European Commission

GEOSS FOR DISASTERS

The GEO Disasters Societal Benefit Area

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GROUP ON
EARTH OBSERVATIONS

2014

Directorate-General for Research and Innovation
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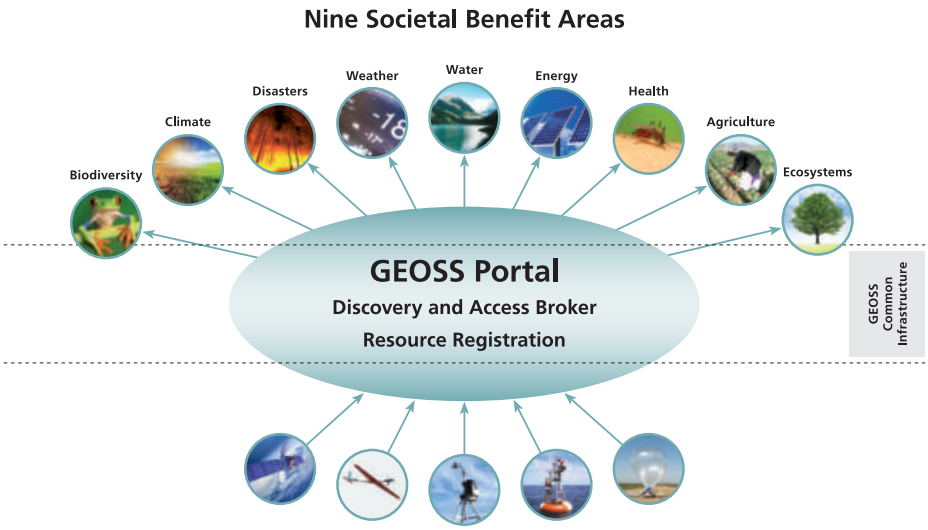
GEOSS - A Global Earth Observation System of Systems

*The **Group on Earth Observations** (**GEO**) is a voluntary partnership of governments and international organizations. It provides a framework within which these partners can develop new projects and coordinate their strategies and investments.*

*GEO is coordinating efforts to build a **Global Earth Observation System of Systems** (**GEOSS**) in the field of Earth observation. It was established in February 2005 by the Third Earth Observation Summit meeting in Brussels. This followed calls for action by the 2002 World Summit on Sustainable Development and the Group of Eight (G8) leading industrialised countries. More information on **www.earthobservations.org***



Earth observations data, information and services.

The **vision for GEOSS** is to realize a future wherein decisions and actions for the benefit of humankind are informed by coordinated, comprehensive and sustained Earth observations and information. GEOSS will work with and build upon existing national, regional, and global systems to provide comprehensive, coordinated Earth observations from thousands of instruments worldwide and to transform the data they collect into vital information for society.

The Global Earth Observation System of Systems

GEOSS will simultaneously address nine **Societal Benefit Areas** (**SBA**) of critical importance to people and society. It aims to empower the international community to protect itself against natural and human-induced **disasters**, understand the environmental sources of **health** hazards, manage **energy** resources, respond to **climate** change and its impacts, safeguard **water** resources, improve **weather** forecasts, manage **ecosystems**, promote sustainable **agriculture** and conserve **biodiversity**. GEOSS coordinates a multitude of complex and interrelated issues simultaneously.

This cross-cutting approach avoids unnecessary duplication, encourages synergies between systems and ensures substantial economic, societal and environmental benefits.

Many efforts are oriented towards solving the standardization of data and interoperability issues within GEO.

At the GEO Ministerial Summit in November 2010, the **GEO Data Sharing Action Plan** was adopted. The Data Sharing Action Plan builds upon the concept of full and open exchange of data and on the Implementation Guidelines accepted by the Plenary which state that data, metadata and products made available through the GEOSS are made accessible with minimal time delay and with as few restrictions as possible on a non discriminatory basis, at minimal cost for no more than the cost of reproduction and distribution.

