

**AW3D - The world`s first five-meter-resolution global 3D map
and its application to disaster management**

August, 24th
Ken Tsutsui, Project Manager
NTT DATA Corporation



AW3D - The world's first five-meter-resolution global 3D map and its application to disaster management

➤ *Overview of AW3D*

➤ *Technical features*

➤ *Case studies of disaster management*



What is AW3D ?

THE WORLD'S FIRST 3D GLOBAL MAP WITH 5M RESOLUTION

- In urban area, even 3D data with 0.5 meter resolution is available.
- Contributing efficiency and sophistication of disaster prevention measures, urban planning, telecom/electricity sector and other services in the global market.



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Mt. Everest



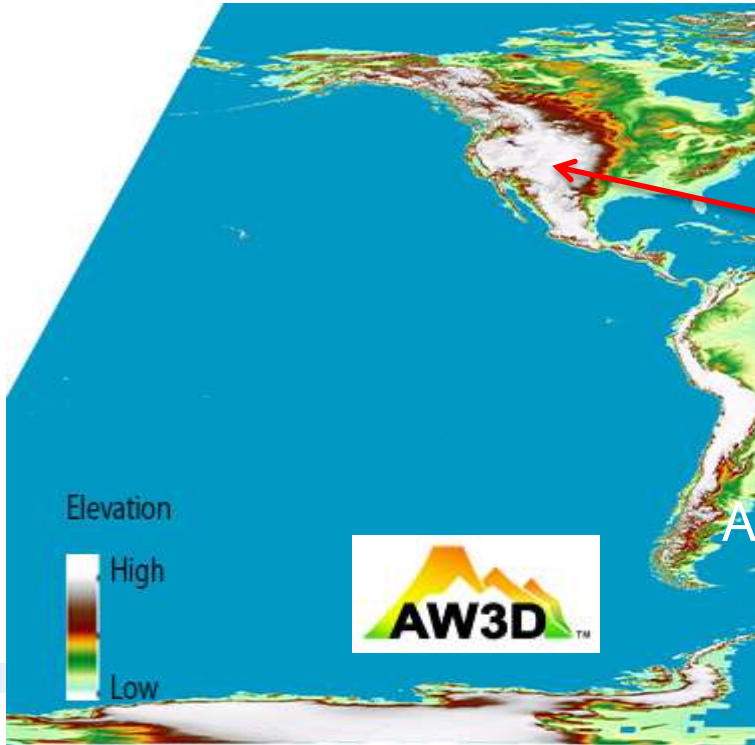
100 projects,
markets

© NTT DATA, RESTEC, Included © JAXA

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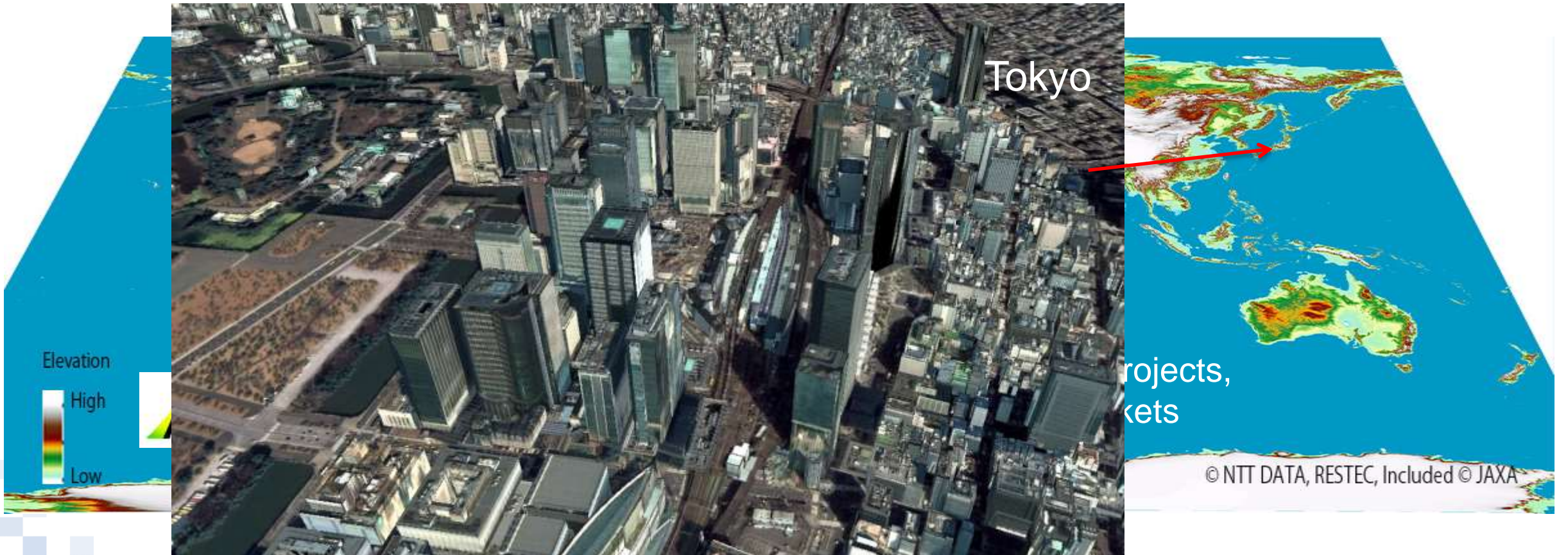
Grand Canyon ➤



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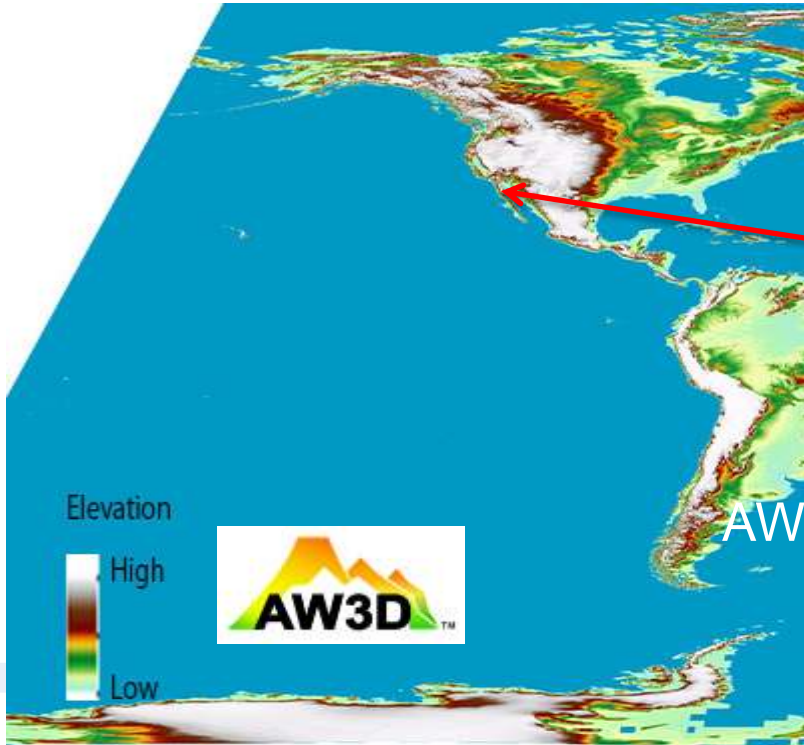
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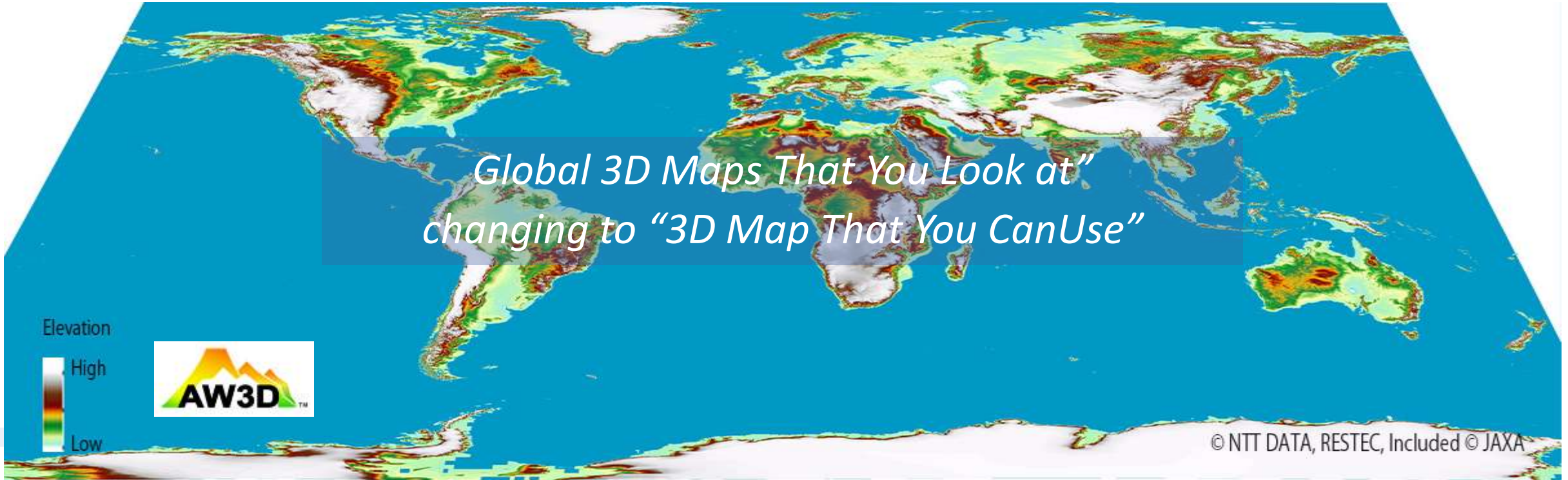
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What is AW3D ?

