IV.9.3 Monitoring concentrations of elemental, organic and black carbon

The first regular measurements of elemental and organic carbon (EC, OC) in the CR were launched in February 2009 at the Košetice Observatory (OBK). The average concentration of total carbon (TC) in 2009–2020 in the sampled $PM_{2.5}$ fraction was 3.3 μg.m^{-3}, of which EC was 0.4 μg.m^{-3} and OC 2.90 μg.m^{-3}. In 2020, the highest average concentration of TC (4.5 μg.m^{-3}) was measured in November. November was 0.5 °C colder at OBK than the average November temperature measured since 2009 (4.3 °C). Several episodes of fog were also observed this month, which continued until December, when the third highest average monthly TC concentration (3.3 μg.m^{-3}) was recorded. Moderately poor meteorological conditions in these months may have affected the results of carbon concentration measurements due to aggravated intermixing of the air owing to the stability of the atmosphere or due to an increase in the need for heating and a rise in the amount of these combustion products. In 2020, the average concentration of TC (2.8 μg.m^{-3}) was the same as in 2019. The average annual EC concentration in 2020 was 0.3 μg.m^{-3} and the OC concentration reached 2.5 μg.m^{-3}. Overall, considering the trend in concentrations during the period of measurements, a slightly decreasing trend can be identified despite the increase in average annual concentrations in some years. While EC concentrations have been gradually

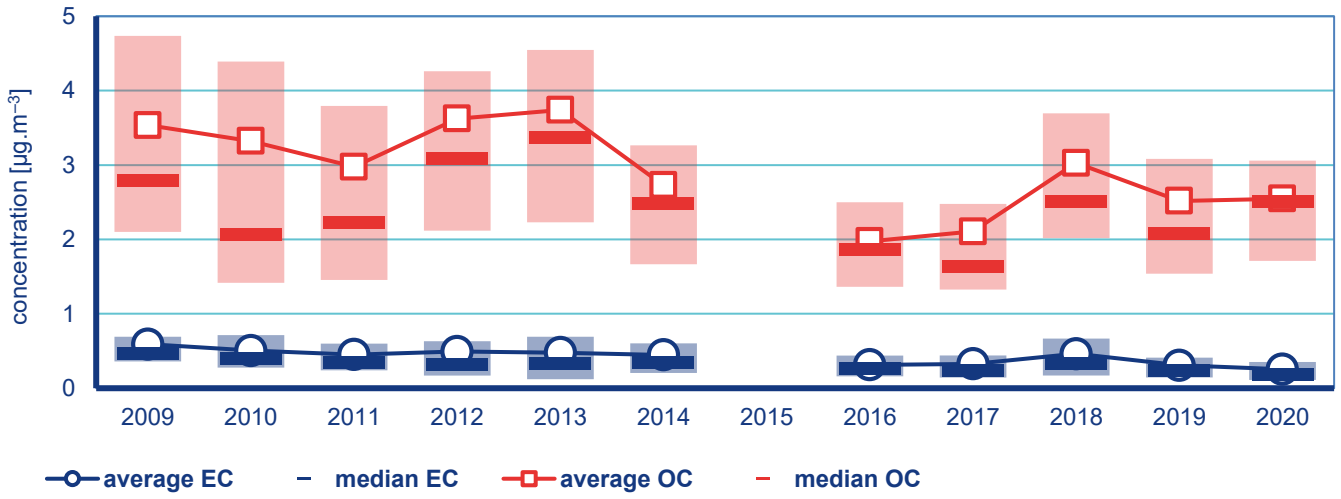

Fig. IV.9.3.1 Annual average concentrations of EC and OC, Košetice Observatory, 2009–2020
Note: The range of daily values is indicated by the top/bottom border of the boxes representing the value of 75th and 25th percentile respectively; the horizontal line indicates the median.

