Aqua/AMSR-E, GCOM-W/AMSR2
Level 3

Soil Moisture Content, Vegetation Water Content based on the Land Data Assimilation Methodology

Product Format Specification

Japan Aerospace Exploration Agency
March 2024

Change record

Issue	Sheet	Description of change	Remarks
		NC	

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1. Introduction

1.1 Purpose

This format specification describes the format of the Soil Moisture Content and Vegetation Water Content based on the Land Data Assimilation Methodology (LDA Product) derived from Advanced Microwave Scanning Radiometer 2 (AMSR2) on-board the Global Change Observation Mission – Water (GCOM-W) and Advanced Microwave Scanning Radiometer for EOS (AMSR-E) on-board the Aqua, which is the earth observation satellite of NASA.

1.2 File format overview

The file format of the GOSAT-GW/AMSR3 product is the Network Common Data Form (NetCDF) version 4 (netCDF-4) and conforms to the Common Format Conventions for Global Earth Observation Satellites specified by JAXA.

NetCDF is a hierarchical data format similar to HDF5 used in the GCOM-W/AMSR2 standard product. Unidata (http://www.unidata.ucar.edu/software/netcdf/) maintains and revises the specification and develops and maintains programming libraries, etc. NetCDF is used in the earth science, including weather, climate, and ocean.

NetCDF-4, released in 2008, uses HDF5 as its implementation model. Therefore, the data can be handled as-is using HDF5 tools and libraries by changing the extension. Conversely, the data can be handled as-is using netCDF-4 tools and libraries by applying certain rules to the structure of HDF5 data.

2. Applicable and reference documents

2.1 Applicable documents

- JAXA Common Product Format Conventions for Global Earth Observation Satellites (SAM-2019036)
- Global Earth Observation Satellites ID System (SAM-150077)

3. Product overview

The LDA product includes the Soil Water Content from land surface to ground water level and Vegetation Water Content. This product integrated the observation of the Aqua/AMSR-E and GCOM-W/AMSR2 and land surface model simulation based on the data assimilation technique.

Developer: Assoc. Prof. Yohei Sawada (The University of Tokyo)
Name: Soil Moisture Content and Vegetation Water Content based on the Land Data Assimilation Methodology

Data source: ECoHydrological Land reAnalysis (ECHLA, the output of the Coupled Land and Vegetation Data Assimilation System (CLVDAS), provided by The University of Tokyo)

Product specification

Product level:	Level-3
Format:	netCDF-4 (HDF5 compatible)
Grid type:	EQuiRectangular (EQR), 0.25 degree grid, Grid node
Grid size:	1441×721
Latitude range:	-90 degree to 90 degree
Longitude range:	-180 degree to 180 degree
Time interval:	Daily
Target Area:	Global land area/Non-snow area (Fig. 1) Excluding areas possibility of snow throughout the year and dense vegetation.

Stored data

Soil Moisture Content (layer averaged SMC): 5 layers (0-5 cm, 5-15 cm, 15-45 cm, 45-105 cm, 105-195 cm)
Vegetation Water Content (VWC)
Leaf Area Index (LAI)
Soil Moisture from ECHLA (SoilM) 20 layers (0-5 cm and 5 cm to 195 cm/10 cm interval)*

* SoilM means the original 20 layers data from ECHLA stored as 3-dementional data.

Product delivery format :

Off-line (No operationally processing)

Product processing and publish: JAXA Earth Observation Research Center (EORC)

Related papers:

[1] Y. Sawada, "Machine Learning Accelerates Parameter Optimization and Uncertainty Assessment of a Land Surface Model," JGR Atmospheres, vol. 125, no. 20, p. e2020JD032688, Oct. 2020, doi: 10.1029/2020JD032688.

[2] Y. Sawada, T. Koike, E. Ikoma, and M. Kitsuregawa, "Monitoring and Predicting Agricultural Droughts for a Water-Limited Subcontinental Region by Integrating a Land Surface Model and Microwave Remote Sensing," IEEE Trans. Geosci. Remote Sensing, vol. 58, no. 1, pp. 14–33, Jan. 2020, doi: 10.1109/TGRS.2019.2927342.

[3] Y. Sawada, T. Koike, K. Aida, K. Toride, and J. P. Walker, "Fusing Microwave and Optical Satellite Observations to Simultaneously Retrieve Surface Soil Moisture, Vegetation Water Content, and Surface Soil Roughness," IEEE Trans. Geosci. Remote Sensing, vol. 55, no. 11, pp. 6195–6206, Nov. 2017, doi: 10.1109/TGRS.2017.2722468.

[4] Y. Sawada, T. Koike, and J. P. Walker, "A land data assimilation system for simultaneous simulation of soil moisture and vegetation dynamics," JGR Atmospheres, vol. 120, no. 12, pp. 5910–5930, Jun. 2015, doi: 10.1002/2014JD022895.

[5] Y. Sawada and T. Koike, "Simultaneous estimation of both hydrological and ecological parameters in an ecohydrological model by assimilating microwave signal," JGR Atmospheres, vol. 119, no. 14, pp. 8839–8857, Jul. 2014, doi: 10.1002/2014JD021536.

