ALOS Global Digital Surface Model (DSM)

ALOS World 3D-30m (AW3D30)
Version 2.1

Product Description

April, 2018

Earth Observation Research Center (EORC),
Japan Aerospace Exploration Agency (JAXA)

ALOS World 3D-30m (AW3D30)
Format Description

Table of Contents

Revision record

Rev	Product version	Date	Chapter/ Table	Field No.	Contents of revision
NC	1	2015/03/31	-	-	First edition
NC	1.1	2017/03/06	Chp.1		Addition of the explanation on the void-filling of DSM values in cloud and snow masked pixels
			Chp.2.1/ Table 1		Format definition change of mask (MSK) file
			Chp.2.3/ Table 3		Field addition to quality assurance information (QA) file
			Chp.5		Chapter addition for references
NC	2.1	2018/04/25	Chp.1		Addition of explanation on the void-filling of DSM
			Chp.2.1/ Table1		Clarification of file composition contents of AW3D30
			Chp.2.2/ Table 2	59-64	Clarification of title of the category.
			Chp.2.2/ Table 2	80	Deletion description of MSK details.
			Chp.2.3/ Table 3		Clarification of title of the category.
			Chp.2.3/ Table 3		Addition of version of source product to QAI file
			Chp.3.1/ Table 5		Correction of fluctuation of description
			Chp.5		Addition of references

1. Overview

The Japan Aerospace Exploration Agency (JAXA) has proceeded since 2014 the project to develop the precise global digital 3D map **"ALOS World 3D" (AW3D)**[*1] covering the global land areas through the use of 3 million scene archives acquired by the PRISM panchromatic stereo mapping sensor on the Advanced Land Observing Satellite "DAICHI" (ALOS) operated from 2006 to 2011[1)-3)].   The developed digital 3D map consists of digital elevation model (DEM) or digital surface model (DSM) that can represent land terrains with approx. 5-meter in spatial resolution and 5 meters in target height accuracy (standard deviation), and orthorectified PRISM nadir look images.   The digital 3D map have been utilized in a wide variety of applications such as map development, damage prediction of natural disasters, and water resource investigation.

JAXA released "ALOS World 3D-30m (AW3D30)", the global DSM dataset with a horizontal resolution of approx. 30-meter mesh (1 arcsecond in latitude and longitude) converted from the AW3D DSM dataset (5-meter mesh), free of charge since May 2015[4)].   Any of the commercial and non-commercial purposes can be used under the conditions of "5. Terms of Use".   In the previous version 1.1 released in March 2017, void height values in the cloud and snow pixels between 60-degree North and 60-degree South were filled with existing DEMs using the Delta Surface Fill[*2] method.

In the newly released version 2.1, the source of AW3D DSM has been upgraded to version 2[*3], and masks of the water and low correlation pixels were also filled with existing DEMs in addition to the cloud and snow pixels between 60-degree North and 60-degree South.   In Japan area, filling was carried out after updating coastline information.   Note that only AVERAGE resampling product is provided in version 2.1 though there were two types of resampling method in previous version i.e. AVERAGE and MEDIAN, but since there is not much difference between them.

This dataset is highly expected to be useful for scientific research, education, as well as the private service sector that uses geospatial information.

*1：Precise Global Digital 3D Map "ALOS World 3D" http://www.eorc.jaxa.jp/ALOS/en/aw3d/index_e.htm
*2：Delta Surface Fill (DSF) is a void-filling method that replaces the void values in the original DEM with the adjusted values calculated from surrounding valid pixels in other reference DSM.   By using the difference of valid height values in the original and reference DEM, this process ensures the smooth continuity of topography at the boundaries of void-fills[5)].
*3：Version up contents of AW3D（the 5m resolution DSM）[6)].
　　・Absolute offset errors from the ICESat reference, and
　　・Relative striping errors along satellite orbits by updated calibration.

2. AW3D30 Dataset

2.1. File composition

A tile of this dataset covers the unit area of 1 degree latitude and longitude. The tile ID stands for the latitude and longitude at lower-left corner. For every tile, the set of data shown in Table 1 is stored in a tar+gz compressed file.

