Summary report on
The 8th International Coordination Group (ICG) Meeting and the 1st Climate Change Assessment and Adaptation Study (CCAA) Workshop of the GEOSS Asian Water Cycle Initiative (AWCI)
held
at the COEX Center, Seoul, Republic of Korea, 6 – 8 October 2011.

The **Eighth GEOSS AWCI ICG meeting** was planned and undertaken (i) to review the status of the GEOSS/AWCI first phase activities, in particular development of the river basin database at DIAS and demonstration project outcomes, (ii) and to initiate the process of planning the next phase of AWCI that aims at further integration and coordination under the Water Cycle Integrator (WCI) framework (introduced below in Attachment 1). The **First CCAA Workshop** was undertaken as an inherent part of the ICG Meeting and reviewed the first outcomes of AWCI CCAA study that was kicked off at the dedicated Training Course held in Tokyo, Japan, March 2011.

More than 50 participants from 17 countries assembled during the meeting and discussed the topics included on the meeting agenda. The result of those discussions is summarized in this report. All of the presentation material provided by the participants at the meeting is available on the Internet through the meeting home page at:
http://monsoon.t.u-tokyo.ac.jp/AWCI/meetings/Seoul_Oct2011/presentations_files.htm

The event was hosted by the Sejong University at the COEX facilities in Seoul and co-organized and co-sponsored by the University of Tokyo, APN and JAXA.

1. Executive Summary of Main Issues/Conclusions and Actions

The meeting reviewed the progress in the AWCI activities, namely the working group updates, country demonstration projects, climate change assessment and adaptation studies, and capacity building program. New developments in modeling, weather prediction, satellite observation as well as advanced infrastructure technologies for climate change were also introduced. It was concluded that the development of the demonstration river basin database at DIAS had been almost finalized and the results of the demonstration projects indicated that the commitments of the first phase of AWCI had been completed.

With the new developments in modeling, prediction and assessment techniques, new satellite observation missions coming in the near future, more opportunities provided by more mature capacity development program and new higher education capabilities, and also with the knowledge gained through the AWCI first phase research activities, the AWCI community felt ready for stepping into the next phase, that would target further integration and coordination as envisioned in the Water Cycle Integrator (WCI) document (Attachment 1). The participants agreed to initiate implementation planning for the new phase. Through intensive discussions during two breakout group sessions and a following plenary summary session, a template for country inputs to the draft implementation plan of the next phase of AWCI was developed and approved by the participants. The template included a rough schedule of the planning process and is available in Attachment 2.

All the AWCI countries were represented at the event and took commitment to continue their involvement in the AWCI framework and to actively contribute to the next phase plans.

The next event related to the AWCI would be the 5th GEOSS AP Symposium, held in Tokyo, Japan, 2 – 4 April 2012.

Meeting Agenda

Thursday 6 October

09:00 – 09:30 Registration

09:30 – 10:00 1. Opening Session, Welcome Remarks, Photo
09:30 – 09:40 Deghyo Bae (Sejong University)
09:40 – 09:50 Jae Heyon Park (Water Resources division, Ministry of Land, Transport and Maritime Affairs)
09:50 – 10:00 Photo session

10:00 – 12:00 2. AWCI Working Group Activity Review Session
10:00 – 10:20 General review of the AWCI status: *Toshio Koike*

10:20 – 10:40 BREAK

10:40 – 10:55 Flood WG report: *Kazuhiko Fukami and Srikantha Herath*
10:55 – 11:10 Drought WG report: *Ichirow Kaihotsu and Ghulam Rasul*
11:10 – 11:25 Water Quality WG report: *Bilqis Hoque*
11:25 – 11:40 Climate Change WG report: *Deghyo Bae and Mafizur Rahman*
11:40 – 12:00 Capacity Building report: *Srikantha Herath*

12:00 – 13:00 Lunch

13:00 – 17:00 3. Country Activity Review and Possible Contributions to the AWCI Next Stage Session
In this session, country and expert reports will be presented. The country reports should cover two main items: (i) Report on current country activities related to AWCI, which includes demonstration projects, Climate Change Assessment and Adaptation (CCAA) study and other activities, and (ii) Ideas and views of possible country involvement in and contribution to the next stage of AWCI that is envisioned in line with the GEOSS Water Cycle Integrator (WCI). Introduction of the WCI mission and concept as well as instructions for presentation preparation have been provided to the presenters in advance. **One report per country** is expected, presented by either the ICG country representative or CCAA leader.
The expert reports include presentations on research and technical achievements related to the AWCI activities that are not included in the country reports.

13:00 – 15:30 First part (10 country reports)

13:00 – 13:15 Vietnam: *Tinh Dang Ngoc*
13:15 – 13:30 Thailand: *Thada Sukhapunnaphan*
13:30 – 13:45 Sri Lanka: *S.B. Weerakoon*
13:45 – 14:00 Philippines: *Rosalina de Guzman*
14:00 – 14:15 Nepal: *Shiv Kumar Sharma*
14:15 – 14:30 Myanmar: *Tin Yi*
14:30 – 14:45 Mongolia: *Gombo Davaa*

14:45 – 15:00 Malaysia: Mohd *Zaki Mat Amin*
15:00 – 15:15 Laos: *Singthong Pathommady*
15:15 – 15:30 Korea: *Deg-Hyo Bae*

15:30 – 16:00 BREAK

16:00 – 18:00 Second part (4 country reports and 3 expert presentations)

16:00 – 16:15 India: *Rakesh Kumar*
16:15 – 16:30 Cambodia: *Long Saravuth*
16:30 – 16:45 Bhutan: *Karma Chhophel*
16:45 – 17:00 Bangladesh: *Ashfakul Islam*
17:00 – 17:15 Water Quality Challenges in Bangladesh: *Bilqis Hoque*
17:15 – 17:30 Community Based Management of Agricultural Resources at Watershed Level for Sustainable Livelihoods: *Thaworn Onpraphai*
17:30 – 17:45 Climate Change Assessment and Adaptation: *Cho Thanda Nyunt*
17:45 – 18:00 Discussion

18:00 Adjourn
18:30 Reception

Friday 7 October

09:00 – 10:30 3. Country Activity Review and Possible Contributions to the AWCI Next Stage Session – continue: Third part (6 expert presentations)
Presentation time 15 min, i.e. 13 min presentation and 2 min discussion; i.e. four contributions in an hour

09:00 – 09:15 Thailand 2011 Experiences on Flood Monitoring: *Hansa Vathananukij*
09:15 – 09:30 Flood Predictability and Optimization of Water Resources Management: *Oliver Saavedra*
09:30 – 09:45 Introduction of GIT4CC (Green Infrastructure Technology for Climate Change): *Hyoungkwan Kim*
09:45 – 10:00 Drought Monitoring and Prediction: *Patricia Sanchez*
10:00 – 10:15 Modeling of Snow- and Glacier- melt Runoff Simulation: *Maheswor Shrestha*
10:15 – 10:20 Discussion

10:20 – 10:50 BREAK

10:50 – 12:30 4. Capability of Observation, Data Integration and Prediction Session
The presentations will focus on capabilities possibly contributing to the GEOSS WCI framework. Each will be allocated ~ 20 minutes (including questions).

