SUPPORTING RISK MANAGEMENT AND DISASTER REDUCTION: THE GEOHAZARDS COMMUNITY OF PRACTICE AND THE SUPERSITE INITIATIVE

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ABSTRACT:

Increased exposure to natural hazards in combination with limited preparedness and risk reduction leads to a rapidly growing number of major disasters and loss of property and human lives. The concept of the risk management cycle with the four phases of mitigation and preparedness, early warning, response, and recovery captures the steps necessary to reduce the number and scale of disasters. In many regions, geohazards dominate the spectrum of natural hazards. Understanding the associated processes and gaining a comprehensive knowledge of the location and characteristics of these hazards is pivotal for informed risk management. Over the past few years, initial steps have been taken by members of the former *Integrated Global Observing Strategy Partnership* (IGOS-P) Geohazards Theme to make progress towards a *Geohazards Community of Practice* (GHCP) for the *Group on Earth Observations* (GEO). A recommendation of the 3rd International Workshop on Geohazards held in 2007 led to the establishment of the *Supersite Initiative*, which has the goal to ensure for a small number of supersites access to comprehensive data for research related to geohazards. This initiative has established a web page where relevant data are available for a number of globally distributed sites. The GHCP has developed a draft roadmap, which lies the ground for utilizing the *Global Earth Observing System of Systems* (GEOSS) in support of all phases of the risk management cycle. Although the roadmap focuses on the risk management cycle as it applies to geohazards, it is to a large extent generic and applicable to all hazards considered in the frame of the *Societal Benefit Area* (SBA) "Disasters" of GEO.

1 INTRODUCTION

Natural hazards are a growing societal challenge. Settlements and infrastructure increasingly are extending into hazardous areas and the sprawling into these areas shows no abating trend. Widespread poverty is common in many hazardous areas, limiting the means to mitigate disasters and build resilience. The increasing exposure in combination with limited preparedness and a lack of risk reduction results in a rapidly growing number of major disasters associated with a rapid increase of damage to infrastructure and loss of human lives. Reducing disasters caused by natural hazards requires appropriate human adaptation and preparedness reducing exposure and risks and increasing resilience. The concept of the risk management cycle with the four phases of mitigation and preparedness, early warning, response, and recovery captures the necessary steps to reduce the number and scale of disasters (UNISDR, 2005). Comprehensive information about natural hazards is a prerequisite for a successful implementation of this concept. But information alone is not sufficient. First, this information needs to be made available to policy and decision makers in an understandable and actionable way. Then policy and decision makers need to have the mandate and will to act on this information. Finally, society needs to be informed about the natural hazards and thus be able to judge the policies and decisions made in terms of their potential for success.

Over the last few decades a number of international programs, both intergovernmental and non-governmental, have reacted to the increasing losses caused by natural disasters and focused on disaster reductions. The *Hyogo Framework for Action 2005-2015* aims on building resilience of nations and communities to disasters. The *International Strategy for Disaster Reduction* (ISDR) and the ISDR system have the overall objective to generate and support a global disaster risk reduction movement to reduce risk to disasters through implementation of the Hyogo Framework. The ISDR priorities for action for 2005 to 2015 implicitly summarize the current status: (1) Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation; (2) Identify, assess and monitor disaster risks and enhance early warning; (3) Use knowledge, innovation and education to build a culture of safety and resilience at all levels; (4) Reduce the underlying risk factors; and (5) Strengthen disaster preparedness for effective response at all levels.

In order to achieve improved risk management and disaster reduction, a focus needs to be on creating in all societal areas a broad awareness of the hazards and of the options for adaptation to these hazards and the mitigation of the risks. Awareness of the hazards and risks and willingness to adapt and mitigate will reduce the scale of disasters, ease response and recovery, and inherently increase resilience. Integrating mitigation and adaptation considerations into planning and development of settlements and infrastructure long before the occurrence of a specific hazardous event is a prerequisite for resilience. Improved data access, better availability and use of information, improved understanding of the hazards, their causes, and their potential impacts are necessary building blocks for efficient risk management. The goal of the "Disaster" *Societal Benefit Area* (SBA) of Earth observations addressed by the *Group on Earth Observations* (GEO) is "*reducing loss of life and property from natural and human-induced disasters*" (GEO, 2005). The Strategic Target of GEO for the "Disaster" SBA (see BOX 1) recognizes the importance of observations and focuses GEO and the *Global Earth Observation System of Systems* (GEOSS) on coordination of observing and information systems.

