Draft

Implementation Plan for

Global Earth Observation System of Systems
Asian Water Cycle Initiative
(GEOSS/AWCI)

Preface

Water comprises the most basic and critical component of all aspects of human life and is an indispensable component of the global life support system. On the whole, the water environment is characterized by the hydrological cycle, including floods and droughts. The widespread scarcity, gradual destruction and aggravated pollution of water resources in many regions have triggered a range of water crises. Nowadays, many water related problems particularly drinking water pollution are reported in various Asian countries. Health damage due to arsenic polluted drinking water is one of such problems. There is an urgent need for international cooperation to overcome the problems and secure the safe and sustainable groundwater utilization. Additionally, global climate change and atmospheric pollution could also have an impact on water resources and their availability.

About 60 % of the world population lives in Asia, and their various social activities including agriculture depend on the bountiful Monsoon rain. At the same time, the vast water cycle variation in Asia can be the cause of droughts and floods, and consequently, may be responsible for an enormous amount of human and economic damage.

To establish a comprehensive, coordinated and sustained earth observation scheme, an agreement for a 10-Year Implementation Plan for a Global Earth Observation System of Systems, known as GEOSS, was reached at the Third Earth Observation Summit held in Brussels, in February 2005; on that occasion the Group on Earth Observation (GEO) was also formally established. “Improving water resource management through better understanding of the water cycle” has been agreed to as one of the targeted societal benefit areas of GEOSS.

Our goal is to better understand the mechanism of variability in the Asian water cycle and to improve its predictability, and furthermore to interpret the information applicable to various water environments in different countries in Asia, then to help to mitigate water-related disasters and promote the efficient use of water resources.

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Summary

There is a rapidly growing concern about the common water issues, including flood and landslide, drought and water scarcity, water pollution and environmental degradation, climate change impacts in Asia.

Based on the regionally common and sharable ideas on the water-related issues in Asia and their natural and socio-economical backgrounds, a well coordinated regional challenge, “Asian Water Cycle Initiative (AWCI) Contributing to GEOSS”, has been organized in cooperation among 18 countries in Asia based on the series of discussions since 2005 just after the GEO established.

The AWCI develops an information system of systems for promoting the implementation of integrated water resources management (IWRM) through data integration and sharing and improvement of understanding and prediction of the water cycle variation as a basis for sound decision making of national water policies and management strategies.

The objectives for AWCI are defined as follows:

- to develop Integrated Water Resources Management (IWRM) approaches;
- to share timely, quality, long-term information on water quantity and quality, and their variation as a basis for sound national and regional decision making;
- to construct a comprehensive, coordinated and sustained observational system of systems, such as prediction systems and decision support capabilities, under the GEOSS;
- to develop capacity building for making maximum use of globally integrated data and information for local purposes as well as for observation and collecting data.

The AWCI is a new type of an integrated scientific challenge in cooperation with meteorological and hydrological bureaus and space agencies. Its uniqueness is described as follows:

- Effective combination of the architecture and data and the capacity building;
- Advanced data infrastructure availability including a river basin meta-data registration system, a data quality control interface, and data-integration and downscaling methods;
- A clearly described data sharing policy agreed among the participating countries;
- Strong linkage among science communities, space agencies, and decision makers;
- Well coordination between the research communities and operational sectors with clear strategy for transferring scientific achievements to operational use;
- Effective cooperation with international projects and cooperative frameworks.

“Improving water resource management through better understanding of the water cycle” is one of the nine societal benefit areas of GEOSS. GEOSS/AWCI is a regionally cooperative contribution to this socio benefit area.

1. Background and Origin of this Plan

1.1 Water-related issues in Asia

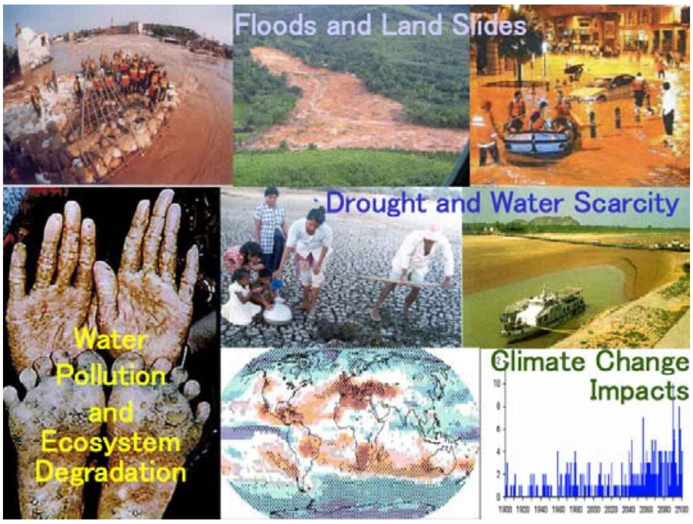
More than 60 percentages of the world population live in Asia associated with the rapid economic growth. The Asian monsoon, which is the largest water circulation system in the world, provides substantial water resources which supports to the food production, energy generation and even transportation in Asia, and causes serious water related problems due to the large seasonal and inter-annual variability of the monsoon rainfall.

Floods are very serious common problems in Asia. More than 80 percent of the loss of human lives by flood in the world occurs in Asia. The expansion of urbanization in Asia is accelerating flood economic damages considerably. Since many Asian countries locate in the tectonic zones, land slides and mud flows are also common natural disasters in Asia.

The Asian monsoon usually provides rich water environment. At same time, its large seasonal and inter-annual variation sometimes leads to severe drought damages in the water consuming societies. The high rate of the population increase is exhausting the water resources and the water scarcity would be a serious issues in the near future.

Excessive water use also affects the water quality and ecosystem. Especially, severe health effects have been observed in populations drinking arsenic-rich water over long periods in some of Asian countries, including Bangladesh, China, India, and Thailand. Over the last decade, it has been recognized that healthy aquatic ecosystems provide tangible economic and social benefits. It is important to understand the drivers and status of ecosystem degradation and the need for watershed restoration in order to improve water productivity across the Asia.

The global warming is changing the water cycle. Heavier rainfall events and larger interannual variations are predicted to be likely to happen according to the "radiative-convective equilibrium". Global warming is considered to make considerable impacts on such a vulnerable region, Asia, where the percentage of completion of river developments is still critically low compared to the high potential water-related hazards.



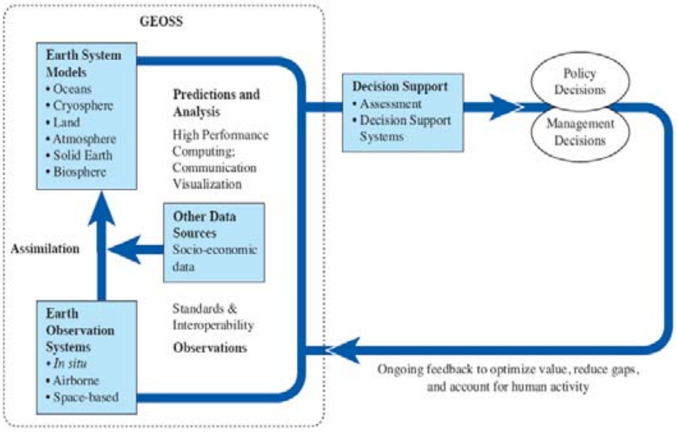
The Water-related Issues in Asia

1.2 GEO and GEOSS

At the World Summit on Sustainable Development (WSSD) in 2002, world leaders proclaimed the need "to promote the development and wider use of Earth observation technologies." That vision built on the outcomes of landmark environmental summits. The need for coordinated Earth observations, and the concept of GEOSS itself, has also been consistently reinforced by G8 Summits. The G8 nations in 2003 at Evian made a clear commitment to strengthen international cooperation on global Earth observations, and reinforced this commitment through the 2005 Gleneagles Plan of Action and the 2007 Summit in Heiligendamm.

Following the discussions at the Earth Observation Summits held in Washington DC and Tokyo, the Brussels Summit established the Group on Earth Observation (GEO) and endorsed the 10 Year Implementation Plan for the Global Observation System of Systems (GEOSS). The goal of GEOSS is to achieve comprehensive, coordinated, and sustained observations of the Earth system to improve monitoring of the changing state of the planet, increase understanding of complex Earth processes, and enhance the prediction of the impacts of environmental change. GEOSS will meet the need for all nations to benefit from access to timely, quantitative, and high-quality long-term global data and information as a basis for sound decision making. "Improving water resource management through better understanding of the water cycle" is one of the nine socio-benefit areas, including *Disasters, Human Health, Energy Management, Climate Variability and Change, Water Cycle, Weather, Protection of Ecosystems, Agriculture,* and *Conserving Biodiversity*.

Vision of GEOSS



Structure of the GEOSS Functions

1.3 Asian Initiative

Under the framework of GEOSS, representatives of hydrological and meteorological organizations and science communities in Asia gathered together, and began to discuss about how to address the water-related issues in Asia in cooperative ways by making maximum use of GEOSS.

At the 1st Asian Water Cycle Symposium (AWCS) in Tokyo, November, 2005, the participants recognized the common water-related issues and socio-economic needs as described above. They shared ideas on the large natural variation of the Asian monsoon and the big impacts of the human activities in Asia as their backgrounds. To address these issues, they considered that well coordinated scientific and operational challenges and efforts should be launched by making maximum use of the GEOSS, which is leading convergence and harmonization of observation activities, interoperability arrangements, and effective and comprehensive data management. Then, they agreed to establish a basic plan for “Asian Water Cycle Initiative (AWCI) contributing to GEOSS” and to organize an International Task Team(ITT) for drafting an implementation plan for demonstration projects.

Based on the discussions at the first ITT meeting and the International Workshop on Capacity Building "Earth Observations in the service of Water Management", both held in Bangkok in September 2006, a baseline implementation plan for the GEOSS/AWCI demonstration projects was proposed at the 2nd AWCS in Tokyo, in January 2006. The symposium fully approved the baseline idea and established the International Coordination Group (ICG) consisting of the national representatives and the working group co-chairs for promoting the cooperative activities.

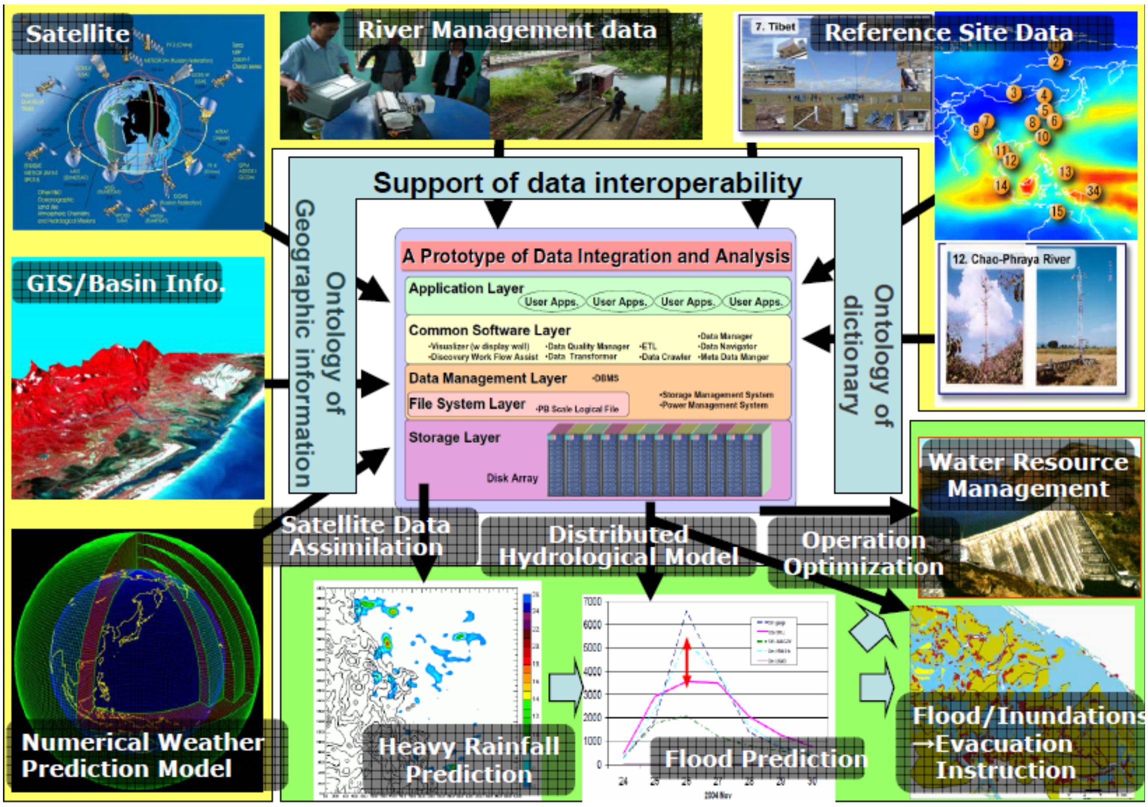
The 1st ICG was held in Bali, in September 2007. The update of each country activity was reported and the contents and procedure of the demonstration project implementation plan were discussed, following the confirmation of the baseline implementation plan.

AWCI Preparation Meetings

2. Scope

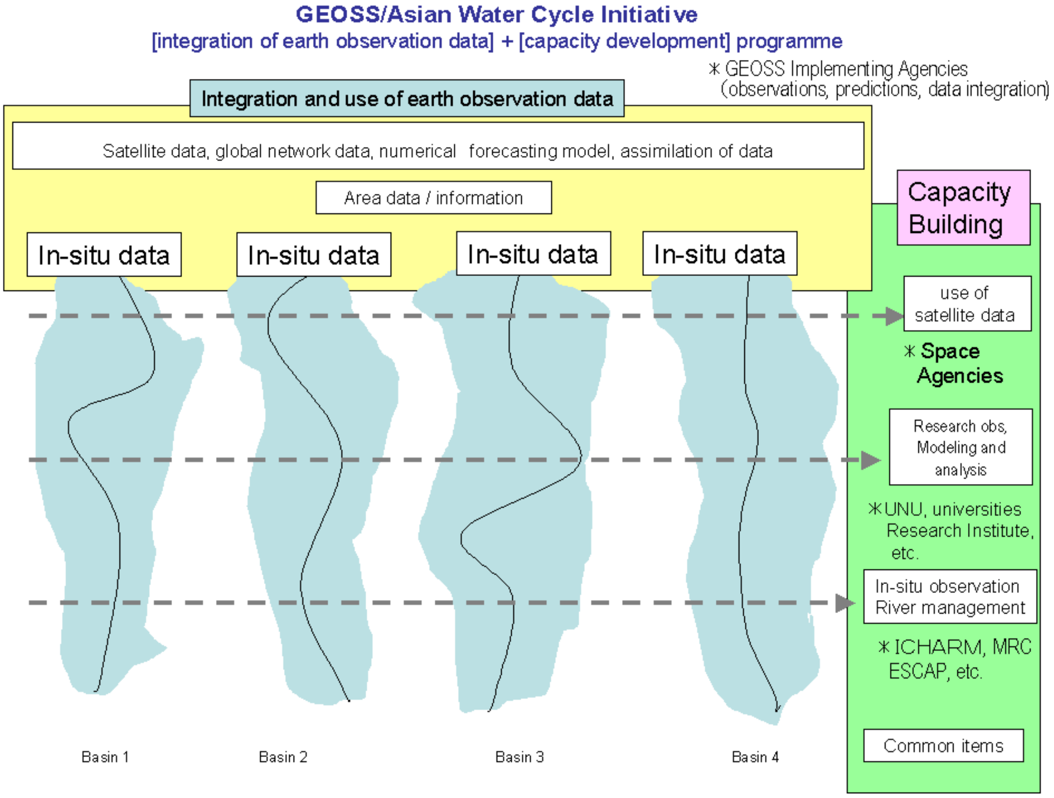
GEOSS/AWCI promotes observation convergence by making seamless access to the data from earth observation satellites, in-situ reference site networks, and operational observation systems, integrates the observed data, numerical weather prediction model outputs, geographical information, and socio-economic data, and disseminates usable information for sound decision making of water resources management against flood and landslide, drought and water scarcity, water pollution and ecosystem degradation, and impacts of the climate change on water.

The Data Integration and Analysis System (DIAS) at the University of Tokyo, one of the members of GEOSS data integration analysis alliance, supports GEOSS/AWCI to realize observation convergence, data integration and data and information sharing. Diverse and large-volume Earth Observation data is archived by a well-managed data infrastructure where user can explore targeted data and information and analyze and integrate them easily and effectively. A meta data directory system, coupled with ontology systems of dictionary and geographical information, supports users to understand the meaning of the data and information across various disciplines and geographical locations. A clearly described data policy is approved for promoting a regional collaboration to address the common water-related issues in Asia.



GEOSS/AWCI Observation Convergence, Data Integration, and Information Sharing

GEOSS/AWCI enforces capacity for a broader community to generate, interpret and utilize value-added products from the observations, beyond training of qualified technical personnel to operate the observing instruments, by coordinating requests from participating countries and potential capabilities of supporting organizations and on-going and/or planed projects.



GEOSS/AWCI Structure

GEOSS/AWCI International Coordination Group (ICG) consisting of international science communities, space agencies, and water-related ministries and agencies of the participating countries, takes a strategic demonstration approach. By showing success stories created through demonstration projects to decision makers, GEOSS/AWCI will shift the emphasis from scientific challenges to operational applications to yield the societal benefits and establishes confirmed water management infrastructure against the water related problems.

3. Observation Convergence, Data integration, and Information Sharing

3.1 Observation Convergence

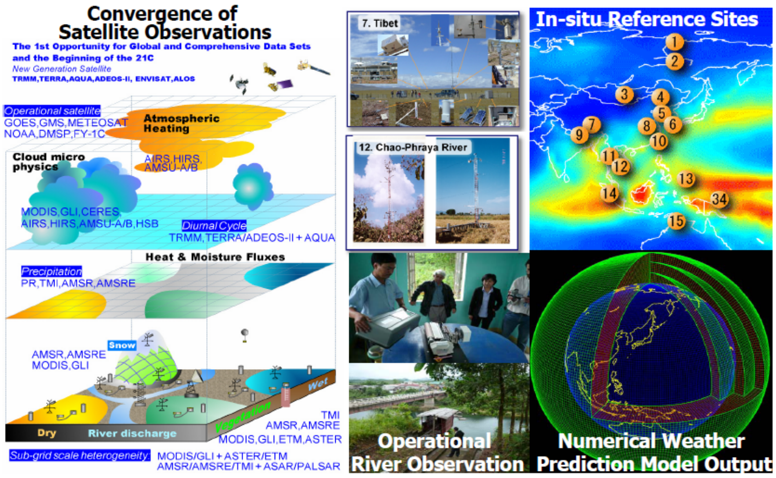
GEOSS/AWCI converges earth observation satellites, in-situ reference site networks, and operational observation systems, integrates the observed data, numerical weather prediction model outputs, geographical information, and socio-economic data, and disseminates usable information for sound decision making of water resources management in cooperation with Coordinated Energy and Water Cycle Observations Project (CEOP) of the Global Energy and Water Cycle Experiment (GEWEX), World Climate Research Programme (WCRP).

