Preparatory Expert Meeting on Improved Meteorological and Hydrological Forecasting for Flood Situations

Geneva, Switzerland, 1 – 2 April 2003

Executive Summary

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1. Statement of current situation

1.1 Numerous examples around the world demonstrate that floods continue to be amongst the most damaging natural disasters. Preparedness and response actions of the various disaster management authorities to prevent or mitigate flood-related disasters are highly dependent on the availability and proper use of accurate and timely meteorological and hydrological forecasting products and the dissemination of adequate and relevant information to authorities responsible for civil protection and the general public. However, many meteorological and hydrological services do not presently have adequate means or the knowledge to provide extended forecasting services in flood critical situations and to communicate effectively with disaster management authorities. Likewise, there is need for an integration of forecasting services, which amongst other issues require an improved cooperation between meteorological and hydrological services.

2. Background of the meeting

2.1 The opportunity for WMO to organize a suit of events and activities on flood forecasting and warning was raised by the Secretary-General at the occasion of his visit to Bratislava, Slovak Republic in connection with CIMO-XIII held from 23 September to 03 October 2002. Consequently, the organization of a preparatory expert meeting was seen as an appropriate step to obtain information and seek advice on the objectives, deliverables and activities in the context of an inter-departmental, inter-Commission based suite of activities in the framework of a WMO Action Programme on Flood Forecasting and Warning.

2.2 The expected outcomes of the meeting were to:

a) Consider the opportunities and challenges in the development and use of state-of-the-art NWP products available from meteorological services, RSMC's and other centres of excellence for application by hydrological services with a view to expand the lead time and improve the reliability of flood advisories and warnings. This should take into account hydrological requirements for flood forecasting as well as the requirements of and links to the disaster mitigation and management partners.
b) Based on the above, develop proposals for the future course of action, keeping in focus and enhancing the leading role of WMO in meteorological and hydrological forecasting, disaster reduction and mitigation activities, in connection with and based on the Draft 6LTP and the corresponding new programme on Natural Disaster Prevention and Mitigation which Cg-IV is expected to be established by Cg XIII.

2.3 The agenda of the meeting is attached as annex 1. Five out of seven invited experts and Secretariat staff attended the meeting from HWR, AREP, WCP and WWW/B (see annex 2). The following paragraphs represent the opinions of the participants of the preparatory expert meeting.

3. General findings from presentations and discussions

3.1 Presentations by the experts and WMO staff and subsequent discussions highlighted the following issues:

3.1.1 NWP products are used by a number of meteorological services using limited area models and there is a growing interest of Members to obtain access to NWP products and use these with additional local inputs. As a strategy, bilateral and regional arrangements need to be promoted to deliver derived NWP products for further use on local level.

3.1.2 An improved quantitative understanding of local atmospheric processes in combination with improved prediction of convective processes and quantitative precipitation forecast greatly facilitate the now-casting capability of flash-floods. This requires improved terrestrial and satellite-based observing networks together with advanced data assimilation capabilities and correction algorithms for precipitation estimates.

3.1.3 While the notion of probability and uncertainty of forecasts is well embedded in meteorological services, the hydrological forecasting services focus largely on the provision of deterministic forecasts. It was noted that for pre-warning services stochastic and ensemble techniques are useful when used in combination with a threshold concept to switch from probabilistic to deterministic forecasting.

3.1.4 It was felt necessary that hydrological models need to be adapted to make use of meteorological inputs. While classical hydrodynamic, flood routing and certain mathematical models do not require meteorological inputs of the kind discussed above, these inputs are especially useful for pre-warning services and thus the extension of lead-time for getting prepared to floods in an adequate manner.

3.1.5 Examples were presented and discussed demonstrating the organizational aspects of collaborative efforts between meteorological and hydrological services that could be used as “living test-beds” in improving flood-forecasting services in an integrated manner with meteorological services. It was shown that this cooperation works comparatively better in areas that are more frequently affected by floods as opposed to regions that rarely experience floods with a potential for disaster.