Many of the disasters caused by natural hazards originate from geohazards, such as earthquakes, volcano eruptions, landslides, and tsunamis (Marsh and the Geohazards Theme Team, 2004). In many regions, geohazards are among the major, if not the major, natural hazards. Increasingly, large urban settlements are sprawl-

BOX 1: GEOSS STRATEGIC TARGET OF THE DISASTER SBA:
Enable the global coordination of observing and information systems to support all phases of the risk management cycle associated with hazards (mitigation and preparedness, early warning, response, and recovery).
This will be achieved through:

- more timely dissemination of information from globally-coordinated systems for monitoring, predicting, risk assessment, early warning, mitigating, and responding to hazards at local, national, regional, and global levels;
- development of multi-hazard and/or end-to-end approaches, as appropriate to meet the needs for disaster risk reduction, preparedness and response in relevant hazard environments;
- supporting the implementation of the priorities for action identified in the Hyogo Framework for Action 2005-2015: Building the resilience of nations and communities to disasters (HFA).

ing into areas exposed to geohazards, thus increasing the likelihood of extreme disasters that could inflict extensive damage and loss and even disrupt whole economies.

Over the last decades, a lot of information on geohazards has been collected. For many regions, geohazards are known increasingly well, many of the driving processes are well understood, and comprehensive descriptions of the characteristics of geohazards are available, for example, in the form of hazard, risk, and vulnerability maps. Early detection of hazardous events increasingly is feasible, thus enabling early warning as a key element in disaster reduction. Nevertheless, in many regions on the globe, the number and scale of disasters caused by geohazards are rising. Partly, this is due to a rapid growth of population and infrastructure into hazardous areas. However, in too many cases, decision and policy making is not sufficiently informed or ignoring the available information, particularly in developing regions. Relevant policy and decision making, for example, related to zoning and building codes, often ignores the available information, particularly in areas with widespread poverty. As a consequence mitigation and adaptation measures are insufficient, and preparedness is low. The comparison of the extreme disaster caused by the 2010 M=7.0 earthquakes in Haiti to the very small impact of similar earthquakes in California provides a clear indication of how informed policy making for mitigation and adaptation can strengthen resilience and significantly reduce the disasters cause by these events. Timely detection of hazardous events is often not possible due to a lack of observations and operational detection systems, and early warnings are not issued due to a lack of infrastructure and decision processes, or ineffective due to limited preparedness. Importantly, prior to disasters, public awareness of the risk is often very limited, particularly in less developed areas, and information on geohazards and associated risks is not integral part of the public environmental information basis.

Many of the geohazards are related to common processes, and the observational requirements for the mapping and monitoring of the hazards, the early detection of hazardous events, and the information needed for response and recovery are to a large extent similar or overlapping across the different geohazards. It therefore appears reasonable to consider geohazards as a separate subgroup of natural hazards. The importance of geohazards

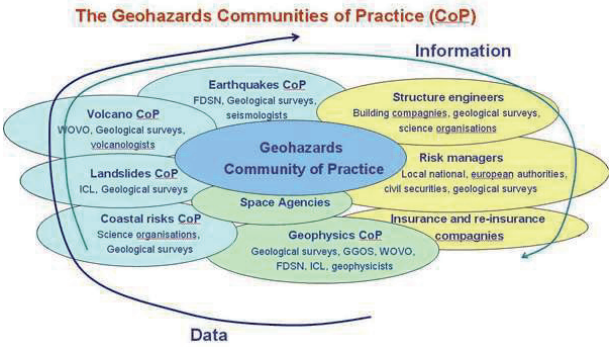

Figure 1: Groups forming the geohazards community of practice. Different groups are related to various aspects of geohazards, including research, monitoring, and assessment, mitigation and adaptation, and disaster reduction and recovery. Ideally, the GHCP of GEO would integrate all these groups in a broad *Community of Practice* (CoP). Currently, membership in the GHCP is more reflecting the groups depicted in the left and center parts of the diagram. These groups are providing observations, assessments, and scientific knowledge related to geohazards. The groups further away from Earth observations and science and closer to societal applications are less represented, and the GHCP will have to make an effort to bring these groups into the CoP. Figure courtesy G. LeCozannet.

