Statistical analysis of ionospheric electric field oscillation associated with Sudden Commencement seen by the SuperDARN radars in the northern hemisphere

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Sudden Commencement (SC) is observed mainly as a sudden increase of the H-component of geomagnetic field at low latitudes. Past studies showed that it is caused by a sudden compression of the magnetosphere associated with rapid increases of the solar wind dynamic pressure. At middle and high latitudes, SCs cause perturbations associated with twin vortex type ionospheric currents. It was reported that the disturbance of the ionospheric current and the electric field associated with SC consists typically of the Preliminary Impulse (PI) and the Main Impulse (MI). Previous studies reported that some of SC-associated electric field disturbances observed by SuperDARN radars show only the two successive pulses of PI and MI, while some others are accompanied by damped oscillations of the ionospheric electric field lasting for about several tens of minutes to an hour with periods of several minutes. The reason why both types of SC-associated disturbances can occur, however, have not yet been understood well. We examine the cause of the difference between the two kinds of SC events, using SuperDARN radars in the northern hemisphere covering ~40 to 90 degree geomagnetic latitudes. For the analyzed period from January 2011 to December 2015, 244 SC events were identified and 61 events out of them were accompanied by the ionospheric electric field oscillations immediately following MIs, as observed by at least one SuperDARN radar. We contrast 183 events (only PI and MI) with 61 events (oscillation following MIs) and find that the average of magnitude of dynamic pressure change does not seem to be the cause of the difference between two types of disturbance associated with SC events. On the other hand, a detailed analysis on the electric field oscillations shows that some of them exhibit phase differences in latitude and longitude, while the others not. These observations indicate that the ionospheric electric field oscillations sometimes show propagation characteristics. We examine frequencies of the electric field oscillations. We also discuss the magnetic local time (MLT) dependence of the ionospheric electric field oscillations as well as its dependence on spatial displacement of the magnetopause associated with SC.

Keywords: SuperDARN, Sudden Commencement, ionospheric electric field oscillation

