

AIR QUALITY REPORT OF THE SLOVAK REPUBLIC 2025

ANNEX

AIR QUALITY ASSESSMENT IN ZONE PREŠOV REGION

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1 DESCRIPTION OF PREŠOV REGION TERRITORY IN TERMS OF AIR QUALITY

The Prešov Region is characterised predominantly by mountainous relief, with the highest point being Gerlachovský štít (2,655 m a. s. l.) and the lowest point having an elevation of 109 m a. s. l. Its territory is predominantly occupied by the Outer Carpathians (Spišská Magura, Podtatranská brázda, Spišsko-šarišské medzihorie, Levočské vrchy, Bachureň, Šarišská vrchovina, Pieniny, Ľubovnianska vrchovina, Čergov, Busov, Ondavská and Laborecká vrchovina, Beskydské predhorie and Bukovské vrchy). The High Tatras belong to the Inner Carpathians. Due to the mountainous and highly varied character of the territory, dispersion conditions differ across individual parts of the region.

According to data from the Statistical Office of the Slovak Republic, the average population density in the Prešov Region is approximately 90 inhabitants per km². The region contains areas with the **lowest** population density in Slovakia. The **highest** population density is recorded in the **Prešov District**, with **187** inhabitants per km², while the **Medzilaborce District** has the lowest population density in the region, with **25** inhabitants per km². For comparison, the Slovak Republic had an average population density of 111 inhabitants per km² as of the stated date.

The entire Prešov Region constitutes one zone for the assessment of air quality with regard to SO₂, NO₂, NOX, PM₁₀, PM_{2,5}, benzene, polycyclic aromatic hydrocarbons and CO in ambient air.

Sources of air pollution in the Prešov Region zone

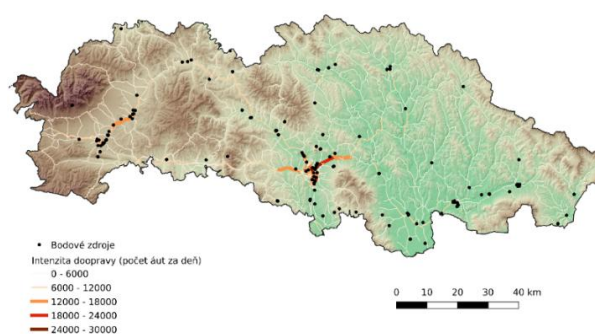
The dominant source of air pollution in the Prešov Region is household heating, particularly in smaller municipalities in the mountainous parts of the territory, where the share of firewood use is the highest compared with other areas of the region. Another source of emissions is road transport. **Tab. 1.1** presents traffic intensity on the most significant roads in the region according to the nationwide traffic census conducted in 2022 and 2023. The map in **Fig. 1.1** shows the point sources and busiest road sections based on data processing by the *Transport Research Centre* for 2024.

Industrial sources of air pollution are less significant in terms of their contribution to local air pollution by basic pollutants. Depending on meteorological conditions, the influence of the woodworking industry and heating plants may be particularly noticeable.

Tab. 1.1 Number of vehicles on the most frequented roads of the Prešov region (vehicle/day)

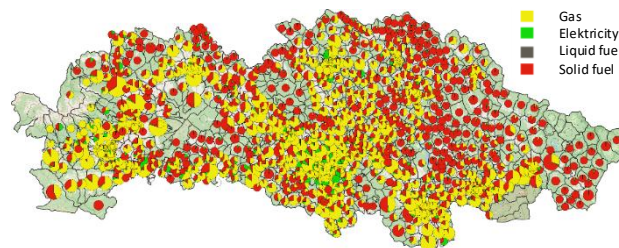
District	Motor way/ road	Number of vehicles	Heavy goods vehicles	Passenger cars
Svidník	č. 21	11 352	2 774	8 520
Kežmarok	č. 66	23 205	1 540	21 576
Poprad	D1	19 816	4 073	15 716
Prešov	D1	26 620	5 838	20 721
	č. 18	39 823	4 499	35 113
St. Ľubovňa	č. 68	17 342	2 289	14 998
Stropkov	č. 15	11 175	1 294	9 814
Bardejov	č. 77	20 716	2 497	18 144
Vranov n/T	č. 18	20 930	2 642	18 218

Fig. 1.1 Road traffic intensity in the Prešov region.
Source: CDV.



Another source of emissions is road traffic. The map in [Fig. 1.1](#) shows the busiest road sections and point sources, based on processing by the Transport Research Centre for 2024.

Fig. 1.2 *Share of different types of fuel used for heating in the municipalities of the region¹.*



Industrial sources of air pollution in the Prešov Region zone are less significant in terms of their contribution to local air pollution by the main pollutants. Depending on meteorological conditions, the influence of the wood-processing industry and heating plants may become apparent.

[Fig. 1.2](#) shows the shares of different fuel types used for heating detached houses in basic settlement units. The spatial

distribution of fuel types is not geographically homogeneous. In the Upper Zemplín area, solid fuels, particularly firewood, predominate. For the zone, gas heating was the predominant heating source in 2021.

¹ <https://www.scitanie.sk>

2 MONITORING STATIONS IN ZONE PREŠOV REGION

There are nine air quality monitoring stations (AMS) located in the zone. Four stations – **Stará Lesná, Gánovce, Starina and Kolonické sedlo** – are rural background stations. They monitor areas distant from major air pollution sources and, due to their different altitudes, reflect changes in pollution levels along the vertical profile.

The Kolonické sedlo station is located near the Astronomical Observatory at an altitude of 454 m above sea level, in the eastern part of the **Snina District**. It characterises air quality in a less polluted area. Air quality monitoring at this site started in 2009.

