

サブストーム時の夜側低緯度の電離圏電場 Substorm electric fields at nightside low latitude

橋本 久美子^{1*}; 菊池 崇²; 富澤 一郎³; 長妻 努⁴

HASHIMOTO, Kumiko^{1*}; KIKUCHI, Takashi²; TOMIZAWA, Ichiro³; NAGATSUMA, Tsutomu⁴

¹ 吉備国際大学, ² 名古屋大学, ³ 電気通信大学, ⁴ 情報通信研究機構

¹Kibi International University, ²Nagoya University, ³University of Electro-Communications, ⁴National Institute of Information and Communications Technology

The convection electric field penetrates from the polar ionosphere to low latitude and drives the DP2 currents in the global ionosphere with an intensified equatorial electrojet (EEJ). The electric field often reverses its direction, that is, the overshielding occurs and causes the equatorial counter electrojet (CEJ) during storm and substorms. In this paper we report that the overshielding electric field is detected by the HF Doppler sounders at low latitude on the nightside. We analyzed the Doppler frequency of the HF radio signals propagated over 120 km in Japan at frequencies of 5 and 8 MHz and compared with the equatorial EEJ/CEJ during the substorm expansion phase. We found that the overshielding electric field reaches around 2 mV/m during major substorms ($AL < -1800$ nT). Taking the geometrical attenuation into account, we estimate the equatorial electric field to be about 1.5 mV/m. We also found that the electric field drives the eastward electrojets in the equatorial ionosphere on the night side. It is to be noted that the overshielding electric field is observed on the nightside at low latitude during the major substorms, while the convection electric field is dominant during smaller size substorms, as the CEJ flows on the dayside. These results suggest that the overshielding electric field associated with the Region-2 field-aligned currents becomes dominant during substorms at low latitude on the nightside as well as on the dayside. On the other hand, we found strong seasonal dependence of the overshielding in the sub-auroral latitudes. Although the substorm CEJs at Huancayo do not depend on season, the overshielding frequently occurs at subauroral latitudes during the winter period from November to February. In contrast, the convection electric field is dominant at the subauroral and low-latitudes during the summer period from April to August. The strong seasonal dependence may suggest that the Region-1 field aligned currents (FACs) have a constant voltage source, while the Region-2 FACs have a constant current source, which results in the convection and overshielding electric fields being dominant in summer and winter, respectively.

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