ENV Product Format

Version 1.0

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Japan Aerospace Exploration Agency

Revision history

revision	date	section	content, reason
Version 1.0	Sept. 2nd 2014	ALL	New

Reference

(1) PRECIPITATION PROCESSING SYSTEM GLOBAL PRECIPITATION MEASUREMENT "File

Specification for GPM Products", Version 1P22 February 20, 2014

(2) PRECIPITATION PROCESSING SYSTEM GLOBAL PRECIPITATION MEASUREMENT

"Metadata for GPM Products", Version 1.00 February 27, 2014

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1.1.1. Dimension definition

Dimension definitions:

- nscan
  - ➢ var Number of scans in the granule.
- nray
  - ➢ 49 Number of angle bins in each NS scan.
- nrayMS
  - ➢ 25 Number of angle bins in each MS scan.
- nrayHS
  - ➢ 24 Number of angle bins in each HS scan.
- nbin
  - ➢ 176 Number of range bins in each NS and MS ray. Bin interval is 125 m.
- nbinHS
  - ➢ 88 Number of range bins in each HS ray. Bin interval is 250 m.
- nNP
  - ➢ 4 Number of NP kinds.
- nRScan
  - ➢ 4 Number of Ref Scan ID.
- method
  - ➢ 6 Number of SRT methods.
- nNode
  - ➢ 5 Number of binNode.
- nDSD
  - ➢ 2 Number of DSD parameters. Parameters are N0 and D0.
- LS
  - ➢ 2 Liquid, solid.
- nwind
  - ➢ 2 Number of wind components: u, v
- nwater
  - ➢ 2 Source of water vapor data.

1.1.2. Data Format Structure for 2AKuENV – Ku environment

The 2AKuENV product contains atmospheric state information used in the DPR Ku retrieval process. This product is created by the 2AKu algorithm.

FileHeader	Metadata	[1.1.2.1]
InputRecord	Metadata	[1.1.2.2]
NavigationRecord	Metadata	[1.1.2.3]
FileInfo	Metadata	[1.1.2.4]
JAXAInfo	Metadata	[1.1.2.5]
SwathHeader	Metadata	[1.1.3.1]
ScanTIme	Group: nscan	[1.1.3.1]
Latitude	4-byte floa: nray x nscan	[1.1.3.1]
Longitude	4-byte floa: nray x nscan	[1.1.3.1]
VERENV	Group: nscan	[1.1.3.1]
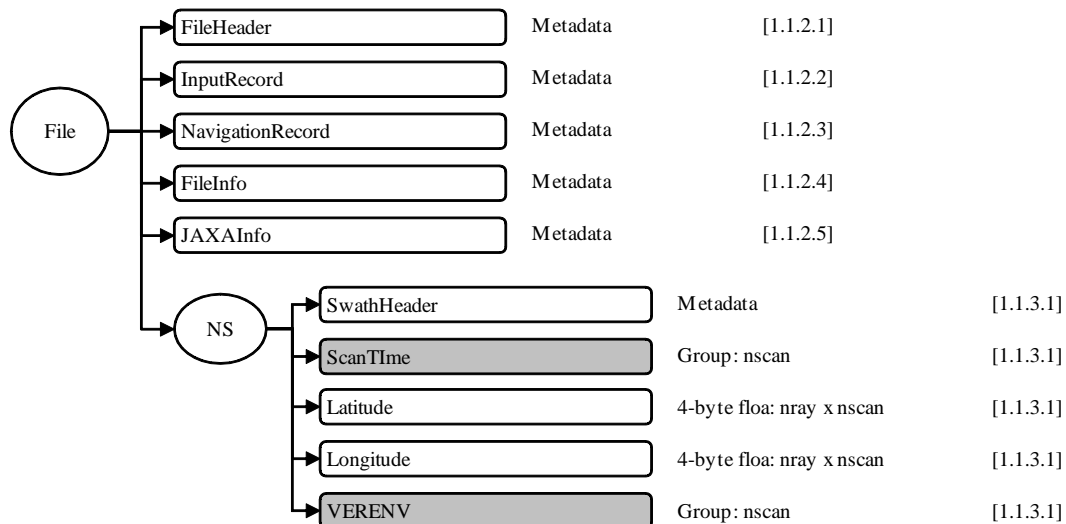
Figure 1.1-1 Data Format Structure for 2AKuENV – Ku environment

1.1.3. Data Format Structure for each Group

1.1.3.1 Data Format Structure for NS Group

NS Group's structure is shown in this section.

ScanTime		
Year	2-byte integer: nscan	[1.1.3.1]
Month	1-byte integer: nscan	[1.1.3.1]
DayOfMonth	1-byte integer: nscan	[1.1.3.1]
Hour	1-byte integer: nscan	[1.1.3.1]
Minute	1-byte integer: nscan	[1.1.3.1]
Second	1-byte integer: nscan	[1.1.3.1]
MiliSecond	2-byte integer: nscan	[1.1.3.1]
DayOfYear	2-byte integer: nscan	[1.1.3.1]
SecondOfDay	8-byte integer: nscan	[1.1.3.1]
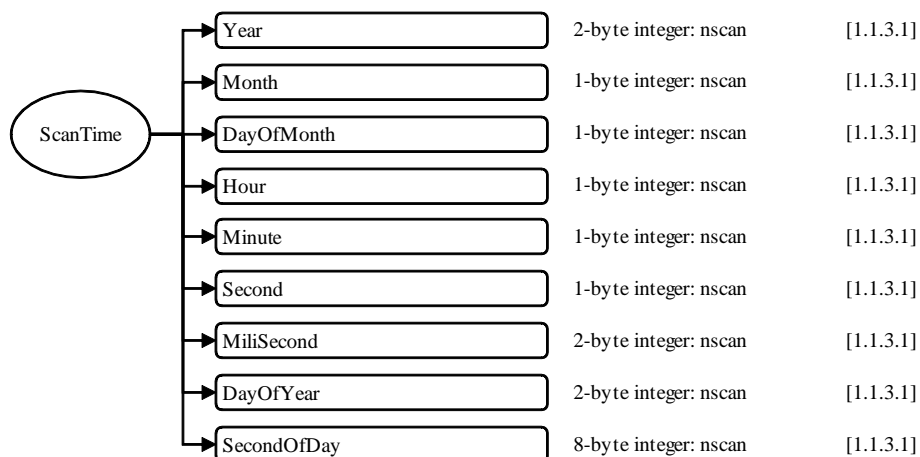
Figure 1.1-2 Data Format Structure for 2AKuENV, NS, ScanTime

VERENV		
airTemperarure	4-byte float: nbin x nray x nscan	[1.1.3.1]
airPressure	4-byte float: nbin x nray x nscan	[1.1.3.1]
waterVapor	4-byte float: nwater x nbin x nray x nscan	[1.1.3.1]
cloudLoquidWater	4-byte float: nwater x nbin x nray x nscan	[1.1.3.1]
surfacePressure	4-byte float: nray x nscan	[1.1.3.1]
skinTemperature	4-byte float: nray x nscan	[1.1.3.1]
surfaceTemperature	4-byte float: nray x nscan	[1.1.3.1]
surfaceWind	4-byte float: nwind x nray x nscan	[1.1.3.1]

Figure 1.1-3 Data Format Structure for 2AKuENV, NS, VERENV

1.1. Contents of objects in each Group

1.1.2. Metadata

1.1.2.1 FileHeader

FileHeader contains metadata of general interest. Table 1.1-1 shows each metadata elements in FileHeader.

Table 1.1-1 FileHeader Group

Metadata Element	Estimated Size (bytes)	Description
DOI	256	Digital Object Identifier
AlgorithmID	50	The algorithm that generated this product, e.g., 2A12.
AlgorithmVersion	50	The version of the algorithm that generated this product.
FileName	50	The file name of this granule.
SatelliteName	10	Values are: TRMM GPM MULTI F10 ... F18 AQUA GCOMW1 CORIOLIS MT1 NOAA15 ... NOAA19 METOPANPP. More values will be added as they are known.
InstrumentName	10	Values are: PR TMI VIRS PRTMI KU KA DPR GMI DPRGMI MERGED SSMI SSMIS AMSRE AMSR2 WIND-SAT MADRAS AMSUA AMSUB SAPHIR MHS ATMS. More values will be added as they are known.
GenerationDateTime	50	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
StartGranuleDateTime	50	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
StopGranuleDateTime	50	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
GranuleNumber	50	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.
NumberOfSwaths	50	The number of swaths in this granule.
NumberOfGrids	50	The number of grid structures in this granule.
GranuleStart	50	The starting place in the orbit of this granule. Currently defined values are ”SOUTHERNMOST LATITUDE” and ”NORTHBOUND EQUATOR CROSSING”.
TimeInterval	50	The time interval covered by this granule. Values are ”ORBIT”, ”HALF ORBIT”, ”HALF HOUR”, ”HOUR”, ”3 HOUR”, ”DAY”, ”MONTH”, ”CONTACT”.
ProcessingSystem	50	The name of the processing system, e.g., ”PPS”, ”JAXA”.
ProductVersion	50	The data version assigned by the processing system.
EmptyGranule	50	Whether a granule is empty. Values are ”EMPTY” or ”NOT EMPTY”.

Metadata Element	Estimated Size (bytes)	Description
MissingData	50	The number of missing scans.

1.1.2.2 InputRecord

InputRecord contains a record of input files for this granule. Table 1.1-2 shows each metadata elements in InputRecord.

Table 1.1-2 InputRecord Group

Metadata Element	Estimated Size (bytes)	Description
InputFileName	1000	A list of input file names for this granule.
InputAlgorithmVersions	1000	A list of algorithm versions of the input files for this granule.
InputGenerationDatteTimes	1000	A list of generation date times of the input files for this granule. The format is the same as GenerationDateTime.

1.1.2.3 NavigationRecord

NavigationRecord contains navigation metadata for this granule. Table 1.1-3 shows each metadata elements in NavigationRecord.

Table 1.1-3 NavigationRecord Group

Metadata Element	Estimated Size (bytes)	Description
LongitudeOnEquator	50	The longitude where the satellite crosses the equator going from south to north.
UTCDateTimeOnEquator	50	The UTC time when the satellite crosses the equator going from south to north. The format is the same as GenerationDate Time.
MeanSolarBetaAngle	50	The average solar beta angle in this granule.
EphemerisFileName	50	Name of the ephemeris file input for processing.
AttitudeFileName	50	Name of the attitude file input for processing.
GeoControlFileName	50	Name of the GeoTK Control Parameters File input for processing.
EphemerisSource	50	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"
AttitudeSource	50	Values are "0 CONSTANT INPUTS FOR TESTING", "1 ON BOARD CALCULATED PITCH ROLL YAW"
GeoToolkitVersion	50	Version of the GeoToolkit
SensorAlignmentFirstRotationAngle	50	Alignment angle, first rotation, in degrees. Rotation adjustment from sensor coordinates to the Attitude Control System Flight Coordinates.
SensorAlignmentSecondRotationAngle	50	Alignment angle, second rotation, in degrees.
SensorAlignmentThirdRotationAngle	50	Alignment angle, third rotation, in degrees.
SensorAlignmentFirstRotationAxis	50	Euler rotation sequence, first rotation axis. Values are "1", "2", "3" (representing X, Y, Z).
SensorAlignmentSecondRotationAxis	50	Euler rotation sequence, second rotation axis. Values are "1", "2", "3" (representing X, Y, Z).

