# Activities for Developing Global Map Version 3 Data

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**Abstract**

Global Mapping Project aims to develop basic geospatial data covering the whole land area of the globe through international cooperation of National Mapping Organizations (NMOs) around the world. The objectives of the project are to contribute to global issues.

Global Map Version 1 was released in 2008. Currently, Global Map Version 2 data development is almost completed with the collaboration of the project participating NMOs aiming to be completed in March 2013. From April 2013, development of Global Map Version 3 was started.

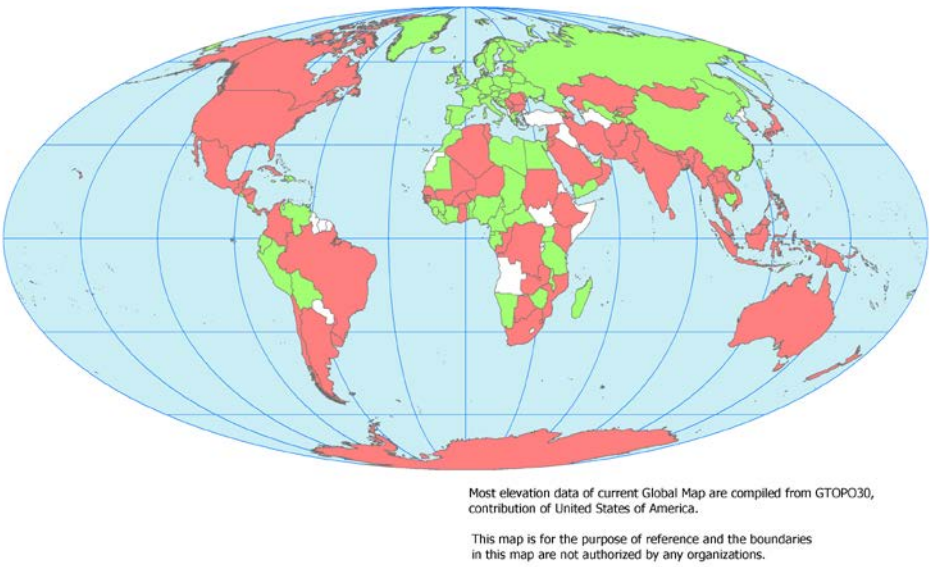
Global Map can be applied to many fields, such as flood analysis and infrastructure development. However, the existing data at a scale equivalent to 1 to 1 million do not include detailed road and village information. Currently, specifications are under discussion for the development of Global Map Version 3 data by incorporating user needs to make Global Map data more usable.

Geospatial Information Authority of Japan (GSI), the NMO of Japan, in charge of the secretariat of International Steering Committee for Global Mapping (ISCGM) is actively supporting the data development by preparing a data development manual and other useful tools pursuant to the new specifications.

## 1. Outline of Global Mapping Project

Global Mapping Project is an international cooperative initiative in which NMOs of the world develop Global Map, basic geospatial data of the whole globe. As of 12

December 2012, 166 countries and 16 regions participate in the project, covering 97% of the whole land area (Figure 1). The objectives of the project are to contribute to solving global environmental issues, achieving sustainable development, and mitigating large-scale disasters.




Legend data available data for verification not participate in the project

Figure 1: Progress Status of Global Mapping Project (as of 12 December 2012)

Global Map is based on consistent specifications-Global Map Specifications- in 1km resolution which is equivalent to 1:1 million scale in paper maps. Global Map consists of 8 thematic layers: boundary, transportation, drainage and population centers in vector format; and vegetation (percent tree cover), land use, land cover and elevation in raster format (Figure 2).

NMOs of the project participating countries are responsible for the development of Global Map of their respective countries. The International Steering Committee for Global Mapping, chaired by Prof. D. R. Fraser Taylor and set up with 20 members who are mostly heads of NMOs of selected countries, functions as the decision-making and progress management body of the project. GSI has been serving as the secretariat of ISCGM since its establishment in 1996.

