V. AIR QUALITY IN REGIONS OF THE CZECH REPUBLIC

For assessing and evaluating air pollution levels, Act No. 201/2012 Coll., on air protection, divides the territory of the CR into zones and agglomerations, with zones consisting of one to three regions. This chapter deals with a more detailed assessment of air quality in regions of the CR, where a region means an administrative region, agglomeration, or the territory of an administrative region without an agglomeration. The following indicators are used for interregional air quality assessments: air quality index (Chap. V.II), the concentration of selected air pollutants weighted by population in regions of the CR and in cities with more than 30 000 inhabitants, the proportion of inhabitants living in areas with above-limit air pollution, and the proportion of the regional area exceeding air pollution limits (Chapter V.III). Characteristics of the regions focusing on effects related to air quality are supplemented by the composition of TSP, NO_x and SO_x emission sources in the given region (Figs. V.1.1, V.1.2, V.1.3).

V.1 Characteristics of regions

Agglomeration of Prague

In terms of air pollution, the capital of Prague ranks among the most polluted areas in the CR. This situation is a result of the interaction of a number of anthropogenic and natural factors. The location of Prague in the complex terrain of the Prague basin fundamentally affects the climatic and dispersion conditions in the territory (Ložek et al. 2005). Particularly in colder times of the year, suitable conditions appear in the Vltava River valley for the formation of temperature inversions, resulting in the accumulation of concentrations of harmful substances in the atmospheric ground layer.

The worsened air quality in Prague is mainly related to the heavy traffic load. Due to its location, Prague is not only the main hub of the road network in the CR, but is also an important hub for international transport. A large number of main transport roads go through the centre of Prague. The growth of the service sector and the associated construction of commercial and administrative centres have resulted in further demands on transport services and energy consumption, including heating.

The consumption of solid fuels for heating of family houses, especially in suburban parts of the city, and the growing popularity of the use of fireplaces and stoves (MHMP 2020) also have a significant impact on the current air pollution in Prague. On the contrary, only two boilers burning solid fuels remain included in the listed sources, using brown coal (NEXIMA Praha Řeporyje) and woodchips (FTV Lipence). The largest proportion of TSP and NO_x emissions comes from transport, with SO_x emissions mostly from household heating.

The most significant listed sources[1] of TSP emissions are permanent or temporarily operating recycling lines of construction wastes (e.g., KARE, Praha Chodovská) and the mining and processing of minerals (Českomoravský Cement – Radotín Plant, KÁMEN Zbraslav, or concrete plants). SO_x emissions are mostly produced by the Českomoravský Cement – Radotín Plant and KNAUF Praha companies, and to a lesser extent also by the NEXIMA coal boiler and Pražské služby – Malešice Incinerator. The most significant sources of NO_x emissions come from the Radotín Plant of Českomoravský Cement (more than 65 % of the listed sources emissions), and the Pražské služby, a. s. – Plant 14, Malešice Facility for Waste Energy Recovery. Other significant sources include Veolia Energie Praha, a. s. – Veleslavín Heating Plant and the operation of co–generation units burning sludge gas (Pražské vodovody a kanalizace, a. s., ÚČOV Praha 6) and landfill gas (TEDOM a. s. – Daewo–Avia Co–generation Heating Plant) are gradually increasing.

In terms of carbon monoxide emissions, the dominant proportion (more than 50 % of the total emissions from the listed sources) comes again from cement production (Českomoravský cement – Radotín Plant). As a result of the SARS-CoV-2 pandemia, NMVOC emissions from both important sources (Svoboda Press Printing House and Trelleborg Wheel Systems Czech Republic, Prague plant) decreased by about 20 % compared to 2020.

1 The sources listed in Annex No. 2 to Act No. 201/2012 on air protection are monitored individually, except for the livestock breeding category. Pursuant to Article 17(3)(c), the operators of these sources are obliged to keep operational records on permanent and variable data on a stationary source describing the source and its operation and data on inputs and outputs from this source (for more see CHMI 2022d).

Central Bohemia zone

Central Bohemia Region

The Central Bohemia Region is the largest region of the CR in terms of size, the number of municipalities, and population. The relief of the region is relatively featureless. The north and east are flat, while the south and south–west are dominated by highlands.

Air quality in the Central Bohemia Region has long been affected by the industrial character of the region; the key industries are mechanical engineering, chemistry and food production. The region has a dense transport infrastructure and high traffic intensity in connection with the Prague agglomeration (NO_x). There are dense residential areas using local heating. 40.7 % of the population live in municipalities with a population of up to two thousand (1 026 municipalities). The ratio of the urban population to the total population of the region was 51.7 % as of 31 December 2019, which was the lowest in the whole CR (CSO, 2020).

The most significant listed sources of TSP emissions include the production of electricity and heat (Energotrans Mělník, Kladno Heating Plant), ŠKODA AUTO – Mladá Boleslav Plant, ORLEN Unipetrol RPA – Kralupy Refinery and the mining or processing of minerals (Čertovy schody Lime Plant, SHB – Bernartice Quarry and other sources). SO_x emissions mainly come from the production of electricity and heat (Energotrans Mělník, Kladno Heating Plant – Kladno Power Plant, Veolia Energy Kolín – Kolín Power Plant) and industrial sources (e.g., ORLEN Unipetrol RPA – Kralupy Refinery). The most significant sources of NO_x emissions are also represented by sources producing electricity and heat (Energotrans Mělník, Kladno Heating Plant – Kladno Power Plant and Veolia Energy Kolín – Kolín Power Plant), and industrial sources (SPOLANA, KAVALIERGLASS Sázava Plant and ORLEN Unipetrol RPA – Kralupy Refinery).

The dominant proportion of other pollutants (approx. 55 % of the total emissions from listed sources) is represented by CO emissions from lime production (Čertovy schody Lime Plant), and by NMVOC emissions from car production (ŠKODA AUTO a. s. – Mladá Boleslav Plant and Toyota Peugeot Citroën Automobile Czech) and production of building materials (Styrotrade Čakovičky and TEMAC Zvěřínek) – together almost 50 % of the total emission of the listed sources.

South–western zone

South Bohemia Region

The South Bohemia Region is the second largest region in the CR by size, and at the same time it has the lowest population density in the entire country. The region represents a geographically relatively closed unit, the core of which is the South Bohemian Basin. The majority of the region lies at an altitude of 400 to 600 m a. s. l. About a third of the region's population lives in České Budějovice and in the four largest cities of the region.

The air quality of the South Bohemia Region within the CR can be evaluated as good. The mountain areas of the Šumava and Novohradské Mountains are among the least affected areas. Worse air quality can be expected in the České Budějovice agglomeration and in the centres of larger cities (Tábor, Písek, Strakonice), where the majority of industrial production in the region is concentrated. Road transport has an equally important effect on air quality in settlements.

The most significant listed sources of TSP emissions include sources producing electricity and heat (České Budějovice Heating Plant – Novohradská Street), the mining and processing of minerals (LB MINERALS – Borovany Branch and Kámen a písek – Plešovice quarry), and other industrial sources (Kasalova Sawmill – Jindřichův Hradec, DIAMO tailing pond, SUL Příbram – Mydlovary, and Aluprogress). The most significant sources of SO_x emissions include the REZZO 1–2 category sources, representing the production of electricity and heat (Strakonice Heating Plant, České Budějovice Heating Plant – Novohradská and Vráto, Písek Heating Plant, ZVVZ ENERGO Milevsko, Kaplice Technical Services – Municipal Heating Plant, Planá Power Plant, Tábor Heating Plant) and the most significant NO_x emission sources include also the production of electricity and heat (České Budějovice Heating Plant – Novohradská Street, Strakonice Heating Plant, C–Energy Planá, CARTHAMUS – Energoblok Domoradice).

Plzeň Region

The Plzeň Region is the third largest region in the CR in terms of area, but in terms of population it ranks eighth in the country. The Plzeň Region is characterized by diverse relief. The border mountains in the south–west (Šumava and Český les) dominate one side, in contrast to the Plzeň Basin in the north–east of the region. The region's topography is complemented by the central part formed by the Plzeň Uplands and partly by the Brdy Highlands.

The air quality of the Plzeň Region within the CR can be evaluated as relatively good. The least affected areas include the mountain areas of Šumava, Český les, western Brdy, and the area around the Manětín and Nečtiny municipalities. The situation is opposite in Plzeň and its surroundings, where specific emissions in the Plzeň–City District exceed the values of specific emissions in the CR by multiple times. Plzeň and its surroundings are affected by a high concentration of industrial activities and road traffic.

The Plzeň Region is characterized by a high number of small settlements with an uneven spatial distribution, but medium–sized cities are missing. The structure of the centres is atypical in comparison with the rest of the CR. Approximately 66.9 % of the total population of the region live in cities.

The most important listed sources of TSP emissions include industrial sources (LASSELSBERGER), the mining and processing of mineral resources (EUROVIA Quarries – Plzeň 6–Litice,

LB MINERALS – VJ Plzeňsko, Kaznějov and Horní Bříza Branch), and sources for electricity and heat production (Plzeňská teplárenská – Heating Plant). The most significant sources of SO_x emissions are represented by sources for electricity and heat production (Plzeňská teplárenská – Power Plant and Heating Plant, or Klatovská Heating Plant), and the most significant sources of NO_x emissions are also represented by sources for electricity and heat production (Plzeňská teplárenská – heating plant and power plant sites, Plzeňská teplárenská and ZEVO Plzeň) and other industrial sources (Pfeifer Holz and STOELZLE UNION).

North–western zone

Karlovy Vary Region

The Karlovy Vary Region is located in the westernmost part of Bohemia. The Karlovy Vary Region is the smallest region in the CR in terms of population, and the third smallest in terms of area. The region includes the Krušné hory mountain range and the terrain has a predominantly highland character.

Balneotherapy in spa facilities is a significant activity in the region. Another important economic sector is the mining of brown coal in the Sokolov region and kaolin in the Karlovy Vary Region. The chemical industry and energy production are located in the Sokolov area. There are also well–known glass and ceramic companies in the region. Light industry is mainly represented by the logging and wood processing industry, the production of parts for the automotive industry, and plastics production.

In terms of air pollution, the region can be divided into three areas. The first, the spa area, can be found in the southern part of the region. There is mainly light industry and food production in this area, with pollution mainly caused by local heating and transport. In the second area of the region, the chemical industry, a lignite mine, and the Vřesová and Tisová power plants are located. These contribute significantly to the pollution of the region, but the influence of light industry, including glassworks and ceramic plants, can also be identified. The third area includes the Krušné hory mountain range, where most of the pollution stems from local heating.

The most significant listed sources of TSP emissions include the production of electricity and heat (Sokolovská uhelná – Vřesová Processing Section and Tisová Power Plant), the mining and processing of coal and minerals (Sokolovská uhelná and Basalt CZ – Libá Processing Plant), and other industrial sources (Synthomer and Lias Vintířov). The most significant sources of SO_x and also NO_x emissions are again represented by sources for the production of electricity and heat (Sokolovská uhelná – Processing Section and Tisová Power Plant), and industrial sources (Lias Vintířov, O–I CR – Nové Sedlo and Synthomer Plants).

Ústí nad Labem Region

The Ústí nad Labem Region is located in northwestern Bohemia. The relief of the region is rather variable, ranging from the border ridge of the Krušné hory Mountains, through the volcanic Central Bohemian Uplands, the Elbe Lowlands, and down to the lowest point of the CR near the Hřensko municipality.

The economy of the region is specific for different parts of the region, ranging from agricultural areas in lowland localities, industrial areas, and mountain areas. In general, however, the economy of the region is characterized by a strong orientation towards heavy industry. Abundant deposits of brown coal have given rise to a coal energy processing industry. The strong pollution emission load of the region also stems from the presence of the largest Czech oil refinery, chemical and ceramic industries, and the processing of ferrous metals and copper. The food industry is also represented in the region, with viticulture and breweries, and agriculture. Light industry and local heating also contribute to the emission load of the region.

