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CLOUD PROCESSING OF ATMOSPHERIC AEROSOL SPECTRA

Naděžda ZÍKOVÁ[1], Petra POKORNÁ[1], Petr PEŠICE[2], Pavel SEDLÁK[2], Vladimír ŽDÍMAL[1]

[1] Institute of Chemical Process Fundamentals, AS CR, Prague, Czech Republic, zikova@icpf.cas.cz
[2] Institute of Atmospheric Physics, AS CR, Prague, Czech Republic,

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INTRODUCTION

Atmospheric aerosol (AA), and its influence on the cloud formation, lifetime and other properties, remains the most uncertain (with low confidence level) element in the IPCC radiative forcing estimations (Stocker et al., 2013). The AA, however, is influenced by the cloud processing as well (Collett et al., 2008; Zíková and Ždímal, 2016).

Cloud processing of AA (and vice versa) can be described on fogs, or on low clouds present at a suitable station. An example of such a station is Milešovka, where fog is present for almost 55 % of the time (Fišák et al., 2009), giving a great opportunity to explore the changes in the particle size distributions due to the cloud processing.

EXPERIMENTAL SETUP

The measurements took place at the meteorological observatory of the Institute of Atmospheric Physics of the Czech Academy of Sciences, located on the top of the Milešovka Mtn. (50°33'18"N, 13°55'54", 837 m a. s. l.). At the station, there are full meteorological data measured continually, and additional measurements on physical and chemical characterization of fog (visibility and present weather data by Present Weather Detector (Vaisala PWD 52, Vaisala, Finland), along with water content and droplet effective radius in the size range 3 – 50 µm by Particle Volume Monitor (PVM-100, Gerber Scientific, USA)).

For the description of the atmospheric aerosol properties, online measurement of outdoor number size distributions in the size range 10 nm – 20 µm was conducted using Scanning Mobility Particle Sizer (size range 10-700 nm, 110 size bins, SMPS 3936 L, TSI, USA), and Aerodynamic Particle Sizer (size range 0.5-20 µm, 52 size bins, APS 3321, TSI, USA). The time resolution was set up to 5 min, to be able to describe the real-time changes in the particle number size distributions. The data were sampled during a month-long campaign from 18.10. to 18.11.2013.

The sampling system consisted of non-heated whole air inlet to minimize losses, metal tubing going vertically to APS, again to minimize the losses of the largest particles, and a subsampling to SMPS.

On the dataset, the receptor modelling using EPA PMF version 5.0 was applied, with each size bin in the dataset considered as an input variable. The model outputs were profiles of particle number size distributions measured at the station. The identified profiles were compared to the temporal behavior of fogs and fog-related variables.

RESULTS AND CONCLUSIONS

After the application of the PMF on the SMPS and APS number size distributions separately, three modes in APS and six modes in SMPS data were found (Tab. 1). The contributions of individual profiles to the total number concentration was compared to fog occurrence and also new particle formation (NPF) analyses, as one of the SMPS profiles (mode 6) was found to be connected to NPF events. In the APS data, the mode 1 was clearly connected to fog events (Fig. 1), confirming the possibility to use the PMF profiles for further analyses of meteorological and cloud physics properties.

Table 1: SMPS and APS modes positions of number size distribution profiles found by the PMF. For bimodal distributions, positions of both modes are included with a semicolon.

	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6
APS [μm]	5.4	1.3	0.63	---	---	---
SMPS [nm]	53; 224	31	76; 91	156; 552	385	15

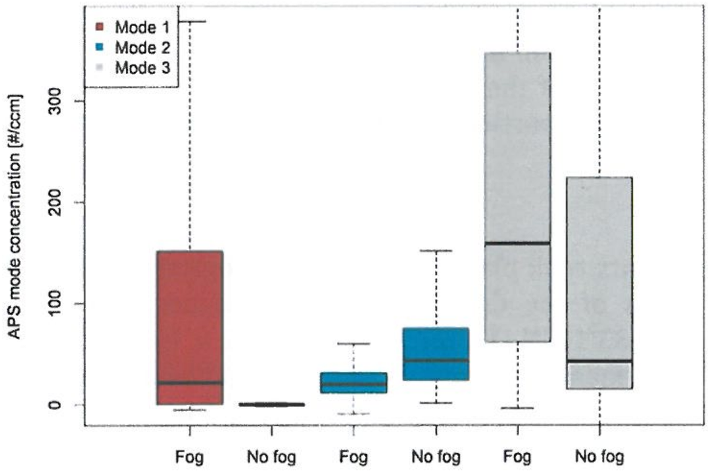

Figure 1: Boxplots of APS modes divided according to the fog appearance. No fog period also excluded any other meteorological phenomena, for example rain, snow etc.

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