

## Background

World Bank Vice President, I. Serageldin, recently observed “Many of the wars of the 20th century were about oil, but wars of the 21st century will be over water.” In reference to the growing global and regional water issues. In 2001, the International Conference on Freshwater in Bonn identified “managing risks to cope with variability and climate change” as one of its primary actions in dealing with governance issues. Recent climate-related water catastrophes, such as floods in in Pakistan, Australia, Brazil and South Africa, serve to remind us that the most significant and harmful impacts of climate change will be experienced through alterations in the water cycle. Climate change adds another formidable challenge, especially in water which is essential in the natural climate system and the human society. Although the impacts are currently far from certain, they are unlikely to be favorable.

## Concept Design

Water is key which makes a bridge between the climate processes in atmosphere, oceans, cryosphere, terrestrial carbon cycle, ecosystems and sea level rise, and the socio benefit areas including agriculture and forestry, health, energy, human settlement and infrastructure and the economy.

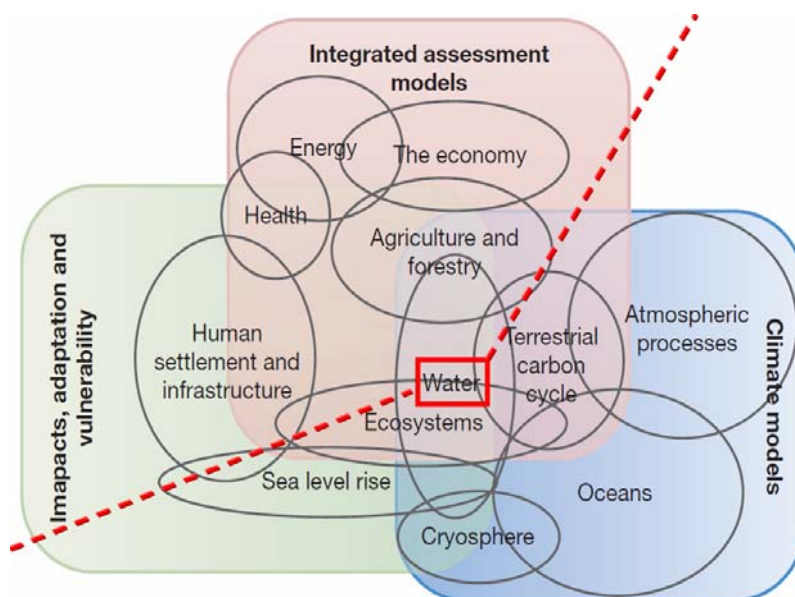


Figure 1. Model Integration for Assessment, Richard H. Moss, et al., Nature, 2010, modified by Author.

The global water cycle, which includes the transport and distribution of large amounts of water associated with its constant phase changes among solid, liquid and gaseous states, is a critical

component of the Earth’s climate system. Due to the effects of the atmospheric and ocean circulations and the variations of water stored as snow and soil moisture, local and regional water cycle variations are correlated across areas and seasons.

People have been developing water cycle management systems considering the water cycle variability as a stationary process. But now, under the current conditions this concept has been shown to be misleading resulting in a need for radical change in approach to develop a clear consensus on how best to utilize model projections of climate and hydrology in conducting frequency analysis of future hydrological hazards. Hydrological regime shifts and changes in extreme events, including floods and droughts, are now fundamental threats to human beings all over the world.

