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Global Mapping: A Tool for Natural Disaster Mitigation*

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Summary

This paper discusses the origins of global mapping and the progress in the creation of Global Map, the major current initiative in global mapping. A major societal challenge facing the world today is how to deal more effectively with growing environmental problems. Reliable geographic information at a global scale is an indispensable element in formulating policy responses to global environmental challenges. The main purpose of Global Map is to describe the status of the global environment to aid in decision-making processes. Global Map provides digital maps of the terrestrial surface of the earth at a resolution of 1 km. with consistent and comparable specifications for every country. It is produced in cooperation with the national mapping organization in each country. Global Map was initiated by the Government of Japan as a contribution to the Action Plan of Agenda 21. There are four vector and four raster layers. Version 1 of Global Map was released in June 2008 and included coverage of Antarctica. It also includes two global maps with complete high quality coverage, one on land cover and the other on percentage tree cover. The paper will describe some recent developments of Global Map for the Americas.

Global Map was not specifically designed to deal with disaster mitigation and management but since 2004 this has become an increasingly important use of Global Map and Global Map is now providing digital base map coverage to the UNOCHA Web site on all major disaster sites within 48 hours of the event. The Global Assessment Report on Disaster Risk Reduction entitled *Risk and Poverty in a Changing Climate* released by the United Nations in May 2009 outlines the complex relationships between a variety of strategic, policy, economic and institutional issues on which concerted action is required to deal more effectively with disaster mitigation and management. Geographical information has an important role to play in providing the information required to deal with disaster mitigation and Global Map is making a significant contribution in this respect but many challenges remain. The provision of useful geoinformation for disaster mitigation and management will require greater integration of geoinformation from different sources and improved and speedier access to that information. At the technical level improved interoperability among datasets is required and the efforts of the Open Geospatial Consortium are of special importance in this respect. Equally, if not more important, is institutional cooperation among the various stakeholders responsible for collecting, storing and distributing geoinformation. This is a human and institutional challenge rather than a technical one. The paper will describe some of the efforts being made to improve the situation including those of the Joint Board of the Geospatial Information Societies and the creation both national and global spatial data infrastructures, of which Global Map is one example

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Antecedents of Global Map

The idea of international cooperation in mapping is not a new one. German geographer Albrecht Penck suggested the idea of an International 1:1 Million Map of the World (IMW) at the end of the 19th century. Although the idea was widely accepted and supported in principle at the time implementation was very slow and the international cooperation required to produce it proved difficult to achieve. It was not until 1909 that agreement was finally reached and work began on the IMW in a number of countries. A major setback took place in 1913 when the United States withdrew from the IMW, partially because of its impatience with the slow progress but also because of the isolationist policies of the government of the time (Pearson, et. al., 2006). The United States decided to produce its own 1:1 million scale map of Latin America, which it considered to be in its "sphere of influence". Despite this, at a second international IMW conference held in Paris in 1913, final agreement on the IMW specifications was reached among the 34 nations represented. A coordinating bureau for the initiative was established at the British Ordnance Survey. The outbreak of World War 1 destroyed the cooperative process which had created the IMW specifications but the impetus did not die. Slow progress on the creation of the IMW continued in the 1920's and 1930's but this was again interrupted by the outbreak of the Second World War in 1939. During that war the value of a 1:1 million map series was recognized by many of the participants on both sides of the conflict and several nations, including Japan, produced their own map series based on IMW specifications.

In 1949 the International Geographical Union suggested that the responsibility for the IMW be given to the cartographic unit of the newly established United Nations and this took place in 1951. There was, however, considerable skepticism over the need for an IMW in the post war era and, despite UN interest and support, relatively few new IMW sheets were produced. The project continued to limp along until in 1989 a UNESCO report concluded that the IMW was no longer feasible and the project came to a formal end with less than half the map sheets required ever having being produced.

