



U.S. Tornado Fatalities: Environmental, Seasonal, and Geographical Perspectives

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Tornado research, at its core, serves the protection of life and property. Using a 15-year U.S. Storm Prediction Center dataset (2003-2017) of tornado event and warning data, as well as environmental data from RUC/RAP operational reanalyses, we present an exploration of tornado deaths in the United States.

We emphasize the importance of distinguishing between statistics related to tornado deaths (over half of which are associated with (E)F4+ tornadoes) and deadly tornadoes (two-thirds of which are rated (E)F2 or (E)F3). This distinction emphasizes the importance of the language used to describe patterns in tornado fatalities; for instance, while the proportion of deadly tornadoes that occur on the weekend is indeed approximately $2/7$, the number of weekend tornado deaths is disproportionately higher, indicating that deadly tornadoes that do occur on the weekend tend to have higher average fatality rates than deadly tornadoes occurring on weekdays. As another example, tornadoes occurring with a quasi-linear convective system (QLCS) storm mode are disproportionately unlikely to result in at least one death, and in addition, those QLCS tornadoes that do cause fatalities nearly always only cause one.

Our analysis also incorporates kernel density estimation (KDE) smoothing of parameter-space plots of tornado deaths and deadly tornadoes, which targets the specific parts of the tornadic near-storm environment that (a) are populated with tornado-related fatalities, (b) are populated with a disproportionately high percentage of deadly tornadoes, and (c) are populated with deadly tornadoes that result in disproportionately high numbers of tornado deaths. These results are grouped by season, geographical region, time of day, warning performance, and storm mode.

We also introduce the use of two-dimensional analogues to proximity-sounding statistics available through the clustering of near-storm environments using self-organizing maps. This methodology will enable us to discuss the two-dimensional patterns of summary parameters, such as the Significant Tornado Parameter, that may be disproportionately associated with high-fatality tornadoes.