GPM/DPR

L2 Product Format Documentation (Experimental product)

Version 1.0

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Japan Aerospace Exploration Agency

Revision history

revision	date	section	content, reason
Version 1.0	June. 1st 2020	ALL	New

Reference

(1) PRECIPITATION PROCESSING SYSTEM GLOBAL PRECIPITATION MEASUREMENT "File Specification for GPM Products",

(2) PRECIPITATION PROCESSING SYSTEM GLOBAL PRECIPITATION MEASUREMENT "Metadata for GPM Products",

(3) PRECIPITATION PROCESSING SYSTEM GLOBAL PRECIPITATION MEASUREMENT "File Specification for GPM Products",

(4) NOAA NESDIS CENTER FOR SATELLITE APPLICATIONS AND RESEARCH GLOBAL 4KM MULTISENSOR AUTOMATED SNOW/ICE MAP (GMASI) ALGORITHM THEORETICAL BASIS DOCUMENT

Table of Contents

1. Level 2 Data Format Structure

Changes in the DPR Level-2 products from V06A to V06X.

- Implementation of a new group “FS” (Full Scan) in V06X and later version as shown in Fig.1-1.
- In V 06A, there are three types of group, which are “NS” (Normal Scan), “MS” (Matched Scan) and “HS” (High-sensitivity Scan).
- In V06X, the FS was implemented instead of the NS and the MS.

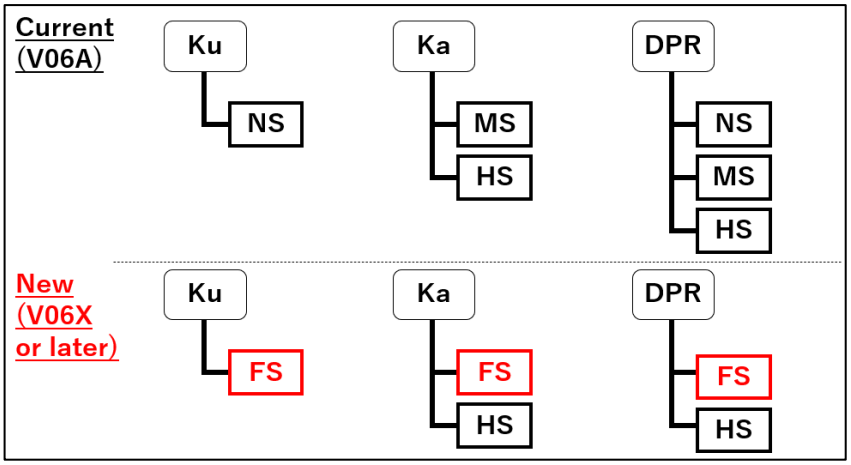


Figure 1-1 Schematic image of changes between current and new format.

1.1. Data Format Structure

The DPR and Level-2 algorithm provide four standard products which are 2AKu, 2AKa, 2ADPR. The 2AKu and 2AKa products are made by single-frequency algorithm and the 2ADPR product is made by dual-frequency algorithm. All products have following data format structure.

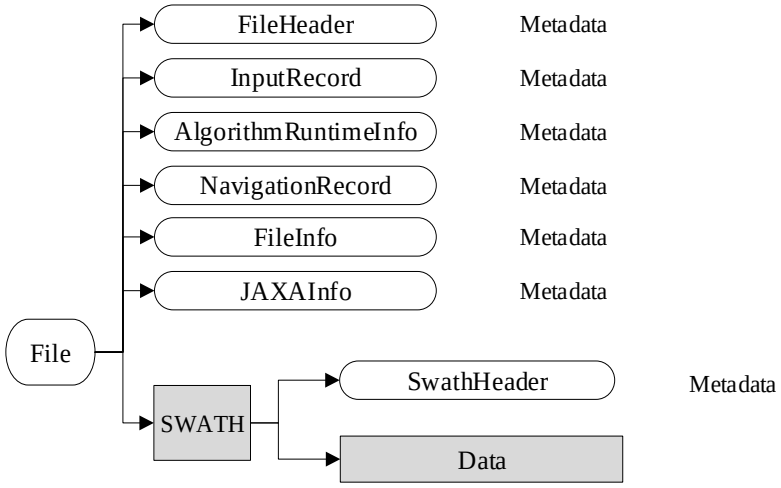


Figure 1.1-1 Data Format Structure

Swath definitions:

- 2AKu has FS swath.
- 2AKa and 2ADPR have FS and HS swath. HS swath is set to missing in V06X.

Dimension definitions:

All bin numbers are specified starting with 1 and ending with nray or nbin (FORTRAN convention), and not from 0 to (nray-1) or 0 to (nbin-1) (C convention).

- nscan

  Number of scans in the granule.

- nray

  Number of angle bins in each scan.

  49 angle bins in each scan in the FS swath (1-49 and not 0-48).

  24 angle bins in each scan in the HS swath (1-24 and not 0-23).

- nbin

  Number of range bins in each ray.

  176 range bins in each ray in the FS swath (1-176 and not 0-175).

  88 range bins in each ray in the HS swath (1-88 and not 0-87).

- Others are described in 1.3 Data Group section.

1.2. Metadata

Metadata has seven elements. Figure 1.2-1 shows metadata structure.

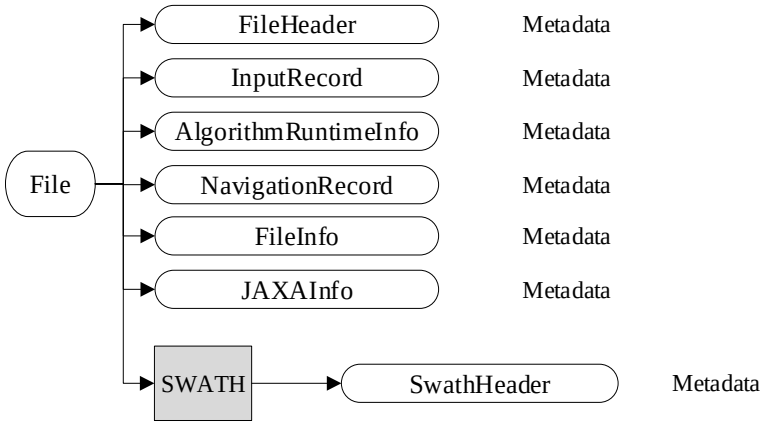


Figure 1.2-1 Metadata

1.2.1. FileHeader

FileHeader contains metadata of general interest. This group appears in all data products. Table 1.2-1 shows each metadata elements in FileHeader.

Table 1.2-1 FileHeader Elements

No	Element	Description	Data size (bytes)
1	DOI	Digital Object Identifier. *Value is blank currently.	256
2	DOIauthority	Digital Object Identifier Authority.	256
3	DOIshortName	Digital Object Identifier Short Name. *Value is blank currently.	256
4	AlgorithmID	The algorithm that generated this product, e.g., 2A12.	50
5	AlgorithmVersion	The version of the algorithm that generated this product.	50
6	FileName	The file name of this granule.	50
7	SatelliteName	Values are: TRMM GPM MULTI F10 ... F18 AQUA GCOMW1 CORIOLIS MT1 NOAA15 ... NOAA19 METOPA NPP. More values will be added as they are known.	10

No	Element	Description	Data size (bytes)
8	InstrumentName	Values are: PR TMI VIRS PRTMI KU KA DPR GMI DPRGMI MERGED SSMI SSMIS AMSRE AMSR2 WINDSAT MADRAS AMSUA AMSUB SAPHIR MHS ATMS. More values will be added as they are known.	10
9	GenerationDateTime	The date and time this granule was generated. The format is YYYY-MM-DDTHH:MM:SS.sssZ, where YYYY is 4-digit year, MM is month number, DD is day of month, T is "T", HH is hour, MM is minute, SS is second, sss is millisecond, and Z is "Z". All fields are zero-filled. The missing value is constructed by replacing all digits with 9, i.e., 9999-99-99T99:99:99.999Z.	50
10	StartGranuleDateTime	The start time defining this granule. The format is the same as GenerationDateTime. DETAILS: An orbital granule starts when the satellite is at the position defined by GranuleStart. Thus the start time is not the first scan time. Some algorithms have overlap scans in the file before the start time as defined in SwathHeader. A monthly granule starts on the first ms of the month, for example March 1998 would be 1998-03-01T00:00:00.000Z.	50
11	StopGranuleDateTime	The stop time defining this granule. The format is the same as GenerationDateTime. DETAILS: An orbital granule stops when the satellite is at the position defined by GranuleStart. Thus the stop time is not the last scan time. Some algorithms have overlap scans in the file after the stop time as defined in SwathHeader. A monthly granule stops on the last ms of the month, for example March 1998 would be 1998-03-31T23:59:59.999Z.	50
12	GranuleNumber	The number of this granule, which starts as in GranuleStart. If the GranuleStart is identical to the orbit start, then the GranuleNumber will be the same as the orbit number. The GranuleNumber will have 6 digits, including leading zeroes, for example 001234.	50
13	NumberOfSwaths	The number of swaths in this granule.	50
14	NumberOfGrids	The number of grid structures in this granule.	50
15	GranuleStart	The starting place in the orbit of this granule. Currently defined values are ”SOUTHERNMOST LATITUDE” and ”NORTHBOUND EQUATOR CROSSING”.	50
16	TimeInterval	The time interval covered by this granule. Values are ”ORBIT”, ”HALF ORBIT”, ”HALF HOUR”, ”HOUR”, ”3 HOUR”, ”DAY”, ”DAY ASC”, DAY DES”, ”MONTH”, ”CONTACT”.	50
17	ProcessingSystem	The name of the processing system, e.g.,”PPS”, ”JAXA”.	50
18	ProductVersion	The data version assigned by the processing system.	50
19	EmptyGranule	Whether a granule is empty. Values are "EMPTY" or "NOT EMPTY".	50
20	MissingData	The number of missing scans.	50

1.2.2. InputRecord

InputRecord contains a record of input files for this granule. This group appears in Level1, Level 2, and Level 3 orbital data products. Level 3 times averaged products have the same information separated into 3 groups since they have many inputs. Table 1.2-2 shows each metadata elements in InputRecord.

Table 1.2-2 InputRecord Elements

No	Element	Description	Data size (bytes)
1	InputFileNames	A list of input file names for this granule.	1000
2	InputAlgorithmVersions	A list of algorithm versions of the input files for this granule.	1000
3	InputGenerationDateTimes	A list of generation date times of the input files for this granule. The format is the same as GenerationDateTime.	1000

1.2.3. AlgorithmRuntimeInfo

AlgorithmRuntimeInfo contains text runtime information written by the algorithm. This group is a ”Long Metadata Group”, which has no elements. This group appears in products if the algorithm developer asks for it.