Product URL: https://www.eorc.jaxa.jp/AMSR/datacatalog/land/index_en.html#lda

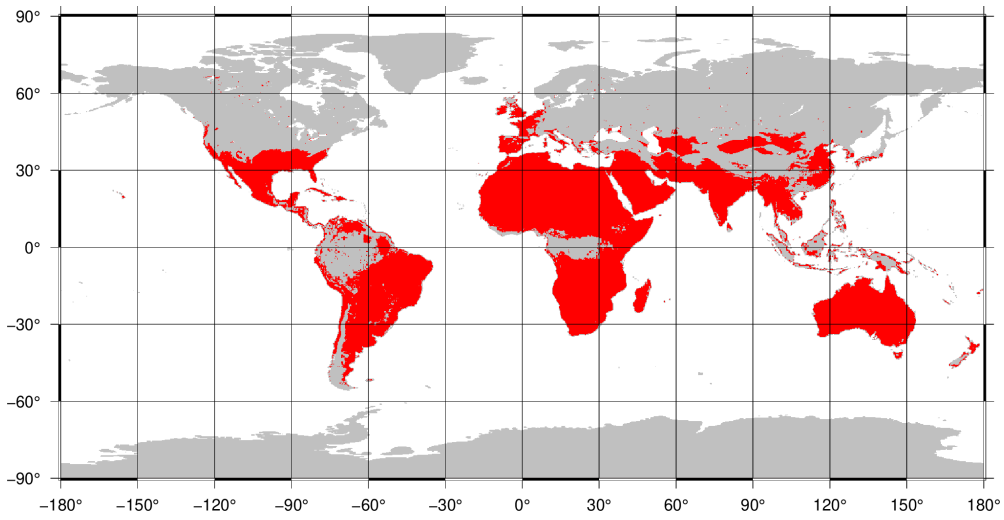

Figure 1: Product target area (red: target area)

3.1 Granule ID and file name

A Granule is the basic unit of products. Its ID is called a “Granule ID”, which uniquely identifies the earth observation satellite data of JAXA. Data files are created in units of the Granule ID, and the extension “.nc” is appended to the Granule ID as the file name. Figure 2 and Table 1 show the rules of Granule IDs for Level 3 products.

Granule IDs and data files for LDA products are organized as daily products.

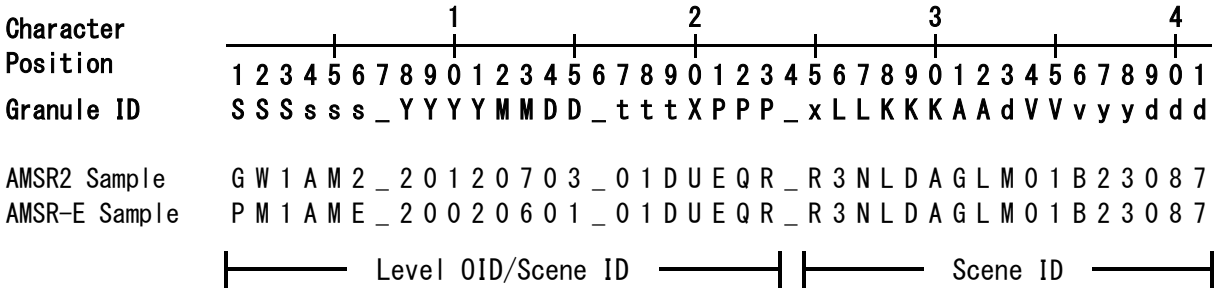

Figure 1: Naming rules of Level-3 product granule ID

Table 1: Naming rules of Level-3 product granule ID

String	Position	Description
SSS	1-3	Satellite(PM1, GW1)
sss	4-6	Sensor (AME, AM2)
YYYYMMDD	8-15	Observation start time (UTC) YYYY: year, MM: month, DD: day
ttt	16-19	Statistical period: 01D:daily (fixed)
X	20	Orbit: U (fixed)
PPP	21-23	Projection: EQR (EQuiRectangulre, fixed)
x	25	Process kind: R Research product (fixed)
LL	26-27	Process Level 3(fixed) and Grid size code N (fixed)
KKK	28-30	Product code: LDA (fixed)
AA	31-32	Area Code: Global Land GL (fixed)
d	33	Developer code M (fixed)
VV	34-35	Product version Major number (00～99)
v	36	Product version Minor number (A～Z)
yyddd	37-41	Product create date: yy: Last 2 digit of the year, ddd: Ordinal date

3.2 Structure of product file

The file format consists of a header part that contains product-specific information and a data part that contains various data sets. In Fig. 3 and Table 2 showed the overview of the file structure and the list of datasets.

