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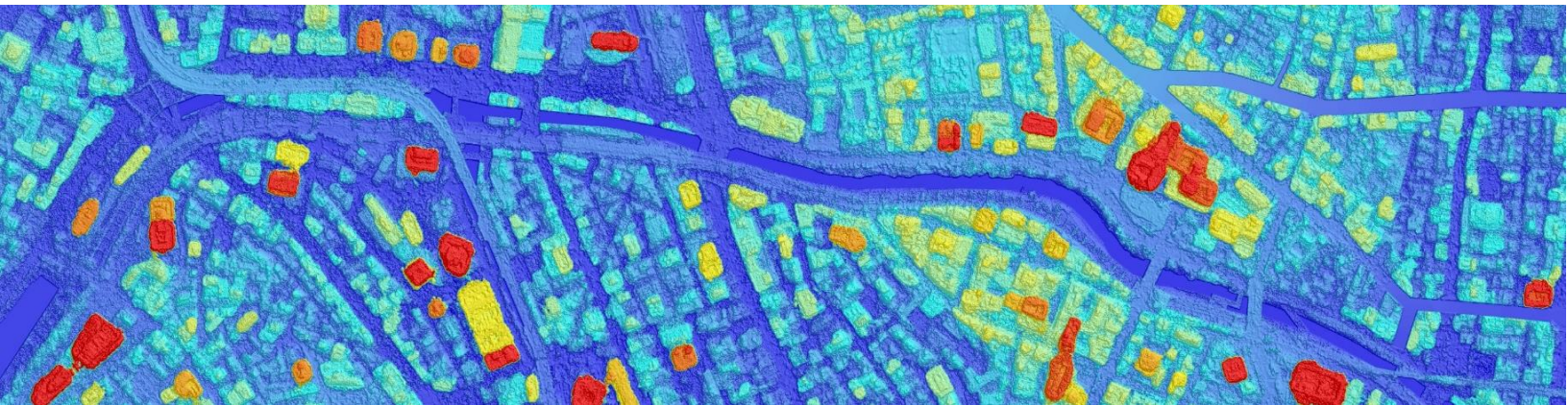
NTT DATA Corporation

AW3D® Enhanced Product Guide

Product Specification Document

Change Record

Rev	Section(s)	Description of Changes	Changed By	Date	Release
0.5	All	Draft	NTT DATA	2019/4/12	
0.6	2.2.1 2.3.1	Anomalies correction explanation. DTM process.	NTT DATA	2019/7/11	
0.7	2.4	Update tecjnical specification	NTT DATA	2020/08/12	
0.7a	6	Add explanation about timeline	NTT DATA	2020/08/13	
	7, 8	Delete	NTT DATA	2020/08/13	

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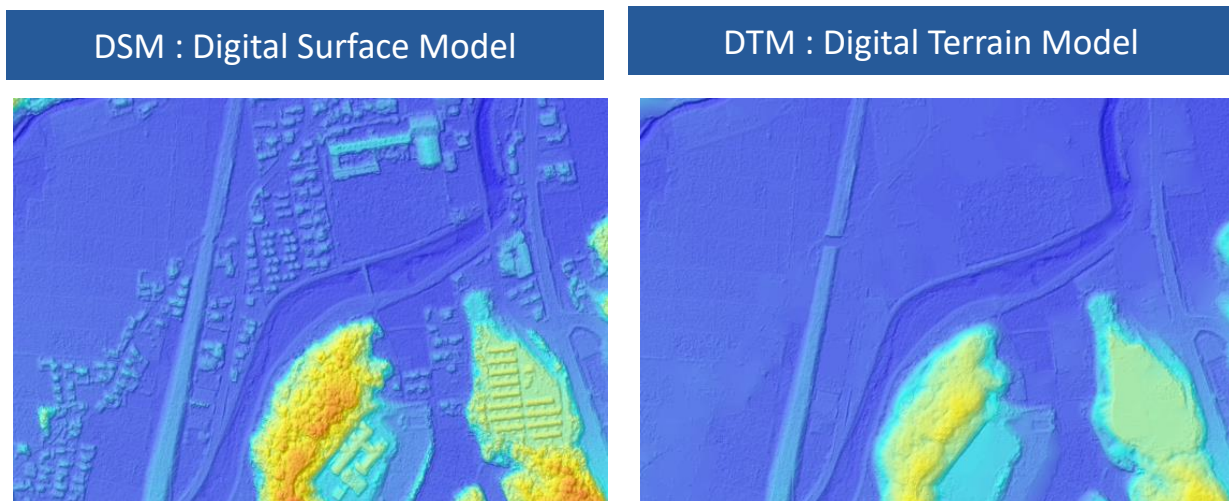
1.   Introduction

1.1   Purpose

The purpose of this document is to define the AW3D® Enhanced product specifications and to give a guide to resellers, distributers, and customers.

