Geophysical Research Abstracts,
Vol. 10, EGU2008-A-06077, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-06077
EGU General Assembly 2008


# Radiation belt electron precipitation into the atmosphere: recovery from a geomagnetic storm

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Large geomagnetic storms are associated with electron population changes in the outer radiation belt and the slot region, often leading to significant increases in the relativistic electron population. The increased population decays in part through the loss, i.e., precipitation from the bounce loss cone, of highly energized electrons into the middle and upper atmosphere (30-90 km). However, direct satellite observations of energetic electrons in the bounce loss cone are very rare due to its small angular width. In this study we have analyzed ground-based subionospheric radio wave observations of electrons from the bounce loss cone at L=3.2 during and after a geomagnetic disturbance which occurred in September 2005. Relativistic electron precipitation into the atmosphere leads to large changes in observed subionospheric amplitudes. Satellite-observed energy spectra from the CRRES and DEMETER spacecraft were used as an input to an ionospheric chemistry and subionospheric propagation model, describing the ionospheric ionization modifications caused by precipitating electrons. We find that the peak precipitated fluxes of $>$150 keV electrons into the atmosphere were 3500$\pm$300 el. cm-2s-1 at midday and 185$\pm$15 el. cm-2s-1 at midnight.

For six days following the storm onset the midday precipitated fluxes are approxi-

mately 20 times larger than observed at midnight, consistent with observed day/night patterns of plasmaspheric hiss intensities. The variation in DEMETER observed wave power at L=3.2 in the plasmaspheric hiss frequency band shows similar time variation to that seen in the precipitating particles. Consequently, plasmaspheric hiss with frequencies below $\sim$500 Hz appears to be the principal loss mechanism for energetic electrons in the inner zone of the outer radiation belts during the non-storm time periods of this study, although off-equatorial chorus waves could contribute when the plasmapause is $L<3.0$.