Commission for Hydrology

Fourteenth session

Geneva
6–14 November 2012

Abridged final report with resolutions and recommendations

World Meteorological Organization
Weather • Climate • Water

WMO-No. 1105

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GENERAL SUMMARY OF THE WORK OF THE SESSION

1. OPENING OF THE SESSION (agenda item 1)

1.1 The president of the Commission for Hydrology (CHy), Mr Julius Wellens-Mensah (Ghana), opened the fourteenth session of CHy at 10.00 a.m. on Tuesday 6 November 2012 at the World Meteorological Organization (WMO) Headquarters, Geneva, Switzerland. In welcoming delegates and the representatives of other international organizations, Mr Wellens-Mensah stressed the continuing importance of the work of the Commission for Hydrology in support of the activities of the National Hydrological Services. Mr Wellens-Mensah also emphasized the need for the Commission, as it prepared and adopted its future programme of work, to take into consideration the growing demand for freshwater resources and the potential implications of climate change on both water availability and extremes (floods and droughts).

1.2 The Secretary-General of WMO, Mr M. Jarraud, welcomed participants. In his address, he expressed his appreciation for the work of the Commission, noting that the reputation that the WMO has for promoting sound scientific and technical work undertaken in a spirit of cooperation, is due in no small measure to CHy. He noted that it was very appropriate that the five theme areas the Advisory Working Group has proposed as the priorities for the work of the Commission in the next intersessional period show the correct mix of traditional issues and new, upcoming areas of interest for National Hydrological Services worldwide. Mr Jarraud reported that since last February he has been in the position of Chair of UN-Water, the coordination mechanism of the United Nations entities which are active in water issues, which also has a number of external partners representing various organizations and civil society. One of the reasons for accepting this designation had been his desire to increase the visibility of WMO in the field of hydrology and water resources management. He assured the participants of the Secretariat's support as well as of his own, for their challenging work ahead, and wished them success in their deliberations.

2. ORGANIZATION OF THE SESSION (agenda item 2)

2.0.1 The documents for the session were reproduced in all six working languages of WMO, namely Arabic, Chinese, English, French, Russian and Spanish. Simultaneous interpretation was provided for all meetings of the plenaries in all six working languages.

2.0.2 A total of 151 participants attended the session, representing 51 Members of WMO and 9 international organizations. The list of participants is given in the appendix to the present report.

2.1 Consideration of the report on credentials (agenda item 2.1)

At the request of the president, the representative of the Secretary-General presented a list of the delegations present, including the capacities in which they were attending the session, whose credentials had been found to be in order.

2.2 Adoption of the agenda (agenda item 2.2)

The provisional agenda was adopted, as contained in CHy-14/Doc.1.

2.3 Establishment of committees (agenda item 2.3)

2.3.1 A Nomination Committee was established, consisting of the following delegates:

RA I : Rajan Mungra (Mauritius)
RA II : Valery Vuglinski (Russian Federation)
RA III : Antonio Cardoso Neto (Brazil)
RA IV : Alain Pietroniro (Canada)
RA V : Dasarath Jayasuriya (Australia)
RA VI : Caroline Wittwer (Ms) (France)

Mr Dasarath Jayasuriya (Australia) was elected chairperson of the Nomination Committee.

2.3.2 A Selection Committee was also established to assist in the selection of members of the AWG consisting of the following delegates:

RA I : Ahmed Fawzy Tolba (Egypt)
RA II : Chongkolnee Yusabye (Ms) (Thailand)
RA III : Antonio Cardoso Neto (Brazil)
RA IV : Karla Patricia Garcia (Ms) (Panama)
RA V : William Putuhena (Indonesia)
RA VI : Markku Puupponen (Finland)

Mr Markku Puupponen (Finland) was elected chairperson of the Selection Committee.

2.3.3 The Commission carried out its work in Plenaries. General Plenary was chaired by the president and discussed agenda items 1, 2, 3, 4, 5, 12, 13, 14, 15, 16, 17, 18, 19, 20 and 21. Plenary A was chaired by Mr Harry Lins (United States of America) and discussed agenda items 6, 7, and 8, while Plenary B was chaired by Mr Liu Zhiyu (China) and discussed agenda items 9, 10 and 11.

2.3.4 A Coordination Committee was established, consisting of the president, the Chairs of Plenaries A and B, and the representative of the Secretary-General.

2.3.5 Five (5) working parties were established to consider in more detail the following topics:

Future Progamme of Work;
Data Operations and Management;
The 2011 WHYCOS Review recommendations;
Review of WMO-No. 258 – Hydrology;
Strategic Planning.

2.4 Organizational questions (agenda item 2.4)

2.4.1 The working hours adopted were 9:30 to 12:30 and 14:30 to 17:30. Concerning the minutes of the session, the Commission agreed to not preparing them.

2.4.2 It was noted that, in line with the previous session and for the sake of efficiency and reducing the session's costs, most of the factual information referring to past activities and not calling for decisions by the Commission was presented as INFs and available in English and French.

2.4.3 The Commission also noted that, with an aim to increase the involvement in its decision process of those Member countries that had not been able to send a delegation to attend the session physically, a pre-Session e-Discussion facilitated by a virtual forum had been carried out under a number of agenda items. Six experts participated directly in the forum and provided their written inputs, while the Website received over 1,000 visits. The outcomes of the pre-Session e-Discussion had been presented to the Commission and included in this report under the relevant agenda items. The Commission was concerned that this method may not be achieving the desired results and requested that the AWG give consideration to the methods of presenting and promoting the material for discussion.

3. REPORT ON THE HYDROLOGY AND WATER RESOURCES PROGRAMME (agenda item 3)

3.1 Report by the president of the Commission (agenda item 3.1)

The Commission noted the report of the president of the Commission for Hydrology, included as Annex I to the present report, and commended him on his leadership in a time of change and the

progress achieved by the Commission during the past intersessional period. The Commission discussed the future directions proposed by the president and stressed the need to continue to work in the topics of capacity development, measurement of uncertainty, assessment of water availability, hydrological forecasting, data operations and management, including data exchange and in the development and implementation of demonstration projects which show the applications of the outputs from the Commission's activities.

3.2 Reports by the Advisory Working Group members (agenda item 3.2)

The Commission noted the reports of the Advisory Working Group Members (see Part II of the abridged final report of the fourteenth session of the Commission for Hydrology) and expressed appreciation for the contribution that they had made to the coordination and delivery of the activities of the Commission with the assistance of OPACHEs during the past intersessional period. The following AWG members (or their representative) presented their reports:

- Quality Management Framework – Hydrology – Mr Harry Lins (United States of America), Ms Zsuzsa Buzás (Hungary);
- Water, Climate and Risk Management – Ms Ann Calver (United Kingdom of Great Britain and Northern Ireland);
- Hydrological Forecasting and Prediction – Mr Johannes Cullman (Germany), Mr Zhyiu Liu (China) and Mr Guido van Langenhove (Namibia);
- WIS/WIGOS – Mr Antonio Cardoso Neto (Brazil);
- Water Resources Assessment – Ms Jeanna Balonishnikova (Russian Federation).

3.3 Report of the Secretary-General (agenda item 3.3)

The Commission noted the report of the Secretary-General on the activities undertaken in the framework of the HWRP, included as Annex II to the present report, and recognized the progress achieved by the joint efforts of the Commission, through its Advisory Working Group, and the WMO Secretariat during the past intersessional period.

3.4 Regional activities related to the Hydrology and Water Resources Programme (agenda item 3.4)

3.4.1 The Commission noted the report of the activities undertaken through the Regional Associations in relation to the HWRP. The Commission was informed of the various approaches that had been made to improve coordination and collaboration between the Technical Commissions and Regional Associations. The Commission strongly supported the process by which the Commission ensured that the needs of the Regional Associations were incorporated into the work programme of the Commission (that is by having representation from the Regional Associations at the last Advisory Working Group prior to the Commission session).

3.4.2 The Commission stressed the need for the continuation of Regional Working Groups on Hydrology and the inclusion of the Regional Hydrological Advisors on the Regional Association Management Groups in order to continue to have regional hydrological issues identified and addressed.

3.4.3 The Commission suggested that closer cooperation between the OPACHEs and the Regional Association Working Groups on Hydrology (or their equivalent) was necessary and recommended that the eBoard and eForum be more widely promoted through the regional associations, especially in the lead up to a Commission meeting.

4. DECISIONS OF CONGRESS AND THE EXECUTIVE COUNCIL OF RELEVANCE TO THE HYDROLOGY AND WATER RESOURCES PROGRAMME (agenda item 4)

WMO Congress

4.1 The Commission was informed that the Sixteenth WMO Congress (Cg-XVI), after reviewing the implementation of the Hydrology and Water Resources Programme expressed its general satisfaction with the Programme and adopted the following resolutions to further advance the work of the Commission:

(a) Resolution 12 (Cg-XVI) - Hydrology and Water Resources Programme;
(b) Resolution 13 (Cg-XVI) - Quality Management Framework – Hydrology;
(c) Resolution 14 (Cg-XVI) - World Hydrological Cycle Observing System (WHYCOS); and
(d) Resolution 15 (Cg-XVI) - Establishment of an Advisory Group for the WMO Flood Forecasting Initiative.

4.2 The Commission was informed that among the major decisions taken by Sixteenth Congress was the adoption of the Strategic Plan (SP) for the period 2012-2015 based on the need to address three broad societal needs through five Strategic Thrusts and eight Expected Results. The adopted SP, which will guide and shape CHy's work plan in the next intersessional period, underscores the importance of improving quality and delivery of user-oriented, timely, accurate and cost-effective products and services by advancing scientific research and applications, having in mind also the challenges of adaptation to climate variability and change, strengthening capacity building and good governance, and building and enhancing partnership and cooperation.

4.3 The Commission also noted that Sixteenth Congress further identified five strategic priorities for the next intersessional period, out of which four relate to the work of the Commission. CHy is therefore expected to contribute significantly in their implementation (see agenda item 5):

(a) Establishment and implementation of the Global Framework for Climate Services (GFCS);
(b) Capacity Building for developing and least developed countries;
(c) Implementation of the new WMO Integrated Global Observing System (WIGOS) and the new WMO Information System (WIS);
(d) Further enhancement of WMO's Disaster Risk Reduction (DRR) programme and activities;
(e) Strengthening and further development of new Services to Civil Aviation.

4.4 The Commission noted that, in addition to adopting the Strategic Plan for 2012-2015 and the above resolutions, Congress took the following decisions of relevance to CHy:

(a) Emphasized the benefits to be derived from Regional Working Groups on Hydrology that provide a platform for hydrologists within a Region to discuss matters of common concern;
(b) Endorsed the revised Strategy on Education and Training in Hydrology and Water Resources;
(c) Affirmed the importance of WHYCOS as a priority activity within the WMO Hydrology and Water Resources Programme, ownership by WMO of WHYCOS and its components and requested the Secretariat to carry out an independent external evaluation of the Programme. This review had been done and had been considered by the WHYCOS International Advisory Group (WIAG) and the Advisory Working Group (AWG) and was being submitted to CHy-14 for consideration and adoption;
(d) Decided that the scope of the WMO Flood Forecasting Initiative should include all the hydrological forecasting activities such as those related to flash floods, riverine floods, including seasonal forecasts and coastal flooding due to storm surges;

(e) Requested the Commission for Hydrology to review the definitions for Hydrologists and Hydrological Technicians and their associated Basic Instruction Packages (BIPs) at its next session. The request was opened up for discussion during CHy-14, taking into account the views of other key stakeholders such as the United Nations Educational, Scientific and Cultural Organization (UNESCO), the International Association of Hydrological Sciences (IAHS), the International Association for Hydro-Environment Engineering and Research (IAHR), etc.; and,

(f) Decided to harmonize the list of WMO publications into: (a) governance and technical publications; and (b) general information publications; and approved for the HWRP in the next financial period the publication of: (i) Guide to Hydrological Practices (in French, Russian and Spanish); (ii) Manual on Stream Gauging (in French, Russian and Spanish); (iii) Manual on Flood Forecasting and Warning (in English and French); and (iv) Manual on Water Resources Assessment (in English, French, Russian and Spanish).

Executive Council

4.5 The Commission recalled that in the intervening period from November 2008 to June 2012, four sessions of Executive Council, namely, EC-LXI, EC-LXII, EC-LXIII and EC-64 have been held. The Commission noted that decisions of the sessions of relevance to CHy include:

(a) The presidents of technical commissions were requested to review the concept of mandatory publications in the light of WMO Quality Management Framework (QMF) and recent technological advances in publications;

(b) The Inter-Commission Task Team on Quality Management Framework was requested to consider the development of a glossary on terminology related to the QMF, including the use of the term 'standard';

(c) The regional associations and technical commissions were requested to incorporate WIGOS implementation in their operational plans and work programmes;

(d) A Joint CCl/CAgM/CHy Expert Group on Climate, Food and Water was established to: (i) oversee and coordinate the joint activities of the Commission for Climatology (CCl), the Commission for Agricultural Meteorology (CAgM) and CHy related to climate variability, climate change adaptation and risk management; (ii) oversee the development and provide guidance on the use of methods, tools and best practices; (iii) recommend ways to improve the availability of data and their integration; and (iv) promote effective use of climate and hydrological information in water resources management and food production;

(e) Agreement with the proposal of the EC Panel on Education and Training to split WMO Publication No. 258 into two separate new publications; one dealing with classifications and qualifications and the other aimed at educators and trainers. Furthermore, when the technical commissions developed competences and education and training requirements for their areas of interest, these requirements should appear in publications produced and maintained by the Commissions;

(f) The EC Working Group on Climate and Related Weather, Water and Environmental Matters was re-established with the task of advising the Executive Council on all matters related to WMO's climate activities, in order to promote better coordination among WMO bodies and programmes and to help strengthen WMO's partnership with other UN and scientific organizations concerned with climate.

4.6 EC-64 noted with satisfaction efforts made to solicit views from presidents of regional associations, presidents of other technical commissions and chairpersons of Regional Working Groups on Hydrology in developing the draft work plan of the Commission. The session endorsed CHy's practice of posting selected pre-session documents on the CHy e-Board and e-Forum to stimulate pre-session discussions and contributions to make the upcoming CHy-14 session more effective and efficient.

5. CONTRIBUTION OF THE HYDROLOGY AND WATER RESOURCES PROGRAMME TO THE PRIORITIES OF THE WORLD METEOROLOGICAL ORGANIZATION (agenda item 5)

5.1 Climate activities and the Global Framework for Climate Services (agenda item 5.1)

5.1.1 The Commission was informed about the progress being made with respect to the implementation of the Global Framework for Climate Services (GFCS), in particular the outcomes of the Extraordinary World Meteorological Congress held from 29-31 October 2012. The Commission was informed that GFCS is a globally coordinated collective of the organizations that are already engaged in producing and using climate information and services. The aim in bringing these together through the Framework is to enable producers, researchers and user organizations to join forces to lift the quality and volume of climate services worldwide, particularly for developing countries. The Commission was also informed about the roles and responsibilities of the WMO with respect to the implementation of the GFCS.

5.1.2 The Commission was made aware of the contributions that have already been made by the Hydrology and Water Resources Programme (HWRP) to the Implementation Plan of the GFCS, in particular in relation to the User Interface Platform, water sector exemplar, and the observations and monitoring and capacity development pillars. The Commission noted that the activities being undertaken in its water, climate and risk management thematic area, including workshops on extended hydrological prediction and publication of a technical report on Climate and Meteorological Information Requirements for Water Management, could be considered as initial contributions to the GFCS. The Commission noted that a discussion paper, How CHy Can Contribute to the Global Framework for Climate Services, had been prepared by the CHy Advisory Working Group (AWG) and been placed on the CHy Pre-Session Forum for discussion leading up to CHy-14. The Commission noted that there had been two written responses to the paper highlighting issues of data sharing between the climate and water communities and the requirement for the hydrological community to see modelling in a wider context of global modelling.

5.1.3 The Commission was pleased to see the advances made with respect to the GFCS and strongly supported the high priority given to the GFCS, especially with regard to the monitoring of climatological and hydrological conditions in support of the GFCS. It stated that monitoring is needed not only in observation-sparse regions and Polar Regions (as suggested by the GFCS), but also for the rest of the world, where NHSs face budget cuts that may negatively affect the observation density and data quality. The Commission also strongly supported the role and responsibility of NHSs and the hydrological community as a whole in the GFCS as the authority for assessing and interpreting the impacts of climate change on water and hydrology. The Commission felt that a statement on the limitations of using climate change scenarios in hydrological impact studies and assessments would be valuable to the hydrological community, as well as the GFCS at large.

5.1.4 The Commission noted that the use of climate data is not new to operational hydrologists and that a variety of approaches have been developed to meet a wide variety of needs, often incorporating divergent data sources. It felt that greater clarity was required in respect to the scope of the GFCS with regard to meeting a wide range of existing needs. The Commission expressed its concern that under the current concept it appears that the GFCS will provide data without fully appreciating the variety of current needs or the uses to which the currently available data is applied. The Commission believed that the User Interface Platform should address this issue and requested that operational hydrologists, as represented by CHy, be considered full partners in defining the specific climate products to be delivered through the GFCS. The Commission felt that CHy, in close cooperation with CCl, could also practically contribute to the activities of the GFCS through the Regional Climate Centers.

5.1.5 Noting the importance of climate data, services and products to sustainable water resources management, especially as related to droughts and floods, the Commission agreed that it has a major role to play as part of the User Interface Platform for the GFCS. The Commission also stressed the importance of the climate and water sectors working more closely together in the development and implementation of tools for assessing, coping with, and adapting to climatic variability and change. Accordingly, the Commission adopted Resolution 1(CHy-14) – Contribution of the Commission to the Global Framework for Climate Services

5.2 Disaster Risk Reduction (agenda item 5.2)

5.2.1 The Commission recalled the decisions of Cg-XVI that identified DRR as one of the five priorities of WMO and noted that a number of DRR User Interface Expert Advisory Groups have been established to work in close collaboration with the WMO constituent bodies, to develop user requirements needed for the implementation of the DRR Work Plan 2012-2015 as approved by EC-64. In this regard, the Commission acknowledged that a number of DRR Work Plan activities are relevant to the work of the CHy, specifically in the areas of:

(a) Hazard/Risk Analysis for floods, through participation in the DRR Expert Advisory Group on Hazard/Risk Analysis;
(b) Development of operational guidelines for Multi-Hazard Early Warning Systems (MHEWS) for various types of floods; and
(c) Further strengthening of CHy linkages to the comprehensive and coordinated DRR national/regional projects in the Caribbean, Southeast Europe and Southeast Asia.

5.2.2 In this regard, the Commission noted the merits of designating a DRR focal point within the CHy Advisory Working Group to coordinate with the DRR focal points in other relevant technical commissions, and agreed that the AWG members responsible for Hydrological Forecasting and Prediction would coordinate the Commission for Hydrology inputs to the DRR-related activities.

5.2.3 The Commission recalled that the Hyogo Framework for Action (HFA) was a framework put in place for the period 2005 to 2015 which has served as a basis for the WMO's DRR programme planning and activities. In this regard the DRR programme is working to more closely integrate the DRR-related activities of all technical commissions into the Work Plan.

5.2.4 The Commission was informed of activities undertaken within the HWRP directly related to DRR. The Commission noted that, from a hydrological perspective, the major disaster risk reduction activities are undertaken through the WMO Flood Forecasting Initiative (FFI) and the Associated Programme on Flood Management (APFM). The principal objectives of these initiatives are to improve the capability of members to manage the risks associated with both flood events and the land and populated areas on which they have the most impact, under the principle of Integrated Flood Management. WMO and the Global Water Partnership are also working on a similar activity based on the concept of Integrated Drought Management. Major activities currently underway include: the implementation of the Flash Flood Guidance System (FFGS) with global coverage in cooperation with the National Oceanic and Atmospheric Administration (NOAA)/ National Weather Service (NWS), the Hydrologic Research Centre (HRC) and the United States Agency for International Development/Office of Foreign Disaster Assistance (USAID/OFDA), which has close linkages to the Severe Weather Forecasting Demonstration Project (SWFDP) activities; the Coastal Inundation Forecasting Demonstration Project (CIFDP), initiated jointly by the WMO-IOC Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM) and CHy, the collaborative Iberoamerican Network for the monitoring and forecasting of hydrometeorological phenomena (PROHIMET) pilot projects and the project Building Resilience to Disasters in Western Balkans and Turkey implemented in partnership with the United Nations International Strategy for Disaster Reduction (UNISDR). The APFM HelpDesk continues to provide capacity building support to the National Hydrological and Meteorological Services (NHMSs) in the establishment of their floodplain management policies and plans.

5.2.5 The Commission was encouraged by efforts to align these technical assistance projects within the context of the existing coordinated DRR national/regional projects in the Caribbean, Southeast Europe and Southeast Asia. The Commission stressed that such technical assistance projects and technical programmes' capacity development activities, in other regions (e.g., Southern Africa, Eastern Africa, South Asia) should be aligned with the WMO DRR Programme crosscutting approach, and the national DRR and early warning system institutional frameworks, to ensure consistency of approach and linkage with the users from an early stage from the design of the concept to the long-term operation of these technical capacities.

5.3 Capacity-building for the developing and least developed countries (agenda item 5.3)

The Commission was informed about activities undertaken within the Hydrology and Water Resources Programme related to capacity development. The Commission noted that these issues were further reported on and discussed under agenda item 11. The Commission agreed that coordination of the Commission for Hydrology Capacity Building related activities should rest with the vice-president of CHy.

5.4 Implementation of the WMO Integrated Global Observing System and the WMO Information System (agenda item 5.4)

5.4.1 The Commission noted that significant progress had been made with the WMO Integrated Global Observing System (WIGOS) and WMO Information System (WIS). The WIGOS Implementation Plan (WIP) had been agreed by EC-64. This outlined the activities that are needed to achieve the WIGOS aims of improving management of observing systems throughout their life cycle so that they better meet user requirements, delivering observation-based services that use a recognized Quality Management Framework and the principles of continuous improvement, and enhancing the return on investments in observing systems through reduced global costs and increased use of observed information. WIS became operational in January 2012. National Centres are essential to WIS; these collect and distribute information nationally, acting as the channel between national activities and the regional and global community. Although the majority of National Centres are the NMSs, many Members have also identified their NHSs as National Centres. Data Collection or Production Centres (DCPCs) are sponsored by WMO Programmes and either collect regional or programmatic information for international exchange (such as GRDC), or produce information of regional or global relevance (such as ECMWF and NOAA NESDIS). The Global Information System Centres (GISCs) each hold a copy of the global WIS Discovery Metadata Catalogue (through which anyone can find what information is available through the WIS) and ensure effective exchange of information, assisting Members in their area of responsibility to participate in WIS. At the time of CHy-14 there were five operational GISCs. The Commission took note of the WIP, encouraged centres to participate in WIS, and considered it essential for its experts to contribute to the definition and maintenance of data representations and metadata for WIS and WIGOS.

5.4.2 The Commission noted the efforts made by the AWG to add focus and direction to the contribution being made by the Hydrology and Water Resources Programme to WIS/WIGOS. In particular, the Commission noted that the AWG at its February 2009 meeting had decided to recommend that the Southern African Development Community-Hydrological Cycle Observing System (SADC-HYCOS) and FFGS in Southern Africa be integrated as a pilot project under WIGOS/WIS. However, the Commission was made aware that there have been challenges in implementing this project and thus showing the potential future benefits to the hydrological community of contributing to WIS/WIGOS. Specifically, the SADC-HYCOS project itself has not proceeded past Phase II and it was under Phase III that the focus was to shift from installation of equipment to the development and delivery of information and products. Also, the implementation of the FFGS in Southern Africa has not proceeded as quickly as planned. Therefore, the environment was not conducive for closer alignment of the data collection and service delivery elements of both activities. This said, considerable benefits have accrued to the flood forecasting

and warning community from access to the severe weather products developed under the FFGS and should SADC-HYCOS Phase III be realized, the potential for integration of observations and associated services should be investigated. The Commission agreed that coordination of the Commission for Hydrology WIS/WIGOS related activities should rest with the AWG member responsible for Data Operations and Management.

5.4.3 The Commission was informed that the catalogues and registries of WIS and the Global Earth Observation System of Systems (GEOSS) have been made fully interoperable. This arrangement allows discovery of data and information located within GEOSS through WIS, and vice versa, thus avoiding duplicative metadata registration.

5.4.4 The Commission noted that it is important to be able to identify datasets and other objects unambiguously, and suggested that the WIS and WIGOS activities consider a system of Uniform Resource Identifiers associated with URLs to achieve this.

5.5 Aviation Meteorological Services (agenda item 5.5)

The Commission noted with interest the issues associated with achieving the International Organization for Standardization (ISO) certification for the provision of aviation meteorological services and the significant role played by the establishment of a quality management system in this regard. The Commission agreed that, in a similar way, it should continue to further develop and evolve the Quality Management Framework – Hydrology. The Commission agreed that coordination of the Commission for Hydrology activities related to this priority of WMO were most closely aligned with the thematic area of Quality Management Framework – Hydrology and thus should rest with the AWG member responsible for Quality Management Framework – Hydrology.

6. WMO QUALITY MANAGEMENT FRAMEWORK – HYDROLOGY (agenda item 6)

6.1 The Commission reaffirmed its commitment to quality management and to the further development and wider use of the Quality Management Framework – Hydrology (QMF–H). In doing so, it specifically noted Resolution 26, (Cg-XVI) wherein Congress recommended full integration of the Quality Management Framework (QMF) into the wider WMO strategic and operational planning process as part of a holistic management system encompassing quality management, risk management, results-based management, as well as monitoring and evaluation.

6.2 The Commission noted that a paper on the Importance of Standards in National Hydrological Service (NHS) Operations had been placed on the CHy Pre-Session Forum for open discussion prior to CHy-14. The Commission was informed about the comments and discussion that this paper had generated on the Forum. The Commission endorsed the general thrust of the paper and encouraged members to adopt standard procedures and a quality management system in the operations of National Hydrological Services and to encourage the expanded use of such procedures in accordance with WMO guidelines and recommendations, in line with the Quality Management Framework – Hydrology. The Commission agreed that such an approach will lead to better management and a more effective organization, employee satisfaction and commitment to the organization, improved quality of products and services and improved customer satisfaction.

6.3 The Commission also noted that the World Meteorological Organization (WMO) and the International Organization for Standardization (ISO) have agreed to increase their cooperation in the development of international standards related to meteorological and hydrological data, products and services. The working arrangements between the WMO and ISO aim to strengthen the development of International Standards and to avoid duplication of work on standards related to meteorological, climatological, hydrological, marine and related environmental data, products and services. The Commission agreed that the recognition of WMO as an international standardizing body for technical standards provided a valuable opportunity to further emphasize the role and benefits of applying the Quality Management Framework–Hydrology and providing

Members with the necessary guidance on technical standards from data collection through to service delivery. As regards the proposal of exploring the possibility of facilitating improved access by NHSs to existing ISO standards on hydrometry, under the umbrella of the Agreement on Working Arrangements between WMO and ISO, the Commission requested the Secretariat to present a suggested plan of action to the first meeting of the AWG, for its consideration.

6.4 The Commission welcomed the offer made by China of contributing, in the framework of QMF-H, material developed by its experts comprising a relatively complete system of technical specifications and procedures, including more than 200 standards in hydrologic networks, hydrometry instrumentation and equipment, hydrological information and forecasting, water resources assessment and databases. The Commission also welcomed the offer by Italy to contribute in this framework, especially for hydrometric network design and precipitation intensity. The Commission agreed that these offers should be considered for use by the AWG in the further development of the QMF-H. The Commission encouraged all members to continue to contribute to the development of the QMF-H.

