Patterns in the transition probability of weather types during drought periods in Austria since 1801

Christine Kroisleitner (1), Klaus Haslinger (2), and Wolfgang Schöner (1)

(1) Institute of Geography and Regional Sciences, Graz, Austria (christine.kroisleitner@uni-graz.at), (2) Zentralanstalt für Meteorologie und Geodynamik, Wien, Austria

This study aims to improve the understanding of drought by examining the relation between the occurrence or absence of atmospheric circulation patterns and drought periods.

We developed a Markov-chain-model to estimate the transition probability of weather types for every day of the year by implementing a Markov process 1. order on the dataset published by Schwander et al. 2017 for the timespan 1801-2009.

We delineated drought periods for the same time span, defined as a sequence of consecutive month showing negative values for SPEI if only one month falls below -1. The weather types appearing during such drought events were compared to a set of possible types derived by 1000runs of the Markov-chain-model.

We compared the actual weather types, found during drought events, with the range of the Markov-chain-model-runs. We found overrepresentation, as in 2003, where the type "High pressure in central Europe" shows, especially at the beginning of the period in spring, unusual high occurrences. At the same time, we detected an underrepresentation of northern and eastern weather types.

Overall, the resulting picture showed heterogeneity in the occurrence or absence of weather types during drought periods. We did not find the presence of a specific type useful to indicate for drought events, but got evidence that the succession of weather types plays an important role, particularly at the beginning of a drought.

We found a high seasonality in transition probability with no significant trend for the monthly frequency of weather types in the timeseries. Additionally, we split the timeseries into periods according to sequences of positive and negative temperature-anomalies on a decennial base to get time slices related to temperature change.

We found differences in the over- and underrepresentation of atmospheric circulation patterns, for example, an absence of the northern circulation pattern during drought events at the end of the little ice age or a constant overrepresentation of the type "high pressure in central Europe" since the year 2000.