The data obtained at the CEOP reference sites in tropics, semi-arid regions, and high mountain areas in Asia is provided to GEOSS/AWCI. Even there are big varieties in observation elements, data format, and recorded interval of the original reference site data, CEOP can provide well quality checked data with a unified format in cooperation with the site observers by using a Web based Quality Control (QC) and format conversion system.

Data from sensors on board Earth observation satellites in various orbits, polar/geostational or sun-synchronous/non-sun-synchronous, around the Earth can be integrated to provide hydrological information, water vapor, cloud, rainfall, soil moisture, and snow, at all spatial scales from local to global and temporal ones from diurnal to decadal.

Model output from many Numerical Weather Prediction (NWP) centers is provided. Ten operational NWP centers and two data assimilation centers are currently contributing to this component of CEOP. To assist with the organization of this activity, a CEOP Model Output Management Document was drafted as a guide for the participating centers to use in setting up their processes for meeting their commitments to CEOP.

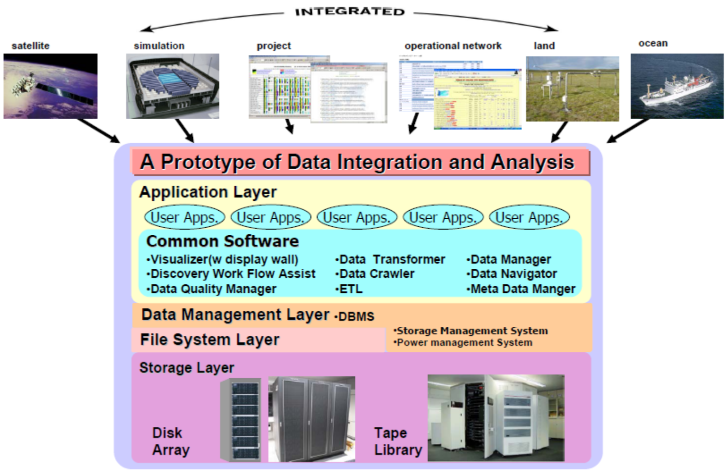
In addition to the above data to be provided by CEOP, run-off data, dam operation data, geographical information including topography, land cover, and land use, population and socio-economic data are collected in the river basins targeted by GEOSS/AWCI.



GEOSS/AWCI Observation Convergence

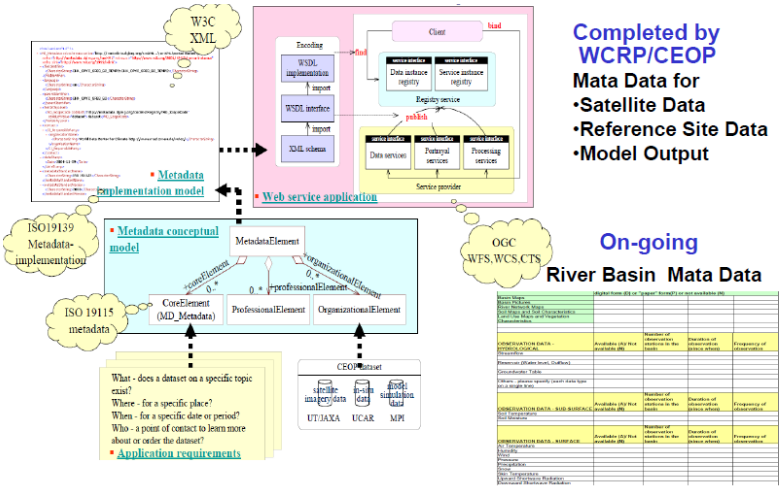
3.2 Data Integration and Analysis

DIAS, which is functioning as the CEOP centralized data integration system, provides cooperative opportunities for constructing GEOSS/AWCI data archives, developing data integration and analysis functions, and develops the required. Specialized system architecture enables the management of large amounts of complex Earth Observation data in an information-rich era. Various observed data and numerical model outputs can be easily integrated. Targeted data can be selected by date and region. Analyzed output can be visualized on a display wall. Results can also be visualized in 3D.



GEOSS/AWCI Data Integration System

An ontology system enables users to find target data and information from diverse data sources. To find data with similar meanings, it is often necessary to clarify the terminology. The ontology system learns the definition. If a data name is not clear, keywords can be input to yield several candidate data names. Standardized meta data are needed for exploring data, confirming its meaning and quality, and to enable it to be widely shared. A Standardized meta data model is now under development in cooperation with the international standardization communities.

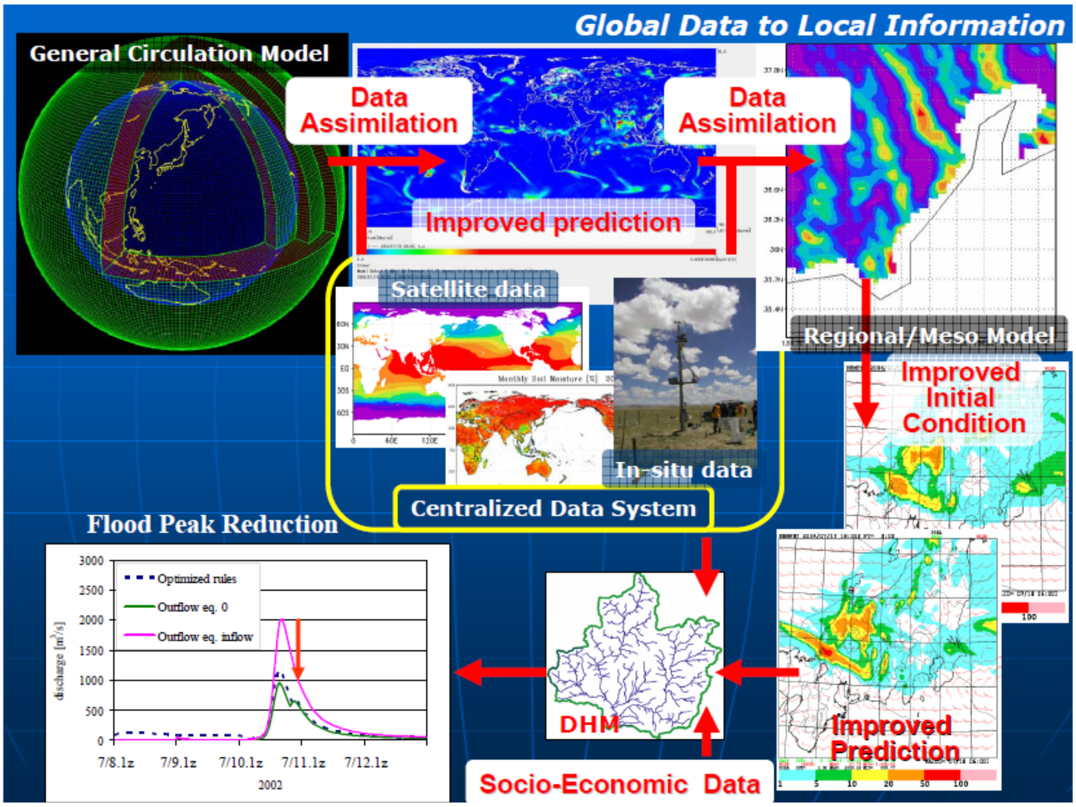


What - does a dataset on a specific topic exist?
Where - for a specific place?
When - for a specific date or period?
Who - a point of contact to learn more about or order the dataset?

GEOSS/AWCI Interoperability Arrangement

Water-related hazards usually occur as causes and consequences of large water cycle fluctuations at scales of global and regional, while disasters and damages due to the hazards happen through strong linkage with human activities in a local scale. The observations and predictions of the water-related hazards and their damages are also enhanced by combining global earth observation and prediction systems and local information. In this context, "downscaling" of water cycle from global to regional and to local is one of the key integration functions of the GEOSS/AWCI.

General Circulation Models (GCMs) currently used for predicting weather and climate have a coarse spatial resolution size, which cannot capture the details of orography and land use nor resolve important cyclonic disturbances or similar-sized circulation features. This precludes an accurate representation of precipitation on scales of individual grid boxes. The method for producing local-to-regional scale information from larger-scale GCM data is called “downscaling”. GEOSS/AWCI makes maximum use of the global earth observation and prediction, develops a downscaling system coupled with satellite-based data assimilations and distributed hydrological models, and disseminates usable information in a river basin scale or less for decision making on disaster mitigation and water resources planning..



GEOSS/AWCI Down-scaling Process

3.3 Data Release and Dissemination Guidelines

The large part of the GEOSS/AWCI data including, the reference site and satellite data and the NWP model outputs, are provided by WCRP/GEWEX/CEOP. It is thus appropriate that any policy for release and dissemination of GEOSS/AWCI data should principally follow the CEOP Data Release and Dissemination Guidelines.

1) Release of Data in Compliance with WMO Resolution 40 (CG-XII) and WMO Resolution 25 (CG-XIII)

GEOSS/AWCI archives meteorological, hydrological, and related data and products in Asia for addressing the common water-related issues in Asia. Any policy for release and dissemination of GEOSS/AWCI data should principally comply with the WMO policy, practice and guidelines for the exchange of meteorological, hydrological, and related data and products, as embodied in Resolution 40 of the Twelfth WMO Congress 1995 (CG-XII), and Resolution 25 of the Thirteenth WMO Congress 1999 (CG-XIII); that is, free and unrestricted exchange of essential data and products.

The no-restriction principle shall in particular mean that no financial implications are involved for the GEOSS/AWCI data exchange. GEOSS/AWCI *data providers* shall transfer their obtained data to the Data Integration and Analysis System (DIAS) free of charge. Also, GEOSS/AWCI data archived at the DIAS shall be offered free of charge to GEOSS/AWCI *data users*.

2) No Commercial Use or Exploitation

It is understood that all GEOSS/AWCI data shall be delivered to *data users* only for scientific studies and operational uses designed to meet GEOSS/AWCI objectives. Commercial use and exploitation by neither the *data users* nor the DIAS is prohibited, unless specific permission has been obtained from the *data providers* concerned in writing.

3) No Data Transfer to Third Parties

One restriction which will be imposed on all *data users* concerns the re-export or transfer of the original data (as received from the DIAS archive) to a third party. Such restriction shall apply to all categories of GEOSS/AWCI data, and is in the best interests of both the data providers and the potential users. Unrestricted copying of the original data by multiple, independent users may lead to errors in the data and loss of identity of its GEOSS/AWCI origin and is strictly prohibited.

DIAS will offer GEOSS/AWCI data to potential *data users* through electronic means, (e.g. the internet) or other designated media (e.g. CD ROMs). The DIAS shall install technical means to keep protocol on all data transfers to *data users* thus maintaining a catalogue of all *data users*, and the data files they have obtained.

4) Timing for Release of GEOSS/AWCI Data from the DIAS Archive

The timing issue clearly involves some conflicting aspects. The *data user* will obviously be interested in obtaining data as soon as possible after the time of measurement. The data provider as well as the DIAS will wish to ensure the highest attainable quality of the data. The latter will generally be time consuming, particularly in view of the shortage of manpower in many cases.

It is suggested that all GEOSS/AWCI data shall be categorized into *real-time use* (category 1), *standard* (category 2), and *enhanced or experimental* (category 3) data. *Real-time use* data shall be open in real- or near-real- time base. *Standard* data shall be freely open after the basic turn-around period of six months. *Enhanced or Experimental* data shall be freely open after a prolonged turn-around period of 15 months at maximum.

5) Acknowledgement and Citation

Whenever GEOSS/AWCI data distributed by DIAS are being used for publication of scientific results, the data's origin must be acknowledged and referenced. A minimum requirement is to reference GEOSS/AWCI and the DIAS. If only data from one river basin (or a limited number of river basins) has been used, additional acknowledgement to the river baisn(s) and its (their) maintaining institutions or organizations shall be given.

Maintaining continuous, high-quality measurements, performing quality and error checking procedures, and submitting data and related documentation to the DIAS will require substantial financial and logistical efforts of the *data providers*. The necessary support for these *data providers'* activities originate from a variety of international, national and institutional sources. The DIAS shall make proper reference to all GEOSS/AWCI *data providers* and, if required, to their funding sources.

6) Co-operation between Data Users and Providers

Data users of GEOSS/AWCI data are encouraged to establish direct contact with the *data providers* for the purpose of complete interpretation and analysis of data for publication purposes. This is in particular recommended for category 2 data.

7) Co-Authorship

Co-authorship of *data users* and *data providers* on papers making extensive use of GEOASS/AWCI data is justifiable and highly recommended, in particular, if *date providers* have responded to questions raised about the data's quality and/or suitability for the specific study in question, or have been involved in directly contributing to the paper in other ways. It is highly recommended that any *data user* should contact the responsible person of the data provider and ask him/her if he/she wants to become co- author, or if an acknowledgement would be sufficient. If co-authorship is requested, the *data provider* and the *data user* should establish a basis for collaboration.

8) GEOSS/AWCI Publication Library

Whenever GEOSS/AWCI data distributed by DIAS are being used for publication of scientific results, the author(s) shall sent a copy of the respective publication, preferably in electronic form, to the DIAS in order to build up a GEOSS/AWCI publication library. DIAS will maintain this library and will it make public, for example via DIAS's web site, for a continuous monitoring of the GEOSS/AWCI data applications and GEOSS/AWCI's achievements in general.

4. GEOSS/AWCI Capacity Development Framework

4.1 Goal and Objectives

The goal of the capacity development program of the GEOSS/AWCI is to facilitate and develop sustainable mechanisms for the countries in Asia Pacific to use advanced earth observations systems, associated data and tools for water cycle research and water resources management under GEOSS framework.

The specific objectives of the program are to develop capacities of the Asian countries for;

1) Downscaling regional and global information to basin scale and to improve accuracy required by operational water management applications through a combination of numerical forecasting and fusion of local observations.
2) Identify reliable and efficient tools to convert the available observations and data to useful information for flood management through data transformations, interpolation, classification and estimation algorithms.
3) Conversion of information to water resources management applications, both for operational use and scenario based assessments for planning purposes.

The initial focus areas of the program have been selected as floods, water quality and droughts.

4.2 Target groups

The program recognizes three main target groups as;

1) Researchers / Scientists where the emphasize is customizing existing knowledge to suit local conditions supported by global experiences
2) Professional / Practitioners which focuses on introducing new methodologies, tools and standards
3) Administrative / Local governments officials to provide an over view of technology and science

Different capacity development tools and programs will be combined to reflect the relevant emphasize and coverage for each target group.

4.3 Methodology

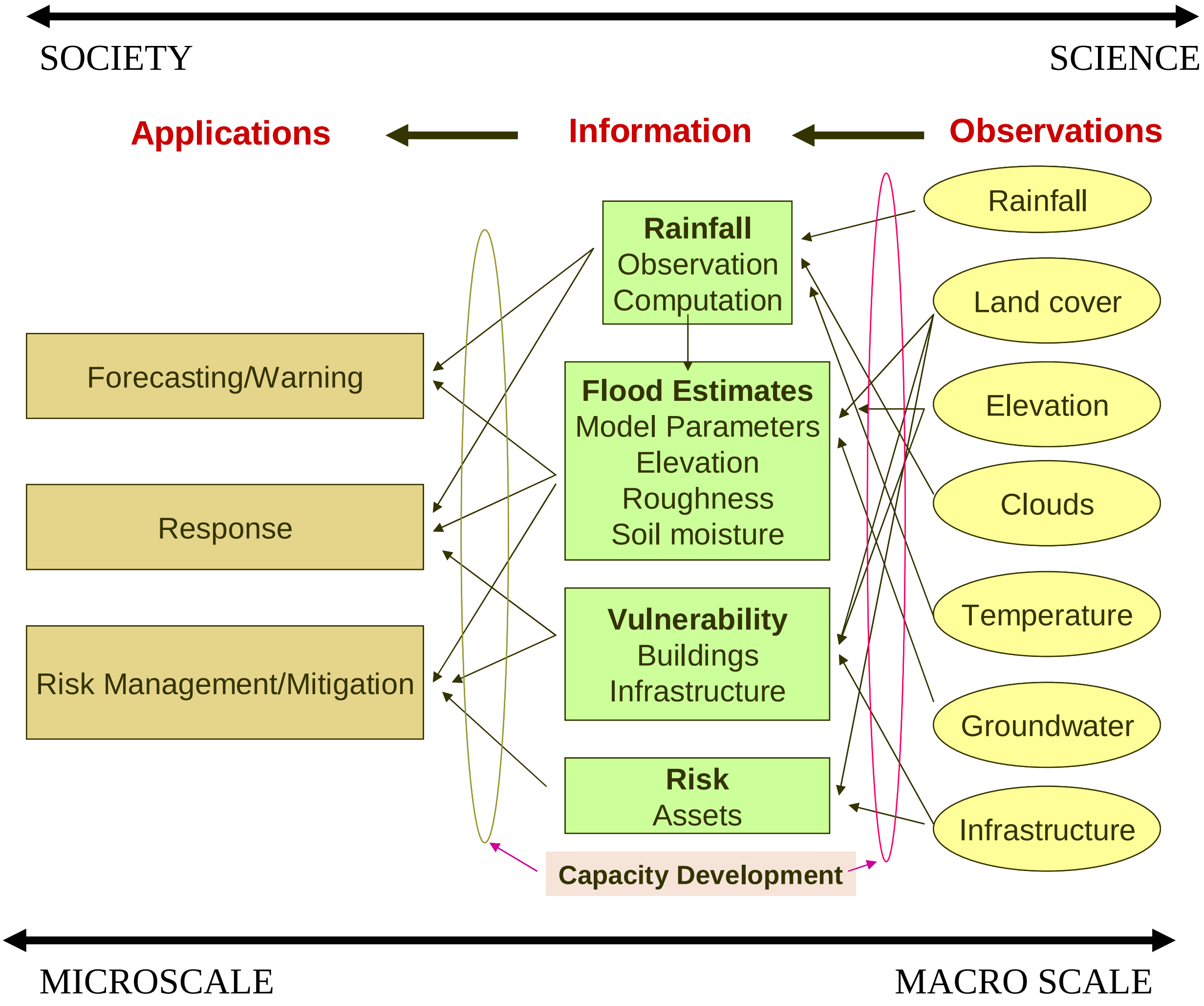
The program will be developed and be used concurrently in support of applications in 19 Asian Basins proposed to be studied within the Asian Water Cycle Initiative for clarification of basin water cycle and the development of appropriate water management practices. The training and capacity development program consist of elements such as short term training/long term training, online training materials, examples or modules, research opportunities, technical advise on existing projects, access to data and access to software. It will emphasize on sustainability and the need to customize technologies to suit local conditions by carefully setting up teams in each country made up of leading educational and research institutes and responsible government organizations that would function as core teams to ensure the future development and enhancement of the methodologies and incorporation of them to national programs.