Guidance Material: Quality Management Framework – Hydrology

6.5 The Commission expressed its satisfaction with the progress made in the preparation and dissemination of guidance material related to quality management in hydrology. In particular, it noted the valuable insight contained in the discussion paper entitled *The Importance of Standards in NHS Operations* that was posted on the CHy Pre-session Forum (http://www.whycos.org/chy14/viewtopic.php?f=18&t=46), as well as the very comprehensive information contained in the *Guidelines for Implementing a Quality Management System in Hydrology* that was posted on the CHy e-Board (http://www.wmo.int/pages/prog/hwrp/chy/chy13/documents/awg3/Doc6_2-Quality_Management.pdf).

6.6 The Commission was made aware of the recent WMO draft publication *A Practical Guide for the Implementation of a Quality Management System for National Meteorological and Hydrological Services* (http://www.wmo.int/pages/prog/amp/aemp/documents/QM_Guide_NMHSs_V10.pdf). It represents the most authoritative blueprint for WMO Members to follow in pursuing a quality management system approach to the delivery of their services. The Commission expressed its support for members to use the new *Practical Guide*, but suggested that members may also find the above-mentioned *Guidelines for Implementing a Quality Management System in Hydrology* prepared by the Advisory Working Group (AWG) with specific reference to NHSs to be a helpful complementary reference. The Commission recommended that the three major QMF-Hydrology guidance documents, i.e.:

(1) Annex 1 to Resolution 1 (CHy-XIII);
(2) The paper on the Importance of Standards in NHS Operations;
(3) The Guidelines for Implementing a Quality Management System in Hydrology;

be placed on the WMO Website on a page devoted exclusively to QMF-Hydrology, after being reviewed and updated, if needed, by the AWG.

Project of the Commission for Hydrology on the Assessment of the Performance of Flow Measurements and Techniques

6.7 The Commission was pleased to learn of the progress achieved in the implementation of the work plan of the project for the assessment of the performance of flow measurement instruments and techniques. In particular, the Commission noted the publication of the *Guidelines for the Assessment of Uncertainty of Hydrometric Measurements* (WMO-No. 1097). The Commission recalled that in February 2009, the AWG, on behalf of CHy, adopted the uncertainty analysis framework for flow measurements as developed by the project and described in the

Guidelines mentioned above, which is based on the Guide to the Expression of Uncertainties in Measurements (GUM, 1993). The adopted report describes in detail the approaches to estimating uncertainty and outlines step-by-step procedures for its practical implementation. A suite of three detailed examples is also included.

6.8 The Commission also noted the other project's outputs (POs), such as the report on the survey on field discharge measurement instrumentation and techniques used operationally, the development of a database of discharge techniques, as well as the progress achieved in the development of an Uncertainty Analysis Decision-Aid Tool (UADAT), the preparation of guidelines for conducting and reporting on the calibration and verification of the performance of discharge measurement instruments, and the initiation of work in preparing guidelines for the estimation of uncertainty analysis of discharge determination via various techniques. It also noted that reports on progress of all of the above mentioned POs are available at the project Website: http://www.wmo.int/pages/prog/hwrp/Flow/index.php

6.9 The Commission thanked the experts that had been so actively involved as members of the Management Committee (MC), namely: P. Pilon (Chair, representing CHy), Z. Buzás (representing WMO's RWGHs), M. Muste (IAHR), J. le Coz (IAHS), T. Yorke (ISO), J. Skripalle and R. Haimelin (HMEI) and J. Fulford and P. McCurry (invited experts).

6.10 The Commission noted that the MC had reviewed its terms of reference and had proposed changes based on their experience during the intersessional period (see Annex to Resolution 2 (CHy-14)). The MC had also recommended continuing the work on the existing seven core activities and had suggested the following new activities for the work programme of the next intersessional period:

(a) Design of regattas (intercomparisons of flow measurement techniques) and guidance on conducting them to answer specific questions;
(b) Extension of the scope of PO 6 to techniques other than stage-discharge relations, first priority being index-velocity method as it was identified in the survey as being the next most commonly employed approach;
(c) Documentation of approaches and examples are needed in task 6 c) to illustrate the estimation of uncertainty of discharge time series;
(d) In PO 6), exploring approaches for treatment of non-stationary rating curves;
(e) Addressing the issues of:
    (i) Influence of bad streamflow gauging location on uncertainty, and
    (ii) Environmental factors that can influence the operator's uncertainty;
(f) Establishing of approaches to estimate the uncertainty for other acoustic instruments and measurement protocols (i.e., transects). Evaluate uncertainties for directly measured and unmeasured areas of the cross section using alternative measurement algorithms. Estimate the total discharge for the cross-section and its uncertainty;
(g) Compiling a short document on References and Reference Standards in laboratories and regattas (limitations of the practices of averaging in measurements, transference process for the references, traceable standards);
(h) Considering the establishment of a collaborative, international, community-built database for Uncertainty Analysis (UA) in hydrometry.

6.11 The Commission adopted Resolution 2 (CHy-14) – Project for the Assessment of the Performance of Flow Measurement Instruments and Techniques.

6.12 The Commission noted that this project serves as an excellent model for use within the other CHy theme areas and encouraged the AWG members to consider, where appropriate, using similar mechanisms for accomplishing technical activities within their respective Terms of Reference.

6.13 The Commission also recalled the importance of maintaining links with relevant regional standardization bodies such as the European Committee for Standardization (CEN), in order to contribute to the accomplishment of QMF-H objectives and for the benefit of all WMO Members.

Technical material and issues

6.14 The Commission noted its appreciation for the publication of several documents under the WMO QMF– Hydrology in the last intersessional period, namely: the *Manual on Estimation of Probable Maximum Precipitation (PMP)* (WMO-No. 1045), the *Manual on Stream Gauging* (WMO-No. 1044), the *Manual on Flood Forecasting and Warning* (WMO-No.1072), the *Guidelines for the Assessment of Uncertainty of Hydrometric Measurements* (WMO-No. 1097), the *Technical Report on Climate and Meteorological Information Requirements for Water Management* (WMO-No. 1094), the *Technical Report on Water Quality Monitoring* (in preparation), the *Technical Report on Technical Material for Water Resources Assessment* (WMO-No. 1095). All of these publications are available online at http://www.wmo.int/pages/prog/hwrp/index_en.php under the "Publications" entry of the right-hand menu. The Commission was also pleased to note the issuance of the CHy Statement on the Scientific Basis for, and Limitations of, River Discharge and Stage Forecasting on the CHy e-Board (http://www.wmo.int/pages/prog/hwrp/publications/statements/stmnt_limitations08042010.pdf).

6.15 The Commission also noted that some planned publications had not been finalized during the last intersessional period, due to several technical and logistical reasons, namely: the Manual on Flood Risk Mapping, the Manual on Water Resources Assessment, the Manual on Design Flood Estimation and the Guidance material on the estimation of the economic benefits of hydrological services.

6.16 Recalling its decision at CHy-XIII to adopt a comprehensive peer review process for CHy publications (Annex 2 to Resolution 1), the Commission expressed its satisfaction with the new process and the form that it was implemented by the AWG and the Secretariat. It also noted that, to align with the overall new WMO policy on publications, the category "Technical Document" approved by CHy-XIII had been renamed "Technical Report", maintaining the same characteristics. Therefore, the CHy classification of publications for the next intersessional period consists of:

(a) Technical Regulations (incorporating standards);
(b) *Guide to Hydrological Practices*;
(c) Manuals on hydrology and water resources;
(d) Guidance material: guidelines in hydrology and water resources;
(e) Technical reports.

6.17 After considering the above information, and having discussed the new requirements for the hydrological community, the Commission decided that, in principle, the following will be the publications to be produced during the intersessional period 2013-2016:

(a) Manual on Water Resources Assessment;
(b) Manual on Flood Risk Mapping.

6.18 The Commission noted the current status of Volume III of the Technical Regulations and requested the AWG to suggest eventual amendments to it at its first meeting.

7. DATA OPERATIONS AND MANAGEMENT (agenda item 7)

The World Meteorological Organization and the Open Geospatial Consortium

7.1 The Commission noted that the World Meteorological Organization (WMO) has signed a Memorandum of Understanding (MOU) with the Open Geospatial Consortium, Inc. (OGC) to enhance the development and use of geospatial standards. It is anticipated that this collaboration will support the implementation of the WMO Information System (WIS) which aims at providing a single coordinated global infrastructure for the collection and sharing of information in support of all WMO and related international programmes.

7.2 In this regard, the Commission was pleased to note the establishment of the Hydrology Domain Working Group which is a Joint Working Group of WMO and the OGC. The purpose of the Hydrology Domain Working Group (DWG) is to provide a venue and mechanism for seeking technical and institutional solutions to the challenge of describing and exchanging data describing the state and location of water resources, both above and below the ground surface. The WMO/OGC Hydrology DWG will provide a means of developing candidate standards for consideration and adoption by WMO as appropriate. In this regard, the Commission invited interested Members to participate in the activities of the joint WMO/OGC Hydrology DWG, as appropriate.

7.3 The Commission noted, in particular, the growing need for adoption of standards with respect to data operations and management with the primary aims of improving the interoperability of data and information and increasing the availability of and access to hydrological data and information. The Commission was pleased to note advances in a number of areas in this regard, including WaterML 2.0, hydrologic feature model and satellite data applications. The Commission invited interested Members to participate in testing of standards prior to their adoption by WMO.

Metadata profile

7.4 The Commission recalled the recommendation in Resolution 6 (CHy-XIII) that the Global Runoff Data Centre (GRDC) should undertake the development of the metadata profile, in collaboration with interested parties, under the overall guidance of WIS/WMO Integrated Global Observing System (WIGOS) to form part of the WMO Core Profile of the International Organization for Standardization (ISO) Metadata Standard. The Commission noted that in 2009, the GRDC had produced a report on the Metadata Profile and that in April 2011 this report had been withdrawn for further review, based on advances made over this period, in particular with respect to the work of the Hydrology DWG. Noting that it is a living document and will evolve with time, the Commission urged the GRDC to finalize this review and make the report available to its members.

WaterML 2.0

7.5 The Commission noted the considerable work being undertaken internationally with respect to the development and agreement on standards for the transfer of hydrologic data between data servers (databases) and users. In particular, the Commission was pleased to note that the work of the Hydrology DWG of the OGC has resulted in WaterML 2.0 being adopted as an OGC Standard (http://www.opengeospatial.org/standards/waterml). WaterML 2.0 is an encoding standard for the representation of in-situ hydrological observations data. OGC WaterML 2.0 supports encoding of hydrological and hydrogeological observation data in a variety of exchange scenarios. Examples of areas of usage are: exchange of data for operational monitoring and forecasting programmes; supporting operation of infrastructure (e.g. dams, supply systems); exchange of observational and forecast data for surface water and groundwater; release of data for public dissemination; enhancing disaster management through data exchange; and exchange in support of national reporting. The Commission noted the importance of such standards to improve service delivery of key CHy programmes including WHYCOS and the WMO Flood

Forecasting Initiative, and further noted the benefit of diligently moving to improve the execution of these programmes through the use of such standards.

7.6 The Commission was informed of the open-architecture data-model integration platform FEWS (Flood Early Warning System), developed by DELTARES. The platform relies heavily on open standards for data exchange and third-party module integration and is also compatible with the WaterML 2.0 standard. The platform contains open-architecture libraries for reading and processing general weather, radar, satellite and hydrological data formats (WMO GRIB, XML, HDF, NetCDF and others) and includes libraries for the integration of the most commonly used hydrological and hydraulic models from third-party vendors. DELTARES technology is presently used to support the institutional forecasting and warning process on floods and droughts in many countries, including the United Kingdom, Australia, Italy, the United States, Switzerland, Germany and Indonesia. DELTARES technology is distributed on a free license basis and supported through training within an open user community.

7.7 The Commission requested that a glossary of terms and vocabulary should be produced for non-specialists that includes the description of the format with examples. The Commission welcomed the offer of the Czech Republic to contribute to the further development of WaterML 2.0 in the field of water quality formats.

7.8 The Commission discussed the role that it may play in the consideration of WaterML 2.0 as a WMO standard for information exchange and adopted Resolution 3 (CHy-14) – Proposed adoption of WaterML 2.0 as a standard, in this regard.

Hydrologic feature model

7.9 The Commission took note of the work being undertaken by the WMO/OGC Hydrology DWG with respect to the Hydrologic Feature Model (HY_Features). It noted that the OGC Discussion Paper is available from: https://portal.opengeospatial.org/files/?artifact_id=47831. The HY_Features model is a conceptual model and is intended to describe hydrologic objects represented in various National Hydrological Service (NHS) datasets. It is being used to describe the surface and groundwater hydrology of Australia. It provides fundamental relationships between hydrologic features, so that a common and stable reference of hydrologic features is available for organizing observational and modelled data, independent of scale. HY_Features also provides capabilities for integration of hydrologic data at basin, national, regional, and global scales. It is designed as a set of interrelated components for organizing information (Application Schema) using the ISO 19103 Conceptual Schema Language and ISO 19109 General Feature Model.

7.10 The Commission commented that discussions on HY_Features needs to continue within the hydrology community to: reflect a wide range of “features”, recognizing the different concepts that Members have; finalize the validation of the model concepts; and support compatibility with other spatial information platforms (such as European Union INSPIRE).

7.11 The Commission referenced a discussion paper on this topic that had been released through the CHy Pre-Session Forum, and was informed on the discussions that had followed. The Commission discussed if it should also start a process to promote the adoption of the Hydrologic Feature Model as a standard and endorse and promote its implementation, testing and use. The Commission decided to support its further development by the WMO/OGC Hydrology DWG and requested that increased engagement with this work is undertaken through the Data Operations and Management thematic area of the AWG.

Access to and use of satellite data

7.12 The Commission agreed that, with respect to satellite applications in hydrology, better communication with the satellite community was required to understand the capabilities and limitations of satellite data. In particular improved estimates of areal precipitation; altimetric

observations of water levels in large rivers, lakes and reservoirs; soil moisture; and snow cover characteristics – snow cover boundaries and snow water equivalent would seem to be the four top requirements from the water sector regarding satellite data. The Commission agreed that improved practices and procedures are required to make satellite-based information and products for hydrological purposes available to National Meteorological and Hydrological Services (NMHSs). The Commission noted that as part of the Scientific Lectures (agenda item 16) at CHy-14, prominence had been given to presentations on satellite-based observations related to key hydrological parameters. The Commission saw merit in cooperating closely with space agencies to develop further and promote satellite-based applications in hydrology and water management, thus promoting the development of hydrological observations that are complementary to terrestrial observations.

Use of radar data

7.13 Noting that the WMO Commission for Instruments and Methods of Observation (CIMO) had initiated activities in order that remote sensing measurements meet the same standard of accuracy and homogeneity as terrestrial observations (CIMO-XV Abridged Final Report, paragraphs 5.17 – 5.20) and considering the increasing use and demand of reliable radar data for nowcasting in operational hydrology, the Commission envisaged the opportunity of a wider use of radar quality data for such an application and invited Members that had developed good practices in this area to support the AWG member responsible for Data Operations and Management in providing guidance, advice and training in this regard during the next intersessional period. The Commission should consider dedicating one of its scientific lectures to radar-based observations related to hydrological parameters at its next session.

Exchange of hydrological data and products

7.14 The Commission recognized the growing demand at the international level for sharing high quality hydrological data and related products often in near real-time for a wide array of applications, including for flood forecasting and warning, water resources assessment, hydrological aspects of drought and impacts of climate variability and change. The Commission made a specific note of a European initiative to develop standards and guidance materials on rainfall intensity and metrological aspects, at the level of the European Committee for Standards (CEN Technical Committee no. 318 Hydrometry) and requested that the products and information be shared with English-speaking member countries of the Commission. The Commission encouraged enhanced cooperation with organizations holding hydrological data and related products including the EUMETSAT “Satellite Application Facility on Support to Operational Hydrology and Water Management” (H-SAF, http://hsaf.meteoam.it), hosted by the government of Italy on behalf of its European partners: Germany, Austria, France, Turkey, Poland, Hungary, Belgium; Slovakia, and Finland.

Data Rescue

7.15 The Commission reiterated the importance of hydrological data rescue and noted that a report on 'Guidelines for Hydrological Data Rescue' has recently been completed and will be available on the CHy Website.

8. WATER RESOURCES ASSESSMENT (agenda item 8)

Technical material on Water Resources Assessment (WRA)

8.1 The Commission noted the progress made in the preparation and publication of the Technical Material for Water Resources Assessment report (WMO-No. 1095). The Commission also noted the preparation of background papers on the areal estimation of evaporation, evapotranspiration and soil moisture; network design and optimization; and estimation of snow water content provided as background documents to the session. With respect to these documents

that had been prepared as background material to the activities of the Advisory Working Group (AWG) member responsible for Water Resources Assessment during the past intersessional period, the Commission agreed that this material should be considered by the next AWG member with responsibility for this thematic area.

8.2 The Commission discussed the need for a Manual on Water Resources Assessment as a component of the Quality Management Framework-Hydrology. In doing so, the Commission noted that there is more to water resources assessment than conducting a water balance, and a manual needs to be more comprehensive in scope, encompassing both water availability and use, and dynamic (that is, capable of being updated at a variety of time and space scales) in nature. The Commission agreed that, building on the existing Technical Report and available procedures and documentation, it should continue preparing guidance material that would help NHSs to enter a more modern era of water resources assessment that is more dynamic in nature, reflects advances in real time monitoring and products derived there from, and incorporates the needs of the hydrological community and users of water information, particularly with respect to their regulatory and policy-oriented mission responsibilities, improving the generation of information needed for decision making processes.

Environmental flows

8.3 The Commission noted the various interests expressed by various Regional Working Groups on Hydrology and Water Resources with respect to the determination and derivation of environmental flows. It decided to include in its work plan for the next intersessional period the development of guidance material for determining adequate ranges of flows for rivers, streams and wetlands that will maintain adequate stream health, water quality and ecological status along with guidance on formulating policies to make these determinations, taking into consideration the interactions with groundwater.

8.4 The Commission recommended to the AWG, as a first approach to the topic, a review of existing relevant documentation (such as those produced by European Working Groups on the Water Framework Directive) in association with UNESCO-IHP environmental flow related Category II Centers and the exploration of other possible partner organizations which would be interested in participating in the development of the guidance material.

World Hydrological Cycle Observing System

8.5 The Commission noted the progress that had been achieved with respect to the World Hydrological Cycle Observing System (WHYCOS) and the current status of the HYCOS components. The Commission noted that six HYCOS components are currently being implemented, including the Carib-HYCOS, the Hindu Kush Himalayan HYCOS (HKH-HYCOS), the Intergovernmental Authority on Development HYCOS (IGAD-HYCOS), the Mekong-HYCOS, the Niger-HYCOS Phase II and the Senegal-HYCOS. Two HYCOS Components were in advanced stages of development, seeking the involvement of donors, namely the Southern African Development Community HYCOS (SADC-HYCOS) Phase III and the Congo-HYCOS. The Commission also noted that a meeting of interested parties had been held during early 2012 to initiate the Arctic-HYCOS. The Commission was concerned to observe the delays that had been occurring between the implementation of phases of HYCOS Components, namely SADC-HYCOS and a proposed Phase II of Pacific-HYCOS, noting that such delays had significant impacts on the sustainability of the activities and the development and use of hydrological services and products from the initiatives. The Commission noted that Niger-HYCOS Phase I, Pacific-HYCOS Phase I, Volta-HYCOS and SADC-HYCOS Phase II had been completed during the intersessional period. The Commission expressed its appreciation to a wide variety of donors who have supported and continue to support the WHYCOS programme. The Commission was pleased to note that there were also some HYCOS components, namely Amazon-HYCOS, La Plata-HYCOS and South East Asia-HYCOS, under consideration.

8.6 The Commission, noting the increasing number of components being implemented or planned, and that they are all regional in scope, in order to ensure that all regional needs and constraints are taken into account, recommended that due consideration be given to countries participating in the projects (especially in regard to shared river basins) and by also having the regional association, and especially their Working Groups on Hydrology, more closely involved in project development and implementation.

8.7 The Commission requested that technical assistance should be provided at all stages, including in the preparatory stages of the project. In order to ensure long-term sustainability, joint ownership (WMO and participating countries) of all aspects of the project should be promoted and, where appropriate, included in the implementation agreements with participating countries.

International Advisory Group of the World Hydrological Cycle Observing System – Composition and terms of reference

8.8 The Commission noted that the 9th meeting of the WHYCOS International Advisory Group (WIAG) had been held in Geneva in December 2011. As requested by Congress (Resolution 14 (Cg-XVI)), the WIAG had submitted its reviewed and revised Composition and Terms of Reference to the Commission for their endorsement (see Annex 2 to Resolution 4 (CHy-14)).

Independent Evaluation of the World Hydrological Cycle Observing System

8.9 The Commission was pleased to note that, as requested by Congress (Resolution 14 (Cg-XVI)), an independent external evaluation of WHYCOS had been performed during September and October 2011. This review was a follow-up to the WHYCOS Review undertaken in 2005.

8.10 The Commission was pleased that the reviewers found that the original concept of WHYCOS, i.e. to strengthen the capacities of National Hydrological Services (NHSs) and regional institutions in discharging their relevant national and regional responsibilities in water resources management, remained valid. It also noted that the programme provided an effective mechanism for bringing donors and recipients together to work on water-related issues. The reviewers also endorsed the increasing focus of HYCOS components on addressing water resources management issues, through the production of hydrological data, services and products.

8.11 The Commission noted the recommendations formulated by the reviewers and reviewed the draft responses (See Annex 1 to Resolution 4 (CHy-14)) prepared by the 9th WIAG the 3rd CHy AWG meetings, both held in December 2011. In particular the Commission noted that the AWG saw merit in the establishment of a more clearly identifiable support structure to the WHYCOS programme within the WMO Secretariat and requested the Secretariat to further study the costs and benefits of different approaches to ascertain the desirability of such a structure.

8.12 The Commission adopted Resolution 4 (CHy-14) – World Hydrological Cycle Observing System.

9. FLOOD AND DROUGHT MANAGEMENT (agenda item 9)

Flood Forecasting Initiative

9.1 The Commission welcomed the progress made under the WMO Flood Forecasting Initiative (FFI), and, in particular, the implementation of elements of the “Strategy and Action Plan for the Enhancement of Cooperation between National Meteorological and Hydrological Services for Improved Flood Forecasting” which was endorsed by Cg-XV. (http://www.wmo.int/pages/prog/hwrp/documents/FFInitiativePlan.pdf)

9.2 In this regard the Commission noted that in December 2009, a WMO Region-specific Activity Plan had been compiled in line with the guidance provided under Resolution 3 (CHy-XIII) "to supplement the Strategy and Action Plan on the Flood Forecasting Initiative with a detailed activity plan that will assist Members in establishing flood forecasting systems". The Commission called on Members to actively support the FFI by providing examples and experiences in flood forecasting and modelling systems and their use for decision making in flood and water management.

9.3 The Commission discussed several components that should be included to strengthen the comprehensive approach of the Flood Forecasting Initiative, such as a review to update methods to improve urban flood forecasting and warning including for urban flash floods, the compilation and development of guidance material on improved streamflow forecasting using hydrological modeling linked to Numerical Weather Prediction products, including application of ensemble processes, and closer linkages of hydrological forecasting and prediction activities with the Severe Weather Forecasting Demonstration Project (SWFDP) being undertaken by CBS and through the recently endorsed SWFDP Project Office. In this regard, the Commission was informed that Tanzania is successfully using the products of the SWFDP for flood forecasting purposes.

9.4 The Commission recalled that the International Flood Initiative (IFI) is promoting Flood Management activities in cooperation with WMO, UNESCO, UNU and UNISDR and expressed its appreciation to ICHARM, Japan for serving as the IFI Secretariat.

9.5 With a view to ensuring adequate monitoring, evaluation and guidance with respect to the implementation of the Strategy and Action Plan on the Flood Forecasting Initiative, the Commission noted activities underway to establish an overarching Advisory Group for the Flood Forecasting Initiative (FFI-AG), as decided by Congress (Resolution 15 (Cg-XVI)). The Commission further noted that the Secretary-General had been requested by EC-64 to report on the establishment and initial operation of the FFI-AG at EC-65. The Commission recommended that the AWG Member(s) coordinating the activities of the Hydrological Forecasting and Prediction Thematic Area should represent the Commission on the FFI-AG.

9.6 The Commission was pleased to note the draft report on the Intercomparison of Flood Forecasting Models developed by a Task Team, established as a result of a workshop on this topic held in Koblenz, Germany in September 2011. This intercomparison, when finalized in 2013, and after review by the AWG, will assist Members in the selection and application of flood forecasting models under different flood situations, environmental and institutional settings and a variety of professional capabilities in NHSs. The Commission called on the AWG to compile materials for capacity building that would enable users to effectively use the guidance document.

9.7 Recalling the need for effective flood forecasting services at NHSs, the Commission noted the draft report of the workshop on "Improving the Effectiveness of Flood Forecasting Services - Development of a Framework for the Assessment of Service Delivery Capabilities of Hydrological Services", held in Geneva in October 2011. The Commission was informed that, during the workshop, the formation of a Task Team to provide guidance to Members had been proposed. The Commission expressed its support for further development of guidance material on service delivery and quality control and recommended that this activity be coordinated through the AWG. The Commission recommended that the recently developed WMO Strategy for Service Delivery and its associated Implementation Plan be used as a basis to help guide the development of service delivery capabilities in NHSs.

9.8 The Commission also appreciated the continued support provided by the government of Spain to the Ibero-American network for the monitoring and forecasting of hydrometeorological phenomena (PROHIMET) and encouraged all partners to continue promoting the activities of PROHIMET, including the further implementation of demonstration projects in the Iberoamerican region.

9.9 The Commission appreciated the results of a workshop on the development of the Zambezi River Basin Flood Forecasting and Early Warning System Strategy (FFEWS) held in May 2012 in Lusaka, Zambia. Participants at the workshop recommended that the arrangements for the ARA-Zambezi demonstration project be implemented as soon as possible and, that following an additional period of review, the draft Zambezi River Basin FFEWS Strategy be adopted. The Commission saw merit in the project as a significant contribution for Members of riparian countries and saw potential in the development of more generic guidance materials based on experiences made so that projects such as for the Zambezi River Basin could be replicated elsewhere.

9.10 The Commission recalled the support of Cg-XVI for ongoing planning and implementation of the joint JCOMM-CHy Coastal Inundation Forecasting Demonstration Project (CIFDP). The Commission further recalled that the hydrological aspects of this project were covered by the Coastal Flood Management component delivered through the Associated Programme on Flood Management (APFM). The Commission noted efforts under way on the development of a field demonstration project on coastal flood management aiming for Bangladesh, Vietnam, Dominican Republic, Fiji and Mozambique. The Commission supported continuation of its involvement in these projects, especially in regards to the interactions between river flooding and storm surge events.

9.11 The Commission expressed satisfaction with progress made in the development of the Flash Flood Guidance System (FFGS) at global level through the implementation of regional and country-level components and noted the foreseen implementation of further components in particular for South Asia and South-East Europe. In this regard, the Commission thanked the Government of the United States of America, which through the United States Agency for International Development (USAID)/Office of Foreign Disaster Assistance (OFDA), provided the core funding for the implementation of this project. In this regard, the Commission noted with satisfaction the extension of the four-party Memorandum of Understanding for the further implementation of the Flash Flood Guidance System with Global Coverage Project beyond 2012. The Memorandum of Understanding (MoU) had been signed by the National Oceanic and Atmospheric Administration (NOAA)/National Weather Service, Hydrological Research Centre (HRC), San Diego, United States, USAID/OFDA and WMO. It also noted that Mexico had self-financed the implementation of a local FFGS and that Oman was also considering doing so. Finally, the Commission recalled that this project, initially endorsed by Cg-XV in 2007, is open to the contributions of all Members and therefore invited other institutions active in flash flood forecasting to join the initiative.

