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Summary Proceedings – INSPIRE In The Global Dimension, a Conference Track Organized by the EuroGEOSS Project

INSPIRE Conference
Krakow, Poland
June 23 through 25, 2010
This track was organized by the EuroGEOSS project, which focuses on integration of European information systems for Drought, Biodiversity, and Forestry. The EuroGEOSS Project is sponsored by the European Commission. It is coordinated through BRGM and the Joint Research Center (JRC). The track was organized by JRC and IEEE.

1. Track Agenda

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<td>14:00</td>
<td>Welcome and opening</td>
<td>Max Craglia, Jay Pearlman</td>
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<td>14:30</td>
<td>INSPIRE and GMES Services</td>
<td>Hans Dufourmont</td>
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<td>GEOSS Perspectives</td>
<td>Alan Edwards</td>
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<td>16:00</td>
<td>What is exportable about INSPIRE How to contribute to a global management of GI</td>
<td>Mauro Salvemini</td>
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<td>16:30</td>
<td>EuroGEOSS – a demonstration Program</td>
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<td>EO2HEAVEN – earth observation and environmental modelling for the mitigation of health risks</td>
<td>Jose Estaban</td>
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<td>Adjourn Session 1</td>
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<tr>
<td>9:00</td>
<td>SDI in support of Capacity Building</td>
<td>Gavin Adlington and Rumyana Tonchovska</td>
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<td>9:25</td>
<td>A strategy for Spatial Data Infrastructure</td>
<td>Suha Ulgen</td>
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<td>9:50</td>
<td>2010 the Year of Biodiversity</td>
<td>Bob Scholes</td>
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<td>10:15</td>
<td>INSPIRE and the Global Dimension</td>
<td>Alessandro Annoni</td>
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## SESSION 3: Global perspectives on selected thematic areas - Chair Stefano Nativi (Room Aula Mala)

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<tr>
<td>10:40</td>
<td>Morning Break</td>
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<tr>
<td>11:00</td>
<td>Drought a Global Perspective: efforts toward a Global Drought Early Warning System</td>
<td>Mark Svoboda</td>
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<td>Roman Michalak</td>
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<td>12:00</td>
<td>Achieving interoperability of spatial data</td>
<td>Clemens Portele</td>
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## SESSION 4: EuroGEOSS contribution to the Global Earth Observation System of Systems – Chair Max Craglia (Room Aula Mala)

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<tr>
<td>14:00</td>
<td>Multi-disciplinary Interoperability: the EuroGEOSS Operating Capacities</td>
<td>Stefano Nativi</td>
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<td>14:20</td>
<td>EuroGEOSS for Biodiversity – New Approaches to Monitoring and Forecasting at the Global Scale</td>
<td>Steve Peedell</td>
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<td>14:40</td>
<td>Drought</td>
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<td>15:00</td>
<td>EuroGEOSS Forestry Operating Capacity – status and outcomes</td>
<td>Gerimantas Gaigalas</td>
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<td>15:20</td>
<td>Cross-cutting benefits of GEOSS</td>
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## SESSION 5: European Research Projects for GEOSS – Chair Stephen Peedell (Room Aula Mala)

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<tr>
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<td>Panel - Adapting EuroGEOSS to African Applications:</td>
<td>Jay Pearlman (Chair); Steve Peedell; Bob Scholes; Tesfaye Korme</td>
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<td>17:00</td>
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<td>17:20</td>
<td>Geo Land2 SDI – A spatial data infrastructure component of the GMES land monitoring core service</td>
<td>Erwin Goor</td>
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<td>17:40</td>
<td>Oceans Apart? – has INSPIRE brokered cooperation in the oceanographic community?</td>
<td>Keiran Millard</td>
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Adjourn for June 24

Friday June 25, 2010

## SESSION 6: European Research Projects for GEOSS – Chair Stefan Niemeyer (Room Aula Mala)

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<td>EuroGEOSS internal meeting</td>
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<td>10.30</td>
<td>Morning Break</td>
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### SESSION 1 - Opening and context for Global Dimension Stream

Attendance progressively built up to approximately 60 participants.

#### Welcome and opening

**Francis Bertrand** from BRGM, moderator for Session 1, introduced the EuroGEOSS project and speakers.

**Max Craglia** from the EC Joint Research Center (JRC) started his presentation by focusing on earth systems. There are fundamental scientific questions regarding change, which we have a collective responsibility to address. Change management can be addressed either via mitigation or adaptation, both of which require information for decision making. Directive 2007/2/EC of the European Parliament established an Infrastructure for Spatial Information in the European Community (INSPIRE). INSPIRE provides the legal framework for sharing existing information on the environment, but does not require the collection of new data. The Global Monitoring for Environment and Security (GMES) on the other hand will collect new data and make them available through services to many different users, as illustrated in the presentation by Hans Dufourmont that follows. Finally the Shared Environmental Information System is a new initiative of the European Commission (See [http://ec.europa.eu/environment/seis/index.htm](http://ec.europa.eu/environment/seis/index.htm)) that builds on both INSPIRE and GMES,
and includes both spatial and non-spatial information. Max then summarized the organization of the INSPIRE in the global dimension track: day 1 provides the background by addressing GEOSS and GMES; day 2 includes the international perspective from the World Bank and UNSDI, and features experts in the three thematic EuroGEOSS areas of drought, forest, and bio-diversity.

**INSPIRE and GMES Services**

**Hans Dufourmont** from JRC focused on GMES and cross-links to INSPIRE. GMES (Global Monitoring for Environment and Security) is a joint initiative between the EU and the European Space Agency regarding the environment. It includes both vertical and crosscutting services. In the area of disaster management, there is a 24/7 response coordination at the EU level and a response upon request (example, floods in France last week). Hans then highlighted the cross-links between INSPIRE and GMES. At the regulation level, the cross-link is explicit. Cross-links exist also at the project level. For example, marine services provided by My Ocean, an EC Framework project, are used in the shipping industry to optimize routes for large ship; these services are INSPIRE compliant. Similarly for land services, the Geo Land 2 portal provides INSPIRE compliant services. Hans also mentioned the local urban atlas data which is now available free of charge from the European Environment Agency (EEA) web site. A joint INSPIRE-GMES workshop was held in June 2009 with a focus on land cover, and the creation of working groups. A new FP7 program (HELM) is currently in negotiation regarding the Harmonization of Land Cover Monitoring for Europe. In conclusion, GMES and INSPIRE are working jointly to ensure the establishment of effective cross-links.

During the discussion that followed, participants asked clarifications about the link between GMES data specification process and that of INSPIRE, the link to GEOSS, and role of in-situ global measurements. In response, Hans clarified that even when GMES data sets are out of scope of INSPIRE, the awareness of the INSPIRE specification process is important and takes place through research projects. Links to GEOSS are through registration in the GEOSS Common Infrastructure to enable access to data and services. The link between the satellite-base measurements of GMES and the in-situ ones is an important coordination task for which the European Environment Agency has taken the leadership. This is an effort clearly focused on Europe, but is an important contribution to the global dimension.

**GEOSS Perspectives**

**Alan Edwards** from the European Commission's Research Directorate-General provided an introduction to GEOSS. He mentioned the 2002 World Summit on Sustainable Development in South Africa, followed by the creation in 2003 of the "ad hoc" GEO and then the formal intergovernmental GEO in 2005. GEO members contribute to the implementation of the GEOSS on a voluntary basis. This voluntary participation is both GEO's strength (agility compared to other intergovernmental organizations), but also its
weakness (there are a few gaps which no-one has volunteered to fill). GEO has a 10-year implementation plan for the GEOSS, which was initiated in 2005. Alan stated the GEOSS vision to realize a future wherein decisions and actions for the benefit of humankind are informed by coordinated, comprehensive and sustained Earth observations and information. The purpose of GEO is to achieve these observations of the Earth system, in order to improve monitoring of the state of the planet, increase understanding of Earth processes, and enhance prediction of the behavior of the Earth system. He briefly addressed the nine GEO Societal Benefit Areas (SBAs); see the GEO website for further details [http://www.earthobservations.org/]. He then summarized the strategic targets for the GEOSS Architecture (see the document from last year’s Plenary for targets in other areas such as capacity building). He reminded the audience that only a limited number of countries produce satellite data, while most countries have to rely on in-situ data collection. Thus, in-situ data systems as well as satellites are critical, leading to the need for data sharing on a global basis. This means going beyond Google, to allow not only visualization but also access to the data, and interoperability. He briefly outlined the GEOSS common infrastructure (GCI), which is composed of the GEO Web Portal, the GEOSS clearing house, standards registry, components registry, and best practice wiki. At a European level, GMES is a main provider and GMES pre-operational services are now registered in GEOSS, which represents a very significant political step. The GEOSS Clearinghouse is the engine that drives the entire system. It connects directly to the various GEOSS components and services, collects and searches their information and distributes data and services via the Portal to the users. The GEOSS clearinghouse is designed to permit access to not only the GEOSS registries, but also to community catalogues. Going beyond the GCI, it is important that data access conditions be included as part of the meta-data (see INSPIRE example). Every GEO member has endorsed the GEOSS data sharing principles and the voluntary nature of GEO works well for promoting data sharing. Alan Edwards then briefly addressed the interoperability driven Service Oriented Architecture (SOA). Although most participants in the INSPIRE conference are familiar with the concept of “services” in the technological context, he warned that this was not necessarily the case for non-technical audiences who interpreted services in a different way, (example servicing an appliance). He highlighted INSPIRE as an EU contribution to the GEOSS registered standards. The INSPIRE portal is now registered with GEOSS. Alan indicated that the EC directs research actions in support of GEOSS, and gave a list of FP7 relevant projects. There is an upcoming call for 2011 projects. Funding goes primarily to EU and developing countries, although other participants are welcome. The 2011 call includes a 7 Million Euro project on interoperability via integration of shared earth observation resources, (water, weather, and marine eco-systems SBAs). In addition to cross-domain projects, such as EuroGEOSS, there are also FP7 projects that focus on individual SBAs. He gave some examples of projects that will be addressed later in the Workshop such as EnviroGRIDS (Black Sea hydrology), AEGOS (geology - Export know-how from Europe to Africa
including INSPIRE), EnerGEO (establish global standards using INSPIRE), and GEOBON (biodiversity).

