I. INTRODUCTION

Polluted air has a demonstrable detrimental impact on human health and pollutants can cause a wide range of health problems from less serious to grave diseases and demonstrably increase the burden on the immune system, which can lead to premature mortality. It also has significant economic impacts as healthcare costs increase and productivity decreases in all sectors of the economy due to increased incapacity for work. Pollutants negatively affect vegetation, can influence its growth and result in decreased yields of agricultural crops and forests. In addition, they lead to eutrophication and acidification of soils and aquatic ecosystems[1] and subsequently to changes in species diversity and a reduction in the number of plant and animal species. Many pollutants accumulate in the environment, with a detrimental impact on ecosystems, and enter into the food chain. In addition, some of them directly or indirectly affect the climate system of the Earth. The damage caused by atmospheric pollutants to materials and

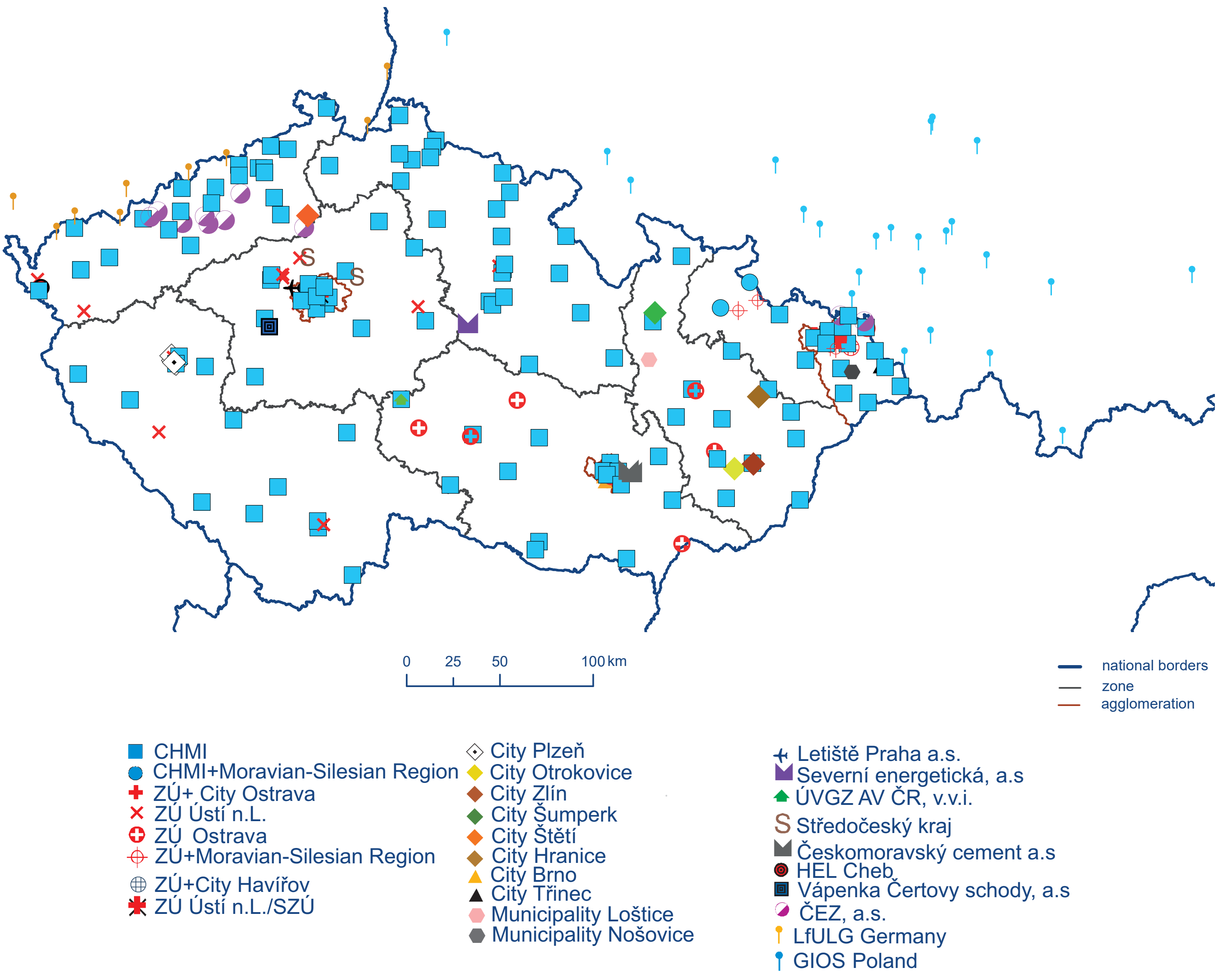

Fig. I.1 Major station networks of ambient air quality monitoring, 2019

1 Eutrophication is a process of enrichment in nitrogen and phosphorus, while acidification leads to increased acidity.

buildings, which are frequently historically important, must also be mentioned. Limiting the effects of these impacts also incurs economic costs related not only to the remediation of damage, but also to research focused on the quantification of pollution and related externalities.

