

Radar and optical observation of medium-scale traveling ionospheric disturbances and field-aligned irregularities in the F region

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We report for the first time simultaneous observations of Medium-Scale Traveling Ionospheric Disturbances (MSTIDs) and Field-Aligned Irregularities (FAIs) in the F region using two all-sky airglow imagers and the MU radar. The all-sky imagers were operated at Sakata (39.0°N, 139.9°E) and Shigaraki (34.9°N, 136.1°E), Japan. MSTID propagating southwestward was simultaneously observed in 630-nm airglow images at the both sites. To investigate spatial relationship between MSTID and FAIs, FAIs were mapped onto the 630-nm airglow layer (260 km altitude). Altitude of the airglow layer was estimated by the triangulation using all-sky images at Sakata and Shigaraki. FAIs with strong echo intensity and upward Doppler velocities coincided with the airglow depleted region due to the MSTIDs. On the other hand, FAIs with weak echo intensity and downward Doppler velocities coincided with the airglow enhancement. The directions of the Doppler velocities is consistent with that of ExB drifts caused by the polarization electric fields associated with the MSTIDs. A model calculation was carried out to simulate electron density perturbations caused by oscillating electric fields due to MSTIDs. The result suggests that FAIs could be generated by the gradient drift instability which operates at the polarization electric fields and spatial gradient of the electron density associated with the MSTIDs.