

**Advances in predicting flash floods**  
**Angel Luis Aldana Valverde, Doctor Ingeniero de Caminos, Canales y Puertos**  
**Centro de Estudios Hidrográficos del CEDEX**  
**Paseo Bajo Virgen del Puerto 3, 28005 Madrid. España**  
**Angel.l.aldana@cedex.es; <http://hercules.cedex.es/hidraulica>**

## **1. Introduction**

The advances in predicting flash floods are conditioned by the evolution of the related scientific and technological matter. They depend on the human resources, institutional relationships and administrative and legal frameworks. The solutions have to be adapted to the singularities of each physical and socioeconomic system.

This presentation is focused to the use of weather radar in the rainfall estimation, the advances in evolutionary computation, which provide solution to complex numerical problems, and it is specially aimed to emphasize the possibilities of the link between numerical weather prediction models and flash forecasting models. The author tries to expose these topics from a general point of view of approaches for advances in predicting flash floods.

## **2. New Applications Of Scientific Methods And Technologies.**

The application of new and former scientific knowledge has been a great step forward. The technological developments have made possible the implementation of new solutions.

### **2.1 INFORMATION TECHNOLOGY AND COMPUTING**

The information technology developments and, specially, the advances in computing have been the foundation for the evolution of other areas. To set an example, the new improvements in computing have provided successful solution to the problem of parameters calibration of simulation models.

### **2.2 Meteorology**

The operational use of numerical weather prediction models is a fact. The recent advances in this field has been really high. The short-range and medium-range rainfall forecasts, which may be the main input to a flood forecasting model, can be considered as a objective and automatic procedure with an high degree of accuracy.

### **2.3 Hydrology**

Even though traditional methods are usually the basis of the operational hydrology, the new advances in observation systems, measurement techniques and computing allow new successful approaches.

## **3. The Expansion Of Telecommunication Technologies**

The expansion of telecommunications technologies has implied a cost reduction in the communication solutions. Thanks to this, the solutions for real time data collection are feasible and commonly affordable.

#### **4. The New Observation Systems**

The evolution of observation technologies provides, to the specialist in flood forecasting, information in abundance. The new possibilities of observation facilitate the reach of a better knowledge about natural phenomena and provide data input to the forecasting models.

##### **4.1 Satellites**

The meteorological satellites are very important for the collection of information for the weather prediction models and for the monitoring of hydro-meteorological phenomena.

##### **4.2 Weather Radar**

The weather radar networks provide a very interesting information, complementary to the rainfall gauge station data, for the estimation of the spatial distribution of rainfalls.

##### **4.3 Sensors To Measure Hydrological Parameters**

The new technological enhancements in hydrological monitoring reduce uncertainties, like those associated to the river flow estimation. The new velocity sensors are very useful to discharge calculation.

#### **5. Development Of Early Warning Systems**

The new advances in technological developments, in addition to the cost reduction of some of the solutions provided by them, facilitate the widespread implementation of modern early warning systems.

#### **6. Link Between Meteorology And Hydrology**

The advances referred above make possible the operational use of outputs of numerical weather prediction models as inputs for flood forecasting models. This current workscheme offers solution to some unsolved problems of warning system and flood prediction, which can be satisfied by the link between meteorology and hydrology.

#### **7. To A New Approach For The Planning, Development And Implementation Of Solutions**

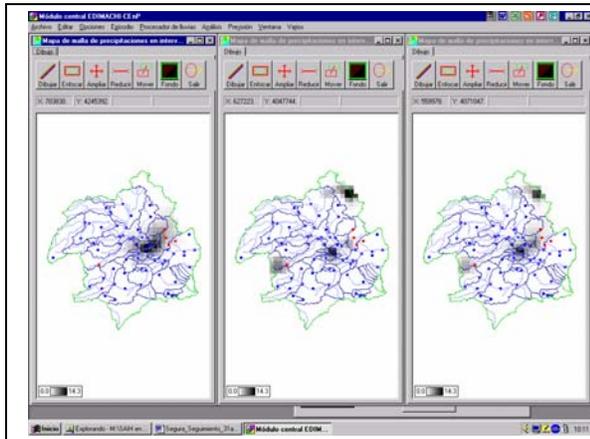
The new approaches for the planning, development and implementation of measures to solve problems related to floods (like those associated to integrated flood management concept) involve an important advance in flood prediction. These approaches aim solution based on participatory processes (bottom-up instead of top-down approach) with special sensitivity about cultural and environmental topics, and enhance the importance of early warning systems, which include flood forecasting systems, like complementary solutions (from a general point of view).

#### **8. Noticed Needs**

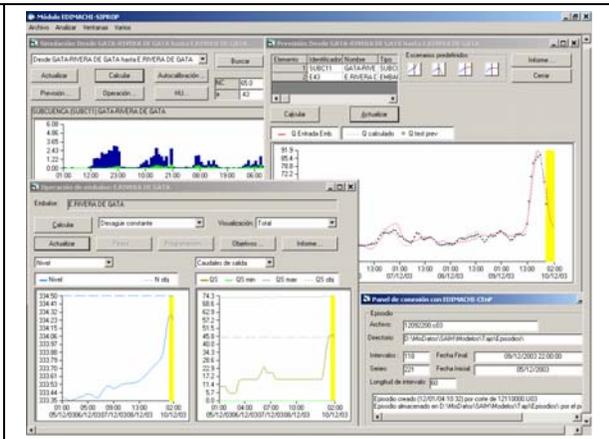
All these advances implies new challenges to different aspects and factors, which have to progress in the same way. Specially, the following needs have been noticed:

- Increase of cooperation between institutions.
- Continuous training of professionals.
- Transfer of training and knowledge. dissemination about risks and solutions.

- Changes in legal and administrative frameworks to consider the new advances and approaches.
- Resources for the maintenance of monitoring and forecasting systems.



*Use of the weather radar in estimation of rainfall*



*Solving of complex optimization problems using evolutionary computing algorithms*