Despite a number of measures implemented in the past years, particular sources produce an amount of emissions that can, in combination with meteorological and dispersion conditions, lead to exceeding the pollution limit levels for some substances. At the present time, of the monitored pollutants, the greatest problems are caused by suspended particulate matter and polycyclic aromatic hydrocarbons bound to them. In the spring and summer, the pollution limit levels for ground-level ozone are exceeded at a number of locations.

However, the specific contributions of the individual sources to ambient air pollution differ in various regions depending on the composition of sources at the given location and also on transfer of pollutants from other areas. The level of air pollution is objectively determined by means of a network of measuring stations that monitor the concentrations of pollutants of the ambient air (air pollution) in the ground layer of the atmosphere (Fig. I.1). Based on the mandate by the Ministry of the Environment, the Czech Hydrome-

Tab. I.1 Limit values (LV) and permitted number of instances exceeding the limit value, upper and lower assessment thresholds according to the Act No. 201/2012 Coll. on the air protection, as amended, and Decree No. 330/2012 Coll., on the method of assessing and evaluating the level of pollution, the scope of informing the public about the level of ambient air pollution and during smog situations

Pollutant	Averaging interval	Assessment threshold [μg.m^{-3}]		Limit value [μg.m^{-3}] LV
		Lower assessment threshold	Upper assessment threshold	
SO_2	1 hour	–	–	**350** max. 24/year
	24 hours	**50** max. 3x/year	**75** max. 3x/year	**125** max. 3x/year
NO_2	1 hour	**100** max. 18x/year	**140** max. 18x/year	**200** max. 18x/year
	calendar year	**26**	**32**	**40**
CO	max. daily 8-hour running average	**5 000**	**7 000**	**10 000**
benzene	calendar year	**2**	**3.5**	**5**
PM_{10}	24 hours	**25** max. 35x/year	**35** max. 35x/year	**50** max. 35x/year
	calendar year	**20**	**28**	**40**
$PM_{2.5}$	calendar year	**12**	**17**	**25**
Pb	calendar year	**0.25**	**0.35**	**0.5**
As	calendar year	**0.0024**	**0.0036**	**0.006**
Cd	calendar year	**0.002**	**0.003**	**0.005**
Ni	calendar year	**0.010**	**0.014**	**0.020**
benzo[*a*]pyrene	calendar year	**0.0004**	**0.0006**	**0.001**
O_3	max. daily 8-hour running average	–	–	**120**, **25x** in 3-year average

Long-term objectives (LTO)

Pollutant	Application	Averaging interval	Long-term objective [μg.m^{-3}]
O_3	for the protection of human health	max. daily 8-hour running average	120

teorological Institute (CHMI) operates the State Air Quality Network in the Czech Republic, the Air Quality Information System (AQIS) of the Czech Republic and routinely processes the measured air pollution values in the form of tabular and graphical reviews.

Pollutants monitored and evaluated for demonstrably harmful effects on population health or vegetation and ecosystems have set limit values. In evaluating the air quality, the observed concentration levels are, in particular, compared with the respective air pollution limit values (Tab. I.1 and I.2), or with the permissible frequencies of these limits being exceeded, which are concentration levels that should not be exceeded under applicable legislation. Brief characteristics of pollutants, overview of their emission sources and their impacts are given in Tab. I.5.

The graphic yearbook contains twelve separate chapters and annexes. The summary and introductory chapter contains the most important information on air quality in a given year and general information on the issue. The next chapters contain detailed elaboration of individual topics related to emissions of polluting substances and greenhouse gases, i.e. production of pollutants and evaluation of the air quality, i.e. level of pollution.

Ambient air quality yearbooks are intended for authorities and organisations dealing with and managing issues related to the environment and air protection in the Czech Republic as well as to professional and wider public. The yearbooks are publicly available on the CHMI website. The publication is the basic information document on air quality in the Czech Republic. Its aim is to evaluate the air quality in a broader context based on available data and information.

