

Commission for Hydrology

Abridged Final Report of the Extraordinary Session

Geneva

13–14 February 2019



WORLD
METEOROLOGICAL
ORGANIZATION

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This report contains the text as adopted by Plenary and has been issued without formal editing. Acronyms used in this report may be found in METEOTERM, the WMO terminology database, at <http://public.wmo.int/en/resources/meteoterm>.

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GENERAL SUMMARY OF THE WORK OF THE SESSION

1. The president of the Commission for Hydrology (CHy), Mr Harry Lins, opened the extraordinary session of the Commission on 13 February 2019 at 2.30 p.m. at the World Meteorological Organization (WMO) Headquarters in Geneva, Switzerland. He recalled that EC-70 tasked him to convene this very first extraordinary session of CHy to engage the hydrological community in: (a) suggesting optimal solutions for effective participation of WMO in the global water agenda, and (b) providing recommendations to Congress on ways to integrate hydrological activities into the new WMO structure. The reform process offers a great opportunity to the hydrological community to enhance its role, and the president expressed his confidence that the Commission will be able to respond appropriately to the EC request.

1.1 Prof. Petteri Taalas, WMO Secretary-General, opened the meeting by expressing his support to the hydrological community and reaffirming his expectation that, as a result of the reform process, WMO will offer a more solid home to hydrology. An integrated earth-system approach needs hydrological expertise for the contribution it can bring to water resources management, multi-hazards early warning systems, climate change impacts mitigation, sustainable urban development and food security.

1.2 The proposed reform also aims at upgrading the role of hydrology within WMO by, inter alia, having the Extraordinary Congress in 2021 with one of its main topics being water. Furthermore, NHS at director level will be invited to attend Congress sessions, adequate hydrology representation will be ensured in the proposed Research Board and Scientific Advisory Panel, and WMO visibility and impact in the broad water sector (including in SDG, Sendai Framework and Paris Agreement implementation) will be enhanced, including through extended partnership. Reporting on positive national examples of cooperation between national hydrological and meteorological services, he expressed his expectation that the Commission will provide constructive proposals and inputs into the reform process to further strengthen this cooperation.

1.3 Mr David Grimes, President of WMO, provided some context to participants by highlighting the outcomes of Cg-16 (2011) and Cg-17 (2015). Cg-16 noted that the most vulnerable countries are also those that are less informed about climate change and its impacts. On this basis, the process that led to the establishment of GFCS was started. Cg-17 asked for a path forward on how WMO needed to embrace hydrology in response to the increasing demand for hydrological data, information and services. This included aspects such as climate change impacts on water cycle, and support to international processes such as the Paris Agreement, Sendai Framework and Sustainable Development Goals. The HydroConference convened in 2018 and the Special Dialogue on Water during EC-70 were the first steps along this path.

1.4 Stressing that water resources are key to ensure a sustainable future, Mr Grimes reaffirmed his support for a more visible role and a stronger voice within WMO for the hydrological community and requested the Commission to provide indication on the core requirements to achieve this result.

2. The agenda of the session is provided in [Appendix 1](#).

3. At the request of the president of the Commission, 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. A total of 160 participants, of which 39 were women (i.e. 25%) attended the session from 80 countries,

and 6 international organizations. Overall, 68 Members of WMO with voting rights were represented at the session. The list of participants is given in [Appendix 4](#).

4. Noting that this was the first time an extraordinary session of the Commission had ever been held, the President described the modality under which the session would be conducted. In particular, he mentioned that debates should be limited to the two items for which the session was convened by EC-70 and that the main outcome would be related to recommendations for Cg-18.

5. The Commission also noted that, in order to ensure that Commission members were fully apprised of CHy issues associated with the WMO reform process and were able to discuss concerns and to provide input, an online [Pre-session Discussion](#) was carried out based on seven "engagement questions". 69 experts from 41 countries participated directly in the discussion and provided 250 written inputs, while the website received over 9749 visits. The outcomes of the Pre-session Discussion were presented to the Technical Conference that preceded the Commission and taken into account in preparing the pre-session documents.

6. The session adopted one Decision, given in [Appendix 2](#) and two Recommendations given in [Appendix 3](#).

7. The extraordinary session of the Commission for Hydrology closed at 8.23 p.m. on 14 February 2019.

APPENDIX 1. AGENDA

1. Organization of the session

- 1.1 Opening of the session
- 1.2 Consideration of the report on credentials
- 1.3 Adoption of the agenda
- 1.4 Establishment of committees
- 1.5 Concepts guiding the conduct of the session
- 1.6 Other organizational matters

2. Effective participation of WMO in the global water agenda

3. Recommendations to Cg-18 on ways to integrate hydrological activities into the new WMO structure

4. Closure of the session

APPENDIX 2. DECISION ADOPTED BY THE SESSION

Decision 1 (CHy-Ext.(2019))

ORGANIZATION OF THE SESSION

THE EXTRAORDINARY SESSION OF THE COMMISSION FOR HYDROLOGY,

Having considered the provisional agenda proposed by the president of the Commission,

Approves the provisional agenda;

Approves the report of the representative of the Secretary-General on credentials in accordance with WMO General Regulations 21 to 24;

Agrees not to establish any committee in light of the limited duration of the session and the absence of elections;

Agrees to the programme of work of the session:

- (1) Working hours of the meetings: 9.30 a.m.–12.30 p.m. and 2.30 p.m.–5.30 p.m.;
- (2) Arrangements and allocation of agenda items for the session;

Decides to suspend General Regulation 110 for the duration of the session to permit a rapid processing of documents in accordance with General Regulation 3;

Decides that in accordance with General Regulation 112, summarized minutes are not required for the session.

APPENDIX 3. RECOMMENDATIONS ADOPTED BY THE SESSION

Recommendation 1 (CHy-Ext.(2019))

WMO VISION AND STRATEGY FOR HYDROLOGY

THE COMMISSION FOR HYDROLOGY,

Recalling Resolution 18 (EC-70) – Outcomes of the special dialogue on water,

Having considered:

- (1) The summary of the pre-session discussion of the extraordinary session of the Commission for Hydrology (CHy) (2019),
- (2) The recommendations of the Executive Council Task Force on Water as summarized in [CHy-Ext.\(2019\)/INF. 2](#),

Noting that:

- (1) Water is the basic prerequisite for life, societal development and prosperity and that it has been increasingly recognized as being of fundamental importance for peace and security, as well as one of the most significant elements relating to global environmental, societal and geopolitical risks, as identified by the World Economic Forum,
- (2) Climate change impacts both the availability of water and water-related hazards around the world and requires a strong response from the international community, including WMO,
- (3) Water resources transcend international boundaries and require an Earth systems approach at regional scales,
- (4) All major components of the Agenda 2030, and in particular the water-related Sustainable Development Goals, the Sendai Framework for Disaster Risk Reduction, the Paris Agreement and the United Nations Economic Commission for Europe Water Convention on the Protection and Use of Transboundary Watercourses and International Lakes need reliable, timely and accurate hydrological information, products and services to support, inter alia, water resources management,
- (5) WMO Members and international stakeholders are increasingly requesting support, cooperation and coordination to provide and improve the needed hydrological data, products and services and to adopt wise water resources management practices,
- (6) WMO is recognized as the United Nations agency with a mandate for developing standards and supporting operational hydrological activities related to hydrological monitoring, modelling, training, forecasting and warnings which are integrally linked to meteorological and climate monitoring, modelling, forecasting and services and which support water resources decision-making,
- (7) It is important that WMO work closely with other United Nations entities, non-governmental organizations, scientific partners, the private sector and other stakeholders in order to make progress towards its water-related ambitions across the hydrological value chain and to support sound decision-making in operational hydrology,
- (8) WMO has a mandate to focus on sustaining and enhancing the ability of Members to provide science-based decision support services related to a wide range of hydrological applications in the hydrosphere, atmosphere, oceans and other related environmental

compartments and that this focus will ultimately enable WMO, through the enhanced capacities of National Hydrological Services, to most effectively address the urgent global challenges we collectively face,

Recommends that Congress task Regional Associations, along with their Hydrological Working Groups, with preparing a Plan of Action to be presented to the extraordinary session of Congress in 2021, taking into account the localized structure of hydrological phenomena, as well as their structure at the basin level. The objectives of the Plan shall be to strengthen operational hydrological services and the ability of national service providers to support better water resources decision-making and to address the recommendations of the Executive Council Task Force on Water as provided in [CHy-Ext.\(2019\)/INF. 2](#) and updated in the [WMO Vision and Strategy for Hydrology](#). The statements indicated below in bold, originally suggested by the Executive Council Task Force on Water, should be taken as long-term ambitions for the operational hydrological community, used as a basis for the above-mentioned Plan of Action and considered as initial inputs for future WMO strategic plans.

- (1) **No one is surprised by a flood** – Risk assessment, proper planning and mitigation are the cornerstones of any National Meteorological and Hydrological Service (NMHS) measure to reduce flood risks. Timely forecasts/warnings must be produced at regional/national/local levels and communicated through appropriate authorities. Current tools for prevention, mitigation and forecasting must incorporate important ancillary data and a thorough understanding of water management and the dynamics of land use. Data and products relevant for flood risk assessment and management should be provided to relevant stakeholders. Achieving this ambition will rely on further integrating the end-to-end early warning systems (E2E EWS) for flood forecasting, the Flash Flood Guidance Systems (FFGS), the Associated Programme on Flood Management (APFM), the Coastal Inundation Forecasting Demonstration Project (CIFDP), together with the Severe Weather Forecasting Demonstration Project (SWFDP) and the Global Data-processing and Forecasting System (GDPFS);
- (2) **Everyone is prepared for drought** – Drought risk management should be undertaken by WMO Members and through regional centres. The Integrated Drought Management Programme (IDMP) can serve as a nucleus to further develop necessary alliances and capabilities, including a detailed understanding of hydrological drought mitigation through reservoir operations, natural systems, conservation and the use of local/regional/national water. IDMP should be supported by climatological and hydrological prediction capabilities, water resources management, the Global Hydrological Status and Outlook System (HydroSOS), Regional Climate Centres (RCCs) and GDPFS;
- (3) **Hydro-climate and meteorological data support the food security agenda** – WMO should support resolving the equation of water demand for human consumption, irrigation requirements, water availability and potential water storage and should provide advice to optimize rainfed and irrigated agriculture. The water-energy-food nexus should be considered as well. This ambition should be supported by integrating the agrometeorological, climatological and hydrological expertise of WMO with socioeconomic and geophysical data and water resources management practices;
- (4) **High-quality data supports science** – WMO should support Members in accessing proper technology and with respect to the generation of high-quality hydrological data and the corresponding information products and services. This ambition can be realized with support from Global Water Data Centres, can benefit from further developing the Global Hydrometry Support Facility (HydroHub), the World Hydrological Cycle Observing System (WHYCOS), the Meteorological, Climatological and Hydrological Database Management System (MCH), the WMO Hydrological Observing System (WHOS), the Innovation Hub and the Quality Management Framework - Hydrology (QMF-H) and is essential for the wise management of our water resources. The future GDPFS and the upcoming operational phase of the WMO Integrated Global Observing System (WIGOS) and the next generation of the WMO Information System (WIS) 2.0 are expected to support the achievement of this ambition;

- (5) **Science provides a sound basis for operational hydrology** – Scientific knowledge should be strengthened to support operational hydrological predictions and modelling as part of an integrated Earth systems approach. This ambition would benefit from an improved understanding of the impacts of various stressors on the hydrological cycle, in support of closing the water balance;
- (6) **We have thorough knowledge of the water resources of our world** – An appropriate monitoring system, addressing all the key variables associated with operational hydrology, including the cryosphere, should span the globe and produce information that can be used to optimize the efficiency of existing services, future policies and services and political decision-making from the local to the global scale. Further development of WMO initiatives such as WHOS, HydroSOS and the Global Cryosphere Watch, matched with other international efforts, should support a fully operational World Water Data Initiative and enable local and global assessments of the availability of water resources;
- (7) **Sustainable development is supported by hydrological information** – Hydrological information should be available at all appropriate scales in space and time in order to support all water-dependent sectors for optimal operational water resources management as well as for planning and adapting to transient environmental conditions, particularly those associated with climate change. The future GDPFS should lend itself to being merged with those WMO activities related to the Global Expanded Monitoring Initiative. This ambition is also a great opportunity to include private partners and research in the provision of future services. Changes to hydrological regimes should be tracked and adequately allocated to support water resources management;
- (8) **Water quality is known** – Surface and groundwater quality should be permanently monitored as a necessary step to ensure water quality in accordance with different requirements for society and ecosystems, and corrective actions should be applied when necessary. A new partnership will be needed to support this ambition, including existing links to the Global Environment Monitoring System-Water (United Nations Environment Programme), the United Nations Educational, Scientific and Cultural Organization and other relevant stakeholders;

Also recommends that Congress approve the "Definition of operational hydrology" (to be prepared by the Advisory Working Group (AWG) augmented and the Executive Council Task Force on Water before the end of February 2019 and then circulated to verify that there is no objection from any member of the Commission for Hydrology);

Further recommends that Congress produce a Declaration, consistent with the roles and responsibilities of WMO, that reinforces the importance of operational hydrology and hydrological services in addressing global water challenges, for presentation at the Extraordinary Congress in 2021;

Recommends that the Secretary-General explore means of enhancing the WMO brand by highlighting the role of WMO and its partnerships in operational hydrology and its importance to addressing international water challenges;

Recommends that the Executive Council evaluate the advantages and disadvantages of a protocol according to WMO regulations related to one or more of the long-term ambitions for presentation at the Extraordinary Congress in 2021.

Recommendation 2 (CHy-Ext.(2019))

INTEGRATION OF HYDROLOGICAL ACTIVITIES INTO THE NEW WMO STRUCTURE

THE COMMISSION FOR HYDROLOGY,

Recalling:

- (1) The Executive Council request, through Resolution 18 (EC-70) – Outcomes of the special dialogue on water, for this extraordinary session of the Commission for Hydrology (CHy) to lay out the path forward with regard to the major developments in hydrology and to propose the necessary organizational arrangements for the hydrological community to deliver on relevant strategic objectives defined in the WMO Strategic Plan, in particular by providing recommendations to Congress on ways to integrate hydrological activities into the new WMO structure,
- (2) Resolution 36 (EC-70) – WMO Constituent Bodies Reform Transition Plan and Communication Strategy,
- (3) Recommendation 25 (EC-70) – WMO technical commissions and other bodies,

Convinced that the WMO reform process is a fundamental step towards enhancing the effectiveness of the Organization and its responsiveness to Members' needs, and that it provides a unique opportunity to enhance the support of WMO to, and the contribution to WMO from, hydrologists worldwide and to increase their visibility and involvement in WMO activities and structures in order to elevate the importance of National Meteorological and Hydrological Services (NMHSs) and of their contributions to the global water agenda,

Noting that the Advisory Working Group (AWG) of CHy, in conjunction with Regional Hydrological Advisers had examined a number of alternative options for organizational structures and recommended to the extraordinary session of the Commission for Hydrology (2019) those consistent with the WMO Convention and best suited to strengthening the operational hydrology component of WMO to ensure that WMO and its members are best positioned to provide hydrological and hydrometeorological data to address global weather, climate and water challenges, especially with regard to climate change and population growth,

Noting also:

- (1) The importance of retaining and coordinating, as well as opening to a wider community the current end-to-end WMO approach to water issues - from data to services, which has proven its efficiency and effectiveness in various projects, including its ability to mobilize important extra-budgetary resources to implement them,
- (2) That in order to derive a maximum benefit from the reform process as regards hydrology and water resources, it is essential to ensure that hydrological experts are properly represented in the relevant components of the new structure,
- (3) The importance the hydrological community assigns to retaining a forum where each Member is allowed to record its position and express its opinion as regards all issues related to operational hydrology and water resources management,
- (4) The importance of integrating the normative aspects of WMO hydrological activities in the two technical commissions,
- (5) The need to further strengthen capacity development and training at individual and institutional levels and the need to promote the rehabilitation and modernization of hydrological networks,

- (6) The need to promote hydrological education and to recommend to decision-makers further investment in staffing and capacity building of hydrologists in national services to carry out work in the field of hydrology,
- (7) The potential benefit that can be generated through more and better partnerships with non-governmental organizations, scientific partners, other United Nations Organizations, the private sector, and other relevant stakeholders in hydrology,
- (8) The fact that other United Nations agencies addressing water issues are currently working within their mandate to strengthen and expand their hydrology, water resources and related portfolios,
- (9) The importance for the Organization to maintain and further enhance its reputation and visibility as a serious, objective, scientific and technical actor in operational hydrology, including for water resources management, to make it attractive for potential partners to collaborate in those domains,

