

AIR QUALITY REPORT IN THE SLOVAK REPUBLIC

2025

ANNEX

AIR QUALITY ASSESSMENT IN THE ZONE ŽILINA REGION

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1 DESCRIPTION OF THE TERRITORY OF ŽILINA REGION IN TERMS OF AIR QUALITY

The territory of the Žilina Region is predominantly mountainous and belongs to the Western Carpathians. The Váh River divides the territory into northern and southern parts. The northern part includes the High, Western and Belianske Tatras, Skorušinské vrchy, Orava Beskids, Orava Magura, Orava Highlands, Choč Mountains, Kriváň Fatra, Kysuce Beskids, Kysuce Highlands, and Javorníky. The southern part includes the Low Tatras, Veľká Fatra, Lúčanská Fatra, and Strážov Mountains. The highest point is Kriváň, with an elevation of 2,494 m above sea level, while the lowest point is at 285 m above sea level. The territory is also characterised by deep and enclosed basins, which have an adverse effect on ventilation and consequently on the dispersion of air pollutants.

According to data from the Statistical Office of the Slovak Republic, the average population density in the Žilina Region is 101 inhabitants per km².

The highest population density is recorded in the Žilina district, with 187 inhabitants per km², while the Turčianske Teplice district has the lowest density in the region, with 40 inhabitants per km². For comparison, the Slovak Republic had an average population density of 111 inhabitants per km² as of the same date.

The entire Žilina Region is considered one air quality assessment zone for SO₂, NO₂, NO_x, PM₁₀, PM_{2,5}, polycyclic aromatic hydrocarbons, and CO in ambient air.

Sources of air pollution in the Žilina Region zone

In the mountainous areas of the region, household heating using solid fuels represents a significant source of air pollution. Road transport contributes to air pollution mainly along the busiest road sections around major towns. Industrial sources of air pollution, such as paper mills, cement plants, lime production facilities, and ferroalloy production, are among the less dominant contributors to local air pollution from basic pollutants in the Žilina Region zone. Over the years, their emissions have decreased due to the modernisation of production processes and increasing requirements of environmental legislation. Characteristics of road transport – the busiest road sections in the Žilina Region with the average number of vehicles per 24 hours are presented in the following table.

Tab. 1.1 Number of vehicles on the busiest roads in the Žilina Region. (vehicles/day)

District	Motorway / road	Number of vehicles	Heavy goods vehicles	Passenger cars
Žilina	n. 11	43 995	7 739	36 069
	n. 60	41 493	6 427	34 772
	D3	25 837	7 439	18 311
	n. 18	29 649	9 111	20 470
Bytča	D1	28 333	6 765	21 477
Martin	n. 18	25 325	6 321	18 915
	n. 65	23 226	4 420	18 661
	n. 18	18 436	4 553	13 810
Ružomberok	D1	14 737	3 627	11 060
	D1	19 637	4 519	15 046
	n. 18	29 580	5 828	23 665
Liptovský Mikuláš	D1	20 448	4 633	15 746
	n. 59	19 636	3 380	16 156
	n. 18	24 361	2 037	22 184
Tvrdošín	n. 584	21 083	1 969	19 045
Dolný Kubín	n. 59	16 950	2 607	14 289
Námestovo	n. 78	16 134	2 607	14 289
Trstená	R3	6 971	2 002	4 942
Čadca	n. 484	4 608	401	4 175

Fig. 1.1 Distribution of road traffic intensity and point sources in the Žilina Region.

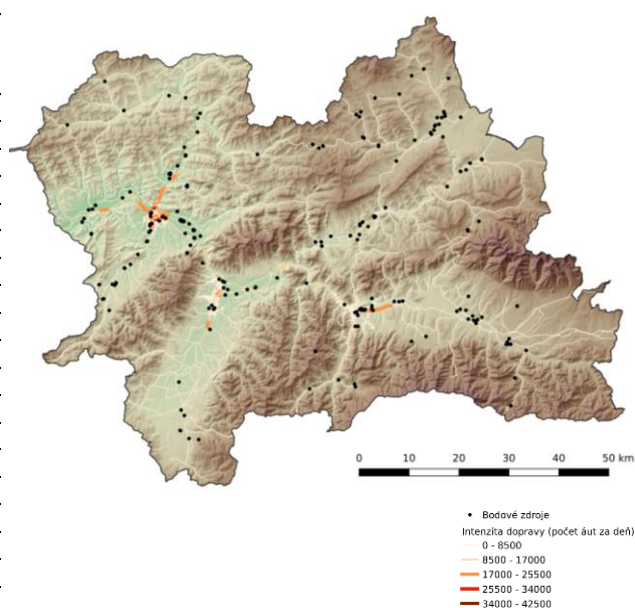
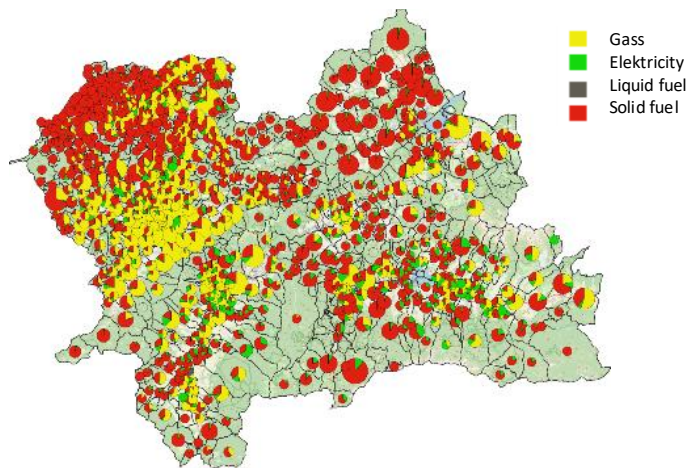


