Seasonal variation of inner belt electron precipitation with lightning

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Previous studies indicate that lightning may be a significant contributor to the loss of inner belt electrons. Observations of lightning-induced electron precipitation (LEP) both in-situ and via the subionospheric VLF method have typically focused on bounce loss cone events; that is, transient bursts of precipitation that are seen in conjunction with the causative lightning discharge. With its energetic electron detector oriented perpendicular to the orbital plane, for much of its orbit, the Instrument for Particle Detection (IDP) onboard the DEMETER satellite is positioned to assess cumulative effects of LEP in the drift loss cone, a region encompassing the electrons that are destined to be precipitated upon reaching the South Atlantic Anomaly (SAA). Analysis of the particle precipitation data over a two-year period shows that energetic electron fluxes in the drift loss cone exhibit a seasonal dependence consistent with LEP. Over the United States, energetic electron fluxes in the slot region (between $L = 2$ and 3) are found to be significantly higher in the Northern summer than in the winter, consistent with the seasonal distribution of lightning activity in the Northern Hemisphere. The association of precipitation flux levels with lightning over the continental United States is further explored using lightning location data from the National Lightning Detection Network (NLDN). The increased and sustained precipitation of particles into the drift loss cone over the Northern Hemisphere in the summer is consistent with expected pitch-angle scattering by non-ducted whistlers, showing that lightning is indeed a significant contributor to the loss of inner belt electrons, as has been theoretically suggested by Abel and Thorne [1998].