Diurnal variations of SC amplitude in the magnetosphere observed by satellites

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It has been generally believed that the amplitude of sudden commencement (SC) observed in low and middle latitudes on the ground as well as in the magnetosphere tends to be much larger in the noon sector than in the night sector [e.g., Kokubun, 1983; Russell et al., 1994]. Kokubun [1983] showed that a local time distribution of SC amplitude on the geostationary orbit has a stronger noon-night asymmetry than on the ground. On the other hand, Kuwashima and Fukunishi [1985] found that magnetic field disturbances associated with SC appears as a negative impulse in the nighttime sector at 6.6Re. However, in the above studies, a local time distribution of the SC amplitude in the entire region of the low-latitude inner magnetosphere has not yet been clarified due to the limitation of the magnetosphric observation and the lack of SC events. In the present study, we analyzed 1985 SC events observed by the Akebono, Tsubasa, CRRES, Polar, and GOES satellites which have been identified in term of the SYM-H index within a period from 1976 to 2007 to investigation the radial distance and magnetic local time dependence of the SC amplitude in the inner magnetosphere.

As a result, a distribution of the dayside SC amplitude showed clear local time dependence, which indicate that the amplitude abruptly enhancements near the magnetopause current region around 7 Re. Especially, the maximum value of the SC amplitude around noon (09-16 h MLT) was about 2.0-2.3 times larger than that observed on the ground. This implies that the dayside magnetosphere within a magnetic local time region from 09 h to 16 h is efficiently compressed due to a sudden enhancement of solar wind dynamic pressure. In the dayside near-Earth region (plasmasphere and ring current regions), the local time dependence of the SC amplitude becomes weaker, compared with that around the dayside geostationary orbit and magnetopause current region.

On the other hand, in the nightside inner magnetosphere, the local time distribution of the SC amplitude showed that the magnetic field amplitude normalized by the SYM-H index abruptly decreases from 1.0-1.2 up to 0.05-0.3. This amplitude depression can be explained by a decrease of magnetic disturbances produced by the magnetopause current and an effect of the tail current enhancements during the compression of the magnetosphere.

Moreover, magnetic field depression during SCs also was found in the night sector of the inner magnetosphere. The occurrence rate of the magnetic field depression events tends to become larger in the partial ring current region within the radial distance and magnetic local time ranges from 4.0 Re to 6.0 Re and from 19 h to 02 h (MLT). This phenomenon can be explained due to a sudden enhancement of the partial ring current by adiabatic heating of high-energy particles associated with the increase of magnetic field intensity during SCs. Also in the near-Earth tail current region within a distance range from 7.0 Re to 10.0 Re, the magnetic field depression appears with a weak dawn-dusk asymmetry, which indicates that the amplitude tends to be larger in the dusk sector than in the dawn sector. The dawn-dusk asymmetry of the magnetic field variations suggests that there exists the same asymmetry of the near-Earth tail current intensity produced by the compression of the magnetosphere.