1.2   Product Outline

AW3D Enhanced is 0.5m, 1m, and 2m resolution Digital Elevation Model (DEM) derived from DigitalGlobe satellites imagery. This is the world most highest resolution satellite-based DEM product available in the market. Digital Surface Model (DSM) and Digital Terrain Model (DTM), are available in its product lineup.

Table 1. Product Outline

Product Type	**DSM (Digital Surface Model)** Surface model including height of trees, buildings, and other structures. **DTM (Digital Terrain Model)** Terrain model that the height of trees, buildings, and other structures are eliminated from DSM.
Resolution	0.5m/1m/2m *Other resolution may be available upon request
Source data	DigitalGlobe constellation satellite imagery
Available area	Entire world *On-demand production *Some area may be unavailable due to imagery availability

Figure 1. Sample of DSM and DTM
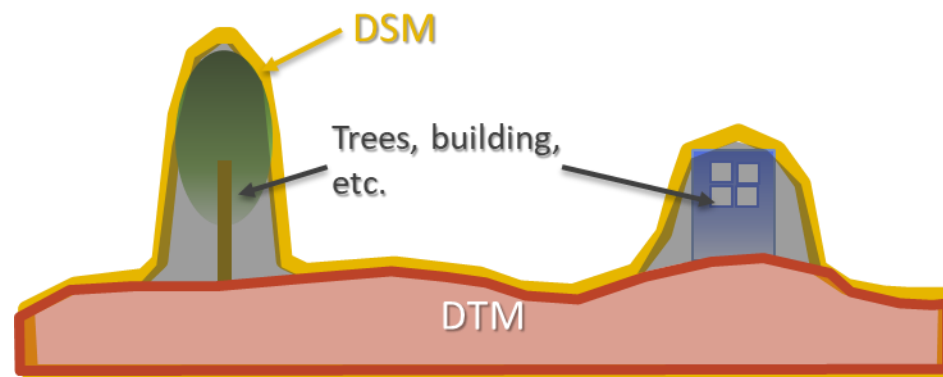
**Figure 2. Illustrative description of difference between DSM and DTM**

2.   Product Specification

2.1   Product Overview

NTT DATA has developed its own production ecosystem that applies multiview technology to generate elevation model by combining any available satellite imageries as possible.

MultiView is a technology to create 3D model by using imageries from multiple point of view:

➢ Traditional Stereo Pair processing only use one pair of stereo-imageries (two point of view) to create 3D model, which resulted in occlusion and accuracy error in some condition

➢ Multiview will solve occlusion problem compare to traditional stereo pair processing (eliminate any blind spots to almost zero)

➢ Positional accuracy is highly improved on Multiview processing

➢ Multiview became possible recently thanks to development of image processing algorithm (notably Dense Image Matching) and improvement of computer power
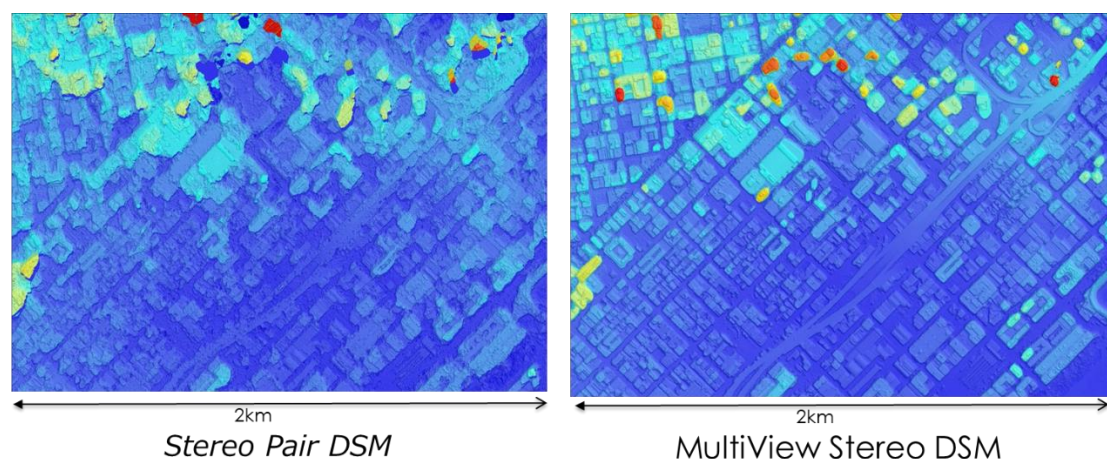
Figure 3. Comparison of DSM generated by Stereo Pair and Multiview Stereo

