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Variation of gravity waves on different time scales and the differences between day and nighttime lidar soundings at mid-latitudes

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A daylight capable Rayleigh-Mie-Raman (RMR) lidar is in operation since summer 2010 at the mid-latitude station at Kühlungsborn (54° N, 12° E). The RMR lidar system is used for measuring wave structures at day and night to investigate short and long periodic atmospheric waves, like gravity waves (GW) and thermal tides (with diurnal, semidiurnal and terdiurnal components) between ∼30 and 70 km altitude. An extensive data set with over 7500 measurements hours allows deriving the seasonal variation of, e.g., gravity wave potential energy density (GWPED), while several multi-day observations show the variability of gravity waves and tides on shorter time scales. To separate gravity waves, tides and other long periodic waves a 1-dimensional spectral filtering technique is used. The seasonal variation of the potential energy per unit volume shows a clear summer minimum for inertia gravity waves as well as for tides. Contrary to this, short periodic gravity waves with periods between 4 and 8 h show no clear seasonal variation. Especially for altitudes above 55 km an additional semiannual component with a second summer maximum is observed, which shows the increasing relevance of these waves. Because of the availability of whole day data, we have the possibility to distinguish between day and nighttime data. By using only data between 20 UT and 4 UT (“nighttime”) we found a summer minimum in GWPED that is hidden in the whole day data. We relate these differences in the seasonal behavior to a diurnal variation of propagation conditions for the particular gravity waves. Beside the monthly averaged data, we will present a 10-day continuous lidar sounding to show the variability of gravity waves and tides on short time scales.