

AMSR-E Level 2(HDF5) Product Format Description

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Japan Aerospace Exploration Agency (JAXA)

Change record

Issue	Date	Sheet	Description of change
NC	2019/06	—	<p>-AMSR-E Level 2 product version 8 format description was established.</p> <p><Major changes in the version 8 products> -Change of the AMSR-E level 2 algorithms. (Applied the AMSR-2 level 2 algorithms)</p> <p>-The data format and file naming convention of the AMSR-E compliance with AMSR-2 level2 products (HDF5).</p>

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1 Introduction

1.1 Purpose

This format specification describes the format of AMSR-E level 2(HDF5) product version 8 which is produced at Japan Aerospace Exploration Agency (JAXA). This document describes the file format, data structure and data contents of AMSR-E level 2 product.

1.2 Overview

AMSR-E on the EOS Aqua which is 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-E products will be distributed to users. There are 5 kinds of products shown in Table 1.2-1.

Table 1.2-1 AMSR-E product processing levels

Level	Contents
Level 1A	<ul style="list-style-type: none">• Swath data with geolocation information• Scene counts• ½ orbit starting from northern/southern-most latitudes
Level 1B	<ul style="list-style-type: none">• Swath data with geolocation information• Brightness temperatures• ½ orbit starting from northern/southern-most latitudes
Level 1R	<ul style="list-style-type: none">• Swath data with geolocation information• Spatial-resolution matched brightness temperatures• 4 resolution sets (6,10,23,36GHz) and raw swath for 89GHz A/B• ½ orbit starting from northern/southern-most latitudes
Level 2	<ul style="list-style-type: none">• Swath data with geolocation information• Geophysical parameters (8 parameters)• ½ orbit starting from northern/southern-most latitudes
Level 3	<ul style="list-style-type: none">• Grid data with 0.1/0.25 degrees (10/25km) resolution• Brightness temperatures and geophysical parameters• Daily and monthly temporal average• Equidistant Cylindrical and Polar Stereo Projection

The data handling unit of a level 2 product is 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 (Descending orbit) for the center of scan lines or in reverse such as from south to north (Ascending orbit).

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.

The major changes in level 2 product version 8 are the following two points.

1) Change of processing algorithm:

The algorithm developed for the AMSR2 onboard the GCOM-W was applied to AMSR-E data.

- 2) The data format and file naming convention of the AMSR-E compliance with AMSR-2 level2 products (HDF5).

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

2 Applicable and reference documents

2.1 Applicable documents

- AMSR-E product specifications (NDX-000184)
- AMSR2 higher level product format specification
- EIS granule ID prescription (NEB-060005B)

2.2 Reference documents

- AMSR-E Data Users Handbook (NCX-030021)
- AMSR-E Level-1B (HDF5) product format description (SAM-160173B)
- AMSR-E Level-1R (HDF5) product format description (SAM-160173B)
- AMSR-E Level 3 (HDF5) product format description (SAM-2019017 Appendix 4)
- Description of GCOM-W1 AMSR 2 Level 1R and Level 2 Algorithms (NDX-120015A)

3 Product description

3.1 Product type

AMSR-E Level 2 product stores the Geophysical quantity from the brightness temperature of level 1 product file and the geometric information as HDF5. The AMSR-E level 2 product is the eight kinds of geophysical quantity data shown below.

- Total Precipitable Water (TPW)
- Cloud Liquid Water (CLW)
- Precipitation (PRC)
- Sea Surface Temperature (SST)
- Sea Surface Wind Speed (SSW)
- Sea Ice Concentration (SIC)
- Snow Depth (SND)
- Soil Moisture Content (SMC)

3.2 Structure of HDF5 file

Table 3.2-1 shows the AMSR-E Level 2 product structure.

Table 3.2-1 AMSR-E Level 2 product file structure

Structure		HDF Data	Content
Header	Product Metadata	Attribute	Describe unique information of the product data. (Sensor specification, Engineering value coefficients...etc)
Data		Dataset	The stored data is shown as below. <ul style="list-style-type: none">• Scanning time• Geophysical quantity• Latitude/Longitude• Quality information

3.3 Structure of data

Fig. 3.3-1 AMSR-E level 2 product data structure [Low resolution *] and Fig. 3.3-2 AMSR-E level 2 product data structure [High resolution *] shows structure of AMSR-E level 2 product data.

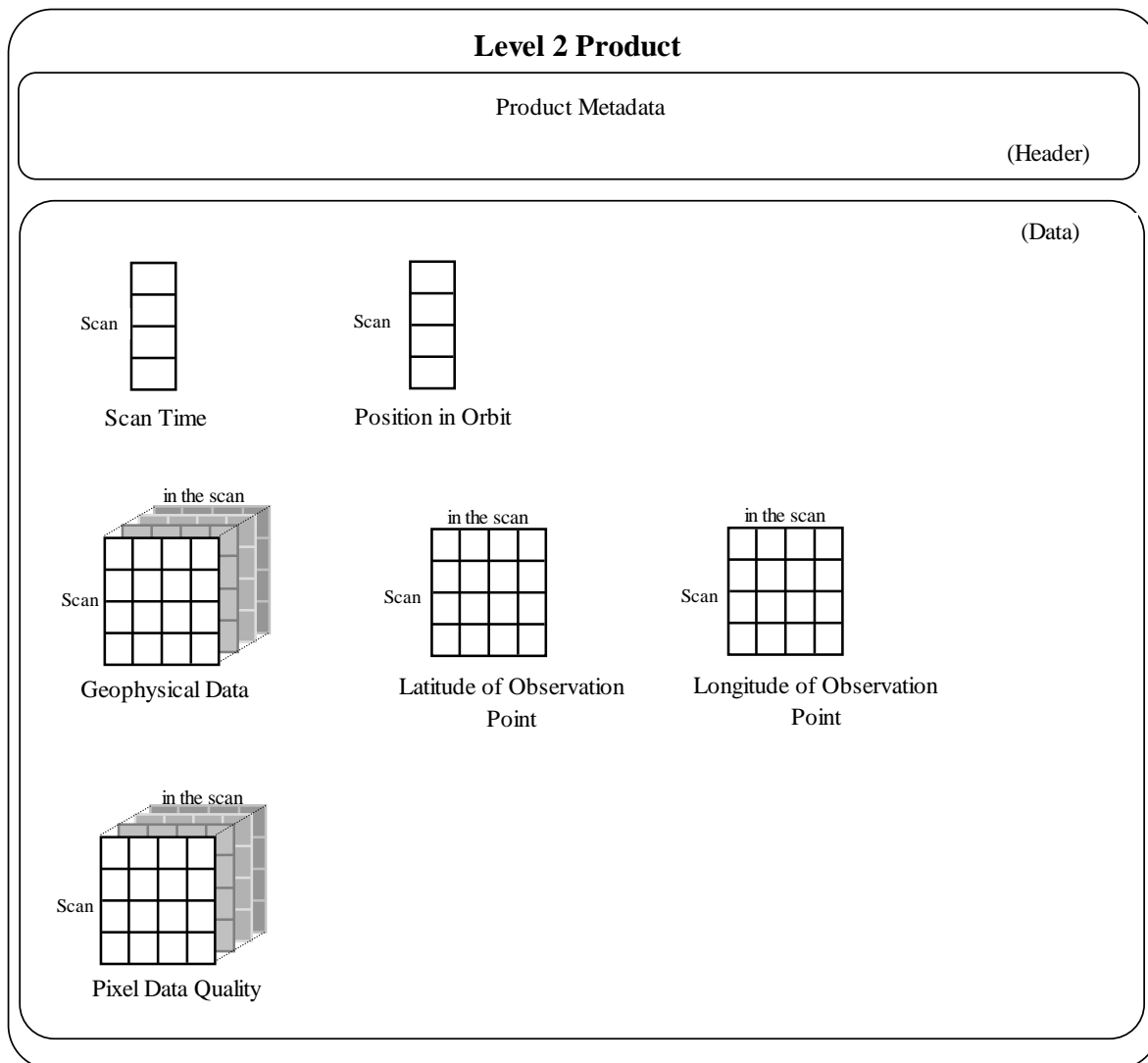


Fig. 3.3-1 AMSR-E level 2 product data structure [Low resolution *]

*Low resolution product: Total Precipitable Water(TPW), Cloud Liquid Water(CLW), Sea Surface Temperature(SST), Sea Surface Wind speed(SSW), Sea Ice Concentration(SIC), Snow Depth(SND), Soil Moisture Content(SMC)

