



Comparison of methods for downscaling runoff from regional climate models in Spanish basins

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At present there is much literature that refers to the advantages and disadvantages of different methods of statistical and dynamical downscaling of climate variables projected by climate models. Less attention has been paid to other indirect variables, like runoff, which play a significant role in evaluating the impact of climate change on hydrological systems. Runoff presents a much greater bias in climate models than other climate variables, like temperature or precipitation. It is very important to identify the methods that minimize bias while downscaling runoff from the gridded results of climate models to the basin scale.

This study compares four methods of downscaling runoff from 10 regional climate models (RCM) of the European project PRUDENCE with emphasis on the ability of each method to reproduce the observed behavior of this variable. It uses information from 338 basins in Spain that cover the entire peninsular territory and whose observed values of naturalized runoff have been estimated by the distributed hydrological model SIMPA. The comparison is done under current climate conditions (period 1961-1990), considering the runoff output of the RCM in the original coordinates of each model (O) and in the unified coordinates CRU (Climate Research Unit) with a spatial resolution of $0.5^\circ \times 0.5^\circ$, applying in each case two methods of calculation: direct method (D) and interpolated method (I). The downscaling procedures above are also applied to the mean annual runoff calculated using five functional forms expressed as a function of the aridity index, defined as the ratio between evaporation and precipitation and to the mean annual runoff of the UNH/GRDC (University of New Hampshire/Global Runoff Data Centre) that provides information of this variable with a spatial resolution of $0.5^\circ \times 0.5^\circ$ generated from the combination of input data observed at major stations hydrological worldwide and the use of a climate model of monthly water balance.

A total of 61 runoff monthly time series are generated in every Spanish basin for each downscaling method: ten corresponding to the RCMs PRUDENCE, fifty for the five functional forms, (ten for each functional form) and one with the UNH/GRDC layer runoff. Using statistics that compare the downscaled with the observed values of runoff, the results show that the original direct method (OD) presents the most appropriate behavior in reproducing the observed runoff in the Spanish basins.