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Modelling maximum monthly precipitation in temporal climate evolution

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The objective of this study was to explore the fitting of generalized extreme value (GEV) distributions to maximum monthly precipitation in the temporal evolution of climate over the Mesochora catchment in central-western Greece. Precipitation was modelled as a stochastic process coupled with atmospheric circulation models. An automated and objective classification of daily patterns (CPs) based on optimized fuzzy rules was used to classify both observed CPs and ECHAM4 GCM-generated CPs for $1xCO_2$ and $2xCO_2$ climate scenarios. We fitted the GEV distribution by maximum likelihood to the series of maximum daily precipitation for each month separately, over the period 1972-1992 for historical data, 1961-2000 for $1xCO_2$, and 2061-2100 for $2xCO_2$. The significance of non-stationarity over time in the GEV parameters of location μ(t) and scale σ(t) was examined by comparing alternative models by likelihood ratio tests. The historical data were generally fitted well by the stationary model, although trends were found in January (steady decline; P = 0.014) and February (increasing to 1986, then decreasing; P = 0.035). The $1xCO_2$ series were also stationary with the exception of August (P = 0.003) and November (P = 0.027). Maxima for August tended to increase for the first half of the period 1961-2000, then decrease, while maxima for November showed the opposite pattern. In the $2xCO_2$ scenario, maxima for May tended to decrease throughout the period 2061-2100 (P = 0.006). Maxima for August (P = 0.002) and September (P = 0.026) decreased in the last few years of the period, while maxima for April (P = 0.036) and November (P = 0.006) increased towards the end of the period. The stationary GEV distribution was a satisfactory fit to the $2xCO_2$ series of the remaining seven months.