I.1 Objectives of the publication

The "Air Pollution in the Czech Republic in 2019" yearbook, together with the electronically published “Summary Table Survey" data yearbook provide a comprehensive annual overview of information on the ambient air quality in the territory of the Czech Republic for the relevant year. The evaluation of air quality is based on the measured data collected within the AQIS using additional data sources and mathematical tools. The data yearbook presents verified measured pollution data and information on the chemical composition of atmospheric precipitation from the individual locations, including aggregated data, while the graphic yearbook provides a commented summary of information in a form of overview maps, graphs and tables.

I.2 Political and legislative framework of ambient air quality protection

The Thematic Strategy on Air Pollution (hereinafter the Strategy) is the basic EU strategic document in the area of assessing and managing ambient air quality. The objective of the Strategy, in accordance with the 6th Environment Action Programme, is to achieve "a level of ambient air quality which does not give rise to risks for human health and the environment and does not have

Tab. I.2 Limit values (LV) for the protection of ecosystems and vegetation according to the Act No. 201/2012 Coll., as amended

Pollutant	Averaging interval	Assessment threshold		Limit value [μg.m^{-3}] LV
		Lower assessment threshold	Upper assessment threshold	
SO_2	year and winter period (1. 10.–31. 3.)	8	12	20
NO_x	calendar year	19.5	24	30
O_3	AOT40, calculated from 1-hour values between May and July	—	—	[μg.m^{-3}.h] 18 000 average for 5 years

Note: AOT40 is the sum of differences between the hourly concentration higher than 80 μg·m^{-3} (= 40 ppb) and the value 80 μg·m^{-3} in the given period by using only hourly values measured every day between 8:00 and 20:00 CET.

Long-term objectives (LTO)

Pollutant	Application	Averaging interval	Long-term objective [μg.m^{-3}.h]
O_3	for the protection of ecosystems and vegetation	AOT40, calculated from 1-hour values between May and July	**6 000**

