PRISM

GeoTIFF Product

Format Description

Product Format Description

PRISM (GeoTIFF Format) Level 1B2 Revision History (1/1)

Rev.	Date	Revision	Revision Contents
NC	2014/2/7		First Edition
A	2015/3/17		Value of GeoTIFF tags are changed, and new GeoTIFF tags are added.

Product format Description (PRISM (GeoTIFF format))

Table of Contents

1 Overview

This document describes about the format specification for ALOS PRISM GeoTIFF Level 1B2 products.

2 Product Specification

2.1 Outline of GeoTIFF

GeoTIFF image is an extension format, which allows geographical information to be added within Tagged Image File Format (TIFF) image.

2.2 Composition of Product

ALOS GeoTIFF product is generated from ALOS Level 1B2 processed data. GeoTIFF product contains a single GeoTIFF file.

Figure 2-1, shows a block diagram of GeoTIFF product. Table 2-1 , shows the number of GeoTIFF files.

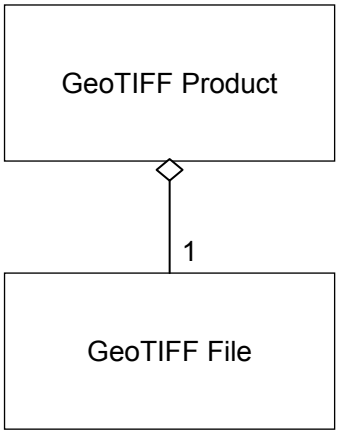

Figure 2-1 Block diagram of GeoTIFF Product

Table 2-1 Number of GeoTIFF Files

No.	File Type	Number of files
1	GeoTIFF	1

2.3 Filename

The filename definition of GeoTIFF product is shown in Table 2-2.

Table 2-2 Filename Definition of GeoTIFF Product

No.	File Type	Definition of Filename	Contents
1	GeoTIFF	IMG-Scene ID -ProductID.tif	The file of GeoTIFF form. An integer value is indicated to each pixel. Geographic information and map projection are written in the header.

Scene ID = AABBBCDDDDDEEEE

AA : Satellite type = "AL"

BBB : Sensor type = "PSM"

C : Supplemental remarks of sensor type

N: PRISM Nadir 35km

F: PRISM Forward 35km

B: PRISM Backward 35km

W: PRISM Nadir 70km

DDDDD : Total calculated orbit number of the scene center

EEEE : Frame number of the scene center

Product ID = FGGGHHIJ

F : Observation Mode

O: Observation, D: Dark current calibration, E: Electrical calibration

GGG : Processing Level

1B2: Level 1B2

HH : 1B2 option

G_ : Geo-coded

R_ : Geo-reference

GD : Geo-coded and DEM correction

RD : Geo-reference and DEM correction

__ : Not specified (underscore)

I : Map Projection

U: UTM, P: PS

J : Observation Data Type

N: Nadir, F: Forward, B: Backward, W: Nadir 70 km

3 Format

3.1 GeoTIFF File

GeoTIFF is a metadata standard which allows geometric information to be embedded within a TIFF image file. In GeoTIFF products, GeoTIFF files are generated in TIFF-Strip format, and some GeoTIFF-tags are different in each processing level. All TIFF files and GeoTIFF-tags are based on TIFF Revision 6.0 and GeoTIFF Revision 1.0 standard, and byte order of image data is recorded in little endian.

3.1.1 TIFF tag

Some TIFF tags used in GeoTIFF file are shown in Table 3-1.

Table 3-1 TIFF tags in GeoTIFF file (1/3)

No.	Tag name	Tag type	Description	Remark
1	ImageLength	LONG	Number of lines	
2	ImageWidth	LONG	Number of pixels	
3	BitsPerSample	SHORT	Number of bits in one sample= 8 (fixed value)	
4	Compression	SHORT	Compression type = 1 (fixed value)	1 = No compression 2 = ITU-T Group3 1 dimension Huffman run length encoding 3 = ITU-T Group3 fax encoding 4 = ITU-T Group4 fax encoding 5 = LZW (fixed-length) compression 6 = JPEG compression (old style) 7 = JPEG compression (new style) 8 = ZIP compression 32773 = Packbits compression

Table 3-1 TIFF tags in GeoTIFF file (2/3)

No.	Tag name	Tag type	Description	Remark
5	PhotometricInterpretation	SHORT	Color space type of bitmap image data = 1 (fixed value)	0 = WhiteIsZero (Pixel value: White0, Black=(2^BitsPerSample-1)) 1 = BlackIsZero (Pixel value: Black0, White=(2^BitsPerSample-1)) 2 = RGB direct color (min= 0, max= (2^BitsPerSample-1)) 3 = Colormap (min= 0, max= (2^BitsPerSample-1)) 4 = Transparency Mask (definition of masked region)
6	StripOffsets	LONG	Byte offset for each strip	
7	Orientation	SHORT	Orientation of image = 1 (fixed value).	1 = row: Top to Bottom, column: Left to Right 2 = row: Top to Bottom, column: Right to Left 3 = row: Bottom to Top, column: Right to Left 4 = row: Bottom to Top, column: Left to Right 5 = row: Left to Right, column: Top to Bottom 6 = row: Right to Left, column: Top to Bottom 7 = row: Right to Left, column: Bottom to Top 8 = row: Left to Right, column: Bottom to Top
8	SamplesPerPixel	SHORT	Number of samples in one pixel = 1 (fixed value)	

