AIR POLLUTION IN THE SLOVAK REPUBLIC 2023

ANNEX

AIR QUALITY ASSESSMENT IN ZONE BANSKÁ BYSTRICA REGION

Emissions and Air Quality Division
SLOVAK HYDROMETEOROLOGICAL INSTITUTE

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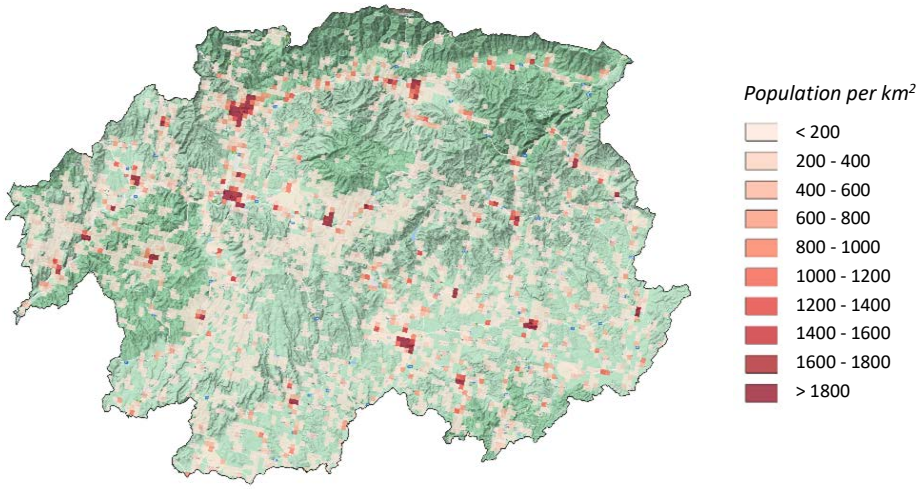
Version 1

1 DESCRIPTION OF BANSKÁ BYSTRICA REGION TERRITORY IN TERMS OF AIR QUALITY

The terrain of the Banská Bystrica region is predominantly mountainous. The mountain basins in the area are characterised by low wind speeds and frequent temperature inversions, especially in winter. In the north there are the higher mountains of the Low Tatras and outcrops of Veľká Fatra. Quite a large part is occupied by the medium-high mountains – the Slovak Ore Mountains, Štiavnické vrchy and Krupinská plain in the central part of the region. The southern part of the region is characterised by lower altitudes – Juhoslovenská kotlina and Cerová vrchovina are located here. The highest point is Ďumbier (2 046 m a. s. l.), the lowest is 124 m a. s. l. **Fig. 1.1** shows the spatial distribution of population density in the zone. The whole Banská Bystrica region is one zone in terms of air quality assessment for SO_2, NO_2, NO_X, PM_{10}, $PM_{2.5}$, benzene, polycyclic hydrocarbons and CO in the air.

Fig. 1.1 *Population density in the zone Banská Bystrica region (Source: EUROSTAT, 2018).*



Air pollution sources in zone Banská Bystrica region

The dominant source of air pollution in the Banská Bystrica region is household heating. The problem is mainly in areas where the share of firewood is the highest, and where heating devices with high emissions are used for heating. The share of solid fuel for heating households in different regions of the region is shown in **Fig. 1.3**. Locally, especially in larger cities, the impact of road traffic is also evident.

The most frequented roads with the average number of vehicles per 24 hours according to the 2022 and 2023 National Traffic Census[1] (dominant road connections in the region and towns, that are important road junctions are listed):

- dominant in terms of traffic intensity in the region is the **R1 highspeed road** connecting Nová Baňa - Žarnovica - Žiar nad Hronom - Zvolen - Banská Bystrica: 26 419 vehicles (5 325 trucks/buses (hereafter referred to as T/B) and 20 985 cars (hereafter referred to as C)) in the Žarnovica district, 28 059 vehicles (6 407 T/B, 21 581 C) in the Žiar nad Hronom district, 34 535 vehicles (7 858 T/B, 26 532 C) in the Zvolen district and a maximum of 53 018 vehicles (7 964 T/B, 44 898 C) in the Banská Bystrica district at the entrance to the city from the south.

Žiar nad Hronom

- **road No. 9** in Žiar nad Hronom: 17 856 vehicles (1 782 T/B, 15 987 C) continuing from the town to the north-west (to Handlová and Prievidza), after connecting the **R2 highspeed road**: 7 361 vehicles (2 631 T/B, 6 972 C);
- **road No. 65** from Žiar nad Hronom to Kremnica (in the Žiar nad Hronom district): 9 653 vehicles (2 631 T/B, 6 972 C).

[1] *https://www.ssc.sk/sk/cinnosti/rozvoj-cestnej-siete/dopravne-inzinierstvo/celostatne-scitanie-dopravy-v-roku-2022-a-2023.ssc*

Banská Bystrica

- **road No. 66** from Banská Bystrica east to Brezno (in the Banská Bystrica district) 32 321 vehicles (3 358 T/B, 28 849 C) is subdivided in Podbrezová: 10 842 vehicles (1 461 T/B, 9 306 C) are heading to Brezno and 5 833 vehicles (631 T/B, 5 154 C) are heading to Čertovica;
- **road No. 59** to Donovaly: 14 203 vehicles (2 652 T/B, 11 467 C).

