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Changes in Vb cyclone frequency and rainfall under anthropogenic climate change

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Cyclones following a track from the central Mediterranean region towards central Europe, passing the Alpine mountain range, have been called "Vb cyclones" according to a classification from the 19th century. They are highly relevant for Europe because of their potential to produce extensive precipitation and subsequent flooding, in particular during the warm season. Well known examples for such events are the Elbe flood in August 2002 and the Odra flood in July 1997.

An objective identification algorithm was developed from ERA40, taking the results from a numerical cyclone detection and tracking algorithm as input. When filtering the results according to ERA40 rainfall amounts in Central Europe, most historical hazardous Vb events can be identified.

The algorithm was applied to the summer months (April-September) of 3 ensemble simulations with the ECHAM5 MPIOM model forced with 20th century and A1B scenario greenhouse gas concentrations for the period 1960-2100. In the model simulations the number of detected Vb events for the 20th century period is 2-3 times higher than in the observations. In particular, the number of events with a relatively short residence time over Central Europe (comparable to the historic Vb cyclone "Axel", responsible for the Vistula flood in 2001) is enhanced. Moreover, composites suggest a smaller vertical extent of some simulated Vb cyclones compared to the observed systems.

For the future scenario period the simulations show a decrease in the total number of cyclones travelling from the Mediterranean to Central Europe. The percentage of Vb cyclones associated with strong precipitation, however, increases. The mean amount of precipitation associated with these cyclones also increases over time.