Fig. 1.1 shows the spatial distribution of traffic density and point sources along the busiest road sections, processed by the Transport Research Centre for 2024.

Fig. 1.2 shows the shares of different fuel types used for heating detached houses in individual municipalities (or basic settlement units, SODB 2021) of the Žilina Region. The figure demonstrates that the spatial distribution of fuel types is not geographically homogeneous. In the western part of the zone, particularly in towns and larger municipalities, gas heating was predominant, whereas in the Orava region and the foothills of the Low Tatras, heating with solid fuels was almost exclusively dominant. Overall, in the entire zone in 2021, gas heating slightly prevailed over solid fuel heating.

Fig. 1.2 Shares of different fuel types used for heating in municipalities of the region.



2 AIR QUALITY MONITORING STATIONS IN ŽILINA REGION

Air quality in the Žilina Region is monitored at six monitoring stations, with measurements in Ružomberok having been carried out since the 1980s. The monitoring station at Ružomberok, Riadok represents air quality at an urban background location, close to a local road with low traffic intensity. The station in Žilina represents urban background pollution levels. The monitoring station in Martin captures the influence of road traffic near a heavily trafficked access road. In 2021, two additional monitoring stations were added to the zone. The station in Liptovský Mikuláš characterises urban background pollution, while Oščadnica represents a rural settlement type, where household heating using solid fuels plays an important role in air pollution.

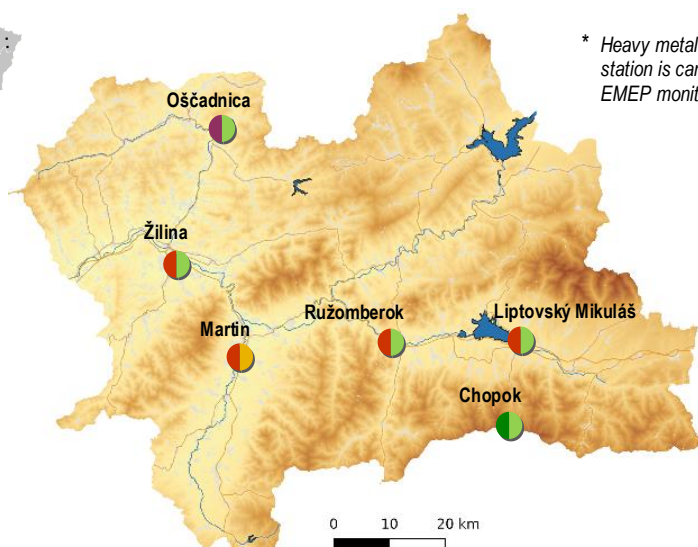
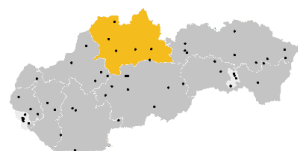
The monitoring station at Chopok is the highest-altitude air quality monitoring station in the Slovak Republic. It operates according to the *EMEP monitoring programme* and is also part of the *GAW network*.

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

- international Eol code, the station characterisation according to the dominant sources of air pollution (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 average concentrations of PM₁₀, PM_{2,5}, nitrogen oxides, sulphur dioxide, ozone, carbon monoxide, and benzene. The SHMÚ Testing Laboratory, as part of manual monitoring, analyses heavy metals and polycyclic aromatic hydrocarbons. The results of the analyses are expressed as 24-hour average values.

Tab. 2.1 Air quality monitoring programme in the Žilina Region zone.

Žilina 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											
Liptovský Mikuláš	SK0002R	Chopok, EMEP	R	B	19°35'21"	48°56'37"	1990										
Liptovský Mikuláš	SK0067A	Liptovský Mikuláš, Školská	U	B	19°37'10"	49°05'02"	578										
Čadca	SK0071A	Oščadnica	S	B	18°53'01"	49°26'07"	465										
Martin	SK0039A	Martin, Jesenského	U	T	18°55'17"	49°03'35"	383										
Ružomberok	SK0008A	Ružomberok, Riadok	U	B	19°18'09"	49°04'45"	475										
Žilina	SK0020A	Žilina, Obežná	U	B	18°46'17"	49°12'41"	356										
Total								5	5	6	3	4	3	2	0	2	3



* Heavy metal monitoring at the Chopok station is carried out according to the EMEP monitoring programme (Tab. 2.2)

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

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

The Chopok monitoring station is included in the EMEP monitoring programme. The AMS carries out extended monitoring of heavy metals (Tab. 2.2) and sampling of atmospheric precipitation (Tab. 2.3). The air quality monitoring programme at Chopok in 2025 is presented in Tab. 2.2. Major ions are analysed from 24-hour samples, while heavy metals in ambient air are analysed from weekly samples of atmospheric aerosol (with sampling intervals of 24 hours and 7 days).