9.12 Regarding satellite-based flood forecasting systems, the Commission noted the operationalization of the Integrated Flood Analysis System (IFAS), supported by the government of Japan. The Commission was informed of a series of training events that are planned mainly in Asia by ICHARM, with support from JICA, UNESCO and the Asian Development Bank.

9.13 The Commission welcomed the initiative of Italy to further contribute to the FFI and APFM activities by providing the DEWETRA system for real-time weather-related risk monitoring and warning, already implemented in the framework of international cooperation activities of the Italian National Civil Protection Department. The Commission encouraged the AWG to explore the suitability of the DEWETRA system, and other similar systems, to contribute to flood forecasting and warning initiatives of the HWRP.

9.14 The Commission saw merit in establishing closer links between the Severe Weather Forecasting Demonstration Project (SWFDP) and the FFGS with the intent to establish a predictive capability for flash floods. Further, aiming to improve the flood forecasting systems including flash flood guidance and prediction systems, the Commission recommended exploring the suitability of global precipitation products and information for various geographical regions and the benefits derived from the use of terrestrial and satellite-based observations of soil moisture, as well asmodelling soil moisture to improve forecasting accuracy of flash floods and riverine floods.

Flood management

9.15 The Commission recognized the substantial achievements made through the Associated Programme on Flood Management (APFM) in the form of providing flood management policy guidance, technical tools and capacity building. Noting that the APFM is being undertaken in partnership with the Global Water Partnership, the Commission commended the operationalization of the HelpDesk for Integrated Flood Management as the backbone of the initiative. The HelpDesk provides technical assistance and disseminates information and guidance material. The Commission called for a demand-based outreach strategy of the HelpDesk and suggested that APFM consider documenting the implementation of flood management practices, especially in developing countries. The Commission appreciated the wide scope of the target audience, reaching beyond NMHSs while fully integrating these in the activities of the APFM. It appreciated the substantial support provided by the governments of Japan, Switzerland, Italy and Germany to the success of the programme and noted with interest pledges made by the United States to provide further funding for APFM activities. The Commission recommended continuing promoting the APFM to increase its field effectiveness and to attract extrabudgetary resources for its activities (www.apfm.info).

9.16 The Commission appreciated the implementation of the first project in the ANADIA (Assessment of Natural Disaster Impacts on Agriculture) programme in Mali, in cooperation with the NMS and NHS and other institutions such as the Institute of Rural Economy, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) etc., and financial support from Italy. The project is addressing impacts of floods and drought on agriculture and rural systems.

Drought management

9.17 The Commission welcomed the recent development of an Integrated Drought Management Programme (IDMP) in association with the Global Water Partnership and UNESCO, based on and inspired by the development and success of the APFM. The Commission urged the Secretariat to establish, at the earliest, a governance structure for the programme and to speed up progress for the IDMP becoming operational and visible to Members, highlighting on the diverse management aspects of drought. It reiterated its view - documented in CHy-XIII - to maintain close links to CAgM and CCl to work towards developing tools and best practices guidance for drought monitoring and prediction. The Commission called for the IDMP activities to include aspects related to climate change and related potential impacts. The Commission adopted Resolution 5 (CHy-14) – Establishment of an integrated drought management programme, in this regard **.**

9.18 The Commission was informed that in order to address the issue of national drought policy, Cg-XVI had recommended the organization of a “High-level Meeting on National Drought Policy (HMNDP)”. Accordingly, WMO and the Secretariat of the United Nations Convention to Combat Desertification (UNCCD), in collaboration with a number of UN agencies, international and regional organizations and key national agencies, plan to organize a High-level Meeting on National Drought Policy (HMNDP) from 11 to 15 March 2013. The Commission noted that preparations are well in hand for the HMNDP and that a representative from the Commission had been involved in the organizing committee.

10. WATER AND CLIMATE ISSUES (agenda item 10)

Extended hydrological forecasts

10.1 The Commission noted that two expert meetings had been organized on this topic, in Guayaquil, Ecuador, in January 2010, and in Melbourne, Australia, in July 2011. The first of these had initiated a pilot experience in the West Coast of South America, where, with the collaboration of the Centro Internacional para la Investigación del Fenómeno de El Niño (CIIFEN), the International Research Institute for Climate and Society (IRI) and the Institut de recherche pour le

développement (IRD), through training of local hydrologists, and their participation in regional Climate Outlook Fora (COFs), an attempt at establishing operational Extended Hydrological Predictions (EHPs) for the region was under way. See http://www.wmo.int/pages/prog/hwrp/DevelopmentofHydrologicaloutlooks.php for more details. The aim of the Melbourne meeting was to identify requirements and current gaps of methods currently available for extended hydrological forecasts and establish action plans for the preparation of relevant guidance material and case studies.

10.2 The Commission noted that a number of conclusions and recommendations were formulated by the Melbourne expert meeting (see above link) addressing, among others, the definition of extended hydrological forecasts and its scientific basis; the relation with users and stakeholders, including understanding their requirements and properly communicating products usability and limitations; the development of appropriate delivery processes and procedures and feedback mechanisms. The Commission endorsed the recommendations of the workshops and in particular those regarding steps for the preparation of guidance material for extended hydrological forecasting, including through the compilation of case studies, and the establishment of an action plan for the production of the guidance material. A number of members of the Commission described, in brief, their activities in seasonal hydrological prediction and offered to provide details of these activities as contributions to the case studies.

10.3 The Commission noted that extended hydrological forecasts, beyond being an important activity on their own right, are also a tool of relevance to develop and implement adaptation strategies to climate change and variability, and therefore an important contribution to the implementation of the Global Framework for Climate Services (GFCS).

Climate and meteorological information requirements for water management

10.4 The Commission was pleased to note that the paper prepared on this topic by Mr James Dent (United Kingdom) had been published as a Technical Document. Prior to publication, the paper had been posted on the CHy e-Board and some substantive comments had been provided and had been addressed in the final version.

10.5 The Commission also noted that the Advisory Working Group (AWG), at its December 2011 meeting, having taken note of the report, had indicated that no further work was required on this topic at this stage and that the document should be used in the preparation of material for the GFCS to assist in defining the water sector requirements for climate information. The Commission also noted that EC-64 had established a Task Team on the WMO Policy for International Exchange of Climate Data and Products to Support the Implementation of the GFCS. The Commission proposed the president of CHy, or his designate from the AWG, as the CHy representative on this Task Team.

Flood frequency estimation

10.6 The Commission noted that work on this topic was conducted through alignment with the European Cooperation in Science and Technology (COST) initiative on flood frequency estimation (FLOODFREQ COST Action). One objective of that Action is to develop and, if possible, test a scientific framework for assessing the ability of methods to predict the impact of environmental change on future flood frequency characteristics. The AWG contributed to this effort by gathering information on flood frequency estimation methods from a small number of countries beyond Europe, emphasizing information on how those methods can incorporate non-stationarity.

10.7 The Commission asked the AWG to continue monitoring developments in the field of flood frequency estimation and for them to report on the CHy Website any significant developments having operational applicability.

10.8 The Commission noted the technical note on Stationarity and Non-Stationarity (provided as background document to the session) prepared by the AWG in response to increasing interest in this topic within the hydrological community, and that this paper had been made available through the CHy Pre-Session Forum for comment and discussion prior to CHy-14. The Commission discussed the content of, and target audience for, the paper and recommended that the paper undergo the required peer review process for it to be published on the Website as a CHy Statement.

Global Terrestrial Network – Hydrology (GTN-H)

10.9 The Commission noted the contribution made by the GTN-H thus far in support of climate research and applications. The Commission stressed the need for strong observational networks covering climate sensitive variables essential for climate- and water-related research and applications. The Commission noted that GTN-H served a number of essential climate variables as defined by the Global Climate Observing System (GCOS). The Commission expressed its appreciation to governments of Members that were sharing data from their networks and to those governments that provided the resources and infrastructure to host the global data centres and institutions that form the core of GTN-H.

Global Framework for Climate Services

10.10 The Commission also discussed the role and contributions it can make to the GFCS under agenda item 5 and had adopted Resolution 1 (CHy-14) in this regard.

11. CAPACITY-BUILDING IN HYDROLOGY AND WATER RESOURCES MANAGEMENT (agenda item 11)

WMO Strategy on Education and Training in Hydrology and Water Resources

11.1 The Commission noted that the implementation of the WMO Strategy on Education and Training in Hydrology and Water Resources, as it had been adopted at its thirteenth session, had been of great assistance in optimizing the available resources, by concentrating WMO support in those areas identified by the “WMO hydrological community” as requiring priority attention. The Commission adopted Resolution 6 (CHy-14) – Capacity-building in hydrology and water resources management, and revised the strategy for the next intersessional period, as indicated in the annex to that Resolution.

11.2 The Commission was pleased to note that, through the collaboration of WMO with COMET and the National Oceanic and Atmospheric Administration (NOAA), a series of Distance Learning (DL) activities had been successfully undertaken in the last intersessional period. In particular, two basic courses had been held, one with global coverage and one for RA V, and one advanced course for Eastern European countries. Since 2010, eight basic hydrological COMET modules have been adapted for an international audience. The Commission considered that the Training of Trainers Workshop on Distance Learning Delivery of Hydrology Courses held in COMET's headquarters in Boulder, United States, from 29 November to 9 December 2011 with 11 participants from eight academic institutions, potentially covering all WMO Regions, had been an important development. In effect, participants were trained in designing, adapting and translating if needed, and delivering DL courses based on the WMO/COMET model. An agreement was reached that the participating institutions will deliver at least a WMO DL course in their respective Region every two years, with limited support from WMO and COMET. WMO's role will mainly consist in the announcement, student selection, Modular Object-Oriented Dynamic Learning Environment (Moodle) support, course monitoring and certificate distribution. A first such course had been successfully held in India in March 2012 with 44 local participants.

11.3 The Commission noted that, in response to the request of CHy-XIII to undertake training activities at the global level on the utilization of the Guides and Manuals issued under the QMF-Hydrology, the AWG had encouraged the approach taken by the Secretariat of creating a community of instructors via the use of a web-based file hosting service, so that instructors could download training material developed by WMO and either use the material as is, or adapt it to suit the needs of the Region of their interest. This approach had been particularly successful in the preparation and dissemination of the training material for the courses on stream gauging based on the second edition of the WMO Manual, designed in cooperation with IAHR, and could also be used for the training material on Flood Forecasting and Warning, which has already been prepared and used in a regional course.

11.4 The Commission thanked the International Association for Hydro-Environment Engineering (IAHR) for their enthusiastic collaboration in the development of the stream gauging courses. It suggested that cooperation with IAHR could be continued, for instance with the development of similar training programmes in areas such as data and information systems (with the involvement of the Hydroinformatics Committee of IAHR) and Integrated Flood Management.

11.5 The Commission noted with appreciation that in the last intersessional period the number of WMO fellowships assigned to hydrology had increased and in particular appreciated that WMO had established an arrangement with the Leibniz Universität, Hannover, Germany to support the WATENV MSc programme in water resources and environmental management and that fellowships for BSc and MSc programmes in Hohai University, Nanjing, and in the Russian State Hydrometeorological University (RSHU) were offered as part of the cooperation with China and Russia. The Commission was pleased to note the presence of three WMO fellows from Argentina, Botswana and Samoa undertaking the WATENV MSc programme, who had been invited as observers for the technical segment of the session. It commended this initiative of the WMO Fellowship programme, as it assisted in introducing new generations of professionals to the WMO community.

11.6 The Commission welcomed the offer of Canada to explore offering a hydrometric technician training programme to selected participants from developing countries, and encouraged the Secretariat to undertake the necessary arrangements to take advantage of this excellent opportunity. The Commission was also pleased to learn of the offers of support to the Capacity Building in HWR sub-programme announced by China (training on operational methods for hydrological forecasting and water resources assessment), Republic of Korea (sharing experience on water supply and flood management and collaboration with the soon to be inaugurated Graduate School on Water Resources Management in Sungkyunkwan University), Japan (through the UNESCO-ICHARM capacity building activities from master and doctoral degree courses on disaster management to short duration training courses in the field of flood and water resources management), Indonesia (via the training offer of the recently established RTC for RA V), New Zealand (via its offer to assist with assessment practices for RA V), Brazil (course on stream gauging of large rivers) and Australia (through its offer to assist with extended hydrological predictions knowledge exchange).

11.7 The Commission was informed that the Group on Earth Observations (GEO) through its Integrated Global Water Cycle Observations (IGWCO) Theme is promoting capacity building activities in cooperation with WMO and noted with pleasure the achievements to date in Ethiopia (RA I) as well as Colombia and Peru (RA III).

Replacement of Guidelines for the Education and Training of Personnel in Meteorology and Operational Hydrology (WMO-No. 258), Vol. II: Hydrology

11.8 The Commission was informed that the Sixteenth World Meteorological Congress had adopted Resolution 32 (Cg-XVI) calling for the replacement of the traditional WMO publication *Guidelines for the education and training of personnel in meteorology and operational hydrology (WMO-No. 258), Volume I: Meteorology*, with the *Manual on the implementation of education and*

training standards in Meteorology and Hydrology, Volume I – Meteorology. The Commission noted that, in this context, it had been requested by Cg-XVI to review the definitions for Hydrologists and Hydrological Technicians and their associated Basic Instruction Packages at the current session of the Commission.

11.9 Cg-XVI had also recommended that all technical commissions develop competence standards for the core job-tasks in meteorology and hydrology, make this a high priority activity and incorporate this task into their current work programmes. Congress had requested that the technical commissions follow the model developed by the Commission for Aeronautical Meteorology (CAeM) in providing top-level competence standards that could be incorporated into the WMO Technical Regulations, as required, and had requested the Executive Council (EC) to engage its Panel of Experts on Education and Training to assist the technical commissions in the development of the competence standards and links with the Education and Training Programme (ETRP).

11.10 In view of the above requests, the Commission established a Working Party during the session to discuss them in depth. Given the general consensus that there is a need for having an agreed global understanding of the hydrological skills and education requirements necessary to be considered as a hydrologist, the Commission decided to invite UNESCO-IHP to establish a joint Task Team with the following tentative terms of reference:

(a) Review existing definitions of hydrologist used by Member States to evaluate, classify and promote hydrologists;
(b) Consider the issue of developing a definition for Hydrologists and Hydrological Technicians and their Basic Instructional Packages (at a reasonable level of detail);
(c) Develop competency standards for a few core job tasks in critical areas;
(d) Recommend the status and target audience the outputs of (b) and (c) should have.

11.11 The final composition of the Task Team will be agreed by the CHy AWG and UNESCO-IHP, but it should include members from different Regions, with both operational and academic backgrounds, a representative from the EC Panel of Experts on Education and Training, and representatives from partner organizations such as UN-Water, IAHS and IAHR.

11.12 The work of the Task Team should be based on the current edition of the *Guidelines for the Education and Training of Personnel in Meteorology and Operational Hydrology (WMO-No. 258), Volume II: Hydrology*, given the relevance of the material contained therein and undertaken primarily through electronic means.

11.13 The Commission requested the Secretariat to initiate consultations and present to the first meeting of the AWG and to UNESCO-IHP a proposed membership and timeline for the Task Team.

11.14 It was noted that hydrologists perform a wide variety of tasks, may have differing educational backgrounds, and can perform many functions (research, modeling, short- and extended-range forecasting, long-range planning, etc.), but that a common understanding of the definition of “hydrologist,” even if it is a multifaceted definition, is required. Several Members already have in place programmes to prepare people with backgrounds in engineering, mathematics, physical sciences and geo-sciences to assume roles as hydrologists, and these can be examined to help in defining job competencies. In this regard, the Commission acknowledged the contribution of relevant material from the United Kingdom. Critical areas suggested for competency development are for hydrological technicians, hydrometry, and flood forecasting (which can include more than one job task).

Technology transfer and knowledge management

11.15 The Commission recalled that CHy-XIII had considered alternative approaches to the future of the Hydrological Operational Multipurpose System (HOMS), with the aim of deriving benefits from a concept which was still felt as being valid, even though its implementation had become outdated due to the technological, institutional and economical developments of recent years.

11.16 In practice, the online version of the HOMS Reference Manual (HRM), in English, French, Spanish and Russian has been maintained, although few new components have been added in the last intersessional period, and it will be maintained until it is felt that its contents are no longer relevant to the National Hydrological Services (NHSs) of developing countries.

11.17 However, the Advisory Working Group (AWG) felt that the original philosophy of HOMS would currently be better served by focusing on developing a thorough system of technical support to a limited number of activities rather than maintaining a huge catalogue of pieces of technology with limited or no support offered. Therefore, it had welcomed the approach of:

(a) Developing capacity building activities related to the manuals issued as part of the QMF-H;
(b) Establishing Help Desks and websites of other Hydrology and Water Resources (HWR) initiatives such as the Associated Programme on Flood Management and its related Integrated Flood Management Series reports and Tools, and the different HYCOS components; and
(c) Developing open source and community of practice solutions for issues of high relevance to NHSs, such as database management systems (under implementation), decision support tool for uncertainty analysis of flow measurements (in its planning stage), and other possible areas of future work, such as techniques for in-filling data, rainfall-runoff models, digitization processes, use of satellite based information for hydrological purposes (to be discussed at the current session for their eventual follow-up by the AWG).

12. COOPERATION WITH WATER-RELATED PROGRAMMES OF OTHER ORGANIZATIONS (agenda item 12)

12.1 The Commission noted that activities developed in cooperation with water-related programmes of other organizations, both within the UN (United Nations) system and outside of it, were being increasingly coordinated through the mechanism of UN-Water, which currently comprises 31 members (UN entities) and 26 partners. After considering the current status of the UN-Water mechanism itself, the Commission reviewed the main issues of bilateral cooperation with some selected organizations, including those which are not part of UN-Water, such as regional arrangements and river basin authorities.

UN-Water

12.2 The Commission was informed that from February 2012 the Secretary-General of WMO became the Chair of UN-Water for a period of two years. In this capacity, and also representing the UN Secretary-General, the WMO Secretary-General headed a delegation at the 6th World Water Forum in Marseille, France, from 12 to 15 March 2012, where a side event on the Global Framework for Climate Services (GFCS) was organized and the importance of climate services for the water community, as well as the fundamental contribution of National Meteorological and Hydrological Services (NMHSs) to disaster risk reduction strategies, were stressed in several high-level panels. UN-Water was also actively involved in the preparation of the Rio+20 Conference and is being increasingly recognized as an example of the UN system trying to improve its coherence and coordination in a very complex area. The UN-Water Day (19 June 2012) during the Rio+20 Conference was used as an opportunity to promote the

importance of weather, climate and water services provided by NMHSs, especially with respect to nexuses such as water and food, water and health, water and cities. UN-Water is playing an important role in shaping the follow-up process to the Rio+20 Conference, especially as it refers to the establishment of a Sustainable Development Goal on water for after 2015.

12.3 In addition to the above, WMO continues coordinating the UN-Water Thematic Priority Area on Water and Climate Change, which has produced important material, such as a Policy Brief, a Guidance Note on Water-related adaptation to climate change, and various communication tools.

12.4 The Commission welcomed the important role that WMO is playing in UN-Water, as it considered that it is enhancing the awareness of partner organizations and Governments of the contributions that WMO in general, and NHSs in particular, can provide to the solution of water issues.

United Nations Educational, Scientific and Cultural Organization (UNESCO)

12.5 The Commission was informed that during the reporting period, WMO followed the intent of the existing Working Arrangements between UNESCO and WMO in the field of Hydrology and Water Resources. WMO participated in and contributed to the meetings of the International Hydrological Programme (IHP) Council and IHP Bureau. UNESCO also participated and contributed to meetings of the Commission for Hydrology Advisory Working Group (CHy AWG), as appropriate. WMO organized meetings of the UNESCO/WMO Liaison Committee, as required, and reports from these meetings were prepared and sent to all of the participants. UNESCO organized a meeting of the Committee in January 2011. In this meeting, WMO presented a draft proposal for a new Working Arrangement, with, among other issues, updated roles and responsibilities of WMO in the field of Hydrology and Water Resources.

12.6 In June 2012, at the session of the UNESCO IHP Intergovernmental Council, side meetings were held between WMO and UNESCO and, as a result, a revised version of the Working Arrangement is in the process of being developed and agreed. The Commission was informed that the main areas of cooperation foreseen under the proposed revised Working Arrangement are:

(a) Hydrological standards and definitions – e.g. the International Glossary on Hydrology;
(b) Hydrological Extremes including hydrological drought (e.g. International Flood Initiative and Integrated Drought Management);
(c) Hydrological modelling in support of water resources management;
(d) Global Framework for Climate Services – water-related issues;
(e) Water Resources Assessment;
(f) Capacity building and training;
(g) Transition from science to hydrological applications; and,
(h) Dialogue between practitioners and decision makers.

12.7 The Commission noted that the WMO has provided UNESCO with copies of the publications in the fields of hydrological standards and definitions, hydrological extremes including hydrological drought, hydrological modelling in support of water resources management, the Global Framework for Climate Services, water resources assessment and capacity building and training.

12.8 The Commission noted that, after several administrative delays, the third edition of the International Glossary of Hydrology was ready for printing in September 2012. At the session, the Commission was shown an advance final copy of the document which is still awaiting final publication.

International Association of Hydrological Sciences (IAHS)

12.9 The Commission was informed that WMO has regularly participated and supported participants from developing countries in the IAHS General Assemblies. During the last General Assembly (July 2011) WMO organized a workshop on Integrated Flood Management. The Commission was also informed that at the next Scientific Assembly, to be held in Gothenburg, Sweden, in July 2013, jointly with the International Association of Seismology and Physics of the Earth's Interior (IASPEI) and the International Association for the Physical Sciences of the Oceans (IAPSO), WMO is co-convening a Workshop on Hydrology Education and Capacity Building in Developing Countries. Finally, the Commission was informed that IAHS had always been represented in CHy AWG meetings.

12.10 The Commission noted that, together with the International Organization for Standardization (ISO) and the International Association for Hydro-Environment Engineering and Research (IAHR), IAHS has been actively participating in the CHy project on the assessment of the performance of flow measurement instruments and techniques. The Commission encouraged continuing and further developing the level of cooperation between WMO and IAHS.

International Association for Hydro-Environment Engineering and Research (IAHR)

12.11 The Commission was informed that in addition to the participation in the Project on the assessment of the performance of flow measurement instruments and techniques, IAHR has made a significant contribution to the development and implementation of training events related to the Manual on Stream Gauging, dissemination of the Integrated Flood Management concept and end-to-end uncertainty analysis.

12.12 In view of the several societal important water-related and specific domain areas whereby partnerships between IAHR and WMO have been initiated and others where the collaborative potential is substantial, the Commission encouraged maintaining the current areas of cooperation and extending them to projects on emerging technologies in hydrometry (such as acoustic instrumentation), hydroinformatics, and development of training programmes on other QMF-H material. IAHR was invited to encourage its members to join the OPACHEs in order to facilitate their contribution to CHy activities.

International Organization for Standardization (ISO)

12.13 The Commission was informed that the cooperation between WMO and ISO in the field of hydrometry has continued. With the contributions from WMO, ISO has improved ISO Standard 772 in relation to aspects related to critical flow. WMO has also contributed to the definition of the Work Programme of ISO Technical Committee 113, through inclusion of some standards to be revised (for example, Standard 3455).

12.14 The Commission noted and supported the proposal that, as part of the Quality Management Framework - Hydrology, the Manual on Stream Gauging becomes a joint WMO/ISO publication.

12.15 The Commission noted that WMO had also cooperated with the ISO Technical Committee 147 Water Quality. This Committee has recognized the complementarity of ISO and WMO in relation to water quality in its meeting, in June 2012, when a report on water quality was presented by WMO.

United Nations Economic Commission for Europe (UNECE)

12.16 The Commission noted the excellent cooperation between UNECE and WMO in the areas of flood risk management and water and climate change in transboundary basins carried out under the UNECE Convention on the Protection and Use of Transboundary Watercourses and

International Lakes (Water Convention). It also noted that, in the work under the Convention, availability of consistent hydrological information at the level of a river basin is crucial for sound management, making cooperation between WMO and the UNECE Water Convention with their complementary mandates and roles important.

12.17 The representative of UNECE explained that in 2006, a UNECE Task Force on Water and Climate was set up, having recognized the importance of climate change adaptation in transboundary basins. In this context WMO, also through the involvement of national hydrometeorological services, had provided support, in 2007-2009, to the development of the Guidance on Water and Adaptation to Climate Change, as well as to the implementation of pilot projects in the transboundary rivers of Neman/Nemunas (Belarus, Lithuania and Russian Federation) and Dniestr (Ukraine and Moldova).

12.18 The Commission noted with interest that the UNECE Water Convention, though originally negotiated as a regional instrument, was amended in 2003 to allow countries outside the UNECE region to accede to it. Such an amendment is expected to enter into force in 2013.

12.19 The UNECE Water Convention will continue contributing to WMO activities, for example in the area of flood and drought management, in particular within the framework of the Associated Programme on Flood Management as well as the future Integrated Drought Management Programme.

Global Water Partnership (GWP)

12.20 The Commission noted the long-standing and successful cooperation in promoting Integrated Flood Management through the Associated Programme on Flood Management, and welcomed the new joint initiative on Integrated Drought Management, as reflected in Resolution 5 (CHy-14). With a view to increase country level promotion of both programmes and enhance their effectiveness, GWP has shared their database of regional and country level water partnerships as possible focal points for future enhanced cooperation.

United Nations Economic and Social Commission for Asia and the Pacific (ESCAP)

12.21 The Commission noted the cooperation of WMO – and in particular the Tropical Cyclone Programme, with ESCAP in the joint ESCAP/WMO Typhoon Committee (TC). In this respect, the Commission welcomed the close cooperation including joint activities between the Working Group Hydrology of the Typhoon Committee and the WMO RA II Working Group on Hydrology.

International Office for Water (OIEau)

12.22 The Commission noted the ongoing cooperation with OIEau in the training component of the project “Support to water resources management of the Congo Basin”, and appreciated the offer to widen the scope of the cooperation to the translation and adaptation in French of manuals, guidelines and training material, as well as to the support and participation in relevant training events.

World Intellectual Property Organization (WIPO)

12.23 The representative of the World Intellectual Property Organization (WIPO) informed the Commission of its mandate related to the promotion of innovation and intellectual property. She highlighted that WIPO had initiated working in water-related issues and was interested in exploring the possibility of developing cooperation with the Commission on capacity-building and technical assistance.

International Groundwater Resources Assessment Centre (IGRAC)

12.24 The Commission noted that a new Memorandum of Understanding between WMO and IGRAC had been recently signed. It further noted that IGRAC had now acquired the status of a UNESCO Category II Centre with funding from the Government of the Netherlands. The Commission welcomed this cooperative effort between WMO and UNESCO.

International Centre for Water Hazard and Risk Management (ICHARM)

12.25 The Commission was informed of the activities undertaken by ICHARM relevant to its thematic areas of Hydrological Forecasting and Prediction, Water Resources Assessment and Water, Climate and Risk Management, such as hosting the International Flood Initiative (IFI) Secretariat, the development and free dissemination of the Integrated Flood Analysis System (IFAS) and of the rainfall-runoff-inundation (RRI) model, the implementation of local projects for flood forecasting/warning systems, the assessment of worldwide impacts of climate change on flood risk, and capacity building activities through master degree and doctoral degree courses on disaster management and through a variety of short-term training courses.