10:50 – 11:10 JAXA: *Toru Fukuda*
11:10 – 11:30 JMA: *Hirotaka Kamahori*
11:30 – 11:50 KMA: Climate Change Projections using Representative Concentration Pathways and HadGEM2-AO Climate Model: *Kyung-On Boo*
11:50 – 12:10 ICHARM: *Kazuhiko Fukami*
12:10 – 12:30 UNU-CECAR: *Srikantha Herath*

12:30 – 13:30 Lunch

13:30 – 14:30 4. Capability of Observation, Data Integration and Prediction Session - continue
13:30 – 14:30 GEOSS Water Cycle Integrator toward Asian regional coordination: *Toshio Koike*

14:30 – 16:00 5. Breakout discussion session 1 – GEOSS WCI: needs and capabilities
14:30 – 14:45 Introduction and instructions for the breakout groups: *Toshio Koike*
Individual groups (3 – 4) are to be decided. Reference material includes the WCI document and the "Green growth with blue" document. Downloadable from the meeting website at: http://monsoon.t.u-tokyo.ac.jp/AWCI/meetings/Seoul_Oct2011/agenda.htm

14:45 – 16:00 **Breakout group discussion**
The groups will discuss several points including (i) possible scope of involvement in the WCI framework identifying needs and capabilities, (ii) coordination and integration of activities across the working groups under the WCI framework, (iii) possible contribution to Rio+20.

16:00 – 16:20 BREAK

16:20 – 18:30 6. Breakout discussion session 2 – GEOSS WCI: practical implementation ideas
The groups will discuss practical implementation of the WCI targets at the AWCI demonstration basins. Ideas for particular projects should be formed that will be complied into an Implementation plan before the January 2012 GEOSS Asia-Pacific Symposium.
Individual groups (3 – 4) are to be decided.

18:30 Adjourn

Saturday 8 October

09:00 – 09:30 7. Breakout session summary

09:30 – 10:30 8. Implementation planning for a regional coordination project targeting Climate Change Adaptation
This is a discussion plenary session, synthesizing the outcomes of the meeting into suggestions/instructions for an implementation plan of the AWCI next step.

10:30 – 11:00 BREAK

11:00 – 11:30 9. Regional Proposal to Rio+20
This is a discussion plenary session that will produce a proposal of AWCI contribution to Rio+20

11:30 – 12:00 10. Summary and Closing session

12:30 Adjourn

2. Full Meeting Report

2.1 Opening

The meeting that was opened by Mr. Jae-Hyun Park of the Korean Ministry of Land, Transport and Maritime Affairs. In his talk, Mr. Park referred to this year excessive rainfall in Korea and other indicators of changing climate and emphasized the importance of integrated approach in addressing the water resources issues. He appreciated that AWCI has been successfully promoting such approach and providing a platform for integrating data and merging them with accumulated know how from which all the participating countries including Korea may benefit.

Opening remarks were also given by Prof. Deg-Hyo Bae, Sejong University and Prof. Toshio Koike, University of Tokyo, who welcomed participants and wished all a successful meeting and pleasant stay in Seoul. They stressed out the absolute necessity of water for life and critical importance to recognize the fundamental linkages among water; land use, including deforestation; carbon cycle and ecosystem services; and food-, energy- and health- securities. Considering these linkages, sharing coordinated, comprehensive and sustained water cycle and related Earth observations and information for sound decision making as promoted by GEOSS AWCI should be further enhanced.

2.2 AWCI Working Group Activity Review Session

General Review
Prof. T. Koike reviewed the evolution of AWCI that had been established as a regional GEOSS activity but has been increasingly becoming linked to a global agenda. Currently, the initiative includes 19 basins in 19 Asian countries that have submitted in-situ data to an open DIAS archive and performed data quality check and metadata registration. Various tools have been developed to performed planned demonstration projects including the data management and quality check tools, distributed hydrological models (e.g. Water and Energy Budget DHM: WEB-DHM) suitable for various conditions of AWCI basins, and climate change assessment techniques using the CMIP3 global model climate projections. Over the past years,

dedicated training sessions and workshops have been organized, the last one being the training course on Climate change assessment and adaptation techniques held in Tokyo, March 2011.

Using the AWCI basin data and developed/adapted tools and methods, demonstration studies have been carried out taking advantage of data sharing and data integration capabilities provided by the GEOSS/AWCI community. The results have shown a high potential of such cooperative approach for addressing various water resources issues at the basin scale while taking into account changing climate. While the AWCI framework and methodologies have been proven effective, further needs for enhanced collaboration among various sectors have emerged. Therefore a next step/phase of AWCI has been proposed that would aim at a GEOSS Water Cycle Integrator (WCI), a virtual space which provides a holistic coordination capability of the following function 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

Preparation for planning the next step/phase of AWCI was a significant part of the Seoul meeting agenda.

Flood Group

Dr. K. Fukami informed the audience about the Flood group activities that included studies in demonstration basins, contributions to several conferences and holding training workshops. The flood group project supported through the APN ARCP funding programme (Flood Risk Management Demonstration Project (phase 1) under the Asian Water Cycle Initiative for the Global Earth Observation System of Systems) has been successfully completed and the final report submitted to APN. It has been concluded that as a result of 2-year cooperative research activities among Flood WG of GEOSS-AWCI, there have emerged many promising technologies and practices for the future sustainable flood risk management that have been tested through the AWCI demonstration projects focused on flood related issues. As a follow-up activity, the group is proposing a new project to the APN ARCP programme named: Study on Innovative Hydrometeorological Technologies and Societal Practices through Coupled Use of Global & In-Situ Earth Observational Data for Flood Risk Management in Asia. Through this project, innovative hydrometeorological monitoring and/or modelling technologies and societal practices for integrated flood risk management coupled with global/in-situ earth observational data will be tested in flood-prone areas. Their effectiveness in wide-range natural and societal conditions will be evaluated and capacity building tools will be developed for operational flood risk management under climate-change impacts with raising public and stakeholders' awareness.

Drought Group

Dr. G. Rasul reviewed recent activities and achievements of the Drought group. The group has been continuing to build up drought monitoring/research network and a data bank for the collected data from 2006 to 2009 of AWCI member countries. Validation studies of AMSR-E soil moisture measurement algorithm using the in situ soil moisture data of the data bank have been performed. Dedicated workshops on drought issues have been held, supported through the APN CAPaBLE programme funded project: Drought monitoring system development by integrating in-situ data, satellite data and numerical model output. Climate change assessment studies from a view point of droughts have been initiated. The group has also submitted a new proposal to the APN CAPaBLE programme, named: Impact of Climate Change on Glacier Melting and Water Cycle Variability in Asian River Basins that is focusing on drought issues under the changing climate and in particular targeting (but not limited to) the basins with snow and glacier conditions.

Water Quality Group

Dr. B. Hoque summarized the Water Quality group activities that included the demonstration project on sustainable water management of the Huong River and the Hue city (with integrated Flood and WQ monitoring); the demonstration project in Bangladesh to observe selected WQ parameters in groundwater and surface water sources and its associations with water use for drinking, domestic and irrigation purposes; and a new proposal to APN ARCP programme, named: Comparative study on monitoring scheme of river water quality taken in consideration of water balance among different watersheds in Asia. The projects aims to conduct an integrated and comparative study on water quality (WQ) standards and

monitoring scheme for pollution control among 4-5 river watersheds in Asia and perform trend analysis of river flow and WQ from the aspects of watershed water balance and influence of climate change.

Climate Change Group
Prof. D.-H. Bae introduced the activities of the Climate Change group over the past year. The Climate Change Assessment and Adaptation (CCAA) techniques training course was held in Tokyo in March that provide insight into the selection of suitable global model climate projections, climate projection bias correction, and downscaling and utilizing the corrected projection data in hydrological analyses using distributed hydrological models. The training course has initiated CCAA studies in AWCI basins that are undertaken under the APN ARCP funded project of the Climate Change group entitled: "Climate change impact assessment on the Asia-Pacific water resources under GEOSS/AWCI". Studies in Vientam (Huong river), Korea (Chungju dam) and Philippines (Pampanga) have been carried out and the results showed increasing trends in temperature and precipitation at most of the tested stations (linear regression and Mann-Kendall test). The group will continue such studies in further AWCI basins.