The Challenge of the GEO Disasters Societal Benefit Area

Disaster risk and vulnerability are increasing in many regions of the world. Natural hazards are a major cause of loss of life and property, and affect key natural resources.

Disaster-induced losses can be reduced through the timely, accurate and reliable provision of Earth observation data. To support disaster management, it is essential to provide information through coordinated systems in order to contribute to monitoring, predicting, risk assessment, early warning, mitigating and responses to hazards.

This requires extensive integration of diverse data streams, improved information extraction methods and modelling capabilities, and the generation and dissemination of the information needed by decision makers and the public.

Europe's capability to respond

Substantial European developments and contributions to GEO in this Societal Benefit Area are provided in the framework of the European Programme Copernicus formerly known as GMES.

The **Copernicus Emergency Management Service** (**EMS**) provides all actors involved in the management of natural disasters, man-made emergency situations, and humanitarian crises with timely and accurate geo-spatial information derived from satellite remote sensing and completed by available in situ or open data sources.

The mapping component of the service (GIO "GMES Initial Operation" EMS - Mapping) has a worldwide coverage and provides the above-mentioned actors (mainly Civil Protection Authorities and Humanitarian Aid Agencies) with maps based on satellite imagery. The service started operations on 1st April 2012.

The products generated by the service can be used as supplied (e.g. as digital or printed map outputs). They may also be combined with other data sources (e.g. as digital feature sets in a geographic information system) to support geospatial analysis and decision making processes of emergency managers.

GIO EMS - Mapping can support all phases of the emergency management cycle: preparedness, prevention, disaster risk reduction, emergency response and recovery.

The service is provided free of charge in rush mode, for emergency management activities which require immediate response and non-rush mode, to support emergency management activities not related to immediate response. It can be activated only by authorised users.

The public portal of the Copernicus/GMES Emergency Management Service allows to download the maps and products delivered by this service.

The European Commission's Communication "Towards a Stronger European Union Disaster Response" adopted and endorsed by the Council in 2010, underpins the importance of strengthening concerted actions for natural disasters, including floods, which are amongst the costliest natural disasters in the EU.

The **European Flood Awareness System** (**EFAS**), developed to produce European overviews on ongoing and forecasted floods up to 10 days in advance, contributes to better protection of the European citizen, the environment, property and cultural heritage. It has been developed at the European Commission's in house science service, the Joint Research Centre, since 2002, in close collaboration with national hydrological and meteorological services, European civil protection organisations, such as the Monitoring and Information Centre (MIC) and other research institutes.

Since 2011, EFAS is part of the Copernicus emergency management service and has now been transferred to operational service in 2012. EFAS also represents the first operational hydrological network in Europe.

The principal aims of EFAS are:

- **To provide added value early flood forecasting products to hydrological services and**
- **To provide unique overview products of ongoing and forecasted floods in Europe more than 3 days in advance**

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The GEO Disasters Societal Benefit Area in context

Target 2015

GEO Strategic Target 2015 for Disasters:

Before 2015, GEO aims to 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).

This will be demonstrated by:

- Improved use of observations and related information to inform policies, decisions and actions associated with disaster preparedness and mitigation.
- More effective access to observations and related information to facilitate warning, response and recovery to disasters.
- Increased communication and coordination between national, regional and global communities in support of disaster risk reduction, including clarification of roles and responsibilities and improved resources management.
- Improved national response to natural and man-made disasters through delivery of spacebased data, resulting from strengthened International Charter on “Space and Major Disasters.”
- Support to the successful implementation of the Hyogo Framework for Action 2005-2015.

