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Long-term Measurements of Black Carbon Concentrations in the Air Basin of Moscow

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Elemental carbon (black carbon, soot) in atmospheric air is present in the form of aerosol particles with the size, mainly, not more than 2.5 microns. Being, for the most part, a product of incomplete combustion of fuel, black carbon is considered one of the main indicators of anthropogenic atmospheric pollution. The need to study black carbon aerosol is primarily due to its unique optical properties, due to which it significantly affects the characteristics of solar radiation passing through the atmosphere and the albedo of the underlying surface (primarily, snow cover), when soot particles are deposited on it [1].

In the period from 1989 to the present time, measurements of soot aerosol concentration in the surface layer of the atmosphere have been carried out at the observation point located in the building of the Obukhov Institute of Atmospheric Physics of the Russian Academy of Sciences at 3 Pizhevsky Lane, Moscow. The place of measurements is located in a dense urban area, not far from highways with a large automobile load.

Until the beginning of 2022, the measurements were carried out with the help of an operator taking aerosol samples on filters and subsequent analysis of data on the change of optical radiation absorption coefficient of the filter with the sampled filter compared to a clean filter. Sampling on filters was performed by the operator on weekdays during daytime hours [2].

Since January 2022, measurements have been performed in automatic mode using a particulate soot aerosol concentration meter (Aethalometer). A series of measurement data of black carbon concentration in the atmosphere obtained with the Aetalometer is characterized by high temporal resolution (1 minute) and small periods of missing data.

According to the data of long-term measurements, the average annual values of the mass concentration of black carbon particles in the air basin of Moscow were calculated and two main periods were identified, one of which is characterized by a well-defined trend for the decrease of black carbon concentration in the atmosphere of Moscow, and the second - by the absence of any noticeable trend.

Using a series of data from 2022 - 2024 of 24-hour measurements of soot aerosol concentration with high temporal resolution, the annual mean values of the mass concentration of soot aerosol were calculated for the entire data set and for a sample in the daytime hours (in accordance with the sampling mode of 1989 - 2021 measurements). It is shown that the differences between the two methods of estimating the mean annual values of black carbon mass concentration in the atmosphere are not more than 4%.

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