The spatio-temporal development of lightning-induced electron precipitation events

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Lightning-induced electron precipitation (LEP) events occur when the electromagnetic energy radiated by lightning couples to the magnetosphere and scatters ¬stably trapped radiation belt electrons. A portion of these scattered electrons in turn precipitate into the underlying ionosphere, producing electron density disturbances in the D-region ionosphere which can be detected by VLF remote sensing. When LEP events are observed nearly simultaneously at both the northern and southern ends of a field line, the LEP event is known as a conjugate LEP event. In this paper, an array of VLF receivers in the northern hemisphere is used to measure the spatial-temporal development of the LEP-related ionization patch produced within the D-region ionosphere. During one interesting event, LEP-associated VLF signal perturbations were observed at three receiver sites in the northern hemisphere (Florida, North Carolina, and Connecticut) and at one receiver in the conjugate hemisphere (Palmer Station, Antarctica). The LEP-related disturbance is observed to move poleward with time, consistent with many past observations. A second interesting event indicates the detection of an eastward expansion (with time) of the LEP-related disturbance, however. Together, these observations indicate that previous large-scale statistics compiled for conjugate LEP events may be seriously impacted by the spatio-temporal development of the LEP-associated ionospheric disturbances in the two hemispheres. Perhaps equally importantly, these observations indicate that VLF remote sensing can be used to measure the temporal and spatial development of energetic electron precipitation from the Earth's radiation belts.

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