Table 3-1 TIFF tags in GeoTIFF file (3/3)

No.	Tag name	Tag type	Description	Remark
9	RowsPerStrip	SHORT	Number of image lines per strip = 8000 (fixed value)	
10	StripByteCounts	LONG	Number of bytes for each strip	
11	PlanarConfiguration	SHORT	Storing order of the data = 1 (fixed value)	"1 = Chunky format: The component values for each pixel are stored contiguously (example: RGBRGBRGB...) 2 = Planar format: The components are stored in separate components. (example: RRR... GGG...BBB...)"

7

3.1.2 GeoTIFF tag

GeoTIFF tags of GeoTIFF file are shown in Table 3-2.

Table 3-2 GeoTIFF tags in GeoTIFF file (1/5)

No.	Tag name	Tag type	Description	Remark
1	(deleted)			
2	(deleted)			
3	ModelTransformationTag	DOUBLE	The conversion matrix from a pixel and line coordinates to map coordinates = (a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p) In two-dimensional coordinate plane $\begin{bmatrix}\text{Map address X}\\ \text{Map address Y}\\ 0\\ 1\end{bmatrix} = \begin{bmatrix}a & b & 0 & d\\ e & f & 0 & h\\ 0 & 0 & 0 & 0\\ 0 & 0 & 0 & 1\end{bmatrix}\begin{bmatrix}\text{Pixel no.}\\ \text{Line no.}\\ 0\\ 1\end{bmatrix}$ ⇒ (a, b, 0, d, e, f, 0, h, 0, 0, 0, 0, 0, 0, 0, 1)	When (pixel no., line no.) = (P, L); Map address X = a* P + b* L + d Map address Y =e* P + f* L + h
4	GTModelTypeGeoKey	SHORT	Coordinate system type = 1 (fixed value)	1 = ModelTypeProjected (Projection Coordinate System) 2 = ModelTypeGeographic (Geographic Latitude-Longitude System) 3 = ModelTypeGeocentric (Geocentric (X, Y, Z) Coordinate System)

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9

Table 3-2 GeoTIFF tags in GeoTIFF file (2/5)

No.	Tag name	Tag type	Description	Remark
5	GTRasterTypeGeoKey	SHORT	Alignment of pixel value = 1 (fixed value)	1 = PixelIsArea The first pixel applies the domain surrounded by (0, 0), (0, 1), (1, 0), and (1, 1). The center of pixel is located in (0.5, 0.5).  2 = PixelIsPoint The first pixel applies the domain surrounded by (-0.5,-0.5), (0.5,-0.5), (-0.5, 0.5), (0.5, 0.5). The center of pixel is located in (0,0). 
6	GTCitationGeoKey	ASCII	Description of this file = "Corrected Satellite Data" (fixed value)	
7	GeographicTypeGeoKey	SHORT	Map coordinate code = 4338 (fixed value)	4338=ITRF97

Table 3-2 GeoTIFF tags in GeoTIFF file (3/5)

No.	Tag name	Tag type	Description	Remark	
8	GeogCitationGeoKey	ASCII	Geographic coordinate system UTM projection: “Datum=ITRF97 Ellipsoid=GRS80 Projection=UTM” Polar Stereographic Projection: “Datum=ITRF97 Ellipsoid=GRS80 Projection=PS”		A
9	GeogGeodeticDatumGeoKey	SHORT	Geographic coordinate system = 6655 (fixed value)	6655=The International Terrestrial Reference Frame	
10	GeogLinearUnitsGeoKey	SHORT	Coordinates unit (length) = 9001 (fixed value)	9001 = Linear_Meter [m]	
11	GeogAngularUnitsGeoKey	SHORT	Coordinates unit (angle) = 9102 (fixed value)	9102 = Angular_Degree [deg]	
12	GeogEllipsoidGeoKey	SHORT	Ellipsoid code = 7019 (fixed value)	7019 = Ellipse_GRS_1980 (GRS80)	
13	GeogSemiMajorAxisGeoKey	DOUBLE	Elliptical major radius	Unit [m] specified in GeogLinearUnitsGeoKey	
14	GeogSemMinorAxisGeoKey	DOUBLE	Elliptical minor radius	Unit [m] specified in GeogLinearUnitsGeoKey	
15	ProjectedCSTypeGeoKey	SHORT	Map projection code UTM projection: 32601-32660, 32701-32760 Other projection: User defined = 32767 (fixed value)	32601-32660: PCS_WGS84_UTM_zone_nnN 32701-32760: PCS_WGS84_UTM_zone_nnS 32767=User definition	A
16	PCSCitationGeoKey	ASCII	Projection coordinate system UTM projection: “Datum=ITRF97 Ellipsoid=GRS80 Projection=UTM” Polar Stereographic Projection: “Datum=ITRF97 Ellipsoid=GRS80 Projection=PS”		

Table 3-2 GeoTIFF tags in GeoTIFF file (4/5)

