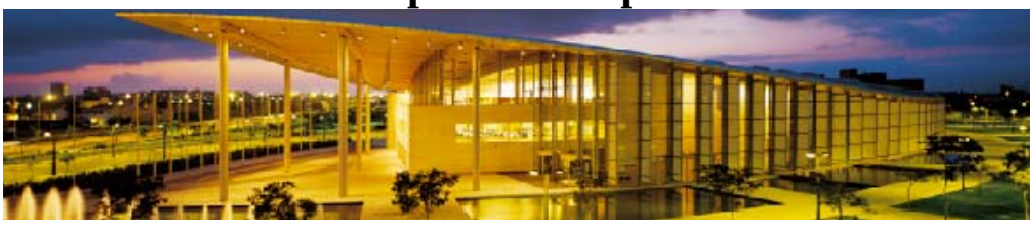
GEOSS Workshop XXV
Perspectives on GEOSS Architecture: Principles and Implementation



Palacio de Congresos, Valencia, Spain
3-4 December 2008

This workshop will focus on the system-of-systems architecture that guides the Group on Earth Observations (GEO) in developing GEOSS.

The Global Earth Observation System of Systems (GEOSS) aims to achieve comprehensive, coordinated and sustained observations of the Earth system. An initial operating capability of the GEOSS Common Infrastructure has recently been established. The workshop will review the architecture that guided the initial capability and will develop recommendations for future developments.

The workshop will interest individuals and organizations from government, academia and industry sectors that seek to use GEOSS to increase access to Earth observations for their own use or for supporting their organizations system planning. Also, the workshop will interest individuals and organizations that seek to understand how their systems can contribute to GEOSS.

Registration at ICEO site: http://www.ieee-earth.org/ select conferences/workshops
Agenda and sessions listed in detail OGC site: http://www.ogcnetwork.net/node/391

The workshop if free to attend, but attendance is limited based upon registration.

Background

The Global Earth Observation System of Systems (GEOSS) aims to achieve comprehensive, coordinated and sustained observations of the Earth system, in order to improve monitoring of the state of the Earth, increase understanding of Earth processes, and enhance prediction of the behavior of the Earth system.

GEOSS provides an overall conceptual and organizational framework for integrated global Earth observations to meet user needs. GEOSS is a "system of systems" consisting of existing and future Earth observation systems, supplementing but not supplanting their own mandates and governance arrangements. It provides the institutional mechanisms for ensuring the necessary level of coordination, for strengthening and supplementing existing Earth observation systems, and for reinforcing and supporting component systems in carrying out their mandates. The emphasis of GEOSS is on societal benefits, initially in nine key areas: Disasters, Health, Energy, Climate, Water, Weather, Ecosystems, Agriculture, and Biodiversity.

An initial operating capability of the GEOSS Common Infrastructure has recently been established. The workshop will review the architecture that guided the initial capability and will develop recommendations for future developments.

GEOSS Architecture Principles

The workshop reviewed how as a system-of-systems (SoS), GEOSS is being developed based upon voluntary contributions using a minimum set of architecture principles to guide the emergence of an operational capability. The architecture principles are:

- GEOSS depends on providers accepting and implementing a set of **interoperability arrangements** focused on interfaces, including technical specifications for collecting, processing, storing, and disseminating shared data, metadata and products. GEOSS interoperability is based on non-proprietary standards, with preference given to formal international standards.
- **Service-oriented architecture (SOA)** approach including use of the architecture pattern of publish-find-bind. The GEOSS Registry and Clearinghouse in concert with community catalogues provide a distributed capability for discovery to resources of value to GEOSS users. The GEO Portal and community portals provide the users the ability to find and invoke services of the GEOSS network
- The **GEOSS Common Infrastructure** (GCI) is defined as the set of critical service components that are required for the discovery, classification, and integration of contributed, externally-operated services. GEOSS encompasses both the GCI and earth observation systems and services offered by GEO member nations and participating organizations.
- GEOSS is coordinating the establishment of a suite of **global datasets** based on improved and validated data sources. GEO aims to promulgate the use of products these especially in developing countries. In addition, GEO will facilitate interoperability among data sets. To achieve interoperability, GEOSS will define common semantics though information models, exchange data through services, and utilize metadata placing the information in context – geospatial, temporal, domain, and community – for effective utilization across the system of systems.

- GEOSS **data sharing principles** provide that there will be full and open exchange of data, metadata, and products shared within GEOSS, while recognizing relevant international instruments and national policies and legislation. All shared data, metadata, and products will be made available with minimum time delay and at minimum cost. All shared data, metadata, and products for use in education and research will be encouraged to be made available free of charge or at no more than the cost of reproduction."
- GEOSS is developed from the **voluntary contribution** of services and components to a federated system. GEOSS comprises of enterprise components to acquire observations; components to process data into useful information; and components to exchange and disseminate observational data and information. Further decomposition of GEOSS using a consistent set of component types is proceeding.