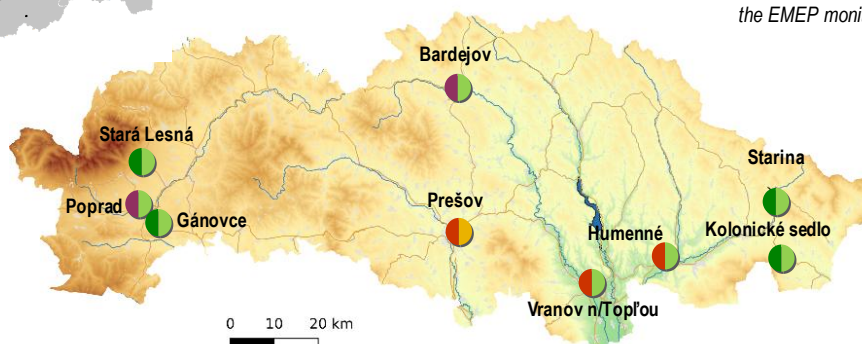
The monitoring station in **Prešov, Arm. gen. L. Svobodu Street**, captures the impact of road traffic at a location with high traffic intensity. The stations in **Humenné, Poprad, Vranov nad Topľou and Bardejov** represent urban or suburban background pollution.

Tab. 2.1 contains information on the air quality monitoring stations in the Prešov Region zone:

- international Eol code, station classification according to the dominant air pollution sources (traffic, background, industrial), the type of area monitored by the station (urban, suburban, rural/regional), and geographical coordinates;
- monitoring programme. Automatic continuous monitoring instruments provide hourly mean concentrations of PM₁₀, PM_{2,5}, nitrogen oxides, sulphur dioxide, ozone, carbon monoxide, benzene and mercury. The SHMÚ Testing Laboratory, as part of manual monitoring, analyses heavy metals and polycyclic aromatic hydrocarbons. The results are expressed as 24-hour mean values.

Tab. 2.1 Monitoring programme in zone Prešov region.

Prešov region zone							Monitoring programme										
							Continuous								Manual		
District	Eol code	Station name	Type		Geographical		Altitude [m]	PM ₁₀	PM _{2,5}	NO, NO ₂	SO ₂	O ₃	CO	Benzene	Hg	As, Cd, Ni, Pb	B(a)P
			areas	stations	length	width											
Humenné	SK0037A	Humenné, Nám. Slobody	U	B	21°54'50"	48°55'51"	149										
Kežmarok	SK0004R	Stará Lesná, AÚ SAV, EMEP	R	B	20°17'22"	49°09'05"	808									*	
Poprad	SK0041A	Gánovce, Meteo. st.	R	B	20°19'22"	49°02'05"	706										
Poprad	SK0069A	Poprad, Železničná	S	B	20°17'09"	49°03'42"	678										
Prešov	SK0266A	Prešov, Arm.gen. L. Svobodu	U	T	21°16'00"	48°59'33"	252										
Snina	SK0006R	Starina, Vodná nádrž, EMEP	R	B	22°15'36"	49°02'34"	345									*	
Snina	SK0406A	Kolonické sedlo, Hvezdáreň	R	B	22°16'26"	48°56'06"	454										
Vranov n/T	SK0031A	Vranov n/T, M. R. Štefánika	U	B	21°41'15"	48°53'11"	133										
Bardejov	SK0074A	Bardejov, pod Vinbargom	S	B	21°16'38"	48°18'00"	263										
Total							7	7	7	1	5	1	0	1	2	2	



* Monitoring of heavy metals at the Stará Lesná and Starina stations is carried out according to the EMEP monitoring programme. (Tab. 2.2)

Area type:
 U – urban
 S – peri-urban
 R – rural (regional)

Station type:
 T – traffic
 B – background
 I – industrial

The Stará Lesná and Starina monitoring stations are included in the EMEP monitoring programme. Extended monitoring of heavy metals (Tab. 2.2) and atmospheric precipitation sampling (Tab. 2.3) are carried out at these monitoring stations. The air quality monitoring programme at Starina and Stará Lesná in 2025 is presented in Tab. 2.2.

Tab. 2.2 Monitoring programme at the EMEP stations Starina and Stará Lesná.

	Sampl. interval	SO ₂	NO ₂	SO ₄ ²⁻	NO ₃ ⁻	HNO ₃	Cl ⁻	NH ₃ , NH ₄ ⁺	Alkaline ions K ⁺ , Na ⁺ , Ca ²⁺ , Mg ²⁺	VOC	PM ₁₀	EC/OC	Pb	As	Cd	Ni	Cr	Cu	Zn
Starina	D/T*	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x
Stará Lesná	T										x	x	x	x	x	x	x	x	x

Note: D – day applies to the sampling of major ions; T – week applies to the other substances;

A wet-only rain sampler is used for precipitation sampling, collecting only precipitation, i.e. wet deposition. The samples are analysed in the SHMÚ Testing Laboratory and are used to assess the wet deposition of monitored substances.

Tab. 2.3 Precipitation monitoring programme at the EMEP stations Starina and Stará Lesná.

	Sampling interval / number of days*	pH	Conductivity	SO ₄ ²⁻	NO ₃ ⁻	Cl ⁻	NH ₄ ⁺	Alkaline ions K ⁺ , Na ⁺ , Ca ²⁺ , Mg ²⁺	Pb	As	Cd	Ni	Cr	Cu	Zn
Starina	1/7	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Stará Lesná	7/M	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Note: The first value applies to sampling for the analysis of the main precipitation parameters; the second value applies to heavy metal analyses.

3 ASSESSMENT OF AIR QUALITY IN THE PREŠOV REGION ZONE

This chapter provides an assessment of air quality in the Prešov Region zone based on monitoring results, supplemented by mathematical modelling results for PM₁₀, PM_{2,5}, benzene and benzo(a)pyrene for the year 2025.

