Ground-optical and satellite measurements of mesoscale traveling ionospheric disturbance at midlatitudes

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We have investigated a mesoscale traveling ionospheric disturbance (MTID) observed by an airglow imager at Shigaraki (34.9N, 25.4MLAT) on May 17, 2001. The structure was identified in the airglow images of OI (630 nm, emission altitude: 250 km) and OI (777.4 nm, emission altitude: 400 km) as NW-SE band structures (wavelength: 230 km) moving southwestward with a velocity of 50 m/s. Peak-to-peak amplitudes of the structures were 80% and 20% for 630 nm and 777.4 nm emissions, respectively. Neutral wind velocity was measured simultaneously from the Doppler shift of the 630-nm emission by a Fabry-Perot interferometer. From these parameters, we have made model calculations of MTIDs generated by gravity waves and by the ionospheric Perkins instability. For the case of gravity waves, estimated vertical wavelength was less than 30 km, which was too small to explain the observed intense amplitudes in airglow intensity. For the case of the Perkins instability, we found that an electric field of 1.2 mV/m (corresponding to the ExB drift velocity of 25 m/s) was necessary to reproduce the observed airglow amplitudes. At about 800 km altitude above Shigaraki, the DMSP satellite simultaneously measured fluctuations of horizontal plasma drift velocity with an amplitude of about 30 m/s and a scale size of about 200 km. These values are fairly comparable to those estimated from the ground-based observations. From these results, we conclude that the observed MTID was generated by non-linear development of the Perkins instability in the midlatitude ionosphere. (DMSP plasma drift data were provided by Dr. F. J. Rich).