9.10 USING WEATHER RADAR AND A NEW ICE MASS ESTIMATOR TO FORECAST LIGHTNING

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Short-term automated forecasts (nowcasts) of lightning are important for a number of applications to help save lives and resources. The presence of ice aloft is known to be a key component in the atmospheric electrification process. The measurement range, resolution, and volumetric nature of weather radar observations provide valuable data which are inherently different from those provided by currently operational lightning detection networks. Weather radar observations can be used to estimate ice mass aloft and are thus favourable for nowcasting lightning.

This paper describes a new model for estimating ice mass aloft using weather radar data. Previously, a simplified bulk microphysical model with fixed parameters was used to estimate ice mass aloft. The new weather radar-based ice mass estimator uses a novel numerical optimization approach to dynamically update the parameters of this bulk microphysical model to improve lightning nowcasts.

This paper also introduces a new approach to nowcasting lightning activity using weather radar data. Previous methodology used a cell-based approach to lightning nowcasting and verification, where storm cells were first identified, lightning activity was associated with a particular cell, but lead times and lightning locations were not specified in the nowcast. The new method described in this paper employs a grid-based approach to lightning nowcasting and verification. This approach leverages spatial correlations and potentially complex interactions between storm cells and atmospheric scales. It also makes specific nowcasts and verifications in space and time.

A novel verification approach is described and used to assess this first-flash lightning nowcasting performance. Preliminary results show that using the new ice mass model significantly improves nowcasts versus using the traditional weather radar-based ice mass estimator or lightning flash-rate density directly for nowcasting first-flash lightning occurrences. The radar data used for this study were collected by the KFWS Weather Service Radar-1988 Doppler radar located near Fort Worth, Texas, during a severe convective storm event occurring on 03 Apr 2014 from 000335 to 235741 UTC. The lightning data used for this study were collected by processing detections of lightning discharges from multiple Vaisala remote lightning sensors part of the National Lightning Detection Network within approximately 1000 km of the KFWS radar during the same time period. The Dynamic Adaptive Radar Tracking of Storms method was used to generate the radar reflectivity nowcasts which were converted to lightning nowcasts using the numerically optimized ice mass model.