

DIGITAL MAP INFORMATION IN JAPAN

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ABSTRACT

Since 1974, the Geographical Survey Institute has been collecting digital information concerning the national land and human activities, that is, coastline, elevation, road and railway, river, political boundary, land use and others for use of administrative planning. GSI has been collecting another type of digital land use data in the metropolitan areas of Tokyo, Osaka and Nagoya. GSI has started a new project on digital map information preparation recently. The aim of the project is to collect the digital data of fundamental categories of 1:25,000 map and to prepare the map data base for coming automated map compilation and production.

OVERVIEW OF DIGITAL MAP INFORMATION COLLECTION AT GSI

The Geographical Survey Institute has a responsibility for preparation and production of national base maps such as 1:25,000 and 1:50,000 scale topographic maps. GSI has been collecting geographical or map information in digital form for over a decade to meet the administrative requirement. In 1974, GSI started the project of preparing the Digital National Land Information and has been collecting various kinds of nationwide digital information concerning the national land and human activities in cooperation with the National Land Agency. Since 1979, GSI has been carrying out the Survey on the Trend of Housing Land Use in collaboration with Economic Affairs Bureau Ministry of Construction. Detailed Digital Land Use Data has been collected through the project for the metropolitan areas of Tokyo, Osaka and Nagoya. According to the 4th Long Term National Survey Plan, GSI started a new project that is, the preparation of Digital Cartographic Data in 1984. The aim of the project is to collect the digital fundamental category data of 1:25,000 scale topographic map and prepare the Digital Cartographic Data Base for coming automated map compilation and production by using computer aided mapping technique. The data related to contour line and political boundary from 1:25,000 scale map sheets have been captured as the first stage of data collection using the Computer aided Cartography Processing System introduced for digitizing and editing map information.

DIGITAL NATIONAL LAND INFORMATION

Outline of the project

Japan is one of the most populated countries in the world with the area of 380,000 sq.km and the population of more than 11 million. The promotion of the effective use of the land resources has become one of the most important administrative tasks in recent years. In order to make the national land plans such as the Comprehensive National Land Development Plan, holding good balance between progress of human activities and conservation of the land resources, it is necessary to prepare various kinds of information on the national land systematically and to establish the scientific method of planning. As one system of the information collection, GSI started the project of collecting the Digital National Land Information in cooperation with the National Land Agency in 1974. Various categories of information on the national land and human activities have been collected through the project in digital form since then and with the expansion of utilization, renewal and maintenance of the information have been mainly conducted recently.

Standard regional grid and mesh code system

The standard regional grid and mesh code system is adopted to express the locations of the Digital National Land Information. This system is based on longitude and latitude coordinates and used for statistical research. Fig.1 shows the concept of the standard regional grid and mesh code system. The whole land of Japan is divided into more than 100 areas of the primary mesh by meridian lines with 1 degree and parallel lines with 40 minutes. The primary mesh corresponds to a sheet area of 1:200,000 scale district map. The secondary mesh is defined by dividing the primary mesh area into 8x8 portions corresponding to 1:25,000 scale topographic map sheet area. And the tertiary mesh is defined by dividing the secondary mesh into 10x10 small portions. The area of a tertiary mesh is close to 1 sq.km in the central part of Japan and becomes smaller with higher latitude. 1/4 or 1/10 division meshes of the tertiary mesh are used in some cases. In this system grid base (mesh) data such as elevation and land use data described with corresponding mesh code, and positions of point-type and line-type data are described by the normalized coordinates within the corresponding secondary mesh.