Tab. 2.2 *Atmospheric aerosol monitoring programme at the EMEP Chopok station.*

	SO ₂	NO ₂	SO ₄ ²⁻	NO ₃ ⁻	HNO _{3(g)}	Cl ⁻	TSP*	Pb	As	Cd	Ni	Cr	Cu	Zn
Chopok	x	x	x	x	x	x	x	x	x	x	x	x	x	x

* TSP – total suspended particles in ambient air

Precipitation is analysed with a sampling interval of 24 hours for basic precipitation parameters and, on a monthly basis, for heavy metals (Tab. 2.3). A “bulk” type precipitation collector is used for precipitation sampling, which captures both wet and dry deposition. Based on the analyses of the collected samples, the wet deposition of the monitored substances is evaluated.

Tab. 2.3 *Precipitation monitoring programme at the EMEP station.*

	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
Chopok	x	x	x	x	x	x	x	x	x	x	x	x	x	x

3 ASSESSMENT OF AIR QUALITY IN ŽILINA REGION

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

Tab. 3.1 Assessment of air pollution according to limit values for the protection of human health and the PM₁₀ smog warning system in the Žilina Region zone – 2025.

Pollutant	Type	Human health protection										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											
Limit value [µg·m ⁻³]		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]
Maximum number of exceedances		350	125	200	40	50	40	20	10 000	120	5	100	150
		24	3	18		35						25	
Chopok, EMEP	RB			0	1					41		0	0
Liptovský Mikuláš, Školská	UB	0	0	0	11	3	18	13				37	0
Martin, Jesenského	UT			0	16	13	22	15	1491		0,5*	9	0
Oščadnica	SB	0	0	0	7	3	18	15		9		1	0
Ružomberok, Riadok	UB	0	0	0	14	7	20	15	1852	0	0,8*	25	0
Žilina, Obežná	UB			0	16	8	20	15	1358	1		0	0

≥ 90 % valid measures

Exceedances of the limit value are indicated in red.

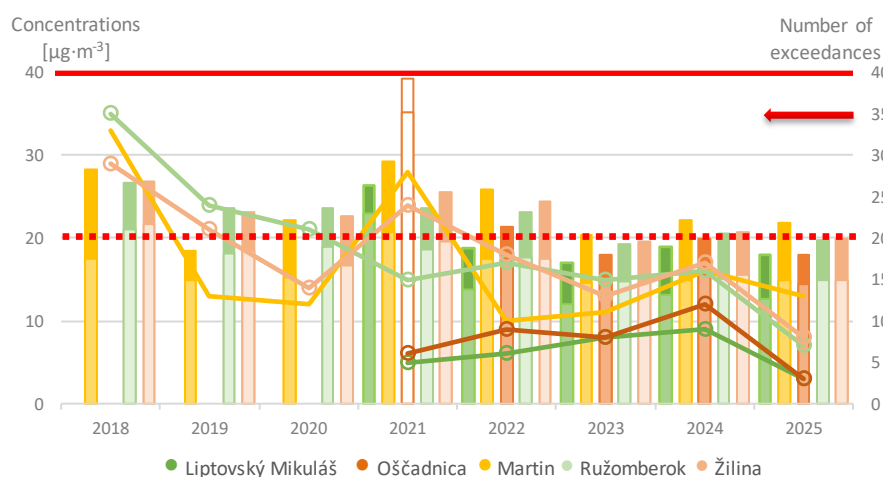
1) maximum eight-hour concentration

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

3.1 PM₁₀ and PM_{2,5}

Fig. 3.1 shows the annual average concentrations of PM₁₀, PM_{2,5}, and the number of days with an average daily PM₁₀ concentration above 50 µg·m⁻³ based on measurements at AMS in the Žilina Region zone in the years 2018–2025.

Fig. 3.1 Annual average concentrations of PM₁₀, PM_{2,5}, and the number of exceedances of the PM₁₀ daily limit value.



