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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

MINISTRY OF ENVIRONMENT
THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA

THE STUDY
ON
AIR POLLUTION MONITORING SYSTEM
IN
THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA

FINAL REPORT
Data Book

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JAPAN ENVIRONMENT ASSESSMENT CENTER CO. LTD., TOKYO

The Study on Air Pollution Monitoring System in the Former Yugoslav Republic of Macedonia

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Data for Chapter 2

REGULATION

FOR MAXIMAL PERMITTED CONCENTRATIONS AND QUANTITIES OF HARMFUL MATTERS WHICH CAN BE EMITTED IN THE AIR FROM DIFFERENT SOURCES OF POLLUTION

(Official Letter No. 3, p. 37, 31 January 1990)

I. General

Article 1

By this Regulation an Maximal Permitted Concentrations (MPC) and Maximal Permitted Quantities (MPQ) of harmful matters in solid, liquid or gaseous condition which can be emitted in the air from industrial, communal and other sources of pollution.

Article 2

In the case of presence of more different matters from different groups, common emission of matters from the same group can not exceed MPC for each matter from the group.

In the case when waste gases contain in the same time different matters from different groups, common emission can not exceed MPC for each group.

Article 3

Contamination of the air is given in form of:

a) Mass concentration of harmful matter in mg/m^3 in the dry gas under normal condition ($t = 0\ ^{\circ}C$ and $P = 1{,}013$ Bar (except in the case when the conditions are not given before) as emission concentration(EC);

b) Mass flow of harmful matters emitted in the air in kg/h or g/h, as emitted quantity (EQ);

Mass flow is common quantity of harmful matters, which are emitted in the air from the plants for one hour in full operation rate.

Emission concentration and emitted quantity of harmful matters, which contaminate air, are determined for each matter according limited values in defined time unit in the process of production at the same location.

Emission concentration are given depending of oxygen concentration in the waste gases is calculated by following equation:

$$EK = \frac{21 - O_{2N}}{21 - O_{2M}} E_M$$

where:

- EK is emission concentration for defined concentration of oxygen;
- O_{2N} - is given oxygen concentration depending of fuel type;
- O_{2M} is measured oxygen concentration
- E_M is measured emission concentration

Calculations of the emission for devices for cleaning of waste gases are done only in the case if the concentration of the oxygen e over the limit.

Article 4

Emission of solid particles is measured continuously when their concentration is over the MPC.

In the cases when the common quantity is from 2 to 5 mg/h emission is measured by optical instruments.

In the cases when the common quantity is over 5 mg/h, devices with mass concentration measure emission are applied.

Measurements are performed before starting the plant, during testing and normal work after changes in the technological process. For the continuos and constant process measurement can be periodical and for the charging process should be continuously.

Emission parameters are measured:

1. Emission of cancerous solid particles, of solid particles from inorganic matters and organic compounds from Group 1 is measured constantly if the mass flow is 5 times higher than permitted according to Articles 9, 12 and 13 from this Regulation.
2. Emission of vapor and gases is measured constantly when the mass flow is higher or the same of:
   - for SO_2 : 50 kg/h
   - for NO, NO_2 : 30 kg/h (calculated as NO_2)
   - for CO : 5 kg/h (in the combustion process)
   - for CO : 100 kg/h (in other process)
   - Fluor and its gaseous inorganic compounds: 0.5 kg/h (calculated as HF)
   - Chlorine and its gaseous inorganic compounds: 3 kg/h (calculated as HCl)
     1 kg/h (calculated as Cl_2)
   - for H_2S : 1 kg/h

During measurement of quantity of SO_2, measurement of SO_3 should be performed and this concentration should be calculated.

If during spot measurement will be found that the content of NO_2 is lower than 10% of total emission of nitrogen oxides, continuously measurement of NO_2 is not necessary and only NO is measured.

3. Emission of organic compounds is measured continuously when the mass flow, given as total organic carbon, is equal or higher than:
   - for organic compounds from the Group 1, 1 kg/h;
   - for organic compounds from Groups 1 and 3 together, 10 kg/h.

For the continuous measurements, despite pollutants, it is necessary to measure also other quantities in the plants for better calculations and evaluations of measurements (for example, temperature, volumetric flow, humidity, pressure, oxygen content etc. of exit gases). From the results of continuously measurements should be obtained half-hours average values, calculated in referent values divided in 20 classes. Limit value is in Class 10. Distribution of the frequency should be followed all the time and to draw at the beginning of the year.

From the half-hour value daily values are obtained. Plan works satisfactory it only 3% of half-hour values in the year exceed for 20% MPC.

Documents of measurements should be keep at least for 5 years.

II. MAXIMAL PERMITTED CONCENTRATIONS (MPC) AND QUANTITIES (MPQ)

Article 5

Emission of total dust from the exit gas of the plant can not be higher than values given in Table I.

Table I

	Emission quantity in g/h	MPC in mg/m^3
	500	50
In special cases	500	150

Article 6

Total emission of inorganic matters in form of solid particles from the plant can not be higher than values given in Table II.

Table II

Group	Harmful matter	MPQ in g/h	MPC in mg/m^3
1	- Cadmium and its compounds, as Cd - Thallium and its compound, as Tl - Mercury and its compounds, as Hg	1	0.2
2	- Arsenic and its compounds (except AsH_3), as As - Cobalt and its compounds, as Co - Nickel and its compounds, as Ni - Tellurium and its compounds, as Te - Selenium and its compounds, as Se	5	1
3	- Antimony and its compounds, as Sb - Copper and its compounds, as Cu - Cyanides and its compounds, as CN - Fluor and its compounds, as F - Tin and its compounds, as Sn - Chromium and its compounds, as Cr - Manganese and its compounds, as Mn - Lead and its compounds, as Pb - Platinum and its compounds, as Pt - Radium and its compounds, as Ra - Vanadium and its compounds, as V - Silica and its compounds, as Si	25	5

If the exit gases matter from different group are present, limit concentrations given in Table III should be applied, and at the same time maximal permitted values for each specific matter given in Table II should be applied too.

Table III

Group	MPQ in g/h	MPC in mg/m^3
1 and 2	5	1
1 and 3 2 and 3 1, 2 and 3	25	5

Article 7

MPC in Tables II and III from the Article 6 of this Regulation are in force and in the cases when one part of those compounds are in gaseous or in liquid form. In such case MPC and MPQ are valid for total sum of the emission of those compounds in gas, liquid and solid form.

Inorganic compounds in solid form, which can provoking cancer, will be arranged in Group III in Table VII of Article 10 of this Regulation.

For other inorganic compounds in form of solid particles, values given in Table I from Article 5 of this Regulation should be applied.

Article 8

Emission of inorganic compounds in liquid or gaseous form in exit gases from the plants can not be higher than values given in Table IV.

Table IV

Group	Harmful matter	MPQ in g/h	MPC in mg/m^3
1	- Arsenic hydride (AsH_3) - Cyanochloride (CNCl) - Orozgen chloride ($COCl_2$) - Phosphine (PH_3)	10	1
2	- Bromium and its compound, as Br - Chlorine (Cl_2) - Cyanohydride (HCN) - Fluor and its compounds, as HF - Sulfur hydride (H_2S)	50	5
3	- Inorganic compounds of chlorine in vapor and gas form if there are not included in Group 1, as HCl - Ammonia (NH_3)	300	30
4	- Sulfur oxides (SO_2 and SO_3), as SO_2 - Nitrogen oxides (NO and NO_2), as NO_2	5000	500

Article 9

Total emission of organic compounds from the plants can not be higher than values given in Table V.

Table V

Group	Harmful matter	Chem. formula	MPQ, in g/h	MPC, in mg/m^3
1	Acetaldehyde	C_2H_4O		
	Acrylic acid	$C_3H_4O_2$		
	Acrylic compounds	-		
	Aniline	C_6H_7N		
	Maleic acid anhydride	$C_4H_7O_3$	100	20
	Benzene chloride	C_6H_5Cl		
	Biphenyl	$C_{10}H_{12}$		
	1,2-dichlorbenzene	$C_6H_4Cl_2$		
	1,2-dichlorethane	$C_2H_4Cl_2$		
	1,1-dichlorethilene	$C_2H_2Cl_2$		
	Dichlorphenole	$C_6H_4Cl_2O$		
	Dietylamine	$C_4H_{11}N$		
	Dimethylamine	C_2H_7N		
	1,4-dioxane	$C_4H_8O_2$		
	Ethylacrilate	$C_5H_8O_2$		
	Ethylamine	C_2H_7N		
	Formamide	HCHO		
	2-furaldehyde	$C_5H_4O_2$		
	Phenol	C_6H_6O		
	Chloracetaldehyde	C_2H_3ClO		
	Cresol	C_7H_8O		
	Xylenol (except 2,4-xylenol	$C_6H_{10}O$		
	Chloracetic acid	$C_2H_3ClO_2$		
	Methylchloride	CH_3Cl		
	Formicacid	CH_2O_2		
	Methylacrylate	$C_4H_6O_2$	100	20
	Methylamine	CH_5N		
	2,4-tholuiden-diazocyanate	$C_9H_6N_2O_2$		
	Nitrobenzene	$C_6H_5NO_2$		
	Nitrocrezol	$C_7H_7NO_3$		
	Nitrophenol	$C_6H_5NO_3$		
	Nitrotholuol	$C_7H_7NO_2$		
	Light dust in respirable form	-		
	Pyridine	C_5H_5N		
	Acrolein	C_3H_4O		
	1,1,2,2,-tetrachloethane	$C_2H_2Cl_4$		
	Tetrachlormethan	CCl_4		
	Thioalcohols	-		
	Thioeters	-		
	o-toluidine	C_7H_9N		
	1,1,2-trichloethan	$C_2H_3Cl_3$		
	Trichlormethan	$CHCl_3$		
	Trichlorphenol	$C_6H_3OCl_3$		
	Triethylamine	$C_6H_{15}N$		

2	2-butoxiethanol	$C_6H_{14}O_2$		
	Butiraldehyde	C_4H_8O		
	Cyclohexanol	$C_6H_{10}O$		
	1,4-dichlobenzene	$C_6H_4Cl_2$		
	1,1-dichoretan	$C_2H_4Cl_2$		
	N,N-dimethylformamide	C_3H_7NO		
	2,6-dimethylheptanole-4	$C_7H_{14}O$		
	Di-(2-ethylhexyl) phthalate	$C_{24}H_{38}O_4$		
	2-etoxyetanol	$C_4H_{10}O_2$		
	Ethylbenzene	C_8H_{10}		
	Furfurylalcohol	$C_5H_6O_6$		
	2,2-iminodietanol	$C_4H_{11}NO_2$		
	Izopropenylbenzene	C_9H_{10}		
	Izopropylbenzene	C_9H_{11}		
	Carbon disulfide	CS_2		
	Chlorbenzene	C_6H_5Cl		
	2-chlor-1,3-butadien	C_4H_5Cl		
	2,4-xylenol	$C_8H_{10}O$	2000	100
	Xylene	C_8H_{10}		
	2-chlorpropane	C_3H_7Cl		
	2-metoxyetanol	$C_3H_8O_2$		
	Methylcyclohexanol	$C_5H_8O_2$		
	Methylformiate	$C_2H_4O_2$		
	Naphthalene	$C_{10}H_8$		
	Propinaldehyde	C_3H_6O		
	Propionic acid	$C_3H_6O_2$		
	Acetic acid	$C_2H_4O_2$		
	Stirol	C_8H_8		
	Tetrachlorethylene	C_2Cl_4		
	Tetrahydrofuran	C_4H_8O		
	Toluol	C_7H_8		
	1,1,1-trichlorethan	$C_2H_3Cl_3$		
	Trichlorethilene	C_2HCl_3		
	Trimethylbenzene	C_9H_{12}		
	Vinylacetate	$C_4H_6O_2$		
3	Acetone	C_3H_6O		
	Alkylacohols	-		
	2-Butanone	C_4H_8O		
	Butylacetate	$C_6H_{12}O_2$		
	Dibutylether	$C_8H_{18}O$		
	Dichlordifluoromethan	CCl_2F_2		
	1,2-dichloretane	$C_2H_2Cl_2$		
	Dietylether	$C_4H_{10}O$		
	Diizopropylether	$C_6H_{14}O$		
	Dimethylether	C_2H_6O		
	Ethylacetate	$C_4H_8O_2$	3000	150

	Ethylenglycol	$C_2H_6O_2$		
	4-methyl-2-penthanone	$C_6H_{12}O$		
	Ethylchloride	C_2H_5Cl		
	Methylbenzoate	$C_8H_8O_2$		
	4-hydroxy-4-methyl-2-pentanone	$C_6H_{12}O_2$		
	N-methylpyrolidone	C_5H_9NO		
	Alkens (except 1,3-butadiene)	-		
	Alkanes (except methane)	-		
	Pinene	$C_{10}H_{16}$		
	Trichlorfluoromethan	CCl_3F		

Art. 10

Emission of cancerous matters in exit gases from the plants can not be higher than values given in Table VII.

Table VII

Group	Harmful matter	MPQ in g/h	PMC in mg/m^3
1	Asbestos (crysolite, crokisolite, actinolite, tremolite) in respirable form Beryllium and its compounds in respirable form, as Be Benzaspirin Dibenz(a, h) antracene 2-naphtylamine	0.5	0.1
2	Arsenic(III) oxide, arsenic(V) oxide, arsenic(V) acid, arsenic(III) acid and its salt (in respirable form, as As Compounds of chromium(VI): calcium chromate, strontium chromate, chromium(III) chromate, zinc chromate, as Cr Cobalt in form of respirable dust or aerosol, aerosols of difficult soluble cobalt salts, as Co 3,3-dichlorbenzidine Dimethylsulfate Ethyleneimine Nickel in form of respirable dust or aerosol, nickel sulfide, nickel oxide, nickel(III) carbonate, nickel tetracarbonate, as Ni	5	1
3	Acrylonitrile Benzene 1,3-butadiene 1-chlor-2,3-epoxylpropane (epoxypropane) 1,2-dichlormethane 1,2-epoxypropane Ethyleneoxide Vinylchloride	25	5

If in the exit gases matter from the different groups are present at the same time, maximal permitted concentrations given in Table VIII will be applied, when the conditions given in Table VII from this Article are filled up.

Table VIII

Group	MPQ in g/h	PMC in mg/m^3
1 and 2	5	1
2 and 3 1 and 3 1, 2 and 3	25	5

Art. 11

Emission from the Combustion Facilities for heating of buildings, for the production of process heating or for production of steam, can not be higher than following values.

Limitation of subtitle 1 of this Article of this Regulation can not be applied for fireplaces for production process (metallurgical furnaces etc.).

1. Combustion facilities on solid fuel

1.1. Coal, briquettes, coke (MPC in mg/m^3 for 7 % of O_2)

Emitted matter or referent value	Heating power of the fire-place in MW		
	1-50	50-300	Over 300
Smoke tar number according JUS M.P. 020	30	30	30
Solid particles in mg/m^3	50	50	50
Carbon monoxide (CO) in mg/m^3	250	250	250
Sulfuric oxides calculated as SO_2, in mg/m^3	2000	400	400
Emission part of sulfur (from the total amount) for fire-paces with grating or firing with dust (%)	-	60	10
Emission part of sulfur (from the total amount) for fire-paces with fluidic layer (%)	15	15	10
Nitrogen oxides (NO_x), as NO_2 (in mg/m^3)	500	400	300
Gases of inorganic compounds of fluor, as F (in mg/m^3)	30	30	15
Gases of inorganic compounds of chlorine, as HCl (in mg/m^3)	200	200	100

For the boilers up to 1 MW limitations given in JUS M. E6110-1978 should be applied.

1.2. Wood briquettes (MPC in mg/m^3 for 11 % of O_2)

Emitted matter or referent value	Heating power of the fire-place in MW		
	1-50	50-300	Over 300
Smoke tar number according JUS M.P. 020	30	30	30
Solid particles in mg/m^3	50	50	50
Carbon monoxide (CO) in mg/m^3	250	250	250
Nitrogen oxides (NO_x) as NO_2, in mg/m^3	500	400	300
Organic matters as total organic carbon, in mg/m^3	50	50	50

For the boilers up to 1 MW limitations given in JUS M. E6110-1978 should be applied.

2. Combustion facilities using liquid fuel (MPC in mg/m^3 for 3% of O_2)

Emitted matter or referent value	Heating power of the fire-place in MW		
	1-50	50-300	Over 300
Smoke tar number according JUS B.H. 8,270			
- for heavy oil	2	2	2
- for other oils	1	1	1
Carbon monoxide (CO) in mg/m^3	170	170	170
Nitrogen oxides (NO_x) as NO_2, in mg/m^3	350	250	150
Sulfuric oxides SO_x, as SO_2 (in mg/m^3) for fuel oil according to JUS B.HO 500	1700	400	400
Emission part of sulfur (%) (from total amount)	-	60	15
Gases of inorganic compounds of fluor, as HF (in mg/m^3)	5	5	5
Gases of inorganic compounds of chlorine, as HCl (mg/m^3)			

Heavy oil for fuel can not be used in plants with up to 5 MW.

For the boilers up to 1 MW limitations given in JUS M. E6110-1978 should be applied.

3. Combustion facilities using gas (MPC in mg/m^3 for 3% of O_2)

Emitted matter or referent value	Heating power of the fire-place in MW		
	1-50	50-300	Over 300
Smoke tar number according JUS B.H. 8,270	0	0	0
Solid particles, mg/m^3	0.5	0.5	0.5
Carbon monoxide (CO), mg/m^3	100	100	100
Nitrogen oxides (NO_x) as NO_2, in mg/m^3	200	200	200

For the boilers up to 1 MW limitations given in JUS M. E6110-1978 should be applied.

For combustion facilities for desulfurization or denitrogenation it is permitted to work without such facilities at least 240 hours per year, with maximum 72-hour continuous work. For Combustion Facilities having dust collectors it is permitted to work maximum 120 hours per year, with maximum 8 hours continuously.

Article 12

Other combustion facilities:

1.For all other combustion facilities of solid fuels statements in Article 9 from this Regulation should applied.

All combustion facilities with power of 1 to 100 MW should have installed continuously measuring instruments of mass concentration of solid particles.

2. Combustion facilities using liquid fuels in primary rafinations or nonremaking oil under 50 MW

MPC calculated on 3% of oxygen in the waste gases are:

- MPC for solid particles: 80 mg/m^3
- MPC for carbon monoxide (CO): 170 mg/m^3
- MPC for nitrogen oxides (NO_x), as NO_2:
  using light oil: 250 mg/m^3
  using other oils: 350 mg/m^3
- MPC for sulfuric oxides (SO_x), as SO_2: 1700 mg/m^3

When fuel oils according to JUS B. HO.500 are used, smoking number should be below 1.

On the filter paper should not be appearing traces of oil derivatives.