WITH THE WORLD TOP-LEVEL TECHNOLOGIES, 3D MAP IS AVAILABLE TO MORE PEOPLE

- **The advanced image processing algorithm** that was co-developed by Remote Sensing Technology Center of Japan (RESTEC) and NTT DATA Corporation.
- **Started as a public-privative cooperation** with Japan Aerospace Exploration Agency (JAXA). Collaborating with DigitalGlobe, a US company who operates the world's highest resolution commercial satellites.
- Transforming images to valuable 3D through technical collaboration. **Providing 3D map anywhere in the globe with short delivery time, highly affordable cost and practical applications.**

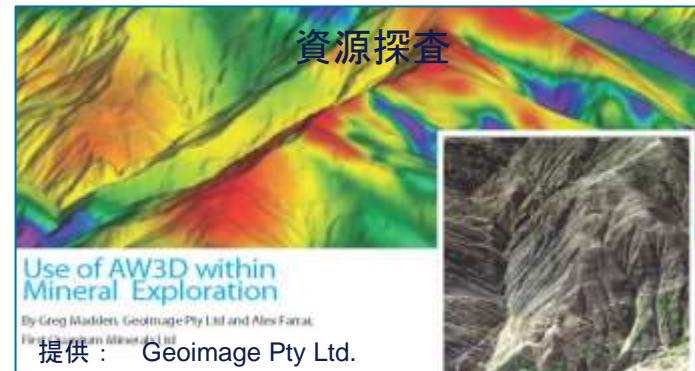
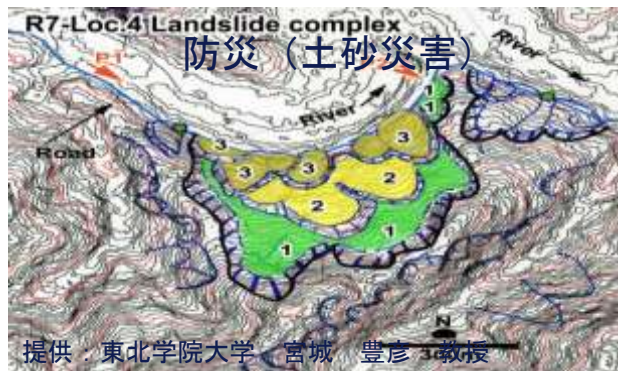
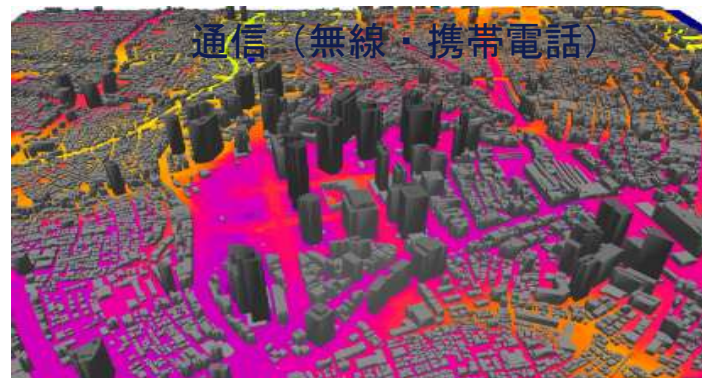
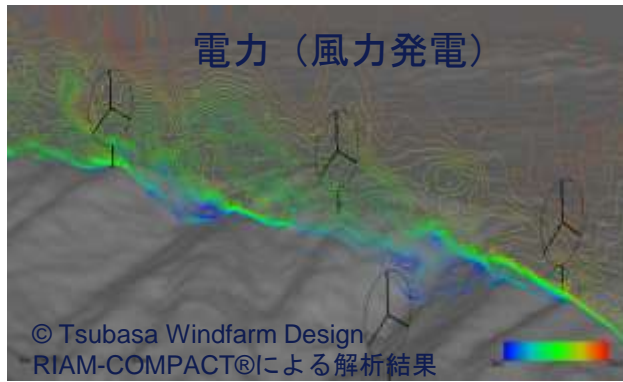


※JAXA陸域観測技術衛星「だいち（ALOS）」

What is AW3D ?

Worldwide projects and numerous applications: more than 300 projects, over 70 countries

- Utilized in various verticals such as infrastructure deployment, disaster management, and climate change adaptation, power plant development, natural resource sector, urban facility planning etc.
- Contributing efficiency and sophistication of the geospatial supplication in the global market

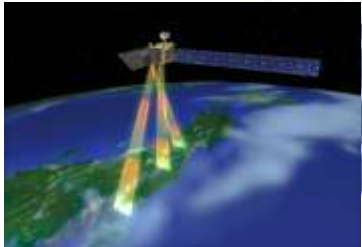


5m grid global 3D mapping using Japanese satellite ALOS

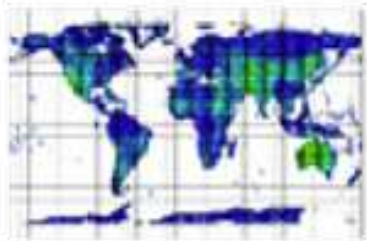
- **3 million tri/stereo images of the entire global land area** acquired by JAXA's ALOS.
- Advanced image processing algorithm x High-speed data processing system
- **2 years to complete worldwide coverage** based on daily processing of 2,000 set of imageries