Capacity Development Implementation
Prof. S. Herath briefly summarized evolution of the AWCI capacity development (CD) program. The structure and achievement of the core activities were introduced that include JAXA's miniprojects for Earth observation and CD modules for the miniprojects; UNU courses and training modules dedicated to various techniques and methodologies needed for climate change impact assessment and adaptation planning; web-based support and tutorials for these courses; UN-CECAR educational framework (http://cecar.unu.edu) including web-based resources; and several advanced tools and methods developed at UT that are necessary in the complex process of CCAA (bias correction and downscaling of GCM climate projections, Drought assessment methodology – standardized drought indices, adaptation of WEB-DHM for snow and glaciers – physically based snow and glacier process submodels). Newly developed metadata registration tool for available training modules was introduced (http://cecar.unu.edu/metadb/) and participants encouraged to test the on-line modules and its tutorials.

2.3 Country Activity Review and Possible Contributions to the AWCI Next Stage Session

The country reports showed great progress in the AWCI demonstration projects and good preparedness of individual countries to step into the next phase that envisions further integration and inter-disciplinary collaboration through the GEOSS Water Cycle Integrator (WCI) concept of "work benches". In particular:

- **Vietnam** has completed demonstration basin (Huong river) data submission, quality control, and document and observation metadata registration; has established and calibrated flood forecasting system using satellite data and numerical rainfall forecast in the demonstration basin; and has been carrying out collaborative research in the Red River under the framework of APRSF/JAXA.
- **Thailand** has completed demonstration basin (Mae Wang river) data submission, quality control, and document and observation metadata registration; has initiated and been continuing a pilot project GEOSS telemetry in Mae Wang Basin by the cooperation of Hydrology and Water Management Center and the University of through which a number of telemetric stations has been established and flood warning system developed; has developed a warning system based on the lead time along the Chao Phraya river and has promoted public awareness and developed evacuation rules and instructions for people in case of floods.
- **Sri Lanka** has completed demonstration basin (Kalu Ganga river) data submission, quality control, and document and observation metadata registration; has begun and continue the AWCI demonstration project designed to minimize the damages caused to the lives, economy and the environment due to floods in the basin, which includes real time flood forecasting for implementation of early warning systems (weather modeling by WRF), identification of inundation levels at different floods and identification of alternative structural and non structural methods (hydrological and inundation models), and identification of adaptations for flood risk reduction considering climate change impacts on water cycle in the basin.
- **Philippines** has completed demonstration basin (Pampanga river) data submission, quality control, and document and observation metadata registration; has implemented the AWCI demonstration project of the multipurpose Angat dam reservoir, which is a main supply of drinking water for Metro Manila, supplies important hydropower plant and also provides supply for irrigation. It is felt to be significantly affected by climate variations and assessment of climate change impacts and needs for

updates of operation rules have been investigated. In addition, flood forecasting & warning system in the Pampanga and Agno River Basins has been improved through a cooperative project with JICA that also included dedicated training sessions for observers.

- **Nepal** has completed demonstration basin (Bagmati river) data submission, quality control, and document metadata registration. The observation metadata task requires more time as it is necessary to visit individual sites but the task has been progressing. The demonstration project in the Bagmati river has been initiated that aims to assist in preparing the formulation of improved River Management Plans, set priority activities and projects to increase water security in the river Basin which are expected to include flood forecasting and management, drought management, water allocation, and pollution control, and to develop an effective Rainfall – Runoff simulation Model. In addition, a CCAA study has begun in the Narayani basin that includes snow and glacier areas and thus requires application of the WEB-DHM-S model.
- **Myanmar** has completed demonstration basin (Shwegyin river) data submission, quality control, and document and observation metadata registration; has initiated and partly implemented the demonstration project aiming to enhance a flood forecasting system for the basin including installation of telemetric stations; and has carried out several capacity development activities including GIS software and IFAS system training. Undertaken trend analyses in the basin showed decreasing rainfall trend but increasing flood frequency and duration, suggesting complex issues involving changes in the basin.
- **Mongolia** has completed demonstration basin (Selbe river) data submission but quality control and document and observation metadata registration is still ongoing. The demonstration project has been initiated and partly implemented that aims to assist development, implementation and revision of Integrated River Basin Management plan in Selbe and Tuul river basins mainly through a long-term monitoring of water and energy cycles. A preliminary study of climate change scenarios in the Tuul river basin using HadCM3, A1B scenario has been carried out that showed slight increase of precipitation in the upstream, and precipitation decrease in the downstream parts of the basin. Efforts to establish IWRM in each of the main river basins in Mongolia have begun.
- **Malaysia** has completed demonstration basin (Langat river) data submission, quality control, and document and observation metadata registration. A plan of complex CCAA study that Malaysia has begun to implement was introduced that included assessment of modeling impacts, climatic driven factors, and non-climatic driven factors and would result in adaptation actions with focus on pro-active adaptive management and cost-benefit analyses of various strategies. The climate change impact assessment (runoff volume calculated for past 40 years and estimated for future 40 years) showed a possible decrease of runoff in some basins.
- **Lao PDR** has completed demonstration basin (Xebangfai river) data submission; work on quality control, and document and observation metadata registration has been continuing. The demonstration project has been initiated that focuses on enhancing in-situ field observation, monitoring, forecasting and warning for national practices as well as service delivery to decision makers and risk communities. Governmental bodies have been established that have been dealing with climate change issues and a CCAA collaborative activities involving Ministry of Natural Resources and Environment (MoNRE) and Mekong River Committee (MRC) have been conducted in some basins and would be expanded to others. In such studies, the Decision Support Framework developed by MRC has been used that provides a toolbox including hydrological models, basin models, hydrodynamic models, and impact assessment tools as well as a knowledge base.
- **Korea** has completed demonstration basin (Chunju-dam river) data submission, quality control, and document and observation metadata registration; has carried out CCAA study in the demonstration project; and has initiated a restoration project of four main rivers in Korea targeting fundamental measures against frequent flooding and drought disasters incurred as a result of climate change. The project objectives include flood control, water acquisition, water quality and ecology, and creation of multipurpose spaces connecting rivers and cities.
- **India** has completed demonstration basin (Seonath river) data submission, quality control, and document metadata registration but observation metadata task is still ongoing. A program for Integrated Water Resources Development and Management for Upper Bhima river basin has been launched that includes climate change impact assessment and development of design flood estimation under hypothetical climate change scenarios and constructing adequate flood risk and inundation maps and evacuation plans. Also, climate variability analysis of North Central Indian basins have been carried out that indicated slight increase in temperature and annual rainfall on average though in some areas cooling, rather than warming was shown and rainfall remained stable.

- **Cambodia** has completed demonstration basin (Sangker river) data submission, quality control, and document and observation metadata registration; has initiated and been implementing the demonstration project aiming at development and promotion of an advanced system supporting integrated water resources management. The project has been carried out in collaboration with the UT team, who is providing the system tools including a land data assimilation system, atmospheric model, hydrological model and data integration systems. A CCAA study has also been initiated using the framework introduced at the March training course in Tokyo.
- **Bhutan** has completed demonstration basin (Punatsangchhu river) data submission, quality control, and document metadata registration but observation metadata task is still ongoing. The demonstration project has been initiated and partly implemented that aims to develop an adequate warning system for floods and monitoring of flow that would also address impacts on hydropower generation and sediment transport using the IWRM practices. In the demonstration basin a project on Reducing Climate Change Risks and Vulnerabilities in the Wangdue has been initiated that includes a GLOF early warning system, lowering of the Thortomi lake and an awareness campaign.
- **Bangladesh** has completed demonstration basin (Meghna river) data submission, quality control, and document metadata registration but observation metadata task is still ongoing. The demonstration project has been initiated and pilot studies carried out focusing on developing information system for improved modeling and disaster forecasting. The current system is being enhanced by including mobile service into the framework. Also, climate change impact studies have been implemented that utilized the IPCC AR4 scenarios and applied hydrological models, basin models, hydrodynamic models, and models to address the local area water management issues and to provide solutions.