1.2.4. NavigationRecord

NavigationRecord contains navigation metadata for this granule. This group appears in Level 1, Level 2, and Level 3 orbital data products. Table 1.2-3 shows each metadata elements in NavigationRecord.

Table 1.2-3 NavigationRecord Elements

No	Element	Description	Data size (bytes)
1	LongitudeOnEquator	The longitude where the satellite crosses the equator going from south to north.	50
2	UTCDateTimeOnEquator	The UTC time when the satellite crosses the equator going from south to north. The format is the same as GenerationDate Time.	50
3	MeanSolarBetaAngle	The average solar beta angle in this granule.	50
4	EphemerisFileName	Name of the ephemeris file input for processing.	50
5	AttitudeFileName	Name of the attitude file input for processing.	50
6	GeoControlFileName	Name of the GeoTK Control Parameters File input for processing.	50
7	EphemerisSource	Values are ”0 CONSTANT INPUT TEST VALUE”, ”1 GROUND ESTIMATED STATE (GES)”, ”2 GPS FILTERED SOLUTION (GEONS)”, ”3 GPS POINT SOLUTION (PVT)”, ”4 ON BOARD PROPAGATED (OBP)”, ”5 OEM GROUND EPHEMERIS FILE”, ”6 GEONS WITH FALLBACK AS FLAGGED”, ”7 PVT WITH FALLBACK AS FLAGGED”, ”8 OBP WITH FALLBACK AS FLAGGED”, ”9 GES WITH FALLBACK AS FLAGGED”.	50
8	AttitudeSource	values are ”0 CONSTANT INPUTS FOR TESTING”, ”1 ON BOARD CALCULATED PITCH ROLL YAW”	50
9	GeoToolkitVersion	Version of the GeoToolkit.	50
10	SensorAlignmentFirstRotationAngle	Alignment angle, first rotation, in degrees. Rotation adjustment from sensor coordinates to the Attitude Control System Flight Coordinates.	50
11	SensorAlignmentSecondRotationAngle	Alignment angle, second rotation, in degrees.	50
12	SensorAlignmentThirdRotationAngle	Alignment angle, third rotation, in degrees.	50
13	SensorAlignmentFirstRotationAxis	Euler rotation sequence, first rotation axis. Values are "1","2", "3" (representing X, Y, Z).	50
14	SensorAlignmentSecondRotationAxis	Euler rotation sequence, second rotation axis. Values are "1","2", "3" (representing X, Y, Z).	50
15	SensorAlignmentThirdRotationAxis	Euler rotation sequence, third rotation axis. Values are "1","2", "3" (representing X, Y, Z).	50

1.2.5. FileInfo

FileInfo contains metadata used by the PPS I/O Toolkit. This group appears in all data products. Table 1.2-4 shows each metadata elements in FileInfo.

Table 1.2-4 FileInfo Elements

No	Element	Description	Data size (bytes)
1	DataFormatVersion	The version of the data format used to write this file. This version is separate for each AlgorithmID. The order is: "a" "b" ... "z" "aa" "ab" ... "az" "ba" "bb".	50
2	TKCodeBuildVersion	Usually TK CodeBuildVersion is "1". If the I/O routines built by TKIO change even though the DataFormatVersion is unchanged, then TK CodeBuildVersion increments to "2", "3", ...If subsequently DataFormatVersion changes, TKCodeBuildVersion becomes "1" again.	50
3	MetadataVersion	The version of metadata used to write this file. This version is separate for each AlgorithmID. The order is: "a" "b" ... "z" "aa" "ab" ... "az" "ba" "bb" ...	50
4	FormatPackage	The underlying format of this granule. Values are ”HDF4”,”HDF5”, ”NETCDF”, ”TKBINARY”.	50
5	BlueprintFilename	The filename of the primary blueprint file that defined the format used to write this file.	50
6	BlueprintVersion	The BlueprintVersion of the format definition.	50
7	TKIOVersion	The version of TKIO used to create I/O routines to write this file. TKIOVersion does not define the format used to write this file.	50
8	MetadataStyle	The style in which the metadata was written, e.g., "PVL"."PVL" means < parameter >=< value >.	50
9	EndianType	The endian type of the system that wrote this file. Values are "BIG ENDIAN" and "LITTLE ENDIAN".	50

1.2.6. JAXAInfo

JAXAInfo contains metadata requested by JAXA. Used by DPR algorithms and GSMaP. Table 1.2-5 shows each metadata elements in JAXAInfo.

Table 1.2-5 JAXAInfo Elements

No	Element	Description	Data size (bytes)
1	GranuleFirstScanUTCDateTime	The date and time of first scan (incl. missing scan). The format is YYYY-MM-DDTHH:MM:SS.sssZ, where YYYY is 4-digit year, MM is month number, DD is day of month, T is "T", HH is hour, MM is minute, SS is second, sss is millisecond, and Z is "Z". All fields are zero-filled. The missing value is constructed by replacing all digits with 9, i.e., 9999-99-99T99:99:99.999Z.	50
2	GranuleLastScanUTCDateTime	Granule Last Scan UTC Date. Date is a 24 character string. The format is YYYY-MM-DDTHH:MM:SS.sssZ, where YYYY is 4-digit year, MM is month number, DD is day of month, T is ”T”, HH is hour, MM is minute, SS is second, sss is millisecond, and Z is ”Z”. All fields are zero-filled.	50
3	TotalQualityCode	The total quality of product is defined based on the quality of input data. Quality meaning are (a) GPM KuPR/KaPR TRMM PR L2 product Good: The total quality of input data (Ku/Ka/PR L1B) is Good. Fair: The GPM KuPR/KaPR L2 is not JMA's global weather forecast (FCST) or JMA's Global ANALsis model data (GANAL) but weather DB file. EG (Empty Granule): The total quality of input data (Ku/Ka/PR L1B) is EG (b) GPM DPR L2 product Good: The total quality of both Ku L2 and Ka L2 is Good. Fair: (i)The total quality of either Ku L2 or Ka L2 is EG (ii)The input data used in GPM DPR L2 is not JMA's global weather forecast (FCST) or JMA's Global ANALysis model data (GANAL) but weather DB file. EG (Empty Granule): The total quality of both Ku L2 and Ka L2 is EG. (c) GPM DPR SLH L2 product Good: The total quality of input data (DPR L2) is Good Fair: The total quality of input data is Fair. EG (Empty Granule): The total quality of input data (DPR L2) is EG.	50
4	FirstScanLat	Latitude of orbit first scan.	50
5	FirstScanLon	Longitude of orbit first scan.	50
6	LastScanLat	Latitude of orbit last scan.	50
7	LastScanLon	Longitude of orbit last scan.	50
8	NumberOfRainPixelsFS	Number of rain pixels in the FS swath, judged at DPR L2 algorithm. At DPR L1, value is "-9999".	50

No	Element	Description	Data size (bytes)
9	NumberOfRainPixelsHS	Number of rain pixels in the HS swath, judged at DPR L2algorithm. At DPR L1, value is "-9999".	50
10	ProcessingSubSystem	The name of the processing sub-system, e.g., "ALGORITHM","PCS".	50
11	ProcessingMode	The name of the processing mode, e.g., "STD","NRT".	50
12	lightspeed	Constant value of light speed.	50
13	dielectricFactorKa	The dielectric factor $\|K^2\|$ at Ka.	50
14	dielectricFactorKu	The dielectric factor $\|K^2\|$ at Ku.	50

1.2.7. SwathHeader

SwathHeader contains metadata for swaths. This group appears in Level 1 and Level 2 data products. Table 1.2-6 shows each metadata elements in SwathHeader.

Table 1.2-6 SwathHeader Elements

No	Element	Description	Data size (bytes)
1	NumberScansInSet	The scans read by TKreadScan are a ”set”. For single swath data, one scan is read so NumberScansInSet=1. For multiple swath data, one TKreadScan may read more than one scan. For example, for SSM/I data one TKreadScan reads one low frequency scan and two high frequency scans. Therefore NumberScansInSet=1 for the low frequency swath and Number-ScansInSet=2 for the high frequency swath.	50
2	MaximumNumberScansTotal	The maximum allowed number of total scans in this swath. Total scans = overlap scans before granule + scans in granule + overlap scans after granule.	50
3	NumberScansBeforeGranule	The number of overlap scans before the first scan of the granule in this swath.	50
4	NumberScansGranule	The number of scans in the granule in this swath.	50
5	NumberScansAfterGranule	The number of overlap scans after the last scan of the granule in this swath.	50

No	Element	Description	Data size (bytes)
6	NumberPixels	The number of IFOV in each scan in this swath.	50
7	ScanType	The type of scan in this swath. Values are: "CROSSTRACK" and "CONICAL".	50

1.3. Data Group

Elements of data group are explained in detail in this section. Each swath has 11 data group (12 data group for FS swath of 2ADPR) and 2 data (Latitude and Longitude) commonly. Figure 1.3-1 shows data group structure.

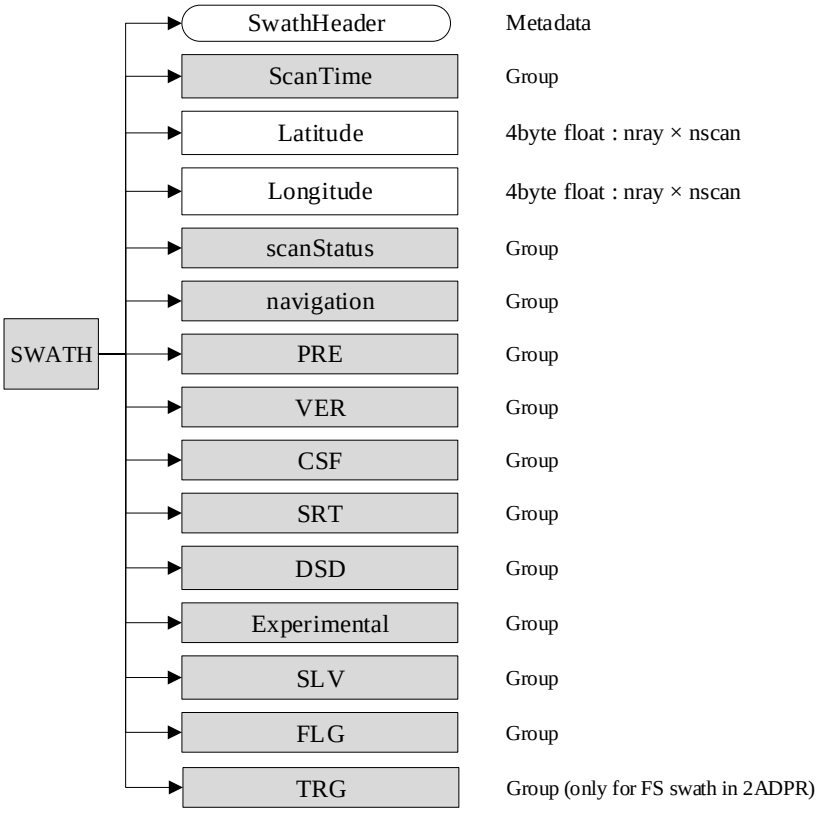


Figure 1.3-1 Data Format Structure for Data Group

1.3.1. ScanTime (Group)

(1) Year

Type	Array	Unit
2-byte integer	nscan	year

4-digit year, e.g., 1998. Values range from 1950 to 2100 years:

Missing Value:

-9999

(2) Month

Type	Array	Unit
1-byte integer	nscan	month

Month of the year. Values range from 1 to 12 months.

