

AIR QUALITY REPORT OF THE SLOVAK REPUBLIC

2025

ANNEX

AIR QUALITY ASSESSMENT

NITRA REGION

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1 DESCRIPTION OF NITRA REGION TERRITORY IN TERMS OF AIR QUALIT

The Nitra region is mostly situated on the Danubian Lowland, partly the Považský Inovec, Trábeč, Pohronský Inovec and Štiavnické vrchy mountain ranges extend here. The highest point is Panská Javorina (943 m a.s.l.) in the northern part of the zone, the lowest altitude in the Nitra region is around 100 m a.s.l. The area of the region is for the most part well ventilated.

The whole Nitra region is one zone in terms of air quality assessment for SO₂, NO₂, NO_x, PM₁₀, PM_{2,5}, benzene, polycyclic aromatic hydrocarbons and CO in the air.

According to the Statistical Office of the Slovak Republic, the average population density in the Nitra Region is 105 inhabitants per km² (as assessed as of 31 March 2025).

The highest population density is in the Nitra District with 189 inhabitants per km², while the Levice District has the lowest density in the region with 70 inhabitants per km². For comparison - the Slovak Republic had an average population density of 111 inhabitants per km² on the given date.

The entire Nitra Region is, in terms of air quality assessment, one zone for SO₂, NO₂, NO_x, PM₁₀, PM_{2,5}, benzene, polycyclic aromatic hydrocarbons and CO in the air.

Air pollution sources in zone Nitra region

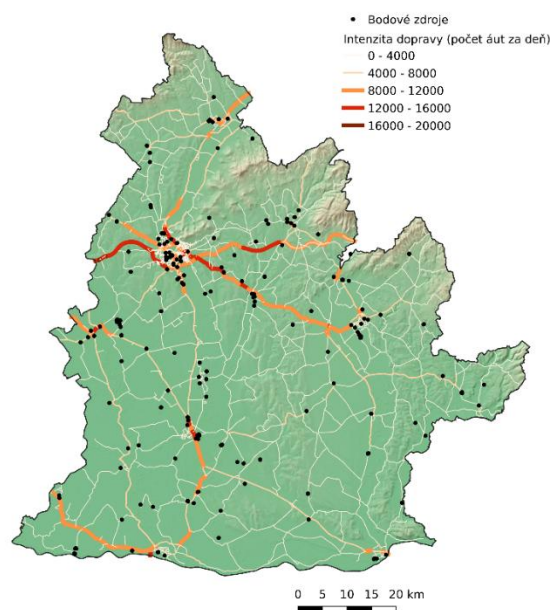
The dominant source of air pollution in the Nitra Region is household heating and, in larger cities, road transport. Mainly natural gas is used for household heating, the share of solid fuels is lower compared to other zones, apart from the more mountainous area in the north of the region (according to population census data).

Tab. 1.1 contains the traffic intensity on major roads in the region according to the national transport census in 2022 and 2023). Map on **Fig. 1.1** shows the more frequent road sections, as processed by the Transport Research Centre (*Centrum dopravného výzkumu*, CDV) for the year 2024.

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

District	Motorway/ road	Number of vehicles	Heavy goods vehicles	Passenger cars
Komárno	n. 63	19412	2746	16530
Komárno	n. 64	9634	1832	7753
Levice	n. 51	17229	1739	15405
Levice	n. 564	14590	1567	12934
Nitra	R1	33116	5767	27221
Nitra	n. 51	24279	3309	20845
Nitra	n. 64	29816	3484	26236
Nové Zámky	n. 64	16958	2683	14195
Topoľčany	n. 64	12357	1584	10703
Trnava	R1	35479	7491	27941
Šaľa	n. 75	20306	2976	17187

Fig.1.1 Road traffic intensity in the Nitra region.
Source: CDV¹.