12.26 The Commission was further informed that future ICHARM activities will focus on water-related hazards and risks (flood and drought) including the effects of climate change.

Group on Earth Observations (GEO)

12.27 The Commission noted with interest the efforts to foster collaboration between the Agriculture and Water Societal Benefit Areas (SBAs), along with the IGWCO Community of Practice, the Agriculture Community of Practice, and WMO, to supplement the development of agricultural drought indicators and crop assessment outlooks.

12.28 The Commission recognized the contribution to its activities that can be provided by the Water and Climate Tasks of the Group on Earth Observations (GEO) Work Plan. In particular it expressed its expectation that the Integrated Global Water Cycle Observations (IGWCO) Community of Practice, supported by both WMO and GEO, would continue to serve as an effective channel for improved cooperation.

Other Organizations

12.29 The Commission also noted with interest the cooperation with the Food and Agriculture Organization (FAO) on early warning systems for farmers, with the International Atomic Energy Agency (IAEA) on Water Resources Assessment, in particular with respect to groundwater resources, and with the European Union on issues related to the implementation of the Water Framework Directive, in particular the participation as observer in the activities and meetings of the Strategic Co-ordination Group (SCG).

13. FUTURE PROGRAMME OF WORK OF THE COMMISSION (agenda item 13)

13.1 The Commission noted that the Advisory Working Group (AWG) had, during its last session in December 2011, invited hydrological representatives (including Regional Hydrological Advisers) from each of the WMO Regional Associations and representatives from the International Association of Hydrological Sciences (IAHS) and the United Nations Educational, Scientific and Cultural Organization (UNESCO) to discuss the future programme of work for the Commission for the period 2013-2016. The International Association for Hydro-Environment Engineering (IAHR) also provided a written contribution to the deliberations. Each of the representatives from the regional associations was requested to undertake a consultation process in their respective Regions. The Commission noted that the president of CHy had also sought inputs from both the presidents of other technical commissions and the presidents of regional associations. Therefore, the regional and global needs of the members were considered by the AWG while preparing the

proposal for the CHy Future Programme of Work 2013–2016. The Commission noted that the AWG had also considered the ongoing activities that needed to be completed and the new proposed activities that were considered by the Commission under previous agenda items.

13.2 The Commission discussed the theme areas for the Programme of Work proposed by the AWG and agreed that the following four theme areas be retained:

- Quality Management Framework – Hydrology,
- Water Resources Assessment,
- Hydrological Forecasting and Prediction,
- Water, Climate and Risk Management,

and that an additional theme area on Data Operations and Management be included to address data management issues, such as observations, data exchange and protocols, data transfer formats, data information, the WMO Information system (WIS) and the WMO Integrated Global Observing System (WIGOS).

13.3 Based on those AWG recommendations, and the deliberations of the working party, as well as the resolutions it had previously adopted during the current session, the Commission adopted Resolution 7 (CHy-14) – Work Programme and structure of the Commission for Hydrology, and its annexes.

13.4 The Commission proposed that, in line with the previous session, the activities, in principle, be categorized by the AWG as: (a) mission critical, which should be accomplished, where practical, within the intersessional period and funded mainly from the core budget; (b) strategic and desirable, which were not critical to achieve during the intersessional period and for which resources could be available from the core budget or could be arranged from extrabudgetary resources; and (c) discretionary, which were beneficial tasks to the Commission but not necessarily of strategic value and did not require completion during the intersessional period and that should be funded essentially through extrabudgetary resources. The Commission recommended that the AWG attempt to complete all mission critical activities within the intersessional period and also, where possible, lower priority activities for which resources (core budget or extrabudgetary) were available.

14. STRUCTURE OF THE COMMISSION FOR HYDROLOGY AND NOMINATION OF ADVISORY GROUP MEMBERS (agenda item 14)

14.1 The Commission also considered its structure and agreed that the structure should continue to include an Advisory Working Group (AWG) and the four Open Panels of CHy Experts (OPACHES) linked to the 5 theme areas, namely:

- Basic Systems – supporting the Quality Management Framework - Hydrology and Data Operations and Management theme areas;
- Water Resources Assessment – supporting the Water Resources Assessment theme area;
- Hydrological Forecasting and Prediction – supporting the Hydrological
- Forecasting and Prediction theme area; and
- Water, Climate and Risk Management – supporting the Water, Climate and Risk Management theme area.

14.2 The Commission agreed that the membership of the four OPACHES should carry over from the previous intersessional period unless otherwise advised by the respective Members. The Commission urged all Members to nominate additional experts to the OPACHES through the appropriate mechanism. In particular, in line with the WMO Policy for Gender Mainstreaming (Cg-XVI), the Commission encouraged female candidates for both the OPACHES and AWG.

14.3 The Commission, noting the requests by Members for, and the expected benefits from, increased cooperation and collaboration with the UNESCO-IHP, decided to include amongst the membership of the AWG, on an ex-officio basis, the Chair of the Intergovernmental Council of the International Hydrological Programme of UNESCO. The Chair of the Intergovernmental Council of the International Hydrological Programme of UNESCO will represent the interests of the Council, enable coordination of UNESCO-IHP and WMO-HWRP activities and also contribute to the work of the AWG in line with his/her personal expertise and experience.

14.4 The Commission agreed that the composition of the AWG for the intersessional period (2013-2016) be:

- President of CHy;
- Vice-president of CHy;
- Seven members of the Advisory Working Group responsible for the following topics:
  (a) Quality Management Framework – Hydrology;
  (b) Water Resources Assessment (2 members);
  (c) Hydrological forecasting and prediction (2 members);
  (d) Water, Climate and Risk Management;
  (e) Data Operations and Management;
- Chair of the Intergovernmental Council of the International Hydrological Programme of UNESCO (ex-officio member).

14.5 The composition of the AWG and terms of references of each one of its members is given in Annex 2 to Resolution 7. The members were designated during the session and their names are listed in Resolution 7 – Work Programme and structure of the Commission for Hydrology. The president of CHy was authorized to designate substitutes should any of those members become unable to serve during any part of the next intersessional period, and recommended that the AWG, at its first meeting, identify potential substitutes and keep them informed of the progress with activities.

14.6 Recognizing the time commitment required of AWG members, the Commission urged members, when nominating candidates for the AWG, to be mindful of their institutional responsibility to ensure that those whom they nominate for AWG membership, if designated, receive their country's full and unequivocal support throughout the intersessional period.

15. WMO STRATEGIC PLAN 2016-2019 AND MONITORING AND EVALUATION OF THE HYDROLOGY AND WATER RESOURCES PROGRAMME (agenda item 15)

Strategic Plan 2016-2019

15.1 The Commission agreed with Congress in reiterating the importance of the strategic planning process to ensure appropriate and coordinated implementation of WMO Programmes, by providing a high level statement on future directions and priorities of the Organization.

15.2 The Commission in particular took note that Congress (Resolution 38 (Cg-XVI)) had requested that technical commissions lead the formulation of the scientific and technical aspects of WMO Programmes and activities falling under their respective responsibilities, in preparing the WMO Operating Plan, and that they develop their own Operating Plan in support of the implementation of the next WMO Strategic Plan.

15.3 The Commission further noted that the Executive Council at its sixty-fourth session had decided that the structure based on Global Societal Needs (GSNs), Strategic Thrusts (STs), Expected Results (ERs) and Key Objectives (KOs) required simplification by reducing the number

of layers. EC-64 further decided that the strategic plan process should be driven by the needs and priorities set by the Members and that regional associations (in consultation with technical commissions and programmes) should propose the Expected Results and that the five priority areas should be better integrated.

15.4 While recognizing the current cooperation outlined in agenda item 12, the Commission noted the need to further increase collaboration with water-related programmes of other organizations, particularly those operating under the UN-Water umbrella. The Commission urged that the strategic directions of the Organization for 2016-2019 be developed considering relevant complementary activities of other organizations. In relation to hydrology and water resources, the Commission requested that the draft future programme of work put forward for consideration at its next session contain specific proposals for joint activities with the water-related programmes of other organizations.

15.5 The Commission endorsed the recommendation of its working party that the priorities for the strategic directions of the Organization in 2016-2019, in relation to hydrology and water resources, should be:

(a) To halt the decline in numbers of hydrological observation stations and in the quality of hydrological information around the world, to make progress toward increasing the coverage of stations and data quality, and increase open access to hydrological data;
(b) To ensure that each Member has the computer software, guidance manuals, and training to perform observations, numeric flow forecasting and water resource assessments to meet its national and regional goals;
(c) To raise adequate world-wide awareness of the range of available hydrological techniques by practitioners and (at a different level) by those needing to use hydrological outputs;
(d) To take advantage and make effective use of improved in-situ instrumentation and remote sensing capabilities, such as radar installations and satellites, including future satellites which will be equipped with greatly improved sensors targeted to making measurements related to water resources and radar installations;
(e) To consider the implementation of global and regional hydrological forecasting systems, complementary to and integrated with national systems. The implementation of global and regional hydrological forecasting systems should, where appropriate, be coordinated through the WMO's Commission for Hydrology; and
(f) To ensure that Members have sufficient numbers of competent, capable and skilled human resources to undertake the work required in hydrology and water resources into the future.

Continuous improvement of WMO processes and practices

15.6 The Commission noted that EC-64 had also agreed that a coordination and information sharing mechanism between the presidents of regional associations (PRAs) and the technical commissions (TCs) was extremely important especially when formulating input into the planning process. Hence it had requested the Working Group on Strategic and Operational Plan (WG/SOP) to continue to examine the mechanisms for enhancing such coordination. The Commission expressed the need to ensure that there is hydrological representation in each step of the process.

15.7 The Commission recalled that Regional Hydrological Advisers (RHAs) had been invited to the meeting of the Advisory Working Group (AWG) immediately preceding the present CHy session to provide inputs on regional priorities to the CHy planning process. In preparation for this session, consultation was also extended to the presidents of Regional Associations and of Technical Commissions soliciting their inputs (expressions of needs) on a series of topics of relevance to the HWRP. The Commission strongly endorsed this process and expressed its concern that not all regional associations had re-established Working Groups on Hydrology for their Regions and thus a crucial element of the process was missing in those Regions. In the

broader context of the optimization of the scheduling of technical commissions and regional association meetings, it has to be stressed that the CHy, as well as the Regional Working Groups on Hydrology, often represent the only opportunity, at global or regional level, for representatives of the hydrological services and the broader hydrological community to meet and discuss themes of common interest. Their very existence is one of the strongest tools for promoting the recognition of WMO in the field of water in a continuous and not in an ad-hoc way, by addressing directly those that, in their everyday work, most need WMO contribution and support.

15.8 The Commission agreed with the president of CHy's proposal that WMO's role in water-related issues would be reinforced by giving Hydrological Advisors a higher level of recognition. This could be achieved by broadening their responsibility and capacity to propose and undertake initiatives related to relevant WMO Programmes. For example, one easy measure in this context would be allowing them to submit proposals for fellowships related to hydrology and water resources, with the relevant Permanent Representative duly copied, directly to the WMO Secretary-General. The Commission noted that this change of guidelines would require the approval of the Executive Council.

15.9 The Commission was also informed that the informal meeting of the president of CHy with the Regional Hydrological Advisors held in association with sessions of the Executive Council continued to prove an excellent opportunity for coordination and evaluation/alignment of activities.

Monitoring and Evaluation (M&E)

15.10 The Commission concurred with Congress that an M&E System is an important component of the Result-based Management (RBM). It noted that Congress had also requested that the M&E System be simplified in order to reduce the workload required for its implementation and encouraged technical commissions and regional associations to continue to contribute to its further development and implementation. The Commission stressed the need for a consistent and robust process and the importance of establishment of the baseline information.

15.11 The Commission took note that the President of WMO in September 2011 had addressed to all presidents of technical commissions and regional associations a letter requesting their views and contributions to a series of topics relevant, *inter alia*, to the alignment of planning process between constituent bodies and the monitoring of progresses. In his reply the president of the Commission referred to the AWG's decision to structure its meetings during the intersessional period in line with the Expected Results and the priority areas identified in the Strategic Plan 2012-2015, and directly focusing the evaluation of progress in alignment with the key performance indicators as presented in the Operating Plan 2012-2015.

16. SCIENTIFIC LECTURES (agenda item 16)

16.1 The Commission devoted two afternoons to a series of scientific lectures on the following subjects:

(a) Inland Water Satellite Altimetry Application to Operational Hydrology, by Jean-François Crétaux, from France;
(b) Soil Moisture Measurements from Space and Application to Operational Hydrology, by Wolfgang Wagner, from Austria;
(c) State of the art in acoustic methods of flow measurement, by Marian Muste, from the United States of America;
(d) State of the art in hydrological data exchange formats and protocols, by David R. Maidment, from the United Sates of America.

16.2 The Commission expressed its appreciation to those experts who had delivered the lectures. The Commission expressed the view that such presentations provided a valuable input to

the discussions regarding the future work programme and also the strategic directions of the Commission and proposed that they be continued. A topic for consideration at the next session was the use of radar-based information in hydrological applications.

17. ELECTION OF OFFICERS (agenda item 17)

Mr Harry Lins (United States) was elected president of the Commission for Hydrology for the next intersessional period and Mr Liu Zhiyu (China) vice-president.

18. REVIEW OF PREVIOUS RESOLUTIONS AND RECOMMENDATIONS OF THE COMMISSION AND OF RELEVANT EXECUTIVE COUNCIL RESOLUTIONS (agenda item 18)

The Commission examined the resolutions and recommendations adopted at its thirteenth session, as well as the Executive Council resolutions relating to CHy activities which were still in force. The decisions of the Commission in that regard are incorporated in Resolution 8 (CHy-14) – Review of previous resolutions and recommendations of the Commission for Hydrology, and Recommendation 1 (CHy-14) – Review of the resolutions of the Executive Council based on previous recommendations of the Commission for Hydrology.

19. OTHER MATTERS (agenda item 19)

19.1 The president of the Commission for Hydrology presented certificates to Ms Ann Calver (United Kingdom), Ms Jeanna Balonishnikova (Russian Federation) and Ms Zsuzsanna Buzás (Hungary) for their outstanding contributions to the work of the Commission during the past intersessional period.

19.2 The Commission expressed its concern with the lack of applications from female candidates for positions on the AWG at this session and requested that the AWG make a greater effort to ensure such applications were forthcoming at the next session.

19.3 The Commission requested that consideration be given to inviting Members to provide optional national reports to future sessions of CHy. Such reports could detail Member's WMO-related hydrological activities over the intersessional period and other material of interest to the Commission.

20. DATE AND PLACE OF THE FIFTEENTH SESSION (agenda item 20)

The Commission agreed that its fifteenth session should be held in 2016 at a place to be determined.

21. CLOSURE OF THE SESSION (agenda item 21)

21.1 At the close of the session the president thanked all those involved in the preparations for the session and the participants for their participation in, and contributions to, the work of the Commission. He congratulated the incoming president, vice-president and the AWG members and wished them well in their activities over the coming intersessional period. The representative of the Secretary-General also thanked the participants for their constructive and thoughtful interventions and their support to the activities of the Commission and wished them a safe trip home.

21.2 The fourteenth session of the Commission for Hydrology closed at 12:35 p.m. on Wednesday 14 November 2012.

RESOLUTIONS ADOPTED BY THE SESSION

Resolution 1 (CHy-14)

CONTRIBUTION OF THE COMMISSION TO THE GLOBAL FRAMEWORK FOR CLIMATE SERVICES

THE COMMISSION FOR HYDROLOGY,

Noting:

(1) Resolution 12 (Cg-XVI) – Hydrology and Water Resources Programme,

(2) Resolution 48 (Cg-XVI) – Implementation of the Global Framework for Climate Services,
(3) Resolution 3 (EC-LXIII) - Establishment of a Joint CCl/CAgM/CHy Expert Group on Climate, Food and Water,

(4) Resolution 1 (Cg-Ext.(2012)) – Implementation Plan of the Global Framework for Climate Services,

(5) Resolution 2 (Cg-Ext.(2012)) – Establishment of the Intergovernmental Board on Climate Services,

(6) Resolution 3 (Cg-Ext.(2012)) – Financing the Intergovernmental Board on Climate Services, Secretariat and Implementation Plan of the Global Framework for Climate Services;

Recognizing:

(1) The importance of climate data, services and products to the development of sustainable water resources management tools,

(2) That climatic variability and change are ever-present factors affecting water availability and hydrological extremes, which need to be understood,

(3) That the National Hydrological Services continue to play a crucial role in providing hydrological data and in understanding and evaluating the hydrological response to climatic variability and change in support of decision-making and planning in water management,

(4) The crucial role played by well coordinated activities of National Meteorological and Hydrological Services (NMHSs) in building a continuous process of user-provider interaction, and the position of the NMHS as a nucleus for implementation of the Global Framework for Climate Services (GFCS) at the national level,

(5) The role that UN-Water has played through its Thematic Priority Area on Water and Climate Change to ensure that the United Nations system in general, and UN-Water in particular, is better prepared to meet future challenges and play an essential role in this area,

(6) The progress made in the field of seasonal forecasting, climate prediction and extended streamflow prediction in recent years and the resulting increase in the number of operational systems of seasonal flow forecasting,

(7) The role played by existing initiatives of the Commission for Hydrology in supporting and reinforcing collaboration and liaison between the climate, hydrology and water resources communities;

Decides that the Commission shall actively participate in, and contribute to, the implementation of the GFCS by:

(1) Fostering the active participation of the water community in the relevant elements of GFCS governance and the GFCS Implementation Plan;

(2) Ensuring that hydrological monitoring, modeling and prediction systems, and related capacity-building initiatives are recognized as fundamental elements of water-related climate services;

(3) Coordinating the development of best practice examples within the relevant priority projects foreseen in the GFCS Implementation Plan;

(4) Providing appraisals of the scientific basis for relevant GFCS outputs targeting water sector applications;

Recommends to the Intergovernmental Board on Climate Services that the relevant programme areas of the WMO Commission for Hydrology and UN-Water be considered as key contributors to the GFCS;

Recommends to the Secretary-General:

(1) That through the Joint CCl/CAgM/CHy Expert Group on Climate, Food and Water, a set of joint Commission initiatives and activities be identified and developed as elements of the implementation of the GFCS;

(2) That initiatives such as the Associated Programme on Flood Management and the Integrated Drought Management Programme align their climate services-related activities with the implementation of the GFCS;

Requests the president of the Commission for Hydrology:

(1) To ensure cooperation between the members of the Advisory Working Group (AWG) responsible for the Climate and Water and the Hydrological Forecasting and Prediction thematic areas in the field of extended (seasonal) hydrological forecasts especially in developing seamless hydrological forecasts;

(2) To promote, through the AWG, the needs of the hydrological community in relation to the outputs of climatological modelling;

Designates the president of the Commission for Hydrology, or his designate from amongst the AWG members, to be responsible for coordinating the contribution of the Commission for Hydrology to the GFCS.

Resolution 2 (CHy-14)

PROJECT FOR THE ASSESSMENT OF THE PERFORMANCE OF FLOW MEASUREMENT INSTRUMENTS AND TECHNIQUES

THE COMMISSION FOR HYDROLOGY,

Noting the progress achieved by the project during the last intersessional period in preparing guidance material to assist National Hydrological Services (NHSs) in the assessment of the performance of flow measurement instruments and techniques, including advice to NHSs on how to make a simple but sound uncertainty analysis of a discharge measurement,

Noting further:

(1) The recommendations made by the Management Committee as regards the future workplan of the project,

(2) That the tenure of members of the Management Committee ends during the current session of the Commission,

Considering the excellent collaboration established with external organizations, which share the interest of WMO in the objectives of the project, such as the International Association for Hydro-Environment Engineering and Research (IAHR), the International Association of Hydrological Sciences (IAHS), the International Organization for Standardization (ISO), and the Association of Hydro-Meteorological Equipment Industry (HMEI);

Decides:

(1) To continue with the implementation of the project during the next intersessional period;

(2) To approve the terms of reference and composition of the Management Committee of the project as provided in the Annex to this resolution;

Requests the Advisory Working Group (AWG), in its capacity as Steering Committee of the project, to approve, at its first meeting, the final workplan of the project for the next intersessional period, 2013-2016, on the basis of the recommendations of the Management Committee and of the deliberations of the current CHy session; the workplan should include specific activities, deliverables, a timeline and an estimated budget;

Requests the Secretariat to provide the necessary support to this important activity, in particular by activating the new composition of the Management Committee as early as possible;

Urges members to participate actively in this project, in particular by promoting the utilization of the project outputs at the national level and by contributing their national guidance material to the database of the project;

Encourages the participating organizations to continue with their active involvement in the project, in particular by supporting their representatives in the Management Committee, and promoting the initiative among their network of affiliates.

———

Note: This resolution replaces Resolution 2 (CHy-XIII), which is no longer in force.

Annex to Resolution 2 (CHy-14)

MANAGEMENT COMMITTEE FOR THE COMMISSION'S PROJECT ON THE ASSESSMENT OF THE PERFORMANCE OF FLOW MEASUREMENT INSTRUMENTS AND TECHNIQUES

1. Terms of reference

(1) To provide general guidance to the Project and to develop, update and carry out the project workplan as necessary to take into account the different perspectives of the participating organizations;
(2) To identify gaps and future requirements in relation to the objectives of the Project;
(3) To make recommendations to the participating organizations on activities that could be considered by those organizations in support of the Project;
(4) Individual representatives of participating organizations should provide periodic progress reports to their constituent bodies, as required by them;
(5) To provide reports on progress and other issues deemed of importance to the president of the Commission for Hydrology, chair of the Steering Committee of the Project.

2. Membership

(1) Representative of the International Association for Hydro-Environment Engineering and Research (IAHR);
(2) Representative of the International Association for Hydrological Sciences (IAHS);
(3) Representative of the International Organization for Standardization (ISO);
(4) Representative of the Association of Hydro-Meteorological Equipment Industry (HMEI);
(5) Representative of the WMO Regional Working Groups on Hydrology;
(6) Representative of the WMO Commission for Hydrology (Chair).

Other experts may be called upon to assist the Committee in their personal and professional capacity.

The term of membership coincides with the intersessional period of CHy. The same representative may be re-appointed by his/her parental organization for an indefinite number of terms.

If it is considered necessary for the implementation of the project, the president of CHy, after consultation with the four other organizations involved, may revise these terms of reference and the composition of the membership.

3. Secretariat support

The WMO Secretariat will provide secretarial assistance to the committee through the WMO Hydrology and Water Resources Branch.

4. Modalities of work

Most of the work will be conducted by e-mail, teleconference and videoconference, with the possibility of holding physical meetings when deemed appropriate by the Chair and if resources are available, but at least twice during an intersessional period, normally in its initial and final years.

Resolution 3 (CHy-14)

PROPOSED ADOPTION OF WATER ML 2.0 AS A STANDARD

THE COMMISSION FOR HYDROLOGY,

Noting:

(1) Resolution 25 (Cg-XIII) – Exchange of Hydrological Data and Products,

(2) Resolution 26 (Cg-XVI) – WMO Quality Management Framework,

(3) Resolution 13 (Cg-XVI) – Quality Management Framework – Hydrology,

(4) Resolution 6 (CHy-XIII) – WMO Integrated Global Observing Systems and WMO Information System;

Recognizing:

(1) The importance of improved access to hydrological data for a range of purposes, including flood forecasting and warning, water resources assessment and evaluation of the impacts of climate variability and change,

(2) The need to adopt standard procedures in the operations of National Hydrological Services,

(3) In particular, the growing need for the adoption of standards related to data operations and management with the primary aims of improving the interoperability of data and information and increasing their availability and accessibility,

(4) The high importance of the working arrangements between WMO and the International Organization for Standardization (ISO), including the recognition of WMO as an international standardizing body for technical standards, a rare distinction given to only three organizations worldwide;

Considering that the work of the WMO/Open Geospatial Consortium (OGC) Hydrology Domain Working Group (including representation from CHy) has resulted in WaterML 2.0 being adopted as an OGC Standard;

Decides to commence a process, including testing, that could see the potential adoption of the WaterML 2.0 as a WMO standard for information exchange managed by WMO (supported by the WMO/OGC Memorandum of Understanding), and to register this standard as a joint WMO/ISO standard;

Requests the Secretariat to take the necessary actions, under the direction of the Advisory Working Group, to commence a process, including testing, that could potentially see WaterML 2.0 become a WMO standard for information exchange managed by WMO (supported by the WMO/OGC Memorandum of Understanding), and to register this standard as a joint WMO/ISO standard;

Requests the Advisory Working Group member responsible for data management and operations to oversee this process;

Requests the president of CHy to report on progress at the next session of the Commission for Hydrology;

Requests Members to actively participate in testing and applying WaterML 2.0 in pilot projects and operational applications and to report their experiences and suggestions to the WMO/OGC Hydrology Domain Working Group and the Advisory Working Group.

Resolution 4 (CHy-14)

WORLD HYDROLOGICAL CYCLE OBSERVING SYSTEM

THE COMMISSION FOR HYDROLOGY,

Noting:

(1) Resolution 14 (Cg-XVI) – World Hydrological Cycle Observing System, requesting the Secretary-General to carry out an independent external evaluation of the World Hydrological Cycle Observing System (WHYCOS) programme, as a follow-up to the one carried out in 2005,

(2) That the same resolution requested the Secretary-General to review the mandate, composition and functioning mechanism of the WHYCOS International Advisory Group (WIAG),

(3) The *Comprehensive Review of the World Hydrological Cycle Observing System,* prepared by independent external experts and the recommendations therein,

(4) The Report of the 9th WIAG meeting and its responses to the evaluation recommendations,

(5) The comments on the recommendations of the WHYCOS review formulated by the Advisory Working Group ,

(6) The proposal formulated by the 9th WIAG meeting on its terms of reference and composition;

Recognizing:

(1) That WHYCOS has proven in the past decade a useful means to mobilize resources to strengthen the National Hydrological Services (NHSs) and their regional cooperation,

(2) The positive impacts of the implemented HYCOS components on the strengthening of technical and institutional capacities of NHSs in a number of countries, including improved international cooperation in transboundary and international rivers basins,

(3) The visibility earned by WMO in the field of water-related issues also thanks to WHYCOS;

Aware and concerned that shortcomings still exist in the implementation of WHYCOS, in particular with respect to the sustainability of the systems installed, which may affect both ongoing components and the potential to implement new ones;

Reaffirms the importance of WHYCOS as a priority activity within the WMO Hydrology and Water Resources Programme;

Endorses:

(1) The *Comprehensive Review of the World Hydrological Cycle Observing System* as prepared by the independent external experts;

(2) The proposed responses to the recommendations formulated in the comprehensive review, as included in Annex 1 to this resolution;

(3) The revised terms of reference and composition of WIAG as contained in Annex 2 to this resolution;

Requests the Secretary-General to report to the sixty-fifth session of the Executive Council on the independent external evaluation of the WHYCOS programme on the basis of the findings of the comprehensive review and of the responses to its recommendations by the Commission.

Annex 1 to Resolution 4 (CHy-14)

RESPONSES OF THE COMMISSION TO THE RECOMMENDATIONS FORMULATED IN THE COMPREHENSIVE REVIEW OF THE WORLD HYDROLOGICAL CYCLE OBSERVING SYSTEM

Recommendation 1
The concept of WHYCOS needs to further evolve to make operational, within its HYCOS components, institutional, organizational, and human resources capacity development to allow the attainment of sustainable outcomes and societal impacts.

Response:
Agreed.

Recommendation 2
The concept of WHYCOS and its HYCOS components be designed to give adequate attention to achieving outcomes, such as the provision of water resources assessments and flood forecasts and warnings, and not solely outputs such as the acquisition and distribution of hydrological data.

