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The application of an index of connectivity as a proxy for flooding risk assessment in a Mediterranean alluvial plain

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The Mediterranean landscape, which is arguably the most human-impacted terrain on Earth, is characterized by high (often extreme) temporal variability in precipitation, and hence discharge. In addition, severe flash floods are an inherent Mediterranean characteristic and because of the occurrence of extreme events in ungauged catchments, there is generally no measured discharge information or formal records of the magnitude of the events. Consequently, flash floods and, especially, geomorphic processes affecting alluvial fans remain poorly understood due that the fluvial network is poorly incised and diffuse. Mediterranean countries are also so-called as very sensitive to global change, considering that as the combination of climate change (e.g. increase of extreme storm events) and the direct human influence (e.g. changes on land uses). Both human-impacts and sensitivity to global change are particularly serious in most of the Mediterranean islands, as it is the case of Mallorca. It illustrates the transformation of the economy, society, and environment of Mediterranean tourist resorts and how, over the past few decades, changes in land uses have transformed the hydrological systems. Such transformations, in combination with climate change are generating an increase of floods in places where they were historically managed by a systematic use of traditional soil and water conservation practices that laminated and diverted the flash floods.

As a synthetic approach between ecology, hydrology and geomorphology, connectivity is defined as the transfer of matter between two different landscape compartments; hydrologic connectivity is the water-mediated transport of matter, energy and organisms within or between elements of the hydrologic cycle. Knowledge of the spatial distribution and the temporal evolution of connectivity in the actual landscape is crucial because it can be used as a tool to estimate the probability that a given part of the landscape transfer its contribution elsewhere in the catchment. Consequently, the index of connectivity allows us to know which areas of the catchment act as flow-paths hence directing the fluxes (what would equal to “river channels”) and which other are predominately zones of accumulation, i.e. areas prone to be flooded; therefore the index of connectivity could theoretically allow us to assess about the areas which are likely to be flooded (flooding risk) during a high-magnitude rainfall event in a certain catchment.

Within this framework, we analyze the affectation that several consecutive extraordinary rainfall events (December 2016- January 2017), had on an alluvial plain widely modified by humans during millennia in the island of Mallorca, the Campos basin (380 km^2). We therefore aim to evaluate the likelihood of using the index of connectivity ?IC? as a proxy for flooding risks assessment. Secondary goals are: i) the analysis and determination of the best pixel-size resolution for using the IC as a tool for flooding risks forecast, ii) the evaluation of the effects of the historical and present man-made alterations of the drainage network on the water fluxes distribution and iii) the analysis of the magnitude-frequency of such extraordinary events and its hydrological response, i.e. flooding, on the study area.