SOURCE APPORTIONMENT AND DYNAMICS INVESTIGATION OF ATMOSPHERIC SUBMICRON AEROSOL FRACTION

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Long-term continuous data (40 years) of gaseous and particulate air pollutants daily concentrations during 1981-2021 at the coastal background monitoring site in Preila (Lithuania) have been analyzed. The Preila site is located in the western part of Lithuania on the shore of the Baltic Sea, on the Curonian Spit and was selected as a motoring site for the European Monitoring and Evaluation Programme location according to strict criteria designed to avoid undue influence from point sources, area sources, and local activities. The long-term trends of all the analyzed S- and N- species were negative except for nitrate concentration. Despite the 95% and 79% decrease of sulfur dioxide and sulfate concentrations, respectively, sulfate comprised a considerable share of the ion balance with nitrate and ammonia.

Atmospheric new particle formation (NPF) is an important phenomenon in terms of global particle number concentrations. The frequency of NPF, formation rates of 10 nm particles, and growth rates in the size range of 10–25 nm using at least 1 year of aerosol number size-distribution observations at 36 different locations including Preila around the world were analyzed. It was found that the NPF frequency has a strong seasonal variability. At the measurement sites analyzed in this study, NPF occurs most frequently in March–May (on about 30 % of the days) and least frequently in December–February (about 10 % of the days). Also it was found that the formation rates of 10–25 nm particles (Jnuc) during the NPF events have a tendency to increase with an increasing degree of anthropogenic influence, being 1 to 2 orders of magnitude higher in urban areas compared with most of the remote and polar sites.

Long-term continuous measurement data of equivalent black carbon (eBC) concentration over a period of 8 years (2008–2015) from the Preila have been analysed. The analysis has shown that the average mean of eBC concentration was 750 ng/m3. A seasonal pattern was also observed with the highest eBC values (1170 ng/m3) in winter gradually declining to the minimum concentration (380 ng/m3) in summer. Cold and warm seasons were parameterized with three and two modes, respectively, showing the concentration being dependent on long-range air masses with different pollution load. A positive annual linear trend for the most of the period was estimated to range from +1.97% to +5.35% per year with the decreasing trend during last two years. This result corresponds with the eBC trends in the Baltic Sea region and will be helpful for assessing the policies of black carbon emissions in Europe.

Inhabitants of cities on average spend more than 90% of their time in indoor spaces where time spent indoors often contributes to many health problems. In order to better evaluate the contribution of outdoor pollution to indoor air pollution, the indoor/outdoor ratios were evaluated during high pollution event and non-event days. During the smoke event days, a substantial increase in the number concentration of larger particles was observed in both indoor and outdoor air. During the event days, the highest PNC was observed at 2.1 µm (21.9 cm−3) and 1.0 µm (2.5 cm−3) in outdoor and indoor air, respectively. In indoor air, particle size ranged up to 3.5 µm while the majority of particles (95.6%) remained < 2.5 µm. eBC mass concentration in both indoor and outdoor air increased twice during the event. eBC mass concentration from fossil fuels origin (eBCff) was dominating in both outdoor and indoor air (68% and 64%). During the event days, the contribution of eBC from biomass burning (eBCbb) to the total BC increased by 22% and 20% (on an absolute scale) in outdoor and indoor air, respectively and no significant differences were found between eBCbb and eBCff particles filtered through the office air supply treatment. These findings are consistent with organic aerosol and eBC source apportionment in Vilnius outdoor air which revealed that during the non-heating season, traffic-related OA contributed to the PM1 fraction by 10% and the contribution of eBCff to total eBC was dominant (up to 92%). In order to improve indoor air quality, a higher standard air filtering system (such as HEPA filters) could be recommended for office buildings, which would provide higher efficiency in BC and other submicron particles removal and, as a result, reduce related possible health impacts.