CO-409

GLOBAL MAPPING ACTIVITIES FOR THE VERSION2 DEVELOPMENT AND ITS APPLICATIONS

FUKUSHIMA Y., NAKAMURA T., YATABE Y., TAKAHASHI H., IIMURA T., TAGKAGI M., KOJIMA S., SUGA M., YOSHIKAWA M., KOARAI M., OKATANI T.

Geospatial Information Authority of Japan, TSUKUBA, JAPAN

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 NMOs of the project participating countries are collaborating for Global Map Version 2 development, with a target completion year of 2012. New Global Map specifications were adopted in 2009 for the development of Global Map Version 2 and further promoting the use of Global Map data. Geospatial Information Authority of Japan in charge of the secretariat of International Steering Committee for Global Mapping is actively supporting the data development by preparing a data development manual and other useful tools pursuant to the new specifications.

Global Map can be applied to many fields, such as flood analysis and infrastructure development. This paper introduces some applications of Global Map data.

1. OUTLINE OF GLOBAL MAPPING PROJECT

Global Mapping Project is an international cooperative initiative in which National Mapping Organizations (NMOs) of the world develop Global Map, basic geospatial data of the whole globe. As of 1 February 2011, 164 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.

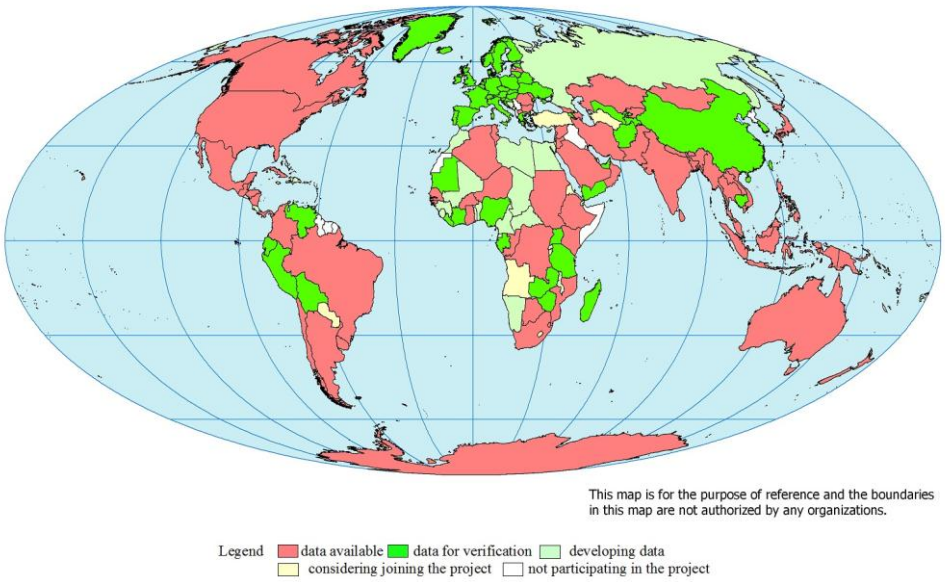


Figure 1: Progress Status of Global Mapping Project (as of 1 February 2011)

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 (ISCGM), 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. Geospatial Information Authority of Japan (GSI), the NMO of Japan, has been serving as the secretariat of ISCGM since its establishment in 1996.

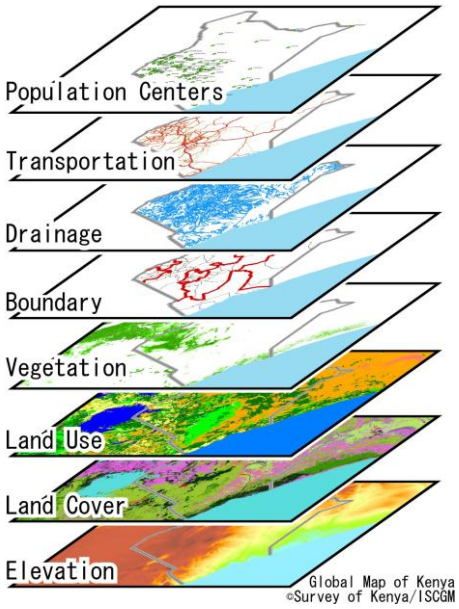
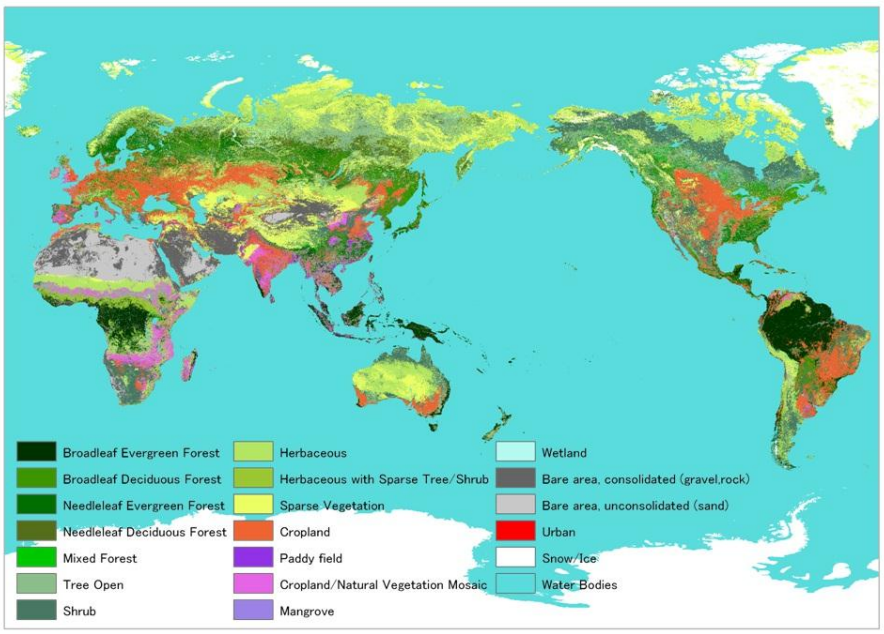