Zvolen

- **road No. 66** from Zvolen south to Krupina and Dudince: in the Zvolen district 18 354 vehicles (3 312 T/B, 14 978 C);
- from Zvolen eastwards to Detva in the Zvolen district: **road No. 16** (34 579 vehicles, 6 647 T/B, 27 786 C) and its continuation on the **R2 highspeed road** (15 129 vehicles, 5 248 T/B, 9 810 C);
- the continuation of **road No. 16** (leading from Zvolen) from Detva to the south-east to Lučenec (12 826 vehicles, 3 093 T/B, 9 685 C), which (No. 16) then in the southern part of the region runs from Lučenec eastwards to Rimavská Sobota and Tornaľa (9 354 vehicles, 2 134 T/B, 7 182 C) and continuing on the R2 highspeed road; **road No. 71** from Lučenec south-eastwards to Fiľakovo: 5 976 vehicles (1 116 T/B, 4 834 C).

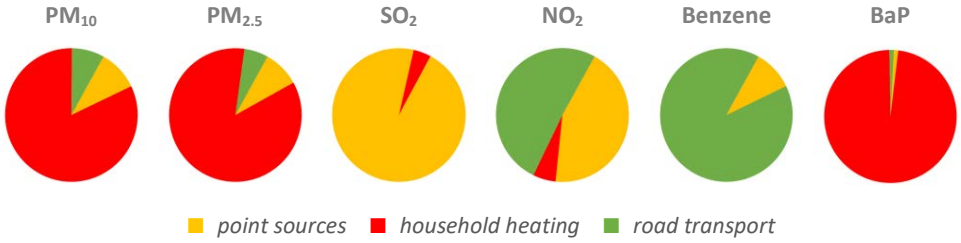
Detva

- **road No. 16** in the southern part of Detva: 9 975 vehicles (1 398 T/B, 8 511 C);
- **road No. 526** from Detva north-east to Hriňová: 7 523 vehicles (1 137 T/B, 6 277 C).

Veľký Krtíš

- **road No. 527** going north-south through town: 5 971 vehicles (429 T/B, 5 501 C) and **road No. 75** (east-west): 8 736 vehicles (847 T/B, 7 810 C).

Fig. 1.2 *Share of different types of air pollution sources in total emissions in the Banská Bystrica region.*

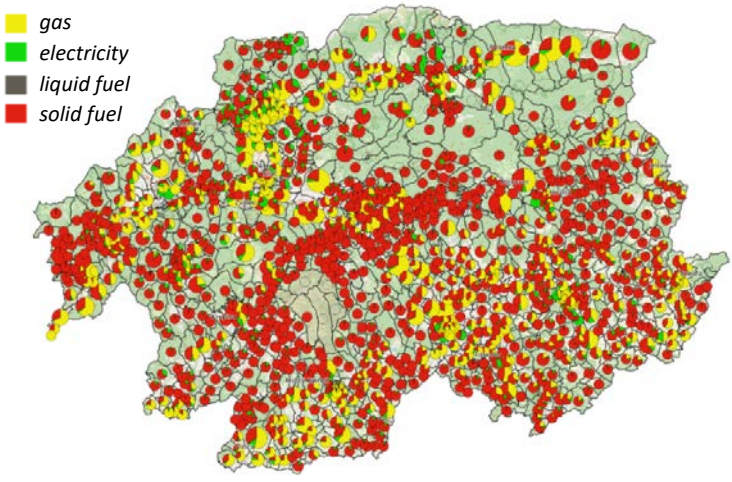


Note: Medium and large air pollution sources registered in the NEIS database are identified for this purpose as "point sources".

Industrial sources of emissions of basic pollutants in the Banská Bystrica region are less significant. Depending on meteorological conditions, the influence of heating plants may also be visible in this zone. Household heating is an important source of air pollution in the zone for particulate matter and BaP. Road traffic is a source of NO_2 and benzene.

Fig. 1.3 shows the shares of fuel types in the heating of family houses and block of flats in individual municipalities (or basic settlement units) of the Banská Bystrica region. It can be seen that the cross-sectional distribution of fuel types is not geographically homogeneous. Compared to other regions, a relatively high share of heating with solid fuel is evident, especially in areas with good availability of firewood.

Fig. 1.3 *Share of different types of fuel used for heating in the municipalities of the region [2].*



[2] *https://www.scitanie.sk*

2 AIR QUALITY MONITORING STATIONS IN ZONE BANSKÁ BYSTRICA REGION

In the Banská Bystrica region, air quality monitoring is being monitored at eight locations. The traffic station is in Banská Bystrica on Štefánikovo nábrežie and in Lučenec. The station Banská Bystrica, Zelená reflects the urban background, similarly to the stations in Zvolen and Žiar nad Hronom. The urban background stations in Jelšava and Hnúšťa monitor mainly the impact of household heating in rural areas. In 2023, the station in Žarnovica was moved to another nearby location with a similar character, so it remains categorised as suburban background station.