Workshop Venue

The workshop was held at the Palacio de Congresos, Valencia, Spain. The Valencia Conference Centre is a unique building of extraordinary design. Several geospatial meetings were held concurrently in the Centre. Each meeting had its own registration and attendance. Several of the breaks were in common to the meetings, affording an opportunity to meet an array of experts with common interest in Earth Observation.

Workshop Objective

A primary focus of the workshop was to review how the GCI **Initial Operating Capability** implements the GEOSS Architecture Principles and how those principles guide further development of GEOSS. Workshop attendees were provided with opportunities for hands-on use of the GEOSS Common Infrastructure.

The goals of this workshop were to share and further develop the GEOSS Architecture approaches, to inform the community about the progress in developing GEOSS, and to engage broader interest and participation in developing the information infrastructure needed for implementing the GEOSS vision. The Workshop was a mixture of presentations and breakout sessions. The breakout sessions were held to engage workshop participants in answering key questions facing the community, such as: (1) benefits of a system-of-systems (SOS) approach based on SOA; (2) Challenges to implementing SOS/SOA (3) Benefits and challenges of a services oriented architecture for example for distributed searching; (4) Approaches to converging to a minimum set of Interoperability Arrangements; (5) Assessment of the state of architecture implementation and recommendations for further activities.

Results of the workshop will be presented to appropriate GEO Committees in order to refine the GEOSS operational architecture and its implementation. Recommendations about GCI IOC will be provide to the IOC Evaluation Task. Results of the workshop will be made available through ICEO and OGC websites.

Intended audience

The workshop was of interest to individuals and organizations that seek to use GEOSS to increase access to Earth observations for their own use or for supporting their organizations system planning. The workshop was of interest to members of Government, Academia and Industry sectors in order to learn about the benefits of GEOSS. Also, the workshop was of interest to individuals and organizations that seek to understand how their systems can contribute to GEOSS. A total of 46 attendees from Europe, North America, and Asia participated in the workshop. An attendance list of provided as attachment 1 to these proceedings.

Valencia Workshop Organizing Committee

George Percivall, Chairman	OGC and GEOSS AIP
David Arctur	OGC, OGCii and GEOSS SIF
Ian Dowman	Univ College London and ISPRS President
Paul Eglitis	IEEE ICEO and GEO SIF
Paolo Gamba	IEEE, ISPRS and University of Pavia
Al Gasiewski	IEEE, NOAA and Univ of Colorado at Boulder
Mike Gould	Universitat Jaume I, Valencia and AGILE
Eva Klien	Fraunhofer Institute and GIGAS Project leader
Ken McDonald	NOAA (US) and CEOS
Francoise Pearlman	IEEE ICEO and GEOSS Workshops Coordination
Jay Pearlman	IEEE and GEOSS ADC Co-Chair
Satoshi Sekiguchi	AIST (Japan) and GEO Grid

Sponsorship

The organizations and agencies listed below are acknowledged for providing either financial, organizational, and logistical co-sponsorship of the GEOSS workshop:

IEEE

IEEE Committee on Earth Observations – ICEO

International Society of Photogrammetry & Remote Sensing (ISPRS)

Open Geospatial Consortium (OGC)

Universitat Jaume I, Valencia

Agenda

See next page.

The User and the GEOSS Architecture XXV
Perspectives on GEOSS Architecture: Principles and Implementation

3 December 2008		
Time	**Topic**	**Speaker**
	Session 1: Opening	
09:00	Welcome and opening	Mike Gould
09:10	Introductions and workshop objectives	George Percivall
	Session 2: Users & GEOSS Common Infrastructure *Session Moderator: George Percivall*	
09:15	"The User and GEOSS"	Jay Pealman, IEEE
09:45	Overview of the GEOSS Common Infrastructure	Ivan DeLoatch, USGS/FGDC
10:15	GEOSS Registries, Best Practices and the Standards and Interoperability Forum (SIF)	Paul Eglitis, IEEE and met.no
10:45	Refreshment Break	
	Session 3: GEOSS Architecture Development *Session Moderator: Jay Pearlman*	
11:00	GEO Web Portal by ESRI – Biodiversity SBA	Guenther Pichler, ESRI
11:30	GEO Architecture Implementation Pilot (AIP): (GEO Task AR-07-02)	George Percivall, OGC
12:00	CEOS Contributions to GEOSS: Virtual Constellations and Global Data Sets	Ken McDonald, NOAA and CEOS
12:30	Lunch – there are several restaurants nearby	
	Session 4: Expanding the GEOSS Architecture *Session Moderator: Paul Eglitis*	
14:00	GEO Web Portal by ESA – Disaster & Climate SBAs	Mirko Albani, ESA
14:30	Grid Technologies for GEOSS	Craig Lee, President, Open Grid Forum
15:00	When does the Sensor Web make sense?	Terrance van Zyl, CSIR
15:30	Refreshment Break	
	Session 5: Data Development Directions *Session Moderator: Francoise Pearlman*	
15:50	Coordinate Reference Systems for GEOSS - the IAG perspective (GEO Task AR-07-03)	João Agria Torres, SPUIAGG
16:20	INSPIRE Data Specifications	Clemens Portele, interactive instruments
16:50	Ontology development for GEOSS	Masahiko Nagai, The University of Tokyo

