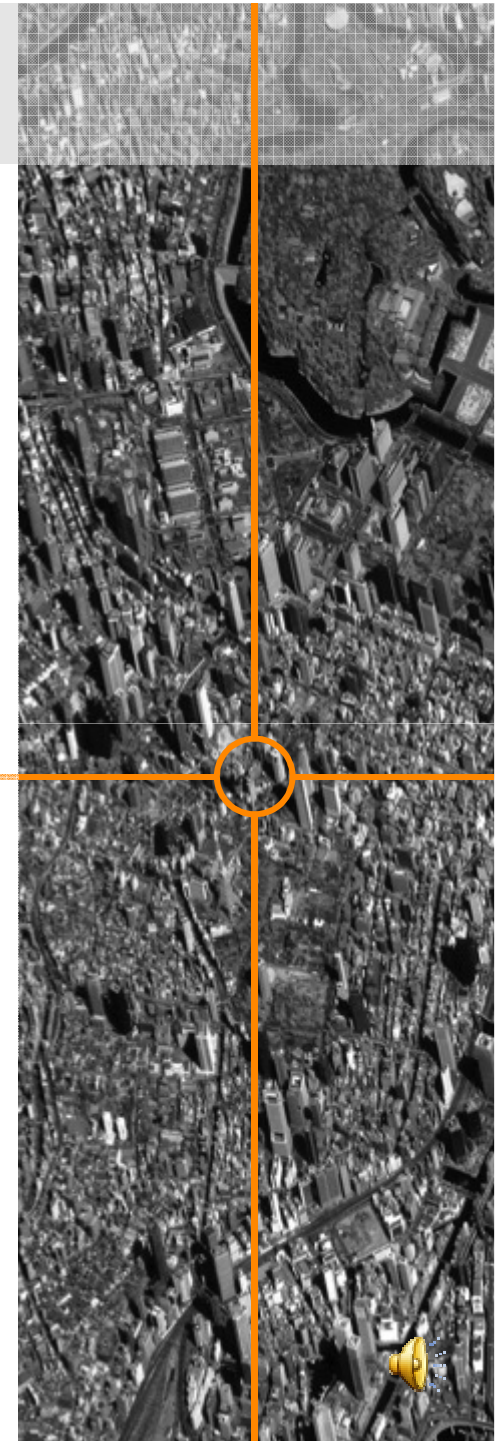


ALOS WORLD 3D TOPOGRAPHIC DATA

**May 29, 2015@GWF 2015
Remote Sensing Technology
Center of Japan (RESTEC)**





AW3D Characteristics

- ❖ Higher Spatial Resolution
 - ❖ The world finest 5m spatial resolution
- ❖ High Geometric Accuracy
 - ❖ 5m RMSE in both horizontal and vertical
 - ❖ Evaluation done with over 5,000 reference points
- ❖ High Image Quality
 - ❖ High frequency noises are removed using precise attitude control
 - ❖ Less occlusion by triplet views of the PRISM radiometers
- ❖ Global Coverage
 - ❖ Over 3 million scenes of PRISM images processed to cover entire globe



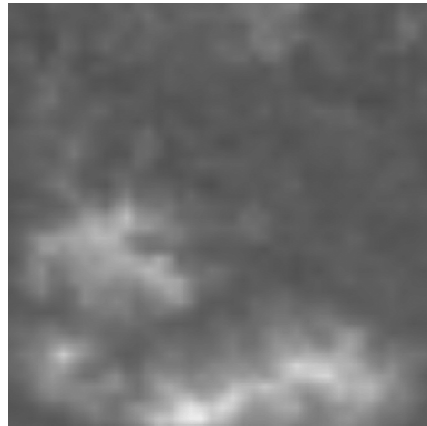
This specification is enough for making the 1/25,000 scale base map.



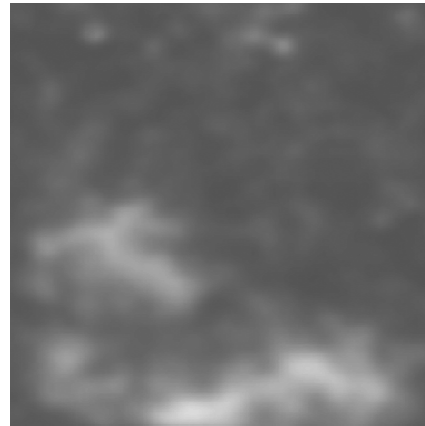
Comparison with other DEM

■ Visual Comparison (4km x 4km)

0m 150m

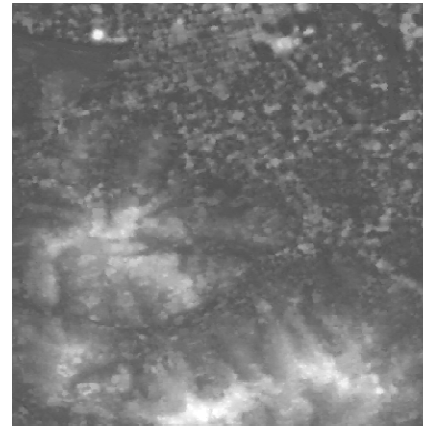


SRTM-3 DEM



ASTER-GDEM

ASTER GDEM is a product of METI and NASA



PRISM-DSM



LiDAR-DSM

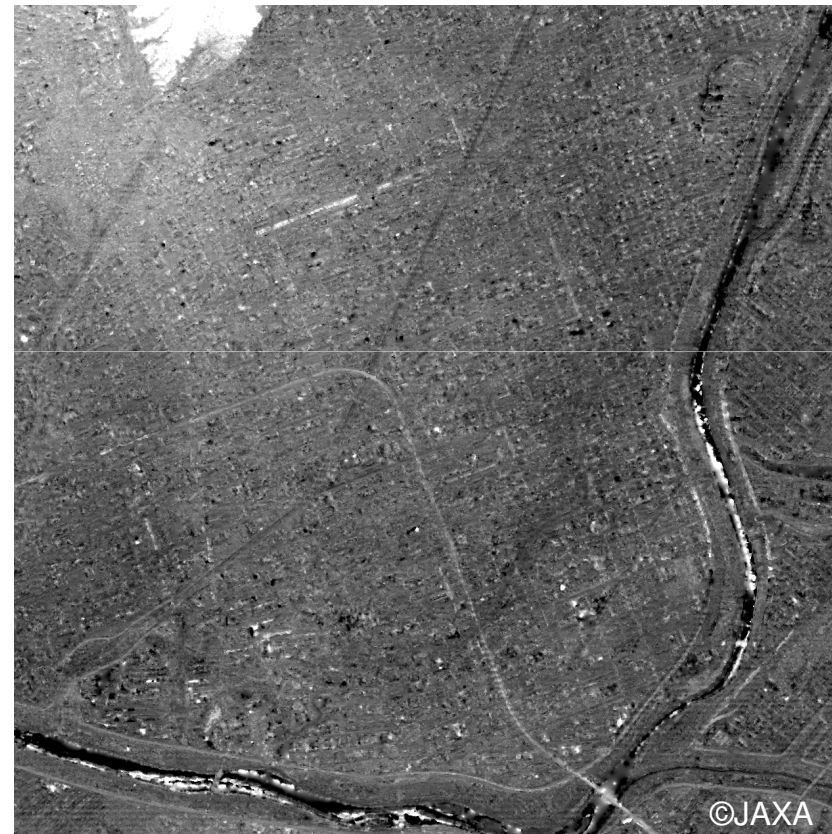
Grid Spacing			
90m	30m	5m	1m
Data Area			
N60°~S56°	N83°~S83°	PRISM data areas except for clouds	N/A
Source			
IfSAR from STS-99	Satellite Stereo Triangulation	Satellite Stereo Triangulation	Airborne LiDAR

High Quality (Influence Reduction in Satellite Location and Position Fluctuation)

Reduction of Periodical Noise (Jitter Noise) by HAD (High-Frequency Attitude Determination) Data