is emphasized in the GEO Work Plan: Most Work Plan Tasks within the Disaster SBA address specifically geohazards (GEO Secretariat, 2008). GEOSS is facilitating a growth of information pertaining to geohazards both in quantity and quality, and by that enables additional research, which will further improve the understanding of the driving processes and the spatial and temporal characteristics of the hazards. The importance of observing and understanding geohazards to the Disaster SBA is obvious. Over the past few years, the former Geohazards Theme Team of the *Integrated Global Observing Strategy Partnership* (IGOS-P) has made initial steps toward a *Geohazards Community of Practice* (GHCP) for GEO. The GHCP has developed a roadmap, which focuses on Earth observation support for the four phases of the risk management cycle.

In 2005 and 2007, the IGOS-P Geohazards Theme Team organized two international workshops on geohazards. The last of these workshops recommended the establishment of a small number of reference sites, often denoted as supersites, at which free access would be given to comprehensive data in support of research related to geohazards (Le Cozannet and Salichon, 2007a). The Supersite Initiative has established an initial web page where relevant data are available for a number of globally distributed sites.

In the following, we will first describe the societal background for the GHCP. We then summarize the GHCP roadmap (Section 3) and discuss the approach to the implementation of this roadmap (Section 4). The Supersite Initiative described in Section 5 is a first step towards the implementation of this roadmap.

2 THE GHCP

The GHCP is a *Community of Practice* (CoP) supporting GEO, which originated from the IGOS-P Geohazards Theme. The IGOS-P Geohazards Theme was initiated in 2002 and published its first report in April 2004 (Marsh and the Geohazards Theme Team, 2004). This report provided a solid basis for the work of the Theme Team in the following years. Major events included the

2nd and 3rd International Geohazards Workshops organized in 2005 and 2007 in Orleans, France, and Frascati, Italy, respectively. Other important milestones were the publication of an updated theme report (Salichon et al., 2007) and a report on observational requirements (LeCozannet and Salichon, 2007b). Between 2005 and 2008, the Theme was actively involved in GEO Committees and GEO Task Teams. In the course of the transition of IGOS-P Themes into GEO, activity shifted more to the emerging GHCP. The GHCP was proposed to the *GEO User Interface Committee* (UIC) in 2005. In an initial phase lasting from 2006 to 2008 most of the activities of the GHCP were coordinated by the Geohazards Bureau hosted during that period by BRGM, France. In December 2008, this Bureau was closed, and the activity level of the GHCP dropped significantly. During 2009, the future of the GHCP was discussed during several meetings of the GEO UIC and GEO *Science and Technology Committee* (STC) as well as separate splinter meetings of the GEO Secretariat with a core GHCP group. As a result of this dialog, it was agreed to draft a roadmap for the GHCP.

The GHCP brings together national and international organizations concerned with geohazards and their impacts on society, and aims to link these organizations to GEO in order to facilitate support for relevant GEO Work Plan Tasks and to increase the societal benefits of GEOSS. The GHCP provides a coordinating platform for high-level policy makers and the broader geohazards community. By bringing together data providers, scientists, and decision makers, the GHCP links GEOSS to relevant S&T communities, provides updated user requirements for applications related to geohazards and the risk management cycle, and contributes to the delivery of information to end users. The GHCP has the goal to improve all four phases of the risk management cycle in order to reduce the loss of lives and property caused by geohazards. The Strategic Target of the GHCP (BOX 2) details GEO's Strategic Target for the Disaster SBA for the case of geohazards. In order to achieve its goal, the GHCP aims to ensure that comprehensive information about geohazards is available to decision and policy makers during all phases of the risk management cycle. This implies that information gaps are identified and addressed through observation and research, and that efficient links between data providers, researchers and the end users, the decision makers and the public, are established in order to ensure the information flow. It also implies that information is made available in applicable form and that expert support is provided for capacity building in the use of the information.

BOX 2: STRATEGIC TARGET OF THE GHCP:
By 2020 put in place all building blocks for comprehensive monitoring of geohazards and the provision of timely information on spatio-temporal characteristics, risks, and occurrence of geohazards, in support of all phases of the risk management cycle (mitigation and preparedness, early warning, response, and recovery), and as a basis for increased resilience and disaster reduction.
This will be achieved by developing a global network of very few carefully selected core sites. These core sites will provide focal points for a large geographical region, where all building blocks of a value chain from observations to end users can be linked together and applied to the phases of the risk management cycle relevant for this region. Thus, these core sites will demonstrate the concept, enable scientific studies and technological developments, provide for capacity building, and inform policy and decision making in the region.

