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Stable sulfur isotope analysis of aerosol in Vilnius, Lithuania

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Stable isotope analysis is important tool in investigation of SO_2 and sulfate particulate matter chemical processes and provides valuable information on their transport, natural and anthropogenic pollution sources. Around half of atmospheric SO_2 is oxidized to sulfate which can then form on existing aerosols or even nucleate to produce new particles [1], [2]. Physical and chemical processes cause fractionation of sulfur isotope ratios which helps us to differentiate between different sulfur sources.

The aim of this work was to examine $\delta^{34}S$ distribution in atmospheric sulfate aerosol particles and to characterize their sources while applying stable isotope mass spectrometry methods. For this task, the dependence between measurements of atmospheric sulfate aerosol $\delta^{34}S$ and particulate sulfate concentration was found. The sample collection was performed in Vilnius, Lithuania from 5 March until 6 May, during the year 2020. By comparing the aerosol sulfate concentrations to air monitoring data it was found that their values change accordingly to the background particulate matter concentrations in Vilnius, however changes in atmospheric SO_2 concentrations produced little effect. Subsequently, relationship between $\delta^{34}S$ values and aerosol sulfate concentrations was plotted which revealed two possible major sources of sulfate aerosol pollution. These results were then related to atmospheric air parcel trajectory models which were applied to help characterize the pollution sources and their effect on measured $\delta^{34}S$ values.

The results of this work showed that during the sampling period atmospheric sulfate aerosol $\delta^{34}S$ values ranged from 6,1 ‰ to 12,6 ‰. Additionally, it was determined that local pollution sources are represented by lower values of $\delta^{34}S$ whereas long range source $\delta^{34}S$ values are higher. Finally, two probable dominant sources of atmospheric sulfate aerosol pollution were found.

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