On 1-2 November 2010 (just prior to the GEO Plenary VII and Ministerial meetings), the Group on Earth Observation’s (GEO’s) User Interface Committee (UIC) held a meeting in Beijing, China, to involve participants from Asia and Oceania and others in:

- Gaining insight into the perspectives of the broad spectrum of users of Earth observation data, products, and tools.
- Learning about successful approaches to engaging users in understanding and acting on their Earth observations needs.
- Hearing how GEO-relevant projects and activities are handling challenges associated with the intended users of the project outputs.
- Discussing ideas and next steps to promote more effective user engagement with GEO/SS activities and products.

Attended by over 60 participants (see Attachment A), the meeting included presentations by representatives of countries and organizations in the Asia / Oceania region, and presentations by GEO’s Communities of Practice (CoPs) on aspects of their work relevant to the region. This report summarizes the meeting presentations and discussions. The presentation slides are available at http://www.earthobservations.org/com_uic_docs_16b.shtml.

Day 1 (1 November 2010)

Opening Remarks—Gary Foley, U.S. Environmental Protection Agency, USA

Gary Foley welcomed participants and described the importance of user engagement in the context of GEO and GEO’s System of Systems (GEOSS) (see slides for details):

- GEOSS starts and ends with users, who range from Earth observation providers, to scientists and modelers, to policy and decision makers and the public.
- Users vary widely in terms of their capabilities and needs. For example, some users understand observation systems; some users know what they need, while others do not. End users, such as policy makers, environmental managers, public officials, advocacy groups, and the public are generally “novice users.” Novice users generally:
  - Are interested in specific issues.
  - Often are not aware that observational requirements can be useful to them.
  - Need Earth observation data that can be easily discovered, viewed, and understood.
- User engagement is important to:
  - Learn what users need and how they can benefit from GEO/SS.
  - Discover whether science/decision-making improved as a result of GEO/SS and whether the anticipated impacts/societal benefits were realized as a result of GEO/SS.
  - Receive feedback important to optimizing the value of GEO/SS for societal benefit and reducing gaps in critical Earth observation requirements.
- The UIC sponsored usability testing of GEO portals and the GCI. Testing involved five sessions collectively involving about 250 testers. Results were passed to the GCI
coordination team to improve the usability of GEOSS. Testing showed that, for novice users, the GEOSS Common Infrastructure (GCI) needs to be user friendly. Metadata, while important, are not useful to novice users. GCI components (i.e., data/services) need to provide sample data sets for easy viewing geographically.

Results of US-09-01a: Identifying Critical Earth Observation Priorities—Lawrence Friedl, NASA, USA

Lawrence Friedl began by noting several developments that emphasize the importance to GEO/SS of user engagement. The 2010 GEO Mid-term Evaluation (Document 6) recommends (Recommendation 6) that GEO act to improve its understanding, engagement, and responsiveness to the user community by:

- Conducting a detailed characterization of its current users to strengthen and expand the user base.
- Increasing opportunities for dialogue with the user community to provide helpful feedback on a timely basis.

GEO’s Executive Committee fully concurs with this recommendation and will work to ensure that the UIC delivers effectively on driving user community engagement initiatives. In addition, GEO has noted that completion of the 10-Year Implementation Plan will connote a new phase in which user engagement, coordination, and resource mobilization will be taken to unprecedented levels (Document 10: GEO 2012-2015 Work Plan Development, Page 1).

Lawrence Friedl then presented the results, lessons learned, and recommendations of the recently completed GEO Task US-09-01a, which examined publications since 2000 to identify Earth observation priorities within each of the individual GEO Societal Benefit Areas (SBAs), as well as common needs across SBAs. The Task serves as a first step within GEO to articulate Earth observation priorities; document how Earth observation needs have been identified; and provide a baseline and entry point for further engagement with end users on their needs.

The US-09-01a project reported what users said about their needs. These needs were articulated using a wide variety of terminology at a level of detail that was often insufficient to determine parameter characteristics. The project revealed the need for an ontology to harmonize the terminology used to articulate needs, and for “translators” who can convert user statements of need into associated parameters. Based on the project results, the team recommends:

- Additional work to gather and analyze information on user needs, including needs for specific characteristics of the priority Earth observations (especially precipitation) identified by the project analysis.
- Assessment of the current and planned availability of priority Earth observations.

The UIC will release the final US-09-01a report at GEO Plenary VII on 3 November 2010 and then propose the report for formal acceptance by GEO. The report may be updated in the future. Updates would involve a broader set of topics and analytic methods. See slides for more details about the project and the Task website at http://sbageotask.larc.nasa.gov/ to obtain copies of the individual SBA reports and the final cross-cutting report.

Next steps involve a gap analysis to assess whether the priority observations are available now and/or expected to be available in the future. The UIC needs to clarify with GEO’s Executive
Committee whether the UIC should contribute to a future gap analysis that will be conducted by GEO's Science and Technology Committee (STC).

Discussion

• Stuart Minchin commented that GEO’s 10-year Implementation Plan calls for a structural and observational gap analysis. At the request of the Monitoring & Evaluation Working Group, the STC is designing a comprehensive gap analysis strategy for GEO that will be brought to GEO Plenary VIII in 2011. An email about this has been sent to all GEO committees and CoPs, and the STC has proposed an Earth observation capacity assessment to GEO’s Executive Committee. This assessment will be a top-down science-style review of observational gaps in observational systems in the SBAs—a mirror image of and complementary to the bottom-up US-09-01a user needs review. The UIC will be an important partner, since user observation priorities will be critical to designing a comprehensive gap analysis for GEO.

• Greg Withey asked how GEO will get to the investment stage after the gap analysis that Lawrence Friedl mentioned as a next step. Lawrence Friedl responded that the UIC needs to develop a formal plan for a gap analysis and submit it to GEO’s Executive Committee for review and acceptance, a task the UIC may take up at its January 2011 meeting. The Committee on Earth Observation Satellites (CEOS) has expressed interest in doing a gap analysis for the satellite dimension of the priorities noted in the US-09-01a report. The UIC will need to decide what it will ask the GEO community to do.

• In response to a question about whether oceans were included in the US-09-01a reports, Lawrence Friedl noted that oceans did not have a separate report because they are not a GEO SBA, but the US-09-01a team tried to make sure oceans were represented in the other SBA reports to the extent possible. For example, aquaculture and fisheries were reviewed under the Agriculture SBA.

• In response to a question about the absence of biodiversity priority needs in the cross-SBA priority analysis (since the individual Biodiversity SBA report did not include Earth observation priorities), Lawrence Friedl noted that the UIC would gladly conduct a revised analysis and issue a revised report that included biodiversity priorities should they become available.

• A participant emphasized that a capacity to understand and meet the near real-time needs of users is very important to tactical responses. Lawrence Friedl agreed, noting that users need to know what happened in the past, what is happening now, and what is predicted, but that the documents examined in US-09-01a did not have sufficient information to provide this differentiation. The project team therefore recommends that additional work be done using other approaches, such as interviews with specific users, to gather more specific information on user needs, which could allow for this type of differentiation. Hans-Peter Plag pointed out that the User Requirements Registry (see below) is a peer contribution system that would allow users to publish their real-time needs immediately.

• Hans DeBlocker asked why carbon was not listed among the US-09-01a priorities. Lawrence Friedl responded that the US-09-01a analysis was historical, and the carbon issue may have been too recent to be reflected in earlier documents from which needs were harvested. Also, carbon may not necessarily align with every SBA. Needs related to the forest carbon connection are addressed in a separate US-09-01a report on forests.

• Stuart Minchin pointed out that, when asked about needs, people tend to focus on what they do not already have, rather than recognizing a need to continue something important they already have. The US-09-01a reports could have this bias. Lawrence Friedl responded that
the US-09-01a team found that documents tended to state frustrations with current observations rather than articulate new needs.

