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Response of ring current ion dynamics during the storm recovery phase to different solar wind drivers

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Geomagnetic storms, which are represented by the Dst index, show time profiles different between solar wind drivers such as Coronal Mass Ejections (CME) and Corotating Interaction Regions (CIR). A super-posed epoch analysis of Dst [Miyoshi and Kataoka, 2005, GRL] shows a distinct difference during the late recovery phase; Dst for CIR-driven storms is smaller than that for CME-driven storms. In addition, the flux of radiation belt electrons is higher for CIR-driven storms than for CME-driven storms.

It is well known that Dst development is strongly coupled with the evolution of the ring current which is mainly governed by ion pressure in the inner magnetosphere. The ring current spatial-temporal evolution results in distortion of the magnetic field configuration in the inner magnetosphere and accordingly can affect the dynamics of radiation belt electrons. In this study, we investigate the response of ring current ion dynamics during the storm recovery phase to different solar wind drivers, by comparing the temporal variations of energy spectra of energetic neutral atoms (ENAs) between CIR- and CME-driven storms.

We use ENA data obtained with the High Energy Neutral Atom (HENA) imager onboard the Imager for Magnetopause-to-Aurora Global Exploration (IMAGE) satellite. The ENA energy used in the present study ranges from 10 keV to 198 keV for hydrogen and from 29 keV to 222 keV for oxygen. We use ENA data integrated over image pixels; ENAs generated within HENA line-of-sights passing by close to the Earth are excluded in order to distinguish high-altitude emissions from low-altitude emissions. The ENA imaging enables continuous monitoring of spatial distributions and energy spectra of ring current ions.

Case studies of the temporal evolution of ENA energy spectra for three CME-driven storms [Keika et al., 2011, JGR, in press] suggested that the contribution from >60 keV H+ to the ring current intensity increases as a storm recovers. The ring current intensity was dominated by higher energy (>60 keV) H+ during the late recovery phase. This paper extends the study toward comparison between different solar wind drivers. We study possible differences in the dominant loss process and energy ranges that contribute most to the ring current energy. We also discuss the role played by the ring current in the difference in radiation belt electron flux between CIR- and CME-driven storms.

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