Metadata Element	Estimated Size (bytes)	Description
SensorAlignmentThirdRotationAxis	50	Euler rotation sequence, third rotation axis. Values are "1", "2", "3" (representing X, Y, Z).

1.1.2.4 FileInfo

FileInfo contains metadata used by the PPS I/O Toolkit. Table 1.1-4 shows each metadata elements in FileInfo.

Table 1.1-4 FileInfo Group

Metadata Element	Estimated Size (bytes)	Description
DataFormatVersion	50	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" ...
TKCodeBuildVersion	50	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.
MetadataVersion	50	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" ...
FormatPackage	50	The underlying format of this granule. Values are "HDF4", "HDF5", "NETCDF", "TKBINARY"
BlueprintFilename	50	The filename of the primary blueprint file that defined the format used to write this file.
BlueprintVersion	10	The BlueprintVersion of the format definition
TKIOVersion	50	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.
MetadataStyle	50	The style in which the metadata was written, e.g., "PVL". "PVL" means < parameter >=< value >;
EndianType	50	The endian type of the system that wrote this file. Values are "BIG ENDIAN" and "LITTLE ENDIAN".

1.1.2.5 JAXAInfo

JAXAInfo contains metadata requested by JAXA.Used by DPR algorithms and GSMaP. Table 1.1-5 shows each metadata elements in JAXAInfo.

Table 1.1-5 JAXAInfo Group

Metadata Element	Estimated Size (bytes)	Description
GranuleFirstScanUTCDateTime	50	Granule First 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. The missing value is constructed by replacing all digits with 9, i.e.,9999-99-99T99:99:99.999Z.
GranuleLastScanUTCDateTime	50	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.
TotalQualityCode	50	Total quality of the GPM product, e.g., "Good", "Fair" or "EG".

Metadata Element	Estimated Size (bytes)	Description
FirstScanLat	50	Latitude of orbit first scan.
FirstScanLon	50	Longitude of orbit first scan.
LastScanLat	50	Latitude of orbit last scan.
LastScanLon	50	Longitude of orbit last scan.
NumberOfRainPixelsNS	50	Number of rain pixels in the NS swath, judged at DPR L2 algorithm. At DPR L1, value is "-9999".
NumberOfRainPixelsMS	50	Number of rain pixels in the MS swath, judged at DPR L2algorithm. At DPR L1, value is "-9999".
NumberOfRainPixelsHS	50	Number of rain pixels in the HS swath, judged at DPR L2algorithm. At DPR L1, value is "-9999".
ProcessingSubSystem	50	The name of the processing sub-system, e.g., "ALGORITHM","PCS".
ProcessingMode	50	The name of the processing mode, e.g., "STD","NRT".
lightSpeed	50	A constant value of light speed.
dielectricConstantKu	50	A parameter of dielectric for Ku.
dielectricConstantKa	50	A parameter of dielectric for Ka.

1.1.3. Data Group

Elements of data group are explained in detail in this section.

1.1.3.1 NS (Swath)

(1) NS_SwathHeader (Metadata)

NS_SwathHeader contains metadata for swaths.

<u>Table 1.1-6 NS_SwathHeader Group</u>

Metadata Element	Estimated Size (bytes)	Description
NumberScansInSet	50	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 NumberScansInSet=2 for the high frequency swath.
MaximumNumberScansTotal	50	The maximum allowed number of total scans in this swath. Total scans = overlap scans before granule + scans in granule + overlap scans after granule.
NumberScansBeforeGranule	50	The number of overlap scans before the first scan of the granule in this swath.
NumberScansGranule	50	The number of scans in the granule in this swath.
NumberScansAfterGranule	50	The number of overlap scans after the last scan of the granule in this swath.
NumberPixels	50	The number of IFOV in each scan in this swath.
ScanType	50	The type of scan in this swath. Values are: "CROSSTRACK" and "CONICAL"

(2) ScanTime (Group in NS)

Year (2-byte integer, array size: nscan)

4-digit year, e.g., 1998. Values range from 1950 to 2100 years. Special values are defined as:

-9999   Missing value

Month (1-byte integer, array size: nscan)

Month of the year. Values range from 1 to 12 months. Special values are defined as:

-99   Missing value

DayOfMonth (1-byte integer, array size: nscan)

Day of the month. Values range from 1 to 31 days. Special values are defined as:

-99   Missing value

Hour (1-byte integer, array size: nscan)

UTC hour of the day. Values range from 0 to 23 hours. Special values are defined as:

-99   Missing value

Minute (1-byte integer, array size: nscan)

Minute of the hour. Values range from 0 to 59 minutes. Special values are defined as:

-99   Missing value

Second (1-byte integer, array size: nscan)

Second of the minute. Values range from 0 to 60 s. Special values are defined as:

-99   Missing value

MilliSecond (2-byte integer, array size: nscan)

Thousandths of the second. Values range from 0 to 999 ms. Special values are defined as:

-9999   Missing value

DayOfYear (2-byte integer, array size: nscan)

Day of the year. Values range from 1 to 366 days. Special values are defined as:

-9999   Missing value

SecondOfDay (8-byte float, array size: nscan)

A time associated with the scan. scanTime sec is expressed as the UTC seconds of the day. Values range from 0 to 86400 s. Special values are defined as:

-9999.9   Missing value

Table 1.1-7 ScanTime Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	Year	-9999	1950	2100	[year]	2-byte integer	2 x nscan	2	nscan	1	1
2	Month	-99	1	12	[month]	1-byte integer	1 x nscan	1	nscan	1	1
3	DayOFMonth	-99	1	31	[day]	1-byte integer	1 x nscan	1	nscan	1	1
4	Hour	-99	0	23	[hour]	1-byte integer	1 x nscan	1	nscan	1	1
5	Minute	-99	0	59	[minute]	1-byte integer	1 x nscan	1	nscan	1	1
6	Second	-99	0	60	[s]	1-byte integer	1 x nscan	1	nscan	1	1
7	MilliSecond	-9999	0	999	[ms]	2-byte integer	2 x nscan	2	nscan	1	1
8	DayOfYear	-9999	1	366	[day]	2-byte integer	2 x nscan	2	nscan	1	1
9	SecoundOfDay	-9999.9	0	86400	[s]	8-byte float	8 x nscan	8	nscan	1	1

(3) Latitude (4-byte float, array size: nray x nscan)

The earth latitude of the center of the IFOV at the altitude of the earth ellipsiod. Latitude is positive north, negative south. Values range from -90 to 90 degrees. Special values are defined as:

-9999.9   Missing value

Table 1.1-8 Latitude Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	Latitude	-9999.9	-90	90	[degree]	4-byte float	4 x 49 x nscan	4	nray	nscan	1

(4) Longitude (4-byte float, array size: nray x nscan)

The earth longitude of the center of the IFOV at the altitude of the earth ellipsiod. Longitude is positive east, negative west. A point on the 180th meridian has the value -180 degrees. Values range from -180 to 180 degrees. Special values are defined as:

-9999.9   Missing value

Table 1.1-9 Longitude Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	Longitude	-9999.9	-180	180	[degree]	4-byte float	4 x 49 x nscan	4	nray	nscan	1

(5) VERENV (Group in NS)

airTemperature (4-byte float, array size: nbin x nray x nsca)

Vertical profile of air temperature inserted from the ancillary data. Values are in K. Special values are defined as:

-9999.9Missing value

airPressure (4-byte float, array size: nbin x nray x nscan)

Vertical profile of air pressure inserted from the ancillary data. Values are in hPa. Special values are defined as:

-9999.9 Missing value

waterVapor (4-byte float, array size: nwater x nbin x nray x nscan)

Vertical profile of water vapor. nwater = 0: a value diagnosed by the algorithm. nwater = 1: a value inserted from the ancillary data.Values are in kg/m^3. Special values are defined as:

-9999.9 Missing value

cloudLiquidWater (4-byte float, array size: nwater x nbin x nray x nscan)

Vertical profile of cloud liquid water. nwater = 0: a value diagnosed by the algorithm. nwater = 1: a value inserted from the ancillary data. Values are in kg/m^3. Special values are defined as:

-9999.9 Missing value

surfacePressure (4-byte float, array size: nray x nscan)

Surface pressure inserted from the ancillary data. Values are in hPa. Special values are defined as:

-9999.9 Missing value

skinTemperature (4-byte float, array size: nray x nscan)

Surface skin temperature inserted from the ancillary data. Values are in K. Special values are defined as:

-9999.9 Missing value

surfaceTemperature (4-byte float, array size: nray x nscan)

Surface (2m) air temperature inserted from the ancillary data. Values are in K. Special values are defined as:

-9999.9 Missing value

surfaceWind (4-byte float, array size: nwind x nray x nscan)

Surface wind. nwind = 0: zonal direction. nwind = 1: meridional direction. Values are in m/s. Special values are defined as:

-9999.9 Missing value

Table 1.1-10 VERENV Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array			
1	airTemperature	-9999.9	-	-	[k]	4-byte float	4 x 176 x 49 x nscan	4	nbin	nray		nscan
2	airPressure	-9999.9	-	-	[hpa]	4-byte float	4 x 176 x 49 x nscan	4	nbin	nray		nscan
3	waterVapor	-9999.9	-	-	[kg/m^3]	4-byte float	4 x 2 x 176 x 49 x nscan	4	nwater	nbin	nray	nscan
4	cloudLiquidWater	-9999.9	-	-	[kg/m^3]	4-byte float	4 x 2 x 176 x 49 x nscan	4	nwater	nbin	nray	nscan
5	surfacePressure	-9999.9	-	-	[hpa]	4-byte float	4 x 49 x nscan	4	nray	nscan		1
6	skinTemperature	-9999.9	-	-	[K:	4-byte float	4 x 49 x nscan	4	nray	nscan		1
7	surfaceTemperature	-9999.9	-	-	[K]	4-byte float	4 x 49 x nscan	4	nray	nscan		1

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
8	surfaceWind	-9999.9	-	-	[m/s]	4-byte float	4 x 2 x 49 x nscan	4	nwind	nray	nscan

2. 2AKaENV – Ka environment

2.1. Data Format Structure

2.1.1. Dimension definition

Dimension definitions:

- nscan
  - ➢ var   Number of scans in the granule.
- nray
  - ➢ 49   Number of angle bins in each NS scan.
- nrayMS
  - ➢ 25   Number of angle bins in each MS scan.
- nrayHS
  - ➢ 24   Number of angle bins in each HS scan.
- nbin
  - ➢ 176   Number of range bins in each NS and MS ray. Bin interval is 125 m.
- nbinHS
  - ➢ 88   Number of range bins in each HS ray. Bin interval is 250 m.
- nNP
  - ➢ 4   Number of NP kinds.
- nRScan
  - ➢ 4   Number of Ref Scan ID.
- method
  - ➢ 6   Number of SRT methods.
- nNode
  - ➢ 5   Number of binNode.
- nDSD
  - ➢ 2   Number of DSD parameters. Parameters are N0 and D0.
- LS
  - ➢ 2   Liquid, solid.
- nwind
  - ➢ 2   Number of wind components: u, v.
- nwater
  - ➢ 2   Source of water vapor data.

