UPGRADE is the European Journal for the Informatics Professional, published bimonthly at <http://www.upgrade-cepis.org/>

Publisher
UPGRADE is published on behalf of CEPIS (Council of European Professional Informatics Societies, <http://www.cepis.org/>) by Novática <http://www.ati.es/novatica/>, journal of the Spanish CEPIS society ATI (*Asociación de Técnicos de Informática*, <http://www.ati.es/>)

UPGRADE monographs are also published in Spanish (full version printed; summary, abstracts and some articles online) by Novática

UPGRADE was created in October 2000 by CEPIS and was first published by Novática and INFORMATIK/INFORMATIQUE, bimonthly journal of SVI/FSI (Swiss Federation of Professional Informatics Societies, <http://www.svifsi.ch/>)

UPGRADE is the anchor point for UPENET (UPGRADE European NETwork), the network of CEPIS member societies' publications, that currently includes the following ones:
- Informatica, journal from the Slovenian CEPIS society SDI
- Informatik-Spektrum, journal published by Springer Verlag on behalf of the CEPIS societies GI, Germany, and SI, Switzerland
- ITNOW, magazine published by Oxford University Press on behalf of the British CEPIS society BCS
- Mondo Digitale, digital journal from the Italian CEPIS society AICA
- Novática, journal from the Spanish CEPIS society ATI
- OCG Journal, journal from the Austrian CEPIS society OCG
- Pliroforiki, journal from the Cyprus CEPIS society CCS
- Pro Dialog, journal from the Polish CEPIS society PTI-PIPS
- Tölvumál, journal from the Icelandic CEPIS society ISIP

Cover page designed by Concha Arias-Pérez
"Steely Blue Storm" / © CEPIS 2009
Layout Design: François Louis Nicolet
Composition: Jorge Llácer-Gil de Ramales

Editorial correspondence: Llorenç Pagés-Casas <pages@ati.es>
Advertising correspondence: <novatica@ati.es>

UPGRADE Newslist available at
<http://www.upgrade-cepis.org/pages/editinfo.html#newslist>

ISSN 1684-5285

Monograph of next issue (June 2009)

"Free Software in Industry"

(The full schedule of **UP**GRADE is available at our website)

CEPIS UPGRADE
The European Journal for the Informatics Professional
http://www.upgrade-cepis.org

Vol. X, issue No. 2, April 2009

* This monograph will be also published in Spanish (full version printed; summary, abstracts, and some articles online) by **Novática**, journal of the Spanish CEPIS society ATI (*Asociación de Técnicos de Informática*) at <http://www.ati.es/novatica/>.

Global Earth Observation Initiatives: European Contributions to GEOSS

Laura Díaz-Sánchez, Carlos Granell-Canut, Joaquín Huerta-Guijarro, and Walter Simonazzi-Domínguez

This article provides an introduction to European initiatives relating to spatial and environmental data policy contributing to the Global Earth Observation System of Systems (GEOSS). We begin by describing the background to and goals of GEOSS as a system of systems which encompasses and coordinates a multitude of independent systems. Then we go on to describe the main aims, players, and collaborations of individual European initiatives that are making a positive contribution to GEOSS.

Keywords. Earth Observation Data, GEOSS, GMES, INSPIRE, Interoperability, Kopernikus, SEIS, SDI, SISE.

1 Introduction

Since the launch of *Sputnik* over fifty years ago [1], satellites have been performing vital communications, military and meteorological related functions, among others. They are our eyes in space, which constantly observe and monitor the Earth, sending back a wealth of data and images for Earth Observation (EO). This EO information is essential if we are to understand and address some of today's scientific challenges, such as achieving a greater understanding of the complexity of our planet and throwing a little light on the processes affecting the surface of our planet, which to a large extent we are yet to fully understand.

As citizens we may question whether the high cost of space programmes and satellites is justifiable if their use is limited to predicting the weather for the day after tomor-

Authors

Laura Díaz-Sánchez graduated in Computer Engineering (2000) from the *Universitat de València* (Spain) and obtained her Master in Intelligent Systems (2008) from the *Universitat Jaume I* (UJI) of Castellón (Spain). She has taken part in several research and development projects, working for the Institute of Robotics of the *Universitat de València* and specialist companies in the field of Geographic Information Systems (GIS) such as Geodan (the Netherlands) and Iver TI (Spain). She is currently a researcher at the UJI where she pursued her doctorate in computer science, specializing in research into automatic methods for the description and creation of services, distributed geoprocessing, and the interoperability of spatial information services and infrastructures. ESMI, AWARE, and currently EuroGEOSS are among the most important international projects she has taken part in. <laura.diaz@lsi.uji.es>.

