M.S. Defense Announcement
Adam Clayton
Friday, December 4 at 1:00 p.m.

Adam Clayton
M.S. Defense

December 4, 2020
1:00 p.m.

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Committee:
Steven Rutledge (Adviser)
Steven Miller (Co-adviser)
Christine Chiu
Richard Eykholt (Physics)

ANALYZING THE DETECTION EFFICIENCY OF THE GEOSTATIONARY LIGHTNING MAPPER IN ISOLATED CONVECTION

The Geostationary Lightning Mapper (GLM) flying on GOES-16 and GOES-17 has provided near-hemispheric lightning detection for nearly two years. Since operation began, several attempts have been made to compare flash rate observations from GLM against ground-based lightning detection systems. While GLM captures a high percentage of flashes in the field-of-view of GOES-16 and GOES-17, some studies have shown reduced detection efficiency at storm-scale. The problem of analyzing lightning from space is a complex one. Several factors such as: flash area, flash length, cloud water and ice contents, flash height, flash brightness and position relative to satellite nadir affect the detection efficiency of GLM. This study analyzes numerous convective cells in the Alabama, Colorado, and W. Texas regions to further analyze the detection efficiency of GLM. Lightning data from VHF-based lightning mapping arrays (LMAs) in each region were compared directly to measurements from GLM. The GLM/LMA ratio for each cell was computed during the lifetime of the thunderstorm. Additionally, graupel echo volumes, precipitation ice water paths, and cloud ice and cloud water paths were calculated to access the microphysics of each cell. This study features an in-depth analysis of thunderstorms that vary in size and severity from each region. Further, a statistical analysis of all of the variables was performed to determine the major factors that affect GLM detection efficiency.

This study found that flash rate, flash brightness and near cloud-top water and ice water paths significantly affect GLM detection efficiency. Specifically, thunderstorms with increased flash rates, cloud-top water paths, and decreased flash size/brightness are often characterized by low (< 20%) GLM detection efficiencies. These characteristics are common in so-called “anomalous” charge structure thunderstorms that frequent the northern Colorado region. Additionally, this study confirmed results from previous studies which found that the GLM DE decreases as the distance from nadir increases. These results will be helpful for meteorologists utilizing GLM observations to assist with decisions regarding severe weather.

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