Geophysical Research Abstracts
Vol. 20, EGU2018-2490, 2018
EGU General Assembly 2018

Observations of nighttime Mid-latitude F Region Irregularity and medium scale traveling ionospheric disturbances with Wuhan VHF radar and a GPS network

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Based on Wuhan VHF coherent scatter radar, GPS network and ionosonde, we present simultaneous observations of field aligned irregularities (FAIs), nighttime medium scale traveling ionospheric disturbances (MSTIDs) and spread F in the F region. Wuhan F region FAIs occur near midnight in the height range of 250-400 km. The Doppler spectra indicates spectral width is less than 50 m/s and Doppler velocity is within $\pm$30 m/s. During the FAIs event, the MSTIDs are observed to propagate southwestward with average horizontal velocity and period of about 250 m/s and 33 min, respectively. We find that the F region irregularities may appear accompanied the uplifts of F layer. The distorted plasma density due to the Perkins instability process might be further modulated by the E$\times$B instability. The eastward polarization electric field associated with nighttime MSTIDs might play a key role in generation of FAIs.