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Tide-tide resonant nonlinear interactions in the mid-latitude winter lower thermosphere

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Data obtained from the Wuhan/China (30˚N, 114˚E) MF radar in 2001 are used to study the resonant nonlinear interactions between tides in lower thermosphere. It is observed that diurnal, semidiurnal and terdiurnal tides are the prominent perturbations in the meridional wind component near mid-latitude winter mesopause region, the quarterdiurnal tide is clear, and the 1/4.8-cph tide can even be distinguished. By bicoherence spectrum analysis, it is revealed most prominent bicoherence peaks stand for phase correlation between tidal harmonics or self-coherence of a single tidal wave. By examining the vertical wavelength time variations, a significant correlation is found between the vertical wavelength of the observed terdiurnal tide and that of the supposed nonlinearly generated one. In the interval of 94.0-98.0 km, there exist not only a certain phase correlation and vertical wavenumber correlation but also a strong amplitude correlation of the oscillatory amplitudes equivalent and oscillatory phases synchronous or reversed between the prominent tides, indicating a wave-wave resonant interaction indeed occurred. The time and height variations of tidal amplitudes combine just showing that the nonlinear interactions between tides make their respective energy redistributed through the accumulation of interactions and thus change the power spectral structure. Below 94.0 km, however, the tides seem to be in a transient state and the tidal resonant interaction is more likely a local and temporary phenomenon. Overall, the spectral amplitudes of all concerned tidal harmonics gradually increase, reach their maxima in 70.0-98.0 km, and then decay in turn from lower frequency components to higher frequency components with increasing height. This

“scene” closely correlates with the resonant nonlinear interactions between tides and gravity waves and planetary waves.