Response:
Agreed.

Recommendation 3
Agreements with each country should be signed at the highest levels clearly defining the financial and human resource commitments of the country towards the project implementation and post-project stages of the component. Such an agreement should be made before commencement of the field implementation stage to ensure participation of the country and long-term sustainability of the investment. If such an agreement cannot be satisfactorily concluded, then the implementation stage should not go forward.

Response:
Agreed.

Recommendation 4
All project stages, namely the Project initiation stages, the Project implementation stages and the Post-project stage, should maximize, to the practicable extent possible, the engagement of NHSs' personnel in the development and implementation of all activities.

Response:
Agreed.

Recommendation 5

WMO needs to redefine and reinvigorate its leadership role of the WHYCOS programme and its HYCOS components. WMO should be taking a much more proactive role in providing oversight and technical assistance by increasing its ability to provide advice and guidance on the operational implementation of on-the-ground projects such as HYCOS components.

Response:
Agreed.

Recommendation 6

WMO needs to create a WHYCOS Office dedicated to the total management of the WHYCOS programme and its HYCOS components thereby focusing Secretariat leadership, having the delegated authority to respond to operational requirements in a timely fashion, and to take advantage of opportunities as they arise. The Office needs to promote awareness of the programme, facilitate donor involvement, and focus on the operational delivery of the programme. The Office may also include a Help Desk on the programme to assist in this process, particularly the provision of technical assistance to NHSs in implementing the components, particularly during the Post-project stage.

Response:
Partially agreed. WMO's role is that of ownership of the WHYCOS concept and supervision, from a technical and governance perspective, of the suite of HYCOS projects. The extent to which a dedicated WHYCOS Office will improve this coordination needs to be ascertained. It is proposed that a further study of the costs and benefits of different approaches could be undertaken including identification of funding sources. In this regard, it will be important to define what is meant by "total management".

Recommendation 7

WMO may need to invest in acquiring and developing its staff to be subject-content experts so they can more effectively provide advice and undertake analyses associated with operational aspects of HYCOS components and the WHYCOS programme in general.

Response:
Partially agreed, see response to Recommendation 6. Consideration could also be given to developing a support-based partners approach, incorporating, in particular, regional partners.

Recommendation 8

As owner of the WHYCOS programme, WMO should be playing a more significant role in mid-term and final evaluation reports that should also address the state of technical outcomes. WMO should also be undertaking a review of the post project stage approximately three years after completion of the project implementation stages. WMO should be paying more attention to understanding the causes of issues and in preventing their recurrence, particularly if they are common pitfalls.

Response:
Agreed.

Recommendation 9

WIAG needs to hold regular meetings comprising only essential participants to be an effective coordinating body and to provide recommendations to the Secretary-General on policy and programme development so that the programme can more rapidly respond to issues and be adjusted over time. WIAG, among its other duties, should focus on defining the persistently

recurring issues associated with the Project implementation stages and Post-project stage and should assist the WMO Secretariat and its WHYCOS Office in developing strategies and approaches to resolve them. WIAG, through its coordination function, should monitor the development of issues and should assess the effectiveness of the strategies and approaches employed to overcome them.

Response:
Agreed in principle, noting that there are resource requirements associated with the implementation of this recommendation. Consideration could be given to other forms of “meetings” including teleconferences.

Recommendation 10

The WHYCOS Guidelines should be reviewed, revised, reissued and widely distributed. Compendiums of: lessons learned; WHYCOS and WIAG policies and procedures; WIAG recommendations; and minutes of WIAG and WCG meetings should be developed, regularly maintained and placed on the WHYCOS Website for all to see.

Response:
Agreed, noting that the internal WHYCOS Coordination Group (WCG) is no longer in operation.

Recommendation 11

To fulfil the global concept of WHYCOS and to fully embrace the spirit of Resolution 25 (Cg-XIII), data collected through the HYCOS components must be exchanged in an unrestricted and free fashion by the participating countries in a timely fashion. If a country does not agree with the unrestricted and free exchange of data, it should not be part of the HYCOS component. WMO, through its WHYCOS Office, should be tracking the state of data exchange within the HYCOS components to ensure compliance with this recommendation and should provide its findings to WIAG.

Response:
Agreed. The Commission noted the opinion expressed by WIAG and AWG that application of Resolution 25 (Cg-XIII) should be encouraged within the WHYCOS programme, noting that within HYCOS Components data exchange among the countries for the purpose of the project was an essential requirement, and also noting that there may be in some instances protocols/agreements that have been signed at the local level that need to be taken into consideration. A set of data and/or products for exchange should be decided at the project level and guidance for this could be addressed in the revision of the WHYCOS Guidelines. Data exchange requirements could also be included in the Memoranda of Understanding signed by countries participating in HYCOS components.

Recommendation 12

WMO and its WMO Integrated Global Observing System (WIGOS), its WMO Information System (WIS) and WHYCOS programme should carefully analyse and clearly determine what specific efforts will be necessary and what costs and benefits will be incurred for HYCOS components to take advantage of the WIGOS and WIS initiatives and for the WHYCOS programme in general. Efforts should be undertaken to document these in as clear and concise a fashion as possible, as well as the costs and benefits that would likely accrue through the integration of the WHYCOS programme with WIGOS and WIS.

Response:
Partially agreed. Noting the importance of the WHYCOS programme as an end-to-end service delivery mechanism, the relationship between WIGOS and WIS and WHYCOS and its component HYCOSs from an information management perspective needs to be more clearly defined. This task should be addressed by the CHy AWG. Regional centres hosting HYCOS components data

banks could register as WIS Data Collection or Production Centres (DCPC) to make WHYCOS-collected data widely discoverable.

Recommendation 13

WMO and the WHYCOS programme should ensure that all documentation such as the WHYCOS Guidelines reflect the requirements to comply with the WIGOS and WIS initiatives. WMO and the WHYCOS programme should also focus on increasing awareness of the WIGOS and WIS initiatives, and more importantly on the requirements they place upon the WHYCOS programme and its HYCOS components. Efforts at increasing awareness should be made as broadly as possible through the hydrology and water resources communities that may consider undertaking a HYCOS project. WMO and the WHYCOS programme should develop a strategy to assist existing HYCOS components in taking advantage of the WIGOS and WIS initiatives.

Response:

Agreed, subject to the response to Recommendation 12 being implemented and the results reported to the Commission.

Recommendation 14

Countries and donors should adopt the "Paris Declaration on Aid Effectiveness" (OECD, 2005) when working with the WMO on implementing the WHYCOS concept through its HYCOS components. This would include, inter alia, simplifying donor policies and procedures, increasing flexibility to better reflect the amount of time to implement components, and aligning components within national priorities.

Response:

Agreed.

Annex 2 to Resolution 4 (CHy-14)

INTERNATIONAL ADVISORY GROUP OF THE WORLD HYDROLOGICAL CYCLE OBSERVING SYSTEM

TERMS OF REFERENCE AND COMPOSITION

1. Terms of reference

The WHYCOS[*] International Advisory Group (WIAG) shall:

(1) Consider and advise WMO on the concept, objectives, expected benefits/costs, and future development of WHYCOS;

(2) Review and assess the status of WHYCOS, and the progress towards its objectives, and propose strategies for any necessary remedial action;

[*] WHYCOS here denotes the overall programme, its component parts and the mechanisms for coordination among them.

(3) Review the relationship of WHYCOS with other relevant international programmes, particularly from the point of view of coordination and avoidance of overlap and duplication, and propose any necessary actions;

(4) Identify and evaluate constraints on, and potential risks to, the future implementation and sustainability of WHYCOS, and propose strategies to minimize those risks. Risks include, inter alia, those of a financial, technical, operational, and institutional/political nature;

(5) Consider and propose plans for the effective promotion and dissemination of the achievements of WHYCOS;

(6) Consider and propose ways and means of engaging with donors in all project stages, especially for the future sustainability and appropriate expansion of WHYCOS;

(7) Review and advise on the terms of reference and composition of WIAG.

2. Composition

The WHYCOS International Advisory Group shall be composed of:

(1) The president of the WMO Commission for Hydrology (chairperson);

(2) One representative from each operational HYCOS;

(3) One representative from each active technical/financial partner;

(4) One representative of the Advisory Working Group of the WMO Commission for Hydrology or appointed CHy expert.

The Director, Hydrology and Water Resources Branch of WMO, shall act as secretary to the WIAG.

Other persons may be invited from time to time to participate in the work of the WIAG as observers including:

(a) Regional hydrological advisors;

(b) Representatives of prospective investors/donors;

(c) Representatives of prospective HYCOSs;

(d) Representatives of prospective technical/financial partners and other relevant international programmes and regional groupings;

(e) Representatives of other relevant WMO Programmes.

Resolution 5 (CHy-14)

ESTABLISHMENT OF AN INTEGRATED DROUGHT MANAGEMENT PROGRAMME

THE COMMISSION FOR HYDROLOGY,

Considering:

(1) The growing need to develop better management strategies based on scientific knowledge and to ensure broader social and economic responses in order to manage the risks of droughts in a rapidly changing environment,

(2) That traditionally response to drought throughout the world has been through a reactive, crisis management approach, which has proved to be costly, often untimely and poorly coordinated, and to reduce the effectiveness of the resources and assistance provided, thereby increasing the economic, social and environmental impacts of droughts worldwide,

(3) That in the context of the Quality Management Framework – Hydrology (QMF-H), and the proposed HelpDesk for Integrated Drought Management, a vehicle for the collection and dissemination of recommended drought management practices would be of considerable value;

Noting:

(1) The continuous efforts in recent years in the area of drought management by the Commissions for Agricultural Meteorology and Hydrology, and in particular the Integrated Drought Management Programme Concept Note jointly developed by WMO and the Global Water Partnership (GWP), available at http://www.wmo.int/pages/prog/wcp/drought/idmp/documents/IDMP_Concept_Note.pdf,

(2) That the joint WMO/GWP Associated Programme on Flood Management, and particularly its HelpDesk for Integrated Flood Management, had been recognized by CHy at its thirteenth session (Resolution 4 (CHy-XIII) – Water and climate issues) and by Congress at its fifteenth session (Resolution 20 (Cg-XV) – Hydrology and water resources programme) as a useful mechanism to achieve the objectives of disaster risk reduction, therefore constituting a positive experience on which to model a programme on Integrated Drought Management,

(3) That continuing efforts are needed to mobilize additional resources to meet the expanding needs of drought management, as these needs can be satisfied only partially with the available resources;

Decides:

(1) To develop, in collaboration with the Commission for Agricultural Meteorology (CAgM) and the Commission for Climatology (CCl), activities to support the drought prediction capabilities of the National Meteorological and Hydrological Services (NMHSs) and the drought management capabilities of national or regional organizations mandated to deal with droughts, through the establishment of an Integrated Drought Management Programme (IDMP) as illustrated in the concept note available on the website referenced in Noting (1);

(2) To support the setting up of a HelpDesk for Integrated Drought Management for the benefit of Members in the areas of drought management policy and strategy, and capacity building in support thereof;

Requests the Secretary-General to further undertake all necessary actions to implement the IDMP, through the collection and dissemination of drought management information and implementation of regional projects and capacity-building activities;

Encourages Members to support the implementation of the Integrated Drought Management Programme by: sharing good practices on drought management; offering courses and expertise in drought management; making use of the resources available through the HelpDesk on Drought Management to be launched in the framework of the Programme; providing, through the Programme, operationally proven technologies in hydrology related to drought management to the WMO hydrometeorological community; and any other action they consider appropriate to enhance the capacities of NMHSs in the fields of hydrology and drought management.

Resolution 6 (CHy-14)

CAPACITY-BUILDING IN HYDROLOGY AND WATER RESOURCES MANAGEMENT

THE COMMISSION FOR HYDROLOGY,

Considering:

(1) The growing importance that education and training issues are assuming in a rapidly changing environment, especially in the fields of hydrology and water resources management,

(2) The special relevance of capacity-building activities in the successful implementation of recommended practices and standards developed under the Quality Management Framework – Hydrology (QMF–H),

(3) That while the Hydrological Operational Multipurpose System (HOMS) had become out-of-date, its underlying philosophy of promoting transfer of operationally proven technology was still valid,

(4) The decisions taken by the sixteenth session of the World Meteorological Congress regarding the definition of meteorologist; the future of *Guidelines for the education and training of personnel in meteorology and operational hydrology* (WMO-No. 258); and competence standards; and its request to CHy to review the corresponding issues in the field of hydrology and water resources;

Noting:

(1) That the WMO Strategy on Education and Training in Hydrology and Water Resources for the period 2009-2012, adopted by the Commission at its thirteenth session and endorsed by Congress at its sixteenth session, had produced positive results by continuing the process of reorienting the education and training activities of WMO towards the real needs of the National Hydrological and Hydrometeorological Services,

(2) That continuing efforts were needed to mobilize additional resources to meet the expanding needs of education and training, as only some of these needs can be met with the available resources,

(3) The results of the surveys of regional training requirements in hydrology and water resources conducted by various working groups on hydrology of the regional associations,

(4) The opinion of its Advisory Working Group (AWG) that a new, more focused approach was called for in support of technology transfer activities in hydrology and water resources management;

Decides:

(1) That the revised WMO Strategy on Education and Training in Hydrology and Water Resources, contained in the annex to this resolution, should guide the activities of the Organization in education and training in hydrology and water resources for the period 2013–2016;

(2) To endorse the approach to technology transfer and knowledge management that consists in moving from a long catalogue of pieces of technology with limited provision of support, such as the Hydrological Operational Multipurpose System (HOMS), to a robust system with full technical support for a limited number of activities as suggested by the AWG;

(3) To ask the AWG and the Secretariat to develop open source and community of practice solutions to promote the transfer of technology for the following:

(a) Database management systems;

(b) Training material for stream gauging courses;

(c) Training material for flood forecasting and warning courses;

(d) A decision-support tool for uncertainty analysis of flow measurements (uncertainty analysis decision-aid tool);

(e) Delivery of distance learning courses in hydrology;

and requests the AWG to consider developing similar solutions for:

(f) Low Flow Estimation and Prediction;

Encourages Members to support the implementation of the Strategy, by offering courses in the priority areas and by providing fellowships and instructors for the international courses organized or co-organized by WMO, and to actively participate in the communities of practice of their interest and in any other action they consider appropriate to further the capacities of National Meteorological and Hydrological Services in the fields of hydrology and water resources management.

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Note: This resolution replaces Resolution 5 (CHy-XIII), which is no longer in force.

Annex to Resolution 6 (CHy-14)

WMO STRATEGY ON EDUCATION AND TRAINING IN HYDROLOGY AND WATER RESOURCES FOR THE PERIOD 2013–2016

General concepts and principles

Introduction

The purpose of this document is to lay down the guiding principles on which the education and training activities of WMO in the field of hydrology and water resources should be based in the period 2013-2016.

The document has been prepared taking into account:

– The experience, accumulated during two intersessional periods (eight years), of conducting business in a demand-driven way on the basis of an overall conceptual framework defined through a strategic document;

– The fact that during recent WMO financial periods the financial resources available for Hydrology and Water Resources (HWR) in general, and for education and training activities in HWR in particular, have remained practically constant in the Organization, while the demand from Members has increased proportionally to the rise of the "water" issue to the top of the international political agenda;

– The continuing need to optimize the available resources by concentrating WMO support – provided directly to organizers of education and training activities or through fellowships – on those courses that (a) address areas identified by the "WMO hydrological community" as requiring priority attention, (b) afford WMO the possibility of influencing the development of curricula, (c) represent an adequate geographical balance, and (d) are proven to be cost-effective;

– The clear advantages derived from the greater involvement of the Commission for Hydrology in the design, implementation, monitoring and update of the strategy;

– The fact that, within the WMO Secretariat, the Education and Training Office is the key unit for the coordination of Education and Training activities and that the assignment of fellowships is under the responsibility of the Fellowship Committee;

– The relative success of the concept of Regional Training Centres (RTCs) in the WMO community;

– The wish expressed by the AWG to move to a more integrated, focused and proactive approach in education and training in HWR;

– The principles contained in the *Guidelines for the Education and Training of Personnel in Meteorology and Operational Hydrology* (WMO-No. 258), Volume II: Hydrology, and/or their substitute;

– The education and training activities in HWR promoted by other agencies of the United Nations system, in particular the United Nations Educational, Scientific and Cultural Organization (UNESCO), and by other intergovernmental and non-governmental organizations, and the fact that the ten-year period beginning on 1 January 2005 has been

proclaimed the United Nations Decade of Education for Sustainable Development (United Nations General Assembly Resolution A/RES/57/254).

The above elements were used to define the mission, vision, main objectives, customer base, mechanisms to establish the priority areas and means of implementation of the subprogramme on Capacity-building in Hydrology and Water Resources Management of the Hydrology and Water Resources Programme (HWRP).

Mission

To support Members in assessing their education and training needs in HWR, and to play a catalytic role in satisfying those needs, by providing both financial and technical assistance.

Vision

The National Hydrological Services (NHSs) contributing effectively to the integrated water resources management in their countries, by generating, organizing and disseminating adequate information on the state of the water resources.

Objectives

– Assisting Members in assessing their own education and training needs in HWR;

– Providing adequate education and training to personnel of the NHSs;

– Assisting Members in developing/updating national curricula in HWR;

– Optimizing the use of available resources and mobilizing extrabudgetary resources.

Identification of target groups

The primary target group comprises the technical and professional staff of the Hydrological and Hydrometeorological Services of WMO Members, including managers, scientists, engineers, technologists and technicians. The secondary group consists of those academic and government agencies involved in hydrology and water resources. While it is common nowadays to include at a high level of priority the local communities and civil society at large, it has to be recognized that they generally will be outside the scope of this strategy, in view of the specialized nature of WMO. Particular attention will be given to the needs of National Meteorological and Hydrological Services (NMHSs) from developing countries, as they are the ones likely to benefit the most from WMO assistance.

Prioritization of subjects

Education and training activities supported by WMO should in principle be demand-driven. The requirements will be determined on the basis of inputs from Members, the Working Groups on Hydrology and Water Resources of the Regional Associations (or similar groupings), CHy and its subsidiary bodies, and surveys undertaken by the WMO Secretariat. The results will be analyzed and prioritized by CHy at its regular sessions, and presented to the following Executive Council session for its endorsement. It will thus be valid for a four-year period. Permanent Representatives with WMO, their Hydrological Advisers, members of CHy and training centres that have maintained relationships with WMO will be informed of the priority areas selected for each period. This means that support given to course organizers as well as the approval of fellowships will be focused on those areas determined as indicated above. There would still be room to support requests on a case-by-case basis, but it should be limited.

Types of education and training activities

In order to maximize the extent of the Capacity-building in Hydrology and Water Resources Management subprogramme, emphasis will be put on activities of a short duration, low cost and great potential impact with regard to the number of beneficiaries, without compromising their quality. Given their proven value, activities such as training of trainers and roving seminars will be given priority, resorting to regional courses only when it is proven to be the most practical solution. Certification awards will be issued, specifying the results, the level and duration of the course.

Conferences, seminars and workshops on specific issues that are not covered by existing training centres will be organized, preferably through co-sponsorship arrangements.

On the basis of the experience gained in recent years in the use of distance learning and blended learning techniques, and application of latest available information technologies, emphasis will be on the delivery of courses of a general nature using these techniques, making all possible efforts to involve RTCs and other academic institutions in the planning and delivery of the courses, in order to multiply the outreach in all WMO Regions.

Another important field of action will be the promotion among Members of *Guidelines for the Education and Training of Personnel in Meteorology and Operational Hydrology* (WMO-No. 258), Volume II: Hydrology, and/or their substitute, since these Guidelines will contribute to the development of national curricula and syllabi under an international framework, both at the higher professional and at the technician level.

This strategy does not focus on public awareness or community training activities, even though they are considered very important, as it is more convenient to separate these areas from those dedicated to the education and training of the NMHS staff.

Means of supporting the activities

WMO provides support to education and training activities in HWR through one of the following mechanisms:

Education and Training Programme (ETRP)

– *Support to training events under the Hydrology and Water Resources Programme*: In view of the available resources, only a handful of international courses will receive support under this modality. Important criteria to decide whether a course qualifies for direct support are: (a) WMO should have the possibility of influencing the development of curricula; (b) adequate geographical balance, even if only at the regional level, should be ensured; and (c) cost-effectiveness;

– *Fellowships*: Requests for fellowships have to be submitted to WMO through the Permanent Representative of the candidate's country. Preference should be given to courses on priority subject areas where WMO has undertaken a review of the content and level of the programme of study, to verify its concordance with the WMO Strategy on Education and Training in HWR.

Hydrology and Water Resources Programme (HWRP)

– *Enabling support (partial):* Under this modality, course organizers request support from WMO in a range of ways, from the simple use of the WMO logo to a limited (normally less than US$ 5 000) financial contribution. Decisions, to be made on a case-by-case basis, should be based on the priority of the subject areas treated, the tradition of cooperation of the organizers with WMO, the reputation of the organizing institution, the number and

geographical representation of international participants, and the number of participants from developing countries;

– *Support as part of regular activities of the HWRP:* Various components of the HWRP of WMO, such as the World Hydrological Cycle Observing System (WHYCOS), the Hydrological Operational Multipurpose System (HOMS) and the Associated Programme on Flood Management, regularly organize training activities on subjects related to their work. These training activities are funded from the regular budget assigned to each programme, and will continue to be organized in the future according to the guiding principles contained in this strategy.

Promoting partnerships

In addition to the above, particular emphasis will be placed on developing partnerships with academic institutions, professional and scientific associations active in the areas of HWR that are of interest to WMO, through, for instance, promotion of exchanges of academic staff, co-sponsorship by institutions of the developed world of specific international courses organized by developing countries' institutions, and technical assistance in the preparation of syllabi and course programmes.

Particular attention will be devoted to the cooperation with the International Association of Hydrological Sciences (IAHS), the International Association for Hydro-Environment Engineering and Research (IAHR) and the United Nations Educational, Scientific and Cultural Organization (UNESCO) in general and with the UNESCO-IHE Institute for Water Education in particular, in order to take advantage of their high academic and scientific level, extended networks and excellent facilities.

Mechanism of implementation

Given that ETRP has the leading role in coordinating education and training activities in the areas of interest to WMO, and that this programme has already well-established mechanisms and procedures, it is convenient to work through similar structures. In view of the decision of the Executive Council, taken at its fifty-eighth session, to widen the scope of WMO RTCs to include other areas of interest to WMO, particular attention should be given to expediting the establishment of new WMO RTCs with a special focus on hydrology and water resources, and to promoting joint activities with those centres already established.

Whenever feasible and applicable, a community of instructors should be established for a particular subject, in order to jointly design the curricula, share teaching material and experiences, and discuss common problems. These communities of instructors will, in addition, constitute a pool of trainers who would be able, with limited supervision from the WMO Secretariat, to organize a training activity according to the CHy criteria established in this strategy.

Evaluation procedures for all courses in HWR supported by WMO will continue to use the customary mechanisms designed for this purpose by the ETRP, and to implement additional ones if needed.

Priority areas for 2013–2016

The Commission noted the following priority areas for education and training in HWR, which were identified by the Working Groups on Hydrology and Water Resources of the Regional Associations, and recommended that, in addition, training activities should be undertaken at the global level on the utilization of the guides and manuals issued under the Quality Management Framework – Hydrology:

Regional Association I: (Africa)	1.	Hydrological forecasting techniques
	2.	Integrated flood management
	3.	Hydrological instruments and methods of observation
Regional Association II: (Asia)	1.	Use of hydrological models
	2.	Use of remote sensing applications in hydrology and water resources management
	3.	New methodologies in water resources assessment
Regional Association III: (South America)	1.	Discharge measurements and stream gauging stations
	2.	Hydrological instruments and methods of observation
	3.	Hydrological forecasting techniques
Regional Association IV: (North America, Central America and the Caribbean)	1.	Operation and maintenance of automatic stations
	2.	Extreme event analysis
	3.	Flood forecasting
Regional Association V: (South-West Pacific)	1.	Integrated water resources management
	2.	Remote sensing in hydrology
	3.	Discharge measurements and stream gauging stations
Regional Association VI: (Europe)	1.	Data processing and quality control
	2.	Flood forecasting
	3.	Hydrological modelling

As and when new surveys on training needs are conducted at the next sessions of the Working Groups on Hydrology and Water Resources of the Regional Associations, the above regional priorities will be revised accordingly.

Note: Surveys for Regional Associations IV and VI are now under way. The data presented is that of the previous intersessional period.

Resolution 7 (CHy-14)

WORK PROGRAMME AND STRUCTURE OF THE COMMISSION FOR HYDROLOGY

THE COMMISSION FOR HYDROLOGY,

Noting:

(1) Resolution 12 (Cg-XVI) – Hydrology and Water Resources Programme,

(2) The report of the president of the Commission for Hydrology (CHy),

(3) The reports of the members of the Advisory Working Group (AWG), which the Commission established at its thirteenth session,

(4) The report of the Secretary-General regarding the activities of the Commission during its previous intersessional period,

(5) The other resolutions adopted by the Commission during the present session;

Recognizing:

(1) The valuable role played by the experts of national agencies in implementing the activities of the Commission,
(2) The benefits of regular communication across all aspects of the hydrological work of WMO;

Decides:

(1) To adopt the five thematic areas contained in Annex 1 to this resolution, together with the corresponding sets of activities and expected outputs and outcomes contained therein, as a priority for the work of the Commission in the next intersessional period;

(2) To re-establish the AWG of the Commission for Hydrology, which will also act as the Steering Committee for the project on Assessment of the Performance of Flow Measurement Instruments and Techniques, with the terms of reference given in Annex 2 to this resolution;

(3) To continue the four Open Panels of CHy Experts (OPACHE) and update them to cover the areas listed in Annex 2 to this resolution, which can be further divided into sub-themes or otherwise as required;

(4) To support and encourage the participation of the AWG members and relevant experts in the Inter-Programme Expert Teams managed by other Commissions where these contribute to the workplan of CHy;

(5) To establish the following general terms of reference applicable to the AWG and other experts:

   (a) The members of the AWG shall ensure that the relevant sections of the *Technical Regulations* (WMO-No. 49), the *Guide to Hydrological Practices* (WMO-No. 168), the manuals on hydrology and water resources, and other guidance material relevant to their particular areas of responsibility are reviewed, and appropriate proposals for revisions and/or additions are included in future editions of these publications;

   (b) The members of the AWG and experts shall take account of relevant international agreements and conventions and of the activities of other international organizations working in fields related to theirs when fulfilling the tasks specified in their individual terms of reference;

(6) To invite the following experts to serve as members of the AWG in the capacities indicated below:

   – Mr Harry Lins (United States of America) – President of CHy

   – Mr Zhiyu Liu (China) – Vice-president of CHy

   – Mr Paul Pilon (Canada) – Quality Management Framework – Hydrology

   – Mr Tony Boston (Australia) – Data Operations and Management

   – Mr Sung Kim (Republic of Korea) – Water Resources Assessment

   – Mr Antonio Cardoso Neto (Brazil) – Water Resources Assessment

   – Mr Johnson Muturi Maina (Kenya) – Hydrological Forecasting and Prediction

– Mr Yuri Simonov (Russian Federation) – Hydrological Forecasting and Prediction

– Mr Jan Danhelka (Czech Republic) – Water, Climate and Risk Management
– Mr Johannes Cullman, Chair of the Intergovernmental Council of the International Hydrological Programme of the United Nations Educational, Scientific and Cultural Organization (UNESCO) (ex-officio member);

Requests the WMO Secretariat to provide short quarterly web updates on the activities of the Hydrology and Water Resources Programme (HWRP);

Urges Members to nominate additional experts to OPACHEs and to facilitate the voluntary contribution of their members to the activities of the Commission.