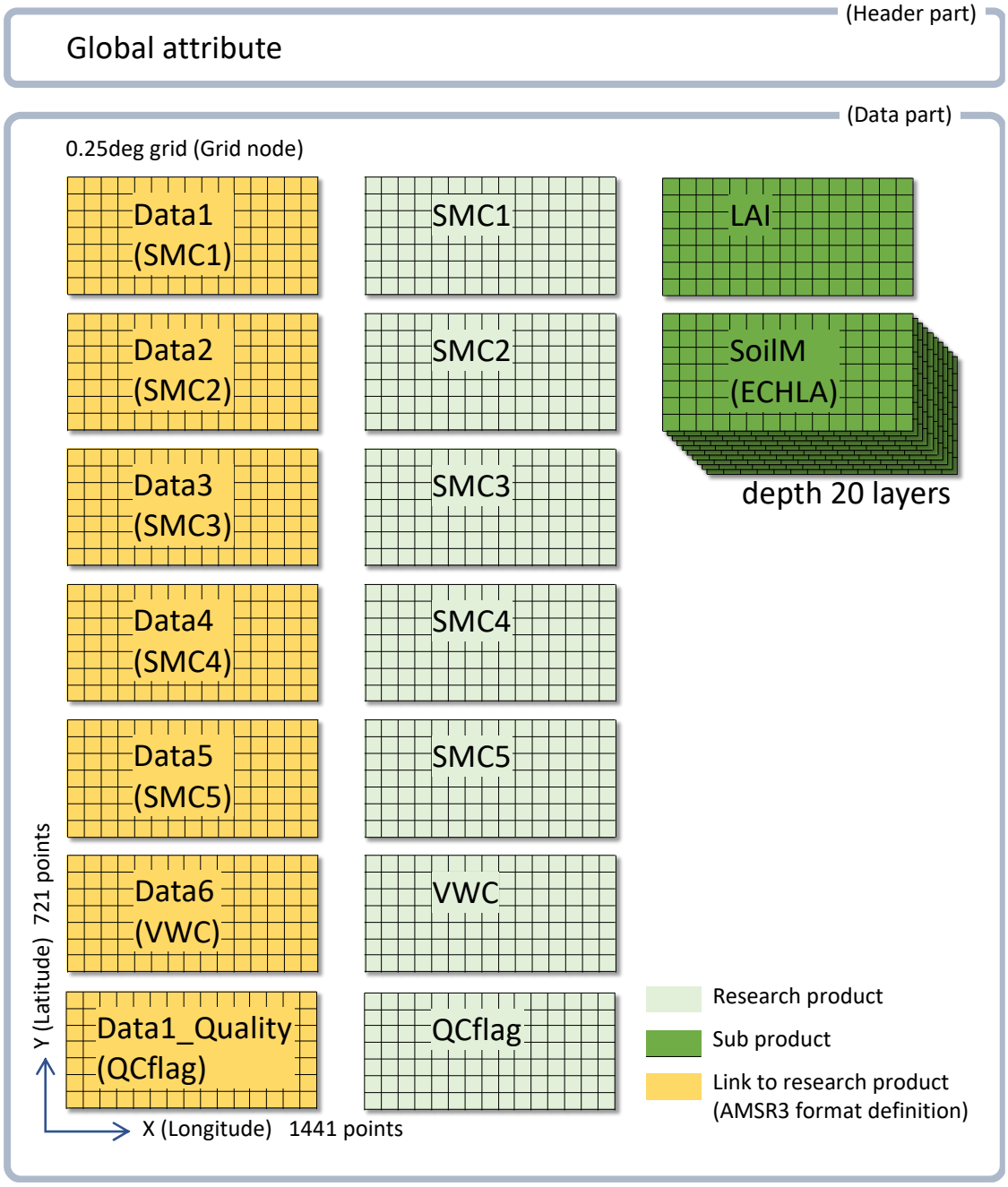

Figure 2: Structure of product file.

Table 2: Level-3 daily product dataset list.

No.	Dataset	Stored values	Remarks
1	SMC1	Soil moisture content for 0～5 cm	Equal to the first layer of SoilM
2	SMC2	Soil moisture content for 5～15 cm	Equal to the second layer of SoilM
3	SMC3	Soil moisture content for 15～45 cm	Average of third to fifth layers of SoilM
4	SMC4	Soil moisture content for 45～105 cm	Average of sixth to eleventh layers of SoilM
5	SMC5	Soil moisture content for 105～195 cm	Average of twelfth to twentieth layers of SoilM
6	VWC	Vegetation water content	
7	LAI	Leaf area index	
8	SoilM	Soil moisture content with 20 layers (0～5 cm, 5～195 cm on 10 cm interval)	ECHLA original data stored in 3-dementional array
9	QCflag	Quality control flag	
10	Data1	Symbolic link to SMC1	
11	Data2	Symbolic link to SMC2	
12	Data3	Symbolic link to SMC3	
13	Data4	Symbolic link to SMC4	
14	Data5	Symbolic link to SMC5	
15	Data6	Symbolic link to VWC	
16	Data1_Quality	Symbolic link to QCflag	

4. Data part

4.1 Dataset attribute

Main dataset attribute is shown in Table 3.

Table 3: List of the dataset attributes.