Missing Value:

-99

(3) DayOfMonth

Type	Array	Unit
1-byte integer	nscan	day

Day of the month. Values range from 1 to 31 days.

Missing Value:

-99

(4) Hour

Type	Array	Unit
1-byte integer	nscan	hour

UTC hour of the day. Values range from 0 to 23 hours.

Missing Value:

-99

(5) Minute

Type	Array	Unit
1-byte integer	nscan	minute

Minute of the hour. Values range from 0 to 59 minutes.

Missing Value:

-99

(6) Second

Type	Array	Unit
1-byte integer	nscan	s

Second of the minute. Values range from 0 to 60 s.

Missing Value:

-99

(7) MilliSecond

Type	Array	Unit
2-byte integer	nscan	ms

Thousandths of the second. Values range from 0 to 999 ms.

Missing Value:

-9999

(8) DayOfYear

Type	Array	Unit
2-byte integer	nscan	day

Day of the year. Values range from 1 to 366 days.

Missing Value:

-9999

(9) SecondOfDay

Type	Array	Unit
8-byte float	nscan	s

A time associated with the scan. It is expressed as the UTC seconds of the day.

Values range from 0 to 86400 s.

Missing Value:

-9999.9

(10) Latitude

Type	Array	Unit
4-byte float	nray * nscan	degrees

The earth latitude of the center of the IFOV at the altitude of the earth ellipsoid. Latitude is positive north, negative south.

Values range from -90 to 90 degrees.

Missing Value:

-9999.9

(11) Longitude

Type	Array	Unit
4-byte float	nray * nscan	degrees

The earth longitude of the center of the IFOV at the altitude of the earth ellipsoid. Longitude is positive east, negative west. A point on the 180th meridian has the value -180 degrees.

Values range from -180 to 180 degrees.
Missing Value:

-9999.9

1.3.2. scanStatus (Group)

(1) dataQuality

Type	Array	Array (2ADPR)	Unit
1-byte integer	nscan	nfreq * nscan	N/A

A summary of data quality in the scan. Unless this is 0 (normal), the scan data is meaningless to higher precipitation processing. Bit 0 is the least significant bit (i.e., if bit i = 1 and other bits = 0, the unsigned integer value is 2**i).

In the 2ADPR,

nfreq(1) : Estimated by KuPR single-frequency algorithm.

nfreq(2) : Estimated by KaPR single-frequency algorithm.

Bit Meaning

0 : missing

5 : geoError is not zero

6 : modeStatus is not zero

(2) dataWarning

Type	Array	Array (2ADPR)	Unit
1-byte integer	nscan	nfreq * nscan	N/A

Flag of data warning for each scan. Bit Meaning is below.

In the 2ADPR,

nfreq(1) : Estimated by KuPR single-frequency algorithm.

nfreq(2) : Estimated by KaPR single-frequency algorithm.

Bit Meaning

0 : beam Matching is abnormal

1 : VPRF table is abnormal

2 : surface Table is abnormal

3 : geoWarning is not Zero

4 : operational mode is not observation mode.

5 : GPS status is abnormal

(3) missing

Type	Array	Array (2ADPR)	Unit
1-byte integer	nscan	nfreq * nscan	N/A

Indicates whether information is contained in the scan data. Bit Meaning is below.

In the 2ADPR,

nfreq(1) : Estimated by KuPR single-frequency algorithm.

nfreq(2) : Estimated by KaPR single-frequency algorithm.

Bit Meaning

0 : Scan is missing

1 : Science telemetry packet missing

2 : Science telemetry segment withing packet missing

3 : Science telemetry other missing

4 : Housekeeping (HK) telemetry packet missing

5 : Spare (always 0)

6 : Spare (always 0)

7 : Spare (always 0)

(4) modeStatus

Type	Array	Array (2ADPR)	Unit
1-byte integer	nscan	nfreq * nscan	N/A

A summary of status modes. If all status modes are routine, all bits in modeStatus = 0. Routine means that scan data has been measured in the normal operational situation as far as the status modes are concerned. modeStatus does not assess geolocation quality. modeStatus is broken into 8 bit flags. Each bit = 0 if the status is routine but the bit = 1 if the status is not routine. Bit 0 is the least significant bit (i.e., if bit i = 1 and other bits = 0, the unsigned integer value is 2**i). The non-routine situations follow:

Bit Meaning
0 : Spare (always 0)
1 : SCorientation not 0 or 180
2: pointingStatus not 0
3 : Non-routine limitErrorFlag
4 : Non-routine operationalMode (not 1 or 11)
5 : Spare (always 0)
6 : Spare (always 0)
7 : Spare (always 0)

In the 2ADPR,

nfreq(1) : Estimated by KuPR single-frequency algorithm.

nfreq(2) : Estimated by KaPR single-frequency algorithm.

(5) geoError

Type	Array	Array (2ADPR)	Unit
2-byte integer	nscan	nfreq * nscan	N/A

A summary of geolocation errors in the scan. geoError is used to set a bit in dataQuality. A zero integer value of geoError indicates 'good' geolocation. A non-zero value broken down into the bit flags below indicates the specified reason, where bit 0 is the least significant bit (i.e., if bit i = 1 and other bits = 0 the unsigned integer value is 2**i). Bits 0, 4, 5, 8 and 9 are per pixel error flags. If the number of bad pixels (for any of the reasons specified by these flags) is greater than the threshold then bit 7 = 1 and each of these flags is set to 1 if any pixel is bad for that reason. At launch this threshold is zero, so data is flagged if any pixel is bad. If the number of bad pixels is less than or equal to the threshold then bit 7 = 0 and all of these flags are also 0. Bit Meaning is below.

In the 2ADPR,

nfreq(1) : Estimated by KuPR single-frequency algorithm.

nfreq(2) : Estimated by KaPR single-frequency algorithm.

Bit Meaning
0 : Latitude limit exceeded for viewed pixel locations
1 : Negative scan time, invalid input
2 : Error getting spacecraft attitude at scan mid-time
3 : Error getting spacecraft ephemeris at scan mid-time
4 : Invalid input non-unit ray vector for any pixel
5 : Ray misses Earth for any pixel with normal pointing

6 : Nadir calculation error for subsatellite position

7 : Pixel count with geolocation error over threshold

8 : Error in getting spacecraft attitude for any pixel

9 : Error in getting spacecraft ephemeris for any pixel

10 : Spare (always 0)

11 : Spare (always 0)

12 : Spare (always 0)

13 : Spare (always 0)

14 : Spare (always 0)

15 : Spare (always 0)

(6) geoWarning

Type	Array	Array (2ADPR)	Unit
2-byte integer	nscan	nfreq * nscan	N/A

A summary of geolocation warnings in the scan. geoWarning does not set a bit in dataQuality. Warnings indicate unusual conditions. These conditions do not indicate bad geolocation but are flagged as a warning that further review of the data may be useful. A zero integer value indicates usual geolocation. A non-zero value broken down into the following bit flags indicates the following, where bit 0 is the least significant bit (i.e., if bit i = 1 and other bits = 0 the unsigned integer value is 2**i). Bit Meaning is below.

In the 2ADPR,

nfreq(1) : Estimated by KuPR single-frequency algorithm.

nfreq(2) : Estimated by KaPR single-frequency algorithm.

Bit Meaning

0 : Ephemeris Gap Interpolated

1 : Attitude Gap Interpolated

2 : Attitude jump/discontinuity

3 : Attitude out of range

4 : Anomalous Time Step

5 : GHA not calculated due to error

6 : SunData (Group) not calculated due to error

7 : Failure to calculate Sun in inertial coordinates

8 : Fallback to GES ephemeris

9 : Fallback to GEONS ephemeris

10 : Fallback to PVT ephemeris

11 : Fallback to OBP ephemeris

12 : Spare (always 0)

13 : Spare (always 0)

14 : Spare (always 0)

15 : Spare (always 0)

(7) SCorientation

Type	Array	Unit
2-byte integer	nscan	degrees

The positive angle of the spacecraft vector (v) from the satellite forward direction of motion, measured clockwise facing down. We define v in the same direction as the spacecraft axis +X, which is also the center of the GMI scan. If SCorientation is not 0 or 180, a bit is set to 1 in modeStatus.

Value Meaning

0 : +X forward (yaw 0)

180 : -X forward (yaw 180)

-8000 : Non-nominal pointing

-9999 : Missing

(8) pointingStatus

Type	Array	Array (2ADPR)	Unit
2-byte integer	nscan	nfreq * nscan	N/A

It is provided by the GeoTK. A value of zero means the pointing is good. Non-zero values indicate non-nominal pointing. If pointingStatus is non-zero, a bit in modeStatus is set to 1. Value Meaning is below.

In the 2ADPR,

nfreq(1) : Estimated by KuPR single-frequency algorithm.

nfreq(2) : Estimated by KaPR single-frequency algorithm.

Value Meaning

0 : Nominal pointing in Mission Science Mode

1 : GPS point solution stale and PVT ephemeris used

2 : GEONS solution stale and GEONS ephemeris used

-8000 : Non-nominal mission science orientation

-9999 : Missing

(9) acsModeMidScan

Type	Array	Unit
1-byte integer	nscan	N/A

It is provided by the GeoTK as taken from Attitude Control System telemetry and is provided in this format for information only.

Value Meaning

0 : LAUNCH

1 : RATENULL

2 : SUNPOINT

3 : GSPM (Gyro-less Sun Point)

4 : MSM (Mission Science Mode)

5 : SLEW

6 : DELTAH

7 : DELTAV

(10) targetSelectionMidScan

Type	Array	Unit
1-byte integer	nscan	N/A

It is provided by the GeoTK as taken from Attitude Control System telemetry and is provided in this format for information only.

