raw Data Records (RDRs) & Application Packets (APs)	Data Record Latency (min)	JPSS Ground System Data Product Performance (470-00067-02)	NESDIS ESPC Data Product Performance (JPSS-REQ-1003)
ATMS RDR & AP	96	JPSS GSRD V2, Section 3.10.3	N/A
CERES RDR & AP	720	JPSS GSRD V2, Section 3.10.5	N/A
CrIS RDR & AP	96	JPSS GSRD V2, Section 3.10.2	N/A
OMPS RDR & AP	96	JPSS GSRD V2, Section 3.10.4	N/A
VIIRS RDR & AP	96	JPSS GSRD V2, Section 3.10.1	N/A
Sensor Data Records (SDRs) * = KPP	**Data Record Latency (min)**	**JPSS Ground System Data Product Performance (470-00067-02)**	**NESDIS ESPC Data Product Performance (JPSS-REQ-1003)**
ATMS SDR *	96	JPSS GSRD V2, Section 3.7.1 & Appendix B, Table B-1	N/A
CrIS SDR *	96	JPSS GSRD V2, Section 3.7.2 & Appendix B, Table B-2	N/A
OMPS SDRs (TC & NP)	96	JPSS GSRD V2, Section 3.7.3 & Appendix B, Table B-3 to B-6	N/A
VIIRS SDR	96	JPSS GSRD V2, Section 3.7.4 & Appendix B, Table B-7	N/A
Temperature Data Records (TDRs)	**Data Record Latency (min)**	**JPSS Ground System Data Product Performance (470-00067-02)**	**NESDIS ESPC Data Product Performance (JPSS-REQ-1003)**
ATMS TDR	96	JPSS GSRD V2, Section 3.7.1 & Appendix B, Table B-1	N/A
Environmental Data Records (EDRs) * = KPP	**Data Record Latency (min)**	**JPSS Ground System Data Product Performance (470-00067-02)**	**NESDIS ESPC Data Product Performance (JPSS-REQ-1003)**
Active Fires	96	JPSS GSRD V2, Table B-9	JERD Section 3.3 & Appendix A, Table 1
Aerosol Optical Thickness	96	JPSS GSRD V2, Table B-9	JERD Section 3.3 & Appendix A, Table 1
Aerosol Particle Size Parameter	96	JPSS GSRD V2, Table B-9	JERD Section 3.3 & Appendix A, Table 1
Albedo (Surface)	96	JPSS GSRD V2, Table B-9	JERD Section 3.3 & Appendix A, Table 1
Greenhouse Gas Products (CO, CO2, CH4)	25 hours		JERD Section 3.3 & Appendix A, Table 1

