CHAPTER 18

FORECASTING FLASH FLOODS
WITH AN OPERATIONAL MODEL
Application in the South-East of France (Gard)

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Abstract: The flash flood forecasting model ALHTAÎR ("Alarme Hydrologique Territoriale
Automatisée par Indicateur de Risque") has been developed during the last five years by
the flood-warning service of the Gard Region (SAC-30), in the South-East of France. A
spatial version for the flash flood forecasting model is described in this paper. This flash
flood forecasting model is divided in three separate tools, which allow a flood hydrograph
simulation for each location, covering all the rivers of the Gard Region, in a real time
processing: CALAMAR® simulates the rainfall intensity on each square kilometre of
the study area every five minutes. This georeferenced information is obtained by the
interpretation of radar images. HYDROKIT® gives the hydrographical characteristics of
a studied watershed using a DEM (Digital Elevation Model) for calculating the concen-
tration time. ALHTAÎR software, processes the data obtained by the two previous tools
and with a module of time concentration and a module of production (calculation of
effective rainfall) calculating in real time the flood hydrograph. The model that calculates
the effective rainfall, based on the Horton principle, takes six parameters into account.
For the first version of ALHTAÎR, these parameters are the same for the whole SAC-
30 supervised territory. The principal results of this version show a good flood crest
synchronization but a general overestimation of the peak flow. This result was observed
during the flash floods of the Gard Region in September 2002. To improve the ALTHAÎR
results, a spatial approach has been tested. The results presented in the paper, show that
the spatial approach according to infiltration capacity improves the reconstitution of the
flood hydrograph

Keywords: flash flood, forecasting model, flood warning service, Mediterranean region
1. INTRODUCTION

The Gard Region, in the South-East of France, is located between the Mediterranean and the first foothills of Central Massif (Les Cévennes). This geographic position (see Figure 1) makes this Region particularly vulnerable to flash floods. Each autumn, some storm events form on the sea and pushed by south winds provoke some extreme rainfall events (Rivrain, 1997). This climatic phenomenon is called “épisode Cèvenol”. During the 8th and the 9th September 2002, an extreme “épisode Cèvenol” occurred in the Gard Region. The precipitation was very important, with the measured rainfall exceeding 650 mm over a period of 48 hours for some areas. The resulting floods had discharges higher than 20 m$^3$/s/km$^2$ (Gaume et al. 2003a) for small watersheds (less than 10 km$^2$, principal tributaries of Gardon river, Vidourle river and Cèze river). One of explanations was the combination of the large area and the duration of the storm event. The flood caused 22 fatalities and 1.2 billion euros damage.

In the Gard Region, the flood warning service is responsible for the whole drainage network yet has hydrometric stations on the main streams. Therefore proposed to use flood modelling to improve flood forecast.

This paper describes this flash flood forecasting model and the first results for some small watersheds during the extreme floods of September 2002. The principal development of this model will be presented, namely the spatial variation of the infiltration capacity.

Figure 1. Gard region and the principal’s rivers location