EVALUATION OF BLACK CARBON IN FINE ATMOSPHERIC PARTICULATE MATTER ON VARIOUS FILTER TYPES BY MULTI-WAVELENGTH LIGHT ABSORPTION TECHNIQUE

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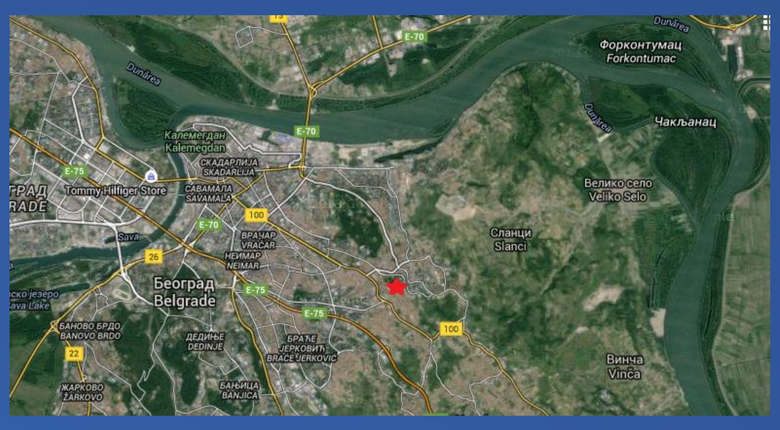
Introduction

❑Black carbon (BC) is important contributor to climate change due to its sunlight absorption and warming effects. It is a major component of fine atmospheric particulate matter emitted during the incomplete combustion of fossil fuels and biomass burning emissions from natural and anthropogenic sources. Measurement methodologies for BC analysis in aerosol samples are mostly based on optical and thermal properties of carbon species and here is presented application of the optical analytical technique based on the multi-wavelenght light attenuation by black carbon component of fine particulate matter deposited on filter media.

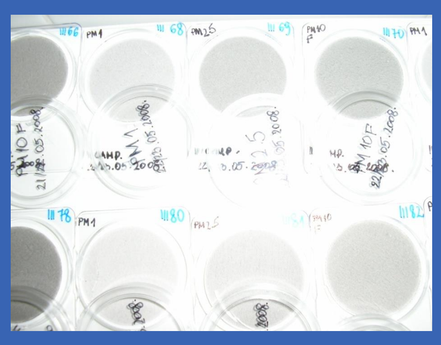


Experimental

❑Membrane filters were exposed for 24 hours each to sample PM 2.5 at urban background monitoring site in one year, using Sven Leckel low-volume air samplers, with 2.3 m^3/h air flow.

❑Four filter types were used for air sampling and BC analysis: polytetrafluoroethylene with 0.2 μm and 0.4 μm pores, quartz and polysaharide filters.

Multi-wavelenght Absorption Black carbon Instrument (MABI) developed by ANSTO, Australia



❑Analysis was done by Multi-wavelenght Absorption Black carbon Instrument (MABI) by irradiation of blank and exposed filters with 405nm, 465nm, 525nm, 639nm, 870nm, 940nm and 1050nm light (LEDs).

❑Black carbon is calculated due to the light attenuation by filter (I_0) and by filter with the deposit (I_0), based on the basic parameters and relations between the light absortion coefficient b_{abs}, mass absorption coefficient ε and BC (1), (2) and (3):

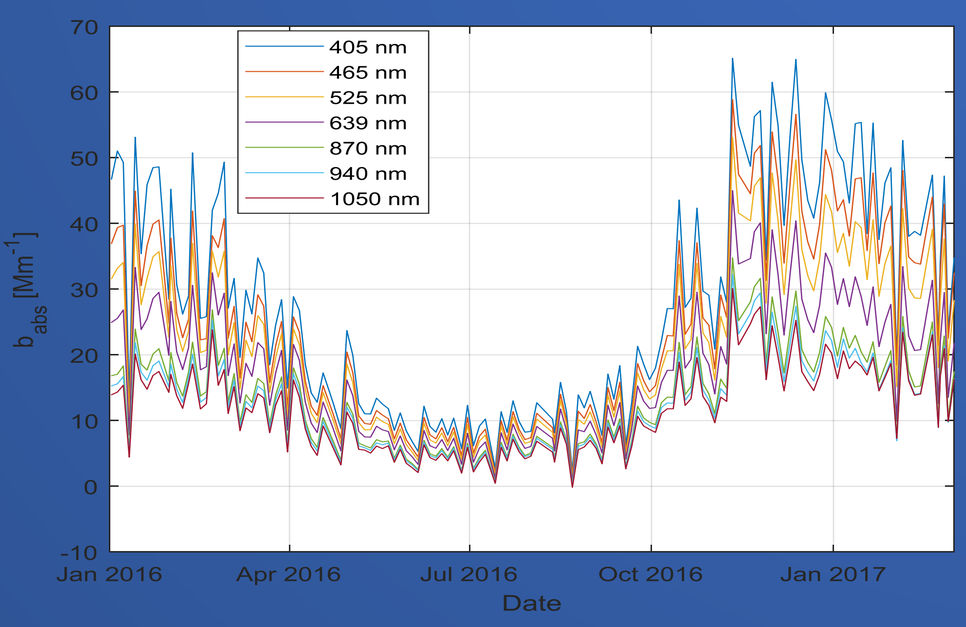
$$b_{\mathrm{abs}}[\mathrm{Mm^{-1}}] = 100\frac{A[\mathrm{cm^2}]}{V[\mathrm{m^3}]}\ln\left[\frac{I_0}{I}\right], (1)$$