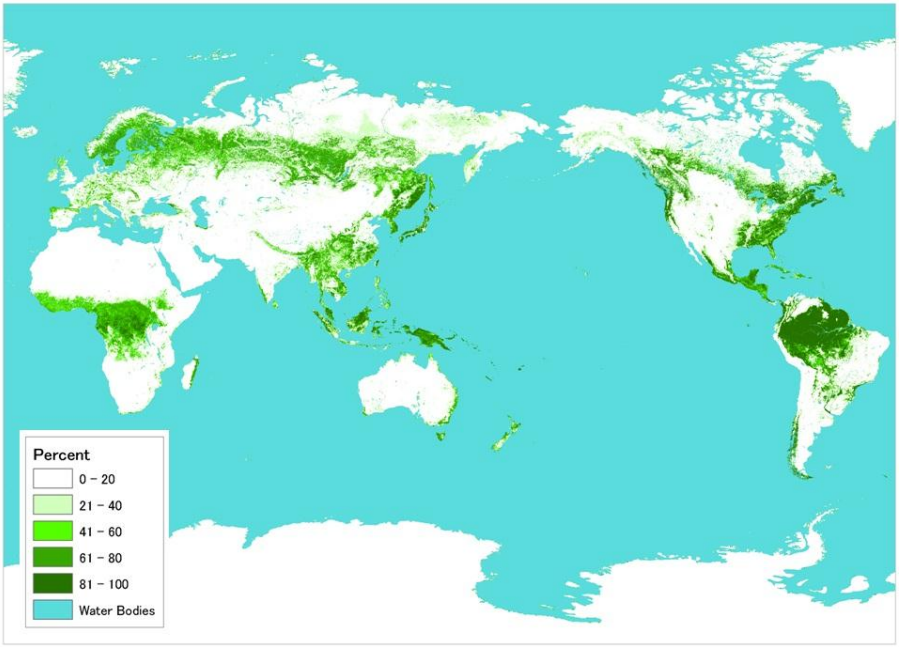
Figure2: Eight layers of Global Map (Kenya)

With the efforts of participating NMOs and supporting stakeholders, Global Map Version 1, which includes Global Land Cover (Figure 3) and Percent Tree Cover (Figure 4) 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.



© Geospatial Information Authority of Japan, Chiba University and Collaborating Organizations

Figure 3: Global Map Global Land Cover



© Geospatial Information Authority of Japan, Chiba University and Collaborating Organizations

Figure 4: Global Map Global Percent Tree Cover

2. ACTIVITIES FOR THE DEVELOPMENT OF GLOBAL MAP VERSION 2

2.1. Revision of Global Map Specifications

NMOs of the participating countries are collaborating in Global Map Version 2 development, with a target completion date of 2012. The new Global Map specifications were adopted as Global Map Specifications Version 2 at the 16th meeting of ISCGM held in Bangkok in October 25, 2009 for the development of Global Map version 2 and further promoting the use of Global Map data. New specifications adopt ISO19136 (GML 3.2.1) standard for the vector data format and ISO 19115 for metadata. This will facilitate data interoperability. Some features such as "Port" and "Railroad station" are added as well as some feature attribute such as "Population," "Administrative code" and "SALB (Second Administrative Level Boundaries) code." It will facilitate integrated uses of statistics with Global Map.

2.2. GSI's Activities to assist in the data development

GSI has hosted a JICA group training course on Global Mapping and 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 Version 2.

