

Present Status of the Global Map Development

Yoshikazu Fukushima, Hiromichi Maruyama
Geographical Survey Institute

1. Introduction

Since the 1972 United Nations Conference on the Human Environment, there has been a growing concern, commonly shared by the people in the world, for the global environment. Contrary to this people's concern, little improvement has been made on the global environment. The 1992 United Nations Conference on Environment and Development (UNCED) recognized that the increasingly serious environmental and developmental problems facing the world require global solutions, and that solutions to these problems require cooperation between nations and between all sectors of society. One of the outcomes of UNCED was Agenda 21 which specifies an action plan for all countries to achieve sustainable development. Eight chapters of Agenda 21, especially Chapter 40 on "Information for Decision Making," describe the need of geographic information for sustainable development.

However, currently available geographic information of scientific quality is still insufficient to provide adequate understanding of actual state of the global environment (Estes and Mooneyhan, 1994). Because of the availability of road maps, colorful pictures of world maps with topographic information and other cartographic products, people tend to think that important, accurate geographic information must have been developed by somebody else and such information must be available somewhere and easily accessible.

Thanks to advances in technologies like satellite remote sensing, geographic information systems, and global positioning systems including computers for large data processing and storage in recent years, development of consistent global geospatial information has become realistic. Actually, some organizations, in cooperation with other countries, have been successful in developing global geospatial information in a relatively short period of time (Geographical Survey Institute, 1996; ISCGM, 1996b). Yet only a limited number of countries and organizations are involved in these activities, and there is still no mechanism to ensure the development and maintenance of consistent, accurate, global geospatial information, and to make such information available and accessible to the public. Without such a mechanism, monitoring the global environment and detecting global change as well as encouraging economic growth within the context of sustainable development would not be attainable.

In order to realize the mechanism, the concept of Global Mapping was developed in 1992 by the Ministry of Construction (MOC) and the Geographical Survey Institute (GSI) of Japan (Geographical Survey Institute, 1996). This paper first summarizes the concept of Global Mapping and the related activities conducted by the GSI, then describes the present status of the Global Map Development including the specifications of the Global Map and data development in South East Asia.

2. Global Map Concept

The International Steering Committee for Global Mapping (ISCGM) defined Global Map as 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, 1996a). This definition clarifies three basic and important ideas about Global Map: i) global coverage; ii) consistent specifications; and iii)

open to the public and distributed worldwide at marginal cost.

i) Global coverage

Most countries have national mapping organizations for national mapping programs to ensure base map coverage of their countries. Likewise, it is necessary to have global coverage of geospatial information to provide a baseline data sets of our planet.

i) Consistent specifications

Better understanding of the earth sometimes requires direct comparison between different parts of the world. However, if the geodetic datum, mapping accuracy, classification criteria, etc. are not consistent worldwide, accurate understanding of the state of the earth may not be realized. For example, total area of forest or desert would be different, if the classification criteria are not consistent between countries or regions. To detect changes of the earth, frequent update of the data is also important. As for spatial resolution, Global Map has one kilometer resolution on the ground.

iii) Open to the public and distributed worldwide at marginal cost

Even though global geospatial information is developed with consistent specifications, it would be almost useless unless it is made widely available to the international community and used among different sectors of the society. There exist a few data sets whose distribution is prohibited or limited to a specific community due to national security, political sensitivities and other reasons. Similar to the idea of national digital geospatial data framework, Global Map should be open to the public and distributed at marginal cost. The spatial resolution of one kilometer on the ground would cause little concern for national security, as we are anticipating sub-meter pixel resolution imagery from commercial high resolution satellites.