4.4 Institutions

United Nations University, Tokyo, Japan will coordinate the capacity development program of AWCI in collaboration with the University of Tokyo, JAXA, ICHARM, AIT and other regional and national academic, research and governmental institutes that are identified though a resource survey.

4.5 Conceptual Diagram

The approach of capacity development program is depicted for capacity development in flood risk reduction as an example.



5. Strategic Implementation

By facilitating “observation convergence, data integration, information sharing” and promoting “capacity building”, GEOSS/AWCI is aiming for;

1) developing an information system of systems for promoting the implementation of integrated water resources management (IWRM);
2) making a bridge between the data and information from the global scale to a river basin scale for sound decision making; and
3) shifting from research activities and achievements to operational use for contributing to societal benefits.

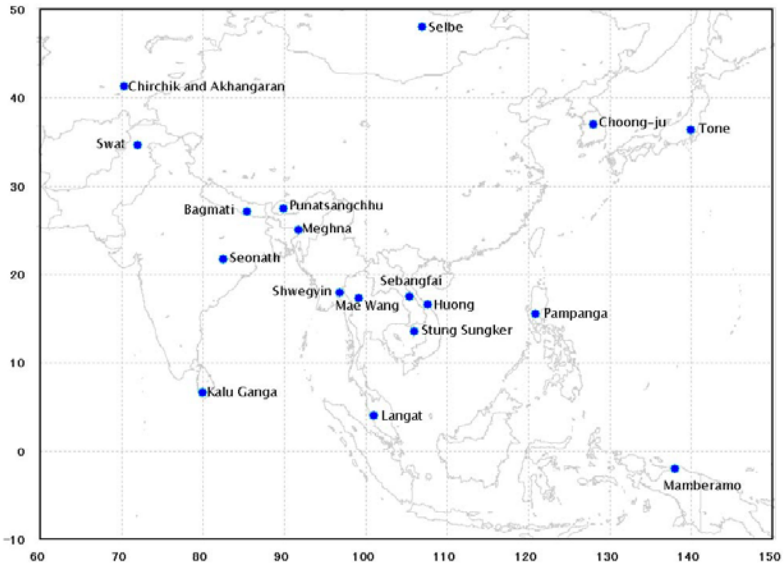
To achieve these objectives, GEOSS/AWCI adopts two approaches, “demonstration approach” and “working group approach”.

Demonstration Approach

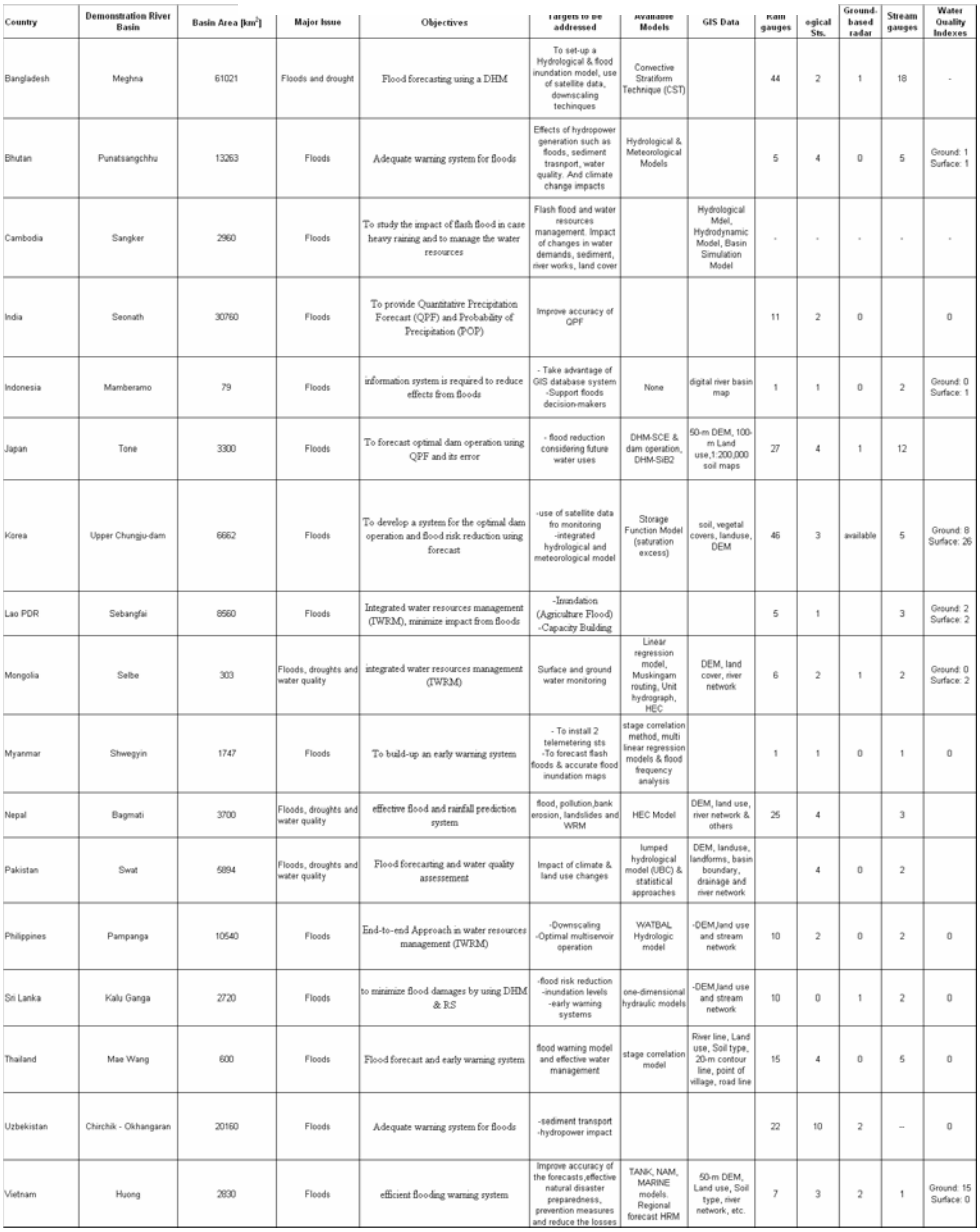
GEOSS/AWCI is a new challenge to lead in the solution of the water-related problems. It is effective to start with small-scale projects and to show early success stories to stake holders after intensive implementation. As the first step, one river basin is selected from each participating country as a target of a demonstration project, according the following criteria:

1) Importance of the basin from the viewpoint of the socio-economic benefit area and hydrological sciences
2) Minimum requirement of data availability:
    a. Data type: rainfall, streamflow, weather station data (air temp., wind speed, pressure, humidity）
    b. Spatial density of observation stations: according to the WMO standard but local specifics to be considered;
    c. Watershed characteristics information
3) Highly expected data:
    d. Upper air observation is highly recommended
    e. Near-real time data availability is highly recommended;
    f. Ground water and water quality data availability for the river basins where those problems should be addressed.
4) Size of the watershed: 100 km^2 – 1,000,000 km^2

So far, 17 river basins are selected as demonstration project targets. The location and summary of the demonstration project river basins are shown as follows:



Location of the demonstration river basins



Country	Demonstration River Basin	Basin Area [km²]	Major Issue	Objectives	Targets to be addressed	Available Models	GIS Data	Rain gauges	ogical Sts.	Ground-based radar	Stream gauges	Water Quality Indexes
Bangladesh	Meghna	61021	Floods and drought	Flood forecasting using a DHM	To set-up a Hydrological & flood inundation model, use of satellite data, downscaling techinques	Convective Stratiform Technique (CST)		44	2	1	18	-
Bhutan	Punatsangchhu	13263	Floods	Adequate warning system for floods	Effects of hydropower generation such as floods, sediment trasnport, water quality. And climate change impacts	Hydrological & Meteorological Models		5	4	0	5	Ground: 1 Surface: 1
Cambodia	Sangker	2960	Floods	To study the impact of flash flood in case heavy raining and to manage the water resources	Flash flood and water resources management. Impact of changes in water demands, sediment, river works, land cover		Hydrological Mdel, Hydrodynamic Model, Basin Simulation Model	-	-	-	-	-
India	Seonath	30760	Floods	To provide Quantitative Precipitation Forecast (QPF) and Probability of Precipitation (POP)	Improve accuracy of QPF			11	2	0		0
Indonesia	Mamberamo	79	Floods	information system is required to reduce effects from floods	- Take advantage of GIS database system -Support floods decision-makers	None	digital river basin map	1	1	0	2	Ground: 0 Surface: 1
Japan	Tone	3300	Floods	To forecast optimal dam operation using QPF and its error	- flood reduction considering future water uses	DHM-SCE & dam operation, DHM-SiB2	50-m DEM, 100-m Land use,1:200,000 soil maps	27	4	1	12	
Korea	Upper Chungju-dam	6662	Floods	To develop a system for the optimal dam operation and flood risk reduction using forecast	-use of satellite data fro monitoring -integrated hydrological and meteorological model	Storage Function Model (saturation excess)	soil, vegetal covers, landuse, DEM	46	3	available	5	Ground: 8 Surface: 26
Lao PDR	Sebangfai	8560	Floods	Integrated water resources management (IWRM), minimize impact from floods	-Inundation (Agriculture Flood) -Capacity Building			5	1		3	Ground: 2 Surface: 2
Mongolia	Selbe	303	Floods, droughts and water quality	integrated water resources management (IWRM)	Surface and ground water monitoring	Linear regression model, Muskingam routing, Unit hydrograph, HEC	DEM, land cover, river network	6	2	1	2	Ground: 0 Surface: 2
Myanmar	Shwegyin	1747	Floods	To build-up an early warning system	- To install 2 telemetering sts -To forecast flash floods & accurate flood inundation maps	stage correlation method, multi linear regression models & flood frequency analysis		1	1	0	1	0
Nepal	Bagmati	3700	Floods, droughts and water quality	effective flood and rainfall prediction system	flood, pollution,bank erosion, landslides and WRM	HEC Model	DEM, land use, river network & others	25	4		3	
Pakistan	Swat	5894	Floods, droughts and water quality	Flood forecasting and water quality assessement	Impact of climate & land use changes	lumped hydrological model (UBC) & statistical approaches	DEM, landuse, landforms, basin boundary, drainage and river network		4	0	2	
Philippines	Pampanga	10540	Floods	End-to-end Approach in water resources management (IWRM)	-Downscaling -Optimal multiservoir operation	WATBAL Hydrologic model	-DEM,land use and stream network	10	2	0	2	0
Sri Lanka	Kalu Ganga	2720	Floods	to minimize flood damages by using DHM & RS	-flood risk reduction -inundation levels -early warning systems	one-dimensional hydraulic models	-DEM,land use and stream network	10	0	1	2	0
Thailand	Mae Wang	600	Floods	Flood forecast and early warning system	flood warning model and effective water management	stage correlation model	River line, Land use, Soil type, 20-m contour line, point of village, road line	15	4	0	5	0
Uzbekistan	Chirchik - Okhangaran	20160	Floods	Adequate warning system for floods	-sediment transport -hydropower impact			22	10	2	--	0
Vietnam	Huong	2830	Floods	efficient flooding warning system	Improve accuracy of the forecasts,effective natural disaster preparedness, prevention measures and reduce the losses	TANK, NAM, MARINE models. Regional forecast HRM	50-m DEM, Land use, Soil type, river network, etc.	7	3	2	1	Ground: 15 Surface: 0

Summary of the demonstration project river basins.

Working Group Approach

GEOSS/AWCI organizes three working groups; flood, drought, and water quality. Each WG covers both of “observation convergence, data integration, information sharing” and “capacity building” and address to the demonstration river basins in a strategic way.

1) Flood WG

The goal of the flood WG is to build up a scientific basis for sound decision-making and developing policy options for most suitable flood risk management for each country and region in Asia, through the full utilization of new opportunities on global, regional and in-situ dataset under the scheme of AWCI (contributing to GEOSS), which was established in 20051).

To attain the goal, we need to provide methodologies, tools and basic datasets to derive such required information to improve real-time flood forecasting system for short-term crisis management (objective #1) and to assess flood risk and vulnerability and then to make flood scenarios for long-term integrated flood risk management (obj. #2).

From technological point of view, it has been becoming possible for us to set those objectives, based on recent scientific achievements on climatology, meteorology and hydrology in the Asian monsoon regions such as those of GAME (GEWEX Asian Monsoon Experiments, WCRP) and on satellite-based observation of rainfall, physical & socioeconomic quantities of earth surfaces and numerical weather reanalysis, downscaling & prediction.

It is, however, indispensable for us to consider the disparity in existing resources and capabilities among different countries/regions as well as their varied needs and environments. Flood WG constructs an international/inter-organizational cooperative field to promote research on a "demonstration project" for each different study basin to build up the first successful implementation about the one or two above objective(s) and to make it a good showcase to strengthen appropriate interactions among scientists and policy-makers and to provide scientific input (corresponding to Policy Agenda of APN Strategic Plan) for the real implementation of the systems all over the flood-prone areas in Asia.

Considering the disparity of capabilities of countries in Asia as above, the demonstration project will be coupled with capacity development offered by advanced global-change research network activities and organizations in Asia. The framework of AWCI contributing to GEOSS has already incorporated with the Coordinated Energy and Water Cycle Observation Project (CEOP), Integrated Global Observing Strategy Partnership (IGOS-P), Monsoon Asian Hydro-Atmosphere Scientific Research and Prediction Initiative (MAHASRI) as a part of Global Energy and Water Cycle Experiment (GEWEX) of WCRP, Prediction in Ungaged Basins (PUB) of International Association of Hydrological Sciences (IAHS), and so forth

Organizations related to global climate change having potential to provide AWCI with technical supports have been also participated in this proposal such as the University of Tokyo, Japan Aerospace Exploration Agency (JAXA), the United Nations University (UNU), Kasetsart University of Thailand, Asian Institute of Technology (AIT), the International Centre for Water Hazard and Risk Management (ICHARM), Mekong River Commission Secretariat (MRCS) and so forth.

Those will facilitate the development of research infrastructure and the transfer of know-how and technology for flood forecasting system (objective #1), flood risk assessment and flood scenario generation (objective #2) in this proposed project. These activities will lead to improving the scientific and technical capabilities of nations in the regions of Asia in terms of hydrological forecasting and planning.

2) Drought WG

GEOSS/AWCI is collaborating among 18 Asian countries in sharing the ground observational data, and trying to support the information exchange and improve the technology of drought monitoring and studying among these Asian countries. The main objectives of this project are:

- To share and improve the drought monitoring capability in various Asian countries such as China, Pakistan, Thailand, Nepal and Philippines
- To set up a drought monitoring and research network in related Asian countries.
- To help developing the early warning system of drought hazard in related countries

The drought study is mainly based on the observation of precipitation, temperature and soil moisture by now, such as various drought index and moisture index. The satellite products have not been widely used since lack of capacity building in many Asian countries. Under the support of JAXA and Tokyo University, the retrieved soil moisture dataset from satellite remote sensing products will be used in these projects, and the related countries collaborators will validate this data set by using the in-situ observation of soil moisture, precipitation and temperature. The GEOSS/AWCI will be in charge of coordinate this regional activity, along with the flood and water quality groups

Drought indices are wildly used in monitoring and studying the drought, such as Standardized Precipitation Index (SPI), Palmer Drought Severity Index (PDSI), Crop Moisture Index (CMI), Surface Water Supply Index (SWSI). These indices mainly based on the ground observations of precipitation, temperature and soil moisture. But the standards of definition of these indices are differed from countries and regions. In addition, the capability of monitoring the drought are various according to the spatial and temporal resolution of observation stations in different countries and regions.

Because of the complex of soil type, ground water deposit. irrigation and vegetation type in the area, soil moisture will be a key indicator of drought monitoring besides precipitation and temperature in this project. JAXA (Japan Space Agency) and University of Tokyo will help developing a set of soil moisture dataset in specific region we are interested in for related countries. Optical and microwave remote sensing datasets will be used in this project. In many studies, microwave products have many advantages in bare surface, especially in dry area. Optical products, such as NDVI and LAI are usually used for full cover vegetation area to understand the vegetation and soil processes. For partly vegetation cover area, optical and microwave products will be both used in getting the high resolution soil moisture data. The University of Tokyo and JAXA will lead in retrieving the remote sensing data. The Asian Institute of Technology, Thailan, proposed a drought index called Temperature Vegetation Dryness Index (TVDI) is calculated from satellite derived vegetation index (NDVI) and surface temperature, TVDI index will be used to monitor the drought in various countries of Asia

The participants from related Asian countries in GEOSS/AWCI will provide the ground observation dataset of temperature, precipitation and soil moisture et al. For example, Shanxi province of China is chosen as the typical research area for drought monitoring in China. Shanxi is a typical semi-arid region with average precipitation about 500mm per year, and it is influenced by drought hazard severely under the global warming and human activity (carbon emission and intensive agriculture). The summer precipitation decreased about 15% in last thirty years, There are 108 observing stations in whole area of Shanxi (150,000KM2). The meteorological observations (T,P,W,P etc) are four times per day. The soil temperature and moisture observation are taken place per ten days, and 32 stations among 108 are having soil observations per five days. Figure 1 shows the summer precipitation (a), 10cm soil moisture in summer (b), and the distribution of 108 stations in Shanxi (blue dot). We could find the dry areas are not always matches the low precipitation, the monitoring of drought severity will be more accurate if we include the information of soil moisture and temperature. It may related to other factors like topography and irrigation. Under the framework of GEOSS/AWCI, we will choose other typical areas in Mongolia, Pakistan, Vietnam, Thailand and Nepal.

