Exploring the Use of Radar for a physically based lightning cessation nowcasting tool

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NASA's Marshall Space Flight Center (MSFC) and the University of Alabama in Huntsville (UAHuntsville) are collaborating with the 45th Weather Squadron (45WS) at Cape Canaveral Air Force Station (CCAFS) to enable improved nowcasting of lightning cessation. This project centers on use of dual-polarimetric radar capabilities, and in particular, the new C-band dual-polarimetric weather radar acquired by the 45WS. Special emphasis is placed on the development of a physically based operational algorithm to predict lightning cessation.

While previous studies have developed statistically based lightning cessation algorithms, we believe that dual-polarimetric radar variables offer the possibility to improve existing algorithms through the inclusion of physically meaningful trends reflecting interactions between in-cloud electric fields and hydrometeors. Specifically, decades of polarimetric radar research using propagation differential phase has demonstrated the presence of distinct phase and ice crystal alignment signatures in the presence of strong electric fields associated with lightning. One question yet to be addressed is: To what extent can these ice-crystal alignment signatures be used to nowcast the cessation of lightning activity in a given storm? Accordingly, data from the UAHuntsville Advanced Radar for Meteorological and Operational Research (ARMOR) along with the NASA-MSFC North Alabama Lightning Mapping Array are used in this study to investigate the radar signatures present before and after lightning cessation.

Thus far, our case study results suggest that the negative differential phase shift signature weakens and disappears *after* the analyzed storms ceased lightning production (i.e., after the last lightning flash occurred). This is a key observation because it suggests that while strong electric fields may still have been present, the lightning cessation signature encompassed the period of the polarimetric negative phase shift signature. To the extent this behavior is repeatable in other cases, even if only in a substantial fraction of those cases, the case analyses suggests that differential propagation phase may prove to be a useful parameter for future lightning cessation algorithms. Indeed, analysis of 15+ cases has shown additional indications of the weakening and disappearance of this ice alignment signature with lightning cessation. A summary of results will be presented.