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).

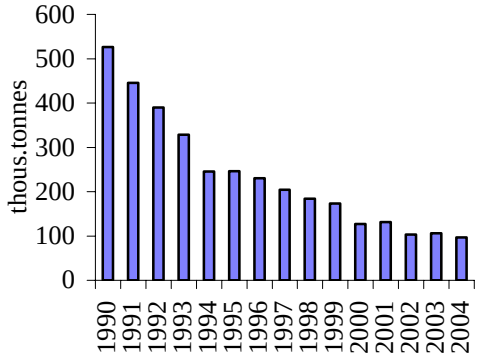
♦ **Trend in emissions of nitrogen oxides**

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**

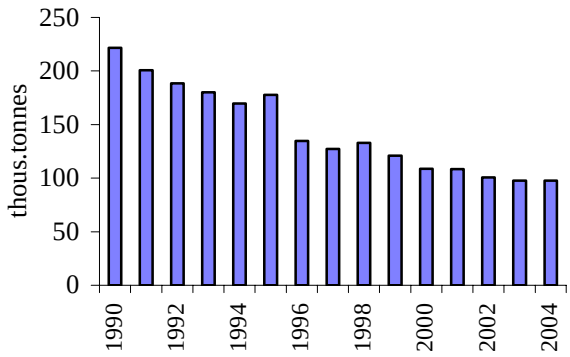
Carbon monoxide emissions (CO) since 1990 have shown a falling tendency, which was caused mainly by reduced consumption and change in fuel composition in the sphere of retail consumers. Trend in reduced CO emissions from large sources was not significant. Iron and steel-producing and processing industry 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



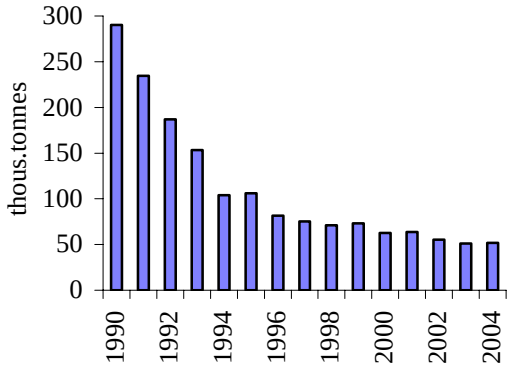
Source: SHMI

Trend in emission of NO_x



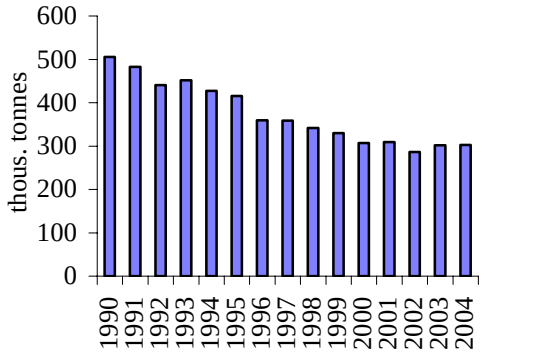
Source: SHMI

Trend in emission of PM



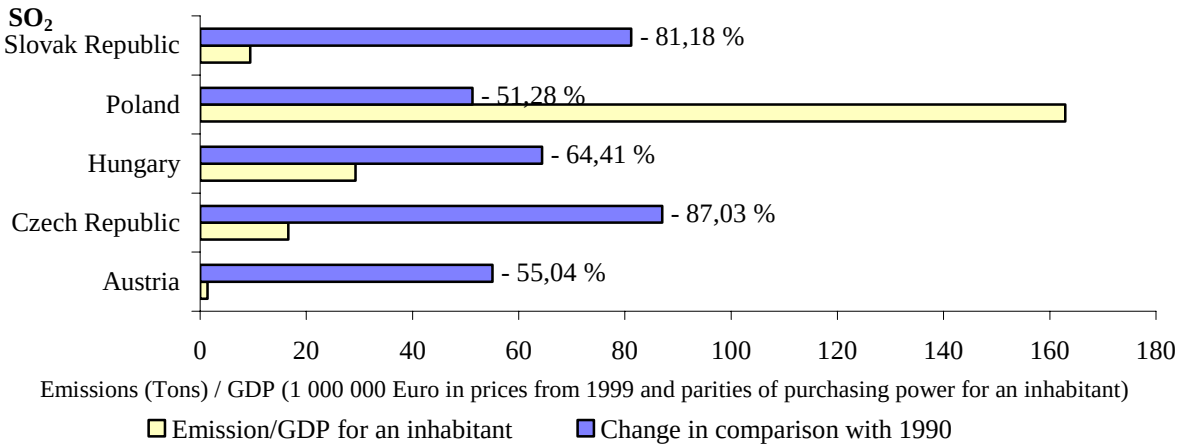
Source: SHMI

Trend in emission of CO

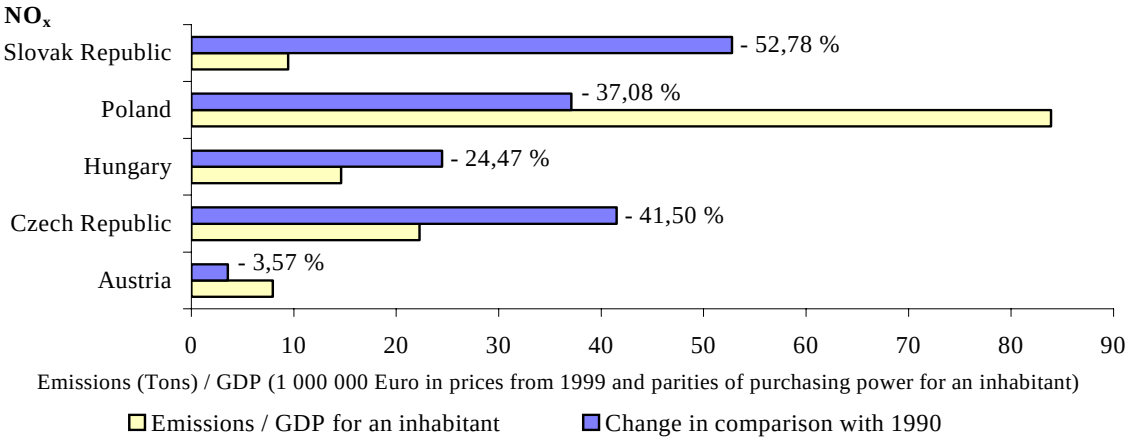


Source: SHMI

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

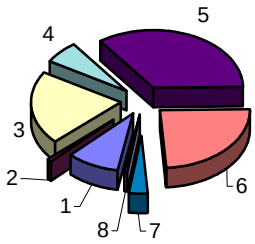
♦ **Emissions of non-methane volatile organic compounds**

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.

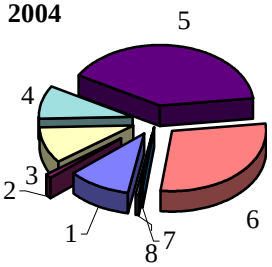
The contribution of the NM VOC emission according to sector of their origin

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

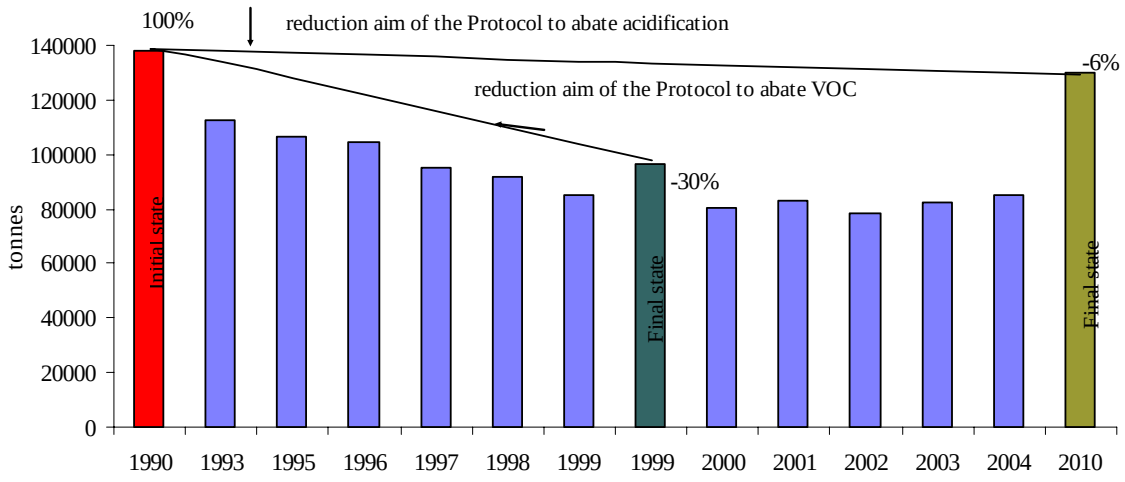


Source: SHMI

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.

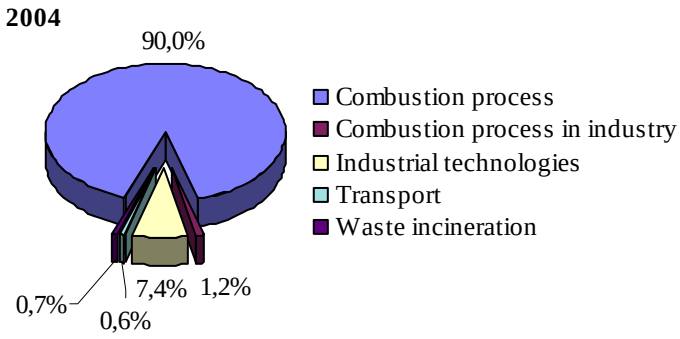
Heavy metals in the air do not represent an environmental issue of only one country. In 1998, the **Protocol on heavy metals** was drafted in Aarhus. This document **followed the UN EEC Convention on Long - Range Trans-boundary Air Pollution,** whose only objective is the decrease heavy metal emissions (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.

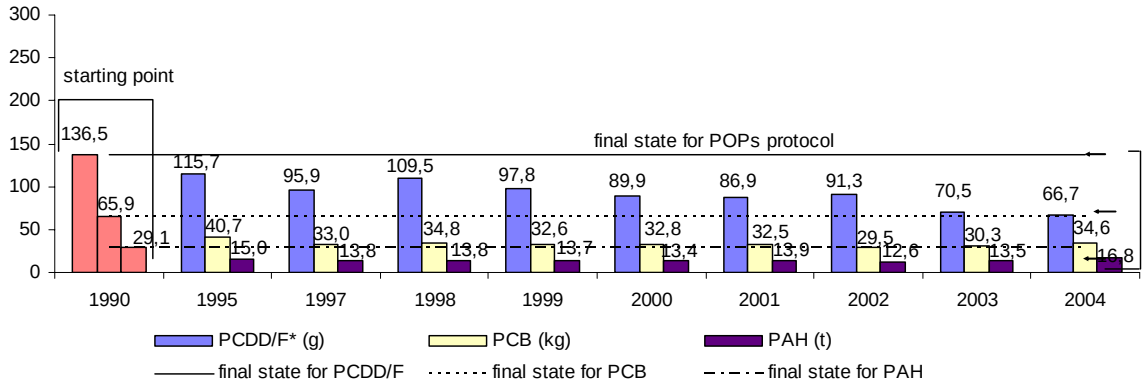
The contribution of the particular sectors in the PAH emission production for year 2004



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

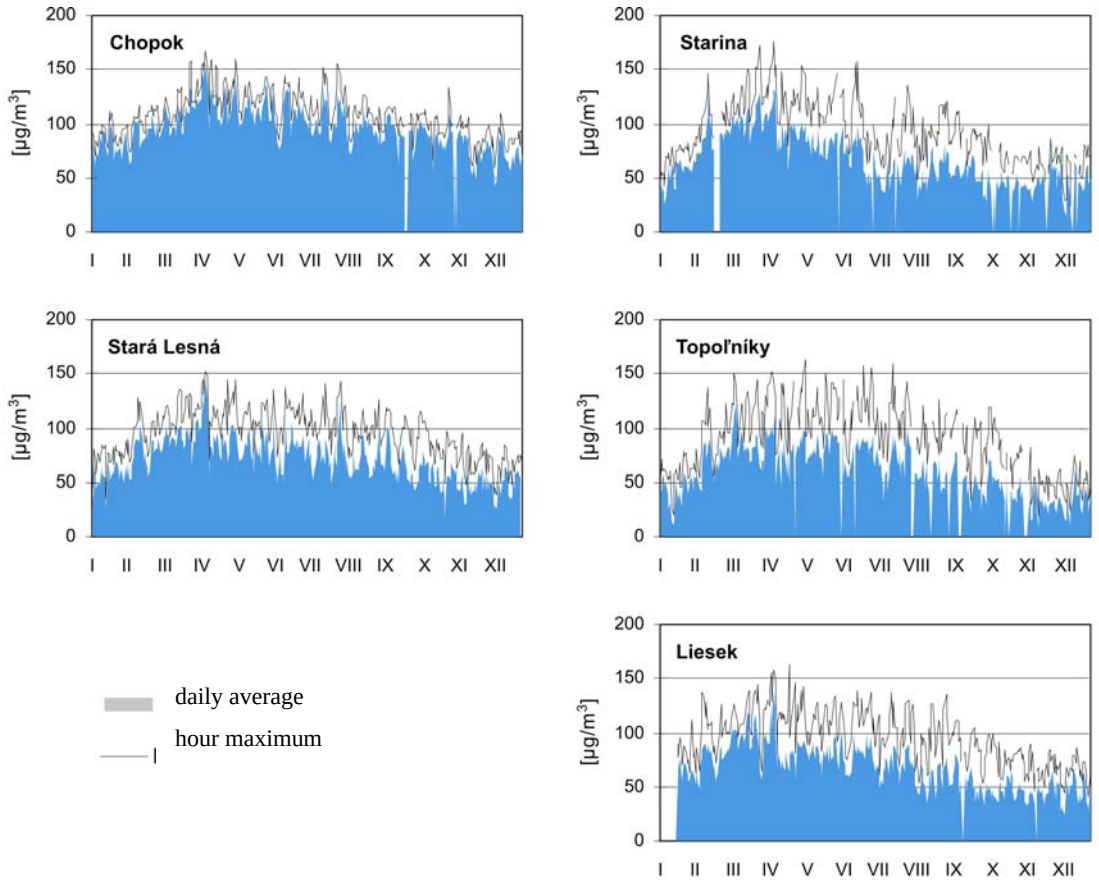
Atmospheric aerosol concentrations in 2005 varied between 6.0 – 22.3 $\mu g.m^{-3}$. Compared to 2004, the PM concentration (TSP – total suspended particulate and PM_{10} – particulate matter) in 2005 at most regional Slovak stations was higher, specifically at Stará Lesná, Starina, and Liesek. At Liesek 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

Whoever is performing an activity, which could have an impact on the ***condition of the surface waters and underground waters, and of water situation,*** *is obliged* ***to exert the necessary effort to provide for their preservation and protection.***

§ 30 par. 1 of the Act No. 364/2004 Coll. on Waters and on Amendment of Act No. 372/1990 Coll. on Offences as amended (Waters Act)

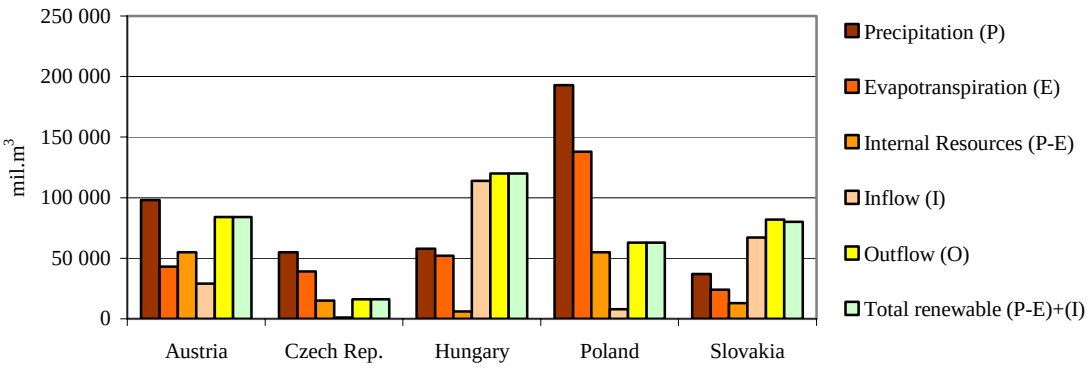
• WATER

Water sources and water fund

Slovakia is a central-European country with the majority of its territory belonging to the West Carpathian mountain range. Only the very north-eastern territory belongs to the East Carpathians and is part of the Carpathian eco-region. Less than a quarter of the whole Slovak territory is lowland – with the Vienna Basin from the west, the Panonia Plane from the south-west, and the Great Danube Basin from the south-east. These are part of the Hungarian lowland eco-region.

