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Mechanisms Controlling the Diurnal Solar Tide: Analysis Using a GCM and a Linear Model

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A GCM (HAMMONIA) and a linear model are used for analyzing the dynamics of the diurnal solar tide. A comparison between this tide in the GCM and in published observations is relatively favorable. The linear model uses monthly means from the GCM as background atmosphere and the diurnal heating rates from that model as forcing. The background atmosphere may be longitude-dependent, so that stationary planetary waves can be included. A straightforward analysis of corresponding effects is thus facilitated. To a large degree the seasonal variability of the diurnal tide is due to variations in the background atmosphere. In addition to corresponding previous results on the impact of the zonal-mean atmosphere on the migrating tide the thermospheric tide is shown to be strongly influenced by the variability of the absorption of solar radiation by O2. With regard to the nonmigrating tidal components, also their most important forcing mechanisms are tropospheric, and their seasonal cycle is mostly controlled by variations of the background atmosphere. In the dynamics of these components, however, the planetary waves take an active role. They can cause reductions in the tidal amplitude, by destructive interference with the directly forced nonmigrating tide, as for DS0 in late NH winter. The opposite effect of enhancing the tidal amplitude is also observed, for DW2 in the same season. The component DE3 is controlled by an interplay between the variability of the zonal-mean background and the diurnal heating. The correct simulation of a meridional-wind-amplitude minimum in this tide during NH summer seems to depend critically on the phase relation between the two.