Study on plasma environment at GEO of the real-time simulation for spacecraft charging forecast

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Plasma environment at geosynchronous orbit (GEO) is closely related to geosynchronous spacecraft surface charging, that would cause spacecraft anomalies with resulting electrostatic discharging. Intense fluxes of hot electrons with energy in the range of several to several tens of keV during substorm activities are mainly responsible for spacecraft surface charging. Therefore study of the plasma environment at GEO is very important in space weather research. A real-time three-dimensional MHD magnetosphere simulation of solar wind-magnetosphere-ionosphere coupling system, using the real-time solar wind data from the ACE spacecraft every minute as the upstream boundary conditions for density, temperature, flow speed, and magnetic field (By and Bz), has started at the National Institute of Information and Communications Technology (NICT). It can reproduce the global response of the magnetosphere and ionosphere. The plasma environment at GEO and AE indices are also calculated in the simulation. We compare the simulated plasma environment to the LANL geosynchronous satellites observations in the night sector. It shows that the simulation can capture a lot of substorm injections. However the simulated plasma pressure tends to be substantially smaller than the observed ion pressure, maybe due to the limitation of the MHD code, i.e. the lack of kinetic heating processes. On the other hand, the simulated plasma pressure shows meaningful quantitative correlation with the observed electron pressure during substorm activities, although its temperature and number density themselves do not always show the good correlation with the observations. We will discuss features of variation of the plasma environment at GEO during substorm activities and the possibility of spacecraft surface charging forecast as space weather services using the real-time MHD magnetosphere simulation.