The discussion that ensued focused primarily on business processes, data sharing and sustainability. GEOSS aims to make interoperable data available, which should greatly facilitate the transformation of the data into the required information. Data maintenance is addressed in the data sharing Action Plan and the relevant GEO Work Plan tasks. Regarding citizen sourcing or data sourced by advocates on behalf of citizens, the short term focus is on system users; in the longer term, for example, applications for smartphones for citizen observations, sourcing and access are likely.

**What is exportable about INSPIRE**

Mauro Salvemini from the Sapienza University of Rome, gave a presentation entitled “how exportable is INSPIRE”. He talked about the extent to which Geospatial Information and Spatial Data Infrastructure (GI/SDI) are well accepted within the international community, the general public and the Non Governmental Organizations. He provided a list of NGOs that are particularly involved in cartography, remote sensing, and standards associated with GI/SDI. He highlighted organizations that are involved within the United Nation and European commission, and addressed early international resolutions within the cartography area. The progress has accelerated since 2000, with some of the more recent resolutions making references to INSPIRE. The tangible aspects of the INSPIRE model such as terms of reference, best practices, and technical documents are much appreciated. There are intangible aspects as well associated with the union based international political model. Mauro closed his presentation by wondering how to capitalize on the heritage brought by INSPIRE to the international community.

**EuroGEOSS – A Demonstration Program**

Max Craglia from the JRC introduced the EuroGEOSS project. The project focuses on building on already existing systems in three communities: forest, drought, and biodiversity, adding a horizontal dimension between these communities through information access and connectivity. Achieving interoperability is done in stages. The first Phase extends current systems to develop an Initial Operating Capacity (IOC) for GEOSS, building upon the GEO Interoperability pilots (IP3/AIP2). To do so, each thematic work package (forestry, drought and biodiversity) interacts with Interoperability Work Package 2 which provides the standards, specifications, and expertise necessary to ensure compliance with INSPIRE and GEOSS, and assesses the requirements of the thematic and societal users. The connectivity is enabled within a thematic area at the local to regional level.

For the Advanced Operating capability (AOC), the key additional tasks in EuroGEOSS Phase II are the documentation of models and (often) tacit assumptions, work flows and theoretical underpinning to achieve a multi-disciplinary Advance Operational Capacity (AOC) in the GEOSS framework. Phase III extends the AOC further through a sustained capacity building effort (WP 7) to include other societal benefit areas and link to other infrastructures and networks. Max Craglia briefed the path forward for each thematic area. He then addressed the approach used to assess the cost benefit analysis for using INSPIRE and GEOSS for the 3 thematic areas, introducing the benefit chain concept.
EuroGEOSS also has an outreach and dissemination work package for fostering international collaboration. Max Craglia addressed the GEOSS data sharing principles, and the use of metadata to support these principles via inclusion of data access and use information/limitations, as implemented for INSPIRE. He briefly addressed the use of open source tools for INSPIRE, such as metadata editors, and concluded by listing the GEOSS tasks the EuroGEOSS project is supporting.

The discussion that followed focused on how the EuroGEOSS project is contributing to GEOSS tasks. It was noted that there are differences between the thematic communities and build bridges between them. The EuroGEOSS broker is providing connectivity between domains, facilitating the delivery of data and services.

**EO2HEAVEN – earth observation and environmental modelling for the mitigation of health risks**

A presentation on EO2HEAVEN, a framework project under FP7, was moved from Friday. The presentation was developed by Jose Lorenzo, and given by one of his colleagues, Jose Esteban. The EO2HEAVEN concept is to develop a better understanding of the complex relationships between environmental factors, population exposure, and health impacts in Europe and Africa. EO2HEAVEN will develop a data infrastructure and associated processing services able to correlate time series of environmental and health data. As a result, researchers and epidemiologists in particular will be able to investigate the environmental factors that are causing different illnesses. EO2HEAVEN will produce risk maps and will allow early alerts to be set up by authorities.

The project will be driven by three case studies dealing with different situations, but all involving the use of health, remote sensing (satellite), and in-situ data:

- Use case 1 in Dresden (Germany) will study cardiovascular and respiratory diseases caused by air pollution
- Use case 2 in Durban (South Africa) will also address pollution related diseases
- Use case 3 in Mozambique will address the gap in current understanding of the dynamics of cholera.

The project was started in 2010 and is in its initial implementation.

Upon conclusion of the last presentation, session 1, opening and context for global dimension stream, was closed.

**Session 2 – INSPIRE Plenary on Global Dimension.**

Attendance for the plenary was between 350 and 400 participants.

Jay Pearlman, chair of the session, provided a brief introduction of each speaker.

**SDI in support of Capacity Building**

Gavin Adlington from the World Bank (WB) gave the first presentation of the plenary, entitled “SDI in support of capacity building” with focus on Europe and Central Asia (ECA). Gavin and Runyana Chonchovska from FAO collaborated in the development of the presentation. The ECA land team includes representatives from the World Bank, FAO,
various consultants, and donor organizations/countries. Land administration and management is recognized as the leading example of collaboration between WB and FAO. Gavin highlighted the changes in land administration since before 1989: from state ownership to privatization of land, and building on reforms over the last 10 years. There are 5 broad objectives for the ECA land projects over the next 10 years. These will be enabled by linking land administration to GEO information, SDI, and INSPIRE. Many themes from INSPIRE Annex I are already being addressed. Many countries are asking the WB for support in 2 key areas: 1) Improving the quality of services and reducing corruption through e-government initiatives (e-Cadastre); and 2) SDI and meeting the requirements of the INSPIRE Directive. Gavin Adlington gave several examples of projects funded by WB in ECA and other regions. He stressed that the bank helps, but the countries are actually doing the implementation. In conclusion, there are a number of challenges including both human (level of coordination and cooperation between key players, capacity building, others), and technical (standards for digital data, data quality, creation of digital data).

A Strategy for Spatial Data Infrastructure
T. Suha Ülgen from the Office of the Assistant Secretary-General and Chief Information Technology Officer, UN Secretariat, addressed the United Nations Spatial Data Infrastructure (UNSDI) and the UN Geographic Information Working Group (UNGIWG). The UNGIWG was established in 2000 as a voluntary network of UN specialized agencies, programs and funds, to facilitate technical collaboration and formulate policies concerning geographic information. Suha Ülgen briefed the working group organization, core data and thematic data. Development, environment, humanitarian, safety, security and peacekeeping are the driving business concerns of UNGIWG. SDI axioms focus on reuse, sharing the costs, and learning from others. SDI provides a framework to facilitate access, exchange and quality of geographically-related information using common standards, protocols and specifications. A list of key UNSDI milestones were provided from the decision to create a UNSDI in Addis-Ababa in 2005, to the current updated UNSDI framework. Suha Ülgen provided a list of 16 thematic geo-datasets and services. The rest of his presentation focused on capacity building at indigenous and UN levels. In conclusion, there is Urgency to address data sharing issues among UN organizations and with partners. A quote from David Snell, founder of OGC, left the audience with the following thoughts: “Interoperability seems to be about the integration of information. What it’s really about is the coordination of organizational behavior.”

2010 the Year of Biodiversity
Bob Scholes, chair of the Group on Earth Observation Biodiversity Observation Network (GEOBON) addressed “2010, the year of Biodiversity”. He focused on how the use of informatics can slow the 6th extinction. He indicated that there is currently an acceleration in the decline of bio-diversity. Historically, based on the fossils record, a species has lasted approximately 1 million years, resulting in 2 species being lost per year. Using this as a background rate, we are seeing a 100% increase in losses in the current time, thus leading to the “6th extinction” period nomenclature. There are 5 big causes of bio-diversity loss: loss of habitat, over-exploitation (for example fisheries), climate
change (which will overtake the previous items), pollution, and invasion by imported species. This century, we will continue to lose bio-diversity, even in the most optimistic scenarios. There are several reasons to be concerned: aesthetical (enjoyment of nature); ethical (stewardship duty); and utilitarian (this is a new argument—we depend on services provided by the ecosystem, such as food, drinking water, etc). Biodiversity indicators, which reflect the current situation, are often under-developed or missing. The World Summit on Sustainable Development highlighted the need to share data essential for planetary management. Using a plan and processes from the Global Earth Observation System of Systems (GEOSS), the GEO Biodiversity Observation Network will connect previously separate efforts, along with some new information, to make an integrated system. Hundreds of organizations collect bio-diversity data. The GEOBON action plan, which was published in May 2010 articulates the vision and mission for the Network—GEO BON focuses on observing and analysing changes in biodiversity over time, stressing connections (interoperability and communications). Dr. Scholes identified several missing pieces such as a global database of interaction observations, a community data base (for example, co-located species), and uses of bio-diversity from a societal benefit standpoint. Linking can be established at the gene level, species level, and ecosystem level. Although bio-diversity can be complex, biodiversity data can be expressed out of a small number of basic records: nouns which indicate what, where and when; adjectives which focus on taxonomy and communities; and verbs which indicate actions and intensity; data quality can be added to these elements. The goal is to work toward information integration, an example being bio-diversity intactness as an integrated indicator. The implementation plan addresses bio-diversity at the genetic level—connectivity with locations, at the species level—identifying edge species in hot spots of evolutionary history, and at the ecosystem scale—including citizen science. In conclusion, Bob Scholes reminded the audience that 2010 is the year of bio-diversity, and that there will be a major conference in Nagoya in October.

