Variability of aerosol main chemical components in Lithuanian rural environment: a 5-years study

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Aerosol particles greatly influence the atmosphere and cause changes in the environment because of their chemical composition. Due to this reason, the chemical composition of aerosols should be well known as well as the pathway in which they are formed.

The main chemical components of aerosol were investigated by using the Aerosol Chemical Speciation Monitor (ACSM) in the rural environment of Rūgšteliškis (Lithuania). The measurements were taken during a period of 5 years (2013, 2014, 2016, 2018 and 2019) in three seasons (Spring, Summer & Autumn). The analysis of time series and diurnal trends of organic and inorganic aerosols (OA and IA, respectively) was done. OA had a higher contribution (60-80 %) over all seasons to the total submicron (diameter less than 1 µm) particulate matter (PM_1) than IA (20-40 %). OA had a higher contribution in the summers of 2013, 2016 and 2018 in comparison to spring and autumn seasons. To the seasons of autumn and spring however, in the years 2014 and 2019 the highest contribution of OA was seen during the season of spring. The mass concentration of OA was seen as dominant (77.04%) during all 5 years when time series always were conducted to the total loading (Fig 1).

Possible day and night aerosol chemistry and sources were characterized by diurnal trends of OA and IA (Fig 2). In spring season (except 2016) OA showed higher mass concentration during the morning hours (5-7 h) and lower mass concentration during the afternoon (13-19 h). OA in summer 2013, 2018 and 2019 exhibited higher mass concentration during the morning hours (2-7 h) and lower mass concentration during the daytime (12-19 h). OA in autumn 2018 showed higher mass concentration during the night hours (2-7 h) and lower mass concentration during the daytime (12-19 h) whereas2013, 2014, and 2016 was not showing clear diurnal trend. The diurnal pattern of organic nitrates and inorganic nitrates diurnal trend was viewed independently. Similar pattern was assessed for the mass concentration of $NO_{3(Org)}$ in the spring, summer & autumn seasons and $NO_{3(Inorg)}$ which rose to its maximum in spring between 2-7 h and minimum between 12-19 h. In 2013, 2016, 2018 and 2019 NH_4 was not showing clear diurnal pattern for all the 3 seasons. Except spring and summer 2014 showed higher mass concentrations in day time (10-15h) and lowered mass concentration in night time (1-5 h). The formation of ammonium derived aerosol could be done in NH_4NO_3 and $(NH_4)_2SO_4$ form which aerosol particles are formed when HNO_3 and H_2SO_4 are neutralized with NH_3[1]. Higher mass concentrations of SO_4 were observed during daytime (12-19h) in comparison to night time (1-6 h) except in 2018. The formation of SO_4 derived aerosol was likely occurring by the oxidation of gaseous precursor SO_2. This is followed by the formation of particles by the condensation. Diurnal trend of biomass burning, transport and other man-made emitted primary organic aerosol (BB, TR & Other MM emission, respectively) was performed which was not showing clear diurnal pattern. Additionally, the correlation of $NO_{3(org)}$ and $NO_{3(Inorg)}$ among (OA, SO_4 and NH_4) observed. The results of this study could lead to a better understanding in regard to the changes in climate on the global and local scale.

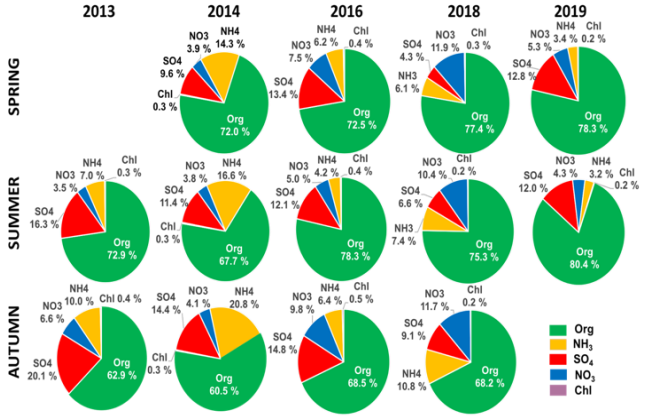

Fig. 1 Main aerosol chemical composition of three seasons (spring, summer and autumn) in the year 2013, 2014, 2016, 2018 and 2019.

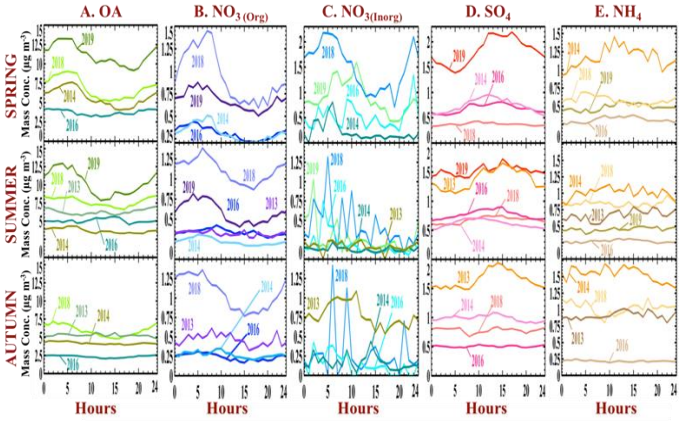

Fig. 2 Five years diurnal trend of (A) OA, (B) $NO_{3(Org)}$, (C) $NO_{3(Inorg)}$, (D) SO_4 and (E) NH_4 for three seasons (spring, summer and autumn).

Keywords; Aerosol, Diurnal, Aerosol chemical speciation monitor

Literature

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