No.	Tag name	Tag type	Description	Remark
17	ProjectionGeoKey	SHORT	Map projection code UTM projection Northern Hemisphere = 16000 + zone number Southern Hemisphere = 16100 + zone number PS projection User definition = 32767 (fixed value)	16001-16060: Proj_UTM_zone_nnN 16101-16160: Proj_UTM_zone_nnS 32767 = User definition
18	ProjCoordTransGeoKey	SHORT	Map projection code PS projection = 15 (fixed value) UTM projection = 32767 (fixed value)	32767 = User defined MER projection 7 = CT_Mercator LCC projection 8 = CT_LambertConfConic_2SP PS, UPS projection 15 = CT_PolarStereographic
19	ProjLinearUnitsGeoKey	SHORT	Projection coordinates unit (length) = 9001 (fixed value)	9001 = Linear_Meter [m]
20	ProjFalseEastingGeoKey	DOUBLE	False Easting distance from false origin. 500000 (fixed value) This tag is set when Map projection method is UTM.	The unit specified in “ProjLinearUnitsGeoKey” is used [m]
21	ProjFalseNorthingGeoKey	DOUBLE	False Northing distance from false origin. Northern hemisphere : 0 (fixed value) or Southern hemisphere: 10000000 (fixed value), This tag is set when Map projection method is UTM.	The unit specified in “ProjLinearUnitsGeoKey” is used [m]

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Table 3-2 GeoTIFF tags in GeoTIFF file (5/5)

No.	Tag name	Tag type	Description	Remark
22	ProjNatOriginLatGeoKey	DOUBLE	Latitude of natural origin: UTM projection = 0 PS projection: Northern hemisphere = -90 (fixed value) Southern hemisphere = 90 (fixed value)	The unit specified in “ProjLinearUnitsGeoKey” is used [m]
23	ProjNatOriginLatGeoKey	DOUBLE	Longitude of natural origin: UTM projection = longitude at the UTM zone PS projection = center longitude of projection	

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3.2 Summary Information

The summary information on PRISM is given below.

3.2.1 Outline of Summary Information

The summary information file includes the information for creating processed data, and it is always made in a pair with its processed data.

3.2.2 Filename of Summary Information

The filename of Summary information is fixed as follows.

summary.txt

3.2.3 File Format of Summary Information

The file format of summary information is same as that of CEOS.

Refer to "Product Format Description (PRISM Product in CEOS format) Appendix Summary Information (PRISM)" regarding the format description of summary information.

AVNIR-2

GeoTIFF Product

Format Description

Product Format Description

AVNIR-2 (GeoTIFF Format) Level 1B2 Revision History (1/1)

Rev.	Date	Revision	Revision Contents
NC	2014/2/7		First Edition
A	2015/3/17		Value of several GeoTIFF tags are changed, and new GeoTIFF tags are added.

Product format Description
(AVNIR-2 (GeoTIFF format))
Table of Contents

1 Overview

This document describes the format specifications for ALOS AVNIR-2 GeoTIFF Level 1B2 products.

2 Product Specifications

2.1 Outline of GeoTIFF

GeoTIFF image is an extension format, which allows geographical information to be added within Tagged Image File Format (TIFF) image.

2.2 Composition of Product

ALOS GeoTIFF product is generated from ALOS Level 1B2 processed data. GeoTIFF product contains GeoTIFF files, which are split for each band.

Figure 2-1, shows a block diagram of GeoTIFF product. Table 2-1Table, shows the number of GeoTIFF files.

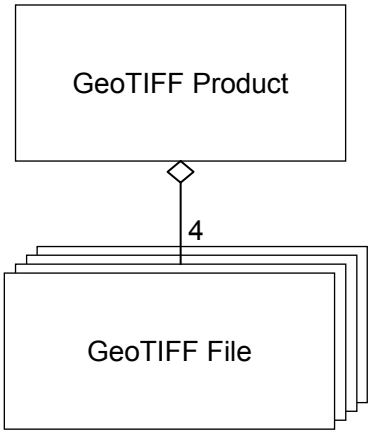

Figure 2-1 Block Diagram of GeoTIFF Product

Table 2-1 Number of GeoTIFF Files

No.	File Type	Number of files
1	GeoTIFF	4

2.3 Filename

The filename definition of GeoTIFF product is shown in Table 2-2.

Table 2-2 Filname Definition of GeoTIFF Product

No.	File Type	Definition of Filename	Contents
1	GeoTIFF	IMG-band number -Scene ID -ProductID.tif	The file of GeoTIFF form. An integer value is indicated to each pixel. Geographic information and map projection are written in the header.