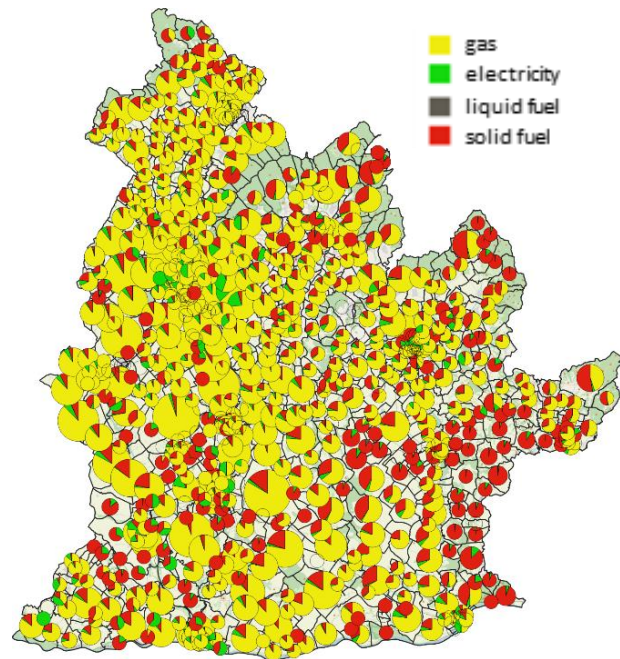


¹ Source: CDV, processing for the year 2025

Industrial sources of air pollution are less significant here in terms of their contribution to local air pollution by basic pollutants; their impact may occur episodically depending on meteorological conditions in the Nitra Region.

Fig.1.2 shows the shares of fuel types in heating family houses in individual municipalities (or basic settlement units) of the Nitra region. The spatial distribution of fuel types is not geographically homogeneous. In total for the entire zone in 2021, gas heating, while around southern Hont, the southern area of Tekov and Dolná Nitra, heating is almost exclusively with solid fuel

Fig.1.2 *Share of different types of fuel used for heating in the municipalities of the region².*



² <https://www.scitanie.sk>

2 AIR QUALITY MONITORING STATIONS IN NITRA REGION

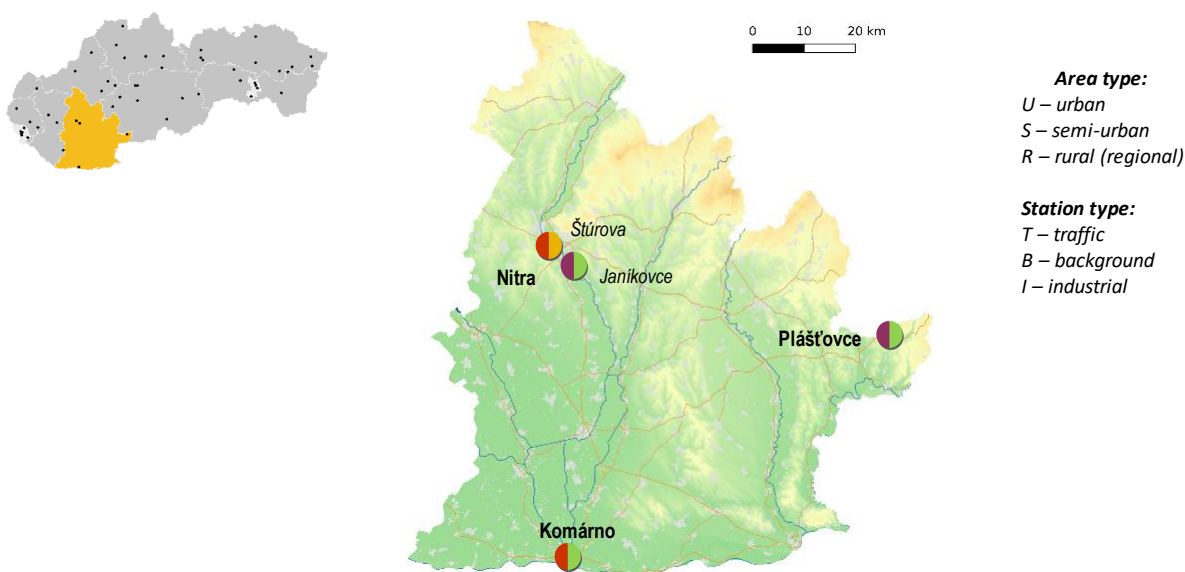
In the Nitra Region, air quality is monitored at 4 stations. The monitoring station Nitra, Štúrova reflects the impact of road traffic approx. 150 meters from the roundabout, the suburban background station is located on the south-eastern edge of the city of Nitra in the district of Nitra, Janíkovce in the school campus. An airport with irregular operations is located approximately 500 m southeast of the monitoring station. The latest additions to the Nitra Region in 2021 were the monitoring stations in Plášťovce and Komárno. The AMS in Komárno is in a housing estate on Vnútoraná Okružná Street, in a location characterizing urban background air pollution. The suburban background AMS in **Plášťovce** - a medium-sized village with mainly family houses, is in the east of the Nitra Region in the Levice District. Airflow here is influenced by the undulating shape of the terrain, which slopes and opens towards the south, which affects the spread and dispersion of pollutants in the air.