Table 1: File composition of AW3D30 dataset

File type	Contents and details	Notes
DSM file (DSM) 〈GeoTIFF format〉	• Signed 16 bits (LSB) raster data • Equirectangular projection, Spacing: 1 arcsec. (approx. 30 m) DSM values are average over the range of 1 arcsec grid pixel. (Round up integer value) • Elevation (in meter) converted from the ellipsoidal height based on ITRF97 and GRS80, using EGM96 geoid model. • Value "-9999" is stored in void pixels. • Value "0m" is stored in sea water pixels	[†1]: Land water and low correlation mask indicates the area with low correlation in the calculation of the 5m resolution DSM. In the DSM file of AW3D30, complemented DSM values are stored by referring to other data sets.
Mask file (MSK) 〈GeoTIFF format〉	• 8 bits raster data • Equirectangular projection, Spacing: 1 arcsec. (approx. 30 m) Mask information for each pixel: • lower 1-2 bit: Valid/Invalid, Mask Information[†1] • lower 3-4 bit: Elevation dataset used for the void-filling processing • lower 5-8 bit: not used <Bit mask lower 4 bits> 0000: Valid 0001: Cloud and show mask (invalid) 0010: Land water and low correlation mask[†1] of the 5 m resolution DSM (valid) 0011: Sea mask[†2] (valid) 0100: National Land Numerical Information 10 m DEM (by Geographical Survey Institute of Japan) (valid)[†3] 1000: Shuttle Radar Topography Mission (SRTM) SRTM-1 Version 3[†3] （valid） 1100: PRISM DSM[†3] (valid)	[†2]: Height values of zero are stored in the DSM pixels of sea mask. [†3]: Height values could be stored in the DSM pixels of land water and low correlation areas in the tiles covering both land and land water areas.
Stacking number file (STK) 〈GeoTIFF format〉	Number of DSM-scene files which were used to produce the 5m-DSM. • 8 bits raster data • Equirectangular projection, Spacing: 1 arcsec. (approx. 30 m) • DSM values are average over the range of 1 arcsec grid pixel. (Round up integer value)	
Header information file (HDR) 〈Text format〉	Meta information such as image size and pixel spacing. • This was derived from HDR file of the 5m-DSM.	Table 2 for details.
Quality assurance information file (QAI) 〈Text format〉	Quality assurance information consisting of the comparison and correlation analysis results of 5 m mesh DSM with other existing DEMs, and statistics from 30 m mesh DSM.	Table 3 for details.
List file (LST) 〈Text format〉	Information of DSM-scene files which were used to produce the 5m-DSM. • ID, type, orbit number, RSP path/frame, stereo mode, observation date.	LST file has been added in the version 2.

2.2. Header information file format

Table 2 shows the detailed items in the header information (HDR) file included in the AW3D30 dataset.

