Effects of the dipole tilt and the interplanetary magnetic field Bx component on the dawn-dusk and interhemispheric asymmetries of the interchange convection cycle

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The interchange cycle is a mode of magnetic flux circulation that appears for periods of northward interplanetary magnetic field (IMF). It is made up of IMF-to-open reconnection in one hemisphere and open-to-closed reconnection in the other hemisphere. The two reconnection processes have the same topological nature in that the roles of the two reconnecting field lines interchange at the time of reconnection. The interchange cycle is characterized by reciprocation of open magnetic flux between the two hemispheres. One observable signature of the interchange cycle is an appearance of a reverse cell circulating in the closed field line region of the ionosphere, which is named the “reciprocal cell.” The reciprocal cell appears in the open-to-closed reconnection hemisphere, whereas in the opposite IMF-to-open reconnection hemisphere, there appears a lobe cell circulating exclusively on open field lines. For given (1) IMF By, (2) IMF Bx, and (3) dipole tilt conditions, two interchange cycles concur, one on the dawnside and the other on the duskside. For an ideal case, one can easily expect the mode of the interchange cycles to occur. For example, for the case of due northward IMF with significant dipole tilt, the twin reverse cells in the summer hemisphere are both lobe cells, while in the winter hemisphere the twin reverse cells are both reciprocal cells. For the general case, however, one cannot predict the mode of the interchange cycles without quantitative modeling. The purpose of this study is to examine how the presence of dipole tilt or IMF Bx alters the dawn-dusk and north-south pattern of the twin reverse cells. For this purpose, we perform numerical magnetohydrodynamic simulations using the REPPU (Reproduce Plasma Universe) code developed by T. Tanaka. In the presentation, we discuss the dipole tilt and IMF Bx effects revealed by the numerical modeling.

Keywords: ionospheric convection, interchange reconnection, reciprocal cell

