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The Roles of Transport and Wave-Particle Interactions on Radiation Belt Dynamics

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Particle fluxes in the radiation belts can vary dramatically during geomagnetic active periods. Transport and wave-particle interactions are believed to be the two main types of mechanisms that control the radiation belt dynamics. Major transport processes include substorm dipolarization and injection, radial diffusion, convection, adiabatic acceleration and deceleration, and magnetopause shadowing. Energetic electrons and ions are also subjected to pitch-angle and energy diffusion when interact with plasma waves in the radiation belts. Important wave modes include whistler mode chorus waves, plasmaspheric hiss, electromagnetic ion cyclotron waves, and magnetosonic waves. We investigate the relative roles of transport and wave associated processes in radiation belt variations. Energetic electron fluxes during several storms are simulated using our Radiation Belt Environment (RBE) model. The model includes important transport and wave processes such as substorm dipolarization in global MHD fields, chorus waves, and plasmaspheric hiss. We discuss the effects of these competing processes at different phases of the storms and validate the results by comparison with satellite and ground-based observations.

Keywords: Radiation Belts, Space Weather, Wave-Particle Interaction, Storm and Substorm