The Acceleration of Ions in the Near-Earth Magnetotail during Geomagnetic Storms

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We investigated the acceleration of ions of ionospheric and solar wind origin in the near-Earth magnetotail during the sudden storm commencements (SSCs) of geomagnetic by using a combination of global magnetohydrodynamic (MHD) simulations and large-scale kinetic particle tracing calculations. For each of the storms studied, we ran a global MHD simulation of the event using upstream solar wind and IMF data. Ions were launched from the solar wind and from the ionosphere beginning 3-4 hours prior to the SSC in the global, time-dependent electric and magnetic fields obtained from the MHD simulation of the event, and ion distributions were computed in the magnetotail and inner magnetosphere just prior to, during, and immediately after the SSC. We examined the impact of the SSC on ion velocity distribution functions and the dependence of this energization on distance from Earth and on local time. We further ascertained the effect of the shock impact on the acceleration and transport of ions in the seed region of the ion radiation belts, and determined the differences, if any, in the energization of protons and heavy ions in the inner magnetosphere. Finally, the acceleration by the SSC was compared to that caused by storm-time substorms.