

HF ドップラーサウンダーにより観測された ULF 帯電場の低緯度電離圏への伝送

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Transmission of ULF electric field to low latitude in magnetosphere-ionosphere current circuit as observed with HF Doppler sounder

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The geomagnetic sudden commencement (SC) and Pc5 pulsations often appear at high latitude and equator with the amplitude decreasing as the latitude decreases but increases at the dayside geomagnetic equator. The SC and Pc5 are caused by the magnetospheric currents and DP2-type ionospheric currents that flow from the polar ionosphere and are intensified by the Cowling effect at the equator (Araki, 1994; Motoba et al., 2002). The electric fields of the SC and Pc5 have been observed with the HF Doppler sounders at low latitude, which are well correlated with the equatorial electrojet (EEJ) (Kikuchi et al., 2016; Motoba et al., 2004). These observations suggest that the electric fields are potential fields associated with the ionospheric currents. To confirm that the Pc5 electric field is transmitted through the magnetosphere-ionosphere current circuit, we made correlation analyses between the Pc5 electric fields at low latitude and geomagnetic Pc5 at high latitude and equator on both the day- and night-sides. We show that the Pc5 electric fields are well correlated with the global DP2-type ionospheric currents in the same manner as the SC electric fields. To identify the location of the field-aligned currents (FACs) feeding the ionospheric currents, we show that a stormtime Pc5 changed its polarity at 64 degs in the morning and 58 degs in the afternoon sectors. The reversal of the polarity may indicate the location of the FACs. We further show that the low latitude PC5 is larger in amplitude on the nightside than on the dayside, suggesting that the PC5 around the midnight is strongly affected by the direct effects of the FACs. We further show that electric fields of the ULF pulsations with periods covering the Pi2 (1-3 min) are well correlated with the EEJ. Consequently, the ULF range electric fields at low latitude are associated with the DP2-type ionospheric currents flowing from the high latitude to the equator. The ULF electric fields are transmitted from the magnetosphere to the equatorial ionosphere through the magnetosphere-ionosphere current circuit, carried by the transverse (Alfven) waves and TM0 mode waves in the magnetosphere and Earth-ionosphere waveguide, respectively.

磁気急始 (SC) や Pc5 地磁気脈動は磁気圏電流の効果に電離圏電流効果が重畳するために、高緯度と赤道で同時に現れる。SC, Pc5 の電場は低緯度で HF ドップラーサウンダーにより観測され、電場と赤道ジェット電流の間に強い相関のあることが知られる (Kikuchi et al., 2016; Motoba et al., 2004)。本論文では、低緯度 HF ドップラーサウンダー、極赤道磁力計網のデータを解析し、低緯度電離圏の Pc5 電場が磁気圏電離圏電流回路を經由して電離圏に流れる導電性電流に伴うポテンシャル場であることを示す。この結果は、Pi2(1min) や DP2(30min) など広い周期範囲の地磁気変動にも適用されることを示す。