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WEATHER, CLIMATE AND WATER

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SUBGROUP ON FLOOD FORECASTING AND WARNING

Draft Report by the Chairperson, Mr I. Karro (Sweden)

World Meteorological Organization
Regional Association VI
Subgroup on Flood Forecasting and Warning

FINAL REPORT

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Contents

1. General
2. Review on the subgroup activities 2003-2005
3. Proposals and recommendations

Annexes

1. The resolution 19 from WMO RA VI thirteenth session, Geneva, 2-10 May 2002. Re-establishing the working Group on Hydrology.
2. The workshop on Flood Forecasting and Warning (Paris, February 2005)
3. Related activities and publications

1 General

The thirteenth session of the Regional Association VI (Europe) held in Geneva, Switzerland in May 2002 adopted Resolution 19 (XII-RA VI) to re-establish the Working group on Hydrology. There was also a decision to establish subgroups, one of them being the subgroup on ”Flood Forecasting and Warning” The resolution 19 (XIII-RA VI) concerning the reestablishment of the hydrology working group and the annex giving the terms of reference for the subgroup on flood forecasting and warning, is found in Annex 1.

2 Review on the Subgroup for Flood Forecasting and Warning activities in 2002-2005

The interpretation of the terms of reference for the subgroup was that emphasis should be put on the use of meteorological input to provide better operational hydrological forecasts and warnings. Therefore effort was made to increase the number of meteorologists in the subgroup and to find good examples of how the cooperation between meteorology and hydrology has proven beneficial in different RA VI countries.

The subgroup consists of a number of representatives from 13 different countries. Active members have been J Danhelka (Czech Republic), B Vehviläinen (Finland), P Krahe (Germany), E Sprokkereef (Netherlands), M Simota (Romania), S Borsch (Russia), A Tastekin (Turkey), T Abrantes (Portugal) and M Dale (United Kingdom). The members represented hydrology as well as meteorology. I Karro (Sweden) has acted co-ordinator during the period.

The subgroup at first corresponded via e-mail and a papers were submitted among the members of the subgroup. The papers described procedures of different aspects of FFW in different countries.

Then a workshop on Flood Forecasting was held in Paris in March 2005. 15 participants from 10 countries took part. Information about the workshop is found in annex 2.

3 Proposals and recommendations

3.1 General:

- A lot of activities in the field of Flood Forecasting and Warning (FFW) are ongoing. It is important to have knowledge about them and spread the information in order to avoid duplication of work and to be able to utilise the results for operational use.
- During the last years there have been several flooding events in the RA VI region. There is a lot of valuable experience that could be collected and serve as guidelines for the handling of new events to come.

- There is expert knowledge in specified areas (flash flooding, plain flooding…) of FFW in many countries. The experts could be invited to share their knowledge with others in working groups. This could lead to ways to identify "best practice" already operationally used.
- In FFW there is a need for every actor in the production chain to have a global view. Weak links have to be identified.
- The need for improvement in precipitation forecasting in the meaning of timing, amount and geographical area is big.

3.2 End users and communication:

- The main end user is the public, other end users can be state or municipal authorities, rescue services or reservoir operators.
- There is a need for producers of FFW to know who the end-user is and what kind of information they really need to take appropriate action in case of prevention work or in an actual flooding situation.
- The information should be tailored for the different end user and has to be easily understood and available via selected information channels.
- Education of end users and communicators is important to ensure that correct information is given and received.

3.3 Producers of FFW:

- To arrive at a mutual understanding of the problems it is beneficial to have close cooperation between meteorologist and hydrologists both in operational forecasting as well as in research and development and in common working groups or projects.
- It is crucial to have clear responsibilities within and between actors participating in FFW

3.4 Methods and Models

- Flash floods: It would be beneficial to have pre-prepard the hydrological response in advance. It is very important to have knowledge of initial moisture conditions. For that purpose modelling of soil moisture as well as measurement (satellite or ground or combined) could be used. Hydrologists should prepare threshold maps for expected amounts of precipitation in advance. This saves time in the case of issuing a warning.
- Ensemble forecasting. The ensembles produced from global models still have rather poor spatial distribution (typically 50 x 50km). Therefore those kinds of ensembles are only useful for large catchments. Finer resolution ensembles are necessary for operational hydrological forecasting in smaller catchments. This is a field where cooperation between hydrologists and meteorologists in research and operational forecasting should be very fruitful.
- Uncertainties: There are uncertainties in the meteorological EPS-forecasts and in the hydrological models and also in the initial conditions. Generally the major part of the total uncertainty is determined by the uncertain precipitation forecast. But there are

some other sources of uncertainty that has to be taken into account. The uncertainty of hydrological model parameters and its initial condition (soil moisture) should be named as very important to. The combination of different uncertainties is researched by many institutions (universities, developing firms etc.). Usually very sophisticated statistical techniques are used for combination (Kalman filter). The operational use of different uncertainties combination is the task for future years.