Significant part of the Slovak surface water fund flows in from the neighboring states and the usability of this fund is limited. In total, the long-term in-flow average is approximately 2.514 $m^3.s^{-1}$ of water, which is about 86 % of our total surface water fund. In the long run, there is approximately 398 $m^3.s^{-1}$ of water springing in Slovakia, which represents 14 % of the water fund. Due to its fluctuating characteristics the Slovak water potential is not able to meet the economic demand of the major economic and residential agglomerations, and it is necessary to increase its volume also by building water tanks.

Long term freshwater resources in the selected countries in 2004



Source: Eurostat

Surface water

♦ Precipitation and runoff conditions

Atmospheric precipitations balance in the Slovak territory in 2005 reached the value of 938 mm, which represents 123 % of the normal level. In terms of precipitations, this year had been considered very humid. In total, the year was evaluated as showing an excessive precipitation activity by as much as 176 mm.

Average total precipitation in the area of the SR

Month	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	Year
Mm	69	69	23	87	83	73	112	157	65	16	51	133	938
% normal	150	164	49	158	109	85	124	194	103	26	82	251	123
Surplus (+)/ Deficit (-)	23	27	-24	32	7	-13	22	76	2	-45	-11	80	176
Character of rainfall period	V	VV	SS	VV	N	N	V	VVV	N	SS	N	VVV	VV

Characteristics of the precipitation season: N - normal, S - dry, SS - very dry, V – humid, VV – very humid, VVV – exceptionally humid Source: SHMI

Depending on the character of the precipitation season, virtually all Slovak watersheds may be considered as very humid, with the exception of the Danube, Morava, and Slaná watersheds that showed normal to humid precipitation characteristics. On the contrary, the Hornád watershed was exceptionally humid.

Average rates of precipitation and runoff in particular catchment areas

Catchment area	Dunaj		Váh		Hron			Bodrog a Hornád				SR
Subcatchment area	*Morava	*Dunaj	Váh	Nitra	Hron	*Ipeľ	Slaná	Bodva	Hornád	*Bodrog	*Poprad and Dunajec	
Catchment area extent (km^2)	2 282	1 138	14 268	4 501	5 465	3 649	3 217	858	4 414	7 272	1 950	**49 014**
Average precipitation (mm)	751	628	1 028	842	961	835	885	923	968	924	1 119	**938**
% of normal	110	100	122	121	122	122	112	126	143	131	133	**123**
Character of rainfall period	N	N	VV	VV	VV	VV	V	VV	VVV	VV	VV	**VV**
Annual runoff (mm)	61	51	343	136	264	158	191	144	301	330	514	**207**
% of normal	52	142	96	86	83	101	91	68	133	140	146	**79**

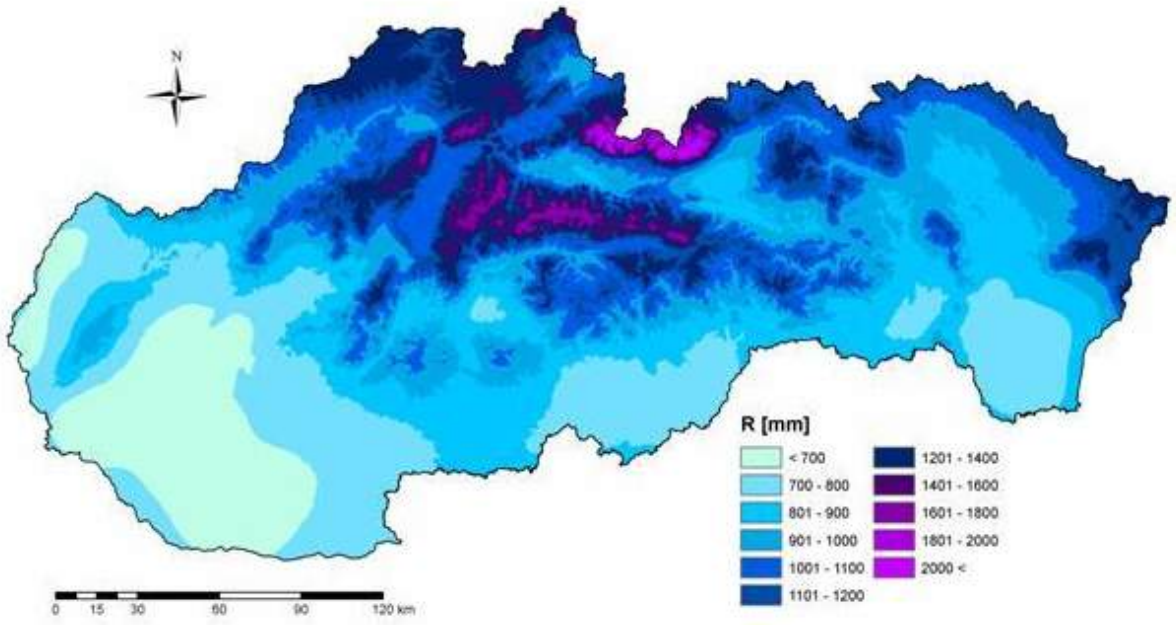
* watercourses and corresponding data only for the Slovak part of the watershed Source: SHMI

Characteristics of the precipitation season: N - normal, S - dry, SS - very dry, V – humid, VV – very humid, VVV – exceptionally humid

The precipitation total by individual watersheds and its distribution in 2005 was shown in the annual runoff volumes from the major watersheds in the following manner: annual runoff volume from partial watershed reached or exceeded 100 % of the long-term average in the Danube, Hornád,

Bodrog, Poprad, and Dunajec watersheds. In the Morava watershed, the annual runoff volume reached only 52 % of the long-term average, and in other watersheds the runoff volume oscillated between 68 to 96 % of the corresponding long-term values.

Annual atmospheric precipitation (mm) in Slovakia in 2005



Source: SHMI

♦ **Water balance**

In 2005, there was 69 806 mil.m^3 flowing into Slovakia, which is by 8 624 mil.m^3 more than in the previous year of 2004. Compared to the previous year, **runoff** from the territory was greater by 8 700 mil.m^3.

As of 1.1.2004, **total water volume** in water reservoirs was 631.0 mil.m^3, which represented 54 % of total usable water volume in water reservoirs. As of 1.1.2005, total available volume of the assessed water reservoirs compared to the previous year increased to 721 mil.m^3, which represents 62 % of total available water.

Total hydrological balance of water resources in the SR

	Volume (mil. m^3)		
	2003	**2004***	**2005**
Hydrological balance:			
Rainfall	28 088	41 715	46 029
Annual inflow to the SR	53 626	61 182	69 806
Annual runoff	60 527	71 279	79 979
Annual runoff from the territory of the SR	7 009	10 097	10 173
Water management balance			
Total abstraction of the surface and ground water in the SR	1 040.20	1 028.00	906.89
Evaporation from water reservoirs and dams	61.8	54.30	5.07

Discharge into surface waters	910.4	955.70	872.00
Impact of water reservoirs (WR)	272.8	355.60	111.61
	improving	**accumulation**	**improving**
Total volume in WR as of 1st January of the following year	573	631	721
% of supply volume in accumulation WR in the SR	49	54	62
Rate of water exploitation (%)	14.8	10.18	8.91

* Note: Data in the table were updated with results from the 2004 assessment Source: SHMI

♦ **Surface water abstraction**

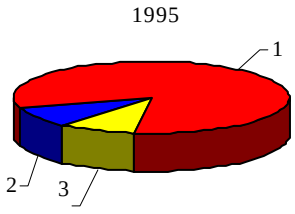
Surface water abstraction in 2005 reached the value of 532 791 mil.m^3, which, compared to the previous year, is a reduction by 21.7 % (compared to 1995, the reduction is 275 mil.m^3, which is 34.1 %). Surface water abstraction for industrial purposes in 2005 represented as much as 88 % of total abstraction volume, which, compared to 2004, was a reduction by 136 770 mil.m^3, that is 22.6 %. A slight reduction was recorded also in surface water abstractions for the public water-supplies, which, compared to the previous year, dropped by 2.16 mil.m^3, that is 3.8 %. These abstractions represented 10 % of total abstractions. In 2005, surface water abstraction for irrigation represented only 2 % of total abstractions and reached the value of 11.01 mil.m^3.

Surface water exploitation in the SR (mil.m^3)

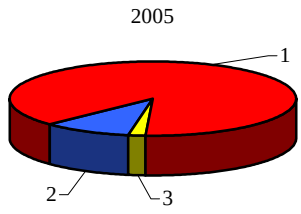
Year	Public water-supplies	Industry	Irrigation	Other agriculture	Total	Discharging
2003	66.449	489.467	65.042	0.0094	620.968	910.426
2004	55.984	604.728	18.935	0.0076	679.723	919.222
2005	53.828	467.957	11.006	0.0110	532.791	871.865

Source: SHMI

Comparison of surface water exploitation between 1995 and 2005



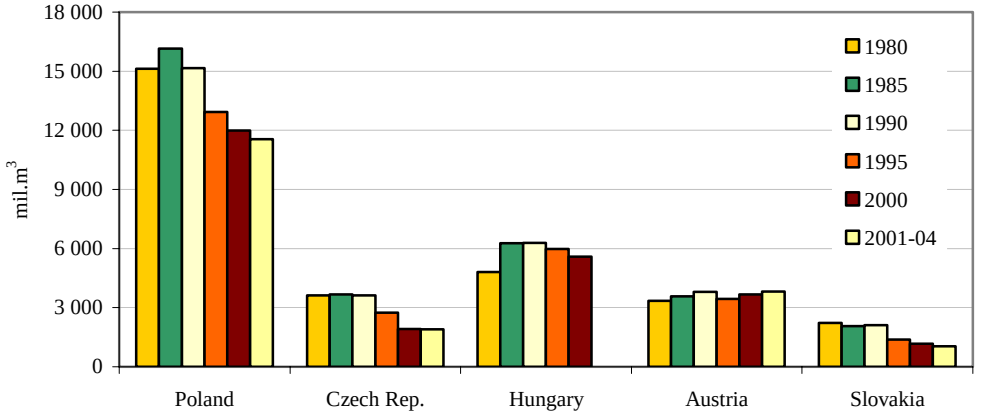
82 %	1 Industry	88 %
9 %	2 Public water supply	10 %
9 %	3 Irrigation	2 %



Source: SHMI Source: SHMI

Decreasing trend in surface water abstraction was shown also in the neighboring countries. Surface water abstraction in the 15 EU countries is at the value of 175 700 mil.m^3.

Water abstraction in the neighboring countries between 1980 – 2004



Source: OECD

♦ **Surface water quality**

The basis for surface water quality assessment is the summary of all classification results under the **STN 75 7221 STANDARD "Water Quality".** Surface water quality classification evaluates water quality through 8 indicator groups of determinants (group A - oxygen demand, group B - basic physical and chemical determinants, group C - nutrients, group D - biological determinants, group E - microbiological determinants, group F – micropollutants, group G – toxicity, group H – radioactivity). Using the threshold values system, water is classified into five quality categories (I. class - very clean water, through V. class – extremely heavily polluted water), while categories I., II., and III. are considered as favorable water quality.

Program of water level monitoring includes surface and ground water quality assessment, which has been carried out on the basis of data obtained from water levels monitoring process.

Water quality monitoring in 2005 was carried out pursuant to the approved Program of Water Level Monitoring at 178 national sampling sites network, which include 175 basic, 3 special sampling sites designated to monitor radioactivity, while 30 sampling sites were monitored as boundary watercourses. Since 2004, water courses and selected water tanks have been included into the state monitoring system. Frequency of individual indicators monitoring in 2005 varied and oscillated between 1-24 times. Indicators with the lower frequency include biological determinants, heavy metals, and specific organic compounds.

In 2004-2005, more than 77 % of the group **A – oxygen demand** sampling sites complied with the conditions of the groups I., II., and III., meeting the acceptable quality criteria (175 sampling sites). Determinants groups **B - basic physical-chemical** (175 sampling sites), **C – nutrients** (175 sampling sites), and **D – biological determinants** (172 sampling sites) stayed at the level of the previous period of years and dominate in the II. and III. quality class. There was 88 % of sampling sites that complied

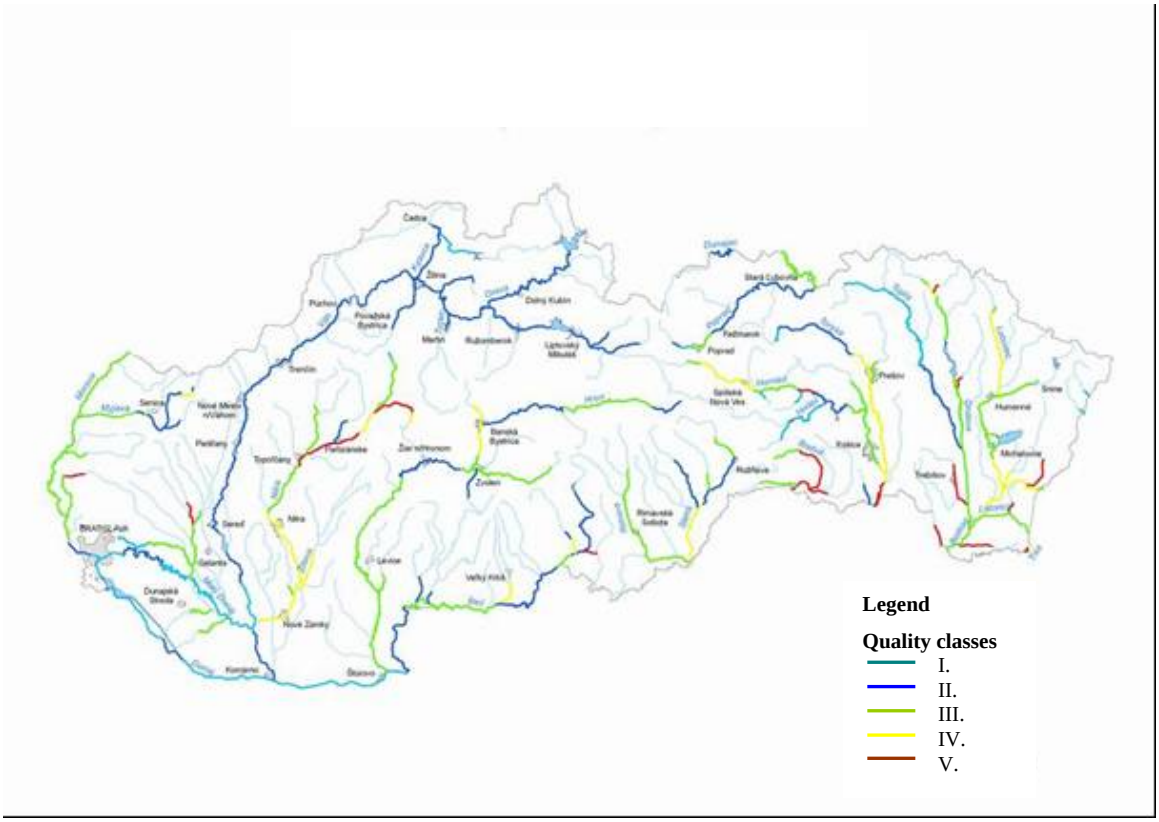
with the B indicators group (in 2002-2003 it was 73.5 % of sampling sites), while there was 64 % of extraction sites in the C determinant group (in 2002-2003 it was 70.1 %), and 83.14 % of extraction sites fell under the D quality group (in 2002-2003 it was 60.9 %). Number of sampling sites with acceptable surface water quality level in the E determinant group - microbiological determinant grew to 33.14 % (in 2002-2003 it was only 19.54 %), while in the F group - micro pollutants, the number of sampling sites dropped to 46.2 % (in 2002-2003 it was 54.5 %).