Having considered:

- (1) The thorough analysis and background information provided by the president of CHY and the AWG, as recorded in [CHY-Ext.\(2019\)/INF. 3](#),
- (2) The conclusions and recommendations of the Technical Conference “Future Hydrological Priorities and Arrangements” (Geneva, 11–13 February 2019),

Recommends that Congress consider the following decision criteria to integrate hydrological activities into the new WMO structure described in Recommendation 25 (EC-70):

- (1) An adequate and appropriate representation and participation of hydrologists in all constituent bodies of WMO;
- (2) A coordination function of operational hydrological activities along the value chain as well as across relevant scales;
- (3) The integration of hydrology with the other Earth-system sciences in all relevant WMO structures and activities, including technical commissions, regional associations, research activities, infrastructure and information management, as well as the provision of any related service;
- (4) Adequate mechanisms that facilitate the effective establishment of partnerships that benefit the WMO hydrological community, especially with a view to enhancing operational capacity at the national and regional levels;
- (5) Effective coordination of ongoing initiatives such as the Global Hydrological Status and Outlook System, the World Water Data Initiative and the Quality Management Framework - Hydrology;

Recommends further to Congress that the following specific arrangements be made:

- (1) General Regulation 30(b) should be amended to read, “In each session of Congress, an open committee of Congress shall be convened, entitled the WMO Hydrological Assembly, attended as a rule by the Hydrological Adviser as designated by the Member (in accordance with Regulation 6(b), amended – see (3) below) and representatives of National Hydrological Services or other national hydrological agencies as designated by the Members,” to provide advice to Congress on strategic decisions related to operational hydrological issues, in accordance with the terms of reference detailed in Annex 1;
- (2) WMO hydrological activities should be integrated by constituting a joint Hydrological Working Group of Congress and the Executive Council (in accordance with General

Regulation 38) to support the integrated delivery of WMO water-related activities between sessions of Congress and to undertake preparatory work for future meetings of the WMO Hydrological Assembly, as well as to support and advise the Executive Council Technical Coordination Committee (EC/TCC) and regional associations, in accordance with the terms of reference as in Annex 2;

- (3) General Regulation 6(b) should be modified to read "Each Member shall appoint a Hydrological Adviser who preferably should be the Director of the respective National Hydrological Service, or other national hydrological agency, and should advise the Permanent Representative with respect to WMO activities in operational hydrology and its application to water management. The Member shall notify the Secretary-General of such appointments. The Hydrological Adviser will serve as the focal point for technical matters relating to operational hydrology and its application to water management";
- (4) Specific steps should be taken to ensure the implementation of Recommendation 25 (EC-70) to ensure the proper representation of the hydrological community in WMO activities;

Requests that the president of the Commission for Hydrology proactively support the presidents of the new technical commissions to ensure a smooth transition of activities and commitments related to hydrology and water resources into the new structure;

Invites Members to continue supporting WMO initiatives focused on operational hydrology and its application to water resources management by encouraging their national hydrological and water resources management experts and managers to participate actively and contribute their experience and knowledge to the Organization's activities in the area;

Urges Members to enable relevant experts in all aspects of operational hydrology to contribute to WMO programmes and governance.

Annex 1 to Recommendation 2 (CHy-Ext.(2019))

TERMS OF REFERENCE OF THE OPEN COMMITTEE OF CONGRESS ENTITLED THE WMO HYDROLOGICAL ASSEMBLY

General Mandate

The WMO Hydrological Assembly (hereafter referred to as Hydrological Assembly) is convened as an open Committee of Congress (in accordance with Regulation 30(b)) to make recommendations to Congress and relevant constituent bodies on matters related to hydrology including but not limited to Article 2(e) of the Convention

To promote activities in operational hydrology and to further close cooperation between Meteorological and Hydrological Services.

The activities of the Hydrological Assembly shall be guided by the WMO Strategic Plan.

Specific terms of reference

The Hydrological Assembly shall:

- (a) Advise Congress on current and emerging scientific and technical water-related global challenges so as to better reflect them in the WMO Strategic Plan; including linking with the Scientific Advisory Panel;
- (b) Advise Congress on representation of hydrological expertise in the two technical commissions and the Research Board;

- (c) Promote compliance with WMO regulatory material regarding hydrology;
- (d) Encourage among Members the implementation of WMO directives related to hydrology;
- (e) Facilitate, together with Regional Associations, the exchange and uptake of experience, technology, research, education and training to meet the needs of Members regarding operational hydrology and its application to water resources management.

Composition

The members of the Hydrological Assembly should be Hydrological Advisers as designated by Members (in accordance with Regulation 6(b) amended – see “Recommends further to Congress” (3)) and representatives of National Hydrological Services or other national hydrological agencies as designated by Members.

Other relevant organizations including UN, international and regional organizations, private partners, academia and NGOs and/or other national hydrological agencies, may be invited to participate in sessions of the Hydrological Assembly as observers and to nominate experts to assist with the work of the Hydrological Assembly.

Working procedures

The Hydrological Assembly shall:

- (a) Elect a chairperson and vice-chair person;
- (b) Propose three candidates for the officers' positions in the two technical commissions, such as the chair of the Standing Committee on hydrological services of the Commission for Weather, Climate, Water and Related Environmental Services and Applications (CSA) and one of the three vice-chairs of the Commission for Observation, Infrastructure and Information Systems (COIIS). The final selection would be the responsibility of the concerned commissions;
- (c) Nominate the hydrology and water resources management experts to be part of the community of expertise that will underpin the work of the technical commissions;
- (d) Guide regional associations, technical commissions, the Research Board, the Joint WMO-IOC Committee for Oceanography and Meteorology (JCOM) and other relevant bodies, as appropriate.

Annex 2 to Recommendation 2 (CHy-Ext.(2019))

TERMS OF REFERENCE OF THE JOINT WORKING GROUP OF CONGRESS AND EXECUTIVE COUNCIL ENTITLED THE HYDROLOGICAL WORKING GROUP

General Mandate

The Hydrological Working Group supports and advises integrated delivery of WMO water-related activities between Sessions of Congress and undertakes preparatory work for future meetings of the Hydrological Assembly, as well as support and advises EC Technical Coordination Committee (EC/TCC) in accordance with the purposes of the Organization related to hydrology including but not limited to Article 2(e) of the Convention

To promote activities in operational hydrology and to further close cooperation between Meteorological and Hydrological Services.

The Hydrological Working Group shall support, through the provision of hydrological experts and expertise, the efforts of the EC/TCC to identify service and related science and technology gaps associated with each element of the seamless end to end operational prediction process whose elements include data, data services, modelling, prediction, dissemination, decision support, training and outreach. Once identified and prioritized, information regarding these gaps can be used to inform investment decisions made by Members to build operational capacity.

The Hydrological Working Group provides the practical mechanism for WMO to support integrated delivery of hydrological activities including those with the private sector, NGOs, other governmental organizations, high level political representatives, UN, other international organizations, and the research community.

The Group supports integration of hydrological, cryospheric, meteorological and climatological activities (such as the Observing Systems Capability Analysis and Review (OSCAR), the WMO Integrated Global Observing System (WIGOS), the Global Data-Processing and Forecasting System (GDPFS), the Global Multi-Hazard Alert System (GMAS), etc.).

Specific terms of reference

The Hydrological Working Group shall support and advise on the implementation of the WMO operating plan related to hydrology as needed by:

- (a) Integrating water-related services across WMO, promoting collaboration and linkages among hydrology, cryospheric science, climatology and meteorology so as to encourage seamless delivery of water-related services;
- (b) Supporting alignment of the work programme across WMO bodies to implement Congress decisions related to hydrology and water resources management;
- (c) Ensuring hydrological community engagement in COHS, particularly in relation to:
 - (i) Supporting Members in developing and maintaining the capabilities in the monitoring of hydrological elements characterizing the quantity and quality of water and sediment in the hydrological cycle;
 - (ii) Supporting Members in their integration of hydrological observing and data systems with those for other parts of the earth system;
 - (iii) Collaborating on the preparation of regulatory material for the basic measurement of variables characterizing water quantity, quality and sediments;
- (d) Supporting hydrological community engagement in CSA, particularly in relation to:
 - (i) The development of climatological and meteorological services for hydrology and of hydrological services for meteorology and climatology;
 - (ii) Supporting Members in developing and maintaining hydrological forecasts and warnings;
 - (iii) Supporting Members in developing and maintaining products and practices for effective and sustainable water resources management;
- (e) Managing implementation of those activities that are purely hydrological in nature, including those with key external partners;
- (f) Ensuring WMO support to Members in their development of new and enhanced capabilities in hydrology and water resources, including, but not limited to:

- (i) Hydrological observations, such as, but not limited to, those related to surface and sub-surface variables characterizing the quantity and quality of water and sediment;
 - (ii) Hydrological status assessments and outlook services through implementation of the Hydrological Status and Outlook System (HydroSOS) and development of other water information and products;
 - (iii) The application of water-related data, information and products to the assessment, effective management, and sustainable development of water resources and to the protection of society from hydrological hazards;
 - (iv) The implementation of practices and procedures for the free and unrestricted exchange of hydrological data and products;
- (g) Maintaining and strengthening WMO key strategic cooperation with relevant intergovernmental, governmental and non-governmental organizations in the areas of hydrology including its application to water resources management to support the implementation of [WMO Vision and Strategy for Hydrology](#).
- (h) Regularly review and update the [WMO Vision and Strategy for Hydrology](#), taking into account the ambitions of Members expressed by the Hydrological Assembly and report to the Executive Council and the Hydrological Assembly on the Plan of Action developed by the Regional Associations as per Recommendation 1 (CHy-Ext.(2019)).
- (i) Providing expert advice in support of the preparation of the regional hydrological Plans of Action.

Composition

The members of the group shall include:

- (a) the Chair and vice-Chair of the Hydrological Assembly;
- (b) Chairs of hydrology related Standing Committees and Study Groups of COIIS and the Commission for Weather, Climate, Water and Related Environmental Services and Applications (CSA). If no specific hydrological Standing Committees exist under a Technical Commission, a vice-Chair of the Commission shall be nominated to be a Member of the body;
- (c) A representative of the Research Board;
- (d) Regional Hydrological Advisers and Chairs of Regional Working Groups on Hydrology (if different);
- (e) Others coordinating major elements of the WMO hydrological portfolio (e.g. HydroSOS, Global Hydrometry Support Facility (HydroHub), Flash Flood Guidance Systems (FFGS), Flood Forecasting Initiative (FFI) as appropriate);
- (f) Representatives of other international and regional organizations in the field of hydrology and water resources as appropriate;
- (g) Representatives of NGOs, private sector, academia and other relevant stakeholders as appropriate.

The Hydrological Working Group reports to Congress and EC and supports EC/TCC.

Working procedures

The Hydrological Working Group shall:

- (a) Normally meet every year;
 - (b) Make effective use of electronic forms for coordination and collaboration;
 - (c) Ensure regional and gender balance and inclusiveness in all its structures and work plans;
 - (d) Organize communication and outreach to inform the global hydrological community of ongoing work, achievements and opportunities;
 - (e) Apply a system for recognition of achievements and promotion of innovation with engagement of young professionals.
-

APPENDIX 4. LIST OF PARTICIPANTS

1. Officers of the session

Harry LINS	President of the Commission for Hydrology (CHy)
Silvano PECORA	Vice-president of CHy

2. WMO Members represented in the technical commission

Argentina

Mariano RE	Principal delegate
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Armenia

Amalya MISAKYAN (Ms)	Principal delegate
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Australia

Robert ARGENT	Principal delegate
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Austria

Günter BLÖSCHL	Principal delegate
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Belarus

Liudmila ZHURAVOVICH (Ms)	Principal delegate
Sviatlana KUZMICH (Ms)	Delegate

Brazil

Marcelo Jorge MEDEIROS	Principal delegate
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British Caribbean Territories

David FARRELL	Principal delegate
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Bulgaria

Elena BOJILOVA (Ms)	Principal delegate
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Cameroon

Jean Claude NTONGA	Principal delegate
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Canada

Alain PIETRONIRO	Principal delegate
Jean-Francois CANTIN	Delegate
Nathan PRITULA	Delegate

Central African Republic

Athanase Hyacinthe Anaclet YAMBELE	Principal delegate
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China

Li WEI (Ms)	Principle delegate
Yanshan YANG	Alternate
Xiaodan NA (Ms)	Delegate

Guoqing WANG	Delegate
Jianqing YANG	Delegate
Hongzheng ZHANG	Delegate
Jingyi ZHANG (Ms)	Delegate
Liuzhu ZHANG	Delegate
Congo	
Jean Bienvenu DINGA	Principal delegate
Costa Rica	
Jose Alberto ZUNIGA MORA	Principal delegate
Côte d'Ivoire	
Kone DIAKARIA	Principal delegate
Ahmed Lamine SOUMAHORO	Delegate
Croatia	
Gordana BUSELIC (Ms)	Principal delegate
Czech Republic	
Jan KUBAT	Principal delegate
Ondrej LEDVINKA	Delegate
Denmark	
Henrik VEDEL	Principal delegate
Kim SARUP	Alternate
Dominican Republic	
Israel ACOSTA LANTIGUA	Principal delegate
Ecuador	
Fernando GARCÍA	Principal delegate
Egypt	
Walid Mohamed Ali Ahmed HAKIKI	Principal delegate
Ashraf ZAKAY	Delegate
Fiji	
Viliame VEREIVALU	Principal delegate
France	
Joel HOFFMAN	Principal delegate
Alain LARAQUE	Delegate
Gambia	
Landing BOJANG	Principal delegate
Georgia	
Irakli MEGRELIDZE	Principal delegate

Germany

Gerhard ADRIAN	Principal delegate
Andreas BECKER	Delegate
Dirk ENGELBART	Delegate
Barbara FRUH (Ms)	Delegate
Harald KOETHE	Delegate

Hungary

Andras CSIK	Principal delegate
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Iceland

Arni SNORRASON	Principal delegate
Jorunn HARDARDOTTIR (Ms)	Delegate

Iran, Islamic Republic of

Sadegh ZEYAEYAN	Principal delegate
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Italy

Angela Chiara CORINA (Ms)	Principal delegate
Nicola BERNI	Delegate
Martina BUSSETTINI (Ms)	Delegate
Umberto DOSSELLI	Delegate

Jamaica

Peter CLARKE	Principal delegate
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Japan

Atsushi OMATA	Principal delegate
Toshio KOIKE	Delegate
Mamoru MIYAMOTO	Delegate
Satoshi OGAWA	Delegate
Tomoyuki OKADA	Delegate

Jordan

Ali SUBAH	Principal delegate
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Kazakhstan

Didar ZHANIBEKULY	Principal delegate
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Liberia

Wynitta Kopeh GWAIKOLO (Ms)	Principal delegate
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Madagascar

Herinjanahary RALAIARINORO	Principal delegate
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Morocco

Rachid SEBBARI	Principal delegate
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Mozambique

Luisa do Ceu Ricardo DA CONCEIÇÃO (Ms) Principal delegate

Myanmar

Htay Htay THAN (Ms) Principal delegate

New Zealand

John FENWICK Principal delegate

Niger

Mohamed Housseini IBRAHIM Principal delegate

Nigeria

Clement NZE Principal delegate
Aishatu IBRAHIM (Ms) Alternate
Daniel Agada AMODU Delegate

North Macedonia

Vasko STOJOV Principal delegate

Norway

Morten JOHNSRUD Principal delegate

Paraguay

Nelson Heriberto PEREZ TRIVERO Principal delegate

Peru

Ken TAKAHASHI GUEVARA Principal delegate

Philippines

Roy A. BADILLA Principal delegate

Poland

Michal KASINA Principal delegate

Republic of Korea

Jaeheyon PARK Principal delegate
Yeunsook CHOI (Ms) Delegate
Hwirin KIM (Ms) Delegate
Sung KIM Delegate
Jungwoong KO Delegate
Jaeman LEE Delegate
Taesuk OH Delegate