	Session 6: Break out sessions	
17:20	Charter to Breakout Groups	Jay Pearlman, IEEE
17:35	Breakout Groups (~3 groups)	
19:00	Closing of Day 1 – facility closes at 1900	

4 December 2008		
Time	**Topic**	**Speaker**
	Session 7: Opening Day 2 Session Moderator: George Percivall	
09:00	Welcome and opening	
09:10	Summary of Breakout Sessions	Session Rapporteurs
10:30	Refreshment Break	
	Session 8: GEO Projects and Planning Session Moderator: Ken McDonald	
10:50	GIGAS	Eva Klien, Fraunhofer Institute
11:20	EuroGEOSS	Francis Bertrand, Max Craglia, and Gobe Hobona
11:50	GCI and the way forward for GEOSS	
12:30	Closing of the workshop	

A glimpse at some of our speakers

George Percivall introduces the GEOSS Architecture

Ivan Deloach Briefs the GCI

Guenther Pichler details a GEOSS portal

Paul Eglitis addresses interoperability

Summary for December 3, 2008

Michael Gould welcomed the audience to Valencia.

George Percivall introduced the GEOSS global framework, including facilitating exchange of data. He talked about the Societal Benefit Areas and communities of practice concepts. He showed the linkage between earth observing systems. He talked about the

10 year implementation plan, and the architecture associated with interoperability which is addressed in one of the annexes to the plan. He briefed the workshop series, and focused on the theme for this workshop (GEOSS architecture – principles and implementation). He summarized the agenda, introducing the session's content.

Jay Pearlman provided the user view of GEOSS as a global system. The users drive the requirements. Users include the people running the observation systems, the teams doing observations and modeling, the people creating tools for decision makers, as well as the decision makers. He gave a couple of examples: linking biodiversity to Lyme disease risk, using real-time data, geographic data, and ultimately, data which relates human socio-economic data to environmental data; the second example illustrated the intersection of human and ecosystem health in Madagascar, with focus on food security. What are the challenges in addressing the users: who are they, what are their requirements, and how can we get them engaged? Dr. Pearlman then introduced the User Interface Committee (UIC), and the communities of practice. He provided an example of a community of practice for air quality and health, with intersection with public health, hazard alerting, etc., and with a broad range of users. He gave the current list of communities of practices and addressed their key accomplishments. They all draw on a broad array of interested parties. Where do we go next: registry of user requirements for earth observation; support and expand communities of practices; look for synergies across domains (for example Interoperability Process Pilot Projects drawing together climate and ecosystems); ultimately the GCI facilitating support of a broad range of services for users.

Ivan DeLoatch introduced the GEOSS Common Infrastructure (GCI), and stressed the need for feedback. The architecture is much broader than the GCI, and other elements will be addressed through out the day. The leadership of GEO established the GCI Initial Operating Capability (GIOC) task force. The GCI provides the core capabilities to enable GEOSS resources to be discovered, understood, and accessed by the users and decision-makers. The GCI includes a series of registries for user requirements, components, services and standards, and a best practice wiki; a search tools known as the GEOSS clearing house; and several portals. Also, there is a concept of operation document, as well as several guidance documents. The GIOC started in June 2008 with the goal of conducting a one year evaluation and provided recommendations for sustainment. He provided a list of current GCI contributors, for the above components as well as the architecture pilots. He presented the Task Force deliverables: concept of operations plan oriented to the enterprise perspective (completed in October 08); process and consolidated user requirements document; evaluation of GCI for sustainment operations document. He provided a list of issues requiring recommendations. The GCI is important, but so is the GEOSS registration process. Many lessons learned are being used to improve the user experience. He mentions encouraging the registration of components, services, and standards. Many of the components currently in the system support multiple SBAs. He addressed the next steps for GCI: evaluate and augment the GCI in concert with the Architecture Implementation Pilots.

Q&A

Q: Craig Lee - what are the main architectural challenges for GEOSS in terms of scaling up?

A: challenges at the interface; scalability; which we will learn from the pilot process.
Q: George Percivall – how are we doing re outreach to policy community?
A: we have done a pretty good job, but we need to continue doing more; the challenges are significant and come with resource implication.
Q: Jay Pearlman – what is the perspective of the architecture committee in addressing developing countries?
A: need to look at alternatives in addressing those countries; example cell phone technology; he is encouraged by the work of the capacity building committee
Q: Josh Liberman – how do you see the architecture serving new Communities of Practice
A: architecture should be able to serve any SBAs.