**INSPIRE and the Global Dimension**

Alessandro Annoni from the Joint Research Center focused on INSPIRE and the Global Dimension. He opened his presentation by asking what lessons and experiences the INSPIRE community can offer to the development of a global SDI. He then reviewed the areas where INSPIRE might be able to contribute by building on their success, and expanding them to the global level. Six challenges were identified. The first challenge, is the understanding of the global landscape (participants include organizations, agencies, industry, programs, etc) focusing on actions, which promote interoperability. The system of system approach of GEOSS provides the right framework for INSPIRE to make its full contribution,
including the registration of components, services and community portals, which provide access to a variety of catalogue, services and data. The second challenge focuses on influencing selected initiatives by offering selected practices and guidelines. For example, INSPIRE includes in its repository, guidelines for development of data specifications.

INSPIRE also faced the challenge of multi-language, and a diverse community. The third item is the promotion of INSPIRE as a process, with focus on building a community and spirit. The fourth challenge is the use of INSPIRE as a conceptual model, providing a lot of freedom, focusing on interoperability of data and services, and allowing for step wise implementation. The fifth challenge is to internationalize INSPIRE. The international community should benefit from the huge effort undertaken by the INSPIRE stakeholders in developing and testing their specifications. The INSPIRE community should ensure that its specifications can be adopted as international standards. INSPIRE provides a unique opportunity to test international standards (such as ISO and OGC standards), thus facilitating global interoperability. The INSPIRE data model constitutes a European contribution to the international community. The sixth and last challenge is the advanced research for the next generation SDI, which should be adapted to emerging technologies and new governance models. In conclusion, INSPIRE is playing an increasingly active role in the international arena, and has the potential for significant influence, but must face the six challenges described above.

SESSION 3 – Global perspectives on selected thematic areas.

Attendance for this and the following sessions peaked around 60 attendees.

Stefano Nativi, chair of the session, introduced the first speaker.

Drought a Global Perspective: efforts toward a Global Drought Early Warning System

Mark Svoboda from the National Drought Mitigation Center (NDMC) in Lincoln, Nebraska, USA, presented a briefing on efforts toward a global drought early warning system. His briefing introduced the NDMC programs, and stressed the importance of drought planning. Svoboda then discussed the use of the Standardized Precipitation Index (SPI) globally. The WMO, UNCCD, U.S. Department of Agriculture and U.S. National Oceanic and Atmospheric Administration jointly sponsored a workshop with the NDMC in Lincoln, Nebraska, that involved 54 participants from 22 countries around the world and came out with a declaration identifying the use of the SPI as a way of characterizing meteorological drought globally. He then focused on the drought monitoring and early warning activities. These include both forecasting and monitoring, using timely data. The synthesis and analysis of the data is used to trigger actions within a drought plan. The system includes tools for decision makers, as well as
for drought risk planning, and education and outreach. There is a wide range of drought products for daily, weekly and monthly release. A lot of good work has been done over the last 5 or 10 years, but still quite a few impediments. In the US, drought monitoring now uses a composite index (Drought Monitor at http://drought.unl.edu/dm) partnering with numerous organizations collaborating and contributing to this weekly map. This work is now being extended to the North American Drought Monitor (NADM) that includes the USA, Canada and Mexico. The resulting map is provided monthly. Forecasts are provided every 2 weeks and provide a seasonal outlook, ranging from a few weeks to 90 days. Drought impacts are used to compare the monitoring and forecasts with reality. The Drought Impact Reporter (droughtreporter.unl.edu) tool includes inputs from a citizen science network of approximately 14,000 members, providing information on precipitation, hail, drought impacts and other items. This is augmented by the use of remotely sensed data and models, using the Vegetation Drought Response Index (VegDRI). Monitoring impacts globally is virtually non-existent. He concluded with a discussion on NIDIS, the National Integrated Drought Information System. NIDIS (drought.gov) provides a drought portal and tools to assist decision-making. There are currently two NIDIS pilot projects. The participating organizations work collectively to generate a drought-monitoring network. Future drought monitoring challenges include collection and quantification of impacts, soil moisture monitoring, hydrology, developing trust in the operational use of remotely sensed data, and environmental and ecological considerations. In summary, a global drought early warning system would heighten awareness and provide a tool for policy makers. In addition, contributions from Citizen science networks should be encouraged.

In a subsequent discussion, Svoboda emphasized that of the products discussed are freely available; he realizes that this is not the case in all countries, but referenced the efforts of GEO in the data sharing area.

Global Approach on Forestry
Roman Michalak from UNECE/FAO Forestry and Timber Section in Geneva discussed forest and forest management assessment at the global, regional and national levels. Historically, forest reporting was accomplished primarily at a local level. This resulted in a variety of systems on local, sub-national and national level and different scopes. As shown in a table comparing various countries, each country used its own basic parameters, and there was little that could be compared. As a result reporting was collected at national level (UNECE and FAO) submitted according to national standards. Standardization attempts failed; thus it was decided to focus on harmonization. After the Rio summit, the situation changed and regional processes on criteria and indicators emerged. These processes elaborated their sets of indicators for reporting, one of them Forest Europe came up with a set for pan-European countries. At the global level, since 2000, all countries have been invited to report at the national level every 5 years, last edition in 2010. There is a different frequency for reporting at regional and global levels. Global forest assessment is a major project by FAO. Scope of the assessment was based on UN seven thematic identifications (very broad). 233 countries are covered. Country reports include 17 tables. Regional workshops were organized to discuss the process with the correspondents. The “State of Europe’s forest” report, which is jointly prepared by
UNECE, FAO and Forest Europe, covers 46 countries, and is released every 4 years. The report is prepared and presented to the Ministerial conference on the protection of European forests, the last one was in 2007. All data collected is made available on a website. Regarding national level, they try to ensure comparability of sub-national, national, regional, and global levels (example from France). Global key findings: forest covers more than 30% of land area. Most of the forest is located in 5 countries (Russia, Canada, Brazil, US and China) Key findings: data on the rate and location of deforestation, and re-forestation. In Europe, the Russian Federation contributes disproportionately to the forest situation. In conclusion, the process benefited much from direct linking with users, as it is based on in-situ data collection. He acknowledged all of the organizations, which contributed to the process on a global level.

In the discussion that followed, the differences between the national reports and the remote sensing data was addressed. Forest definition includes two components: forest cover, which can be monitored using remote sensing, and forest land use; at the JRC, there were comparisons between the 2 sources, and the difference was about 10%. Remote Sensing carried by FAO includes validation of satellite images by the countries, thus fostering consistency.

Achieving Interoperability of Spatial Data

Clement Portele presented a briefing on Achieving Interoperability of Spatial Data. He reported on the work done on the GIGAS program. This effort, which has been completed, focused on the commonality between GEOSS, INSPIRE, and the Global Monitoring for Environment and Security (GMES). Looking at interoperability on a European level, shared commonalities included: a focus on environmental monitoring, use of geographical information, a European or global dimension, reliance on international standards, and the advanced SDI needed for their implementation. However, there were many fundamental differences as well (such as differences in governances, funding, level of implementation, and others). These differences could result in evolution into separate, incompatible services, which would not benefit from interoperability. The approach fostered coherent and interoperable development of the initiatives, and concerted adoption of standards, protocols and open architecture. The 2 year project was iterative (including two loops) and consensus driven. Each iteration included the following steps: 1) analysis; 2) comparison and recommendation; 3) discussion with stakeholders and attempt for consensus; and 4) shaping initiatives evolution. Multiple events were conducted to promote communications, including a stakeholder workshop in January 2010, and an open networking event in April 2010. The architectural themes included catalogues and metadata, data interoperability (which was prioritized), data access and processing, and user management. Cross initiative scenarios were also addressed, and an interoperability test bed was set-up. The lack of data interoperability had been identified as a priority item.
for GIGAS. The effort focused primarily on semantic level issues, analyzing harmonization/semantic interoperability approach from the 3 initiatives, major standard organizations, and FP7 programs as applicable. The list of topics to analyze was broader than the INSPIRE list, and resulted in 26 data interoperability components. Opportunities for improving data interoperability were identified. Recommendations were provided in the following areas: the need for a common foundation (including terminology, and concepts); building on top of the common foundation with coherent thematic views (for the 3 initiatives and standard organizations). However, Clemens Portele noted that one can only go so far in data interoperability. There are technical and operational structure limitations. The tools are still relatively rigid (such as UML), and some of the initiatives have to work within a legal framework. Ontology and semantic interoperability are still considered research topics. The SDI infrastructure needs to include central components, such as a controlled vocabulary, which must be available in order to proceed. The strategy for evolution is complex, as you must allow for changes without breaking what is already there. Maintenance processes, backwards compatibility, and technological independence are important to enable sustained interoperability. Also, education, training, and capacity building should not be neglected. In conclusion, what is the relevance of GIGAS results for INSPIRE? A unique cross-initiative knowledge base has been established, and improved communications between the stakeholders have been enabled (including a new liaison group and participation to the GEO SIF Europe).