3. History of the Concept and Activities

The idea of Global Mapping, including the establishment of an international body for Global Mapping, was first conceived by MOC and GSI in 1992 as one of the measures of the Ministry for global issues (Geographical Survey Institute, 1996). Since cooperation between all countries and related international organizations in the world are needed for the Global Map development, MOC and GSI have been promoting this Global Map concept at the following academic and UN conferences:

- 1992
 - the Thirteenth Asian Conference on Remote Sensing.
 - the Working Group on Data Use of the Committee on Earth Observation Satellites (CEOS).
- 1993
 - the Fifth United Nations Regional Cartographic Conference for the Americas.
- 1994
 - the U.S.-Japan Framework for New Economic Partnership.
 - the Thirteenth United Nations Regional Cartographic Conference for Asia and the Pacific. Promotion of geographical information exchange was resolved.
 - the International Symposium on Core Data Needs for Environmental Assessment and Sustainable Development Strategies organized by the United Nations Environmental Programme and the United Nations Development Programme. Ten "core" geospatial data types were listed at this Symposium to be developed with top priority (Estes, et al., 1994).
 - the Cambridge Conference for National Mapping Organizations (Cambridge Conference).
 - the International Conference Concerning the Establishment of the Permanent Committee on GIS Infrastructure for Asia and the Pacific.
 - the Seventeenth Conference of International Cartographic Association (ICA).

- 1997
- the Fourteenth UN Regional Cartographic Conference for Asia and the Pacific. Development of the Global Map was resolved.
 - the Sixth United Nations Regional Cartographic Conference for the Americas. Development of the Global Map was resolved.
 - the Fifth session of Committee on Sustainable Development. The executive summary of "Interregional Seminar on Global Mapping for the Implementation of Multinational Environmental Agreements" was submitted.
 - the Special Session of the United Nations General Assembly. The executive summary of the above seminar was submitted. The adopted document of the Special Session "Programme for the Further Implementation of Agenda 21" refers to Global Mapping in its Paragraph 112.

In addition, GSI organized the First International Workshop on Global Mapping in Izumo, Japan (Izumo Workshop) in November 1994. At this workshop, delegates from mapping organizations from fourteen countries and one international organization reached a number of resolutions regarding ways to promote international cooperation in the development of Global Mapping. Delegates agreed that:

- Action should be taken to achieve the development of Global Mapping by the year 2000;
- Ways must be found to encourage scientific and technological development needed to use data more efficiently;
- A need exists for and ways must be found to provide technical and economic support to developing countries; and,
- There is a need to establish an international steering committee to coordinate the Global Map development preparatory activities and the development and encouragement of this work.

To advance and implement the resolutions of the Izumo Workshop, the Second International Workshop on Global Mapping was held in Tsukuba in February 1996. During the Second Workshop, the International Steering Committee for Global Mapping (ISCGM), which consists of heads and experts of National Mapping Organizations and related international organizations, was established. The primary purpose of ISCGM is to examine measures that concerned national, regional and international organizations can take to foster the development of Global Mapping in order to facilitate the implementation of global agreements and conventions for environmental protection as well as the mitigation of natural disasters and to encourage economic growth within the context of sustainable development (ISCGM, 1996). GSI was designated as the Secretariat of ISCGM.

Based on the resolution of the Izumo Workshop regarding the Global Map development by the year 2000, an idea of phased approach was introduced at the First ISCGM meeting held during the Second Workshop (Geographical Survey Institute, 1996). The first phase of the data development focuses on employing existing global or regional geographic information through mutual information exchange between international agencies and organizations in different countries, and by voluntary efforts of filling in blank areas to complete the Global Map by 2000. In this case, the three basic principles of the Global Map, (i) total global coverage, (ii) consistent specifications, and (iii) open availability (no restrictions, marginal cost) may not be completely realized, but this approach is considered most realistic. Subsequent phases of the Global Map development will include revisions to detect/highlight environmental changes.

