Rapid acceleration of outer radiation belt electrons associated with solar wind pressure pulse: Arase and Van Allen Probe observations and code-coupling simulation

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Relativistic electron fluxes of the outer radiation belt rapidly change in response to solar wind variations. One of the shortest acceleration processes of electrons in the outer radiation belt is caused by interactions between drifting electrons and fast-mode waves induced by compression of the dayside magnetopause associated with interplanetary shocks. In order to investigate this process, we investigate the Sutorm Suddun Commencement (SSC) event on July 16, 2017 using the Arase(ERG) satellite and Van Allen Probes. The satellites observed the rapid flux enhancement of sub-relativistic and relativistic electrons for wide energy range associated with the fast mode waves. In order to investigate these wide energy electron acceleration associated with the fast mode waves, we perform a code-coupling simulation using the GEMSIS-RB test particle simulation (Saito et al., 2010) and the GEMSIS-GM global MHD magnetosphere simulation (Matsumoto et al., 2010). As a case study, an interplanetary pressure pulse with the enhancement of ~2 nPa is used to investigate the compression of the dayside magnetopause and subsequent propagation of the fast mode waves. The fast mode waves with the azimuthal electric field (negative Ephi : |Ephi| ~ 10 mV/m, azimuthal mode number : m ≦ 2) propagates from the dayside to nightside, interacting with electrons. The simulation results indicate the flux enhancments in the wide energy range after the fast mode wave propagation. Condiering the interaction process, we derive the critical energy for the acceleration. The high energy electrons above the critical energy can be effectively accelerated by the fast mode waves, and these tendency seem to be consistent with the observations.

Keywords: Arase, Radiation belt, electron acceleration

