Controlling Effect of Wave Models and Plasma Boundaries on the Dynamic Evolution of Relativistic Radiation Belt Electrons

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Modeling and observations have shown that energy diffusion by chorus waves is an important source of acceleration of electrons to relativistic energies. By performing long-term simulations using the three-dimensional Versatile Electron Radiation Belt (VERB-3D) code, we test how the latitudinal dependence of chorus waves can affect the dynamics of the radiation belt electrons. Results show that the variability of chorus waves at high latitudes is critical for modeling of megaelectron volt (MeV) electrons. We show that, depending on the latitudinal distribution of chorus waves under different geomagnetic conditions, they cannot only produce a net acceleration but also a net loss of MeV electrons. Decrease in high-latitude chorus waves can tip the balance between acceleration and loss toward acceleration, or alternatively, the increase in high-latitude waves can result in a net loss of MeV electrons. Variations in high-latitude chorus may account for some of the variability of MeV electrons.

Our simulation results also show that the position of the plasmapause plays a significant role in the dynamic evolution of relativistic electrons. The magnetopause shadowing effect is included by using last closed drift shell (LCDS), and it is shown to significantly contribute to the dropouts of relativistic electrons at high L*.