Cloud Base Height	96	JPSS GSRD V2, Table B-9	JERD Section 3.3 & Appendix A, Table 1
Cloud Coverage/Layers	96	JPSS GSRD V2, Table B-9	JERD Section 3.3 & Appendix A, Table 1
Cloud Effective Particle Size	96	JPSS GSRD V2, Table B-9	JERD Section 3.3 & Appendix A, Table 1
Cloud Liquid Water	103		JERD Section 3.3 & Appendix A, Table 1
Cloud Mask	96	JPSS GSRD V2, Table B-9	JERD Section 3.3 & Appendix A, Table 1
Cloud Optical Thickness	96	JPSS GSRD V2, Table B-9	JERD Section 3.3 & Appendix A, Table 1
Cloud Top Height	96	JPSS GSRD V2, Table B-9	JERD Section 3.3 & Appendix A, Table 1
Cloud Top Pressure	96	JPSS GSRD V2, Table B-9	JERD Section 3.3 & Appendix A, Table 1
Cloud Top Temperature	96	JPSS GSRD V2, Table B-9	JERD Section 3.3 & Appendix A, Table 1
Green Vegetation Fraction	24 hours		JERD Section 3.3 & Appendix A, Table 1
Ice Surface Temperature	96	JPSS GSRD V2, Table B-9	JERD Section 3.3 & Appendix A, Table 1
Imagery *	103 (JPSS GS) / 130 (ESPC)	JPSS GSRD V2, Table B-9	JERD Section 3.3 & Appendix A, Table 1
Land Surface Emissivity	103		JERD Section 3.3 & Appendix A, Table 1
Land Surface Temperature	103	JPSS GSRD V2, Table B-9	JERD Section 3.3 & Appendix A, Table 1
Moisture Profile	103		JERD Section 3.3 & Appendix A, Table 1
Ocean Color/Chlorophyll	120 (JPSS GS & ESPC)	JPSS GSRD V2, Table B-9	JERD Section 3.3 & Appendix A, Table 1
Outgoing Long Wave Radiation	720		JERD Section 3.3 & Appendix A, Table 1
Ozone Nadir Profile	96	JPSS GSRD V2, Table B-9	JERD Section 3.3 & Appendix A, Table 1
Ozone Total Column	96	JPSS GSRD V2, Table B-9	JERD Section 3.3 & Appendix A, Table 1
Polar Winds	204 (JPSS GS & ESPC)	JPSS GSRD V2, Table B-9	JERD Section 3.3 & Appendix A, Table 1
Quarterly Surface Type	96	JPSS GSRD V2, Table B-9	JERD Section 3.3 & Appendix A, Table 1
Rainfall Rate	103		JERD Section 3.3 & Appendix A, Table 1

Sea Ice Characterization	96	JPSS GSRD V2, Table B-9	JERD Section 3.3 & Appendix A, Table 1
Sea Ice Concentration	103		JERD Section 3.3 & Appendix A, Table 1
Sea Surface Temperature	120 (JPSS GS & ESPC)	JPSS GSRD V2, Table B-9	JERD Section 3.3 & Appendix A, Table 1
Snow Cover/Depth	103	JPSS GSRD V2, Table B-9	JERD Section 3.3 & Appendix A, Table 1
Snow Water Equivalent	103		JERD Section 3.3 & Appendix A, Table 1
Surface Type	96	JPSS GSRD V2, Table B-9	JERD Section 3.3 & Appendix A, Table 1
Suspended Matter	96	JPSS GSRD V2, Table B-9	JERD Section 3.3 & Appendix A, Table 1
Temperature Profile	103		JERD Section 3.3 & Appendix A, Table 1
Total Precipitable Water	103		JERD Section 3.3 & Appendix A, Table 1
Vegetation Indices	96	JPSS GSRD V2, Table B-9	JERD Section 3.3 & Appendix A, Table 1
Vegetation Health Index Suite	1 week + 6 hours		JERD Section 3.3 & Appendix A, Table 1

Table 5-2 captures the mapping between the individual mission instrument performance requirements in Section 4.7 with the specific sensor data records (SDRs). SDRs associated with the mission success criteria (e.g. KPPs) are identified in the table, as well as the reference to the appropriate section of the JPSS GSRD V2 that contains the specific sensor data record performance requirements.

Table 5-2 JPSS-1 Mission Instrument & SDR Performance Requirements

Mission Instrument	Performance Requirements	Sensor Data Record (SDR) * = KPP	Performance Requirements (470-00067-02)
ATMS	Section 4.7.2	ATMS SDR *	JPSS GSRD V2, Section 3.7.1 & Appendix B, Table B-1
CrIS	Section 4.7.3	CrIS SDR *	JPSS GSRD V2, Section 3.7.2 & Appendix B, Table B-2
OMPS	Section 4.7.5	OMPS SDRs (TC & NP)	JPSS GSRD V2, Section 3.7.3 & Appendix B, Table B-3 to B-6
VIIRS	Section 4.7.4	VIIRS SDR	JPSS GSRD V2, Section 3.7.4 & Appendix B, Table B-7