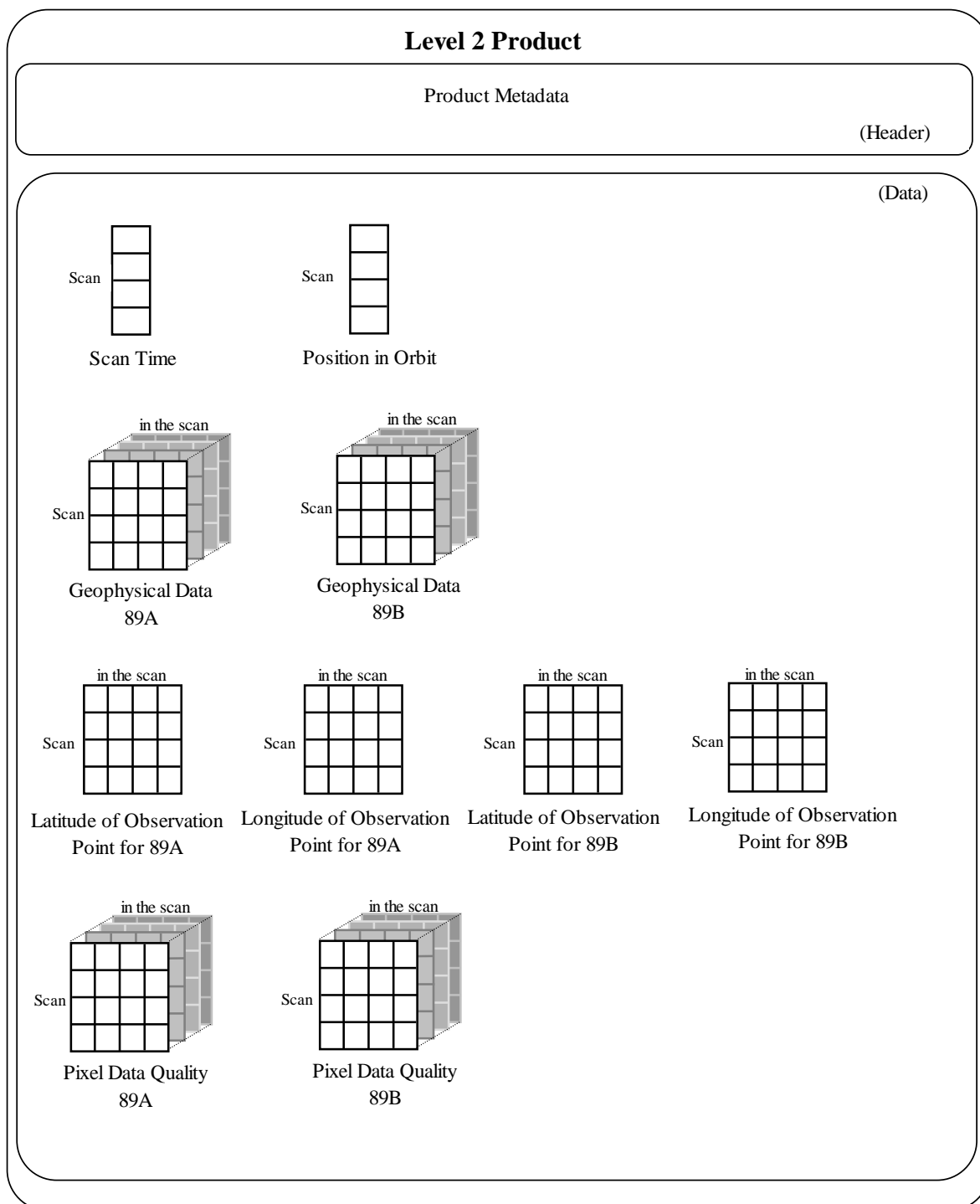


Fig. 3.3-2 AMSR-E level 2 product data structure [High resolution *]

*High resolution product: Precipitation (PRC)

3.4 Meta data

Table 3.2-1 shows the product metadata items.

Table 3.4-1 Product metadata items

No	Attribute Name	Max Size (Byte)	Explanation	Example	Fixed/Variable
1	ProductName	12	Abbreviated name	[XXXXXXXXXXXX] AMSR-E-L2	Fixed
2	GeophysicalName	36	Geophysical quantity name	[XXXXXXXXXXXX] Total Precipitable Water Cloud Liquid Water Precipitation Sea Surface Temperature Sea Surface Wind speed Sea Ice Concentration Snow Depth Soil Moisture Content	Variable
3	ProductVersion	1	Product version	[X] 0~Z	Variable
4	AlgorithmVersion	3	Algorithm version	[XXX] 000~999	Variable
5	ParameterVersion	3	Parameter version	[XXX] 000~999	Variable
6	ProductSize_MByte	8	Product size(MByte)	[XXXXX. X](x1024x1024byte) 0. 0~99999. 9	Variable
7	GranuleID	64	Granule ID	[XXXXXXXXXXXX]	Variable
8	Operation	22	Product type	[XXXXXXXXXXXX] Standard : Standard operation	Fixed
9	ProductionDateTime	24	Product generate time and date (UTC)	[YYYY-MM-DD T hh:mm:ss.uuuZ] YYYY : XXXX(Year) MM : 01~12(Month) DD : 01~31(Day) hh : 00~23(Hour) mm : 00~59(Minute) ss : 00~59(Second) uuu : 000~999(milli-second)	Variable

No	Attribute Name	Max Size (Byte)	Explanation	Example	Fixed/Variable
10	ObservationStartDateTime	25	Start time and date of observation data (UTC)	[YYYY-MM-DD T hh:mm:ss.uuuZ] YYYY : XXXX(Year) MM : 01~12(Month) DD : 01~31(Day) hh : 00~23(Hour) mm : 00~59(Minute) ss : 00~59(Second) uuu : 000~999(milli-second)	Variable
11	ObservationEndDateTime	25	End time and date of observation data (UTC)	[YYYY-MM-DD T hh:mm:ss.uuuZ] YYYY : XXXX(Year) MM : 01~12(Month) DD : 01~31(Day) hh : 00~23(Hour) mm : 00~59(Minute) ss : 00~59(Second) uuu : 000~999(milli-second)	Variable
12	GringPointLatitude	80	Latitude of data effective range	Ex.) 83.71,73.23,34.10,-25.31,-84.97,-73.60,-23.13,36.52 See the section 4.2 for more information	Variable
13	GringPointLongitude	80	Longitude of data effective range	Ex.) 152.28,91.82,-10.34,-24.72,-39.30,-105.73,-40.70,-27.99 See the section 4.2 for more information	Variable
14	PGEName	20	Data processing software name	[XXXXXXXXXXXXX] AMSR-E Reprocessing System	Fixed
15	InputFileName	128	Input file name (Level1 data file name)	[XXXXXXXXXXXXXXXXXXXXX] Strings	Variable
16	ProcessingCenter	12	Data processing center	[XXXXXXXXXXXXX] JAXA JSS2	Fixed
17	ContactOrganizationName	300	Contact organization name	[XXXXXXXXXXXXX] JAXA SAOC	Fixed
18	ContactOrganizationTelephone	16	Contact telephone number	Blank	Fixed
19	StartOrbitNumber	6	Start orbit number	[XXXXX] 0~99999	Variable
20	StopOrbitNumber	6	End orbit number	[XXXXX] 0~99999	Variable

No	Attribute Name	Max Size (Byte)	Explanation	Example	Fixed/Variable
21	EquatorCrossingLongitude	8	Longitude at the time of equatorial passage	[XXXX.XX] -180.00~180.00	Variable
22	EquatorCrossingDateTime	25	Time and date of equatorial passage (UTC)	[YYYY-MM-DD T hh:mm:ss.uuuZ] YYYY : XXXX(Year) MM : 01~12(Month) DD : 01~31(Day) hh : 00~23(Hour) mm : 00~59(Minute) ss : 00~59(Second) uuu : 000~999(milli-second)	Variable
23	OrbitDirection	11	Orbit direction	[XXXXXXXXXX] Ascending Descending	Variable
24	PassNumber	4	Pass number of observation start point	[XXX] 0~999	Variable
25	OrbitDataFileName	128	Support orbit file name	[XXXXX] Strings It may be blank, when the process didn't use this file.	Variable
26	EphemerisMissingDataRate	5	Missing rate of orbit data	[XXXXX] Good Fair NG	Variable
27	AttitudeMissingDataRate	5	Missing rate of attitude data	[XXXXX] Good Fair NG	Variable
28	OrbitDataType	8	orbit data type	[XXXXXXXXXX] ELMD : Defined orbit data	Fixed
29	PlatformShortName	8	Platform name	[XXXXXXXXXX] AQUA	Fixed
30	SensorShortName	8	Sensor names	[XXXXXXXXXX] AMSR-E	Fixed
31	NumberOfScans	6	Number of scan	[XXXXX] 0~99999	Variable
32	NumberOfMissingScans	8	Number of missing scans	[XXXXX] 0~99999	Variable

No	Attribute Name	Max Size (Byte)	Explanation	Example	Fixed/Variable
33	AntennaRotationVelocity	4	Velocity of antenna rotation (30~40rpm)	[XX.X] 30.0~40.0	Variable
34	ECSDataModel	8	Meta data model name	[X.X] B.0	Fixed
35	NumberOfPackets	8	Number of level 0 packets	Blank	Fixed
36	NumberOfInputFiles	2	Number of input level 0 files	[X] 0~9	Variable
37	NumberMissingPackets	9	Number of missing packets	[XXXXXX] 0~99999999	Variable
38	NumberOfGoodPackets	9	Number of packets	[XXXXXX] 0~99999999	Variable
39	OverlapScans	3	Number of overlap scans(One side)	[X] 0	Fixed
40	QALocationOfPacketDiscontinuity	16	Continuity of Packet Sequence Counter	[XXXXXXXXXXXXXXXXXX] Continuation Discontinuation	Variable
41	EphemerisQA	3	Ephemeris limit check	[XX] OK NG	Variable
42	AutomaticQAFlag	5	Limit check by software	[XX] Good Fair NG	Variable
43	ScienceQualityFlag	8	Quality flag of calculating geophysical quantity	[XXXXXXXX] Strings	Variable
44	ScienceQualityFlagExplanation	512	Explanation of "ScienceQualityFlag"	[XXXXXXXX] Strings	Fixed
45	AutomaticQAFlagExplanation	512	Explanation of limit check by software	1.MissingScanQA:Less than 21 is available->OK, 2.MissingDataQA:Less than 321 is available->OK, 3.AntennaRotationQA:Less than 21 is available->OK, 4.HotCalibrationSourceQA:Less than 21 is available->OK, 5.AttitudeDataQA:Less than 21 is available->OK, 6.EphemerisDataQA:Less than 21 is available->OK, 7.QualityofGeometricInformationQA:Less than 1 is available->OK, 8.BrightnessTemperatureQA:Less than 21 is available->OK	Variable

No	Attribute Name	Max Size (Byte)	Explanation	Example	Fixed/Variable
46	QAPercentMissingData	7	Number of missing data	[XXX.XX] 0~100,-9999	Variable
47	QAPercentOutOfBoundsData	8	Percentage of out of bound data(%)	[XXX] 0~100	Variable
48	QAPercentParityErrorData	8	Percentage of parity error data	[XXX.XX] 0~100,-32768	Variable
49	ProcessingQADescription	12	Description of the processing error	[XXXXXXXXXXXXXXXXXX] Strings	Variable
50	ProcessingQAAttribute	128	The attribute name which is abnormal by QA metadata	[XXXXXXXXXXXXXXXXXX] Strings	Variable
51	GlobalMeteorologicalDataType	8	Used meteorological data	[XXX] Analysis : Process didn't use Analysis meteorological data Forecast : Process didn't use Forecast meteorological data None : Process didn't use meteorological data * Blank in the Level 1 product	Variable
52	AncillaryDataInformation	256	Information of ancillary data	[XXXXXX] Strings (Used ancillary data in Level 2 process)	Variable

3.5 Data size and Scaling facator

Table 3.2-1 shows the data size and scaling factor.

