MINISTRY OF THE ENVIRONMENT OF THE SLOVAK REPUBLIC

STATE OF THE ENVIRONMENT REPORT

SLOVAK REPUBLIC 2005

Environment *is everything that creates natural conditions for existence of organisms, including the humans, and is a condition of their further development. Environment is created* ***by its parts,*** *first of all air, water, rocks, soil and living organisms.*

§2 of Act No 17/1992 Coll. on Natural Environment as amended

COMPONENTS OF THE ENVIRONMENT AND THEIR PROTECTION

• AIR

Emission situation

♦ **History of particulate matter emissions and sulfur dioxide emissions**

Records show a steady reduction in **particulate matter emissions (PM)** since 1990. Decreasing trend in SO_2 emissions since 1996 was caused by reduction in brown coal, lignite, and heavy heating oil consumption, use of low-sulfur heating oils, and installing de-sulfurization equipment at large energy sources. Slight fluctuation in the SO_2 emissions in 2001 and 2003 was caused by their partial or complete operation, quality of used fuels, and volume of production. SO_2 emissions decreased in 2004 as a consequence of increasing burning of low-sulfur heating oils. Slight increase in particulate matter was caused by increased consumption of wood by small sources (households).

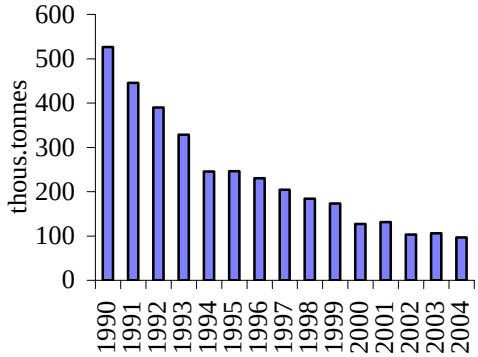
♦ **Trend in emissions of nitrogen oxides**

Nitrogen emissions (**NO_x**) showed a slight reduction in 1990 - 2004. This trend was partly interrupted in 1995, when a slight increase occurred, due to increased consumption of natural gas. Another reduction in nitrogen oxides emissions was recorded in 1996, as the result of a change to the emission factor that reflects the existing situation in incineration equipment and technologies. Reducing the consumption of solid fuels led to a further decrease in NO_x emissions since 1997. In 2002 - 2003, emissions were significantly reduced due to de-nitrification at large energy sources. Since 2004, the trend in emissions has seen no major changes.

♦ **Trend in carbon monoxide emissions**

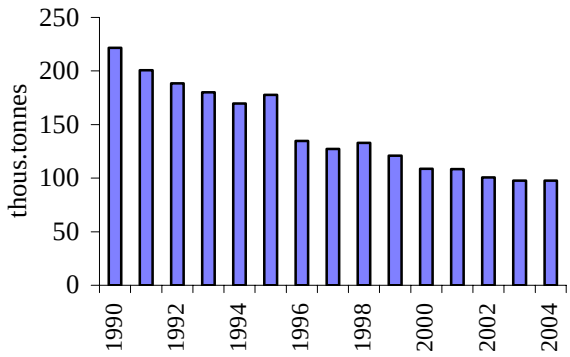
Carbon monoxide emissions (CO) since 1990 have shown a falling tendency, which was caused mainly by reduced consumption and change in fuel composition in the sphere of retail consumers. Trend in reduced CO emissions from large sources was not significant. Iron and steel-producing and processing industry has been the major contributor to total emissions. Reduction in CO emissions in 1992 was caused by decreased volume of production in this type of industry. In 1993, after the mentioned production reached the level of 1989, CO emissions increased correspondingly. In 1996, there was again a slight reduction in carbon oxides emissions, as a consequence of CO emissions reduction measures in the most significant production area (iron and steel production). Fluctuating trend in emissions in 1997 - 2003 relates to the volume of produced iron, together with fuel consumption. Although in 2004 CO emissions increased, especially at large sources, they dropped in the area of road transport. Reduction of emissions in the area of road transport relates to decreased consumption of petrol types, as well as to an on-going renewal of vehicles, and introduction of those with three-way operated catalyzer.