During the ensuing discussion, it was highlighted that GIGAS players were also involved in other initiatives or work in standard organizations (such as AIP3 and SIF) to create a common foundation. Conversely, members of OGC and of the organization chairing ISO TC 211 participated in the project. GIGAS is now completed, and a convergence process has been initiated. A liaison group between the 3 initiatives has been established, but not yet funded. Time will tell if the convergence process is continued.

**SESSION 4 – EuroGEOSS contributions to the Global Earth Observation System of Systems.**

Attendance for this and the following sessions peaked around 60 attendees. Max Craglia chaired the session.

**Multi-disciplinary Interoperability: the EuroGEOSS Operating Capacities**

Stefano Nativi from the CNR addressed multi-disciplinary interoperability. The approach he described is to apply INSPIRE and GEOSS principles to EuroGEOSS. The team is building on existing resources, and Interoperability Standards, supplementing rather than supplanting what has already been done. There are 3 phases: first registering existing autonomous task-oriented systems; second performing mediation; and third, implementing service interoperability and metadata sharing. Stefano Nativi described the System of System approach, building incrementally and progressively adding heterogeneous resources and shifting from technical interoperability to conceptual composability via interoperability arrangements.
There are 3 levels of infrastructure: distributed computing; geospatial information; and digital earth. The approach includes relaxing the traditional Service Oriented Architecture to avoid its traditional tight coupling between services and taking into account the level of complexity of the System of Systems with their many heterogeneous components. A EuroGEOSS broker was established to perform discovery, access, processing and chaining. The EuroGEOSS Operating Capability includes three interoperability phases: first, enabling thematic capacity from local to global level; second, enabling multi-disciplinary interoperability; and third, extending interoperability to other Societal Benefit Areas (SBAs) and systems. For the Initial Operating Capacity, each SBA develops standards, and the Interoperability Work Package develops the broker to perform multi-disciplinary discovery providing general common geospatial services. For the Advanced Operational Capacity, advanced semantic tools (knowledge-based and ontology) will be connected into the EuroGEOSS system and, ultimately, to the GCI. In conclusion, Stefano reviewed the Science and Technology challenges such as connecting different autonomous systems at different levels of infrastructure, shifting from technical interoperability to conceptual composability, making use of broker and mediation service frameworks, developing holistic interdisciplinary approaches for digital earth applications. An outcome of the project will be to provide specific guidance to the Earth Science community in the evolution and development of their systems.

**EuroGEOSS for Biodiversity – New Approaches to Monitoring and Forecasting at the Global Scale**

**Stephen Peedell** from the JRC addressed EuroGEOSS for Biodiversity, new approaches for monitoring and forecasting at the global scale. The JRC global environment monitoring unit and others take an integrated approach, looking at both land and sea beyond Europe. They make use of remote sensing global data sets such as the forest global data products. Stephen Peedell then addressed the approach to African Protected Areas Assessment. For the European Commission, the policy question on how to define funding priorities for protected areas needs answering. Spatial analysis is used to look at areas under threat, and map the habitat. The African Protected Areas Assessment tool (APAAT) was developed for that purpose. It addresses species distribution, but is static, geographically restricted, and includes neither monitoring nor forecasting. To provide monitoring and prediction, ecological forecasting and climate change web services make use of the Habitat Replace-ability Index (HRI) that was developed to identify habitats similar to the area under threat. EuroGEOSS provides an architecture that is global and interoperable. The advantage of the EuroGEOSS broker is that it can hide the complexity. The digital observatory for protected areas (DOPA) will provide methods and tools to assess, monitor, and forecast biodiversity in areas of ecological interest on a global scale. One question is how to assess and quantify data and information quality. The uncertweb project is looking at reliability. Data services are available. They are starting processing
services. Implementation is already planned or under way, such as the e-station using EUMETCAST. In conclusion, Stephen highlighted the DOPA challenges: gaps in existing initial operational capability (reference data gaps), scalability, complexity (distributed models), and uncertainty. For the current state of DOPA see http://dopa.jrc.ec.europa.eu.

In a following discussing about feature services, the example of GBIF was given. In an initial phase interoperability arrangements were set-up; the next phase is for GBIF to use OGC services; the data models are mapped and extended for access through the broker.

Drought

Stefan Niemeyer from JRC spoke about the EuroGEOSS for drought – linking the European Drought Observatory at the local and global scales. He stressed that the economic cost of droughts in Europe has been considerable, and there have been major drought events affecting all regions in Europe. He showed the potential linkage between droughts and climate change, especially in summer. He addressed the European Drought Observatory (EDO), a contribution to improve drought risk management. The EDO prototype will perform drought detection, monitoring, forecasting and assessment based on a multi-scale approach that integrates drought information at the continental, national, regional and local levels. As a result there is a need for interoperability between the various drought systems. The objectives of the EuroGEOSS for drought include: the definition of interoperability arrangements between drought information systems in Europe; the establishment of interoperability between EDO and national and regional drought information system sources; the contribution to multi-disciplinary research conducted by the other thematic areas within EuroGEOSS; and the facilitation of access to drought information through GEOSS. Requirements include the development of a tool to discover and access drought relevant information. Stefan Niemeyer highlighted the EuroGEOSS drought partners and their competence. He showed the EDO map server and demonstrated two scenarios. In the first scenario, an administrative user is searching through the EDO map catalogue first, and then accessing the needed information via the EuroGEOSS meta-data catalogue. In the second scenario, an expert user is searching the meta-data catalogue directly. The technical outlook includes the use of the meta-data catalogue with improved search criteria, the development of a download capability for drought data, the addition of analysis, updating and archiving tools, and the addition of more partner resources. The thematic outlook focuses on collaboration with the other EuroGEOSS thematic areas (such as forest and biodiversity).

A brief discussion followed regarding the scalability of the process at the regional level. It was indicated that this would not be an issue as information overflow is not likely since regional authorities have shown some hesitations in getting engaged.
EuroGEOSS Forestry Operating Capacity – status and outcomes

Gerimantas Gaigalas from JRC addressed the Forest Operating Capacity for EuroGEOSS. Before EuroGEOSS, there were many individual tools and forest applications, but they did not result in a clear picture. JRC was responsible for the forestry and soil data centers. Gerimantas Gaigalas highlighted the main systems available prior to EuroGEOSS. He addressed the European forest data center meta-data catalogue, map viewer, European forest resource, and European Forest Fire Information system context prior to EuroGEOSS. He then focused on the gaps to be addressed by EuroGEOSS. Many datasets with forestry information are available but not published via a catalogue system and/or not available via standard OGC web services. The main objectives of the EuroGEOSS forest work package is to extend the existing forestry data and information capabilities into a distributed global database of forestry information, serving information from a wide array of data providers at local, regional and global level. The forest work package team inventoried the web service at local and global level, intending to make more web services available. They are now looking at the generation of multi-disciplinary forest scenarios such as forest fires impact on biodiversity protected areas. The resulting processes will be contributed to GEOSS.

Cross-cutting benefits of GEOSS

Steffen Fritz from IIASA gave a presentation on the cross-cutting benefits of GEOSS. He first discussed the Global Earth Observation – Benefit Estimation, Now, Next, and Emerging project (GEOBENE), which was a precursor project to EuroGEOSS. The GEOBENE project developed methodologies and analytical tools to assess societal benefits of GEO in several SBAs; it forms the basis for the EuroGEOSS crosscutting benefit work. A meta-data catalogue was compiled regarding GEO benefits. Steffen Fritz then introduced the concept of benefit chain, where improved interoperability leads to improvements in decisions, resulting in economic benefits. There are associated costs in achieving these benefits, thus leading to the need for a cost/benefit relationship. GEOBENE analyzed the benefit of integration, focusing on crop
yield and hunger in Africa. Another example was in the comparison between terrestrial mapping and areal photography (photography was much better). Several spatial data infrastructure examples were given including a scenario to compute the value of land availability uncertainty (better data resulted in less expenses for land). Another area addressed the value of reducing uncertainties in land cover with respect to climate change mitigation policy assessment. The GEO-WIKI tool is available on the web for everyone to examine land cover for his or her area (see geo-wiki.org), thus reducing uncertainty. Steffen Fritz also introduced FeliX, a system dynamics model for analysis and measuring the benefit of Global Earth Observation. The model addresses the interactions between land, energy, and population projections, looking for example at drought impacts. The analysis of cross-benefits undertaken in EuroGEOSS is also carrying out a survey of the benefits of spatial infrastructures, which will be of interest to a broad community.

**Session 5, European Research Projects for GEOSS**
This session was chaired by Steve Peedell.

**Panel - Adapting EuroGEOSS to African Applications:**

Jay Pearlman chaired a panel of speakers who discussed Adapting EuroGEOSS to African Applications. The participants included Steve Peedell from JRC, Bob Scholes from the CSIR in South Africa, and Tesfaye Korme from the Regional Center for Mapping of Resources for Development (RCMRD) in Kenya.

**Steve Peedell** opened the discussions, with a short presentation. Priority issues and societal needs center around poverty alleviation, within the context of increased competition for land, population increase, and climate change. He stressed the importance of cross-domain collaboration, as land is being used for increasing functions including its role in the ecosystem. This leads to an increased level of information complexity (multi-scale, multi-use and multi stake-holders). GIS and SDI provide easy and reliable tools that are driven by the need of regional and national institutions. The fundamental backbone of SDI needs to be strengthened as a way to unlock existing repositories and “repatriate” data. Recommendations from EuroGEOSS include: reinforcing links between thematic domains, addressing issues raised by major initiatives such as Reducing Emissions from Deforestation and Forest Degradation (REDD), bringing practical solutions to networking and data exchange challenges, and looking at possible case studies focusing on drought and biodiversity. He gave the example of BIOPAMA, a European Development Fund project designed to improve the management of protected areas.

