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Influence of Thunderstorms on the Structure of the Ionosphere over North America

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Accurate characterization of the ionosphere in response to thunderstorms has important implications for the effective use of high frequency (HF) communications in civilian and military operations, to include emergency services, amateur radio, aviation, and over-the-horizon radar. This study investigates changes in the structure of the ionosphere due to strong convective activity and cloud electrification associated with thunderstorms over North America. Superposed Epoch Analysis (SEA) is applied to surface weather observations and ionosonde data at Eglin Air Force Base, Boulder, and Millstone Hill from 2010 to 2017. Initial findings indicate that lightning significantly modifies the structure of the ionosphere, generating statistically different measurements of several key parameters compared to clear-sky observations. The influence of seasonal and diurnal variations is also presented. Results of this research may eventually lead to the development of a parameterization scheme to incorporate thunderstorm and cloud electrification effects into global and regional ionosphere models. Because troposphere-ionosphere coupling has been poorly addressed, analysis of the electrodynamic connection between the lower and upper atmospheres has important implications for both space physics and atmospheric science communities.

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