Scene ID = AABBBCDDDDDEEEE

AA : Satellite type = "AL"

BBB : Sensor type = "AV2"

C : Supplemental remarks of sensor type=”A”

DDDDD : Total calculated orbit number of the scene center

EEEE : Frame number of a scene center

Product ID = FGGGHHI

F : Observation Mode

O: Observation, C: Inner light calibration

GGG : Processing Level

1B2: level 1B2

HH : 1B2 option

G_ : Geo-Coded

R_ : Geo-Reference

GD : Geo-Coded and DEM correction

Rd : Geo-Reference and DEM correction

__ : Not specified (underscore)

I : Map Projection

U: UTM, P: PS

Band number = XX

01-04

3 Format

3.1 GeoTIFF File

GeoTIFF is a metadata standard which allows geometric information to be embedded within a TIFF image file. In GeoTIFF products, GeoTIFF files are generated in TIFF-Strip format, and some GeoTIFF-tags are different in each processing level. All TIFF files and GeoTIFF-tags are based on TIFF Revision 6.0 and GeoTIFF Revision 1.0 standard, and byte order of image data is recorded in little endian.

3.1.1 TIFF tag

Some TIFF-tags used in GeoTIFF file are shown in Table 3-1.

Table 3-1 TIFF-tags in GeoTIFF file (1/3)

No.	Tag name	Tag type	Description	Remark
1	ImageLength	LONG	Number of lines	
2	ImageWidth	LONG	Number of pixels	
3	BitsPerSample	SHORT	Number of bits in one sample = 8 (fixed value)	
4	Compression	SHORT	Compression type = 1 (fixed value)	1 = No compression 2 = ITU-T Group3 1 dimension Huffman run length encoding 3 = ITU-T Group3 fax encoding 4 = ITU-T Group4 fax encoding 5 = LZW (fixed-length) compression 6 = JPEG compression (old style) 7 = JPEG compression (new style) 8 = ZIP compression 32773 = Packbits compression

Table 3-1 TIFF-tags in GeoTIFF file (2/3)

No.	Tag name	Tag type	Description	Remark
5	PhotometricInterpretation	SHORT	Color space type of bitmap image data = 1 (fixed value)	0 = WhiteIsZero (Pixel value: White=0, Black=(2^ BitsPerSample-1)) 1 = BlackIsZero (Pixel value: Black=0, White=(2^ BitsPerSample-1)) 2 = RGB direct color (min = 0, max= (2^ BitsPerSample-1)) 3 = Colormap (min= 0, max= (2^ BitsPerSample-1)) 4 = Transparency Mask (definition of masked region)
6	StripOffsets	LONG	Byte offset for each strip	
7	Orientation	SHORT	Orientation of image = 1 (fixed value).	1 = row: Top to Bottom, column: Left to Right 2 = row: Top to Bottom, column: Right to Left 3 = row: Bottom to Top, column: Right to Left 4 = row: Bottom to Top, column: Left to Right 5 = row: Left to Right, column: Top to Bottom 6 = row: Right to Left, column: Top to Bottom 7 = row: Right to Left, column: Bottom to Top 8 = row: Left to Right, column: Bottom to Top
8	SamplesPerPixel	SHORT	Number of samples in one pixel = 1 (fixed value)	

Table 3-1 TIFF-tags in GeoTIFF file (3/3)

No.	Tag name	Tag type	Description	Remark
9	RowsPerStrip	SHORT	Number of image lines per strip = 8000 (fixed value)	
10	StripByteCounts	LONG	Number of bytes for each strip	
11	PlanarConfiguration	SHORT	Storing order of the data = 1 (fixed value)	"1 = Chunky format: The component values for each pixel are stored contiguously (example: RGBRGBRGB…) 2 = Planar format: The components are stored in separate components. (example: RRR…GGG…BBB…)"

3.1.2 GeoTIFF tag

GeoTIFF tags of GeoTIFF file are shown in Table 3-2.

Table 3-2 GeoTIFF tags in GeoTIFF file (1/4)

No.	Tag name	Tag type	Description	Remark
1	(deleted)			
2	(deleted)			
3	ModelTransformationTag	DOUBLE	The conversion matrix from a pixel and line coordinates to map coordinates = (a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p) In two-dimensional coordinate plane, $\begin{bmatrix}\text{Map address X}\\ \text{Map address Y}\\ 0\\ 1\end{bmatrix} = \begin{bmatrix}a & b & 0 & d\\ e & f & 0 & h\\ 0 & 0 & 0 & 0\\ 0 & 0 & 0 & 1\end{bmatrix}\begin{bmatrix}\text{Pixel no.}\\ \text{Line no.}\\ 0\\ 1\end{bmatrix}$ ⇒ (a, b, 0, d, e, f, 0, h, 0, 0, 0, 0, 0, 0, 0, 1)	When (pixel no., line no.) = (P, L); Map address X = a* P + b*L + d Map address Y =e* P + f* L + h
4	GTModelTypeGeoKey	SHORT	Coordinate system type = 1 (fixed value)	1 = ModelTypeProjected (Projection Coordinate System) 2 = ModelTypeGeographic (Geographic Latitude-Longitude System) 3 = ModelTypeGeocentric (Geocentric (X, Y, Z) Coordinate System)

A

9

Table 3-2 GeoTIFF tags in GeoTIFF file (2/4)