Annex 1

Draft resolution

Res. 8/1 (XIII-RA VI) - WORKING GROUP ON HYDROLOGY

THE REGIONAL ASSOCIATION FOR EUROPE,

NOTING:

(1) The report of its Working Group on Hydrology;

(2) Resolution 16 (Cg-XIII) - Hydrology and Water Resources Programme (HWRP);

(3) Resolution 37 (Cg-XIII) – Terms of Reference of the Technical Commissions;

(4) The Fifth WMO Long-term Plan, 2000-2009;

CONSIDERING:

(1) That Regional Association VI plays an important and active role in conducting regional WMO activities relating to hydrology and water resources;

(2) That HWRP is a priority programme for the Region;

(3) That the Working Group on Hydrology proposed at its ninth session that it continue its activities during the next intersessional period;

DECIDES:

(1) To re-establish the Working Group on Hydrology and that the future activities be undertaken by the group in the areas listed below, and according to the detailed description given in the Annex, and to establish Subgroups on Institutional Aspects of Monitoring and Assessment and on Flood Forecasting and Warning to address areas (f) and (g) below respectively:

(a) Public relations and the visibility of National Hydrological Services;

(b) Climate and water;

(c) Water quality assessment;

(d) Potential extreme floods;

(e) Drought assessment and forecasting;

(f) Institutional aspects of monitoring and assessment;

(g) Flood forecasting and warning;

(2) To invite all Members in the Region to designate experts in hydrology and water resources, preferably including the hydrological advisors to the Permanent Representatives and representatives of the HOMS National Reference Centers and of other bodies working in the field of water, to participate in the Working Group on an ongoing basis and attend its meetings. In selecting such participants, Members should take into account that they will have to devote time and effort to the Working Group's activities;

(3) To invite Members in the Region to designate experts in meteorology to participate in the Subgroup on Flood Forecasting and Warning;

(4) To designate Mr.J.Kubát (Czech Republic) as Regional Hydrological Advisor and chairperson of the Working Group and Mr.P.Givone (France) as vice-chairperson of the Working Group and rapporteur on public relations and the visibility of National Hydrological Services;

(5) To designate Mr.A.Snorrason (Iceland) as coordinator of the Subgroup on Institutional Aspects of Monitoring and Assessment and Mr.I.Karro (Sweden) as coordinator of the Subgroup on Flood Forecasting and Warning;

(6) To designate:

(a) Mr.O.Varis (Finland) as Rapporteur on Climate and Water;

(b) Mr.P.Rončak (Slovakia) as Rapporteur on Water Quality Assessment;

(c) Mr.B.Ozga-Zielinski (Poland) as Rapporteur on Potential Extreme Floods;

(d) Ms.G.Monacelli (Italy) as Rapporteur on Drought Assessment and Forecasting;

INVITES the Regional Hydrological Adviser and chairperson of the Working Group:

(1) To prepare an implementation plan and designate, in consultation with the president of the regional association, appropriate members from the Working Group to conduct activities on the various aspects of the terms of reference;

(2) To participate in EC sessions, when invited, representing the regional interests in relation to hydrology and water resources and to coordinate the WGH activities with CHy and other regional WGsH;

(3) To submit to the president of the regional association an annual report on 31 December every year and a final report no later than six months before the fourteenth session of RA VI;

REQUESTS the Members concerned to give their full support to the members of the Working Group from their countries so that they may carry out the tasks entrusted to them;

INVITES the Secretary-General:

(1) To provide assistance to hydrological activities in the Region, including seeking sources of finance and implementing the projects that could be prepared as part of the activities of the RA VI Working Group on Hydrology;

(2) To publish in the technical document series selected technical reports prepared by the Working Group and distribute them to all concerned.

Annex to draft Resolution 8/1 (XIII-RA VI)

TERMS OF REFERENCE OF THE WORKING GROUP ON HYDROLOGY

i. Public Relations and Visibility of Hydrological Services

Considering the need to enhance the visibility of the NHSs and the recognition of their role by national authorities, as well as their involvement in the formulation of new international policy tools concerning water:

(a) To collect, analyse and disseminate information on the activities undertaken by NHSs in the area of public relations, and on tools and approaches used to enhance their visibility and recognition;

(b) To develop and expand the existing Web site “Hyperlinks in Hydrology” as an operational tool for the activities of the Working Group, in particular as concerns the exchange of information, the establishment of an address book, the publication of reports, the provision of links for the hydrological community; including in particular information on the current activities of the NHSs;

(c) To produce a concept of a European Yearbook of Water Resources for selected basins and observation sites;

(d) To formulate suggestions for the presentation to the public at large through communication media of daily hydrological bulletins and forecasts for a country or large river basins.