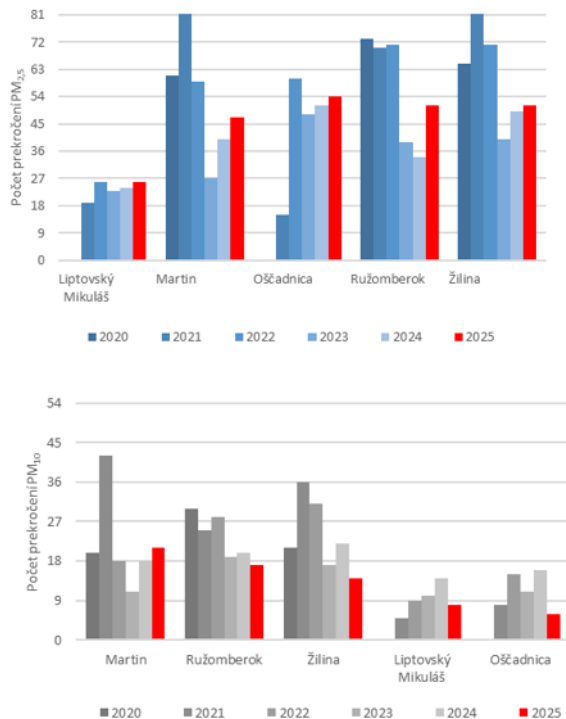
PM₁₀ – dark-coloured bars, PM_{2,5} – light-coloured bars; number of exceedances – broken lines.

Horizontal lines represent limit values (LV): red solid line – PM₁₀ (annual average concentration: 40 µg·m⁻³); red dashed line – PM_{2,5} (annual average concentration: 20 µg·m⁻³).

Red solid arrow – LV for the number of exceedances (daily average PM₁₀ concentration of 50 µg·m⁻³; maximum number of exceedances: 35 per calendar year). The AMS Oščadnica started measurements at the end of 2021; the value for 2021 is not representative.

The limit values for the annual average concentrations of PM_{10} ($40 \mu\text{g}\cdot\text{m}^{-3}$) and $\text{PM}_{2,5}$ ($20 \mu\text{g}\cdot\text{m}^{-3}$) were not exceeded in the Žilina Region zone. Likewise, the permitted number of exceedances (35) of the daily PM_{10} limit concentration ($50 \mu\text{g}\cdot\text{m}^{-3}$) was not exceeded at any monitoring station (Fig. 3.1).

Fig. 3.2 Number of exceedances of the daily $\text{PM}_{2,5}$ and PM_{10} limit values applicable from 2030*.



* The daily average concentration of $\text{PM}_{2,5} > 25 \mu\text{g}\cdot\text{m}^{-3}$ and $\text{PM}_{10} > 45 \mu\text{g}\cdot\text{m}^{-3}$ may be exceeded a maximum of 18 times per year; the limit applies from 1 January 2030. AMS Oščadnica – the data for 2021 are not representative, as the station started measurements at the end of 2021.

Compared with the previous year, all stations except AMS Martin recorded a decrease in PM_{10} daily exceedances.

The stricter annual average PM_{10} limit value would be exceeded at the AMS Martin station. However, the annual average concentrations measured at the stations in Žilina and Ružomberok were close to this future limit value, indicating the need for further reductions in concentrations to ensure long-term compliance with the Directive requirements.

In the case of $\text{PM}_{2,5}$, the new Directive limit values would be exceeded at all monitoring stations. The new annual $\text{PM}_{2,5}$ limit value of $10 \mu\text{g}\cdot\text{m}^{-3}$ would be exceeded at all AMS in the Žilina Region zone.

The highest annual average PM_{10} concentration was recorded at the monitoring station in Martin ($22 \mu\text{g}\cdot\text{m}^{-3}$), where the highest number of daily exceedances was also observed. Annual average $\text{PM}_{2,5}$ concentrations were very consistent at all stations, except for Liptovský Mikuláš ($13 \mu\text{g}\cdot\text{m}^{-3}$).

■ Assessment of compliance with the requirements of the new Directive

Fig. 3.2 (top) shows the number of days with exceedances of the new EU daily limit value for $\text{PM}_{2,5}$ ($25 \mu\text{g}\cdot\text{m}^{-3}$), with more than 18 exceedances per calendar year. The stricter annual limit value for $\text{PM}_{2,5}$ ($10 \mu\text{g}\cdot\text{m}^{-3}$), as well as the daily limit value for $\text{PM}_{2,5}$, would be exceeded at all AMS. More than twice the permitted number of exceedances was recorded at all AMS except the Liptovský Mikuláš monitoring station.

During the period 2020–2022, significantly higher values were recorded, particularly at the Martin and Žilina stations. However, since 2023, a gradual decrease in these values has been observed. Compared with 2024, daily $\text{PM}_{2,5}$ exceedances at all stations show a slight increase.

The new daily limit value for PM_{10} would have been exceeded in 2025 at the AMS Martin station (Fig. 3.2, bottom). Relatively low numbers of PM_{10} daily limit exceedances were recorded at the AMS Liptovský Mikuláš and Oščadnica stations.

Fig. 3.3 Annual average PM_{10} concentration (top) and the number of exceedances of the PM_{10} daily limit value (bottom).