Romania

Marius MATREATA Principal delegate

Russian Federation

Sergei ZHURAVLEV Principal delegate

Sergey BORSHCH	Delegate
Artem SHEVCHENKO	Delegate
Yury SIMONOV	Delegate
Valery VUGLINSKY	Delegate
Sao Tome and Principe	
Argentino DA COSTA VANGENTE	Principal delegate
Senegal	
Bocar Abdallah SALL	Principal delegate
Serbia	
Slavimir STEVANOVIC	Principal delegate
Bojan PALMAR	Delegate
Slovakia	
Jana POÓROVÁ (Ms)	Principal delegate
Danica LESKOVA (Ms)	Delegate
Spain	
José Pablo ORTIZ DE GALISTEO MARÍN	Principal delegate
Sweden	
Cristina ALIONTE EKLUND (Ms)	Principal delegate
Switzerland	
Olivier OVERNEY	Principal delegate
Peter BINDER	Delegate
Manuel KELLER	Delegate
Thailand	
Kornawee SITTHICHIVAPAK (Ms)	Principal delegate
Rattana PRAKHAMMINTARA (Ms)	Alternate
Turkey	
Hikmet EROGLU	Principal delegate
Emel UNAL (Ms)	Delegate
Veysel YILDIZ	Delegate
Ukraine	
Viacheslav MANUKALO	Principal delegate
Denys BORDIIAN	Delegate
United Kingdom of Great Britain and Northern Ireland	
Phil EVANS	Principle delegate
Alan JENKINS	Alternate
Harry DIXON	Delegate
Jane WARDLE (Ms)	Delegate

United Republic of Tanzania

Habiba Ismail MTONGORI (Ms)
Robert K. M. SUNDAY

Principal delegate
Alternate

United States of America

Thomas GRAZIANO
William Carl BOLHOFER
Janice FULFORD (Ms)
Angela GUTIERREZ-MAGNESS (Ms)
Daniel MULLER
Aaron SALZBERG

Principal delegate
Delegate
Delegate
Delegate
Delegate
Delegate

Uruguay

Silvana MSC. ING. ALCOZ (Ms)
Yliana ABIMORAD (Ms)
Valentina SIERRA (Ms)

Principal delegate
Delegate
Delegate

View Nam

Thanh Mai DANG (Ms)

Principal delegate

Zambia

Kenneth NYUNDU

Principal delegate

3. WMO Members not represented in the technical commission**Bhutan**

Sangay TENZIN

Principal delegate

Bosnia and Herzegovina

Darko BOROJEVIC

Principal delegate

Chad

Nguemadjita DJASRABE

Principal delegate

Comoros

Ahmed Mohamed YAHAYA

Principal delegate

Curaçao and Sint Maarten

Frans WERLEMANN

Principal delegate

Montenegro

Ervin KALAC
Maja JOVOVIC SCHMIDT (Ms)

Principal delegate
Delegate

Samoa

Malaki IAKOPO

Principal delegate

South Sudan

Simon OTOUNG AWIJAK

Principal delegate

Tajikistan

Abduvali KHOMITOV Principal delegate

Tonga

Rennie VAIOMOUNGA Principal delegate

4. Invited experts

Curtis B. BARRETT
 Valeriu CAZAC
 Fadi DOUMIT
 David GRIMES President of WMO
 Ronaldo INGUANE
 Angelika Perrine KOBSIK (Ms)
 Ratu Aminisitai Tagaga LOCO
 Marie Pierre MEGANCK (Ms)
 Aloys RURANTIJE
 Marcelo URIBURU QUIRNO
 Carolina WITWER (Ms)

5. Lecturers

Nilay DOGULU (Ms)
 Henk OVINK
 Maciej ZALEWSKI

6. Representatives of international organizations and other bodies**Global Water Partnership**

Frederik PISCHKE Observer
 Monika WEBER-FAHR (Ms) Observer

International Commission on Irrigation and Drainage

Mario ARCIERI Observer

International Union of Geodesy and Geophysics

Arthur ASKEW Observer
 Christophe CUDENNEC Observer

United Nations Educational, Scientific and Cultural Organization

Abou AMANI Observer
 Maria de la Concepcion Itzel DONOSO CHUMILLAS (Ms) Observer

World Federation of Engineering Organizations

Pierre QUELOZ Observer

World Bank

Daniel KULL Observer

APPENDIX 5. BACKGROUND DOCUMENTS



World Meteorological Organization
COMMISSION FOR HYDROLOGY
Extraordinary Session
Geneva, Switzerland
13 to 14 February 2019

CHy-Ext.(2019)/INF. 1(1)
Submitted by:
Secretary-General
12.XII.2018

MATERIAL ARRANGEMENTS FOR THE SESSION

Venue

The Extraordinary session of the Commission for Hydrology (CHy-Ext.(2019)) will be held in Geneva (Switzerland), on 13 February (pm) and 14 February 2019, at the WMO headquarters building, 7bis, avenue de la Paix. The opening ceremony will take place at 2.30 pm on Wednesday, 13 February 2019 in the main conference hall, Salle Obasi.

A Technical Conference (TECO-Hydro) will be held at the same venue from Monday, 11 February to Wednesday, 13 February 2019 (am).

Working languages

During the TECO-Hydro and the CHy-Ext.(2019) sessions, simultaneous interpretation in the six WMO official languages (Arabic, Chinese, English, French, Russian and Spanish) will be provided in the main conference room. Additional meeting rooms without interpretation facilities will also be available.

Documents

Delegations wishing to submit documents before the session are invited to send them to the WMO Secretariat, as soon as possible but not later than 60 days before the opening of the session, in accordance with the provisions of Regulation 190(b) of the WMO General Regulations to allow time for translation. According to Regulation 189 of the WMO General Regulations, session documents should be distributed as soon as possible and preferably not later than 45 days before the opening of the session. Any document presented by a delegation should be submitted in the name of the Member of the Organization and not by an individual person.

Processes and document workflows

The presentation of session documents and the organization of the work of the session will differ this year from the practice of previous sessions, as explained on the CHy-Ext.(2019) website (meetings.wmo.int/CHy-Ext). See [Document INF 1\(2\)](#).

Distribution of documents

Documents will be posted before and during the session on the session website, in line with WMO greening efforts to promote paper-smart meetings. Participants are therefore kindly invited to bring internet-enabled portable computers capable of handling Microsoft Word 2010 and Adobe PDF formats so that they can work in paper-smart mode during the session.

Provisional abridged report

Approved documents showing amendments in all languages will be posted as soon as possible after the session on the CHy-Ext.(2019) website in the folder "Provisional Final Report".

Registration of participants

Online pre-registration is strongly recommended for those wishing to participate in the TECO-Hydro and CHy-Ext.(2019). In view of their official status with WMO, Permanent Representatives of WMO Members (PRs) have been given access to an [online Event Registration System](#) allowing the pre-registration of their respective delegations. More information concerning online pre-registration will be provided in due course on the CHy-Ext.(2019) session website (meetings.wmo.int/CHy-Ext).

A conference information and registration desk will be set up close to the meeting rooms to facilitate the registration of participants and provide general information. Registration for the TECO-Hydro and CHy-Ext.(2019) will take place on 10 February 2019 between 4 and 6 pm and will continue throughout the TECO-Hydro and the CHy-Ext.(2019) sessions. At the time of registration, participants will receive identification badges which should be worn throughout the session.

Credentials

Pursuant to Regulation 21 of the General Regulations, prior to a session of a constituent body other than the Executive Council, each Member should, if possible, communicate to the Secretary-General the names of the persons composing the delegation to that body, indicating which of these shall be regarded as its principal delegate. In addition, a letter giving these particulars and signed by, or on behalf of, an appropriate governmental authority of the Member shall be sent to the Secretary-General or handed to his representative at the session. This letter shall be regarded as appropriate credentials for the participation of the individuals named therein in all activities of the constituent body.

Representatives of international organizations invited as observers to the session should provide in advance, or bring to the session, a letter of representation signed by the appropriate authority from their organization.

List of participants

A provisional list of participants will be uploaded on the session website shortly after the beginning of the meeting. This list will be updated on a daily basis.

Internet facilities

A Wireless Internet connection (Wi-Fi) will be available in the main conference room and at the WMO Conference Centre. Access is free and does not require a password.

Entry requirements

All participants who require an entry visa for admission to Switzerland should apply for their visa directly to the nearest diplomatic representation of Switzerland and include a copy of the notification of the meeting with the visa application. It is advisable that such applications be made as soon as possible (a minimum of 20 days and a maximum of 3 months before departure). Please inform us through ffol@wmo.int and chy@wmo.int if you require an individual invitation letter for your visa application.

Switzerland applies Schengen regulations for the issuance of visas. This means that all participants requiring a visa to enter Switzerland should apply for their visa directly to the Embassy or Consulate-General of Switzerland in their country. In cases where no Swiss Embassy or Consulate is available, participants should apply to the country designated by Switzerland to handle visa applications.

Under Schengen regulations, it is necessary for each visa applicant to make an appointment and to present him/herself in person, in order to submit and register biometric data. On 11 October 2011, the Schengen member states introduced the Visa Information System (VIS), which is used to store biometric data of Schengen visa applicants. Data remains valid in the VIS system for a period of 5 years.

Additional information in several languages regarding the implementation of VIS, registration of biometric data and the rollout timetable for Swiss embassies/consulates implementing VIS is available through the following link:

www.bfm.admin.ch/bfm/en/home/themen/einreise/einfuehrung_vis.html

Time needed to obtain a visa may vary from case to case. It is strongly recommended that delegates inform themselves on the relevant appointment system and procedures as early as possible, to ensure that the visa can be issued in a timely manner. Delegates can find this information on relevant national government websites, or they can consult directly with the Swiss Embassy/Consulate in the applicant's country of residence.

In cases where no diplomatic relations exist between a Member and Switzerland, or where a Member considers that difficulties may be experienced in obtaining visas, delegates can submit a visa request directly to Switzerland. However, under Annex I of the General Regulations of the Organization, this request must be sent by the delegate to the Secretary-General of the World Meteorological Organization who will in turn submit it to Switzerland.

Such requests must contain all the necessary details: name, surname, date and place of birth, father's name, nationality, passport number, date and place of issue, expiry date, profession, place where the visa is to be issued, and duration of stay in Switzerland. Requests should be received by the Secretary-General as far in advance of the meeting as possible.

Additional information regarding entry visas for Switzerland and Swiss representation abroad may be found through the following links:

(i) www.bfm.admin.ch/bfm/en/home/themen/einreise/merkblatt_einreise.html

(ii) www.eda.admin.ch/eda/en/home/repr.html

Transportation

Hotels in Geneva provide all guests, upon demand, with a free ticket for public transport. In addition, upon arrival at Geneva airport, free tickets are available from the machine in the baggage collection hall before passing customs.

General information on how to get to WMO from the airport and how to get to the city centre can be found on the WMO website: [Here](#).

Currency

The local currency is the Swiss franc (CHF). The average exchange rate is as follows:

1 EUR = 1.14 CHF

1 USD = 0.98 CHF

Health requirements/medical services

Up-to-date information on international travel and health requirements are provided by the World Health Organization (WHO) at the following websites:

<http://www.who.int/ith/en/>

<http://www.who.int/countries/che/en/>

It is strongly recommended that you take out personal travel insurance (with health insurance cover) for the duration of the trip.

Electricity and mobile phone connection

Power systems are generally 230 volts and 50 Hz. A power adapter may be necessary.

Participants are advised to bring their own plug adapters in order to use Swiss power sockets. Information on the appropriate plugs may be found on the Internet (for example, at: <http://www.iec.ch/worldplugs/typeJ.htm>). A limited number of adapters will be available on loan from the Conference Information Desk.

Use of mobile telephones

Participants are kindly reminded that, as a courtesy to their colleagues, their mobile telephones should be muted upon entry to the conference room. Participants are requested to hold phone conversations outside of the conference rooms.

Local climate in February

Climate data in February for Geneva are listed below:

Mean temperature	3°C
Mean maximum temperature	7°C
Mean minimum temperature	-1°C
Mean relative humidity	77%
Mean precipitation	31.8 mm
Mean number of days with precipitation ≥ 1 mm	8.1 days
Mean duration of sunshine	3.1 h/day

Hotel reservations

Participants are advised that hotel accommodation in Geneva and the surrounding area may be scarce. Participants should inquire with the hotels to see if it is possible to have special UN rates for the dates of their stay. Please find below the list of some of the hotels located in the vicinity of WMO.

1) [Hotel Ibis Genève Centre Lac](#)

Rue de Berne 26, Pâquis, 1201 Geneva, Switzerland

2) [Hotel Drake-Longchamp](#)

Rue Butini 7, Pâquis, 1202 Geneva, Switzerland

3) [Hotel Ibis Genève Centre Nations](#)

Rue du Grand Pré 33-35, 1201 Geneva, Switzerland

4) [Hotel Les Nations](#)

Rue du Grand Pré 62, 1202 Geneva, Switzerland

5) [Hotel Eden](#)

Rue de Lausanne 135, 1202 Geneva, Switzerland

6) [Hotel Mon Repos](#)

Rue de Lausanne 131, 1202 Geneva, Switzerland

For more information, you can consult the [Geneva Tourism](#) official website.



World Meteorological Organization
 COMMISSION FOR HYDROLOGY
 Extraordinary Session
 Geneva, Switzerland
 13 to 14 February 2019

CHy-Ext.(2019)/INF. 1(2)

Submitted by:
 Secretary-General
 12.XII.2018

DOCUMENT PROCESSING FOR THE EXTRAORDINARY SESSION OF THE COMMISSION FOR HYDROLOGY (CHY-EXT.(2019))

Document types for the extraordinary session of the Commission for Hydrology (CHy-Ext.(2019))

- (1) The extraordinary session of the Commission for Hydrology (CHy-Ext.(2019)) will use two types of document:
 - **Doc.** (documents) whose contents are listed below; these will appear in the final report;
 - **INF.** (information) papers, which provide additional information relevant to the decisions/recommendations/resolutions adopted at the meeting; these will appear only in Part II of the report.

- (2) The first type of document (**Doc.**) will consist of up to three parts, and every document will contain at least one decision and/or one resolution and/or one recommendation:
 - (a) **Resolutions** (optional) are decisions of CHy that concern only the internal activities of the Commission, such as actions to carry out its part of the strategic programme of the Organization, the establishment and terms of reference of a working group or the designation of a rapporteur, in line with General Regulation 182(b);
 - (b) **Decisions** (optional) place on record instructions/directives to the Advisory Working Group from CHy, Congress or EC resolutions or decisions, or provide records of CHy opinions/observations on a specific topic, procedural decisions and other decisions pertaining to the internal matters of CHy, in line with General Regulation 182(c);

The decision justification (optional) is additional information that is essential to support the decision being made. This should be short and should refer, as far as possible, to pre-existing documents. This part of the document will appear in the final report immediately after the corresponding decision.
 - (c) **Recommendations to Congress or the Executive Council** (optional) are decisions of CHy requiring financial support or implementation by Members, proposals for Secretariat action or requiring coordination with other WMO bodies or with bodies outside the Organization, in line with General Regulation 182(a).

Document processing

- (3) The first version (DRAFT 1) of documents will be published on the CHy-Ext.(2019) website, and members of the Commission will be invited to send suggestions for modifying the document to the Secretariat (chy-ext.2019.plenary@wmo.int). These

proposals will be assessed and the second draft (DRAFT 2) will be posted on the CHy-Ext.(2019) website.

- (4) Information documents will be posted on the CHy-Ext.(2019) website, but are not intended for amendment or discussion. These will normally be available in English only.
- (5) During the session, the Chair for an agenda item will lead the discussion on the documents for that item. Within a document, each decision will be discussed separately. In many cases each component of that decision, such as related annexes, will be discussed individually. Following current practice, component parts of a document may be approved by the session while other components may still need additional debate. Documents amended during the session will be posted successively as DRAFT 2, DRAFT 3, and so forth, and the final approved version will be marked APPROVED.
- (6) Discussion of the document may end in two ways. The complete document may be approved, in which case any agreed changes to the document will be included and the approved version will be published on the CHy-Ext.(2019) website in the PROVISIONAL REPORT folder. Alternatively, the Chair of the session may decide that no further progress can be made with the document at that time, in which case changes to the document will be included in the next draft, and the modified document will be published on the CHy-Ext.(2019) website in the DRAFTS FOR DISCUSSION folder. This will be published as the next draft in the sequence (DRAFT 2, DRAFT 3, and so forth), whereas the previous draft will be moved to the SESSION ARCHIVE folder.