Satellite data

JAXA's ALOS satellite imageries

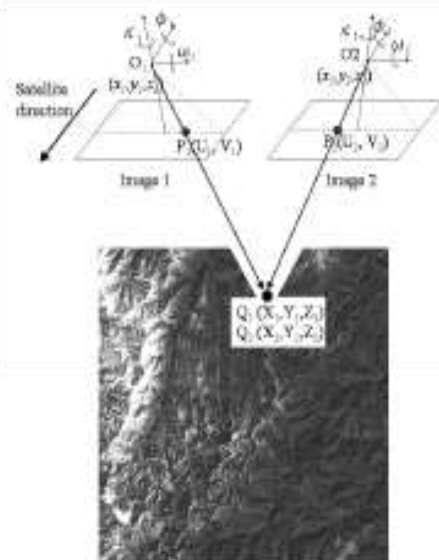


3million imageries
(About one-peta bytes)
as much as eight-earth



calculating the satellite shooting position

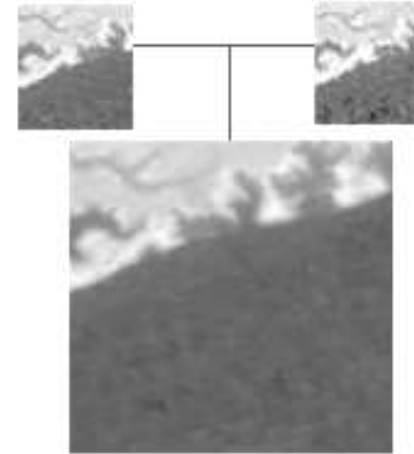
3D Analysis



Measuring each 5 meters height from the height of 700 kilo-meters

Map Creation

Connecting each 3D map as seamless



Removing defects and making maps seamless

Quality Assurance

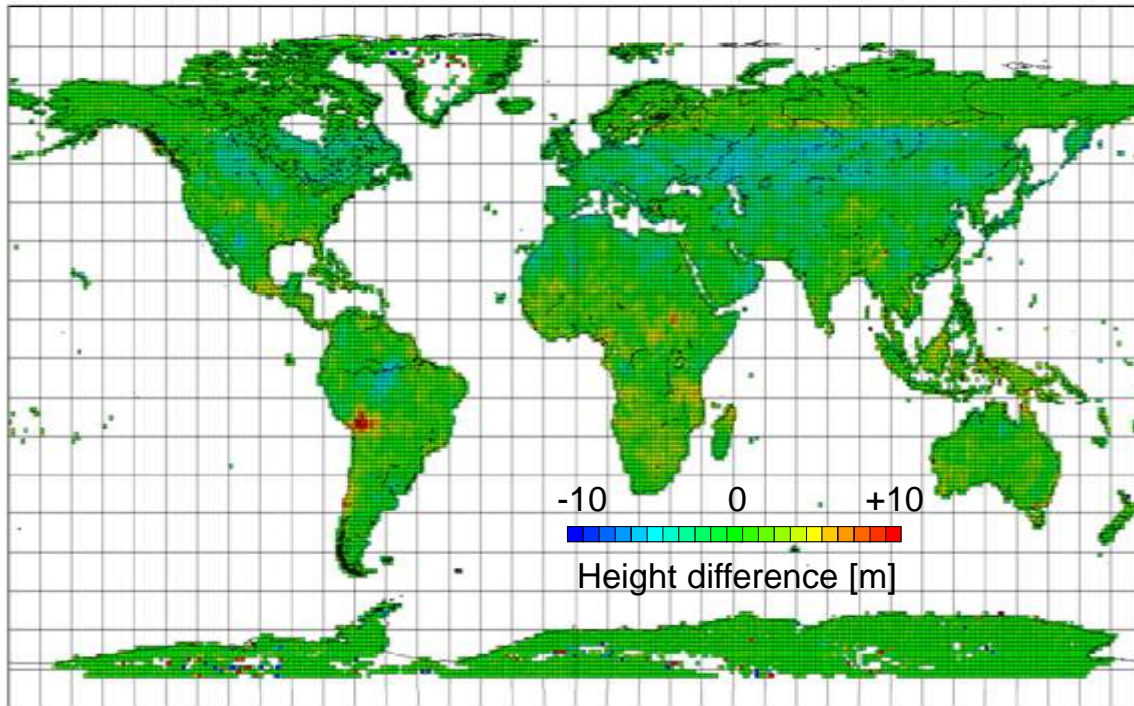


Checking quality

5m grid global 3D mapping using Japanese satellite ALOS

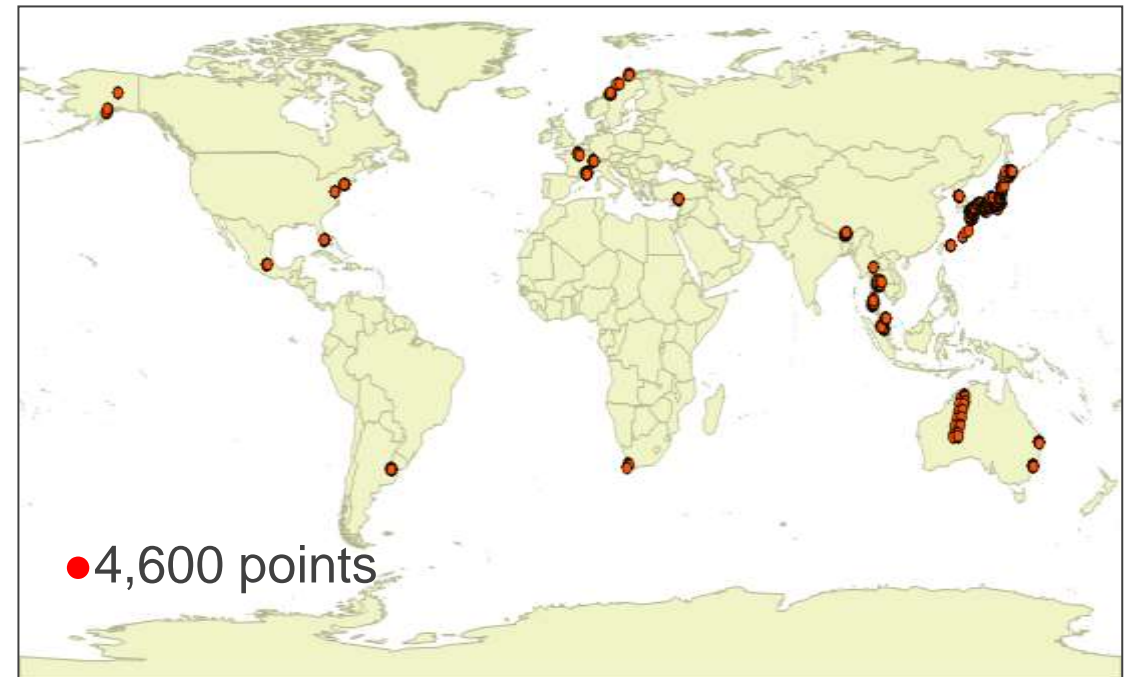
- Strict quality management throughout the world by comparing with other satellites and ground truth.
- Height accuracy is 3m (RMSE) based on more than 4,600 verification ground points.
 - Applicable to 1/25,000 scale of mapping, suitable to nation wide base mapping

Comparison with ICESaT



Z accuracy: 3.4m (RMSE)

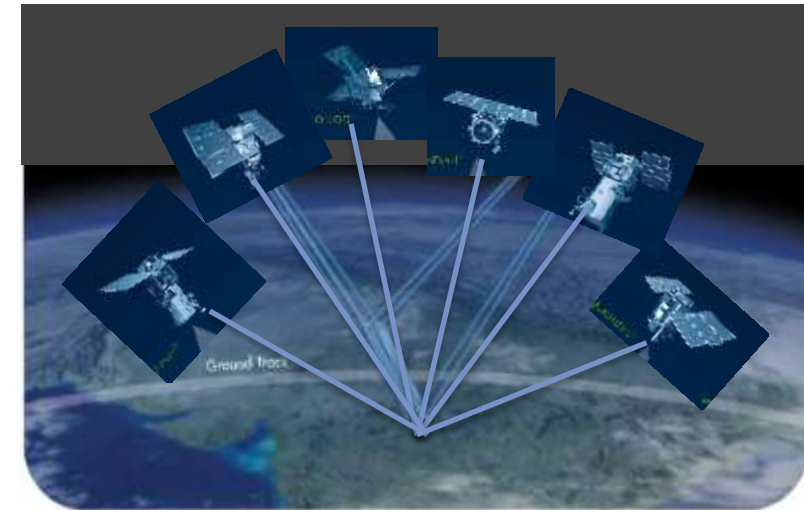
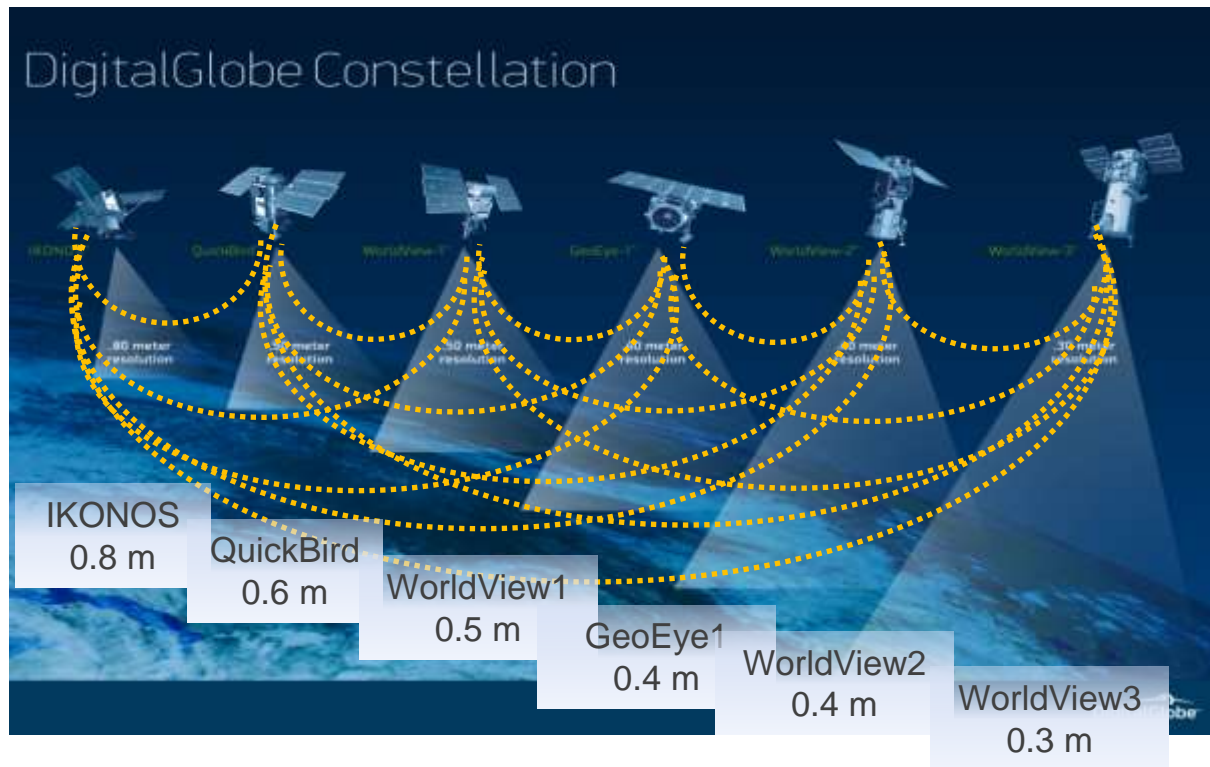
Comparison with Ground Truth



Z accuracy: 3.3m (RMSE)

Updating and Upgrading the 3D map with maximum 0.5m resolution

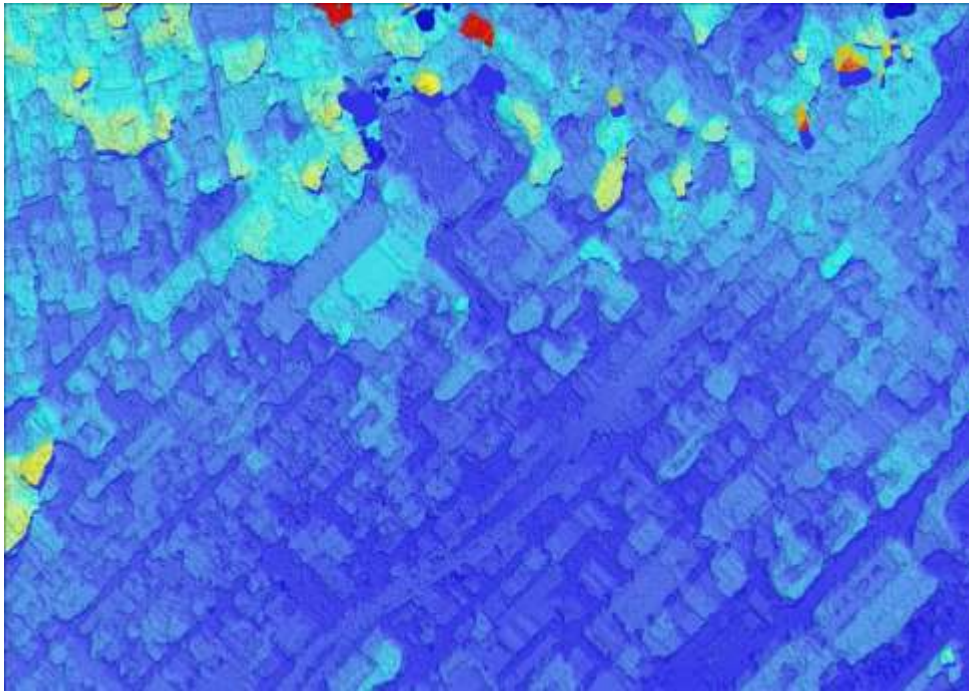
- **Technical innovation including processing imageries in multiple angles taken with various satellites.**
- High Resolution 3D Map up to 0.5 m grid by collaborating with DigitalGlobe.
- Combining deep stacks of images shot by several satellites and produce high-quality 3D map