2.1.2. Data Format Structure for 2AKaENV – Ka environment

The 2AKaENV product contains atmospheric state information used into the 2AKu retrieval algorithm.
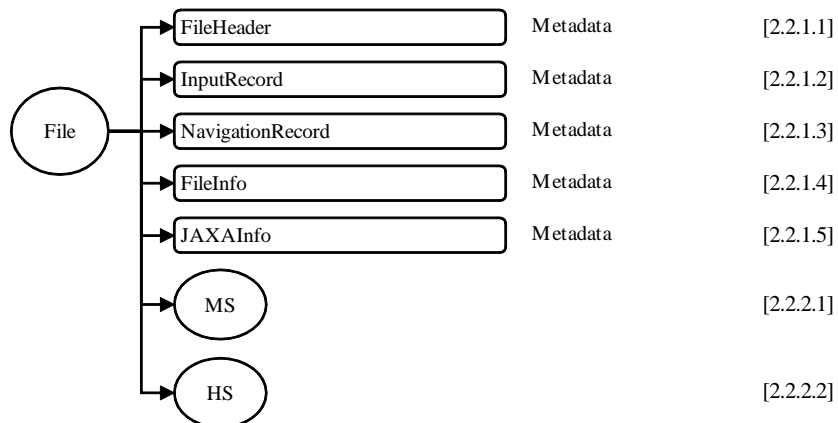
Figure 2.1-1 Data Format Structure for 2AKaENV – Ka environment

2.1.3. Data Format Structure for each Group

2.1.3.1 Data Format Structure for MS Group

MS Group's structure is shown in this section.

MS_SwathHeader	Metadata	[2.2.2.1]
ScanTime	Group: nscan	[2.2.2.1]
Latitude	4-byte float: nrayMS x nscan	[2.2.2.1]
Longitude	4-byte float: nrayMS x nscan	[2.2.2.1]
VERENV	Group: nscan	[2.2.2.1]
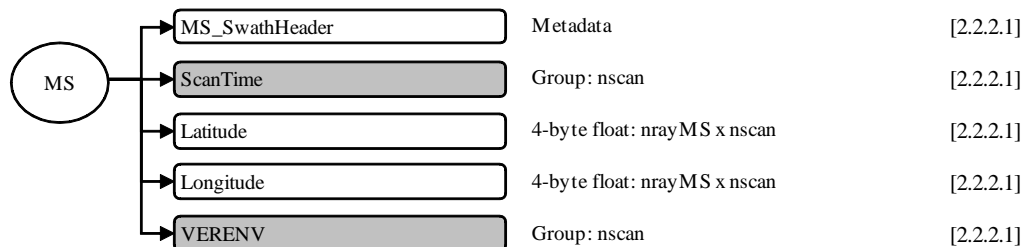
Figure 2.1-2 Data Format Structure for 2AKaENV, MS

Year	2-byte integer: nscan	[2.2.2.1]
Month	1-byte integer: nscan	[2.2.2.1]
DayOfMonth	1-byte integer: nscan	[2.2.2.1]
Hour	1-byte integer: nscan	[2.2.2.1]
Minute	1-byte integer: nscan	[2.2.2.1]
Second	1-byte integer: nscan	[2.2.2.1]
MiliSecond	2-byte integer: nscan	[2.2.2.1]
DayOfYear	2-byte integer: nscan	[2.2.2.1]
SecondOfDay	8-byte integer: nscan	[2.2.2.1]
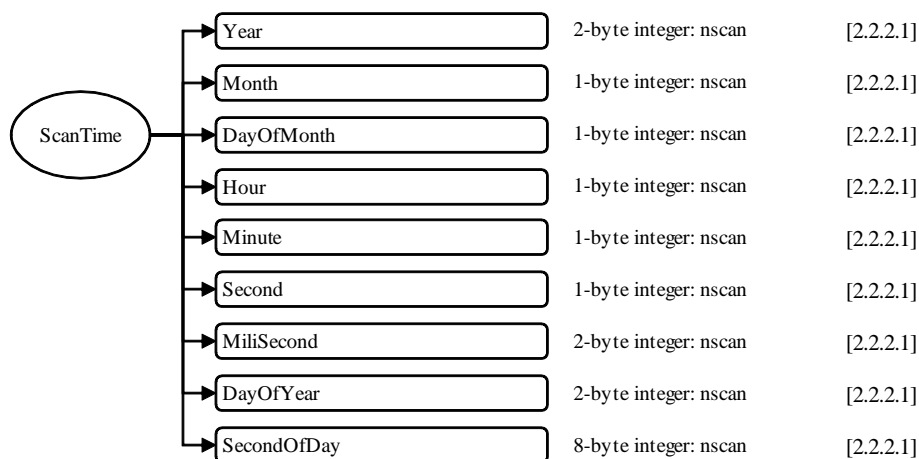
Figure 2.1-3 Data Format Structure for 2AKaENV, MS, ScanTime

airTemperarure	4-byte float: nbin x nrayMS x nscan	[2.2.2.1]
airPressure	4-byte float: nbin x nrayMS x nscan	[2.2.2.1]
waterVapor	4-byte float: nwater x nbin x nrayMS x nscan	[2.2.2.1]
cloudLoquidWater	4-byte float: nwater x nbin x nrayMS x nscan	[2.2.2.1]
surfacePressure	4-byte float: nrayMS x nscan	[2.2.2.1]
skinTemperature	4-byte float: nrayMS x nscan	[2.2.2.1]
surfaceTemperature	4-byte float: nrayMS x nscan	[2.2.2.1]
surfaceWind	4-byte float: nwind x nrayMS x nscan	[2.2.2.1]

Figure 2.1-4 Data Format Structure for 2AKaENV, MS, VERENV

2.1.3.2 Data Format Structure for HS Group
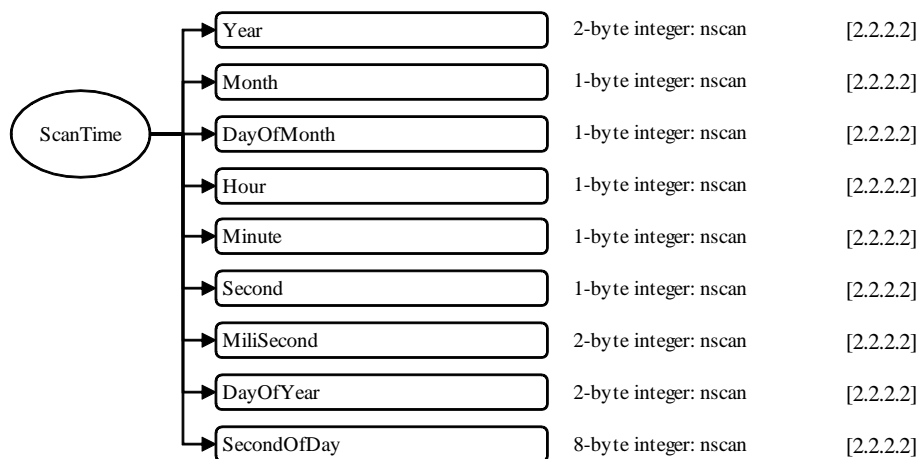
HS Group's structure is shown in this section.

NS_SwathHeader	Metadata	[2.2.2.2]
ScanTime	Group: nscan	[2.2.2.2]
Latitude	4-byte float: nrayHS x nscan	[2.2.2.2]
Longitude	4-byte float: nrayHS x nscan	[2.2.2.2]
VERENV	Group: nscan	[2.2.2.2]
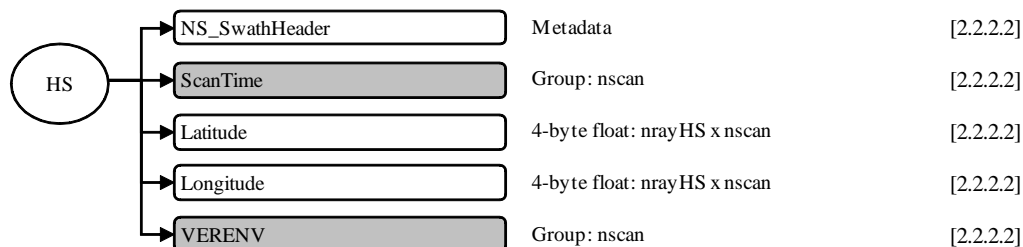
Figure 2.1-5 Data Format Structure for 2AKaENV, HS

Year	2-byte integer: nscan	[2.2.2.2]
Month	1-byte integer: nscan	[2.2.2.2]
DayOfMonth	1-byte integer: nscan	[2.2.2.2]
Hour	1-byte integer: nscan	[2.2.2.2]
Minute	1-byte integer: nscan	[2.2.2.2]
Second	1-byte integer: nscan	[2.2.2.2]
MiliSecond	2-byte integer: nscan	[2.2.2.2]
DayOfYear	2-byte integer: nscan	[2.2.2.2]
SecondOfDay	8-byte integer: nscan	[2.2.2.2]

Figure 2.1-6 Data Format Structure for 2AKaENV, HS, ScanTime

airTemperarure	4-byte float: nbin x nrayHS x nscan	[2.2.2.2]
airPressure	4-byte float: nbin x nrayHS x nscan	[2.2.2.2]
waterVapor	4-byte float: nwater x nbin x nrayHS x nscan	[2.2.2.2]
cloudLoquidWater	4-byte float: nwater x nbin x nrayHS x nscan	[2.2.2.2]
surfacePressure	4-byte float: nrayHS x nscan	[2.2.2.2]
skinTemperature	4-byte float: nrayHS x nscan	[2.2.2.2]
surfaceTemperature	4-byte float: nrayHS x nscan	[2.2.2.2]
surfaceWind	4-byte float: nwind x nrayHS x nscan	[2.2.2.2]

Figure 2.1-7 Data Format Structure for 2AKaENV, HS, VERENV

2.2. Contents of objects in each Group

2.2.1. Metadata

2.2.1.1 FileHeader

FileHeader contains metadata of general interest. Table 2.2-1 shows each metadata elements in FileHeader.