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Note: This resolution replaces Resolution 7 (CHy-XIII), which is no longer in force.

Annex 1 to Resolution 7 (CHy-14)

WORK PROGRAMME OF THE COMMISSION FOR HYDROLOGY

Thematic Areas

The Programme of Work of the Commission for Hydrology will focus on the following five thematic areas that fall under the mandate of WMO:

1. Quality Management Framework – Hydrology (QMF–H);
2. Data Operations and Management;
3. Water Resources Assessment;
4. Hydrological Forecasting and Prediction;
5. Water, Climate and Risk Management.

The activities under each thematic area include those recommended by the previous Advisory Working Group, together with those added by the session. The contribution of the outcomes within each thematic area to the WMO expected results is also highlighted.

Thematic Area 1: Quality Management Framework – Hydrology (QMF–H)

List of activities

(a) Continue implemention of the project to assess the performance of flow measurement instruments and techniques against WMO standards, commenced during the previous intersessional period;
(b) Compile, develop and disseminate guidance material on methods for evaluating the uncertainty associated with the measurement of hydrological variables;
(c) Provide background material to National Hydrological Services (NHSs) explaining why they should use standardized methods in their data collection;
(d) Facilitate the development of policies, frameworks and information sources to promote standardization of and guidance on the most suitable equipment and technologies in order to achieve high levels of reliability, user training effectiveness and other economies of scale;

(e) Coordinate a review of standards used in hydrology and water resources, issued by the International Organization for Standardization (ISO) and other entities, and specify what the joint ISO/WMO standards will be, and how they will be established;
(f) Monitor and report on new technologies in hydrology and water resources and make recommendations for future actions in this regard;
(g) Review material for the *Technical Regulations* (WMO-No. 49);
(h) Coordinate and promote the provision of guidance to NHSs for implementation of a Quality Management System (QMS), linked to the WMO Quality Management Framework (WMO-QMF), including case studies where possible;
(i) Review and revise relevant HWRP documents (with no QMF logo) from a QMF perspective in order to add basics of operational hydrology;
(j) Provide guidance material on the calculation of rating curves.

Expected outputs/outcomes – Contribution to Expected Result 3

(a) Additional guidance and information on the quality and performance of flow measurement instruments and techniques;
(b) Identification of hardware and, as appropriate, compilation of software to support the requirements of NHSs in hydrometry, including discharge measurement and estimation;
(c) Additional guidance material for NHSs in the areas of Quality Management, uncertainty analysis, standardized methods and rating curves;
(d) Guidance on the development and adoption of joint ISO/WMO standards for hydrological purposes;
(e) Up-to-date technical regulations (*Technical Regulations*, Vol. III: Hydrology (WMO-No.49)) that are relevant to the roles and responsibilities of Members.

Thematic Area 2: Data Operations and Management

List of activities

(a) Guide the implementation of Resolution 3 (CHy-14) – Proposed adoption of WaterML 2.0 as a standard;
(b) Monitor and report on new developments dealing with data management issues, such as observations, data exchange and protocols, data transfer formats, data information, the WMO Information System (WIS) and the WMO Integrated Global Observing System (WIGOS);
(c) Review progress in the exchange of hydrological data and products and, if required, propose additional guidance to data suppliers on data that should be exchanged, including harmonization of exchange practices and protocols for the provision of feedback on data use, suitability and benefits;
(d) Provide guidance, advice and training with regard to the spatial estimation of rainfall and other hydrological parameters, including the use of remote sensing devices such as radars and satellites.

Expected outputs/outcomes – Contribution to Expected Results 3 and 4

(a) Internationally agreed standards, formats and protocols for the transfer of hydrological data and information;
(b) Increased exchange of hydrological and related data at national, regional and international levels;
(c) Guidance on improved methods of estimation of areal precipitation and other related hydrological variables.

Thematic Area 3: Water Resources Assessment (WRA)

List of activities

(a) Finalize the Manual on Water Resources Assessment (surface and groundwater) including assessment of water availability and use, and of water resources for water-scarce regions;
(b) Compile and document guidelines on optimization, such as geospatial techniques as applied to hydrological networks (surface water, groundwater, soil moisture, etc.);
(c) Develop approaches for continuous tracking of current water resources availability using appropriate information technology;
(d) Monitor and report on methodologies for the calculation of design discharge (including probable maximum flood) for hydraulic structures, taking into consideration climate variability and change, and make recommendations for future actions in this regard;
(e) Consider producing guidance material to determine adequate ranges of environmental flows that will maintain or achieve good ecological status in all water bodies, along with guidelines on the formulation of related policies for water ecosystem management;
(f) Review and provide advice on how the Commission could contribute to the topic of water sharing/allocation, specifying the advantages and disadvantages of the different approaches and, importantly, in what conditions/environments they may be more widely useful;
(g) Undertake an investigation of modelling approaches to the characterization and prediction of water availability and use.

Expected outputs/outcomes – Contribution to Expected Result 3

(a) Manual on Water Resources Assessment;
(b) National Meteorological and Hydrological Services (NMHSs) provided with tools and techniques for the optimization of their hydrological data collection and related networks;
(c) Tools and techniques for continuous tracking of current water resources availability;
(d) Revised guidance material on determining design floods, including flood frequency analysis;
(e) A comprehensive report on environmental flows (e-flows) including case studies;
(f) Improved guidance and advice on drought monitoring and management, and design information for hydrological purposes;
(g) Guidance on approaches to water sharing/allocation;
(h) Guidance on the methods for and benefits of prediction of water availability and use.

Thematic Area 4: Hydrological Forecasting and Prediction

List of activities

(a) Continue to provide guidance on the further implementation of the flood forecasting initiatives, including the Flash Flood Guidance System (FFGS) with global coverage, the Coastal Flood Inundation Demonstration Project (CFIDP) and the Severe Weather Forecasting Demonstration Project (SWFDP);
(b) Review and, if required, update approaches to urban flood forecasting and early warning;
(c) Prepare a comprehensive report on large-scale flood inundation analysis and prediction models;
(d) Assist in the preparation of a Manual on Flood Risk Mapping (including vulnerability and hazard);

(e) Assist in the promotion and application of the Manual on Low-flow Estimation and Prediction (WMO-No. 1029) and the Manual on Flood Forecasting and Warning (WMO-No.1072), and in related training;
(f) Compile and provide guidance material on streamflow forecasting, including application of ensemble methods, using hydrological modelling linked to numerical weather prediction, radar rainfall nowcasting products and satellite-based estimates of precipitation;
(g) Compile case studies and provide guidance on extended hydrological prediction for water resources management, including information on related climate drivers;
(h) Promote and assist in the use of the distance-learning and advanced training module on flood forecasting and hydrological prediction;
(i) Identify good practices and make recommendations for ways forward in drought prediction;
(j) Collect examples of good practice in the dissemination of flood and drought information to the public, and compile and provide guidance on flood and low-flow warning signal approaches;
(k) Identify good practices and make recommendations for ways forward in hydrological aspects of debris flow forecasting.

Expected outputs/outcomes – Contribution to Expected Results 3 and 7

(a) Availability of new techniques and better assimilation of available data into hydrological models to support improved flood forecasting capabilities;
(b) Assistance to, and guidance in, disaster mitigation and risk management in support of the role and responsibilities of NMHSs;
(c) Guidance and case studies on the application of extended hydrological prediction capabilities;
(d) Improved guidance on how to deal with floods and droughts at the national and regional levels, including information dissemination;
(e) Improved guidance in forecasting droughts at the regional, national and local levels;
(f) Increased cooperation and coordination with other relevant groups and agencies, which will increase the effectiveness of CHy activities.

Thematic Area 5: Water, Climate and Risk Management

List of activities

(a) Assist in the implementation of water-related initiatives within the Global Framework for Climate Services (see Resolution 1 (CHy-14) – Contribution of the Commission for Hydrology to the Global Framework for Climate Services), liaising as appropriate with the Joint CCl/CAgM/CHy Expert Group on Climate, Food and Water (JCEG-CFW), the Executive Council Working Group on Climate and related Weather, Water and Environmental Matters (EC-WG-CWE) and beyond WMO;
(b) Prepare guidance material on how to use regional climate modelling (i.e. long-term climate scenarios) in strategic hydrological management;
(c) Prepare a comprehensive report on downscaling approaches for hydrological applications and their associated uncertainties, including commenting on existing case studies;
(d) Prepare a state-of-the-art report/bibliography on hydrological analysis and modelling approaches in data-sparse conditions;
(e) Compile guidance material and detailed procedures on essential steps in the analysis of vulnerability to water-related impacts, especially in relation to adaptation to climate variability and change;
(f) Provide advice and guidance on the availability of climate data and climate model results for undertaking impact studies in support of adaptation to climate variability and change.

Expected outputs/outcomes – Contribution to Expected Result 3

(a) Improved information on both the water sector contribution to and requirements from the Global Framework on Climate Services;
(b) Guidance material on the use of regional climate modelling and thus improved strategic hydrological management;
(c) Increased knowledge and guidance on the approaches used in downscaling and the implications for hydrological modelling;
(d) Guidance material that will enable improved water resources management in vulnerable situations.

Cross-cutting issues

The following cross-cutting issues will be taken into account in the development of the Work Programme and in the implementation of the Programme activities:

(a) Methods for data-sparse areas

Methodologies that will be applicable in data-sparse area must be identified and included under many of the thematic areas, for example, water resources assessment, flood forecasting, seasonal flow forecasting, etc.

(b) World Hydrological Observing System (WHYCOS)

WHYCOS addresses cross-cutting topics as all of its projects cover activities related to data collection and transmission; development of information systems that provide specific services, products and knowledge on water resources assessment; hydrological forecasting; flood management and integrated water resources management. Activities under each of the thematic areas assist in general in the development of material in support of the WHYCOS projects. They form the main vehicle for both human and infrastructure capacity-development in NHSs.

(c) Capacity-building

Capacity-building is a key expected result of all activities in the CHy Work Programme, for this reason all activities would contribute to capacity-building initiatives across all thematic areas.

(d) Modelling

The requirement for modelling is implicit in all thematic areas. AWG members should consider the advantages and disadvantages of modelling approaches in their area of application. This should include not only consideration of what hydrological modelling can do for hydrologists directly, and for end-users, but also the value of feedback to atmospheric and other relevant types of modelling.

(e) Communication of uncertainty

Uncertainty is also a cross-cutting issue and AWG members should, where possible, take into consideration methods of determining and communicating uncertainty in their respective activities.

(f) Communication mechanisms

In all thematic areas, data reporting, sharing and dissemination in a timely manner is of great importance. In this regard, the use of appropriate information technology should be considered.

(g) Regional Associations

The activities of Regional Associations, and in particular the Regional Association Working Groups on Hydrology, or their equivalent, should be coordinated within the overall thematic area activities

and effective communication should be maintained between the thematic areas and the working groups, as appropriate.

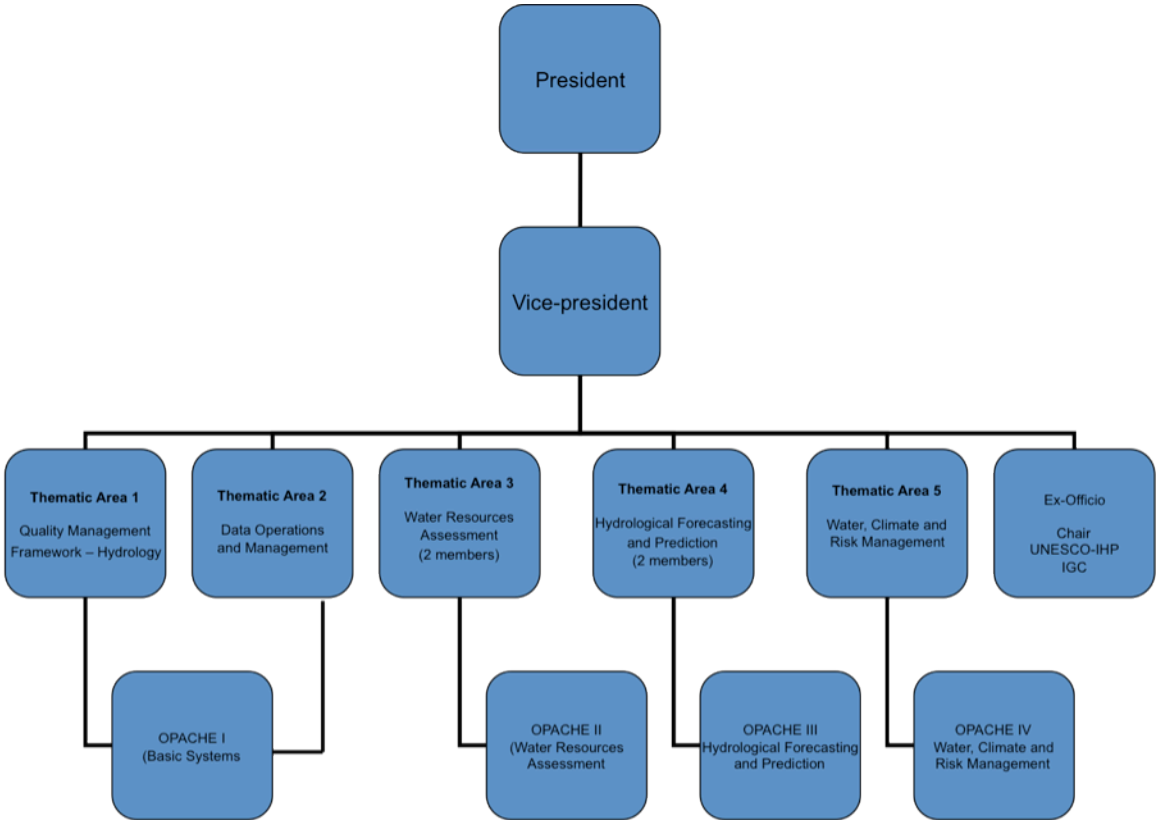
Annex 2 to Resolution 7 (CHy-14)

STRUCTURE OF THE COMMISSION FOR HYDROLOGY AND TERMS OF REFERENCE OF THE ADVISORY WORKING GROUP MEMBERS

The Advisory Working Group (AWG) will consist of the following:

1. President: Mr Harry Lins)
2. Vice-president: Mr Zhiyu Liu
3. Thematic Area 1: Mr Paul Pilon
4. Thematic Area 2: Mr Tony Boston
5. Thematic Area 3: 2 members, Mr Antonio Cardoso Neto and Mr Sung Kim
6. Thematic Area 4: 2 members, Mr Johnson Muturi Maina and Mr Yuri Simonov
7. Thematic Area 5: Mr Jan Danhelka
8. Chair of the Intergovernmental Council of the International Hydrological Programme of UNESCO (ex-officio member): Mr Johannes Cullman

ORGANIGRAM



The members of the AWG responsible for a particular thematic area would carry out their activities with support from the relevant Open Panel of CHy Experts (OPACHEs) established by the Commission at its thirteenth session. It is proposed that the OPACHE on Basic Systems support the activities of Thematic Areas 1 and 2, namely Quality Management Framework – Hydrology and Data Operations and Management. The OPACHES for the other three thematic areas would remain unchanged. The Commission urged interested members to join the OPACHEs and support the Programme of Work.

TERMS OF REFERENCE

While developing the activities, it should be ensured that the cross-cutting issues, that is, methods for data-sparse areas, need and outreach of the World Hydrological Cycle Observing System (WHYCOS) and capacity-building requirements, modelling, communication of uncertainty, communication technology, and cooperation with Regional Associations will be taken into account.

President of the Commission for Hydrology

Terms of reference

(a) To undertake the duties required of a president of a WMO technical commission in accordance with WMO General Regulation 186;
(b) To chair meetings, as required, within the above duties including, for example, the CHy AWG and the WHYCOS International Advisory Group (WIAG);
(c) To represent CHy within WMO, in cooperation with other United Nations agencies, especially UNESCO, and at a range of other meetings, workshops and conferences;
(d) To coordinate the CHy activities for implementation of the GFCS, or to delegate an AWG member responsible for this coordination (Resolution 1 (CHy-14) – Contribution of the Commission to the Global Framework for Climate Services);
(e) To promote recognition and increase awareness of the role of WMO in international cooperation in the field of hydrology and water resources;
(f) To ensure that the activities of Regional Associations, and in particular the Regional Association Working Groups on Hydrology, are coordinated with the overall activities of the Commission and that effective communication is maintained between the Commission and the working groups;
(g) To ensure that joint activities with the other technical commissions (TCs) are coordinated to the satisfaction of CHy and that there is effective communication between the Commission and the other TCs;
(h) To monitor changes in the operation and management of National Meteorological and Hydrological Services (NMHSs), including product delivery and public awareness in the field of hydrology and water resources.

Vice-president of the Commission for Hydrology

Terms of reference

(a) To assist the president of the Commission in the light of his terms of reference, as and when requested;
(b) To assist the AWG in fulfilling its duties in relation to the Hydrological Operational Multipurpose System (HOMS), in agreement with the new approach described in paragraph 11.17 of the general summary;
(c) To coordinate the editing and production of publications prepared on behalf of CHy;
(d) To identify and lead actions with regard to the education and training requirements of Commission activities under the adopted Strategy on Education and Training in Hydrology and Water Resources and the Quality Management Framework–Hydrology;
(e) To monitor and report on the updating of the Hydrological Information Referral Service (INFOHYDRO);

(f) To promote data rescue and protection activities in NMHSs;
(g) To support the development and promotion of guidance material on the estimation of the economic benefits of NMHSs.

Member leading activities associated with Thematic Area 1:

Quality Management Framework – Hydrology (QMF–H)

Terms of reference

(a) To lead, monitor, report and provide advice on the activities of Thematic Area 1, as indicated in the Work Programme (Annex 1 to Resolution 7 (CHy-14) – Work programme and structure of the Commission for Hydrology);
(b) To liaise, as necessary, with relevant bodies of WMO, such as the Commission for Aeronautical Meteorology and groups working on WMO and related quality management frameworks and systems, the International Organization for Standardization (ISO) and other United Nations agencies, with regard to quality management;
(c) To develop and implement capacity-building initiatives based on the activities undertaken within Thematic Area 1;
(d) To report on activities at each AWG meeting and as requested by the president of CHy.

Note: While developing the activities, it should be ensured that cross-cutting issues are taken into account.

Member leading activities associated with Thematic Area 2:

Data Operations and Management

Terms of reference

(a) To lead, monitor, report and provide advice on the activities of Thematic Area 2, as indicated in the Work Programme (Annex 1 to Resolution 7 (CHy-14));
(b) To provide a focal point and liaise, as necessary, with relevant areas of WMO such as WHYCOS, the WMO Integrated Global Observing System (WIGOS) and the WMO Information System (WIS); the Open Geospatial Consortium (OGC) and the Global Terrestrial Network – Hydrology (GTN-H);
(c) To represent the Commission for Hydrology on the WIAG and the Steering Committee of the Global Runoff Data Centre (GRDC);
(d) To assist in the activities of the Global Precipitation Climatology Centre (GPCC), the International Data Centre on the Hydrology of Lakes and Reservoirs (HYDROLARE) and the International Groundwater Resources Assessment Centre (IGRAC);
(e) To develop and implement capacity-building initiatives based on the activities undertaken within Thematic Area 2;
(f) To report on activities at each AWG meeting and as requested by the president of CHy.

Note: While developing the activities, it should be ensured that cross-cutting issues are taken into account.

Members (2) leading activities associated with Thematic Area 3:

Water Resources Assessment (the terms of references will be distributed between the 2 members at the first AWG meeting)

Terms of reference

(a) To lead, monitor, report and provide advice on the activities of Thematic Area 3, as indicated in the Work Programme (Annex 1 to Resolution 7 (CHy-14));
(b) To liaise, as necessary, with relevant areas of WMO, United Nations agencies such as the United Nations Educational, Scientific and Cultural Organization (UNESCO), the Food and Agriculture Organization (FAO) and the United Nations Environment Programme (UNEP), and other relevant groups with regard to water resources assessment activities;
(c) To be the focal point for the Commissions's involvement in Integrated Drought Management;
(d) To develop and implement capacity-building initiatives based on the activities undertaken within Thematic Area 3;
(e) To report on activities at each AWG meeting and as requested by the president of CHy.

Note: While developing the activities, it should be ensured that cross-cutting issues are taken into account.

Members (2) leading activities associated with Thematic Area 4:

Hydrological Forecasting and Prediction (the terms of reference will be distributed between the 2 members at the first AWG meeting)

Terms of reference

(a) To co-lead, monitor, report and provide advice on the activities of Thematic Area 4, as indicated in the Work Programme (Annex 1 to Resolution 7 (CHy-14));
(b) To liaise, as necessary, with relevant structures of WMO, in particular the Disaster Risk Reduction Programme, the Commission for Atmospheric Sciences and the Commission for Basic Systems with regard to the WMO Flood Forecasting Initiative, and with other programmes and organizations such as the UNESCO Institute for Water Education (UNESCO-IHE), the International Flood Initiative (IFI), and the International Centre for Water Hazard and Risk Management (ICHARM) with regard to hydrological forecasting and prediction and disaster risk reduction activities;
(c) To represent CHy on the Advisory Group for the WMO Flood Forecasting Initiative;
(d) To develop and implement capacity-building initiatives based on the activities undertaken within Thematic Area 4;
(e) To report on activities at each AWG meeting and as requested by the president of CHy.

Note: While developing the activities, it should be ensured that cross-cutting issues are taken into account.

Member leading activities associated with Thematic Area 5:

Water, Climate and Risk Management

Terms of reference

(a) To lead, monitor, report and provide advice on the activities of Thematic Area 5, as indicated in the Work Programme (Annex 1 to Resolution 7 (CHy-14));
(b) To liaise, as necessary, with relevant structures of WMO, for example, the Global Framework for Climate Services (GFCS) and the Commission for Climatology (CCl), and with other organizations and programmes such as the UNESCO International Hydrological Programme (IHP), UNEP, the International Association for Hydro-Environment Engineering and Research (IAHR) and the International Association of Hydrological Sciences (IAHS) with regard to climate and water activities;

(c) To represent CHy, as determined by the president of CHy, in groups concerned with water, climate and risk management such as GFCS-related and inter-commission groups;
(d) To develop and implement capacity-building initiatives based on the activities undertaken within Thematic Area 5;
(e) To report on activities at each AWG meeting and as requested by the president of CHy.

Note: While developing the activities, it should be ensured that cross-cutting issues are taken into account.

Resolution 8 (CHy-14)

REVIEW OF PREVIOUS RESOLUTIONS AND RECOMMENDATIONS OF THE COMMISSION FOR HYDROLOGY

THE COMMISSION FOR HYDROLOGY,

Considering:

(1) That the resolutions adopted prior to its thirteenth session are no longer in force,

(2) That Resolution 7 (CHy-XIII) – Work programme and structure of the Commission for Hydrology, and Resolution 8 (CHy-XIII) – Review of previous resolutions and recommendations of the Commission for Hydrology are now obsolete;

Noting the action taken on the recommendations adopted prior to its fourteenth session;

Decides:

(1) To keep in force Resolution 1 (CHy-XIII) – WMO Quality Management Framework – Hydrology, with the changes to the Annexes adopted by the fourteenth session of the Commission, Resolution 3 (CHy-XIII) — Hydrological forecasting and flood management, and Resolution 6 (CHy-XIII) – WMO Integrated Global Observing Systems and WMO Information System, and not to keep in force any of the other resolutions of its prior sessions;

(2) To note with satisfaction the action taken by the competent bodies on the recommendations of its prior sessions, and to keep in force Recommendation 2 (CHy-IX) – Support to global data centres, Recommendations 1 (CHy-X) – Hydrological networks and 2 (CHy-X) – Participation of women in the work of the Commission (except the text under REQUESTS of Recommendation 2), all other recommendations now being redundant.

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Note: This resolution replaces Resolution 8 (CHy-XIII), which is no longer in force.

RECOMMENDATION ADOPTED BY THE SESSION

Recommendation 1 (CHy-14)

REVIEW OF THE RESOLUTIONS OF THE EXECUTIVE COUNCIL BASED ON PREVIOUS RECOMMENDATIONS OF THE COMMISSION FOR HYDROLOGY

THE COMMISSION FOR HYDROLOGY,

Noting with satisfaction the action taken by the Executive Council on previous recommendations of the Commission for Hydrology addressed to it,

Considering that some of these recommendations still bear significance for future activities, while other have become redundant,

Recommends:

(1) That Resolution 5 (EC-LXI) – Report of the Thirteenth Session of the Commission for Hydrology, be no longer considered necessary,

(2) That Resolution 5 (EC-LVII) – Participation of WMO in the International Flood Initiative, be kept in force.

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Note: This Recommendation replaces Recommendation 2 (CHy-XIII), which is no longer in force.

ANNEXES

ANNEX I

Annex to paragraph 3.1 of the general summary

REPORT OF THE PRESIDENT OF CHy

Introduction

1. It is my pleasure and honour as acting president of the Commission for Hydrology to present to you this report containing the results of the work of the Commission from November 2008 to November 2012. At the thirteenth session of the Commission held in Geneva, Mr Bruce Stewart was elected as the president of the Commission with me as the vice-president. In December 2010, Mr Bruce Stewart resigned as president of the Commission to take up an appointment in the WMO Secretariat. By WMO regulations, I then became the acting president of the Commission. Thus the results of our work recorded in this report were achieved partly under the watch of Mr Bruce Stewart and partly under my watch. With my assumption of the position of acting president it became necessary to elect a new vice-president for the remainder of the intersessional period. Again by WMO regulations, voting by correspondence was conducted twice by the WMO Secretariat for the election of a new vice-president. Regrettably, both ballots did not attain the required quorum to validate the voting. It therefore became necessary to combine the functions and activities of the acting president and the vice-president for execution with the support of the Secretariat in the period running up to this session. We therefore now have the opportunity at this session to fill the full complement of positions of officers of the Commission.

2. This report is in three parts. Firstly, it will cover the Commissions' response and contributions to WMO's role and activities on key issues at country, sub-regional, regional and global levels through the decision-making bodies and mechanisms within WMO such as Congress, the Executive Council and the Meetings of Presidents of Technical Commissions. Secondly, it will cover the Commission's future direction, work and activities. Thirdly, it will address emerging challenges that affect global water resources issues and how CHy and WMO should respond to these challenges. Other aspects of the Commission's works carried out within WMO will be addressed in the report of the Secretariat.

Background

3. Since the fifteenth session of Congress (and the thirteenth session of CHy), WMO in fulfilling its role, has organized its programmes and activities based on a WMO Strategic Plan (SP) and a WMO Strategic Operating Plan (SOP). The SP can be found at: http://www.wmo.int/pages/about/documents/1069_en.pdf

4. The Operating Plan is at http://www.wmo.int/pages/about/documents/WMO_OP_2011_en.pdf

5. The Commission in turn organized its activities according to four Thematic Areas and one specific topic, in order to align its work plan with the WMO Strategic Plan.

6. The four thematic areas were:

- Quality Management Framework – Hydrology (QMF-H);
- Water Resources Assessment;
- Hydrological Forecasting and Prediction; and
- Water, Climate and Risk Management; and the specific topic:

- WMO Integrated Global Observing System (WIGOS) and WMO Information System (WIS) (including the World Hydrological Observing System (WHYCOS) and Global Hydrology Issues).

7. Activities in these thematic areas were led by six Advisory Working Group members and supported by four Open Panel of CHy Experts (OPACHES). The reports of the lead the Advisory Working Group (AWG) members on their activities are presented in CHy-14/INF 4.

WMO Congress and Executive Councils

8. Details of the decisions of Congress and the Executive Council of relevance to the Hydrology and Water Resources Programme are addressed under agenda item 4.