Attribute	description	Data type
product_code	Describe the product code of the geophysical quantity data.	string
long_name	Provide an arbitrary name that describes the contents of the dataset.	string
standard_name	Provide a name selected from the standard name table of the CF Convention[*1].	string
units	Describe units of the dataset quantities and observation. In the description, it recommends using the units supported by the UDUNIT-2 library. If the data is a dimensionless value, the attribute "units" may not be set.	string
valid_range valid_min valid_max _FillValue	The values of valid range in the dataset are stored in "valid_range" (2-element numeric type array) or "valid_min" and "valid_max". Outside values of the valid range are invalid values. If the invalid value consists of only a single value, the value may be stored in the attribute "_FillValue" and the attributes "valid_min" and "valid_max" may not be set.	Same type of dataset
scale_factor add_offset	Some products stores converted original data values to smaller data type (e.g., 2-byte integer) as stored values. The "scale_factor" and "add_offset" are coefficients used in the conversion. The conversion fomula from stored value to data value is as follows: Data value = scale_factor × stored value + add_offset Note: ・ The "units" is the unit of measure for the observed/geophysical quantity. ・ The data type of "scale_factor" and "add_offset" should be type of precision required by the data value. ・ The "_FillValue" or "valid_min/valid_max" mean the invalid, maximum, or minimum value of the stored values.	32-bit floating-point
flag_value flag_masks flag_meanings	The quality flag dataset describes the contents of the quality information to be stored. See Section 4.1.1.	string

*1 CF convention is an abbreviation for the Climate and Forecast Convention. It is a standardized metadata convention in the fields of weather, climate, and oceans.
*2 A library that expresses units of physical quantities included in Unidata.

4.1.1 Dataset attribute of the quality flag

In the quality information dataset (QCflag, linked from Data1_Quality), the definition of quality is established to attribute.

In the JAXA Common Product Format Conventions for Global Earth Observation Satellites, one of the following two methods of expression defined in the CF Convention shall be used. This product is described by the simple enumeration in Section 4.1.1.1.

4.1.1.1 Simple enumeration using “flag_values” and “flag_meanings”

All possible values of data elements in the dataset are listed in the attribute “flag_values” (an array of integer). The meanings corresponding to each value of “flag_values” are described in “flag_meanings”, separated by spaces.

e.g.)
flag_values
[0,1,2,3,4]
flag_meanings
“quality_good quality_fair quality_poor quality_bad sensor_nonfunctional”

In this example, a data element value equal to 0 means "quality_good", 1 means "quality_fair", 2 means "quality_poor", 3 means “quality_bad” and 4 means "sensor_nonfunctional".

4.1.1.2 Expression of the bit mask using “flag_masks” and “flag_meanings”

The bit mask which applies to the stored values in the dataset for AND operation are listed in the attribute “flag_masks” (an array of integer) as an exponential of 2. The meanings corresponding to each bit masks of “flag_masks” are described in the “flag_meanings” with separation by spaces.

e.g.)
flag_masks
[1,2,4,8,16]
flag_meanings
“low_battery processor_fault memory_fault disk_fault software_fault”

In this example, a data element value equal to 1 means "low_battery", 2 means "processor_fault", 3 means "low_ battery" and "processor_fault", etc.

4.2 Geophysical quantity dataset

4.2.1 Soil Moisture Content (layer average) SMC1～SMC5

Table 4: Soil Moisture Content (layer average) SMC1～SMC5 (link to Data1 to Data5)

content	explanation and stored value
stored value	Soil Moisture Content
contents	The soil moisture content (volumetric moisture content) for each layer is stored in a two-dimensional array as a separate data set for each layer.
dataset code	SMC1, SMC2, SMC3, SMC4, SMC5
data type	32-bit floating-point
units	% ($m^3/m^3 \times 100$)
missing value/_FillValue	-9999.0
valid_range	0, 100
scale_factor	1.
add_offset	0.

4.2.2 Soil Moisture Content (ECHLA) SoilM

Table 5:Soil Moisture Content (ECHLA) SoilM

content	explanation and stored value
stored value	Soil Moisture Content
contents	ECHLA original soil moisture content (volumetric moisture content) as 20 layers are stored in a 3-dimensional array.
dataset code	ECHLA_SMC
data type	32-bit floating-point
Units	% ($m^3/m^3 \times 100$)
missing value/_FillValue	-9999.0
valid_range	0, 100
scale_factor	1.
add_offset	0.

4.2.3 Vegetation Water Content VWC

Table 6: Vegetation Water Content VWC (link to Data6)

content	explanation and stored value
stored value	Vegetation Water Content
contents	The total amount of water contained in vegetation per unit area is stored in a two-dimensional array.
dataset code	ECHLA_VWC
data type	32-bit floating-point
Units	kg/m^2
missing value/_FillValue	-9999.0
valid_range	0, 100
scale_factor	1.
add_offset	0.

4.2.4 Leaf Area Index LAI

Table 7: Leaf Area Index LAI

content	explanation and stored value
stored value	Leaf Area Index
contents	The total leaf area extent (single side) present per unit area is stored in a two-dimensional array.
dataset code	ECHLA_LAI
data type	32-bit floating-point
units	m^2/m^2
missing value/_FillValue	-9999.0
valid_range	0, 100
scale_factor	1.
add_offset	0.