2.2.1. JICA Training Course on Global Mapping

GSI has hosted the JICA group training course on Global Mapping for technology transfer to developing countries. In 2010, a new training course "Global Mapping for Sustainable Development" started. The new course focuses on the development and update of the Global Map data according to the new specifications as well as the utilization of the data. It was held for 2 and half months, and 8 participants from 8 countries took part in the course (Figure 5). As a total of 16 years from 1994 to 2010, 102 participants from 58 countries attended.

Figure 5: Scenes from JICA training course on Global Mapping

2.2.2. Preparation of data development manual based on new specifications

ISCGM Secretariat has prepared the “Manual for Development and Revision of Global Map based on Global Map Specifications Version 2” in order to assist in data development based on the new specifications. The manual describes typical process of development and revision of Global Map. The manual was provided to each participating NMO.

2.2.3. Development of Metadata Editor

GSI has developed “Global Map Metadata Editor” which is software for creating metadata compliant with Global Map Specifications Version 2 (Figure 6). The editor was distributed to each NMO participating in the project.

2.2.4. Development of Data Check Software

GSI is developing “Global Map Data Check Software” for checking whether the data are compliant with Global Map Specifications Version 2 (Figure 7). The software will be distributed to each NMO participating in the project in the middle of 2011.

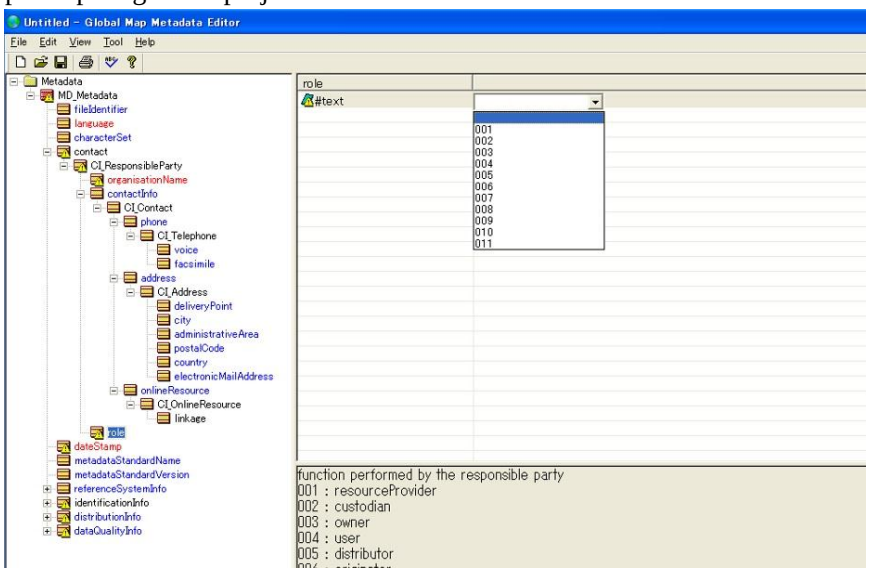


Figure 6 Global Map Metadata Editor

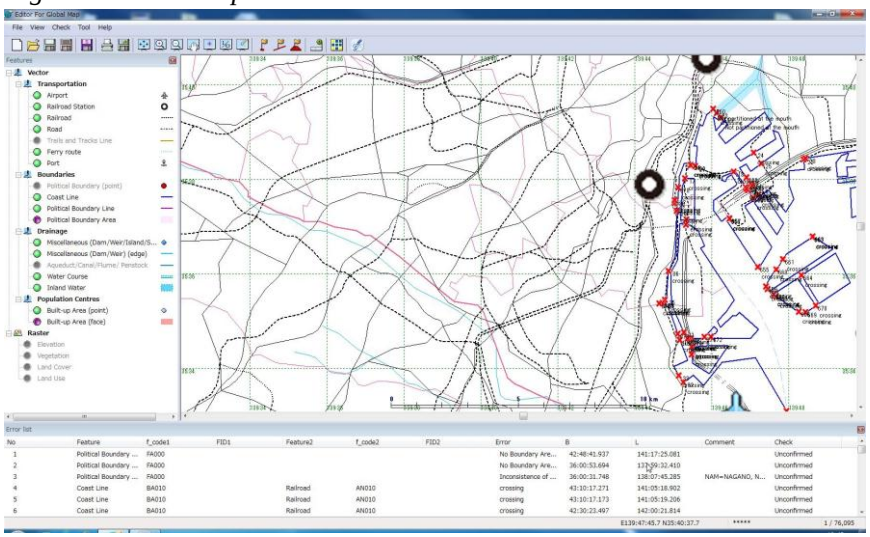


Figure 7 Global Map Data Check Software (Under development)

2.2.5. Preparation of French and Spanish versions of Global Map Specifications

There are many participating countries whose official languages are French or Spanish. In order to assist these countries, GSI has prepared French and Spanish versions of Global Map Specifications Version 2 for their reference. These were provided to the participating NMOs. Currently, GSI is preparing the French and Spanish version of data development manual and the manual for Metadata Editor.

