

## Substorm Modulation of Lightning Occurrence over North America

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The response of lightning rates over North America to the occurrence of substorms is investigated using superposed epoch analysis. Composites of daily National Lightning Detection Network (NLDN) data and SuperMAG substorm events from 1990-2012 indicate a statistically significant *increase* in lightning strikes across North America, especially at higher latitudes. Strikingly, these results suggest a strong connection between the upper atmosphere and cloud electrification processes in the lower troposphere, most likely through an enhancement of the auroral electrojet. It is hypothesized that increased conductivities (i.e., electron densities) in the E-layer associated with the global atmospheric electrical circuit result in favorable conditions for lightning initiation. Because magnetosphere-ionosphere-thermosphere (MIT) coupling has been poorly addressed, analysis of the electrodynamic connection between the troposphere and upper atmosphere has important implications for both space physics and atmospheric science communities.

Keywords: substorm, MIT coupling, lightning, National Lightning Detection Network, SuperMAG, auroral electrojet