Appendix A: JPSS-1 Level 1 Requirements Traceability Matrix

JPSS Program Systems Engineering (PSE) maintains the mission requirements traceability matrices external to this document, in the following JPSS eRooms location:

Website:

https://jpss-erooms.ndc.nasa.gov/eRoom/JPSSProgram/JPSSProgramSystemEngineering/0_3b1c9

eRoom Path:

My eRooms > JPSS Program System Engineering > System Verification > JPSS > Mission Verification

Appendix B: JPSS-1 Level 2 Requirements Verification Matrix

JPSS Program Systems Engineering (PSE) maintains the mission requirements verification matrices external to this document, in the following JPSS eRooms location:

Website:

https://jpss-erooms.ndc.nasa.gov/eRoom/JPSSProgram/JPSSProgramSystemEngineering/0_3b1c9

eRoom Path:

My eRooms > JPSS Program System Engineering > System Verification > JPSS > Mission Verification

Appendix C: JPSS-1 Mission Technical Performance Metrics

The JPSS-1 mission has identified the following group of technical performance metrics (TPMs), based on the applicable mission performance requirements provided in the JPSS Level 1 requirements which serve to meet the mission objectives and mission success criteria identified in Section 3.1 and 3.2 of this document. These mission TPMs are being managed and tracked at the JPSS program level since they flow from JPSS Level 1 requirements and may involve performance allocation to the JPSS flight and/or JPSS ground systems through requirement decomposition. The JPSS-1 mission TPM's are:

- Mission Operational Availability
- Mission Data Latency
- Mission Data Availability

Mission Operational Availability

The operational availability (Ao) requirement for the JPSS-1 mission from the JPSS Level 1 requirements provides the allocation (over any 30 day period) that the mission elements necessary to meet the minimum mission success criteria in Section 3.2 are operational. Meeting the minimum mission success criteria requires that the associated instruments are collecting sensor data, transmitting and storing this sensor data on the spacecraft for eventual downlink to the ground sites and subsequent transmission to the ground system elements necessary to generate and distribute the associated data products. For the JPSS-1 mission, the related requirement (JPSS L1RD 6.1.1.3) states that, "Excluding on-orbit failures, JPSS-1 shall maintain an Operational Availability of greater than or equal to 98% over any 30 day period for the mission lifetime. The remaining 2% (or 14.4 hours over any 30 day period) is presently allocated as separate requirements in the JPSS L1RDS providing operational outage allocations for the JPSS ground system, NESDIS ESPC and the satellite for each mission. The suballocation is done conservatively and assumes no correlation between the satellite and ground segment elements. This results in a summation of the suballocations, as opposed to using other techniques (e.g. RSS), to arrive at the mission-level allocation.

The mission-level Ao requirement intentionally excludes on-orbit failures, which are defined as the unplanned permanent or temporary loss of a function provided by the spacecraft and/or instruments necessary to meet the minimum mission success criteria (e.g. functional loss of an entire ATMS instrument or select VIIRS instrument channels). On-orbit failures include recoverable faults of the spacecraft and/or instruments, as it is understood that the duration of the total outage associated with these events is unpredictable and determined by the type of fault and the need to perform sufficient analysis and diagnosis with various support teams (e.g. mission operations, spacecraft and instrument vendors, etc.) to understand what happened, why it happened and determine when it is safe to recover the spacecraft and/or instrument to nominal operations.

Though the mission-level Ao requirements in the JPSS Level 1 requirements specify performance over the mission lifetime, it is understood that the satellite (spacecraft &

instruments) is not expected to be able to provide sensor data that meets the minimum mission success criteria until the spacecraft and instruments complete the initial post-launch on-orbit functional checkout and calibration activities necessary to declare the satellite as operational (nominally planned for launch + 90 days).

