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RESPONSE OF AEROSOL CONCENTRATIONS TO THE DAILY ATMOSPHERIC BOUNDARY LAYER VARIABILITY AT THE NATIONAL ATMOSPHERIC OBSERVATORY KOŠETICE

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INTRODUCTION

The atmospheric boundary layer (ABL) is the part of the troposphere directly influenced by the properties of the Earth's surface. The ABL thickness reaches from hundreds of meters to a few kilometres. The daily cycle of the ABL height is primarily result of interaction between incoming solar radiation and Earth's surface heat fluxes because a turbulent motion is dominant in this layer. Air pollutants are generally emitted from surface and their measured concentrations are also influenced by dilution of the atmosphere, or ABL thickness (Quan et al. 2013, Stull 2003).

This study is focused on the linkage between the diurnal ABL height evolution and aerosol particle number concentrations.

MEASUREMENT AND METHODS

Evaluated data were recorded at National Atmospheric Observatory Košetice (NAOK – 49°34′24"N, 15°4′49"E, 534 m a. s. l.) located in the NW part of the Vysočina Region. NAOK is equipped by a wide range of modern instrumentation intended for measurement of selected gaseous pollutants concentrations, atmospheric aerosol properties and meteorological conditions. Within this study data recorded by Scanning mobility particle sizer (SMPS – IfT TROPOS) and Ceilometer (Vaisala - CL51) in 2016 were evaluated. SMPS measures particle number size distribution over size range 10–800 nm. Ceilometer uses a pulsed diode laser-LIDAR (Light Detection And Ranging) technology. Laser pulses (wavelength of 910 nm) sent out in a vertical direction are scattered at particles in the atmosphere and the backscattered light is detected (Wagner and Schäfer 2015, Lotteraner and Piringer 2016).

Ceilometer data processing method is based on the method published by Lotteraner and Piringer 2016. The instrument output contains three aerosol-layer heights and three cloud-base heights. Firstly, the lowest aerosol-layer from instrument output was defined as the height of mixing layer (part of the ABL). Secondly, last two aerosol-layers were used to determine the height of ABL. Default data time resolution of 16 s was converted to 5 minutes intervals and then data were smoothed by the Local Polynomial Regression Fitting method (Lotteraner and Piringer 2016, Cleveland et. al 1992).

RESULTS AND CONCLUSIONS

More and less diluted conditions of the atmosphere were determined by splitting time series of the mixing layer height into two groups – above and below daily median value (665 m). The diurnal variation of the ABL is well pronounced under more diluted conditions. Mixing layer started increase after 6 AM and after reaching maximum value (1500 m) around 4 PM, decreased to initial height of 750 m. Boundary layer had the same evolution. In contrast, the total number concentrations (TNC) had opposite daily development under these conditions. The rising height of the ABL was followed by a drop of TNC due to the dilution (Fig 1 a). More or less constant height of the boundary layer and TNC is typical for less diluted conditions. Although the increase in TNC after the ABL height decrease in the afternoon is also visible (Fig 1.b).

These first results confirm aerosol number concentrations response to different dilution conditions caused by ABL thickness changes.

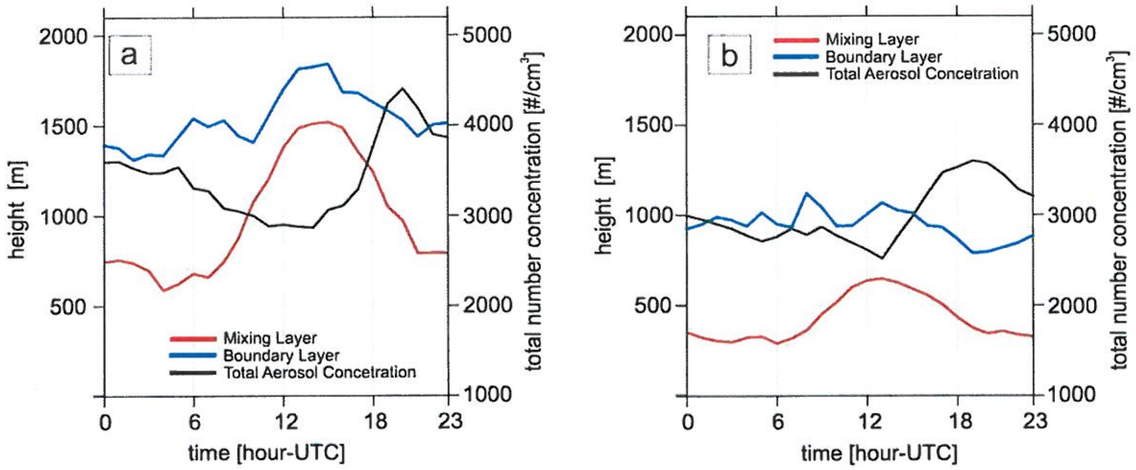

Fig. 1: Daily evolution of the ABL and TNC above (a) and below (b) daily median of mixing layer height in 2016.

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