



Statistics of Severe Tornadoes and Severe Tornado Outbreaks

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The standard measures of the intensity of a tornado in the USA and many other countries are the Fujita and Enhanced Fujita scales. These scales are based on the damage that a tornado causes. Another measure of the strength of a tornado is its path length of touchdown, L . In this study we consider 4,061 severe tornadoes (defined as $L \geq 10$ km) in the continental USA for the time period 1981-2010 (USA Storm Prediction Center Severe Weather Database). We find for individual severe tornadoes: (i) 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. (ii) There is a strong linear scaling between the number of severe tornadoes in a year and their total path lengths in that year. We then take the total path length of severe tornadoes in a day, L_D , as a measure of the strength of a 24-hour USA tornado outbreak. We find that: (i) On average, the number of days per year with at least one continental USA severe tornado (path length $L \geq 10$ km) has increased 16% in the 30-year period 1981-2010. (ii) The daily numbers of severe tornadoes in a USA outbreak have a strong power-law relationship (exponent 0.87) on their daily total path lengths, L_D , over the range $20 < L_D < 1000$ km dy $^{-1}$. (iii) The noncumulative frequency-length statistics of tornado outbreaks, $10 < L_D < 1000$ km dy $^{-1}$, is well approximated by an inverse power-law relationship with exponent near 1.7. 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.