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Particle concentrations and number size distributions in the planetary boundary layer derived from airship based measurements

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Atmospheric particles play a key role for regional and global climate due to their direct and indirect radiative forcing effects. The concentration and size of the particles are important variables to these effects. Within the continental planetary boundary layer (PBL) the particle number size distribution is influenced by meteorological parameters, local sinks and sources resulting in variable spatial distributions. However, measurements of particle number size distributions over a broad vertical range of the PBL are rare.
The airship ZEPPELIN NT is an ideal platform to measure atmospheric aerosols on a regional scale within an altitude range up to 1000 m. For campaigns in the Netherlands, Northern Italy and South Finland in 2012 and 2013 the airship was deployed with a wide range of instruments, including measurements of different trace gases, short lived radicals, solar radiation, aerosols and meteorological parameters. Flights were carried out at different times of the day to investigate the influence of the diurnal evolution of the PBL on atmospheric trace gases and aerosols.
During night and early morning hours the concentration and size distribution of atmospheric particles were found to be strongly influenced by the layered structure of the PBL, i.e. the nocturnal boundary layer and the residual layer. Within the residual layer particle concentrations stay relatively constant as this layer is decoupled from ground sources. The particles persist in the accumulation mode as expected for an aged aerosol. In the nocturnal boundary layer particle concentrations and size are more dynamic with higher concentrations than in the residual layer. A few hours after sunrise, the layered structure of the PBL intermixes. During daytime the PBL is well mixed and a negative concentration gradient with increasing height is observed. Several height profiles at different times of the day and at different locations in Europe were measured. The aerosol measurements will be discussed together with meteorological parameters and trace gas measurements.

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