The 2004-2005 period of years showed a negative trend in the **E group - microbiological determinants** (175 sampling sites) that fall under the IV. and V. quality class, being the case of 66.86 % of all extraction (in 2002-2003 it was 80.46 %). Water quality improved significantly in the **F group – micro pollutants** (158 extraction sites) which showed unacceptable water quality (IV. and V. class) at 53.8 % of extraction sites (in 2002-2003 it was 45.4 %).

Compared to the previous period, the number of sampling sites with unacceptable (group IV. and V.) quality class increased only in the A group - oxygen demand, to 22.85 %, while in other groups there was a reduction in sampling sites - in the B group – physical-chemical determinants they dropped down to 12 % of sampling sites, in the C group – nutrients it was down to 36 %, and down to 16.6 % in the D group – biological indicators.

Water quality in the **H group of determinants - radioactivity** (31 sampling sites) for the monitored period complied with the I., II., and III. water quality class.

Surface water quality categories in the group A – oxygen demand in years 2004 – 2005



Source: SHMI

Legend: I. Class – very clean water (blue), II. Class – clean water (dark blue), III. Class – polluted water (green), IV. Class – heavily polluted water (yellow), V. class – very heavily polluted water (red)

Proportional representation of the water quality categories at the sampling points of the observed watercourses

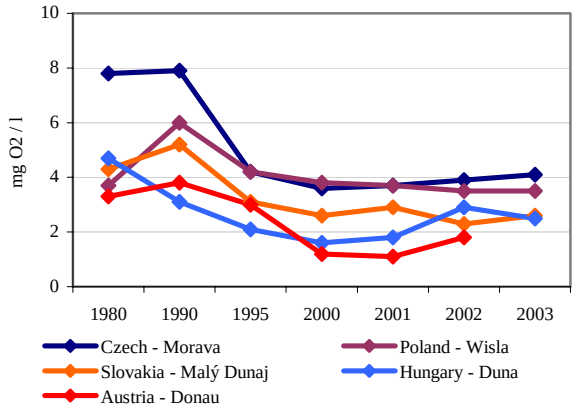
Water quality category according to STN 75 7221 standard	Year	A Oxygen demand indicators		B Basic physical and chemical indicators		C Nutrients		D Biological indicators		E Microbiological indicators		F Micropollutants		G Toxicity		H Radioactivity	
		Number of sampling points	%	Number of sampling points	%	Number of sampling points	%	Number of sampling points	%	Number of sampling points	%	Number of sampling points	%	Number of sampling points	%	Number of sampling points	%
1	**2000-01**	12	6.90	5	2.90	4	2.30	-	-	-	-	11	7.70	-	-	15	51.70
	2001-02	9	5.10	4	2.20	2	1.10	-	-	-	-	4	2.90	-	-	15	50.00
	2002-03	11	6.32	0	0	2	1.15	0	0	0	0	9	6.29	-	-	13	56.52
	2004-05	**23**	**13.14**	**11**	**6.29**	**0**	**0**	**0**	**0**	**0**	**0**	**8**	**5.06**	-	-	**22**	**70.97**
2	**2000-01**	60	34.30	79	45.10	64	36.6	36	20.60	1	0.60	4	2.80	-	-	14	48.30
	2001-02	81	45.50	67	37.60	70	39.3	29	16.30	1	0.60	12	8.80	-	-	14	46.70
	2002-03	81	46.55	56	32.18	71	40.80	34	19.54	2	1.15	23	16.08	-	-	10	43.48
	2004-05	**60**	**34.3**	**93**	**53.14**	**37**	**21.14**	**89**	**51.74**	**6**	**3.43**	**12**	**7.6**	-	-	**7**	**22.58**
3	**2000-01**	68	38.90	66	37.70	61	34.90	109	62.30	12	6.90	35	24.50	-	-	-	-
	2001-02	68	38.20	84	47.20	58	32.60	106	59.50	23	12.90	45	32.80	-	-	1	3.30
	2002-03	64	36.78	72	41.38	49	28.16	72	41.38	32	18.39	46	32.17	-	-	-	-
	2004-05	**52**	**27.71**	**50**	**28.57**	**75**	**42.86**	**54**	**31.4**	**52**	**27.71**	**53**	**33.54**	-	-	**2**	**6.45**
4	**2000-01**	21	12.00	18	10.30	29	16.60	25	14.30	88	50.30	77	53.90	-	-	-	-
	2001-02	10	5.60	17	9.60	32	18	37	20.80	108	60.70	67	48.90	-	-	-	-
	2002-03	10	5.75	36	20.69	31	17.82	45	25.86	102	58.62	47	32.87	-	-	-	-
	2004-05	**23**	**13.14**	**17**	**9.71**	**38**	**21.71**	**28**	**16.28**	**82**	**46.86**	**51**	**32.28**	-	-	-	-
5	**2000-01**	14	8.00	7	4.00	17	9.70	5	2.90	74	42.30	16	11.20	-	-	-	-
	2001-02	10	5.60	6	3.40	16	9	6	3.40	46	25.80	9	6.60	-	-	-	-
	2002-03	8	4.60	10	5.75	21	12.07	23	13.22	38	21.84	18	12.59	-	-	-	-
	2004-05	**17**	**9.71**	**4**	**2.29**	**25**	**14.29**	**1**	**0.58**	**35**	**20.00**	**34**	**21.52**	-	-	-	-
Total	**2000-01**	175	100	175	100	175	100	175	100	175	100	143	100	-	-	29	100
	2001-02	178	100	178	100	178	100	178	100	178	100	137	100	-	-	30	100
	2002-03	174	100	174	100	174	100	174	100	174	100	143	100			23	100
	2004-05	**175**	**100**	**175**	**100**	**175**	**100**	**172**	**100**	**175**	**100**	**158**	**100**	-	-	**31**	**100**

Source: SHMI

Since 1980, there has been a decreasing trend in the pollution of watercourses also in the other V4 countries and Austria.

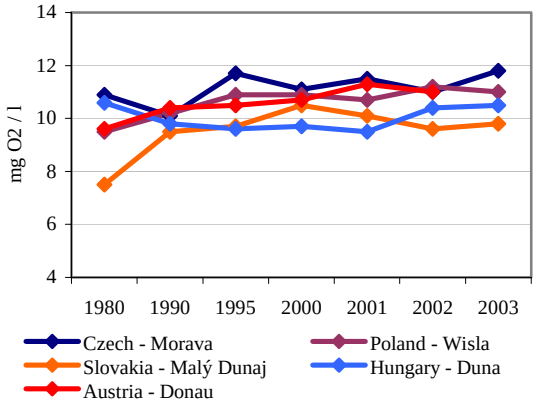
Comparison of the surface water quality development in the selected watercourses

BOD (mg O_2. l^{-1})



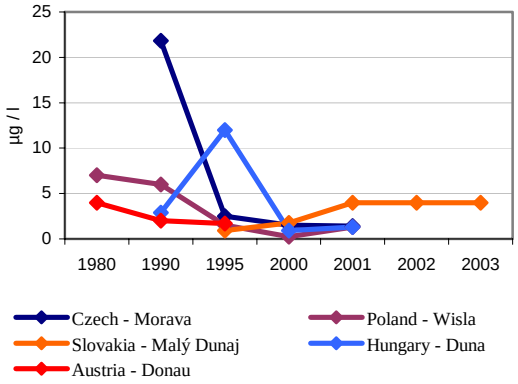
Source: OECD

Dissolved oxygen (mg O_2. l^{-1})



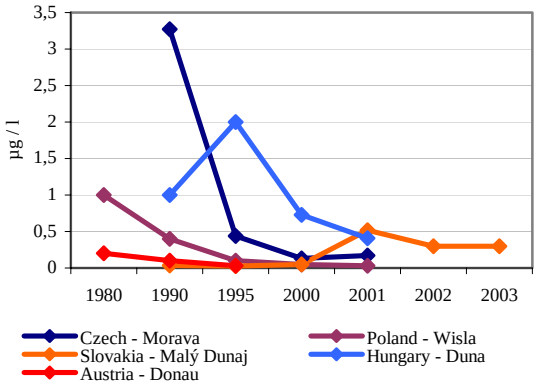
Source: OECD

Lead (µg. l^{-1})



Source: OECD

Cadmium (µg. l^{-1})



Source: OECD

Note: Average annual concentrations measured at the outflow points of watercourses or at their national border-line lower section.

Ground water

♦ Water resources

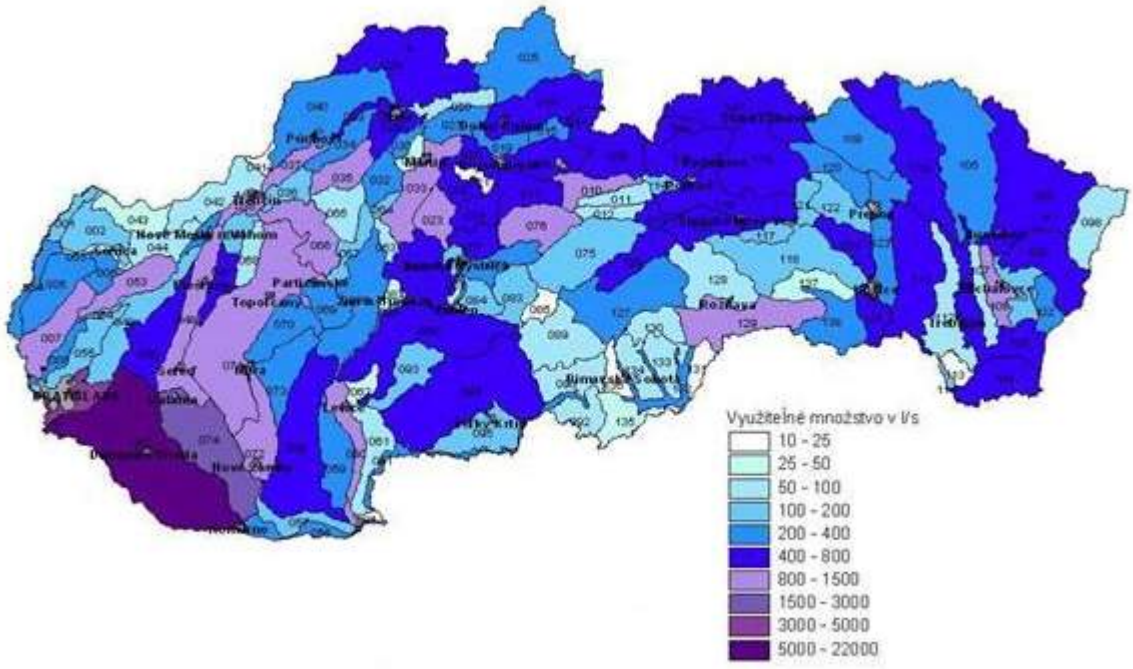
Groundwater is an irreplaceable component of environment. It represents an invaluable, yet easily accessible and most appropriate source of drinking water in terms of its quantitative, qualitative, and economic aspects. Despite favorable hydrological and hydro-geological conditions undermining the generation, circulation and accumulation of groundwater in Slovakia its uneven distribution offsets these advantages. The most significant groundwater volumes are recorded in the Bratislava and Trnava regions (46 %), while the least groundwater volumes are documented in areas of the Prešov and Nitra regions.

In 2005, based on the hydro-geological assessment and surveys in Slovakia, there were **76 806 l.s^{-1}**

available groundwater resources. Compared to the previous year of 2004, there was an increase in available groundwater volume by 257 $l.s^{-1}$, which is by 0.34 %. In the long run increase in available volume is 2 031 $l.s^{-1}$, that is 2.7 %, compared to 1990.

Greatest groundwater volumes are bound to the Quaternary and the Mesozoic hydro-geological structures or regions. By far, the greatest number of the available volumes (24.8 $m^3.s^{-1}$) has been documented in Europe's unique structure that stores great volumes of high-quality groundwater – the Podunajská lowland (the Žitný island). The area is represented by a strong Quaternary-Pliocene system of gravel and sand layers that also show the greatest abstractions of drinking water, while water from this area is used to supply the inhabitants through remote aqueducts going to central Slovakia and the Záhorie region.

Efficient groundwater volumes in the hydrogeological regions in 2005 ($l.s^{-1}$)



Source: SHMI

♦ **Groundwater levels**

Trend in groundwater levels and spring yields over the course of the year copies climatic indicators that ultimately impact the year's characteristics. For this reason trend in groundwater level and spring yield is not uniform within the same territory, since the orographic character of the territory plays an important role in the overall trend.

From the climatology point of view, trend in the overall precipitation in Slovakia was not uniform. Distribution of precipitation figures by individual territories and months is not uniform. Exceptionally high precipitation figures were recorded in April, August, and in December. The region of West Slovakia showed slightly abnormal annual characteristics (+109 mm above normal), while Middle

Slovakian regions (+189 mm above normal) and East Slovakian regions (+1 209 mm above normal) showed increased precipitation figures and we characterize them as humid.

In 2005, the highest annual recorded values of groundwater levels and spring yields in lowlands were dominant in the spring season, from the end of March till the beginning of June, occasionally in August. With increasing altitudes, occurrence of the greatest groundwater levels and spring yields delays until May or June. Occurrences of maximal spring yields also in higher altitudes were recorded only at the local level. Minimal groundwater levels and spring yields were recorded mainly during the winter season, in November and December, while for the springs alone, minimal yields persisted until March.

Recently, exceeding of the long-term maximal levels or spring yields or not reaching the minimal levels or spring yields become more frequent, which also may be caused by either a relatively short monitoring scale or weather fluctuations over the year - increased extreme periods, such as long drought, flood, and excessive rain episodes.

♦ **Gabčíkovo interest area**

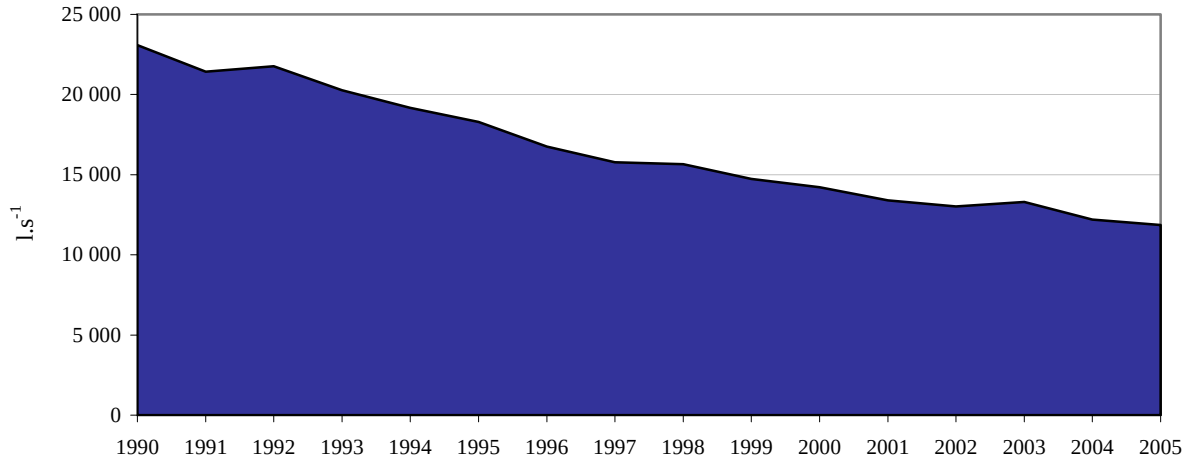
Groundwater balance in the area of the Žitný island is influenced by the presence of the Gabčíkovo water dam. Reduced water flow in the old Danube canal has been improved by letting more water into the affluent canal VD (during July) through the feeding gateway at Dobrohošť (appr. 30 $m^3.s^{-1}$). This additive measure gradually increased water level and besides having a positive impact also on groundwater levels. it revived the surrounding fauna and flora in the whole watershed area.

The runoff balance below the Gabčíkovo VD (just below the outflow of the draining canal) has been impacted only very little. This place shows more fluctuation in the momentary states and runoffs not only in the Danube watercourse itself, but also in groundwater levels. Regulating the flows at the Dobrohošť feeding gateway, it is possible to maintain the flow and level balance similar to the one that existed naturally (including the floods).

