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Hydrological impact of climate change in a Mediterranean catchment with limited data availability.

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The Mediterranean basin is one of the areas of the world where climate changes due to global warming are expected to be more significant. Future scenarios predicted by global and regional climate models (GCMs and RCMs) indicate a decrease in water availability, which will lead to social and economic consequences, mainly affecting the agricultural sector. Reducing the uncertainty in the quantification of the climate changes impacts in Mediterranean watersheds is the main goal of the Climate Induced Changes on the Hydrology of Mediterranean Basins (CLIMB) project, funded by the 7th EU Framework Programme. One of the study sites of CLIMB is the Rio Mannu at Monastir (473 km2) basin, located in an agricultural area of Southern Sardinia, Italy, that has experienced severe drought periods during the last 30 years with dramatic decreases of crop productivity. To quantify the climate change impacts, outputs of four RCMs are used to force a distributed and physically-based hydrologic model, known as TIN-based Real time Integrated Basin Simulator (tRIBS). In this study, we first illustrate the tRIBS model calibration, using the limited dataset available in the Rio Mannu basin, a common feature in most regions of the world. In our study site, hydrometeorological data (streamflow, precipitation, temperature and meteorological variables) are available at different resolution and during non-overlapping periods. To create the database at hourly resolution required for tRIBS application, we designed two downscaling strategies, aimed at (i) disaggregating precipitation from daily to hourly resolution using a multifractal model, and (ii) obtaining reference evapotranspiration at hourly time scale from daily records of minimum and maximum temperature. We demonstrate how the downscaling tools are able to generate a reliable database to calibrate the hydrologic model, and how they can be used to disaggregate coarse outputs of climate models. In a second part of the study, the downscaled outputs of the RCMs are used to force the calibrated hydrologic model for the future (from 2041 to 2070) and reference (from 1971 to 2000) periods. The impacts on water budget and availability in the Rio Mannu basin under the future climatic scenarios is quantified through several techniques and metrics computed from the time series and the spatial maps of the hydrologic variables simulated in the two periods.