18–22 September 2017, Pula, Croatia
ECSS2017-62

Temporal and spatial variability of convective predisposition across Europe and potential drivers

Michael Kunz (1,2), David Piper (1), Susanna Mohr (1,2)

(1) Karlsruhe Institute of Technology (KIT), Institute of Meteorology and Climate Research, Eggenstein-Leopoldshafen, Germany (michael.kunz@kit.edu), (2) Center for Disaster Management and Risk Reduction Technology (CEDIM), Karlsruhe, Germany

Due to the lack of long-term, reliable, and consistent information about the occurrence of severe convective storms in Europe, we have developed a methodology that enable to indirectly estimate thunderstorm probability from numerical models. One method is a logistic hail model that quantifies the number of days with hail-favoring conditions from the combination of appropriate hail-relevant meteorological parameters such as convective parameters and moisture content. The other approach estimates thunderstorm probability on a specific day from weather type classification scheme specifically adapted to convective storms. Using the two approaches, we investigated the temporal and spatial variability of convective predisposition and hail potential over past decades and identified atmospheric parameters and processes on the synoptic scale that mainly govern the spatio-temporal variability observed.

Using downscaled reanalysis data available for a long-term period of 60 years, the potential hail index (PHI) obtained from the logistic model shows a high spatial correlation at different sites across Europe and high annual and multiannual variability, but no trend. 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) 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.