Tab. 3.1 Assessment of air pollution in the Prešov Region zone in 2025 based on the limit values for the protection of human health and the smog warning system for PM₁₀.

Pollutant	Type	Protection of human health										IT ²⁾	AT ²⁾	
		SO ₂		NO ₂		PM ₁₀		PM _{2,5}	CO	O ₃	benzene	PM ₁₀	PM ₁₀	
	Averaging period		1 h	24 h	1 h	1 year	24 h	1 year	1 year	8 h ¹⁾	8 h ²⁾	1 year	12 h	12 h
	Parameter	Areas / stations	number of exceedances	number of exceedances	number of exceedances	average	number of exceedances	average	average	average	average	average	Duration of exceedance[h]	Duration of exceedance[h]
			Limit value [µg·m ⁻³]	350	125	200	40	50	40	20	10 000	120	5	100
Maximum number of exceedances	24		3	18		35				25				
Gánovce, Meteo. st.	RB				0	7					1		0	0
Humenné, Nám. slobody	UB			0	9	5	19	15		2		0	0	
Prešov, Arm. gen. L. Svobodu	UT			0	31	24	25	17	1826		0,6*	0	0	
Vranov n/T, M. R. Štefánika	UB	0	0			8	18	14				0	0	
Stará Lesná, AÚ SAV, EMEP	RB			0	4	0	9	7		6		0	0	
Starina, Vodná nádrž, EMEP	RB			0	3					0		0	0	
Kolonické sedlo, Hvezdáreň	RB					0	12	11				0	0	
Poprad, Železničná	SB			0	14	1	16	11				0	0	
Bardejov, Pod Vinbargom	SB			0	9	3	17	13		1		0	0	

≥ 90 % valid measurements, * output of the CMAQ model.

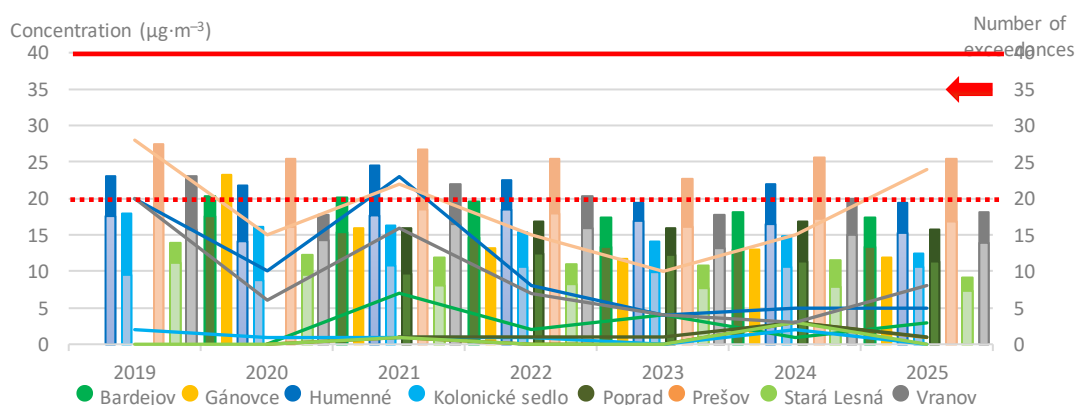
¹⁾ maximum 8-hour concentration

²⁾ IT, AT – duration of exceedance (in hours) of the information threshold (IT) and alert threshold (AT) for PM₁₀.

In accordance with Annex No. 1 to Decree of the Ministry of Environment of the Slovak Republic No. 250/2023 Coll. on air quality, the required proportion of valid values was achieved at the monitoring stations.

3.1 PM₁₀ and PM_{2,5}

Fig. 3.1 Average annual concentrations of PM₁₀ and PM_{2,5} and the number of daily PM₁₀ exceedances.



PM₁₀ – dark coloured bar, PM_{2,5} – light coloured bar; number of exceedances of the daily limit value – dashed line.

The horizontal lines indicate the limit values (LVs): the solid red line represents the PM₁₀ annual mean concentration limit value (40 µg·m⁻³); the dashed red line represents the PM_{2,5} annual mean concentration limit value (20 µg·m⁻³); and the solid red arrow indicates the PM₁₀ daily limit value criterion (50 µg·m⁻³ and 35 exceedances).

Fig. 3.1 presents the annual mean concentrations of PM_{10} and $PM_{2,5}$, as well as the number of days with daily mean PM_{10} concentrations above $50 \mu g \cdot m^{-3}$, based on measurements at the monitoring stations in the Prešov Region zone during 2019–2025. Measurements at the Bardejov station started during 2020 and at the Poprad station in 2021; therefore, the data for these years are not representative.

The limit value for the annual mean concentration of PM_{10} , the limit value for the annual mean concentration of $PM_{2,5}$, and the limit value for the daily mean concentration of PM_{10} were not exceeded at any AMS in the zone. No exceedances have been recorded since 2018.

The highest number of exceedances of the PM_{10} daily limit value ($50 \mu g \cdot m^{-3}$) in 2025 was recorded at the traffic AMS in Prešov (24) (**Fig. 3.1**). Most exceedances occurred in February, when very unfavourable dispersion conditions prevailed. The highest annual mean concentrations of PM_{10} ($25 \mu g \cdot m^{-3}$) and $PM_{2,5}$ ($17 \mu g \cdot m^{-3}$) were also measured at this station.

Compared with 2024, a decrease in annual mean PM_{10} concentrations was recorded at all stations. The most pronounced decrease was observed at rural stations, which in 2024 were significantly affected by a major episode of natural dust transport from the Sahara at the turn of March and April. The largest year-on-year decrease in concentration was recorded at the Stará Lesná AMS, by approximately 12.5%.

