ANNEX G

AIR QUALITY - SUPPLEMENTARY INFORMATION

CONTENTS

G.1 ENERGY SITUATION IN SLOVAKIA AND THE STUDY AREA

1. ENERGY POLICY OF THE SLOVAK REPUBLIC

The main goals in energy policy in Slovakia were laid down in the "Energy Strategy for the Slovak Republic up to 2005," which was approved by the Government in 1993 and amended in 1997 after the First National Communication.

These objectives are:

- to establish a new legal framework for the energy sector
- to enhance the transit capacity for gas and electricity
- to expand the gas distribution networks
- to diversify imports
- to improve supply security and emergency preparedness
- to optimise the extraction and use of domestic energy sources, and
- to minimise the environmental pollution in accordance with the international commitments of Slovakia

Until now, only the energy law adopted is the Law on Peaceful Use of Nuclear Energy of 1998.

The majority of the energy industry is owned by the state directly or indirectly through the National Privatisation Fund. The electricity and gas industry, crude oil transport and parts of lignite mining are owned entirely by the state. The Government aims to maintain a controlling interest in these companies, at least in the medium terms.

Distributors are, however, entitled to own and operate central heating plants, primarily for providing heat to agglomerations and industries, and this would allow competition to emerge. This desegregated structure should be maintained and strengthened in any future restructuring of the energy industry. In contrast, the state-owned gas company is responsible for all gas business with the exception of gas storage. The gas company has the sole right to import, transport and distribute gas.

In the petroleum sector, the Slovnaft refinery holds a dominant market position in refining, product pipeline distribution and retailing. Some international companies and independent local distributors have gained market share in products retailing. However, Slovnaft still supplies directly and indirectly through shareholdings about two-thirds of the market.

Electric space heating is encouraged by preferential tariffs that are well below the prices for any other consumer groups. The growing demand for heating is of particular concern since it alters the load pattern and makes the construction of medium-and peak-load capacity a priority.

Pre-tax oil product prices for petroleum products are comparable to Western European levels. Since sales taxes are much lower, end-user prices are about 40% below the price levels in Germany. Prices for electricity and gas require urgent action, both regarding their structure as well as their levels. Prices for households are only about 20% of the levels of OECD-Europe, and residential customers generally pay less than industry. Prices for heat supply to households cover only 60% of the production costs.

With the exception of district heat and the coal industry, the energy industry operates without direct state subsidies. Although Slovakia has succeeded in reducing subsidies paid to the lignite mining industry to very low levels, direct state supports for residential heat consumers remain high and are substantial. According to current political discussions this subsidies will be lowered step by step. An amendment of the Act on prices is also in preparation.

Low-quality brown coal is the largest domestic energy source, accounting approximately for 6% of TPES. The Energy Strategy foresees only a gradual phasing out of domestic brown coal mining after 2005 with a possible closure by 2020, a year that is linked to the planned date for the decommissioning of Slovakia's main brown coal fired power station. Domestically produced brown coal is of poor quality and is increasingly being replaced by imported coal in power generation and by natural gas as well as electricity in the residential sector.

Given Slovakia's large share of energy-intensive industries together with its outdated technology and production processes, opportunities for energy savings are considerable. Options for reducing energy demand for residential space heating and in the district heating supply system are also promising. Robust economic growth has already helped modernise certain energy-intensive industries, and increasing income levels will further narrow the energy efficiency gap between Slovakia and Western Europe, which is still substantial.

Table G.1 - 1 shows the current status of energy price regulations. Energy prices that are based on sound economic principles are a precondition for fully exploiting the potential for energy efficiency. Enhancing efficiency would also help dramatically reducing the need for new supply-side expenditure, for example in generating capacity or imports. The currently prepared Energy Efficiency Law should support these efforts.

Table G.1 - 1 Current Status of Price Regulation

	Wholesale	Retail
Transport Fuels	maximum ex-refinery prices	maximum prices
Heating Fuels	maximum ex-refinery prices	liberalised
Natural Gas	maximum price	maximum price
Electricity	maximum price*)	maximum price
Heat	maximum price, based on all costs and reasonable profits	maximum price**)
Coal	liberalised	liberalised

* Includes prices for purchases by distribution companies from the generator

** Price is insufficient to cover costs, a significant portion of the costs is covered by state subsidies

Note: Price supervision is based on Act No. 18/1996 on Prices

Energy conservation is listed as one of the main pillars of Slovakia's energy policy. Nevertheless, all the instruments needed to underpin this objective are not fully in place yet. A planned reorganisation of the different bodies active in the field should lead to some streamlining.

The Government sees nuclear energy as an important option for reducing electricity imports, which amounted to 12% of domestic supplies in 1996, and for meeting its environmental objectives. In 1996, about 45% of domestically produced electricity were generated in nuclear power plants.

2. ENERGY BALANCE IN SLOVAKIA

Table G.1 - 2 shows the basic data on the energy demand and supply in the Slovak Republic. While total primary energy supply (TPES) declined by 22% between 1990 and 1994, this trend was reversed in 1995 when economic recovery gave momentum to energy demand growth, in particular for electricity, natural gas and transport fuels. Consequently, in 1995 TPES increased by 5.2% and estimates for 1996 indicate that TPES grew by a further 2.5%.

After growing 5.1% in 1995, electricity demand increased in 1996 by another 5.7%, with particularly strong growth in industry (7%) and household electricity demand for heating (33%).

Table G.1 - 2 Energy Supply and Demand in the Slovak Republic, 1990-1996

	1990	1991	1992	1993	1994	1995	1996	Annual Change 1990-96 (%)	Annual Change 1995-96 (%)
Hard Coal (1000 t)									
Production	-	-	-	-	-	-	-	-	-
Net Imports	5866	5160	4945	5124	5168	4932	5199	-11.4	5.4
Consumption	5879	5395	5092	5315	4990	5330	5394	-8.2	1.2
Brown Coal (1000 t)									
Production	4766	4119	3497	3547	3634	3759	3885	-18.5	3.4
Net Imports	6753	6767	5791	5576	3656	3423	3390	-49.8	-1.0
Consumption	12481	10913	9351	8957	7303	7221	7273	-41.7	0.7
Natural Gas (mcm)									
Production	444	305	404	232	268	314	307	-30.8	-2.2
Net Imports	6989	6050	5968	5059	5214	5605	6700	-4.1	19.5
Consumption	6666	6361	6399	5856	5572	6198	7007	5.1	13.1
Oil (1000 t)									
Crude and NGL Production	75	120	92	69	70	76	73	-2.7	-3.9
Net Imports of Crude	6169	4924	4299	4511	4762	5390	5341	-13.4	-0.9
Refinery Output	6434	5184	4557	4366	4950	5261	5331	-17.1	1.3
Net Exports of Products	-1424	-1138	-809	-1286	-1663	-1703	-2145	50.6	26.0
Products Consumption	4941	4201	3790	3054	3359	3487	3134	-36.6	-10.1
Electricity (GWh)									
Production	24067	22746	22347	23417	24740	25905	25290	5.1	-2.4
Net Imports	5196	4338	3468	1113	438	1418	3592	-30.9	153.3
Consumption	29263	27084	25815	24530	25178	27323	28882	-1.3	5.7
TPES (1000 toe)	21197	19280	17859	17151	16751	17524	17963	-15.3	2.5

Domestic oil and gas production is negligible and Slovakia imports virtually all of its oil and gas needs from Russia. These imports equal 48% of TPES. Together with nuclear fuel, which is supplied from Russia, and coal imports from the Czech Republic, Poland, Russia and Ukraine, Slovakia imports 89% of its energy needs. Since 1994, electricity imports have increased substantially and reached 2% of TPES in 1996 (or 12% of electricity supplies).

Low-quality brown coal is the largest domestic energy source, accounting approximately for 6% of TPES. Hydropower, the third largest source for electricity production after nuclear and coal, accounts for 2% of TPES.

Energy intensity in Slovakia is relatively high as shown in Table G.1 - 3 due to the large share of energy intensive industries together with their outdated technology and production processes.

Table G.1 - 3 Energy Intensity and Per Capita Energy Consumption (1995)

	Slovakia	OECD Europe	Austria	Hungary	Czech
TPES/GDP (Toe / 1000 US$ by 1990 exchange rates)	1.55	0.20	0.15	0.82	1.70
TPES/GDP (Toe / 1000 US$ using 1990 PPP's)	0.59	0.22	0.18	0.41	0.49
TPES/capita (Toe per capita)	3.25	3.34	3.28	2.44	3.78
Electricity/capita (kWh per capita)	4 695	5 417	6 305	3 075	5 469

Toe: ton oil equivalent

3. ENERGY CONSUMPTION IN THE STUDY AREA

Evaluation of the energy situation in the Study Area is complicated by the fact, that all energy statictic data are related to administrative units like okres or kraj. However, some data related to the area concerned were available. The energy balance was estimated according to the following data:

- Fuel consumption by large sources (REZZO 1)[1]
- Fuel consumption by middle and small sized sources (REZZO 2 and 3, according to okres areas which are included in the Study Area)
- Electricity consumption from the network by the largest sources (information from the Kraj Energy Agency)

The following adittional information/assumptions were used, according to information from Kraj Energy Agency :

- Energy produced in the Study Area is also spent in the Study Area
- There is no fuel production in the Study Area

Consumption of fuels (1997) and electricity (1998) in the Study Area thus obtained are shown in Tables G.1 - 4 and G.1 - 5, respectively.

Based on the analysis of above data and relevant information, the following may be said regarding the characteristics of energy consumption in the Study Area :

- The Hron river basin has a negative energy balance, due to the relatively high energy demand from the aluminium production industry, which consumes 6% of the total electricity production in Slovakia. However, this consumption is remarkably lower than that before the reconstruction, when $Al2O3$ was also produced from bauxite.

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[1] REZZO: Emission and Air Pollution Source Inventory in Slovakia. This inventory is classified into 4 components as explained in Section 5.3 of the Main Report.

- There is remarkably high consumption of biomass (24% of the Slovak total) due to the waste wood availability/utilization in the wood-processing factories.
- Consumption of natural gas in the Study Area as percentage in the national total is significantly lower than those of coals and their derivatives.
- The whole of the power produced in the Study Area with a total installed capacity of 2 730 MW thermal output is consumed in the area. There is no contribution of electricity to the national network.

Table G.1 - 4 Fuel Consumption in the Study Area(1997)

Fuel Kind	Slovakia Total (TJ)	Study Area (TJ)	Study Area Ratio to the Total (%)
Coal for coke production	71 690		
Hard coal	57 271	3 149	5.5
Brown coal	79 508	5 828	7.3
Briquettes	176		
Coke	4 295	398	9.3
Biomass	3 478	828	24
Crude oil	221 790	-	
Gasoline	- 12 331	2 900*	
Diesel	- 44 218	1 800*	
Heavy fuel oil	- 21 160	2 095	
Light fuel oil	- 2 497	200	
Petrol	- 2 237	761	
Other liquid fuels	27	-	
Natural gas	235 965	10 457	4.4
Propane butane	- 840	-	
Others	- 2	-	
Total	590 915	28 416**	4.8

* Assumed to be11 % of the Slovak total in 1997 (source: VUDI)
**Out of which consumption in REZZO 2 and 3 was 842 TJ

Table G.1 - 5 Electricity Consumption at Largest Consumers in the Study Area (1998)

Electricity consumption (1998)-main sources in Hron RB	GWh	% of Slovak production	% of Slovak consumption
Zeleziarne Podbrezová	216.345	0.8	
ZSNP Ziar nad Hronom	19.884	0.07	
Slov Alco Ziar nad Hronom	1 577.319	6	5
Harmanecké papierne Harmanec	44 440	0.17	
Izomat Nová Bana	19.388	0.07	
Total	1 877.376	7.22	6

Total electricity production in SR (1998)	26 017 GWh
Total electricity consumption in SR (1998)	31 359 GWh

G.2 FIGURES FOR AIR QUALITY IN THE STUDY AREA

Figures G.2 - 1 through G.2 - 5

Annual Mean Concentration of SO_2, NOx, CO, solid particles and ozone measured at monitoring stations in and around the Study Area.

Figures G.2 - 6 through G.2 - 15

Monthly average concentration of SO_2, NOx, and solid particles at each monitoring station.

Figures G.2 - 16 and G.2 - 17

Monthly average tropospheric ozone concentrations at 5 stations.

Figure G.2 - 18

Monthly average CO concentration at Station Namestie Slobody.

Figures G.2 - 19

Modelling result: Contributions of different source categories to the annual average concentrations of SO_2, NOx, solid particles, and CO over the Study Area (1998).

Figure G.2 - 20

Modelling result: Ratios of contribution of different source categories to the annual average concentration of SO_2, NOx, solid particles, and CO over the Study Area (1998).

Figure G.2 - 21

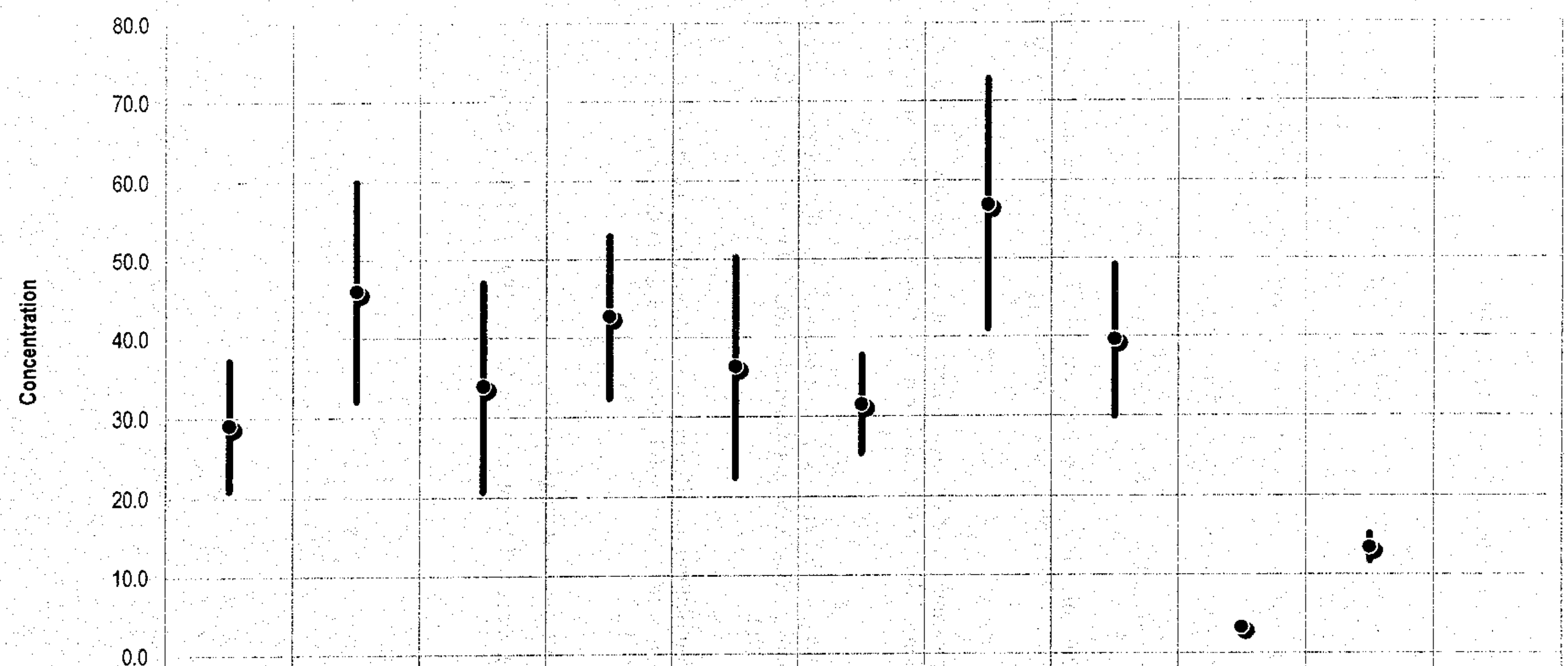
Modelling result: Contributions of different source categories to the annual average concentrations of SO_2, NOx, solid particles, and CO in the centre of Banska Bystrica (1998).