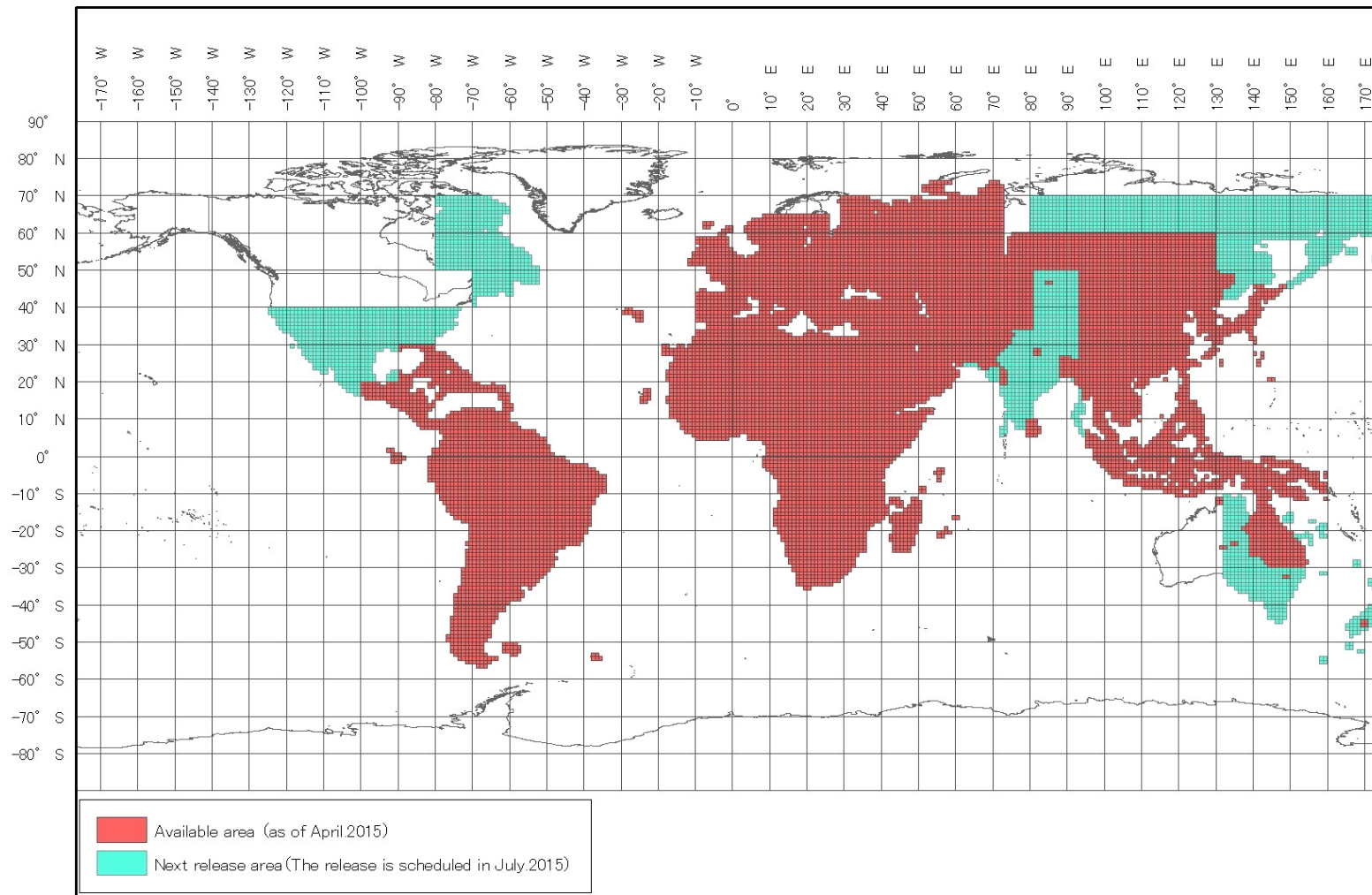


DSM by Previous Method



DSM by New Method

Status of AW3D Development



ALOS World 3D Topographic Data Lineup (1/2)

Product level	Type	Description	Price	Minimum order size
Level 1: DSM (Raw)	5m resolution 1 x 1 Degree	DSM Processed Raw Data (Defective images kept unprocessed)	JPY 200/km ²	1 Degree x 1 Degree
	5m resolution Clipped by Mesh	DSM Processed Raw Data set clipped by Mesh (Defective images kept unprocessed)	JPY 250/km ²	0.2 Degree x 0.2 Degree
	5m resolution Clipped by AOI* ¹	DSM Processed Raw Data set clipped by AOI (Defective images kept unprocessed) Provided by AOI	JPY 300/km ²	400km ²
Level 2: DSM (Standard)	5m resolution Clipped by AOI* ¹	Deficiency supplemented and noises corrected on DSM processed raw data set Quality checked product for utilizing maps Provided by AOI	JPY 500/km ²	400km ²
Level 3: DTM	5m resolution Clipped by AOI* ¹	Building and tree heights eliminated and corrected to ground height value Provided by AOI	* ²	100km ²

Optional	Type	Description	Unit price	Minimum order size
Panchromatic Ortho	2.5m resolution Scene* ³	Additional option for Level 1 : DSM (Raw) Provides 1 PRISM Ortho-scene image to be layered for DSM products (Produced concurrently with DSM), minimum deficits caused by cloud on path flame basis	JPY 100/km ²	Same as the ordered data
	2.5m resolution Clipped by AOI* ¹	Additional option for Level 2 DSM (standard) & Level 3 DTM Mosaic image for PRISM Ortho-scene image to be layered for DSM products (Produced concurrently with DSM) Provided by AOI	JPY 100/km ²	Same as the ordered data
Quality-control File/Layer	5m resolution Clipped by AOI* ¹	Optional product for Level 1 DSM, Level 2 DSM, and Level 3 DTM Raster imagery showing correlation coefficients calculated during the image matching process in DSM generation The correlation coefficients can be used as reliability index of height value in DSM. Provided by AOI	JPY 50/km ²	Same as the ordered data



ALOS World 3D Topographic Data Lineup (2/2)

Optional	Type	Description	Unit Price	Minimum order size
Color Ortho	2.5m resolution Clipped by AOI*1	Ortho-Mosaic Pan-Sharpen imagery identical area to DSM Provided by AOI	JPY 200/km ²	2,500km ²
	2.5m resolution Scene*3	Ortho-Mosaic Pan-Sharpen imagery overlapped to DSM (One scene) Provided by scene	JPY 120,000 /Scene	1 Scene*3

NOTE

- Prices listed on this Price List are targeted for customers outside of Japan only.
- Prices listed on this Price List excludes any taxes (Withholding taxes, VAT, GST or similar taxes), duties, stamps, and other fees.

*1 : Irregular shapes cannot be accepted. (Doughnut shaped, multi-parts shapes etc)

*2 : Price differs from area and/or available information. As referenced price, Level 3 DTM of "Standard 3D topographic data" is JPY 1,600 /km² -.

For further details, please contact data@restec.or.jp.

*3 : 1 scene of ALOS satellite imagery is approx. 35 km x 35 km, or approx. 35 km x 70 km.

Prices and product line-ups might be changed without notices.



High resolution 3D Topographical Data

Product Level	Type	Description	Unit price	Minimum order size
DSM	4m resolution Clipped by AOI*1	DSM Processed Data set clipped by AOI Provided by AOI	JPY 5,400/km ²	50km ²
	2m resolution Clipped by AOI*1		JPY 10,800/km ²	25km ²
DTM	4m resolution Clipped by AOI*1	Building and tree heights eliminated and corrected to ground height value Provided by AOI	*2	50km ²
	2m resolution Clipped by AOI*1			25km ²

■Data provision service for 3D printer

Optional	Type	Description	Unit price
Format conversion	STL file	Data provision by STL file format which can be handled by 3D printers directly*3 Additional cost is necessary on 3D topographic data cost	JPY 50,000~/ file

NOTE

- Prices listed on this Price List are targeted for customers outside of Japan only.
- Prices listed on this Price List excludes any taxes (Withholding taxes, VAT, GST or similar taxes), duties, stamps, and other fees.

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For further details, please contact data@restec.or.jp.

*3 : 1 scene of ALOS satellite imagery is approx. 35 km x 35 km, or approx. 35 km x 70 km.

Prices and product line-ups might be changed without notices.



ALOS World 3D Topographic Data

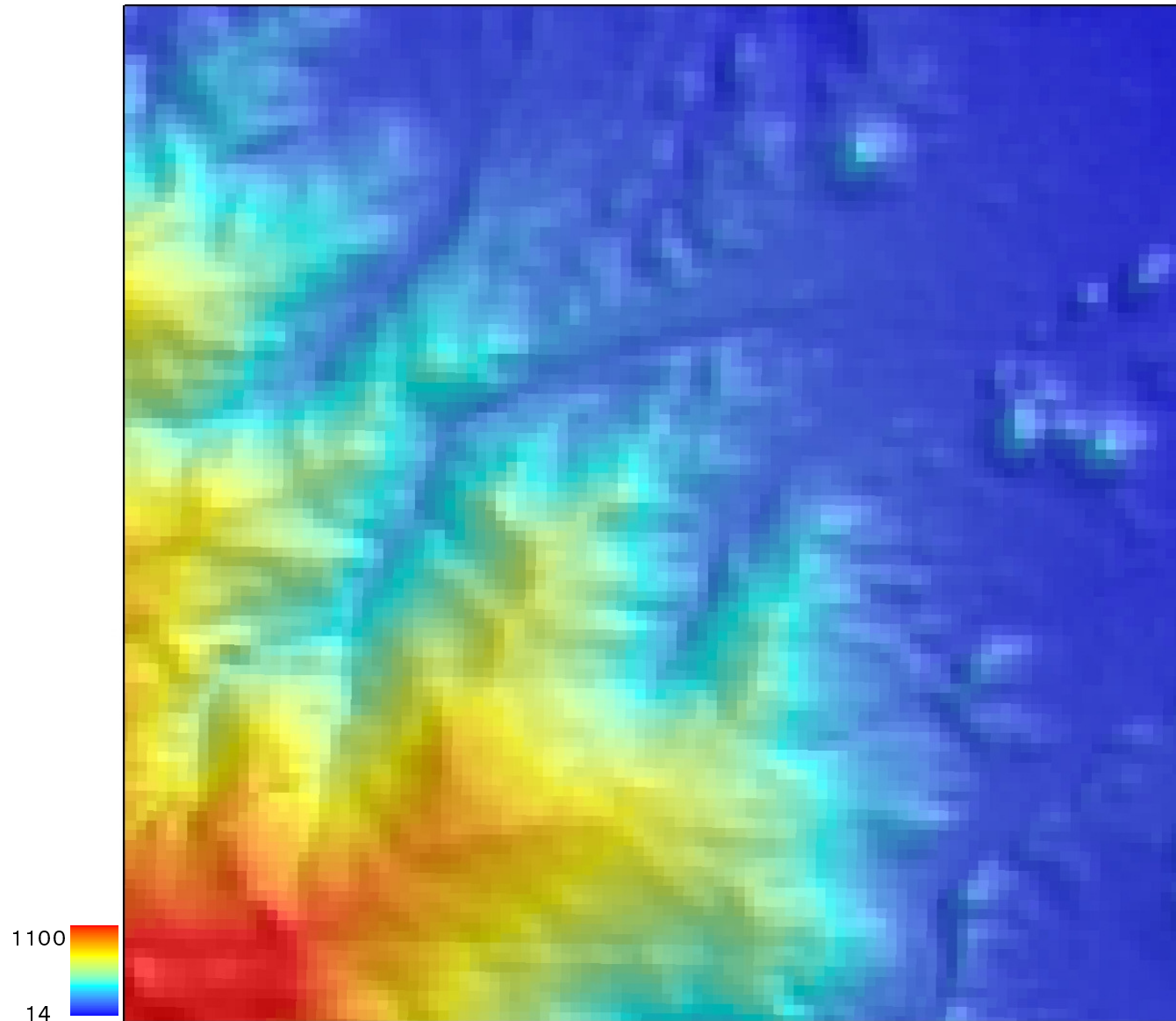
	Level 1	Level 2	Level 3
Type	DSM Digital Surface Model	DSM Digital Surface Model	DTM Digital Terrain model
Coverage	Global (land)		
Unit	Tile (1 degree x 1 degree) Mesh (0.2 degree x 0.2 degree) AOI*	AOI*	AOI*
Resolution	5m (Please ask for other resolution)		
Horizontal Accuracy	5m (RMSE)		
Vertical Accuracy	5m (RMSE)		
Coordinate system	Geographic Lat/Lon (ITRF97[GRS80]) (Please ask for UTM)		
Format	GeoTIFF		
Image files	DSM (elevation in meter, 16bit integer), Mask image	DSM (elevation in meter, 16bit integer**), Mask image	TBD
Height type	Ellipsoid height	Ellipsoid height or Elevation (height above sea level)	Ellipsoid height or Elevation (height above sea level)
Minimum sales area (AOI)	400km ²	400km ²	400km ²

*: Single polygon with 4 or more vertices. Each side: 10km or more. Each angle: 90degrees or more.