♦ **Groundwater abstraction**

In 2005, total volume of **abstracted groundwater average was 11 867 $l.s^{-1}$**, which is 15.4 % of all recorded available volumes. Over the course of 2004, ground water abstractions again showed a reduction, this time is was milder - only by 333.3 $l.s^{-1}$, which is a reduction by 2.7 %, compared to 2004.

Progress of groundwater extraction in Slovakia



Source: SHMI

After a more rigorous evaluation of groundwater abstraction in Slovakia by individual purposes we could see reduced water abstraction for most of the monitored abstraction categories with the exception of abstractions for irrigation (45 %) and other use (5 %) which showed an increase. Compared to 2004 groundwater abstractions for public water-supply purposes showed most reduction. by 27.6 $l.s^{-1}$ (-2.8 %) social purposes by 47.3 $l.s^{-1}$ (-14.4 %) and other industries by 44.9 $l.s^{-1}$ (-4.9 %).

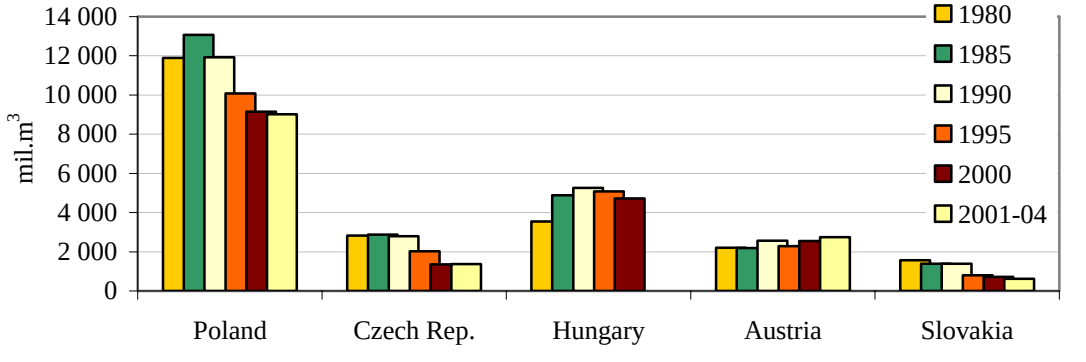
Groundwater extraction in 2005 according to the purpose of use

Year	Public water supplies	Food-processing industry	Industry excl. Food-processing	Agricult. and Livestock	Vegetable prod.. Irrigation	Social purposes	Others	Total
2003	10 064.94	329.51	999.29	385.49	380.87	320.74	822.52	13 303.60
2004	9 431.53	322.04	901.65	320.51	65.17	327.02	832.93	12 200.85
2005	9 159.87	288.25	856.75	308.82	95.07	279.72	878.98	11 867.46

Source: SHMI

Groundwater abstraction balance has changed since 1980 also in the neighboring countries and groundwater use shows a falling trend.

Groundwater abstraction in the neighboring countries



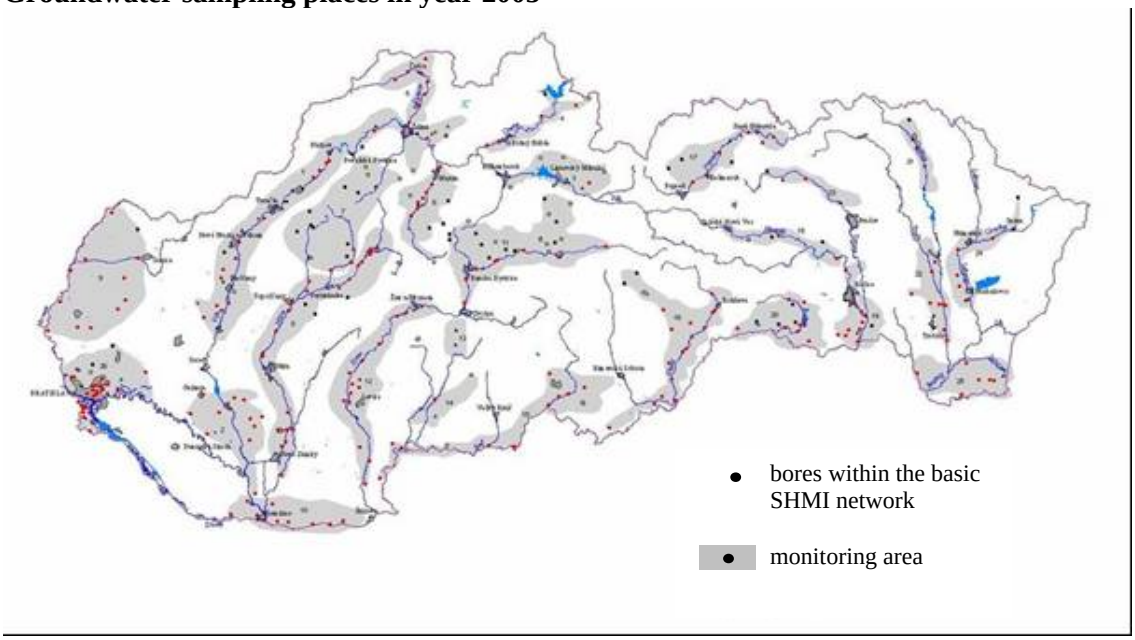
Source: SHMI

♦ Groundwater quality in Slovakia

Systematic groundwater quality monitoring has been carried out since 1982 under the **national monitoring program**. At present there are 26 monitored significant water management areas (river alluviums, Mesozoic and Neo-volcanic complexes). The monitoring now also includes the pre-Quaternary formations to meet the needs to obtain information on the trend in water quality in areas with a low anthropogenic impact.

In 2005, there were 334 objects monitored in total, which included 219 bores within the basic SHMI network, 25 used and 19 idle bores (investigative bores), 43 used and 28 idle springs.

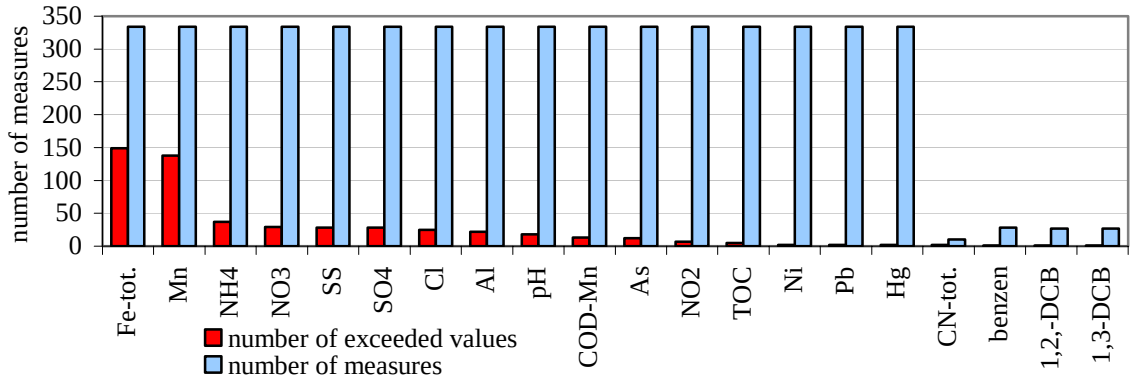
Groundwater sampling places in year 2005



Source: SHMI

Acceptable concentration figures (maximum acceptable concentration) defined under Regulation of the MoH SR No. 151/2004 Coll. on drinking water demands and drinking water quality, were exceeded in 2005 mostly for the following indicators: Fe_{total} (149 times), Mn (138 times), and NH_4^+ (37 times) out of the all 334 assessments.

Number of exceedings of the limit values of the concentrations of the particular indicators



Source: SHMI

The Figure suggests that there is a major issue of adverse **oxidation-reduction conditions** within the groundwater monitored areas documented by frequently increased concentrations in Fe, Mn, and NH_4^+.

Besides the already mentioned **physical-chemical indicators** concentrations of RL 105, SO_4^{2-} , and Cl^- anions were also exceeded.

Just like in the previous years, contamination by **organic substances,** indicated by exceeded acceptable COD-Mn concentration, is still present. Since in 2005, non-polar extractable substances were determined as the hydro-carbon index, we did not record any exceeding values for this indicator at any groundwater quality monitoring sites.

The on-going utilization of landscape within the monitored areas (urbanized and agriculture territories) is reflected in increased contents of the **oxidized and reduced nitrogen** forms in water (29 times in nitrates, 7 times in nitrites).

Most frequently recorded **trace elements** included increased aluminium (22 times) and arsenic (12 times) concentrations. In case of nickel, mercury, and lead, the limit values were exceeded 2 times, while in chrome, the limit was exceeded once in 2005.

Contamination by specific organic substances shows only local character and the majority of specific organic substances was recorded below the detection limit.

Percentage of exceeded limit values under Regulation of the MoH SR No. 151/2004 Coll. on drinking water demands and drinking water quality control (or STN 75 7111)

Indicator	Limit (according to regulation MoH SR No. 151/2004 Coll.)	Values over limit (%)		
		2003	2004	2005
Ammonium ions	**0.5 mg/l**	10.65	10.81	11.08
Magnesium	**10.0-30.0 (125)**	0	0	0
Manganese	**0.05 mg/l**	42.6	43.24	41.32
Iron	**0.2 mg/l**	40.5	44.44	44.61
Chlorides	**100 (250) mg/l**	7.39	6.61	7.49
Nitrites	**0.1 mg/l**	2.36	2.7	2.10
Nitrates	**50.0 mg/l**	8.87	10.51	8.68
Disulfates	**250 mg/l**	7.98	8.11	7.78
COD_{Mn}	**3.0 mg/l**	4.73	7.51	3.89
Aluminium	**0.2 mg/l**	2.36	5.71	6.59
Mercury	**0.001 mg/l**	0.29	0.3	0.60
Arsenic	**0.01 mg/l**	6.21	3.9	3.59
Chrome	**0.05 mg/l**	0	0	0.30
Nickel	**0.02 mg/l**	0.59	0.3	0.60
Mercury	**0.01 mg/l**	0.29	0.3	0.60
FN1		0.29	0.3	-
Humin substances		2.36	2.1	-
EPN_{UV}		22.18	18.92	-
1.1.-dichloretene		22.72	0	2.38
PCE	**10 µg/l**	0	0	-
DDT		0	0	0
Heptachlorine		0	0	0
HCB		0	0	0
Lindane		0	0	0
Metoxychlorine		0	0	0

FN1: phenols released in vaporized water
PCE: 1.1.2.2-tetrachloretylene

Source: SHMI

Waste Water

Decreasing trend in discharged waste water remained also in 2005, 881 946 thous.m^3 of **waste water** was discharged into surface watercourses in Slovakia, which represents a reduction by 37 923 thous.m^3 (4.3 %) compared to 2004, and a drop by 285 978 thous.m^3 (25 %) compared to 1995. Most significant reduction in waste water load was recorded in insoluble substances (IS), by 8 719 t.year^{-1}, and in chemical oxygen demand by dichromate (COD), by 7 850 t.year^{-1}, while there was only a slight reduction in other indicators.

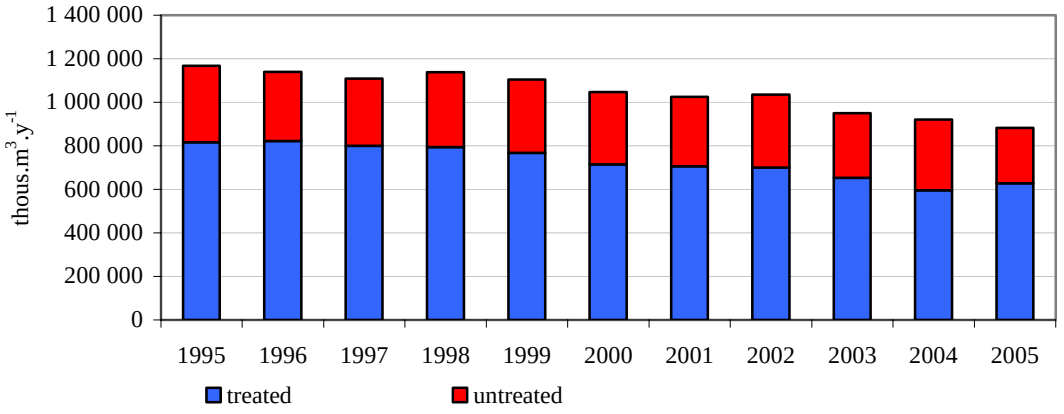
Percentage of discharged treated waste water to **total volumes of waste water** discharged into watercourses in 2005 was 71.2 %.

Load of the balanced contamination sources discharged into surface watercourses in the period of years 1995 - 2005

Discharged waste water	Volume (thous.m^3.y^{-1})	IS (t.y^{-1})	BOD_5 (t.y^{-1})	COD_{Cr} (t.y^{-1})	ENP_{uv} (t.y^{-1})
1995	1 167 924	45 044	32 227	87 894	879
2002	1 035 068	22 790	18 803	59 204	252
2003	950 686	21 193	17 372	56 829	232
2004	919 869	21 389	13 702	45 162	57
2005	881 946	12 670	10 661	37 312	55

Source: SHMI

Trend in discharging of the treated and untreated waste waters into watercourses in the period of 1995 - 2005



Source: SHMI

The currently valid Water Act and its legal provisions draw on the EC legislation, for example the European Parliament and the Board Directive No. 2000/60/EC, the so called Framework Directive on Water and Board Directive 91/271/EEC relating to treatment of municipal waste water, adopted May 21, 1991. This Directive addresses one of very significant environmental pollution sources – municipal waste water. The Directive addresses collection, treatment, and discharge of municipal

wastewater and water from specific industries, as well as handling the sludge generated during treatment of municipal waste water.

Proportion of waste water treatment in specific parameters of Directive 91/271//EEC

Category	< 2000 EO	2001 – 10 000 EO	10 001 – 15 000 EO	15 001 – 150 000 EO	> 150 001 EO	Average
COD_{Cr}	78.2 %	91.5 %	90.0 %	90.4 %	66.7 %	**85.37 %**
BOD_5	64.1 %	78.0 %	80.0 %	76.9 %	66.7 %	**72.20 %**
IS	73.1 %	91.5 %	80.0 %	88.5 %	66.7 %	**82.44 %**
N_{total}	-	-	20.0 %	19.2 %	33.3 %	**20.59 %**
P_{total}	-	-	10.0 %	23.1 %	50.0 %	**23.53 %**

Source: WRI

Mentioned values show that the level of treatment in the smallest agglomerations that are not so demanding in terms of the depth of purification is relatively poor, and the ratio of acceptable waste water treatment plants to all plants is little below three quarters. Majority of middle-sized and large municipal WWTPs used to be designed and built to meet lower qualitative requirements than those existing today. For that reason, today there are extensive reconstructions and intensifications of run-off networks and WWTPs.

Public water supply, sewerage systems and waste water treatment plants

- **Public water supplies**

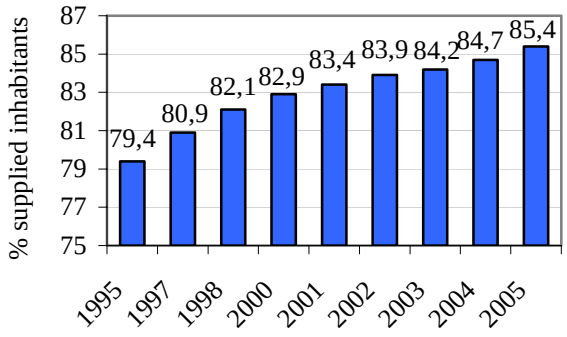
Number of inhabitants supplied with drinking water from the public water supply in 2005 reached the number of 4 605 thousand, which represented 85.4 % of supplied inhabitants. In 2005, there were in the SR 2 196 individual municipalities that were supplied with public water supply, and their portion on total SR municipalities was 76 %. Compared to 2004, share of supplied municipalities increased in the Trnava region (84.5 %), Bratislava region (95.5 %), and Žilina region (98.7 %). However, compared to 2004, Trenčín, Banská Bystrica, Prešov, and Košice regions showed unchanged number of municipalities with public water supply.