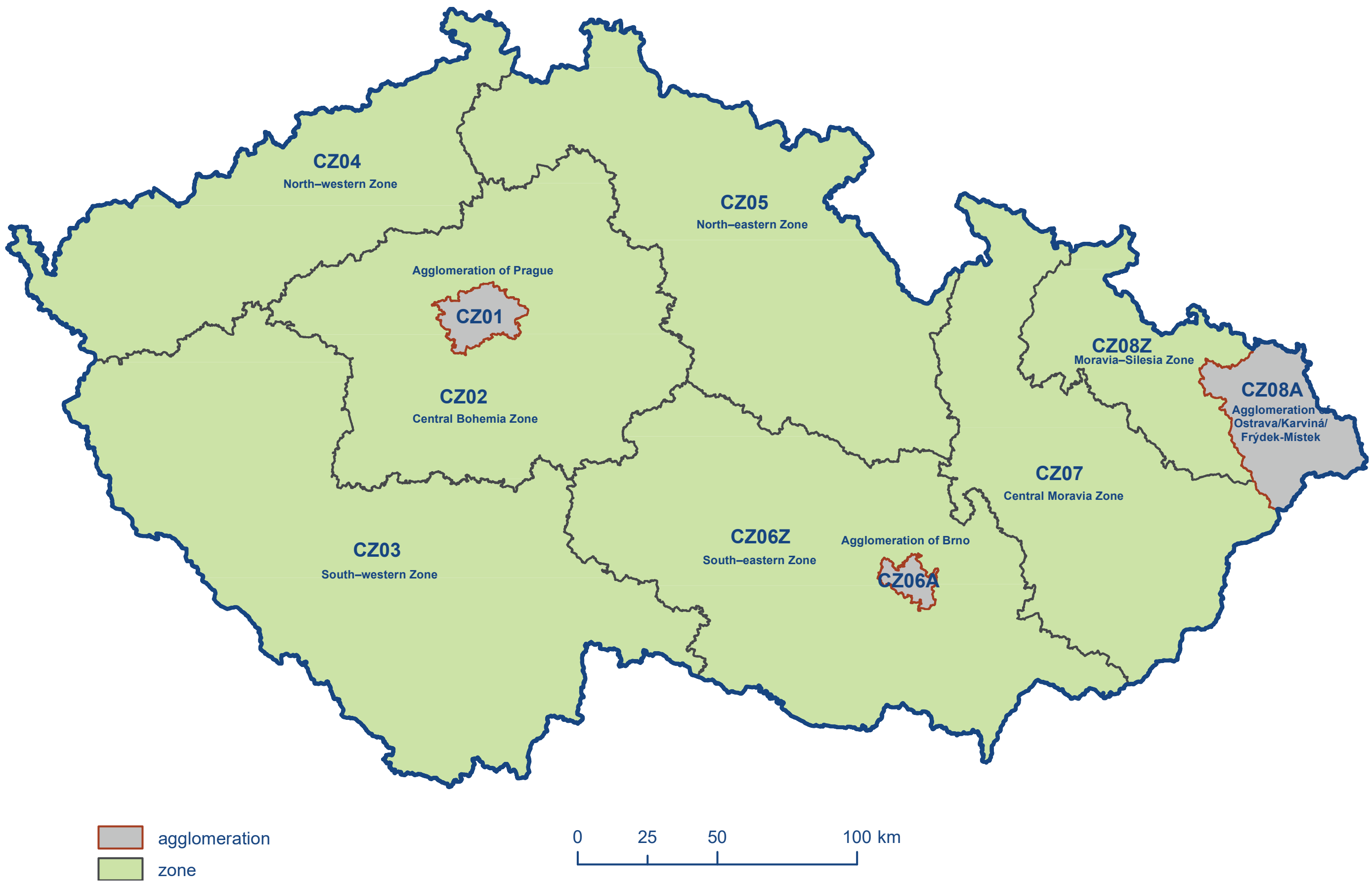

Fig. I.2 The zones and agglomerations for ambient air quality assessment and evaluation of ambient air pollution level according to the Act No. 201/2012 Col/. on Clean Air Protection, as amended

markedly negative impacts on them". On the basis of the Strategy of 2005, the European Commission carried out a comprehensive review of current EU policy in the area of air protection. This resulted in the adoption of a package of measures (Clean Air Policy Package) in December 2013. The package contains, for example, the "Clean Air for Europe" programme document, outlining new objectives in ambient air quality for the period up to 2030 (EC 2013a).

Within the framework of the EU, the main tools for ambient air quality protection and improvement are Directive 2008/50/EC on ambient air quality and cleaner air for Europe, Directive 2004/107/EC relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air, Directive 2016/2284/EU on the reduction of national emissions of certain atmospheric pollutants, and European Parliament and Council Directive No. 2010/75/EU on industrial emissions (integrated pollution prevention and control). Newly, EU Commission Decree 2015/1480 of 28 August 2015 amends several annexes to European Parliament and Council Directives 2004/107/ES and 2008/50/ES, which set the rules for reference methods, data verification and location of sampling sites for assessing ambient air quality.

Based on the requirement of the European Commission to prepare a coherent approach to air quality control in the Czech Republic, a Medium-Term Strategy (up to 2020) for improving air quality in the Czech Republic has been prepared. This conceptual document was approved in December 2015 and summarizes the outputs of the basic strategic documents for improving air quality – National Emission Reduction Programme of the Czech Republic and ten programmes for improving air quality (PZKO) elaborated for designated zones and agglomerations. Among other things, it acts as a basic document for financing measures for decreasing emissions and improving air quality from EU funds via operational programmes (MŽP 2015).

At the beginning of 2020, the Ministry of the Environment published an updated National Emission Reduction Program of the Czech Republic. The Czech Republic has been preparing this document continuously since 2004 and its main purpose is to ensure a reduction in the overall production of pollutants and the level of air pollution in the Czech Republic. The working group, of which CHMI was also an active participant, coordinated the meetings of working teams for individual sectors of interest – agriculture, transport, public energy and local household heating. In connection with the outcomes of these negotiations and analyti-

Tab. I.3 WHO Air Quality Guidelines for the protection of public health (WHO 2000, WHO 2005)

	Averaging interval	Guideline value
PM_{10}	calendar year	20 $\mu g.m^{-3}$
	24 hours	50 $\mu g.m^{-3}$
$PM_{2,5}$	calendar year	10 $\mu g.m^{-3}$
	24 hours	25 $\mu g.m^{-3}$
benzo[*a*]pyrene[a)]		not recommended
NO_2	calendar year	40 $\mu g.m^{-3}$
	1 hour	200 $\mu g.m^{-3}$
O_3	max. daily 8-h running average	100 $\mu g.m^{-3}$
benzene[a)]		not recommended
Pb	calendar year	0.5 $\mu g.m^{-3}$
Cd[a, b)]		not recommended
As[a)]		not recommended
Ni[a)]		not recommended
SO_2	24 hours	20 $\mu g.m^{-3}$
	10 minutes	500 $\mu g.m^{-3}$
CO	1 hour	30 000 $\mu g.m^{-3}$
	8 hours	10 000 $\mu g.m^{-3}$

a) These are human carcinogens therefore no safe level of the substance can be established. The WHO guideline value is not established. More information on the risks of cancer occurrence see WHO (2000). The WHO only determines the unit risk value (UCR) for non-threshold active substances.

