

A REVIEW OF THE STATUS OF THE INTEGRATED GLOBE
WATER CYCLE OBSERVATIONS THEME AND ITS
LINKS TO GEO

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UIC Panel Meeting
Boulder, CO
September, 2008

THE PAST:

2000: CEOP was endorsed by CEOS and IGOS-P asked WCRP take the lead in developing a proposal for a water cycle theme.

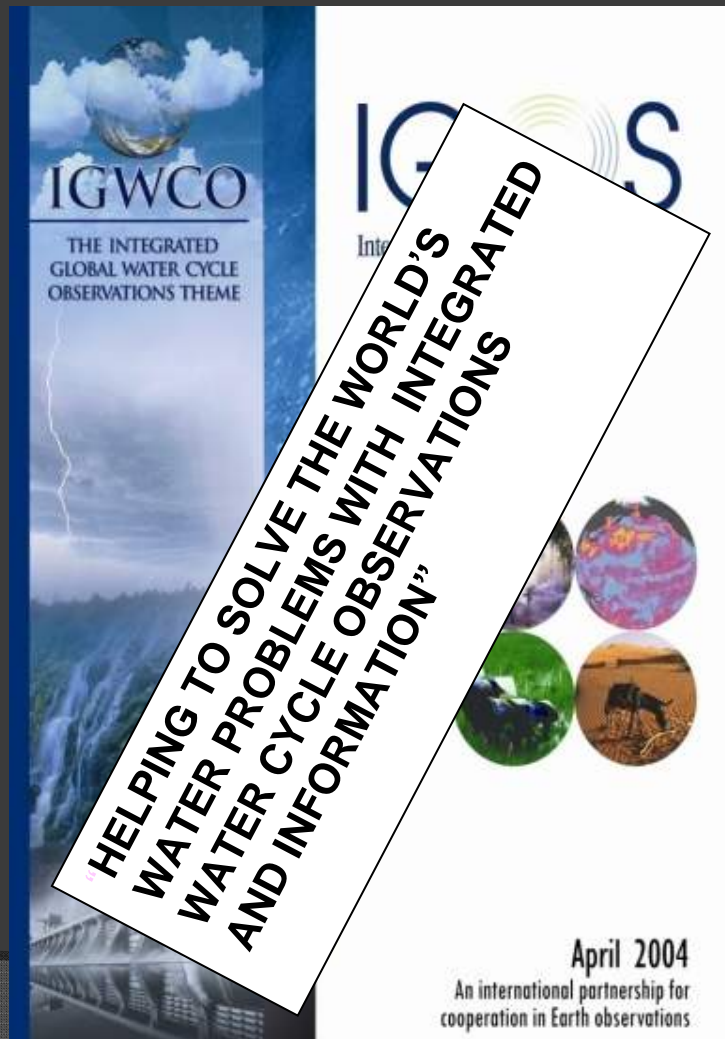
2001: Proposal for IGWCO accepted by IGOS-P and CEOS-SIT.

2002-2003: Series of workshops held and the IGWCO theme report was developed.

2003-2004: Theme was accepted by IGOS-P and the IGWCO report was published by ESA.

2004 –present: IGWCO was implemented with WMO, WCRP and CEOS (JAXA) leadership.

THE INTEGRATED GLOBAL WATER CYCLE OBSERVING THEME (IGWCO) HAS THE FOLLOWING OBJECTIVES:



1. Provide a framework for guiding decisions on priorities and strategies regarding water cycle observations for:
 - Monitoring climate variability and change,
 - Effective water management and sustainable development of the world's water resources,
 - Societal applications for resource development and environmental management,
 - Specification of initial conditions for weather and climate forecasts,
 - Research directed at priority water cycle questions
2. Promote strategies that facilitate the processing, archiving and distribution of water cycle data products

	GOALS	LEADERS	ACTIONS	COMMIT	FUNDING
CEOP	YES	Toshio Koike	Merger with GHP	YES	YES/JP YES/NOAA
PCPN	YES	Phil Arkin	Workshops held	YES	NO
SOIL MOIST.	YES	Tom Jackson Peter v. Ovel	Workshop held	YES	NO
RUNOFF	YES	Wolfgang Grabs	HARON	YES	NO
WATER QUALITY	YES	Steve Greb	Workshop in Geneva	YES	GEO
GWSP LINKS	PRELIM	Charles Vorosmarty	TBD	NO	NO
GRND WATER	YES	Matt Rodell Jay F. Neno K.	Workshop held in the Netherlands	NO	NO
CAP BLDG	YES	RL, CI,AM	EA workshop SA proposal	YES	SOME

Workshop on the Evaluation of High Resolution Precipitation Products

- ◎ Recommendations to be presented to IPWG:
 - Several high resolution precipitation products exhibit useful skill, but clear superiority for one is not yet evident
 - IPWG should establish a continuing effort to conduct, facilitate and coordinate validation and evaluation of such products
 - A concerted validation/intercomparison campaign, covering multiple climatic regimes and seasons, should be designed and conducted