Carlos Granell-Canur is a postdoctoral researcher at the UJI, where he graduated in Computer Engineering (2000) and received his doctorate in Computer Science (2006). His lines of research are centred on Geographic Information Systems (GIS), Spatial Data Infrastructures (SDI), interoperability, geoprocessing services, workflow, and the composition and reuse of geographic services. He has taken part in several public funded research projects, both at a Spanish and a European level, the most important of which are the European projects ACE-GIS and AWARE. He has carried out research stages at SINTEF (Norway) and at the ITC (the Netherlands). <carlos.granell@lsi.uji.es>.

Joaquín Huerta-Guijarro is a Doctor in Computer Engineering and has been an Associate Professor at the UJI since 1999. He is a diplomate (1988) and a graduate (1990) in Computer Science from the *Universidad Politécnica de Valencia* where he also obtained a Master degree in CAD/CAM (1990/91). In 1992 he began working as an assistant lecturer in the UJI where he was awarded his Doctorate (1998) which had been jointly directed by the UJI and the University of Texas at Austin, Texas. Initially he researched into Computer Graphics at the Centre for Interactive Visualization (CeVI) but recently he has changed the direction of his research towards Geospatial Technologies and Geographic Information Systems. He is the co-director of the Master in Geospatial Technologies funded by the Erasmus Mundus Programme. In addition to his university work he has also been involved in a number of enterprises as a consultant or partner. With regard to his business activities, he has been a founding partner of one of the pioneer Internet Service Providers in Spain since 1995. <huerta@lsi.uji.es>.

Walter Simonazzi-Dominguez is MSc. In Geographic Information Science by the City University of London (United Kingdom) and MBA my the *Universidad Autónoma de Barcelona* (Spain). He heads the GIS Department of the European Topic Center on Land Use and Spatial Information (ETC/LUSI) of the European Environment Agency (EEA). His lines of research are centred on Geographic Information Systems (GIS), mainly concerned with harmonization, quality, and the analysis of geographic information; Spatial Data Infrastructures (SDI), and the use and promotion of open technologies within the scope of European projects. He takes part in a number of European public funded research and development projects, among the most important of which are EnviroGrids, Pegaso, ESPON, and EEA projects such as Land Use Data Center, Water Information System of Europe (WISE), WFD GIS guidance for the European Water Framework Directive and project SEIS (Shared Environmental Information System for Europe) project. <walter.simonazzi@uab.es>.

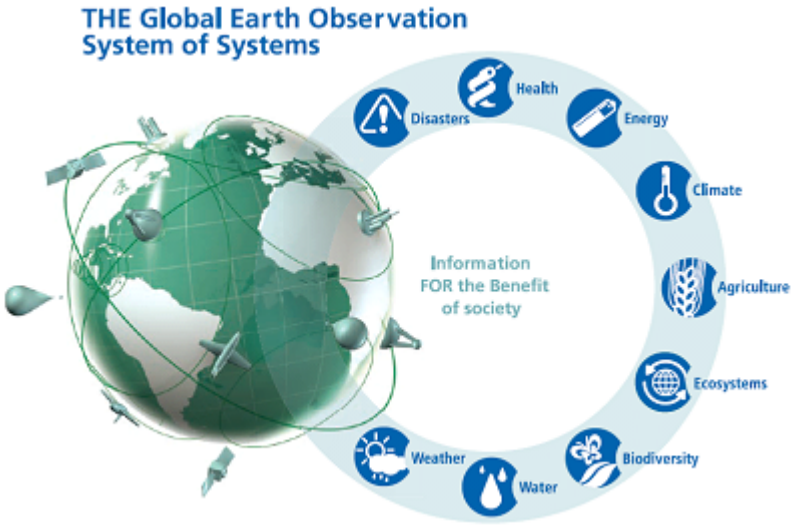

Figure 1: Important GEOSS-Related Areas of Social Benefit [8].

