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A dual stable isotope and radiocarbon approach for apportionment of aerosol sources

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Various natural and anthropogenic activities generate atmospheric sulfur and carbon aerosol which in turn has an adverse effect on human health, climate change and visibility [1], [2]. Man-made sources of aerosol include power plants, vehicular traffic, domestic heating, biomass burning and other industrial emissions. The stable isotope ratio analysis of bulk aerosol material provides valuable information on the origin of its constituents but a combination of stable isotope and radiocarbon techniques allows for an even greater level of differentiation [3].

The aim of this work was to employ stable carbon and sulfur isotope ratio analysis together with radiocarbon data in apportionment of aerosol sources. The collection of aerosol PM₁ samples was performed in Vilnius, Lithuania during a period of 5 months. Stable isotope $\delta^{34}\text{S}$ and $\delta^{13}\text{C}$ values were measured with a stable isotope mass spectrometer and ^{14}C measurements were done using a single stage accelerator mass spectrometer. Simple isotope mixing equations were applied to stable isotope and radiocarbon data to distinguish inputs of biomass, traffic and coal sources of carbonaceous aerosol. By comparing calculated source fractions to $\delta^{34}\text{S}$ values we find that biomass and coal combustion were dominant sulfur aerosol pollutants. In addition, average contributions of coal and fossil combustion, biogenic, soil emissions to sulfate aerosol were evaluated. Finally, the preceding results together with total carbon and sulfate concentrations were related to HYSPLIT air mass back trajectory plots. Such an approach allows for a comprehensive description of sulfur and carbon aerosol pollution sources.

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