Hydrological Applications – Runoff Project (HARON)

Basic Rationale of the Initiative

Global monitoring of runoff and lake storage:

- important elements of Integrated Global Observing Systems
- integral parts of water resources management including prevention of water-induced disasters



Goals & Objectives

Main Goals

- Support water resources management while contributing in a cross-cutting fashion to all societal benefit areas of GEO
- Improve & support the closure of the global water budget, in line with requirements of GCOS and the Global Water Cycle Experiment (GEWEX) of WCRP



Main Objective

Integrate, in a phased approach, dedicated river gauging networks of existing hydrological stations into a global runoff observation network

HYDROLOGICAL APPLICATIONS RUNOFF NETWORK PROJECT (HARON)

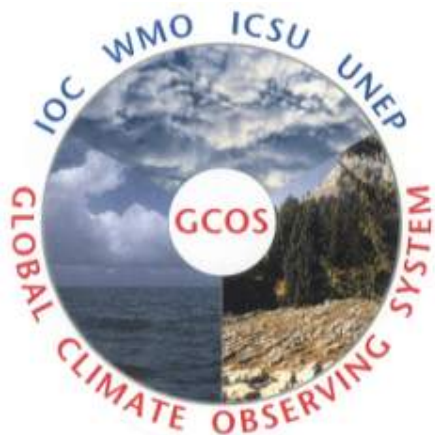
Implementation Phases

PHASE I – Upgrade & sustained maintenance of major global run-off stations, monitoring continental freshwater fluxes into the world's oceans

PHASE II – *Integration of hydro-meteorological and related in-situ components with satellite observations*

PHASE III – Consolidation of integrated hydrological observation network development and application of user-oriented information products made available by HARON

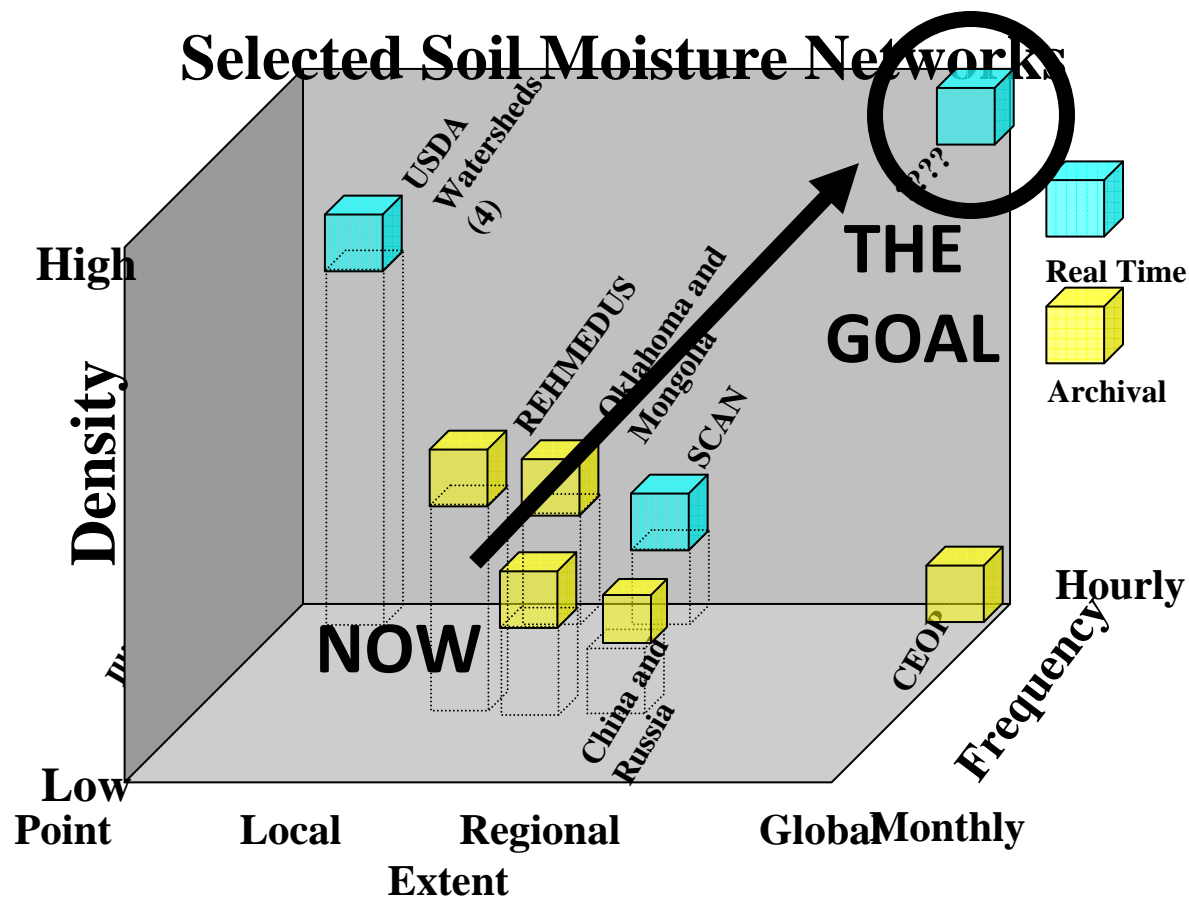
Production of an implementation plan for a broad global water cycle data integration system, combining water cycle in-situ, satellite, and model output data



