Investigating the role of gravity waves on equatorial ionospheric irregularities using TIMED/SABER and C/NOFS satellite observations

[1]Melessew Nigussie, Mark Moldwin, Endawoke Yizengaw, Keith Groves

[1]Washera Geospace and Radar Science Research Lab., Bahir Dar University, Ethiopia

Abstract

In this paper, for the first time, simultaneous atmospheric temperature perturbation profiles obtained from TIMED/SABER satellite and equatorial ion density and vertical plasma drift velocity observations with and without ESF activity obtained from C/NOFS satellite are used to investigate the effect of gravity wave (GW) on ESF. The horizontal and vertical wavelengths of ionospheric oscillations and GWs are estimated applying wavelet analysis techniques. In addition, vertically propagating GWs that dissipate energy in the ionosphere-thermosphere system are investigated using spectral analysis technique. We find that vertical wavelength of GW, corresponding to dominant wavelet power, ranges from 12 to 31 km regardless of the conditions of the ionosphere; however, GWs with vertical wavelengths between about 1 to 13 km are found every day saturated between 90 and 110 km at different longitudinal sectors. Filtering out vertical wavelengths above 13 km from temperature perturbations, ranges of zonal wavelengths of GW (i.e. from about 290 to 950 km) are found corresponding to irregular and non-irregular ionosphere. Similarly, corresponding to dominant oscillations, zonal wavelength of ion density perturbations is found within 16 to 1520 km. Moreover, we find an excellent agreement among the median zonal wavelengths of GW for the cases of irregular and non-irregular ionosphere and ion density perturbations that are 518, 495, and 491 km, respectively. The results imply that seed perturbations due to GW with vertical wavelength from about 1 to 13 km evolve to ion density irregularity and may be amplified due to post-sunset vertical upward drift velocity.