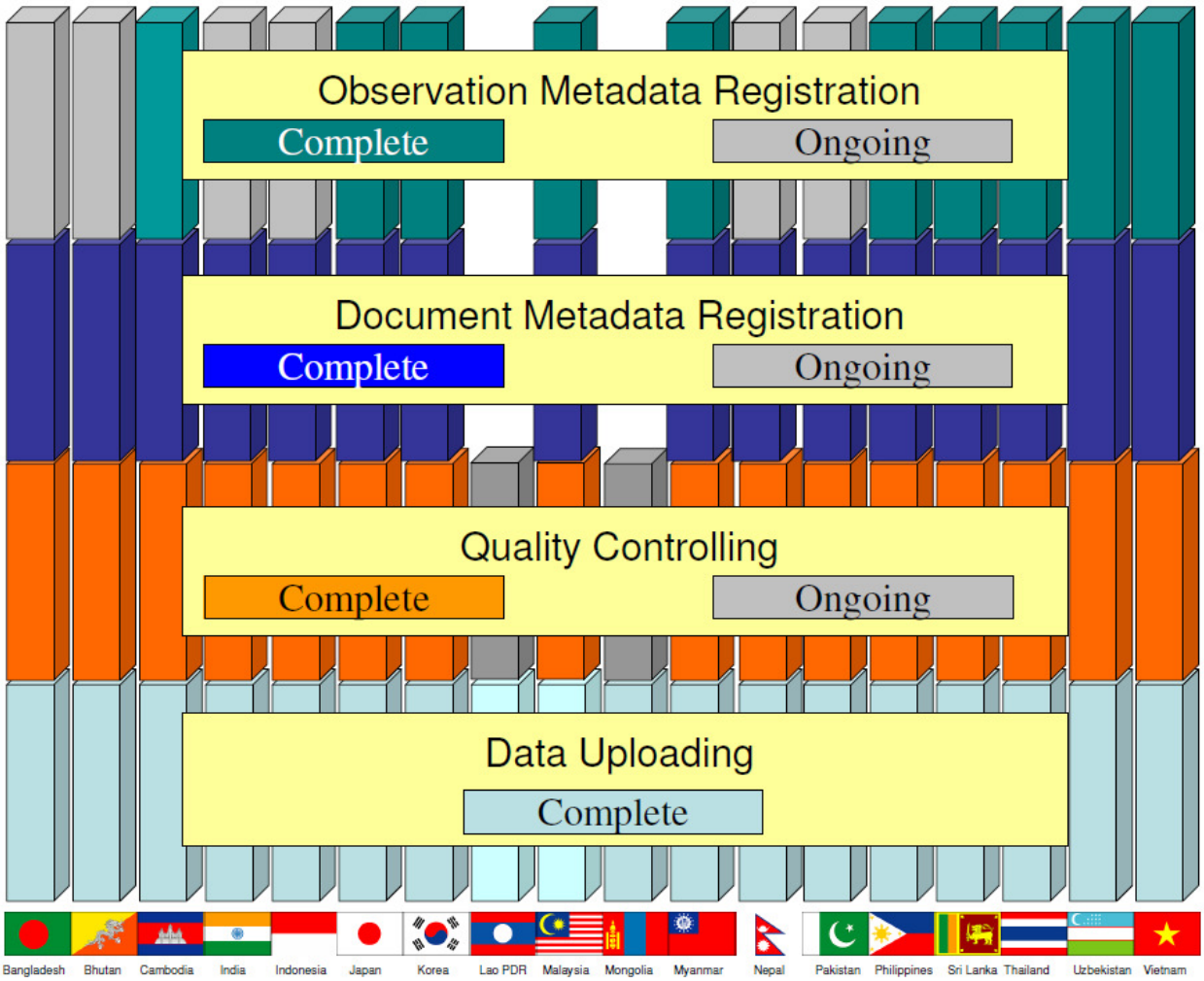

Figure 1: Chart of the status of demonstration basin data submission, quality control and metadata registration.

In addition to their achievements in recent activities, the country representatives introduced their country views on proposed Water Cycle Integrator and explained their possible contributions and envisioned benefits. All the countries welcomed the idea and expected mutual benefits from further integration under the GEOSS WCI framework. In general, multiple agencies and institutions are involved in water resources management in the countries and while certain level of coordination among these exist, it is not always adequate and should be further promoted.

The expert presentations of this session introduced certain on-going projects in some countries and several methods and new tools for hydrological modeling and assessment of climate change impact on water resources. The presented projects addressed water quality issues in Bangladesh, implementation of IWRM practices in a specific mountain watershed in Thailand including a flood early warning system, enhancing and promoting Hydroinformatics in Thailand by integrating further information from various sources and its capability to predict the 2011 big flood in the Chao Phraya river, and the green infrastructure technology approach for climate change that is being developed and implemented in Korea with focus on adaptation technology for civil infrastructure to sustain extreme weather and serve in higher floods. The new/improved tools and methodologies included GCM rainfall bias correction and downscaling technique; flood forecasting and water resources optimization systems; drought assessment methodology – standardized drought indices; and adaptation of WEB-DHM hydrological model for snow and glaciers including physically based snow and glacier process submodels.

2.4 Capability of Observation, Data Integration and Prediction Session

This session focused on capabilities possibly contributing to the GEOSS WCI framework and included inputs by JAXA, JMA, KMA, ICHARM and UNU.

Dr. T. Fukuda reviewed a broad scope of satellite data that JAXA has been contributing to the DIAS system and introduced new earth observation missions planned in the near future that would contribute to the water cycle and climate areas. The loss of ALOS will be compensated by ALOS-2 (SAR) and ALOS-3 (optical) satellites in 2013 and 2015 respectively. The Global Satellite Mapping for Precipitation (GSMaP) was introduced (http://sharaku.eorc.jaxa.jp/GSMaP/), which is a satellite combined product providing hourly precipitation map of global coverage (Fig. 2) and has a great potential of use in AWCI activities.

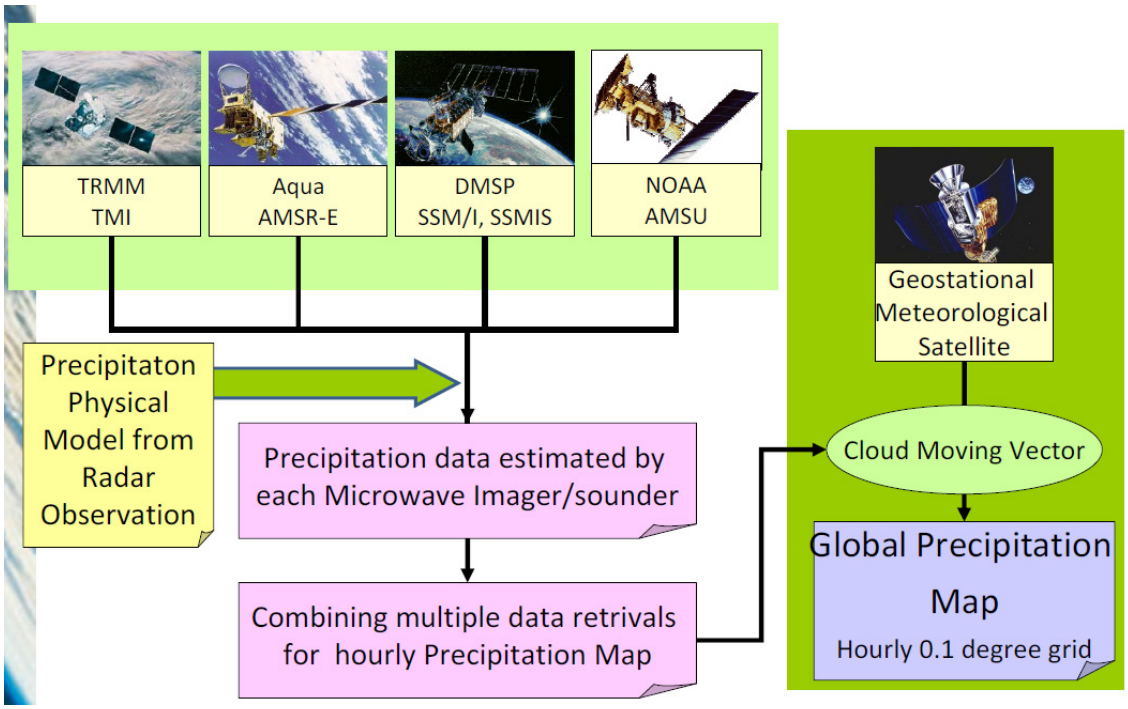

Figure 2: Scheme of generation of the Global Precipitation Map.