4. Current weaknesses of forecasting systems

4.1 Within the thematic scope of the expert meeting and without the intention to be comprehensive, the following weaknesses of forecasting systems were identified:

a) Meteorological information and forecasting are often not provided in a form usable for hydrological pre-warnings and forecasting,
b) Meteorological forecasts are often qualitative and not quantitative,
c) Extreme meteorological and hydrological events are not risk qualified. What does i.e. severe rainfall mean for the input to hydrological forecasting or the general public?
d) Advanced methods and techniques including the use of NWP products and ensemble forecasting techniques are not widely used in the meteorological and hydrological communities, i.e. only slightly over 1/3 of WMO Members have the capability to run NWP models and generate products,
e) Fragmented data holdings, non-standardized data archiving, data formats and transmission protocols severely limit timely access to data and information,

f) There is a pronounced “communication gap” between meteorological and hydrological services with regard to forecasting concepts, methods, products and services, outreach to end-users and even the technical language used,
g) Forecasting is often not objective-driven; different users of forecasting information require specific forecasting products,
h) Uncoordinated multi-service warnings could conceivably conflict with each other and lessen their usefulness,
i) Warnings directed to disaster management agencies and the general public use technical vocabulary not easily understood by those who should benefit from the warnings.

5. Concept of a WMO Action Programme

5.1 Based on the presentations and discussions and with a background of information on WMO’s relevant programmes and activities as well as a general perception of WMO’s involvement in improving cooperation of NMHSs, participants developed a general framework of a WMO Action Programme on Flood Forecasting and Warning which is outlined below.

5.2 A WMO Action Programme on Flood Forecasting and Warning should be initiated with the principal objective to contributing to the improvement of meteorological services in detecting flood-critical situations and the improvement of hydrological services in using meteorological forecasting information to provide accurate and timely flood forecasting services to the public and disaster managers active in flood emergency preparedness and response. The proposed action programme should also provide guidance and expertise with regard to priority activities related to flood forecasting/warning for the new WMO Programme on Natural Disaster Prevention and Mitigation.

6. Objective

6.1 Focusing on the ability of NMHSs to cooperate in an effective manner to provide improved flood forecasting services, the objective of an Action Programme can be defined to:

Improve the capacity of meteorological and hydrological services to jointly deliver timely and more accurate products and services required in flood forecasting and warning and in collaborating with disaster managers, active in flood emergency preparedness and response.

7. Expected results

7.1 The discussion of the participants revealed that the following results need to be achieved to reach the objective defined above:

a) Improved quantitative and qualitative weather forecasting products are available in such a way that these can be directly used for flood forecasting,
b) Medium-range weather forecasting and climate prediction tools can be applied to extend warning times and produce pre-warning information,
c) NHMSs have improved their capacity to cooperate to jointly deliver timely and accurate flood forecasting information,
d) Integrated weather, climate and hydrological forecasting information is available in a relevant format for use by civil organizations responsible for disaster preparedness and mitigation.

8. Implementation and outreach process

8.1 Participants agreed that a series of global, regional and national meetings is a means to achieve the objective but not its end. It is therefore envisaged to facilitate a well-defined outreach process which could include the following elements:

8.2 The formulation of guiding materials for the improved cooperation between meteorological and hydrological services and regional bodies and organizations. Such guidelines could amongst others contain recommendations on the institutionalization of joint activities, harmonization and standardization of communication protocols and data formats, choices in processing procedures, modelling and interpretation of results, dealing with probability and uncertainty in forecasting, development of joint forecasting products, and clear identification of the roles and responsibilities of meteorological and hydrological services during pre-warning times and actual flood situations.

8.3 Facilitated national consultations are seen as an appropriate means to sensitize national meteorological and hydrological services to each other's responsibilities, needs and opportunities/necessities for an improved cooperation. WMO is seen as the lead agency to facilitate these consultations.

8.4 Pilot projects with a high visibility are an important means to demonstrate the value of the cooperation between meteorological and hydrological services and also the use of advanced meteorological forecasting and prediction outputs such as those obtained from regional centres and organizations such as ECMWF and the use of NWP and ensemble forecasting.

8.5 Fostering twinning agreements between NMHSs with the objective of sharing know how and technology in improved cooperation and the development and use of advanced forecasting products and their dissemination is a promising option in many parts of the world.

8.6 A detailed outreach process needs to be developed to connect improved pre-warning and forecasting capabilities to users in general and specifically to the disaster prevention and mitigation community.

