

Evolution of convection vortices associated with sudden impulses observed by SuperDARN

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Spatial evolution of transient ionospheric convection induced by sudden impulses (SIs) recorded by ground magnetometers is studied statistically by using SuperDARN (SD) data. An advantage of using SD data instead of ground magnetic fields is that ionospheric flows measured by the radars are not virtually biased by the spatially-varying ionospheric conductance or the magnetospheric currents. First we surveyed the Sym-H index for Jan., 2007 to Dec., 2012 to identify SI events with a peak amplitude $|\text{dSym-H}|$ greater than 10 nT. Next we searched all SD data over the northern hemisphere during the SI events for ionospheric backscatters which give us the light-of-sight velocity of horizontal ionospheric flows. For each SI event, the collected ionospheric flow data were sorted into the four periods: the pre-SI period, the pre-Main Impulse (MI), middle-MI, and post-MI periods. In the present study, we examine the differences in flow velocity between the pre-SI period and the three MI periods to clarify how ionospheric flows change in association with SIs. As a result, the ionospheric flow shifts eastward on the dusk side and westward on the dawn side at the higher latitudes during positive SIs (SI+), while it shows a roughly westward/eastward shift on the dusk/dawn side, respectively, during negative SIs (SI-). These polarities of flow shifts are basically consistent with the higher latitude portions of the DP current for the MI phase as shown by Araki [1994] and Araki and Nagano [1988]. The high latitude flow shifts are basically larger for SI events with larger Sym-H variations, in the same fashion as ground magnetic field variations at high latitudes. In addition to the major dependence on SI amplitude, the flow shift magnitude shows a minor dawn-dusk asymmetry particularly under strong IMF-By conditions. We speculate that the interaction with pre-existing convection cells might cause the selective enhancement of either side of flow shifts.

Keywords: sudden impulse, SuperDARN, ionospheric convection