- Greg Withey asked what the plans were for future work to refresh and/or build on the information in the US-09-01a reports. L. Friedl responded that the report includes many recommendations to improve the process and gather further information on user needs. There is an assumption the work will continue. He thought a revision every three years would be a good frequency.

- Kathy Fontaine noted that the approach of using available documents since 2000 was always intended as a starting point that would require follow-up analysis. Gary Foley added that the User Requirements Registry (URR—see below) opens a new dimension for obtaining information on user needs. The URR can provide an important supplement to potential future work under US-09-01a to incorporate needs harvested from future documents as they are produced.

GEO Call for Proposals (CFP)—Lawrence Friedl, NASA, USA

Lawrence Friedl and Masami Onoda presented the status of GEO’s Call for Proposals in Earth Observations for Decision Support, a joint effort of GEO’s Capacity-Building Committee (CBC) and the UIC (see slides for details). The purpose of the CFP initiative is to showcase the value and benefits of Earth observations and GEOSS through projects in four GEO SBAs (agriculture, water, health, and energy) that demonstrate successful applications of Earth observations to improve policy and management decisions. The initiative relates directly to user needs because the projects focus on practical applications of Earth observations to meet specific user needs.

A total of 71 full proposals have been selected (agriculture 25%; water 55%; health 17%; energy 3%). Examples relevant to Asia/Oceania include projects to:

- Facilitate decision support for mountain development policies and practices by developing a knowledge base on natural resources in the Hindu Kush-Himalayan region.
- Facilitate monitoring variability and trends in seasonal flooding to estimate exposure to climate-related disasters in the Lower Mekong and Ganges basins.
- Integrate key Earth observation data along with multi-scale, multi-pollutant atmospheric chemistry-transport model outputs and advanced analysis tools for the Indian subcontinent.
- Create a spatially resolved data set for a long-term air pollution database by building a robust association between satellite data, model simulations, and available local monitoring data in the Yangtze River Delta, China.
- Ensure that reduced emissions from deforestation and forest degradation provide significant biodiversity and livelihood benefits in Indonesia.
- Encourage long-term environmental monitoring to grasp environmental change and to mitigate global warming hazards by applying space applications, especially remote sensing technology, in Vietnam/Cambodia.

Work under the CFP initiative is now focusing on arranging advisors and funding for projects. CBC/UIC is requesting support (e.g., contacts, resources) from the GEO community to broker 1) relationships between projects and Earth observation experts, and 2) projects with potential resource/funding organizations. CBC/UIC also encourages GEO organizations and CoPs to support or “adopt” projects that align with their objectives and funding criteria; and to provide in-kind and pro bono funding—for example, by providing technical advice and by advising project teams during the funding process.
Discussion

- Joern Hoffmann asked how the proposals were selected and whether the process had involved checking and comparing to work already underway in the regions of interest. Lawrence Friedl responded that the review panels included members with science and technology and management expertise. The hope was that panel members would have knowledge of any similar ongoing projects in the regions for which the projects were proposed.
- Joern Hoffmann noted that many science and technology organizations have competitive proposal processes and suggested it would be good to consider how to mesh the selected full proposals with these processes.
- Stuart Minchin noted that funders will need to know that the proposed projects have been well conceived. Engaging advisors before going to funding agencies will be critical to success so that advisors can work with organizations to ensure optimal presentation, in addition to brokering relationships with potential funding organizations. He suggested starting with clarity about the project’s societal benefits in order to match the benefits with funding organization(s) whose mission and goals cover those benefits. He pointed out that, at present, the CFP website simply lists the proposals; he suggested it would be more effective if the website provided a synopsis of each proposal, a summary of the science and technology skills needed, and a description of the benefits to the proposer/society. Even just having the proposals available (e.g., via a link) would be helpful.
- Lawrence Friedl responded that the CFP project has experienced staffing resource and continuity issues. Kathy Fontaine mentioned the GEO Secretariat has been considering a dedicated position to support the brokering process. There is a general consensus this is important, but broader agreement and a job description are needed to advance this concept.

User Requirements Registry Overview—Hans-Peter Plag, University of Nevada at Reno, USA, and Greg Ondich, Scientific Consulting Group (U.S. EPA contractor), USA

Greg Ondich (on Day 1) and Hans-Peter Plag (on Day 2) presented the status of development of the User Requirements Registry and encouraged participants to test the URR prototype at the URR booth during the Beijing Ministerial Summit or at http://www.scgcorp.com/urr/.

The task of capturing what society needs in terms of Earth observations is immense, involving many different kinds of users in developing and developed countries with a wide variety of needs. Some users, such as the weather community, understand their needs; however, many other user types do not understand their needs or what a “user requirement” is. The GEOSS interface therefore needs to be flexible and proactive to enable users to express their needs, and capacity building is important to help novice users understand their needs.

Currently under development, the URR is a registry in the GEOSS Common Infrastructure (GCI) where users can describe their needs by entering and linking information on user types, applications, and requirements. An open Wikipedia-like approach based on peer contributions is being used as a first step in populating the URR. This approach allows users to publish new data and edit data previously published by others. Other approaches based on expert contributions and harvesting of existing databases are also being utilized. When populated, the URR’s analysis function should enable:
• Answers to questions like: Who is using my data for what? Are there data products that would meet my needs? I am doing interdisciplinary research and would like to know what data are used by my colleagues in other disciplines? What user types and applications depend on this requirement? What data products are needed for this application?
• A gap analysis by comparing users needs registered in the URR to the products registered in GEOSS.
• Linkage of users expressing a need with products registered in the GCI that meet that need.

Initial population of the registry with results of the US-09-01a project and open peer contributions revealed considerable issues in understanding how to properly publish data in the registry, including confusion around key terms such as “user types,” “applications,” “requirements,” and “links.” A home page, brochure, and Webex and online tutorials have been created to address these issues, and review and editing of entries will be important. In addition, the ongoing development of a lexicon is essential to ensure consistency in the description of user needs; accurate linkage of needs with users, applications, and products meeting those needs; and gap analysis and prioritization.

Four new registries will be created in the URR to capture:
• Research and development (R&D) needed to enable applications of Earth observations.
• Technologies and methodologies (e.g., sensors, models, algorithms) needed to enable or support applications.
• Gaps in infrastructure (observation systems, services, data accessibility, etc.) that are hampering or disabling applications.
• Needs for capacity building to facilitate improved utilization of the benefits of Earth observations.

Hans-Peter Plag concluded by noting that the URR can only connect users with useful products and be used to perform a gap analysis if it has been connected with the GCI and the information provided about products registered in the GCI is at a similar level of specificity as the registered needs.

Discussion

• George Percivall commented that the GEOSS Components and Services Registry is part of distributed product catalogue, with access to tens of thousands of products. It provides progressive disclosure of information that could yield the specificity needed for a gap analysis, though that may take a few steps. Hans-Peter Plag responded that he remained concerned that the lack of direct access in the GCI to specific parameters such as latency and resolution could be a barrier to performing a gap analysis.
• A participant questioned the comparison of the GEO community to the wiki community, noting that there were differences in community size and expertise, and asked whether the process of populating the URR should be controlled. Hans-Peter Plag responded that the URR was designed to obtain as much input as possible from users worldwide, including users who are not members of the GEO community.

User Engagement Handbook—Lawrence Friedl, NASA, USA

Lawrence Friedl provided a brief overview the initial “User Engagement Handbook” that the UIC distributed participants at GEO’s Joint Task Symposium in Pretoria, South Africa, in May 2010.
The handbook describes eight techniques (e.g., online user surveys, email newsletters, webinars, conferences) and serves as a start for developing a GEO User Engagement Handbook. Such a handbook could be a useful tool to build relationships with and engage users in the nine GEO SBAs. This would help create ongoing users of GEO/SS, and provide channels for user input and feedback. Analysis of GEO Tasks indicates that workshops have been the predominant user engagement mechanism so far. A handbook could help expand the breadth of techniques used.