■ Outputs of mathematical modelling for particulate matter PM

Fig. 3.2 (top) shows the results of PM_{10} concentration modelling, calculated using the RIO model and subsequently corrected using the IDW-R regression method. The highest annual mean PM_{10} concentrations were identified mainly in the vicinity of the city of Prešov and in adjacent areas of the southern part of the region, where local values exceeded $25 \mu g \cdot m^{-3}$. Elevated concentrations also occurred in parts of the Sabinov and Vranov nad Topľou districts. The lowest concentrations were recorded in the north-western part of the region, particularly in the Tatra Mountains area and the Poprad District, as well as in higher-altitude areas of north-eastern Slovakia..

Fig. 3.2 Top: Average annual PM_{10} concentration; bottom: number of exceedances of the PM_{10} daily limit value.

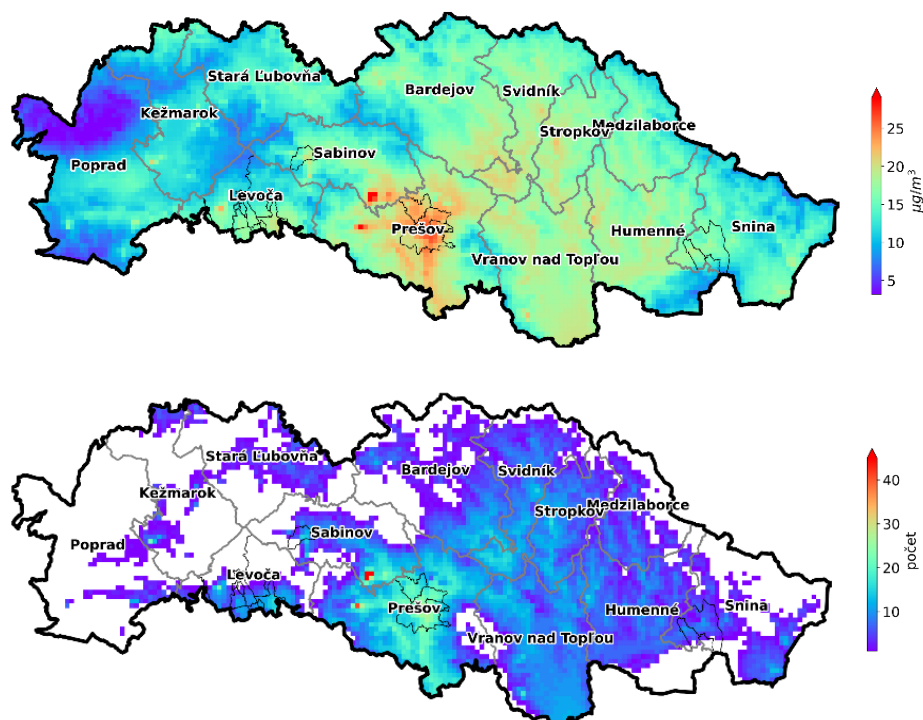
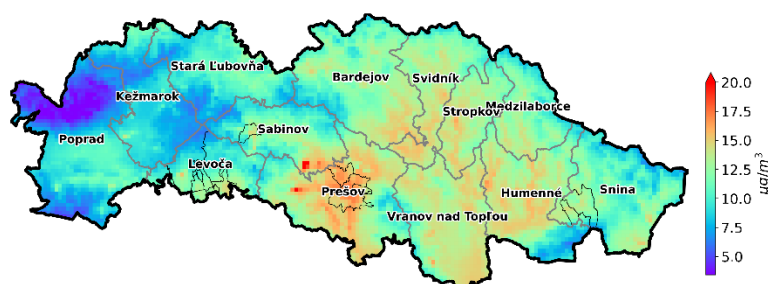


Fig. 3.3 Average annual $PM_{2,5}$ concentrations in 2025 according to the RIO/IDW-R model output.



The map of the number of exceedances of the PM_{10} daily limit value in Fig. 3.2 (bottom) shows the highest number of exceedances in the vicinity of Prešov and in the southern part of the zone, with more than 25 exceedances per calendar year. Most of the region showed a low number of exceedances, with the

lowest values occurring in the north-western and mountainous areas.

The spatial distribution of concentrations and exceedances reflects the combined influence of local emissions from domestic heating, traffic, industrial sources, and dispersion conditions, which are less favourable mainly in basin and urbanised areas.

Fig. 3.3 shows the spatial distribution of average annual $PM_{2,5}$ concentrations based on the output of the RIO model combined with IDW-R and indicates a similar pattern to PM_{10} .

■ Assessment of compliance with the requirements of the new Directive

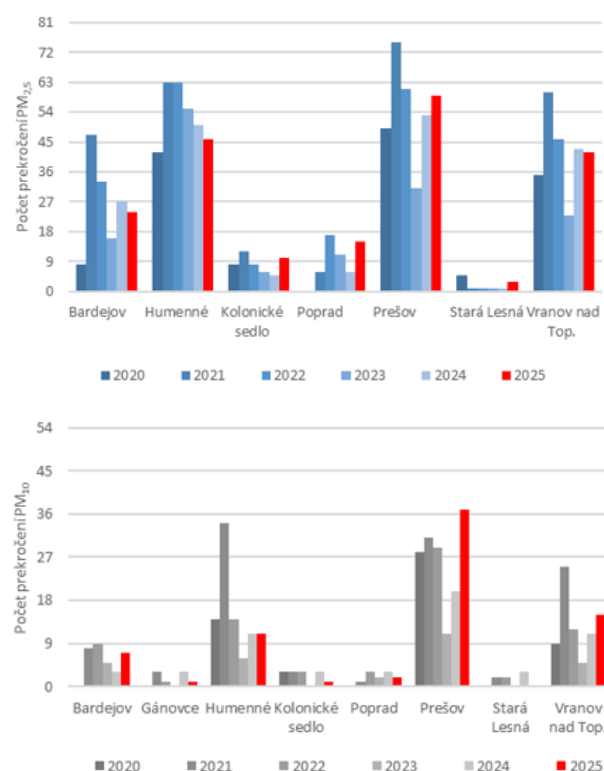
The daily limit value for PM_{10} according to the new EU Directive ($45 \mu\text{g}\cdot\text{m}^{-3}$), with a maximum of 18 exceedance days per calendar year, would have been exceeded in the Prešov Region zone in 2025 at the traffic AMS in Prešov. The annual mean PM_{10} concentration limit value would also have been exceeded at this station.