Trend in emission of SO_2



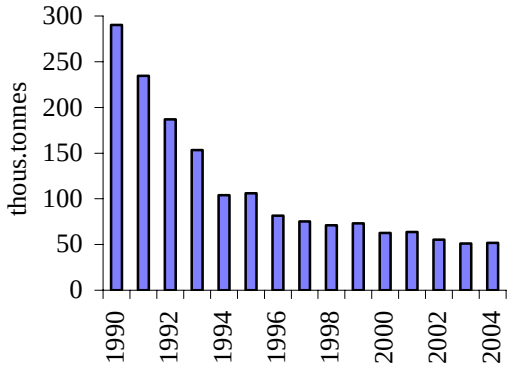
Source: SHMI

Trend in emission of NO_x



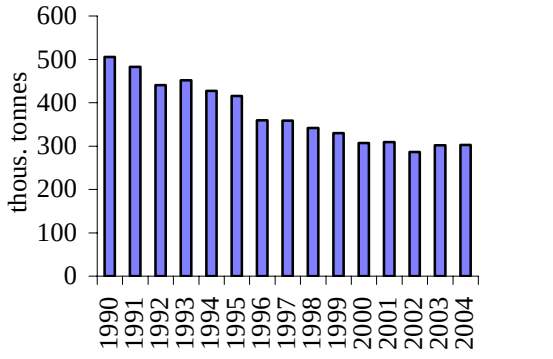
Source: SHMI

Trend in emission of PM



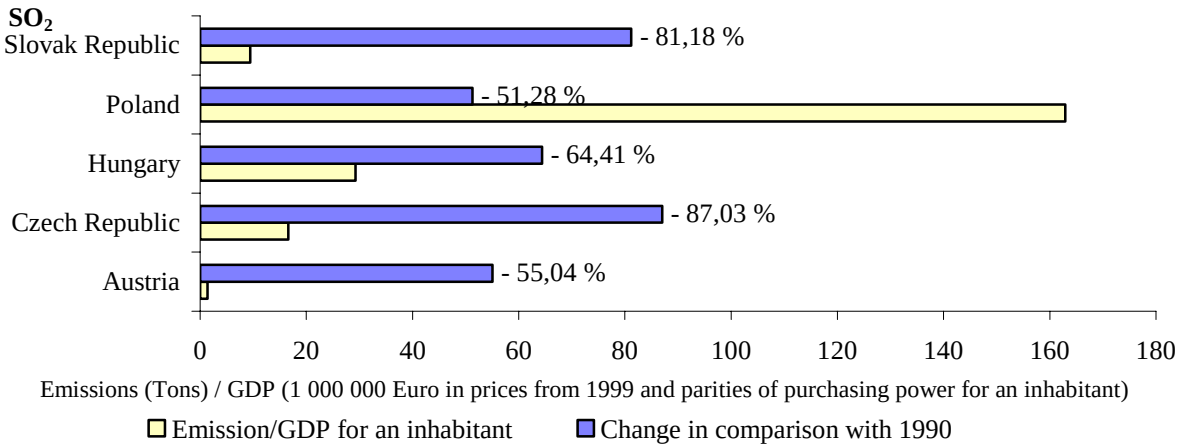
Source: SHMI

Trend in emission of CO

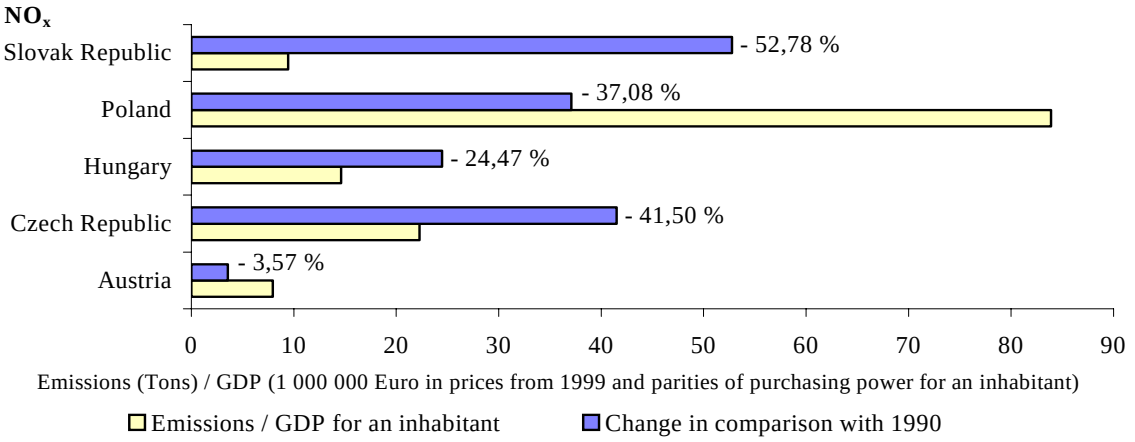


Source: SHMI

Comparison of the emission of basic polluting substances in 2002 (Tones/GDP on 1 inhabitant) in the selected states



Source: Eurostat



Source: Eurostat

- **Ammonia emissions (NH_3)**

NH_3 emissions in 2004 reached 26 474 tons. In 1990 – 2004 ammonia emissions were reduced by 59 %. This reduction was caused mainly by changes in agriculture. Numbers of livestock was reduced, which in turn contributed to decreased production of animal waste. Organic and industrial fertilizer volumes on agricultural land were also reduced.

The contribution of the particular sectors in NH_3 emission

Emissions were stated to the date 15.02.2006.

Source: SHMI

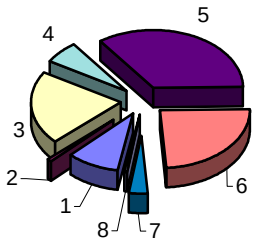
♦ **Emissions of non-methane volatile organic compounds**

