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Understanding the Simultaneous Dropout of Radiation Belt Electrons and Ring Current Protons

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Recent observations by NASA Van Allen Probes have revealed concurrent and fast dropout of both radiation belt (RB) electrons and ring current (RC) protons. Theoretically, electromagnetic ion cyclotron (EMIC) wave scattering and magnetopause shadowing (MPS) combined with outward radial diffusion are effective loss mechanisms for both populations. However, the relative role of these two mechanisms to the dropout of both RB electrons and RC protons have not been quantified due to the lack of a detailed comparative study between the two populations. In this work we first convert the long-term energetic electron and proton flux observed by Van Allen Probes to phase space densities (PSD) as a function of μ, K, and L* to identify the concurrent fast dropout events between RB electrons and RC protons. Then by investigating the μ, K, and L* dependence of the PSD drop for both populations, the dominated loss mechanisms are identified. In addition, one interesting event will be reported in detail in this presentation. Specifically, the simultaneous dropout of MeV electrons and 100s keV protons observed by Van Allen Probes within ~40 min on 27 February 2014 is modeled using a 2-D pitch angle and energy diffusion model. The wave and particle measurements during the period of most intense EMIC waves at L ~ 5.2 are used to calculate the quasilinear diffusion coefficients and simulate the evolution of both energetic electrons and protons. Our model well captures the dropout of electrons with energies > 1 MeV and pitch angles < 75°, and the concurrent dropout of protons with energies > 200 keV and pitch angles > 40°. This is the first modeling work quantitatively reproducing the simultaneous dropout of both populations due to EMIC wave scattering.