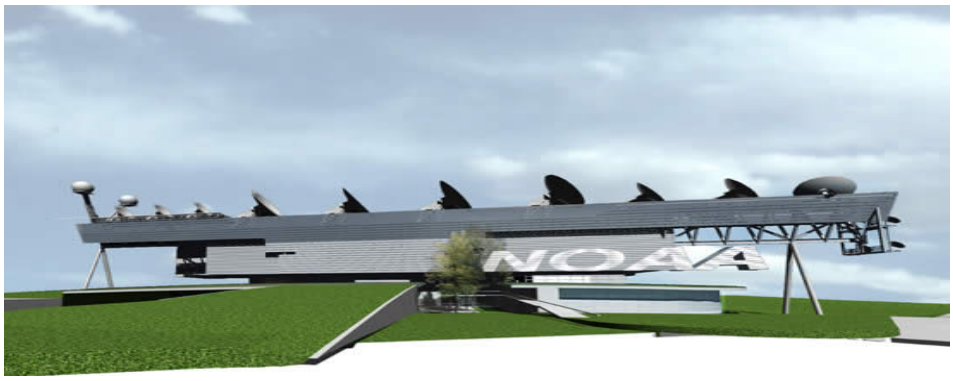
Environmental Satellite Processing Center



GCOM-W1 AMSR2 Algorithm Software Package (GAASP) External User's Manual

March, 2016, Version 2.0

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DOCUMENT HISTORY
DOCUMENT REVISION LOG

The Document Revision Log identifies the series of revisions to this document since the baseline release. Please refer to the above page for version number information.

DOCUMENT TITLE: GAASP External User's Manual			
DOCUMENT CHANGE HISTORY			
Revision No.	**Date**	**Revision Originator Project Group**	**CCR Approval # and Date**
1.0	N/A	No version 1	N/A
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LIST OF CHANGES

Significant alterations made to this document are annotated in the List of Changes table.

DOCUMENT TITLE: GAASP External User's Manual					
LIST OF CHANGE-AFFECTED PAGES/SECTIONS/APPENDICES					
Version Number	**Date**	**Changed By**	**Page**	**Section**	**Description of Change(s)**
2.0	March 2016	Letitia Soulliard	Full Document	Full Document	Updated for Day 2 changes and new products

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LIST OF ACRONYMS

AMSR2	Advanced Microwave Scanning Radiometer 2
APID	Application Packet ID
ASD	APID Sorted Data
ATBD	Algorithm Theoretical Basis Document
CDL	network Common data format Description Language
CLW	Cloud Liquid Water
DDS	Data Distribution Server
EDR	Environmental Data Record
GAASP	GCOM-W1 AMSR2 Algorithm Software Package
GCOM-W1	Global Change Observation Mission – Water 1
GFS	Global Forecast System
GPROF	Goddard PROfiling algorithm
GRIB2	GRIdded Binary format (version 2)
IDPS	Interface Data Processing Segment
JAXA	Japan Aerospace Exploration Agency
KSAT	Kongsberg Satellite Services
MBT	Microwave Brightness Temperatures
NCEI	National Centers for Environmental Information
netCDF4	Network Common Data Format version 4
NOAA	National Oceanic and Atmospheric Administration
OSPO	Office of Satellite and Product Operations
PAL	Product Area Lead
PDA	Product Distribution Area
RFI	Radio Frequency Interference
SDR	Sensor Data Record
SIC	Sea Ice Cover
SMM	System Maintenance Manual
SMOPS	Soil Moisture Operational Products System
SPSRB	Satellite Product and Services Review Board
SST	Sea Surface Temperature
SSW	Sea Surface Winds
STAR	Center for SaTellite Applications and Research
SWE	Snow Water Equivalent
TPW	Total Precipitable Water
WSPD	Wind Speed (sea surface)

1. PRODUCTS

This is an external user's manual document describing the Global Change Observation Mission – Water 1 (GCOM-W1) Advanced Microwave Scanning Radiometer 2 (AMSR2) Algorithm Software Package (GAASP) products and output files. The GAASP system was developed at the Center for Satellite Applications and Research (STAR). It will be delivered to the NPOESS Data Exploitation (NDE) team and run in a pre-operational manner. After a preliminary testing period, the NDE will, in turn, be delivered to the Office of Systems Development (OSD) to be run operationally.

The intended users of the External User's Manual (EUM) are end users of the output products and files, and the product verification and validation (V&V) teams. The purpose of the EUM is to provide product users and product testers with information that will enable them to acquire the product, understand its features, and use the data. External users are defined as those users who do not have direct access to the processing system (those outside of OSD). The output files are defined as those leaving the NDE as opposed to those that are output by the GAASP processing, but available only internally within the NDE.

1.1 Product Overview

1.1.1 Product Requirements

All GAASP basic and derived requirements are available in the GAASP Requirements Allocation Document (RAD). These requirements identify the users and their needs with respect to file content, format, latency, and quality. This document is available upon request from the STAR Project Lead.Product Team.

The GAASP product team consists of the following individuals from STAR, OSD and OSPO.

Table 1-1 – Product Team Information

Team Member	Organization	Role	Contact Information
Walter Wolf	STAR	STAR Project Lead	5830 University Research Court Riverdale, MD. 20740 Phone: 301-683-1314 Email: Walter.Wolf@noaa.gov

Paul Chang	STAR	STAR Algorithm Lead	5830 University Research Court Riverdale, MD. 20740 Phone: 301-683-3355 x 167 Email: paul.s.chang@noaa.gov
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Peter Keehn	STAR	Developer	5830 University Research Court Riverdale, MD. 20740 Phone: 301-683-3548 Email: Peter.Keehn@noaa.gov
Limin Zhao	OSPO	OSPO Product Area Lead	5830 University Research Court Riverdale, MD. 20740 Email: Limin.Zhao@noaa.gov
Steve Quinn	OSPO	Operations Programmer	5830 University Research Court Riverdale, MD. 20740 Phone:301-683-3285 Email: Stephen.Quinn@noaa.gov

Paul Haggerty	OSPO	ESPC Operations Team Lead	4231 Suitland Rd Suitland, MD 20746 Phone:301-817-3876 Email: Paul.Haggerty@noaa.gov

1.1.2 Product Description

The GAASP products set described in this document are generated entirely from GCOM-W1 SDR data. The GAASP is run operationally at the Office of Satellite and Product Operations (OSPO). The products include calibrated Microwave Brightness Temperatures (MBT), Precipitation Rate (PR), Sea Surface Temperature (SST), Sea Surface Winds (SSW), Total Precipitable Water (TPW), Cloud Liquid Water (CLW), Soil Moisture (SM), Surface Type (ST), Snow Cover (SC), Snow Depth (SD), Snow Water Equivalent (SWE), and Sea Ice Cover (SIC). All products are output in netCDF4. In addition, the non-bias corrected MBT and SST products are available in BUFR, Sea Ice is available in GRIB2, and Soil Moisture is available in binary format (for SMOPS). The BUFR and GRIB tailoring is performed by the BUFR/GRIB Toolkit within NDE, but outside of the GAASP package. For information on the science algorithms, see the GAASP Algorithm Theoretical Basis Document (ATBD). This document can be provided on request from the GAASP OSPO Product Area Lead (PAL) identified in the Product Team table in section 1.1.2.

1.1.3 Product History

The GAASP is being delivered in two phases defined by Day 1 and Day 2 product sets. Day 1 products were available in late 2015 and will consist of (1) Microwave Brightness Temperatures, (2) Precipitation (land and ocean rain rates), and (3) the following Ocean EDRs: Sea Surface Temperature, Sea Surface Winds, Total Precipitable Water, and Cloud Liquid Water. Day 2 products will be available in mid-2016 and will consist of the following land/ocean surface EDRs: Soil Moisture, Surface Type, Snow Cover, Snow Depth, Snow Water Equivalent, and Sea Ice. Two more additional enhancements to these products will be delivered and implemented in the following years.

1.1.4 Product Access

GAASP operational products are generated in near-real time from GCOM-W1 AMSR-2 data, and made available to users on the data distribution server at ESPC for real-time use. For access to this server, information about data files, and associated documentation, the GCOM PAL should be contacted (see Table 1-1). In general, users are required to fill out

the Data Access Request Form located on http://www.ospo.noaa.gov/Organization/About/access.html, and submit to nesdis.data.access@noaa.gov with a copy to the PAL.

The plan is to make historical products for external users through the NOAA Comprehensive Large Array-data Stewardship System (CLASS) archive at the National Centers for Environmental Information (NCEI). Data should be queried and ordered from CLASS at the following web URL: http://www.class.noaa.gov after the archive starts. Currently, discussion between NJO and CLASS is still ongoing.

GAASP products are mainly distributed as netCDF4 files; however, BUFR and binary files also exist on the DDS. The GAASP files are generated as the GCOM-W1 AMSR-2 data comes in as orbital dump files and stored on the ESPC DDS system after being produced for FTP access. These data files will be maintained on the DDS for a max of 3 days. If the files are not available at the normal time, notification by email will automatically be sent to the following authorized personnel (contact info can be found in Table 1-1):

- Limin Zhao
- Steve Quinn
- Paul Haggerty

If users have issues to get data from the DDS, the DDS administrator/manager Donna McNamara (Donna.McNamara@noaa.gov) should be contacted.

