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Gravity wave characteristics from the troposphere to the lower thermosphere at 54°N

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Since approximately 2 years continuous temperature profiles are observed at Kühlungsborn (54°N) during night conditions by combining data from a Rayleigh/Mie/Raman lidar (appr. 1 to 90 km) and a potassium lidar (appr. 80 to 105 km). This allows for the first time to study the propagation and filtering of gravity waves (GW) from the troposphere up to the mesosphere/lower thermosphere (MLT). We have also performed GW simulations by launching at the upper troposphere a large number of GW with a randomly chosen set of wavelengths, amplitudes, phase speeds etc. We will present case studies for typical summer and winter conditions. We observe typical vertical wavelengths of 10 - 18 km and > 25 km and diverse periods in the covered range of 1 - 6 hours both in summer and winter. The mean temperature variability caused by GW is larger in winter (up to 25 K in the MLT) compared to summer (up to 10 K in the MLT) which is partly caused by the larger observation period in winter (more night hours) and by filtering of GW by the background atmosphere. In contrast to other studies we find that the impact of the background atmosphere on the variability via the polarization relation cannot explain the summer/winter difference. The main features of our observations are nicely reproduced by the simulation. For example, we find that local fluctuation minima ('nodes') are caused by enhanced gravity wave removal due to breaking and reflection. Combining observations and simulation we conclude that the gravity wave source plays a minor role in the seasonal variation of temperature variability in the upper atmosphere.