

Appendix 3.1 AMSR Product Format

AMSR Level 2 format description (NDX-000154D)

NDX-000154D

AMSR Level 2 Product Format Description Document

Japan Aerospace Exploration Agency (JAXA)

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1. Introduction

1.1. Purpose

This document describes the format of AMSR level 2 product which is produced at Earth Observation Center (EOC) of Japan Aerospace Exploration Agency (JAXA). This format specification describes the structure and contents of AMSR level 2 product.

1.2. Scope

AMSR on the ADEOS-II which was planned to solve the mechanism of trend warming on the earth and so on, and it observes various bands of microwave radiation even if it is cloudy or at night. The AMSR data is reprocessed at the EOC, and its products are distributed to users. There are 6 kinds of products shown in Table 1.2-1.

Table 1.2-1 Kinds of AMSR product

Product name	Outline
1A	Raw data observed by AMSR. It is the product that is processed on level 0 data for radiometric and geometric correction.
1B	Brightness temperature that is transformed from antenna temperature in level 1A by transformation coefficients.
2	Geophysical quantity for water, water vapor (WV), cloud liquid water (CLW), precipitation (AP), sea surface wind speed (SSW), sea surface temperature (SST), sea ice concentration (IC), snow water equivalent (SWE), and soil moisture (SM), are calculated from the level 1B.
3	Average data that is calculated level 1B or level 2, and projected it on each map by equirectangular and polar stereo graphic.
1B Map	Projected level 1B product on map.
2Map	Projected level 2 product on map.

The data handling unit of a level 2 product is basically a scene, which is defined as a half orbit of the satellite. So it is defined as a strip from the most north to the most south for the center of scan lines or in reverse such as from south to north. Level 1B product includes the overlap between a scene and before or next, so you must be attentive to it that the scene definition in level 1B product is different from level 2. There exist two kinds of products produced at EOC. The one is named *Standard Product* and the other is called *Near Real-Time Product*. Standard Product is processed with *Weather Analysis Data* which is applied an input data for Level2 processing. On the other hand, Near Real-Time Product is produced with *Weather Forecast Data*. Furthermore it has two kinds of products. One is produced from MDR(Mission Data Recorder) data and another is produced from MRT(Mission Real-time Transfer) data. The product data size produced from MRT data is different from Standard Product or Near Real-Time Product from

MDR data. MRT data is real-time data observed over the EOC. Its data size is smaller than MDR.

Level 2 product is processed from level 1B product. The AMSR standard higher processing software reads level 1B product, and estimates some geophysical parameters, such as water vapor, cloud liquid water, precipitation, sea surface wind speed, sea surface temperature, sea ice concentration, snow water equivalent, and soil moisture. The algorithms are selected from PI's research activities. It is output in HDF (Hierarchical Data Format).

This document describes only an outline of data in level 2 product and its format.

2. Related and reference documents

2.1. Related Documents

(1) ADEOS-II AMSR/GLI Product Specifications (NDX-000118)

2.2. Reference Documents

(1) 「RESEARCH ANNOUNCEMENT Retrieval Algorithm and Related Study Advanced Microwave Scanning Radiometer (GLI / AMSR) on Advanced Earth Observing Satellite-II」 (NDX-000098)

(2) ADEOS-II Science Plan (Science Research) (NDX-000114)

(3) ADEOS-II Science Plan (Science Plan) (NDX-000115)

(4) Document of ADEOS-II AMSR Retrieval Algorithm Development (Ver.0.00) (NDX-000156)

(5) AMSR-E/AMSR Level 2Map/3 Software Design (AMSR-HS-I-027B)

(6) ADEOS-II AMSR EORC Common Library Function Description (NDX-00146)

(7) Granule ID Denomination (NCX-000231)

(8) ADEOS-II AMSR Level 1 Product Specifications (NEB-01040A)

(9) AMSR L2 Product Specifications (NDX-000154)

(10) AMSR L3 Product Specifications (NDX-000155)

(11) EOC Toolkit Revision Requirement(Draft) (AMSR-SA-MS-I-006E)

(12) HDF Reference Manual Ver4.2r1, March 2005

(13) HDF User's Guide Ver4.2r0, December 2003

3. Structure of product

Level 2 product contains geophysical quantities, such as water vapor, cloud liquid water, precipitation, sea surface wind speed, sea surface temperature, sea ice concentration, snow water equivalent, and soil moisture, which are calculated from the brightness temperature. Observation point information is also stored in it. These data is stored by HDF format per a scene or MRT. It contains two major parts the header and data. The header part is composed of Coremeta data. Coremeta data describes the information about a product. Its detail is shown in the section 3.1.1. The calculated geophysical quantity data and position data are stored in the data part.

The structure of level 2 product is shown in Figure 3-1.