Multiview Stereo

Updating and Upgrading the 3D map with maximum 0.5m resolution

- **Technical innovation including processing imageries in multiple angles taken with various satellites.**
- High Resolution 3D Map up to 0.5 m grid under the collaboration with DigitalGlobe.
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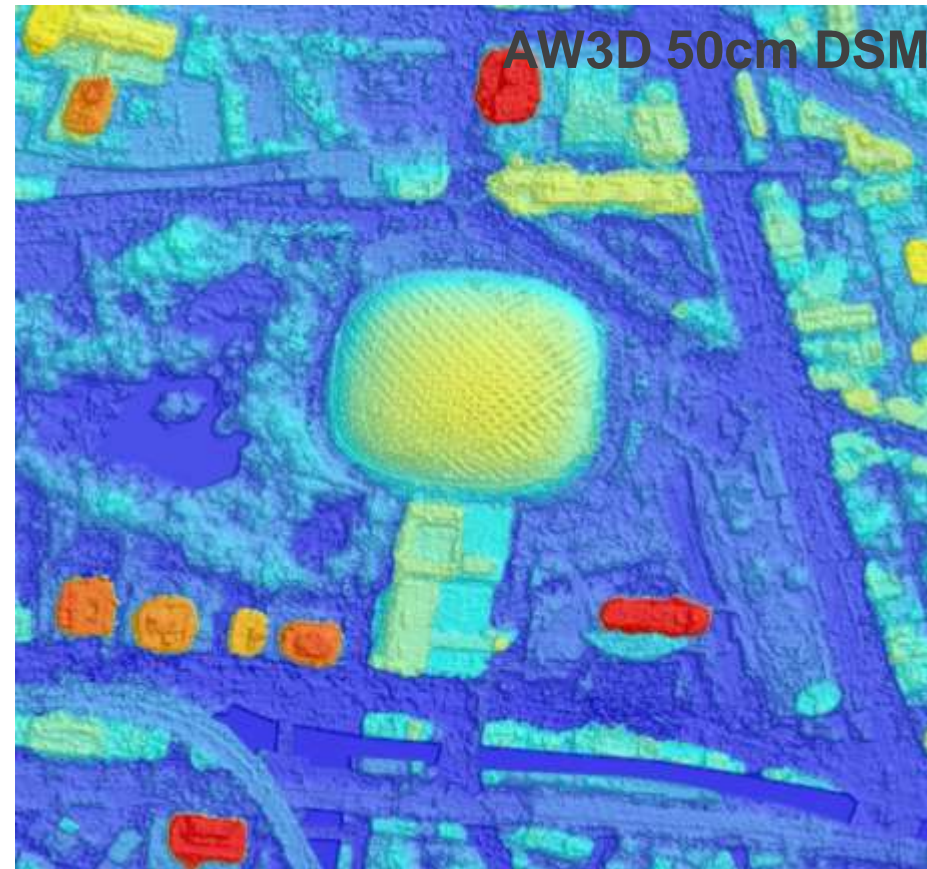
Traditional Stereo



Multiview Stereo

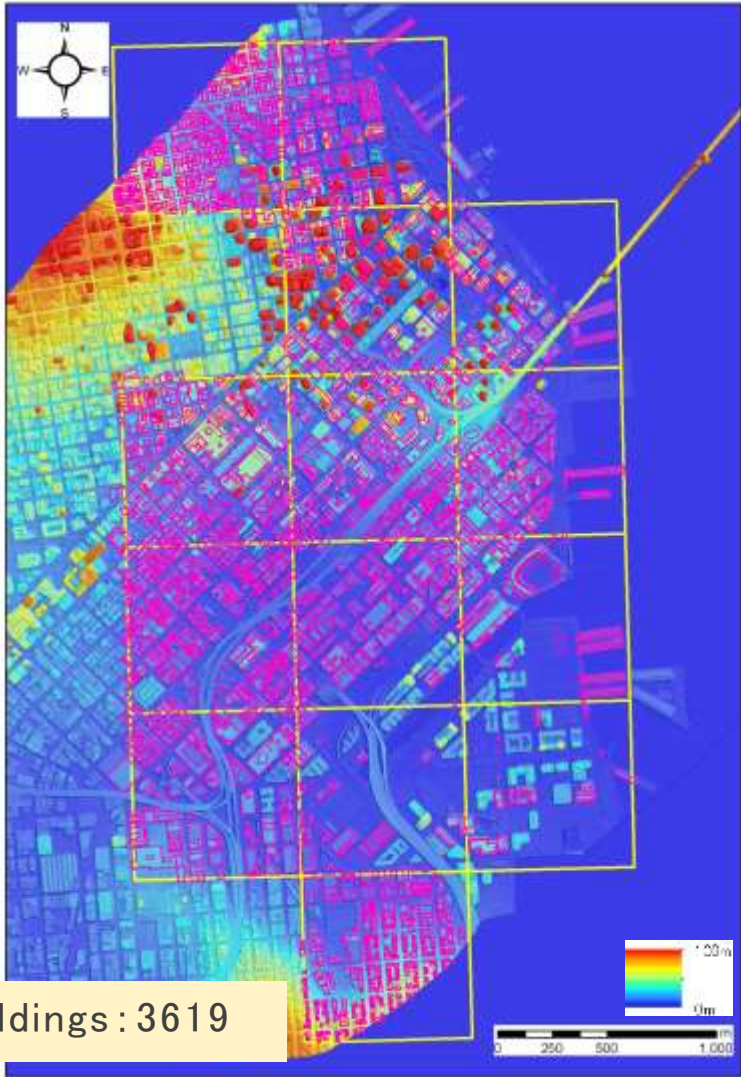
Updating and Upgrading the 3D map with maximum 0.5m resolution

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Elevation Accuracy (0.5m resolution)

AW3D 0.5m resolution



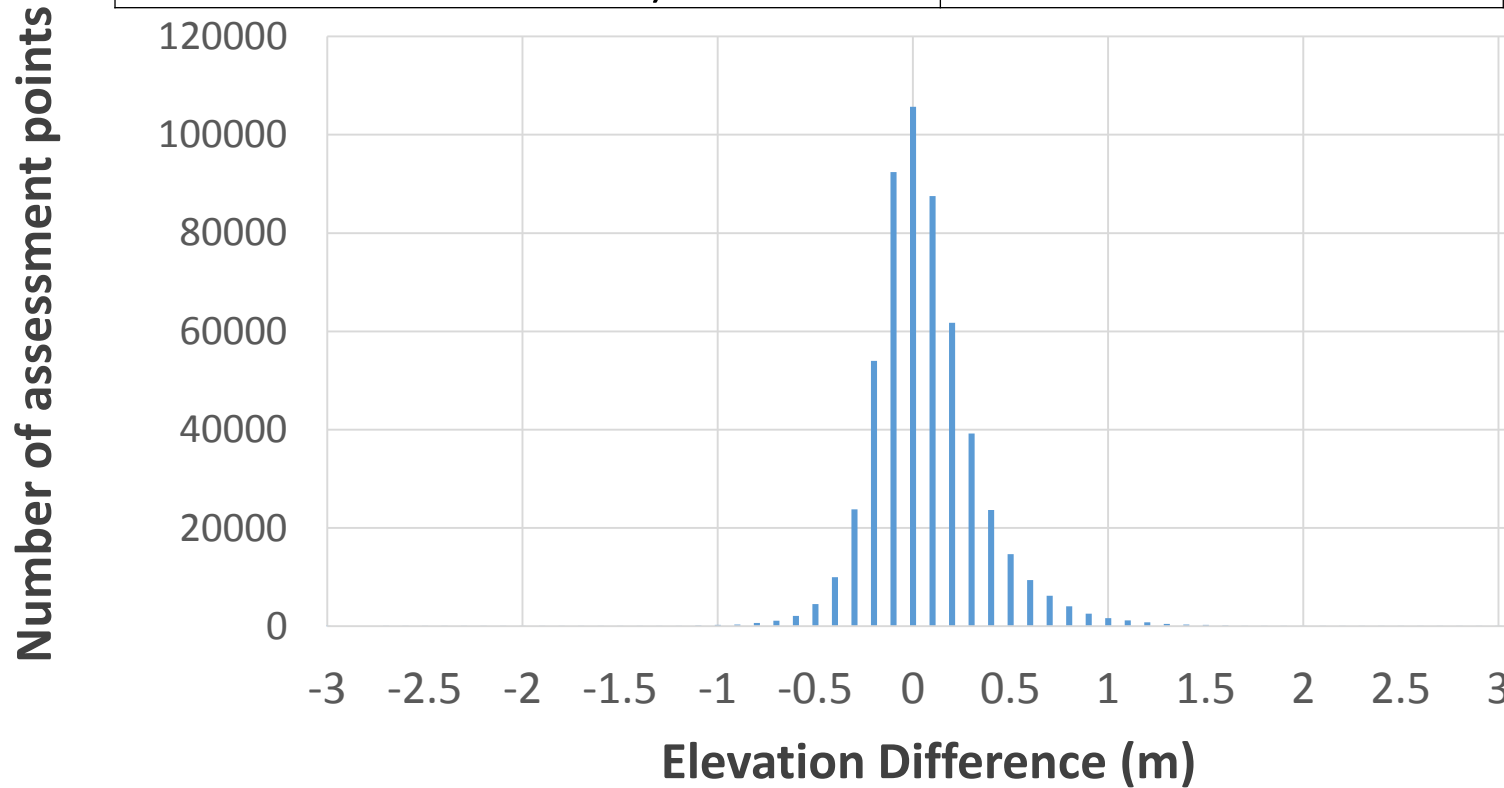
Number of buildings : 3619

Comparison with LiDAR point clouds



Elevation Accuracy (0.5m resolution)

