DEVELOPMENT AND APPLICATION
OF CHINA VECTOR DATASETS OF GLOBAL MAP

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Abstract.

Global Map is a group of global geographic data sets of known and verified quality, with consistent specifications which will be open to the public, considered a common asset of mankind and distributed worldwide at marginal cost (ISCGM, 1996).

In this paper the basic data sources for the China vector datasets of the Global Map are introduced. The development process of the vector datasets in flow chart. The paper also reviews some applications of 1: 1,000,000 datasets in China. Some issues regarding Global Mapping are discussed in the paper, such as development of criteria for cartographic feature selection, and addition of some other contents to the Global Map.

KEY WORDS   China datasets   Global Map   Development process

1   Data Sources

The main vector data source for the China data set of Global Map is the 1:1,000,000 Digital Map of China (International Version), which comes from the 1:1,000,000 topographic maps, the 1:1,000,000 database of the National Fundamental Geographic Information System and the 1:1,000,000 Map of China published in 1997.

The 1:1,000,000 Topographic Maps

The 1:1,000,000 topographic maps were compiled by the State Bureau of Surveying and Mapping of China in the 1970s. There are 77 map sheets in the series. Each map sheet covers six degrees in longitude by four degrees in latitude (as shown in Fig. 1).

E120 E126 E132

E84 E90   E114 N51 N52   E138

E78   M45   E96   M50 M51 M52 M53   N48

E72 L44 L45 L46   E102   L49 L50 L51 L52 L53   N44

N40 K43 K44 K45 K46 K47 K48 K49 K50 K51 K52   N40

N36 J43 J44 J45 J46 J47 J48 J49 J50 J51   N36

N32 I43 I44 I45 I46 I47 I48 I49 I50 I51 I52   N32

N28   H44 H45 H46 H47 H48 H49 H50 H51 H52   N28

N24   G45 G46 G47 G48 G49 G50 G51 G52   N24

N20   F47 F48 F49 F50 F51   N20

N16   E48 E49 E50 E51   N16

N12   D49 D50   N12

N8   C49 C50   N8

N4   B49 B50   N4

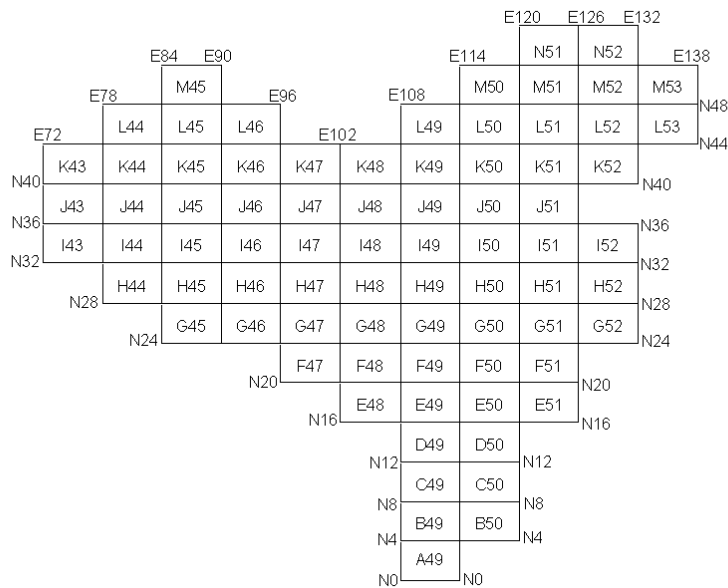N0   A49   N0

Fig. 1   Index Map

The 1:1,000,000 topographic maps is the smallest scale in the national basic topographic map series in China, which gives a comprehensive reflection of the natural, social and economic conditions of the whole country and forms a fundamental geographic data source.

The 1:1,000,000 Database of the National Fundamental Geographic Information System

Since the middle of 1980s, the State Bureau of Surveying and Mapping of China has began to build the National Fundamental Geographic Information System (NFGIS). Included in the NFGIS are the topographic database, the geographic name database, the geodetic database and the gravity database. The main data source of the 1:1,000,000 database is the 1:1,000,000 topographic maps. Before digitization, the transportation, administrative boundaries, residential centers of the 1:1,000,000 topographic maps were updated to June 1990.

The 1:1,000,000 database includes 77 tiles. The size of each tile is the same as that of the 1:1,000,000 topographic maps (as shown in Fig.1). There are over ten layers in the database. They are boundary, residence (point layer and area layer), railway, road, trail, hydrography (point, line layer and area layer), contour, vegetation and other point features and line features.

