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Predicting tornado frequency using environmental factors on big convective days in the United States

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Environmental factors are consistently used in forecasting when and where an outbreak of tornadoes is likely to occur. Factors such as convective available potential energy (CAPE), convective inhibition, helicity, and bulk shear provide information about the potential development of tornadoes on a given day. However, more work is needed to quantify how the number of tornadoes generated on a convective day varies with specific environmental factors. The objective of this research is to quantify the relationship between the number of tornadoes and the environmental factors on a big day. A big day is defined as a 24-hour period starting at 6 AM (convective day) with ten or more tornadoes that are clustered in both space and time. On average, big days produce twenty-two tornadoes and occur most frequently in April, May, and June. Here we develop a statistical model that can be used to predict the number of tornadoes while controlling for environmental factors on these big days. The model uses a truncated Poisson likelihood and is fit within a Bayesian framework using functions from the "brms" package in R. The model contains a random effect term for month and predicts the rate of tornadoes for unit changes in CAPE, helicity, and bulk shear.