Analysis of the IMW experience suggests that there were a number of reasons why this ambitious experiment did not succeed. There were no "…clear, consistent and manageable objectives" (Pearson et. al., 2006, p. 24) and those promoting it over the years failed to create and implement a "clear and consistent vision for their project" (Pearson et. al, 2006, p. 24). This experience provides valuable lessons for subsequent attempts to utilize geoinformatics, especially mapping, to respond to the challenges of agenda item 7(a) on strategy, policy, economic and institutional issues which is a major theme of this conference.

The Vision, Origin and Purpose Of Global Map

There are direct and interesting parallels between the vision and plans to create Global Map with the earlier attempts to create the IMW (Pearson et. al., 2006). Almost exactly a century after IMW was proposed the Government of Japan, with support from the United States, proposed a new initiative to create a 1:1 million digital map of the world to aid in environmental and sustainable development decision making. Japan had a special interest in environmental issues at the international level and saw the creation of Global Map as one specific response to the challenges posed by the United Nations Conference on Environment and Development held in Brazil in 1992. The action plan of Agenda 21, which came out of that meeting, included a specific call for the creation of global environmental data as an aid to decision making (Pearson et. al., 2006).

International recognition and involvement has been key to the creation of Global Map as outlined by Maruyama (1998), Masaharu and Akiyama (2003), and Okatani et. al. (2006). Receiving continuing international endorsement and political support especially, from the United Nations, has been a critical factor for success. Global Map requires the active participation of national and regional mapping organizations and great care has been taken to ensure that each member of the Global Map family can effectively make a contribution to Global Map. This “bottom-up” participative process is a key element of the Global Map initiative. For many nations this involves an ongoing capacity building process which again is an important feature of Global Map.

The first international workshop on Global Mapping was held in Japan in 1994, which set a target date of a first version of Global Map by the year 2000. The International Steering Committee for Global Mapping (ISCGM), made up of representatives of national mapping organizations, was established at a second workshop held in 1996. Professor John Estes of the United States was elected as the first Chair of ISCGM and the Director General of the Geographical Survey Institute of Japan, Kunio Nonmura, outlined the proposals for the creation of Global Map. It was to be a digital map of the world at 1 km. resolution (approximately 1:1 million scale) with eight layers, four vector and four raster, with common specifications. It was to be made freely available for public use in the international arena. Global Map was formally proposed by Japan and the United States and accepted as part of the implementation plan for Agenda 21 in 1997 at the 19th Special Session of the United Nations Economic and Social Council. The first Global Map Forum was held later that year and the specifications of Global Map were finalized after an extensive consultation process. In January 1998 ISCGM sent out a letter with endorsement from the United Nations, inviting all of the national mapping organizations of the world to participate in Global Map.

Many nations lacked the initial capacity to create their own digital map coverage. This challenge was met in two ways. First, to create Version 0 of Global Map existing digital datasets such as G TOPO 30, Vector Map level 0, and One Kilometer Advanced Very High Land Radiometer data, were freely provided to each participating organization which then updated and verified that coverage according to Global Map specifications. The provision of these datasets was facilitated by the United States Geological Survey. Without this support the release of Version 0 in 2000, which was largely based on these three datasets, would not have been possible. The quick release of Version 0 with global coverage was important to demonstrate the viability of the Global Map vision. American isolationism seriously damaged the creation of IMW but the involvement of the United States as a global player was a great advantage for the creation of Global Map.

A second factor was the capacity building program built in as an integral part of the Global Map initiative. From the outset nations were asked to identify the level of involvement they wished to undertake. A country choosing Level A involvement agrees not only to process its own data but also to help one or more other countries to do so. Countries requiring assistance to complete their coverage choose the Level C designation and those choosing Level B agree only to process data for their own country.