After users submit the Data Access Request, the NESDIS Data Access Review Board will evaluate it, and give its approval or rejection. Users will be contacted after the Board makes the decision. For an approved DAR, the user will be assigned an ID on the DDS. The user will have to follow detailed procedures on how to pull the data.

Table 1-2 lists all external distributed GAASP files and their formats. Table 1-3, Table 1-4, Table 1-5, Table 1-6, Table 1-7, Table 1-8, and Table 1-9 show the detailed contents of each netCDF4 output files listed in Table 1-2. Table 1-10 shows the detailed contest of the soil Binary file. Table 1-11, Table 1-12, Table 1-13, Table 1-14, Table 1-15, and Table 1-16 show the BUFR User Definition tables for each of the BUFR output files listed in Table 1-2.

Table 1-2 – GAASP Output Files

File	Description	Format	Size/file
AMSR2-MBT-89A_v1r0_GW1_s????????	The MBT SDR file contains the raw (non-bias corrected)	BUFR	~37.9 MB/file 14-15

???????_e??????????????_c??????????????.bufr	brightness temperatures for the 89A GHz channel.		files/day
AMSR2-MBT-89B_v1r0_GW1_s???????????????_e??????????????_c??????????????.bufr	The MBT SDR file contains the raw (non-bias corrected) brightness temperatures for the 89B GHz channel.	BUFR	~37.9 MB/file 14-15 files/day
AMSR2-MBT-LR_v1r0_GW1_s???????????????_e??????????????_c??????????????.bufr	The MBT SDR file contains the raw (non-bias corrected) brightness temperatures for the 6.9, 7.3, 10.7, 18.7, 23.8, and 36.5 GHz channels.	BUFR	~41.4 MB/file 14-15 files/day
AMSR2-MBT_v2r0_GW1_s???????????????_e???????????????c??????????????.nc	The MBT EDR file contains the bias corrected brightness temperatures as well as the NOAA created RFI values.	netCDF	~244 MB/file 14-15 files/day
AMSR2-OCEAN_v2r0_GW1_s???????????_e????????????_c???????????????.nc	The OCEAN EDR file contains the ocean EDR's of TPW, CLW, SST, and SSW, as well as the precipitation EDR of Rain Rate.	netCDF	~116 MB/file 14-15 files/day
AMSR2-PRECIP_v2r0_GW1_s???????????_e????????????_c???????????????.nc	The PRECIP EDR file contains the precipitation EDR of Rain Rate.	netCDF	~60.4 MB/file 14-15 files/day
AMSR2-SNOW_v2r0_GW1_s???????????_e????????????_c??????????????.nc	The SNOW EDR file contains the snow EDR of Snow Depth and Snow Cover.	netCDF	~37.1 MB/file 14-15/day
AMSR2-SOIL_v2r0_GW1_s???????????_e????????????_c??????????????.nc	The SOIL EDR file contains the soil moisture EDR of Soil Moisture and Land Cover Type.	netCDF	~30.8 MB/file 14-15/day
SOIL_v2r0_GW1_s???????????_e????????????	The SOIL EDR file contains the soil moisture EDR of Soil	Binary	~4.9 MB/file 14-15/day

???_c??????????????.bin	Moisture.		
AMSR2-SEAICE-NH_v2r0_GW1_s???????????????_e??????????????_c??????????????.nc	The SEAICE EDR file contains the seaice EDR of Ice Concentration for the Northern Hemisphere.	netCDF	~64.0 MB/file 14-15/day
AMSR2-SEAICE-SH_v2r0_GW1_s???????????????_e??????????????_c??????????????.nc	The SEAICE EDR file contains the seaice EDR of Ice Concentration for the Southern Hemisphere.	netCDF	~24.0 MB/file 14-15/day
AMSR2-SST_v1r0_GW1_s???????????????_e??????????????_c??????????????.bufr	The SST EDR file SST from the Ocean EDR netCDF file.	BUFR	~6.9 MB/file 14-15/day

Table 1-3 – GAASP MBT netCDF4 EDR File Content Description

Variable	Type	Description	Dim	Units	Range
Across_Scan_High_Resolution	Short	FOV count across scan for High Resolution field	486	N/A	1-486
Across_Scan_Low_Resolution	Short	FOV count across scan for Low Resolution field	243	N/A	1-243
Along_Scan	Short	Scan count along scan	3960[1]	N/A	1-360
Brightness_Temperature_10_GHzV	Float	Brightness Temperatures for the 10.7GHz Vertical Polarization Channel	3960[1] x 243	K	10 – 500
Brightness_Temperature_10_GHzH	Float	Brightness Temperatures for the 10.7GHz Horizontal Polarization Channel	3960[1] x 243	K	10 – 500
Brightness_Temper	Float	Brightness	3960[1] x	K	10 – 500

[1] The actual number of scan lines varies between 3840-3841, 3960-3961, and 4080-4081 with 3960 being the most frequent.

ature_18_GHzV		Temperatures for the 18.7GHz Vertical Polarization Channel	243		
Brightness_Temperature_18_GHzH	Float	Brightness Temperatures for the 18.7GHz Horizontal Polarization Channel	3960[1] x 243	K	10 – 500
Brightness_Temperature_23_GHzV	Float	Brightness Temperatures for the 23.8GHz Vertical Polarization Channel	3960[1] x 243	K	10 – 500
Brightness_Temperature_23_GHzH	Float	Brightness Temperatures for the 23.8GHz Horizontal Polarization Channel	3960[1] x 243	K	10 – 500
Brightness_Temperature_36_GHzV	Float	Brightness Temperatures for the 36.5GHz Vertical Polarization Channel	3960[1] x 243	K	10 – 500
Brightness_Temperature_36_GHzH	Float	Brightness Temperatures for the 36.5GHz Horizontal Polarization Channel	3960[1] x 243	K	10 – 500
Brightness_Temperature_6_GHzV	Float	Brightness Temperatures for the 6.9GHz Vertical Polarization Channel	3960[1] x 243	K	10 – 500
Brightness_Temperature_6_GHzH	Float	Brightness Temperatures for the 6.9GHz Horizontal Polarization Channel	3960[1] x 243	K	10 – 500
Brightness_Temperature_7_GHzV	Float	Brightness Temperatures for the 7.3GHz Vertical Polarization Channel	3960[1] x 243	K	10 – 500
Brightness_Temperature_7_GHzH	Float	Brightness Temperatures for the 7.3GHz Horizontal Polarization Channel	3960[1] x 243	K	10 – 500
Brightness_Temper	Float	Brightness	3960[1] x	K	10 – 500

ature_89_GHz-AV		Temperatures for the 89.0GHz-A Vertical Polarization Channel	486		
Brightness_Temperature_89_GHz-AH	Float	Brightness Temperatures for the 89.0GHz-A Horizontal Polarization Channel	3960[1]**Error! Bookmark not defined.** x 486	K	10 – 500
Brightness_Temperature_89_GHz-BV	Float	Brightness Temperatures for the 89.0GHz-B Vertical Polarization Channel	3960[1]**Error! Bookmark not defined.** x 486	K	10 – 500
Brightness_Temperature_89_GHz-BH	Float	Brightness Temperatures for the 89.0GHz-B Horizontal Polarization Channel	3960[1] x 486	K	10 – 500
C_Band_Ocean_RFI_Flag	Short	C Band Ocean RFI Flag as created by the OCEAN algorithm	3960[1] x 243	N/A	0-1
Earth_Azimuth_Angle	Float	Earth Azimuth Angle	3960[1] x 243	Deg	-180.0 – 180.0
Earth_Incidence_Angle	Float	Earth Incidence Angle	3960[1] x 243	Deg	-180.0 – 180.0
Land_Ocean_Flag_6_to_36	Short	Land(100) to Ocean(0) flag for each low resolution channel's field of view	6 x 3960[1] x 243	% Land	0 – 100
Land_Ocean_Flag_89	Short	Land(100) to Ocean(0) flag for each of the 89GHz field of views	2 x 3960[1] x 486	% Land	0 – 100
Latitude_ for_10	Float	Latitude for the 10.7GHz channel's field of view	3960[1] x 243	Deg	-90.0 – 90.0
Latitude_ for_18	Float	Latitude for the 18.7GHz channel's field of view	3960[1] x 243	Deg	-90.0 – 90.0
Latitude_ for_23	Float	Latitude for the	3960[1] x	Deg	-90.0 – 90.0

