IGWCO REPORT TO IGOS-P
May 23, 2006
Geneva, Switzerland

IGWCO IMPLEMENTATION
FINAL REPORT

Introduction

Since its approval in November 2003, significant progress has been made in the structural formation of the theme and the implementation of its main elements. The development of GEO has opened opportunities for IGWCO to significantly contribute to this important global effort and IGWCO has therefore streamlined a number of its activities to synchronize them with the GEO implementation plan. In 2006, a number of activities have been started, amongst them the development of a soil moisture network and the planning for a global runoff monitoring product. Oversight of the IGWCO has also been strengthened through shared secretarial services continued by JAXA for the Science Advisory Group and WMO by serving secretarial functions for the IGWCO Executive. Progress of some activities are however slower than expected due to shortages in resources, both financial and human capacity. The following paragraphs summarize the activities of IGWCO since the May 2005 IGOS meeting focusing on recent developments and plans for 2006 and beyond.

Precipitation

The objectives of IGWCO require time series of accurate gridded precipitation fields with fine spatial and temporal resolution for nearly all of the land areas of the world which rain gauges alone are not able to provide because they are often too sparse or inappropriately distributed. In many cases the data from rain gauges are not available in a timely manner usable for several application purposes such as forecasting. However, the terrestrial precipitation network is vital to obtain high quality precipitation data that are a backbone for many services provided by meteorological services. At present, available global products using satellite-derived estimates (GPCP, CMAP) are too coarse and not timely enough, however, new combined satellite-based precipitation products (PERSIANN, TMPA, CMORPH) are promising in reducing errors, and improve on resolution in time and space. For example, CMORPH (NOAA CPC) uses a combination of precipitation estimates from passive microwave and cloud motion from geostationary IR (see Joyce et al., 2004, J. Hydrometeorology). The Programme for the Evaluation of High Resolution Precipitation Products (PEHRPP) will yield a hypothesis-based assessment to see if they can provide either the basis for a more comprehensive product or insights into the best ways to combine the data. An integrated system will be developed through IGWCO after an initial assessment of the quality of the high resolution global precipitation products currently available. The plan calls for holding an intercomparison workshop as the first step in this proposal. Although it has not been supported as a stand-alone project it is now part of a broader proposal under consideration by several agencies in the USA. The Programme is sponsored by the International Precipitation Working Group (Working Group of CGMS) and endorsed by GEWEX. A number of presentations of early results will be made at the WWRP QPF05 Workshop in Boulder, CO in June 2005. The International Precipitation Working Group will hold a workshop to assess results and make recommendations to IGWCO in October 2006 in Melbourne, Australia. IGWCO continues to be supportive of a Global Precipitation Measurements (GPM) mission to be launched in the 2010-2011 time frame and will evaluate

these methods to determine how they can be used as the basis for a new-generation Integrated Precipitation Product.

Soil Moisture

Soil moisture information is critical for understanding the global water and energy cycles, for predicting precipitation and for advising local water resource managers. Improved global observations and model estimates of soil moisture are needed on a priority basis. IGWCO will coordinate its soil moisture activities with the Global Climate Observing System (GCOS) plans to bring the best available *in situ* observations together with satellite data and the modeling and data assimilation capabilities of numerical weather and climate forecast programs to produce an integrated soil moisture product. Developing global soil moisture information requires contributions from *in situ* measurements, satellite observations, and a reliable data assimilation framework. To obtain improved soil moisture information, it will be necessary to enhance both *in situ* sites and satellite data. As at present no global in-situ network for soil moisture exists, the development of a Global In-Situ Soil Moisture Network is at the centre of these efforts. This will involve network enhancement by expansion and standardization, dedicated soil moisture missions (support for SMOS, ESA's soil moisture ocean salinity satellite mission), and improved coordination of soil moisture data network planning, observing standards, and data exchange. IGWCO is addressing this issue through its International Soil Moisture Working Group ISMWG) which is developing mechanisms for cooperation between national groups and individual scientists that will enhance global soil moisture observation. The major outcomes of the ISMWG workshop held in March 2006 relate to the standardization of measurement protocols such as: Cross-Validation (site specific, temp, soil texture & bulk density, relationship with gravimetric soil moisture, density/depth of sensors, units of representation. With regard to network design, outputs relate to the network density, linkage of networks and the availability of metadata. Next steps in 2006 are the publication of the workshop report, set-up of a website, development of a White Paper. In 2007, a workshop is planned in Asia to address the widening of the working group framework and its formalization and embedding in existing initiatives as well as issue related to the hosting of soil moisture data.
These activities are also in response to the request for near-term actions and interaction with GEOSS.

