

Development of the research data portal

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Abstract

In recent years, academic research has increasingly embraced the open science movement, and there is a growing demand for free access to numerical data obtained through research activities. The Research and Development Plan of the Geospatial Information Authority of Japan (GSI), in line with the national open data strategy, also promotes the strategic sharing and utilization of data generated through research activities. However, at the Geography and Crustal Dynamics Research Center, GSI, although a large amount of research data—including observational and analytical data—has been acquired through research operations, only a limited portion has been made publicly available outside the GSI. Against this background, we developed a website to openly and freely publish research and development outputs as well as data generated throughout the entire research process. The website organizes and disseminates a wide range of outputs into eight categories, including observational data, aerial photographs and satellite imagery, field survey data, analysis results and GIS data, software, reports and figures, and supplementary data associated with academic publications. For each dataset, explanatory pages and metadata have been prepared, clearly presenting overviews, citation methods, and terms of use, thereby enabling users to easily understand and utilize the data. In addition, Digital Object Identifiers (DOIs) have been assigned to some datasets, allowing them to be cited and referenced using persistent and unique identifiers. In principle, the published data are freely available at no cost under the GSI Website Terms of Use. This initiative is expected to enhance the visibility of research outputs, promote broader impacts on academic research and technological development, and contribute to the creation of new research outcomes through data reuse.

1. Introduction

At the Geography and Crustal Dynamics Research Center, the Geospatial Information Authority of Japan (hereinafter referred to as Research Center), a large volume of observational and analytical data is acquired through research activities. Although the results derived from these data are often disseminated in the form of reports and academic papers, much of the data itself has remained stored within the Research Center. Even after their use in specific research projects has concluded, such data continue to hold high value for research and technological development across a wide range of fields. However, some of these datasets have not been made public and therefore remain underutilized. In some cases, individual researchers have responded to external requests on a case-by-case basis by providing analytical data or related materials. Nevertheless, reliance on such ad hoc arrangements has made it difficult for research outputs to be widely disseminated throughout the research community, thereby limiting their broader impact on diverse research fields. In addition, in recent years, academic research has

increasingly aligned with the open science movement, creating a growing demand for free access to numerical data obtained through research activities.

The Research and Development Plan of the Geospatial Information Authority of Japan (hereinafter referred to as GSI), against the backdrop of the national open data strategy (Cabinet Office, 2021; Council for the Promotion of Integrated Innovation Strategy, 2021), also stipulates the promotion of strategic sharing and utilization of data generated through research activities at the Research Center (Chapter 6, Section 2) (the Geography and Crustal Dynamics Research Center, the Geospatial Information Authority of Japan, 2024).

In light of these circumstances, we developed and launched a web-based platform to publicly disseminate research data—defined here as research and development outputs and data generated throughout the entire research process—with the aim of promoting appropriate data sharing and reuse. It should be noted that survey results and survey records as defined under the Survey Act are excluded from the

scope of research data made publicly available under this framework.

2. Outline of the research data portal

The Research Center began publishing research data on its website on July 1, 2025 (<https://research-opendata.gsi.go.jp/index.html>) (Fig. 1).

By following the “Research Data” link on the top page, users are directed to a web page that lists all publicly available datasets. As described below, the research data are classified into eight categories: “Observation data”, “Aerial photographs, satellite imagery, etc.”, “Field survey data”, “Analysis results, GIS data, DEM, etc.”, “Software, Programs”, “Report, Thematic map, Figure and Table”, “Data accompanying the paper”, and “Others”.

The web page uses an accordion-style menu layout, and clicking on a category displays a table of research data belonging to that category (Fig. 2). For each dataset, the table provides information such as the year of publication, title, and a brief description.

For each dataset, a dedicated explanatory page is provided, with links available from the dataset list. These pages contain detailed metadata, including an overview, citation instructions, data type, and other relevant information, which users can consult when using the data (Fig. 3). In anticipation of access by international researchers, many of these pages are prepared in both Japanese and English. In addition, these pages also serve as landing pages required for the assignment of Digital Object Identifiers (DOIs), as described below.

In conjunction with the development of the research data portal, the Research Center formally positioned the publication of research data as part of its regular operations in order to ensure continuity. Furthermore, to facilitate smooth data publication by clarifying operational content and responsibilities, internal procedures for publishing research outputs were established, and the “Guidelines for the Publication of Research Data at the Geography and Crustal Dynamics Research Center” were internally formulated. These guidelines define methods for managing research data, procedures and role assignments related to external publication and provision, as well as procedures for the assignment of DOIs. In principle, the use of the published

research data is governed by the “GSI Website Terms of Use” (Geospatial Information Authority of Japan, 2025). Unless otherwise specified that different terms of use apply, the research data are released as “open data”, freely accessible and usable by anyone, and as “free data”, available at no cost, allowing unrestricted use.