b) The recommended value of cadmium concentration in ambient air to prevent further increase of this element in agricultural soils is 0.005 $\mu g.m^{-3}$.

cal documents including emission and air pollution assessments of the situation since 2008, measures were proposed to reduce emissions of monitored pollutants. Measures according to their nature are divided into three groups, namely priority, support and cross-cutting measures. The responsible coordinator was designated for the implementation of individual measures. In the case of priority measures, in addition to the coordinator, the deadline for their fulfilment, the method of implementation and indicators for monitoring their implementation were also determined. The methods were also defined and the benefits of measures to reduce emissions below the level of emission ceilings set by the requirements of Directive 2016/2284/EU on the reduction of national emissions of certain pollutants were assessed (see Chapter II.).

The aim of air quality improvement programs is to set out measures to achieve the required air quality in the shortest possible time. PZKO set measures mainly at the regional and local level. Air quality improvement programs were issued by the Ministry of the Environment in 2016 for all zones and agglomerations of the Czech Republic. The Ministry of the Environment is currently preparing, in cooperation with CHMI, regions and municipalities, an update of air quality improvement programs for the 2020+ horizon.

The national legislation on air quality evaluation in the Czech Republic is based on the European legislation. The basic legislative norm in the CR is the Act No. 201/2012 Coll., on air protection, as amended (hereinafter the "Air Protection Act"), defining, among other things, the zones and agglomerations for which ambient air quality is being evaluated. A zone is a territory specified by the MoE for monitoring and managing the air quality; an agglomeration is a settlement area with at least 250 000 inhabitants. The Air Protection Act sets out three agglomerations and seven zones (Fig. I.2). Details are specified in Decree No. 330/2012 Coll., on the method of assessment and evaluation of ambient air pollution levels and on the extent of informing the public on the level of ambient air pollution and during smog situations.

This yearbook presents air quality evaluation in 2018 pursuant to the requirements of the Czech legislation on air quality protection. In accordance with the Air Protection Act, the evaluation is aimed at defining areas where the limit values for the protection of health and the protection of ecosystems and vegetation are exceeded (Tab. I.1 and I.2). Where a limit value is exceeded in a zone or agglomeration or if the limit value is exceeded in a zone or agglomeration multiple times and more than the permitted maximum number of instances, the Ministry of the Environment, in cooperation with the relevant regional or local authority, is obliged to develop a programme aimed to improve air quality in the given zone or agglomeration, which it must prepare within 18 months after the end of the calendar year. During the preparation of each programme to improve air quality, the MoE adopts measures to ensure that the pollution limit level is attained as soon as possible.

The pollution limit levels are based on the recommended (guideline) values set by the World Health Organization (WHO) based on a number of epidemiological studies or, in the case of substances without a set limit, from established carcinogenic risk values (Tab. I.3 and I.4). In the interests of protecting public health, WHO recommends maintaining pollutant concentrations at levels that are even lower than those at which negative effects on human health have been documented. Nonetheless, these values stem from conclusions regarding the impacts on health from ambient air pollution and do not take into account the aspects of technical and economic feasibility and further political and social factors. Consequently, the pollution limit levels set by the legislation may be higher, but the process heading towards meeting the WHO guideline values must be generally supported (WHO 2013).

Tab. I.4 WHO Air Quality Guidelines for the protection of vegetation (WHO 2000)

	Averaging interval	Vegetation category	Guideline value
NO_2	calendar year		30 μg.m^{-3}
	24 hours		75 μg.m^{-3}
SO_2	year and winter period	agricultural crops	30 μg.m^{-3}
	year and winter period	forests and natural vegetation	20 μg.m^{-3}
	calendar year	lichens	10 μg.m^{-3}
O_3	AOT40, calculated from 1-hour values between May and July	agricultural crops	6 000 μg.m^{-3}
	AOT40, calculated from 1-hour values between April and October	forests	20 000 μg.m^{-3}
	AOT40, calculated from 1-hour values between May and July	semi-natural vegetation	6 000 μg.m^{-3}

Tab. I.5 Brief characteristics, overview of major emission sources and major effects of ambient air pollutants