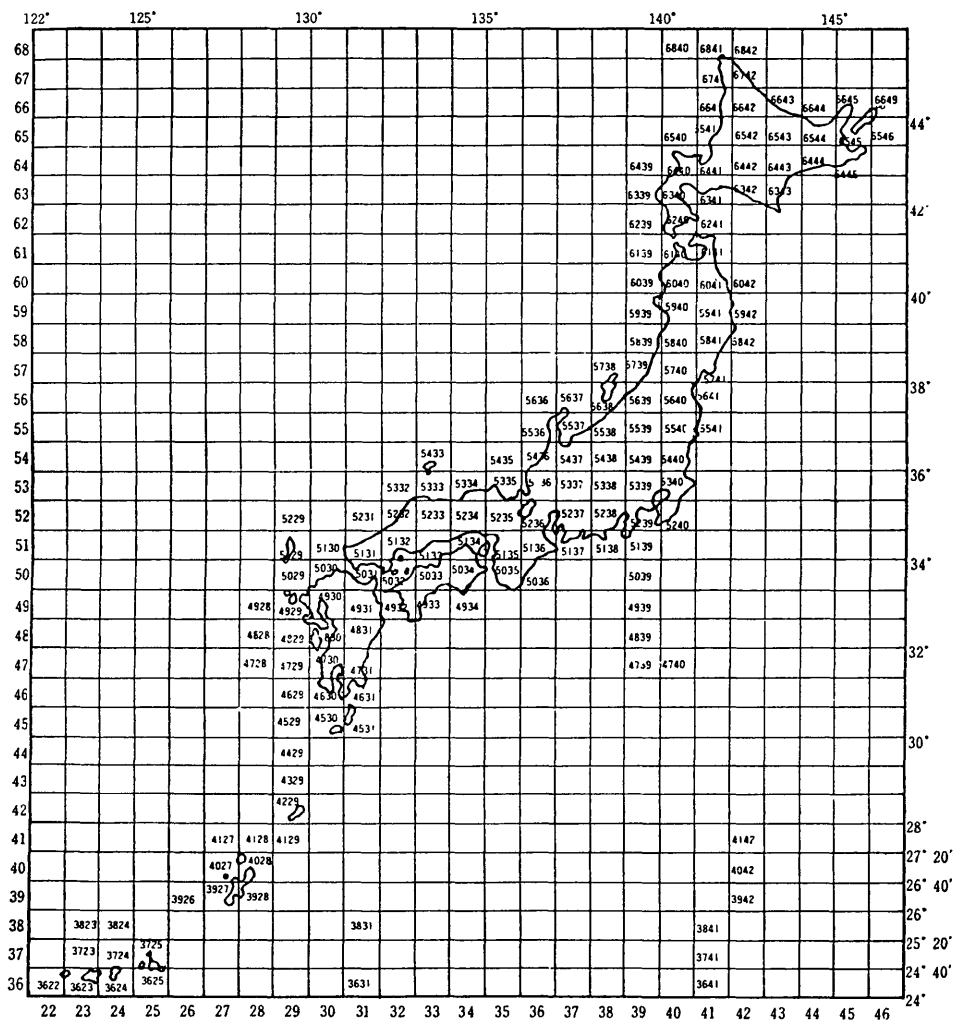
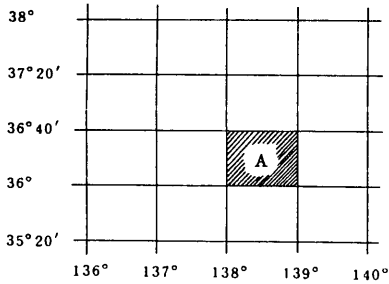


Fig.1 The concept of the standard regional grid and mesh code system.



The primary mesh

Longitudinal length is 1°
 Latitudinal length is $40'$
 The area is close to 6400 sq.km

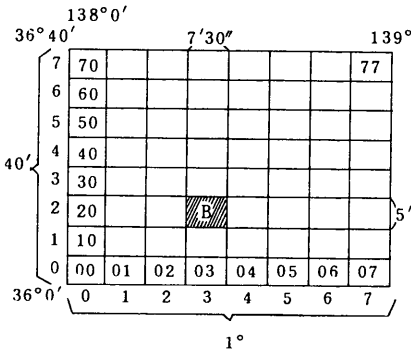
An example of encoding for mesh A, 5438

$$54 = 36 \times 1.5$$

└─northern latitude

$$38 = 138 - 100$$

└─eastern longitude



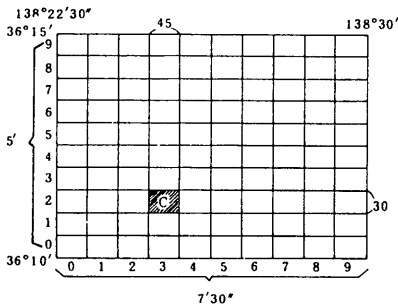
The secondary mesh

Longitudinal length is $7'30''$
 Latitudinal length is $5'$
 The area is close to 100 sq. km