2.2 DSM

DSM product is suitable for customers that requires to understand three-dimensional situation of any objects above the ground, including trees and buildings. Non-permanent object (such as cars) will not be represented, and semi-permanent object (such as marquees) may or may not be represented depend on whether it detectable or not in most imageries being used.

2.2.1 Processing

NTT DATA is generating DSM by analyzing and calculating imageries with our unique's multi-view technology. The imageries covering entire or part of the AOI that satisfies some condition such as nadir-angle and cloud cover will be selected and used in the process.

After DSM generated, following processes will be conducted:

Table 2. DSM Data Processing

| Process	Description
Basic Processing	
Anomalies correction	Anomalies such as spikes, wells, and blunders will be removed to aesthetically meet product's accuracy specification.
Voids infilling	Deficiency such as void of cloud/snow will be interpolated or be infilled with AW3D Standard (if unavailable, SRTM) or other available sources by default.
Water flattening	Height value for inland water area (such as lakes) will be set to a fixed value, mainly by interpolation from surroundings lands. Height value for sea area will be set to 0 (orthometric height).
Tiling	Deliverables with size over 2GB will be tiled so each file will have size less than 2GB.
Hydro enforcing (basic)	Permanent river (i.e. not seasonal river) that recognable from satellite and has width of water body over approx. 30m will be hydro-enforced.
Optional Processing (additional fee may apply)	
Road flattening	Road area that recognable from satellite and has width over approx. 15m will be flattened
Hydro enforcing	Hydro-enforcing for smaller river with width of watr body over approx. 10m will be conducted.
Smoothing	Actual measurement result (including local elevation variation) will be preserved by default. Smoothing can be conducted as an option, however, please note that this may resulting in loss of natural features of the surfaces such as sharpeness of terrain.
GCP correction	When provided before production starts, GCP correction will be conducted to improve product accuracy. GCP needs to meet NTT DATA's designated specification (see:"GCP Collection Guide").

2.3 DTM

DTM product is suitable for customers that requires to understand three-dimensional situation of terrain (i.e. bare soil), and not any objects above the ground, such as trees and buildings.

2.3.1 Processing

NTT DATA is generating DTM from DSM. All DSM processes will be conducted (including option process if being opted), in addition to following process:

Table 3. DTM Data Processing

Process	Description
DTM processing	• The height of trees, buildings, and other structures that can be recognized from satellite are eliminated from DSM. • Regarding the heavy vegetation area (e.g. continuous forest), such as the case that the ground surface cannot be seen on the satellite imageries, we will eliminate tree height for the entire area based on estimated average tree height in the edge of the vegetation area. See Figure 4 for details.
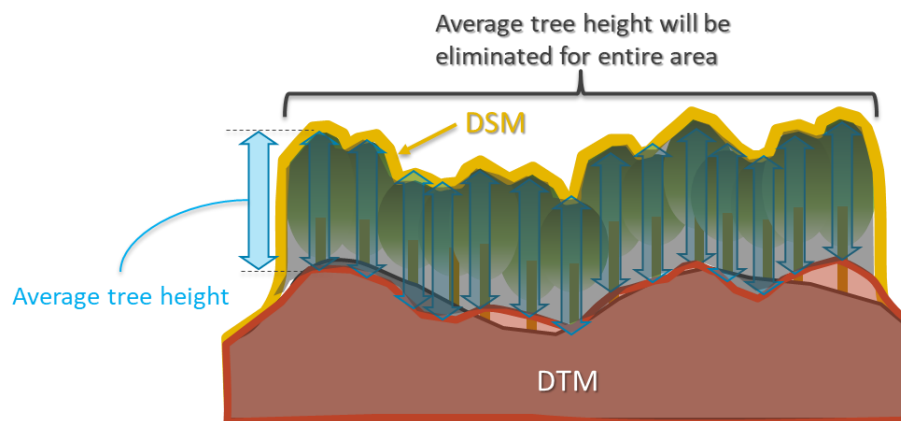
Figure 4. DTM processing for heavy vegetation area

