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Development of 3D Digital Japan Basic Map

Mana Ishitsuka *, Hidekazu Minami, Mayumi Noguchi, Gen Nagano

Geospatial Information Authority of Japan, ishitsuka-m96ps@mlit.go.jp, minami-h96py@mlit.go.jp, noguchi-m96c3@mlit.go.jp, nagano-g96s2@mlit.go.jp

* Corresponding author

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Abstract:

As a fundamental map covering the whole land of Japan, GSI (the Geospatial Information Authority of Japan) maintains the map called the Digital Japan Basic Map. The Digital Japan Basic Map serves as the basis for all maps of Japan and is produced with a standardized schema throughout the entire country. The Digital Japan Basic Map has been designated as a base registry, which is a database containing especially fundamental information for society, which has increased the need to continually maintain and update it.

The Digital Japan Basic Map has been prepared as 2D map information. However, in order to realize a digital society, it is necessary to prepare the fundamental national map in 3D and maintain it by quickly reflecting the changes in the country in the 3D map information. Against this background, Cabinet Decisions were made on the "Priority plan for the realization of a digital society" on June 9th, 2023, and the "Follow-up on the Growth Strategy, etc." on June 16th, 2023, which require GSI to implement 3D mapping across the whole country by FY2028 and to start publishing the 3D maps sequentially in public in FY2025. Buildings, roads and railways were selected as the target features of this three-dimensionalization because they can be effectively and continuously updated throughout the country.

In FY2024, GSI started preparing raw 3D map information of the national land area to create the 3D Digital Japan Basic Map. In parallel, product specifications for the 3D Digital Japan Basic Map were developed in preparation for a future product provision, and a trial of three-dimensionalization of an area of approximately 100 km^2 including both of urban and mountainous areas was conducted.

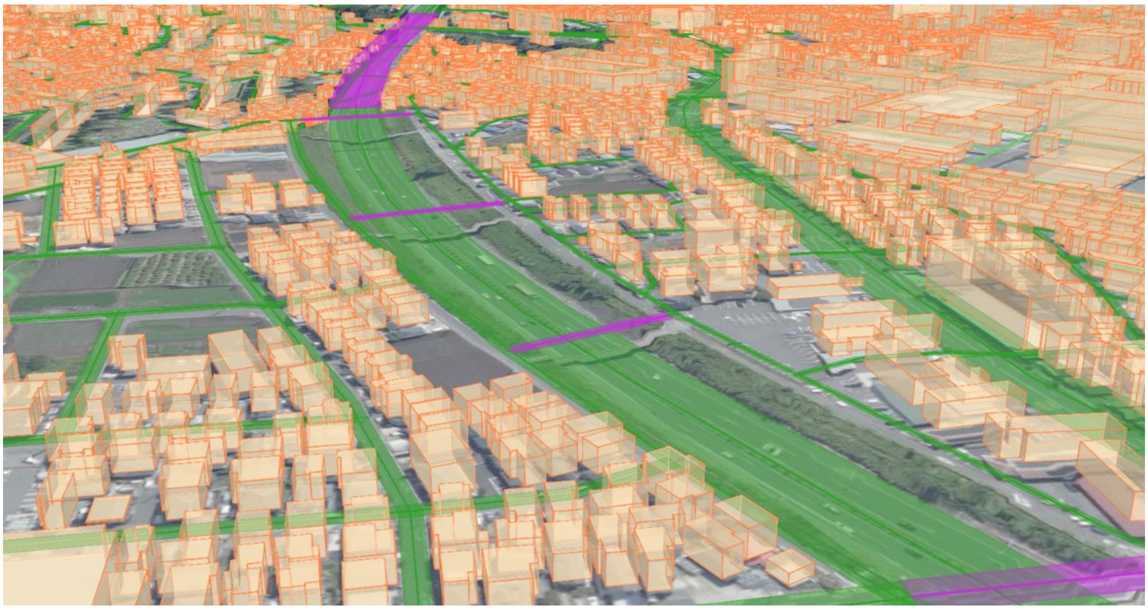

Figure 1. The 3D Digital Japan Basic Map for illustrative purposes.
Created by using point cloud data from Tokyo Digital Twin Project (https://info.tokyo-digitaltwin.metro.tokyo.lg.jp/).