Figure G.2 - 22

Modelling result: Ratios of contribution of different source categories to the annual average concentration of SO_2, NOx, solid particles, and CO in the centre of Banska Bystrica (1998).

Data year for Figures 1 through 18: 1993 - 1998 except for:

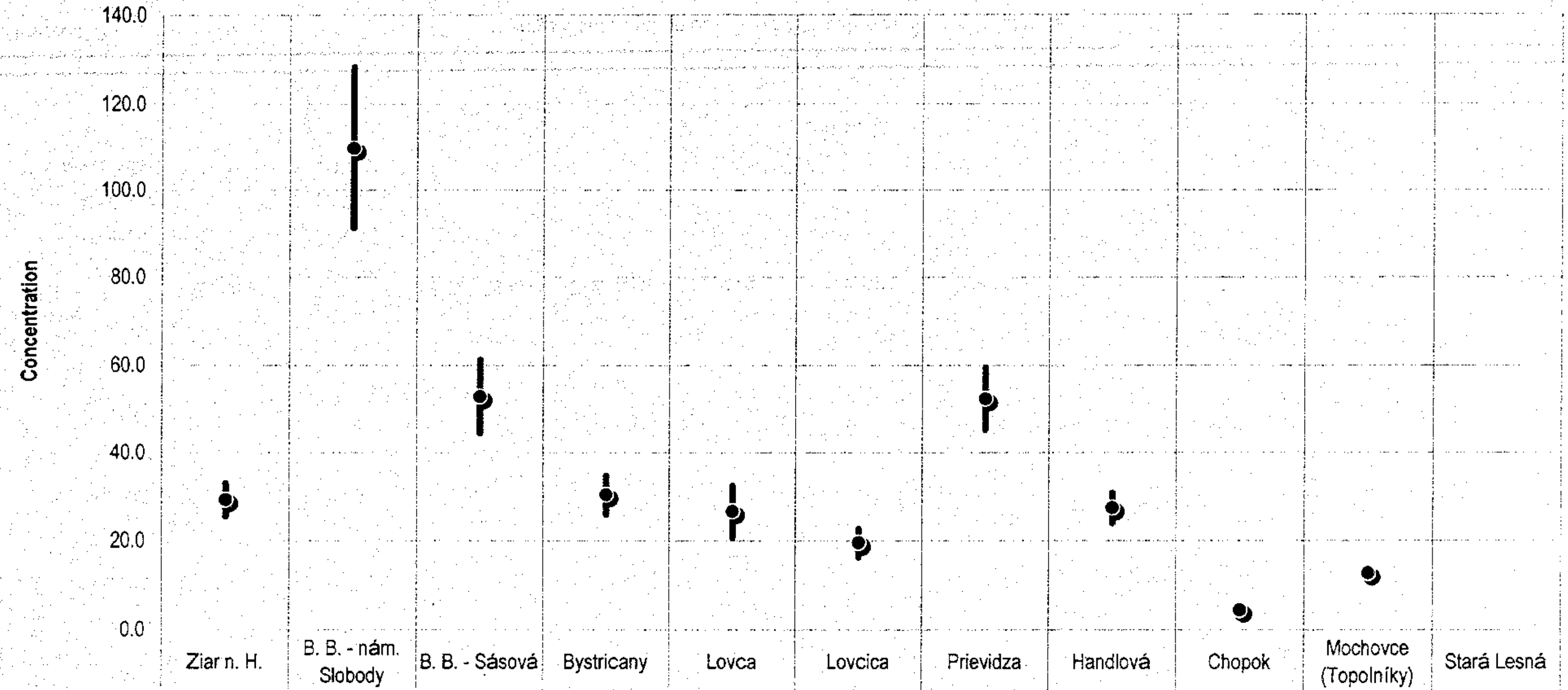
Station Handlova (1994 - 1998), Stations Chopok and Mochovce (1990 - 1998), solid particles at Station Sasova (1997 - 1998).



	Ziar n. H.	B. B. - nám. Slobody	B. B. - Sásová	Bystricany	Lovca	Lovcica	Prievidza	Handlová	Chopok	Mochovce	Stará Lesná
Minimum	20.9	32.1	20.7	32.4	22.4	25.3	41.0	29.9	3.0	11.6	
Maximum	37.2	60.0	47.0	53.0	50.3	37.7	72.8	49.2	3.7	15.2	
● MEAN	29.1	46.0	33.9	42.7	36.3	31.5	56.9	39.6	3.3	13.4	

Locality

Figure G.2 - 1 Average Concentration of SO_x ($\mu g.m^{-3}$) at Probability Interval 95%



	Ziar n. H.	B. B. - nám. Slobody	B. B. - Sásová	Bystricany	Lovca	Lovcica	Prievidza	Handlová	Chopok	Mochovce (Topolníky)	Stará Lesná
Minimum	25.4	91.2	44.5	25.9	20.6	16.4	45.2	23.9	4.2	11.8	
Maximum	33.1	128.3	61.3	34.8	32.6	22.7	59.6	30.9	4.7	13.7	
● Average	29.2	109.7	52.9	30.4	26.6	19.6	52.4	27.4	4.5	12.8	

Figure G.2 - 2 Average Concentration of NO_x ($\mu g.m^{-3}$) at Probability Interval 95%

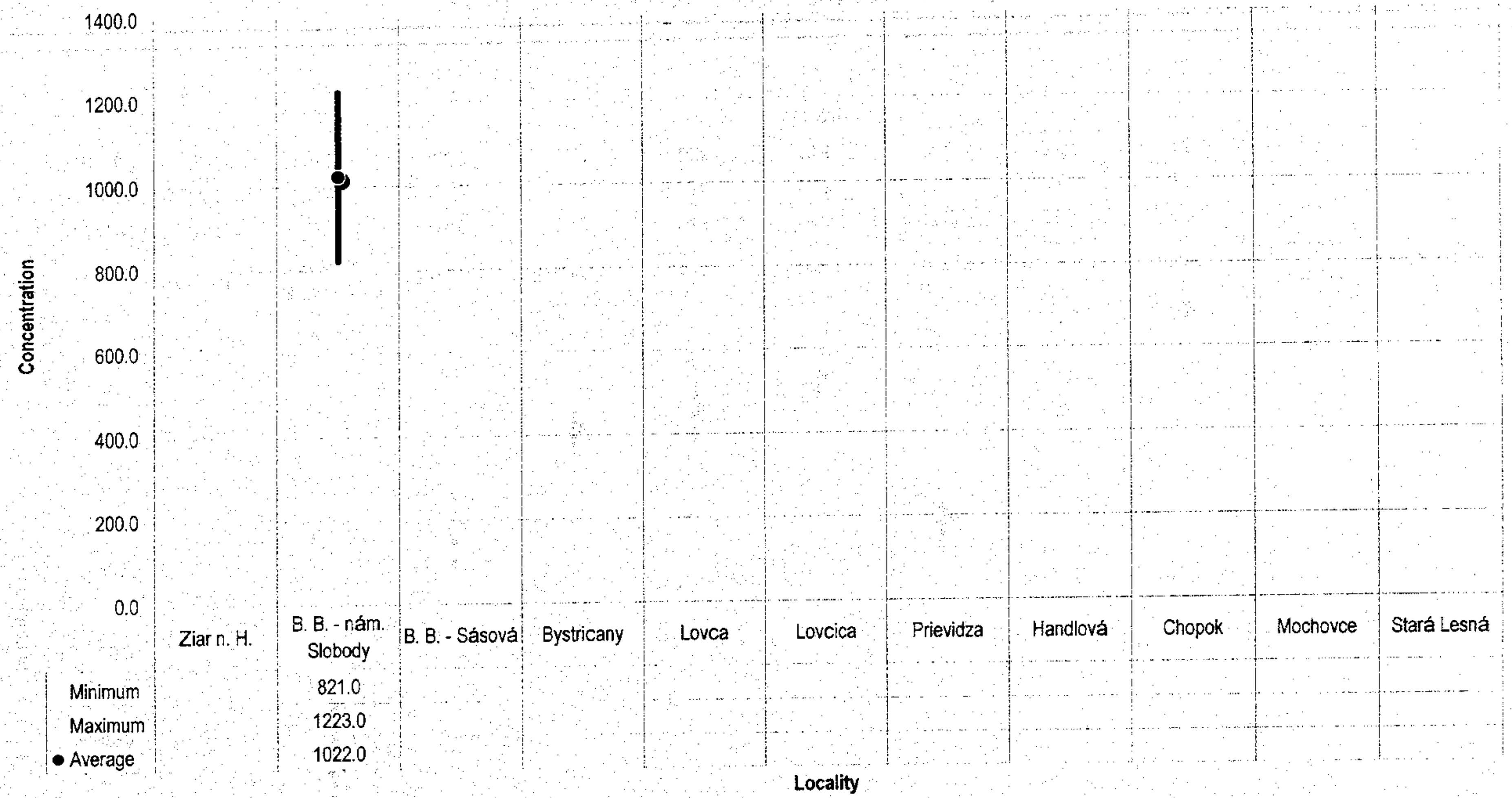
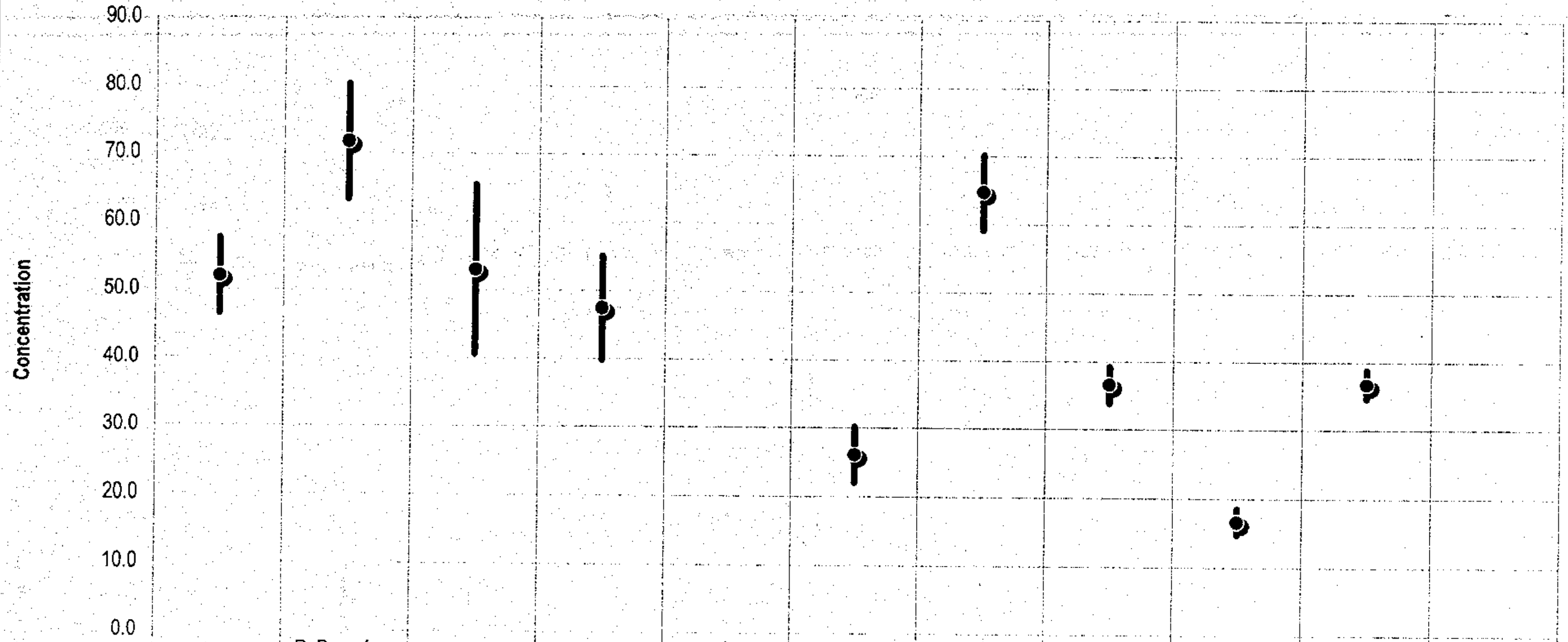


