

Zaragoza Declaration
Expert Meeting on Flood Forecasting in the Mediterranean Basin

1. Preamble

(a) *The Expert Meeting, organized by the National Meteorological Institute and the Water General Direction of the Ministry of Environment of Spain, and the World Meteorological Organization (WMO) in the headquarters of the International Centre for Water and Environment of the Government of Aragón in La Alfranca, Zaragoza, Spain, from 26 to 28 September 2006, brought together approximately 70 participants from 20 Mediterranean countries, from bodies responsible for meteorological and hydrological forecasting, river basin organizations, universities and research institutions.*

(b) *The event was held as part of the WMO Flood Forecasting Initiative, which is being promoted at the global level by WMO and has the main objective of improving the capabilities of National Meteorological and Hydrological Services (NMHSs) to provide the timely and accurate services and products required for flood forecasting and warnings, by encouraging close cooperation between them, and thus optimize decision making.*

(c) *The Meeting was held alternating technical presentations divided in five thematic sessions: "Meteorological Observation and Forecasting Systems", "Hydrological Observation and Forecasting Systems", "Challenges and Opportunities of Enhanced Cooperation between NMSs and NHSs", "Capacity Building Aspects" and "Institutional Aspects" with country presentations, where the participants described the flood forecasting situation in their home country. A last session was dedicated to the preparation, discussion and adoption of this Declaration.*

2. The Expert Meeting considered that:

(a) *close cooperation between meteorologists and hydrologists and their respective organizations is necessary for accurate and timely flood forecasting, as shown by the Spanish experience and, in a very interesting and innovative way, by the recent restructuring of the sector in France, where experiments to increase even more that cooperation are currently under way. It might be interesting to transfer these experiments to other Mediterranean countries.*

(b) *in practically all countries, effort are made to improve cooperation between meteorological and hydrological forecasters. Some very good examples of operational services and applied research were presented in the Meeting. Furthermore, it is considered important to adopt a multidisciplinary approach in all flood forecasting related activities, in particular by including also civil protection experts in the forecasting teams.*

(c) *despite the above, institutional difficulties continue to hinder cooperation between Meteorological and Hydrological Services. Even those countries seeking cooperation have technical difficulties to overcome caused by varying spatial and temporal scales, operational procedures and the academic training of the professional staff at these institutions. Therefore, initiatives such as this Expert Meeting are welcome.*

d) *as a cause of concern in several countries, even the most developed ones, there is a severe lack of qualified and motivated staff in both National Hydrological and Meteorological Services.*

(e) *in the future it would be advisable that decision makers have a more proactive attitude with respect to forecasting systems rather than waiting for a catastrophe to happen before supporting their implementation.*

(f) *in recent years, numerical weather models have improved considerably, but it is important to know their limitations, in particular as regards the forecasting of precipitation fields. It has been shown that Ensemble Prediction System (EPS) are the best system for mid-term forecast, with a probabilistic output which is very useful for the decision maker.*

(g) *Mediterranean hydrology involves special problems. Every progress in nowcasting of precipitation fields and in the coordination between SMNs and SHNs is a very important step ahead. In this respect, the utilization of the meteorological radar is unavoidable.*

(h) *As regards hydrological models, no single solution applies to all circumstances. Therefore, models must adapt to the characteristics of each river basin. As regards the inclusion in the hydrological models of the probabilistic output of the EPSs, this will produce different scenarios such as: most likely scenario or extreme scenarios. This uncertainty is unavoidable; therefore efforts should continue to be made in order that the hydrological community uses thoroughly these new products.*

(i) *To enable hydrologists to make optimal use of the above-mentioned meteorological information, advice from meteorologists experts in forecasting would be useful on the following areas: radar and satellite images interpretation; nowcasting; uncertainties and most frequent errors of meteorological models.*

(i) *An integrated information system, such as the SAIH used by the Confederaciones Hidrográficas of Spain, where hydrologic, hydraulic and meteorological data is collected in real time and transmitted to the corresponding decision centre to be processed and applied to the solution of water resources management problems, be it under normal circumstances or in emergency situations, is a fundamental tool to improve hydrological forecasting. Although investment needed is high and the maintenance costs considerable, its pay off is in short term and therefore ways should be investigated to implement similar systems, even if in a more limited version, in other Mediterranean countries. There are similar systems, with more limited performances, with installation and maintenance cost more affordable.*

(k) *In addition to hydrological forecasting systems, it is important to develop decision support systems to assist local authorities, civil protection, etc. to take the necessary preventive measures.*

(l) *it is recommendable to strengthen the international agreements on data exchange of any type, but in particular radar data in border areas where the radar range may be useful for neighbouring countries, in order to improve the areal coverage or overlap of echoes, in order to improve the meteorological forecasts for flood forecasting in those regions.*

(m) *the application of products derived from satellite observations should be considered due to its limited costs, as an alternative to the development of radar networks, in those countries where their implementation is currently not realistic. In this regard, the potential of tools of an international nature, such as the software application of the Satellite Application Software (SAF) of nowcasting from EUMETSAT, the TRMM satellites and others, should be considered.*

(n) *given that short term (12 to 72 hours) hydrological forecasting depends from meteorological forecasting, and given the limitations of meteorological forecasting, in particular as regards strong precipitations in the Mediterranean, efforts to improve these predictions, from a deterministic point of view and to better limit uncertainties, are considered essential.*

3. The Expert Meeting made the following recommendations:

(a) *that WMO make efforts to improve the status of hydrometeorological forecasting in the Mediterranean countries, such as reinstate the MED-HYCOS project (including the rehabilitation or reinstallation of the stations established in the original project), support the BALWOIS project, and promote a Flood Forecasting System for the Mediterranean and its sub-regions.*

(b) *that WMO include in its future plans actions to (i): improve the capacities of NMSs to create meteorological products for flood forecasting, particularly quantitative precipitation forecasting and probabilistic quantitative precipitation forecasting; and (ii) support development and outreach activities between NMSs on effective methods to incorporate probabilistic products into their hydrological forecasting, when possible.*

(c) *that the concept that the development of a legal and regulatory framework is an essential prerequisite for effective flood forecasting system, be promoted. Also that the cooperation between meteorologists and hydrologists should be expanded to the civil protection teams that manage the emergency situations related to floods*

(d) *that the Governments of the region realize that strengthening of human resources of NMHS, in number, training and motivation, especially in the area of monitoring and forecasting, is a need that cannot be any longer postponed. This is witnessed by the increase of loss of lives and properties caused by flooding.*

(e) *that WMO look for innovative ways to transfer well organized information and flood forecasting systems such as SAIH (or an adaptation thereof) to other Mediterranean countries, for example through pilot projects.*

(f) *that technical assistance programmes be developed in this area, either bilateral or, preferably, through regional organizations interested in the area.*

(g) *that a policy to strengthen links between NMHSs and the academic community to optimize the mutual benefits of sharing information, data, studies and research, should be developed.*

(h) *that new radar networks be supported and existing ones upgraded.*

(g) that WMO promote and support the international exchange of research addressing the improvement of intense rainfall forecasts in the Mediterranean, through project such as MEDEX.

(h) that a thematic network similar to PROHIMET (Iberoamerican Network for the monitoring and forecasting of hydrometeorological events) to improve the hydrometeorological forecast activities in the Mediterranean region, be developed.

(i) to disseminate successful flood forecasting systems through WMO publications

Zaragoza, Spain, 28 September 2006