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A stochastic bias-corrected downscaling method for climate change impacts assessment on droughts

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Despite uncertainties on future climates, climate change will influence the hydrology of a region through changes in the timing, amount of precipitation, temperature, evapotranspiration and soil moisture, which in turn will affect the drought characteristics in a region. This study is focused on the assessment of climate change scenarios on drought events and their characteristics in Acheloos river basin, Greece. The outputs of the Canadian Centre for Climate Modeling Analysis Global Circulation Model CGCM3 were applied for three socioeconomic scenarios, namely SRES B1, SRES A1B and SRES A2 for the assessment of climate change impact on droughts. A statistical downscaling method has been applied to estimate monthly precipitation and temperature time series for present and future climate periods. The methodology is based on multiple linear regressions of GCM predictant variables with observed areal precipitation and temperature as well as on the application of a stochastic time series model for precipitation and temperature residuals simulation. The Standardized Precipitation Index (SPI) and the Standardized Precipitation Evapotranspiration Index (SPEI) computed at various timescales were used as indicators of meteorological droughts for present and future climate conditions. Results show that climate change will have minor impacts on drought characteristics derived from the SPI and SPEI but the uncertainty introduced is quite large and is increasing as the study timescale increases. Larger timescales of the meteorological drought indices, which, are used to monitor hydrological and water resources droughts, are more sensitive to climate change than smaller timescales, which, are used to monitor meteorological and agricultural droughts. Future drought predictions should be handled with caution and their uncertainty should always be evaluated as these results demonstrate.