The geographical location of the Ústí nad Labem Region, which is further affected by emissions from surface lignite mines and thermal power plants, leads to the formation of inverse layers and the retention of emerging pollutants in the lower atmosphere. Thanks to desulphurisation and dust extraction of power plants and other industrial enterprises, pollution in the region is no longer as high as in the past, but the region is still loaded by higher concentrations of pollutants. This is one of the reasons why there are a larger number of stations for measuring ambient air pollution in the region.

The most significant listed sources of TSP emissions include electricity and heat production (Počerady Power Plant, ČEZ – Tušimice Power Plant, ČEZ – Ledvice Power Plant, ČEZ – Prunéřov 2 Power Plant), lignite and mineral resources mining (e.g., COLAS CZ Císařský Quarry), and industrial sources (e.g., Mondi Štětí – Cellulose Plant). The most significant sources of SO_x emissions are again represented by sources for electricity and heat production (Počerady Power Plant, ČEZ – Tušimice Power Plant, ORLEN Unipetrol RPA – T 700 Heating Plant, ČEZ – Trmice Heating Plant, United Energy – Komořany Heating Plant, ČEZ – Ledvice Power Plant, ČEZ – Prunéřov Power Plant), and industrial sources (e.g., AGC Flat Glass Czech – Řetenice Plant, and Lafarge Cement). The most significant sources of NO_x emissions are also represented by sources for electricity and heat production (Počerady Power Plant, ČEZ – Tušimice Power Plant, ČEZ – Ledvice Power Plant, ČEZ – Prunéřov 2 Power Plant, ORLEN Unipetrol RPA – T 700 Heating Plant), and industrial sources (e.g., ORLEN Unipetrol RPA – PETROCHEMIE plant).

Significant NMVOC emissions are produced during the processing of vegetable oils at the Viterra Czech and PREOL Company. NH_3 emissions originate from the production of mineral wool in the Knauf Insulation Company and glass in the AGC Flat Glass Czech – Řetenice Plant, or also from the denitrification process at the Počerady Power Plant.

North–eastern zone

Liberec Region

The Liberec Region is located in the very north of Bohemia, and its area is the second smallest after Prague. The relief of the region is rather variable – the Lužické and Jizera Mountains in the north, the Krkonoše Mountains in the north–east, and hilly areas in the middle and south of the region.

Air pollution in the Liberec Region is low, and there are no significant sources of heavy industry. The mining of glass and building sands and gravel and the quarrying of building stone, light industry (glassmaking, rubber industry, jewellery production and mint), the food industry, and local heating significantly contribute to the pollution in the region. A significant source of air pollution by cadmium is the glass industry in Desná and its surroundings (for more details see Chapter IV.6).

The most significant listed sources of TSP emissions include stone mining and processing (EUROVIA Quarries – Košťálov and DP Chlum, Provodínské písky and CEMEX Sand – Smrčí Quarry), and other industrial sources (MLÝN PERNER SVIJANY and Wotan Forest OPO JILOS). The most significant sources of SO_x emissions are represented by sources for the production of electricity and heat (ENERGIE Holding – Hradčany Heating Plant, Liberec Heating Plant) and industrial sources (Liberec Asphalt Mixing Plant, Sklostroj Turnov CZ – Turnov and Galvanoplast Fischer). The most significant sources of NO_x emissions are represented by sources for electricity and heat production (TERMIZO – Municipal Waste Incinerator, ENERGY Holding – Hradčany Heating Plant, and DIAMO TÚU Stráž pod Ralskem), and industrial sources (PRECIOSA ORNELA – Desná Plant and Polubný and Crystalex CZ – Nový Bor Plant). Significant NMVOC emissions are produced by the Fehrer Bohemia Česká Lípa Company, the Magna Exteriors (Bohemia) – Liberec Plant, and Bombardier Transportation Czech Republic.

Hradec Králové Region

The Hradec Králové Region is located in the north–east of Bohemia. The northern border of the region, formed by the Orlické hory Mountains and the Krkonoše Mountains, contrasts with the southern border formed by the Elbe Lowlands. Air quality in the Hradec Králové Region is at a relatively good level. It is mainly affected by the traffic load despite the very dense railway network, which is completely electrified on only two lines. The regional city of Hradec Králové is a major road junction, despite the fact that the motorway network is still under construction. Furthermore, the air quality is affected by local heating.

The most significant listed sources of TSP emissions include industrial sources (Tereos TTD – České Meziříčí Sugar Factory, Seco Industries foundry – Jičín plant), electricity and heat production (ČEZ – Poříčí Power Plant), and the mining and processing of minerals (production of mineral wool Saint–Gobain Construction Products CZ – Častolovice plant, Krkonoše Lime Production Kunčice – Lánov Quarry and ENVISTONE Předměřice). The most significant sources of SO_x emissions are again represented by industrial sources (Tereos TTD – České Meziříčí Sugar Factory and Saint–Gobain Construction Products CZ – Častolovice plant), and sources for the production of electricity and heat (ČEZ – Poříčí Power Plant and Dvůr Králové Heating Plant, Heat Management – Draha Plant). The most significant sources of NO_x emissions are represented by sources for the production of electricity and heat (ČEZ – Poříčí Power Plant operation and Dvůr Králové Heating Plant), and industrial sources (Tereos TTD – České Meziříčí Sugar Factory and Saint–Gobain Construction Products CZ – Častolovice plant). Considerable NMVOC emissions are produced by car industry (Škoda Auto – Kvasiny) and packaging production (AMCOR Nový Bydžov). NH_3 emissions are produced in manufacturing mineral wool at Saint–Gobain Construction Products CZ – Častolovice plant.

Pardubice Region

The Pardubice Region is located in the south–east of the CR. The northern border is formed by the Orlické hory mountain area and the Kralický Sněžník mountain range. It borders the Vysočina Region in the south, which is a moderate hilly area. Flat terrain is mainly located in the vicinity of the regional town of Pardubice and the neighbouring town of Chrudim. It is the tenth largest region in terms of area.

Air quality in the region is mainly affected by the chemical industry (for example, the world–famous Semtex production), transport, and local heating.

The most significant listed sources of TSP emissions include the production of electricity and heat (Chvaletice Power Plant, Opatovice Power Plant), and other industrial sources (CEMEX CR, P-D Refractories CZ a. s., division 06 – firing Anna, ALL-IMPEX Pardubice – Dried Milk Manufacture). The most significant sources of SO_x emissions are also represented by sources for electricity and heat production (Opatovice Power Plant, Chvaletice Power Plant and Synthesia – Energy Department), and industrial sources (CEMEX CR, Synthesia – SBU Nitrocellulose – Inorganic Part or P–D Refractories CZ). The most significant NO_x sources are again represented by sources for the production of electricity and heat (Chvaletice Power Plant and Opatovice Power Plant) and industrial sources (CEMEX CR). Considerable NMVOC emissions originate from asphalt roofing manufacture (KVK Parabit) and the truck production (IVECO Czech Republic – Vysoké Mýto). NH_3 emissions are produced in manufacturing cement (CEMEX Czech Republic) and mineral wool (Saint-Gobain Adfors CZ – Litomyšl plant).

South–eastern zone

Vysočina Region

The Vysočina Region is one of the larger regions of the CR in terms of area. It differs from the surrounding regions by having a higher average altitude, a higher fragmentation of the territory, and a sparse population (it is the fifth largest region, but also has the fourth lowest population). More than half of the territory is covered by agricultural land (60.6 %) and the rest predominantly by forests (30.4 %). The whole area lies in the Bohemian–Moravian Highlands.

In terms of air pollution, the region can be assessed very positively. The high proportion of forests, the smaller proportion of cities and at the same time the absence of significant industry mean that air quality is good in most places. Air quality in the region is affected by local heating (the main source of TSP and SO_X) and traffic, especially by the D1 motorway (the main source of NO_X).

The most significant listed sources of TSP emissions include stone mining and processing (COLAS CZ – Rančířov, Mirošov and Vícenice quarries), and other industrial sources (Lukaform, Stora Enso Timber Ždírec, KRONOSPAN CR and Lukavec Woodworking Cooperative). The most significant sources of SO_X emissions are represented by the ŽĎAS energy sources, and also by the boiler room of the ATOS – Stínadla boiler and Woodworking Cooperative. The most significant sources of NO_X emissions are mainly represented by the KRONOSPAN OSB and KRONOSPAN CR industrial sources, and the boiler rooms of the Lukavec Woodworking Cooperative, Stora Enso Timber Ždírec and ŽĎAS. Considerable NMVOC emissions originate from wood processing (KRONOSPAN OSB, Lukaform, KRONOSPAN CR and Woodworking Cooperative).

South Moravia Region without Brno agglomeration

The South Moravia Region is located in the south–east of the CR. Its centre is Brno – the second largest city in the CR. From a meteorological point of view, it is one of the warmest areas within the CR. Agriculture is particularly widespread in the southern part of the region, with more than 90 % of all vineyards in the CR. In total, agricultural land makes up approximately 60 % of the territory. Compared to other regions, the South Moravia Region has a higher population density.

Air quality in the South Moravia Region is affected by local household heating (especially in small municipalities), while the influence of the already mentioned agriculture and soil erosion in the southern part of the region is more pronounced. Locally, air quality is also significantly affected by transport, especially in urban areas and in areas with higher traffic intensity (for example, along the D1 and D2 motorways, which pass through the region).

The most important listed sources of TSP emissions include electricity and heat production (ČEZ – Hodonín Power Plant), food processing (NAVOS Hustopeče), the mining and processing of minerals (Českomoravský Cement – Mokrá Plant, COLAS CZ – Tasovice Quarry, KAMENOLOMY ČR – Lhota Rapotina Quarry), and other industrial sources (e.g., P-D Refractories CZ – Velké Opatovice). The most significant sources of SO_X emissions are represented by industrial production (VETROPACK MORAVIA GLASS and SAINT-GOBAIN ADFORS CZ – Hodonice), sources for the production of electricity and heat (ČEZ – Hodonín Power Plant), and processing of mineral resources (Českomoravský Cement – Mokrá Plant). The most significant sources of NO_X emissions are represented by industrial sources (Českomoravský Cement – Mokrá Plant, VETROPACK MORAVIA GLASS and CARMEUSE CR – Mokrá Lime Production), and sources for the production of electricity and heat (ČEZ – Hodonín Power Plant).

The emissions of other pollutants are dominated (by more than 70 % of the total emissions of the listed sources) by CO from cement production at the Českomoravský Cement – Mokrá Plant, which also produces higher NH_3 emissions. Considerable NMVOC emissions are produced by the GUMOTEX Coating – Břeclav.

Agglomeration of Brno

The Brno agglomeration covers the territory of the second largest city in the CR, Brno. It lies approximately in the middle of the South Moravia Region.

As in every major city, air quality in Brno is affected by traffic, which is a source of NO_X in particular. On the contrary, local household heating is not such a significant problem, as the whole area is gasified and heating in solid fuel boilers is not very common. However, this source of pollution in Brno cannot be neglected and mainly affects the outskirts of the city.

Recently, two negative aspects in connection with air quality have manifested themselves in the territory of Brno. The first is the still unfinished large city ring road, which would divert transit as well as some passenger traffic outside the densely populated area and increase the smooth flow of traffic. The second aspect includes construction activities, which in some localities (especially south of the main railway station) very locally but very significantly negatively affect air quality by increasing the concentrations of suspended PM_{10} particles.

Under specific dispersion and meteorological conditions, the impact of long–range transport is also more pronounced in the territory of Brno, especially during north–east wind flows, when the agglomeration receives pollution from the Moravia–Silesia Region or across the border as far as from Poland through the Moravian Gate geomorphologic formation.