**Bob Scholes** started by reminding the audience of the Millennium goals. Droughts have an impact everywhere in Africa. Food security issues are associated with maintaining
food balance between production, access and distribution. Disaster aid focus should not be to provide carbohydrates but rather proteins to handle chronic issues. Do not separate drought, forest and bio-diversity as the themes are closely connected and depend on common ecological processes. As mentioned by other speakers, bandwidth is an issue, but connectivity is not. Cell phones usage has been expanding rapidly. Bob Scholes gave the example of students on a fixed budget spending less on beer, so that they can pay their increasing phone bills. He also talked about the fire early warning system, which is very popular in South Africa – although the initial information about hot spots is satellite based, the fire warning is a text message on subscribers cell phones. His recommendations for EuroGEOSS include: do a few things and do them well; reinforce data democracy (it is often easier to get data about Africa, from sources outside of Africa); and finally work in Africa rather than on Africa.

**Tefsaye Korme** introduced the RCMRD mission. He discussed the priority issues and need for Africa in the 3 thematic areas (Drought, forest and bio-diversity). There have been droughts in Africa since historical times. Priorities include: accurate early warning, development of coping mechanisms, advisory service on use of environmental resources, and development of rain-fed agriculture. Drought prediction with Fewsnet was an initial development. Tesfaye Korme focused on forest priorities, with the need to provide information for forest conservation. He gave numerous examples of forest mapping projects in Africa. There is a need for the communities to understand the value of the forest resources. Bio-diversity needs to be mapped as well. Cross-domain collaboration was then addressed. How can collaboration across domains improve results? For each thematic area, Tesfaye Korme gave a list of required domains (such as geo-information, ecology, socio-economics, etc) and resulting improved capabilities. He than asked how GIS and geo-spatial data infrastructure can address these issues via interoperability and data sharing, and highlighted improvements which can be made in those areas. He concluded with a discussion of SERVIR-Africa. SERVIR is a Regional Visualization and Monitoring System; for further information on SERVIR see [http://www.servir.net/en/](http://www.servir.net/en/). Recommendations for EuroGEOSS over the next 2 years included supporting initiatives that are already dealing with INSPIRE-like projects, (such as SERVIR-Africa and TIGER – see [http://www.tiger.esa.int/](http://www.tiger.esa.int/)), customizing and applying good practices learned from INSPIRE and EuroGEOSS, and obtaining top-down political support.

Recommendations for EuroGEOSS regarding Africa over the next 2 years were discussed earlier. The follow-on discussion addressed development goals. The focus should be on infrastructure, expanding beyond physical infrastructure (roads for example), to include science as infrastructure, and sustainment of scientific capacity; education and agriculture were also added. The importance of using shared data, user friendly tools and open source software were also stressed.

**EnviroGRIDS**

**Anthony Lehmann** introduced the goals of the EnviroGRIDS project (see [http://www.envirogrids.net/](http://www.envirogrids.net/)) as exploring the past, present and future of the Black Sea catchment, especially for hydrology. The EnviroGRIDS team is a strong and motivated consortium with 27 Partners in the Black Sea catchment and Western Europe. One of the
main aims of the EnviroGRIDS project is to explore how changes in climate will impact the quantity and quality of water reaching the Black Sea. He gave the example of the Lake Balaton (Hungary) where the SWAT model (Soil and Water Assessment Tool) was used in a previous project. SWAT models every part of a hydrological balance across the full landscape under study. Four weather stations were used to provide time series of weather and hydrological information. Varying climate or land cover and looking at the impact showed a possible decrease of water in the lake of up to 20% by 2040. They are now expanding the model to the full Black Sea catchment. Another aspect of the EnviroGRIDS project is the use of GRID technology to store and process large amounts of data. He gave the example of the work at the CERN super computer center where 160 thousand computers are employed across the word. The third part is spatial data Infrastructure (SDI) and its use in the context of GEOSS and INSPIRE. GEOSS is taking advantage of new Internet technology to look at many sources of information accessed via a portal. Bringing together these capabilities, the challenge is to fill the gap between science and decision-making. To meet this challenge, tasks in the project include the preparation of scenarios regarding climate land cover and other changes, running the SWAT models and assessing the sustainability of water resources in the Black Sea catchment. The team takes advantage of remote sensing to address societal benefit areas, and capacity building. They need to convince regional data holders to make their data available. This would allow the Black Sea Commission and the Danube Commission to take advantage of emerging data. The goal is to make information available through Web service (data or/and meta-data available through a variety of mechanisms). In terms of capacity building, they organized courses and workshops for people to register their products. In conclusion, Anthony Lehman thanked the audience on behalf of the EnviroGRIDS consortium partners.

Following discussions briefly addressed the difference between the GRID and the cloud technology concepts, and their applicability to the project. EnviroGRIDS selected the GRID before the cloud was popular, and will adapt as the information technology evolves. Another topic focused on how to engage the general public to participate in the program. The project has a task specifically about earth observation for citizens, but the way citizens will be engaged is not yet clearly defined.

**Geoland 2 SDI – A spatial data infrastructure component of the GMES land monitoring core service**

Edwin Goor from VITO then addressed the Geoland 2 project (see [http://www.gmes-geoland.info/](http://www.gmes-geoland.info/)). Geoland 2 intends to constitute a major step forward in the implementation of the GMES Land Monitoring Core Service (LMCS). The three components (Regional, Continental, and Global) of the LMCS are addressed. The architecture of Geoland 2 is made out of two different geo-information service layers, the Core Mapping Services (CMS) and the Core Information Services (CIS). These form ten service groupings; all together are responsible for the definition, algorithmic evolution and pre-operational generation of some 70 different products (geospatial data set series and algorithmic tools). The processing relies upon availability of space, in-situ, references and other (partially user-provided) input data streams. In most cases an internal value chain is established such that the CIS are building on output products from
the CMS. The Spatial Data Infrastructure (SDI) is mandatory for (a) the access to input data, (b) the internal data flows and processing chains, and (c) the dissemination and provision to users. The Spatial Data Infrastructure (SDI) Task in the project aims to set up a pre-operational service for the discovery, viewing, access, delivery and the support of all products generated in the Geoland 2 project by the Core Services. The SDI establishes first of all the mechanisms for discovery of all dataset series and services provided by Geoland 2 by means of a centralised point of access to ‘dataset series and services’ catalogue. The SDI provides also distributed access to dataset catalogues residing at the various CMS or CIS service providers. A common metadata profile is agreed amongst all service providers in the project and is promoted for wide adoption by other land monitoring initiatives. The SDI is hence the “single access point” provided by Geoland 2 allowing clients to discover metadata of any of the connected production centres, without necessarily hosting the metadata at one central place.

**Oceans Apart? – Has INSPIRE brokered cooperation in the oceanographic community?**

Keiran Millard then discussed Oceans Apart, asking if INSPIRE has brokered cooperation in the oceanographic community. Based on the examples of the European Coastal sea Operational observing and Forecasting system (ECOOP) [http://www.ecoop.eu/](http://www.ecoop.eu/) and MyOcean, this presentation gives a status report on the services that the oceanography is using, considering the technology used and the standards employed. It illustrates where and how INSPIRE is being adopted. This includes the development of scientific 'mash ups' in the oceanographic domain. Lastly it considers the implications on this for the development of the Annex III specifications ‘Oceanographic geographical features’ and ‘Sea regions’. ECOOP focused on the regional level. It has been completed and followed by MyOcean. The projects key issues and scope include: Deploying a consistent suite of services for view and download of data, independent of data representation; Building on pre-existing services without limiting future development; and Packaging the coverage (ISO19126) along with semantic models of the observation process to support discovery and use. The Regional Operational Oceanographic Systems (ROOS) (there are about 6 in Europe) are functioning in a semi-silo fashion and need to be harmonized. The community has mature profiles and services for catalogues. Linking to view services, the application has the appearance of a web map service. At the end of ECOOP, there was for the first time a single point for accessing these products. He gave the example of comparing gridded data with point series data in ECOOP. He then described the transition to MyOceans, and briefly showed the MyOceans architecture. In conclusion, the data products are discrete products, harmonized according to sampling feature and observation method. Regarding meta-data, the community is mature adopters of ISO19115/19 and implementation according to ISO 191139. Regarding network services, they make consistent use of discovery services based on CWS, and have harmonized view services for gridded data products based on WMS.

A discussion followed regarding the use of the Common Data Model (COM) and Common data Index (CDI). The decision to use COM was related to elements of Ocean science for ARGO [http://www.argo.ucsd.edu/index.html](http://www.argo.ucsd.edu/index.html). CDI is a very comprehensive
work that proceeded INSPIRE; CDI adds the specialized meta-data that a community of interest needs, and is likely to persist at the community level.

Session 6 on European research projects for GEOSS was chaired by Stefan Niemeyer.

