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Climate change impacts on the fluvial regime in a Mediterranean mountainous area.

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The water flow regime in Mediterranean basins is greatly influenced by the high variability of the meteorological patterns, with recurrent drought periods, and the heterogeneity of both terrain physical properties and land uses. These aspects together with the simultaneous demands of water resources for human consumption, irrigation and energy production make it crucial to have a continuous flow series on control points along the river network. In the current context of Global Warming, mountainous semiarid watersheds, where Mediterranean and alpine climates coexist, constitute singular places to evaluate its effects on the river flow regime. Sierra Nevada Mountain area (SN) (southern Spain), with altitudes ranging from 2000 to 3500 m.a.s.l., is a clear example of snow regions in a semiarid environment. Due to its special climate conditions, SN is part of the global climate change observatories network.

The aim of this work is to estimate the influence of climate change on the flow regime over several control points along the main channel of the Guadalfeo River (in the South face of SN), by means of analysing the observed trends and focusing in the occurrence of drought period and extreme flood events. For this, the flow regime at three selected points in the river was simulated by using WiMMed, a physically-based hydrological model developed for Mediterranean regions, which includes flow routing calculations. The model was calibrated and validated from observations at a gauge station point, from which the flow series were obtained at upstream. Precipitation and temperature datasets from the reference period (1960-2000) and two different scenarios (A2, B1) for a future period (2046-2100) proposed by the Fourth Assessment Report of IPCC (Intergovernmental Panel on Climate Change) were used as forcing meteorological variables. The comparison was performed over different flow indicator variables: 1) annual mean daily flow; 2) annual maximum daily flow; 3) annual number of days without flow (flows lower than the 5th percentile of the distribution of simulated flows); 4) annual number of days with extreme flow (flows greater than the 95th percentile of the distribution of simulated flows).

The results show similar trends for the annual mean daily flow in the three different control points during the reference period (approximately -0.0015 $m^3 \cdot s^{-1} \cdot year^{-1}$). Higher decreasing trends were found for the higher point upstream because of the influence on the regime of the snow changes. As expected, the rate of decline found in the annual average daily flow and the maximum annual average daily flow, are higher for A2, the most severe scenario. Nevertheless, a more torrential behaviour is observed in the case of maximum annual average daily flow in B1.

As a whole, the annual mean daily flow has decreased between 0.26-0.43% over the period 1960-2000, with simulated decreases of 0.4-1.1% and 0.03-0.34% for scenarios A2 and B1, respectively. The significance of the obtained trends increase upstream; where the influence of the presence-absence of snow is more dominant. These results highlight the impact of the changes in the snow regime on the river flow and the need for adaption actions related to water resource management.