The most important listed source of TSP emissions is the Eligo – Brno Branch Plant. The most significant sources of SO_X emissions are represented by sources for the production of electricity and heat (SAKO Brno – ZEVO Division 3 and Brno Heating Plant facilities), as well as industrial sources (e.g., HEUNISCH Brno Foundry). The most significant sources of NO_X emissions are also repre-

sented by sources for the production of electricity and heat (Brno Heating Plant and SAKO Brno – ZEVO Division 3), and industrial sources (REMET – Brno facility and Brno mixing plant).

Central Moravia zone

Olomouc Region

The Olomouc Region is average in terms of population density and area in the CR. Geographically, it includes the north and north–west of Moravia (where the territory reaches the highest altitude in the Hrubý Jeseník Mountains) and the west of Bohemian Silesia. It borders Poland to the north. The south–eastern parts of the region are characterized by lowland areas of Haná, rimmed by highland protrusions. The Morava River flows through the region from north to south. These geographical conditions affect not only the location of the main transport corridors, but also the transmission of pollutants in the atmosphere.

The region is dominated by the manufacturing and engineering industries and agricultural activities. The D1, D35 and D46 motorways pass through the region. Long–range and regional transborder air pollution from abroad (Poland) and from the neighbouring Moravia-Silesia Region also contributes to the air pollution. However, a significant amount of local emissions arise from the incomplete combustion of fuels in the household heating sector.

The most significant listed sources of TSP emissions include stone mining and processing (Cement Hranice, PRECHEZA, OMYA CZ – Pomezí Plant, CIDEM Hranice), and other industrial sources, e.g., Javořice Ptení. The most significant sources of SO_x and NO_x emissions are represented by sources for the production of electricity and heat (Veolia Energy ČR – Přerov Heating Plant and Olomouc Heating Plant), and industrial sources (PRECHEZA, Tereos TTD, Kojetín Distillery Plant, Vrbátky Sugar Factory and Litovel Sugar Factory).

Concerning other pollutants, the dominant proportion (more than 50 % of the total emissions of the listed sources) is generated by CO emissions of the Cement Hranice Company, which also produces greater NH_3 emissions. Significant NMVOC emissions are produced by the ADM Olomouc Company.

Zlín Region

The Zlín Region lies in the east of the CR and is formed by hilly terrain, which in places turns mountainous. In whole, the Zlín Region covers 5 % of the total territory of the CR. The region has above–average forest cover in comparison with other regions in the CR. Agricultural land makes up approximately half of the region's territory.

The air quality in the Zlín Region can be assessed as generally worsened in comparison with other regions in the CR. This is largely due to small sources of pollution, mainly local household heating. These smaller sources of air pollution are dominant in the case of TSPs and benzo[*a*]pyrene. To some extent, larger industrial sources also contribute to pollution, especially for NO_x and SO_x. NO_x emissions come mainly from transport, which affects air quality in this region locally, especially in urban areas and areas with higher traffic intensity. Deteriorated air quality in the region is also to a large extent due to the long–range transport of pollutants from nearby areas, especially from the north and north–east, that is from the areas of the Moravia-Silesia Region or across border from Poland.

The most important listed sources of TSP emissions include sources for the production of electricity and heat (DEZA – Energy, Otrokovice Heating Plant) and also industrial sources (CS CABOT, SAKER o.z., ALUSAK – Kroměříž, ZEVOS Dolní Němčí Drying Facility and Pellets Bylnice). The most significant sources of SO_x and NO_x emissions are represented by sources for the production of electricity and heat (DEZA – Energy, Otrokovice Heating Plant, Zlín Heating Plant, and CTZ Uherské Hradiště), and industrial sources (DEZA – Chemical Production and CS CABOT and SAKER o.z. ALUSAK).

Among the emissions of other pollutants, NMVOC emissions from SPUR – Zlín are among the most significant.

Moravia-Silesia Region

According to Act No. 201/2012 Coll., on air protection, the Moravia-Silesia Region is divided into the Moravia-Silesia zone and the O/K/F-M agglomeration for the purposes of assessing and evaluating air quality (Fig. I.2).

The Moravia-Silesia Region is the third most populous in the CR, and the second largest in terms of population density after Prague. Most of the region lies in Bohemian Silesia. Its location in the north–east of the country includes both the most industrialized regions of the CR, as well as agricultural and mountain areas. This diversity is caused by geographical and geological conditions (ranging from mountainous to hilly areas, plateaus to lowland terrain). In addition, the location on the border with Poland plays an important role. The D47–Lipník–Ostrava motorway is an important traffic route, and two international railway corridors pass through the region.

The natural character and different economic development contribute to differences in the quality of the environment of individual areas of the region. The most serious impacts on the environment are apparent in the central and north–eastern part of the region (Ostrava, Karviná, Frýdek-Místek and Třinec areas), where the population is exposed to the highest levels of air pollution in the CR. On the other hand, the Moravia-Silesia Region also includes places with significant and valuable natural resources, which are protected within three PLAs.

Moravia-Silesia zone

Outside the industrial centre of the region, located in the separately described Ostrava/Karviná/Frýdek-Místek (O/K/F-M) agglomeration, there are only a relatively small number of listed sou-

rces of pollution. The most important such technological source is lime production; others are heating and technological sources (food industry, pharmaceuticals). Although central heating sources predominate on average for domestic heating, the region still has a high proportion of solid fuel combustion in obsolete types of combustion equipment.

Apart from the industrial centre of the region, the most important listed sources of TSP emissions include stone mining and processing (EUROVIA Quarries, Jakubčovice nad Odrou, Quarries of the CR – Bohučovice Quarry) and other industrial sources (Moravia-Silesia Sugar Factory – Opava Branch Plant, TATRA METALLURGY – foundry and Břidličná AL INVEST). The most important sources of SO_x and NO_x emissions are represented by industrial sources (Moravia-Silesia Sugar Factory – Opava Branch Plant, LB Cemix, KOTOUČ ŠTRAMBERK – lime production) and sources for electricity and heat production (TEPLO BRUNTÁL – Central Heating Plant, Veolia Energy ČR – Krnov Heating Plant).

Among other pollutants, the dominant proportion (more than 85 % of the total emission of the listed sources) is represented by CO emissions from lime production (LB Cemix, KOTOUČ ŠTRAMBERK). Significant NMVOC emissions are produced by the Teva Czech Industries, STYROTRADE Rýmařov and AL INVEST Břidličná companies.

Agglomeration of Ostrava/ Karviná/Frýdek-Místek

The character and area of the Ostrava/Karviná/Frýdek-Místek agglomeration differ significantly from the other two agglomerations in the CR (Prague and Brno). This agglomeration includes the area of three whole districts, not just urban areas. In total, the O/K/F-M agglomeration covers more than a third of the Moravia-Silesia Region. The area is historically burdened by extensive industrial activity in the Upper Silesian Basin. The key factors affecting the resulting air quality are the high concentration of industrial production, the high density of built–up areas with local solid–fuel heating, and the dense transport infrastructure on both sides of the Czech–Polish border. Municipalities in most of the agglomeration are directly connected to each other (a so–called Silesian type of urban development) and industrial areas are often located within municipalities.

A significant factor that contributes to the resulting reduced air quality in the agglomeration is the extent and nature of cross–border and interregional pollution transfer in the predominant directions of wind flow. In the area at the Czech–Polish border, this flow typically occurs along the south–west — north–east axis. Air quality in the agglomeration (and not only in the immediate vicinity of the border at the Karviná region) is also significantly affected by cross–border emissions and air pollution originating from Poland (in certain meteorological situations even dominating). Other meteorological factors also determine the potential for dispersion or transport of pollutants in the atmosphere (Chapter III). There are frequent weather inversions with stable thermal stratification of the atmosphere and thus worsened dispersion conditions, not only in the lowlands of the Ostrava Basin but also in the mountain valleys of the agglomeration, which also significantly contribute to increasing concentrations of air pollutants. The most frequent smog episodes with above–threshold concentrations of suspended PM_{10} particles within the agglomeration occur in the Olše River and Odra River valley areas, mostly from December to February (details are presented in Chapter VI).

Individual categories of emission sources show different proportions in the O/K/F-M agglomeration compared to other areas of the CR. The proportion of industrial and energy sources in emissions of major pollutants has been continuously declining. However, significant metallurgical complexes together with coal coke production, energy and other individually monitored sources still produce a substantial part of pollution.

In view of heating, significant differences can be found in the area, resulting mainly from the character of the households in individual districts. While in the Frýdek-Místek district the proportion of flats heated locally by solid fuels is close to 20 %, in the district of Karviná it is about 8 %, and in the district of Ostrava it is 4 %. This fact, accompanied by the higher average altitude of settlements in the Frýdek-Místek district and the larger average size of flats, is reflected mainly in emissions for which the REZZO 3 category forms a more significant proportion, namely for TSPs and particulate matter, VOCs, benzene and especially for emissions. benzo[*a*]pyrene.

The most important listed sources of TSP emissions include industrial sources (Liberty Ostrava with particularly Plant 13 Steelworks, Plant 12 Blast Furnaces and Coke Plant, TŘINECKÉ ŽELEZÁRNY Ironworks – Production of pig iron and also OKK Coke Productioin – Svoboda Coke Plant), sources for electricity and heat production (Dětmarovice Power Plant, TŘINEC Energy and Veolia Energy ČR – Třebovice Power Plant), and industrial sources (OKK Coke Production – Svoboda Coke Plant and Lenzing Biocel Paskov). The most significant sources of SO_x emissions are industrial sources (Liberty Ostrava – Plant 12 Blast Furnaces, TŘINECKÉ ŽELEZÁRNY Ironworks – Production of pig iron) and sources for electricity and heat production (Veolia Energy ČR – Třebovice Power Plant and ČSA, TAMEH Czech and TŘINEC Energy). The most significant sources of NO_x emissions are also represented by industrial sources (TŘINECKÉ ŽELEZÁRNY Ironworks, Liberty Ostrava and Biocel Paskov) and electricity and heat production (TAMEH Czech – Heating Plant of the company, Veolia Energy CR – Třebovice Power Plant, TŘINEC ENERGY and Dětmarovice Power Plant).

The emissions of other pollutants are dominated by CO emissions from the steel production (TŘINECKÉ ŽELEZÁRNY Ironworks and Liberty Ostrava). Significant NMVOC emissions are produced by car manufacturing of the HYUNDAI MOTOR MANUFACTURING CZECH and Lenzing Biocel Paskov companies. Higher NH_3 emissions are generated by the ROCKWOOL Company, Bohumín Production Plant and BorsodChem MCHZ.