Table 2 : Items in AW3D30 header information (HDR) file

Field No.	Description		Number of Bytes	Start Byte Position	Type	Note	Source
Product Record		Data Identifier				Field No.1-58	
	Product Information	Product Identifier Details				Field No.1-10	
1	Mesh ID = 'NNNNNNNNbbbbbbbb'		16	1	A16		WO
2	DSM Product ID = 'AABBBCDEEbbbbbbb' AA : Satellite code = 'AL' BBB : Sensor code = 'PSM':PRISM C : Grid type = 'L': Lat-Lon D : DSM type = 'A': Absolute EE : DSM grid spacing = '05'		16	17	A16		WO
3	Product type = 'PSM-DSMbbbbbbbbb'		16	33	A16		WO
4	Mesh code = 'NNNNNNNNbbbbbbbb'		16	49	A16		WO
5	Satellite name = 'ALOSbbbb' (fixed)		8	65	A8		Fixed
6	Sensor code = 'PSMbbbbb': PRISM		8	73	A8		WO
7	Coordinates = 'LTLNbbbb': Lat-Lon		8	81	A8		WO
8	DSM type = 'Abbb': Absolute		4	89	A4		WO
9	DSM grid spacing (sec) = 'b1.00bbb'		8	93	A8		WO
10	Blank (fixed)		28	101	A28		Fixed
		Subtotal	128				
	Mesh Information	Mesh Identifier				Field No.11-35	
11	Mesh upper-left line number = 'bNNNNN.N'		8	129	F8.1	Addresses correspondence to the corner of a pixel, not its center. Since each pixel/line integer value is assigned at pixel center, pixel/line number for four corners is described with real values.	Proc.
12	Mesh upper-left column number = 'bNNNNN.N'		8	137	F8.1		Proc.
13	Mesh upper-right line number = 'bNNNNN.N'		8	145	F8.1		Proc.
14	Mesh upper-right column number = 'bNNNNN.N'		8	153	F8.1		Proc.
15	Mesh lower-left line number = 'bNNNNN.N'		8	161	F8.1		Proc.
16	Mesh lower-left column number = 'bNNNNN.N'		8	169	F8.1		Proc.
17	Mesh lower-right line number = 'bNNNNN.N'		8	177	F8.1		Proc.
18	Mesh lower-right column number = 'bNNNNN.N'		8	185	F8.1		Proc.
19	Mesh upper-left latitude (deg.) = 'NNNNNNNN.NNNNNNN' (-90.0000000 - 90.0000000)		16	193	F16.7	Negative value for southern hemisphere	Proc.
20	Mesh upper-left longitude (deg.) = 'NNNNNNNN.NNNNNNN' (-180.0000000 - 180.0000000)		16	209	F16.7	Negative value for west longitude	Proc.
21	Mesh upper-right latitude (deg.) = 'NNNNNNNN.NNNNNNN' (-90.0000000 - 90.0000000)		16	225	F16.7	Negative value for southern hemisphere	Proc.