Post-session publication

- (7) Approved documents from the session will be translated into all six WMO official languages and placed on the CHy-Ext.(2019) website in the PROVISIONAL REPORT (Approved documents) folder.
 - (8) The approved documents, the agenda and the list of participants will be combined to form the abridged report of the session, which will be edited and published in the six WMO official languages. A second part of the report, consisting of information documents will also be published, in English only.
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World Meteorological Organization
COMMISSION FOR HYDROLOGY
Extraordinary Session
 Geneva, 13 and 14 February 2019

CHy-Ext.(2019)/INF. 2

Submitted by:
 Chair of EC Task Force on
 Water
 24.I.2019

EFFECTIVE PARTICIPATION OF WMO IN THE GLOBAL WATER AGENDA

1. Foreword

1.1 The Seventieth session of the Executive Council (EC-70), through Resolutions 16, 17 and 18, called for a further strengthening of the essential role of hydrology in WMO and for the enhancing of the critical contribution of WMO to the global water agenda. It recommended enhancing Members' capacity to deliver hydrological services, strengthening the promotion of and assistance to hydrological data exchange, focusing hydrological service delivery on decision-makers, defining and implementing hydrology (and/or hydrological centres) in the Global Data-processing and Forecasting System (GDPFS), strengthening the representation of the hydrological community in the governance of WMO, and implementing the recommendations of the WMO HydroConference: Global Conference for Prosperity through Hydrological Services, held in May 2018.

1.2 It also established the EC Task Force on Water. Between EC-70 in June 2018 and CHy-EXT. in February 2019, this group met twice to provide guidance on WMO's grand challenges in hydrology and the embedding of hydrology within the Earth System's approach. Two major guiding questions for the Task Force were:

- What major external changes and dynamics demand a response from National Hydrological Services (NHSs) and the hydrological community in WMO?
- What is needed to strengthen the capacity of NHSs, particularly in the area of cooperation?

1.3 Furthermore, EC-70 recommended to Cg-18, through Recommendation 15, the approval of the Implementation Plan for the Future Seamless Global Data-processing Forecasting System (S/GDPFS) which outlines the Earth System modelling capability of the integrated Earth System and its components, i.e. weather, water, climate, ice, the land surface and environment including human impact. S/GDPFS is backed by the research, operations and services sections of WMO in a value chain framework, and the S/GDPFS Steering Group for the implementation plan is co-chaired by P-CBS and P-CAS.

2. Background

2.1 This section sets out the major hydrological challenges in operational hydrology in respect of the following three considerations:

- Water is increasingly being identified as one of the highest global risks in terms of impact by the World Economic Forum. Whereas in the past water-related risks were largely considered environmental, they are now recognized as societal and geopolitical;
- Addressing water issues involves consideration of both risks and opportunities: WMO is committed to taking a programmatic approach that will maximize benefits to Members while minimizing risks;

- Water-related actions must consider three distinct types of uncertainty: unknown or poorly understood and inadequately measured natural processes associated with the hydrological cycle; diverse and often competing water uses and users; and the diversity of services and service providers.

2.2 With respect to water use and users, specific requirements include:

- Real-time management of flood and drought events, integrated flood management including inundation mapping;
- Integrated water management in national and transboundary catchments;
- Information on water quality, sediments and other elements;
- Civil engineering for design of infrastructure;
- Agriculture, drainage and irrigation schemes and management;
- Ecosystem management including wetlands;
- Design and management of hydropower systems;
- Design and management of fluvial transport;
- Academic support for climate studies, trend analysis, decision support systems.

2.3 In terms of service provision, there is considerable fragmentation among water sector players. This is true for administration/science/research/operations on a national level, and is mirrored in a multifaceted community of regional and international entities including NGOs, research associations/programmes and UN Organizations. In order to coordinate work on water management and hydrology more effectively, and to ensure more coherence on regional and global scales, WMO, together with 7 partners, organized a global hydroconference in May 2018, attended by 219 participants from 85 countries and 34 organizations, where it:

- Recommended that the WMO Commission for Hydrology take a leading role in organizing follow-up efforts to advance the complete hydrological value chain, in particular those related to operational hydrology;
- Stressed the importance of fora for intergovernmental cooperation in operational hydrology to support Member States in building and enhancing hydrological data, products and services, and recommended strengthening hydrological representation in WMO Constituent Bodies;
- Recognized the important role of weather and climate communities in supporting the development of hydrological services and called for increased cooperation at national, regional and global levels;
- Resolved to form a partnership and develop a framework and guidance for reinforcing hydrological services based on user needs in order to:
 - (a) Foster collaboration for sustainable, improved, tailored and affordable hydrological services;
 - (b) Strengthen the capacities of National Hydrological and Hydrometeorological Services;
 - (c) Support regional and transboundary initiatives and approaches that optimize basin-wide water management, including hydrological data exchange;

- (d) Improve the general understanding of the societal benefits of hydrological services;
- (e) Assist in responding to the requirements of international processes; and
- (f) Develop and maintain an online “Matrix of Engagements”, updated as necessary.

2.4 This background and the recommendations of the Special Dialogue on Water at EC-70, which endorsed the HydroConference’s outcome and the request to include the World Water Data Initiative (a strategic activity initiated by the UN High Level Panel on Water that was transferred to WMO by the Australian government on the same occasion) in the CHy work programme, call for solutions that would amend the classical CHy remit. New features and functionalities should aim at:

- Strengthening integrated scientific foundations of operational hydrology, as the hydrological service provision needs to be science-driven in order to exploit the opportunities in the framework of seamless Earth System modelling and the growing interoperability of observations in the Earth System’s components (weather, water, climate, soil, ice and biogeochemistry including human activities). The S/GDPFS, under evolution in WMO, forms an appropriate framework as it embraces weather, water, climate and environmental systems, and all time and space scales as well as interfaces with societal needs and societal economics. With the support of hydrological and Earth System research communities, coupled with the hydrological service provision in a value chain, the prospects can grow for significant societal benefits and risk reduction in the field of hydrology;
- Organizing an efficient and sustainable coordination of the value chain for hydrological service provision across hydrology, climatology and meteorology, but also across WMO Members, other UN Organizations and other international bodies, the private sector and the many NGOs that work to link sustainable development with water management;
- Generating high level political impact, e.g. mitigating humanitarian crises, providing data for sustainable development and climate change adaptation and mitigation, building peaceful and trusting relationships, particularly through transboundary water management mechanisms.

3. Assessment of the relevance of hydrology in WMO with respect to the global water agenda

3.1 Currently, there are a number of important agendas addressing various aspects of hydrology within the context of sustainable development, climate change adaptation and regional cooperation/peace. This section reviews the principal international agendas, with reference to the WMO hydrological activities/strategic objectives that relate to them.

A. Water in the Sustainable Development Agenda:

SDG 6 of the Agenda 2030 specifically addresses water. At the same time, water is linked to a considerable number of other SDGs. The achievement of SDG 6 is critical to the success of several other SDGs, namely, 2, 8, 11, 12, 13 and 15. The relationship between the WMO hydrology and water resources areas of activity and its strategic goals and the specific SDGs and relevant indicators is listed in brackets below:

SDG 2 End hunger, achieve food security and improved nutrition and promote sustainable agriculture

2.4 By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality. [Integrated water management, floods, droughts, water availability, water storage capacity, irrigation potential, hydrometry]

SDG 6 Ensure availability and sustainable management of water and sanitation for all

6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally. [Hydrometry, water information systems]

6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawal and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity. [Integrated water management, droughts, water availability, hydrometry]

6.5 By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate. [Integrated water management, water availability, hydrometry, capacity-building, hydrological status and outlook, integration of hydro and met service components]

6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes. [Water availability, hydrological status and outlook]

6.A By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies [Water availability, hydro-met development and cooperation, water resource assessment, education and training, capacity building]

6.B Support and strengthen the participation of local communities in improving water and sanitation management. [Water availability, citizen hydrological observations, integrated flood and drought management]

SDG 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

8.4 Improve progressively, through 2030, global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation, in accordance with the 10-year framework of programmes on sustainable consumption and production, with developed countries taking the lead. [Integrated water management, water availability, water monitoring]

SDG 11. Make cities and human settlements inclusive, safe, resilient and sustainable

11.5 By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global

gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations. [Integrated water management, floods, droughts, early warning systems]

11.6 By 2030, reduce, per capita, the adverse environmental impact of cities, including by paying special attention to air quality and municipal and other waste management. [Water availability]

SDG 12. Ensure sustainable consumption and production patterns

12.2 By 2030, achieve the sustainable management and efficient use of natural resources [Integrated water management, water availability, hydrological status and outlook, integrated flood and drought management]

SDG 13. Take urgent action to combat climate change and its impacts¹

13.1 Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries. [Integrated water management, floods, droughts]

13.2 Integrate climate change measures into national policies, strategies and planning. [Integrated water management, water availability, water resources assessment, integrated flood and drought management]

13.3 Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning. [Integrated water management, floods, droughts, water availability, capacity building]

13.b Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing states, including focusing on women, youth and local and marginalized communities. [Integrated water management, floods, droughts, water availability, capacity building]

SDG 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

15.1 By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements. [Integrated water management, water availability, Earth System modelling]

15.3 By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world. [Integrated water management, floods, droughts, integrated modelling]

15.4 By 2030, ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development. [Integrated water management, water availability]

¹ Acknowledging that the United Nations Framework Convention on Climate Change is the primary international, intergovernmental forum for negotiating the global response to climate change.

B. Water and the Paris Agreement:

At COP21 in Paris, on 12 December 2015, Parties to the UNFCCC reached a landmark agreement to combat climate change and to accelerate and intensify the actions and investments needed for a sustainable low carbon future.

The Paris Agreement's central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius. Additionally, the agreement is aimed at increasing the ability of countries to deal with the impacts of climate change, and at catalysing finance flows consistent with a low GHG emissions and climate-resilient pathway. To reach these ambitious goals, appropriate mobilization and provision of financial resources, a new technology framework and enhanced capacity-building is to be put in place, thus supporting action by developing countries and the most vulnerable countries, in line with their own national objectives.

At COP24, the foundations for a regulatory framework to report on climate change and related efforts were agreed. Water is at the frontline of climate change adaptation as we face the new reality of having both too much and too little water in many places. Water is, together with soil, the limiting factor for CO₂ uptake in biosystems on the landmass and will play a crucial role for the transition of energy systems away from fossil fuel. Water ranks highest overall in terms of the activities that countries want to prioritize through their Nationally Determined Contributions to the Paris Agreement.

The Paris Agreement addresses crucial areas necessary to combat climate change. Some of the key aspects of the agreement that WMO activities in water and hydrology should address are set out below, brackets relate to the specific topics in operational hydrology that WMO currently focuses on:

- **Sinks and reservoirs** (Art. 5) – The Paris Agreement also encourages Parties to conserve and enhance, as appropriate, sinks and reservoirs of GHGs including forests. [Integrated water management, water availability, hydrological status and outlook]
- **Adaptation** (Art. 7) – The Paris Agreement establishes a global goal on adaptation – of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change in the context of the temperature goal of the Agreement. It aims to significantly strengthen national adaptation efforts, including through support and international cooperation. It recognizes that adaptation is a global challenge faced by all. All Parties should engage in adaptation, including by formulating and implementing National Adaptation Plans, and should submit and periodically update an adaptation communication describing their priorities, needs, plans and actions. The adaptation efforts of developing countries should be recognized. [Integrated water management, floods, droughts, water availability]
- **Loss and damage** (Art. 8) – The Paris Agreement recognizes the importance of averting, minimizing and addressing loss and damage associated with the adverse effects of climate change, including extreme weather events and slow onset events, and the role of sustainable development in reducing the risk of loss and damage. Parties are to enhance understanding, action and support on a cooperative and facilitative basis with respect to loss and damage associated with the

adverse effects of climate change. [Integrated water management, floods, droughts]

- **Climate change education, training, public awareness, public participation and public access to information** (Art. 12) is also to be enhanced under the Agreement. [Integrated water management, floods, droughts, water availability, capacity building]

C. The Sendai Framework for Disaster Risk Reduction:

The Sendai Framework is a 15-year, voluntary, non-binding agreement which recognizes that the State has the primary role to reduce disaster risk but that responsibility should be shared with other stakeholders including local government, the private sector and other stakeholders. Its objective is: The substantial reduction of disaster risk and loss of life, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries.

The Sendai Framework for Disaster Risk Reduction charts the global course over the next 15 years. During the consultations and negotiations that led to its finalization, strong calls were made to develop practical guidance to support implementation, ensure engagement and ownership of action by all stakeholders, and strengthen accountability in disaster risk reduction.

WMO activities in flood and drought forecasting, early warning, preparedness, vulnerability and resilience are crucial to all 7 global goals of the framework as listed below:

- Substantially reduce global disaster mortality by 2030, aiming at a lower average per 100 000 global mortality rate in the decade 2020-2030 compared to the period 2005-2015;
- Substantially reduce the number of affected people globally by 2030, aiming at a lower average global figure per 100 000 in the decade 2020-2030 compared to the period 2005-2015;
- Reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030;
- Substantially reduce disaster-related damage to critical infrastructure and the disruption of basic services, such as health and educational facilities, including through developing their resilience by 2030;
- Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020;
- Substantially enhance international cooperation targeting developing countries through adequate and sustainable support to complement their national action plans for implementation of this framework by 2030;
- Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030.

D. UNECE Water Convention:

The Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) was adopted in Helsinki in 1992 and entered into force in 1996. Almost all countries sharing transboundary waters in the region of the United Nations Economic Commission for Europe (UNECE) are Parties to the Convention. In 2003, the Water Convention was amended to allow accession by countries outside the UNECE region. The amendment entered into force on 6 February 2013, turning the Water Convention into a legal framework for transboundary water cooperation worldwide. As of 1 March 2016, all United Nations Member States can accede to the Convention. Two African countries were granted membership in 2018.

The Water Convention strengthens transboundary water cooperation and measures for ecologically sound management and protection of transboundary surface waters and groundwaters. The Convention fosters the implementation of integrated water resources management, using the basin approach in particular. The Water Convention requires Parties to prevent, control and reduce transboundary impact, use transboundary waters in a reasonable and equitable way and ensure their sustainable management. Parties bordering the same transboundary waters have to cooperate by entering into specific agreements and establishing joint bodies.

Specifically, Article 4 of the Water Convention states that “the Parties shall establish programmes for monitoring the conditions of transboundary waters”. Here, WMO can support the convention with knowledge, technical expertise, training and technology.

3.2 Although there is a growing awareness that water is one of the key elements for future development, in practice there is still a lack of proper attention given to the topic at both national and UN level. The UN High Level Political Forum on Sustainable Development (HLPF) is reviewing the SDGs in a 4-year cycle. The water goal was reviewed in 2018 against the backdrop provided by the UN-Water SDG 6 Synthesis Report 2018 on Water and Sanitation, which clearly highlights that the world is currently off-track to solve the global water crisis. Results were disappointing both in terms of the process (not all countries were able to take the floor), as well as the content (nobody really knows how to interpret single targets or indicators in relation to overall mid to long-term development pathways).

3.3 From an analysis of all goals, targets and indicators and their interconnectedness, it is clear that there is no readily available, transparent, objective and consistent background information in terms of the hydrological cycle, i.e. how much water is really available where and when, and of what quality is that water. To address this issue, CHy launched an initiative to develop the Hydrological Status and Outlook System at its 15th session in Rome.

3.4 In September 2018, a WMO co-led UN-Water team formulated a proposal to the UN Secretary-General on how to put in place a UN-level water analysis or stocktaking process to address the issues described in sections 3.2 and 3.3 above in an integrated manner.

3.5 Generally, WMO's existing and potential role amongst UN agencies is highly valued by some partners, but mostly unknown by the majority of national level players, as well as those involved with the global water agenda. Therefore, WMO Members' involvement in the water agenda must be strengthened in order to guarantee that NHTs are able (in terms of capacity, structure and equipment) and willing (considered trusted partners at national and international level) to support national to global water stocktaking. This, in turn, will allow them to increase their visibility at the national level and strengthen their financial situation.

3.6 In conclusion, WMO is uniquely positioned within the UN system as a technical agency that is recognized and appreciated by all partners for its expertise and neutrality. This

allows it to play an increasingly important role in assisting Members in increasing their capabilities and in supporting the national to global stocktaking efforts.

4. Strategic goals, principles and conditions for guiding operational hydrology² in WMO into the medium and long term future

4.1 This section summarizes the deliberations of the EC Task Force on Water:

4.1.1 The **strategic goals** for the hydrological community in WMO on the impact scale are:

1) No one is surprised by a flood

Integrated flood management is implemented by WMO Members. Timely flood forecasts/warnings, produced at regional and/or national level, are communicated through national authorities to all people at risk. Flood risk and inundation maps are established and updated. Flood risk reduction measures are undertaken to optimize benefits to society.

