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Comparison between dynamical and stochastic downscaling methods in central Italy

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Global climate models (GCMs) are the primary tool to assess future climate change. However, most GCMs currently do not provide reliable information on scales below about 100 km and, hence, cannot be used as a direct input of hydrological models for climate change impact assessments. Therefore, a wide range of statistical and dynamical downscaling methods have been developed to overcome the scale discrepancy between the GCM climatic scenarios and the resolution required for hydrological applications and impact studies.
In this context, the selection of a suitable downscaling method is an important issue. The use of different spatial domains, predictor variables, predictands and assessment criteria makes the relative performance of different methods difficult to achieve and general rules to select a priori the best downscaling method do not exist. Additionally, many studies have shown that, depending on the hydrological variable, each downscaling method significantly contributes to the overall uncertainty of the final hydrological response. Therefore, it is strongly recommended to test/evaluate different downscaling methods by using ground-based data before applying them to climate model data.
In this study, the daily rainfall data from the ERA-Interim re-analysis database (provided by the European Centre for Medium-Range Weather Forecasts, ECMWF) for the period 1979-2008 and with a resolution of about 80 km, are downscaled using both dynamical and statistical methods. In the first case, the Weather Research and Forecasting (WRF) model was nested into the ERA-Interim re-analysis system to achieve a spatial resolution of about 4 km; in the second one, the stochastic rainfall downscaling method called RainFARM was applied to the ERA-Interim data to obtain one stochastic realization of the rainfall field with a resolution of $\sim$1 km.
The downscaled rainfall data obtained with the two methods are then used to force a continuous rainfall-runoff model in order to obtain a hydrological response in terms of discharge output. Preliminary results show that both downscaling methods are able to reproduce the statistical properties and temporal pattern of rainfall observations while the results in terms of discharge will be shown at the conference session. This analysis will provide useful guidelines for the selection of the best performing downscaling approach applied to rainfall data in this particular study area.