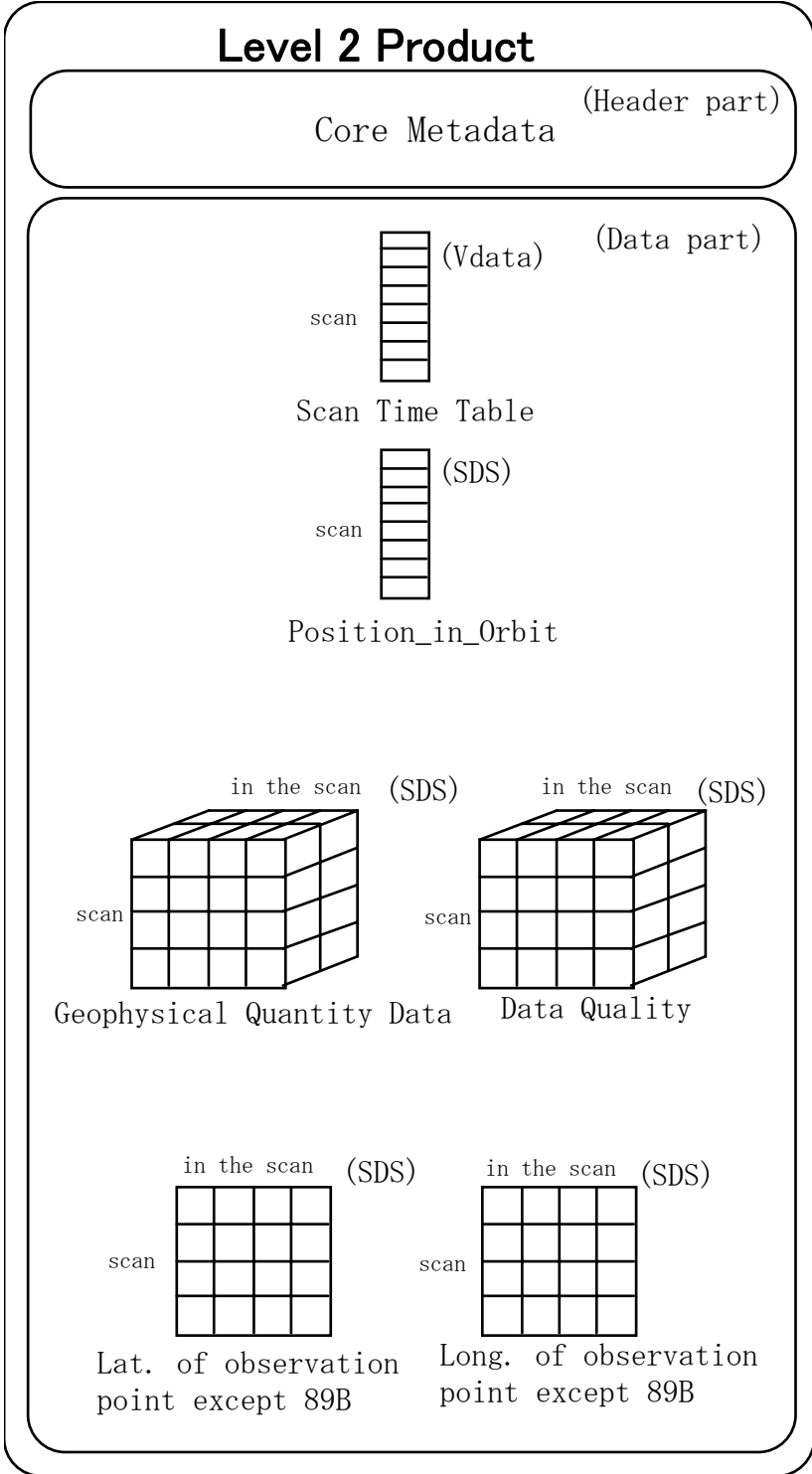


Figure 3-1 Structure of level 2 product.

3.1. Header part

3.1.1. Coremeta data

Coremeta data contains the necessary information about the product. These items are selected from the necessary attributes listed in the NASA ECS format, revision B.0. NASA ECS retrieves the dataset location with attributes. The meta data is stored in the Coremeta data and its name is considered as global attribute. Metadata in each global attribute is preserved in ASCII.

A list of coremeta data is shown in Table 3.1.1-1.

