

Midnight temperature maximum simulated by a whole atmosphere GCM

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The midnight temperature maximum (MTM) is one of the typical features of the low-latitude upper thermosphere. Since 1970s, the following characteristics of the MTM have been shown from ground-based and satellite observations: 1) the larger amplitude of the MTM in summer than in winter, 2) the MTM appearance occurring later at night for the winter than for the equinoxes and summer, 3) little dependence of the MTM amplitude on the phase of the solar cycle, 4) convergence of thermospheric tidal winds at the equator near local midnight as a cause of the density maximum and the MTM through adiabatic heating, and 5) reversals of the meridional wind after producing the MTM. However, all the MTMs never show the above characteristics. The details of the behaviors and generation mechanisms of the MTM are still unknown. In order to understand the MTM, GCM simulations are essential. The importance of the tidal waves for forming the MTM has been pointed out from GCM simulations mainly performed with the NCAR GCM, while the maximum amplitudes of the MTMs reproduced by the previous GCMs (~30 K) were much smaller than those observed (~150-200 K). Since the previous GCMs assumed some tidal modes for reproducing the MTM, the maximum amplitudes of the MTMs would be calculated as small ones. On the other hand, our GCM, which covers all the atmospheric regions and generates various tidal waves, reproduces the MTMs with amplitudes of several 10s - 150 K. In addition, the simulated MTMs tend to appear later at night in winter than in summer, which is in agreement with previous observations. In this study, we present characteristics and day-to-day variation of the MTMs simulated by our GCM. The generation mechanisms of the MTM are also discussed here.