The 1:1,000,000 Digital Map of China (International Version)

The 1:1,000,000 Digital Map of China (International Version) is a digital cartographic product developed from the 1:1,000,000 database of the National Fundamental Geographic Information System by the State Bureau of Surveying and Mapping of China, and published in 1998. Most of the data is current to June 1990, while those of Chongqing Municipality and Hong Kong Special Administrative Region are up to 1998.

In addition to vector graphical data which is in ARC/INFO format, the 1:1,000,000 Digital Map of China (International Version) also contains overview maps introducing China's overall natural geography, administrative division, transportation system, tourism industry, relevant attribute data and images. A tool for data display, query and selection is provided for the users.

The 1:1,000,000 Digital Map of China (International Version) is also divided into 77 tiles. The size of each tile is the same as that of the 1:1,000,000 topographic maps (as shown in Fig.1). The layers are as follows.

Layer	Contents
Administrative areas	Political boundaries, coastlines, islands
Populated places	Cities with population greater than 500,000 or places with population less than 500,000
Railroads	Railroads, railroad bridge, etc.
Roads	Roads, trails, road bridges, etc.
Cultural features	Natural reserves, the Great Wall, temples, pagodas, etc.
Hydrography	Streams, lakes, reservoirs, canals, etc. Wells, springs, etc.
Hypsography	Contours, elevation points
Vegetation	Forests, grasslands, Protected forests (depicted not to scale)
Land cover	Desert, saline-alkali etc.
Other natural features	Volcanoes, sink holes, etc.
Bathymetry	Bathymetric contours, bathymetric points, etc.
Other ocean features	Navigation lines, rock, etc.
Geographic grid	Meridians and parallels, the Tropic of Cancer

Table 1.   Layers in the 1:1,000,000 Digital Map of China (International Version)

The 1:1,000,000 Digital Map of China (International Version) is the basic vector data source for the China datasets of Global Map.

The 1:1,000,000 Map of China

The 1:1,000,000 Map of China was compiled by the State Bureau of Surveying and Mapping of China and was published by the China Cartographic Publishing House in 1997. The Map is the first color hill shading map series. Each map sheet covers the same area as that of the 1:1,000,000 topographic maps.

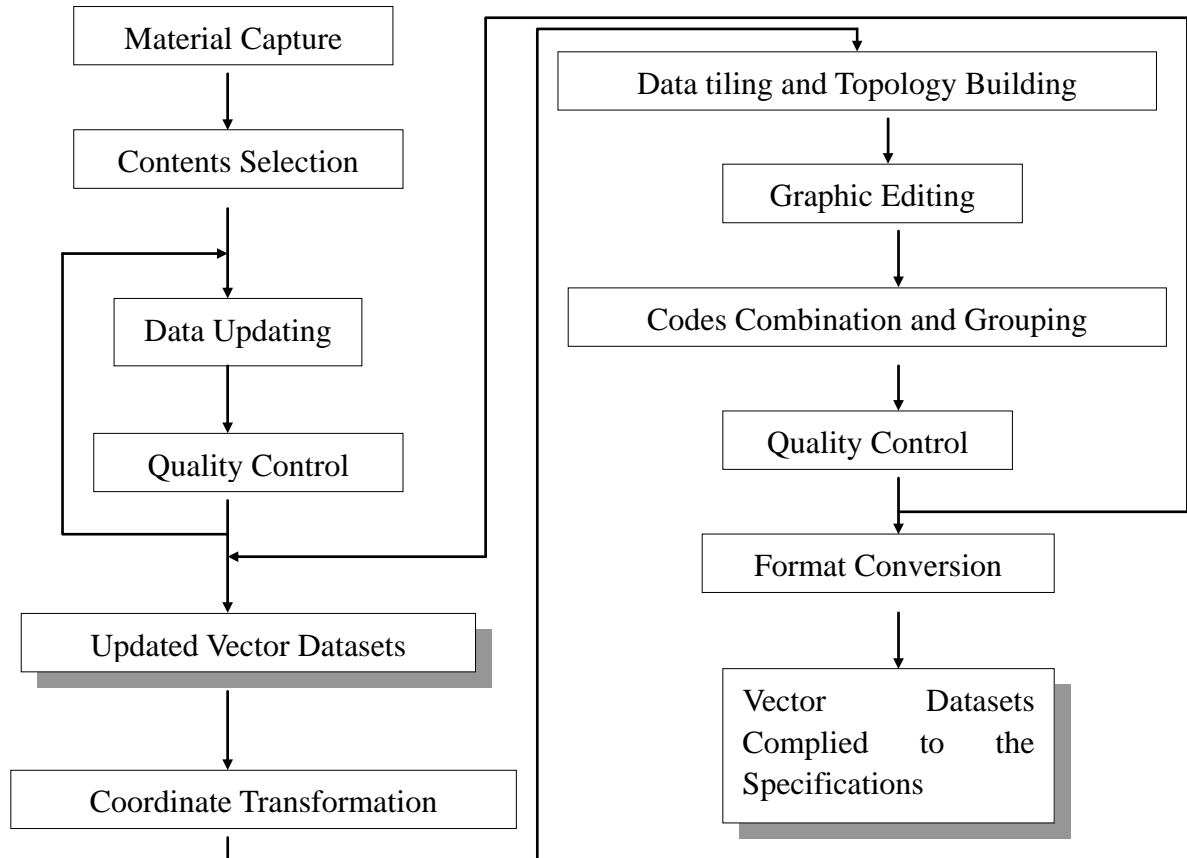The 1:1,000,000 Map of China is one of the data sources for the China datasets of Global Map.