Table 3.1.1-1 List of Coremeta data

Item	Explanation	Example
ShortName	Product name	AMSR-L2
GeophysicalName	Geophysical quantity name	Water Vapor/Cloud liquid water/Precipitation/Sea surface temperature/Sea surface wind speed/Sea ice concentration/Snow water equivalent/Soil moisture
VersionID	ID of product version	0255
SizeMBECSDDataGranule	Product size (Mbyte)	30(actual)
Local Granule ID	Number for production management	A2AMS020101001A_P2WV0Tak111
ProcessingLevelID	ID of processing level	L2
ProductionDateTime	Time of production (UT)	2002-1-3-T00:00:00.00Z
RangeBeginningTime	Time to start observing (UT)	00:00:00.00Z
RangeBeginningDate	Date to start observing (UT)	2002-1-3
RangeEndingTime	Time to end observing (UT)	01:00:00.00Z
RangeEndingDate	Date to end observing (UT)	2002-1-3
GringPointLatitude	Area of interest for latitude	90
GringPointLongitude	Area of interest for longitude	-180
PGEName	Name of software	(max 20 character)
PGEVersion	Version of software	(max 18 character)
PGEAlgorismDeveloper	Name of algorism developer	(max 20 character)
InputPointer	Input file name	A2AMS02010101MA_P01B000000000.00
ProcessingCenter	Name of data processing center	JAXA/EOC
ContactOrganizationName	Organization name to contact about this product	JAXA,1401,Ohashi,Hatoyama-machi,Hiki-gun,Saitama,350-0393,JAPAN,+81-49-298-1307,orderdesk@eoc.jaxa.jp
StartOrbitNumber	Start orbit number	100
StopOrbitNumber	Stop orbit number	100
EquatorCrossingLongitude	Equator crossing latitude	89
EquatorCrossingDate	Equator crossing date	1998.2.4
EquatorCrossingTime	Equator crossing time	00:30:00Z
OrbitDirection	Orbit direction	DESCENDING
EphemerisGranulePointer	File name for using orbit	EPHEMERIS-1
EphemerisType	Type of using orbit	ELMPELMD,GPS
PlatformShortName	Abbreviated name of platform	ADEOS-II
SensorShortName	Abbreviated name of observing sensor	AMSR
NumberofScans	Number of scan	2019
ECSDDataModel	Name of meta data model	B.0
DiscontinuityVirtualChannelCounter	Discontinuity flag of virtual channel unit counter	Continuation/Discontinuation
QALocationofPacketDiscontinuity	Discontinuity flag of packet sequence counter	Continuation/Discontinuation
NumberofPackets	Number of L0 packet	32320
NumberofInputFiles	Number of L0 file	1
NumberofMissingPackets	Number of missing packet	0
NumberofGoodPackets	Number of good packet	32320
	Condition for record or receive	
ReceivingCondition	Result of limit check for ephemeris	GOOD or POOR
EphemerisQA	Result by program check	OK or NG
AutomaticQAFlag	Explanation of program check	PASS or FAIL
AutomaticQAFlagExplanation	Organization name to contact about this product	
ScienceQualityFlag	Flag when it calculates geophysical quantity	Blank for L1A,L1B,L1BMap
ScienceQualityFlagExplanation	Explanation when it calculate geophysical quantity	Blank for L1A,L1B,L1BMap
QAPercentMissingData	Number of missing data	0
QAPercentOutOfBoundsData	Ratio of data out of bound	0

3.2. Data part

AMSR observes the ground at 196 samples per a scan. (392 samples in case 89GHz) and 2019 scans per a half orbit. In the case of Standard Product and Product from MDR, the geophysical quantity in level 2 product is stored in SDS , 196×2019, 2 dimension array. (Level 1B product has two overlaps with before or next scan. On the other hand the overlaps are deleted in level 2 product for a half orbit. Scan number is not 1976, but 1975 in order to remove pole point included in both scenes, such as Ascending, Descending.)