2.4 Technical Specification

Table 4. Product Technical Specification

Basic Specification	
Horizontal accuracy	1m RMSE / 1.5m CE90 (with GCP) 2m RMSE / 3m CE90 (without GCP)
Vertical accuracy	1m RMSE / 1.5m CE90 (with GCP) 2m RMSE / 3m CE90 (without GCP)
File format	GeoTIFF 1.0 (other format may available upon request)
Bit Depth	32bit
Data type	Float
Horizontal datum	WGS84
Vertical datum	WGS84 (Ellipsoid) or EGM2008 (Elevation)
Map projection	Lat/Lon or UTM
Deliverable area	Minimum bounding rectangle. Elevation for area outside the AOI will be set to -9999

Standard Deliverables	
DSM/DTM file	In GeoTIFF format

Mask file	Information of available area. The values stored in the mask file is as follows;
	  - Available area = 0
	  - Mask area = 1

Readme file	Following basic information about deliverables will be provided in .txt file
	• Product Area: Country/area name
	• Product Files: List of deliverables files
	• Specification for each file, including:
	  • File Format
	  • Projection
	  • Spheroid
	  • Datum
	  • Upper Left LON
	  • Upper Left LAT
	  • Width (total pixel number in width)
	  • Height (total pixel number in height)
	  • Pixel Size LON
	  • Pixel Size LAT
	  • Data Type
	  • Elevation Info (vertical datum)
	  • Value (for mask file)

Optional Deliverables (additional fee apply)	
QC Layer (Stack file)	Stack file, which has the number of imageries used for generating elevation values, in 8bit raster format
Vintage file	Vintage file, which has the date of imageries used for generating elevation values, in 32bit long integer raster format
Contour line	Only apply for DTM

3. Ordering Parameters

The following parameters will be collected by reseller or distributor for an AW3D standard order. A response to all parameter is required, except where noted.

Table 5. Ordering Parameters

Parameter	Selectable	Default	Notes
Product Type	• DSM • DTM • DSM+DTM	N/A	
Resolution	• 0.5m • 1m • 2m	N/A	Other resolution may be accepted with some conditions.
Bit Depth	• 32 Bit	32 Bit	16 Bit is available as non-standard option, however the values stored will be in integer rather than float

Parameter	Selectable	Default	Notes
Contour	• Yes • No	No	• Additional fee apply • Recommended contour line width is double of the resolution of original product
AOI	• Shapefile (WGS84) • Kml file	N/A	Shape file or kml file expresses the customer's AOI needs to be submitted. The conditions of the AOI are as follows: • Minimum order size is 25 km^2 • The shape like 'ring' or 'doughnut' is not accepted. • Minimum width is 2 km • Maximum points of polygon is 1000. • In case of multiple polygons, each separate polygon should fulfill above conditions
Delivery method	• Online • DVD • Others	Online	• FTP information will be provided on delivery • If DVD/Others are selected, additional fee apply
Delivery file format	• GeoTIFF	GeoTIFF	• Geotiff 1.0 unsigned 32 bit floating points is default and guaranteed format. • Other format may be available upon request (additional fee may apply)
Vertical datum/ellipsoid	• WGS84 (Ellipsoid) • EGM2008 (Elevation)	EGM2008 (Elevation)	
Map projection	• UTM • Lat/Lon	UTM	• In case "UTM" is selected, by default the UTM zone of the most part of the AOI is located will be applied to the entire data. • Customer can specify the UTM zones, or decide whether the deliverables should be divided per UTM zones.
User information	N/A	N/A	• End user name, organization name, contact information, and purpose of use information
QC file	• Yes • No	No	Additional fee apply
Vintage file	• Yes • No	No	Additional fee apply

Parameter	Selectable	Default	Notes
Contour	• Yes • No	No	• Additional fee apply • If "Yes", please inform the width (Recommended width is double of the resolution of original product) • Only apply for DTM order

4. Product Deliverables

Table 6. Product Deliverables

Deliverables	File names	File extensions

(Base file name)	<hXXXXXHXXXXXX>_<hXXXXXHXXXXXX>_<map projection>_<product type>
	
	<hXXXXXHXXXXX>: coordinate of upper left (and lower right) minimum bounding rectangle
	   h: hemisphere (N or S)
	   XXXXX: coordinate (latitude or longtitude)
	   H: hemisphere (E or W)
	
	<map projection>: LT (latitude/longtitude) or UM (UTM)
	