THROUGH ITS SOIL MOISTURE EFFORTS IGWCO IS DEVELOPING A SET OF FOCUS ISSUES THAT ALIGNS WITH THE GLOBAL CLIMATE OBSERVING SYSTEM (GCOS) IMPLEMENTATION PLAN

ISSUES TO BE CONSIDERED FOR A GLOBAL NETWORK AT A SPRING 2006 MEETING AT ESA WILL INCLUDE:

- Extent of network
- Density
- Frequency of measurement
- Latency
- Availability
- Measurement Technique



Results of a joint IGWCO/UNESCO/ Geohazards workshop:
 More convergence is needed in national in-situ groundwater
 monitoring programmes to meet GEOSS objectives

Country	GW monitor. QN Quantity QU Quality	W Wells S Springs Q Qanats	S Special wells O Other wells	O One aquifer- well M More aquifers - well	GW table measure ments M Manual S Sensor	Water table frequency measurem ents per year	GW sampling per year	GW analysis DWS- Drink. Wat.Stan. MI Major Ions S Spec. Variables	GIS	Data accessi bility CH Charge N-CH No charge	Data collec tion C Centr al V Variou s
India	QN QU	W	S mostly	O mostly	M 80%	4	1	DWS S	yes	N CH	C
China	QN QU	W S	S O	O M	S mostly	52	2	MI	yes	CH	V
Iran	QN QU	W S Q	S O	O mostly	M	12	2	MI	no	N CH	C V
South Africa	QN QU	W S	S O	O mostly	M S	4 - 12 - 52	2	MI S	no	N CH	C V
Australia	QN QU	W S	S O	O	M S	4	1 mostly	MI S	yes	N CH	C
Brazil - Sao Paulo	QU	W	O	O	-	-	1	DWS S	no	CH	C
Russia	QN QU	W S	S O	O mostly	S mostly	12 - 36	4 - 12	DWS S	yes	N CH	C V
USA	QN QU	W S	S O	O M	S M	variable	1 or more	DWS S	yes	N CH	C V
Poland	QN QU	W S	S O	O	M mainly	1 - 12 - 52	1- 2 or less	DWS S	yes	CH	C
Czech Republic	QN QU	W S	S	O	S 80%	52	2	DWS S	yes	CH	C
England, Wales	QN QU	W S	S O	O 80%	M 80%	12	variable	DWS S	partially	CH	C V

(After Vrba)

While standards are maintained for a number of water cycle variables by WMO there are a number of gaps for groundwater and water quality.

GEO Inland and Nearshore Coastal Water Quality Remote Sensing Workshop

27 - 29 March 2007, Geneva, Switzerland

Goal

To bring together remote sensing data providers and expert users to improve our ability and capacity to remotely assess and monitor inland and nearshore coastal water quality.

Objectives

To assess existing and planned remote sensing capabilities; identify gaps relative to user needs in the acquisition, processing, distribution and utilization of remote sensing data and derived products for water quality research and applications; and formulate potential solutions to address these gaps and other related challenges.

Products

Recommendations to data providers and GEO Members and Participating Organizations on short-term priorities for improving remote sensing capacity and utilization for water quality assessment and monitoring, as well as formulating short and long term strategies to identify, enable and implement enhanced capabilities.

GEO Inland and Nearshore Coastal Water Quality Remote Sensing Workshop

Key workshop recommendations focused on:

- Continuity of existing satellites
- Development of new and improved sensor/platform technology
- Algorithm development and calibration/validation activities
- Improvements in data accessibility
- Increased education, and capacity building through new demonstration project initiatives
- Formation of a scientific group dedicated to inland and coastal water quality remote sensing

Another workshop is being planned for the USA to assess algorithms for estimating water quality from space.

WORLD METEOROLOGICAL ORGANIZATION
Weather. Climate. Water

**In collaboration with the UNEP Global Environment Monitoring
System – Water (GEMS/Water) Collaborating Centre
Burlington, Canada**