Value Meaning

0 : S/C Z axis nadir, +X in flight direction

1 : Flight Z axis nadir, +X in flight direction

2 : S/C Z axis nadir, -X in flight direction

3 : Flight Z axis nadir, -X in flight direction

4 : +90 yaw for DPR antenna pattern calibration

5 : -90 yaw for DPR antenna pattern calibration

-99 : Missing

Other standard target orientations TBD

(11) operationalMode

Type	Array	Array (2ADPR)	Unit
1-byte integer	nscan	nfreq * nscan	N/A

The operational mode of KuPR/KaPR/PR stored in science telemetry basically. However, if science telemetry is not made like as stand-by mode, KuPR/KaPR L1B algorithm decides it using HK telemetry. PR L1B algorithm stored missing value. The values range is 1 to 20 for KuPR/KaPR. The values range is 1 to 3, 5, 6, 10, -99. The value meaning is shown below.

In the 2ADPR,

nfreq(1) : Estimated by KuPR single-frequency algorithm.

nfreq(2) : Estimated by KaPR single-frequency algorithm.

Value Meaning

1 : Ku/Ka/PR Observation

2 : Ku/Ka/PR External Calibration

3 : Ku/Ka/PR Internal Calibration

4 : Ku/Ka SSPA Analysis

5 : Ku/Ka/PR LNA Analysis

6 : Ku/Ka/PR Health-Check

7 : Ku/Ka Standby VPRF Table OUT

8 : Ku/Ka Standby Phase Out

9 : Ku/Ka Standby Dump Out

10 : Ku/Ka Standby (No Science Data)

11 : Ku/Ka/PR Independent Observation

12 : Ku/Ka Independent External Calibration

13 : Ku/Ka Independent Internal Calibration

14 : Ku/Ka Independent SSPA Analysis

15 : Ku/Ka Independent LNA Analysis

16 : Ku/Ka Independent Health-Check

17 : Ku/Ka Independent Standby VPRF Table OUT

18 : Ku/Ka Independent Standby Phase Out

19 : Ku/Ka Independent Standby Dump Out

20 : Ku/Ka Independent Standby (No Science Data)

-99 : PR missing value (No Science Data)

(12) limitErrorFlag

Type	Array	Array (2ADPR)	Unit
1-byte integer	nscan	nfreq * nscan	N/A

It has 2 error information. One is as for noise power limit, another one is as for binEllipsoid limit. The former is defined that if there are more than 2 overlimitted rays in a swath, limitErrorFlag(at 0bit) is adapted. On the other hand, the later is defined that if there is even an overlimitted ray, limitErrorFlag(at 1bit) is adapted. Then, LimitErrorFlag is used in modeStatus, dataQuality in scanStatus Group picks it up consequently. Bit Meaning is below.

In the 2ADPR,

nfreq(1) : Estimated by KuPR single-frequency algorithm.

nfreq(2) : Estimated by KaPR single-frequency algorithm.

Bit Meaning

0 : noise power limit error

1 : binEllipsoid is missing

2 : Spare (always 0)

3 : Spare (always 0)

4 : Spare (always 0)

5 : Spare (always 0)

6 : Spare (always 0)

7 : Spare (always 0)

(13) FractionalGranuleNumber

Type	Array	Unit
8-byte float	nscan	N/A

The floating point granule number. The granule begins at the Southern-most point of the spacecraft's trajectory. For example, FractionalGranuleNumber = 10.5 means the spacecraft is halfway through granule 10 and starting the descending half of the granule. Values range from 0 to 100000. In Near Real Time (NRT) process, granule number is stored only '0', so Fractional Granule Number less than 1.0.

Missing value:

N/A

1.3.3. navigation (Group)

(1) scPos

Type	Array	Unit
4-byte float	XYZ * nscan	m

The position vector(m) of the spacecraft in Earth-Centered Earth Fixed (ECEF) Coordinates at the Scan mid-Time (i.e., time at the middle pixel/IFOV of the active scan period). Values range from -10000000 to 10000000 m.

Missing value:

-9999.9

(2) scVel

Type	Array	Unit
4-byte float	XYZ * nscan	m/s

The velocity vector (m/s) of the spacecraft in ECEF Coordinates at the Scan mid-Time. Values range from -10000000 to 10000000 m/s.

Missing value:

-9999.9

(3) scLat

Type	Array	Unit
4-byte float	nscan	degrees

The geodesic latitude (decimal degrees) of the spacecraft at the Scan mid-Time. Values range from -70 to 70 degrees.

Missing value:

-9999.9

(4) scLon

Type	Array	Unit
4-byte float	nscan	degrees

The geodesic longitude (decimal degrees) of the spacecraft at the Scan mid-Time. Values range from -180 to 180 degrees.

Missing value:

-9999.9

(5) scAlt

Type	Array	Unit
4-byte float	scan	m

The altitude (m) of the spacecraft above the Earth Ellipsiod at the Scan mid-Time. It is computed by GeoTK. Values range from 350000 to 500000 m.

Missing value:

-9999.9

(6) dprAlt

Type	Array	Unit
4-byte float	nscan	m

The altitude (m) of the spacecraft above the Earth Ellipsiod at the Scan mid-Time from DPR science telemetry. This is empty in non-DPR products. It is stored 'GPS Altitude Data' with LSB equal to 10m in DPR science telemetry. Values range from 350000 to 500000 m.

Missing value:

-9999.9 : at missing scan and internal calibration mode.

(7) scAttRollGeoc

Type	Array	Unit
4-byte float	nscan	degrees

The geocentric satellite attitude Euler roll angle (degrees) at the Scan mid-Time. The order of the components in the file is roll, pitch, and yaw. However, the angles are computed using a 3-2-1 Euler rotation sequence representing the rotation order yaw, pitch, and roll for the rotation from Orbital Coordinates to the spacecraft body coordinates. Orbital Coordinates represent an orthogonal triad in Geocentric Inertial Coordinates where the Z-axis is toward the geocentric nadir, the Y-axis is perpendicular to the spacecraft velocity opposite the orbit normal direction, and the X-axis is approximately in the velocity direction for a near circular orbit. Note this is geocentric, not geodetic, referenced, so that pitch and roll will have twice orbital frequency components due to the onboard control system following the oblate geodetic Earth horizon. Note also that the yaw value will show an orbital frequency component relative to the Earth fixed ground track due to the Earth rotation relative to inertial coordinates. Values range from -180 to 180 degrees.

Missing value:

-9999.9

(8) scAttPitchGeoc

Type	Array	Unit
4-byte float	nscan	degrees

The geocentric satellite attitude Euler pitch angle (degrees) at the Scan mid-Time.Values range from -180 to 180 degrees.

Missing value:

-9999.9

(9) scAttYawGeoc

Type	Array	Unit
4-byte float	nscan	degrees

The geocentric satellite attitude Euler yaw angle (degrees) at the Scan mid-Time. Values range from -135 to 225 degrees.

Missing value:

-9999.9

(10) scAttRollGeod

Type	Array	Unit
4-byte float	nscan	degrees

The geodetic satellite attitude Euler roll angle (degrees) at the Scan mid-Time. The order of the components in the file is roll, pitch, and yaw. However, the angles are computed using a 3-2-1 Euler rotation sequence representing the rotation order yaw, pitch, and roll for the rotation from Geodetic Coordinates to the spacecraft body coordinates. Geodetic Coordinates represent an orthogonal triad in Geocentric Inertial Coordinates where the Z-axis is toward the geodetic nadir, the Y-axis is perpendicular to the spacecraft velocity opposite the orbit normal direction, and the X-axis is approximately in the velocity direction for a near circular orbit. Values range from -180 to 180 degrees.

Missing value:

-9999.9

(11) scAttPitchGeod

Type	Array	Unit
4-byte float	nscan	degrees

The geodedic satellite attitude Euler pitch angle (degrees) at the Scan mid-Time.Values range from -180 to 180 degrees.

Missing value:

-9999.9

(12) scAttYawGeod

Type	Array	Unit
4-byte float	nscan	degrees

The geodedic satellite attitude Euler yaw angle (degrees) at the Scan mid-Time. Values range from -135 to 225 degrees.

Missing value:

-9999.9

(13) greenHourAng

Type	Array	Unit
4-byte float	nscan	degrees

The rotation angle (degrees) from Geocentric Inertial Coordinates to Earth Fixed Coordinates. Values range from 0 to 390 degrees.

Missing value:

-9999.9

(14) timeMidScan

Type	Array	Unit
8-byte float	nscan	s

The Scan mid-Time in GPS Atomic time, namely the seconds since 0000 UTC, 6 Jan 1980. timeMidScan is used as the reference time for the scPos and scVel values. Values range from 0 to 10000000000 s.

Missing value:

-9999.9

(15) timeMidScanOffset

Type	Array	Unit
8-byte float	nscan	s

Offset from the secondary header packet time to the timeMidScan. Values range from 0 to 100 s.

Missing value:

-9999.9

1.3.4. PRE (Group)

(1) elevation

Type	Array	Unit
4-byte float	nray * nscan	m

Elevation of the measurement point. It is a copy of DEMHmean of level 1B product.

Missing Value:

-9999.9

In the 2ADPR, it is estimated by dual-frequency algorithm.

(2) landSurfaceType

Type	Array	Unit
4-byte integer	nray * nscan	N/A

Land surface type.

The values are

Value Meaning
0-99 : Ocean
100 - 199 : Land
200 - 299 : Coast
300 - 399 : Inland water
-9999 : Missing

In the 2ADPR, it is estimated by dual-frequency algorithm.

(3) localZenithAngle

Type	Array	Array (2ADPR)	Unit
4-byte float	nray * nscan	nfreq * nray * nscan	degrees

Local zenith angle of each ray. It is a copy of scLocalZenith of level 1B product.

Missing Value:

-9999.9

In the 2ADPR,

nfreq(1) : Estimated by KuPR single-frequency algorithm.

nfreq(2) : Estimated by KaPR single-frequency algorithm.

(4) flagPrecip

Type	Array	Unit
4-byte integer	nray * nscan	N/A

The values are

Value Meaning
0 : No precipitation
1 : Precipitation
-9999 : Missing

In the 2ADPR,

Value Meaning
00: No precipitation estimated by both KuPR and KaPR single-frequency algorithm.
01: Precipitation estimated by KaPR single-frequency algorithm only.
10: Precipitation estimated by KuPR single-frequency algorithm only.
11: Precipitation estimated by both KuPR and KaPR single-frequency algorithm.

(5) binRealSurface

Type	Array	Array (2ADPR)	Unit
2-byte integer	nray * nscan	nfreq * nray * nscan	range bin

Range bin number for real surface.

Missing Value:

-9999

In the 2ADPR,

nfreq(1) : Estimated by KuPR single-frequency algorithm.

nfreq(2) : Estimated by dual-frequency algorithm.

(6) binStormTop

Type	Array	Unit
2-byte integer	nray * nscan	range bin

Range bin number for the storm top.

Missing Value:

-9999

In the 2ADPR, it is estimated by dual-frequency algorithm.