Paul Eglitis addressed GEOSS Registries, Best Practices and the Standards and Interoperability Forum (SIF).
The GEOSS Registries are an essential resource in enabling the interoperability within the GEOSS Common Infrastructure. The Service and Components Registry and the Standards Registry provide a source of information for client applications to harvest in order to satisfy the queries and service-subscription requests of end-users. This process relies on the complete and accurate registration of Systems and their Interoperability Arrangements by system providers. The Standards and Interoperability Forum (SIF) provides support in the registration process through the analysis of the registry contents (primarily the Standards Registry) and by answering requests for assistance on issues relating to standards and interoperability for GEOSS. Interoperability arrangements comprise both official Standards published by Standards Development Organizations (SDOs) and Special Arrangements, where the arrangement typically involves a combination of both informal (i.e. not an official SDO standard) and/or formal standards designed for a particular application within GEOSS. With regards the overall GEOSS objectives, other agreed and commonly adopted processes or techniques may be utilized to carry out specific actions and achieve specific results, where these mechanisms do not fall under Interoperability Arrangements in the Standards Registry they are identified as Best Practices and are documented in the Best Practices Wiki. A multi-disciplinary team of specialist editors is engaged to help contributors to the wiki. Clearly some Best Practices will also be applicable to interoperability objectives and both Best Practices and Special Arrangements may evolve in time to become future GEOSS standards.

A Call For Participation for the SIF in June 2007 resulted in 40+ organizations expressing an interest in the activity. A core group of SIF members has since worked to set up the business processes to manage all SIF tasks while conducting a preliminary analysis of the registry contents. Specific activities have included the approach to register grouped components within GEOSS that already have their own intrinsic interoperability mechanism, ongoing specification work for the development of the Standards Registry, the identification of mechanisms to optimize GEOSS interoperability and the support of the development of GEOSS ontologies to act as mediation services within GEOSS. Ontology development is a specialized task and the co-ordination of the effort has been localised to the Best Practices Wiki with dedicated editors assigned. Currently, the Best Practices Wiki has a well-defined hierarchical structure of pages covering, amongst

others, the Societal Benefit Areas and GEOSS Transverse Areas such as Architecture and Data, with 60+ registered users as of the time of the XXV workshop. The wiki provides a flexible and open structure for collaboration and convergence on recommendations.

Having completed a pilot phase for the Best Practices Wiki and with an Initial Operational Capability in place for the GEOSS Common Infrastructure, both the important human facilitators discussed here (i.e. the Best Practices Wiki Editorial Team and the Standards and Interoperability Forum) have an ongoing task to improve the GEOSS knowledge base, gain insight from the lessons learned and help realize the full potential of GEOSS through the application of that knowledge.

There were no questions.

Guenther Pichler is presenting the GEO Portal by ESRI. He showed a public opinion survey regarding the climate change. He addressed European space policy. Political awareness is there and over 60 EU directives need geospatial information. There is increased awareness of the added value of geospatial information. Major initiatives, in addition to GEOSS, include INSPIRE, GMES, and SEIS (Shared Environmental Information Systems). All of those are interlinked (for example. GMES is the European contribution to GEOSS). The portal was re-launched a couple of days ago, and the attendance is encouraged to access it. He went through a variety of portal capabilities such as role based functionality, search functionality, GEO-RSS feeds, map viewer supporting OGC interfaces, interactive globe which data can be added to, access to an on line resource pool, access clearinghouses and harvest associated material, support metadata, semantic searching, multi-lingual capability via GEMET. He highlighted ESRI's commitment to GEOSS.
Q&A
Q: Eric Delory – is the portal truly open
A: Yes, we can discuss the details off line
Q: Gobe Hobona – can the portal support other ontologies besides GEMET
A: He believes so. At the end, he encourages feedback on the ESRI GEO portal from GCI users.

George Percivall introduced the architecture implementation pilot (GEO Task AR-07-02), which accesses services through GEOSS interoperability arrangements. The key terms for this task are: design, develop, and deploy. We are now on AIP Phase 2, which will extend into next year. AIP phase 1 focused on the development of an evolutionary development process for international cooperation. Key items during Phase I included a call for participation (CFP), a kick off event (face to face social process), execution, and wrap up. Phase 1 had about 120 organizations participating. Phase 1 contributed several components to the GEOSS Common Infrastructure including GEO Web Portals and Clearinghouse components. A screen-cast of the AIP-1 Results was produced and an Architecture Implementation Report was prepared. Phase 2 is now established with the following themes: augment the GCI, emphasize the SBAs identified by UIC/ADC collaboration (4), develop persistent exemplars (such as leave behind services), elaborate

GEOSS architecture. He provided the master schedule from June 2008 through the first quarter 2009, and noted that the CFP remains open, even though it is after the kick-off. He then detailed the engineering viewpoint for the architecture, with 3 levels: client tier (where decision makers can access the information without having to understand the details of the underlying infrastructure), business process tier, and access tier. The GCI includes the GEO portals, clearinghouse and registries. There were 37 responses to the AIP Phase II, some of them with many organizations. The AIP-2 workshop had 85 attendees in Boulder, CO, USA. Working groups, and work plans were established. There were community working groups, Community of Practice related. Those working groups are supported by transfer technology working group, which focus on technology, and will lead to a test facility for service registration. George provided the list of working group leaders. He provided the communication and collaboration approach (telecons and webex), e-mail list servers, collaborative web sites (Google sites). The teams are developing user provided scenarios, and technology based transverse reusable use cases. An AIP Phase II design review was held yesterday.
Q&A
Q: Josh Lieberman – note accessibility of the material on Google site; it is a very open process
Q: from Eric Delory – what about test facilities?
A: test facilities are built using reusable OGC tools, but are tuned for GEOSS interoperability arrangements, not the compliance test.

