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Numerical Estimates of Outer Radiation Belt Electron Flux Dropouts during Geomagnetic Storms

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Kyung-Chan Kim[1*], Dae-Young Lee[2], Hee-Jeong Kim[3], Ensang Lee[4], Cheong-Rim Choi[5], Yuri Shprits[1]
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[1]IGPP/UCLA, USA, [2]Chungbuk National University, Korea, [3]AOS/UCLA, USA, [4]Kyung-Hee University, Korea, [5]KAIST, Korea
[1]IGPP/UCLA, USA, [2]Chungbuk National University, Korea, [3]AOS/UCLA, USA, [4]Kyung-Hee University, Korea, [5]KAIST, Korea

Satellite observations often show that relativistic electron fluxes that decrease during a geomagnetic storm main phase do not recover their pre-storm level even when the storm has substantially recovered. A possible explanation for such sustained flux dropout is that the electrons that move to larger shells (L shells) aided by the Disturbance Storm Time (Dst) effect associated with the main phase geomagnetic field depression may be suffering drift-lost to the magnetopause, resulting in irreversible (non-adiabatic) flux decreases during a geomagnetic storm. In addition, a possible radial diffusion can be induced after there is a drift loss at outer L-shells during the storm main phase, which then can redistribute the remaining particle fluxes during the storm recovery. In this study, we numerically evaluate the drift loss effect by combining it with the Dst effect and including off-equatorially mirroring electrons for three different storm conditions obtained by averaging 95 geomagnetic storms that occurred from 1997 to 2002. Using the Tsyganenko T02 model and our own simplified method, we estimate the storm time flux changes based on the guiding center orbit dynamics. Then by solving diffusion equations numerically, we investigate details of this diffusion process driven by the steep radial gradient across the trapping boundary after there is a fast drift loss during the storm main phase and its effectiveness in changing the particle flux level during the storm recovery. We also examine the radial diffusion process by comparing it to the results based on the combined adiabatic Dst and drift loss.

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