Flux decrease of outer radiation belt electrons associated with solar wind pressure pulse: A Code coupling simulation of GEMSIS-RB and GEMSIS-GM

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Relativistic electron flux of the outer radiation belt dynamically changes in response to solar wind variations. There exist several conditions to cause the flux drop-out of the outer belt electrons. The magnetopause shadowing (MPS) is one of the processes to cause the rapid loss of outer belt electrons (e.g.,Kim et al.,2008). In this study, we investigate how radiation belt electrons are lost through the MPS process with a code-coupling simulation using GEMSIS-RB test particle simulation code (Saito et al., 2010) and GEMSIS-GM global MHD magnetosphere simulation code (Matsumoto et al., 2010) by focusing the equatorial pitch angle and local time dependence. We calculate trajectories of electrons in electromagnetic fields calculated from GEMSIS-GM with initial L-shells from 6 to 11, initial energies from 1 MeV to 10 MeV, and initial pitch angles between 50 degrees and 90 degrees, using the relativistic guiding-center equation. The simulation consists of the following three phases associated with variations of the solar wind dynamic pressure; [i] The standoff distance of magnetopause at the subsolar point is 12 Re with the initial dynamic pressure of 1.0 nPa. [ii] The solar wind dynamic pressure becomes 2.5 nPa, and the magnetopause moves to 9 Re. [iii] The solar wind dynamic pressure decreases, so that the inflation of the magnetopause takes place and the standoff distance of the magnetopause is 10 Re. During phase [ii], the high-latitude reconnections occur at dawn-side firstly and many electrons escape from the magnetosphere to the interplanetary magnetic field along the field line in the dawn side. Subsequently, the high-latitude reconnections occur at the high-latitude in the dusk side. In phase [iii], the remained electrons in the magnetosphere escape into the interplanetary in both the dawn and dusk sides. The loss at the dusk-side is outward motion of the trapped electrons caused by the dawn-to-dusk electric fields associated with the inflation of the magnetosphere. The study showed detailed process of the electron escape into the interplanetary magnetic field and the electron escape occur in both enhancement/decrease of the dynamic pressure.

Keywords: Magnetopause Shadowing, global MHD magnetosphere simulation, test particle simulation

