

Integration of the total lightning jump algorithm into current operational warning environment conceptual models

Christopher J. Schultz^{1,2}, Lawrence D. Carey¹, Elise V. Schultz¹, Geoffrey T. Stano³, Patrick N. Gatlin²,
Danielle M. Kozlowski¹, Richard J. Blakeslee², Steven J. Goodman⁴

1 -Department of Atmospheric Science, UAHuntsville, Huntsville, AL

2 – NASA Marshall Space Flight Center, Huntsville, AL

3- NASA SPoRT/ENSCO, Inc., Huntsville, AL

4- NOAA/NESDIS, GOES-R System Program Office, NASA Goddard Space Flight Center, Greenbelt, MD

The presence and rates of total lightning are both correlated to and physically dependent upon storm updraft strength, mixed phase precipitation volume and the size of the charging zone. The updraft modulates the ingredients necessary for electrification within a thunderstorm, while the updraft also plays a critical role in the development of severe and hazardous weather. Therefore utilizing this relationship, the monitoring of lightning rates and jumps provides an additional piece of information on the evolution of a thunderstorm, more often than not, at higher temporal resolution than current operational radar systems. This correlation is the basis for the total lightning jump algorithm that has been developed in recent years.

In order to become a viable option for operational forecasters to incorporate into their severe storm monitoring process, the total lightning jump must be placed into the framework of several severe storm conceptual models (e.g., radar evolution, storm morphology) which forecasters have built through training and experience. Thus, one of the goals of this study is to examine and relate the lightning jump concept to often used radar parameters (e.g., dBZ vertical structure, VIL, MESH, MESO/shear) in the warning environment. Tying lightning trends and lightning jump occurrences to these radar based parameters will provide forecasters with an additional tool that they can use to build an accurate real-time depiction as to what is going on in a given environment. Furthermore, relating the lightning jump concept to these parameters could also increase confidence in a warning decision they have already made, help tip the scales on whether or not to warn on a given storm, or to draw the forecaster's attention to a particular storm that is rapidly developing. Furthermore the lightning information will add vital storm scale information in regions that are not well covered by radar, or when radar failures occur.

The physical basis for the lightning jump algorithm in relation to severe storm dynamics and microphysics is a key component that must be further explored. Many radar studies have examined flash rates and their relation to updraft strength, updraft volume, precipitation-sized ice mass, etc.;

however, very few have related the concept of the lightning jump and manifestation of severe weather to storm dynamics and microphysics using multi-Doppler and polarimetric radar techniques. Therefore, the second half of this study will combine the lightning jump algorithm and these radar techniques in order to place the lightning jump concept into a physical and dynamical framework. This analysis includes examining such parameters as mixed phase precipitation volume, charging zone, updraft strength and updraft volume. Such a study should provide increased understanding of and confidence in the strengths and limitations of the lightning jump algorithm in the storm warning process.