	<product type>: DSM or DTM or MSK or STK
		-

DSM (if ordered)	<NXXXXXEXXXXXX>_<NXXXXXEXXXXXX>_<map projection>_DSM.tif *If the size is over 2GB, the file will be divided.	.tif
DTM (if ordered)	<NXXXXXEXXXXXX>_<NXXXXXEXXXXXX>_<map projection>_DTM.tif *If the size is over 2GB, the file will be divided.	.tif
Mask file	<NXXXXXEXXXXXX>_<NXXXXXEXXXXXX>_<map projection>_MSK.tif	.tif
Readme file	Readme_<country name>.txt	.txt
QC file (option)	<NXXXXXEXXXXXX>_<NXXXXXEXXXXXX>_<map projection>_STK.tif	.tif
Vintage file (option)	<NXXXXXEXXXXXX>_<NXXXXXEXXXXXX>_<map projection>_DAT.tif	.tif
Contour line (option)	<NXXXXXEXXXXXX>_<NXXXXXEXXXXXX>_<map projection>_CONTOUR.shp	.shp

5. Delivery Layout

Table 7. Delivery Layout

| Product Support Data	
Top directory name	<hXXXXXHXXXXXX>_<hXXXXXHXXXXXX> <hXXXXXHXXXXX>: coordinate of upper left (and lower right) minimum bounding rectangle h: hemisphere (N or S) XXXXX: coordinate (latitude or longtitude) H: hemisphere (E or W)
Contents in the top directory	• Geotiff file • Mask file • Readme file • QC file (option) • Vintage file (option) • Contour line (option)

6. Feasibility Process

Before the order, NTT DATA will conduct feasibility check (FC) over the customer's AOI, and determine whether there will be enough imageries to generate elevation model or not. Following information is needed to conduct FC:

- Customer information
- Area of interest (AOI)
- Product type and resolution
- Other technical requirements (if any)
- Purpose of use

If the AOI is small and simple, FC response will be either "Feasible," "Partially Feasible," or "Infeasible." In case the AOI is larger than 200 km^2 and/or complex (e.g. multiple parts), preliminary FC will be conducted, and heatmap representing imagery availability will be provided.
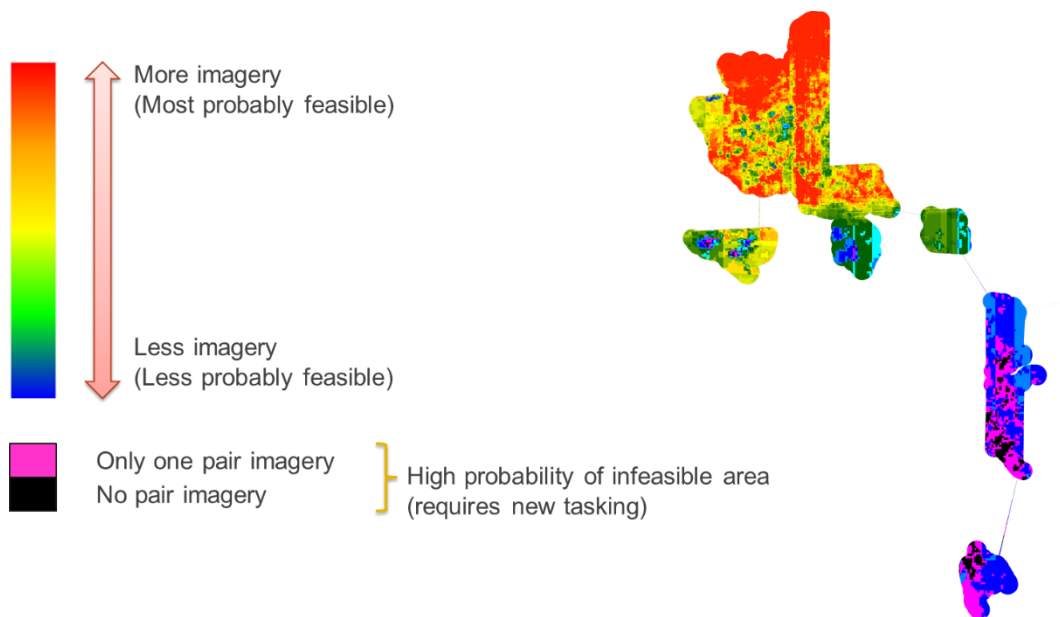
Figure 5. Heat map sample

Please note that before any confirmed order, comprehensive FC need to be conducted to ensure the feasibility over the AOI, which could take several days for large and complex AOI. Also timelines for FC and data delivery will be provided as part of the customer request.