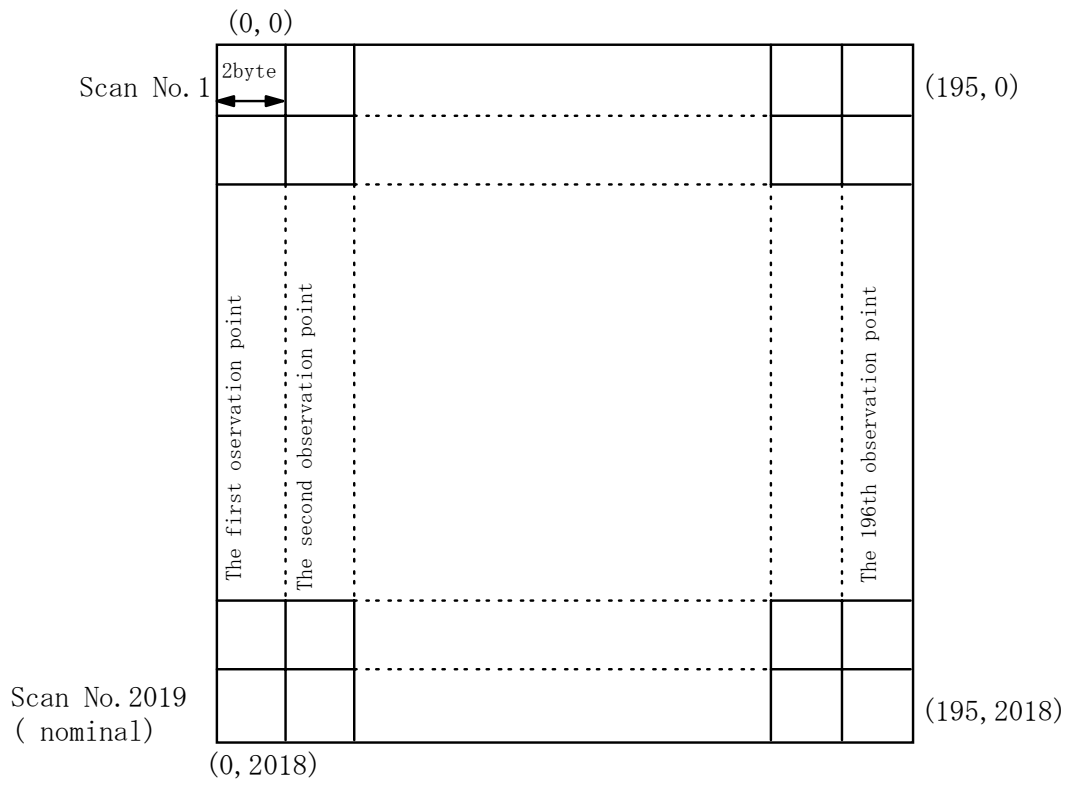
Every start time of scanning are recorded as a Vdata with a system of TAI.

The latitude and longitude of observation points are also stored as SDS.

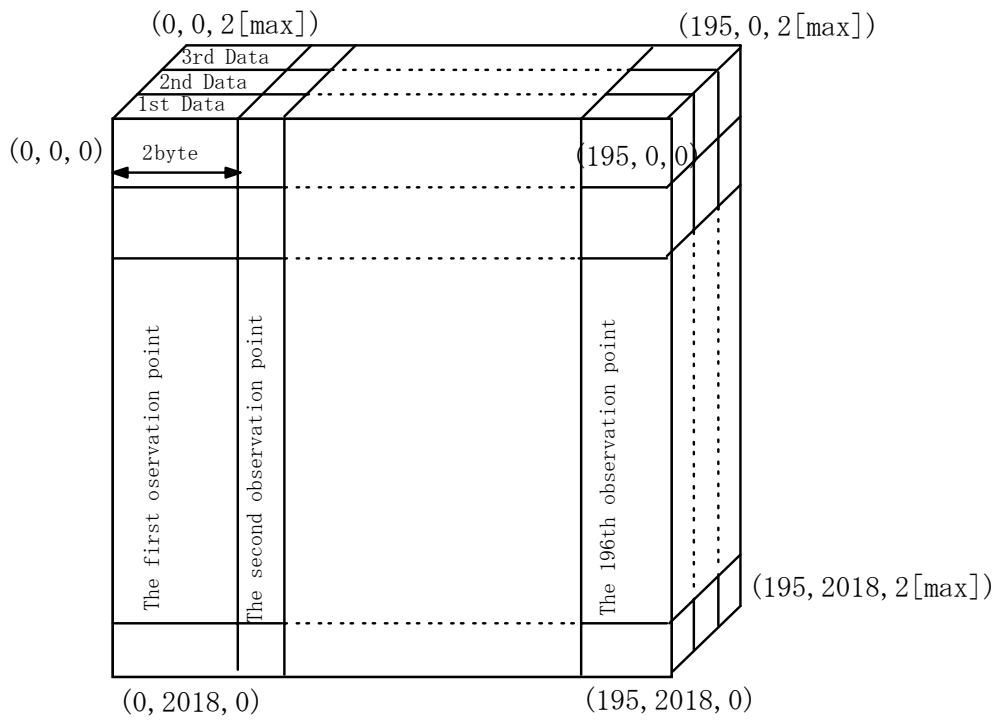
The detail of Data part is shown in Table 3.2-1. Its data structures are shown in Figure 3.2-1~3. *Scan number* in the table is a number in Standard Product and Product from MDR. The number of Product from MRT is different from this.