The year 2005 showed only a minimal reduction in drinking water abstraction. **Volume of produced drinking water** in 2005 reached the value of 352 mil.m^3, which compared to 2004, represents a reduction only by 1 mil.m^3. Of all the ground water sources, 299 mil.m^3 was produced (increased by 3 mil.m^3), while 53 mil.m^3 of drinking water was produced of all surface water sources, (reduction by 4 mil.m^3). Of total water produced at water management facilities, **water losses** by pipe network were 27.9 % in 2005. **Specific water consumption for households** increased in 2005 to 104 l.$inhab^{-1}$.day^{-1} (in 2004 it was 101.1 l.$inhab^{-1}$.day^{-1}).

Also other countries showed a decreasing trend in the annual water consumption from public water supplies per capita. Czech Republic and Slovakia are approximately at the same level in terms of

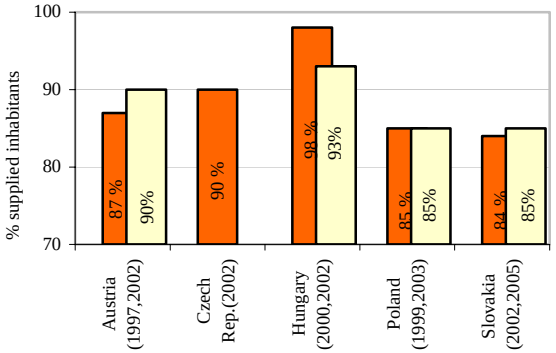
water consumption, while Poland shows the least consumption – only 57 m^3.$inhab^{-1}$.year, Hungary shows the best characteristics with having as much as 93 % of its inhabitants supplied with drinking water from public water supplies.

Drinking water supplying of the inhabitants from the public water supplying in the SR



Source: SO SR

Comparison of the drinking water supplying of the inhabitants from the public water supplying in selected countries



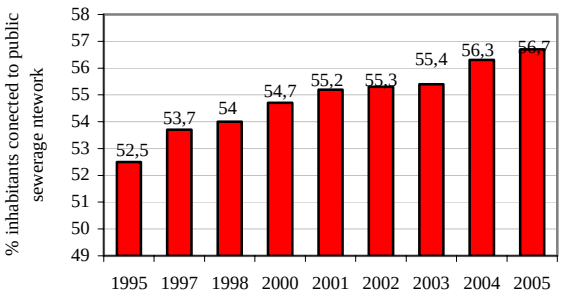
Source: OECD, SO SR

♦ **Sewerage system**

Number of inhabitants living in households **connected to public sewerage systems** in 2005 grew by 25 thousand, compared to 2004, and reached the number of 3 055 thous. inhabitants, which is 56.7 % of all inhabitants. In 2005, there were 612 municipalities in Slovakia (i.e. 21.2 % of all Slovak municipalities) with a built public sewerage network, while 545 municipalities (i.e. 18.9 % of all Slovak municipalities) had their wastewater sent directly off to the wastewater treatment plant. In 2005, the greatest increment in municipalities with public sewerage system was in the Bratislava region (54.8 %), while other regions showed only a minimal growth.

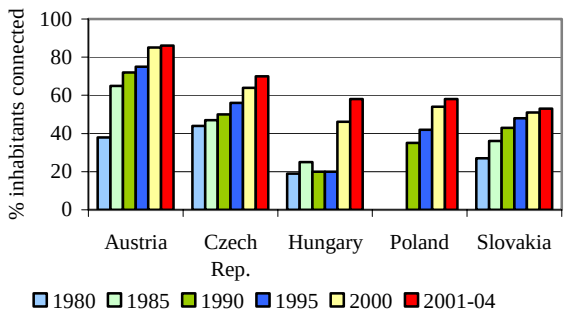
Greatest level of connectedness of the public to the public sewerage system from among the V4 countries reached Austria (86 %), and the Czech Republic (70 %), Poland, Hungary, and Slovakia show approximately the same level of connectedness, 56 % on average.

Connecting of the inhabitants to the public sewerage network in the SR (%)



Source: SO SR

Comparison of the connecting of the inhabitants to the public sewerage network in the selected countries (%)

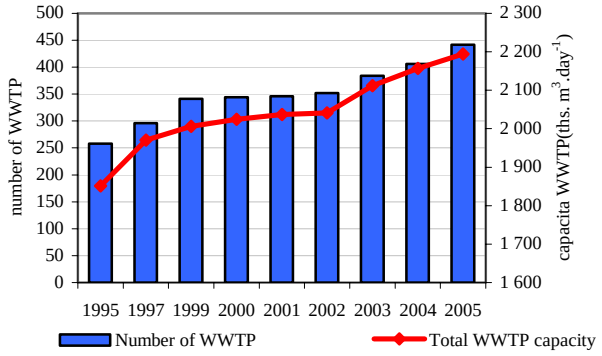


Source: OECD

♦ **Waste water treatment plants**

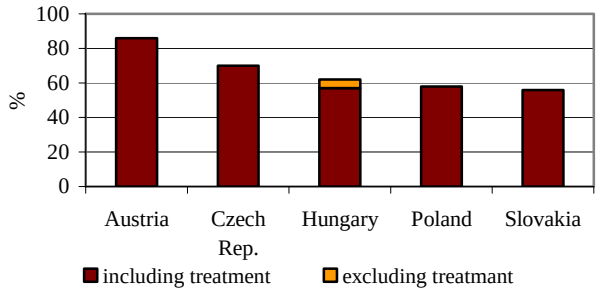
In 2005, there were 442 wastewater treatment plants administered by the VaK company and individual municipalities in Slovakia, and their number grew by 36, compared to 2004. Greatest share on these had mechanical-biological WWTPs (85.3 %). Also, the WWTP capacity changed, in 2005, it was 2 194 $m^3.day^{-1}$ (in 2004 it was 2 157 $thous.m^3.day^{-1}$).

Development in number and capacity of WWTP



Source: SO SR

Comparison of the connection of the inhabitants to the wastewater treatment plants in the selected countries



Source: OECD

In 2005, watercourses with public sewerage system (administered by municipalities and water management companies) received 443 $mil.m^3$ of discharged waste water, which was by 5 $mil.m^3$ more than in the previous year, and the volume of treated waste water discharged into the public sewerage system in 2005 reached 428 $mil.m^3$.

Waste water treatment plants with the secondary purification level are most developed in the V4 countries. In 2002 in Austria, as much as 80 % of wastewater was treated at biological WWTPs with chemical post-treatment (tertiary level of wastewater purification). In relation to the approximation of law within the EC, more attention will be given to this purification level also in Slovakia.

Volume of the discharged wastewater by the public sewerage system (in administration of VaK and in administration of the municipalities) and WWTP in 2005

Water discharged by the public sewerage and WWTP	Sewage	Industrial and other	Precipitation	Separate	Administration of the municipalities	Total
	(thous.m^3.$year^{-1}$)					
Treated	122 043	92 532	42 355	161 052	10 206	428 188
Untreated	2 829	1 405	1 892	6 290	2 658	15 074
Total	124 872	93 937	44 247	167 342	12 864	443 262

Source: WRI

Sludge from WWTPs is a necessary by-product of the wastewater treatment process. In 2005, there were 56 360 tons of the sludge dry matter produced in municipal WWTPs. Significant sludge volumes – 39 120 tons were recycled through their application into the agricultural land (69.4 %).

WWTPs temporarily stored 8 710 tons (15.5 %) while 8 530 tons (15.1 %) of waste was stored at landfills. In 2005, only 5 870 tons of sludge dry matter was directly applied into the agricultural land, 28 910 tons of sludge dry matter was used for compost production, while 4 340 tons of sludge was used for land purposes through different ways (recultivation, etc.).

Sludge produced in the waste water treatment plant

Year	Amount of the sludge (tons of dry residue)							
	Total	Used			Disposed			
		Applied into the agricultural soil	Applied into the forest soil	Composted and used in other way	Incinerated	Land filled		In other way
						Total	Suitable for the further use	
2002	52 149	42 836	0	0	0	0	4 443	4 870
2003	54 340	16 640	605	22 085	0	8 110	7 610	6 900
2004	53 085	12 067	0	30 437	0	4 723	3 470	5 858
2005	56 360	5 870	0	33 250	0	8 530	6 960	8 710

Source: WRI

Drinking water

♦ **Drinking water quality monitoring and assessment**

In 2005, drinking water quality monitoring and assessment was carried out pursuant to the new **Regulation MoH SR No. 151/2004 Coll., on demands on drinking water and drinking water quality control.** The Resolution distinguishes a number of water quality indicators limit values, according to their corresponding health effects. Radiological indicators were determined in accordance with the Regulation of MoH SR No. 29/2002 Coll, on demands to ensure radiation control. In 2005, 12 353 samples were analysed at operation laboratories of water management companies. The samples were abstracted at sites located within distribution networks and 320 939 analyses were carried out to monitor individual drinking water quality indicators. Share of drinking water analyses that complied with the sanitary limits reached 99.23 % in 2005 (in 2004 it was 99.15 %). Percentage of samples that meet drinking water quality demands for all indicators reached 89.59 % (in 2004 it was 87.84 %). These samples did not include the active chlorine indicator, as this test was done separately, in relation to the microbiological quality of drinking water.

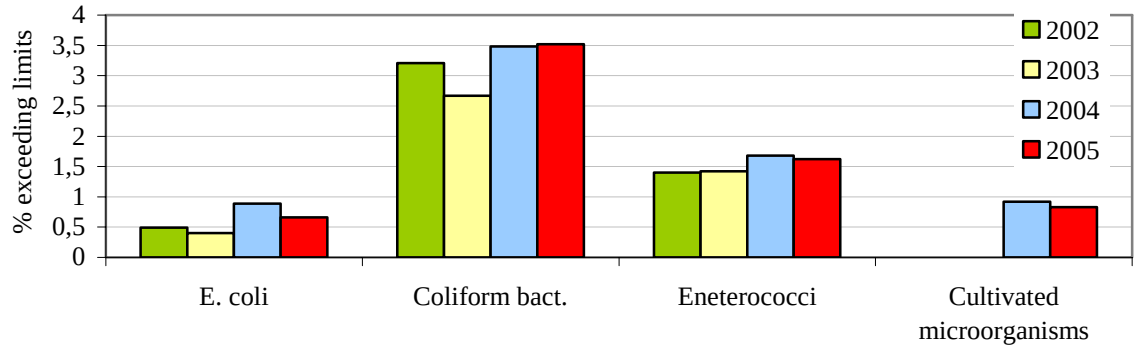
Exceeding limits in drinking water samples in accordance with the Regulation MoH SR No. 151/2004 Coll. on demands on drinking water and drinking water control

Year	2003	2004	2005
Share of drinking water samples that do not meet the NMH and MHRR limit.	-	2.03 %	2.10 %
Share of drinking water quality indicators analyses that do not meet NMH and MHRR	0.09 %	0.54 %	0.55 %
Share of drinking water samples that do not meet the MH, NMH, MHRR, and IH limit.	10.36 %	22.56 %	19.29 %
Share of drinking water indicator analyses that do not meet the MH, NMH, MHRR, and IH limits, pursuant to STN 75 711.	0.71 %	1.48 %	1.15 %

Source: WRI

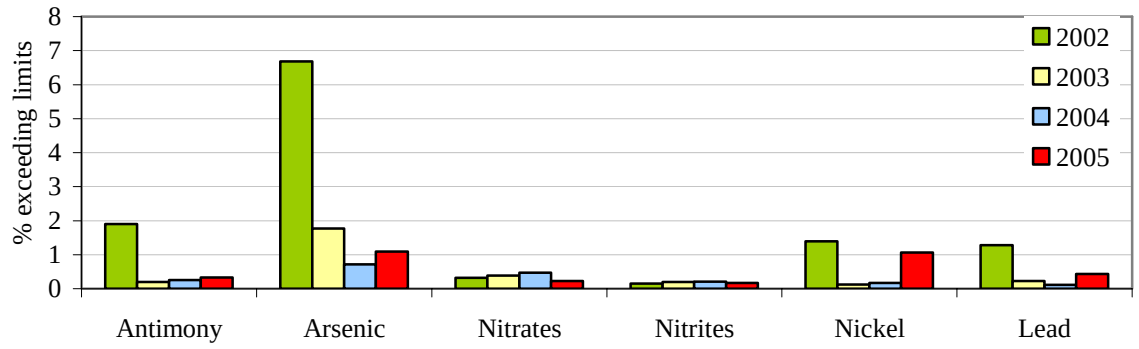
IH – indicative values, MH - threshold values, NMH - maximum threshold values, MHRR – threshold values of the reference risk

Results of monitoring the microbiological and biological indicators of drinking water within Slovakia's distribution networks



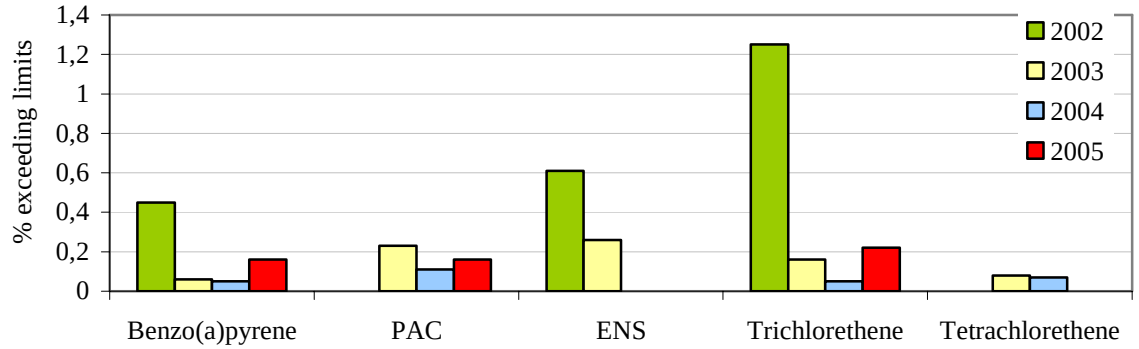
Source: WRI

Results of physical and chemical drinking water indicators monitoring within Slovakia's distribution networks - inorganic indicators



Source: WRI

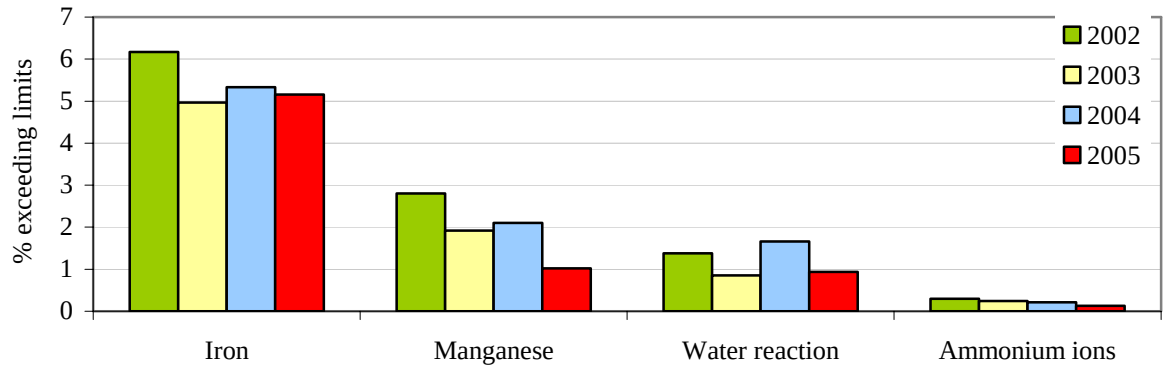
Results of physical and chemical drinking water indicators monitoring within Slovakia's distribution networks - organic indicators



Source: WRI

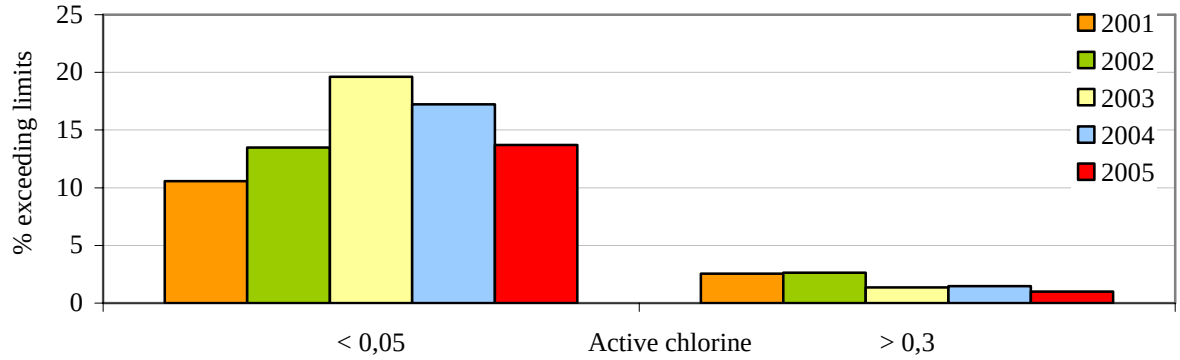
Note: PAC - Polycyclic aromatic carbohydrates
ENS - Non-polar extractable substances

Results of physical and chemical drinking water indicators monitoring within Slovakia's distribution networks - indicators that cannot adversely affect drinking water sensorial quality



Source: WRI

Results of monitoring for the presence of disinfection agents and their by-products in drinking water within Slovakia's distribution networks



Source: WRI

The purpose of this law is to establish the principles ***of protection and rational exploitation of mineral resources,*** *especially by carrying out geological researches, openings, preparation and breaking of mineral deposits, enrichment and refining of minerals, performed in relation with their extraction, as well as providing for security of operations and environment protections during these operations.*

§ 1 of the Act on Protection and Exploitation of the Mineral Resources No. 44/1988 Coll. (Mining Act) as subsequently amended

• ROCKS

Geological environmental factors

Partial Monitoring System - Geological factors (PMS - GF) as part of environmental monitoring in Slovakia, is focused mainly on so-called geological hazards or harmful natural or anthropogenic geological processes that threaten the natural environment and eventually the humans.

