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Dawn-dusk asymmetry of SI-induced transient ionospheric convection

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The statistics based on SuperDARN (SD) observations revealed that the transient oscillation of ionospheric convection associated with sudden impulses (SIs) showed some dawn-dusk asymmetric structures. The previous study showed that the higher latitude portion of the twin vortex-shaped convection perturbation has a dawn-dusk asymmetry depending on the combination of IMF-By polarity and SI polarity. In addition to the asymmetry depending on IMF-By polarity, the lower latitude portion of the induced twin vortices has a dawn-dusk asymmetry in such a way that the dawn side flow perturbation is always weaker than the dusk side one. Interestingly, our statistical study shows that this feature does not depend on either the IMF-By polarity or SI polarity, existing more or less for all conditions. This fact suggests that a different mechanism causes the difference in flow magnitude of lower latitude side of vortices between dawn and dusk. We perform a set of global MHD simulation runs to examine physical mechanisms causing the response of ionospheric convection associated with SIs. The simulations basically reproduce a weaker flow at the lower latitude portion of the dawn-side vortex, quite similar to those observed by SD. In addition to the realistic situations, a simulation run without the ionospheric Hall conductance (only with finite Pedersen conductance) shows a fairly dawn-dusk symmetric pair of flow vortices. This result strongly suggests that the Hall current closure in the ionosphere plays an important role in causing the dawn-dusk asymmetry of the vortex pair induced by SIs.