Examples of the European Projects contributing to the GEO Disasters Societal Benefit Area

CORE-CLIMAX

COordinating Earth observation data validation for RE-analysis for CLIMAte ServiceS

The CORE-CLIMAX project is vital to supporting the Copernicus Climate Service in developing effective products. The project aims to coordinate the identification of available physical measurements, which can be reconciled with previously existing data records, to form long term time series. These data will help monitoring, assessing, and ultimately ***understanding key indicators of climate variability and change****.*

CORE-CLIMAX teams are identifying gaps in ongoing climate and climate change activities, establishing dialogue mechanisms between climate and climate change researchers, modellers and policy makers at the national level in Europe, as well as globally. The team is also establishing a forum for providers of Earth observation (EO) data and climate researchers to assess the status of available observational records, integrate space data with in situ records and establish the foundations for a validated base of EO data for climate research. It is expected that this repository of validated space-based observational data (together with in situ data) will substantially support (in combination with reanalyses and model predictions) climate change impact and adaptation action assessments, policy development and monitoring for national, European and global users.

Specific Objectives

1. Coordinate with Copernicus on-going activities and contribute to the formulation of the Copernicus climate service theme

2. Propose a structured process for delivering Essential Climate Variables (ECVs) through the stepped and quality controlled elaboration of Climate Data Records (CDR), the latter being derived from prioritisation of the most appropriate input data sets

3. Propose a validation process aiming at qualifying the accuracy of the climate variables

4. Propose a feedback mechanism ensuring that the results of the re-analysis process get appropriately reflected into updates of the CDR

5. Propose a process to compare reanalyses

Project website: http://coreclimax.itc.nl/

FUTUREVOLC

A European volcanological supersite in Iceland: a monitoring system and network for the future

FUTUREVOLC is an FP7 EU-funded project initiated in October 2012 and has a life span of 3.5 years. It is led by the University of Iceland together with the Icelandic Meteorological Office. It forms part of the GEO Supersites initiative. The Supersite initiative fosters the integration of, and open access to space and ground based observations for improved monitoring and evaluation of geologically active regions of Europe prone to natural hazards. ***FUTUREVOLC is currently establishing an innovative volcano monitoring system in Iceland and developing new EO methods in order to achieve best practice in early warnings preparation for future global eruption responses****.*

Results

The monitoring carried out in FUTUREVOLC project includes many of the most active volcanoes in Iceland located under ice caps like Mýrdalsjökull and Vatnajökull. Close monitoring of these subglacial volcanoes will increase their preparedness level and enable tracking magma movements through migration of microseismicity and through detailed analysis of earthquake source mechanisms. The emphasis is on **real-time processing of detected signals for early warning of volcanic eruptions**. The project cooperates closely with MARsite, another FP7 Supersites project, which develop seismic instruments suitable for deployment in the ice.

Policy Relevance

FUTUREVOLC contributes to the Hyogo Framework for Action (HFA) 2005-1015 on building the resilience of nations and communities to disasters. It contributes to the GEO 2012-2015 Work Plan by providing easy access to data from space, air and ground-based monitoring before, during or after a volcanic eruption. This research, will empower and support all actors involved in disaster management, from citizens to governments and can ultimately help to save lives. The project has agreed to an Open Data access policy contributing thus to GEOSS in terms of European preparedness for volcanic eruptions. The project will in particular develop common technical and data standards to facilitate data sharing in GEOSS. At an international level, the project collaborates with other Supersites projects directly and through EPOS (European Plate Observing System). The project has strong collaboration with many international projects, and has submitted a proposal to CEOS, the Committee on Earth Observing Satellites, for establishing Iceland Volcanoes permanent supersite under the GEO Geohazard Supersites and Natural Laboratory (GSNL) initiative.

Project website: http://futurevolc.hi.is/

INCREO

Increasing Resilience through Earth Observation

The objective of IncREO is to provide actors responsible for civil protection and disaster management with EO-based solutions contributing to an **improved preparedness and mitigation planning for areas highly vulnerable to natural disasters** and already noticeable climate change trends. These solutions will be adjusted to the users' needs and will also reflect on short-term climate change scenarios and related legislature – both on national, supranational and European level. As a multi-risk designed project per se any type of natural disaster is addressed. However, selected use cases (dam failure, storm surge and wave height, flood and landslide) and the transfer of solutions to a specifically multi-risk prone test site are covered as well. Furthermore, emphasis is placed on "assets mapping" which is understood here as geo-locating monetary values per area unit."

