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Joint Polar Satellite System (JPSS) Level 1 Requirements Document Supplement (L1RDS) - Final

Goddard Space Flight Center
Greenbelt, Maryland

Check the JPSS MIS Server at https://jpssmis.gsfc.nasa.gov/frontmenu_dsp.cfm to verify that this is the correct version prior to use.

Review/Signature/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:

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Change History Log

Revision	Effective Date	Description of Changes (Reference the CCR & CCB/ERB Approval Date)
v 1.0	7/9/10	Initial Draft Release
v 1.1	8/20/10	Highlighted areas of duplication in L1RD; Moved tables to match L1RD Categories; Added "placeholder " tables for AMSR-2 in Sect. 5.1; Added text and updated MIS tables to Section 6.1; Deleted Section 7
v 1.2	9/16	Reformatted TOC, captions and Table references using a new section organization that aligns EDR category with Section number
v 1.2.1 Baseline (Archived)	12/1/10	Incorporated text and table changes requested at 9/14/10 JPSS RWG. Accepted all red-lined changes in v1.2. Added General Information and Notes front matter. Deleted blue highlighted material which duplicates L1RD information. Revised Active Fires EDR. Revised MIS tables (4.1.x) to show legacy SSMIS as threshold and MIS projected as Objective. Deleted LaRC processing from Earth Radiation tables (2.1.x). Made administrative changes to tables. Updated Acronym list. **This will be the baseline version.**
V1.3	2/11/11	"Accepted" all red-lines from v 1.2.1; Deleted ITAR constraints; Updated Scope (Swath Width, IPs, and Enhanced Performance). Reformatted Tables to show Swath Width and other changes. Updated Ozone (1.2.3, 1.2.4 & 2.3.1); Veg Index 1.5.2; Active Fires (1.5.5); OC/C (1.6.4); AMSR-2 (3.1); SEM-N (4.2); Glossary. Added Appendix A, LRD (5), and P3I (6).
V1.3A	3/11/11	"Accepted" all text red-lines from v1.3; Updated Low Rate Data and P3I; Incorporated DP&A SME comments; Revised "Refresh" to hours.
V1.4	4/1/11	**Released for SME Review**. Updated TSIS (2.2); Added new CERES sections 2.1.1 through 2.1.4; corrected LRD aperture size; Updated Net Heat Flux Table 1.6.2
V1.4.1	6/24/11	Incorporated all resolved CRM comments.
V1.4.2	7/29/11	Incorporated changes resulting from 7/21 – 7/22/11 management review.
V1.4.3	9/30/11	Changed CERES Sect. 4.1 to ERB; Deleted CERES-C Sect. 4.4; Updated LST Accuracy & Precision in Table 3.4.1; Inserted new Sections 2.3, 2.4 & 2.5 & modified App. A to incorporate Stability requirements; Renumbered all sections and requirements. Updated LTS material in all tables.

Revision	Effective Date	Description of Changes (Reference the CCR & CCB/ERB Approval Date)
V1.4.4	12/9/11	Added new Section 2; Renumbered remaining sections; Incorporated comments from post v1.4.3 Supplement CRM; Moved L1RD Tables 5,6,7 & 8 into Section 4.1 of Supplement and incorporated comments from post L1RD v4.7 CRM; General clean-up.
V1.5	12/16/11	LORWG review version. Populated sections 2.2 – 2.7; Minor cleanup.
V1.5.1	4/20/12	Incorporated LORWG Review Comments and comments from PSE staff; Added S-NPP Exclusion Appendix D; Removed DWSS MIS & SEM-N requirements; Removed historical footnotes from tables; Documented all changes except Minor administrative cleanup in CRM version 1.0.
V1.5.1A	5/4/12	Fixed exponents, references, and numbering in Tables 4.1.4, 4.2.1, 4.2.2, 4.2.3, 4.5.4.2, 4.6.2, 4.6.4, 5.1.1, 5.1.5, 5.3.1, 6.1.6, 6.1.7 & 9.2.3.
V2.0	9/19/12	Major changes to align with new L1RD. See the L1RDS 2.0 CRM for details.
V2.1	10/17/12	Updated to capture changes resulting from formal review of L1RDS v2.0 and flow down of changes from L1RD v1.1. See JPSS L1RDS-F v2.0 Master CRM for details.
V2.2	10/26/12	Accepted all changes in red-lined versions 2.1 and reorganized entire document. No content changes.
V2.3	11/2/12	Updated to capture changes resulting from internal review. Added Section 4 SDR tables. See JPSS L1RDS-F v2.2 Master CRM for details.
V2.4	12/21/12	Incorporated 350+ changes resulting from formal LORWG review of v2.3. See JPSS L1RDS-F v2.3 to v2.4 Master CRM for details.
V2.5	1/24/13	Incorporated changes resulting from formal NOSC review of v2.4. See JPSS L1RDS-F v2.4 to v2.5 CRM-NOSC Comments 22 Jan 2013 SE for details.
V2.6	1/28/13	Incorporated changes resulting from NOSC review of v2.5. See JPSS L1RDS-F v2.5 to v2.6 CRM 28 Jan 2013 for details.
V2.7	1/30/13	Incorporated changes resulting from NJO PCB review of v2.6. See JPSS L1RDS-F v2.5 to v2.6 to v2.7 CRM 30 Jan 2013 for details.
V2.8	5/24/13	Incorporated minor changes resulting from PSE review of v2.7 and changes directed by the NJO in response to the 2014 Presidents Budget. See JPSS L1RDS-F v2.7 to v2.8 CRM, Rev D, 22 May2013 for details.
V2.9	6/27/13	Changed CERES-FO to RBI; Changed NOSC Chair to Devany.

Revision	Effective Date	**Description of Changes** (Reference the CCR & CCB/ERB Approval Date)
V2.10	6/25/14	Incorporated NJO PCB approved CCRs: NJO-2013-039, -040, -042, -043, -044, -045, -046B, -047A, -048B, -049A, -050A, -051A, -052A, -055E, -058, -059, -060B, -061, -063, -065C, -066B, -067A, -069, -070; NJO-2014-003A, -004C.1, -008A, -022C, and -025.
V2.11	2/07/19	Incorporated NJO PCB Approved CCRs: NJO-2013-015, -041A, -053D.1, NJO-2014-011H, -016D, -017, -018, -019, -020A.2, -021A, -027, -035, -042A, NJO-2015-002, -015C, -027B, -033, -034B, NJO-2016-006, -015C, -018, -021A, -027, -030A, NJO-2017-005, -007, -015, -016, and -017.

Deviations/Waivers Record

Item No.	Deviation/Waiver	Requirement Impacted?	Waiver Approved	Effectivity
1	Extend the time allocated to ESPC for reformatting the VIIRS SDR into BUFR, currently specified in L1RDS-3127 (L1RDS Table 2.2) and JERD-259 (Appendix A) as 7 minutes, to 100 minutes. The proposed time extension will allow the NDE 2.0 system to reformat the VIIRS SDR with its current planned system hardware. Per NWS, the waiver for the VIIRS BUFR SDR is valid for 4 years, or until August 2018. NJO-2014-011, Rev H - VIIRS SDR Reform	L1RDS-3127	NOSC Concurred with Deviation on 12/04/14	Per NWS, the Deviation for the VIIRS BUFR SDR is valid for 4 years, or until August 2018.
2	For all JPSS-1 Priority 3 and 4 data products and the Ocean Color EDR, waive the science performance requirements for IDPS B2.0 and NDE 2.0 subject to pre-operational verification to the algorithm/data product performance represented by the documented S-NPP data product validation maturity as of the date of the NOAA JPSS Program Office directive. Links to the performance artifacts describing the documented validation maturity for each applicable data product are included in the accompanying DD Form 1694 and Tab A. NJO-2014-042 Rev A, Pri 3-4 Data Produ	L1RDS-149, L1RDS-183, L1RDS-123, L1RDS-2554, L1RDS-129, L1RDS- 2560, L1RDS-632, L1RDS-638, L1RDS- 628, L1RDS-2445, L1RDS-167, L1RDS- 167, L1RDS-2451, L1RDS-155, L1RDS- 376, L1RDS-231, L1RDS-193, L1RDS- 219, L1RDS-2567, L1RDS-2457, L1RDS-225, L1RDS- 199, L1RDS-206, L1RDS-213, L1RDS- 239, L1RDS-328, L1RDS-273, L1RDS- 246	NOSC Concurred with Waiver on 6/10/15	The period of requirements relief will be three years from the date of IDPS B2.0 and NDE 2.0 transition to operations (TTO).

Item No.	Deviation/Waiver	Requirement Impacted?	Waiver Approved	Effectivity
	NJO-2014-042, DD1694 Tab A - IDPS	L1RDS-149, L1RDS-183, L1RDS-123, L1RDS-2554, L1RDS-129, L1RDS-2560, L1RDS-632, L1RDS-638, L1RDS-628, L1RDS-2445, L1RDS-167, L1RDS-2451, L1RDS-155, L1RDS-376, L1RDS-231, L1RDS-193, L1RDS-219, L1RDS-2567, L1RDS-2457, L1RDS-225, L1RDS-199, L1RDS-206, L1RDS-213, L1RDS-239, L1RDS-328, L1RDS-273, L1RDS-246, L1RDS-2487, L1RDS-2568, L1RDS-259, L1RDS-2493, L1RDS-415, L1RDS-267, L1RDS-254, L1RDS-2570, L1RDS-291, L1RDS-300, L1RDS-279, and L1RDS-2571		
3	For the JPSS-1 mission only, accept the following waive-to values for the VIIRS SDR against the following 13 of the 236 attribute values associated with requirement L1RDS-2290 and Table 4.6 in the L1RD Supplement: -- Band M11 Absolute Radiometric Calibration Uncertainty – 2.3% (vs spec of 2%) -- Dynamic Range Lmax: Band M5LG – 644.5 (vs spec of 651), Band M8 – 107.2 (vs spec of 164.9), Band M9 – 73.2 (vs spec of 77.1), Band M10 – 68.4 (vs spec of 71.2), Band M11 – 31.5 (vs spec of 31.8), Band I1 – 682.1 (vs spec of 718), Band I3 – 60.9 (vs spec of 72.5), DNB – 194 (vs spec of 200)	L1RDS-2290 and Table 4.6	NOSC Concurred with Waiver on 6/10/15	For the JPSS-1 mission only,

Item No.	Deviation/Waiver	Requirement Impacted?	Waiver Approved	Effectivity
	-- Dynamic Range Tmax: Band I4 – 339 (vs spec of 353) -- DNB FOV at Edge of Swath: 1.5 km (vs spec of 0.8 km) -- DNB Radiometric Calibration Uncertainty: Low Gain: 7% (vs spec of 5%), High Gain: 39% (vs spec of 30%) Adobe Acrobat Document NJO-2015-002 Waiver			
4	Waive L1RD-S requirement (L1RDS-2475) and JERD requirement (JERD-2043) NJO-2016-027, Waiver of Science Pe	L1RDS-2457	NOSC Concurred with Waiver on 3/22/17	Indefinite. An additional CCR is in progress to revise the requirement and correct this inaccuracy for future verification events.
5	Waives L1RDS-57as retesting may negatively impact verification of essential capabilities and ongoing operations leading into JPSS-1 launch. JPSS will develop a plan to re-evaluate system performance during the outage recovery scenario post-JPSS-1 launch to avoid impacting operations and shifting resources away from essential JPSS-1 verification efforts. This will allow JPSS to also assess the duration used for the outage scenario, as the utilization of multiple ground sites for JPSS-1 operations (e.g. McMurdo and Svalbard) suggests that the likelihood of a 24-hour outage is extremely low. NJO-2017-015, L1RDS_57 Waiver (P	L1RDS-57	PCB Chair approved this waiver OOB on 7/28/17 (NOSC Concurrence not required)	Until post JPSS-1 launch

Item No.	Deviation/Waiver	Requirement Impacted?	Waiver Approved	Effectivity
6	Waive L1RDS-2533 from the set of requirements necessary to verify for JPSS-1 ORR. This requirement can be waived as SDS pulls pertinent data and products directly from the JSH and thus the SD3E interface requirement is no longer applicable to the JPSS Ground System. NJO-2017-016, L1RDS_2533 Waiver	L1RDS-2533	PCB Chair approved this waiver OOB on 7/28/17 (NOSC Concurrence not required)	Indefinite since the services specified in L1RDS-2533 are no longer necessary.
7	Waives JPSS Program of Record (i.e. Block 2.x) requirements verification for Level 1 Requirements Document (L1RD) Supplement and JPSS Environmental Satellite Processing Center (ESPC) Requirements Document, Vol 1 (JERD Vol.1) requirements associated with the Clouds and the Earth's Radiant Energy System (CERES) Raw Data Record (RDR) ESPC Pass- Through Product. NJO-2017-017, Waive Verification of	L1RDS-2259, L1RDS-3127, L1RDS-3128, L1RDS-2266,	PCB Chair approved this waiver OOB on 9/28/17 (NOSC Concurrence not required)	This waiver expires at the first JPSS System and ESPC Verification Events following the contingent identification and approval of an ESPC Registered User for the CERES RDR ESPC Pass-Through Product

Table of TBDs/TBRs/TBSs

Item No.	Location	Summary	Ind./ Org.	Status	Due Date
TBR-3	L1RDS-14	**Resolve:** The mean calibrated radiometric response of each channel of an instrument to a uniform scene shall not change by more than +/- 1% (TBR-3) for all spectral channels over time scales longer than two weeks up to and including the sensor design life.	JPSS PSE	The S-NPP SDRs are essentially validated but still need a few fixes. The necessary analysis is ongoing.	6/30/14
TBR-8	Table 2.2	The objective latency of the OMPS-L SDR is currently "TBD"	JPSS PSE	TBD	TBD
TBR-9	Table 2.2	The objective latency of the Ozone Limb Profiler is currently "TBD"	JPSS PSE	TBD	TBD
TBR-10	Table 2.3	The objective latency of the OMPS-L SDR is currently "TBD"	JPSS PSE	TBD	TBD

Table of Contents

1 DOCUMENT SCOPE 1
1.1 Approach to Enhance Performance 1
1.2 JPSS Space Segment 1
1.3 JPSS Ground Segment 1
1.4 Control Authority 2
1.5 Applicable Document 2
1.6 Reference Documents 2
2 JPSS SERVICES 3
2.1 JPSS Communication Services 3
2.2 Data Product Users 3
2.3 Alternate Processing Center 14
2.4 Direct Broadcast Support 18
2.5 Reimbursable and Other Negotiated Services 19
3 JPSS SDR/EDR OVERVIEW 21
3.1 General EDR Information 21
3.1.1 Key Performance Parameters (KPPs) 21
3.1.2 Description of EDR Terms and Conventions 21
3.1.2.1 EDR Description/Rationale 21
3.1.2.2 Latency 22
3.1.2.3 Availability 22
3.2 EDR Performance Requirements 22
3.3 Degradation and Exclusion Conditions for EDRs, SDRs and TDRs 23
3.4 System Stability Requirements 24
3.4.1 Sensor Characterization and Monitoring 25
3.4.2 Sensor and Data Trending 25
3.5 Data Quality Monitoring 25
3.6 Intermediate Products 26
4 JPSS SENSOR DATA RECORDS (SDRS) 28
4.1 Advanced Technology Microwave Sounder (ATMS) 28
4.2 Reserved 29
4.3 Cross-track Infrared Sounder (CrIS) 29
4.4 Ozone Mapping and Profiling Suite (OMPS) 30
4.4.1 OMPS Nadir Total Column Mapper SDR 30
4.4.1.1 OMPS NM SDR Performance Requirements 30
4.4.1.2 Wavelength and SNR Required for Ozone Profile Product 31
4.4.2 OMPS Nadir Profiler SDR 31
4.4.2.1 OMPS NP SDR Performance Requirements 31
4.4.2.2 Wavelength, SNR, and Radiances for Critical Channels 32
4.4.3 OMPS Limb Profiler SDR 32
4.5 Reserved 34
4.6 Visible Infrared Imaging Radiometer Suite (VIIRS) 34
5 JPSS ENVIRONMENTAL DATA RECORD (EDRS) 36
5.1 Imagery EDRs 36
5.1.1 VIIRS Imagery 36

5.1.2 ATMS Imagery 37
5.2 Atmospheric EDRs 37
5.2.1 Aerosol Optical Depth (AOD) 37
5.2.2 Aerosol Particle Size (APS) 39
5.2.3 Atmospheric Vertical Moisture Profile (AVMP) 39
5.2.3.1 CrIS/ATMS Atmospheric Vertical Moisture Profile 40
5.2.3.2 ATMS Moisture Profile 41
5.2.4 Atmospheric Vertical Temperature Profile (AVTP) 42
5.2.4.1 CrIS/ATMS Atmospheric Vertical Temperature Profile 42
5.2.4.2 ATMS Temperature Profile 43
5.2.5 Carbon Monoxide (CO) 44
5.2.6 Carbon Dioxide (CO_2) 45
5.2.7 Methane (CH_4) 46
5.2.8 Infrared Ozone Profile (IOP) 47
5.2.9 Ozone Limb Profile (Ozone LP) 48
5.2.10 Ozone Nadir Profile (Ozone-NP) 49
5.2.11 Ozone Total Column (Ozone-TC) 50
5.2.12 Polar Winds (PW) 51
5.2.13 Rainfall Rate (RR) 52
5.2.14 Aerosol Detection (AD) 53
5.2.15 Volcanic Ash Detection and Height (VolAsh) 54
5.2.16 Total Precipitable Water (TPW) 54
5.3 Cloud EDRs 55
5.3.1 Cloud Height (Top and Base) (CH) 56
5.3.2 Cloud Cover/Layers (CC/L) 56
5.3.3 Cloud Particle Size Distribution (CPSD) 57
5.3.4 Cloud Liquid Water (CLW) 58
5.3.5 Cloud Mask (CM) 58
5.3.6 Cloud Phase (CP) 59
5.3.7 Cloud Optical Depth (COD) 60
5.3.8 Cloud Top Pressure (CTP) 60
5.3.9 Cloud Top Temperature (CTT) 61
5.4 Earth Radiation Budget EDR 62
5.4.1 Albedo (Surface) 62
5.4.2 Outgoing Longwave Radiation (OLR) 62
5.5 Land EDRs 63
5.5.1 Active Fires (AF) 63
5.5.2 Green Vegetation Fraction (GVF) 64
5.5.3 Land Surface Emissivity (LSE) 64
5.5.4 Land Surface Temperature (LST) 65
5.5.4.1 VIIRS Land Surface Temperature 65
5.5.4.2 ATMS Land Surface Temperature 66
5.5.5 Annual Surface Type (QST) 66
5.5.6 Snow Cover (SC) 67
5.5.6.1 VIIRS Snow Cover 67

5.5.6.2 ATMS Snow Cover 68
5.5.7 Snow Water Equivalent (SWE) 68
5.5.7.1 Snowfall Rate (SFR) 69
5.5.8 Vegetation Indices (VIs) 69
5.5.9 Vegetation Health Index Suite (VHI) 70
5.6 Ocean/Water EDRs 71
5.6.1 Ice Surface Temperature (IST) 71
5.6.2 Ocean Color/Chlorophyll (OC/C) 72
5.6.3 Ice Concentration (IC) 74
5.6.4 Ice Age/Thickness (IAT) 74
5.6.5 Sea Ice Concentration (SICon) 76
5.6.6 Sea Surface Temperature (SST) 76
6 JPSS REQUIREMENTS FROM GCOM SENSORS 78
6.1 AMSR-2 Products 78
6.1.1 Imagery 78
6.1.2 Cloud Liquid Water (CLW) 79
6.1.3 Total Precipitable Water (TPW) 79
6.1.4 Sea Surface Winds - Speed (SSW-S) 80
6.1.5 Sea Surface Temperature (SST) 81
6.1.6 Rainfall Rate (RR) 81
6.1.7 Sea Ice Characterization (SIC) 82
6.1.8 Snow Cover/Depth (SC/D) 83
6.1.9 Snow Water Equivalent (SWE) 84
6.1.10 Soil Moisture (SM) 85
6.1.11 Surface Reflectance (ST) 86
7 FLIGHT PERFORMANCE REQUIREMENTS 87
7.1 General 87
7.1.1 Sensor Characterization and Monitoring 87
7.1.2 Instrument Long Term Stability 87
7.1.3 Calibration 87
7.2 Advanced Technology Microwave Sounder (ATMS) 87
7.3 Clouds and the Earth's Radiant Energy System (CERES) 88
7.4 Cross-Track Infrared Sounder (CrIS) 88
7.5 Ozone Mapping and Profiler Suite (OMPS-N) 88
7.6 Reserved 88
7.7 Visible Infrared Imaging Radiometer Suite (VIIRS) 88
APPENDIX A - CONVENTIONS AND RATIONALE 89
APPENDIX B - LIST OF ACRONYMS 93
APPENDIX C - GLOSSARY 99
APPENDIX D - SUOMI NPP DATA PRODUCT PERFORMANCE 116

List of Tables

Table 2.2. Data Recipients and Allocated Latencies v2.11, Rev -, 10/31/18 4
Table 2.2.1. GCOM-W1 Data Recipients and Allocated Latencies, v2.11, Rev -, 10/31/18 12
Table 2.3. JPSS Alternate Processing Center (APC) Products v2.11, Rev -, 8/31/18 15
Table 2.4. JPSS Alternate Processing Center (APC) Products, v2.11, Rev -, 8/16/17 18
Table 3.6. RIPs v.2.2, 9/26/12 26
Table 4.1. ATMS SDR/TDR Threshold Performance Characteristics v2.10, 3/18/14 28
Table 4.3. CrIS Threshold Performance Characteristics v2.5, 1/22/13 29
Table 4.4.1.1. J1 OMPS NM SDR Performance Requirements v2.10, 1/24/14 30
Table 4.4.1.2. Wavelength and SNR Required for Ozone Profile Project v2.10, 1/24/14 31
Table 4.4.2.1. J1 OMPS NP SDR Performance Requirements v2.10, 1/24/14 31
Table 4.4.2.2. Wavelength, SNR, and Radiances for Critical Channels v2.10, 1/24/14 32
Table 4.4.3. OMPS Limb Profiler SDR Products 32
Table omps-lp-2a. Signal-to-noise ratio allocations to the limb sensor channels as a function of wavelength and altitude. 33
Table omps-lp-2b. Signal-to-noise ratio allocations to the limb sensor channels as a function of wavelength and altitude. 33
Table omps-lp-2c. Signal to noise ratio allocations to the limb sensor channels as a function of wavelength and altitude. 34
Table 4.6. VIIRS SDR Threshold Performance Characteristics v2.11, 11/17/16 34
Table 5.1.1. Imagery (VIIRS) v2.11, 11/17/16 36
Table 5.1.2. Imagery (ATMS) v2.11, 11/17/16 37
Table 5.2.1. Aerosol Optical Depth (VIIRS) v2.11, 11/17/16 38
Table 5.2.2. Aerosol Particle Size (VIIRS) v2.11, 10/31/18 39
Table 5.2.3.1. Atmospheric Vertical Moisture Profile (CrIS/ATMS) v2.11, 11/17/16 40
Table 5.2.3.2. Moisture Profile (ATMS) v2.11, 11/17/16 41
Table 5.2.4.1. Atmospheric Vertical Temperature Profile (CrIS/ATMS) v2.11, 11/17/16 42
Table 5.2.4.2. Temperature Profile (ATMS) v2.11, 11/17/16 43
Table 5.2.5. CO (Carbon Monoxide) Column (CrIS) v2.11, 11/17/16 45
Table 5.2.6. CO2 (Carbon Dioxide) Column (CrIS) v2.11, 11/17/16 46
Table 5.2.7. CH4 (Methane) Column (CrIS) v2.11, 11/17/16 47
Table 5.2.8. Infrared Ozone Profile (CrIS) v2.11, 11/17/16 48
Table 5.2.9. Ozone Limb Profile (OMPS-L) v2.11, 11/17/16 48
Table 5.2.10. Ozone Nadir Profile (OMPS-N) v2.11, 11/17/16 50
Table 5.2.11. Ozone Total Column (OMPS-N) v2.11, 11/17/16 51
Table 5.2.12. Polar Winds (VIIRS) v2.11, 11/17/16 51
Table 5.2.13. Rainfall Rate (ATMS) v2.11, 11/17/16 52
Table 5.2.14. Aerosol Detection (VIIRS) v.2.11, 11/17/16 53
Table 5.2.15. Volcanic Ash Detection and Height v2.11, 11/17/16 54
Table 5.2.16. Total Precipitable Water (ATMS) v2.11, 11/17/16 54
Table 5.3.1. Cloud Height (Top and Base) (VIIRS) v2.11,11/17/16 56
Table 5.3.2. Cloud Cover/Layers (VIIRS) v2.11, 11/17/16 57
Table 5.3.3. Cloud Particle Size Distribution (VIIRS) v2.11, 11/17/16 57
Table 5.3.4. Cloud Liquid Water (ATMS) v2.11, 11/17/16 58

Table 5.3.5. Cloud Mask (VIIRS) v2.11, 11/17/16 58
Table 5.3.6. Cloud Phase (VIIRS) v2.11, 11/17/16 59
Table 5.3.7. Cloud Optical Depth (VIIRS) v2.11, 11/17/16 60
Table 5.3.8. Cloud Top Pressure (VIIRS) v2.11, 10/31/18 61
Table 5.3.9. Cloud Top Temperature (VIIRS) v2.11, 10/31/18 61
Table 5.4.1. Albedo (Surface) (VIIRS) v2.11, 2/18/15 62
Table 5.4.2. Outgoing Longwave Radiation (CrIS) v2.11, 11/17/16 63
Table 5.5.1. Active Fires (VIIRS) v2.11, 11/17/16 63
Table 5.5.2. Green Vegetation Fraction (VIIRS) v2.11, 11/17/16 64
Table 5.5.3. Land Surface Emissivity (ATMS) v2.11, 11/17/16 64
Table 5.5.4.1. Land Surface Temperature (VIIRS) v2.11, 11/17/16 65
Table 5.5.4.2. Land Surface Temperature (ATMS) v2.11, 11/17/16 66
Table 5.5.5. Quarterly Surface Type IP (VIIRS) v2.11, 11/17/16 66
Table 5.5.6.1. Snow Cover (VIIRS) v2.11, 10/31/18 67
Table 5.5.6.2. Snow Cover (ATMS) v2.11, 11/17/16 68
Table 5.5.7. Snow Water Equivalent (ATMS) v2.11, 11/17/16 68
Table 5.5.7.1. Snowfall Rate (ATMS) v2.11, 10/31/18 69
Table 5.5.8. Vegetation Indices (VIIRS) v2.11, 10/31/18 70
Table 5.5.9. Vegetation Health Index Suite (VCI, TCI, VHI) (VIIRS) v2.11, 10/31/18 71
Table 5.6.1. Ice Surface Temperature (VIIRS) v2.11, 11/17/16 71
Table 5.6.2. Ocean Color/Chlorophyll (VIIRS) v2.11, 11/17/16 72
Table 5.6.3. Ice Concentration (VIIRS) v2.11, 10/31/18 74
Table 5.6.4. Ice Age/Thickness (VIIRS) v2.11, 10/31/18 75
Table 5.6.5. Sea Ice Concentration (ATMS) v2.11, 10/31/18 76
Table 5.6.6. Sea Surface Temperature (VIIRS) v2.11, 10/31/18 77
Table 6.1.1. Imagery (AMSR-2) v2.11, 11/17/16 78
Table 6.1.2. Cloud Liquid Water (AMSR-2) v2.11, 11/17/16 79
Table 6.1.3. Total Precipitable Water (AMSR-2) v2.11, 11/17/16 80
Table 6.1.4. Sea Surface Winds - Speed (AMSR-2) v2.11, 11/17/16 80
Table 6.1.5. Sea Surface Temperature (AMSR-2) v2.11, 11/17/16 81
Table 6.1.6. Rainfall Rate (AMSR-2) v2.11, 10/31/18 82
Table 6.1.7. Sea Ice Characterization (AMSR-2) v2.11, 11/17/16 82
Table 6.1.8. Snow/Cover Depth (AMSR-2) v2.11, 10/31/18 83
Table 6.1.9. Snow Water Equivalent (AMSR-2) v2.11, 11/17/16 84
Table 6.1.10. Soil Moisture (AMSR-2) v2.11, 11/17/16 85
Table 6.1.11. Surface Reflectance (SR) (VIIRS) v2.11, 10/31/18 86
Table D-1. SNPP Performance Exclusions 116

1 DOCUMENT SCOPE

The requirements contained in this Joint Polar Satellite System (JPSS) Level 1 Requirements Document (L1RD) Supplement are derived from and flow down from the requirements in the JPSS L1RD, latest version in effect. The L1RD describes the JPSS Sensor Data Records (SDRs), Environmental Data Records (EDRs) and key system requirements at a high level. The L1RD should be reviewed first as it contains contextual information helpful in understanding and applying these requirements. Each requirement in this Supplement has been assigned a specific number of the type L1RDS-xxxx.

1.1 Approach to Enhance Performance

The threshold performance requirements stated in this Supplement represent the baseline JPSS performance. However, the government expects to continue optimizing the value of JPSS over the life of the Program and may invest in system capabilities beyond those currently itemized in the L1RD and Supplement if justified by operational requirements and allowed by available resources. The National Oceanic and Atmospheric Administration (NOAA) will periodically assess and prioritize evolving customer needs for JPSS performance that exceed L1RD threshold requirements and the JPSS Director (of the NOAA Joint Polar Satellite System Office (NJO)) will direct any and all JPSS initiatives to enhance system capabilities beyond that driven by these requirements. These initiatives may be designed to facilitate closure on documented objective requirements found in the L1RD Supplement or may represent the pursuit of new requirements where the positive impact of emerging science and technology on data product quality is deemed significant by NOAA. Any change to the L1RD baseline requirements will subsequently be incorporated into this Supplement.

1.2 JPSS Space Segment

The JPSS Space Segment consists of the JPSS-1 & -2 satellites and the Suomi-National Polar-orbiting Partnership (S-NPP) satellite. The instruments flown on these satellites are designed to provide the data necessary to produce the SDRs and EDRs described in Sections 4 & 5 of this Supplement. As noted in Section 6 below, data from the Advanced Microwave Scanning Radiometer 2 (AMSR-2) instrument on the Japan Aerospace Exploration Agency (JAXA) Global Change Observation Mission -Water (GCOM-W1) are available through NOAA/JAXA cooperative arrangements.

1.3 JPSS Ground Segment

The JPSS Ground Segment is a shared ground infrastructure consisting of multiple subsystems that support a heterogeneous constellation of polar- orbiting satellites, both JPSS Missions and JPSS Supported Missions, through a comprehensive set of services. The services provided by the JPSS Ground System include Enterprise Management and Ground Operations, Flight Operations, Data Acquisition, Data Routing, Data Product Generation, Data Product Calibration and Validation, and Direct Readout Support. Traditional NOAA systems and facilities which form a part of the JPSS Ground Segment include the NOAA Satellite Operations Facility (NSOF), the Environmental Satellite Processing Center (ESPC), the S-NPP Data Exploitation system (NDE), the Product Distribution and Access (PDA) system, and the Consolidated Backup (CBU) facility. Services provided by the ESPC systems which support JPSS functionality include Data Product Generation, Verification and Validation, and Product Distribution. The

Department of Defense (DoD) data processing centers and the NOAA Comprehensive Large Array-data Stewardship System (CLASS) are not a part of the JPSS Ground Segment. However, JPSS will support hardware and software modifications to NOAA's CLASS archive to accommodate the archiving of data/data products from S-NPP, JPSS, and GCOM-W satellites.

Section 2.5 captures "Reimbursable and Other Negotiated Services" which fall under the responsibility of the Ground Segment.

1.4 Control Authority

This L1RD Supplement is configuration controlled at a lower level than the base L1RD document. As such, revisions to this document which maintain fidelity to the L1RD, are coordinated through the Low earth-Orbiting Requirements Working Group (LORWG) and can be adopted with concurrence by the NOAA Observing Systems Council (NOSC) and the LORWG Chair (JPSS Program Scientist) and approval by the Director, NJO.

