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Quantification of the expected changes in flood peak flows and hydrograph volumes under climate change conditions

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Climate change will affect rainfall extremes and temperatures in the future. Therefore, floods are expected to change. This study aims to identify such expected changes in flood behaviour through a rainfall-runoff simulation approach. Climate change precipitation and temperature projections are used as input data in a hydrological model. Changes in both flow peak and hydrograph volume frequency curves are identified from the output flow series of the hydrological model.

Climate projections provided by EURO-CORDEX are used, as a recent study has shown that they characterise extreme events better than Spanish AEMET projections. Four catchments located in northwestern Spain have been selected as case studies. Flood response in such catchments has been simulated by using the HBV rainfall-runoff model. The model has been calibrated in each catchment by comparing the observed data with the model outputs in the control period (1971-2004). In addition, the best bias correction techniques have been identified in each catchment, in order to obtain the most similar behaviour of floods compared with observations in the control period. Three periods in the future have been simulated (2011-2040; 2041-2070; 2071-2095) with the calibrated HBV models and bias corrected data. Expected changes in frequency curves of floods and accumulated volume in one, two, three, four and five days have been identified. The study finds that the simulations obtained by the HBV model show a general reduction in flood and volume quantiles, smoothing the expected increases in precipitation quantiles. In general, the period 2071-2095 presents the smallest reductions, as well as the larger increases in flow peak and volume quantiles in some cases. Finally, expected changes in volumes and flow peaks can differ. For instance, if flow peak quantiles decrease, volume quantiles can increase. Therefore, both peak flow and hydrograph volume changes must be studied to obtain a complete knowledge about the expected behaviour of floods in the future.