磁気圏 MHD シミュレーションとテスト粒子シミュレーションの連成計算にもとづく太陽風動圧変化に伴う放射線帯外帯電子の消失

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Flux decrease of outer radiation belt electrons associated with solar wind pressure pulse: A Code coupling simulation

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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 have done 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) to demonstrate how radiation belt electrons are lost through the MPS process, by focusing pm 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 9 to 11, initial energies from 100 keV to 10 MeV, and initial pitch angles between 85 degrees and 90 degrees, using the guiding-center equation. The simulation consists of the following three phases associated with variations of the solar wind dynamic pressure; [1] The standoff distance of magnetopause at the subsolar point is 12 Re with the initial dynamic pressure of 1.0 nPa. [2] The solar wind dynamic pressure becomes 2.5 nPa, and the magnetopause moves to 9 Re. [3] 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. The simulation shows that electrons move to the open field line due to the earthward movement of the magnetopause and then electrons escape to the interplanetary along the field line at the dayside in the phase [2]. On the other hand, electrons are lost at the night side along the open field lines when the dynamic pressure decreases in phase [3] due to the outward motion of trapped electrons caused by dusk-to-dawn electric fields associated with the expansion of the magnetosphere. Almost all lost electrons (˜90%) have strong pitch angle scattering by the drift shell bifurcation which breaks the second adiabatic invariant.