1.5 Applicable Document

Applicable documents consist of documents that contain provisions or other pertinent requirements directly related to and necessary for the performance of the activities specified by this Level 1 Requirements Document Supplement. Unless specifically noted, all requirements contained in these documents, of the current revision number/date of issue, are applicable to the JPSS Program and system.

Document Number	Title
JPSS-REQ-1001/470-00031	JPSS Level-1 Requirements Document
ISO 19115	Metadata Standards for Geographic Information
ISO 19115-2	Metadata Standards for Geographic Information, Part 2: Extensions for Imagery and Gridded Data

1.6 Reference Documents

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

Document Number	Title
602-04-1AC02	Agreement Between National Oceanic and Atmospheric Administration (NOAA) and European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) for Joint Transition Activities (JTA)
	Agreement Between The United States National Oceanic And Atmospheric Administration and the European Organisation For the Exploitation of Meteorological Satellites on a Joint Polar System
	MOU Between NOAA and JAXA in relation to the Cooperation for the Global Change Observation Mission 1-Water (GCOM-W1)

2 JPSS SERVICES

2.1 JPSS Communication Services

The JPSS Ground Segment provides communication services for the JPSS missions as follows:

L1RDS-2256 The JPSS Ground System shall provide communication services for the S-NPP, JPSS-1, and JPSS-2 missions.

L1RDS-2258 The JPSS Ground System shall generate and distribute JPSS data (including ancillary data) and products from the S-NPP, JPSS, and GCOM missions in accordance with Tables 2.2 and 2.3.

L1RDS-2531 The JPSS Ground System shall distribute the Application Packets (APs), AMSR2 APID Sorted Data (ASD) files, Raw Data Records (RDRs), SDRs, Temperature Data Records (TDRs) and EDRs identified in Tables 2.2 and 2.3 as soon as they are generated, not to exceed the maximum latency.

L1RDS-2259 The ESPC systems which support JPSS functionality shall generate and distribute data (including ancillary data) and products from the S-NPP, JPSS, and GCOM missions in accordance with Tables 2.2 and 2.3.

L1RDS-2532 The ESPC systems which support JPSS functionality shall distribute the SDRs, TDRs, and EDRs identified in Tables 2.2 and 2.3 as soon as they are generated, not to exceed the maximum latency.

L1RDS-2260 The JPSS shall support modifications to ESPC blended products.

2.2 Data Product Users

All JPSS and GCOM EDRs are described in detail in this Supplement. The requirements for Climate Data Records (CDRs) are defined in other documents. Since the production of CDRs is outside the scope of the JPSS program, no CDRs are described in this supplement.

L1RDS-3125 The JPSS Ground Segment shall generate and make available each of the JPSS products specified in Table 2.2.

The “X” in Table 2.2 specifies which JPSS entity (JPSS Ground System or ESPC system which supports JPSS functionality) is responsible for the generation and distribution of a particular JPSS data product to one or more data recipients per NOAA data policies. The end-to-end latency requirements for every JPSS data product are documented in the JPSS L1RD Appendix A. Table 2.2 of the JPSS L1RD Supplement decomposes those end-to-end scalar values into the allocations to the elements (JPSS Ground System and ESPC systems which support JPSS functionality) that comprise the end-to-end JPSS system.

The latencies shown in the “Allocated Entity” column of Table 2.2 reflect the maximum time that the respective entity has to make the AP, RDR, TDR, or EDR available to the recipient. It does not imply a “processing” time for each product. The entity allocations may not add up to

Check the JPSS MIS Server at http://jpssmis_gsfc.nasa.gov/frontmenu_dsp.cfm to verify that this is the correct version prior to use.

the Total System Threshold, depending on which processes are required to deliver the final product. Using the ATMS instrument as an example, to deliver a reformatted ATMS SDR would require the JPSS Ground System to retrieve the satellite data and generate the SDR (80 minutes max.) plus the time for ESPC to reformat the SDR (7 minutes max.) for a total of 87 minutes vice the Total System Threshold of 96 minutes. However, to deliver the ATMS Cloud Liquid Water EDR requires 80 minutes for the SDR generation plus 16 minutes for the ESPC EDR generation for a total of 96 minutes.

L1RDS-3127 The JPSS Ground Segment shall meet the latency requirements specified in Table 2.2.

The JPSS Ground System develops RDRs from the APs received from the satellites, and, except as noted later in the specific EDR sections, produces the SDRs and many of the EDRs specified in Table 2.2. The JPSS Ground Segment also includes the ESPC systems which are responsible for receiving various JPSS Ground System produced products and performing one or more of the following JPSS functions in accordance with Table 2.2:

a) Make available Ground Segment products to non-NOAA partners

b) "Reformat" Ground Segment products as required by NOAA users

c) Generate additional products required by NOAA users

d) Distribute Ground Segment products to NOAA users. (The data product subscription process is managed by the ESPC and CLASS in accordance with NOAA data policies.)

L1RDS-3128 The JPSS Ground Segment shall "pass-through" those JPSS products specified in Table 2.2

L1RDS-3129 The JPSS Ground Segment shall "reformat" those JPSS products specified in Table 2.2.

L1RDS-2261 All S-NPP and JPSS data products shall include, or point to the location of, associated metadata.

Table 2.2. Data Recipients and Allocated Latencies v2.11, Rev -, 10/31/18

	Maximum Latency (minutes)		**Data Recipients**						
Product/Parameter	**Total System (Th. / Obj.) (1)**	**Allocated To Entity (Threshold)**	**JPSS GS - ESPC**	**JPSS GS - CLASS (7, 10)**	**JPSS GS - USN**	**ESPC - NOAA**	**ESPC - CLASS (10)**	**ESPC - AFWA (9)**	**ESPC - USN (9)**
ATMS Instrument									
ATMS Application Packets	**80**								
JPSS Ground System (2)		80			X				
ATMS RDR	**80** / 30								
JPSS Ground System (2)		80	X	X					
ATMS TDR	**87** / 30								
JPSS Ground System (2)		80	X	X					

	Maximum Latency (minutes)		**Data Recipients**						
Product/Parameter	**Total System (Th. / Obj.) (1)**	**Allocated To Entity (Threshold)**	**JPSS GS - ESPC**	**JPSS GS - CLASS (7, 10)**	**JPSS GS - USN**	**ESPC - NOAA**	**ESPC - CLASS (10)**	**ESPC - AFWA (9)**	**ESPC - USN (9)**
ESPC Pass-through / Reformatting (5)		3 / 7				X / X		X / X	
ATMS SDR	**87** / 30								
JPSS Ground System (2)		80	X	X					
ESPC Pass-through / Reformatting (5)		3 / 7				X / X		X / X	
ATMS Snowfall Rate	96/30								
JPSS Ground System CrIS/ATMS SDR (4)		114	X						
ESPC Product Generation (3)		16				X	X	X	X
CERES Instrument									
CERES Application Packets	**80**								
JPSS Ground System (2)		80			X				
CERES RDR	**80**								
JPSS Ground System (2)		80	X	X					
ESPC Pass-through		3				X			
CrIS Instrument									
CrIS Application Packets	**80** / -								
JPSS Ground System (2)		80			X				
CrIS RDR	**80** / 30								
JPSS Ground System (2)		80	X	X					
CrIS SDR	**87** / 30								
JPSS Ground System (2)		80	X	X					
ESPC Pass-through / Reformatting (5)		3 / 7				X / X		X / X	
OMPS Instruments									
OMPS-N Application Packets	**80** / -								
JPSS Ground System (2)		80			X				
OMPS-N RDR	**80** / 30								
JPSS Ground System (2)		80	X	X					
OMPS-N SDR	**83** / 30								
JPSS Ground System (2)		80	X	X					
ESPC Pass-through (5)		3				X		X	
OMPS-L Application Packets	**80** / 60								
JPSS Ground System (2)		80			J2				
OMPS-L RDR	**80** / 60								
JPSS Ground System (2)		80	SNPP & J2	SNPP & J2					
OMPS-L SDR	96 / TBD								
JPSS Ground System OMPS-L RDR (12)		80	SNPP	SNPP					
ESPC Product Generation (3)		16				X	X	X	X

	Maximum Latency (minutes)		**Data Recipients**						
Product/Parameter	**Total System (Th. / Obj.) (1)**	**Allocated To Entity (Threshold)**	**JPSS GS - ESPC**	**JPSS GS - CLASS (7, 10)**	**JPSS GS - USN**	**ESPC - NOAA**	**ESPC - CLASS (10)**	**ESPC - AFWA (9)**	**ESPC - USN (9)**
VIIRS Instrument									
Application Packets	**80** / -								
JPSS Ground System (2)		80			X				
RDR	**80** / 30								
JPSS Ground System (2)		80	X	X					
SDR	**87** / 30								
JPSS Ground System (2)		80	X	X					
ESPC Pass-through / Reformatting (5)		3 / 7				X / X		X / X	
Active Fires (VIIRS)	**96** / 30								
JPSS Ground System VIIRS SDR (4)		80	X						
ESPC Product Generation (3)		16				X	X		
Aerosol Detection (VIIRS)	**96** / 30								
JPSS Ground System VIIRS SDR (4)		80	X						
ESPC Product Generation (3,8)		16				X	X	X	
Aerosol Optical Depth (VIIRS)	**103** / 30								
JPSS Ground System VIIRS SDR (4)		80	X						
ESPC Product Generation (3,8)		16				X	X	X	
ESPC Reformatting (5)		7				X			
Aerosol Particle Size (VIIRS)	**96** / 30								
JPSS Ground System VIIRS SDR (4)		80	X						
ESPC Product Generation (3,8)		16				X	X	X	
Albedo (Surface) (VIIRS)	**96** / 30								
JPSS Ground System VIIRS (4)		80	X						
ESPC Product Generation (3,8)		16				X	X	X	
Atmospheric Vertical Moisture Profile (CrIS/ATMS)	**96** / 30								
JPSS Ground System CrIS/ATMS SDRs (4)		80	X						
ESPC Product Generation (3,8)		16				X	X	X	X
Atmospheric Vertical Temperature Profile (CrIS/ATMS)	**96** / 30								
JPSS Ground System CrIS/ATMS SDRs (4)		80	X						

	Maximum Latency (minutes)		**Data Recipients**						
Product/Parameter	**Total System (Th. / Obj.) (1)**	**Allocated To Entity (Threshold)**	**JPSS GS - ESPC**	**JPSS GS - CLASS (7, 10)**	**JPSS GS - USN**	**ESPC - NOAA**	**ESPC - CLASS (10)**	**ESPC - AFWA (9)**	**ESPC - USN (9)**
ESPC Product Generation (3,8)		16				X	X	X	X
Carbon Monoxide (CO) (CrIS)	**96** / 30								
JPSS Ground System CrIS SDR (4)		80	X						
ESPC Product Generation (3)		16				X	X		
Carbon Dioxide (CO_2) (CrIS)	**96** / 30								
JPSS Ground System CrIS SDR (4)		80	X						
ESPC Product Generation (3)		16				X	X		
Cloud Cover/Layers (VIIRS)	**96** / 30								
JPSS Ground System VIIRS SDR (4)		80	X						
ESPC Product Generation (3,8)		16				X	X	X	
Cloud Height (Top and Base) (VIIRS)	**96** / 30								
JPSS Ground System VIIRS SDR (4)		80	X						
ESPC Product Generation (3,8)		16				X	X	X	
Cloud Liquid Water (ATMS)	**96** / 30								
JPSS Ground System ATMS SDR (4)		80	X						
ESPC Product Generation (3)		16				X	X	X	X
Cloud Mask (VIIRS)	**96** / 30								
JPSS Ground System VIIRS SDR (4)		80	X						
ESPC Product Generation (3,8)		16				X	X	X	X
Cloud Optical Depth (VIIRS)	**96** / 30								
JPSS Ground System VIIRS SDR (4)		80	X						
ESPC Product Generation (3,8)		16				X	X	X	
Cloud Particle Size Distribution (VIIRS)	**96** / 30								
JPSS Ground System VIIRS SDR (4)		80	X						
ESPC Product Generation (3,8)		16				X	X	X	
Cloud Phase (VIIRS)	**96** / 30								
JPSS Ground System VIIRS SDR (4)		80	X						

	Maximum Latency (minutes)		**Data Recipients**						
Product/Parameter	**Total System (Th. / Obj.) (1)**	**Allocated To Entity (Threshold)**	**JPSS GS - ESPC**	**JPSS GS - CLASS (7, 10)**	**JPSS GS - USN**	**ESPC - NOAA**	**ESPC - CLASS (10)**	**ESPC - AFWA (9)**	**ESPC - USN (9)**
ESPC Product Generation (3,8)		16				X	X	X	
Cloud Top Pressure (VIIRS)	**96** / 30								
JPSS Ground System VIIRS SDR (4)		80	X						
ESPC Product Generation (3,8)		16				X	X	X	
Green Vegetation Fraction (VIIRS)	**25 hr** / 30								
JPSS Ground System VIIRS SDR (4)		80	X						
ESPC Product Generation (3)		24 hr				X	X		
ESPC Reformatting		7				X			
Ice Age/Thickness(VIIRS)	**96** / 60								
JPSS Ground System VIIRS SDR (4)		80	X						
ESPC Product Generation (3)		16				X	X	X	
Ice Concentration (VIIRS)	**96** / 60								
JPSS Ground System VIIRS SDR (4)		80	X						
ESPC Product Generation (3)		16				X	X	X	
Ice Surface Temperature (VIIRS)	**96** / 60								
JPSS Ground System VIIRS SDR (4)		80	X						
ESPC Product Generation (3,8)		16				X	X	X	
Imagery (ATMS)	**96** / 30								
JPSS Ground System ATMS SDR (4)		80	X	X					
ESPC Product Generation (3)		16				X	X	X	X
Imagery (VIIRS)	**87** / 30								
JPSS Ground System VIIRS SDR (4)		80	X	X					
ESPC Pass-through/Reformatting (5)		3 / 7				*X / X*		*X*	
Infrared Ozone Profile (CrIS)	**96** / 60								
JPSS Ground System CrIS SDR (4)		80	X	X					
ESPC Product Generation (3)		16				X	X		
Land Surface Emissivity (ATMS)	**96** / 60								
JPSS Ground System ATMS SDR (4)		80	X						

	Maximum Latency (minutes)		**Data Recipients**						
Product/Parameter	**Total System (Th. / Obj.) (1)**	**Allocated To Entity (Threshold)**	**JPSS GS - ESPC**	**JPSS GS - CLASS (7, 10)**	**JPSS GS - USN**	**ESPC - NOAA**	**ESPC - CLASS (10)**	**ESPC - AFWA (9)**	**ESPC - USN (9)**
ESPC Product Generation (3)		16				X	X	X	X
Land Surface Temperature (ATMS)	**96** / 60								
JPSS Ground System ATMS SDR (4)		80	X						
ESPC Product Generation (3)		16				X	X	X	X
Land Surface Temperature (VIIRS)	**96** / 60								
JPSS Ground System VIIRS SDR (4)		80	X						
ESPC Product Generation (3,8)		16				X	X	X	
Methane (CH_4) (CrIS)	**96** / 30								
JPSS Ground System CrIS SDR (4)		80	X						
ESPC Product Generation (3)		16				X	X		
Moisture Profile (ATMS)	**96** / 30								
JPSS Ground System ATMS SDR (4)		80	X						
ESPC Product Generation (3)		16				X	X	X	X
Ocean Color/Chlorophyll (VIIRS)	**118** / 30								
JPSS Ground System VIIRS SDR (4)		80	X						
ESPC Product Generation (3, 8)		31				X	X		
ESPC Reformatting		7				X			
Outgoing Longwave Radiation (CrIS)	**96** / 60								
JPSS Ground System CrIS SDR (4)		80	X						
ESPC Product Generation (3, 8)		16				X	X		
Ozone Limb Profile (OMPS-L)	119 / TBD								
JPSS Ground System RDR (4)		80	SNPP						
ESPC Product Generation SDR (3)		16				X			
ESPC Product Generation (3)		16				X	X	X	
ESPC Reformatting (5)		7				X			
Ozone Nadir Profile (OMPS-N)	**103** / 60								
JPSS Ground System OMPS-N SDR (4)		80	X						

	Maximum Latency (minutes)		**Data Recipients**						
Product/Parameter	**Total System (Th. / Obj.) (1)**	**Allocated To Entity (Threshold)**	**JPSS GS - ESPC**	**JPSS GS - CLASS (7, 10)**	**JPSS GS - USN**	**ESPC - NOAA**	**ESPC - CLASS (10)**	**ESPC - AFWA (9)**	**ESPC - USN (9)**
ESPC Product Generation (3,8)		16				X	X	X	
ESPC Reformatting (5)		7				X			
Ozone Total Column (OMPS-N)	**103** / 60								
JPSS Ground System OMPS-N SDR (4)		80	X	X					
ESPC Product Generation (3,8)		16				X	X	X	
ESPC Reformatting (5)		7				X			
Polar Winds (VIIRS)	**204** / 130								
JPSS Ground System VIIRS SDR (4)		80	X						
ESPC Product Generation (3)		117				X	X	X	X
ESPC Reformatting		7				X			
Rainfall Rate (ATMS)	**96** / 30								
JPSS Ground System ATMS SDR (4)		80	X						
ESPC Product Generation (3)		16				X	X	X	X
Sea Ice Concentration (ATMS)	**96** / 30								
JPSS Ground System ATMS SDR (4)		80	X						
ESPC Product Generation (3)		16				X	X	X	X
Sea Surface Temperature (VIIRS)	**12 hr** / **103** / 30 (6)								
JPSS Ground System VIIRS SDR (4)		80	X						
ESPC Product Generation (3,8)		16				X	X		
ESPC Reformatting		7				X			
Snow Cover (ATMS)	**96** / 60								
JPSS Ground System ATMS SDR (4)		80	X						
ESPC Product Generation (3)		16				X	X	X	X
Snow Cover (VIIRS)	**96** / 60								
JPSS Ground System VIIRS SDR (4)		80	X						
ESPC Product Generation (3,8)		16				X	X	X	
Snow Water Equivalent (ATMS)	**96** / 60								
JPSS Ground System ATMS SDR (4)		80	X						
ESPC Product Generation (3)		16				X	X	X	X

	Maximum Latency (minutes)		**Data Recipients**						
Product/Parameter	**Total System (Th. / Obj.) (1)**	**Allocated To Entity (Threshold)**	**JPSS GS - ESPC**	**JPSS GS - CLASS (7, 10)**	**JPSS GS - USN**	**ESPC - NOAA**	**ESPC - CLASS (10)**	**ESPC - AFWA (9)**	**ESPC - USN (9)**
Surface Reflectance (VIIRS)	**96** / 60								
JPSS Ground System VIIRS SDR (4)		80	X						
ESPC Product Generation (3,8)		16				X	X	X	
Temperature Profile (ATMS)	**96** / 30								
JPSS Ground System ATMS SDR (4)		80	X						
ESPC Product Generation (3)		16				X	X	X	X
Total Precipitable Water (ATMS)	**96** / 30								
JPSS Ground System ATMS SDR (4)		80	X						
ESPC Product Generation (3)		16				X	X	X	X
Vegetation Indices (VIIRS)	24 hr/24 hr								
JPSS Ground System SDR (4)		80	X						
ESPC Product Generation (3)		24 hr				X	X		
Vegetation Health Index Suite (VIIRS)	**175 hr** / 60								
JPSS Ground System VIIRS SDR (4)		80	X						
ESPC Product Generation (3)		174 hr (1 week + 6 hr)				X	X		
Volcanic Ash Detection and Height (VIIRS)	**96** / 30								
JPSS Ground System VIIRS SDR (4)		80	X						
ESPC Product Generation (3)		16				X	X	X	

Notes:

1. The Total System Threshold Latency (bolded) is specified in the L1RD Appendix A and replicated here for convenience. The Total System Objective Latency is driven by National Weather Service needs.

2. JPSS Ground System Generation latency is the period starting from the time of observation of all requisite data by the satellite until the product is delivered to the ESPC. This includes the time that the data remains on the satellite, data acquisition and routing to the IDP, IDP processing, and the distribution time to the ESPC.

3. ESPC Generation 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. Latency times are for granule generation. The latency times to generate regional, orbital and global products will be longer. Latency times do not include distribution time to users who retrieve their products from CLASS (Note 7).

4. JPSS Ground produces the RDR and/or SDR, reformats and delivers these products in accordance with the RDR and/or SDR requirements. For ESPC-generated EDRs, the RDR and/or SDR is utilized as intermediate processing data product specific to the EDR requirement as noted in the latency budget. These EDR requirements specify the delivery of the EDR data product only.

	Maximum Latency (minutes)		Data Recipients						
Product/Parameter	**Total System (Th. / Obj.) (1)**	**Allocated To Entity (Threshold)**	**JPSS GS - ESPC**	**JPSS GS - CLASS (7, 10)**	**JPSS GS - USN**	**ESPC - NOAA**	**ESPC - CLASS (10)**	**ESPC - AFWA (9)**	**ESPC - USN (9)**
5. ESPC provides both delivery and reformatting of JPSS Ground System Products to the user community. JPSS Ground System HDF5-formatted products are passed-through ESPC with an allocated 3 minutes of latency, making the maximum latency at 83 minutes. ESPC reformatting requirements are specified in the JERD where this processing and delivery is allocated 7 minutes, making the maximum latency 87 minutes. For simplicity if both native HDF5 and reformatted products are distributed, JPSS maintains the maximum possible latency amount associated.									
6. The NOS/NMFS operational requirement for the Priority 2 (Critical) SST product is 12 hours since they do not run 24/7 operations. The NWS requires this product quicker (within 103 minutes) but at a Priority 3 criticality. However, the lower latency capability is beneficial to NOS/NMFS, consistent with what is done with current operations, and therefore the ground system shall be developed and procured to meet the 103 minute requirement.									
7. There is no latency requirement for products delivered to CLASS. They are currently delayed for 6 hours (configurable) to ensure that CLASS only receives one set of the best data.									
8. JPSS Ground System produces the upstream SDR within 80 minutes and provides this to ESPC for EDR product generation.									
9. ESPC is only required to make these products available to USN and/or AFWA. Any additional work will be done on a reimbursable basis. Latency for these products is driven by NOAA.									
10. Products specified in the JPSS/NCDC Submission Agreement									
11. Quarterly Surface Type (QST) product was changed to Annual Surface Type (AST). The AST product is Government Furnished Information (GFI). AST will remain a Level 1 EDR requirement and the Algorithm Management Project (AMP) will be responsible for science verification of the product. However, the STAR-managed processing system is outside the JPSS ground requirements scope, and is therefore not subject to verification by PSE.									
12 The OMPS-Limb SDR will only be produced from the SNPP Satellite within ESPC									

Table 2.2.1. GCOM-W1 Data Recipients and Allocated Latencies, v2.11, Rev -, 10/31/18

	Maximum Latency (minutes)		Data Recipients						
Product/Parameter	**Total System (Th. / Obj.) (1)**	**Allocated To Entity (Threshold)**	**JPSS GS - ESPC**	**JPSS GS - CLASS (7, 10)**	**JPSS GS - USN**	**ESPC - NOAA**	**ESPC - CLASS (10)**	**ESPC - AFWA (9)**	**ESPC - USN (9)**
AMSR-2/3 Instrument									
AMSR APID Sorted Data (ASD)	117/30								
JPSS Ground System (2)		114							
ESPC Pass-through		3	X	X					
AMSR Calibrated Sensor Data	137/30								
JPSS Ground System AMSR ASD (4)		114							
ESPC Product Generation (3)		16				X	X	X	X
ESPC Reformatting (5)		7							
Cloud Liquid Water (AMSR-2/3)	**130** / 30								
JPSS Ground System AMSR ASD (4)		114	X						
ESPC Product Generation (3)		16				X	X	X	X

	Maximum Latency (minutes)		Data Recipients						
Product/Parameter	**Total System (Th. / Obj.) (1)**	**Allocated To Entity (Threshold)**	**JPSS GS - ESPC**	**JPSS GS - CLASS (7, 10)**	**JPSS GS - USN**	**ESPC - NOAA**	**ESPC - CLASS (10)**	**ESPC - AFWA (9)**	**ESPC - USN (9)**
Imagery (AMSR-2/3)	**130** / 30								
JPSS Ground System AMSR ASD (4)		114	X						
ESPC Product Generation (3)		16				X	X	X	X
Rainfall Rate (AMSR-2/3)	**130** / 30								
JPSS Ground System AMSR ASD (4)		114	X						
ESPC Product Generation (3)		16				X	X	X	X
Sea Ice Characterization (AMSR-2/3)	**137** / 60								
JPSS Ground System AMSR ASD (4)		114	X						
ESPC Product Generation (3)		16				X	X	X	X
ESPC Reformatting (5)		7							
Sea Surface Temperature (AMSR-2/3)	**137** / 60								
JPSS Ground System AMSR ASD (4)		114	X						
ESPC Product Generation (3)		16				X	X	X	X
ESPC Reformatting (5)		7							
Sea Surface Wind Speed (AMSR-2/3)	**130** / 30								
JPSS Ground System AMSR ASD (4)		114	X						
ESPC Product Generation (3)		16				X	X	X	X
Snow Cover/Depth (AMSR-2/3)	**130** / 60								
JPSS Ground System AMSR ASD (4)		114	X						
ESPC Product Generation (3)		16				X	X	X	X
Snow Water Equivalent (AMSR-2/3)	**130** / 60								
JPSS Ground System AMSR ASD (4)		114	X						
ESPC Product Generation (3)		16				X	X	X	X
Soil Moisture (AMSR-2/3)	**130** / 60								

	Maximum Latency (minutes)		Data Recipients						
Product/Parameter	**Total System (Th. / Obj.) (1)**	**Allocated To Entity (Threshold)**	**JPSS GS - ESPC**	**JPSS GS - CLASS (7, 10)**	**JPSS GS - USN**	**ESPC - NOAA**	**ESPC - CLASS (10)**	**ESPC - AFWA (9)**	**ESPC - USN (9)**
JPSS Ground System AMSR ASD (4)		114	X						
ESPC Product Generation (3)		16				X	X	X	X
Total Precipitable Water (AMSR-2/3)	**130** / 30								
JPSS Ground System AMSR ASD (4)		114	X						
ESPC Product Generation (3)		16				X	X	X	X

2.3 Alternate Processing Center

The Alternate Processing Center (APC) is the NOAA facility located at the Vertex Center in Fairmont, WV. The APC will have full command and control but only partial processing capability for the JPSS.

L1RDS-2262 The Alternate Processing Center shall be capable of performing backup operations within 12 hours of the decision to perform failover from the primary Mission Management Center (MMC) to the backup.

L1RDS-2263 The Alternate Processing Center shall be capable of sustaining backup operations for at least 30 consecutive days during each failover event.

L1RDS-2264 The Alternate Processing Center functionality shall be remotely operable from the NSOF.

L1RDS-2265 The Alternate Processing Center shall operate without on-site operations staff, except in the case of Continuity Of Operations deployments.

L1RDS-2266 JPSS shall make the data products listed in Table 2.3 available to AFWA from the APC.

L1RDS-2267 JPSS shall make USN releasable Application Packets (listed in Table 2.3) available to the Fleet Numerical Meteorology and Oceanography Center (FNMOC) and the Naval Oceanographic Office (NAVOCEANO) from the APC.

Table 2.3. JPSS Alternate Processing Center (APC) Products v2.11, Rev -, 8/31/18

	Maximum Latency (minutes)		Data Recipients						
Product/Parameter	**Total System (Th. / Obj.) (1)**	**Allocated To Entity (Threshold)**	**JPSS GS - ESPC**	**JPSS GS - CLASS (7, 10)**	**JPSS GS - USN**	**ESPC - NOAA**	**ESPC - CLASS (10)**	**ESPC - AFWA (9)**	**ESPC - USN (9)**
ATMS Instrument									
ATMS Application Packets	**80**								
JPSS Ground System (2)		80			X				
ATMS RDR	**80** / 30								
JPSS Ground System (2)		80	X	X					
ATMS TDR	**87** / 30								
JPSS Ground System (2)		80	X	X					
ESPC Pass-through / Reformatting (5)		3 / 7				X / X		X / X	
ATMS SDR	**87** / 30								
JPSS Ground System (2)		80	X	X					
ESPC Pass-through (5)		3				X		X	
CERES Instrument									
CERES Application Packets	**80**								
JPSS Ground System (2)		80			X				
CERES RDR	**80**								
JPSS Ground System (2)		80	X	X					
ESPC Pass-through		3				X			
CrIS Instrument									
CrIS Application Packets	**80**								
JPSS Ground System (2)		80			X				
CrIS RDR	**80** / 30								
JPSS Ground System (2)		80	X	X					
CrIS SDR	**87** / 30								
JPSS Ground System (2)		80	X	X					
ESPC Pass-through (5)		3 / 7				X / X		X / X	
ESPC Reformatting		7				X		X	
OMPS Instruments									
OMPS-N Application Packets	**80** / -								
JPSS Ground System (2)		80			X				
OMPS-N RDR	**80** / 30								
JPSS Ground System (2)		80	X	X					
OMPS-N SDR	**83** / 30								
JPSS Ground System (2)		80	X	X					
ESPC Pass-through		3				X		X	
OMPS-L Application Packets	**80** / 60								
JPSS Ground System (2)		80			J2				
OMPS-L RDR	**80** / 60								
JPSS Ground System (2)		80	SNPP & J2	SNPP & J2					
OMPS-L SDR	96/TBD								

	Maximum Latency (minutes)		Data Recipients						
Product/Parameter	**Total System (Th. / Obj.) (1)**	**Allocated To Entity (Threshold)**	**JPSS GS - ESPC**	**JPSS GS - CLASS (7, 10)**	**JPSS GS - USN**	**ESPC - NOAA**	**ESPC - CLASS (10)**	**ESPC - AFWA (9)**	**ESPC - USN (9)**
JPSS Ground System OMPS-L RDR (11)		80	SNPP	SNPP					
ESPC Product Generation (3)		16				X	X	X	X
VIIRS Instrument									
Application Packets	**80** / -								
JPSS Ground System (2)		80			X				
RDR	**80** / 30								
JPSS Ground System (2)		80	X	X					
SDR	**87** / 30								
JPSS Ground System (2)		80	X	X					
ESPC Reformatting/Reformatting (5)		3 / 7				X / X		X / X	
Green Vegetation Fraction (VIIRS)	**25 hr** / 30								
JPSS Ground System VIIRS SDR (4)		80	X						
ESPC Product Generation (3)		24 hr				X	X		
ESPC Reformatting		7				X			
Imagery (VIIRS)	**87** / 30								
JPSS Ground System VIIRS SDR (4)		80	X	X					
ESPC Pass-through/ Reformatting (5)		3 / 7				X / X		X	
Land Surface Emissivity (ATMS)	**96** / 60								
JPSS Ground System ATMS SDR (4)		80	X						
ESPC Product Generation (3)		16				X	X	X	X
Ocean Color/Chlorophyll (VIIRS)	**118** / 30								
JPSS Ground System VIIRS SDR (4)		80	X						
ESPC Product Generation (3,8)		31				X	X		
ESPC Reformatting		7				X			
Ozone Nadir Profile (OMPS-N)	**103** / 60								
JPSS Ground System OMPS-N SDR (4)		80	X						
ESPC Product Generation (3,8)		16				X	X	X	
ESPC Reformatting (5)		7				X			
Ozone Total Column (OMPS-N)	**103** / 60								
JPSS Ground System OMPS-N SDR (4)		80	X	X					
ESPC Product Generation (3,8)		16				X	X	X	

	Maximum Latency (minutes)		Data Recipients						
Product/Parameter	**Total System (Th. / Obj.) (1)**	**Allocated To Entity (Threshold)**	**JPSS GS - ESPC**	**JPSS GS - CLASS (7, 10)**	**JPSS GS - USN**	**ESPC - NOAA**	**ESPC - CLASS (10)**	**ESPC - AFWA (9)**	**ESPC - USN (9)**
ESPC Reformatting (5)		7				X			
Polar Winds (VIIRS)	**204** / 130								
JPSS Ground System VIIRS SDR (4)		80	X						
ESPC Product Generation (3)		117				X	X	X	X
ESPC Reformatting		7				X			
Sea Surface Temperature (VIIRS)	**12 hr** / **103** / 30 (6)								
JPSS Ground System VIIRS SDR (4)		80	X	X					
ESPC Product Generation (3,8)		16				X	X		
ESPC Reformatting		7				X			

Notes:

1. The Total System Threshold Latency (bolded) is specified in the L1RD Appendix A and replicated here for convenience. The Total System Objective Latency is driven by National Weather Service needs.
2. JPSS Ground System Generation latency is the period starting from the time of observation of all requisite data by the satellite until the product is delivered to the ESPC. This includes the time that the data remains on the satellite, data acquisition and routing to the IDP, IDP processing, and the distribution time to the ESPC.
3. ESPC Generation 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 and making the data available to the end user interface. Latency times are for granule generation. The latency times to generate regional, orbital and global products will be longer. Latency times do not include distribution time to users who retrieve their products from CLASS (Note 7).
4. JPSS Ground produces the RDR and/or SDR, reformats and delivers these products in accordance with the RDR and/or SDR requirements. For ESPC-generated EDRs, the RDR and/or SDR is utilized as intermediate processing data product specific to the EDR requirement as noted in the latency budget. These EDR requirements specify the delivery of the EDR data product only.
5. ESPC provides both delivery and reformatting of JPSS Ground System Products to the user community. JPSS Ground System HDF5-formatted products are passed-through ESPC with an allocated 3 minutes of latency, making the maximum latency at 83 minutes. ESPC reformatting requirements are specified in the JERD where this processing and delivery is allocated 7 minutes, making the maximum latency 87 minutes. For simplicity if both native HDF5 and reformatted products are distributed, JPSS maintains the maximum possible latency amount associated.
6. The NOS/NMFS operational requirement for the Priority 2 (Critical) SST product is 12 hours since they do not run 24/7 operations. The NWS requires this product quicker (within 103 minutes) but at a Priority 3 criticality. However, the lower latency capability is beneficial to NOS/NMFS, consistent with what is done with current operations, and therefore the ground system shall be developed and procured to meet the 103 minute requirement.
7. There is no latency requirement for products delivered to CLASS. They are currently delayed for 6 hours (configurable) to ensure that CLASS only receives one set of the best data.
8. JPSS Ground System produces the upstream SDR within 80 minutes and provides this to ESPC for EDR product generation.
9. ESPC is only required to make these products available to USN and/or AFWA. Any additional work will be done on a reimbursable basis. Latency for these products is driven by NOAA.
10. Products specified in the JPSS/NCDC Submission Agreement.