9. Proposed actions

9.1 Based on the recommendations of the invited experts and the interactions between HWR, AREP, WWW and WCP the following actions are proposed in the order as they appear below:

9.2 Scoping exercise

On the basis of commissioned case studies and regional synthesis papers, the scoping exercise aims to provide a global and regional overview on issues such as the use of meteorological forecasts for flood forecasting, development and application of state-of-the-art NWP and ensemble techniques for flood forecasting, access to relevant data and network adequacy to support high accuracy weather and flood forecasting, institutional issues of cooperation between NMSs and NHSs as well as technical and resource capacity of involved institutions to improve flood forecasting on the basis of improved weather forecasting and the use of climate predictions (such as seasonal outlooks). The results of the scoping exercise will be used for the preparation of the proposed regional workshops.

9.3 Regional workshops

The aim of regional workshops will be to initiate dialogue between NMHSs with a focus of improving tools and methodologies for weather- and flood forecasting taking into account also the potential benefit of seasonal climate prediction. These workshops will also be designed to define present shortcomings, levels

of applied technologies, challenges and opportunities for improved forecasting with a view to strengthening regional cooperation. The regional workshops will also serve to preparing a reference base of information to structure and conduct national consultations. Noting, that slightly over 1/3 of WMO's Members have the capability to run NWP global, regional and/or limited-area models, and a large majority of Members have access and make use of NWP products from other NMCs, bilateral and regional arrangements are envisaged to deliver derived NWP products for use on "local" levels.

9.4 National dialogue

The value of meteorological and hydrological forecasting is still under-estimated in a number of member countries. The facilitation of national dialogues aims to bring together the users of forecasting services to express their needs and requirements and NMHSs to explain present state forecasting techniques as well as opportunities and limitations in forecasting, especially with regard to floods. These activities, while helping to create awareness of the benefit of forecasting services would also serve as a platform for the development and use of appropriate forecasting techniques to be used in flood forecasting and beyond.

9.5 Pilot projects

The development and implementation of pilot projects as showcase projects will aim to demonstrate the benefits of closer collaboration of meteorological and hydrological services with a focus on flood forecasting. Approaches, methodologies and lessons learnt are then expected to be applied in full-fledged projects with external funding and transferred to other countries/regions as seems appropriate.

9.6 Technical Conference

A global technical conference on improved meteorological and hydrological forecasting for flood situations will provide a synthesis of national and regional issues and strategies for the development and application of improved weather forecasting, climate prediction and hydrological forecasting with emphasis on floods. The results of the global conference will serve as inputs in the review of cooperation mechanisms between NMHSs, the promotion of the application of NWP products for flood forecasting as well as the mechanisms and modes to access relevant meteorological forecasting products and the development of advanced products for use especially in the developing world. As a consequence, the findings from such a conference would also influence present-day capacity building efforts in NMHSs with a view to improving forecasting techniques and practices.

10. Topics to be covered in the proposed actions

10.1 A number of topics were identified which need to be covered in any of the outreach activities proposed above. Without being comprehensive, these topics include:

10.2 General focus should be on the needs of the developing world, the information requirements and the use of appropriate forecasting tools to contribute to the mitigation of flood impacts on lives, property and infrastructure in affected river basins.

a) Observational networks including space-based systems, data exchange/transmission and data analysis including data quality;
b) State-of-the-art of meteorological models used including now-casting,
c) State-of-the-art possibilities of NWP precipitation forecasts,
d) State-of-the-art of hydrological modelling and forecasting and including applications in now-casting of flash-floods;
e) Assimilation of the outputs of NWP, including ensemble forecasts, using radar and satellite information in hydrological models and operational flood forecasting/warning,
f) Critical aspects with respect to predictability, thresholds, interpretation and use of these forecasts related to precipitation and other relevant parameters,

g) Development and application of climate predictions in the preparation of seasonal river-flow outlooks
h) Needs for capacity building in NMHSs to make use of weather forecasting for hydrological forecasting,
i) Means of coordination between meteorological and hydrological services,
j) Operational aspects of integrated flood forecasting/warning systems,
k) Definition of objective functions for flood forecasting
l) Issues related to uncertainties and verification of forecasts
m) Coordination with end-users of information,
n) Warning procedures and the development of information and its dissemination down to community level.

