Electron Precipitation Loss due to Scattering by Hiss in Plasmaspheric Plumes

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Summary

Non-adiabatic loss processes of radiation belt energetic electrons include precipitation loss to the atmosphere due to pitch-angle scattering by various magnetospheric plasma wave modes. In this study we consider electron precipitation loss due to pitch-angle scattering by whistler-mode ELF hiss in plasmaspheric plumes. Using wave observations and inferred plasma densities from the Plasma Wave Experiment on the Combined Release and Radiation Effects Satellite (CRRES), we analyze plume intervals for which well determined hiss spectral intensities are available. We then select 14 representative plumes for detailed study, comprising 10 duskside plumes and 4 non-duskside plumes, with local hiss amplitudes ranging from maximum values of above 300 pT to minimum values of less than 1 pT. We estimate the electron loss timescale τ_{loss} due to pitch-angle scattering by hiss in each chosen plume as a function of L-shell and electron energy; τ_{loss} is calculated from quasi-linear theory as the inverse of the bounce-averaged diffusion rate evaluated at the equatorial loss cone angle. We find that pitch-angle scattering by hiss in plumes can be efficient for inducing precipitation loss of outer-zone electrons with energies throughout the range 100 keV – 1 MeV, though the magnitude of τ_{loss} can be highly dependent of wave power, L-shell, and electron energy. Apart from inducing direct precipitation loss of MeV electrons, scattering by hiss in plumes can reduce the generation of MeV electrons by depleting the lower-energy electron seed population.