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Linking scales between global and local hydrological models in a mountainous catchment in South Spain

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High mountain areas constitute a complex environment in which hydrological modeling involves an accurate representation of the spatial distribution of weather variables, among others, and the inclusion of snow processes on the relevant time and spatial scales. In Mediterranean regions, the snow ablation undergoes different cycles during the cold season in which some components of the energy balance may have a dominant role driven by states of dry air, high insolation, or their combination. This poses a constraint for the application of global hydrological models to analyze future climate scenarios on a long-term basis, since their spatial scales are not usually capable of capturing this highly heterogeneous regime and the associated spatial pattern. However, local hydrological models are usually time-demanding and might result in unrealistic representations due to their need of highly detailed input information which is not easy to project in the future climate scenarios.

This work shows the combination of both approaches in the Guadalfeo River Basin in South Spain, a mountain catchment close to the coast which comprises the Sierra Nevada range (up to 3479 m a.s.l.), to downscale river flow on different control points along the fluvial network and generate different climate scenario analysis. The results consist of transfer functions between river flow provided by both E-HYPE and WiMMed models on a given time scale at each control point. The E-HYPE river flow time series were downloaded from the C3S_441-Lot1-SMHI platform developed under the SWICCA C3S contract. A monthly scale was found to be relevant on the control point downstream the mountain area, whereas a daily scale was successfully derived on the control point upstream in a highly snow-influenced tributary.

The availability of a hydrological model, WiMMed, which incorporates snow processes on a high resolution scale, that had been locally validated in the area was key to obtain successful transfer functions and take advantage of the efficient performance of the global model E-HYPE to generate long term series of river flow and estimate future impacts.