Steering Global Mapping Project and Developing Global Map Version 2

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Abstract

The Geospatial Information Authority of Japan is conducting a Global Mapping Project, and is serving as the Secretariat of the International Steering Committee for Global Mapping. After the release of Version 1 of the Global Map in 2008, we have developed Version 2 of the Global Map, and more and more countries and regions have released their Global Map data sets. In addition, Global Land Cover and Vegetation (Percent Tree Cover) layers also became available in finer resolution as compared with the previous version. ISCGM has started working closely with the United Nations Committee of Experts on Global Geospatial Information Management trying to reflect international needs for developing reliable geospatial information.

1. Introduction

The Global Mapping Project is an effort in which National Geospatial Information Authorities (NGIAs) of the world develop Global Map, digital geospatial data sets of the whole globe, through international cooperation. The Geospatial Information Authority of Japan (GSI) has been contributing to the project not only as a participating organization, but also by serving as the Secretariat of the International Steering Committee for Global Mapping (ISCGM) since its establishment in 1996.

The objectives of the project are clearly defined in Article 2 of the Rules of ISCGM, which 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. In consideration of growing demands and international interests in global environmental and development issues, the roles of the Global Map have become a more important agenda in the global geospatial information community.

GSI has promoted the project by being actively involved in the project. After releasing Version 1 of the Global Map in 2008, we have revised the Global Map Specifications (Kishimoto et al., 2009) and promoted developing the data sets based on the revised specifications.

This paper will report on the current situation of the Global Mapping Project, including its progress and GSI's activities, and introduce some close working relationships with other international activities, focusing on the activities after 2009 which is the year we revised the specifications. Our previous activities and revision of the Global Map Specifications have already been reported by many other authors (e.g. Iimura et al., 2011).

2. Development and Release of Global Map Version 2

2.1 Progress of data development

Since the Global Map Specifications were revised in 2009, project participating countries and regions have developed and released their Global Map data sets. The countries/regions that had already released Version 1 of their Global Map updated their data sets as Version 2, while those which had not yet released data newly released their data sets. With these efforts, Version 2 of the Global Map has now been released from the websites of participating organizations or the ISCGM website. At the 14th Meeting of ISCGM in 2007, the need for releasing data sets from national/regional websites was recognized. As a result, some countries, especially in developed

countries, have started releasing their data from their own websites, which enables more frequent updating, easier data-maintenance, and a wide variety of applications.

Figure 1 shows the progress of data development. As of September 9, 2013, the number of data-releasing countries/regions has increased from 73 to 118 since the release of Version 1 of the Global Map in 2008. There was a significant increase in the number especially around 2012. Regarding the areal coverage, as indicated in Figure 2, Global Map data sets are available over about 66 percent of the whole land of the globe.

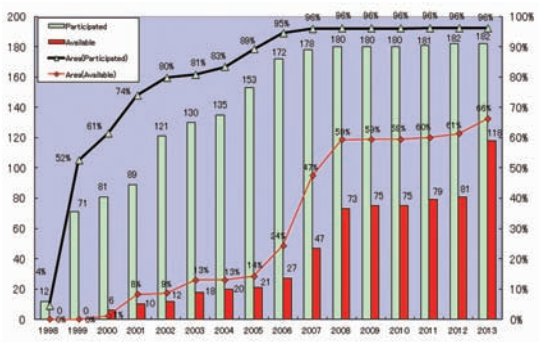

Fig.1 Number of the project participating countries/ regions and releasing Global Map data sets

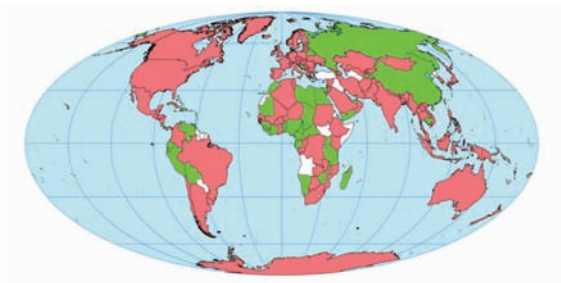

Fig.2 Progress Map (Red: released data, Green: developing data, Blank: not participating)

European countries/regions have released their data sets as part of the Global Map recently, which has greatly contributed to the increase in coverage. On the other hand, progress in the African Continent is still slow, and Russia and China have not released their Global Map yet.

The number of participating countries/regions is 182, which covers more than 96 percent of the land. This figure has not changed dramatically in recent years.