Table 3.5-1 Data size and Scaling facator (Low resolution)

No.	Data	Samples	Bytes/ Sample	Type	Bytes/ Record	Records (nominal)	Sum(bytes)	Scale factor	Units
1	ProductMeta Data	52	100	-	5,200	1	5,200	-	-
2	Scan Time	1	8	double	8	1,978	15,824	1	Sec
3	Position in Orbit	1	8	double	8	1,978	15,824	1	-
4	Geophysical Data	243	2	signed int	486	1,978	961,308	0.01 0.001 0.01 0.01 0.1 0.1 0.1	TPW:kg/m2 CLW:kg/m2 SSW:m/s SST:°C SND: cm SMC: % SIC: %
5	Latitude of Observation Point	243	4	float	972	1,978	1,922,616	1	deg
6	Longitude of Observation Point	243	4	float	972	1,978	1,922,616	1	deg
7	Pixel Data Quality	243	1	unsigned char	243	1,978	480,654	-	-
	Total(Bytes)						5,324,042		
	Total(MB)						5.32		

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*Geophysical Data of SND has the two-layer structure. Primary SND is stored in the first layer. SWE, which is calculated from the SND (Snow water: Snow Water Equi valent) is stored in the second layer.

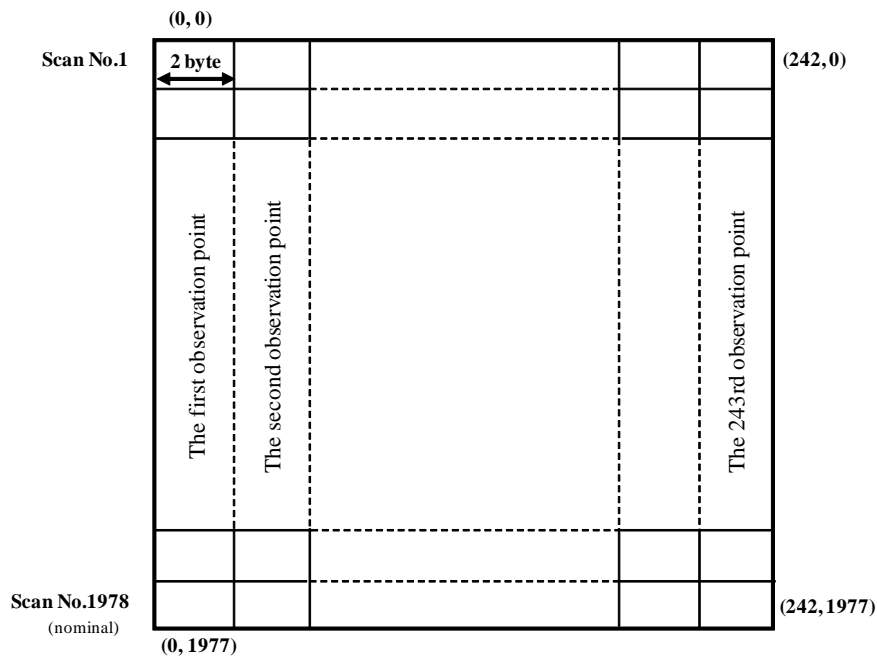
So, the data size is also doubled. SWE: Scale factor = 0.1, Units = cm.

*Geophysical Data of SST has the two-layer structure. Primary SST observed by 6GHz is stored in the first layer. SST observed by 10GHz, which has higher spatial resolution than the primary SST (more pixels are available in coastal area), is stored in the second layer. So, the data size is also doubled.

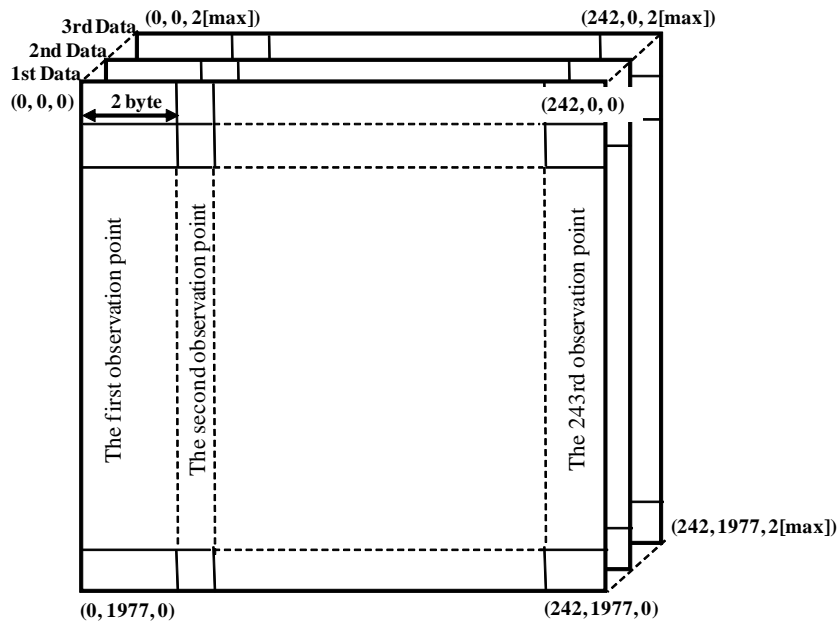
Table 3.5-2 Data size and Scaling factor (High resolution)

No.	Data	Samples	Bytes/ Sample	Type	Bytes/ Record	Records (nominal)	Sum(bytes)	Scale factor	Units
1	ProductMeta Data	52	100	-	5,200	1	5,200	-	-
2	Scan Time	1	8	double	8	1,978	15,824	1	Sec
3	Position in Orbit	1	8	double	8	1,978	15,824	1	-
4	Geophysical Data for 89A	486	2	signed int	972	1,978	1,922,616	0.01	PRC:mm/h
5	Geophysical Data for 89B	486	2	signed int	972	1,978	1,922,616		
6	Latitude of Observation Point for 89A	486	4	float	1,944	1,978	3,845,232	1	deg
7	Longitude of Observation Point for 89A	486	4	float	1,944	1,978	3,845,232	1	deg
8	Latitude of Observation Point for 89B	486	4	float	1,944	1,978	3,845,232	1	deg
9	Longitude of Observation Point for 89B	486	4	float	1,944	1,978	3,845,232	1	deg
10	Pixel Data Quality for 89A	486	1	unsigned char	486	1,978	961,308	-	-
11	Pixel Data Quality for 89B	486	1	unsigned char	486	1,978	961,308	-	-
	Total(Bytes)						21,185,624		
	Total(MB)						21.		

3.6 Definition of grid



In case of the product has 1 Geophysical Data.



In case of the product has some Geophysical Data.

*The stored order of the data can differ from this figure, it depends on output by tools or libraries .

Fig. 3.6-1 Structure of Geophysical Data (Low resolution)

Note) Geophysical Data of SND and SST have the two-layer structure. Other data have the single-layer structure.

