SC triggered disturbances in the polar region and plasmasphere

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1.Introduction

Sudden commencements (SCs) are very clear global geomagnetic signature and are important phenomena in understanding the response of the earth's magnetosphere, plasmasphere and ionosphere associated with a passage of solar wind discontinuity of density and velocity. In order to clarify flow of solar wind energy and momentum into the magnetosphere, plasmasphere and ionosphere and to understand the plasma and plasma wave transferred responses including the propagation mode of geomagnetic disturbances and intensification and modification of ULF, ELF and VLF plasma wave phenomena and particle energization, we analyzed the Akebono satellite observation data which have been carried out more than 13 years since March 1989.

2.Observation data

Plasma wave data are provided by instruments of PWS (20kHz - 5.1MHz), VLF (3.16Hz - 17.8 kHz) and ELF (0Hz - 80Hz) onboard the Akebono satellite. The data analysis of the plasma waves has been combined with the low energy particle data of LEP, electric field data of EFD and magnetic field data of MGF, which are also installed on the Akebono satellite. The time resolution of the dynamic spectra of PWS is 2 sec, while the time resolution of VLF, ELF, LEP, EFD and MGF data is 8 sec, referred from the science data base of the Akebono satellite.

Within a period from March 1989 to November 2001, 930 events of SC's have been identified in term of SYM-H with the time resolution of 1 min. We picked up SC events as a rapid increase of SYM-H values with more than 5 nT within ten minutes in the SYM-H index data. For each SC event, the precise onset time was identified by referring the H-component geomagnetic variation from the rapid sampling records with the time resolution of 1 sec obtained at Kakioka Magnetic Observatory. Within a period of the Akebono satellite observation during 13 years of the Akebono satellite operation from March 1989 to November 2001, 257 cases of plasma wave observation were found to cover the onset time of SCs. For each case, we found well responses of plasma wave signature with intensification or change of spectra.

3.Results and conclusion

Electromagnetic whistler mode, ion cyclotron waves and UHR waves are enhanced in the low latitude plasmasphere. On the other hand, electrostatic whistler mode waves and electromagnetic ion cyclotron waves are generated in the polar region. The response of the electric field perturbations associated with SCs in the plasmasphere shows the amplitude of 1 mV/m to 20 mV/m in all geomagnetic local times. The direction of the electric field and Poyting vector associated with SCs is directed westward and earthward, respectively. Results of the analysis also indicate that energy of SC triggered disturbances propagates near the geomagnetic equator from the dayside to nightside of the plasmasphere. SC related pulsation consists of toroidal and poloidal mode waves with the electric field amplitude of about 2 mV/m to 10 mV/m in the plasmasphere. On the other hand, the response of electric field fluctuations associated with SCs in the polar region has amplitude of 8 mV/m to 80 mV/m in all geomagnetic local times. The magnetic field perturbation also has large amplitude within a range from 150 nT to 500 nT in the cusp region. The Poyting vector is directed earthward in the cusp region and away from the earth in the auroral region. Therefore, we can conclude that SC triggered disturbances propagate from dayside to nightside polar region not only in the plasmasphere but also in the polar region