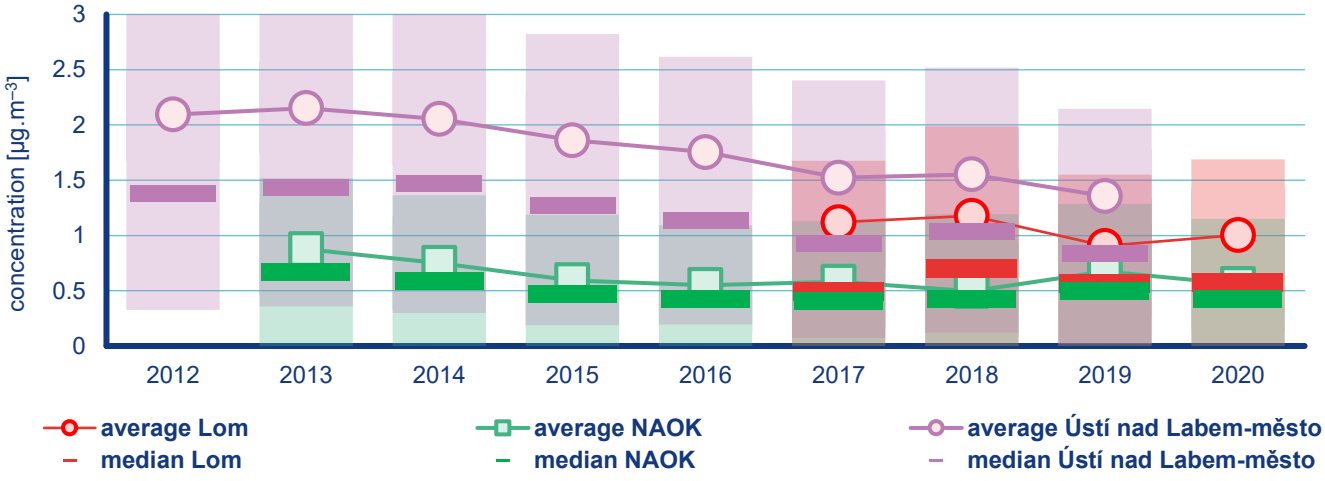

Fig. IV.9.3.2 Annual average concentrations of BC, NAO košetice, Lom, Ústí nad Labem-město, 2012–2020
Note: The range of daily values is indicated by the top/bottom border of the boxes representing the value of 75th and 25th perectentile respectively; the horizontal line indicates the median.

decreasing since the beginning of measurements (2009 – 0.6 μg.m^{-3}), in 2012, 2013, and 2018, concentrations again increased. After the renewal of measurements in 2016, the annual average concentrations were slightly above 0.3 μg.m^{-3}. A significant increase was recorded in 2018. A similar but more noticeable trend was also observed for OC. The highest average value was observed in 2013 (3.7 μg.m^{-3}), while the lowest OC concentration was characteristic for 2016 (2.0 μg.m^{-3}) (Fig. IV.9.3.1).

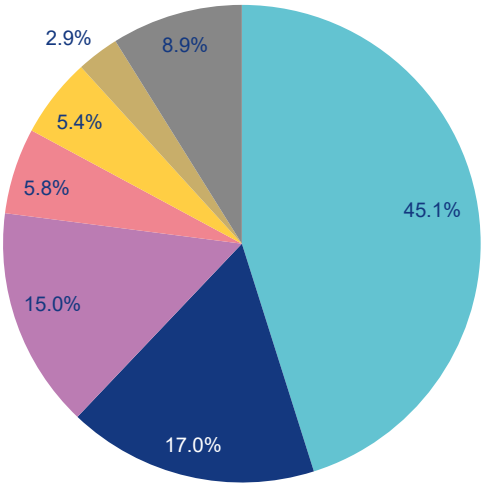

Fig. IV.9.3.3 Share of NFR sectors in total emissions of BC, 2019

Measurements of concentrations of black carbon (BC) take place at three stations, namely the Ústí nad Labem-město, Lom, and the National Atmospheric Observatory Košetice (NAOK)[1], with the Košetice Observatory representing the core station. The Ústí nad Labem-město and NAOK stations have measured BC since 2012, and the station Lom since 2017.

The annual variability of BC concentrations reflects higher amounts of emissions produced during the heating season, as increased values are recorded during the cold part of the year. Apart from the heating season, weekly maxima can be identified namely due to traffic. Another source of BC in the summer months are barbecues.

An evaluation of BC concentrations at all three stations cannot be performed with sufficient reliability in terms of average annual concentrations as the Ústí nad Labem-město station was excluded from the comparison for 2020 due to a significant lack of data (more than 60% data gap). The annual average concentration at the Lom station in 2020 was 1.0 μg.m^{-3} with quartile range of values similar to previous years (the 1st and 3rd quartiles reached 0.3 μg.m^{-3} and 1.3 μg.m^{-3} respectively). The annual average BC concentration at the NAOK station declined from 0.9 μg.m^{-3} in 2013 to 0.6 μg.m^{-3} in 2020. The variability of measured data