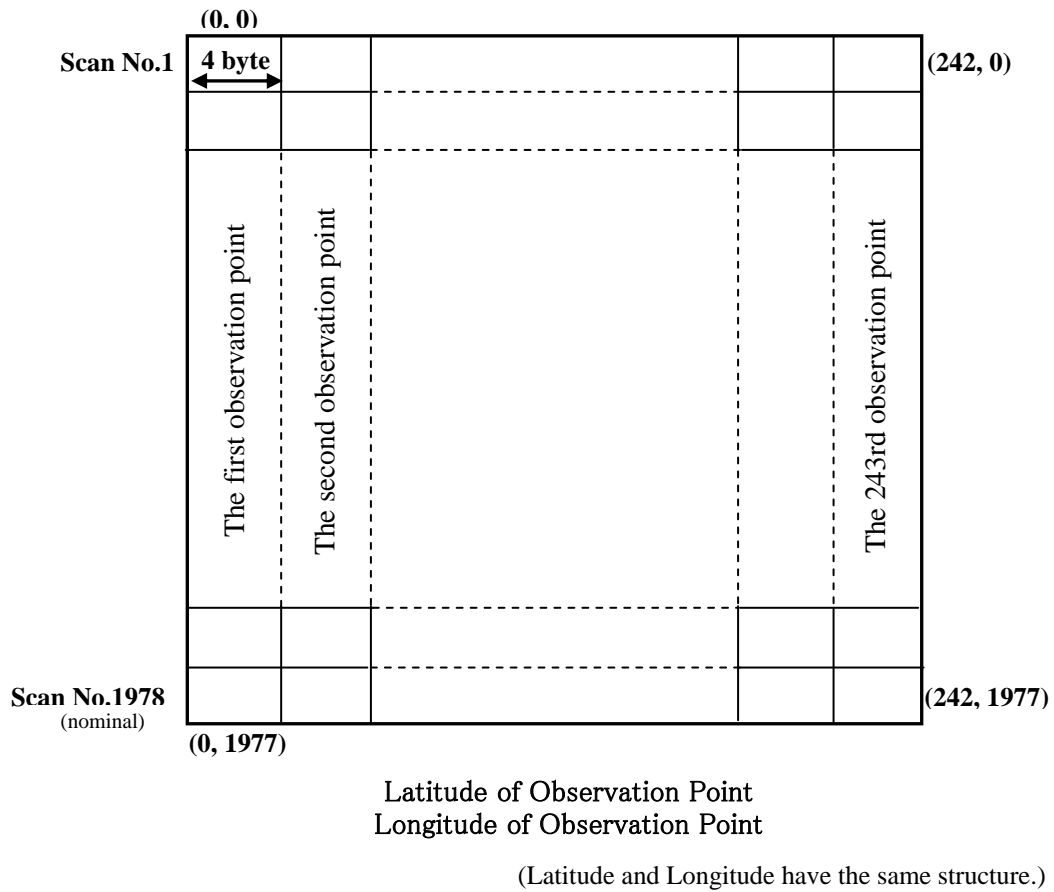
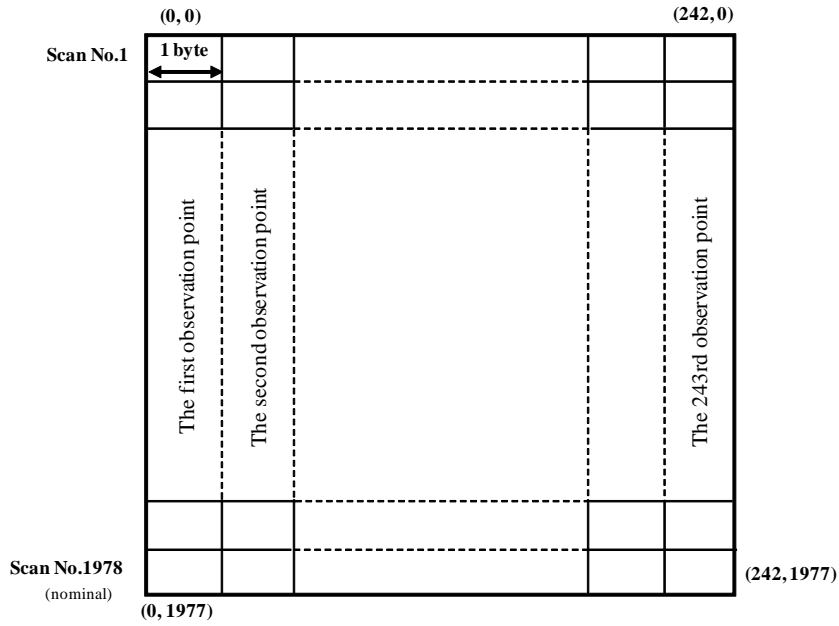
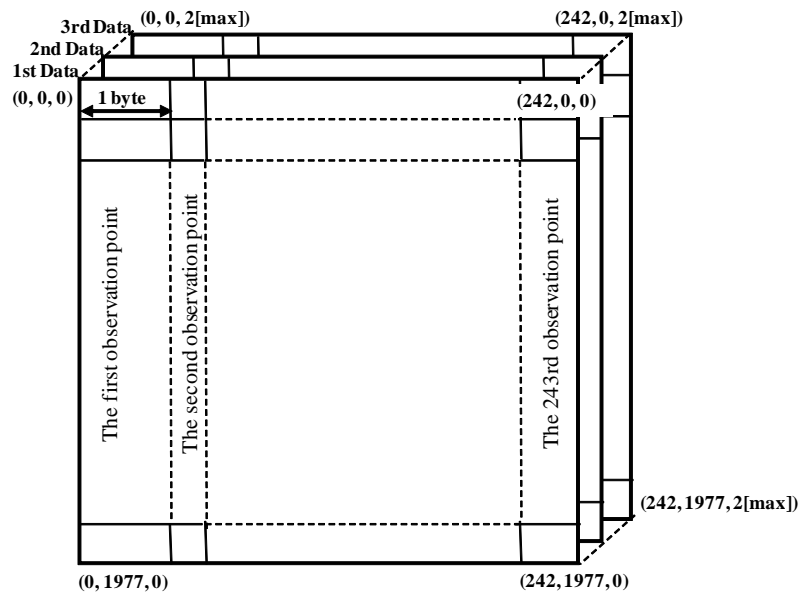


Fig. 3.6-2 Structure of Latitude and Longitude. of the observation point (Low resolution)



In case of the product has 1 Geophysical Data.

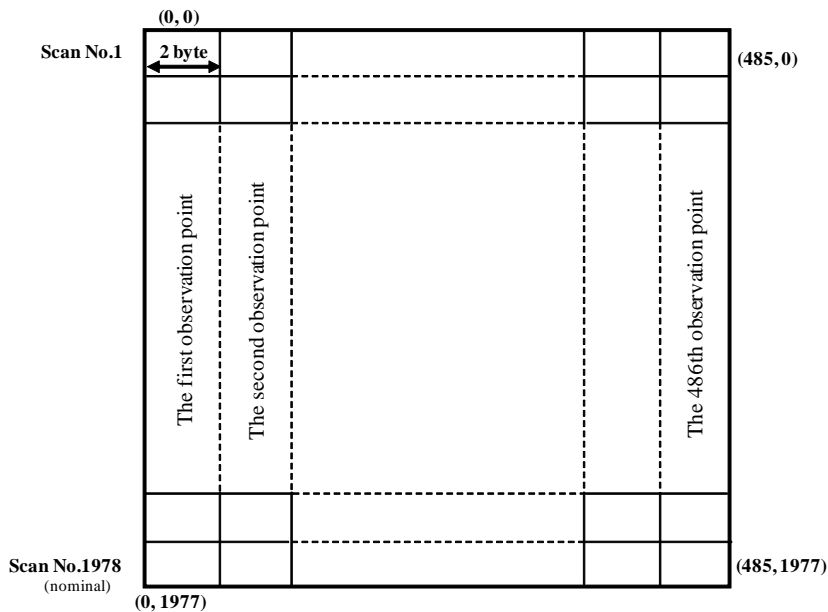


In case of the product has some Geophysical Data.

*The stored order of the data can differ from this figure, it depends on output by tools or libraries .

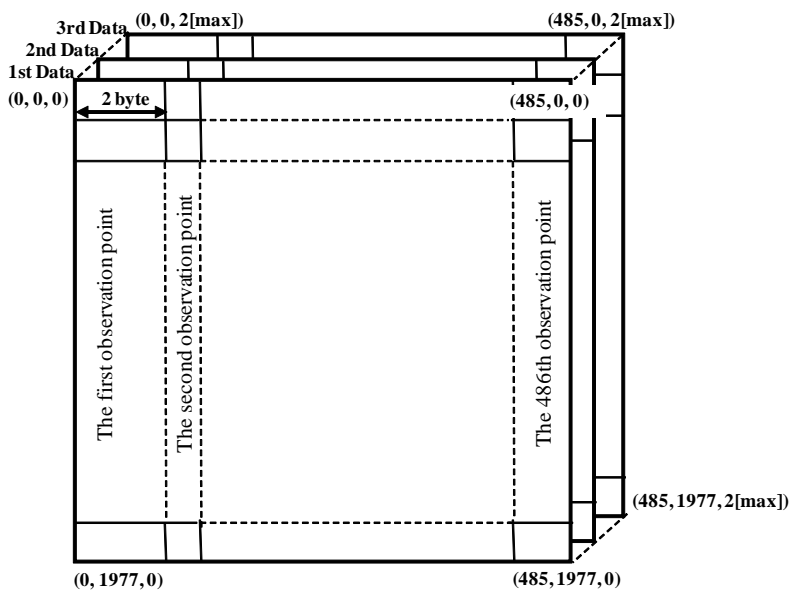
Fig. 3.6-3 Structure of Pixel Data Quality (Low resolution)

Note) Geophysical Data of SND and SST have the two-layer structure. Other data have the single-layer structure.



Geophysical Data for 89A (In case of the product has 1 Geophysical Data.)

(89B have the same structure)



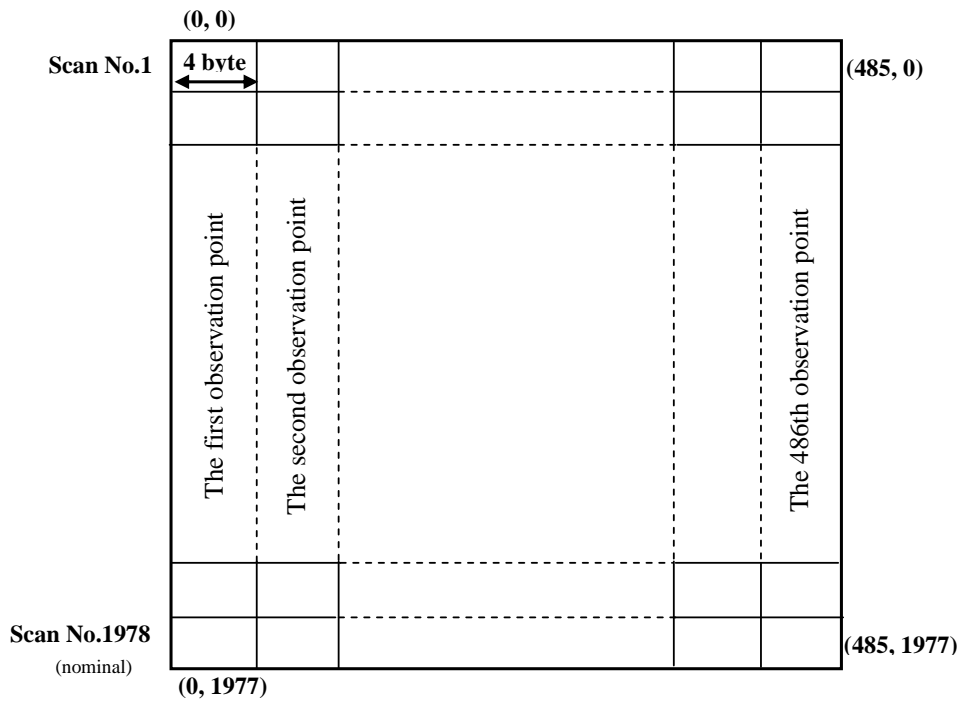
Geophysical Data for 89A (In case of the product has some Geophysical Data.)

