Ambient organic aerosol origin at rural background site in the Czech Republic

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Introduction

Atmospheric aerosols (AA) are ubiquitous particles in the atmosphere that influence the Earth's climatic system, environmental interactions, and human health. Among AA, great interest is dedicated to organic aerosols (OA) since it can represent from 20 to 90% of total submicron mass. Source apportionment of OA at background sites is one of the important tasks of current air quality protection.[1]

Methods

The variability of OA concentrations and their origin during four measurement campaigns was studied at the rural background station National Atmospheric Observatory Košetice (NAOK) in the Czech Republic. Ambient aerosol measurements of non-refractory PM_1 (NR-PM_1) were performed using a Compact Time-of-Flight Aerosol Mass Spectrometer (C-ToF-AMS,[2]) from 8th January to 14th October 2019 with a 5-min time resolution. The C-ToF-AMS measurements were supplemented with equivalent black carbon (eBC) data using an aethalometer (Model AE33, Magee Scientific, Berkeley, CA), 1-hour boundary layer height (BLH) by satellite measurements (ERA hourly dataset provided by the Copernicus Climate Change Service), 72-h back-trajectories (GDAS 1°) for every hour using the Hybrid Single Particle Lagrangian Integrated Trajectory model (HYSPLIT) and 1-hour meteorolocigal data. 30-min averages of NR-PM_1 were calculated and Positive Matrix Factorization (PMF) with multi-linear engine (ME-2) was applied, alongside the use Source Finder (SoFi,[3]) was used.

Results and discussion

Five OA factors/sources were identified during the seasons of winter, spring and autumn: biomass burning OA (BBOA), coal combustion OA (CCOA) and more- and less-oxidized OA (MO-OOA and LO-OOA). Four OA factors/sources were identified for summer, HOA, BBOA, MO-OOA, and LO-OOA. Three of these factors represent primary sources (HOA, BBOA, and CCOA), while the other two represent secondary/oxidized factors. The concentrations of individual factors were significantly influenced by meteorological conditions. The highest concentrations of primary factors seen during were periods with low wind speed and atmospheric boundary layer height. Therefore, the largest share of primary factors (29% of total OA concentrations) was found in winter and the lowest (20%) in summer. Since the aged primary OA becomes part of OOA, the percentage of primary factors cannot be directly related to the share of these emission sources in the overall immission budget.

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