Table 2.4. JPSS Alternate Processing Center (APC) Products, v2.11, Rev -, 8/16/17

	Maximum Latency (minutes)		Data Recipients						
Product/Parameter	**Total System (Th. / Obj.) (1)**	**Allocated To Entity (Threshold)**	**JPSS GS - ESPC**	**JPSS GS - CLASS (7, 10)**	**JPSS GS - USN**	**ESPC - NOAA**	**ESPC - CLASS (10)**	**ESPC - AFWA (9)**	**ESPC - USN (9)**
AMSR-2/3 Instrument									
AMSR Calibrated Sensor Data	130		X		X				
JPSS Ground System (2)		114							**X**
AMSR-2/3 APID Sorted Data	117 / 30								
JPSS Ground System (2)		114							
ESPC *Pass-through*		*3*	*X*	*X*					
Sea Surface Temperature (AMSR-2/3)	**137** / 60								
JPSS Ground System AMSR-2/3 RDR (4)		114	X						
ESPC Product Generation (3)		16				X	X	X	X
ESPC Reformatting		7				X			

2.4 Direct Broadcast Support

The JPSS Program supports the Direct Broadcast community by broadcasting sensor data continuously in real-time from satellites such as S-NPP and JPSS-n. Further, the JPSS Ground System will make available data processing software and documentation to enable Direct Broadcast users to use their own hardware to receive High Rate Data (HRD) broadcasts and to produce data products.

The JPSS Ground System Direct Broadcast/Field Terminal Support Node will provide limited support to the users of the Direct Broadcast downlinks as described below. Since the JPSS Program is not responsible for developing, testing, or deploying any JPSS capable field terminal, NOAA and DoD agencies and Direct Broadcast/Field Terminal Users will need to develop (or procure) and operate their own hardware suite to receive the HRD broadcasts. The JPSS program scope is limited to providing the Direct Broadcast/Field Terminal community with software and ancillary data (only) to enable them to produce instrument data products from the JPSS satellites.

L1RDS-2269 The JPSS Ground System shall provide specifications for the real-time data receipt and processing hardware framework that is required to receive and process the JPSS Direct Broadcast.

L1RDS-2270 The JPSS Ground System shall provide a description of the science algorithms needed to process the JPSS Direct Broadcast data.

L1RDS-2271 The JPSS Ground System shall monitor the quality of the HRD Direct Broadcast downlinks during at least 3 passes per day for each of the JPSS managed satellites.
(Monitoring consists of ensuring that the downlink is functioning properly and that application packets generated on the spacecraft are arriving in good condition at the ground system monitoring point. This support does not include monitoring the scientific quality of any products generated by the user's field terminal.)

L1RDS-2272 The JPSS Ground System shall provide ancillary and auxiliary data required by the field terminal software in order for local users to acquire satellite signals and generate high quality products.

2.5 Reimbursable and Other Negotiated Services

The following requirements reflect services provided by the JPSS Ground Segment per NOAA agreements, or services whose cost is reimbursed to the JPSS program by the recipient of the services.

L1RDS-2273 The JPSS Ground System shall provide Metop data routing services to/from the NASA-Metop interface at McMurdo Ground Station (MGS) and the Metop Service Delivery Point at Darmstadt, Germany. (NOAA Funded Negotiated Service)

L1RDS-2274 The JPSS Ground System shall provide data acquisition and routing services for the Defense Meteorological Satellite Program (DMSP) to/from the McMurdo Ground Station and the DMSP Service Delivery Point at Offutt AFB near Omaha, Nebraska. (Reimbursable Service)

L1RDS-2275 The JPSS Ground System shall provide Coriolis/Windsat data acquisition and routing services to/from Svalbard and the Coriolis/Windsat Service Delivery Point at the NOAA Satellite Operations Facility (NSOF). (Reimbursable Service)

L1RDS-2276 The JPSS Ground System shall provide data routing services from the JPSS Svalbard and McMurdo ground stations to the NASA Space Communications and Navigation (SCaN) Point of Presence for NASA SCaN supported missions in the Continental United States (CONUS). (Reimbursable Service)

L1RDS-2277 The JPSS Ground System shall provide data routing services between the McMurdo Ground Station and the NSF Service Delivery Point in Centennial, Colorado. (Reimbursable Service)

L1RDS-2533 The JPSS shall make available all sensor science data acquired to the NASA Science Data Segment (SDS) service delivery point at the NSOF.

L1RDS-2542 The JPSS Ground Segment shall provide reimbursable and other negotiated services to the DoD data processing centers and other non-NOAA recipients. (Reimbursable Service)

3 JPSS SDR/EDR OVERVIEW

3.1 General EDR Information

JPSS users have stated system requirements that meet baseline system performance in terms of Environmental Data Records (EDRs) with measurable performance attributes. Where attributes have not been specified and do not need to be specified by the user, the term Not Specified (NS) will be used in this document to denote deliberate omission. These EDRs/attributes specify the capabilities of the system required to achieve the operational effectiveness required for their specific missions.

3.1.1 Key Performance Parameters (KPPs)

Minimum mission success[1] of the JPSS requires all four performance attributes identified as Key Performance Parameters (KPPs) in Section 5.0 of the L1RD 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, and would be cause for program reevaluation or cancellation. Data for the KPPs are generated by three of the JPSS sensors: the Advanced Technology Microwave Sounder (ATMS), the Cross-track Infrared Sounder (CrIS) and the Visible Infrared Imaging Radiometer Suite (VIIRS).

The JPSS KPPs, repeated here for completeness, are:

- ATMS Temperature Data Records (TDRs)
- CrIS SDRs
- VIIRS Imagery EDR for bands I1, I4, I5, M14, M15, M16, and the Near-Constant Contrast (NCC) EDR for latitudes greater than 60ºN in the Alaskan Region
- 96 minute data latency for the ATMS TDRs and CrIS SDRs and the VIIRS Imagery EDR channels specified above.

Although they are not considered KPPs and are not considered relevant to minimum mission success/KPP performance, all EDR attributes are important to the system in order to meet the baseline target performance. If the thresholds for any EDR attribute cannot be met, then a waiver is required from the JPSS Director, with concurrence from the NOSC, or NOAA may elect to provide additional funding to make the necessary changes to instruments or algorithms to achieve Threshold performance.

3.1.2 Description of EDR Terms and Conventions

3.1.2.1 EDR Description/Rationale

A brief description and the rationale explaining the use/need for each JPSS EDR is contained in the Glossary to this Supplement.

[1] The use of "Full / Minimum system success" is a deliberate departure from NPR 7120.5 (which uses "baseline requirements" and "threshold requirements"). The use of "Full" and "Minimum" meets NOAA stakeholder communication needs.

3.1.2.2 Latency

System latency is defined 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 Ground Segment/User Interface. Latency requirements (which must be met at least 95% of the time) are specified in the L1RD Appendix A, Table 1, and are allocated in L1RDS Table 2.2 to the systems comprising the JPSS Ground Segment.

L1RDS-56 In a missed pass scenario, data shall be recovered on subsequent passes.

L1RDS-57 Recovery of missed data shall not impact the delivery of data that can still meet EDR latency requirements.

3.1.2.3 Availability

Availability is the measure of the probability that a system is operationally capable (ready for tasking) of performing an assigned mission (e.g., delivering a KPP) at any given time. The L1RD Operational Availability requirements for the total JPSS System are specified in terms of maximum outages (hours) per month, apportioned as shown in the following requirements.

L1RDS-2278 The total JPSS System operational outages, excluding on orbit failures, shall be less than 14 hours over any 30-day period for the mission lifetime.

L1RDS-2279 JPSS Ground System operational outages, excluding on orbit failures, shall be less than 7.2 hours over any 30-day period for the mission lifetime.

L1RDS-2280 Operational outages of ESPC systems which support JPSS functionality shall be less than 5 hours over any 30-day period for the mission lifetime.

L1RDS-2281 S-NPP and JPSS-n satellite operational outages, excluding on-orbit failures, shall be less than 2 hours over any 30-day period for the mission lifetime.

3.2 EDR Performance Requirements

General EDR conventions and requirements are described in Appendix A to this Supplement. EDR specific performance requirements are specified in EDR specific attribute tables except as modified by Appendix D of the Suomi National Polar-orbiting Partnership (S-NPP) mission. The following general EDR requirements apply to all environmental data derived from the JPSS data stream and made available via the external interfaces to JPSS customers and users.

L1RDS-62 Each EDR shall satisfy the Threshold requirements described in its respective EDR attribute table, except as modified by Appendix D for the S-NPP mission.

L1RDS-63 Accuracy, Precision, and Uncertainty (APU), and Probability of Correct Typing (PCT) requirements shall apply only within the specified Measurement Range.

L1RDS-64 JPSS shall measure and report retrieved values outside of the required Measurement Range to the extent necessary for validating retrievals at the ends of the range, but such retrieved values are not subject to APU and PCT requirements.
In most cases the capability of the sensors and supporting algorithms must allow retrievals beyond the limits of the required Measurement Range in order to facilitate a sufficient distribution of samples for validating retrieved values at the ends of the range.

L1RDS-66 Data Product APU and PCT performance shall be assessed and validated against their requirements using correlative data that are well-defined and generally accepted by the user community.

Estimates of known errors and uncertainties in correlative data will be factored into APU and PCT performance estimates. The correlative data used for performance validations may result from analysis, laboratory measurements, simulations, and direct or indirect observations including measurements from in-situ, aircraft, or spacecraft platforms.

3.3 Degradation and Exclusion Conditions for EDRs, SDRs and TDRs

Degradation and Exclusion Conditions define environmental or sensor viewing conditions that may be unique to each EDR, SDR, or Temperature Data Record (TDR) and are known to affect the quality of the retrieved data product. Examples include, but are not limited to, sun glint, high solar zenith angle, prohibitive aerosol optical depth and cloud optical thickness, shallow water, stressing Earth surface conditions, failed instrument detectors, and sensor near-field scattering adjacent to a bright source in a scene. Degradation and Exclusion conditions related to specific EDRs are captured in the Level 2 documents.

Under Degradation Conditions, a retrieved value within a data product has utility but may be degraded in performance or falls outside of the required coverage or measurement range.

L1RDS-79 Retrieved values within an EDR, SDR, or TDR that are described by Degradation Conditions shall be produced and delivered.

L1RDS-80 There is no requirement for validation of retrieved values that are described by Degradation Conditions; however, performance shall be characterized during the validation campaign, to the extent that validation data are available, in order to provide an assessment of performance for the delivered product.

L1RDS-81 A quality flag shall be included to indicate the application and identity of a Degradation Condition to a retrieved value in a data record.

L1RDS-83 Under Exclusion Conditions, a retrieved value within a data product may be so degraded as to have reduced utility, measurement by the system may not be possible (e.g., due to a failed detector), or a supporting algorithm may fail to converge. No estimate of performance under an Exclusion Condition is required, nor is performance required to be characterized during the validation campaign.
Values within an RDR, SDR, and TDR that can be retrieved and processed by the system shall be produced and delivered under all environmental and sensor viewing conditions.

L1RDS-85 All raw and sensor data available from the system should be delivered regardless of whether or not EDR Degradation and Exclusion Conditions apply.
Unless otherwise indicated for an EDR and where possible, retrieved values that are described by Exclusion Conditions shall be produced if necessary to support additional downstream processing.

L1RDS-86 A quality flag shall be included to indicate the application and identity of an Exclusion Condition to a retrieved value in a data record.

L1RDS-87 Unless otherwise indicated for a particular EDR or requirements attribute, Degradation and Exclusion Conditions shall apply to an entire horizontal cell as defined by the Horizontal Cell Size (HCS) requirement for that EDR.

When the EDR cell value is produced from an aggregate of retrievals at finer resolution, not all of which are under the same condition, the condition defined is associated with the aggregate product for the cell and is not determined by a Degradation or Exclusion Condition that may exist for a small subset of retrievals within the cell.

3.4 System Stability Requirements

JPSS data are leveraged for maintenance of the long-term climate record. Climate quality data products cannot be produced within the latency requirements of the JPSS operational product stream since the climate products require application of traditional scientific methods for producing these products, i.e., post-processing and analysis of the data to apply knowledge of environmental parameters not available at the time of initial data product production and to account for all contributing error sources at the temporal and spatial scales unique to climate science.

The reprocessing and validation of JPSS data records using refined algorithms and post-facto knowledge of sensor characteristics in order to produce long-term records of climate quality is outside the scope of the JPSS Program. JPSS is responsible for providing data sufficient to facilitate the reprocessing and scientific analysis necessary for supporting climate applications of the JPSS data records.

L1RDS-92 The system shall maintain the mean calibrated radiometric retrieved value of an SDR or TDR for a uniform scene to a relative accuracy of 2% (TBR-2).

3.4.1 Sensor Characterization and Monitoring

The following system requirements for sensor characterization and monitoring are imposed on the JPSS Program.

L1RDS-96 Sensor calibration data and statistics shall be produced, monitored, and archived over the operational life of the JPSS instruments.

L1RDS-97 Sensor engineering, housekeeping, characterization, and telemetry data and other records required for sensor parameter trending shall be collected, monitored, archived, and made accessible to the JPSS stakeholders for the duration of the Program.

L1RDS-98 As allowed by launch phasing and the availability of on-orbit assets, overlapping sensor engineering, housekeeping, characterization, and telemetry data and other records required for sensor parameter trending from analogous sensors on consecutive JPSS missions shall be collected, monitored, archived, and made accessible to the JPSS stakeholders for at least three months and up to one year of the mission overlap for cross-comparison and bias determination.

3.4.2 Sensor and Data Trending

L1RDS-102 Sensor trending data shall be analyzed and the trending analysis results archived and made accessible to the JPSS stakeholders.

L1RDS-103 All versions of, and documents describing, data product algorithms, algorithm coefficient tables, and Look-Up Tables used to produce JPSS data records shall be archived and made publically accessible.

L1RDS-104 Performance impact assessments of proposed configuration changes to the data product ground processing software shall be completed and documented prior to those changes being implemented in the operational baseline.

3.5 Data Quality Monitoring

Data Quality Monitoring provides metrics and near real-time reports that provide the operators with a capability to assess the performance of the JPSS acquisition, processing and product delivery in near real-time. These metrics and reports ensure the operators that all science products are complete and delivered to the JPSS Ground Segment/User Interface. It provides access to data which can be used off-line to monitor the science quality of the environmental data products.

L1RDS-2282 The JPSS Ground System shall provide metrics and near real-time reports on data quality and Stored Mission Data (SMD) accounting data to the ESPC.

L1RDS-2534 The ESPC systems which support JPSS functionality shall monitor data input and output quality.

3.6 Intermediate Products

An Intermediate Product (IP) is a product generated at a specific point in the Data Processing node processing stream, stored for a finite period of time, and used internally as an input to other data processing applications. There are no performance attribute requirements associated with an IP.

Retained Intermediate Products (RIPs) are a finite category of IPs specifically identified as important for off-line analysis, calibration and validation, and post-processing of JPSS SDRs and EDRs.

L1RDS-108 The system shall make the RIPs identified in Table 3.6 available for access and archival.

If the equivalent data are packaged within an EDR, the system will not be required to make available RIPs with duplicative data.

Table 3.6. RIPs v.2.2, 9/26/12

Atmospheric Vertical Moisture Profile Line-of-Sight Infrared
Atmospheric Vertical Moisture Profile Line-of-Sight Microwave
Atmospheric Vertical Temperature Profile Line-of-Sight Infrared
Atmospheric Vertical Temperature Profile Line-of-Sight Microwave
Cloud Cleared Radiances
Infrared Surface Emissivity
Microwave Surface Emissivity
Skin Temperature
OMPS Nadir Profile Averaging Kernel
OMPS Nadir Total Column Ozone First Guess
VIIRS Aerosol Model Information
VIIRS Aerosol Optical Thickness
VIIRS Bright Pixel
VIIRS Calibrated Dual-Gain Band
VIIRS Cloud Base Height
VIIRS Cloud Cover-Type
VIIRS Cloud Layer-Type
VIIRS Cloud Optical Properties
VIIRS Cloud Top Parameters
VIIRS Ice & Night Water Cloud Top Temperature
VIIRS Ice Concentration
VIIRS Ice Quality Flags
VIIRS Ice Reflectance/Temperature
VIIRS Ice Weights
VIIRS On-board Calibrator
VIIRS Parallax Corrected Cloud Mask
VIIRS Parallax Corrected Cloud Optical Properties

VIIRS Parallax Corrected Cloud Top Parameters
VIIRS Surface Reflectance
VIIRS Surface Temperature
VIIRS Surface Ice Cover
VIIRS Un-Aggregated 750m Dual-Gain Band Geo
VIIRS Global/Rolling 5-km NBAR NDVI Gridded RIP Format
VIIRS Land Surface Albedo Gridded RIP Format
VIIRS Monthly Brightness Temperature, Surface Reflection, and Vegetation Index
VIIRS Snow/Ice Cover Gridded RIP Format
VIIRS Solar Diffuser History

4 JPSS SENSOR DATA RECORDS (SDRS)

The SDR converts the reconstructed unprocessed instrument and payload data at full resolution in an RDR into processed instrument data at full resolution, time-referenced, and with radiometric and geometric calibration coefficients and geolocation parameters applied. Microwave instruments may produce analogous TDRs, which consist of geolocated antenna temperatures for each applicable channel. The existence of the SDRs provides reversible data tracking back from the EDRs to the RDRs.

The values in the Section 4 tables are Threshold values and failure to meet any of the listed attributes would require a deviation or waiver.

4.1 Advanced Technology Microwave Sounder (ATMS)

ATMS SDR/TDR Description:

The ATMS TDR is comprised of multiple, consecutive scans (i.e., a data granule) for 22 channels and consists of antenna brightness temperatures (T_a) in units of Kelvin with the reference geolocation position (latitude and longitude in degrees) associated with the beam center from each instrument feed horn. Also includes applicable quality flags and metadata.

The ATMS SDR is comprised of multiple, consecutive scans for 22 channels and consists of brightness temperatures in units of Kelvin adjusted for antenna patterns, and including applicable quality flags, metadata, and the reference geolocation position (latitude and longitude in degrees) associated with the beam center from each instrument feed horn.

ATMS and Cross-track Infrared Sounder (CrIS) SDRs are used to produce the CrIS/ATMS EDRs.

L1RDS-2288 The ATMS TDR and SDR shall satisfy the Threshold performance characteristics as given in Table 4.1, for a uniform scene, across the instrument Effective Field of View (EFOV).

Table 4.1. ATMS SDR/TDR Threshold Performance Characteristics v2.10, 3/18/14

Channel	Center Frequency (GHz) (1)	Total Bandpass (GHz)	Polarization	Accuracy (K)	NEdT @300 K (K)	EFOV Cross-Track (deg.)	EFOV Along-Track (deg.)	Dynamic Range (k)
1	23.8	0.27	QV	1	0.7	6.3	5.2	0-330
2	31.4	0.18	QV	1	0.8	6.3	5.2	0-330
3	50.3	0.18	QH	0.75	0.9	3.3	2.2	0-330
4	51.76	0.4	QH	0.75	0.7	3.3	2.2	0-330
5	52.8	0.4	QH	0.75	0.7	3.3	2.2	0-330
6	53.596±0.115	0.17	QH	0.75	0.7	3.3	2.2	0-330
7	54.4	0.4	QH	0.75	0.7	3.3	2.2	0-330
8	54.94	0.4	QH	0.75	0.7	3.3	2.2	0-330
9	55.5	0.33	QH	0.75	0.7	3.3	2.2	0-330
10	57.290344	0.33	QH	0.75	0.75	3.3	2.2	0-330
11	57.290344±0.217	0.078	QH	0.75	1.2	3.3	2.2	0-330

Channel	Center Frequency (GHz) (1)	Total Bandpass (GHz)	Polarization	Accuracy (K)	NEdT @300 K (K)	EFOV Cross-Track (deg.)	EFOV Along-Track (deg.)	Dynamic Range (k)
12	57.290344±0.3222±0.048	0.036	QH	0.75	1.2	3.3	2.2	0-330
13	57.290344±0.3222±0.022	0.016	QH	0.75	1.5	3.3	2.2	0-330
14	57.290344±0.3222±0.010	0.008	QH	0.75	2.4	3.3	2.2	0-330
15	57.290344±0.3222±0.0045	0.003	QH	0.75	3.6	3.3	2.2	0-330
16	88.2	2	QV	1	0.5	3.3	2.2	0-330
17	165.5	3	QH	1	0.6	2.2	1.1	0-330
18	183.31±7	2	QH	1	0.8	2.2	1.1	0-330
19	183.31±4.5	2	QH	1	0.8	2.2	1.1	0-330
20	183.31±3	1	QH	1	0.8	2.2	1.1	0-330
21	183.31±1.8	1	QH	1	0.8	2.2	1.1	0-330
22	183.31±1	0.5	QH	1	0.9	2.2	1.1	0-330

Notes:

QV = Quasi-Vertical QH = Quasi-Horizontal NEdT = Noise Equivalent Differential Temperature

1. The specified values for the center frequency of each channel do not include plus/minus "tolerances" on the center frequency. As with heritage microwave sounding instruments, the nomenclature used with the requirements values specify the passband characteristics of each channel, i.e., whether it is a single passband, double sideband, or quadruple sideband channel.

4.2 Reserved

4.3 Cross-track Infrared Sounder (CrIS)

CrIS Sensor Data Record Description:

The CrIS SDR is comprised of multiple, consecutive scans of the calibrated, unapodized radiance (real and imaginary) for each Field of View (FOV), reported in mW/(m^2 sr cm^{-1}) for each of 1317 output radiance bins, along with the estimated Noise Equivalent Differential Radiance (NEdN), applicable quality flags, metadata, and the associated geolocation (latitude and longitude in degrees) for each FOV.

L1RDS-2289 The CrIS SDR shall satisfy the Threshold performance characteristics as given in Table 4.3, for the given channels, for a uniform scene, for each instrument FOV.

Table 4.3. CrIS Threshold Performance Characteristics v2.5, 1/22/13

Channel	Wavenumber (cm^{-1})	Spectral Resolution (cm^{-1})	Polarization	Accuracy @ 287 K (%)	Maximum NEdN (mW/(m^2-sr-cm^{-1})	Nadir FOV (km)	Spectral Uncertainty (ppm)
LW	650-1095	0.625	NS	0.45	0.45 @ 670 cm^{-1} 0.15 @ 700 cm^{-1} 0.15 @ 850 cm^{-1} 0.15 @ 1050 cm^{-1}	15	10
MW	1210-1750	1.25 (Obj. 0.625)	NS	0.58	0.055 @ 1225 cm^{-1} 0.045 @ 1250 cm^{-1} 0.049 @ 1500 cm^{-1} 0.053 @ 1700 cm^{-1}	15	10

Channel	Wavenumber (cm^{-1})	Spectral Resolution (cm^{-1})	Polarization	Accuracy @ 287 K (%)	Maximum NEdN ($mW/(m^2\text{-}sr\text{-}cm^{-1})$)	Nadir FOV (km)	Spectral Uncertainty (ppm)
SW	2155-2550	2.5 (Obj. 0.625)	NS	0.77	0.0062 @ 2200 cm^{-1} 0.007 @ 2350 cm^{-1} 0.007 @ 2550 cm^{-1}	15	10
Notes:							
LW = Longwave		MW= Mid-Wave		SW = Shortwave	NS = Not Specified		

4.4 Ozone Mapping and Profiling Suite (OMPS)

The OMPS-N consists of two instruments, a Nadir Total Column Mapper (NM) and a Nadir Profiler (NP).

4.4.1 OMPS Nadir Total Column Mapper SDR

The OMPS NM SDR is comprised of calibrated radiances [mW/(m^2 sr nm)] in 288 channels from multiple, consecutive fields of view (FOV), along with applicable quality flags, metadata, and the associated geolocation (latitude and longitude in degrees). The OMPS NM SDR requirements facilitate satisfaction of the ozone EDR and performance necessary for exploitation of these data in external Climate Data Record production.

L1RDS-2293 The OMPS NM SDR shall satisfy the Threshold performance characteristics as given in Tables 4.4.1.1 and 4.4.1.2 for all scenes and all Fields of View.

4.4.1.1 OMPS NM SDR Performance Requirements

Table 4.4.1.1. J1 OMPS NM SDR Performance Requirements v2.10, 1/24/14

Parameter	Requirements	Comments
Wavelength range	300-420 nm	Ozone and path length range, aerosol index leverage, stray light monitoring, solar features for Ring effect
Bandwidth	< 1.1 nm	Distinguish Solar lines and O_3, and SO_2 absorption features
Samples/FWHM	> 2.3	λ-shift, Ring effect, Multiple pairs and triplets for O_3, additional wavelengths for SO_2, intervals for Cloud Optical Centroid
Horizontal cell size	< 50 km @ Nadir	SO_2, aerosols
Horizontal coverage	> 2800 km	Daily global coverage
SNR	> 300 for SZA < 80	Precision for pixel bin factor of 4 and 1 sec integration, for 305 - 380 nm at min. radiance
Polarization sensitivity	< 5%	Accuracy
λ-registration	< 0.01 nm	O_3 and SO_2 Absorption features and solar registration
Albedo calibration	< 2%	Accuracy and stability
Pixel to pixel calibration (includes linearity)	< 0.5%	Accuracy
Albedo deviation error	< 1%	Accuracy and stability
Stray Light (out of band)	< 1%	For 305 - 380 nm. < 2% for other channels. After correction.

4.4.1.2 Wavelength and SNR Required for Ozone Profile Product

Table 4.4.1.2. Wavelength and SNR Required for Ozone Profile Project v2.10, 1/24/14

Wavelength (nm)	Minimum SNR	Min. Radiance (ph/sec-cm^2-sr-nm)
312.5	1000	2.61E+12
318	1000	3.26E+12
331	1000	4.43E+12
336	1000	1.17E+13
364	1000	5.01E+12
377	1000	5.16E+12

4.4.2 OMPS Nadir Profiler SDR

The OMPS NP SDR is comprised of calibrated radiances [mW/(m^2 sr nm)] in 144 channels from consecutive fields of view (FOV), along with applicable quality flags, metadata, and the associated geolocation (latitude and longitude in degrees). The OMPS NP SDR requirements facilitate satisfaction of the ozone EDR and performance necessary for exploitation of these data in external Climate Data Record production.

L1RDS-2541 The OMPS NP SDR shall satisfy the Threshold performance characteristics as given in Tables 4.4.2.1 and 4.4.2.2 for all scenes and all Fields of View.

4.4.2.1 OMPS NP SDR Performance Requirements

Table 4.4.2.1. J1 OMPS NP SDR Performance Requirements v2.10, 1/24/14

Parameter	Requirement	Comments
Wavelength range	250 - 310 nm	Ozone profiling, column, and UV reflectivity
Bandwidth (FWHM)	< 1.1 nm	Discrete channels
Samples/FWHM	> 2.3	λ-shift, Mg II Index, Many more channels will be used to reduce noise for smaller FOVs
Horizontal cell size	< 50 km @ Nadir	Oversampling
SNR	See Table 4.4.2.2	Precision for bin size of 100 and 38 sec integration, all pixels binned at min. radiance
Polarization sensitivity	< 5%	Accuracy
λ-registration	< 0.01 nm	Ozone absorption λ-dependence and solar variability
Albedo calibration	< 2%	Accuracy and stability
Pixel to pixel calibration (includes linearity)	< 1%	Accuracy
Stray light, out-of-band	< 1%	For critical channels in Table 4.4.2.2, after applying correction

4.4.2.2 Wavelength, SNR, and Radiances for Critical Channels

Table 4.4.2.2. Wavelength, SNR, and Radiances for Critical Channels v2.10, 1/24/14

Wavelength nm	Minimum SNR	Min. Radiance ph/sec-cm^2-sr-nm
252.00	35	1.52E+08
273.61	100	6.86E+08
283.10	200	1.39E+09
287.70	260	1.88E+09
292.29	400	3.52E+09
297.59	400	5.21E+09
301.97	400	5.84E+09
305.87	400	1.03E+10

4.4.3 OMPS Limb Profiler SDR

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

L1RDS-13252 The OMPS Limb Profiler SDR shall satisfy the Threshold performance characteristics as given in Tables omps-lp-1, omps-lp-2a, omps-lp-2b, and omps-lp-2c for all scenes with solar zenith angles less than 80 degrees and all Fields of View.

L1RDS-13253 The OMPS Limb Profiler SDR shall produce OMPS LP SDR products globally.