Mission operational availability is determined by the operational status of the necessary space and ground segments elements, using the following mission-level functional attributes:

- Space Segment
  - Spacecraft is nadir-pointing, collecting sensor data from the instruments and storing sensor data on-board
  - ATMS, CrIS and VIIRS instruments are collecting environmental data and transmitting the sensor data to the spacecraft necessary for the ground segment to produce the data records associated with the minimum mission success criteria (Key Performance Parameters - KPPs)
- Ground Segment
  - Ground system is downlinking the on-board stored sensor data, and transmitting this data for data product processing within the constraints of data latency and data availability

Though the JPSS missions are expected to operate 24 hours per day, 365 days per year for the mission lifetime, operational missions experience outages (both planned and unplanned) that need to be accounted for and factored into the operational availability analysis.

Operational availability modeling accounts for the JPSS ground system design, including functional redundancy where applicable, as well as operational outages. Operational outages are events which result in the inability of the mission system to generate the environmental data products associated with the mission success criteria. Examples include orbit maintenance, collision avoidance and sensor calibration slews, which may result in movement of the instrument sensor fields of view away from Nadir viewing and therefore impact the ability to generate environmental data products to the necessary performance requirements. In order for the satellite to be operationally available, the instruments must be powered and configured to capture environmental data necessary for data product generation and the spacecraft must be oriented such that the instruments are pointed at the intended target (e.g. Nadir pointing) and configured for the on-board collection and storage of the same environmental data. The flight and ground system designs take into account the desire to optimize the operational availability of the mission system through the redundancy and backup systems provided.

Mission Data Latency

The purpose of this technical performance metric and related requirement is to ensure that the environmental sensor data stored on-board each of the JPSS missions is downlinked to the ground system for data product generation and available for distribution to the operational users in a timely fashion. The JPSS Level 1 requirements provides the definition of Data Latency as the period from the time of observation of all requisite data by the satellite until the EDR or data product produced from those data is available to the user at the JPSS/User Interface. To this extent, the JPSS Level 1 requirements provides a mission data latency requirement for the JPSS-1 mission (JPSS L1RD 6.2.6) that states, “On a 30-day basis, data latency requirements, as specified in Appendix A, shall be met at least 95% of the time for data collected by the primary operational sensors on the JPSS [Priority 1], Free Flyer [Priority 2], and GCOM [Priority 2] satellites.” Table 2-2 of the JPSS L1RDS provides the specific data latency values for each of the mission data products for the ground elements (e.g. JPSS ground system, NESDIS ESPC).

The JPSS Ground Project is responsible for the coordination of data latency modeling, using representations of the associated flight and ground system elements. The JPSS ground system concept of operations for stored mission data (SMD) downlink has been designed specifically to optimize the data latency performance, in that at each pass it provides 1) the most recent half orbit of SMD, 2) provides the previous half orbit of SMD that had been downlinked once during the previous pass, 3) provides the SMD captured during the current pass at the end of the scheduled contact and 4) provides the NASA-SN (TDRSS) to supplement the polar ground sites for SMD downlink.

Mission Data Availability

The purpose of this technical performance metric and related requirement is to ensure that close to all of the environmental sensor data collected and stored on-board the JPSS missions is downlinked and delivered to the JPSS ground system for data product processing and archive. The JPSS Level 1 requirements provides the definition of Data Availability as the percentage of data collected by operational sensors on each JPSS satellite that is delivered to the JPSS data processing system. To this extent, the JPSS Level 1 requirements provides a mission data availability requirement for the JPSS-1 mission (JPSS L1RD 6.1.1.11) that states, “On a 30-day basis, at least 99% of the data collected by operational sensors on the JPSS-1 satellite shall be delivered to the data processing system.”