Ken McDonald is addressing the Committee on Earth Observation Satellites (CEOS) contributions to GEO. CEOS is about 25 years old. Its goal is to optimize the benefit of earth observation via satellite through cooperation. The structure of the organization was provided (Thailand is the current chair). The strategic implementation team, lead by Mary Kizha (2 year term), focuses on the future. There are 3 working groups. The WGISS is where interoperability is addressed. The CEOS executive officer position was created a couple of years ago to support the interface with GEO and is a full time dedicated position. CEOS can serve as a key contributor to GEOSS. Ken provided a summary of the activities over the last year. He stressed the virtual constellations concept, regarding the coordination of satellites and products from multiple agencies. He cited four virtual constellation studies currently under way: precipitation; land-surface; ocean-surface topography, and atmospheric composition. A couple more ocean-related constellations have been added recently. A list of working group constellation leads was provided. CEOS developed a prioritization scheme for the tasks, and discussed the associated task tracking data base use to manage the contributions. CEOS and CEOS members have supported 18 workshops, symposiums, conferences and courses to ensure interaction with the community. Other relevant contributions include the recently published CEOS Earth Observation Handbook special climate edition; portals which provide views and extension to the WGISS International directory network (land surface imaging and climate diagnostics portals); WGISS Interoperability handbook. He concluded by stressing the magnitude of the volunteer contributions from CEOS to GEO, and discussing the Systems Engineering Office (SEO) activities regarding measurements. In summary CEOS is both a committed contributor and a beneficiary to GEO.
Questions:

Q: Craig Lee – he commented on the similarity with the virtual observatory
A: they will talk off line.

Mirko Albani introduced the ESA GEO Web portal. The ESA initiative on climate change was discussed. Inputs will be taken from existing archives, with the data re-processed. Data from ESA missions will also be used for disasters management. The GEO web portal is a part of the GCI, and a single access point for EO information. ESA and /FAO developed the portal in collaborations in 2006, and supports all 9 SBAs. It is based entirely on open source software. The portal provides a variety of services such as the Geospatial portal service. The rotating globe and some feeds are displayed on the main page. The information is organized according to the 9 SBAs, or can be accessed by an area of interest on the globe. An advanced search is available. Mirko provided some examples such as accessing the ESA information, including on-line archive; using the search capability to access the landsat archive; user searching for fire data over Europe; user looking for flood data in Asia; and finally search for climate data. A reminder was given on the importance of registering data, so that it becomes available for access via the portal. The next step is the participation into the AIP phase II by providing 3 products: portal; FEdEO EO community Clearinghouse in cooperation with Eumetsat, International charter "space and major disasters", and CNES. He showed direct access to metadata if the specific OGC standard has been implemented. The 3rd contribution is the Service support environment to support the creating of new GEOSS services, and provide a test environment. He requested feedback from the GEOSS User community, IOC task force and GEO secretariat.
Questions
Q: Eric Delory – he asked for clarification re the OGC standard being implemented
A: if the OGC standard is implemented in the catalogue, then the metadata can be displayed
Q: Gobe Hobona – in a situation where a user looks for details which are not immediately available, can the users post a request re data availability?
A: the GEO portal is an entry point; data can be requested, but data availability is related with the data policy
Q: Paul Eglitis – he asked about GEOSS interoperability
A: convergence between GEMS, and INSPIRE in Europe; interoperability should become easier

Craig Lee introduced the concept of Grid technologies (for remote execution) for GEOSS. He focused on the collaboration between OGC and the OGF (the open grid forum). EGEE (Enabling Grids for E-science), a large European grid shows the number of sites, countries, and CPUs involved. Over 150 virtual organizations come together to work using the grid. How do we integrate grid and geo-spatial technologies? He referenced an article on last month (Nov) IEEE computer journal. The key OGC standards were discussed especially regarding Web technologies. He then introduced the key OGF standards including Simple API for Grid Applications (SAGA); Grid Remote Procedure Calls (GridRPCs); data access and integration specs (WS-DAI-*). A chart shows an overview of how the compute-related standards relate to each other. Craig also addressed data-related standards. The HPC-basic profile addresses remote resources.