Table 4.4.3. OMPS Limb Profiler SDR Products

Parameter	Requirements	Comments
Wavelength range	290 nm to 1020 nm	Ozone and path length range, aerosol dependence, stray light monitoring, solar features for wavelength scale, RSAS pointing
Bandwidth	1.5 nm to 40 nm	Distinguish Solar lines and O3 absorption features.
Samples /FWHM	≥ 2	λ-shifts, gridding

Parameter	Requirements	Comments
Number of channels	32 (for 12 images with 80 vertical pixels)	Gridding/interpolation, Multiple pairs and triplets for O3, reflectivity, aerosols, RSAS pointing
Horizontal cell size	125 km along track	Stratospheric features
Horizontal coverage	3 Nadir FOVs ±250 km	4 day global coverage
Signal to noise ratio (SNR)	See tables	Precision, pixel bin factor of 1, 19-S integration
Polarization sensitivity	< 3 %	Accuracy
λ-registration	< 0.01 pixels	O3 Absorption features and solar registration
Albedo calibration	2%	Accuracy and stability
Pixel to pixel calibration	0.5% max.	Accuracy
Albedo deviation error	< 1%	Accuracy and stability between weekly solar
Stray Light	< 10%	Accuracy (Instrument performance before SDR correction

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

	290 nm		293 nm		296 nm		299 nm		302 nm	
	snr	mr	snr	mr	snr	mr	snr	mr	snr	mr
61-65 km	65	4.45	70	4.33	75	4.20	70	3.47	80	3.67
53-60 km	75	5.43	85	5.33	n/a	5.22	n/a	4.36	n/a	4.63
50-53 km	105	8.1	125	9.0	145	9.89	145	9.05	170	10.0
47-50 km	n/a	7.1	n/a	8.45	145	9.8	170	11.6	200	13.4
45-47 km	n/a	6.67	n/a	7.83	n/a	8.99	170	11.6	220	16.0
43-45 km	n/a	6.34	n/a	7.38	n/a	8.42	160	10.6	240	17.2
38-43 km	n/a	5.74	n/a	6.62	n/a	7.49	n/a	9.17	n/a	17.4
[illegible]	n/a	[illegible]	n/a	[illegible]	n/a	[illegible]	n/a	[illegible]	[illegible]	[illegible]
[illegible]	n/a	[illegible]	n/a	[illegible]	n/a	[illegible]	n/a	[illegible]	[illegible]	[illegible]
[illegible]	n/a	[illegible]	n/a	[illegible]	n/a	[illegible]	n/a	[illegible]	[illegible]	[illegible]

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

	310 nm		320 nm		347 nm		353 nm		400 nm	
	snr	mr	snr	mr	snr	mr	snr	mr	snr	mr
61-65 km	95	3.87	135	5.08	150	4.76	150	4.69	90	4.31
53-60 km	n/a	4.91	n/a	6.46	180	6.05	180	5.97	110	5.48
50-53 km	n/a	11.0	n/a	14.8	300	14.1	300	13.9	190	12.7
47-50 km	n/a	15.3	n/a	21.1	360	20.3	360	20.0	240	18.3
45-47 km	n/a	20.5	n/a	29.6	460	29.1	460	28.7	300	26.4
43-45 km	320	23.8	440	36.9	500	37.1	500	36.7	360	33.7
38-43 km	320	25.6	500	45.1	500	47.5	500	46.9	400	43.3
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Check the JPSS MIS Server at http://jpssmis_gsfc.nasa.gov/frontmenu_dsp.cfm to verify that this is the correct version prior to use.

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

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

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

4.5 Reserved

4.6 Visible Infrared Imaging Radiometer Suite (VIIRS)

VIIRS Sensor Data Record Description:

The VIIRS SDR is comprised of multiple, consecutive scans for a selectable set of 22 channels and consists of both radiance in units of W/(m^2-sr-µm) and reflectance (no units) or brightness temperatures in units of Kelvin (less the Day-Night Band (DNB) channel) for each FOV, along with applicable quality flags, metadata, and the associated geolocation (latitude and longitude in degrees) for each FOV within each channel. The DNB channel (Channel 17) is provided in units of W/(sr-cm^2).

L1RDS-2290 The VIIRS SDR shall satisfy the Threshold performance characteristics as given in Table 4.6, for a uniform, unpolarized scene, across the instrument Effective Field of Regard.

Table 4.6. VIIRS SDR Threshold Performance Characteristics v2.11, 11/17/16

Channel	Center Wavelength (nm)	Bandpass (nm)	Maximum Polarization Sensitivity (%)	Accuracy @ Ltyp or Scene Temperature (%) (5)	SNR @ Ltyp or NEdT @ Ttyp (3)	FOV @ Nadir (km)	FOV @ Edge-of-Scan (km)	Ltyp or Ttyp [(K or W/(m^2-sr-µm)]	Dynamic Range [K or W/(m^2-sr-µm)]
1	412	20	3	2	352 316	0.8	1.6	44.9 155	30-615
2	445	18	2.50	2	380 409	0.8	1.6	40 146	26-687
3	488	20	2.50	2	416 414	0.8	1.6	32 123	22-702
4	555	20	2.50	2	362 315	0.8	1.6	21 90	12-667

Channel	Center Wavelength (nm)	Bandpass (nm)	Maximum Polarization Sensitivity (%)	Accuracy @ Ltyp or Scene Temperature (%) (5)	SNR @ Ltyp or NEdT @ Ttyp (3)	FOV @ Nadir (km)	FOV @ Edge-of-Scan (km)	Ltyp or Ttyp [(K or W/(m^2-sr-µm)]	Dynamic Range [K or W/(m^2-sr-µm)]
5	672	20	2.50	2	242 360	0.8	1.6	10 68	8.6-651
6	746	15	2.50	2	199	0.8	1.6	9.6	5.3-41.0
7	865	39	3	2	215 340	0.8	1.6	6.4 33.4	3.4-349
8	1240	20	NS	2	74	0.8	1.6	5.4	3.5-164.9
9	1378	15	NS	2	83	0.8	1.6	6	0.6-77.1
10	1610	60	NS	2	342	0.8	1.6	7.3	1.2-71.2
11	2250	50	NS	2	90	0.8	1.6	1.0	0.12-31.8
12	3700	180	NS	0.70	0.396	0.8	1.6	270 K	230-353 K
13	4050	155	NS	0.70	0.107 0.423	0.8	1.6	300 K 380 K	230-634 K
14	8550	300	NS	0.60	0.091	0.8	1.6	270 K	190-336 K
15	10763	1000	NS	0.40	0.07	0.8	1.6	300 K	190-343 K
16	12013	950	NS	0.40	0.072	0.8	1.6	300 K	190-340 K
17	700	400	NS	5/10/30 (2)	6 (4)	0.8	0.8	NS	3E^{-5} to 200 (1)
18	640	80	2.5	2	119	0.4	0.8	22	5-718
19	865	39	3	2	150	0.4	0.8	25	10.3-349
20	1610	60	NS	2	6	0.4	0.8	7.3	1.2-72.5
21	3740	380	NS	5	2.5	0.4	0.8	270K	210-353 K
22	11450	1900	NS	2.5	1.5	0.4	0.8	210K	190-340 K

Notes:

1. DNB Units are in W/(sr-m^2)
2. DNB Low Gain / Mid-Gain / High Gain requirements
3. Dual entries indicate requirements for dual-gain channels
4. For the DNB, the SNR requirement is referenced to the minimum radiance (Lmin), vice Ltyp, and is applicable to scan angles less than 53 degrees.
5. The stated Accuracy requirements for the VIIRS solar reflective bands are on the reflectance, not the radiance. The reflectance accuracy requirement is applicable at the stated typical radiance (Ltyp). The radiance range represents the range over which reflectance values are measured. The accuracy requirements for the thermal emissive moderate resolution bands (Channels 12-16) are applicable to a scene brightness temperature of 270K. The accuracy requirements for the thermal emissive imagery resolution bands (Channels 21 and 22) are applicable to a uniform scene of brightness temperature 267K.
6. Ltyp = Typical Radiance SNR = Signal-to-Noise Ratio NS = Not Specified

5 JPSS ENVIRONMENTAL DATA RECORD (EDRS)

5.1 Imagery EDRs

Imagery Description:

Imagery enables weather forecasters to discern environmental phenomena via manual analysis and multispectral displays within the visible, near-infrared, and infrared portions of the spectrum. Imagery is also used as digital input to remote sensing algorithms that produce other environmental measurements, although this does not replace the explicit requirement for retrieval of individual parameters described elsewhere in this document. Imagery is required by meteorologists to verify the validity and accuracy of numerical weather prediction analyses and forecasts, and to identify immediate weather-related impacts and operationally significant events. The performance of the Imagery EDR is dependent on satisfaction of the VIIRS SDR performance characteristics specified in Table 4.6. The Imagery EDR will maintain the available dynamic range of each applicable VIIRS band used for the production of imagery products.

5.1.1 VIIRS Imagery

The L1RD designates the VIIRS Imagery EDRs produced from selected VIIRS bands as KPPs essential to minimum mission success. See Section 3.1.1.

L1RDS-13254 The system shall continuously satisfy JPSS minimum mission success criteria for Imagery EDRs while simultaneously producing and making available Imagery EDRs from each of the following VIIRS channels: (1) the five Imagery Resolution Bands; (2) the Day-Night Band; and (3) at least six Moderate Resolution Bands.

L1RDS-13255 The system shall provide for off-line configurability of the Moderate Resolution Bands used to produce Imagery EDRs, with a nominal default set of six Bands and the ability to substitute any other Moderate Resolution Band for any band in the default set.

L1RDS-134 Table 5.1.1. - Imagery (VIIRS)

Table 5.1.1. Imagery (VIIRS) v2.11, 11/17/16

EDR Attribute	Threshold	Objective
Imagery Applicable Conditions: 1. The Imagery EDR shall be delivered under all weather conditions.		
a. Horizontal Spatial Resolution for Imagery Resolution bands		
1. Nadir	0.4 km	0.1 km
2. Edge of Swath	0.8 km	0.1 km
b. Horizontal Spatial Resolution for moderate resolution bands (1)		
1. Nadir	0.8 km	NS
2. Edge of Swath	1.6 km	NS

EDR Attribute	Threshold	Objective
c. Horizontal Spatial Resolution for Imagery derived from the Day-Night Band (DNB)		
1. Nadir	0.8 km	0.65 km
2. Edge of Swath	1.6 km	NS
d. Mapping Uncertainty, 3 Sigma		
1. Nadir	1 km	NS
2. Edge of Swath	3 km	0.5 km
e. Reserved		
f. Coverage	Global	NS
Notes:		
1. M-Band Imagery requirements are applicable any VIIRS Moderate Resolution band Imagery EDR that is produced by the system		

5.1.2 ATMS Imagery

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

L1RDS-2550 Table 5.1.2. - Imagery (ATMS)

Table 5.1.2. Imagery (ATMS) v2.11, 11/17/16

EDR Attribute	Threshold	Objective
Imagery Applicable Conditions: 1. Deliverable under "all weather conditions. 2. Each channel shall be provided at its highest native resolution. 3. All channels shall be vertically and horizontally polarized.		
1. Horizontal Reporting Interval (at Nadir)	15 km	Same as Threshold
2. Mapping Uncertainty, 3 Sigma	5 km	3 km
Notes:		
1. Imagery EDRs are brightness temperature data from each microwave channel displayed at the original TDR resolution.		

5.2 Atmospheric EDRs

5.2.1 Aerosol Optical Depth (AOD)

<u>AOD Description</u>:

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

L1RDS-146 The aerosol product shall be defined at 11 wavelengths over land and ocean: 412 nm, 445 nm, 488 nm, 550 nm, 555 nm, 672 nm, 746 nm, 865 nm, 1240 nm, 1610 nm and 2250 nm.

L1RDS-147 The APU performance requirements shall only apply to the AOT at 550 nm.

L1RDS-149 Table 5.2.1. - Aerosol Optical Depth (VIIRS)

Table 5.2.1. Aerosol Optical Depth (VIIRS) v2.11, 11/17/16

EDR Attribute	Threshold	Objective
AOD Applicable Conditions: 1. Clear, daytime only 2. Zenith angles less than or equal to 80 degrees. (3)		
a. Vertical Coverage	Total Column	Total Column
b. Horizontal Cell Size	0.8 km (nadir); 1.6 km (Edge of Scan)	1 km
c. Vertical Cell Size	Total Column	0.25 km
d. Mapping Uncertainty, 3 Sigma (2)	4 km	1 km
e. Measurement Range	-0.05 to 5 (5)	0 to 10
f. Measurement Accuracy		
1. Over Ocean	0.08 (Tau < 0.3) 0.15 (Tau ≥ 0.3) (1,2,3,4)	1%
2. Over Land	0.06 (Tau < 0.1); 0.05 (0.1 ≤ Tau ≤ 0.8); 0.2 (Tau > 0.8) (1,2,4)	1%
g. Measurement Precision		
1. Over Ocean	0.15 (Tau < 0.3) 0.35 (Tau ≥ 0.3) (1,2,3,4)	0.01
2. Over Land	0.15 (Tau < 0.1) 0.25 (0.1 ≤ Tau ≤ 0.8) 0.45 (Tau > 0.8) (1,2,4)	0.01
Notes:		
1. Tau is the true observed AOD from ground-based measurements. A single linear regression equation for the dependency of accuracy and precision on Tau cannot be used to cover the dynamic range for Tau (0.05 to 5).		
2. For the stratified AOD ranges that are based on ground-based measurements, JPSS VIIRS AOD product accuracy and precision are to be determined by comparing it to ground-based measurements with specific matchup criteria: The VIIRS AOD from pixels within a radius of 27.5 km from ground-based measurements are averaged and compared to the hourly average of ground-based measurement AOD; a minimum of five best quality VIIRS AOD retrievals and two ground-based observations must be available within these spatial and temporal constraints. Ground-based measurement AOD data, if observed at wavelengths other than 550 nm, should be interpolated to 550 nm using the best available methodologies. Product evaluation should include the entire dynamic range, all aerosol types over all seasons.		
3. Applies to total column optical depth.		
4. See Appendix C - Glossary for the definition of Tau (τ)		
5. AOD Measurement Accuracy and Precision requirements are applicable and should be verified only at 550 nm and only over this Measurement Range 0 - 2.		

5.2.2 Aerosol Particle Size (APS)

Aerosol Particle Size Description:

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

L1RDS-183 Table 5.2.2. - Aerosol Particle Size (VIIRS)

Table 5.2.2. Aerosol Particle Size (VIIRS) v2.11, 10/31/18

EDR Attribute	Threshold (3)	Objective
APS Applicable Conditions: 1. Clear, daytime, ocean only		
a. Vertical Coverage		
b. Horizontal Cell Size 1. Nadir	0.8 km (nadir); 1.6 km EOS	1 km
c. Vertical Cell Size	Total Column	0.25 km
d. Mapping Uncertainty, 3 Sigma (1)	4 km	1 km
e. Measurement Range (2)		
1. Operational	-1 to +3 alpha units	-2 to +4 alpha units
f. Measurement Precision (2)		
1. Operational Over Ocean	0.6 alpha units	0.1 alpha units
g. Measurement Uncertainty (2)		
1. Operational Over Ocean	0.3 alpha units	0.1 alpha units
Notes:		
1. Reserved		
2. To meet the Climate requirements specified in the IORD for the Aerosol Particle Size EDR, an Aerosol Polarimetry Sensor is needed. Since an APS is not going to be flown on JPSS, the APS Climate requirements have been deleted from this Supplement.		
3. EDR performance is dependent on the accuracy of model-based ancillary data for this parameter.		

5.2.3 Atmospheric Vertical Moisture Profile (AVMP)

Atmospheric Vertical Moisture Profile Description:

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

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

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

5.2.3.1 CrIS/ATMS Atmospheric Vertical Moisture Profile

L1RDS-123 Table 5.2.3.1. - Atmospheric Vertical Moisture Profile (CrIS/ATMS)

Table 5.2.3.1. Atmospheric Vertical Moisture Profile (CrIS/ATMS) v2.11, 11/17/16

EDR Attribute	Threshold	Objective
AVMP Applicable Conditions: 1. All scenes (cloud-free, partly cloudy & cloudy)		
a. Horizontal Cell Size		
1. Nadir	50 km (1)	1 km
b. Vertical Reporting Interval		
1. Surface to 850 mb	20 mb	5 mb
2. 850 mb to 100 mb	50 mb	10 mb
c. Mapping Uncertainty, 3 Sigma	5 km	0.5 km
d. Measurement Uncertainty (expressed as a percent of average mixing ratio in 2 km layers)		
1. Cloud-Free to Partly Cloudy, Surface to 600 mb (2)	Greater of 20% or 0.2 g kg^{-1}	10%
2. Cloud-Free to Partly Cloudy, 600 mb to 300 mb (2)	Greater of 35% or 0.1 g kg^{-1}	10%
3. Cloud-Free to Partly Cloudy, 300 mb to 100 mb (2)	Greater of 35% or 0.1 g kg^{-1}	10%
4. Cloudy, Surface to 600 mb (3)	Greater of 20% or 0.2 g kg^{-1}	10%
5. Cloudy, 600 mb to 400 mb (3)	Greater of 40% or 0.1 g kg^{-1}	10%
6. Cloudy, 400 mb to 100 mb (3)	Greater of 40% or 0.1 g kg^{-1}	NS
Notes:		
1. JPSS will process one sounding per Field Of Regard (FOR) for a clear or cloudy resolution of better than or equal to ~50 km at Nadir, all 9 CrIS FOVs are used in the processing step to produce one FOR sounding.		
2. Partly cloudy conditions are those where both the infrared and microwave retrievals are used and are typically scenes with less than or equal to 50% cloudiness.		
3. Cloudy conditions are those where only the microwave retrievals are used and are typically scenes with greater than 50% cloudiness.		

5.2.3.2 ATMS Moisture Profile

L1RDS-2554 Table 5.2.3.2. - Moisture Profile (ATMS)

Table 5.2.3.2. Moisture Profile (ATMS) v2.11, 11/17/16

EDR Attribute	Threshold (1,2,3,4,5)	Objective
a. Horizontal Reporting Interval	15 km @ Nadir	
b. Vertical Reporting Interval	From surface to 0.01 mb	
c. Mapping Uncertainty, 3 Sigma	NS	NS
d. Measurement Precision (%)		
1. Sea: Clear (6)		
a. 400 mb	60	40
b. 500 mb	60	40
c. 700 mb	50	35
d. 900 mb	30	15
2. Sea: Cloudy (6)		
a. 400 mb	60	47
b. 500 mb	65	55
c. 700 mb	60	40
d. 900 mb	30	17
3. Land: Clear/Cloudy (6)		
a. 400 mb	60	40
b. 500 mb	60	40
c. 700 mb	50	35
d. 900 mb	50	30
e. Measurement Accuracy (%)		
1. Sea: Clear (6)		
a. 400 mb	30	20
b. 500 mb	20	10
c. 700 mb	20	10
d. 900 mb	20	10
2. Sea: Cloudy (6)		
a. 400 mb	30	20
b. 500 mb	20	10
c. 700 mb	10	5
d. 900 mb	20	10
3. Land: Clear/Cloudy (6)		
a. 400 mb	30	20
b. 500 mb	10	5
c. 700 mb	10	5
d. 900 mb	20	10
f. Measurement Uncertainty	NS	NS
Notes:		
1. Those performances are relative to the Global Data Assimilation System (GDAS).		
2. The performances are for all non-rainy conditions, including clear and cloudy.		
3. The performances are for individual layers (not averaged vertically).		

EDR Attribute	Threshold (1,2,3,4,5)	Objective
4. The pressure values are averaged layer values.		
5. The described performances include the MiRS algorithm performance, as well as the collocation error, the instrument noise and the errors inherent to the reference used to measure the performances.		
6. Sea performances are assumed ice-free and Land performances are assumed over snow-free land.		
7. Refresh, coverage and horizontal size are all dependent on the refresh, coverage and horizontal size of the brightness temperatures measurements. The Microwave Integrated Retrieval System (MiRS) algorithm outputs characteristics will reproduce the TB characteristics of these factors.		

5.2.4 Atmospheric Vertical Temperature Profile (AVTP)

Atmospheric Vertical Temperature Profile Description:

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

Restricting the Measurement Uncertainty in Row d(1) of Table 5.2.4.1 to "over ocean" enables CrIS/ATMS to meet the Global average requirement. Over land and ice mass, the Uncertainty is 1.7 K due to the state of the science of the land emissivity knowledge within the temperature sounding algorithm.

5.2.4.1 CrIS/ATMS Atmospheric Vertical Temperature Profile

L1RDS-129 Table 5.2.4.1. - Atmospheric Vertical Temperature Profile (CrIS/ATMS)

Table 5.2.4.1. Atmospheric Vertical Temperature Profile (CrIS/ATMS) v2.11, 11/17/16

EDR Attribute	Threshold	Objective
AVTP Applicable Conditions: 1. All Scenes (cloud-free, partly cloudy, cloudy)		
a. Horizontal Cell Size		
1. Nadir	50 km (1)	1 km
b. Vertical Reporting Interval		
1. Surface to 850 mb	20 mb	10 mb
2. 850 mb to 300 mb	50 mb	10 mb
3. 300 mb to 100 mb	25 mb	10 mb
4. 100 mb to 10 mb	20 mb	10 mb
5. 10 mb to 1.0 mb	2 mb	1 mb
6. 1.0 mb to 0.5 mb	0.2 mb	0.1 mb
c. Mapping Uncertainty, 3 Sigma	5 km	0.5 km
d. Measurement Uncertainty - Expressed as an error in layer average temperature		
1. Cloud-Free to Partly Cloudy, Surface to 300 mb over ocean (2)	1.6 K per 1 km layer	0.5 K per 1 km layer
2. Cloud-Free to Partly Cloudy, 300 mb to 30 mb (2)	1.5 K per 3 km layer	0.5 K per 3 km layer
3. Cloud-Free to Partly Cloudy, 30 mb to 1 mb (2)	1.5 K per 5 km layer	0.5 K per 5 km layer
4. Cloud-Free to Partly Cloudy, 1 mb to 0.5 mb (2)	3.5 K per 5 km layer	0.5 K per 5 km layer

EDR Attribute	Threshold	Objective
5. Cloudy, Surface to 700 mb (3)	2.5 K per 1 km layer	0.5 K per 1 km layer
6. Cloudy, 700 mb to 300 mb (3)	1.5 K per 1 km layer	0.5 K per 1 km layer
7. Cloudy, 300 mb to 30 mb (3)	1.5 K per 3 km layer	0.5 K per 3 km layer
8. Cloudy, 30 mb to 1 mb (3)	1.5 K per 5 km layer	0.5 K per 5 km layer
9. Cloudy, 1 mb to 0.5 mb (3)	3.5 K per 5 km layer	0.5 K per 5 km layer
Notes:		
1. JPSS will process one sounding per FOR for a clear or cloudy resolution of better than or equal to ~50 km at Nadir, all 9 CrIS FOVs are used in the processing step to produce one FOR sounding.		
2. Partly cloudy conditions are those where both the infrared and microwave retrievals are used and are typically scenes with less than or equal to 50% cloudiness.		
3. Cloudy conditions are those where only the microwave retrievals are used and are typically scenes with greater than 50% cloudiness.		

5.2.4.2 ATMS Temperature Profile

L1RDS-2560 Table 5.2.4.2. - Temperature Profile (ATMS)

Table 5.2.4.2. Temperature Profile (ATMS) v2.11, 11/17/16

EDR Attribute	Threshold (1,2,3,4,5)	Objective
a. Horizontal Reporting Interval	15 km @ Nadir	NS
b. Vertical Reporting Interval	From surface to 0.01 mb	NS
c. Mapping Uncertainty, 3 Sigma	NS	NS
d. Measurement Precision (K)		
1. Sea: Clear		
a. 100 mb	2.0	1.5
b. 300 mb	2.0	1.6
c. 500 mb	2.0	1.3
d. 900 mb	3.0	2.4
2. Sea: Cloudy		
a. 100 mb	2.0	1.4
b. 300 mb	2.5	1.8
c. 500 mb	2.0	1.5
d. 900 mb	3.0	2.4
3. Sea: Rainy		
a. 100 mb	2.5	1.5
b. 300 mb	2.5	1.8
c. 500 mb	2.5	1.9
d. 900 mb	3.5	2.9
4. Land: Clear/Cloudy		
a. 100 mb	2.0	1.4
b. 300 mb	2.0	1.4
c. 500 mb	2.5	1.5
d. 900 mb	5.5	4.5
5. Land: Rainy		
a. 100 mb	2.5	1.5
b. 300 mb	2.5	1.5
c. 500 mb	3.0	1.8

EDR Attribute	Threshold (1,2,3,4,5)	Objective
d. 900 mb	5.5	4.5
e. Measurement Accuracy (K)		
1. Sea: Clear		
a. 100 mb	0.2	0.1
b. 300 mb	0.5	0.2
c. 500 mb	0.2	0.1
d. 900 mb	1.5	1.2
2. Sea: Cloudy		
a. 100 mb	0.8	0.4
b. 300 mb	0.8	0.4
c. 500 mb	0.6	0.3
d. 900 mb	2.0	0.9
3. Sea: Rainy		
a. 100 mb	1.0	0.5
b. 300 mb	1.5	1.0
c. 500 mb	2.0	1.3
d. 900 mb	2.0	1.5
4. Land: Clear/Cloudy		
a. 100 mb	0.5	0.2
b. 300 mb	0.8	0.4
c. 500 mb	0.2	0.1
d. 900 mb	2.5	1.9
5. Land: Rainy		
a. 100 mb	1.5	0.8
b. 300 mb	1.0	0.4
c. 500 mb	0.5	0.2
d. 900 mb	2.5	1.6
f. Measurement Uncertainty	NS	NS
Notes:		
1. Those performances are relative to the Global Data Assimilation System (GDAS).		
2. The performances are for all non-rainy conditions, including clear and cloudy.		
3. The performances are for individual layers (not averaged vertically).		
4. The pressure values are averaged layer values.		
5. The described performances include the Microwave Integrated Retrieval System (MiRS) algorithm performance, as well as the collocation error, the instrument noise and the errors inherent to the reference used to measure the performances.		
6. Refresh, coverage and horizontal size are all dependent on the refresh, coverage and horizontal size of the brightness temperatures measurements. The MiRS algorithm outputs characteristics will reproduce the TB characteristics of these factors.		

5.2.5 Carbon Monoxide (CO)

Carbon Monoxide Description:

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

Note: Carbon monoxide is a short-lived gas (≈ 1 month) in the troposphere and has air-quality, atmospheric chemistry, and climate applications. It has applications in monitoring of combustion products (e.g., forest fires, biomass burning, and industrial pollution) and is a cause

of tropospheric ozone production. It has potential as a tracer of atmospheric transport of pollution and could be used as a proxy for fossil fuel emissions. Knowledge of the carbon monoxide concentration is also useful in the determination of sources and sinks for CO_2 and CH_4 through partitioning of combustion sources relative to other natural and anthropogenic sources and through its interaction with the hydroxyl radical which is the primary sink for both carbon monoxide and methane in the upper troposphere.

L1RDS-632 Table 5.2.5. - CO (Carbon Monoxide) Column (CrIS)

Table 5.2.5. CO (Carbon Monoxide) Column (CrIS) v2.11, 11/17/16

EDR Attribute	Threshold	Objective
a. Vertical Coverage	Total Column	Total Column
b. Horizontal Resolution	100 km	100 km
c. Mapping Uncertainty, 3 Sigma (1)	25 km	25 km
d. Measurement Range	0 to 200 ppbv (1)	0 to 200 ppbv (1)
e. Measurement Precision	35% (2,3)	3%
f. Measurement Accuracy	± 25% (2,3)	± 5%
Notes:		
1. 7 µmoles is equivalent to 200 ppbv.		
2. With existing CrIS short-wave resolution (0.2 cm OPD), the carbon monoxide measurement can barely improve beyond background variability. Simulations suggest precision of 35% and accuracy of 25% are achievable.		
3. With full resolution CrIS short-wave resolution (0.8 cm OP), precision and accuracy improves to 15% and 5%, respectively.		

5.2.6 Carbon Dioxide (CO_2)

Carbon Dioxide Description:

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

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

of the global geographical distribution of patterns or gradients in the trace gas concentrations that are not feasible otherwise.

L1RDS-638 Table 5.2.6. - CO_2 (Carbon Dioxide) Column (CrIS)

Table 5.2.6. CO2 (Carbon Dioxide) Column (CrIS) v2.11, 11/17/16

EDR Attribute	Threshold	Objective
a. Vertical Coverage	Total Column	Total Column
b. Horizontal Resolution	100 km	100 km
c. Mapping Uncertainty, 3 Sigma	25 km	25 km
d. Measurement Range	300 to 500 ppmv (1)	770 to 1050 ppmv
e. Measurement Precision	0.5% (2 ppmv) (2)	1.05 to 1.4 ppmv
f. Measurement Accuracy	± 1% (4 ppmv) (3)	NS
Notes:		
1. Measurement range is extended to 500 ppmv (17,800 μmoles) to cover potential increases of CO_2 concentration during mission life.		
2. Measurement precision of 20 μmoles/cm^2 is equivalent to 1.4 ppmv (0.37%). Simulations and experience with AIRS suggest the CrIS instrument should be able to achieve 2 ppmv (0.5%) precision.		
3. Simulations and experience with AIRS suggest the CrIS instrument should be capable of 4 ppmv (1%) accuracy.		

5.2.7 Methane (CH_4)

Methane Description:

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

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

L1RDS-628 Table 5.2.7. - CH_4 (Methane) Column (CrIS)

Table 5.2.7. CH4 (Methane) Column (CrIS) v2.11, 11/17/16

EDR Attribute	Threshold	Objective
a. Vertical Coverage	Total Column	NS
b. Horizontal Resolution	100 km	NS
c. Mapping Uncertainty, 3 Sigma	25 km	NS
d. Measurement Range	1100 to 2250 ppbv (1)	NS
e. Measurement Precision	1% (~ 20 ppbv) (2)	NS
f. Measurement Accuracy	±4% (~ 80 ppbv) (3)	NS
Notes:		
1. 40 µmoles is equivalent to 1100 ppbv (a more common unit)		
2. Experience with AIRS and CrIS simulations suggest we can achieve 1% precision.		
3. Experience with AIRS suggests we can achieve an accuracy of 4%.		

5.2.8 Infrared Ozone Profile (IOP)

Infrared Ozone Profile Description:

The CrIS instrument is sensitive to ozone in the 10 micron region of its spectrum. This allows retrieval of ozone in both daytime and nighttime conditions. This retrieval is only possible when cloud clearing is successful (the partly cloudy condition of AVTP and AVMP), otherwise a climatological first guess is reported. The sensitivity of the 10 micron channels is mostly located in the lower stratosphere and under the right conditions (e.g., stratosphere-troposphere exchange) has some sensitivity in the upper troposphere.

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

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

L1RDS-2445 Table 5.2.8. - Infrared Ozone Profile (CrIS)

Table 5.2.8. Infrared Ozone Profile (CrIS) v2.11, 11/17/16

EDR Attribute	Threshold	Objective
a. Horizontal Cell Size	50 km at nadir	15 km at nadir
b. Vertical Reporting Interval		
1. TOA to surface	Report on the radiative transfer grid used within retrieval (100 layers). Each layer reports the layer column density (molecules/cm^2) within the layer.	Report on 100 layers used within retrieval
c. Mapping Uncertainty, 3 Sigma	10 km	5 km
d. Measurement Precision		
1. 4 hPa to 260 hPa (6 statistic layers)	20%	10%
2. 260 hPa to surface (1 statistic layer)	20%	10%
e. Measurement Accuracy		
1. 4 hPa to 250 hPa (6 statistic layers)	10%	5%
2. 260 hPa to surface (1 statistic layer)	10%	5%
f. Measurement Uncertainty		
1. 4 hPa to 250 hPa (6 statistic layers)	25%	15%
2. 260 hPa to surface (1 statistic layer)	25%	15%
Notes:		
1. Ozone retrievals only exist when the CrIS radiances are used in the retrieval (i.e., "partially cloudy" condition in the AVTP and AVMP requirements). For "cloudy" conditions the first guess is reported. Users must use QC to determine if retrieval was performed.		
2. CrIS measurements are most accurate near the tropopause and statistic layers used to compute performance must mimic standard Umkehr reporting layers of ~5 km per layer (recommend statistic layers = 4-8, 8-16, 16-32, 32-66, 66-125, 125-260 hPa).		
3. Lower layer statistic is computed on a single thick layer of variable thickness due to surface pressure variability.		