row. However, we need to be aware of our vulnerability to natural disasters such as desertification, droughts, floods, or to inefficient energy use and the pollution caused by the uncontrolled spread of our towns and cities. The proper monitoring and management of natural resources and the environment by means of systems that are able to collect environmental information has an inevitable impact on society as a whole and on our present and future way of life on this planet of ours. Paradoxically, given the close to three thousand satellites currently orbiting the Earth (according to data from NASA, the North American Space Agency), it might seem incredible that we were not able to detect such natural disasters as hurricane Katrina early enough, largely as a result of the absence of sufficient collaboration and interrelation between Earth Observation systems.

The need for EO data for the sustainable development of our planet was recognized by the 2002 World Summit on Sustainable Development [2], where it was agreed that "*international collaboration is essential for exploiting the growing potential of Earth Observations to support decision making in an increasingly complex and environmentally stressed world*". One of the decisions of this world summit was to set up the Group on Earth Observations (GEO[1]) to provide a framework for international collaboration in the coordination and implementation of EO data-related projects by international, national, and regional organizations. The importance of sustainable development and of appropriate environmental policies was reflected in GEO's action plan for the forthcoming years [3] [4], with the sole aim of setting up a Global Earth Observation System of Systems (GEOSS). The goal of this ambitious project, initiated in 2005 and scheduled to be completed by 2015, is to create a worldwide network connecting the geographic information and Earth Observation systems of all the different countries involved. In short, GEOSS will enable us to access, exchange, and use the data collected by the systems involved in order to deliver useful services to interested communities (scientific, political, technical, citizens, etc.).

The success of any large scale project that brings together other projects that are already underway ultimately depends on two factors [5]. On the one hand, organizational aspects; that is, finding a way to administrate and coordinate the project in a sustainable manner over a long period of time, with the added complication that GEOSS has a global scope and involves a great variety of international organizations such as the WMO, FAO, UNESCO or IOC, to name but a few. On the other hand, care must be taken to ensure that the parties involved are integrated into a cohesive and functional unit to form an interoperable system of systems allowing GEOSS to provide real added value in all aspects related to environmental information, from its access and use to its application to decision making processes in any environmental domain. These aspects are GEOSS's two major challenges.

In this article we look at the most important European initiatives, the ones that have spawned and developed the European systems that are playing a vital role in the growth of GEOSS; initiatives which ultimately provide geospatial and EO information and services to European citizens and, as an added value, to all the world's citizens.

2 GEOSS: A Global System of Interoperable Systems

GEOSS is defined as a **global system of systems** for Earth Observation, but it is not really a system per se, if we consider a system as being autonomous. The aim of this political initiative is to coordinate the various Earth Observation and monitoring devices and systems by creating an interoperable framework capable of enabling access to and the use of data and services available in existing systems.

[1] <http://www.earthobservations.org/>.

Organizations, institutions, research groups, universities and, in short, all GEOSS's participating members, are who ultimately own, manage, and operate the systems making up the GEOSS network of systems.

So, what value can GEOSS add to the individual systems of the participating members? First of all, the nature of GEOSS's mission is sufficiently broad and general as to allow it to benefit society as a whole [6]. GEOSS's efforts are aimed at areas of great social impact. Figure 1 shows the nine areas of social benefit addressed by GEOSS. These areas are essential for sustainable development and are precisely those that correspond to the basic needs that are still unresolved in many developing countries [7].

Secondly, GEOSS is a an intergovernmental organization which strives to coordinate the multitude of complex interrelationships that can arise between the different individual systems around the world, while supporting new collaborative initiatives and the development of new systems that may have an important contribution to make in the areas of social benefit mentioned above. A flood alert system covering an international area such as Europe is only possible if it is conceived as a cross-cutting project that brings together a number of systems from several different thematic areas (such as disasters, water, and climate) and from various organizations and institutions. Therefore the addressing of global problems must necessarily involve international coordination and collaboration to avoid unnecessary duplication of projects while leveraging possible synergies between projects to ensure a sustained socio-economic development and environmental benefits for society at large. GEOSS's mission is to ensure that there is no lack of coordination and collaboration between geospatial and Earth Observation systems belonging to different countries so that the mistakes of the past in the detection of natural disasters can be avoided.