PMS - GF consists of 13 independent sub-systems:

01: Landslides and other slope deformation
02: Erosion processes
03: Weathering processes
04: Volume unstable soils
05: Influence of mineral exploitation upon environment
06: Change of anthropogenic sediments
07: Stability of massifs underlying historic objects
08: Covered anthropogenic sediments
09: Tectonic and seismic activity of the territory
10: Monitoring of snow pack quality
11: Monitoring of seismic phenomena in Slovakia
12: Monitoring of stream sediments
13: Monitoring of the volume activity of Radon in the geological environment

Summary of the major outcomes from the monitoring activities in 2005:

Landslides and other slope deformities belong to the most prevalent and socially challenging geo-dynamic phenomena. In 2005, monitoring activities were carried out at 22 sites. Primary measurements

are saved in a database that is part of a detailed information system. As of December 2005, the database contained more than 900 000 entries from monitoring activities.

In 2005, automated level measuring devices with online connected interfaces were installed at socially significant sliding sites of **Veľká Čausa and Okoličné**. This is an important shift to a higher level of monitoring in terms of regime monitoring and direct implementation of its outcomes. The devices were installed at new, specifically equipped hydro-geological wells, in order to reach the maximum quality of monitoring. We suppose that after checking the devices‘ functionality, toward the end of 2006, it will be possible to set the limit levels of ground water depth in the most objective manner, as well as the level's rising speed, which will initialize sending alarm signals.

Greatest increment in **erosion processes**’ area and length was recorded at the Plaveč site, located in the flysh rocks of the Spiš and Šariš ridges. Over the last 43 years, area of erosion furrows at this site increased by 58 % (1.3 % per year) and grew in length by 11 % (0.25 % per year).

In 2005, we focused our monitoring on 10 sites within the sub-system called 07: **Stability of massifs underlying historic objects**. Most important movements were recorded near Perúnova rock at the Spiš castle. Over the last year there was a gradual closing up followed by a subsequent re-opening of the rift, with the movement amplitude of 0.27 mm. Since the Summer of 1992, the rift opened by 5.034 mm.

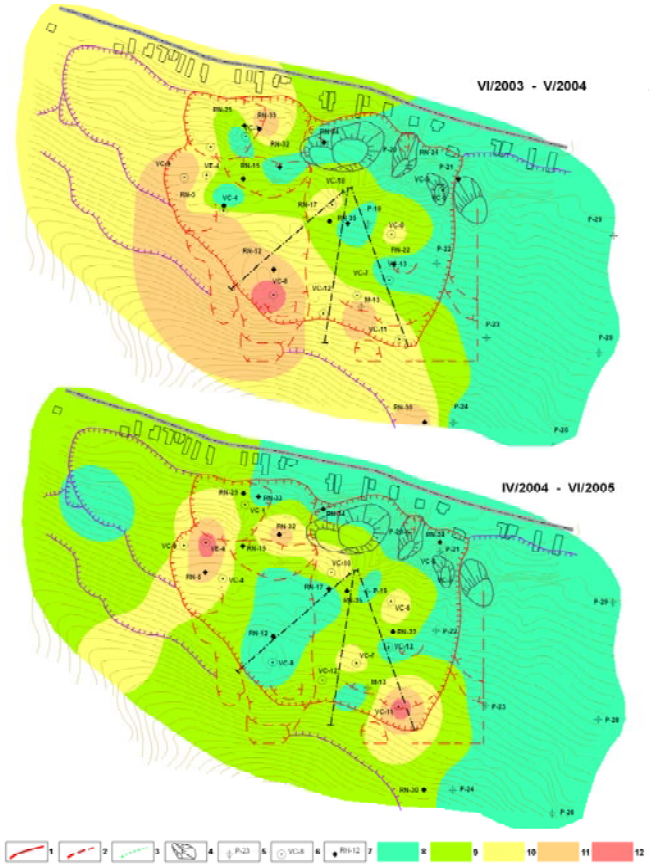
Vertical surface movements together with movements alongside the furrows, as well as seismic activity of the territory, were monitored within the **Tectonic and Seismic Activity of Territory** subsystem. An on-going registration of **seismic phenomena** in 2005 was carried out at **12 seismic stations**. All of the stations are registered in the International Seismological Centre, ISC, in Great Britain. 78 earthquakes were localised with the epicentre in the focal area of the Slovak Republic. 1 earthquake was recorded on the macro-seismic scale in Slovakia, in the Komárno focal zone.

Snowcap quality monitoring has been carried out since 1976. After the snow melts away, the samples are homogenised and subsequently analysed for the following association of elements: Na, K, Mg, Ca, NH_4, Sr, Al, Zn, Cu, Pb, Fe, Mn, Cl, F, NO_3, SO_4, HCO_3. Overall snow mineralisation in the Winter of 2004/2005 was between 2.68 to 23.07 mg/l. Values below 3 mg/l were measured at the sites of ***Banský Studenec and Chopok – Srdiečko***, while the maximum values were recorded at ***Vojany*** - beyond 20 mg/l, showing an apparent anthropogenic impact.

Chemical monitoring of alluvial sediments showed that exceeding the C group limit values, which induced very heavy contamination, was in 2005 recorded in the watercourses of Štiavnica (Pb), Hnilec (As), and Nitra (Hg).

Monitoring of the volume Radon activity was done in 2005 at five sites that showed medium to high Radon risk. Long winter season and frequent rainfalls increased soil humidity and consequently the Radon transfer within rocks. As a consequence of the mentioned fact, volume Radon activity monitoring activities showed higher values than in the previous years.

Complex summary of monitoring outcomes from the sliding site of Veľká Čausa for 2003 through 2005



1 - demarcation of active landslide forms,
2- demarcation of potential and stabilised landslides,
3-local landslides and tears,
4-displaced blocks of the volcanic rock,
5-geodetic network points,
6- inclinometer and piezometer wells,
7- monitoring of surface residual tensions,
8- stable condition of parts of territory,
9-signals of the landslide movement activity,
10-slightly active state,
11-active state,
12-highly active state,

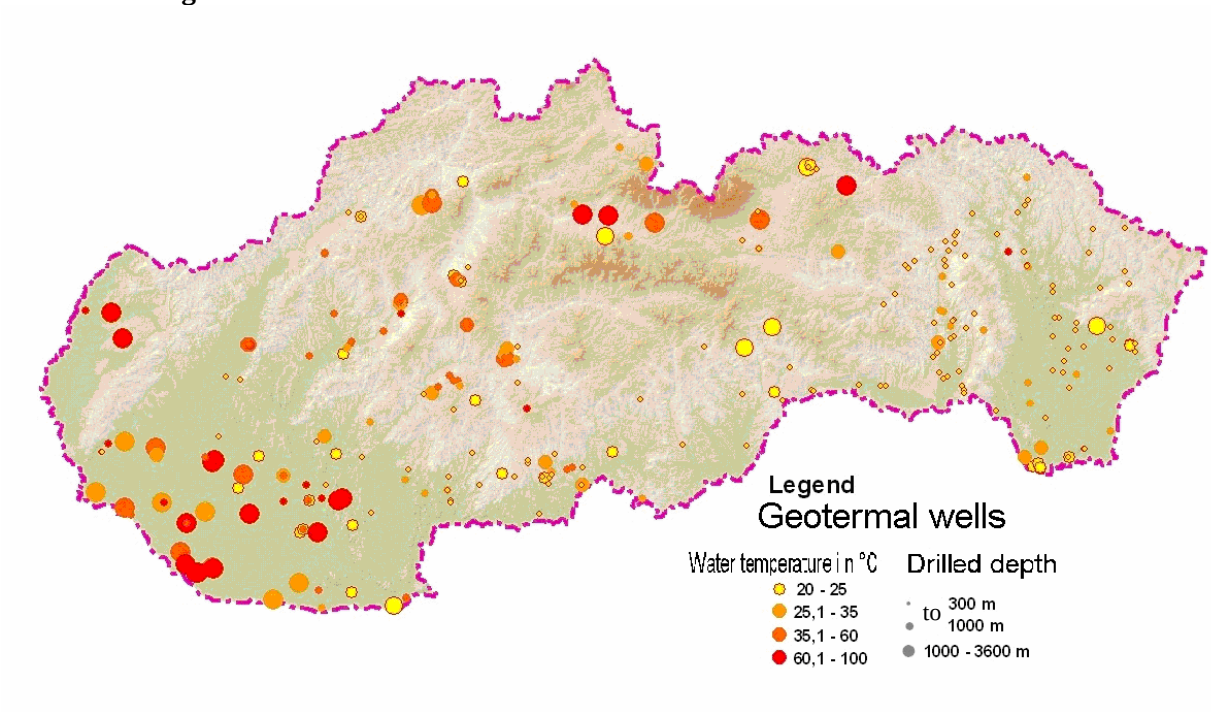
Source: SGI DS

Geothermal energy

Geothermal energy represents a significant, thermo-energetic potential of Slovakia. At present, there are 26 designated hydro-thermal areas in Slovakia, taking up 27 % of the state's territory. Rocks that function as thermal water collectors outside the spring areas are found in the depth of 200-500 m and contain geothermal water with the temperature of 20 – 150 ^{o}C.

Summary **thermo-energetic potential of geothermal water** of all prospective areas represents 5 538 MW_t.

Distribution of geothermal wells in Slovakia and their thermal characteristics



Source: SGI DS

Register of geological mapping

The registers are processed in form of typical registers on records sheets and maps. Individual registers are kept also inside a computer database and the geolographical information system.

Registers of geological mapping (as of December 31, 2005)

Registers of	Accumulation in 2005	Total number
surveyed territories	30	428
surveyed territories drafts	29	359
landslides	2	11 393
wells	6 094	732 956
hydro-geological wells	158	22 795
landfills	6	8 318
map drawing and purpose mapping	182	9 368
geophysical mapping	374	3 681
abandoned mining works	45	16 517

Source: SGI DS

Abandoned mining works

Pursuant to **Act No. 44/1988 Coll. on protection and exploitation of mineral deposits (Mining Act),** as amended, MoE SR also ensures searching for abandoned mining works. The State Geological Institute of Dionyz Stur in Bratislava was commissioned to maintain the Register.

Abandoned mining works as of December 31, 2005

Type of abandoned mine	Number
Mining shaft	4870
Pit (hole)	506
Chute	63
Cut, excavation	88
Pingo	3 987
Pingo field	109
Pingo draw	128
Dump	6 124
Old randing	205
Sink mark	292
Placer	20
Tailings dump	10
Other	115
Total	**16 517**

Source: SGI DS

Survey territories

Under the geology legislation and pursuant to the GS SR status - the GEOFOND department keeps the register of survey areas for selected geological activities. In 2005, there were 30 survey areas and 29 registered proposals to designate a survey area. As of December 31, 2005, there were 100 recognised areas.

Overview of deposits in Slovakia

Energy deposits (state to the date 31st December 2005)

Raw material	Number of deposits included into balance	Number of free balance deposits	Number of deposits for mining in 2005	Unit	Balance deposits free	Geological deposits
Anthracite	1	1	0	thous. t	2 008	8 006
Bitumen sediments	1	1	0	thous. t	9 780	10 797
Brown coal	12	7	4	thous. t	180 483	536 088
Flammable natural gas – gasoline gas	8	6	4	thous. t	207	405
Lignite	8	3	1	thous. t	112 264	619 882
Non-resinous gases	1	0	0	mil. m^3	0	6 360
Underground stores of natural gas	8	1	2	mil. m^3	25	2 450
Crude oil non-paraffinic	3	3	1	thous. t	1 632	3 422
Crude oil - semi-paraffinic	8	4	4	thous. t	159	6 494
Uranium ores	2	1	0	thous. t	1 148	2 861
Natural gas	39	25	15	mil. m^3	9 110	27 545
Total	**91**	**52**	**31**			

Source: SGI DS

Ore deposits (state to the date 31st December 2005)

Type of ore	Number of deposits included into balance	Number of free balance deposits	Number of deposits for mining in 2005	Unit	Balance deposits free	Geological deposits
Sb ores	9	1	0	thous. t	85	3 344
Complex Fe ores	9	2	0	thous. t	5 806	60 057
Mn ores	2	0	0	thous. t	0	11 009
Cu ores	15	0	0	thous. t	0	49 336
Molybdenum ores	2	0	0	thous. t	0	131 855
Nickel and cobalt ores	1	0	0	thous. t	0	17 000
Hg ores	4	0	0	thous. t	0	3 311
Other ores	1	0	0	thous. t	0	73
Poly-metallic ores	8	1	0	thous. t	1 623	26 459
Wolfram ores	2	0	0	thous. t	0	10 286
Precious soils	1	0	0	thous. t	0	8
Gold and silver ores	12	6	1	thous. t	3 292	13 202
Fe ores	4	2	1	thous. t	21 974	30 273
Total	**70**	**12**	**2**			

Source: SGI DS

Non-metallics deposits (state to the date 31st December 2005)

Raw material	Number of deposits included into balance	Number of free balance deposits	Number of deposits for mining in 2005	Unit	Balance deposits free	Geological deposits
Anhydride	6	5	1	thous. t	646 846	1 059 599
Asbestos and aspestos rock	4	1	1	thous. t	5 022	28 216
Baryte	4	0	0	thous. t	0	1 732
Bentonite	21	15	5	thous. t	1 031 071	1 044 351
Cast basalt	4	4	2	thous. t	23 085	40 080
Decorative rock	23	20	1	thous. m^3	22 240	27 798
Diatomite	3	2	0	thous. t	6 556	8 436
Dolomite	20	20	8	thous. t	610 344	633 677
Precious stones	1	1	0	ct	1 207 812	2 518 510
Graphite	1	0	0	thous. t	0	294
Halloysite	1	0	0	thous. t	0	2 249
Rock salt	4	4	1	thous. t	840 644	1 351 626
Kaolin	14	13	3	thous. t	54 696	59 978
Ceramic clays	37	34	5	thous. t	271 468	346 059
Quartz	7	7	0	thous. t	311	328
Quartzite	15	13	1	thous. t	18 357	26 956
Magnesite	10	6	3	thous. t	753 909	1 134 034
Talc	6	3	1	thous. t	93 664	242 228
Mineralized I - Br waters	2	1	0	thous. t	3 658	3 658
Pearl stone	5	5	1	thous. t	30 296	30 616
Pyrite	3	0	0	thous. t	0	18 771
Gypsum	6	5	2	thous. t	62 792	93 552
Sialitic raw material	5	5	3	thous. t	83 302	96 665
Glass sands	2	2	1	thous. t	53 289	53 289
Marl	8	7	2	thous. t	167 553	169 805