(7) heightStormTop

Type	Array	Unit
4-byte float	nray * nscan	m

Height of storm top.

Missing Value:

-9999.9

In the 2ADPR, it is estimated by dual-frequency algorithm.

(8) height

Type	Array	Unit
4-byte float	nbin * nray * nscan	m

Height of precipitation.

Missing Value:

-9999.9

In the 2ADPR,

Estimated by KuPR single-frequency algorithm

(9) binClutterFreeBottom

Type	Array	Unit
2-byte integer	nray * nscan	range bin

Range bin number for clutter free bottom.

Missing Value:

-9999

In the 2ADPR, it is estimated by KuPR single-frequency algorithm

(10) sigmaZeroMeasured

Type	Array	Array (2ADPR)	Unit
4-byte float	nray * nscan	nfreq * nray * nscan	dB

Surface backscattering cross section without attenuation correction (as measured).

Missing Value:

-9999.9

In the 2ADPR,

nfreq(1) : Estimated by KuPR single-frequency algorithm.

nfreq(2) : Ka-band sigmaZeroMeasured estimated by dual-frequency algorithm.

(11) zFactorMeasured

Type	Array	Array (2ADPR)	Unit
4-byte float	nbin *nray * nscan	nfreq * nbin * nray * nscan	dBZ

Vertical profile of reflectivity factor (Z) without attenuation correction (as measured).

10log10(Z) where Z is in mm^6/m^3.

Missing Value:

-9999.9

In the 2ADPR,

nfreq(1) : Estimated by KuPR single-frequency algorithm.

nfreq(2) : Estimated by KaPR single-frequency algorithm.

(12) ellipsoidBinOffset

Type	Array	Array (2ADPR)	Unit
4-byte float	nray * nscan	nfreq * nray * nscan	m

Distance between the ellipsoid and a center range bin of binEllipsoid defined by level 1B algorithm.

ellipsoidBinOffset =scRangeEllipsoid – (startBinRange + (binEllipsoid-1) * rangeBinSize)

scRangeEllipsoid : Distance between a sensor and the ellipsoid [m]

startBinRange : Distance between a sensor and a center of the highest observed range bin [m]

binEllipsoid : Range bin number of the Ellipsoid (1 - 260)

rangeBinSize : Range bin size [m]

Missing Value:

-9999

In the 2ADPR,

nfreq(1) : Estimated by KuPR single-frequency algorithm.

nfreq(2) : Estimated by KaPR single-frequency algorithm.

(13) snRatioAtRealSurface

Type	Array	Array (2ADPR)	Unit
4-byte float	nray * nscan	nfreq * nray * nscan	N/A

Signal/Noise ratio at real surface range bin.

snRatioAtRealSurface= 10*log10(echoPowertrueV[mW]/noisePowertrueV[mW])

Missing Value:

-9999

In the 2ADPR,

nfreq(1) : Estimated by KuPR single-frequency algorithm.

nfreq(2) : Estimated by KaPR single-frequency algorithm.

(14) adjustFactor

Type	Array	Array (2ADPR)	Unit
4-byte float	nray * nscan	nfreq * nray * nscan	dB

Adjustment factor (dB) for zFactorMeasured (dBZm') and sigmaZeroMeasured (dBs0m'). dBZm' and dBs0m' are used and stored as follows:

dBZm' = dBZm – adjustFactor

dBs0m' = dBs0m – adjustFactor

The adjustment factor is the sum of 3 components:

base adjustment for instrument dependency,

angle-bin adjustment for angle-bin dependency, and

temporal adjustment for orbit number dependency.

Missing Value:

-9999.9

In the 2ADPR,

nfreq(1) : Estimated by KuPR single-frequency algorithm.

nfreq(2) : Estimated by KaPR single-frequency algorithm.

(15) snowIceCover

Type	Array	Unit
1-byte integer	nray * nscan	N/A

Snow and ice cover information. It refers to the multisensor snow/ice cover maps provided by NOAA.

The values are

Value Meaning
0 : Open water
1 : Land, no snow
2 : Snow cover on land
3 : Ice on water
-99 : Missing

In the 2ADPR, it is estimated by KuPR single-frequency algorithm

(16) flagSigmaZeroSaturation

Type	Array	Array (2ADPR)	Unit
1-byte unsigned integer	nray * nscan	nfreq * nray * nscan	N/A

A flag to show whether echoPower is under a saturated level or not at a range bin with a calculation of sigmaZeroMeasured. The values are below.

Value Meaning
0 : Normal (under saturated level)
1 : Possible saturated level at real surface
2 : Saturated level at real surface
99 : Missing

In the 2ADPR,

nfreq(1) : Estimated by KuPR single-frequency algorithm.

nfreq(2) : Estimated by KaPR single-frequency algorithm.

1.3.5. VER (Group)

(1) binZeroDeg

Type	Array	Unit
2-byte integer	nray * nscan	range bin

Range bin number with 0 degrees C level.

Missing Value:

-9999

(2) attenuationNP

Type	Array	Array (2ADPR)	Unit
4-byte float	nNP *nray * nscan	nfreq * nNP *nray * nscan	dB/km

Vertical profile of attenuation by non-precipitation particles (cloud liquid water, cloud ice water, water vapor, and oxygen molecules).

Missing Value:

-9999.9

nNP (1) : Total (sum of 2, 3, and 4)

nNP (2) : Water Vapor

nNP (3) : Oxygen molecules

nNP (4) : Cloud liquid water

In the 2ADPR,

nfreq(1) : Ku

nfreq(2) : Ka

(3) piaNP

Type	Array	Array (2ADPR)	Unit
4-byte float	nNP * nray * nscan	nfreq * nNP * nray * nscan	dB

Path integrated attenuation caused by non-precipitation particles (cloud liquid water, water vapor, and oxygen molecules).

Missing Value:

-9999.9

nNP (1) : Total (sum of 2, 3, and 4)

nNP (2) : Water vapor

nNP (3) : Oxygen molecules

nNP (4) : Cloud liquid water

In the 2ADPR,

nfreq(1) : Ku

nfreq(2) : Ka

(4) sigmaZeroNPCorrected

Type	Array	Array (2ADPR)	Unit
4-byte float	nray * nscan	nfreq * nray * nscan	dB

Surface backscattering cross section with attenuation correction only for non-precipitation particles.

Missing Value:

-9999.9

In the 2ADPR,

nfreq(1) : Ku

nfreq(2) : Ka

(5) heightZeroDeg

Type	Array	Unit
4-byte float	nray * nscan	m

Height of freezing level (0 degrees C level) Values are in m.

Missing Value:

-9999.9

(6) airTemperature

Type	Array	Unit
4-byte float	nbin *nray * nscan	K

Air temperature. Values are in K.

Missing Value:

-9999.9

1.3.6. CSF (Group)

(1) flagBB

Type	Array	Unit
4-byte integer	nray * nscan	N/A

Bright band (BB) exists or not.

In case of 2AKu and 2AKa,

The values are

Value Meaning

0 : BB not detected

1 : BB detected

-1111 : No rain value

-9999 : Missing

In case of 2ADPR,

The values are

Value Meaning

0 : BB not detected

≥ 1: BB detected

1: BB detected by both single-frequency (Ku-band) and dual-frequency algorithm.

2: BB detected by single-frequency (Ku-band) algorithm only.

3: BB detected by dual-frequency algorithm only.

-1111 : No rain value

-9999 : Missing

(2) binBBPeak

Type	Array	Unit
2-byte integer	nray * nscan	range bin

Range bin number for the peak of bright band.

Missing Value:

-9999

(3) binBBTop

Type	Array	Unit
2-byte integer	nray * nscan	range bin

Range bin number for the top of bright band.

Missing Value:

-9999

(4) binBBBottom

Type	Array	Unit
2-byte integer	nray * nscan	range bin

Range bin number for the bottom of bright band.

The values are

Value Meaning
0 : BB not detected
-1111 : No rain value
-9999 : Missing

(5) heightBB

Type	Array	Unit
4-byte float	nray * nscan	m

Height of bright band.

The values are

Value Meaning
0.0 : BB not detected
-1111.1 : No rain value
-9999.9 : Missing

(6) widthBB

Type	Array	Unit
4-byte float	nray * nscan	m

The width of bright band.

The values are

Value Meaning
0.0 : BB not detected
-1111.1 : No rain value
-9999.9 : Missing

(7) qualityBB

Type	Array	Unit
4-byte integer	nray * nscan	N/A

Quality of the bright band.

The values are

Value Meaning
1 : Good
0 : BB not detected in the case of rain
-1111 : No rain value
-9999 : Missing

(8) typePrecip

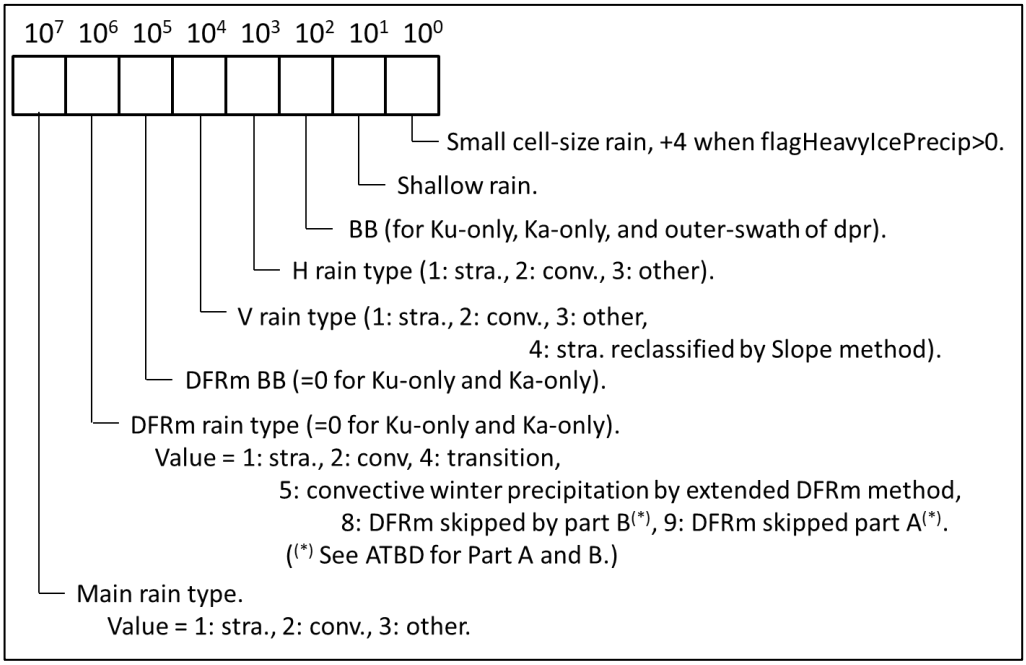
Type	Array	Unit
4-byte integer	nray * nscan	N/A

When positive, typePrecip shows precipitation type by an 8-digit number as shown in the next box. The negative typePrecip means as follows:

-1111: No rain,

-9999: Missing.

