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11:15〜11:30

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Analysis of the surface charging events and their plasma environment of the Van Allen probes

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Spacecraft surface charging is induced by the interaction of ambient plasma with the spacecraft surface and sometimes causes spacecraft anomalies due to electrostatic discharging (ESD) in the inner magnetosphere. We studied surface charging events of the Van Allen Probes using their Electric Field and Wave (EFW) instruments and their Helium Oxygen Proton Electron (HOPE) sensors from 2012 to 2019. During daylight, almost all surface charging ($<-$ 10 V) events are observed in the region from night to dawn where L $>$4 Re, and during the first three years, which correspond to the solar maximum phase. Analysis of the period shows that the large integral flux of high-energy ($>$8 keV) electrons is a necessary condition for negative charging. However, the charging rate is less than 0.2, even under severe flux conditions. Statistical analysis indicates that secondary electron emission induced by sufficient electron flux with energies in the hundreds of eV prevents negative charging in the inner magnetosphere. In the last five years, which correspond to the solar declining and minimum phases, almost no charging events are observed, even though severe plasma conditions, which are similar to those of the first three years, occur occasionally in the declining phase and rarely in the minimum phase. We discuss the effects of surface material degradation due to years of exposure, resulting in an increase in the secondary electron emission coefficient, and how to model the plasma environment for the statistical analysis of surface charging in the inner magnetosphere.