Tab. 2.1 contains information on air quality monitoring stations in the zone Nitra region:

- international Eol code, station characteristics according to the dominant sources of air pollution (traffic, background, industrial), type of monitored area (urban, suburban, rural/regional) and geographical coordinates;
- monitoring programme. Continuous monitoring automatic instruments provide hourly average concentrations of PM₁₀, PM_{2,5}, nitrogen oxides, sulphur dioxide, ozone, carbon monoxide, benzene and mercury. The SHMÚ test laboratory analyses heavy metals and polycyclic aromatic hydrocarbons as part of manual monitoring, resulting in 24-hour average concentrations.

Tab. 2.1 Air quality monitoring programme in the zone Nitra region.

Nitra 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											
Nitra	SK0269A	Nitra, Štúrova	U	T	18°04'37"	48°18'34"	143										
Nitra	SK0134A	Nitra, Janíkovce	S	B	18°08'27"	48°16'59"	149										
Komárno	SK0064A	Komárno, Vnútorná Okružná	U	B	18°08'19"	47°45'51"	110										
Levice	SK0070A	Plášťovce	S	B	18°58'42"	48°09'35"	149										
Total							4	4	4	1	3	1	1	0	0	2	



3 ASSESSMENT OF AIR QUALITY IN ZONE NITRA REGION

This chapter contains an assessment of air quality in the zone Nitra region based on monitoring, 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 according to limit values for protection of human health and smog warning system for PM₁₀ in the zone Nitra region.

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	areas / stations	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		number of exceedances	number of exceedances	number of exceedances	average	number of exceedances	average	average	average	average	average	Duration of he exceedance [h]	Duration of he exceedance [h]
Limit value [µg·m ⁻³]		350	125	200	40	50	40	20	10 000	120		100	150
Maximum number of exceedances		24	3	18		35				25			
Nitra, Janíkovce	SB			0	9	2	16	12		27		0	0
Nitra, Štúrova	UT	0	0	0	21	5	19	12	1104		0,3*	0	0
Komárno, Vnúťorná Okružná	UB			0	12	5	18	12		20		0	0
Plášťovce	SB			0	6	37	24	19		10		24	0

 < 90 % valid measures . Values highlighted in red indicate an exceedance of the limit value.

¹⁾ eight-hour maximum concentration

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

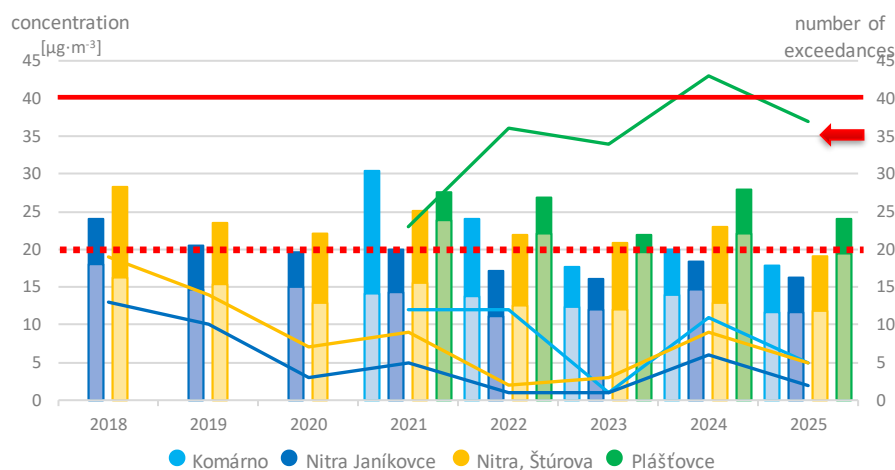
³⁾ exceedance of the maximum daily 8-hour average concentration of **120 µg·m⁻³**, expressed as the average over **three calendar years**.

* Output from the **CMAQ** model.

