

OCCURRENCE RATES OF VLF SIGNATURES OF LEP  
EVENTS MEASURED BY THE HAIL ARRAY

W. B. Peter, U.S. Inan

STARLab, Stanford University, 350 Serra Mall, Stanford, CA  
94305

Subionospherically propagating Very Low Frequency (VLF) signals have long been used to detect localized disturbances of the lower ionosphere. A distributed set of VLF observing sites, known as the Holographic Array for Ionospheric and Lightning Research (HAIL), captures the occurrence of lightning-induced electron precipitation (LEP) events over the Central United States. Quantitative understanding of the occurrence properties of LEP events is needed for accurate quantification of the role of lightning discharges in radiation belt losses at mid-to-low latitudes.

In particular, we examine the effects of several geomagnetic storms, including the Halloween storm (late October of 2003), on the occurrence rates of LEP events. The occurrence rate is found to be highly variable with geomagnetic activity. Comparison of LEP event occurrence rates with measurements of energetic electron flux levels from the NOAA-POES satellite supports the notion that this variability in the number of LEP events detected by the HAIL array is largely due to increases in the energetic electron population in the slot region with the advent of geomagnetic activity.

We also examine the occurrence of LEP events associated with highly localized and long lasting thunderstorms, such as that which occurs in lightning associated with hurricanes. In mid-September of 2003, Hurricane Isabel passed through the Great Circle Path (GCP) of a sub-ionospherically propagating LF signal between the NAU transmitter in Puerto Rico and a VLF/LF receiver located outside Boston. Cloud-to-ground lightning flashes detected by the Long-Range Lightning Detection Network (LRLDN) and located in the outer rainbands of the hurricane were associated with perturbations in the received LF signal consistent with LEP events. The number of perturbations detected on the LF signal consistent with lightning-induced electron precipitation events tended to increase with the occurrence of hurricane-associated lightning near the GCP.

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1. (a) William Peter  
Stanford University  
350 Serra Mall  
Packard Building, Room 351  
Stanford, CA  
94305 USA  
wpeter@stanford.edu
- (b) 650-723-3789
- (c)
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