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On the influence of the diurnal tide on mesospheric and lower thermospheric mean zonal wind

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Atmospheric tides are forced by solar irradiation in the different layers of the atmosphere and can propagate with increasing amplitudes up to the thermosphere. The propagation of tides is controlled by the background wind, vice versa due to interactions between the tidal waves and the zonal mean winds, they are able to influence the basic state as well.

In the paper we use data form the general circulation model HAMMONIA (Max-Planck Institute for Meteorology, Hamburg), the simple circulation model KMCM and a linear model including planetary waves in the basic state. Using the linear model the individual processes of tidal forcing and the influence of the mean circulation state onto the tidal propagation can be analysed in particular.

It the paper we consider the behaviour of the diurnal migrating component and of the nonmigrating ones. It is shown that the migrating component dominates in the mesosphere and results mainly from the thermal forcing in the tropospheric water vapour. For the nonmigrating tides, both the eastwards travelling wave -3 and the westwards travelling wave 2 show large influences on the mesospheric tidal structure. These components are forced in the troposphere due to large scale convection and condensation processes.

To study the influence of tides onto the mean circulation the Eliassen-Palm-Fluxes for the tides have been calculated. The EPF divergence derived from migrating tides reaches in the lower thermosphere values between -20 and 6 m/s/day. For the nonmigrating component -3 we found large amounts of the order of 10 m/s/day.

The tidal influence on the mean circulation is studied additionally using the simple circulation model KMCM. The differences between results with and without tidal forcing in the model runs show that the lower thermospheric circulation is accelerated in subtropical latitudes and decelerated in higher latitudes. These results are discussed with respect to the EPF terms derived from the linear model.