**AEGOS**

Agnes Tellez-Arenas addressed the African-European Geo-resources Observation System (AEGOS) project [http://www.aegos-project.org/](http://www.aegos-project.org/). African geo-scientific data exists, but it is generally difficult to access. AEGOS scope focused on visibility and accessibility of accurate and reliable public data, including: capacity building for qualified human resources; and efficient promotion of the available information on potential resources with appropriate Intellectual Property Right management. AEGOS objectives include: strengthening the sustainable use of underground resources in Africa by designing the SDI for geo-resources based on interoperable geo-science data and user-oriented services; safeguard, share and valorize the knowledge and data archived in African and European geological surveys; support geo-scientific communities and institutional decision-makers for sustainable development public policies; and elaborate common strategies for capacity building and training programs. Benefits for African participants and end-users include: be an active partner in designing and implementing a modern geo-resources Spatial Data Infrastructure for Africa and relevant capacity building programs; benefit from the strength and efficiency of collective means and actions rather than at individual level; facilitate cross-border harmonization of geo-resources data with AEGOS partners; enhance the capacity to plan and build scenarios to better manage the non-renewable resources wealth in minerals, aggregate and groundwater; market investment opportunities in the geo-resources sector; improve the governance taking into account the socio-economic factors; further develop domestic commodities to support the economy and meet the Millennium Development Goals (poverty reduction); enhance the level of human capacities through dedicated schemes in information technologies and SDI management.

In the discussion that followed the relationship between AEGOS and OneGeology was addressed. OneGeology defines data models; those are reused in AEGOS. It was noted that mining companies are not partners in the project, due to data right considerations. The project plans to use GeoNETCAST for data distribution, thus leading to adaptation to one-way broadcast.

**GS Soil – progress of the transnational cooperation in building up a SDI for European soil data**

Katharina Feiden from the Coordination Center PortalU (the German Environmental Information Portal) at the Lower Saxony Ministry of Environment and Climate Protection (Germany) addressed the progress of the transnational cooperation in building an SDI for European soil data (see [http://www.gssoil.eu/](http://www.gssoil.eu/)). While INSPIRE and its Implementing Rules (IR) provide the framework to establish a European spatial data infrastructure, vital obstacles in reference to harmonization and interoperability of data and services as well as in reference to the organizational structure are not removed yet. The project GS Soil “Assessment and strategic development of INSPIRE compliant Geo-data-Services for European Soil Data” aims to make a contribution to remove these obstacles. Within the project 34 partners from 18 European member states are involved;
out of which 24 are data providers. The project is co-funded by the European Community program eContentplus. The project duration is from June 2009 until May 2012.

Based on the INSPIRE directive and its Implementing Rules GS Soil aims at establishing a European network to improve the access to spatial soil data for public sector bodies, private companies and citizens. This network can be seen as example for practical implementation of a European spatial data infrastructure for soil and soil related data. Thereby aspects of data organization, data harmonization as well as semantically and technical interoperability will be taken into account in order to produce seamless geospatial information. InGrid®, the technology of the German Environmental Information Portal PortalU®, is used as technical base to build up a European GS Soil Portal.

The results of the project will be:
1. Consolidated soil-related theme catalogue / framework standards.
2. INSPIRE compatible metadata profile for spatial soil datasets, dataset series and services.
3. Generic application schemes.
4. Web portal (GS Soil Portal) including a view service, discovery and view of the INSPIRE conform metadata, interoperable spatial soil datasets etc.
5. Best practice guidelines for creating and maintaining metadata for soil database, and data harmonization.

The following clarifications were provided during follow-on discussions. GS SOIL is a European initiative, a EU-funded project. The main focus is the implementation of the project tasks with special regards to INSPIRE, which is also focused on European level. Nevertheless, project partners are also involved in global, GEOSS related initiatives. They might bring the experiences gained in GS SOIL and thus the European perspective into the global discussion. The project is not a research project and focuses more on implementation. eContentplus is a funding program established by the DG Information Society and Media. It aims to make digital content in Europe more accessible, usable and exploitable. In the funding program GS SOIL is defined as a Best Practice Network. GS SOIL gets funding due to the clear project structure and aims that support the implementation of the program aims, the valuable partnership between IT and Domain experts and the building up of existing technical solutions – the software of the German Environmental Information Portal (PortalU). In the framework of the eContentplus program and in relation to INSPIRE it will make the existing digital soil information provided by the involved partners available via the GS SOIL portal. Interoperability, metadata standards and further harmonization approaches are the main focus. GS SOIL will also provide reference material for the data specification process and will test the 2nd draft of the INSPIRE “soil” data specification. GS SOIL interlinks the activities with the activities of the European Soil Data Center, which is located at the JRC: The JRC is also in the advisory board of the project and several partners are members at the European Soil Bureau Network. One of the activities of the project is to develop a methodical framework to share data while using OGC and other (theme-specific) services. For doing so GS SOIL will develop/test and/or modify data specifications, define harmonization
components for soil, develop/test transformations and finally will provide a data harmonization best practice guidelines.

**EU DEM – the new EU-DEM for the initial GMES service for geospatial reference data access**

Andreas Keim from Intermap Technologies briefed the new EU-DEM project. This seamless Digital Elevation Model (DEM) will cover the EEA38, the 32 member countries and 6 cooperating countries of the European Environment Agency. This project is part of an EC funded 3-year project called “Implementation of an Initial GMES Service for Geospatial Reference Data Access covering Europe.” The EU-DEM will be one of two reference datasets provided to the European GMES User Community – within the scope of the project – with consistent mid-scale DEM coverage. This continuous, homogenous DEM will provide an underlying 3D geographic framework on top of which additional thematic datasets can be produced and distributed. The EU-DEM will also enable the assessment, analysis and monitoring of geospatial relationships between combinations of databases, thereby significantly contributing to the European Spatial Data Infrastructure (ESDI).

The challenges presented by the lack of consistency, coverage, precision and licensing in the elevation datasets currently available from commercial and public sources presented a formidable technical obstacle to their individual consideration as the source for a new pan-European DEM. The EU-DEM is created from a merge of the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) GDEM data with Shuttle Radar Topography Mission (SRTM) data supported by Intermaps high-precision NEXTMap® Europe data. The publically available SRTM and GDEM datasets offer strengths and shortcomings. However, manual editing combined with an innovative fusion process of these two datasets will overcome most of the more significant problems and provide a reliable solution for a homogenous full-coverage. Andreas Keim gave some initial examples of their work in the Pyrenees, and for hydrology, with flattened oceans and lakes. In summary, they plan for full coverage of all EEA38 countries; automated production process with manual edits and quality control; edited oceans, lakes and rivers; no voids. The EU-DEM product has a 1 arc second grid spacing and will be publicly available in 2011.

It was mentioned that GEOSS has a digital Elevation Model (DEM) task, thus the inclusion of this project in the INSPIRE in the Global dimension track. Subsequent discussions focused on the use of the NEXTMap DEM versus high precision models for various applications.

**Modernising Aeronautical Information Management**

Debbie Wilson gave the last presentation on Modernizing Aeronautical Information Management. Current global Air Traffic Management (ATM) systems have already reached their capacity to effectively and efficiently manage current levels of air transport.
At many of the world’s busiest airports congestion has increased, percentage of on-time arrivals has steadily declined. These problems are due to get worse as air traffic levels are projected to increase by 2-3 times by 2025. Most ATM systems are based on 1960s technology and have already reached operating capacity and cannot be expanded to handle the requirements for improved air traffic management. Therefore, EUROCONTROL and the US Federal Aviation Authority (FAA) have established two initiatives, which aim to revolutionise ATM systems by developing a net centric, global aeronautical information management (AIM) system: Single European Sky ATM Research (SESAR); and Next Generation Air Transport System (NextGen).

At the heart of the AIM paradigm is the development of a System Wide Information Management (SWIM) architecture and information exchange models. SWIM provides enterprise governance and will define or approve standards for core business services to be made available throughout the network. As most of the information exchanged and used within the AIM system is spatio-temporal, the information exchange models are based on the ISO 19100 series.

To demonstrate the benefits that this net-centric, global AIM system will bring, EUROCONTROL and FAA have been working closely with OGC on a series of Web Services (OWS) test beds to demonstrate how OGC and existing SWIM web services can provide loosely-coupled access to aeronautical (AIXM 5.1) and meteorological data (WXXM 1.1) to support real-time air traffic management and control. Using scenarios reflecting real-world airline operations and flight dispatch activities, OWS-7 will demonstrate the benefits that can be provided to both flight dispatchers and pilots by exchanging and accessing critical information via web services in real-time. Two demonstration scenarios were given to represent real-life ATM processes: a transatlantic flight from USA to Estonia, and a charter flight between USA and Canada. Both scenarios included flight planning, pre-flight briefing, and in-flight monitoring and assistance (including deviation due to volcanic ash hazard). In conclusion, demonstrated services can support all data access requirements for dispatcher and pilots. Aeronautical and weather data can be exchanged in near-real time through distributed web services to enable a common operating picture.
3. Speakers Biographies.

Gavin Adlington

Gavin Adlington is the program team leader for land issues in the Europe and Central Asia (ECA) region of the World Bank. He has extensive experience in cadastre and land registration for over thirty years in most parts of the World, the last fifteen of which have been mainly in the Europe and Central Asia region. He is currently overseeing a program that covers 18 projects in 16 countries of the region.

Massimo Craglia (Max)

Max Craglia is the research coordinator of the SDI Unit at the Joint Research Center (JRC) Institute for Environment and Sustainability. He is one of the founders of the Vespucci Initiative for the advancement of Geographic Information Science (www.vespucci.org) and he is also the editor of the *International Journal of Spatial Data Infrastructures Research*.

Prior to joining the JRC in 2005, Max was a Senior Lecturer at the University of Sheffield teaching GIS for urban planners, and researching areas of spatial data infrastructure deployment and use, and data policy. Whilst at Sheffield, Max coordinated several European projects related to geographic information, including the GISDATA Programme of the European Science Foundation, and was Director of the Centre for Geographic Information and Spatial Analysis (SCGISA).