Pollutant and its sources	Health effects	Environmental effects
Suspended particles (atmospheric aerosol) Atmospheric aerosol consists of liquid or solid particles suspended in the air, originating from natural or anthropogenic processes. The natural sources include volcanic activity, wind borne dust particles and pollen, and natural fires. The largest anthropogenic source of suspended particles in the CR originates from residential combustion, road transport, farm-level agricultural operations (harvesting, tillage, etc.) and public energy and heat production. Suspended particles can be of primary or secondary origin. The primary particles are emitted directly into the air, the secondary particles are formed in the air by a gas-to-particle conversion. The main gas precursors of secondary particles are SO_2, NO_X, NH_3 and VOC (Pöschl 2011; EEA 2013a). The size range of atmospheric aerosol covers five orders of magnitude – from units of nm up to hundreds of μm. Based on similar particle properties, this scale can be divided into fine mode (particles ≤ 2.5 μm) and coarse mode (particles ≥ 2.5 μm). Fine particles are mainly products of imperfect combustion, coarse particles are formed mechanically (Hinds 1999; Seinfeld, Pandis 2006). Fine particles can be further divided into nucleation, Aitken and accumulation mode particles. Particles of the nucleation mode (< 20 nm) are released into the air directly or are formed in it, if they are not removed from the atmosphere by the diffusion process they are transformed into particles of the Aitken mode. Aitken mode particles (20–100 nm) are formed during combustion processes (Finlayson-Pitts and Pitts 1999). The accumulation mode of size between 100 nm and 2.5 μm is formed by transformed particles of the previous two modes (Seinfeld and Pandis 2006). Mobile sources produce particles of 10–100 nm. Stationary sources give rise to particles in the range of 50-200 nm. Long range particle transport transfers particles of 100–1000 nm (Gu et al. 2011, Hinds 1999, Zhang et al. 2004, Zhu et al. 2004, Zhou et al. 2005, Yue et al. 2008). Coarse mode particles consist of e.g. soil particles, sea salt, particles from industrial and agricultural activities. Their high sedimentation rate determines a short residence time in the atmosphere in the range of several hours to days. They are removed from the atmosphere by dry deposition and precipitation (Hinds 1999; Tomasi et al. 2017; Seinfeld and Pandis 2006). The legislation sets air pollution limits for the mass concentration of particles of the size fraction PM_{10} (particles with a diameter ≤ 10 micrometers) and $PM_{2.5}$ (particles with a diameter ≤ 2.5 micrometers). The mass of particles (especially ultra-fine particles < 100 nm) in the standard PM_{10} and $PM_{2.5}$ size spectrum is negligible in comparison with their numbers. Therefore, measurements of the number of particles and their size distribution are used for specific evaluations of the influence of aerosol particles (health impacts, climate impact) (Tuch et al. 1997, Stanier et al. 2004).	Suspended particles cause a broad spectrum of effects on the cardiovascular and respiratory systems. They irritate the respiratory tract, reduce defence mechanisms and facilitate the development of infection, cause an inflammatory reaction in lung tissue, contribute to oxidative stress and thus the development of atherosclerosis, affect the electrical activity of the heart and have been classified as proven human carcinogens since 2013 (IARC 2015). The effect depends on the size, shape and composition of particles. Short-term increase of daily PM_{10} concentrations contributes to increasing total morbidity and mortality due to mainly cardiovascular diseases, to the growth of the number of persons hospitalized due to respiratory diseases, increasing infant mortality and increasing the frequency of coughing and breathing problems, mainly in asthmatics (SZÚ 2015b). Long-term increased concentrations can result in reduced pulmonary function, increased morbidity due to respiratory diseases and increased incidence of chronic bronchitis symptoms and decreased lifespan, especially due to increased mortality of the elderly and sick persons due to cardiovascular and respiratory diseases, including lung cancer (SZÚ 2015b). A safe threshold concentration for the impact of aerosol particles in the air has not yet been determined.	They affect the Earth's radiation balance, cloud and precipitation formation, and visibility. They have a direct influence (by scattering of incoming solar radiation) and indirect influence (as condensation nuclei in the clouds affecting the reflection of radiation by the clouds). The particles reflect and / or absorb solar radiation and thus contribute to the cooling or warming of the Earth's climate system (IPCC 2013). Suspended particles affect both animals and humans, affect plant growth and ecosystem processes, and may damage and tarnish buildings (EEA 2013a).