In this respect, GEOSS pursues the dream of an interoperable system of systems which allows users to search for, access, and use data, images, services, tools and software packages, and where it will also be possible to combine sets of data from different remote systems in a coherent manner. However, the cross-cutting, coordinated and global approach to multiple systems adopted by GEOSS would not be possible without the individual contributions from each of the organizations and participating members. Without the individual effort of its members to keep their own systems operational with up-to-date and reliable information, the system of systems promoted by GEOSS would simply be doomed to failure.

Figure 2: GEOSS Geoportal.

In order to meet the above challenges, it is necessary to establish a common framework within which the various systems can communicate with one another and share data in an interoperable manner, while remaining sufficiently agile and flexible to allow for changes and the incorporation of new individual systems to the worldwide network. This interoperable framework defines GEOSS's common architecture which promotes the use of common principles, rules, techniques, and standards for all GEOSS systems [9]. Figure 2 shows the home page of the GEOSS geoportal, the backbone element in GEOSS's common architecture, which acts as a point of entry and enables members to connect directly with all the network's systems, services and components. In accordance with the implementation plan [3], the Geoportal is currently limited to registering any components, services, and standards that are of interest to GEOSS's purpose. Each participating member voluntarily registers the services and components which it manages and which will contribute to the growth and expansion of the global system of systems. The portal also provides a catalogue of standards to be used in these services and components in order to facilitate the integration of services and information.

The term "system of systems" in the acronym GEOSS underlines the fact that it groups together a set of elements (components, services, systems, etc.) which operate, are managed, and are developed independently of the other elements in the system and even of the global system itself, but which work collaboratively towards common goals. The following section presents some specific European initiatives which aim to promote the development of geospatial and Earth Observation systems forming part of the global system of interoperable systems.

3 European Contributions to GEOSS

3.1 Spatial Initiatives

To observe and monitor the Earth requires an infrastructure of operational satellites which enable EO data to be captured continuously. Europe's contribution to this infrastructure is centred mainly on two major initiatives (Kopernikus, formerly known as GMES, and Galileo) jointly developed by the European Commission (EC) and the European Space Agency (ESA). Galileo is the EC's flagship space programme and gives its name to the future European satellite-based global navigation and positioning system. Kopernikus addresses another key space-related issue; Earth Observation. In the short term, both initiatives strive to create a service and marketing industry for the space sector [10] but without losing sight of what is really the fundamental goal of the two projects; to establish an autonomous and operationally reliable infrastructure in the medium to long term that will ensure European independence in strategic areas of the space sector.

In spite of its recent change of name, the Kopernikus programme remains true to the original principles of GMES (*Global Monitoring for Environment and Security*) [11] with the aim of meeting the Europe's needs in environmental affairs and ensuring the resources and capabilities required by Earth Observation from space. The collaboration between the EC and the ESA in the Kopernikus programme hinges fundamentally on two types of components: one space-related and the other service-related. The ESA is responsible for space components covers the coordination, development and commissioning of Europe's own satellite infrastructure, space missions, and land-based space components for the capture of regular, up-to-the-minute EO data. Meanwhile, the EC is responsible for the initiative as a whole, and of the management of the future set of public and private data integration and management services. Kopernikus aims to make efficient use of the space infrastructure available so as to develop a comprehensive set of operational services upon this base, services that can really act as decision making support systems, capable of acquiring, processing, and interpreting information related to, say, the monitoring of natural resources (soil, etc.), oceanographic and atmospheric information, risk and emergency management (fires, floods, etc.) and security.

Kopernikus is doubtless Europe's most important contribution to GEOSS in terms of monitoring and Earth Observation. A number of pilot services related to the management of emergencies and marine services, and which to a great extent address GEOSS's areas of social benefit, are already in their development stage. Since the aims of Kopernikus and GEOSS are perfectly aligned, as more services come into existence as a result of developments from R&D projects funded by Kopernikus and other similar programmes (see Section 4.1), so Europe's contribution to the expansion of GEOSS will increase.