2) Everyone is prepared for drought

Drought risk management is implemented and updated by WMO Members, with support from regional centres with necessary data and information.

3) Hydro-climate and meteorological data support the food security agenda

WMO supports resolving the equation of future water demand for human consumption, irrigation, and industry versus water availability. Advice is provided on potential storage and on optimizing rain-fed agriculture.

4) High quality data supports science, operational hydrology and their products

WMO is the international authority that supports Members in the generation of high quality hydrological data and corresponding information, products and services.

5) We know the water resources of our world

An appropriate monitoring system of all elements associated with operational hydrology, including the cryosphere, spans the globe and produces information that can be used to optimize efficiency of existing services, future policies and services, and political decision making from the local to the global scale.

6) Sustainable development is supported by hydrological information

² The role of WMO in promoting international co-operation in "operational hydrology" pertains in varying degrees to the following elements: Precipitation, snow cover, evaporation (from lakes, river basins and reservoirs), water level, flow, temperature and ice regime of rivers, lakes and reservoirs, water and sediment discharge of rivers, soil moisture and depth of soil frost, quality of water, groundwater. *Annex to Resolution 13 (Congress VI)*

Hydrological information is available at all scales in space and time to support all water-dependent sectors for optimal operational resource management as well as for planning and adaptation to transient boundary conditions.

7) Nobody is concerned about water quality degradation

Surface and ground water is permanently monitored to ensure its quality in accordance with its different requirements, and corrective actions are applied when necessary.

4.1.2 The **core principles** necessary to achieve the above are:

1) Hydrological data and products are a global public good

Free and unrestricted access to public and private high-quality hydrological data and products for all.

2) Interoperability is key to improved services

Related disciplines, data, models, and risk management systems across all scales need to be interoperable and connected wherever it improves our analysis and optimization capabilities.

3) Capabilities are catalysed through digital revolution

Using the full potential of the digital revolution to improve science and operations.

4) Innovation and technology improve established systems

Benefitting from new sources of information.

5) Hydrological services are sustainable

Hydrological services are recognized as being of high priority and of public interest having clearly defined roles and responsibilities and sustainable financing.

6) New actors are incorporated along the hydrological value chain from data to product/service

4.1.3 The **conditions** that need to be met/created to achieve the strategic goals are:

1) The capabilities of national and regional entities need to be known

A comprehensive monitoring of capabilities needs to be agreed and put into routine operation.

2) The value chains from hydrological data to products/services must be clear

The products and services needed must be defined at local, national and regional level and examples championed by WMO can serve as starting points to design the necessary links in the value chains.

3) Capacity issues are expressed and addressed

Capacity gaps with regard to data and products are analysed and activities linked to developing the necessary value chains are harmonized with those linked to capacity building.

4) Cooperation is wanted and supported

Cooperation must be focused and based on a common understanding so that the entire system benefits equally.

5) Policies reflect the fact that economic development is predicated on adequate hydrological infrastructure

The actions of national policymakers demonstrate that hydrological data and products are essential to economic prosperity and societal well-being.

6) Free and unrestricted data policy is promoted among Members**7) Users of water resources monitor and report the real usage of the resource****5. Hydrology as a core mandate of WMO**

5.1 The WMO main hydrological activities should focus on increasing the capability of Members to collect data and produce tangible and high quality products. Thanks to its unique expertise in operational hydrology within the UN in conjunction with well-recognized regulations, WMO has an important role to play in rationalizing the global stocktaking process with its international partners. A solid collaboration and coordination of these efforts will lead to more effective and more sustainable achievements.

5.2 The core value of what WMO contributes to the development and implementation of globally coordinated systems includes acquiring, processing, transmitting and disseminating Earth System observations, and related standards and the development and implementation of globally harmonized weather, climate, water, ocean and environment related services and applications to enable informed decision making and thus the realization of socioeconomic benefits by all user communities and society as a whole.

5.3 A closer collaboration with all WMO domains will reinforce the following specific issues:

- Regulation and normalization, with a unified approach wherever possible;
- Development of end-to-end multi-hazard early warning systems;
- Improved understanding and ability in disaster risk reduction and water management processes;
- Building a value chain that links global, regional and national climate services and hydrological services;
- Information on the current and future status of the Earth System considering the whole hydrological cycle;
- Improving synergies in applied research activities;
- Coordinating capacity building and training activities.

5.4 Stronger WMO internal coordination and gains in efficiency will help reach the very diverse and lesser-known public and private users of hydrological services, in addition to the well-known users of the meteorological and climatological communities.

5.5 WMO must strengthen its partnerships with relevant UN agencies and other international players, beyond its traditional links with UNESCO-IHP, IAHS and IAHR, such as

UN Environment, UNDP, UNICEF, FAO, UNECE, international basin commissions, the World Economic Forum to name but a few. Key indicators of success will be the measurable improvement in capabilities of NHSs to address the challenges of the global water agenda and the increased visibility of hydrological activities in WMO contributing to this on global, regional and national scales. These efforts will enhance the overall recognition of WMO as a trusted and solid partner, providing unique and concrete contributions to societal, economic and environmental challenges.

6. Aspiration and impact

- WMO provides guidance for investment in hydrometeorological and water development;
 - WMO provides methodology and builds the capacity of its Members to provide hydrological services to all relevant stakeholders;
 - WMO is seen as an objective, trusted advisor in hydrological disputes with respect to quantity and quality;
 - WMO is contributing to sustainable development and peace;
 - WMO is the link between hydrological scientific research and operations;
 - WMO is the platform for regional cooperation in integrated water resource management;
 - WMO is the lead agency for the appraisal of hydrological conditions, i.e. status and outlook, on a global and regional level.
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World Meteorological Organization
COMMISSION FOR HYDROLOGY
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CHy-Ext.(2019)/INF. 3
Submitted by:
president of CHy
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[All amendments have been made by the Secretariat]

RECOMMENDATIONS TO Cg-18 ON WAYS TO INTEGRATE HYDROLOGICAL ACTIVITIES INTO THE NEW WMO STRUCTURE

1. Foreword

1.1 Established in 1950, the World Meteorological Organization (WMO) recognizes the need to continuously adapt to a rapidly changing world. In 2015, the Seventeenth World Meteorological Congress¹ requested the Executive Council (EC) to undertake a holistic review of the Organization, and to provide recommendations to the Eighteenth Congress on constituent body constructs, as appropriate, including possible new structures for TCs, RAs, EC, and also to provide recommendations on rules, procedures, processes, working mechanisms, and duties, of constituent bodies, WMO Officers (President, vice-presidents, PRAs and PTCs) and the relationship between them and the WMO Secretariat to enhance the efficiency and effectiveness of the Organization and good governance.

1.2 In this context, EC-70 urged “the president of the Commission for Hydrology (CHy) to convene an extraordinary session of CHy as soon as possible in Geneva to lay out the path forward with regard to the major WMO developments in hydrology and to propose the necessary organizational arrangements for the hydrological community to deliver on relevant strategic objectives defined in the WMO Strategic Plan”. As such, recommendations from EC-70 regarding the organizational arrangements for hydrology within the proposed reforms were held pending the outcome of CHy-Ext.

1.3 The purpose of this document is to provide the hydrological community with the necessary background information to make the best possible proposals in response to the request of EC-70. It has been prepared by the Advisory Working Group (AWG) of CHy augmented by the Regional Hydrological Advisers (referred to from hereafter as AWG-augmented) with the assistance of the WMO Secretariat. The proposals themselves will be presented as Recommendations by CHy-Ext. to Cg-18, which will take the final decision.

1.4 In a nutshell, the AWG-augmented sees the WMO reform process as a great opportunity to enhance the support of WMO to hydrologists worldwide and increase the visibility and involvement of the hydrological community in WMO activities and structures in order to elevate the WMO importance and its contribution to the global water agenda. However, two main concerns were raised.

1.5 The first refers to the impact of the proposed new two-Commission structure vis-à-vis the current end-to-end approach of CHy: it was felt that the reform, by integrating meteorological activities according to the meteorological value chain, would *de facto* have the effect of disaggregating the current seamless CHy approach to water issues - from data to services - into the two new Commissions, their standing committees and study groups.

¹ [Seventeenth World Meteorological Congress: Abridged final report with resolutions](#) – 7.7 Continuous improvement of WMO processes and practices.

1.6 The second concern refers to the importance of proper representation of the hydrological community in the different components of the new structure: it was felt that the current proposals put forward by EC-70 risk inadvertently disenfranchising the WMO water community by increasing their costs of involvement and reducing their voice within the Organization.

1.7 The AWG-augmented concluded that the main challenge facing CHy-Ext. would then be to propose ways to engage the best hydrological and water resources management experts to deliver the same seamless approach in the new framework, while taking advantage of the opportunities offered by the Reform.

1.8 **Section 2** presents a succinct description of the main elements of the WMO Reform and describes the status of the Transition Plan at the moment of the writing of this document (November 2018). As this is work in progress, it is possible that during CHy-Ext. an update will be presented.

1.9 **Section 3** is an overview of the past and existing programmes and structures related to hydrology in WMO, their relationship to other WMO programmes and strategic priorities, as well as their evolution in meeting the needs of the National Hydrological Services (NHSs).

1.10 **Section 4** contains a set of principles the AWG-augmented agreed upon and proposes to CHy-Ext. as the basis for evaluating the different structural alternatives related to hydrology in the context of WMO.

1.11 **Section 5** presents the two alternative options in relation to the future organizational arrangements for the hydrological community that the AWG-augmented decided to submit to the consideration of CHy-Ext. While only two options are presented, this is done on the understanding that CHy-Ext. participants have the possibility to propose new, different options, and explains why other options were considered but discarded in the process. The AWG-augmented agreed that the objective of CHy-Ext shall be to finally submit only one consensus option to Congress.

1.12 **Section 6** briefly discusses possible next steps in the process.

1.13 A separate document (CHy-Ext.(2019)/INF. 2) provides the background information to assist CHy-Ext. with Item 2 of the agenda, namely the effective participation of WMO in the global water agenda.

2. Explanation of the WMO Constituent Body Reform (CBR) process

The guidance by WMO governing bodies

2.1 As the UN Specialized Agency responsible for weather, climate and water, the World Meteorological Organization (WMO) serves the interests of its Members within its remit and domain of expertise. It seeks to support them in achieving their goals in the most efficient and cost-effective manner possible. In particular, WMO Members are committed to delivering high-quality weather, climate and water resources management, monitoring and prediction services that will assist decision-makers at all levels of society. In addition to helping national interests in providing safety and security for populations and fostering economic prosperity, these services also contribute to the broader global agenda, notably the Sustainable Development Goals, the Sendai Framework on Disaster Risk Reduction, and the Paris Agreement on climate change.

2.2 The Seventeenth World Meteorological Congress requested the Executive Council to provide recommendations to the Eighteenth Congress on constituent body constructs, as

appropriate, including possible new structures for technical commissions, regional associations and the Executive Council, and also to provide recommendations on rules, procedures, processes, working mechanisms, and duties, of constituent bodies, WMO Officers (President, Vice-presidents, presidents of regional associations and technical commissions) and the relationship between them and the WMO Secretariat to enhance the efficiency and effectiveness of the Organization and good governance.

2.3 In response to this request, in 2016 the Executive Council (EC), at its sixty-eighth session² tasked the EC Working Group on Strategic and Operational Planning (WG/SOP) with launching this review. In 2017 the sixty-ninth EC³ expressed its agreement with the need for change, noting that it should be implemented through a phased approach ensuring smooth and effective transformation of different kinds of WMO constituent bodies. It also observed that transformative and innovative processes have already started in several key areas.

2.4 The supporting documentation for EC-69⁴ also included a number of key criteria that would need to be met by a new structure; these have subsequently been used as the basis for an assessment of the different structure options considered by the WG/SOP:

- (a) Doing no harm – WMO core business is, at a minimum, maintained during and after transition to the new structure;
- (b) Building all WMO Members' resilience to the consequences of weather, hydrological and climate hazards;
- (c) Yielding improved relevance, effectiveness and efficiency through a flexible structure, improving WMO ability to deliver its core functions and respond to change;
- (d) Evolution toward a seamless Earth system approach whilst minimizing the gap between research and operations;
- (e) Aligning structure with the value chain in provision of hydrometeorological services;
- (f) Improving strategic and structural alignment of the constituent bodies, improving the inter-relationships and adaptiveness among the technical commissions and other constituent bodies, specialized regional centres and Regional Training Centres;
- (g) Strengthening of user and client focus through a holistic fit and synergy with other key international, national, and regional organizations; and
- (h) Optimizing WMO resources through the ability to attract and use all the best experts, including from outside the NMHS community.

2.5 These factors or criteria are recommended as guidance for the work of EC-70 and in-session committee(s) in considering the proposed reform.

The proposed WMO Strategic Plan 2020-2023 as a reference framework for the proposed constituent body reform

2.6 The work of WMO is guided by strategic and operational plans that are adopted every four years. The new Strategic Plan will be adopted by the Eighteenth World

² [Executive Council - Sixty-eighth session: Abridged final report with resolutions and decisions – Decision 84 \(EC-68\)](#).

³ [Executive Council - Sixty-ninth session: Abridged final report with resolutions and decisions – Decision 68 \(EC-69\)](#).

⁴ [EC-69/INF. 16.3 Proposal for WMO constituent body reform](#), section 7, "Rethinking an operating model and governance for WMO".

Meteorological Congress in June 2019. A revised system of WMO constituent bodies is also meant to support the implementation of the Strategic Plan in 2020-2023.

2.7 The seventieth session of the Executive Council⁵ recommended to Congress a new comprehensive vision for the Organization: “We envision a world in 2030 where all WMO Members, especially the most vulnerable, are more resilient to the socioeconomic consequences of extreme weather, water, climate and other environmental events; and support their sustainable development through the best possible services, whether over land, at sea or in the air”.

2.8 It also endorsed three overarching priorities – addressing disaster risk reduction, climate risk and socioeconomic benefits – and the structure of the draft Strategic Plan based on five long-term goals and associated objectives:

- (a) Better serve societal needs: Delivering, authoritative, accessible, user-oriented and fit-for-purpose information and services,
- (b) Enhance Earth system observations and predictions: Strengthening the technical foundation for the future,
- (c) Advance targeted research: Leveraging leadership in science to improve understanding of the Earth system for enhanced services,
- (d) Close the capacity gap on weather, climate, hydrological and related environmental services:⁶ Enhancing service delivery capacity of developing countries to ensure availability of essential information and services needed by governments, economic sectors and citizens,
- (e) Strategic realignment of WMO structure and programmes for effective policy- and decision-making and implementation.

2.9 These five long-term goals, and in particular the first three, provide a reference framework for the organization of a system of technical commissions to support their implementation.

The recommendations of the Executive Council based on the proposal by the WMO Executive Council Working Group on Strategic and Operational Planning (WG/SOP)

2.10 Based on the work carried out by the EC WG/SOP through four meetings between 2016 and 2018⁷, the seventieth session of the Executive Council adopted a consolidated proposal for the reform of WMO constituent bodies, aligned with the concept of the Strategic Plan. While all recommendations regarding hydrology were made pending the outcome of CHy-Ext., the generality of the EC-70 proposal can be summarized as follows:

- (a) An intergovernmental technical **Commission for Weather, Climate, Water⁸ and Related Environmental Services and Applications** (CSA) to support the implementation of Long-Term Goal 1 and further the application of meteorology to aviation, shipping, water problems, agriculture and other human activities through the development and implementation of globally harmonized services in all main domains of the Organization – weather, climate, water⁹ and other environmental services - to

⁵ Recommendation 20 (EC-70).

⁶ e.g. air quality, sand dust and storms, ozone.

⁷ Geneva: 16-19 February 2016; 1-3 March 2017; 28-29 October 2017; 11-13 April 2018.