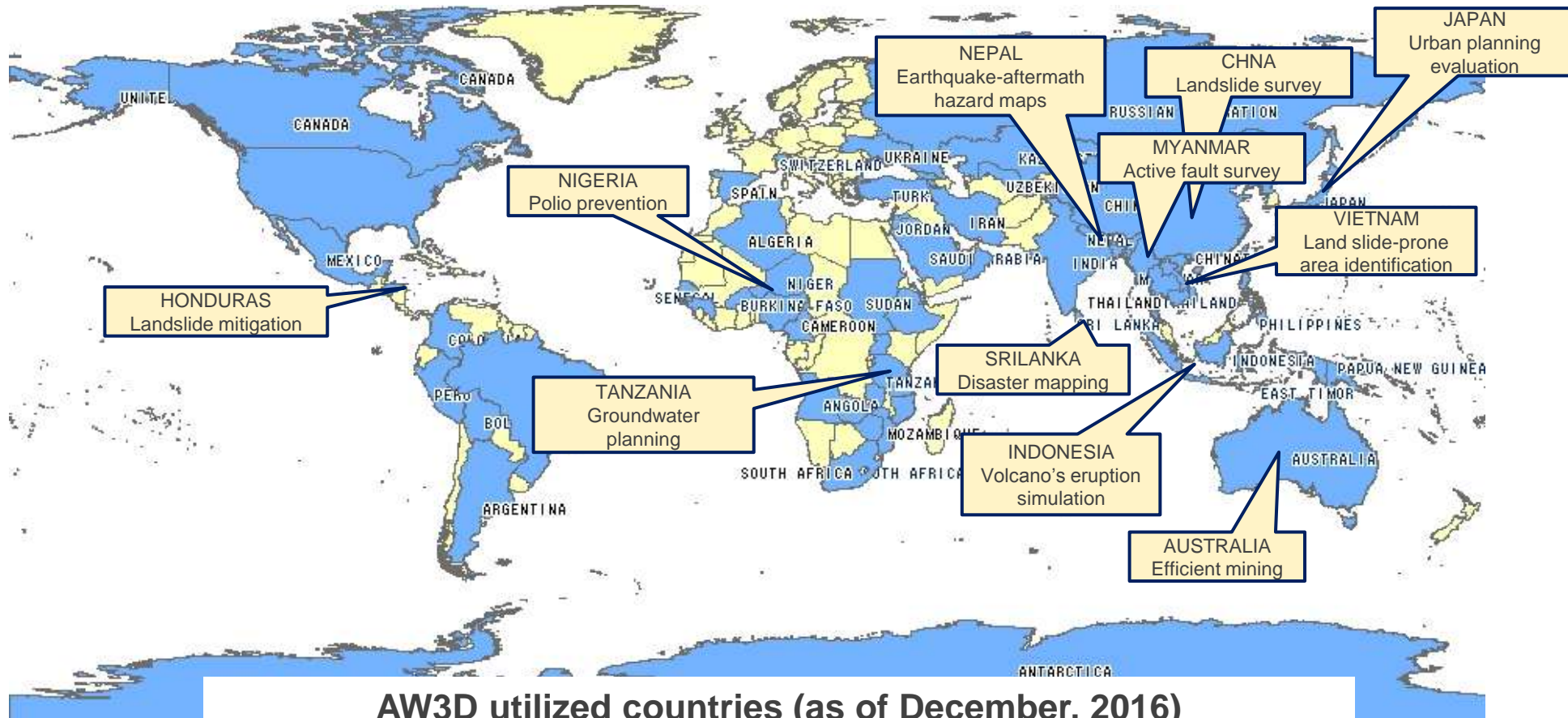
| Statistics index | Accuracy (m) |
|----------------------------------|--------------|
| Average | 0.01 |
| Median | -0.02 |
| Standard Deviation (1σ) | 0.28 |
| RMSE | 0.28 |
| LE90 (90%) | 0.42 |



Overview of World 3D Map (AW3D) utilization

The data utilization has been expanded globally, especially in emerging countries.

- Utilized in more than 72 countries and areas so far
- Especially in emerging countries of Asia/Oceania, Africa, and South America
- Application field; disaster prevention, mapping, natural resource etc.



Landslide runout distance simulation using AW3D Standard DSM

| Item | Description |
|--------------|--|
| Organization | Sinotech Engineering Consultants. INC |
| Filed | Disaster prevention |
| Location | Shuchuan, China |
| Background | <ul style="list-style-type: none">• The massive landslide was occurred in Shichuan, China on 24th June, 2017.• In order to conduct the prompt analysis, AW3D Standard DSM of off-the-shelf dataset was utilized. |
| Overview | <ul style="list-style-type: none">• Sinotech Engineering Consultants. conducts landslide runout distance simulation using AW3D standard DSM. |

Landslide analysis (Shichuan, China)

AW3D 5m DSM is utilized for landslide runout distance simulation by RAMMS.

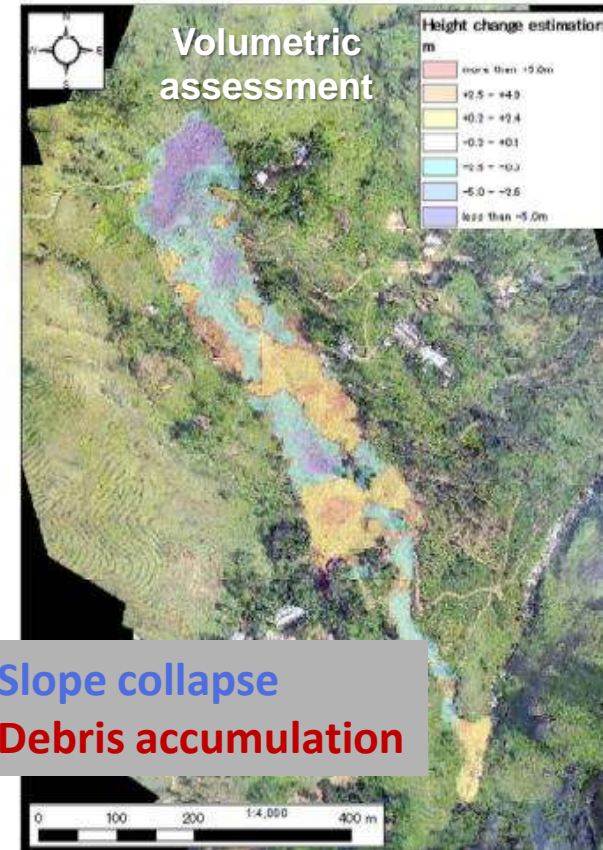


Data source: Sinotech Engineering Consultants, INC

Project Prompt landslide volumetric assessment for recovery in Sri Lanka

Conductor JICA (Japan International Corporation Agency)

- The landslide disaster occurred on Oct. 29th 2014, which was the largest scale ever recorded. JICA conducted the disaster initial survey.
- Conduct comprehensive damage and secondary risk assessment for the region.

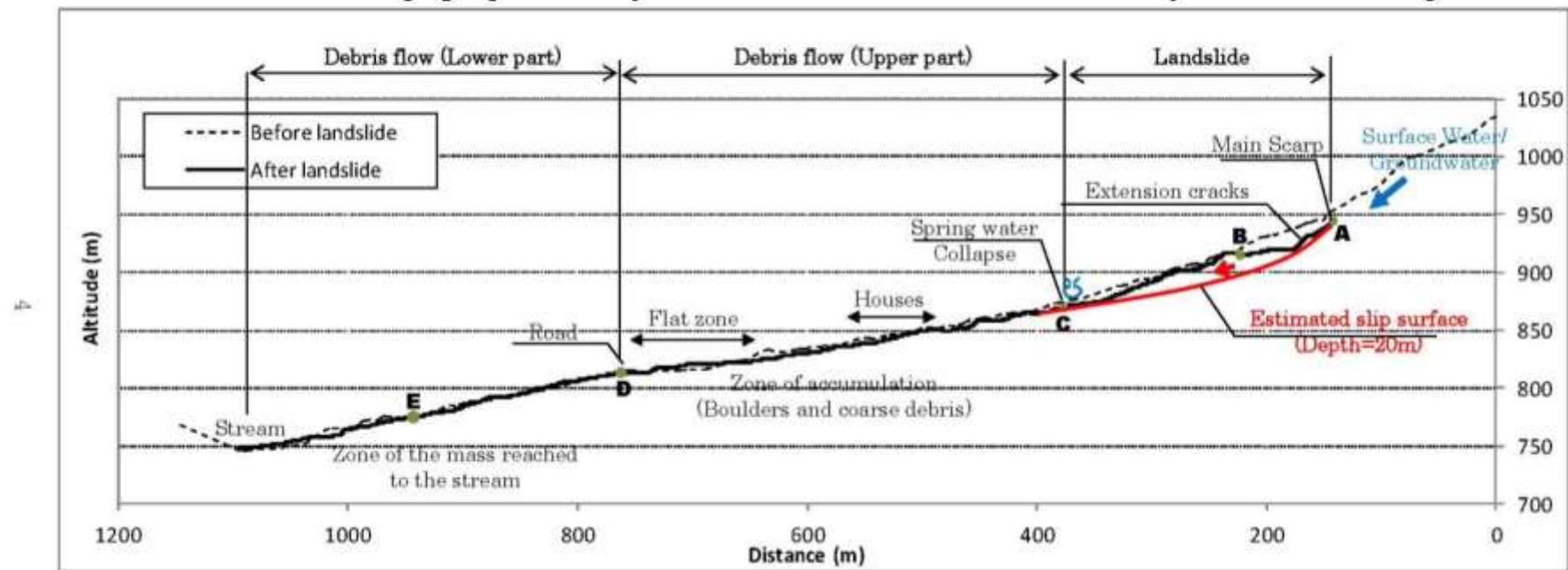


Reference) Survey Results of Koslanda Landslide (2nd Report), JICA Technical Cooperation for Landslide Mitigation Project, November 25, 2014
<http://www.jica.go.jp/srilanka/office/information/press/141125.html>

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Before the Landslide: DEM data of AW3D