Japan has been the most active of the countries choosing the Level A designation. This is largely because of the partnership established between the Geographical Survey Institute (the national mapping organization), the Japan International Cooperation Agency (JICA) and the Ministry of Lands, Infrastructure and Transport (MLIT). JICA is one of the few aid agencies specifically giving assistance to mapping agencies in the developing world (JICA, 2003). Part of that assistance involves support for the creation of Global Map. For a number of years MLIT has supported a Global Map workshop in Africa and has also helped to facilitate an annual scholarship program funded by JICA since 1994 which brings trainees from national mapping organizations to the Geographical Survey Institute for extended periods to receive training in the production of Global Map. These efforts have been supplemented by the private sector and both ESRI and Intergraph have provided grant support to aid national mapping organizations, especially in the acquisition of software.

As a result of these capacity building efforts many of the first nations to complete their Global Map coverage were developing nations including Kenya, Myanmar and Mongolia among others.

A major event in the history of Global Map was the involvement of the Global Map Secretariat in the World Summit for Sustainable Development held in Johannesburg in 2002 (Masahara and Akiyama, 2003). The Secretariat participated in all four workshops leading up to the Summit and in the Summit itself and, largely as a result of this input, the implementation document which came out of the Summit contains paragraphs 132 and 133 as follows:

"132. Promote the development and wider use of earth observation technologies, including satellite remote sensing, global mapping and geographic information systems, to collect quality data on environmental impacts, land use and land-use changes, including through urgent actions at all levels to: (a) Strengthen cooperation and coordination among global observing systems and research programmes for integrated global observations, taking into account the need for building capacity and sharing of data from ground-based observations, satellite remote sensing and other sources among all countries; (b) Develop information systems that make the sharing of valuable data possible, including the active exchange of Earth observation data; (c) Encourage initiatives and partnerships for global mapping.
133. Support countries, particularly developing countries, in their national efforts to: (a) Collect data that are accurate, long-term, consistent and reliable; (b) Use satellite and remote-sensing technologies for data collection and further improvement of ground-based observations; (c) Access, explore and use geographic information by utilizing the technologies of satellite remote sensing, satellite global positioning, mapping and geographic information systems."(United Nations WSSD, 2002).

The explicit recognition of Global Map and the identification of ISCGM as an implementing agency were important to reaffirm United Nations support for Global Map. All of the nations present at the Summit endorsed the document and at the national level this provides each national mapping agency with strong arguments for the allocation of national resources for the production of Global Map.

It is important to note that, as outlined earlier, Global Map is part of a much wider program by the Government of Japan to support initiatives leading to improvements in environment and sustainable development of the global level. In 2000 Japan committed almost one third of its large ODA budget for this purpose (Okada, 2003) and at the Johannesburg Summit announced a new program, the Environmental Conservation Initiative for Sustainable Development (ECOISD) (Okada, 2003) further strengthening Japan's international support for environmental initiatives of which Global Map is a part.