Water Quality and Bioindicators of Aquatic Ecosystem Stress

Management systems in Agriculture and Aquaculture must comply with environmental standards. In lieu of the expensive monitoring of the ambient concentrations of anthropogenic chemicals such as pesticides and fertilizers and their stress on environmental systems, approaches using bio-indicators are being developed. IGWCO plans to evaluate the potential of remote sensing data to assess areas where environmental stress is high so that a focused surface based monitoring program could be implemented in the region. With satellite data it should be possible to take the results of intensive bio-monitoring studies in selected basins and to generalize them to a regional scale. More detailed plans for specific indicator projects using satellite data will be developed at an indicators workshop. The following new initiatives are being planned or carried out, respectively:

a) Development of a Freshwater Color Coordination Group

This group will serve as a focal point and voice of the freshwater water quality remote-sensing community and advocate the use of remote sensing technology for inland water quality science

and management. Further purposes of this group will be to foster expertise in using freshwater-color data through capacity building; to advocate the importance of the use of remote sensing to the global community and to optimize data quality for calibration and validation purposes.

b) Multisensor Space borne Monitoring of Global Large Lakes: Towards an Operational Assessment of Trends in Water Quantity and Quality (University of Wisconsin (NASA Grant))

The objectives of this project are the following: For a set of approximately 40 large lakes worldwide, produce satellite-derived maps showing fluctuations in area over the time of the study (and extending back to 2000 in some cases); evaluate the ability of the ICES/GLAS instrument to provide accurate measurements of lake level, for the same set of 40 lakes. For a second set of lakes, acquire both field observations using the GEMS/Water database and atmospherically corrected satellite imagery. The lakes would be classified using spectral and physical factors, and empirical models relating to satellite measurements, water clarity and other in-lake conditions will be developed.

c) Capacity Building

Increased capacity building requirements will be addressed at a planned workshop in Latin America with the objectives to provide information on capabilities of remote sensing techniques for freshwater systems; provide a basic understanding of needed expertise, equipment, associated software and costs to analyze the image data; provide hands-on experience in processing/interpreting remotely sensed images and to obtain input/feedback from workshop participants on water quality information needs, hardware, software, training needs and course effectiveness

d) An expert's workshop on space-borne and in-situ observations for water quality to determine requirements and state of present and future technology

In accordance with the GEOSS Task WA-06-01, experts from space agencies, research institutions and the user community will be called to collaboratively chart a course for the future in this area of interest.

The Global Runoff Monitoring Project

Recognizing the need for a global hydrological product based on in-situ river and lake gauge observations and satellite observations based on altimetry that are currently available or under development the global runoff monitoring product has been proposed during the CEOP/IGWCO workshop in March 2006. The basic rational for the development of this product is that global monitoring of runoff and lake storage is an important element of Integrated Global Observing Systems and an integral part of water resources management including prevention of water induced disasters. The objective of the project is to provide near real-time monitoring products of large scale rivers and lakes to observe and analyze surface runoff and lake storage variations and variability over time.

Application areas for Hydrological Services and research are with regard to support to regional and continental scale modelling and data assimilation and the potential to provide critical early warning information on floods, hydrological drought and water resources assessment for management purposes

The building components of the project are outlined below:

i. The project builds on ESA's "Rivers and Lakes" Project that utilizes ENVISAT Radar Altimetry;
ii. Science input is provided by De Montford University, UK in developing the high resolution radar masks and echo interpretation algorithms to convert surface water radar echoes into variations of water levels in rivers and lakes;
iii. Reference data sets will be provided by GRDC in terms of both historical runoff data series and future provision of reference terrestrial water-level observation of selected river gauges
iv. Core-partners for the project will therefore be ESA, De Montofrd University and GRDC.