Dr. H. Kamahori introduced the new JMA Reanalysis product (JRA-55) and explained improvements from the JRA-25 product, which included new radiation scheme, higher horizontal and vertical resolution, semi-Lagrangean time integration, more greenhouse gas emission scenarios, 4D-VAR assimilation, and improved bias correction. The JRA-55 generation will be fully completed and made available in 2013. The current outcomes show a significant improvement in RMSE comparing to JRA-25. Another JMA contribution is the JMA global model short- to seasonal-range forecasts and typhoon forecasts that are possible due to the model's high spatial resolution. Important forecast confidence information is also generated by utilizing the ensemble prediction system for typhoon, one week, one month, and seasonal forecasts.

Dr. K.-O. Boo introduced activities of KMA dedicated to climate change projections using Representative Concentration Pathways (RCPs) and the HadGEM2 model. The results of 2001 – 2099 climate projections were presented focusing on temperature, precipitation and extreme climate indices. All scenarios indicated warming and increase of precipitation on a global scale, however there were differences among individual regions with East Asia expecting larger changes than global mean.

Dr. K. Fukami presented the capabilities and improvements of the Integrated Flood Analysis System (IFAS), which is a freely downloadable flood runoff analysis system with satellite-based rainfall & global GIS information (http://www.icharm.pwri.go.jp/index.html). As such, the system may be used even with very limited or even missing local in-situ data and still provide usable information. The most recent advancement of the system is incorporation of the Rainfall-Runoff-Inundation model, which was applied in Pakistan and Indonesia (Java) to construct flood hazard map and prepare instructions for an evacuation drill. The model has also been used in ensemble studies of flood hazards changes due to climate change and provided useful results for planning adaptation strategies. A comment was highlighted that together with hazard changes, also the vulnerability change must be assessed that depends on socio-economic parameters and is very challenging.

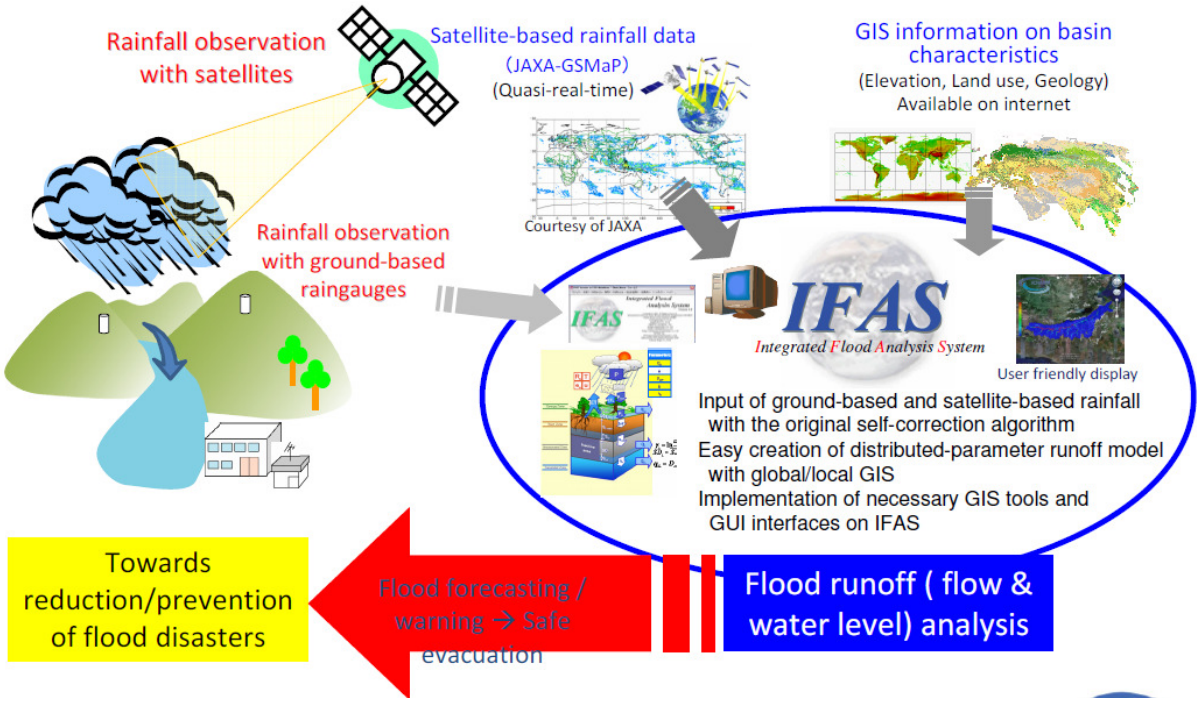

Figure 3: Schematic illustration of the IFAS system and utilized data sources.

Prof. S. Herath introduced the University Network for Climate and Ecosystem Change Adaptation Research (UN-CECAR) and evolution of its activities targeted on the higher education and research in the arena of global change and adaptation (http://cecar.unu.edu). The Network includes 19 Universities in the Asia Pacific region, which collaborate on development of curriculum and joint research projects using a multidisciplinary approach and a holistic view. In focus are interactions among three main fields including

climate change, biodiversity, and desertification. The curriculum includes three themes, namely Science of Climate and Ecosystems Change, Adaptation and Mitigation, and Impacts and Vulnerabilities. The joint research project development focuses on two themes, namely Rapid Onset Changes (Floods, Cyclones) and Slow Onset Changes (Land degradation, Bio-diversity loss). UN-CECAR provides several postgraduate courses (Master and PhD degree) and training seminars, organizes conferences, and carries out research. Possibility of on-line provision of the courses has been tested and proven efficient and thus the practice of on-line courses will be further developed.