		23.8GHz channel's field of view	243		
Latitude_ for_36	Float	Latitude for the 36.5GHz channel's field of view	3960[1] x 243	Deg	-90.0 – 90.0
Latitude_ for_6	Float	Latitude for the 6.9GHz channel's field of view	3960[1] x 243	Deg	-90.0 – 90.0
Latitude_ for_7	Float	Latitude for the 7.3GHz channel's field of view	3960[1] x 243	Deg	-90.0 – 90.0
Latitude_ for_89A	Float	Latitude for the 89.0GHz-A channel's field of view	3960[1] x 486	Deg	-90.0 – 90.0
Latitude_ for_89B	Float	Latitude for the 89.0GHz-B channel's field of view	3960[1] x 486	Deg	-90.0 – 90.0
Latitude_ for_High_Resolution	Float	Latitude for the 89.0GHz-A channel's field of view	3960[1] x 486	Deg	-90.0 – 90.0
Latitude_ for_Low_Resolution	Float	Latitude for the 89.0GHz-A channel's field of view thinned to just the odd values	3960[1] x 243	Deg	-90.0 – 90.0
Longitude_ for_10	Float	Longitude for the 10.7GHz channel's field of view	3960[1] x 243	Deg	-180.0 – 180.0
Longitude_ for_18	Float	Longitude for the 18.7GHz channel's field of view	3960[1] x 243	Deg	-180.0 – 180.0
Longitude_ for_23	Float	Longitude for the 23.8GHz channel's field of view	3960[1] x 243	Deg	-180.0 – 180.0
Longitude_ for_36	Float	Longitude for the 36.5GHz channel's field of view	3960[1] x 243	Deg	-180.0 – 180.0
Longitude_ for_6	Float	Longitude for the 6.9GHz channel's field of view	3960[1] x 243	Deg	-180.0 – 180.0
Longitude_ for_7	Float	Longitude for the 7.3GHz channel's field of view	3960[1] x 243	Deg	-180.0 – 180.0

Longitude_ for_89A	Float	Longitude for the 89.0GHz-A channel's field of view	3960[1] x 486	Deg	-180.0 – 180.0
Longitude_ for_89B	Float	Longitude for the 89.0GHz-B channel's field of view	3960[1] x 486	Deg	-180.0 – 180.0
Longitude_ for_High_Resolution	Float	Longitude for the 89.0GHz-A channel's field of view	3960[1] x 486	Deg	-180.0 – 180.0
Longitude_ for_Low_Resolution	Float	Longitude for the 89.0GHz-A channel's field of view thinned to just the odd values	3960[1] x 243	Deg	-180.0 – 180.0
Pixel_Data_Quality_6_to_36	Short	The flag that shows the data include RFI is stored for each frequency and polarization except 89.0GHz.	3960[1] x 486	N/A	See AMSR2 L1 Format Guide section (JAXA 2013)
Pixel_Data_Quality_89	Short	The flag that shows the data include RFI is stored for each frequency and polarization for 89.0GHz.	3960[1] x 486	N/A	See AMSR2 L1 Format Guide section (JAXA 2013)
RFI_NOAA_LAND_06v	Float	The NOAA created RFI value over land for the 6.9GHz Vertical Polarization channel	3960[1] x 243	N/A	-10 – 20
RFI_NOAA_LAND_06h	Float	The NOAA created RFI value over land for the 6.9GHz Horizontal Polarization channel	3960[1] x 243	N/A	-10 – 20
RFI_NOAA_LAND_07v	Float	The NOAA created RFI value over land for the 7.3GHz Vertical Polarization channel	3960[1] x 243	N/A	-10 – 20
RFI_NOAA_LAND_	Float	The NOAA created RFI	3960[1] x	N/A	-10 – 20

07h		value over land for the 7.3GHz Horizontal Polarization channel	243		
RFI_NOAA_LAND_10v	Float	The NOAA created RFI value over land for the 10.7GHz Vertical Polarization channel	3960[1] x 243	N/A	-10 – 20
RFI_NOAA_LAND_10h	Float	The NOAA created RFI value over land for the 10.7GHz Horizontal Polarization channel	3960[1] x 243	N/A	-10 – 20
RFI_NOAA_OCEAN_10v	Float	The NOAA created RFI value over land for the 10.7GHz Vertical Polarization channel	3960[1] x 243	N/A	-10 – 20
RFI_NOAA_OCEAN_10h	Float	The NOAA created RFI value over land for the 10.7GHz Horizontal Polarization channel	3960[1] x 243	N/A	-10 – 20
RFI_NOAA_OCEAN_18v	Float	The NOAA created RFI value over land for the 18.7GHz Vertical Polarization channel	3960[1] x 243	N/A	-10 – 20
RFI_NOAA_OCEAN_18h	Float	The NOAA created RFI value over land for the 18.7GHz Horizontal Polarization channel	3960[1] x 243	N/A	-10 – 20
Scan_Angle	Float	Scan Angle	3960[1] x 243	Deg	46.5 – 48.5
Scan_Time	Float	Scan line Start Time 6-D for (YYYY, MM, DD, HH, MM, SS.SSS)	3960[1] x 6	GMT	YYYY = 2012 – 2032 MM = 1-12 DD = 1-31 HH = 0-23 MM = 0-59 SS = 0-59 .SSS=000-999
Sun_Azimuth_Angl	Float	Sun Azimuth Angle	3960[1] x	Deg	-180.0 –

e			243		180.0
Sun_Elevation	Float	Sun Elevation	3960[1] x 243	Deg	-180.0 – 180.0
Sun_Glint_Flag	Short	Sun Glint Flag as created by the OCEAN algorithm	3960[1] x 243	N/A	0-1

Table 1-4 – GAASP OCEAN netCDF4 EDR File Content Description

Variable	Type	Description	Dim	Units	Range
Across_Scan_High_Resolution	Short	FOV count across scan for High Resolution field	486	N/A	1-486
Across_Scan_Low_Resolution	Short	FOV count across scan for Low Resolution field	243	N/A	1-243
Aggressive_Land_mask	Float	Aggressive Land and Seaice Mask	3960[1] x 243	N/A	0-1
Along_Scan	Short	Scan count along scan	3960[1]	N/A	1-360
CLW	Double	Cloud Liquid Water	3960[1] x 243	mm	0 – 1
Descending_Flag	Short	Descending Flag	3960[1]	N/A	0-1
EDR_QC_Flag	Float	Quality Control Flag for the entire Ocean Algorithm	3960[1] x 243	N/A	N/A
Earth_Azimuth_Angle	Float	Earth Azimuth Angle	3960[1] x 243	Deg	-180.0 – 180.0
Earth_Incidence_Angle	Float	Earth Incidence Angle	3960[1] x 243	Deg	-180.0 – 180.0
GFS_Model_SST	Float	The sea surface temperature from the GFS model	3960[1] x 243	Kelvin	269 – 309
GFS_Model_WDIR	Float	The derived wind direction from the GFS model	3960[1] x 243	Degrees	0 – 360
GFS_Model_WSPD	Float	The derived wind speed from the GFS model	3960[1] x 243	m/s	0-30
Land_mask	Float	The derived land-sea	3960[1] x	N/A	N/A

		mask from the GFS model	243		
Latitude_ for_High_Resolution	Float	Latitude for the 89.0GHz-A channel's field of view	3960[1] x 486	Deg	-90.0 – 90.0
Latitude_ for_Low_Resolution	Float	Latitude for the 89.0GHz-A channel's field of view thinned to just the odd values	3960[1] x 243	Deg	-90.0 – 90.0
Longitude_ for_High_Resolution	Float	Longitude for the 89.0GHz-A channel's field of view	3960[1] x 486	Deg	-180.0 – 180.0
Longitude_ for_Low_Resolution	Float	Longitude for the 89.0GHz-A channel's field of view thinned to just the odd values	3960[1] x 243	Deg	-180.0 – 180.0
Pixel_Data_Quality_6_to_36	Float	The flag that shows the data include RFI is stored for each frequency and polarization except 89.0GHz.	3960[1]**Error! Bookmark not defined.** x 486	N/A	N/A
Prelim_Reynolds_SST	Float	Preliminary analysis of Reynolds-OI SeaSurface Temperature	3960[1] x 243	Kelvin	269 – 309
QM_max_EIA	Float	Quality Monitoring: Maximum Earth Incident Angle	1	Deg	-180.0 – 180.0
QM_max_SST_diff	Float	Quality Monitoring: Max SST difference between model and algorithm	1	Celsius	-2.5 – 35
QM_max_WSPD_diff	Float	Quality Monitoring: Max Wind Speed difference between model and algorithm	1	m/s	0 – 30
QM_mean_EIA	Float	Quality Monitoring: Mean Earth Incident Angle	1	Deg	-180.0 – 180.0