Table 3.2-1 Data specifications

No.	Items	Byte	Type	Scale factor	Sample number	Scan number	Unit
1	Scan Time Table	8	double	-	1	2019	Sec
2	Position in Orbit	8	double	-	1	2019	-
3	Geophysical Quantity Data	2	signed int	0.1 0.001 0.1 0.1 0.1 1 0.001 1	196	2019	WV:kg/m ² CLW:kg/m ² AP:mm/h SSW:m/s SST:°C IC:% SM:g/cm ³ SWE:mm
4	Lat. of observation point except 89B	2	signed int	0.01	196	2019	deg
5	Long. of observation point except 89B	2	signed int	0.01	196	2019	deg
6	Data Quality	1	unsigned int	-	196	2019	-

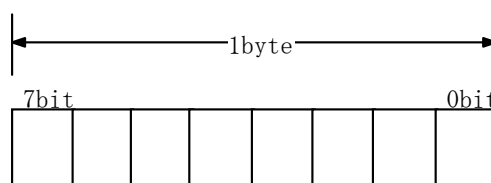
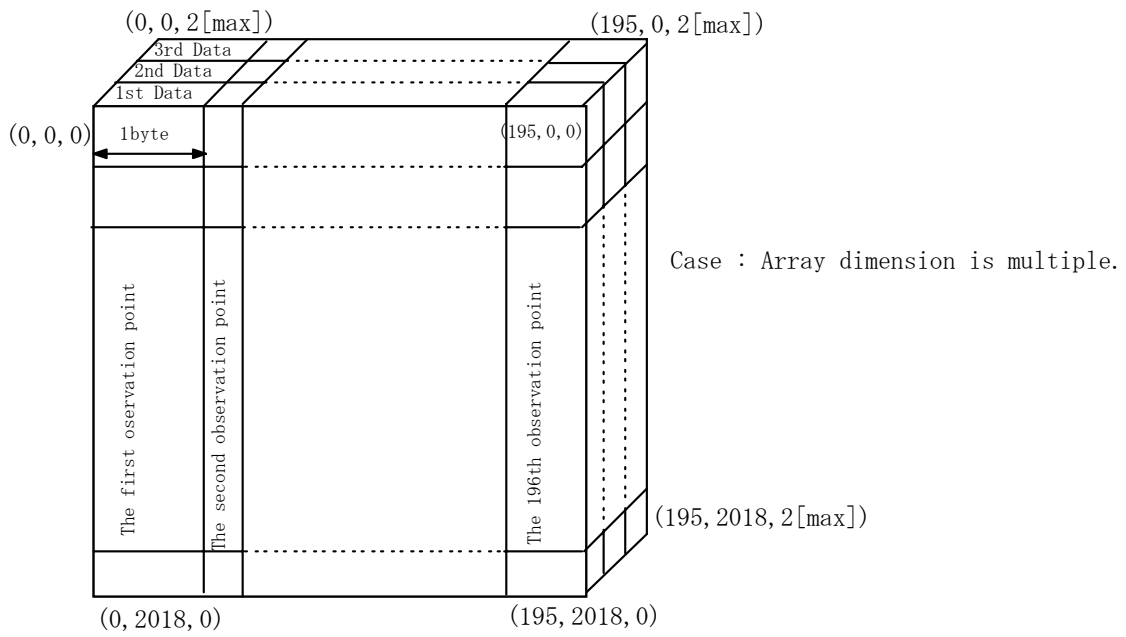
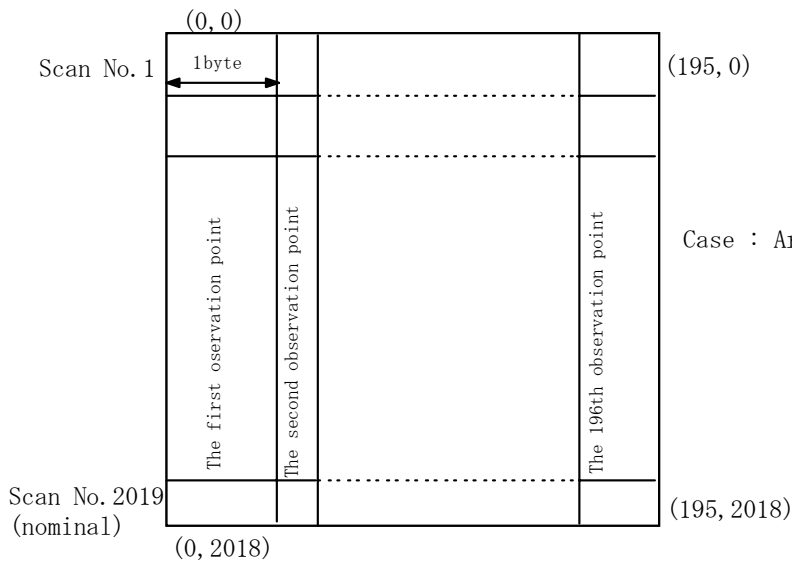


Case : Array dimension is 1.