2 Datasets Development

2.1 General Methodology

To develop the China Datasets of Global Map, Global Map Specifications is analyzed first. Differences between existing data and those required by Global Map are identified. The differences are mainly in classification and codes, data layers, coordinate systems, map sheet size, and data format. Hence, a comparison table of classification and codes is built. The methods to build and reorganize data are experimented and tested. The vector data is updated before reorganization. Data quality control is performed throughout the whole process.
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2.2 Data Processing Flow

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┌─────────────────────┐              ┌─────────────────────────────────────────┐
│   Material Capture  │              │    Data tiling and Topology Building     │
└─────────────────────┘              └─────────────────────────────────────────┘
          │                                              │
          ▼                                              ▼
┌─────────────────────┐                      ┌─────────────────────┐
│  Contents Selection │                      │   Graphic Editing   │
└─────────────────────┘                      └─────────────────────┘
          │                                              │
          ▼                                              ▼
┌─────────────────────┐              ┌─────────────────────────────────────────┐
│    Data Updating    │              │    Codes Combination and Grouping        │
└─────────────────────┘              └─────────────────────────────────────────┘
          │                                              │
          ▼                                              ▼
┌─────────────────────┐                      ┌─────────────────────┐
│   Quality Control   │                      │   Quality Control   │
└─────────────────────┘                      └─────────────────────┘
          │                                              │
          ▼                                              ▼
┌─────────────────────┐                      ┌─────────────────────┐
│ Updated Vector Datasets │                  │  Format Conversion  │
└─────────────────────┘                      └─────────────────────┘
          │                                              │
          ▼                                              ▼
┌─────────────────────────┐              ┌─────────────────────────┐
│ Coordinate Transformation │            │  Vector Datasets        │
└─────────────────────────┘              │  Complied to the        │
                                         │  Specifications         │
                                         └─────────────────────────┘
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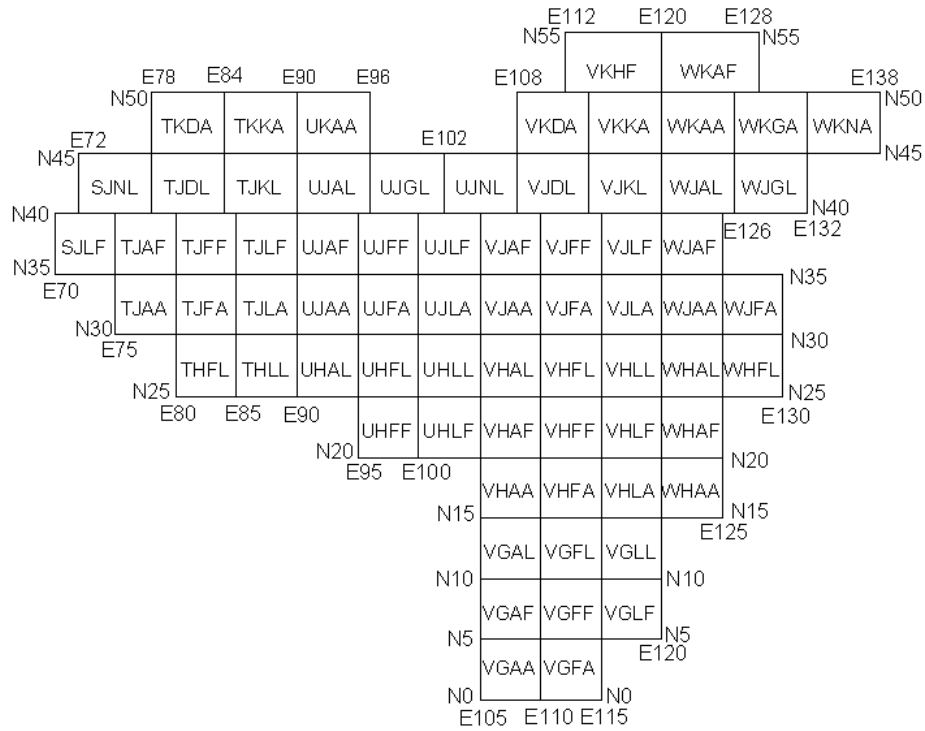
Fig. 2 Index Map for China datasets of Globe Map

