# An Overview of the Total Lightning Jump Algorithm: Past, present and future work

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Rapid increases in total lightning prior to the onset of severe and hazardous weather have been observed for several decades. These rapid increases are known as "lightning jumps" and can precede the occurrence of severe weather by tens of minutes. Over the past decade, a significant effort has been made to quantify lightning jump behavior in relation to its utility as a predictor of severe and hazardous weather. Based on a study of 34 thunderstorms that occurred in the Tennessee Valley, early work conducted in our group at Huntsville determined that it was indeed possible to create a reasonableoperational lightning jump algorithm (LJA) based on a statistical framework relying on the variance behavior of the lightning trending signal. We the expanded this framework and tested several variance-related LJA configurations on a much larger sample of 87 severe and non severe thunderstorms. This study determined that a configuration named the "2σ" algorithm had the most promise in development of the operational LJA with a probability of detection (POD) of 87%, a false alarm rate (FAR) of 33%, a Heidke Skill Score (HSS) of 0.75. The 2σ algorithm was then tested on an even larger sample of 711 thunderstorms of all types from four regions of the country where total lightning measurement capability existed. The result was very encouraging.Despite the larger number of storms and the inclusion of different regions of the country, the POD remained high (79%), the FAR was low (36%) and HSS was solid (0.71). Average lead time from jump to severe weather occurrence was 20.65 minutes, with a standard deviation of +/- 15 minutes. Also, trends in total lightning were compared to cloud to ground (CG) lightning trends, and it was determined that total lightning trends had a higher POD (79% vs 66%), lower FAR (36% vs 54 %) and a better HSS (0.71 vs 0.55). From the 711-storm case study it was determined that a majority of missed events were due to severe weather producing thunderstorms in low flashing environments. The latest efforts have been geared toward examining these low flashing storms in order to adjust the algorithm for such storms, thus enhancing the capability of the LJA. Future work will test the algorithm in real time using current satellite and radar based cell tracking methods, as well as, comparing total lightning jump occurrence to both satellite based and ground base observations of thunderstorms to create correlations between lightning jumps and the observed structures within thunderstorms. Finally this algorithm will need to be tested using Geostationary Lightning Mapper proxy data to transition the algorithm from VHF ground based lightning measurements to lower frequency space-based lightning measurements.