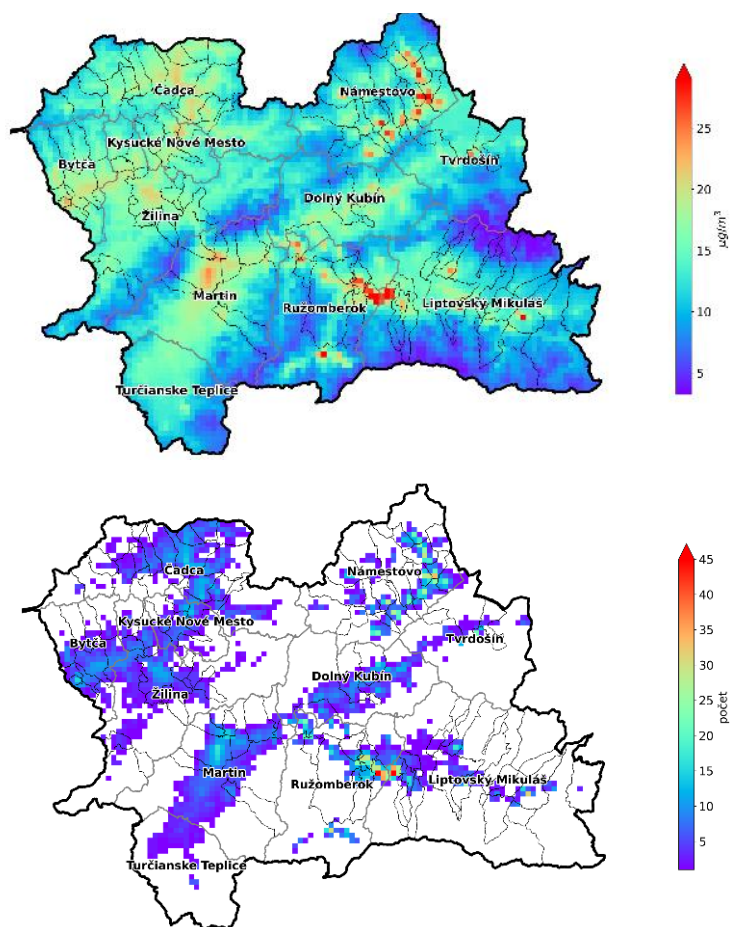


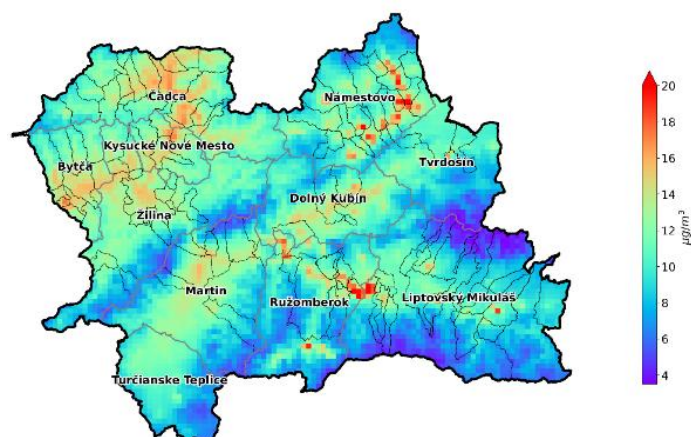
Fig. 3.3 shows the results of PM_{10} concentration modelling for 2025, calculated using the RIO model, which was subsequently adjusted using the IDW regression method.

The model predicts the highest annual average PM_{10} concentrations, as well as the highest number of exceedances of the daily limit value, in municipalities around Ružomberok and Námestovo. The Orava region is identified as a potentially problematic area based on the modelling results, which was also confirmed by indicative monitoring carried out in the municipality of Breza in Orava in 2022. This region is not yet covered by a permanent monitoring station; however, its establishment is planned.

Fig. 3.4 Annual mean concentrations of $PM_{2.5}$.

Fig. 3.4 shows the spatial distribution of annual average $PM_{2.5}$ concentrations based on the output of the RIO model combined with the IDW-R model.

The distribution of $PM_{2.5}$ concentrations indicates that annual average $PM_{2.5}$ concentrations exceed $10 \mu g \cdot m^{-3}$ outside mountainous areas. In 2025, the new EU limit value would have been exceeded across almost the entire area of the zone, with the highest concentrations occurring mainly in the districts of Námestovo and Ružomberok.



3.2 Nitrogen dioxide

Monitoring of nitrogen dioxide (NO_2) concentrations in the zone was carried out at six monitoring stations. A comparison of the average concentrations measured in 2025 with the average values for the period 2017–2024 is presented in Fig. 3.6. Values for 2025 are shown as blue bars, while the grey curve represents the long-term average for the years 2017–2024.

The highest annual average NO_2 concentrations in 2025 were recorded at the Žilina and Martin stations, reaching approximately $16 \mu\text{g}\cdot\text{m}^{-3}$. Compared with the long-term average, concentrations were lower at most stations, while at Chopok and Oščadnica they remained practically unchanged. The most pronounced decrease compared with the 2017–2024 period was observed in Martin, Ružomberok, and Žilina. The lowest value was recorded at the background station Chopok, with a concentration of approximately $1 \mu\text{g}\cdot\text{m}^{-3}$. Overall, the results indicate a favourable decreasing trend in NO_2 concentrations at most monitored locations compared with the long-term average.

