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Proximity soundings of severe and non-severe thunderstorms in Central Europe

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The environments of severe and non-severe thunderstorms in Central Europe were analysed using 16 421 proximity soundings from December 2007 to December 2013 taken at 32 sounding stations. The soundings were assigned three severity categories (non-severe, severe and extremely severe) for the hazards hail, wind, tornado and two severity categories (non-severe and severe) for rain. For each of the soundings, parameters were calculated representing the instability, vertical wind profile and moisture of the environment.

The probability of the various hazards as a function of CAPE and 0-6 km bulk shear (DLS) is different for each of the hazards. Large hail is most likely for high CAPE and high DLS. Wind events are most likely in two regimes, the first one in high CAPE and high DLS, the second one in low CAPE and very high DLS. The low-CAPE very high DLS regime is dominated by cold season events.

Storms with significant tornadoes occur with similar CAPE as storms with weak or no tornadoes, but DLS is higher. We also found that 0-1 km bulk shear (LLS) does not discriminate better than DLS between weak and strong tornadoes. LCL height does not discriminate well between the intensity categories of tornadoes, but higher LCL heights were associated with higher probability of severe hail.

Heavy rain events occur across a wide range of DLS, but with CAPE above the median for non-severe thunderstorms. They are most probable when both absolute humidity in the boundary layer and relative humidity in the low- to mid-troposphere are high.

Furthermore, some implications for forecasters are presented. First, forecasters should know that the forecasting of particular hazards can be done better when considering additional parameters beyond the combination of high CAPE and high DLS. Second, forecasters must be aware that the area of parameter space with the highest probability of a particular hazard is typically not the area where it occurs most frequently.