Dynamics of the Ionosphere/Plasmasphere System: Comparisons Between Arase/PWE Observations and the IPE Model Simulations

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We compared an extreme erosion of the plasmasphere arising from the September 2017 storm between Arase observations and the Ionosphere-Plasmasphere Electrodynamics (IPE) model simulations. The cold electron density is identified from the upper limit frequency of upper hybrid resonance waves observed by the Plasma Wave Experiment instrument onboard the Exploration of energization and Radiation in Geospace/Arase satellite. 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 = 1.6-1.7 at 23 UT 8 September 2017. This is the first report of deep erosion of the plasmasphere (LPP < 2) with the in situ observation of the electron density. The Arase/PWE’s wide coverage of frequency (10 kHz - 10 MHz) enables continuous observation of electron density from sparse magnetosphere to dense ionosphere and detection of the plasmapause even if it is during the deep erosion event. The degree of the severity is much more than what is expected from the relatively moderate value of the SYM-H minimum (-146 nT). We attempt to find a possible explanation for the observed severe depletion by using both observational evidence and numerical simulations. Our results suggest that the middle latitude electric field had penetrated from the high-latitude storm time convection for several hours. Such an unusually long-lasting penetration event can cause this observed degree of severity.