Plinius Conference Abstracts
Vol. 16, Plinius16-13, 2018
16th Plinius Conference on Mediterranean Risks

Spatialization of flood indicators on Mediterranean catchments (Southern France) - Implication for prediction

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The use of hydrological models for flood forecasting implies having some information regarding the spatialization of runoff over the basin. Mapping flood runoff is a challenge in Mediterranean regions for medium and large catchments, in which there is a high spatial variability of rainfall amount and morphological properties.

The aim of our work is to characterize the relationships between hydrological indicators that can be indicative of flood flows, and morphometric properties, in order to map runoff at the regional scale. The hydrological approach is based on standard water balance approaches (L'vovich, Budyko), but applied to intermediate sub-catchments. In this aim, dimensional and non-dimensional representations of catchments are proposed. We also use the index of development and persistence of the river network, IDPR (Gay et al., 2016), as a proxy of infiltration/runoff areas. This morphological index has been computed by comparing the topographic thalweg network with the natural hydrographic network. It is available as a 25m spatial resolution grid over France.

The test site is a large region of 10 000 km^2 around the Cévennes Mountains (South France), including the 6 main catchments (and their sub-catchments) of the Tarn, Ardèche, Cèze, Gardons, Vidourle and Hérault rivers. They are characterized by heterogeneous geology and climate (hard rocks with around 1 500 mm/yr rainfall in the upstream zones, and karstified limestone with around 1 000 mm/yr rainfall in the intermediate and downstream zones). Daily streamflow time series were collected for 53 gauging stations, as well as daily precipitation and potential evapotranspiration (SAFRAN meteorological reanalyses). Total discharge values (Qt) are then separated into baseflow (Qb) and flood (Qf) components using a digital filter method.

First results show that most karstified catchments differ from others, with annual water balances in excess or in deficit. Those unbalanced water cycles are the sign of specific hydrological responses, and thus of typical behavior, notably during flood events. To explain such variability devoted to karstic catchments, we find a correlation between the Qf/Qt ratio computed with inter-annual mean data, and the mean IDPR value of each sub-catchment: the higher the IDPR values (indicating areas promoting runoff), the higher the Qf/Qt ratio. Catchments are distributed between two end-members: hard-rock areas in reliefs with high Qf/Qt and karstic areas with low Qf/Qt characterized by low IDPR values due to their infiltration properties. A sensitivity analysis is also performed on parameters of this relationship, in order to assess the influence of i) information aggregation (catchments surface), and ii) hydrograph separation model. Globally, our results show that specific infiltration properties of karst may explain their contrasted hydrological response compared to other areas. Thus, these specific properties have to be considered and integrated to catchments conceptual models in order to provide efficient flood modelling and forecasting, promoting the simulation of underground flows for karstic catchments. Identifying such catchments using IDPR mapping also gives interesting perspectives to prevent the application of non-devoted flood models.