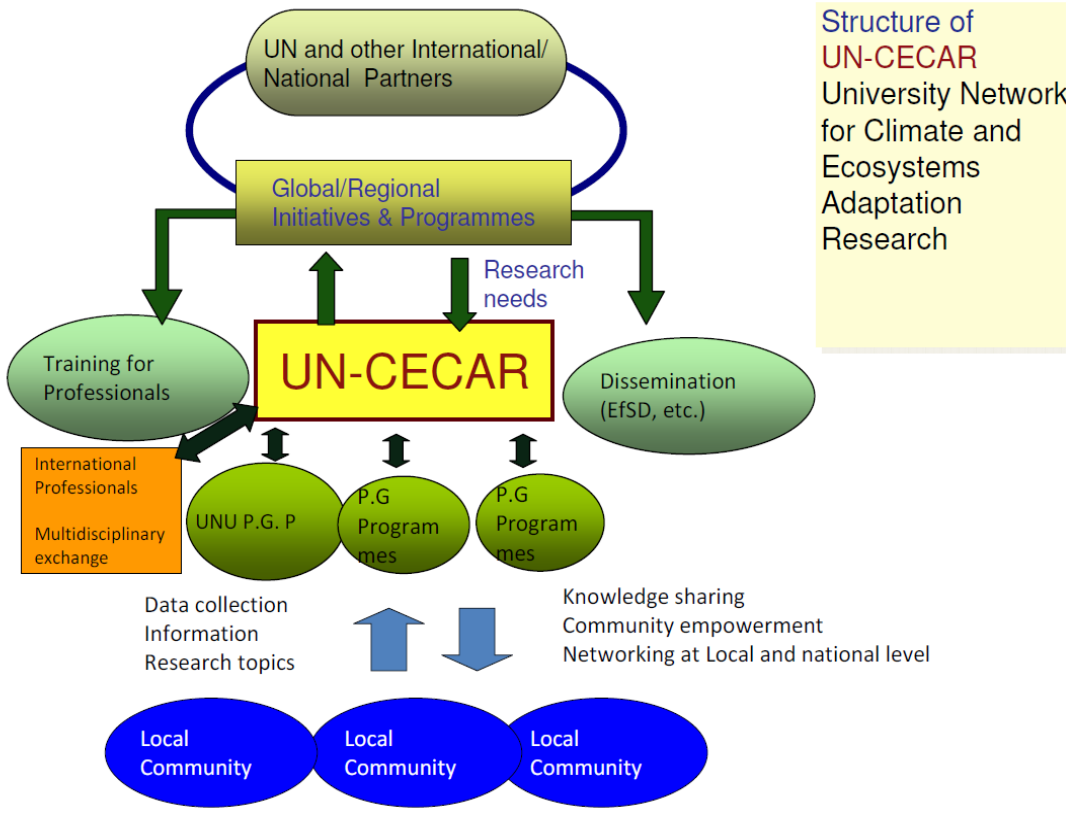

Figure 4: Structure of UN-CECAR University Network for Climate and Ecosystems Adaptation Research.

Prof. T. Koike provided overview of current climate status and related issues as felt in various AWCI countries and reiterated the key role of water in the complex phenomenon of climate variation. The country reports given earlier at the meeting were summarized and it was concluded that all countries might be ready for stepping into the next phase of AWCI that will aim at the Water Cycle Integrator (WCI) framework. The WCI basis and features were explained emphasizing the integrated and coordinated approach realized through work benches that will facilitate coordination among different sectors – one of the key issues for implementing IWRM practices. Schematic diagram of WCI framework is shown in Figure 5. Examples of activities and strategies in AWCI countries that are in line with the WCI framework components have been identified in the country and expert reports and highlighted. Another essential issue is how to translate research findings for sound assessment of various adaptation and mitigation actions and based on a complex evaluation to prioritize adaptation options (Fig. 6).

After the plenary sessions introducing the current status and views and suggestions for future steps by countries, working groups and collaborative research organizations, breakout groups were organized to discuss how to step in to the next phase of AWCI targeting the GEOSS Water Cycle Integrator. Four groups were formed representing South Asia, South-East Asia, North Asia, and Snow and Glacier focus. Two sessions were organized, first focusing on identification of needs and capabilities and the second on practical implementation ideas. The groups were given a set of points that were addressed during the discussion.

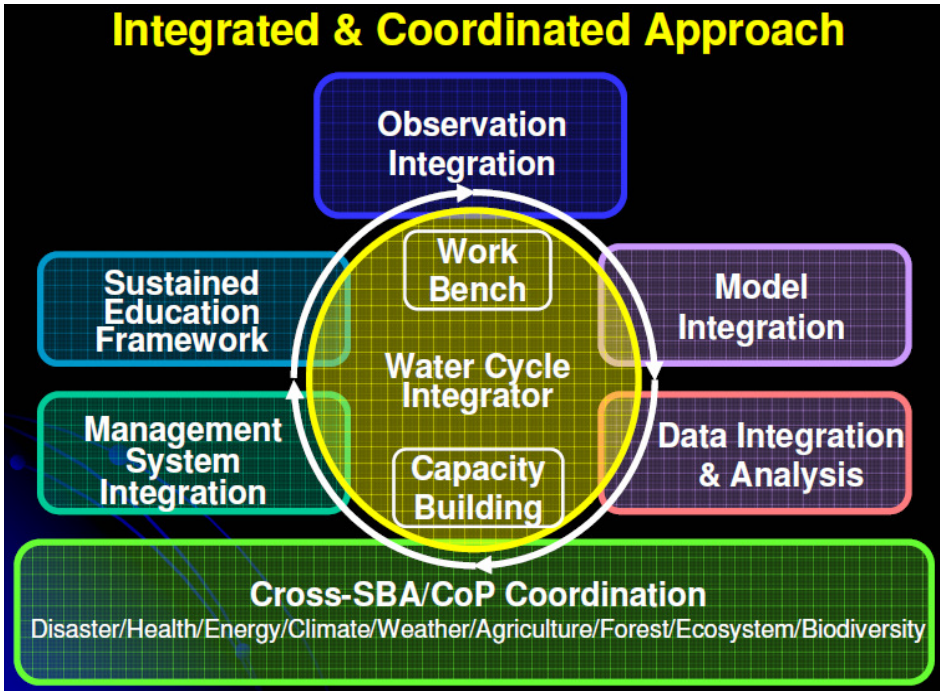

Figure 5: WCI framework

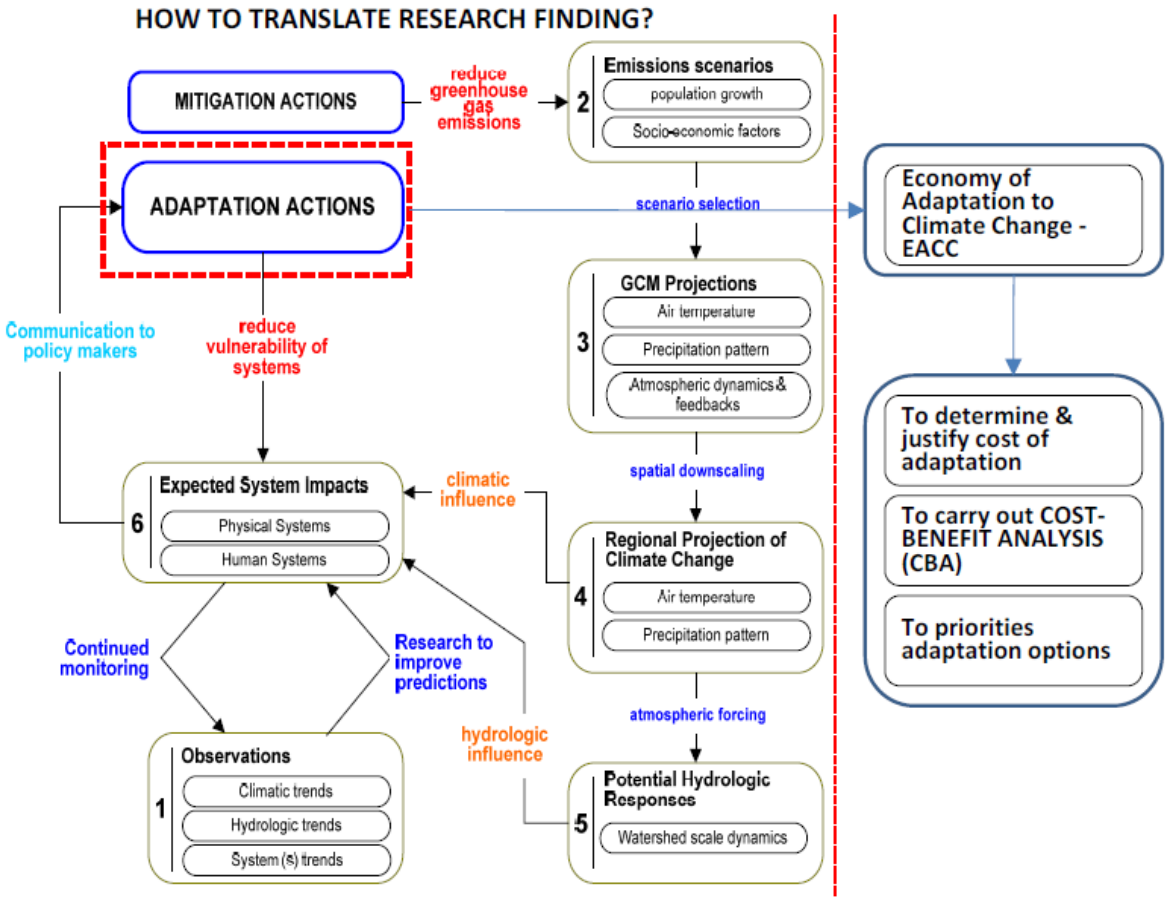

Figure 6: How to translate research findings – schematic chart.