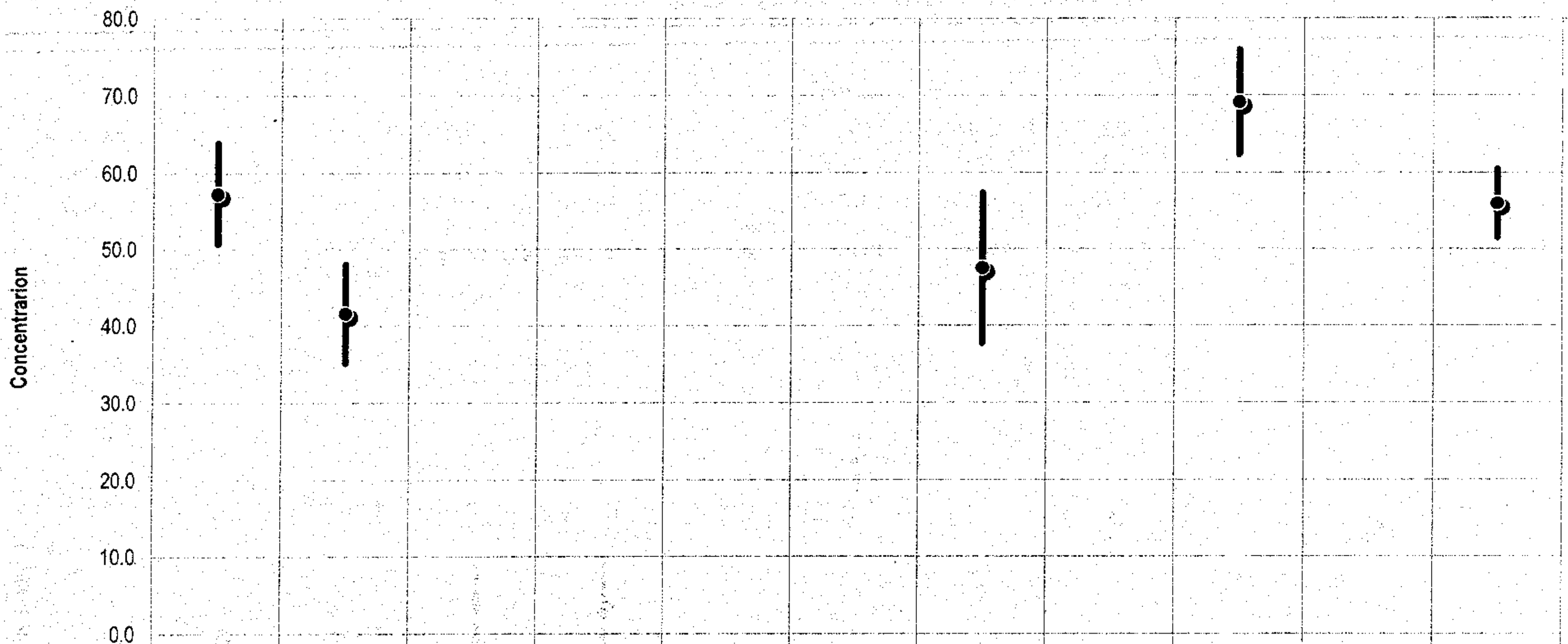
Figure G.2 - 3 Average Concentration of CO ($\mu g.m^{-3}$) at Probability Interval 95%



	Ziar n. H.	B. B. - nám. Slobody	B. B. - Sásová	Bystricany	Lovca	Lovcica	Prievidza	Handlová	Chopok	Mochovce	Stará Lesná
Minimum	46.5	63.2	40.6	39.8		21.9	59.1	33.8	14.7	34.6	
Maximum	57.6	80.3	65.4	55.1		30.2	70.2	39.3	18.6	38.9	
● Average	52.0	71.7	53.0	47.5		26.0	64.7	36.6	16.6	36.7	

Locality

Figure G.2 - 4 Average Concentration of Soil Particles ($\mu g.m^{-3}$) at Probability Interval 95%



	Ziar n. H.	B. B. - nám. Slobody	B. B. - Sásová	Bystričany	Lovca	Lovcica	Prievidza	Handlová	Chopok	Mochovce	Stará Lesná
Minimum	50.7	35.2					37.7		62.3		51.5
Maximum	63.9	48.1					57.4		75.9		60.5
● Average	57.3	41.6					47.5		69.1		56.0

Locality

Figure G.2 - 5 Average Concentration of Ozone ($\mu g.m^{-3}$) at Probability Interval 95%

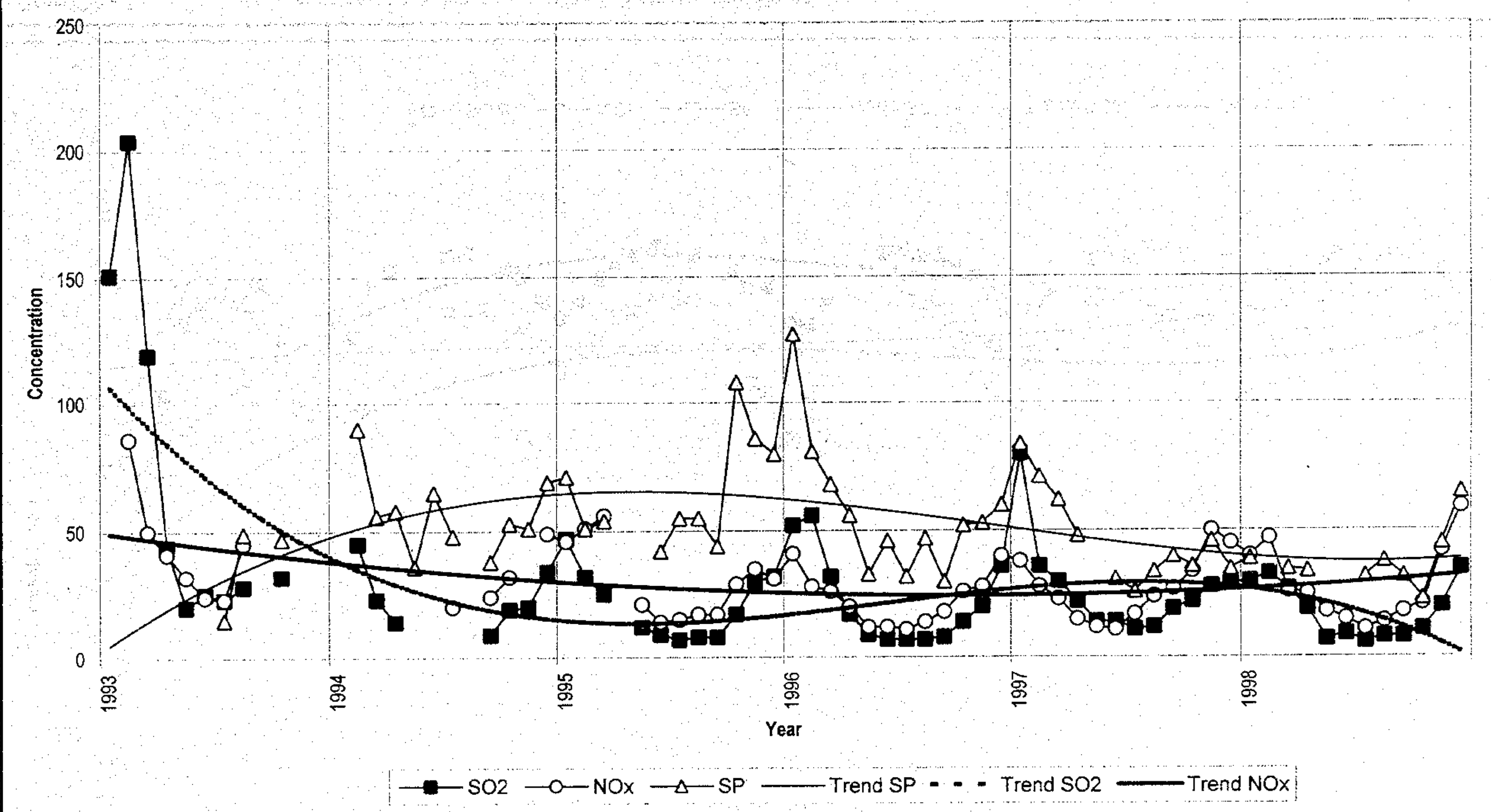


Figure G.2 - 6 Concentration of Pollutants ($\mu g.m^{-3}$) - Ziar nad Hronom

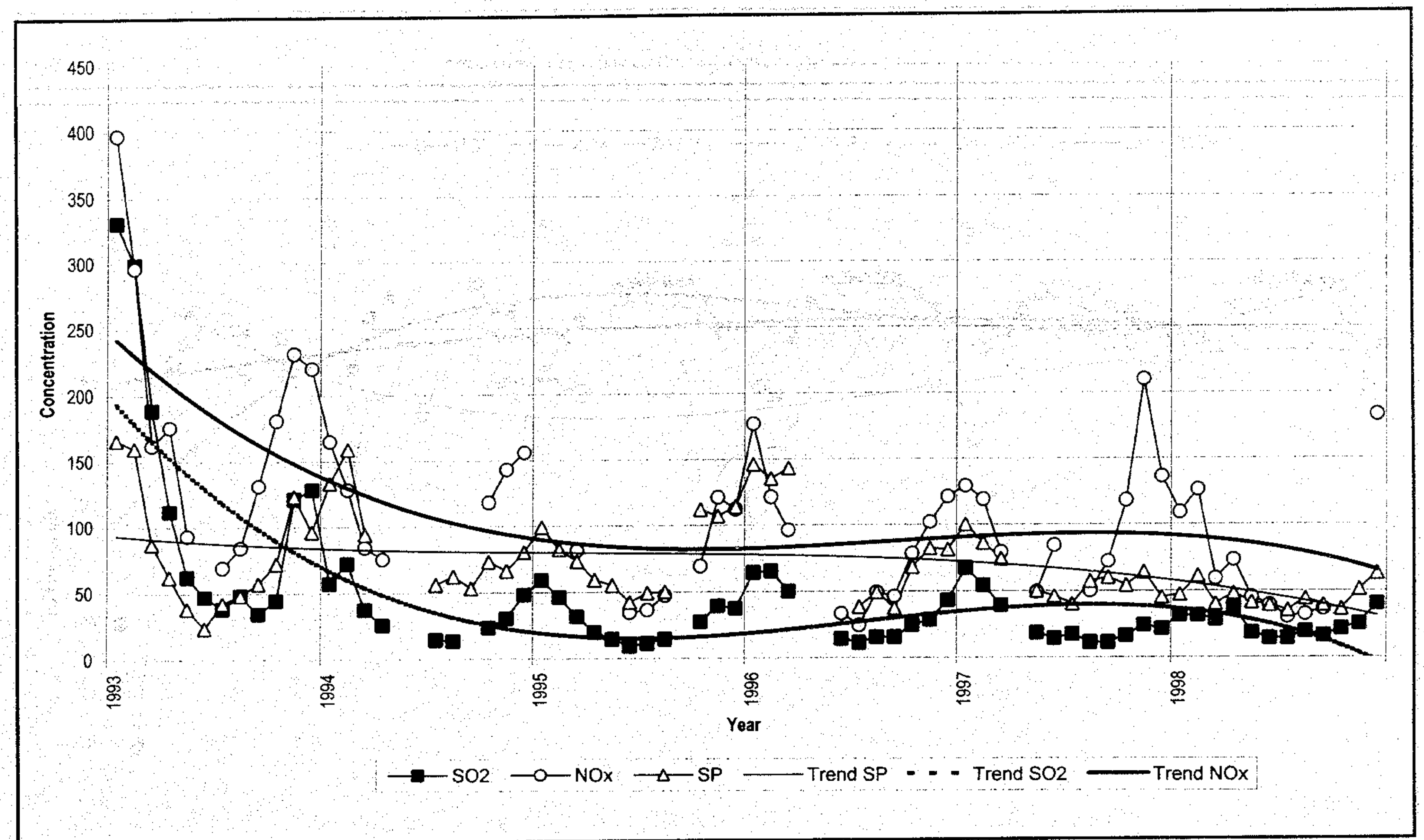


Figure G.2 - 7 Concentration of Pollutants (μg.m^{-3}) - B. Bystrica - nám. Slobody

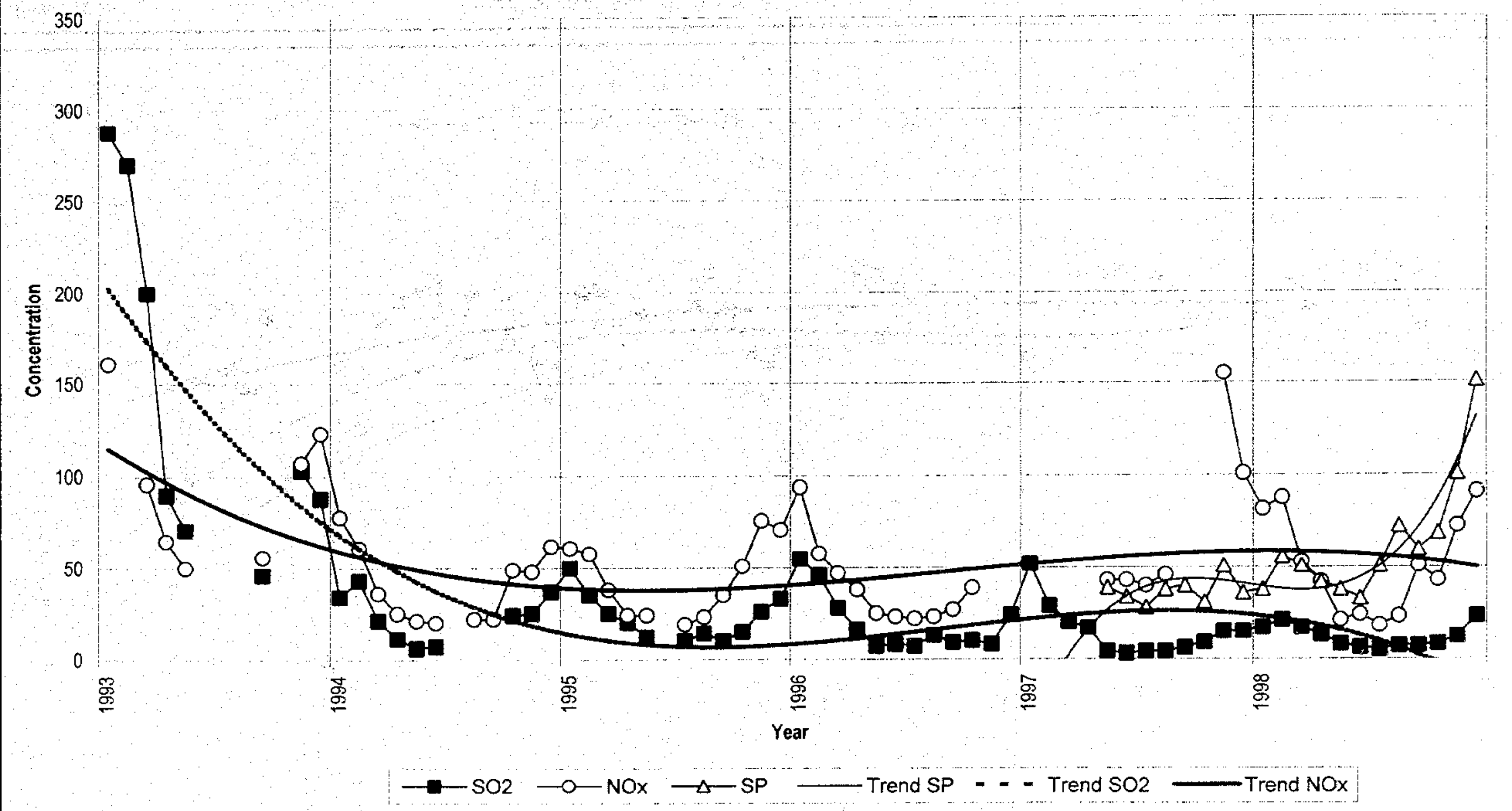


Figure G.2 - 8 Concentration of Pollutants ($\mu g.m^{-3}$) - B. Bystrica - Sásová