Discussion

- Jay Pearlman commented that, to be useful, a user engagement handbook must be broader than GEO Tasks, i.e., it should include other programs, but that leads to the question of how the relevant programs can be characterized. Lawrence Friedl responded that it may make sense to conduct a program analysis before developing a user engagement handbook.

Operational Infrastructure of the Global Monitoring for Environment and Security (GMES) Marine Core Service: MyOcean—Jun She, Danish Meteorological Institute

Jun She described MyOcean, a single, integrated core service, sponsored by the European Commission’s GMES, to apply Earth observations for ocean monitoring and forecasting (see slides for details). MyOcean provides a single access point (www.myocean.eu) to free and open data on the marine and coastal environment, marine resources and operations, and marine-relevant climate and weather forecasting. Earth observations are provided by five operating centres (for sea level, ocean color, sea surface temperature, sea ice and wind, and in situ) and processed through seven monitoring and forecasting centres (using models for the global, Arctic, and Atlantic oceans, as well as the Baltic, Mediterranean, and Black Seas) that ensure data quality; output is provided via a service desk.

MyOcean involves 61 partners in 28 countries. Currently in a 3-year demonstration phase, MyOcean has a growing number of users; approximately 80 users registered during the first 6 months. Users include European policymakers; member states; environmental, weather, and ocean agencies; and maritime businesses. GEO/SS may benefit from MyOcean forecast and observations, and MyOcean may benefit from local validation done in GEO’s ocean-related Tasks. Development of user uptake protocols to facilitate use of MyOcean data will be an important future step to improve access and usability.

Options and Choices for Meteorological Satellite Direct Broadcast Users in Real-Time Applications—Hung-Lung Allen Huang, Space Science and Engineering Center (SSEC) / Cooperative Institute for Meteorological Satellite Studies (CIMSS), University of Wisconsin-Madison, USA

On behalf of Hung-Lung Huang, Ms. Hong Zhang described the development and capabilities of East China Normal University’s (ECNU’s) direct broadcast receiving, processing and application system, and how this system contributes to expanded options and choices worldwide for users of meteorological satellite direct broadcasts. Direct broadcasting systems make satellite data available to users for meteorological and environmental modeling and applications, including weather forecasting, natural resources management, drought monitoring, aviation safety, and climate study. Onsite hardware and software training is provided to users, including scientists,
researchers, and students in various regions of the world, as new products and processing packages become available.

The ECNU system became operational in May 2010 and is now fully functional. All data, products, software, and application outputs are available on-line in real-time at http://dbps.ecnu.edu.cn/data/. Capabilities include an air quality data assimilation and regional forecast system. Outputs from the ECNU system have been accessed by over 300 users in 54 countries. With the addition of the ECNU system, direct broadcast users around the world now have more options and choices to support their real-time regional operation and applications using current and future U.S., European, and Chinese polar orbiting satellite systems. See slides for details.

**Introduction of Forest Mapping Activities in the Asia-Pacific Region—Li Zengyuan, Chinese Academy of Forestry**

Li Zengyuan provided an overview of forest mapping activities in the Asia-Pacific Region (see slides for details). Proposed by China in 2007 and launched in 2008, APFNet is an international organization to promote and improve sustainable forest management and rehabilitation in the Asia-Pacific Region via information sharing, capacity building, regional policy dialogues, and pilot projects.

APFNet sponsored an “International Workshop on Forest Monitoring in Support of Sustainable Forest Management in the Asia-Pacific Region” in Beijing, China in April 2010, which was attended by 35 scientists and officers from countries in the Asia-Pacific and other regions, as well as international organizations. Participants shared their experiences on forest monitoring and assessed the current situation, challenges, and opportunities to harmonize national forest monitoring systems at a regional scale. They discussed the needs of Asia-Pacific countries for forest monitoring in support of sustainable forest management, including system design and outputs, capacity building and training, research priorities, and regional harmonization, and how the ability to meet these needs could be enhanced through improved data access/sharing, monitoring system management, and regional coordination.

Current activities include synthesizing country reports to clearly understand the regional situation; evaluating other programs in the region with similar objectives; compiling a Forest Geospatial Resource Manual describing useful resources available to users; and further articulating needs and how they can be met through capacity building, pilot activities, and demonstration projects. A proposed 2011-2013 APFNet pilot project for multi-temporal forest mapping and carbon dynamics in the Greater Mekong Subregion aims to use Earth observation data sources to produce forest monitoring products similar to GEO’s Forest Carbon Tracking Task. The project team welcomes collaboration with the GEO Forest Carbon Tracking Task. For more information, see http://www.apfnet.cn.

**Connecting Ecosystems, Biodiversity, and Human Health: Using Earth Observations to Reduce and Prevent Infectious Diseases—Gary Foley, U.S. Environmental Protection Agency, USA**

Gary Foley reviewed the importance of work under GEO Task HE-09-03c, as well as current projects by U.S. organizations to examine how biodiversity decline (i.e., changes in the abundance, composition, and distribution of animal hosts and vectors) may impact human
health by catalyzing the emergence, re-emergence, and spread of infectious disease. The ultimate goal of this work is to develop environmentally based tools and strategies to prevent and reduce disease risk. To be effective, the work must be trans-disciplinary, involving health scientists, the ecosystems services community, ecologists, social scientists, and economists.

One important line of work involves raising awareness and understanding among land use planners and local communities about how land cover configuration, including ecosystem connectivity and forest fragmentation, affects the risk of diseases, such as Lyme disease, West Nile virus, and malaria. The U.S. Environmental Protection Agency (U.S. EPA) sponsored a cross-disciplinary workshop on Lyme disease and land use planning in New England (USA). The cross-disciplinary aspect created powerful synergies, particularly since many participants had had little prior cross-discipline communication on the topic. One participant, a land use planner in a small rural community, started a blog on the relationship of land use planning and Lyme disease. The blog has sparked interest among other land use planners in forming a community of practice on the topic. Under related research projects, scientists are collecting data on vectors and hosts, as well as remote-sensing data on land use to increase understanding and support development of tools to measure and put an economic value on the occurrence of Lyme disease in a region. See slides for details.

Discussion

- Lawrence Friedl noted that huge opportunities potentially exist when a connection can be made between Earth observations and health. He asked whether the health community was interested and engaged in wanting to learn about Earth observations. Gary Foley responded that work thus far with the community shows there are many misunderstandings. As good science is produced, it is important to get it to the medical and public health communities, and to schoolchildren, who teach their parents.

- Masami Onoda noted that the public health and Earth observation communities have not yet connected closely in Health CoP meetings. She also emphasized that providing the information through channels that truly reach the target audience is critical. The meningitis project (GEO Task HE-09-03a, Implementation of a Meningitis Decision Support Tool) provides a good example of communicating Earth observation information to end users; in this case, information relevant to optimal timing of vaccinations is transmitted to vaccinations providers. She suggested that examining models for successfully connecting the public health community with critical Earth observation data might be an interesting project for the UIC.

