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Mesospheric gravity waves from simultaneous measurements of winds and temperatures in connection with model data

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MF radar measurements are excellent tools for the continuous monitoring of upper mesospheric winds between about 70 and 95 km. In particular, wind fluctuations caused by atmospheric waves can be identified and studied over extended time periods. However, the investigation of their vertical propagation is obviously limited to the height range where radar observations are feasible. With lidar measurements, wave-induced temperature fluctuations can be studied from the ground up to the MLT region. Here, however, the temporal coverage is limited especially to nighttime and cloud-free atmospheric conditions. Therefore, the combination of radar and lidar techniques allows the investigation of vertical wave structures over an extended altitude and time range.
The present study is based on wind observations using the MF radar at Juliusruh (54.6°N, 13.4°E) and on temperature measurements using lidar data at Kühlungsborn (54.1°N, 11.8°E). Here, common volume and simultaneous measurements are used to identify gravity wave packages, to check the polarization relations between temperature and wind fluctuations, and to determine the proportion of kinetic to potential energy in the wave field. Finally, the results from the measurements are compared to the characteristics of gravity waves over an extended altitude range derived from simulations with the wave-resolving mechanistic general circulation model KMCM.