Details of 8-digit typePrecip:



The three major rain categories, stratiform, convective, and other, can be obtained from typePrecip as follows:

When typePrecip is greater than zero,

Major rain type = typePrecip/10000000

1 : stratiform

2 : convective

3 : other

In the DPR product, rain type by the CSU's DFRm (measured dual frequency ratio) method is also included in typePrecip and can be obtained as follows:

DFRm rain type = (typePrecip%10000000)/1000000 in C

DFRm rain type = (MOD(typePrecip,10000000)/1000000 in FORTRAN

DFRm rain type

1 : stratiform

2 : convective

4 : transition

5 : Decided winter precipitation as convective by extended DFRm method.

8 : DFRm method cannot be applicable at Part B (in this case

the conventional method determines the major rain type)

9 : DFRm method cannot be applicable at Part A (in this case

the conventional method determines the major rain type)

-1111 : No rain value

-9999 : Missing value

(9) qualityTypePrecip

Type	Array	Unit
4-byte integer	nray * nscan	N/A

Quality of the precipitation type.

The values are

Value Meaning
1 : Good
-1111 : No rain value
-9999 : Missing

(10) flagShallowRain

Type	Array	Unit
4-byte integer	nray * nscan	N/A

Type of shallow rain.

The values are

Value Meaning
0 : No shallow rain
10 : Shallow isolated (maybe)
11 : Shallow isolated (certain)
20 : Shallow non-isolated (maybe)
21 : Shallow non-isolated (certain)
-1111 : No rain value
-9999 : Missing

(11) binDFRmMLBottom (Only for 2ADPR)

Type	Array	Unit
2-byte integer	nray * nscan	range bin

The DFRm method detects melting layer (ML) the meaning of which is wider than that of BB. Since ML and BB are different, new output item binDFRmMLBottom and binDFRmMLTop are added to MS and HS data.

Range bin number for ML bottom detected by the DFRm method.

The values are

Value: Meaning

> 0 : Range bin number when ML bottom is detected

0 : ML bottom is not detected

-1111 : Value for no rain in MS (HS) mode at Ka band

-9999 : Missing value

(12) binDFRmMLTop (Only for 2ADPR)

Type	Array	Unit
2-byte integer	nray * nscan	N/A

The DFRm method detects melting layer (ML) the meaning of which is wider than that of BB. Since ML and BB are different, new output item binDFRmMLBottom and binDFRmMLTop are added to MS and HS data.

Range bin number for ML top detected by the DFRm method.

The values are

Value: Meaning

> 0 : Range bin number when ML top is detected

0 : ML top is not detected

-1111 : Value for no rain in MS (HS) mode at Ka band

-9999 : Missing value

(13) binHeavyIcePrecipTop (Other than HS in 2ADPR)

Type	Array	Array(2ADPR)	Unit
2-byte integer	nray * nscan	nfreq * nray * nscan	range bin

Range bin corresponding to the top height wher Heavy Ice Precipitation (HIP) is detected.

The values are:

(A) In the single frequency 2AKu,

>0: Range bin corresponding to the Ku-band top height for HIP when it is detected

0: When HIP is not detected

-1111: No rain value

-9999: Missing value

(B) In the single frequency 2AKa,

>0: Range bin corresponding to the Ka-band top height for HIP when it is detected

0: When HIP is not detected

-1111: No rain value

-9999: Missing value

(C) In the 2ADPR,

nfreq(1) : Same to the above (A)

nfreq(2) : Same to the above (B)

nfreq(3) :

>0: Range bin corresponding to the top height for HIP detected by the dual frequency method

0: When HIP is not detected by the dual frequency method

-1111: No rain value

-9999: Missing value

(14) binHeavyIcePrecipBottom (Other than HS in 2ADPR)

Type	Array	Array(2ADPR)	Unit
2-byte integer	nray * nscan	nfreq * nray * nscan	range bin

Range bin corresponding to the bottom height wher Heavy Ice Precipitation (HIP) is detected.

The values are:

(A) In the single frequency 2AKu,

>0: Range bin corresponding to the Ku-band bottom height for HIP when it is detected

0: When HIP is not detected

-1111: No rain value

-9999: Missing value

(B) In the single frequency 2AKa,

>0: Range bin corresponding to the Ka-band bottom height for HIP when it is detected

0: When HIP is not detected

-1111: No rain value

-9999: Missing value

(C) In the 2ADPR,

nfreq(1) : Same to the above (A)

nfreq(2) : Same to the above (B)

nfreq(3) :

>0: Range bin corresponding to the bottom height for HIP detected by the dual frequency method

0: When HIP is not detected by the dual frequency method

-1111: No rain value

-9999: Missing value

(15) nHeavyIcePrecip (Other than HS in 2ADPR)

Type	Array	Array(2ADPR)	Unit
1-byte unsigned integer	nray * nscan	nfreq * nray * nscan	range bin

Number of range bins where HIP is detected.

The values are:

(A) In the single frequency 2AKu,

>0: The total number of bins where Ku-band HIP is detected

0: When Ku-band HIP is not detected or No rain or Missing

(B) In the single frequency 2AKa,

>0: The total number of bins where Ka-band HIP is detected

0: When Ka-band HIP is not detected or No rain or Missing

(C) In the 2ADPR,

nfreq(1) : Same to the above (A)

nfreq(2) : Same to the above (B)

nfreq(3) :

>0: The total number of bins where HIP is detected by the dual frequency method

0: When HIP is not detected by the dual frequency method or No rain or Missing

(16) flagMLquality (Only for 2ADPR)

Type	Array	Unit
1-byte unsigned integer	nray * nscan	None

This flag will indicate the quality of detected ML related quantities.

In V6X, the following tentative values are assigned to the flag.

Value meaning
1: ML is detected.
1: ML top and/or bottomis detected by the standard DFRm method.
2: ML top and/or bottomis detected by an extension, but the result is not used in the V6X rain type decision.
(Missing value is not assigned in V6X)

(17) flagHeavyIcePrecip

Type	Array	Unit
1-byte integer	nray * nscan	N/A

This flag denotes detection of solid ice hydrometeors which cause severely strong Z factor or huge DFRm in the sky less than -10 degree C temperature.

Value Meaning

(A) The case of Ka band MS:

1 (=0x01): 35dBZ >= Zm(Ka) > 30dBZ

2 (=0x02): 40dBZ >= Zm(Ka) > 35dBZ

3 (=0x03): Zm(Ka) > 40dBZ

(B) The case of Ku band NS:

4 (=0x04): 35dBZ >= Zm(Ku) > 30dBZ

8 (=0x08): 40dBZ >= Zm(Ku) > 35dBZ

12 (=0x0c): Zm(Ku) > 40dBZ

(C) The case of DPR NS:

Outer swaths are same as (B).

Inner swaths are addition of (A) and (B). If Zm(Ku) > 27dBZ and DFRm > 7dB in inner swaths, the following value is added in addition to (A) and (B).

16(=0x10)

0 : Missing value

(18) flagAnvil (Other than 2AKa)

Type	Array	Unit
1-byte integer	nray * nscan	N/A

flagAnvil is positive values when anvil precipitation is detected by the Ku-band radar. 0 when anvil precipitation is not detected.

The values are

Value Meaning

1 : Type 1 (without rain downward)

2 : Type 2 (with rain downward)

0 : Missing

1.3.7. SRT (Group)

(1) PIAalt

Type	Array	Array (2ADPR)	Unit
4-byte float	method * nray * nscan	nfreq * method * nray * nscan	dB

The path-integrated attenuation (dB) from the jth estimate, (PIAj in the notation above), where

PIAalt (j=1) = PIA derived from the forward along-track spatial reference data

PIAalt (j=2) = PIA derived from the backward along-track spatial reference data

PIAalt (j=3) = PIA derived from the forward hybrid/cross-track reference data

PIAalt (j=4) = PIA derived from the backward hybrid/cross-track reference data

PIAalt (j=5) = PIA derived from standard temporal reference data

PIAalt (j=6) = PIA derived from the light-rain temporal reference data

Note that for product versions 1 through 3, the standard temporal path-attenuation estimate, PIAalt(5), is set to missing but is defined for versions 4 and higher. For product versions 1 through 6, the light-rain temporal estimate, PIAalt(6), is set to missing. Note also that the forward/backward hybrid/cross-track path attenuations are defined only over ocean and are set to missing over land.

Missing Value:

-9999.9

In the 2ADPR,

nfreq(1) : TBD

nfreq(2) : TBD

(2) PIAdw (Only for 2ADPR)

Type	Array	Unit
4-byte float	nfreq * nray * nscan	dB

PIAdw (dB) is the path attenuation estimate derived from the standard dual-wavelength method.

Missing Value:

TBD

In the 2ADPR,

nfreq(1) : TBD

nfreq(2) : TBD

(3) PIAhb

Type	Array	Array (2ADPR)	Unit
4-byte float	nray * nscan	nfreq * nray * nscan	dB

PIAhb (dB) is the path attenuation estimate derived from the Hitschfeld-Bordan equation.

Missing Value:

-9999.9

In the 2ADPR,

nfreq(1) : TBD

nfreq(2) : TBD

(4) PIAhybrid

Type	Array	Array (2ADPR)	Unit
4-byte float	nray * nscan	nfreq * nray * nscan	dB

For the dual-frequency output, PIAhybrid (dB) is a weighted sum of the path attenuations from the SRT, HB, and DW methods. For the single-frequency outputs, PIAhybrid is a weighted sum of the SRT and HB methods.