Data availability pertains to stored mission data that has already been captured on the satellite, such that the performance suballocations are provided solely to the ground system, which has the responsibility to downlink the SMD and provide it to the data processing system. The JPSS ground system concept of operations for stored mission data (SMD) downlink has been designed specifically to optimize the mission data availability performance, in that 1) an entire orbit of SMD is downlinked at each polar site so that they can back up each other, 2) data lost due to weather or station/communication outages at one site can be recovered a half-orbit later at the other site without sending new spacecraft commands, 3) recovery processing impact is minimized, 4) ad hoc retransmission can be done through real-time commands, but should be rarely needed and 5) autonomous ground system operations are provided for managing the SMD contacts.

Mission TPM Concepts

In order to understand better the definitions and relationships between the mission TPMs, the figures on the next pages present the TPMs expressed as a set of common functional performance attributes defined at the ‘mission-level.’ The attributes that are considered part of the TPM are highlighted, and those that are not are shaded-out. All of the mission TPMs are initially assessed and evaluated using modeling-based techniques during the mission design phase. Following the satellite launch and operational checkout, the primary mission TPMs that are being monitored and evaluated on a 30-day basis are the operational availability, data availability and data latency. Figure 6-1 illustrates the mission TPM expressed as mission system functional chains. Each TPM is described using a set of functional attributes for the space and ground segment elements, which together form the functional chain. For example, in order to meet the operational availability TPM, the instruments must be collecting sensor data while the spacecraft is nadir-pointing, and the instruments must be transmitting the sensor data to the spacecraft when the spacecraft is capable of storing the sensor data.