3. Fireplaces using gas with power up to 100 MW

MPC calculated on 3% of oxygen in the waste gases are:

- MPC for solid particles: 5 mg/m^3
- MPC for carbon monoxide (CO): 100 mg/m^3
- MPC for nitrogen oxides (NO_x), as NO_2:
- MPC for sulfuric oxides (SO_x), as SO_2 using:
  a) refinery gas: 100 mg/m^3
  b) liquid gas: 5 mg/m^3
  c) natural gas using for the production of steam: 1700 mg/m^3
  d) other gases: 35 mg/m^3

Combustion facilities with over 50 MW should have installed measuring instruments for carbon monoxide (CO).

4. Sources for air pollution with gas turbines

Calculated on 15% of oxygen in waste gases, smoking number can be:

a) at turbines with a gas flow of 60000 m^3/h or more, during continuous wok lower than 2, during putting in operation power than 3.

b) at turbines with a gas flow below 60000 m^3/h during all types of work lower than 4.

- MPC for carbon monoxide (CO): 100 mg/m^3
- MPC for nitrogen oxides (NO_x), as NO_2:
  at gas flow of 60000 m^3/h or more: 300 mg/m^3
  at gas flow lower than 60000 m^3/h: 350 mg/m^3

5. Motors with internal combustion

For stable motors on liquid fuel:

a) MPC for solid particles: 130 mg/m^3

b) MPC for carbon oxide (CO): 650 mg/m^3

c) MPC for nitrogen oxides (NO_x), as NO_2:

- for diesel motors with power of 3 MW or more: 200 mg/m^3
- for diesel motors with power below 3 MW: 400 mg/m^3
- for other fourtakts motors: 500 mg/m^3
- for other twotakt motors: 800 mg/m^3

Those values are applied for process motors of plants for the production of electricity.

6. For all other combustion facilities points 1-3 from the Articles 11 and 12 of this Regulation should be applied.

Article 13

Emission of different production plants can not be higher than:

1. Cement factories

Harmful matter	Kind of plant	MPC in mg/m^3
Nitrogen oxides (NO_x), as NO_2	Cement furnaces with preheater	1500
	- with cyclone preheater and using waste heat	1300
	- with cyclonic preheater without using waste heat	1800
Sulfuric oxides (SO_x), as SO_2	Cement furnaces	400

2. Roasting of bauxite, dolomite, gypsum, magnezite, quartzite, shamot

Harmful matter	Type of plant	MPC in mg/m^3
Solid particles of chromium and its compounds, as Cr	Furnaces for roasting chromium ore	10
Nitrogen oxides (NO_x), as NO_2	Rotation furnaces	1800
	Other furnaces	1500
Gaseous inorganic compounds of fluor, as HF	Furnaces for roasting of quartz	10

3. Furnaces for ceramic products on the base of clay

Harmful matter	Content of sulfur in raw material, in %	Emitted amount, over g/h	MPC in mg/m^3 at 18% O_2
Sulfur oxides (SO_x), calculated as SO_2	Below 0.12	10000	500
	Over 0.12	10000	1500

4. Plants for smelting of mineral materials, especially of basalt, diazobaz and remaking of slag

Harmful matter	Type of plant	Type of combustion (fuel)	Emission over g/h	MPC in mg/m^3, at 8% O_2
Nitrogen oxides (NO_x), as NO_2	Potassium furnaces	Oil		1200
		Gas		1200
	Tub furnaces with recuperation for obtaining waste heat	Oil	10000	1200
		Gas		1400
	Okenic furnaces	Oil		1800
		Gas		2200
Sulfuric oxides (SO_x, as SO_2			10000	

5. Glass production factories

Limited emission concentrations for flame glass furnaces are given for 8% O_2 and for potassium furnaces using flame and daily tub furnaces are given for 0.13% O_2.

If during the process it is necessary nitrogen treatment, emission concentrations for nitrogen oxides can not be higher of double values given in the Table.

Harmful matter	Type of plant	Type of combustion (fuel)	Emitted amount over g/h	MPC in mg/m^3
Nitrogen oxides (NO_x), as NO_2	Potassium furnaces	Oil		1200
		Gas		1200
	Continuous tub furnaces with requperator for obtaining waste heat	Oil		1200
		Gas		1400
	Daily tub furnaces	Oil		1600
		Gas		1600
	Continuous tub furnaces with regenerative obtaining waste heat	Oil		1800
		Gas		2200
	Continuous tub furnaces with normal positioned burners with regenerative obtaining of waste heat	Oil		3000
		Gas		3500
Sulfuric oxides (SO_x, as SO_2	Glass furnaces	Flame		1800
	Potassium furnaces	Flame	10000	1100
	Daily tub furnaces	Flame		1100

6. Plants for the production or smelting of mixtures of bitumen or tar with mineral materials, asphalt bases

MPC for solid particles in exit gas from the dryers and from the mixers is 20 mg/m^3 (calculated at 17% O_2).

7. Production of nitric acid

MPC of nitrogen oxides (NO_x) calculated as NO_2 in the exit gas from this process is 450 mg/m^3.

8. Production of sulfuric acid

Harmful matter	Process	Rate of transformation SO_2/SO_3 (%)	MPC in mg/m^3
SO_2	One 6% SO_2	97.5	4800
SO_3	One 6% SO_2	97.5	120
SO_2	Double 8-10.5 % SO_2	99.6	1100-1400
SO_3	Double 8-10 % SO_2	99.6	60

9. Production of chlorine

MPC of chlorine in the exit gas during the production of chlorine is 1 mg/m^3, except at the production of chlorine by total liquidation, where MPC is 6 mg/m^3.

10. Production of fertilizers

During granulation and drying of fertilizers containing more than 50% of ammonium nitrate or more than 10% ammonium phosphate, MPC of solid particles in the exit gas is 75 mg/m^3.

11. Production of plant protection matters

In the exit gas from the plant for the production of protection matters, MPC of difficult soluble solid particles, easy accumulative or high toxic matters (exp. carbofuran, dinitro-o-crezol) and of matters having prohibition or limitation of concentrations, is 5 mg/m^3.

12. Refinery of mineral oils

Harmful matter	Type of work	MPC in mg/m^3
Hydrogen sulfide (H_2S)	Desulfurization	10
Solid particles	Catalytic decomposition	50
Nitrogen oxides (NO_x), as NO_2	Catalytic decomposition	700
Sulfuric oxides (SO_x), as SO_2		1700

13. Plants for milling and drying of coal

MPC for solid particles from the plants for cleaning of dryers, presses or opens for collecting of dust from presses is 0.10 mg/m^3.

14. Production of iron, steel and other metals

During remaking of iron ore, steel and other metals, despite general limitations for the emission of solid particle, there is:

1. Plants for agglomeration of iron ore

MPC for nitrogen oxides (NO_x), calculated as NO_2 is 400 mg/m^3.

2. Plants for raw non-iron metals

MPC for solid particles is 20 mg/m^3.

MPC for solid particles in the lead production plants is 10 mg/m^3.

In the process can be used only fuel containing less than 1 % of the total sulfur, calculated on the combustion of solid fuels is 29.3 mg/kg. This limitation is not in force when the ore have higher content of sulfur.

MPC of sulfuric oxides (SO_x), calculated as SO_2 at the emitted amount of 5000 g/h or more, is 800 mg/m^3.

3. Plants for obtaining iron alloys (ferroalloys) by electrothermal or other procedure

MPC of solid particles in this process is 30 mg/m^3.

4. Plants for obtaining steel by converter process, electric furnaces, and plants for vacuum smelting, plants for smelting of steel and raw alloys

MPC for solid particles is:

a) at electric furnaces and industrial furnaces is 20 mg/m^3.

b) at covered furnaces is 50 mg/m^3. MPC of CO is 1000 mg/m^3

5. Plants for electric smelting of slag

MPC of fluor compounds calculated as HF is 1 mg/m^3.

6. Production of aluminum

Harmful matter	Type of plant	MPC in mg/m^3
Solid particles	Furnace for electrolyzes	30
Inorganic compounds of fluor, as HF		1.5

Daily amount of inorganic compounds of fluor as HF can not be higher than 0.7 kg/t of Al, and daily amount of solid particles can not be higher than 5 kg/t Al.

7. Plants for smelting of aluminum

MPC of solid particles for these plants is 20 mg/m^3 for the mass flow of 0.5 kg/h or more.

MPC for chlorine (Cl_2) in the exit gases from the refinery is 3 mg/m^3.

MPC for organic compounds in aerosols in gas phase, calculated as organic carbon is 50 mg/m^3.

8. Plant for smelting and refinery of non-ferrous metals and their compounds, except aluminum

MPC of solid particles is 20 mg/m^3 at mass flow of 0.2 kg/h or more.

MPC of solid particles during smelting or refinery of lead is 10 mg/m^3.

MPC of copper and copper compounds, calculated at copper, from the plants for smelting copper is 10 mg/m^3.

MPC of organic compounds, as total organic carbon is 50 mg/m^3.

9. Plants for rolling of metals, heating furnaces for thermal remaking of metal, calculated for 5% O_2

MPC for nitrogen oxides calculated as NO_2, depending of temperature of gases is:

Temperature of preheating (°C)	200	300	400	500	600	650
MPC of NO_2, mg/m^3	500	515	600	800	1100	1300

10. Casting of nonferrous metals

MPC of solid particles is 20 mg/m^3 at the emitted amount of 0.5 kg/h.

MPC for amines is 5 mg/m^3.

11. Plant for hot zinc plating

MPC for solid particles is 10 mg/m^3.

MPC for inorganic compound of chlorine, as HCl, is 20 mg/m^3.

12. Plants for surface remaking of metals by nitric acid

MPC for nitrogen oxides calculated as NO_2 is 1500 mg/m^3.

13. Plants for the battery production

MPC for sulfuric acid is 1 mg/m^3.

16. Plants for impregnation of glass and mineral fibbers with artificial resign

MPC for organic compounds listed in Art. 12? from this Regulation in the exit gas is 40 mg/m^3.

17. Plants for the production of wood, fibber and collected plates

MPC for solid particles in the exit gas is:

- at machines for polishing: 10 mg/m^3
- in dryers: 50 mg/m^3

For dryers limit emission concentration given in Art. 9 from this Regulation are not in force.

MPC for 1-group of organic compound given in Art. 9 of this Regulation in form of vapor or gas in the exit gases from the presses is 0.12 mg/m^3.

18. Plants for remaking of wood

Plants for remaking of wood should have devices for cleaning of exit gases.

MPC for solid particles in the exit gas from the polishing machines is 20 m/m^3.

When in the exit gases there is no polishing dust, is should be:

At air flow of	$m^3/h \cdot 10^3$	15	30	40	50	60	70
MPC of solid particles	mg/m^3	150	125	103	80	70	50

REGULATION
FOR TECHNICAL MEASURES AND CONDITIONS FOR AERATION OF HOUSES

(Official Letter No. 35, p. 985, 13 August 1970)

I. General

Article 1

Technical measures and condition according to this Regulation are applied during projecting and build of houses living buildings and living rooms in other buildings, as during projecting and build of social activities in living building.

Article 2

By this Regulation a technical measures and conditions for aeration of rooms according to Art. 1 are regulated.

II. Aeration

Article 3

According to this Regulation aeration means exchange of the air in living buildings (houses) and other rooms from Art. 1 on the way that air in the rooms is moved in the atmosphere and from the atmosphere an fresh air is introduced in the rooms by the goal to have constant humidity, pure air and flow of the air according to the regulations which correspond to the needs for human health and comfortable living in the apartments.

Article 4

Technical measures and conditions given in this Regulation are referring to the natural and artificial aeration.

Natural aeration is aeration when exchange of the air is coming from the different temperature in the rooms and outside without using mechanical or other devices. Natural aeration is acting through gaps or walls, opened windows or opens or channels for ventilation.

Artificial aeration is aeration obtained by using ventilators or other similar devices.

Article 5

Living building (houses) and other rooms according to Art. 1 can be build in the areas where atmosphere have following conditions given in Table 1.

Table 1. Maximal permitted concentration (MPC) of harmful materials in the atmosphere in the settlement

No.	Substance	Formula	MPC (in mg/m^3 at 0 °C, 760 Torrs)	
			For minute	Daily
1	Nitrogen dioxide	NO_2	0.085	0.085
2	Nitric acid	HNO_3	0.4	-
3	Nitrogen pentoxide	N_2O_5	0.3	0.10
4	Nitric acid as N	H	0.006	0.006
5	Acrolein	CH_2CHCHO	0.3	0.1
6	Amilene	$CH_3(CH_3)_2$	1.5	1.5
7	Amyl acetate	$CH_3COOCH_2CH_3$	0.1	0.1
8	Ammonia	$(NH)_2$-	0.20	0.20
9	Aniline	C_6H_5-NH_2	0.05	0.03
10	Arsenic inorganic compounds (except AsH_3)		-	0.003
11	Acetaldehyde, as	CH_3CHO	0.01	-
12	Acetone	CH_3COCH_3	0.35	0.35
13	Acetophenone	C_8H_5-CO_5-CH_2	0.003	0.003
14	Benzene	C_6H_6	1.5	0.89
15	Benzene in crude oil (with low S), as C		5.0	1.5
16	Benzene in coal, as C		5.0	1.5
17	Beryllium	Be	-	0.00001
18	Butane	$CH_3CH_2CH_2CH_3$	200	-
19	Butyric acid	C_2H_5-CH_2-CH_2COOH	0.015	0.01
20	Butyl-triphosphate (Butipfos)	C_6H_4-CO-CH-CH	0.1	-
21	n-butyl acetate	C_4H_9-OCO-CH_3	0.1	0.1
22	n-butyl alcohol	$CH_3CH_2CH_2CH_2OH$	0.3	-
23	Butylene	C_2H_5-$CH=CH_2$	0.3	0.3
24	Valeric acid	$CH_3(CH_2)_3COOH$	0.03	0.01

25	Vanadium pentoxide	V_2O_5	-	0.003
26	Vinyl acetate	$CH_3COOCH\text{-}CH_2$	0.2	0.2
27	Divinyl	$CH_2\text{-}CH\text{-}CH\text{-}CH_2$	3.0	1.0
28	Diethylamine	$C_2H_5NH_2$	0.05	0.05
29	Diketone	$CH_3COCOCH_3$	0.007	-
30	N,N-dimethylaniline	$C_6H_5N(CH_3)_2$	0.0055	-
31	Dimethyl disulfide	$(CH_3)_2S_2$	0.07	-
32	Dimethyl sulfide	$(CH_3)_2S$	0.08	-
33	Dimethyl formamide	$HCO\text{-}N\text{-}(CH_3)_2$	0.03	0.03
34	Dinil [24% diphenyl (C_6H_5-C_6H_5) + 76% diphenyl oakdide)	$C_6H_5\text{-}C_6H_5$	0.01	0.01
35	Dichorethane	$CH_2Cl\text{-}CH_2Cl$	3.0	1.0
36	Dichloro-1-2,3-naphtahinone-1,4		0.05	0.05
37	Epichlorhydrine	$OCH_2CHCHCl$	0.2	0.2
38	Ethanol	C_2H_5OH	5.0	3.0
39	Ethyl acetate	$CH_3COOC_2H_5$	0.1	0.1
40	Ethylene	$CH_2\text{-}CH_2$	3.0	3.0
41	Ethylene oxide	$CH_2\text{-}CH_2\text{-}O$	0.3	0.03
42	Mercury	Hg	-	0.0003
43	Cadmium	Cd	0.01	0.003
44	Caprilic acid	$CH_3(CH_2)\ COOH$	0.01	0.005
45	Caprolactam	$CHCHCOCONH_2$	0.06	0.06
46	Carbofos (Malathion)	$CH_3PSSCHCOOC_2H_5$ $CH_2COOCRH_5$	0.015	-
47	Xylene (Xylol)	$C_6H_4(CH_3)_2$	0.2	0.2
48	Maleic acid	COOCH-CHCO	0.2	0.05
49	Manganese and Mn compounds (as MnO_2)		-	0.01
50	Mesidine (2-amino-1,3,5-trimetyl benzene		0.03	-
51	Methanol	CH_3OH	1.0	0.5
52	Methyl acrylate	$CH_3COOCH{=}CH_2$	0.01	-
53	Methyl aniline	$C_6H_5NHCH_3$	0.04	-
54	Methyl acetate	CH_3COOCH_3	0.07	0.07
55	Methyl mercaptane	CH_3SH	$9\cdot10^{-6}$	-

56	Methyl metacrylate	$CH_2C(CH_3)_2COOCH_3$	0.1	0.1
57	Methyl parathione (Metafon)	$C_{10}H_{14}NO_5PS$	0.008	-
58	Methyl styrene	$C_6H_5C\text{-}(CH)_2\text{-}CH_3$	0.04	0.04
59	Naphtahynone	$C_6H_4COCOCH\text{-}CH$	0.005	0.005
60	Nitrobenzene	$C_6H_5NO_2$	0.008	0.008
61	Lead and lead compounds (except $Pb(C_2H_5)$, as Pb		-	0.0007
62	Lead sulfide	PbS	-	0.0017
63	n-Pentane	$CH_3(CH_2)_2CH_3$	100.0	25.0
64	Pyridine	C_5N_5N	0.08	0.08
65	Dust, inert, nontoxic		0.5	0.15
66	iso-propylbenzene	$(CH_3)_2CH\text{-}C_6H_5$	-	-
67	iso-propylbenzene hydroxide	$(HOC_6H_4CH)CH_3$	0.007	0.007
68	Propylene alcohol	$CH_3CHOHCH$	0.3	0.3
69	Acetic acid	CH_3COOH	0.2	-
70	Acetic acid anhydride	$(CH_3CO)_2O$	0.1	-
71	Styrene	$C_6H_5CH{=}CH_2$	0.003	0.003
72	Hydrogen sulfide	H_2S	0.008	0.008
73	Sulfur dioxide	SO_2	0.5	0.15
74	Sulfuric acid, as H_2SO_4	H_2SO_4	0.3	0.1
75	Sulfuric acid, as H	H	0.006	0.006
76	Tiophen	$CH_3\text{-}S\text{-}CH$	0.6	-
77	Toluene	$C_6H_5CH_3$	0.6	0.6
78	diisocianate toluene	$CH_3C_6H_3\text{-}(NCO)_2$	0.05	0.02
79	Tricholethylene	$ClCH{=}CCl_2$	4.0	1.0
80	Carbon disulfide	CS_2	0.03	0.01
81	Carbon monoxide	CO	3.0	1.0
82	Carbon tetrachloride	CCl_4	4.0	-
83	Phenol	C_6H_5OH	0.01	0.01
84	Fluor - gas compounds	HF	0.02	0.005
85	Flour - insoluble inorganic compounds	AlF_3, Al_2F_6, CaF_2	0.2	0.03
86	Flour - soluble inorganic compounds	NaF	0.03	0.01