AIRNow-International Status and Next Steps—Gary Foley, U.S. Environmental Protection Agency, USA

Gary Foley reported on the status of the AIRNow-International project (see slides for details). AIRNow-International seeks to promote international exchange of environmental data; advance air quality knowledge and applications; and build a worldwide community of people and organizations working in air quality. For many years, AIRNow (an air quality data collection and information management system) has provided real-time reporting of air quality in the form of color-coded maps to the U.S. public. The AIRNow team recently supported the China Meteorological Agency in developing a similar real-time reporting system for Shanghai. A pilot system at the Shanghai Environmental Monitoring Center was launched in May 2010 at the 2010 World Expo in Shanghai and is now operational. Similar systems can be available to any interested country using the U.S.-developed software, as long as the country provides the air...
quality data. Mexico has expressed an interest. AIRNow is also providing air quality data to the “Eye on Earth” project in Europe, where it will be displayed in real-time with an opportunity for citizen feedback.

**Discussion**

- Lawrence Friedl observed that AIRNow is a good example of a project that meets the needs of two very different types of users: scientific users (by providing the data) and the public (via color-coded maps). To date, AIRNow data have been from in situ monitors. U.S. EPA and NASA are now working to explore how satellite data can be used to interpolate in the areas between the in situ monitor locations.

- Carol Meyer described work that the Federation of Earth Science Information Partners (ESIP) sponsored in 2009 to aggregate different social media feeds around a wildfire air quality event in southern California, USA. Google Pipes was used to search for and pull relevant information from feeds, and then rebroadcast the data via a Twitter feed. A location was provided on the ESIP wiki for citizen scientists who were documenting the event to upload photos. For more information, search for “air twitter” at [http://www.esipfed.org/](http://www.esipfed.org/). Carol Meyer thought this approach could be applied to other types of disasters such as flash flooding.

**Participation, Visualisation, Collaborative Infrastructure, and Games: New Approaches to User Engagement with Earth Observation in the Australasian Region**

Stuart Minchin, Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia

Stuart Minchin described several relatively novel approaches to foster participation and engage users in the Australasian region with Earth observations (see slides for details):

- **Participation:** ECOOCEAN ([http://www.whaleshark.org/](http://www.whaleshark.org/)) is a website created to involve citizens in learning about and contributing to work to protect the whale shark, a species listed as “vulnerable to extinction.” Interested members of the public are encouraged to take and submit photos of whale sharks to help scientists uniquely identify them for purposes of mark-recapture analysis.

- **Participation:** Community Waterwatch ([http://www.waterwatch.org.au/](http://www.waterwatch.org.au/)) invites Australian citizens to become active in protecting their waterways by measuring water quality in streams. This program compared community measures to quality controlled measures and found a close correlation between the two measures on average, with differences only at the extremes.

- **Visualization:** The eReefs project aims to integrate marine and freshwater data and models relevant to the Great Barrier Reef into a unified framework to enable visualizations of historical, current, and forecast data that will significantly enhance decision and policy making and outreach to and communication with the public. For example, a visualization tool has been constructed to show how multiple threats, including farming practices, impact the Great Barrier Reef over time. This tool aids decision-makers and help communities understand the basis for decisions—for example, to close off an area of the reef. A generic version of the eReef visualization tool is being developed for application to other watersheds. The tool will likely be made available to the GEO community via registration in the GCI in late 2010. The data formats are open and the software product will be freely downloadable. The product is not open source, but users will be supported if they want to change the source code.
**Collaborative Research and Data-Sharing Infrastructures:** Examples include:

- The Integrated Marine Observing System (IMOS) and Terrestrial Ecosystem Research Network, which are nationally integrated systems for collecting and making marine and ecosystem/natural resource data, respectively, available to researchers and other users (see [http://ncris.innovation.gov.au/](http://ncris.innovation.gov.au/)).

- Atlas of Living Australia ([http://www.ala.org.au/](http://www.ala.org.au/)), which provides access to an array of information on Australia’s plants, animals, fungi, and microorganisms to help researchers and others protect and manage Australia’s biodiversity. Users are encouraged to contribute photos and information.

- Australian National Data Service ([http://ands.org.au/](http://ands.org.au/)), which compiles data and other research resources from all of Australia’s research institutions to make it easier for Australian researchers to publish, discover, access, and use/re-use research data.

- Australia Research Collaboration Service ([http://www.arcs.org.au/](http://www.arcs.org.au/)), which provides Australia’s research community with e-research support, including authorisation, an interoperability and collaboration infrastructure, and services and tools.

**Games:** The Catchment Detox game ([http://www.catchmentdetox.net.au/](http://www.catchmentdetox.net.au/)) challenges players to manage a virtual river catchment to create a sustainable and thriving economy. More than 500,000 games were played in first three months, and all schools in Australia have picked the game up as a curriculum aid. Development took 3 months and cost approximately $300,000. The game won Australia’s interactive media award for the best interactive website. Google Earth was used as the visualization tool because it is freely available and easy to use.

**Facebook:** A Facebook community page for fisherman has provided useful information about the size and species of fish that are caught.

**Discussion**

- Gary Foley emphasized that the UIC needs to think about how to make this information more widely available, for example, by getting information about these applications into GEOSS so that they can be discovered by GEOSS users.

- Ellsworth LeDrew stressed the importance of visualization tools to making Earth observations useful to end users such as decision makers and the public. He recommended that the UIC encourage the registration of such tools in GEOSS, with the possibility of having a component of the GCI devoted to such tools.

- Lawrence Friedl hoped that the GEO community would develop best practices for applying the generic visualization eReefs tool, once it has been registered in GEOSS, to facilitate its application by others. Stuart Minchin agreed this type of support would be important to catalyze the tool’s dissemination and use after it has been registered in the GCI.

**Monitoring Atmospheric Composition and Climate (MACC)—Adrian Simmons, European Centre for Medium-Range WeatherForecasts (ECMWF)**

Adrian Simmons presented MACC, a project (funded by the European Union under the GMES initiative) to develop and establish pilot operation of systems for monitoring and forecasting the chemical and particulate composition of the atmosphere (see slides for details). Services are targeted mostly to specialized users, including environmental agencies; weather services and other providers of downstream services; scientists; policy-makers; and space agencies and
other data providers. The public occasionally also becomes interested. Products include global records and forecasts of greenhouse and other reactive gases and aerosols; forecasts of European air quality; and records and forecasts for stratospheric ozone, UV radiation, and solar energy. Specific applications and outputs have included the air quality impacts of Australian dust storms, the 2010 eruption of the Eyjafjallajökull volcano in Iceland, and the 2010 fires over Russia. The system is not yet fully operational, but maps are provided at www.gmes-atmosphere.eu and data are becoming available on public servers. Data are being supplied to support international projects, and will be supplied as part of World Meteorological Organization’s (WMO’s) Information System. Future work includes consolidating the interface with user communities and liaising with agencies regarding their observational requirements.

DAY 2 (2 November 2010)

Summary of Day 1—Kathy Fontaine, NASA, USA

Kathy Fontaine reviewed observations, themes, and challenges gleaned from the Day 1 presentations and discussions (see slides for details):

- Users range from politicians and policy-makers who need visualization tools, to citizen scientists who contribute data, to scientists and application providers who use data for analysis, modeling, and development of applications/products. Different users have different levels of comfort with Earth observations.
- There are many valuable ways to engage users. Success depends on knowing the full spectrum of users and their needs.
- Regularly asking what users want and making user needs openly available helps build a critical mass of needs information that may attract other users.
- Common challenges experienced by projects include how to make information valuable to users.
- The different types of work to collect and display user needs reveal the importance of clearly defined, consistent terminology and semantics.
- Visualization is a powerful tool, including not only graphs and charts, but also pictures, movies, and games. Visualization tools are particularly powerful if users can change parameters and learn how those changes affect environmental outcomes.
- Ongoing outreach (e.g., via presentations, exhibits, cross-disciplinary workshops to bring together people who don’t normally talk to one another, registration of components, etc.) is critical to make Earth observation information, programs, and tools ‘common knowledge’ in the Earth observation/GEO community.
- Challenges include understanding where the gaps are in user priorities and how to fill them:
  - Do users really tell you all their needs, or do they omit needs that are currently met because they assume these needs will be met in the future?
  - How do we leverage the connections and networks of GEO to fill the gaps and to get users what they need?
- Engaging all types of users, repeatedly, in a variety of ways is challenging, but productive efforts can create lasting partnerships and powerful outcomes.

