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Evaluation of statistical downscaling procedures for the estimation of climate change impacts on droughts

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Despite uncertainties in future climates, there is considerable evidence that there will be substantial impacts on the environment and human interests. Climate change will affect the hydrology of a region through changes in the timing, amount, and form of precipitation, evaporation and transpiration rates, and soil moisture, which in turn affect also the drought characteristics in a region. Droughts are long-term phenomena affecting large areas causing significant damages both in human lives and economic losses. The most widely used approach in regional impact studies is to combine the output of the General Circulation Models (GCMs) with an impact model. Although this approach is quite realistic, there are inherent uncertainties about the details of regional climate changes. The major drawback of the current generation of GCMs is the limitation of their spatial resolution and the resolution of the output. In this study, various methodologies have been applied for the statistical downscaling of monthly precipitation and temperature. These methodologies are based on the multiple regression of GCM predictant variables with observed precipitation and temperature and the application of stochastic timeseries models. The methodologies were developed for the base historical period 1960-1990 and validated against observed precipitation and temperature for the basin of Lake Karla in Thessaly for the period 1990-2002. The validation indicated the accuracy of the methodologies and the uncertainties introduced by the downscaling procedures in the estimation of drought indices. Two types of drought indices have been used in this study: the Standardized Precipitation Index (SPI) and the Palmer Drought Severity Index (PDSI). The first index (SPI) requires only precipitation data for its calculation, whereas PDSI requires precipitation and temperature. Comparison of the drought indices timeseries calculated from observed

and downscaled meteorological parameters indicated the accuracy and reliability of the downscaling methods for future projections.