Table 2.2-1 FileHeader Group

Metadata Element	Estimated Size (bytes)	Description
DOI	256	Digital Object Identifier
AlgorithmID	50	The algorithm that generated this product, e.g., 2A12.
AlgorithmVersion	50	The version of the algorithm that generated this product.
FileName	50	The file name of this granule.
SatelliteName	10	Values are: TRMM GPM MULTI F10 ... F18 AQUA GCOMW1 CORIOLIS MT1 NOAA15 ... NOAA19 METOPANPP. More values will be added as they are known.
InstrumentName	10	Values are: PR TMI VIRS PRTMI KU KA DPR GMI DPRGMI MERGED SSMI SSMIS AMSRE AMSR2 WIND-SAT MADRAS AMSUA AMSUB SAPHIR MHS ATMS. More values will be added as they are known.
GenerationDateTime	50	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
StartGranuleDateTime	50	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
StopGranuleDateTime	50	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
GranuleNumber	50	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.
NumberOfSwaths	50	The number of swaths in this granule.
NumberOfGrids	50	The number of grid structures in this granule.
GranuleStart	50	The starting place in the orbit of this granule. Currently defined values are "SOUTHERNMOST LATITUDE" and "NORTHBOUND EQUATOR CROSSING".
TimeInterval	50	The time interval covered by this granule. Values are "ORBIT", "HALF ORBIT", "HALF HOUR", "HOUR", "3 HOUR", "DAY", "MONTH", "CONTACT".
ProcessingSystem	50	The name of the processing system, e.g., "PPS", "JAXA".
ProductVersion	50	The data version assigned by the processing system.
EmptyGranule	50	Whether a granule is empty. Values are "EMPTY" or "NOT EMPTY".

Metadata Element	Estimated Size (bytes)	Description
MissingData	50	The number of missing scans.

2.2.1.2 InputRecord

InputRecord contains a record of input files for this granule. Table 2.2-2 shows each metadata elements in InputRecord.

Table 2.2-2 InputRecord Group

Metadata Element	Estimated Size (bytes)	Description
InputFileName	1000	A list of input file names for this granule.
InputAlgorithmVersions	1000	A list of algorithm versions of the input files for this granule.
InputGenerationDatteTimes	1000	A list of generation date times of the input files for this granule. The format is the same as GenerationDateTime.

2.2.1.3 NavigationRecord

NavigationRecord contains navigation metadata for this granule. Table 2.2-3 shows each metadata elements in NavigationRecord.

Table 2.2-3 NavigationRecord Group

Metadata Element	Estimated Size (bytes)	Description
LongitudeOnEquator	50	The longitude where the satellite crosses the equator going from south to north.
UTCDateTimeOnEquator	50	The UTC time when the satellite crosses the equator going from south to north. The format is the same as GenerationDate Time.
MeanSolarBetaAngle	50	The average solar beta angle in this granule.
EphemerisFileName	50	Name of the ephemeris file input for processing.
AttitudeFileName	50	Name of the attitude file input for processing.
GeoControlFileName	50	Name of the GeoTK Control Parameters File input for processing.
EphemerisSource	50	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"
AttitudeSource	50	Values are "0 CONSTANT INPUTS FOR TESTING", "1 ON BOARD CALCULATED PITCH ROLL YAW"
GeoToolkitVersion	50	Version of the GeoToolkit
SensorAlignmentFirstRotationAngle	50	Alignment angle, first rotation, in degrees. Rotation adjustment from sensor coordinates to the Attitude Control System Flight Coordinates.
SensorAlignmentSecondRotationAngle	50	Alignment angle, second rotation, in degrees.
SensorAlignmentThirdRotationAngle	50	Alignment angle, third rotation, in degrees.
SensorAlignmentFirstRotationAxis	50	Euler rotation sequence, first rotation axis. Values are "1", "2", "3" (representing X, Y, Z).
SensorAlignmentSecondRotationAxis	50	Euler rotation sequence, second rotation axis. Values are "1", "2", "3" (representing X, Y, Z).

Metadata Element	Estimated Size (bytes)	Description
SensorAlignmentThirdRotat ionAxis	50	Euler rotation sequence, third rotation axis. Values are "1", "2", "3" (representing X, Y, Z).

2.2.1.4 FileInfo

FileInfo contains metadata used by the PPS I/O Toolkit. Table 2.2-4 shows each metadata elements in FileInfo.

Table 2.2-4 FileInfo Group

Metadata Element	Estimated Size (bytes)	Description
DataFormatVersion	50	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" ...
TKCodeBuildVersion	50	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.
MetadataVersion	50	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" ...
FormatPackage	50	The underlying format of this granule. Values are "HDF4", "HDF5", "NETCDF", "TKBINARY"
BlueprintFilename	50	The filename of the primary blueprint file that defined the format used to write this file.
BlueprintVersion	10	The BlueprintVersion of the format definition
TKIOVersion	50	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.
MetadataStyle	50	The style in which the metadata was written, e.g., "PVL". "PVL" means < parameter >=< value >;
EndianType	50	The endian type of the system that wrote this file. Values are "BIG ENDIAN" and "LITTLE ENDIAN".

2.2.1.5 JAXAInfo

JAXAInfo contains metadata requested by JAXA. Used by DPR algorithms and GSMaP. Table 2.2-5 shows each metadata elements in JAXAInfo.

Table 2.2-5 JAXAInfo Group

Metadata Element	Estimated Size (bytes)	Description
GranuleFirstScanUTCDate Time	50	Granule First 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. The missing value is constructed by replacing all digits with 9, i.e.,9999-99-99T99:99:99.999Z.
GranuleLastScanUTCDateT ime	50	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.
TotalQualityCode	50	Total quality of the GPM product, e.g., "Good", "Fair" or "EG".

Metadata Element	Estimated Size (bytes)	Description
FirstScanLat	50	Latitude of orbit first scan.
FirstScanLon	50	Longitude of orbit first scan.
LastScanLat	50	Latitude of orbit last scan.
LastScanLon	50	Longitude of orbit last scan.
NumberOfRainPixelsNS	50	Number of rain pixels in the NS swath, judged at DPR L2 algorithm. At DPR L1, value is "-9999".
NumberOfRainPixelsMS	50	Number of rain pixels in the MS swath, judged at DPR L2algorithm. At DPR L1, value is "-9999".
NumberOfRainPixelsHS	50	Number of rain pixels in the HS swath, judged at DPR L2algorithm. At DPR L1, value is "-9999".
ProcessingSubSystem	50	The name of the processing sub-system, e.g., "ALGORITHM","PCS".
ProcessingMode	50	The name of the processing mode, e.g., "STD","NRT".
lightSpeed	50	A constant value of light speed.
dielectricConstantKu	50	A parameter of dielectric for Ku.
dielectricConstantKa	50	A parameter of dielectric for Ka.

2.2.2. Data Group

Elements of data group are explained in detail in this section.

2.2.2.1 MS (Swath)

(1) MS_SwathHeader (Metadata)

MS_SwathHeader contains metadata for swaths.

Table 2.2-6 MS_SwathHeader Group

Metadata Element	Estimated Size (bytes)	Description
NumberScansInSet	50	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 NumberScansInSet=2 for the high frequency swath.
MaximumNumberScansTotal	50	The maximum allowed number of total scans in this swath. Total scans = overlap scans before granule + scans in granule + overlap scans after granule.
NumberScansBeforeGranule	50	The number of overlap scans before the first scan of the granule in this swath.
NumberScansGranule	50	The number of scans in the granule in this swath.
NumberScansAfterGranule	50	The number of overlap scans after the last scan of the granule in this swath.
NumberPixels	50	The number of IFOV in each scan in this swath.
ScanType	50	The type of scan in this swath. Values are: "CROSSTRACK" and "CONICAL"

(2) ScanTime (Group in MS)

Year (2-byte integer, array size: nscan)

4-digit year, e.g., 1998. Values range from 1950 to 2100 years. Special values are defined as:

-9999   Missing value

Month (1-byte integer, array size: nscan)

Month of the year. Values range from 1 to 12 months. Special values are defined as:

-99   Missing value

DayOfMonth (1-byte integer, array size: nscan)

Day of the month. Values range from 1 to 31 days. Special values are defined as:

-99   Missing value

Hour (1-byte integer, array size: nscan)

UTC hour of the day. Values range from 0 to 23 hours. Special values are defined as:

-99   Missing value

Minute (1-byte integer, array size: nscan)

Minute of the hour. Values range from 0 to 59 minutes. Special values are defined as:

-99   Missing value

Second (1-byte integer, array size: nscan)

Second of the minute. Values range from 0 to 60 s. Special values are defined as:

-99   Missing value

MilliSecond (2-byte integer, array size: nscan)

Thousandths of the second. Values range from 0 to 999 ms. Special values are defined as:

-9999   Missing value

DayOfYear (2-byte integer, array size: nscan)

Day of the year. Values range from 1 to 366 days. Special values are defined as:

-9999   Missing value

SecondOfDay (8-byte float, array size: nscan)

A time associated with the scan. scanTime sec is expressed as the UTC seconds of the day. Values range from 0 to 86400 s. Special values are defined as:

-9999.9   Missing value

Table 2.2-7 ScanTime Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	Year	-9999	1950	2100	[year]	2-byte integer	2 x nscan	2	nscan	1	1
2	Month	-99	1	12	[month]	1-byte integer	1 x nscan	1	nscan	1	1
3	DayOFMonth	-99	1	31	[day]	1-byte integer	1 x nscan	1	nscan	1	1
4	Hour	-99	0	23	[hour]	1-byte integer	1 x nscan	1	nscan	1	1
5	Minute	-99	0	59	[minute]	1-byte integer	1 x nscan	1	nscan	1	1
6	Second	-99	0	60	[s]	1-byte integer	1 x nscan	1	nscan	1	1
7	MilliSecond	-9999	0	999	[ms]	2-byte integer	2 x nscan	2	nscan	1	1
8	DayOfYear	-9999	1	366	[day]	2-byte integer	2 x nscan	2	nscan	1	1
9	SecoundOfDay	-9999.9	0	86400	[s]	8-byte float	8 x nscan	8	nscan	1	1

(3) Latitude (4-byte float, array size: nrayMS x nscan)

The earth latitude of the center of the IFOV at the altitude of the earth ellipsiod. Latitude is positive north, negative south. Values range from -90 to 90 degrees. Special values are defined as:

-9999.9   Missing value

Table 2.2-8 Latitude Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	Latitude	-9999.9	-90	90	[degree]	4-byte float	4 x 25 x nscan	4	nrayMS	nscan	1

(4) Longitude (4-byte float, array size: nrayMS x nscan)

The earth longitude of the center of the IFOV at the altitude of the earth ellipsiod. Longitude is positive east, negative west. A point on the 180th meridian has the value -180 degrees. Values range from -180 to 180 degrees. Special values are defined as:

-9999.9   Missing value

Table 2.2-9 Longitude Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	Longitude	-9999.9	-180	180	[degree]	4-byte float	4 x 25 x nscan	4	nrayMS	nscan	1

(5) VERENV (Group in MS)

airTemperature (4-byte float, array size: nbin x nrayMS x nsca)

Vertical profile of air temperature inserted from the ancillary data. Values are in K. Special values are defined as:

-9999.9Missing value

airPressure (4-byte float, array size: nbin x nrayMS x nscan)

Vertical profile of air pressure inserted from the ancillary data. Values are in hPa. Special values are defined as:

-9999.9 Missing value

waterVapor (4-byte float, array size: nwater x nbin x nrayMS x nscan)

Vertical profile of water vapor. nwater = 0: a value diagnosed by the algorithm. nwater = 1: a value inserted from the ancillary data.Values are in kg/m^3. Special values are defined as:

-9999.9 Missing value

cloudLiquidWater (4-byte float, array size: nwater x nbin x nrayMS x nscan)

Vertical profile of cloud liquid water. nwater = 0: a value diagnosed by the algorithm. nwater = 1: a value inserted from the ancillary data. Values are in kg/m^3. Special values are defined as:

-9999.9 Missing value

surfacePressure (4-byte float, array size: nrayMS x nscan)

Surface pressure inserted from the ancillary data. Values are in hPa. Special values are defined as:

-9999.9 Missing value

skinTemperature (4-byte float, array size: nrayMS x nscan)

Surface skin temperature inserted from the ancillary data. Values are in K. Special values are defined as:

-9999.9 Missing value

surfaceTemperature (4-byte float, array size: nrayMS x nscan)

Surface (2m) air temperature inserted from the ancillary data. Values are in K. Special values are defined as:

-9999.9 Missing value

surfaceWind (4-byte float, array size: nwind x nrayMS x nscan)

Surface wind. nwind = 0: zonal direction. nwind = 1: meridional direction. Values are in m/s. Special values are defined as:

-9999.9 Missing value

Table 2.2-10 VERENV Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array			
1	airTemperature	-9999.9	-	-	[k]	4-byte float	4 x 176 x 25 x nscan	4	nbin	nrayMS		nscan
2	airPressure	-9999.9	-	-	[hpa]	4-byte float	4 x 176 x 25 x nscan	4	nbin	nrayMS		nscan
3	waterVapor	-9999.9	-	-	[kg/m³]	4-byte float	4 x 2 x 176 x 25 x nscan	4	nwater	nbin	nrayMS	nscan
4	cloudLiquidWater	-9999.9	-	-	[kg/m³]	4-byte float	4 x 2 x 176 x 25 x nscan	4	nwater	nbin	nrayMS	nscan
5	surfacePressure	-9999.9	-	-	[hpa]	4-byte float	4 x 25 x nscan	4	nrayMS	nscan		1
6	skinTemperature	-9999.9	-	-	[K]	4-byte float	4 x 25 x nscan	4	nrayMS	nscan		1
7	surfaceTemperature	-9999.9	-	-	[K]	4-byte float	4 x 25 x nscan	4	nrayMS	nscan		1

2.2. UContents of objects in each Group
2.2.2. Data Group
2.2.2.1. MS (Swath)

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
8	surfaceWind	-9999.9	-	-	[m/s]	4-byte float	4 x 2 x 25 x nscan	4	nwind	nrayMS	nscan

2.2.2.2 HS (Swath)

(1) HS_SwathHeader (Metadata)

HS_SwathHeader contains metadata for swaths.

<p align="center"><u>Table 2.2-11 HS_SwathHeader Group</u></p>

Metadata Element	Estimated Size (bytes)	Description
NumberScansInSet	50	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 NumberScansInSet=2 for the high frequency swath.
MaximumNumberScansTotal	50	The maximum allowed number of total scans in this swath. Total scans = overlap scans before granule + scans in granule + overlap scans after granule.
NumberScansBeforeGranule	50	The number of overlap scans before the first scan of the granule in this swath.
NumberScansGranule	50	The number of scans in the granule in this swath.
NumberScansAfterGranule	50	The number of overlap scans after the last scan of the granule in this swath.
NumberPixels	50	The number of IFOV in each scan in this swath.
ScanType	50	The type of scan in this swath. Values are: "CROSSTRACK" and "CONICAL"

(2) ScanTime (Group in HS)

Year (2-byte integer, array size: nscan)

4-digit year, e.g., 1998. Values range from 1950 to 2100 years. Special values are defined as:

-9999   Missing value

Month (1-byte integer, array size: nscan)

Month of the year. Values range from 1 to 12 months. Special values are defined as:

-99   Missing value

DayOfMonth (1-byte integer, array size: nscan)

Day of the month. Values range from 1 to 31 days. Special values are defined as:

-99   Missing value

Hour (1-byte integer, array size: nscan)

UTC hour of the day. Values range from 0 to 23 hours. Special values are defined as:

-99   Missing value

Minute (1-byte integer, array size: nscan)

Minute of the hour. Values range from 0 to 59 minutes. Special values are defined as:

-99   Missing value

Second (1-byte integer, array size: nscan)

Second of the minute. Values range from 0 to 60 s. Special values are defined as:

-99   Missing value

MilliSecond (2-byte integer, array size: nscan)

Thousandths of the second. Values range from 0 to 999 ms. Special values are defined as:

-9999   Missing value

DayOfYear (2-byte integer, array size: nscan)

Day of the year. Values range from 1 to 366 days. Special values are defined as:

-9999   Missing value

SecondOfDay (8-byte float, array size: nscan)

A time associated with the scan. scanTime sec is expressed as the UTC seconds of the day. Values range from 0 to 86400 s. Special values are defined as:

-9999.9   Missing value

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Table 2.2-12 ScanTime Elements

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No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	Year	-9999	1950	2100	[year]	2-byte integer	2 x nscan	2	nscan	1	1
2	Month	-99	1	12	[month]	1-byte integer	1 x nscan	1	nscan	1	1
3	DayOFMonth	-99	1	31	[day]	1-byte integer	1 x nscan	1	nscan	1	1
4	Hour	-99	0	23	[hour]	1-byte integer	1 x nscan	1	nscan	1	1
5	Minute	-99	0	59	[minute]	1-byte integer	1 x nscan	1	nscan	1	1
6	Second	-99	0	60	[s]	1-byte integer	1 x nscan	1	nscan	1	1
7	MilliSecond	-9999	0	999	[ms]	2-byte integer	2 x nscan	2	nscan	1	1
8	DayOfYear	-9999	1	366	[day]	2-byte integer	2 x nscan	2	nscan	1	1
9	SecoundOfDay	-9999.9	0	86400	[s]	8-byte float	8 x nscan	8	nscan	1	1

(3) Latitude (4-byte float, array size: nrayHS x nscan)

The earth latitude of the center of the IFOV at the altitude of the earth ellipsiod. Latitude is positive north, negative south. Values range from -90 to 90 degrees. Special values are defined as:

-9999.9   Missing value

<div align="center">

Table 2.2-13 Latitude Elements

</div>

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	Latitude	-9999.9	-90	90	[degree]	4-byte float	4 x 24 x nscan	4	nrayHS	nscan	1

(4) Longitude (4-byte float, array size: nrayHS x nscan)

The earth longitude of the center of the IFOV at the altitude of the earth ellipsiod. Longitude is positive east, negative west. A point on the 180th meridian has the value -180 degrees. Values range from -180 to 180 degrees. Special values are defined as:

-9999.9   Missing value

<div align="center">

Table 2.2-14 Longitude Elements

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No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	Longitude	-9999.9	-180	180	[degree]	4-byte float	4 x 24 x nscan	4	nrayHS	nscan	1

(5) VERENV (Group in HS)

airTemperature (4-byte float, array size: nbin x nrayHS x nsca)

Vertical profile of air temperature inserted from the ancillary data. Values are in K. Special values are defined as:

-9999.9Missing value

airPressure (4-byte float, array size: nbin x nrayHS x nscan)

Vertical profile of air pressure inserted from the ancillary data. Values are in hPa. Special values are defined as:

-9999.9 Missing value

waterVapor (4-byte float, array size: nwater x nbin x nrayHS x nscan)

Vertical profile of water vapor. nwater = 0: a value diagnosed by the algorithm. nwater = 1: a value inserted from the ancillary data.Values are in kg/m^3. Special values are defined as:

-9999.9 Missing value

cloudLiquidWater (4-byte float, array size: nwater x nbin x nrayHS x nscan)

Vertical profile of cloud liquid water. nwater = 0: a value diagnosed by the algorithm. nwater = 1: a value inserted from the ancillary data. Values are in kg/m^3. Special values are defined as:

-9999.9 Missing value

surfacePressure (4-byte float, array size: nrayHS x nscan)

Surface pressure inserted from the ancillary data. Values are in hPa. Special values are defined as:

-9999.9 Missing value

skinTemperature (4-byte float, array size: nrayHS x nscan)

Surface skin temperature inserted from the ancillary data. Values are in K. Special values are defined as:

-9999.9 Missing value

surfaceTemperature (4-byte float, array size: nrayHS x nscan)

Surface (2m) air temperature inserted from the ancillary data. Values are in K. Special values are defined as:

-9999.9 Missing value

surfaceWind (4-byte float, array size: nwind x nrayHS x nscan)

Surface wind. nwind = 0: zonal direction. nwind = 1: meridional direction. Values are in m/s. Special values are defined as:

-9999.9 Missing value

Table 2.2-15 VERENV Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array			
1	airTemperature	-9999.9	-	-	[k]	4-byte float	4 x 176 x 24 x nscan	4	nbin	nrayHS		nscan
2	airPressure	-9999.9	-	-	[hpa]	4-byte float	4 x 176 x 24 x nscan	4	nbin	nrayHS		nscan
3	waterVapor	-9999.9	-	-	[kg/m^3]	4-byte float	4 x 2 x 176 x 24 x nscan	4	nwater	nbin	nrayHS	nscan
4	cloudLiquidWater	-9999.9	-	-	[kg/m^3]	4-byte float	4 x 2 x 176 x 24 x nscan	4	nwater	nbin	nrayHS	nscan
5	surfacePressure	-9999.9	-	-	[hpa]	4-byte float	4 x 24 x nscan	4	nrayHS	nscan		1
6	skinTemperature	-9999.9	-	-	[K:	4-byte float	4 x 24 x nscan	4	nrayHS	nscan		1
7	surfaceTemperature	-9999.9	-	-	[K]	4-byte float	4 x 24 x nscan	4	nrayHS	nscan		1

2.2. UContents of objects in each Group
2.2.2. Data Group
2.2.2.2. HS (Swath)

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
8	surfaceWind	-9999.9	-	-	[m/s]	4-byte float	4 x 2 x 24 x nscan	4	nwind	nrayHS	nscan

3. 2ADPRENV – DPR environment
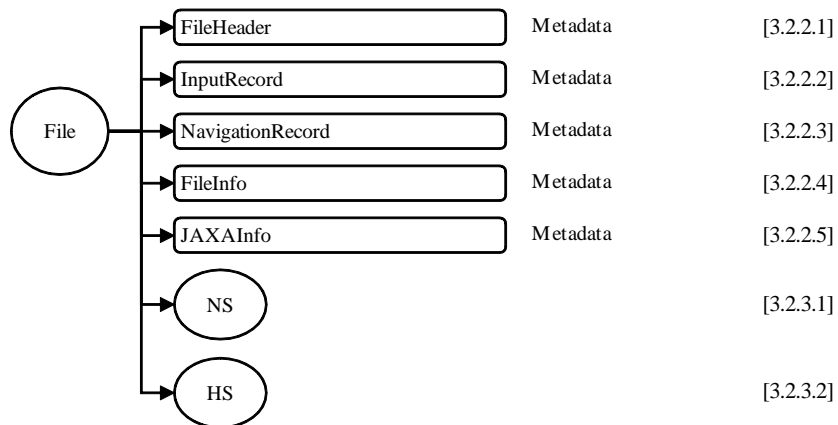
3.1. Data Format Structure

3.1.1. Dimension definition

Dimension definitions:

- nscan
  - ➢ var Number of scans in the granule.
- nray
  - ➢ 49 Number of angle bins in each NS scan.
- nrayMS
  - ➢ 25 Number of angle bins in each MS scan.
- nrayHS
  - ➢ 24 Number of angle bins in each HS scan.
- nbin
  - ➢ 176 Number of range bins in each NS and MS ray. Bin interval is 125 m.
- nbinHS
  - ➢ 88 Number of range bins in each HS ray. Bin interval is 250 m.
- nNP
  - ➢ 4 Number of NP kinds.
- nRScan
  - ➢ 4 Number of Ref Scan ID.
- nNode
  - ➢ 5 Number of binNode.
- nDSD
  - ➢ 2 Number of DSD parameters. Parameters are N0 and D0.
- LS
  - ➢ 2 Liquid, solid.
- nwind
  - ➢ 2 Number of wind components: u, v.
- nwater
  - ➢ 2 Source of water vapor data.