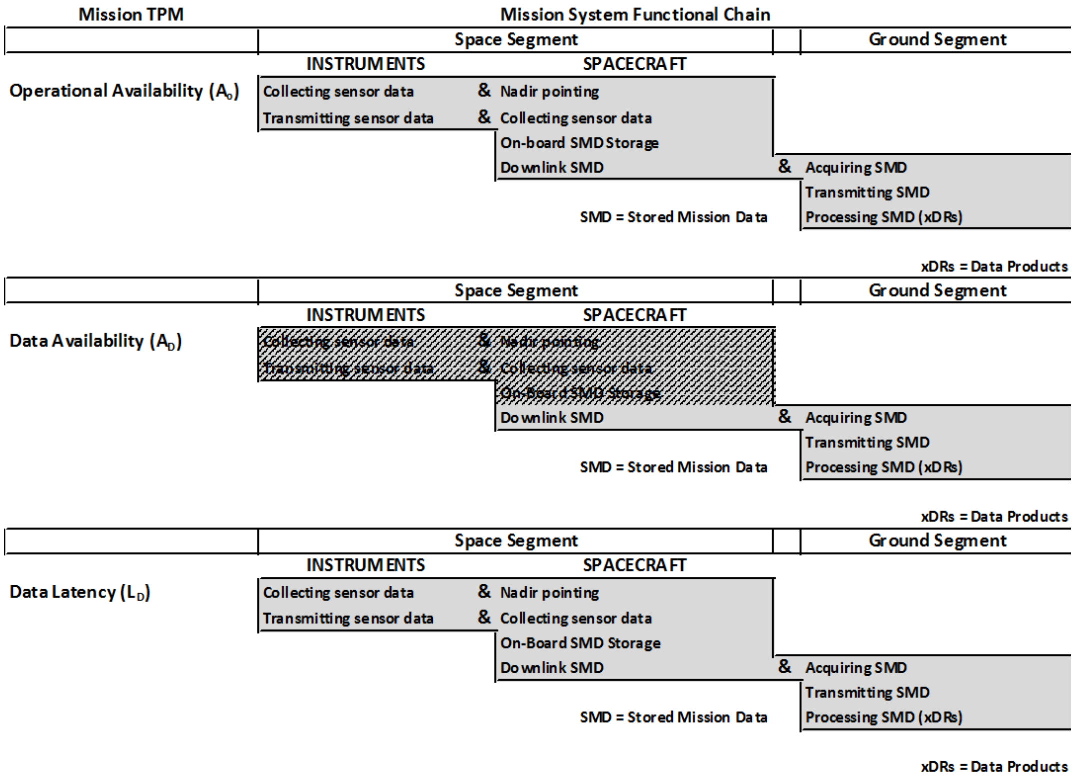

Figure 8-1 Mission TPM Attributes and Relationships

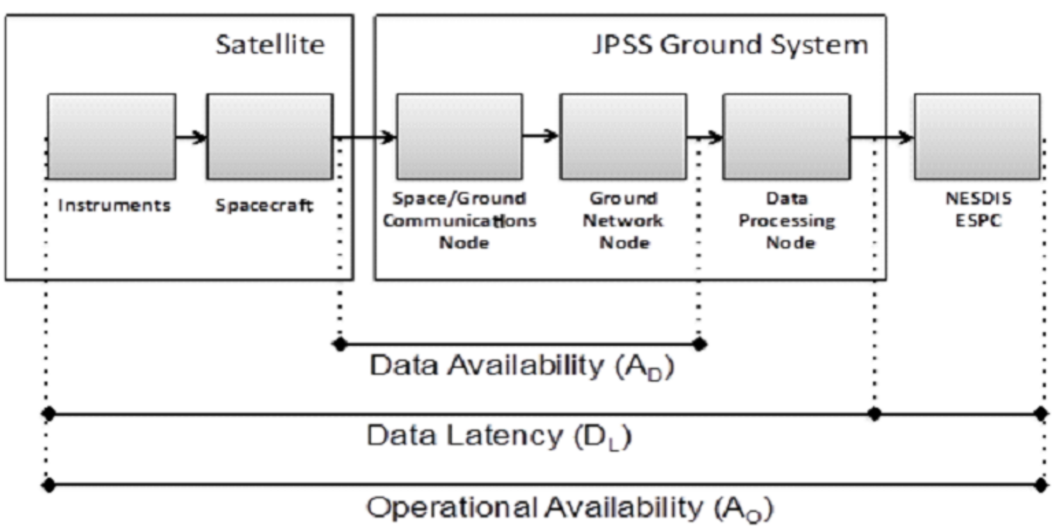

Figure 8-2 Mission TPMs Based on Mission Architecture

In the process of mission TPM monitoring and evaluation, it is necessary to classify the relationship between potential fault/failure events and the associated TPMs that are affected. Certain faults/failures may impact more than one mission TPM, such that it is necessary to properly assess the impacts in order to avoid over-penalization of mission TPM performance. Figure 6-2 provides the mission TPMs based on the mission architecture, such that the relationships between the TPMs can be observed as a function of the necessary mission elements. Figure 6-3 provides a list of possible mission-level events and identifies the mission TPMs affected. For example, a missed ground station contact pass (weather-related) is counted against the data latency TPM, and not the operational availability TPM.

Events	Satellite Reliability	Ao	Data Availability	Data Latency	Note
On-orbit anomalies, failures, and recoveries	X				No mission data generated, or mission data generated but not stored in SSR
Ground System anomalies, failures, and recoveries		X		X	Only when it's affecting delivery of KPPs
S/C maneuvers, instrument calibrations, table loads		X			No observations or no product generated
S/C maneuvers, instrument calibrations and other onboard activities that result in products not meeting specified quality		X			Products are flagged for those onboard activities
Missed pass (weather-related)				X	Data recovered later
Missed pass (system-related)		X		X	Data recovered later
Missed pass (operator-related)		not modeled		X	Data recovered later
Network failure		X		X	Data recovered later
Data loss due to Ground System failure		X	X		Extremely unlikely. Latency is not accounted for data never delivered

