IV.6 Heavy metals

IV.6.1 Air pollution by heavy metals in 2019

Arsenic

The annual pollution limit level for arsenic (6 ng.m^{-3}) was not exceeded at any of 52 stations with valid annual average value in 2019 (Tab. XI.16, Fig. IV.6.4). The highest annual average was observed at the Kladno-Švermov urban background station (3.3 ng.m^{-3}). Compared to 2018 with 3.9 ng.m^{-3}, it is a decrease by 15%. The Kladno district and the territory of the capital of Prague were loaded by the highest concentrations of arsenic in 2019. Following a support by the Moravian-Silesian region, a location with a similar concentration level was identified also in Bruntál (Fig. IV.6.2).

Arsenic concentrations have long been below the limit value over most of the Czech Republic, except for the Kladno and Prague areas (Fig. IV.6.3). In non-polluted areas, concentrations are below half of the limit value, in polluted areas, also above the limit value. Of the total number of 39 stations that measured arsenic concentrations in both 2018 and 2019, the annual average concentration increased at only 3 stations (8%), while decreased at 33 stations (85%). The concentration remained unchanged at 3 stations (8%).

Cadmium

The annual pollution limit level for cadmium (5 ng.m^{-3}) was not exceeded at any of 60 stations with valid annual average value in 2019 (Tab. XI.15, Fig. IV.6.4). The highest annual average was observed at the Tanvald-školka urban background station (4 ng.m^{-3}). Compared to 2018 with 3.2 ng.m^{-3}, it is an increase by 20%. The highest annual average concentrations were identified mostly at stations in the Jablonec nad Nisou district (Fig. IV.6.5).

In the long term, cadmium concentrations are below the limit value over the territory of the Czech Republic, except for the Jablonec nad Nisou vicinity (Fig. IV.6.6). Of the total number of 39 stations measuring cadmium concentrations in both 2018 and 2019, the annual average concentration increased at 13 stations (33%), while it decreased at 11 stations (28%). The concentration remained unchanged at 15 stations (38%).

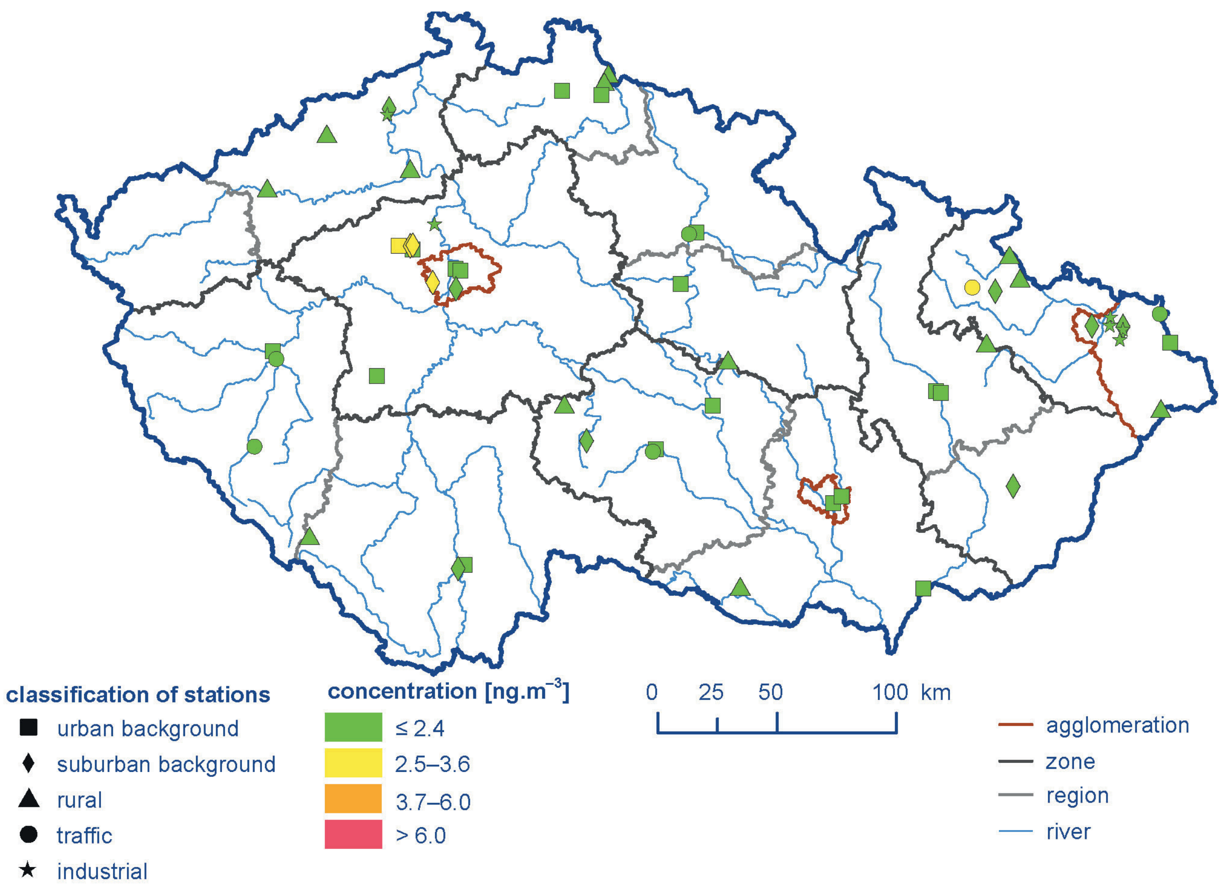

Fig. IV.6.1 Annual average concentrations of arsenic at air quality monitoring stations, 2019