Fig. 1 Top page of research data portal.



Fig. 2 Data classification items.

Fig. 3 Example of a landing page.

An overview and specific examples of the classification of publicly available data are presented below (Table 1).

This category contains various types of raw observational data, data to which different corrections have been applied, as well as data obtained through subsequent analytical processes. It includes GNSS observation data, gravity observation data, airborne laser scanning data, terrestrial 3D scanner data, and other datasets acquired as a result of research activities conducted by the Research Center. For example, data collected in observations using compact GNSS receivers conducted on the Boso Peninsula and the Noto Peninsula between 2021 and 2025 are publicly available in RINEX format.

This category contains image data acquired from aerial photographs and artificial satellites. It includes aerial photographs taken from aircraft, as well as visible images, near-infrared images, SAR intensity images, and other imagery acquired by satellites in the course of research activities. Orthoimages generated by applying geometric and radiometric corrections to aerial photographs and satellite imagery are also included in this category.

This category contains data obtained through field surveys. It includes various datasets collected during geological surveys and post-disaster field investigations, such as photographs and positional information documenting terrain changes caused by disasters.

This category contains products derived from analyses conducted on observational data, aerial photographs, satellite imagery, and other datasets collected during research activities. It also includes intermediate products generated during the analysis process. Examples include coordinate values obtained from GNSS analyses, geoid models, DEMs, interferometric SAR images, earthquake source fault

parameters, coordinate transformation parameters, and GIS data. For instance, the site hosts a variety of analytical products such as the improved Japanese gravity geoid model “JGEOID2024” developed by the Geospatial Information Authority of Japan, PPP positioning solutions for the 2024 Noto Peninsula earthquake and the August 8, 2024, Hyuganada earthquake, global terrain classification maps, and surface deformation distribution maps derived from DEM interpretation and PIV analysis for the 2024 Noto Peninsula earthquake. Additionally, results of crustal deformation analyses from SAR data urgently processed for large-scale earthquakes and volcanic events are also included; for example, crustal deformation data associated with the January 7, 2025, Tibet earthquake are publicly available on the site.

3.5 Software, Program

This category contains software and computational programs developed during research activities. For example, programs and pretrained models for automatic feature extraction using AI, as well as computational toolsets for modeling crustal deformation associated with earthquakes and volcanic activity, are publicly available and can be used by researchers.

3.6 Report, Thematic map, Figure and Table

This category contains reports, figures, and other materials compiled during the research process. Examples include lunar topographic maps based on laser altimeter observations from the lunar orbiter “Kaguya,” rapid reports on vertical displacements observed in Wakayamamachi, Suzu City, Ishikawa Prefecture, following the 2024 Noto Peninsula earthquake, and aerial photograph-based maps interpreting cracks around the Futagawa fault zone caused by the 2016 Kumamoto earthquake. This category also includes educational support tools, such as quick-reference tables, in which GSI Maps and related contents are organized and labeled with curriculum guideline codes for each Earth science unit in accordance with the classifications of the 2018 Course of Study.

3.7 Data accompanying the paper

The outcomes of the Research Center’s activities are published not only in reports (such as the Bulletin of the GSI)

but also as academic papers in domestic and international journals. In this category, research data associated with these papers and reports are made publicly available. Examples include crustal deformation data used in publications, parameters of earthquake source fault models obtained through analysis, and terrain classification data derived from DEMs.

3.8 Others

This category contains data that do not fall under the classifications described in Sections 3.1 through 3.7.

Table 1 Classification of research data

Category Name		Description
Observation data		Various raw observational data or data with applied corrections, intended for subsequent analyses.
Aerial photographs, Satellite images, etc.		Image data such as aerial photographs and satellite images.
Field survey data		Data obtained from geological surveys or post-disaster field investigations.
Analysis results, GIS data, DEM, etc.		Data obtained as a result of analyses conducted on observational data, aerial photographs, satellite images, etc.
Software, Program		Software and programs developed during the research process.
Report, Thematic map, Figure and Table		Reports, thematic maps, and figures compiled during the research process.
Data accompanying the paper		Data accompanying academic papers and similar publications.
Others		Items not classified in the above categories.

4. Assignment of Digital Object Identifiers (DOIs)

A portion of the research data has been assigned DOIs. A DOI is an internationally recognized identifier in the academic information field, assigned to digitized scholarly

publications and research data, and standardized by ISO (ISO 26324:2012). By assigning a DOI to content and maintaining accurate metadata, each piece of content can be uniquely identified, and persistent access without the risk of broken links is ensured (Japan Link Center, 2025).