3.1.2. Data Format Structure for 2ADPRENV – DPR environment

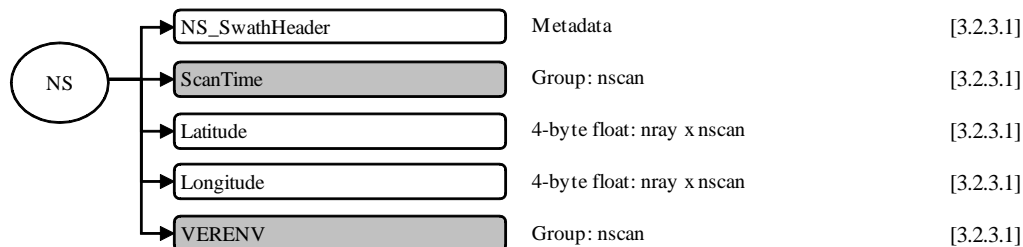The 2ADPRENV product contains atmospheric state information used by the 2ADPR retrieval.

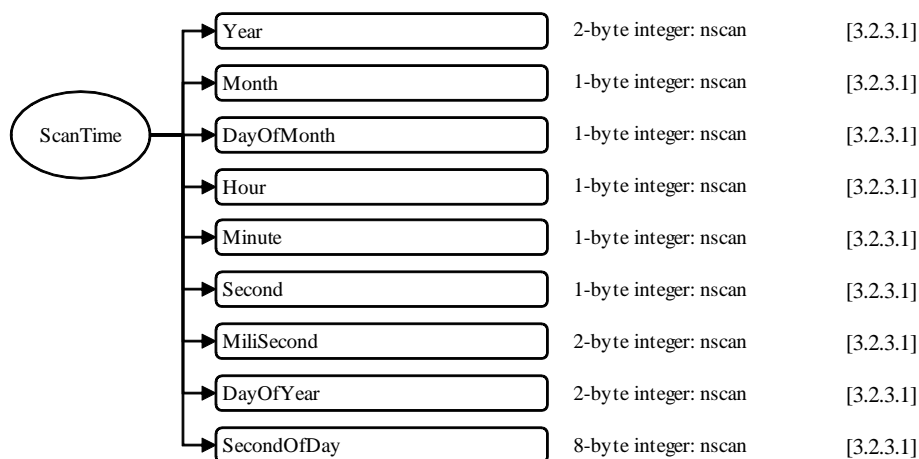**Figure 3.1-1 Data Format Structure for 2ADPRENV – DPR environment**

3.1.3. Data Format Structure for each Group
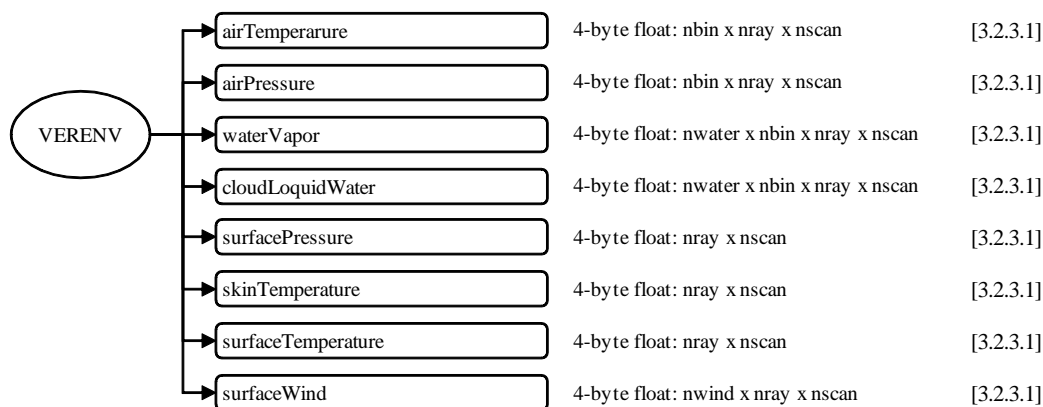
3.1.3.1 Data Format Structure for NS Group

NS Group's structure is shown in this section.

NS			
	NS_SwathHeader	Metadata	[3.2.3.1]
	ScanTime	Group: nscan	[3.2.3.1]
	Latitude	4-byte float: nray x nscan	[3.2.3.1]
	Longitude	4-byte float: nray x nscan	[3.2.3.1]
	VERENV	Group: nscan	[3.2.3.1]

Figure 3.1-2 Data Format Structure for 2ADPRENV, NS

ScanTime			
	Year	2-byte integer: nscan	[3.2.3.1]
	Month	1-byte integer: nscan	[3.2.3.1]
	DayOfMonth	1-byte integer: nscan	[3.2.3.1]
	Hour	1-byte integer: nscan	[3.2.3.1]
	Minute	1-byte integer: nscan	[3.2.3.1]
	Second	1-byte integer: nscan	[3.2.3.1]
	MiliSecond	2-byte integer: nscan	[3.2.3.1]
	DayOfYear	2-byte integer: nscan	[3.2.3.1]
	SecondOfDay	8-byte integer: nscan	[3.2.3.1]

Figure 3.1-3 Data Format Structure for 2ADPRENV, NS, ScanTime

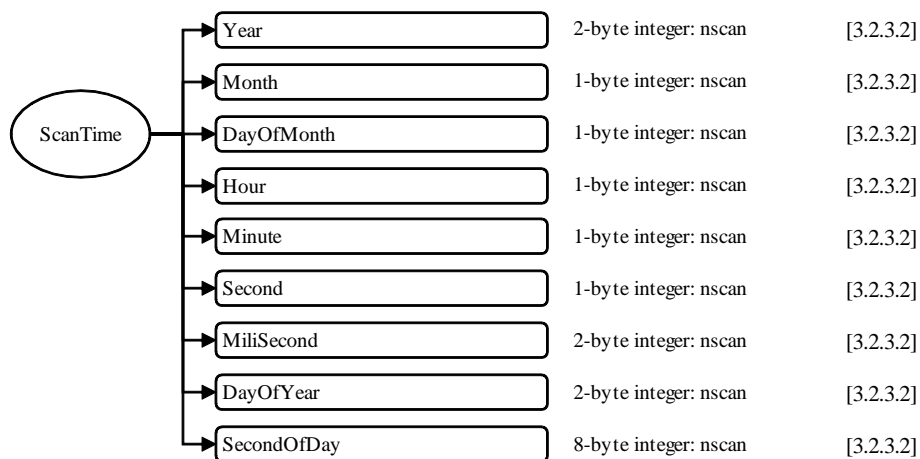| VERENV			
	airTemperarure	4-byte float: nbin x nray x nscan	[3.2.3.1]
	airPressure	4-byte float: nbin x nray x nscan	[3.2.3.1]
	waterVapor	4-byte float: nwater x nbin x nray x nscan	[3.2.3.1]
	cloudLoquidWater	4-byte float: nwater x nbin x nray x nscan	[3.2.3.1]
	surfacePressure	4-byte float: nray x nscan	[3.2.3.1]
	skinTemperature	4-byte float: nray x nscan	[3.2.3.1]
	surfaceTemperature	4-byte float: nray x nscan	[3.2.3.1]
	surfaceWind	4-byte float: nwind x nray x nscan	[3.2.3.1]

Figure 3.1-4 Data Format Structure for 2ADPRENV, NS, VERENV

3.1.3.2 Data Format Structure for HS Group

HS Group's structure is shown in this section.

HS			
	NS_SwathHeader	Metadata	[3.2.3.2]
	ScanTime	Group: nscan	[3.2.3.2]
	Latitude	4-byte float: nray x nscan	[3.2.3.2]
	Longitude	4-byte float: nray x nscan	[3.2.3.2]
	VERENV	Group: nscan	[3.2.3.2]
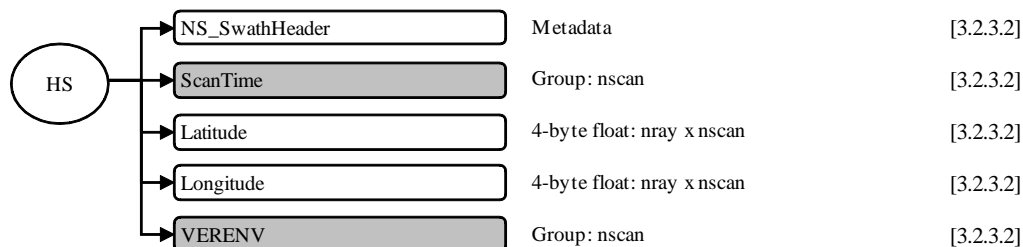
Figure 3.1-5 Data Format Structure for 2ADPRENV, HS

ScanTime			
	Year	2-byte integer: nscan	[3.2.3.2]
	Month	1-byte integer: nscan	[3.2.3.2]
	DayOfMonth	1-byte integer: nscan	[3.2.3.2]
	Hour	1-byte integer: nscan	[3.2.3.2]
	Minute	1-byte integer: nscan	[3.2.3.2]
	Second	1-byte integer: nscan	[3.2.3.2]
	MiliSecond	2-byte integer: nscan	[3.2.3.2]
	DayOfYear	2-byte integer: nscan	[3.2.3.2]
	SecondOfDay	8-byte integer: nscan	[3.2.3.2]

Figure 3.1-6 Data Format Structure for 2ADPRENV, HS, ScanTime

VERENV			
	airTemperarure	4-byte float: nbin x nray x nscan	[3.2.3.2]
	airPressure	4-byte float: nbin x nray x nscan	[3.2.3.2]
	waterVapor	4-byte float: nwater x nbin x nray x nscan	[3.2.3.2]
	cloudLoquidWater	4-byte float: nwater x nbin x nray x nscan	[3.2.3.2]
	surfacePressure	4-byte float: nray x nscan	[3.2.3.2]
	skinTemperature	4-byte float: nray x nscan	[3.2.3.2]
	surfaceTemperature	4-byte float: nray x nscan	[3.2.3.2]
	surfaceWind	4-byte float: nwind x nray x nscan	[3.2.3.2]

Figure 3.1-7 Data Format Structure for 2ADPRENV, HS, VERENV

3.2. Contents of objects in each Group

3.2.2. Metadata

3.2.2.1 FileHeader

FileHeader contains metadata of general interest. Table 3.2-1 shows each metadata elements in FileHeader.