5.2.9 Ozone Limb Profile (Ozone LP)

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

L1RDS-13256 Table 5.2.9. - Ozone Limb Profile (OMPS-L)

Table 5.2.9. Ozone Limb Profile (OMPS-L) v2.11, 11/17/16

Attribute	Threshold	Objective
Ozone LP Applicable Conditions	SZA < 80 degrees	SZA < 88 degrees
a. Horizontal Attributes		
1. Horizontal Cell Size	250 km	125 km
2. Horizontal Reporting	125 km	50 km

Attribute	Threshold	Objective
b. Vertical Attributes		
1. Vertical Coverage	TH to 60 km	0 km to 60 km
2. Vertical Reporting	1 km	1 km
3. Vertical Resolution		
i. 0 to TH (1)	N/A	3 km
ii. TH to 25	5 km	1 km
iii. 25 km to 60 km	5 km	3 km
c. Mapping Uncertainty, 1 Sigma	< 25 km	< 5 km
d. Measurement Range		
1. 0 to TH (1)	N/A	0.01 to 3 ppmv
2. TH - 60 km	0.1 to 15 ppmv	0.1 to 15 ppmv
e. Measurement Precision		
1. 0 to TH (1)	N/A	10%
2. TH to 15 km	Greater of 10 % or 0.1 ppmv	3%
3. 15 to 50 km	Greater of 3 % or 0.05 ppmv	1%
4. 50 to 60 km	Greater of 10% or 0.1 ppmv	3%
f. Measurement Accuracy		
1. 0 to TH (1)	N/A	10%
2. TH to 15 km	Greater of 20 % or 0.1 ppmv	10%
3. 15 to 60 km	Greater of 10 % or 0.1 ppmv	5%
g. Refresh	At least 75% coverage of the globe every 4 days (monthly average) (2)	24 hrs (2)
h. Long-term Stability	2% over 7 years	1% over 7 years
Notes:		
1. TH is Tropopause Height or 8 km, whichever is greater as determined by ancillary data.		
2. All OMPS measurements require sunlight, so there is no coverage in polar night areas. With three limb curtains (each with a Vertical FOV of ~ 1.85°) positioned at Nadir and 250 km (+/- 4.3 degrees) on each side, the measurements are taken to give a good representation of the ozone profile in the central 750 Km of the orbital track. With a 4-day repeat cycle in the orbital tracks, this will yield a 4-day revisit time (approximately) for 30,000 km out of 40,000 km equator.		

5.2.10 Ozone Nadir Profile (Ozone-NP)

Ozone Nadir Profile Description:

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

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

L1RDS-167 Table 5.2.10. - Ozone Nadir Profile (OMPS-N)

Table 5.2.10. Ozone Nadir Profile (OMPS-N) v2.11, 11/17/16

Attribute	Threshold	Objective
Ozone NP Applicable Conditions: 1. Clear, daytime only (3)		
a. Horizontal Cell Size	250 x 250 km (1)	50 x 50 km^2
b. Vertical Cell Size	5 km reporting	
1. Below 30 hPa (~ <25 km)	10 - 20 km	3 km (0 - Th)
2. 30 - 1 hPa (~ 25 - 50 km)	7 - 10 km	1 km (TH - 25 km)
3. Above 1 hPa (~ >50 km)	10 - 20 km	3 km (25 - 60 km)
c. Mapping Uncertainty, 1 Sigma	< 25 km	5 km
d. Measurement Range		
Nadir Profile, 0 - 60 km	0.1-15 ppmv	0.01 - 3 ppmv (0 - TH) 0.1 - 15 ppmv (Th - 60 km)
e. Measurement Precision (2)		
1. Below 30 hPa (~ < 25 km)	Greater of 20% or 0.1 ppmv	10% (0 - TH)
2. At 30 hPa (~ 25 km)	Greater of 10% or 0.1 ppmv	3%
3. 30 - 1 hPa (~ 25 - 50 km)	5% - 10%	1%
4. Above 1 hPa (~ > 50 km)	Greater of 10% or 0.1 ppmv	3%
f. Measurement Accuracy (2)		
1. Below 30 hPa (~ <25 km)	Greater of 10% or 0.1 ppmv	10% (0 - 15 km)
2. 30 - 1 hPa (~ 25 - 50 km)	5% - 10%	5% (15 - 60 km)
3. At 1 hPa (~ 50 km)	Greater of 10% or 0.1 ppmv	5% (15 - 60 km)
4. Above 1 hPa (~> 50 km)	Greater of 10% or 0.1 ppmv	5% (15 - 60 km)
Notes:		
1. The SBUV/2 has a 180 km x 180 km cross-track by along-track FOV. It makes its 12 measurements over 24 samples (160 km of along-track motion). The OMPS Nadir Profiler is designed to be operated in a mode that is able to subsample the required HCS.		
2. The OMPS Nadir Profiler performance is expected to degrade in the area of the South Atlantic Anomaly (SAA) due to the impact of periodic charged particle effects in this region.		
3. All OMPS measurements require sunlight, so there is no coverage in polar night areas.		

5.2.11 Ozone Total Column (Ozone-TC)

Ozone Total Column Description:

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

L1RDS-161 Table 5.2.11. - Ozone Total Column (OMPS-N)

Table 5.2.11. Ozone Total Column (OMPS-N) v2.11, 11/17/16

EDR Attribute	Threshold	Objective
Ozone TC Applicable Conditions: 1. Threshold requirements only apply under daytime conditions with Solar Zenith Angles (SZA) up to 80 degrees. 2. The EDR shall be delivered for all SZA		
a. Horizontal Cell Size	50 x 50 km^2 @ nadir	10 x 10 km^2
b. Vertical Cell Size	0 - 60 km	0 - 60 km
c. Mapping Uncertainty, 1 Sigma	5 km at Nadir	5 km
d. Measurement Range	50 - 650 milli-atm-cm	50 - 650 milli-atm-cm
e. Measurement Precision		
1. X < 0.25 atm-cm	6.0 milli-atm-cm	1.0 milli-atm-cm
2. 0.25 < X < 0.45 atm-cm	7.7 milli-atm-cm	1.0 milli-atm-cm
3. X > 0.45 atm-cm	2.8 milli-atm-cm + 1.1%	1.0 milli-atm-cm
f. Measurement Accuracy		
1. X < 0.25 atm-cm	9.5 milli-atm-cm	5.0 milli-atm-cm
2. 0.25 < X < 0.45 atm-cm	13.0 milli-atm-cm	5.0 milli-atm-cm
3. X > 0.45 atm-cm	16.0 milli-atm-cm	5.0 milli-atm-cm
Notes:		
1. Reserved		

5.2.12 Polar Winds (PW)

Polar Winds Description:

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

L1RDS-624 Table 5.2.12. - Polar Winds (VIIRS)

Table 5.2.12. Polar Winds (VIIRS) v2.11, 11/17/16

EDR Attribute	Threshold	Objective
a. Vertical Coverage	Surface to Tropopause	Surface to 20 km
b. Horizontal Resolution	19 km	10 km
c. Vertical Reporting Interval	At cloud tops	0.1 km
d. Mapping Uncertainty, 3 Sigma	5 km	5 km
e. Measurement Range	Speed: 3 to 100 m/sec (1) Direction: 0 to 360 degrees	Speed: 0 to 100 m/sec Direction: 0 to 360 degrees
f. Measurement Precision	Mean vector difference: 3.8 m/sec	0.5 m/s
g. Measurement Accuracy	Mean vector difference: 7.5 m/sec	± 1 m/s
Notes:		
1. Changed from "0 - 100 m/s" to "3 - 100 m/s" as wind vectors below 3 m/s are usually removed.		

5.2.13 Rainfall Rate (RR)

Rainfall Rate Description:

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

L1RDS-2451 Table 5.2.13. - Rainfall Rate (ATMS)

Table 5.2.13. Rainfall Rate (ATMS) v2.11, 11/17/16

EDR Attribute	Threshold	Objective
a. Horizontal Cell Size	15 km @ nadir	
b. Vertical Reporting Interval	NS	NS
c. Mapping Uncertainty, 3 Sigma	NS	NS
d. Measurement Precision (mm/h)		
1. Sea	1.0	0.5
2. Land	1.5	0.8
e. Measurement Accuracy (mm/h)		
1. Sea	0.10	0.05
2. Land	0.05	0.02
f. Measurement Uncertainty	NS	NS
g. Probability of Detection (%)		
1. Sea	50	60
2. Land	50	70
h. False Alarm Rate (%)		
1. Sea	5.0	3.0
2. Land	6.0	4.0
i. Heidke Skill Score (-1 - +1)		
1. Sea	0.30	0.55
2. Land	0.30	0.55
Notes:		
1. The described performances include the Microwave Integrated Retrieval System (MiRS) algorithm performance, the collocation error, the instrument noise and the errors inherent to the reference used to measure the performances, as well as the errors due to differences in the footprint size of the collocated ATMS and the reference measurements (beam filling effect).		
2. Over ocean performances are relative to the TRMM Microwave Imager (TMI) Level 2A Hydrometeor Profile Product Version 7. For the comparisons, 3 min and 7.5 km were used as the time and space collocation thresholds, respectively. This assessment is over the +/- 38 deg. latitudes.		
3. Over land performances are relative to the hourly NCEP Stage IV precipitation analysis over the CONUS. The Stage IV precipitation analysis product is much more of an integrated hourly estimate, while the satellite-based MiRS precipitation estimation products represent an instantaneous observation. Because of that, during the comparison, it has been assumed that the Stage IV rainfall rate is a constant amount for an entire hour and is compared with the MiRS precipitation estimates that had occurred within that hour. Stage IV rainfall rate is approximately 4 km resolution. For the comparisons, 3 min and 7.5 km were used as the time and space collocation thresholds, respectively.		
4. For the computation of precision and accuracy rainfall rate values equal to zero were included.		

5. For the purpose of computing the POD, FAR and HSS the definition of rain is where the rainfall rate is greater than 0.6 mm/hr.
6. Refresh, coverage and horizontal size are all dependent on the refresh, coverage, and horizontal size of the brightness temperatures measurements. The MiRS algorithm outputs characteristics will reproduce the TB characteristics of these factors.

5.2.14 Aerosol Detection (AD)

Aerosol Detection Description:

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

L1RDS-155 Table 5.2.14. - Aerosol Detection (VIIRS)

Table 5.2.14. Aerosol Detection (VIIRS) v.2.11, 11/17/16

EDR Attribute	Threshold	Objective
Applicable Conditions: 1. Aerosol Detection includes dust/sand, and smoke at any altitude. 2. Clear, for AOT greater than 0.15, daytime only.		
a. Horizontal Cell Size	0.8 km at Nadir (2)	1 km
b. Vertical Cell Size	Total Column	0.2 km
c. Mapping Uncertainty, 3 Sigma	3 km	0.1 km
d. Measurement Range		
1. Detect suspended matter (dust/sand, smoke) (1)	Type: Dust/sand, smoke	Dust/sand, ash, smoke, sea salt
e. Probability of Correct Typing (2)		
1. Suspended Matter	80 %	100 %
2. Dust	80 %	100 %
3. Smoke	70 %	100 %
4. Mixed Aerosol (1)		80 %
Notes:		
1. DOC has a responsibility for analyzing areas of volcanic ash, blowing dust, and smoke. There is therefore a requirement that the aerosol detection algorithm identify instances of multiple types of aerosols at the same location and not merely provide a single aerosol type with the highest concentration or probability.		
2. Probability of Correct Typing performance will be verified and validated for an aggregated 3 km horizontal cell to provide for adequate comparability of performance across the scan.		

5.2.15 Volcanic Ash Detection and Height (VolAsh)

Volcanic Ash Detection and Height Description

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

L1RDS-13257 Table 5.2.15 Volcanic Ash Detection and Height

Table 5.2.15. Volcanic Ash Detection and Height v2.11, 11/17/16

EDR Attribute	Threshold	Objective
Applicable Conditions: 1. Clear, for AOD > 0.15		
a. Horizontal Cell Size 1. Nadir	0.8 km	
b. Vertical Cell Size	Total Column	0.2 km
c. Mapping Uncertainty, 3 Sigma	3 km	0.1 km
d. Measurement Accuracy (1)	2 tons/km^2, 3 km height	
e. Measurement Precision (1)	2.5 tons/km^2	
f. Measurement Uncertainty		
g. Refresh	At least 90% coverage of the globe every 12 hours (monthly average)	3 hours
1. Accuracy and precision requirements only apply to actual pixels that contain volcanic ash as the highest cloud layer.		

5.2.16 Total Precipitable Water (TPW)

Total Precipitable Water Description:

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

L1RDS-376 **Table 5.2.16. - Total Precipitable Water (ATMS)**

Table 5.2.16. Total Precipitable Water (ATMS) v2.11, 11/17/16

EDR Attribute	Threshold (1,2,3)	Objective
a. Horizontal Cell Size (4)	15 km @ nadir	
b. Vertical Reporting Interval	NS	NS
c. Mapping Uncertainty, 3 Sigma	NS	NS
d. Measurement Precision (mm)		

EDR Attribute	Threshold (1,2,3)	Objective
1. Sea		
a. Clear	2.5	1.9
b. Cloudy	2.5	1.7
2. Sea-Ice		
a. Clear/Cloudy	2.0	1.5
3. Land		
a. Clear/Cloudy	5.5	4.4
4. Snow		
a. Clear/Cloudy	2.0	1.2
e. Measurement Accuracy (mm)		
1. Sea		
a. Clear	1.5	0.8
b. Cloudy	0.5	0.1
2. Sea-Ice		
a. Clear/Cloudy	2.0	1.0
3. Land		
a. Clear/Cloudy	2.5	1.6
4. Snow-Land		
a. Clear/Cloudy	0.5	0.2
f. Measurement Uncertainty (mm)		
1. Sea		
a. Clear	2.5	2.0
b. Cloudy	2.5	1.7
2. Sea-Ice		
a. Clear/Cloudy	2.5	2.0
3. Land		
a. Clear/Cloudy	5.5	4.7
4. Snow		
a. Clear/Cloudy	2.0	1.2
Notes:		
1. Those performances are relative to the Global Data Assimilation System (GDAS).		
2. The described performances include the Microwave Integrated Retrieval System (MiRS) algorithm performance, as well as the collocation error, the instrument noise and the errors inherent to the reference used to measure the performances.		
3. The spatial distribution of the assessment data is global, encompassing the natural variability of the different geophysical conditions.		
4. Refresh, coverage and horizontal size are all dependent on the refresh, coverage and horizontal size of the brightness temperatures measurements. The MiRS algorithm outputs characteristics will reproduce the TB characteristics of these factors.		

5.3 Cloud EDRs

In this section cloud means detectable cloud as defined in the glossary unless cloud is otherwise specified. Day condition for Cloud EDRs is when the solar zenith angle is less than 75 deg.

5.3.1 Cloud Height (Top and Base) (CH)

Cloud Height Description:

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

L1RDS-231 **Table 5.3.1. - Cloud Height (Top and Base) (VIIRS)**

Table 5.3.1. Cloud Height (Top and Base) (VIIRS) v2.11,11/17/16

EDR Attribute	Threshold	Objective
CTH/CBH Applicable Conditions: 1. Requirements apply whenever detectable clouds are present.		
a. Horizontal Cell Size	0.8 km	0.4 km
b. Vertical Reporting Interval	Top and Base of highest cloud in column	Top and Base of multiple cloud layers in the column
c. Mapping Uncertainty, 3 Sigma	4 km	1 km
d. Measurement Precision for CTH		
1. COT ≥ 1 (1)	1.0 km	0.15 km
2. COT < 1 (1)	2.0 km	0.15 km
e. Measurement Accuracy for CTH		
1. COT ≥ 1 (1)	1.0 km	0.3 km
2. COT < 1 (1)	2.0 km	0.3 km
f. Measurement Precision for CBH		
1. COT ≥ 1 (2)	2.0 km	0.3 km
2. COT < 1 (2)	3.0 km	0.3 km
g. Measurement Accuracy for CBH		
1. COT ≥ 1 (2)	2.0 km	0.3 km
2. COT < 1 (2)	3.0 km	0.3 km
h. Refresh	At least 90% coverage of the globe every 12 hours (monthly average)	4 hrs.
Notes:		
1. COT, expressed in units of "Tau", is also referred to as "Optical Thickness" or "Optical Depth 2. CBH specifications only apply for clouds where the CTH met its specifications.		

5.3.2 Cloud Cover/Layers (CC/L)

Cloud Cover/Layers Description:

Cloud cover is the fraction of a given area of the earth's horizontal surface that is masked by the vertical projection of clouds.

L1RDS-193 Table 5.3.2. - Cloud Cover/Layers (VIIRS)

Table 5.3.2. Cloud Cover/Layers (VIIRS) v2.11, 11/17/16

EDR Attribute	Threshold	Objective
CC/L Applicable Conditions: 1. Requirements apply whenever detectable clouds are present. 2. Cloud Cover shall be computed and reported at each separate, distinct layer, as well as for the total cloud cover.		
a. Horizontal Cell Size	10 km	1 km
b. Vertical Reporting Interval	Cloud Cover in 3 predefined layers and total cloud cover in the column	Cloud Cover in 6 predefined layers with additional detection of convective cloud and super cooled water cloud.
c. Mapping Uncertainty, 3 Sigma	4 km	1 km
d. Measurement Range	0 to 1.0 HCS Area	0 to 1.0
e. Measurement Uncertainty (Applies only to total cloud cover; Not applicable to layers)	15%	NS
Notes:		
1. Predefined layers are high = 0 - 350 hPa, middle = 350 - 642 hPa and low = 642 to 1100 hPa. These are high/middle/low boundaries used by NOAA NWP models.		

5.3.3 Cloud Particle Size Distribution (CPSD)

CPSD Description:

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

L1RDS-219 Table 5.3.3. - Cloud Particle Size Distribution (VIIRS)

Table 5.3.3. Cloud Particle Size Distribution (VIIRS) v2.11, 11/17/16

EDR Attribute	Threshold	Objective
CPSD Applicable Conditions: 1. Requirements apply both day and night and whenever detectable clouds are present.		
a. Horizontal Cell Size	0.8 km	0.4 km
b. Vertical Reporting Interval	N/A	N/A
c. Mapping Uncertainty, 3 Sigma	4 km	1 km
d. Measurement Range	2 to 50 µm(day); 2 to 32 µm for water (night); 2 to 50 µm for ice (night)	NS
e. Measurement Precision	greater of 4 µm or 25% for water; greater of 10 µm or 25% for ice	10 %
f. Measurement Accuracy	greater of 4 µm or 30% for water; 10 µm for ice	
Notes:		
1. Reserved 2. The vertical reporting level was struck because CPSD is only derived at cloud top, not multiple layers		

5.3.4 Cloud Liquid Water (CLW)

Cloud Liquid Water Description:

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

L1RDS-2567 Table 5.3.4. - Cloud Liquid Water (ATMS)

Table 5.3.4. Cloud Liquid Water (ATMS) v2.11, 11/17/16

EDR Attribute	Threshold (1,2)	Objective
a. Horizontal Cell Size (3)	15 km @ nadir	
b. Vertical Reporting Interval	NS	NS
c. Mapping Uncertainty, 3 Sigma	NS	NS
d. Measurement Precision (mm)		
1. Sea	0.08	0.06
e. Measurement Accuracy (mm)		
1. Sea	0.03	0.02
f. Measurement Uncertainty	NS	NS
Notes:		
1. Those performances are relative to the TRMM Microwave Imager (TMI) Level 2A Hydrometeor Profile Product Version 7. For the Comparisons, 3 min and 7.5 km were used as the time and space collocation thresholds, respectively.		
2. The described performances include the Microwave Integrated Retrieval System (MiRS) algorithm performance, the collocation error, the instrument noise and the errors inherent to the reference used to measure the performances, as well as the errors due to differences in the footprint size of the collocated ATMS and the reference measurements (beam filling effect).		
3. Refresh, coverage and horizontal size are all dependent on the refresh, coverage and horizontal size of the brightness temperatures measurements. The MiRS algorithm outputs characteristics will reproduce the TB characteristics of these factors.		

5.3.5 Cloud Mask (CM)

Cloud Mask Description:

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

L1RDS-2457 Table 5.3.5. - Cloud Mask (VIIRS)

Table 5.3.5. Cloud Mask (VIIRS) v2.11, 11/17/16

EDR Attribute	Threshold	Objective
Cloud Mask Applicable Conditions: 1. Requirements apply whenever detectable clouds are present. 2. Cloud Mask shall be computed and reported for the total cloud cover.		
a. Horizontal Cell Size	0.8 km at Nadir	400m
b. Cloud Mask Horizontal Reporting Interval	Cloud Mask HCS	NS

EDR Attribute	Threshold	Objective
c. Mapping Uncertainty, 3 Sigma	4 km	1 km
d. Cloud Mask Measurement Range	Cloudy/ Not Cloudy	NS
e. Cloud Mask Probability of Correct Typing		
1. Global	87%	NS
2. Ocean, Day	92%	NS
3. Ocean, Night	90%	NS
4. Snow-free Land, Day	90%	NS
5. Snow-free Land, Night	88%	NS
6. Desert, Day	85%	NS
7. Desert, Night	85%	NS
8. Snow-Covered Land, Day	88%	NS
9. Snow-Covered Land, Night	85%	NS
10. Sea-Ice, Day	82%	NS
11. Sea-Ice, Night	72%	NS
12. Antarctica and Greenland, Day	80%	NS
13 Antarctica and Greenland, Night	70%	NS
f. Cloud Leakage Rate		
1. Ocean, Day, COT> 1.0, outside Sun Glint region (2)	1%	NS
2. Land, Day, COT> 1.0	3%	NS
3. Land, Ocean, Night, COT> 1.0	5%	NS
g. False Alarm Rate		
1. Ocean, Day, COT> 1.0 (2)	5%	NS
2. Land, Day ToC NDVI < 0.2 or ToC NDVI> 0.4, or Desert, COT> 1.0	7%	NS
3. Land, Ocean, Night, COT >1.0	8%	NS
Notes:		
1. Attribute (a) shows the Cloud Map HCS as 0.8 km which is approximately the VIIRS M band Nadir pixel size.		
2. Cloud Optical Thickness (COT) is defined as the extinction (scattering plus absorption) per unit length, integrated over each and every distinguishable cloud layer in a vertical column and all distinguishable cloud layers in aggregate, in a vertical column of the atmosphere.		

5.3.6 Cloud Phase (CP)

Cloud Phase is derived from the cloud type and is the primary phase of the cloud (Clear, Liquid, Supercooled, Mixed, Ice and Unknown) product.

L1RDS-13258 Table 5.3.6. - Cloud Phase (VIIRS)

Table 5.3.6. Cloud Phase (VIIRS) v2.11, 11/17/16

EDR Attribute	Threshold	Objective
Type/**Phase Applicable Conditions:** 1. Requirements apply whenever detectable clouds are present.		
a. Horizontal Cell Size	0.8 km	0.4 km
b. Vertical Reporting Interval	N/S	N/S
c. Mapping Uncertainty, 3 Sigma	4km	1 km
d. Measurement Precision	N/S	

EDR Attribute	Threshold	Objective
e. Measurement Accuracy	60% Correct Classification (Cloud Type) 80% Correct Classification (Cloud Phase)	
f. Refresh	At least 90% coverage of the globe every 12 hours (monthly average)	4 hr
Notes: 1. Reserved		

5.3.7 Cloud Optical Depth (COD)

COD Description:

COD is defined as the optical thickness of the atmosphere due to cloud droplets, per unit cross section, integrated over each and every distinguishable cloud layer and all distinguishable cloud layers in aggregate, in a vertical column above a horizontal cell on the Earth's surface. The term "Cloud Optical Thickness" is often used synonymously.

L1RDS-225 Table 5.3.7. - Cloud Optical Depth (VIIRS)

Table 5.3.7. Cloud Optical Depth (VIIRS) v2.11, 11/17/16

EDR Attribute	Threshold	Objective
COT Applicable Conditions: 1. Requirements apply whenever detectable clouds are present.		
a. Horizontal Cell Size	0.8 km	0.4 km
b. Vertical Reporting Interval	N/A	N/A
c. Mapping Uncertainty, 3 Sigma	4 km	1 km
d. Measurement Range	0.5 - 50 (Day) 1 - 5 (Night)	
e. Measurement Precision	Greater of 30 % or 3.0 Tau (Day) Greater of 30 % or 0.8 Tau (Night)	10 %
f. Measurement Accuracy	Liquid phase: 20% (Day), 30% (Night); Ice phase: 20% (Day), 30% (Night)	
Notes:		
1. Reserved 2. The vertical reporting level was struck because COT is only derived at cloud top, not multiple layers		

5.3.8 Cloud Top Pressure (CTP)

Cloud Top Pressure Description:

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

L1RDS-206 Table 5.3.8. - Cloud Top Pressure (VIIRS)

Table 5.3.8. Cloud Top Pressure (VIIRS) v2.11, 10/31/18

EDR Attribute	Threshold	Objective
CTP Applicable Conditions: 1. Requirements apply whenever detectable clouds are present.		
a. Horizontal Cell Size	0.8 km	0.4 km
b. Vertical Reporting Interval	Tops of up to four layers	
c. Mapping Uncertainty, 3 Sigma	4 km	1 km
d. Measurement Precision;		
COT ≥ 1	100 hPa	50 mb
COT < 1	200 hPa	100 mb
e. Measurement Accuracy		
COT ≥ 1	100 hPa	50 mb
COT < 1	200 hPa	100 mb
Notes:		
1. Detectable clouds are defined as clouds with optical depths greater than 0.3.		

5.3.9 Cloud Top Temperature (CTT)

Cloud Top Temperature Description:

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

L1RDS-213 Table 5.3.9. - Cloud Top Temperature (VIIRS)

Table 5.3.9. Cloud Top Temperature (VIIRS) v2.11, 10/31/18

EDR Attribute	Threshold	Objective
CTT Applicable Conditions: 1. Requirements apply whenever detectable clouds are present.		
a. Horizontal Cell Size	0.8 km	0.4 km
b. Vertical Reporting Interval	Tops of highest cloud in column	Tops of multiple clouds in column
c. Mapping Uncertainty, 3 Sigma	4 km	1 km
d. Measurement Precision		
1. Optical thickness ≥ 1	6 K	1.5 K
2. Optical thickness < 1	12 K	2 K
e. Measurement Accuracy		
1. Optical thickness ≥ 1	6 K	1.5 K
2. Optical thickness < 1	12 K	2 K
Notes:		
1. Detectable cloud is cloud with an optical thickness greater than 0.3.		

5.4 Earth Radiation Budget EDR

5.4.1 Albedo (Surface)

Albedo Description:

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

L1RDS-239 **Table 5.4.1. - Albedo (Surface) (VIIRS)**

Table 5.4.1. Albedo (Surface) (VIIRS) v2.11, 2/18/15

EDR Attribute	Threshold	Objective
Albedo Applicable Conditions: 1. Daytime, clear only		
a. Horizontal Cell Size	0.80 km	0.50 km
b. Mapping Uncertainty, 3 Sigma	1 km at Nadir	1 km
c. Measurement Range	0 to 1.0 (albedo units)	0 to 1.0
d. Measurement Precision (1)	0.05 (albedo units)	0.02
e. Measurement Accuracy (1)	0.08 (albedo units)	0.0125
f. Reserved		
g. Coverage (2)	Global, including land and ice surface conditions	Global, including land, ocean and ice surface conditions
h. Spectral Coverage	Broad band value from 0.4 to 4.0 microns	Broad band value from 0.3 to 4.0 microns, and spectral values for bands M1-M5, M7-M8, M10-M11.
Notes:		
1. Accuracy and precision performance will be verified and validated for an aggregated 4 km horizontal cell to provide for adequate comparability of performance across the scan.		
2. There is currently no ability to validate Surface Albedo retrievals over the ocean; however, it is recognized that this is valid NOAA user need and thus will be pursued as an objective requirement.		

5.4.2 Outgoing Longwave Radiation (OLR)

Outgoing Longwave Radiation Description:

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

L1RDS-328 Table 5.4.2. - Outgoing Longwave Radiation (CrIS)

Table 5.4.2. Outgoing Longwave Radiation (CrIS) v2.11, 11/17/16

EDR Attribute	Threshold	Objective
OLR Applicable Conditions: 1. Daytime and nighttime, regardless of sky conditions.		
a. Horizontal Cell Size	25 km at Nadir	10 km at Nadir
b. Mapping Uncertainty, 3 Sigma	5 km at Nadir	2 km at Nadir
c. Measurement Range	0 to 500 W/m^2	0 to 500 W/m^2
d. Measurement Precision	12 W/m^2	6 W/m^2
e. Measurement Accuracy	5 W/m^2	3 W/m^2
Notes:		
1. OLR is now an infrared product produced from CrIS, rather than CERES data.		

5.5 Land EDRs

5.5.1 Active Fires (AF)

Active Fires Description:

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

L1RDS-273 Table 5.5.1. - Active Fires (VIIRS)

Table 5.5.1. Active Fires (VIIRS) v2.11, 11/17/16

Attribute (1)	Threshold	Objective
AF Applicable Conditions: 1. Delivered in daytime and night-time regimes under clear-sky conditions and within the clear areas between scattered and broken clouds.		
a. Horizontal Cell Size (2)		
1. Nadir	0.80 km	0.25 km
2. Worst Case	1.6 km	NS
b. Horizontal Reporting Interval (2)	HCS	NS
c. Horizontal Coverage (2)	Global	Global
d. Mapping Uncertainty, 3 Sigma (2)	1.5 km	0.75 km
e. Measurement Range		
1. Fire Radiative Power (FRP) (3)	1.0 MW to 5.0 $(10)^3$ MW	1.0 MW to 1.0$(10)^4$ MW
f. Measurement Uncertainty		
1. Fire Radiative Power (FRP)	50%	20%
Notes:		
1. NOAA has endorsed the inclusion of an Active Fires EDR based on strong community interest in providing continuity of validated MODIS-based fire products (geolocation of fire detections, FRP, and a full fire mask) consistent with the recommendations of the NOAA-NASA Land Science Team. This change proposes the institution of Active Fires as an EDR with threshold requirements based on the demonstrated capabilities of the VIIRS F1 sensor and S-NPP spacecraft.		

2. The requirement of global coverage is based on user community stated intentions to extend Active Fires product capabilities to non-land based targets (e.g., offshore gas flares).
3. The high end of the FRP Measurement Range threshold requirement (5000 MW) is based on current design capabilities (i.e., the present 634 K saturation specification for the M13 Band on VIIRS) and the recommendation of the NOAA-NASA Land Science Team.

5.5.2 Green Vegetation Fraction (GVF)

Green Vegetation Fraction Description:

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

L1RDS-2469 Table 5.5.2. - Green Vegetation Fraction (VIIRS)

Table 5.5.2. Green Vegetation Fraction (VIIRS) v2.11, 11/17/16

EDR Attribute	Threshold	Objective
a. Horizontal Cell Size	16 Km	4 Km (global), 1 Km (regional)
b. Vertical Reporting Interval	NS	NS
c. Mapping Uncertainty, 3 Sigma	4 Km	1 Km
d. Measurement Precision		
1. Global	15%	8%
2. Regional	15%	8%
e. Measurement Accuracy		
1. Global	12%	5%
2. Regional	12%	5%
f. Measurement Uncertainty		
1. Global	17%	10%
2. Regional	17%	10%
Notes:		

5.5.3 Land Surface Emissivity (LSE)

Land Surface Emissivity Description:

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

L1RDS-2475 **Table 5.5.3. - Land Surface Emissivity (ATMS)**

Table 5.5.3. Land Surface Emissivity (ATMS) v2.11, 11/17/16

EDR Attribute	Threshold (1,2,3,4,5)	Objective
a. Horizontal Cell Size (6)	15 km @ Nadir	
b. Vertical Reporting Interval	NS	NS
c. Mapping Uncertainty, 3 Sigma	NS	NS
d. Measurement Precision (%)		
1. Clear/Cloudy		

EDR Attribute	Threshold (1,2,3,4,5)	Objective
a. 23.8 GHz (V-Pol)	3.0	2.0
b. 50.3 GHz (H-Pol)	3.0	2.0
c. 165.5 GHz (H-Pol)	4.0	3.0
e. Measurement Accuracy (%)		
1. Clear/Cloudy		
a. 23.8 GHz (V-Pol)	2.0	1.3
b. 50.3 GHz (H-Pol)	1.5	1.0
c. 165.5 GHz (H-Pol)	1.5	1.0
Notes:		
1. Those performances are relative to derived analytical emissivity based on the Global Data Assimilation System (GDAS) products.		
2. The emissivity performance is for snow-free land surfaces.		
3. The reported emissivity properties are a composite performance over all the ATMS zenith angles (-65 to 65 deg).		
4. The described performances include the Microwave Integrated Retrieval System (MiRS) algorithm performance, as well as the collocation error, the instrument noise and the errors inherent to the reference used to measure the performances.		
5. This performance assessment does not include precipitating cases, but does include cloud contaminated points.		
6. Refresh, coverage and horizontal size are all dependent on the refresh, coverage and horizontal size of the brightness temperatures measurements. The MiRS algorithm outputs characteristics will reproduce the TB characteristics of these factors.		