3.1 PM₁₀ and PM_{2,5}

Fig.3.1 shows the average annual concentrations of PM₁₀, PM_{2,5} and the number of days with average daily PM₁₀ concentrations above 50 µg·m⁻³ according to the results of measurements at monitoring stations in the Nitra region in 2018 – 2025.

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



PM₁₀ dark column colour, PM_{2,5} – light column colour; number of exceedances – solid broken lines

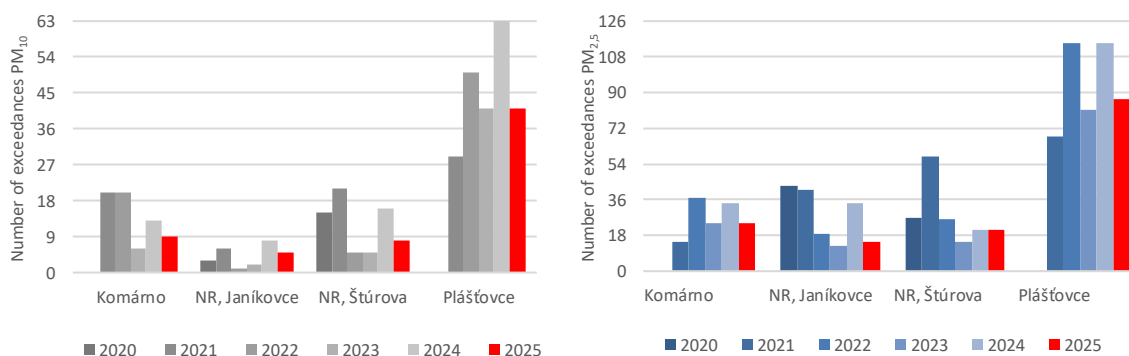
Horizontal lines show limit values (LH), red solid PM₁₀ (average annual concentration: 40 µg·m⁻³);

red striped PM_{2,5} (average annual concentration: 20 µg·m⁻³); red solid arrow – LH number of exceedances (average daily PM₁₀ concentration 50 µg·m⁻³ max. number of exceedances 35/calendar year).

The annual limit value for the PM₁₀ concentration (40 µg·m⁻³) **was not exceeded** in the Nitra Region zone. The limit value for the number of exceedances of the daily mean PM₁₀ concentration (50 µg·m⁻³) **was not exceeded at any air quality monitoring station (AMS)**. The station at Plášťovce recorded 37 exceedances; however, after subtracting the contribution from natural dust, the number of exceedances was reduced to 35.

The annual limit value for PM_{2,5} (20 µg·m⁻³) was not exceeded at any AMS. As in previous years, the PM₁₀ and PM_{2,5} concentrations measured at Plášťovce were significantly higher than those recorded at the other monitoring stations in the Nitra Region.

Fig.3.2 Number of exceedances of the new limit value for PM₁₀ and PM_{2,5} in 2020 – 2025.



* The air quality monitoring stations (AMS) at Plášťovce and Komárno did not operate for the full calendar year in 2021.

■ Assessment of Compliance with the Requirements of the New Directive

As part of the European Green Deal, the European Union has developed a Zero Pollution Action Plan, which sets out a vision for 2050. Its objective is to reduce air pollution by that year to levels that are no longer considered harmful to human health and natural ecosystems. The Action Plan includes new EU limit values and target values for many pollutants. The greatest challenge for Slovakia will be achieving compliance with the limit values for $PM_{2,5}$. For $PM_{2,5}$, the Plan introduces a daily limit value of $25 \mu\text{g}\cdot\text{m}^{-3}$, which must not be exceeded more than 18 times per year (to be achieved by 1 January 2030).

The annual limit value for PM_{10} ($20 \mu\text{g}\cdot\text{m}^{-3}$) proposed in the new Directive **would be exceeded** at the **Plášťovce** AMS.

The annual limit value for $PM_{2,5}$ would be exceeded **at all AMS**, with the most significant exceedance recorded at the **Plášťovce** AMS (by 94%). At the other monitoring stations, this limit value would be exceeded by approximately 20%.

The daily limit value for PM_{10} proposed in the new Directive ($45 \mu\text{g}\cdot\text{m}^{-3}$ with 18 exceedances allowed) **would be exceeded at the Plášťovce** AMS.

