Comparison of global MHD simulations of sudden impulses with SuperDARN observations

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A set of global MHD simulations of the magnetosphere-ionosphere (M-I) coupled system have been performed to examine the IMF-By dependence of ionospheric convection variations associated with sudden impulses. The previous study on the IMF-By dependence but using SuperDARN (SD) radar observations showed that the higher-latitude portion of induced flow vortices has a dawn-dusk asymmetry in speed for negative SIs and its polarity of flow asymmetry flips depending on the IMF-By polarity. It was suggested that temporal evolution of the round convection cell due to variations of IMF-By generates this flow asymmetry. To study such an M-I coupled response to varying IMF-By from a theoretical point of view, we conducted global MHD simulations with increasing/fixed/decreasing IMF-By intensity associated with SIs. As a result, the simulation runs for negative SIs have basically reproduced the dawn-dusk asymmetry of the higher-latitude flows showing the same dependence on IMF-By intensity and polarity as seen by the SD observations. As also expected, the round cell strengthens in the case of increasing IMF-By as compared with the fixed and decreasing cases. A detailed examination, however, indicates that the evolution of the round cell upon solar wind pressure changes seems to be more complicated than expected. For example, the round cell always intensifies from the pre-SI level for negative SIs, while it weakens systematically for positive SIs, regardless of the change of IMF-By intensity. This result suggests that not only the IMF-By intensity but also some upstream conditions associated with solar wind pressure changes can contribute to the evolution of round cell. Therefore, the observed flows with a dawn-dusk asymmetry could result from the interplay of these two effects.