Pollutant and its sources	**Health effects**	**Environmental effects**
Benzo[*a*]pyrene Benzo[*a*]pyrene, which occurs in the air primarily bound to particles, is a suitable marker of ambient air pollution caused by PAHs. The reason is its stability and relatively constant contribution to carcinogenic activity of the mixture of PAHs bound to particles (EC 2001a). Residential heating belongs to the major sources of benzo[*a*]pyrene in the Czech Republic.	PAHs represent a group of substances of which many have toxic mutagenic or carcinogenic properties, belong among endocrine disruptors (substances damaging the function of endocrine glands) or act immunosuppressively. They affect foetal growth. Prenatal exposure to PAH is related to markedly lower birth weight (Choi et al. 2006) and probably also adversely affects the cognitive development of young children (Edwards et al. 2010). Benzo[*a*]pyrene itself is classified as a proven human carcinogen (IARC 2020).	PAHs can bioaccumulate and enter the food chain (Brookes et al. 2013, EEA 2013b).
Nitrogen oxides The term “nitrogen oxides” (NO_x) refers to nitric oxide (NO) and nitrogen dioxide (NO_2). More than 90% of anthropogenic emissions of NO_x are represented by NO emissions. The major anthropogenic sources of NO_x in the Czech Republic are road transport and public energy production.	As concerns the impact on human health, the most significant nitrogen oxide is NO_2 (WHO 2006). NO_2 can affect mainly the respiratory tract. The main effect of short-term exposure to high concentrations of NO_2 is increased reactivity of the respiratory tract and ensuing worsened symptoms in people with asthma (Samet et al. 2000). Exposure to NO_2 impairs lung functions and increases the risk of respiratory diseases in children due to reduced immunity to infections (EEA 2013a, Peel et al. 2005). It is also linked to increase of the total, cardiovascular and respiratory mortality (Stieb et al. 2003, Samoli et al. 2003), however, it is difficult to separate the effects of NO_2 from other simultaneously acting substances, mainly aerosols (WHO 2006), hydrocarbons, ozone, and other substances (Brauer et al. 2002).	NO_x contribute to acidification and eutrophication of soil and water. High NO_x concentrations can lead to damage to plants. NOx act as precursors of ground-level ozone and particulate matter (EEA 2013b, Brookes et al. 2013)
Ground-level ozone Ozone (O_3) is a secondary pollutant without its own emission source; it is formed as a part of photochemical smog under the influence of solar radiation during a series of reactions mainly between NO_x, VOC and oxygen. (EEA 2013a). Ozone can be transported over long distances, accumulate and reach high concentrations far from its place of origin (Brookes et al. 2013)	The main effect of ozone on the human body is irritative. It irritates the conjunctiva, nasal mucosa and bronchi. Short-term studies show that O_3 concentrations can have adverse effects on lung function leading to inflammation and respiratory problems (EEA 2013a). At higher concentrations, respiratory tract irritation will narrow and make it difficult to breathe. People with chronic obstructive diseases of the lungs and asthma are more sensitive to ozone. Higher ozone concentrations are associated with an increase in daily mortality (WHO 2006).	Ground-level ozone damages vegetation, impairs plant growth and decreases crop yields; it can damage forest ecosystems and reduce biodiversity (EEA 2013b).
Benzene Benzene is present in the air mainly due to anthropogenic activities. The largest source of benzene emissions is represented by incomplete combustion of fuels by vehicles. Other sources of benzene emissions include domestic heating, oil refineries, petrol distribution and storage (EEA 2013a).	Benzene ranks among human carcinogens (IARC 2020). At high concentrations, it can have haematotoxic, genotoxic and immunotoxic effects (SZÚ 2015a).	Benzene can bioaccumulate; it can damage leaves of agricultural crops and kill plants (EEA 2013b).