To further advance the idea of Global Mapping, "Interregional Seminar on Global Mapping for the Implementation of Multinational Environmental Agreements" was held in Santa Barbara, California in November 1996 under the joint auspices of the United Nations, the University of California at Santa Barbara and GSI. The

Seminar adopted "Santa Barbara Statement on Global Mapping for Implementation of Agenda 21" (Santa Barbara Statement) with nine recommendations including the following items (ISCGM, 1996c):

- i) A Global Mapping Forum must be created bringing data users and providers together to facilitate creation of Global Spatial Data Infrastructure (GSDI);
- ii) Agencies implementing Agenda 21 accords should precisely define their spatial data and information requirements for implementation, compliance, and monitoring with the assistance of expert groups (e.g. ISCGM). These requirements should be included as priorities of the GSDI;
- iii) Overall Global Map development should be fostered under the umbrella of the United Nations and should recognize initiatives being taken at national, regional and global levels; and
- iv) These recommendations should be embodied in a report to be presented to the Special Session of the United Nations General Assembly on the Implementation of Agenda 21 in 1997.

Regarding the last item, the executive summary of this Seminar, including the Santa Barbara Statement, was actually submitted jointly by the United States and Japan to the Special Session of the United Nations General Assembly on the Implementation of Agenda 21, as written already.

Global Mapping Forum, which was recommended in the Santa Barbara Statement, was held in Gifu, Japan in November 1997, and in Sioux Falls in June 1998. These forums gave good opportunities to exchange views and opinions on the Global Map between data users and providers. The meetings of the ISCGM were held just after the forums, and the specifications of the Global Map and the invitation to the Global Mapping Project for the national mapping agencies in the world were discussed (ISCGM, 1997,1998). These issues are the first issues to be determined in the implementation stage of the project.

4. Specifications of the Global Map

It is necessary to determine the specifications for starting the development of global mapping data. The specifications were focused on the implementation of the first phase of the data development where existing global or regional geographic information is used as much as possible.

4.1 Data Sources

The following data are used as data sources for the Global Map development.

- i) Global 30 Arc Second Elevation Data Set (GTOPO30), which has prepared by USGS, EROS Data Center and other organizations : elevation.
- ii) Global Land Cover Characterization Database, which has prepared by USGS, EROS Data Center, Univ. of Nebraska-Lincoln, and EC Joint Research Center : land use / cover and vegetation.
- iii) VMAP Level 0, which has prepared by NIMA : drainage system, transportation, boundaries, etc.

Besides these, existing small scale topographic maps are important data source.

4.2 Data Model

The Global Map covers whole land area of the earth at the scale of 1:1 million, or equivalently one km resolution. It consists of both vector layers and raster layers. Vector layers are "Transportation", "Boundaries", "Drainage", and "Population Centers." "Transportation" layer include railroad, road and trail as mandatory. "Boundaries" includes administrative boundaries under international boundaries as mandatory. "Drainage" includes rivers and lakes as mandatory. "Population centers" includes Built-up area, but all features are optional. Elevation, land use / cover and vegetation are stored as raster layers

Data in the both vector and raster layers are described based on the horizontal coordinate system in latitude and longitude referenced to ITRF1994 and GRS80.

4.3 Tiling

The Global Map covers the land area extending entire globe, thus tiling is required to deal with it efficiently. The tiling system is that used for VMAP Level 0. Tile size in longitude direction increases as latitude increases in order to avoid the big difference in the dimension of the tile on the ground among tiles. If the latitude is less than 40 degree, the tile size is 5 degrees by 5 degrees in latitude and longitude direction. If latitude is between 40 degree and 50 degree, the tile size is 5 degree in latitude direction and 6 degree in longitude direction.

4.4 Metadata

The contents of metadata follow the ISO standard of metadata (ISO 15046) which is being discussed at the ISO /TC211. Metadata at conformance level 1 is mandate, and those at conformance level 2 is optional in the Global Map.

4.5 File Format

The vector layers is described by Vector Product Format(VPF), which has been determined by NIMA. The raster data are described in Band Interleaved (BIL) format with a separate header file.

5. The Implementation of the Global Mapping Project

In order to increase the number of national mapping organizations participating in the Global Mapping Project, the invitation letter to the project has sent through UN to the NMOs of Member States. GSI, as the advocator of this project, has started the data development in parts of Asia in cooperation with the countries of the area, which is expected to encourage as many as countries to participate in the project.