European countries/regions participate in the Global Mapping Project jointly through EuroGeographics, and their data sets, EuroGlobalMap became available as open data in March 2013. It is freely available for both commercial and non-commercial purposes. The specifications for EuroGlobalMap are compatible with the Global Map Specifications, but not exactly the same, therefore users may need to adjust the data attributes and so forth. EuroGeographics also developed the EuroRegionalMap in 1:250,000 scale and the EuroBoundaryMap in 1:100,000 scale, but they are products that cost money to access.

In addition to Europe, a lot of countries voluntarily contribute to data development. Some countries, however, need external support to develop their data sets. In this aspect, GSI not only develops its own data set, but also provides participating countries, especially those in developing countries, with technical support to develop the Global Map, which is explained in the following chapter. GSI also hosted a JICA group training course on Global Map development to share its knowledge and experience in data the development.

At the 20th Meeting of ISCGM in 2013, great progress was recognized and it was agreed that Version 2 of the Global Map should continue to be developed in 2014. Therefore, we will continue our effort to support countries, especially those countries which have not yet released their Global Map Version 2 data sets.

2.2 Release of Global Map Global Version (Land Cover and Vegetation)

For the two layers (land cover and vegetation) among Global Map eight layers, GSI and Chiba University have jointly developed data sets covering the whole globe with the cooperation of project-participating countries and regions. The latest version of Global Map Global Version was released in July 2013, by updating the previous version released in 2008.

NGIAs have contributed to this process by providing ground truth and by verifying the product. In verifying the product, we used the Chiba University's CEReS Gaia system (http://gaia.cr.chiba-u.ac.jp/portal/). The final products were released from the website of ISCGM, and the source data sets (MODIS imagery and training data sets) will be released from CEReS Gaia.

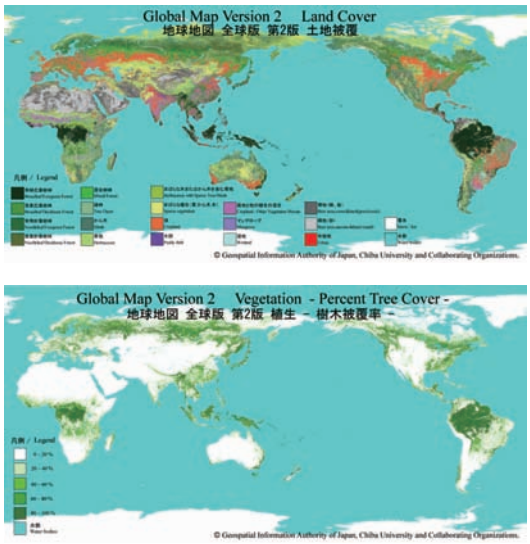

Fig.3 Global Map Global Version (Version 2): Land Cover and Vegetation

2.3 Accuracy and characteristics of Global Map Global Version

As Kishimoto et al. (2009) explained about the detailed structures of Global Map Version 2 data sets, we will focus on the characteristics of Global Map Global Version (land cover and vegetation).

Compared with the previous version (V.1) in 30 arc-second resolution, the latest version has finer spatial resolution of 15 arc-second. The former was developed from the satellite imagery observed in 2003, while the latter from the imagery in 2008 (see Table 1).

Due to the improvement in classification method and spatial resolution in the latest version, the accuracy of land cover classification in some areas seems to have increased compared with the previous version. Japan for example, comparison between Version 1 and Version 2 shows that cropland (orange), paddy field (purple) and cropland-other vegetation mosaic (pink) are classified better and the distribution of paddy field is well recognized in Version 2 data (Figure 4).

Table 1 Major elements of Global Map Global Version

	Version 1	Version 2
Spatial Resolution	30 arc-second	15 arc-second
Source Data	MODIS/TERRA (16-day composite)	MODIS/TERRA and AQUA (16-day composite)
Observed Year	2003	2008
Year of Release	2008	2013

On the other hand, however, these improvements in classification make it difficult to detect the real land cover changes simply by comparing Version 1 and 2 data sets. In particular, among the land cover classes that have close meaning each other in its nature (e.g. forest classes),

