18–22 September 2017, Pula, Croatia
ECSS2017-165

Hail frequency in central Europe estimated from 2D radar data and the relation to atmospheric characteristics

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Hail probability for European countries such as France, Germany, Luxembourg, and Belgium is estimated from 2D radar data by applying the simple Mason criterion in combination with a cell tracking algorithm for the period from 2005 to 2014. The event set comprising more than 21.000 individual radar-estimated hailstreaks show a very high spatial variability, which is mainly caused by large-scale climatology and local-scale flow dynamics. Regions highly exposed to hail hazard are those in the vicinity of mountain ranges such as the Massif Central (France) or the Black Forest mountains (Germany).

To further examine the relation between the events and prevailing ambient conditions, the event set is combined with ERA-Interim reanalysis and detections of cold fronts. Analyses reveal that while most of the hailstreaks over the northern parts of Germany require a cold front to act as a trigger mechanism, only 10-20% of the events in the south have a front nearby. Pre-convective conditions show highest mid-level temperature lapse rate and, thus, maximum CAPE. However, CAPE is much higher in the south of Germany and France compared to the north, whereas vertical wind shear is much more homogeneously distributed. The event set is further combined with hail reports from the European Severe Weather Database (ESWD) to extract a sub-event set that provide additional information about observed hail diameter. Analysis show that both ambient conditions and main properties of the hail streaks (track length, seasonal/daily cycles) are controlled to a large degree by the maximum hail diameter.