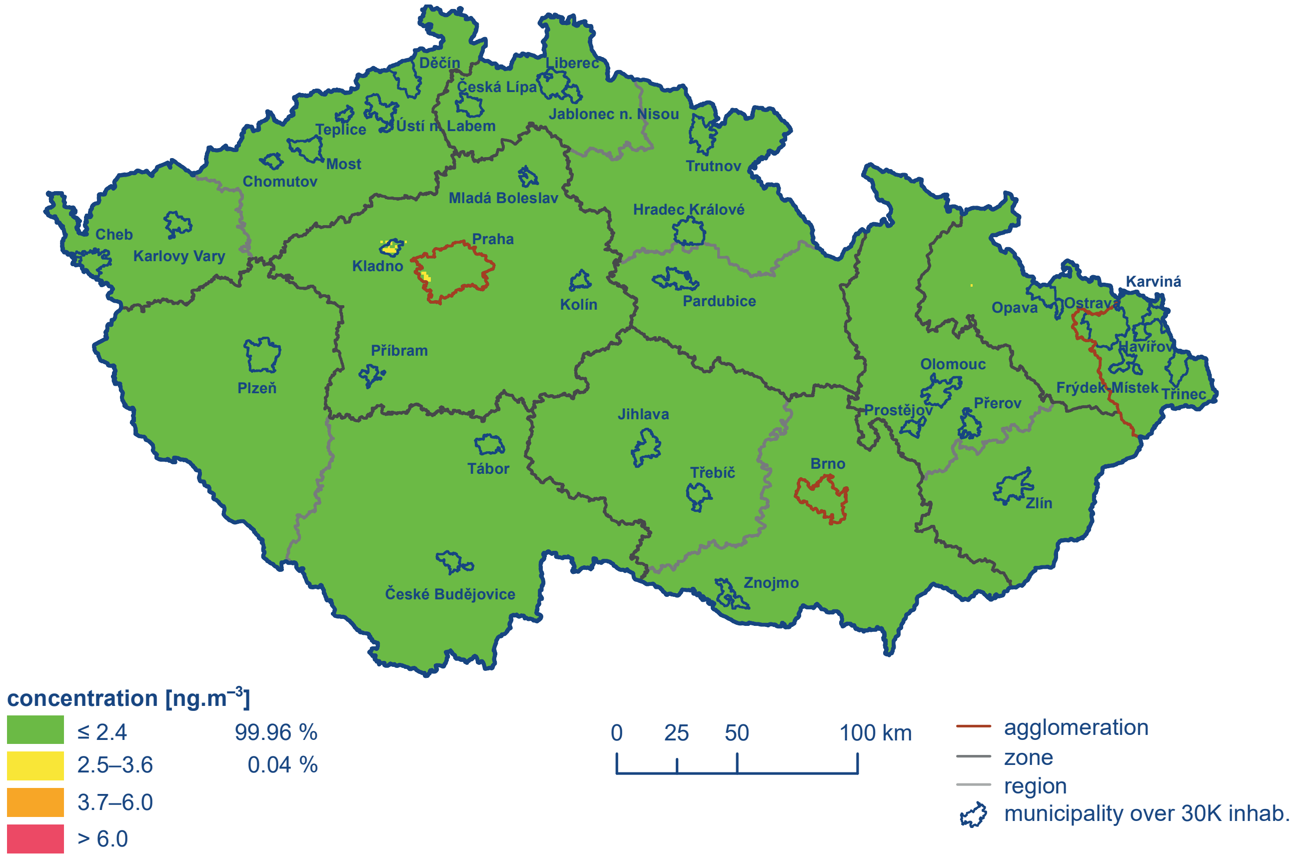

Fig. IV.6.2 Field of annual average concentration of arsenic, 2019

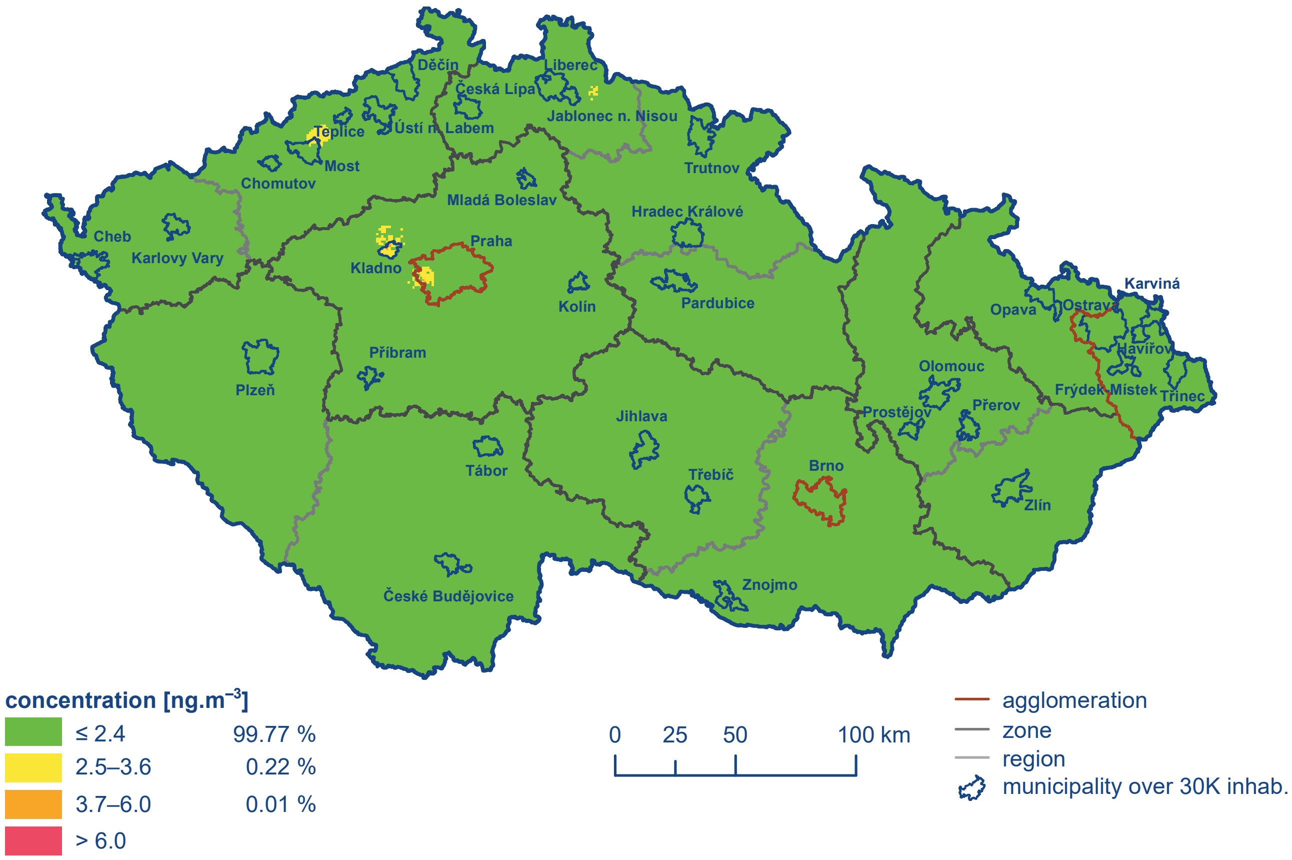

Fig. IV.6.3 Five-year average of annual average concentrations of arsenic, 2015–2019

Nickel

The annual pollution limit level for nickel (20 ng.m^{-3}) was not exceeded at any of 53 stations with valid annual average value in 2019 (Tab. XI.17). The highest annual average value (4 ng.m^{-3}) was observed at the Ostrava-Mariánské Hory industrial station. The same value was observed in 2018. The highest nickel concentrations are repeatedly measured in the O/K/F-M agglomeration.

Nickel concentrations have long been very low over the whole territory of the Czech Republic and do not even reach half of the pollution limit level. Of the total number of 39 stations measuring nickel concentrations in both 2018 and 2019, the annual average concentration increased at only 1 station (3%), while it decreased at 82 stations (82%). The concentration remained unchanged at 6 stations (15%).

Lead

The annual pollution limit level for lead (500 ng.m^{-3}) was not exceeded at any of 52 stations with the valid annual average value in 2019 (Tab. XI.14). The highest annual average (52 ng.m^{-3}) was observed at the Ostrava-Radvanice ZÚ station. Compared to 2018 with 47 ng.m^{-3}, it is an increase by 9%. The highest lead concentrations are repeatedly measured in the O/K/F-M agglomeration.

In the long term, lead concentrations are very low over the whole territory of the Czech Republic and do not even reach half of the pollution limit level. Of the total number of 39 stations measuring lead concentrations in both 2018 and 2019, the annual average concentration increased at only 2 stations (5%), while it decreased at 37 stations (95%).

