Geophysical Research Abstracts, Vol. 9, 05116, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-05116

Lightning-Induced Electron Precipitation: DEMETER and Ground-based Observations

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Lightning-induced Electron Precipitation (LEP) events have been extensively observed on the ground via subionospheric VLF methods, most recently revealing the spatial extent of the ionospreic regions affected to be $\geq$1000 km. New metrics are now developed by which the total precipitated fluxes induced by individual lightning discharges may be estimated. These ground-based observations are now calibrated via direct observations of LEP bursts on the DEMETER spacecraft, allowing quantification of lightning-whistler-driven loss of electron radiation with unprecedented accuracy. DEMETER spacecraft detects short bursts of lightning-induced electron precipitation (LEP) observed simultaneously with newly-injected upgoing 0$^+$ whistlers, and sometimes also with once-reflected 1$^-$ whistlers. Lightning data available in some cases allows definitive identification of the causative lightning discharges. Large regions of enhanced background precipitation are observed, apparently produced and maintained by high rate of of lightning within a localized thunderstorm. Timing and energy spectra of LEP events are consistent with estimates of precipitation produced by the identified causative lightning and whistlers. In this paper, we present a brief comparison of ground- and DEMETER-based observations of LEP events.