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Modelling the effects of plasmaspheric hiss and lightning-generated whistlers in three dimensional radiation belt models

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In the Earth's radiation belts the relativistic electron flux is highly variable and can change by orders of magnitude in a few hours. Since these energetic electrons can damage satellites, understanding the causes of this variation is important. Three dimensional diffusion models of this high-energy electron population solve a Fokker-Planck equation for the phase-space density and can include the effects of radial transport, wave-particle interactions and collisions. Various different wave-particle interactions can be included in the models. We present results from the BAS Radiation Belt Model using new diffusion coefficients for plasmaspheric hiss and lightning-generated whistlers. These diffusion coefficients, based on observations of the wave properties, depend on L, energy, pitch-angle and geomagnetic activity. We show that losses due to plasmaspheric hiss depend critically on the wave-normal angle distribution and that a model where the peak of the distribution depends on latitude best reproduces the observed decay rates. Higher frequency waves ($\sim$ 1–2 kHz) only make a significant contribution to losses for $L* < 3$ and the highest frequencies (2–5 kHz), representing lightning-generated whistlers, have a limited effect on relativistic electrons for $L* > 2$.