Figure 8-3 Fault/Failure Event Impacts on Mission TPMs

Appendix D: Abbreviations & Acronyms

Reference the JPSS Program Lexicon (470-00041) document for definitions

AES	Advanced Encryption Standard
AFWA	Air Force Weather Agency
AMMC	Alternate Mission Management Center
Ad	Data Availability
Ao	Operational Availability
APID	Application Process ID
ATMS	Advanced Technology Microwave Sounder
Cal/Val	Calibration/Validation
CCB	Configuration Control Board
CCSDS	Consultative Committee for Space Data Systems
CDR	Climate Data Record
CERES	Clouds and the Earth's Radiant Energy System
CLASS	Comprehensive Large Array-Data Stewardship System
CrIS	Cross-Track Infrared Sounder
DFOV	Dynamic Field Of View
DMSP	Defense Meteorological Satellite Program
DNB	Day-Night Band
DoD	Department of Defense
DOORS	Dynamic Object-Oriented Requirements System
DWSS	Defense Weather Satellite System
EDR	Environmental Data Record
EOS	NASA Earth Observing System
ESPC	NESDIS Environmental Satellite Processing Center
EUMETSAT	European Organization for the Exploitation of Meteorological Satellites
FDF	GSFC Flight Dynamics Facility
FNMOC	Fleet Numerical Meteorology and Oceanography Center
FT	Field Terminal
FVTS	Flight Vehicle Test Simulators
FY	Fiscal Year
GCOM	Global Change Observation Mission
GN	NASA Ground Network
GFE	Government Furnished Equipment
GPD	GSFC Program Directive
GPS	Global Positioning System
GS	Ground System
GSE	Ground Support Equipment
GSFC	Goddard Space Flight Center
HRD	High Rate Data
HSR	Horizontal Spatial Resolution
ICD	Interface Control Document
IDPS	Interface Data Processing Segment
IP	Intermediate Product
IRD	Interface Requirements Document
ITU	International Telecommunications Union
JPSS	Joint Polar Satellite System
Km	Kilometer
KPP	Key Performance Parameter
Lbrt	Radiance of bright target
LEO	Low-Earth Orbit

LS	Launch Segment
LSF	Line Spread Function
LTAN	Local Time Ascending Node
LV	Launch Vehicle
LWIR	Long Wave Infrared
MMC	Mission Management Center
Metop	EUMETSAT Meteorological Operational satellites
MIS	Management Information System
MSS	Mission Systems Specification
MWIR	Medium Wave Infrared
NASA	National Aeronautics and Space Administration
NAVOCEANO	Naval Oceanographic Office (NAVOCEANO)
NEdN	Noise Equivalent Radiance Difference
NEdT	Noise Equivalent Delta Temperature
NESDIS	National Environmental Satellite Data & Information Service
NIST	National Institute of Standards and Technology
NJO	NOAA JPSS Office
NOAA	National Oceanic and Atmospheric Administration
NOSC	NOAA Observing Systems Council
NPD	NASA Policy Directive
NPOESS	National Polar-orbiting Operational Environmental Satellite System
NPP	NPOESS Preparatory Project
NPR	NASA Procedural Requirement
NSA	National Security Agency
NSOF	NOAA Satellite Operations Facility
NTIA	National Telecommunications & Information Administration
NWS	National Weather Service
OMPS	Ozone Mapping Profiler Suite
POES	NOAA Polar-orbiting Operational Environmental Satellites
Ps	Probability Of Success
RDR	Raw Data Record
RF	Radio Frequency
SDR	Sensor Data Record
SDS	Science Data Segment/System
SMD	Stored Mission Data
SN	NASA Space Network (TDRS)
SNPP	Suomi National Polar-orbiting Partnership
SS	Space Segment
SSR	Solid State Recorder
SWIR	Short Wave Infrared
T&C	Telemetry and Commanding
TBD	To Be Determined
TBR	To Be Refined/Reviewed/Resolved
TDR	Temperature Data Record
TDRSS	Tracking and Data Relay Satellite System
UTC	Universal Time Coordinated
VIIRS	Visible Infrared Imaging Radiometer Suite
WAN	Wide Area Network
xDR	Data Record (EDR, RDR, SDR, TDR)