3.2 SDI Initiatives

In Europe there are a number of initiatives being developed jointly to create a technical, political and social infrastructure to support the implementation of an interoperable space for sharing and managing environmental information and tools. Adopted as a European directive in February 2007, INSPIRE (*Infrastructure for Spatial Information in Europe*) [12] sets out a legal framework for the European Spatial Data Infrastructure (SDI), with regard to policies and activities having an environmental impact.

INSPIRE is actually based on infrastructures which have already been set up and are managed by each member state, thereby creating an infrastructure or network of SDI nodes that are operational at a national, sub-national (regional, local, etc.) and thematic level (i.e. devoted to specific domains such as natural parks, etc.) for the shared use of and access to data in multidisciplinary and cross-border projects.

SDI initiatives as a whole contribute to GEOSS by providing a portfolio of standards, protocols, and interfaces to allow geospatial data to be accessed and exchanged. All this set of detailed specifications and standards promoted by INSPIRE considerably enhances interoperability between the services and components provided by distributed SDI nodes. In short, SDI infrastructure, which is made up of SDI nodes (member states, and autonomous community, regional and local governments) managed independently

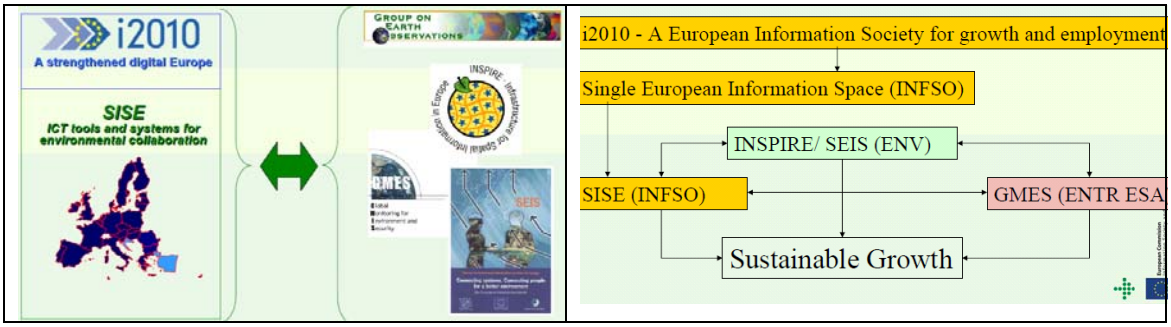

Figure 3: SISE and How it Relates to Other EU Policies [13].

but under principles of collaboration and reuse, is a good practical demonstration of the fact that the approach adopted by GEOSS for its global system of systems may be viable in the future.

3.3 Digital Information Initiatives

There are other initiatives in Europe working towards developing digital information infrastructure in general but which encompass environmental information and are therefore important in the context of GEOSS.

3.3.1 SISE

i2010[2] is the European framework for information society policies. It aims to facilitate the positive contribution that communication and information technologies make to the economy, to society, and to the quality of life. The primary aim of i2010 is to establish a *Single European Information Space*[3] (SEIS) offering affordable and secure high-bandwidth communications. And within this space we find SISE (*Single Information Space for the Environment in Europe*), which bears a direct relation to other important initiatives in the field of environmental information. The actions promoted in this area combine laws and other regulatory instruments to create a legal framework for the digital economy.

Figure 3 shows who the main players are in SISE and what relation it has to some of the initiatives mentioned earlier. Thus we can see that not only does SISE's scope of action include environmental information, but it is also directly related to SEIS (*Shared Environmental Information System for Europe*[4]), which is coordinated by DG-ENV, whose main purpose is to manage everything to do with European environmental information. SEIS is in turn directly related to GMES-Kopernikus (coordinated by DG-ENTR and ESA) and INSPIRE (coordinated by DG-ENV) with a view to creating a common framework for data management, the creation of legal and social infrastructure, and the development of software, satellite, and space mission infrastructure for monitoring the Earth, all with the ultimate purpose of ensuring sustainable growth and efficient Earth Observation.

3.3.2 SEIS

SEIS is another important European initiative due to its intersection with GEOSS, INSPIRE and Kopernikus. SEIS is a collaborative initiative involving the EC and the European Environment Agency (EEA) and member states, the main objectives of which are:

- To establish a common, integrated information system in order to improve the availability and quality of European environmental information and to provide e-Government/e-Environment services to citizens and politicians.
- To provide member states and European institutions with an up-to-date reporting system to meet their reporting obligations arising from their adoption of European environmental policy and so avoid duplication of effort, overlaps and redundancy. To this end the European Commission also plans to update its Directive on reporting (Directive 91/692/CEE) to bring it in line with SEIS principles.