No.	Tag name	Tag type	Description	Remark
5	GTRasterTypeGeoKey	SHORT	Alignment of pixel value = 1 (fixed value)	1 = PixelIsArea The first pixel applies the domain surrounded by (0, 0), (0, 1), (1, 0), and (1, 1). The center of pixel is located in (0.5, 0.5). (0,0) (1,0) ↓ ↓ # ----- # ----- # ----- | + | + | # ----- # ----- # ----- ↑ ↑ (0,1) (1,1) 2 = PixelIsPoint The first pixel applies the domain surrounded by (-0.5,-0.5), (0.5,-0.5), (-0.5, 0.5), (0.5, 0.5). The center of pixel is located in (0,0). (0,0) (1,0) ↓ ↓ + ----- + ----- + ----- | | | + ----- + ----- + ----- ↑ ↑ (0,1) (1,1)
6	GTCitationGeoKey	ASCII	Description of this file = "Corrected Satellite Data" (fixed value)	
7	GeographicTypeGeoKey	SHORT	Map coordinate code = 4338 (fixed value)	4338=ITRF97

10

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Table 3-2 GeoTIFF tags in GeoTIFF file (3/4)

No.	Tag name	Tag type	Description	Remark	
8	GeogCitationGeoKey	ASCII	Geographic coordinate system UTM projection: “Datum=ITRF97 Ellipsoid=GRS80 Projection=UTM” Polar Stereographic Projection: “Datum=ITRF97 Ellipsoid=GRS80 Projection=PS”		A
9	GeogGeodeticDatumGeoKey	SHORT	Geographic coordinate system = 6655 (fixed value)	6655=The International Terrestrial Reference Frame	
10	GeogLinearUnitsGeoKey	SHORT	Coordinates unit (length) = 9001 (fixed value)	9001 = Linear_Meter [m]	
11	GeogAngularUnitsGeoKey	SHORT	Coordinates unit (angle) = 9102 (fixed value)	9102 = Angular_Degree [deg]	
12	GeogEllipsoidGeoKey	SHORT	Ellipsoid code = 7019 (fixed value)	7019 = Ellipse_GRS_1980 (GRS80)	
13	GeogSemiMajorAxisGeoKey	DOUBLE	Elliptical major radius	Unit [m] specified in GeogLinearUnitsGeoKey	
14	GeogSemMinorAxisGeoKey	DOUBLE	Elliptical minor radius	Unit [m] specified in GeogLinearUnitsGeoKey	
15	ProjectedCSTypeGeoKey	SHORT	Map projection code UTM projection: 32601-32660, 32701-32760 Other projection: User defined = 32767 (fixed value)	32601-32660: PCS_WGS84_UTM_zone_nnN 32701-32760: PCS_WGS84_UTM_zone_nnS 32767=User definition	A
16	PCSCitationGeoKey	ASCII	Projection coordinate system UTM projection: “Datum=ITRF97 Ellipsoid=GRS80 Projection=UTM” Polar Stereographic Projection: “Datum=ITRF97 Ellipsoid=GRS80 Projection=PS”		

Table 3-2 GeoTIFF tags in GeoTIFF file (4/4)

No.	Tag name	Tag type	Description	Remark
17	ProjectionGeoKey	SHORT	Map projection code UTM projection Northern Hemisphere = 16000 + zone number Southern Hemisphere = 16100 + zone number PS projection User definition = 32767 (fixed value)	16001-16060: Proj_UTM_zone_nnN 16101-16160: Proj_UTM_zone_nnS 32767 = User definition
18	ProjCoordTransGeoKey	SHORT	Map projection code PS projection = 15 (fixed value) UTM projection = 32767 (fixed value)	32767 = User defined MER projection 7 = CT_Mercator LCC projection 8 = CT_LambertConfConic_2SP PS, UPS projection 15 = CT_PolarStereographic
19	ProjLinearUnitsGeoKey	SHORT	Projection coordinates unit (length) = 9001 (fixed value)	9001 = Linear_Meter [m]
20	ProjFalseEastingGeoKey	DOUBLE	False Easting distance from false origin. 500000 (fixed value) This tag is set when Map projection method is UTM.	The unit specified in “ProjLinearUnitsGeoKey” is used [m]
21	ProjFalseNorthingGeoKey	DOUBLE	False Northing distance from false origin. Northern hemisphere : 0 (fixed value) or Southern hemisphere: 10000000 (fixed value), This tag is set when Map projection method is UTM.	The unit specified in “ProjLinearUnitsGeoKey” is used [m]

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A

12

Table 3-2 GeoTIFF tags in GeoTIFF file (5/5)

No.	Tag name	Tag type	Description	Remark
22	ProjNatOriginLatGeoKey	DOUBLE	Latitude of natural origin: UTM projection = 0 PS projection: Northern hemisphere = -90 (fixed value) Southern hemisphere = 90 (fixed value)	The unit specified in “ProjLinearUnitsGeoKey” is used [m]
23	ProjNatOriginLatGeoKey	DOUBLE	Longitude of natural origin: UTM projection = longitude at the UTM zone PS projection = center longitude of projection	

A

13

3.2 Summary Information

The summary information on AVNIR-2 is given below.

3.2.1 Outline of Summary Information

The summary information file includes the information for creating processed data, and it is always made in a pair with its processed data.

3.2.2 Filename of Summary Information

The filename of summary information is fixed as follows.

summary.txt

3.2.3 File Format of Summary Information

The file format of summary information is same as that of CEOS.