3 THE GHCP ROADMAP

3.1 Motivation, Audience, and Approach

The GHCP roadmap has the goal to ensure support through Earth observation for all phases of the risk management cycle. In order to prepare for the occurrence of hazardous events, to mitigate the danger of these events causing disasters, and to ensure proper response and recovery from unavoidable disasters, humanity urgently needs information about the types of hazards to be expected in a region, their spatio-temporal characteristics, and, in case of specific hazardous events occurring, timely early warnings. The roadmap lies the ground to utilize GEOSS in a best effort to provide this information to society and the relevant policy and decision makers. Although the roadmap focuses on the risk management cycle as it applies to geohazards, it is to a large extent generic and provides an example for all hazards. Thus, the roadmap is a pilot initiative for all hazards considered in the frame of the Disaster SBA of GEO.

Official regulations, adaptations, warnings, and response and recovery actions are mostly mandated to governmental agencies. The roadmap recognizes and respects these mandated activities, and the goal is to support and inform authorities in their mandated responsibilities where needed.

Achieving significant reduction of disasters caused by geohazards requires coordinated, multi-disciplinary input into all phases of the risk management cycle. For each of these phases, the roadmap specifies activities that would lead to significantly improved support of risk management through Earth observations and GEOSS. These activities have the common goal of increasing resilience throughout all phases of the risk management cycle, i.e., before the occurrence of a hazardous event, during the event, during the response, and during the recovery phase after the event. The roadmap aims at facilitating the coordination of these activities, in particular across national and disciplinary boundaries. Increased awareness of geohazards that can occur and impact a given location is considered a key step towards mitigation and preparedness. The interface between data providers and researchers on the one side and the mandated authorities and the public on the other side deserves specific attention in order to ensure that information about geohazards is available where and when needed. The roadmap is addressed to the *Member Countries* (MCs) and *Participating Organizations* (POs) of GEO and provides a framework for coordination of national and international programs and activities of the POs to facilitate support of geohazards-related applications through GEOSS. It also addresses the science and technology communities whose active participation is needed in order to reach the challenging but highly gratifying goal of providing observations and information needed to improve risk management and reduce disasters.

3.2 Cross-cutting Issues

The different phases of the risk management cycle share a number of cross-cutting issues associated with the various elements of the value-added chain from observations to end users. Comprehensive observations are crucial for the understanding and characterization of geohazards, and the development of appropriate observation systems, sensors, and information systems is required for all phases. The integration of ground-based systems with airborne and space-borne systems and the provision of groundtruth for remote sensing are challenging issues particularly in the context of a rapid development of sensors and observational infrastructure. Scientific advances in our understanding of the temporal and spatial characteristics of geohazards and the driving processes benefit all phases. Limitations in data access hamper the

full exploitation of available observations for research and applications. Intellectual property rights require attention.

Reaching out to scientists and research groups and connecting them to end users and mandated agencies is relevant along the temporal progression of the risk management cycle. In many geographical areas, promotion of evidence and knowledge-based policy making is urgently needed. Capacity building in all parts of the value chain from observations to end-applications, including observations, research, and policy and decision making based on scientific knowledge is an important issue during all phases of the risk management cycle. Finally, sufficient human and financial resources for the network of the broad community involved in risk management and disaster reduction are mandatory to achieve the demanding goal of a significant disaster reduction.

3.3 Activity 1: Mitigation and preparedness

The overarching goal of this activity is to provide the information basis for mitigation, disaster reduction, and building of resilience before hazard occurrence.

Activity 1.1: *Identifying stakeholders*. In order to achieve support of risk management by Earth observations and research results, those involved in mitigation, response, and recovery need to be linked to those providing observations and research results relevant to geohazards. The GHCP will identify those end users who determine risk management actions in society and will link these to research groups addressing the origin and spatio-temporal characteristics of geohazards.

