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Regional precipitation extremes in Central Europe in the 21st century

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In order to estimate the regional flooding potential in Central Europe under ongoing climate change, an evaluation of the relationship between atmospheric circulation types and regional precipitation events took place in the bilateral research project WETRAX (WEather Patterns Cyclone TRAcks and related precipitation EXtremes).

For parts of Central Europe, a data set of gridded daily precipitation with 6km horizontal resolution has been generated for the period 1951-2006 by the Austrian Zentralanstalt für Meteorologie und Geodynamik (ZAMG). S-mode principal component analysis has been applied to determine regions with similar precipitation variability. These regional precipitation records have been calculated as the regional arithmetic mean of daily precipitation during the standard seasons (DJF, MAM, JJA and SON). Extreme precipitation events have been defined by the 95th percentile for each 'rainfall region'. Large-scale atmospheric circulation types have been derived by different statistical methods and variables applying the COST733 classification software to gridded daily NCEP1 reanalysis data.

To evaluate the performance of a particular circulation type classification with respect to regional precipitation extremes, multiple regression models have been derived between the circulation type frequencies as predictor variables and monthly frequencies of extreme precipitation.

The application of suitable models to 21st century GCM data reveals that the use of different GCMs results in partial significant trends in the frequencies of regional precipitation extremes. Increasing frequencies of regional precipitation events (up to +10%) are shown for ECHAM6 and RCP8.5 scenario in nearer future (2021-2050), while the same scenario leads to significant decreases in occurrences of regional precipitation extremes (up to -16%) in the later projection period (2071-2100).

In other seasons, varying trends in regional precipitation extremes are determined. These uncertainties are depending on used GCMs, scenarios and time periods. Significant changes can only be shown for some northern regions in spring, while the changes of regional precipitation extremes in winter remain insignificant.