Non-methane volatile organic compounds (NM VOC) *are all organic compounds of anthropogenic nature other than methane, which through reaction with nitrogen oxides and in the presence of sunlight are able to produce photochemical oxidants.*

NM VOC emissions show a lasting decreasing trend since 1990. Drop in total NM VOC emissions was caused by a number of measures, such as reduction in using coating compounds and by gradual introduction of low-solvent types of coatings, extensive introduction of measures in the sector of crude oil processing and fuel distribution, introduction of gas technologies into incineration, especially in the energy area, and by the change to the portfolio of automobiles toward vehicles equipped with the operated catalyzer.

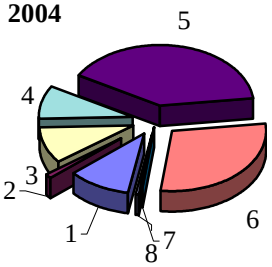
The contribution of the NM VOC emission according to sector of their origin

1990



9.4 %	1. Combustion processes	10.8 %
0.8 %	2. Combustion processes in the industry	1.3 %
20.5 %	3. Industrial technologies	9.6 %
6.4 %	4. Mining and distribution of raw materials	9.1 %
34.8 %	5. Using the solvents and other products	39.6 %
24.3 %	6. Transport	29.0 %
3.3 %	7. Waste disposal	0.2 %
0.5 %	8. Agriculture	0.5 %