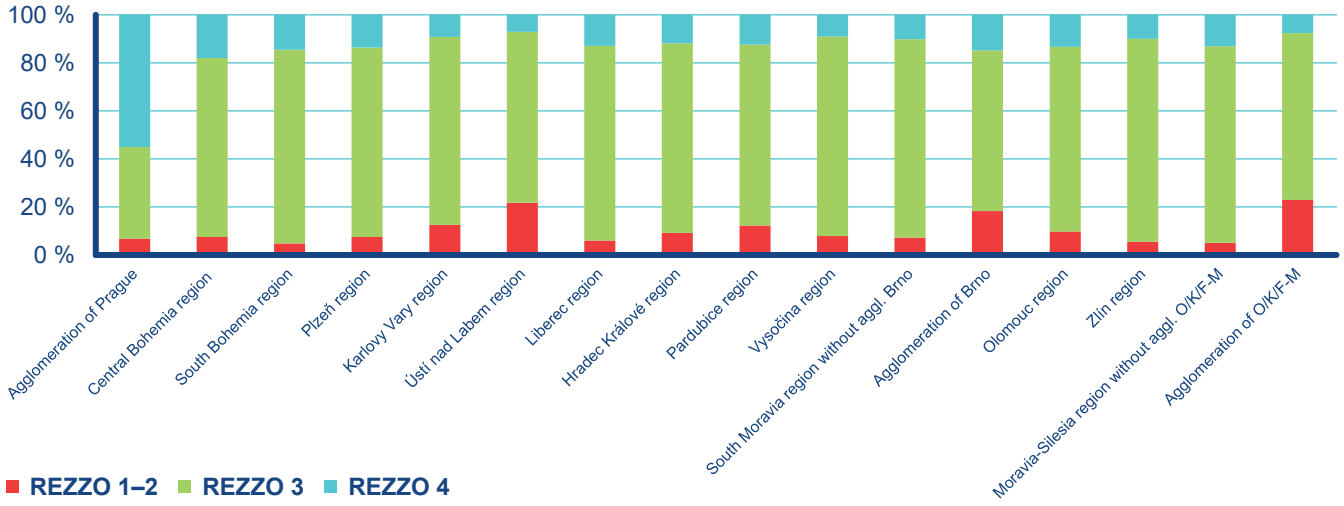


Fig. V.1.1 Composition of TSP emissions in regions of the Czech Republic, 2020

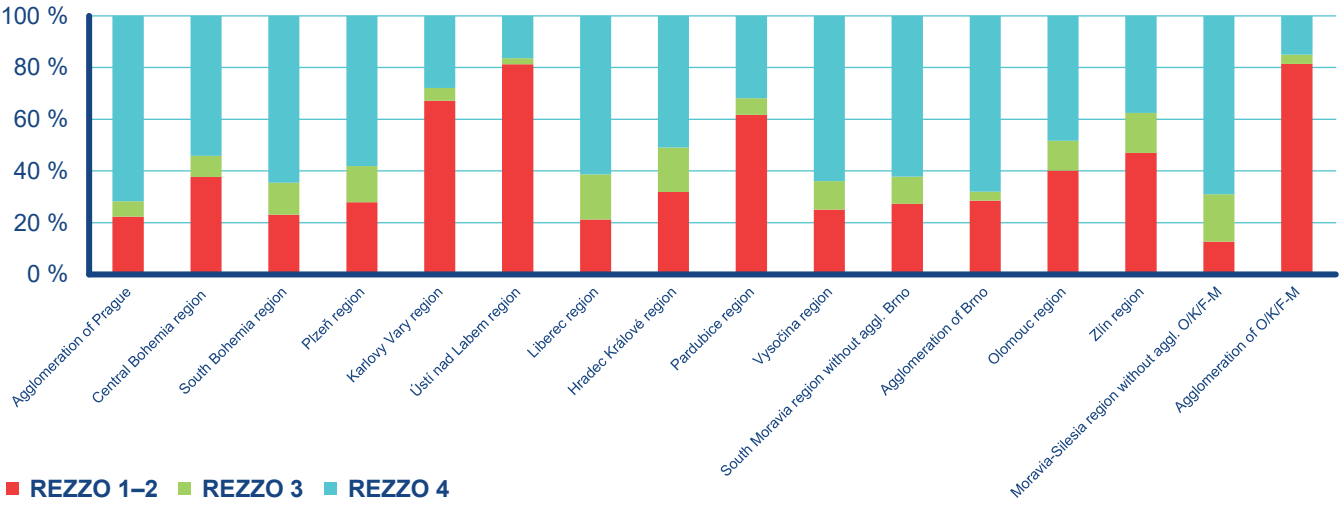


Fig. V.1.2 Composition of NO_x emissions in regions of the Czech Republic, 2020

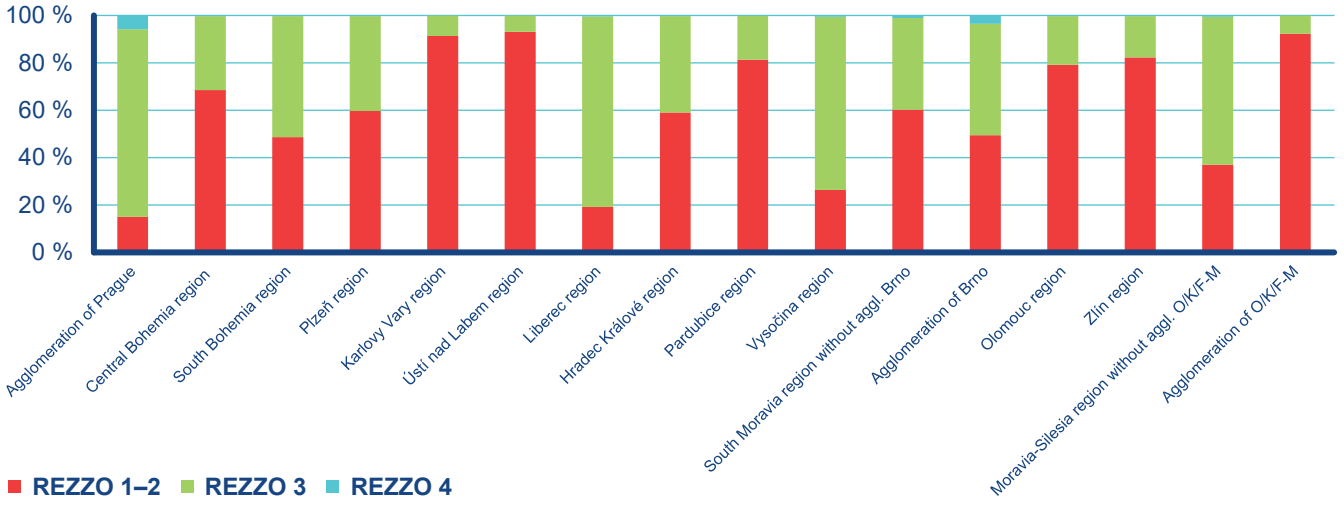


Fig. V.1.3 Composition of SO_x emissions in regions of the Czech Republic, 2020

V.2. Air quality index in regions of the Czech Republic

The air quality index (AQI) provides summary information on air quality at a specific measuring station. The air quality index (AQI) was designed by the CHMI Air Quality Department in cooperation with the National Institute of Public Health (SZÚ). The AQI calculation is based on simultaneous evaluation of 3-hour moving average concentrations of sulphur dioxide (SO_2), nitrogen dioxide (NO_2), and suspended particles (PM_{10}). For the summer period (1 April to 30 September), 3-hour moving average concentrations of ground-level ozone (O_3) are also evaluated. The 3-hour moving average describes the potential impact of air pollution on the population health better than hourly or daily average concentrations. An advantage of the AQI is the basic three-level colour indication of the index level. AQI current values are available on the CHMI website[2], together with specific advice and recommendations of the SZÚ[3] to ensure the protection of human health (Table V.2.1). These health recommendations are based on evaluations by the World Health Organization (WHO 2000).

In individual regions, very good to good air quality prevailed in 2021 (level 1A, 1B), at the range of 57–74 % (Fig. V.2.1). Moderate air quality (level 2A, 2B) at the range of 26–42 %. Poor to very poor air quality occurred in all regions of the CR, except for the Karlovy Vary and Liberec Regions, at the range of 0–1 %.

Tab. V.2.1 V.2.1 Recommendations of the SZÚ for reducing the exposure of the population to air pollutants and for the health protection

Level	Index range	Air quality	Sensitive and vulnerable groups	General population
1A	< 0.34	Very good to good.	Ideal conditions for outdoor activities.	Ideal conditions for outdoor activities.
1B	≥ 0.34–0.67		Outdoor activities without restrictions.	Outdoor activities without restrictions.
2A	≥ 0.67–1.00	Moderate.	There might be a slight risk of inconvenience to a very small number of persons who are extremely sensitive to air pollution. No need to change your usual outdoor activities if you do not notice symptoms such as coughing and throat irritation.	Outdoor activities without restrictions.
2B	≥ 1.00–1.50		Consider reducing or postponing/moving intense outdoor activities, notably if your health condition aggravates or you experience symptoms such as coughing and throat irritation.	No need to change your usual outdoor activities.
3A	≥ 1.50–2.00	Poor to very poor.	Reduce intense activities, particularly outdoors, notably if your health condition aggravates or symptoms such as coughing and throat irritation occur. Asthmatics and persons with chronic disease may need to use a relief medicine more often. All older people and children should limit their physical activity.	Consider reducing or postponing/moving intense outdoor activities if you experience symptoms such as coughing and throat irritation occur.
3B	≥ 2.00		Shorten your stay outdoors and avoid physical activities. Asthmatics and persons with chronic disease may need to use a relief medicine more often.	Reduce or postpone intense outdoor activities, notably if you experience any discomfort and symptoms such as irritation in the throat, eye irritation, coughing, etc.

2 www.chmi.cz/files/portal/docs/uoco/web_generator/actual_3hour_data_CZ.html
3 www.chmi.cz/files/portal/docs/uoco/web_generator/d_szu.pdf

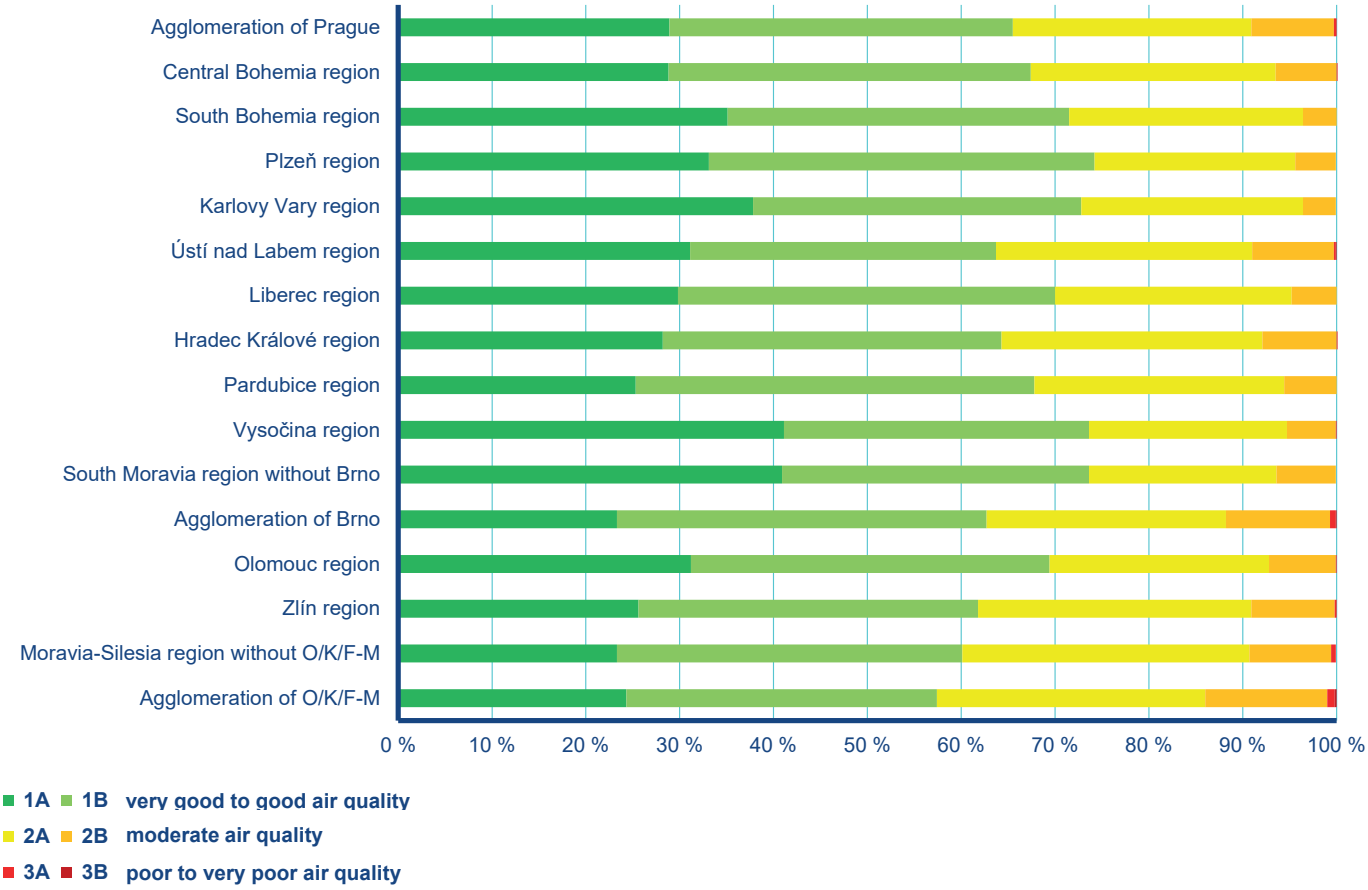


Fig. V.2.1 Proportional representation of the air quality index in individual regions of the Czech Republic, 2021

Air quality index at urban and suburban stations

At urban and suburban stations, the first AQI level (1A and 1B, very good to good air quality) occurred most frequently in 2021, at the range of 60–80 %, depending on the particular region (Fig. V.2.2). The highest rate was recorded in the Vysočina Region (80 %), the lowest in the O/K/F-M agglomeration (60 %). The second AQI level (2A and 2B, moderate air quality) was most often recorded in the O/K/F-M agglomeration (39 %), least frequently in the Vysočina Region (20 %). Except for the Karlovy Vary, Liberec, and South Moravia Regions, all regions experienced also the third AQI level (3A and 3B, poor to very poor air quality), mostly the O/K/F-M agglomeration (1 %).