3. APPLICATION OF GLOBAL MAP

Global Map can be used to predict, assess, prepare for and cope with global issues by combining with other geospatial data. Global Map data have characteristics such as global coverage, consistent

specifications and five-year update cycle. The data with these strong points enable us to make a comparison of the status of the environment internationally. In addition to this comparability, usability based on open data policy and reliability with authorization of each government enable us to use Global Map data effectively for global issues. This section introduces application cases of Global Map.

3.1. Climate Change

Global Map can contribute to policy making processes in climate change field, because forest and land management through GIS and remote sensing are becoming important to keep terrestrial carbon accounting in both developed and developing countries in United Nations Framework Convention on Climate Change (UNFCCC) processes.

Based on UNFCCC and Kyoto Protocol, contracting parties have obligation to submit their national greenhouse gas (GHG) inventories concerning emissions and removals of GHGs to UNFCCC Secretariat. Global Map can be used for the GHG inventory in Land Use, Land-Use Change and Forestry (LULUCF) sector. Global Map Land Cover data are introduced as an example of international land cover dataset in the IPCC Guidelines for GHG inventory: "Intergovernmental Panel on Climate Change (IPCC) Good Practice Guidance for LULUCF" and "2006 IPCC Guidelines for National Greenhouse Gas Inventories." Global Map Land Cover data can be used for calculation of emissions and removals of GHGs as well as its supplementation and cross-checking, especially in the countries where statistics and geographic information are not well developed.

Nowadays in the field of climate change, reducing emissions from deforestation and forest degradation has become one of the most important issues. Figure 8 shows the annual change rate of forest area from 2000 to 2005. This is developed by combing Global Map Percent Tree Cover with Global Forest Resources Assessment by FAO. For each color, the denser the color is, the higher the percent tree cover is. This figure can be used to identify the areas which are needed to preferentially take countermeasures by combining with other statistics. Also, it helps people who are not experts in the environmental field to understand and think of the global environment. This map appeared in "Annual governmental report on the Environment in Japan" as well as in the educational text on environment for elementary or junior-high school students.

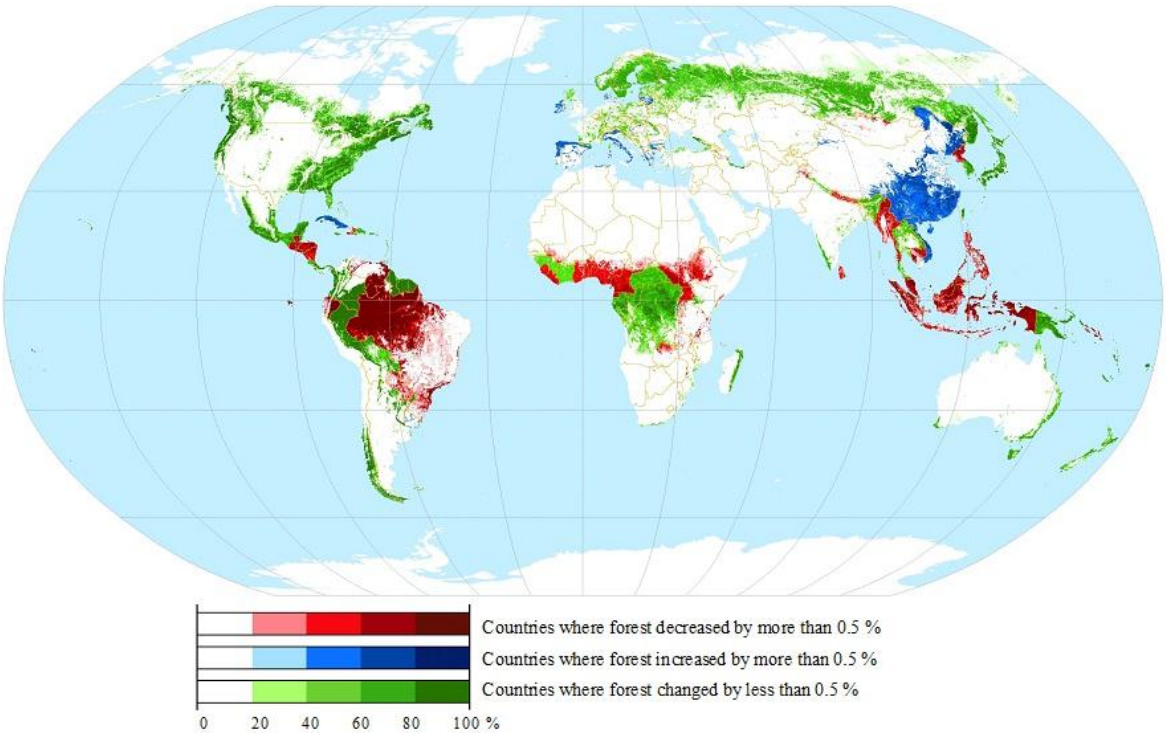


Figure 8: Annual Change Rate of Forest Area (2000-2005)

