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Assessment and differentiation of light absorbing carbon in atmospheric aerosols

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Light Absorbing Carbon (LAC) or Black carbon (BC) is one of the most important components of fine particulate matter ($PM_{2.5}$), which is formed through the incomplete combustion of fossil fuels, biofuels and biomass. Based on a number of studies, it has been shown that carbonaceous particles significantly affect air quality/environment and they are an important factor in the carbon cycle and climate change. BC, as one of the constituents of carbonaceous respirable particles, has the property of absorbing light and leads to an increase in the annual average air temperature. Therefore, its quantitative analysis and differentiation for determination of potential radiative effects is extremely important. The BC concentration is usually determined by using thermal or optical methods. In this paper, the results of the application of multi-wavelength optical technique for BC estimation which is based on measuring the intensity of absorption/transmission of light through samples of deposited aerosols on PTFE filters, are presented. Sample collection was conducted at Belgrade suburban background site, in heating and nonheating seasons, using low-volume air samplers. In order to estimate the BC concentration of different particle diameters, measurements were performed by using the MABI ANSTO instrument, with LEDs that emit light at seven different wavelengths: 405 nm, 465 nm, 525 nm, 639 nm, 870 nm, 940 nm and 1050nm. The measurement procedure is started by determination of the value of light transmission I_0 through an unexposed or blank filter at different wavelengths. After sampling, the estimation of light transmission I through the exposed filters was performed. Before estimation of BC concentration, the light-absorbing coefficient (b_{abs}) at each wavelength was determined separately. More intense variations in the values of b_{abs} were observed, which most likely occur due to the change in the nature of the pollution sources at the sampling site. The accuracy of the BC concentration depends on the value of the mass absorption coefficient (ε) estimated experimentally and whose values are compared with the predefined manufacturer values. BC generated by combustion at lower temperatures is better absorbed at shorter wavelengths. On the other hand, BC generated through high-temperature processes is better absorbed in the infrared region of the electromagnetic spectrum. Therefore, the differences of BC concentrations at two boundary wavelengths: 405 nm and 1050 nm were analyzed. Finally, seasonal BC variations were observed, with increased values in the winter and autumn periods compared to the summer period.