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Origin of energetic electron precipitation > 30 keV into the atmosphere

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Energetic electrons are deposited into the atmosphere from Earth's inner magnetosphere resulting in the production of odd nitrogen NOx. During polar night NOx can be transported to low altitudes, where it can destroy ozone, affecting the atmospheric radiation balance. Since the flux of energetic electrons trapped in the magnetosphere is related to solar activity, the precipitation of these electrons into Earth's atmosphere provides a link between solar variability and changes in atmospheric chemistry which may affect Earth's climate. To determine the global distribution of the precipitating flux, we have built a statistical model binned by auroral electroject (AE) index, magnetic local time (MLT) and L shell of E>30 keV precipitating electrons from the MEPED instrument on board the NOAA POES low-altitude satellites NOAA-15, -16, -17 and -18. We show that the precipitating flux increases with geomagnetic activity suggesting that the flux is related to substorm activity. The precipitating fluxes maximise during active conditions where they are primarily seen outside of the plasmapause on the dawnside. The global distribution of the precipitating flux of E>30 keV electrons is well-correlated with the global distribution of lower band chorus waves as observed by the Plasma Wave Experiment instrument onboard the CRRES satellite. In addition, the electron precipitation occurs where the pitch angle diffusion coefficient due to resonant interaction between electrons and whistler-mode chorus waves is high, as calculated using the PADIE code. Our results suggest that lower band chorus is very important for scattering >30 keV electrons from Earth's inner magnetosphere into the atmosphere.

Keywords: chorus waves, outer radiation belt, energetic electrons, pitch angle diffusion, POES satellite, inner magnetosphere