



New approaches to determine analogs: A case study within the framework of analyzing extreme heat events in the city of Augsburg

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Heat waves, precipitation extremes and a changing composition of the atmosphere are only some examples of climate related risks the population of urban areas has to deal with under an enhanced anthropogenic climate change. Especially temperature extremes imply a higher level of risk notably for older and vulnerable people. In order to analyze the development and impacts of future heat events within urban areas, new analog methods are introduced here to find days with similar characteristics within the recent period.

The daily temperature data set from Augsburg-Mühlhausen weather station operated by the German Weather Service and circulation dynamic variables (sea-level pressure, geopotential heights) of the ERA-Interim data set were used in order to analyze the recent temperature development associated with the prevailing circulation for the period of 1979-2017. Here, special interest is paid to weather types which are responsible for heat related extreme events. In the following, an analog method will be used to assign future extremes with similar characteristics to events prevailing within the recent period. By means of different training periods the results of two new analog approaches are compared and checked against an established and widely used analog method based on the leading empirical orthogonal functions of the anomalies of the large-scale circulation.

The first new method is based on the normal vector of the regression plane. Here, for each day the regression plane of the respective circulation was assessed and, subsequently, the normal vector of these planes was calculated. The horizontal (xy) and vertical (z) deviations were then used to define the most suitable analog for the respective day. Since the normal vector gives no information about the mean level of the regression plane, a second criteria was implemented to select the best analog from a subsample. Here, the least deviations of the local temperatures between the day of interest and the analog of the ERA-Interim data set were taken into account. The second method is based on the centers of gravity of the circulation. Here, an imaginary plane (zero-level) was assumed and the gridded values (absolute) of the circulation are considered as weights. Subsequently, the centers of gravity were calculated for each day separately and the distances between the centers were used to define the best analog match. The temperatures of ERA-Interim were also taken into account as a second selection criteria for the second and the reference method.