Sound, rational management of the planet, in both its natural and human aspects, requires continuous and coordinated observation of the Earth system at all scales. In recent years, political consensus has developed around this well-established scientific idea, and a new programmatic approach has emerged, considering the Earth as an integrated system facing major common challenges. This marks an intentional departure from earlier observation strategies organized to examine individual components of the Earth’s system.

Recognizing this, world leaders first highlighted the urgent need for coordinated Earth observations at the 2002 World Summit on Sustainable Development in Johannesburg. The following year, government ministers gave formal expression to the idea at the First Earth Observation Summit in the Washington Declaration, which officially stated this need:

“To monitor continuously the state of the Earth, to increase understanding of dynamic Earth processes, to enhance prediction of the Earth system, and to further implement our international environmental treaty obligations . . . [we] recognize the need to support improved coordination of strategies and systems for observations of the Earth . . .”

**Building a Global Earth Observation System of Systems**

Moving from principles to action, ministers met again for a Second Earth Observation Summit in Tokyo in 2004 to define a framework for building a Global Earth Observation System of Systems, or GEOSS. Less than one year later, the Third Earth Observation Summit was held in Brussels to endorse the GEOSS 10-Year Implementation Plan and to formally establish the intergovernmental Group on Earth Observations (GEO) to carry it out. GEO currently includes 64 member countries, the European Commission, and 43 participating organizations. The GEO Secretariat is located in Geneva.

Vaisala News readers were introduced early to the concept of GEOSS, first reported in these pages in January 2005. Experts in Earth observations, particularly in the domain of weather, will immediately ask how GEOSS will interact with and enhance the legions of existing Earth observation systems (e.g. for meteorology, hydrology, seismology, ocean dynamics, etc.). Indeed, many international organizations and programs have been working for some time to sustain and improve the coordination of Earth observations. The 10-Year Plan provides the answer: “GEOSS will be a ‘system of systems’ consisting of existing and future systems, supplementing but not supplanting their own mandates . . . the contributing systems will range across the processing cycle, from primary observation to information production. Through GEOSS, they will share observations and products with the system as a whole, and will take the necessary steps to ensure that the shared observations and products are accessible, comparable, and understandable, by supporting common standards and adaptation to users’ needs.”

**Identifying observational gaps**

However, many existing efforts have been plagued by eroding technical infrastructure, large spatial and temporal gaps in specific data sets, inadequate interoperability, a lack of access to data, particularly in the developing world, and a host of other challenges. GEOSS will provide mechanisms for identifying observational gaps and mobilizing the resources needed to fill them. As an intergovern-
mental forum for dialogue among system operators, scientists and engineers, and end users of Earth observation information across national and international agencies, GEO can build consensus around funding major Earth observation priorities and strengthening important networks, in particular by closing unacceptable gaps in the developing world.

In the 1970s and 1980s, the term “Earth observation” was adopted by space programs and defined narrowly to describe observations made via remote sensing from space. Today, within GEO and GEOSS, Earth observation refers more correctly to all data gathered from in-situ, airborne, and space-based instruments, as effective observation requires the integration of data from all platforms. Moreover, the term includes processing, modeling, and dissemination of data about the Earth system.

**Improving in-situ observations**

As a matter of priority, GEOSS expressly intends to address the need for improving in-situ observation networks and facilitating their integration with other observation systems. This is reflected throughout the 10-Year Plan and in GEO's annual workplans. For example, the 10-Year Plan makes a strong commitment to improving in-situ hydrological observations, as well as ecosystem and biodiversity observations:

“In-situ networks and the automation of data collection will be consolidated, and the capacity to collect and use hydrological observations will be built where it is lacking . . . Ecosystem observations will be better harmonized and shared and in-situ data will be better integrated with space-based observations . . . Implementing GEOSS will unify many disparate biodiversity-observing systems . . . taxonomic and spatial gaps will be filled, and the pace of information collection and dissemination will be increased.”

**Defining clear social objectives**

These examples demonstrate another innovative dimension of GEOSS, namely to address observation requirements through the lens of the end user in nine “societal benefit areas.” GEO’s programmatic efforts are structured to coordinate observing systems in the context of social objectives, such as “understanding environmental factors affecting human health and well-being” and “reducing loss of life and property from natural and human-induced disasters.” In the case of the latter, GEO has already begun to provide a global point of coordination for applying Earth science to disaster early warning and mitigation, alert, response, and recovery.

GEO's transverse programmatic structure has given rise to innovative cross-disciplinary projects that examine, for example, the effects of biodiversity loss on human health. GEO also fosters efforts to expand the use of leading-edge scientific techniques into new domains, such as exploiting ensemble-based techniques originally developed for weather and climate forecasting for improved management of energy resources.

**Creating cross-disciplinary tools**

Creating common, cross-disciplinary tools is also a significant aspect of GEOSS. In 2006, GEO is pursuing a demonstration project for its flagship effort, GEONET-Cast. Building on existing networks, this project will create a dissemination system by which environmental satellite and in-situ data, products, and services from GEOSS are transmitted to users through a global network of communications satellites, using a multicast, access-controlled, broadband capability. GEO is also examining how GEONET-Cast could evolve into a data collection system in later phases.

The backbone of all these efforts involves a reinforced commitment by GEO Members to the principle of data sharing, where component systems will engage in “full and open exchange of data, metadata, and products shared within GEOSS . . . made available with minimum time delay and at minimum cost.” This commitment, while tempered by a caveat recognizing existing national and international data policies and legislation, demonstrates renewed appreciation for the importance of data sharing. Even within the constraints of existing data policies, GEO will make significant strides in this domain by advancing technical interoperability among the component systems of GEOSS.

Ultimately, the GEO vision for GEOSS is “to realize a future wherein decisions and actions for the benefit of humankind are informed via coordinated, comprehensive and sustained Earth observations and information.” Fully realized, this eloquent vision will translate into an ever-improving network of Earth observation systems yielding better models, better maps, better forecasts, and better information tools for decision makers.

Further information: www.earthobservations.org