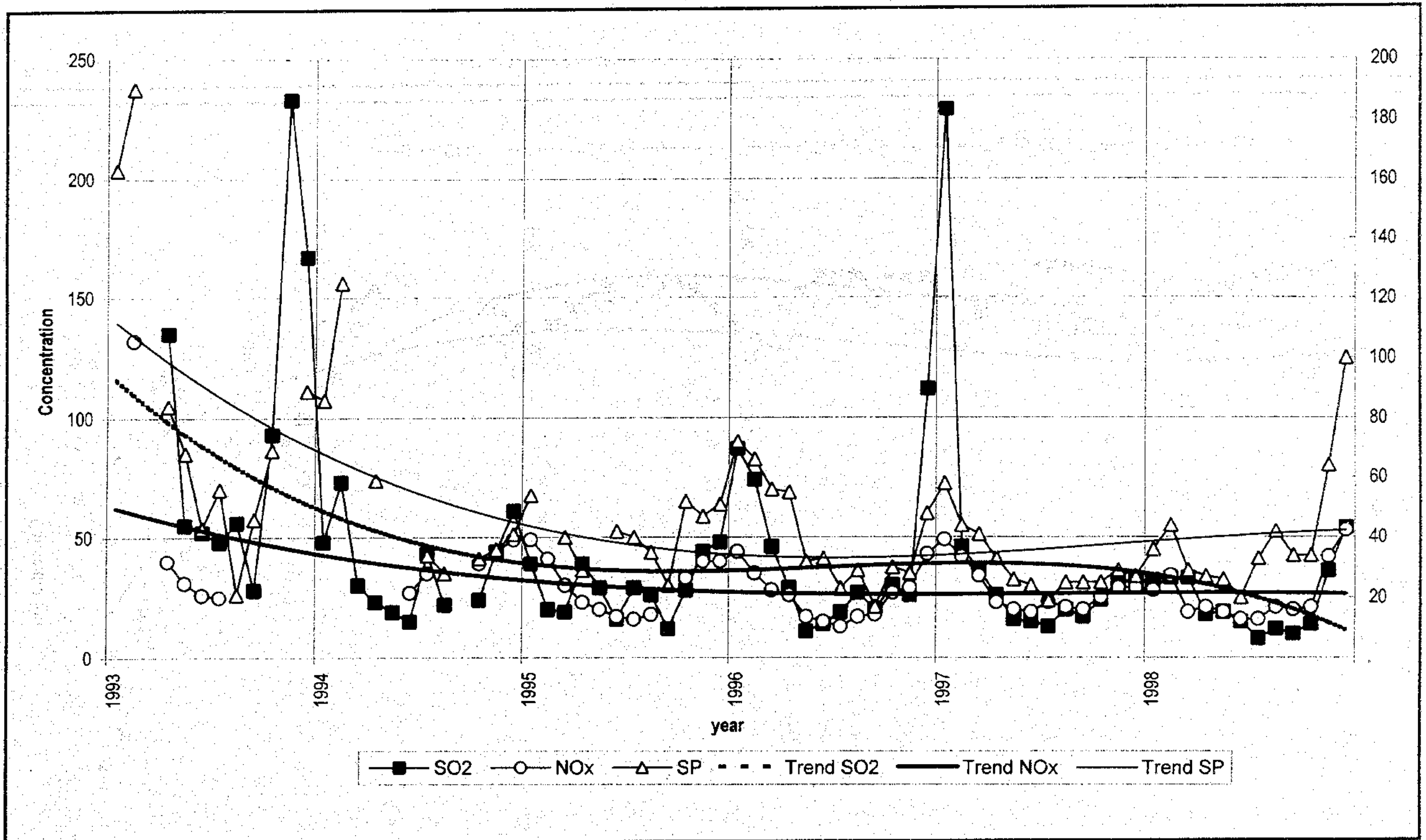


Figure G.2 - 9 Concentration of Pollutants ($\mu g.m^{-3}$) - Bystricany

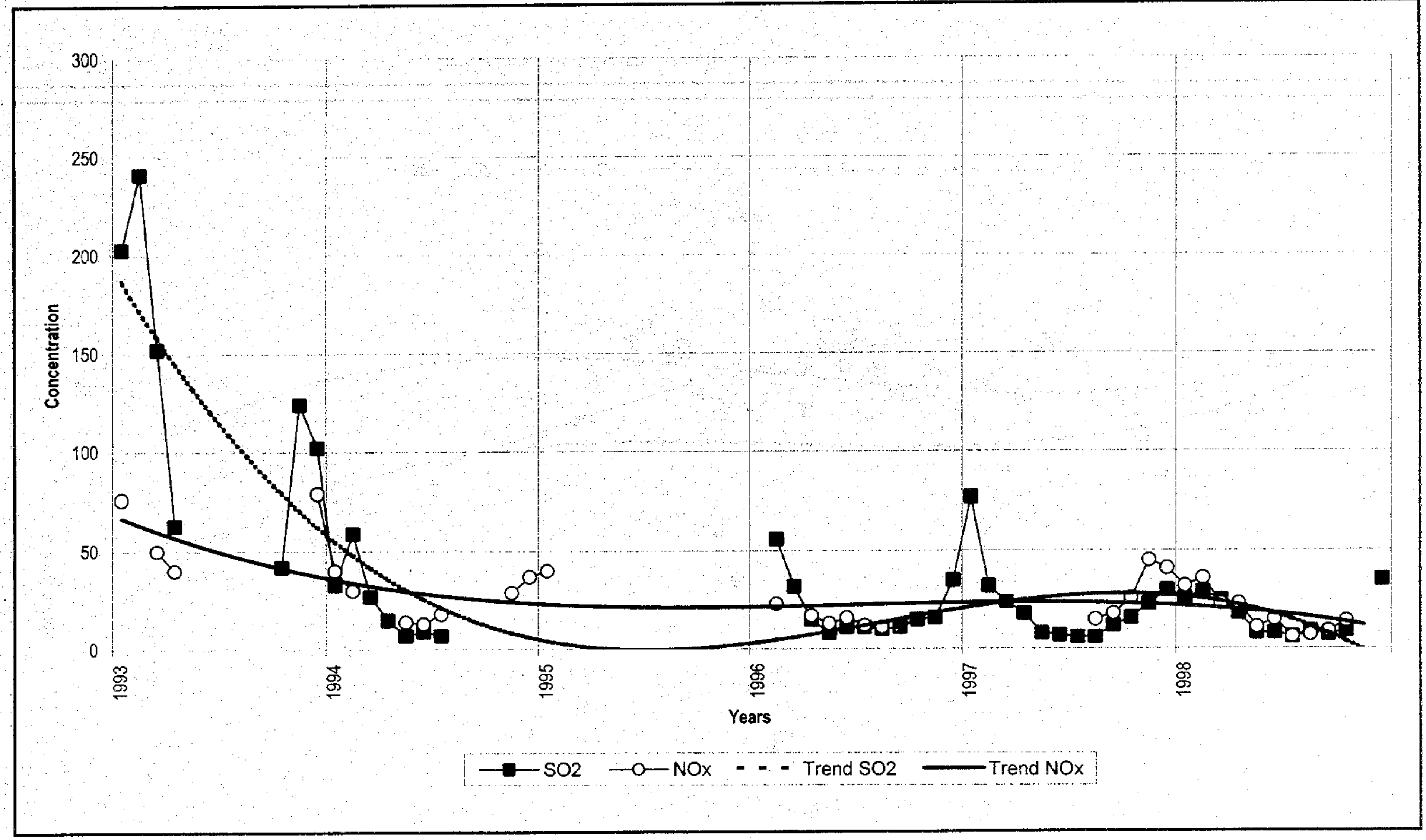


Figure G.2 - 10 Concentration of Pollutants ($\mu g.m^{-3}$) - Lovca

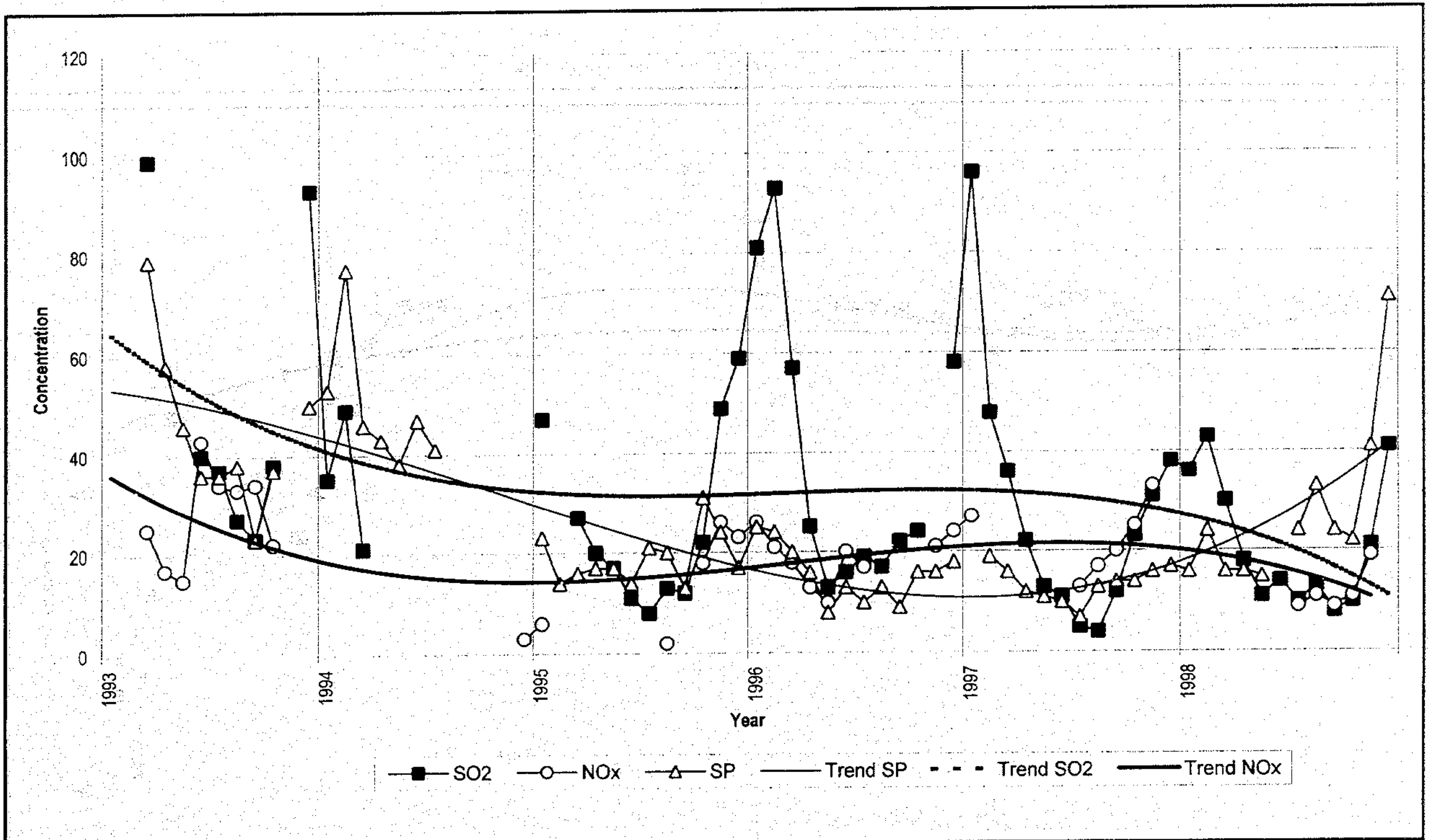


Figure G.2 - 11 Concentration of Pollutants ($\mu g.m^{-3}$) - Lovcica

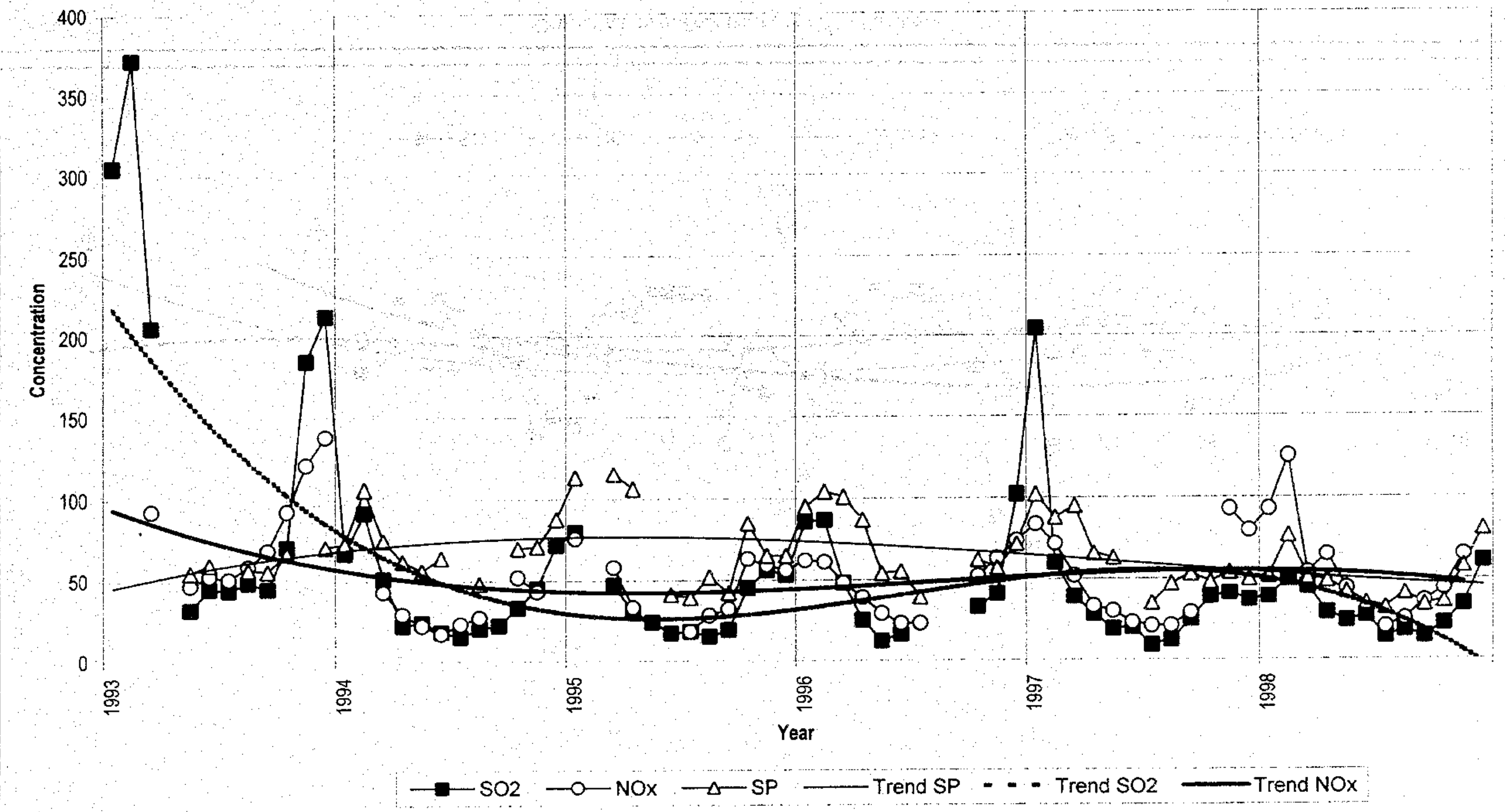