The daily limit value for $PM_{2,5}$ proposed in the new Directive ($25 \mu\text{g}\cdot\text{m}^{-3}$ with 18 exceedances allowed) **would be exceeded at the Plášťovce** AMS; exceedances would also be recorded at the **Nitra, Štúrova** and **Komárno** AMS.

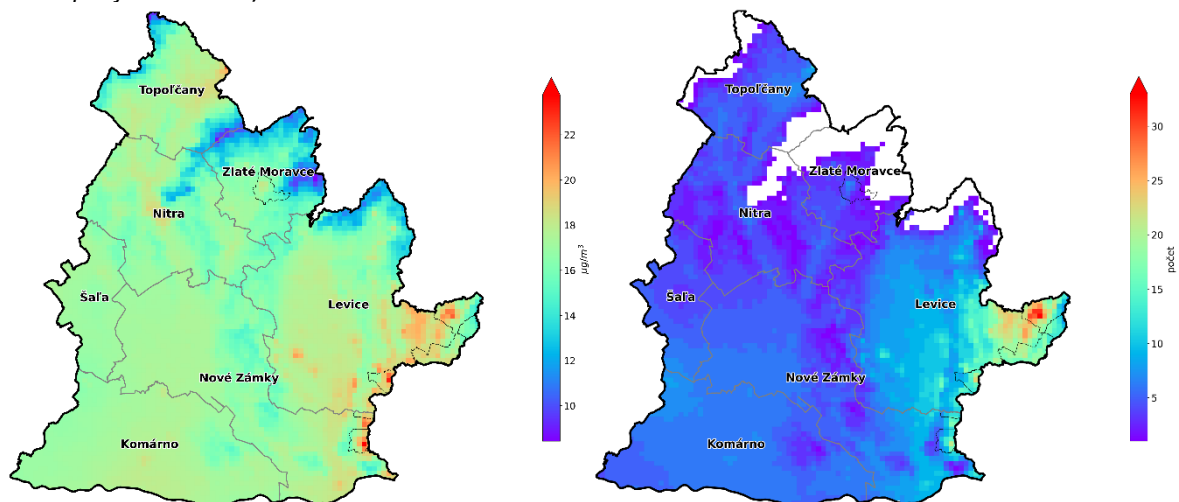
Fig.3.3 (left) shows the daily exceedances of the new PM_{10} limit value. In 2025, the highest number of exceedances would be recorded at the Plášťovce AMS (41). Compared with 2024, a slight decrease can be observed, reaching a level similar to that in 2023. At the other AMS, the number of exceedances would be relatively low (fewer than 9), with the lowest value recorded at the Nitra Janíkovce AMS (5).

Fig.3.3 (right) shows the number of days with exceedances of the new daily $PM_{2,5}$ limit value. The highest number of exceedances was recorded at the Plášťovce AMS (87). The limit value would also be exceeded at the Komárno and Nitra Štúrova AMS.

Air quality in the Nitra Region is least favourable in the south-eastern part of the region, near the border with the Banská Bystrica Region, as confirmed by both monitoring and modelling results.

The assessment according to the new EU Directive 2024/2881 indicates significant exceedances of the future limit values at the Plášťovce AMS, particularly for daily PM_{10} and $PM_{2,5}$ concentrations, where the number of exceedances is several times higher than the future permitted values.

Fig.3.3 Left: average annual PM_{10} concentration; right: number of exceedances of the daily PM_{10} limit value. Output from the RIO/IDW-R model.

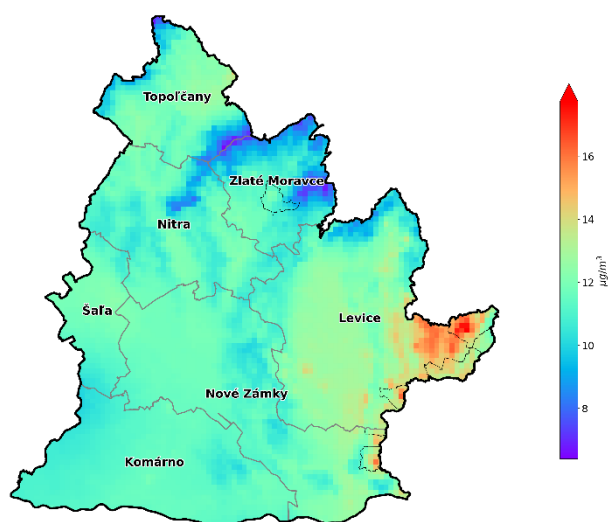


Compared with previous years, a significant decrease in the number of exceedances can be observed.