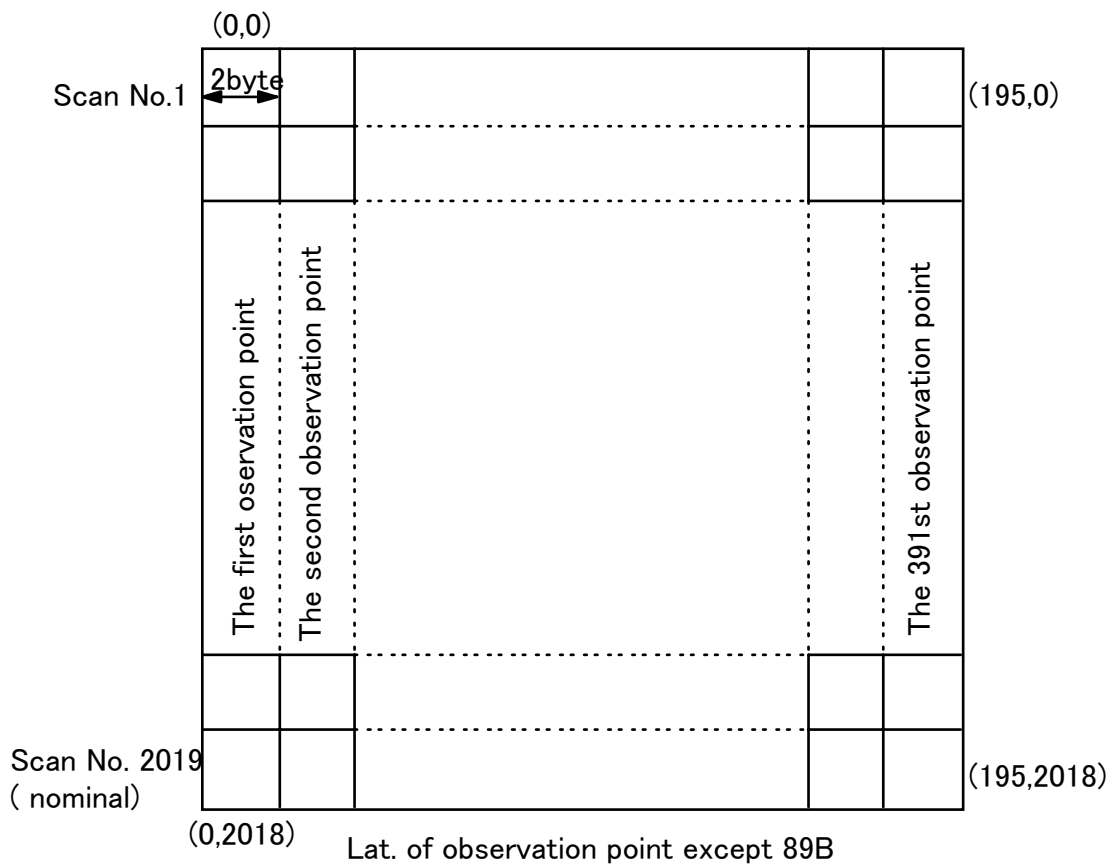
Case : Array dimension is multiple.

Figure 3.2-1 Structure of Geophysical Quantity Data



(Refer to Appendix-A for each bit in detail)

Figure 3.2-2 Structure of Data Quality



(Long. of observation point except 89B is the same structure)

Figure 3.2-3 Structure of Lat. and Long. of observation point except 89B

4. Data size in Product

Data size in level 2 product in the case of Standard Product and Product from MDR is shown in Table 4-1.

Table 4-1 Data size in level 2 product

Item	No. of Sample	No. of Bytes	Semi Total	Remark
Scan Time Table	1	8	8	
Position in Orbit	1	8	8	
Geophysical Quantity Data	196	2	392	Except SM
Lat. of observation point except 89B	196	2	392	
Long. of observation point except 89B	196	2	392	
Data Quality	196	1	196	
Total			1388	
Volume/Granule (MB)			2.67	
Volume/Day (MB)			77.43	
Volume/Month (GB)			2.27	

5. Others

5.1. Local Granule ID

A system of Local Granule ID is shown the following. Details for each item are shown in Table 5.1-1 and Table 5.1-2.

SASENYYMMDDPPPX_XLpppxxxvvv

Local Granule ID in the case of Water Vapor is shown the followings.