(89B have the same structure)

*The stored order of the data can different from this figure, it depends on output by tools or libraries .

Fig. 3.6-4 Structure of Geophysical Data (High resolution)

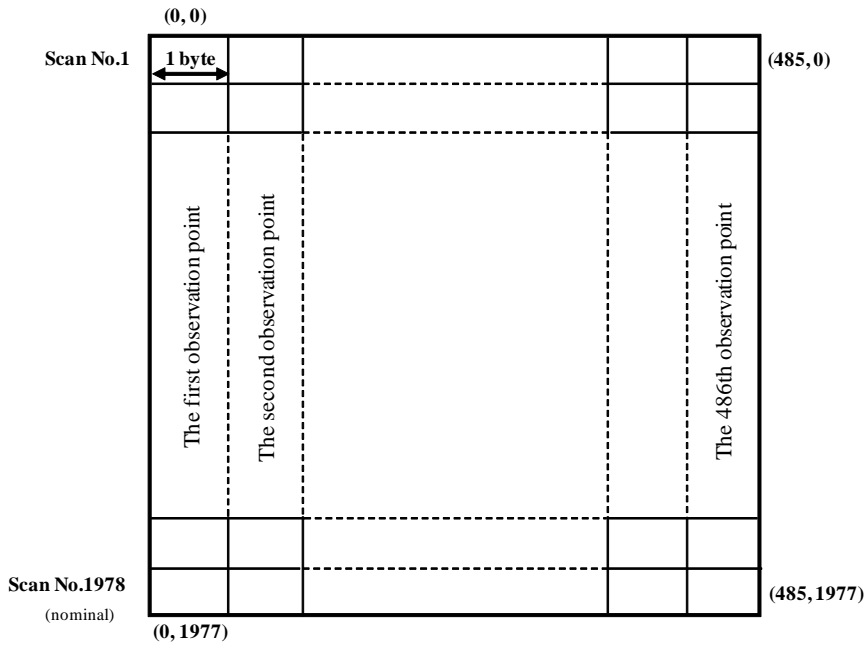
Note) Current high resolution data(=PRC) have the single-layer structure.



Latitude of Observation Point for 89A
 Longitude of Observation Point for 89A

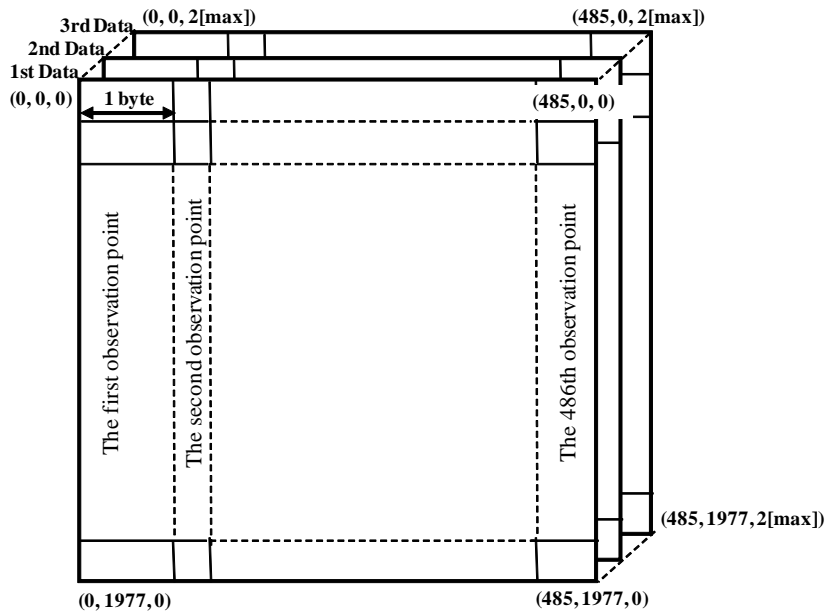
(Latitude and Longitude have the same structure.)
 (89B have the same structure)

Fig. 3.6-5 Structure of Latitude and Longitude of Observation Point (High resolution)



Pixel Data Quality for 89A
(In case of the product has 1 Geophysical Data.)

(89B have the same structure)



Pixel Data Quality for 89A
(In case of the product has some Geophysical Data.)

(89B have the same structure)

*The stored order of the data can different from this figure,
it depends on output by tools or libraries .

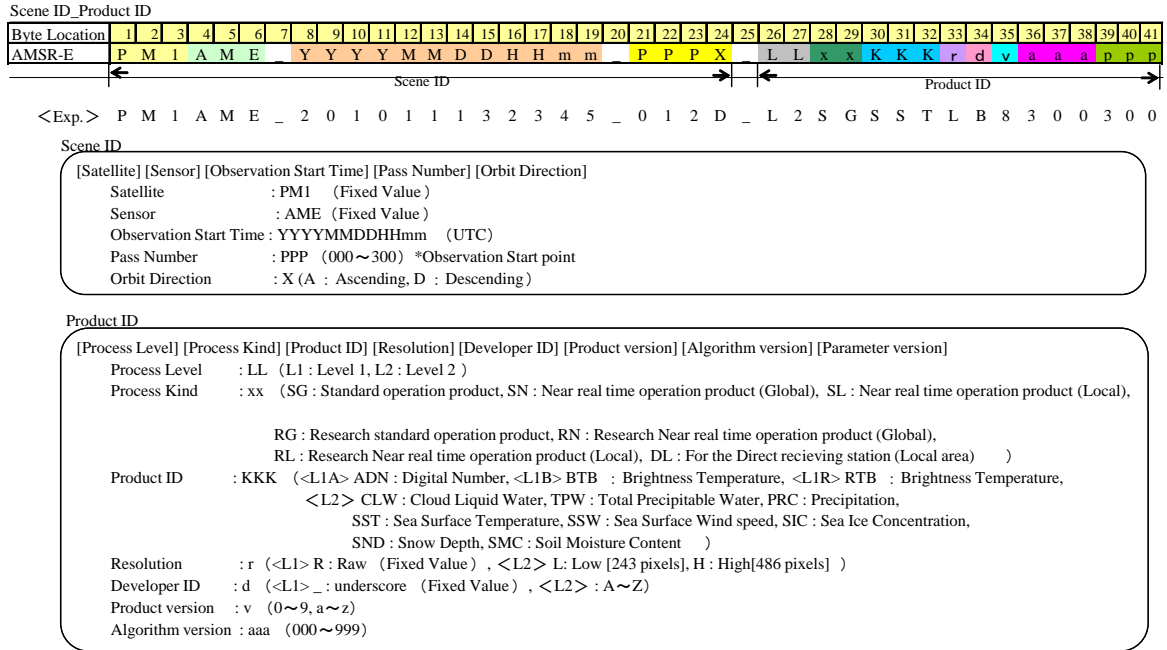
Fig. 3.6-6 Structure of Pixel Data Quality

3.7 Special instruction

3.7.1 File naming convention

AMSR-E level 2 product file follows the file naming convention in below. Granule ID is stated by reference documents.

File name = Granule ID + extension [.h5]



3.7.2 Coordinate system

AMSR-E level 2 product stores the observation position (latitude, longitude) and the orbit information of satellite. The observation positions are expressed in Greenwich coordinate system (Earth Fixed Coordinate). The range of the east longitude is from 0 to 180 degrees and the range of the west longitude is from 0 to -180 degrees. Similarly, the range of the north latitude is from 0 to 90 degrees, the range of the south latitude is from 0 to -90 degrees. Earth model of WGS84 is adopted for geometric calculation. The orbit information is stored as WGS84 earth fixed coordinate system.

3.7.3 Missing and Error Value

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.

Missing value : In case of the input data is missing [-32768]

Error value : In case of the input data is error value or it is out of order target [-32761~-32767]

3.7.4 Scaling factor

In order to make the data volume small, scaling factors are applied for some floating number in AMSR-E level 2product. AMSR-E dataset has scaling factor in the HDF5 file. The scaling factor is set for each dataset and stored with the data unit in the attribute information.

4 Description of data

This chapter describes each data item in the AMSR-E level 2 product file.

4.1 Product metadata (Attribute)

The following describes each product metadata item in the AMSR-E level 2 product file. Some of them are common items with AMSR-E level 1 product.

(1) ProductName

Abbreviated name of the product is stored as below.

[AMSR-E-L2] : AMSR-E level 2 process

(2) GeophysicalName

The geophysical quantity name is stored as below.

Item	Content	Remarks
<u>GeophysicalName</u>	[Total Precipitable Water] [Cloud Liquid Water] [Precipitation] [Sea Surface Temperature] [Sea Surface Wind speed] [Sea Ice Concentration] [Snow Depth] [Soil Moisture Content]	-

(3) ProductVersion

The product version is stored as below.

Item	Minimum	Maximum	Error value	Unit	Remarks
<u>ProductVersion</u>	0	Z	-	-	single-digit or alpha-numeral

(4) AlgorithmVersion

The algorithm version is stored as below.

Item	Minimum	Maximum	Error value	Unit	Remarks
<u>AlgorithmVersion</u>	000	999	-	-	3-digit numeral

(5) ParameterVersion

The parameter version is stored as below.

Item	Minimum	Maximum	Error value	Unit	Remarks
<u>ParameterVersion</u>	000	999	-	-	3-digit numeral

(6) ProductSize_MByte

The product size is stored as below.

