The evolution of operational hydrology within WMO

by Harry F. Lins*

The role of hydrology within WMO has evolved significantly since enactment of the WMO Convention in 1950. From an implicit function under the label “other geophysical observations related to meteorology” in the Convention and the establishment of the Commission for Hydrological Meteorology in 1959, to the transformative resolutions of Congress VI in 1971 that defined “operational hydrology” and ultimately the establishment of the Department of Hydrology and Water Resources within the Secretariat, operational hydrology has evolved to be a core part of the WMO mission and the technical practices of National Meteorological and Hydrological Services (NMHSs).

Seeking its level

Hydrology and water resources are currently explicit and increasingly important components of WMO activities. Notably, however, when the WMO Convention entered into force on 23 March 1950, hydrology was only tacitly recognized as part of the organization. This changed quickly during WMO’s first decade, however, as there was growing awareness of the need for international cooperation in hydrology in the areas of water resources assessment, development, and management. As described in the October 1956 issue of the WMO Bulletin, the Organization had been encouraged by the United Nations and some of its specialized agencies to assume certain responsibilities in the field of hydrology, especially with regard to the collection of data. The WMO Secretary-General had been requested to carry out specific steps to:

- Make appropriate arrangements for ensuring the collection, analysis and dissemination of information on current development of water projects, research programmes and related activities;
- Initiate, in cooperation with the competent specialized agencies and with the governments concerned, a preliminary inquiry on existing hydrological services, plans for their extension and conditions for the execution of these plans; and
- Constitute a panel of world-renowned experts for reviewing the administrative, economic and social implications of integrated river basin development and for advising on the proper action, including the convening of an international conference to be taken in order to ensure a worldwide exchange of experience and data in related domains.

All is flux; nothing stays still

Heraclitus

At an inter-agency meeting in Geneva in July 1956, it had been recommended that WMO draft a questionnaire in consultation with the International Association for Scientific Hydrology, which would take into account the information received as a result of an earlier inquiry by WMO on the relations between NMHSs.

Another subject discussed at the inter-agency meeting was the need to prepare a comprehensive international terminology, or glossary, covering the various sciences related to water resources development. Realizing of course the difficulty of getting the various groups involved to coalesce around a unified document, the group agreed that the most urgent matter was to ensure coordination among the different bodies engaged in preparing glossaries.

The inter-agency meeting was followed by the first session of the WMO Panel on Water Resources Development. One proposal made by the Panel was that WMO should ultimately assume responsibilities in the field of hydrology similar to those discussed in the October 1956 issue of the WMO Bulletin.

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Collecting hydrological data

All countries rely on freshwater to serve their societal needs. To that end, effective management of water resources requires a thorough understanding of the resource’s availability and variability over time and space. Real- or near-real-time hydrological data, as well as the careful preservation of historic records, are therefore essential to ensure such understanding.

The WMO World Hydrological Cycle Observing System (WHYCOS), launched in 1993, helps fill the gap in availability of freshwater resource data and information for countries worldwide. It builds capacity for water resources assessment at the national, river basin, regional and global levels, while at the same time promoting international cooperation in the collection, analysis and exchange of water-related information, including boosting use of modern technologies. So far, several regional components have been launched, in the Mediterranean, Southern Africa, Western and Central Africa (including the basins of the Niger and Volta rivers), Southeast Asia (the Mekong river basin), and the small islands of the Pacific and the Caribbean, while a number of new projects are being planned (for example, the basins of Senegal and Congo) together with the extension of the existing ones.

The individual components, conforming to commonly shared standards outlined in the WHYCOS Guidelines, are shaped to better respond to the specific needs of the region or basin in which they are implemented. In most of the cases, when important internationally shared water bodies are involved, one of the major objectives of the project is the establishment of a network of state-of-the art hydrological stations linked in real time to a regional database. This has been the case of the projects in the Mediterranean, Southern Africa and the basins of the Niger, Volta and Mekong.