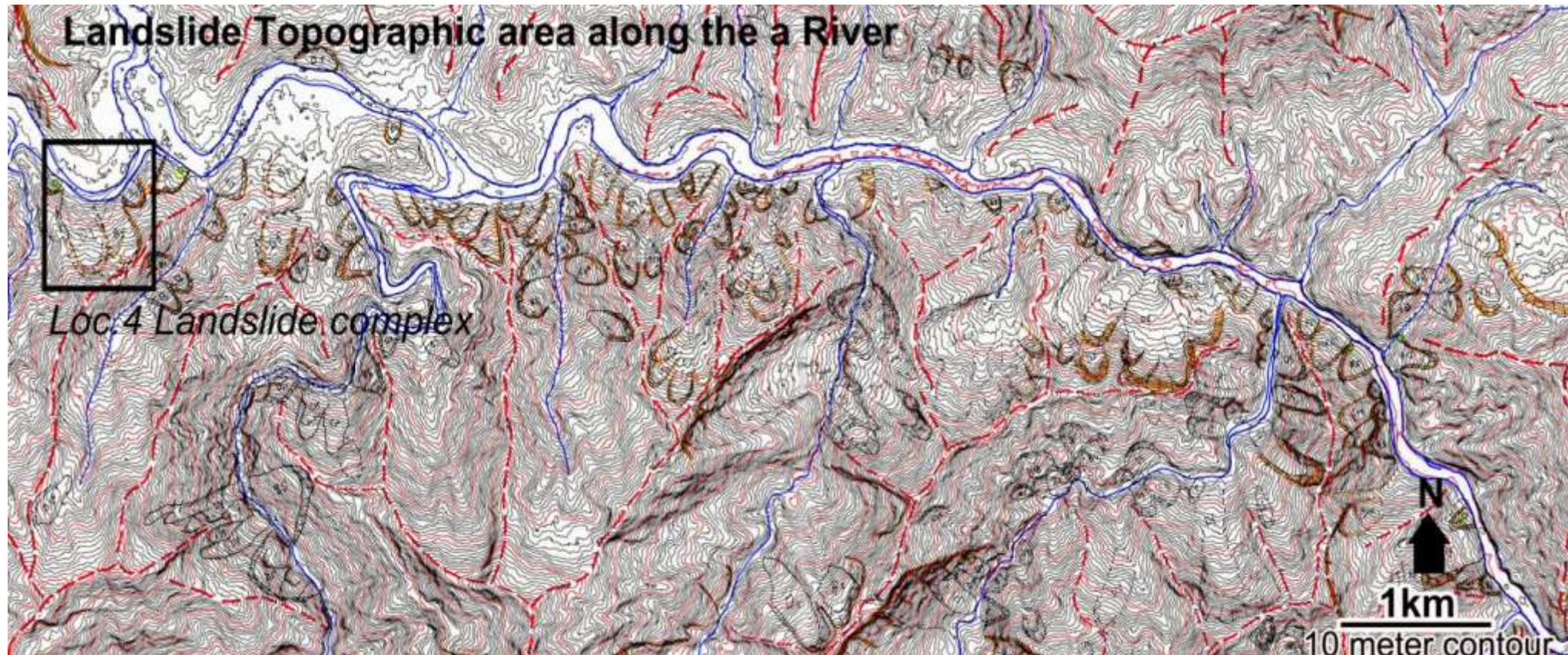
After the Landslide: Topographic Analysis from Photos of the Aerial Survey from the Helicopter



Assumed cross section of Koslanda Landslide

Reference) Survey Results of Koslanda Landslide (2nd Report), JICA Technical Cooperation for Landslide Mitigation Project, November 25, 2014
<http://www.jica.go.jp/srilanka/office/information/press/141125.html>

- Necessity of landslide prevention on the on National roadways in center of Vietnam, but difficulty of aerial photo shooting for the whole area due to cost limitation
- More than 1,000 hazardous locations were successfully extracted based on AW3D.

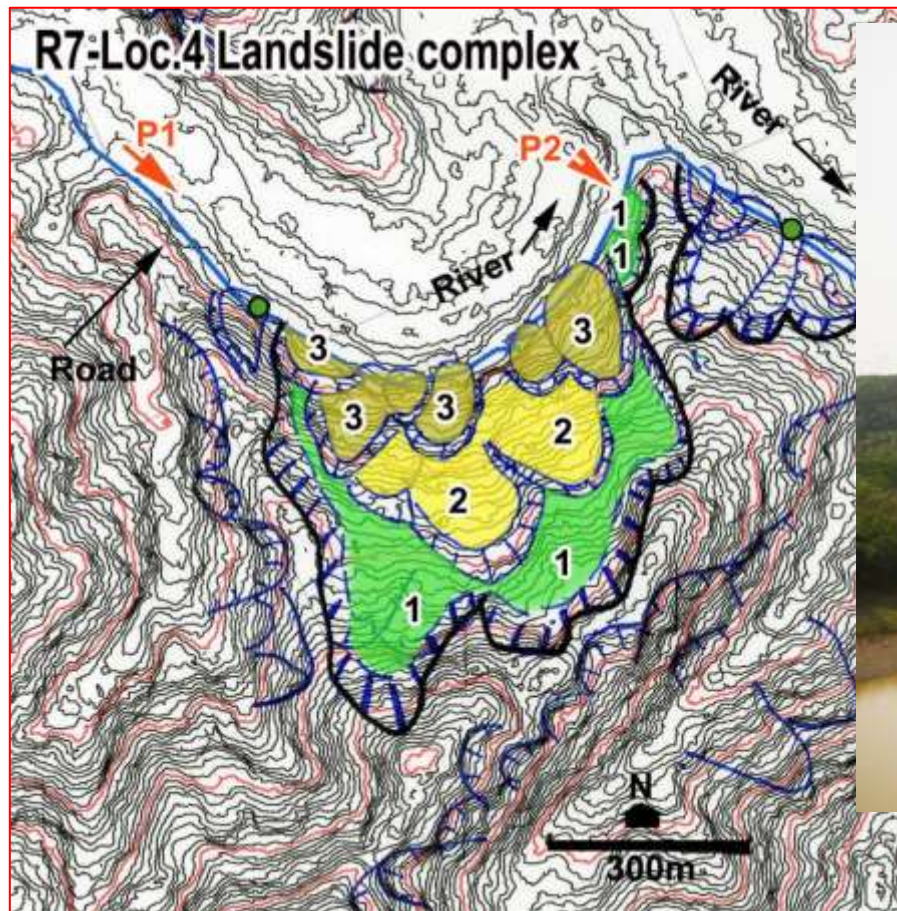


Provided from Professor MIYAGI, Toyohiko (Division of Human Informatics, Graduate School of Tohoku-Gakuin Univ.)

Project Landslide hazardous area extraction along National roadways in Vietnam

Conductor International Consortium on Landslides (ICL)

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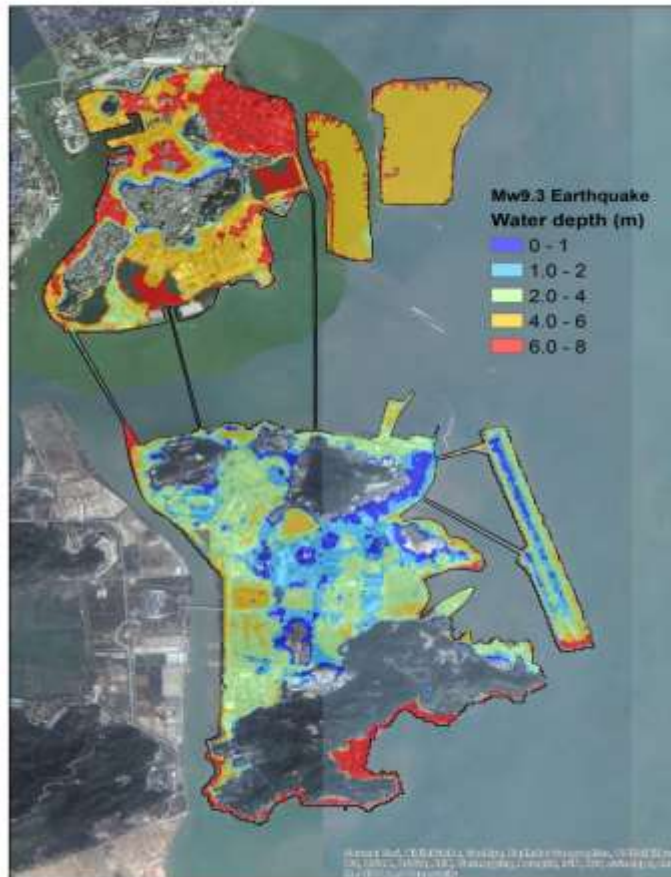
Provided from Professor MITSUO, Toyoniko (Division of Human Informatics, Graduate School of Tohoku-Gakuin Univ.)

Project Tsunami Hazard Mapping by Inundation Flood Simulation over Macau

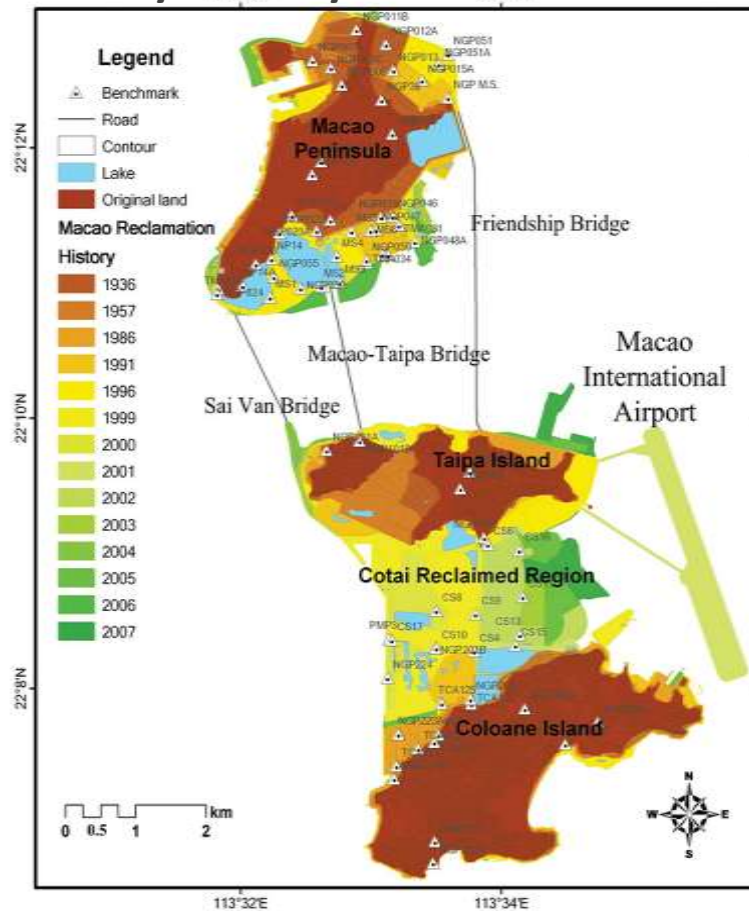
Conductor Earth Observatory of Singapore