v. Emphasis is laid on the the establishment of close collaborative links with the Water Level Recovery Mission (WatER) that is currently under development

Amongst others, the following science and applications issues are considered in the development of the project:

Satellite altimeters used for years to measure inland water heights of a few special targets
Existing missions: ERS and ENVISAT instruments are specially configured to operate over non-ocean surfaces with sample same locations re-visited every 35 days. TOPEX and JASON-1 are optimized for ocean surfaces but could be also used under certain conditions for inland waters with a sample interval every 10 days. The problem is that inland water echoes are very complex and hard to interpret to get range to surface. A possible solution is to design range of re-tracking algorithms to deal with different shapes.

In order to obtain wider global coverage, there are plans to incorporate Asian rivers in the Lakes and Rivers project with the objective to support the development of a regional flood information system in the Hindu Kush Himalayan region, using altimetry information. This sub-project will be based on WMO's continued work in the region to establish such a system based on in-situ information in the Ganges-Brahmaputra-Meghna basins with six riparian countries participating in the project.

For 2006 and extending into 2007, the following tasks are envisaged:

i. Formalization of the cooperation to develop and operationalize the project between ESA and WMO
ii. Creation of a Task Team for the preparation of a project implementation plan based on existing projects and activities of the core partners with opportunities for linkages with additional partners
iii. Prepare 1 arc masks for priority areas including Asia
iv. Obtain gauge height time-series and rating curves for selected rivers
v. Obtain bathymetric information for large lakes and reservoirs to calculate volume changes in storage
vi. Operationalize NRT products for new lakes/rivers

The initial time scale for the development and implementation is about 3 years.

Global Terrestrial Network Hydrology (GTN-H)

Launched in 2000, the Global Terrestrial Network for Hydrology (GTN-H) is the result of the joint efforts of the WMO Hydrology and Water Resources (HWR) Department, the Global Climate Observing System (GCOS) and the Global Terrestrial Observing System (GTOS). In the context of the IGWCO, GTN-H has the status of a complementary programme that supports the implementation of the IGWCO.

GTN-H comprises of existing networks, global databases covering ten variables amongst them GCOS essential climate variables and global data product centers, and is managed by a Coordination Panel. Basic objectives and activities focus on developing and improving the availability of hydrological data and information required addressing global and regional climate, water resources and environmental issues. Benefits will include: improved weather and of change; and an understanding of the global water cycle in an integrated context of weather, water and climate. Other benefits will be the improved assessment of freshwater availability and variability, and the greater understanding of large-scale hydrological processes. Central to achieving the objectives is the development of global-scale data products. A major area of activity within GTN-H aims to develop and implement improved approaches and tools for data collection, access and management to support GTN-H objectives, and here GTN-H is a key partner in implementation of the Integrated Global Water Cycle Observation (IGWCO) theme of the IGOS partners.

The work of GTN-H, through its partners is project-oriented. GTN-H progress in the last biennium included: Draft definition of hydrological metadata standards, based on the WMO core metadata standards (in collaboration with GRDC); a prototype online near-real-time river gauge stations data system; access to a first-guess global gridded precipitation product (courtesy of GPCC); online access to the global water quality database of GEMS/Water; second edition of the estimation of freshwater fluxes to the ocean (in collaboration with the University of New Hampshire and GRDC); establishment of the GTN-H Web site and creation of an inventory of hydrological data and product sources (in collaboration with Environment Canada and the University of New Hampshire); and contribution to the Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC and the implementation plan of GEOSS. The GTN-H Coordination Panel met in Koblenz, Germany (4–5 July 2005) to review key GTN-H projects; identify additional networks, products and plans relevant to global aspects of hydrology. The tasks and recommendations that emerged from the meeting included: linking to the arctic and oceanographer community regarding river runoff into oceans; designate responsibility for global harmonization of systematic observations of water vapour; endorse support to the proposed NASA/ESA surface water interferometry mission(s)[1]; identify datasets (in situ and satellite) and research groups to be included in an international data centre for lakes; coordinate the development of standard observational practices for hydrological variables; ensure relevancy to GEOSS; and ensure collaboration and synergy with GTOS-TEMS, through the hydrology module.