Confluence of the Sava and Danube rivers in Belgrade, Serbia (SPOT 6 satellite image).

Project website: http://www.increo-fp7.eu/

MARsite

New Directions in Seismic Hazard Assessment through Focused Earth Observation in the Marmara Supersite

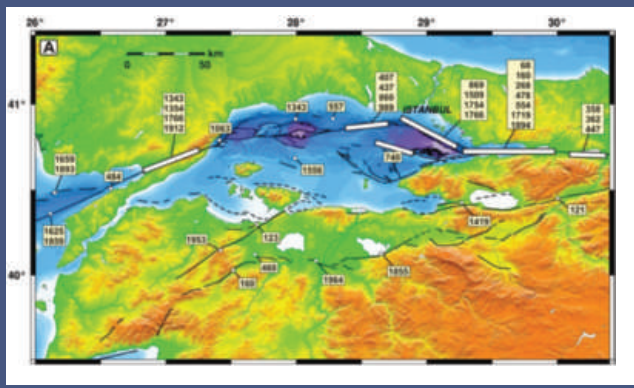
In the last 12 years, Europe experienced destructive earthquakes such as 1999 Izmit (Turkey), 1999 Athens (Greece) and 2009 L'Aquila (Italy). More destructive earthquakes happened earlier: Istanbul in 1509 and 1766, Izmir in 1688, Eastern Sicily in 1693 and Lisbon in 1755.

Such catastrophic event is now expected in the Marmara region, with a probability in excess of 65% in 30 years, due to the existing seismic gap and the post-1999 earthquake stress transfer at the western portion of the 1000km-long North Anatolian Fault Zone (NAFZ), passing through the Marmara Sea about 15 km from Istanbul.

MARsite (New Directions in Seismic Hazard Assessment through Focused Earth Observation in the Marmara Supersite) project will identify the Marmara region as a 'Supersite' in order to **compile on-shore, off-shore and space-based observations, comprehensive geophysical monitoring, improved hazard and risk assessments** encompassed in an integrated set of activities. The project coordinates research groups with different scientific skills (from seismology to engineering to gas geochemistry) in a comprehensive monitoring activity developed both in the Marmara Sea and in the surrounding areas.

The MARsite objectives are to:

- Achieve long-term hazard monitoring and evaluation by in-situ monitoring of: earthquakes, tsunamis, landslides, displacements, chemical-radioactive emission and other physical variables by the use of space-based techniques.
- Improve existing earthquake early-warning and rapid-response systems by involving common activities, participants, competences, knowledge and experts from Europe.
- Improve ground shaking and displacement modelling by the development/updating of source models and the use of probabilistic and deterministic techniques with real-time and time-dependent applications.
- Pursue scientific and technical innovation by including state-of-the-art R&D in developing novel instruments and instrumentation.
- Interact with end users and contribute to the improvement of existing policies and programs on preparedness, risk mitigation and emergency management.



Project website: http://marsite.eu/

PanGeo

Enabling access to geological information in support of GMES

The PanGeo project is providing the European citizen with open access to geohazard information across major European towns and cities. Geohazards are natural and man-made phenomena that cause ground instability and in a built environment can be both costly and dangerous. PanGeo improves the knowledge of geohazards in the urban environment, by making available unique geohazard products that are generated by collaboration between InSAR service providers, the European Geological Surveys and IT specialists. The results are two validated outputs compliant with European Standards (INSPIRE): A Ground Stability Layer (GSL) which maps, using vector polygons, all areas of a given town that are affected by terrain motion and a Geohazard description (GHD) which describes the geological interpretation for each of the discovered motion polygons. To date, the first 52 major towns and cities have been completed across 27 European countries; this represents approximately 13% of the EU population. The products are free to download for any user from the PanGeo website which links to the dedicated portal, built on One Geology Europe infrastructure, or visualized in Google Earth.