22	Mesh upper-right longitude (deg.) = 'NNNNNNNN.NNNNNNN' (-180.0000000 - 180.0000000)		16	241	F16.7	Negative value for west longitude	Proc.
23	Mesh lower-left latitude (deg.) = 'NNNNNNNN.NNNNNNN' (-90.0000000 - 90.0000000)		16	257	F16.7	Negative value for southern hemisphere	Proc.
24	Mesh lower-left longitude (deg.) = 'NNNNNNNN.NNNNNNN' (-180.0000000 - 180.0000000)		16	273	F16.7	Negative value for west longitude	Proc.
25	Mesh lower-right latitude (deg.) = 'NNNNNNNN.NNNNNNN' (-90.0000000 - 90.0000000)		16	289	F16.7	Negative value for southern hemisphere	Proc.
26	Mesh lower-right longitude (deg.) = 'NNNNNNNN.NNNNNNN' (-180.0000000 - 180.0000000)		16	305	F16.7	Negative value for west longitude	Proc.
27	Mesh upper-left map address X (km) = 'NNNNNNNN.NNNNNNN' (Northing for UTM)		16	321	F16.7	All blank for LTLN product	Proc.
28	Mesh upper-left map address Y (km) = 'NNNNNNNN.NNNNNNN' (Easting for UTM)		16	337	F16.7		Proc.
29	Mesh upper-right map address X (km) = 'NNNNNNNN.NNNNNNN' (Northing for UTM)		16	353	F16.7		Proc.
30	Mesh upper-right map address Y (km) = 'NNNNNNNN.NNNNNNN' (Easting for UTM)		16	369	F16.7		Proc.
31	Mesh lower-left map address X (km) = 'NNNNNNNN.NNNNNNN' (Northing for UTM)		16	385	F16.7		Proc.
32	Mesh lower-left map address Y (km) = 'NNNNNNNN.NNNNNNN' (Easting for UTM)		16	401	F16.7		Proc.
33	Mesh lower-right map address X (km) = 'NNNNNNNN.NNNNNNN' (Northing for UTM)		16	417	F16.7		Proc.
34	Mesh lower-right map address Y (km) = 'NNNNNNNN.NNNNNNN' (Easting for UTM)		16	433	F16.7		Proc.
35	Blank (fixed)		16	449	A16		Fixed
		Subtotal	336				
	Processing Information	Processing Details				Field No.36-58	
	Map Projection	Map Projection Parameters					
36	Coordinates = 'LTLNbbbb'		8	465	A8		WO
37	PS origin latitude (deg.) = 'NNNNNNNN.NNNNNNN'		16	473	F16.7	All blank for LTLN product	Proc.
38	PS origin longitude (deg.) = 'NNNNNNNN.NNNNNNN'		16	489	F16.7	All blank for LTLN product	Proc.
39	PS reference latitude (deg.) = 'NNNNNNNN.NNNNNNN'		16	505	F16.7	All blank for LTLN product	Proc.
40	PS reference longitude/ UTM central meridian (deg.) = 'NNNNNNNN.NNNNNNN'		16	521	F16.7	All blank for LTLN product	Proc.
41	Hemisphere = 'bbbN':North / 'bbbS':South		4	537	A4		Proc.

