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Downscaling maximum and minimum temperatures over Greece: A comparison of three methods of modelling.

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Statistical downscaling techniques are developed for generating maximum and minimum temperatures in Greece. The research is focusing on the four conventional seasons and three modelling approaches are employed and compared to assess their performance skills and reveal the most appropriate to provide accurate reproduction of temperature series. Multiple Regression Analysis (MRA), Canonical Correlation Analysis (CCA) and Artificial Neural Networks (ANN) are the methods investigated in the current study. The models were employed for two independent datasets. The calibration period was the 1958-1978 and 1994-2000 (regarded as one period), while the period 1979-1993 was defined for validation and testing. In all methodologies the 1000-500hPa thickness field, derived from the NCEP/NCAR archive, was used as predictor in the regression models. Moreover, observations of daily maximum and minimum surface air temperature from 21 meteorological stations evenly distributed around Greece were selected, and further used in comparisons against the model-derived temperatures. The regression models were developed individually for each variable (Tmax, Tmin), station and season. The accuracy of downscaled values has been quantified in terms of a number of performance criteria, such as differences of the mean and the standard deviation between observed and modelled data, the correlation coefficients of the two sets and also the RMSE of the downscaled values relative to the observed.

During the cool season Tmax seems to be better reproduced, whereas Tmin is overestimated especially over western Greece, which is characterised by higher orography. With respect to the warm season of the year, the simulation of Tmax reveals greater divergences, whereas Tmin is better generated. The distinction among the three techniques seems blurred. None of the methods was found superior to the rest and each has been shown to be a good estimator in some cases. In general, MRA provides better simulations, while CCA and ANN often overestimate the observed temperatures. In other cases, such as for winter Tmax, ANN reveals superior performance. Nevertheless, the inefficiency of the latter method to simulate temperatures over high altitudinal areas (i.e. western Greece) was noticeable. Concluding, this study found that all these methods provide a useful tool for simulating temperatures, since the correlation coefficients between observed and estimated values were usually high. However, the importance of local factors which affect the natural variability of the temperature was underlined, indicating that the geography of a region comprises an important and rather complex factor which should be included in the models to improve their performance.