- Macau is surrounded by sea having the risk of large tsunamis from earthquake in the Manila trench.
- High-resolution elevation model datasets is required to accurately simulate the inundation.
- Using AW3D Enhanced, accurate simulation of tsunami was conducted, and the result is highly hypothetical: Worst case scenario will inundate exactly the very area of reclaimed lands of Macau

Inundation simulated map using AW3D



Provided by Dr. Linlin Li of Earth Observatory of Singapore

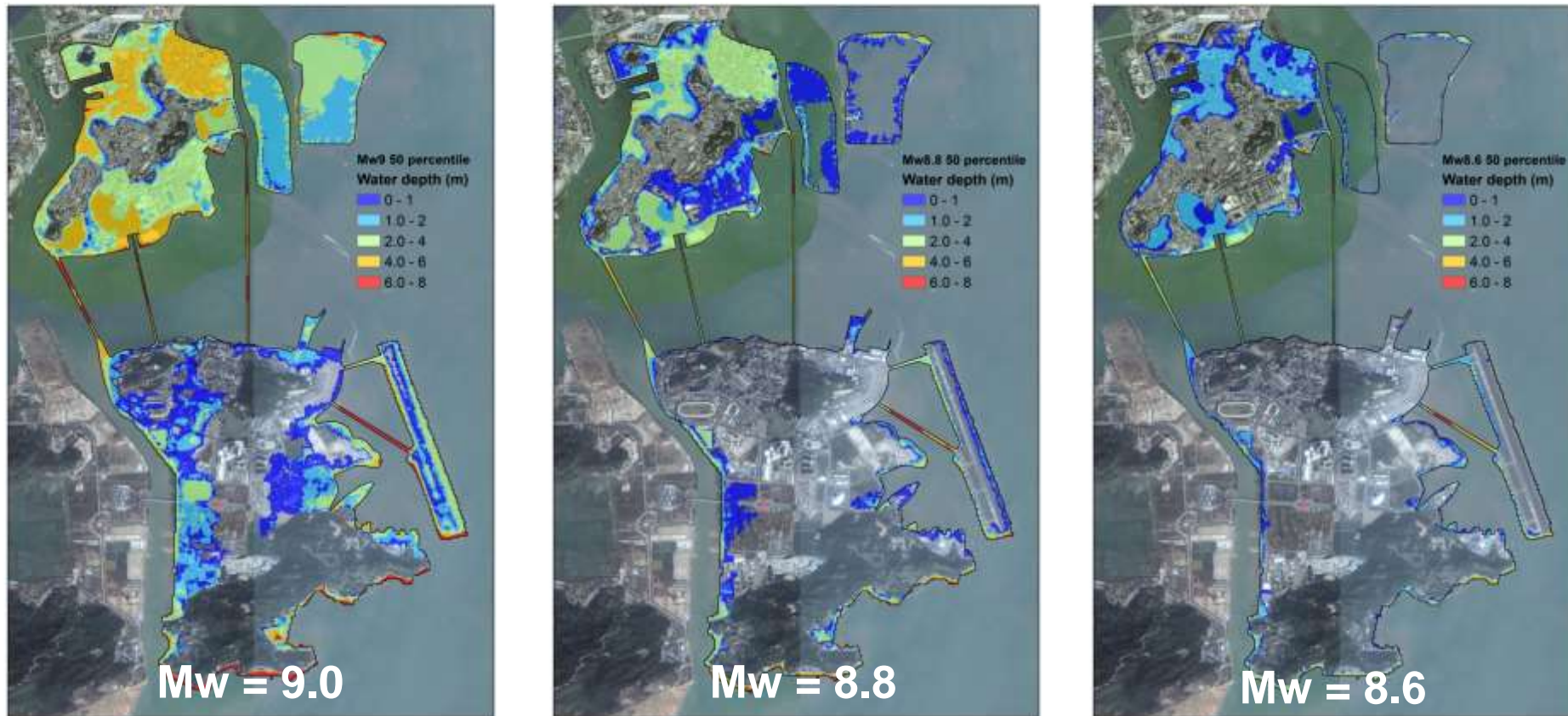


Reclamation evolution [Jiang et al., 2011]

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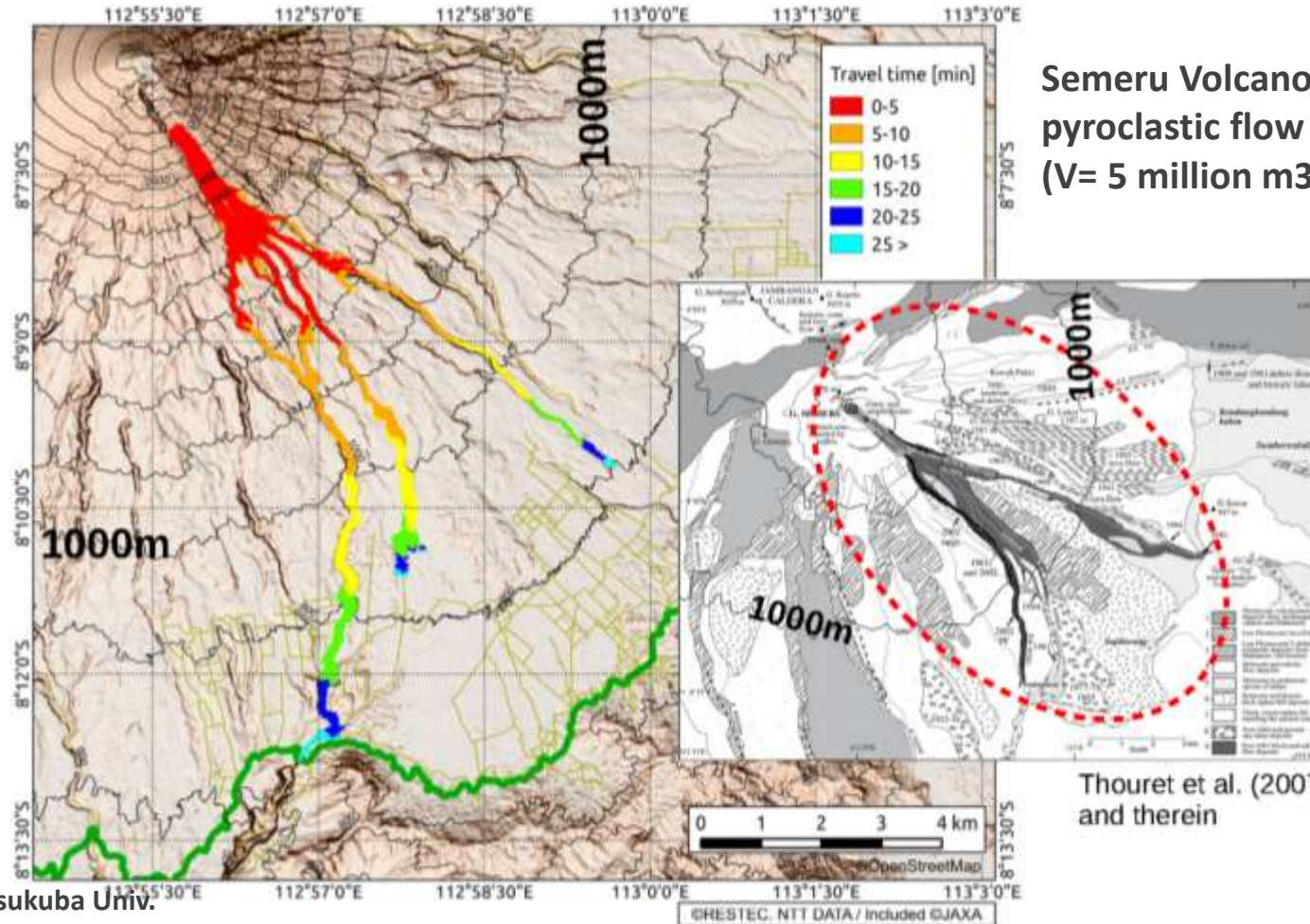


Provided by Dr. Linlin Li of Earth Observatory of Singapore

Project Simulate the volcanic pyroclastic flow over Semeru Volcano, Indonesia

Conductor Tsukuba University (under a project of SATREPS by JICA-JST)

- Semeru Volcano eruptions have been caused serious damages.
- AW3D made it possible to simulate the pyroclastic flow based on the various scenarios. The prediction of a falling-range of the pyroclastic flow and arrival time has been conducted.