The easy and open access to the PanGeo products is expected to increase the uptake of geohazard information across Europe and promote the requirement for improved knowledge to assist disaster preparedness and understanding of local geohazards. All users including the public, policy makers at local, national or regional level, local authorities and the commercial sector have access to the same expertly interpreted information and are able to freely incorporate it into their own systems to provide improved information and thus understanding of the ground instability in their town or city.

The project has expanded links between the InSAR community, which monitor ground motion using radar satellites, and the European Geological Surveys. It is anticipated that these will continue to grow and develop as the demand for geohazard information increases as cities, as well as the need for assuring the safety and security of their inhabitants, expand.

Project website: http://www.pangeoproject.eu/

WeSenseIt

Citizen Observatory of Water

WeSenseIt develops **citizen observatories of water** to harness environmental data and knowledge to effectively and efficiently manage water resources. The Citizen Observatories allow citizens and communities to take on a new role in the information chain: a shift from the traditional one-way communication paradigm towards a two-way communication model in which citizens become active stakeholders in information capturing, evaluation and communication. Areas of research concern physical and social sensors, heterogeneous sensor networks and water models, and methods for participatory decision support in water management. Citizen and stakeholder groups are involved throughout the project; theoretical and conceptual social models are developed to better understand citizen motivation and engagement, their needs, abilities, preferences and potential for input into decision-making processes.

The citizen water observatory is tested and validated in three case studies in water management in Venice (Italy), Delft (the Netherlands) and Doncaster (UK), which have been proposed by civil protection agencies in the target areas. The studies cover the entire hydrological cycle with **a major focus on variables responsible for floods and drought occurrences**. Where relevant, the case studies will address water quality issues.

WeSenseIt will enable the direct transfer of environmental (water-related) knowledge for use by policy-makers, industry and research as well as society to effectively and efficiently manage water resources.

Project website: http://www.wesenseit.eu/

PREFER

Space-based Information Support for Prevention and REcovery of Forest Fires Emergency in the MediteRranean Area

DIAEE. www.prefer- copernicus.eu

All reports on the state of Europe's forests indicate that **the broad Mediterranean area is systematically affected by uncontrolled forest fires with large impact on ecosystems, soil erosion, slope instability, desertification trends, and local economies as a whole**, with a negative mid-to-long term prospect because of Climate Change. In this scenario, the need to improve the information and the intelligence support to forest fire prevention is widely recognized to be relevant. PREFER intends to contribute at responding to such a pragmatic need of Southern Europe's forests by: 1) providing timely information products based on the exploitation of all available spacecraft sensors within the project time frame; 2) offering a portfolio of products focused both on Pre-crisis and Post-crisis forest fire emergency cycle which, due to the synoptic nature of the satellite based data, can be exploited by users in the different countries of the EU Mediterranean area and in compliance to the local regulations for Forest Fire Management; 3) preparing the exploitation of new spaceborne sensors available by 2020 contributing to the definition of User requirements for the new Earth Observation missions.

PREFER will set up a regional service, able to process and distribute the information to end users, developed and maintained by a regional cluster of core users, industries and research institutes. The Information Service will provide several innovative products whose effectiveness, accuracy and reliability will be demonstrated, in strict collaboration with a group of users, on 5 test areas representative of the EU Mediterranean region.

The regional service is intended to stimulate further the coordination between countries on forest fires prevention in the EU Mediterranean region.