QM_mean_SST_diff	Float	Quality Monitoring: Mean SST difference between model and algorithm	1	Celsius	-2.5 – 35
QM_mean_WSPD_diff	Float	Quality Monitoring: Mean Wind Speed difference between model and algorithm	1	m/s	0 – 30
QM_min_EIA	Float	Quality Monitoring: Minimum Earth Incident Angle	1	Deg	-180.0 – 180.0
QM_min_SST_diff	Float	Quality Monitoring: Minimum SST difference between model and alogrithm	1	Celsius	-2.5 – 35
QM_min_WSPD_diff	Float	Quality Monitoring: Minimum Wind Speed difference between model and algorithm	1	m/s	0 – 30
Rain_Rate	Float	Surface Rain Rate	3960[1] x 486	mm/hr	0 – 100
Rain_Rate_QC_Flag	Byte	Rain Rate Error Flag	3960[1] x 486	N/A	0 – 2
SST	Double	Sea Surface Temperature	3960[1] x 243	Celsius	-2.5 – 35
SST_QC	Float	Sea Surface Quality Control Flag	3960[1] x 243	N/A	0-1
Scan_Angle	Float	Scan Angle	3960[1] x 243	Deg	46.5 – 48.5
Scan_Time	Float	Scan line Start Time 6-D for (YYYY, MM, DD, HH, MM, SS.SSS)	3960[1] x 6	GMT	YYYY = 2012 – 2032 MM = 1-12 DD = 1-31 HH = 0-23 MM = 0-59 SS = 0-59 .SSS = 000-999
Sun_Azimuth_Angl	Float	Sun Azimuth Angle	3960[1] x	Deg	-180.0 –

e			243		180.0
Sun_Elevation	Float	Sun Elevation	3960[1] x 243	Deg	-180.0 – 180.0
Sun_Glint_Flag	Short	Sun Glint Flag	3960[1]**Error! Bookmark not defined.** x 243	N/A	0-1
TPW	Double	Total Precipitable Water	3960[1]**Error! Bookmark not defined.** x 243	mm	0 – 75
WSPD	Double	Wind Speed	3960[1]**Error! Bookmark not defined.** x 243	m/s	0 – 30

Table 1-5 – GAASP PRECIP netCDF4 EDR File Content Description

Variable	Type	Description	Dim	Units	Range
Across_Scan_High_Resolution	Short	FOV count across scan for High Resolution field	486	N/A	1-486
Across_Scan_Low_Resolution	Short	FOV count across scan for Low Resolution field	243	N/A	1-243
Along_Scan	Short	Scan count along scan	3960[1]**Error! Bookmark not defined.**	N/A	1-360
Earth_Azimuth_Angle	Float	Earth Azimuth Angle	3960[1]**Error! Bookmar**	Deg	-180.0 – 180.0

			k not defined. x 243		
Earth_Incidence_Angle	Float	Earth Incidence Angle	3960[1]**Error! Bookmark not defined.** x 243	Deg	-180.0 – 180.0
Latitude_ for_High_Resolution	Float	Latitude for the 89.0GHz-A channel's field of view	3960[1] x 486	Deg	-90.0 – 90.0
Latitude_ for_Low_Resolution	Float	Latitude for the 89.0GHz-A channel's field of view thinned to just the odd values	3960[1]**Error! Bookmark not defined.** x 243	Deg	-90.0 – 90.0
Longitude_ for_High_Resolution	Float	Longitude for the 89.0GHz-A channel's field of view	3960[1]x 486	Deg	-180.0 – 180.0
Longitude_ for_Low_Resolution	Float	Longitude for the 89.0GHz-A channel's field of view thinned to just the odd values	3960[1] x 243	Deg	-180.0 – 180.0
Probability_of_Precip	Float	Probability of Precipitation	3960[1] x 486	%	0 – 100
QM_Avg_Rain_Land_Amt	Float	Quality Monitoring:	1	mm/hr	0 – 100
QM_Avg_Rain_Ocean_Amt	Float	Quality Monitoring:	1	mm/hr	0 – 100
QM_Cond_Rain_Land_Amt	Float	Quality Monitoring:	1	mm/hr	0 – 100
QM_Cond_Rain_Ocean_Amt	Float	Quality Monitoring:	1	mm/hr	0 – 100
QM_Num_Ambig_Land	Long	Quality Monitoring:	1	N/A	0-3960[1]
QM_Num_Ambig_Ocean	Long	Quality Monitoring:	1	N/A	0-3960[1]
QM_Num_Flagged_L	Long	Quality Monitoring:	1	N/A	0-3960[1]

and					
QM_Num_Flagged_Ocean	Long	Quality Monitoring:	1	N/A	0-3960[1]
QM_Num_Good_Land	Long	Quality Monitoring:	1	N/A	0-3960[1]
QM_Num_Good_Ocean	Long	Quality Monitoring:	1	N/A	0-3960[1]
QM_Num_Land_Pixels	Long	Quality Monitoring:	1	N/A	0-3960[1]
QM_Num_Missing	Long	Quality Monitoring:	1	N/A	0-3960[1]
QM_Num_Ocean_Pixels	Long	Quality Monitoring:	1	N/A	0-3960[1]
QM_Num_Rain_Land_Pixels	Long	Quality Monitoring:	1	N/A	0-3960[1]
QM_Num_Rain_Ocean_Pixels	Long	Quality Monitoring:	1	N/A	0-3960[1]
QM_Sum_Rain_Land_Pixels	Float	Quality Monitoring:	1	mm/hr	0 – 1000000
QM_Sum_Rain_Ocean_Pixels	Float	Quality Monitoring:	1	mm/hr	0 – 1000000
Rain_Rate	Float	Surface rain rate	3960[1] x 486	mm/hr	0 – 100
Rain_Rate_QC_Flag	Byte	Flag denoting precipitation quality flag	3960[1]x 486	N/A	0 – 2
Scan_Angle	Float	Scan Angle	3960[1]x 243	Deg	46.5 – 48.5
Scan_Time	Float	Scan line Start Time 6-D for (YYYY, MM, DD, HH, MM, SS.SSS)	3960[1]x 6	GMT	YYYY = 2012 – 2032 MM = 1-12 DD = 1-31 HH = 0-23 MM = 0-59 SS = 0-59 .SSS = 000-999
convectPrecipitation	Float	Rain rate of convective clouds	3960[1] x 486	mm/hr	0 – 100
surfaceType	Byte	Surface Type (Land,	3960[1] x	N/A	10 – 42

		Coast, Ocean)	486		

Table 1-6 – GAASP SNOW netCDF4 EDR File Content Description

Variable	Type	Description	Dim	Units	Range
Across_Scan_Low_Resolution	Short	FOV count across scan for Low Resolution field	243	N/A	1-243
Along_Scan	Short	Scan count along scan	3960[1]	N/A	1-360
Earth_Azimuth_Angle	Float	Earth Azimuth Angle	3960[1]x 243	Deg	-180.0 – 180.0
Earth_Incidence_Angle	Float	Earth Incidence Angle	3960[1] x 243	Deg	-180.0 – 180.0
Latitude_ for_Low_Resolution	Float	Latitude for the 89.0GHz-A channel's field of view thinned to just the odd values	3960[1] x 243	Deg	-90.0 – 90.0
Longitude_ for_Low_Resolution	Float	Longitude for the 89.0GHz-A channel's field of view thinned to just the odd values	3960[1] x 243	Deg	-180.0 – 180.0
QM_Total_Pixels	Float	Quality Monitoring: Total number of Pixels	1	N/A	0-3960[1]
QM_Total_Pixels_SCI_3	Float	Quality Monitoring: Total Number of Pixels with Snow in Climatology	1	N/A	0-3960[1]
QM_Total_Pixels_SDI_0	Float	Quality Monitoring: Total Number of Pixels with No Snow Depth Retrieval	1	N/A	0-3960[1]
QM_Total_Pixels_SDI_1	Float	Quality Monitoring: Total Number of Pixels with No Snow Depth Retrieval but either glacier detected or permanent show where snow depth and SWE can not be retrieved	1	N/A	0-3960[1]

QM_Total_Pixels_SDI_2	Float	Quality Monitoring: Total Number of Pixels over Land with Snow, but snow depth or SWE exceeded limit	1	N/A	0-3960[1]
QM_Total_Pixels_SDI_3	Float	Quality Monitoring: Total Number of Pixels over Land with snow and valid snow depth and SWE retrievals.	1	N/A	0-3960[1]
QM_Total_Pixels_SSI_9	Float	Quality Monitoring: Total Number of Pixels with Snow Retrieval	1	N/A	0-3960[1]
SWE	Float	Snow Water Equivalent	3960[1] x 486	Kg/m^2	0 - 300
Scan_Angle	Float	Scan Angle	3960[1]x 243	Deg	46.5 – 48.5
Scan_Time	Float	Scan line Start Time 6-D for (YYYY, MM, DD, HH, MM, SS.SSS)	3960[1] x 6	GMT	YYYY = 2012 – 2032 MM = 1-12 DD = 1-31 HH = 0-23 MM = 0-59 SS = 0-59 .SSS = 000-999
Scattering_Surface_Index	Short	Scattering Surface Index (aka Surface Classification Index)	3960[1] x 243	N/A	0 – 9
Snow_Climatology_Index	Short	Snow Climatology Index	3960[1] x 243	N/A	0 – 2
Snow_Cover	Short	Snow Cover (aka Snow Surface Flag)	3960[1] x 243	N/A	0 – 4
Snow_Depth	Float	Snow Depth	3960[1] x 243	cm	0 - 2000
Snow_Depth_Index	Short	Snow Depth Index	3960[1] x 243	N/A	0 – 3