Refer to "ALOS Product Format Description (AVNIR-2 Product in CEOS format) Appendix Summary Information (AVNIR-2)" regarding the format description of summary information.

PALSAR Level 1.5

GeoTIFF Product

Format Description

Product Format Description

PALSAR Level 1.1/1.5 (GeoTIFF Format (Level 1.5)) Revision History (1/1)

Rev.	Date	Revision	Revision Contents
NC	2014/2/7		First Edition
A	2015/3/17		Value of GeoTIFF tags are changed, and new GeoTIFF tags are added.

Product format Description
(PALSAR Level 1.1/1.5, GeoTIFF format))
Table of Contents

1 Overview

This document describes the format specifications for ALOS PALSAR GeoTIFF Level 1.5 products.

2 Product Specifications

2.1 Outline of GeoTIFF

GeoTIFF image is an extension format, which allows geographical information to be added within Tagged Image File Format (TIFF) image.

2.2 Composition of Product

ALOS GeoTIFF product is generated from ALOS level 1.5 processed data. GeoTIFF product contains GeoTIFF files, according to the number of polarizations. Figure 2-1, shows a block diagram of GeoTIFF product. Table 2-1, shows the number of GeoTIFF files in each observation mode.

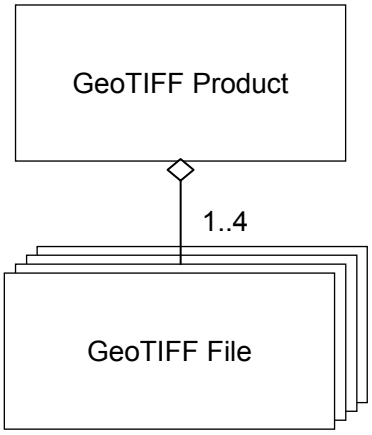

Figure 2-1 Block Diagram of GeoTIFF Product

Table 2-1 Number of GeoTIFF Files

No.	Observation mode	File Type	Number of files
1	Single polarization	GeoTIFF	1
2	Dual polarization		2
3	Full polarimetry		4

2.3 Filename

The filename definition of GeoTIFF product is shown in Table 2-2.

Table 2-2 Filename Definition of GeoTIFF Product

No.	File Type	Definition of Filename	Contents
1	GeoTIFF file	IMG-polarization information - Scene ID -ProductID.tif	The file of GeoTIFF form. An integer value is indicated to each pixel. Geographic information and map projection are written in the header.

Scene ID = AABBBCDDDDDEEEE

AA : Satellite type = "AL"

BBB : Sensor type = "PSR"

C : Supplemental remarks of sensor type

S: Wide observation mode

P: Except wide observation mode

DDDDD : Total calculated orbit number of the scene center

EEEE : Frame number of the scene center

Product ID = FGGGHIJ

F : Observation Mode

H : Fine mode

W : ScanSAR mode

D : Direct downlink mode

P : Polarimetry mode

C : Calibration mode

GGG : Processing Level

1.5: Level 1.5

H : Processing Option

G: Geo-Coded

_: Not specified (underscore)

I : Map Projection

U: UTM, P: PS, M: MER, L: LCC

J : Ascending Node

A: Ascending, D: Descending

Polarization (Transmission and Receiving) = XX

HH : Horizontally polarized wave transmission/Horizontally polarized wave receiving

HV : Horizontally polarized wave transmission/Vertically polarized wave receiving

VH : Vertically polarized wave transmission/Horizontally polarized wave receiving

VV : Vertically polarized wave transmission/Vertically polarized wave receiving

2.4 Backscattering coefficient calculation formula

Backscattering coefficient of level 1.5 is calculated by the below formula.

$$\sigma^0 = 10 \times \log_{10} < DN^2 > + CF$$

Backscattering coefficient of the applicable pixels is obtained with the ensemble average <>, i.e. it is obtained with the average processing that surrounds the points that are to be obtained. DN is level 1.5 pixel value; CF is calibration factor (CF).

Also, the calibration factor (CF) is not included in the GeoTIFF product.

3 Format

3.1 GeoTIFF File

GeoTIFF is a metadata standard which allows geometric information to be embedded within a TIFF image file. In GeoTIFF products, GeoTIFF files are generated in TIFF-Strip format, and some GeoTIFF-tags are different in each processing level. All TIFF files and GeoTIFF-tags are based on TIFF Revision 6.0 and GeoTIFF Revision 1.0 standard, and byte order of image data is recorded in little endian.

3.1.1 TIFF tag

Some TIFF-tags used in GeoTIFF file are shown in Table 3-1.