Item	Minimum	Maximum	Error value	Unit	Remarks
<u>ProductSize_MByte</u>	0.0	99999.9	-	MByte	Mbyte(×1024×1024byte)

(7) GranuleID

The granule ID is stored. Granule ID is unique ID for product file. Please see the section 3.7.1 for more detail.

(8) Operation

The product kind is stored as below.

Standard : Standard operation

NearRealTime(Global) : Near Real Time operation (Global area)

NearRealTime(local) : Near Real Time operation (Local area)

(9) ProductionDateTime

The product creation time and date is stored as below.

Item	Format	Remarks
<u>ProductionDateTime</u>	[YYYY-MM-DD T hh:mm:ss.uuuZ] YYYY : XXXX(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)	When the leap second is updated, "ss" may show 60.

(10) ObservationStartDateTime

The start time and date of observation data is stored as below.

Item	Format	Remarks
<u>ObservationStartTime</u>	[YYYY-MM-DD T hh:mm:ss.uuuZ] YYYY : XXXX(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)	-

(11) ObservationEndTime

The end time and date of observation data is stored as below.

Item	Format	Remarks
<u>ObservationEndTime</u>	[YYYY-MM-DD T hh:mm:ss.uuuZ] YYYY : XXXX(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)	-

(12) GringPointLatitude, GringPointLongitude

Eight representative points (latitude and longitude) of the outline for the observation are stored. They are set as a clockwise from the scanning start position, and these positions are observation points of 89 GHz A-horn. Since the spatial information in a product cannot be expressed as a rectangle on the equidistant cylindrical projection map, it is expressed in polygon like "G". The stored data are delimited by comma [,].

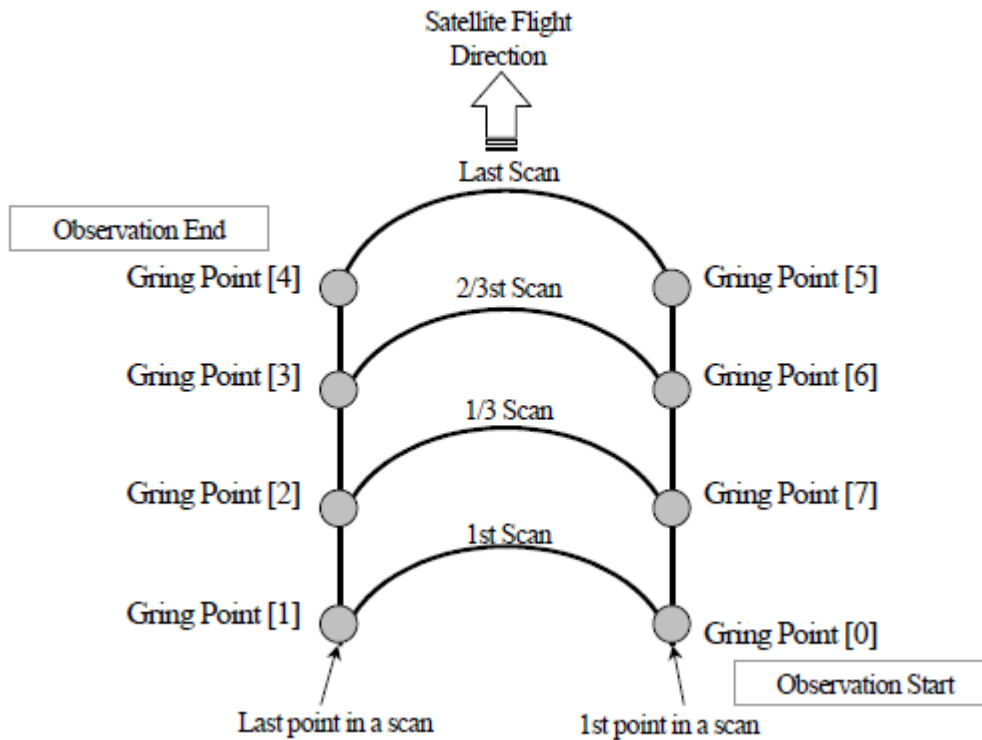


Fig. 4.1-1 The relationship between Gring Point and data location

(13) PGEName

The application name is stored.

Item	Content	Remarks
<u>PGEName</u>	Application name	Maximum size of character is 20.

(14) InputFileName

The input file names are stored. If there are some input files, the stored data are delimited by comma [,].

Item	Content	Remarks
<u>InputFileName</u>	Input File Name	Maximum size of character is 128.

(15) ProcessingCenter, ContactOrganizationName, ContactOrganizationTelephone

The information of data processing center is stored.

Item	Content	Remarks
<u>ProcessingCenter</u>	Processing Center	Maximum size of character is 12.
<u>ContactOrganizationName</u>	Organization Name	Maximum size of character is 300.
<u>ContactOrganizationTelephone</u>	Organization Telephone number	Maximum size of character is 16.

(16) StartOrbitNumber, StopOrbitNumber

The orbit numbers at the observation start and end point in the product file are stored. The orbit number shows total orbit number. This number means integrated value from the Aqua satellite launch.

Item	Content	Minimum	Maximum	Error value	Unit	Remarks
<u>StartOrbitNumber</u>	Start orbit number	0	99999	-9999	-	Under 5 digit number
<u>StopOrbitNumber</u>	End orbit number	0	99999	-9999	-	Under 5 digit number

(17) EquatorCrossingLongitude, EquatorCrossingDateTime

The equator crossing longitude, date and time (UTC) are stored. However, if the satellite does not pass through an equator (like near real time product or short product by the lack of observation data), it is filled with blank.

Item	Content	Minimum	Maximum	Error value	Unit	Remarks
<u>EquatorCrossing Longitude</u>	The equator crossing longitude	-180.00	180.00	-9999.0	-	The longitude at the first crossing equator is stored in case of near real time operation.

Item	Content	Format	Remarks
<u>EquatorCrossing DateTime</u>	The equator crossing time	[YYYY-MM-DD T hh:mm:ss.uuuZ] YYYY : XXXX(Year) MM : 01~12(Month) DD : 01~31(Day) hh : 00~23(Hour) mm : 00~59(Minute) ss : 00~59(Second) uuu : 000~999(milli-second)	The time at the first crossing equator is stored in case of near real time operation.

(18) OrbitDirection

The orbit direction at the observation start point is stored.

Item	Content	Format	Remarks
<u>OrbitDirection</u>	Orbit direction	Ascending or Descending	Maximum size of character is 11.

(19) PassNumber

The pass number at the observation start point is stored.

Item	Content	Minimum	Maximum	Error value	Unit	Remarks
<u>PassNumber</u>	Pass number	0	233	-99	-	Under 3 digit number

(20) OrbitDataFileName

If the L1 process used supplemental orbit data file, the orbit file name would be stored. If there are some input files, it would be stored with comma-delimited.

Item	Content	Format	Remarks
<u>OrbitDataFileName</u>	Supplemental orbit data file name	-	Maximum size of character is 128.

(21) EphemerisMissingDataRate, AttitudeMissingDataRate

The rate of lack with orbit data and attitude data are stored.

Item	Content	Format	Remarks
<u>EphemerisMissingDataRate</u>	The rate of lack with orbit data	[Good]	Maximum size of character is 5.
<u>AttitudeMissingDataRate</u>	The rate of lack with attitude data	[Fair] [NG]	

(22) OrbitDataType

The orbit data type used in L1 process is stored.

Item	Content	Format	Remarks
<u>OrbitDataType</u>	Orbit data type	[ONBOARD] : On board data [ELMD] : Fixed orbit data [ELMP] : Predicted orbit data [NOMINAL] : Nominal orbit data	Maximum size of character is 8.

(23) PlatformShortName, SensorShortName

The satellite name [AQUA] and sensor name [AMSR-E] are stored.

(24) NumberOfScans, NumberOfMissingScans

The number of scans and lack of scans in product file are stored. "NumberOfScans" doesn't include overlap scans. So you need to calculate sum of scans in product files as below.

$$\begin{aligned} &\text{Sum of scans in product files} \\ &= \text{OverlapScans} \times 2 + \text{NumberOfScans} \end{aligned}$$

Item	Content	Minimum	Maximum	Error value	Unit	Remarks
<u>NumberOfScans</u>	Number of scans	0	99999	-9999	-	Under 5 digit number
<u>NumberOfMissingScans</u>	Number of lack scans					

(25) AntennaRotationVelocity

The observed rotating velocity of the AMSR-E antenna is stored.

Item	Content	Minimum	Maximum	Error value	Unit	Remarks
<u>AntennaRotationVelocity</u>	Rotating velocity of the AMSR-E antenna	30.0	40.0	-999	rpm	-

(26) ECSDataModel

The metadata model name is stored.

Item	Content	Format	Remarks
<u>ECSDataModel</u>	Metadata model name	[B.0]	Maximum size of character is 8.

(27) NumberOfPackets

The number of packets is stored. But it is difficult to estimate correct value, so it is always set blank.

(28) NumberOfInputFiles

The number of input L0 files is stored. It is corresponding to the number of L0 files described to “(14) InputFileName”.

Item	Content	Minimum	Maximum	Error value	Unit	Remarks
<u>NumberOfInputFiles</u>	Number of input L0 files	0	9	-	-	1 digit number It is stored blank in case of near real time operation.

(29) NumberMissingPackets, NumberOfGoodPackets

The number of the lack packets and number of packets in the product file are stored.

Item	Content	Minimum	Maximum	Error value	Unit	Remarks
<u>NumberMissingPackets</u>	Number of lack packets	0	99999999	-99999999	-	Under 8 digit number
<u>NumberOfGoodPackets</u>	Number of packets					

(30) OverlapScans

The number of one side overlap scans is stored.

Item	Content	Number	Remarks
<u>OverlapScans</u>	Number of one side overlap scans	0	One side value

(31) QALocationOfPacketDiscontinuity

The consecutiveness of “Packet Sequence Counter” is stored.