4.3 Quality flag dataset

4.3.1 Qality flag QCflag (link to Data1_Quality)

Table 8: Quality flag QCflag

content	explanation and stored value
stored value	Quality flag
contents	Quality information (mainly focused on the reason of missing) of each grid are stored.
data type	8-bit unsigned integer

Table 9: Definition of the quality flag

Number	Condition	Explanation
0	Good	retrieved
64	Low quality	Dataset contains missing value partly.
128	Missing	Possibly snow
129	Missing	Heavy vegetation area
130	Missing	Other
131	Missing	Coastal region
132	Missing	Water

4.4 Coordinate dataset

4.4.1 Latitude

Table 10: Latitude

content	explanation and stored value
stored value	Latitude (-90 to 90)
contents	Latitude on each grid is stored as one-dimensional array.
data type	64-bit floating-point
units	degrees_north (positive value means north)

4.4.2 Longitude

Table 11: Longitude

content	explanation and stored value
stored value	Longitude (-180 to 180)
contents	Longitude on each grid is stored as one-dimensional array.
data type	64-bit floating-point
units	degrees_east (positive value means east)

4.4.3 Depth

Table 12: Depth

content	explanation and stored value
stored value	Depth (0 to 1.95)
contents	Depth is stored as one-dimensional array.
data type	64-bit floating-point
units	meter
positive	down

5. Header part

There are two types of global attributes stored in the header part: items defined in the Common Product Format Convention for Global Earth Observation Satellites (Common Convention items) and items defined for the AMSR series (AMSR extension items).

Common convention items are conformed to the Climate and Forecast Convention (CF Convention), which is a standardized metadata convention in the weather, climate and oceans; the ISO-19115, which is an international standard for geographic information; and Attribute Conventions for Data Discovery (ACDD), which is a standard for data cataloging and searching. On the other hand, AMSR extension items are determined from the compatibility with global attributes defined in the AMSR2 HDF5 format, and from the improving convenience for data users. Although there are overlapping items between common convention items and AMSR3 items, they are stored according to the definition of each global attribute.

5.1 List of the global attribute (common convention items)

Table 13: Global attribute (common convention items)

attribute	data type	stored value (example)	explanation
acknowledgement	string	The ECHLA was created at the University of Tokyo.	Supplementary information about the project.
characterSet	string	004	Select from the character code table in the ISO-19115. In this format, it is fixed as 004 (utf8).
comment	string	Data1-5 and smc1-5 are the same data, respectively. smc-x is a soft link to Data-x. Similarly, vwc is a soft link to Data6.	The information that are not included other attribute described.
Conventions	string	CF-1.7, ACDD-1.3	Describe the CF and ACDD as a standard complied in CF Convention. Along the ACDD update, this format will be revised and describe along the latest version of the CF Convension and ACDD.
creator_email	string	Z-GCOM_QA@ml.jaxa.jp	Describe the e-mail address of the product creator.
creator_name	string	Japan Aerospace Exploration Agency (JAXA)	Describe the name of the product creator. In this format, “Japan Aerospace Exploration Agency (JAXA)” is stored as fixed value.
creator_type	string	institution	Select the product creator type from “person”, “group”, “institution”, “position”. In this format, “institution” is stored as fixed value.

attribute	data type	stored value (example)	explanation
creator_url	string	https://www.eorc.jaxa.jp/AMSR/	Describe the URL of the product creator information.
date_created	string	2023-03-28T01:23:45.678Z	Describe the file created date as ISO 8601:2004 format. See section 5.4.1.
DOI	string		Describe the Digital Object Identifier. At the moment, it is a blank.
DOIauthority	string	http://doi.org/	Describe the URL of the IDF(International DOI Foundation) that conduct the DOI as a fixed value.
geospatial_bounds	string	POLYGON ((-180 90, -180 -90, 180 -90, 180 90, -180 90))	Describe the range of two- or three-dimensional space in Well-Known Text (WKT) Geometry format of OGC. “geospatial_bounds_crs” is not specified, the coordination for describing “geospatial_bounds” is interpreted as the EPSG:4326 coordinate reference system. In EPSG:4326 coordinate, latitude is represented in decimal degrees as degrees_north, and longitude is represented in decimal degrees as degrees_east.
geospatial_bounds_crs	string	EPSG:4326	Describe Coordinate Reference System (CRS) of point coordinates in the “geospatial_bounds” attribute.
geospatial_lat_max	32-bit floating-point	90.	Store the maximum latitude in the observation area. If the value does not have meaning in this section (e.g. the product scanning more than half of the orbit), it isn’t stored any value and described the observation area in “geospatial_bounds” using polygons.