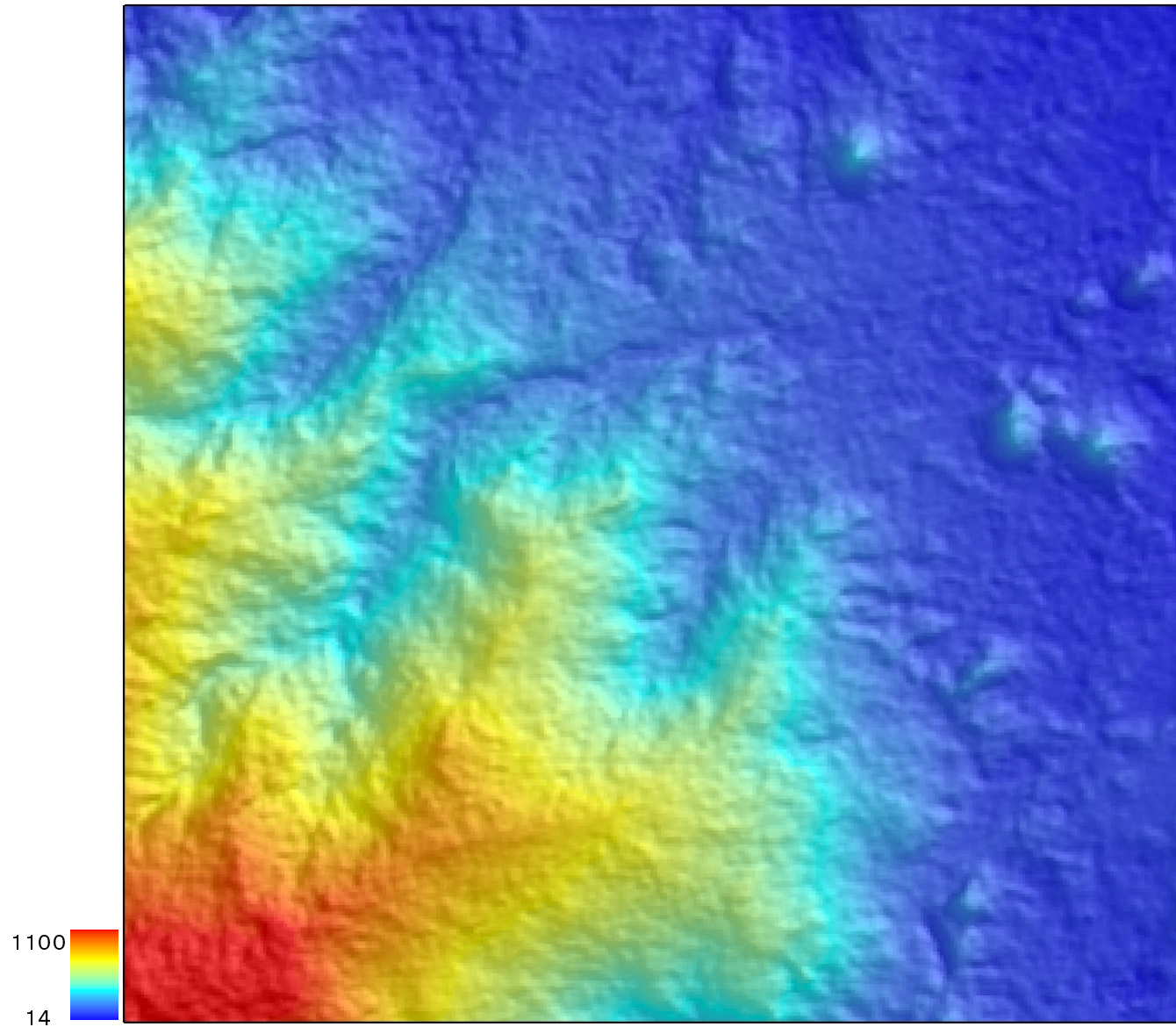
** : Please ask for float.