An example of encoding for mesh B,

$$5438 - 23$$

└─primary mesh code



The tertiary mesh

Longitudinal length is $45''$
 Latitudinal length is $30''$
 The area is close to 1 sq.km

An example of encoding for mesh C,

$$5438 - 23 - 23$$

└─primary mesh code

└─Secondary mesh code

Collection of the Digital National Land Information

various categories of information have been captured manually or automatically by using digitizers, color scanner and others. As the original materials for digitizing, 1:25,000 and 1:50,000 scale topographic maps and other thematic maps on scales of 1:50,000, 1:200,000 and others were used with associated documents. The items listed below are some of the data prepared in the project.

Data items	Expression of location and attribute data
Coast line	Coordinates of coastline. sea-shore condition
Elevation	Elevation at each 1/4 division of tertiary mesh
Lake, pond	Coordinates of water edge line. lake code
Municipality	Coordinates of political boundary
River, basin	Coordinates of basin boundary, and center line of river flow
Land use	Land use of 1/10 division of tertiary mesh
Road, railway	Coordinates of center line, road and railway codes, tunnel bridge
Legally designated zone	Coordinates of zone boundary, classification of zone. Designation of 1/10 division of tertiary mesh
Land classification	Land classification of tertiary mesh
Cultural property	Coordinates of place, classification of property
Public facility	Coordinates of place, name, address, classification
Published land price	Coordinates of published standard point, land price. landuse

These data are filed according to every item in magnetic tape and available to national and local governments, universities and research institutes. The Digital National Land Information has been used not only for national land planning but also for various applied fields, namely, land use planning, city planning, water use planning, environmental assessment, simulation of polluted air diffusion, disaster hazard assessment and others.

DETAILED DIGITAL LAND USE DATA

Survey on the Trend of Housing Land Use

GSI started the project of the Survey on the Trend of Housing Land Use in 1981 and has been collecting the Detailed Digital Land Use Data. Owing to the recent imbalance between the supply and demand of housing lots, problems

such as steep rise of land prices and disordered development, of very small residential lots have been growing in metropolitan areas in Japan. The necessity of the preparation of detailed information on housing land use have been pointed out to take effective administrative measures for coping with this situation. GSI has been carrying out the survey to prepare information in collaboration with Economic Affairs Bureau of the Ministry of Construction. The aim of the survey is to prepare 10m grid base (mesh) land use data at different periods with associated data and to classify and analyze the state and change of housing land use. The survey was carried out for Tokyo metropolitan area of 7500 sq.km in 1981 and 1982. Osaka area of about 3300 sq.km was surveyed in 1983. and Nagoya area of about 2800 sq.km in 1984. The survey for Tokyo area has been resumed to get time series information.

Classification

Categories of land use. Land use is classified into 15 categories according to the purpose of the survey, focusing on housing land use.

- 1) Forest and wasteland
- 2) Paddy field
- 3) Other agricultural field
- 4) Land under construction
- 5) Open space
- 6) Industrial area
- 7) Residential area for ordinary houses less than three stories
- 8) Residential area for crowded houses less than three stories
- 9) Residential area for higher stories
- 10) Commercial and business area
- 11) Road
- 12) Park, green space
- 13) Area for other public facilities
- 14) River, lake and other water body
- 15) Others

Associated items. For classification and analyzation of land use data, the following associated data have been prepared in the case of the survey for Tokyo area for instance.

- 1) Municipality : City ward or town
- 2) Distance belt : The distance from Tokyo station of the Japan National Railway (JNR)
- 3) Time belt : Traveling time from the nearest JNR station on the Yamate Loop Line
- 4) DID : densely inhabited district
- 5) Area for city planning
- 6) Regulation on land use : National forest, area for prevention of landslide, green conservation area, etc
- 7) Elevation
- 8) Use zone and bulk ratio prescribed by the City

Planning Act

9) Land price

Collection of the Detailed Digital Land Use Data

In the survey for the Tokyo area conducted in 1981 and 1982 for instance, color aerial photographs taken at the different periods of 1974 and 1979 were used for interpretation to determine each land use. To digitize land use maps, 15 land use categories were colored on miler sheets overlaid upon 1:10,000 scale maps and then digitized by color scanner. Detailed Digital Land Use Data corresponding to 10m grid data on the ground were produced through some editing and compiling process. Other data of the associated items were also collected and compiled into mesh data of corresponding 10m or 100m grid. These mesh data have been filed in magnetic tapes according to every item. In the data collection, another grid and mesh code system from the standard regional grid and mesh code system is adopted. This system is based on the local plane rectangular coordinates and the area of each mesh can be the same. These data are also available in the same manner with the Digital National Land Information.