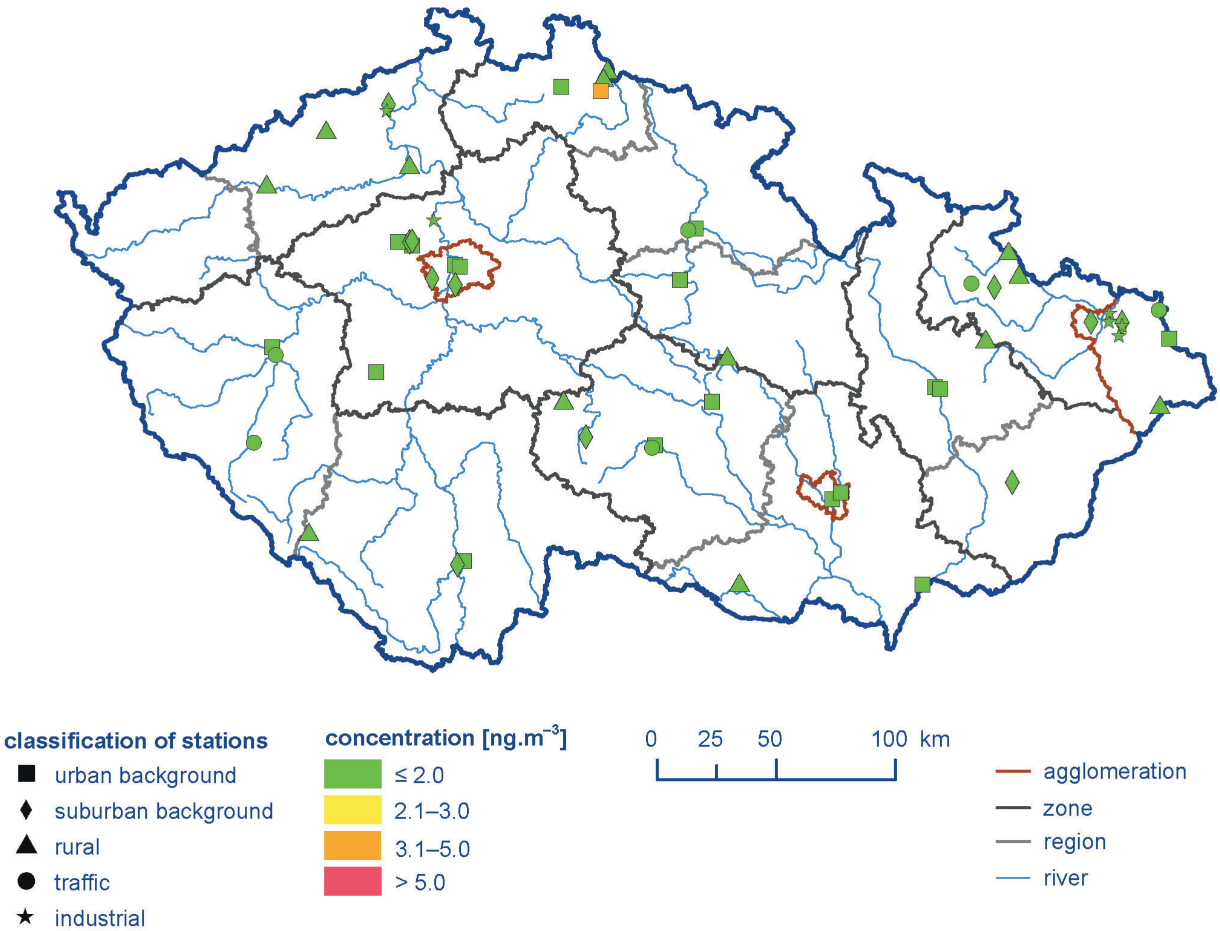

Fig. IV.6.4 Annual average concentrations of cadmium at air quality monitoring stations, 2019

Fig. IV.6.5 Field of annual average concentration of cadmium, 2019

Fig. IV.6.6 Five-year average of annual average concentrations of cadmium, 2015–2019

IV.6.2 Trends in heavy metal concentrations

Arsenic concentrations have been stable over the last 11 years, and have been slightly declining since 2017 (Fig. IV.6.7). In the most polluted area, the Kladno district, the limit level for arsenic was being exceeded in the period under review until 2013. Since 2014, annual concentrations have been just above the upper assessment limit (Fig. IV.6.8). The Kladno district is one of the areas where the campaign measurement of heavy metal concentrations under the Technology Agency of the CR project (No. TITSMZP704) took place. Preliminary results show that the increased

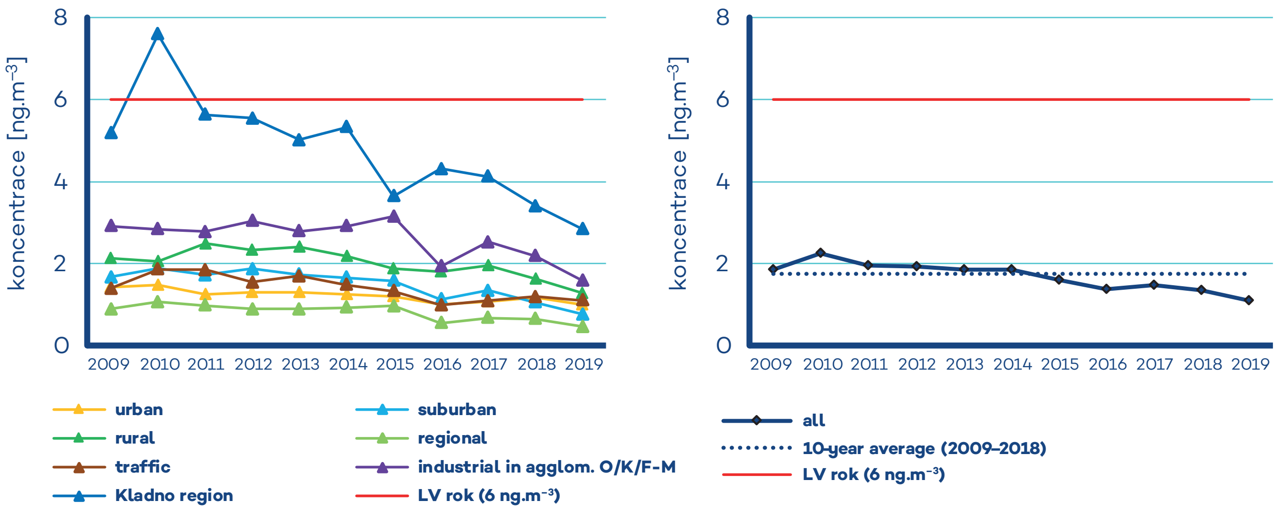

Fig. IV.6.7 Annual average concentrations of arsenic, at particular types of stations in the Czech Republic, 2009–2019

Fig. IV.6.8 Annual average concentrations of arsenic at selected stations, 2009–2019

arsenic concentrations in this region are due to the use of specific type of coal for individual household heating. The issue is subject to further investigation.