Air quality index at rural stations

At rural stations, the first AQI level occurred most frequently in 2021, at the range of 54–71 %, depending on the particular region (Fig. V.2.3). The highest occurrence of the first AQI level was recorded in the South Moravia Region (71 %), the lowest in the Zlín Region (54 %). The second AQI level was most often recorded in the Zlín Region (45 %), the least often in the South Moravia Region (28 %). The third AQI level was recorded in the Moravia-Silesia Region, including the O/K/F-M agglomeration, and in the South Bohemia, South Moravia, Olomouc, Central Bohemia, Ústí nad Labem and Zlín Regions. The third AQI level most often occurred in the Moravia-Silesia Region without the O/K/F-M agglomeration (0.4 %).

Air quality index at traffic stations

In 2021, the first AQI level occurred at traffic stations most often, at the range of 48–77 %, depending on the particular region (Fig. V.2.4). An exception represented the Ústí nad Labem Region, where the second AQI level prevailed (51 %) in comparison to the first level (48 %). The highest occurrence of the first AQI level was recorded in the Plzeň Region (77 %). After the Ústí nad Labem Region, the second AQI level was most often recorded in the O/K/F-M agglomeration (44 %), the least frequently in the Plzeň Region (23 %). The third AQI level occurred in all regions where measurements from traffic stations were available. The third AQI level most often occurred in the O/K/F-M agglomeration (1.2 %).

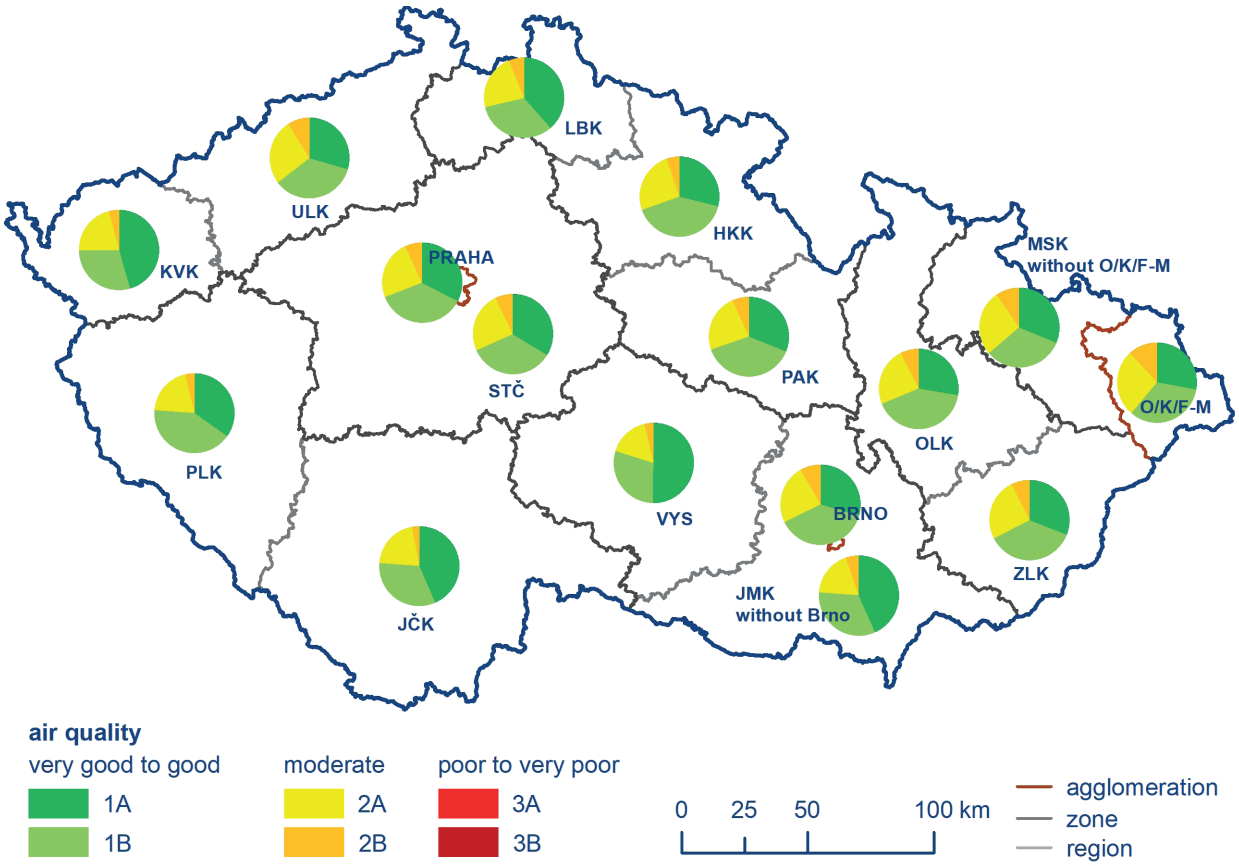


Fig. V.2.2 Proportional representation of the air quality index at urban and suburban background stations in individual regions of the Czech Republic, 2021

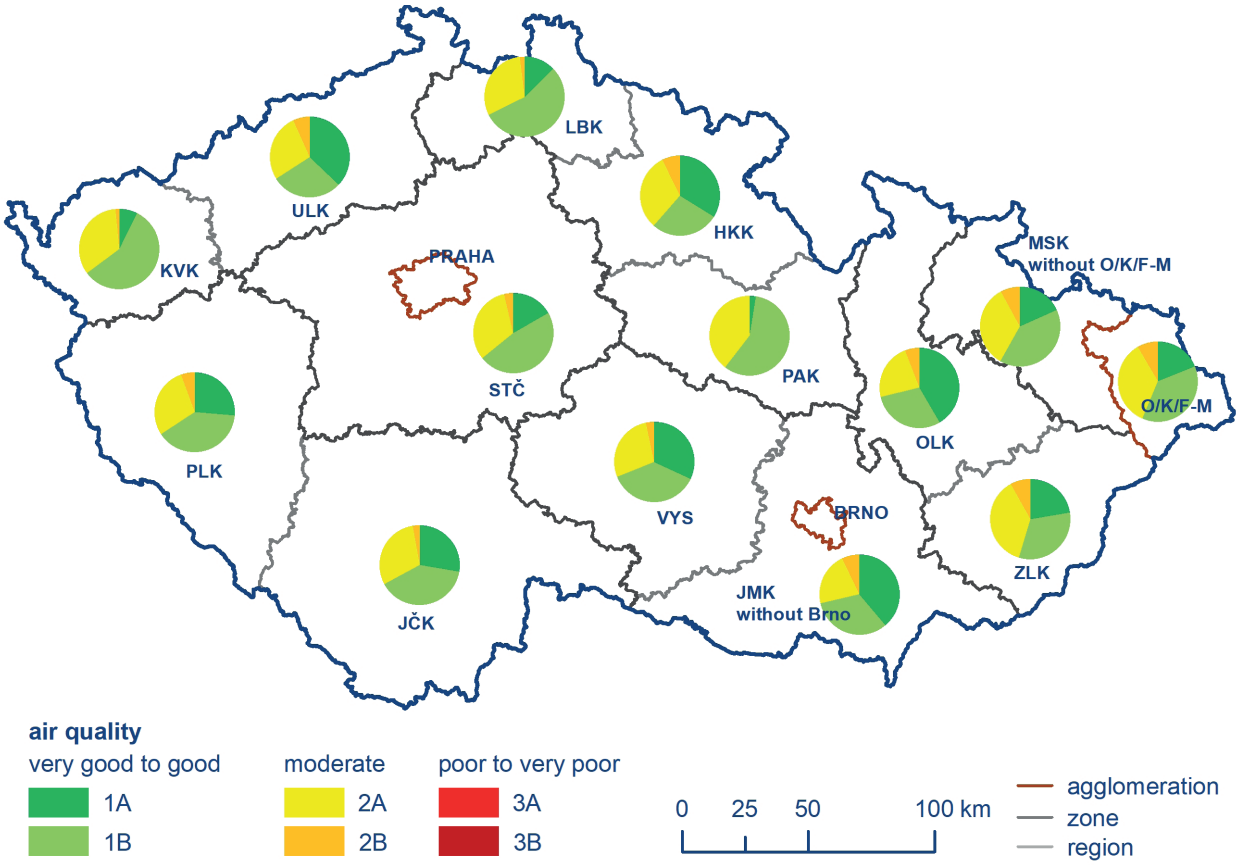


Fig. V.2.3 Proportional representation of the air quality index at rural background stations in individual regions of the Czech Republic, 2021

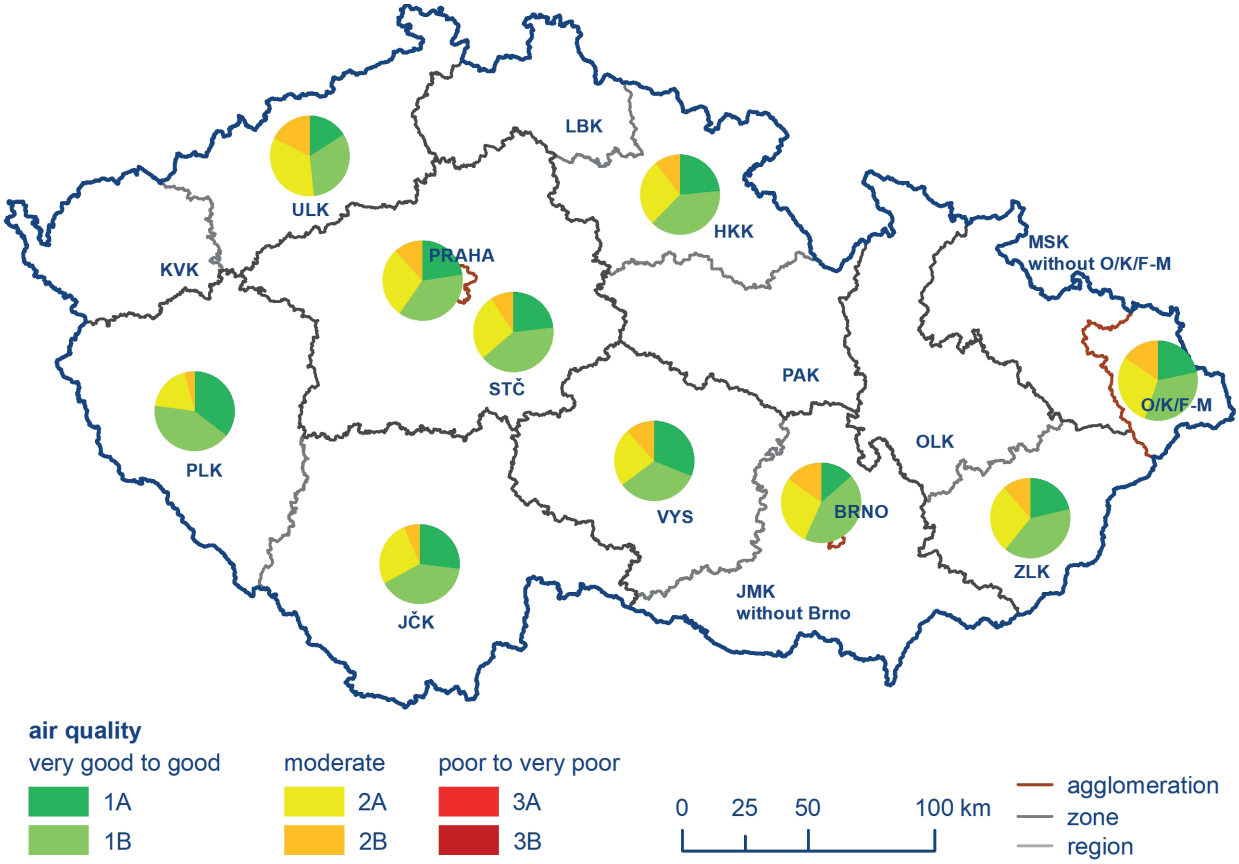


Fig. V.2.4 Proportional representation of the air quality index at traffic stations in individual regions in the Czech Republic, 2021