DIGITAL CARTOGRAPHIC DATA FROM 1:25,000 SCALE MAP

The concept of the data collection

GSI started the new project on digital map information preparation in 1984, according to the 4th Long Term National Survey Program. Through the project, data of fundamental categories of 1:25,000 scale topographic map, the largest scale base map covering the whole national land with about 4400 sheets, are to be digitized from the map sheets with their contents and locational accuracy maintained. These categories are coastline, river and lake, contour line, road and railway, political boundary and others. The goal of the project is to prepare the Digital Cartographic Data Base from 1:25,000 scale maps for automated map compilation and map production and for service of digital map information. There are some requirements for the Digital Cartographic Data. They are as follows.

By using the data base, it is possible

- 1) to reproduce 1:25,000 scale topographic map,
- 2) to compiled 1:50,000 scale topographic map and other smaller scale maps.
- 3) to make thematic maps and other maps of various style flexibly, and
- 4) to carry out spatial data analysis as geographical information.

Data collection

In 1984-1985, Computer aided Cartography Processing System was introduced for digitizing and editing the cartography data at GSI. By using the system, digitizing data related to political boundary and contour line has been continued as the first stage of the data preparation. To meet the above requirements, very careful attention must be paid to the locational accuracy of captured data. In the case of the data collection of contour line for instance, exact center of each contour line is digitized by the drum type scanner with the pitch of $50\mu\text{m}$, and filed in vector form with the corresponding elevation value. At the same time, symbols representing precipice, bank and others and numeral figures of elevation value are divided automatically and stored into the different file. GSI, on the other hand, continues a research on another method of digital data collection at the early stage of photo plotting. In the future, Digital Cartographic Data should be collected by the new method as well as by the present method digitizing from map sheets.

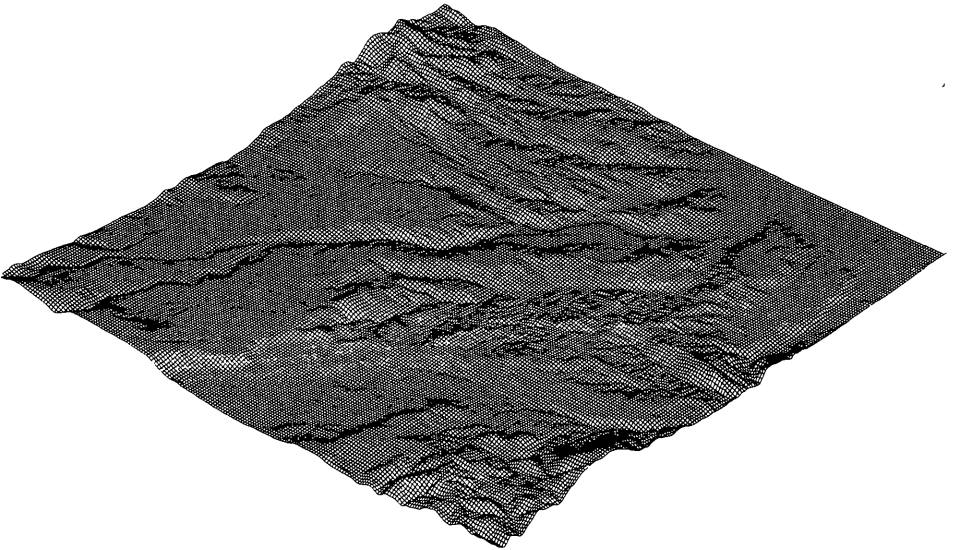


Fig.2 Bird's eye view map of mountainous area by 50m grid base elevation data compiled from the Digital Cartographic Data (corresponding to a sheet area of 1:25,000 scale map of about 10kmx 10km)