Bayesian Merging of GLM data with Ground-Based Networks

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Abstract

While space-based measurements of lightning can detect total lightning with high efficiency, previ-ous instruments were only able to observe a particular area on time scales much smaller than the lifetime of a storm. This limited the ability to use such data operationally; hence, ground-based lightning locating systems (LLSs) that can continuously detect lightning have been used despite having a lower detection efficiency of total lightning. The Geostationary Lightning Mapper (GLM) will significantly advance our ability to detect total lightning across a hemispheric domain in a time continuous manner. However, there is a benefit to combining ground-based LLSs and GLM data to yield a better characterization of total lightning. For example, (1) Ground-based LLSs have a bias to cloud-to-ground lightning detection, whereas space-based imagers have a bias to the detection of in-cloud lightning; (2) space-based systems perform better over the oceans than the ground-based systems whose detection efficiency drops rapidly with distance from the coastline. Importantly, this can be done in real-time. This work will build upon the investigators' previous experience with combining different lightning datasets to create a merged data set of GLM and ground-based data. This is done in a robust, rigorous statistical manner using a Bayesian methodology. The merged data has applications to (1) aviation and maritime safety, (2) early identification of light-ning producing clouds, and (3) tropical cyclone development. Besides providing a more complete estimate of total lightning activity, the merged data set can also leverage the flash-type classifica-tion from ground-based LLSs. This can be used to calculate the IC:CG ratio, which may have skill in forecasting severe weather and can be applied to fire weather applications. The proposed work will provide the basic research into the Bayesian methodology and transition this into a product suitable for an operational environment. Ultimately, this proposal will help maximize the benefits of the GOES-R mission and is applicable to future GOES missions.