V.3 The Ostrava/ Karviná/Frýdek-Místek agglomeration

The character and area of the Ostrava/Karviná/Frýdek-Místek agglomeration (O/K/F-M) differ significantly from the other two agglomerations of the Czech Republic (Prague and Brno). Since the agglomeration covers an area of three whole districts, not only urban areas, the air quality in the territory is represented by all basic types of localities, i.e. besides urban and suburban or transport localities, also sites with industrial, rural, and regional character located from lowlands to mountain areas. The area has been historically burdened with extensive industrial activity in the Upper Silesia basin. The key factors influencing the resulting air quality are high concentration of industrial production, high density of built-up areas with local heating by solid fuels and dense transport infrastructure (Chap. IV) on both sides of the Czech-Polish border. Municipalities in most areas of the agglomeration are directly interconnected (called the Silesia type of built-up area) and industrial sites are part of municipalities. In order to monitor long-term above-limit concentrations of pollutants in the air and their trends, the area is covered by a dense network of more than twenty permanent measuring stations of various organizations supplemented by specialized temporary measurements.

An important factor contributing to the resulting reduced air quality in the agglomeration is the rate and nature of cross-border and inter-regional transport of pollution along the most frequent wind directions. In the area of the Czech-Polish border, it is most typical in the south-west – north-east axis. In the agglomeration (and not only in the immediate vicinity of the Karviná region border), air

Tab. V.3.1 The territory of the Ostrava/Karvinná/Frýdek-Místek agglomeration with the exceeded limit values of individual pollutants

Year	PM_{10} annual average	PM_{10} 24h	$PM_{2.5}$ annual average	NO_2 annual average	Benzo[*a*]pyrene annual average	O_3
2012	31.05 %	85.38 %	67.04 %	–	87.91 %	16.28 %
2013	27.12 %	77.38 %	58.55 %	–	100.00 %	26.51 %
2014	15.88 %	69.28 %	50.15 %	–	88.66 %	5.23 %
2015	0.77 %	53.96 %	28.73 %	–	100.00 %	27.15 %
2016	–	46.32 %	20.50 %	–	97.92 %	7.55 %
2017	1.00 %	65.54 %	34.88 %	–	83.02 %	11.66 %
2018	4.68 %	57.88 %	40.86 %	–	77.13 %	3.33 %
2019	–	9.91 %	1.57 %	–	70.55 %	9.16 %

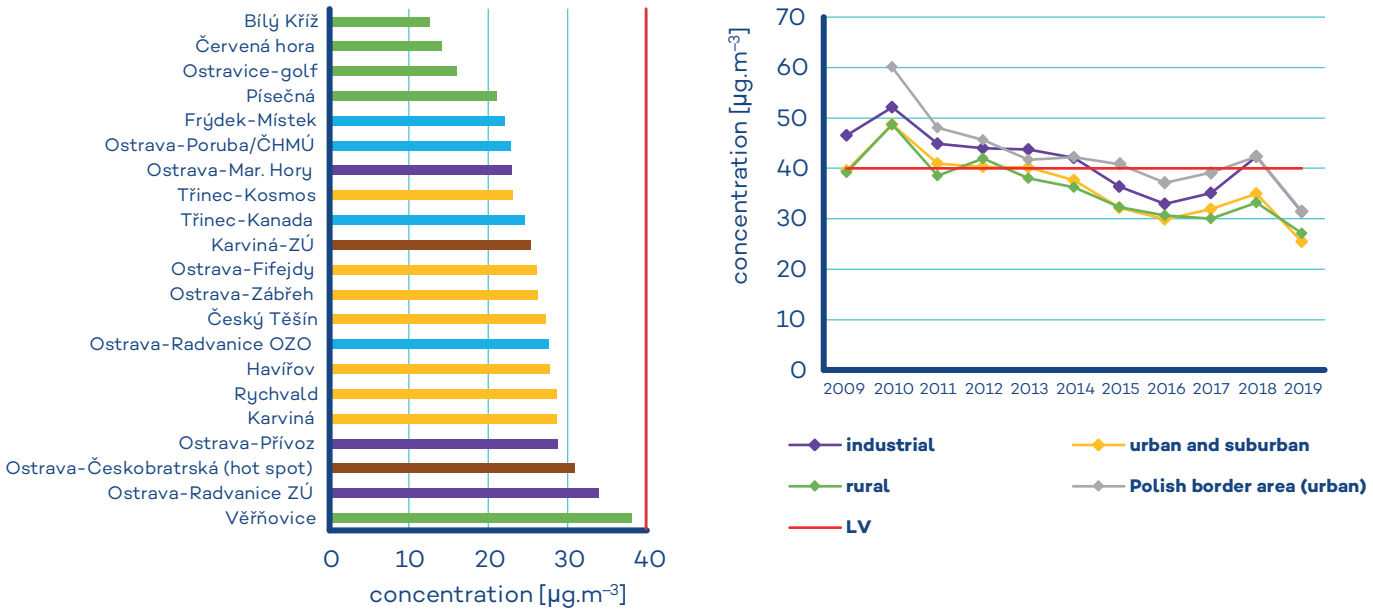

Fig. V.3.1 Annual average concentration of PM_{10} in 2019 and variation of concentrations in 2009–2019, agglomeration of Ostrava/Karviná/Frýdek-Místek

