An extreme erosion of the plasmasphere during the 7–10 September 2017 storm

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We report an extreme erosion of the plasmasphere arising from the September 2017 storm. The cold electron density is identified from the upper limit frequency of UHR waves observed by the HFA of the PWE instrument onboard the Arase spacecraft. The HFA provides the spectrograms of electric fields in a frequency range from 10 kHz to 10 MHz with an 8-sec time resolution (Kasahara et al., 2018; Kumamoto et al., 2018). Such wide frequency coverage allows observation of the UHR frequency even deep inside the plasmasphere.

The electron density profiles reveal that the plasmasphere was severely eroded during the recovery phase of the storm and the plasmapause was located at L~1.7 at 23 UT on 8 Sep 2017. This is the first report of such deep erosion of the plasmasphere (L_{PP}<2) with the in-situ observation of the electron density. The degree of the severity is much more than what is expected from the SYM-H minimum (−146 nT) of the event.

We further study absolute GNSS-TEC, ground-based magnetic field, the doppler velocity obtained from the SuperDARN Hokkaido Radars to investigate the location of the midlatitude ionospheric trough, the penetration of the convection electric field to the equator and middle latitudes, respectively. Our results suggest that the middle latitude electric field was penetrated from the high-latitude storm time convection for several hours. Futhermore, the Ionosphere-Plasmasphere-Electrodynamics (IPE) model (Sun et al., 2015; Maruyama et al., 2016) is used to understand the dynamics of the plasmasphere. The IPE results suggest that the middle latitude electric field penetrates from the high-latitude storm time convection that lasts for several hours can explain the degree of severity during the September 7-11 2017 storm.

Keywords: plasmasphere, innner magnetosphere, Magnetosphere-ionosphere coupling