There is a remote computing usage primer for running applications remotely. How do we manage progress for distributed geospatial systems? You must agree on clear goals and a clear schedule, plus return on investment. He provided an example end to end demonstration (EO1 data for fire situation last year). He then focused on geo-processing workflows for many geospatial and grid topics. Emerging technologies are also present in the green world: green IT (energy cost and location feasibility) and virtualization and clouds (infrastructure, platforms or services). OGF green VM projects is an effort to coordinate existing projects on virtualization, clouds and green computing under the OGF umbrella. Cloud interoperability starts to look grid like, such that the current grid work can be leveraged. A number of companies are starting to develop as cloud framework providers. Issues include data access and interoperability, security, reliability, frameworks, performance management, and costing models. OGF has a number of clouds efforts underway, but the major companies are not terribly interested in clouds interoperability (absent from recent forum). He highlighted a number of OGF workshops.
Questions:
Q: Herve Caultmont – AIP2 scenarios provide an opportunity to assess these solutions
A; will talk off line.

Terence Van Zyl addressed the sensor web. When does sensor web provide technology to use? The sensor web is an open complex adaptive system organized as a network of open sensor resources. Vision: sensors will be web accessible; will be discoverable; will be self-describing; will be easily accessible in real-time over the web; standardized web services will exist for accessing sensor information; sensor systems will be capable of real-time data mining; sensors will be capable of issuing alerts (push model); capable of on-demand processing without a-prior knowledge; capable of being tasked through standard interface; autonomous, intelligent sensors. Sensor Web Enablement (SWE) is an OGC open standard initiative to facilitate interoperability. Initial objectives of SWE: discover sensors; determine capabilities and reliability; retrieve real-time data and time series; task sensors and simulators (blurred boundary with models); subscribe for alerts. Interface standards to achieve this vision include Sensor Observation services (SOS), sensor alerting service (SAS). Supporting encoding standards include a sensor modeling language (SensorML); Observation and measurements (O&M); transducer Markup Languages (TML). There is no single solution, and we need to keep looking for new emerging standards and solutions. When do you use SWE: open system on the web (not cobra, not FTP); time series data or real time data (not needed for large static data). You need to know the source of the data and want the ability to task a sensor and receive alerts; basically it is applicable for service oriented architecture. SWE is applicable to developing countries (light weight, low governance, and minimal effort for deployment). You need to build the right tool for the system of systems job.
Questions:
Q: Jay Pearlman – Platforms already using sensor web approaches are undersea cable observatories. Have you looked at systems like these which actively track objects in their environment?
A: he has not looked at the under sea observatory
Q: George Percivall – he asked about workshops on sensor web

A: workshops were mostly getting people aware of sensor web; a document was issued as a result of the last workshop
Q: Eric Delory – he works with the observatories, and they are working on a standard; they have requested the inclusion of oceans in the task Terence is a lead for
A: the task has been updated; oceans sensors are the biggest potential users of sensor web
Q: Eric Delory – what about time series data?
A: technically, the data is time stamped; visualization of time series is the challenge
Q: Josh Lieberman – discovery is the biggest challenge
A: trying to get people to accept discovery of new sensors is a challenge; people do not want to redirect effort for use of new sensors
Q: Paul Eglitis – Have you built a prototype sensor that can register itself in the GEOSS Registries?
A: no.

Joao Agria Torres briefed the International Association of Geodesy (IAG) perspective on Coordinate Reference Systems for GEOSS (GEO Task AR-07-03).

The International Association of Geodesy (IAG) is perhaps the very first scientific international organization. Its origin goes back to 1887 with the participation of 20 countries. Later on, in 1919, the IAG integrated the International Union of Geodesy and Geophysics (IUGG), where it stands together with seven more scientific associations. The present structure of the IAG, approved in 2003, is composed by Services, Commissions, Inter commission Committees, Communication and Outreach and the project GGOS (Global Geodetic Observing System).
One of the IAG Services is the IERS (International Earth Rotation and Reference Systems Service), responsible for the definition, realization and promotion of the ITRS (International Terrestrial Reference System). The ITRS is a global geocentric system. The realization of the ITRS is the ITRF (International Terrestrial Reference Frame), a set of geodetic references whose coordinates are estimated by space geodetic techniques: VLBI (Very Long Baseline Interferometry), SLR (Satellite Laser Ranging), GPS (Global Positioning System) and DORIS (Doppler Orbitography Radiopositioning Integrated by Satellite). These techniques are run by the respective Services of the IAG, which guarantee the highest quality of the individual solutions to compute the ITRF solutions. Several versions of the ITRF have been computed until now; the latest one is the ITRF2005.
The IAG is also responsible for regional structures whose main task is the realization and maintenance of systems to be used at continental level, based on the ITRS. EUREF in Europe, SIRGAS in Central and South America and NAREF in North America can be mentioned as examples. It's also important to refer the initiatives that are taking place in Africa, involving a huge international cooperation, for the establishment of AFREF.
In conclusion,
a) the present geo-referencing systems are realized through an observing system based on geodetic space techniques;
b) there is a strong international effort and cooperation for the maintenance of the global and regional geodetic reference frames;

c) all the current systems used at continental or global level like ETRS89 (in Europe), WGS84 (the reference system for GPS), PZ90 (the reference system for Glonass) and GTRF (the reference frame for GALILEO) are all connected to (compatible with) a unique system defined and maintained by the IAG: the ITRS.