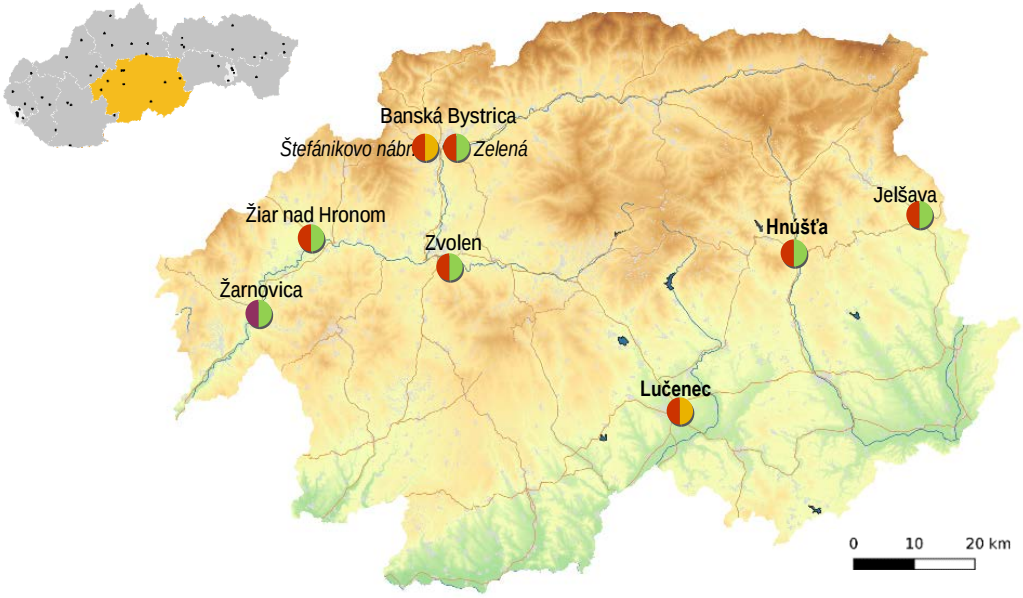
Tab. 2.1 contains information about air quality monitoring stations in the zone Banská Bystrica region:

- international EoI code, characteristics of the station according to dominant sources of air pollution (traffic, background, industrial), type of area that the station monitors (urban, suburban, rural/ regional) and geographical coordinates;
- monitoring programme. Automatic continuous monitoring devices provide hourly average concentrations of PM_{10}, $PM_{2.5}$, 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. The results of measurement are average 24-hour values.

Tab. 2.1 *Air quality monitoring programme in the zone Banská Bystrica region.*

Zone Banská Bystrica region								Monitoring programme									
								Continuously								Manually	
District	EoI code	Station	Type of area	Type of station	Geographical longitude	Geographical latitude	Altitude [m]	PM_{10}	$PM_{2.5}$	NO, NO_2	SO_2	O_3	CO	Benzene	Hg	As, Cd, Ni, Pb	BaP
Banská Bystrica	SK0214A	Banská Bystrica, Štefánikovo nábrežie	U	T	19°09'18“	48°44'06“	346										
Banská Bystrica	SK0263A	Banská Bystrica, Zelená	U	B	19°06'55“	48°44'01“	425										
Revúca	SK0025A	Jelšava, Jesenského	U	B	20°14'26"	48°37'52"	289										
Rimavská Sobota	SK0022A	Hnúšťa, Hlavná	U	B	19°57'06"	48°35'02"	320										
Lučenec	SK0072A	Lučenec, Gemerská cesta	U	T	19°40'33"	48°20'12"	183										
Zvolen	SK0262A	Zvolen, J. Alexyho	U	B	19°09'25"	48°33'30"	321										
Žarnovica	SK0065A	Žarnovica, Dolná	S	B	18°43'10"	48°28'58"	222										
Žarnovica	SK0065A	Žarnovica*	S	B	18°43'04"	48°28'59"	222										
Žiar n/Hronom	SK0268A	Žiar n/Hronom, Jilemnického	U	B	18°50'34"	48°35'59"	296										
							Total	8	8	5	1	3	2	2	0	2	4

* New location in Žarnovica, after moving the monitoring station from Žarnovica, Dolná. Data are available from December 2023.



Type of area:
U – urban
S – suburban
R – regional

Type of station:
T – traffic
B – background
I – industrial

3 ASSESSMENT OF AIR QUALITY IN ZONE BANSKÁ BYSTRICA REGION

This chapter contains an assessment of air quality in the zone Banská Bystrica region based on monitoring, supplemented by mathematical modelling results for PM_{10}, $PM_{2.5}$ and benzo(a)pyrene for the year 2023.

Tab. 3.1 *Assessment of air pollution according to limit values for protection of human health and smog warning system for PM_{10} in the zone Banská Bystrica region – 2023.*

	Protection of human health									IT[2]	AT[2]
Pollutant	SO_2		NO_2		PM_{10}		$PM_{2.5}$	CO	Benzene	PM_{10}	PM_{10}
Averaging period	1 h	24 h	1 h	1 year	24 h	1 year	1 year	8 h[1]	1 year	12 h	12 h
Parameter	number of exceedances	number of exceedances	number of exceedances	average	number of exceedances	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	5	100	150
Maximum number of exceedances	24	3	18		35						
Banská Bystrica, Štefánik. nábr.	0	0	0	22	18	24	13	1 696	0.49	52	8
Banská Bystrica, Zelená			0	8	1	14	11			0	0
Jelšava, Jesenského			0	7	42	28	20			28	0
Hnúšťa, Hlavná					1	19	13			0	0
Lučenec, Gemerská cesta			0	14	9	21	15	1 267	0.34	0	0
Zvolen, J. Alexyho					4	17	13			0	0
Žarnovica [3]			0	11	15	21	19			0	0
Žiar n/H, Jilemnického					0	14	10			0	0

≥ 90% of valid measurements *Exceedance of the limit value is marked in red.*

[1] *eight-hour maximum concentration*

[2] *IT, AT – duration of exceedance (in hours) of the information threshold (IT) and alert threshold (AT) for PM_{10}*