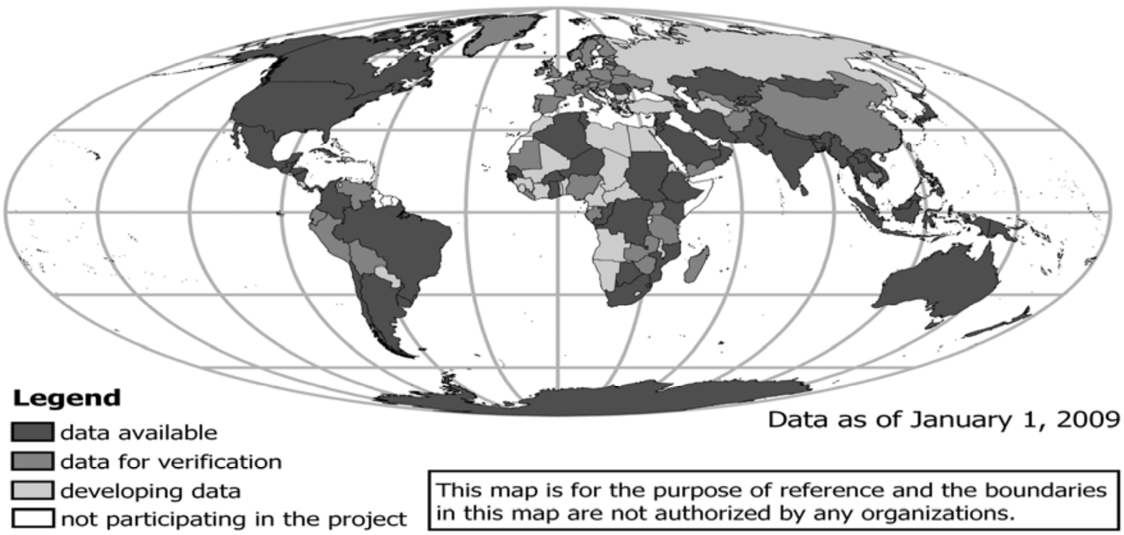
Geomatics initiatives are much more likely to be effective if they are part of a much wider commitment to a specific goal. In the case of Global Map this is the commitment of Japan to provide long term funding and support to policies and programs aimed at improving global environmental conditions and furthering sustainable development at the global scale. It can be argued that no geomatics initiative can be fully effective if it is an isolated program. The IMW was isolated from other international initiatives of the time, which may have contributed to its lack of success. Global Map plays a very specific role in a much wider effort. It is also an effort that has been sustained over time with adequate funding and continuing support. This support has been provided since 1992 and the Government of Japan has indicated that support will continue for a new phase of Global Map after the release of Version 1 of Global Map in June 2008.

The Current Status of Global Map

Participation in Global Map as of January 1, 2009 is shown in Figure 1. As of May, 2009 164 countries and 16 regions including Antarctica were participating in Global Map. This represents over 96% of the earth's territorial surface. Data have been released for almost 60% of the earth's surface by area and 52% by population and data for many other countries are undergoing verification. Version I of Global Map was released on June 5,

2008. In addition to the coverage mentioned above a Global Percentage Tree Cover Map and a Global Land Cover Map were launched (Akatsuka, 2008). Unlike its predecessor, the International Map of the World, Global Map has made remarkable progress but many challenges remain in achieving 100% coverage.

Figure 1



Global Map and the Americas

Almost all of the countries in the Americas are participating in the Global Map project (Maruyama, 2006) as can be seen in Figure 1. Both Mexico and Brazil completed their coverage very early and Brazil used its Global Map coverage as the basis for its National Spatial Data Infrastructure. Some smaller countries, especially some of the islands of the Caribbean, are not yet actively participating in Global Map. One of the reasons for this is that the scale of Global Map is too small to be of practical utility at the national level. To overcome this problem Global Map has agreed to accept the coverage at the larger scale of 1:250,000. Discussions are currently underway to explore the possibility of using the Caribbean Community (CARICOM) as an institutional framework for the creation of Global Map for the Caribbean region.

Cooperation is a key element in the creation of Global Map and this institutional approach is being used in the Americas. One of the drawbacks of the current Global Map coverage is that it is not seamless. Each country creates its own coverage using the current tile structure although the specifications of Global Map are under review and new specifications will be released in 2009. Several regional initiatives are underway to create seamless coverage for the Americas.

Since 2004, managers and map makers from INEGI in Mexico, the Atlas of Canada, and the National Atlas of the United States have worked together to create and maintain an Atlas of North America at one to ten million scale. At their most recent annual meeting held in Ottawa in late October of 2008, these representatives agreed to expand their work to embrace harmonized frameworks at a scale of one to one million. In this meeting, the delegates from INEGI expressed reservations about using their existing 1:1,000,000-scale frameworks since these were collected fifteen years ago while those from the United States were produced in recent years. They generously offered to update the Mexico data before serious work began to integrate their base cartographic layers with those from the United States. This revision work is underway in Aguascalientes. A technical working team from these organizations meets monthly via teleconference. Their current efforts include: production of harmonized datasets of international borders; creation of a common data dictionary built upon the

Global Map specifications; integration of streams at the Canadian-US border; and the identification of classification differences among the three Nations that make the work more challenging. A separate management team, which includes a representative from the NAFTA Commission for Environmental Cooperation, also meets monthly. It may be two years before these harmonized cartographic frameworks are ready. They will be offered at no cost to the end user by the national mapping organizations; will be contributed to the Global Map effort, and will be maintained according to a revision schedule yet to be determined.

