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Comparison among different downscaling approaches in building water scarcity scenarios in an Alpine basin.

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Various downscaling techniques have been developed to bridge the scale gap between global climate models (GCMs) and finer scales required to assess hydrological impacts of climate change. Although statistical downscaling (SD) has been traditionally seen as an alternative to dynamical downscaling (DD), recent works on statistical downscaling have aimed to combine the benefits of these two approaches. The overall objective of this study is to assess whether a DD processing performed before the SD is able to provide more reliable climate forcing for crop water demand models. The case study presented here focuses on the Maggiore Lake (Alpine region), with a watershed of approximately 4750 km2 and whose waters are mainly used for irrigation purposes in the Lombardia and Piemonte regions. The fifth-generation ECHAM model from the Max-Planck-Institute for Meteorology was adopted as GCM. The DD was carried out with the Protheus system (ENEA), while the SD was performed through a monthly quantile-quantile correction of the precipitation data collected in the period 1950-2012 by the 19 rainfall gauges located in the watershed area (some of them operating not continuously during the study period). The relationship between the precipitation regime and the inflow to the reservoir is obtained through a simple multilinear regression model, validated using both precipitation data and inflow measurements to the lake in the period 1996-2012 then, the same relation has been applied to the control (20c) and scenario (a1b) simulations downscaled by means of the different downscaling approaches (DD, SD and combined DD-SD). The resulting forcing has been used as input to a daily water balance model taking into account the inflow to the lake, the demand for irrigation and the reservoir management policies. The impact of the different downscaling approaches on the water budget scenarios has been evaluated in terms of occurrence, duration and intensity of water scarcity periods.