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Heavy precipitation over Central Europe and the role of atmospheric cyclone track types

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Precipitation patterns over Europe are largely controlled by atmospheric cyclones embedded in the general circulation of the mid-latitudes. This study evaluates the climatologic features of precipitation for selected regions in Central Europe with respect to cyclone track types for 1959-2015, with a focus on heavy precipitation.

The analysis suggests that each of the cyclone track types is connected to a specific pattern of the upper level atmospheric flow, usually characterized by a major trough located over Europe. However, shape, amplitude and position differ significantly between the types. A dominant upper level cut off low is found over Europe for strong CON and Vb cyclones.

The Central European precipitation climate can indeed be explained by track type frequency. Additionally, air temperature is a major driver in the warm season and high frequency of strong cyclones in the cold season. The occurrence of large precipitation totals for track events is strongly related to the track type and the region, with the highest value of 45% of all Vb cyclones connected to heavy precipitation in summer over the Czech Republic and Eastern Austria. In Western Germany, Atlantic winter cyclones are most relevant for heavy precipitation. In contrast, around the Eastern Alps, cyclones emerging in the leeside of the Alps dominate, especially in summer and autumn. The analysis of the top-50 precipitation events revealed an outstanding heavy precipitation period from 2006 to 2011 in the Czech Republic, but no gradual long term change.

The findings help better understand spatio-temporal variability of heavy precipitation in the context of floods, and may be used for evaluating climate models.