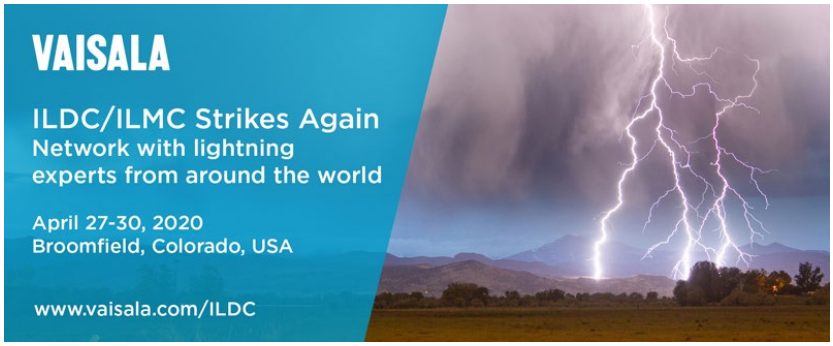

Interactions between the Ionosphere and High Altitude Lightning Observed through GNSS Signal Scintillation Analysis

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Abstract

The ionosphere is a turbulent area of the upper atmosphere with varying electron density that can be affected by high altitude lighting. High altitude lighting refers to several different types of lighting that differ in appearance and height, but all go beyond the troposphere to the upper layers of the atmosphere. Gigantic jets and sprites are the most commonly observed high altitude lightning that can reach the ionosphere. To help determine the extent this lighting can affect the ionosphere, Global Navigation Satellite System (GNSS) data is reviewed for scintillation. Scintillation is an observed phenomenon when fluctuations in the ionosphere cause fluctuations in the power and phase of the GNSS signals. This scintillation negatively affects the performance of the satellites and causes a loss of lock. Because of the increasing need for precise location data in industry and government use, even a loss of lock for several seconds can be detrimental. For the purpose of this research, several receivers have been set up in Daytona Beach, FL. The location is significant because high altitude lighting occurs more often around the tropics, but can occur at other latitudes. The data received is graphed at a high rate to show fluctuations in signal over seconds to increase accuracy and because lightning can travel extremely quickly, the effects could dissipate just as fast. There have been instances observed where scintillation is recorded within seconds to minutes after a lighting strike pointing towards an appreciable correlation. Another step taken to further prove the correlation is by mapping the location of the satellite and determining the Ionospheric Pierce Point (IPP) of the signal, or in other words, where the signal passed through the ionosphere. The height of the IPP can be used to estimate the height the scintillation occurred and then the possible height of the lightning to have caused such scintillation. The correlation between high altitude lightning, ionospheric disturbances, and scintillations in GNSS data is becoming more apparent and even on a small scale could be detrimental to more precise technology.

Attachments

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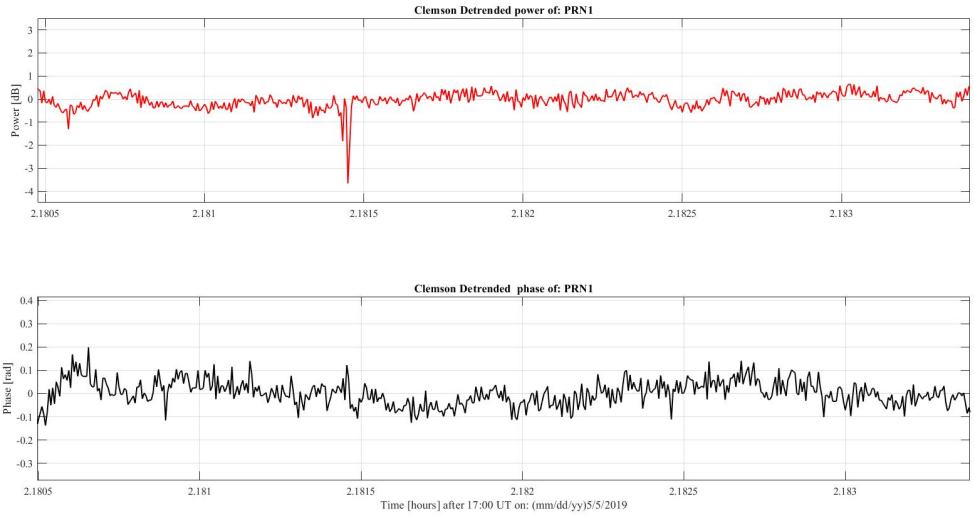