V.3 Regional differences in air quality in the Czech Republic

V.3.1 Proportion of the territory and population of regions exposed to above-limit concentrations

Changes in the extent of areas with above-limit concentrations of pollutants, excluding O_3, in zones and agglomerations between 2012 and 2021[4] point to significant regional differences in air quality in the CR (Fig. V.3.1.1). The O/K/F-M agglomeration, the Moravian-Silesia region without the O/K/F-M agglomeration, and the Olomouc and Zlín regions have long been the most polluted territories in terms of proportion of the area where the pollution limit value for at least one air pollutant was exceeded. Until 2018, the regions with a significant part of the territory with above-limit concentrations included also the Prague agglomeration, in which the area with above-limit concentrations decreased most significantly in 2019 in relation to decreasing concentrations of benzo[a]pyrene and suspended PM_{10} particles. A similar situation takes place in the Brno agglomeration, and in the Ústí nad Labem and Central Bohemia regions, although in these three regions the proportion of areas with above-limit concentrations was lower in comparison with Prague before 2019. On the contrary, the Karlovy Vary, Plzeň, Vysočina and South Bohemia regions belong to territories with the lowest or, in some years, even zero proportion of the area with above-limit concentrations.

After the inclusion of ground-level O_3, there is a significant increase in the proportion of areas with above-limit concentrations, namely in regions where air pollution from other pollutants is not dominant (Fig. V.3.1.2). Except for the Vysočina region in 2014, such areas occurred in all regions for the evaluated period 2012–2020. In some regions in the CR (the Karlovy Vary, Ústí nad Labem, South Bohemia and Plzeň regions, the Prague agglomeration, and the Central Bohemia and Liberec regions), there is an apparent increase in this proportion for the period 2012–2020, while in Moravia (the Olomouc, Zlín and Moravian-Silesia regions), areas with above-limit concentrations decrease. In other regions, the changes are volatile. In 2021, however, a situation occurred when the pollution limit for ground-level O_3 was not exceeded in most regions. Specifically, these included Prague, the Central Bohemia, Pardubice and Vysočina regions, Brno, the South Moravia region without Brno, as well as the Olomouc, Zlín and Moravian-Silesia regions, and the O/K/F-M agglomeration. In the remaining regions, the pollution limit for ground-level O_3 was exceeded in a very small area (for details see Tab. VII.1.2). This situation resulted from relatively low concentrations of ground-level O_3 measured in the last two years, 2020 and 2021, and the following reduction of the area exceeding the O_3 pollution limit in the three-year period 2019–2021 to only 0.2 % of the CR territory with 0.02 % of the population (for more see Chapter IV.4).

In addition to the comparison of areas with exceeded air pollution limits in the regions, a comparison of the percentage of the population living in these areas in 2012–2021 is also presented (Fig. V.3.1.3 and Fig. V.3.1.4).

Due to the fact that population densities differ among regions, the indicator of the proportion of the territory of regions with above-limit concentrations is supplemented by the indicator of the population living in these areas, as the affected territories in some regions (if O_3 is included) may cover areas with low population density. However, in densely populated areas, the opposite situation may occur, where a relatively small area with above-limit concentrations is inhabited by a large population (i.e., in areas without including O_3, where air pollution is affected by emissions of suspended particulates and benzo[*a*]pyrene, in particular from domestic heating and traffic).

For the above reason, the indicator of the number of inhabitants living in above-limit exposed areas was used to compare the regions (Fig. V.3.1.5 and Fig. V.3.1.6).

In 2021, a majority of population exposed to above-limit concentrations, except for O_3, lived in the O/K/F-M agglomeration (more than 750 000 inhabitants). Other affected regions were the Olomouc, Zlín, and Moravian-Silesia regions with approximately 403 000, 284 000, and 276 000 inhabitants exposed to above-limit concentrations. In Prague and in the South Bohemia, Karlovy Vary, and Vysočina regions the population exposed to above-limit concentrations of pollutants (excluding ground-level O_3) was zero in 2021.

After including ground-level O_3 in the evaluation, it can be stated that in 2021 there was no significant increase in the number of inhabitants exposed to above-limit concentrations of pollutants in any region, except for the Ústí nad Labem. The reason is the already mentioned exceeding the O_3 pollution limit in only 0.2 % of the territory of the CR. The pollution limit for ground-level O_3 is being evaluated for a three-year average. The evaluation of exceeding the O_3 pollution limit in 2021 thus includes the years 2019–2021, when low concentrations were measured in 2020 and 2021 (the lowest for the evaluated period, see Chapter IV.4 and Fig. IV.4.11). In the Ústí nad Labem region, where some of the highest concentrations of ground-level O_3 are measured in the CR, the number of inhabitants affected increased by approximately 2 500 after the inclusion of O_3 in the assessment.

4 In 2012, a new Act No. 201/2012 Coll., on air protection, entered into force, which introduced a new specification of areas with above-limit concentrations of air pollutants.

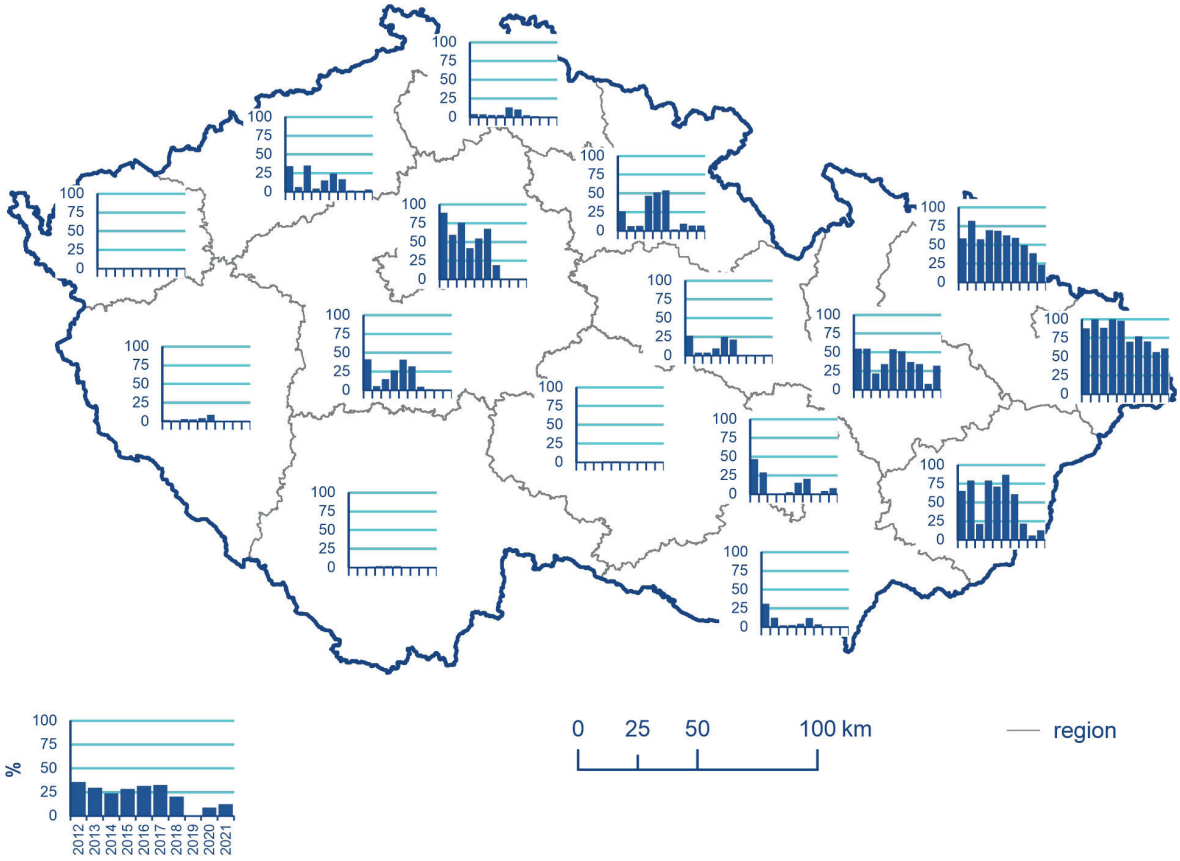


Fig. V.3.1.1 Proportion of region areas exceeding the pollution limit values (excluding ground-level O_3), 2012–2021

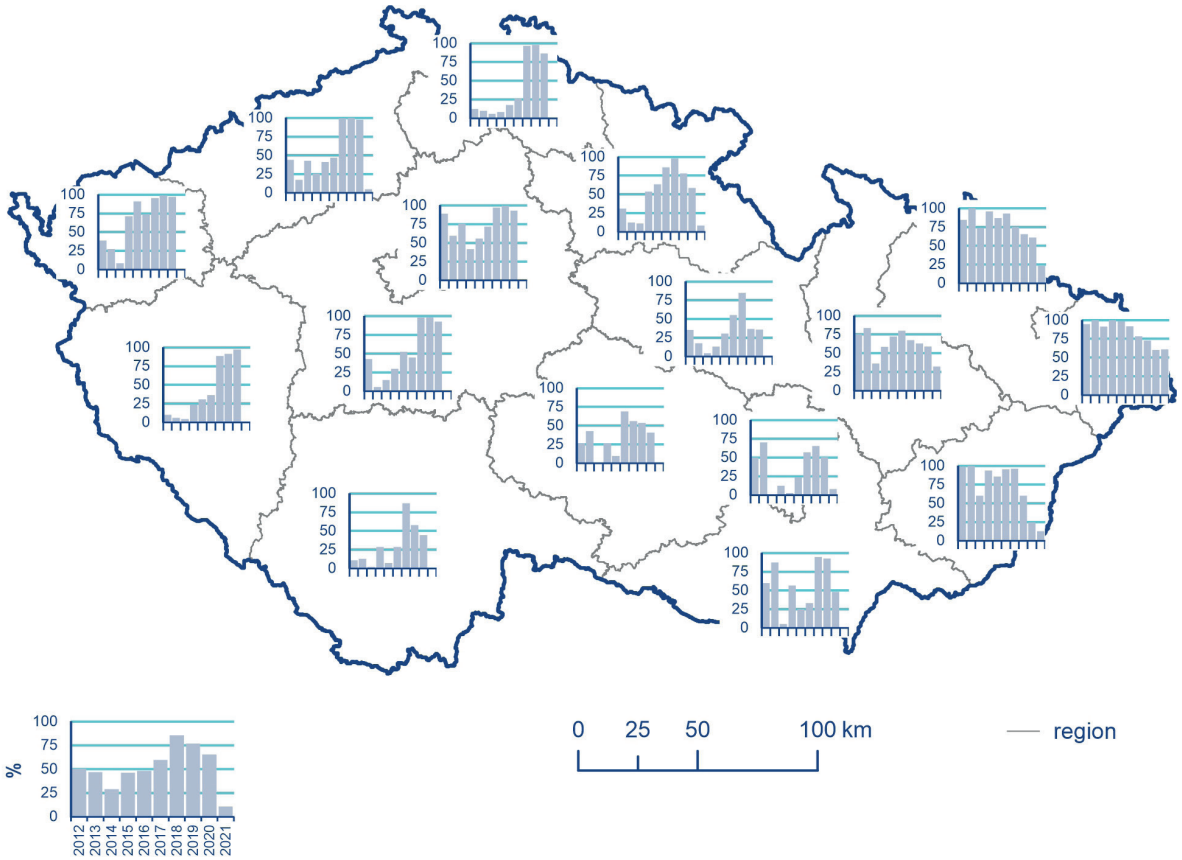


Fig. V.3.1.2 Proportion of region areas exceeding the pollution limit values (including ground-level O_3), 2012–2021