2004

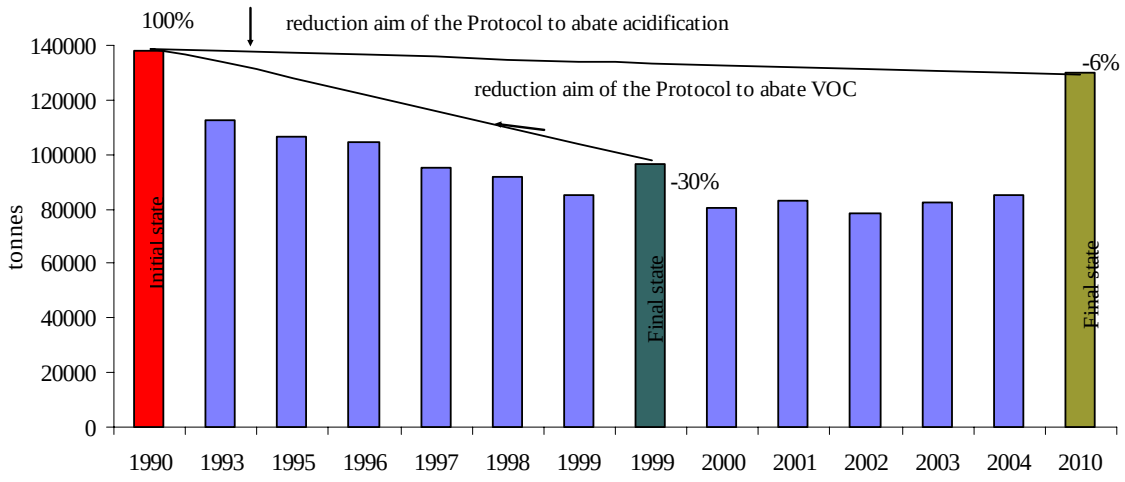


Source: SHMI

Emissions were stated to the date 15.02.2006.

In 1999, the Slovak Republic signed the Protocol on the Reduction of Acidification, Eutrophication and Ground Ozone, and bound itself to reduce the volume of NM VOC by 6 % by 2010, compared to emissions from 1990. This plan has been followed so far.

Trend in NM VOC emissions with regard to fulfilling of the international agreements (tons)



Source: SHMI

- **Balance of heavy metals emissions**

Heavy metals *are metallic, or in some cases partly-metallic, elements and their compounds that are stable and have density higher than 4.5 g/cm*^{3}.

Heavy metal emissions (Pb, As, Cd, Cr, Cu, Hg, Ni, Se, Zn, Sn, Mn) have been decreasing since 1990. In that year, heavy metal emissions were at the volume of 886.6 tons, while in 2004 it was 290.03 tons, which is a 67 % reduction in comparison to 1990. Besides shutting off a number of old-fashioned and non-effective technologies, this trend has been influenced by extensive reconstructions of the separation equipment, change in raw material used, and, most of all, by transition to using unleaded petrol types.

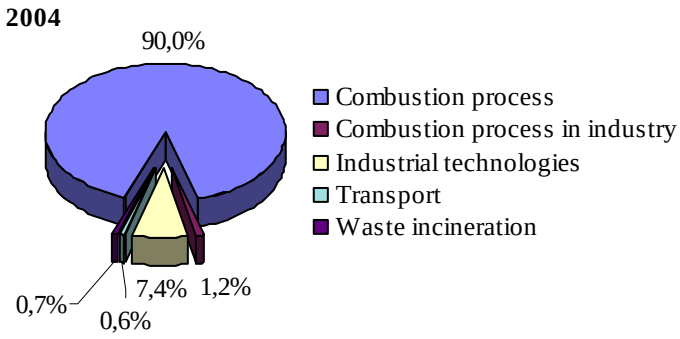
Heavy metals in the air do not represent an environmental issue of only one country. In 1998, the **Protocol on heavy metals** was drafted in Aarhus. This document **followed the UN EEC Convention on Long - Range Trans-boundary Air Pollution,** whose only objective is the decrease heavy metal emissions (Pb, Cd, Hg) to the level of 1990. The Slovak Republic signed this Protocol in that same year. This goal is still being followed.