Table 1-7 – GAASP SOIL NetCDF4 EDR File Content Description

Variable	Type	Description	Dim	Units	Range
Across_Scan_Low_Resolution	Short	FOV count across scan for Low Resolution field	243	N/A	1-243
Along_Scan	Short	Scan count along scan	3960[1]	N/A	1-360
Earth_Azimuth_Angle	Float	Earth Azimuth Angle	3960[1] x 243	Deg	-180.0 – 180.0
Earth_Incidence_Angle	Float	Earth Incidence Angle	3960[1] x 243	Deg	-180.0 – 180.0
Land_Cover_Type	Short	Land Cover Type	3960[1] x 243	N/A	0 – 14
Latitude_ for_Low_Resolution	Float	Latitude for the 89.0GHz-A channel's field of view thinned to just the odd values	3960[1] x 243	Deg	-90.0 – 90.0
Longitude_ for_Low_Resolution	Float	Longitude for the 89.0GHz-A channel's field of view thinned to just the odd values	3960[1] x 243	Deg	-180.0 – 180.0
QM_Total_BT_Problems	Float	Quality Monitoring: Total Pixels with brightness temperature problems	1	N/A	0-3960[1]
QM_Total_Bad_Retrievals	Float	Quality Monitoring: Total Pixels with a bad retrieval	1	N/A	0-3960[1]
QM_Total_Cold_Desert	Float	Quality Monitoring: Total Pixels with Cold Desert	1	N/A	0-3960[1]
QM_Total_Frozen_Ground	Float	Quality Monitoring: Total Pixels with Frozen Ground	1	N/A	0-3960[1]
QM_Total_Good_Quality	Float	Quality Monitoring: Total Pixels with Soil Moisture Quality is Good	1	N/A	0-3960[1]
QM_Total_No_Retrieval	Float	Quality Monitoring: Total Pixels where a	1	N/A	0-3960[1]

		retrieval was not attempted			
QM_Total_Num_Pixels	Float	Quality Monitoring: Total Number of Pixels	1	N/A	0-3960[1]
QM_Total_SM_GT_Porosity	Float	Quality Monitoring: Total Pixels where Soil Moisture is greater than Porosity	1	N/A	0-3960[1]
QM_Total_Snow_Rain	Float	Quality Monitoring: Total Pixels with Snow or Rain	1	N/A	0-3960[1]
Scan_Angle	Float	Scan Angle	3960[1] x 243	Deg	46.5 – 48.5
Scan_Time	Float	Scan line Start Time 6-D for (YYYY, MM, DD, HH, MM, SS.SSS)	3960[1] x 6	GMT	YYYY = 2012 – 2032 MM = 1-12 DD = 1-31 HH = 0-23 MM = 0-59 SS = 0-59 .SSS = 000-999
Soil_Moisture	Float	Soil Moisture	3960[1] x 243	%volume/volume	0 – 100
Soil_Moisture_QA	Long	Soil Moisture QA Flag	3960[1] x 243	N/A	0 – 114180

Table 1-8 – GAASP SEAICE-NH netCDF4 EDR File Content Description

Variable	Type	Description	Dim	Units	Range
Across_X_Dimension	Short	X dimension count	1050	N/A	1 – 1050
Along_Y_Dimension	Short	Y dimension count	1050	N/A	1 – 1050
Bootstrap_Ice_Concentation	Long	Ice Concentration calculated by the Bootstrap algorithm	1050 x 1050	Fraction	0 – 100
Flags	Short	Quality Flags	1050 x 1050	N/A	0 – 64

Latency	Long	Time in seconds from most current time	1050 x 1050	Seconds	0 – 2,147,483,647
Latitude	Float	Latitude for EASE-2 grid	1050 x 1050	Deg	-90.0 – 90.0
Longitude	Float	Longitude for EASE-2 grid	1050 x 1050	Deg	-180.0 – 180.0
NASA_Team_2_Ice_Concentration	Long	Ice Concentration calculated by the NASA Team 2 algorithm	1050 x 1050	Fraction	0 – 100
NASA_Team_2_Multiyear_Ice	Long	Multi-year Ice Concentation calculated by the NASA Team 2 algorithm	1050 x 1050	Fraction	0 – 100
NT2_minus_Bootstrap	Long	Difference between NASA Team 2 and Bootstrap Methods	1050 x 1050	Fraction	0 – 100
QM_Num_Grid_Range_25	Float	Quality Monitoring: Number of Grid Boxes with Range > 25%	1	N/A	0-1102500
QM_Num_Grid_Range_50	Float	Quality Monitoring: Num ber of Grid Boxes with Range > 50%	1	N/A	0-1102500
QM_Total_Ice	Float	Quality Monitoring: Total Ice Extent	1	N/A	0-1102500
QM_Total_Pixels	Float	Quality Monitoring: Toatal Number of Grid Boxes	1	N/A	0-1102500
Range_of_Ice_Concentation	Long	Range of Ice Concentration	1050 x 1050	Fraction	0 – 100
Scan_Time	Float	Scan line Start Time 6-D for (YYYY, MM, DD, HH, MM, SS.SSS)	1050 x 1050 x 6	GMT	YYYY = 2012 – 2032 MM = 1-12 DD = 1-31 HH = 0-23 MM = 0-59 SS = 0-59

					.SSS = 000-999

Table 1-9 – GAASP SEAICE-SH netCDF4 EDR File Content Description

Variable	Type	Description	Dim	Units	Range
Across_X_Dimension	Short	X dimension count	840	N/A	1 – 840
Along_Y_Dimension	Short	Y dimension count	840	N/A	1 – 840
Bootstrap_Ice_Concentation	Long	Ice Concentration calculated by the Bootstrap algorithm	840 x 840	Fraction	0 – 100
Flags	Short	Quality Flags	840 x 840	N/A	0 – 64
Latency	Long	Time in seconds from most current time	840 x 840	Seconds	0 – 2,147,483,647
Latitude	Float	Latitude for EASE-2 grid	840 x 840	Deg	-90.0 – 90.0
Longitude	Float	Longitude for EASE-2 grid	840 x 840	Deg	-180.0 – 180.0
NASA_Team_2_Ice_Concentration	Long	Ice Concentration calculated by the NASA Team 2 algorithm	840 x 840	Fraction	0 – 100
NASA_Team_2_Multiyear_Ice	Long	Multi-year Ice Concentation calculated by the NASA Team 2 algorithm	840 x 840	Fraction	0 – 100
NT2_minus_Bootstrap	Long	Difference between NASA Team 2 and Bootstrap Methods	840 x 840	Fraction	0 – 100
QM_Num_Grid_Range_25	Float	Quality Monitoring: Number of Grid Boxes with Range > 25%	1	N/A	0-705600
QM_Num_Grid_Range_50	Float	Quality Monitoring: Num ber of Grid Boxes with Range > 50%	1	N/A	0-705600
QM_Total_Ice	Float	Quality Monitoring: Total Ice Extent	1	N/A	0-705600

QM_Total_Pixels	Float	Quality Monitoring: Toatal Number of Grid Boxes	1	N/A	0-705600
Range_of_Ice_Concentation	Long	Range of Ice Concentration	840 x 840	Fraction	0 – 100
Scan_Time	Float	Scan line Start Time 6-D for (YYYY, MM, DD, HH, MM, SS.SSS)	840 x 840 x 6	GMT	YYYY = 2012 – 2032 MM = 1-12 DD = 1-31 HH = 0-23 MM = 0-59 SS = 0-59 .SSS = 000-999

Table 1-10 – GAASP SOIL Binary EDR File Content Description

Variable	Type	Description	Units	Range
Column	Short	indices to reproject GCOM pixels to a 0.25 degree grid.	N/A	1 [180 W-179.75 W) to 1440 [179.75 E-180 W)
Row	Short	indices to reproject GCOM pixels to a 0.25 degree grid.	N/A	1 [90 N-89.75 N) to 720 [89.75 S-90 S]
Year	Short	Year from the Scan Time UTC for the row	N/A	2012 – 2032
Month	Short	Month from the Scan Time UTC for the row	N/A	1 – 12
Day	Short	Day from the Scan Time UTC for the row	N/A	1 – 31
Hour	Short	Hour from the Scan Time UTC for the row	N/A	0 – 23
Minute	Short	Minute from the Scan Time UTC for the row	N/A	0 – 59

Soil_Moisture	Short	percentage of soil moisture in the profile that was measured for that pixel with a scale factor of 0.01	%	1 – 9999
QA	Short	Quality Flag, see Table 3-6	N/A	0 – 114180

Table 1-11 – AMSR2 1B BUFR User Definitions (Table-A)

Mnemonic	Number	Description
NC021248	A50249	MSG TYPE 021-248 Advanced Microwave Scanning Radiometer 2 (AMSR2) 1B brightness temperature data
YYMMDD	301011	Date -- year, month, day
HHMM	301012	Time -- hour, minute
LTLONH	301021	High accuracy latitude/longitude position
AMSRCH	310193	AMSR2 channels and brightness temperatures set
SAID	001007	Satellite identifier
OGCE	001033	Identification of originating/generating center
GSES	001034	Identification of originating/generating sub-center
SIID	002019	Satellite instruments
SCLF	002020	Satellite classification
ANPO	002104	Antenna polarization
MTYP	002141	Measurement type
SCCF	002153	Satellite channel center frequency
YEAR	004001	Year
MNTH	004002	Month
DAYS	004003	Day
HOUR	004004	Hour
MINU	004005	Minute
SECO	004006	Second
CLATH	005001	Latitude (high accuracy)
SOLAZI	005022	Solar azimuth
ORBN	005040	Orbit number
SLNM	005041	Scan line number
FOVN	005043	Field of view number
CLONH	006001	Longitude (high accuracy)
SOEL	007022	Solar elevation
TMBR	012163	Brightness temperature (high accuracy)
ALFR	021166	Land fraction
IANG	025081	Incidence angle
AANG	025082	Azimuth angle

