Radar-based Characteristics of Convective Storm associated with Cloud-to-Ground Lightning Flashes

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The cloud-to-ground (CG) lightning is significant threat to space vehicle launch and its ground operation. The radar-derived storm characteristics of CG lightning were investigated in this study. We specially focused on the potential use of cell-based characteristics to distinguish the convective cells with CG lightning from non-lightning cells.

The algorithm utilizes fuzzy logic with membership functions and weights that are statistically derived from radar-based statistical analysis. A number of potentially significant radar-based characteristics (e.g. area, volume, mean reflectivity, maximum reflectivity, maximum reflectivity above melting layer, top height, precipitation ice mass) were analyzed in order to determine the best classifier of CG flashes using Bayesian information criterion (BIC) and tested the sensitivity of these parameters to five observation range (180 km, 150 km, 120 km, 90 km, and the area with the detective efficiency of CG flashes above 90%).

The convective cells by 30 dBZ (35 dBZ) with a matching radius of 15 km and 25 km (more than 20 km) at an observational range of 90 km had highest CSI values of 0.42. In contrast, the highest CSI value was 0.32 for the convective cell by 40 dBZ with a matching radius of 0 km and an observational range of 90 km.