The establishment of these observing networks is of particular value in those areas of the world that have undergone severe data degradation in the past decades as a result of shrinking state and international support. Hydrology data can help support existing or new developments in the water sector, as will be the case for the planned Senegal and Congo WHYCOS components. So far more than 200 stations have been rehabilitated or established in the framework of the various components.

WHYCOS also importantly works on the rescue, collection and organization of precious and irreplaceable historical data series, which hold unique value for tracing across decades the evolution and variability of water flows and therefore contribute to a better understanding of climate. These data, which all too often are poorly preserved on fragile media, are recovered into newer and better performing databases easily accessible to the users, as it has been the case, for instance, for the WHYCOS data of Western African rivers.

to its responsibilities in the field of meteorology at the time. The Panel understood that this would necessitate some changes in the WMO Convention and recommended that in the meantime, attention should be concentrated on those aspects of hydrology most closely related to meteorology.

The long-term programme that was envisaged included the preparation of technical regulations and guides on international practices in hydrology, the development of international standards for hydrological observations and networks, the routine exchange of hydrological data, forecasts and yearbooks, the preparation of technical notes on various aspects of hydrology, and the organization of international symposia and seminars.

To execute these new responsibilities successfully, WMO needed full-time specialists in the Secretariat working on the programme in hydrology. The Secretary-General assigned at least two highly qualified persons to the Secretariat from countries having large staffs dealing with hydrometeorological problems.

The Organization quickly embraced this challenge and began making appropriate changes in its technical and scientific structure, as well as in its programme. The most significant early change was the establishment of the Commission for Hydrological Meteorology (CHM) in 1959. Its terms of reference included: the study and formulation of meteorological requirements for hydrology, especially with regard to the rapid exchange and arrangement of data; the design and promotion of networks for the measurement and study of those parameters in the hydrological cycle that involve meteorological consideration; and the development, improvement, promotion and international standardization of methods, procedures and techniques for 1) the application of meteorology to hydrology (as in, for example, river-stage and flood forecasting), and 2) the
provision of meteorological services to international hydrology.

At its first session in 1961, CHM established working groups on hydrological forecasting, hydrological network design, publication and exchange of data, terminology, instruments and methods of observations, and hydrological design, as well as one for the preparation of the Guide on Hydrological Meteorology. In the ensuing years, considerable practical guidance material was prepared for the standardization of hydrological instruments and methods of observation, including technical regulations in operational hydrology, network planning, data processing, analysis for design purposes and hydrological forecasting.

WMO also began providing worldwide technical advice and assistance in national and regional hydrological and hydrometeorological projects for the expansion and improvement of networks and conducting basic surveys. At the Commission’s second session, in 1964, a subtle but enduring change occurred: the Commission’s abbreviation changed from CHM to CHy, although its name remained the same.

The era of operational hydrology

By the late 1960s, the stage was set for hydrology to emerge from its focused organizational role as a component of meteorology to the broader complementary discipline within WMO that it is today. That transformation took shape during the Commission’s third session in 1967. CHy-III occurred early in the International Hydrological Decade (1965-1974), a period when considerable attention was focused on the hydrological sciences and their role in water resources management.

During the session, many delegates expressed concerns and doubts about WMO responsibilities in hydrology. The Commission agreed that, considering the Organization’s experience and structure, it would be appropriate for it to assume responsibility for international cooperation with respect to the collection, transmission and publication of hydrological data, and for the operational aspects associated with the land phase of the hydrological cycle.

Accordingly, the Commission recommended that the name of CHy be changed to Commission for Hydrology and that its terms of reference be changed to clearly reflect its responsibilities and to establish correct terminology. It suggested that the Commission’s new terms of reference reflect primary responsibility for:

- Operational aspects of the collection, transmission, processing and publication of hydrological data related to the land phase of the hydrological cycle, including precipitation, snow cover, water level of lakes and streams, streamflow and storage, evaporation and evapotranspiration, soil moisture and groundwater (only as it relates to surface water), water temperature, sediment discharge, river and lake ice, and chemical quality of water;

- Research, development, improvement and promotion of methods, procedures and techniques for the design of networks, standardization of instruments, and methods of observations, as well as hydrological forecasting, and meteorological and hydrological data for the design of projects; and

- Rendering assistance to governments in planning and organizing hydrological services, training personnel in the collection and analysis of hydrological data, and in procuring suitable equipment.