Activity 1.2: *Understanding geohazards and mitigation measures*. The GHCP will continuously identify relevant science issues and foster research and development that addresses these issues. Open access to all relevant observations will be crucial in order to enable the necessary research. The activities will include the measuring, mapping, modeling, and monitoring of hazards. The goal of these activities is a comprehensive description of the spatio-temporal characteristics of the hazards. An overview of adaptation and mitigation approaches and measures will also be compiled.

Activity 1.3: *Informing policy and decision makers and society.* Considerable information about geohazards and their characteristics is available for many regions, but often this information does not reach the policy and decision makers in a timely manner. The GHCP will aim to improve the information flow to society at large and specifically to relevant policy and decision makers. Information products will include but not be limited to hazard, exposure and vulnerability maps, and risk assessments.

Activity 1.4: *Creating awareness*. A key factor limiting preparedness and reducing resilience is the lack of awareness of geohazards in a broad part of society ranging from the layman and public media to the policy and decision makers. The GHCP will initiate and support activities that create awareness of geohazards, their nature and characteristics, and the potential hazardous events that can be expected in a given region. The goal of these activities is to integrate information on geohazards in the environmental information channels, and to ensure integration of geohazards into education at all levels from primary schools to universities and public education.

3.4 Activity 2: Early Warning

In an end-to-end approach, the GHCP aims to foster connections between the data/product providers and the end users making information-based decision with the goal to support decisions on different levels (including the public and individuals) through appropriate and timely information. However, issuing public warnings is outside the mandate of the GHCP and GEO, and the mandate of authorized bodies and the agreed-upon chain of commands will be respected.

Activity 2.1: *Improving models and forecasts/predictions*. Early warning depends on timely detection and/or reliable forecasting and/or prediction of hazardous events. In many cases, the necessary algorithms and/or models are currently not available or not sufficiently tested in an operational environment. Where necessary, the GHCP will foster and, where possible, facilitate the development of models and forecasting and prediction algorithms. The GHCP will work with mandated authorities to ensure that the algorithms are tested and, if suitable, implemented in early warning systems.

Activity 2.2: *Monitoring and detecting hazards*. Timely detection and forecasting of hazardous events requires dedicated monitoring in carefully selected locations. The GHCP will aim to identify areas to be monitored. In order to enable timely detection of hazardous events, an effort will be made to understand the requirements for monitoring and to identify indicators, precursors, and thresholds for early detection. The GHCP will work with GEO MCs and POs to ensure the implementation of necessary ground-based networks and space-borne infrastructure.

Activity 2.3: *Informing (early) warning systems*. Early warning systems informing public warnings issued by mandated authorities have specific requirements in terms of products and their characteristics. The GHCP will work with the relevant authorities to specify observation-based products for warning system and will link data and product providers to these warning authorities. Potential synergies between observing and warning infrastructure will be explored. Together with the *Architecture and Data Committee* (ADC), the GHCP will initiate demonstration of product delivery through GEOSS channels, for example, the delivery of hazard data via GeoNetCast.

Activity 2.4: *Integrating geohazards into public environmental information systems*. Geohazards are in principle not different from other hazards such as storm surges, hurricanes, tornadoes, floods, etc. For these latter hazards, information including early warnings are today integral part of the environmental information made available to the public through internet or other public media. The GHCP will consider how information on geohazards, including information on impeding hazardous events and early warnings, can be integrated in public information provision in ways comparable to information on other hazardous events.

3.5 Activity 3: Response

During the response phase of the risk management cycle, the GHCP can provide important links and connections to the Disaster Charter. By taking an end-to-end and multi-hazard approach, the GHCP will support the preparation of complex response actions and thus contribute to building resilience during and after events.

Activity 3.1: *Characterizing and assessing the disaster.* Earth observations are crucial for the characterization of hazardous events and their impact on environment, infrastructure, and human population. However, the potential of available and expected future Earth observations has not been fully exploited for timely disaster assessments, and too often response is hampered by a lack of sufficient information on the impacts of a hazardous event. The GHCP will initiate activities to increase the usage of Earth observations for the assessment of hazardous events and their impacts as a support for immediate response activities. Information to be

extracted from observations includes type of event, magnitude, extent, mechanism, impacts, damage assessment, and the detection and description of secondary hazards.