- **Persistent organic pollutants (POPs)**

POPs *are organic compounds with varying degree of resistance to photolytic, biological, and chemical degradation. A number of POPs are halogenated and characteristic for low water solubility and high solubility in lipids. This results in their bioaccumulation in fat-containing carriers. Since they are also semi-volatile, before their deposition they are transferred in the atmosphere over long distances (long-range transfer).*

In 1990 – 2004 **emissions of persistent organic particles** (PCDD/PCDF, PCB, and PAH {B(a)P, B(k)F, B(b)F, I(1,2,3-cd)P}) had a decreasing trend with fluctuating characteristics over the last years. They were most apparent in the emissions of poly-aromatic carbohydrates (PAH). Trend in reduction of emission volumes was caused mostly by changed aluminum production technology (using of prior-burned anodes), installation of thermal destruction in Elektrokarbon Inc. Topoľčany, as well as by a change to the wood-impregnation technology.

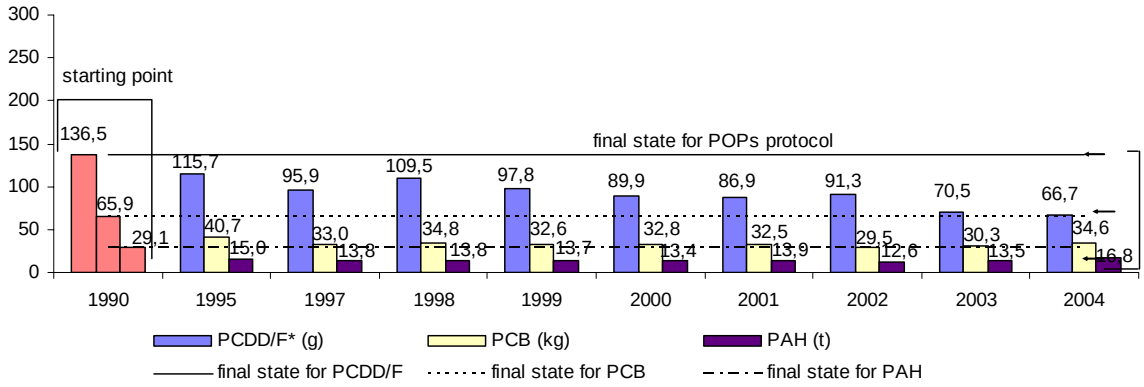
The contribution of the particular sectors in the PAH emission production for year 2004



Emission as they were stated to 15.2.2006 Source: SHMI

In 1998, the Slovak Republic also accessed to **Protocol on Limitation of Persistent Organic Compounds (POP) Emissions under the mentioned Convention**, whose objective was to reduce POP emissions to the emission level of the year 1990, compared to the reference year of 1990. The Slovak Republic signed the Protocol in the same year. This goal is still being followed.

The trend of POPs emissions regarding the fulfillment of the international convention



** Expressed like I-TEQ; I-TEQ is calculated from the values for 2,3,7,8 – substituted congeners PCDD and PCDF using I-TEF according NATO/CCMS (1988)*

Source: SHMI

Air pollution

♦ Air quality and its limits

MoE SR Resolution No. 705/2002 Coll. on air quality that executes Act No. 478/2002 Coll. on air quality, which amends Act No. 401/1998 Coll. on fees for air pollution as amended. This Resolution is fully harmonized with the EU legal regulations in the area of air quality assessment and management.

In 2005, the **national air assessment quality monitoring network consisted of 28 automated monitoring stations (AMS) including 5 stations to monitor regional air pollution and precipitation water chemical composition**. In 2005, automated benzene measurements were carried out at 4 stations, while at 11 stations benzene was measured through passive, 14-day extractions. Besides basic pollutants monitoring, hydrogen sulfide pollution was monitored at one station. Heavy metals analyses (Pb, As, Ni, Cd) were concurrently carried out at 20 extraction sites. In accordance with legal provisions, the Slovak territory has been divided into eight zones and two agglomerations. Boundaries of the zones correspond with regional boundaries, while certain territorial units selected from the Bratislava and Košice regions are considered as agglomerations. Stations that monitor regional air pollution are part of the EMEP – Co-operative Program for the Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe.