In response to the recommendations made at CHy-III, the Executive Council XXI called for a technical conference on hydrological and meteorological services in the autumn of 1970 “to consider the ways in which the World Weather Watch can be planned and developed so as to be of maximum benefit to Hydrological Services of Members, particularly in the field of hydrological forecasting.” The conference was the first time hydrologists representing National Hydrological Services (NHSs) met under the auspices of WMO. The participants stressed the need to have the operational aspects of hydrology, which are closely associated with those of meteorology, coordinated

Hydrologic technicians measure the amount of water from a flooded river.
Internationally by WMO. They also made specific reference to these WMO responsibilities as “operational hydrology.”

The most significant outcome of the conference was a proposal to the Congress regarding the procedural and institutional changes needed to strengthen WMO efforts in operational hydrology, and to facilitate increased representation of the views of NHSs in its policymaking bodies. Other important outcomes of the conference included the finalization of a draft of the WMO Technical Regulations in Operation Hydrology. In a strong display of unity, the Conference overwhelmingly recommended the adoption of its proposals by the Sixth Congress.

All the elements were now in place for hydrology to assume a new and more prominent role within WMO, and Congress acted decisively in 1972 to make it so. Its most significant action was to define “operational hydrology”. This definition included: measurements of basic hydrological elements from networks of meteorological and hydrological stations — collection, transmission, processing, storage, retrieval and publication of basic hydrological data; hydrological forecasting; and development and improvement of relevant methods, procedures and techniques in network design, specification of instruments, standardization of instruments and methods of observation, data transmission and processing, supply of meteorological and hydrological data for design purposes, and hydrological forecasting.

Congress also officially changed the name of the former Commission for Hydrological Meteorology to Commission for Hydrology, and approved the revised terms of reference recommended by CHy-III. Congress specifically noted in so doing the expressed needs of Members for internationally recognized standards and practices in operational hydrology, and the Organization’s unique capabilities for integrated flood management.

Integrated flood management

Floods affect almost all sectors of societal activities and services. Especially in the developing world, floods can influence socio-economic development, impacting everything from poverty to food security. Land and water managers, together with emergency planners, policymakers and the private sector, have to change course from traditional flood management towards a fully integrated approach to managing floods.

Traditionally, flood control practices have been reactive and ad hoc. They have relied on controlling floods through structural measures that often disturb the ecological balance of an area and shift flood risks. The WMO Associated Programme on Flood Management (APFM), a joint WMO-Global Water Partnership project, promotes integrated flood management that draws of multidisciplinary expertise to develop a range of flood solution multiple stakeholders.

This joint programme was an important consequence of the change in the terms of reference of the Commission for Hydrology, approved by the World Congress in 1999, and the consequential broadening of the scope of WMO involvement in water issues. Thanks to the work of the APFM, integrated flood management is now widely recognized and adopted by several countries worldwide.

A key goal is to maximize the net benefits from floodplains for agriculture and development, while reducing the negative impacts of floods if deemed appropriate from an integrated point of view. For example, in Kenya, flood management for the Lake Victoria Basin must simultaneously address the problems of the poor flood-plain dwellers and the future development of agriculturally fertile land that is prone to frequent flooding. This requires that each sector of the economy take a role in the ways floods are managed, jointly with all national ministries, agencies and the affected provinces and communities. To that end, the Government of Kenya has been working towards a National Flood Management Strategy through a WMO pilot project. A similar project has been undertaken for Zambia’s Kafue Basin.