In fiscal year 2022, the GSI joined the domestic DOI registration agency, Japan Link Center (JaLC), as a full member. This allows GSI to assign DOIs to its technical publications and various datasets and register them with JaLC. A DOI consists of a prefix assigned to the organization by the DOI registration agency and a suffix unique to the content, determined by the content-managing organization, formatted as (prefix)/(suffix). For the research data, the suffix “RESEARCH_YYYY_NN” has been adopted, where YYYY indicates the calendar year in which the data were published, and NN is a sequential number for data published within that year. Since GSI has been assigned the DOI prefix 10.57499, a DOI for research data would take the form, for example, 10.57499/RESEARCH_2025_01.

GSI also uses other suffixes for different content: “GSI_GNSS_YYYY_NNN” for GEONET data, “JOURNAL_XXX_NN” for the Journal of the GSI, and “BULLETIN_XXX_NN” for the Bulletin of the GSI. Here, YYYY represents the year of DOI assignment, XXX the volume number, and NN or NNN a sequential number within the year or volume. The suffixes for research data are assigned to avoid overlap with these existing identifiers.

When assigning a DOI to content, a landing page must be prepared. A landing page is the web page to which the DOI redirects when accessed and contains metadata about the content. In establishing procedures for assigning DOIs to research data, the required elements for the landing page are also defined. Specifically, the landing page includes the following: Title, DOI, Authors, Publication date, Publisher, Version and Date, a link to the research data or download page, Abstract, and Correspondence. Additional fields, as needed, include Citation, Resource type, Resource format, Key word, Fund, and Rights. These elements are determined based on the “Guidelines for DOI Registration of Research Data” (Subcommittee for Promoting DOI Registration for Research Data, 2024), referencing metadata elements used in existing portals such as the Geodetic Data Portal of the Geodetic

HOME > Geodata > Observation data and result of the Compact GNSS Observation Equipment

Download Page of Compact GNSS Observation Equipment data

[The Bousou Peninsula](#) [The Noto Peninsula](#)

The Bousou Peninsula

GNSS observation data

- The data was zipped quarterly for the year of observation (File name: yyyy_ddd(1)_ddd(2).zip where yyyy: 4-digit year, ddd(1): start DOY (day of the year), ddd(2): end DOY)
- Contains RINEX observation files and navigation files. File names conform to RINEX short file naming conventions.
- The directory structure is as follows:
yyyy/ddd(1)/ssddd0.yyy.Z, Lfssddd0.yyy.Z
↳ yyyy: 4 digit year ddd: 3 digit DOY Lfss: site ID (LF01-LF30) yy: 2 digit year
↳ [Site ID table \(The Bousou Peninsula\)](#)

Observation year	Period (start DOY - end DOY)	File	Note
2021	001-090	2021_001_090.zip (0.7GB)	LF01-LF10
2021	091-181	2021_091_181.zip (1.4GB)	LF01-LF10
2021	182-273	2021_182_273.zip (1.4GB)	LF01-LF10
2021	274-365	2021_274_365.zip (1.4GB)	LF01-LF10
2022	001-090	2022_001_090.zip (1.4GB)	LF01-LF10
2022	091-181	2022_091_181.zip (1.3GB)	LF01-LF10
2022	182-273	2022_182_273.zip (1.4GB)	LF01-LF10
2022	274-365	2022_274_365.zip (1.5GB)	LF01-LF10
2023	001-090	2023_001_090.zip (3.0GB)	LF01-LF30
2023	091-181	2023_091_181.zip (4.0GB)	LF01-LF30
2023	182-273	2023_182_273.zip (4.1GB)	LF01-LF30
2023	274-365	2023_274_365.zip (4.1GB)	LF01-LF30
2024	001-090	2024_001_090.zip (3.8GB)	LF01-LF30
2024	091-181	2024_091_181.zip (3.8GB)	LF01-LF14, LF16-LF30
2024	182-273	2024_182_273.zip (3.7GB)	LF01-LF14, LF16-LF23, LF25-LF30
2024	274-366	2024_274_366.zip (3.6GB)	LF01-LF14, LF16-LF17, LF19-LF30

Site coordinate

- Time-series file (pos file) of coordinates by year and site were zipped in one file
- The directory structure is as follows:
bousou_pos/yyyy/yyLfss.yyy.pos
↳ yyyy: 4-digit year Lfss: site ID (LF01-LF30) yy: 2-digit year
↳ [Site ID table \(The Bousou Peninsula\)](#)
- File format is same as that of the “daily coordinates of GEONET” file
- Coordinate is aligned to ITRF2014. Geographic coordinate is referenced to GRS80

Download time-series file of coordinate of the Bousou Peninsula: [bousou_pos.zip \(526KB\)](#)

