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Investigation of processes leading to high air pollution in the urban area of Augsburg

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Urban regions are frequently influenced by enhanced air pollution inducing serious impacts upon human health. This is mainly due to emissions but also to meteorological processes. Wind speeds and directions as well as mixing layer height (MLH) are important factors which influence exchange processes of ground level emissions. It will be discussed how the knowledge of the meteorological parameters and MLH is supporting the understanding of processes directing air quality.
The mixing layer height was continuously monitored by uninterrupted remote sensing measurements with ceilometer, SODAR and RASS in Augsburg. The Vaisala ceilometers LD40 and CL31 were used which are eye-safe commercial lidar systems. Special software for these ceilometers provides routine retrievals of lower atmosphere layering from vertical profiles of laser backscatter data. These remote sensing instruments were operated at three different sites: at the northern edge (CL31 or LD40, RASS), in the middle (CL31) and at the southern edge of the town (SODAR).
A comparison of the different measurement results of these remote sensing systems during simultaneous measurements was performed. The information content of the different remote sensing instruments for mixing layer height was analysed further. In the absence of low clouds and precipitation ceilometers can estimate the MLH fairly well. During broken clouds the retrieval of MLH can be handled also. Because the optical technique observes the aerosol distribution different layers like the stable surface layer, the convective boundary layer and the residual layer can be easily distinguished. The aerosol structures seen in lower layers by the ceilometer agree well with the temperature inversions measured by the RASS.
In addition to the monitoring air pollution network operated by Bavarian State Agency of Environment (LfU) in situ concentration measurements of CO, NO, NO_x, and O_3 inside a van as well as PM10 were performed together with wind measurements at the northern edge of the town. The meteorological data were collected by the monitoring station of the LfU at the southern edge of Augsburg, at the airport at the northern edge of Augsburg by the German National Meteorological Service (DWD) and at the aerosol measurement station in the middle of Augsburg by the Cooperative Health Research in the Region of Augsburg (KORA).
These air pollutant and meteorological measurement data are the basis to study the processes influencing upon air quality in Augsburg. The two intensive measurement periods during the winter 2006/2007 and 2007/2008 are studied. The weather situations are characterised, the meteorological influences upon air pollutant concentrations like wind speed and wind direction are studied and the correlations of air pollutant concentrations with meteorological parameters and mixing layer height are determined. This includes also a definition of the lower limit of the wind speed and of periods with nearly constant wind speed and wind direction. Further, the representativity of the ground-based meteorological measurements is studied. Finally, the spatial variations of the measured air pollution and meteorological data are investigated. The results of these investigations will be presented.