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Temporal and spatial variability of convective predisposition across Europe and most relevant drivers

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Due to the lack of long-term, reliable, and consistent information about the occurrence of convective storms in Europe, we have developed a specific weather type classification that estimates thunderstorm probability indirectly from model data. Based on this approach, we investigated the temporal and spatial variability of convective predisposition between 1958 and 2014 using the CoastDatII reanalysis data set and identified atmospheric parameters and processes on the synoptic scale that mainly govern the spatio-temporal variability observed.

To identify potential drivers for convective days, typical upper-level flow patterns associated with a high convective predisposition were deduced using a multivariate approach. While all over Central Europe the most prominent pattern is given by a southwesterly flow type over the respective area, distinct regional discrepancies regarding further favorable flow types are observed. For instance, in parts of eastern Central Europe, convection-favoring conditions are frequently associated with the advection of moist air masses from the southeast. Moreover, our results suggest a link between large-scale flow and the relevance of local-scale trigger mechanisms owing to the spatial distribution of dynamical lifting. The crucial role of large-scale flow is further studied by assessing the impact of atmospheric teleconnection patterns on the occurrence of thunderstorms. It is found that positive phases of the North Atlantic Oscillation (NAO) or negative sea surface temperature over the Gulf of Biscay go along with a significant reduction of convective activity in most of the European regions investigated. Some secondary teleconnection modes have a significant impact as well, such as the Scandinavian Pattern with its positive phase leading to enhanced thunderstorm activity in northern Germany.