The daily limit value for $PM_{2,5}$ ($25 \mu\text{g}\cdot\text{m}^{-3}$), with a maximum of 18 exceedance days per calendar year, would have been exceeded at the AMSs in Bardejov, Humenné, Prešov and Vranov nad Topľou.

Fig. 3.4 (top) shows the development of the number of exceedances of the $PM_{2,5}$ daily limit value during 2020–2025. An increase in exceedances can be observed at the background stations Poprad and Kolonické sedlo. The highest number of exceedances was recorded at the Prešov AMS (54); this limit value was exceeded by more than a factor of two also at the Humenné and Vranov nad Topľou AMSs.

The highest number of exceedances of the new PM_{10} daily limit value (Fig. 3.4, bottom) was recorded at the Prešov AMS, exceeding 36 days, which is twice the new limit value. Compared with 2024, a higher number of exceedances was recorded at the Prešov, Vranov nad Topľou and Bardejov AMS.

Fig. 3.4 Number of exceedances* of the PM_{10} and $PM_{2,5}$ daily limit values in 2020–2025.



*The daily mean concentration may exceed $25 \mu\text{g}\cdot\text{m}^{-3}$ for $PM_{2,5}$ and $45 \mu\text{g}\cdot\text{m}^{-3}$ for PM_{10} a maximum of 18 times per year; the limit values apply from 1 January 2030.

3.2 Nitrogen dioxide

Monitoring of nitrogen dioxide is carried out at seven AMSs in the zone. The NO₂ limit values have not been exceeded in the Prešov Region since 2018. The main source of NO₂ emissions is road traffic. For this reason, **the highest concentrations are recorded at the traffic station in Prešov**, where the highest annual mean NO₂ concentration in Slovakia was again measured: 31 µg·m⁻³.

Fig. 3.5 shows a comparison of annual mean concentrations with the reference period 2017–2025. In 2025, concentrations were at a level comparable to the reference period.

Fig. 3.5 Average NO₂ concentrations: comparison of 2025 with the reference period 2017–2024.

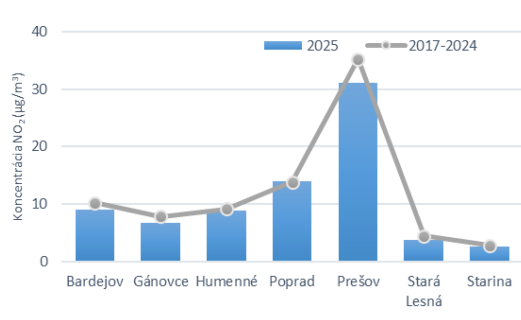
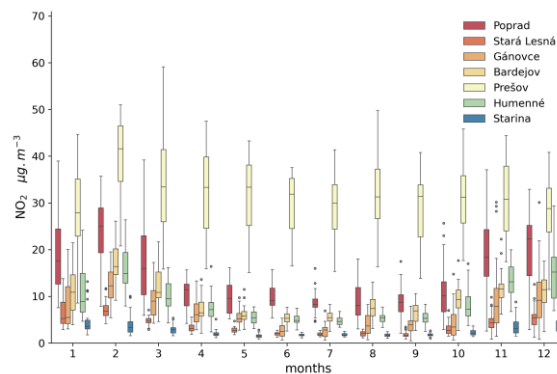


Fig. 3.6 Boxplots of monthly NO₂ concentrations.



The boxplots of monthly NO₂ concentrations are shown in **Fig. 3.6**. The highest concentrations were recorded in February and March. NO₂ pollution in the zone is at a relatively low level, except for Prešov.

At five stations, the annual mean NO₂ concentrations were lower than the WHO recommendation (10 µg·m⁻³), which is twice as strict as the new EU limit value applicable from 1 January 2030.

■ Assessment of compliance with the requirements of the new Directive

The new EU annual mean NO₂ limit value (20 µg·m⁻³), applicable from 2030, **would have been exceeded at the traffic AMS in Prešov**.

3.3 Ozone

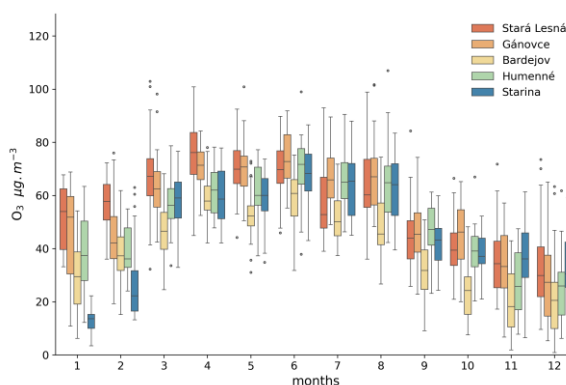
Ozone monitoring in the zone is carried out at four monitoring stations: Stará Lesná, Starina, located at the north-eastern border of Slovakia, and in the two district towns of Bardejov and Humenné.

The target value for the protection of vegetation was not exceeded in 2025.

The highest ground-level ozone concentrations generally occur during warm months with high solar radiation intensity (**Fig. 3.7**). Large differences in ground-level ozone concentrations are also observed between the warm and cold seasons.

