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Evaluation of Med-CORDEX regional climate model simulations for hydrological impact studies in Morocco

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In the framework of the international initiative Coordinated Regional Downscaling Experiment (CORDEX) program, new regional climate model (RCM) simulations at high spatial resolutions are completed for the Mediterranean region (Med-CORDEX). This study evaluates the most up-to-date high-resolution simulations for hydrological impact studies over a catchment located in North Morocco. Different approaches are compared to analyze the climate change impacts on the hydrology of this catchment, using RCMs from the Med-CORDEX initiative at two different spatial resolutions (50 and 12 km) and for two different Radiative Concentration Pathways (RCP4.5 and RCP8.5). The main issues addressed in the present study are: (i) what is the impact of increased RCM resolution on present-climate hydrological simulations and on future projections? (ii) Are the bias-correction for the RCM outputs and the parameters of the hydrological model stationary and transferable to different climatic conditions? (iii) What is the climate and hydrological change signal based on the new scenarios (RCP4.5 and RCP8.5)? Results indicate that high resolution simulations at 12 km better reproduce the seasonal patterns, the seasonal distributions of precipitation and the extreme precipitation events. The parameters of the hydrological model, calibrated to reproduce runoff at the monthly time step over the time period 1984-2010, do not show a strong variability between dry and wet calibration periods in a differential split-sample test. However the bias correction of precipitation by quantile-matching does not give satisfactory results in validation using the same differential split-sample testing method. Therefore a quantile-perturbation method that does not rely on any stationarity assumption and produces ensembles of perturbed series of precipitation was introduced. The climate change signal under RCP4.5 and RCP8.5 forcings indicates a decrease in between -30 to -57% in surface runoff for the mid-term (2041-2062) with the different models, when for the same period the projections for precipitation are ranging between -15 and -24% and for temperature between + 1.3 and + 2.3 degrees C.