Investigation of meteorological influences and mixing-layer height upon ultrafine particle size distribution in the urban area of Augsburg


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INTRODUCTION
Urban regions - frequently influenced by enhanced air pollution. Particulate matter and especially ultrafine particles (UFP) are of high health risk. Wind speeds and directions as well as mixing layer height (MLH) - important factors which influence exchange processes of ground level emissions.

RESULTS

DAILY VARIATION OF THE PARTICLE NUMBER CONCENTRATION
3-10 nm: relative constant 10-100 nm: strong daily course 100-500 nm: weak daily course >500 nm: intensity of daily course decreases

CAUSED BY UFP FORMATION processes which are dependent on the emission characteristics and humidity.

MIXING LAYER HEIGHTS
In most cases (see Figures to the right) decreasing relative humidity and increasing potential virtual temperature with height (radiosonde data) correlated well with the height of the near-surface layer determined from ceilometer data.

CORRELATIONS
Significant correlation of the hourly-mean values of PM number concentrations in the size range 100-500 nm with MLH and wind speeds (see Figures to the right).

CONCLUSIONS
Mainly during winter MLH determines near-surface concentration of air pollutants by about 50% in areas not influenced by strong emissions and during time periods without strong vertical mixing and advection.

METHODOLOGY
Particle size distribution are measured with a Twin Differential Mobility Particle Sizer by HMGU. Meteorological data are collected by the monitoring stations of the Bavarian Environment Agency and the German National Meteorological Service (DWD). MLH is continuously determined with ceilometer in Augsburg by IMK-IFU. Vaisala ceilometers LD40 and CL31 are used which are eye-safe commercial lidar systems. In the absence of low clouds and precipitation and during broken clouds ceilometers estimate the MLH fairly well.

The results of measurements were compared during simultaneous operations.

Comparison of the hourly-mean values of PM number concentrations in the size range 100 - 500 nm with hourly-mean mixing layer height (MLH) values (left) and wind speeds (right) during winter 2008. As an example a linear regression function is given.