Geophysical Research Abstracts
Vol. 15, EGU2013-10120, 2013
EGU General Assembly 2013

Flash flood warning in mountainaious areas: using damages reports to evaluate the method at small ungauged catchments

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In Europe, flash floods mainly occur in the Mediterranean area on small catchments with a short concentration time. Anticipating this kind of events is a major issue in order to reduce the resulting damages. But for many of the impacted catchments, no data are available to calibrate and evaluate hydrological models.
In this context, the aims of this study is to develop and evaluate a warning method for the Southern French Alps. This area is of particular interest, because it regroups different hydrological regimes, from purely Mediterranean to purely Alpine influences.
Two main issues should be addressed:
- How to define the hydrological model and its parameterization for an application in an ungauged context?
- How to evaluate the final results on 'real' ungauged catchments?
The first issue is a classic one. Using a 'observed' data set (154 streamflow stations with catchment areas ranging from 5 to 1000 km^2 and distributed rainfall available on the 1997-2006 period), we developed a regional model specifically for the studied area. For this purpose, the AIGA method, initially developed for Mediterranean catchments was adapted, in order to take into account snowmelt and to produce baseflows. Then, different parameterizations were tested, derived from different simple regionalisation techniques:
- the same parameters set for the whole area defined as the median of the local calibrated parameters;
- the same technique as the previous case, but by considering different sub-areas, defined as "hydro-climatically" homogeneous by previous studies;
- and finally the neighbour's method.
The second issue is more original. Indeed, in most studies the final evaluation is done using gauged stations as they were 'ungauged', ie keeping the at-site discharge data only for validation ant not for calibration. The main disadvantage of this approach is that the evaluation is made at the scale of the gauged catchments, which are in general greater than the catchments impacted by flash floods. Furthermore, many events are missed, since flash floods can occur very locally. In this study, we try to evaluate the results on observations collected by witnesses on 'real' ungauged catchments. The proposed method consists to use an historical data-base of flood damages reports. These data have been collected by local authorities (RTM). Finally, 139 ungauged locations were considered, where we simulated discharges for the entire 1997-2006 period. The comparison of these modelled discharges with the occurrence of an observed discharge makes it possible to determine a local 'modelled' discharge threshold above it most of the damages are observed. The pertinence of this threshold (and consequently of the model used for the simulation) is assessed by considering classical contingency statistics: probability of detection (POD), false alarm rate (FAR) and critical success index (CSI). The main advantage of this historical approach is the availability of many events in the database on very small catchments (50% less than 20 km^2).

The preliminary results show that on gauged basins, the base flow and the snowmelt added modules improve the performance of the AIGA method when locally calibrated. But when results are applied on real ungauged catchments, improvements become less obvious, with a small advantage for neighbour's method. These results shows the difficulty arising with ungauged catchments, specially when target catchments are smaller than the gauged 'parents'. It also illustrates the interest of the damages database used as 'proxy' data to investigate the model performances at smaller scales.

This work has been done in the framework of the RHYTMME project, with the financial support of the European Union, the Provence-Alpes-Côte d'Azur Region and the French Ministry in charge of Ecology.