2.3 Data Updating

The vector data is updated before reorganization. Administrative Boundaries, Transportation, Population Centers of 1:1,000,000 information are updated, according to National Standard "Codes for the administrative divisions of the People's Republic of China" and "Brief manual for the administrative divisions of the People's Republic of China" 1999, and other new cartographic documents.

2.4 Result

In the end of 2000, we have almost accomplished China datasets of Globe Map, according to the Global Mapping Specifications. There are 70 tiles in China datasets of Globe Map. The format of the vector datasets is arc/info format according to Data Dictionary for Global Map. Generally speaking, China datasets of Globe Map are updated to 1998.

3 Applications

3.1 In Government Decision Making

The 1:1,000,000 vector datasets has been applied in central and provincial governments

of China as positioning basis for government office automation systems, which integrate and analyze spatial and non-spatial data to help with government decision making. Examples are buffer analysis through combination of social-economic and transportation information, and evaluation of airport site selection.

3.2 In Environmental Protection

The 1:1,000,000 vector datasets has been used in the establishment of the Environmental GIS for Minjiang River Drainage Area of Fujian Province. This system provides not only fundamental geographic and social-economic information of the Province, but also boundary of Minjiang River drainage area, hydrologic monitoring positions, dam sites, pollution sources and profile distribution of water quality monitoring. It has the function of query for fundamental information on dams, which includes name, area of water surface, height of dam, normal water volume, annual amount of power generation, etc. It can display the annual amount of used water discharged from the cities in the drainage area, and the distribution of all pollution generating industries in the drainage area, such as paper making, chemistry, brewage, metallurgy, and etc.

3.3 In Disaster Prevention and Alleviation

A flood control GIS has been jointly established by the State Bureau of Surveying and Mapping, National Headquarters for Flood and Drought Control, Ministry of Water Resources, China Meteorological Bureau, and the National Center for Remote Sensing, to provide flood-related information to the government in the flood season. The system consists of 1:4,000,000 and 1:1,000,000 fundamental spatial information, meteorological information such as cloud images, rainfalls, rainfall forecast and typhoons, flood information such as reservoirs and hydrologic stations, water conditions and remote sensed data. Through the combination of vector data, DEM and other social-economic data, potential flooding areas can be forecasted and losses can be evaluated.

3.4 Potential Applications

The 1:1,000,000 datasets has been widely used in many fields in China. We can predict that the Global Map will contribute to the solution of global issues in resources, environment, population and disaster alleviation and thus for the global sustainable development. It will also be used in many areas, such as agriculture, forestry, water conservancy, geology, energy, land management, oceanography, environment protection, surveying and mapping, disaster monitoring, etc.

The first edition of Global Map will help us to better understand our planet, its natural,

social and economic situations. As the Global Map Project continues and the datasets is updated every 5 years, it can help us to simulate the global changes, understand the development of residential areas and transportation, changes of forests and deserts, and the relations between human beings and the nature. The better understanding of the Earth surface will then assist in scientific decision-making processes.