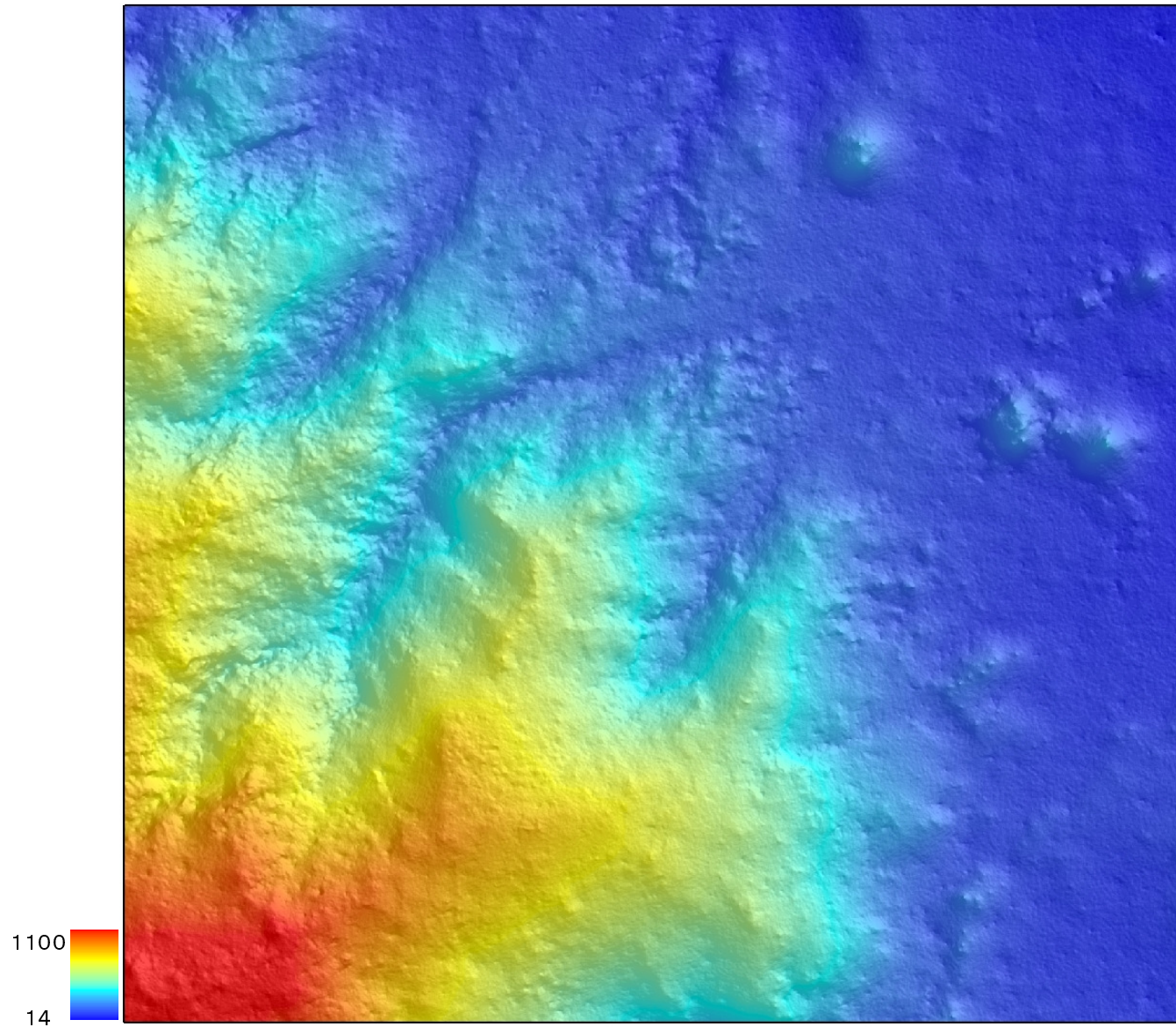
①SRTM_Philippines(area1) 1/50000



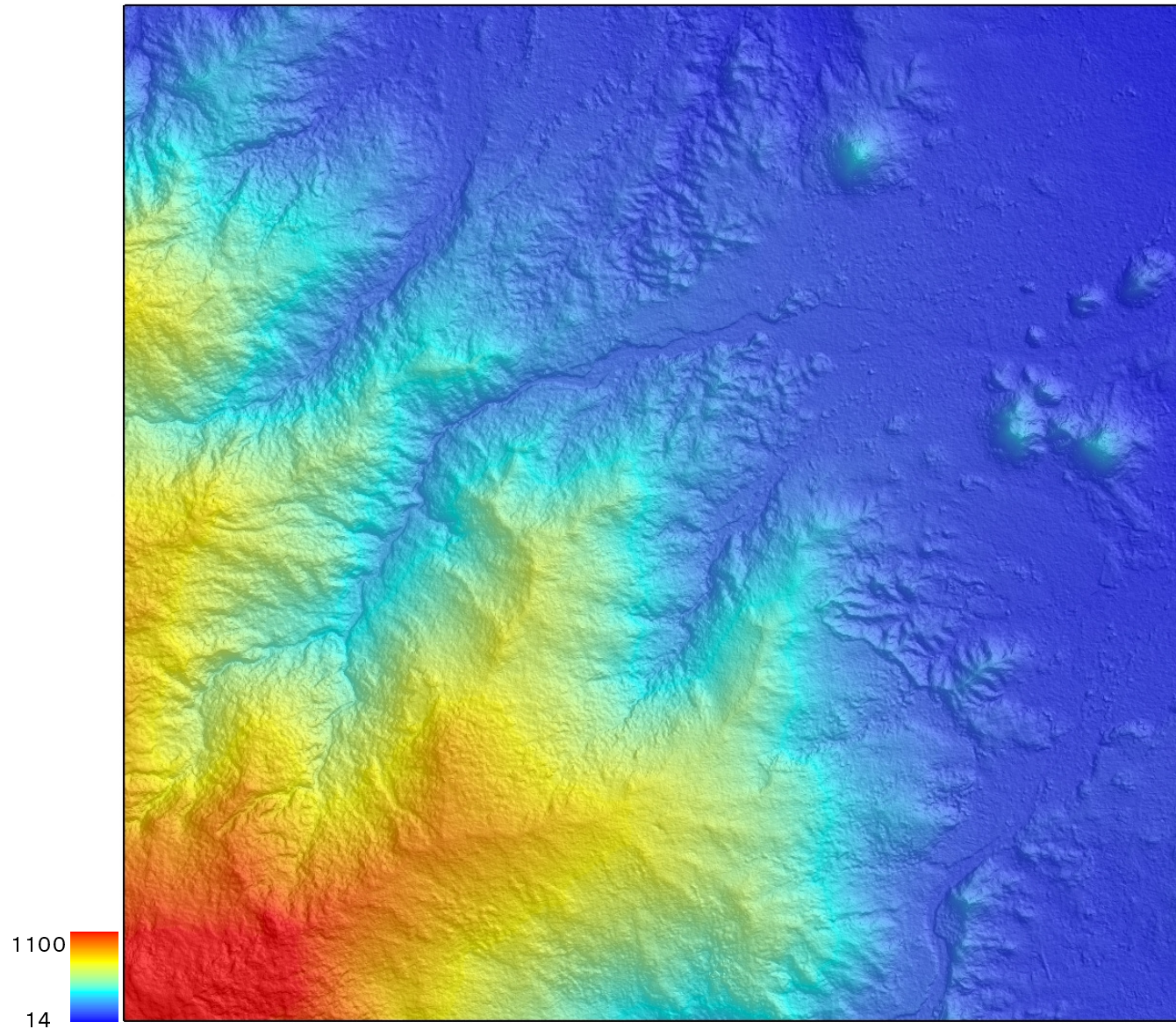
①GDEM_Philippines(area1) 1/50000



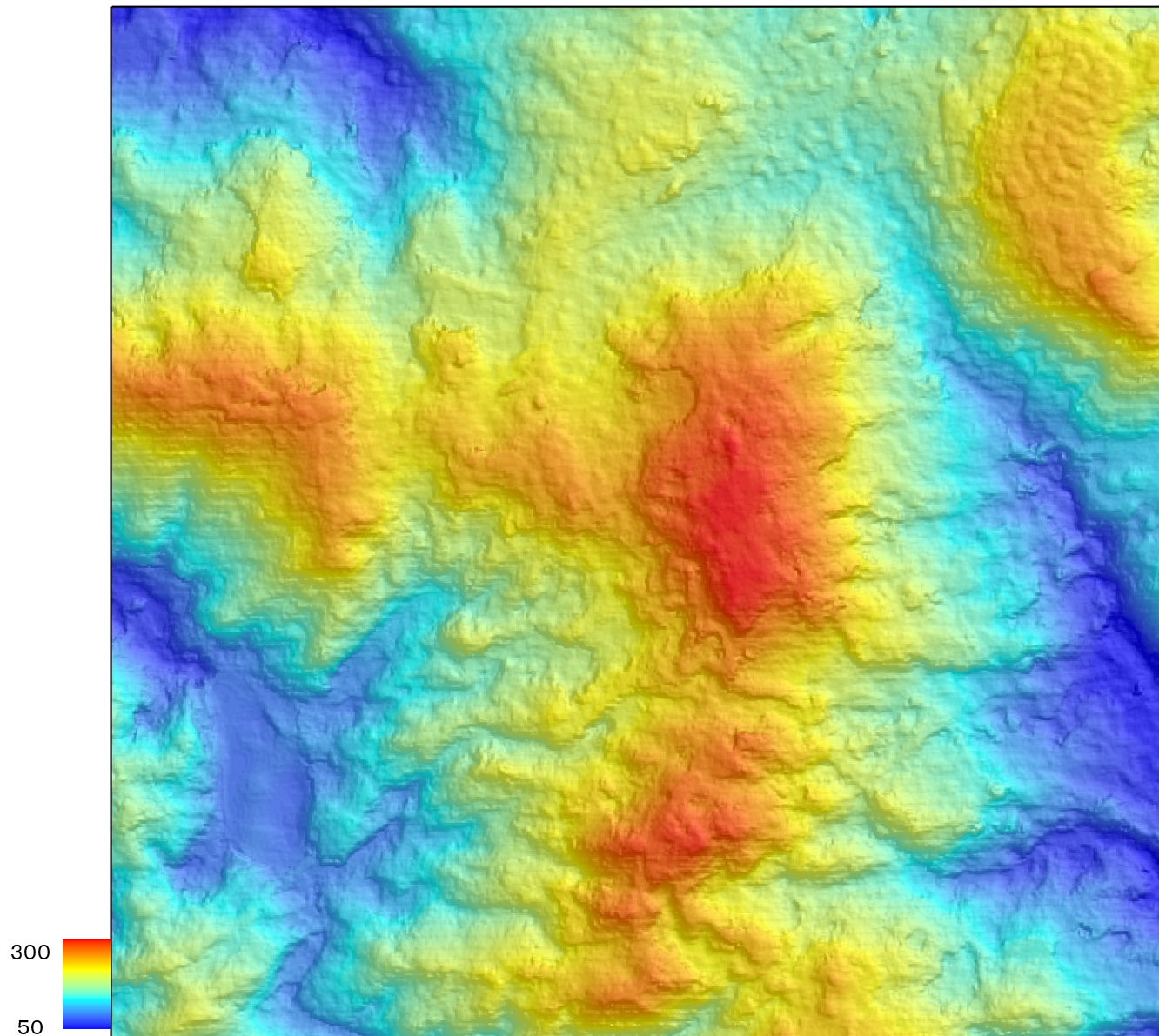
①RaderSAT_Philippines(area1) 1/50000



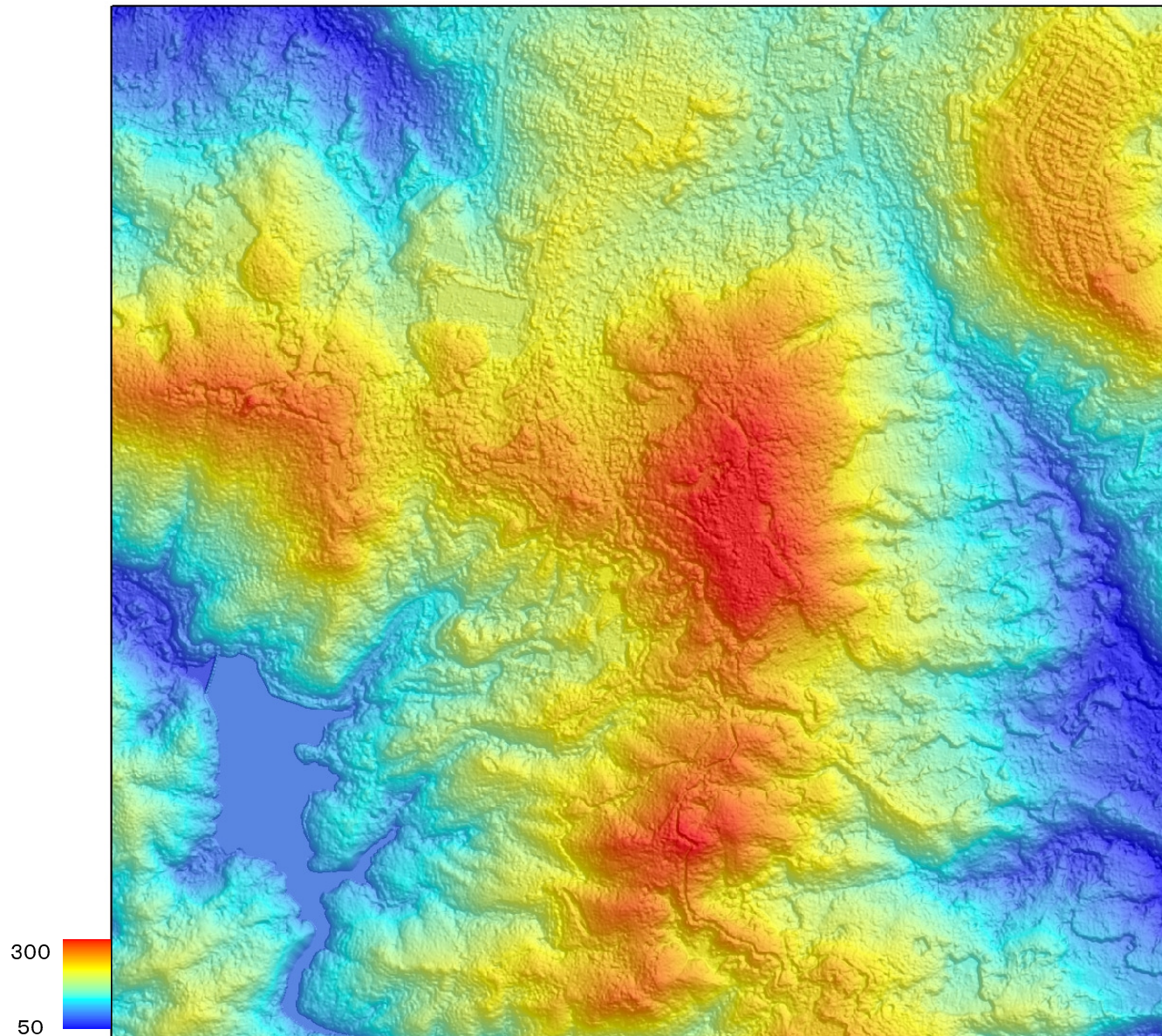
①AW3D_Philippines(area1) 1/50000



②AW3D_Nagasaki 1/12500



②DG2m_Nagasaki 1/12500



Use case of countermeasure against disease expansion in health field (Nigeria, Niger)

- Identification of “poliovirus infection route” by grasping sewage flow passages utilizing AW3D

Items	Description
Organization	WHO (World Health Organization) * Analysis support by JAXA/RESTEC
Field	Health
Location	Nigeria (Kano State), Niger (Niamey and other cities)
Background	<ul style="list-style-type: none">• Nigeria, Pakistan, and Afghanistan are registered as polio ever-present countries.• WHO acquires surface sewage and investigates if poliovirus is contained.• Needs to narrow the better sewage acquiring locations.
Overview	<ul style="list-style-type: none">• At first, drainage system analysis was conducted using World 3D topographic data in Kano State, Nigeria. Achieved efficient identification of sewage flowing areas.• The drainage system analysis of three cities in Niger were conducted and WHO chose the sewage acquiring locations. The analysis was effective especially in metropolitan areas of complex topography.