In the data development in parts of Asia, source data of vector layers are not VMAP Level 0, but topographic maps prepared by national mapping organization in respective countries. Satellite imagery is also used for updating recent changes on the earth surface related to the contents of the Global Map. The countries involved in this data development are now Philippines, Thailand and Vietnam. GSI plans to extend this cooperative work to other Asian countries.

It is important to make it possible for anybody to access the Global Map easily. The first product developed based on the specifications of the Global Map will be appear next year. Therefore, GSI, as the Secretariat of the ISCGM, is now demanding the budget of the distribute system of the Global Map through Internet as a part of the Budget of GSI in fiscal 1999. It is also important to integrate other global thematic data set, such as soil and population, on the Global Map, which will increase the extent of the application of the Global Map largely.

6. References

- Estes, J. E., and D. W. Mooneyhan (1994), Of Maps and Myths, *Photogrammetric Engineering and Remote Sensing*, Vol. 60, No. 5, pp. 517-524.
- Estes, J. E., J. Lawless and D. W. Mooneyhan (1994), *Report of the International Symposium on Core Data Needs for Environmental Assessment and Sustainable Development Strategies*, Bangkok, Thailand, Nov. 1994, Vols. I & II, Washington D. C.; U. S. Geological Survey, National Mapping Division, Vol. 59p.; Vol. II, 130p.

- Geographical Survey Institute (1996), Present Status and Future Prospects of Global Map Development: A Background Paper for the First Meeting of the International Steering Committee for Global Mapping, *Report of the First Meeting of the International Steering Committee for Global Mapping*, Tsukuba, Japan, Feb. 1996.
- ISCGM (1996a), Rules of the International Steering Committee for Global Mapping, *Report of the First Meeting of the International Steering Committee for Global Mapping*, Tsukuba, Japan, Feb. 1996.
- ISCGM (1996b), A Survey of Global Mapping Related Activities, *Report of the Second Meeting of the International Steering Committee for Global Mapping*, Santa Barbara, California, U.S.A., Nov. 1996.
- ISCGM (1996c), Santa Barbara Statement on Global Mapping for Implementation of Agenda 21, *Report of the Second Meeting of the International Steering Committee for Global Mapping*, Santa Barbara, California, U.S.A., Nov. 1996.
- ISCGM(1997), *Report of the Third Meeting of the International Steering Committee for Global Mapping*, Gifu, Japan, Nov. 1997, 68p.
- ISCGM(1998), *Report of the Fourth Meeting of the International Steering Committee for Global Mapping*, Sioux Falls, South Dakota, U.S.A., June. 1998, 128p.
- Kline, K., J. Estes and T. Loveland (1996), The Need for Global Mapping, A background paper prepared for the Interregional Seminar on Global Mapping for Implementation of Multinational Environmental Agreements, *Proceedings of the Interregional Seminar on Global Mapping for Implementation of Multinational Environmental Agreements*, Santa Barbara, CA, USA, November 13-16, 1996.
- Murkami, H. (1993), Global Mapping – Global Geographic Data Set for Global Environment Studies, *Proceedings of the International Workshop of Global GIS*, Tokyo, Japan, Aug. 1993.
- Nonomura, Kunio (1996), History and Future Prospect of Global Map Concept, *Proceedings of the Interregional Seminar on Global Mapping for Implementation of Multinational Environmental Agreements*, Santa Barbara, CA, USA, November 13-16, 1996.
- URL:<http://edcwww.cr.usgs.gov/landdaac/glcc/glcc.html>, Global Land Cover Characterization Database.
- URL:<http://edcwww.cr.usgs.gov/landdaac/gtopo30/gtopo30.html>, Global 30Arc Second Elevation Data Set.
- URL:<http://164.214.2.59/publications/specs/printed/VMAP0/vmap0.html>, VMAP Level 0.