The national average of cadmium concentrations has been declining over the last 11 years (Fig. IV.6.9). In the most polluted area, in the Tanvald district, high to above-limit concentrations were observed between 2012 and 2015 (Fig. IV.6.10). The Tanvald area

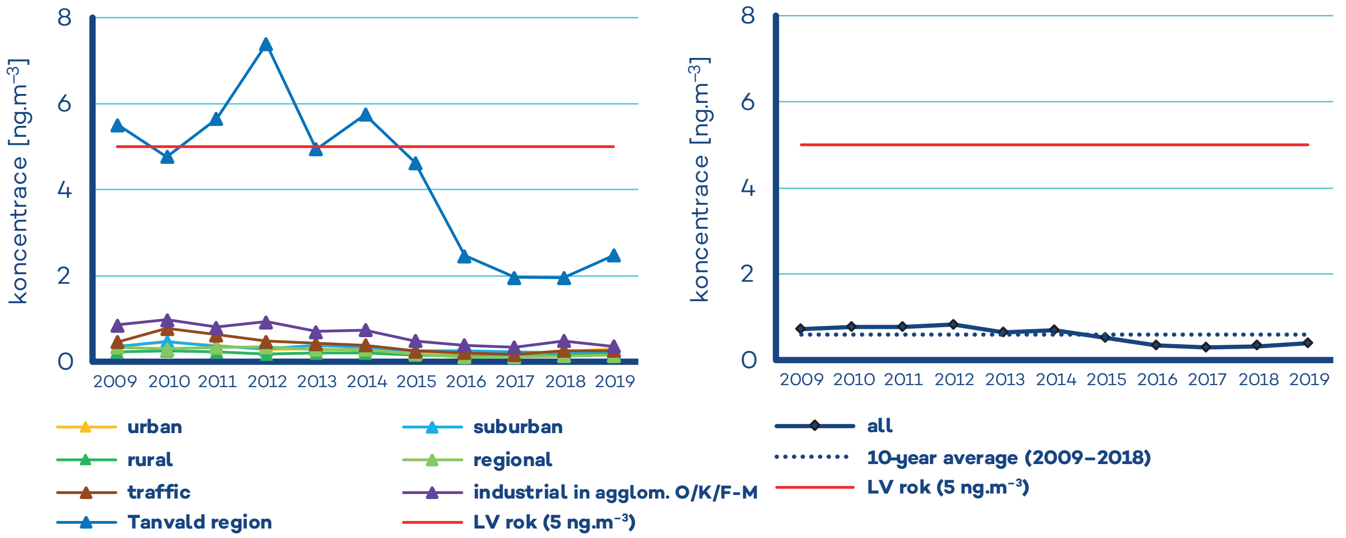

Fig. IV.6.9 Annual average concentrations of cadmium at particular types of stations in the Czech Republic, 2009–2019

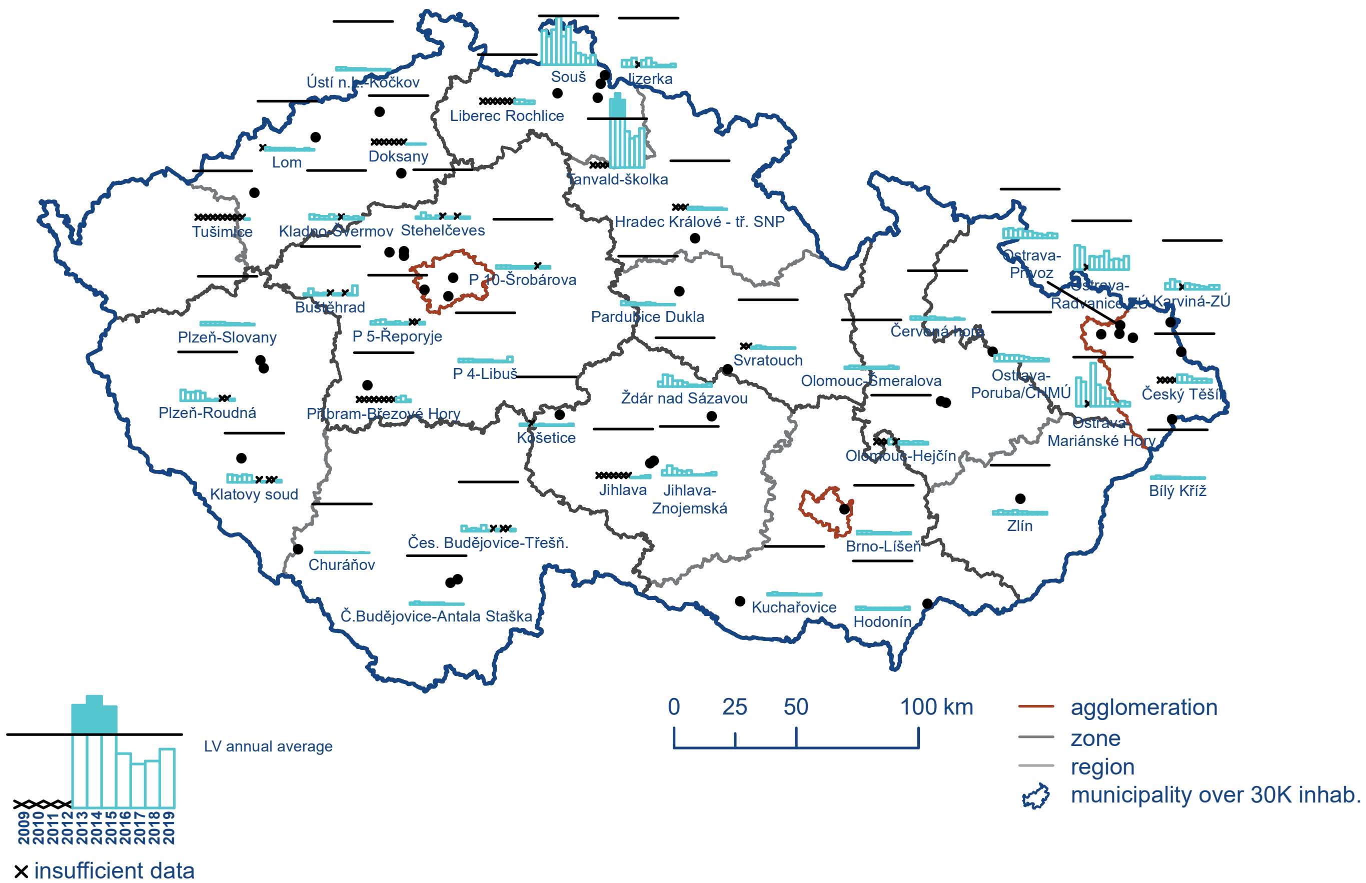

Fig. IV.6.10 Annual average concentrations of cadmium at selected stations, 2009–2019

is characterized by a high representation of the glass industry (ASKPCR 2014) which is a significant source of cadmium emissions from application of paints and fluxing agents (Beranová 2013). In 2015 and 2016, the production operation was adapted to be ecologically favourable which led to a decrease of annual average cadmium concentrations below the limit level. However, an annual evaluation of measurements at the Tanvald-školka station and monitoring of results is still needed to assess the effectiveness of particular measures.

The national average of nickel concentrations has been slightly declining in the last 11 years, and has been developing steadily after 2015 (Fig. IV.6.11). In 2013, there was a significant increase in nickel concentrations at traffic stations. The highest concentrations since 2009 were recorded at industrial stations in 2018 and 2019. The cause of these fluctuations has not yet been sufficiently clarified.

Lead concentrations show a declining trend in the last 11 years, except for 2018, when there was an increase in concentrations at all types of stations (Fig. IV.6.12).