3) Water Quality WG

The goal is to contribute towards sustainable management and development of water and health. The main objective is to conduct a phased (2- 3 years) research on the scopes of institutions to develop appropriate water quality monitoring program for domestic water in developing in Asia and disseminate the results. The specific objectives during the first year (as this proposal is detailing out first year) will include:

- Analysis of the roles, capacities, practices, policies, methods (and indicators), synergies, and needs in monitoring WQ by the water concerned main institutions in Bangladesh, Pakistan and Vietnam.
- Identification and comparison of the common and specific problems as well as the related best approaches in WQ monitoring in the three countries
- Conducting of a formative/indicative research to investigate preliminary appropriate WQ monitoring options for domestic water by in-situ and satellite measurements based on selected specified indicators.
- Incorporating the results and experiences gained here into the GEOSS/AWCI
- Suggest policy advice on how the institutions and countries can make attempts for appropriate WQ monitoring in the 3 countries in particular and in other countries of the

region in general.

The methodology will include analyses of national and international literatures and, regional information exchange/discussion/result finalization in regional meeting among collaborating countries. There will be three multiple country/regional meetings. The first meeting will be between Co-chairs and lead organizations finalize the investigation tools about preliminary WQ indicators by in-situ and satellite methods. It will be done in the University of Tokyo.

The first regional meeting (RG-1) will be among Bangladesh, Pakistan, Vietnam, and Japan to finalize and agree upon the country level data collection plan, tools and reporting guidelines. It will be done in Bangladesh. The main information to be collected will include: existing WQ monitoring program and indicators (during flood and other periods), policies, roles and responsibilities by the institutions, needs, capacities, best practice case studies, opportunities at national and international perspectives, and other issues. The final regional meeting (RG-2) will include: presentation of all the results by the 3 countries, presentation of invited papers by the investigators and participants from other 7 developed and developing countries, finalization of the draft results, development of technical and policy recommendations for the countries and outline of the final report among representatives from various institutions.

The activities under the specific objective # iii about the preliminary WQ options will be done between RG-1 and RG-2. The indicative results and experiences gained will be discussed in the final regional consultations to suggest its further testing and/or other possibilities in Bangladesh as well as in the other countries in the following years or by other projects. In addition to the multi-country meetings (consultations in person), there will be planned quarterly consultations among the investigators and chairs over internet.

6. International Cooperation and Project Management

To promote international cooperation and project management, GEOSS/AWCI established the International Coordination Group consisting of a national representative of each member country, working group co-chair, invited experts and secretariat.

Country Representative
Bangladesh: Samarendra Karmakar (Bangladesh Meteorological Department)
Bhutan: Karma Chhophel(Hydro-met Services)
Cambodia: So Im Monichoth (Department Hydrology and River Works)
China: Qian Mingkai (Huaihe River Commission, Ministry of Water Resources)
India: Surinder Kaur (India Meteorological Department)
Indonesia: Joesron Loebis (Research Institute for Water Resources)
Japan: Toshio Koike (The University of Tokyo)
Korea: Deg-Hyo Bae (Sejong University)
Lao: Chanthachith Amphaychith (Lao National Mekong Committee)
Malaysia: Ahmad Jamalluddin Shaaban (National Hydraulic Research Institute of Malaysia)
Mongolia: Davaa Gombo (Institute of Meteorology and Hydrology)
Myanmar: Htay Htay Than (Dept. of Meteorology and Hydrology)
Nepal: Shiv Kumar Sharma (Department of Water Induced Disaster Prevention)
Pakistan: Bashir AHMAD(Water Resources Research Institute/ National Agriculture Research Center)
Philippines: Flaviana Hilario (PAGASA/DOST)
Sri Lanka: S. B. Weerakoon (University of Peradeniya)
Thailand: Thada Sukhapunaphan (Ministry of Agriculture and Cooperatives)
Uzbekistan: Sergey Myagkov (Hydrometeorological Research Institute)
Vietnam: Khanh Van Duong (National Hydro-meteorological Forecasting Center)

WG Co-chairs:
K. Fukami/S. Herath (Flood)
Ailikun/A. Dolgosuren(Drought)
B.Hoque/ H.Furumai (Water Quality)

Invited Experts:
C. Ishida (Satellite), D. Yang (Hydrological Model), V. Hansa (Integration)

AWCI Secretary:
A.Goda, P.Koudelova, O. Saavedra, K.Tamagawa, K. Taniguchi, K.Umezawa, K.Misawa

7. Implementation Plans for the Demonstration Projects

Once the demonstration river basin was selected for each country according to the requirements described in Chapter 5, each country representative was asked to fill out a basin template. This template attempts to retrieve a description of reference basins and their implementation plans in 5 key sections as described below.

1) Background, targeted issues and objectives

In this section a brief introduction to the river basin including major issues, latest event when the issue was evident, targets to be addressed through demonstration, and objectives are expected.

2) River basin characteristics

A brief description of basin characteristics including climate regime, topographical feature, dominant land use and soil type, and socio-economic information was asked. Moreover, with the geographic coordinates in longitude and latitude which encloses the basin was requested. Additionally, a river basin map in JPEG format was asked to illustrate the basin extension, river network and the observation stations.

3) Observation system

A template chart was provided in order be filled out with number of stations available in the basin for the most relevant and expected variables. The location of observation sites is included in the river basin map according to the possibility of each representative.

4) Models, GIS, Data Integration System, Prediction System

In this section the available hydrological and meteorological models, GIS, data integration systems, prediction systems are targeted. Also, the current means of flood and/or drought forecast and water quality monitoring.

5) Implementation Schedule of the Demonstration

This template timeline chart was proposed to propose an implementation schedule of the demonstration. The activities selected in the chart are the most representative in order to meet the goals of our approach.

From next page please find a two-page basin template for each of the following 17 countries respectively:

Bangladesh/Bhutan/Cambodia/India/Indonesia/Japan/Korea/Laos/Mongolia/Myanmar/Nepal/Pakistan/ Philippines /Sri Lanka/Thailand/Uzbekistan/Vietnam

Country: Bangladesh **River basin name:** Meghna **Basin Area:** 61021 [km^2]

1. Background, targeted issues and objective

1.1 Brief introduction to the river basin within four lines

Natural disasters like flood and drought occurs almost every years in Bangladesh. In recent years (2004 and 2007) the occurrence of flood in this basin hampers the development of the country. Moreover, there is a shortage of observational data hampers proper monitoring of flood situation and utilization of forecasting techniques. The inundation areas are widely extended through the country.

1.2 Major issues (Please use a circle): [✓ Floods] [✓ Droughts] Water Quality

1.3 Latest event when the issue was evident according to above one(s):

Variable/indicator & date: major floods on 2004.07.24 and 2007.08.04

1.4 Targets to be addressed through demonstration (up to 3):

To set-up a Hydrological & flood inundation model, use of satellite data and downscaling techniques

1.5 Objective: The main goal is to achieve flood forecasting using a Hydrological model and inundation areas in order to obtain an optimal flood warning system and evacuation plan.

2. River basin characteristics

2.1 Climate regime (Please use a circle):

Very Humid [✓ Humid] Temperate Semi-arid Arid Cold/Tundra

2.2 Topography (minimum, average and maximum elevation): -24, 480, 3817

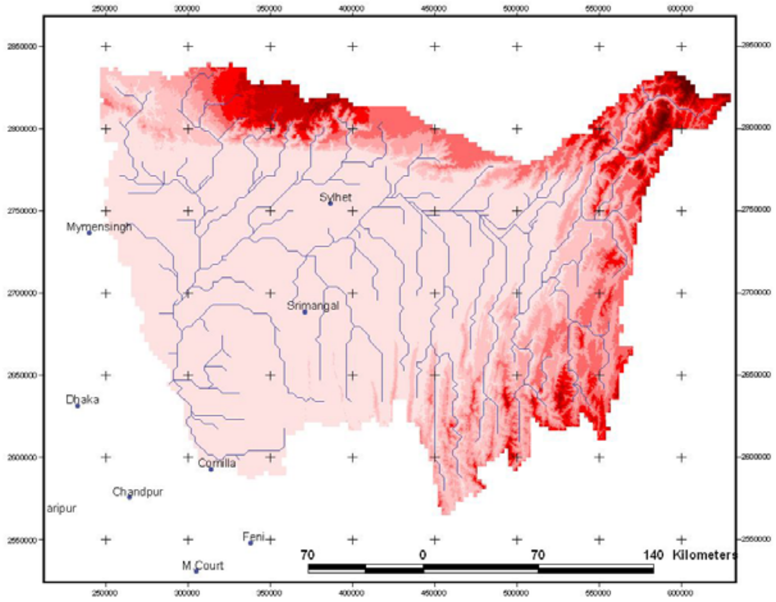
2.3 Annual average rainfall of about [mm]: At Meghalaya Hills higher 3000

2.4 Dominant land use: agriculture and forest

2.5 Dominant soil type: loam-clay

2.6 Geographic coordinates [Lon, Lat]: from 90.5° to 92.5° E, from 23.25° to 25.25°

2.7 River basin map [JPEG] with location of major observation sites:



3. Observation system

SURFACE	**Number**	**HYDROLOGICAL**	**Number**
Air Temperature	2	Stream flow	18
Humidity	2	Reservoir (Water level, Outflow)	38
Wind	2	Groundwater Table	
Pressure	2	Evaporation	2
Precipitation	44	Soil Temperature	2
Snow Depth		Soil Moisture	2
Skin Temperature	RCM data	**Atmosphere**	**Number**
Upward Shortwave Radiation	RCM data	Planetary Boundary Layer Tower	
Downward Shortwave Radiation	RCM data	Pilot Balloon	1
Upward Long wave Radiation	RCM data	Radiosonde	
Downward Long wave Radiation	RCM data	Radar	1
Net Radiation	RCM data	**Water Quality**	**Number**
Sensible Heat Flux	RCM data	Groundwater quality indicators	
Latent Heat Flux	RCM data	Surface water quality indicators	
Ground Heat Flux	RCM data	**Others**	**Number**
CO2 Flux		Ground Water Well	20

4. Models, GIS, Data Integration System, Prediction System

4.1 Hydrological model: -------------

4.2 Land Surface Scheme:----------- Meteorological model: Convective Stratiform Technique (CST)

4.3 List of digital GIS data at fine resolution (besides global data set):

4.4 Data integration system:-----------

4.5 Type of Prediction system and Downscaling technique: CST, flood forecasting and warning center

Used mainly for: [✓ Floods] Droughts Water Quality Monitoring IWRM

5. Implementation Schedule of the Demonstration. Modify the arrows

ACTIVITIES	2008/I	2008/II	2009/I	2009/II	2010/I	2010/II	2011/I	2011/II
Hydro-meteorological & water quality monitoring	→	→						
Data integration system (input data preparation, quality check)					→	→		
Improvement of in-situ observation network system	→	→						
Setting-up a Distributed Hydrological Model (optional LSS)					→	→		
Scenario Studies: Land use change analysis, dry periods, etc.					→	→		
Capacity building on Floods, Droughts & Water Quality	→	→	→	→	→	→		
Parallel testing of the system at operational stage								
IWRM plan development of floods, droughts & water quality								

Country: Bhutan **River basin name:** Punatsangchhu **Basin Area:** 13,263 [km^2]

1. Background, targeted issues and objective

1.1 Brief introduction to the river basin within four lines

The river basin is the second largest in Bhutan and very important from an economic point of view. Punakha-Wangdue is one of the most fertile valleys. In addition, the biggest hydropower plants are also planned in this basin. On the other hand, the frequent glacier melt increases the risk of glacial lake outburst floods (GLOF) and then decreasing flow in the rivers afterwards.

1.2 Major issues (Please use a circle): [✓ Floods] Droughts Water Quality

1.3 Latest event when the issue was evident according to above one(s):

Variable/indicator & date: flood due to glacial outburst in October 1994

1.4 Targets to be addressed through demonstration (up to 3):

-Flood forecast

-Impacts of the hydropower generation

-A sediment transport study

1.5 Objective: Determination of an adequate warning system for floods and assist in monitoring the flow regimes in the rivers due to climate change.

2. River basin characteristics

2.1 Climate regime (Please use a circle): dominated by the monsoon

Very Humid Humid [✓ Temperate] Semi-arid Arid Cold/Tundra

2.2 Topography (minimum, average and maximum elevation): 200(min), 6500(max)

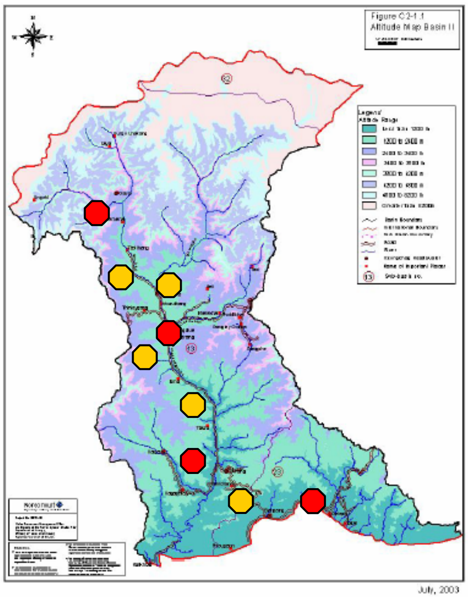
2.3 Annual average rainfall of about [mm]: 500 at foothills and above 5000 in upper reaches

2.4 Dominant land use: agriculture

2.5 Dominant soil type: it varies

2.6 Geographic coordinates [Lon, Lat]: E 89°21’-90°24’ ; N 26°42’- 28°18’

2.7 River basin map [JPEG] with location of major observation sites:



3. Observation system

SURFACE	**Number**	**HYDROLOGICAL**	**Number**
Air Temperature	17	Stream flow	5
Humidity	17	Reservoir (Water level, Outflow)	
Wind	4	Groundwater Table	
Pressure		Evaporation	5
Precipitation	17	Soil Temperature	5
Snow Depth	3	Soil Moisture	
Skin Temperature		**Atmosphere**	**Number**
Upward Shortwave Radiation		Planetary Boundary Layer Tower	
Downward Shortwave Radiation		Pilot Balloon	
Upward Long wave Radiation		Radiosonde	
Downward Long wave Radiation		Radar	
Net Radiation	4	**Water Quality**	**Number**
Sensible Heat Flux		Groundwater quality indicators	1
Latent Heat Flux		Surface water quality indicators	1
Ground Heat Flux		**Others**	**Number**
CO2 Flux			

4. Models, GIS, Data Integration System, Prediction System

4.1 Hydrological model: available

4.2 Land Surface Scheme: ------------ Meteorological model: available

4.3 List of digital GIS data at fine resolution (besides global data set): available

4.4 Data integration system: ------------

4.5 Type of Prediction system and Downscaling technique: ------------

Used mainly for: Floods Droughts Water Quality Monitoring IWRM

5. Implementation Schedule of the Demonstration. Modify the arrows

ACTIVITIES	2008/I	2008/II	2009/I	2009/II	2010/I	2010/II	2011/I	2011/II
Hydro-meteorological & water quality monitoring								
Data integration system (input data preparation, quality check)								
Improvement of in-situ observation network system								
Setting-up a Distributed Hydrological Model (optional LSS)								
Scenario Studies: Land use change analysis, dry periods, etc.								
Capacity building on Floods, Droughts & Water Quality								
Parallel testing of the system at operational stage								
IWRM plan development of floods, droughts & water quality								

Country: Cambodia **River basin name:** Sangker **Basin Area:** 2961[km^2]

1. Background, targeted issues and objective

1.1 Brief introduction to the river basin within four lines

It is one of the tributaries of Tonle Sap Lake, located in Battambang Province at southwest of Cambodia. Two hydropower stations are under planned at its upper basin. The middle basin is covered with mixed agriculture and urban area and suffered from flash flood. The downstream region is inundated for 6month in a year by the flood from Tonle Sap Lake and floating rice is cultivated.

1.2 Major issues (Please use a circle): [✓ Floods] Droughts Water Quality

1.3 Latest event when the issue was evident according to above one(s):

Variable/indicator & date:

1.4 Targets to be addressed through demonstration (up to 3):

- Impact of changes in the demands of water intake and dams → basin simulation model
- Impact of changes in climate, water resources, land cover → hydrological model
- Impact of changes in the canal level, sediment, flooding, river works → hydrodynamic model

By using the three model outputs, the impacts on the environment and socio-economics will be addressed.