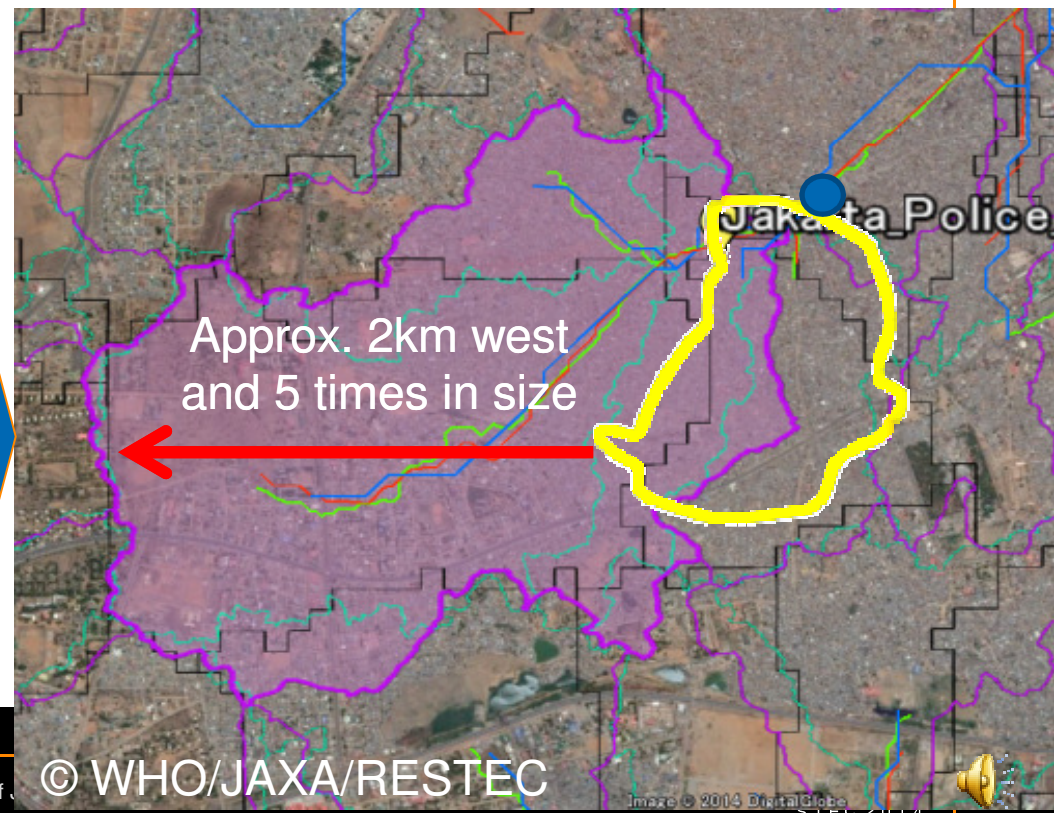
Use case of countermeasure against disease expansion in health field (Nigeria, Niger)

- By the analysis with AW3D of 5m resolution, the sewage flowing area is identified as approx. 2km west to and approx. 5 times as large as the existing analysis result.

Existing analysis result with 30m resolution imagery



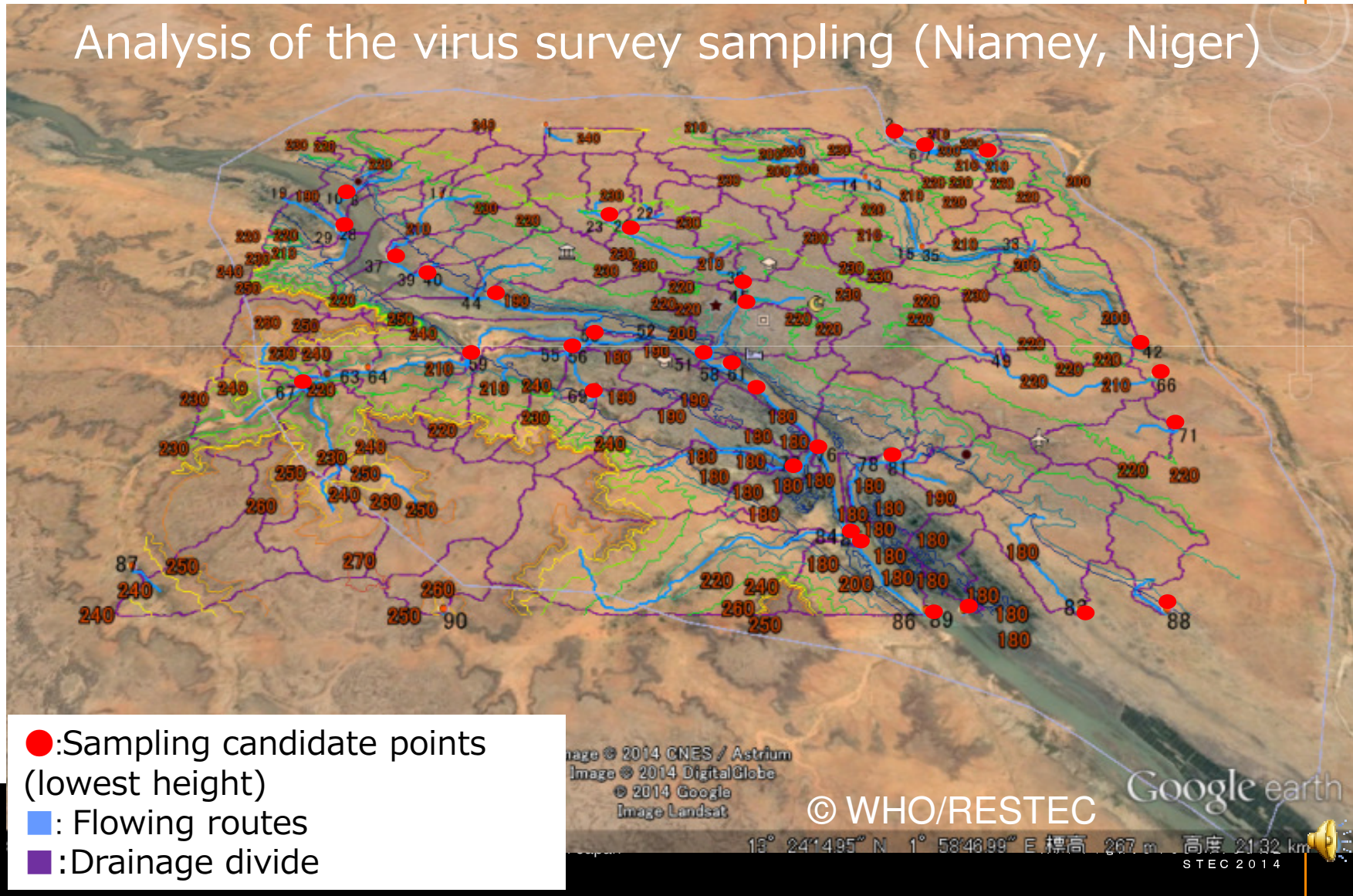
Analyzed area with AW3D of 5m resolution



Use case of countermeasure against disease expansion in health field (Nigeria, Niger)

- By utilizing the analysis, WHO chose the sewage acquiring points.

Analysis of the virus survey sampling (Niamey, Niger)



Use case of countermeasure against landslide disaster in disaster prevention field (Sri Lanka)

