

Numerical simulation of coupling between midlatitude ionospheric E and F regions and atmospheric gravity waves

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Ionospheric irregularities or disturbances in the midlatitude ionosphere have been intensively studied for several decades. Ionospheric irregularities in the midlatitude E region have been known to be strongly related with polarization electric field generated in sporadic-E (Es) layers from the SEEK and SEEK-2 rocket experiments or numerical simulations. The simulations have shown that neutral wind shear or atmospheric gravity waves can produce such strong polarization field. On the other hand, medium-scale traveling ionospheric disturbances (MSTID) observed in the midlatitude F region in nighttime are also considered to be associated with electric fields. While the Perkins instability is the most plausible mechanism of MSTID, the growth rate of the instability is so small that it cannot explain the amplitude of the observed disturbances. Recently, it is proposed that the electrical coupling between the E and F regions can increase the growth rate of the Perkins instability. We study this coupling effect with a three-dimensional numerical simulation. We will show that the polarization electric field generated in Es layers can map up to the F region and seed the Perkins instability effectively. Polarization electric field produced by gravity waves may also have significant effect on the midlatitude F-region dynamics.