A recent APFM project is the HelpDesk For Integrated Flood Management, which was launched in June 2009 to provide demand-driven guidance to all countries working on integrated flood management policy, strategy and development. The HelpDesk, at http://www.floodmanagement.info, provides the central access point for a range of services, tools and learning materials. A virtual discussion forum allows flood management practitioners to exchange views and experiences, and to access tools from a flood management reference centre.
in promoting international cooperation in this field. It further adopted the WMO Technical Regulations in Operational Hydrology (Volume III), which, in addition to standardizing instruments and methods of observation, aimed to facilitate the creation and improvement of hydrological networks, cooperation within international river basins, uniformity in the exchange of hydrological data and assistance in the establishment and expansion of NHSs, particularly in developing countries. Finally, and very importantly, Congress restructured the WMO Secretariat by establishing the Department of Hydrology and Water Resources, which reported directly to the office of the Secretary-General of WMO.

These actions had broad implications beyond the immediate role of hydrology within the Organization. Its decisions conformed to the recommendation of the International Conference on the Practical and Scientific Results of the International Hydrology Decade and on international cooperation in hydrology, whereby international governmental and non-governmental organizations were asked to continue their activities in the field of hydrology and in problems concerning the human environment. It further opened the door to collaboration in the short and long-term programmes and projects in hydrology, water resources and related environmental issues of other United Nations bodies and agencies, as well as other international organizations. Notably, the decisions implemented by the Sixth Congress provided a fundamentally solid structure for WMO hydrological activities that has endured for nearly 40 years.

Into the twenty-first century — the era of water

During the ensuing two decades, the availability and sustainability of clean fresh water began to emerge as an increasingly prominent global concern. In 1992, WMO organized the International Conference on Water and the Environment in Dublin, Ireland, which was a preparatory session to the Earth Summit in Rio de Janeiro that same year. The outcome of the Dublin conference was a set of principles or statements specifying how water issues should be viewed and addressed. They included: freshwater is a finite and vulnerable resource, essential to sustain life, development and the environment; water development and management should be based on a participatory approach, involving users, planners and policymakers at all levels; and water has an economic value in all its competing uses and should be recognized as an economic good.

These principles formed the basis of an action plan for helping countries address a broad array of water resources problems, and have significantly influenced the course of international efforts to ensure water security ever since. The actions associated with the World Water Forums, World Water Assessment Programme and even the Millennium Development Goals (goal 7 is to ensure environmental sustainability), among others, drew heavily on the concepts articulated in the Dublin Statement on Water and Sustainable Development.

Recognizing the importance of its own capabilities, as well as those of its Members to assist in these efforts, the Congress revised the CHy terms of reference at its thirteenth session in 1999. The new terms of reference expanded the focus of CHy activities from technical regulations, standardization of observing methods and instruments and data exchange, to a broader consideration of hydrology and water resources problems wherein socio-economic development and environmental protection gained increased significance. New emphasis was placed on the international exchange of experience and technology, the international dissemination of hydrological information, forecasts and warnings, and on raising the public awareness of the social, economic and environmental significance of water.

Perhaps the most visible indicator of just how far hydrology has evolved as a component of the Organization came with the decision made
by the Fourteenth Congress in 2003 to adopt the WMO slogan “Weather, climate and water” for use on all official documentation, correspondence and publications. It was clear and unequivocal recognition that water was not simply a subset of the Organization’s weather and climate functions but, rather, a full and equivalent responsibility.

As WMO enters its seventh decade of service to the international community, the visibility and strength of, and need for, its hydrology and water resources capabilities continue to grow. Significantly, the maturity of its operational hydrology program has positioned WMO to contribute uniquely and meaningfully to the critical problems of water security and sustainability.

As noted by the Secretary-General in his address opening the thirteenth session of CHy in 2008: “While integrated water resources management has practically gained world acceptance, actions and decisions by some countries seem to indicate that management may not be possible unless the respective planners and decision-makers can be made more aware of their actual water resources, expressed in time and space, in quantity and quality, and in terms of their variability . . . In addition, water-related natural hazards will require continued monitoring, forecasting and warning, in order for countries to develop the necessary resilience and to mitigate the adverse impacts of extreme hydro-meteorological events . . . In this context, it will be of fundamental importance for the WMO Commission for Hydrology to continue providing the necessary technical assistance to the NHSs of WMO Members, especially in developing countries, by focusing future CHy activities on those areas where WMO contributions may be most useful.”