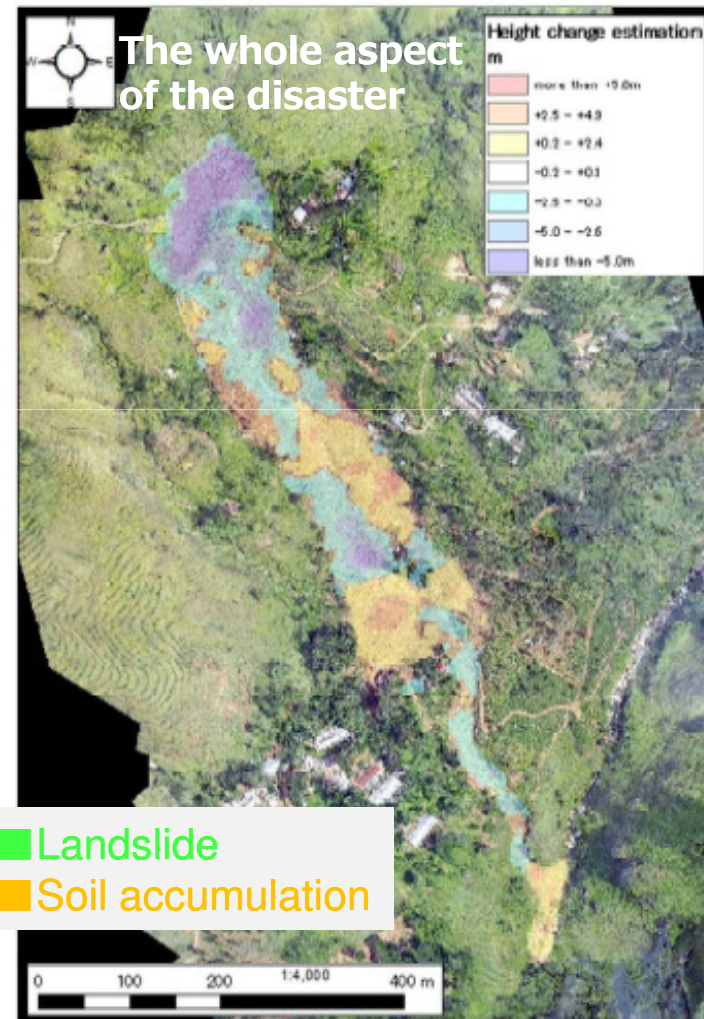
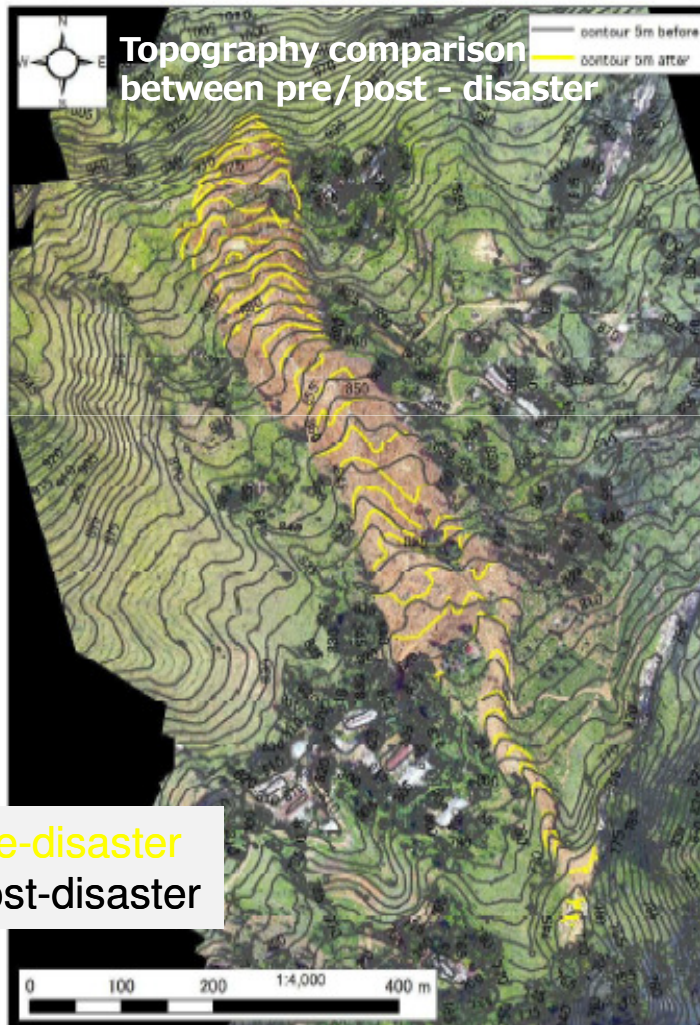
- Evaluation of “the whole aspect of the landslide disaster damage and secondary damage risk” by grasping landslide topography utilizing AW3D

Items	Description
Organization	JICA (Japan International Cooperation Agency)
Field	Disaster prevention
Location	Badulla District, Sri Lanka
Background	<ul style="list-style-type: none">• The landslide disaster occurred on Oct. 29th 2014, which was the largest scale ever recorded. JICA conducted the disaster survey including capacity building of the counterpart country.• Grasping the whole aspect of the damage and secondary risk including the surrounding areas.
Overview	<ul style="list-style-type: none">• Grasping the pre-disaster topography using World 3D topographic data of 5m resolution.• Comparing it with post-disaster topography taken from a helicopter and evaluating the whole aspect of the disaster damage and the risk of the secondary damage.



Use case of countermeasure against landslide disaster in disaster prevention field (Sri Lanka)

- Detailed pre-disaster topography by AW3D and the topographic investigation of post-disaster from the helicopter were analyzed. Those were compared and the whole aspect of disaster and risk of the secondary damage were analyzed.

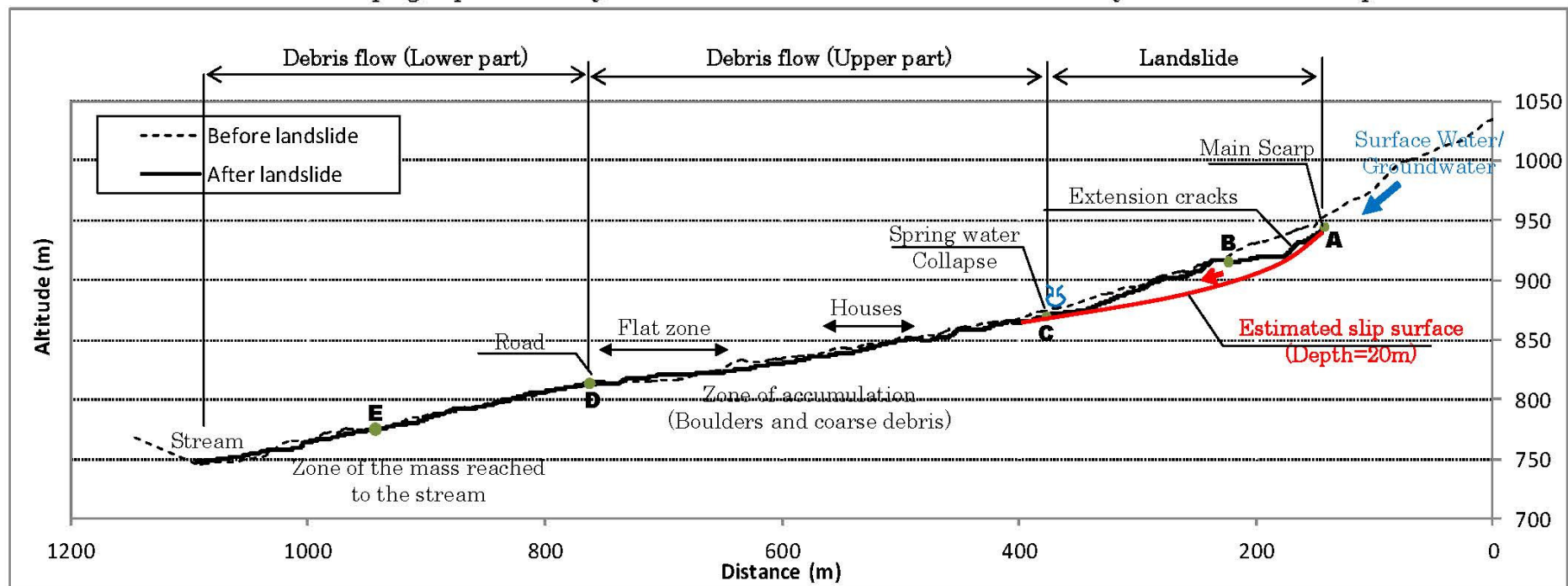


Use case of countermeasure against landslide disaster in disaster prevention field (Sri Lanka)

- Detailed pre-disaster topography by AW3D and the topographic investigation of post-disaster from the helicopter were analyzed. Those were compared and the whole aspect of disaster and risk of the secondary damage were analyzed.

Before the Landslide: DEM data of AW3D

After the Landslide: Topographic Analysis from Photos of the Aerial Survey from the Helicopter



Assumed cross section of Koslanda Landslide

Use case of wind power generation planning in electronic power field

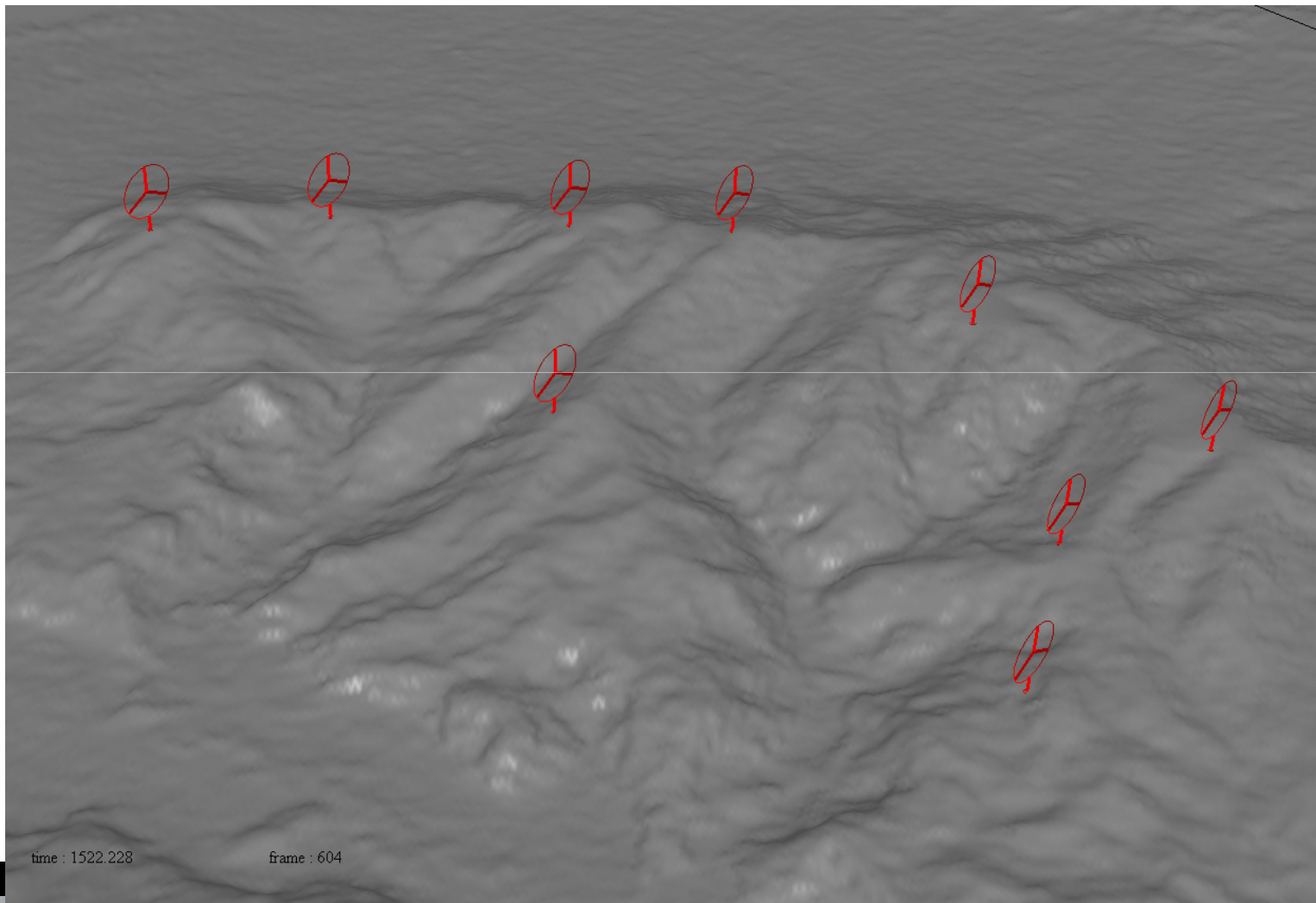
- Selection of wind power generation locations by grasping wind situation utilizing AW3D