Item	Content	Format	Remarks
<u>QALocationOfPacketDiscontinuity</u>	The consecutiveness of “Packet Sequence Counter”	“Continuation” “Discontinuation”	Maximum size of character is 16.

(32) EphemerisQA

The quality of satellite orbit and attitude data checked by software is stored. The quality inspection result becomes NG, when either number of following limit check errors exceeds 20 % of the data. And it becomes OK in other cases. The calculating with limit check is shown as below.

Check the satellite orbit data

$$LowerLimit \leq R \leq UpperLimit$$

$$R = \sqrt{X^2 + Y^2 + Z^2}$$

Check the satellite attitude data

$$LowerLimit \leq Roll, Pitch, Yaw \leq UpperLimit$$

Check the satellite velocity data

$$LowerLimit \leq V \leq UpperLimit$$

$$V = \sqrt{V_x^2 + V_y^2 + V_z^2}$$

Item	Content	Format	Remarks
<u>EphemerisQA</u>	Ephemeris check	[OK] [NG]	Maximum size of character is 2.

(33) AutomaticQAFlag

The automatic inspection result of data processing is stored. The items of the automatic inspections are shown in the attribute “AutomaticQAFlagExplanation”. And the following value is stored.

- Good When all check items are in the state of ‘OK’.
- Fair When some check items are in the state of ‘NG’.
- NG When all check items are in the state of ‘NG’.

Item	Content	Format	Remarks
<u>AutomaticQAFlag</u>	The result checked by software.	Good Fair NG	Maximum size of character is 4.

(34) ScienceQualityFlag

The quality flag is stored when the L2 process calculates geophysical data. It is stored blank for the L1 product file.

Item	Content	Format	Remarks
<u>ScienceQualityFlag</u>	The quality flag of geophysical data	Strings	Maximum size of character is 8.

(35) ScienceQualityFlagExplanation

The explanation of ScienceQualityFlag is stored. It is stored blank for the L1 product file.

Item	Content	Format	Remarks
<u>ScienceQualityFlagExplanation</u>	The explanation of ScienceQualityFlag	Strings	Maximum size of character is 512.

(36) AutomaticQAFlagExplanation

The result checked by software automatically is stored.

Item	Content	Format	Remarks
<u>AutomaticQAFlagExplanation</u>	The result checked by software	See example below	Maximum size of character is 512.

< AutomaticQAFlagExplanation の例 >

1.MissingDataQA:Less than 20 is available->OK, 2.MissingPacketQA:Less than 20 is available->OK, 3.AntennaRotationQA:Less than 20 is available->OK, 4.HotCalibrationSourceQA:Less than 20 is available->OK, 5.AttitudeDataQA:Less than 20 is available->OK, 6.EphemerisDataQA:Less than 20 is available->OK, 7.QualityofGeometricInformationQA:Less than 0 is available->OK, 8.BrightnessTemperatureQA:Less than 20 is available->OK, All items are OK, 'PASS' is employed

(37) QAPercentMissingData

The rate of lack scan data is stored.

Item	Content	Minimum	Maximum	Error value	Unit	Remarks
<u>QAPercentMissingData</u>	The lack of data	0	100	-99	%	Under 3 digit number

(38) QAPercentOutOfBoundsData

The percentage of the limit error to all data is stored. It is judged as error when the antenna temperature and brightness temperature exceed the limit value.

Item	Content	Minimum	Maximum	Error value	Unit	Remarks
<u>QAPercentOutOfBoundsData</u>	The percentage of the limit error	0	100	negative value	-	Under 3 digit number

(39) QAPercentParityErrorData

The percentage of parity error data is stored. It is judged as error whether the parity error flag exists in the raw observation data.

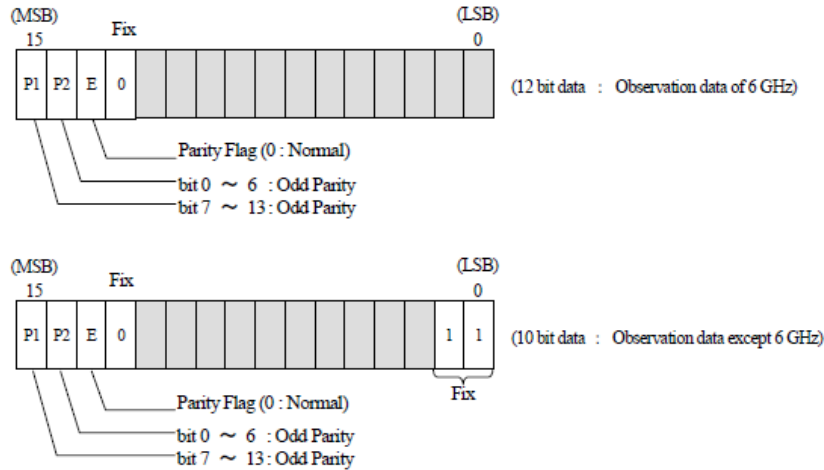


Fig. 4.1-2 Format of the raw observation data

Item	Content	Minimum	Maximum	Error value	Unit	Remarks
<u>QAPercentParityErrorData</u>	The percentage of the parity error	0	100	-32768	-	Under 6 digit number

(40) ProcessingQADescription

The error message generated by data-processing software is stored. "PROC_COMP" is stored when processing software is completed normally.

Item	Content	Format	Remarks
<u>ProcessingQADescription</u>	The error information in the process error	[PROC_COMP] [*****]	Maximum size of character is 12.

(41) ProcessingQAAttribute

As the quality information of the processed data, the item name corresponding to the following

standard of the anomaly judgment is stored.

Item	Error criteria
<u>NumberOfMissingPackets</u>	In case of the lack of more than packet
<u>EphemerisQA</u>	In case of NG
<u>QAPercentMissingData</u>	In case of more than 1%
<u>QAPercentOutOfBoundsData</u>	In case of more than 1%
<u>QAPercentParityErrorData</u>	In case of more than 1%

Item	Content	Format	Remarks
<u>ProcessingQAAttribute</u>	The attribute name of QA metadata in which occurred	[NumberOfMissingPackets] [EphemerisQA] [QAPercentMissingData] [QAPercentOutOfBoundsData] [QAPercentParityErrorData]	Maximum size of character is 128.

(42) GlobalMeteorologicalDataType

The meteorological data type used in L2process is stored. It is stored blank for the L1 product file.

Item	Content	Format	Remarks
<u>Global Meteorological Type</u>	The meteorological data type used in L2process	[XXX] Analysis : Analyzed meteorological data Forecast : Predicted meteorological data None : None use	Maximum size of character is 8 .* It is stored blank in the L1 product.

(43) AncillaryDataInformation

The ancillary data used in L2process is stored. It is stored blank for the L1 product file.

Item	Content	Format	Remarks
<u>Ancillary Data Information</u>	The ancillary data used in L2process	[XXXXXXXXXX]	Maximum size of character is 512 .* It is stored blank in the L1 product.

4.2 Dataset (Low resolution)

(1) Scan Time

The observation start time of 89GHz A-horn in every scan is stored. This time is a total second (TAI) from 0:00 (UTC) on January 1st, 1993.

(2) Position in Orbit

The satellite position on the orbit is stored. The position of a satellite consists of an orbit number and a position from the ascending node. This is expressed in the following formula.

$$\text{Position_in_Orbit} = \text{Total orbit number} + \text{Satellite position}$$

$$\text{Satellite position} = (\text{Scan_Time} - \text{Ascending node passage time}) / (98.9 * 60)$$

Item	Minimum	Maximum	Error value	Unit	Remarks
<u>Position in Orbit</u>	0.0	99999.9999	-9999.0	-	-

(3) Geophysical Data

The geophysical quantity data processed by Level 2 algorithm is stored.

Item	geophysical quantity	Scaling factor	Valid range	Error value (DN value)	Remarks
<u>Geophysical Data</u>	Total Precipitable Water	0.01	0~70 kg/m2	-32768 ~ -32768	-
	Cloud Liquid Water	0.001	0~1.0 kg/m2	-32761 ~ -32768	-
	Sea Surface Wind speed	0.01	0~30 m/s	-32761 ~ -32768	-
	Sea Surface Temperature	0.01	-2~35 °C	-32761 ~ -32768	Two layer structure *1
	Sea Ice Concentration	0.1	0~100 %	-32761 ~ -32768	-
	Snow Depth	0.1	0~100 cm	-32761 ~ -32768	Two layer structure *2
	Soil Moisture Content	0.1	0~40 %	-32761 ~ -32768	-

*1

Geophysical Data of SST has the two-layer structure. Primary SST observed by 6GHz is stored in the first layer. SST observed by 10GHz, which has higher spatial resolution than the primary SST (more pixels are available in coastal area), is stored in the second layer.

*2

Geophysical Data of SND has the two-layer structure. Primary SND is stored in the first layer. SWE(Snow Water Equivalent), which is calculated from the SND is stored in the second layer.

SWE: Scale factor = 0.1, Units = cm.density

(For more detail information, refer to the algorithm Specification)

(4) Latitude of Observation Point

The latitude of the observation point on the earth surface at the odd number point of 89.0A horn is stored. (1 origin)

$$-90^{\circ} < latitude \leq 90^{\circ}$$

Item	Minimum	Maximum	Error value	Unit	Remarks
<u>Latitude of Observation Point for 89A</u>	-90.00	90.00	-9999.0	deg	Negative value shows south latitude. Positive value shows north latitude.

(5) Longitude of Observation Point

The longitude of the observation point on the earth surface at the odd number point of 89.0A horn is stored. (1 origin)

$$-180^{\circ} < longitude \leq 180^{\circ}$$

Item	Minimum	Maximum	Error value	Unit	Remarks
<u>Longitude of Observation Point for 89A</u>	-180.00	180.00	-9999.0	deg	Negative value shows west longitude. Positive value shows east longitude.