Table 2 : Items in AW3D30 header information (HDR) file

Field No.	Description		Number of Bytes	Start Byte Position	Type	Note	Source
42	UTM zone no. = 'bbb1' - 'bb60'		4	541	I4	All blank for LTLN product	Proc.
43	Angle between vertical axis of coordinates and true north direction (deg) = 'NNNNNNNN.NNNNNNN'		16	545	F16.7	At mesh center All blank for LTLN product	Proc.
44	Blank (fixed)		32	561	A32		Fixed
	Subtotal		128				
	Datum	Datum Parameters					
45	ECR coordinates = 'ITRF97bbbbbbbbbb'		16	593	A16		Fixed
46	Ellipsoid model = 'GRS80bbbbbbbbbbb'		16	609	A16		Fixed
47	Equator radius of ellipsoid model (km) = 'NNNNNNNN.NNNNNNN'		16	625	F16.7		Fixed
48	Polar radius of ellipsoid model (km) = 'NNNNNNNN.NNNNNNN'		16	641	F16.7		Fixed
49	Inverse flattening (1/f) of ellipsoid model = 'NNNNNNNN.NNNNNNN'		16	657	F16.7		Fixed
50	Blank (fixed)		48	673	A48		Fixed
	Subtotal		128				
	DSM Data	DSM Data Parameters					
51	Coordinates = 'LTLNbbbb'		8	721	A8	Same as field No.7	WO
52	DSM type = 'Abbb': Absolute		4	729	A4	Same as field No.8	WO
53	Vertical grid spacing (m)/(sec) = 'NNN.NNNb'		8	733	A8		WO
54	Horizontal grid spacing (m)/(sec) = 'NNN.NNNb'		8	741	A8		WO
55	Height resolution of DSM (m) = '1bbbbbbb'		8	749	I8		Fixed
56	Height type = 'Ebbb': Ellipsoidal Height / 'Obbb': Orthometric Height		4	757	A4		Proc.
57	Geoid data = 'XXXXXXXXXXXXXXXX' 'GSI-2000bbbbbbbb': Japan Geoid 2000 / 'NGA-EGM96bbbbbbb': EGM96		16	761	A16	All blank for height type 'E'	Proc.
58	Blank (fixed)		8	777	A8		Fixed
	Subtotal		64				
Quality Record		Quality Information from the 5m DSM				Field No.59-64	
59	Mask (00000000) rate = 'bNNN' %		4	785	I4	Right-aligned	Proc.
60	Mask (00000001) rate = 'bNNN' %		4	789	I4		Proc.
61	Mask (00000010) rate = 'bNNN' %		4	793	I4		Proc.
62	Mask (00000011) rate = 'bNNN' %		4	797	I4		Proc.
63	DSM data quality = 'bbbX' 'G': Good = 100 - 81 % (Rate of valid pixels) 'F': Fair = 80 - 51 % 'P': Poor = 50 - 0 %		4	801	A4		Proc.
64	Blank		44	805	A44		Fixed
	Subtotal		64				
Format Record		Data Format Information				Field No.65-82	
65	Header record length (byte) = 'bbbbNNNN'		8	849	I8	Variable header file size	Fixed
66	Data column length (number of pixels for each line) = 'bbbNNNNN'		8	857	I8		Proc.
67	Data line length (number of pixels for each column) = 'bbbNNNNN'		8	865	I8		Proc.
68	Byte order = 'MSBbbbbb' / 'LSBbbbbb' (default)		8	873	A8		Fixed
	Subtotal		32				
	DSM Data Format	DSM Data Format Structures					
69	Number of bits for DSM 1 pixel (bit) = 'bb16'		4	881	I4		Fixed
70	Number of pixels for DSM 1 data (pixel) = 'bbb1'		4	885	I4		Fixed
71	Number of bytes for DSM 1 data (byte) = 'bbb2'		4	889	I4		Fixed
72	Bit start for DSM 1 pixel (bit) = 'bbb0'		4	893	I4	0-15 bits per data	Fixed
73	Bit end for DSM 1 pixel (bit) = 'bb15' DSM data settings 2 bytes (signed short) with a vertical accuracy of 1m		4	897	I4	0-15 bits per data	Fixed
74	Number of DSM files = 'bbb1' (fixed)		4	901	I4		Fixed
75	Blank (fixed)		8	905	A8		Fixed
	Subtotal		32				
	MSK Data Format	MSK Data Format Structures					
76	Number of bits for MSK 1 pixel (bit) = 'bbb8'		4	913	I4		Fixed
77	Number of pixels for MSK 1 data (pixel) = 'bbb1'		4	917	I4		Fixed
78	Number of bytes for MSK 1 data (byte) = 'bbb1'		4	921	I4		Fixed
79	Bit start for MSK 1 pixel (bit) = 'bbb0'		4	925	I4	0-7 bits per data	Fixed
80	Bit end for MSK 1 pixel (bit) = 'bbb7'		4	929	I4	0-7 bits per data	Fixed
81	Number of MSK files = 'bbb1' (fixed)		4	933	I4		Fixed
82	Blank (fixed)		40	937	A40		Fixed
	Subtotal		64				
System Record		Data Processing System Information				Field No.88-95	
83	Processing date (JST) = 'YYYYMMDDbbbbbbbb' YYYY : Year MM : Month DD : Day		16	977	A16		Proc.
84	Processing time (JST) = 'HHMMSSbbbbbbbbbb' HH : Hour MM : Minute SS : Second		16	993	A16		Proc.
85	Processing country = 'JAPANbbbbbbbbbbb'		16	1009	A16		Fixed
86	Processing organization = 'JAXAbbbbbbbbbbbb'		16	1025	A16		Fixed
87	Processing facility = 'EORC-AGAPbbbbbbb'		16	1041	A16		Fixed