ACQF	033032	Channel quality flags for ATOVS
VIIRSQ	033083	Radiance data quality flags

Table 1-12 – AMSR2 1B BUFR User Definitions (Table-B)

Mnemonic	**Sequence**						
NC021248	SAID	OGCE	GSES	SIID	SCLF	YYMMDD	HHMM
NC021248	207003	SECO	207000	ORBN	201133	SLNM	FOVN
NC021248	201000	LTLONH	SOLAZI	SOEL	IANG	AANG	ACQF
NC021248	208006	MTYP	208000	{AMSRCH}			
YYMMDD	YEAR	MNTH	DAYS				
HHMM	HOUR	MINU					
LTLONH	CLATH	CLONH					
AMSRCH	SCCF	ALFR	VIIRSQ	ANPO	TMBR		

Table 1-13 – AMSR2 1B BUFR User Definitions (Table D)

Mnemonic	**Scal**	**Reference**	**Bit**	**Units**
SAID	0	0	10	Code table
OGCE	0	0	8	Code table
GSES	0	0	8	Code table
SIID	0	0	11	Code table
SCLF	0	0	9	Code table
ANPO	0	0	4	Code table
MTYP	0	0	24	CCITT IA5
SCCF	-8	0	26	Hz
YEAR	0	0	12	Year
MNTH	0	0	4	Month
DAYS	0	0	6	Day
HOUR	0	0	5	Hour
MINU	0	0	6	Minute
SECO	0	0	6	Second
CLATH	5	-9000000	25	Degree
SOLAZI	2	0	16	Degree true
ORBN	0	0	24	Numeric
SLNM	0	0	8	Numeric
FOVN	0	0	8	Numeric
CLONH	5	-18000000	26	Degree

SOEL	2	-9000	15	Degree
TMBR	2	0	16	K
ALFR	3	0	10	Numeric
IANG	3	0	17	Degree
AANG	3	0	19	Degree
ACQF	0	0	24	Flag table
VIIRSQ	0	0	16	Flag table

Table 1-14 – AMSR2 SST BUFR User Definitions (Table-A)

Mnemonic	Number	Description
NC012222	A62222	Advanced Microwave Scanning Radiometer 2 (AMSR2) sea
YYMMDD	301011	Date -- year, month, day
HHMM	301012	Time -- hour, minute
LTLONH	301021	High accuracy latitude/longitude position
SAID	1007	Satellite identifier
OGCE	1033	Identification of originating/generating center
GSES	1034	Identification of originating/generating sub-center
SIID	2019	Satellite instruments
YEAR	4001	Year
MNTH	4002	Month
DAYS	4003	Day
HOUR	4004	Hour
MINU	4005	Minute
SECO	4006	Second
CLATH	5001	Latitude (high accuracy)
SLNM	5041	Scan line number
FOVN	5043	Field of view number
CLONH	6001	Longitude (high accuracy)
SST0	22049	Sea surface temperature
IANG	25081	Incidence angle
AANG	25082	Azimuth angle
SANG	25196	Scan angle
VIIRSQ	33083	Radiance data quality flags

Table 1-15 – AMSR2 SST BUFR User Definitions (Table-B)

Mnemonic	Sequence

NC012222	SAID	SIID	OGCE	GSES	YYMMDD	HHMM	207003
NC012222	SECO	207000	201133	SLNM	FOVN	201000	LTLONH
NC012222	SANG	IANG	AANG	VIIRSQ	SST0		
YYMMDD	YEAR	MNTH	DAYS				
HHMM	HOUR	MINU					
LTLONH	CLATH	CLONH					

Table 1-16 – AMSR2 SST BUFR User Definitions (Table D)

Mnemonic	Scal	Reference	Bit	Units
SAID	0	0	10	Code table
OGCE	0	0	8	Code table
GSES	0	0	8	Code table
SIID	0	0	11	Code table
YEAR	0	0	12	Year
MNTH	0	0	4	Month
DAYS	0	0	6	Day
HOUR	0	0	5	Hour
MINU	0	0	6	Minute
SECO	0	0	6	Second
CLATH	5	-9000000	25	Degree
SLNM	0	0	8	Numeric
FOVN	0	0	8	Numeric
CLONH	5	-18000000	26	Degree
SST0	2	0	15	K
IANG	3	0	17	Degree
AANG	3	0	19	Degree
SANG	3	0	18	Degree
VIIRSQ	0	0	16	Flag table

An archive agreement is currently in progress for GCOM products. The current plan is to archive the GCOM-W1 EDRs in netCDF4 format at NCEI, and the metadata content will follow the Climate and Forecast metadata convention that NDE adopts for all NPP products.

2. ALGORITHM

2.1 Algorithm Overview

The GAASP products are generated by a set of fast operationally oriented regression-based algorithms based partly on AMSR-E product heritage. The details of all GAASP algorithms are described in the GAASP Algorithm Theoretical Basis Document (ATBD). This document can be made available by either the GAASP Product Area Lead (PAL) or STAR Algorithm Lead. The input science data to GAASP are the orbital-dump HDF5 SDR (L1B and L1R) output of the JAXA RDR-to-SDR code. These data are preprocessed before being used in the GAASP EDR codes. A preprocessor code applies brightness temperature bias corrections, assigns an RFI flag, and performs internal reformatting. The ocean EDR algorithms are regression-based approaches of AMSR-E heritage. The precipitation product is generated by the Goddard PROFiling algorithm (GPROF). Soil moisture uses a hybrid of the Single Channel Retrieval (SCR) and Land Parameter Retrieval Model (LPRM). Snow uses the Enhanced Grody Special Sensor Microwave Imager (SSMI) algorithm. Sea Ice uses the NASA Team 2 and Bootstrap algorithm.

2.2 Input Satellite Data

2.2.1 Satellite Instrument Overview

GCOM is a series of JAXA Earth observation missions lasting 10-15 years. GCOM is part of Japan's contribution to GEOSS (Global Earth Observation System of Systems). The GCOM mission is two series of three satellites each. GCOM-W is for water cycle observations and GCOM-C is for climate observations.

The GCOM-W1 platform launched May 18, 2012 and is the first satellite for the GCOM-W series. GCOM-W1 is part of the "A-Train" in a sun-synchronus orbit (~700 km altitude) with an ascending node equator crossing time of 13:30 UTC. The AMSR2 instrument onboard the GCOM-W1 satellite continues Aqua/AMSR-E observations of water vapor, cloud liquid water, precipitation, SST, sea surface wind speed, sea ice concentration, snow depth, and soil moisture.

The AMSR2 instrument passively observes Earth-emitted microwave frequencies over six horizontally and vertically polarized channels (6.9, 10.65, 18.7, 23.8, 36.5, and 89.0 GHz). The instrument has a conical scanning mirror that rotates every 1.5 seconds measuring a 1450 km swath. It observes 99% of the Earth every 2 days. Additional information about the instrument and the mission goals can be found in this document on the JAXA website:

global.jaxa.jp/projects/sat/gcom_w/

2.2.2 Satellite Data Preprocessing Overview

The raw AMSR2 data packets are dumped every orbit (~101 minutes) at Svalbard, Norway. These raw data are separated by APID and placed into separate files called APID Sorted Data (ASD) files by Kongsberg Satellite Services (KSAT). Beyond this point, the data processing will follow different pathways depending upon the version of the IPDS. IDPS block 1.0 is currently running and is expected to switch to block 2.0 in the summer of 2016.

For IDPS block 1.0, the ASD files will be sent to JAXA, processed into SDR files and sent to NASA. From NASA, the files will be transferred to NOAA and made available to the NDE system on the DDS. The GAASP input data will be full orbital dump SDR files. The last 3 days of input data will reside on DDS and be pulled by the NDE system for operational processing by the GAASP algorithms.

For IDPS block 2.0, the NDE data ingest process will change. ASD data will be sent directly to IDPS. IDPS will package the ASD files into an HDF5 wrapper and make them available to the NDE system. These files will contain two full orbits of data (the current and the previous). The NDE system will extract only the current orbit, convert them into APID Sorted Data (ASD) files, and then pass the ASD files into the JAXA RDR-to-SDR code. The JAXA SDR full-orbit files will then be made available to the GAASP code. The rest of the downstream processing will remain the same except that the current DDS distribution will be replaced by the Product Distribution Area (PDA).

The GAASP software produces the EDRs described within this document. They are produced at the same granularity, except for the Sea Ice product which is produced on a EASE-2 grid separated into Northern and Southern Hemisphere sections, but it is updated at the same temporary granularity. The NDE system distributes the EDRs to the DDS where near real time users may access them. More details about the processing sequence can be found within the GAASP System Maintenance Manual (SMM).