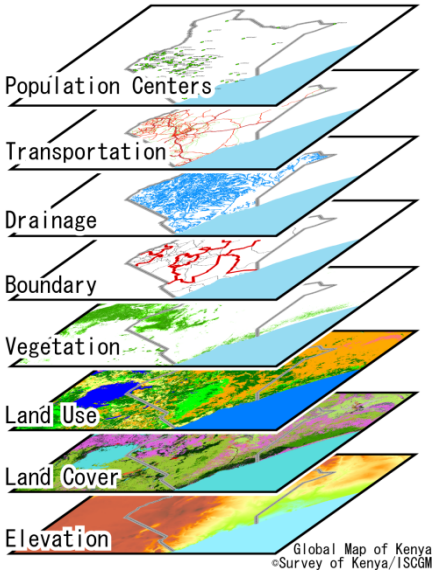


Figure 2: Eight layers of Global Map (Kenya)

With the efforts of participating NMOs and supporting stakeholders, Global Map Version 1, which includes Global Land Cover and Percent Tree Cover data, was released in 2008. Global Map data are freely downloadable for non-commercial purposes from the website of ISCGM or of respective participating NMOs. The data are to be updated every five years so that the changes of global environment can be better monitored and detected.

**2. Position of Global Map at Rio+20**

Global Map was proposed by Japan in 1992 in the wake of the United Nations Conference on Environment and Development (Earth Summit) held in Rio de Janeiro, Brazil, and the Global Mapping Project was started. As a follow-up for 20 years to the Earth Summit and to discuss the way forward of 10 years to come for achieving sustainable development, the United Nations Conference on Sustainable Development (Rio+20) was held in Rio de Janeiro in June 2012. A seminar entitled “Global Map and Integrated Water Resources Management for Sustainable Development” by the MLIT was held at the Japan Pavilion.

Rio+20 outcome document “The future we want” adopted, includes the importance of “reliable geospatial information” and “global mapping.” In concrete terms, in the paragraph of “Technology,” it reads, “We recognize the importance of

space-technology-based data, in situ monitoring and reliable geospatial information for sustainable development policymaking, programming and project operations. In this context, we note the relevance of global mapping and recognize the efforts in developing global environmental observing systems,……”

Figure 3: Presentation and conference at Rio+20

## 3. Activities for developing Global Map

### 3. 1 Activities for developing Global Map Version3

Global Map is to be updated once every five years to monitor global environment. Global Map Version 1 which includes Global Land Cover and Vegetation (Percent Tree Cover) data was released in 2008. Currently, Global Map Version 2 data development is almost completed with the collaboration of the project participating NMOs aiming to be completed in March 2013. From April 2013, development of Global Map Version 3 was started.

#### 3.1.1 Necessity of revision of Global Map Specifications

Global Map is used as data which represent the status of global environment for climate change simulation, and grasping the progress of deforestation and desertification, in a global level; and infrastructure development, understanding the outline of land use and flood analysis, in a national level. However, the existing data at a scale equivalent to 1 to 1 million do not include detailed road and village information, which as a result were deemed not to be sufficient enough for a use in individual and concrete matter, such as recovery support in a large-scale disaster, climate change vulnerability assessment, and understanding the land use change in urban area. In order to solve this situation, in

Global Map Version 3, data development at a scale equivalent to 1 to 1 million will be continued, and at the same time, data of areas which especially have high demand such as urban area, where population is concentrated, will be developed in larger scales such as 1 to 250,000 scale to enable detailed survey and analysis. Currently, specifications are under discussion for the development of Global Map Version 3 data by incorporating user needs to make Global Map data more usable. In parallel with this work, an error analysis was made on Global Map data of respective countries which have been released, by validating their accuracy with a use of satellite imagery. In order for countries, when they update the data, to create data with better accuracy for areas which have less accuracy, preparation of a manual is being considered which describes ways to increase accuracy by using satellite imagery and other materials. These efforts are considered to also help improve mapping technologies of developing and other countries.

### 3.1.2 Creation of a prototype of Global Map Version 3

In order to understand issues which would occur in the course of the large-scale data development, a prototype of Global Map data at a scale of 1:250,000 was created. Assuming a revision of Global Map data by using satellite imagery and other materials, a certain area was corrected by extracting an area where a secular change was detected using an ALOS AVNIR-2 image (Figure 4).