GSI participated in the 14th Session of the Conference of Parties (COP14) of UNFCCC (2008, Poland), COP15 (2009, Denmark), COP16 (2010, Mexico) jointly with Japan's Ministry of Land, Infrastructure, Transport and Tourism (MLIT) to promote the use of Global Map for measures against climate change. GSI gave presentations on utilization of Global Map in the side events by the Japanese Government and displayed posters at the exhibition booth of the Japanese Government (Figure 9).

Figure 9: Global Map presentation at UNFCCC COP16

3.2. Flood Analysis

Global Map data are used for runoff analysis in Integrated Flood Analysis System (IFAS) developed by International Center for Water Hazard and Risk Management (ICHARM), Public Works Research Institute of Japan (PWRI). The main objective of IFAS is to reduce flood damages in developing countries where hydrologic information is not sufficiently available. In addition to satellite-based and ground-based rainfall data, Global Map data are used for runoff analysis. Global Map Land Use and Land Cover data are used for setting parameters such as roughness, surface permeability in combination with other data such as soil and geological data. Global Map Elevation data are used for creating a basin boundary and a water flow network.

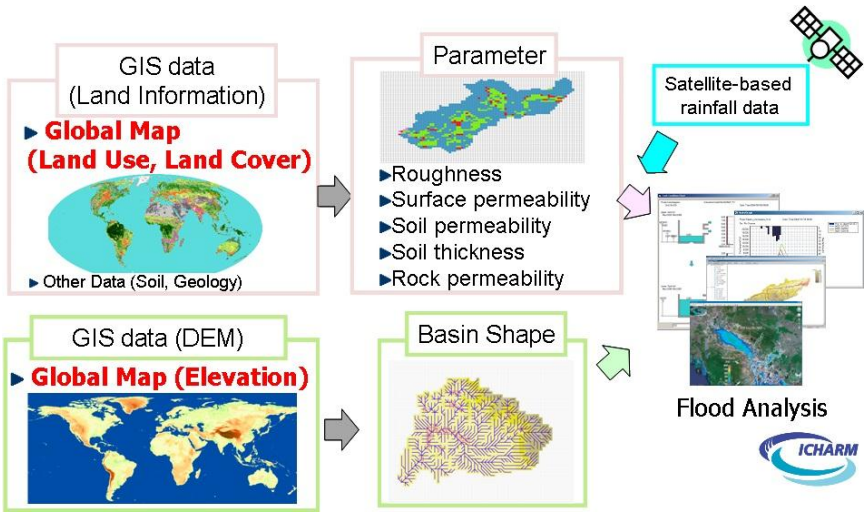


Figure 10: Flow of Flood Analysis in IFAS

3.3. Disaster Mitigation

To prevent secondary disaster and to efficiently provide aids for victims in the event of a large scale natural disaster, GSI prepares maps using Global Map data which show geographic features of disaster hit area. Figure 11 shows an example. These maps are distributed to all over the world through the Relief Web (www.reliefweb.int) operated by the United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA) as well as the websites of ISCGM and GSI.