Activity 3.2: *An EO clearinghouse for major international disasters*. For recent disasters, a large amount of observation-based information was available shortly after the hazardous event, but not widely distributed through media. Value and utilization of this information would be greatly improved if it was accessible through a single clearinghouse. The GHCP will work with the ADC to explore options for an Earth observation clearinghouse for major (international) disasters. This clearinghouse would give access to relevant observations, products, modeling results, and assessments. The clearinghouse would also support immediate scientific *in situ* studies by providing comprehensive information on available useful observation infrastructure in the disaster area, and by maintaining an overview on experienced science response teams.

3.6 Activity 4: Recovery

The main goal of this activity is to ensure that recovery is informed about future hazards and thus enabled to strengthen resilience after the event. Here, too, an end-to-end and multi-hazard approach is necessary.

Activity 4.1: *Informing the Recovery Phase*. The crisis caused by disasters often presents an opportunity to learn about the hazards and their potential impacts and thus to strengthen resilience after the event. The GHCP will engage in the assessment of lessons learned from specific hazardous events and their impacts and will provide feedback to Activities 1 and 2. Of immediate importance in the early recovery phase is the assessment of safety of areas, infrastructure, and access to the areas. Revised hazard assessment are required to plan recovery that will lead to increased resilience.

4 IMPLEMENTATION

Implementation of the GHCP roadmap depends on voluntary contributions of the GEO MCs and POs. In order to implement the activities described in the previous section, the GHCP will as far as possible utilize the existing Tasks in the GEO Work Plan (Section 4.1), interact with relevant international organizations, and initiate regional actions based on funding available in these regions. A central new element of the implementation is a network of a few core cites developed as regional centers of excellence (see Section 4.2).

4.1 The GEO Work Plan Tasks

The GEO Work Plan 2009-2011 includes a number of Tasks that would benefit from support by the GHCP. In fact, a number of Tasks list the GHCP as Task Team supporter (Table 1). The GHCP interacts with the Task Teams of these tasks and assesses to what extent the activities discussed above are already covered by these Tasks. The GHCP engages in supporting these Tasks. An assessment of the above GEO Tasks was carried out in March 2010 in the frame of the Disasters SBA Review of the STC (Plag and Marsh, 2010).

4.2 Global Network of Core Sites

Many of the monitoring activities described in the GHCP roadmap, in particular the space-borne ones, will be of global nature. However, the end-to-end approach implicit in the roadmap activities and the full coverage of the risk management cycle will have to be implemented and demonstrated in a regional approach. For this, the GHCP proposes the establishment of a global network of core sites, for which the end-to-end and multi-hazards approach can be applied to all relevant phases of the risk management cycle. These core sites can be considered as pillars linking together and integrating the various part of the monitoring and processing infrastructure to end-to-end and multi-hazards systems.

Table 1: GEO Work Plan Tasks supported by the GHCP.

DI-06-09	Use of Satellites for Risk Management
DI-09-01	Syst. Monit. for Geohazards Risk Assessment
DI-09-01a	Vulnerability Mapping and Risk Assessment
DI-09-01b	Seismographic Networks Improv. and Coord.
DI-09-02	Multi-Risk Manag. and Regional Applic.
DI-09-02a	Implement. of a Multi-Risk Manag. Approach
DI-09-02b	Regional End-to-End Disaster Manag. Applic.
DI-09-03	Warning Systems for Disasters
DI-09-03a	Tsunami Early Warning System of Systems

Core sites are intended as regional centers for large geographical regions (e.g., the Americas, Africa, Europe, Asia, Oceania), which provide focal points for the regions in many hazard and risk management related aspects. Therefore, these sites should be agreed upon by the GEO MCs in a region. A call for site nominations should be issued through GEO, and sites should be nominated by each region. Regions could be defined to be consistent with the GEO caucuses.

The core sites would have several functions:
They would act as natural laboratories for geohazards. As such, they would be in location where the occurrence of hazardous events is likely. In these locations, comprehensive monitoring would take place, and free data access to observations from *in situ*, air-borne, and space-borne sensors would be granted.
They would provide a test field for the end-to-end multi-hazard approach. Thus, links between data providers, research teams, policy and decision makers and the general public would be established, and channels for information flow from observations to end applications would be created.
They would in principle allow consideration of the full risk management cycle from mitigation and preparedness, early warning, to response and recovery. Thus, activities in support of all four phases would have to be initiated.
They would provide centers for capacity building (in monitoring, processing, science, applications) in the region by being open for participation from other countries in a region.
Where they qualify as Supersites, they would contribute to the relevant GEO Task by providing a focus for the dissemination of space agency data sets of use for geohazard studies to the research community and ultimately more operational scientists.

