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Assessing the role of spatial rainfall variability on watersheds response using weather radar A case study in the Gard region, France

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The consideration of spatial rainfall variability in hydrological modeling is not only an important scientific issue but also, with the current development of high resolution rainfall data from weather radars, an increasing request from managers of sewerage networks and from flood forecasting services. Although the literature on this topic is already significant, at this time the conclusions remain contrasted. The impact of spatial rainfall variability on the hydrological responses appears to highly depend both on the organization of rainfall fields and on the watershed characteristics.

The objective of the study presented here is to confirm and analyze the high impact of spatial rainfall variability in the specific context of flash floods. The case study presented is located in the Gard region in south east of France and focuses on four events which occurred on 13 different watersheds in 2008. The hydrological behaviors of these watersheds have been represented by the distributed rainfall – runoff model CINECAR, which already proved to well represent the hydrological responses in this region (Naulin et al., 2013). The influence of spatial rainfall variability has been studied here by considering two different rainfall inputs: radar data with a resolution of 1 km x 1 km and the spatial average rainfall over the catchment. First, the comparison between simulated and measured hydrographs confirms the good performances of the model for intense rainfall events, independently of the level of spatial rainfall variability of these events. Secondly, the simulated hydrographs obtained from radar data are taken as reference and compared to those obtained from the average rainfall inputs by computing two values: the time difference and the difference of magnitude between the simulated peaks discharge. The results highly depend on the rainfall event considered, and on the level of organization of the spatial rainfall variability. According to the model, the behavior of the studied watersheds may sometimes remain very similar with a homogeneous rainfall input, whereas for some cases the differences in the peak discharges can reach up to 80%. A detailed analysis illustrates the possible role of the watershed in enhancing the effect of rainfall spatial variability.

In a further step, the objective is to test the ability of four rainfall variability indicators to identify the situations for which spatial rainfall variability has the greatest influence on the watershed response. The selected indicators include those of Zoccatelli et al. (2010), and all rely on a detailed analysis of spatial rainfall organization in function of hydrological distances (i.e. the distances measured along the stream network from one point of the watershed to the outlet). The analysis of the links between these indicators and the hydrological behaviors identified is currently in progress.

Reference:

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