



Mid-tropospheric patterns and historic tornado outbreaks.

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The majority of tornado-related fatalities in the United States comes as a result of tornado outbreaks [1]. Major tornado outbreaks are particularly dangerous because they consist of multiple, often violent, long-track tornadoes and, therefore, are more likely to affect populated areas [2]. Environmental conditions which support the development of those outbreaks can be studied in terms of atmospheric patterns. Accordingly, this research identifies large-scale atmospheric patterns associated with tornado outbreaks. First, a database of historic tornado outbreaks was created utilizing kernel density estimation. Second, a matrix with tornado outbreaks and geopotential height at 500 hPa for 2070 grid points over the United States, was generated. Finally, using the principal component analysis (PCA) on the tornado data matrix, a series of maps with atmospheric patterns was generated. The PCA was performed for tornado outbreaks from 2004 to 2014 in S-mode decomposition where grid points are treated as variables (raw tornado rapport obtained from SPC database). The preliminary results indicate that the Promax transformation of the PCA provides the most robust results and that the strongest outbreaks are clearly visible among patterns even if the analysis is based on only one atmospheric field. The analysis period will be extended, analyzed, and discussed in this presentation, focusing on the importance of resulting atmospheric patterns in tornado outbreak prediction and risk mitigation efforts.

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1) Schneider, R. S., A. R. Dean, S. J. Weiss, and P. D. Bothwell, 2006: Analysis of estimated environments for 2004 and 2005 severe convective storm reports. Preprints, 23rd Conf. on Severe Local Storms, St. Louis, MO, Amer. Meteor. Soc., 3.5.

2) Brooks, H.E., 2004: On the relationship of tornado path length and width to intensity. *Weather Forecasting* 19, 310–319.