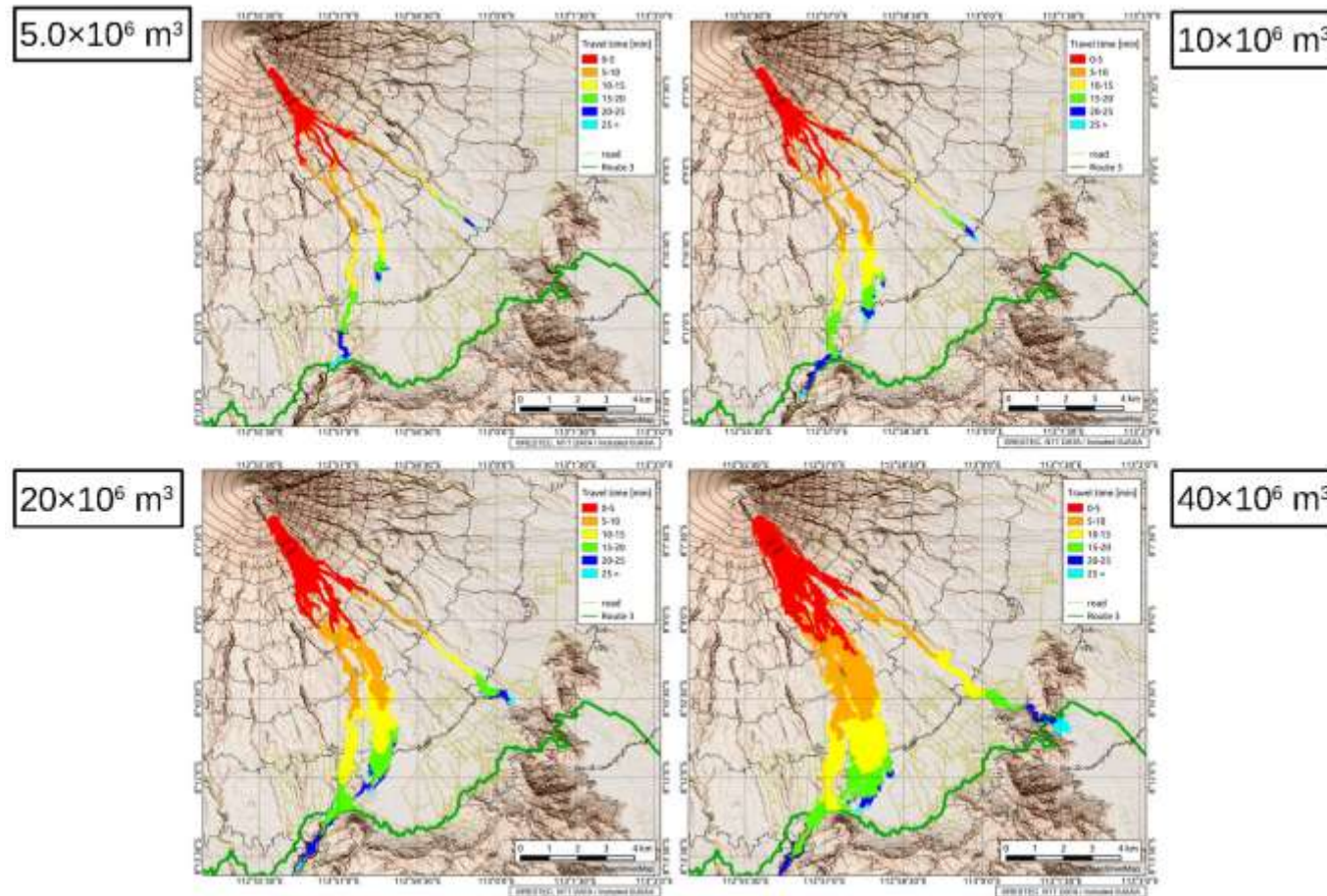
Semeru Volcano, simulation of the pyroclastic flow :travel time (V= 5 million m3)

Data source: Tsukuba Univ.

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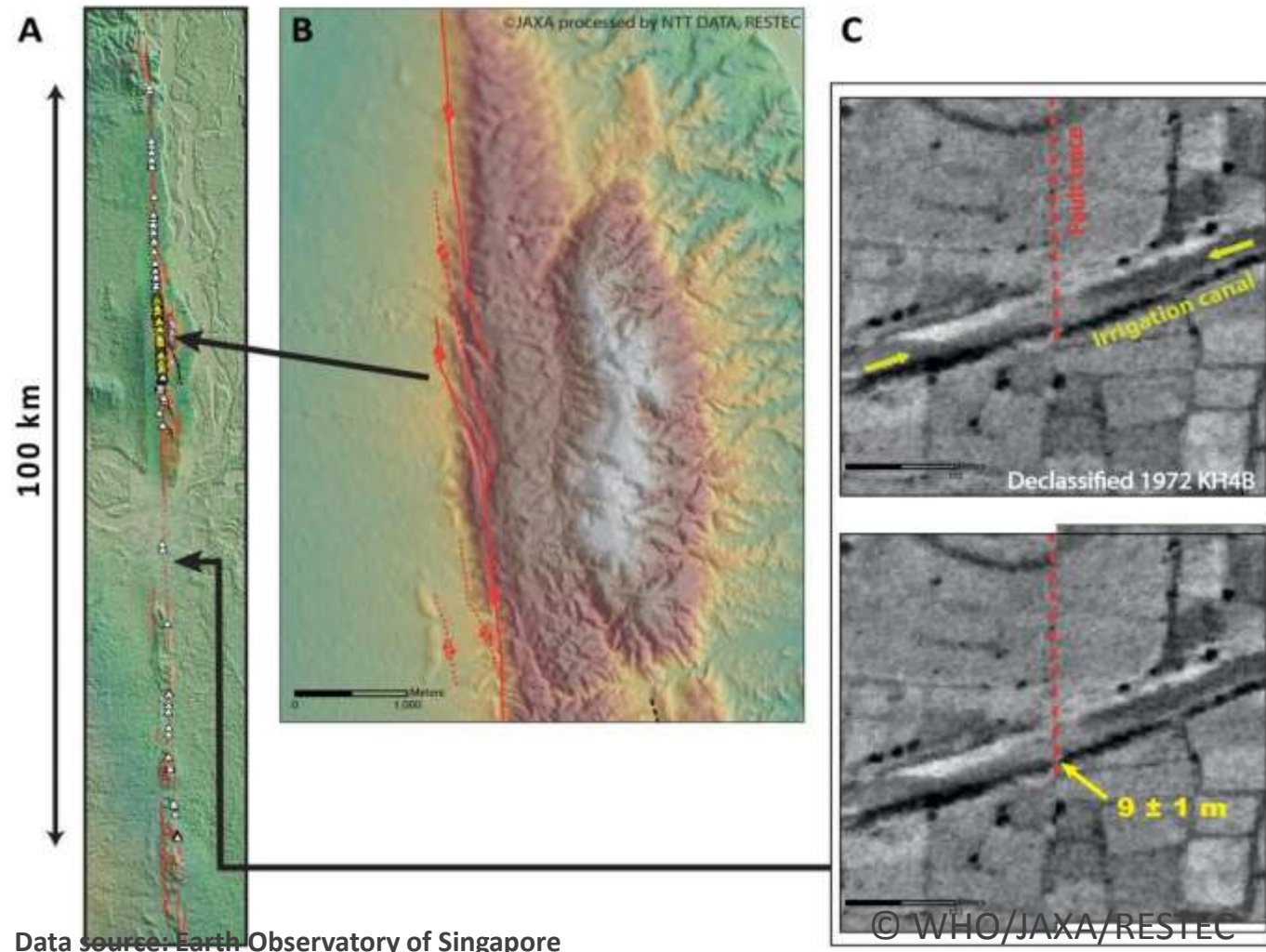


Data source: Tsukuba Univ.

Project Active faults search in nation wide area, Sagaing fault, Myanmar

Conductor Earth Observatory of Singapore (Nanyang Technological University)

- Necessity of active faults distribution mapping for earthquake preparation in Myanmar
- AW3D is applied to this project thanks to its global coverage and high resolution.

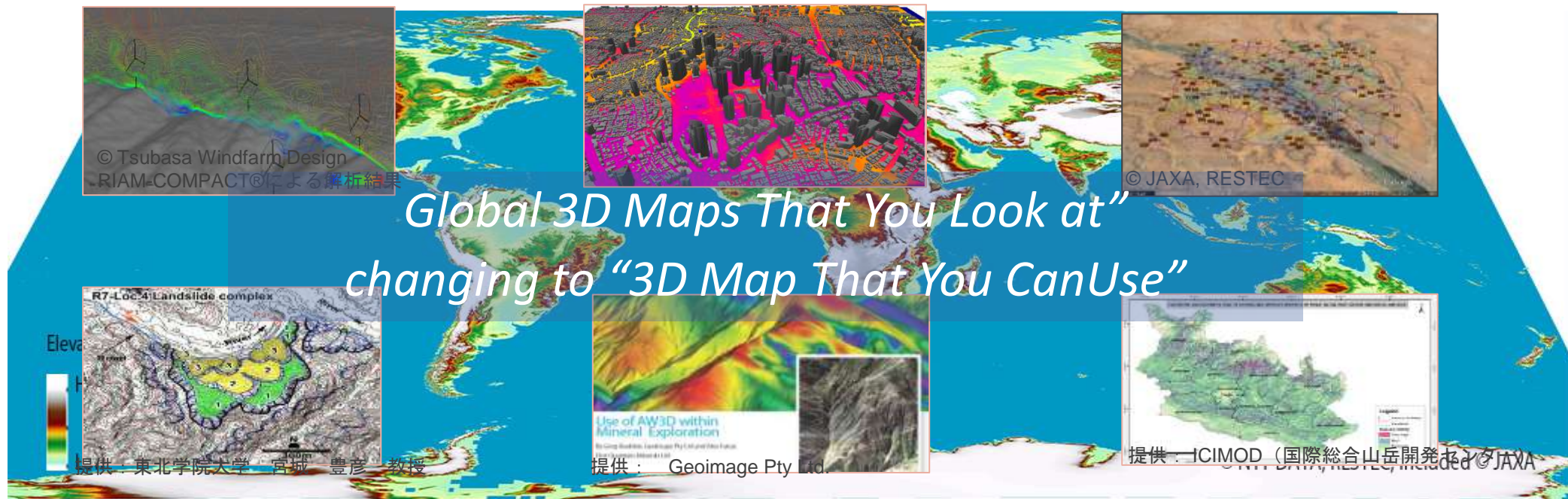


Data source: Earth Observatory of Singapore

© WHO/JAXA/RETEC

One example of new active fault map from this study. (a) The overview of the new active fault near Mandalay. White and yellow triangles are the offset measurements. (b) Detailed fault geometry at the western flank of the Sagaing Hills, showing a series of right-stepping faults mapped from the 5m DSM. (c) One of the small offset found south on the young flood plain from the 1972 satellite imagery.

- AW3D aims to provide “practical & useful geospatial information” for **disaster applications by “continuous upgrade & update” of the 3D map.**
- AW3D is moving forward to create more higher value added geospatial application by **collaborating with other geospatial contents and services.**





Visit our website: <http://aw3d.jp/en/>

- High accuracy 3D maps covering whole the nation have not been available so far.
- Landslide hazard map, pointing out high risk areas of landslide, are being developed on the several earthquake damaged areas for reconstruction and resettlement planning.

