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Characteristics of radar-derived hailstreaks across Central Europe

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Hailstorms are among the most damaging natural disasters in various parts of Europe. For example, two supercells in Germany, on 27 and 28 July 2013, bearing hailstones with a diameter of up to 10 cm, caused economic losses of around 4.0 billion EUR. Despite the large damage potential of severe hailstorms, knowledge about the probability and severity of hail events and hailstorm-favoring conditions in Europe still is limited.

A large event set of past severe thunderstorms that occurred between 2004 and 2014 was identified for Germany, France, Belgium, and Luxembourg from radar data considering a lower threshold of 55 dBZ of the maximum Constant Altitude Plan Position Indicator (maxCAPPI). Additional filtering with lightning data and applying a cell tracking algorithm improves the reliability of the detected severe thunderstorm tracks. The obtained statistics show a gradual increase of the track density with increasing distance to the Atlantic and several local-scale maxima, mostly around the mountains. Both the seasonal and daily cycle of severe thunderstorms show large differences across the investigation area. For example, while in Southern France most events occur in June, the peak month in Northern Germany is August, which can be plausibly explained by differences in convective energy due to the large-scale circulation. Furthermore, ambient conditions in terms of convection-related quantities (e.g., CAPE, wind shear, lapse rate) and prevailing synoptic scale fronts were studied both for the entire event set and a subset, where radar-derived storm tracks were combined with hail observations provided by the European Severe Weather Database ESWD. Over Northern Germany, for example, up to 40% of all radar-derived thunderstorm tracks were associated with cold fronts, while in Southern Germany the ratio is only around 20%. Overall, around 25% of all hail streaks were associated with cold fronts.