A2AMS020101001A_P2WV0Tak111

Table 5.1-1 System of Scene ID

Format	Items	Contents
SASENYYMMDDPPPX		
SA	Satellite name	'A2':ADEOS-II
SEN	Kind of sensor	'AMS':ADEOS-II AMSR
YYMMDD	Date to start observing	It is expressed A.D.(UT).
PPP	Path number	'001'~'057':
X	Orbit direction	'A': Ascending 'D': Descending

Table 5.1-2 System of Product ID

Format	Items	Contents
XLpppxxxvzv		
X	Kind of product	'P': Planned product 'N': Semi-real time product (MDR data) 'L' : Semi-real time product (MRT data)
L	Processing level	'2': Fixed
ppp	Product code	'WV0': Water Vapor 'CLW': Cloud Liquid Water 'AP0': Amount of Precipitation 'SSW': Sea Surface Wind 'SST': Sea Surface Temperature 'IC0': Ice Concentration 'SM0': Soil Moisture 'SWE': Snow Water Equivalence
xxx	Name of algorithm developer	'000': This item is effective only in EORC. If it is used in EOC, it is set '000'. 'Tak': Takeuchi 'Cav': Cavaliere 'Wen': Wentz 'Liu': Liu 'Pet': Petty 'Jac': Jackson 'Shi': Shibata 'Njo': Njoku 'Com': Comiso 'Pal': Paloscia 'Koi': Koike 'Kel': Kelly
vzv	Algorithm version	It is expressed 3 characters, 'nnn'. First character, (Major version) ('0'~'9') .Last 2 characters are used as minor version('00'~'99').

5.2. Coordinate system

Geometric information of the observation point is stored in level 2 product. Its coordinate system is Earth Centered Rotating Coordinate System. Its X-axis is directed to Greenwich meridian line, using an earth center as the starting point and Z-axis along the direction to the pole of north. It is Right-hand system. East longitude is expressed 0°~180°, west for -180°~0°. Same as the longitude the north latitude is expressed 0°~90°, south for -90°~0°.

5.3. Time system

Start time of every scan is stored in Vdata of level 2 product as a floating double. This time is expressed at TAI defined as international system of unit. Therefore the time is expressed as total seconds from 00:00:00 1 January-1993 (UTC).

5.4. Dummy data

In Level2 processing geophysical quantity data is not estimated when the brightness temperature is abnormal or packet loss or the other reasons. For example, SST is not estimated in the land area because SST is the geophysical quantity data on the ocean. In these case it is filled dummy data in Level 2 data. Its value is -9999.

6. Explanation about data

Explanation for each data is shown in next section. Each item in its explanation is described the followings. A number of *ARRAY_DIMENSION* is a number in Standard Product and Product from MDR. The number of Product from MRT is different from this.

HDF_MODEL : HDF model to put each data in the file. In the case of standard product, the data has "scientific data sets", "Vdata" and "global attribute". Most of data elements are set as scientific data sets in it.

ARRAY_DIMENSION : Data size of each dimension if data type is array dimension(in the case of nominal).

STORAGE_TYPE : Type of data element. There are "int 8", "int16", "int32", "unsigned integer8", "unsigned integer32", "float32", "float64".

NUMBER_OF_BYTE : Number of byte to preserve the data element.

UNIT : Data unit. For example, there are "deg", "count2", "Kelvin", and so on.

MINIMUM_VALUE : Minimum value of data element.

MAXIMUM_VALUE : Maximum value of data element.

SCALE_FACTOR : Standard product has some elements which is changed float into integer for interchangeable among the machines and preserved(for example, geophysical quantity etc.). That's why it is necessary to multiply the stored data by *scale_factor* for use. The *scale_factor* is used when the data, which is changed float into integer is put it back.

(For example, when the sea surface temperature is 18.36°C, it is stored as 1836 and *scale_factor* becomes 0.01.)

6.1. Explanation for each data

Explanations for each data are as follows.

(1) Scan Time Table (Time to start observation)

Time to start observation by AMSR. It scans every 1.5 seconds. The first data corresponds to the time of the first point of geophysical quantity data. Time is expressed by the system of TAI.

HDF_MODEL : Vdata
ARRAY_DIMENSION : 2019 (Nominal)
STORAGE_TYPE : float64
NUMBER_OF_BYTE : 8
UNIT : Sec

(2) Position_in_Orbit (Orbit number)

It expresses the position in a round as the floating number. For example, 100.5 expresses it that the satellite is at the center point between the orbit 100 and the orbit 101.

HDF_MODEL : SDS
ARRAY_DIMENSION : 2019 (Nominal)
STORAGE_TYPE : float64
NUMBER_OF_BYTE : 8

(3) Geophysical Quantity Data

HDF_MODEL : SDS
ARRAY_DIMENSION :196×2019 (×3[max]) (Nominal)
STORAGE_TYPE : Signed int 16
NUMBER_OF_BYTE : 2
UNIT : kg/m² (WV,CLW) / mm (SWE) / mm/h (AP) / m/s (SSW) / °C (SST) / % (IC)
g/cm³ (SM)
MINIMUM_VALUE : 0 (WV) / 0 (CLW) / 0 (AP) / 0 (SSW) / -2 (SST) / 0 (IC) / 0 (SM)
0 (SWE)
MAXIMUM_VALUE : 70 (WV) / 1.0 (CLW) / 100 (AP) / 30 (SSW) / 35 (SST) / 100 (IC)
TBD (SM) / 10000 (SWE)
SCALE_FACTOR : 0.1 (WV) / 0.001 (CLW) / 0.1 (AP) / 0.1 (SSW) / 0.1 (SST) / 1 (IC)
0.001 (SM) / 1 (SWE)

(4) Lat. of observation point except 89B

Latitude and longitude data of 89GHz-A horn have 392 samples for each scan. But this data has 196 samples which is pulled out every 2 samples. North latitude is from 0° to 90° and south from -90° to 0°.