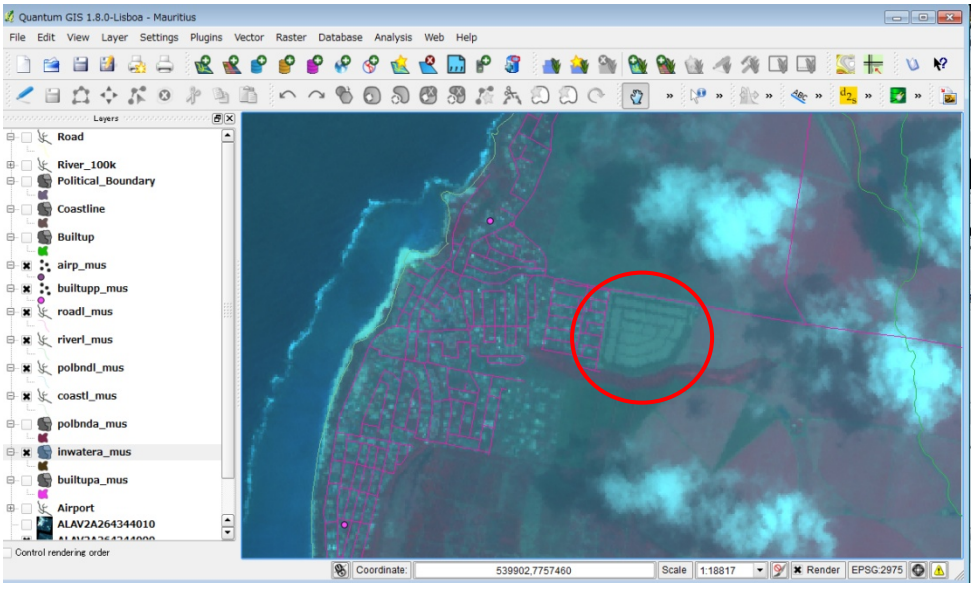



Figure 4: Example of an area of secular change (road)

For an area, the issues which need considerations in developing data at 1:250,000 scale and in extracting an area where secular change is detected are as follows:

・It was difficult to adjoin some parts between an area in the existing map at 1:1 million scale and a newly created area at 1:250,000 scale.

・Features in an area at the existing 1:1 million map are frequently displaced. As a result, new additions of features at 1:250,000 scale sometimes collapsed the relative relation with the existing features.

・Road, coastline, drainage and airport were successfully interpreted and updated without trouble. However, some railroad could not be updated due to the difficulty of interpretation. For features in face such as inland water, acquisition of its right shape was also difficult.

### 3.2. Accuracy verification on Global Map Version 2

In order to improve the accuracy of map data of Global Map Version 3, the accuracy of Version 2 was verified and listed for those data currently released.

#### 3.2.1 Vector Layers

By superimposing Global Map Vector data of the country versions with ALOS images, displacements which exceed allowable values were found for some countries (Figure 5).

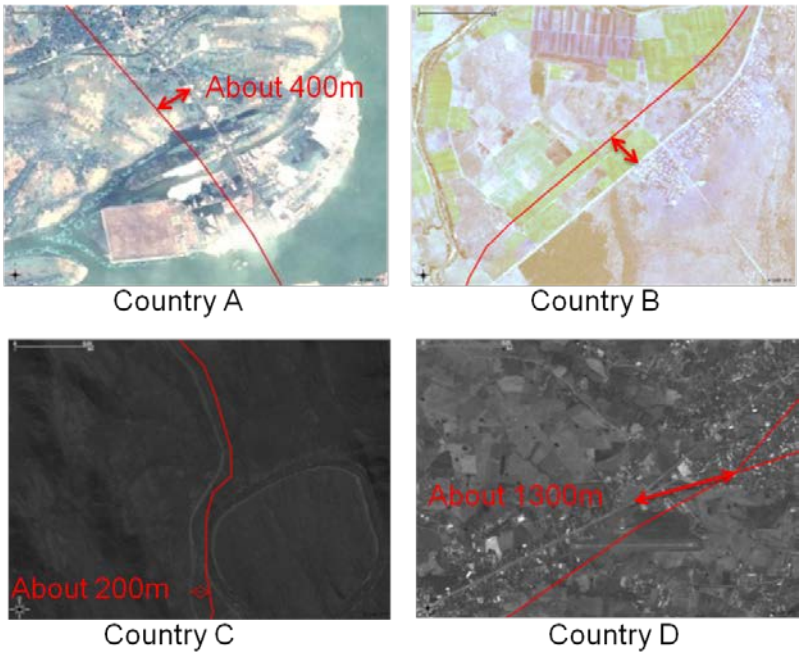



Figure 5: GM_error examples (Road)

In this connection, in order to understand the present status, problems which would be caused in improving the accuracy are being analyzed by distributing an accuracy verification request (Figure 6) and an ALOS-PRISM image to NMOs of respective countries.