Table 3-1 TIFF tags in GeoTIFF file (1/3)

No.	Tag name	Tag type	Description	Remark
1	ImageLength	LONG	Number of lines	
2	ImageWidth	LONG	Number of pixels	
3	BitsPerSample	SHORT	Number of bits in one sample = 16 (fixed value)	
4	Compression	SHORT	Compression type = 1 (fixed value)	1 = No compression 2 = ITU-T Group3 1 dimension Huffman run length encoding 3 = ITU-T Group3 fax encoding 4 = ITU-T Group4 fax encoding 5 = LZW (fixed-length)compression 6 = JPEG compression (old style) 7 = JPEG compression (new style) 8 = ZIP compression 32773 = Packbits compression

Table 3-1 TIFF tags in GeoTIFF file (2/3)

No.	Tag name	Tag type	Description	Remark
5	PhotometricInterpretation	SHORT	Color space type of bitmap image data = 1 (fixed value)	0 = WhiteIsZero (Pixel value: White=0, Black=(2^ BitsPerSample-1)) 1 = BlackIsZero (Pixel value: Black=0, White=(2^ BitsPerSample-1)) 2 = RGB direct color (Min = 0, max= (2^ BitsPerSample-1)) 3 = Colormap (min= 0, max= (2^ BitsPerSample-1)) 4 = Transparency Mask (definition of masked region)
6	StripOffsets	LONG	Byte offset for each strip	
7	Orientation	SHORT	Orientation of image = 1 (fixed value).	1 = row: Top to Bottom, column: Left to Right 2 = row: Top to Bottom, column: Right to Left 3 = row: Bottom to Top, column: Right to Left 4 = row: Bottom to Top, column: Left to Right 5 = row: Left to Right, column: Top to Bottom 6 = row: Right to Left, column: Top to Bottom 7 = row: Right to Left, column: Bottom to Top 8 = row: Left to Right, column: Bottom to Top
8	SamplesPerPixel	SHORT	Number of samples in one pixel = 1 (fixed value)	

Table 3-1 TIFF tags in GeoTIFF file (3/3)

No.	Tag name	Tag type	Description	Remark
9	RowsPerStrip	SHORT	Number of image lines per strip = 8000 (fixed value)	
10	StripByteCounts	LONG	Number of bytes for each strip	
11	PlanarConfiguration	SHORT	Storing order of the data = 1 (fixed value)	"1 = Chunky format: The component values for each pixel are stored contiguously (example: RGBRGBRGB...) 2 = Planar format: The components are stored in separate components. (example: RRR... GGG... BBB...)"

3.1.2 GeoTIFF tag

GeoTIFF tags of GeoTIFF file are shown in Table 3-2.

Table 3-2 GeoTIFF tags in GeoTIFF file (1/6)

No.	Tag name	Tag type	Description	Remark
1	(deleted)			
2	(deleted)			
3	ModelTransformationTag	DOUBLE	The conversion matrix from a pixel and line coordinates to map coordinates = (a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p) In two-dimensional coordinate plane, $\begin{bmatrix}\text{Map address X}\\ \text{Map address Y}\\ 0\\ 1\end{bmatrix} = \begin{bmatrix}a & b & 0 & d\\ e & f & 0 & h\\ 0 & 0 & 0 & 0\\ 0 & 0 & 0 & 1\end{bmatrix}\begin{bmatrix}\text{Pixel no.}\\ \text{Line no.}\\ 0\\ 1\end{bmatrix}$ ⇒ (a, b, 0, d, e, f, 0, h, 0, 0, 0, 0, 0, 0, 0, 1)	When (pixel no., line no.) = (P, L); Map address X = a*P + b*L + d Map address Y =e*P + f*L + h
4	GTModelTypeGeoKey	SHORT	Coordinate system type = 1 (fixed value)	1 = ModelTypeProjected (Projection Coordinate System) 2 = ModelTypeGeographic (Geographic Latitude-Longitude System) 3 = ModelTypeGeocentric (Geocentric (X, Y, Z) Coordinate System)

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10

Table 3-2 GeoTIFF tags in GeoTIFF file (2/6)

No.	Tag name	Tag type	Description	Remark
5	GTRasterTypeGeoKey	SHORT	Alignment of pixel value = 1 (fixed value)	1 = PixelIsArea The first pixel applies the domain surrounded by (0, 0), (0, 1), (1, 0), and (1, 1). The center of pixel is located in (0.5, 0.5). (0,0) (1,0) ↓ ↓ # ----- # ----- # ----- | + | + | # ----- # ----- # ----- ↑ ↑ (0,1) (1,1) 2 = PixelIsPoint The first pixel applies the domain surrounded by (-0.5,-0.5), (0.5,-0.5), (-0.5, 0.5), (0.5, 0.5). The center of pixel is located in (0,0). (0,0) (1,0) ↓ ↓ + ----- + ----- + ----- | | | + ----- + ----- + ----- ↑ ↑ (0,1) (1,1)
6	GTCitationGeoKey	ASCII	Description of this file = “Corrected Satellite Data” (fixed value)	
7	GeographicTypeGeoKey	SHORT	Map coordinate code = 4338(fixed value)	4338=ITRF97

Table 3-2 GeoTIFF tags in GeoTIFF file (3/6)