♦ Local air pollution

Assessment of local air pollution focuses on air quality in residential areas, and belongs to critical indicators of the quality of environment.

Sulfur dioxide

In 2005, no agglomeration showed exceeded levels of pollution in hourly or daily values beyond the public health limit.

Nitrogen dioxide

Limit value in 2005 for the human health protection for the averaging period of one calendar year was not exceeded at any monitoring station.

PM_{10}

PM_{10} are particles with diameter less than 10 μm and form the fine fraction of the overall dust concentration. In 2005, PM_{10} particles were monitored at 28 stations. At the same time, the $PM_{2.5}$ measurements were carried out at 3 stations, with no limits set for this fraction up to this day. To

calculate the concentrations obtained by automated monitoring, it is recommended to use the factor 1.3 to make the conversion. This factor has been used at all monitoring stations. During the year 2005, PM_{10} measurements were installed at all the stations, using the FMDS model with the assumption that measurements will be equivalent with the reference method. Comparison measurements in 2006 will determine new correction factors, based on the type of devise and site. In 2005, the 24-hour limit for this pollutant was exceeded at all AMS, except the Bratislava-Jeséniova station. 10 stations showed exceeded yearly limit value.

Carbon monoxide

Carbon monoxide pollution level is relatively low and does not pose a major risk in Slovakia. In 2005, its 2005 limit value was not exceeded at any zone or agglomeration in Slovakia.

Lead

At present, air pollution by lead does not pose a major risk in Slovakia. Its concentrations do not exceed the upper threshold evaluation limit.

Benzene

One site (in the Nitra region's zone) shows the pollution level slightly above the limit value of 5 $\mu g.m^{-3}$ (in Nitra it was 5.2 $\mu g.m^{-3}$), to be reached by Slovakia in 2010.

- **Regional air pollution**

Sulfur dioxide, sulfates

In 2005, regional level of **sulfur dioxide concentrations** varied within the interval of 0.43 µg $S.m^{-3}$ (Chopok) to 1.74 µg $S.m^{-3}$ (Liesek). Compared to previous years, values for sulfur dioxide at most stations are lower; differences are negligible at Chopok, Liesek, and Stará Lesná. The upper limit of the concentration interval represents less than 20 % of the critical sulfur dioxide limit (critical limit for the forest and natural vegetation is 10 µg $S.m^{-3}$). In line with Annex 1 of the MoE SR Resolution No. 75/2002 Coll. the limit value for the protection of ecosystems is 20 µg $S0_2.m^{-3}$ for the calendar year and the winter season. This value did not even reach one fifth for the calendar year at any station while only at one station (Liesek) was the maximum value for the winter season from all the stations lower that one third of the mentioned limit. Compared to 2004, **sulfate concentrations in atmospheric aerosol** in 2005 were lower only at Stará Lesná, identical at Starina, slightly higher at Chopok, Liesek, and Topoľníky. Percentage of sulfates on total mass

of atmospheric ozone was 15-24 %. Sulfates and sulfur dioxide concentration ratios expressed in sulfur is shown in the interval of 0.7-1.3, which corresponds to the regional pollution level.

Nitrogen oxides, nitrates

Concentration of nitrogen oxides at regional stations expressed in NO_2-N varied in 2005 between 0.69–2.64 µg $N.m^{-3}$, with the least average annual value at Chopok – 0.69 µg $N.m^{-3}$, higher at Starina – 1.06 µg$N.m^{-3}$, at Stará Lesná – 1.64 µg $N.m^{-3}$, at Liesek – 1.84 µg $N.m^{-3}$, and 2.82 µg $N.m^{-3}$ at a lowland station in Topoľníky. In line with Annex 1 of the MoE SR Resolution No. 705/2002 Coll. the **limit value for the protection of ecosystems is 30 µg $N.m^{-3}$** for the calendar year. This value was not exceeded at any regional station. Maximum value of 8.7 µg NO_x-$NO_2.m^{-3}$ from all stations at Topoľníky is at the level lower than 30 % of the limit value.