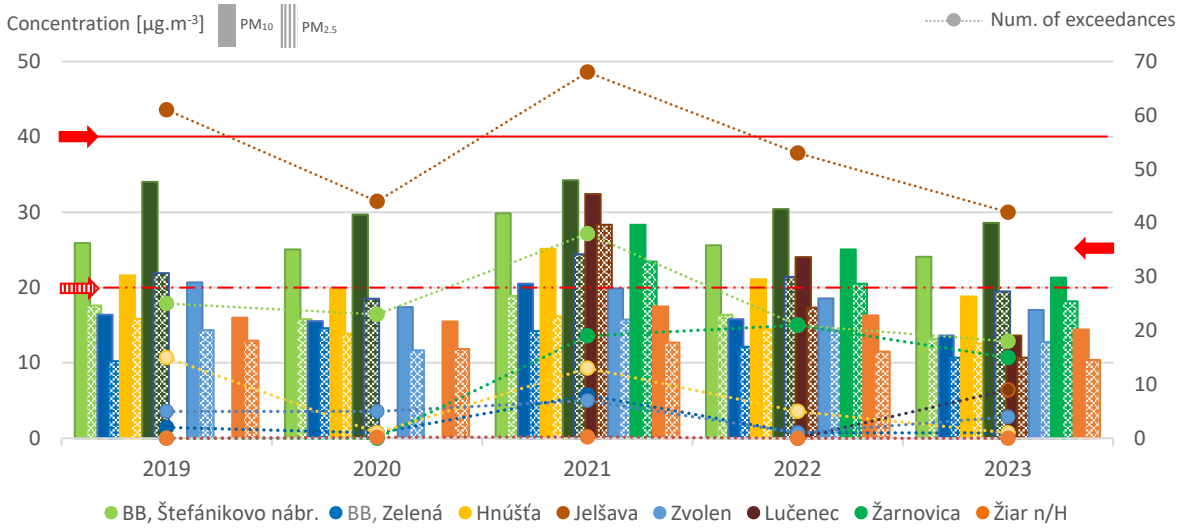
[3] *The monitoring station in Žarnovica has been relocated, the measurement does not cover the period from 11. 10. 2023 to 5. 12. 2023. The data in the table are obtained by including both sites in Žarnovica, but they do not reach the minimum required proportion of valid ones needed for the assessment.*

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

3.1 PM_{10} and $PM_{2.5}$

Fig. 3.1 shows the average annual concentrations of PM_{10}, $PM_{2.5}$ and the number of days with average daily PM_{10} concentrations above 50 $\mu g \cdot m^{-3}$ according to the results of measurements at monitoring stations in the Banská Bystrica region in 2023.

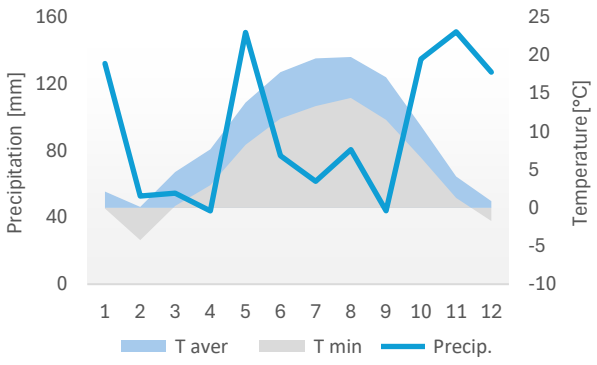
Fig. 3.1 *Average annual concentrations of PM_{10}, $PM_{2.5}$ and the number of exceedances of the daily limit value for PM_{10}.*



*The arrows show the limit values, **red striped** $PM_{2.5}$ (average annual concentration: 20 $\mu g \cdot m^{-3}$); **red on the left** PM_{10} (average annual concentration: 40 $\mu g \cdot m^{-3}$); **red on the right** number of exceedances (average daily PM_{10} concentration of 50 $\mu g \cdot m^{-3}$ must not be exceeded more than 35 times in a calendar year).*

The limit value for the number of exceedances (maximum 35) of the average daily concentration of PM_{10} was exceeded in 2023 only in Jelšava (42 exceedances), where the situation was slightly more favourable than in 2022, in which Jelšava had 53 exceedances. No exceedances of the limit value for the average daily concentration of PM_{10} were measured at the traffic station in Banská Bystrica in 2023 or in 2022. An exceedance was last recorded here in 2021 when the site was affected by construction activity near the station. The limit value for the annual average PM_{10} concentration (40 $\mu g \cdot m^{-3}$) in the Banská Bystrica region was not exceeded.

Fig. 3.2 *Monthly precipitation totals, average and minimum temperatures (Banská Bystrica, Zelená).*



Air quality is determined not only by emissions (the number of pollutants entering the air), but also by meteorological parameters – vertical temperature profile, wind conditions, precipitation, dispersion conditions in different pressure formations or atmospheric fronts. At present, when emissions from solid fuel household heating are a problem at most of the monitored sites, especially during the cold half of the year, air temperature, which determines heating requirements, is one of the parameters that indirectly influence air pollution. This simple assumption is confirmed by comparing the minimum temperature (**Fig. 3.2**) with the maximum PM concentrations (**Fig. 3.4**). In 2023, the lowest mean monthly temperatures were measured during February. Absolute minima were recorded in February in the valleys and basins of central Slovakia – for example, in Brezno a minimum temperature of –22.5 °C was measured on 7 February 2023. The occurrence of low temperatures continued in February for only a few days, but the situation was complicated for almost 2/3 of the month by the long-term influence of pressure highs with adverse dispersion conditions.