attribute	data type	stored value (example)	explanation
geospatial_lat_min	32-bit floating-point	-90.	Store the minimum latitude in the observation area. If the value does not have meaning in this section (e.g. the product scanning more than half of the orbit), it isn't stored any value and described the observation area in "geospatial_bounds" using polygons.
geospatial_lon_max	32-bit floating-point	180.	Store the maximum longitude in the observation area. If the value does not have meaning in this section (e.g. the product scanning more than half of the orbit), it isn't stored any value and described the observation area in "geospatial_bounds" using polygons.
geospatial_lon_min	32-bit floating-point	-180.	Store the minimum longitude in the observation area. If the value does not have meaning in this section (e.g. the product scanning more than half of the orbit), it isn't stored any value and described the observation area in "geospatial_bounds" using polygons.
geospatial_vertical_bounds_crs	string	EPSG:5831	Describe the Coordinate Reference System (CRS) altitude/depth of point coordinates in the "geospatial_bounds". A three-dimentional CRS is specified in the "gepspational_bounds_crs", this attribute is not used. Altitude data does not exist in the Level-3 product, this field is left as blank. (In case altitude data exists, "EPSG:5829" is stored as fixed value.)

attribute	data type	stored value (example)	explanation
geospatial_vertical_max	32-bit floating-point	1.95	Describe the maximum value in the vertical direction.
geospatial_vertical_min	32-bit floating-point	0	Describe the minimum value in the vertical direction.
geospatial_vertical_positive	string	down	Describe either “up” for altitude or “down” for depth in the vertical direction. “up” is interpreted as “height”, while “down” is interpreted as “depth”. If necessary, describe the units for altitude/depth in the “geospatial_vertical_units”. If it is omitted, the unit is interpreted as “EPSG:4979” (meter).
geospatial_vertical_units	string	meter	Describe the unit for altitude/depth.
history	string		List the history of the file modification. Describe the modification date and time, username, program name and command line arguments in separate lines.
id	string	GW1AM2_20120703_01DUEQR_R3NLDAGLM01B23087	This is the unique identifier that specified the product. In this format, the granule ID is stored.
institution	string	Japan Aerospace Exploration Agency (JAXA)	Set the name of organization that created the product. In this format, “Japan Aerospace Exploration Agency (JAXA)” is stored as fixed value.
keywords	string	Soil Moisture Content, Vegetation Water Content, Leaf Area Index, Land Data Assimilation	Describe the keywords represent the contents of the file separated by commas.

attribute	data type	stored value (example)	explanation
language	string	en	Describe the language. In this format, “en” is stored as fixed value.
license	string	https://gportal.jaxa.jp/gpr/index/eula?lang=en	Describe the data rights and usage conditions. It is allowed to store the website URL describing them.
naming_authority	string	jp.jaxa	Describe the name of organization providing the product as the reverse DNS name format (recommended). In this format, “jp.jaxa” is stored as fixed value.
processing_level	string	Level 3	Describe the processing level.
project	string	Earth Observation Research Center	Describe the project name of product creator.
publisher_email	string	Z-GCOM_QA@ml.jaxa.jp	Describe the e-mail address of the contact person responsible for data publish.
publisher_name	string	JAXA Earth Observation Research Center (EORC)	Describe name responsible for data publish.
publisher_url	string	https://www.eorc.jaxa.jp/AMSR/	Describe the website URL responsible for data publish.
Role	string	003	Select the role from ISO19115 role code. In this format, “003 (information owner)” is stored as fixed value.
source	string	ECHLA (ECoHydrological Land reAnalysis), da	Describe the method used to generate the data. For observation data, describe descriptions characterizing the observation. For simulated or calculated data from some models, describe model name and version.

attribute	data type	stored value (example)	explanation
standard_names_vocabulary	string	CF Standard Name Table (v49, 12 February 2018)	Describe the name and version of the terminology glossary referenced in the “standard_name”. In this format, stored “CF Standard Name Table” as the terminology glossary name.
summary	string	This is a NetCDF version of ECHLA (ECoHydrological Land reAnalysis) developed by the University of Tokyo. JAXA has converted ECHLA to NetCDF and distributes it.	Describe the summary of file.
time_coverage_end	string	2012-07-03T23:59:59.999Z	Describe the end time of the stored data in the ISO 8601:2004 format. See section 5.4.1.
time_coverage_start	string	2012-07-03T00:00:00.000Z	Describe the start time of the stored data in the ISO 8601:2004 format. See section 5.4.1.
title	string	GOSAT-GW/AMSR3 Level-3, Soil Moisture Content (SMC) and Vegetation Water Content (VWC) based on the Land Data Assimilation Methodology, Undefined, Monthly, Equi-rectangular Projection, 0.25x0.25 deg (grid node)	Describe the product title.
topicCategory	string	farming, climatologyMeteorologyAtmosphere, geoscientificInformation, inlandWaters	Describe the topic category of ISO19115 in the format separated by commas.