K. Fontaine encouraged participants to consider user engagement methods, partnerships, and other approaches to promote engaged Earth observation users, and to consider how the GEO network can be leveraged, particularly at the highest levels of government, to fill gaps in user priorities.
Update on US-09-01a: Identifying Earth Observation Priorities—Lawrence Friedl, NASA, USA

Lawrence Friedl noted the increased recognition of the importance of user engagement to GEO/SS. For example, GEO’s 2012-2015 Work Plan states that completing GEO’s 10-Year Implementation Plan will “connote a new phase for GEO where user engagement, coordination and resource mobilization are taken to unprecedented levels.” At its January 2011 meeting, the UIC will be discussing how to fulfill GEO Mid-Term Evaluation Recommendation #6, which recommends that GEO improve its understanding, engagement, and responsiveness to the user community by characterizing users and increasing opportunities for dialogue with the user community to provide helpful feedback on a timely basis. One idea would be to pursue in-depth engagement with users in one or two GEO SBAs each year (e.g., via meetings and workshops with other GEO committees and groups) to examine user needs across different user types. The goal would be an SBA-specific report that the UIC would deliver to the GEO Plenary. Lawrence Friedl encouraged participants to provide input on user engagement and feedback on this idea. He then briefly reviewed the information on US-09-01a status he presented during the first day of the workshop (see presentation summary above).

Introduction to GEO Communities of Practice—Ellsworth LeDrew, University of Waterloo, Canada, and IEEE

Ellsworth LeDrew presented an overview of the GEO CoPs (see slides for details). The UIC has defined a GEO CoP as “a self-organized group of people who commit to working together to apply/foster application of Earth observations for societal benefit in their shared field of interest and expertise.” CoP work is funded by voluntary contributions from host organizations and by in-kind contributions of CoP members. GEO currently has ten active CoPs and two to three in development. There can be several CoPs within one GEO SBA.

CoPs are not administrative units, but may become involved supporting GEO Tasks. CoP Leaders are responsible for communicating/liaising with the UIC, including preparing quarterly progress reports for submission to the GEO Secretariat. A co-chair of the UIC is assigned as a point of contact for each CoP.

The UIC has developed guidance (available at http://www.earthobservations.org/cop.shtml) to help CoPs understand principles, procedures, and resources for CoP formation and operation. The guidance provides a template for groups who want to apply to the UIC to be recognized as a GEO CoP.

Agriculture CoP and GEO TASK AG–07–03a (Global Agricultural Monitoring)—Jai Singh Parihar, Indian Space Research Organisation

Jai Parihar described work of the Agriculture CoP, which focuses on GEO TASK AG-07-03a (Global Agricultural Monitoring) (see slides for details). Work under the Task aims to evolve a Global Agricultural Monitoring System of Systems (GLAMSS) that provides global monitoring of agricultural production; timely and accurate national (and subnational) agricultural statistical reporting; accurate forecasting of shortfalls in crop production and food supply; effective early warning of famine; and global mapping, monitoring, and modeling of changes in agricultural land use, type and distribution, in their social and ecological context. Work is underway in five areas:
• Development of the Multi-source Production, Acreage and Yield (PAY) centralized online database to enable objective assessment of food security and risk management planning. Currently open only to the GEO Agriculture CoP, the interface allows for PAY queries by agency, commodity (corn, soybean, wheat, rice), country, year (2005-present), date of forecast, and data type (forecast, reported).

• Joint Experiments on Crop Assessment and Monitoring (JECAM) to develop international standards for monitoring and reporting protocols; define best practices on agricultural monitoring; and identify requirements for future Earth observation systems for agriculture monitoring (see http://www.umanitoba.ca/outreach/aesb-jecam/).

• Coordinated Data Initiatives for Global Agricultural Monitoring (CDIGAM) to ensure the accessibility and continuity of satellite data during the crop growing season; compile the best available information on agricultural areas, crop calendars, crop rotations, and cropping systems; and fill gaps in current in situ observations.

• GLAMSS community workshops on methodological issues and topics to improve communication within the CoP; develop best practices and standards; and increase international cooperation, coordination, and data sharing.

• Global Agriculture and Climate Change (GACC) Initiative, for which a working group is forming. Interested individuals and institutions are welcome to join (see www.commission8.isprs.org/wg6/).

Air Quality CoP: Activities in India—Virendra Sethi, Indian Institute of Technology (IIT), Bombay, India

Virendra Sethi presented examples of community-based efforts to build capacity for air quality management in India and described the work of the Indian Air Quality CoP (see slides for details).

• In one project, seven institutes worked with the Indian Central Pollution Control Board for 3 years to conduct a six-city source apportionment study. Opportunities for future work to achieve societal benefit by building off this study are hampered by the lack of a formal structure for participants to engage.

• As a result of another project, air quality in 88 industrial clusters was declared “critical” to “very critical” (based on a Comprehensive Environmental Pollution Index), and new projects have been banned in these clusters until the Industry and State Pollution Control Boards develop abatement action plans. Further progress is currently impeded by lack of resources and by the time needed to develop the action plans.

At a recent meeting in Bombay, the Indian Environmental Association (IEA) identified factors that impair progress in tackling persistent air quality issues. These factors include: government agencies tend to focus on “immediate” issues; non-government organizations lack resources (and sometimes credibility); researchers and academia are reluctant to tackle “non-research/academic” issues; and the air quality community lacks a voice, think tank, and structure to share air quality research, education, and best practices.

In March 2010, the IEA convened environmental, energy, and climate change institutes to explore opportunities for future collaboration. The Indian Air Quality CoP has been networking and connecting with GEO and other relevant organizations within India and in other countries, and will continue to build the air quality community across the Indian subcontinent and within the GEO Air Quality CoP. They intend to define and gather air quality data and decision support tools for India and share them through GEOSS.
Discussion

- Lawrence Friedl and Virendra Sethi agreed to discuss opportunities for the Indian Air Quality CoP to connect with SERVIR’s recently established node in Katmandu.

Biodiversity CoP: GEO Biodiversity Observation Network (GEOBON)—Jesse Ausubel, Program Director, Census of Marine Life

Jesse Ausubel described the importance of a biodiversity observation network for marine life (see slides for details). Over the past decade, the international marine biodiversity community has created the first global census of marine life. The census is the most comprehensive inventory of diversity, distribution, and abundance of known marine life ever compiled and cataloged. It shows that significant changes have occurred in the biodiversity of marine life over the past decade, including species extinctions at increasingly larger rates and scales. There is an urgent need for an operational and sustained integrated international Global Ocean Observing System (GOOS), including both satellite and in situ observations, to monitor status and trends of marine life, identify hot spots, and understand and forecast changes and impacts in order to support research, management, and conservation of marine resources. The need for an operational GOOS grows ever more important as marine ecosystems are increasingly threatened by many factors, including offshore oil and gas development, international shipping, submarine cables to support telecommunication, noise pollution, overfishing, the spread of invasive species, and climate change-induced impacts on the ocean environment, including acidification and rising sea temperature.

Discussion

- A participant commented that work on GOOS to date has been mostly successful in the area of physical climate variables, but nations’ interest in contributing to that work seems to be diminishing. How realistic would it be to anticipate interest in the area of biodiversity? Jesse Ausubel responded that solidarity and collaboration among stakeholders and academic disciplines is essential to success. In addition, the industrial and shipping communities prefer to deal with a unified community. Appreciation for oceans has risen over the past decade. A key job of the marine biodiversity community will be to raise awareness and overcome resistance. The marine community had written many plans in recent years and is eager to focus on action and implementation over the next decade.
- Another participant thought it important to develop new routes into government and suggested the Climate Change Convention as one mechanism. Kathy Fontaine responded that GEO’s protocol is to establish a GEO Task to accomplish important goals. One idea could be to create a GEO Task to develop networks designed to promote specific outcomes. This could be a great platform for interested parties to get involved.