No.	Tag name	Tag type	Description	Remark	
8	GeogCitationGeoKey	ASCII	Geographic coordinate system UTM projection: "Datum=ITRF97 Ellipsoid=GRS80 Projection=UTM" Polar Stereographic Projection: "Datum=ITRF97 Ellipsoid=GRS80 Projection=PS" Lambert Conformal Conic Projection: "Datum=ITRF97 Ellipsoid=GRS80 Projection=LCC" Mercator Projection: "Datum=ITRF97 Ellipsoid=GRS80 Projection=MER"		A
9	GeogGeodeticDatumGeoKey	SHORT	Geographic coordinate system = 6655 (fixed value)	6655=The International Terrestrial Reference Frame	
10	GeogLinearUnitsGeoKey	SHORT	Coordinates unit (distance) = 9001 (fixed value)	9001 = Linear_Meter [m]	
11	GeogAngularUnitsGeoKey	SHORT	Coordinates unit (angle) = 9102 (fixed value)	9102 = Angular_Degree [deg]	
12	GeogEllipsoidGeoKey	SHORT	Ellipsoid code = 7019 (fixed value)	7019 = Ellipse_GRS_1980 (GRS80)	
13	GeogSemiMajorAxisGeoKey	DOUBLE	Elliptical major radius	Unit [m] specified in GeogLinearUnitsGeoKey	
14	GeogSemMinorAxisGeoKey	DOUBLE	Elliptical minor radius	Unit [m] specified in GeogLinearUnitsGeoKey	
15	ProjectedCSTypeGeoKey	SHORT	Map projection code UTM projection: 32601-32660, 32701-32760 Other projection: User defined = 32767 (fixed value)	32601-32660: PCS_WGS84_UTM_zone_nnN 32701-32760: PCS_WGS84_UTM_zone_nnS 32767=User definition	A

Table 3-2 GeoTIFF tags in GeoTIFF file (4/6)

No.	Tag name	Tag type	Description	Remark
16	PCSCitationGeoKey	ASCII	Projection coordinate system UTM projection: “Datum=ITRF97 Ellipsoid=GRS80 Projection=UTM” Polar Stereographic Projection: “Datum=ITRF97 Ellipsoid=GRS80 Projection=PS” Lambert Conformal Conic Projection: “Datum=ITRF97 Ellipsoid=GRS80 Projection=LCC” Mercator Projection: “Datum=ITRF97 Ellipsoid=GRS80 Projection=MER”	
17	ProjectionGeoKey	SHORT	Map projection code UTM projection Northern Hemisphere = 16000 + zone number Southern Hemisphere = 16100 + zone number PS projection User definition = 32767 (fixed value)	16001-16060: Proj_UTM_zone_nnN 16101-16160: Proj_UTM_zone_nnS 32767 = User definition
18	ProjCoordTransGeoKey	SHORT	Map projection code MER projection = 7 (fixed value) LCC projection = 8 (fixed value) UPS projection = 15 (fixed value) UTM projection = 32767 (fixed value)	32767 = User definition MER projection 7 = CT_Mercator LCC projection 8 = CT_LambertConfConic_2SP PS, UPS projection 15 = CT_PolarStereographic
19	ProjLinearUnitsGeoKey	SHORT	Projection coordinates unit (length) = 9001 (fixed value)	9001 = Linear_Meter [m]

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Table 3-2 GeoTIFF tags in GeoTIFF file (5/6)

No.	Tag name	Tag type	Description	Remark
20	ProjFalseEastingGeoKey	DOUBLE	False Easting distance from false origin. 500000 (fixed value) This tag is set when Map projection method is UTM.	The unit specified in “ProjLinearUnitsGeoKey” is used [m]
21	ProjFalseNorthingGeoKey	DOUBLE	False Northing distance from false origin. Northern hemisphere : 0 (fixed value) or Southern hemisphere: 10000000 (fixed value), This tag is set when Map projection method is UTM.	The unit specified in “ProjLinearUnitsGeoKey” is used [m]
22	ProjNatOriginLatGeoKey	DOUBLE	Latitude of natural origin: UTM projection = 0 PS projection: Northern hemisphere = -90 (fixed value) Southern hemisphere = 90 (fixed value) LCC projection: Northern hemisphere = -90 (fixed value) Southern hemisphere = 90 (fixed value) MER projection = 0	
23	ProjNatOriginLatGeoKey	DOUBLE	Longitude of natural origin: UTM projection = longitude at the UTM zone PS projection = center longitude of projection LCC projection = center longitude of projection MER projection = center longitude of projection	

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Table 3-2 GeoTIFF tags in GeoTIFF file (6/6)

No.	Tag name	Tag type	Description	Remark
24	ProjStdParallel1GeoKey	DOUBLE	LCC first standard parallel. This tag is set only LCC projection.	
25	ProjStdParallel2GeoKey	DOUBLE	LCC second standard parallel. This tag is set only LCC projection.	
26	ProjFalseOriginLatGeoKey	DOUBLE	Latitude of false origin. This tag is set only LCC projection.	
27	ProjFalseOriginLongGeoKey	DOUBLE	Longitude of false origin. This tag is set only LCC projection.	

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15

3.2 Summary Information

The Summary information on PALSAR is given below.

3.2.1 Outline of Summary Information

The summary information file includes the information for creating processed data, and it is always made in a pair with its processed data.

3.2.2 Filename of Summary Information

The filename of summary information is fixed as follows.

summary.txt

3.2.3 File Format of Summary Information

The file format of summary information is same as that of CEOS.

Refer to “ALOS PALSAR DATA(Level 1.1/1.5) DATA FORMAT(The volume on CEOS) Chapter 4 Summary Information”.