2.2.3 Input Satellite Data Description

The only instrument providing data to the processing is the AMSR2 instrument. The input data is the L1B HDF5 files that are retrieved from the JAXA software. Each file contains all the sensor, geolocation, and quality assessment information needed by the algorithm code. Details about this input file can be found in this document on the JAXA website:

ftp://suzaku.eorc.jaxa.jp/pub/AMSR2/public/Format/AMSR2_Level1_Product_Format_EN.pdf

If the above link does not work, please request the file.

2.3 Input Ancillary Data

2.3.1 Sea-Ice Filter File

The L1B_Correction code, L1R_Correction code, RFI_detection code and the ocean algorithm need a daily sea-ice mask file. The L1B_Correction code, L1R_Correction code, and RFI_detection code cannot run without it, while the ocean algorithm can run in a diminished way without it. The file can be found on the DDS in a grib2 format and has the following naming convention:

seaice.t00z.5min.grb.grib2.${Year}${Month}${Day}

Where:
${Year} = the 4-digit year of the file
${Month} = the 2-digit month of the file
${Day} = the 2-digit day of the file

This file arrives from the DDS in a grib2 format, but it must be converted to a netCDF format prior to being passed to the GAASP system via the PCF file. This can be done using the wgrib2 command.

```
wgrib2 $filename -netcdf $filename.nc -nc4
```

Where:
${filename} is the filename as given above.

The GAASP system will be expecting the file using this naming convention, as it will test the date string in the name to verify that the file is not too old to be used.

2.3.2 Daily OI SST File

The GPROF algorithm needs a daily OI SST file. The GPROF cannot run without it. The file can be found on the DDS in a binary format, and has the following naming convention:

avhrr-only-v2.${Year}${Month}${Day}_preliminary

Where:
${Year} = the 4-digit year of the file
${Month} = the 2-digit month of the file
${Day} = the 2-digit day of the file

The GAASP system will be expecting the file using this naming convention, as it will test the date string in the name to verify that the file is not too old to be used.

2.3.3 GFS Data File

These are 0.5 degree Global Forecast System (GFS) forecast files generated by NCEP and pushed (by NCEP) to the ESPC/DDS. These files are needed for the Ocean EDR product generation. The files have the following name structure:

gfs.t${Hour}z.pgrb2.0p50.f0${Forecast}.${YYYYMMDD}

Where:
${Hour} = the time for which the forecast is run (00Z, 06Z, 12Z, and 18Z)
${Forecast} = the forecast projection time (in hours = 00, 03, 06, 09, and 12)
$YYYYMMDD = the date string in 4-digit year, 2-digit month, and 2-digit day format for the date of the forecast file.

The 00, 03, 06, 09, and 12 hour forecasts are run every six hours. Note that this file name pattern is the name pattern for these file on DDS. In other locations (servers) this name pattern is different for this same file type. The files are GRIB2 format files and are read with the *wgrib2* reader which is freely available from NCEP. The variables that will be used are the ice concentration (icec), land ocean mask (land), sea surface temperature (tmp), ugrd wind component (ugrd), and vgrd wind component (vgrd).

The GAASP system will be expecting to find these files in the GFS_FILE_DIR with this naming pattern, so that it can calculate and use the closest file available.

2.3.4 NPR Ancillary Files

The NPR code comes with a static ancillary data file this is necessary for running the code. This file is delivered with the system. Table 2-1 contains the file name and a brief description of the file.

Table 2-1 – NPR Ancillary Files

File Name	File Description
AMSR2_1B_BUFR_Table	The table definition file for the AMSR2 L1B BUFR files.
AMSR2_SST_BUFR_Table	The table definition file for the AMSR2 SST BUFR files.

2.3.5 Ocean Ancillary Files

The ocean algorithm comes with a set of static ancillary data files that are necessary for running the code. These files are delivered with the system. Table 2-2 contains the file names and a brief description of the files.

Table 2-2 – Ocean Ancillary Files

File Name	File Description
amsr2_clw_regress_coeff_11_07122013_const.bin	CLW coefficient file for the ocean algorithms
amsr2_clw_regress_coeff_11_07122013_res.bin	CLW coefficient file for the ocean algorithms
amsr2_tpw_regress_coeff_11_07142013_const.bin	TPW coefficient file for the ocean algorithms
amsr2_tpw_regress_coeff_11_07142013_res.bin	TPW coefficient file for the ocean algorithms
amsr2_ws_sst_lat_regression_coefficients_08222013_sst12ch.bin	Coefficient file for the ocean algorithms
amsr2_ws_sst_lat_regression_coefficients_08222013_ws12ch.bin	Coefficient file for the ocean algorithms
coeffs_sst_v2_hf_all_const.bin	The constant for regression when using high frequency channels
coeffs_sst_v2_lf_coeff0_des.bin	The C0 for regression when using low frequency channels, Descending
coeffs_sst_v2_lf_coeff1_asc.bin	The C1 for regression when using low frequency channels, Ascending
coeffs_sst_v2_lf_coeff1_des.bin	The C1 for regression when using low frequency channels, Descending

hich_coeff_asc4.bin	High Channel Coefficient, Ascending
hich_coeff_des4.bin	High Channel Coefficient, Descending
lowch_coeff_asc4.bin	Low Channel Coefficient, Ascending
lowch_coeff_des2.bin	Low Channel Coefficient, Descending

2.3.6 GPROF Ancillary Files

The GPROF algorithm comes with a set of static ancillary data files that are necessary for running the code. These files are delivered with the system. Table 2-3 contains the file names and a brief description of the files.

Table 2-3 – GPROF Ancillary Files

File Name	File Description
seaice_amsre_csea_0.25.dat	Sea-ice file for the gprof algorithm
elev.dbase.asc	Elevation database file for the gprof algorithm
global_snow_cover.bin	Snow cover for the gprof algorithm
global_desert_cover.bin	Desert cover file for the gprof algorithm
TMI_correction.txt	TMI correction file for the gprof algorithm
TMI_correction_rain.txt	TMI rain correction file for the gprof algorithm
landmask56-32_16.bin	Land mask file for the gprof algorithm
kext_amsre_3freq.tbl	Forward model coefficient file for the gprof algorithm
AMSR2_V2.dtb	AMSR2 Bayesian profile database for gprof algorithm

2.3.7 Snow Ancillary Files

The snow algorithm comes with a set of static ancillary data files that are necessary for running the code. These files are delivered with the system. Table 2-4 contains the file names and a brief description of the files.

Table 2-4 – Snow Ancillary Files

File Name	File Description
new_sclass.txt	A file containing a snow climatology used in the calculation of snow water equivalent

sn_freq_latlon_wk_??.dat	53 files for typical snow climatologies for the northern hemisphere (one file per week)
snow_freq_sh_week-??_24km	53 files for typical snow climatologies for the southern hemisphere (one file per week)
max_min_lat_lon_h??v??_qkm.dat	289 files which are tile used for vegetation
max_min_lat_lon_qkm_merge.list	A list of all of the max_min_lat_lon_h??v??_qkm.dat files
averaged_7km_vcf_h??v??.bin	289 files of vegetation continuous field data
averaged_7km_veg_h??v??.bin	289 files of vegetation field data

2.3.8 Soil Moisture Ancillary Files

The soil moisture algorithm comes with a set of static ancillary data files that are necessary for running the code. These files are delivered with the system. Table 2-5 contains the file names and a brief description of the files.

Table 2-5 – Soil Moisture Ancillary Files

File Name	File Description
LandCover_8km.bin	A land cover map from the University of Maryland's geography department
CLAY_TOP_fp.IMG	A file containing the clay fraction of the soil (in volume per volume)
PORO_TOP_fp.IMG	A file containing the porosity of the soil (in volume per volume)
SAND_TOP_fp.IMG	A file containing the sand fraction of the soil (in volume per volume)
TAU_CDF_LPRM.bin	A file containing a list of 101 vegetation optical depths for the Land Parameter Retrieval Module
TAU_CDF_Reference.bin	A file containing a list of 101 vegetation optical depths for the Global Land Data Assimilation System

2.3.9 Seaice Ancillary Files

The Seaice algorithm comes with a set of static ancillary data files that are necessary for running the code. These files are delivered with the system. Table 2-6 contains the file names and a brief description of the files.

Table 2-6 – Seaice Ancillary Files

File Name	File Description
e2_mask_north.dat	This is the northern hemisphere EASE-2 land mask
e2_mask_south.dat	This is the southern hemisphere EASE-2 land mask
e2_sst_n_??.dat	12 northern hemisphere sea surface temperature mask files, one for each month
e2_sst_s_??.dat	12 southern hemisphere sea surface temperature mask files, one for each month
EASE2_NPolar.gpd	This is a file used to recreate the northern hemisphere EASE-2 grid in the Map-X software.
EASE2_NPolar_lat.bin	This is a binary file that stores all of the latitudes for each grid box on the northern hemisphere EASE-2 grid.
EASE2_NPolar_lon.bin	This is a binary file that stores all of the longitudes for each grid box on the northern hemisphere EASE-2 grid.
EASE2_SPolar.gpd	This is a file used to recreate the southern hemisphere EASE-2 grid in the Map-X software.
EASE2_SPolar_lat.bin	This is a binary file that stores all of the latitudes for each grid box on the southern hemisphere EASE-2 grid.
EASE2_SPolar_lon.bin	This is a binary file that stores all of the longitudes for each grid box on the southern hemisphere EASE-2 grid.