Like other initiatives, the general goal pursued by SEIS is to preserve and improve the quality, comparability, and availability of environmental information. To do this SEIS has developed a set of principles in order to ensure that (i) the environmental information is organized in the most efficient way possible and (ii) the investment in data collection and monitoring procedures produce the greatest possible benefits.

Among the benefits that a system like SEIS would produce, apart from improving the quality and comparability of and access to European environmental information, would be to simplify (with a concomitant increase in efficiency) reporting processes, which would lead to a greater citizen involvement and would make the work of our legislators easier thanks to the availability of better quality and more timely information.

The EEA and its thematic centres play a fundamental role in the application of the SEIS system, since they clearly

[2] <http://ec.europa.eu/information_society/eeurope/i2010/index_en.htm>.
[3] <http://ec.europa.eu/information_society/eeurope/i2010/single_infor_space/index_en.htm>.
[4] <http://ec.europa.eu/environment/seis/index.htm>.

play a key role in the collection and delivery of environmental information (with the aid of its European Environment Information and Observation Network (EIONET)), which has made it the driving force behind many of the principles outlined above. In order to continue to fulfil its mandate to provide timely and reliable environmental information, the EEA has made the SEIS system central to its strategy for the years 2009 to 2013.

From a more technological point of view, SEIS is a "system of systems"; an integrated system which is Web distributed and accessible. It will be developed gradually on top of existing infrastructures, systems, and e-Services, in both member states and other European institutions. To a great extent SEIS's objectives overlap the objectives pursued by INSPIRE and Kopernikus, which has led to the development of approaches that try to ensure that these initiatives work together and pull in the same direction, providing a common added value in the shape of a European contribution to GEOSS, as we shall see later in the section on synergies.

SEIS shares the same commitment to interoperability and data sharing that underpins GEOSS. Early projects in this field focused on improving data access and sharing, the production of specifications and standards and other agreements in respect of interoperability, and the performance of viability tests on the underlying architecture and on user interface components. As SEIS development progresses, this initiative will deliver a European system of systems to GEOSS capable of providing comparable, quality, and timely environmental information.

4 Synergies

Having reviewed the scope and main lines of action of the various initiatives, we will now look at some of the overlaps and synergies that exist between them[5]. In principle these are initiatives that mutually support each other; they provide complementary mechanisms that enable users to enjoy global interoperable access to data and tools [14].

Looking first at INSPIRE, this initiative establishes a legal framework including the implementation rules governing how to create data, metadata, and services, in a manner that ensures interoperability between the different systems administrating geographic information. Meanwhile SEIS ensures the availability of data in the form of a decentralized network, and Kopernikus provides funding for space missions and satellites as well as for projects creating added value geospatial services which will increase the use and amount of EO information. Thus Kopernikus is at the same time a user and a supplier of SEIS, and vice versa: the two initiatives are mutual customers [14]. For example, the services created by Kopernikus projects use inputs consisting of data provided by SEIS's data infrastructure, while the output produced by these services may also be part of that same infrastructure. Finally, it should be mentioned that Kopernikus, like SEIS, contributes to the availability of important data and products, thereby promoting the open data policy. In this respect, while INSPIRE does address certain inefficiencies relating to the usability and use of spatial data, it also has certain limitations. For example, it only refers to public and spatial data and does not consider other aspects such as improving the creation and management of reporting of European environmental legislation (use of an integrated e-reporting system). Neither does INSPIRE lead directly to an improvement in the quality, comparability and timeliness of environmental data, since these aspects will be addressed by SEIS.

To sum up, Table 1 shows the aspects that, while they being addressed at least partially by all the initiatives, are more important in some than in others. As we can see in the table, INSPIRE is focused mainly on the establishment of an interoperable infrastructure within a legal framework. GMES-Kopernikus is responsible for the creation of a critical mass of projects and services in order to consolidate and build up the spatial information market. Finally, SEIS will work more on content management; i.e. managing the data and also the services used by that data.