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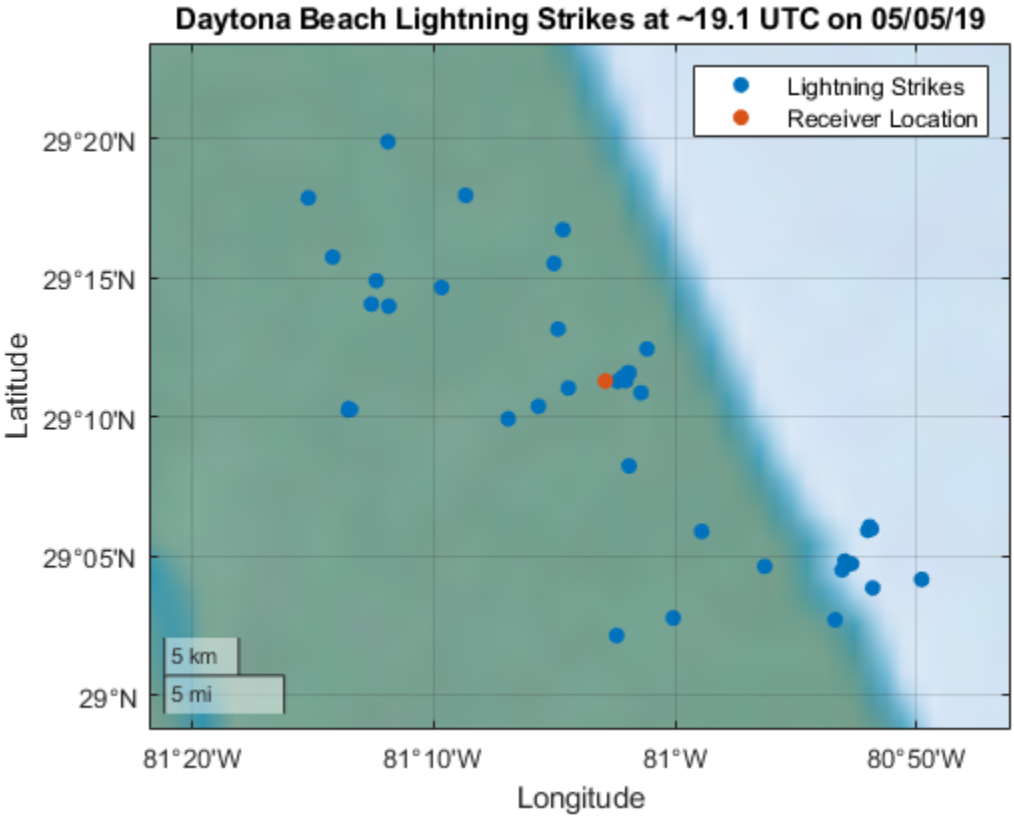
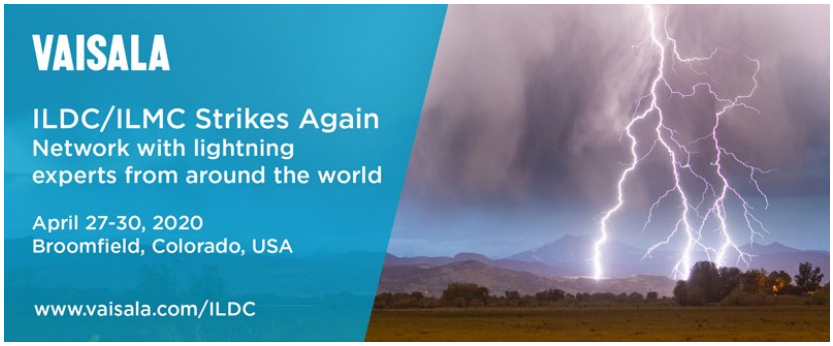


Topic Areas

Lightning Interactions with the Upper Atmosphere, Aviation and Other Unique Uses of Lightning Data



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No preference