2.3.10 netCDF Template Files

The system also comes with a set of CDL and netCDF template files. These files are necessary for the creation of the final netCDF output files. These files are delivered with the system. Table 2-7 contains the file names and a brief description of each file.

Table 2-7 – netCDF Template Ancillary Files

File Name	File Description
gcom_mbt.cdl	The CDL template for the MBT netCDF file. This is human readable and is used by ncgen to create the netCDF template file.
gcom_mbt.nc	The netCDF template file for the MBT product.
gcom_ocean.cdl	The CDL template for the OCEAN netCDF file. This is human readable and is used by ncgen to create the netCDF template file.
gcom_ocean.nc	The netCDF template file for the OCEAN product.
gcom_precip.cdl	The CDL template for the PRECIP netCDF file. This is human readable and is used by ncgen to create the netCDF template file.
gcom_precip.nc	The netCDF template file for the PRECIP product.

3. PERFORMANCE

3.1 Product Testing

3.1.1 Test Data Description

Description of all GAASP test data (input, output, and intermediate) used in unit and system tests is provided in the GAASP Code Test Review document (NOAA/NESDIS/STAR, 2013), located in the GAASP project artifact repository at:

http://www.star.nesdis.noaa.gov/smcd/spb/iosspdt/qadocs/GCOM_CTR/GAASP_CTR.pptx

If the above link does not work, please request the file.

3.1.2 Unit Test Plans

Description of all GAASP test plans used in unit and system tests is provided in the GAASP Code Test Review document (NOAA/NESDIS/STAR, 2013), located in the GAASP project artifact repository at:

http://www.star.nesdis.noaa.gov/smcd/spb/iosspdt/qadocs/GCOM_CTR/GAASP_CTR.pptx

If the above link does not work, please request the file.

3.2 Product Accuracy

3.2.1 Test Results

Description of all GAASP test plans used in unit and system tests is provided in the GAASP Code Test Review document (NOAA/NESDIS/STAR, 2013), located in the GAASP project artifact repository at:

http://www.star.nesdis.noaa.gov/smcd/spb/iosspdt/qadocs/GCOM_CTR/GAASP_CTR.pptx

If the above link does not work, please request the file.

3.2.2 Product Accuracy

The results of verification and validation tests are contained within the GAASP project's Algorithm Readiness Review presentation package. This is available upon request from the GAASP project science lead. The algorithm performance shown in the tests is verified against the GCOM project requirements defined in the JPSS L1RD Supplement document. These results are also presented to the Satellite Product and Services Review Board (SPSRB) in a briefing slide package prior to becoming operational. After the products are made operational, GAASP product validation efforts will continue in the following years. In addition, OPSO will conduct its own product quality monitoring on the near real time GAASP products. The development schedule allows for two additional product enhancements in after the final Day 2 product delivery. A summary of GAASP product performance based on validation are shown in Table 3-1.

Table 3-1 – Summary of GAASP Product Performance

Products/Retrievals	Precision	Accuracy	Accuracy Specs
TPW	1.8 mm	0.1 mm	1 mm, Precision: 2mm or 10% whichever is greater

CLW	0,09 mm	0.01 mm	0.01mm, Precision: 0.05 mm over ocean
RR	0.01 mm/hr	1.2mm/hr over ocean, 3.6 mm/hr over land	2 mm/hr over ocean, 5 mm/hr over land
SST	0.8 K	0.0 K	0.5 K, Precision: 1.0 K
WSPD	1.3 m/s	0.1 m/s	0.5 m/s, Precision: 2m/s or 10% whichever is greater

3.3 Product Quality Output

There are six quality flags in the GAASP system. The first can be found in the OCEAN netCDF4 file and is called EDR_QC. It is a bit field flag and the means of the bits can be found in Table 3-2.

Table 3-2 – Ocean EDR Quality Flags

Bit #	Meaning
0	RFI detected or land flag set in channel 1 (6.9 GHz)
1	Wind speed out of range (0 to 30).
2	SST out of range (-2.5 to 35).
3	CLW out of range (0 to 1).
4	TPW out of range (0 to 75).
5	
6	Wind speed > 20.
7	CLW > 0.18
8	TPW > 60.
9	
10	Bit 0 set, or Bit 1 set, or CLW > 0.3
11	Bit 0 set, or Bit 2 set, or TPW > 60, or WSPD > 17 and CLW > 0.3, or ABS(earth_incidence-55) > 0.5
12	Bit 0 set, or Bit 3 set.
13	Bit 0 set, or Bit 4 set.

The second is also found in the OCEAN netCDF4 file and is the Quality Flag specifically for the SST product, SST_QC. It is an integer field and meanings of each integer value can be found in Table 3-3.

Table 3-3 – Sea Surface Temperature Quality Flags

Value	Meaning
0	No quality issues
1	Bad Quality

The third can be found in both the OCEAN and the PRECIP netCDF4 file and is called Rain_Rate_QC_Flag. It is an integer field and meanings of each integer value can be found in Table 3-4.

Table 3-4 – Precipitation Quality Flags

Value	Meaning
0	No quality issues
1	Over ocean: Extended bin search to reach minimum threshold of profiles for inversion. Over coast: Not confident in retrieval. Over land: Ambiguous cold temperature that could be surface emission or rainfall
2	Over ocean: Sea ice expected. Over land: climatological snow or desert; Tb screening for ambiguous cold surface, possible arid land, or snow contamination.

The third can be found in the SNOW netCDF4 file and is called Snow_Depth_Index. It is a short integer field and meanings of each integer value can be found in Table 3-5.

Table 3-5 – Snow Depth Index

Value	Meaning
0	No snow depth retrieval
1	No snow depth retrieval but either glacier detected or permanent snow where snow depth and swe cannot be retrieved
2	land with snow, but snow depth or SWE exceeded limit
3	land with snow, valid snow depth and SWE retrievals

The fourth can be found in the SOIL netCDF4 file and is called Soil_Moisture_QA. It is an bit field flag and the meanings of each bit can be found in Table 3-6.

Table 3-6 – Soil Moisture QA

Value	Meaning
Byte 1, Bit 0	soil moisture over good land source 0 = overall quality is not good

	1 = overall quality is good
Byte 1, Bit 1	soil moisture > porosity 0 = ok 1 = retrieval attempted but quality not good
Byte 1, Bit 2	not determined in this algorithm
Byte 1, Bit 3	other input quality 0 = ok 1 = retrieval attempted but quality not good
Byte 1, Bit 4	retrieval attempted? 0 = retrieval attempted 1 = retrieval not attempted
Byte 1, Bit 5	cold desert 0 = not cold desert 1 = cold desert
Byte 1, Bit 6	snow or rain 0 = not snow or rain 1 = snow or rain
Byte 1, Bit 7	frozen ground 0 = not frozen ground 1 = frozen ground
Byte 2, Bits 0 – 5	not determined in this algorithm
Byte 2, Bit 6	overall brightness temperature quality (0=good)
Byte 2, Bit 7	not determined in this algorithm

The fifth can be found in each of the SEAICE netCDF4 files and is called Flags. It is a short integer and the meanings of each value can be found in Table 3-7.

Table 3-7 – Seaice Flags

Value	Meaning
0	Good
4	SST missing
8	Weather
16	Spillover
32	Filled
64	NT2 Missing

3.4 External Product Tools

No external product tools are supplied. The GAASP output files are in netCDF4 and BUFR formats. External users can choose their own tools to display and analyze these output files with any public available netCDF tools.

4. PRODUCT STATUS

4.1 Operations Documentation

Please see the GCOM-W1 AMSR2 Algorithm Software Package (GAASP) System Maintenance Manual, Section 4 "Normal Operations" for detailed information about operational procedures. A set of SPSRB required documentation is available for GCOM-W1, which includes the External User manual (this document), the Algorithm Theoretical Basis Document, the System Maintenance Manual, and the Environmental Satellite Processing and Distribution System (ESPDS) Development Global Change Observation Mission – Water (GCOM) Processing and Distribution System (GPDS) Software User Manual. Other useful documents available include:

JAXA (2013), AMSR2 Level 1 Product Format Specification. Available online at:

ftp://suzaku.eorc.jaxa.jp/pub/AMSR2/public/Format/AMSR2_Level1_Product_Format_EN.pdf

NOAA/NESDIS/STAR (2013), The GCOM-W1 AMSR2 Algorithm Software Package (GAASP) Code Test Review. Available online at:

http://www.star.nesdis.noaa.gov/smcd/spb/iosspdt/qadocs/GCOM_CTR/GAASP_CTR.pptx

If the above links do not work, please request the files.

4.2 Maintenance History

Please see the GCOM-W1 AMSR2 Algorithm Software Package (GAASP) System Maintenance Manual, Section 5 "Monitoring and Maintenance" for detailed information about monitoring and maintenance support. The Environmental Satellite Processing and Distribution System (ESPDS) Development Global Change Observation Mission – Water (GCOM) Processing and Distribution System (GPDS) Software User Manual may also be helpful.

END OF DOCUMENT