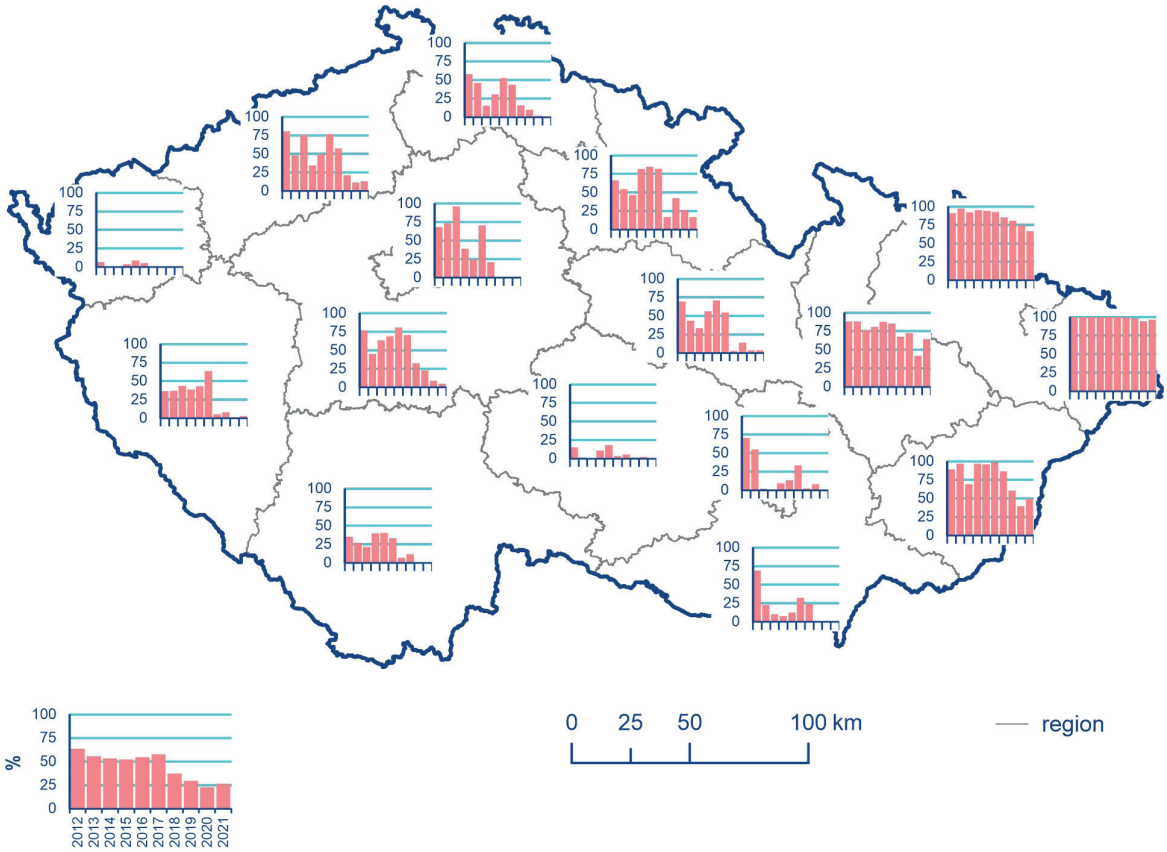


Fig. V.3.1.3 Proportion of inhabitants in areas exceeding the pollution limit values (excluding ground-level O_3), 2012–2021

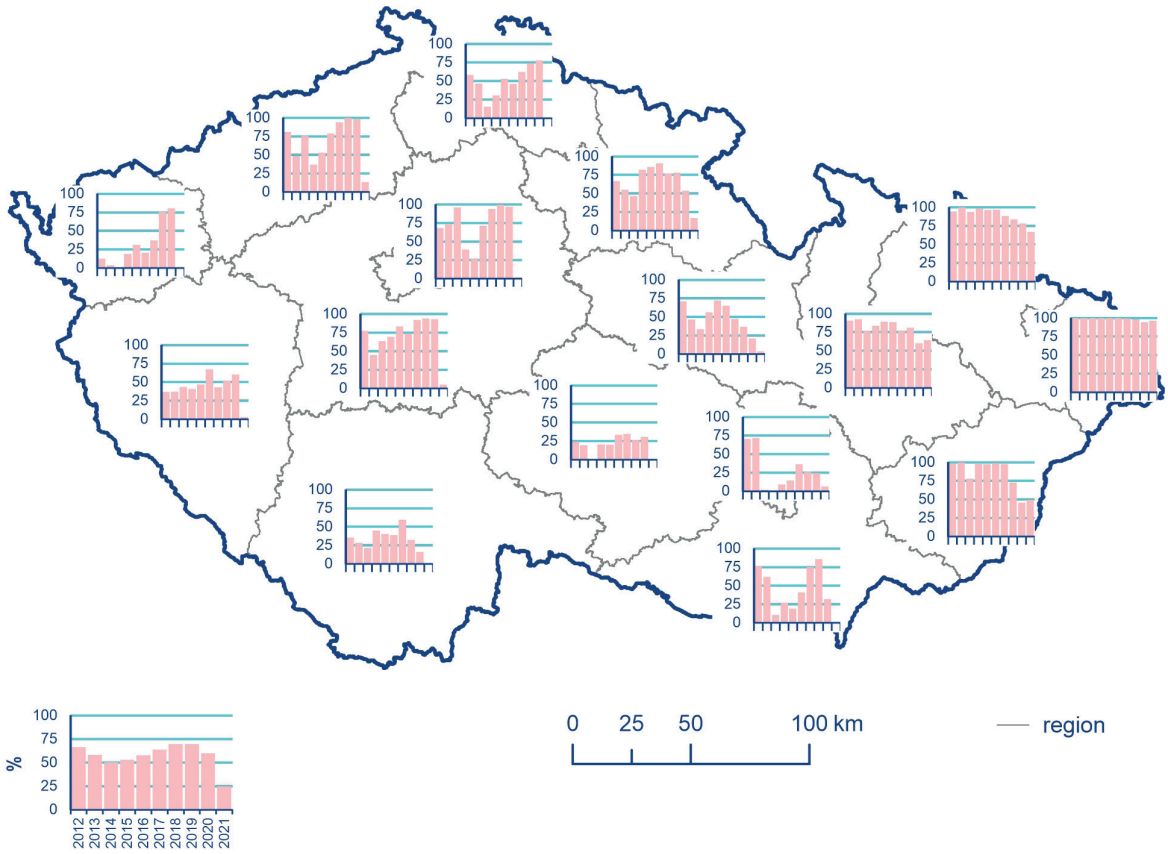


Fig. V.3.1.4 Proportion of inhabitants in areas exceeding the pollution limit values (including ground-level O_3), 2012–2021

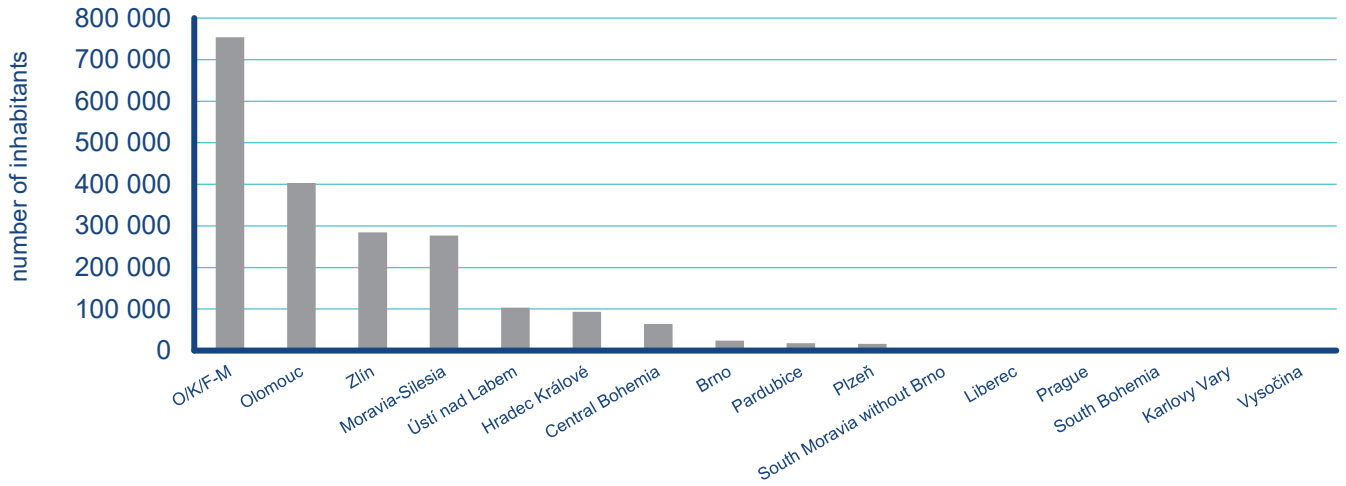


Fig. V.3.1.5 Number of inhabitants living in areas exceeding the pollution limit values (excluding ground-level O_3) in individual regions of the Czech Republic, 2021

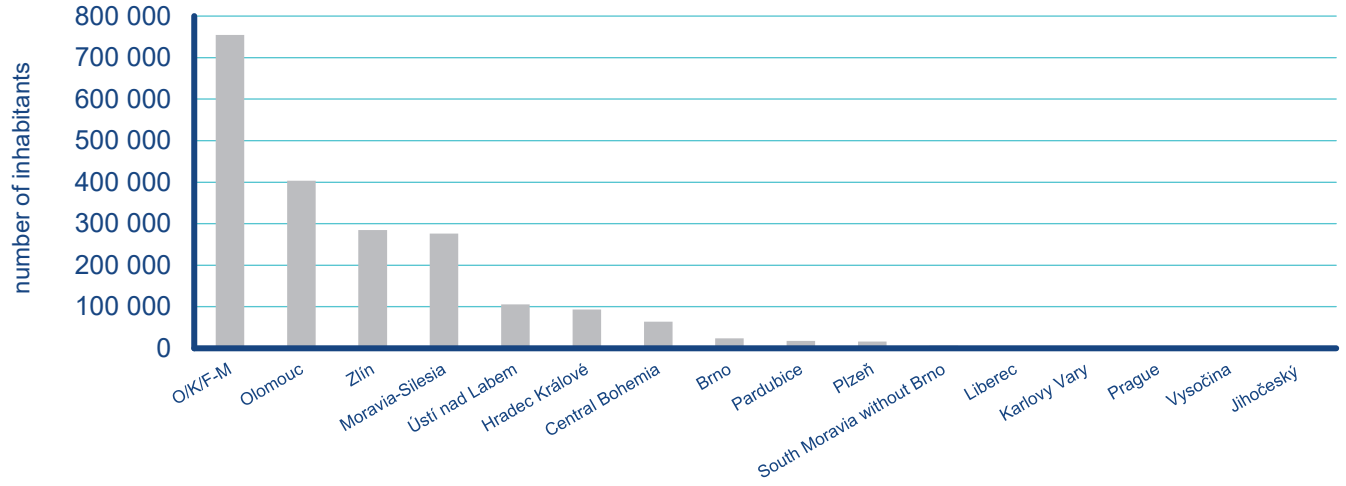


Fig. V.3.1.6 Number of inhabitants living in areas exceeding the pollution limit values (including ground-level O_3) in individual regions of the Czech Republic, 2021

V.3.2 Population-weighted PM_{10}, $PM_{2.5}$, NO_2, and O_3 concentrations

As part of the population exposure assessment, population-weighted average concentrations for PM_{10} and $PM_{2.5}$ suspended particulates, NO_2, and O_3 were calculated for regions (Fig. V.3.2.1) and cities with more than 30 000 inhabitants (Fig. V.3.2.2). Population-weighted concentrations can be simply characterized as pollutant concentrations to which a person living in a given city/region is exposed to on average. This characteristic is published for individual countries within the European air quality assessment (ETC/ACM 2018).

