Creating Integrated Scientific Knowledge for Disaster Risk Reduction, Climate Change Adaptation and Sustainable Development

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Our actions for development, meeting human needs such as food, water, energy and health, together with rapid increase in population have brought about societal problems such as improper land use changes, disorderly urbanization, and unstable governance. Development has also resulted in unwanted global-scale environmental issues such as climate change, desertification, deforestation and loss of biodiversity. All of these are obstacles for each state to achieving truly needed development goals, and even have become causes of devastating damage when coupled with intensifying hazards.

Under such serious circumstances, important global decisions were made and came to fruit in 2015, the Sendai Framework for Disaster Risk Reduction in March, the Sustainable Development Goals in September and the Paris Agreement on Climate Change in December. To clearly recognize and improve the connection among disaster resilience, sustainable development and climate change and build resilient and sustainable societies, it is critically important to create holistic knowledge which is applicable to cross-disciplinary issues. We need to establish interdisciplinary and transdisciplinary cooperative frameworks so that scientific and technological knowledge can transcend disciplines and be realized by society.

The IPCC AR5 modeling strategy addresses climate change with a collaboration between the climate models, integrated assessment models including energy, economy, agriculture, health, and the models of adaptation, vulnerability, and human settlement and infrastructure. These models identify water as central to these systems. If a water expert can develop an interrelated system including each component, the integrated crisis can be addressed by collaboration with various disciplines. To realize this purpose, we are developing a water-related data- and model-integration system called a water cycle integrator (WCI).

Various satellite data were archived to provide various hydrological information such as cloud, rainfall, soil moisture, or land-surface snow. These satellite products were validated using land observation in-situ data. Water cycle models can be developed by coupling in-situ and satellite data. River flows and other hydrological parameters can be simulated and validated by in-situ data. Model outputs from weather-prediction, seasonal-prediction, and climate-prediction models are archived. Some of these model outputs are archived on an online basis, but other models, e.g., climate-prediction models are archived on an offline basis. After models are evaluated and biases corrected, the outputs can be used as inputs into the hydrological models for predicting the hydrological parameters. Additionally, we have already developed a data-assimilation system by combining satellite data and the models. This system can improve our capability to predict hydrological phenomena. The WCI can provide better predictions of the hydrological parameters for integrated water resources management and climate change impact assessment.

We need to collaborate with other disciplines to make maximum use of hydrological information in other socioeconomic areas, including urban engineering, agriculture, and biodiversity. With the cross-disciplinary exchange of data and models, usable information for environmental conservation and agricultural support can be provided by the WCI.

In November 2005, we developed the Global Earth Observation System of Systems

(GEOSS) Asian Water Cycle Initiative (AWCI) under this framework to promote integrated water resource management by making available usable information from GEOSS. Each member country identified a river basin in their country as a WCI demonstration basin for promoting transdisciplinary cooperation. Based on these experiences in Asia, we are now working with African countries. We have agreed to a basic idea for implementation. Then, the first GEOSS Africa & Asia Joint Water Cycle Symposium was held in Tokyo at the end of November, 2013.

We should accelerate such interdisciplinary and transdisciplinary cooperation to achieve holistic solutions for seeking sustainable development, climate change mitigation and adaptation, and disaster risk reduction. The WCI is a supporting tool for guiding people to build resilient and sustainable societies.

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