$$\varepsilon[\mathrm{m^2/g}] = {b_{\mathrm{abs}}[\mathrm{Mm^{-1}}]}\Big/{\rho[\mathrm{g/cm^3}]}. (2)$$

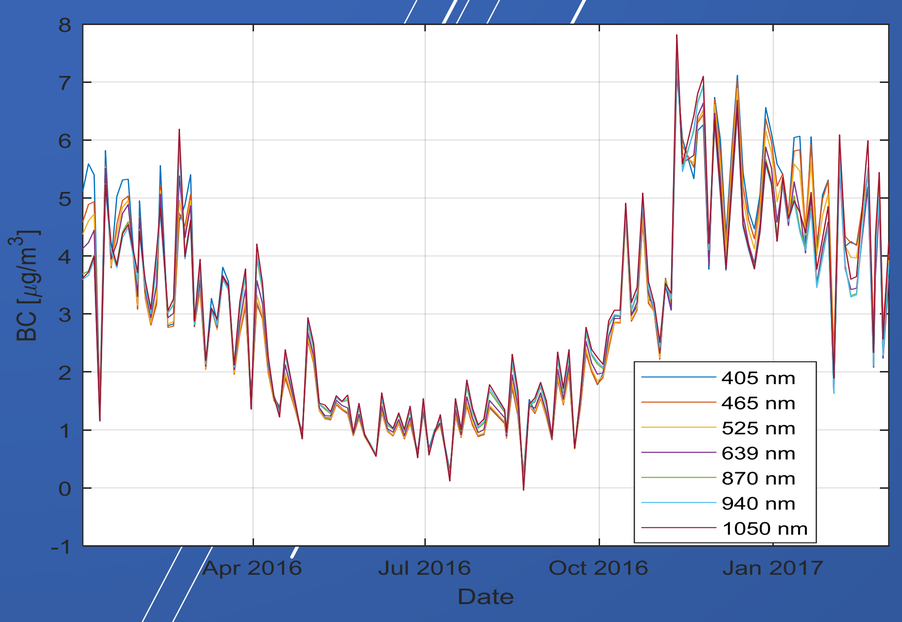
$$BC\ [\mathrm{ng/m^3}] = \frac{10^5 A[\mathrm{cm^2}]}{\varepsilon[\mathrm{m^2/g}]V[\mathrm{m^3}]}\ln\left[\frac{I_0}{I}\right]. (3)$$

Results and Discussion

❑Temporal series of light absorption coefficients b_{abs} calculated for PTFE filters irradiated with seven wavelengths show similar shape for different wavelengths with obvious differences in domain of low wavelengths during heating season.



Temporal series of $b_{abs}[Mm^{-1}]$ for PTFE filters with 0.2 μm pores, for 7 applied wave-lengths by MABI



Temporal series of $BC[\mu gm^{-3}]$ for PTFE filters with 0.2 μm pores, for 7 applied wave-lengths by MABI

- Presented results are obtained for PTFE filters only. Characteristics of quartz and polysaharide filters, particularly their density and thickness do not allow application of this optical analysis in described experimental set-up.
- If the difference $Diff = BC|_{\lambda=405\ \mathrm{nm}} - BC|_{\lambda=1050\ \mathrm{nm}}$. is formed, it could be used to estimate portion of BC originated from the biomass buring sources from the BC coming from traffic related sources i.e. fossil fuel combustion
- The main advantage of this method is simplicity and possibility to be used as complementary to EDXRF or PIXE non-destructive nuclear analytical techniques for elemental analysis of fine aerosol fraction on specific filter media.
- Differentiation between BC coming from different sources represents additional valuable data for source apportionment by positive matrix factorization and reliable discussion of air pollution of selected receptor site.

Acknowledgment
This study was supported by Serbian Ministry of Education, Science and Technological Development and by the International Atomic Energy Egency, TC RER/1/015.