No exceedances of the ozone (O₃) target value were recorded at any station in 2025 (**Tab. 3.2**).

Fig. 3.7 Boxplots of O₃ concentrations by months



Tab. 3.2 Number of days with a maximum daily 8-hour mean O_3 concentration above $120 \mu g \cdot m^{-3}$

Station	2023	2024	2025	Average 2023 – 2025
Gánovce, Meteo. st.	0	2	1	1
Humenné, Nám. Slobody	2	0	5	2
Stará Lesná, AÚ SAV, EMEP	*0	10	2	6
Starina, Vodná nádrž, EMEP	1	0	0	0
Bardejov, Pod Vinbargom	1	1	1	1

■ $\geq 90\%$ required valid data

■ Assessment of compliance with the requirements of the new Directive

The stricter EU ozone (O_3) limit value of 18 days (as a three-year average), where the maximum daily 8-hour mean concentration exceeds $120 \mu g \cdot m^{-3}$, **would not have been exceeded at any station in the Prešov Region zone.**

3.4 Benzo(a)pyrene

Benzo(a)pyrene [B(a)P] is monitored at two monitoring stations in the zone: Starina and Stará Lesná. The B(a)P target value ($1 \text{ ng} \cdot \text{m}^{-3}$) was not exceeded (**Tab. 3.3**). However, these are rural background stations and are not directly affected by emissions from domestic solid fuel heating; therefore, low B(a)P concentrations can be expected at these locations.

Tab. 3.3 Annual mean concentrations of benzo(a)pyrene in 2018–2025.

	2018	2019	2020	2021	2022	2023	2024	2025
Target value [$\text{ng} \cdot \text{m}^{-3}$]	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
Starina, Vodná nádrž, EMEP	1,2	0,4	0,3	0,4	0,2	0,3	0,2	0,3
Stará Lesná, EMEP		0,4	0,3	0,4	0,3	0,3	0,2	0,2

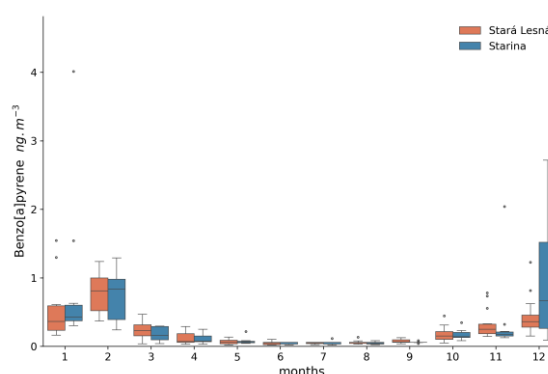
■ $\geq 90\%$ valid measurements

The monthly variation of B(a)P concentrations is shown in **Fig. 3.8**. Although the annual target value was not exceeded, concentrations are relatively high during the winter period, particularly at the Starina monitoring station, which may be a result of regional transport or local influences.

Mathematical modelling results are also a useful tool for assessing B(a)P pollution in the region. **Fig. 3.9** shows the spatial distribution of B(a)P concentrations based on the RIO/IDW-R model results.

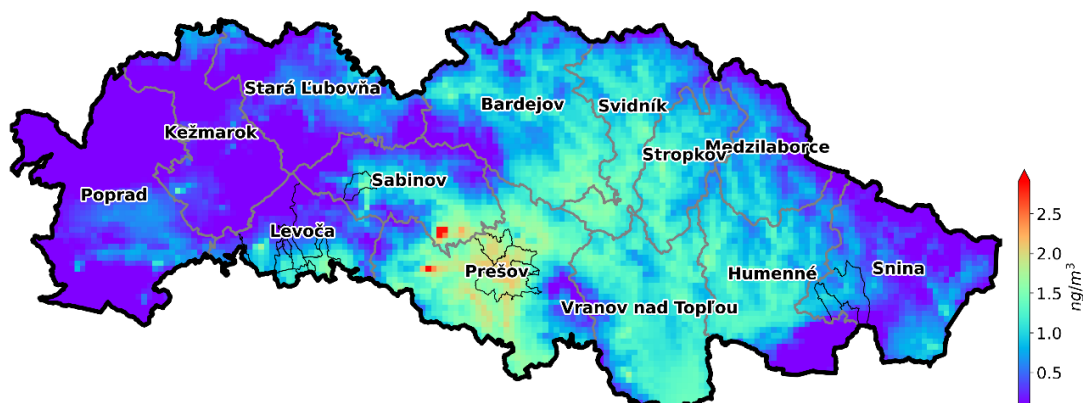
Further information on the applied methodology is provided in Chapter 4 of the *Air Quality Assessment Report in the Slovak Republic for 2025*. The model is based on measured data and auxiliary fields; however, the outputs over the extensive area of the Prešov Region are associated with considerable uncertainty. The map should therefore be interpreted primarily as an indication of relative differences between areas rather than as an accurate representation of absolute concentrations.

Fig. 3.8 Boxplots of B(a)P concentrations.



The highest concentrations occur in municipalities within the districts of Levoča, Vranov nad Topľou, Prešov, Svidník, Sabinov and Stropkov. To obtain a more detailed assessment of the spatial distribution, high-resolution modelling using detailed emission data would be required, including information on the amount and type of fuels used, as well as the types of domestic heating appliances.

Fig. 3.9 Annual mean concentrations of benzo(a)pyrene according to outputs of CMAQ model.