1.5 Objective: To studies the impact of flash flood in case heavy raining and to manage the water resources

2. River basin characteristics

2.1 Climate regime (Please use a circle):

[✓ Very Humid] Humid Temperate Semi-arid Arid Cold/Tundra

2.2 Topography (minimum, average and maximum elevation):

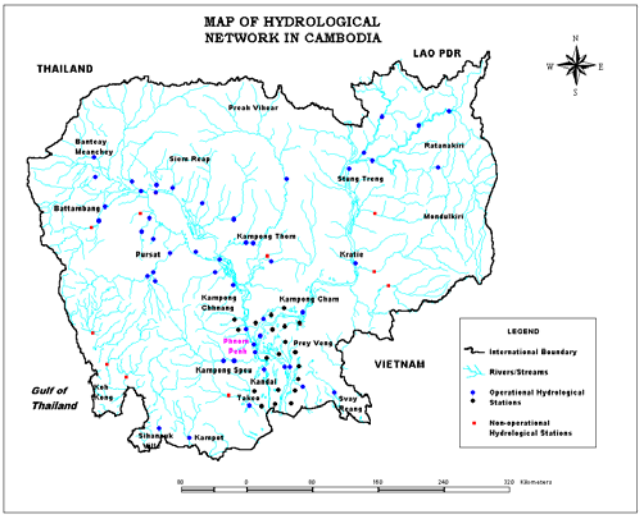
2.3 Annual average rainfall of about [mm]:

2.4 Dominant land use: cultivation

2.5 Dominant soil type:

2.6 Geographic coordinates [Lon, Lat]: 102.5 to 104.0E, 12.5 to 13.5 N

2.7 River basin map [JPEG] with location of major observation sites:



3. Observation system

SURFACE	**Number**	**HYDROLOGICAL**	**Number**
Air Temperature	available	Stream flow	available
Humidity	available	Reservoir (Water level, Outflow)	
Wind	available	Groundwater Table	
Pressure		Evaporation	
Precipitation	available	Soil Temperature	
Snow Depth		Soil Moisture	
Skin Temperature		**Atmosphere**	**Number**
Upward Shortwave Radiation		Planetary Boundary Layer Tower	
Downward Shortwave Radiation		Pilot Balloon	
Upward Long wave Radiation		Radiosonde	
Downward Long wave Radiation		Radar	
Net Radiation	available	**Water Quality**	**Number**
Sensible Heat Flux		Groundwater quality indicators	
Latent Heat Flux		Surface water quality indicators	
Ground Heat Flux		**Others**	**Number**
CO2 Flux			

4. Models, GIS, Data Integration System, Prediction System

4.1 Hydrological model: SWAT, IQQM, ISIS

4.2 Land Surface Scheme: Meteorological model:

4.3 List of digital GIS data at fine resolution (besides global data set): DEM with 50 m grid resolution

4.4 Data integration system: Sharing Hymos Databas

4.5 Type of Prediction system and Downscaling technique:

Used mainly for: [✓ Floods] Droughts Water Quality Monitoring [✓ IWRM]

5. Implementation Schedule of the Demonstration. Modify the arrows

ACTIVITIES	**2008/I**	**2008/II**	**2009/I**	**2009/II**	**2010/I**	**2010/II**	**2011/I**	**2011/II**
Hydro-meteorological & water quality monitoring								
Data integration system (input data preparation, quality check)								
Improvement of in-situ observation network system								
Setting-up a Distributed Hydrological Model (optional LSS)								
Scenario Studies: Land use change analysis, dry periods, etc.								
Capacity building on Floods, Droughts & Water Quality								
Parallel testing of the system at operational stage								
IWRM plan development of floods, droughts & water quality								

Country: India **River basin name:** Seonath river **Basin Area:** 30,760 [km^2]

1. Background, targeted issues and objective

1.1 Brief introduction to the river basin within four lines

It is the largest tributary of Mahanadi basin. It rises in the Chandrapur district of Maharashtra at an elevation of about 532m and meets Mahanadi river after traversing a distance of about 383km.

1.2 Major issues (Please use a circle): [✓ Floods] Droughts Water Quality

1.3 Latest event when the issue was evident according to above one(s):

Variable/indicator & date:

1.4 Targets to be addressed through demonstration (up to 3):

1.5 Objective: The objective of the project is to provide Quantitative Precipitation Forecast (QPF) and Probability of Precipitation (POP) of the basin by downscaling technique (MOS, PPM, neural network etc) using the NWP model products and other data to the station/basin level. The accuracy of QPF should be high enough so that it can be used in flood forecasting model (at least 80%).

2. River basin characteristics

2.1 Climate regime (Please use a circle):

Very Humid [✓ Humid] Temperate Semi-arid Arid Cold/Tundra

2.2 Topography (minimum, average and maximum elevation):

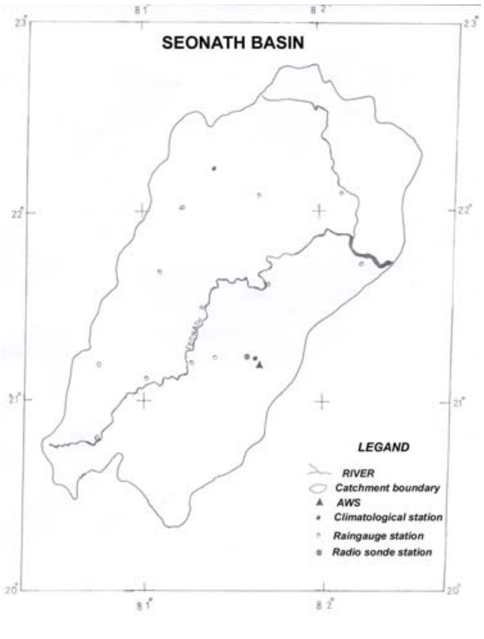
2.3 Annual average rainfall of about [mm]:

2.4 Dominant land use: cultivation (72%)

2.5 Dominant soil type:

2.6 Geographic coordinates [Lon, Lat]: 80.5 to 82.5 E, 20 to 23N

2.7 River basin map [JPEG] with location of major observation sites:



3. Observation system

SURFACE	**Number**	**HYDROLOGICAL**	**Number**
Air Temperature	2	Stream flow	
Humidity	2	Reservoir (Water level, Outflow)	
Wind	2	Groundwater Table	
Pressure	1	Evaporation	1
Precipitation	11	Soil Temperature	1
Snow Depth		Soil Moisture	1
Skin Temperature		**Atmosphere**	**Number**
Upward Shortwave Radiation		Planetary Boundary Layer Tower	
Downward Shortwave Radiation		Pilot Balloon	
Upward Long wave Radiation		Radiosonde	1
Downward Long wave Radiation		Radar	
Net Radiation		**Water Quality**	**Number**
Sensible Heat Flux		Groundwater quality indicators	
Latent Heat Flux		Surface water quality indicators	
Ground Heat Flux		**Others**	**Number**
CO2 Flux			

4. Models, GIS, Data Integration System, Prediction System

4.1 Hydrological model:

4.2 Land Surface Scheme: Meteorological model: available

4.3 List of digital GIS data at fine resolution (besides global data set):

4.4 Data integration system:

4.5 Type of Prediction system and Downscaling technique:

Used mainly for: [✓ Floods] Droughts Water Quality Monitoring IWRM

5. Implementation Schedule of the Demonstration. Modify the arrows

ACTIVITIES	2008/I	2008/II	2009/I	2009/II	2010/I	2010/II	2011/I	2011/II
Hydro-meteorological & water quality monitoring								
Data integration system (input data preparation, quality check)			→	→	→	→		
Improvement of in-situ observation network system								
Setting-up a Distributed Hydrological Model (optional LSS)								
Scenario Studies: Land use change analysis, dry periods, etc.								
Capacity building on Floods, Droughts & Water Quality								
Parallel testing of the system at operational stage							→	→
IWRM plan development of floods, droughts & water quality								

Country: Indonesia **River basin name:** Mamberamo **Basin Area:** 78992 [km^2]

1. Background, targeted issues and objective

1.1 Brief introduction to the river basin within four lines

Annual flood is occurred during rainy season and nowadays also during drought season, due to Indonesia lay on the monsoon climate zone. Regarding to that, information system is required to inventory and process data about flood occurrence as information for decision-maker to take the right action in managing the flood.

1.2 Major issues (Please use a circle): [✓ Floods] Droughts Water Quality

1.3 Latest event when the issue was evident according to above one(s):

Variable/indicator & date: ------------------------------

1.4 Targets to be addressed through demonstration (up to 3):

-Take advantage of GIS database system

-Support floods decision-makers

1.5 Objective: A system is required to forecast floods in order to reduce their effects

2. River basin characteristics

2.1 Climate regime (Please use a circle): monsoon

Very Humid [✓ Humid] Temperate Semi-arid Arid Cold/Tundra

2.2 Topography (minimum, average and maximum elevation): 0, 5000

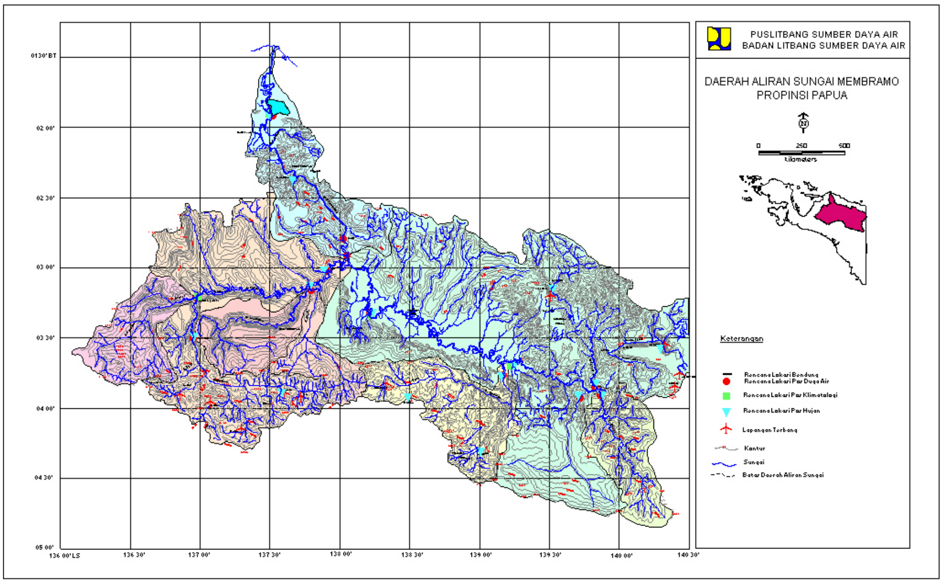
2.3 Annual average rainfall of about [mm]: 3500 to 5000

2.4 Dominant land use: upper tropical forest; while swamps in lowlands

2.5 Dominant soil type: ---------------

2.6 Geographic coordinates [Lon, Lat]: 136.3º through 140.82º E; 1.45º through 4.53º S

2.7 River basin map [JPEG] with location of major observation sites:



3. Observation system

SURFACE	**Number**	**HYDROLOGICAL**	**Number**
Air Temperature	1	Stream flow	2
Humidity	1	Reservoir (Water level, Outflow)	
Wind	1	Groundwater Table	
Pressure	1	Evaporation	
Precipitation	1	Soil Temperature	
Snow Depth		Soil Moisture	
Skin Temperature		**Atmosphere**	**Number**
Upward Shortwave Radiation		Planetary Boundary Layer Tower	
Downward Shortwave Radiation		Pilot Balloon	
Upward Long wave Radiation		Radiosonde	
Downward Long wave Radiation		Radar	
Net Radiation	1	**Water Quality**	**Number**
Sensible Heat Flux	1	Groundwater quality indicators	
Latent Heat Flux		Surface water quality indicators	1
Ground Heat Flux		**Others**	**Number**
CO2 Flux			

4. Models, GIS, Data Integration System, Prediction System

4.1 Hydrological model: ----------

4.2 Land Surface Scheme: --------- Meteorological model: ----------

4.3 List of digital GIS data at fine resolution (besides global data set):

-digital river basin map

4.4 Data integration system: ----------

4.5 Type of Prediction system and Downscaling technique:

Used mainly for: Floods Droughts Water Quality Monitoring IWRM

5. Implementation Schedule of the Demonstration. Modify the arrows

ACTIVITIES	2008/I	2008/II	2009/I	2009/II	2010/I	2010/II	2011/I	2011/II
Hydro-meteorological & water quality monitoring	→	→	→	→				
Data integration system (input data preparation, quality check)	→	→						
Improvement of in-situ observation network system								
Setting-up a Distributed Hydrological Model (optional LSS)	→	→						
Scenario Studies: Land use change analysis, dry periods, etc.								
Capacity building on Floods, Droughts & Water Quality			→	→				
Parallel testing of the system at operational stage					→	→		
IWRM plan development of floods, droughts & water quality								

Country: Japan **River basin name:** Upper Tone River **Basin Area:** 3300 [km^2]

1. Background, targeted issues and objective

1.1 Brief introduction to the river basin within four lines

It is located in the northern headwaters of the Tone river basin. The Tone river is a very important source of water supply, irrigation and power generation for the Tokyo area. Therefore its management is crucial for the region. According to Japan Meteorological Agency (JMA), the trend of frequency and intensity of heavy rainfall in this region has been increasing on average from 1961-2001.

1.2 Major issues (Please use a circle): [✓ Floods] Droughts Water Quality

1.3 Latest event when the issue was evident according to above one(s):

Variable/indicator & date: Sep. 1947, 171 mm/h caused by a typhoon, 1.6 million people affected

1.4 Targets to be addressed through demonstration (up to 3):

The system which is able to 1) reduce flood peaks at downstream and 2) replenish water levels in reservoirs after a flood event by using quantitative precipitation forecast will be developed. The error forecast will be also considered by the bets means.

1.5 Objective: Release schedule of dams during extreme events does not follow manual, rather the experiences of dam operators are required. Therefore, a system that can support them will be developed.

2. River basin characteristics

2.1 Climate regime (Please use a circle):

Very Humid [✓ Humid] Temperate Semi-arid Arid Cold/Tundra

2.2 Topography (minimum, average and maximum elevation): 100, 1020, 2500

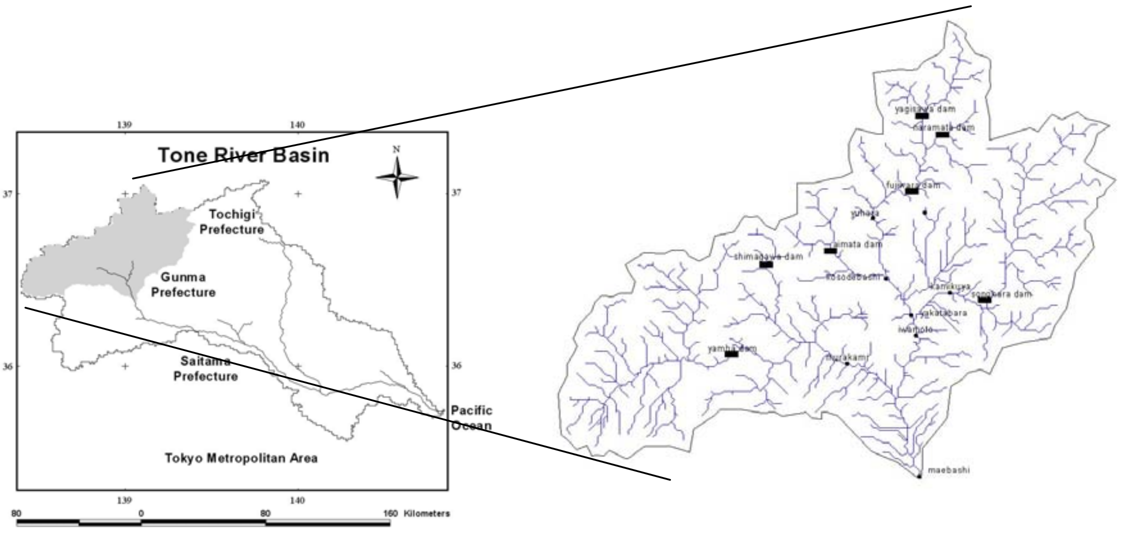
2.3 Annual average rainfall of about [mm]: 1500mm

2.4 Dominant land use: forest (79.3 %) and grasslands (9.5 %)

2.5 Dominant soil type: forest soil (56%), black soil (22%) and high permeable soil (15%)

2.6 Geographic coordinates [Lon, Lat]: 138.2º to 139.6ºE, 36.2º to 37.2º N

2.7 River basin map [JPEG] with location of major observation sites:



3. Observation system

SURFACE	**Number**	**HYDROLOGICAL**	**Number**
Air Temperature	4	Stream flow	12
Humidity	4	Reservoir (Water level, Outflow)	6
Wind	4	Groundwater Table	
Pressure	4	Evaporation	
Precipitation	27	Soil Temperature	
Snow Depth	1	Soil Moisture	
Skin Temperature		**Atmosphere**	**Number**
Upward Shortwave Radiation		Planetary Boundary Layer Tower	
Downward Shortwave Radiation		Pilot Balloon	
Upward Long wave Radiation		Radiosonde	
Downward Long wave Radiation		Radar	1
Net Radiation		**Water Quality**	**Number**
Sensible Heat Flux		Groundwater quality indicators	
Latent Heat Flux		Surface water quality indicators	
Ground Heat Flux		**Others**	**Number**
CO2 Flux			

4. Models, GIS, Data Integration System, Prediction System

4.1 Hydrological model: GBHM

4.2 Land Surface Scheme: SiB2 Meteorological model: Meso-scale Grid Point Data(MSM-GPV)

4.3 List of digital GIS data at fine resolution (besides global data set): 50-m DEM, 100-m digital land use, digitized 1:200,000 soil maps, hydrological thematic maps (slope, river network, and soil depth)

4.4 Data integration system:

4.5 Type of Prediction system and Downscaling technique:

Used mainly for: [✓ Floods] Droughts Water Quality Monitoring IWRM

5. Implementation Schedule of the Demonstration. Modify the arrows

ACTIVITIES	2008/I	2008/II	2009/I	2009/II	2010/I	2010/II	2011/I	2011/II
Hydro-meteorological & water quality monitoring								
Data integration system (input data preparation, quality check)								
Improvement of in-situ observation network system								
Setting-up a Distributed Hydrological Model (optional LSS)	→							
Scenario Studies: Land use change analysis, dry periods, etc.	→	→	→	→				
Capacity building on Floods, Droughts & Water Quality								
Parallel testing of the system at operational stage		→	→	→	→	→		
IWRM plan development of floods, droughts & water quality				→	→	→	→	→

Country: Korea (Republic) **River basin name:** Upper Chungju-dam Basin **Basin Area:** 6,662 [km^2]

1. Background, targeted issues and objective

1.1 Brief introduction to the river basin within four lines

There has been significant damages from floods and flash floods in Korea. In addition to flood control works, some other non-structural countermeasures should be considered. The study area is located at the middle-east of Korean Peninsula. It is an upper part of South Han River and the outlet is at Chungju-dam, which is the largest multi-purpose dam in South Han River basin.

1.2 Major issues (Please use a circle): [✓ Floods] Droughts Water Quality

1.3 Latest event when the issue was evident according to above one(s):

Variable/indicator & date:

1.4 Targets to be addressed through demonstration (up to 3):

1) the use of satellite data for flood and drought monitoring and prediction for enhancement of the existing system; 2) utilization of an integrated hydrological and meteorological forecast system for the optimal dam operation and flood risk reduction.