5.2 List of the Global Attribute (AMSR extension items)

Table 14: Global Attribute (AMSR extension items)

attribute	data type	stored value (example)	explanation
AlgorithmDeveloper	string	The University of Tokyo	Describe the algorithm developer.
AlgorithmVersion	string	v20220923	Describe the version of ECHLA.
AncillaryDataInformation	string	The ERA5 global atmospheric reanalysis dataset (Hersbach et al. 2020)	Describe the ancillary data information used in data assimilation.
AutomaticQAFlag	string	Good	Describe the Quality flag: “Good”, “Fair”, or “NG”. See section 5.4.2.
AutomaticQAFlagExplanation	string	p=NumberOfPixelsAll-NumberOfPixelsOutsideArea, a=NumberOfPixelsRetrieved/p*100 (%); Good: p>0 and a>=80%; Fair: p>0 and a>0% and a<80%; NG: p=0 or NumberOfPixelsRetrieved=0;	Describe the criteria for determining “AutomaticQAFlag”. See section 5.4.2.
ContactOrganizationEmail	string	Z-GCOM_QA@ml.jaxa.jp	Describe the e-mail address of the product contact organization.
ContactOrganizationName	string	Earth Observation Research Center (EORC), Japan Aerospace Exploration Agency (JAXA)	Describe the name of the product contact organization.

attribute	data type	stored value (example)	explanation
DataCode	string	LDA_SMC1;LDA_SMC2;LDA_SMC3;LDA_SMC4;LDA_SMC5;LDA_VWC;ECHLA_LAI;ECHLA_SMC;	List the product code stored geophysical data separated by commas. See section 5.4.3.
DataDatasetName	string	SMC1;SMC2;SMC3;SMC4;SMC5;VWC;LAI;SoilM;	List the dataset name corresponding to the product code described in the global attribute “Data Code” separated by semicolons. See section 5.4.3.
DataDynamicRange	string	0-100%;0-100%;0-100%;0-100%;0-100%;0-2kg/m^2;undefined;0-100%;	List the dynamic range corresponding to the product code described in the global attribute “Data Code” separated by semicolons. See section 5.4.3.

attribute	data type	stored value (example)	explanation
DataLongName	string	Soil Moisture Content Layer-1 0.00-0.05m (ECHLA SMC layer-1);Soil Moisture Content Layer-2 0.05-0.15m (ECHLA SMC layer-2);Soil Moisture Content Layer-3 0.15-0.45m (Average of ECHLA SMC from layer-3 to layer-5);Soil Moisture Content Layer-4 0.45-1.05m (Average of ECHLA SMC from layer-6 to layer-11);Soil Moisture Content Layer-5 1.05-1.95m (Average of ECHLA SMC from layer-12 to layer-20);ECHLA Vegetation Water Content;ECHLA Leaf Area Index;ECHLA Soil Moisture Content (0.00-0.05m for the first layer, 19 other layers from 0.05m to 1.95m depth, layer thickness 0.10m)	List the geophysical data name (long name) corresponding to the product code described in the global attribute “Data Code” separated by semicolons. See section 5.4.3.
DataNumber	32-bit integer	8	Store the number of product code described in the global attribute “Data Code”. See section 5.4.3.
DataType	string	32-bit floating-point;32-bit floating-point;32-bit floating-point;32-bit floating-point;32-bit floating-point;32-bit floating-point;32-bit floating-point;	List the data type of the dataset described in the global attribute “DataDatasetName” separated by semicolons. See section 5.4.3.

attribute	data type	stored value (example)	explanation
EarthEllipsoidName	string	WGS84	Describe the ellipsoidal model used for latitude and longitude calculation.
EarthFlatteningRatio	string	0.00335	Describe the oblateness of the ellipsoidal model.
EarthSemiMajorAxis	string	6378.1km	Describe the equatorial radius of the ellipsoidal model.
FileFormatType	string	netCDF-4/HDF5 File Format	Describe the file format type.
FileFormatVersionHDF	string	HDF5-1.x.x	Describe the HDF5 format version.
FileFormatVersionNC	string	netCDF-4.x.x	Describe the netCDF format version.
FileSizeByte	32-bit integer	9276235	Describe the product file size (byte).
GranuleID	string	GW1AM2_20120703_01DUEQR_R3NLDAGLM01B23087	Describe the granule ID. See section 3.1.
InputFileName	string		Describe input file names. At the moment, it is a blank.
L3MeanType	string	DailyMean	(fixed)
L3Projection	string	EQR	Describe projection code.
L3Resolution	string	0.25x0.25 deg (grid node)	Describe the grid size,
MeteorologicalDataType	string	The ERA5 global atmospheric reanalysis dataset (Hersbach et al. 2020)	Describe the meteorological dataset name used in the data assimilation.
NumberOfInputFiles	32-bit integer		Describe the number of input files. At the moment, it is a blank.
NumberOfPixelsAll	32-bit integer	1038961	Describe the number of all pixels.
NumberOfPixelsOutsideArea	32-bit integer	938202	Describe the number of pixels on outside area.