⁸ CHy-Ext. may wish to recommend to Cg-18 substituting “water” for “hydrological” in the name of the Commission

⁹ CHy-Ext. could recommend a similar change as the one in the previous footnote

enable informed decision-making and realization of socioeconomic benefits by all user communities and society as a whole;¹⁰

- (b) An intergovernmental technical **Commission for Observation, Infrastructure and Information Systems** (COIIS) to support the implementation of Long-Term Goal 2 through the development and implementation of globally coordinated systems for acquiring, processing, transmitting and disseminating observations; the development and promulgation of standards for meteorological, hydrological and other environmental observations; the coordination of the production and use of standardized analysis and model forecast fields; and the development and implementation of sound data management practices, for all WMO Programmes and their associated application areas;¹¹
- (c) A **Scientific Advisory Panel** of independent experts under the Congress and a **Research Board** to support the implementation of Long-Term Goal 3 through advising on the efforts required to enhance weather, climate, water and related environmental sciences, guiding the scientific development of seamless systems across time and spatial scales, disciplines and programmes and activities and forward looking strategic advice on emerging challenges and opportunities;¹²
- (d) An enhanced role of **regional associations** to support the implementation of Long-Term Goal 4 together with a mechanism for capacity development and education and training aiming at reducing gaps among members and keeping the principle of no Member left behind and left alone;¹³
- (e) The consolidation of the structures of the **Executive Council** around a **Policy Advisory Committee** and a **Technical Coordination Committee** to implement Long-Term Goal 5 by guiding the optimization of WMO structures and programmes and facilitating the collaboration between technical commissions and regional associations;¹⁴
- (f) A formal **interagency mechanism** to continue and deepen the collaboration with the Intergovernmental Oceanographic Commission of UNESCO (IOC) that was formerly established under JCOMM, as well as to further develop common standards and interoperability of the observations and information management systems and harmonization of service delivery mechanisms;¹⁵
- (g) Enhanced **working arrangements** to facilitate engagement with other key user agencies (the International Civil Aviation Organization [ICAO] for aviation; the International Maritime Organization [IMO] for shipping; the Food and Agriculture Organization [FAO] for food security) and the contribution of expert groups outside the WMO community to the work of the technical commissions.

2.11 The graphic representation of the proposed reform is as shown in Figure 1. The Terms of reference of the new bodies mentioned above can be found in the resolutions and recommendations mentioned in the respective footnotes or in the WMO Reform website:

<https://public.wmo.int/en/governance-reform>

¹⁰ Recommendation 25 (EC-70) and annexed Draft Resolution xx (Cg-18).

¹¹ Ibid.

¹² Ibid.

¹³ Recommendation 24 (EC-70) and annexed Draft Resolution xx (Cg-18)

¹⁴ Resolution 35 (EC-70)

¹⁵ See Footnote 10.

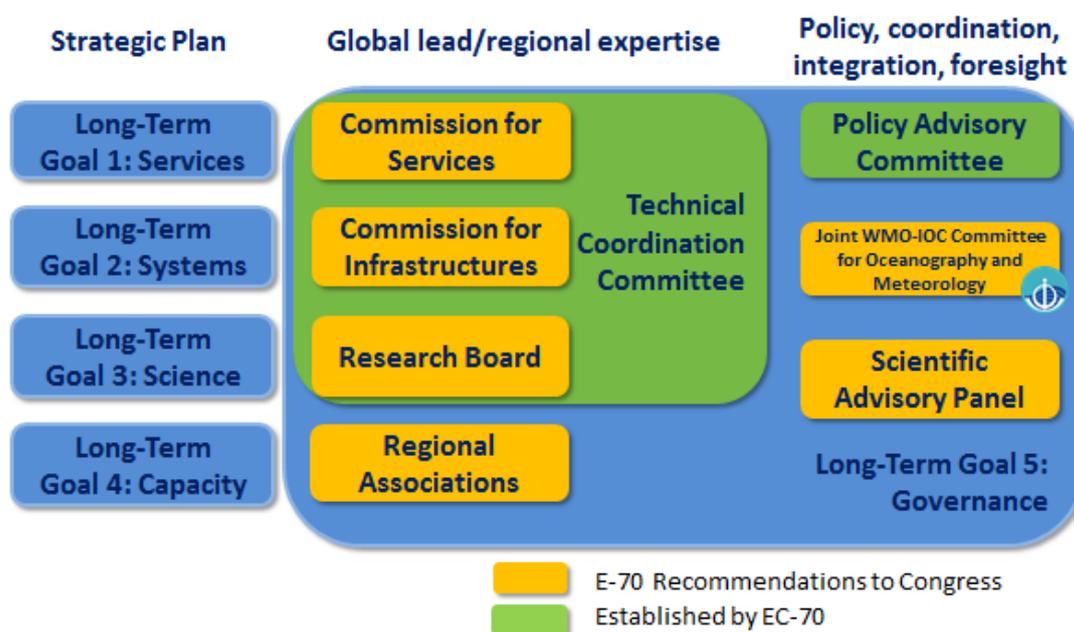


Figure 1. Proposed new bodies of WMO

The WMO Reform Transition Plan

2.12 Through Resolution 36 (EC-70), the Executive Council adopted a Transition Plan describing how the changes of the structure will be implemented. The objective is to ensure a scheduled approach and to assign governing and reporting functions along the process. The Plan focuses on changes that are anticipated, planned ahead of time. To support the implementation of the Transition Plan, the Executive Council established the Constituent Bodies Reform Task Force (CBR-TF).

2.13 The Transition Plan was based on decisions/resolutions of EC-70. An initial revision was undertaken by the first meeting of the CBR-TF (Geneva, 6-8 September 2018). Further revisions are envisaged based on decisions by the extraordinary session of the Commission for Hydrology (CHy-Ext., February 2019) and Cg-18 (June 2019) to ensure timely and effective follow-up on the agreed actions related to the CBR. The transition plan is aligned with the (draft) WMO Strategic Plan 2020–2023 (to be adopted by Cg-18) with a view to synchronize the reform process with the planned activities in all technical and capacity development areas and ensure continuity of work needed to achieve its strategic objectives.

2.14 It is understood that the reform will be an evolving process that requires flexibility and readjustment of the implementing actions while maintaining the main objectives, milestones and targets. Therefore, the transition plan will be a living document continuously monitored and reviewed with well-established feedback mechanisms and ability for corrective actions.

2.15 At its first meeting, the CBR-TF also reviewed EC recommendations concerning the establishment of standing committees and study groups to support the work of technical commissions. The CBR-TF agreed on the following definitions:

2.16 Standing Committee of a technical commission: a quasi-permanent expert body established by and reporting to a technical commission in accordance with the general terms of reference of technical commissions, items 2 and 3 (Annex III to the General Regulations) and with the specific terms of reference of the commission concerned with limited scope and terms of reference defined by the parent commission; normally, established for a period of 4 years.

Standing committees are expected to deal mostly with the required normative work in accordance with their Terms of Reference, and submit recommendations and suggestions on behalf of the committee to the respective commission.

2.17 Study Group: an expert body established by and reporting to a technical commission in accordance with the general terms of reference of technical commissions, item 1 (Annex III to the General Regulations) and with the specific terms of reference of the commission concerned to study an identified technical issue in order to provide guidance and assess the feasibility/necessity of development of technical regulations on the subject. The study group should be established for a fixed time period with a limited scope and clearly defined deliverables.

2.18 The CBR-TF further recommended that in the initial definition of the structures of the technical commissions the guidance of Recommendation 25 (EC-70) should be recommended, while allowing for evolution in the future and avoiding prescriptive indications on the difference between standing committees and study groups:

Commission for Observation, Infrastructure and Information Systems

- (a) Earth observing systems and measurement networks
- (b) Methods of observations, measurements and instrumentation
- (c) Data, products and information exchange and life cycle management
- (d) Data processing for applied Earth system modelling and prediction

Commission for Weather, Climate, Water and Related Environmental Services and Applications

- (a) Aeronautical meteorological services
- (b) Marine and oceanographic meteorological services
- (c) Agrometeorological and climatological services
- (d) Hydrological services
- (e) Public services and disaster risk reduction (noting Members' sovereignty on warnings)

2.19 Membership of standing committees and study group will be populated from experts nominated by Permanent Representatives and partner organizations and will constitute the WMO Expert Network accessible through the Country Profile Database.

2.20 The CBR-TF also noted that the financial implications of the establishment of substructures by technical commissions should be vetted by Congress.

3. History of CHy and the evolution of hydrology in WMO^{16, 17}

3.1 The origin of the Commission for Hydrology dates to 1946 when it was established within the International Meteorological Organization (IMO), the precursor of WMO. It held one session in 1947 and addressed topics that included cooperation between National Hydrological Services (NHSs) and National Meteorological Services (NMSs), regional cooperation in hydrology, and an international glossary of terms. When WMO was established in 1950, CHy had not yet gained enough momentum to produce any reports. Given that there were no hydrologists among the NMS directors during the first WMO Congress (Cg-I) in 1951, there

¹⁶ Askew, 2008, WMO Bulletin, 57 (3)

¹⁷ Lins, 2010, WMO Bulletin, 59 (1)

was no one present to defend the interests of CHy. Thus, it was dropped from the initial list of technical commissions established by Cg-I.

3.2 In the early days of WMO, Regional Associations (RAs) and the Commission for Climatology (CCI) discussed hydrological matters during their sessions, but no real move was made to re-introduce hydrology until 1954, when the United Nations Economic and Social Council (ECOSOC) recommended that the UN specialized agencies give more attention to water resources management, including the collection of hydrological data. It explicitly proposed that WMO fulfil this role in cooperation with NHSs and the International Association of Hydrological Sciences (IAHS). As a result, the Secretary General proposed to Cg-II (1955) that WMO take on this responsibility.

3.3 At this time, the WMO Convention could easily have been changed to make the Organization responsible for all meteorological and water resource matters. No other agency had the WMO ability to take on this role, nor would they have challenged the decision, but, instead, Congress accepted only that WMO be responsible for those aspects "which fall in the common ground between meteorology and hydrology". The Executive Committee (EC) meeting immediately after Cg-II had a somewhat broader view and set up the Panel on Water Resources Development to draft proposals for future water activities of the Organization. The panel ultimately evolved into the Hydrology and Water Resources (HWR) Programme of WMO. **The Panel also recommended that "WMO should assume responsibilities in the field of hydrology similar to its present responsibilities in the field of meteorology" and that the Convention should be changed to put NHSs on the same footing as NMSs.** When EC met in 1957, it decided to seek the views of Members on this matter. Not surprisingly, EC Members were divided on giving parity to hydrology and opted instead for having WMO accept responsibility in all aspects of hydrology "which involve meteorological considerations." It recommended that Congress establish a Commission for Hydrology, but there was no mention of changing the Convention. That same year, high-level meetings within the UN explicitly asked WMO to take responsibility for a broad range of surface water matters and IAHS and the International Union of Geodesy and Geophysics later added their weight to this proposal.

3.4 Based on this internal preparatory work and external encouragement, there was hope that Cg-III (1959) would re-establish WMO as a new joint meteorological/hydrological agency. However, Congress did not and only agreed to have WMO coordinate activities in "hydrological meteorology," thereby establishing the pattern of addressing hydrology primarily as a sub-discipline of meteorology. Thus, Cg-III created the Commission for Hydrological Meteorology, although it did not define this term, and problems arose almost immediately over what hydrology's identity was supposed to be in WMO.

3.5 Of course, a major concern was that if WMO were to take on wide-ranging responsibilities in freshwater, then the water community would expect representation on the Organization's governing bodies. PRs participate in discussions at Congress and EC to seek the best for the Organization as a whole and as representatives of their countries. In so doing, they draw on their experiences at national level. However, no country has one single national agency responsible for all freshwater matters and so, even if the PRs were willing to share authority over WMO with the hydrologists, it was not at all clear as to whom their natural partners would be. Also, given that any one of the government water departments was likely to be more powerful, both financially and politically than the NMS, it was not surprising that many PRs saw sharing authority as diluting the aims and identity of WMO and possibly raising the spectre of the Organization becoming dominated by high-level political interests. **The important point here is that Cg-III had the opportunity to put hydrology on an equal footing with meteorology and decided against doing so. Had it decided otherwise, WMO would have undoubtedly assumed the pre-eminent role in hydrology and water resources within the UN System in 1959. Now, sixty years later, Cg-18 is similarly addressing how hydrology will fit into the overall structure of WMO and, once again,**

has the opportunity to elevate hydrology to a more equitable status with meteorology.

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

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

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

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

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

- (a) Operational aspects of the collection, transmission, processing and publication of hydrological data related to the land phase of the hydrological cycle, including precipitation, snow cover, water level of lakes and streams, streamflow and storage, evaporation and evapotranspiration, soil moisture and groundwater (only as it relates to surface water), water temperature, sediment discharge, river and lake ice, and chemical quality of water;
- (b) Research, development, improvement and promotion of methods, procedures and techniques for the design of networks, standardization of instruments, and methods of observations, as well as hydrological forecasting, and meteorological and hydrological data for the design of projects; and
- (c) Rendering assistance to governments in planning and organizing hydrological services, training personnel in the collection and analysis of hydrological data, and in procuring suitable equipment.

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

need to have the operational aspects of hydrology, which are closely associated with those of meteorology, coordinated internationally by WMO. They also made specific reference to these WMO responsibilities as “operational hydrology.”

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

3.13 All the elements were now in place for hydrology to assume a new and more prominent role within WMO, and Sixth Congress acted decisively in 1971 to make it so. Its most significant action was to define “operational hydrology”. This definition included: measurements of basic hydrological elements from networks of meteorological and hydrological stations — collection, transmission, processing, storage, retrieval and publication of basic hydrological data; hydrological forecasting; and development and improvement of relevant methods, procedures and techniques in network design, specification of instruments, standardization of instruments and methods of observation, data transmission and processing, supply of meteorological and hydrological data for design purposes, and hydrological forecasting.

3.14 Congress also officially changed the name of the former Commission for Hydrological Meteorology to Commission for Hydrology, and approved the revised terms of reference recommended by CHy-III. Congress specifically noted in so doing the expressed needs of Members for internationally recognized standards and practices in operational hydrology, and the Organization’s unique capabilities in promoting international cooperation in this field. It further adopted the WMO *Technical Regulations in Operational Hydrology* (Volume III), which, in addition to standardizing instruments and methods of observation, aimed to facilitate the creation and improvement of hydrological networks, cooperation within international river basins, uniformity in the exchange of hydrological data and assistance in the establishment and expansion of NHSs, particularly in developing countries. Finally, and very importantly, Congress restructured the WMO Secretariat by establishing the Department of Hydrology and Water Resources, which reported directly to the office of the Secretary-General of WMO. Cg-VII (1975) made an important change in the WMO Convention so as to state explicitly that promotion of activities in operational hydrology and furthering close cooperation between Meteorological and Hydrological Services was one of the purposes of the Organization.¹⁸

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

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

¹⁸ Convention of the WMO-Article 2 (e).

prosperity and sustainability. However, to do so it will be of fundamental importance for the Commission for Hydrology to continue providing the necessary technical assistance to the NHSs of WMO Members, especially in developing countries, by focusing future CHy activities on those areas where WMO contributions may be most useful.

4. Core principles for advancing hydrology within WMO

Proposed overall objective of the WMO reform as regards water:

To develop an effective platform that will support enhancement of capacities of the National Hydrological Services based on end user needs and increase the visibility and involvement of the hydrological community in the WMO activities and structures in order to elevate the WMO importance and its contribution to the global water agenda.

4.1 In order to assess the various structural options presented in Section 5 and their likelihood to contribute to the overall objective quoted above, the AWG discussed which general features should be considered essential and desirable elements of each option. They represent what should be considered the foundational elements underpinning the role and operations of hydrology within WMO.