Similar repeated synoptic situations with anticyclones occurred in 2022 in March, but they were additionally accompanied by dust transport from dry areas. In 2023, maximum values of both PM_{10} and $PM_{2.5}$ were measured in February and December (**Fig. 3.4**). PM_{10} values at most stations were higher in February, when most exceedances of the daily limit value for PM_{10} also occurred. In December, the maximum daily concentration in the zone was reached at Jelšava (17 December 2024: 86 $\mu g \cdot m^{-3}$). Although the highest average daily concentration of PM_{10} was recorded in Banská Bystrica at Štefánikovo nábr. (10/2/2023: 121.6 $\mu g \cdot m^{-3}$), Jelšava had the highest number of exceedances of the daily limit value in December. Based on the preliminary evaluation of the CAMS model outputs, we can attribute two PM_{10} exceedances to natural sources in Jelšava out of a total of 42 exceedances measured in 2023. At the other stations in the zone, the number of exceedances would not decrease after subtracting the contribution of natural sources.

Fig. 3.3 and **Fig. 3.5** show the modelling results for PM_{10} and $PM_{2.5}$, calculated for the year 2023 using the RIO model subsequently adjusted using the regression IDW-R method (see Chapter 4 of *Air pollution in the Slovak Republic 2023 Report* for more details).

Fig. 3.3 *Average annual PM_{10} concentration (left) and number of exceedances of the PM_{10} daily limit (right) in 2023.*

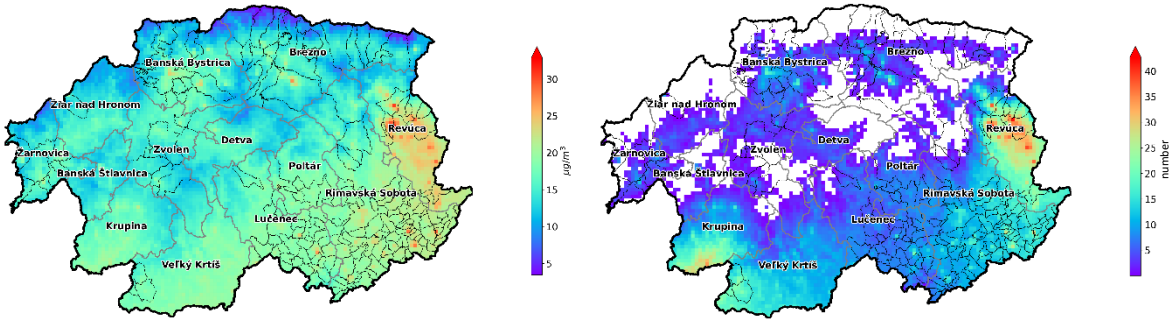
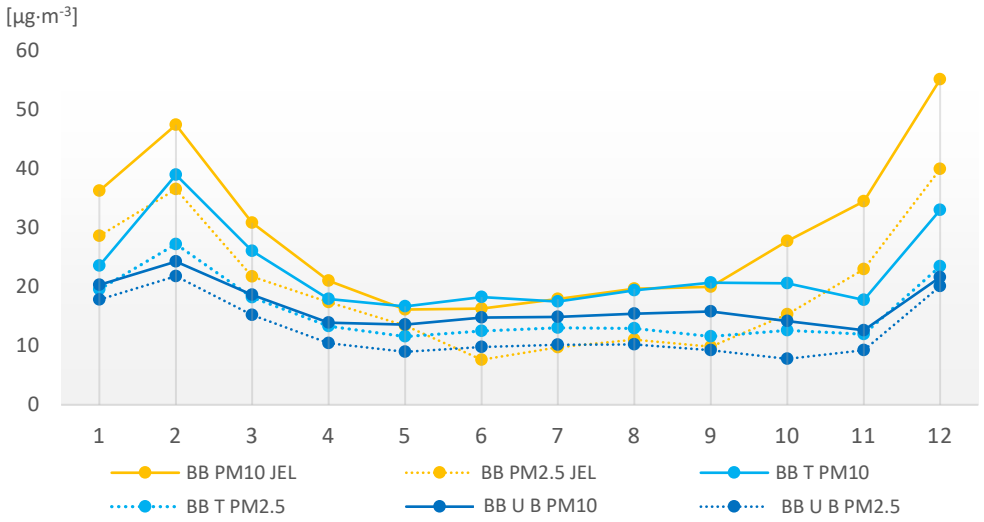


Fig. 3.4 compares the monthly average PM_{10} and $PM_{2.5}$ of traffic stations with urban/suburban background stations, with the values for Jelšava shown separately.

Fig. 3.4 *Average monthly concentrations of PM_{10} and $PM_{2.5}$ in the region by station type.*



T PM10 *and* ***T PM2.5*** *- average of monthly concentrations of PM_{10} and $PM_{2.5}$ at the traffic stations Banská Bystrica, Štefánikovo. nábr. and Lučenec;* ***U B PM10*** *and* ***U B PM2.5*** *- average of monthly concentrations of PM_{10} and $PM_{2.5}$ at the urban background Banská Bystrica, Zelená; Hnúšťa; Zvolen and Žiar n/Hronom;* ***PM10 JEL*** *and* ***PM2. 5 JEL*** *- average monthly concentration of PM_{10} and $PM_{2.5}$ at the urban background station Jelšava.*

High concentrations of $PM_{2.5}$ are particularly risky because of their adverse effects on human health. In Jelšava, the average annual concentration of $PM_{2.5}$ has just reached the limit value (20 µg·m^{-3}). As with PM_{10}, high concentrations were recorded for $PM_{2.5}$, especially in February, which, in addition to persistent heating demands, also saw repeated adverse dispersion conditions during situations of high air pressure[3], which occurred with a short break from approximately 6 to 18 February 2023.

