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Financial losses of tornadoes in European countries

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We discuss the risk of severe damage due to tornadoes in Europe. Many tornadoes have been recorded in Europe during recent years. Whilst most of them caused little or no damage, violent tornadoes can still likely strike some European country in the future.

Tornado observations allow estimates of the frequency of tornadoes per country. Based on tornado intensity and footprint-size distributions, we estimate country-specific average occurrence intervals (AOI).

We then apply an aggregated loss model to estimate average annual loss ratios (AALR) per nation. To do so we model individual tornadoes as moving Rankine vortices creating footprints of elliptic shape with either fully correlated or fully uncorrelated length and width. Results are provided for both these cases.

Based on the Rankine-vortex model, local maximum wind speeds within a tornado footprint are estimated. This allows for the estimation of an effective building vulnerability function for specific tornado intensities.

Aside from providing national AOI and AALR estimates by country, we found that about 90% of the tornadoes contribute less than 1% to the average annual loss, while F4 tornadoes contribute about 50% and the even rarer F5 tornadoes about 25%.

According to these results, the fact that most national tornado databases in Europe cover only the most recent years and therefore contain only few (if any) severe tornadoes, can lead to a pronounced underestimation of potential tornado risk in Europe.