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Evaluation of climate change effects on the hydrology of a medium-sized Mediterranean basin affected by data sparseness

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Many studies based on global and regional climate models agree on the prediction that the Mediterranean area will be most likely affected by climate changes with consequent reduced water availability and intensified hydrologic extremes. This study evaluates the effects of climate changes on the hydrologic response of a medium-sized Mediterranean basin through downscaling techniques and hydrologic simulations. The watershed is the Rio Mannu at Monastir basin (473 km2), located in an agricultural area of southern Sardinia, Italy, which has suffered drought issues in the last decades. It is one of the seven study cases of a multidisciplinary European research project, CLIMB (Climate Induced Changes on the Hydrology of Mediterranean Basins). In such basins, characterized by strong climate variability and by a complex hydrologic response, process based distributed hydrologic models, DHMs, combined with regional climate models, RCMs, and downscaling techniques can help in the evaluation of the local impacts of climate change on water resources decreasing the uncertainty. Since the Rio Mannu basin is affected by data sparseness (meteorological and streamflow data are collected in non overlapping time periods and at diverse time resolutions), two statistical downscaling strategies for precipitation and potential evapotranspiration have been designed which allow to obtain the high-resolution input data required for the calibration of our hydrologic model, the TIN-based Real time Integrated Basin Simulator (tRIBS). We show how the DHM has been calibrated and validated with reasonable accuracy using the disaggregation tools. Next, the same downscaling algorithms have been used to fill the resolution discrepancy between RCMs and the hydrologic model. The outputs of four RCMs, selected as the best performing and bias corrected within the CLIMB project, have been downscaled and used to force the tRIBS during a reference (1971-2000) and a future (2041-2070) period. Several hydro-climatic indicators have been computed based on the time series and spatial maps produced by the DHM to assess the variation in Rio Mannu water resources budget and hydrologic extremes in the future period as compared to the reference one. Our results confirms what is generally predicted for the Mediterranean area, showing a basin future condition of more water shortages due to both reduced precipitations and increased temperatures.