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Simulation of Extreme Temperature in Greece using a Circulation Type Approach

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In this study an attempt is made to examine in space and time the relationship between temperature extremes in the Greek area with the regional atmospheric circulation, as well as to identify the best potential circulation based on predictor variables for temperature extremes. Furthermore, a downscaling procedure is constructed based on circulation type approach with a multiple regression analysis, in order to develop a plausible scenario for seasonal extreme temperatures in Greece.

Daily maximum and minimum temperature series for 22 Greek stations evenly distributed over Greece have been used for the period 1958-2000. Geopotential data for the thickness field 1000-500hPa that are used, derived from the National Center for Environmental Prediction – National Center of Atmospheric Research (NCEP-NCAR) reanalysis project and from the general circulation model (GCM)-HadAM3P. The atmospheric circulation over the Greek area was classified according to the geopotential thickness field 1000-500 hPa. It was found that the anticyclonic circulation types present generally positive trends, while the cyclonic types present negative ones.

The analysis of the annual trends of temperature extreme indices demonstrated an overall increasing (decreasing) of the warm (cold) extremes over the Greek area with spatial and seasonal variations. The investigation of the temperature anomalies corresponding to each circulation type revealed that the increase of the

frequency of the anticyclonic types, in the majority of the stations, could explain partly the upward trend of the maximum temperature in summer.

The downscaling model was calibrated for the period 1958-1978 + 1994-2000 (NCEP-NCAR data, station data) and validated for the period 1979-1993 (NCEP-NCAR data, station data). The correlation coefficients between observed and simulated data for the validation period were high both for maximum and minimum temperature. The highest correlation coefficient appeared in winter maximum temperature, where these coefficients are higher than 90% for some stations. Additionally, there were small biases between observed and simulated data for the majority of the stations. For almost all stations, the maximum and minimum simulated temperatures are overestimated compared to the observed values. On the contrary, there is an underestimation of the model's variability in which, for some stations, the biases of the standard deviation are statistical significant at the level of 0.05.

Finally, the application of the model using the HadAM3P data (calibration period: 1958-2000 (NCEP-NCAR data, stations data) and validation period 1960-1990 (HadAM3P, control run data) showed that summer maximum temperatures presented a non-statistical significant overestimation, while the winter minimum temperature presented an underestimation. The biases for winter minimum temperature - not statistically significant for a number of stations - varied between –0.2^{o}C and -1.2^{o}C. It becomes evident that the downscaling model can be used for the construction of a plausible future climate change scenario for extreme temperatures.

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