Fig.3.3 and **Fig. 3.4** show the results of PM₁₀ and PM_{2,5} modelling calculated for 2025 using the RIO model, subsequently adjusted using the regression-based IDW-R method. More detailed information is provided in the *Air Quality Report in the Slovak Republic for 2025*, Chapter 4.

The modelling outputs indicate an uneven spatial distribution of PM₁₀ and PM_{2,5} concentrations across the Nitra Region. The highest annual concentration values, as well as the highest number of exceedances of the daily limit value, occur in the south-eastern part of the region, particularly in the area near the border with the Banská Bystrica Region. In contrast, most of the region reaches lower levels of pollution.

Fig.3.4 Average annual PM_{2,5} concentrations in 2025. Output from the RIO/IDW-R model.



3.2 Nitrogen dioxide

Monitoring of nitrogen dioxide is carried out at four stations within the zone. The main source of NO₂ emissions is road traffic. For this reason, the highest concentrations are recorded at the traffic-related Nitra, Štúrova AMS; with an annual mean NO₂ concentration of 21 µg·m⁻³, the annual limit value (40 µg·m⁻³) **was not exceeded**.

The annual mean concentrations in 2025 were lower at all stations compared with the period 2017–2024 (**Fig.3.5**). The annual mean concentrations at the Plášťovce AMS (6 µg·m⁻³) and Nitra, Janíkovce AMS (9 µg·m⁻³) are low and comply with the WHO guideline value (10 µg·m⁻³), which is considerably stricter than both the current and future EU limit values.

Fig.3.5 Average NO₂ concentrations (µg/m³); comparison of 2025 with 2017–2024.

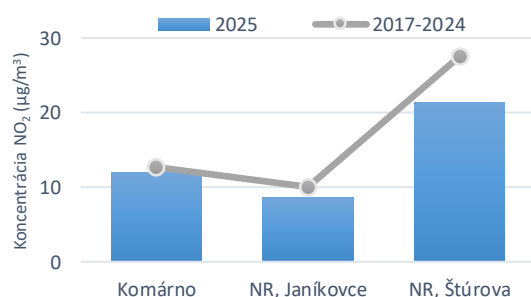
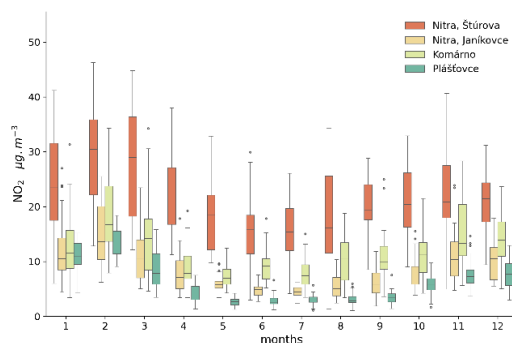


Fig.3.6 Box plots of NO₂ concentrations by months



The graph in **Fig.3.6** shows the monthly NO₂ concentrations. The highest concentrations were recorded during the winter period, with maximum values observed in February and March, which is related to

poorer dispersion conditions. During the summer months, concentrations were significantly lower; this is also associated with lower traffic intensity during this period (school holidays, vacations) and more favourable dispersion conditions.

■ Assessment of Compliance with the Requirements of the New Directive

The limit value for the annual mean concentration of NO₂ would be exceeded at AMS Nitra Štúrova, with an exceedance of 5% (1 µg·m⁻³).

3.3 Ozone

Monitoring of ozone is carried out at three AMS: Komárno, Plášťovce and Nitra, Janíkovce.

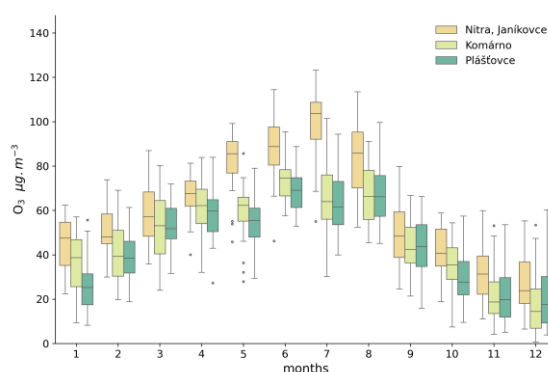
The target value for ozone **was exceeded** at the Nitra, Janíkovce AMS, with 27 exceedances recorded (Tab. 3.2).