3

ii. Climate and Water

Considering the potential impacts of climate variability and change on water resources, as well as the uncertainties of the outputs of climatological models:

(a) To study and report on the experiences gained in RA VI countries in addressing climate and water related issues, mainly:

- The evolution and changes of the operational practices of National Hydrological Services in response to the developing demand for information on, and need of monitoring and assessment of climate change impacts on water resources,

- Cooperation with the other national and international organizations and institutions on climate and water related issues;

(b) To liaise with and provide advice to those experts of the Association working on potential extreme floods and drought assessment, forecasting and warning. (see iv and v below)

iii. Water-Quality Assessment

Considering the present and anticipated responsibilities of the NHSs in the area of water quality assessment:

(a) To evaluate current methods used for the assessment of surface and ground water quality;

(b) To prepare a revue of and proposals on:

- Criteria for the classification of the state of rivers and groundwater bodies, according to different water quality parameters;

- Monitoring frequency requirements for the assessment of surface and groundwater quality parameters.

4

iv. Potential Extreme Floods

Considering the importance of hydrological design data for the security of hydraulic structures (e.g. dams and bridges) and safety of people:

(a) To undertake a brief literature review of research carried out on hydrological design data for extreme floods occurrences;

(b) To undertake an international survey on best available practices and on national standards in estimation of hydrological design data for extreme floods occurrences;

(c) To carry out an investigation of methods of PMP/PMF derivation and other methods for extreme flood estimation;

(d) To contact key individuals or research groups to canvass opinion and comment on future research priorities;

(e) To prepare a catalogue of extreme floods that have occurred in the Region since the year 2000.

(f) To liaise with and provide advice to the experts of the Association working on climate and water. (see ii above)

v. Drought Assessment, Forecasting and Warning

In consideration of the increase of water-stress during a period of drought and with a view to ensuring the proper management of water resources during such conditions:

(a) To review and evaluate meteorological and hydrological medium- and long-term drought forecasting systems in RA VI countries;

(b) To assess the use of satellite data in drought monitoring and assessment;

(c) To identify ways of promoting the exchange of data and products, as well as of forecasts and warnings, during low flow situations in RA VI countries;

(d) To propose ways for ensuring effective cooperation with other international and regional bodies involved in drought assessment and mitigation;

(e) To review and evaluate activities undertaken by, or in cooperation with, National Hydrological Services to mitigate the impacts of drought in RA VI countries;

(f) To liaise with and provide advice to the experts of the Association working on climate and water. (se ii above).

vi. Institutional Aspects of Monitoring and Assessment (surface water, groundwater, quality and quantity)

In consideration of the problem posed by the insufficient standardization of data collection and processing procedures, even at national level between various agencies, and of the requirements for monitoring set by the EU Water Framework Directive:

(a) To investigate the institutional and organizational aspects of hydrological monitoring and assessment, by means of a mapping of the monitoring actors and programmes;

(b) To assess the needs for hydrological information, to contribute to the formulation of standards on measurements and data processing and to formulate proposals for integrated monitoring network design and assessment;

(c) To support RA VI member countries in the application of river basin management plans and of the EU Water Framework Directive;.

(d) To establish and maintain collaborative contacts with the main actors (NHSs, European Commission, European Environment Agency, etc.), in this area with a view to increasing the role and visibility of Hydrological Services with international conventions and the European Commission, also by means of attendance to, or organization of workshops involving the key actors for cooperation and active participation in the planning of the Conference on Hydrological Monitoring foreseen for 2005 in the Netherlands.

vii. Flood Forecasting and Warning

To improve the capability of NHSs in flood forecasting and warning of different types of floods:

(a) To study the present applications of:

- Radar data, satellite data and other data, including outputs of numerical models, for integrated meteorological information;
- An integrated approach to quantitative precipitation forecasting;
- Calibration and testing of hydrological models using outputs from meteorological models, preferably in gridded form;
- The development of common probabilistic and ensemble forecasts;
- Methodologies and criteria for evaluation of quantitative precipitation forecast and hydrological forecasts;

(b) To review existing practices and make proposals on effective ways of disseminating meteorological and hydrological information and warnings for floods.

Annex 2

Flood Forecasting and Warning Workshop

Paris, France 16-18 March 2005

Fifteen participants from ten countries participated at the workshop held under the plan of work for the subgroup on ”Flood Forecasting and warning” RA VI WMO. The workshop was organised with involvement of a number of experts outside the preliminary established group.