Hans Dufourmont

With a master in Geography, Hans Dufourmont joined the Belgian Science Policy Office in 1985, in view of the development and management of a national R&D program for satellite remote sensing. In 1990, starting at the KULeuven, he became part of a multidisciplinary research team focusing on satellite image classification techniques for structural landscape analysis. In 1997, he joined GIS-Flanders, where he became responsible for GI-policy development, which yielded in 2000 one of the early legislative frameworks for a Regional Spatial Data Infrastructure in Europe. In 2003, he joined the Eurostat GISCO team in order to help preparing the INSPIRE directive. After the entry into force of INSPIRE, he became the National Contact Point for INSPIRE, based at the Flemish Agency for Geographic Information. In 2008 he joined...
again the EC, at the GMES bureau, in order to contribute to the coherence between INSPIRE and GMES and to contribute to the development of the GMES Land Services.

**Alan Edwards**

Alan Edwards has worked throughout his career in a global scientific research environment. He began his research career in 1973, working in the domain of elementary particle physics and in particular the electromagnetic interactions of matter. In 1984 he moved to the Joint European Torus (JET) to work on the development of nuclear fusion as a potential energy source using magnetically confined plasmas.

At the beginning of 1999, he began his career in the European Commission, becoming a Programme Officer in the Research Directorate General. His initial responsibilities within the Environment Research Programme lay in the domains of: marine operational forecasting and observing systems; physical oceanography; ocean-margin and deep-ocean research.

In addition to these duties, Alan was also a member of the original Support Team for the Global Monitoring for Environment and Security (GMES) initiative, with a focus on scientific, technical and data policy related issues.

He has also represented the Research Directorate General on the Commission's European Marine Observation and Data Network (EMODNet) inter-service working-group.

Following the GMES Initial Period, he became involved with the Group on Earth Observations (GEO) initiative as member of the GEO Architecture and Data Committee. From mid-2007 he has worked full time on the GEO, serving as the representative of the European Commission Co-Chair of the GEO and, in addition, as a Co-Chair of: the GEO Capacity Building Committee; the GEOSS Common Infrastructure Initial Operating Capability Task Force / GEOSS Common Infrastructure Co-ordination Team; and the GEOSS Data Sharing Task Force.

**José Esteban** is the Head of Innovation in Atos Origin Spain, and has worked for the company since 2000. He has a Master in Engineering in Telecommunications from the Polytechnic University of Madrid, Spain. He specialised in Radio-Communications and Digital Signal Processing. He worked for the Agencia Española del Medicamento (Spanish Medicines Agency), where he designed the applications that control the authorisation of medicines and the realisation of clinical trials in Spain. Before his current position, he worked in Atos Research & Innovation, where he led R&D activities in healthcare, environment, space and transport. He was the coordinator of the ORCHESTRA and DEWS projects.
Katharina Feiden

Mrs. Feiden is Geographer (Diplom, University of Göttingen, Germany) and experienced coordinator in international project management. She gained specific experiences in the field of sustainable development, water management, spatial planning and geo-data issues in the last 8 years. She has valuable experience in building up transnational cooperation in the South East European Space and Central Europe due to her previous occupation as consultant in the framework of the EU-INTERREG-programme. As chief project manager at the Coordination Center PortalU – the German Environmental Information Portal at the Lower Saxony Ministry of Environment and Climate protection - Mrs. Feiden is in charge for the eContentplus-project GS SOIL “Assessment and strategic development of INSPIRE compliant Geodata-Services for European Soil Data”. She is responsible for the overall scientific coordination as well as the coordination of the 34 involved project partners.

Steffen Fritz

Dr. Fritz studied physics and geography at the University of Tübingen (Germany) and received his Master of Science degree from the University of Durham (UK) in 1996. His thesis was entitled “Mapping and Modeling of Wild Land Areas in Europe and the British Isles, a Multi-Scale Approach.” He received his PhD from the University of Leeds in 2001. Dr. Fritz has been carrying out a number of consultancy projects in the field of wild land and vegetation mapping. He received a Postdoctoral Fellowship at the Joint Research Centre (Italy) in 2002 where his tasks were to mosaic, harmonize, and produce the Global Land Cover 2000 database, and to carry out the validation of the regional GLC-2000 contributions within the tropics. In 2004 he took up a research post at the European Commission’s Joint Research Centre and got involved in the GEOLAND project where his task was to develop a methodology for acreage estimations of different agricultural crops in South-Western Russia. In January 2007 joined the International Institute for Applied Systems Analysis (IIASA), Austria where he worked on the GEO-BENE project. The project aimed at assessing the benefits of the Global Earth Observation System of Systems. Currently, Dr. Fritz is work package leader of the EU funded EUROGEOSS projects and continues to work on EO related benefit studies. Dr. Fritz has been the initiator and now co-ordinates Geo-Wiki.org a global land cover validation tool which is based on crowd-sourcing. He has published reports, book chapters, and peer reviewed papers in the field of earth observation, crowd-sourcing, fuzzy logic, remoteness mapping, global and regional vegetation monitoring, crop yield and crop acreage estimations of agricultural crops, and wild land research.

His research interests are: Geographical information science, advanced spatial analysis techniques such as fuzzy logic and neural nets, remote sensing and land cover mapping,
land cover change, fires and deforestation in the tropics, studies on the distribution of global biomass, crop yield, and crop acreage estimations as well as EO related benefit assessment studies.

Gerimantas Gaigalas

Gerimantas Gaigalas is the scientific officer at the Institute of Environment and Sustainability - Land Management Unit of the EC Joint Research Centre. He is responsible for the development and implementation of European Forest Data Center (EFDAC) as well as other activities supporting INFOREST. He previously was Resource Mobilization Specialist for the United Nation Development Program (UNDP) Papua New Guinea Country Office (2007). He was head of International Relations and Agreements Division, Ministry of Environment of the Republic of Lithuania (2004-2006). Previously, he was chief desk officer at the Department of Forests, Ministry of Environment of the Republic of Lithuania (1995 – 2004).

Gerimantas Gaigalas holds a Master's degree in Forestry at the University of Agriculture, Kaunas – Lithuania (1995); Diploma in programming at the Electronic College, Vilnius - Lithuania (1999); Bachelor of Law at University of Law, Vilnius – Lithuania (2004); Master's degree in Law, Mykolas Romeris University, Vilnius - Lithuania (2006).

Erwin Goor

Erwin Goor is working at the Remote Sensing department of the Flemish Institute for Technological Research VITO in Belgium (http://www.vito.be). He has been coordinating the SDI related activities for e.g. SPOT-VEGETATION data and derived earth observation products. He is currently leading the development on the product distribution facility for the PROBA-V mission, to be launched in spring 2012. He is also acting as task manager for the SDI activities of the FP-7 project Geoland 2 (http://www.gmes-geoland.info).

Erwin was born in Belgium in 1973. He obtained a degree of master of applied science and engineering, computer science, applied mathematics in 1997 at the University of Leuven KUL. After being a research assistant for nearly one year at the department of computer science of KUL, he worked for 9 years in the telecommunication business at Siemens and Nokia Siemens Networks as team leader of a team of software designers for signaling protocols. Since 2007 he joined the staff of VITO.

Andreas Keim
Andreas Keim received the Dipl.Ing. degree in Cartography from the Munich University of Applied Sciences in 1998. From 1996 to 2002, he was with Aerosensing Radarsysteme GmbH, Wessling, Germany, where he operated and managed several InSAR mapping campaigns in Europe and the Americas. He also has been Head of the Cartography Group. Since 2002, he has been with Intermap Technologies GmbH in Munich, mainly working in the field of Quality and Project Management. From 2006 to 2009 he was responsible for the NEXTMap® Europe countrywide 3D mapping program. He is currently working as Project Manager on various projects within Europe, such as the new EU-DEM creation for the EC’s initial GMES reference data access project.

Tesefaye Korme

Tesefaye Korme is Director of Remote Sensing, GIS and Mapping at the Regional Centre for Resources Mapping for Development (MRCRMD), in Nairobi, Kenya. Dr Korme holds a Ph.D. degree in Quantitative geology and Basins Modeling from the University Pierre and Mary Curie, Paris France. Dr Korme has also been working closely with international organization such as IAEA (in Tanzania, Burkina Faso), FAO (Rome, South Africa, Kenya), UNDP and WHO, WFP, UNEP, UN-Habitat, National organizations such as NASA, ESA, Ethiopian Science and Technology Commission, Bureau of Agriculture, Ministries of Agriculture, water resources and development, Urban development, Bureau of Tourism and land use plan office in the last ten years in different application areas of Geoinformation.

He has implemented over 150 regional and national projects in different applications of GIS and Remote Sensing.

His contact information is e-mail. tkorme@yahoo.co.uk, or korme@rcmrmd.org.

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Anthony Lehmann

Dr. Anthony Lehmann is the EnviroGRIDS project initiator and coordinator. He holds a Masters Degree and a PhD in Aquatic Biology from the University of Geneva, and a Postgraduate Master in Statistics from the University of Neuchâtel. He specialized during his career in combining GIS
analyses with statistical models. At the University of Geneva, he is in charge of the enviroSPACE laboratory exploring Spatial Predictions and Analyses in Complex Environments. He works also with the United Nations Environment Programme (UNEP) Global Resource Information Database (GRID) under a special agreement between the University of Geneva and UNEP. At GRID, Dr. Lehmann is responsible for organizing research activities by leading the “environmental monitoring and modeling” unit. With the EnviroGRIDS project, his personal objective is to motivate all the partners to give their best in order to create a great observation system for the Black Sea Catchment.