GLOBAL WATER QUALITY MONITORING CAPABILITIES
August 2008

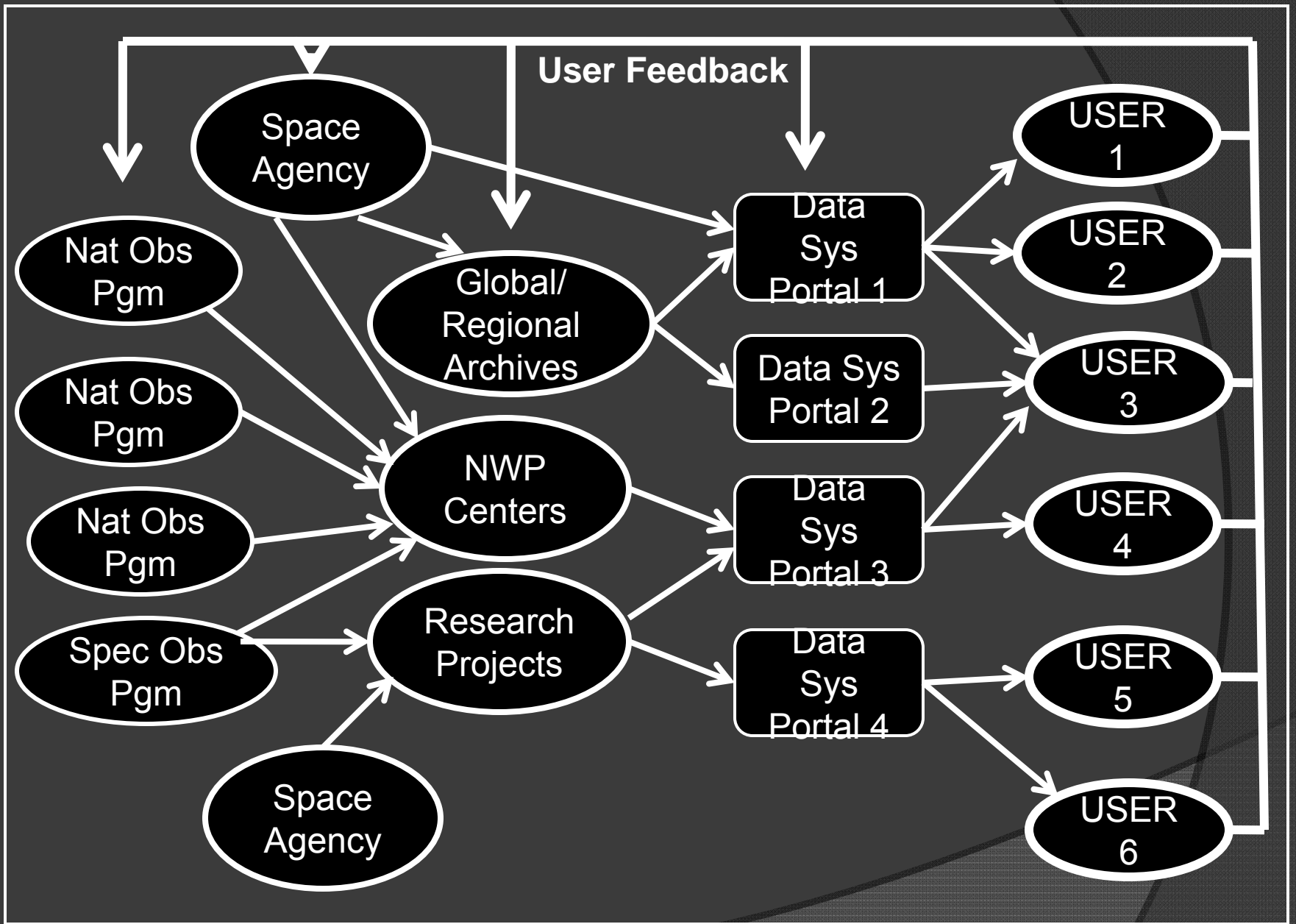


WMO Survey on water quality monitoring

General comments based on the results:

- WQ programs operated mostly by Government agencies (except Finland – polluter pays principle)
- Generally inadequate number of monitoring stations
- Generally inadequate spatial coverage, more water quality variables and higher level of technology needed
- Little remote sensing (except Brazil, Chile, Finland, Hong Kong, Norway),
- Very little automatic monitoring, pledged by responding countries to be increased within 5 years
- Monitoring budgets decreasing in developed countries
- Urgency of WQ monitoring programs realized but not matched with budgets (national/development partners).

One solution: Advanced rapid monitoring, automatic stations and remote sensing could partially improve the situation



Scope of the Integrated Global Data and Information System

E2E INITIATIVES

The *End-to-End Water (E2E-Water)* will demonstrate the value of integrated water cycle observations by developing a full and operational data cycle of environmental information from "producer-to-consumer" / "source-to-sink".

Initial pilots: *Impacts from drought*, assessment of the global water resource base under the "*State of the Global Water System*" and "*Water Towers of the World*."

There will be six supporting objectives:

- 1) Develop pilot projects that will advance the use of integrated data products within the framework of IGWCO, GEO, and the GEO Water Cycle Community of Practice.
- 2) Engage core elements of the GTN-H data consortium and principal data provision affiliates;

- 3) Assemble theme-based application communities, composed of both data users and providers, to articulate the needs of data consumers directly to the data providers and to optimize the relevance and utility of integrated water cycle observations;
- 4) Develop integrated water cycle data sets, data assimilation schemes, geospatial models, and other necessary tools to serve the needs of the theme-based user community;
- 5) Translate *E2E-Water* outputs into concrete values that support GEO policy, development, management, and educational priorities.
- 6) Demonstrate the added value of IGWCO and GEO integrating water cycle information for various applications.