In 2025, a significant increase in sunshine duration was observed, which resulted in an increase in the number of exceedances at the Nitra, Janíkovce site.

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

In 2025, no exceedances of the information or alert thresholds for O₃ were recorded in the zone.

Fig.3.7 Box plots of O₃ concentrations by months



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
Nitra, Janíkovce	21	18	43	27
Komárno, Vnúťorná Okružná	16	29	16	20
Plášťovce	13	8	8	10

≥ 90% required valid data Exceedances of the target value are highlighted in red.

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 mean concentration must not exceed 120 µg·m⁻³ on more than 25 days per calendar year, averaged over three years.

■ Assessment of Compliance with the Requirements of the New Directive

The target value for ozone **would be exceeded** at the Nitra, Štúrova and Komárno, Vnúťorná Okružná AMSs.

3.4 Benzo(a)pyrene

Benzo(a)pyrene is monitored in the Nitra Region zone at two monitoring stations – in Nitra, Štúrova Street, and in Plášťovce. Compared with PM particles, the annual pattern of concentrations shows an even more pronounced maximum during the cold months (Fig.3.8).

In Plášťovce, the annual mean concentration in 2025 was $1.9 \mu\text{g}\cdot\text{m}^{-3}$. The required proportion of valid measurements (90%) was not achieved at Plášťovce; the measurement outage occurred during the heating season in December. Therefore, it is assumed that the annual mean concentration with complete annual coverage would likely have been higher.

The target value for B(a)P is considered to have been exceeded in Plášťovce in 2025 (Tab. 3.3). The monthly mean concentrations of B(a)P at Štúrova Street in Nitra were generally low, with the highest values recorded in February and November, i.e. during the heating season.

Tab. 3.3 Average annual concentrations of benzo(a)pyrene in 2020–2025.

	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
Nitra, Štúrova	0,6	0,8	0,6	0,5	0,5	0,5
Plášťovce		2,2	2,4	2,7	*2,2	*1,9

≥ 90 % required valid data Exceedances of the target value are highlighted in red; * 80 % valid data

The most significant source of B(a)P is domestic heating using solid fuels, particularly insufficiently dried wood or unsuitable fuels (various types of waste). Fig.3.9 shows the spatial distribution of the average annual B(a)P concentration based on the outputs of the RIO model combined with IDW-R.

To obtain more detailed outputs, mathematical modelling with high spatial resolution and a detailed temporal and spatial distribution of emissions is required. In areas with a high share of solid fuels used for domestic heating and unfavourable dispersion conditions during the winter months, B(a)P air pollution represents a potential problem.

Fig.3.8 Box plots of daily B(a)P concentrations by months

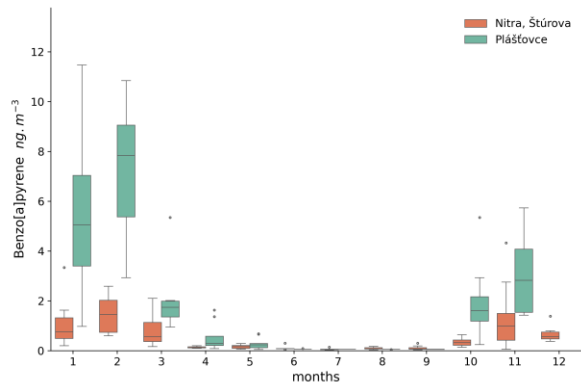
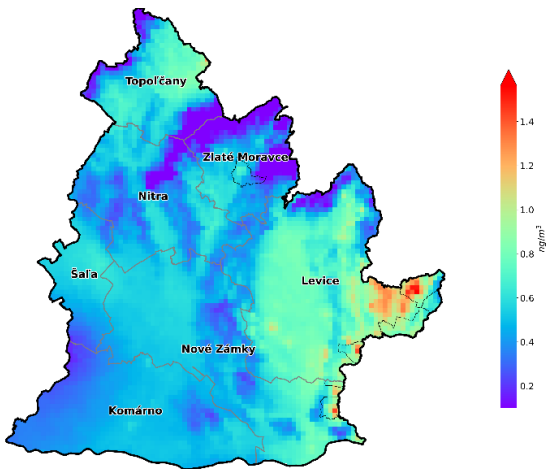


Fig.3.9 Average annual concentration of benzo(a)pyrene according to the RIO and IDW-R model output.



