Simultaneous observation of temperatures and ice particles in the mid-latitude (54°N) mesopause region

M. Gerding, J. Höffner, M. Zecha, W. Singer and F.-J. Lübken

Leibniz-Institute of Atmospheric Physics, Kühlungsborn, Germany (gerding@iap-kborn.de)

At the mid-latitude location of Kühlungsborn (54°N, 12°E) a number of noctilucent clouds (NLC) and mesospheric summer echos (MSE) have been observed in the last years by lidars and VHF radar, respectively. Since 1997 up to five NLC per year have been observed by lidar (overall observation probability up to 12%), showing that the atmospheric conditions for NLC are fulfilled only occassionally at this location. Despite this small occurrence rate of NLC, there is an obvious interannual variation with a minimum during the years 2000 and 2002. Since 2003 the NLC occurrence rate is increasing again, which is in good anti-correlation with the solar Lyman-alpha flux. The mean NLC altitude is 83.0 km and the mean NLC backscatter coefficient at 532 nm wavelength is about $2.5 \cdot 10^{-10}$ $m^{-1}sr^{-1}$. Therefore the mid-latitude NLC are a few hundred meters lower and much weaker than NLC at higher latitudes. From four-color lidar soundings of stronger NLC events we derived mode radii between 25 and 60 nm and particle densities between 50 and 400 cm^{-1}. This is well within the range of parameters observed at more polar locations. The combination of Rayleigh/Mie and potassium resonance lidar at our location additionally enables temperatures measurements in the mesosphere and lower thermosphere. The average night mean mesopause temperatures during the summers 2003 to 2005 were observed to be about 150 K at 87 km, therefore a few Kelvin warmer than the frost point temperature. But typically the temperature profiles are disturbed by tidal and gravity waves and observations just below and above the NLC indicate temperatures below the frost point. While direct temperature measurements within the NLC are inhibited by observational constraints, daytime temperature profiles within MSE have been observed by the potassium lidar, directly showing ice supersaturation. Recent temperature and NLC soundings are complemented by wind observations of a co-located meteor radar. We will compare temperature measurements during ice events as well as during supersaturated periods without ice with the wind measurements. The role of horizontal advection of NLC layers as a premise for our observations will be discussed.