87	Flour - mixture with gaseous fluor	-	0.03	0.01
88	Formaldehyde	HCHO	0.035	0.012
89	Phosphor pentoxyde	P_2O_5	0.15	0.05
90	Phtalic anhydride	$C_6H_4CO\text{-}COO$	0.40	0.2
91	Phurphurol	OCHCHCHCCHO	0.05	0.05
92	Hexamethylenediamine	$NH_2(CH_2)_6NH_3$	0.01	0.01
93	Chlor	Cl	0.1	0.03
94	Chloranyline	$ClC_6H_4NH_2$	0.04	-
95	Chlorbenzene	C_6H_5Cl	0.1	0.1
96	Hydrochloric acid, as HCl	HCl	0.2	-
97	Hydrochloric acid, as H	H	0.006	0.006
98	Chlorpropene	$CH=CCl\text{-}CH=CH_2$	0.1	0.1
99	Chlorphenyl-m-isocyanate	$Cl\text{-}C_6H_4NCO$	0.005	0.005
100	Chlorphenyl-p-isociynate	$Cl\text{-}C_6H_4NCO$	0.0015	0.0015
101	Chromium(VI)	CrO_3	0.0015	0.0015
102	Cyclohexanol	$C_6H_{11}OH$	0.06	0.06
103	Cyclohexanone	$C_6H_{10}O$	0.04	0.04
104	Zinc	Zn	-	-
105	Black smoke	-	0.15	0.05

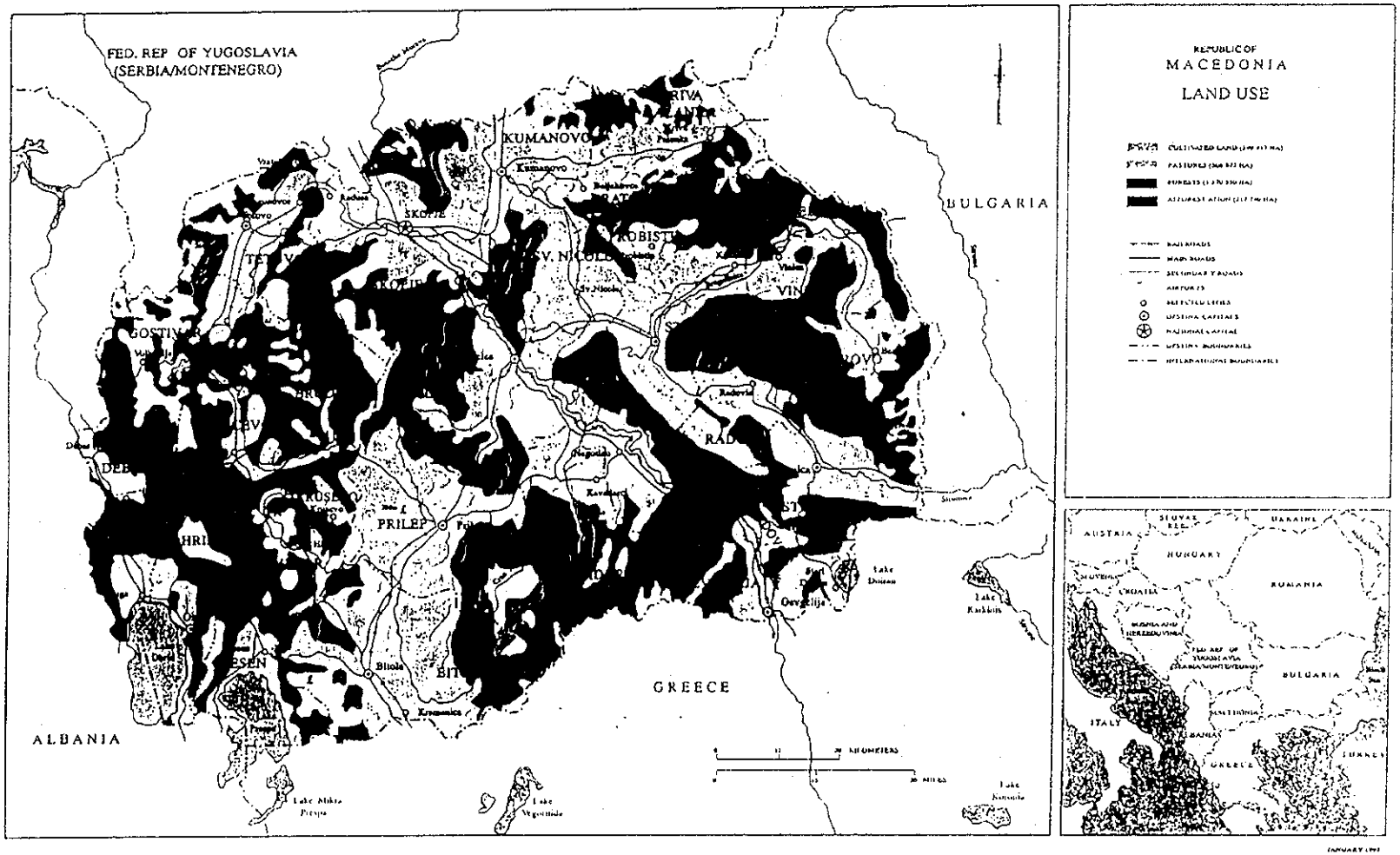


Figure D2.1 Land Utilization in the Republic of Macedonia

Refference: NEAP

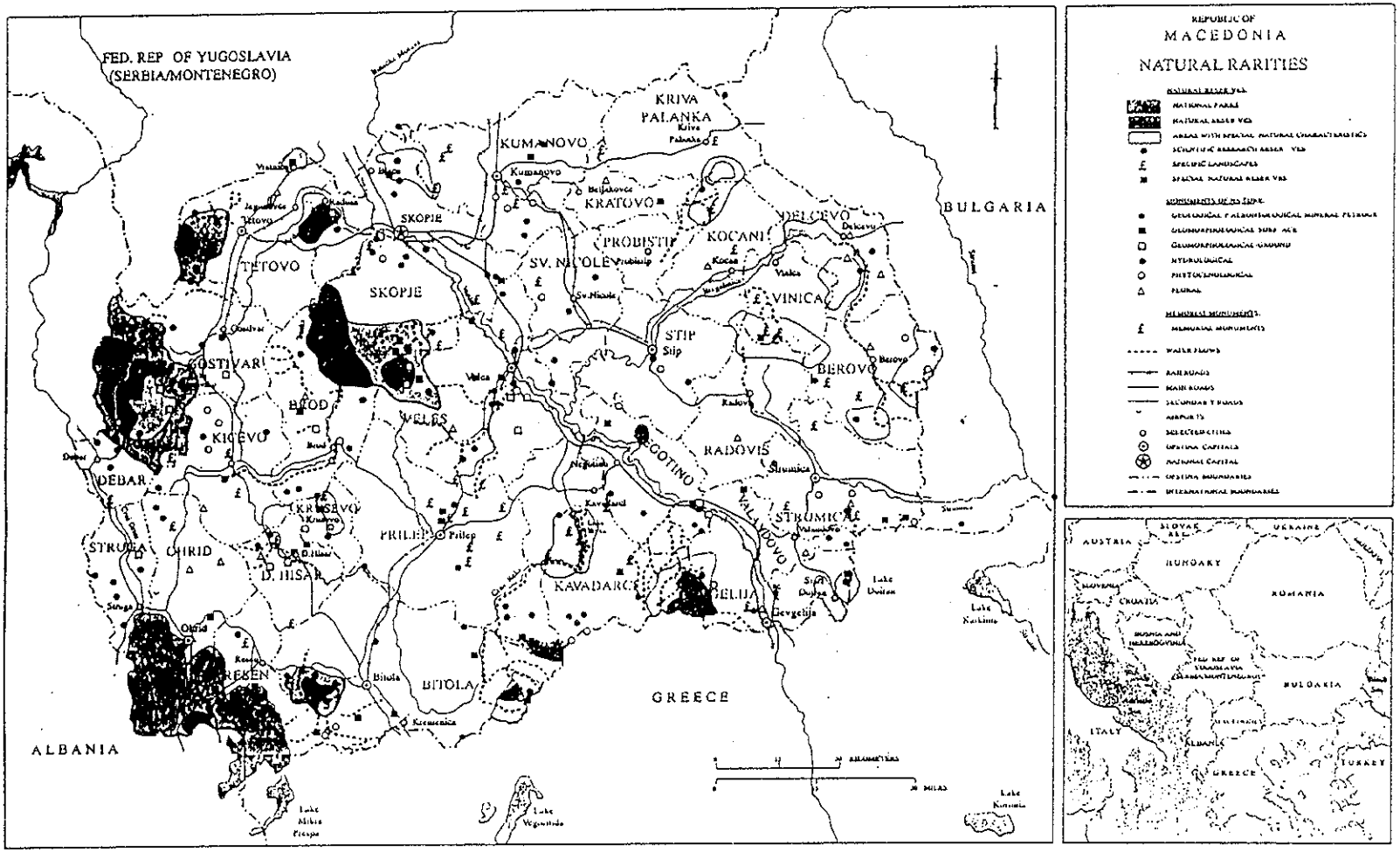


Figure D2.2 Precious Nature in the Republic of Macedonia

Refference: NEAP

Table D2.1 Estimation of the energy consumption in Skopje in the Period of 1995-2020 and 2000-2010

Year	Heavy oil (t)	Gas – Total (Nm^3)	Gas – Industry (Nm^3)	Gas – Other (Nm^3)	Coal (t)	Coke (t)	Wood (m^3)	Briquettes (t)
1995	122 011	0	0	0	15 250	14 440	295 500	0
% of yearly increase	1.14	-	-	-	-0.33	-0.62	-0.52	-
2000	129 132	54 500 000	32 000 000	22 500 000	15 000	14 000	285 000	4 500
% of yearly increase	8.91	12.4	8.45	17.5	0.0	0.0	-2.2	24.57
2005	197 849	98 400 000	48 000 000	50 400 000	15 000	14 000	255 000	13 500
% of yearly increase	1.51	7.9	8.45	7.39	-7.79	0.0	-2.47	14.87
2010	213 212	144 000 000	72 000 000	72 000 000	10 000	14 000	225 000	27 000
% of yearly increase	-2.39	6.2	5.92	6.58	0.0	0.0	-2.82	3.13
2015	188 880	195 000 000	96 000 000	99 000 000	10 000	14 000	195 000	31 500
% of yearly increase	2.08	4.7	4.56	4.94	0.0	0.0	-3.29	3.55
2020	209 393	246 000 000	120 000 000	126 000 000	10 000	14 000	165 000	37 500
Total mean yearly % of increase in the period of 1995-2020	2.18	7.83	6.83	7.13	-1.67	-0.12	-2.25	11.18
Increasing between 1995-2020	71.62	351.38	275.0	460.0	-34.43	-3.05	-2.3	733.33
Total mean % of increase in the period of 2000-2010	5.14	10.20	8.45	12.33	-3.97	0.0	-2.25	19.62
Increase between 2000-2010	65.11	164.22	125.0	220.0	-33.33	0.0	-21.05	500.0

Table D2.2 Emission Control Technology for NOx and Particulate Matter (PM)

Category	Technology	Reduction Effect			Applicable Facility Scale
		SOx	NOx	PM	
Improvement of fuel	Reduction of S content of fuel (reduction of N content is difficult)	Large	Some	Effective	All
Change of fuel	From heavy oil and coal to natural gas or diesel	Large	Effective	Effective	All
Improvement of combustion control (energy saving)	1. Improvement of heat recovery 2. Optimization of air flow 3. Low air-ratio combustion	Reduction of emissions resulting from reduction of fuel use (indirect effect)			All
Improvement of combustion method	1. Improvement of operational condition • Low air-ratio combustion • Reduction of combustion chamber loading • Reduction of air preheating temperature	 - - -	 Effective Effective Effective	 Increase Decrease Tends to increase	 All All Large
	2. Improvement of equipment				
	• Low-NOx burner	-	20 - 45% Large for natural gas, small for heavy oil	Increase with some burners	Small to medium
	• Two-stage combustion • MACT method	- -	50 - 60% Effective for both F. NOx and T. NOx	Slight tendency to increase	Large
	• Off-stoichiometric combustion	-	20 - 30% Large for T. NOx	Slight tendency to increase	Facilities with 2 or more burners
	• Exhaust gas recirculation	-	30% Large effect only for T. NOx	-	Large
	• Steam/water injection • Emulsion combustion	- -	10 - 20% Effective only for T. NOx	Slight tendency to decrease	All
	• Fluidized bed combustion	max. 90%	about 50% Effective for both F.NOx and T.NOx	Tends to increase	Medium to large boilers
Exhaust gas treatment	1. Dust removal • Electric precipitator • Bag filter • Scrubber • Centrifuge	 - - 90% by use of absorbent -	 - - - -	 90% or more 90% or more 90% or more 50% or more	 Large All All Small to medium
	2. Desulfurization	90% or more	-	50% or more	All
	3. Denitration	-	90% or more	-	All
	4. Total treatment of exhaust gas	90% or more	90% or more	50% or more	Large
Others	1. Plant relocation	Effects at original site are large. But high cost and availability of a suitable new location are required.			All
	2. District heat supply	Energy-saving effect due to concentrating scattered sources. But control measures are required at the heat supply source.			Small to medium
	3. Higher smokestacks	Ground-level concentration is reduced. But the total emission is unchanged.			All

Note: F. NOx = Fuel NOx, T. NOx = Thermal NOx

Table D2.3 SOx, NOx, CO, HC, SPM and Pb
Reduction Method for Automobiles

Kind of Reduction Method	Objective Substances
* Suppression of gross traffic volume Improvement of public transport network Promotion of a joint distribution system Conversion from bus to the new transport system (monorail, trolley bus, highway new transport system) * Traffic flow control measures Improvement of expressway Consideration of direction of traffic (Skopje City) Improvement of parking facilities Regulation of illegal parking * Emission gas control measures Regulation of periodic inspection Promotion of propane gas vehicles like taxis Promotion of substitution by new car through revision of the tax system (introduction of hybrid cars in the future) * Greening of roads	Common to all substance
* Sulfur reduction of diesel	SOx
* Reinforcement of emission gas regulation	NOx, CO, HC
* Lead-free gasoline	Pb
* Pavement of road * Cleaning of road * Water spray with spray car * Prohibition of the use of spike tires	SPM

Data for Chapter 3

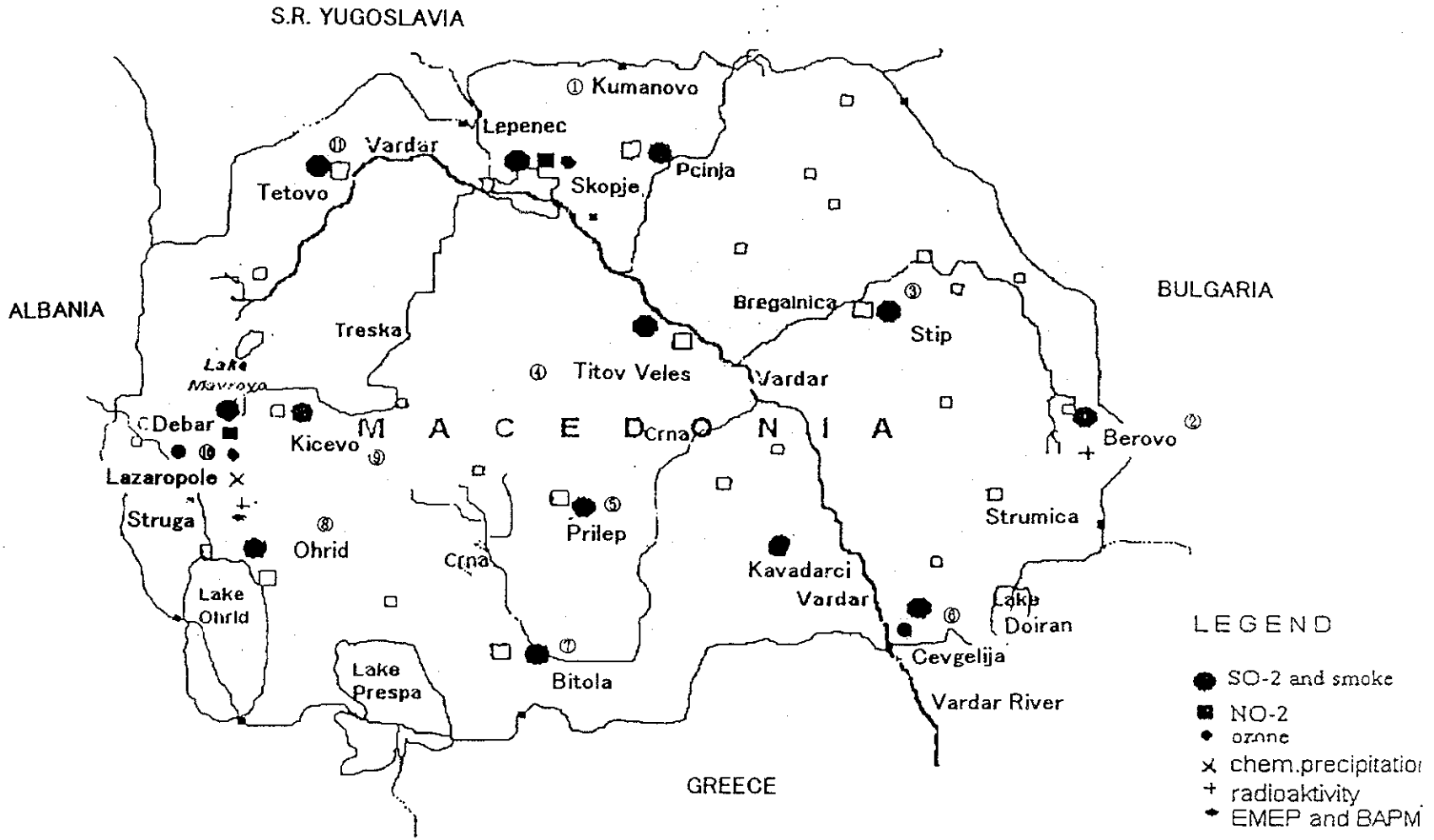


Figure D3.1 Air Quality Network Station of the Republic Hydrometeorological Institute