Items	Description
Organization	Tsubasa Windfarm Design (TWD)
Field	Electronic power
Location	Inside and outside of Japan
Background	<ul style="list-style-type: none">• Mountains in Japan have steep undulating topography, which cause wind turbulence. The wind turbulence may adversely affect on windmills.• For stable and efficient wind power generation in complex mountainous topography, it's important to grasp the wind turbulence by utilizing AW3D.
Overview	<ul style="list-style-type: none">• Candidate locations of the wind power are numerically analyzed with AW3D and wind situation analysis software*.• Windmill locations are selected with analysis of the wind turbulence risk. <p>* RIAM-COMPACT® http://www.twd-wind.com/</p>



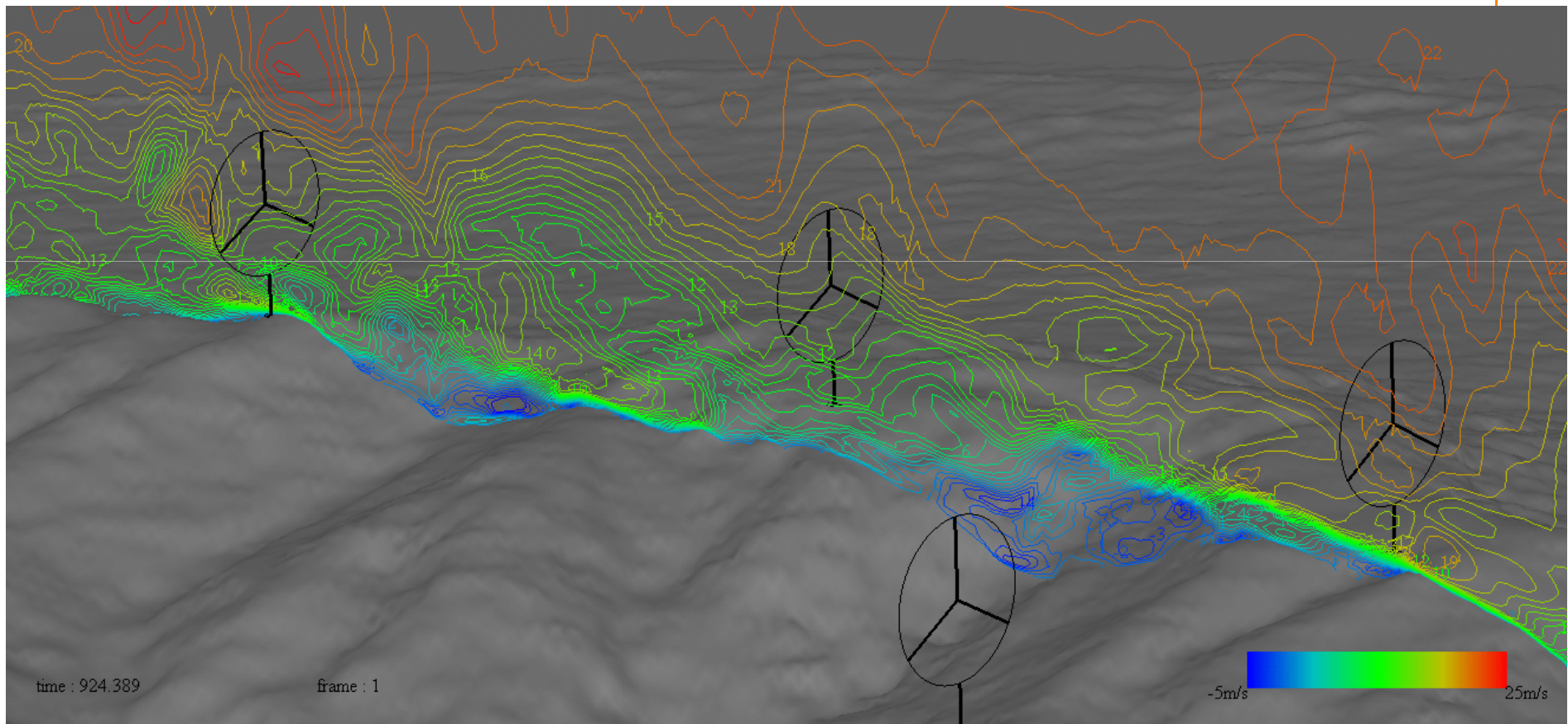
Use case of wind power generation planning in electronic power field

- Candidate locations of the wind power are numerically analyzed with **AW3D and the wind situation analysis software**. Windmill locations are selected with analysis of **the wind turbulence risk**.



Use case of wind power generation planning in electronic power field

- Candidate locations of the wind power are numerically analyzed with **AW3D and the wind situation analysis software**. Windmill locations are selected with analysis of **the wind turbulence risk**.



Use case of ground water use planning in water resource field (Tanzania)

- Efficiency and accuracy improvement of water resource development utilizing AW3D in Africa

Item	Description
Organization	JICA, Earth System Science Co., Ltd. (ESS)
Field	Water resource
Location	Tanzania
Background	<ul style="list-style-type: none">• Development of underground water resource and stable/safe water supply are an urgent issue of countries in Africa.• Finding potential well excavation locations from the extensive land is very hard. The potential locations are estimated by analyzing AW3D.
Overview	<ul style="list-style-type: none">• Grasping the detailed features of underground water topography (lineament) by multiple meters of ten basis utilizing numeric height data of AW3D.• Ground survey measuring lines are decided and excavation plans are formed with a result of the lineament extractions and water supply priorities among villages.

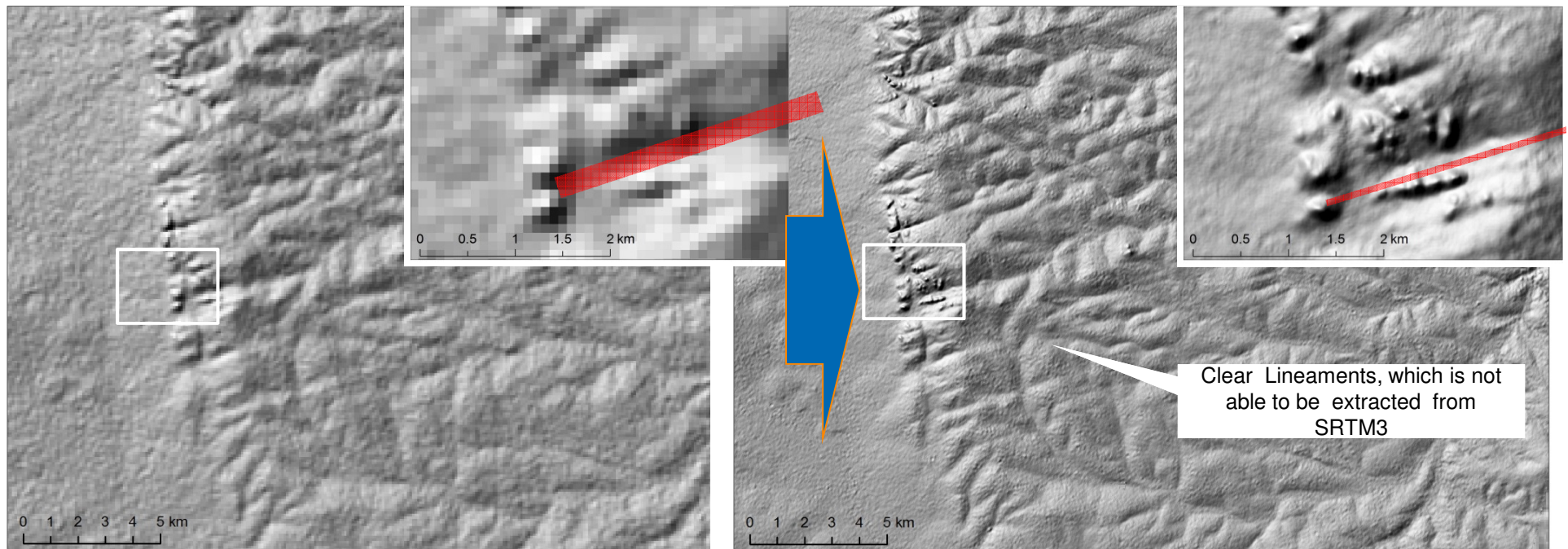


Use case of ground water use planning in water resource field (Tanzania)

- Achieved to extract the detailed features of underground water topography (lineament) utilizing AW3D, which was not available with the existing 3D map. **The lineaments were extracted by multiple meters of ten basis** and the most efficient ground survey measuring lines were available.