1.5 Objective: understanding of the regional and global water cycle mechanisms in case of climate change.

2. River basin characteristics

2.1 Climate regime (Please use a circle):

Very Humid Humid [✓ Temperate] Semi-arid Arid Cold/Tundra

2.2 Topography (minimum, average and maximum elevation): 0, 1561

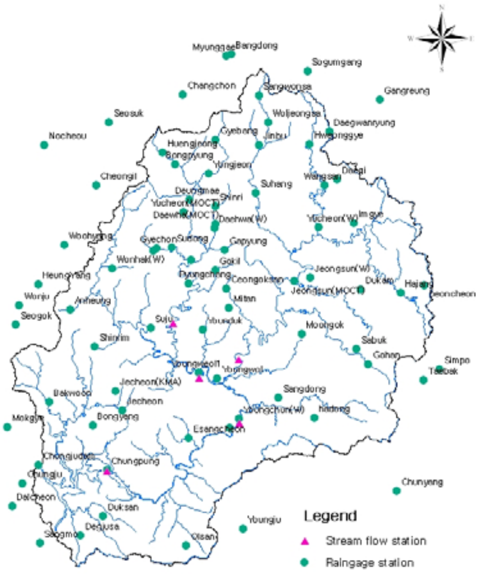
2.3 Annual average rainfall of about [mm]:

2.4 Dominant land use: mountain covered by coniferous and deciduous forests.

2.5 Dominant soil type:

2.6 Geographic coordinates [Lon, Lat]: 127.92 to 129.02 E, 36.79 to 37.82 N

2.7 River basin map [JPEG] with location of major observation sites:



3. Observation system

SURFACE	**Number**	**HYDROLOGICAL**	**Number**
Air Temperature	3	Stream flow	5
Humidity	3	Reservoir (Water level, Outflow)	1
Wind	3	Groundwater Table	
Pressure	3	Evaporation	3
Precipitation	46	Soil Temperature	3
Snow Depth	3	Soil Moisture	
Skin Temperature	3	**Atmosphere**	**Number**
Upward Shortwave Radiation		Planetary Boundary Layer Tower	
Downward Shortwave Radiation		Pilot Balloon	
Upward Long wave Radiation		Radiosonde	
Downward Long wave Radiation		Radar	available
Net Radiation	3	**Water Quality**	**Number**
Sensible Heat Flux		Groundwater quality indicators	8
Latent Heat Flux		Surface water quality indicators	26
Ground Heat Flux		**Others**	**Number**
CO2 Flux			

4. Models, GIS, Data Integration System, Prediction System

4.1 Hydrological model: Storage Function Model 4.2 Land Surface Scheme:

Meteorological model: The global data assimilation and prediction system (GDAPS) for GCM models and the regional data assimilation and prediction system (RDAPS) for regional climatic models

4.3 List of digital GIS data at fine resolution (besides global data set): various data such as soil, vegetal covers, landuse, DEM, etc.

4.4 Data integration system:

4.5 Type of Prediction system and Downscaling technique:

Used mainly for: [✓ Floods] Droughts Water Quality Monitoring IWRM

5. Implementation Schedule of the Demonstration. Modify the arrows

ACTIVITIES	2008/I	2008/II	2009/I	2009/II	2010/I	2010/II	2011/I	2011/II
Hydro-meteorological & water quality monitoring								
Data integration system (input data preparation, quality check)								
Improvement of in-situ observation network system								
Setting-up a Distributed Hydrological Model (optional LSS)								
Scenario Studies: Land use change analysis, dry periods, etc.								
Capacity building on Floods, Droughts & Water Quality								
Parallel testing of the system at operational stage								
IWRM plan development of floods, droughts & water quality								

Country: Lao PDR **River basin name:** Sebangfai River **Basin Area:** 8560 [km^2]

1. Background, targeted issues and objective

1.1 Brief introduction to the river basin within four lines

It is located in Khammouane Province. At the source, the river flows from the Vietnam border in the southeast-northwest direction to Boualapha District and changes direction to the west to Mahaxay District and then turns from the northeast-southwest into the Mekong. With an annual increase of 2.6% since 1990, the total population in the basin is estimated to reach 192,200 in 1998.

1.2 Major issues (Please use a circle): [✓ Floods] Droughts Water Quality

1.3 Latest event when the issue was evident according to above one(s):

Variable/indicator & date:

1.4 Targets to be addressed through demonstration (up to 3):

1) Capacity building of the staffs of Department of Meteorology and Hydrology in making a more accurate flood forecasting and analysis; 2) Assessment of the current conditions of hydro-meteorological stations; 3) discussion on how to improve the current data transmission system and the operation and maintenance of these stations

1.5 Objective:

2. River basin characteristics

2.1 Climate regime (Please use a circle):

[✓ Very Humid] Humid Temperate Semi-arid Arid Cold/Tundra

2.2 Topography (minimum, average and maximum elevation): 150, , 1397

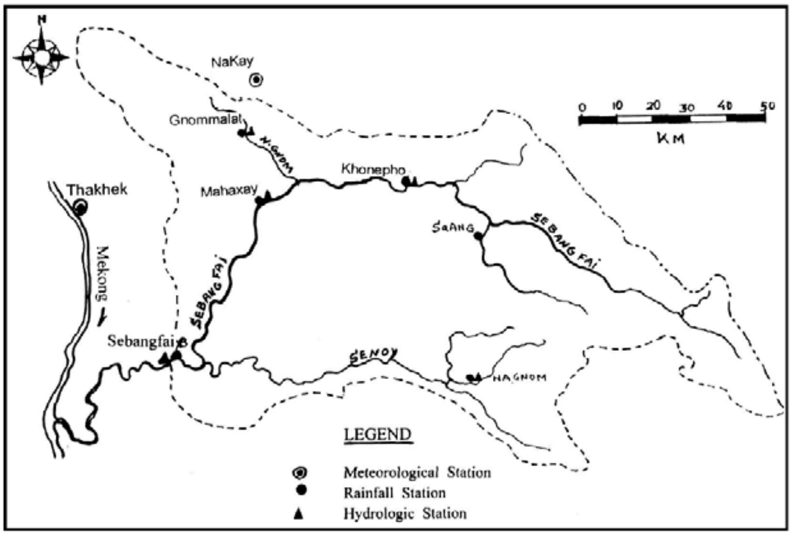
2.3 Annual average rainfall of about [mm]: 2300

2.4 Dominant land use: forest (59 %), paddy (20 %), upland crops (10 %)

2.5 Dominant soil type: Mesozoic, Cretaceaus, Jurassic and Palaezoic

2.6 Geographic coordinates [Lon, Lat]: 105 to 106.5 E, 17 to 18 N

2.7 River basin map [JPEG] with location of major observation sites:



3. Observation system

SURFACE	**Number**	**HYDROLOGICAL**	**Number**
Air Temperature	1	Stream flow	3
Humidity	1	Reservoir (Water level, Outflow)	
Wind		Groundwater Table	
Pressure		Evaporation	1
Precipitation	5	Soil Temperature	1
Snow Depth		Soil Moisture	
Skin Temperature		**Atmosphere**	**Number**
Upward Shortwave Radiation		Planetary Boundary Layer Tower	
Downward Shortwave Radiation		Pilot Balloon	
Upward Long wave Radiation		Radiosonde	
Downward Long wave Radiation		Radar	
Net Radiation		**Water Quality**	**Number**
Sensible Heat Flux		Groundwater quality indicators	2
Latent Heat Flux		Surface water quality indicators	2
Ground Heat Flux		**Others**	**Number**
CO2 Flux			

4. Models, GIS, Data Integration System, Prediction System

4.1 Hydrological model:

4.2 Land Surface Scheme: Meteorological model:

4.3 List of digital GIS data at fine resolution (besides global data set):

4.4 Data integration system:

4.5 Type of Prediction system and Downscaling technique:

Used mainly for: Floods Droughts Water Quality Monitoring IWRM

5. Implementation Schedule of the Demonstration. Modify the arrows

ACTIVITIES	2008/I	2008/II	2009/I	2009/II	2010/I	2010/II	2011/I	2011/II
Hydro-meteorological & water quality monitoring								
Data integration system (input data preparation, quality check)								
Improvement of in-situ observation network system								
Setting-up a Distributed Hydrological Model (optional LSS)								
Scenario Studies: Land use change analysis, dry periods, etc.								
Capacity building on Floods, Droughts & Water Quality								
Parallel testing of the system at operational stage								
IWRM plan development of floods, droughts & water quality								

Country: Mongolia **River basin name:** Selbe **Basin Area:** 303 [km^2]

1. Background, targeted issues and objective

1.1 Brief introduction to the river basin within four lines

It is located in center of Mongolia, in the north of Ulaanbaatar. It is the upper basin of the Tuul Stream basin (6300km^2). From mid of 90th, settling area and population have been rapidly increasing. Following the human activities, individual house building, paved areas, groundwater wells and livestock pasture are in creasing. Also forest cut and cultivation took place in some extend.

1.2 Major issues (Please use a circle): [✓ Floods] [✓ Droughts] [✓ Water Quality]

1.3 Latest event when the issue was evident according to above one(s):

Variable/indicator & date:

1.4 Targets to be addressed through demonstration (up to 3):

1) Environmental degradation (vegetation, soil degradation, deforestation and rapid urbanization impacting on surface and ground water regime and interaction mechanism, ground water contamination, water scarcity and flood control)

2) Surface and ground water monitoring and modeling to assist better management in light of anthropogenic influences and climate change impact and flood control.

3) Assistance of the development of information systems for promoting the implementation of integrated water resources management (IWRM) in the Selbe and Tuul Stream Basins.

1.5 Objective:

2. River basin characteristics

2.1 Climate regime (Please use a circle):

Very Humid Humid Temperate [✓ Semi-arid] Arid Cold/Tundra

2.2 Topography (minimum, average and maximum elevation):

2.3 Annual average rainfall of about [mm]:

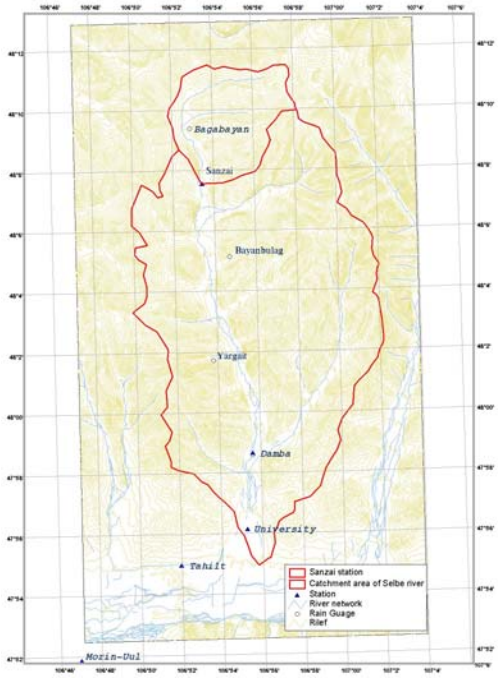
2.4 Dominant land use: forest (59%), urban, pasture

2.5 Dominant soil type: brown and podosor

2.6 Geographic coordinates [Lon, Lat]:

106.8 to 107.0E, 47.9 to 48.3 N

2.7 River basin map [JPEG] with location of major observation sites:



3. Observation system

SURFACE	**Number**	**HYDROLOGICAL**	**Number**
Air Temperature	2	Stream flow	2
Humidity	2	Reservoir (Water level, Outflow)	Not yet defined
Wind	2	Groundwater Table	
Pressure	2	Evaporation	
Precipitation	6	Soil Temperature	1
Snow Depth	1	Soil Moisture	1
Skin Temperature		**Atmosphere**	**Number**
Upward Shortwave Radiation		Planetary Boundary Layer Tower	
Downward Shortwave Radiation		Pilot Balloon	
Upward Long wave Radiation		Radiosonde	1 (Ulaanbaatar, 0800LT & 2000LT)
Downward Long wave Radiation		Radar	1
Net Radiation	1	**Water Quality**	**Number**
Sensible Heat Flux	1	Groundwater quality indicators	Not yet defined
Latent Heat Flux	1	Surface water quality indicators	
Ground Heat Flux		**Others**	**Number**
CO2 Flux			

4. Models, GIS, Data Integration System, Prediction System

4.1 Hydrological model: Linear regression model, Muskingem flood routing, Unit hydrograph model

4.2 Land Surface Scheme: Meteorological model:

4.3 List of digital GIS data at fine resolution (besides global data set): DEM, river network,topography

4.4 Data integration system:

4.5 Type of Prediction system and Downscaling technique:

Used mainly for: Floods Droughts Water Quality Monitoring IWRM

5. Implementation Schedule of the Demonstration. Modify the arrows

ACTIVITIES	2008/I	2008/II	2009/I	2009/II	2010/I	2010/II	2011/I	2011/II
Hydro-meteorological & water quality monitoring	—	—	—	—	—	—	—	→
Data integration system (input data preparation, quality check)					—	—	—	→
Improvement of in-situ observation network system	—	—	—	—	—	→		
Setting-up a Distributed Hydrological Model (optional LSS)	—	—	—	—	—	→		
Scenario Studies: Land use change analysis, dry periods, etc.	—	→						
Capacity building on Floods, Droughts & Water Quality	—	—	—	—	—	→		
Parallel testing of the system at operational stage					—	—	—	→
IWRM plan development of floods, droughts & water quality					—	—	—	→

Country: Malaysia **River basin name**: Langat **Basin Area**: 2,350 [km²]

1. Background, targeted issues and objective

1.1 Brief introduction to the river basin within four lines

Langat River Basin is one of the four major basins in Selangor State. Langat Dam is the major source of domestic water supply for Kuala Lumpur, Putrajaya and areas adjoining to it. Groundwater extraction for industrial use is the minor water source of the basin. The Malaysian Government Administrative Centre Putrajaya is located at the centre of the basin.

1.2 Major issues (Please use a circle): [✓ Floods] [✓ Drought] [✓ Water Quality]

1.3 Latest event when the issue was evident according to above one(s):

Severe drought and water crisis in 1998

1.4 Targets to be addressed through demonstration (up to 3):

- Impact of climate change and land use change on hydrology, water resources and socio-economic activities (HydroClimate Model)
- Impact of changes in the demands of water intake and dam (Basin Simulation Model)
- Impact of changes in the sediment, river level, flooding, river networks (Hydrodynamic Model)

1.5 Objective:

The main goal is to achieve reservoir inflow and water intake forecasting, flood and drought forecasting, and the impact of climate and land use changes on the resources, environment and socio-economics of the basin.

2. River basin characteristics

2.1 Climate regime (please use a circle):

[✓ Very Humid] Humid Temperate Semi-arid Arid Cold/Tundra

2.2 Topography (minimum, average and maximum elevation): 0m, 40m, 100m

2.3 Annual average rainfall of about [mm]: 2,470

2.4 Dominant land use: Agriculture, Urban Area and Forest

2.5 Dominant soil type: Sandy Clay

2.6 Geographic coordinates [Lon, Lat]: From E 101°17’ To E 101°53’; From N 2°40’ To N 3°09’

2.7 River basin map [JPEG] with location of major observation sites:

3. Observation system

SURFACE	**Number**	**HYDROLOGICAL**	**Number**
Air Temperature	11	Stream flow	6
Humidity	11	Reservoir (Water level, Outflow)	1
Wind	1	Groundwater Table	30
Pressure	1	Evaporation	7
Precipitation	35	Soil Temperature	-
Snow Depth	-	Soil Moisture	-
Skin Temperature	-	**Atmosphere**	**Number**
Upward Shortwave Radiation	1	Planetary Boundary Layer Tower	
Downward Shortwave Radiation	1	Pilot Balloon	1
Upward Long wave Radiation	1	Radiosonde	1
Downward Long wave Radiation	1	Radar	1
Net Radiation	1	**Water Quality**	**Number**
Sensible Heat Flux	-	Groundwater quality indicators	30
Latent Heat Flux	-	Surface water quality indicators	30
Ground Heat Flux	-	**Others**	**Number**
CO2 Flux	-		

4. Models, GIS, Data Integration System, Prediction System

4.1 Hydrological model: -

4.2 Land Surface Scheme: - Meteorological model: -

4.3 List of digital GIS data at fine resolution (besides global data set): -

4.4 Data integration system: -

4.5 Type of Prediction system and Downscaling technique: -

Used mainly for: Floods Droughts Water Quality Monitoring IWRM

5. Implementation Schedule of the Demonstration. Modify the arrows

ACTIVITIES	2008/I	2008/II	2009/I	2009/II	2010/I	2010/II	2011/I	2011/II
Hydro-meteorological & water quality monitoring	—	→						
Data integration system (input data preparation, quality check)					—	→		
Improvement of in-situ observation network system	—	→						
Setting-up a Distributed Hydrological Model (optional LSS)					—	→		
Scenario Studies: Land use change analysis, dry periods, etc.	—	→						
Capacity building on Floods, Droughts & Water Quality	—	—	—	—	—	→		
Parallel testing of the system at operational stage								
IWRM plan development of floods, droughts & water quality								

Country: Myanmar **River basin name:** Shwegyin **Basin Area:** 1747 [km^2]

1. Background, targeted issues and objective

1.1 Brief introduction to the river basin within in four lines

Shwegyin town is situated on the mouth of Shwegyin River and composed of 8 wards and 26 villages. It is about 42 miles from north to south and 19 miles from east to west. The high mountains are formed in northern and eastern part and plain areas are in the western and southern part of the basin. There are 5 rivers flowing through the township including Shwegyin River.