5.5.4 Land Surface Temperature (LST)

LST Description:

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

5.5.4.1 VIIRS Land Surface Temperature

L1RDS-246 Table 5.5.4.1. - Land Surface Temperature (VIIRS)

Table 5.5.4.1. Land Surface Temperature (VIIRS) v2.11, 11/17/16

EDR Attribute	Threshold	Objective
LST Applicable Conditions: 1. Clear only		
a. Horizontal Cell Size	0.80 km	0.50 km
b. Mapping Uncertainty, 3 Sigma	1 km at Nadir	1 km at Edge of Scan
c. Measurement Range	213 - 343 K	183 - 343 K
d. Measurement Precision (1 Sigma) (1)	2.5 K	1.5 K
e. Measurement Accuracy (bias) (1)	1.4 K	0.8 K
Notes:		
1. Accuracy and precision performance will be verified and validated for an aggregated 4 km horizontal cell to provide for adequate comparability of performance across the scan.		

5.5.4.2 ATMS Land Surface Temperature

L1RDS-2487 Table 5.5.4.2. - Land Surface Temperature (ATMS)

Table 5.5.4.2. Land Surface Temperature (ATMS) v2.11, 11/17/16

EDR Attribute	Threshold (1,2)	Objective
a. Horizontal Reporting Interval	15 km @ Nadir	NS
b. Vertical Reporting Interval	NS	NS
c. Mapping Uncertainty, 3 Sigma	NS	NS
d. Measurement Precision (K)		
1. Clear/Cloudy	7.0	6.3
e. Measurement Accuracy (K)		
1. Clear/Cloudy	4.0	3.4
f. Measurement Uncertainty (K)		
1. Clear/Cloudy	8.0	7.1
Notes:		
1. Those performances are relative to the European Centre for Medium-Range Weather Forecasts (ECMWF) model.		
2. The described performances include the Microwave Integrated Retrieval System (MiRS) algorithm performance, as well as the collocation error, the instrument noise and the errors inherent to the reference used to measure the performances.		
3. Refresh, coverage and horizontal size are all dependent on the refresh, coverage and horizontal size of the brightness temperatures measurements. The MiRS algorithm outputs characteristics will reproduce the TB characteristics of these factors		

5.5.5 Annual Surface Type (QST)

Annual Surface Type Description:

Annual Surface Type is a global surface type map generated with at least one full year of VIIRS monthly gridded composited NDVI, BT and surface reflectance data. AST is an ancillary data layer for the Surface Type EDR and is generated annually.

L1RDS-2568 Table 5.5.5. - Quarterly Surface Type IP (VIIRS)

Table 5.5.5. Quarterly Surface Type IP (VIIRS) v2.11, 11/17/16

EDR Attribute	Threshold	Objective
QST Applicable Conditions: 1. Both clear and partly cloudy sky conditions.		
a. Horizontal Cell Size	1 km at Nadir	1 km at Edge of Scan
b. Mapping Uncertainty, 3 Sigma	5 km	1 km
c. Measurement Range	17 IGBP Classes specified in Table 5.5.8.1	17 IGBP Classes
d. Measurement Precision	NS	NS
e. Measurement Accuracy	70% correct for 17 types	80% correct for 17 types
Notes:		
1. Annual Surface Type is an intermediate product (IP) to be used as input to the Surface Type EDR and various land surface models for weather, climate, hydrological, agricultural and other models.		

5.5.6 Snow Cover (SC)

Snow Cover Description:

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

5.5.6.1 VIIRS Snow Cover

L1RDS-259 Table 5.5.6.1. - Snow Cover (VIIRS)

Table 5.5.6.1. Snow Cover (VIIRS) v2.11, 10/31/18

EDR Attribute	Threshold	Objective
Snow Cover Applicable Conditions: 1. Clear Daytime, only		
a. Sensing Depth	Not Applicable (1)	1 m
b. Horizontal Cell Size		
1. Clear	1.6 km EOS	1 km
2. Cloudy and/or nighttime	Not Applicable (1)	1 km
c. Measurement Range, Snow Cover	0 - 100% area fraction; 0 or 1 binary mask	
d. Mapping Uncertainty, 3 Sigma		
1. Clear	3 km	1 km
2. Cloudy	Not Applicable (1)	1 km
e. Snow Depth Ranges	Not Applicable (1)	>8 cm; >15; >30; >51; >76 cm
f. Measurement Uncertainty		
1. Clear	20% of snow fraction; 90% probability of correct snow/no-snow classification (2,3)	10% snow fraction; 90% probability of correct BSC snow/no snow classification (VIIRS)
2. Cloudy	Not Applicable (1)	10% for snow depth
Notes:		
1. A microwave instrument is needed to provide the cloudy measurement capability.		
2. The probability of correct snow/no-snow detection applies only to climatologically snow-covered regions.		
3. These requirements apply only to the viewable snow area, i.e., the portion of the land surface which is seen as snow covered by the satellite sensor. They do not include the effect of snow masking by forest cover or by topographic shading.		

5.5.6.2 ATMS Snow Cover

L1RDS-2493 Table 5.5.6.2. - Snow Cover (ATMS)

Table 5.5.6.2. Snow Cover (ATMS) v2.11, 11/17/16

EDR Attribute	Threshold	Objective
a. Horizontal Reporting Interval	15 km @ Nadir	NS
b. Vertical Reporting Interval	NS	NS
c. Mapping Uncertainty, 3 Sigma	NS	NS
d. Probability of Detection (0-1)	0.80	0.90
e. False Alarm Ratio (0-1)	0.10	0.05
f. Heidke Skill Score (-1 - +1)	0.55	0.65
Notes:		
1. Those performances are relative to the NASA AMSR-E product during NH cold season (Nov-Mar).		
2. The described performances include the Microwave Integrated Retrieval System (MiRS) algorithm performance, as well as the collocation error, the instrument noise and the errors inherent to the reference used to measure the performances.		
3. For the purpose of computing the POD, FAR and HSS the snow water equivalent threshold is 0.01 cm.		
4. Refresh, coverage and horizontal size are all dependent on the refresh, coverage and horizontal size of the brightness temperatures measurements. The MiRS algorithm outputs characteristics will reproduce the TB characteristics of these factors.		

5.5.7 Snow Water Equivalent (SWE)

Snow Water Equivalent Description:

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

L1RDS-415 Table 5.5.7. - Snow Water Equivalent (ATMS)

Table 5.5.7. Snow Water Equivalent (ATMS) v2.11, 11/17/16

EDR Attribute	Threshold	Objective
a. Horizontal Cell Size	15 km @ Nadir	NS
b. Vertical Reporting Interval	NS	NS
c. Mapping Uncertainty, 3 Sigma	NS	NS
d. Measurement Precision (cm)	6.0	5.0
e. Measurement Accuracy (cm)	3.0	2.0
f. Measurement Uncertainty	NS	NS
Notes:		
1. Those performances are relative to the NASA AMSR-E product during NH cold season (Nov-Mar)		
2. The described performances include the Microwave Integrated Retrieval System (MiRS) algorithm performance, as well as the collocation error, the instrument noise and the errors inherent to the reference used to measure the performances.		

3. Those performances are dependent on the grain size assumed in the retrieval. For MiRS, this quantity is part of the retrieved state vector.
4. Refresh, coverage and horizontal size are all dependent on the refresh, coverage and horizontal size of the brightness temperatures measurements. The MiRS algorithm outputs characteristics will reproduce the TB characteristics of these factors.

5.5.7.1 Snowfall Rate (SFR)

Snowfall Rate Description:

L1RDS-15043 The Snowfall rate product shall provide water equivalent snowfall amount in unit time globally. The resolution will depend on the sensor used to retrieve the product.

L1RDS-13259 Table 5.5.7.1. - Snowfall Rate (ATMS)

Table 5.5.7.1. Snowfall Rate (ATMS) v2.11, 10/31/18

EDR Attribute	Threshold	Objective
Snowfall Rate Applicable Conditions: Limb-corrected 53.6 GHz ≥ 240 K		
a. Geographic Coverage	Global Land	Global
b. Vertical Coverage	Single layer in lower atmosphere	Single layer in lower atmosphere
c. Horizontal Cell Size	15 km at nadir	15 km at nadir
d. Mapping Uncertainty, 3 Sigma	N/A (reflects SDR characteristics)	N/A (reflects SDR characteristics)
e. Measurement Range	N/A	N/A
f. Snowfall Rate Accuracy	0.3 mm/hr	0.15 mm/hr
g. Snowfall Rate Precision	1 mm/hr	0.7 mm/hr
h. Probability of Detection	40% over land and 30% over ocean	50% over land and 40% over ocean
i. False Alarm Rate	15% over both land and ocean	10% for both land and ocean
Notes:		

5.5.8 Vegetation Indices (VIs)

Vegetation Indices Description:

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

L1RDS-254 Table 5.5.8. - Vegetation Indices (VIIRS)

Table 5.5.8. Vegetation Indices (VIIRS) v2.11, 10/31/18

EDR Attribute	Threshold	Objective
Vegetation Indices Applicable Conditions: 1. Clear, land (not ocean), daytime only		
a. Horizontal Cell Size	4 km global, 1 km regional	1 km global
b. Mapping Uncertainty, 3 Sigma	4 km	1 km
c. Measurement Range		
1. $NDVI_{TOA}$	-1 to +1	-1 to +1
2. EVI_{TOC} (1)	-1 to +4	-1 to + 4
3. $NDVI_{TOC}$	-1 to +1	-1 to +1
d. Measurement Accuracy - $NDVI_{TOA}$ (2)	0.05 NDVI units	0.03 NDVI units
e. Measurement Precision - $NDVI_{TOA}$ (2)	0.04 NDVI units	0.02 NDVI units
f. Measurement Accuracy - EVI_{TOC} (2)	0.05 EVI units	0.03 NDCI units
g. Measurement Precision - EVI_{TOC} (2)	0.04 EVI units	0.02 EVI units
h. Measurement Accuracy - $NDVI_{TOC}$ (2)	0.05 NDVI units	0.03 NDVI units
i. Measurement Precision - $NDVI_{TOC}$ (2)	0.04 NDVI units	0.02 NDVI units
Notes:		
1. EVI can produce faulty values over snow, ice, and residual clouds (EVI > 1)		
2. Accuracy and precision performance will be verified and validated for an aggregated 4 km horizontal cell to provide for adequate comparability of performance across the scan.		

5.5.9 Vegetation Health Index Suite (VHI)

Vegetation Health Index Suite Description:

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

These indices are all produced from a common Vegetation Health Index Suite table as shown below.

L1RDS-2570 Table 5.5.9. - Vegetation Health Index Suite (VCI, TCI, VHI) (VIIRS)

Table 5.5.9. Vegetation Health Index Suite (VCI, TCI, VHI) (VIIRS) v2.11, 10/31/18

EDR Attribute	Threshold	Objective
a. Horizontal Cell Size	0.036° (4 km)[3]	0.018°, 0.009°. (2,1 km)
b. Vertical Reporting Interval	NS	NS
c. Mapping Uncertainty, 3 Sigma	<0.036° (< 4 km)	<0.018°, <0.009°, <0.0045°
d. Measurement Precision	4.0% (for the range 0-100%)	NS
e. Measurement Accuracy	1%	NS
Notes:		
1. Three VH indices are produced: VCI- Vegetation condition index, TCI - Temperature condition index, VHI - Vegetation health index. They characterize moisture (VCI), thermal (TCI) and total vegetation health (VHI) conditions 2. Latency: At the end of each 7-day period the data are available between 2 and 3 am (on the 7th day). 4 hours later (7 am the latest) the products are ready to use. The US main users (CPC and USDA) will have the products by the time they come to work. These arrangements we confirmed with users. 3. Based on National Weather Service user request, the JPSS Program will develop and verify the Horizontal Cell Size requirements at the objective level of 1 km. Tis action has been funded by the JPSS Program and approved by the LORWG as a documented NOAA user requirement. The requirement for a 1 km horizontal cell size shall flow down as the baseline requirement into lower level documents henceforth.		

5.6 Ocean/Water EDRs

5.6.1 Ice Surface Temperature (IST)

Ice Surface Temperature Description:

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

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

L1RDS-291 Table 5.6.1. - Ice Surface Temperature (VIIRS)

Table 5.6.1. Ice Surface Temperature (VIIRS) v2.11, 11/17/16

EDR Attribute	Threshold	Objective
IST Applicable Conditions: 1. Clear, only		
a. Sensing Depth	Ice Surface	Ice Surface
b. Horizontal Cell Size		
1. Nadir	1 km	0.1 km
2. Worst Case	1.6 km	0.1 km
c. Mapping Uncertainty, 3 Sigma		
1. Nadir	1 km	0.1 km
2. Worst Case	1.6 km	0.1 km
d. Measurement Range	213 - 275 K	213 - 293 K (2 m above ice)
e. Measurement Uncertainty	1 K	NS
f. Reserved		
g. Geographic Coverage	Ice-covered oceans (1)	All ice-covered waters.

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

5.6.2 Ocean Color/Chlorophyll (OC/C)

Ocean Color/Chlorophyll Description:

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

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

Science Quality requirements will be achieved using post-processing techniques (i.e., additional ancillary data) external to the JPSS Ground Segment. Additional reprocessing work is outside the scope of the JPSS program.

L1RDS-300 Table 5.6.2. - Ocean Color/Chlorophyll (VIIRS)

Table 5.6.2. Ocean Color/Chlorophyll (VIIRS) v2.11, 11/17/16

EDR Attribute	Threshold	Objective
OC/C Applicable Conditions: 1. Clear, daytime only		
a. Horizontal Cell Size		
1. Nadir	0.75 km	0.1 km
2. Worst Case	1.6 km	0.3 km
b. Mapping Uncertainty, 3 Sigma		
1. Nadir	0.75 km	NS
2. Worst Case	1.6 km	0.1 km
c. Measurement Range		
1. Ocean Color	0.1 - 50 W m^{-2} μm^{-1} sr^{-1}	0.05 - 100 W m^{-2} μm^{-1} sr^{-1}

EDR Attribute	Threshold	Objective
2. Optical Properties		
a) Absorption (1)	4.6 $(10)^{-2}$ to 1.0m^{-1}	4.6 $(10)^{-2}$ to 3.4 m^{-1}
b) Backscattering (1)	4.0 $(10)^{-4}$ to 1.1 $(10)^{-2}m^{-1}$	4.0 $(10)^{-2}$ to 1.3 $(10)^{-2}$ m^{-1}
c) Chlorophyll Fluorescence	Not Applicable (P3I)	Detectable signal in waters with chlorophyll from 0.1 to 50 mg^{-3} at 1 km resolution
3. Chlorophyll (2)	0.01 to 100 mg m^{-3}	0.001 to 100 mg m^{-3}
d. Measurement Precision (Open Ocean, Blue Band) (3)		
1. Ocean Color	10% Operational, 5% Science Quality	5% Operational, 3% Science Quality
2. Optical Properties	20%	20% Operational, 10% Science Quality
3. Chlorophyll		
a) Chl < 1 mg/m^3	30%	10% Operational, 5% Science Quality
b) 1.0 mg/m^3 < Chl < 10 mg/m^3	30%	10% Operational, 5% Science Quality
c) Chl > 10 mg/m^3	50%	10% Operational, 5% Science Quality
e. Measurement Accuracy (Open Ocean, Blue Band) (3)		
1. Ocean Color	10% Operational, 5% Science Quality	5% Operational, 3% Science Quality
2. Optical Properties	35% Operational, 25% Science Quality	30% Operational, 20% Science Quality
3. Chlorophyll		
a) Chl < 1 mg/m^3	35% Operational, 25% Science Quality	20% Operational, 10% Science Quality
b) 1.0 mg/m^3 < Chl < 10 mg/m^3	35% Operational, 25% Science Quality	20% Operational, 10% Science Quality
c) Chl > 10 mg/m^3	40% Operational, 30% Science Quality	20% Operational, 10% Science Quality
f. Reserved		
g. Spectral Correlation	JPSS shall demonstrate that nLw errors in the contributing sensor bands are spectrally correlated as observed in heritage data. (See above paragraphs in this section for context.)	
Notes:		
1. These requirements are based on studies of these data in the NASA vetted and culled validation archive (NOMAD v2) and modeling using the baseline SNPP IOP algorithms. The threshold requirements reflect the baseline SNPP system capability. The objective requirements reflect the full range of observed in-situ values in NOMAD.		
2. The required range is pursuant to a recommendation by the JPSS L1RD Ocean Color Attributes Team to accommodate coastal region ocean waters that may have higher observed levels of biological activity.		

EDR Attribute	Threshold	Objective
3. Heritage requirements dictated that APU requirements be satisfied equally in all contributing VIIRS bands with regard for the variability of naturally occurring reflectances between bands. The Open Ocean, Blue Band qualifier has been recommended by the ocean community and endorsed by the JPSS L1RD Ocean Color Attributes Team to make the application of APU requirements more realistic in the absence of band-specific requirements. This qualifier necessitates the demonstration that sensor nLw errors will be spectrally correlated as observed in heritage data, a prescription that has been explicitly added to the leading paragraph for this EDR. This qualifier also provides for the exclusion of optically complicated waters where algorithm assumptions are no longer viable.		

5.6.3 Ice Concentration (IC)

Ice Concentration Description:

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

L1RDS-279 Table 5.6.3. - Ice Concentration (VIIRS)

Table 5.6.3. Ice Concentration (VIIRS) v2.11, 10/31/18

EDR Attribute	Threshold	Objective
a. Vertical Coverage	Ice Surface	Ice Surface
b. Horizontal Cell Size		
1. Clear	1.0 km	0.5 km
2. All Weather	No capability	1 km
c. Mapping Uncertainty, 3 Sigma		
1. Clear	1 km at Nadir	0.5 km
2. Cloudy	No capability	1 km
d. Measurement Range	0 - 100%	0 - 100%
e. Measurement Accuracy	10% (Notes 1, 2, 3)	5%
f. Measurement Uncertainty	25% (Notes 1, 2, 3)	10%
g. Geographic coverage	All ice-covered regions of the global ocean	All ice-covered regions of the global ocean
Notes:		
1. VIIRS produces sea ice concentration in clear sky conditions only. 2. Performance Exclusion Conditions: a. VCM IP cloud confidence: confidently cloudy and probably cloudy. b. Sun glint regions c. Slant path 550 nm aerosol optical thickness > 1 d. Cloud adjacency exclusion (more than 15% confidently cloudy pixels within a tiepoint collection window) 3. a. Cloud shadow region: cloud shadows identified by VCM cloud shadow flag b. Night and terminator region: SZA > 85 deg c. Low thermal contrast region: ice/water tie point thermal contrast < 1.5 d. Melt ponded ice region: ice tiepoint temperature or surface temperature IP temperature > 271.1 K		

5.6.4 Ice Age/Thickness (IAT)

Ice Age/Thickness Description:

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

L1RDS-15118 Table 5.6.4 Ice Age/Thickness (VIIRS)

Table 5.6.4. Ice Age/Thickness (VIIRS) v2.11, 10/31/18

EDR Attribute	Threshold	Objective
a. Vertical Coverage	Ice Surface	Ice Surface
b. Horizontal Cell Size		
1. Clear	1.0 km	0.5 km
2. All Weather	No capability	1 km
c. Mapping Uncertainty, 3 Sigma		
1. Clear	1 km at Nadir	0.5 km
2. Cloudy	No capability	1 km
d. Measurement Range	Ice free, New/Young Ice, all other ice	Ice Free, Nilas, Grey White, Grey, White, First Year Medium, First Year Thick, Second Year, and Multiyear; Smooth and Deformed Ice
e. Measurement Uncertainty, Probability of Correct Typing of ice classes:		
1. New/young ice	70% (Notes 1, 2, 3)	90%
2. Other ice	70% (Notes 1, 2, 3)	90%
f. Geographic coverage	All ice-covered regions of the global ocean	All ice-covered regions of the global ocean
Notes:		
1. VIIRS produces sea ice characterization in clear sky conditions only.		
2. Performance Exclusion Conditions: a. VCM IP cloud confidence: confidently cloudy and probably cloudy b. Sun glint regions c. Slant path 550 nm aerosol optical thickness > 1		
3. Performance Degradation Conditions a. Cloud shadow region: cloud shadows identified by VCM cloud shadow flag b. Night and terminator region: SZA > 85 deg c. Low thermal contrast region: ice/water tiepoint thermal contrast < 1.5 d. Melt ponded ice region: ice tiepoint temperature or surface temperature IP temperature > 271.1 K		

5.6.5 Sea Ice Concentration (SICon)

Sea Ice Concentration Description:

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

L1RDS-2571 Table 5.6.5. - Sea Ice Concentration (ATMS)

Table 5.6.5. Sea Ice Concentration (ATMS) v2.11, 10/31/18

EDR Attribute	Threshold	Objective
a. Horizontal Reporting Interval	15 km @ nadir	NS
b. Vertical Reporting Interval	NS	NS
c. Mapping Uncertainty, 3 Sigma	NS	NS
d. Measurement Precision (%)	25.0	18.0
e. Measurement Accuracy (%)	10.0	5.0
f. Measurement Uncertainty (%)	NS	NS
Notes:		
1. Performances are relative to the F17 SSMIS near real time product (NASA Team Algorithm). 2. The described performances include the Microwave Integrated Retrieval System (MiRS) algorithm performance, the collocation error, the instrument noise and the errors inherent to the reference used to measure the performances, as well as the errors due to differences in the footprint size of the collocated ATMS and the reference measurements (beam filling effect). 3. Refresh, coverage and horizontal size are all dependent on the refresh, coverage and horizontal size of the brightness temperatures measurements. The MiRS algorithm outputs characteristics will reproduce the TB characteristics of these factors.		

5.6.6 Sea Surface Temperature (SST)

Sea Surface Temperature Description:

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

of the ocean surface. Note that the derived skin SST product will automatically meet similar specifications for bulk SST required by the bulk SST users community.

L1RDS-139 Table 5.6.6. - Sea Surface Temperature (VIIRS)

Table 5.6.6. Sea Surface Temperature (VIIRS) v2.11, 10/31/18

EDR Attribute	Threshold	Objective
a. Horizontal Cell Size (Resolution)	1.6 km (1)	0.25 km
b. Mapping Uncertainty, 3 Sigma	2 km (1)	0.1 km
c. Measurement Range	271 K to 313 K	271 K to 318 K
d. Measurement Accuracy (2)	0.2 K	0.05 K
e. Measurement Precision (2)	0.6 K	0.2 K (<55° View Zenith Angle)
f. Reserved		
g. Geographic coverage	Global cloud and ice-free ocean; excluding lakes and rivers	Global cloud and ice-free ocean, plus large lakes and wide rivers

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

6 JPSS REQUIREMENTS FROM GCOM SENSORS

Although the AMSR-2 instrument will not be flown on the JPSS satellites, the JPSS Ground System will retrieve the data from this GCOM sensor and relay it to NOAA/NESDIS for processing.

The GCOM space segment is operated by the Japan Aerospace Exploration Agency (JAXA). Under NOAA-JAXA cooperative arrangements, NOAA provides ground segment support in exchange for access to AMSR-2 data. NOAA is obligated to use JAXA executable software to develop Level 1 AMSR-2 products, to assure consistency of GCOM data products, and to confirm with third party users to whom NOAA distributed AMSR-2 Level 1 products that they understand and agree to comply with JAXA data policy.

6.1 AMSR-2 Products

The following EDRs will be produced from the AMSR-2 data using NOAA-provided algorithms within the ESPC systems which support JPSS functionality: Imagery, Total Precipitable Water, Cloud Liquid Water, Precipitation (Type/Rate), Snow Cover/Depth, Soil Moisture, Sea Ice Characterization, Sea Surface Temperature, Sea Surface Winds - Speed, and Snow Water Equivalent.

6.1.1 Imagery

Imagery Description:

Imagery enables weather forecasters to discern environmental phenomena (by either manual analysis or automated algorithms) within the visible, near-infrared, infrared, and microwave portions of the spectrum. AMSR imagery includes Microwave Brightness Temperatures. See also Section 5.1.1, Imagery.

L1RDS-372 Table 6.1.1. - Imagery (AMSR-2)

Table 6.1.1. Imagery (AMSR-2) v2.11, 11/17/16

EDR Attribute	Threshold	Objective
Imagery Applicable Conditions: 1. Delivered under "all weather" conditions 2. Each channel shall be provided at its highest native resolution. 3. All channels shall be Vertically and Horizontally polarized.		
a. Horizontal Reporting Interval	10 km except 89 GHz which is at 5 km (2)	Same as threshold
b. Mapping Uncertainty, 3 Sigma	5 km	3 km
Notes:		
1. Reserved.		

2. All channels are sampled at 10 km except 89 GHz, which is at 5 km. All channels V & H polarization. The native resolutions for each channel are as follows: 6.925 GHz - 35 x 62 km 7.3 GHz - 35 x 62 km 10.65 GHz - 24 x 42 km 18.7 GHz - 14 x 22 km 23.8 GHz - 15 x 26 km 36.5 GHz - 7 x 12 km 89.0 GHz - 3 x 5 km

6.1.2 Cloud Liquid Water (CLW)

Cloud Liquid Water Description:

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

L1RDS-380 Table 6.1.2. - Cloud Liquid Water (AMSR-2)

Table 6.1.2. Cloud Liquid Water (AMSR-2) v2.11, 11/17/16

EDR Attribute	Threshold	Objective
CLW Applicable Conditions: 1. Delivered under "all weather" conditions		
a. Horizontal Cell Size	10 km (37 GHz FOV size); 10 km sampling (1)	5 km
b. Vertical Reporting Interval	Total Column	Total Column
c. Mapping Uncertainty, 3 Sigma	5 km	1 km
d. Measurement Uncertainty (1 kg/m^2 = 1 mm)	0.05 mm over ocean; Best efforts over land	0.02 mm over ocean; best effort basis over land
e. Measurement Accuracy	0.01 mm	NS
f. Coverage	Global Ice-free Oceans	Global
g. Reserved		
h. Range (1 kg/m^2 = 1 mm)	0.005 - 1 mm	0 - 2 mm
Notes:		
1. HCS is consistent with 36 GHz SDR product HCS.		

6.1.3 Total Precipitable Water (TPW)

Total Precipitable Water Description:

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

L1RDS-2520 Table 6.1.3. - Total Precipitable Water (AMSR-2)

Table 6.1.3. Total Precipitable Water (AMSR-2) v2.11, 11/17/16

EDR Attribute	Threshold	Objective
a. Horizontal Cell Size	10 km (21 GHz FOV sampling) (1)	5 km
b. Mapping Uncertainty, 3 Sigma	5 km	1 km
c. Measurement Range	1-75 mm	1 - 100 mm
d. Measurement Uncertainty	2 mm or 10%, whichever is greater	1 mm or 4%, whichever is greater
e. Measurement Accuracy	1 mm	0.2 mm
f. Reserved		
g. Coverage	Ice-free global ocean	Ice-free global ocean
Notes:		
1. This HCS consistent with the 23 GHz SDR product HCS.		
2. This refresh requirement is consistent with the AMSR-2 cross-track swath width design of 1450 km for a single orbit plane.		
3. The spatial distribution of the assessment data is global, encompassing the natural variability of the different geophysical conditions.		
4. Refresh, coverage and horizontal size are all dependent on the refresh, coverage and horizontal size of the brightness temperatures measurements. The MiRS algorithm outputs characteristics will reproduce the TB characteristics of these factors.		

6.1.4 Sea Surface Winds - Speed (SSW-S)

Sea Surface Wind Description:

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

L1RDS-411 Table 6.1.4. - Sea Surface Winds - Speed (AMSR-2)

Table 6.1.4. Sea Surface Winds - Speed (AMSR-2) v2.11, 11/17/16

EDR Attribute (1,2)	Threshold	Objective
SSW Applicable Conditions: 1. Delivered under "all weather" conditions		
a. Horizontal Cell Size (Wind speed)	33 km (10.7 GHz FOV size) (3,6)	10 km
b. Mapping Uncertainty, 3 Sigma	5 km	1 km
c. Measurement Range (Speed)	2 - 30 m/sec	1 - 50 m/sec
d. Measurement Uncertainty (Speed)	Greater of 2.0 m/sec or 10%	NS
e. Measurement Accuracy	0.5 m/sec (4)	0.2 m/sec
f. Reserved		
g. Geographic Coverage	Global Ice-free Oceans	Global Ice-free Oceans
Notes:		
1. There is no SSW capability on JPSS.		
2. There is no SSW - Direction capability on GCOM (AMSR-2).		
3. This HCS is consistent with the 10 GHz SDR product HCS.		

4. Accuracy requirements apply for Cloud Liquid Water up to 2mm.
5. This Refresh requirement is consistent with the AMSR-2 Cross-track Swath Width design of 1450 km for a single orbit plane.
6. Reserved

6.1.5 Sea Surface Temperature (SST)

Sea Surface Temperature Description:

Sea surface temperature (SST) is defined as a measurement of the skin temperature of the ocean surface, following the internationally accepted definition used by the Group for High-Resolution SST (GHRSST) and the CEOS Virtual Constellation for SST.

L1RDS-406 **Table 6.1.5. - Sea Surface Temperature (AMSR-2)**

Table 6.1.5. Sea Surface Temperature (AMSR-2) v2.11, 11/17/16

EDR Attribute	Threshold	Objective (5)
SST Applicable Conditions: 1. Delivered under "all weather" conditions		
a. Horizontal Cell Size	40 km (1)	20 km
b. Mapping Uncertainty, 3 Sigma	5 km	3 km
c. Measurement Range	271 K to 313 K (2)	271 K to 313 K
d. Measurement Accuracy	0.5 K	0.1 K
e. Measurement Uncertainty	1.0 K	0.5 K
f. Reserved		
g. Geographic Coverage	Global Oceans (4)	Global Oceans
Notes:		
1. This HCS requirement is consistent with the 6 GHz SDR product HCS.		
2. For all weather, 301 K is the AMSR-E limit. 307 K is the realistic upper limit (Objective) per the MOAT.		
3. Reserved.		
4. Note that MW instruments cannot retrieve within ~50-100 km of land due to contamination of the side-lobe, so coastal waters are problematic.		
5. The characterization of errors for each retrieval is a MW SST user community requirement ((e.g.) GHRSST L2P format). Although not defined in this document, such error characteristic will be defined for the AMSR-2 SST product as an objective requirement.		

6.1.6 Rainfall Rate (RR)

Rainfall Rate Description:

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

L1RDS-386 Table 6.1.6. - Rainfall Rate (AMSR-2)

Table 6.1.6. Rainfall Rate (AMSR-2) v2.11, 10/31/18

EDR Attribute	Threshold	Objective
PT/R Applicable Conditions: 1. Delivered under "all weather" conditions		
a. Horizontal Cell Size	5 km land (89 GHz FOV) (1); 5 km ocean (37 GHz FOV size); 5 - 10 km sampling	5.0 km, both ocean and land
b. Mapping Uncertainty, 3 Sigma	5 km	3.0 km
c. Measurement Range	0 - 50 mm/hr	NS
d. Measurement Precision	0.05 mm/hr	0.05 mm/hr
e. Measurement Uncertainty	2 mm/hr ocean; 5 mm/hr over land	2 mm/hr
f. Reserved		
g. Precipitation Type	Stratiform or Convective	NS
Notes:		
1. The HCS is consistent with the 89 GHz SDR product HCS.		