Capacity Building

[1] WaTER was not selected by ESA to advance to the next round of competition, see the ESA webpage: http://www.esa.int/esaEO/SEMHQH9ATME_index_0.html (status: 6th June 2004)

The opportunities for using Earth Observations to support water management are significant in every part of the world. The value of these observations and the systems needed to support them has been recognized by many organizations in South and Central America and by the new IGWCO theme that the Integrated Global Observing Strategy Partnership launched in 2004. In order to respond to this opportunity the IGWCO and CONAE have organized a Capacity Building workshop in South America. The workshop was sponsored by NOAA, NASA, WMO and UNESCO. All of these agencies believe there is great potential for increasing the efficiency of water use through better use of observations and predictions of the current and possible future availability of water. The workshop: "Capacity building in Latin America – Earth Observations in the Service of Water Management" was held in Buenos Aires, October 2005 with the objective to bring together those involved in the activities of water management in Latin America with the Earth observation data providers, in order to create a suitable environment for the exchange of experiences and achievements between these two sectors, and to show the possibilities that current Earth observations tools offer today to the field of water management. Participants included water services, hydrological services, agricultural services, universities, international and regional programs and space agencies. One important outcome of the meeting has been the recommendation to ensure that the data provided by data and information generating systems are used effectively and efficiently in water management. It was therefore further recommended that special efforts should be directed at placing the subject in the agenda of the governments through socio-economic and environmental studies. One important element of this activity should be a capacity building activity modeled in part after the TIGER and PUMA activities in Africa that builds on regional expertise and data services and is led by national and regional centers in Latin America in close coordination with international Earth observation agencies.

Planning is underway to have similar workshop organized in South-East Asia and Africa.

Further in the capacity building component, an "Asian Water Resources Management Capacity Building Workshop" is planned from 26-28 September 2006 in Bangkok, Thailand. The workshop is co-sponsored by JAXA, AIT, GEO, WCRP/GEWEX, WMO, UNESCO, UNESCAP, ICHARM and others. The main objectives of the workshop are to:

i. To exchange Information on best practices for applications of Earth observations for water resource management in Asia and other regions;
ii. To exchange Information on available data and tools for applications of Earth observations for water resource management in Asia;
iii. To consolidate regional requirements upon existing requirements for Earth observations and capacity building activities for water resource management in Asia;
iv. To discuss and propose a next step of the regional capacity building projects for applications of Earth observations for water resource management in Asia.

Coordinated Enhanced Observing Period (CEOP)

CEOP has been successful in establishing a prototype integrated observation system formed by combining different types of observations such as in-situ and satellite. In addition, the numerical weather prediction model outputs are merged with the observed data to provide spatially and temporally continuous coverage in a complementary way. The coordinated enhanced observation and model output generation were completed during the first Enhanced Observing Period (EOP-1), which extended from July-September 2001, the EOP-3 (from October 2002-September 2003), and the EOP-4 (from October 2003-December 2004).

The following major achievements have been made until May 2006:

With regard to the data component, in-situ, satellite, and model output data are more than 50% completed and are available on-line through the respective archives and the Centralized Data Integration System. Significant portions of the archived data are available through the Distributed Data Integration System
With regard to the science component the following results have been initiated or have been already achieved in the reporting period:

CEOP special issue of the Journal of Meteorological Society of Japan (JMSJ) to be published in February 2007 with 41 contributions submitted;
Publications in other journals, CEOP Newsletter (#1 – #9);
Water and Energy Cycle Simulation and Prediction (WESP): Model output validation; GLDAS; GHP/CEOP model transferability study; Model intercomparisons;
CEOP Inter Monsoon Studies (CIMS): Monsoon intercomparisons; diurnal, intraseasonal and seasonal variability; monsoon process study using models; impacts of local and remote forcing on monsoon systems;
Satellite: Algorithm development and validation (soil moisture, snow); data assimilation for land hydrology (soil moisture, surface fluxes).

With the conclusion of CEOP Phase I, three unique capabilities have been established and are functioning:

1. Convergence of observations from in-situ and satellite observations and model output data. 35 terrestrial reference centers have been established over the globe and from satellite observations, over 20 variables are being collected. Currently, 12 contributing NWP and Data Assimilation Centres are contributing to CEOP, enabling CEOP to provide a wide range of products.