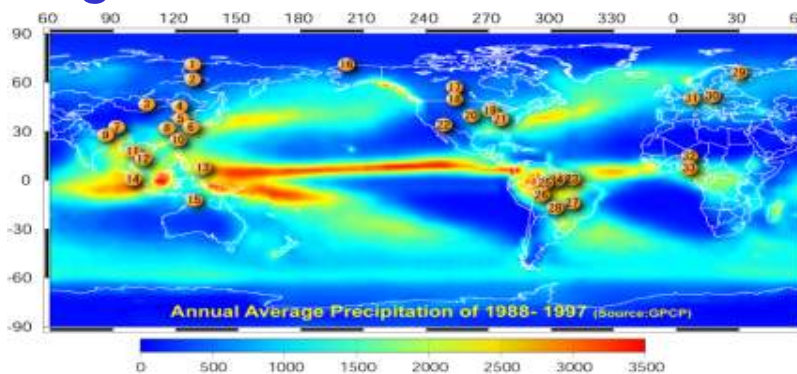
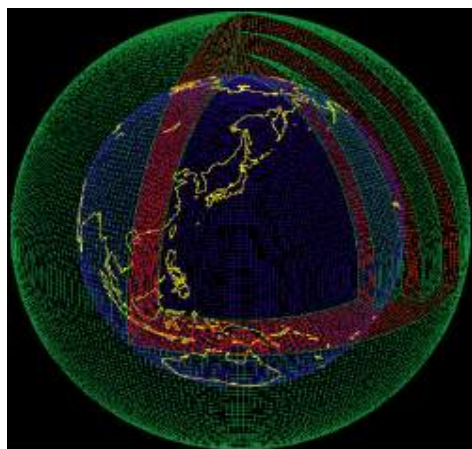
The E2E activity provides a testbed for IGWCO/GWSP indicators that are currently under development.



Coordinated Enhanced Observing Period Three Unique Capabilities

Interoperability Arrangement

A well organized collecting, processing, storing, and disseminating shared data, metadata and products



Model Output Data Archiving Center at **the World Data Center for Climate, Max-Planck Institute for Meteorology** of Germany

In-Situ Data Archiving Center at **NCAR (National Center for Atmospheric Research)** of USA

Data Integrating/Archiving Center at **University of Tokyo and JAXA** of Japan



Contribution to DA=06-04?

CEOP Phase II at ceop.wdc-climate.de

The screenshot shows a web browser window with two tabs: "Model & Data: Welcome to t..." and "Model & Data: CEOP Ph...". The website header features the "M&D Modelle & Daten" logo on the left and a large "MODEL & DATA" banner in the center. Below the banner is a navigation bar with links for "M&D Home", "Impressum", "Contact", "Sitemap", and "Login", along with a search box. A left-hand navigation menu lists various categories, with "CEOP Phase II" highlighted. The main content area is titled "CEOP Phase II" and includes a breadcrumb trail: "M&D Home > Projects at M&D > CEOP > CEOP Phase II".

CEOP Phase II

The structure of the model output

For CEOP Phase II WDC-Climate proposes a more homogeneous [netcdf](#) data structure for gridded data and MOLTS. The WMO-GRIB format is used for the gridded data. MOLTS can be stored in NetCDF-CF format as an [example header](#) of JMA data shows. Find a set of example NetCDF files (Also JMA) here: [\(tar\) example](#). The tarball contains 4 NetCDF files for one day with the 12:00 file containing 72 forecast steps. The [Stationlist](#) list of the station names with proposals for changes.

MOLTS

The Information of the MOLTS (Model Output Location TimeSeries) is available as a [pdf](#) map and as a [pdf](#) list as well.

Data Sets included into the CERA Database

Center	MOLTS Data	GRID DATA
JMA	1-JAN-2007 - 30-JUN-2008	1-JAN-2007 - 30-JUN-2008