4   Some Related Issues

4.1   Selection Criteria for Cartographic Features

To solve global environmental problems, alleviate natural disasters and realize sustainable development, we need the general representation criteria for cartographic features in the Global Map. On the whole, the Specifications of Global Map is comprehensive, detailed and operational. But it needs to be enhanced in the aspect of representation criteria for cartographic features. The following two figures exemplify criteria differences through comparison of the China datasets of Global Map and the Digital Chart of the World (DCW).   Figure 3 shows the difference in selection criteria for rivers between the China datasets and DCW (longitude from 115 to 117 degrees and latitude from 38 to 40 degrees). Figure 4 shows the difference in selection criteria for population centers (area) in the same area between the China datasets and DCW.
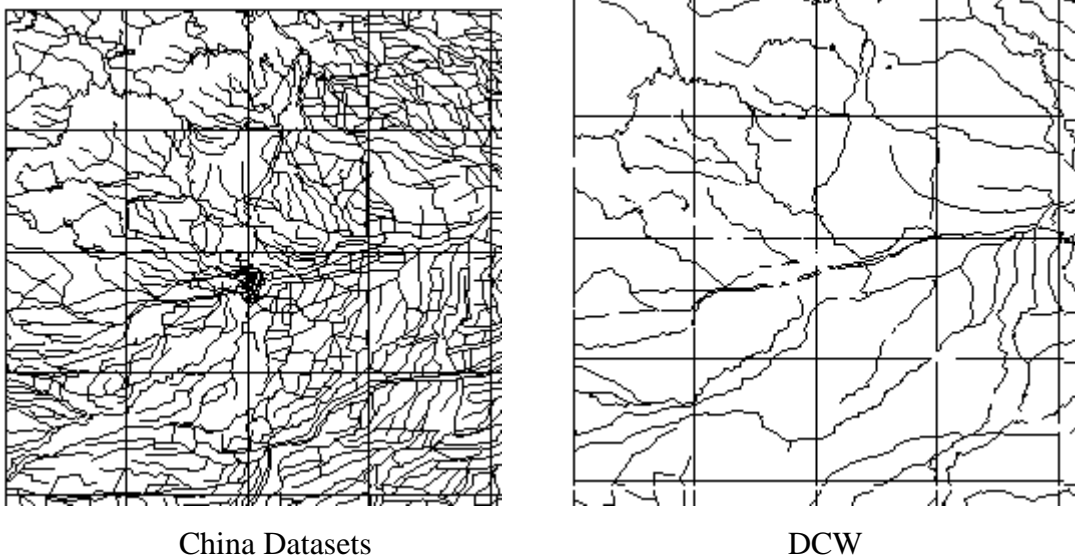

China Datasets   DCW
Fig. 3   Comparison of China datasets and DCW for rivers

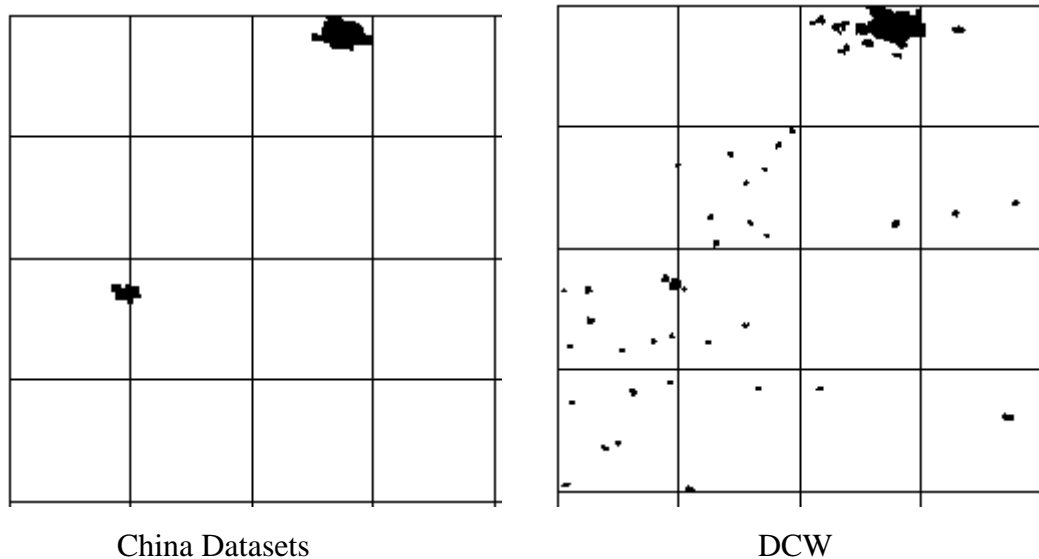China Datasets   DCW

Fig. 4 Comparison of China datasets and DCW for population centers (area)

In conclusion, it is necessary to establish selection criteria for cartographic features of Global Map.

4.2 Addition to Global Map Contents

We could consider adding one or two attribute items for every feature. One attribute item keeps the classification and codes for each nation. The other identifies an entity. For example, the codes for administrative divisions can be put in the item at the administrative boundary layer, and levels of population centers can be put in the item at the population center layer.

Features and codes of reef and shoal should be added to the Global Map Specifications, for representation of a nation's sovereignty.

4.3 Datasets distribution

According to the requirement of the International Steering Committee for Global Mapping, the countries participating in the Global Map project have finished the first edition of Global Map on the basis of the Global Map Specifications. We wish the National Mapping Organizations would release the data to the world in possible means as soon as possible.

5   References

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