In order to produce the 3D map information, height information is added to 2D map information from DSMs obtained from aerial laser surveying or aerial photography. In this process, map updating and elevation surveying are basically carried out simultaneously using aerial photography, so that topographic information and height information are obtained at the same time. This simultaneity results in highly accurate 3D map information because there is no inconsistency in

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the survey of topographic and elevation information. However, due to some constraints, existing 2D map information and height information provided by aerial laser height information produced at different times would be used in some areas. For this trial, the existing 2D map data prepared using aerial photographs taken in October 2020 and the aerial laser point cloud prepared in 2022 were used to develop the trial data.

These trial data were converted into the format specified by the tentative product specifications for the 3D Digital Japan Basic Map, based on the specifications of the conventional 2D map product: GML and shape file format. As for other formats, trial CityGML data were also prepared as samples for reference when considering the final file format, since CityGML has been adopted as the data format for other 3D city model development projects.

These trial data have three feature categories: building polygons, road arcs and railway arcs. Building polygons are specified as 3D features and have both maximum and median building heights as attribute values. Each height information can be selected by the user according to the purpose of use. Ground level elevation is also stored as an attribute value, allowing users to use both absolute and relative building heights. Road and railway arcs have XYZ coordinates, and elevation values are stored in the Z value.

In order to verify the accuracy of the trial data, data aggregation and field observation were carried out. In the field observation, the trial data for 21 locations that had clearly anomalous values were compared with the actual structures.

As a result, the number of buildings to which a height of less than 1m was added was 759 out of 47,141 (approximately 1.6%) due to loss of buildings between the time the 2D map information was produced and the time the laser point cloud was acquired. Also, several examples of anomalous building processing were found where point data from nearby trees and power lines in the sky above were added as the height value indicates the roof surface. The influence of superstructures such as trees was also observed in the process of roads. In addition, there were cases where spike values were added at bridge and tunnel junctions due to small misalignments between the 3D point clouds and the 2D arcs, and cases where the same height values were added to both the upper and lower road at bridge junctions. For railway bridges, laser points passing through gaps between tracks and rail ties were sometimes added as the height value of the bridge itself.

In the trial data, these error data were either flagged to indicate that the value contains errors, or manually corrected, for example by interpolation.

The trial data has been open to the public since March 2025.

3D data and 2D data have been separately accumulated and maintained for now, therefore, it is a future challenge that how to correlate and simultaneously update 3D data with 2D data. In the future, when the 3D maps are developed in a certain standard and quality throughout the entire country, advanced analysis such as comprehensive flood simulation will become possible and the range of use will expand, which is expected to contribute to the creation of new value.

References

Digital Agency, Government of Japan, “Priority Plan for the Advancement of a Digital Society”, Digital Agency, 21 Jun. 2024, https://www.digital.go.jp/en/policies/priority-policy-program (accessed 25 Apr. 2025).

Cabinet Secretariat, Government of Japan, “Follow-up on the Growth Strategy, etc.”, Cabinet Secretariat, 16 Jun. 2023, https://www.cas.go.jp/jp/seisaku/atarashii_sihonsyugi/pdf/fu2023en.pdf (accessed 25 Apr. 2025).

Okubo, H., Kikkojin, M. and Minami, H., 2024, [Development of a tool to combine elevation data with 2D map data using 3D point clouds] 3 次元点群を用いた地図データへの標高値付与ツールの作成. 国土地理院令和 5 年度調査研究年報 (Annual Report 2023 of Geospatial Information Authority of Japan), pp. 58-67.

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