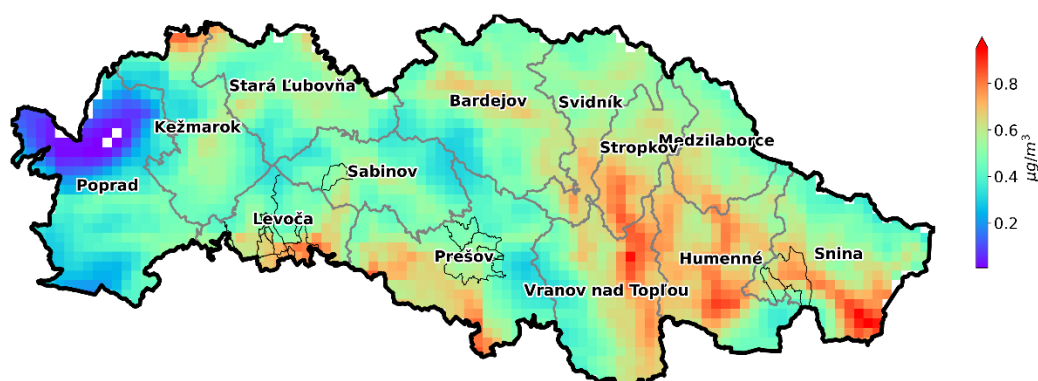


3.5 Benzene

Benzene concentrations in the Prešov Region zone have been consistently below the lower assessment threshold for a long period. Therefore, in 2025, mathematical air quality modelling was used to assess the spatial distribution of concentrations (Fig. 3.10). The modelling results indicate slightly higher concentrations mainly in the south-eastern part of the region, particularly in the vicinity of Humenné, Snina and Vranov nad Topľou.

However, benzene concentrations remained below the lower assessment threshold throughout the entire zone, confirming the low level of air pollution by benzene. The annual mean concentration at the Prešov was $0.6 \mu\text{g}\cdot\text{m}^{-3}$ (output of CMAQ model).

Fig. 3.10 Annual mean concentrations of benzene according to outputs of CMAQ models.



3.6 Chemical composition of precipitation

Tab. 3.4 Annual volume-weighted mean pH of precipitation and annual deposition of nitrogen, sulphur and lead.

Monitoring station	pH	SO ₄ ²⁻ g deposition Sulphur/m ² /year	NO ₃ ⁻ g deposition Nitrogen/m ² /year	Pb deposition g/ha/year
Stará Lesná	5,28	0.10	0.08	3.7
Starina	5,23	0.12	0.12	4.8

Precipitation quality is monitored at the rural background stations Starina and Stará Lesná. The chemical composition of major ions, pH values and conductivity are measured. The annual volume-weighted mean pH value and wet deposition of SO₄²⁻, NO₃⁻ and lead are presented in the **Tab. 3.4**.

■ Elemental and organic carbon (EC/OC)

At the Stará Lesná monitoring station, samples of atmospheric aerosol in the PM_{2,5} fraction have been collected since the end of 2020 for the analysis of organic and elemental carbon (OC/EC), which constitute a significant part of PM₁₀ and PM_{2,5}. Sampling is carried out over 24 hours twice a week. The analyses are performed in the laboratory of the Czech Hydrometeorological Institute in Ostrava.

Organic carbon comprises a wide range of compounds, from natural (biogenic) substances to anthropogenic compounds and secondary organic aerosols (SOA), which are formed through chemical reactions of gaseous precursors in the atmosphere.

Elemental carbon is a component of atmospheric aerosol formed during the incomplete combustion of organic materials, such as fossil fuels and biomass. It is characterized by a graphitic structure and has a strong ability to absorb light.

Fig. 3.11 shows a clear predominance of OC over EC throughout the year. EC reflects local combustion processes, such as domestic heating, as well as traffic emissions. A significant increase in total carbon (TC) concentration was observed in February. In contrast to the increases in January, when EC concentrations also increased (indicating the influence of heating), the February peak was mainly caused by an increase in OC. This suggests that the episode was not primarily associated with direct local combustion sources, but rather with the accumulation or regional transport of organic aerosols and their precursors. The increase may also have been enhanced by the unfavourable dispersion conditions prevailing in February.

Organic carbon has different sources depending on the season:

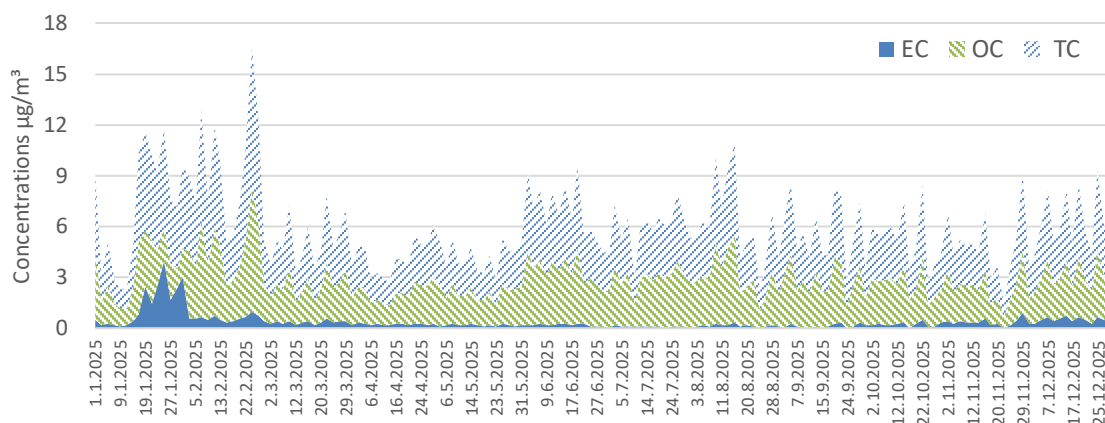
Summer OC – biogenic origin

In summer, a higher proportion of secondary organic carbon (SOC) is typically observed, formed through the oxidation of biogenic volatile organic compounds (BVOCs) emitted by plants and trees. These compounds may also act as allergens for sensitive individuals. EC concentrations remain low.

