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Summer PM₁ measured at a rural background site in Central Europe

Petra Pokorná¹, Naděžda Zíková¹, Radek Lhotka^{1,2}, Petr Vodička¹, Jean-Eudes Petit³, Saliou Mbengue⁴, Adéla Holubová Šmejkalová⁵, Jakub Ondráček¹, Jaroslav Schwarz¹, and Vladimír Ždímal¹

¹Department of Aerosol Chemistry and Physics, Institute of Chemical Process Fundamentals, Czech Academy of Sciences, Rozvojová 2/135, 165 02 Prague, Czech Republic (pokornap@icpf.cas.cz)

²Institute for Environmental Studies, Faculty of Science, Charles University, Benátská 2, 128 01 Prague, Czech Republic

³LSCE - UMR8212, CNRS-CEA-UVSQ, Gif-sur-Yvette, F-91191, France

⁴Global Change Research Institute, Czech Academy of Sciences, Bělidla 986/4a, 603 00 Brno, Czech Republic

⁵Czech Hydrometeorological Institute, Branch Košetice, Na Šabatce 2050/17, 143 06 Prague, Czech Republic

This work aims to assess the summer PM₁ based on particle size distribution, density and origin. An intensive sampling campaign was conducted in July 2019 at the National Atmospheric Observatory Košetice (NAOK) in the Czech Republic.

5-min integrals of particle number concentration (PNC) and particle number size distribution (PNSD) data were recorded by a Scanning Mobility Particle Sizer (size range 10 – 800 nm, SMPS, IFT TROPOS, Leipzig, with CPC 3772, TSI USA) and size-resolved PM chemical composition was measured by a Compact Time of Flight Aerosol Mass Spectrometer (C-ToF-AMS, Aerodyne, USA). 1-min PM₁ black carbon (BC) concentrations by aethalometer (AE33, Magee Scientific, USA) and 4-h PM_{2.5} organic and elemental carbon (OC/EC) concentrations (Sunset Laboratory Inc., USA) were measured. Also 12-h PM₁ samples by a sequential Leckel LVS-3 (Sven Leckel Ingenieurbüro, Germany) for a subsequent chemical analysis (water-soluble ions, monosaccharides, anhydrides, and saccharides) were collected. Additionally, 10-min average SO₂, NO₂, NO_x and CO concentrations along with the values of meteorological parameters were recorded. To determine the origin of non-refractory PM₁ (NR-PM₁) species (Org, NO₃⁻, SO₄²⁻, NH₄⁺) the back trajectories describing the air mass origin were clustered using the Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model [1]. Last, but not least, the multi-time factor analysis model [2] with modifications was applied on combined dataset (on-line and off-line measurements) to refine the analysis results with respect to the organic aerosol factors as well as organic aerosol sources and their origin.

The campaigns was characterized by prevailing westerly winds with average wind speed of 3.0±1.5 m s⁻¹, average temperature of 18.5±4.7 °C and negligible precipitation. The average PM₁ (NR-PM₁ and eBC) measured concentration was 8.5±3.5 µg m⁻³ (12h PM₁ 10.1±6.4 µg m⁻³). Based on the PNC predominated particles in the size range 25 – 80 nm (N25 – 50 and N50 – 80), also called the Aitken mode, typical for rural background stations and originates from the aging of the particles generated during new particle formation events [3]. NR-PM₁ was composed primarily by organics

(58%) and sulphate (22%) in the accumulation mode (Org mode diameter 300 nm and SO_4^{2-} mode diameter 385 nm) with average particle density $\sim 1.4 \text{ g m}^{-3}$. This result in combination with the cluster analysis points to the regional origin of the particles from southeast (Austria-Hungary-Slovakia). Six Org factors (primary organic aerosol (POA) – fungal origin, biomass burning organic aerosol (BBOA) – related secondary aerosol (SA), semivolatile aerosol – nitrate-rich, secondary organic aerosol (SOA) – oxalate-rich, semivolatile aerosol – microbial origin, primary traffic and biomass organic aerosol (OA)) based on combined data were resolved by multi-time factor analysis model. Modelling of combined dataset provided insides into processes involved in SOA formation and sources.

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