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Supporting Information for

Global Storm-Time Depletion of the Outer Electron Belt

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Contents of this file

Additional Supporting Information (Files uploaded separately)

Movie S1 "2014JA020645 ms01.mp4"
Movie S2 "2014ja020645 ms02.mp4"

Introduction

This file contains: (a) Figure S1 that shows radial profiles of relativistic electron intensities captured by the MagEIS instrument on Van Allen Probes A during March 17, 2013 geomagnetic storms, (b) Figure S2 that shows a comparison of the electric field induced by fluctuations in the solar wind dynamic pressure in a global MHD model and the TS07D, (c) captions to Movies S1-S2 showing results of our test particle simulations.

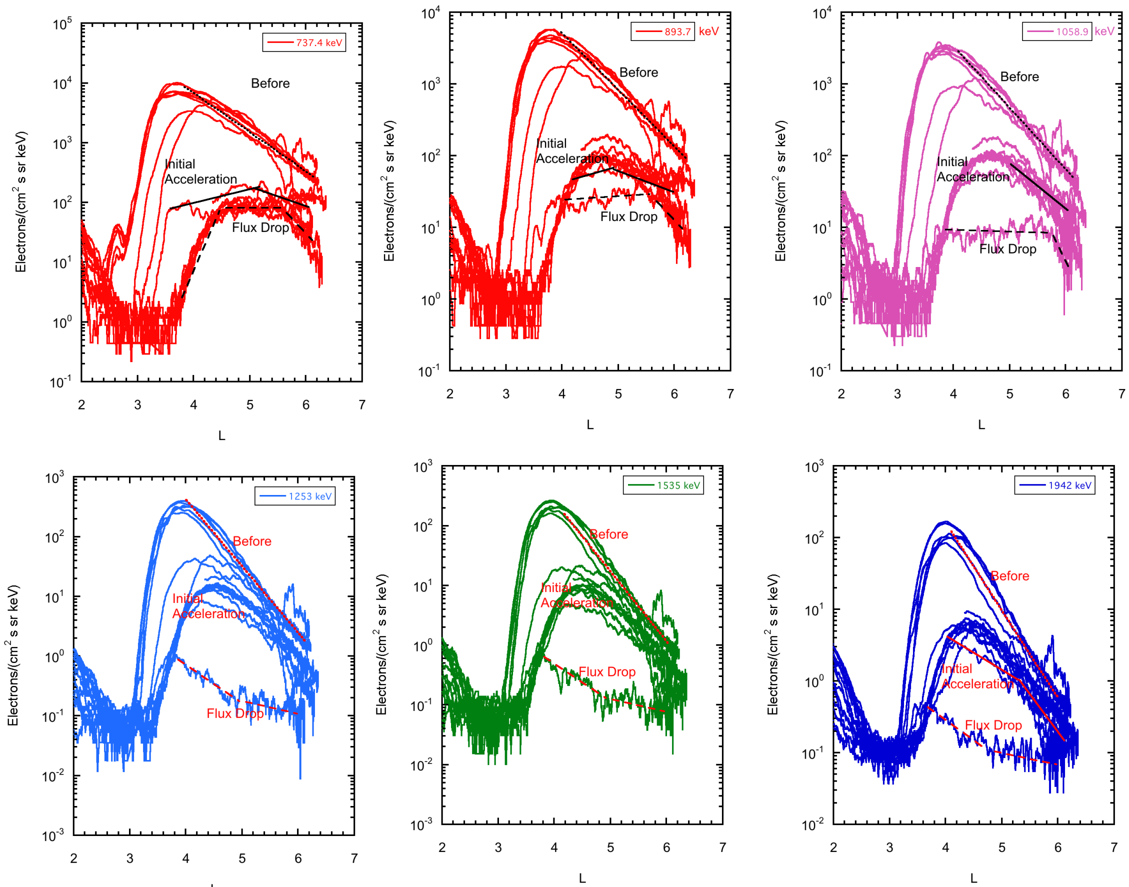

Figure S1. Radial profiles of intensities of the near-equatorial electrons captured by MagEIS-A at various stages of March 17, 2013 geomagnetic storm: (“before”) prior to the storm (02:24-06:00 UT), (“Flux Drop”) after the depletion (11:07-14:40 UT), and “Initial Acceleration” at the end of the storm main phase (14:40-18:10). Deep depletion of electron intensities is observed in all energy channels between 0.74 MeV and 1.94 MeV. The depletion is less pronounced at lower energies (< 1.25 MeV) due to direct injections of electrons from the magnetotail identified by multiple localized peaks at $L \gtrsim 4$.