At first the subgroup stated that the prevention for floods will never be perfect – therefore forecasts and warnings will always be needed.

The discussions were focused on the benefits of increased co-operation between meteorologists and hydrologists both operationally and in research and development. The subgroup also noted that it is crucial to identify the end-users in order to find out heir needs. It is also important to try adopt a global view in the forecasting chain to ensure that relevant information is submitted to the end users. Further the possibilities with ensemble forecasting (EPS) was discussed, there are activities both in international and national research projects.

The discussions are reported on in more detail in chapter 3 (Proposals and recommendations)

Flood Forecasting and Warning Workshop

Paris, France 16-18 March 2005

List of presentations and submitted papers

T Tastekin	Spatial and Temporal Distributions of Flood Hazards in Turkey
P Krahe	Ongoing changes in the flood forecasting practices in Germany
J Danhelka	Data assimilation, uncertainty and hydrologist – meteorologist relationships.
E Sprokkereef	The activities on flood forecasting and warning in the Netherlands
M Simota	Flood forecasting and warning system in Romania – present and perspective approach.
I Karro	Flood Forecasting from a Swedish Perspective
P Givone/C Perrin/V Andreassian	Recent developments in flood forecasting and alert tools, the projects FRAMEA, AIGA and ”Three-days ahead flood forecasting on the Seine river using continuous rainfall-runoff model”
M Benko	Flood forecasting and warning system in Slovakia

T Abrantes	Co-operation meteorology-hydrology-civil protection service
J-M Tanguy	The new French Flood forecasting system; Towards a digital experimental catchment.
T Abrate	Message from WMO

Annex 3

Related activities and publications

There are a lot of activities going on in the field of FFW. The EU framework 5 programme has been instrumental in supporting a number of major research project aimed, in part, at linking observations from weather radar and output from NWP models to hydrological models and end user requirements, examples being CARPE DIEM, MUSIC, MANTISSA and Voltaire.

Below are some related activities identified by the subgroup.

The **COST-717** Action "Use of radar observation in hydrological and NWP-models (Quantitative precipitation forecasts (QPF) based on radar data for hydrological models) lasted from 1999 to 2004 and sought to promote the application of radar data and combined three quite distinct communities, i.e. hydrologists, radar scientists and NWP modellers.

A **new COST action** is proposed "Propagation of uncertainty in advanced meteo-hydrological forecast systems". The proposed action will address the problem of forecasting heavy precipitation events and the corresponding hydrological processes in connection with the uncertainty inherent in this task. The goal of the action is to thoroughly investigate the propagation of uncertainty through the various steps of modelling and decision making.

There is also a proposal for the development of a "Satellite Application Facility" on "Support to Operational Hydrology and Water Management" **(H-SAF)**. The focus in the proposal is on creating new products for precipitation, soil moisture and snow parameters and the usefulness of the new products in hydrological models and NWP.

The **PREVIEW** project within the EU framework 6 programme has the first and foremost objective to develop new or enhanced information services to support the management of risks, mainly intended for the European Civil Protection Units and local or regional authorities. The selected portfolio of PREVIEW services is first based on the priorities in term of risk to be managed in Europe and in terms of the service to be developed. These priorities has been defined by the communities of end-users, and in particular the Civil Protection units, involved in the project. In practice the PREVIEW will develop information services for assets mapping, risk mapping, risk monitoring, risk forecasting and awareness and damage assessment for different types of hazards, for example (plain floods, flash floods and northern floods)

EFAS,(European Flood Alert System), the follow up to the EU Framework 5 Project EFFS, explores the interface between hydrological and meteorological modelling. EFAS uses selected ensembles of ECMWF as an input of distributed hydrological model of large European catchments. The output is ten days ensemble hydrological forecast which is planned to serve as an early warning tool for National Hydrological Services concerning plain floods forecasting on large basins.

HEPEX *(*Hydrological Ensemble Prediction Experiment*)* The main objective of HEPEX is to bring the international hydrological community together with the meteorological community to demonstrate how to produce reliable hydrological ensemble forecasts that can be used with confidence by the emergency management and water resources sectors to make decisions that have important consequences for the economy, for public health and safety.

EXCIFF (European exchange Circle on Flood Forecasting) – The first meeting was held in Toulouse in August 2005. The main goal of the exchange group is to share the experiences between forecasters, developers and users in the field of Flood Forecasting.

Publications

Recently a WMO-report has been issued “Recommendations for the verification and intercomparison of QPFs from operational NWP-models. (WWRP/WGNE Joint Working group on Verification)

There is also an ongoing work to make a revision of the WMO Guide to Hydrologic Practices