Since road traffic is the dominant source of NO_2 emissions, higher concentrations generally occur in urbanised and traffic-exposed areas. Nevertheless, annual average concentrations at all monitoring stations remained well below the currently valid limit value of $40 \mu\text{g}\cdot\text{m}^{-3}$.

The WHO recommended value ($10 \mu\text{g}\cdot\text{m}^{-3}$) would be met only at the Chopok and Oščadnica stations; higher concentrations were recorded at the other locations.

Fig. 3.5 Comparison of annual NO_2 concentrations with the long-term trend.

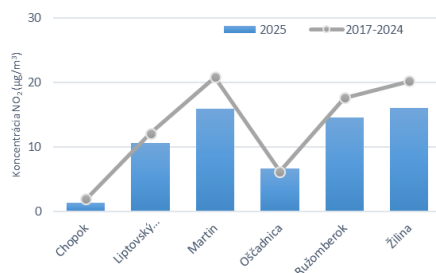
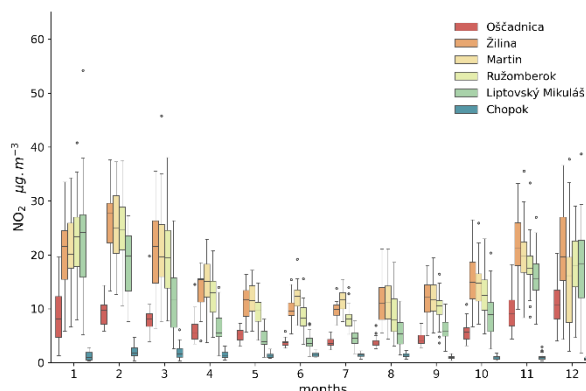


Fig. 3.6 Box plots of NO_2 concentration variability



■ Assessment of compliance with the requirements of the new Directive

The new EU limit value for the annual average NO_2 concentration ($20 \mu\text{g}\cdot\text{m}^{-3}$), applicable from 2030, would be met **at all monitoring stations** in the zone.

3.3 Ozone

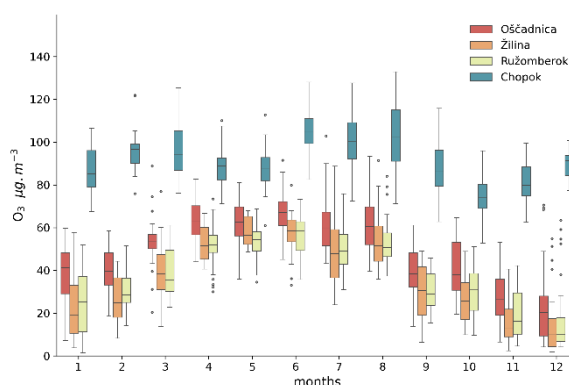
Ozone monitoring in this zone is carried out at four monitoring stations – Chopok, Žilina, Ružomberok, and Oščadnica. The target value for the protection of human health was exceeded at the AMS Chopok station.

The highest ozone concentrations are measured at the Chopok station, while the stations in Ružomberok and Žilina record among the lowest concentrations within the National Air Quality Monitoring Network. This is related to the characteristics of the stations. Chopok is a high-altitude station where the contribution of ozone transported from the upper troposphere is more significant. At urban stations located near roads, ozone titration by NO occurs (Fig. 3.7).

The highest concentrations of ground-level ozone generally occur during warm months with high solar radiation intensity. O₃ concentrations increase after sunrise, reach their maximum around midday, and gradually decrease during the evening hours to a minimum occurring in the early morning. Significant differences in ground-level ozone concentrations are also observed between warm and cold seasons.

In 2025, no exceedances of the information or alert thresholds for ground-level ozone were recorded at any monitoring station.

Fig. 3.7 Box plots of O₃ concentrations.



Tab. 3.2 Number of days with a maximum daily 8-hour mean O₃ concentration above 120 µg·m⁻³

Station	2023	2024	2025	Average 2022 – 2025
Chopok, EMEP	34	53	37	41
Oščadnica	6	10	10	9
Ružomberok, Riadok	1	0	0	0
Žilina, Obežná	1	0	2	1

≥ 90 % Required valid data.

Red colour indicates exceedance of the target value.

Note: According to Decree of the Ministry of Environment of the Slovak Republic No. 250/2023 Coll. on air quality, the target value for the protection of human health for ground-level ozone is defined as follows: the maximum daily 8-hour average concentration shall not exceed 120 µg·m⁻³ on more than 25 days per calendar year, averaged over three years.

■ Vyhodnotenie plnenia požiadaviek novej smernice

The stricter EU limit value for O₃, defined as 18 days with the maximum daily 8-hour average concentration > 120 µg·m⁻³ (averaged over three years), would be exceeded at the **AMS Chopok** in the Žilina Region, with the number of exceedances being **more than twice the permitted limit (Tab. 3.2)**.

3.4 Benzo(a)pyrene

Benzo(a)pyrene [B(a)P] is monitored in the Žilina Region at four AMS stations – in Žilina, Ružomberok, Oščadnica, and Martin.