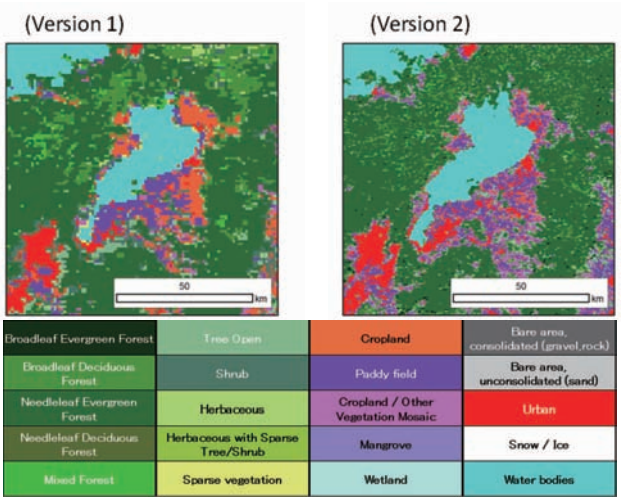

Fig.4 Global Map Global Version (Land Cover) around the Lake Biwa in Japan

slight difference in the method and the spatial resolutions seems to affect the result significantly. We are now conducting a detailed accuracy study, and the result will be reported in the future.

While Global Map Land Cover has 20 classes based on the LCCS (Land Cover Classification System) defined by FAO, simple classification with fewer classes could have higher accuracy to detect real land cover changes. Figure 5 shows an example of simple land cover derived from Global Map, which was prepared by integrating and simplifying classes such as forest (green), tree open/grass (yellow green), cropland/agriculture (orange), urban (red) and water body (blue). It clearly shows the decrease of forest and the growth of urban area.

It was agreed that Version 2 of the Global Map will be updated as Version 3 in the future. We will continue developing a method to detect the real land cover changes from our products, including simplifying the land

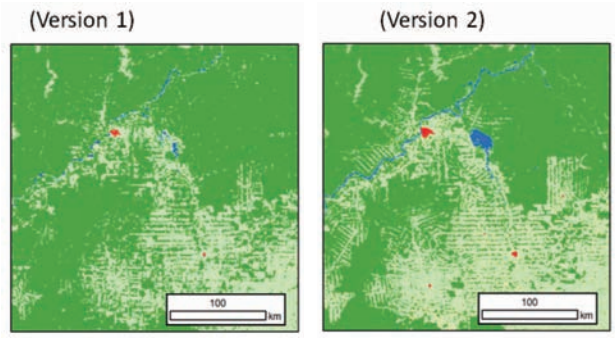

Fig.5 Global Map Global Version (Land Cover) around Amazonian Forest in Brazil

cover classes.

3. GSI's activities to support data development in developing countries/regions

In order to accelerate data development by participating countries/regions, GSI has developed technical manuals and tools dedicated to the Global Map as follows.

3.1 Development of the Manuals

A Manual for Development and Revision of Global Map Version 2 was developed and distributed to the NGIAs in December 2010. This manual includes a procedure to efficiently develop Global Map data; standards of acquiring features; and methodology to make the data using GML format and metadata. It was prepared in multiple languages: English, Japanese, French and Spanish.

In addition, a Manual for Developing and Updating the Global Map Data from Satellite Imagery was developed and distributed. This manual illustrates how to update the Global Map data from satellite imagery, showing an example of updating with open source software such as QGIS and ALOS satellite imagery.

3.2 Development of the Global Map Metadata Editor

To create metadata in accordance with Global Map Metadata profile defined in Global Map Specifications Version 2 which is compliant with ISO19115, some NGIAs had difficulty in developing the metadata and newly acquiring necessary knowledge, such as expertise in metadata and XML schema. In order to support them, GSI developed Global Map Metadata Editor, which is a software tool to easily develop Global Map metadata.

The Metadata Editor has two modes, "outline design" and "detailed design." The outline design mode is designed to enter minimum items for metadata in accordance with the guidance of the wizard.

The Global Map Metadata Editor was prepared in English, Japanese, French and Spanish, and was distributed to all the participating NGIAs of the Global Mapping Project in June 2011.

3.3 Development of the Global Map Data Check Software (GMDC)

In order to improve the quality of the data toward the completion of Version 2 of the Global Map, GSI has developed the Global Map Data Check software (GMDC) from 2010 to 2012. The latest version is 2.1. This software was specially dedicated to the Global Map and distributed to the project participating NGIAs.

By using this software, each NGIA easily finds topological errors, inappropriate attributes and logical inconsistency of features, which they had to manually detect before. The GMDC detects basic errors, such as dangles, overlap and disconnection within a feature class. In addition, it also detects logical errors between feature classes such as the relation between boundary lines and boundary areas. Major functions of the GMDC are as follows:

1) Import GML/shape file data,
2) Overlay images (tiff/bil),
3) Basic check
   (file name, attributes, topology and so on),
4) Inter-feature check,
5) Display/hide error marks and save the error list, and
6) Modify errors automatically or manually.