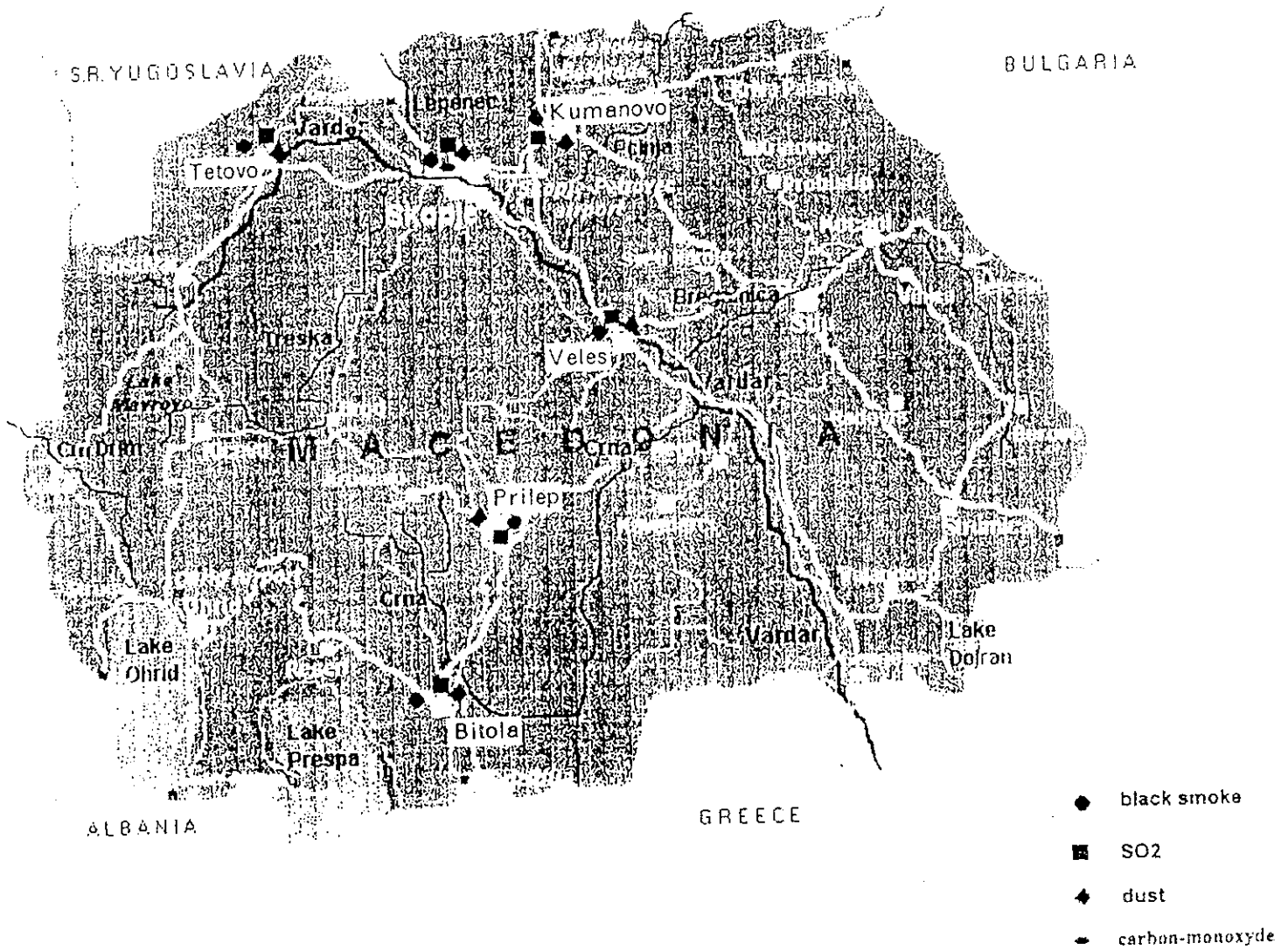


Figure D3.2 Air Quality Network Station of the Institute for Public Health

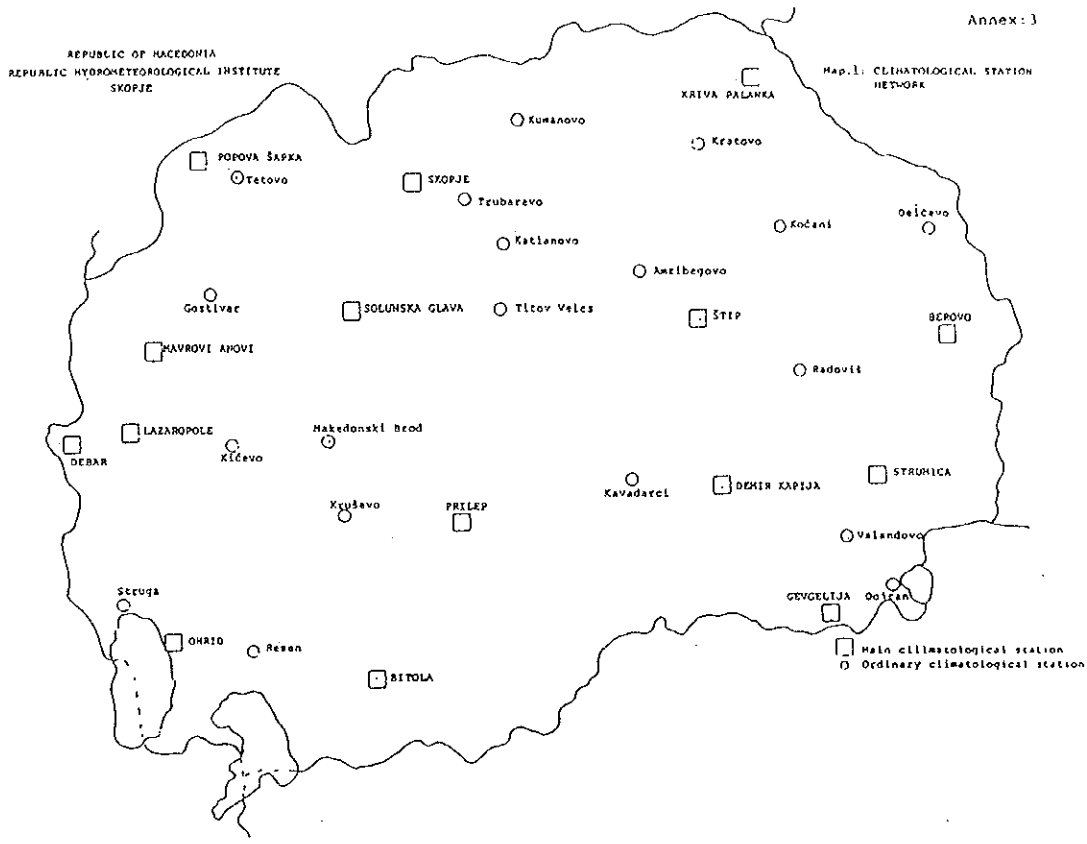


Figure D3.3 Climatological Station Network

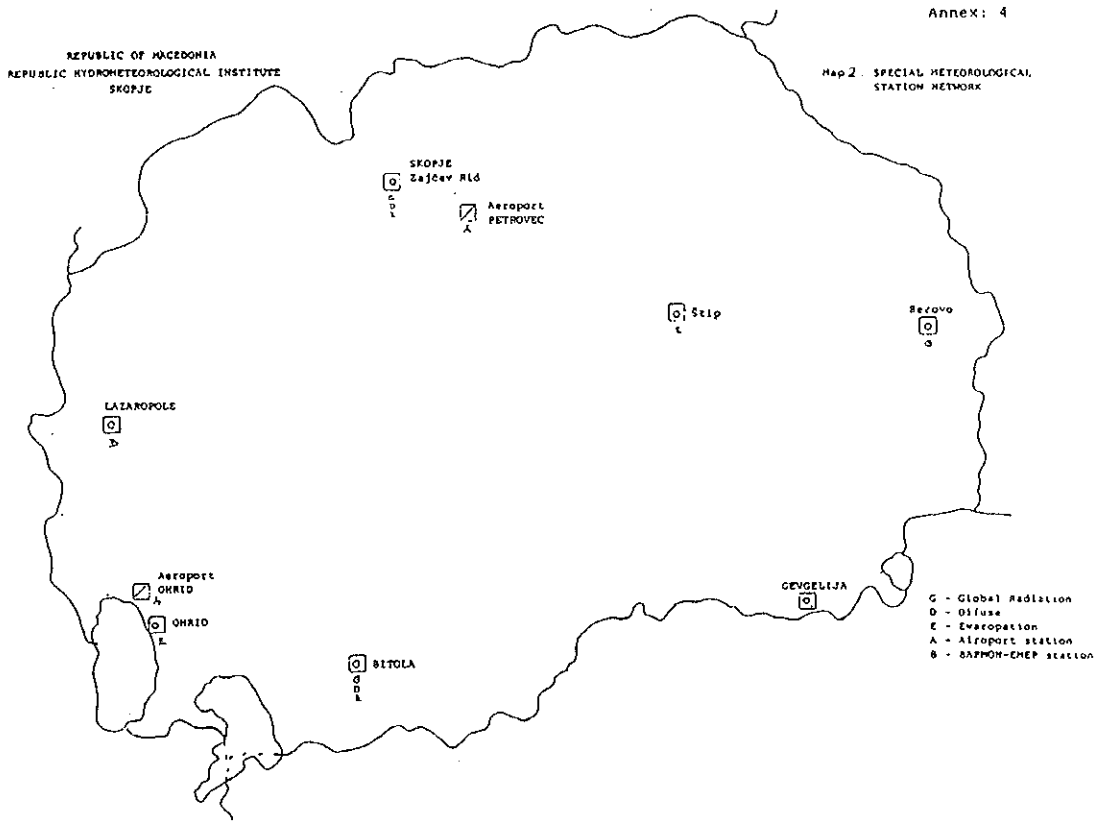


Figure D3.4 Special Meteorological Station Network

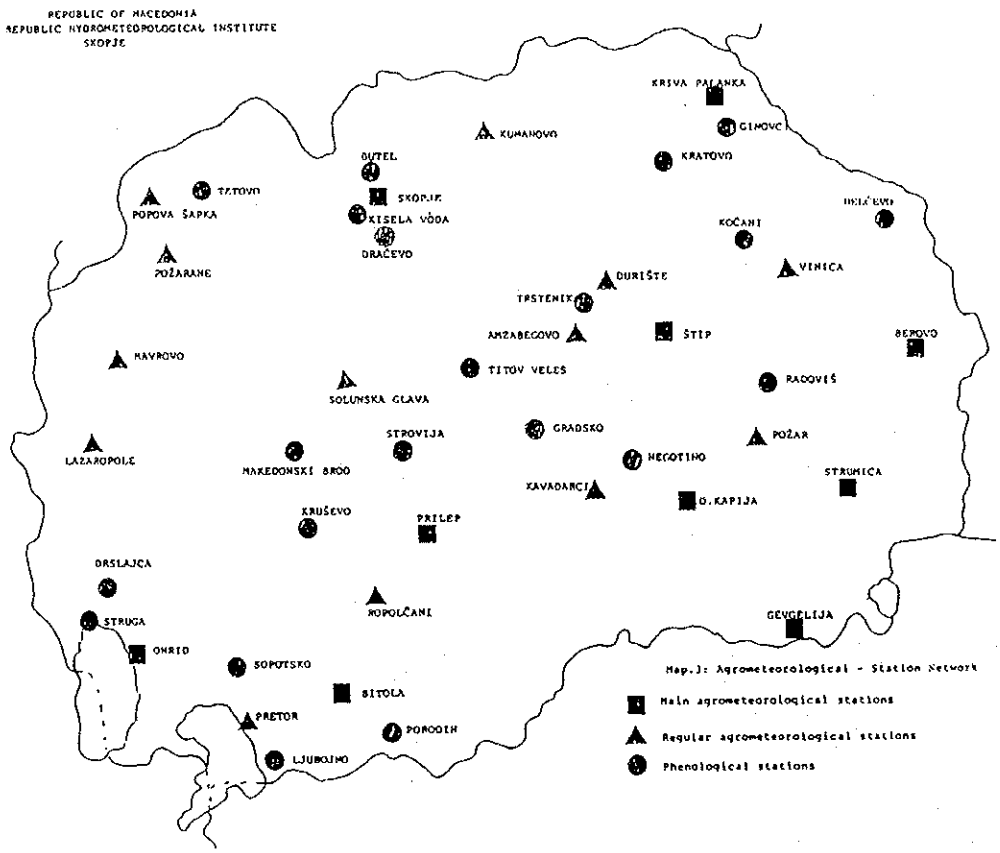


Figure D3.5 Agrometeorogical Station Network

Table D3.1 Existing Equipment List (RHI)

Description	Manufacturer	Country	Remarks
Smokestain Reflectmeter	Diffusion System	UK	For simplified monitoring
Colorimeter	Iskra Electronika	Slovenia	For simplified monitoring
UV/VIS Spectrophotometer	Perkin Elmer	USA	The equipment was manufactured by Hitachi of Japan and is old, but can be used.
pH meter	Meter. LAB		
Conductivity Meter	Meter. LAB		
AA Spectrophotometer	KARL CEIS	W. Germany	Cannot be used at present. Has become obsolete.
Gas Chromatograph	H.P.	USA	Should be used more fully.
Flame Photometer	Radiometer	Denmark	Has become obsolete.
Flue Gas Analyzer	TESTO GmbH & Co.	Germany	Simplified measuring instrument.
Wet Sampler	MTX	Italy	
Gas Meter	J.B. Rombach	W. Germany	
Glassware			Not sufficient.
Dryer			One with higher accuracy is needed in the future.
Water Purification Device			Glass evaporator
Direct-Reading Balance			Can weigh to 0.1mg

Table D3.2(1) Cross-checking Result of Existing Samplers by Standard SO_2 Gas

(Management : Republic Hydrometeorological Institute)

Condition of Sampler	Point No.	Testing Day	Introduction of SO_2 Conc.		Appearances Data			Difference Pressure	Mean Temp.	*Actual Flow	Steam Pressure	Steam P. Correction	Evapo. Ratio	Correction of SO_2 Conc.	
					Total Flow	SO_2 Conc.									
		(Month/Day)	(mg/m^3)	(ppm)	(m^3)	(mg/m^3)	(ppm)	(mm H_2O)	(°C)	(m^3)	(mb)	(m^3)	(ml)	(mg/m^3)	(ppm)
No Improvement	1	10/25~26	0.259	0.097	0.770	0.344	0.129	96	10	0.720	12.3	0.711	6.5	0.324	0.122
		24~25	0.504	0.190	0.775	0.658	0.247	96	15	0.712	17.0	0.700	8.8	0.600	0.226
		23~24	0.761	0.286	0.761	0.952	0.358	96	18	0.692	20.6	0.678	10.3	0.848	0.319
	2	10/29~30	0.259	0.097	1.302	0.602	0.226	111	14	1.199	16.1	1.180	14.0	0.478	0.180
		28~29	0.504	0.190	1.135	0.751	0.282	111	14	1.045	16.1	1.028	12.2	0.626	0.235
	3	10/25~26	0.259	0.097	1.002	0.375	0.141	114	10	0.935	12.3	0.924	8.4	0.338	0.127
		24~25	0.504	0.190	1.004	0.722	0.271	114	15	0.921	17.0	0.905	11.4	0.618	0.233
		23~24	0.761	0.286	2.111	1.196	0.450	185	18	1.903	20.6	1.864	28.4	0.586	0.220
	4	10/29~30	0.259	0.097	1.427	0.434	0.163	127	14	1.312	16.1	1.291	15.4	0.332	0.125
		28~29	0.504	0.190	1.259	0.729	0.274	127	14	1.157	16.1	1.139	13.6	0.588	0.221
	5	10/29~30	0.259	0.097	1.790	0.442	0.166	195	14	1.634	16.1	1.608	19.1	0.304	0.114
		28~29	0.504	0.190	1.683	0.796	0.299	195	14	1.537	16.1	1.512	18.0	0.567	0.213
	6	10/25~26	0.259	0.097	1.302	0.334	0.126	155	10	1.210	12.3	1.196	10.9	0.285	0.107
		24~25	0.504	0.190	1.198	0.772	0.290	155	15	1.094	17.0	1.076	13.5	0.627	0.236
		23~24	0.761	0.286	1.149	1.088	0.409	155	18	1.039	20.6	1.018	15.5	0.848	0.319
	7	10/25~26	0.259	0.097	1.385	0.379	0.143	140	10	1.289	12.3	1.274	11.6	0.317	0.119
		24~25	0.504	0.190	1.159	0.816	0.307	140	15	1.060	17.0	1.043	13.1	0.670	0.252
		23~24	0.761	0.286	1.015	1.074	0.404	140	18	0.919	20.6	0.900	13.7	0.879	0.330
	8	10/25~26	0.259	0.097	1.058	0.378	0.142	98	10	0.989	12.3	0.977	8.9	0.337	0.127
		24~25	0.504	0.190	0.965	0.766	0.288	98	15	0.886	17.0	0.872	11.0	0.662	0.249
		23~24	0.761	0.286	0.950	0.862	0.324	98	18	0.864	20.6	0.846	12.9	0.718	0.270
	9	10/29~30	0.259	0.097	1.601	0.349	0.131	162	14	1.467	16.1	1.443	17.2	0.254	0.095
Improvement of Pipe and the Others	1	10/26~27	0.259	0.097	1.152	0.395	0.149	51	14	1.067	16.1	1.050	12.5	0.325	0.122
		27~28	0.761	0.286	1.104	1.403	0.527	51	15	1.019	17.0	1.002	12.6	1.157	0.435
	3	10/26~27	0.259	0.097	1.220	0.373	0.140	60	14	1.129	16.1	1.111	13.2	0.301	0.113
		27~28	0.761	0.286	1.278	1.467	0.551	60	15	1.178	17.0	1.159	14.6	1.147	0.431
	6	10/26~27	0.259	0.097	1.381	0.495	0.186	60	14	1.278	16.1	1.257	15.0	0.381	0.143
		27~28	0.761	0.286	1.313	1.467	0.551	60	15	1.211	17.0	1.190	15.0	1.134	0.426
	7	10/26~27	0.259	0.097	2.206	0.494	0.186	73	14	2.038	16.1	2.006	23.9	0.284	0.107
		27~28	0.761	0.286	2.179	1.973	0.741	73	15	2.007	17.0	1.973	24.8	1.099	0.413
	8	10/26~27	0.259	0.097	1.125	0.422	0.159	44	14	1.043	16.1	1.026	12.2	0.350	0.132
		27~28	0.761	0.286	1.080	1.411	0.530	44	15	0.997	17.0	0.981	12.3	1.171	0.440

Note * Actual Flow : At 20°C、Correction of Instrumental error(-9.7 %)

Table D3.2(2) Cross-checking Result of Existing Samplers by Standard SO_2 Gas

(Management : Institute for Health Protection)

