Evaluating Severe Weather Prediction Methods from Thermodynamic Profiles

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Severe weather events such as tornadoes and high-wind thunderstorms pose a significant threat to human life and well-being. According to the NOAA, severe storms have caused over $200 billion in damage since 1980. We are currently able to predict the occurrence of specific event types from a thermodynamic profile of the atmosphere. These prediction methods rely on indices such as CAPE, CIN, and BRN to quantify convective instability in the atmosphere. However, few empirical studies have been done to test the efficacy of these indices over a large period of time. This study aimed to apply atmospheric sounding data to the issue of better understanding severe weather prediction. The study analyzed the frequencies of index values for severe weather and tornado events in sounding data collected from 1973 to 2017 in the continental US when compared against severe weather occurrences in the same locales. It was found for the set of all severe weather event types that while CAPE(V) and BRN(V) are well suited for use as prediction parameters, CIN(V) is a less effective indicator. For tornado events, however, only CAPE and CAPEV were statistically significant indicators. Since tornadoes pose the greatest problem for prediction, a novel, integrated tornado-specific prediction index was created on the basis of the findings and further analysis of other indices via a logistic regression algorithm. This model was tested to be accurate 62% of the time. The novel index retains the advantages of individual indices while streamlining the prediction process.

Awards Won:
American Meteorological Society: Certificate of Honorable Mention
King Abdulaziz &amp
his Companions Foundation for Giftedness and Creativity: Award of $1500 in Intelligent-Based Solutions in Cyber-security