Mica	1	1	0	thous. t	14 073	14 073
Building rock	139	136	76	thous. m^3	464 608	761 456
Gravel sands and sands	29	27	21	thous. m^3	185 530	210 566
Brick clay	42	39	12	thous. m^3	113 192	138 061
Technically usable mineral crystals	3	1	0	thous. t	253	69 743
Limestone – unspecified	31	28	13	thous. t	1 916 861	2 264 717
High-content limestone	10	10	4	thous. t	3 202 636	3 366 558
Zeolite	7	7	2	thous. t	103 250	111 474
Foundry sands	16	16	1	thous. t	730 997	946 033
Refractory clays	9	6	0	thous. t	3 106	5 490
Feldspars	6	6	0	thous. t	10 402	11 640
Total	**505**	**450**	**170**			

Source: SGI DS

Classification of mineral deposits by state of extraction (2005)

Extraction symbol (ZV)	Characteristics	Number of deposits
1	*Deposits with developed extraction activity* include exclusive mineral deposits sufficiently open and technically apt for extraction of industrial deposit.	**205**
2	*Deposits with fading extraction activity* include extraction mineral deposits where extraction activity will cease in a near future (within 10 years)	**40**
3	*Deposits before completion* include exclusive mineral deposits with documented deposits that give basis to one of the construction phases (starting with the projection phase)	**24**
4	*Deposits with ceased extraction* include exclusive mineral deposits with definitely or temporarily stopped extraction activity.	**116**
5	*Non-extracted deposits* include documented exclusive mineral deposits soon **to be** constructed and extracted.	**47**
6	*Non-extracted deposits* include documented exclusive mineral deposits **with no plans** for their extraction.	**220**
7	*Surveyed deposits* include deposits of exclusive and non-exclusive minerals with various degree of mapping.	**15**

Source: SGI DS

♦ Ground water volumes

Ground waters deposits in the SR (state to the date 31st December 2005)

Category	A	B	C	Total
Efficient deposits of the ground waters (l.s-1)	-	88.56	2 714.68	2 803.24
Efficient amounts of the ground waters (l.s-1)	-	-	9 299.93	9 299.93

Source: SGI DS

Legend:
C calculated on the basis of assessment of the existing hydrogeological mapping
B calculated on the basis of hydrogeological mapping with long-term extraction test
A calculated on the basis of hydrogeological mapping with semi-operational test

Geological activities funded from the state budget

Summary of geological activities carried out in 2005 from the state budget funds

Surveyed area	Task	Objective
Research and development	Basic hydro-geological maps of selected Slovak regions	Production of basic hydro-geological maps in the scale of 1: 50 000 from 11 regions with captions
	Thermal and pressure changes in the Earth's crust of the West Carpathian in the geological past, and their probable repeated pattern in the near and distant future	Defining the type of crust, its nature, composition and evolution (age) in the West Carpathian territory Study of the paleo-climatic conditions in the area, based on the paleo-ontological information and the lithological trend in the rock complexes.
Nuclear fuel	Assessment of geological activities with the U ore in selected areas of Slovakia	Processing the results of research and survey of the uranium ore in geological formations of the West Carpathians, complex revision of written and graphic documentation from these deposits.
Energy other than electricity	Regional hydro-geo-thermal assessment of the Humenné ridge	Assessment of the geothermal potential of the Humenné ridge and its extraction potential.
	Regional assessment of the Topoľčany bay	Assessment of the geo-thermal potential of the Topoľčany bay
Extraction of minerals	Auriferous structures in the crystalline metamorphic rocks of the south-western Slovak Rudohorie ridge	Determination of the magnitude and distribution of auriferous structures, determination of the basic gold mineralisation parameters.
	Ore clusters at the border of the crystalline rocks and the central Slovakia neo-volcanic formations	Search for ore clusters at the border of crystalline shales and granitoid forms with sequences of central Slovakian neovolcanic rocks, and determine their prognostic significance in terms of the revision of primary and secondary, mostly ore accumulations.
	Searching for formations containing precious ores, near the Hodruša Svetozár deposit	Implementation of geologic activities to verify the Au /Ag, Pb, Cu ore deposit's trend in unmapped areas of the Štiavnicko-hodrušský ore-mining territory, and revision of 500 thous. tons of economically extractable stores of the quality of 8 g/t Au.
Reduction in pollution	Monitoring of environmental loads' impacts on geological environmental factors, in selected West Carpathian regions	Monitoring of environmental loads' impacts on geological environmental factors, in selected West Carpathian areas.
	Implementation of the globe's remote monitoring to monitor environmental loads for geological environmental factors in selected regions	Use of the globe's remote monitoring to assess the interaction of selected environmental loads with geological factors in a designated territory in Slovakia.
Nature and landscape protection	Evaluation of the effectiveness of surveys and landslide repair in various geological structures of Slovakia	Evaluation of the effectiveness of implemented surveys and proposed repair activities in various geological structures of Slovakia prone to landslides.
	Atlas of slope stability of Slovakia in the scale of 1: 50 000	Stable regionalisation of landslides of Slovakia and definition of basic geological fault types.
	Kremnica - securing the land sink at the Štefánik square	Securing and elimination of the abandoned mining work and a created land sink at the square in Kremnica.

Environmental protection	Building the geo-park of Banská Štiavnica	Preserving the unique geological importance phenomena, uniqueness for scientific research focused on environmental education.
	Uses of magneto-telluric measurements to interpret depth composition and verify geo-physical (gravitational) transects of the eastern part of the West Carpathian mountains	Re-evaluation of the geological composition of Slovakia, examination of the tectonic composition and characteristics of the aquifer of the inner-Carpathian tertiary planes, interpretation of the depth composition and the aquifer of the Alpine formations, regional faults, and deformation zones.
	Set of regional maps of environmental geo-factors of the Myjavská hills and White Carpathians regions	Maps created in the scale of 1: 50 000 that evaluate major environmental factors, state of pollution, and distribution of elements in individual components of environment (rocks, water, soil, alluvial sediments), and natural radioactivity of rocks and water.
	Hydro-geological map of the southern SGR part	Objective of the project is to create hydro-geological and hydro-geochemical basic map of the region of Spiš - Gemer rudohorie, and draft directives.
	Engineering geology atlas of rocks in Slovakia	Creation and publishing of the engineering geology atlas of Slovakia. The atlas will include major engineering geology characteristics of most dominant rock types in Slovakia.
	Set of environmental geological factors Ipeľ region (IPREG)	Maps of the Ipeľ region created in the scale of 1: 50 000 that evaluate major environmental factors, especially the state of pollution, and distribution of 36 elements in individual components of environment (rocks, water, soil, alluvial sediments), and natural radioactivity of rocks and water.
	Set of geological environmental factors maps of the Lučenská and Rimavský basins	Maps created in the scale of 1: 50 000 that evaluate major environmental factors, state of pollution, and distribution of 36 elements in individual components of environment (rocks, water, soil, alluvial sediments), and natural radioactivity of rocks and water.
	Set of geological environmental factors maps of the Záhorská lowland region	Maps created in the scale of 1: 50 000 that evaluate major environmental factors, state of pollution, and distribution of 36 elements in individual components of environment (rocks, water, soil, alluvial sediments), and natural radioactivity of rocks and water.
	Engineering geological mapping of slope deformities in the most threatened areas of the flysch zone in the scale of 1: 10 000	Drafting geological purpose maps focused on slide and flood risks of the most vulnerable territories of the flysch zone, as well as proposals for necessary measures for their elimination.
Water supply	Hg Tracking and localisation survey of the Veľká Fatra and Law Tatras Mesozoic formation, between Ploská and Donovaly	Objective is to assess hydro-geological and hydro-geochemical conditions of the territory, assess the natural and available ground water volumes, and set the conditions for quantitative and qualitative ground water protection.
	Neo-volcanic formations of the northern slopes of the Štiavnické hills	Objective is to assess hydro-geological and hydro-geochemical conditions of the territory, assess the natural and available ground water volumes, and set the conditions for quantitative and qualitative ground water protection.
	Hg tracking and location survey of the eastern part of the PQ 115 hydro-geological region – Palaeogene of the Hornád basin and parts of the Poprad basin	Objective is to assess hydro-geological and hydro-geochemical conditions of the territory, assess the natural and available ground water volumes, and set the conditions for quantitative and qualitative ground water protection.
Public health	Trenčianske Teplice - calculations of mineral water volumes	Objective is to calculate natural and available volumes of mineral ground water in the Trenčianske Teplice category C hydro-geological structure.

Source: MoE SR

The terms sustainable exploitation of the arable land and farming the farmland mean exploitation and protection of the properties and functions of the soil by the means and to the extent, which would keep its biological diversity, fertility, restoration ability and potential to perform all functions.

§ 2 letter e/ of the Act on Protection and Use of Farmland No. 220/2004 Coll., including the change of Act on Integrated Pollution Prevention and Control No. 245/2003 Coll., and on change and amendment of some laws

• SOIL

Land use

♦ Land Use on the basis of the Land Register's data

Total size of the Slovak Republic is 4 903 467 ha. In 2005, the share of agricultural land was 49.62 % of total land size, while the share of forestland was 40.89 %, and the share of non-agricultural and non-forest land was 9.48 %.

Land Use categories (state to the date 31st December 2005)

Land category	Area (ha)	% of total area
Agricultural land	2 432 979	49.62
Forest land	2 005 234	40.89
Water areas	93 381	1.91
Build-up land	226 257	4.61
Other land	145 616	2.97
Total area	4 903 467	100.00

Source: IGCC SR

♦ Changes to the landscape cover evaluated by comparing satellite images

Application of the CLC (Corine Land Cover) data layers from 1990 and 2000 showed changes in 1 612 km^2 of Slovakia's land cover. Major changes included:

in the area of forest and semi-nature land:

- change of 580.3 km^2 of forestland to woodland shrub,
- change of 529.7 km^2 of woodland shrub to forestland,
- 186 km^2 of agricultural grasslands, natural grasslands and heterogeneous agricultural areas have become woodland shrub,

in agricultural landscape:

- increase to the area of the mosaic pattern of fields, grasslands, and permanent cultures by 165.5 km^2, at the expense of the arable land especially (132.1 km^2),
- reduction of arable land by 56.9 km^2, beneficial to grasslands especially (46.2 km^2),
- changes of vineyards and orchards to arable land (49.6 km^2),

in urbanised landscape:

- increase in the area of residential, industrial, and recreational zones, as well as roads by 44.6 km^2 and water bodies with inflow canals by 64.2 km^2.

Soil properties

Information on state, trend in land properties and their degradation may be obtained from the Partial Monitoring System - Soil (PMS-S) carried out by the Soil Science and Conservation Research Institute.

♦ Chemical properties of soil

The following tables show changes to soil reaction values, volumes of acceptable phosphorus and potassium, and humus in the A-horizon of agricultural land over three PMS-S cycles.

Trend in soil reaction (pH/H_2O) in the A-horizon of soil in Slovakia, based on the comparison of outcomes from three PMS-S cycles

Main soil unit	1993	1997	2002
Mollic Fluvisols AL	7.29	7.24	7.03
Fluvisols AL	7.13	6.95	-
Chernozems AL	7.28	7.31	-
Haplic Luvisols AL	6.71	6.85	-
Planosols AL	6.66	6.70	-
Planosols PG	6.31	6.24	-
Rendzic Leptosols AL	7.27	7.25	7.54
Rendzic Leptosols PG	7.17	7.18	6.57
Regosols AL	6.68	6.54	6.95
Cambisols AL	6.56	6.42	6.18
Cambisols PG	5.61	5.56	5.29
Solonchaks and Solonetz PG	8.29	7.88	8.45
Podzols PG	4.21	3.93	3.88

AL – Arable Land, PG – Permanent Grassland Source: SSCRI

Trend in the amount of acceptable P in the A-horizon of soil in Slovakia, based on the comparison of outcomes from three PMS-S cycles ($mg.kg^{-1}$)

Main soil unit	1993	1997	2002
Mollic Fluvisols	101.50	94.40	61.70
Andosols	44.62	58.25	57.22
Regosols	145.76	77.30	140.94
Rendzic Leptosols	95.60	62.80	64.94
Eutric Cambisols	48.78	66.10	30.62
Dystric Cambisols	106.50	98.90	47.50
Solonchaks and Solonetz	39.20	32.30	22.32
Podzols	46.12	27.30	25.11

Source: SSCRI

Trend in the amount of acceptable K in the A-horizon of soil in Slovakia, based on the comparison of outcomes from three PMS-S cycles (mg.kg^{-1})

Main soil unit	1993	1997	2002
Mollic Fluvisols	251.20	198.40	238.45
Andosols	153.00	109.00	101.00
Regosols	232.75	103.60	155.13
Rendzic Leptosols	240.00	152.40	188.16
Eutric Cambisols	193.75	211.60	173.14
Dystric Cambisols	212.37	118.50	175.13
Solonchaks and Solonetz	179.66	105.30	116.52
Podzols	144.33	103.10	101.65

Source: SSCRI

Trend in the amount of humus in the A-horizon of soil in Slovakia, based on the comparison of outcomes from three PMS-S cycles (%)

Main soil unit	1993	1997	2002
Chernozems AL	2.74	2.17	-
Mollic Fluvisols AL	3.69	3.14	3.74
Fluvisols AL	2.72	2.26	-
Haplic Luvisols AL	2.07	1.71	-
Planosols and Luvisols AL	2.07	1.69	-
Planosols and Luvisols PG	3.85	3.47	-
Cambisols on vulcanite PG	5.00	3.62	5.69
Cambisols on vulcanite AL	3.65	3.17	4.52
Stagni-Cambisols PG	4.55	3.52	4.98
Stagni-Cambisols AL	2.86	2.26	3.17
Cambisols on acid substrates and slates PG	6.17	4.72	6.76
Cambisols on acid substrates and slates AL	3.09	2.41	3.71
Cambisols on carbonates substrates PG	6.47	5.00	6.72
Cambisols on carbonates substrates AL	2.98	2.52	3.40
Cambisols PG	5.55	4.22	6.04
Cambisols AL	3.15	2.59	3.70
Regosols AL	1.76	1.57	2.05
Podzols, Sceletic Leptosols, Leptosols PG	18.79	20.00	24.79
Solonchaks and Solonetz PG	2.40	2.02	2.83
Rendzic Leptosols AL	3.05	2.62	2.76
Rendzic Leptosols PG	6.03	5.34	7.59

AL – Arable Land, PG – Permanent Grassland

Source: SSCRI

♦ **Physical properties of soil**

The table shows changes to values of total porosity in the A-horizon of agricultural land during three PMS-S cycles.

Trend in overall porosity in the A-horizon of soil in Slovakia, based on the comparison of outcomes from three PMS-S cycles

Main soil unit	Volume %								
	Light soils			Medium heavy soils			Heavy soils		
	1993	1997	2002	1993	1997	2002	1993	1997	2002
Mollic Fluvisols	-	-	-	46.42	49.52	49.79	53.45	48.8	48.57
Rendzic Leptosols	-	-	-	53.71	41.76	46.79	46.66	50.29	55.55
Regosols	44.64	44.31	45.90	-	-	-	-	-	-
Cambisols	32.70	45.50	-	40.20	48.30	50.92	51.90	51.60	53.24

Source: SSCRI

Soil degradation

Soil contamination by heavy metals

Results from the III. cycle of PMS-S with samples extracted in 2002 showed that the content of the majority of risk substances in selected agricultural land of Slovakia are below the limit, especially being the case of arsenic, chromium, copper, nickel, and zinc. In case of cadmium, excessive limit values were recorded only in soils situated in higher altitudes, podzols, andosols, which might relate to remote transfer of emissions (Kobza and coll., 2002).

Most recent average distribution of risk elements ($mg.kg^{-1}$) in the A-horizon of some agricultural land types in Slovakia (III. monitoring cycle of PMS-S)

Main soil unit	Risk elements in 2 $ml.dm^{-3}$ of HNO_3 leachate						
	As	Cd	Cr	Cu	Ni	Pb	Zn
Podzols and Sceletic Leptosols	3.55	0.48	2.24	4.52	0.85	63.61	12.94
Andosols	1.42	0.51	3.32	11.00	1.01	49.72	33.44
Regosols	0.65	0.17	3.31	8.38	1.84	5.31	9.34
Solonchaks and Solonetz	1.03	0.20	4.24	5.84	4.33	11.71	9.49
Cambisols	1.89	0.25	3.08	10.20	3.07	18.88	11.92
Rendzic Leptosols	0.69	0.38	3.50	9.10	5.15	20.40	21.55
Mollic Fluvisols	1.45	0.22	3.55	13.05	5.95	16.10	15.55

Source: SSCRI

In the III. monitoring cycle covering 274 agricultural hunts with the size of 15 802 ha, no excessive limit pollutants (PAU, PCB, chlorinated hydrocarbons) were found in the monitored hunts.