Figure G.2 - 12 Concentration of Pollutants ($\mu g.m^{-3}$) - Prievidza

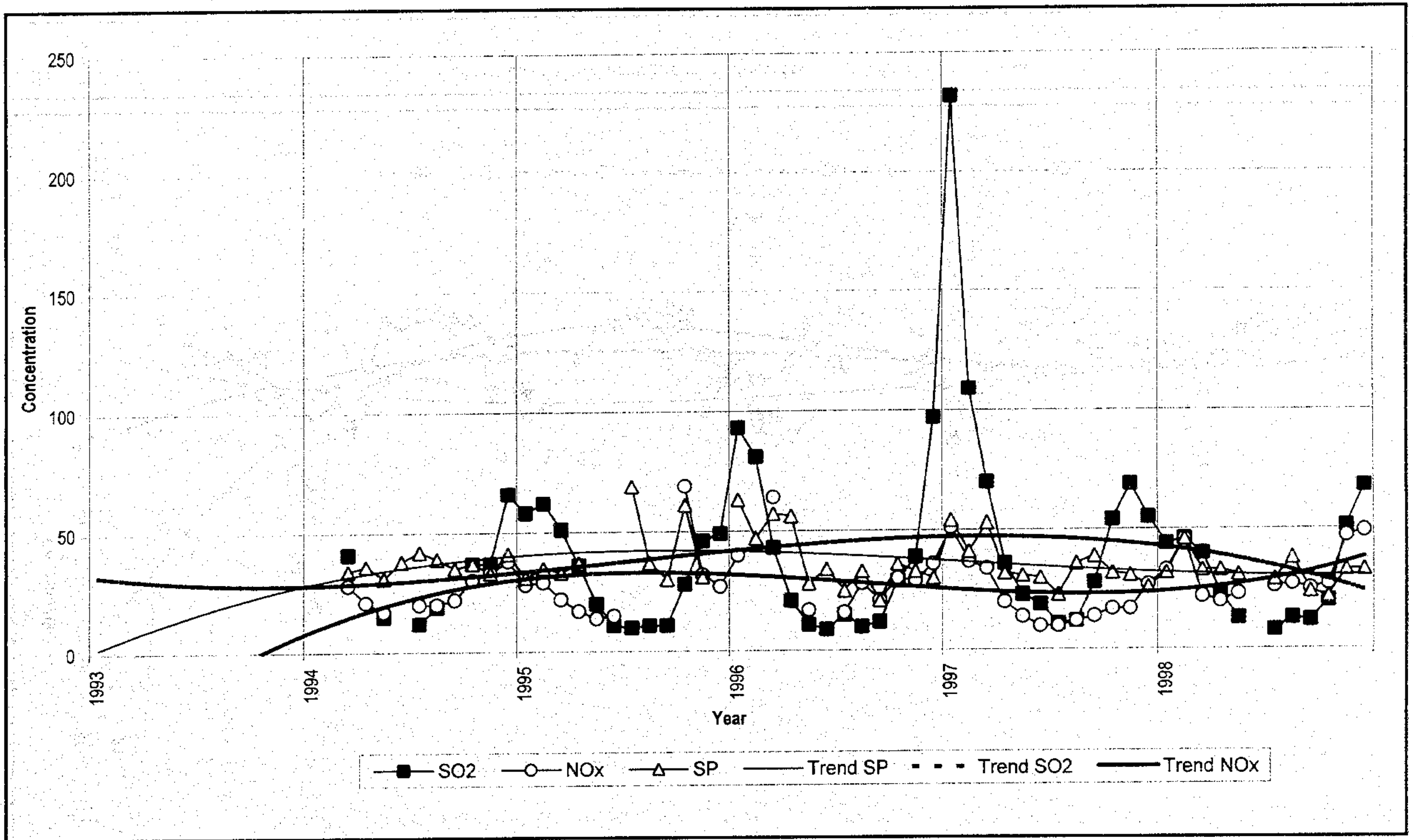


Figure G.2 - 13 Concentration of Pollutants (μg.m^{-3}) - Handlová

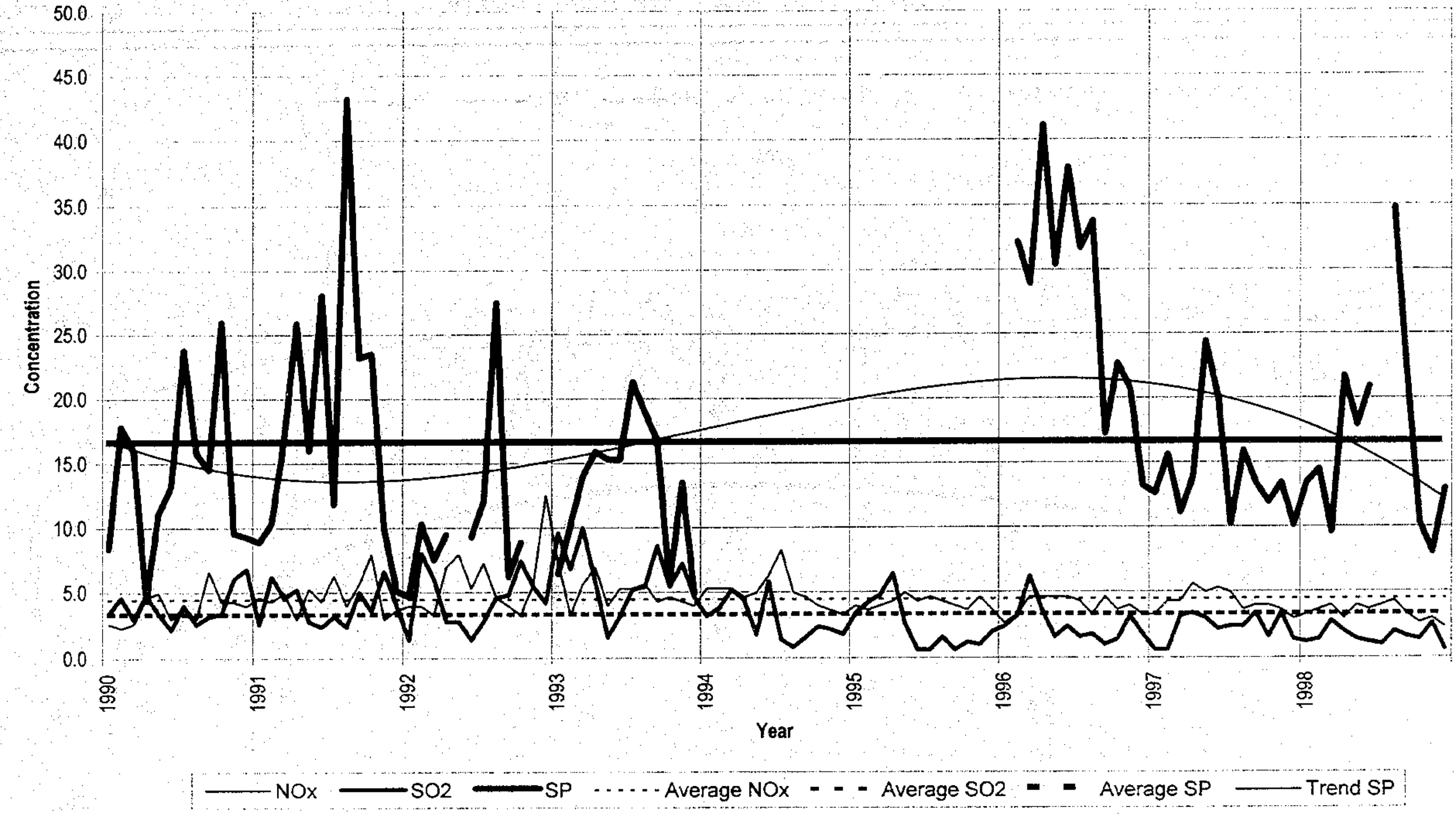


Figure G.2 - 14

Chopok - Monthly Average Concentrations of Pollutants ($\mu g.m^{-3}$)

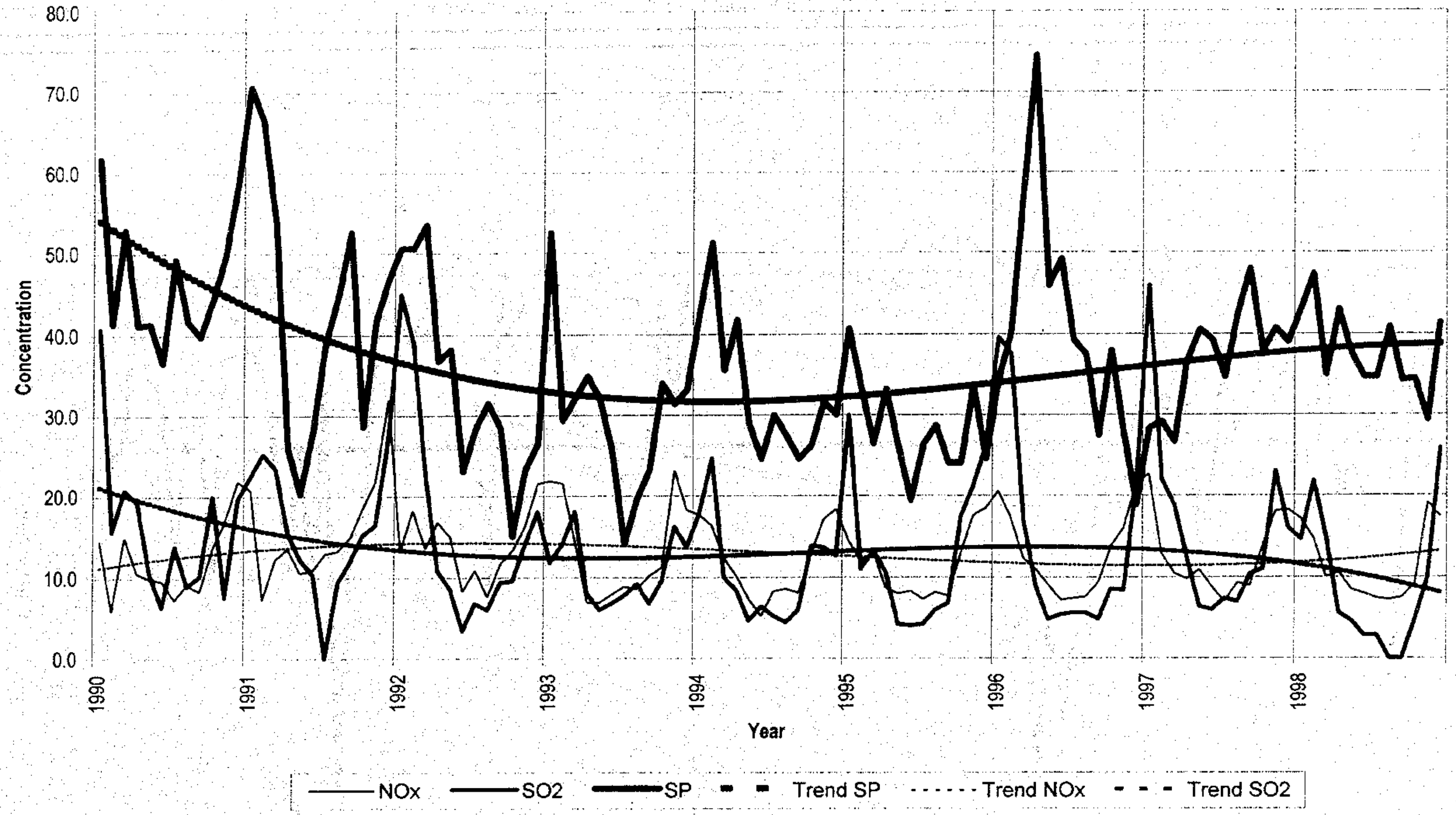


Figure G.2 - 15 Mochovce - Monthly Average Concentrations of Pollutants (μg.m^{-3})

