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The role of circulation anomalies in the emergence of extreme precipitation events in Central Europe

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Largescale extreme precipitation events (EPEs) seem to repeat over time in accordance with recurring atmospheric circulation conditions. This suggests the possibility of classification of EPEs into several groups with different sets of circulation anomalies related to the occurrence of EPEs. In the presented study, we aim to define groups of EPEs with characteristic circulation anomalies, as well as to find out whether a climatology of circulation anomalies relates to EPEs climatology. We use the ERA5 reanalysis data to divide a set of 43 Central European events since 1979 into three groups representing (i) events with dominating moisture flux from the north, (ii) events with dominating moisture flux from the west, (iii) and low flux events. Within these groups, various averaged meteorological variables are displayed in relative numbers (in terms of not exceeding a given value), which makes it possible to assess the significance of an anomaly for a group of events. A strong anomaly of moisture flux from the north is evident within the first group, as high values of moisture flux coincide with the occurrence of EPEs. The presence of such a strong anomaly is not so obvious in other groups, although there exist smaller anomalies associated with the presence of a cyclone over Central Europe, such as anomalies of vertical motion, cyclonic vorticity, low-level convergence or divergence aloft. Because some of the circulation extremes seem to be directly connected to extremes in precipitation, there is a potential to use circulation anomalies as predictors of EPEs. Using ERA-Interim re-forecasts, it turns out that the medium range forecast skill of some circulation anomalies is better than the skill of quantitative precipitation forecast, which would be beneficial for EPEs early warnings.