quality is also significantly affected (during certain meteorological situations even principally) by cross-border emissions and air pollution contributions originating in the territory of the Republic of Poland. Possibilities of dispersion or transport of pollutants in the atmosphere are also modified by other meteorological factors (Chap. III). Not only in the lowland plane of the Ostrava basin, but also in the mountain valleys of the agglomeration, the inverse character of the weather with steady atmosphere and subsequent worsening dispersion conditions often occur which also significantly contribute to increasing concentrations of pollutants in the air. The most frequent smog episodes with above-limit threshold concentrations of suspended PM_{10} particles within the agglomeration appear in the Olše and Odra river floodplain areas with the centre of occurrence from December to February.

V.3.1 Air quality in the Ostrava/Karviná/Frýdek-Místek agglomeration

Suspended particulate matter PM_{10} and $PM_{2.5}$

In 2019, the limit annual average concentration of PM_{10} (40 $\mu g.m^{-3}$) was not exceeded in the agglomeration (Fig. V.3.1, Tab. V.3.1). Between 2010 and 2019, except for 2017 and 2018, there was a gradual decrease in concentrations at all types of localities, including the most polluted part of the agglomeration, the Polish border area. Average annual concentrations in 2019 were the lowest in the last ten years. Compared to the ten-year maxima (2010), PM_{10} concentrations at almost all types of agglomeration sites were approximately half in 2019; there was a lower decrease in some industrial localities. This positive result was mainly due to the nature of the prevailing meteorological conditions (Chapter III) which contributed favourably, additionally to the effect of gradual reduction of emissions (Chapter V.3.2). A similar trend was observed in Polish and Czech localities in the border area which have long dominated air pollution surveys.

In 2019, the legally permitted number of 35 days with above-limit daily PM_{10} concentration was exceeded in 2019, unlike in previous years, only in localities of the Karviná area near the Czech-Polish border (Věřňovice, Rychvald, Karviná) and in some Ostrava localities directly affected by significant industrial or traffic sources of pollution (the Ostrava-Radvanice ZÚ and Ostrava-Přívoz industrial stations, traffic hot spot Ostrava-Českobratrská) (Fig. V.3.2). The most cases exceeding the daily PM_{10} limit value (50 $\mu g.m^{-3}$) were recorded in January. In the last ten-day period of this month, particularly poor dispersal conditions caused the emergence and announcement of a smog situation and regulation due to high concentrations of PM_{10} in both parts of the O/K/F-M agglomeration, i.e. without the Třinec area and in the Třinec area (Chapter VI). A higher number of days with above-limit concentrations also occurred in February and March, as well as in October and November. In the opposite, the only month in the year when no day with above-limit concentration was recorded in the agglomeration was August (Fig. V.3.3). The share of stations at which the daily limit value was exceeded in the agglomeration decreased dramatically year-on-year. For the first time in the last decade, the limit has not been exceeded in most urban areas of the agglomeration. The share of localities exceeding the limit value has fallen from earlier 90% to one third.

In 2019, the average annual $PM_{2.5}$ concentrations ranged above the limit (the limit value is 25 $\mu g.m^{-3}$) at two stations in the agglomeration (out of the total of 15 with a sufficient number of measurements). These concerned the Ostrava-Radvanice ZÚ industrial station and the Věřňovice station, which represent the background rural area of the most polluted part of the Czech-Polish border in the Karviná area. The pollution limit value (20 $\mu g.m^{-3}$), in force