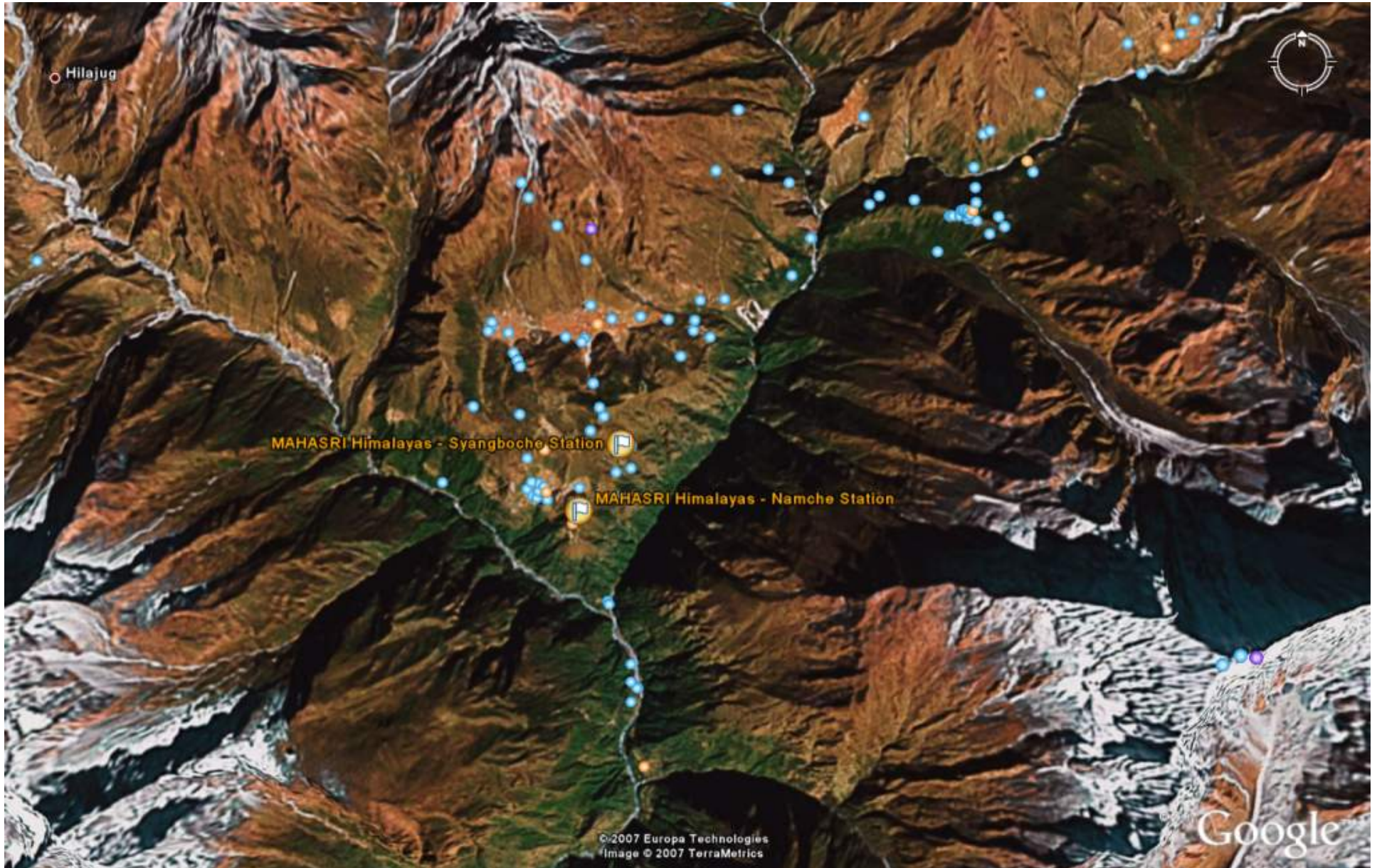
Data size

Currently the data base contains **618.6 GByte** of data.

latest update: 2008-08-20 15:37



REFERENCE SITE GOOGLE EARTH (.KMZ) FILE



GEOSS Asian Water Cycle Initiative (AWCI)

17 River Basins for Initial Demonstration

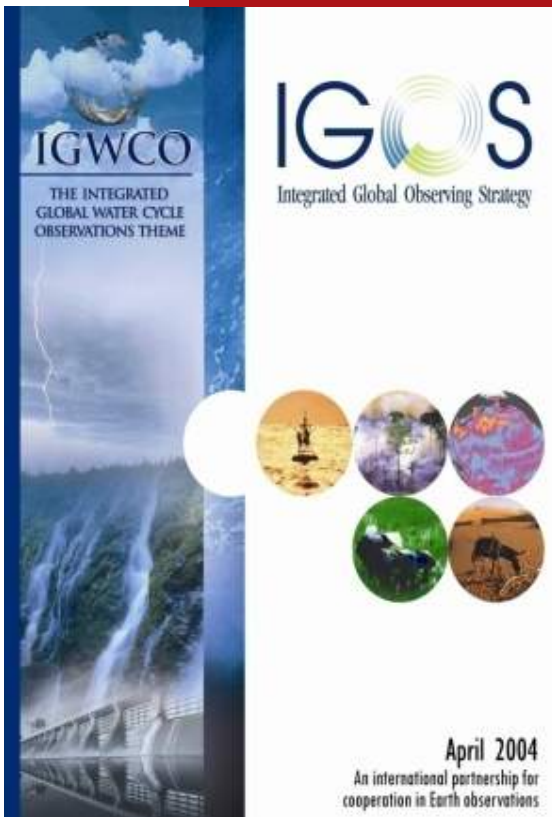


WaterNet: A NASA supported “Solutions” Network that addresses the Water Cycle and the use of Water Cycle information

Objectives:

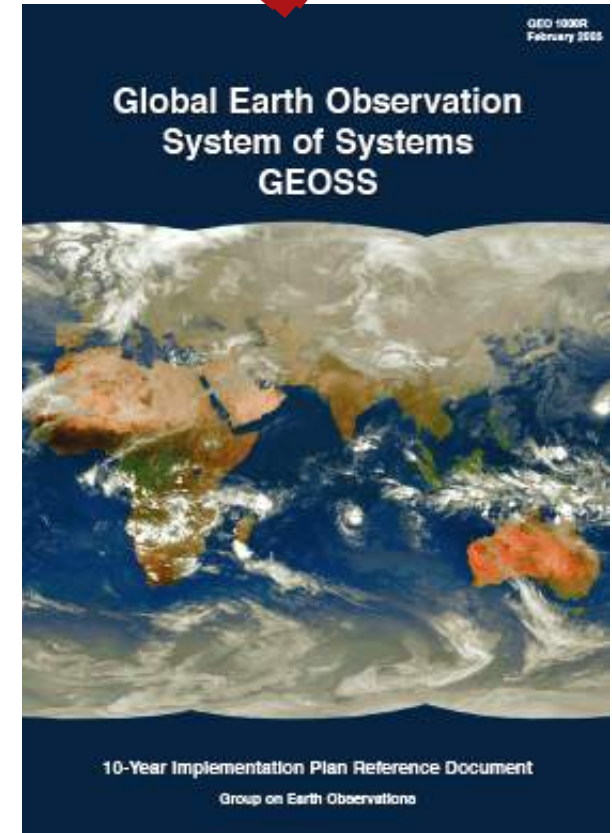
1. **Evolve a network of water cycle partners:** identify and analyze water cycle community-of-practice organizations, DSTs and their requirements and develop well-constructed teams and partnerships to define collaboration pathways.
2. **Routinely identify, prioritize, mine and communicate relevant NASA water cycle results** that address NPAs, and develop operational information system pathways to provide timely user-community access.
3. **Optimize water cycle partner access** to NASA water cycle research, through developing prototypes, evaluation methods, verification procedures, and benchmarking standards to create an evolving and self-sustaining network.
 - **Network Optimization**
 - **OSSEs:** MIT Integrated Global System Model (IGSM)
 - **PROTOTYPES:** SAHRA/USBR Western Rivers Water Management; Coral Reef Early Warning System (CREWS); CUAHSI-Hydrologic Information System (HIS); State-of-the-Water-Cycle Demonstration; CNRFC-Water and Emergency Management Demonstration; NCAR’s Research Applications Lab (RAL)
4. **Analyze and document** the *WaterNet* effectiveness by developing metrics, standards, resource estimates, documentation procedures, guidelines, and pre-evaluation reports to describe the steps to access and utilize NWRs
5. **Engage in education and outreach** to help society understand the water cycle and its potential application benefits.