Missing Value:

-9999.9

In the 2ADPR,

nfreq(1) : TBD

nfreq(2) : TBD

(5) PIAweight

Type	Array	Unit
4-byte float	method * nray * nscan	N/A

The weights, w, of the individual PIA estimates used in deriving the effective PIA. The weight for a particular PIA estimate is proportional to the inverse of the error variance associated with the method. The sum of the weights should equal one. As with PIAalt(6), PIAweight(6) is set to missing.

$$w_j = \frac{1}{\sigma_j^2}\frac{1}{\Sigma\frac{1}{\sigma_j^2}} \equiv u_j / \Sigma u_j$$

where

$u_j = 1/\sigma_j^2$

$$\sum w_j = 1$$

Missing Value:

-9999.9

method(1): TBD

method(2): TBD

method(3): TBD

method(4): TBD

method(5): TBD

method(6): TBD

(6) PIAweightHY

Type	Array	Unit
4-byte float	method * nray * nscan	N/A

TBD

Missing Value:

method(1): TBD

method(2): TBD

method(3): TBD (Only for 2ADPR)

(7) pathAtten

Type	Array	Array (2ADPR)	Unit
4-byte float	nray * nscan	nfreq * nray * nscan	dB

The estimated effective 2-way path-attenuation in (dB) where

$$\text{pathAtten} = 2\int_0^r k(s)ds$$

where k(s) is the attenuation coefficient in dB/km where the integral is taken from the storm top to the surface. The path attenuation is often designated as the PIA, the path-integrated attenuation. In the notation used above and in ATBD:

$$pathAtten = PIA_{eff} = (\Sigma u_j)^{-1}\Sigma u_j PIA_j$$

Where u_j is equal to the inverse of the variance associated with the jth reference data point:

$$u_j = 1/\sigma_j^2$$

Missing Value:

-9999.9

In the 2ADPR,

nfreq(1) : TBD

nfreq(2) : TBD

(8) reliabFactor

Type	Array	Unit
4-byte float	nray * nscan	N/A

Reliability Factor for the effective PIA estimate, pathAtten. This is defined as:

$$reliabFactor = \mathrm{Rel}_{eff} = (\Sigma u_j)^{-1/2} \Sigma u_j PIA_j$$

Missing Value:

-9999.9

(9) reliabFactorHY

Type	Array	Unit
4-byte float	nray * nscan	N/A

reliabFactorHY is the reliability factor associated with the PIAhybrid estimate and is defined as the mean over the standard deviation of the estimate.

Missing Value:

-9999.9

(10) reliabFactorAlt

Type	Array	Unit
4-byte float	method * nray * nscan	N/A

The reliability factors associated with the individual PIA estimates in PIAalt. As with PIAalt(6), (10) reliabFactorAlt(6) is set to missing.

$$reliabFactorAlt_j = \mathrm{Rel}_j = PIA_j/\sigma_j; j = 1,\ldots,6$$

Missing Value:

-9999.9

method(1): TBD

method(2): TBD

method(3): TBD

method(4): TBD

method(5): TBD

method(6): TBD

(11) reliabFlag

Type	Array	Unit
2-byte integer	nray * nscan	N/A

The reliability flag for the effective PIA estimate (pathAtten) based on the reliability factor (Rel_eff) in reliabFactor. Reliability Flag is:

= 1 if Rel_eff > 3 ; PIAeff estimate is considered reliable

= 2 if 3 >= Rel eff > 1 ; PIAeff estimate is considered marginally reliable

= 3 if Rel_eff ≦1 ; PIAeff is unreliable

= 4 if SNR at surface < 2dB ; provides a lower bound to the path-attenuation

= 9 (no-rain case)

Missing Value:

-9999.9

(12) reliabFlagHY

Type	Array	Unit
2-byte integer	nray * nscan	N/A

reliabFlagHY is the reliability flag for the PIAhybrid and is defined in the same way as reliabFlag where PIAeff is replaced by PIAhybrid.

Missing Value:

-9999.9

(13) refScanID

Type	Array	Unit
2-byte integer	nearFar * foreBack * nray * nscan	Number

refScanID gives the number of scan lines between the current scan and the beginning (or end) of the along-track reference data at each angle bin. The values are computed by the equation: Current Scan Number - Reference Scan Number. The values are positive for the Forward estimates and negative for the Backward estimates. The Fortran indices are:

Bit Meaning
1,1 : Forward - Near reference
2,1 : Forward - Far reference
1,2 : Backward - Near reference
2,2 : Backward - Far reference
9999 : Missing

To illustrate, consider the following example. At a certain incidence angle assume that rain is present at scan numbers from 100 to 105 and from 110 to 120. At scan number 112, refScanID(1,1)=3, refScanID(2,1)=16; i.e., the eight rain-free NRCS data points, used to estimate the mean and standard deviation of the rain-free NRCS, begin at scan 112-16 = 96 and end at scan 112-3=109. These numbers provide information on the distance (in terms of the numbers of scans where 1 scan ~5 km) of the rain-free reference data from the rain pixel of interest. See section 6 for further details.

(14) stddevEff

Type	Array	Array (2ADPR)	Unit
4-byte float	nsdew * nray * nscan	nfreq * nsdew * nray * nscan	N/A

stddevEff(1) contains the standard deviation of the PIAeff (i.e., the composite or effective SRT or hybrid path attenuation estimate). It is given by

$$\sigma_1 = (\sum 1/\sigma_{e,j}^2)^{-1/2} = (\sum u_j)^{-1/2}$$

It is important to note that in the definition of the reliability factor, it is this standard deviation that is used. In other words, with the notation in ATBD, we have $\sigma 1 = \sigma$ eff .

stddevEff(2) is a weighted root mean square error and provides a measured of the error of the individual PIA estimates from the effective PIA estimate. It is given by

$$\sigma_2 = [\sum w_j (A_{eff} - A_j)^2]^{1/2}$$

stddevEff(3) is given by

$$\sigma_3 = \left[\sigma_1^2 + \sigma_2^2 \right]^{1/2}$$

Missing Value:

-9999.9

In the 2ADPR,

nfreq(1) : TBD

nfreq(2) : TBD

(15) stddevHY

Type	Array	Array (2ADPR)	Unit
4-byte float	nray * nscan	nfreq * nray * nscan	N/A

stddevHy is the standard deviation (dB) of the hybrid estimate of path attenuation.

Missing Value:

-9999.9

In the 2ADPR,

nfreq(1) : TBD

nfreq(2) : TBD

(16) zeta

Type	Array	Array (2ADPR)	Unit
4-byte float	nray * nscan	nfreq * nray * nscan	N/A

zeta (unitless) is a parameter in the Hitschfeld-Bordan equation.

Missing Value:

-9999.9

In the 2ADPR,

nfreq(1) : TBD

nfreq(2) : TBD

1.3.8. DSD (Group)

(1) phase

Type	Array	Unit
1-byte unsigned integer	nbin * nray * nscan	N/A

Phase state of the precipitation. As an unsigned byte value this represents:

phase < 100 Temperature(C)=phase-100

phase > 200 Temperature(C)=phase-200

phase = 100 Top of the bright band

phase = 200 Bottom of the bright band

phase = 125 is used for the range bins between

the top and peak of bright band

phase = 175 is used for the range bins between

the peak and bottom of bright band

Integer values of phase/100 =

0 - solid

1 - mixed phase

2 - liquid

Missing Value:

225

(2) binNode

Type	Array	Unit
2-byte integer	nNode * nray * nscan	N/A

The bin number of the 5 nodes defined as:

1 - Bin number of storm top.

2 - Stratiform: 500m above center of bright band.

Convective: 750m above 0deg C level.

3 - Stratiform: center of bright band.

Convective: 0deg C level.

4 - Stratiform: 500m below center of bright band.

Convective: 750m below 0deg C level.

5 - Bin number of real surface equal to binRealSurface in PRE group.

For NS and MS swaths, bin numbers are 1-based ranging from 1 at the top of the data window with 176 at the Ellipsoid. For HS swaths, bin numbers are 1-based ranging from 1 at the top of the data window with 88 at the Ellipsoid.

Missing Value:

-9999

1.3.9. Experimental (Group)

(1) precipRateESurface2

Type	Array	Unit
4-byte float	nray * nscan	mm/hr

Estimates Surface Precipitation using alternate method.

Missing Value:

-9999.9

(2) precipRateESurface2Status

Type	Array	Unit
1-byte unsigned integer	nray * nscan	N/A

Status of the estimated surface precipitation using alternate method.

Missing Value:

225

(3) sigmaZeroProfile

Type	Array	Array (2ADPR)	Unit
4-byte float	nbinSZP * nray * nscan	nfreq * nbinSZP * nray * nscan	dB

Surface backscattering cross section profile around the current IFOV.

Missing Value:

-9999.9

nbinSZP(1): TBD

nbinSZP(2): TBD

nbinSZP(3): TBD

nbinSZP(4): TBD

nbinSZP(5): TBD

nbinSZP(6): TBD

nbinSZP(7): TBD

In the 2ADPR,

nfreq(1) : TBD

nfreq(2) : TBD

(4) seaIceConcentration

Type	Array	Unit
4-byte float	nray * nscan	%

Sea ice concentration (30.0 – 100.0%) estimated by Ku.

Missing Value:

-9999.9

(5) flagSurfaceSnowfall (Only for 2ADPR)

Type	Array	Unit
1-byte unsigned integer	nray * nscan	N/A

This flag takes the following value:

1: when surface snowfall exists (on surface, not aloft).

0: when surface snowfall doesn't exist.Missing Value:

-9999.9

(6) surfaceSnowfallIndex (Only for 2ADPR)

Type	Array	Unit
4-byte float	nray * nscan	N/A

flagSurfaceSnowfall is 1 when this index exceed the defined threshold.

When no rain or skipped, the value is 0.0.

Missing Value:

-9999.9

(7) flagGraupelHail (Only for 2ADPR)

Type	Array	Unit
1-byte unsigned integer	nray * nscan	N/A

This flag takes the following value:

1: Flag = 1 indicates graupel or hail exists along vertical profile.

0: Flag = 0 indicates no graupel or hail exists along profile.

Missing Value:

0

(8) binMixedPhaseTop (Only for 2ADPR)

Type	Array	Unit
2-byte integer	nray * nscan	range bin

Range bin number of MixedPhaseTop when it is detected.

Missing Value:

-9999

1.3.10. SLV (Group)

(1) flagSLV

Type	Array	Unit
1-byte integer	nbin * nray * nscan	N/A

A flag for each range bin data. At rain range bins, flagSLV is positive. At no-rain range bins, flagSLV is 0. If a range bin is located below ESurface, flagSLV is negative (-64). When the retrieval is abnormally terminated or data quality is bad, flagSLV is negative (-128).

The values are

flagSLV%2

0:no rain

1:rain

flagSLV%4

3:Zm is used for the retrieval

(1:extrapolated Ze is used for the retrieval)

(0:no rain)

flagSLV%16

(0-3:no rain)

4-7:only KuPR is used for the retrieval

8-11:only KaPR is used for the retrieval

12-15:Both KuPR and KaPR’s Zm are used for the retrieval

flagSLV%64

0-15:Dm takes normal value (or no-rain)

16-31:Dm takes the minimum value

32-47:Dm takes the maximum value

48-63:Dm takes an abnormal value

flagSLV% 256

0-63:R takes an normal value (or no-rain)

64-127:R takes the maximum value

(128:bad data quality)

(192:below ESurface)

Missing Value:

-99

(2) binEchoBottom

Type	Array	Unit
2-byte integer	nray * nscan	N/A

The bin number of bottom of echo. For NS and MS swaths, bin numbers are 1-based ranging from 1 at the top of the data window with 176 at the Ellipsoid. For HS swaths, bin numbers are 1-based ranging from 1 at the top of the data window with 88 at the Ellipsoid.