Thus, INSPIRE and Kopernikus are key elements in the development of SEIS. The effective implementation of the INSPIRE directive is essential to the provision of the interoperability between systems that SEIS requires in order to share and access geospatial environmental data. Outside the scope of the INSPIRE directive, SEIS will also provide non-geospatial data. Kopernikus will contribute by developing environmental services.

Finally we should say that these European initiatives will not only help establish infrastructures capable of supporting other infrastructures of a global and cross-cutting nature, such as GSDI (*Global SDI*) and UNSDI (*United Nations SDI*), but will also help the development of GEOSS which, as we have seen earlier, will make use of (and in fact be comprised of) existing systems to form a global system of systems for Earth Observation.

Figure 4 shows the synergies existing between these initiatives. At the bottom we can see how the three European initiatives mentioned in the previous section help disseminate the spatial data information systems and infrastruc-

INSPIRE	GMES	SEIS
Content	Content	Content
Infra structure	Infra structure	Infra structure
Services	Services	Services
Obligation	Obligation	Obligation?
Business	Business	Business

Table 1: Main Lines of these European Initiatives

[5] The existence of such synergies is borne out by recent forums such as the European *Towards e-Environment* Conference < http://www.e-envi2009.org>.

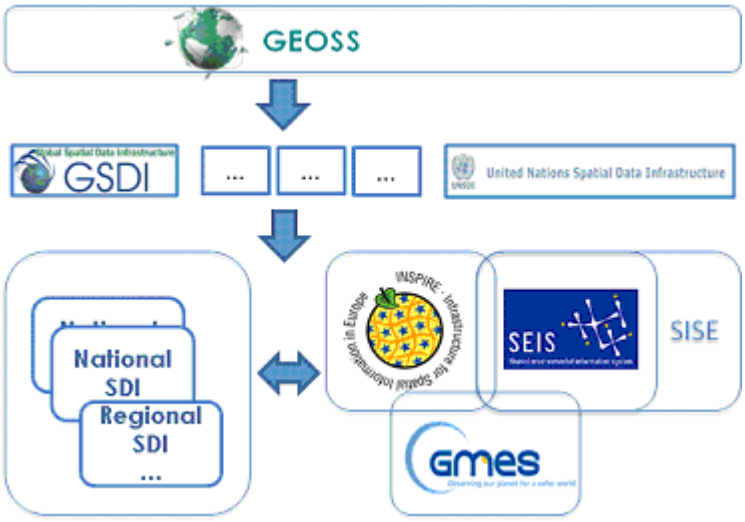

Figure 4: Synergies Between GEOSS/GMES/SEIS/INSPIRE.

tures of member states at different administrative levels. These individual systems will support larger global systems, all of which help make up the global system of systems which is GEOSS.

4.1 Harmonization Projects

As a result of the proliferation of these initiatives there are overlaps in the goals which not only cause a duplication of effort but may give rise to similar action lines and objectives being steered towards the use of different standards, thereby impeding interoperability between the systems produced by each initiative. Therefore there is a need to organize the initiatives so that requirements are standardized and objectives are harmonized. This has led to the appearance of projects whose mission is to integrate these initiatives. This is the case of GIGAS[6] (*GEOSS, INSPIRE and GMES, in a "Support Action"*) which promotes the coherent interoperable development of the initiatives GMES-Kopernikus, INSPIRE and GEOSS through the adoption of agreed upon standards and protocols and open architectures. Given the complexity and dynamic nature of the initiatives and the large number of interested parties, the key to GIGAS's added value is to ensure that the European organizations promoting these initiatives guide them towards a synergetic convergence.

SOSI (*Spatial Observation Services & Infrastructure*) [15] is a similar project, the main aim of which is to check the concepts behind SEIS in respect of infrastructure and services, and to evaluate SSE (*Service Support Environment*) where it touches upon the sustainability of SEIS, for example with regard to the existence of reusable technology. The coherence of the SOSI project with the above and other initiatives should be ensured through collaboration with the project GIGAS.

Moving away from the organizational level, there are other projects within the same European framework that take a more practical approach to monitoring the synergies between these initiatives, such as the Humboldt[7] project, which aims to harmonize spatial data and services. Along similar lines we can find such projects as the thematic eSDI-Net+[8] network, funded under the auspices of the European *e-contentPlus* programme, which aims to encourage collaboration and the exchange of experiences and best practices in SDI project implementations at sub-national levels throughout Europe.