attribute	data type	stored value (example)	explanation
NumberOfPixelsRetrieved	32-bit integer	93771	Describe the number of valid pixels. Count as 1 if there is any data available.
NumberOfPixelsRetrievedEachDS	string	93771;93771;93771;93771;93771;93771;93771;93771	Describe the numbers of valid pixels in each dataset separated by semicolons.
NumberOfPixelsX	32-bit integer	1441	Describe the number of grid points in X-direction.
NumberOfPixelsY	32-bit integer	721	Describe the number of grid points in Y-direction.
ObservationEndDateTime	string	2012-07-03T23:59:59.999Z	Describe the end date time of observation day in ISO 8601:2004 format. See section 5.4.1.
ObservationStartDateTime	string	2012-07-03T00:00:00.000Z	Describe the start date time of observation day in ISO 8601:2004 format. See section 5.4.1.
OrbitDirection	string	ASC. DSC.	Describe the direction for Level-3 statistical analysis. ASC.: Ascending orbit DSC.: Descending orbit
OrbitNumberEnd	32-bit integer		Describe the end orbit number. At the moment, it is a blank.
OrbitNumberStart	32-bit integer		Describe the start orbit number. At the moment, it is a blank.
ParameterVersion	string	v20220923	Describe the ECHLA version.
PGEName	string	ECHLA offline	Describe the name of data processing software.
PlatformShortName	string	EORC	Describe the platform abbreviation.
ProcessingCenter	string	JAXA Earth Observation Research Center (EORC)	Describe the name of the data processing center.

attribute	data type	stored value (example)	explanation
ProductCreationDateTime	string	2023-03-28T01:23:45.678Z	Describe the product creation date time in ISO 8601:2004 format. See section 5.4.1.
ProductName	string	AMSR3 L3 LDA	Describe the processing level and its abbreviation.
ProductProcessingType	string	Research product (Global)	Describe the product processing type. It should correspond to the product processing type of Granule ID (letters in 25th). See section 3.1.
ProductSupplement	string		Describe the product supplementary information.
ProductVersion	string	1	Describe the product version It should correspond to the product processing type of Granule ID (letters in 34th to 35th). See section 3.1.
SatelliteAltitude	string	approx. 699 km	Describe the satellite altitude.
SatelliteOrbit	string	Sun-synchronous_sub-recurrent	Describe the satellite orbit.
SatelliteRevisitTime	string	16 days	Describe the satellite revisit time.
SensorShortName	string	AMSR2	Describe the sensor abbreviation name.
SensorSwathWidth	string	Nominal 1450km, effective 1620km	Describe the observation swath of AMSR3.

5.3 List of the global attribute (other extension items)

Table 15: Global attribute (other extension items)

attribute	data type	stored value (example)	explanation
NumberOfPixelsSomeDataMissing	32-bit integer	0	In case multiple datasets are stored, describe the number of pixels where some data is missing. If all data is complete or missing, do not count pixels.
Node_offset		0	Attribute for GMT. 0 - Grid node, 1 - Pixel node

5.4 Supplement information for global attribute

5.4.1 Description of date time (ISO 8601:2004 format)

The datetime used in the global attribute is described in ISO 8601:2004 format. If a leap second occurred, ss may be 60.

YYYY-MM-DD T hh:mm:ss.uuuZ

YYYY: a four-digit year
MM: 01～12 (month)
DD: 01～31 (day)
hh: 00～23 (hour)
mm: 00～59 (minute)
ss : 00～59 (second)
uuu: 000～999 (millisecond)
Z: it means the time is in UTC (Coordinated Universal Time)

※ Target attribute:
date_created
time_coverage_start
time_coverage_end
ObservationStartDateTime
ObservationEndDateTime
ProductCreationDateTime

5.4.2 Automatic quality assessment flag (AutomaticQAFlag, AutomaticQAFlagExplanation)

The “AutomaticQAFlag” is stored the automatic quality inspection result in product creation (“Good”, “Fair”, pr “NG”). The criteria for automatic quality inspection is described in “AutomaticQAFlagExplanation”. The criteria for automatic inspection are as follows:

Good: Valid date count is 80% or more of the target area pixel count.
Fair: Valid data count is less than 80% of the target area pixel count.
NG: Valid data count or target area pixel count is zero.

Here, valid data count is the stored value described in the global attribute “NumberOfPixelsRetrieved”. The target area pixel count is calculated by subtracting “NumberOfPixelsOutsideArea” from “NumberOfPixelsAll”.

※ Target attribute:
AutomaticQAFlag, AutomaticQAFlagExplanation
※ Related attribute:
NumberOfPixelsAll, NumberOfPixelsOutsideArea, NumberOfPixelsRetrieved

5.4.3 Global attribute related to stored dataset

Information regarding brightness temperature or geophysical parameter is stored in the following global attributes. In case multiple brightness temperature or geophysical parameter datasets, each dataset is stored separated by semicolons respectively. The order in the list is followed to “DataCode” listing.

DataCode: Product data code.
DataNumber: Number of product code described in the “DataCode” (number of stored datasets).
DataDatasetName: Name of dataset stored geophysical parameters.
DataType: Data type of dataset.
DataLongName: Name of dataset (long name).
DataDynamicRange: Dynamic range of dataset.

※ Target global attribute:
DataCode, DataNumber, DataDatasetName, DataType, DataLongName, DataDynamicRange