

The Science and Technology Roadmap

SUMMARY

Following the GEO-V Plenary (November 2008) the Science and Technology Committee (STC) took action to develop a Science and Technology (S&T) Roadmap. This Roadmap was finalized in early 2009 and subsequently approved by the STC. This Roadmap defines the set of activities the STC has decided to pursue to accomplish its objectives, as set forth in the GEO Rules of Procedure¹. An Annex to this Roadmap presents an indicative set of actions to be implemented along these activities.

The GEO Work Plan for 2009-11 included two new cross-cutting Tasks in the Science and Technology area, namely ST-09-01 and ST-09-02. These Tasks are the principal avenues for implementing the S&T Roadmap. Other activities are either pursued through other GEO Tasks or directly through STC actions. The STC regularly reviews the status of the Roadmap implementation and progress in the S&T Tasks.

Because of its strategic relevance for structuring the activities of the STC as well as interactions between GEO and the S&T communities, the STC wishes to support its oral report given to GEO-VI by presenting the S&T Roadmap document.

1 INTRODUCTION

This roadmap identifies and motivates the path that the Science and Technology Committee (STC) of the Group on Earth Observation (GEO) has decided to pursue to achieve its objectives.

It primarily addresses the Committees of GEO, its Task Teams, working groups and Communities of Practise. It also addresses the Science and Technology (S&T) communities within the scope of the Societal Benefit Areas of the Global Earth Observation System of Systems (GEOSS) and the S&T communities needed to build, deploy, access and sustain the GEOSS.

The STC invites GEO Members and Participating Organizations to take note on its approach. Many activities will benefit from – or even depend on – active participation of the GEO Committees and other communities. For the community at large this document may be useful as a concise explanation of the direction the STC is taking to fulfil its mandate.

2 WHERE WE WANT TO GO

The vision for GEOSS is to realize a future wherein decisions and actions for the benefit of humankind are informed by coordinated, comprehensive and sustained Earth observations and information, based upon sound scientific and technical advice. Through GEOSS, GEO aims at enabling societal benefits of Earth observations, including advances in scientific understanding in the nine Societal Benefit Areas (SBA).

3 WHAT WE NEED IN ORDER TO GET THERE

To realize this vision GEO must integrate advances in science and technology through appropriate consultation with the research and observation communities. It must support research efforts that are necessary for the development of tools required. It must promote research and development in key

¹ GEO Rules and Procedures, Appendix 3 to Annex B

areas of Earth sciences to facilitate improvements to Earth observation systems. And it must encourage and facilitate the transition of systems and techniques from research to operations.

Individual scientists and their institutions, both public and private, from relevant fields must be convinced to invest their time and efforts to advise on the content of the GEO Work Plan and work on its implementation. The S&T communities must be involved at all stages of the system design, data analysis, validation and documentation to meet scientific and technological standards in GEOSS components, data, and services. Engaging these S&T communities is the goal of the STC.

4 WHERE WE ARE

The STC has been set up to ensure that GEO has access to scientific and technological advice. Its objectives support the 2015 strategic target of ensuring “full interaction and engagement of relevant science and technology communities such that GEOSS advances through integration of innovations in Earth observation science and technology, enabling the research community to fully benefit from GEOSS accomplishments.” These high-level objectives of the STC are:

- Enable GEO to make decisions on best available and sound scientific and technological advice, through the solicitation of input from a broad, trans-disciplinary scientific and technological community;
- Ensure scientific and technological integrity and soundness of GEO Work Plans.

From its inception, GEO has benefited from ideas and advice of scientists and engineers. These S&T communities have arguably been the most active in developing the common vision for GEOSS and in contributing to its initial development.

Not all GEO Member countries have arranged for effective ways to integrate their national Earth observation and related scientific activities with GEO. Furthermore, many contributions from scientists are to a large extent made at best-effort within the scope of their funded research projects. Without dedicated resources, including funding, available for activities directed specifically towards GEO or GEOSS, it is difficult for scientists to respond to GEOSS needs. Additional incentives and fresh approaches are therefore needed to strengthen and expand their engagement at the level required for GEOSS.