4.3 Regional Offices

It is envisaged to implement the concept of a global network of core sites representing the large regions (GEO caucuses) through regional offices associated with these sites. These offices would take a lead in organizing the core sites as regional pillars truly integrating the monitoring infrastructure and data processing into an end-to-end and multi-hazards approach covering all relevant phases of the risk management cycle. The offices would support the regional geohazards communities of practice and link these to the global GHCP.

A key issue particularly in developing regions is capacity retention. The regional offices would work towards the establishment of centers of excellence around the core sites, and these centers would provide a major incentive for capacity retention.

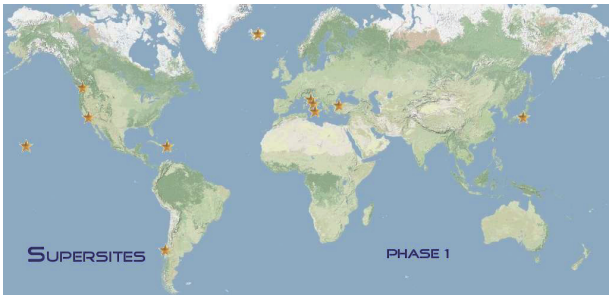

Figure 2: Location of Geohazards Supersites. The figure displays the set of supersites as of May 2010. From http://supersites.unavco.org.

4.4 Networking of the Global Community

The successful implementation of this roadmap requires a sustainable networking of the global geohazards community bringing together actors involved in all links of relevant value chains from observations to applications. Partially, this networking can be developed in the frame of existing GEO elements.

For the more science-related part of the community and activities, the European COST Program may offer an option to establish a COST Action as an initially European nucleus with a potential of a global extension. Considerations for submission of a COST proposal are underway and the intention is to submit a COST proposal during 2010 as part of the roadmap implementation.

5 THE SUPERSITE INITIATIVE

The origin of the Supersite Initiative is in the so-called Frascati Declaration of the 3rd International Workshop on Geohazards. This Declaration recommends "*to stimulate an international and intergovernmental effort to monitor and study selected reference sites by establishing open access to relevant datasets according to GEO principles to foster the collaboration between all various partners and end-users*" (Le Cozannet and Salichon, 2007a). These reference sites were denoted as "natural laboratories" or "supersites." The initial set of reference sites included sites representing volcanoes (Hawaii, Vesuvius, Etna, Iceland) and seismic hazards (Los Angeles, Seattle-Vancouver, Istanbul, Tokyo) (see Fig. 2). The initial web page provides access to data for these sites. In 2009 and 2010, new sites were selected in response to recent disasters (Chile, Haiti, L'Aquila). With this recent development, the supersite web site acquired the role of a disaster clearinghouse particularly focused on the needs of scientists investigating the hazardous events causing these recent disasters. During the further implementation of the GHCP roadmap, it will be important to ensure that the choice of supersites is consistent with the regional decisions on core sites.

6 DISCUSSION

The GHCP roadmap is an important milestone in the development of a multi-hazards approach of GEO to disaster reduction, which focuses on end-to-end demonstrations of concepts and the development of all building blocks for support of risk management through Earth observations and research. Considering the enormous impact disasters caused by geohazards have on human lives and property, it appears timely to assess the current state of knowledge concerning geohazards. Looking further ahead, the GHCP will therefore consider whether a body for such an assessment should be established. The *Intergovernmental Panel on Climate Change* (IPCC) will be considered as a potential model. A United Nations Convention on Geohazards could provide a basis for the creation of a geohazards assessment body comparable to the IPCC.

7 CONCLUSIONS

The GHCP is important for GEO as a link to a wide range of groups, organizations, and individuals involved in all phases of the risk management cycle as it relates to geohazards. The Strategic Target of the GHCP aims at a significant improvement in the Earth observation-based support of risk management concerning geohazards. The roadmap details activities that would facilitate progress toward the Strategic Target. The concept of a global network of a few regional core sites provides the basis for end-to-end projects linking global Earth observations to local decision making. Centers of excellence built around the core sites would provide the means for capacity building and capacity retention in a region.

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