HDF_MODEL : SDS
ARRAY_DIMENSION :196×2019 (Nominal)
STORAGE_TYPE : signed int 16
NUMBER_OF_BYTE : 2
UNIT : deg
MINIMUM_VALUE : -90
MAXIMUM_VALUE : 90
SCALE_FACTOR : 0.01

(5) Long. of observation point except 89B

Latitude and longitude data of 89GHz-A horn have 392 samples for each scan. But this data has 196 samples, which is pulled out every 2 samples. East longitude is from 0° to 180° and west from -180° to 0°.

HDF_MODEL : SDS
ARRAY_DIMENSION :196×2019 (Nominal)
STORAGE_TYPE : signed int 16
NUMBER_OF_BYTE : 2
UNIT : deg
MINIMUM_VALUE : -180
MAXIMUM_VALUE : 180
SCALE_FACTOR : 0.01

(6) Data quality

This is quality information corresponding to each point of geophysical quantity data. Refer to Appendix A.

HDF_MODEL : SDS
ARRAY_DIMENSION :196×2019 (×3[max]) (Nominal)
STORAGE_TYPE : Unsigned int 8
NUMBER_OF_BYTE : 1
MINIMUM_VALUE : 0
MAXIMUM_VALUE : 255

7. Abbreviation

Abbreviation	Formula name
ADA	Antenna Drive Assembly
ADA ROT	Antenna Drive Assembly Rotor
ADE	Antenna Drive Electronics
AP	Amount of Precipitation
CLW	Cloud Liquid Water
CSM	Cold Sky Mirror
HTS	Hot Temperature Noise Source
IC	Ice Concentration
LNA	Low Noise Amplifier
MDR	Mission Data Recorder
MREF	Main Reflector
MRT	Mission Real-time Transfer
MWA	Momentum Wheel Assembly
NRT	Near Real-time
PDUC	Power Distributor Unit Control Unit
PDUS	Power Distributor Unit Sensor Unit
RX	Receiver
SM	Soil Moisture
SPC	Signal Processor Control Unit
STR	Structure
SPS	Signal Processor Sensor Unit
SST	Sea Surface Temperature
SSW	Sea Surface Wind Speed
SWE	Snow Water Equivalence
TCC	Thermal Controller Control Unit
TCS	Thermal Controller Sensor Unit
WV	Water Vapor

Appendix A Quality Flag in detail

Data	Bit position							
	7	6	5	4	3	2	1	0
WV	Land/coast	Abnormal brightness temperature	Sea ice	Abnormal supplementary-sea_surface temperature-wind at sea-temperature of 850hPa	Abnormal calculation of sea_surface emissivity	Cloud	Rainfall	Low precision
CLW	IRETX(2) means no retrieval was done	ISUR2 means land contamination	IICE means sea ice	IOOB(2) means TB OOB	Unused	Unused	Unused	Unused
AP	Tb OK/Bad Tb	no rain/light rain	no rain/heavier rain	retrieval done/no retrieval	Unused	Unused	Unused	Unused
SSW	Land area	Sea ice	Sun glitter	Rain	no data of w6 in correcting wind direction	incident angle error	abnormal wind speed	not used
SST	Land area	Sea ice	Sun glitter	Rain	Wind	Incident angle	Abnormal SST + RFI	Not enough number for average TB
IC	No calculation took place	Invalid brightness temperature	Land location	Latitude is out of ice range	Pixel is out of sea area	High SST	Unused	Unused

Appendix A-1

Data	Bit position							
	7	6	5	4	3	2	1	0
SWE	0:No snow (normal retrieval) 1:Water 2:Snow impossible 3:Permanent ice 4:Surface temperature too warm 5:Heavy forest 6:Mountainous region 7:Rain 8:Wet snow 9:Dry snow (currently unused) 10:Wet soil 11:Dry soil (currently unused) 12:Tb out of range 13:Snow possible 14:Satellite attitude out of range * 15:Missing Tb values *							
SM	Retrieval done	Water surface	Dense vegetation	Retrieval error	Unused	Unused	Unused	Unused