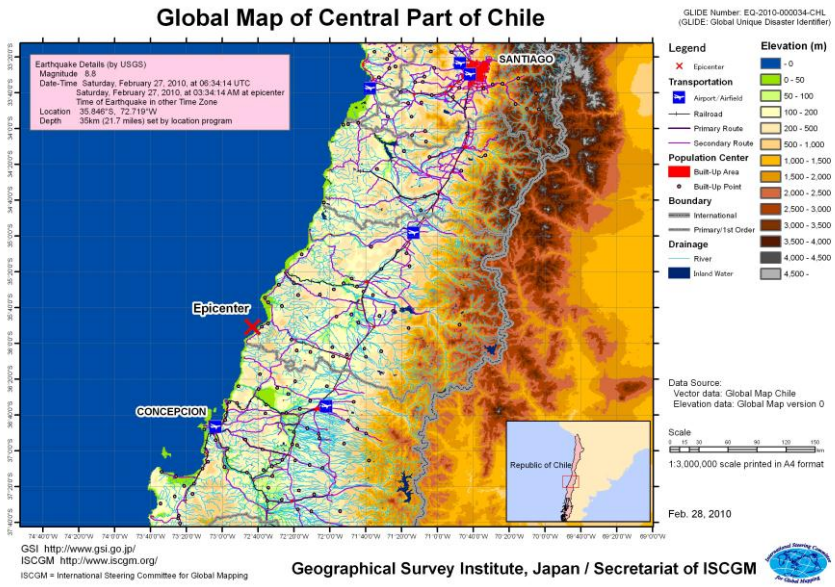


Figure 11: Global Map around the area damaged by Chile Earthquake, Feb. 2010

3.4. Biodiversity

By layering the Global Map with data on natural habitats, it is possible to visualize the spatial distribution of biodiversity, providing supports in biodiversity conservation through international efforts. Figure 12 shows the island of Kalimantan (Borneo) taken from the Global Map Percent Tree Cover overlaid on data concerning the habitat of orangutans (Orangutan Habitat ©IUCN Red List of Threatened Species Version 2009.1). Combination of such layers of different data can contribute to the quality use of map, including a plan for green corridors to link forest areas, and other measures of conserving and restoring biodiversity.

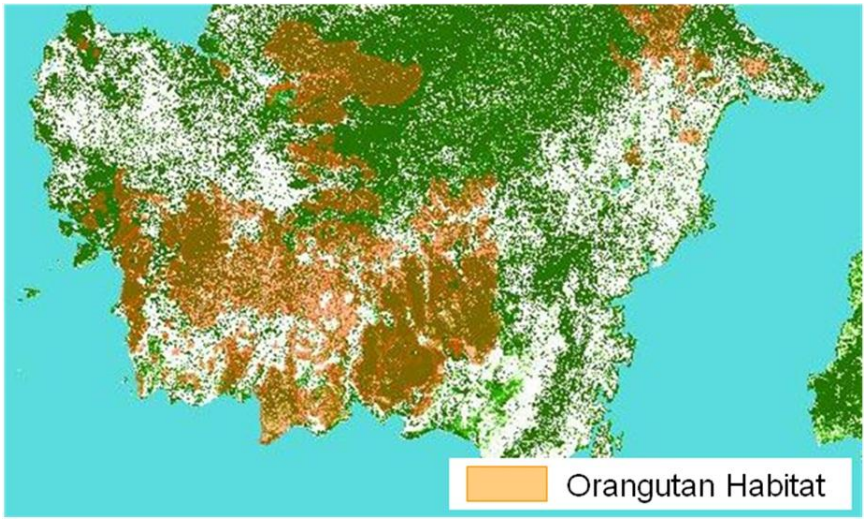


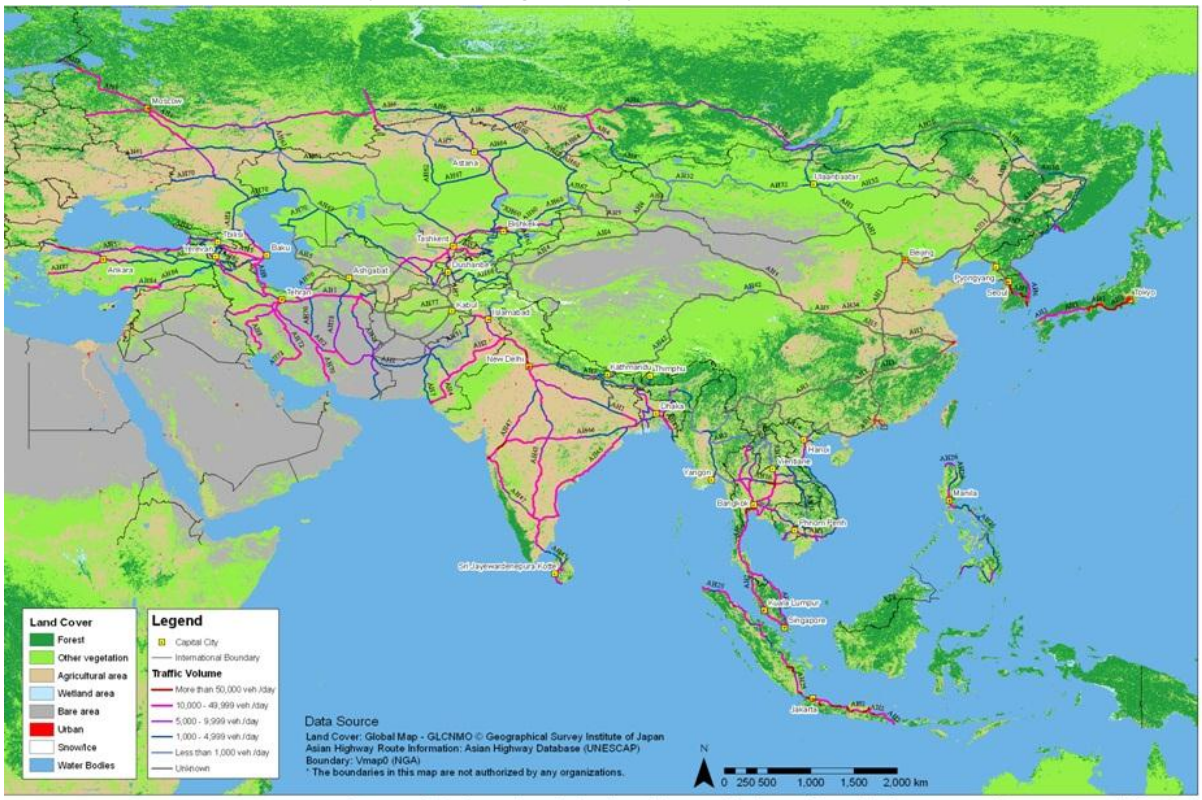
Figure 12 Utilization of Global Map for biodiversity conservation planning