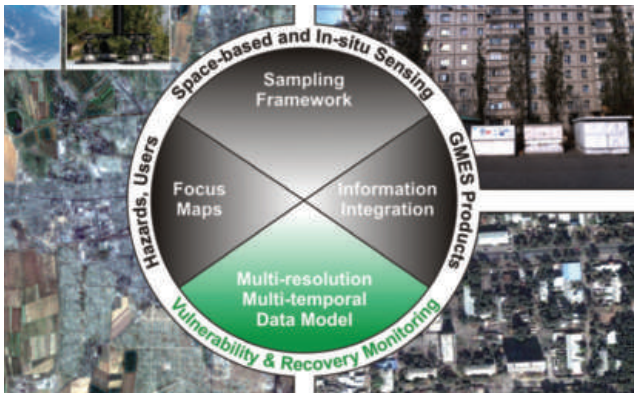
Project website: www.prefer-copernicus.eu

SENSUM

Framework to integrate Space-based and in-situ sENSing for dynamic vUlnerability and recovery Monitoring

The SENSUM project is setting out to confront the issue that while human society is increasingly exposed to natural hazards through urbanisation, its greater dependency on technological infrastructures and environmental change, there is at the same time a serious deficit of information about the susceptibility of many urban environments to natural extreme events. This is especially acute in economically developing regions, where area-wide knowledge of existing building stock, and the manner in which it is evolving over time, is lacking.

SENSUM's activities involve developing innovative methods for integrating observations and data from Earth observing satellites and ground-based methods such as omni-directional camera surveys, which in turn will lead to more robust risk and potential loss estimates, as well as the monitoring of recovery activities. **SENSUM is focusing on earthquakes and landslides**, which also form one of the classic examples of so called "cascade" events, that is where an initial event triggers subsequent, sometimes more damaging, occurrences.



SENSUM is dealing with a range of spatial scales, as well as both space- and ground-based data acquisition systems.

Interactions with stakeholders and end-users from the various communities in the different partner countries who are expected to benefit from the SENSUM products and developments are a critical aspect of the project. SENSUM is expected to benefit from, and contribute to, on-going programs related to space-based observations, such as the various GMES projects and the forth-coming SENTINEL series of ESA space missions. From its very beginning, SENSUM has set out to develop software tools on a Free and Open Source basis, allowing its wider dissemination to the disaster management and mitigation communities.

SENSUM will develop methods to integrate data from remote-sensing satellites such as the future SENTINEL-2 and ground-based camera surveys into multi-spatial scale vulnerability data sets.

Objectives

- **Develop methods and tools for the Continuous Vulnerability Assessment and Analysis of urban areas. Several test cases are being considered: the Isfara-Batken region between Kyrgyzstan and Tajikistan, considered to be a "data poor" case, the Izmir area, Turkey, under threat from earthquakes, each being prone to earthquakes and landslides, and the city of Cologne, Germany, which is susceptible to earthquakes and floods, while being a "data rich" area. This includes the consideration of temporal and spatial relationships.**
- **Investigate the application of remote sensing and ground-based methods for multi-type risk analysis.**
- **Explore the potential for the application of space technologies to disaster recovery.**
- **The enhancement of the scientific and technical capacities of the project's Central Asian partner countries for disaster risk management and mitigation.**

Project website: http://www.sensum-project.eu/

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Recognising the need to improve our understanding of the Earth system and enhance our ability for informed decision-making for the benefit of our planet and the sustainability of our societies, over **150** governments and leading international organisations are participating in the Group on Earth Observations, or GEO, to coordinate the construction of a Global Earth Observation System of Systems (GEOSS) by the year 2015.

This series of brochures provides a snapshot of the process developed by the GEO to build the GEOSS taking advantage of the international framework of cooperation and of the common vision to share and integrate information with a view to serving nine Societal Benefit Areas.

Examples of contributions from European and the European Commission-funded projects contributing to **specific Societal Benefit Areas** or to the **GEOSS Building Blocks** are presented in each thematic brochure.

GEOSS for Disasters
GEOSS for Health
GEOSS for Energy
GEOSS for Climate
GEOSS for Water
GEOSS for Weather
GEOSS for Ecosystems
GEOSS for Agriculture
GEOSS for Biodiversity
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