A related initiative is underway led by the Cartography Commission of the Pan American Institute of Geography and History (PAIGH). The Americas Global Map project has its origins in a cooperation agreement between ISCGM and the Pan-American Institute for Geography and History (PAIGH) (Barriga, 2008). The project is being coordinated by the PAIGH Cartography Commission and involves a growing number of PAIGH member states. PAIGH provides financial support as one of its technical cooperation projects. The Americas Global Map (MGA in Spanish) has an Executive Committee with members from several PAIGH member countries. The sub-projects initiated so far have included a major survey of Spatial Data Infrastructures and small-scale digital datasets in the region (with the support of a grant from GSDI) and some technical advice to El Salvador on that country's contribution to the ISCGM program.

The core of the MGA program is the creation of a seamless map of South America from the existing GM vector datasets of the Americas. A methodology has been determined, trials carried out and now work is in progress on merging many of the GM datasets needed. A first draft will be presented as a concrete deliverable on the completion of the PAIGH Technical Cooperation project. The project will continue as a Working Group within the PAIGH Cartography Commission.

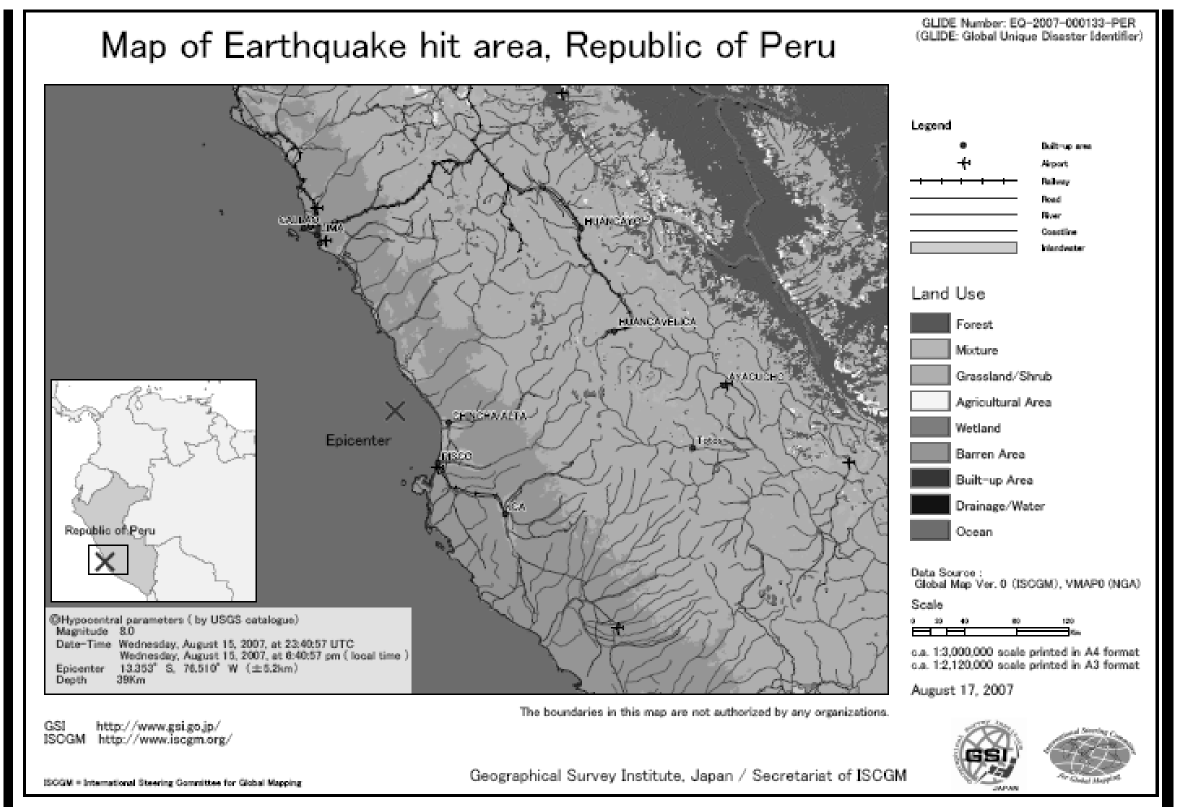
These and other initiatives, such as those of the Andean countries to create regional coverage, and the creation of the Territorial Information System for MesoAmerica funded by the Inter-American Development Bank and led by PAIGH, will complement Global Map in the Americas. A major goal of the MesoAmerican system is to aid in disaster mitigation and management.