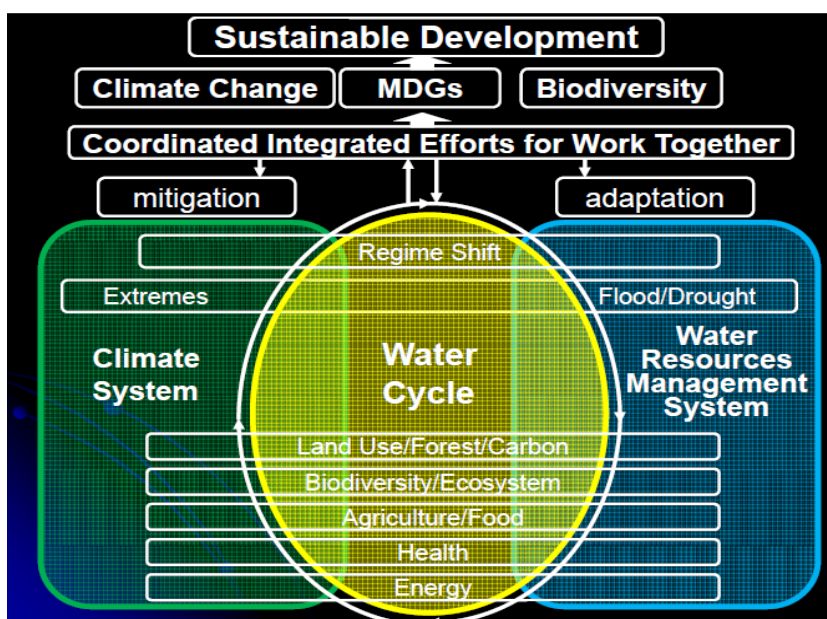


Figure 2 Concept Design

Increased water cycle variability impacts primarily through water, biological processes and human dimensions with implications for land use and societal development. It is critically important to recognize the fundamental linkages among water; land use, including deforestation; carbon cycle and ecosystem services; and food-, energy- and health- securities. By sharing coordinated, comprehensive and sustained water cycle and related Earth observations and information for sound decision making, GEOSS could lead in developing effective interdisciplinary collaborations for working together based on coordinated and integrated efforts and subsequently to both mitigation and adaptation benefits. Building resilience to the climate change and variability is essential for establishment toward the final goal, the sustainable development of Earth’s societies and ecosystems.

### Implementation Design

To accelerate the coordinated and integrated efforts, we need to develop “GEOSS *Water Cycle Integrator (WCI)*”, which develops a holistic coordination capability of the following function

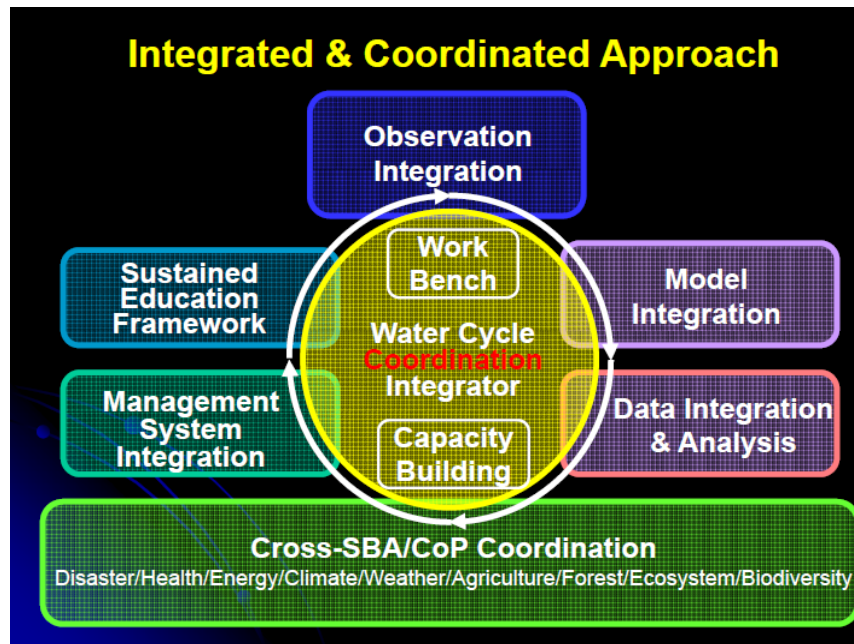


Figure 3 Implementation Design.

in cooperation with various partners:

- observation integration
- science and model integration
- data integration & analysis
- cross-Socio Benefit Areas and Community of Practices
- management system integration
- sustained education framework

GEOSS/WCI will set up “work benches” where partners can share data, information and applications in an interoperability way, exchange knowledge and experiences, deepen mutual understanding and work together effectively. (A work bench is a virtual geographical or phenomenological space where experts and managers work together to use information to address a problem within that space). GEOSS/WCI enhances the coordination of efforts to strengthen individual, institutional and infrastructure capacities, especially for effective interdisciplinary coordination and integration

#### **CEOS’s Key Roles in GEOSS/WCI**

In order to implement GEOSS/WCI CEOS would be expected to lead “satellite observation integration” and “data integration” for GEOSS/WCI. These elements are essential components for the technical and architectural elements of WCI.

To quantify the impacts and vulnerabilities and develop and assess adaptation options, it is important to combine climate projections with integrated assessment models by utilizing comprehensive data of the climate, water cycle and resources for each societal benefit area observed by satellites. This effort would address the need for a Bridge between the current CEOS constellation projects and promote the development of a new observational and analysis integration



Figure 4 Coordinated Observation and data integration.

capability.

This effort will build on the mutual cooperation between CEOS/WGISS and WCRP/GEWEX, which successfully implemented the Coordinated Enhanced Observing Period (CEOP) and its integration capability for in-situ and satellite observation data and numerical model outputs. The CEOS Water Portal is now developing a wider and deeper data integration capability under GCI framework. A GEOSS/WCI data integration function will be developed by accelerating the effort and incorporating developments and expertise of other systems including those in NASA, ESA and other CEOS members. Other efforts will be needed to build the networks and to involve the experts and managers who will test and utilize this system.

GEO has established GEOSS Asian Water Cycle Initiative (AWCI) and GEOSS African Water Cycle Coordination Initiative (AWCCI). In Latin America, the GEOSS water capacity building programs are now on going. Through regional, inter-disciplinary and inter-agency coordination, and integrated efforts, GEOSS/WCI will lead to effective actions and public awareness toward water security and sustainable development.