1.2 Major issues (Please use a circle): [✓ Floods] Droughts Water Quality

1.3 Latest event when the issue was evident according to above one(s):

Variable/indicator & date: 2650 mm/40 hours 1997.08 30870persons, 6050 area of paddy field

1.4 Targets to be addressed through demonstration (up to 3):

To install two telemeter stations and receiving station in Shwegyin basin

To develop forecasting technique for flash flood

To develop accurate flood inundation maps using all available data including GIS data sources

1.5 Objective:

To get early flood warning system for Shwegyin River Basin

2. River basin characteristics

2.1 Climate regime (Please use a circle):

Very Humid [✓ Humid] Temperate Semi-arid Arid Cold/Tundra

2.2 Topography (minimum, average and maximum elevation): 12, 951, 1890

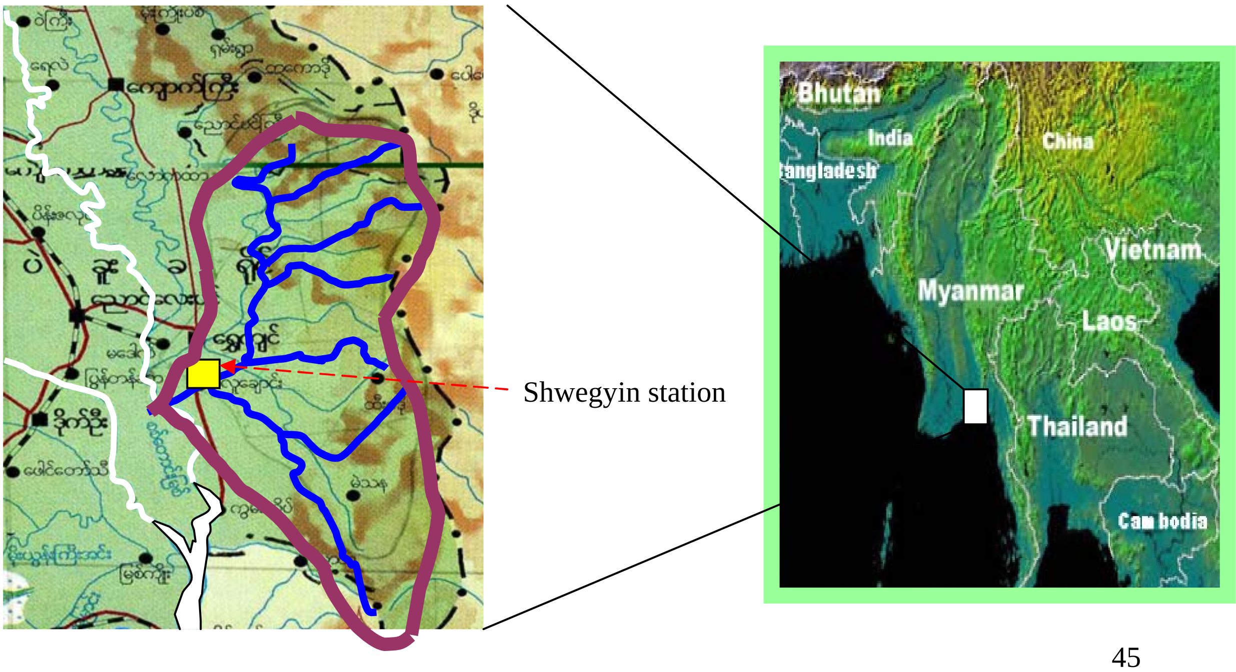
2.3 Annual average rainfall of about [mm]: 35520

2.4 Dominant land use:

2.5 Dominant soil type:

2.6 Geographic coordinates [Lon, Lat]: 96.75 to 97.167 E, 17.5 to 18.5 N

2.7 River basin map [JPEG] with location of major observation sites:



3. Observation system

SURFACE	**Number**	**HYDROLOGICAL**	**Number**
Air Temperature	1	Stream flow	1
Humidity	1	Reservoir (Water level, Outflow)	
Wind	1	Groundwater Table	
Pressure	1	Evaporation	
Precipitation	1	Soil Temperature	
Snow Depth		Soil Moisture	
Skin Temperature		**Atmosphere**	**Number**
Upward Shortwave Radiation		Planetary Boundary Layer Tower	
Downward Shortwave Radiation		Pilot Balloon	
Upward Long wave Radiation		Radiosonde	
Downward Long wave Radiation		Radar	
Net Radiation		**Water Quality**	**Number**
Sensible Heat Flux		Groundwater quality indicators	
Latent Heat Flux		Surface water quality indicators	
Ground Heat Flux		**Others**	**Number**
CO2 Flux			

4. Models, GIS, Data Integration System, Prediction System

4.1 Hydrological model:

4.2 Land Surface Scheme: Meteorological model: multilinear regression

4.3 List of digital GIS data at fine resolution (besides global data set):

4.4 Data integration system: Asynchronous (alphanumeric) Type - 3hourly

4.5 Type of Prediction system and Downscaling technique: flood frequency analysis, stage correlation

Used mainly for: [✓ Floods] Droughts Water Quality Monitoring IWRM

5. Implementation Schedule of the Demonstration. Modify the arrows

ACTIVITIES	2008/I	2008/II	2009/I	2009/II	2010/I	2010/II	2011/I	2011/II
Hydro-meteorological & water quality monitoring								
Data integration system (input data preparation, quality check)								
Improvement of in-situ observation network system								
Setting-up a Distributed Hydrological Model (optional LSS)								
Scenario Studies: Land use change analysis, dry periods, etc.								
Capacity building on Floods, Droughts & Water Quality	→	→	→	→	→	→		
Parallel testing of the system at operational stage								
IWRM plan development of floods, droughts & water quality								

Country: Nepal **River basin name:** Bagmati **Basin Area:** 3700 [km^2]

1. Background, targeted issues and objective

1.1 Brief introduction to the river basin within four lines

Bagmati river originates from the southern slopes of *Shivapuri Lekh* at *Vagdhara*, north of Kathmandu. It flows towards south west from its origin and turns to west in Kathmandu city and emerges out of Kathmandu Valley at *Chovar*. The maximum flood discharge observed is about 11,000 m^3/sec.

1.2 Major issues (Please use a circle): [✓ Floods] Droughts [✓ Water Quality]

1.3 Latest event when the issue was evident according to above one(s):

Variable/indicator & date: rain 540 mm on July 20, 1993 caused extensive damage, 200 deaths

1.4 Targets to be addressed through demonstration (up to 3):

- Reduce flood damages: bank erosion and inundation
- Reduce landslides and debris flows by means of landslides hazard mapping
- Water Pollution is crucial since it is used to meet the irrigation demand

1.5 Objective: to evolve an effective flood and rainfall prediction system including disaster management, resource management, resource allocation and environmental conservation.

2. River basin characteristics

2.1 Climate regime (Please use a circle): sub-tropical

Very Humid [✓ Humid] Temperate Semi-arid Arid Cold/Tundra

2.2 Topography (minimum, average and maximum elevation): Middle Mountain highest 2740 m

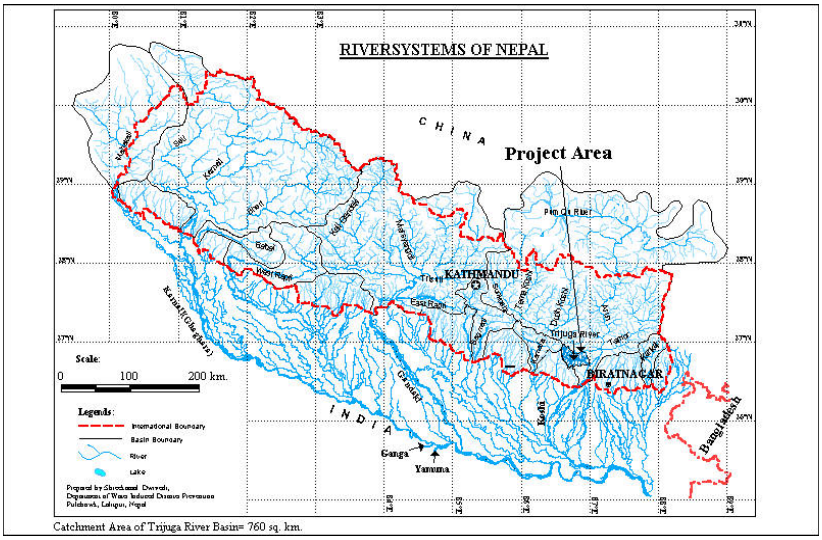
2.3 Annual average rainfall of about [mm]:

2.4 Dominant land use: forest

2.5 Dominant soil type: ----------

2.6 Geographic coordinates [Lon, Lat]: from 85º to 86ºE and 27.83º to 26.75º N

2.7 River basin map [JPEG] with location of major observation sites:



Catchment Area of Trijuga River Basin= 760 sq. km.

3. Observation system

SURFACE	**Number**	**HYDROLOGICAL**	**Number**
Air Temperature	11	Stream flow	3
Humidity	4	Reservoir (Water level, Outflow)	
Wind	4	Groundwater Table	
Pressure	4	Evaporation	2
Precipitation	25	Soil Temperature	2
Snow Depth		Soil Moisture	
Skin Temperature		**Atmosphere**	**Number**
Upward Shortwave Radiation		Planetary Boundary Layer Tower	
Downward Shortwave Radiation		Pilot Balloon	
Upward Long wave Radiation		Radiosonde	
Downward Long wave Radiation		Radar	
Net Radiation		**Water Quality**	**Number**
Sensible Heat Flux		Groundwater quality indicators	
Latent Heat Flux		Surface water quality indicators	
Ground Heat Flux		**Others**	**Number**
CO2 Flux			

4. Models, GIS, Data Integration System, Prediction System

4.1 Hydrological model: HEC Model

4.2 Land Surface Scheme: --------------- Meteorological model: Not available

4.3 List of digital GIS data at fine resolution (besides global data set):

Transportation networks, contours, settlement area, administrative boundaries, land use, river system

4.4 Data integration system: Started archiving data sets such as LANDSAT, SRTM DEM

4.5 Type of Prediction system and Downscaling technique: On-going development, CDMA

Used mainly for: [✓ Floods] Droughts Water Quality Monitoring IWRM

5. Implementation Schedule of the Demonstration. Modify the arrows

ACTIVITIES	2008/I	2008/II	2009/I	2009/II	2010/I	2010/II	2011/I	2011/II
Hydro-meteorological & water quality monitoring								
Data integration system (input data preparation, quality check)								
Improvement of in-situ observation network system								
Setting-up a Distributed Hydrological Model (optional LSS)								
Scenario Studies: Land use change analysis, dry periods, etc.								
Capacity building on Floods, Droughts & Water Quality								
Parallel testing of the system at operational stage								
IWRM plan development of floods, droughts & water quality								

Country: Pakistan **River basin name:** Swat **Basin Area:** 5894 [km^2]

1. Background, targeted issues and objective

1.1 Brief introduction to the river basin within four lines

Almost 70-90 % of the water in the Upper Indus River Basin comes from snowmelt and remote glaciers and precipitation during the monsoon season. Increasing water scarcity and pollution, environmental degradation including desertification, sedimentation, land sliding and water quality are increasing seriously in the Upper Indus Basin. Socio-economic conditions in the area are poor.

1.2 Major issues (Please use a circle): [✓ Floods] [✓ Droughts] [✓ Water Quality]

1.3 Latest event when the issue was evident according to above one(s):

Variable/indicator & date:

1.4 Targets to be addressed through demonstration (up to 3):

- Water resources assessment using in-situ and Remote Sensing data
- Impact of climate change on snow cover and glacier resources
- Impact of land use system changes on agriculture in response to climate change

1.5 Objective: Flood forecasting and water quality monitoring

2. River basin characteristics

2.1 Climate regime (Please use a circle): Affected by monsoon

Very Humid [✓ Humid] Temperate Semi-arid Arid Cold/Tundra

2.2 Topography (minimum, average and maximum elevation): 750 to 5800 m.a.s.l.

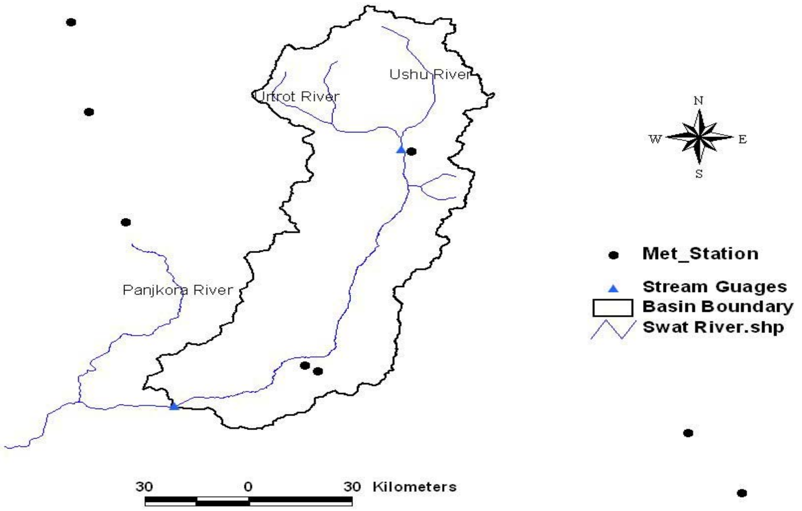
2.3 Annual average rainfall of about [mm]:

2.4 Dominant land use: upper mostly covered with snow and glaciers, some with lakes

2.5 Dominant soil type:

2.6 Geographic coordinates [Lon, Lat]: 71.9° to 72.87° E and 34.52° to 35.93° N

2.7 River basin map [JPEG] with location of major observation sites:



3. Observation system

SURFACE	**Number**	**HYDROLOGICAL**	**Number**
Air Temperature		Stream flow	2
Humidity		Reservoir (Water level, Outflow)	
Wind		Groundwater Table	
Pressure		Evaporation	
Precipitation	4	Soil Temperature	
Snow Depth		Soil Moisture	
Skin Temperature		**Atmosphere**	**Number**
Upward Shortwave Radiation		Planetary Boundary Layer Tower	
Downward Shortwave Radiation		Pilot Balloon	
Upward Long wave Radiation		Radiosonde	
Downward Long wave Radiation		Radar	
Net Radiation		**Water Quality**	**Number**
Sensible Heat Flux		Groundwater quality indicators	
Latent Heat Flux		Surface water quality indicators	
Ground Heat Flux		**Others**	**Number**
CO2 Flux			

4. Models, GIS, Data Integration System, Prediction System

4.1 Hydrological model: lumped hydrological model (UBC) & statistical approaches

4.2 Land Surface Scheme: Meteorological model: ---------------

4.3 List of digital GIS data at fine resolution (besides global data set): DEM, landuse, landforms, basin boundary, drainage and river network, image based glacier/glacial lakes areas

4.4 Data integration system:

4.5 Type of Prediction system and Downscaling technique: statistical approaches for floods and drought indices are used. [✓ Floods] [✓ Droughts] Water Quality Monitoring IWRM

5. Implementation Schedule of the Demonstration. Modify the arrows

ACTIVITIES	2008/I	2008/II	2009/I	2009/II	2010/I	2010/II	2011/I	2011/II
Hydro-meteorological & water quality monitoring	→	→	→	→				
Data integration system (input data preparation, quality check)	→	→	→	→				
Improvement of in-situ observation network system								
Setting-up a Distributed Hydrological Model (optional LSS)	→	→	→	→				
Scenario Studies: Land use change analysis, dry periods, etc.	→	→	→	→				
Capacity building on Floods, Droughts & Water Quality								
Parallel testing of the system at operational stage					→	→	→	→
IWRM plan development of floods, droughts & water quality					→	→	→	→

Country: Philippines **River basin name:** Pampanga **Basin Area:** 10540 [km^2]

1. Background, targeted issues and objective

1.1 Brief introduction to the river basin within four lines

It is the forth largest basin in the Philippines. The total length of the main river is about 260kilometers. The basin is drained through the Pampanga River and via the Labangan Channel into the Manila Bay. The main river is supported by several tributaries. It has a relatively low-gradient channel at the middle and lower sections. There are two dams within the river basin.

1.2 Major issues (Please use a circle): [✓ Floods] Droughts Water Quality

1.3 Latest event when the issue was evident according to above one(s):

Variable/indicator & date:

1.4 Targets to be addressed through demonstration (up to 3):

Downscaling

Optimal multi-purpose reservoir operation

1.5 Objective:

End-to-end approach in water resources management (IWRM)

2. River basin characteristics

2.1 Climate regime (Please use a circle):

Very Humid [✓ Humid] Temperate Semi-arid Arid Cold/Tundra

2.2 Topography (minimum, average and maximum elevation): 100 - 1115

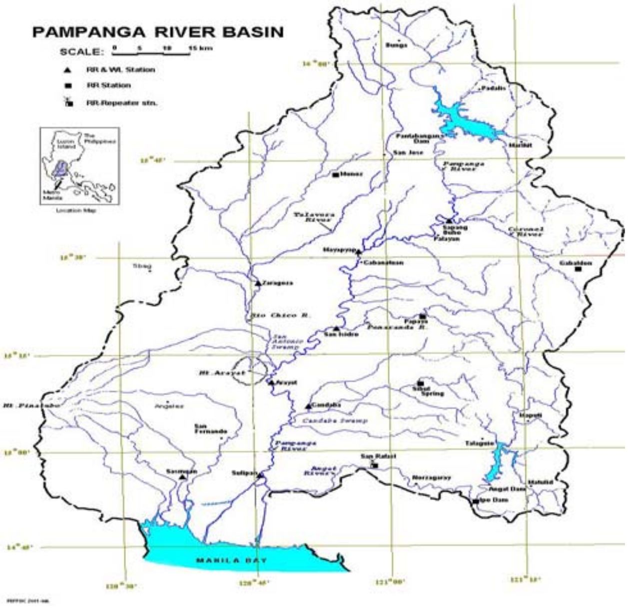
2.3 Annual average rainfall of about [mm]: 4200

2.4 Dominant land use:

2.5 Dominant soil type:

2.6 Geographic coordinates [Lon, Lat]: 120.5 to 121.5 E, 14.75 to 16.25 N

2.7 River basin map [JPEG] with location of major observation sites:



3. Observation system

SURFACE	**Number**	**HYDROLOGICAL**	**Number**
Air Temperature	2	Stream flow	2
Humidity	2	Reservoir (Water level, Outflow)	2
Wind	2	Groundwater Table	
Pressure	2	Evaporation	1
Precipitation	10	Soil Temperature	
Snow Depth		Soil Moisture	
Skin Temperature		**Atmosphere**	**Number**
Upward Shortwave Radiation		Planetary Boundary Layer Tower	
Downward Shortwave Radiation		Pilot Balloon	
Upward Long wave Radiation		Radiosonde	
Downward Long wave Radiation		Radar	
Net Radiation		**Water Quality**	**Number**
Sensible Heat Flux		Groundwater quality indicators	
Latent Heat Flux		Surface water quality indicators	
Ground Heat Flux		**Others**	**Number**
CO2 Flux			

4. Models, GIS, Data Integration System, Prediction System

4.1 Hydrological model: WATBAL Hydrologic model

4.2 Land Surface Scheme: Meteorological model:

4.3 List of digital GIS data at fine resolution (besides global data set):

4.4 Data integration system:

4.5 Type of Prediction system and Downscaling technique:

Used mainly for: [✓ Floods] Droughts Water Quality Monitoring IWRM

5. Implementation Schedule of the Demonstration. Modify the arrows

ACTIVITIES	2008/I	2008/II	2009/I	2009/II	2010/I	2010/II	2011/I	2011/II
Hydro-meteorological & water quality monitoring								
Data integration system (input data preparation, quality check)								
Improvement of in-situ observation network system								
Setting-up a Distributed Hydrological Model (optional LSS)								
Scenario Studies: Land use change analysis, dry periods, etc.								
Capacity building on Floods, Droughts & Water Quality								
Parallel testing of the system at operational stage								
IWRM plan development of floods, droughts & water quality								

Country: Sri Lanka **River basin name:** Kalu Ganga **Basin Area:** 2720 [km^2]

1. Background, targeted issues and objective

1.1 Brief introduction to the river basin within four lines

The Kalu (River) Ganga basin located at the South-Western part of Sri Lanka. It is about 130 km long discharges into the Indian Ocean. The flood disasters continue in the basin due to climatic, hydrologic, topographic and land use characteristics in the basin. **.** There is a hydropower reservoir at one of the upper reaches. Population density in Kalutara and Ratnapura districts are 677 and 314 person/sq km.