Condition of Sampler	Point No.	Testing Day	Introduction of SO_2 Conc.		Appearances Data			Difference Pressure	Mean Temp.	*Actual Flow	Steam Pressure	Steam P. Correction	Evapo. Ratio	Correction of SO_2 Conc.	
					Total Flow	SO_2 Conc.									
		(Month/Day)	(mg/m^3)	(ppm)	(m^3)	(mg/m^3)	(ppm)	(mm H_2O)	(°C)	(m^3)	(mb)	(m^3)	(ml)	(mg/m^3)	(ppm)
No Improvement	4	10/30~31	0.259	0.097	2.348	0.212	0.080	48	14	2.175	16.1	2.140	-	0.233	0.087
		11/ 1~ 2	0.259	0.097	2.507	0.244	0.092	48	8	2.372	10.5	2.347	-	0.261	0.098
		2~ 3	0.504	0.190	2.640	0.454	0.171	48	8	2.498	10.5	2.472	-	0.485	0.182
	5	10/30~31	0.259	0.097	3.078	0.264	0.099	86	14	2.841	16.1	2.796	-	0.291	0.109
		11/ 1~ 2	0.259	0.097	3.488	0.237	0.089	86	8	3.288	10.5	3.254	-	0.254	0.096
		2~ 3	0.504	0.190	3.541	0.424	0.159	86	8	3.338	10.5	3.303	-	0.455	0.171
	6	10/30~31	0.259	0.097	2.566	0.209	0.079	85	14	2.368	16.1	2.331	-	0.230	0.087
		11/ 1~ 2	0.259	0.097	3.013	0.238	0.089	85	8	2.840	10.5	2.811	-	0.255	0.096
		2~ 3	0.504	0.190	3.018	0.456	0.171	85	8	2.845	10.5	2.816	-	0.489	0.184
	7	11/ 5~ 6	0.259	0.097	2.404	0.339	0.127	54	10	2.257	12.3	2.230	-	0.366	0.137
		4~ 5	0.504	0.190	2.564	0.622	0.234	54	16	2.357	18.2	2.315	-	0.689	0.259
		3~ 4	0.761	0.286	2.585	0.677	0.255	54	15	2.385	17.1	2.345	-	0.746	0.281
Improvement of Pipe and the Others	4	11/ 5~ 6	0.259	0.097	2.675	0.341	0.128	38	10	2.515	12.3	2.485	-	0.367	0.138
		4~ 5	0.504	0.190	2.730	0.477	0.179	38	16	2.514	18.2	2.469	-	0.528	0.198
		3~ 4	0.761	0.286	2.732	0.564	0.212	38	15	2.524	17.1	2.482	-	0.621	0.233
	5	11/ 5~ 6	0.259	0.097	3.552	0.201	0.076	35	10	3.341	12.3	3.300	-	0.216	0.081
		4~ 5	0.504	0.190	3.632	0.402	0.151	35	16	3.345	18.2	3.285	-	0.444	0.167
		3~ 4	0.761	0.286	3.625	0.450	0.169	35	15	3.350	17.1	3.294	-	0.495	0.186
	6	11/ 7~ 8	0.259	0.097	2.872	0.248	0.093	32	17	2.637	19.3	2.587	-	0.275	0.104
		6~ 7	0.504	0.190	2.997	0.384	0.144	32	16	2.761	18.2	2.712	-	0.424	0.160
		9~10	0.504	0.190	3.166	0.451	0.170	32	12	2.958	14.1	2.917	-	0.490	0.184
		8~ 9	0.761	0.286	3.236	0.683	0.257	32	12	3.023	14.1	2.981	-	0.741	0.279
	7	11/ 7~ 8	0.259	0.097	2.276	0.272	0.102	35	17	2.089	19.3	2.049	-	0.302	0.114
		6~ 7	0.504	0.190	2.422	0.421	0.158	35	16	2.231	18.2	2.191	-	0.465	0.175
		9~10	0.504	0.190	2.440	0.494	0.186	35	12	2.279	14.1	2.247	-	0.536	0.202
		8~ 9	0.761	0.286	2.565	0.591	0.222	35	12	2.396	14.1	2.362	-	0.642	0.241

Note * Actual Flow : At 20°C、Correction of Instrumental error(-9.7 %)

Table D3.2(3) Cross-checking Result of Existing Samplers by Standard SO_2 Gas

(Reexamination ; Exchange of Analytical Technique)

(Management : Republic Hydrometeorological Institute)

Condition of Sampler	Point No.	Testing Day	Introduction of SO_2 Conc.		Appearances Data			Difference Pressure	Mean Temp.	*Actual Flow	Steam Pressure	Steam P. Correction	Evapo. Ratio	Correction of SO_2 Conc.	
					Total Flow	SO_2 Conc.									
		(Month/Day)	(mg/m^3)	(ppm)	(m^3)	(mg/m^3)	(ppm)	(mm H_2O)	(°C)	(m^3)	(mb)	(m^3)	(ml)	(mg/m^3)	(ppm)
Improvement of Pipe and the Others	3	11/ 7~ 8	0.259	0.097	2.620	0.183	0.069	60	17	2.399	19.3	2.353	-	0.204	0.077
		6~ 7	0.504	0.190	2.071	0.389	0.146	60	16	1.903	18.2	1.869	-	0.431	0.162
		9~10	0.504	0.190	2.670	0.427	0.161	60	12	2.488	14.1	2.453	-	0.465	0.175
		8~ 9	0.761	0.286	2.723	0.617	0.232	60	12	2.537	14.1	2.502	-	0.672	0.253

Note * Actual Flow : At 20°C、 Correction of Instrumental error(-9.7 %)

Existing measuring Station

(Management : Republic Hydrometeorological Institute)

No.1 : AMSM - Center
No.2 : Fruit Farming Institute - K. Voda
No.3 : HMI - Karpos
No.4 : Dracevo - K. Voda
No.5 : Avtokomanda - G. Bada
No.6 : Karpos IV - Karpos
No.7 : University Library - Center
No.8 : J. B. Tito
No.9 : Novo Lisice

(Management : Institute for Health Protection)

No.4 : Hotel Panorama(recreation zone)
No.5 : Elementary School Dimo Hadzi Dimov
No.6 : DDD Station
No.7 : Municipal Health Institute

Table D3.2(4) Cross-checking Result of Existing Samplers by Standard SO_2 Gas

(Management : Republic Hydrometeorological Institute)

Condition of Sampler	Standard Gas Point No.	0.259 (mg/m^3)	0.097 (ppm)	Error (%)	0.504 (mg/m^3)	0.190 (ppm)	Error (%)	0.761 (mg/m^3)	0.286 (ppm)	Error (%)
No Improvement	1	0.324	0.122	25	0.600	0.226	19	0.848	0.319	11
	2	0.478	0.180	85	0.626	0.235	24	-	-	-
	3	0.338	0.127	31	0.618	0.232	23	0.586	0.220	-23
	4	0.332	0.125	28	0.588	0.221	17	-	-	-
	5	0.304	0.114	17	0.567	0.213	13	-	-	-
	6	0.285	0.107	10	0.627	0.236	24	0.848	0.319	11
	7	0.317	0.119	22	0.670	0.252	33	0.879	0.331	16
	8	0.337	0.127	30	0.662	0.249	31	0.718	0.270	-6
	9	0.254	0.096	-2	-	-	-	-	-	-
	Average	0.330	0.124	27.4	0.620	0.233	23.0	0.776	0.292	1.9
Improvement of Pipe and the Others	1	0.325	0.122	25	-	-	-	1.157	0.435	52
	3	0.301	0.113	16	-	-	-	1.147	0.431	51
	6	0.381	0.143	47	-	-	-	1.134	0.426	49
	7	0.284	0.107	10	-	-	-	1.099	0.413	44
	8	0.350	0.132	35	-	-	-	1.171	0.440	54
	Average	0.328	0.123	26.7				1.142	0.429	50.0
Reexamination : Exchange of Analytical Technique (Point No.3)		0.204	0.077	-21	0.431 0.465	0.162 0.175	-14 -8	0.672	0.253	-12

Table D3.2(5) Cross-checking Result of Existing Samplers by Standard SO_2 Gas

(Management : Institute for Health Protection)

Condition of Sampler	Standard Gas Point No.	0.259 (mg/m^3)	0.097 (ppm)	Error (%)	0.504 (mg/m^3)	0.190 (ppm)	Error (%)	0.761 (mg/m^3)	0.286 (ppm)	Error (%)
No Improvement	4	0.233	0.088	-10	0.485	0.182	-4	-	-	-
		0.261	0.098	1	-	-	-	-	-	-
	5	0.291	0.109	12	0.455	0.171	-10	-	-	-
		0.254	0.096	-2	-	-	-	-	-	-
	6	0.230	0.086	-11	0.489	0.184	-3	-	-	-
		0.255	0.096	-2	-	-	-	-	-	-
	7	0.366	0.138	41	0.689	0.259	37	0.746	0.280	-2
	Average	0.270	0.102	4.2	0.530	0.199	5.1	0.746	0.280	-2
Improvement of Pipe and the Others	4	0.367	0.138	42	0.528	0.199	5	0.621	0.233	-18
	5	0.216	0.081	-17	0.444	0.167	-12	0.495	0.186	-35
	6	0.275	0.103	6	0.424	0.159	-16	0.741	0.279	-3
		-	-	-	0.490	0.184	-3	-	-	-
	7	0.302	0.114	17	0.465	0.175	-8	0.642	0.241	-16
		-	-	-	0.536	0.202	6	-	-	-
	Average	0.290	0.109	12.0	0.481	0.181	-4.5	0.625	0.235	-17.9

Table D3.3 Comparison between British and Simplified Sampler

	97. Oct										Ave.
	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	
AMSH	-	14.5	22.40	9.1	5.0	19.6	12.7	11.3	13.3	3.7	13.3
61	7.2	14.4	32.99	29.0	5.3	10.1	21.6	19.9	25.9	17.3	17.5
Fruit Farming Institute	-	13.2	13.30	5.5	3.3	7.3	10.2	10.6	16.5	3.3	10.5
33	11.5	25.9	33.05	13.7	7.1	1.4	14.3	17.3	22.3	27.4	19.2
RHMZ	-	9.6	-	5.3	-	-	-	6.4	8.6	2.2	6.5
31	11.5	10.1	(17.3)	4.4	(4.3)	(4.3)	(1.4)	15.8	15.9	24.6	14.2
AVTOKOMANDA	-	6.4	10.13	7.7	3.4	3.6	5.8	6.4	10.3	6.7	6.7
50	14.4	15.9	30.24	8.6	2.9	4.3	4.3	1.4	14.3	2.9	9.4
KARPOS IV	-	9.0	13.50	6.3	3.7	1.7	5.6	6.1	9.3	3.3	7.2
43	11.5	31.6	12.92	4.3	8.6	1.4	15.8	8.6	14.4	11.5	12.1
UNIV. LIBRARY	-	10.6	16.36	12.3	9.3	12.5	-	12.0	16.7	8.0	12.3
59	24.4	28.7	27.31	14.4	4.3	5.8	(17.2)	10.1	17.3	14.5	15.3
NOVO LISICE	-	6.9	6.04	3.0	3.0	3.4	3.8	3.4	9.8	(5.7)	5.5
81	1.4	23.0	31.62	4.3	5.7	4.3	14.4	13.7	27.3	-	16.2
J.B.TITO	-	12.6	21.30	8.9	7.5	7.7	10.0	12.3	13.5	8.4	12.0
60	7.2	8.6	22.99	21.4	8.6	5.3	25.9	25.6	33.1	14.5	18.5
INTERNAT	-	4.7	11.31	6.2	26.2	9.6	5.3	19.7	15.2	(13.0)	12.4
52	21.6	24.4	8.62	1.4	12.7	4.4	4.4	10.2	22.8	-	11.6
DRACEVO	6.0	2.2	2.16	1.1	0.9	0.3	0.6	2.2	4.3	1.1	1.7
100	1.4	20.1	17.50	10.1	10.1	4.3	18.7	4.3	12.9	2.9	10.5
R.I. for H.P.	-	29.3	26.00	26.8	19.9	13.3	18.8	(50.3)	19.3	13.4	21.6
74	14.4	14.4	27.31	18.7	5.7	5.8	14.3	(18.8)	25.9	14.4	15.8
PANORAMA	-	54.3	21.50	13.6	28.6	27.0	27.0	26.9	8.6	26.0	25.9
85	14.4	10.1	35.98	2.9	2.9	5.8	10.1	17.2	20.1	21.7	14.1
DDD	-	18.6	18.40	15.1	32.4	14.8	14.8	29.5	19.3	20.1	20.3
27	12.9	11.5	15.31	12.9	2.9	4.3	7.2	2.9	7.2	2.9	7.5
P.S.DIMO HAZI DIMOV	-	21.6	33.90	20.0	3.4	3.4	3.4	12.3	12.3	13.6	14.4
42	10.1	21.6	18.64	7.2	8.6	1.4	14.5	7.1	7.2	25.3	12.6
Existing samoler(average)		15.3	17.5	10.1	11.7	10.0	9.9	12.7	13.5	10.1	12.3
Simplified sampler(average)		18.6	23.00	10.7	6.6	4.5	13.5	12.2	19.4	15.0	13.7

Note: The values in parenthesis are exclusived.

Table D3.4(1) Comparison of SO_2 Existing with Automatic Measurement Station

(April, 1998) (Unit:μg/m³)

Date	Around the St-1		Around the St-2					Around the St-3			Around the St-4			Other Measuring Point			
	RIH-5	St-1	RIH-1	RIH-8	IPH-4	IPH-7	St-2	RIH-6	IPH-5	St-3	RIH-2	RIH-9	St-4	RIH-3	RIH-4	RIH-7	IPH-6
1	39	19	43		51.9	58.2	21	26	35.4	16	32	13	14	15	5	61	41.1
2	29	14	27		42.3	44.1	18	24	20.0	13	28	22	12	13	5	39	27.2
3	31	8	26		42.7	33.7	15	23	23.9	13	27	13	10	7	6	34	11.4
4	18	9	21		29.2	31.5	10	20	23.9	8	17	32	6	9	5	29	11.4
5	18	7	27		29.2	31.5	14	31	23.9	13	29	-	8	9	5	31	11.4
6	39	15	31		26.0	35.7	15	29	24.1	11	25	26	6	14	5	49	34.4
7	42	11	28		24.7	32.7	11	29	22.9	11	24	23	8	18	5	61	22.9
8	39	14	27		28.6	4.8	15	30	19.4	8	29	23	15	14	5	-	30.8
9	21	10	15		13.0	2.2	11	8	13.1	4	13	12	11	13	5	20	11.9
10	33	7	12		8.5	1.5	8	13	8.6	6	11	11	8	6	5	25	26.6
11	14	9	8		3.2	0.7	6	5	8.6	9	6	8	6	5	5	7	11.4
12	9	1	8		3.2	0.7	5	6	8.6	8	5	5	3	5	-	6	11.4
13	12	0	11		8.1	0.8	4	6	12.1	4	6	7	1	7	5	11	14.4
14	17	4	17		9.6	2.3	9	8	9.5	8	9	6	2	8	5	14	19.4
15	27	8	20		13.1	19.2	10	11	27.9	9	14	6	7	7	5	16	21.7
16	22	9	22		23.4	30.9	13	12	16.5	9	20	10	10	10	5	25	33.1
17	26	10	22		25.0	29.6	15	16	-	14	16	11	9	10	5	22	15.7
18	16	1	12		-	13.2	9	8	-	7	12	8	5	5	5	12	15.7
19	10	0	11		-	13.2	6	5	-	3	11	5	4	5	5	9	15.7
20	14	5	16		9.2	13.2	10	9	-	11	12	6	6	5	5	9	15.7
21	26	6	26		9.2	22.3	12	8	9.8	9	15	5	5	5	5	19	16.6
22	31	3	18		18.7	15.6	8	7	16.6	8	12	5	7	5	5	15	17.4
23	30	4	23		7.7	16.7	12	13	11.4	12	21	7	7	6	5	27	12.0
24	15	8	12		0.8	9.7	6	5	7.5	6	7	5	4	5	5	9	7.8
25	13	6	12		4.0	14.4	7	5	7.5	4	7	6	6	6	5	9	12.8
26	15	7	11		4.0	14.4	5	6	7.5	4	7	6	7	5	5	11	12.8
27	24	9	27		21.3	22.7	11	7	9.7	6	18	6	11	6	5	10	16.2
28	33	14	33		12.5	28.5	36	12	16.7	10	21	5	24	6	5	25	12.0
29	10	8	15		1.6	8.6	9	5	13.0	7	9	5	7	5	5	5	4.6
30	16	8	5		4.8	13.1	11	5	6.7	8	11	5	9	6	5	10	2.9
31																	
Ave.	23.0	7.7	19.5		17.0	18.9	11.4	13.1	15.6	8.6	15.8	10.4	7.9	8.0	5.0	21.4	17.3
Max.	42	19	43		51.9	58.2	36	31	35.4	16	32	32	24	18	6	61	41.1
Min.	9	0	5		0.8	0.7	4	5	6.7	3	5	5	1	5	5	5	-2.9

Note: Ave.: Average Max.: Maximum Min.: Minimum

The SO_2 concentration indicate <5μg/m³ = 5μg/m³(Existing station data:RHI)

Table D3.4(2) Comparison SO_2 Existing with Automatic Measurement Station

(May, 1998) (Unit:μg/m³)

Date	Around the St-1		Around the St-2					Around the St-3			Around the St-4			Other Measuring Point			
	RIH-5	St-1	RIH-1	RIH-8	IPH-4	IPH-7	St-2	RIH-6	IPH-5	St-3	RIH-2	RIH-9	St-4	RIH-3	RIH-4	RIH-7	IPH-6
1	8	6	11	11	4.8	13.1	8	5	6.7	6	8	5	6	5	5	8	2.9
2	7	15	9	9	4.8	13.1	6	5	6.7	7	7	5	6	5	5	7	2.9
3	5	-	5	5	4.8	13.1	-	5	6.7	-	5	5	-	5	5	5	2.9
4	8	7	5	5	1.0	6.5	7	5	4.6	5	5	5	4	5	5	5	-
5	5	4	5	5	0.8	4.5	5	5	5.0	3	5	5	4	5	-	5	-
6	5	1	5	5	2.1	7.4	4	5	3.8	2	5	5	3	5	-	5	1.2
7	8	4	6	9	1.7	11.2	5	5	4.9	3	5	5	3	5	5	5	8.9
8	14	9	8	10	6.0	0.8	7	5	4.1	9	5	5	10	5	-	5	11.6
9	7	17	5	6	0.5	0.4	5	5	4.1	12	5	5	13	6	5	5	0.9
10	7	6	5	5	0.5	0.4	3	5	4.1	8	5	5	6	5	5	5	0.9
11	15	14	8	11	0.7	0.5	11	8	0.7	19	6	5	18	5	5	12	1.0
12	15	10	10	14	0.8	0.6	18	7	0.7	14	8	5	15	5	5	10	1.0
13	21	25	13	20	0.6	0.5	28	11	0.7	28	11	5	20	5	5	13	1.1
14	16	29	12	17	0.4	0.4	20	7	0.2	19	-	7	14	5	5	10	0.3
15	14	19	8	7	0.3	0.3	13	9	0.1	17	5	5	9	5	5	5	0.2
16	5	4	5	5	0.2	0.2	6	5	0.1	7	5	5	2	5	5	5	0.2
17	8	5	5	6	0.2	0.2	8	5	0.1	6	5	5	2	5	5	5	0.2
18	11	14	6	8	0.0	0.1	12	5	0.0	9	5	5	12	5	-	5	0.0
19	5	5	5	11	0.3	0.2	11	5	0.1	5	5	5	3	5	-	5	0.2
20	6	8	8	11	0.1	0.7	11	5	0.4	7	5	5	6	5	5	5	1.5
21	5	6	5	15	0.3	1.8	12	5	0.5	8	5	5	5	5	-	7	3.0
22	12	17	7	9	0.4	0.8	12	7	0.1	13	5	5	10	5	5	5	0.7
23	5	5	6	10	0.7	8.4	6	5	0.1	9	5	5	1	5	5	5	8.3
24	12	19	8	9	0.7	8.4	14	5	0.1	13	7	5	16	5	5	6	8.3
25	20	19	10	12	0.9	8.9	18	7	3.3	16	9	5	16	5	5	5	7.1
26	10	11	8	9	0.5	4.7	12	5	2.9	11	5	5	8	5	-	5	3.4
27	16	10	7	10	1.8	9.0	13	5	2.7	9	5	5	12	5	-	5	8.7
28	21	18	11	11	3.2	10.8	11	7	4.4	14	8	5	18	5	5	7	11.0
29	14	19	10	9	0.8	6.7	18	5	3.0	19	7	5	20	5	5	5	9.7
30	10	14	8	9	0.9	9.1	13	5	3.0	13	5	5	4	5	-	6	9.7
31	9	13	7	8	0.9	9.1	11	5	3.0	9	5	5	8	5	5	-	9.7
Ave.	10.5	11.9	7.5	9.4	1.3	4.9	10.9	5.7	2.5	10.6	5.9	5.1	9.0	5.0	5.0	6.2	4.1
Max.	21	29	13	20	6.0	13.1	28	11	6.7	28	11	7	20	6	5	13	11.6
Min.	5	1	5	5	0.0	0.1	3	5	0.0	2	5	5	1	5	5	5	0.0