Missing Value:

-9999

(3) piaFinal

Type	Array	Array (2ADPR)	Unit
4-byte float	nray * nscan	nfreq * nray * nscan	dB

The final estimates of path integrated attenuation caused by precipitation particles. It is calculated from the retrieved DSD profiles. It includes the attenuation only by precipitation.

Missing Value:

-9999.9

In the 2ADPR,

nfreq(1) : TBD

nfreq(2) : TBD

(4) sigmaZeroCorrected

Type	Array	Array (2ADPR)	Unit
4-byte float	nray * nscan	nfreq * nray * nscan	dB

Surface backscatter cross section with attenuation correction.

Missing Value:

-9999.9

In the 2ADPR,

nfreq(1) : TBD

nfreq(2) : TBD

(5) zFactorCorrected

Type	Array	Array (2ADPR)	Unit
4-byte float	nbin * nray * nscan	nfreq * nbin * nray * nscan	dBZ

Vertical profile of reflectivity factor with attenuation correction.

10 log10(Z) where Z is in mm^6/m^3.

Missing Value:

-9999.9

In the 2ADPR,

nfreq(1) : TBD

nfreq(2) : TBD

(6) zFactorCorrectedESurface

Type	Array	Array (2ADPR)	Unit
4-byte float	nray * nscan	nfreq * nray * nscan	dBZ

Reflectivity factor with attenuation correction at estimated surface.

10 log10(Z) where Z is in mm^6/m^3.

Missing Value:

-9999.9

In the 2ADPR,

nfreq(1) : TBD

nfreq(2) : TBD

(7) zFactorCorrectedNearSurface

Type	Array	Array (2ADPR)	Unit
4-byte float	nray * nscan	nfreq * nray * nscan	dBZ

Reflectivity factor with attenuation correction at near surface.

10 log10(Z) where Z is in mm^6/m^3.

Missing Value:

-9999.9

In the 2ADPR,

nfreq(1) : TBD

nfreq(2) : TBD

(8) paramDSD

Type	Array	Unit
4-byte float	nDSD * nbin * nray * nscan	10 log10(Nw) mm

Parameters of DSD functions, Nw and Dm. Nw in $1/m^3$ mm

nDSD(1) : TBD

nDSD(2) : TBD

Missing Value:

-9999.9

(9) precipRate

Type	Array	Unit
4-byte float	nbin * nray * nscan	mm/hr

Precipitation rate.

Missing Value:

-9999.9

(10) precipWaterIntegrated

Type	Array	Unit
4-byte float	LS * nray * nscan	g/m^2

Precipitation water vertically integrated.

For LS=1, sum of liquid water (phase >= 200)

For LS=2, sum of non-liquid water (phase < 200)

Missing Value:

-9999.9

(11) precipRateNearSurface

Type	Array	Unit
4-byte float	nray * nscan	mm/hr

Precipitation rate for the nearSurface bin, i.e., at binClutterFreeBottom.

Missing Value:

-9999.9

(12) precipRateESurface

Type	Array	Unit
4-byte float	nray * nscan	mm/hr

Precipitation rate for the estimated surface, i.e., at binRealSurface.

Missing Value:

-9999.9

(13) precipRateAve24

Type	Array	Unit
4-byte float	nray * nscan	mm/hr

Average of precipitation rate for 2 to 4km height.

Missing Value:

-9999.9

(14) phaseNearSurface

Type	Array	Unit
1-byte unsigned integer	nray * nscan	N/A

Value of the Phase parameter in the DSD module at binClutterFreeBottom (nearSurface bin).

Missing Value:

255

(15) epsilon

Type	Array	Unit
4-byte float	nbin * nray * nscan	N/A

Epsilon is the indication of the adjustment away from the initial drop size distribution, epsilon = 1 is no adjustment.

Missing Value:

-9999.9

(16) paramNUBF

Type	Array	Unit
4-byte float	nNUBF * nray * nscan	N/A

The parameter to adjustment of None Uniform Beam Filling (NUBF).

paramNUBF(1) is σ_T^2 where $\sigma_T = \sqrt{\frac{\sigma^2+1}{p} - 1}$.

paramNUBF(2) is σ^2 where σ is the coefficient of variation of Nw.

paramNUBF(3) is p where p is the ratio of the raining area to the total area in FOV. (Currently p is set to 1.)

Missing Value:

-9999.9

(17) qualitySLV

Type	Array	Unit
4-byte integer	nscan	N/A

T.B.D

The values are

T.B.D

Missing Value:

-9999

1.3.11. FLG (Group)

(1) flagEcho

Type	Array	Unit
1-byte integer	nbin * nray * nscan	N/A

The values are

Bit Meaning
0 : For L2 Ku/PR: Precipitation judged by L2 Ku algorithm (copy of bit 2)
0 : For L2 Ka: Precipitation judged by L2 Ka algorithm (copy of bit 3)
0 : For L2 DPR: Precipitation judged by L2 DPR algorithm (copy of bit 1)
1 : Precipitation judged by L2 DPR algorithm
2 : Precipitation judged by L2 Ku algorithm
3 : Precipitation judged by L2 Ka algorithm
4 : Main lobe clutter judged by L2 Ku algorithm
5 : Main lobe clutter judged by L2 Ka algorithm
6 : Side lobe clutter judged by L2 Ku algorithm
7 : Side lobe clutter judged by L2 Ka algorithm

(2) qualityData

Type	Array	Unit
4-byte integer	nray * nscan	N/A

Normal data gives ”0”. Non-zero values mean the kinds of errors

The values are

The 2 bit flag for each module has values:
[higher bit lower bit]
[0 0] : Good
[0 1] : Warning but usable
[1 0] : NG or error
The bits of qualityData are assigned as follows:
0 - 7 : Copy of dataQuality in level 1B product

8 - 9 : Flag by input module

10 - 11 : Flag by preparation module

12 - 13 : Flag by vertical module

14 - 15 : Flag by classification module

16 - 17 : Flag by SRT module

18 - 19 : Flag by DSD module

20 - 21 : Flag by solver module

22 - 23 : Flag by output module

24 - 31 : Spare

-9999 : Missing

(3) flagSensor

Type	Array	Array (2ADPR)	Unit
1-byte integer	nscan	nfreq * nscan	N/A

Flag of input Ku/Ka data condition.

In the 2ADPR,

nfreq(1) : TBD

nfreq(2) : TBD

The values are

1 : Valid

-99 : Invalid (judged by dataQuality)

(4) qualityFlag

Type	Array	Array (2ADPR)	Unit
1-byte integer	nray*nscan	nfreq * nscan	N/A

qualityFlag is a sample flag gererated by qualityData.

In the 2ADPR,

nfreq(1) : TBD

nfreq(2) : TBD

The values are

0: High quality. No issues.

1 : Low quality. (DPR modules had warnings but still made a retrieval)

2: Bad. (DPR modules had errors or dataQuality is bad and retrieval is missing)

-99: Missing value

(5) flagScanPattern

Type	Array	Array (2ADPR)	Unit
2-byte integer	nscan	nfreq * nscan	N/A

Flag of scan pattern information. Ku and PR are always “0”.

In the 2ADPR,

nfreq(1) : Ku

nfreq(2) : Ka

The values are

0 : Original scan pattern. (from the beginning of the mission until May 21, 2018)

1 : KaHS outer swath scan pattern(After May 21, 2018)

-99: Others or Missing

1.3.12. TRG (Group)

(1) NUBFindex

Type	Array	Unit
4-byte float	nray * nscan	N/A

The value is 0.

(2) MSindex

Type	Array	Unit
1-byte unsigned integer	nray * nscan	N/A

The value is 0.

(3) MSindexKu

Type	Array	Unit
1-byte integer	nray * nscan	N/A

The value is 0.

(4) MSindexKa

Type	Array	Unit
1-byte integer	nray * nscan	N/A

The value is 0.

(5) precipFrac

Type	Array	Unit
1-byte unsigned integer	3*nray * nscan	N/A

The value is 0.

(6) RNUBFcond

Type	Array	Unit
4-byte float	nray * nscan	N/A

The value is 0.

(7) MSsurfPeakIndexKu

Type	Array	Unit
1-byte unsigned integer	nray * nscan	N/A

The value is 0.

(8) MSsurfPeakIndexKa

Type	Array	Unit
1-byte unsigned integer	nray * nscan	N/A

The value is 0.

(9) MSthroughsurfIndexKu

Type	Array	Unit
1-byte unsigned integer	nray * nscan	N/A

The value is 0.

(10) MSthroughsurfIndexKa

Type	Array	Unit
1-byte unsigned integer	nray * nscan	N/A

The value is 0.

(11) MSkneeDFRindex

Type	Array	Unit
1-byte unsigned integer	nray * nscan	N/A

The value is 0.

(12) MSthrZindex

Type	Array	Unit
1-byte unsigned integer	nray * nscan	N/A

The value is 0.

(13) NUBFratioPIAindex

Type	Array	Unit
1-byte unsigned integer	nray * nscan	N/A

The value is 0.

(14) NUBFnZmVarIndex

Type	Array	Unit
1-byte unsigned integer	3 * nray * nscan	N/A

The value is 0.

(15) NUBFnZkVarIndex

Type	Array	Unit
1-byte unsigned integer	3 * nray * nscan	N/A

The value is 0.

(16) NUBFnZmVarScaling

Type	Array	Unit
2-byte integer	nray * nscan	N/A

The value is 0.

(17) NUBFnZkVarScaling

Type	Array	Unit
2-byte integer	nray * nscan	N/A

The value is 0.

(18) NUBFsurfSliceIndex

Type	Array	Unit
4-byte float	30 * nray * nscan	N/A

The value is 0.

(19) NUBFprofZPC

Type	Array	Unit
4-byte float	30 * nray * nscan	N/A

The value is 0.

(20) MSbreakpoints

Type	Array	Unit
2-byte integer	13 * nray * nscan	N/A

The value is 0.

(21) MSslopes

Type	Array	Unit
4-byte float	10 * nray * nscan	N/A

The value is 0.

(22) MSslopePoints

Type	Array	Unit
4-byte float	13 * nray * nscan	N/A

The value is 0.

(23) MSslopeFits

Type	Array	Unit
4-byte float	6 * nray * nscan	N/A

The value is 0.

(24) MSlowSNRrangeFilter

Type	Array	Unit
1-byte unsigned integer	4 * nray * nscan	N/A

The value is 0.

(25) NUBFcorrPIA

Type	Array	Unit
4-byte float	2 * nray * nscan	N/A

The value is 0.

(26) triggerParameters

Type	Array	Unit
4-byte float	8 * nray * nscan	N/A

The value is 0.

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