Questions and Answers
Q: George Percivall asked about harmonization of global data sets, and thus importance of the reference framework for ISO 19111
A: IAG contributes to ISO 19111 and continues working to achieve the international standardization of ITRS.

Clemens Portele addressed INSPIRE data specifications. INSPIRE includes requirements on the interoperability of spatial data. The presentation describes the approach taken to satisfy these requirements.

Today, users accessing spatial data from different sources have to deal with a lack of interoperability when interpreting the available heterogeneous data in different formats and identify, extract and post-process the information that they actually need. At the same time, the existing data sets are in operational use and it is not feasible to expect to change them and all associated business processes and software systems to make them homogenous and fully harmonized in the near future. Therefore, INSPIRE data specifications are being developed with the goal of providing interoperable access to existing spatial data while minimizing the needs to change the underlying SDIs in Europe. The data specifications aim at balancing the needs of the environmental users and feasibility of publishing existing data in a coherent way that allows users to combine spatial data from different themes and regions in Europe. 20 so-called data interoperability components have been identified that need to be addressed consistently for all themes – including reference systems (see the previous presentation), application schemas, data transfer, portrayal and others.

In order to achieve interoperability not only across national borders, but also across themes, the development of INSPIRE data specifications is a three-step process. In the first step – which was completed in 2008 – a framework for the development of the specifications was established involving all stakeholders. In the second step, specifications for the first nine Annex I themes are being developed since February 2008. A stakeholder consultation is planned from December 2008 until February 2009 in parallel to an open testing program. The specifications are expected to be adopted in 2009 after inclusion of the comments from the consultation and the testing program. Spatial data for these themes must be made available between 2011 and 2016 in all European member states. In the third step, the specifications for the remaining 25 Annex II/III themes will be developed until 2012 with data available from between 2014 and 2019 onwards.

Questions and Answers:

Q: George Percival – he asked about results AIP can use

A: besides the specifications themselves there is the open testing program for the nine themes in Annex I with about 80 participating organizations, that includes the testing of transformation of data to the proposed specifications, their publication via web services and their use in applications (through early March 09)

Masahiko Nagai presentation addressed the Ontology development for GEOSS.
The Ontology registry system is developed to collect, manage and compare ontological information for integrating global observation data. Data sharing and data service such as support of metadata design, structuring of data contents, support of text mining are applied for better use of data as data interoperability. Semantic MediaWiki based system and gazetteers are constructed for ontology development as a trans-disciplinary dictionary.

Ontological information is added to the system to develop"knowledge writing tool" for experts, and extracting semantic relations from authoritative documents with natural language processing technique. Also, data model registry system is constructed to collect data specification and data model. It helps to share the data by understanding data structure, such as UML class diagram, and XML schema.
Questions and Answers
Q: Eva Klien – how do you handle discrepancies in definitions?
A: by using a wiki
Q: George Percivall – how often will the ontology change
A: using a wiki and web-site, the wiki is updated every time there is a new paper
Q: Paul Eglitis – how difficult is it to update the system to include mapping between ontologies?
A: there is 1 ontology per wiki; mapping can be done between systems.

Jay Pearlman discussed the breakout session charter. The idea is to "breakout" in smaller groups for informal discussions. Several potential topics were listed: 1) issues for convergence (processes and structure; influencing standards and SDOs); 2) bridging communities (ontologies, taxonomies and interfaces), 3) global data sets; and 4) models interoperability. After checking for interest from the participants, it was decided to have 3 groups corresponding to items 1 through 3 (there was no interest in number 4). The groups met to answer a series of questions posed in the charter. This concluded the workshop sessions for December 3rd.

Summary for December 4, 2008

The workshop reconvened to hear presentations from the breakout sessions groups, followed by a final session on GEO projects, and a discussion on the way forward.
A summary of the discussion following presentations by the breakout sessions leaders is provided below.

Break out group 1 – Paul Eglitis

- See Paul's slides and Gobe's notes

- Gobe Hobona pointed out that the example of EEA looking at ISO19115 raises the importance of a crosswalk or mapping between metadata fields because some of the fields in INSPIRE MIR and GEOSS metadata are different.
- Ingo Simonis: we have registered standards and demonstrated that it works. But how do we move beyond the specifications toward a cookbook approach that guides users and implementers through deploying a new system.
    - New GEO book that explains how to use the system (both decisin maker and system providers)
- Eric Delory: How to measure the peformance of interoperability as evidence for policy and funding agencies. Quoting Luis Bermudez " How do you measure the performance of a car when you do not have a car?"
    - IEEE Engineering in Medicine and Biology magazine Nov/Dec 2008 issue: "Uninteroperability"
    -
- Ingo: Experiences in interoperability – biggest problem is not the interoperability and integration but rather to find the relevant items – discovery and understanding of the available data and services
    - Need to consider developed countries and developing countries differently. In developed countries, it is about sorting out what is available because much is available – discovery and assessment is the biggest issue. In developing countries achieving the systems is needed.