Note: Ave.: Average Max.: Maximum Min.: Minimum

The SO_2 concentration indicate <5μg/m³ = 5μg/m³(Existing station data:RHI)

Table D3.4(3) Comparison of SO_2 Existing with Automatic Measurement Station

(June, 1998) (Unit:μg/m³)

Date	Around the St-1		Around the St-2					Around the St-3			Around the St-4			Other Measuring Point			
	RIH-5	St-1	RIH-1	RIH-8	IPH-4	IPH-7	St-2	RIH-6	IPH-5	St-3	RIH-2	RIH-9	St-4	RIH-3	RIH-4	RIH-7	IPH-6
1	13	16	10	10	4.7	11.0	15	5	3.6	9	6	5	17	5	5	5	11.0
2	12	11	7	21	4.6	11.1	17	5	3.8	12	5	5	14	5	5	5	8.4
3	11	17	11	14	9.2	14.8	-	5	5.5	-	9	5	19	5	5	7	12.2
4	5	20	9	5	6.7	11.5	21	5	6.3	16	6	5	-	5	5	14	8.2
5	6	17	9	5	5.3	13.5	19	6	3.9	14	7	5	19	5	5	14	7.8
6	5	20	9	5	3.7	10.5	18	5	3.9	14	8	5	13	5	5	37	7.8
7	5	12	7	5	3.7	10.5	14	5	3.9	10	5	5	11	5	5	6	7.8
8	15	20	10	12	2.4	12.2	16	7	4.5	12	6	5	13	5	5	6	10.5
9	10	11	5	8	0.6	5.9	12	5	1.9	9	5	5	15	5	5	5	6.5
10	7	11	5	6	0.9	7.6	11	5	2.6	7	5	5	11	5	5	5	2.2
11	16	14	8	9	0.7	9.2	12	6	4.6	12	5	5	13	5	5	7	9.8
12	10	14	7	6	1.7	7.4	13	5	2.4	13	5	5	13	5	5	5	3.8
13	5	6	5	5	0.8	5.6	7	5	2.4	5	5	5	8	5	5	5	3.8
14	5	4	5	5	0.8	5.6	6	5	2.4	4	5	5	6	5	5	5	3.8
15	12	13	8	7	5.2	8.6	15	5	2.9	10	5	5	11	5	5	5	6.8
16	11	16	9	11	-	9.6	18	5	5.2	15	7	5	18	5	5	7	6.2
17	11	16	7	8	0.7	9.4	16	5	2.2	11	6	5	18	5	5	6	4.8
18	6	4	5	8	0.4	5.5	11	5	4.4	7	5	5	7	5	5	5	4.0
19	6	8	6	13	0.6	8.6	13	5	3.6	9	6	5	9	5	5	7	2.7
20	11	19	5	9	0.7	8.9	13	5	3.6	10	7	5	16	5	5	7	5.2
21	8	10	5	9	0.7	8.9	14	5	3.6	12	6	5	17	5	5	5	5.2
22	12	18	5	6	1.0	8.8	15	4	4.1	10	5	5	22	5	5	4	4.8
23	8	18	6	5	0.7	9.5	13	4	4.3	12	4	5	19	5	5	4	0.9
24	10	15	5	6	0.6	9.1	14	5	3.1	10	5	5	17	5	5	4	7.0
25	9	14	5	5	0.5	2.1	13	5	3.4	9	5	5	12	5	5	7	5.1
26	6	16	5	6	1.2	9.6	14	5	4.5	9	5	5	15	5	5	8	8.2
27	6	18	5	6	15.5	9.8	18	5	4.5	11	5	5	16	5	5	6	8.2
28	11	19	6	10	15.5	9.8	19	6	4.5	12	6	5	16	5	5	6	8.2
29	8	17	5	8	1.4	6.4	16	6	3.5	12	4	5	15	5	5	8	7.1
30	11	17	7	7	3.1	7.8	15	9	5.3	14	5	5	15	5	5	6	7.9
31																	
Ave.	9.0	14.4	6.7	8.0	3.2	9.0	14.3	5.3	3.8	10.6	5.6	5.0	14.3	5.0	5.0	7.4	6.5
Max.	16	20	11	21	15.5	14.8	21	9	6.3	16	9	5	22	5	5	37	12.2
Min.	5	4	5	5	0.4	2.1	6	4	1.9	4	4	5	6	5	5	4	0.9

Note: Ave.: Average Max.: Maximum Min.: Minimum

The SO_2 concentration indicate <5μg/m³ = 5μg/m³(Existing station data:RHI)

Table D3.4(4) Comparison of SPM Existing with Automatic Measurement Station

(April, 1998) (Unit:μg/m³)

Date	Around the St-1		Around the St-2			Around the St-3		Around the St-4			Other Measuring Point		
	5	St-1	1	8	St-2	6	St-3	2	9	St-4	3	4	7
1	50	76	63		119	62	96	58	25	101	34	4	62
2	33	81	51		124	53	101	37	17	92	25	3	40
3	51	71	54		113	47	84	44	25	83	15	8	56
4	20	57	43		103	47	74	40	5	75	13	2	38
5	36	79	46		85	47	84	40	-	88	11	4	55
6	32	69	39		108	45	93	26	12	79	11	3	28
7	38	55	44		87	47	84	39	24	58	18	3	44
8	41	70	49		105	50	82	44	19	91	18	4	-
9	28	105	17		244	22	125	12	9	125	8	1	12
10	42	68	35		76	37	73	25	7	84	16	4	50
11	34	29	22		31	63	38	14	7	37	10	7	29
12	12	17	8		20	16	34	3	3	20	3	-	8
13	13	13	14		18	17	23	3	2	16	7	0	12
14	14	26	15		40	15	37	7	3	26	5	1	11
15	31	35	34		53	30	33	29	17	45	13	4	24
16	28	50	39		88	29	-	31	15	59	9	4	28
17	24	54	30		72	29	26	18	7	51	7	3	30
18	16	29	18		42	12	33	6	3	32	6	3	12
19	12	19	12		27	10	21	6	3	17	1	3	8
20	25	31	24		37	23	37	26	13	31	10	3	31
21	20	42	24		51	24	45	17	5	38	7	4	26
22	25	40	36		61	16	50	28	14	54	8	3	35
23	20	-	29		70	24	62	21	9	60	8	3	28
24	24	36	40		39	21	40	19	3	33	13	3	21
25	24	43	26		51	17	45	19	15	47	6	3	25
26	25	44	24		47	20	44	23	10	46	10	3	28
27	14	54	42		67	38	57	47	25	65	14	4	41
28	25	59	36		83	25	65	18	3	56	13	3	18
29	26	35	48		45	32	41	25	3	33	12	6	34
30	39	36	50		50	37	42	35	19	53	17	3	47
31													
Ave.	27.4	49.1	33.7		71.8	31.8	57.5	25.3	11.1	56.4	11.6	3.4	30.4
Max.	51	105	63		244	63	125	58	25	125	34	8	62
Min.	12	13	8		18	10	21	3	2	16	1	0	8

Note: Ave. : Average Max. : Maximum Min. : Minimum

Table D3.4(5) Comparison of SPM Existing with Automatic Measurement Station

(May, 1998) (Unit:μg/m³)

Date	Around the St-1		Around the St-2			Around the St-3		Around the St-4			Other Measuring Point		
	5	St-1	1	8	St-2	6	St-3	2	9	St-4	3	4	7
1	26	39	28	32	52	20	49	24	15	52	10	4	36
2	15	37	16	15	44	11	45	12	5	43	7	3	19
3	17	40	15	13	44	16	52	13	3	37	10	2	18
4	19	56	23	18	61	20	59	11	5	53	10	2	17
5	31	55	32	39	56	26	68	20	11	41	9	4	44
6	23	41	32	28	41	7	33	21	15	36	10	4	28
7	29	62	34	33	58	11	52	24	11	51	10	4	30
8	35	57	42	48	74	24	70	38	15	53	13	3	41
9	20	45	24	23	64	16	47	17	9	54	7	3	30
10	23	39	18	22	41	10	44	20	9	35	9	1	22
11	35	35	32	35	49	7	45	23	11	43	10	1	38
12	25	39	29	31	54	7	44	16	7	41	10	4	23
13	39	60	31	45	78	14	69	37	15	67	14	4	38
14	31	71	36	40	69	21	56	-	12	58	11	3	34
15	18	41	21	0	55	15	49	5	7	38	10	3	18
16	25	22	19	22	26	14	25	14	9	22	9	1	30
17	15	29	14	19	31	16	32	18	15	29	4	2	22
18	20	36	19	32	42	18	32	11	9	46	5	1	23
19	20	29	13	26	38	15	27	10	7	26	6	3	26
20	16	29	14	29	39	18	29	12	11	32	8	3	27
21	21	29	24	34	37	18	32	20	12	29	9	2	34
22	25	45	23	23	54	23	45	13	7	41	5	3	21
23	13	24	14	23	24	7	25	11	9	22	3	1	19
24	22	42	20	24	46	16	45	19	11	44	13	2	28
25	21	61	43	27	71	20	59	18	8	57	13	1	23
26	19	19	26	25	21	21	17	14	5	17	6	3	25
27	26	35	23	18	37	20	111	20	11	37	7	1	31
28	34	47	32	30	65	26	74	28	18	64	11	3	31
29	30	46	39	42	58	32	55	26	15	-	14	2	34
30	22	51	17	28	51	16	51	14	9	-	5	3	17
31	23	90	19	27	78	19	75	15	8	-	6	4	-
Ave.	23.8	43.5	24.9	27.5	49.2	16.9	48.9	18.1	10.2	41.6	8.9	2.5	27.6
Max.	39	71	43	48	78	32	111	38	18	67	14	4	-44
Min.	13	19	13	0	21	7	17	5	3	17	3	1	17

Note: Ave. : Average Max. : Maximum Min. : Minimum

Table D3.4(6) Comparison of SPM Existing with Automatic Measurement Station

(June, 1998) (Unit:μg/m³)

Date	Around the St-1		Around the St-2			Around the St-3		Around the St-4		Other Measuring Point		
	5	St-1	1	8	St-2	6	St-3	2	9 St-4	3	4	7
1	38	91	38	44	101	37	88	32	17	11	4	29
2	35	53	33	37	67	31	56	25	10	7	1	30
3	29	53	32	42	77	30	63	34	16	9	2	25
4	33	69	37	42	92	38	74	27	17	16	1	29
5	31	64	38	45	95	27	76	25	17	15	1	30
6	27	67	22	30	83	22	69	17	11	12	2	19
7	18	59	14	25	66	24	59	14	0	14	1	9
8	20	64	38	37	88	24	80	20	18	16	1	26
9	25	64	27	31	77	16	66	22	8	11	3	30
10	22	65	32	31	72	24	58	15	6	15	2	23
11	17	42	31	28	59	26	49	19	6	9	1	21
12	21	64	28	27	77	25	69	15	6	7	1	21
13	18	31	15	22	33	16	37	10	4	5	1	18
14	17	24	15	18	30	12	25	11	4	5	1	16
15	22	31	24	29	43	22	50	19	6	9	0	14
16	24	69	34	40	83	32	76	25	16	15	1	31
17	21	77	24	25	78	23	70	15	5	9	1	19
18	13	37	19	27	48	17	43	11	10	3	1	18
19	15	38	16	17	43	12	36	13	6	2	3	24
20	17	48	18	21	52	19	47	16	8	7	3	20
21	21	60	23	24	62	20	70	26	10	7	4	23
22	25	68	36	37	79	30	68	23	16	6	2	30
23	23	49	24	24	66	23	61	13	8	11	3	20
24	32	70	32	33	87	34	71	21	14	16	3	30
25	27	61	30	28	69	24	70	18	8	15	3	27
26	35	63	38	48	65	35	73	31	17	12	4	37
27	26	60	35	38	69	30	79	26	18	16	5	28
28	24	57	25	31	92	24	72	27	10	15	3	26
29	33	61	35	35	71	27	72	22	14	10	4	28
30	29	63	38	47	65	38	77	27	17	13	5	30
31												
Ave.	24.6	57.3	28.4	32.1	69.5	25.4	63.4	20.6	10.8	10.6	2.2	24.4
Max.	38	91	38	48	101	38	88	34	18	16	5	37
Min.	13	24	14	17	30	12	25	10	0	2	0	9

Note: Ave.: Average Max.: Maximum Min.: Minimum

Table D3.5 Average Monthly Value Precipitation and Quantities of Dust Fall

	Average daily value in mg/m2 calculated from the monthly quantity dust fall 1990-1994											
Month	I	II	III	IV	V	IV	VII	VIII	IX	X	XI	XII
Dust fall mg/m2	180	180	242	323	258	245	238	184	153	215	232	285
Average precipitation RR(mm)	22.8	20.9	20.4	56.6	31.3	27.8	44.4	18.4	13	33	44.5	32

Source: NEAP

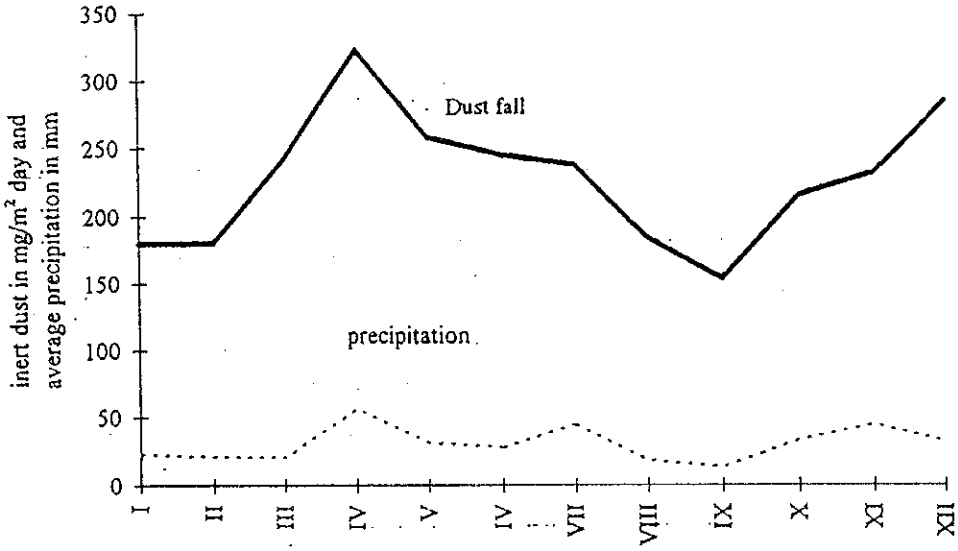
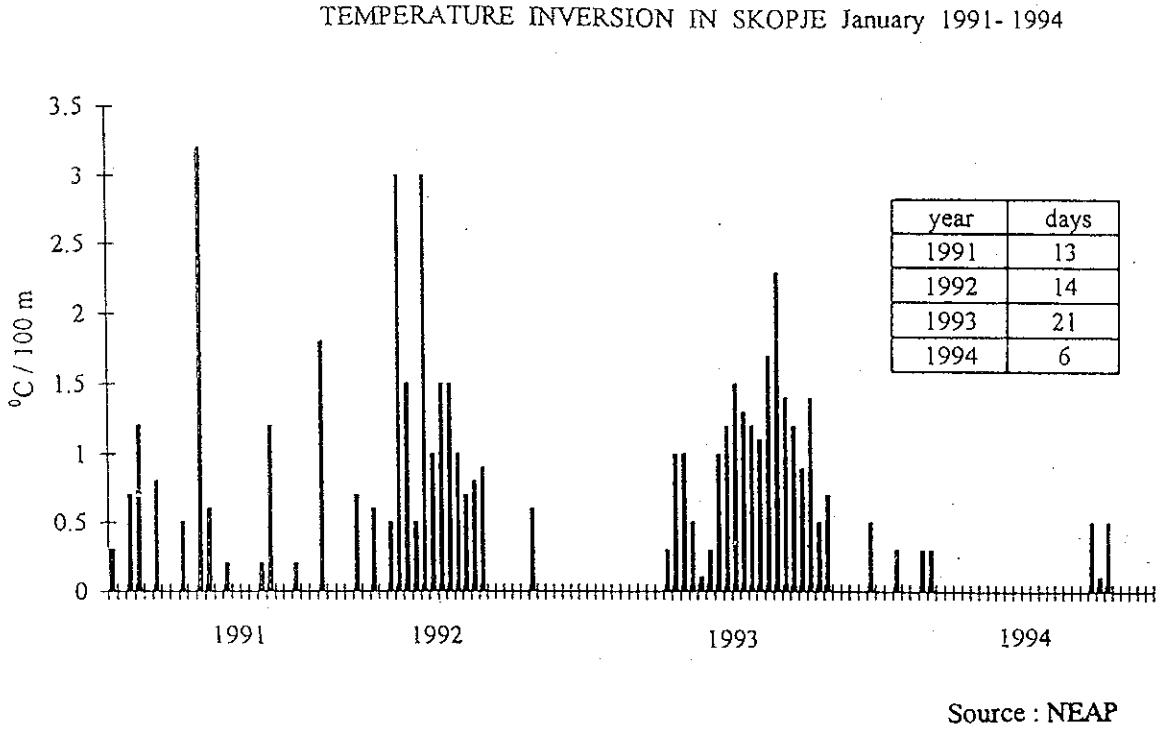


Figure D3.6 Average Monthly Value Precipitation and Quantities of Dust Fall

Table D3.6 The Monthly Quantities of Dust Fall for Skopje (1990-1994)

measuring station	max. value.	min. value.
1. PSDimiter Haxi Dimov	462	33
2. hotel Panorama	420	53
3. DDD Stanica	649	34
4. Singelic	737	42
5. Zelezara	884	42
6. Cair	857	98
7. Healthy Station	551	40
8. Usje	622	45
9. Pivara	540	41
10. Kinder garten Veseli Cvetovi	98	50
11. Health Protection Institute	472	56

Source : NEAP



Source : NEAP

Figure D3.7 The Number of Times and Intensity of Temperature Inversion

Table D3.7 Annual Accumulation of SO_2, Black Smoke and NO_2 (1994)

