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IMAGE/RPI density measurements in the inner magnetosphere

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The radio plasma imager (RPI) on NASA's IMAGE satellite performs radio sounding in the magnetosphere transmitting coded signals in the frequency range from 3 kHz to 3 MHz, corresponding to the range of electron plasma frequencies in the inner magnetosphere. Echoes received from remote reflecting locations where the wave frequency equals the cutoff frequency form discrete echo traces that are inverted to electron density profiles. Waves at frequencies between the local electron plasma frequency and up to hundreds of kHz higher propagate along the magnetic field line through the satellite [Reinisch et al., *Geophys. Res. Letts*., 28, 1167-1170, 2001], and the calculated profiles give the instantaneous electron density distribution Ne(r) along the magnetic field. These measurements led to the development of empirical models of Ne in the plasmasphere [Huang et al., *Adv. Space Res*., 33, 6, 829-832, 2004] and the polar cap [Nsumei et al., *J. Geophys. Res*., 108, A2, 2003]. An attempt is made to smoothly connect the topside ionosphere profiles to the plasmasphere/polar cap profiles by using a Chapman function for the density height variation.

Plasmasphere depletion during a magnetic storm has been investigated by comparing the quiet time model with the instantaneous densities measured while IMAGE crosses a number of L shells within a few minutes. During and after the March 31, 2001 magnetic storm, the equatorial plasma was substantially depleted in a range of L-shells. The flux tubes were refilled after the storm. The filling ratio, defined by the equatorial plasma density normalized by its quiet-time value before the storm, is introduced to assess the time evolution of the depletion and refilling processes. The depletion, more than two thirds of the quiet time content, appeared to occur rather quickly after the

storm onset, as determined by the limited temporal resolution of the measurements (14 hour orbit). The refilling proceeded, although more slowly than the depletion process, significantly faster than the theoretical prediction of a 3-day time scale.