Pollutant and its sources	Health effects	Environmental effects
Lead Most lead present in the atmosphere is released from anthropogenic emission sources. The main sources in the Czech Republic include road transport (tire and brake wear), iron and steel production, and public energy and heat production.	Long-term exposure is harmful to the biosynthesis of haem, the nervous system and blood pressure in humans. Exposure to lead also poses risks to developing foetus; it may negatively influence brain development and, consequently, mental development, (Černá et al. 2011; EEA 2013a). As concerns its carcinogenic effects, lead is classified within group 2B – possibly carcinogenic to humans (IARC 2020).	Lead can accumulate in the bodies of organisms (bioaccumulation) such as fish and can enter the food chain (Brookes et al. 2013, EEA 2013b).
Cadmium Cadmium is bound mainly to the particles with aerodynamic diameter of up to 2.5 µm (EC 2001b). The main sources in the Czech Republic are local household heating, iron and steel production, and public energy and heat production.	Long-term exposure to cadmium affects the function of kidneys. It can also have negative impacts on the respiratory tract; the effects of cadmium exposure also include lung cancer (WHO 2000).	Cadmium can bioaccumulate (EEA 2013b).
Arsenic Arsenic occurs largely in particles with aerodynamic diameter up to 2.5 µm (EC 2001b). The main sources in the Czech Republic include local household heating, public energy and heat production, and manufacturing of lead.	High concentrations affect the nervous system (SZÚ 2015a). Lung cancer is considered to be the critical effect following the long-term inhalation (EC 2001b; WHO 2000).	Arsenic can bioaccumulate; it reduces plant growth and crop yields from soils containing arsenic (EEA 2013b).
Nickel Nickel is found in particles in the form of several chemical compounds with various levels of toxicity to humans and also to ecosystems. The main sources in the Czech Republic are public electricity and heat production, stationary combustion in manufacturing industries and construction (chemical industry), and local household heating.	Nickel can affect the respiratory and immune systems in humans (WHO 2000, EEA 2013a). Nickel compounds are classified as proven human carcinogens; metallic nickel and its alloys are classified as possibly carcinogenic to humans (IARC 2020).	Nickel may cause the pollution of soil and water.
Sulphur dioxide Sulphur dioxide (SO_2) is emitted into the atmosphere during the combustion of sulphur-containing fuels. The main sources in the Czech Republic are public electricity and heat production, and residential combustion.	SO_2 causes irritation of the eyes and respiratory tract. High SO_2 concentrations can lead to respiratory problems. Inflammation of the respiratory tract causes coughing, mucus secretion, aggravation of asthma and chronic bronchitis, and makes people more prone to infections of the respiratory tract. Those suffering from asthma and chronic lung disease are the most sensitive towards SO_2 exposure (EC 1997; WHO 2014).	SO_2 contributes to acidification of the environment. It also contributes to the formation of secondary suspended particles with a proven negative impact on human health (EEA 2013a).
Carbon monoxide Carbon monoxide (CO) is a gas emitted due to incomplete combustion of fossil fuels. The largest sources of CO emissions in the Czech Republic are household heating, road transport, combustion processes in industry and construction (iron and steel) and the production of iron and steel	CO binds to haemoglobin more strongly than oxygen and thus reduces the oxygen-carrying capacity of blood. The first subjective symptoms of poisoning are headaches followed by impaired coordination and reduced awareness. Those suffering from cardiovascular disease are again the most sensitive towards CO exposure (EEA 2013a). Toxic effects of CO become evident in organs and tissues with high oxygen consumption such as the brain, the heart and skeletal muscles. It is also dangerous to developing foetus (WHO 2000).	CO can contribute to the formation of ground-level ozone (EEA 2013b, Brookes et al. 2013).

Pollutant and its sources	**Health effects**	**Environmental effects**
Elemental carbon Elemental carbon (EC) is a product of incomplete combustion of organic materials (coal, oil, petrol, wood and biomass) (Schwarz et al. 2008). EC is emitted into the air only directly (primary particles). The term black carbon (BC) is also used in addition to the term EC. Black and elemental carbon basically designate the same component appearing in the atmosphere. While EC contains only carbon, BC can contain, apart from EC, also organic ingredients (Chow et al. 2009; Husain et al. 2007; Petzold et al. 2013). The use of terminology to denote elemental and black carbon differs in the concept of the nature of this substance. The term EC denotes volatility properties, while black carbon (BC) entails absorption properties across the spectrum of visible wavelengths (Seinfeld, Pandis 2006).	EC is a part of the fine fraction of aerosol particles ($PM_{2.5}$). It has been concluded from the evaluation of health impacts of $PM_{2.5}$ on human health that variability of epidemiologic results cannot be explained by only variance of concentrations of $PM_{2.5}$ in the environment. Causes can include just more active toxicological components of $PM_{2.5}$ (Luben et al. 2017). Compared to OC, EC (or BC) penetrates more readily into the human body and aggravates heart and lung diseases (Na, Cocker 2005). Organic particles (including organic carbon), which can contain among other components fractions of polycyclic aromatic hydrocarbon (PAHs), are studied for their carcinogenic and mutagenic effects (Seinfeld, Pandis 2006; Satsangi et al. 2012).	BC strongly absorbs solar radiation and contributes significantly to the warming of the Earth's climate system (Bachman 2009).
Organic carbon Organic (OC) carbon is formed during incomplete combustion, the production of biogenic particles (viruses, bacteria, pollen, fungal spores and all kinds of vegetation fragments) and the resuspension of transport-associated dust (Schwarz et al. 2008). OC is both primary and secondary particle, i.e. it can be formed by reactions of gaseous organic precursors.	OC is a part of the fine fraction of aerosol particles ($PM_{2.5}$). Organic particles (including organic carbon), which may contain, inter alia, polycyclic organic hydrocarbon fractions (PAHs), are being studied for their carcinogenicity and mutagenic effects (Seinfeld, Pandis 2006; Satsangi et al. 2012).	OC scatters solar radiation, which has a cooling effect on the Earth's climate system. (IPCC 2013).