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Frequency path-length scaling of severe tornadoes during individual tornado outbreaks

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In this study we consider severe tornadoes, which we define as tornadoes with path lengths L > 10 km, in the continental USA (USA Storm Prediction Center Severe Weather Database). We find that for the period 1982–2011, for individual severe tornadoes (L > 10 km): (i) There is a strong linear scaling between the number of severe tornadoes in a year and their total path length in that year. (ii) The cumulative frequency path length data suggests that, not taking into account any changing trends over time, we would expect in a given year (on average) one severe tornado with a path length L > 115 km and in a decade (on average) one severe tornado with a path length L > 215 km. (iii) The noncumulative frequency-length statistics of severe tornado touchdown path lengths, 20 < L <200 km, is well approximated by an inverse power-law relationship with exponent near 3. We then consider the frequency path-length scaling of severe tornadoes (L > 10 km) during two tornado outbreaks, 27 April 2011 (67 severe tornadoes) and 25 May 2011 (16 severe tornadoes), and find similar statistical distributions with robust scaling. We believe that our robust scaling results provide evidence that touchdown path lengths can be used as quantitative measures of the systematic properties of severe tornadoes and severe tornado outbreaks.