Winter OC – biomass combustion origin

In winter, OC concentrations increase mainly due to local domestic heating with wood. Biomass combustion also produces EC; therefore, winter OC peaks are usually accompanied by increased EC concentrations.

Fig. 3.11 Organic and elemental carbon concentrations.



Detailed results of the EMEP monitoring are presented in Chapter 3, in the section Regional monitoring of the Air Quality Assessment Report in the Slovak Republic 2025.

3.7 Risk areas

Fig. 3.12 Risk areas in Prešov region.

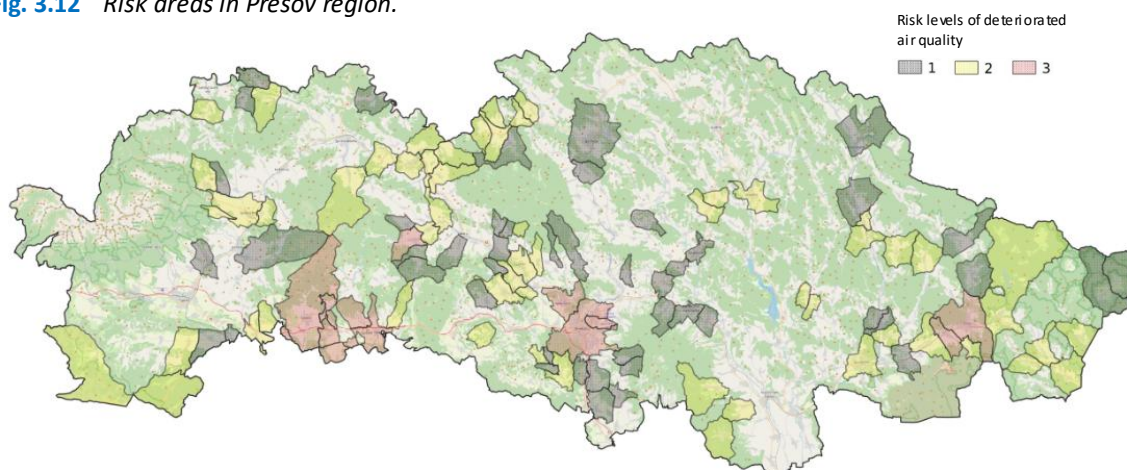


Fig. 3.12 shows municipalities at risk of deteriorated air quality, identified using the Integrated Assessment Method for Municipalities². Risk level 3 corresponds to the highest probability of being affected by air pollution. The methodology includes the extent of domestic solid fuel heating, the influence of unfavourable dispersion conditions from both short-term and long-term perspectives, results from the CMAQ chemical transport model, the RIO interpolation model, and high-resolution CALPUFF modelling results for selected domains with a presumed risk of deteriorated air quality.

Municipalities in which the limit value for PM or NO₂, or the target value for B(a)P, was exceeded according to high-resolution modelling were automatically assigned risk level 3, as were municipalities where exceedances of limit or target values were identified through measurements. A list of municipalities and their assigned risk levels is available on the SHMÚ website³.

² Štefánik, D., Krajčovičová, J.: *Metóda integrovaného posúdenia obcí vzhľadom na riziko nepriaznivej kvality ovzdušia*, Slovenský hydrometeorologický ústav, 2023, dostupné na <https://www.shmu.sk/sk/?page=996>

³ <https://www.shmu.sk/sk/?page=2967>

Zones and agglomerations containing at least one municipality with risk level 3 are required to prepare an Air Quality Improvement Programme. In this context, municipalities with risk level 3 correspond to air quality management areas. However, emission reduction measures must be implemented throughout the designated zone in all municipalities with risk levels 2 or 3, and ideally also in municipalities with risk level 1.

The assessment using the Integrated Assessment Method aims to identify areas where measures to improve air quality should be targeted. Due to the distribution of emission sources and the microclimatic characteristics of the area, pollution levels may vary between individual locations within the risk area. The spatial distribution of air pollution is illustrated by high-resolution modelling results, which are gradually being supplemented on the SHMÚ website⁴.

⁴ <https://www.shmu.sk/sk/?page=2835>

3.8 Summary

No exceedance of any limit or target value has been measured in the Prešov Region zone since 2018. Compared with 2024, a decrease in annual mean PM₁₀ concentrations was recorded at all AMSs.

An increase in NO₂ concentrations was observed at the AMSs in Gánovce, Humenné and Poprad, while a decrease was recorded at the AMSs in Prešov and Bardejov. **NO₂ concentrations in Prešov continue to reach the highest levels among all monitored locations.** At the other monitoring stations, this pollutant remains at a consistently low level.

Based on the results of mathematical modelling, it is evident that in some areas higher PM and B(a)P concentrations occur mainly during the winter months in locations with a higher share of solid fuels used for domestic heating, particularly under unfavourable dispersion conditions.

If compliance with the requirements of the new Air Quality Directive (EU) 2024/2881 were assessed, the main challenges in the Prešov Region zone would be meeting the new PM_{2,5} limit values and the annual NO₂ limit value.

Annual mean PM₁₀ concentrations would meet the 2030 target at all stations except the traffic AMS in Prešov, similarly to 2024. Annual mean PM_{2,5} concentrations in 2025 would exceed the new EU limit value at all stations except the rural background AMS in Stará Lesná. The new daily PM_{2,5} limit value would be exceeded at the AMSs in Bardejov, Humenné, Prešov and Vranov nad Topľou.

Meeting the requirements of the new Directive will require additional measures to reduce pollution to the required levels.

If air quality in the zone were assessed according to WHO recommendations, pollutant concentrations would only rarely meet the recommended levels. The annual mean NO₂ recommendation would be met at all stations except Prešov and Poprad. The ambition of the Zero Pollution Action Plan is to achieve air quality levels in line with these recommendations by 2050.