6.1.7 Sea Ice Characterization (SIC)

Sea Ice Characterization Description:

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

L1RDS-402 Table 6.1.7. - Sea Ice Characterization (AMSR-2)

Table 6.1.7. Sea Ice Characterization (AMSR-2) v2.11, 11/17/16

Attribute	Threshold	Objective
SIC Applicable Conditions: 1. Delivered under "all weather" conditions		
a. Vertical Coverage	Ice Surface	Ice Surface
b. Horizontal Cell Size	10 km	5 km
c. Mapping Uncertainty, 3 Sigma	5 km	3 km
d. Measurement Range		
1. Ice Concentration	1/10 - 10/10	0 to 100%
2. Ice Age Classes	Ice free, first-year, multiyear ice	Ice Free, Nilas, Grey White, Grey, White, First Year Medium, First Year Thick, Second Year, and Multiyear, Smooth and Deformed Ice
e. Measurement Uncertainty		
1. Ice Concentration	10%	5%

Attribute	Threshold	Objective
f. Probability of Correct Typing of Ice Age Classes	70%	90%
g. Reserved		
h. Geographic coverage	All ice-covered regions of the global ocean	All ice-covered regions of the global ocean
Notes:		

6.1.8 Snow Cover/Depth (SC/D)

Snow Cover/Depth Description:

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

L1RDS-390 Table 6.1.8. - Snow/Cover Depth (AMSR-2)

Table 6.1.8. Snow/Cover Depth (AMSR-2) v2.11, 10/31/18

EDR Attribute	Threshold	Objective
SC/D Applicable Conditions: 1. Delivered under "all weather" conditions		
a. Sensing Depth	0 - 60 cm	1 m
b. Horizontal Cell Size	10 km	5 km
c. Mapping Uncertainty, 3 Sigma	5 km	1 km
d. Snow Depth Ranges	5 - 60 cm	> 8 cm; > 15 cm; > 30cm: >51 cm; >76 cm
e. Measurement Uncertainty (1)		
1. Clear	80% probability of correct snow/no snow classification Snow Depth: 20 cm (30 cm if forest cover exceeds 30%)	10% for snow depth
2. Cloudy	80% probability of correct snow/ no snow classification Snow Depth: 20 cm	NS
Notes:		
1. Uncertainty requirements do not apply to (1) mountainous areas (2) melting snow condition. Formulated uncertainty requirements are based on past results of validation of other snow depth products derived from the data of SSMI and AMSR-E. Retrievals with algorithms utilizing only satellite data (no RT model involvement) were considered.		

6.1.9 Snow Water Equivalent (SWE)

Snow Water Equivalent Description:

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

L1RDS-2515 Table 6.1.9. - Snow Water Equivalent (AMSR-2)

Table 6.1.9. Snow Water Equivalent (AMSR-2) v2.11, 11/17/16

EDR Attribute	Threshold	Objective
SWE Applicable Conditions: 1. Delivered under "all weather" conditions		
a. Horizontal Cell Size	10 km	5 km
b. Mapping Uncertainty, 3 Sigma	5 km	1 km
c. Measurement Range	10 - 200 mm	NS
d. Measurement Uncertainty (1)		NS
1. Shallow to moderate snow packs (10 - 100 mm)	20 mm or 50%	NS
2. High snow accumulation (above 100 mm)	70%	NS
Notes:		
1. Uncertainty requirements do not apply to (1) mountainous areas (2) melting snow condition. Relaxed accuracy requirement should be specified for densely forested areas. Formulated uncertainty requirements are based on past results of validation of other SWE products derived from the data of SSMI and AMSR-E. Retrievals with algorithms utilizing only satellite data (no RT model involvement) were considered.		

6.1.10 Soil Moisture (SM)

Soil Moisture Description:

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

L1RDS-398 Table 6.1.10. - Soil Moisture (AMSR-2)

Table 6.1.10. Soil Moisture (AMSR-2) v2.11, 11/17/16

EDR Attribute	Threshold	Objective
SM Applicable Conditions: 1. Delivered under "all weather" conditions		
a. Sensing Depth	Surface to -0.1 cm (Skin Layer)	Surface to - 80 cm
b. Horizontal Cell Size	40 km	20 km
c. Mapping Uncertainty, 3 Sigma	5 km	1 km
d. Measurement Uncertainty	6% volumetric RMSE (goal), with VWC < 1.5 kg/m^2 or GVF < 0.5 and < 2 mm/hr. Precip. Rate	Surface: 5% 80 cm column: 5%
e. Measurement Range	0 - 50% (1)	0 - 100%
Notes:		
1. Under Attribute (e), the threshold measurement range is given as 0-50% which is appropriate. However, the objective is given as 0-100%. A 0-100% range in absolute soil moisture only makes sense if you are including some fraction of standing water in the total of what you are calling “soil moisture” since soils will saturate at an absolute soil moisture level of 40-50%. The community often converts % soil moisture into absolute units (for ex., 50% = 0.50 cm^3/cm^3) to avoid confusion. The later approach would not include standing water in the units of soil moisture since the “per cm^3” volume referred to is the soil volume at and below the soil surface and would not include anything sitting on top of the surface like puddles of water.		

6.1.11 Surface Reflectance (ST)

Surface Reflectance Description:

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

L1RDS-13260 Table 6.1.11. - Surface Reflectance (SR) (VIIRS)

Table 6.1.11. Surface Reflectance (SR) (VIIRS) v2.11, 10/31/18

EDR Attribute	Threshold	Objective
SR Applicable Conditions: 1. Clear, daytime only (1)		
a. Horizontal Cell Size	Pixel resolution in radiometric (800m) and imagery (400m) bands	250m
b. Mapping Uncertainty, 3 Sigma	VIIRS SDR pixel geolocation uncertainty	
c. Measurement Range	0-1 (In some instances (e.g. at certain angles over snow), the reflectance can be larger than 1)	
d. Measurement Accuracy (A) (1)	0.005+0.05ρ	0.003+0.03ρ
e. Measurement Precision (P) (1)	0.005+0.05ρ	0.003+0.03ρ
g. Refresh	At least 90% coverage of the globe every 24 hours (monthly average)	24h
Notes:		
Notes: 1. The symbol ρ denotes the retrieved surface reflectance. The APU metrics are applicable in conditions of low-to-moderate atmospheric turbidity (AOT (0.55μm) x m <1) where m is the air mass. The performance is degraded for the SR at wavelengths lower than 0.55μm by at least a factor 2. The SR errors may also be higher under partly cloudy and snow conditions.		

7 FLIGHT PERFORMANCE REQUIREMENTS

7.1 General

7.1.1 Sensor Characterization and Monitoring

The following system requirements for sensor characterization and monitoring are imposed on the JPSS Program.

L1RDS-11 The spatial and radiometric performance of the JPSS instruments shall be characterized and documented prior to launch.

The goal is to achieve the quality necessary to maintain National Institute of Standards and Technology (NIST) traceability where possible.

7.1.2 Instrument Long Term Stability

Long Term Stability is not used operationally, but is important for Climate Research. EDR Long-Term Stability (LTS) requirements have been replaced by Level 1 accuracy requirements on the mean calibrated radiometric retrieved value of an SDR or TDR and complementary requirements on sensor characterization and monitoring, instrument stability, and sensor and data trending.

L1RDS-14 The mean calibrated radiometric response of each channel of an instrument to a uniform scene, defined as the ratio of the calibrated measured radiance to the scene radiance, shall not change by more than +/- 1% (TBR-3) for all spectral channels over time scales longer than two weeks up to the sensor design life. In determining the mean calibrated radiometric response, a sufficient number of successive samples are averaged such that the noise in the average response is much less than the +/- 1% stability requirement.

7.1.3 Calibration

L1RDS-2283 The JPSS spacecraft and instruments shall perform calibration maneuvers as required to maintain data product accuracy.

7.2 Advanced Technology Microwave Sounder (ATMS)

L1RDS-16 The system shall provide calibrated ATMS measurements of Earth-atmosphere emitted microwave radiation at the top of the atmosphere necessary for deriving vertical profiles of atmospheric temperature and moisture, while operating from the nominal JPSS orbit, over any location on the Earth surface.

L1RDS-17 The system shall provide ATMS measurements that can be spatially and temporally co-registered with coincident CrIS measurements.

7.3 Clouds and the Earth's Radiant Energy System (CERES)

L1RDS-19 The system shall provide CERES measurements of Earth-atmosphere reflected solar and emitted thermal radiation at the top of the atmosphere necessary for monitoring the Earth's energy budget, while operating from the nominal JPSS orbit, for any location on the Earth surface. (JPSS-1, only) The Radiation Budget Instrument (RBI) will be the NASA follow-on to CERES which may be flown on JPSS-2.

7.4 Cross-Track Infrared Sounder (CrIS)

L1RDS-21 The system shall provide calibrated CrIS measurements of Earth-atmosphere emitted thermal radiation at the top of the atmosphere necessary for deriving vertical profiles of atmospheric temperature and moisture, while operating from the nominal JPSS orbit, over any location on the Earth surface.

L1RDS-22 The system shall provide CrIS measurements that can be spatially and temporally co-registered with coincident ATMS measurements.

7.5 Ozone Mapping and Profiler Suite (OMPS-N)

L1RDS-24 The system shall provide calibrated OMPS-N (only) 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, for any location on the Earth surface.

7.6 Reserved

7.7 Visible Infrared Imaging Radiometer Suite (VIIRS)

L1RDS-28 The system shall provide calibrated VIIRS measurements of Earth-atmosphere reflected solar and emitted thermal radiation at the top of the atmosphere necessary for producing imagery while operating at the nominal JPSS orbit, for any location on the Earth surface.

L1RDS-29 The system shall provide calibrated VIIRS measurements of Earth-atmosphere reflected solar and emitted thermal radiation at the top of the atmosphere necessary for deriving Earth surface, ocean, cryosphere, cloud, and atmospheric aerosol properties, while operating from the nominal JPSS orbit, for any location on the Earth surface.

Appendix A - Conventions and Rationale

1.0 EDR Performance Characteristics

JPSS customers may use RDRs, SDRs, TDRs, or EDRs and satellite auxiliary data for other applications since these products represent the full information content of JPSS capabilities. Accordingly, the system will produce RDRs and SDRs by exploiting the full sensing capability of the JPSS sensors to the maximum extent practical.

EDR threshold requirements are cited first and objective requirements are cited second throughout this document. The thresholds and objectives refer to the minimum requirement at any point where measurements are sensed, (e.g., a requirement for horizontal resolution of 25 km indicates a need for data at that resolution or better across the entire area where data are being measured, unless specifically indicated at nadir (direct overhead view) or worst case (normally at the edge of satellite field of view) resolution separately). Any requirement giving "nadir resolution" as an attribute presumes that the expansion of the resolution at oblique viewing angles is a natural outcome of observing a spheroid from space, and does not presume a specific scanning methodology. In these instances, technology will be driven by the nadir, or highest quality, field of view. Vertical height expressed in millibars is a measurement of atmospheric pressure. Vertical height expressed in kilometers is a measurement of the height above sea level. A value of zero km for height or vertical coverage refers to the land or water surface. Negative values of height refer to depth below the earth's surface (land or water).

Global coverage denotes the observation of all points on the Earth or its atmosphere at least once per given time period (consistent with observational requirements).

EDR Accuracy, Precision, Uncertainty (APU) and Probability of Correct Typing (PCT) threshold requirements must be met only under clear conditions unless otherwise specified. Thresholds given for attributes broken into "cloudy" (a pixel with a Cloud Optical Thickness (COT*) $\geq$ 1.0 (TBR-4)), "clear" (a pixel with a COT $\leq$ 0.2 (TBR-4) or no clouds present), and "all weather" (all cloud conditions and rainfall rates less than or equal to 2 mm hr^{-1} km^{-2} unless otherwise specified in individual EDRs). That is, if within any given HCS, if 30% (TBR-4) of the HCS area has an average rain rate > 2 mm/hr/km^2, then it is not necessary to meet the APU thresholds for that pixel.

(*The COT contains a "TBR" since the correct value for a "detectable cloud" cannot be determined until the sensor is in space and the NPP calibration/validation effort has been completed.)

These cases indicate the government's recognition that different technologies must be employed to provide accurate measurements under these different atmospheric conditions. Threshold value differences among cloudy, clear, and all weather cases specified in the EDR tables demonstrate how the most stringent of the three is required when obtainable, and will add important information in the ultimate operational application of the data.

The Measurement Range threshold and objective requirements establish the range of values against which the requirements for APU and PCT apply. The span of possible observable conditions is likely to extend beyond the required measurement range for each EDR.

2.0 EDR Conventions and APU Performance Requirements

APU requirements represent the fundamental standards for EDR performance. The APU conventions that are normally used to assess and validate EDR performance are discussed in this section.

PCT requirements are used in lieu of APU for EDRs containing classification requirements.

2.1 Definition of True Value

True value, x_T, is defined as the actual value of a geophysical parameter corresponding to a JPSS measurement.

2.2 Definition of Measurement Error

Measurement error is the difference between the estimated value of a parameter and its true value. This estimate may be the result of a direct measurement, an indirect measurement, or an algorithmic derivation.

The measurement error ε is given by:

$$\varepsilon = x_E - x_T$$

where: x_E is the estimate of the parameter x and x_T is its true value.

2.3 Definition of Probability of Correct Typing (PCT)

PCT is the probability that a cell reported as being of type x is in fact of type x.

2.4 Sample Set Requirements for APU and PCT

A set of measurements and corresponding true values used to estimate APU and PCT as defined in this Appendix will satisfy the following conditions:

2.4.1 The set will be large enough so that the sample size error in the estimated attribute is much smaller than the required value for that attribute.

2.4.2 The true values corresponding to the measurements in the set will fall into a range which is narrow with respect to the EDR measurement range, unless otherwise specified.

2.4.3 Where a stratification of measurements is against an attribute other than the measurement range of an EDR, the set of true values within that stratification will fall into a range which is narrow with respect to the required range of values for that stratification.

Note: 2.4.2 and 2.4.3 are imposed because, ideally, a measurement attribute requirement must be met for any true value of the parameter within the parameter range, not in an average sense over the parameter range.

2.4.4 To the extent practical, the collection of sample sets will be well populated and distributed across the EDR measurement range and will be geographically, seasonally, and phenomenologically diverse enough to be environmentally representative of observed conditions across the globe, throughout an annual seasonal cycle, and inclusive of important spatial and temporal variations commonly observed in any particular EDR.

2.5 Measurement Accuracy

Measurement accuracy is defined as the magnitude of the mean measurement error. For a sample set of N measurement errors, the measurement accuracy βN is given by the following formula:

$$\beta_N = |\mu_N|$$

where: μ_N is the mean measurement error, and |…| denotes absolute value. The mean measurement error μ_N is given by the following formula:

$$\mu_N = (\Sigma_{i=1,N}\ \varepsilon_i)/N$$

where: ε_i is the value of the measurement error for the i'th measurement and $\Sigma_{i=1,N}$ denotes summation from i = 1 to i = N.

2.6 Measurement Precision

Measurement precision is defined as the standard deviation (one sigma) of the measurement errors. For a sample set of N measurement errors, the measurement precision σ_N is given by the following formula:

$$\sigma_N = [\Sigma_{i=1,N}(\varepsilon_i - \mu_N)^2/(N - 1)]^{1/2}$$

where ε_i is the value of the measurement error for the i'th measurement, μ_N is the mean measurement error, and $\Sigma_{i=1,N}$ denotes summation from i = 1 to i = N.

2.7 Measurement Uncertainty

Measurement uncertainty is defined as the root-mean-square (RMS) of the measurement errors. It results from the combined effects of all systematic and random errors. Measurement uncertainty converges to the square root of the sum of the squares (RSS) of the measurement accuracy and precision in the limit of an infinite number of measurements. For a sample set of N measurement errors, the measurement uncertainty ξ_N is given by the following formula:

$$\xi_N = [\Sigma_{i=1,N}\ \varepsilon_i^2/N]^{1/2}$$

where ε_i is the value of the measurement error for the i'th measurement and $\Sigma_{i=1,N}$ denotes summation from i = 1 to i = N.

2.8 EDR Requirement Attribute Values

2.8.1 Unless stated otherwise, EDR capabilities are specified in a global sense, implying that the capability is desired all the time, everywhere, and under all weather conditions.

2.8.2 Unless otherwise specified, EDR requirement attribute values will be interpreted as upper bounds anywhere in the area where measurements are obtained, including the edge of the measuring sensor field of view.

2.8.3 Tolerances for verification and validation compliance with a required threshold or objective value will be based on the number of significant digits appearing in that value, with the following exceptions:

2.8.3.1 All attribute values, including single digit integers, are considered expressed to a minimum of two significant digits.

2.8.3.2 A value V with tolerance +/- X means acceptable values of V fall within $(V - X) \leq V \leq (V + X)$ to a two-digit minimum significance of X.

2.8.3.3 All digits to the left of the decimal point in integer Measurement Range and Swath Width attribute values, including zeros, are considered significant.

2.8.4 Gaussian rounding, which rounds to even at half-points, will be applied to performance estimates for comparison against associated attribute values.

Appendix B - List of Acronyms

A_o	Operational Availability
AB	Auroral Boundary
AED	Auroral Energy Deposition
AF	Active Fires
AFWA	Air Force Weather Agency
AMSR	Advanced Microwave Scanning Radiometer
AOT	Aerosol Optical Thickness
AP	Application Packet
APC	Alternate Processing Center
APS	Aerosol Polarimetry Sensor
APS	Aerosol Particle Size
APU	Accuracy, Precision, Uncertainty
ATMS	Advanced Technology Microwave Sounder
AVMP	Atmospheric Vertical Moisture Profile
AVTP	Atmospheric Vertical Temperature Profile
BUV	Backscattered Ultraviolet
C^2	Command and Control
C^3	Command, Control, and Communications
C^3S	Command, Control, and Communications Segment
CAL/VAL	Calibration/Validation
CBH	Cloud Base Height
CCD	Charge Coupled Device
CC/L	Cloud Cover/Layers
CDR	Climate Data Record
CEPS	Cloud Effective Particle Size
CERES	Clouds and the Earth's Radiant Energy System
CGS	Common Ground System
CIR	Climate Information Record
CIWP	Cloud Ice Water Path
CLASS	Comprehensive Large Array-Data Stewardship System

CLW	Cloud Liquid Water
CLWC	Cloud Liquid Water Content
COT	Cloud Optical Thickness
CPS	CIR/CDR Production System
CrIMSS	CrIS + ATMS (Cross-track Infrared Microwave Sounder Suite)
CrIS	Cross-Track Infrared Sounder
CTH	Cloud Top Height
CTP	Cloud Top Pressure
CTT	Cloud Top Temperature
DA	Data Acquisition
DLR	Downward Longwave Radiation (Surface)
DMSP	Defense Meteorological Satellite Program
DOC	Department of Commerce
DoD	Department of Defense
DPGV	Data Product Generation and Verification
DR	Data Routing
DRS	Direct Readout Support
DSR	Downward Shortwave Radiation (Surface)
DWSS	Defense Weather Satellite System
EDR	Environmental Data Record
EI	Energetic Ions
EM&GO	Enterprise Management and Ground Operations
EOS	Edge of Scan
ESPC	NOAA Environmental Satellite Processing Center
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EVI	Enhanced Vegetation Index
FNMOC	Fleet Numerical Meteorology and Oceanography Center
FOR	Field of Regard
FOV	Field-of- View
GCOM	Global Change Observation Mission
GFE	Government Furnished Equipment
GHz	Gigahertz

GVF	Green Vegetation Fraction
HCS	Horizontal Cell Size
HIRS	High Resolution Infrared Sounder
HRD	High Rate Data
HRI	High Resolution Imager
HSR	Horizontal Spatial Resolution
IASI	Infrared Atmospheric Sounding Interferometer
ICAPOP	Image, Cloud and Aerosol Product Oversight Panel
ICT	Ice Surface Temperature
IDP	Interface Data Processor
IDPS	Interface Data Processing System
IGBP	International Geosphere Biosphere Program
IOP	Inherent Optical Properties
IP	Intermediate Product
IST	Ice Surface Temperature
ITAR	International Trafficking in Arms Regulation
J#	Sequential numbering for JPSS launches, e.g., J1, J2
JAXA	Japan Aerospace Exploration Agency
JPSS	Joint Polar Satellite System
kg	Kilograms
km	Kilometer
KPP	Key Performance Parameter
L1RD	JPSS Level 1 Requirements Document
LASP	Laboratory of Atmospheric and Space Physics
LST	Land Surface Temperature
LTAN	Local Time of Ascending Node
LTS	Long Term Stability
Metop	Meteorological Operational (satellite)
MiRS	Microwave Integrated Retrieval System
MIS	Microwave Imager Sounder
MMC	Mission Management Center
MODIS	Moderate Resolution Imaging Spectroradiometer

NASA	National Aeronautics and Space Administration
NAVOCEANO	Naval Oceanographic Office
NCC	Near-Constant Contrast
NCDC	National Climate Data Center
NDE	S-NPP Data Exploitation project
NDVI	Normalized Difference Vegetation Index
NEdN	Noise Equivalent Differential Radiance
NEdT	Noise Equivalent Differential Temperature
NESDIS	National Environmental Satellite, Data, and Information Service
NIST	National Institute of Science and Technology
nLw	Normalized Water-Leaving Radiances
NWLR	Normalized Water-Leaving Radiances
NOAA	National Oceanic and Atmospheric Administration
NOMAD	NASA bio-Optical Marine Algorithm Data set
NP	Nadir Profile
NPOESS	National Polar-orbiting Operational Environmental Satellite System
NPP	National Polar-orbiting Partnership
NSOF	NOAA Satellite Operations Facility
NWP	Numerical Weather Prediction
OC/C	Ocean Color/Chlorophyll
OLR	Outgoing Longwave Radiation (TOA)
OLWR	Outgoing Longwave Radiation
OMPS	Ozone Mapping and Profiler Suite
OMPS-Limb	Ozone Mapping and Profiler Suite Limb Sounder
OMPS-Nadir	Ozone Mapping and Profiler Suite Nadir Sounder
P	Precipitation (Type/Rate)
P3I	Potential Pre-Planned Product/Process Improvement
PCT	Probability of Correct Typing
PDA	NOAA Product Distribution and Access system
POES	Polar-orbiting Operational Environmental Satellite
Ps	Probability of Success
P-S/P	Pressure (Surface/Profile)

PT/R	Precipitation (Type/Rate)
PW	Precipitable Water
RBI	Radiation Budget Instrument
RDR	Raw Data Record
RIP	Retained Intermediate Product
RMSE	Root Mean Square Error
RSR	Reflected Solar Radiation
SC	Snow Cover
SC/D	Snow Cover/Depth
SDR	Sensor Data Record
SeaWiFS	Sea-viewing Wide Field-of-view Sensor
SEM	Space Environment Monitor
SEM-N	Space Environment Monitor - New
SI	Solar Irradiance
SIC	Sea Ice Characterization
SM	Soil Moisture
SM	Suspended Matter
SMD	Stored Mission Data
S-NPP	Suomi National Polar-orbiting Partnership
SO_2	Sulfur Dioxide
SSI	Solar Spectral Irradiance
SSMIS	Special Sensor Microwave Imager Sounder
SST	Sea Surface Temperature
SSW-D	Sea Surface Wind Direction (SSWD)
SSW-S	Sea Surface Winds Speed (SSWS)
SSWS	Sea Surface Wind Stress
ST	Surface Type
STAR	Center for Satellite Applications and Research
SWE	Snow Water Equivalent
TC	Total Column
TDR	Temperature Data Record
TDRSS	Tracking and Data Relay Satellite System

TOA	Top of Atmosphere
TOC	Top of Canopy
TPW	Total Precipitable Water
TWC	Total Water Content
U.S.	United States
VCM	VIIRS Cloud Mask
VCS	Vertical Cell Size
VIIRS	Visible Infrared Imaging Radiometer Suite
VRI	Vertical Reporting Interval
VWC	Volume Water Content
W#	Sequential numbering for GCOM launches, e.g., W1, W2
xDR	An RDR, SDR, TDR or EDR

Appendix C - Glossary

Absolute Humidity

The mass of water vapor per unit volume of moist air expressed in grams per cubic centimeter.

Active Fires

Active surface fires are natural or anthropogenic fires. This EDR provides the geolocation of the pixels in which active fires are detected. It also includes a full mask consisting of a two-dimensional array of values representing the fire and other relevant thematic classes for each pixel of the swath data granule, and the variable “Fire Radiative Power”.

Aerosol Optical Depth

See Aerosol Optical Thickness

Aerosol Optical Thickness

Aerosol Optical Thickness is the optical thickness of the atmosphere due to aerosol particles, per unit cross section, integrated over a vertical column above a horizontal cell on the Earth's surface, usually in a narrow spectral band about a wavelength of interest. The term “Aerosol Optical Depth” is often used synonymously.

Aerosol Particle Size (APS)

Atmospheric aerosols affect the radiation regime of the atmosphere directly by absorption and scattering. APS information is also useful to numerical weather prediction (NWP) and aerosol dispersion models. Some of the original attributes for this EDR (particularly climate elements) could only be produced by the Aerosol Polarimetry Sensor (APS) which is not flown on JPSS. Consequently, this EDR is produced from VIIRS data only.

Aerosol Particle Size Parameter (APSP)

The APSP is the Angström Exponent of the thickness of an atmospheric aerosol particle. The Angström exponent characterizes the dependency of AOT on wavelength and is related to the average size of the particles in the aerosol (the larger the exponent, the smaller the particles).

Albedo

Surface albedo is defined as the total amount of solar radiation in the 0.4 to 4.0 micron band reflected by the Earth’s surface into an upward hemisphere (sky dome), including both diffuse and direct components, divided by the total amount incident from this hemisphere, including both direct and diffuse components.

All Weather

The “all weather” requirement includes all cloud conditions and rainfall rates less than 2 mm/hour per square kilometer unless otherwise specified in individual EDRs. See also “Clear/cloudy”.

Application Packet

An Application Packet is a formatted unit of data carried by a packet mode computer network. The Consultative Committee for Space Data Systems (CCSDS) packet telemetry standard defines the protocol used for the transmission of spacecraft instrument data.

Atmosphere-centimeter (atm-cm)

Read as atmosphere-centimeter, atm-cm denotes the amount of a gas in a vertical column from the earth's surface to space. It is the thickness of the slab of gas, in centimeters, if all the gas were concentrated in a layer at a pressure of atmosphere.

Atmospheric Vertical Moisture Profile (AVMP)

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

[Note that specific humidity is the ratio of the mass of water vapor to the total mass of the system (dry air plus water vapor). If w = mixing ratio, then specific humidity = w/ (1+w), and for most practical cases, specific humidity ≈ w.]

See Section 5.2.3, AVMP, for additional information.

Atmospheric Vertical Temperature Profile (AVTP)

An Atmospheric Vertical Temperature Profile (AVTP) is a sampling of temperatures at stated intervals throughout the atmosphere.

See Section 5.2.4, AVTP, for additional information.

ATMS and CrIS:

The Cross-track Infrared Sounder (CrIS) combined with the Advanced Technology Microwave Sounder (ATMS) globally produces atmospheric temperature, moisture and pressure profiles from space. The combined ATMS/CrIS sensor suite is called the Cross track Infrared and Microwave Sounder Suite (CrIMSS).

Availability

The measure of the probability that a system is operationally capable (ready for tasking) of performing an assigned mission (e.g., delivering a KPP) at any given time.

Blended Product

A data product that is dependent on direct measurements from sensors on more than one satellite.

C3 System

The C^3 system is responsible for Command, Control, and Communications (C^3). Also appears in the documentation as C3S (for C^3 Segment).

Centrals (DoD)

Primary DoD data processing centers that use JPSS data to produce environmental products for their customers. The processing, archiving, and dissemination of these data are their

responsibility. The DoD data processing centers are: Air Force Weather Agency (AFWA), Fleet Numerical Meteorology and Oceanography Center (FNMOC), and the Naval Oceanographic Office (NAVOCEANO).

CERES and RBI

The Clouds and the Earth's Radiant Energy System. The CERES instrument is designed to measure both solar-reflected and Earth-emitted radiation from the top of the atmosphere to the Earth's surface. The measurements from CERES are used to observe and understand the role of clouds and the energy cycle in global climate monitoring and prediction. The Radiation Budget Instrument (RBI) will be the NASA follow-on to CERES.

CLASS

CLASS is a web-based data archive and distribution system for NOAA's environmental data, to include S-NPP and JPSS satellite data.

Clear / Cloudy Conditions

Data products are required to be delivered under all weather conditions. However, EDR accuracy, precision and uncertainty (APU) threshold requirements must be met only under clear conditions only unless otherwise specified. Thresholds given for attributes are broken into three cases: a) cloudy (a pixel with a Cloud Optical Thickness (COT) $\geq$ 1.0 (TBR-4)); b) clear (a pixel with a COT $\leq$ 0.2 (TBR-4) or no clouds present), and c) all weather (all cloud conditions and rainfall rates less than 2 mm hr^{-1} km^{-2} unless otherwise specified in individual EDRs). That is, if within any given HCS, if 30% (TBR-4) of the HCS area has an average rain rate > 2 mm hr^{-1} km^{-2}, then it is not necessary to meet the APU thresholds for that pixel. Bad pixels within the retrieval Field of Regard must be flagged. These cases indicate the government's recognition that different technologies may be required to provide accurate measurements under these three different atmospheric conditions. Threshold value differences among cloudy, clear, and all weather cases demonstrate how the most stringent of the three is required when obtainable, and will add important information in the ultimate operational application of the data.

Note: The COT contains a "TBR" since the correct value for a "detectable cloud" cannot be determined until the sensor is in space and the S-NPP calibration/validation effort has been completed.

Climate Data Record (CDR)

A CDR is a time series of measurements (e.g., sea surface temperature) of sufficient length, consistency, and continuity to determine climate variability and change [National Research Council, 2004]. In practice, NOAA will use JPSS data together with heritage and other data sets to provide climate records typically covering multiple decades in time.

Cloud

An aggregate of minute non-precipitating water and/or ice particles in the atmosphere above the earth's surface.

Cloud Base Height (CBH)

Cloud base height is defined as the height above sea level where cloud bases occur. Cloud Base Height is used to support aviation operations.

Cloud Cover

The fraction of a given area overlaid in the local normal direction by clouds. It is the portion of the earth's horizontal surface masked by the vertical projection of clouds. Cloud cover data is a critical input to general forecasting, albedo measurements, and other meteorological applications.

Cloud Effective Particle Size (CEPS)

Cloud effective particle size (CEPS) is a representation of the cloud particle size distribution. The effective particle size or effective radius is defined as the ratio of the third moment of the drop size distribution to the second moment, averaged over a layer of air within a cloud. These data are required in global NWP models and in hurricane forecasting. Cloud optical depth and other cloud radiative properties vary substantially with CEPS. Uncertainties in the CEPS can generate large differences among Ice Water Content retrievals with remote sensing techniques. IWC has become the key variable used in models to characterize cloud radiative, dynamical, and hydrological properties.

Cloud Ice Water Path (CIWP)

Cloud Ice Water Path is defined as the equivalent amount of water in the form of cloud ice particles in a specified segment of a vertical column of the atmosphere. For this EDR, vertical cell size is the vertical height of the total atmospheric column specified and the horizontal reporting interval specifies the locations of the column segment bottoms for which cloud ice water path must be reported.

Cloud Leakage Rate

Cloud “leakage” occurs in the Cloud Mask when a Confidently Clear pixel actually contains cloud. Consequently, for the Cloud Mask, the probability of correct typing (PCT), leakage and false alarm rates will sum to 100% only when there are no Probably Cloudy or Probably Clear pixels classified by the Cloud Mask.

Cloud Liquid Water (CLW)

Cloud liquid water is defined as the equivalent amount of water within cloud particles in a specified segment of a vertical column of the atmosphere. For this EDR, vertical cell size is the vertical height of the total atmospheric column specified and the horizontal reporting interval specifies the locations of the column bottoms for which CLW must be reported.

Cloud Mask (CM)

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

Cloud Optical Depth

See Cloud Optical Thickness

Cloud Optical Thickness (COT)

Cloud Optical Thickness is the optical thickness of the atmosphere due to cloud droplets, per unit cross section, integrated over every distinguishable cloud layer and all distinguishable cloud layers in aggregate, in a vertical column above a horizontal cell on the Earth's surface. The term "Cloud Optical Depth" is often used synonymously.