The 10th meeting of the Conference of the Parties of Convention on Biological Diversity (COP10) took place in Nagoya, Japan in October 2010. GSI displayed a large-scale Global Map poster (5m by 3m) on the floor in the exhibition booth of MLIT. The poster was created by overlaying habitats of threatened species on Global Map Land Cover (Figure 13).

Figure 13 Global Map exhibition at CBD COP10

3.5. Infrastructure Development

Figure 14 was created by overlaying route information of Asian Highway on Global Map with the cooperation from UNESCAP. Asian Highway Project was advocated in 1959 by member countries of the UNESCAP for the development and improvement of international road network. The map, which gives information on the relation between traffic volume of each route of Asian Highway and geographical distribution of cities, can be used for policy formulation in the development of Asian Highway. These maps were distributed to all the participants for their reference in Asian Highway 50th Anniversary Seminar, which was held in Tokyo in 2010 organized by MLIT and UNESCAP.



Geospatial Information Authority of Japan, Ministry of Land, Infrastructure, Transport and Tourism

Figure 14 Asian Highway Route Map (Traffic Volume)

3.6. Analysis of impacts of human activities on the environment

An analysis on relationship between arterial roads (primary route in Global Map Transportation layer) and earth's surface condition (Global Map Percent Tree Cover and Land Cover layer) was done in South East Asia and South Asia region(Figure 15).

Generally, like Nepal, quantity of percent tree cover is controlled by topography. Flat lands are mainly covered with agricultural land or other artificial land cover with low percent tree cover. This shows that the percentage of agricultural land does not seem to increase by the new development of arterial roads in such flat lands(Figure 16).

On the contrary, like Thailand, cultivated area might be seen even in relatively steep area if there are arterial roads, and this shows that land cover change would happen by the development of arterial roads. This suggests that land cover change caused by the development of arterial roads can be simulated, at a certain extent, by using Global Map data(Figure 17).

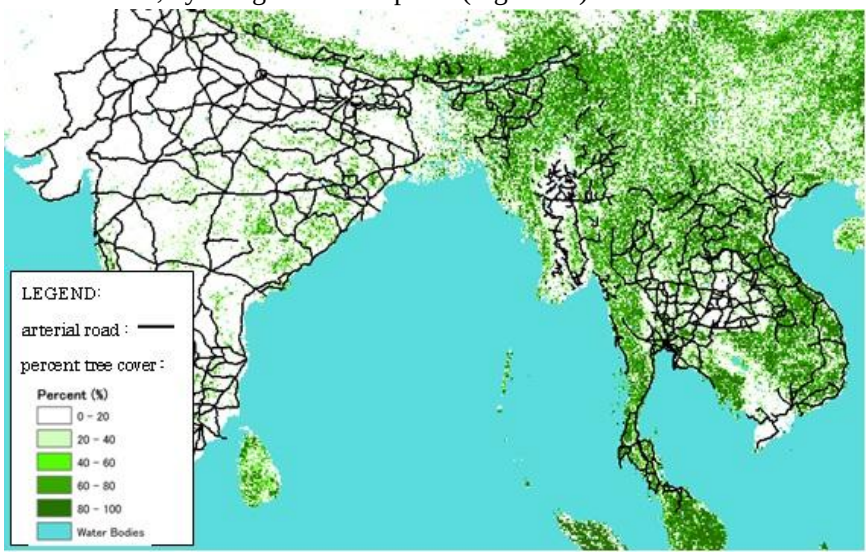


Figure 15 Relationship between arterial roads and percent tree cover at South East Asia and South Asia countries (India, Bhutan, Nepal, Myanmar, Thailand, Laos, Viet Nam)