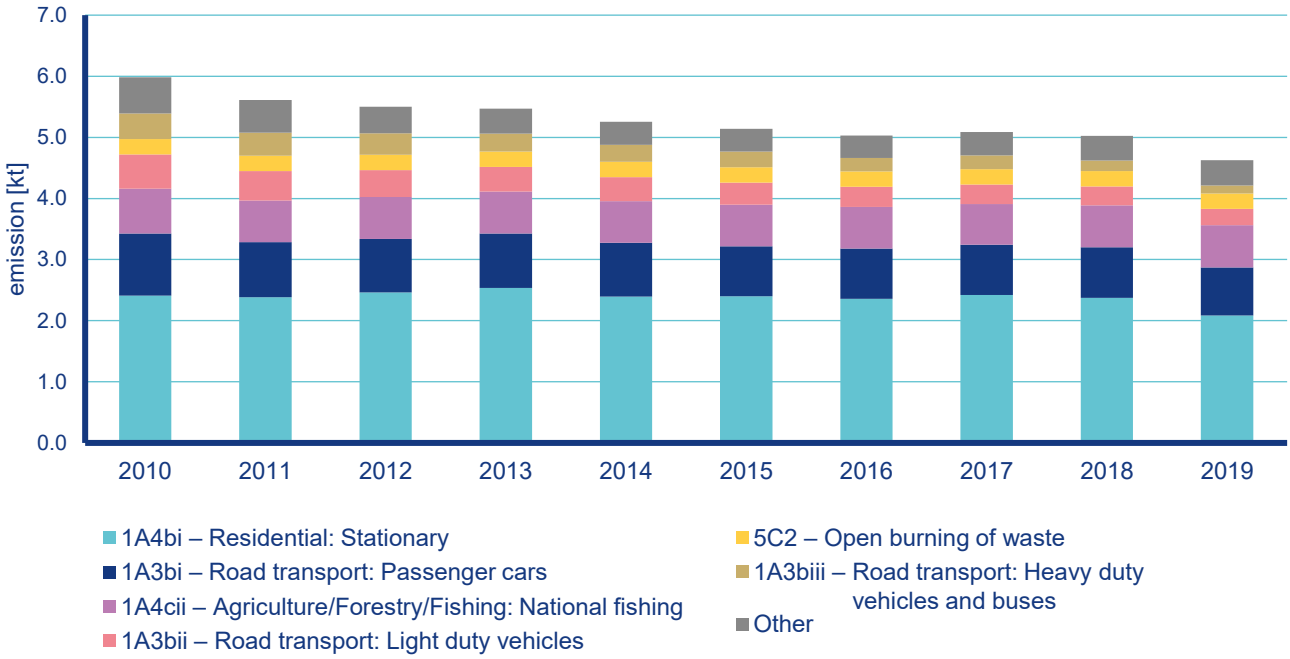

Fig. IV.9.3.4 Total emissions of BC, 2010–2019

1 The indication of the NAOK locality is used for measurements taken within the ACTRIS-CZ project. It is a part of research activities carried out by four partner organizations - the Czech Hydrometeorological Institute, the Institute of Chemical Process Fundamentals of the Czech Academy of Sciences, the Global Change Research Institute of the Czech Academy of Sciences, and the Masaryk University. The NAOK includes the Košetice Observatory and the facilities of the Atmospheric Mast.

was lowest in 2016 (1st and 3rd quartiles reached the values of 0.3 μg.m^{-3} and 0.7 μg.m^{-3} respectively), and moderately increased the following year, similarly to the average concentration. Compared to the previous year, a slight decrease in BC concentrations was recorded in 2020 (from an annual average of 0.7 to 0.6 μg.m^{-3}). However, this decrease does not necessarily mean an improvement in air quality. In 2019, the NAOK updated the monitoring device with a higher measurement frequency and more advanced measurement technology. This change in instrumentation, along with missing data, could have caused minor changes in the results in 2019. Despite the fact that both the Lom and NAOK stations are background stations, almost two times higher average annual concentrations were measured at the Lom station than at NAOK. These differences may be associated with the different structure of sources that affect BC concentrations (Fig. IV.9.3.2).

Based on the results of inventories in the CR in 2019, up to 47% of BC emissions originated from the transport sector, particularly from the combustion of fuel in diesel engines. Of this, the following sectors contributed the most to the total BC emissions: Road transport: Passenger cars (1A3bi) by 17%, and Agriculture, forestry, fishing: Off-road vehicles and other machinery (1A4cii) by 15%. Of stationary sources, the highest BC emissions were produced by the Residential: Heating, water heating, cooking (1A4bi) with a proportion of 45% to total emissions (Fig. IV.9.3.3). Developments in total BC emissions in the 2009–2019 period can be characterized by a decreasing trend, particularly due to measures in the transport sector (Fig. IV.9.3.4)[2].

2 The proportion of BC emissions by sectors has recently been recalculated and the results given in previous years may therefore differ.