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Evaluation of radar rainfall estimates and nowcasts to prevent flash flood in real time by using a road submersion warning tool

Pierre-Antoine Versini and Daniel Sempere-Torres
CRAHI-UPC, Barcelona, Spain

Important damages occur in small headwater catchments when they are hit by severe storms with complex spatio-temporal structure, sometimes resulting in flash floods. As these catchments are mostly not covered by sensor networks, it is difficult to forecast these floods. This is particularly true for road submersions. These are major concerns for flood event managers. The use of Quantitative Precipitation Estimates and Forecasts (QPE/QPF) especially based on radar measurements could particularly be adequate to evaluate rainfall-induced risks. Although their characteristic time and space scales would make them suitable for flash flood modelling, the impact of their uncertainties remain uncertain and have to be evaluated.

The Gard region (France) has been chosen as case study. This area is frequently affected by severe flash floods and different kinds of rainfall observations are available in real time: radar rainfall estimates and nowcasts from METEO FRANCE and the CALAMAR system from SPC (state authority in charge of flood forecasting). An application devoted to the road network, has also been recently developed for this region. It combines distributed hydro-meteorological very short range forecasts and vulnerability analysis to provide warnings of road submersions. The first results demonstrate that it is technically possible to provide distributed short-term forecasts for a large number of sites. The study also demonstrates that a reliable estimation of the spatial distribution of rainfall is essential. For this reason, the road submersion warning system can be used to evaluate the quality of rainfall estimates and nowcasts.

The warning system has been tested on the specific storm of the 29-30 September 2007. During this event, more than 300mm dropped on the South part of the Gard and many roads were submerged. Each of the mentioned rainfall datasets (i.e. estimates and nowcasts) was available in real time. They have been used to forecast the exact location of road submersions and the results have been compared to the effective road submersions actually occurred during the event as listed by the emergency services.

The results confirm that the road submersion warning system represents a promising tool for anticipating and quantifying the consequences of storm events at ground. It rates the submersion risk with an acceptable level of accuracy and a reasonable false alarm ratio. It demonstrates also the quality of high spatial and temporal resolution radar rainfall data in real time, and the possibility to use them despite their uncertainties. However because of the quality of rainfall nowcasts falls drastically with time, it is not often sufficient to provide valuable information for lead times exceeding one hour.