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MLT dependence of the response of ionospheric electric fields at mid-low latitude during geomagnetic sudden commencement

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SC is caused by MHD waves transmitted toward the ionosphere associated with the compression of the magnetosphere due to solar flare disturbances. The characteristic of its variation is explained by the 3-demensional current systems composed of the Chapman-Ferraro current, the field-aligned current, and the ionospheric current[Araki,1994]. It is known that SC is accompanied with the instant transmission of the electric field, which is found in the ionosphere derived by the HF Doppler[Kikuchi,1986] and in the plasmasphere observed by Akebono[Shinbori et al.,2006]. Nishimura et al.(2010) indicated the upward Poynting flux at the plasmaspheric electric field derived by Cluster observation. They showed the electric field transmission from ionosphere to polar magnetosphere, and estimated that plasmaspheric electric fields during SC originate in the ionosphere. The ROCSAT-1 is rare satellite in terms of in-situ observation of the ionospheric electric field. It had orbited at the altitude of 600km, and observed during the solar maximum, thus it has detected many SC events[Shinbori et al.,2009]. This data indicates the Preliminary Impulse(PI) or Main Impulse(MI) electric field variation[Su et al.,to be submitted]. However, the simultaneity to geomagnetic variation and the MLT distribution of the electric field have not investigated. We need to clear them to understand the convection process of the electric field. Therefore, we will eliminate effects of the magnetospheric current and the ionospheric conductance by in-situ observation, and analyze the time and spatial evolution during SC. Underlying data are the drift velocity observed by the Ionospheric Plasma and Electrodynamics Instrument(IPEI) onboard ROCSAT-1, and we derived in-situ electric fields with the IGRF-10 model. We referred geomagnetic field variations from 8 stations where has sampled per a second. We selected the SC events from the list of Shinbori et al.(2009), with the following criteria; (1) IPEI observation is available(1999/3/11˜2004/6/13), (2) the PI amplitude more than 2nT near the dayside magnetic equator, and (3) the Preliminary Reverse Impulse(PRI) signature at both high latitude and daytime magnetic equator. We identified 203 events under the above conditions, and 44 events showed that SC signatures detected on the ground is synchronized to the onset at the ionospheric electric field. At these events we could detect the ionospheric electric field variation corresponding to the PI and MI signature of geomagnetic fields. This result indicates that PRI and MI signatures of the electric field are potential fields associated with conduction currents, and instantly transmit globally. We confirmed that the ionospheric electric field was changed simultaneously with geomagnetic variations even if they observed at different MLT locations. For events which are seen relatively massive electric fields, we pursued Superposed Epoch Analysis. We extracted events which PI was detected in the electric field, and derived the LT distribution of PI in the electric field after regarding the PI peak time of each electric field as the time reference. Therefore, we showed that the PRI appears at 6-21 LT, while the Preliminary Positive Impulse(PPI) at 21-6 LT, which is consistent with Kikuchi et al.(1985) senario. Also we first detected the evening enhancement by in-situ electric field observation. This result is similar to the daily variation of equatorial ionospheric electric fields[Fejer et al.,1991], and we estimate the relation of the electric field originated by the magnetosphere. Our results show that equatorial ionspheric electric fields transmit instantly, and that it is caused by the transmission of convection electric field from polar region. And the detection of the evening enhancement means that the transmission process during SC is similar to what causes the daily variation, and suggests that its process is affected by the electric field transmission from magnetosphere.