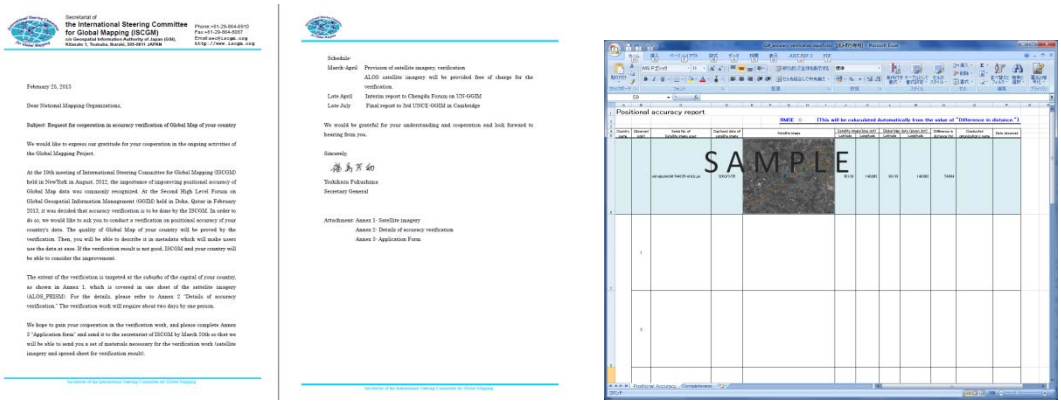



Figure 6: GM accuracy verification request and report format

### 3.2.2 Raster Layers (Global Version)

GSI and Chiba University in collaboration with NMOs of respective countries have been developing Version 2 of Global Version of Global Map Land Cover and Global Map Percent Tree Cover from the data observed in 2008 by MODIS sensors loaded on Terra and Aqua satellites. These data are being developed aiming to be released in summer (in Japan) of 2013. Currently, a prototype version of Version 2 has been completed (Figure 7 and Figure 8). At the same time, a possibility of extracting vegetation changes and its methodology have been discussed by comparing Version 1 data created by using the data in 2003 from the same sensors with Version 2 which is currently developed.