Cloud Top Height (CTH)

Cloud top height is defined for each cloud-covered earth location as the set of heights above mean sea level of the tops of the cloud layers overlying the location. Cloud top data are of particular interest to forecasters providing weather support to aircraft operations. These data are vital as inputs to both NWP and specialized cloud analysis/forecast models, particularly for severe weather forecasting, aircraft routing, and determining visibility at altitude for aerial refueling missions. CTH observations will help the forecaster predict rime and mixed icing in stratiform clouds from 3000-6000 feet; and clear or mixed icing in cumuliform clouds from 3000-20000 feet. Cloud top data are also needed in mesoscale studies and climatological analyses, particularly those focused on the radiative balance of the atmosphere.

Cloud Top Pressure (CTP)

Cloud top pressure is defined for each cloud-covered earth location as the set of atmospheric pressures at the tops of the cloud layers overlying the location. Operational measurements of CTP are needed to improve operational numerical weather prediction.

Cloud Top Temperature (CTT)

Cloud top temperature data are used for operational forecasting. Determination of cloud top temperature offers weather forecasters a means to discriminate convective vs. non-convective clouds, intensity change (cooling vs. warming), and distribution/intensity of convective elements along a squall line. These data are used in global NWP models, and have application to aviation guidance forecasting and hurricane forecasting.

Cloud Type

The classification of clouds into the 18 types given in Tables 3-19 and 3-20 of the Federal Meteorological Handbook 1B.

Cloudy

Cloudy conditions are those where only the microwave retrievals are used and are typically scenes with greater than 50% cloudiness.

Customers

The JPSS Program sponsoring and stakeholder Government agencies whose operational requirements are drivers of the system architecture and design.

Data Availability

Data Availability is the percentage of data collected by operational sensors on each JPSS satellite that is delivered to the JPSS Data Distribution System. Data Availability is calculated on a 30 day basis.

Data Latency

Data Latency is defined as the period from the time of observation of all requisite data by the satellite until the EDR or data product produced from those date is available to the user at the distribution system.

Degradation Condition

See Section 3.3.

Deliver

To push data or material, either physically or electronically, to a specified end point.

Detectable Cloud

A detectable cloud is an aqueous aerosol having a vertical extinction optical depth (COT) exceeding 0.1 (TBR-5) in the visible (0.64 µm region).

Direct Broadcast

A spacecraft capability to broadcast satellite mission data via a High Rate Data (HRD) downlink directly to users equipped with suitable field terminals

Distribute

To push data or material, either physically or electronically, to one or more specified end points.

Environmental Data

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

Environmental Data Record (EDR)

Data record produced when an algorithm is used to convert the calibrated and geolocated radiances and their associated reflectances and brightness temperatures delivered by Sensor Data Records (SDRs) into geophysical parameters at the same geographic location using additional geophysical ancillary data as necessary.

Environmental Satellite Processing Center (ESPC)

The NOAA ESPC is located within the NSOF. The ESPC is composed of multiple systems which support JPSS functionality by receiving RDRs, SDRs and EDRs from the IDPS, processing these data into unique NOAA products, and making these products available to the user.

Exclusion Condition

See Section 3.3.

False Alarm Rate

In the Cloud Mask, a “false alarm” is applied to pixels classified as Confidently Cloudy when the pixels are actually cloud-free. Consequently, for the Cloud Mask, the probability of correct typing (PCT), leakage and false alarm rates will sum to 100% only when there are no Probably Cloudy or Probably Clear pixels classified by the Cloud Mask.

Global Coverage

Global coverage denotes the observation of all points on the Earth or its atmosphere at least once per given time period (consistent with observational requirements).

Green Vegetation Fraction (GVF)

Green Vegetation Fraction (GVF) is defined as the fraction of a vertically viewed scene that is covered by active green vegetation. The real-time weekly GVF provides an excellent characterization of the surface in the NOAA land-surface model (LSM). The LSM is a component of all operational numerical weather prediction models and GVF helps improve near-surface winds, temperature and humidity forecasts.

High Rate Data (HRD) Broadcast

The JPSS satellites will broadcast data to the Direct Broadcast Users' field terminals via a near continuous, X-Band, transmission. The HRD broadcast is expected to include virtually all collected mission data.

Horizontal Cell Size

See Horizontal Spatial Resolution.

Horizontal Sampling Interval (HSI)

The Horizontal Sampling Interval (HSI) is defined as the distance, as measured on the ground, between adjacent samples reported by an instrument.

Horizontal Spatial Resolution

Imagery EDR: For a scanning imager on a space-based platform, a specified band, and a specified nadir angle, one half of the wavelength corresponding to the earth surface spatial frequency at which the end-to-end system Modulation Transfer Function (MTF) equals 0.5 in the in-scan or cross-scan direction.

Other EDRs: For a parameter which is an estimate of the uniform spatial average* of an environmental parameter over a square region of the earth’s surface or within a square layer of the atmosphere, the side length of this square region or layer. (For a parameter which is an estimate of an environmental parameter at a point, the horizontal cell size is defined to be zero.) For a reported parameter not of this type but which is defined for a square region of the earth’s surface or a square layer of the atmosphere (e.g., cloud cover, ice concentration, etc.), the side length of this square region.

Microwave EDRs: The Horizontal Cell Size (HCS) is the diameter of a circle on a spherical Earth's surface (or in the Earth's atmosphere) containing the equivalent area inside the boundary over which a uniform spatial average* of the truth value of the given EDR is estimated. The shape of the boundary of the horizontal cell used may be any regular shape that is not concave (circle, square, ellipse, rectangle, etc.).

* If the scene variance in a 3 x 3 matrix of pixels exceeds the uncertainty threshold by a factor of 3 (TBR-6), then the middle pixel of the matrix does not have to be used in the calculation of the APUs.

Horizontal Wind Vector Accuracy

The wind speed error is [[Wm]-[Wt]] where Wm is the measured velocity and Wt is the true velocity. The wind direction error is the angular difference between the directions of each component.

Ice Surface Temperature (IST)

IST is the temperature at the ice surface. Remotely-sensed ice surface temperatures is an invaluable daily, large scale, and reliable data set used to estimate sea ice growth and decay.

Interface Data Processing System (IDPS)

The IDPS developed by the JPSS Ground Project receives raw data downlinked from the satellite, processes these data into RDRs, SDRs, TDRs and EDRs and makes these products available to the user community.

Imagery

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

Imagery (Microwave)

Brightness temperature data from each microwave channel displayed at the native resolution.

Infrared Ozone profile (IP)

Ozone profile derived primarily from the CrIS instrument.

Intermediate Product (IP)

A product generated at a specific point in the Data Processing Node processing stream, stored for a finite period of time, and used internally as an input to other IDPS processing applications.

Interface Data Processor Segment (IDPS)

The JPSS ground processing capability located at the user components, aka the JPSS Data Processing Node. The IDPS receives RDRs from the Space or C^3 segment, temporarily stores RDRs, processes the RDRs into SDRs and subsequently into Intermediate Products (as necessary) and EDRs, then makes the required data products available for delivery across the JPSS-to-user interface.

In-Track Resolution

Resolution of in-situ measurements along the orbital path, determined by sampling frequency.

JPSS Data Generation

The period from the time of observation of all requisite data by the satellite until the EDR or data product produced by those data is available to the user at the output of the JPSS processing node.

JPSS Ground Segment

A shared ground infrastructure consisting of multiple subsystems that support a heterogeneous constellation of polar-orbiting satellites, both JPSS Missions and JPSS Supported Missions. This includes among other things, the NOAA ESPC, NOAA Satellite Operations Facility, the NOAA Alternate Processing Facility, the JPSS Ground System, several satellite ground stations, and the communications which tie everything together.

JPSS Ground System

That portion of the JPSS Ground Segment that is provided by the JPSS Ground Project.

Key Performance Parameter

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, and would be cause for program reevaluation or cancellation.

Land Surface Emissivity (LSE)

Emissivity of a material is the relative ability of its surface to emit energy by radiation. It is the ratio of energy radiated by a particular material to energy radiated by a black body at the same temperature. Emissivity is most widely used in NWP models.

Land Surface Temperature

Land Surface Temperature (LST) is defined as the skin temperature of the uppermost layer of the land surface. It includes the aggregate temperature of objects comprising the land surface, including any open water, in the cell. Surface temperature information is needed for NWP and hydrological modeling, automated cloud analysis, and for general forces operations (i.e., wind chill temperatures and heat stress factors). LST is also used to support rescue operations and land/sea assault operations. Also see Section 5.5.4.

Latency

See Data Latency.

Long Term Stability

Long Term Stability (LTS) is defined as the maximum excursion of the short-term average measured value of a known "truth" reference under identical conditions over the life of the JPSS mission. The short-term average is the average of a sufficient number of successive measurements of the reference under identical conditions such that the random error is negligible relative to the systematic error.

Make Available

To place data or material, either physically or electronically, in a location where it can be retrieved by authorized parties.

Mapping Accuracy

The 3 sigma value of the error in the geographic location of the measured data.

Mapping Uncertainty

The root-mean-square (RMS) of the geographic location errors associated with the measured data.

Measurement Accuracy / Precision / Uncertainty

See Appendix A, Sections 2.5, 2.6 and 2.7.

Measurement Bias

Measurement bias is defined as the mean of the distribution of measurement errors over a long period of time. Measurement bias is commonly corrected in data analysis to improve measurement accuracy.

Measurement Error

See Appendix A, Section 2.2.

Measurement Range

Parameter range over which Measurement Accuracy, Precision, Uncertainty, and Probability of Correct Typing performance must be validated and monitored.

Measurement Stability

Measurement stability is generally used to describe the category of metrics of the measurement biases.

Mission Sensors

Any sensor on the spacecraft directly used to satisfy any of the EDR requirements.

Mixed Aerosol

Mixed aerosol defines a mixture of different types or composition of aerosols. This is a typical occurrence in the atmosphere except in the event of fires, dust storms, or volcanic eruptions where one type of aerosol is predominantly present. For example, in the event of a fire the aerosol type is predominantly smoke in the vicinity of the fire. As the smoke is transported downwind, it mixes with other types of aerosols present in the atmosphere and smoke may or may not be the dominant type. In general, atmospheric aerosol loading is very high when one aerosol type dominates and therefore easy to detect that aerosol type from remote sensing measurements compared to when different aerosol types are present as a mixture.

Moisture Profiles

Relative and absolute humidity - the mass of water vapor per unit volume of moist air.

Native Resolution

The spatial resolution that can be supported by a single dynamic field of view or beamwidth associated with an instrument measurement.

Nephanalysis

Analysis of cloud cover in terms of type and amount.

Noise Equivalent Differential Radiance (NEdN)

The amount of uncertainty that random errors due to noise give to the measured radiance.

Noise Equivalent Differential Temperature (NEdT)

The variation in the scene dependent temperature that is equivalent to the system noise.

Objective

An operationally significant increment above the threshold provided as a justifiable requirements target for additional research, development, and technology insertion.

Ocean Color/Chlorophyll (OC/C)

OC/C is used is used to quantify water-leaving radiances to quantify various pigments in the water in order to determine chlorophyll concentrations, turbidity, and other changing optical conditions and provides continuity from previous ocean color missions (MODIS and SeaWiFS).

OMPS

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

Operational Availability (Ao)

The measure of the probability that the JPSS system will be operationally capable of delivering KPPs over any given thirty day period after Operational Handover to NOAA (L+90 days). Once on orbit, the JPSS satellites are assumed to operate 24/7, 365 days per year for the mission lifetime. The availability criteria include system reliability (besides the observatory reliability which is specified separately), redundancy, and planned outages (downtime for spacecraft maneuvers and calibration and ground system sustainment).

Optical Depth

See Optical Thickness

Optical Thickness.

Optical Thickness is a measure of the opacity of the atmosphere. It is expressed as the quantity of wavelength-dependent visible light removed from the optical path (i.e., extinction) by scattering or absorption. If I_0 is the initial radiant energy at the source and I is the observed radiant energy after transiting through a given optical path, then I / I_0 is the

atmospheric transmittance and the Optical Thickness τ (Tau) is defined by the following equation: $I/I_0 = e^{-\tau}$.

Outgoing Longwave Radiation (OLWR)

Outgoing Longwave Radiation is the instantaneous radiative energy flux emitted by the Earth-atmosphere system at TOA to space in the wavelength rage of 5.0 to 100 μm.

Ozone Profile (OP)

Ozone profile can be generated from OMPS-nadir data. When OMPS-L data is used in conjunction with the OMPS-Nadir sensor, the EDR provides global ozone observations at high vertical resolution (< 3 km). The detailed vertical structure of stratospheric ozone (12 – 25 km altitude region) has been shown to be a useful contributor to extended range (beyond 1 week) forecast skill in global models.

Ozone Total Column (OTC)

Ozone Total Column (also called Atmospheric Ozone) is defined as the amount of ozone in a vertical column of the atmosphere measured in Dobson Units (milli-atm-cm). Operational measurements of stratospheric ozone are needed to improve operational numerical weather prediction and to support requirements for depiction of the upper atmosphere. This information also has relevance to human health.

Partly Cloudy

Partly cloudy conditions are those where both the infrared and microwave retrievals are used and are typically scenes with less than or equal to 50% cloudiness.

Parts per million by volume (ppmv)

Read as parts per million by volume, ppmv denotes volume mixing ratio, specifically the amount of gas in a sample of air under standard temperature and pressure. This is the volume of gas in a volume of air.

Payload

Mission sensors and on-board processor.

Polar Winds (PW)

Polar wind observations provide atmospheric wind speed, direction, and height data. These data are used primarily in operational numerical weather prediction systems. Satellite-derived winds over the polar regions have been shown to have a positive impact on weather forecasts, not just at high latitudes, but globally. Over oceans and at high latitudes, in situ wind information is sparse. Polar wind measurements from space therefore fill a critical gap.

Precipitable Content

The total amount of water and ice contained in a vertical column of the atmosphere.

Precipitable Water (PW)

Precipitable Water (PW) is defined as the total equivalent water (in the form of water vapor) of unit cross-sectional area between any two specified levels, including the total atmospheric column. For this EDR, vertical cell size is the vertical height of the total atmospheric column specified and the horizontal reporting interval specifies the locations of the column bottoms for which TIWV must be reported.

Precipitation (Type/Rate) (PT/R)

The precipitation rate is defined as the amount of rain or ice reaching the ground in a certain amount of time.

Pressure (Surface/Profile) (PS/P)

A pressure profile is a set of estimates of the atmospheric pressure at specified altitudes above the Earth's surface. Pressure (Surface/Profile) information is required as an input to numerical weather prediction models.

Probability of Correct Typing (PCT)

The probability that a cell reported as being of type x is in fact of type x.

Probability of Success (Ps)

The probability that an outcome (n) is in fact the expected or desired outcome. Mathematically, if a trial must result in any of n equally likely ways, and if s is the number of successful ways and f is the number of failing ways, the probability of success is

$$p = \frac{s}{s+f} \quad \text{where} \quad s + f = n$$

Quarterly Surface Type (QST)

Quarterly Surface Type is defined as the predominant type of one of the seventeen International Geosphere Biosphere Program (IGBP) classes (Table 5.5.8.1) in any area of global land surface. Quarterly Surface Type is an Intermediate Product (IP) required for generating the VIIRS Surface Type EDR that is a combination of the QST IP, active fires and snow/ice products. QST IP is also often required as input to numerical weather, climate, hydrological and agricultural models supporting various U.S. Government customers.

Raw Data Record (RDR)

Full resolution digital sensor data, time referenced and earth located, with absolute radiometric and geometric calibration coefficients appended (or identified in the SRD metadata), but not applied, to the data and with communications artifacts removed. Refer to L1RD Glossary for further details.

Reflected Solar Radiation (RSR)

Reflected Solar Radiation is the instantaneous amount of electromagnetic radiation flux emitted by the Sun that is reflected back to space by the Earth at the top of its atmosphere in the wavelength range of 0.3 - 5.0 µm.

Refresh (Revisit)

Refresh, or Revisit, is the time interval between successive collections of data from the same geographical point on, or above, the surface of the earth. The time interval is typically stated as a maximum local average.

Retained Intermediate Product (RIP)

Retained Intermediate Products (RIPs) are a finite category of IPs specifically identified as important for off-line analysis, calibration and validation, and post-processing of JPSS SDRs and EDRs.

Sea Ice Characterization

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

Sea Surface Temperature

Sea surface temperature (SST) is defined as a highly precise measurement of the skin temperature of the ocean surface. The measured radiances will typically enable the derivation of both skin and surface layer (1 meter depth) sea surface temperature to the specifications listed below, although an EDR algorithm is required only for skin temperature.

Sea Surface Wind Speed (SSW-S)

Sea Surface Winds (SSW) from AMSR2 is the measure of atmospheric wind speed only at the sea/atmosphere interface in clear sky and cloudy conditions. Winds indicate global and local circulation patterns, force ocean surface circulation (surface currents), determine sea state, influence water levels along the coast, help to determine surface height, produce storm surge, and drive the motion of the lower layers of the atmosphere.

Sea Surface Wind Stress (SSWS)

Sea Surface wind stress is defined as the magnitude of the frictional stress of the wind acting on the sea surface, causing it to move as a wind-drift current, and causing the formation of waves. Sea Surface Wind Stress is a parameter derived from Sea Surface Wind Speed and Direction as well as air-sea temperature difference.

Sensing Depth

The specified vertical region of interest where data are to be collected or information is to be provided.

Sensor Data Record (SDR)

Data record produced when an algorithm is used to convert the reconstructed unprocessed instrument and payload data at full resolution as delivered by Raw Data Records (RDRs) into processed instrument data at full resolution, time-referenced, and with radiometric and

geometric calibration coefficients and georeferencing parameters (i.e., platform ephemeris) computed and applied. The existence of the SDRs provides reversible data tracking back from the EDRs to the RDRs.

Service Delivery Point (SDP)

The functional location or locations where the JPSS must provide data or services.

Snow Cover/Depth

The snow cover/depth is defined as horizontal and vertical extent of snow cover. Snow cover data at specified values are required to determine background conditions for electro-optical sensors.

Snow-Water Equivalent (SWE)

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

Soil Moisture

Soil Moisture is moisture in the soil within the zone of aeration, including water vapor present in soil pores. The requirement is to measure soil moisture within a thin layer at the surface for bare soil in regions with known soil type, as well as soil moisture for vegetated terrain.

Solar Spectral Irradiance (SSI)

Solar Spectral Irradiance is the power per unit area per unit wavelength interval. Solar Irradiance is used as a component for monitoring the current state and variability of the climate system.

Space Segment

The spacecraft, including its associated sensors, subsystems, equipment, and processors.

Specific Humidity

The mass of water vapor contained in a unit mass of air (dry air plus water vapor) expressed in grams per kilogram.

Spectral Irradiance Monitor (SIM)

The SIM measures the solar spectral irradiance useful in determining the response of different layers in the Earth's atmosphere to solar variations and in diagnosing the solar causes of irradiance variations.

Surface Albedo

The fraction of solar radiation incident at the Earth's surface that is returned to space by reflection from the Earth's surface. In-band surface Albedo refers to the surface Albedo within a visible/NIR bandpass of an imager. Broad-band surface albedo refers to the surface

Albedo within the 0.4 - 2.0 mm bandpass, which may be inferred from the in-band Albedos. The solar insolation at the surface must be estimated to calculate these quantities. The major applications are twofold: 1) characterization of backgrounds by electro-optical systems, and 2) use in the visible cloud/no cloud decision for processed cloud data.

Suspended Matter (SM)

Suspended matter consists of particles such as sand, dust, smoke, SO_2, volcanic ash, and urban/industrial particulate matter. It can damage many different systems. For example, aircraft flying through these materials can suffer damage to cockpit canopies or windscreens. Additionally, aircraft engines suffer extremely high wear in the presence of suspended matter, leading to increased sustainment or engine failure. Volcanic ash plumes are a threat to military and civil aviation. DOC participates in a civil aviation warning system for volcanic ash hazards by monitoring these plumes in satellite imagery. DOC also monitors smoke from large scale fire events to provide information to the relevant agencies and the public. Suspended matter is detected in a pixel when the Aerosol Optical Thickness (AOT) is greater than 0.15 but for the quality of the suspended matter type (dust, smoke, volcanic ash, sea salt) to be “high”, the AOTs should be at least 0.5 or higher.

Tau (τ)

See Optical Thickness.

Temperature Data Record (TDR)

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

Threshold

The minimum requirement below which utility of the output of the system associated with that requirement becomes questionable.

Timeliness

Elapsed time between initiation of measurement of the environmental data parameter and delivery of the EDR to the user site.

Total Water Content

Total Water Content (TWC) is defined as the water vapor (vertically resolved TIWV), cloud liquid water (vertically resolved CLWC), and cloud ice liquid equivalent (vertically resolved CIWP) in specified segments of a vertical column of the atmosphere. For this EDR, vertical cell size is the vertical height of the column segment and the vertical reporting interval specifies the location of the column segment bottoms for which TWC must be reported.

Tracking and Data Relay Satellite System (TDRSS)

NASA’s TDRSS consists of a constellation of geosynchronous satellites and associated ground systems and operates as a bent pipe relay system between customer space platforms and customer ground facilities.

True Value

See Appendix A, Section 2.1.

Users

Entities other than the Program's Government sponsors and stakeholders whose mission objectives are expected to be positively served through the use of JPSS data products.

Vegetation Index (VI)

Vegetation/surface type data are required as input to agricultural and hydrological analysis models. Vegetation Index is used in numerical weather forecast models as one aspect of specifying surface boundary conditions. USDA is one of the largest users of global vegetation index information for assessing crop conditions and yield. It is also used for monitoring drought, flooding, and general vegetation conditions.

Vertical Cell Size (VCS)

For a parameter which is an estimate of the uniform spatial average of an environmental parameter within a square layer of the atmosphere, the vertical thickness of this layer. (For a parameter which is an estimate of an environmental parameter at a point, the vertical cell size is defined to be zero.)

Vertical Reporting Interval

The spacing between nearest neighbor points along a local vertical at which an environmental parameter is estimated and reported. These points can also represent "layers".

Vertical Resolution

The thickness of an atmospheric layer for which average parameters should be specified.

Vertical Sampling Interval

The vertical increments at which the values of a parameter that varies with height are reported. For soundings, it represents the pressure levels at which the profile is to be specified.

VIIRS

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

VIIRS Cloud Mask (VCM)

The VIIRS Cloud Mask (VCM) is the cloud mask that is used to generate the CCL EDR and several other user applications.

Appendix D - Suomi NPP Data Product Performance

The ongoing Suomi NPP (SNPP) Calibration and Validation (Cal/Val) campaign was planned, implemented, and is being executed against the system-level performance requirements that defined the verified S-NPP baseline during the transition from the heritage NPOESS Program. During the evolution of the JPSS Ground System to support the initial JPSS-1 mission, verification and validation of S-NPP EDR performance will reference the requirements contained in this L1RD Supplement as modified by the performance exclusions listed in Table D-1. In most cases these S-NPP exclusions are against expanded or new Level 1 requirements with an effectivity associated with the JPSS-1 mission.

The ongoing NDE project was planned, implemented, and is being executed against system specification requirements which were defined before the development of the JPSS Supplement. The NDE performance for S-NPP capabilities may not be consistent with those identified in the Supplement. In addition, the ESPC processing capabilities for S-NPP satellite products is dependent on JPSS funding.

Table D-1. SNPP Performance Exclusions

Requirement ID	Requirement	Exclusion Condition	Rationale
L1RDS-92	SDR/TDR Radiometric Accuracy	Not applicable to SNPP	New requirement; SNPP baseline imposes data product performance requirements on EDRs only
L1RDS-96, L1RDS-97, L1RDS-98, L1RDS-102, L1RDS-103, L1RDS-104	Sensor Characterization and Monitoring; Sensor and Data Trending	Not applicable to SNPP	The capabilities to meet these new requirements are being developed as part of the S-NPP Cal/Val campaign; the NESDIS ICVS tool is being leveraged for sensor and data monitoring and trending; data product error budget development, analysis, and modeling are required (formerly a responsibility of the NPOESS prime contractor)
5.1.1, a(2)	Imagery HSR at Edge of Swath	Not applicable to S-NPP	S-NPP Edge of Swath performance is waived due to non-compliances in the VIIRS F1 instrument (refer to Waivers 429-09-04-051, 429-09-04-094, and 429-09-04-103)
5.6.5, d(1), e(1)	SST Measurement Accuracy; Precision	Accuracy, Precision, and Uncertainty (APU) performance excluded in the presence of thin cirrus clouds	The definition of Clear/Cloudy Conditions is new and depends on the results of S-NPP Cal/Val to establish the required threshold for a detectable cloud; science algorithms require enhancement for handling thin cirrus radiative transfer

Requirement ID	Requirement	Exclusion Condition	Rationale
5.2.1, f(1), f(2), g(1), g(2)	AOT Measurement Accuracy; Precision	APU performance excluded in the presence of thin cirrus clouds and bright background (e.g., snow cover)	The definition of Clear/Cloudy Conditions is new and depends on the results of S-NPP Cal/Val to establish the required threshold for a detectable cloud; science algorithms require enhancement for handling thin cirrus radiative transfer and for bright surface conditions
5.2.14, e(1) – e(5)	SM Probability of Correct Typing (PCT)	PCT performance excluded in the presence of thin cirrus clouds	The definition of Clear/Cloudy Conditions is new and depends on the results of S-NPP Cal/Val to establish the required threshold for a detectable cloud; science algorithms require enhancement for handling thin cirrus radiative transfer
5.2.11, e(1), e(2), e(3), f(1), f(2), f(3)	Ozone Total Column Measurement Precision; Accuracy	APU performance excluded in the presence of thin cirrus clouds	The definition of Clear/Cloudy Conditions is new and depends on the results of S-NPP Cal/Val to establish the required threshold for a detectable cloud; science algorithms require enhancement for handling thin cirrus radiative transfer
5.2.10	Ozone Nadir Profile	Not applicable to S-NPP	Ozone Nadir Profile is a Delivered Intermediate Product for S-NPP without associated performance requirements
5.3.2, b, e	CCL Vertical Reporting Interval and Measurement Uncertainty;	Performance is limited to confidently cloudy pixels; APU performance excluded in the presence of thin cirrus clouds; height reporting excluded for multi-layered clouds	The definition of Clear/Cloudy Conditions is new and depends on the results of S-NPP Cal/Val to establish the required threshold for a detectable cloud; science algorithms require enhancement for handling thin cirrus radiative transfer, partly cloudy pixels, and multi-layered clouds
5.3.7, b, d(1), d(2), e(1), e(2)	CTH Vertical Reporting Interval; Measurement Precision; Accuracy	Performance is limited to confidently cloudy pixels; APU performance excluded in the presence of thin cirrus clouds; height reporting excluded for multi-layered clouds	The definition of Clear/Cloudy Conditions is new and depends on the results of S-NPP Cal/Val to establish the required threshold for a detectable cloud; science algorithms require enhancement for handling thin cirrus radiative transfer, partly cloudy pixels, and multi-layered clouds
5.3.8, b, d(1) – d(3), e(1) – e(3)	CTP Vertical Reporting Interval; Measurement Precision; Accuracy	Performance is limited to confidently cloudy pixels; APU performance excluded in the presence of thin cirrus clouds; height reporting excluded for multi-layered clouds	The definition of Clear/Cloudy Conditions is new and depends on the results of S-NPP Cal/Val to establish the required threshold for a detectable cloud; science algorithms require enhancement for handling thin cirrus radiative transfer, partly cloudy pixels, and multi-layered clouds

Requirement ID	Requirement	Exclusion Condition	Rationale
5.3.9, b, d(1), d(2), e(1), e(2)	CTT Vertical Reporting Interval; Measurement Precision; Accuracy	Performance is limited to confidently cloudy pixels; APU performance excluded in the presence of thin cirrus clouds; height reporting excluded for multi-layered clouds	The definition of Clear/Cloudy Conditions is new and depends on the results of S-NPP Cal/Val to establish the required threshold for a detectable cloud; science algorithms require enhancement for handling thin cirrus radiative transfer, partly cloudy pixels, and multi-layered clouds
5.3.3, b, e, f	CEPS Vertical Reporting Interval; Measurement Precision; Accuracy	Performance is limited to confidently cloudy pixels; APU performance excluded in the presence of thin cirrus clouds; height reporting excluded for multi-layered clouds	The definition of Clear/Cloudy Conditions is new and depends on the results of S-NPP Cal/Val to establish the required threshold for a detectable cloud; science algorithms require enhancement for handling thin cirrus radiative transfer, partly cloudy pixels, and multi-layered clouds
5.3.6, b, d, e	COT Vertical Reporting Interval; Measurement Precision; Accuracy	Performance is limited to confidently cloudy pixels; APU performance excluded in the presence of thin cirrus clouds; height reporting excluded for multi-layered clouds	The definition of Clear/Cloudy Conditions is new and depends on the results of S-NPP Cal/Val to establish the required threshold for a detectable cloud; science algorithms require enhancement for handling thin cirrus radiative transfer, partly cloudy pixels, and multi-layered clouds
5.3.1, b, d	CBH Vertical Reporting Interval; Measurement Uncertainty	Performance is limited to confidently cloudy pixels; APU performance excluded in the presence of thin cirrus clouds; average base height reporting excluded for multi-layered clouds	The definition of Clear/Cloudy Conditions is new and depends on the results of S-NPP Cal/Val to establish the required threshold for a detectable cloud; science algorithms require enhancement for handling thin cirrus radiative transfer, partly cloudy pixels, and multi-layered clouds
5.5.9, c(3), h, i	VI Normalized Difference Vegetation Index at Top of Canopy ($NDVI_{TOC}$) Measurement Range; Measurement Accuracy; Precision	Delivery of $NDVI_{TOC}$ product not required; APU performance excluded in the presence of thin cirrus clouds, Sun glint, cloud shadows	Requirement for delivery of $NDVI_{TOC}$ product is new and not included in the S-NPP design; the definition of Clear/Cloudy Conditions is new and depends on the results of S-NPP Cal/Val to establish the required threshold for a detectable cloud; science algorithms require enhancement for handling thin cirrus radiative transfer; additional quality flags are required to describe environmental conditions affecting JPSS-1 performance (e.g., Sun glint, cloud shadows)

Requirement ID	Requirement	Exclusion Condition	Rationale
5.5.1	Active Fires	Not applicable to S-NPP	Active Fires is an Application Related Product in the S-NPP design that is limited to reporting a sparse array of latitude-longitude positions of detected fires; algorithms require enhancement for JPSS-1 to deliver Fire Radiative Power and a full fire mask consisting of a two-dimensional array of enumerated values representing the fire and other relevant classifications (e.g., cloud) for each pixel in a data granule
5.6.1, e	IST Measurement Uncertainty	APU performance excluded in the presence of thin cirrus clouds	The definition of Clear/Cloudy Conditions is new and depends on the results of S-NPP Cal/Val to establish the required threshold for a detectable cloud; science algorithms require enhancement for handling thin cirrus radiative transfer
5.6.2 c, d, e	OCC Measurement Range; Precision; Accuracy	Not applicable to S-NPP	OCC APU performance for S-NPP is on a best effort basis based on the "use-as-is" decision associated with the VIIRS F1 Integrated Filter Assembly (see Waiver 429-09-04-092); Measurement Range requirements for normalized water-leaving radiance (nLw), optical properties, and chlorophyll have been modified from the S-NPP design to reflect the NOAA observational requirements and the NASA validation archive (NOMAD v2) for consistency with historically observable values; the requirement for demonstrating spectral correlation of nLw errors is associated with the new “blue band” qualifier on the APU requirements and has a JPSS-1 effectivity
4.2; L1RDS-2291; 5.4.2; 5.4.3	Earth Radiation Budget	Not applicable to S-NPP	The S-NPP baseline does not include performance requirements for Earth Radiation Budget SDRs and EDRs

Requirement ID	Requirement	Exclusion Condition	Rationale
Table 2.2	EDR Latency for multiple EDRs.	Not applicable to S-NPP	The S-NPP ground system design was based on the overall mission Data Timeliness requirement (MRS-22) of 180 minutes, 95% of the time on an annualized basis, per the S-NPP MRS (GSFC 429-99-02-03 Rev C). There is no plan to retroactively impose the JPSS-era EDR latency requirements contained in the L1RD Supplement on S-NPP EDRs.