Sensitivity of Hydrological Model Simulations to Underling Assumptions in a Stochastic Downscaling method

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Climate Change Impacts Studies (CCIS) for Water Resources Management (WRM) are of crucial importance for the human community and especially for water scarce Mediterranean- like regions, where the available water is expected to decrease due to climate change. General Circulation Models (GCM) are one of the most valuable tools available to perform CCIS. However, they cannot be directly applied to water resources evaluations due to their coarse spatial resolution and bias in their simulation of certain outputs, especially precipitation.

Downscaling methods have been developed to address this problem, by defining statistical relationships between the variables simulated by GCMs and local observations. Once these relationships are defined and tested via post evaluation during a control period, the relationship is used to generate synthetic time series for the future, based on the different future climate scenarios simulated by the GCMs. For CCIS in WRM, synthetic time series of precipitation and temperature are applied as input variables to run hydrological models and obtain future projections of hydrological response. The main drawbacks of this procedure are: (1) inevitably we have to assume time stationary in the downscaling parameters (which in principle can vary with climate change), and (2) The downscaling parameterizations are another source of model uncertainties that must be quantified and communicated.

Here, we evaluate the sensitivity of hydrological model simulations to assumptions underlying a downscaling method based on a Stochastic Rainfall Generating process (SRGP). The method is used to demonstrate that exact daily rainfall sequences are not necessary for climate impacts assessment, and that the "stochastically equivalent" rainfall sequence simulations provided by the model are both sufficient, and provide important added value in terms of realistic assessments of uncertainty. The method also establishes which parameters of the rainfall generating process are primary controllers of the impacts caused by climate variability/change, and which must therefore be given special consideration during long-term climate simulations.