Analysis with 3D map of 90m resolution

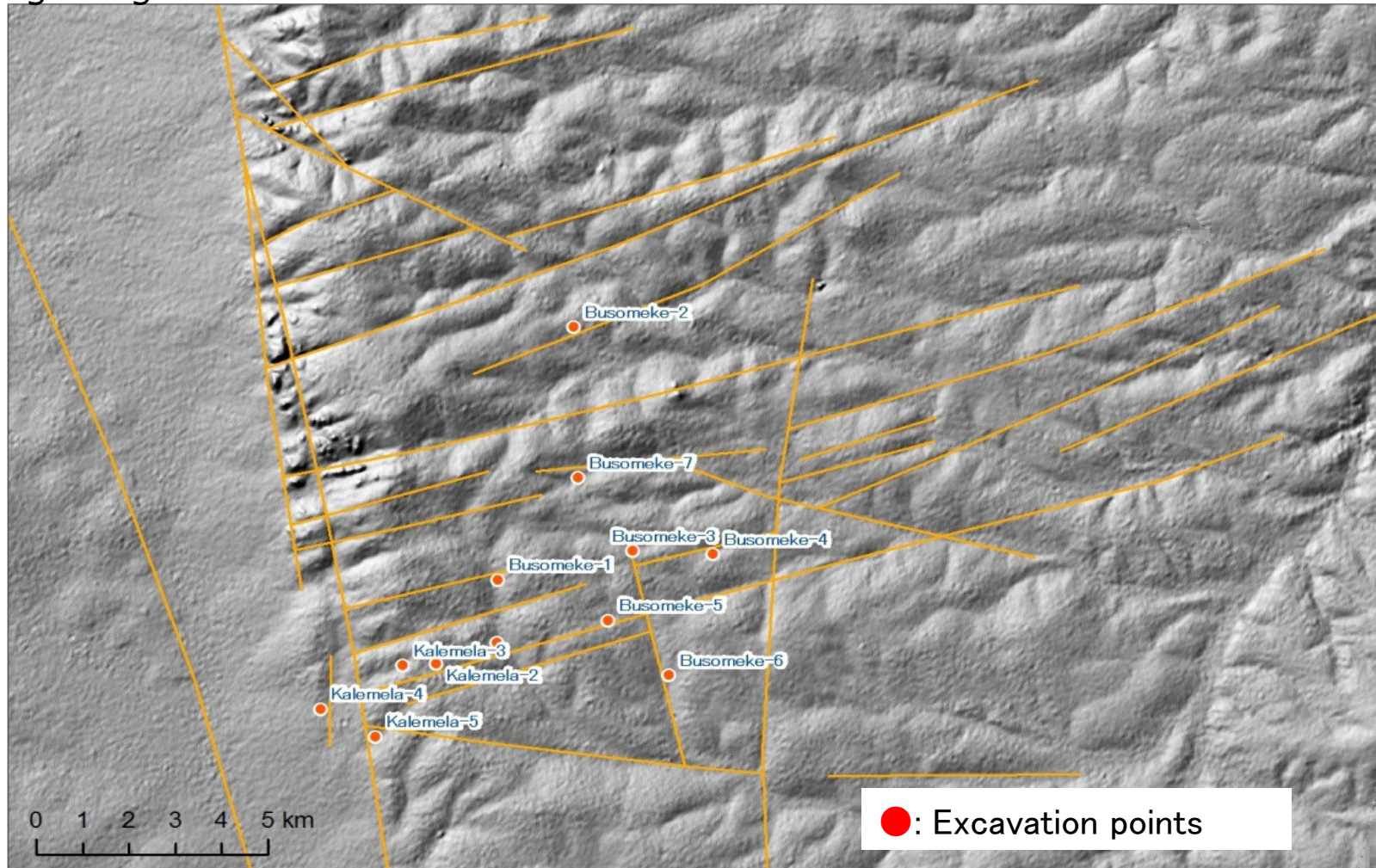
Analysis with AW3D of 5m resolution



Provided by Earth System Science Co. Ltd., (ESS)

Use case of ground water use planning in water resource field (Tanzania)

- Ground survey measuring lines are defined and well excavation plans are formed with a result of the lineament extractions using AW3D and water supply priorities among villages.



Analysis result with AW3D and underground water excavation points

Provided by Earth System Science Co. Ltd., (ESS)

Use case of ground water use planning in water resource field (Tanzania)

- Ground survey measuring lines are defined and well excavation plans are formed with a result of the lineament extractions using AW3D and water supply priorities among villages.



Use case in other fields

- The extended data use in various fields
 - ✓ Data use track records in **18 fields** including map creation, disaster prevention, map system, road and so on.
 - ✓ In the upcoming future, **highly sophisticated data analysis** and **value-added data usage in collaboration with software/application** are extended.

Fields of AW3D use track records (As of May, 2015)

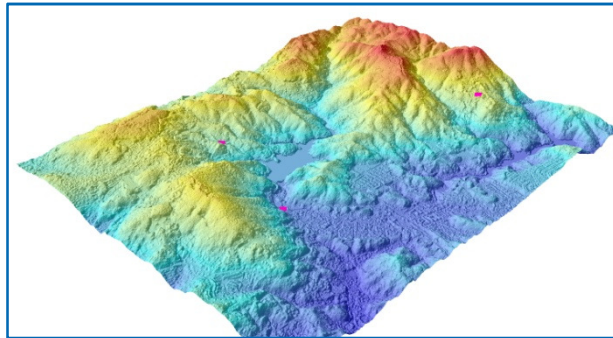
Map creation, flood countermeasure, disaster prevention, water resources, satellite imagery processing, GIS (map system), roads, pipe-lines, electronic power, geothermal energy, metal resources, irrigation, railroads, climate change countermeasures, natural gas, health, forest



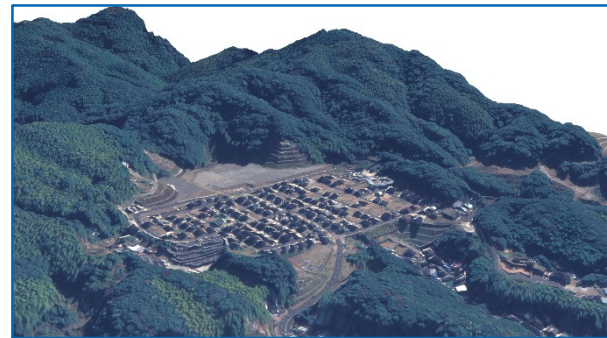
High resolution 3D Topographical Data

High resolution (2m) and definition DEM data (DSM/DTM) is available by utilizing Digital Globe's satellite imageries of industry-leading resolution. The detailed undulation such as buildings and height value calculation with high accuracy of "large-scale" map level are described, which was not realized by the DEM data made of usual satellite imageries. Contour line data is also available upon request.

See and feel the 3D topographical data



High resolution 3D Topographical Data



Overlay of high resolution 3D Topographical Data and satellite imagery

High resolution 3D Topographical Data

1 High resolution (2m)

2m mesh DEM data, the highest quality as Earth observation satellite imageries is available. With such high resolution, the detailed undulation of building level can be described. Our detailed 3D map data is suitable for urban development and planning, facility management and other fields.

2 High vertical geolocation accuracy

2m RMSE of vertical geolocation accuracy is now realized. This high accuracy enables its use as large scale map data and topographical data for precise simulations, which was not possible with the usual satellite imageries.

3 Wide coverage

Our geolocation accuracy level is achieved with stereo pair usage of multi-orbits / multi-day photographing (Cross-track). This development technique can provide wide coverage of the DEM data development compared to the usual technique of stereo pair usage of same-orbit / same-day photographing (In-track).



Satellite imagery High resolution 3D topographical Data

Line up	DSM DTM
Resolution	2m
Vertical geolocation accuracy	2m RMSE (with GCP) 4m RMSE (without GCP)
Minimum order size	25km ²





High resolution 3D Topographical Data

■ Use case

The high resolution and precise geolocation DEM data is available without field survey. The DEM data is suitable for wide-range of projects all over the world.

【Urban field】

- Urban development and planning
- Infrastructure planning of roads, railways, and waterworks

【Engineering】

- Planning and monitoring of civil engineering works
- Facility planning for power generation, plants

【Disaster prevention field】

- Damage simulations for flooding, debris flow, pyroclastic flow, etc
- Grasping topographical changes by natural disasters.

【Transportation】

- Planning routes for aircraft
- Vehicle navigation

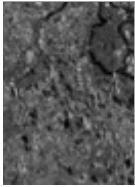
【Telecommunications】

- Radio wave propagation simulation for wireless communication

【Natural resources, environmental】

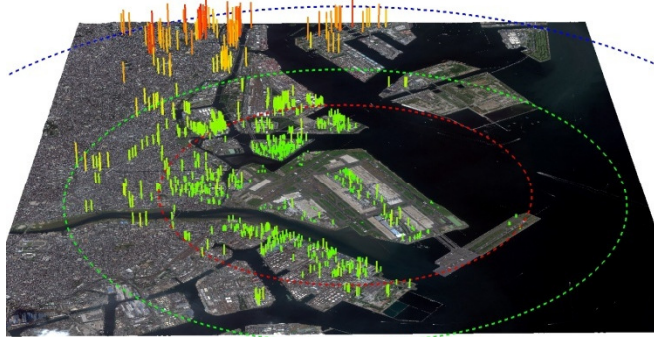
- Monitoring excavation status in mines
- Grasping forest development status



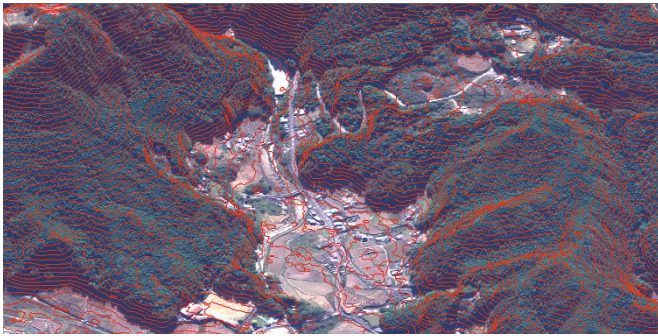


<Detailed topography : Everest>

<Planning routes for aircraft>



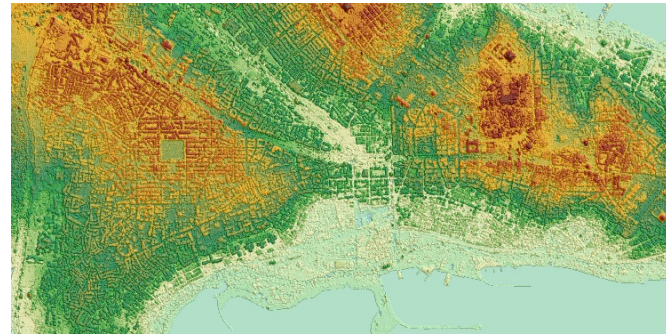
<Large scale map /
Contour line development>



<Radio wave propagation simulation
for wireless communication>



<Urban development planning>



Contact point

➤ *AW3D URL*

<http://alos-world3d.jp/en/index.html>

➤ *Contact point*

data@restec.or.jp

RESTEC Customer Service

Thank you veru much for your attention !