Meetings of Presidents of Technical Commissions

9. The work of the presidents of technical commissions dealt mainly with inter-commission issues and cross-cutting activities and, among others, took the following decisions:

- The Commission for Hydrology should continue its work on the estimation and expression of uncertainty within its existing activity and that the president of CHy will provide feedback on progress through the normal WMO reporting mechanisms;

- The presidents of technical commissions will each prepare a short paper (1-2 pages) on the approaches that their Commissions are applying to the expression of uncertainty (noting other relevant material, e.g. IPCC guidance) as a basis for further discussion on this topic at PTC-2013. During the discussion, the Secretariat will present the Intergovernmental Panel on Climate Change (IPCC) guidance.

Cooperation with the United Nations Educational, Scientific and Cultural Organization (UNESCO), other water-related UN bodies and other international scientific organizations

10. Cooperation with UNESCO continues to be strong and complementary. The coordinating role of the UNESCO/WMO Liaison Committee has served the interests of the two organizations well. The need has however been felt to update the existing agreement between the two organizations and is currently being reviewed. A significant outcome of this cooperation is the soon to be published revised edition of the Joint WMO/UNESCO International Glossary of Hydrology.

11. Through UN-Water, which is currently chaired by the Secretary-General of WMO, the activities of UN agencies with an interest in water have been efficiently coordinated. WMO is playing a leading role in coordinating the Water and Climate Change Thematic Priority Area of UN-Water; actively participating in UN-Water/Africa activities; cooperating with the African Ministers' Council on Water (AMCOW) and the African Development Bank, culminating in the launching of the African Water Facility that provides financial support for hydrological activities in Member countries.

12. CHy has continued to cooperate with the International Association of Hydrological Sciences (IAHS), the International Association of Hydro-Environment Engineering (IAHR), the Global Water Partnership (GWP), the International Commission on Irrigation and Drainage (ICID) and increasingly with the International Organization for Standardization (ISO) and other intergovernmental and non-governmental organizations as a means of pursuing the objectives of the Hydrology and Water Resources Programme (HWRP), as well as meeting the needs of climate services to the water sector.

Performance of the AWG and OPACHEs during the intersessional period

13. The overall performance of the AWG and the OPACHEs has been more than satisfactory. With the support of the Secretariat, the AWG has functioned effectively with members rising up to their responsibilities when called upon. In the course of the intersessional period it became necessary to co-opt another expert as a member to support the work of the Hydrological Forecasting and Applications Thematic Area.

14. It must however be emphasized that the role of the AWG members is to lead or co-lead activities that fall within their thematic areas. While acknowledging their leadership roles it must be recognized that the bulk of the actual work was carried out with the contributions of members of the OPACHEs and other colleague experts roped in by AWG members and the Secretariat, to whom I am very grateful.

15. The achievements of the Commission, as evidenced in the reports of the AWG members and the Secretariat's report, are very encouraging, bearing in mind that the execution of the work of the Commission has been driven mostly by the spirit of volunteerism. Overall, the concept and approach of using OPACHEs in the work of the Commission has proved successful and needs to be continued. The structure and organization of the work of the Commission through the AWG, Thematic Areas and the OPACHEs, has so far proved successful.

16. There is however no guarantee that we will continue to enjoy such a success rate by adopting a business-as-usual approach. To start with, we need to sustain and renew the concept of OPACHEs by engaging more with the experts in the OPACHEs and recognizing their contribution, through, among others, letters of commendation signed by an appropriately high official of WMO. Secondly, we need to consider the idea of identifying and engaging with institutions with specialization in specific areas of Hydrology and Water Resources that we designate as collaborating institutions through a Memorandum of Understanding along the lines of the Global Runoff Data Centre (GRDC). Thirdly, an increasing number of experts are retiring, but in excellent health, who may be willing to contribute some of their time and expertise to the work of CHy and to the benefit of Member countries through appropriate arrangements. This corps of experts will be particularly useful in capacity development activities such as development of manuals and offering hands-on training to young hydrologists.

Future Direction of CHy

17. In planning the future direction, work and activities of CHy, the AWG retained the four of the five thematic areas from the previous intersessional period and replaced one with a thematic area on data operations and management. Thus, the thematic areas for the intersessional period 2012–2016 are:

- Quality Management Framework – Hydrology (QMF-H);
- Water Resources Assessment;
- Hydrological Forecasting and Prediction;
- Water, Climate and Risk Management; and
- Data Operations and Management.

18. Apart from the detailed work plans that will be developed for each thematic area, I wish to express my own thoughts on issues that the Commission may wish to consider for the next intersessional period and beyond.

On Quality Management Framework – Hydrology

19. The present Quality Management Framework-Hydrology (QMF-H), though useful, is inadequate to meet the quality management needs of the National Hydrological Services (NHSs). The existing quality management framework guiding NHSs consists of a set of technical guidance documents and materials of WMO such as technical regulations, manuals, guides, guidelines and technical reports. It thus fails to address the Quality Management System (QMS) needs of NHSs. CHy now has to provide guidance to enable each NHS to adopt, implement and mainstream an appropriate QMS suitable to its setting and circumstances, while ensuring that its operations conform to recommended practice. Mainstreaming QMS into operations of NHSs will enable NHSs to improve on their service delivery to meet user requirements in terms of quantity, quality, accuracy and timeliness.

On Water Resources Assessment

20. Water management decisions will continue to be based on reliable and accurate data, information and hydrological services. Despite the importance of accurate and reliable data in making water resources decisions, the networks and means of collecting such data and information has been on the decline for decades in many countries, particularly in developing, and least developed countries, as well as in countries that have in the recent past experienced the trauma of civil strife and severe natural disasters. It is therefore imperative that Member countries should provide the resources to enable NHSs to restore hydrological networks to collect and transmit, in real or near-real time, both in-situ and remotely sensed data for water resources management and decisions. The target should be that networks in Member countries should meet the minimum recommended guidelines of WMO for network density. With improved data availability, water resources assessment should go beyond providing information about the quantity and quality of the resources in time and space to value-addition to such data and information by developing hydrological products, tools and decision support systems for decision making.

On Hydrological Forecasting and Prediction

21. Hydrometeorological disasters, arising from floods and droughts in the past decades have become more frequent and devastating in terms of lives lost, damage to property and infrastructure, and economic loss. The role of the Commission in contributing to the solutions to these disasters is to provide more accurate and reliable forecasts, prediction and warnings with reasonable lead times and outlooks for decision making and disaster preparedness. Improved forecasts and predictions call for more collaboration between hydrologists and meteorologists and increased utilization of integrated data. Also, NHSs need to make use of new technologies, tools and products that have become available to improve outputs of models, predictions and forecasting. Among the cutting edge technologies and tools available for improved hydrological modeling and forecasting are the use of radar and satellite-based rainfall estimation, quantitative precipitation forecasts and numerical weather prediction.

22. Combining such technologies and tools with the significant advances in spatial modeling technologies such as digital elevation models and Geographical Information System (GIS) tools have a great potential to improve significantly the accuracy of the outputs of hydrological models. Such improved modeling techniques will deliver high quality products, advisories and decision support systems such as flood forecasts and warnings, flood plain and inundation maps, flow forecasts for reservoir operation, drought predictions, seasonal forecasts and outlooks for water resources management, among others. Effective use of these tools requires close collaboration with meteorologists.

On Water, Climate and Risk Management

23. There is a strong link between climate and water. Climate is the major driver of water resources availability, the others being land use and anthropogenic factors. Climate variability and change pose both a threat and a challenge to society. Climate variability in a changing world is a challenge that hydrologists need to address, possibly through revision of certain hydrological tools and assumptions, such as *stationarity* in hydrological data sets, to address this challenge. To do this the hydrological community needs to connect better with the climate community to better understand the state of the science and the implications of climate predictions and projections for the future for water resources. This will enable the hydrological community to better assess the risks associated with water resources availability in a varying and changing climate. To enable the hydrological community to apply this knowledge, CHy will need to develop guidance on how to incorporate into hydrology probabilistic inputs from meteorology and climatology.

On Data Operations and Management

24. We need to focus on the infrastructure and the means of collecting, transmitting, processing and disseminating of hydrological data. The infrastructure and means for hydrological data collection need to be augmented by acquisition and installation of new available cost-effective, more accurate technologies and instrumentation such as divers, data loggers and radar water level sensors for water level measurements; Acoustic Doppler Current Profilers (ADCP) for current measurements; and satellite-based observations for soil moisture, rainfall, snow and cryosphere variables, and altimetry with resolutions of 5cm or better. Satellite-based observations hold great promise for remote and data-sparse locations,

25. In the case of physiographic data collection, upgrading from surveying leveling instruments to Total Station Surveying instruments and Global Positioning Systems (GPS) greatly facilitate physiographic data collection with higher accuracy and efficiency.

26. Apart from data transmission via telemetry and satellite, the availability and increasing coverage of mobile telephony technology offers an alternative cost-effective data transmission in real and near-real time especially for developing and least developed countries. CHy should promote data exchange more vigorously for the common good. To facilitate data exchange we need to agree and adopt a common data exchange format or protocol with other data providers and users.

27. The use of new technologies, however, imposes on us the responsibility to ensure accurate measurements through verification and “ground thruthing” of measurements and observations. Also required of us is ensuring that uncertainty analyses are carried out for outputs from new instrumentation, technologies, methods and applied in making use of data and outputs from such new tools. The uncertainty analyses should encompass meteorological and climate data and products used in hydrological models.

CHy and Emerging Challenges in Hydrology and Water Resources

28. The issues of water stress, scarcity and uneven distribution in time and space are still with us. Superimposed on these are increasing populations, increasing water demand (particularly for potable water and agriculture) and uncertainties of climate change. This calls for better water resources management practices. It is well established that the starting point of any sound management of a resource is the measurement, quantification and assessment of the resource. In terms of freshwater resources, WMO through its Members and their National Meteorological and Hydrological Services (NMHSs) are in the forefront of water measurement and therefore a vital primary contributor to water resources management. The contribution of groundwater to freshwater resources availability is enormous. This important contribution to freshwater resources is however a lesser priority in the operations of most NMHSs. CHy should promote the monitoring and assessment of groundwater by encouraging NMHSs (where another agency is responsible for

monitoring groundwater) to forge relationships with agencies that monitor and assess groundwater resources to enable a total assessment of water resources in basins and aquifers at the country level and eventual integration to the regional level. At the WMO level, CHy should endeavor to improve the rather weak cooperation and collaboration with the International Groundwater Resources Assessment Centre (IGRAC).

29. The effects of increasing population on freshwater resources manifest through rapid urbanization that aggravates urban flooding, emergence of slums with poor sanitation and waste management facilities that compromise freshwater bodies through pollution and a higher demand for potable water and sanitary facilities. An increase in population also results in a higher demand for water for food production and animal husbandry. Increased food production invariably through cultivation of large tracts of arable lands and use of fertilizers results in sedimentation and pollution of water bodies and rivers.

30. The uncertainties of climate variability and change make prediction and forecasts of extreme events such as floods and droughts unreliable, further aggravating the effects of uneven distribution of water resources. Tackling these uncertainties of climate change requires improved and better prediction and forecasting models and tools supported with accurate and reliable data and effective collaboration between meteorologists and hydrologists that has been constantly promoted by WMO.

31. A significant contribution to finding solutions to these challenges in water resources issues is the monitoring, measurement and assessment of water resources. WMO is very well placed to provide this vital contribution to the solutions through CHy and the NMHSs. NMHSs need to build their technical and management capacities for improved observations and data collection through upgrading hydrological networks and adopting new technologies and instruments that give more accurate observations and measurements in rainfall, water quantity and water quality, including sediments. Beyond collecting accurate and reliable data, WMO and the NMHSs have a wealth of experience and capability for modeling, development of products, tools and making predictions and forecasts for decision making to provide solutions to these emerging challenges. The challenges of climate change, increasing populations and increasing water demand for agriculture, potable water, sanitation and extreme events could partly be addressed by construction of dams and impoundments to harness and manage water resources to meet different needs. The construction of effective structures for these needs depends on accurate and reliable data, their analyses, models, products and tools for the design and effective operation of the structures.

32. The initiative of the Global Framework for Climate Services (GFCS) is a valuable contribution to providing solutions to the climate-related water challenges identified above and many more other climate-related challenges. The provision of effective climate services requires more access to, and availability of, integrated data. This calls for countries to regard water data as a commodity of universal commons to be exchanged freely for the benefit of mankind. CHy should champion the free access to and exchange of hydrological data and products and be actively involved in identifying and providing the water-related climate services within the GFCS.

33. Finally, WMO needs to continue and even play a bigger role in UN-Water and other global initiatives to ensure better harnessing and management of water resources for sustainable development and natural ecosystems for the present generation. Furthermore, WMO should exercise an even greater responsibility of ensuring inter-generational equity in water resources availability by bequeathing to the next and subsequent generations water resources in sufficient quantity and quality to sustain life on this planet.

ANNEX II

Annex to paragraph 3.3 of the general summary

REPORT OF THE SECRETARY-GENERAL

1. The present document contains a brief report of the activities undertaken in the last intersessional period (2009-2012) under the framework of the Hydrology and Water Resources Programme, which Cg-XVI had adopted as per Resolution 12 (Cg-XVI) and the programme description given in Annex I.

2. Detailed discussions of various topics were held under relevant agenda items of the session.

BASIC SYSTEMS IN HYDROLOGY

Quality Management Framework – Hydrology

3. Congress, through Resolution 13 (Cg-XVI) decided to establish a Quality Management Framework – Hydrology (QMF-H), within the overall WMO QMF, covering hydrological observations as well as hydrological products and services in accordance with the recommendation of CHy-XIII. The Quality Management Framework-Hydrology (QMF-H) is aimed at ensuring that all of the activities necessary to design, develop and deliver a hydrological product or service are conducted efficiently and effectively and are based on established science and best practice.

4. During the intersessional period, the following publications were issued according to the new peer review process approved during CHy-XIII:

Guide to Hydrological Practices

- 6th edition in English and Spanish. French and Russian to be issued in 2013.

Manuals on hydrology and water resources

- 2nd edition of the Manual on Stream Gauging;
- Manual on Low Flow Estimation and Prediction;
- Manual on Estimation of Probable Maximum Precipitation (PMP);
- Manual on Flood Forecasting and Warning;
- 3rd edition of the UNESCO/WMO International Glossary of Hydrology.

Guidelines in hydrology and water resources

- Guidelines for the Assessment of Uncertainty of Hydrometric Measurements.

Technical reports

- Climate and Meteorological Information Requirements for Water Management;
- Water Quality Monitoring;
- Technical Material for Water Resources Assessment.

5. In addition, following the request of CHy-XIII, comprehensive training material has been developed and made available for the Manual on Stream Gauging and the Manual on Flood Forecasting and Warning, while it is being developed for the Manual on Low Flow Estimation and Prediction.

6. The Work Plan of the Project on the *Assessment of the Performance of Flow Measurement Equipment* established through Resolution 2 (CHy-XIII) continues to evolve, with the most up-to-date version being available on the working Website of the project: http://www.wmo.int/pages/prog/hwrp/Flow/flow_tech/index.php. The project currently comprises seven core project activities and its main outputs consist of the publication of the Guidelines for the assessment of uncertainty of hydrometric measurements, the report on the survey on field discharge measurement instrumentation and techniques used operationally, the development of a database of discharge techniques, as well as the progress achieved in the development of an Uncertainty Analysis Decision-Aid Tool (UADAT), the preparation of guidelines for conducting and reporting on the calibration and verification of the performance of discharge measurement instruments, and the initiation of work in preparing guidelines for the estimation of uncertainty analysis of discharge determination via various techniques. Detailed information on the different outputs can be found at the main project Website: http://www.wmo.int/pages/prog/hwrp/Flow/index.php

7. The project is being implemented through collaboration with the International Association of Hydraulic Engineering and Research (IAHR), the International Association of Hydrological Sciences (IAHS), the International Organization for Standardization (ISO), and the Association of Hydro-Meteorological Equipment Industry (HMEI). As decided at CHy-XIII, the Advisory Working Group (AWG) has assumed the role of Steering Committee of the project, providing general guidance to it, while representatives of the above organizations, together with a representative of the WMO Regional Working Groups on Hydrology (/RWGHs) and invited experts, under the chairmanship of the representative of CHy, constitute the Management Committee, responsible for the day-to-day implementation. The tenure of the current Management Committee ends at CHy-14 and, in order to continue with the smooth implementation of the project, if so decided by the Commission, the membership for the next intersessional period should be decided at the session or soon thereafter.

8. The cooperation with the International Organization for Standardization (ISO) in the field of hydrometry increased during the intersessional period, especially in the areas of water data transfer formats and Acoustic Doppler Current Profilers (ADCPs), and further cooperation in the future is envisaged. With input from WMO, ISO made improvements to standards ISO 772 Vocabulary and ISO 3455 Calibration of Current Meters.

9. The Commission had recommended in Resolution 6 (CHy-XIII) that the Global Runoff Data Centre (GRDC) should undertake the development of the metadata profile, in collaboration with interested parties, under the overall guidance of WIS/WMO Integrated Global Observing System (WIGOS) to form part of the WMO Core Profile of the International Organization for Standardization (ISO) Metadata Standard. In October 2012, GRDC submitted a summary document of the Hydrology Metadata, available as background document here, as basis for discussions at CHy-14. The document refers to ongoing work and will be further developed into the detailed description of the Hydrology Metadata concept.

10. During the last intersessional period, the Commission had contributed to the work of the joint WMO/Open Geospatial Consortium (OGC) Hydrology Domain Working Group, through its designated expert Ulrich Looser. In particular, this has led to the adoption of WaterML 2.0, (available here), as an OGC Standard and to progress in the development of a Hydrologic Feature Model (HY_Features) (discussion paper available here). WaterML 2.0, is an encoding standard for the representation of in-situ hydrological observations data. OGC WaterML 2.0 supports encoding of hydrological and hydrogeological observation data in a variety of exchange scenarios. Under agenda item 7 the Commission will discuss its role in the eventual adoption of WaterML 2.0 and HY-Features as WMO standards.

World Hydrological Cycle Observing System (WHYCOS)

11. Congress (Resolution 14 (Cg-XVI)) requested the Secretary-General to carry out an independent external evaluation of the World Hydrological Cycle Observing System (WHYCOS) programme as a follow-up to the first review conducted in 2005. In addition, Congress requested a review of the WHYCOS International Advisory Group (WIAG) mechanism to make it more responsive to the new challenges facing the WHYCOS programme. The 2011 WHYCOS Review was undertaken in late 2011 by Mr Pilon (Canada) and Mr Kidane (Ethiopia). Mr Pilon and/or Mr Kidane visited the Niger-HYCOS, the Mekong-HYCOS and the Carib-HYCOS as well as being briefed on other HYCOS Projects by the Secretariat. The recommendations from the review were considered by the ninth meeting of the WIAG and the CHy Advisory Working Group in December 2011. The recommendations, along with draft responses as compiled by the WIAG and the CHy AWG, are presented in Annex I to CHy-14/Doc. 8 to be discussed by the Commission.

12. A number of WHYCOS component projects continue development and/or implementation in various regions in the current intersessional period. All of these projects were demand-driven and helped strengthen national hydrological activities as well as regional cooperation in water-related matters. In particular Volta-HYCOS was instrumental in contributing to the establishment of a new international river basin authority in the Volta River Basin.

13. RA I remains the Region with most of the components under implementation or planned. Niger-HYCOS has entered a second phase of implementation since 2011, to consolidate and expand on the achievements of the previous one, in terms of data collection and management, and information dissemination. In 2009 responsibility of Volta-HYCOS implementation was transferred from WMO to the newly established Volta Basin Authority (VBA) and negotiations on funding project activities are ongoing. WMO has implemented in 2011-2012 the preparatory phase of IGAD-HYCOS, and, following the adoption of the project document, has engaged, starting in July 2012, in its implementation for a further period of three years. Project documents have been developed in collaboration with relevant basin authorities for Senegal-HYCOS and Congo-HYCOS, and negotiations with prospective funding partners for their implementation are well advanced. SADC-HYCOS phase II was completed in 2010, having achieved considerable results in the establishment of the observing network and the improvement of data management; unfortunately, funding of an eventual third phase is being delayed.

14. In Region IV, the final steering committee meeting of Carib-HYCOS is planned for November 2012, where proposals on the continuation of activities beyond 2012 will be discussed. In Region II, Mekong-HYCOS, which contributed to strengthening field observations, improved data-management practices and providing data to flood forecasting activities, was completed in 2012. A second phase of HKH-HYCOS has been implemented since 2009 and is expected to be completed by the end of 2012, providing fast regional exchange of flood-related data. In Region V, Pacific-HYCOS was completed in 2011 and data from the project stations contributed to the preparation of the Catalogue of Rivers for the Pacific Islands. Finally, Arctic-HYCOS, characterized by a more science-oriented approach and originally conceived as a WMO contribution to the International Polar Year, is aimed at providing better coordination and integration in data management among participating countries and other scientific programmes and initiatives in the area.

15. Projects have been the object of mid-term and final reviews by third party independent experts, which have provided useful insight on the success factors as well as difficulties encountered in project implementation and hints on ways to overcome them. Elements from these reviews were input into to the independent external evaluation of the WHYCOS programme (see above) and in the preparation of the new version of the WHYCOS Guidelines.

16. On most of the above projects, WMO acts as a supervising agency, providing technical advice and support (e.g. tendering processes, training design) and ensuring coherence of project

implementation with the agreed project document and the general WHYCOS principles. Only in exceptional cases, when local institutional arrangements or specific donors' requirements demand so, is WMO more directly engaged as implementing agency (Volta-HYCOS and IGAD-HYCOS).

17. The WMO Secretariat expresses its appreciation to the various donors and the other partners for the financial and technical support provided to the HYCOS components. The WHYCOS International Advisory Group (WIAG) met on two occasions during the intersessional period, February 2009 and December 2011. Reports on these meetings are available at: http://www.whycos.org/whycos/documents-and-technical-material.

18. In response to the Congress Resolution 30 (Cg-XV), Resolution 6 (CHy-XIII), WMO Integrated Global Observing System (WIGOS) and WMO Information System (WIS), proposed the integration of SADC-HYCOS and the Southern Africa Region Flash Flood Guidance System (SARFFG) as pilot projects under WIGOS/WIS. The aim of this integration is to demonstrate the benefits of the WIGOS/WIS information flow and output, including associated metadata, in hydrology and water resources. A one day regional consultation meeting was organized for the development of the WIS/WIGOS Pilot Project on hydrology and to identify potential contribution from other major projects in the region in December 2009. Participants supported WMO's proposal to develop a WIGOS/WIS pilot project in the region and made specific recommendations for the development of the pilot project. Since then, progress has not been as expected (primarily due to delays in implementing the SADC-HYCOS Phase III) and renewed efforts will be required during the next intersessional period as the concepts of WIGOS/WIS become more firmly established.

Water Resources Assessment

19. The application of Water Resources Assessment (WRA) activities in the framework of the HWRP is an essential tool in supporting Member States, through their NHSs, in reducing the risks and potential impacts of hazards caused by weather, climate, water and related environmental elements, as well as in enhancing socio-economic development.

20. During the intersessional period, a Technical Material for Water Resources Assessment report has been published. In addition, three brief draft reports on "Methodological Approaches to Assessment of Basic Moisture Regime Characteristics - Soil Moisture and Evaporation – A Review", "Current problems of hydrological networks design and optimization" and "Review on Remote Sensing of the Snow Cover and on Methods of Mapping Snow" have been prepared.

21. With a view to assisting the Commission in deciding the way forward in this area (for instance, whether the preparation of a WRA Manual under the QMF-H is still needed and if so, what should its contents be) and as a way to take into consideration regional needs, a Workshop on Development of Water Resources Assessment Methodologies and Establishment of an Information System for WRA in RA II was held in Seoul in October 2012, and a similar meeting for RA IV is planned for the first quarter of 2013 in Panama. The recommendations from these meetings will be presented to the Commission and its AWG.

22. Over the past two years, the Hydrology and Water Resources Programme (HWRP) has been working closely with the International Atomic Energy Agency (IAEA) in the field of water resources asessment. IAEA is undertaking a project aimed at enabling Member States to enhance the availability of freshwater (with an emphasis on groundwater) through science-based comprehensive assessments of national water-resources. This initiative is closely aligned with the WMO's role in assisting its Members improve their capabilities in undertaking national water resources assessments primarily from a surface water resources perspective. WMO assisted in one wokshop held in Manila, Philippines in March 2011 and provided names of possible resource persons for a workshop in Costa Rica in April 2012.

23. During the last intersessional period, a new online version of INFOHYDRO was launched. This version is more user friendly than the previous one, is based on a data base and

not on pdf documents, and includes the changes suggested by CHy-XIII regarding the clarification on some of the terms used in INFOHYDRO. As of October 2012, updated information from 44 countries was included in the database. The WGH of the RAs have been extremely helpful in encouraging National Hydrological Services (NHSs) of their Regions to provide the information related to their countries into INFOHYDRO. However, it has been observed that progress in populating this important database is still slow.

24. Through the technical cooperation project PROMMA (Programme for the Modernization of Water Resources Management (Mexico)), a water and climate database management system suited to the needs of the Mexican National Water Commission was developed (in Spanish). At the end of the project, Mexico made it available to the Programme of Cooperation for the Iberoamerican National Meteorological and Hydrological Services (NMHSs), which, thanks to a Trust Fund established by Spain in WMO to support its activities, added a meteorological component and adapted it to the needs of a more general audience. During Cg-XVI, this open-source, freely available software was transferred to WMO, which has now translated it into English and is planning to translate it into French in the near future. Installation in Ghana, as a pilot country, was undertaken in August 2012. NMHSs in need of such a system can apply to the WMO Secretariat for its installation and related training programme. Plans are being considered for the development of an online community of users of the system, to promote exchange of experiences and share eventual future developments.

FORECASTING AND APPLICATIONS IN HYDROLOGY

WMO Flood Forecasting Initiative

25. The WMO Flood Forecasting Initiative is the basic implementation framework related to hydrological forecasting and flood management. Its principal objective is to enhance the capability of NMSs and NHSs to cooperate in an effective manner in the provision of improved flood forecasting services.

26. A number of initiatives and projects are being implemented in the framework of the Strategy and Action Plan of the WMO Flood Forecasting Initiative (FFI) (available as a background document of the session), involving NHSs, NMSs and other stakeholders, including:

(a) The Flash Flood Guidance System (FFGS) project with global coverage, endorsed by Resolution 21 (Cg-XV) as a FFI component, that had been developed by the WMO Commission for Hydrology (CHy) jointly with the WMO Commission for Basic Systems (CBS) and in collaboration with the US National Weather Service, the US Hydrologic Research Centre and USAID/OFDA. Currently five components are being implemented: in Central America (since 2004), in the Southern African Region (since July 2009), in the Mekong River Basin (since March 2008), in the Black Sea and Middle East Regions (since March 2010), and in Mexico (since November 2010). Additional projects are planned for the next intersessional period, including in South East Europe and South East Asia;

(b) A project to develop a Strategy for Flood Forecasting and Early Warning in the Zambezi River Basin, implemented with support from USAID;

(c) The establishment of PROHIMET (Red Iberoamericana para el monitoreo y pronóstico de fenómenos hidrometeorológicos), which is a regional initiative supported by WMO and the Government of Spain that promotes pilot projects, training courses and working groups on thematic areas such as hydrological forecasting models and observing network management and maintenance in the Ibero-American countries. The Ibero-American Network on monitoring and forecasting of hydrometeorological phenomena (PROHIMET) involves the implementation of pilot projects, where meteorologists and hydrologists of most of the Ibero-American countries are contributing their expertise;

(d) A PROHIMET pilot project for the development of a hydrometeorological system in the catchments of the rivers Nare and Guatape (Antioquia Department, Colombia) to improve civil protection response and dam operations;
(e) A PROHIMET flood early warning pilot project for the river Yí in the city of Durazno (Uruguay) to improve the emergency response of the civil protection;
(f) The Coastal Inundation Forecasting Demonstration Project (CIFDP), initiated jointly by CHy and the Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) which aims to provide combined forecasting of storm surges and coastal flooding in two countries, namely Bangladesh and the Dominican Republic.