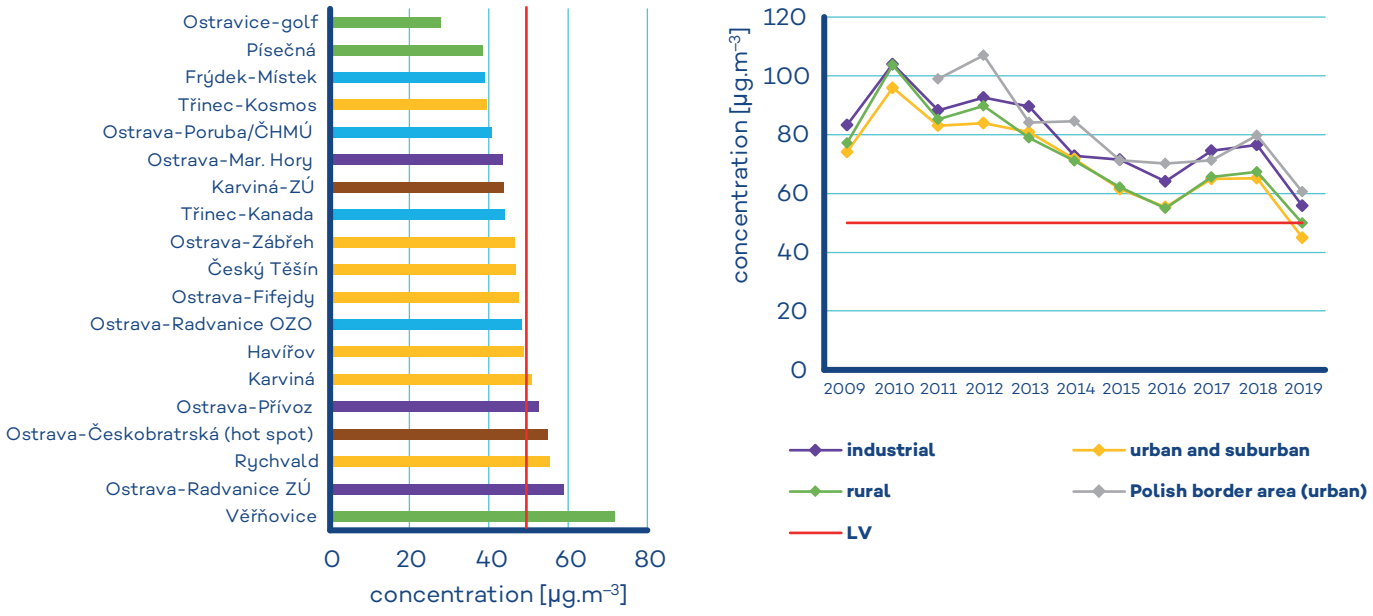

Fig. V.3.2 36th highest 24-hour PM_{10} concentrations in 2019 and variation of concentrations in 2009–2019, agglomeration of Ostrava/Karviná/Frýdek-Místek

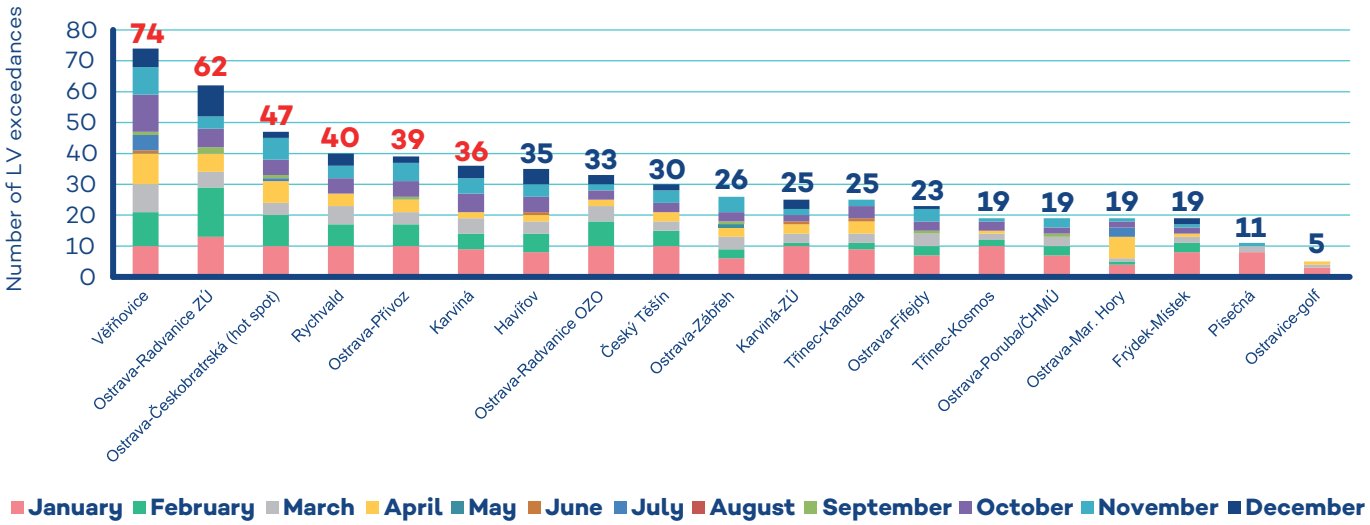

Fig. V.3.3 Number of days with concentrations of PM_{10} > 50 µg.m^{-3} by months, including total number of cases exceeding the pollution limit, agglomeration of Ostrava/Karviná/Frýdek-Místek, 2019