Atmospheric **nitrates** at regional stations in Slovakia were mostly in the aerosol form, and at almost all the stations they showed values little increased than in 2004, except for Chopok, which showed more increase. Gaseous nitrates are in comparison with the aerosol ones lower at all stations and, compared to the previous year, differences were negligible. Despite the fact that gaseous and particulate nitrates are trapped and monitored separately, their sum is expressed in line with EMEP, since their phase distribution depends on atmospheric temperature and humidity. Percentage share of nitrates on atmospheric aerosol varied between 9 % and 22 %. Ratio of total nitrates (HNO_3 + NO_3) to NO_2, as expressed in nitrogen, varied between 0.2 – 0.4.

Particulate matter, heavy metals in atmospheric aerosol

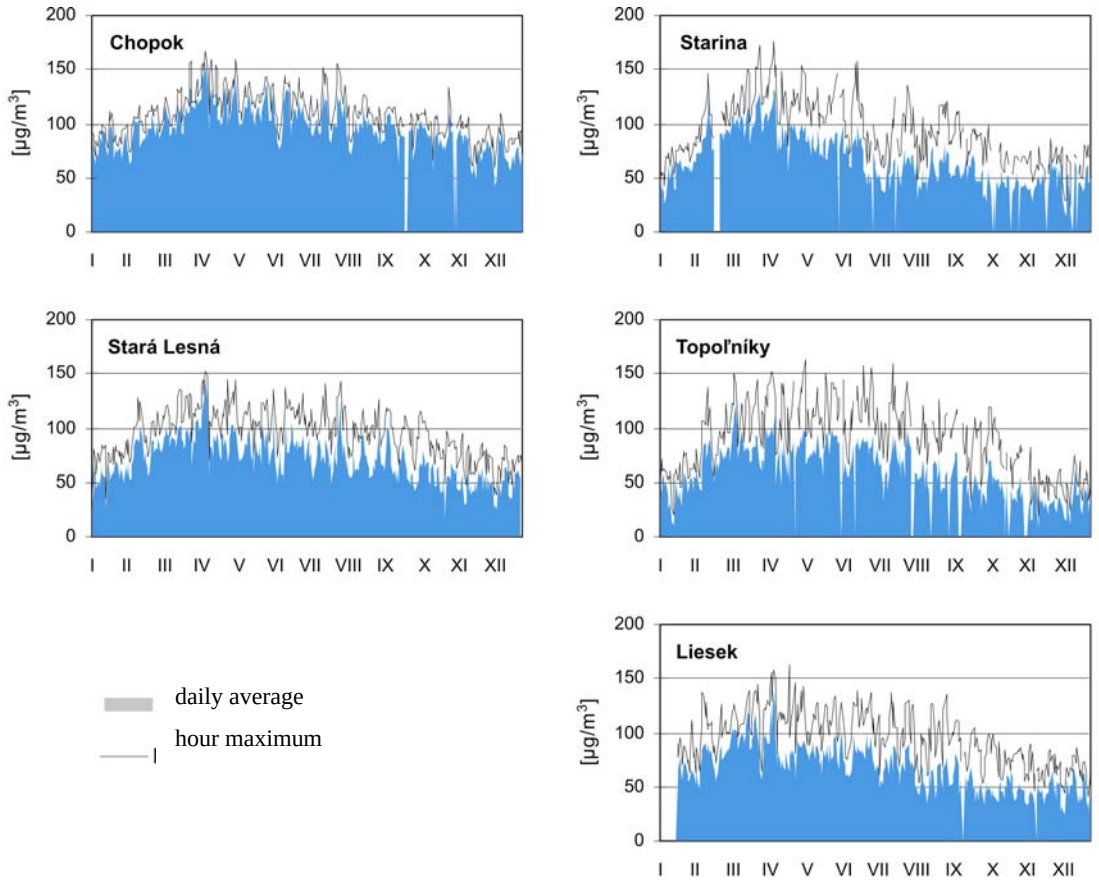
Atmospheric aerosol concentrations in 2005 varied between 6.0 – 22.3 $\mu g.m^{-3}$. Compared to 2004, the PM concentration (TSP – total suspended particulate and PM_{10} – particulate matter) in 2005 at most regional Slovak stations was higher, specifically at Stará Lesná, Starina, and Liesek. At Liesek the increase was almost 20 %. On the contrary, a slight reduction in concentrations was shown at Topoľníky, while a significant decrease of almost 25 % was measured at Chopok.

