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Gravity wave-tidal interactions in the extratropics: Effects on the large-scale circulation

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Ground-based observations of tides in the high-latitude mesosphere/lower thermosphere (MLT) show a dominating diurnal tide in the lower mesosphere and a strong semi-diurnal tide around the mesopause and higher up. Such a behavior is also seen in climate models including the MLT, but less so in linear models. The Kühlungsborn Mechanistic general Circulation Model (KMCM) has been run with full thermal excitation of tides, yielding a tidal behavior at high latitudes that compares reasonably well with corresponding ground-based observations. We prove that the wave-mean flow interaction of the tides is significant at low latitudes, but entirely negligible in the extratropics. A sensitivity experiment nevertheless reveals that the tides strongly affect the residual circulation in the MLT. In particular, the inclusion of tides gives rise to an efficient reduction of GW amplitudes, GW drag, and dissipation around the summer mesopause. Comparing the daily cycle of the zonal wind and GW effects in the simulation and in radar soundings suggests that enhanced GW filtering during the positive tidal wind phase in the lower mesosphere is an obvious explanation.