In April 2024, the Directive of the European Parliament and of the Council on ambient air quality and cleaner air for Europe[4] was approved, containing a target value and new EU limits for air pollutants to be achieved (i.e. not exceeded) by EU Member States by 1 January 2030. Comparing the PM_{10} values in 2023 against this target, we see that the new EU limit of 20 µg·m^{-3} for the annual average PM_{10} concentration would be exceeded at the traffic stations in Banská Bystrica and Lučenec and at the urban background station in Jelšava. The monitoring station in Žarnovica was relocated to another site of similar character during 2023 for technical reasons. Although the measurements in Žarnovica do not cover the whole year 2023, it is likely that the annual average PM_{10} concentration would also exceed the value of 20 µg·m^{-3} with the required number of measurements in Žarnovica.

As already mentioned above for PM_{10}, air quality monitoring is being carried out also for the pollutant $PM_{2.5}$. The map in **Fig. 3.5** is the output of the RIO model in combination with IDW-R.

Fig. 3.5 *Average annual $PM_{2.5}$ concentrations in 2023.*

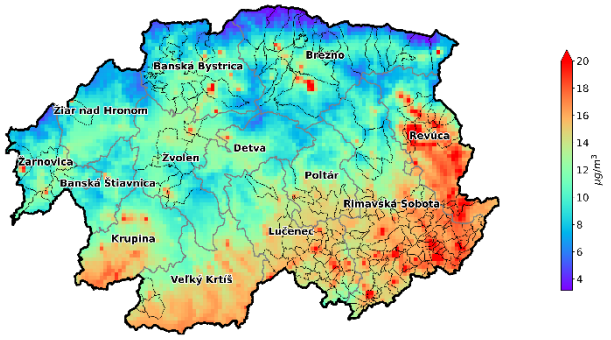
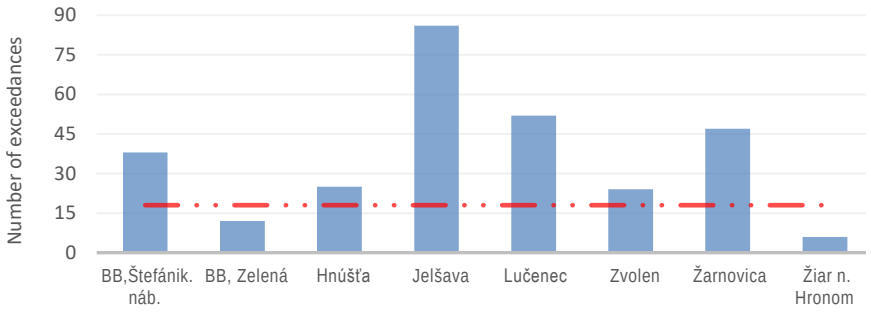


Fig. 3.6 shows the $PM_{2.5}$ concentrations with respect to the new EU limit that will apply from 1 January 2030. Only the station in Žiar nad Hronom and the urban background station in Banska Bystrica, Zelená would meet this limit value in the Banska Bystrica region.

The new EU limit value of 10 µg·m^{-3} – to be achieved by 1 January 2030 – for the annual average concentration of $PM_{2.5}$ would be closely met in 2023 only by the station in Žiar nad Hronom.

Fig. 3.6 *Number of days with average daily $PM_{2.5}$ concentration > 25 µg·m^{-3}) in 2023 – evaluation in view of the newly introduced EU limit*.*



** Under the new EU limit, which will come into force on 1 January 2030, the average daily concentration of $PM_{2.5}$ must not exceed 25 µg·m^{-3} more than 18 times a year.*

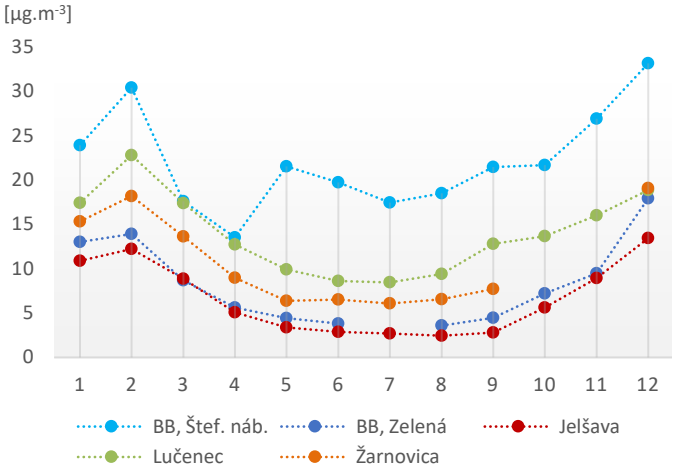
[3] *https://www.shmu.sk/sk/?page=8*

[4] *https://www.europarl.europa.eu/news/sk/press-room/20240419IPR20587/znecistenie-ovzdusia-parlament-prijal-zakon-prevyssiu-kvalitu-ovzdusia*

3.2 Nitrogen dioxide

Nitrogen dioxide monitoring is carried out at five stations in the zone. The limit value for the annual average or hourly concentration was not exceeded at any station, the highest annual average concentration did not even reach 2/3 of the limit value. The average monthly concentrations for individual stations are shown in **Fig. 3.7**. The February maxima, which occurred at the traffic stations in Banská Bystrica and Lučenec, were probably caused by unfavourable dispersion conditions brought by several anticyclones that passed over our territory.

Fig. 3.7 *Average monthly NO_2 concentrations in 2023.*



Average annual NO_2 concentrations at urban background stations in the Banská Bystrica region exceeded 10 µg·m^{-3} at all monitoring stations except Jelšava and Banská Bystrica, Zelená. This NO_2 level (10 µg·m^{-3}) represents the WHO recommendation (2021). In general, the WHO recommendations are significantly more stringent than the EU limits. The new EU limit value for the annual average NO_2 concentration (20 µg-m^{-3}) – to be reached by 1 January 2030 – approved by the European Parliament in April 2024[5] would be exceeded by the traffic station in Banská Bystrica.

