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Seasonal variation of the amplitude of geomagnetic sudden commencements from low latitude to the magnetic equator

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Seasonal dependence of diurnal variation of the main impulse (MI) of geomagnetic sudden commencements (SCs) has been investigated using the long-tern geomagnetic field data with high time resolution of 1 sec within a period from 1996 to 2008 provided from the NSWM [Kikuchi et al., 2008] and CPMN [Yumoto and the CPMN group, 2001] chains and the WDC for Geomagnetism, Kyoto. In the present analysis, we used the geomagnetic field data obtained from the 6 stations: Pohnpei (geomagnetic latitude, MLAT = 0.27 degree), Yap (MLAT = 0.38 degree), Cebu (MLAT = 0.85 degree), Guam (MLAT = 5.22 degree), Okinawa (MLAT = 16.54 degree), Kakioka (MLAT = 27.18 degree). In this study, the SC events have been defined as a rapid increase with its amplitude of more than 5 nT within 10 minutes in the SYM-H index. In this case, 4158 events of the magnetic field disturbance are found in a long period from January 1996 to October 2012, which has no Pi 2 signature around 10 minutes at the SC onset. Details of the analysis method have been described in the paper of Shinbori et al. [2009]. Moreover, the SC amplitude obtained at the above 6 stations has been normalized by that in the SYM-H index with latitude correction in order to minimize the different contribution of the rapid change in solar wind dynamic pressure. We also used solar wind data obtained from the IMP-8, Geotail, Wind and ACE satellites within the same period. As a result, the diurnal variation of SC amplitude in the equatorial region (0.27-5.22 degree) showed an equatorial enhancement in the daytime (6-18 h) with its maximum around 11 h produced by the enhanced eastward ionospheric currents due to the Cowling effect. The local time showing the peak amplitude tends to shift from the noon to the morning side by 1 hour. The equatorial enhancement was observed in an off-dip equatorial region (dip latitude: ˜15 degrees). The seasonal variation of the equatorial enhancement of SC amplitude shows that the SC amplitude tends to become relatively smaller in the summer than in the equinox or winter. This variation is different from that in the middle latitudes reported by Shinbori et al. [2012], and suggests that the intensity of the equatorial electrojet current does not simply depend on the solar zenith angle. One of the implications of the equatorial seasonal dependence is that the penetration polar electric field tends to become weak in the summer, compared with that in the winter and that there exists a contribution of ionosphere current flowing in the lower F-region. In future, in order to verify this feature, we will need to perform a comparable analysis between the SC amplitude and ionospheric conductivity calculated with the IRI-2007 and NRLMSIS-00 models.

Keywords: Sudden commencement, Magnetic equator, Seasonal variation, Ionospheric conductivity, Solar zenith angle, Cowling effect