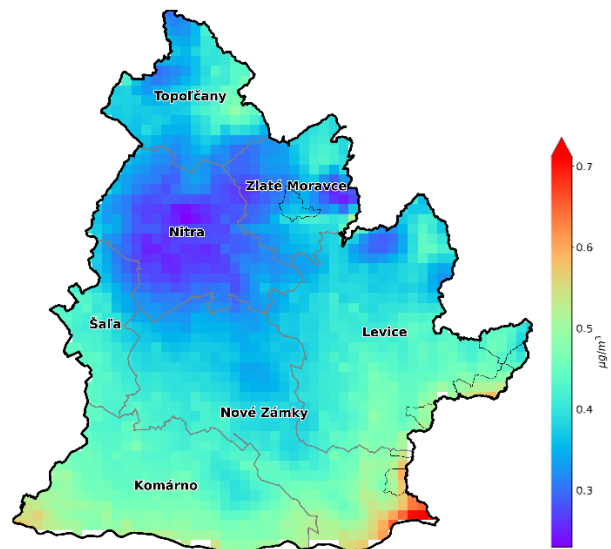
3.5 Benzene

CMAQ modelling results indicate that benzene concentrations in the Nitra Region remain at a low level and are well below the limit value of $5 \mu\text{g}\cdot\text{m}^{-3}$ across the entire region.

The highest concentrations occur mainly in the south-eastern part of the region near the border with the Banská Bystrica Region, as well as locally in the southern border areas. In contrast, the lowest values were modelled in the central part of the region, including the surroundings of Nitra.

At the location of the Nitra, Štúrova monitoring station, the CMAQ model calculated an annual mean benzene concentration of $0.3 \mu\text{g}\cdot\text{m}^{-3}$. This confirms the low level of air pollution by this substance, below the lower assessment threshold.

Fig.3.10 Average annual benzene concentration according to the CMAQ model output.



3.7 Risk areas

Fig.3.11 shows municipalities at risk of deteriorated air quality, identified using the **Integrated Assessment Method for Municipalities**. Risk level 3 corresponds to the highest probability of being affected by air pollution. The methodology includes the share of domestic heating using solid fuels, the impact of unfavourable dispersion conditions from both short- and long-term perspectives, results from the CMAQ chemical transport model, the RIO interpolation model, and high-resolution modelling results from the CALPUFF model for selected domains with a potential risk of deteriorated air quality.

Municipalities where modelling with high spatial resolution indicated exceedances of the PM or NO₂ limit value, or the B(a)P target value, were automatically assigned risk level 3, similarly to municipalities where exceedances of limit or target values were identified through measurements. The list of municipalities and their risk levels is available on the [SHMÚ website](#).

Zones and agglomerations containing at least one municipality with risk level 3 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. Considering the distribution of air pollution sources and the microclimatic characteristics of the area, it is likely that pollution levels vary between individual locations within the risk area. An overview of the spatial distribution of air pollution is provided by high-resolution modelling results, which are gradually being added to the [SHMÚ website](#).

3.8 Summary

At all monitoring stations in the Nitra Region, a year-on-year decrease in PM₁₀ concentrations was recorded in 2025 compared with 2024. NO₂ concentrations decreased slightly at the Nitra, Štúrova and Plášťovce AMSs, while values at the remaining two stations remained unchanged.

In 2025, no exceedances of the limit values for SO₂, NO₂ or CO were measured in the Nitra Region zone. An exceedance of the target value for O₃ occurred at the Nitra, Janíkovce station.

The limit value for the annual mean PM₁₀ concentration was not exceeded at any monitoring station. The limit value for the daily mean PM₁₀ concentration was also not exceeded at any station in 2025; at Plášťovce, after subtracting the contribution from natural dust, the number of exceedances was 35.

The target value for benzo(a)pyrene was exceeded at the Plášťovce AMS in 2025. According to the CMAQ model outputs, higher B(a)P concentrations may also occur in other areas east of Levice within the Nitra Region zone.

Fig.3.11 Risk areas in Nitra region.

