PEM07-P03 Room:Convention Hall Time:May 26 18:15-19:30

Ionospheric convection enhancement for extremely weak (<1 nT) interplanetary magnetic field

MINOBU, Iwaki[1*] ; KATAOKA, Ryuho[2] ; WATANABE, Masakazu[3] ; FUJITA, Shigeru[4] ; TANAKA, Takashi[3] ; YUKIMATU, Akira sessai[2] ; HOSOKAWA, Keisuke[5] ; GROCOTT, Adrian[6]

[1]Department of earth and planetary sciences, Faculity of sciences, Kyushu University, [2]National institute of polar research SOKENDAI (The Graduate University for Advanced Studies), [3]Graduate School of Sciences, Kyushu University, [4]Meteorological College, Japan Meteorological Agency, [5]Department of Communication Engineering and Informatics, University of Electro-Communications, [6]University of Leicester

It is well known that the north-south component of the interplanetary magnetic field (IMF B_Z) controls the strength of ionospheric two-cell convection. When the IMF is southward, ionospheric convection exhibits the two-cell pattern that is generated by low-latitude dayside reconnection (known as Dungey-type reconnection, after Dungey [1961]). In contrast, when the IMF is northward, the two-cell convection becomes weaker, and the viscous interaction [Axford and Hines, 1961] between magnetosheath flow and magnetospheric flow remains. The viscous interaction is considered to be independent of IMF B_Z. However, Milan [2004] determined the cross polar cap potential as a function of IMF B_Z and obtained a different picture. His results indicated that for northward IMF the cross polar cap potential was on average 25 kV. He concluded that the contribution of the viscous interaction was about 10 kV. He further suggested that the remnant convection for northward IMF was caused by a combination of nightside (tail) reconnection and high-latitude (lobe-cell) reconnection. On the basis of their results, we investigated the ionospheric convection pattern for extremely weak northward IMF using the SuperDARN statistical database established by Grocott et al., [2009]. It is found that for northward IMF, the statistical ionospheric convection shows an enhancement during intervals of weak IMF (B <1nT) compared to intervals of stronger IMF (B >1nT).

In order to elucidate the physical mechanism of the peculiar convection system for weak (<1 nT) IMF, we performed global MHD simulation using the REPPU code developed by T. Tanaka. The simulation reproduced the observed ionospheric convection enhancement for such conditions. The cause of the convection enhancement is explained as follows in terms of the magnetospheric dynamo. At the upper part of the cusp adjacent to the magnetosheath, for strong IMF, there is a strong magnetic pressure region that prevents magnetosheath plasmas from intruding into the cusp. On the other hand, for weak IMF, that high magnetic pressure region disappears, resulting in an increase of the cusp thermal pressure. In consequence, the dynamo region where $J \cdot E$ is negative is formed at the high latitude boundary region with enhanced intensity. The enhanced dynamo makes field-aligned currents and ionospheric convection strong. This mechanism for driving the convection is therefore distinct from the conventional Dungey cycle and viscous interaction.

When the solar activity is extremely weak like the Maunder minimum, it is expected that the IMF also becomes extremely weak. This study therefore contributes to the prediction of magnetospheric phenomena in a grand solar minimum in the future.

Keywords: MHD simulation, severe space weather, M-I convection