11. Collaborating agencies and organizations

11.1 It is evident that a network of collaborating partners and centres of excellence is required on global, regional and national levels to implement the proposed actions and to meaningfully cover the topics to be covered under these actions. Without being exclusive a brainstorming exercise produced the following suggestions for collaborating agencies and organizations that could be involved in aspects of the Action Programme:

USGS – United States Geological Survey
US NWS – US National Weather Service
NOAA - US National Oceanic and Atmospheric Administration
HRC – US Hydrologic Research Centre
OFDA – US Office for Disaster Assistance
INBO – International River Basin Office (France)
ECMWF – European Centre for Medium Range Weather Forecast
ADPC – Asian Disaster Preparedness Centre
CEH – UK Centre for Ecology and Hydrology
Mèteo-France – Meteorological Service of France
UK Met Office - United Kingdom Meteorological Office
EUMETSAT - European Organisation for the Exploitation of Meteorological Satellites
ACMAD - African Centre for Meteorological Applications for Development
ISDR – International Secretariat for Disaster Reduction
IRD - Institut de Recherche pour le Développement (France)
SAWS - South African Weather Service
CPTEC - Centre for Weather Prediction and Climate Studies (Brazil)
ASMC - ASEAN Specialized Meteorological Centre

12. Collaboration with Technical Commissions of WMO and their working-groups

12.1 With support from HWR, WWW/B, AREP and WCP, activities envisaged under the Action Programme are expected to be planned and implemented under the auspices of CHy, CBS, CAS and CCl. In particular, the relevant working groups and OPAGs of these Commissions are expected to provide substantial inputs in this regard. The detailed approach for making best use of this pool of expertise and know-how existing within the Technical Commissions of WMO needs to be outlined in direct communication with the Presidents of the Technical Commissions and the Chairs of the relevant Working Groups and OPAGs.

12.2 In CHy, the two subject-oriented working groups, namely the Working Group on Hydrological Forecasting and Prediction and the Working Group on Water Resources are in a position to provide inputs that will be coordinated through the Advisory Working Group of CHy.

12.3 In CBS, the OPAGs on Integrated Observing Systems, Information Systems and Services, Data Processing and Forecasting Systems and on Public Weather Services are expected to provide expertise and significant inputs to the Action Programme.

12.4 In CAS, the Science Steering Committee for the WWRP and the Working Group on Tropical Meteorological Research could provide expertise and support to the proposed activities mentioned above.

12.5 In CCl, the OPAG on Climate Applications, Information and Prediction Services is expected to provide inputs related to seasonal predictions in water resources and flood management systems, especially relating to end-user liaison.

13. Resources for implementation of the proposed activities

13.1 Concluding the preparatory expert meeting, participants reiterated the benefit of the Action Programme to the general public once the proposed activities are implemented. Participants however noted that substantial resources are required in the planning and implementation of this ambitious programme. Participants therefore proposed that the proposed activities should be sponsored not only through WMO Programmes but also through Members and other organizations that can provide resources both in terms of expertise and human resources as well as contributions in kind and hosting the proposed meetings and events.

Annex 1: Agenda of the Expert Meeting
Annex 2: List of participants

ANNEX 1

Preparatory Expert Meeting on Improved Meteorological and Hydrological Forecasting for Flood Situations

Geneva, Switzerland, 1 - 2 April 2003

Agenda

Tuesday 1 April

09:30 Opening of the expert meeting
09:45 Briefing on WMO activities and the background to organize a Technical Conference on Improved Meteorological and Hydrological Forecasting for Flood Situations
10:30 Round-table discussion and brief presentations on the state-of-the-art and use of Numerical Weather Prediction products and other meteorological forecasting products for flood situations
12:00 Lunch
14:00 Round-table discussion and brief presentations on the state-of-the-art and use of hydrological observations, modelling and forecasting products for flood situations
15:30 Break
15:45 The use of meteorological and hydrological information in disaster prevention activities
16:45 Meeting adjourns

Wednesday, 2 April

09:00 Opportunities and challenges in the development and use of state-of-the-art specialized NWP products available today
09:30 Strategies to improve integrated meteorological and hydrological forecasting in flood situations and the use of forecasting products for disaster prevention
10:30 Break
10:45 Topics and expected results of the proposed Technical Conference
11:45 Definition of an outreach process as a result of the Technical Conference
12:30 Lunch
14:00 Identification of organizations and agencies to be contacted for the Technical Conference
14:30 Collaboration with Technical Commissions of WMO and their working groups
15:00 Formation of an Organising Committee
15:30 Break
15:45 Development of an action plan to hold a Technical Conference
16:15 Summary of the meeting results and recommendations
16:30 Meeting adjourns

ANNEX 2

PREPARATORY EXPERT MEETING ON IMPROVED METEOROLOGICAL AND HYDROLOGICAL FORECASTING FOR FLOOD SITUATIONS

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