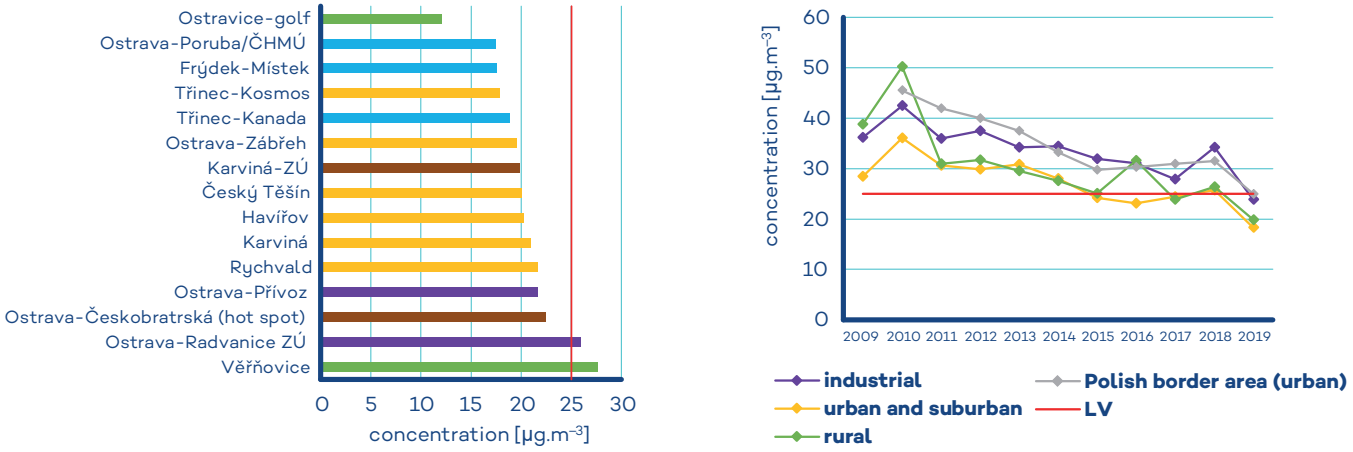

Fig. V.3.4 Annual average concentration of $PM_{2.5}$ in 2019 and variation of concentrations in 2009–2019, agglomeration of Ostrava/Karviná/Frýdek-Místek

from 2020, would be exceeded at approximately half of the stations with measurements available for this pollutant (Annex II). Nevertheless, this is the most favourable situation recorded in the agglomeration since the beginning of the measurement of this pollutant. The course of concentrations since 2009 (Fig. V.3.4) has been similar to that of PM_{10}, with $PM_{2.5}$ showing an even greater decrease in pollution in rural areas than PM_{10}.

Benzo[*a*]pyrene

The level of pollution by benzo[*a*]pyrene, an indicator of the contamination of the air by carcinogenic organic substances, is a very serious problem posing health risks in the entire cross-border area of Silesia and Moravia. Compared to the average concentration in the Czech Republic, several-times higher content of this pollutant is permanently measured in suspended particulates in the O/K/F-M agglomeration. Also in 2019, the annual average concentration of benzo[*a*]pyrene in PM_{10} mostly exceeded the limit value of 1 ng.m^{-3} several times in the agglomeration. The annual variation of concentration exhibits maximum benzo[*a*]pyrene values in the colder parts of the year while summer concentrations are substantially lower. However, in industrial locations of the O/K/F-M agglomeration, daily concentrations higher than 1 ng.m^{-3} occur persistently even in the warm part of the year which indicates the year-round effect of benzo[*a*]pyrene industrial emissions in these areas. As in previous years, in 2019, the highest annual average concentration of benzo[*a*]pyrene (8.7 ng.m^{-3}) was measured at the Ostrava-Radvanice ZÚ industrial station. So, the pollution limit value was exceeded there more than eight times. High values of benzo[*a*]pyrene can, however, be anticipated in the Czech-Polish border area (Chap. VIII) because of high concentrations measured in the south of the

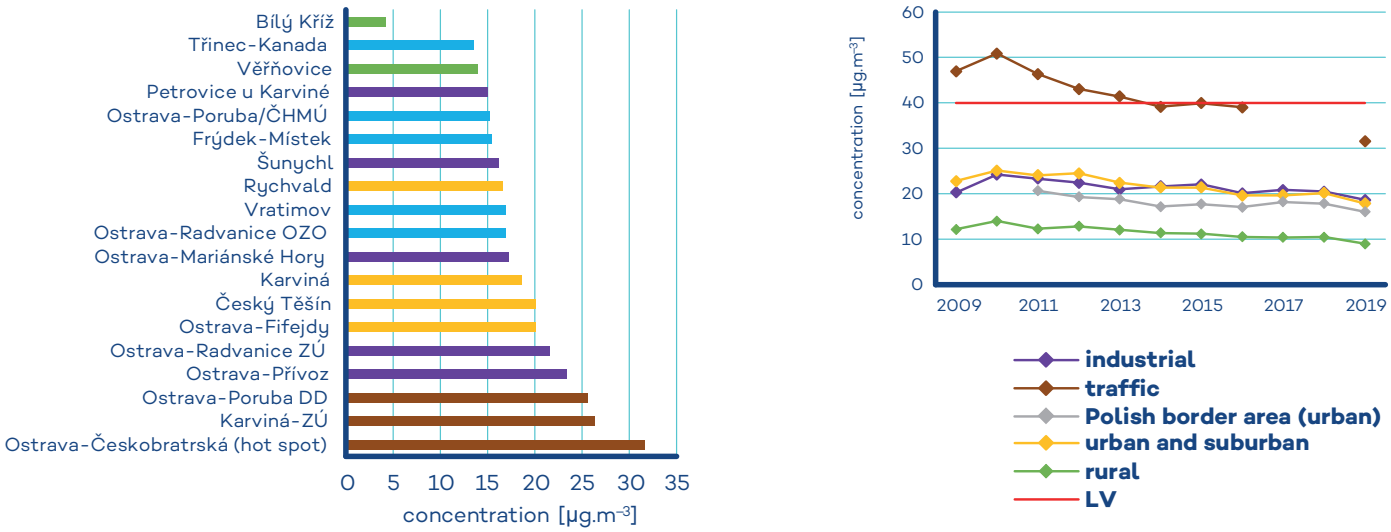

Fig. V.3.5 Annual average concentration of NO_2 in 2019 and variation of concentrations in 2009–2019, agglomeration of Ostrava/Karviná/Frýdek-Místek