The Noto Peninsula

GNSS observation data

- All data was zipped in one file (File name: noto.zip)
- Contains RINEX observation files and navigation files. File names conform to RINEX short file naming conventions.
- The directory structure is as follows:
noto/yyyy/ddd/ssssddd.yyy.Z
↳ yyyy: 4-digit year ddd: 3-digit day of the year (DOY) ssss: site ID yy: 2-digit year
site ID: 9096, 9097, 9098: Noroshi, NOT1: Shitsura, NOT2: Monzen, NOT3: Akakami
(At observation point Noroshi, GNSS antenna was moved twice within the same site)

Download GNSS observation data file of the Noto Peninsula: [noto.zip \(2.0GB\)](#)

Site coordinate

- Time-series file (pos file) of coordinates by year and site were zipped in one file
- The directory structure is as follows:
noto_pos/yyyy/yyssss.yyy.pos
↳ yyyy: 4-digit year ssss: site ID yy: 2-digit year
site ID: 9096, 9097, 9098: Noroshi, NOT1: Shitsura, NOT2: Monzen, NOT3: Akakami
(At observation point Noroshi, GNSS antenna was moved twice within the same site)
- File format is same as that of the “daily coordinates of GEONET” file
- Coordinate is aligned to ITRF2014. Geographic coordinate is referenced to GRS80

Download time-series file of coordinate of the Noto Peninsula: [noto_pos.zip \(324KB\)](#)

Fig. 4 Example of the data download dedicated page.

Society of Japan. To facilitate the work of content creators and ensure consistent site design, HTML templates and CSS files for landing pages were also prepared.

Users can access metadata for the research data either directly from the landing page or via a linked dedicated data download page (Fig. 4).

For research data without a DOI, explanatory pages following the same format and including the same metadata fields as landing pages have also been created to promote effective use of these datasets.

5. Relation to the FAIR principles

One of the principles expressing appropriate methods for publishing open data is the FAIR principles (Wilkinson et al., 2016). FAIR stands for “Findable, Accessible, Interoperable, and Reusable” and has become widely recognized as an international guideline for data sharing. These principles provide guidance that data and resources should be findable, accessible, interoperable, and reusable, aiming to enhance transparency and reusability of data.

The current initiative to publish research data has been carried out under the philosophy of being open and free, and can be considered highly compatible with the FAIR principles. Various research datasets held by the Research Center are published on a single website with appropriate metadata and DOIs, improving the discoverability of data (Findable), enabling easy access for anyone (Accessible), enhancing interoperability with other datasets and systems through metadata-driven publication (Interoperable), and allowing reuse in accordance with the GSI Website Terms of Use (Reusable).

The assignment of DOIs further reinforces these principles. DOIs provide unique identifiers for resources, making data and publications easier to find (Findable), provide direct links to resources for improved accessibility (Accessible), promote interoperability across different systems through standardized identifiers (Interoperable), and facilitate citation and reference, thereby supporting reuse (Reusable).

In this way, both the research data publication initiative and the DOI assignment practices align closely with the internationally recognized FAIR principles.

6. Concluding remarks

The Research Center has, over the years, acquired a wide range of observational and analytical data through its research activities. While the results of these activities have been published in reports and academic papers, the underlying data itself has not been sufficiently shared or utilized. Against the backdrop of recent advances in open science and the national open data strategy, there is increasing demand for the strategic sharing and use of research data. In response, the Research Center has initiated efforts to make its research data

publicly available.

On July 1, 2025, a dedicated website for research data publication was launched, marking the start of systematic dissemination of diverse research outputs, including observational data, aerial photographs and satellite imagery, field survey data, analysis results and GIS data, software, reports and figures, and data associated with academic papers. Each dataset is accompanied by an explanatory page containing metadata such as overviews and citation instructions, and also serves as a landing page compatible with DOI assignment. In addition, the “Guidelines for the Publication of Research Data at the Geography and Crustal Dynamics Research Center” were established to clarify internal procedures for publishing research outputs, ensuring a sustainable and smooth data dissemination framework.

The published research data are made available, in principle, as open and free data under the GSI Website Terms of Use, allowing anyone to access them at no cost. Some datasets are also assigned DOIs, providing persistent and unique identifiers that enable reliable citation and reference. This enhances the visibility and credibility of the research data and is expected to facilitate their use in academic research and technological development.

From the perspective of the FAIR principles, this initiative improves the findability, accessibility, interoperability, and reusability of the data, aligning with international trends in data sharing. It is expected that the research data accumulated by the Research Center will be widely utilized, contributing to new research and the creation of social value. Moving forward, the Research Center plans to continue publishing newly obtained research data on the website as its research activities progress.

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