Global Map and Disaster Mitigation and Management

Each year disasters of various types cause thousands of deaths and injuries, extensive population displacement and major property damage throughout the world. A recent U.N. Report (UN, May 15, 2009) estimated that in 2007 alone there were over 300 disasters which killed 236,000 people, affected 200 million more, and causing damages totaling $280 billion. Major disasters receive wide publicity and often international assistance. Some, such as earthquakes, tsunamis and volcanic eruptions are of geophysical origins. Others, such as health pandemics or locust infestations are biological. Yet others are societal in origin and are largely man-made. The major disasters are usually well documented but for every major disaster there are hundreds which remain either undocumented or at best under-documented. Collectively such disasters probably cause as much damage and destruction as the major ones. In all disasters there is a need for good geoinformation. Data collection technologies, such as sensors, can help assess risk and provide early warning for some types of disasters. Data processing systems can provide real-time monitoring as well as predictions on impact. Data management and analysis, including modeling, can be invaluable. Data visualization, especially mapping, is a basic element in all forms of disaster mitigation and management as well as in risk assessment. Of special importance is data access and sharing. Here we are facing major problems of both access to, and interoperability of, geospatial information. Often substantial geospatial information is available but is either not readily accessible for a variety of administrative and political reasons, or not easy to use because of the incompatibility of the different systems used to collect, store and manipulate it. Even in advanced technological societies such as the United States the impact of such issues can be great. Hurricane Katrina is a prime example. Very substantial geospatial information was available but the problems outlined above made its effective use in the disaster sigution very much less that it could have been.

Global Map was not initially designed with disaster mitigation and management in mind but over the last five years in particular this has become an increasing priority application area for Global Map. The first application of Global Map data to disaster management initiatives took place after the Indian Ocean earthquake and tsunami on December 24, 2004 (Ubukawa, Kisanuki, Akatasuka, 2008). The Geographical Survey Institute of Japan released a regional map of the affected area using Global Map data within days of the disaster. The base map data of the eight layers of Global Map is particularly useful when more than one nation is affected by a disaster. The common specifications and standards and the ready online availability of Global Map provides a useful small scale framework to which other information can readily be added. Global Map is an operational global spatial data infrastructure (Taylor, 2005). Since 2004 Global Map has released maps for use in disaster mitigation for all major disasters which have taken place since that time and these are now released within 48 hours of the occurrence of a disaster. Figure 2 shows one of the maps released after the earthquake in Peru in 2007.

Figure 2



These maps are available on the ISCGM Web site, the GSI Web site and on the UN Relief Web of the United Nations Office of Community and Humanitarian Affairs (UNOCHA) which coordinates information on disaster areas. Speedy availability of high quality base map data is of great utility in disaster management. Although the maps are small-scale they are of special value in areas where base map availability is a problem. Global Map coverage of Myanmar, for example, was of special value during the floods in that country in 2008. As Myanmar had completed its Global Map coverage this was one of the few comprehensive series of base maps available. Global Map data is primarily base map data but it can be used together with other information for modeling and predictive purposes. At the Fifth World Water Forum held in Istanbul in 2009, for example, Global Map base map data was used in conjunction with projected changes in maximum daily rainfall to identify areas at risk of flooding in the future.

