

Observational evidence of coupling between quasi-periodic echoes and medium scale traveling ionospheric disturbances

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To study coupling processes between the mid-latitude E and F regions, simultaneous observations of E region irregularities by the Middle-and-Upper atmosphere (MU) radar and total electron content (TEC) variations by the GEONET GPS receiver network in Japan were conducted from 30 May to 3 June 2005.

Quasi-periodic (QP) echoes in the E region are found to be well defined when medium scale traveling ionospheric disturbances (MSTIDs) in the F region are present. The appearance and disappearance of the MSTIDs observed by the dense GPS receiver network are well correlated with the development and decay of QP echoes. Interferometric Imaging of the QP echoes by using the MU radar's Ultra-Multi-Channel receiving system shows that bands of echoing regions aligned in northwest–southeast drift southwestward, of which wavefront and propagation direction are the same as the MSTIDs. This result confirms the expectation by Hysell et al. [2002] who observed band structures in QP echoes by the MU radar and suggested their relation to MSTIDs. Our result suggests that the midlatitude E and F regions are coupled through the geomagnetic field line, although it is not clear either of the E or F region is the source.