♦ Physical degradation

Erosion and soil compaction belong among the major phenomena of physical degradation in Slovakia.

Soil erosion

Water erosion is prevalent in Slovakia.

Agricultural land endangered by erosion in the SR

Erosion categories	Water erosion		Wind erosion	
	Land area in ha	% from Agricultural Land	Land area in ha	% from Agricultural Land
No erosion or slightly	1 274 857	52.3	2 286 822	93.8
Medium	217 487	9.0	73 186	3.0
Strong	368 704	15.1	45 753	1.9
Extremely strong	575 831	23.6	31 118	1.3
Total	2 436 879	100.0	2 436 879	100.0

Source: SSCRI

Application of the sewage sludge and bottom sediments into the soil

From the available data in 2005, production of sludge in that year resulted in 56 360 tons of dry matter. Of this volume, 39 120 tons (64.4 %) were used, and 8 710 tons (15.5 %) were landfilled, 5 870 tons of sludge dry matter were directly applied into agricultural land, 28 910 tons of sludge dry matter was used for compost production, while 4 340 tons of sludge was used for land purposes through different ways (recultivation, etc.).

Sewage sludge application into the soil

Year	Amount of sewage sludge (t)	Content (mg/kg dry matter)						
		Cd	Cr	Cu	Hg	Ni	Pb	Zn
2003	17 245	2.53	85.7	284	5.20	52.6	131.0	1 460
2004	12 067	1.84	115.0	276	3.12	23.9	72.6	1 130
2005	5 870	2.01	74.3	218	2.80	26.3	58.1	1 235

Source: WRI

*Everybody, while performing an activity, which could endanger, harm or destroy **plants or animals,** or their biotopes, are obliged proceed so that there is no pointless death loss or damage and destruction.*

§ 4 par. 1 of the Act No. 543/2002 Coll. on Nature and Landscape Protection as subsequently amended

• FLORA AND FAUNA

Flora

♦ Endangerment of wild-growing plant taxons

State of endangerment of the particular taxons of the plants is processed according to the current red lists (BALÁŽ, D., MARHOLD, K. & URBAN, P. EDS., 2001: **Red list of plants and animals of Slovakia**. Nature conservation n. 20 (Suppl.), 160 pp.).

State of endangerment of plant taxons in 2005

Group	Total number of taxons		Endangered (IUCN cat.)						Ed
	World (global estimation)	Slovakia	EX	CR	EN	VU	LR	DD	
Cyanophytes and Algae	50 000	3 008	-	7	80	196	-	-	-
Lower fungi	80 000	1 295	-	-	-	-	-	-	-
Higher fungi	20 000	2 469	5	7	39	49	87	90	-
Lichens	20 000	1 508	88	140	48	169	114	14	-
Bryophytes	20 000	909	26	95	104	112	85	74	2
Vascular plants	250 000	3 352	77	266	320	430	285	50	220

Source: SNC SR

Legend:
Ed – endemic species

IUCN categories of endangerment:
EX – extinct
CR – critically endangered
EN – endangered
VU – vulnerable
LR – less endangered
DD – data deficient

The basic **reason** of plants endangerment is especially **the destruction of the sites.** The most of the critically endangered flora species of the SR comes from the biotopes globally endangered in all central Europe.

Comparison of the vascular plant endangerment* in selected countries (%)

	Slovakia	Austria	Hungary	Poland	Czech Rep.
Vascular plants	26.9	39.2	19.8	12.1	43.3

Source: OECD

* Among "endangered" taxons are those taxons classified under categories: CR, EN, and VU under IUCN.

♦ **Protection of plant taxons**

Protection of plant taxons is in the presence regulated by the **Decree of MoE SR No. 24/2003 Coll.** to the *Act on Nature and Landscape Protection No. 543/2002 Coll.* Number of the **state protected taxons** is now **1 368** (vascular plants – 1 208; bryophytes – 46; higher fungi – 85; lichens – 21; algae – 8). Nowadays, there are legislatively protected even the **species of the European importance** of the *92/43/EEC Council Directive on the conservation of natural habitats and of wild fauna and flora,* which does not occur in the SR area. From the total number of 1 368 protected taxons there are **850 taxons** occurring in Slovakia (vascular plants – 713, bryophytes – 23, higher fungi – 85, lichens – 21, algae – 8).

The basic criterion of the plant taxons protection is, except endangerment, also their listing in the lists of proper **international conventions** and **the environmental law of EU.**

Wild-growing plant taxons in Slovakia protected by international conventions and EU regulations (2005)

	Cyanophytes and Algae	Fungi	Lichens	Bryophytes	Vascular plants
In attachment II of **Habitats Directive**	-	-	-	9	328
In attachment IV of **Habitats Directive**	-	-	-	-	530
In attachment I and II of **CITES**	-	-	-	-	110
In attachment I of **Bern Convention**	-	-	-	8	34

Source: SNC SR

Processed and realized rescue programmes

Rescue programmes (RP)	Vascular plants species
Processed in 2005	There were processed RP for 2 critically endangered species in 2005: *Carex pulicaris, Glaux maritima*
Realized in 2005	There were realized RP for the following species in 2005: *Spiranthes spiralis, Liparis loeselii, Herminium monorchis, Peucedanum arenarium, Artemisia austriaca, Groenlandia densa, Lathyrus transsilvanicus, Ferula sadleriana, Onosma tornense, Astragalus asper, Fritillaria meleagris, Alkana tinctoria, Colchicum arenarium, Dactylorhiza ochroleuca, Orchis coriophora subsp. coriophora, Ophrys holubyana, Drosera anglica, Rhynchosphora alba, Scheuchzeria palustris, Lycopodiella inundata, Pulsatilla zimmermannii, Pulsatilla pratensis subsp. flavescens, Orchis palustris, Orchis elegans, Anacamptis pyramidalis, Carex chordorhiza*

Source: SNC SR

Actual problem endangering the diversity of plant species in last years has been becoming **invasive species**. **Mapping** of invasive species in Slovakia in 2005 was done in 42 small-size protected areas, and in other 148 sites. The following species were recorded most frequently: *Falopia japonica, Impatiens parviflora, I. glandulifera, Helianthus tuberosus, Ailanthus altissima, Echinocystis lobata, Solidago canadensis, and S. gigantea.*

There was observed approximately **175 allochtonous species** of plants in Slovakia, whereof in the presence about **20** species behaves as invasive ones. **The most spread** invasive plant species in our country are *Fallopia japonica, Helianthus tuberosus, Heracleum mantegazzianum, Impatiens parviflora, Solidago canadensis, Fallopia sachalinensis, Impatiens glandulifera, Solidago gigantea, Aster novi-belgii, Aster lanceolatus, Robinia pseudoacacia, Ailanthus altissima, Rudbeckia laciniata.*

Fauna

- **Endangerment of wild animals**

State of endangerment of the particular animal taxons is processed similarly as the endangerment of the plants according to the current red lists. State of endangerment of the molluscs (ŠTEFFEK, 2005) and Orthoptera (Gavlas & Krištín, 2005) draws on the updated red lists compiled in 2005.

State of endangerment of the particular invertebrate taxons in 2005

Taxons	Number of taxons		Categories of endangerment (IUCN)							Endangerment total	Endang. %
Group	World	SR	EX	CR	EN	VU	LR	DD	NE		
Mollusca	128 000	277	2	26	22	33	45	8	135	136	49.1
Aranea	30 000	934	16	73	90	101	97	46	-	424	45.4
Ephemers	2 000	132	-	8	17	16	-	-	-	41	31.1
Odonata	5 667	75	4	-	14	11	13	5	-	47	62.7
Orthoptera	15 000	118	-	6	7	10	20	10	-	53	44.9
Heteroptera	30 000	801	-	14	7	6	4	-	-	31	3.9
Coleoptera	350 000	6 498	2	15	128	500	81	2	-	728	11.2
Hymenoptera	250 000	5 779	-	23	59	203	16	-	-	301	5.2
Lepidoptera	100 000	3 500	6	21	15	41	17	11	-	111	3.2
Diptera	150 000	5 975	-	5	10	71	19	93	-	198	3.3

Source: SNC SR

State of endangerment of the particular vertebrate taxons in 2005

Taxons	Number of taxons		Categories of endangerment (IUCN)							Total	%
Group	World [4)]	SR	EX	CR	EN	VU	LR	DD	NE		
Lampreys		4	-	4	-	-	-	-	-	4	100.0
Pisces	25 000	79	6	7	8	1	22	2	-	45[1)]	57.0
Amphibians	4 950	18	-	-	3	5	10	-	-	18	100.0
Reptiles	7 970	12	-	1	-	4	6	-	-	11	91.6
Birds[2)]	9 946	219	2	7	23	19	47	4	19	121	55.3 (35.5[3)])
Mammals	4 763	90	2	2	6	12	27	15	4	68	75.6

Source: SNC SR

[1] taxon has two forms listed under two different categories (EX, CR)
[2] only nesting birds – of total number of 341 birds of Slovakia, only the all 219 species of nesting birds were assessed
[3] % of total number of birds 341
[4] Source: UNEP – GBO

IUCN Categories:
EX - extinct taxon
CR - critically endangered taxon
EN - endangered taxon
VU - vulnerable taxon
LR - lower risk taxon
DD - data deficient taxon
NE - non evaluated taxon

Comparison of vertebrates endangerment [1] in selected countries (%) (2002)

	Slovakia	Austria	Hungary	Poland	Czech Rep.
Invertebrates	5.2	-	> 0.9	11.7	0.4
Pisces	23.8	65.5	32.1	36.4	29.2
Amphibians	44.4	100.0	100.0	0	90.0
Reptiles	41.7	87.5	100.0	33.3	100.0
Birds	14.4	37.0	18.8	26.8	55.9
Mammals	22.2	35.4	71.1	18.1	33.3

Source: OECD

[1] "endangered" taxons include species under categories: CR, EN, and VU under IUCN

Austria) only autochthonous species; endangerment of the mammals: including EX and/or extinct species; birds: only nesting species in the area of the country; pisces: only freshwater ones, invertebrates: insecta, decapoda, mysidacea and mollusca.
Czech Rep.) data refer to autochthonous species and EX including.
Hungary) Endangerment of the mammals: protected and highly protected species; pisces: freshwater species, whereof there are 2 autochthonous species; "Endangered" pisces species including undetermined species. "Endangered" reptiles and amphibians refer to the protected and highly protected species.
Poland) mammals: only autochthonous species (from 89 species); birds: only nesting species (total number of species has ever been observed in Poland: 418); pisces: freshwater autochthonous species besides lampreys (from 78 freshwater species). invertebrates: estimation.
Slovakia) Pisces: only freshwater species

♦ Protection of animal species

Protection of animal species is regulated by the **Decree of MoE SR No. 24/2003 Coll.**, which implements the *Act on nature and landscape protection No. 543/2002 Coll.* The number of **animal taxons under state protection** has increased to **792 taxons** on the level of species and subspecies and to **12 taxons** on the level of genus.

Animal wildlife in Slovakia protected by international conventions and EU regulations (2005)

	Invertebrates	Pisces	Amphibians	Reptiles	Birds	Mammals
In annex II of **Habitats Directive**	48	24	5	1	-	22
In annex IV of **Habitats Directive**	46	1	10	8	-	28
In annex I of **Birds Directive**	-	-	-	-	112	-
In annexes I and II **of CITES**	2	-	-	-	61	6
In annexes II and III of **Bern Convention**	26	36	11	8	120	26
In annexes II and III of **Bonn Convention**	-	3	-	-	54	-
In annex of **AEWA***	-	-	-	-	122	-

* AEWA – African-Eurasian Migratory Water Bird Agreement
Source: SNC SR

Rescue programmes in 2005 were realized for the following taxons: *Rupicapra rupicapra tatrica, Marmota marmota, Lutra lutra, Aquila heliaca, Aquila chrysaetos, Aquila pomarina, Falco cherrug, Falco peregrinus, Otis tarda, Crex crex, Emys orbicularis* a *Paranssius apollo*.

In **breeding** and **rehabilitation stations** operated by the nature and landscape protection organizations (including ZOO Bratislava) there were **adopted** in 2005 altogether **538** injured individuals or otherwise disabled animals. Back to wild nature there were **released** altogether **281** individuals and there was spent more than 330 thous. SKK.

There was provided **the guarding** of 92 nests of 8 bird of prey species (*Aquila heliaca, Aquila chrysaetos, Aquila pomarina, Haliaeetus albicilla, Falco peregrinus, Falco vespertinus, Circus pygargus, Milvus milvus*) - information only for the organization organs of SNC SR. There were successfully **brought up** 108 nestlings, which is in average 1.2 brought up nestlings per nest and there were **spent** about 390 thous. SKK.

In term of in situ animal preservation in 2005 there were organized **transfers and restitutions** of protected and endangered animals into proper nature biotopes by nature and landscape protection organizations. There were these animals – *Emys orbicularis, Spermophillus citellus, Bison bonasus, Castor fiber, Amphibia and Pisces* and there was **spent** altogether 236 thous. SKK.

Within the **improvement of nesting and living conditions** of animals, there were realized 326 actions, while there was invested 390 thous. SKK.

In **breeding stations** operated in cooperation with the nature protection organizations there were **situated** 2 species of the protected and endangered animals (*Emys orbicularis* and *Parnassius apollo*). Into the wilderness there were **released** 17 brought up individuals with investments of altogether 35 thous. SKK.

In concern of preventing the collisions of **migrating Amphibians** with the car transport, **over 18 kilometres of barriers** in total were build in 2005, with investment of more than 130 thous. SKK.

- **Numbers and quotas for fishing and hunting game**

Also in 2005, monitoring of game stock and fish continued as the basis for coordination of hunting or fishing of the selected species in hunting and fishing territories.

To 31st March 2005, the **spring stock numbers** of all the ungulate game species were higher in comparison to the previous year. Hunting for the rare animal species is strictly regulated (for more information see the chapter Forestry/Hunting).

Spring stock of game and game hunting as of March 31, 2005 (pieces)

Species	2003		2004		2005	
	stock	hunting	stock	hunting	stock	hunting
Deer	38 030	13 064	38 264	13 118	39 738	14 030
Fallow deer	7 501	2 109	7 475	2 011	8 425	2 529
Roe deer	83 756	20 770	84 547	20 269	85 124	20 659
Wild boar	28 779	21 118	27 415	23 727	27 116	22 551
Brown hare	219 450	28 144	201 316	31 842	199 226	36 511
Grey partridge	22 594	1 042	18 622	832	17 293	484
Pheasant	204 856	115 598	180 105	116 050	181 374	143 373
Chamois	553	8	522	7	625	12
Bear	1 318	13	1 419	34	1 483	35
Wolf	973	112	1 158	86	1 165	74
Otter	304	0	315	0	343	0

Source: SO SR

Amount of the fish **caught** in the fish ponds, water dams and water flows for economic and sport purposes achieved **2 652 t** in 2005. The waters were **stocked** by **28 741 377 pieces of setting**.

Fishing for the economic and sport purposes in 2005 (t)

Fish species	2003		2004		2005	
	total	of this SFA*	total	of this SFA*	total	of this SFA*
Fish total Of these:	**2 528**	1 631	**2 783**	1 565	**2 652**	1 663
Carp	1 186	1 040	1 360	988	1 281	1 092
Trouts	743	50	878	52	800	49
Crucians	101	71	80	75	76	71
White amur	36	34	28	28	33	24
Bighead carps	10	4	8	5	12	6
Sheat fish	36	35	36	35	37	35
Maskalonge	59	56	66	60	74	67
Sand-eel	78	78	78	76	83	82
Grayling	12	12	9	8	13	7
Huchen	1	1	1	1	1	1
Breams	99	98	98	98	106	105
Torgoch	1	0	0	0	9	1
Chevins	27	27	21	21	16	16
Other fish species	139	125	120	117	111	107

*SFA – Slovak Fishing Association

Source: SO SR