4.2 The following features are considered essential:

- (a) **Topical Uniqueness:** EC adopted as one of the key criteria guiding the WMO reform, the need to evolve toward a seamless Earth system approach whilst minimizing the gap between research and operations. This aspiration is best fulfilled if the different component elements are strengthened. Therefore, while many issues of concern to WMO require the engagement of hydrologists with meteorologists, the capability of addressing uniquely hydrological problems and issues (such as reservoir operation, water resources assessment, water supply and water rights allocations, runoff and sediment transport measurement, groundwater monitoring) should be maintained. To deal effectively with these hydro-centered needs, some type of forum dedicated exclusively to the core discipline of operational hydrology and water resources management is required;
- (b) **Integrated and Autonomous:** Hydrology and components of water resources management are ideally situated within WMO, benefiting from and adding value to common issues associated with geophysical observing networks, instrumentation, and data and information systems. However, hydrology is a distinct discipline, independent of, though related to meteorology. Self-determination is key to engagement and hydrologists should, therefore, be responsible for developing appropriate end-to-end programmes and work plans, in conformance with the strategic priorities of WMO and the requests of Congress and EC, without having to do so through intermediary structures dedicated principally to the meteorological community. Increasingly, hydrology in WMO is more than just operational hydrology, it includes aspects of water resources management;
- (c) **Discipline Coherence:** To ensure effective delivery of end-to-end hydrological services, there is a need for effective coordination of hydrological activities, partnerships and resources across WMO. The Organization's efforts across different technical sub-divisions of hydrology, different regions, with different external water specific partners and key national hydrological stakeholders should be aligned. Cohesion between hydrological working structures should be maximized;
- (d) **Serving the Needs of NHSs and Maximizing Engagement:** The working mechanisms of WMO should serve the needs of NHSs with a view to strengthen

their capacity to deliver on end user service requirements, provide a platform for bringing their concerns to the WMO agenda and serve as an easy access point to WMO with the aim to maximize the active engagement of NHSs and their hydrologists in both the governance and delivery of the Organization's water related activities;

- (e) **Chain-of-Command:** The WMO hydrological community, addressing hydrological and water resources challenges through its self-determined leadership, should function and answer directly to Members (Congress) and the Organization's executive body (Executive Council). That leadership, regardless of form or title, should not have to report to Congress or EC through a crosscutting technical commission, technical panel or committee, or any other body dedicated principally to the meteorological community;
- (f) **Intergovernmental:** Each WMO Member should have the opportunity to provide technical- and executive-level hydrologists to represent and present their perspectives with respect to hydrological and water resources issues. Moreover, the Members hydrological voices should be heard in an intergovernmental setting without regard to any selective criteria, whether administrative, scientific, economic or historical;

The following element is considered desirable:

- (g) **Representation:** Hydrologists should be meaningfully represented in all decision-making bodies of WMO (Technical Commissions, Regional Associations, Executive Council, and Congress). Their representation should be commensurate with the proportion of work being devoted to hydrological activities within the body, and should include representation at senior levels of all bodies and in the Secretariat. Optimal representation is achieved by ensuring the involvement of widely recognized and accomplished hydrologists.

5. Reform options for enhancing the role of WMO in the UN System water agenda

5.1 AWG-augmented and the WMO Secretariat have examined a suite of alternative organizational structures for consideration by CHy-Ext. The alternatives retained are consistent with the WMO Convention, and are suggested to enhance the ability of WMO to become a stronger, more visible and dominant player in meeting the needs of the varied problems and issues associated with the global water agenda, while also enhancing the ability of the NHSs to be more effective at addressing such issues at the transboundary basin to national to local level. Each alternative includes an assessment against the core principles described in Section 4.

Option A. Integration of hydrological activities within the Two-Commission structure recommended by EC-70

DESCRIPTION OF OPTION

5.2 This option is described in Section 2 above as regards its general elements. As regards how current hydrological activities, issues and concerns would be executed and addressed, a distinction should be made between the two TCs, as the current plan is for COIIS to have four process-related standing committees, while CSA would have five subject-related standing committees including one on hydrological services.

5.3 This different approach would mean that it will be relatively straightforward to allocate all hydrological service-related activities, such as FFI and its components (FFGS, APFM, E2E EWS for flood forecasting) to the SC on Hydrological Services in CSA, while several options could be envisaged for activities concerning hydrological observations, infrastructure and information systems, such as HydroHub and its components (WHYCOS, WHOS, Innovation Hub and HSIP) which would naturally be implemented under COIIS. For instance, each of the four standing committees could have a hydrological sub-group (or Expert Team), although this would be expensive and prone to duplications and overlaps. Alternatively, a fifth standing committee dedicated to hydrology could be proposed, in addition to the participation of hydrological experts in the other four standing committees. This would depend on the initial approval of Cg-18 and subsequent approval by COIIS itself, but might be seen as contrary to the spirit of integration.

5.4 Whatever the adopted solution is, the need of coordination of hydrological activities between the two TCs to ensure maintenance of the seamless approach promoted and utilized by CHy, would have to be addressed by some form of joint inter-commission mechanism. This joint mechanism would also be fundamental to the implementation of current end-to-end CHy activities such as HydroSOS and QMF-Hydrology capacity development activities, which have both observational, infrastructure and service components.

Interactions with Regional Associations

5.5 Several actions to increase the interactions of the TCs with the RAs have been envisaged by the CBR-TF. Currently, all RAs have some kind of working group dealing with hydrology and water resources matters, under different titles, but not in all cases the Regional Hydrological Adviser is a member of the Management Committee of the RA, which could constitute a challenge when trying to ensure proper integration of hydrological activities at the regional level as well as appropriate RA hydrological representation in the subsidiary bodies of the TCs. RA working groups for hydrology would need to establish interactions with all relevant subsidiary bodies of TCs.

Interactions with External Partners

5.6 WMO has established a number of key collaborations with partners in the water field, some dating from several decades, others more recent. Examples include the Associated Programme on Flood Management (jointly delivered with the Global Water Partnership), and the collaborations with the International Association for Hydrological Sciences (IAHS), the UNESCO International Hydrological Programme (IHP) and the International Organization for Standardization (ISO) (in hydrometry and water quality). To date, most such collaborations have been overseen by CHy. The responsibility for coordinating WMO input to such collaborations, ensuring harmonized contributions from across the Organization, would have to be decided on a case-to-case basis.

Delivery of Discipline Specific Activities

5.7 Although the majority of current CHy activities would be implemented through mechanisms under the two TCs, for those activities of a purely hydrological nature, such as Project X, the development of a Manual on Sediment Transport, and Guidelines on Environmental Flows, some special arrangement should be found, perhaps under the same joint mechanism mentioned above regarding the implementation of HydroSOS.

EVALUATION OF THE OPTION

5.8 The option of inserting all hydrological activities under the two-commission structure recommended by EC-70 has been assessed against the principles described in Section 4 as outlined in Table 1.

Table 1 - Alignment with CHy AWG Principles

CHy AWG Principles	Assessment
(a) Recognizing Topical Uniqueness	The level of satisfaction of this principle will depend on the solution adopted for dealing with cross-cutting and purely hydrological issues.
(b) Integrated and Autonomous	This option will deliver greater integration with the meteorological community, (e.g. of normalisation material with TCs) but self-determination for the hydrological community will be difficult to realize and limited at best.
(c) Discipline Coherence	The end-to-end nature of WMO current hydrological support to Members will depend on the inter-commission coordinating mechanism adopted.
(d) Serving the Needs of NHSs and Maximizing Engagement	The lack of a single primary point of entry for National Hydrological Services and Water Resources Management agencies, may complicate their access to WMO programmes, potentially affecting their engagement with the Organization.
(e) Chain-of-Command	The WMO hydrological community will report to Congress and EC through the two Technical Commissions officials.
(f) Intergovernmental	The WMO hydrological community will no longer have a dedicated intergovernmental entity to present their perspectives on hydrological and water resources issues, but may have a partial representation through their participation in the two TCs.
(g) Representation	Involvement of widely recognized and accomplished hydrological experts will depend on their nomination by the Permanent Representatives and by the decision of the Management Groups of the various constituent bodies.

Summary of Key Advantages

- 5.9 Some of the key advantages this option provides are thought to include:
- (a) It maintains the streamlined structure envisaged by EC,
 - (b) It enhances coordination across disciplines,
 - (c) In principle, it fosters the cooperation between the meteorological and hydrological communities. The real impact will depend on the procedures adopted to provide hydrological representation in the different constituent and subsidiary bodies and the capacity of the hydrological community to engage across these fora.

Issues for further consideration

- 5.10 The following issues would need to be considered during the implementation phase:
- (a) The costs (in terms of staff time and travel expenses) incurred by Member's National Hydrological Services or Water Resources Management organizations in engaging with WMO may increase due to the requirement to interact across multiple subsidiary bodies in order to influence, and benefit from, the full hydrological value-chain.
 - (b) The lack of an intergovernmental forum for hydrology within WMO may risk disenfranchising Member's hydrological community. To avoid this, other ways of ensuring WMO water related activities reflect Member's needs would need to be strengthened – for example, through seeking greater alignment with the priorities established within remaining intergovernmental fora for hydrology in other parts of the UN.

Option B. Hydrological Assembly and Hydrological Bureau¹⁹

DESCRIPTION OF OPTION

5.11 Reflecting the WMO desire to further strengthen its water related activities and the complex nature of the water community both within and outside the Organization, this structure sees the formation of an auxiliary subsidiary mechanism, complementary to the EC-70 governance reform proposal. This mechanism consists of two elements, 1) the WMO Hydrological Assembly, and 2) an inter-session management and coordination mechanism, the Hydrological Bureau.

Position within WMO

5.12 The Hydrological Assembly would be a mechanism of the Organization, reporting to Congress. The role of the Assembly would be of a strategic nature leaving, as much as possible, technical work to the two technical commissions. The Assembly would have responsibility for guiding the Organization's contributions to the global, regional and national water agendas through the coordination of joint hydrological activities with other bodies inside WMO and more widely. It could be considered as the main Congress adviser on water-related issues.

5.13 The Hydrological Assembly main responsibilities may be summarized as:

- (a) preparation of work plans to implement Congress decisions related to hydrology and water resources management;

¹⁹ Both these names could and perhaps should be changed to avoid possible confusion with existing similarly named entities. They are kept in this document for easy of reference, but CHy-Ext should discuss this issue and come up with a consensus decision.

- (b) advise Cg and EC on scientific and political water-related current and emerging global challenges;
- (c) nominate hydrology and water resources management experts to be part of the community of expertise that will underpin the technical commissions.

5.14 Key to the success of this option will be the inter-sessional interactions with the WMO lead constituent bodies for technical and scientific activities (COIIS, CSA and RB) and for regional activities (the RAs). It is proposed to optimize these interactions by the establishment of a Hydrological Bureau which will include representatives of all the relevant bodies and will ensure the day-to-day coordination in all water-related activities of the Organization, assist WMO to adapt to the evolving global water priorities and directly implement only those activities that are of a purely hydrological and water resources management nature and are considered not suitable to be undertaken by the new technical commissions, including those with key external partners.

5.15 The WMO Hydrological Assembly would be established by Congress in accordance with Article 8 (h) of the WMO Convention.

Composition of the Hydrological Assembly and Hydrological Bureau

5.16 According to the desire expressed by EC to increase the engagement of the hydrology and water resources community in WMO activities, and reflecting the fact that the majority of Members maintain separate Hydrological and Meteorological Services, and that in general the governance of hydrology and water resources management is different from country to country, the Hydrological Assembly members should be directors of National Hydrological Services or directors of Water Resources Management organizations, designated by Members. The Assembly would report to Congress.

5.17 The Hydrological Assembly would elect a chair and a vice-chair. The individuals chosen should have both demonstrated leadership skills and technical expertise in hydrology and water resources management.

5.18 The Hydrological Bureau would be composed of the chair and vice-chair of the Hydrological Assembly, the chair of the SC on hydrological services of CSA, one of the vice-presidents of COIIS, the six Regional Hydrological Advisers (or their future equivalent), a representative of the RB, the chairs of water-related Experts Groups and invited partners (such as IHP-UNESCO, IAHS, IAHR).

Interactions with Technical Commissions

5.19 The Hydrological Bureau would help coordinate technical guidance and normalisation activities with the two Technical Commissions (COIIS and CSA) where these relate to hydrology, where Members consider cross-discipline alignment between hydrology and meteorology to be desirable, and/or when mainly hydrological issues would benefit from input by meteorological experts. A possible working procedure would be that whenever a TC establishes a SC, SG or Expert Team, it coordinates with the HB the desirable percentage of hydrological expertise in the membership and the subsequent selection of the necessary hydrological experts.

5.20 The Hydrological Bureau may also conduct such activities with other global bodies such as ISO and UNESCO where these organizations deliver significant contributions unique to the water field, however it is expected that this would only be necessary in a minority of cases and most such technical work would be completed by COIIS and CSA.

Interactions with Regional Associations

5.21 Within the field of hydrology, WMO Members have long benefited from the close links that have been maintained between the working structures under the Commission for Hydrology and those within Regional Associations. The participation of the Regional Hydrological Advisers in the Hydrological Bureau will maintain and further strengthen the links between the Organization's water activities at a global and regional level, so as to support Members in their implementation of activities in operational hydrology.

5.22 This mechanism for regional collaboration would allow WMO to strengthen its ability to provide geographically appropriate solutions. Within hydrology, there are often distinct differences in the suitability of technical solutions and implementation approaches across the world. For example, the management of transboundary river systems through basin agreements/organisations may necessitate (and facilitate) different approaches to data sharing. Similarly, the vast differences in the way in which Members manage water resources mean that technical approaches in hydrology are rarely global in nature. Therefore, the practice of establishing regional working groups on hydrology and water resources management issues should be maintained by all Regional Associations.

Interactions with External Partners

5.23 Operational hydrology represents just a small part of the global water agenda. Acknowledging the important role that other global bodies have in delivering future water security, the Hydrological Assembly will provide a focal point for hydrological collaboration with WMO. The Hydrological Assembly will provide a very visible presence for the WMO on the global water stage. It will help Members coordinate their interaction with key external partners in the water area, thereby raising the profile of the organisation and Member's activities that contribute to the global water agenda.

5.24 WMO has established a number of key collaborations with partners in the water field, some dating from several decades, others more recent. Examples include the Associated Programme on Flood Management (jointly delivered with the Global Water Partnership), and the collaborations with the International Association for Hydrological Sciences (IAHS), the International Association for Hydro-Environment Engineering and Research (IAHR), the UNESCO International Hydrological Programme (UNESCO-IHP) and the International Organization for Standardization (ISO) (in hydrometry and water quality). The Hydrological Bureau will assume responsibility for coordinating the WMO input to such collaborations, ensuring harmonized contributions from across the Organization.

5.25 A single coordinating body for external collaborations in water will ensure WMO continues to co-deliver high impact hydrological activities with existing partners. It will also provide opportunities to augment such strategic partnerships with new collaborations where needed in a way which would be difficult if water-related activities were uncoordinated internally within WMO.

Delivery of Discipline Specific Activities

5.26 While many of the WMO hydrological activities relate in some way to meteorology, the Organization also provides important support to its Members in other areas of operational hydrology. Some current activities under CHy (such as Project X, the development of a Manual on Sediment Transport, and Guidelines on Environmental Flows) support areas of hydrology which Members generally conduct in partial or complete separation from hydro-meteorology. As such, the Hydrological Assembly may establish some working mechanisms that report directly to it alone. It is however, thought that the majority of activities would be implemented through mechanisms under the TCs, RAs or external bodies.

EVALUATION OF THE OPTION

5.27 The option of establishing a Hydrological Assembly and a Hydrological Bureau has been assessed against the principles described in section 4 as outlined in Table 2.

Table 2 - Alignment with CHy AWG Principles

CHy AWG Principles	Assessment
(a) Recognizing Topical Uniqueness	A coordinating focal point for hydrology will ensure representation of Member's hydrological needs and issues across subsidiary bodies while also proving continued WMO support to Members in areas of hydrology that would otherwise not be covered.
(b) Integrated and Autonomous	This option provides a balanced approach which will deliver greater integration where required (e.g. of normalisation material with TCs) while maintaining self-determination for the hydrological community.
(c) Discipline Coherence	A primary hydrological forum for Members and the coordinating Bureau will maintain the end-to-end nature of WMO current hydrological support to Members by integrating across the new TC structure.
(d) Serving the Needs of NHSs and Maximizing Engagement	By providing a single primary point of entry for National Hydrological Services and Water Resources Management agencies, this option will minimise the costs of engagement for Members (for example, in attending WMO subsidiary body Sessions).
(e) Chain-of-Command	Through the HA, Congress and EC will receive direct input from the hydrological community allowing WMO to respond more quickly and coherently to the global water agenda.
(f) Intergovernmental	National Hydrological Services and Water Resources Management agencies will be part of the decision making process within WMO reducing the risk of disenfranchisement.
(g) Representation	The nomination of hydrological experts by

CHy AWG Principles	Assessment
	the HA and working procedures along the lines described in the sections on Interactions with TCs and RAs above should satisfy the need of proper hydrological representation in all decision-making bodies of WMO.