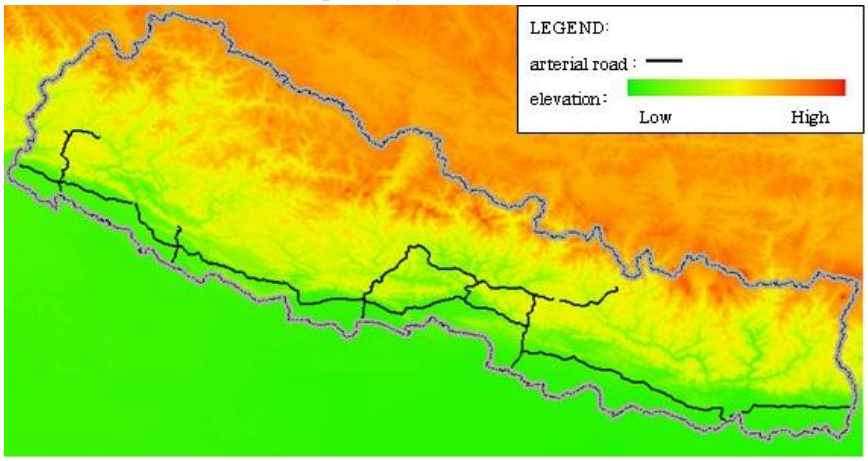


Figure16 Relationship between arterial roads and topography (Nepal)

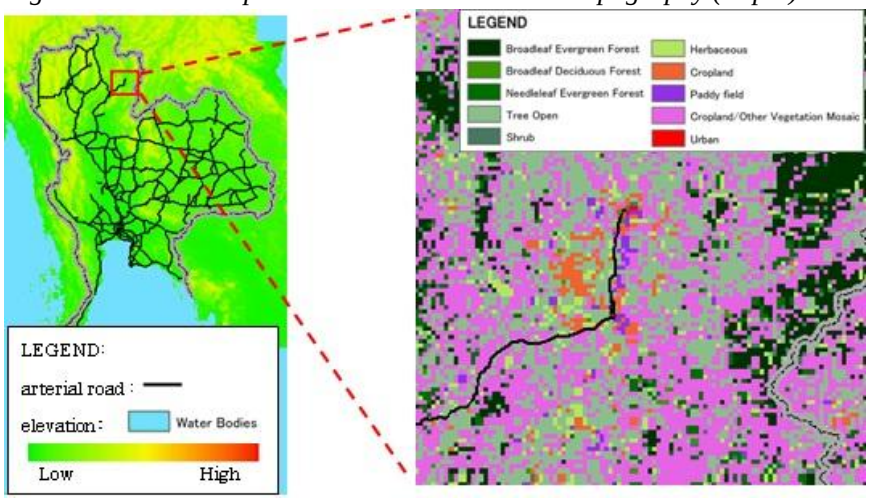


Figure17 Relationship between arterial roads and topography, land cover (Thailand)

4. CONCLUSIONS

The Global Mapping Project is making steady progress. Global Map Version 1 was completed and now Global Map Version 2 is being developed for completion in 2012 through the international cooperation of NMOs worldwide based on the new specifications.

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. Recently some countries including developing countries are capable of developing larger-scale data such as 1:250,000 scale data for all or specific regions of the country. ISCGM Secretariat is conducting a questionnaire survey to NMOs about the necessity and feasibility of developing larger-scale Global Map. Based on the results, the Secretariat and the Working Group 2 of ISCGM which is in charge of Specifications will discuss the new specifications for the larger-scale data.

REFERENCES

International Steering Committee for Global Mapping, Global Map Specifications Version 2, Revised at 16th ISCGM meeting, Bangkok, October 2009

Toru Nagayama, Yoshikazu Fukushima, Shozo Kajikawa, Junichi Kisanuki, Toshihiro Tsutsui, Seiichi Oomiya, Futoshi Akatsuka, Taro Ubukawa, Shuhei Kojima, Osamu Akutsu, Global Map -Achievements and issues of the one to one million scale global geographic datasets-, ICC2009, Santiago, November 2009

Noriko Kishimoto, Yoshikazu Fukushima, Tsuneo Tanaka, Takayuki Nakamura, Kosei Otoi, Hidehisa Takahashi, Seiichi Oomiya, Shuhei Kojima, and Masayuki Yoshikawa, Revision of Specifications for Global Map Version 2, Bulletin of the GSI, vol. 57, December 2009

Noriko Kishimoto, Yoshikazu Fukushima, Kosei Otoi, Takayuki Nakamura, Hidehisa Takahashi, Seiichi Oomiya, Shuhei Kojima, and Masayuki Yoshikawa, Application of the Global Map data for Global Issues, ISPRS Technical Commission VIII symposium, Kyoto, August 2010

Yoshikazu Fukushima, Takayuki Nakamura, Hidehisa Takahashi, Noriko Kishimoto, Shuhei Kojima, Application of the Global Map data for Global Issues, GSDI12 World Conference, Singapore, October 2010

ISCGM website

http://www.iscgm.org/