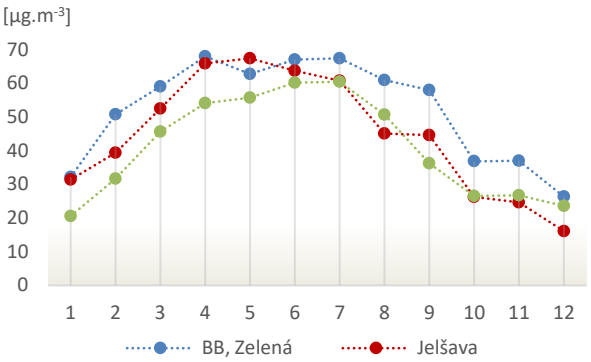
3.3 Ozone

Ozone monitoring is carried out at three monitoring stations – in the regional town of Banská Bystrica, Zelená, Jelšava and Lučenec.

The highest concentrations of ground-level ozone generally occur in warm months with high sunshine intensity (**Fig. 3.8**).

In the Banská Bystrica region in 2023, no exceedance of the target value for the protection of human health, the information or the alert threshold for ground-level ozone has been measured.

Fig. 3.8 *Average monthly O_3 concentrations in 2023.*



3.4 Benzo(a)pyrene

Benzo(a)pyrene is monitored in the Banská Bystrica region at one urban and two suburban background stations (Banská Bystrica, Zelená, Jelšava and from 2021 also in Žarnovica) and one traffic station (Banská Bystrica, Štefánikovo nábrežie).

In 2023, the target value was exceeded at all monitored sites with the exception of the station Banská Bystrica, Zelená (**Tab. 3.2**). Due to the relocation of the station, the values in Žarnovica do not reach the required number of valid data. However, since the measurement failure was during the heating season, it can therefore be assumed that the target value would have been exceeded at this station as well. In the winter months, BaP values are alarmingly high in Žarnovica as well as in Jelšava (**Fig. 3.9**).

[5] *https://www.europarl.europa.eu/RegData/etudes/BRIE/2023/747087/EPRS_BRI(2023)747087_EN.pdf*

Tab. 3.2 *Average annual concentration of benzo(a)pyrene in 2018 – 2023.*

	2018	2019	2020	2021	2022	2023
Target value [ng·m⁻³]	1.0	1.0	1.0	1.0	1.0	1.0
Banská Bystrica, Štefánikovo nábrežie	2.1	1.7	1.6	1.7	1.4	1.2
Banská Bystrica, Zelená		1.1	1.2	1.3	0.9	0.9
Jelšava, Jesenského	3.9	4.0	3.0	2.8	2.7	3.4
Žarnovica, Dolná				2.2	2.7	*2.0

≥ 90% of valid measurements

Exceeding the target value is marked in red if there were enough (≥ 90%) valid measurements at the station in the given year.

** Žarnovica - station relocation, outage in November and fewer measurements in December, 82% of valid measurements*

The most significant source of benzo(a)pyrene is the heating of households with solid fuel, especially insufficiently dried wood, or unsuitable fuel (various types of waste). Modern heating devices achieve relatively low emissions with proper maintenance and operation. However, there is likely to be little use of modern boilers in the problem areas, which is related to the significant representation of low-income households in these localities. In Jelšava, which has a long-term poor air quality, samples for the analysis of polycyclic aromatic hydrocarbons were taken every second day and at the other stations every third day. In **Fig. 3.9** we can see that the highest concentrations (values above 7 ng·m^{-3}) were measured only in Jelšava and Žarnovica, in December.

Fig. 3.10 shows the average annual concentration according to the outputs of mathematical modelling. In areas with extremely adverse dispersion conditions, such as Jelšava, this pollutant with carcinogenic properties is a significant problem.

Fig. 3.9 *Measured concentrations of benzo(a)pyrene in 2023.*

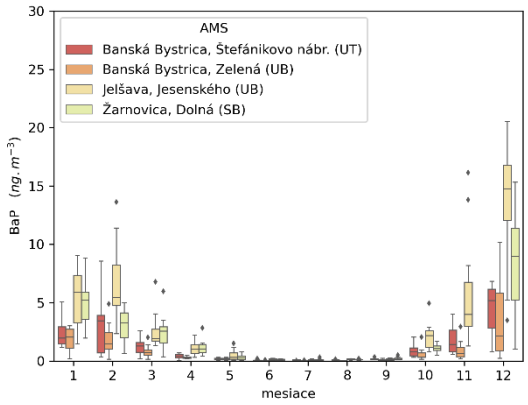
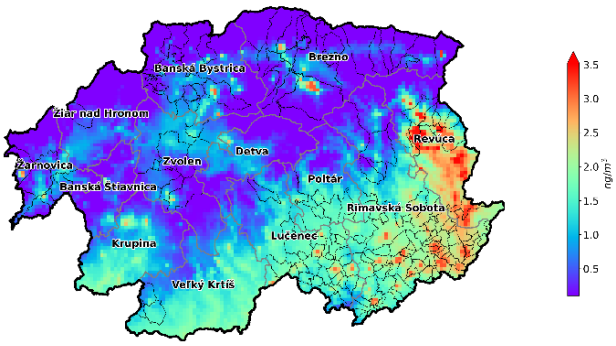


Fig. 3.10 *Average annual concentration of benzo(a)pyrene from RIO model output, IDW-R (2023).*



3.5 Risk municipalities

Fig. 3.11 shows municipalities at risk of poor air quality, identified by the integrated municipal assessment method with regard to the risk of adverse air quality[6]. Risk level 3 corresponds to the highest probability of being at risk from air pollution.