The target value for B(a)P (1 ng·m⁻³) was exceeded at all four AMS stations. In Žilina, this pollutant has been monitored since 2018, and in Ružomberok since 2020; during the period 2021–2023, the target value there was exceeded by approximately twofold (Tab. 3.3).

Tab. 3.3 Annual average concentrations of benzo(a)pyrene in the years 2018–2025.

	2018	2019	2020	2021	2022	2023	2024	2025
Target value [ng·m ⁻³]	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
Žilina, Obežná	6,0	2,0	1,9	1,9	1,9	1,2	1,3	*1,6
Ružomberok, Riadok			4,5	2,3	2,2	2,0	1,5	1,4
Oščadnica				*12,0	*2,5	1,9	2,1	1,6
Martin, Jesenského							**1,0	1,1

≥ 90 % valid measures

Exceedance of the target value is indicated in red if the station had a sufficient number (≥ 90%) of valid measurements in the given year.

*80 % valid measures

** Monitoring of B(a)P in Martin started in 2024

The most significant source of benzo(a)pyrene is domestic heating with solid fuels, particularly insufficiently dried wood or unsuitable fuels (various types of waste).. Figure X shows the average monthly concentrations measured at the monitoring stations in Žilina, Oščadnica, Ružomberok, and Martin. The highest B(a)P concentrations, similarly to other pollutants, were recorded during the cold months of February and December, with the highest peak measured in Žilina at $10 \text{ ng}\cdot\text{m}^{-3}$ (Fig. 3.8).

Fig. 3.8 Box plots of benzo(a)pyrene concentrations in 2025.

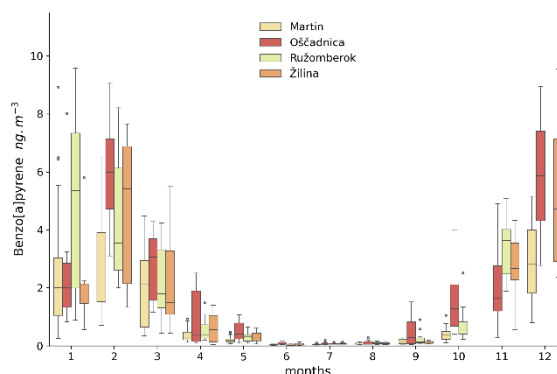
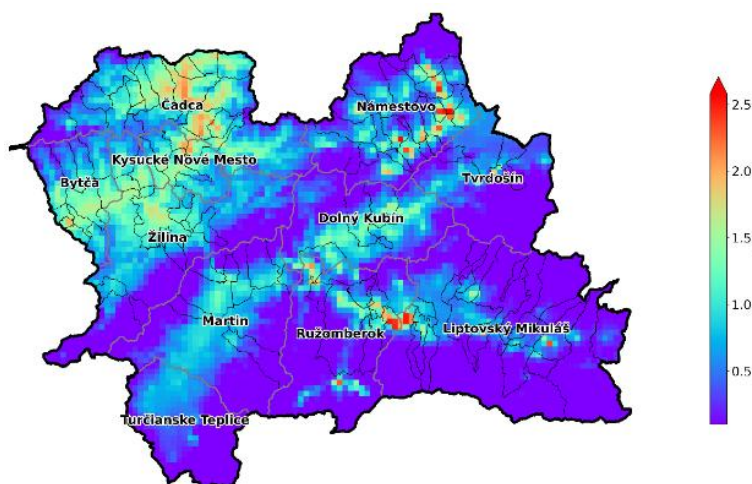


Fig. 3.9 Annual average benzo(a)pyrene concentration according to the RIO and IDW-R model outputs.



The newest AMS in Oščadnica confirms, together with the results of mathematical modelling (Fig. 3.8), that the Kysuce region is also among the areas where B(a)P concentrations exceed the target value. In Orava and in the area north of Ružomberok, modelling results indicate even higher concentrations.

These are areas with increased heating demand during the winter period and a higher occurrence of unfavourable dispersion conditions.

3.5 Chemical composition of precipitation

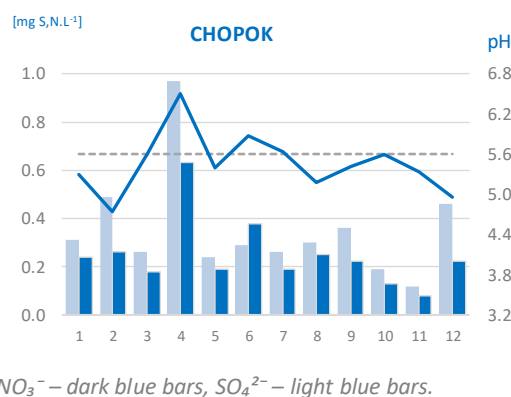
At the rural background station Chopok, precipitation quality is monitored on a daily basis (Fig. 3.10). The monitoring includes the chemical composition of major ions, pH values, and conductivity.

At AMS Chopok, a total precipitation amount of 1006 mm was measured. The annual volume-weighted average pH value was **5.45**.

