Geophysical Research Abstracts
Vol. 21, EGU2019-16812, 2019
EGU General Assembly 2019

Spatial Structure of (Super)-Clausius-Clapeyron Scaling in Austria

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It is generally expected, that precipitation intensity will increase in a warming climate. An increase in precipitation intensity will induce a higher risk of erosion, flash floods, debris flows, or land slides. Therefore, the knowledge about the extent of higher precipitation intensity is essential for estimating risk. It is supposed that local scale short term precipitation intensity is dependent to the temperature increase, formally by the Clausius-Clapeyron scaling (CCs), which is 6 – 7 %/K. However higher rates have been observed specially for very extreme events with short duration (sub daily), referred to as Super-CCs. Several studies have been performed to underline the (Super)-CCs, often using statistical approaches by extreme value theory. In this study we investigated the spatial structure of (Super)-CCs depending on duration and return period of precipitation events for several stations in Austria.

One major concern in this context is the sufficient sample size for fitting extreme value distributions. One aim of this study is to close the gap in knowledge for an adequate time series length for sub-daily precipitation measurements in varying temperature bins. We analyzed a station data-set of Vienna – Hohe Warte. Our data-set consists of hourly precipitation measurements from 1979 to 2017 and the 6 hourly relative topography between 500 hPa to 700 hPa of ERA-Interim, representing the cloud temperature ($T_{700-500}$). We used temperature bins of 1 K and selected the associated precipitation. To ensure independent samples, only the maximum hourly precipitation of each day was chosen. The Generalized Pareto Distribution (GPD) was applied to each precipitation series within a temperature bin and we performed parametric bootstrapping for each model and varying sample sizes from 11 to 150 values. Further, we introduced a deviation metric to identify a satisfying sample size for each temperature bin.

Knowing the adequate sample size, we could select stations with sufficient time series length. Again we split the precipitation data-sets into temperature bins of $T_{700-500}$ with sufficient sample size. For each bin the GPD was fitted. Then the precipitation intensity of given return periods (from 1 up to 100 years) of each temperature bin was determined, and the scaling across the temperature bins was calculated. In the last step the spatial structure of the (Super)-CCs for several precipitation durations and return periods were analyzed.