Health Showcase: Using Earth Observations to Benefit Public Health—Meghan Radtke, U.S. Environmental Protection Agency, USA

Meghan Radtke provided a brief overview of the health showcase that would be featured at the GEO Plenary VII Ministerial Summit meetings on 3-5 November 2010. The showcase highlights several projects, including a meningitis outbreak prediction effort in Africa and an air quality-health monitoring tool in the United States that is being replicated in Shanghai, China. These
projects demonstrate how Earth observations can be applied in a variety of ways to improve public health. She encouraged participants to visit the showcase. Gary Foley noted that GEO will be adding Tasks concerning water and health in the next version of its Work Plan.

Carbon CoP—Takashi Moriyama, Japan Aerospace Exploration Agency (JAXA)

Takashi Moriyama provided an overview of the work of the Carbon CoP (see slides for details). Launched in September 2009, the Carbon CoP is conducting GEO Task CL-09-03 (Global Carbon Observation and Analysis System), which includes three integrated subtasks: (a) Integrated Global Carbon Observation (IGCO); (b) Forest Carbon Tracking; and (c) Global Monitoring of Greenhouse Gases from Space (CEOS Carbon Task Force).

In June 2010, as part of subtask (a), the Carbon CoP published the “GEO Carbon Strategy," which describes key strategic actions needed to expand current carbon cycle observations into a fully Integrated Global Carbon Observing (IGCO) System measuring the essential parameters and variables. The strategy has the potential to contribute to the next scientific assessment of the Intergovernmental Panel on Climate Change. It is available at: (http://www.earthobservations.org/documents/sbas/cl/201006_geo_carbon_strategy_report.pdf).

Under subtask (c), the Carbon CoP has a strong relationship with the CEOS Carbon Task Force, which provides an important connection to the space community, and additional support for GEO Task CL-09-03.

Harnessing Space for Societal Benefits: Indian Experience—Jai Singh Parihar, Indian Space Research Organisation (ISRO)

Jai Parihar presented an overview of how India has been using satellite observations for societal benefit (see slides for details). India’s space program has a large constellation of satellites producing data that can be applied to all GEO SBAs. Successful application of these observations has been enhanced by a well-developed space and ground infrastructure; development of applications in partnership with users, researchers, and academia; and development of an institutional framework to reach out to users. Benefits are being realized in many areas, including food and water security; management and protection of terrestrial, coastal, and marine resources; understanding, monitoring, and conserving biodiversity; improving weather information, forecasting, and warning; understanding, assessing, predicting, mitigating, and adapting to climate variability and change; reducing loss of life and property from natural and human-induced disasters; forecasting health hazards; and improving management of energy resources. Data are being made available to the global community by a variety of channels.

Coastal Zone CoP (CZCP)—Hans-Peter Plag, University of Nevada, Reno, USA

Hans-Peter Plag presented a brief update of the work of the Coastal Zone CoP (see slides for details). Up to now, the CZCP has focused on organizing regional workshops with the goal of engaging end users. The first workshop (held in Greece in 2008) involved far more scientists than end users. The key “take-home” message was that providers of Earth observations and services need to understand how and why decisions are being made in order to support them. The second workshop (held in Benin in 2010) brought scientists together with government
officials. Participants emphasized the need to go beyond capacity building to emphasize capacity retention (i.e., keeping individuals within the region after they are trained), capacity sustainability, and empowerment. A third workshop (planned for 2011 in Puerto Rico) will involve end users and focus on sustainable tourism. Additional regional workshops are being considered for Indonesia and the Arctic. A challenge with all workshops is how to catalyze subsequent application of workshop outcomes to foster meaningful change in a region. Hans-Peter Plag noted that regional-scale differences in observational capabilities are hindering development of basin-wide observational and decision-support systems both on Mediterranean and global scales.

The CoP launched a webpage “You and the CZCP” at http://www.czcp.org/you_and_the_CZCP/, which has generated some input and interest. The CZCP is considering a project to engage users in assessing the state of the world’s coasts. In response to a question, Hans-Peter Plag noted that ocean and terrestrial observation networks often do not sufficiently cover the coastal zone. Coastal zone scientists, on the other hand, need to understand the larger environmental and global context in order to provide useful advice to coastal zone managers.

Geohazards CoP (GHCP)—Hans-Peter Plag, University of Nevada, Reno, USA

Hans-Peter Plag presented a brief update of the work of the Geohazards CoP (see slides for details). A major goal of this CoP is to support end-to-end links between Earth observation providers and end users who apply geohazard data to risk management. Particularly in developing regions, these links are often not working. For example, scientific information on a pending >7.0 earthquake in Haiti was available as early as 2008, but this information failed to reach risk managers before the 2010 earthquake occurred. An end-to-end linkage might have enabled early warning and preparedness prior to this disaster.

The CoP is looking at several strategies for achieving societal benefits in the geohazards area, including establishing regional centers of excellence and pairing centers in developed and developing countries so they can learn from one another. The CoP plans to issue a call to GEO member nations for these core centers.

Discussion

- Fernando Echavarria emphasized the importance of leveraging existing structures, such as the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER) and the Pacific Disaster Center, to enhance value and avoid redundancy of effort. Hans-Peter Plag agreed with this comment, remarking that most of the ongoing programs were participating in the GHCP, but pointed out that despite many important ongoing efforts, disasters like the Haiti earthquake still happen, which he considered sufficient justification to focus more on the end-to-end link.

- Jesse Ausubel noted that evolving web technology is opening new possibilities for a volunteer wiki-type rapid response utilizing open source technology to support disaster relief. A notable recent example was the rapid response to the Haiti Earthquake by Crisis Commons. This response included development of Haiti OpenStreetMap, a digital map of Haiti’s roads, hospitals, triage centers, and refugee camps. He was concerned these cutting edge approaches could overwhelm the CoP’s work, e.g., by pulling traffic away or proving more timely or valuable. Kathy Fontaine noted that this example emphasized the importance of social media and suggested the group discuss this further later in the day.
Energy CoP—Ellsworth LeDrew (University of Waterloo, Canada and IEEE) / Thierry Ranchin (MINES ParisTech, France)

Ellsworth LeDrew provided a brief overview of the work of the Energy CoP (see slides and the CoP’s portal at http://www.geoss-ecp.org for more information). The CoP supports use of Earth observation data via GEOSS for societal benefit in the energy area, including effective design, siting, operation, and management of power plants and facilities; yield estimation and forecasting; trading, and monitoring of power and environmental credits; environmental monitoring of impacts; life cycle considerations; and economic analysis. The CoP is leading three GEO Tasks: EN-07-01 (Management of Energy Sources): EN-07-02 (Energy Environmental Impact Monitoring); and EN-07-03 (Energy Policy Planning). The CoP is also supporting Phase 3 of the Architecture Implementation Pilot; specifically, MINES – ParisTech is leading the effort to provide an environmental impact assessment of the production, transportation, and use of energy for a photovoltaic system.