Table 3.2-1 FileHeader Group

Metadata Element	Estimated Size (bytes)	Description
DOI	256	Digital Object Identifier
AlgorithmID	50	The algorithm that generated this product, e.g., 2A12.
AlgorithmVersion	50	The version of the algorithm that generated this product.
FileName	50	The file name of this granule.
SatelliteName	10	Values are: TRMM GPM MULTI F10 ... F18 AQUA GCOMW1 CORIOLIS MT1 NOAA15 ... NOAA19 METOPANPP. More values will be added as they are known.
InstrumentName	10	Values are: PR TMI VIRS PRTMI KU KA DPR GMI DPRGMI MERGED SSMI SSMIS AMSRE AMSR2 WIND-SAT MADRAS AMSUA AMSUB SAPHIR MHS ATMS. More values will be added as they are known.
GenerationDateTime	50	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
StartGranuleDateTime	50	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
StopGranuleDateTime	50	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
GranuleNumber	50	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.
NumberOfSwaths	50	The number of swaths in this granule.
NumberOfGrids	50	The number of grid structures in this granule.
GranuleStart	50	The starting place in the orbit of this granule. Currently defined values are "SOUTHERNMOST LATITUDE" and "NORTHBOUND EQUATOR CROSSING".
TimeInterval	50	The time interval covered by this granule. Values are "ORBIT", "HALF ORBIT", "HALF HOUR", "HOUR", "3 HOUR", "DAY", "MONTH", "CONTACT".
ProcessingSystem	50	The name of the processing system, e.g., "PPS", "JAXA".
ProductVersion	50	The data version assigned by the processing system.
EmptyGranule	50	Whether a granule is empty. Values are "EMPTY" or "NOT EMPTY".

Metadata Element	Estimated Size (bytes)	Description
MissingData	50	The number of missing scans.

3.2.2.2 InputRecord

InputRecord contains a record of input files for this granule. Table 3.2-2 shows each metadata elements in InputRecord.

Table 3.2-2 InputRecord Group

Metadata Element	Estimated Size (bytes)	Description
InputFileName	1000	A list of input file names for this granule.
InputAlgorithmVersions	1000	A list of algorithm versions of the input files for this granule.
InputGenerationDatteTimes	1000	A list of generation date times of the input files for this granule. The format is the same as GenerationDateTime.

3.2.2.3 NavigationRecord

NavigationRecord contains navigation metadata for this granule. Table 3.2-3 shows each metadata elements in NavigationRecord.

Table 3.2-3 NavigationRecord Group

Metadata Element	Estimated Size (bytes)	Description
LongitudeOnEquator	50	The longitude where the satellite crosses the equator going from south to north.
UTCDateTimeOnEquator	50	The UTC time when the satellite crosses the equator going from south to north. The format is the same as GenerationDate Time.
MeanSolarBetaAngle	50	The average solar beta angle in this granule.
EphemerisFileName	50	Name of the ephemeris file input for processing.
AttitudeFileName	50	Name of the attitude file input for processing.
GeoControlFileName	50	Name of the GeoTK Control Parameters File input for processing.
EphemerisSource	50	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"
AttitudeSource	50	Values are "0 CONSTANT INPUTS FOR TESTING", "1 ON BOARD CALCULATED PITCH ROLL YAW"
GeoToolkitVersion	50	Version of the GeoToolkit
SensorAlignmentFirstRotationAngle	50	Alignment angle, first rotation, in degrees. Rotation adjustment from sensor coordinates to the Attitude Control System Flight Coordinates.
SensorAlignmentSecondRotationAngle	50	Alignment angle, second rotation, in degrees.
SensorAlignmentThirdRotationAngle	50	Alignment angle, third rotation, in degrees.
SensorAlignmentFirstRotationAxis	50	Euler rotation sequence, first rotation axis. Values are "1", "2", "3" (representing X, Y, Z).
SensorAlignmentSecondRotationAxis	50	Euler rotation sequence, second rotation axis. Values are "1", "2", "3" (representing X, Y, Z).

Metadata Element	Estimated Size (bytes)	Description
SensorAlignmentThirdRotationAxis	50	Euler rotation sequence, third rotation axis. Values are "1", "2", "3" (representing X, Y, Z).

3.2.2.4 FileInfo

FileInfo contains metadata used by the PPS I/O Toolkit. Table 3.2-4 shows each metadata elements in FileInfo.

Table 3.2-4 FileInfo Group

Metadata Element	Estimated Size (bytes)	Description
DataFormatVersion	50	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" ...
TKCodeBuildVersion	50	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.
MetadataVersion	50	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" ...
FormatPackage	50	The underlying format of this granule. Values are "HDF4", "HDF5", "NETCDF", "TKBINARY"
BlueprintFilename	50	The filename of the primary blueprint file that defined the format used to write this file.
BlueprintVersion	10	The BlueprintVersion of the format definition
TKIOVersion	50	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.
MetadataStyle	50	The style in which the metadata was written, e.g., "PVL". "PVL" means < parameter >=< value >;
EndianType	50	The endian type of the system that wrote this file. Values are "BIG ENDIAN" and "LITTLE ENDIAN".

3.2.2.5 JAXAInfo

JAXAInfo contains metadata requested by JAXA.Used by DPR algorithms and GSMaP. Table 3.2-5 shows each metadata elements in JAXAInfo.

Table 3.2-5 JXAInfo Group

Metadata Element	Estimated Size (bytes)	Description
GranuleFirstScanUTCDateTime	50	Granule First 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. The missing value is constructed by replacing all digits with 9, i.e.,9999-99-99T99:99:99.999Z.
GranuleLastScanUTCDateTime	50	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.
TotalQualityCode	50	Total quality of the GPM product, e.g., "Good", "Fair" or "EG".

Metadata Element	Estimated Size (bytes)	Description
FirstScanLat	50	Latitude of orbit first scan.
FirstScanLon	50	Longitude of orbit first scan.
LastScanLat	50	Latitude of orbit last scan.
LastScanLon	50	Longitude of orbit last scan.
NumberOfRainPixelsNS	50	Number of rain pixels in the NS swath, judged at DPR L2 algorithm. At DPR L1, value is "-9999".
NumberOfRainPixelsMS	50	Number of rain pixels in the MS swath, judged at DPR L2algorithm. At DPR L1, value is "-9999".
NumberOfRainPixelsHS	50	Number of rain pixels in the HS swath, judged at DPR L2algorithm. At DPR L1, value is "-9999".
ProcessingSubSystem	50	The name of the processing sub-system, e.g., "ALGORITHM","PCS".
ProcessingMode	50	The name of the processing mode, e.g., "STD","NRT".
lightSpeed	50	A constant value of light speed.
dielectricConstantKu	50	A parameter of dielectric for Ku.
dielectricConstantKa	50	A parameter of dielectric for Ka.

3.2.3. Data Group

Elements of data group are explained in detail in this section.

3.2.3.1 NS (Swath)

(1) NS_SwathHeader (Metadata)

NS_SwathHeader contains metadata for swaths.

Table 3.2-6 NS_SwathHeader Group

Metadata Element	Estimated Size (bytes)	Description
NumberScansInSet	50	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 NumberScansInSet=2 for the high frequency swath.
MaximumNumberScansTotal	50	The maximum allowed number of total scans in this swath. Total scans = overlap scans before granule + scans in granule + overlap scans after granule.
NumberScansBeforeGranule	50	The number of overlap scans before the first scan of the granule in this swath.
NumberScansGranule	50	The number of scans in the granule in this swath.
NumberScansAfterGranule	50	The number of overlap scans after the last scan of the granule in this swath.
NumberPixels	50	The number of IFOV in each scan in this swath.
ScanType	50	The type of scan in this swath. Values are: "CROSSTRACK" and "CONICAL"

(2) ScanTime (Group in NS)

Year (2-byte integer, array size: nscan)

4-digit year, e.g., 1998. Values range from 1950 to 2100 years. Special values are defined as:

-9999   Missing value

Month (1-byte integer, array size: nscan)

Month of the year. Values range from 1 to 12 months. Special values are defined as:

-99   Missing value

DayOfMonth (1-byte integer, array size: nscan)

Day of the month. Values range from 1 to 31 days. Special values are defined as:

-99   Missing value

Hour (1-byte integer, array size: nscan)

UTC hour of the day. Values range from 0 to 23 hours. Special values are defined as:

-99   Missing value

Minute (1-byte integer, array size: nscan)

Minute of the hour. Values range from 0 to 59 minutes. Special values are defined as:

-99   Missing value

Second (1-byte integer, array size: nscan)

Second of the minute. Values range from 0 to 60 s. Special values are defined as:

-99   Missing value

MilliSecond (2-byte integer, array size: nscan)

Thousandths of the second. Values range from 0 to 999 ms. Special values are defined as:

-9999   Missing value

DayOfYear (2-byte integer, array size: nscan)

Day of the year. Values range from 1 to 366 days. Special values are defined as:

-9999   Missing value

SecondOfDay (8-byte float, array size: nscan)

A time associated with the scan. scanTime sec is expressed as the UTC seconds of the day. Values range from 0 to 86400 s. Special values are defined as:

-9999.9   Missing value

Table 3.2-7 ScanTime Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	Year	-9999	1950	2100	[year]	2-byte integer	2 x nscan	2	nscan	1	1
2	Month	-99	1	12	[month]	1-byte integer	1 x nscan	1	nscan	1	1
3	DayOFMonth	-99	1	31	[day]	1-byte integer	1 x nscan	1	nscan	1	1
4	Hour	-99	0	23	[hour]	1-byte integer	1 x nscan	1	nscan	1	1
5	Minute	-99	0	59	[minute]	1-byte integer	1 x nscan	1	nscan	1	1
6	Second	-99	0	60	[s]	1-byte integer	1 x nscan	1	nscan	1	1
7	MilliSecond	-9999	0	999	[ms]	2-byte integer	2 x nscan	2	nscan	1	1
8	DayOfYear	-9999	1	366	[day]	2-byte integer	2 x nscan	2	nscan	1	1
9	SecoundOfDay	-9999.9	0	86400	[s]	8-byte float	8 x nscan	8	nscan	1	1

(3) Latitude (4-byte float, array size: nray x nscan)

The earth latitude of the center of the IFOV at the altitude of the earth ellipsiod. Latitude is positive north, negative south. Values range from -90 to 90 degrees. Special values are defined as:

-9999.9   Missing value

Table 3.2-8 Latitude Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	Latitude	-9999.9	-90	90	[degree]	4-byte float	4 x 49 x nscan	4	nray	nscan	1

(4) Longitude (4-byte float, array size: nray x nscan)

The earth longitude of the center of the IFOV at the altitude of the earth ellipsiod. Longitude is positive east, negative west. A point on the 180th meridian has the value -180 degrees. Values range from -180 to 180 degrees. Special values are defined as:

-9999.9   Missing value

Table 3.2-9 Longitude Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	Longitude	-9999.9	-180	180	[degree]	4-byte float	4 x 49 x nscan	4	nray	nscan	1

(5) VERENV (Group in NS)

airTemperature (4-byte float, array size: nbin x nray x nsca)

Vertical profile of air temperature inserted from the ancillary data. Values are in K. Special values are defined as:

-9999.9Missing value

airPressure (4-byte float, array size: nbin x nray x nscan)

Vertical profile of air pressure inserted from the ancillary data. Values are in hPa. Special values are defined as:

-9999.9 Missing value

waterVapor (4-byte float, array size: nwater x nbin x nray x nscan)

Vertical profile of water vapor. nwater = 0: a value diagnosed by the algorithm. nwater = 1: a value inserted from the ancillary data.Values are in kg/m^3. Special values are defined as:

-9999.9 Missing value

cloudLiquidWater (4-byte float, array size: nwater x nbin x nray x nscan)

Vertical profile of cloud liquid water. nwater = 0: a value diagnosed by the algorithm. nwater = 1: a value inserted from the ancillary data. Values are in kg/m^3. Special values are defined as:

-9999.9 Missing value

surfacePressure (4-byte float, array size: nray x nscan)

Surface pressure inserted from the ancillary data. Values are in hPa. Special values are defined as:

-9999.9 Missing value

skinTemperature (4-byte float, array size: nray x nscan)

Surface skin temperature inserted from the ancillary data. Values are in K. Special values are defined as:

-9999.9 Missing value

surfaceTemperature (4-byte float, array size: nray x nscan)

Surface (2m) air temperature inserted from the ancillary data. Values are in K. Special values are defined as:

-9999.9 Missing value

surfaceWind (4-byte float, array size: nwind x nray x nscan)

Surface wind. nwind = 0: zonal direction. nwind = 1: meridional direction. Values are in m/s. Special values are defined as:

-9999.9 Missing value

Table 3.2-10 VERENV Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array			
1	airTemperature	-9999.9	-	-	[k]	4-byte float	4 x 176 x 49 x nscan	4	nbin	nray		nscan
2	airPressure	-9999.9	-	-	[hpa]	4-byte float	4 x 176 x 49 x nscan	4	nbin	nray		nscan
3	waterVapor	-9999.9	-	-	[kg/m^3]	4-byte float	4 x 2 x 176 x 49 x nscan	4	nwater	nbin	nray	nscan
4	cloudLiquidWater	-9999.9	-	-	[kg/m^3]	4-byte float	4 x 2 x 176 x 49 x nscan	4	nwater	nbin	nray	nscan
5	surfacePressure	-9999.9	-	-	[hpa]	4-byte float	4 x 49 x nscan	4	nray	nscan		1
6	skinTemperature	-9999.9	-	-	[K]	4-byte float	4 x 49 x nscan	4	nray	nscan		1
7	surfaceTemperature	-9999.9			[K]	4-byte float	4 x 49 x nscan	4	nray	nscan		1

3.2. Contents of objects in each Group
3.2.3. Data Group
3.2.3.1. NS (Swath)

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
8	surfaceWind	-9999.9			[m/s]	4-byte float	4 x 176 x 49 x nscan	4	nwind	nray	nscan

3.2.3.2 HS (Swath)

(1) HS_SwathHeader (Metadata)

HS_SwathHeader contains metadata for swaths.

Table 3.2-11 HS_SwathHeader Group

Metadata Element	Estimated Size (bytes)	Description
NumberScansInSet	50	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 NumberScansInSet=2 for the high frequency swath.
MaximumNumberScansTotal	50	The maximum allowed number of total scans in this swath. Total scans = overlap scans before granule + scans in granule + overlap scans after granule.
NumberScansBeforeGranule	50	The number of overlap scans before the first scan of the granule in this swath.
NumberScansGranule	50	The number of scans in the granule in this swath.
NumberScansAfterGranule	50	The number of overlap scans after the last scan of the granule in this swath.
NumberPixels	50	The number of IFOV in each scan in this swath.
ScanType	50	The type of scan in this swath. Values are: "CROSSTRACK" and "CONICAL"

(2) ScanTime (Group in HS)

Year (2-byte integer, array size: nscan)

4-digit year, e.g., 1998. Values range from 1950 to 2100 years. Special values are defined as:

-9999　Missing value

Month (1-byte integer, array size: nscan)

Month of the year. Values range from 1 to 12 months. Special values are defined as:

-99　　Missing value

DayOfMonth (1-byte integer, array size: nscan)

Day of the month. Values range from 1 to 31 days. Special values are defined as:

-99　　Missing value

Hour (1-byte integer, array size: nscan)

UTC hour of the day. Values range from 0 to 23 hours. Special values are defined as:

-99　　Missing value

Minute (1-byte integer, array size: nscan)

Minute of the hour. Values range from 0 to 59 minutes. Special values are defined as:

-99　　Missing value

Second (1-byte integer, array size: nscan)

Second of the minute. Values range from 0 to 60 s. Special values are defined as:

-99　　Missing value

MilliSecond (2-byte integer, array size: nscan)

Thousandths of the second. Values range from 0 to 999 ms. Special values are defined as:

-9999　Missing value

DayOfYear (2-byte integer, array size: nscan)

Day of the year. Values range from 1 to 366 days. Special values are defined as:

-9999   Missing value

SecondOfDay (8-byte float, array size: nscan)

A time associated with the scan. scanTime sec is expressed as the UTC seconds of the day. Values range from 0 to 86400 s. Special values are defined as:

-9999.9   Missing value

Table 3.2-12 ScanTime Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	Year	-9999	1950	2100	[year]	2-byte integer	2 x nscan	2	nscan	1	1
2	Month	-99	1	12	[month]	1-byte integer	1 x nscan	1	nscan	1	1
3	DayOFMonth	-99	1	31	[day]	1-byte integer	1 x nscan	1	nscan	1	1
4	Hour	-99	0	23	[hour]	1-byte integer	1 x nscan	1	nscan	1	1
5	Minute	-99	0	59	[minute]	1-byte integer	1 x nscan	1	nscan	1	1
6	Second	-99	0	60	[s]	1-byte integer	1 x nscan	1	nscan	1	1
7	MilliSecond	-9999	0	999	[ms]	2-byte integer	2 x nscan	2	nscan	1	1
8	DayOfYear	-9999	1	366	[day]	2-byte integer	2 x nscan	2	nscan	1	1
9	SecoundOfDay	-9999.9	0	86400	[s]	8-byte float	8 x nscan	8	nscan	1	1

(3) Latitude (4-byte float, array size: nray x nscan)

The earth latitude of the center of the IFOV at the altitude of the earth ellipsiod. Latitude is positive north, negative south. Values range from -90 to 90 degrees. Special values are defined as:

-9999.9   Missing value

Table 3.2-13 Latitude Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	Latitude	-9999.9	-90	90	[degree]	4-byte float	4 x 49 x nscan	4	nray	nscan	1

(4) Longitude (4-byte float, array size: nray x nscan)

The earth longitude of the center of the IFOV at the altitude of the earth ellipsiod. Longitude is positive east, negative west. A point on the 180th meridian has the value -180 degrees. Values range from -180 to 180 degrees. Special values are defined as:

-9999.9   Missing value

Table 3.2-14 Longitude Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	Longitude	-9999.9	-180	180	[degree]	4-byte float	4 x 49 x nscan	4	nray	nscan	1

(5) VERENV (Group in HS)

airTemperature (4-byte float, array size: nbin x nray x nsca)

Vertical profile of air temperature inserted from the ancillary data. Values are in K. Special values are defined as:

-9999.9Missing value

airPressure (4-byte float, array size: nbin x nray x nscan)

Vertical profile of air pressure inserted from the ancillary data. Values are in hPa. Special values are defined as:

-9999.9 Missing value

waterVapor (4-byte float, array size: nwater x nbin x nray x nscan)

Vertical profile of water vapor. nwater = 0: a value diagnosed by the algorithm. nwater = 1: a value inserted from the ancillary data. Values are in kg/m^3. Special values are defined as:

-9999.9 Missing value

cloudLiquidWater (4-byte float, array size: nwater x nbin x nray x nscan)

Vertical profile of cloud liquid water. nwater = 0: a value diagnosed by the algorithm. nwater = 1: a value inserted from the ancillary data. Values are in kg/m^3. Special values are defined as:

-9999.9 Missing value

surfacePressure (4-byte float, array size: nray x nscan)

Surface pressure inserted from the ancillary data. Values are in hPa. Special values are defined as:

-9999.9 Missing value

skinTemperature (4-byte float, array size: nray x nscan)

Surface skin temperature inserted from the ancillary data. Values are in K. Special values are defined as:

-9999.9 Missing value

surfaceTemperature (4-byte float, array size: nray x nscan)

Surface (2m) air temperature inserted from the ancillary data. Values are in K. Special values are defined as:

-9999.9 Missing value

surfaceWind (4-byte float, array size: nwind x nray x nscan)

Surface wind. nwind = 0: zonal direction. nwind = 1: meridional direction. Values are in m/s. Special values are defined as:

-9999.9 Missing value

Table 3.2-15 VERENV Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array			
1	airTemperature	-9999.9	-	-	[k]	4-byte float	4 x 176 x 49 x nscan	4	nbin	nray		nscan
2	airPressure	-9999.9	-	-	[hpa]	4-byte float	4 x 176 x 49 x nscan	4	nbin	nray		nscan
3	waterVapor	-9999.9	-	-	[kg/m^3]	4-byte float	4 x 2 x 176 x 49 x nscan	4	nwater	nbin	nray	nscan
4	cloudLiquidWater	-9999.9	-	-	[kg/m^3]	4-byte float	4 x 2 x 176 x 49 x nscan	4	nwater	nbin	nray	nscan
5	surfacePressure	-9999.9	-	-	[hpa]	4-byte float	4 x 49 x nscan	4	nray	nscan		1
6	skinTemperature	-9999.9	-	-	[K]	4-byte float	4 x 49 x nscan	4	nray	nscan		1
7	surfaceTemperature	-9999.9	-	-	[K]	4-byte float	4 x 49 x nscan	4	nray	nscan		1

3.2. Contents of objects in each Group
3.2.3. Data Group
3.2.3.2. HS (Swath)

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
									nwind	nray	nscan
8	surfaceWind	-9999.9	-	-	[m/s]	4-byte float	4 x 176 x 49 x nscan	4	nwind	nray	nscan

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