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Investigating the effect of different downscaling techniques on the simulated hydrologic cycle of a Mediterranean catchment

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In this study we investigate the effect of different downscaling methods on the hydrologic cycle of a Mediterranean catchment in Sardinia (Italy) that is prone to extreme flooding. To this aim, we use an ensemble of four combinations of GCM - RCM projections (see Deidda et al., 2013, and Langousis et al., 2016), statistically downscaled using: a) the parametric statistical scheme of Mamalakis et al. (2017), and b) its widely used non-parametric variant based on empirically derived Q-Q (quantile-quantile) correction relationships. In particular, we analyze differences in the climate projections of the available downscaled climate model outputs, considering or not the elevation factor (in the latter case by re-projecting outputs at the mean elevation of the basin). We further quantify the impact of these differences on modeled hydrologic variables. The hydrologic impact of climate change is evaluated during five 30-year periods (1951-1980, 1981-2010, 2011-2040, 2041-2070, 2071-2100), focusing on a set of variables that characterize the water balance, including precipitation, air temperature, discharge, leakage, and actual evapotranspiration. The response of the basin is quantified at the outlet and also at 33 subcatchments, analyzing the influence of features such as the area and mean elevation of the subcatchments. The results show that the choice of climate model and downscaling method leads to variations in the simulated hydrologic response of the basin, and that this effect varies also by subwatershed. Notwithstanding these differences, the reduction in precipitation predicted by the climate models is more pronounced as the watershed area increases, and as the altitude decreases.

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