5 THE WAY FORWARD

This roadmap presents a set of activities grouped under two headings, which can be mapped to the objectives.

5.1 Actively engaging and incorporating science and technology participants in the development of GEOSS

- **Revolving scientific review of each Work Plan**, starting with the current work plan for 2009-2011 on grounds of scientific and technological soundness and completeness against the outstanding questions and challenges in each of the SBAs;
- **Implement review indicators in the M&E Framework** to ensure that activities in individual GEO Tasks and Sub-Tasks meet the applicable scientific and technological standards;
- **Assess the requirement for continuity and long-term monitoring** by Earth observation systems of essential data from GEOSS components;
- **Ensuring state-of-the-art technology in the GEOSS Common Infrastructure (GCI) and Observation Infrastructures**;
- **Responding to S&T needs and priorities** in Earth observation for GEOSS.

5.2 Creating incentives and promoting GEO in the S&T communities

- **Getting GEO/GEOSS better acknowledged** in the scientific community.
- **Establishing a “GEO label”** to recognise the scientific relevance, quality, acceptance and societal needs for activities in support of GEOSS;
- **Building awareness of GEO and GEOSS** in the different S&T communities, within the scope of the GEOSS development;
- **Showing GEOSS at work** with a set of compelling examples showing how GEOSS serves the S&T communities in their work;
- **Enhancing registration of scientific data sets** as an important indicator for potential contributors from the science communities in assessing the relevance of GEOSS for their work;
- **Identify key commercial partners**, which could contribute to GEOSS and also benefit from improved observational means, products and services and might therefore support certain S&T development;
- **Catalyze research and developing funding** to help engaging the S&T communities in the implementation of the GEOSS.

ANNEX 1
ACTING ON THE S&T ROADMAP

1 ACTIVELY ENGAGING AND INCORPORATING SCIENCE AND TECHNOLOGY PARTICIPANTS IN THE DEVELOPMENT OF GEOSS

Activity 1a: Work Plan Review

A revolving scientific review of each Work Plan, starting with the current work plan for 2009-2011 will be conducted. The outcome of this review will be an assessment report of the Work Plan against the outstanding questions and challenges in each of the GEO Societal Benefit Areas (SBA). This assessment may recommend changes to objectives and scope of existing Tasks or propose new Tasks to respond to any identified deficits or overlaps. The recommendations may also identify opportunities for cooperation between Tasks, suggest inclusion of specific activities from outside GEOSS, or motivate the definition of new ones. The scope of the Work Plan Review also includes reviewing the completeness of the nine SBAs. To be effective, the Work Plan review will need to involve scientists and institutions of significant standing in the community and retain sufficient independence from the authors of the Work Plan. A team of experts – one from each of the nine SBAs – should coordinate this review. Experts who were involved in compiling the Theme Reports of the Intergrated Global Observing Strategy-Partnership (IGOS-P) may be an asset to such a team. The first assessment report should be completed in time for the GEO Ministerial Summit in 2010. The STC will advise on the review effort and seek ways to support the work with dedicated funding from science foundations of member countries.

Initiate Review Process for GEO Work Plan 2009-11 <ul style="list-style-type: none"> • Identify Responsible team of experts • Identify main challenges/open questions within the SBAs that should be addressed by the S&T component of GEOSS • Conduct review 	STC [new task]	Starts mid-2009; Assessment report for Work Plan 2009-11 by Ministerial 2010
Seek ways to raise dedicated funding from science foundations of member countries for review work	ST-09-01	Starts immediately
Initiate Review Processes for future GEO Work Plan(s)	STC	Starts 2011

Activity 1b: Implement task review indicators in the Monitoring and Evaluation (M&E) Framework

