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Black carbon and $PM_{2.5}$ concentrations in two Bulgarian cities

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Abstract. Urban air pollution is the 10th most important risk factor for human health in many countries according to the World Health Organization. In a number of European cities the main problem with air pollution is related to exceedances of limit values for fine particulate matter (PM). In the atmosphere particulate matter is emitted from various anthropogenic and natural sources. Once emitted PM undergo various chemical and physical transformations under the influence of atmospheric processes of different spatial scales. All these factors determine the great variability in the spatio-temporal concentrations of PM and their chemical composition, and require more detailed analyses of interdisciplinary nature. Black carbon (BC) is one of the most significant ingredients of atmospheric fine particle matter. It is typically formed through the incomplete combustion of fossil fuels, biofuel, and biomass, and is emitted in both anthropogenic and naturally occurring soot.

This work presents results from parallel field campaigns for $PM_{2.5}$ sampling in two Bulgarian cities (Sofia and Burgas). The aim of this study is to estimate BC concentration in urban fine particulate matter ($PM_{2.5}$). Two $PM_{2.5}$ sampling campaigns (one in the summer and one during the autumn of 2020) were organized in the Central Meteorological Observatory (CMO) at NIMH Sofia and in the University "Prof. Dr. Assen Zlatarov", Burgas. A total number of 70 $PM_{2.5}$ samples were collected. The Multi-wavelength Absorption Black instrument (MABI), is used for evaluation of the mass absorption coefficient (ε) and the black carbon concentrations in $PM_{2.5}$ samples. This instrument measures light absorption at seven different wavelengths, spanning from ultraviolet to infrared (405nm, 465nm, 525nm, 639nm, 870nm, 940nm and 1050nm), which provides opportunities to differentiate the contributions from sources such as biomass burning (BrC) and fossil fuel burning (BC). The comparisons between $PM_{2.5}$ mass, BC, and BrC concentrations are presented and discussed. The mean $PM_{2.5}$ concentrations are 11μg.m^{-3} for Sofia and 17.4μg.m^{-3} for Burgas. The obtained BC mean concentrations are 1.96 μg.m^{-3} in Sofia samples and 1.39 μg.m^{-3} in Burgas samples. It was found that on an average base 18.4% of the Sofia $PM_{2.5}$ mass is consisted from BC and only 1.3 % is BrC. For Burgas $PM_{2.5}$ mass, 10.3% is consisted from BC and 1.6% is BrC. The concentration of $PM_{2.5}$, BC and BrC during weekdays and weekends are compared. Variations in $PM_{2.5}$, BC and BrC concentrations during different meteorological conditions in both sampling sites are also presented and discussed.

Keywords: Black carbon, $PM_{2.5}$, Urban Air Quality