1.2 Major issues (Please use a circle): [✓ Floods] Droughts Water Quality

1.3 Latest event when the issue was evident according to above one(s):

District	Affected Families	Deaths	Houses destroyed	Houses partially damaged
Kalutara	21,550	8	7,658	35
Ratnapura	47,756	137	5,726	6,902

1.4 Targets to be addressed through demonstration (up to 3):

-Flood risk reduction

-Identification of inundation levels

-Implementation of early warning systems based on real time flood forecasting

1.5 Objective: To minimize flood damages by using DHM & RS

2. River basin characteristics

2.1 Climate regime (Please use a circle):

Very Humid [✓ Humid] Temperate Semi-arid Arid Cold/Tundra

2.2 Topography (minimum, average and maximum elevation): 2250

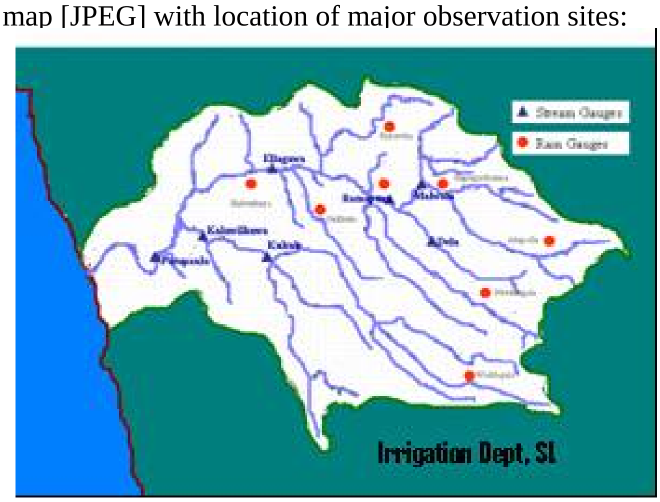
2.3 Annual average rainfall of about [mm]: 3000

2.4 Dominant land use: tropical rain forest

2.5 Dominant soil type:

2.6 Geographic coordinates [Lon, Lat]: 80 to 80.67 E, 6.4167 to 6.83 N

2.7 River basin map [JPEG] with location of major observation sites:



3. Observation system

SURFACE	**Number**	**HYDROLOGICAL**	**Number**
Air Temperature	1	Stream flow	2
Humidity	1	Reservoir (Water level, Outflow)	
Wind	1	Groundwater Table	
Pressure	1	Evaporation	1
Precipitation	10	Soil Temperature	1
Snow Depth		Soil Moisture	
Skin Temperature		**Atmosphere**	**Number**
Upward Shortwave Radiation		Planetary Boundary Layer Tower	
Downward Shortwave Radiation		Pilot Balloon	
Upward Long wave Radiation		Radiosonde	
Downward Long wave Radiation		Radar	
Net Radiation		**Water Quality**	**Number**
Sensible Heat Flux		Groundwater quality indicators	
Latent Heat Flux		Surface water quality indicators	
Ground Heat Flux		**Others**	**Number**
CO2 Flux			

4. Models, GIS, Data Integration System, Prediction System

4.1 Hydrological model: one-dimensional hydraulic model

4.2 Land Surface Scheme: Meteorological model:

4.3 List of digital GIS data at fine resolution (besides global data set):

DEM, land use and river network

4.4 Data integration system:

4.5 Type of Prediction system and Downscaling technique:

Used mainly for: [✓ Floods] Droughts Water Quality Monitoring IWRM

5. Implementation Schedule of the Demonstration. Modify the arrows

ACTIVITIES	2008/I	2008/II	2009/I	2009/II	2010/I	2010/II	2011/I	2011/II
Hydro-meteorological & water quality monitoring								
Data integration system (input data preparation, quality check)								
Improvement of in-situ observation network system								
Setting-up a Distributed Hydrological Model (optional LSS)	→							
Scenario Studies: Land use change analysis, dry periods, etc.								
Capacity building on Floods, Droughts & Water Quality	—	→						
Parallel testing of the system at operational stage		→						
IWRM plan development of floods, droughts & water quality								

Country: Thailand **River basin name:** Mae Wang **Basin Area:** 600 [km^2]

1. Background, targeted issues and objective

1.1 Brief introduction to the river basin within four lines

Mae Wang Basin is one of the sub-basins of the Mae Ping Basin in Northern Thailand. Most of the basin is mountain area declining from west to east consists of the mixed unit of steep slope highland soil series.

1.2 Major issues (Please use a circle): [✓ Floods] Droughts Water Quality

1.3 Latest event when the issue was evident according to above one(s):

Variable/indicator & date:

1.4 Targets to be addressed through demonstration (up to 3):

To install telemetering station for observation and collection of Hydro-meteorological data

For programming the flood warning model and effective water management

1.5 Objective:

Flood forecast and early warning system

2. River basin characteristics

2.1 Climate regime (Please use a circle):

Very Humid [✓ Humid] Temperate Semi-arid Arid Cold/Tundra

2.2 Topography (minimum, average and maximum elevation): 300, 1000, 2500

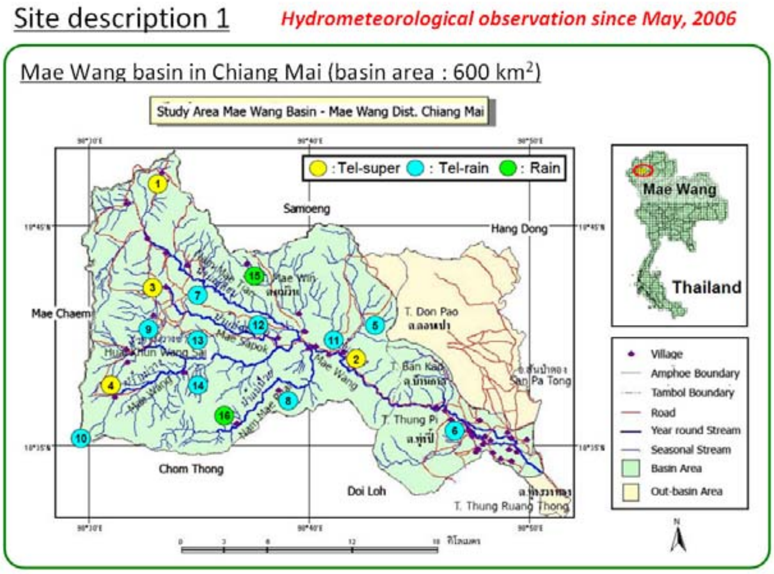
2.3 Annual average rainfall of about [mm]:

2.4 Dominant land use: forest and agriculture

2.5 Dominant soil type: mixed unit of steep slope highland soil

2.6 Geographic coordinates [Lon, Lat]: 98.5 to 98.83 E, 18.583 to 18.75 N

2.7 River basin map [JPEG] with location of major observation sites:



3. Observation system

SURFACE	**Number**	**HYDROLOGICAL**	**Number**
Air Temperature	13	Stream flow	5
Humidity	4	Reservoir (Water level, Outflow)	
Wind	4	Groundwater Table	4
Pressure	4	Evaporation	
Precipitation	15	Soil Temperature	10
Snow Depth		Soil Moisture	10
Skin Temperature		**Atmosphere**	**Number**
Upward Shortwave Radiation	4	Planetary Boundary Layer Tower	
Downward Shortwave Radiation	4	Pilot Balloon	
Upward Long wave Radiation	4	Radiosonde	
Downward Long wave Radiation	4	Radar	
Net Radiation		**Water Quality**	**Number**
Sensible Heat Flux		Groundwater quality indicators	
Latent Heat Flux		Surface water quality indicators	
Ground Heat Flux		**Others**	**Number**
CO2 Flux			

4. Models, GIS, Data Integration System, Prediction System

4.1 Hydrological model: stage correlation model

4.2 Land Surface Scheme: SiBUC, MATSIRO Meteorological model: MM5

4.3 List of digital GIS data at fine resolution (besides global data set): River line, Land use, Soil type, 20-m contour line, point of village, road line

4.4 Data integration system: Water cycle information integrative system (UT)

4.5 Type of Prediction system and Downscaling technique:

Used mainly for: [✓ Floods] Droughts Water Quality Monitoring IWRM

5. Implementation Schedule of the Demonstration. Modify the arrows

ACTIVITIES	2008/I	2008/II	2009/I	2009/II	2010/I	2010/II	2011/I	2011/II
Hydro-meteorological & water quality monitoring								
Data integration system (input data preparation, quality check)								
Improvement of in-situ observation network system								
Setting-up a Distributed Hydrological Model (optional LSS)								
Scenario Studies: Land use change analysis, dry periods, etc.								
Capacity building on Floods, Droughts & Water Quality								
Parallel testing of the system at operational stage								
IWRM plan development of floods, droughts & water quality								

Country: Uzbekistan **River basin name:** Chirchik-Okhangaran **Basin Area:** 20160 [km^2]

1. Background, targeted issues and objective

1.1 Brief introduction to the river basin within four lines

It is Located in northeastern part of Uzbekistan. Snowmelt induced runoff of rivers of the Chirchik – Okhangaran basin comprised 60-90% of the total stream flow. In Chirchik -Okhangaran river basins have 19 hydropower stations. There are two rivers – Chirchik (161 km) and Okhangaron (223 km). River basin has 67 lakes with different genesis type. This basin had 2384.6 thousand people.

1.2 Major issues (Please use a circle): [✓ Floods] Droughts Water Quality

1.3 Latest event when the issue was evident according to above one(s):

Variable/indicator & date: Mudslide 1969, March

1.4 Targets to be addressed through demonstration (up to 3):

Sediment transport

Impacts of hydrological process and on hydropower generation

To monitor the flow regimes in the rivers due to climate change

1.5 Objective:

Determination of an adequate warning system for floods

2. River basin characteristics

2.1 Climate regime (Please use a circle):

Very Humid [✓ Humid] Temperate Semi-arid Arid Cold/Tundra

2.2 Topography (minimum, average and maximum elevation): 400, 600, 4301

2.3 Annual average rainfall of about [mm]:

2.4 Dominant land use: agriculture

2.5 Dominant soil type:

2.6 Geographic coordinates [Lon, Lat]: 69.33 to 71.25 E, 40.167 to 42.25 N

2.7 River basin map [JPEG] with location of major observation sites:

3. Observation system

SURFACE	**Number**	**HYDROLOGICAL**	**Number**
Air Temperature	10	Stream flow	
Humidity	10	Reservoir (Water level, Outflow)	19
Wind	10	Groundwater Table	
Pressure	10	Evaporation	**3**
Precipitation	22	Soil Temperature	10
Snow Depth	23	Soil Moisture	3
Skin Temperature		**Atmosphere**	**Number**
Upward Shortwave Radiation		Planetary Boundary Layer Tower	
Downward Shortwave Radiation		Pilot Balloon	
Upward Long wave Radiation		Radiosonde	
Downward Long wave Radiation		Radar	2
Net Radiation		**Water Quality**	**Number**
Sensible Heat Flux		Groundwater quality indicators	
Latent Heat Flux		Surface water quality indicators	
Ground Heat Flux	2	**Others**	**Number**
CO2 Flux	2		

4. Models, GIS, Data Integration System, Prediction System

4.1 Hydrological model:

4.2 Land Surface Scheme: Meteorological model:

4.3 List of digital GIS data at fine resolution (besides global data set):

4.4 Data integration system:

4.5 Type of Prediction system and Downscaling technique:

Used mainly for: Floods Droughts Water Quality Monitoring IWRM

5. Implementation Schedule of the Demonstration. Modify the arrows

ACTIVITIES	2008/I	2008/II	2009/I	2009/II	2010/I	2010/II	2011/I	2011/II
Hydro-meteorological & water quality monitoring								
Data integration system (input data preparation, quality check)								
Improvement of in-situ observation network system								
Setting-up a Distributed Hydrological Model (optional LSS)								
Scenario Studies: Land use change analysis, dry periods, etc.								
Capacity building on Floods, Droughts & Water Quality								
Parallel testing of the system at operational stage								
IWRM plan development of floods, droughts & water quality								

Country: Vietnam **River basin name:** Huong **Basin Area:** 2830 [km^2]

1. Background, targeted issues and objective

1.1 Brief introduction to the river basin within four lines

Huong river basin belongs to Thua Thien Hue province in coastal of the Central Viet Nam. Huong river system contains 3 main rivers: Ta Trach, Huu Trach and Bo River. Huong River is short and steep runs from mountain to the low plain area. Time of concentration is short and river basin has low storage capacity. Floods and inundation often occur very quickly and severely.

1.2 Major issues (Please use a circle): [✓ Floods] Droughts Water Quality

1.3 Latest event when the issue was evident according to above one(s):

Variable/indicator & date: 2320mm/3day 1999.11

1.4 Targets to be addressed through demonstration (up to 3):

To improve accuracy of the forecast, effective natural disaster preparedness, prevention measures and reduces the losses

1.5 Objective:

To get efficient flood warning system

2. River basin characteristics

2.1 Climate regime (Please use a circle):

[✓ Very Humid] Humid Temperate Semi-arid Arid Cold/Tundra

2.2 Topography (minimum, average and maximum elevation): 500 - 1000

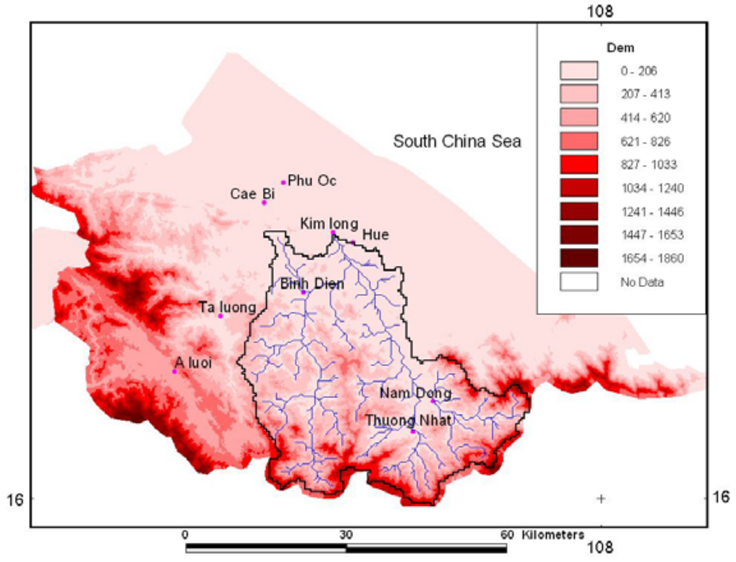
2.3 Annual average rainfall of about [mm]: 3000

2.4 Dominant land use: forests

2.5 Dominant soil type: erodible laterit soil

2.6 Geographic coordinates [Lon, Lat]: 107 to 108 E, 16 to 17 N

2.7 River basin map [JPEG] with location of major observation sites:



3. Observation system

SURFACE	**Number**	**HYDROLOGICAL**	**Number**
Air Temperature	3	Stream flow	1
Humidity	3	Reservoir (Water level, Outflow)	1
Wind	3	Groundwater Table	
Pressure	1	Evaporation	3
Precipitation	7	Soil Temperature	3
Snow Depth		Soil Moisture	3
Skin Temperature		**Atmosphere**	**Number**
Upward Shortwave Radiation		Planetary Boundary Layer Tower	
Downward Shortwave Radiation		Pilot Balloon	1
Upward Long wave Radiation		Radiosonde	1
Downward Long wave Radiation		Radar	2
Net Radiation		**Water Quality**	**Number**
Sensible Heat Flux		Groundwater quality indicators	15
Latent Heat Flux		Surface water quality indicators	
Ground Heat Flux		**Others**	**Number**
CO2 Flux			

4. Models, GIS, Data Integration System, Prediction System

4.1 Hydrological model: Multivariable regression, TANK, NAM, MARINE

4.2 Land Surface Scheme: Meteorological model:

4.3 List of digital GIS data at fine resolution (besides global data set):

50 m DEM, land use, soil type, river network etc...

4.4 Data integration system: HydroMet Data, Digital Hydrological database, Digital Meteorological database

4.5 Type of Prediction system and Downscaling technique: HRM, ETA and WBAR

Used mainly for: [✓ Floods] Droughts Water Quality Monitoring IWRM

5. Implementation Schedule of the Demonstration. Modify the arrows

ACTIVITIES	2008/I	2008/II	2009/I	2009/II	2010/I	2010/II	2011/I	2011/II
Hydro-meteorological & water quality monitoring								
Data integration system (input data preparation, quality check)	→	→						
Improvement of in-situ observation network system	→	→						
Setting-up a Distributed Hydrological Model (optional LSS)	→	→						
Scenario Studies: Land use change analysis, dry periods, etc.								
Capacity building on Floods, Droughts & Water Quality			→	→				
Parallel testing of the system at operational stage			→	→				
IWRM plan development of floods, droughts & water quality					→	→		