2.5 Breakout discussion session 1 – GEOSS WCI: needs and capabilities

The points to be discussed were:
1. Background: Water cycle, climate system, water use and issues among these – clarification
2. Issues related Water Nexus: agriculture, energy, health – water quality, biodiversity, and ecosystem
3. Needs for functions and/or tools of WCI to address the identified issues
4. Needs for collaboration framework at the national level: inter-agency, interdisciplinary

Note: Identification of specific issues in each country and then summarizing for the sub-region

2.6 Breakout discussion session 2 – GEOSS WCI: practical implementation ideas

The points to be discussed were:
1. Steps and Strategy
2. Additional resources – suggestion of potential collaborators
3. Specific request to GEOSS and to international community (data/tools accessibility)
4. Coordination between water cycle integration and capacity development
5. Schedule

The resulting reports were presented after the breakout group discussion time and are available along with other presentations at the meeting website at:
http://monsoon.t.u-tokyo.ac.jp/AWCI/meetings/Seoul_Oct2011/presentations_files.htm.

2.7 Breakout groups summary and synthesis for implementation planning and Rio+20 contributions.

On the last day of the meeting, the breakout group outcomes were summarized and synthesized for a template that would be used for individual country inputs to the AWCI next phase implementation plan draft. It was pointed out that the as identified under the “needs”, the requirements to GEOSS and CEOS should be clearly specified so that these can be presented to GEOSS and CEOS. The resulting template is provided in Attachment 2 below. A schedule for submitting the country inputs has been decided.

A short discussion session was included to communicate a proposal for governments of AWCI countries to submit contributions to Rio+20 regional caucus meeting and conference on sustainable development that would be held in Seoul later in October. The importance of such contributions coming from AWCI community was highlighted as the recognition of the AWCI activities at such top level forum is highly desirable and would be very helpful for policy mainstreaming efforts in the participating countries.

2.8 Closing

Prof. Koike and Prof. Bae thanked all the attendees for their active participation and valuable contributions. Substantial progress in the AWCI country activities was acknowledged and the readiness for stepping into the next phase aiming at further integration under the WCI framework was declared. All countries agreed to prepare inputs for the next phase implementation plan according to the proposed schedule. The next AWCI related event would be the 5th GEOSS AP Symposium, in Tokyo, Japan, 2 – 4 April 2012.

Attachment 1 GEOSS Water Cycle Integrator

Toshio Koike, Japan GEO WG Chair

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.

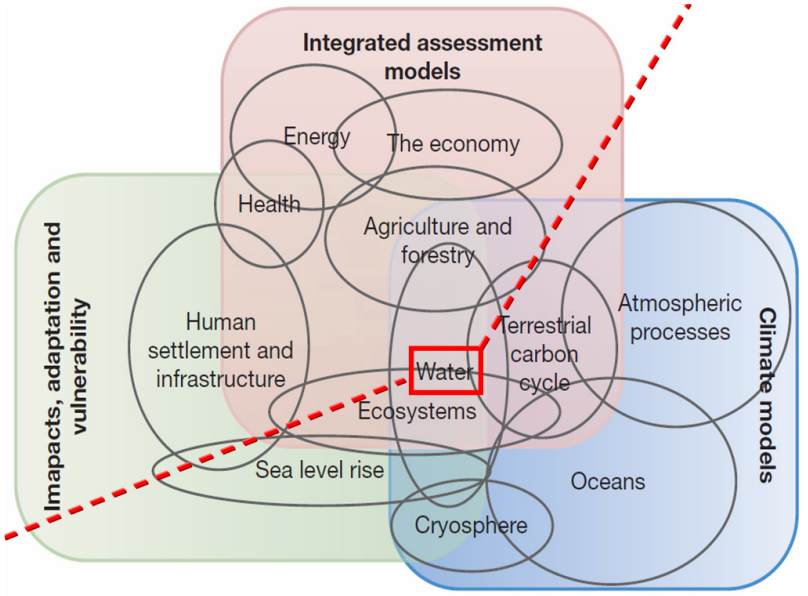

Figure 1. Model Integration for Assessment, Richard H. Moss, et al., Nature, 2010, modified by Author.

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 sifts and

changes in extreme events, including floods and droughts, are now fundamental threats to human beings all over the world.

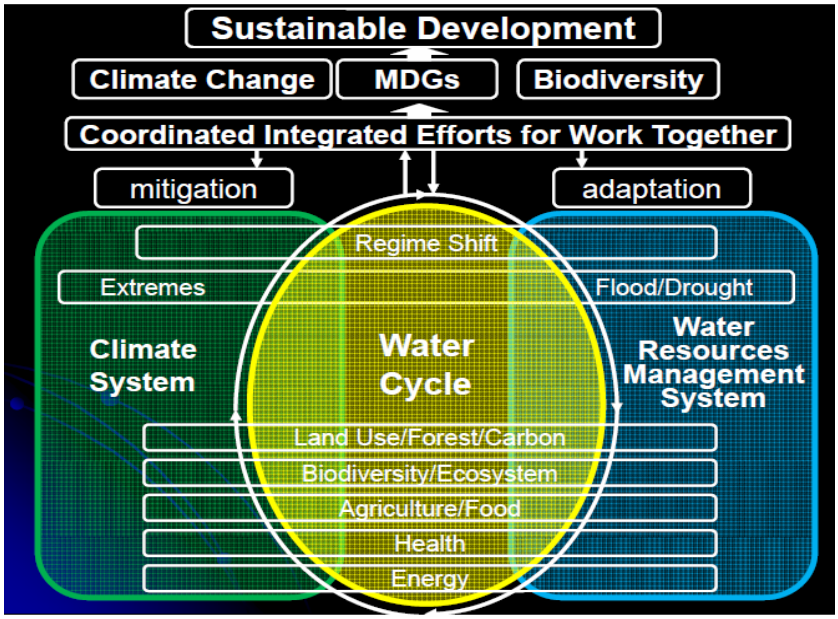

Figure 2 Concept Design

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

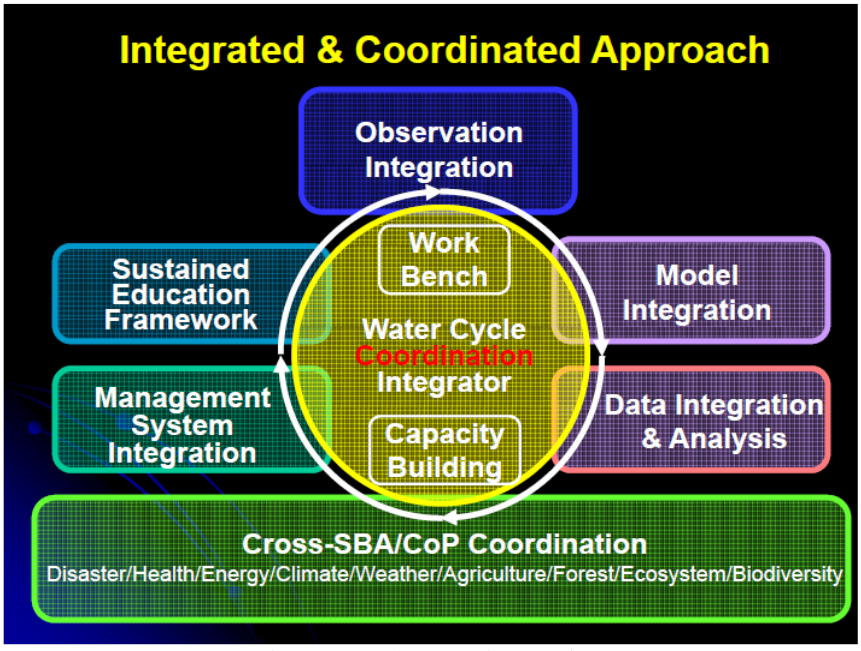

Figure 3 Implementation Design.