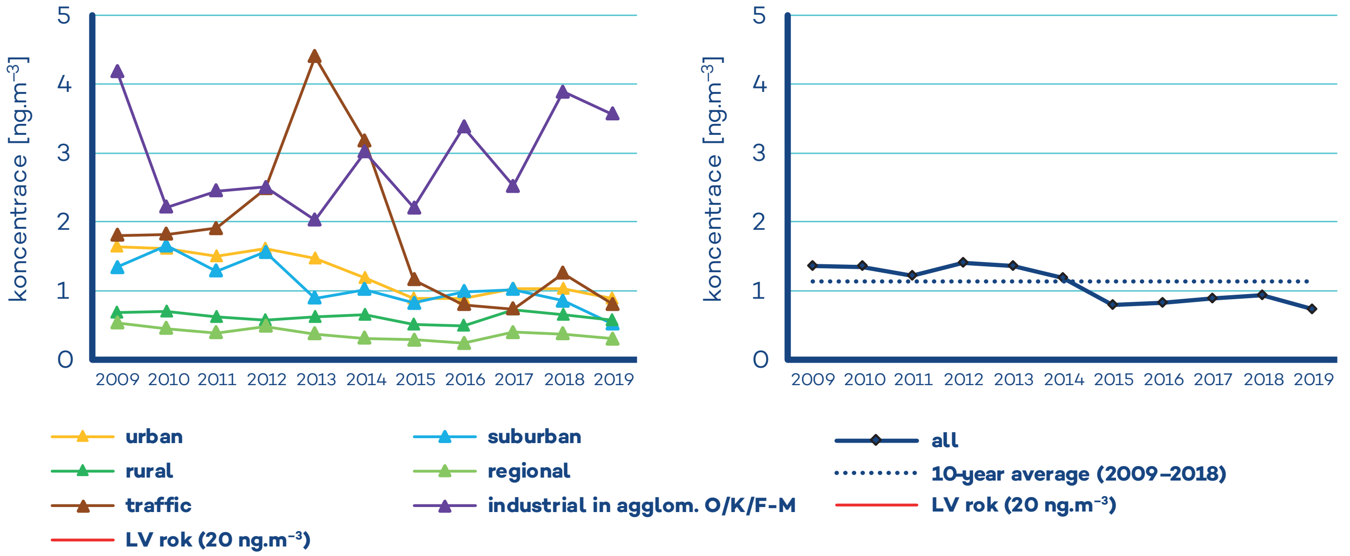

Fig. IV.6.11 Annual average concentrations of nickel at particular types of stations in the Czech Republic, 2009–2019

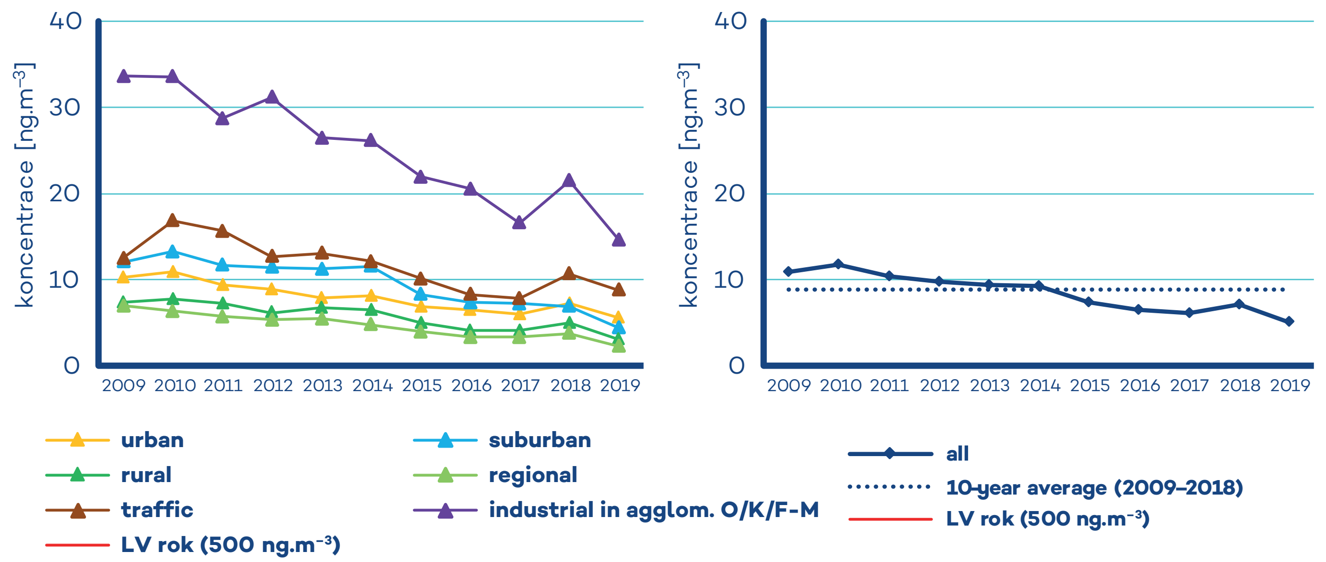

Fig. IV.6.12 Annual average concentrations of lead at particular types of stations in the Czech Republic, 2009–2019

IV.6.3 Emissions of heavy metals

The group of heavy metals comprises metals with a specific density greater than 4.5 $g.cm^{-3}$ and their compounds. Heavy metals are a natural component of solid fuels and their contents in fuels vary in dependence on the mining site. The amounts of heavy metal emissions from the combustion of solid fuels depends primarily on the kind of fuel, type of combustion equipment, and combustion temperature which affects the volatility of the heavy metals. Heavy metal emissions are also formed in some technological processes because they are contained in the input raw materials (e.g. iron ore, scrap metal, glass batches, coatings, glass shards). In addition to these processes, there are also a number of sources of fugitive emissions containing heavy metals (for example, particles from abrasion of brakes and tyres or emissions related to old environmental burdens left by mining and metallurgical activities).

Combustion processes are of predominant importance primarily for emissions of arsenic and nickel. The most significant sectors at a national scale include 1A1a — Public electricity and heat production which contributed 26.8% to arsenic emissions and 37.5% to nickel emissions in 2018 (Fig. IV.6.13 and Fig. IV.6.15). In 2018, significant contributions from the sectors of iron and steel production (1A2a and 2C1) related primarily to lead emissions (22.5%; Fig. IV.6.19). The impact of sector 1A4bi — Residential: Stationary predominated for cadmium emissions with a share of 50.8% (Fig. IV.6.17) and was significant also for arsenic emissions (36.8%; Fig. IV.6.13). Significant share of total lead emissions is formed by emissions from triggering of fireworks and pyrotechnics (29.2%; Fig. IV.6.19) which belong to sector 2G – Other sources. The cadmium emissions accounted for 10.7% from 2G sector with the main source of emissions being tobacco smoke (Fig. IV.6.17). The decreasing trend in emissions of heavy metals in the 2008–2018 period relates to the rate of emissions of suspended particles (Chap. IV.1.3) to which these substances are bound (Figs. IV.6.14, IV.6.16, IV.6.18, and IV.6.20). Measures in the sector of production of iron and steel made a substantial contribution to the decrease in heavy metal emissions, especially the improvements in the dust-removal system for agglomeration sintering strands. Technical measures have also succeeded in reducing heavy metal emissions from glass production. In recent years, there has been an increase in the volume of secondary production of non-ferrous metals, especially aluminium and lead. Emissions of heavy metals from these sources are very variable in dependence on the quality of the processed scrap metal.