In case of **individual metals concentrations**, compared to 2004, measured lead and manganese concentrations at Chopok in 2005 remained unchanged. Cadmium, zinc, and nickel concentrations were slightly lower, while chrome, copper, and arsenic concentrations increased. In Topoľníky, concentrations of all measured metals remained at similar concentration levels to the previous year, while the concentrations of cadmium, zinc, chrome, manganese, copper, and arsenic increased. Nickel concentrations slightly dropped. At Starina in 2005, the measured lead, cadmium, and zinc values were lower than in 2004, while chrome, manganese, and arsenic concentrations showed a slight increase. At Stará Lesná, concentrations of lead, zinc, nickel, and chromium were at lower concentration levels than in 2004; however, concentrations of manganese and copper were higher. At Liesek, manganese and

arsenic showed lower values. Lead, chromium, and copper at Liesek were higher in 2005 than in 2004, while cadmium and nickel remained almost unchanged. Among the evaluated trends, lead shows the most significant reduction, which relates to gradual decrease of the lead content in fuels since 1982 as well as to their present lead-free production. Percentage share of the sum of assessed heavy metals on air-borne dust at regional stations of Slovakia varies between 0.19 and 0.30 %.

Ozone

During the years 1970 - 1990 was recorded an increase in ozone concentrations by 1-3 $\mu g.m^{-3}$ per year on average. Following the year 1990, in line with other European monitorings, the trend slowed down and even stopped. This trend relates to the European trend in the generation of ozone precursors. The following chart shows the **annual characteristics in the ozone concentration** at regional stations of Chopok, Starina, Stará Lesná, Topoľníky, and Liesek. Stará Lesná shows the longest timeline in ozone measurements. Highest average annual concentrations of ground ozone in 2005 were at the Chopok mountain stations (96 $\mu g.m^{-3}$). This relates to high ozone concentration in the zone of the accumulated tropospheric ozone above the European territory. Ground ozone concentrations in Slovakia in 2005 were only slightly below the level reached in the exceptionally hot year of 2003.



Source: SHMI

Volatile organic compounds $C_2 – C_6$

Volatile organic compounds $C_2 – C_6$ or the so-called light carbohydrates began to be captured at the Starina station in the Fall of 1994. Starina belongs to the few European stations classified listed under the EMEP network, with regular monitoring of volatile organic compounds. They are evaluated according to the EMEP methodology and the NILU. Their concentrations range between individual units to hundreds of units ppb. In 2005, most of hydrocarbons showed similar values as in 2004; significantly higher values were shown in n-hexane, toluene, propane, and isoprene. On the contrary, the butane values dropped. Analyses of volatile organic compounds of identical air samples were carried out at SHMI and at NILU, where the initial years showed a high degree of identity in precision of analyses. SHMI also participated in monitoring within the AMOHA Project (Accurate Measurements of Hydrocarbons in Atmosphere), organized by the NPL (National Physical Laboratory) in England. Its final outcome will be a European Directive for the optimal sampling and evaluation of hydrocarbons.

Average annual VOC concentrations in ambient air in 2005 - Starina (in ppb)

ethane	ethane	propane	propane	i-butane	n-butane	acetylene	butane	pentene	i-pentane	n-pentane	isoprene	n-hexane	benzene	toluene	o-xylene
2.046	0.662	0.974	0.192	0.243	0.379	1.291	0.058	0.038	0.422	0.225	0.127	0.104	0.351	0.090	0.366

Source: SHMI