Integrated Global Water Cycle Observation CoP—Rick Lawford, University of Maryland, Baltimore, USA

Rick Lawford presented an update on the Integrated Global Water Cycle Observation CoP (IGWCO) (see slides for details), which is organized into four subgroups to support development of Earth observation data; demonstration of tools and applications; dissemination via capacity building; and deployment via regional CoPs. IGWCO is involved in a broad range of activities to produce comprehensive data, information products, and services to support decision-making for efficient management of the world’s water resources based on coordinated, sustained observations of the water cycle on multiple scales. IGWCO supports three GEO Tasks:

- Task WA-08-01 (Integrated Products for Water Resource Management and Research) to stimulate development of integrated new water cycle data products (e.g., soil moisture, precipitation, runoff, ground water, water quality).
- Task WA-06-02 (Droughts, Floods and Water Resource Management) to address decision-making challenges related to the management of hydrometeorological extremes (e.g., droughts, floods), and the sustainable use of water.
- Task WA-06-07 (Capacity Building for Water Resource Management) to foster worldwide dissemination and use of data products and decisions support systems.

IGWCO initiated or participated in many activities, workshops, and outcomes to advance the goals of the CoP during 2009-2010. These included studies conducted under the Asian Water Cycle Initiative to examine how better information leads to better decision-making; development of a dynamic website listing data sets, services, and project summaries with interactive capabilities; projects in India and Ghana under an IEEE “Water for World Program” to support sustainable communities; demonstration of GEO water quality tools in shared Canada/United States water basins; development of a report on data needs of water resource managers; and a recent survey of Data Centres to provide a basis for establishing data centre alliances.

Discussion

- Lawrence Friedl asked whether IGWCO had characterized members to see what user types were represented. R. Lawford responded that the research community was strongly
involved, and IGWCO was working to strengthen representation of the applications community. Increased dialogue with users will help IGWCO target for relevance. For example, end users at capacity-building sessions have made their needs clear, and a next step for IGWCO will be to involve them in coauthoring white papers.

- Lawrence Friedl asked representatives of other CoPs whether their members were largely data providers. Hans-Peter Plag responded that CZCP membership was strongly biased toward providers, but the Geohazards CoP was starting to involve international and national disaster agencies. Another participant responded that Air Quality CoP members were primarily researchers and academicians, but the CoP hoped to involve state agencies in the future. Lawrence Friedl noted that an issue for the UIC is how to support getting users engaged in CoPs.

- Rick Lawford observed that increased participation by users can change the character of the discussion and make it harder to organize a CoP. As users join, it will become important to protect the development component from being overwhelmed by the volume of users. He supported broadening CoPs to include more end users, but noted that boundaries may be needed. He suggested that the most productive approach to involving different types of users would be through specific projects that would allow scientists to work with different communities in a focused way.

- Gary Foley noted that global CoPs were more likely to be populated by scientists than regional CoPs, since end users tend to be interested in regional or local issues. This was an important lesson learned from the Lyme disease example mentioned earlier, in which a local CoP formed with many users because the disease was of local interest.

- Rick Lawford said that IGWCO organized an event at the World Water Forum, but did not have good turnout because of unfavorable logistics. Establishing a relationship with the sponsoring organization can be key to obtaining an event location and time that will enable broader participation.

- Virendra Sethi noted that people are needed to help identify who key users are and what products are important to them. Specific education or training courses might be important to develop professionals with these types of skills.

- Lawrence Friedl suggested that a CoP that spanned user types might help provide this type of bridge building and translation.

- Gary Foley said he has generally found it difficult to get U.S. scientists and researchers interested in turning their research into tools and applications for decision support.

- Hans-Peter Plag said he tried to reach out to non-government organizations involved in disaster emergency, but they responded that they are too busy to discuss needs.

**Why Observe the Arctic Ocean?—Keith Alverson, UNESCO Intergovernmental Oceanographic Commission**

Keith Alverson described the clear need for a sustained Arctic Ocean observing system (see slides for details). By providing services to user groups, the observing system will become central to efforts to adapt to climate change in the Arctic. A Global Ocean Observing System for climate is about 60 percent complete, but the Arctic continues to be a major gap.

Monitoring of the Arctic Ocean is increasingly important as the Arctic is now experiencing rapid environmental and social change due in large part to the effects of global climate change. Melting of Arctic ice opens opportunities for commercial exploitation and new shipping routes through the Arctic, while threatening species whose existence depends on the cryosphere. The potential environmental, social, and economic Impacts of these changes in the Arctic are
substantial. A sustained Arctic Ocean observing system is critical to protect one of the most pristine ecosystems on Earth and its many iconic species; manage economically important fish stocks; protect food security and indigenous peoples and their culture; and support carbon regulation and sustainable tourism. Potential users of such a system include conservation and natural resource managers; global climate scientists; shipping companies; indigenous peoples; industrial and economic developers; and the military. Observations are needed to monitor species numbers and distributions; ocean and food chain contaminants; commercial fish stocks and the impacts of commercial fishing; ocean acidity and carbon; and the status of protected areas.

Discussion

• Keith Alverson noted that at least half of current Arctic Ocean monitoring is performed by countries that do not border the region. Ongoing participation and investment by many different countries is important, as changes to the Arctic region have implications around the world. Hans-Peter Plag agreed and hoped that pressure could be created for an internationally coordinated observation network.

• Jesse Ausubel said that actions have been taken recently to designate protected areas in Arctic, and there is talk of trying to create a world-protected area around the North Pole. An observational system would have great value for monitoring a large protected area.

Chlorophyll Globally Integrated Network (ChloroGIN)—Shubha Sathyendranath, Partnership for Observation of the Global Oceans

Shubha Sathyendranath provided an overview of work to develop a Chlorophyll Globally Integrated Network (ChloroGIN). ChloroGIN, which addresses GEO Task EC-09-01c, was conceived of as a network of networks to promote in situ measurement of chlorophyll in combination with satellite-derived estimates and provide user communities with easy access to chlorophyll data and products worldwide. The overall goal is ecosystem-based management of marine resources, and activities are relevant to many GEO Societal Benefit Areas. ChloroGIN is conceived as a network of networks, with nodes in Africa, the Indian Ocean, northeast Asia, Latin America, Europe, and Canada. The project is particularly interested in involving developing countries to ensure global participation. The European Union project EAMNet and the marine component of EU project Devcocast are offshoots of ChloroGIN and are carried out in the context of ChloroGIN. The Canadian Space Agency supports an international secretariat for the combined activities of ChloroGIN and SAFARI (see below). For more information, see presentation slides and http://www.chlorogin.org/world/.

Societal Applications in Fisheries and Aquaculture Using Remotely Sensed Imagery (SAFARI)—Trevor Platt, Partnership for Observation of the Global Oceans

Trevor Platt provided an overview of the SAFARI initiative (part of GEO Task AG-06-02) to coordinate application of Earth observation data to achieve benefits for fisheries and aquaculture (see slides for details). The initiative, which involves researchers from over 15 countries, aims to reach people and organizations, including scientists, government policy and decision makers, and industry, who can apply remote-sensing data for effective management of fishery and aquaculture resources. Activities to expand SAFARI worldwide include international workshops and symposia to discuss relevant research; information sessions with fisheries industry, government officials, and resource managers; representation of SAFARI at policy
meetings, development and dissemination of publications; and networking and collaboration with other international networks, such as ChloroGIN (see above). SAFARI and ChloroGIN (see above) are supported by the Canadian Space Agency, and will be linked in the future under a single program, Fisheries Applications of Remotely Sensed Ocean Color (FARO) (http://www.faro-project.org/index.html).

Mapping and Monitoring Emissions from Deforestation and Degradation in Indonesia—Yukio Haruyama, Remote Sensing Technology Center (RESTEC), Japan

Yukio Haruyama provided an overview of a project, which has been accepted under GEO’s Call for Proposals (see presentation above), to utilize ALOS satellite data to support mapping and monitoring of emissions from deforestation and degradation in Indonesia. The project will establish a prototype system supporting decision makers in the Indonesian forestry sector and then train trainers so that Indonesian experts can then disseminate the system within the country via further training. RESTEC will also provide technical assistance for end users. See slides for details.