(6) Pixel Data Quality

The quality flag is stored for each observation point.

Table 4.2-1 Pixel Data Quality of TPW

No	Status	bit7~bit4 Error				bit3~bit0 Normal				Unsigne d byte	Signed byte
01	Clear sky	0	0	0	0	0	0	0	0	0	0
02	Cloud	0	0	0	0	0	0	0	1	1	1
03	Light rain	0	0	0	0	0	0	1	0	2	2
04	Heavy rain	0	0	0	1	0	0	0	0	16	16
05	Abnormal calculation of TPW	0	0	1	0	0	0	0	0	32	32
06	Abnormal calculation of sea surface emissivity	0	0	1	1	0	0	0	0	48	48
07	Invalid retrieval or RFI	0	1	0	0	0	0	0	0	64	64
08	Invalid retrieval of sea ice	0	1	0	1	0	0	0	0	80	80
09	Invalid L1	0	1	1	0	0	0	0	0	96	96
10	Sea ice	0	1	1	1	0	0	0	0	112	112
11	Land	1	0	0	0	0	0	0	0	128	-128
12	L1 Land/Ocean Flag Error	1	0	0	1	0	0	0	0	144	-112

Table 4.2-2 Pixel Data Quality of CLW

No	Status	bit7~bit4 Error				bit3~bit0 Normal				Unsigne d byte	Signed byte
01	Clear sky	0	0	0	0	0	0	0	0	0	0
02	Cloud	0	0	0	0	0	0	0	1	1	1
03	Light rain	0	0	0	0	0	0	1	0	2	2
04	Negative CLW	0	0	0	0	0	0	1	1	3	3
05	Heavy rain	0	0	0	1	0	0	0	0	16	16
06	Abnormal calculation of TPW	0	0	1	0	0	0	0	0	32	32
07	Abnormal calculation of sea surface emissivity	0	0	1	1	0	0	0	0	48	48
08	Invalid retrieval or RFI	0	1	0	0	0	0	0	0	64	64
09	Invalid retrieval of sea ice	0	1	0	1	0	0	0	0	80	80
10	Invalid L1	0	1	1	0	0	0	0	0	96	96
11	Sea ice	0	1	1	1	0	0	0	0	112	112
12	Land	1	0	0	0	0	0	0	0	128	-128
13	L1 Land/Ocean Flag Error	1	0	0	1	0	0	0	0	144	-112

Table 4.2-3 Pixel Data Quality of SMC

No	Status	bit7~bit4 Error				bit3~bit0 Normal				Unsigne d byte	Signed byte
01	Retrieval done	0	0	0	0	0	0	0	0	0	0
02	possible precipitation area	0	0	0	0	0	0	0	1	1	1
03	Invalid L1	0	0	0	1	0	0	0	0	16	16
04	L1 Land/Ocean Flag Error	0	0	1	0	0	0	0	0	32	32
05	Retrieval error	0	0	1	1	0	0	0	0	48	48

Table 4.2-4 Pixel Data Quality of PRC

No	Status	bit7~bit4 Error				bit3~bit0 Normal				Unsigne d byte	Signed byte
01	Ocean	0	0	0	0	0	0	0	0	0	0
02	Land	0	0	0	0	0	0	0	1	1	1
03	Coast	0	0	0	0	0	0	1	0	2	2
04	Latitude is out of range	0	0	0	1	0	0	0	0	16	16
05	Regions of low temperatures	0	0	1	0	0	0	0	0	32	32
06	Regions of sea ice	0	0	1	1	0	0	0	0	48	48
07	TB out of range	0	1	0	0	0	0	0	0	64	64
08	Invalid TB (TB missing)	0	1	0	1	0	0	0	0	80	80
09	Satellite attitude out of range	0	1	1	0	0	0	0	0	96	96
10	L1 Land/Ocean Flag Error	0	1	1	1	0	0	0	0	112	112

Table 4.2-5 Pixel Data Quality of SST

No	Status	bit7~bit4 Error				bit3~bit0 Normal				Unsigne d byte	Signed byte
01	normal	0	0	0	0	0	0	0	0	0	0
02	10G : strong wind (15 ~ 23m/s)	0	0	0	0	0	0	0	1	1	1
03	incident angle error	0	0	0	1	0	0	0	0	16	16
04	land area	0	0	1	0	0	0	0	0	32	32
05	sea ice	0	0	1	1	0	0	0	0	48	48
06	sun glitter	0	1	0	0	0	0	0	0	64	64
07	rain, abnormal TB	0	1	0	1	0	0	0	0	80	80
08	abnormal SST or RFI	0	1	1	0	0	0	0	0	96	96
09	6G:strong wind 10G:strong wind (23m/s above)	0	1	1	1	0	0	0	0	112	112
10	10G : below 9C for 10GHz	1	0	0	0	0	0	0	0	128	-128

Table 4.2-6 Pixel Data Quality of SSW

No	Status	bit7~bit4 Error				bit3~bit0 Normal				Unsigne d byte	Signed byte
01	normal	0	0	0	0	0	0	0	0	0	0
02	incident angle error	0	0	0	1	0	0	0	0	16	16
03	land area	0	0	1	0	0	0	0	0	32	32
04	sea ice	0	0	1	1	0	0	0	0	48	48
05	sun glitter	0	1	0	0	0	0	0	0	64	64
06	rain, abnormal TB	0	1	0	1	0	0	0	0	80	80
07	abnormal wind speed	0	1	1	0	0	0	0	0	96	96
08	no data of w6* in correcting wind direction	0	1	1	1	0	0	0	0	112	112
09	RFI	1	0	0	0	0	0	0	0	128	-128

* w6:SSW observed by 6GHz TB

Table 4.2-7 Pixel Data Quality of SND

No	Status	bit7~bit4				bit3~bit0				<i>Unsigne d byte</i>	<i>Signed byte</i>
		Error				Normal					
01	no snow	0	0	0	0	0	0	0	1	1	1
02	wet snow	0	0	0	0	0	0	1	0	2	2
03	dry snow	0	0	0	0	0	0	1	1	3	3
04	cold snow	0	0	0	0	0	1	0	0	4	4
05	High elevation false snow (frozen ground)	0	0	0	0	0	1	0	1	5	5
06	shallow snow	0	0	0	0	0	1	1	0	6	6
07	Ocean	0	0	0	1	0	0	0	0	16	16
08	Snow impossible	0	0	1	0	0	0	0	0	32	32
09	Permanent ice	0	0	1	1	0	0	0	0	48	48
10	Lake Ice	0	1	0	0	0	0	0	0	64	64
11	Lake	0	1	0	1	0	0	0	0	80	80
12	Tb out of range	1	1	0	0	0	0	0	0	192	-64
13	Satellite attitude out	1	1	0	1	0	0	0	0	208	-48
14	Missing Tb values	1	1	1	0	0	0	0	0	224	-32
15	no data snow density	1	1	1	1	0	0	0	0	240	-16

Table 4.2-8 Pixel Data Quality of SIC

No	Status	bit7~bit4				bit3~bit0				<i>Unsigne d byte</i>	<i>Signed byte</i>
		Error				Normal					
01	normal	0	0	0	0	0	0	0	0	0	0
02	SST mask	0	0	0	0	0	0	0	1	1	1
03	Latitude mask	0	0	0	0	0	0	1	0	2	2
04	Land filter target pixel	0	0	0	0	0	1	0	0	4	4
05	not used (will be used by RFI)	0	0	0	1	0	0	0	0	16	16
06	Land mask	0	0	1	0	0	0	0	0	32	32
07	Satellite attitude out	0	1	0	0	0	0	0	0	64	64
08	Invalid TB	1	0	0	0	0	0	0	0	128	-128
09	L1 Land/Ocean Flag Error	1	0	0	1	0	0	0	0	144	-112

4.3 Dataset (High resolution)

(1) Scan Time

See the “Scan time” of low resolution.

(2) Position in Orbit

See the “Position in Orbit” of low resolution.

(3) Geophysical Data for 89A

The geophysical quantity data processed by Level 2 algorithm is stored on the earth surface at 89GHz A-horn.

Item	Geophysical quantity	Scaling factor	Valid range	Error value (DN value)	Remarks
<u>Geophysical Data</u>	Precipitation	0.01	0~20mm/h	-32761~ -32768	

(4) Geophysical Data for 89B

The geophysical quantity data processed by Level 2 algorithm is stored on the earth surface at 89GHz B-horn.

(5) Latitude of Observation Point for 89A

The latitude of the observation point on the earth surface at 89GHz A-horn is stored.

$$-90^{\circ} < latitude \leq 90^{\circ}$$

Item	Minimum	Maximum	Error value	Unit	Remarks
<u>Latitude of Observation Point for 89A</u>	-90.00	90.00	-9999.0	deg	Negative value shows south latitude. Positive value shows north latitude.

(6) Longitude of Observation Point for 89A

The longitude of the observation point on the earth surface at 89GHz A-horn is stored.

$$-180^{\circ} < longitude \leq 180^{\circ}$$

Item	Minimum	Maximum	Error value	Unit	Remarks
<u>Longitude of Observation Point for 89A</u>	-180.00	180.00	-9999.0	deg	Negative value shows west longitude. Positive value shows east longitude.

(7) Lat of Observation Point for 89B

The latitude of the observation point on the earth surface at 89GHz B-horn is stored. The data range and abnormal value are the same as 89 GHz A-horn.

(8) Long of Observation Point for 89B

The longitude to the observation point on the earth surface at 89GHz B-horn is stored. The data range and abnormal value are the same as 89 GHz A-horn.

(9) Pixel Data Quality for 89A

See the Table 4.2-4 Pixel Data Quality of PRC.

(10) Pixel Data Quality for 89B

See the Table 4.2-4 Pixel Data Quality of PRC.