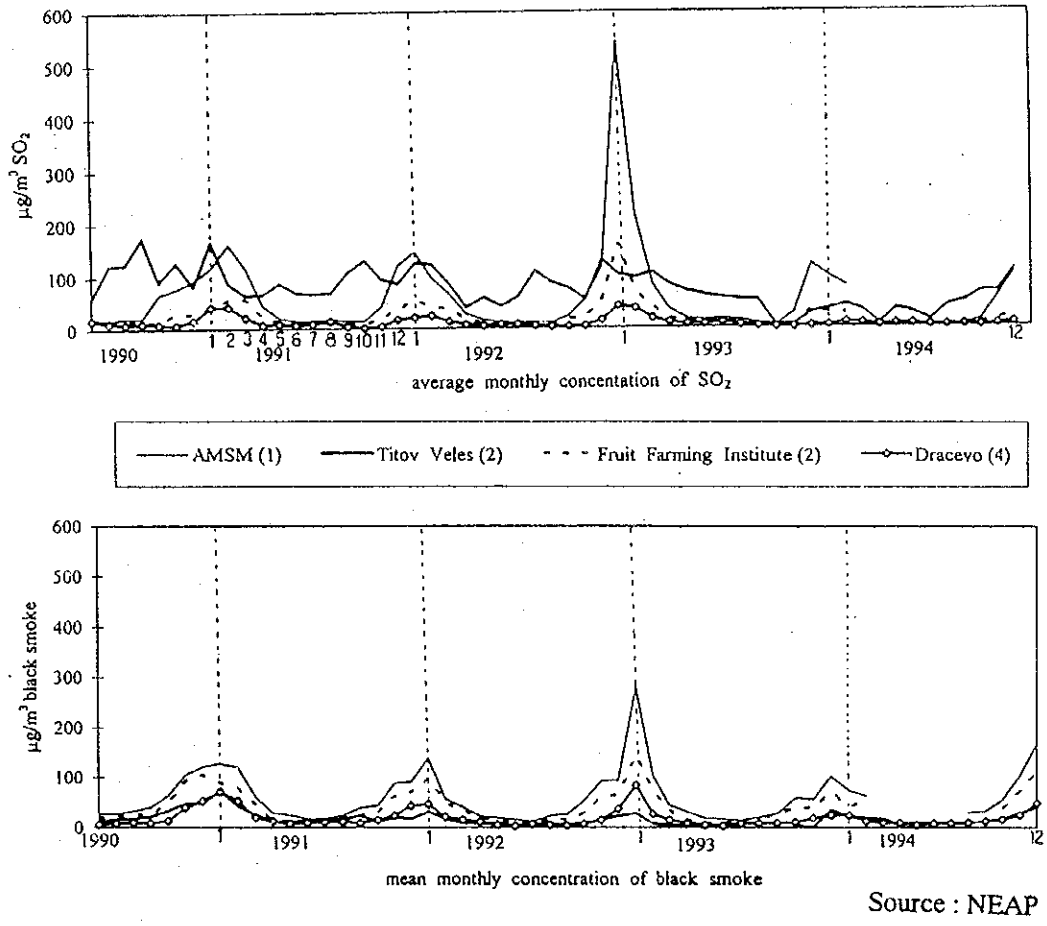
AVERAGE ANNUAL PARAMETERS IN $\mu g/m^3$

no.	measuring station - commune			% of realization			average annual concentration			max.annual concentration			no. of days > MPC		
				SO_2	bl. smoke	NO_2	SO_2	bl. smoke	NO_2	SO_2	bl. smoke	NO_2	SO_2	bl. smoke	NO_2
1	AMSM	Centar	Skopje	[illegible]			15	37		64	270			71	
2	Fruit Farming Institute	K.Voda	Skopje	99	98		56	82		256	362		14	88	
3	HMI	Karpos	Skopje	[illegible]			10	17		101	164			16	
4	Dracevo	K.Voda	Skopje	100	100		5	16		94	122			19	
5	Avtokomanda	G.Baba	Skopje	98	97		26	32		208	173		3	65	
6	Karpos IV	Karpos	Skopje	94	94	94	7	45	9	56	342	123		92	1
7	University library	Centar	Skopje	85	92		40	43		414	348		11	79	
8 *	J.B.Tito	Centar	Skopje	\	\		\	\		\	\	\	\	\	
9	MMS,Lazaropole		Lazaro.	98	59	82	4	3	1	81	11	48			1
10	MMS - Bitola		Bitola	100	100		8	14		33	124			18	
11	MMS - Gevgelija		Gevgelija	92	92		7	11		37	84			5	
12	Kinder garten "Mladost"		Tetovo	94	94		3	23		18	192			29	
13	MMS - Stip		Stip	95	87		8	13		55	103			6	
14	MMS - Berovo		Berovo	69	69		7	9		45	84			2	
15	Filter station		Kumanovo	85	85		7	14		66	136			10	
16	MMS - Prilep		Prilep	100	100		9	17		59	153			24	
17	MMS - Ohrid		Ohrid	99	99		6	8		63	79			1	
18	Assembly (Tyeks)		Titov Veles	97	97		43	17		384	116		23	14	
19	Filter station		Titov Veles	97	97		64	11		405	179		17	8	
20	Oslomej		Kicevo	[illegible]			5	9		44	50				

* short time of measurement

HMI - Hydrometeorologikal Institute
MMS - Main Meteorologikal Station
MPC - max. permite concentration

Source : NEAP



Source : NEAP

Figure D3.8 Monthly Fluctuations of SO2 and Black Smoke (1990-1994)

Table D3.7 Annual Accumulation of SO_2, Black Smoke and NO_2 (1994)

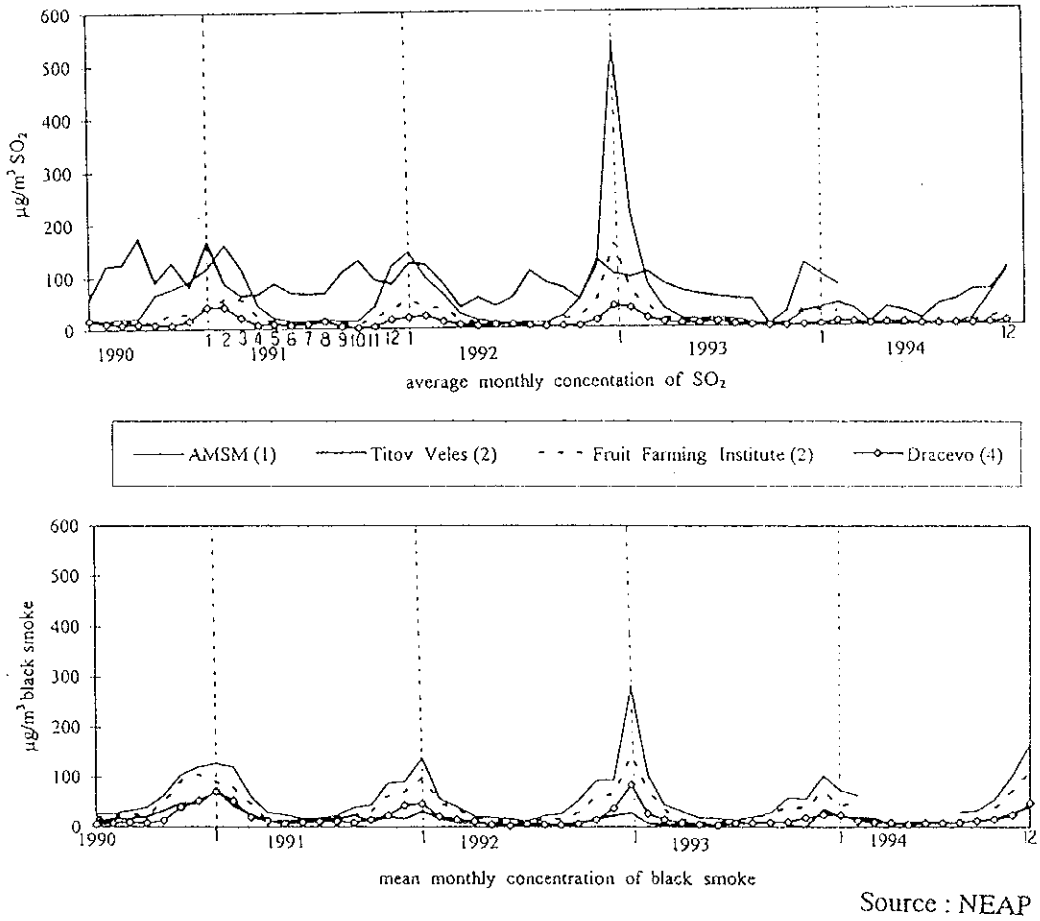
AVERAGE ANNUAL PARAMETERS IN $\mu g/m^3$

no	measuring station - commune			% of realization			average annual concentration			max annual concentration			no. of days > MPC		
				SO_2	bl. smoke	NO_2	SO_2	bl. smoke	NO_2	SO_2	bl. smoke	NO_2	SO_2	bl. smoke	NO_2
1	AMSM	Centar	Skopje	[redacted]			15	37		54	270			71	
2	Fruit Farming Institute	K.Voda	Skopje	99	98		56	82		256	362		14	88	
3	HMI	Karpos	Skopje	[redacted]			10	17		101	164			16	
4	Dracevo	K.Voda	Skopje	100	100		5	16		94	122			19	
5	Avtokomanda	G.Baba	Skopje	98	97		26	32		208	173		3	65	
6	Karpos IV	Karpos	Skopje	94	94	94	7	45	9	56	342	123		92	1
7	University library	Centar	Skopje	85	92		40	43		414	348		11	79	
8 *	J.B.Tito	Centar	Skopje	\	\		\	\		\	\	\	\	\	
9	MMS,Lazaropole		Lazaro.	98	59	82	4	3	1	81	11	48			1
10	MMS - Bitola		Bitola	100	100		8	14		33	124			18	
11	MMS - Gevgelija		Gevgelija	92	92		7	11		37	84			5	
12	Kinder garten "Mladost"		Tetovo	94	94		3	23		18	192			29	
13	MMS - Stip		Stip	95	87		8	13		55	103			6	
14	MMS - Berovo		Berovo	69	69		7	9		45	84			2	
15	Filter station		Kumanovo	85	85		7	14		66	136			10	
16	MMS - Prilep		Prilep	100	100		9	17		59	153			24	
17	MMS - Ohrid		Ohrid	99	99		6	8		63	79			1	
18	Assembly, T.Veles		T.Veles	97	97		45	17		384	116		23	14	
19	Filter station		T.Veles	97	97		64	11		405	179		47	8	
20	Oslomej		Kicevo	[redacted]			5	9		44	50				

* short time of measurement

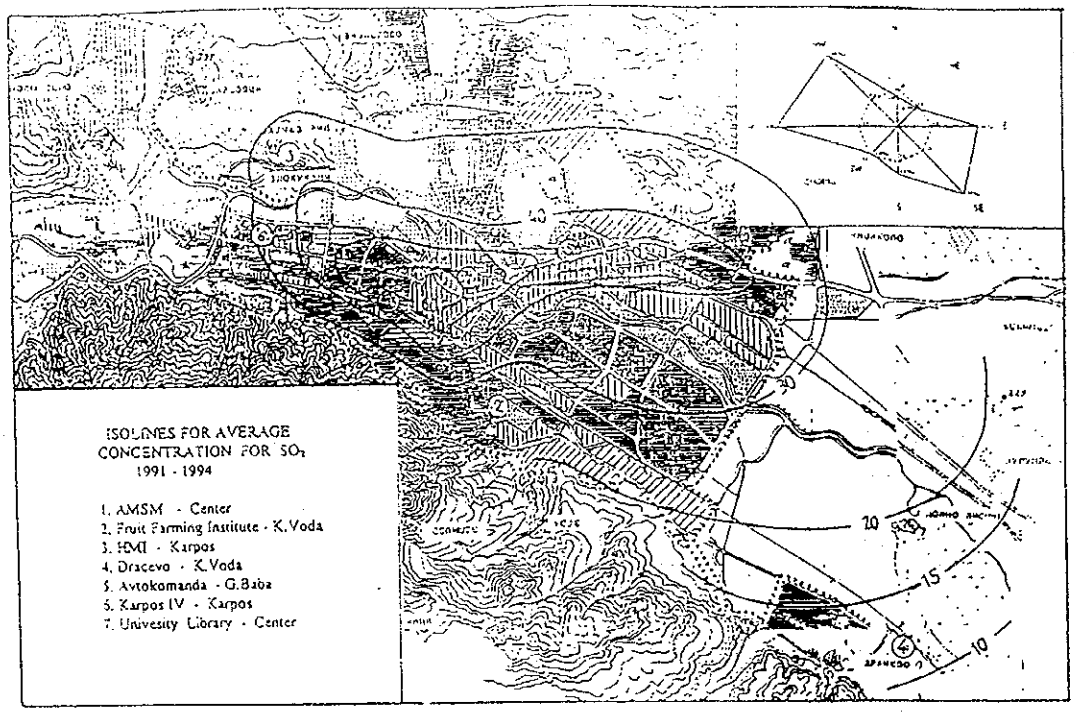
HMI - Hydrometeorologikal Institute
MMS - Main Meteorologikal Station
MPC - max. permite concentration

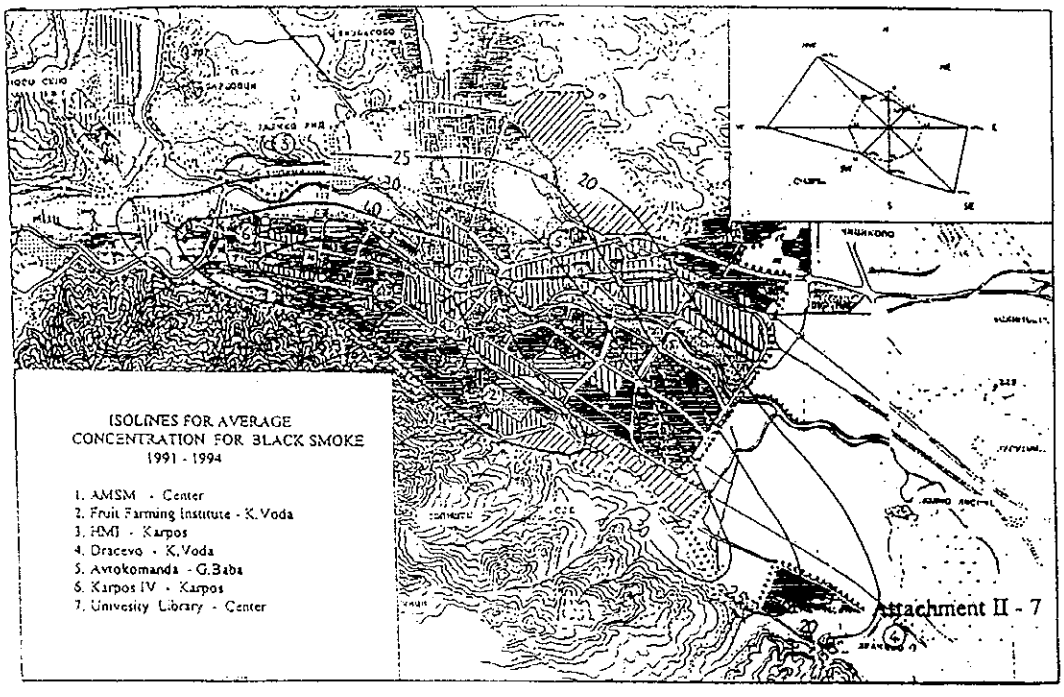
Source : NEAP



Source : NEAP

Figure D3.8 Monthly Fluctuations of SO2 and Black Smoke (1990-1994)





Source : NEAP

Figure D3.9 The Isosbestic Chart of Average Concentration of SO_2 and Black Smoke (1991-1994)

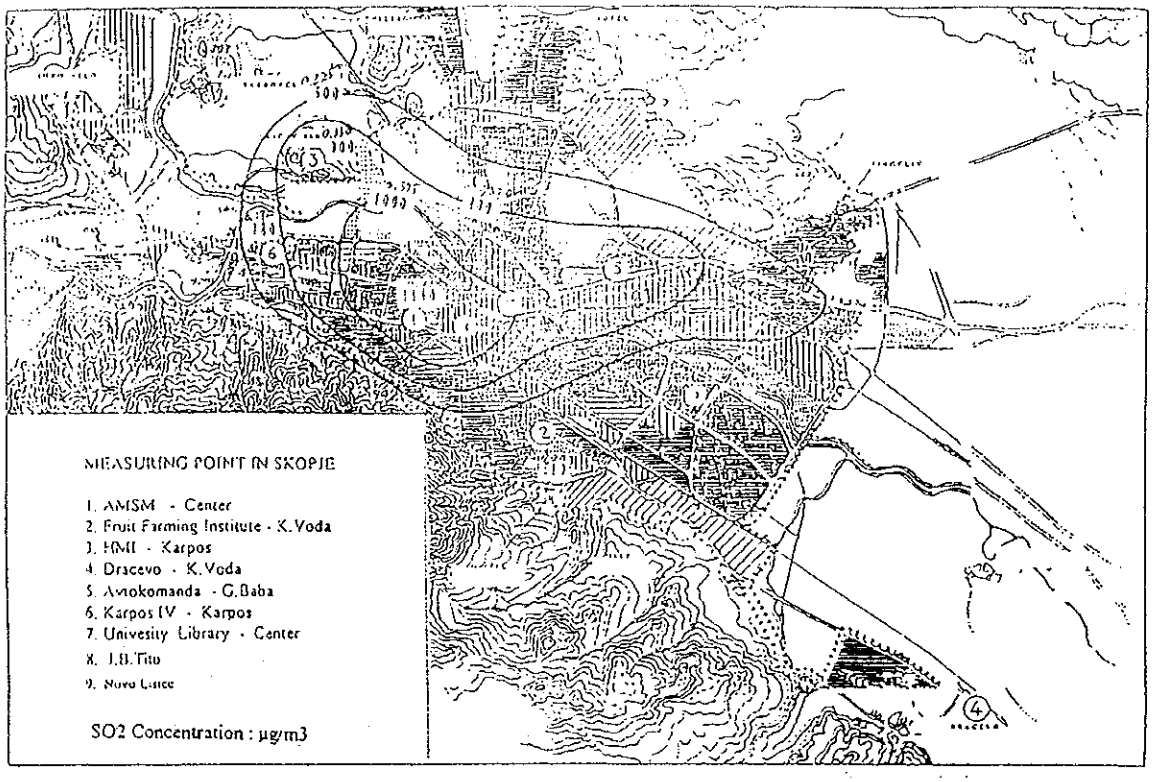


Figure D3.10 The Isosbestic Chart of SO_2 (January 12, 1993)