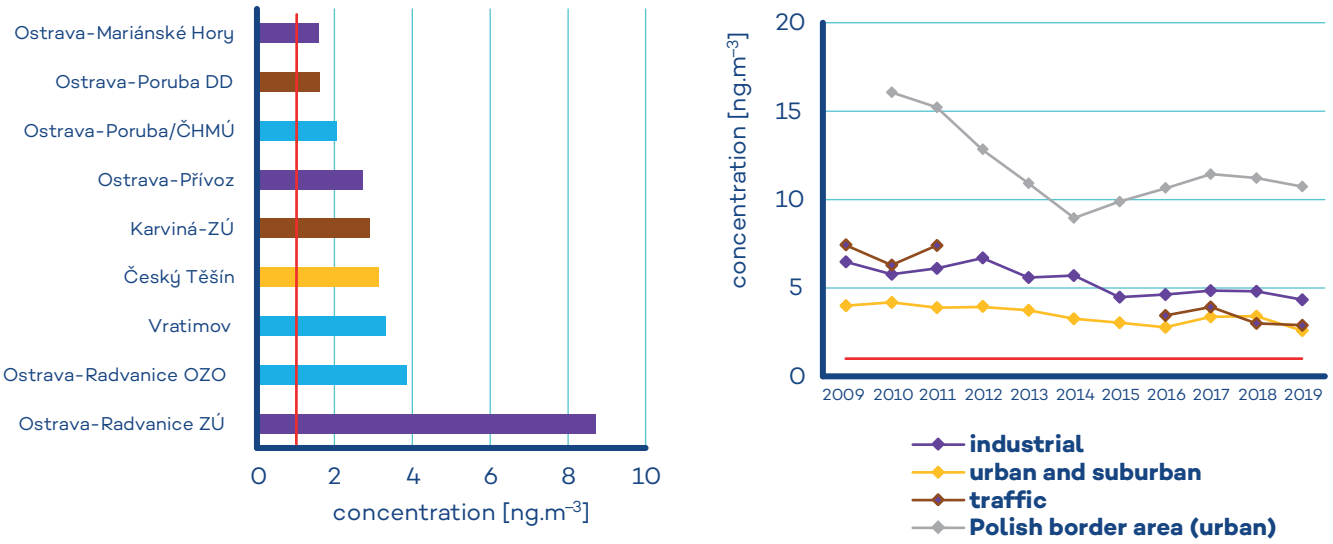

Fig. V.3.6 Annual average concentration of benzo[*a*]pyrene in 2019 and variation of concentrations in 2009–2019, agglomeration of Ostrava/Karviná/Frýdek-Místek

Republic of Poland (Fig. V.3.6). The amount of emissions of hydrocarbons released in the territory of Poland ranks, so far, among the highest within EU and a proportion of households with solid fuel heating is much higher at the Polish border area than at the Czech side of the border (VŠB-TU Ostrava 2018). Above-limit values can be expected also in other municipalities and urban areas of the agglomeration with a higher share of solid fuel heating of households where benzo[*a*]pyrene is not routinely measured in the long term. An example can be the above-limit value at the Vratimov station (3.3 ng.m^{-3}) where the observation was subsidized in 2019 from the budget of the Moravian-Silesia region. Historically, below the limit concentration of benzo[*a*]pyrene in the agglomeration was measured only in 2017 at the Bílý Kříž rural background mountain locality in the Moravian-Silesia Beskydy. The average annual concentrations of benzo[*a*]pyrene have rather been fluctuating in the last ten years (Fig. V.3.6). In 2019, in view of year-on-year changes, a decrease was recorded at almost all stations compared to 2018. The exception was the Ostrava-Radvanice ZÚ industrial station where the average annual concentration increased from 7.7 ng.m^{-3} in 2018 to 8.7 ng.m^{-3}.