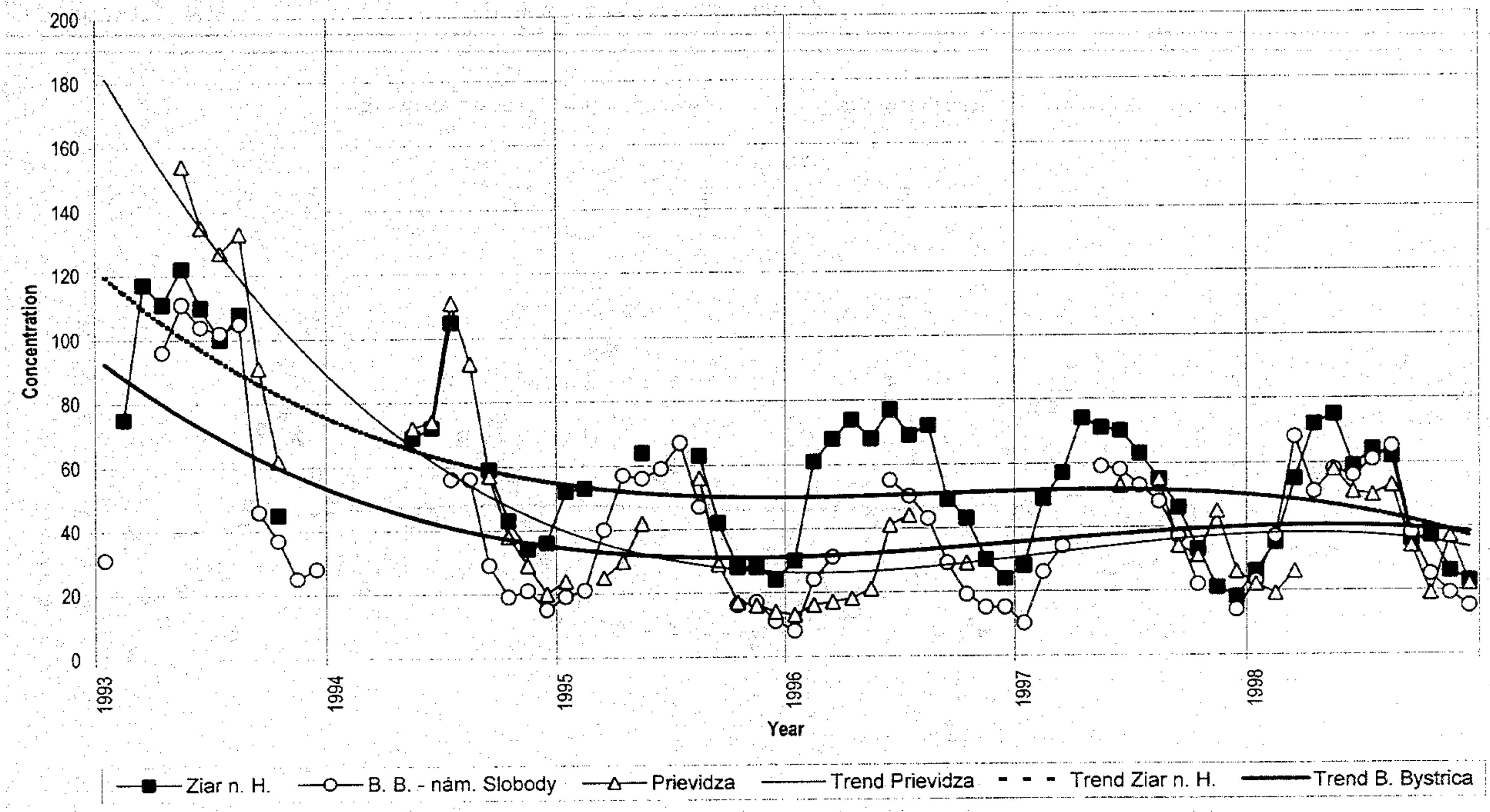


Figure G.2 - 16 Tropospheric Zone Concentration ($\mu g.m^{-3}$)

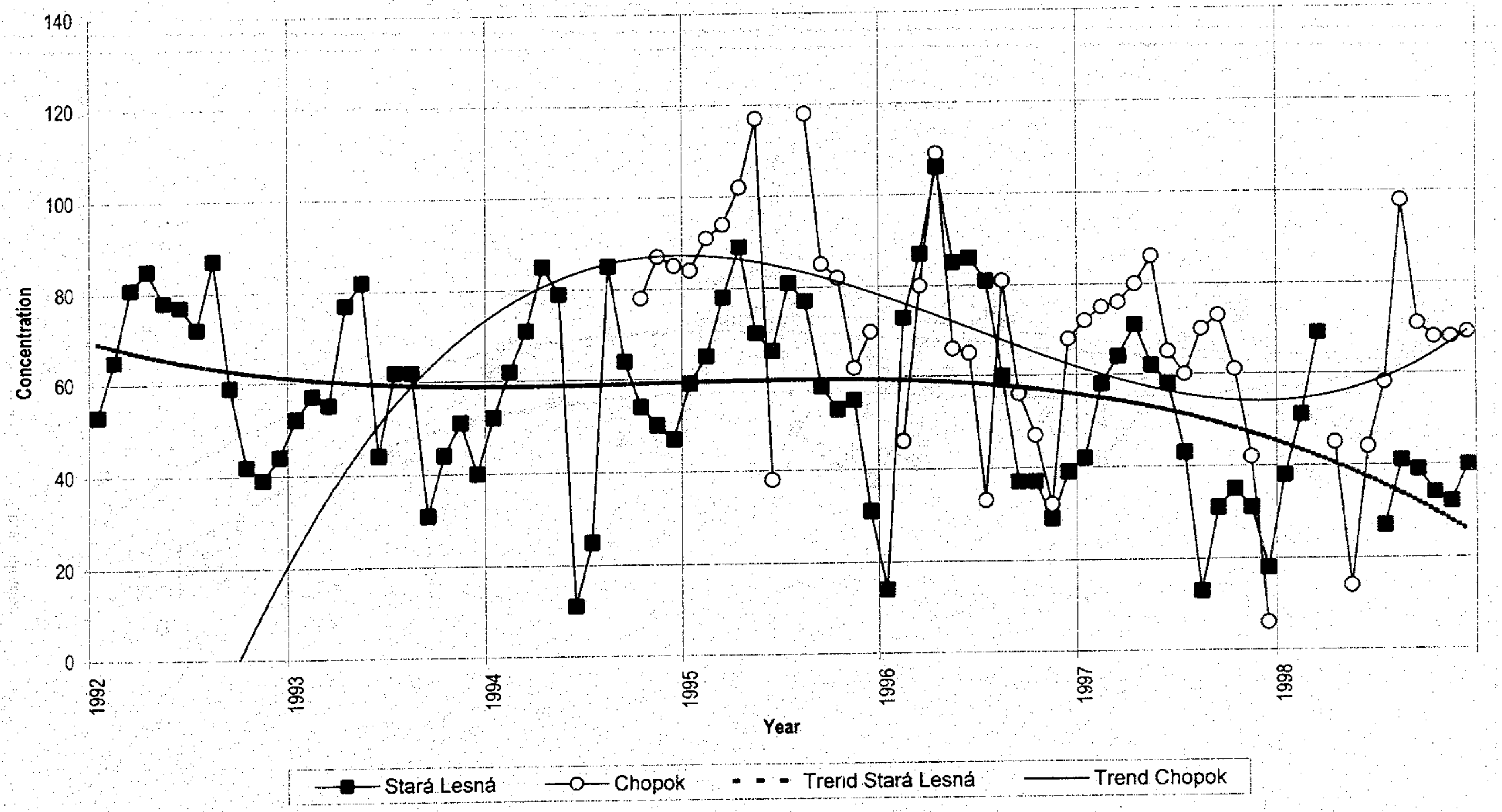


Figure G.2 - 17 Tropospheric Zone Concentration ($\mu g.m^{-3}$)

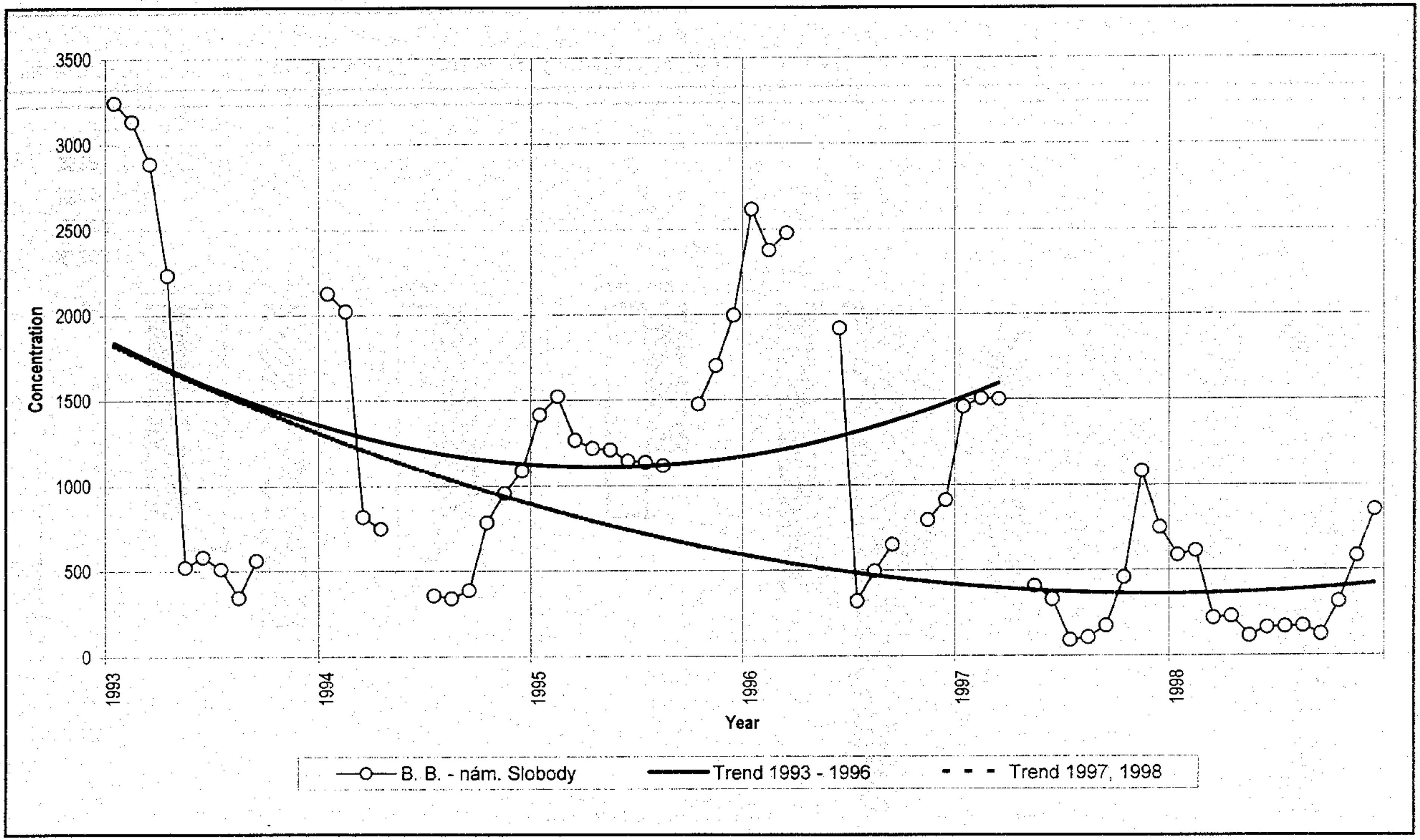
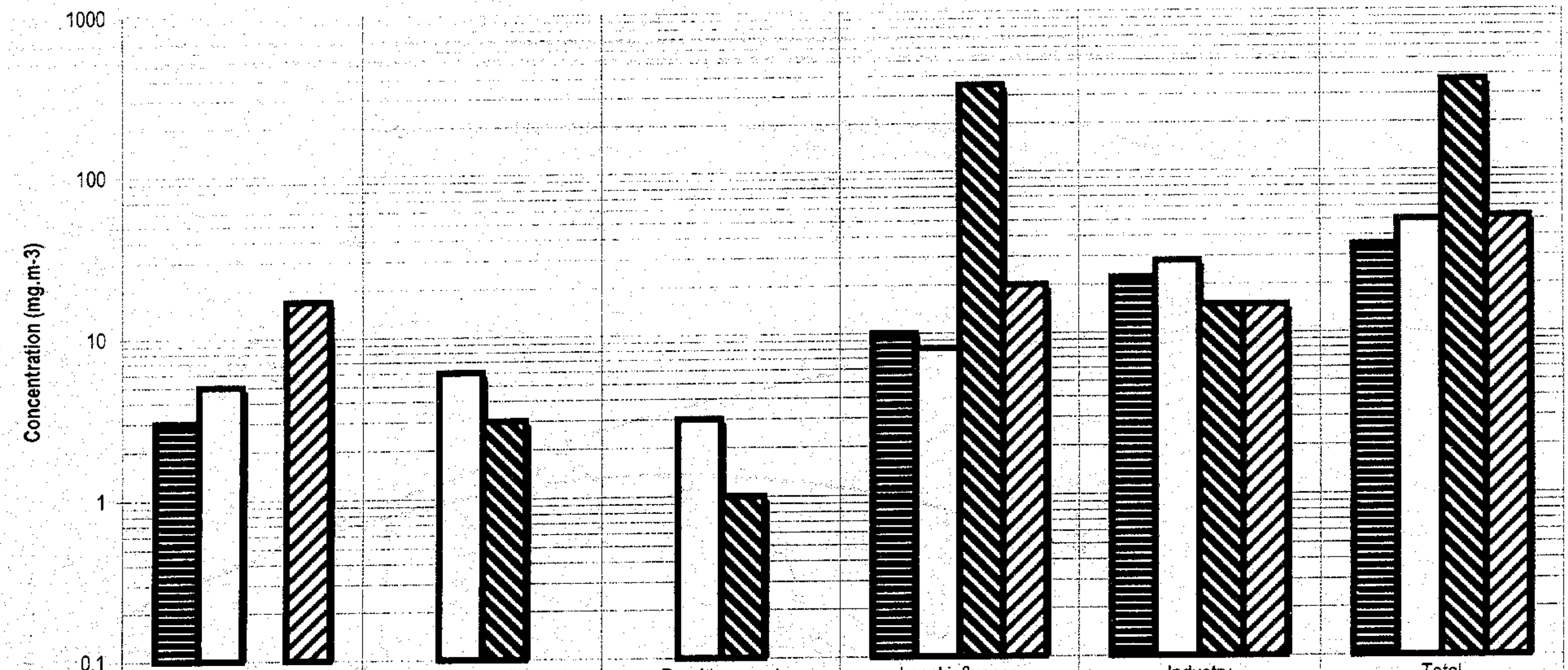
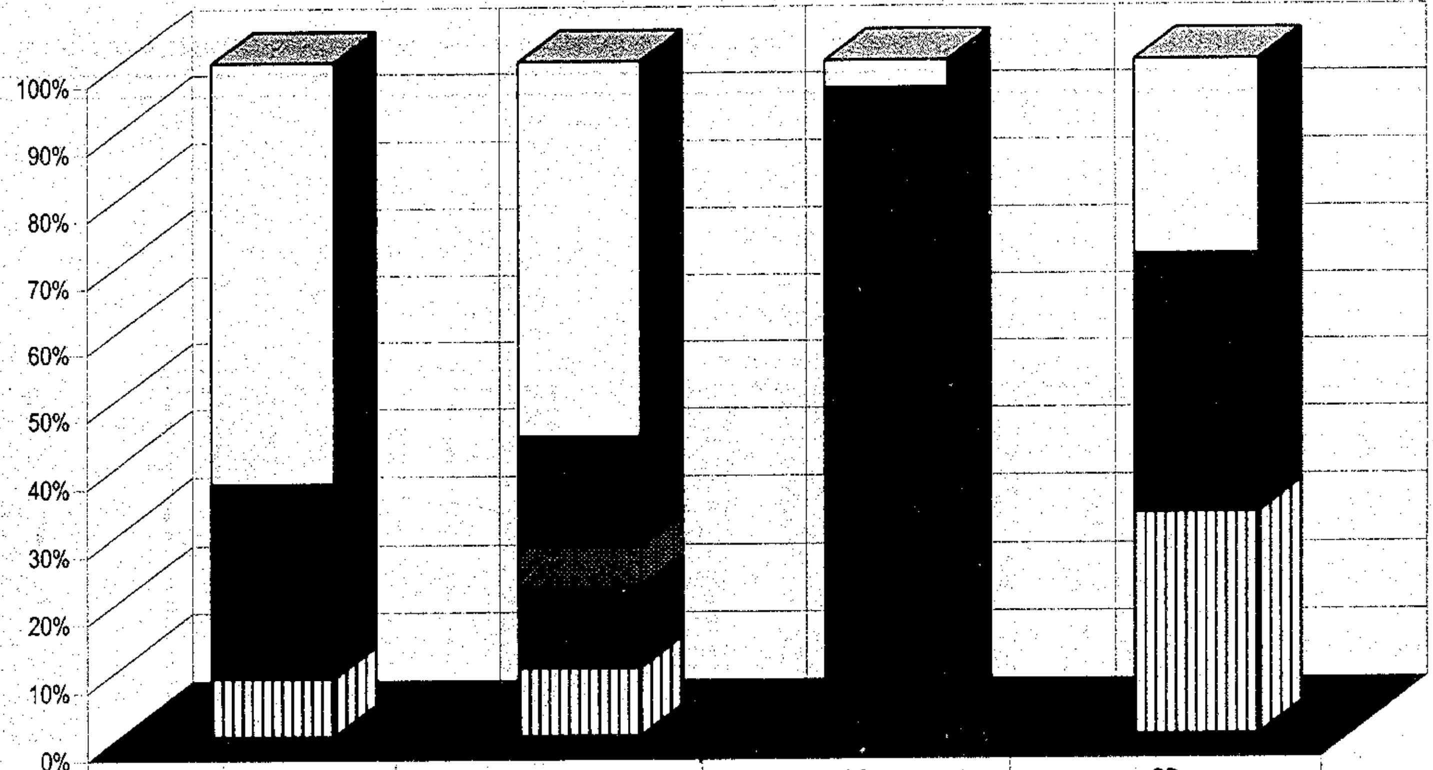


