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Correlation between the ionospheric wavenumber-4 structure and the upper atmospheric DE3 tide

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This work studies the relationship between the longitudinal ionospheric structure of wavenumber-4 (WN4) and the upper atmospheric tide of non-migrating mode DE3 (diurnal eastward wavenumber-3). The global ionospheric maps produced by JPL are used to deduce the latitudinally integrated total electron content (ITEC) at low latitude ionosphere, and the measurements from SABER and TIDI on board the TIMED satellite are used to obtain respectively the atmospheric temperature (T) and horizontal winds (zonal wind U and meridional wind V). By a Fourier filtering or fitting method both the WN4 and the DE3 components are respectively derived from data of ionosphere and upper atmosphere. We then study in detail the correlation between the WN4 and the DE3. It is found that the seasonal variation of WN4 is consistent with those of both the zonal wind and temperature of DE3, while it is inconsistent with that of the meridional wind. The WN4 amplitude of ITEC in day time and the DE3 amplitudes of T and U at low latitudes are very intense and well developed in northern summer and early northern autumn, but quite weak in northern winter; they increase in northern spring and decreased rapidly in later northern autumn. We attribute this to the reason that the temperature and zonal wind in DE3 are likely in symmetric modes, while the meridional wind is in antisymmetric mode. Numerical simulation demonstrates that the ionospheric response to DE3 tide is more efficient to symmetric mode than to antisymmetric one. The present results support the suggestion that the longitudinal WN4 structure in the ionosphere should be originated from the non-migrating tide mode DE3 in the upper atmosphere.