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Temporal Clustering of Regional-Scale Extreme Precipitation Events in Southern Switzerland

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Temporal clustering of extreme precipitation events on subseasonal time scales is a form of compound extremes and is of crucial importance for the formation of large-scale flood events. Here, the temporal clustering of regional-scale extreme precipitation events in southern Switzerland is studied. These precipitation events are relevant for the flooding of lakes in southern Switzerland and northern Italy. This research determines whether temporal clustering is present and then identifies the dynamics that are responsible for the clustering.

An observation-based gridded precipitation dataset of Swiss daily rainfall sums and ECMWF reanalysis datasets are used. To analyze the clustering in the precipitation time series a modified version of Ripley's K function is used. It determines the average number of extreme events in a time period, to characterize temporal clustering on subseasonal time scales and to determine the statistical significance of the clustering. Significant clustering of regional-scale precipitation extremes is found on subseasonal time scales during the fall season.

Four high-impact clustering episodes are then selected and the dynamics responsible for the clustering are examined. During the four clustering episodes, all heavy precipitation events were associated with an upperlevel breaking Rossby wave over western Europe and in most cases strong diabatic processes upstream over the Atlantic played a role in the amplification of these breaking waves. Atmospheric blocking downstream over eastern Europe supported this wave breaking during two of the clustering episodes. During one of the clustering periods, several extratropical transitions of tropical cyclones in the Atlantic contributed to the formation of high-amplitude ridges over the Atlantic basin and downstream wave breaking. During another event, blocking over Alaska assisted the phase locking of the Rossby waves downstream over the Atlantic.