There are other advantages of Global Map in disaster mitigation and management. One is that Global Map coverage of the disaster areas allows decision makers to get an overall picture of the scale and distribution of disaster impacts. This is also available to all of the agencies involved as well as to non-government agencies, the press and the general public.

Another advantage is that Global Map is built by a bottom-up cooperation process among the national mapping agencies of the world and in cooperation with international agencies and organizations of all types. The institutional coordination and cooperation is essential in helping to draw together geospatial information to respond to disasters. This institutional contribution may be just as valuable a contribution as the provision of the base mapping.

Conclusion

On May 17, 2009 the United Nations released the first ever Global Assessment Report of Disaster Risk Reduction entitled *Risk and Poverty in a Changing Climate* (United Nations, 2009). This outlined the complex relationships between a variety of strategic, policy, economic and institutional issues on which concerted action is required if society is to deal more effectively with disaster mitigation and management. None of the report's 20 recommendations mentioned geospatial data although a link was given to the Global Risk Data Platform maintained by UNEP, UNDP, UN/ISDR and the World Bank which contains information in map form at very small scales and of a very general nature. The report does call for "…the functional integration of scientific bodies" (p. 197) responsible for risk management but geospatial information and mapping are not specifically mentioned. Geospatial information has an important role to play in providing the information required to deal with disaster situations and Global Map is making a significant contribution in this respect but many challenges remain. The provision of useful geoinformation for disaster mitigation and management will require greater integration of geoinformation from different sources and much improved and more speedy access to that information. At a technical level much more needs to be done to improve interoperability among datasets. What has been called "interoperability science" (Jackson, Schell and Taylor, 2009a) is in its infancy. In this respect the work of the Open Geospatial Consortium (OGC) is of special importance and OGC has an active Emergency Information Interoperability Framework Incubator Group. Equally, if not more important, is institutional cooperation among the various stakeholders responsible for collecting, storing and distributing geoinformation. This is a human and institutional challenge rather than a technical one.

Some progress is being made. In 2008 the Joint Board of the Geospatial Information Societies (JBGIS) in cooperation with UNSPIDER initiated a project to produce a "Best Practices Booklet on Geo-Information for Risk and Disaster Management". The aim is "to cr eat e a decision support forum based on the knowledge and experience of experts to outline the potential uses of geo-information technologies to governmental, institutional and operative decision makers all over the world." (http://www. FIG.NET/JBGIS) The publication is planned for July 2010 in Vienna At UNOOSA. This is an important and necessary first step and Global Map hopes to make a contribution to the booklet but much more needs to be done. More effective use of geoinformation for disaster mitigation and management will require much better availability to that information and a major barrier to this is the need for more effective cooperation among the main agencies and organizations responsible for the collection and management of that information both at the national and international level. At the national level the People's Republic of China has made impressive progress with the establishment in July 2007 of an Emergency Centre for Spatial Data involving all of the main agencies involved in disaster mitigation and management.

In addition, a major effort is required to ensure that efforts by the geospatial agencies to create institutional frameworks, such as national spatial data infrastructures (NSDI), designed to help coordinate geospatial data, include all major stakeholders, not just those responsible for geospatial data. As Jackson, Schell and Taylor argue, “We need to elevate NSDI to the highest level if we are to adequately deal with the rapidly advancing progress in geospatial information and technology. NSDI is too important to be left only in the hands of the geospatial community.” (2009b). This has particular relevance to the complex field of disaster mitigation and management where Margareta Wahlstrom, the UN Assistant Secretary General for Disaster Risk Reduction has argued that merging disaster risk reduction, poverty and climate change adaptation into a single coherent and innovative approach” is needed. High quality geospatial information in an integrated, easily accessible, free or low cost format is fundamental to the effective implementation of disaster mitigation and management and strategies. Global Map provides a concrete and ongoing contribution but the way forward lies in greater institutional cooperation among the various organizations involved in the geospatial sciences and increased technical efforts to make various geospatial datasets of utility to disaster mitigation and management much more interoperable. Considerable progress has been made in the latter area but more effective institutional cooperation at both national and international scales faces numerous political and bureaucratic challenges.

