

Penetration depth of multi-energy ions and evolution of the plasmasphere during magnetic storms: Arase observations

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During geomagnetic storms, enhanced convection electric field causes the earthward transport of ions from the plasma sheet, and the enhanced ion pressure drives the ring current. According to the Dessler-Parker-Sckopke formula, variation of the Dst (Sym-H) index can be approximately expressed as a function of the total kinetic energy of ring current ions. However, the relationship between the penetration depth of ring current ions and the Dst (Sym-H) index, and ion energy dependence of the penetration depth have not well been investigated. We examine temporal and spatial evolution of multi-energy protons using the Low-energy particle experiments-ion mass analyzer (LEP-i) and the Medium-energy particle experiments-ion mass analyzer (MEP-i) instruments onboard the Arase satellite. We also investigate the storm-time variations of the plasmasphere using the in-situ plasma density derived from the upper hybrid resonance (UHR) waves emissions observed by the Plasma wave experiment (PWE)/High frequency analyzer (HFA) and the ambient electric field observed by PWE/electric field detector (EFD). We study 19 magnetic storms in 2017 after the Arase launch. During the storm main phase, the plasma sheet ions penetrate into the inner magnetosphere and the plasmapause moves earthward due to the enhanced convection electric field. The penetration depth of ions depends on the minimum amplitude of the Dst (Sym-H) index. The correlation coefficient between the minimum L-shell of 25 keV protons and the minimum Sym-H index is 0.744. Lower energy ions penetrate closer toward the earth than high-energy ions due to energy dependence of magnetic drifts (grad-B and curvature drifts). We also discuss the relationship between the temporal and spatial variations of the protons and evolution of the ambient electric field.