2. Inter-operability arrangement: A well organized archiving system relating to data collection, processing, storage, and dissemination has been established. This system is based on a data sharing policy and using a metadata standard that is based on ISO TC/211 19115
3. Data Management: The following systems are on-line available since June 2005: Distributed Data Integration System and the Centralized Data Integration System. The data management system encompasses functions such as Quality Assessment/Quality Control, access to data, and archiving of data, data integration and visualization, and information fusion.

3. Data Management: The Distributed Data Integration System and the Centralized Data Integration Systems are available on-line since June 2005.

Activities for the planned CEOP Phase II (2005 – 210) have been initiated: The basic framework of the CEOP Phase 2 plan (which extends the existing data and observation processes and adds greater emphasis on the research and analysis components of CEOP) providing for CEOP to meet its commitments to CEOS/IGOS-P Water Theme, WCRP/COPES and GEOSS, was endorsed. This next Phase of CEOP will, therefore, proceed in two stages (2005-2007; 2007-2010) that run from 1 January 2005 to 31 December 2010. CEOP will, therefore, continue to move forward with its original timeline while accommodating the new initiatives that it has undertaken in support of the core projects in WCRP and in the broader international water and energy cycle climate research community. CEOP has agreed that GEWEX maintains oversight

of the research component of CEOP and to provide the draft of the Phase 2 Implementation/Science Plan at JSC-XXVII, March 2006.

IGWCO Secretariat

JAXA, through its support of the IGWCO Secretariat has been an important part of the theme's success. JAXA has provided support through the organization of teleconference calls, hosting the first IGWCO planning workshop (held jointly with the 4th CEOP meeting), finalizing and printing the IGWCO brochure with ESA support. As from mid-2006, the IGWCO-Secretariat will be a distributed Secretariat with distributed responsibilities for JAXA and WMO as WMO has assumed responsibilities to chair the IGWCO Executive and provide secretarial support to the Executive Committee. Frequent interactions between JAXA and WMO parts of the Secretariat will ensure the continued smooth operation and coordination of IGWCO activities.

The Second IGWCO Workshop and CEOP Science Meeting were held with over 65 participants at UNESCO in Paris, 28 February - 3 March 2006. Details of the results of the meeting are documented in the annex to this report.

During the 4th World Water Forum in Mexico in spring 2006, IGWCO in collaboration with IAHS and UNESCO conducted a special session on space observations for water management. …." It also worked with GEO Secretariat to host a special side event on Observations from Space for water management. This action completed Task WA-06-03 in the GEO 2006 work plan.

Future Plans

In 2006-2007 IGWCO will give a high priority to completing those aspects of its implementation plan that relate to the GEO work plan. One priority here is to take action in GEO WA-06 02 (Hydrological Ensemble Prediction) and to coordinate with GEO on several work plan goals including the organization of one or two water cycle workshops in 2007. In the past a lack of resources has been an impediment to moving forward with a number of these activities. It is hoped that GEO will enable us to overcome these obstacles and make significant progress.

A focus will be placed on moving the Capacity Building activities forward through efforts in South America followed by a workshop in Asia and another in Africa in collaboration with the TIGER project. A related activity is the effort IGWCO directed towards the World Water Forum 4 that was held in Mexico City in the spring of 2006.

Of special importance is the fast-track development of a GEO Water Cycle Community of Practice. a first draft outline of a proposal for a community of practice that will be fully developed for the next GEO Users Interface Committee meeting. A number of new topics will also be advanced in 2006. These include:

The development of a flood project to fill an apparent gap in the Integrated Global Observing Strategy–Partners (IGOS-P) themes and possibly the GEO plan. A planning workshop will be proposed in collaboration with the International Centre for Water Hazard and Risk Management (ICHARM) Program (Japan) and other organizations. IGWCO will also consider Drought as a possible demonstration project of how to link remote sensing and socioeconomic data. The formation of a UNESCO-IGWCO-GARS Working Group on groundwater and the establishment of an initial task list are also envisaged.

Prepared by:
Wolfgang Grabs
Chief, Water Resources Division,
World Meteorological Organization (WMO), Geneva

…with contributions from IGWCO partners