電波・光学の同時観測による中緯度MSTIDの分極電場

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Polarization electric field in MSTIDs estimated from simultaneous radio and optical measurements over midlatitudes

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Medium-scale traveling ionospheric disturbances (MSTIDs), which typically have a horizontal scale of 100-500 km and a period of ˜1 h, are observed in the F region ionosphere at middle latitudes. To date, quite a few observations of MSTIDs in nighttime have been carried out especially in the middle latitudes; they predominantly had a northwest-southeast frontal structure and propagated southwestward in the northern hemisphere. Recently, several numerical studies reported that the ionospheric E-F coupling processes through the polarization electric field play a key role for the generation and propagation mechanism of MSTIDs. However, the observational evidence for that is still limited. In this study, based on the coordinated airglow and SuperDARN measurements from Jan. 2010 to Jun. 2014, we investigated statistical characteristics of nighttime MSTIDs especially the polarization electric field embedded in the MSTIDs. The SuperDARN Hokkaido HF radar has been installed at Rikubetsu (43.5N, 143.6E), Japan, and an OI 630-nm airglow imager has been operated at Paratunka (53.0N, 158.2E), Russia, within the radar field of view.

We found 6 conjugate events of MSTIDs in the simultaneous measurements: Doppler velocities of field aligned irregularities (FAI) echoes observed by SuperDARN showed systematic polarity changes which were consistent with airglow intensity variations. The MSTIDs propagated southwestward and had amplitudes in the airglow intensity of 10-15%, while line-of-sight Doppler velocities amplitudes of 70-100 m/s were detected by SuperDARN. Assuming polarization electric field is perpendicular to wavefronts of MSTIDs, these measurements yielded polarization electric fields of 4.5-8.5 mV/m. Our result also suggests importance of the E-F coupling via MSTID-related polarization electric field, because the above estimation requires quite large effective field ($\mathbf{E}_0 + \mathbf{u} * \mathbf{B}$) and seems to be improbable at midlatitudes considering the continuity of the electric current in the F region alone.