IDEAS TRANSFERRED INTO GEO
TYIPP AS TARGETS AND NOW TASKS

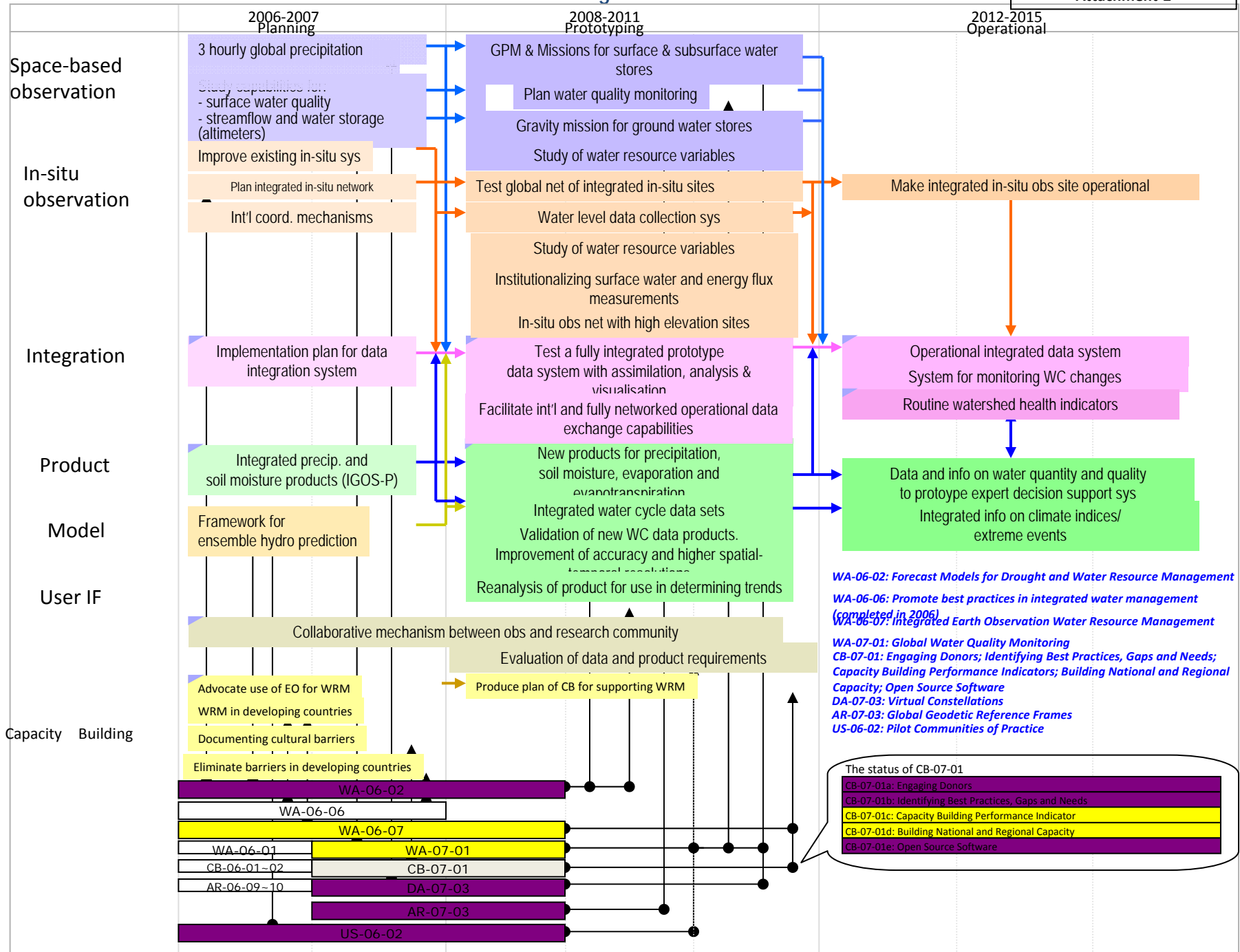


SOME GWC TARGETS
IN THE GEO TYIPP:

- PRECIPITATION
- NETWORKS OF SUPERSITES
- NETWORK PLANNING
- DATA SHARING
- CAPACITY BUILDING



GEOSS IP Targets - Water



THE FUTURE:

During the next few years IGWCO is planning to:

- Focus more IGWCO work towards the GEO goals.
- Build strongly on the activities of space agencies and international data agencies (e.g. WMO).
- Entrain more groups into the IGWCO activities.
- Take advantage of GEO infrastructure (possibly by leading a broad Water Cycle Community of Practice or by more active interaction with the S&T committee.)
- Annual IGWCO Planning meeting will be held in Asia in February 2009.

GEO TASKS WITH SUBSTANTIVE IGWCO INPUTS

WA-06-02: Forecast Models for Drought and Water Resource Management

WA-06-07: Capacity Building Program for Water Resources Management

WA-07-01: Global Water Quality Monitoring

WA-08-P1: Integration of In-situ and Satellite Data for Water Cycle Monitoring (Runoff-HARON, Soil Moisture, Groundwater, ET*)

OTHERS WHERE IGWCO CAN/DOES INPUT:

DI-07-01: Risk Management for Floods

CL-06-01: Sustained Reprocessing and Reanalysis Efforts

US-06-02: Pilot Communities of Practice

DA-07-03: Virtual Constellations

DA-07-06: Data Integration and Analysis System

HE-07-02: Environment and Health Monitoring and Modelling

AG-07-03: Operational Agricultural Monitoring System

NASA – Phase II (2013-2016)

- HypsIRI – land surface composition for agriculture and mineral characterization; vegetation types for ecosystem health (Hyperspectral spectrometer)
- ASCENDS – Day/night, all-latitude, all season CO2 column integrals for climate emissions (multi-frequency laser)
- SWOT – Ocean, lake, and river water levels for ocean and inland water dynamics (Ka-band wide swath radar and C-band radar)
- GEO-CAPE – Atmospheric gas columns for air quality forecasts ocean color for coastal ecosystem health and climate emissions (High & low spatial resolution hyperspectral imagers)
- ACE – Aerosol and cloud profiles for climate and water cycle ocean color for open ocean biogeochemistry (backscatter lidar multiangle polarimeter Doppler radar)

NASA Phase III (2016-2020)

- LIST – land surface topography for landslide hazards and water runoff (Laser altimeter)
- PATH – High frequency, all-weather temperature and humidity soundings for weather forecasting and SST (GEO – MW array spectrometer)
- GRACE-II – High temporal resolution gravity fields for tracking large-scale water movement (microwave/laser ranging system)
- SCLP – Snow accumulation for fresh water availability (Ku and X-band radars & K/Ka-band radiometers)
- GACM – Ozone and related gases for intercontinental air quality and stratospheric ozone layer prediction (UV & IR Spectrometer, Microwave limb sounder)
- 3D-Winds (Demo) – Tropospheric winds for weather forecasting and pollution transport (Doppler Lidar)

**Water Cycle Community of Practice
(WCCOP) Executive**

**Regional
Water Cycle
COP's
(deployment)**

- WaterNET
- Asian Water Cycle Init. (AWCI)
- TIGER

**IGWCO
(development)**

- Precipitation
- Soil moisture
- Runoff
- Water Quality
- Ground water
- CEOP
- E2E projects

**Water Cycle
Applications
(demonstration)**

Coordination by various international and national Bodies.

(e.g. ICCC Water Study)

**Water Cycle
Capacity
Building
(dissemination)**

- Asian Capacity Building
- TIGER followon
- "Water" CB in the Americas