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Assessment of future heat events for the city of Augsburg by means of a normal vector based analog approach

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Under enhanced anthropogenic greenhouse gas forcing heat waves are only one example of climatic risks mankind has to deal with. Especially in urban areas where most of the people will live until the end of the 21st century heat waves are a serious risk factor since the urban heat island will reinforce such events. For the city of Augsburg, new analog methods are utilized for assessing the development and impacts of heat waves taking into account the varying urban structure.

For model calibration the temperature data from the Augsburg-Mühlhausen weather station operated by the German Weather Service (DWD) and atmospheric circulation variables of the ERA5 reanalysis data set were used to analyze the recent temperature development. For this purpose, the least deviation of the normal vector was used to determine a subsample of analogs corresponding to the day of interest. The normal vector was derived from the regression plane of the prevailing circulation on the respective day. Subsequently, the temperature patterns were used to define the analog day from the subsample. For future periods, the same method was applied to model data for two representative concentration pathways (RCP4.5, RCP8.5) of different general circulation models (GCM: ACCESS1-0, CNRM-CM5, MPI-ESM-LR). Thus, we derive future time series of analogs corresponding to events prevailing in the observational period. To account for projected trends of the GCMs, the trends of all time-series were first removed and, after the analog selection process, added again according to the trends of the GCMs.

Temperature extremes are defined as days with temperatures exceeding the 90th quantile (Q90) and heat days are defined as days where at least two temperature indices (TMIN, TMEAN, TMAX) exceed Q90. When at least three consecutive days are defined as heat day a heat wave is proclaimed. Analysis have shown that under consideration of RCP8.5 (RCP4.5) and all model runs the number of heat days in the end of the 21st century will be nine (five) times higher than within the reference period 1970-2000. Furthermore, the mean duration of heatwaves will extend by factor four (two), whereby heat waves of more than 30 (15) consecutive days are possible.