Table 2 : Items in AW3D30 header information (HDR) file

Field No.	Description	Number of Bytes	Start Byte Position	Type	Note	Source
88	Software version = 'VVV-RRR-YYYYMMDDbbbbbbbb' VVV : Version No. RRR : Release No. YYYY : Release year MM : Release month DD : Release date	24	1057	A24		Proc.
89	DFCB revision = 'Abbb' - 'Zbbb' (26 types)	4	1081	A4		Proc.
90	Blank (fixed)	20	1085	A20		Fixed
	Subtotal	128				
Reserve	Reserve				Field No.91	
91	Blank (fixed)	4	1105	I4		Proc.
	Subtotal	4				
	Total	**1108**				

2.3. Quality assurance information file format

Detailed items in the quality assurance information (QAI) file included in the AW3D30 dataset are summarized in Table 3. First half of the items are the quality assurance information obtained from the 5m resolution DSM which are the original data in producing the 30m resolution DSM.

Table 3 : Items in AW3D30 quality assurance information (QAI) file.

Category	Item	Key	Value (sample)
5m DSM	Comprehensive assessment: accuracy[*1]	TOTAL_ACCURACY	G
	Comprehensive assessment: completeness[*1]	TOTAL_INTEGRITY	G
	Comprehensive assessment: reliability[*1]	TOTAL_RELIABILITY	G
	Average of difference: SRTM	SRTM_AVERAGE	0.25
	Standard deviation of difference: SRTM	SRTM_STDEV	11.38
	RMS of difference: SRTM	SRTM_RMS	11.38
	Maximum of difference: SRTM	SRTM_MAX	463
	Mode of difference: SRTM	SRTM_MODE	0
	Average of difference: ASTER GDEM	ASTER_AVERAGE	0.27
	Standard deviation of difference: ASTER GDEM	ASTER_STDEV	23.95
	RMS of difference: ASTER GDEM	ASTER_RMS	26.36
	Maximum of difference: ASTER GDEM	ASTER_MAX	61.28
	Mode of difference: ASTER GDEM	ASTER_MODE	1
	Number of comparison points with ICESat	ICESAT_NUM	3386
	Average of difference: ICESat	ICESAT_AVERAGE	0.24
	Standard deviation of difference: ICESat	ICESAT_STDEV	3.14
	RMS of difference: ICESat	ICESAT_RMS	3.15
	Maximum of difference: ICESat	ICESAT_MAX	41.16
	Mode of difference: ICESat	ICESAT_MODE	0
	Average of relative error between stacked images	REL_STACK_AVERAGE	1.93
	Standard deviation of relative error between stacked images	REL_STACK_STDEV	1.88
	Number of valid pixel	MASK_NUM_VALID	568409256
	Number of cloud and snow masked pixel	MASK_NUM_CLOUDSNOW	5092528
	Number of inland water and low correlation masked pixels	MASK_NUM_INLANDWATER	2498216
	Number of sea masked pixels	MASK_NUM_SEA	0
	Rate of valid pixel	MASK_RATE_VALID	98.68
	Rate of cloud and snow masked pixels	MASK_RATE_CLOUDSNOW	0.88
	Rate of inland water and low correlation masked pixels	MASK_RATE_INLANDWATER	0.43
	Rate of sea masked pixels	MASK_RATE_SEA	0
	Correlation coefficient: average	CORREL_AVERAGE	0.72
	Correlation coefficient: standard deviation	CORREL_STDEV	0.16
	Correlation coefficient: maximum	CORREL_MAX	-0.59
	Correlation coefficient: minimum	CORREL_MIN	1
	Correlation coefficient histogram: from -1.0 to -0.9	CORREL_HIST_-1.0to-0.9	0
	Correlation coefficient histogram: from -0.9 to -0.8	CORREL_HIST_-0.9to-0.8	0
	Correlation coefficient histogram: from -0.8 to -0.7	CORREL_HIST_-0.8to-0.7	0
	Correlation coefficient histogram: from -0.7 to -0.6	CORREL_HIST_-0.7to-0.6	21
	Correlation coefficient histogram: from -0.6 to -0.5	CORREL_HIST_-0.6to-0.5	123
	Correlation coefficient histogram: from -0.5 to -0.4	CORREL_HIST_-0.5to-0.4	461
	Correlation coefficient histogram: from -0.4 to -0.3	CORREL_HIST_-0.4to-0.3	1236
	Correlation coefficient histogram: from -0.3 to -0.2	CORREL_HIST_-0.3to-0.2	4193
	Correlation coefficient histogram: from -0.2 to -0.1	CORREL_HIST_-0.2to-0.1	15003
	Correlation coefficient histogram: from -0.1 to 0.0	CORREL_HIST_-0.1to0.0	646970
	Correlation coefficient histogram: from 0.0 to 0.1	CORREL_HIST_0.0to0.1	1699541
	Correlation coefficient histogram: from 0.1 to 0.2	CORREL_HIST_0.1to0.2	5350540
	Correlation coefficient histogram: from 0.2 to 0.3	CORREL_HIST_0.2to0.3	11789461
	Correlation coefficient histogram: from 0.3 to 0.4	CORREL_HIST_0.3to0.4	30902088

Table 3 : Items in AW3D30 quality assurance information (QAI) file.