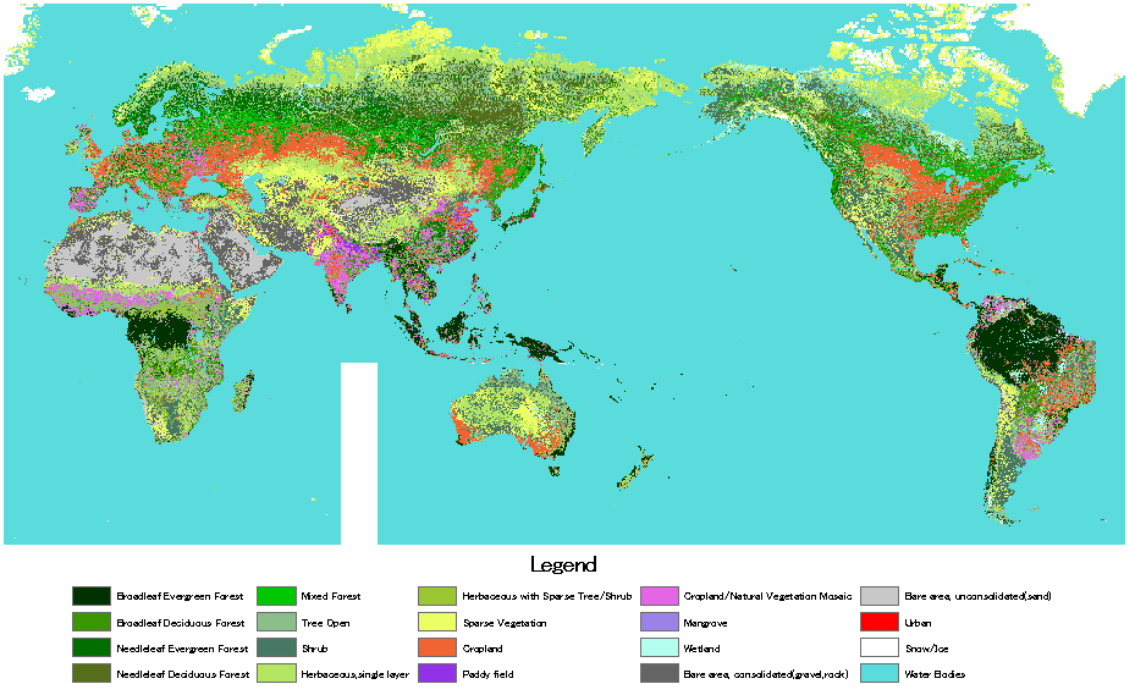



Figure 7: Prototype of Global Version of Land Cover Version 2

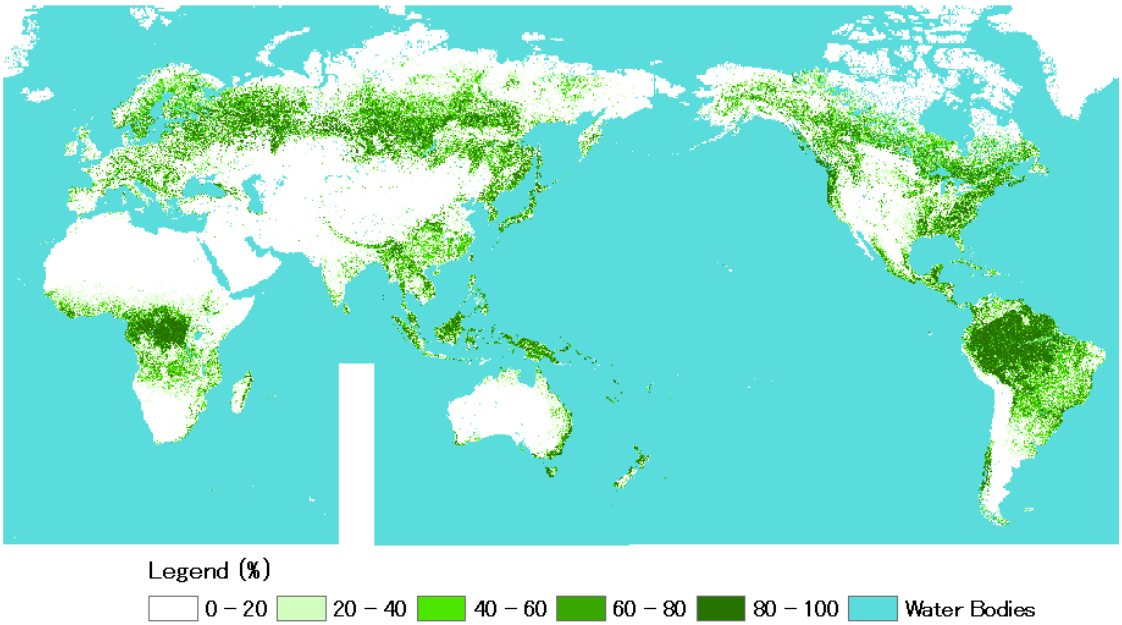



Figure 8: Prototype of Global Version of Percent Tree Cover Version 2

For the prototypes of Global Versions of Version 2 data, their accuracy was verified by using verification data (868 points for Land Cover, and 553 points for Percent Tree Cover) prepared by interpreting GoogleEarth satellite imagery.

Analyses on the trend of classification errors in Land Cover found that approximate kinds of vegetation were misclassified each other. Then, verification was done once again by integrating 20 classes of Global Map Land Cover into 6 classes and the result showed that the accuracy was improved.

In order to improve the accuracy of individual classification, the number of training data needs to be increased and reclassification will be made after reviewing training areas. These ways are considered to improve the accuracy rate of land cover classification. On the other hand, one problem lies in cropland, in which brightness values remarkably differ by the growing products and this is considered to make classification difficult.

