Mechanisms of the outer radiation belt flux variation during magnetic storms

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While it is known that the variation of the outer radiation belt during magnetic storms is linked to typical variations of the magnetic field, its mechanisms are still controversial. We have investigated variations of the energetic electron flux (higher than 0.4 MeV) and the magnetic field in the outer radiation belt obtained from the Standard DOse Monitor (SDOM) and the MAgnetoMeter (MAM) of the Space Environment Data Acquisition equipment (SEDA) onboard Tsubasa (Mission Demonstration Test Satellite (MDS)-1). Since Tsubasa was operated in geostationary transfer orbit (GTO) with an orbital period of 10 hours and an inclination of 28.5 degrees from 4 December 2002 to 24 September 2003, it had provided a rare opportunity for directly observing near-equatorial radiation belt plasma particles and the magnetic field during magnetic storms. At the moment that the outer radiation belt flux sharply drops during the main phase of the 17 April 2002 magnetic storm, the butterfly distribution is observed at L=5 and the magnetic equator where the magnitude of magnetic field is much smaller than the IGRF model. Calculation of the energetic electron drift motions in the Tsyganenko 2001 magnetospheric magnetic field model shows that the drift-shell splitting mechanism could generate the butterfly distribution due to loss of the near-equatorially mirroring electrons through dayside magnetopause boundary. By using both the newer Tsyganenko model and the other storm data that is under archiving, we verify that the loss mechanism of the drift-shell splitting is a major flux loss process during magnetic storms.