Break out Group 2 – Eric Delory

GEOSS users need some guidelines as to how to define transformations for data integration. Ontologies are part of the methodology to answer this need.

GEOSS must try to ease defining, registering, discovery, merging, and processing of datasets. Processes and datasets should be compatible and identifiable for correctness and match.

There should be a semantic bridge to identify whether a process can be applied to a dataset.

The question was raised whether a cross-community dictionary /thesaurus/ontology would be useful or desired, the User Requirements registry will help answer and define the needs and work focus.

Users should be guided for ease of semantic annotation for data during registration. When a keyword is used, the user have to be sure that the concept reflects the intended meaning.

What level of granularity is needed for ontologies in GEOSS? Defining the granularity level / semantic texture is a prerequisite before identifying possible solutions or candidates. What is the scope of ontologies and the benefit for

GEOSS and users is an important question. User requirements will help define the level of detail and identify the needs by SBA or transverse areas.

Practices are needed (the GEO Best-Practice ontology wiki will inventory them).

  - Significant outcome was the identification that the focus should not just be on "data" but on "processes and data"
  - Is there need for a "GEOSS Ontology?" Important to consider the User Requirements before deciding this question.
  - The best thing of the session was that we are creating a small community within GEOSS and this meeting helped to advance this community formation.
- Ingo: non-purpose driven ontology development is of little value. More valuable is data dictionary. Identify all existing dictionaries and link them to the GEOSS registries.
- Gobe: GEO is 10 year project. We should consider research topic like ontologies
- Max: Multilingual needs to be addressed.

Breakout Group 3 – Ken McDonald

- See Ken's powerpoint
  - Biggest issue is data policies: more so than discovery and access
- Herve: GeoHub on grid computing service. Objective is to mash-up data from many providers. This is being developed in AIP. Tools for quickly aggregating data into a consistent data set. Open street map is an example of a collaborative data set.
  - Two approaches to global data sets:
    - Singular data set: all data into a single
    - Federate data set: distributed services providing access to multiple data sets that collectively provide global coverage.
- Craig Lee: OGF working with Ed Seidel NSF Cyber infrastructure to define a workshop series regarding distributed data sets.
- Max: Need global data sets for social and demographic datasets
  - George: ADC is focusing on Global Data Sets but not sure there are social data sets. The CIESIN data sets are of value here.
- Paul: Data Policies must address steady state access

Following the discussion, **Eva Klien** provided a presentation on scope and targets of the GIGAS project. GIGAS is an EU funded Support Action (SA) that promotes the coherent and interoperable development of the GMES, INSPIRE and GEOSS initiatives through their concerted adoption of standards, protocols, and open architectures. Given the complexity and dynamics of each initiative and the large number of stakeholders involved, the key added value of GIGAS is bringing together the leading organisations in Europe who are able to make a difference and achieve a truly synergistic convergence of the initiatives. Among them, the Joint Research Centre is the technical coordinator of INSPIRE, the European Space Agency is responsible for the GMES space component,

and both organisations together with a third partner, the Open Geospatial Consortium play a leading role in the development of the GEOSS architecture and components. This core group is supported by key industrial players in the space and geographic information sectors, with the scientific leadership of the Fraunhofer Institute. This consortium will achieve the objectives set through an iterative and consensus-based approach which includes: in-depth analysis of the requirements and barriers to interoperability in each of the three initiatives and strategic FP 6/FP 7 projects; comparative evaluation of this activity as input to a forum of key stakeholders at a European level; consensus building in the forum on how to update and integrate the architectures of GMES, INSPIRE and GEOSS, and influence standards development and adoption. From these recommendations follow actions to shape the direction of the initiatives and to define a roadmap for future development, including the key research topics to be addressed to sustain the convergence of the initiatives.

Francis Bertrand, Max Craglia, and Gobe Hobona introduced the upcoming EuroGEOSS project, selected for funding by the European Commission and currently under negotiation.
EuroGEOSS will demonstrate the added value to the scientific community and society of making existing systems and applications interoperable and used within the GEOSS and INSPIRE frameworks. The project will build an initial operating capacity for a European Environment Earth Observation System in the three strategic areas of Drought, Forestry and Biodiversity. It will then undertakes the research necessary to develop this further into and advanced operating capacity that provides access not just to data but also to analytical models made understandable and useable by scientists from different disciplinary domains. This concept of inter-disciplinary interoperability requires research in advanced modelling from multi-scale heterogeneous data sources, expressing models as workflows of geo-processing components reusable by other communities, and ability to use natural language to interface with the models. The extension of INSPIRE and GEOSS components with concepts emerging in the Web 2.0 communities in respect to user interactions and resource discovery, also supports the wider engagement of the scientific community with GEOSS as a powerful means to improve the scientific understanding of the complex mechanisms driving the changes that affect our planet.
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Following a brief discussion on the way forward for GEOSS, George Percivall thanked all of the attendees, presenters and workshop committee members for their participation and contributions.

Attachment 1.

Attendance List for Valencia Workshop

The attendance list below is sorted by professional affiliation.

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