Activities in individual GEO Tasks and Sub-Tasks must be reviewed against applicable scientific and technical standards. In science this is commonly done through peer review of publications, which in many cases are already produced by the tasks contributors. GEOSS component systems or services contributed by institutions operating them have typically undergone a review procedure. Transparent indicators of the review that task outputs have undergone will help to build trust in GEOSS while building on activities already conducted at the task and component level. Additionally, user-feedback based indicators are valuable instruments to help users gauge the quality and applicability of individual services or data sets and finding the most applicable one for their need. The STC will work with the GEO Secretariat to integrate into the Task Sheets an element that allows an easy assessment of the level of peer review or other review procedures that various task activities have been subjected

to. The GEO Secretariat will be asked to include a high-level status indicator for each task in their work plan progress reports. Community-based simple ratings and indicators, similar to those available on commercial vendor sites for customer rating of, for example, products, sellers, or hotels, should be included in the GEO Portal(s) as an efficient way of helping users evaluating the quality and applicability of registered GEOSS Components and Services.

Propose review-level indicator element for Task Sheets <ul style="list-style-type: none"> Request Task-Leads to suggest appropriate review-indicators for their Task and review those 	STC [new task]	End of 2009
Monitor review-level indicators in the context of the overall M&E Framework, approach Task leads in case of low of review activities, alert STC in case of problem	GEOSEC	Starts 2010; continuous
Implement a Component User Feedback Mechanism using ratings and indicators into the GEO Portal(s)	ADC with UIC/STC	By 2010

ADC: GEO Architecture and Data Committee; UIC: GEO User Interface Committee

Activity 1c: Assess the requirement for continuity and long-term monitoring

Earth System Sciences often require long-term monitoring by Earth observation systems. The continued availability of essential data from GEOSS components is fundamentally important for the scientific relevance of GEOSS. This activity therefore aims at establishing

- a process that alerts to imminent discontinuations of systems or datasets, and
- a framework to help find appropriate responses.

By this activity, GEO will play a role in evaluating the relevance of specific observation infrastructure or systems in a broad context and ensuring the continued availability of essential data.

Scientific systems, in particular, are frequently not developed with long-term funding perspectives. Many scientific GEOSS components are therefore likely to be discontinued at some time, unless they are taken up in operational programs. In order to offer support to those scientific systems and services that warrant continuation for GEOSS, GEO needs a way to evaluate the broader relevance of components and ways and means to support those essential components.

Develop a continuity indicator for all registered GEOSS components <ul style="list-style-type: none"> Set up data base of epochs of scheduled discontinuations of systems/data set provisions Develop automated test of availability of Components at GCI-level Propose appropriate reporting and options for reactions 	ADC with UIC/STC	End of 2009
Propose process to evaluate the relevance/criticality of components for GEO	UIC with STC	End of 2010
Set up framework for coordinating activities towards ensuring continued operations of essential components	Task ST-09-01	By 2015

Activity 1d: Ensuring state-of-the-art technology in the GEOSS Common Infrastructure (GCI) and Observation Infrastructures

The technology used for building the GCI must be assessed and upgraded regularly to remain an attractive and accepted by the user communities. Also, the observation infrastructures – the systems of GEOSS – must continue to be improved and developed.

Review the technology supporting the GCI	ADC with STC	2010, repeated regularly
Review the continued quality and relevance of individual component systems of GEOSS	M&E or new ST-task	End of 2010

Activity 1e: Responding to S&T needs and priorities

In order to address identified deficits and gaps efficiently, an attractive platform must be established for broadly agreeing on priorities. GEO should set up a process for coordinating scientific priorities in Earth observation and report them in a way that stimulates appropriate responses from GEO Members and Participating Organizations.

Propose a process for communicating scientific priorities in Earth Observation in a way that effects appropriate responses from GEO Members and Participating Organizations	Task ST-09-01	2009
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2 CREATING INCENTIVES AND PROMOTING GEO IN THE S&T COMMUNITIES

Activity 2a: Getting GEO/GEOSS better acknowledged

Recognition and renown are important currencies in the scientific community. In order to increase the attractiveness of GEO and GEOSS for scientists, their contributions must be acknowledged visibly when others use it to their benefit. The STC will work to propose a GEOSS citation standard by the end of 2009 and continue to promote its use in the science community.

