Estimating changes in high-end hail losses in Europe using a hail event set

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Severe thunderstorms cause nearly € 3 billion in annual damages in Europe, and hailstorms account for asignificant portion of it, and yet climatological aspects of large hail are not well understood. While the European Severe Weather Database (ESWD) is the most comprehensive archive of hail observations in Europe, it cannot be used for studying long-term trends of hail, because of spatial and temporal inhomogeneities. We have therefore developed a method to generate a hail event set for Central Europe.

We did so by objectively identifying recent hail swaths from high-resolution vertically integrated ice radar data from the German Weather Service (DWD). Properties of the swaths and distributions of observed hail size as a function of instability, deep-layer shear and pseudo-potential temperature were used to generate a set of hail events, each consisting of multiple swaths. The number of swaths in any 6-hourly period and location was modulated by the probability of given by the Additive Regression Convective Hazard Model (AR-CHaMo) for hail, which gives a probability of large hail as a function of predictor parameters that include deep-layer shear, mid-level relative humidity, and instability.

With this event set, time-dependent past and project future changes of hailstorm frequency as a function of location were studied. By combining the hail event set with exposure and vulnerability data, loss estimates were made. Of particular interest, especially for to the (re-) insurance sector, is the risk that rare high-loss events occur. Using reanalysis data, as well as an ensemble of regional climate models, we are able to model the changes of probability of hail events with long return periods, both in the past and in the 21st century. In our presentation, we will explain the basics of the hail loss model while addressing the various limitations introduced by the assumptions that were made.