Category	Item	Key	Value (sample)
	Correlation coefficient histogram: from 0.4 to 0.5	CORREL_HIST_0.4to0.5	65110659
	Correlation coefficient histogram: from 0.5 to .6	CORREL_HIST_0.5to0.6	111734882
	Correlation coefficient histogram: from 0.6 to 0.7	CORREL_HIST_0.6to0.7	142957951
	Correlation coefficient histogram: from 0.7 to 0.8	CORREL_HIST_0.7to0.8	129144617
	Correlation coefficient histogram: from 0.8 to 0.9	CORREL_HIST_0.8to0.9	69039487
	Correlation coefficient histogram: from 0.9 to 1.0	CORREL_HIST_0.9to1.0	24940
	Number of stacking: average	STACK_AVERAGE	3.76
	Number of stacking: standard deviation	STACK_STDEV	1.19
	Number of stacking: Minimum	STACK_MIN	0
	Number of stacking: Maximum	STACK_MAX	11
Pre-processing Information on void-filling (Japanese island)	Number of valid pixel	InsPSM10M_MASK_NUM_VALID	568409256
	Number of cloud and snow mask pixel	InsPSM10M_MASK_NUM_CLOUDSNOW	5092528
	Number of inland water and low correlation mask pixels	InsPSM10M_MASK_NUM_INLANDWATER	2498216
	Number of sea mask pixels	InsPSM10M_MASK_NUM_SEA	0
	Rate of valid pixel	InsPSM10M_MASK_RATE_VALID	98.68
	Rate of cloud and snow mask pixels	InsPSM10M_MASK_RATE_CLOUDSNOW	0.88
	Rate of inland water and low correlation mask pixels	InsPSM10M_MASK_RATE_INLANDWATER	0.43
	Rate of sea mask pixels	InsPSM10M_MASK_RATE_SEA	0
30m DSM before void-filling	Number of valid pixel	DegradeXXX_MASK_NUM_VALID[2]	15789146
	Number of cloud and snow mask pixel	DegradeXXX_MASK_NUM_CLOUDSNOW[2]	141459
	Number of inland water and low correlation mask pixels	DegradeXXX_MASK_NUM_INLANDWATER[2]	69394
	Number of sea mask pixels	DegradeXXX_MASK_NUM_SEA[2]	0
	Rate of valid pixel	DegradeXXX_MASK_RATE_VALID[2]	98.68
	Rate of cloud and snow mask pixels	DegradeXXX_MASK_RATE_CLOUDSNOW[2]	0.88
	Rate of inland water and low correlation mask pixels	DegradeXXX_MASK_RATE_INLANDWATER[2]	0.43
	Rate of sea mask pixels	DegradeXXX_MASK_RATE_SEA[2]	0
Information on 30m DSM void-filling	Number of cloud and snow mask pixel (after void-filling)	GapFillXXX_MASK_NUM_CLOUDSNOW[2]	0
	Number of pixels filled with GSI 10m DEM	GapFillXXX_MASK_NUM_FILLED_GSI10[2]	0
	Number of pixels filled with SRTM-1 Version 3	GapFillXXX_MASK_NUM_FILLED_SRTM-1_V3[2]	141459
	Number of pixels filled with PRISM DSM	GapFillXXX_MASK_NUM_FILLED_PSM[2]	0
	Rate of cloud and snow mask pixel (after void-filling)	GapFillXXX_MASK_RATE_CLOUDSNOW[2]	0
	Rate of pixels filled with GSI 10m DEM	GapFillXXX_MASK_RATE_FILLED_GSI10[2]	0
	Rate of pixels filled with SRTM1 Version 3	GapFillXXX_MASK_RATE_FILLED_SRTM-1_V3[2]	0.88
	Rate of pixels filled with PRISM DSM	GapFillXXX_MASK_RATE_FILLED_PSM[2]	0
Pre-processing	Version of void-filling product Information on void-filling	VERSION_GapFill_PRODUCT	2.1
Source product	Version of source product	VERSION_AW3D_PRODUCT	2

*1: Evaluation items and strategies in comprehensive assessment are as follows.
  1) Comprehensive assessment - accuracy: statistical evaluation on the absolute difference from existing global topographic data such as SRTM-3, ASTER GDEM, and ICESat
  2) Comprehensive assessment - completeness: evaluation on the area occupancy of cloud and snow mask and land water and low correlation mask to land areas
  3) Comprehensive assessment - reliability: statistical evaluation on the histograms of correlation coefficients in stereo-pair matching and on stacking number
  4) Descriptions of source products are from version.2
*2: XXX = AVE: Average DSM (Only AVE is available and MED is not available in version 2.1.)

Table 4: Criteria for comprehensive evaluation in QAI file

Item	Good	Fair	Poor
Accuracy	< 5m	< 7m	>= 7m
Completeness	>= 90%	>= 70%	< 70%
Reliability	>= 1.5	>= 1.0	< 1.0

3. GeoTIFF Product

3.1. TIFF tag settings for GeoTIFF product

Table 5 and Table 6 summarize the TIFF tag settings for GeoTIFF product.