Figure G.2 - 18 CO Concentration ($\mu g.m^{-3}$)



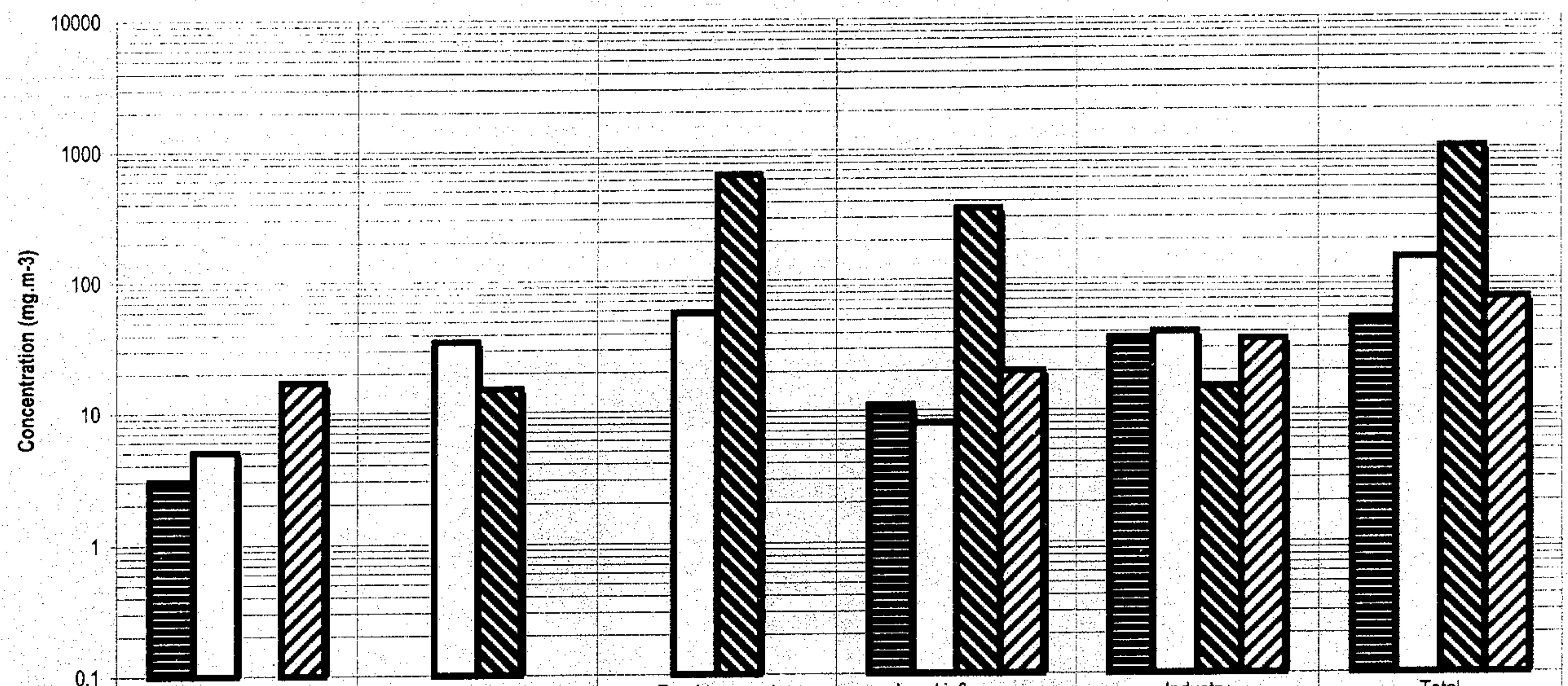
	Transboundary air pollution	Rail transport	Road transport	Local influence	Industry	Total
SO2	3			10	22	35
NOx	5	6	3	8	28	50
CO		3	1	350	15	369
SP	17			20	15	52

Figure G.2 - 19 Contribution of Different Source - Categories to Air Pollution - Average Concentrations in the Study Area



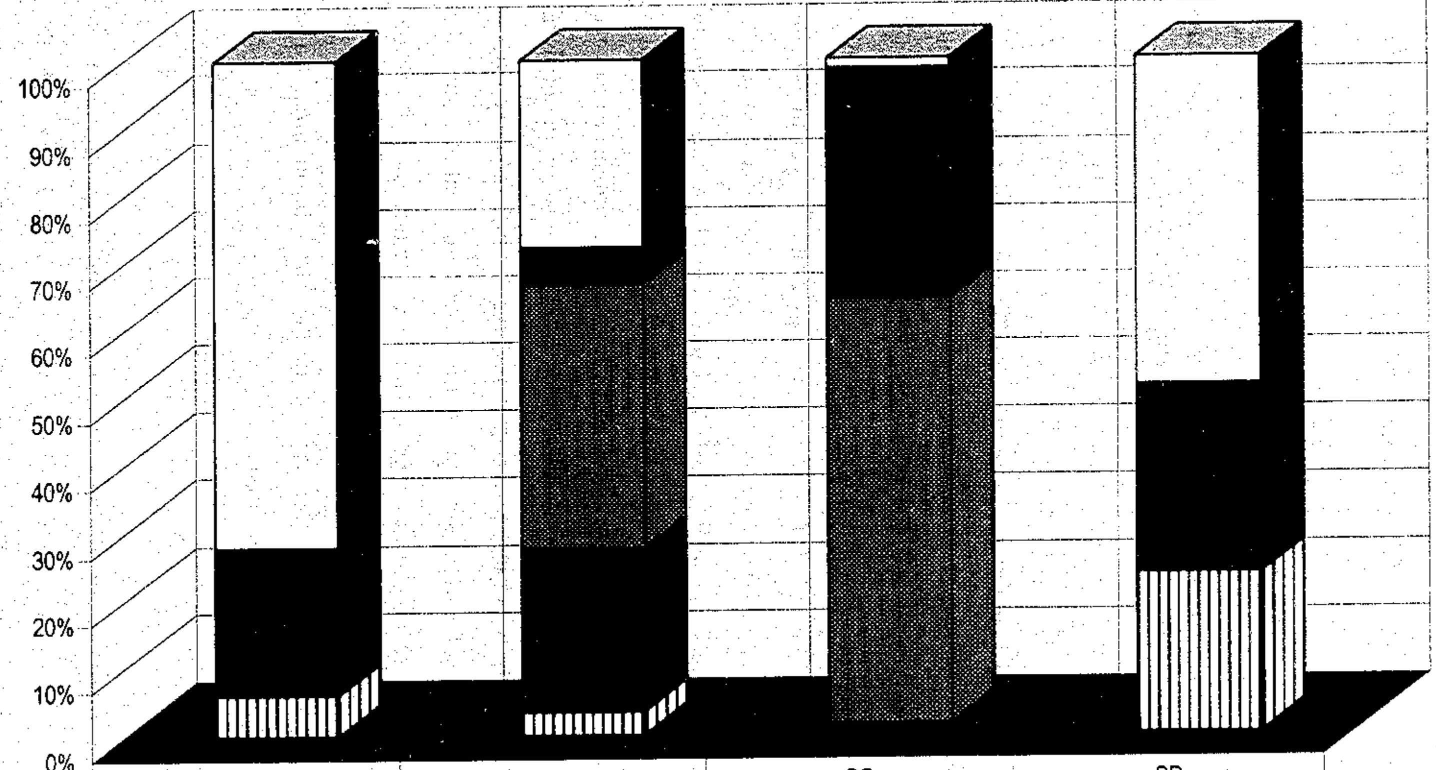
	SO2	NOx	CO	SP
Industry	62.9%	56.0%	4.1%	28.8%
Local influence	28.6%	16.0%	94.9%	38.5%
Road traffic	0.0%	6.0%	0.3%	0.0%
Rail traffic	0.0%	12.0%	0.8%	0.0%
Transboundary air pollution	8.6%	10.0%	0.0%	32.7%

Figure G.2 - 20 Average Contribution of Different Source Categories to Air Pollution in the Study Area



	Transboundary air pollution	Rail transport	Road transport	Local influence	Industry	Total
SO2	3			11	36	50
NOx	5	35	57	8	40	145
CO		15	650	350	15	1030
SP	17			20	35	72

Figure G.2 - 21 Contribution of Different Source Categories to Ambient Air Quality in Centre of Banská Bystrica



	SO2	NOx	CO	SP
Industry	72.0%	27.6%	1.5%	48.6%
Local influence	22.0%	5.5%	34.0%	27.8%
Road transport	0.0%	39.3%	63.1%	0.0%
Rail transport	0.0%	24.1%	1.5%	0.0%
Transboundary air pollution	6.0%	3.4%	0.0%	23.6%

Figure G.2 - 22 Contribution of Different Source Categories to Air Pollution in Centre of Banská Bystrica

G.3 METEOROLOGICAL CHARACTERISTICS OF THE HRON BASIN RELATED TO AIR POLLUTION

The following text has been extracted from Reference 8 - 11.

1. GENERAL CIRCULATION CONDITIONS ABOVE SLOVAK TERRITORY AND THE OROGRAPHIC INFLUENCES ON WIND CONDITIONS IN HRON BASIN REGION

The prevailing flux of air is in quadrant from North-East to South-West in the height of 3 km over Slovakia territory. The mean wind speed reaches 10 m/sec in this level. In the annual regime the maximum values are observed in the end of autumn and the beginning of winter (11 to 12 m/sec), the minimum in summer months (7 to 9 m/sec). In the direction to the ground level, the mean speed of wind decreases and the persistence of air flux increases. The influence of complex terrain, namely the West - East direction of the main ridge of Low Tatras massif, which reaches the height 1 800 to 2 000 m a.s.l. is very important. Other mountains surrounding the Hron Basin create with their ridges the borders of area. The directions of axes of their ridges are different. From this reason the East-West direction of the upper part of Hron river swifts to North-South direction. But after leaving the Zvolen basin the river flow takes up the previous direction again. The configuration of surrounding mountains causes the gradual turning with wide bend to the North-South direction in the territory of Podunajská rovina plain. This part of Hron Basin is bordered by decreasing axes of hilly country ridges. The considerable elevation of ridges of surrounding mountains over Hron valley cause the accommodation of prevailing wind direction to the axes of Horn river valley over the whole basin area. The good developed local circulation systems, the frequent causes of stagnation of air and considerable decreasing of wind speed are typical in the Hron basin area. The important effect is the aggravated air pollution conditions.

2. ANNUAL WIND REGIME

The annual wind regime is distinguished by higher frequency of northern components in summer half-year in the higher levels of atmosphere (Tables G.3 - 3 and G.3 - 4). On the other hand, the southern components occur with higher frequency in the autumn and winter seasons (Tables G.3 - 2 and G.3 - 5). This tendency is observed in the surface layer of the atmosphere in the Hron Basin.

