Using the VAHIRR Radar Algorithm to Investigate Lightning Cessation

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Accurately determining the threat posed by lightning is a major area for improved operational forecasts. Most efforts have focused on the initiation of lightning within a storm, with far less effort spent investigating lightning cessation. Understanding both components, initiation and cessation, are vital to improving lightning safety. Few organizations actively forecast lightning onset or cessation. One such organization is the 45th Weather Squadron (45WS) for the Kennedy Space Center (KSC) and Cape Canaveral Air Force Station (CCAFS). The 45WS has identified that charged anvil clouds remain a major threat of continued lightning and can greatly extend the window of a potential lightning strike. Furthermore, no discernable trend of total lightning activity has been observed consistently for all storms. This highlights the need for more research to find a robust method of knowing when a storm will cease producing lightning.

Previous lightning cessation work has primarily focused on forecasting the cessation of cloud-to-ground lightning only. A more recent, statistical study involved total lightning (both cloud-to-ground and intra-cloud). Each of these previous works has helped the 45WS take steps forward in creating improved and ultimately safer lightning cessation forecasts. Each study has either relied on radar data or recommended increased use of radar data to improve cessation forecasts. The reasoning is that radar data is able to either directly or by proxy infer more about dynamical environment leading to cloud electrification and eventually lightning cessation.

The authors of this project are focusing on a two-step approach to better incorporate radar data and total lightning to improve cessation forecasts. This project will utilize the Volume Averaged Height Integrated Radar Reflectivity (VAHIRR) algorithm originally developed during the Airborne Field Mill II (ABFM II) research project. During the project, the VAHIRR product showed a trend of increasing values with increases in the electric field magnitude above 3 kV/m. An extreme value analysis showed that VAHIRR values ≤ 10 dBZ-km showed that the probability of having an electric field magnitude larger than 3 kV/m was less than one in ten thousand. VAHIRR also was found to be sensitive at indicating anvil clouds that posed a threat of initiating a lightning flash. This project seeks to use VAHIRR to analyze its utility as a lightning cessation tool, particularly dealing with the threat posed by detached anvils. The results from this project will serve as a baseline effectiveness of radar-based lightning cessation algorithms. This baseline will be used in the second, and concurrent work by the co-author's who are developing a lightning cessation algorithm based on dual-polarimetric radar data. Ultimately, an accurate method for identifying lightning cessation can save money on lost manpower time as well as greatly improve lightning safety.