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Quantitative Assessment of Earth's Radiation Belt Electron Dynamics

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Extended Abstract

In the collisionless Earth's radiation belt environment, wave-particle interaction is a fundamental physical process in transferring energy and momentum between particles with different species and energies. The Van Allen radiation belts exhibit a dramatic variability due to delicate balance between acceleration, loss, and transport processes. Various physical processes are known to affect energetic electron dynamics in the Earth's radiation belts, but their quantitative effects in different time and space need further investigation. This presentation will focus on discussing the quantitative roles of various physical processes that affect Earth's radiation belt electron dynamics using quasilinear theory and unprecedented multi-satellite observations. We will use realistic global distributions of whistler-mode chorus waves obtained from an innovative technique based on low-altitude electron measurements, adopt various available radial diffusion models, and construct the global evolution of other potentially important plasma waves including plasmaspheric hiss, magnetosonic waves, and electromagnetic ion cyclotron waves using all available multi-satellite observations (e.g., Van Allen Probes, THEMIS, MMS, etc.). Those state-of-the-art wave properties and distributions on a global scale will be used to calculate diffusion coefficients, which will be adopted as inputs to simulate the dynamical electron evolution using a 3D diffusion simulation during a few interesting events (including storm-time and non-storm-time events). The quantitative role of each physical process will be determined by comparing against the Van Allen Probes electron observation in different energies, pitch angles, and L-MLT regions. This quantitative comparison will also indicate if quasilinear theory is sufficient to explain the observed electron dynamics or nonlinear interaction is essential in reproducing the energetic electron evolution observed from the Van Allen Probes.