Further, in order to examine a possibility to extract changed areas by comparing Version 1 and Version 2 data, 50 areas were selected from the globe, where forests had been decreased or increased for 1km$^2$ or more between the year 2003 and 2008. Then, these areas were acquired as verification points to identify the changes as to from which vegetation class, or to which vegetation class.

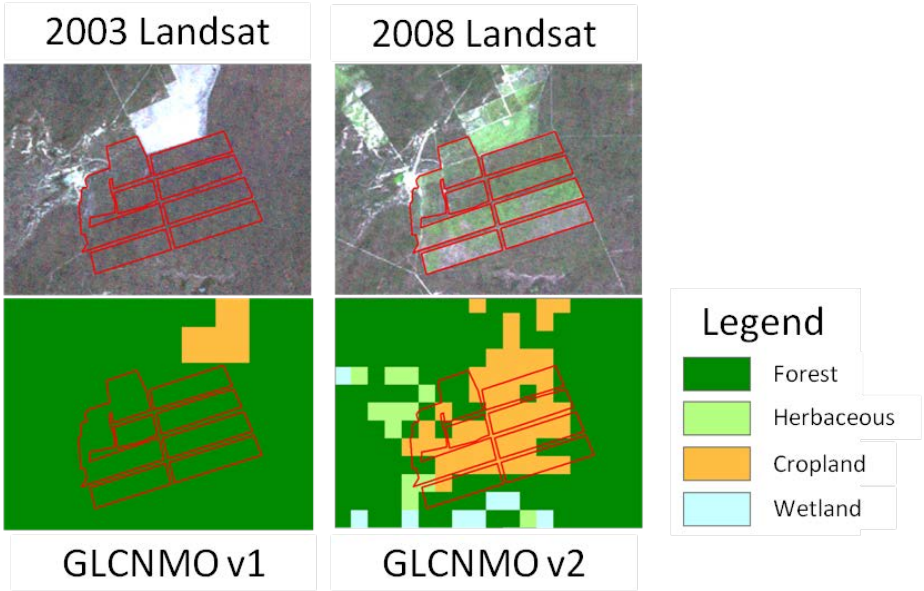



Figure 9: Example of verification points of changed area (Paraguay)

### 3.3. GSI's Activities to assist in the data development

GSI has hosted a JICA group training course on Global Mapping as well as preparing a data development manual, metadata editor, and data check tool in order to assist in the data development of Global Map.

#### 3.3.1. JICA Training Course on Global Mapping

GSI has hosted the JICA group training course on Global Mapping for technology transfer to developing countries. A new course, "Global Mapping for Sustainable Development" which started in 2010, focuses on the development and update of the Global Map data as well as the utilization of the data. In 2012, it was held for 2 and half months, and 7 participants from 5 countries took part in the course (Figure 10). As a total of 19 years from 1994 to 2012, 112 participants from 59 countries attended.

Figure 10: Scenes from JICA training course on Global Mapping at GSI in 2012

#### 3.3.2. Preparation of data development tool and manual for raster layers

As a part of the support for the data development of respective countries, GSI has prepared a tool using GRASS free software, etc. to develop Raster data of the country version and its manual. This tool will be distributed without cost to NMOs which participate in the Global Mapping Project.

#### 3.3.3. Multilingualization of Global Map data development support tool and its manual

Among the countries which participate in the Global Mapping Project, there are many countries whose official language is not English. In order to support these countries, GSI is multilingualizing the tools and manuals which are being distributed to respective

countries. In 2012, in addition to French and Spanish, Russian version was made for Specifications, and manuals of Metadata Editor and Global Map Data Check Software (GMDC). ISCGM Home Pages in French and Spanish are being prepared.

## 4. Conclusions

The Global Mapping Project is making steady progress. Global Map Version 1 was completed and now Global Map Version 2 is almost completed through the international cooperation of NMOs worldwide.

Although Global Map has got broader application, it is still important to continue activities to accelerate the use of Global Map. There are a lot of potential Global Map applications in various fields. Currently, the scale of Global Map is 1:1,000,000. However, larger-scale data will better contribute to addressing global issues. ISCGM and GSI will develop such larger-scale Global Map, and continue to assist in the data development of the countries which participate in the Global Mapping Project.

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ISCGM website
http://www.iscgm.org/