The methodology includes the rate of household heating with solid fuels, the impact of impaired dispersion conditions in the short and long term, the results of the CMAQ chemical-transport model, the RIO inter-field model and the results of high-resolution CALPUFF modelling on selected domains with a presumption of impaired air quality.

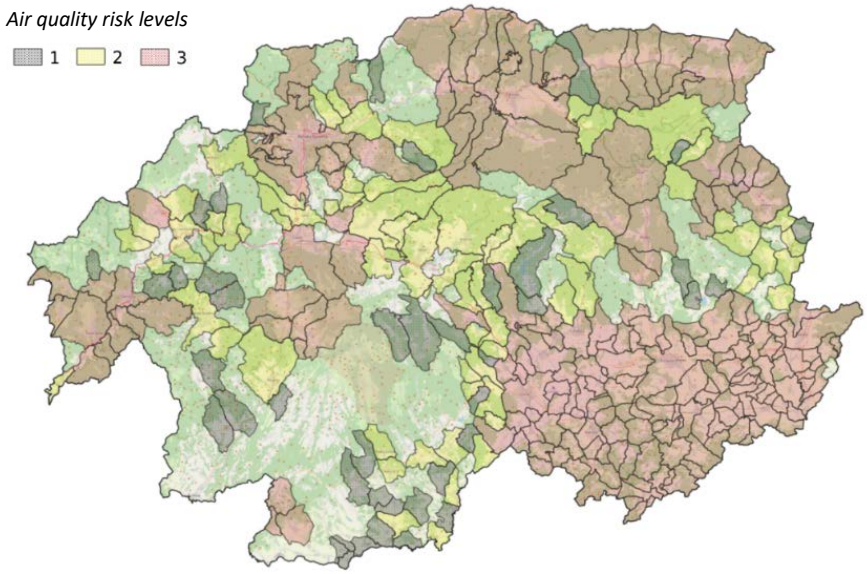
[6] *D. Štefánik, J. Krajčovičová: Metóda integrovaného posúdenia obcí vzhľadom na riziko nepriaznivej kvality ovzdušia. SHMÚ, 2023. available at https://www.shmu.sk/File/oko/studie_analyzy/Metodika_final_v2a.pdf*

Municipalities where the limit value for PM, NO_2 or the target value for BaP was exceeded according to modelling with high spatial resolution were automatically assigned a risk level 3, similarly to municipalities where the limit or target value was exceeded according to measurement. A list of municipalities and their risk levels is available on the SHMÚ website.[7]

Zones and agglomerations containing at least one municipality with a risk level 3 are required to prepare Air Quality Plan. Based on this, municipalities at risk level 3 correspond to *air quality management areas.* However, measures to reduce emissions must be implemented in all municipalities with a risk level 2 or 3 included in the zone, ideally also in municipalities with a risk level of 1.

The integrated assessment method aims to identify areas where action to improve air quality needs to be targeted. Given the distribution of air pollution sources and the microclimatic characteristics of the area, it is likely that the level of pollution in the risk area will vary from one location to another. An idea of the spatial distribution of air pollution is provided by the results of high-resolution modelling, which are progressively added to the website[8].

Fig. 3.11 *Risk municipalities in zone Banská Bystrica region.*



3.6 Summary

The target value for the annual average concentration of benzo(a)pyrene was exceeded at the monitoring station in Jelšava and at the monitoring station in Banská Bystrica, Štefánikovo nábrežie. High values of benzo(a)pyrene were also measured in Žarnovica (5 daily samples from Žarnovica had a concentration of benzo(a)pyrene higher than 10 $ng \cdot m^{-3}$), however, for this station in 2023 we do not evaluate the average annual concentration, since the measurements did not cover the whole year.

The annual mean concentration of benzo(a)pyrene at the monitoring station in Banská Bystrica on Zelená Street remained just below the target value.

The limit value for the daily mean concentration of PM_{10} was exceeded at the monitoring station Jelšava, Jesenského.

The new EU limit values, which will come into force in 2030, would be exceeded at most stations in the Banská Bystrica region. The most significant problem is $PM_{2.5}$ – only AMS in Žiar nad Hronom would not exceed the limit value in 2023. In contrast, only the traffic station in Banská Bystrica, Štefánikovo nábrežie would exceed the new limit value for NO_2.

[7] *https://www.shmu.sk/sk/?page=2768*
[8] *https://www.shmu.sk/sk/?page=2699*

Air pollution is particularly significant in poorly ventilated areas with frequent temperature inversions. The dominant source of pollution is household heating with solid fuel, probably often insufficiently dried wood or various types of waste, using high-emission heating equipment.

Locations with higher pollutant levels, especially BaP, occur in closed mountain valleys. The situation is also influenced by the social structure of the population, whose economic situation does not allow them to purchase and operate low-emission heating equipment.

When analysing the long-term trend of pollution in the *Banská Bystrica region*, we can see an improvement compared to the situation several decades ago, in recent years, however, the values tend to fluctuate depending on meteorological conditions. This is illustrated by the high values measured in cold January 2017, or to a lesser extent during anticyclonic situations with unfavourable dispersion conditions in combination with long-range transport of dust from dry areas in March 2022.

In 2023, in the zone Banská Bystrica region, no exceedances of the limit values for SO_2, NO_2, CO and benzene were measured, nor exceedances of the limit value for the annual average concentration of PM_{10}.