Summary of Key Advantages

- 5.28 Some of the key advantages this option provides are thought to include:
- (a) It enhances the role of hydrological and water resources managers in the decision-making process of the Organization, therefore encouraging them to increase their engagement with WMO;
 - (b) It elevates the status of hydrology and water resources within WMO to a distinct discipline, rather than being a sub-discipline of meteorology;
 - (c) It strengthens the WMO ability to deliver through global strategic partnership in the water area;
 - (d) It promotes integration with meteorological activities where needed but maintains topical uniqueness where appropriate;
 - (e) It closes the gap between the WMO regional and global activities within operational hydrology allowing Members to more effectively shape and benefit from geographically appropriate solutions;
 - (f) It retains a hydrological entity that has served WMO well and allows this to be further developed to provide WMO with a strong hydrological focus and a single point of entry of water users;
 - (g) It preserves the end-to-end nature of hydrological services provision, providing a route to easy interaction between all bodies responsible for water activities which would otherwise be split;
 - (h) It enables greater participation of and guidance by the hydrological and water resources management community in the work of WMO, thus minimizing the risk of their disengagement;
 - (i) It provides self-determination for the hydrological and water resource management community, ensuring that they have a formal role in taking decisions about the activities which they will largely resource and undertake; and
 - (j) It provides an opportunity to align the TC and RA subsidiary body structures as all Regional Associations already contain a subsidiary body for hydrology.

Issues for further consideration

- 5.29 The following issues would need to be considered during the implementation phase:
- (a) Success of the option requires the two proposed TCs and the RAs to support integrated working in the hydrology area;
 - (b) It also requires that the HA has an influence on the selection of the chair of the SC on hydrological services of CSA and of one of the vice-presidents of COIIS. A possible compromise might be for the HA to pre-select three candidates for each of

those positions with different geographical backgrounds, from which the relevant TC would choose the definitive appointee; and

- (c) The Hydrological Assembly must have a direct and substantive relationship with Congress that is not predicated on working exclusively through the Permanent Representatives.

Option C. Option proposed by members during CHy-Ext

5.30 AWG-extended agreed that participants to CHy-Ext should have the possibility to propose a new, different option, if there are strong arguments justifying why one of the two above does not satisfy them.

Option D. Discarded options

5.31 AWG-augmented examined several other structural options, but decided not to recommend them to CHy-Ext., for the reasons given here below.

5.32 Retaining CHy as is: this option would go against the spirit of the WMO reform and would go against Article 2 (e) of the Convention, namely "...to further close cooperation between Meteorological and Hydrological Services".

5.33 Creating a Virtual Hydrological Forum in substitution of CHy: this option was discarded as it was considered too difficult to manage, hard to understand for Members and working against the integration desired by the WMO Reform.

5.34 More extreme options, such as moving the operational hydrology intergovernmental process under the umbrella of another UN organization (such as UNESCO or UNEP), or proposing the creation of a new international organization, were considered not to be in line with the intents of the Reform as they would potentially result in disruption of global hydrological activities carried by WMO and likely lead to uncertainty in governance.

6. Possible follow-up actions

6.1 Regardless of the option CHy-Ext. decides to recommend to Cg-18, it might be advisable to propose possible amendments to the WMO Reform Transition Plan, which will depend on the specific option recommended to Cg-18.

6.2 In particular, AWG-augmented noted that the Cg-18 notification addressed to Foreign Affairs Ministries mentions the possibility of holding a side-event referred to as "a hydrological assembly". The AWG-augmented welcomed this idea, but recommended it not be named "hydrological assembly" in order to avoid confusion with the option B. described in Section 4 above (however, see footnote 19). As an Extraordinary Congress session will probably be approved by Cg-18 for 2021, with a possible focus on water issues, a process could be started at Cg-18, possibly through a Declaration proposed by the "hydrological assembly", which could be seen as a forerunner of the definitive solution, potentially encompassing a form of hydro-protocol, to be adopted by Cg-18 and set up the basis for the actions to be taken in the following months. For instance, if Option B. is recommended by CHy-Ext. and adopted by Cg-18, the process for nominating Hydrological Assembly members, and other transition measures could be discussed at the side event and endorsed by Congress through a Declaration, which may set the scene for the first meeting of the Hydrological Assembly described in Option B. to be held at the earliest convenient time.

6.3 Finally, similarly to all the other existing TCs, the AWG of CHy should prepare a transition plan to ensure all ongoing activities planned at CHy-15 are either finalized or their advance is reported to the appropriate new constituent body.



World Meteorological Organization
COMMISSION FOR HYDROLOGY
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 Geneva, 13 and 14 February 2019

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 Submitted by:
 Secretary-General
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SUMMARY OF THE CHY-EXT PRE-SESSION DISCUSSION

1. Prior to the Extraordinary Session of the Commission for Hydrology held in Geneva from 13 to 14 February 2019, an online pre-session discussion platform was open for members of the hydrological community to provide their ideas on the topics to be discussed at the extraordinary session.
2. The online discussion was initiated on 26 November 2018 and consisted of seven questions. The discussion was closed on 10 February 2019 at which time there had been 250 comments posted in three languages, by 69 individuals, representing 41 countries, among which 15 were from RA I, four from RA II, six from RA III, five from RA IV, one from RA V and ten from RA VI. The website received 9749 visits.
3. The questions had been developed by the CHy Advisory Working Group, augmented by the six Regional Hydrological Advisers and the Chair of the EC Task Force on Water. They addressed three primary themes:
 - What are the main water challenges facing WMO? (questions 1 and 2)
 - What can WMO do for you? (questions 3 to 5)
 - How can the WMO structure improve? (questions 6 and 7)
4. This summary provides an overview of the principal issues mentioned by the respondents. Only the more commonly expressed comments are highlighted here. The complete set of answers can be accessed on the website of the CHy pre-session discussion: <https://www.hydroref.com/chy-ext-presession/>.

Question 1: What are the major external changes and dynamics that demand a response by the National Hydrological Services and the hydrological community of WMO?

55 replies

5. Evolving data and information capabilities were mentioned by a large number of respondents as the major issue for the hydrological community. Services have to deal with new data requirements with regard to renewable energy, ecological issues, urban sanitation projects, hydraulic and road infrastructures and changing water policies. WMO is seen as a valuable platform for exchange of information for guidance and advice on the use of new technologies in data acquisition, communication (software and hardware including social networks) and data management, including big data, satellite and artificial intelligence.
6. Increasingly dense and optimized networks are needed to improve hydrological knowledge. Some participants expressed regret that their NHS only publishes data and not value-added products. In addition, real time data, quality control and uncertainty analysis were mentioned as necessary improvements to add value for decision makers.
7. Maintenance of record integrity, particularly in a rapidly changing monitoring context, along with the operation of both traditional and modern hydrological equipment represent a challenge for the NHSs, especially in developing countries. Some respondents noted the need for telemetric solutions to avoid difficulties in accessing remote stations. Data rescue is also seen as an important issue.

8. To follow these technological changes, human resources need to be trained to process the data and provide the relevant information. Most Services face the challenge of limited staff with appropriate technological capacity.
9. Issues requiring cooperative arrangements at the local, transboundary and international level, were also mentioned several times, particularly addressing water security and in the context of increased frequency of hazardous hydrological events. They provide opportunities for WMO to become a facilitator in the sharing of knowledge, expertise and experience to strengthen collaboration between professionals and organizations.
10. Climatic variability and change were noted as impacting hydrological regimes and adding new dimensions to existing hydrological practices; such as research on prediction tools, relationships between regional trends and climate variables, and integration of local knowledge. Drought was also mentioned as an increasing hazard, while a number of NHSs face a total lack or scarcity of low flow data.
11. Furthermore, socio-economic changes were noted for their impact on water demand; pressure on the environment; soil degradation and related siltation of water courses and bodies; and exposure of people and their activities to flood damage, disasters and epidemics. The long-term aspect of water management, with quantitative forecasts/outlooks for periods up to 50 years, was stressed for the water-dependent sectors of the economy.

Question 2: What are the top three areas where the capacities of National Hydrological Services need to be strengthened, in particular through international cooperation?

51 replies

12. The most frequently mentioned area in need of strengthening by NHSs related to the ever-increasing amount of data. Respondents underlined the need for quality assurance and quality control in the data acquisition chain. Access to database systems and the establishment of data centres, including online hubs for data sharing, were also seen as important elements to be consolidated. International support should help foster data sharing, the use of open data formats, and the development of standards and best practices.
13. Complementing these data needs were the design, maintenance, and especially the modernization of monitoring networks, which were pointed out by half of the respondents as being of critical importance. This involved not only the hydrometeorological stations, but all hydrological cycle components, including groundwater, glaciers, and water quality. Low cost and reliable technologies are required for sensors, gauges and data transfer. Real-time monitoring was pointed out several times.
14. Respondents also underlined the data access possibilities afforded by remote sensing technologies, as well as the development and assimilation of satellite data. Acquisition of high-resolution terrain and topographic satellite images is another area where needs were noted.
15. Training and capacity building were mentioned by half of the participants as a recurrent need in all aspects of their hydrological operations, from scientific education of young professionals to field activities, particularly in adapting to new technologies.
16. Improvement of hydrological modelling and forecasting was raised by a third of the participants as a major area needing improvement; particularly with respect to short- and long-term forecasting, extreme events (floods and drought), having high resolution, and to decrease the uncertainty of meteorological forecasts.

Question 3: Which WMO programmes, project or initiatives having the potential to advance hydrology do you currently value the highest and what is missing?

27 replies

17. Fully one-quarter of the respondents mentioned the Hydrology and Water Resources Programme (HWRP), the Regional HYCOS projects, the HydroHub, HydroSOS and the Flash Flood Guidance System (FFGS) as being the most successful activities they have been contributing to. Nevertheless, some stressed that the long-term sustainability of many activities was being compromised by a lack of funding by Governments, coupled with the absence of a long-term strategy, for continuing operations beyond the financing period granted by external financial institutions.

18. Some also noted that the Initiative on Climate Risk Early Warning Systems (CREWS) could benefit from more awareness, dissemination and publicity in the countries.

19. Finally, several respondents mentioned the value of the global data centres, publications (in particular the Guide to Hydrological Practices that should be updated with the latest information), the Education and Training Programme (ETRP), and the Disaster Risk Reduction Programme (DRR).

Question 4: What do you think is needed to:

- (a) Ensure production and dissemination of flood warnings that reach all people in your country? What do you expect from WMO in this regard?**
- (b) Drought-proof your country? What do you expect from WMO in this regard?**
- (c) Be informed enough to manage water wisely for food, energy, health, and the biosphere? What do you expect from WMO in this regard?**

38 replies

20. In addition to links with the civil protection agencies, National Hydrological Services and related hydrometeorological organizations should pursue closer cooperation with various economic sectors to improve the benefits of flood warnings to the population. WMO could help NHSs gain support from decision makers for the establishment of a fund to strengthen hydrological activities. In the scientific domain, the respondents mentioned cooperation with the group of experts of the FRIEND-Water programme under the UNESCO-IHP, and experience sharing among practitioners and international agencies, including the European Commission and its Joint Research Centre, and European transnational programmes (e.g. DAREFFORT).

21. There were a number of comments advocating for the broader use of social media and the dissemination of forecasts and warnings through news channels. The timely and adequate dissemination of warnings at the local level, including courses and educational programmes for citizens and schools to understand and respond to hazard warnings, and the use of new technologies for data access ("one-window" approach, web options) should be encouraged as mechanisms for improving the dissemination of warnings. Some respondents noted the need to support communication standards for raising public awareness.

22. Respondents also suggested expanding flood and drought forecasting techniques to Members by providing the methodologies and systems, by developing models for short- and long-term forecasting, and by integrating soil and climate effects. Data assimilation, high resolution analysis, uncertainty analysis, regional climate simulations, seasonal forecasts, and radar data were also noted as needing to be improved and/or implemented. An early warning

system based on simple and reliable indexes was foreseen as a useful tool for drought forecasting.

23. For drought relief, respondents noted that the use of low-cost technologies (desalination, rain harvesting, off-river storages, managed aquifer recharge, wastewater reuse) were solutions that could also be integrated into water management, as well as in the development of warning systems.

24. Free access to knowledge and publications was also mentioned as a necessary measure.

Question 5: Is there anything more WMO can do to make the government agencies that fund your operational hydrology activities more knowledgeable about the efficiency and essential character of these services to the social and economic well-being of your country? How does your Service relate with the disaster/emergency, agriculture, health and other relevant national agencies, academia and private sector?

27 replies

25. Various measures were proposed by the respondents to increase the visibility of hydrological activities at the national level, therefore illustrating their socio-economic impact and, hopefully, leading to increased financial support being dedicated to the NHSs.

26. Several comments noted that an effective way to gain support among decision makers was by organizing multi-stakeholder sensitization workshops that promote multi-sectoral cooperation. Highlighting the value of hydrological monitoring and prediction systems at the national level would assist member countries in justifying the services provided by the NHS. One way of facilitating such cooperation would be to promote the development of new, or the participation in existing, consultation platforms that convene a large group of integrated water resources management (IWRM) actors that can provide opportunities for explaining the role of the NHSs in the complex chain of water management.

27. In the same context, expanded cooperation with the UNESCO-IHP could open new opportunities for involvement with a larger community and benefit from its wide recognition within the hydrological community.

28. In the area of education and dissemination, more investment by WMO in capacity building, the development of guidelines for the basic hydrological services an NHS should offer, including minimal qualitative requirements, could be a valuable means for reaching a wider audience and for gaining more support from national funding agencies. The publication of project success stories or partnerships that promoted multi-sectoral cooperation highlighting the importance of hydrological information, as well as the integrated use of hydrological, meteorological and climatological information, could be helpful in convincing funding agencies and national agencies of the added-value of hydrological services.

29. WMO could encourage governments to support investment in the financing of NHSs and operational hydrology. Increasing the visibility of NHSs within WMO structures could help enhance the recognition and status of hydrology within national governments as well as at the international level.

30. Collaboration with other national agencies is occurring through diverse methods (from the distribution of hydrological bulletins to freely accessible, single-window database to allow access to water availability and flow data and information), and various types of engagements (from bilateral agreements and institutional involvement to joint commissions) either on a long-term basis or upon request when relevant for the political agenda.

31. Some countries report that their NHS has no relationship with their disaster and emergency services, nor with academia, which may help explain why 60 percent of the countries do not have an early warning system.

Question 6: What are the key fora (for example: expert groups, Regional Association, Technical Commissions, Executive Council/Congress) through which your organization currently engages, or would like to engage, with WMO in the field of operational hydrology?

27 replies

32. One-half of the respondents noted that the Commission for Hydrology and the Regional Associations, along with their related expert groups, were the primary means of participating in WMO, with the expert groups providing a more regular involvement. Some noted that the concept of a technical commission for hydrology should be maintained in the new WMO reform structure as it provides a means for expanding personal contacts and expert discussions. Special mention was also made about the Hydrology Forums of RA III and RA VI, which have been providing a successful way to network and share experiences, and which will hopefully continue.

33. The WHYCOS and regional HYCOS projects were also mentioned several times as a mechanism for involvement in operational activities.

34. The Open Panel of Commission for Hydrology Experts (OPACHE) was mentioned several times as a good solution to involve a larger group of experts with different competencies and origins.

35. Other forms of collaborative work, such as communities of practice, exchange platforms on flood forecasting and risk assessment, and river basin organizations, were also mentioned as valuable sources of information exchange and cooperation.

36. Some noted that WMO is still seen as an organization for meteorologists which served as an impediment to their participation in WMO activities. This was particularly so in countries where the NHS and NMS are separated, which seemed to make the involvement of the NHS more difficult in some cases.

37. It is noted by a few respondents that, on occasion, they had been able to contribute to hydrological issues discussed during the EC, and that this practice should be encouraged in the new structure.

Question 7: Meteorology and hydrology in many countries are dealt with by different government organizations. What is your suggestion to make the WMO structure better adapted to the reality of such management of different sectors, to promote more effectively coordination of meteorology and hydrology in Member countries?

25 replies

38. Most of the respondents suggested the need to reinforce the links between WMO and NHSs by better integrating their respective needs and by more closely aligning their expectations. Some noted that it is beneficial when this collaboration is extended to the local agencies and to academia.

39. At the national level, mention was made of having meetings with policy makers, supporting hydrological projects through the development budgets of governments, expanding collaboration with other related institutions involved in water management, as well as in expanding the use of remotely sensed data, in climatology, in addressing the water-energy-

food nexus, as being positive measures to study and understand the entire hydrological cycle and to raise awareness.

40. Some respondents also stressed the role of WMO in pursuing synergies with other UN organizations, particularly in leading data collection and dissemination.

41. Regarding the integration or separation of the NMS and NHS, some participants described the success that their organization had in establishing various solutions to ensure a closer engagement (for example a virtual Flood Center), but some stressed the need for a cooperative framework to strengthen the relationships between hydrologists and meteorologists, and that WMO should support and promote such strengthening at the national level and between Members.

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