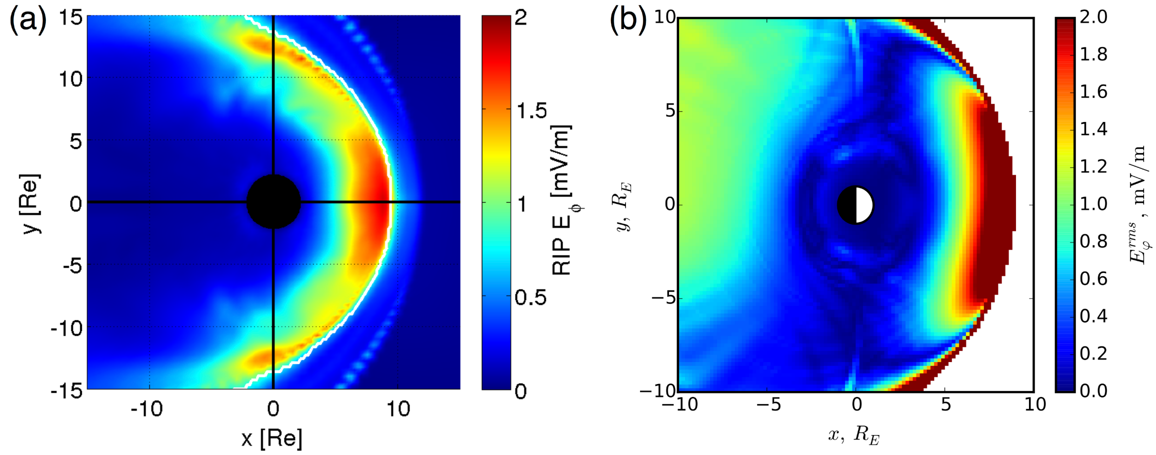

Figure S2. A comparison of the electric field induced by fluctuations in the solar wind dynamic pressure with a white-noise spectrum computed in the LFM global MHD model [the "continuum" run in Claudepierre et al., 2010] (panel (a)) and the TS07D model (panel (b)) used in this paper. The root-mean-square amplitudes of the azimuthal electric field component are shown in the XY plane of the GSM coordinate system (the tilt angle was set to zero in both models). The parameters of the dynamic pressure time series in the TS07D were selected to match spectral properties of the solar wind fluctuations in [Claudepierre et al., 2010] computed upstream of the bow-shock (X=20 R_E): $P(t)=P_0+\Delta P\Sigma_k\cos(2\pi\Delta\nu\cdot kt+\psi_k)$, k=1,…,N, where the average value P_0=3.5 nPa, the spacing among harmonics $\Delta\nu$=0.1 mHz, the maximum frequency $\nu_{max}=N\Delta\nu$=10 mHz (N=100), the random phase shift ψ_k varies between 0 and 2π, and ΔP corresponds to the root-mean-square amplitude $P_{rms}= \Delta P\cdot(N/2)^{1/2}$=0.33 nPa. The dayside electric fields in both simulations show a very good agreement (the field amplitude over most of the red saturated zone in panel (b) is less then 3 mV/m). There is an additional minor enhancement of the electric field amplitude on the nightside of the TS07D, which is attributed to variations of the cross-tail current in response to the magnetopause compressions. However, these nightside variations are concentrated outside of the stably trapped region of the outer radiation belt and therefore do not substantially affect the dynamics of radiation belt particles.

Movie S1. Test particle simulation of electron intensities during first 6 hours of March 17, 2013 storm. Panel (a): 10-min averaged solar wind dynamic pressure, P_{dyn}. Panel (b): the *SymH* index. Panel (c): the simulated intensity of 1.25-1.50 MeV electrons with near-perpendicular pitch angles of 80 – 90° along the midnight meridian at the magnetic equator. Panel (d): the pitch angle distribution of 1.25-1.50 MeV electron intensity at L = 4.3. Panel (e): the intensity of 1.25-1.50 MeV electrons with near-perpendicular pitch angles of 80 – 90° at the equator. Panel (f): the normalized number of particles with initial energies of 1.25-1.50 MeV and initial pitch angles of 80 – 90° at the equator. Panel (g): the normalized average weight of particles with current values of energy of 1.25-1.50 MeV and pitch angles of 80 – 90° at the equator. Panel (h): the average change in their *L*-bar location at the equator. Panel (i): the equatorial projection of test-particles with initial energies of 1.25-1.5 MeV (particles on the bifurcating orbits bouncing either below or above the equator are marked with purple). Panel (j): the current density at the equator. Panel (k): the magnetic field amplitude at the equator. Panel (l): the inductive electric fields amplitude at the equator.

Movie S2. Test-particle simulations without a ring current (same format as Movie S1).