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Gravity wave variability at 69° N above ALOMAR in Northern Norway

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The ALOMAR Rayleigh/Mie/Raman lidar, located at 69° N in Northern Norway, measures relative density profiles and aerosol particles and derives temperatures in the stratosphere and mesosphere. It is operated year-round whenever permitted by the weather during both nighttime and daytime. The lidar signal consists of backscattered laser light and is separated during daytime from scattered sunlight by using spectral filters optimised to the highly stabilised lasers and a small field of view of the receiving telescopes. This technical design together with a dedicated crew of operators allow us to collect 500 h – 1100 h of lidar observations per year, on average one profile every fourth day. Assuming hydrostatic equilibrium, temperature profiles are derived in the aerosol-free part of the middle atmosphere above 30 km. Temperature fluctuations with periods of up to a few hours are identified as gravity waves.

We will present analyses of the observed gravity waves in the upper stratosphere and mesosphere. Gravity wave energies show a semi-annual variation with maxima in winter and summer. The gravity wave amplitude growth with height also changes with season indicating differences in wave filtering. The observed gravity wave variability depends on both the wave sources and the wave propagation. Investigating an orographic or tropospheric wave source showed that there is no clear correlation between wave energies in the stratosphere and the wind in the troposphere. Wind profiles from ECMWF analyses were used to calculate a gravity wave transmission index from the troposphere to the upper stratosphere assuming a constant, isotropic gravity wave source. The calculated transmission is not correlated to the observed gravity wave energies in the upper stratosphere. These two findings indicate that the explanation for the observed gravity wave variability must include both multiple sources and the filtering and dissipation of these waves as they propagate to the middle atmosphere.