5 Conclusions

International governments and organizations often tend towards the use of ad hoc agreements to address specific situations rather than implementing a general policy that might prove hard to negotiate. This approach may end up wasting a considerable amount of time, mainly due to negotiations with, for example, the public agencies which possess the data. If a prior agreement is reached, immediate access to the required data can help institutions act more swiftly in response to critical situations. Therefore, in a global and international context, the establishment of global infrastructures and agreements regarding data access policies, and the use of standardized interoperable systems, should bring about a reduction in response times to critical natural or environmental situations.

GEO enables collaboration in three different ways. Firstly, by encouraging countries that develop their own national SDI to register their systems, services and standards with GEOSS, so they can be used both by GEOSS and by GSDI. Secondly, by harmonizing GSDI's and GEOSS's approach. And, finally, by ensuring that the EO community

[6] <http://www.thegigasforum.eu/>.
[7] <http://www.esdi-humboldt.eu/>.
[8] <http://www.esdinetplus.eu/>.

moves towards the open exchange of information, just as is happening in the SDI community.

The downside to this long-term benefit is precisely the timeframe: when we talk about the development of all these initiatives, we are talking in terms of years, and in some cases even decades. However, there is a clear political commitment at an international level to participate in these initiatives due to the current level of interest being generated. This means that agreements need to be reached not only on how to implement the systems, how to access the data, and which standards to use, but we also need to ensure that all the organizations involved are pulling in the same direction, and that any agreements reached are compatible and achievable.

Acknowledgements

This work has been partially funded by the project CONTIENE (TIN-2007-68066-C04-02).

References

[1] El Mundo (Spanish journal). "*50 años del Sputnik* (50 years from Sputnik)". September 2007. <http://www.elmundo.es/especiales/2007/09/ciencia/sputnik/index.html>.

[2] United Nations. "Plan of Implementation of the World Summit on Sustainable Development". Johannesburg (South Africa), August 26 to September 4, 2002. <http://www.un.org/esa/sustdev/documents/WSSD_POI_PD/English/POIToc.htm>.

[3] Group on Earth Observation. "The GEOSS 10 Year Implementation Plan". GEO document 1000, February 2005. <http://www.earthobservations.org/>.

[4] Eliot Christian. "Planning for the Global Earth Observation System of Systems (GEOSS)". Space Policy, 21(2): pp. 105-109, 2005.

[5] Group on Earth Observation. "The Full Picture". 2007. <http://www.earthobservations.org/documents/the_full_picture.pdf>.

[6] Conrad C. Lautenbacher. "The Global Earth Observation System of Systems: Science Serving Society". Space Policy 22(1): pp. 8-11, 2006.

[7] Donald MacPhail. "Increasing the use of Earth observations in developing countries". Space Policy 25(1): pp. 6-8, 2009.

[8] GEOSS Secretariat. "The first 100 steps to GEOSS". Ed: GEOSS Secretariat. 30 November 2007.

[9] Anne Barbance. "A market for GMES? Results of the Graz conference". Space Policy 23(1): pp. 53-56, 2007.

[10] Nicola Rohner, Kai-Uwe Schrogl, Simonetta Cheli. "Making GMES better known: Challenges and opportunities". Space Policy 23(4): pp. 195-198, 2007.

[11] INSPIRE EU Directive. <http://eur-lex.europa.eu/LexUriServ/site/en/oj/2007/l_108/l_10820070425en00010014.pdf>.

[12] Guy Weets. "Toward a Single European Information Space for Environment. A contribution to i2010 and SEIS". DG INFSO, ICT for Sustainable Growth. Frascati April 3rd, 2007.

[13] Arno Kaschl. "GMES: recent developments". INSPIRE Conference 2008, Maribor (Eslovenia).

[14] G. Triebnig. "SOSI –Spatial Observation Services & Infrastructure. A Good Practice Demonstrator for the Sharing of Environmental Information". 4th GRID & e-Collaboration Workshop, February 25th 2009. <http://www.congrex.nl/08M16/presentations/Day1/S1_06_Triebnig.pdf>.