Nitrogen dioxide

The annual average NO_2 concentrations in the agglomeration were below the limit values in all monitored localities with sufficient number of measurements in 2019. The value of the hourly limit for NO_2 at 200 µg.m^{-3} was not exceeded at any of the stations (the

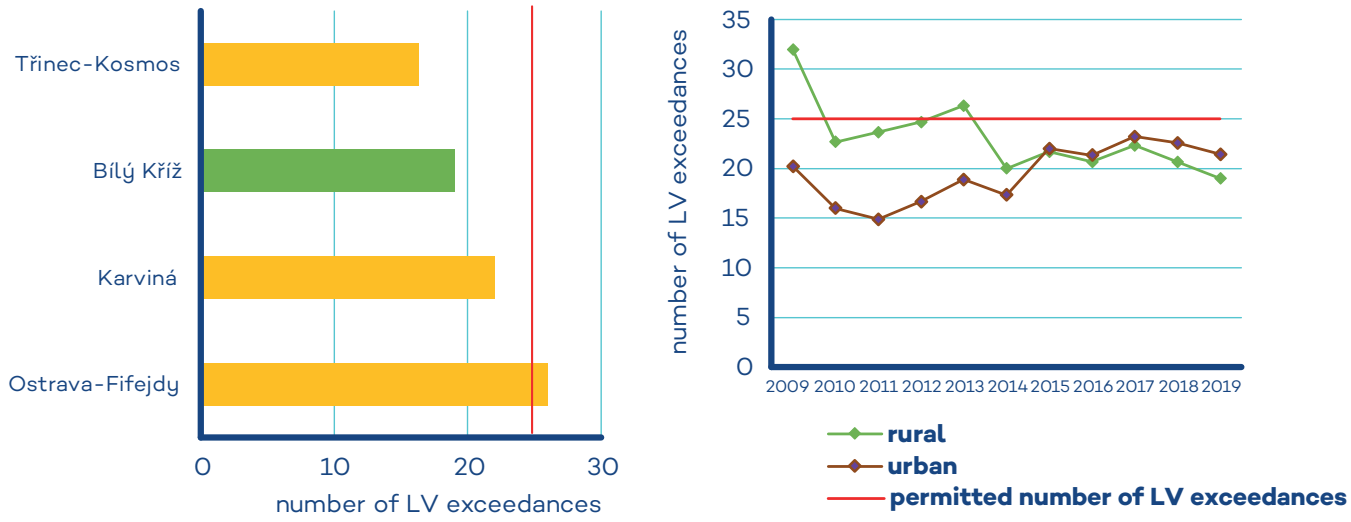

Fig. V.3.7 Number of cases exceeding the pollution limit of O_3 in the average for three years in 2010–2019, agglomeration of Ostrava/Karviná/Frýdek-Místek

maximum hourly concentration of 128.2 μg.m^{-3} was measured at the Ostrava-Poruba, DD traffic station). Within the agglomeration, the highest average concentrations occur at the Ostrava-Českobratrská (hot spot) station. It is focused on monitoring pollution originating primarily from traffic in the Ostrava city narrow street area where the concentration level in the past oscillated close to the annual pollution limit value of 40 μg.m^{-3}, or exceeded it. The variation of NO_2 concentrations over a ten-year time series shows only a slow decrease. There has been a year-on-year decrease in concentrations at all types of localities (Fig. V.3.5).

Ground-level ozone

In 2019, the number of instances exceeding the pollution limit level for ground-level ozone (maximum 8-hour daily average) on an average over three years surpassed the permitted limit of 25 days at three Ostrava stations (Ostrava-Fifejdy, Ostrava-Mariánské Hory, Ostrava-Radvanice OZO). In the O/K/F-M agglomeration, ozone was measured at 7 stations. The number of cases exceeding the limit value decreased year-on-year (Fig. V.3.7). No smog situation was announced for O_3 in the agglomeration in 2019 (Chapter VI).

Other substances

In 2019, there was a year-on-year decrease in benzene concentrations. The highest average concentration was observed at the Ostrava-Přívoz industrial station (4.2 μg.m^{-3}). Unlike in 2018, the limit value of 5 μg.m^{-3} was not exceeded there. In this locality, the limit value was being exceeded in the past. Screening measurements (Krejčí and Černikovský, 2013) in 2011–2012 confirmed the well-known position of the most important large sources producing benzene emissions in the city of Ostrava (chemical production at BorsodChem MCHZ, Ltd., and coking plants) situated at the axis of prevailing air flow direction towards the monitoring station. It cannot be ruled out that emissions resulting from the remediation work carried out at the old ecological burden on the Ostrava waste lagoons of the Ostramo processing plant could also contribute to the resulting concentration in 2018. The occurrence of short-term extreme peak benzene values in this part of Ostrava is, however, necessary to monitor systematically. None of other localities in the agglomeration exceeded the pollution limit value, nor has it occurred in the long term.

In 2018, intensive remediation activities were carried out in removal of the so called over-the-amount sludge from oil lagoons formed by deposition of waste from refinery production and use of lubricating oils at the former Ostramo processing plant in Ostrava. In relation to this activity, peaks of extreme hourly SO_2 concentrations occurred at some Ostrava air quality monitoring stations, similarly to 2011. In 2019, similar extreme air pollution concentrations no longer occurred. The average annual SO_2 concentrations decreased year-on-year in all types of localities in the whole agglomeration.

Carbon monoxide concentrations in the Czech Republic have long been below the limit. In relation to higher emissions from industrial sources, higher values are persistently observed at the Ostrava localities in the agglomeration than in other areas of the Czech Republic.