Propose a GEOSS citation standard	ST-09-02	End of 2009
Continue to promote the use of the citation standard in S&T community	ST-09-02	Starts 2010; continuous

Activity 2b: Establishing a “GEO label”

Activities supporting an assessment of the scientific relevance, quality, acceptance and societal needs for activities in support of GEOSS can be developed further to establish the GEO-indicators as citable reference in other contexts, e.g. supporting funding proposals.

Propose a draft “GEO label” concept	ST-09-02	End of 2009
Discuss potential of developing the “GEO label” as an attractive incentive for involvement of the S&T communities and initiate the relevant activities	STC	2010

Activity 2c: Interface with S&T communities

Sustained effort is needed to explain and demonstrate the connection of science to GEOSS in different topic areas. As a means to build awareness of GEO and GEOSS in different S&T communities, specific sessions should be convened at major scientific conferences to highlight the relationship by examples. These conferences could include academic as well as relevant private industry meetings.

Coordinate the organization of specific GEOSS sessions at relevant scientific conferences <ul style="list-style-type: none"> • Compile and maintain a list of relevant conferences • Actively engage individuals to prepare GEOSS-related sessions 	ST-09-02	Starts 2009; continuous
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Activity 2d: Showing GEOSS at work

The effort to broaden the involvement of the S&T communities can be supported by a set of compelling examples showing how GEOSS serves the S&T communities in their work. These examples should be derived from the GEO Tasks in the Work Plan and be documented and publicized on the GEO webpage, the GEO portals, in reports and at conferences (Activity 2c). This activity strongly feeds into the preparations for the Ministerial in 2010.

Compile set of examples from the GEO Tasks and ensure that these are documented effectively	ST-09-02	End of 2009
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Activity 2e: Enhancing registration of scientific data sets.

An important indicator for potential contributors from the science communities in assessing the relevance of GEOSS for their work is the availability of core data sets, which are often produced by science organizations. This could initially focus on broadly applicable basic data sets, e.g. global digital elevation models (DEM), bathymetry maps, coarse land-cover maps (including inland water bodies). Once feedback is available from the user community or the review activities, these should increasingly drive the priorities. To the extent possible it must be ensured that such data sets are included in the GEOSS registries. Accomplishing this will dramatically increase the acceptance of GEOSS as a resource for accessing scientific data in the S&T communities.

Compile a list of data sets and where they exist.	ST-09-02	Mid-2010
Actively approach their owners to solicit their registration with GEOSS.	ST-09-02	2010

Activity 2f: Identify key commercial partners.

Many commercial companies are using publically available capabilities, knowledge and observations. These companies could benefit from improved observational means, products and services and might therefore be interested in funding certain S&T development in this context. Moreover, such companies may produce datasets relevant to GEOSS users, and should be encouraged to make them available when possible.

Compile a list of key companies with substantial commercial interests or datasets of broad scientific value and make it available to the GEO community	ST-09-01	End 2009
Pursue opportunities of making company resources available for developing the GEOSS S&T content	ST-09-01	2011

Activity 2g: Catalyze research and developing resources.

The lack of dedicated resources to support specific S&T activities in support of GEOSS is one of the most important obstacles to engaging the S&T communities in its implementation. This problem can be addressed by establishing explicit linkages between research and development programmes having

resources provided by GEO Members and Participating Organizations and GEOSS. In appropriate funding programs, these links may take the form of requiring explanations of how projects to be funded will interface with GEOSS and ensuring that demonstrating significant relevance for GEOSS is viewed as an asset of these proposals, requiring registration of Earth observing systems developed in these projects, or stipulating that data and products must adhere to the GEOSS Data Sharing Principles. Important science organizations in this respect include the American Association for the Advancement of Science (AAAS), the European Space Agency (ESA), the United States National Aeronautics and space Administration (NASA), national research funding organizations and science programmes.

Identify relevant organizations and points of contact	ST-09-01	Mid 2009
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