User Engagement Experiences in the Drought Research Initiative—Rick Lawford, University of Maryland, Baltimore, USA

Rick Lawford provided an overview of user engagement work under the Canadian Drought Research Initiative (DRI) (see slides for details). Through a series of workshops and tabletop exercises, the DRI engaged users in a dialogue about how they might use of DRI research results and data products in decision-making. Participants included resource managers and federal and provincial program managers in Canada who are responsible for delivering a range of services affected by drought. Results showed that:

- Readiness of governments to deal with drought and to assess how information is used in decision making has been improving, but more information, adaptation, policies, and programs are still needed to improve drought responses.
- Participants found uses for all types of data, but there is a clear need for scientifically robust indicators of drought specific to the region.
- Spatial resolution of most products needs to be enhanced for use at the farm gate level, but was suitable at the current resolution for policy applications.
- Relationships between observation and modeling results and impacts need to be further developed.
- Predictions were generally the products most desired by users, who wanted a high accuracy level (>70 percent) in these products.

Discussion

- Kathy Fontaine noted that policy and decision makers often think they need data to be 100 percent certain and asked how the DRI had dealt with this issue. Rick Lawford responded that it was important to engage in a dialogue with users to help them understand probability.
Global Mapping for GEOSS Societal Benefit Areas—Yoshikazu Fukushima, International Steering Committee on Global Mapping

Yoshikazu Fukushima described work under GEO Task US-09-03a to develop a Global Map for GEOSS SBAs (see slides for details). With input from National Mapping Organizations (NMOs), the map will provide full and consistent coverage of land on the Earth to a 1-kilometer resolution. The map will provide a wide variety of data, including land use, land use change, forestry, elevation, transportation, and population data. Applications include greenhouse gas inventories, policy formulation and planning, and flood analysis. The Global Map is also an educational tool that students can use to open dialogue and exchange views on geography, environmental issues, etc. As part of the map specifications drafting phase, the International Steering Committee on Global Mapping sent more than 1,500 emails to users and NMOs according to the advice of the project team and held an open forum for environmental and disaster management experts and NMOs to ask them what they need.

Supporting GEO: Building Multi-Disciplinary Interoperability for Science and Society—Jay Pearlman, IEEE

Jay Pearlman described initial results of a 2010 survey of GEO participants and information providers to assess how well EuroGEOSS is meeting user needs for integrated information (see slides for details). Providers responded that the two most important benefits of participating in GEOSS are increased visibility for research and increased information flow. The survey questions to users were designed to elicit information to help understand obstacles to and benefits of use, and to estimate the time data users spend searching, accessing, integrating, and elaborating the data in key areas of forest, drought, and biodiversity. Initial results showed that many of the 23 EuroGEOSS partners produce their own data, and all respondents have problems with use of spatial data. Almost two thirds use data from different disciplines. The main expected benefits were increased data access, greater interoperability, and improved data integration. Many respondents noted that participation and interaction with GEO observational data was low and that more outreach was needed to create awareness that GEOSS exists. User responses show that turning data into information dominates their time, which is something GEO should probably look into. Key user needs revealed from the initial survey results include the ability to cross domains; a need to have additional information on data elaboration, done by the data provider, in order to turn data into information; and a need to share analytical models. A key message to GEOSS is the need to reduce data search and access time.

Closing Remarks

Kathy Fontaine reviewed some of the key take-home messages about user engagement that had emerged during the meeting:

- As illustrated by many examples during this session, social network technologies are becoming increasingly important as a communication tool that GEO and the UIC need to better understand and exploit, both in terms of reaching users and potentially providing new, more virtual ways for CoPs to form and function.
- It is important to ask users repeatedly what they need and to manage their expectations.
- SERVIR, which combines an observational system with technology transfer and capacity building, may be a useful model in other arenas.
Creating a GEO Task may be a useful mechanism for GEO communities interested in developing observational systems.

Gary Foley suggested that the UIC consider preparing a handbook to capture and disseminate, within and beyond the GEO community, information about best practices for successful user engagement. He hoped the handbook would catalyze more user engagement and help Ministers and government agencies understand the value of their investment in GEO. He invited participants to attend future UIC meetings (currently scheduled for 25-28 January 2011 in Vienna, Austria, and 5-7 April 2011 in Sydney, Australia) and continue a dialogue about user engagement.

Ellsworth LeDrew said that the UIC has been considering holding a conference for CoPs and asked for feedback on this concept. Gary Foley responded that a Pretoria-type meeting focusing on GEO’s Work Plan would be valuable; a CoP meeting could also be valuable, but the meeting to bring together Integrated Global Observing Strategy (IGOS) themes and CoPs a year ago was not as successful as hoped. It will be important to hear from CoPs what would be useful to them in terms of plenary and breakout sessions. Kathy Fontaine suggested that the UIC take an action to query CoP leads about what would be useful and then develop a draft agenda based on their responses.

The UIC co-chairs thanked participants for their input and encouraged them to stay in touch about user engagement.
Attachment A
List of Participants

Keith Alverson, UNESCO
Jesse Ausubel, Marine Life
Ana Casals Carro, AEMET, Spain
Jean-Marc Chouinard, Canadian Space Agency
Jan Connery, ERG (USEPA Contractor)
Lizhier Coralde, Asia-Pacific Network for Global Change Research (APN)
Jens Danzeglocke, DLR (German Aerospace Center)
Jeff Dechka, Natural Resources Canada (NRCan)
Carsten Dettmann, Federal Ministry of Transport, Germany
Fernando Echavarría
Gary Foley, U.S. Environmental Protection Agency (USEPA)
Kathy Fontaine, NASA, USA
Lawrence Friedl, NASA, USA
Yoshikazu Fukushima, International Steering Committee for Global Mapping (ISCGM)
Ken Harkin, Sparx Systems
Yukio Haruyama, Remote Sensing Technology Center (RESTEC)
Leonard Hirsch, Smithsonian Institution, USA
Jörn Hoffmann, DLR (German Aerospace Center)
Yin Hong, Institute of Oceanology, Chinese Academy of Sciences
Manfred Kloppel, European Centre for Medium-Range Weather Forecasts
Elisabeth Koch, Zentral Anstalt für Meteorologie und. Geodynamik (ZAMG), Austria
Rick Lawford, University of Maryland, Baltimore, USA
Ellsworth LeDrew, University of Waterloo, Canada /IEEE
Russell Leferre, IEEE
Gao Li, Institute of Oceanology, Chinese Academy of Sciences
Lionel Menard, Mines, Paristech, France
Ratish Menon, Centre for Environmental Science & Engineering, Bombay, India
Carol Meyer, Federation of Earth Science Information Partners (ESIP), USA
Stuart Minchin, Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia
Takashi Moriyama, Japan Aerospace Exploration Agency (JAXA)
Ruth Neilan, Global Geodetic Observing System (GGOS) / International GPS Service for Geodynamics (IGS)
Greg Ondich, Scientific Consulting Group (USEPA Contractor)
Masami Onoda, GEO Secretariat
Tom O'Reilly, Sparx Systems
Jai-Sing Parihar, Indian Space Research Organisation (ISRO)
Francoise Pearlman, IEEE
Jay Pearlman, IEEE
George Percivall, Open Geospatial Consortium
Francesco Pignatelli, European Commission
Hans Peter Plag, University of Nevada at Reno, USA
Trevor Platt, Partnership for Observation of the Global Oceans (POGO)
Meghan Radtke, U.S. Environmental Protection Agency
Gabor Remetey, Global Spatial Data Infrastructure Association (GSDI)
Chris Rizos, International Association of Geodesy (IAG) / Global Geodetic Observing System (GGOS)
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