In the O/K/F-M agglomeration in the last decade, concentration of metals in PM_{10} suspended particulates mostly decreased. In 2019, annual average concentrations of all metals followed the year-on-year trend apparent for suspended particulates and, in comparison of 2018/2019, a slight decrease of annual average concentrations occurred in all types of localities. The pollution limit values (adopted for nickel, arsenic, cadmium and lead) were not exceeded in 2019 in the O/K/F-M agglomeration.

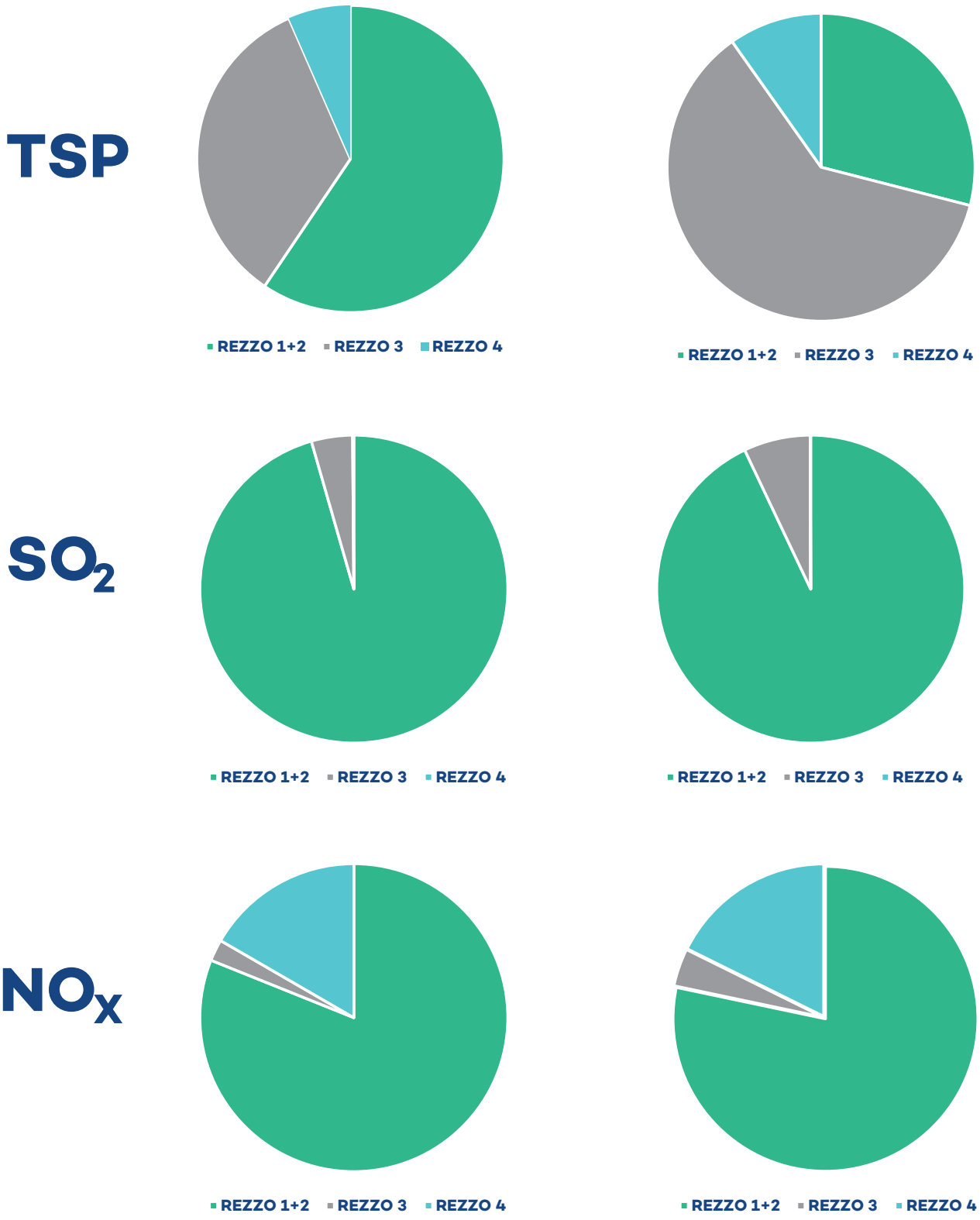

Fig. V.3.8 Emissions of selected pollutants classified according to REZZO, agglomeration of Ostrava/Karviná/Frýdek-Místek, 2018

V.3.2 Emissions in the Ostrava/Karviná/Frýdek-Místek agglomeration

The particular categories of emission sources have different proportion in the O/K/F-M agglomeration than in other parts of the Czech Republic (Fig. V.3.8). According to a detailed assessment of the course of emissions in 2008–2016 prepared for update of the programme for improving air quality in 2018, the share of industrial sources and the energy sector in the emissions of the main pollutants is still decreasing. According to preliminary data for 2019, significant metallurgical complexes together with coking plants, energy sector and other specifically monitored sources produced about 725 t of SPM emissions which was again less (by about 18%) than in the previous year. Further reductions were also recorded for SO_2 emissions (by 16.5%) and NO_x emissions (by 16.3%). The most significant reduction in SPM emissions (by more than 80 t) took place at the steel and crude iron production plants of Liberty Ostrava, a.s. (successor of ArcelorMittal). In addition to further greening of the operation, a reduction by 20% in production capacity from mid-July 2019 also contributed to this result. A decrease in SP emissions by about 10 t was also recorded at the production of Třinecké železárny, a.s. For benzo[*a*]pyrene, the share of emissions from local heating predominates and the year-on-year changes therefore occur mainly due to variable parameters of the heating period. Approximately 2% of benzo[*a*]pyrene emissions are attributable to individually monitored sources, mainly coke production (Liberty Ostrava, a.s., TŘINECKÉ ŽELEZÁRNY, a.s. and OKK Koksovny, a.s.) and iron production — especially the processing of iron ore into agglomerates.