In view of the predominant contribution of the sector of public electricity and heat production and the sector of iron and steel production, the territorial distribution of heavy metal emissions (excluding emissions from sector 2G – Other sources) is determined mainly by the location of production facilities in these sectors. Emissions of arsenic and nickel are concentrated in areas in which thermal power plants and heating plants burning coal are located (Figs. IV.6.21, and IV.6.22). These are primarily enterprises in the Ústí nad Labem, Central Bohemian and Pardubice regions. Emissions of cadmium and lead are predominantly produced in the O/K/F-M agglomeration due to concentration of enterprises producing iron and steel. A significant amount of lead emissions in the Central Bohemian region originates from secondary lead production at Kovohutě Příbram (Figs. IV.6.23, and IV.6.24).

- Other
- 1A2c – Stationary combustion in manufacturing industries and construction: Chemicals
- 2C1 – Iron and steel production
- 2C3 – Aluminium production
- 1B2aiv – Fugitive emissions oil: Refining and storage
- 1A4ai – Commercial/Institutional: Stationary
- 1A2f – Stationary combustion in manufacturing industries and construction: Non-metallic minerals
- 2A3 – Glass production
- 1A1a – Public electricity and heat production
- 1A4bi – Residential: Stationary

Legend to Figs IV.6.13 and IV.6.16

- Other
- 1A4ai – Commercial/Institutional: Stationary
- 1A2f – Stationary combustion in manufacturing industries and construction: Non-metallic minerals
- 1A3bvi – Road transport: Automobile tyre and brake wear
- 2A3 – Glass production
- 2C1 – Iron and steel production
- 2G – Other product use
- 1A4bi – Residential: Stationary
- 1A2c – Stationary combustion in manufacturing industries and construction: Chemicals
- 1A1a – Public electricity and heat production

Legend to Figs IV.6.17 and IV.6.18

- Other
- 1A2a – Stationary combustion in manufacturing industries and construction: Iron and steel
- 2C3 – Aluminium production
- 1B2aiv – Fugitive emissions oil: Refining and storage
- 2G – Other product use
- 1A1a – Public electricity and heat production
- 2C1 – Iron and steel production
- 2A3 – Glass production
- 1A4bi – Residential: Stationary