S Roman Michalak (PhD Forestry)

Dr Michalak is program manager in the UNECE/FAO Forestry and Timber Section in Geneva. He is responsible for coordination and development of forests and forest management assessment in the pan-European region. Contributes to the FAO global forest resources assessment process. Formerly working as a scientific expert for the Ministerial Conference on the Protection of Forests in Europe, Liaison Unit in Warsaw (LUW). Prior to this, acted as senior researcher and the head of Forest Management Planning and Inventory Department at the Forest Research Institute in Warsaw.

Collaborator in several national and international scientific and technical forestry projects on forest resources and their historical development, status and forecast. Editor of the guidelines for the Polish National Forest Inventory (NFI) and main author for several editions of the state of Polish Forests report. Extensive experience as national correspondent for Poland and member of several advisory bodies on international forest related assessment processes – UNFCCC/IPCC, FAO FRA UNECE/FAO and Forest Europe.

Stefano Nativi

Stefano Nativi is the coordinator of the Earth and Space Science Informatics Laboratory of the Institute of Methodologies for Environmental Analysis of the Italian National Research Council. He teaches, “Web services management” at the University of Florence and “Systems for land management” at the University of Padua. He is co-chair of the GEO Science & Technology Committee and lead of the European Team of the GEO Standard and Interoperability Forum. He is member of the INSPIRE Drafting Teams and president of the Earth and Space Sciences Informatics division of the European Geosciences Union. He is member of the IEEE ICEO and OGC.
Stefan Niemeyer

Stefan Niemeyer graduated in 1994 in hydrology/geography and holds a PhD (Dr. rer. nat.) in applied meteorology from the University of Freiburg, Germany. During his post-graduate research work he worked on low flows at the former Institute of Hydrology in Wallingford, UK, and on land surface energy balance modeling at the former Space Applications Institute of the Joint Research Centre, European Commission (CEC-JRC), in Ispra, Italy. After finishing his PhD in 2000 he work on winter storms at the Federal Institute for Snow and Avalanche Research in Davos, Switzerland, and on integrated modelling of water resources at the University of Munich, Germany. In 2004 Stefan joined the Floods group at the Institute for Environment and Sustainability of the JRC and developed spin-off activities in the field of water scarcity and droughts. Since 2007 he has been leading the development of the European Drought Observatory at JRC.

Jay Pearlman

Dr. Jay Pearlman was Chief Engineer of NCOC&EM at Boeing and a Boeing Technical Fellow. He was responsible for advanced development of information systems. Previously he was Northrup Grumman deputy program manager of Hyperion on the NASA EO-1 satellite program. He has a Ph.D. from the University of Washington and a B.S. from the California Institute of Technology. Jay is a Fellow of the IEEE. Dr. Pearlman is past-Chair of the IEEE Committee on Earth Observation and Co-Chair of the GEO Architecture and Data Committee, which is the organization building the GEOSS information infrastructure. Jay is a member of the Committee of Earth Studies of the US National Research Council and the US National Academy’s Ocean Studies Board. Dr. Pearlman has more than 75 publications and 25 international patents.

Steve Peedell

Steve Peedell is a Researcher in the Global Environment Monitoring (GEM) Unit, Institute for Environment and Sustainability (IES), Joint Research Centre (JRC), European Commission.

He has been at the JRC since 1996, working on Geospatial data management and analysis, Geographic Information Systems and, more recently, Spatial Data Infrastructures. He has been involved in the design and implementation of information systems to support key European environmental policies, specifically
Natura2000 and the Water Framework Directive, and also in the development and implementation of the INSPIRE (Infrastructure for Spatial Information in Europe) Directive. In 2009 he moved to the GEM Unit, where his main tasks are focused on the development of interoperable systems and services for environmental modeling at the global scale.

Steve has a Bachelors degree in Geography and an M.Sc. in Natural Resource Management, both from the University of Leicester.

**Clemens Portele**

Clemens Portele is Managing Director of interactive instruments, based in Bonn, Germany. He is a world class expert in the field of spatial information modeling, SDI-related standards and SDI architectures. He is an active contributor to INSPIRE where he chairs the INSPIRE Drafting Team "Data Specifications" and is editor of key INSPIRE documents related to data interoperability as well as to the international standardization in ISO/TC 211 and the Open Geospatial Consortium, for example as project leader of the Geography Markup Language (GML). Clemens is involved in a number of national and international projects that deal with the design and implementation of SDIs. In July 2007, he was awarded the prestigious ninth annual Kenneth D. Gardels Award in recognition of his contributions to the Open Geospatial Consortium (OGC).

**Mauro Salvemini**

Professor Mauro Salvemini is an internationally recognized expert in applied informatics to spatial planning, environment and e-government. He was a pioneer of spatial data infrastructure. Engineer since 1972, he is professor of applied computer technology in planning and urban design professor at Sapienza University of Rome and at Italian and foreign universities. As a UN expert, he was invited in 2009 to join to the small group of world experts to implement the UN World Conference on Geographic Information Management. Expert of the European Commission for e-government and the spatial information, he has been involved since the beginning in the INSPIRE directive of the European Union. He is head of Laboratory of Geographic and Environmental Information Systems, University of Rome and president of Italian Association AMFM GIS Italy and of European Association EUROGI. Former President of AGILE European association of research laboratories for spatial information, he taught in American universities, Spanish and Egyptian. He is a member of the Global Advisory Committee of OGC. He has been head of research for public and private organizations, designer and project manager of major public contracts in the field of information systems and digital
mapping. Author of more than eighty publications, most presented at international conferences. Member of national and European committees, already director of public corporations, he is settled in Italy, between Rome and Anzio.

Bob Scholes

Dr Bob Scholes is a systems ecologist, employed by the Council for Scientific and Industrial Research. He has over two decades of research experience on the topic of global climate change, including over a hundred peer-reviewed scientific publications on this and related topics. He has been involved in several high-profile environmental assessments and contributes to the formulation of national environmental policy. He is or has been a member of several steering committees of international research programmes, such as the International Geosphere-Biosphere Programme and the Global Climate Observing System, and has served as a convening lead author in the third and fourth Assessments for Intergovernmental Panel on Climate Change. He has been Chairman of the Global Terrestrial Observing System, a member of the GEO Implementation Plan Task Team, a Board Member of the International Centre for Research in Agroforestry, a co-chair of the Conditions Working Group of the Millennium Ecosystem Assessment, and a Board Member of the South African National Parks. He led the Southern African Millennium Assessment at regional scale and the Scientific Assessment of Elephant Management in South Africa. He is currently Chair of the Group on Earth Observations Biodiversity Observation Network and co-chair of the steering committee of DIVERSITAS. He is a Fellow of the CSIR, the South African Academy and the Royal Society of South Africa, and serves on the editorial board of several journals.

Agnès Tellez-Arena

Agnès Tellez-Arena obtained a PhD in Computer Science from the University of Orleans. She is project leader in Information Systems and Technology since 1999. At BRGM she is involved in several European projects including AEGOS, EO2Heaven, and OneGeology-Europe where she is the work package leader for the geoportal and the services developments. She is also involved in the GeoSciML group of the Commission for the Management and Application of Geoscience Information (CGI) as co-chair of the testbed working group.

Rumyana Tonchovska
Rumyana Tonchovska is a Senior Land Administration Officer - Information Technology, Climate, Energy and Tenure Division, Natural Resource management and Environment Department, FAO, UN. She is a key advisor to the World Bank land team in more than 12 countries in Europe and Central Asia under the FAO/World Bank Cooperative Program on the cadastre and registration IT systems implementation and implementation of the SDI. She supports the supervision of the FAO project for development of Open Source Cadastre and Registration Software.

Suha Ulgen

Suha Ulgen is Senior Advisor on Spatial Data Infrastructure, for the Office of the Assistant Secretary-General and Chief information Technology Officer of the United Nations Secretariat, New York, NY USA. Suha joined the Assistant Secretary-General’s Office in Oct. 2009 to support UN Geographic Information Working Group’s (UNGIWG) efforts to move the UN Spatial Data Infrastructure initiative forward. Previously, he was the Coordinator of the UNGIWG Secretariat in Geneva.

When he first joined the UN, Suha assumed the role of the Technical Manager for Field Information Services Unit of the UN Office for the Coordination of Humanitarian Affairs in New York. Between 1985-95 Suha had worked for Los Angeles County in California where he held various information management posts with an explicit geospatial focus. Later he headed a small socially-responsible international consulting firm focusing on disaster management and public health applications of geo-informatics which eventually lead him to his UN post in 2005.

Suha received his graduate degrees at the University of California in Los Angeles where he studied Urban and Regional Development Planning as a Fulbright scholar.

Debbie Wilson

Debbie Wilson is a Business Consultant and Trainer for Snowflake Software, providing a wide range of consultancy services for promoting and improving the use of open standards for modelling, encoding and exchange of location based data using web services. Before joining Snowflake, Debbie was seconded to Defra to work on the UK Location Programme, assisting the conceptual design for the implementation of a UK Spatial Data Infrastructure to deliver the
requirements of the INSPIRE Directive and UK Location Strategy. Most recently, Debbie has been a key member on the Clean Air For Europe (CAFE) project and the OGC’s OWS-7 test-bed. She has also been a key member on many JRC INSPIRE themed projects. Debbie is the Snowflake Software INSPIRE guru.