大型短波レーダーや地上地場で観測される磁気圏急圧縮に伴って起こる電離圏対流変動

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Statistical analysis of ionospheric electric field oscillations associated with Sudden Commencement observed by SuperDARN radars and ground magnetometers

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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. The rapid compression of the magnetosphere caused by the passage of the interplanetary shock or the tangential discontinuity. 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 June 2017, 309 SC events were identified and 74 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 235 events (only PI and MI) with 74 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 the two types of disturbance associated with SC events. On the other hand, the variation of the solar wind speed before and after SC has some difference between two types of SC events. Regarding the magnetic local time (MLT) dependence of the ionospheric electric field oscillations, the occurrence rate is somewhat high from 15:00 MLT to 18:00 MLT. The seasonal variation of the occurrence rate tends to be lower in summer than in winter. We discuss the cause of the MLT dependence and the seasonal variation. In addition to the statistical study, we also made a detailed analysis of individual events. The result shows that some of them have global structures in the longitudinal direction, while the others have local structures (seen by only one or two radars).