Wet deposition of sulphur in the form of SO_4^{2-} reached **$0.24 \text{ g S}\cdot\text{m}^{-2}\cdot\text{year}^{-1}$** , while wet deposition of oxidised nitrogen in the form of NO_3^- was **$0.18 \text{ g N}\cdot\text{m}^{-2}\cdot\text{year}^{-1}$** and reduced nitrogen in the form of NH_4^+ reached **$0.37 \text{ g N}\cdot\text{m}^{-2}\cdot\text{year}^{-1}$** .

Wet deposition of lead was **$5.6 \text{ g}\cdot\text{ha}^{-1}\cdot\text{year}^{-1}$** . Detailed monitoring results are presented in Chapter 3, in the section Regional Monitoring of the Air Quality Report in the Slovak Republic 2025.

Fig. 3.10 Ion concentrations in precipitation and pH value.



NO_3^- – dark blue bars, SO_4^{2-} – light blue bars.

3.6 Risk areas

Fig. 3.11 shows municipalities at risk of deteriorated air quality, identified using the Integrated Assessment Method for municipalities¹. Risk level 3 corresponds to the highest probability of air pollution impact.

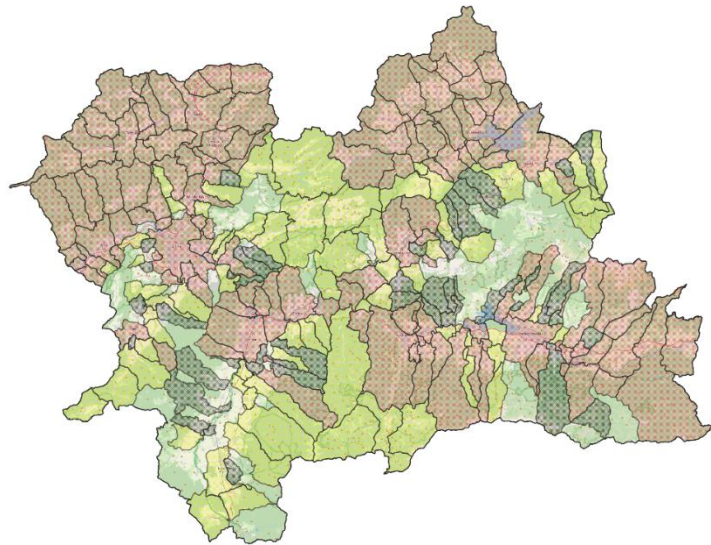
The methodology considers the extent of solid fuel use for domestic heating, the influence of unfavourable dispersion conditions from both short- and long-term perspectives, results of the CMAQ chemical transport model, the RIO interpolation model, and high-resolution CALPUFF modelling results for selected domains with a potential risk of deteriorated air quality.

Municipalities where high-resolution modelling identified exceedances of limit values for PM or NO₂, or the target value for B(a)P, were automatically assigned risk level 3, similarly to municipalities where exceedances of limit or target values were confirmed by measurements. The list of municipalities and their assigned risk levels is available on the SHMÚ website².

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 represent air quality management areas. Measures to reduce emissions 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 local microclimatic characteristics, pollution levels are expected to vary between individual locations within the risk area. High-resolution modelling results, which are continuously updated on the SHMÚ website³, provide an overview of the spatial distribution of air pollution.

Fig. 3.11 Risk municipalities in the Žilina Region.



¹ 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>

² <https://www.shmu.sk/sk/?page=2967>

³ <https://www.shmu.sk/sk/?page=2808>

3.7 Summary

According to monitoring results, no exceedances of the limit values for SO₂, NO₂, CO, O₃, PM₁₀, and PM_{2,5} were recorded in the Žilina Region zone in 2025. The highest target value for O₃ was recorded at the rural background monitoring station Chopok.

The target value for the annual average concentration of B(a)P was exceeded at all monitoring stations in the zone.

Long-term trends in PM and NO₂ pollution show a decreasing pattern in the zone. Since 2018, the number of exceedances of the PM₁₀ daily limit value has decreased significantly at all monitoring stations.

Based on the outputs of the RIO and IDW-R models, it can be concluded that in the Žilina Region zone there is a risk of elevated PM_{2,5} and B(a)P concentrations in several municipalities in Orava and Kysuce, in the vicinity of Ružomberok and Martin, as well as in some municipalities in the Liptovský Mikuláš district.

When assessing compliance with the requirements of the new Air Quality Directive 2024/2881, the main challenge in the Žilina Region zone would be meeting the new limit values for PM_{2,5}. All monitoring stations in the region currently fail to meet several of the stricter air quality requirements introduced by the new Directive. Although pollution levels in the region show a decreasing trend, additional measures will be necessary to reduce pollution to the required levels and ensure compliance with the new requirements.

If air quality were assessed according to WHO recommendations, none of the monitoring stations would meet the recommended concentration levels for particulate matter (PM), and some stations would also exceed the recommended NO₂ values. The ambition of the Zero Pollution Action Plan is to achieve air quality corresponding to these recommendations by 2050.

In the Žilina Region zone, the main air quality issue remains the high level of benzo(a)pyrene (B(a)P) pollution.