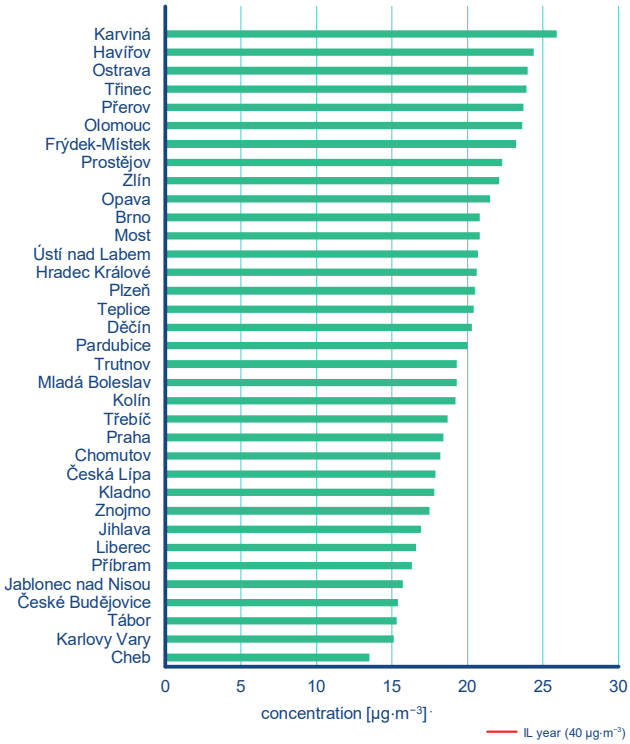
In 2021, the annual weighted average concentrations of PM_{10} and $PM_{2.5}$ suspended particulates did not exceed the limit value in any region. A comparison of weighted concentrations in the regions of the CR shows that inhabitants in the O/K/F-M agglomeration, Brno, and the regions of Olomouc, Zlín and Moravian-Silesia without the O/K/F-M agglomeration were exposed to the highest PM_{10} and $PM_{2.5}$ suspended particulates concentrations. Large cities with the highest weighted PM_{10} and $PM_{2.5}$ suspended particulates concentrations (Karviná, Havířov, Ostrava, Třinec) are located in the most exposed region of the CR – the O/K/F-M agglomeration. Levels of average weighted concentrations of PM_{10} in the CR do not exceed the pollution limit. The average weighted concentration of $PM_{2.5}$ above the pollution limit was determined for the only city with more than 30 000 inhabitants, namely the city of Karviná. The lowest weighted PM_{10} suspended particulate concentrations were calculated for the Plzeň, Liberec, Vysočina, South Bohemia and Karlovy Vary regions. The lowest weighted concentrations for $PM_{2.5}$ suspended particulates were calculated for the Liberec, Plzeň, Vysočina, South Bohemia and Karlovy Vary regions. The cleanest cities in terms of evaluation of suspended particle concentrations include Cheb, Karlovy Vary, Tábor, Příbram, and Jablonec nad Nisou. Relatively low values in cities located in the Karlovy Vary and South Bohemia regions are related to the local low regional background concentrations of suspended particles. Unlike the most exposed regions, long-range transport of air pollution is not as important there and the landscape character allows good ventilation (particularly in the South Bohemia area). The low emission burden of these areas is also significant.

In view of evaluating the level of NO_2 air pollution, the situation is somewhat different. This is mainly due to different main emission sources than in the case of suspended particles. The main sources of NO_x emissions, which incorporate NO_2, include public energy, heat production and road transport. The evaluation for 2021 shows that in connection with intensive traffic and reduced traffic flow, inhabitants are exposed to the highest NO_2 concentrations in the two most populous cities in the CR, i.e. Prague and Brno. The next in standing are cities in the Olomouc, Moravian-Silesia, and Ústí nad Labem regions. In 2021, inhabitants of the cities of Trutnov, Jablonec nad Nisou, Příbram, Tábor, and Cheb were exposed to the lowest NO_2 concentrations within large cities. Relatively low NO_2 concentrations are observed in cities with lower population and related lower traffic intensity, and in areas with lower regional background NO_2 concentrations due to lower emissions from large pollution sources and less significant long-range transport of pollution (the South Bohemia and Vysočina regions). Average weighted NO_2 concentration levels in the CR do not exceed the pollution limit value, however, from long-term NO_2 measurements in some traffic localities, particularly in sites with high traffic intensity experiencing poor ventilation (dense build-up areas) and frequent restrictions of traffic flow (intersections and traffic jams), instances exceeding the pollution limit values in the immediate vicinity of heavily busy roads can be assumed.

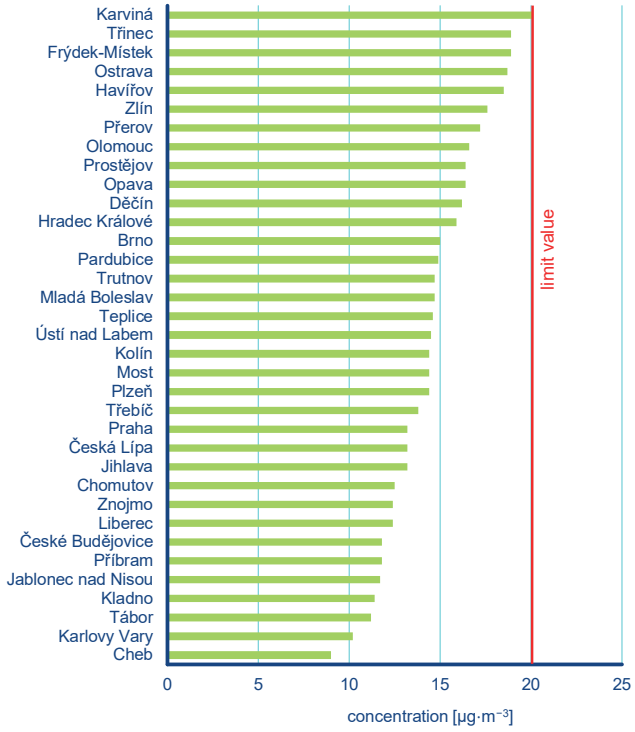
Weighted ground-level O_3 concentrations (26th highest maximum daily 8-hour average in 2021) can be compared with the pollution limit value (120 $\mu g \cdot m^{-3}$) in contrast to the air pollution limit based on a three-year average (Table I.1). In view of the fact that ground-level O_3 does not have its own emission source and the formation and chemistry of O_3 is complex and depends on many factors, its increased concentrations may occur in even relatively clean areas (for more see Chapter IV.4). In 2021, weighted O_3 concentrations higher than the pollution limit value were not observed in any region. In 2021, inhabitants in the O/K/F-M and Brno agglomerations, and in the South Moravia without Brno, Moravian-Silesia without O/K/F-M and Central Bohemia regions were exposed to the highest weighted O_3 concentrations. However, differences between individual regions were not as pronounced as in the case of other pollutants.

Weighted ground-level O_3 concentrations did not exceed the value of the pollution limit in any city with more than 30 000 inhabitants. The highest concentrations were determined for Karviná, Ostrava, Havířov, Třinec, Brno, Teplice and Ústí nad Labem cities.

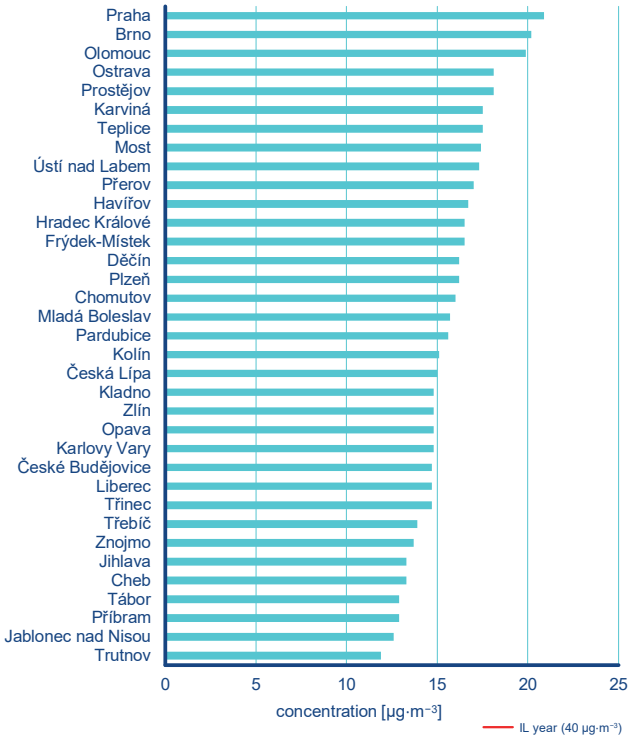
Fig. V.3.2.1 Average population-weighted concentrations of pollutants in regions of the Czech Republic, 2021



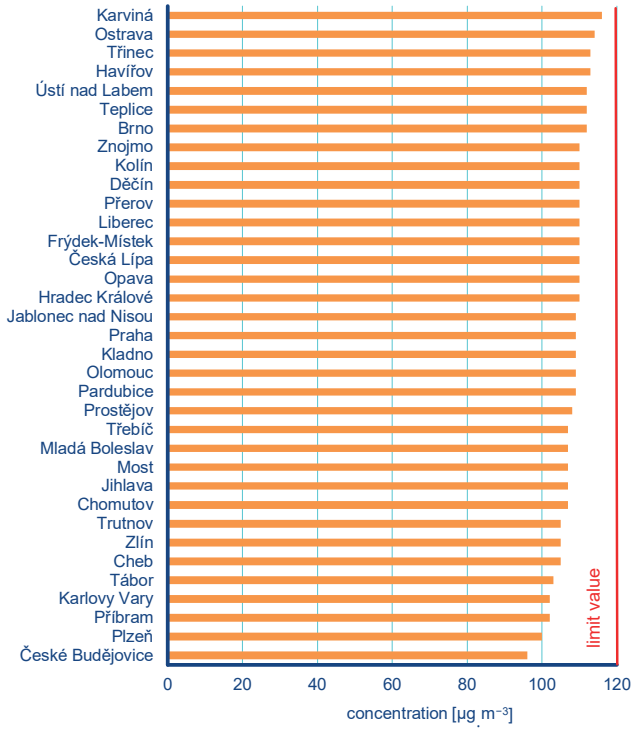
PM_{10} – annual average



$PM_{2,5}$ – annual average



NO_2 – annual average



O_3 – 26. highest max. 8hour average

Fig. V.3.2.2 Average population-weighted concentrations of pollutants in municipalities with more than 30 000 inhabitants, 2021