Legend to Figs IV.6.19 and IV.6.20

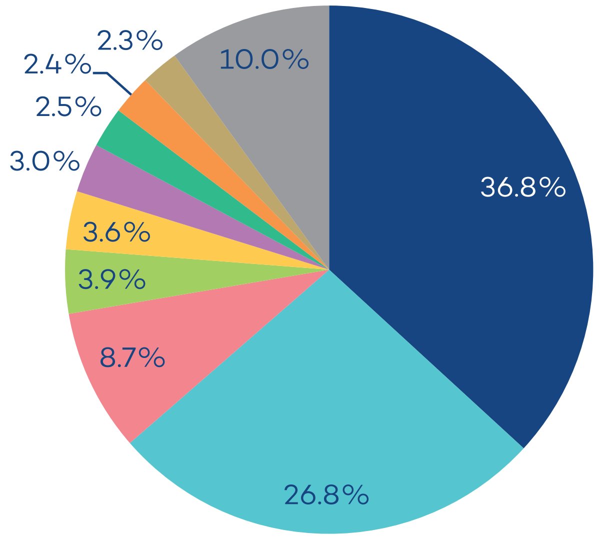

Fig. IV.6.13 Share of NFR sectors in total emissions of arsenic, 2018

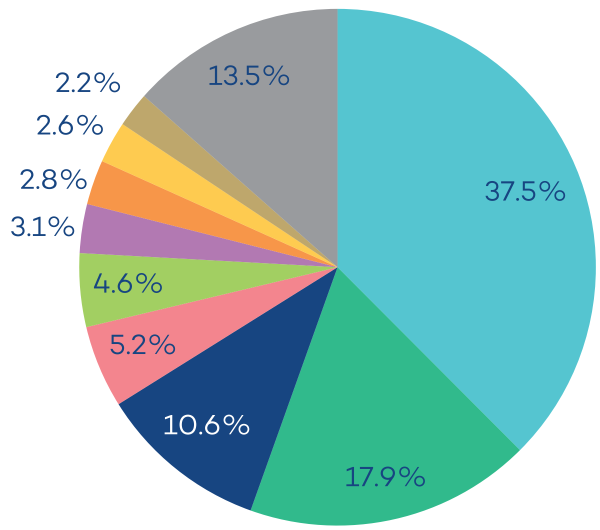

Fig. IV.6.15 Share of NFR sectors in total emissions of nickel, 2018

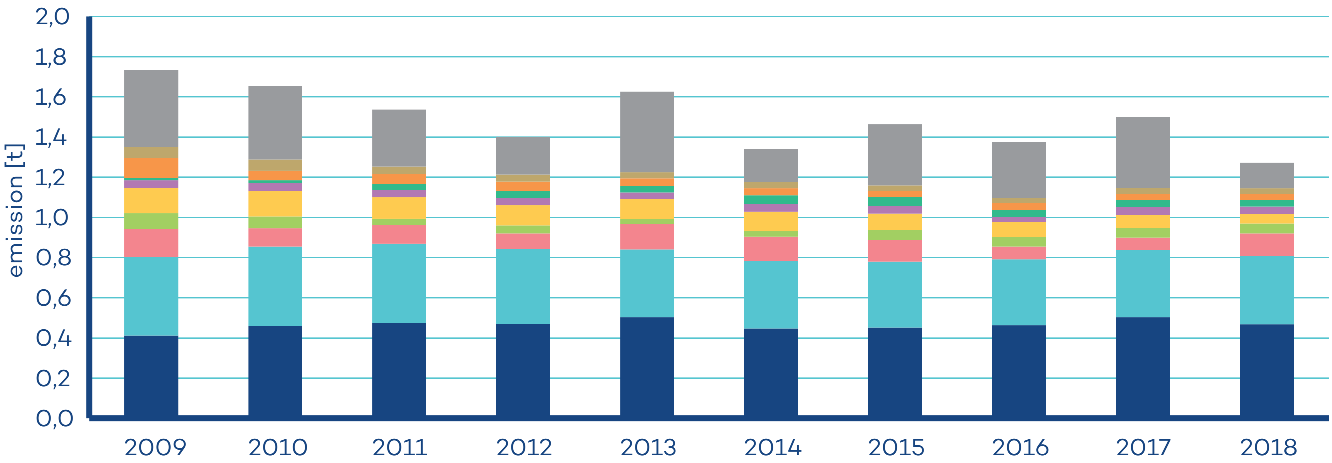

Fig. IV.6.14 Total arsenic emissions of arsenic, 2009–2018

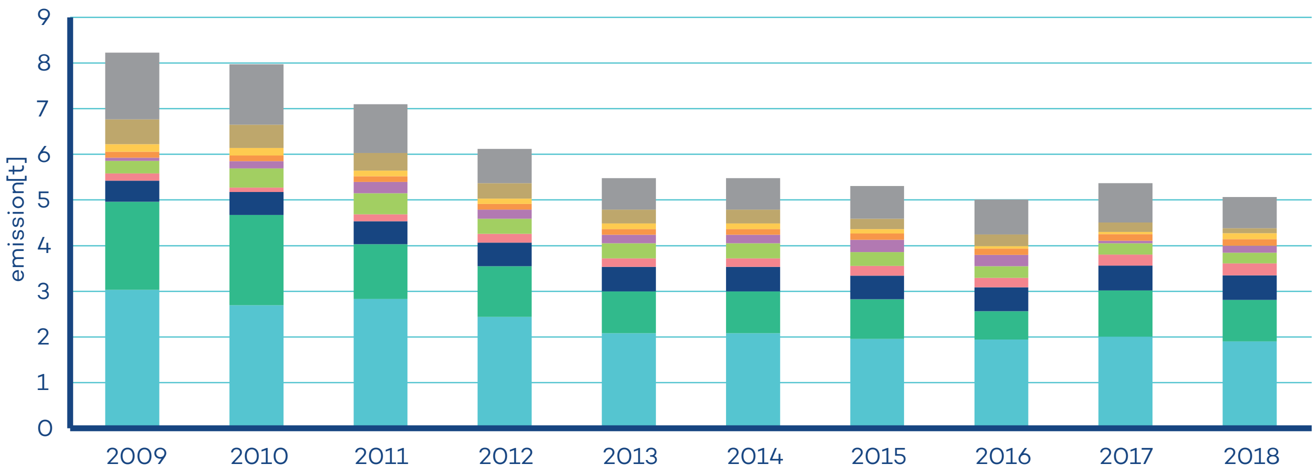

Fig. IV.6.16 Total emissions of nickel, 2009–2018

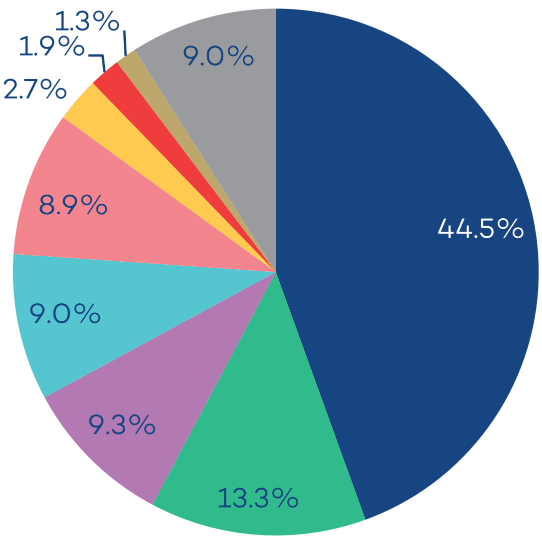

Fig. IV.6.17 Share of NFR sectors in total emissions of cadmium, 2018

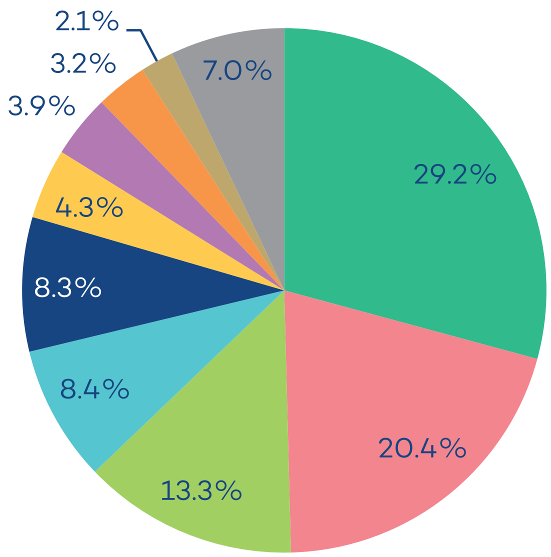

Fig. IV.6.19 Share of NFR sectors in total emissions of lead, 2018

