Electric field variation observed inside the plasmasphere during SC and magnetic storms

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Electric and magnetic field variations inside the plasmasphere associated with SCs are analyzed based on the Akebono satellite observations which have been carried out more than 14 years since March 1989. 126 electric field observation data corresponding to SCs show abrupt change of intensity as well as direction within a few minutes inside the plasmasphere. Temporal variations of the electric field showed a bipolar signature of waveform with the amplitude range of 0.2-38 mV/m. The strong electric field perturbation is followed by a dumping oscillation with the period of Pc3-4 ranges. The initial excursion of the electric field during SCs tends to be directed westward. The amplitude does not show a dependence on magnetic local time that has been observed outside the plasmasphere. The Poynting vector of the initial SC impulse is directed toward the earth, which suggests that energy of magnetic disturbances associated with SCs propagates toward the earth inside the plasmasphere with the refraction due to the plasma density gradient. The electric field drift velocity associated with electric field perturbations of about 20-40 mV/m is about 8-16 km/sec in the presence of the 2400 nT total magnetic field at the position of the Akebono satellite during SC, while the co-rotation velocity at the same position is about 1.2 km/sec. To say, the electric field drift velocity induced by the SC is significantly large than the co-rotation velocity. Therefore, this evidence suggests that plasmaspheric particles do not co-rotate with the earth in a time period of disturbed state of SC condition. If the plasmaspheric particles maintained a constant phase relation with the electric field and encountered the full 20-40 mV/m over an entire drift period at L=2.6, then, the total inward drift would be about 500-1000 km in radius. Assuming conservation of the first adiabatic invariant in a dipole magnetic field, a suprathermal electrons and ions (~10 eV) would increase its energy by a factor of 1.1-1.2 in this case. One of the most interesting results from the present study is that a DC offset of the Ey component of the electric field appears after the initial electric field impulse associated with SCs. This signature can be interpreted as a magnetospheric convection electric field penetrating into the inner plasmasphere (L=2.5). The intensity of the offset of the Ey field gradually increases by 0.5-2.0 mV/m with a few minutes after the onset of the initial electric field impulse and persists about 10-30 minutes.