Currently, approx. 770 places of operation of sources of air pollution included in the REZZO 1 and 2 databases are specifically registered in the territory of the agglomeration. Only several dozen of them have a substantial effect on overall emissions. In a total of SPM, SO_2 and NO_x emissions the highest amounts are produced by power plants and enterprise energy generation (e.g. TAMEH Czech s.r.o. – heating plant of the enterprise, Veolia Energie ČR, a.s. – Třebovice power plant, and Dětmarovice power plant). For technological sources, these are metallurgical production facilities, primarily ore agglomeration and production of crude iron (Liberty Ostrava a.s. – Plant 12 Blast Furnaces and TŘINECKÉ ŽELEZÁRNY, a.s. – Production of pig iron), but also some other sources such as Viadrus, a.s. in Bohumín or VÍTKOVICE HEAVY MACHINERY a.s., Plant 3. Approximately fifteen of the most important facilities produce annually 90% of all SPM, SO_2 and NO_x emissions of individually monitored sources and their share on equal type of emissions of all categories of sources is above 65%. This proportion does not include difficult-to-estimate fugitive SP emissions produced, for example, from landfills, handling of bulk materials and halls with dusty operations.

According to the output of SLDB 2011, central heating sources predominate in heating households (approx. 59% of flats), followed by gas boilers and local gas boilers (together approx. 25% of flats). The greatest differences can be found in the evaluated territory stemming primarily from the character of households in the districts. While in the Frýdek-Místek district the fraction of flats heated locally with solid fuels is close to 20%, this fraction equals only approx. 8% in the Karviná district and only 4% in the Ostrava district. This fact, exacerbated in addition by the higher average altitude of settlements in the Frýdek-Místek district and the greater average size of flats, is manifested primarily in emissions that have a substantial portion in the REZZO 3 category, i.e. SP and particulates, VOC, benzene and especially emissions of benzo[*a*]pyrene.

V.3.3 Summary

In the O/K/F-M agglomeration, some limit values for the concentrations of suspended particles and the benzo[*a*]pyrene bound thereto are still exceeded. Concentrations measured at the localities in the agglomeration are among the highest in the Czech Republic. The maximum values of average annual concentrations of PM_{10} and $PM_{2.5}$ measured there occur not only in the vicinity of large industrial sites but also near the Czech-Polish border. Pollutant concentrations below the limit values are more frequently measured in the southern part of the agglomeration in the background and rural localities in the Moravian-Silesia Beskydy mountains and their foothills. Air pollution by suspended particles is not only a problem in the agglomeration in the cold half of the year. The $PM_{2.5}/PM_{10}$ concentration ratio is highest at industrial sites of the O/K/F-M agglomeration (Fig. IV.1.16). Although the limit values for the protection of human health are exceeded on both sides of the Czech-Polish border, the concentration level of suspended particles and the benzo[*a*]pyrene adsorbed on them is different in the Czech and Polish localities in the border area of interest. Particularly in the case of benzo[*a*]pyrene concentrations, pollution in the adjacent Polish part of southern Silesia clearly dominates. The impact of transborder pollution transmission is most noticeable in the concentration levels measured in the valley localities of the border water streams, which are often comparable with industrial sites in Ostrava.

There is a specific sharing of particular categories of primary emission sources in the O/K/F-M agglomeration; REZZO 1 sources dominate in all the registered categories except for benzo[*a*]pyrene. The resulting effect of a complicated emission profile and mesoclimate conditions of the area, and also of mutual trans-boundary transport of polluting substances and their precursors between the Czech Republic and the Republic of Poland, is above the limit pollution concentration of pollutants in the air demonstrated by increased risks for the population.

The benefits of the measures implemented to reduce emissions released into the air in the agglomeration area were accompanied in 2019 by a positive effect of the prevailing improved meteorological conditions. In the O/K/F-M agglomeration, the average concentrations of the vast majority of pollutants decreased year-on-year. The most significant improvement occurred regarding suspended particulates. Despite this, smog situations were announced in the agglomeration in January due to high concentrations of PM_{10}. There was an increase in benzo[*a*]pyrene concentrations only at one industrial station in Ostrava, in other cases a decrease was also recorded for this pollutant.

In the warm part of the year, the above-limit level of pollution was reached by exceeding the permitted number of 25 days with a maximum daily 8-hour average of ground-level ozone concentration averaged over three years in Ostrava localities.