The GMDC enables participating NGIAs to modify their data easily even if they do not have an adequate number of GIS software licenses. It is expected to play an important role in developing Global Map dataset especially in the countries whose GIS environment is not sufficient.

Together with the GMDC, a Manual for Creation

of Global Map Data using Global Map Data Check Software Version 2.0 was also developed, which describes the method to create the Global Map using the GMDC with its data editing function.

4. Use of the Global Map

4.1 Number of Downloads

The number of Global Map users who have registered with ISCGM is more than 43,000 in total (ISCGM, 2013) as of May 2013. Global Map data sets have been downloaded from the ISCGM website more than 20,000 times every year since 2007 (Figure 6), while some countries release their Global Map data sets from their own websites, as mentioned before, these numbers are not included in these numbers.

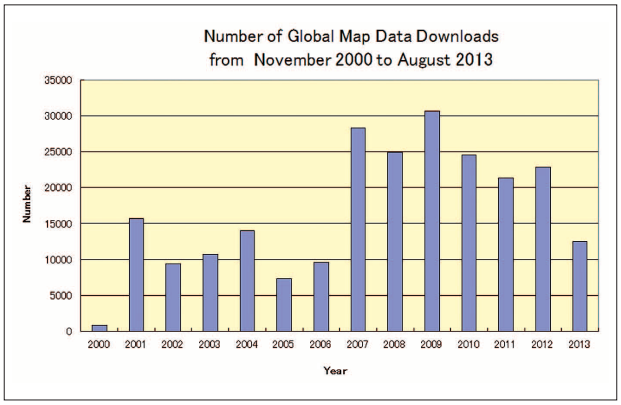

Fig.6 Number of Global Map Data Downloads

We started a survey on the purpose of the data use since May 2011 on the Global Map download page, and the survey result is annually reported to the ISCGM meetings so that ISCGM can be responsive to users' needs. Figure 7, 8 and 9 show the purpose of data use answered from August 2012 to May 2013 for global land cover, global vegetation and national/regional Global Map data sets, respectively. All types of data sets are used in various ways, which implies that Global Map is used in a variety of fields. For global land cover and vegetation, many people answered that their purposes of use are for biodiversity, ecosystem and agriculture, while education and research study are dominant purposes of use for all types of data sets including national/regional data sets.

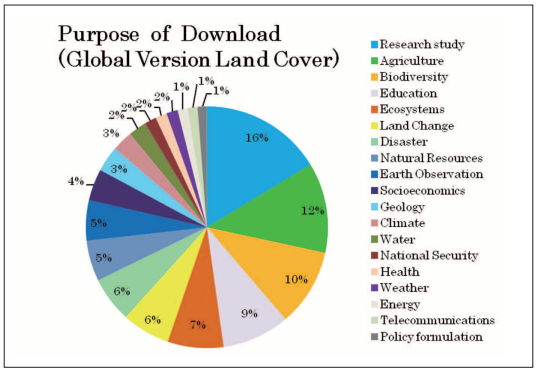

Fig.7 Purpose of download (Global Land Cover)

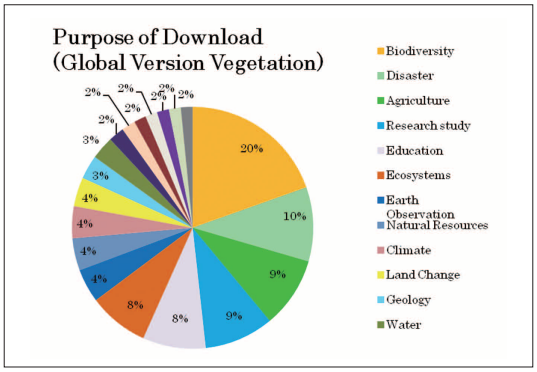

Fig.8 Purpose of download (Global Vegetation)

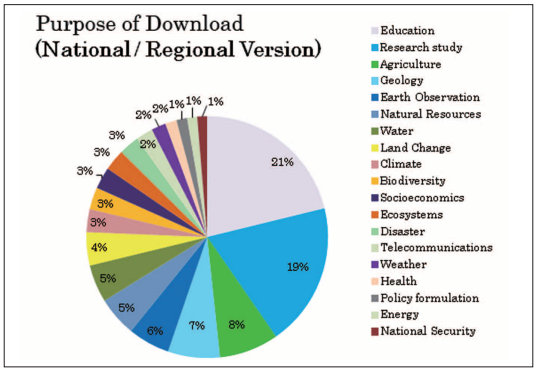

Fig.9 Purpose of download (National/regional data sets)

4.2 Application of Global Map at GSI Maps

GSI has released the latest map information from GSI Maps (former Digital Japan Web). Initially, Digital Japan Web could not display the area out of Japanese territory, but its new version now covers the whole world, supporting the tile mapping system, with a small scale world map developed from various sources including elevation layers of the Global Map and General Bathymetric Chart of the Oceans (GEBCO) seabed data

set. Global Land Cover and vegetation have also been released with tile mapping from the GSI Maps (http://portal.cyberjapan.jp/site/mapuse4/).