Table 5: TIFF tag settings for GeoTIFF product (DSM)

Tag	Value
TIFFTAG_SUBFILETYPE	0
TIFFTAG_IMAGEWIDTH	DSM width
TIFFTAG_IMAGELENGTH	DSM height
TIFFTAG_BITSPERSAMPLE	16
TIFFTAG_COMPRESSION	COMPRESSION_NONE
TIFFTAG_PHOTOMETRIC	PHOTOMETRIC_MINISBLACK
TIFFTAG_ORIENTATION	ORIENTATION_TOPLEFT
TIFFTAG_SAMPLESPERPIXEL	1
TIFFTAG_ROWSPERSTRIP	DSM height
TIFFTAG_XRESOLUTION	72
TIFFTAG_YRESOLUTION	72
TIFFTAG_RESOLUTIONUNIT	RESUNIT_INCH
TIFFTAG_SAMPLEFORMAT	SAMPLEFORMAT_INT
TIFFTAG_PLANARCONFIG	1
GTIFF_TIEPOINTS	6 parameters of model tie point tag
GTIFF_PIXELSCALE	3 parameters of model pixel scale tag
GTIFF_ASCIIPARAMS	text data

Table 6: TIFF tag settings for GeoTIFF product (MSK and STK)

Tag	Value
TIFFTAG_SUBFILETYPE	0
TIFFTAG_IMAGEWIDTH	image width
TIFFTAG_IMAGELENGTH	image height
TIFFTAG_BITSPERSAMPLE	8
TIFFTAG_COMPRESSION	COMPRESSION_NONE
TIFFTAG_PHOTOMETRIC	PHOTOMETRIC_MINISBLACK
TIFFTAG_ORIENTATION	ORIENTATION_TOPLEFT
TIFFTAG_SAMPLESPERPIXEL	1
TIFFTAG_ROWSPERSTRIP	image height
TIFFTAG_XRESOLUTION	72
TIFFTAG_YRESOLUTION	72
TIFFTAG_RESOLUTIONUNIT	RESUNIT_INCH
TIFFTAG_SAMPLEFORMAT	SAMPLEFORMAT_UINT
TIFFTAG_PLANARCONFIG	1
GTIFF_TIEPOINTS	6 parameters of model tie point tag
GTIFF_PIXELSCALE	3 parameters of model pixel scale tag
GTIFF_ASCIIPARAMS	text data

3.2. GeoTIFF key settings for GeoTIFF product

Table 7 shows the GeoTIFF key settings for GeoTIFF product.

Table 7: GeoTIFF key settings for GeoTIFF product

Key	Value
GTModelTypeGeoKey	ModelTypeProjected
GTRasterTypeGeoKey	RasterPixelIsArea
GeographicTypeGeoKey	GCS_WGS_84
GeogAngularUnitsGeoKey	Angular_Degree
GTCitationGeoKey	text data
PCSCitationGeoKey	text data

4. Others

Please contact to the ALOS Science Project via e-mail to the address below for any questions or inquiries regarding the use of the dataset.   For our future reference, sending the offprints and copies of the research results using the dataset to the following point of contact is highly appreciated.

5. References

1) T. Tadono, H. Ishida, F. Oda, S. Naito, K. Minakawa, and H. Iwamoto, "Precise Global DEM Generation by ALOS PRISM," ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Vol.II-4, pp.71-76, 2014.

2) J. Takaku, T. Tadono, and K. Tsutsui, "Generation of High Resolution Global DSM from ALOS PRISM," The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, ISPRS, Vol.XL-4, pp.243-248, 2014.

3) J. Takaku, T. Tadono, K. Tsutsui, and M. Ichikawa, "Validation of 'AW3D' Global DSM Generated from ALOS PRISM," ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Vol.III-4, pp. 25-31, 2016.

4) T. Tadono, H. Nagai, H. Ishida, F. Oda, S. Naito, K. Minakawa, and H. Iwamoto, "Initial Validation of the 30 m-mesh Global Digital Surface Model Generated by ALOS PRISM, The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, ISPRS, Vol.XLI-B4, pp.157-162, 2016.

5) G. Grohman, G. Kroenung, and J. Strebeck, "Filling SRTM Voids: The Delta Surface Fill Method," Photogrammetric Engineering & Remote Sensing, Vol.72, No.3, pp.213-216, 2006.

6) J. Takaku and T. Tadono, "Quality updates of 'AW3D' global DSM generated from ALOS PRISM," Proc. IGARSS2017, IEEE, Fort Worth, TX, USA., pp. 5666-5669, 2017.

Point of contact
ALOS Science Project
Earth Observation Research Center (EORC)
Japan Aerospace Exploration Agency (JAXA)
E-mail: aproject@jaxa.jp