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 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 capability.

Figure 4 Coordinated Observation and data integration.

This effort will build on the mutual cooperation between CEOSS/WGISS and WCRP/GEWEX, which successfully implemented the Coordinated Enhanced Observing Period (CEOP) was 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.

Attachment 2

Template for Country Input to the AWCI Phase 2 Implementation Plan

(based on the outcomes of the Seoul meeting breakout sessions)

1. Issues and Needs

1. Issues related climate system - water cycle - water use

- Regionally common issues - identify which of the common issues are relevant to your country:
  - changes in climate and consequences – quantitative assessment
    - ✓ intensification of variability (heavy rainfall and dry spells), cyclones
    - ✓ frequency of extremes: flood (localized + social)and drought
    - ✓ seasonal climate pattern (precipitation, dry and wet, maxima,)
  - Identify available capability/resources in your country – specify clearly
  - Identify lack of capability – specify clearly, including more details, which capability out of the following ones is missing: monitoring, modeling, inventory of water resources, understanding planning & management

- Describe critical and specific issues in your country, include more details:
  - landslides / erosion
  - Sea level rise
  - Temperature rise→GLOF
  - Depletion of ground water
  - Hydropower
  - Trans-boundary and international coordination (MRC)
  - Shifting snow residency, melting period, snow-line→biodiversity

Issues related to Water Nexus: agriculture, energy, health – water quality, biodiversity, and ecosystem

A. Introduce issues related to Water Nexus in your country and identify two directions (see the example below):

1. Water and Climate Change affect each Socio-Benefit Area (SBA)
2. Each SBA affects water and environment

B. Introduce on-going projects and programs related to Water Nexus in your country

SBA	CC, Water, and Environment
• Agriculture:	←water scarcity and surplus, crop failures → quality of surface and ground water (fertilizer, pesticide)
• Energy:	←hydropower
• Urban:	→water quality, ground water depletion, increase of municipal water demand, inefficient municipal water management (low tariff, unplanned conjunctive), decrease of flood plains,
• Ecosystem and Biodiversity:	←change in flow pattern, water diversion
• Health	←water bone diseases (dry and wet spells: Malaria, Dengue, flood: Diarrhea)
• Infrastructure:	←design and management

C. Respond to each of the following questions by considering water and climate change specifically for your country:

- How can we address seasonal variability at national level?
- How can we manage water resources in proper way between upstream and downstream and among different sector uses: hydropower, irrigation, water supply?
- How can we give the right information to these different sectors? They are demanding for more customized climate information?
- How can we adapt the design criteria to changing characteristics and magnitude of water hazards, e.g. for new drainage?
- How can we share the data to the different sectors beyond laboratories?

2. Needs for functions and/or tools of WCI to address the identified issues

Specify needs for your country:

- Observations:
  - in-situ telemetric network (mountain areas)
  - remote sensing (satellite, radar) currently and in future
- Data Access
  - satellite data access (operationally coupled with in-situ near real-time data)
  - global data access (Numerical Weather Prediction, Reanalysis, Climate Projection)
- Models
- Management systems
  - Forecasting
  - Early Warning
  - Decision support
    - ✓ National/local government (climate proofing, urban management, risk reduction measures, adaptation strategies)
    - ✓ community-based
- Platform for sharing data and knowledge and exchanging ideas and experiences
- Capacity building – describe in other section (Part 2: Implementation Proposal)

3. Needs for collaboration framework at the national level: inter-agency, interdisciplinary

Please introduce existing activities and what kind of activities/framework is needed in your country with regards to each of the following points:

- We need to show a holistic view of water and climate change and their impacts on water nexus to all the stakeholders through sharing data and information, exchanging ideas and experiences, and working together.
- We need a well-organized interdisciplinary and inter-sectoral body at professional- and/or policy making- levels by involving academia and civil societies.
- We need to implement demonstrations and exchange good (failure) practices through regional conferences/workshops.
- We need criterion to maintain data quality, at least for rainfall, water level and hopefully river discharge and technical standards to design infrastructures in terms of water.

2. Implementation proposal

1. Please describe Steps and Strategy following the three approaches:

Framework development approach – describe desirable framework in your country

- Demonstration design ←→ infrastructure integrity
- Introducing legislation→high level coordination body→research promotion→Improvement of awareness→private sector involvement

Strategic approach

- Showcase: intention, background, objectives, collaborations, achievements with accuracy and feasibility, benefits to other sectors, interest → involvement one by one starting with existing inter-agency collaborations)
- Demonstrations → regional and general commonality
- Expansion of the AWCI demonstration studies to a whole region → sharing experiences →a holistic understanding and technology.

Technical approach – propose a technical approach considering your target basin/country

Monitoring→understanding→Climate change assessment including downscaling, bias correction→detail assessment→model→demonstration→ mainstreaming→ creation of regional knowledge

2. Additional resources – suggestion of potential collaborators

- Please identify local, national, regional, and worldwide (including UN) collaborators in the field of research, operation, administration, financial and human resources supports. Please fill the matrix:

Collaborators **----------** **Field**	Local	National	Regional	Worldwide
Research				
Operation				
Administration				
Financial res.				
Human res.				

- Mainstreaming water and climate change within the national policy by getting supports from water nexus. Please describe mainstreaming strategy suitable for your country.

3. Specific request to GEOSS and to international community (data/tools accessibility)

Describe in a concrete way and specifically for your country needs:

- Inventory and summary directory – what kind is needed in your specific case
- Data request function responding to new needs – what kind of function
- Data access and information exchange
- Models and Tools: analysis, prediction, early warning, risk assessment, decision support – what kind for what purpose
- Regional office and/or data center – what kind of function you expect for the office

4. Coordination between water cycle integration and capacity development strategy

- Identify contents of capacity development needs in your country
- Introduce existing and on-going activities and the needs and support related to these five items:

- Synchronize capacity development with national implementation programme coordinated by the regional programme.
- Training for not only researchers but also practitioners from top level to operator/technician's level, with appropriate standards depending on the level (various kinds of training) including

trainer's training to be followed by practice and identify it as a postgraduate program in collaboration with international educational framework (e.g. UNU, UN-CECAR).

- Short term capacity development workshops on specific observation and modeling skills and medium to long term supports to regional resource centers.
- Coordinate with national and regional centers of excellence (ex. WMO centre in Hanoi on WR)
- Organize capacity development workshops in each country for the agencies involved in the project at national level on the WCI implementation. Identify agencies and participating organizations for making such an opportunity.

5. Schedule

Apr. 2012 5th GEOSS AP Symposium: Preparation for Implementation Plan
Oct. 2012 4th AWCI Symposium: Approval of the 2nd stage implementation plan

2013-2015: Step 1 - demonstration project (feasible study) at each basin
2016-2018: Step 2 - project implementation at national and/or regional scale
Please make a rough design for step 1 and step 2.

Due date for the input: 27 January 2011

*Based on the inputs from countries following this template a paper will be drafted for submission to a journal with intention to contribute to IPCC AR5.

**The template will be sent to ADB, JICA,…and a report will be asked for the 5th GEOSS AP Symposium session in Japan, April 2012.