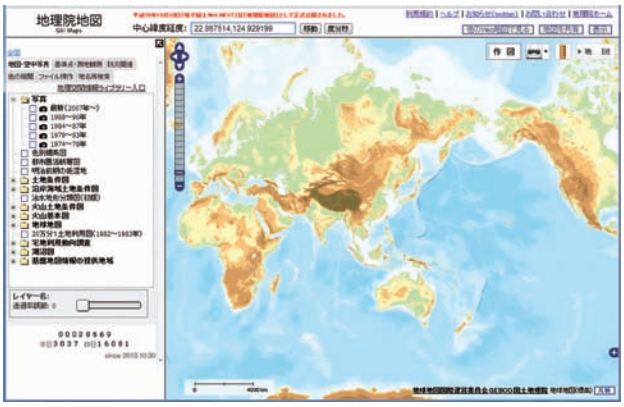

Fig.10 Screenshot from the GSI Maps

5. Global Mapping Activities in harmony with other international initiatives

5.1 Seminar at Rio+20

In order to promote application of the Global Map in the field of sustainable development, GSI joined the UN Conference on Sustainable Development (Rio+20) held in Rio de Janeiro in 2012. On June 22, a seminar entitled "Global Map and Integrated Water Resources Management for Sustainable Development" organized by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) was held at the Japan Pavilion where GSI made a presentation on the Global Mapping Project and the use of data for sustainable development. Dr. Vanessa Lawrence, Director General and Chief Executive or Ordnance Survey, U.K., Dr. Luciana Mara Temponi de Oliveira, Technologist, Geographic Information and Statistics, Brazilian Institute of Geography and Statistics, and Dr. Masanori Homma, Executive Director, Japan Aerospace Exploration Agency (JAXA) presented papers on the use of Global Map and importance of geospatial information and earth observations.

The Rio+20 outcome document, "The future we want" includes the importance of "reliable geospatial information" and "global mapping."

5.2 Working closely with UNCE/GM4SD

In 2011, UN ECOSOC adopted a resolution to establish a Committee of Experts on Global Geospatial Information Management (UNCE-GGIM), which provides a platform for the development of effective strategies on how to build and strengthen national capacity on geospatial information and sets directions on the production and use of geospatial information within national and global policy frameworks. At the 2nd and 3rd sessions of the UNCE-GGIM, it was agreed that the committee will develop a Global Map for Sustainable Development (GM4SD), and advised a closer working relationship be evolved between GM4SD and ISCGM. It also advised that ISCGM plays a central operating role.

Before the 3rd session of the UNCE-GGIM in the U.K. in 2013, ISCGM with the cooperation of NGIAs completed a review on current Global Map products. This was in response to the 2nd High Level Forum on GGIM in Doha, Qatar in February 2013.

The Global Map data sets were verified with ALOS/PRISM imagery provided by JAXA, in which quality of data, such as positional accuracy and completeness, was reviewed to confirm if the Global Map data could be the basis of GM4SD. Through the review, it was confirmed that almost all reviewed data had sufficient accuracy that meets the Global Map Specifications.

GSI continues to actively join in UNCE-GGIM and Global Mapping processes, not only as the Japanese NGIA, but also as the Secretariat of ISCGM.

6. Conclusion

Since the release of Version 1 of the Global Map in 2008, GSI has been working with NGIAs to develop and release Version 2 of the Global Map, and the number of available Global Map data sets has steadily increased. The Global Mapping Project now has a close working relationship with several ongoing international initiatives such as UNCE-GGIM, and ISCGM is now facing new tasks and challenges.

Under such circumstances, Dr. D. R. Fraser Taylor terminated his term as the chair of ISCGM, and Dr. Paul Cheung was appointed as the new chair in July 2013. GSI, as the Secretariat of ISCGM and taking advantage of ISCGM as the cooperation body of NGIAs in the world, will continue to make efforts so that the Global Mapping Project can provide valuable data sets that employ ease

of accessibility to contribute to solving global issues including sustainable development.

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