

EGU21-16500

<https://doi.org/10.5194/egusphere-egu21-16500>

EGU General Assembly 2021

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Exploring causes of hydrological alterations and the relative contributions of climate change and human activities in the Isser catchment, Algeria

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The water resources of Mediterranean countries are strongly affected by climate change and anthropogenic activities, which exert considerable pressure on the overall water security. Understanding the relative contributions of each of the possible causal factors to the hydrological alteration is pivotal to design sustainable water resources management strategies. In this study, the hydrological alteration of the Isser catchment in Algeria is assessed and explained in terms of possible explanatory factors. A long term hydro-meteorological dataset was reconstructed and the nonparametric Mann-Kendall test was used to detect the alteration of streamflow and the possible causal factors. To identify the role of causal factors in the hydrologic alterations, two techniques were used. First, Convergent Cross Mapping (CCM), which is an advanced data-based nonlinear time-series analysis tool, was used to identify causality in time-series. Second, a Fuzzy Analytical Hierarchical Process (FAHP) expert-based model was applied to assess the possible underlying causes for hydrologic alterations and to quantify the potential influences of human activities and climate change. The results of the trend analysis show a significant downward trend for streamflow ($p_{\text{value}} < 0.05$) for the period 1971-2010. The CCM method shows that the streamflow alteration is unidirectionally caused by changes in precipitation, temperature, irrigation, evapotranspiration, and NDVI patterns and that there is little feedback from streamflow alteration to these causing factors. The FAHP suggests that climate change is dominating the decreasing trend in streamflow, being responsible for 60 % of the alterations as compared to 40 % of the alterations caused by changes in the land use patterns and intensive water extraction.