Referencens

Akatsuka, F. 2008. Release of land cover and percentage tree cover data of the Global Map Version 1 (Global Version). *Global Mapping Newsletter* 51: 3.

Barriga, R. 2005. America’s Global Map. Presentation to the 12th ISCGM (International Steering Committee for Global Mapping). Cairo, April 25.

Jackson, M., Schell, D., Taylor, D.R.F., 2009a. The evolution of geospatial technology calls for changes in geospatial research directions, education and government. Directions Magazine, April 6. http://www.directionsmag.com, accessed May 20, 2009.

Jackson, M., Schell, D., Taylor, D.R.F., 2009b. National spatial data infrastructures: coordinating framework or battleground for the management of geospatial data. *GIS Professional*, June 2009.

Japan International Cooperation Agency (JICA). 2003. *Contributions to national mapping progress*. Tokyo: JICA Social Development Study Department.

Joint Board of the Geospatial Information Societies (JBGIS), 2009. Call for abstracts: JBGIS Best Practices on Geo-Inforamtiona for Riask and Data Management. http://www. fig.nat/jbgis/, March 18.

Maruyama, H. 1998. History of activities for international agreement on the development of the Global Map. *Bulletin of the Geographical Survey Institute* 44: 63-90.

Maruyama, H. 2006. Situation of Global Map development in the Americas. Presentation to GSDI 9 Conference, Santiago, Chile

Masaharu, M. and Akiyama, M. 2003. Publicity activities of Global Mapping at Johannesburg Summit and outcomes of the Summit. *Bulletin of the Geographical Survey Institute* 49: 56-69.

Okada, S. 2003. Towards a green future. *Asian Pacific Perspectives*. Japan+1 1:26-29.

Okatani, T., Maruyama, H., Sasaki, M., Yaguguchi, T., Magayama, S., Kayaba, M., Abe, M. and Kishimoto, N. 2006. Progress of Global Mapping project since the Johannesburg Summit in 2002. *Bulletin of the Geographical Survey Institute of Japan* 53: 7-16.

Pearson, A., Taylor, D. R. Fraser, Kline, K. D. and Heffernana, M. 2006. Cartographic ideals and geopolitical realities: International maps of the world from the 1890s to the present. *The Canadian Geographer* 50 (2): 149-176.

Penck, A. 1893. Construction of a Map of the World on a scale of 1:1 million. *Geographical Journal* 1: 253-261.

Taylor, D R. F. 2005. The history and development of Global Map as a global spatial data infrastructure. Presentation to International Federation of Surveyors Writing Week and the 8th International Conference of the Global Spatial Data Infrastructure Association, Cairo, April 20.

Taylor, D. R. F. 2008. Global Map standards and specifications. Presentation to Standards Workshop, GSDI-10 Conference. Trinidad, February 25, 2007. *Proceedings of GSDI-10*, CD-ROM.

Ubukawa, T. Kisanuki, J. and Akatsuka, F., 2008. Global Map – an international project. *Geographische Rundschau*. International Edition. 4: 62-65.

Wahlstrom, Magareta, 2009. Statement on the release of the United Nations report on disaster risk reduction: Risk and poverty in a changing climate. May 17. Bahrein: Reuters Alert Net.

United Nations, 2002. Report of the world summit on sustainable development. http://www.Johannesburg summit.org/html/documents/su;mmit-docs.html (accessed December 2008).

United Nations International Strategy for Disaster Reduction (2008). Global assessment report on disaster risk reduction: *Risk and poverty in a changing climate*. Geneva: United Nations Press, 200 pages.