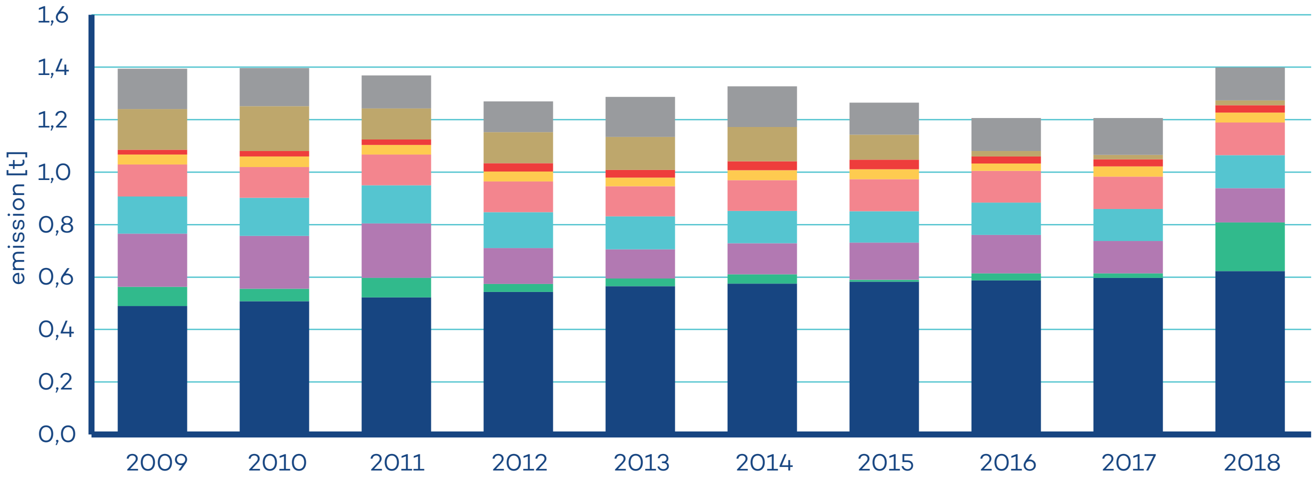

Fig. IV.6.18 Total emissions of cadmium, 2009–2018

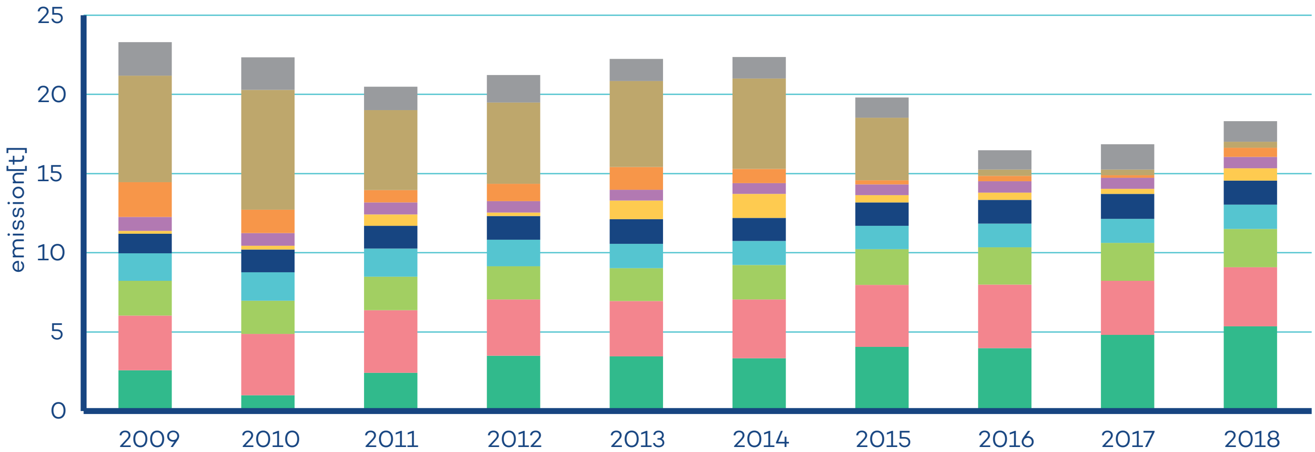

Fig. IV.6.20 Total emissions of lead, 2009–2018

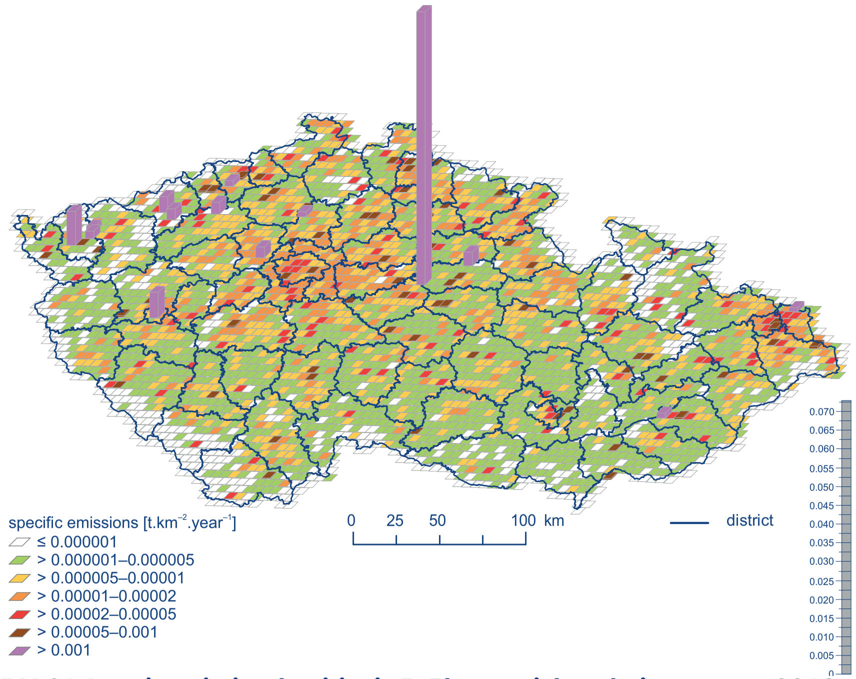

Fig. IV.6.21 Arsenic emission densities in 5x5 km spatial resolution squares, 2018

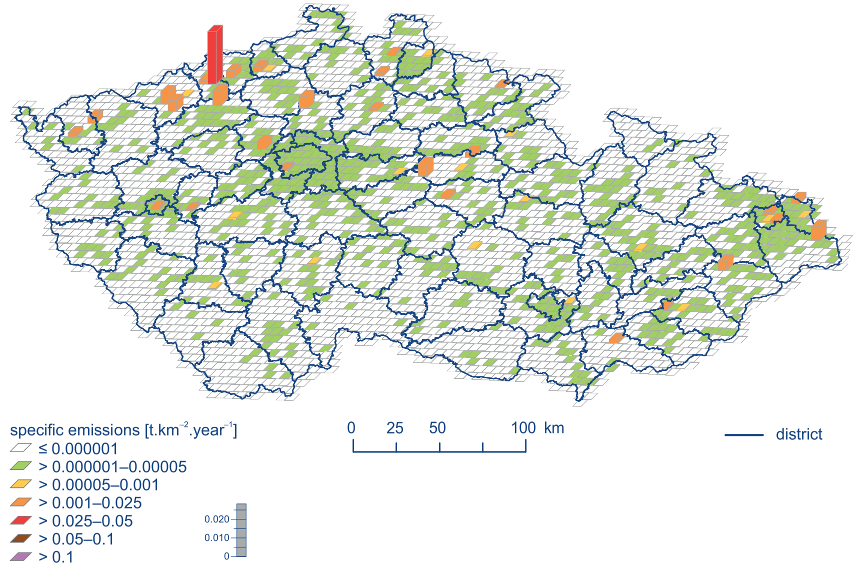

Fig. IV.6.22 Nickel emission densities in 5x5 km spatial resolution squares, 2018

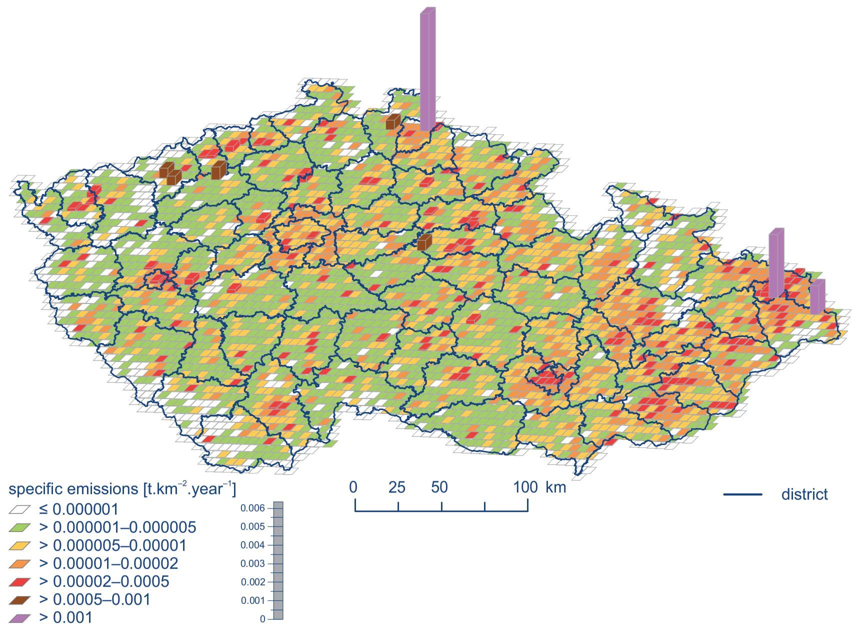

Fig. IV.6.23 Cadmium emission densities in 5x5 km spatial resolution squares, 2018

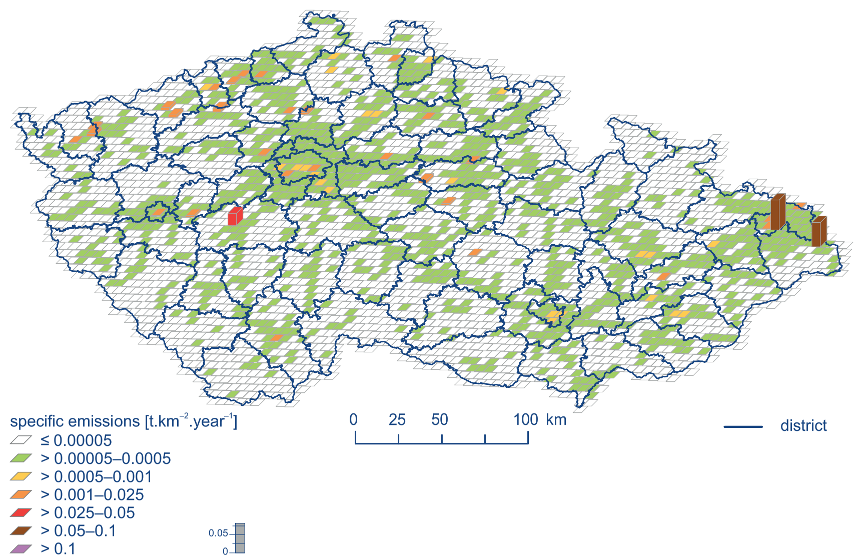

Fig. IV.6.24 Lead emission densities in 5x5 km spatial resolution squares, 2018