27. Other activities currently progressing include a task group working on the intercomparison of flood forecasting models to provide guidance on the applicability of forecasting models under different environments and institutional settings. The task group proposal for the Development of a Decision-Aiding Tool for the Selection of Flood Forecasting Models is available here. Another task group is working on the assessment of the efficiency of flood forecasting services. The draft report of the workshop on "Improving the Efficiency of Flood Forecasting Services" - Development of a Framework for the Assessment of Service Delivery Capabilities of Hydrological Services", held in Geneva in October 2011, is available here. The future of both these activities will be discussed at CHy-14.

28. Resolution 15 (Cg-XVI) called for the establishment of an overarching Advisory Group for the Flood Forecasting Initiative (FFI-AG) to provide technical oversight on the hydrological forecasting elements of these initiatives. In December 2011, the CHy AWG discussed the proposed membership of the FFI-AG and the process that will lead to its establishment. The first meeting of the FFI-AG is scheduled for the first half of 2013.

29. The CHy Statement on the scientific basis for, and limitations of, river discharge and stage forecasting, which appears on the CHy Website, provides a perspective on the current state of hydrological forecasting, including an overview and a summary of factors affecting forecast accuracy and lead-time. (http://www.wmo.int/pages/prog/hwrp/publications/statements/stmnt_limitations08042010.pdf).

30. The first project in the ANADIA (Assessment of Natural Disaster Impacts on Agriculture) programme, which is currently being implemented in Mali, addresses impacts of floods and drought on agriculture and rural systems. This project, funded by Italy, is implemented in cooperation with NMS and NHS of Mali and other local institutions, including the Institute of Rural Economy and the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT).

Associated Programme on Flood Management (APFM)

31. The APFM, a joint initiative with the Global Water Partnership (GWP), was established in 2001 in order to promote the concept of Integrated Flood Management (IFM) and to facilitate its application from the concept to practice. The IFM concept provides the rationale and means to shift from the traditional reactive 'flood control' approach, focusing mainly on engineering measures, to a more proactive, integrated and multi-disciplinary approach.

32. Phase I (August 2001-July 2006) of the APFM has seen the principles of IFM being established through a Concept Paper supported by a Flood Management Policy Series, and a first application of these concepts in various regional pilot projects. Phase II of the programme (2006-2010) has consolidated these achievements developing capacities in the countries by supporting local and regional actions that advocate, support or demonstrate the IFM principles, and by collecting, synthesizing and disseminating flood management case studies through its Website.

33. Phase III (started in 2010 and expected to last up to 2014) is being characterized by an intensification and improvement of activities and services established in the previous phases. Particular focus on the demand-driven assistance facility is provided through the HelpDesk on IFM.

The overall goal of the APFM Phase III is to improve field-effectiveness of IFM practices and outreach.

34. The Governments of Japan, Switzerland, United States of America, the Netherlands, Italy and Germany have provided support to the programme financially or in-kind; moreover, the Government of Spain has supported specific associated activities. Additional details are available through the Associated Programme on Flood Management Website (currently undergoing restyling and updating), the annual reports of the APFM (available as reference materials) and in CD format upon request from the Technical Support Unit of the APFM.

35. During the last intersessional period, a wide range of activities have been undertaken through the APFM, with particular regard to capacity building activities, both in the form of guidance materials and training courses (including training of trainers), or in the implementation of projects aimed at the development of local capacities and capabilities in flood management. Notably, publications such as the policy series or the IFM tools have been updated and further developed; trainings have been held and training manuals have been published in cooperation with other agencies and institutions; national or regional workshops on IFM strategies formulation have been implemented; and advocacy and outreach activities have been carried on. In addition, the HelpDesk for IFM was launched in 2009 as a mechanism for transferring knowledge and skills on flood management issues to managers and decision makers. In its Help Yourself function it provides a large number of technical tools and publications covering flood management issues from different perspectives. In its GetHelp function, the HelpDesk provides multi-disciplinary technical assistance in close cooperation with cooperating institutions (Support Base Partners). Approximately 20 Support Base Partners have so far signed agreements with WMO for mutual cooperation in the framework of activities related to the HelpDesk.

36. Since its launch in June 2009, the HelpDesk has received around 70 requests either through the Website interface or direct contacts to the APFM Technical Support Unit (TSU). About three quarters of these requests were successfully fulfilled, or are currently being processed, in the form of training workshops, assistance in national strategy development, or simple rapid guidance on specific information related to IFM. These requests were coming not only from governmental agencies or institutions, but also from universities, NGOs and the private sector. This proves that the HelpDesk is an excellent tool to allow access to information, dissemination and advocacy of the IFM concept. Moreover, the HelpDesk acts as a hub for exchange of information and expertise between relevant competent institutions (Support Base Partners) and the requesting parties.

37. The third edition of the Concept Paper on IFM, taking into due consideration urban flood management and climate change issues, has been published and translated into French, Spanish, Russian and Japanese. Moreover, the publication “Economic aspects of flood management” has been revised into a second edition and is currently undergoing peer-review process; and a supporting collection of “Case studies on Legal and Institutional Aspects of Flood Management” has been published. These publications (available from the APFM Website) have been widely distributed during training and advocacy workshops, as well as to Hydrological Advisors, various universities and institutions with curricula relevant to Integrated Water Resources Management (IWRM) or IFM. The publications were also delivered to NGOs and other government organizations.

38. IFM Tools are guiding materials for flood management practitioners for various specific purposes. These tools are intended to provide substantive guidance to the practitioner and a clear perspective of how different aspects of flood management fit together forming an integrated approach. The tools serve as resource material and are published as living documents to be updated regularly, based on experiences of members of CHy and various other partners. Ten new tools (available from the APFM Website) were developed during the reporting period, four tools have been revised into a second edition and another nine are being developed or finalized.

39. In addition to these publications, six training manuals and other guidance materials were produced in collaboration with partners such as CapNet, the World Health Organization (WHO), the United Nations Economic Commission for Europe (UNECE) or the World Bank on topics related to flood management covering urban, policy, community-based, sanitation, or climate change issues. As per the training courses, eighteen were organized in Africa, Asia, South America and Europe during the reporting period, of which eight in collaboration with CapNet, six with the Japan International Cooperation Agency (JICA), and another four exclusively by the APFM. Further details on these training activities can be found in the annual reports of the APFM.

40. Eight national or regional workshops on IFM strategies formulation have been implemented, or are currently undergoing development. Three of these strategy formulation workshops took place during the intersessional period in Pakistan, Thailand, and Lao PDR, while five other activities are being currently planned to be implemented in South East Europe, in Iowa State, in the Dniester, Sava and Neman river basins (with UNECE). Uganda, Ghana, Cambodia and Vietnam are also being considered for the development of Action Plans and demonstration projects to implement IFM practices.

41. Advocacy and outreach activities have also been carried out in the reporting period, with APFM participating in over fifteen major international conferences. Outreach has also been improved through the planning and inception of a series of educational multimedia activities (namely with Project WET, the Danish Hydraulic Institute (DHI), Metameta), e-learning platforms (with the Technical University of Hamburg (TUHH) and CapNet), and an additional 349 new entries in the Flood Management Reference Centre. The latter consists of three continuously updated databases on Flood Management Institutions, Literature, and Policy and Laws, and plays a vital role in establishing linkages among various disciplines, institutions, and actors involved in flood management.

Water, climate and risk management

42. Noting that water resources are significantly affected by climatic variability and potential climate change, the important role that HWRP can play in helping Members to understand better the role of water resources management in mitigating the risks of hydrological extremes and in developing adequate response and mitigation measures has been recognized. Various initiatives aimed at fostering cooperation between the hydrological and climatological communities, the development of national adaptation strategies and the reinforcement of capabilities for managing risks to natural hazards are being implemented.

43. CHy-XIII had decided to actively participate in the development of a WMO initiative to encourage provision and dissemination of climate and hydrological information in support of hydrology and climate research, adaptation to climate change and climate variability, and in providing feedback from the water community.

44. A Regional Workshop on Integration of Seasonal Forecasts and Hydrological Information for Water-related Sectors in the Western Coast of South America (WCSA) was held in Guayaquil, Ecuador in January 2010, in cooperation with the Centro Internacional para la Investigación del Fenómeno de El Niño (CIIFEN), to foster the interaction between the hydrologic and climatic communities for the implementation of hydrological outlooks based on climate outlooks in the region, as a first contribution from the region to the implementation of the GFCS. The Workshop proposed a regional action plan, which is being implemented, including a Training of three Trainers in the headquarters of the International Research Institute (IRI) in Palisades, United States, in September 2010, on techniques and approaches such as statistical flow forecasts and methods to produce probabilistic hydrological outlooks based on seasonal precipitation forecasts disaggregated in daily time series. These methods were later discussed at the Tenth Climate Outlook Forum for the West Coast of South America (COF-WCSA) in Quito, on November 2010, as well as at the 11th COF-WCSA in Santiago, in December 2011.

45. An Experts Meeting on Extended Hydrological Prediction workshop was held in July 2011 in Melbourne, Australia. The report is available at http://www.wmo.int/pages/prog/hwrp/documents/EHP_Final_Report_2011_Melbourne.pdf. The recommendations of the workshop included the identification of steps for the preparation of guidance materials for extended hydrological forecasting, including through the compilation of case studies, and to establish an action plan for the production of the guidance materials. These recommendations will be discussed under agenda item 10 of the present session of the Commission.

46. The Global Terrestrial Network – Hydrology (GTN-H) continues to promote improved access to hydrometeorological data and information through its alliance of major global data centres. The development of joint data products on global scales is a main driver of the programme that is supported by CHy and the Global Climate Observing System (GCOS). Coordination of the GTN-H has recently changed from the CrossRoads Initiative of the City College of New York (CCNY) to the Federal Institute of Hydrology, Germany.

CAPACITY BUILDING IN HYDROLOGY AND WATER RESOURCES MANAGEMENT

47. Cg-XVI endorsed the revised Strategy on Education and Training in Hydrology and Water Resources adopted by the Commission through Resolution 5 (CHy-XIII). The revised strategy offers a framework for responding better to the capacity building needs of Members. Congress also invited the Secretariat to pursue the provision of training according to the guidelines defined by the Commission, particularly in developing further distance- and blended-learning training courses, and in developing systematic training for the NHSs and other professionals based on the manuals and guidelines produced as part of the QMF-H.

48. In accordance with the Strategy, training needs have been determined in consultation with Members and Regional Associations Working Groups on Hydrology, CHy and its subsidiary bodies based on the surveys undertaken by the WMO Secretariat. Accordingly, a number of training events have been organized in the last intersessional period, namely:

(a) Roving Seminars on Operation and Maintenance of Automatic Hydrometeorological Stations were organized in 11 Iberoamerican countries, training more than 300 professionals (sponsored by Spain);
(b) Training of Trainers Course on Climate and Water Affairs held in April 2009 in Skopje, (co-sponsored by the UN-Water Decade Programme on Capacity Development (UNW-DPC));
(c) Training on Acoustic Doppler Current Profiler (ADCP) flow measurements in South Africa, attended by 68 hydrologists, engineers and technicians from NHSs and WHYCOS Project Pilot Regional Centres from RA I (Jointly with the European Space Agency (ESA));
(d) Regional Course on Measurement and Computation of Discharge for RA V, held in October 2010 in Bekasi and Bandung, Indonesia, with 46 participants from 10 countries of the Region;
(e) Training Course on the Manual on Low-Flow Estimation and Prediction, organized in conjunction with the meeting of the RA V Working Group on Hydrology in Bandung (Indonesia) in December 2009;
(f) Training Course on the Role, Operation and Management of NHSs (based on WMO-No. 1003) in Kinshasa, RDC in April 2012, in cooperation with the Office International de l'Eau.

49. CHy-XIII recommended that under the QMF-Hydrology, training activities should be undertaken at the global level on the utilization of the Guides and Manuals. With the objective of designing and planning the preparation of training material and organizing future courses and roving seminars on the use of the WMO Manual on Stream Gauging, a Planning Meeting for Trainers of the IAHR/WMO Stream Gauging Course was held in Geneva in November 2009. In cooperation with IAHR, two versions of the course on stream gauging based on the second edition

of the WMO Manual were designed: a short one (three class days plus one field day) for the IAHR audience and a two-week (which could be reduced to one-week depending on resources availability) one for WMO's audience (staff of NMHSs). The first course in the IAHR version was held in Brescia, Italy in September 2011, while the first course in the WMO version is scheduled for December 2012 in Ghana. The training material has been translated in Spanish and is currently being utilized in courses organized in the framework of technical assistance projects in Mexico and Dominican Republic. A first version of training material on Flood Forecasting and Warning has also been prepared and used in the training course on the subject, held in Nanjing, China in October 2011. In both cases, an online community of trainers will be established, to share, adapt and translate, if necessary, the training material which has been developed by CHy experts.

50. The first International Basic Hydrologic Sciences Distance Learning Course, held from19 October to14 December 2009, and jointly organized by COMET, the National Oceanic and Atmospheric Administration (NOAA), and WMO, was attended by 54 students from 39 countries covering all six WMO Regions. The last two weeks were dedicated to the preparation of a final written assignment. The course was very positively received by the students, who demonstrated a high level of participation, with twenty of them earning a diploma. Subsequently, COMET, at the request of WMO, adapted eight basic hydrological modules to an international audience; these modules were used to deliver two additional Distance Learning Courses in 2011, a basic one for RA V and an advanced one for Eastern European countries. In order to multiply the offer of these very popular courses and involve WMO Regional Training Centres (RTCs) and interested academic institutions, a Training of Trainers Workshop on Distance Learning Delivery of Hydrology Courses was held in COMET's headquarters in Boulder, United States, from 29 November to 9 December 2011 with 11 participants from eight training institutions, potentially covering all WMO Regions. An agreement was reached that the participating institutions will deliver at least a WMO Distance Learning course in their respective Region every two years, with limited support from WMO and COMET. An online community has been established, where participants of the workshop and experts from COMET and WMO share their experiences in planning, organizing and delivering distance learning courses.

51. The WMO Strategy for Education and Training (ETR) in Hydrology and Water Resources (HWR) called for particular attention to be given to the establishment of new WMO RTCs with a special focus in hydrology and water resources, in view of the decision of the EC-LVIII to widen the scope of WMO RTCs to include other areas of interest of WMO. In the past intersessional period this approach resulted in the approval by EC-64 in 2012 of the National Water Academy in Pune, India and the training facilities of BMKG and the Research Center for Water Resources (RCWR) in Indonesia as a component of the RTC in India and a new RTC respectively.

52. As approved by Cg-XV, the *Guidelines for the Education and Training of Personnel in Meteorology and Operational Hydrology*, Volume II: Hydrology (WMO-No. 258) was published in all the official languages in November 2008 and is now available on the WMO Website. CHy-14 will consider the replacement of this publication following the requests by Cg-XVI on this matter.

53. The online version of the Hydrological Operational Multipurpose System (HOMS) Reference Manual (HRM), in English, French, Spanish and Russian has been maintained, although few new components have been added in the last intersessional period, and it will be maintained until it is felt that its contents are no longer relevant to the National Hydrological Services (NHSs) of developing countries.

COOPERATION IN WATER-RELATED ISSUES

54. During the last intersessional period, the activities of the various water-related UN agencies continued being efficiently coordinated by UN-Water. This coordination mechanism has actually increased its relevance in the international water arena in recent years. In particular, in 2011 the decision was taken to elevate the level of its Chair to that of Chief Executive, and as a

consequence since February 2012, the Secretary-General of WMO has assumed the role of Chair for a period of two years. The benefits deriving from the WMO Secretary-General chairmanship of UN-Water for the period 2012-2013 are, among others: (i) the opportunity to strengthen the engagement of other UN agencies in GFCS; (ii) the enhanced visibility of WMO's water-related activities; (iii) the multiple opportunities to advocate for the importance of supporting the activities of the NMHSs; and (iv) the renewed interest from donors in WMO Programmes.

55. In addition, since 2008, WMO has been coordinating the UN-Water Task Force on Water and Climate Change, later transformed into the Water and Climate Change Thematic Priority Area (WCC-TPA), which is aimed at strengthening UN System coordination on activities related to water and climate change in order to facilitate adoption of strategies for meeting the challenges of climate change, both for adaptation and mitigation in the related water sub-sectors. An extensive UN-Water Policy Brief on “Climate Change Adaptation: The Pivotal Role of Water”, has been prepared by the TPA (http://www.unwater.org/downloads/unw_ccpol_web.pdf). Earlier, a one-page statement “Climate Change Adaptation is Mainly about Water”, prepared by the Task Force, was presented at the UNFCCC 2009 COP 15 (Copenhagen, Denmark). As coordinator of the TPA, WMO participated in the Deutsche Welle Global Media Forum (June 2010, Bonn, Germany). A Guidance Note on Water-related Adaptation to Climate Change, developed by a group of experts from various UN-Water member agencies and partners to address the needs of UN Country Teams and other professionals dealing with the impact of climate change on water resources, is scheduled to be issued in late 2012. Its main objective is to enable UN organizations to effectively assist Member States in preparing and implementing coherent strategies to tackle the impacts of climate change on the management of water resources.

56. WMO regularly contributes to the preparation of the previous four editions of the World Water Development Reports (WWDR) under the aegis of UN-Water and is actively participating in the current restructuration of the report undertaken to respond to the comments received through a wide ranging survey.

57. WMO has also continued to support UN-Water/Africa and the African Ministerial Council on Water (AMCOW) and AMCOW Technical Advisory Committee (AMCOW TAC). WMO actively participated and contributed to the preparations and organization of the four Africa Water Weeks held since 2008, the last being held in May 2012 in Cairo.

58. Jointly with the United Nations Educational, Scientific and Cultural Organization (UNESCO), the International Strategy for Disaster Reduction (ISDR), IAHS and the United Nations University (UNU), WMO is participating in the International Flood Initiative, with its secretariat in the International Centre for Water Hazard and Risk Management (ICHARM). WMO has also actively participated in the High-level Panel on Disaster under the UN SG’s Advisory Board on Water and Sanitation.

59. WMO’s functional synergy with UNESCO has continued and the UNESCO/WMO Liaison Committee plays an important coordination role. WMO and UNESCO are in the process of reviewing and updating the working arrangements between the two agencies. There has been effective and fruitful cooperation between WMO and UNESCO for example, involving the provision of technical assistance to Pakistan in direct response to the 2010 flood disaster and also in respect to flood forecasting and early warning activities being undertaken in the Zambezi River Basin.

60. Cooperation with IAHS, IAHR, ISO, the International Commission on Irrigation and Drainage (ICID), GWP and other intergovernmental and non-governmental organizations has expanded in the last intersessional period. This cooperation provides a useful mechanism for pursuing the objectives of the HWRP as well as a vehicle for exploring the climate services needs of the water sector.

61. Cooperation also continued with the Group on Earth Observations (GEO) Integrated Global Water Cycle Observations (IGWCO) Community of Practice through its ongoing programme activities.

REGIONAL ACTIVITIES

62. A range of different institutional arrangements have been adopted by the WMO Regional Associations for addressing issues relevant to hydrology and water resources in their respective Regions.

63. The AWG, in order to incorporate the regional needs in the work programme of CHy, has continued to conduct extensive consultations with the Regional Hydrological Advisers, both through informal meetings during sessions of the Executive Council and by inviting them to participate in its third meeting in December 2011, dedicated to the planning for CHy-14.

64. In order to better address the regional needs in the work of CHy, Regional Hydrological Advisors (RHAs) were therefore requested to provide input from the Regional Working Groups on Hydrology to the preparation of the proposed future Programme of Work of the Commission.

65. With the goal of streamlining the use of resources and better responding to the regional needs, the regional associations during the present intersessional period have established, among their subsidiary bodies, the following bodies to deal with water related matters:

1. RA I: Working Group on Climate Matters and Hydrology
2. RA II: Working Group on Hydrological Forecasts and Assessments
3. RA III: Working Group on Hydrology and Water Resources
4. RA IV: Task Team in Hydrology
5. RA V: Working Group on Hydrological Services
6. RA VI: Working Group on Climate and Hydrology

SUPPORT TO CHy

66. The Secretariat supported the president of CHy in the organization of three AWG meetings. The first meeting was held in Geneva in February 2009. That meeting approved the work plan of all the AWG members. In the second meeting, convened in Brisbane, Australia in April 2010, the AWG appointed an additional expert to work in the Hydrological Forecasting and Prediction theme area, and took some steps to continue preparing the Manual on Flood Forecasting and Warning. The third meeting, held in Geneva in December 2011, prepared a proposal for the future programme of work of the Commission. Just prior to that session, one of the AWG members resigned, causing a delay in the preparation of a new edition of WMO publication No. 49-Technical Regulations Volume III - Hydrology.

ANNEX

PROGRAMME DESCRIPTION

HYDROLOGY AND WATER RESOURCES PROGRAMME (HWRP)

1. Overall objective

The overall objective of HWRP is to apply hydrology in meeting the needs for sustainable water resources development through integration of hydrological, meteorological and climatological information and forecasts for use in water resources management; prevention and mitigation of water-related disasters; and in climate change adaptation in the water sector at national, regional and international levels.

2. Purpose and scope

2.1 HWRP fulfils one of the major purposes of WMO, namely to promote application of hydrology and to further close cooperation between Meteorological and Hydrological Services (paragraph *(e)* of Article 2 of the Organization's Convention).

2.2 HWRP promotes improvements in the capabilities of Members, particularly in developing countries and those in transition, through technology transfer and capacity-building, so as to enable them to assess their water resources on a continuous basis, and respond, through risk management strategies, to the threats of floods and droughts; and thus to meet the requirements for water and its use and management for a range of purposes. The Programme aims at providing hydrologic information to various national development agencies, the civil society and the general public so that they can effectively use water resources for various development activities. At the same time the Programme endeavors to underscore the importance of hydrology and the role of National Hydrological Services (NHSs) in the development activities of various sectors through water resources management.

2.3 The Programme takes into consideration the existence of climate variability and change and its hydrological impacts. It promotes increased collaboration between NHSs and National Meteorological Services (NMSs), particularly in the provision of timely and accurate hydrological forecasts, ranging from flash floods guidance to seasonal predictions as a contribution to the protection of life and property and overall climate risk management.

2.4 The Programme supports activities that contribute to the improved accuracy and usefulness of hydrological forecasts, resulting in the protection of life and property, and increased information and knowledge in support of sustainable socio-economic and environmental development and use of water. The activities of HWRP encompass the following broad areas:

(a) Measurement of basic hydrological elements from networks of hydrological, climatological and meteorological stations;
(b) Collection, processing, storage, retrieval and publication of hydrological data, including data on the quantity and quality of both surface water and groundwater;
(c) Implementation of a quality management framework in hydrologic activities;
(d) Provision of hydrologic data and related information for use in planning and operation of water resources projects and for monitoring the state of the freshwater resources;
(e) Installation and operation of hydrological forecasting systems;
(f) Development of flood management policies and strategies;
(g) Integration of meteorological and climatological information and forecasts into water resources management;
(h) Climate change adaptation in water resources management; and
(i) Evaluation of hydrological research outcomes for their potential benefits for application by NMHSs.

2.5 The Programme effectively contributes to the implementation of all the Expected Results (ER) in the WMO Strategic Plan and particularly to ER 3 along with ER 2 and ER 4 (2012-2015). Many of the activities under the HWRP are strongly linked with other Programmes, in particular the World Weather Watch Programme, the World Climate Programme, the Tropical Cyclone Programme, the Education and Training Programme, and contributes to the overall objectives of the Disaster Risk Reduction Programme, the Regional Programme and the Least Developed Countries Programme. The Programme will act as an interlocutor and conduit to provide climate services under GFCS for use in the water sector.

3. HWRP Governance

The technical guidance for the HWRP is provided by the Commission for Hydrology (CHy). The Commission interacts closely with the Commission for Climatology and Commission for

Agrometeorology on the Global Framework for Climate Services (GFCS) and the Commission for Basic Systems on WIGOS.

4. HWRP structure

The HWRP is implemented through three mutually supporting components:

(a) Basic Systems in Hydrology;
(b) Forecasting and Applications in Hydrology;
(c) Capacity Building in Hydrology and Water Resources Management.

5. Basic Systems in Hydrology (BSH)

Long-term objective

5.1 The long-term objective of the component is to provide guidance to, and support for, NHSs in hydrometry and its application for monitoring freshwater resources, with an emphasis on quality assurance.

Purpose and scope

5.2 BSH provides the basic building blocks and framework for the hydrometric support for hydrology and water resources management. It covers the collection, transmission and storage of data, implementation of Quality Management Framework within Hydrology, the further development of WHYCOS including its internal and external coordination, establishment of hydrologic information systems, assessment of water resources, applications of hydrologic information and socio-economic benefit analysis of hydrologic networks. The component will contribute to the implementation of ER 3, and support meeting the objectives of ER 4 through enhancing integration (WIGOS) and communication systems for delivering information (WIS); the BSH component, through WHYCOS activities, assists the LDCs by enhancing capacity of NMHSs, thus contributing to ER 6.

6. Forecasting and Applications in Hydrology (FAH)

Long-term objective

6.1 The long-term objective of the component is to apply hydrometric observations for hydrological forecasting, flood risk assessment and management, prevention and mitigation of water-related disasters, and to better understand the implications of climate variability and change for water management.

Purpose and scope

6.2 The purpose of FAH is to support NHSs in the application of hydrological analysis through hydrologic modeling, development of flood forecasts, provision of flash flood guidance, studies on low season flows, storm surge coastal flooding, and design flood, in order to meet water resources management objectives. The component will undertake regular review of operational requirements for flood forecasts and warnings and keep up to date with new technological developments. The component organizes activities in support of integrated flood management and provides support to countries through a HelpDesk on flood management. Through its activities closely linked to flood prevention, mitigation and response, it contributes to the implementation of ER 2. The component will support climate change adaptation and environmental protection, and serve as the provider of climate information to the water sector users, and, as envisaged under the GFCS, serve as an arm of the User Interface Programme and thus contribute to ER 3. The component works through increased collaboration between NMSs and NHSs, which is promoted and facilitated. The component will continue to closely link its activities with the World Climate

Programme (WCP), the Tropical Climate Programme (TCP) and the Marine Meteorology and Oceanography Programme (MMOP).

7. Capacity Building in Hydrology and Water Resources Management (CBH)

Long-term objective

7.1 The long-term objective of the component is to assist the rational development, management and operation of NHSs, including the education and training of their staff, strengthening institutional coordination with NMSs and increasing general awareness of the importance of hydrological work.

Purpose and scope

7.2 The purpose of CBH is to provide guidance to NHSs on the institutional management within the hydrological and water resources development context and to build their capacities to serve their respective countries, through the implementation of the Hydrological Operational Multipurpose System (HOMS) for technology transfer and staff education and training. The component supports informing and educating the public, stakeholders and other government institutions about the socio-economic benefits of hydrologic services. The component also supports the technical cooperation activities in the developing and least developed countries and thus contributes to ER 6. This is a cross-cutting component that has strong linkages to other components within HWRP and will contribute to their implementation.

APPENDIX

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