Global Remote Sensing of Atmospheric Discharges

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Extremely-low frequency electromagnetic waves are used to explore the atmospheric electromagnetic environment of the Earth. Three networks of magnetometers record the properties of natural electromagnetic fields on the global, regional, and on the local scale.

The global magnetometer network detects locations of lightning discharges around the globe and monitors the temporal and spatial evolution of particularly intense thunderstorms. Satellite based cloud cover recordings help to determine the effective charge density of thunderclouds and reveal the electrical nature of severe weather.

The regional magnetometer network detects mesospheric electrical breakdown between the troposphere and the ionosphere, optically imaged with an intensified video camera as a transient optical emission, denoted sprite. About 20 % of the sprites produce electromagnetic signals, which are similar to intense lightning discharges and the global detection efficiency of those signals is on the order of 80 % with a false alarm rate of 20 %.

The local magnetometer network is operated as an interferometer to measure the electromagnetic wave propagation speed, which is determined by the mesospheric conductivity. This variable conductivity is controlled by solar short wave radiation and energetic particle precipitation into the atmosphere, and can be monitored from the diurnal to the decadal time scale and this variability is likely to modulate the remote sensing of intense lightning discharges sprites.