Table G.3 - 1 Mean Annual Frequency of Wind Direction (in per mill)

Station	N	NE	E	SE	S	SW	W	NW	Calm
Chopok	189	41	32	96	306	52	79	187	18
Telgárt	24	86	198	25	32	212	159	28	236
Sliac	168	47	22	43	48	66	53	70	483
Nový Tekov	55	51	134	59	31	39	143	137	351
Pohronský Ruskov	42	48	30	127	42	76	47	180	408

Table G.3 - 2 Mean wind frequency in winter months (XII - II) (in per mill)

Station	N	NE	E	SE	S	SW	W	NW	Calm
Chopok	184	56	41	67	272	64	89	209	18
Telgárt	17	72	200	15	22	239	167	36	232
Sliač	158	40	21	30	26	48	40	71	566
Nový Tekov	52	47	170	56	19	25	116	128	387
Pohronský Ruskov	37	49	31	129	44	58	42	168	442

Table G.3 - 3 Mean wind frequency in spring months (III - V) (in per mill)

Station	N	NE	E	SE	S	SW	W	NW	Calm
Chopok	204	39	32	95	321	47	73	168	21
Telgárt	29	106	211	29	34	193	142	32	224
Sliač	206	45	23	47	60	76	61	72	410
Nový Tekov	62	54	132	63	42	46	160	160	281
Pohronský Ruskov	49	59	34	142	46	88	48	201	333

Table G.3 - 4 Mean wind frequency in summer months (VI - VIII) (in per mill)

Station	N	NE	E	SE	S	SW	W	NW	Calm
Chopok	241	36	25	104	284	36	66	192	16
Telgárt	34	103	204	35	36	178	115	20	275
Sliač	170	51	16	39	62	73	62	78	449
Nový Tekov	61	59	77	47	41	46	182	156	331
Pohronský Ruskov	47	50	27	101	34	85	42	206	409

Table G.3 - 5 Mean wind frequency in autumn months (IX - XI) (in per mill)

Station	N	NE	E	SE	S	SW	W	NW	Calm
Chopok	128	31	31	118	348	61	90	177	16
Telgárt	17	61	179	22	34	240	211	21	215
Sliač	138	50	29	55	45	66	50	58	509
Nový Tekov	46	44	158	69	23	37	115	104	404
Pohronský Ruskov	38	34	27	134	42	74	57	146	448

The most frequent mean annual wind direction is east in the higher part of the Hron River valley, north in the middle part and north-west in the lower part (see Tables G.3 - 1, G.3 - 3 and G.3 - 4). The frequency of calm is mostly from 20 to 50%. The second most frequent wind direction is south accommodated to direction of the valley axe. In the higher elevations, prevailing winds are southern or south-western, sometimes being strongly deformed in Low

Tatras ridge position. The southern components of wind direction are strongly impressed in cold year seasons in the all positions of basin (Tables G.3 - 1 and G.3 - 2).

The annual regime of the mean speed of upper wind is connected with circulation conditions over Central Europe region (see Tables G.3 - 6 and G.3 - 7). The monthly mean wind speed reaches to the maximum when the maximum pressure gradient occurs, ie in the end of autumn and in the winter. The monthly mean wind speed is minimum in the end of summer. In the direction to the ground level, the wind speed is modified by the stratification of air temperature. The highest values are observed in months with the most unstable conditions of the atmospheric boundary layer, ie in the end of spring. The lowest values of speed are observed in the most stabile conditions, ie in the end of summer and in the beginning of autumn. The maximum frequency of calm is also observed in the low positions in autumn. The most frequent wind speed class in the higher positions of the basin is 6 - 10 m/sec, in the middle positions 3 - 5 m/sec, and in the lower positions 1 - 2 m/sec (see Table G.3 - 8).

Table G.3 - 6 Mean monthly and annual wind speed when wind occurred (m/sec)

Station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Chopok	11.6	12.1	10.6	10.3	8.9	8.4	7.8	8.3	9.1	9.8	11.8	11.0	10.0
Telgárt	6.0	5.7	5.5	5.1	4.8	4.5	4.5	4.3	4.5	5.0	5.4	5.8	5.0
Sliac	3.6	3.6	3.6	3.9	3.5	3.5	3.3	3.3	3.1	3.0	3.2	3.2	3.3
Nový Tekov	2.8	2.8	2.6	2.4	2.6	2.6	2.5	2.3	2.5	2.4	2.9	2.6	2.6
Pohronský Ruskov	3.4	3.5	3.5	3.1	2.7	2.8	2.8	2.7	3.0	3.5	3.4	2.9	3.1

Table G.3 - 7 Mean monthly and annual wind speed including calm (m/sec)

Station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Chopok	11.4	11.9	10.4	10.1	8.7	8.2	7.7	8.4	8.9	9.6	11.7	10.8	9.8
Telgárt	4.4	4.5	4.4	3.9	3.8	3.3	3.4	2.9	3.4	3.8	4.5	4.6	3.9
Sliač	1.4	1.9	2.0	2.4	2.1	2.0	1.9	1.7	1.4	1.3	1.8	1.2	1.8
Nový Tekov	1.7	1.9	1.8	1.8	1.9	1.8	1.6	1.5	1.5	1.4	1.8	1.4	1.6
Pohronský Ruskov	1.8	2.3	2.3	2.1	1.8	1.7	1.7	1.5	1.6	1.8	2.0	1.4	1.8

Table G.3 - 8 Mean Annual Frequency of Occurrence of Wind Speed Classes (in per mill)

Station	Wind Speed Class (m/sec)						
	Calm	1 - 2	3 - 5	6 - 10	11 - 15	16 - 20	> 20
Chopok	18	96	207	273	211	137	58
Telgárt	236	189	274	274	27	0	
Sliac	483	219	220	75	3	0	
Nový Tekov	351	465	100	72	11	1	
Pohronský Ruskov	408	350	155	77	10	0	0

3. DIURNAL WIND REGIME

The local circulation systems are well developed in the Horn River valley. There is the katabatic wind blowing down the slopes in the nocturnal hours under the radiative weather. In the diurnal hours, there exists the opposite anabatic wind, blowing up the slopes.

The occurrence of calm is more frequent during the night, when the temperature stratification is more stable. It is the significant characteristics of closed basins and the narrow valleys. Mean speed is lower too. In the diurnal regime, the maximum wind speed occurs around the noon, and the minimum occurs at sunset or sunrise hours when the local circulation systems change between diurnal and nocturnal regimes. This pattern is more remarkable in the summer and the beginning of autumn.

4. INFLUENCE OF COMPLEX TERRAIN ON THE WIND CONDITION AND TTRANSPORT OF AIR POLLUTANTS

When the suitable transport conditions occur, ie the stabile stratification conditions and the North - West direction of wind in the middle part of basin, there is possibilities of air pollutants transport in the depression between Vtácnik and Kremnické Vrchy massifs. The opposite direction of the transport is possible too. The most important transport of pollutants exists entirely in the Hron river valley and can spread into Zvolen basin area.

5. STABILITY OF ATMOSPHERIC BOUNDARY LAYER

The stability of atmospheric boundary layer is evaluated by Pasquill - Uhlig method (Table G.3 - 9). The mean annual probability of occurrence of stability categories shows that in the basin position of catchment there are the highest values of the stabile categories occurrence (Sliač station). In the higher parts of basin are similar frequency of occurrence the stabile categories, the labile are more numerous in lowland position.

Table G.3 - 9 Annual probability of occurrence (%) of stability categories

	Category					
Station	A	B	C	D	E	F
Telgárt	1	6	15	40	13	25
Sliac	3	10	18	27	6	36
Mochovce	3	11	20	32	12	22

A - Extreemly unstable
B - Unstable
C - Slightly unstable
D - Neutral
E - Moderately stabile
F - Stabile

6. EVALUATION OF AUTOMATIC WEATHER STATION (AWS) WIND MEASUREMENT

The ASW was recently purchased by JICA and installed in the Ziar nad Hronom town for precise measurements of wind. The VAISALA station data were collected, checked and the hourly data were used to evaluate the monthly and seasonal wind roses for the February - May 1999 period. The roses are presented in Figs. 1 through.5. They show that the prevailing direction of wind is downward the Hron river valley in parallel with its axis, while the second most frequent direction is the opposite. If the suitable circulation conditions occur, this second direction is prevailing (Fig. 3 suggests this case). The possibility of transport of air from the North-western direction, from neighbouring valley, is shown in Fig. 1, where the second frequent direction is the NW. The mean monthly wind speed was in the range of 1.3 to 1.6 m/sec (Figs. 6 through 10). The wind speeds of the most frequent directions were not the highest. The directions of the highest speeds are mostly W - NNW, with speeds of 2.0 to 2.5 m/sec. The prevailing winds of the direction NE had speeds of about 0.8 m/sec.

Fig.1 Relative frequency of wind directions at AWS Žiar n/Hronom (%), February 1999, Calm= 0.4%

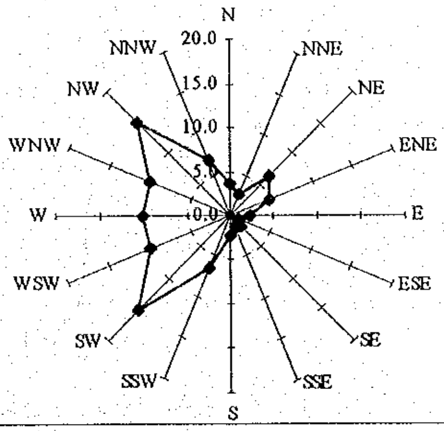


Fig.2 Relative frequency of wind directions at AWS Žiar n/Hronom (in%), March 1999, Calm= 0.0%

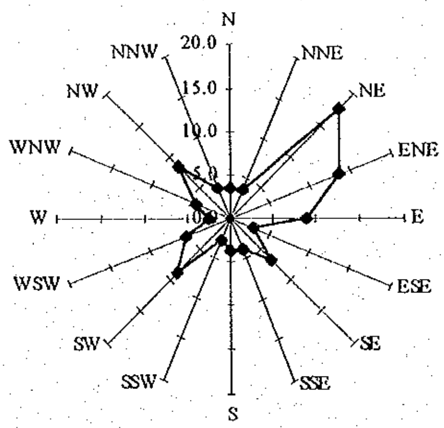


Fig.3 Relative frequency of wind directions at AWS Žiar n/Hronom (in%), April 1999 Calm= 0.3%

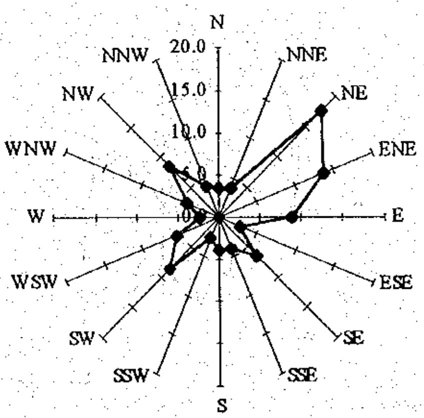


Fig.4 Relative frequency of wind directions at AWS Žiar n/Hronom (in%), May 1999 Calm= 0.4%

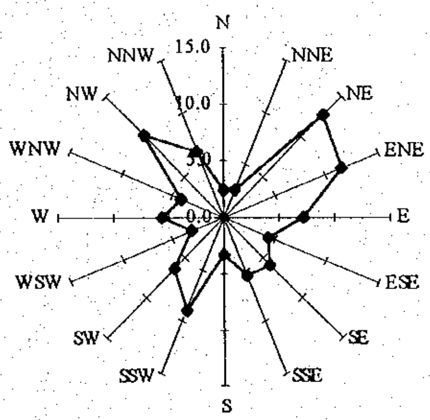


Fig.5 Relative frequency of wind directions at AWS Žiar n/Hronom (in%), II - V 1999, Calm= 0.3%

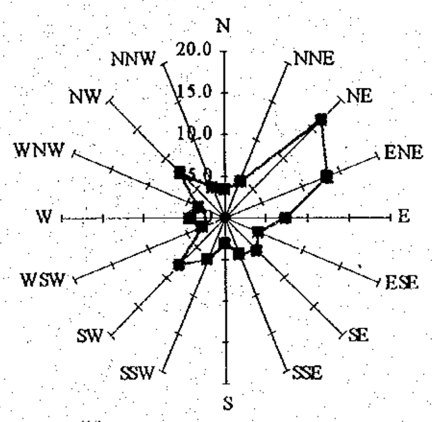


Fig.6 Wind velocity (m.s-1) at AWS
Žiar n/Hronom, February 1999

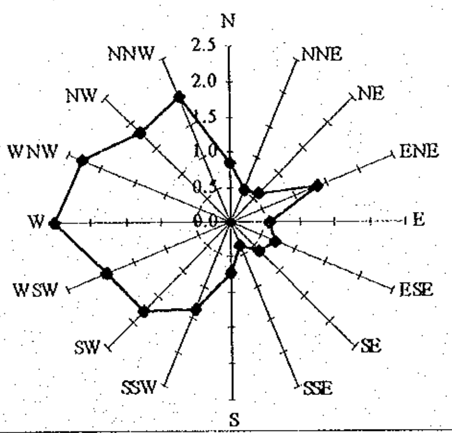


Fig.7 Wind velocity (m.s-1) at AWS
Žiar n/Hronom, March 1999

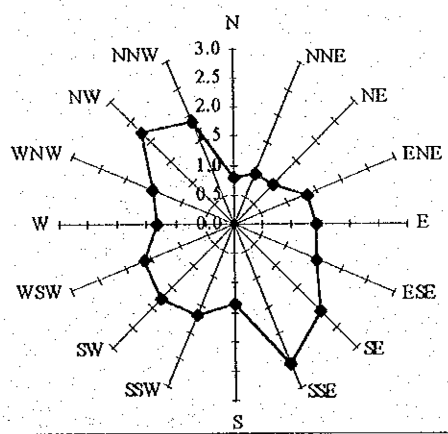


Fig.8 Wind velocity (m.s-1) at AWS
Žiar n/Hronom, April 1999

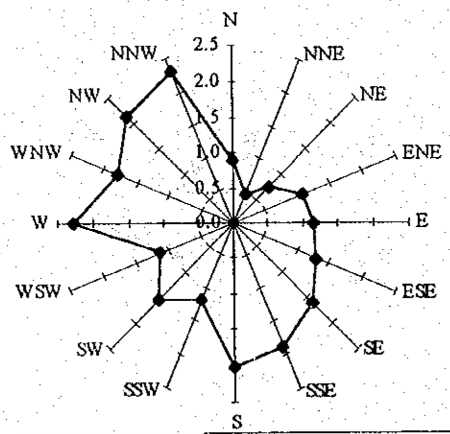


Fig.9 Wind velocity (m.s-1) at AWS
Žiar n/Hronom, May 1999

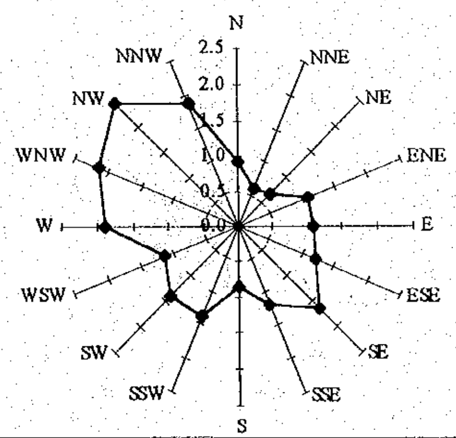


Fig.10 Wind velocity (m.s-1) at AWS
Žiar n/Hronom, II - V 1999