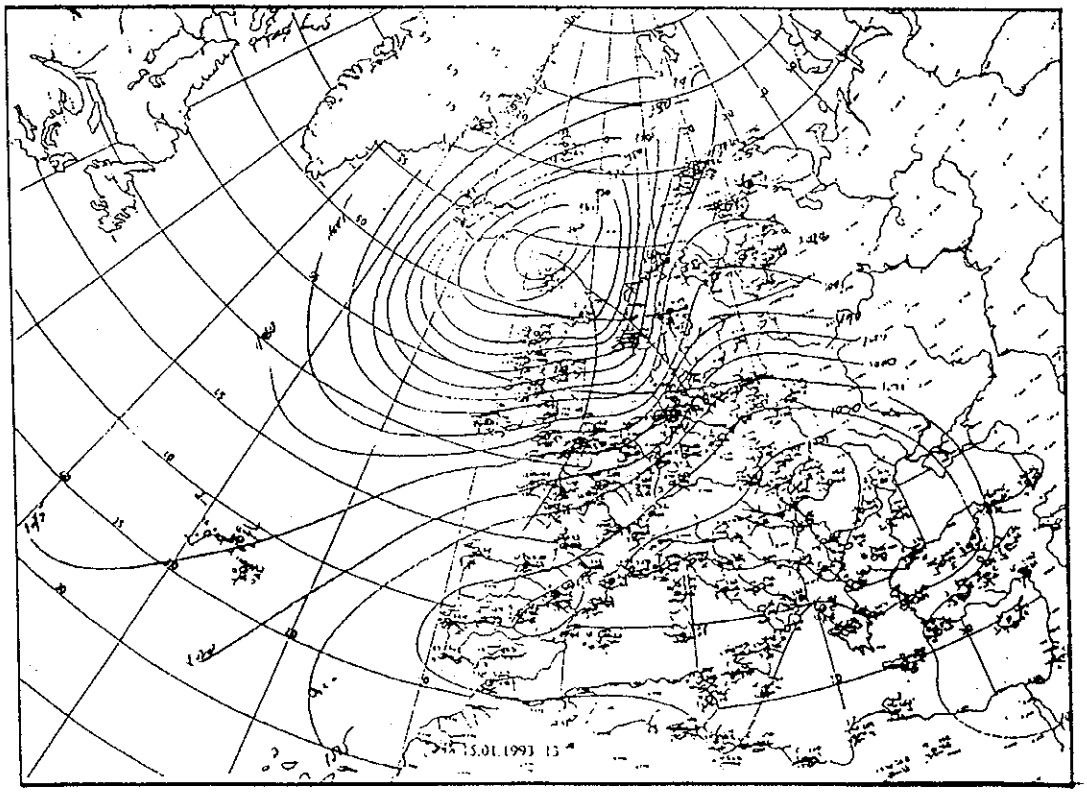
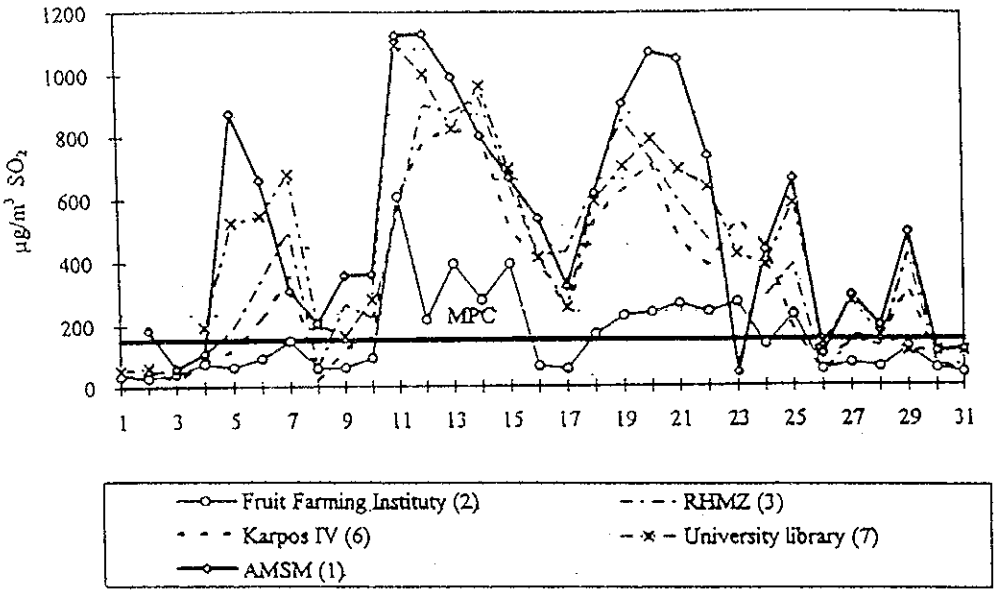
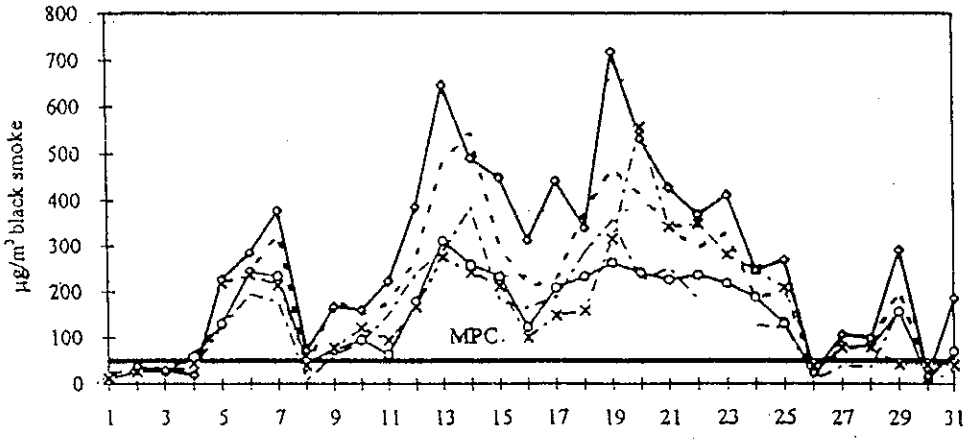


Figure D3.11 The Barometric Pattern of Europe at 13:00 on January 15, 1993

Source : NEAP

JANUARY 1993





Source : NEAP

Figure D3.12 The Fluctuation Chart of SO_2 and Black Smoke (January, 1993)

Table D3.8 Air Quality Level in Skopje for SO_2 (1996)

Month	No. of measurement sites	Average concentration (mg/m^3)	Minimum - maximum (mg/m^3)	No. of days above the MPC*
January	7	0.0359	0.0000-0.1594	1
February	7	0.0436	0.0000-0.2008	3
March	7	0.0400	0.0017-0.1909	1
April	7	0.0254	0.0000-0.2067	1
May	7	0.0174	0.0000-0.2281	3
June	7	0.0218	0.0000-0.1731	2
July	7	0.0226	0.0000-0.2091	3
August	7	0.0167	0.0000-0.1350	0
September	7	0.0091	0.0000-0.2105	1
October	7	0.0317	0.0000-0.1398	0
November	7	0.0450	0.0000-0.1696	1
December	7	0.0591	0.0000-0.2152	6
Total - 1996	7	0.0307	0.0000-0.2281	22

* MPC - maximum permited concentration (0.150 mg/m^3)

Remark- SO_2 is measured on 4 measurement sites, and total acidity on 3 sites

Table D3.9 Air Quality Level in Skopje for Smoke (1996)

Month	No. of measurement sites	Average concentration (mg/m^3)	Minimum - maximum (mg/m^3)	No. of days above the MPC*
January	7	0.0503	0.0055	84
February	7	0.0446	0.0064-0.1438	57
March	7	0.0214	0.0057-0.0678	9
April	7	0.0156	0.0037-0.0375	0
May	7	0.0130	0.0034-0.0376	0
June	7	0.0122	0.0028-0.0383	0
July	7	0.0107	0.0024-0.0296	0
August	7	0.0129	0.0041-0.0421	0
September	7	0.0212	0.0040-0.0883	12
October	7	0.0341	0.0039-0.1554	42
November	7	0.0749	0.0027-0.2104	123
December	7	0.0637	0.0067-0.3497	103
Total - 1996	7	0.0312	0.0024-0.3497	430

* MPC - maximum permited concentration (0.050 mg/m^3)

Table D3.10 Air Quality Level in Skopje for SO_2, Total Acidity and Smoke
(Annual Average Concentration, 1996)

Pollutants	Measurement site	Annual average concentration (mg/m^3)	Minimum - maximum (mg/m^3)	No. of days above the MPC*
Total acidity	Factory of cement	0.0374	0.0000-0.2008	3
Total acidity	Brewery	0.0465	0.0000-0.2281	12
Total acidity	Kinder garden "Srnichka"	0.0483	0.0000-0.1628	1
SO_2	Institute for Health Protection	0.0222	0.0002-0.1531	2
SO_2	Elementary school "D.H.Dimov"	0.0184	0.0003-0.1157	0
SO_2	Hotel "Panorama"	0.0181	0.0001-0.1387	0
SO_2	Department for DDD	0.0240	0.0002-0.2152	4
Smoke	Factory of cement	0.0272	0.0038-0.1410	52
Smoke	Brewery	0.0334	0.0027-0.1971	68
Smoke	Kinder garden "Srnichka"	0.0285	0.0042-0.2104	56
Smoke	Institute for Health Protection	0.0359	0.0039-0.1870	83
Smoke	Elementary school "D.H.Dimov"	0.0243	0.0042-0.1395	36
Smoke	Hotel "Panorama"	0.0175	0.0024-0.1156	27
Smoke	Department for DDD	0.0518	0.0041-0.3497	108

*MPC - maximum permited concentration (anual avreage concentration 0.050 mg/m^3 according the World Health Organization)

Table D3.11 Air Quality Level in Skopje for Lead (1996)

No. of measurement sites	No. of samples	Average concentration (mg/m^3)	Minimum - maximum (mg/m^3)	No. of samples above the MPC*
1	14	0.0009	0.0001-0.0020	7

*MPC - maximum permited concentration (24 hour - 0.0007 mg/m^3)

Table D3.12 Result of Heavy Metal Survey at Four Intersections (1988)

($\mu g/m^3$)

No	Term	particles mg/m^3	Pd	Cd	Fe	Zn	Mn
1	88/6/08 (06/18hour) 88/7/14 (06/18hour)	352 846	0.89 1.87	0.052 0.07	4.335 9.135	0.948 0.605	0.135 0.225
2	88/6/8 (06/18hour) 88/7/7 (06/18hour)	312 158	0.337 0.663	0.077 0.035	4.47 1.375	1 0.257	0.121 0.4
3	88/12/13 (06/18hour) 88/12/13 (06/18hour)	142 411	 1.04	 0.055	5.99 8.103	0.432 1.917	0.275 0.537
4	88/12/14 (06/18hour) 88/12/15 (06/18hour)	166 221	 0.44	 0.027	2.647 3.6	0.59 0.367	0.168 0.035

*MPC - maximum permited concentration (24 hour - 0.0007 mg/m^3)

Remark - measurement sites are the following crossroads:

1. boulevard Goce Delcev and Krste Misirkov
2. boulevard J N A and boulevard Ivo Lola Ribar
3. boulevard Edvard Kardel and sreet Internacional Brigadi
4. boulevard Srbija and Prvomajska

Table D3.13 Air Quality Level in Skopje for Dust (1996)

Month	No. of measurement sites	Average concentration (mg/m^2)	Minimum - maximum (mg/m^2)	No. of samples above the MPC*
January	30	147.4	52.-817.2	1
February	30	157.3	93.3-283.8	0
March	30	186.7	83.2-341.7	1
April	30	188.7	80.0-357.1	5
May	30	265.5	127.0-541.8	11
June	30	136.5	37.6-502.3	2
July	30	167.5	15.7-407.9	2
August	30	244.1	16.9-875.9	5
September	30	250.5	89.4-582.6	7
October	30	148.7	49.3-477.7	2
November	30	246.0	98.6-582.4	7
December	30	159.6	53.9-405.6	4
Total - 1996	30	192.0	15.7-875.9	47

* MPC - maximum permited concentration (24 hour - 300 mg/m^2)

Remark - **dust** measurement sites are the following:

- Institute for Health Protection - Skopje
- Park "Zena Borec"
- Comune "Centre"
- Vlae
- Karposh III - kinder garden
- Kozle - pump station
- T.E.C. Madjari
- M.Z. Tito
- st."Tajmishka"
- Department for DDD
- Hotel "Panorama"
- Shuto Orizari - prison
- Przino
- Factory "Ohis"
- J.Sandanski - kinder garden
- Factory "Treska"
- Univerzalna sala
- Gjorche Petrov
- Karposh III - Ilindenska
- st."Sofiska"
- Heating station - west
- st."Finska"
- Smelting Plant for iron
- st."Gemidjiska"
- Brewery
- Butel I - medical station
- Butel II
- 11 Oktomvri
- Factory of cement
- Lisiche

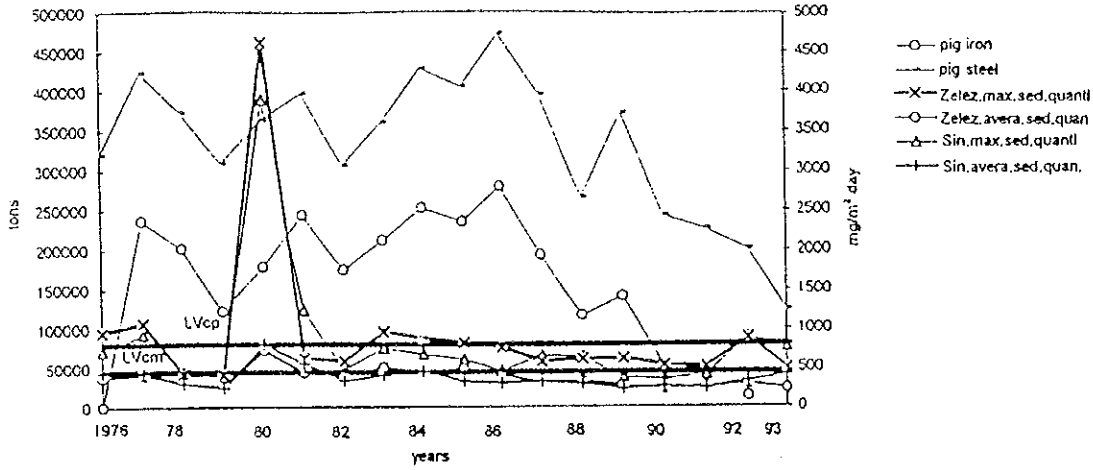


Figure D3.13 Dependence on the Quantity in the Sediment of the Iron and Steel Company production

Table D3.14 Review of the Production of Mining and Steel Company "Skopje"

Year	Production T/year			
	Iron	Steel	Feaiours	Iron pasta
1976	450	319668		512382
1977	236222	423363		592904
1978	201722	372190		633965
1979	122165	308635		610601
1980	178903	364363		579349
1981	243643	397592		637267
1982	174944	305544		502539
1983	211903	360341		643147
1984	252519	427988		855296
1985	235067	404449		953309
1986	279747	472562		1096021
1987	193874	394741		1040510
1988	117488	265103		1006156
1989	141779	372450		1085500
1990	53416	243372	23327	1014553
1991		227120		938227
1992	13192	201885	38231	425933
1993		123486	12291	206827

Table D3.15 Review on the Sediment Quantities

Year	Average quantity of Sediment mg/m² day					
	Settlement Zelezarnica			Settlement Singelic		
	Average	Maximum	Minimum	Average	Maximum	Minimum
1976	376	953	205	443	721	131
1977	409	1068	233	441	936	201
1978	304	420	54	300	444	73
1979	265	414	142	242	409	126
1980	732	4623	198	808	3894	171
1981	441	628	227	557	1241	124
1982	401	591	248	342	489	217
1983	505	962	315	405	757	186
1984	449	876	140	459	681	238
1985	494	821	303	324	617	138
1986	413	761	181	309	471	203
1987	311	586	159	324	664	130
1988	330	815	111	296	646	153
1989	268	620	152	232	378	148
1990	234	538	100	265	356	191
1991	262	520	132	236	416	35
1992	297	884	86	334	893	120
1993	233	496	35	413	767	44

Table D3.16 Review on the Content of Fe and Mn in Sediment

Year	Content of Fe and Mn in sediment			
	Sett. Zelezarnic		Sett. Singelic	
	Fe	Mn	Fe	Mn
1989	8.11		6.68	
1990	5.01	0.53	3.52	0.12
1991	4.81	0.29	3.51	0.06
1992	5.78	0.73	3.42	0.41
1993	7.54	0.46	5.31	0.31

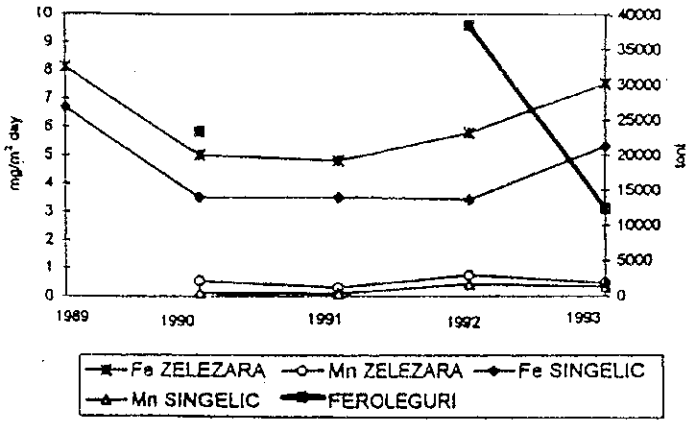


Figure D3.14 Dependence on the Content of Fe and Mn in the Sediment of the Ferroalloy Production

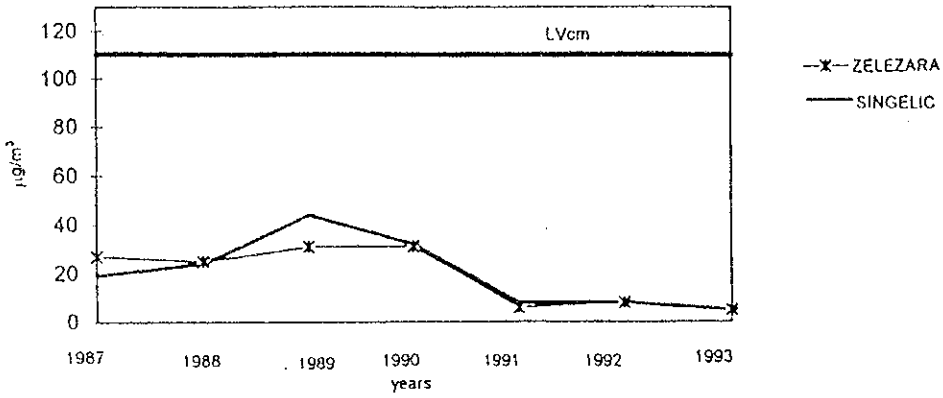


Figure D3.15 Average Annual Quantity of SO2

Table D3.17 Review on the Concentration of SO2

Year	Concentration of SO_2 µg/m³					
	Settlement Zelezarnica			Settlement Singelic		
	Average	Maximum	Minimum	Average	Maximum	Minimum
1987	27	275	1	19	262	2
1988	25	130	0	24	269	0
1989	31	962	0	44	119	0
1990	31	193	0	32	318	0
1991	6	40	0	8	39	0
1992	8	50	0	8	57	0
1993	5	36	0	5	27	0

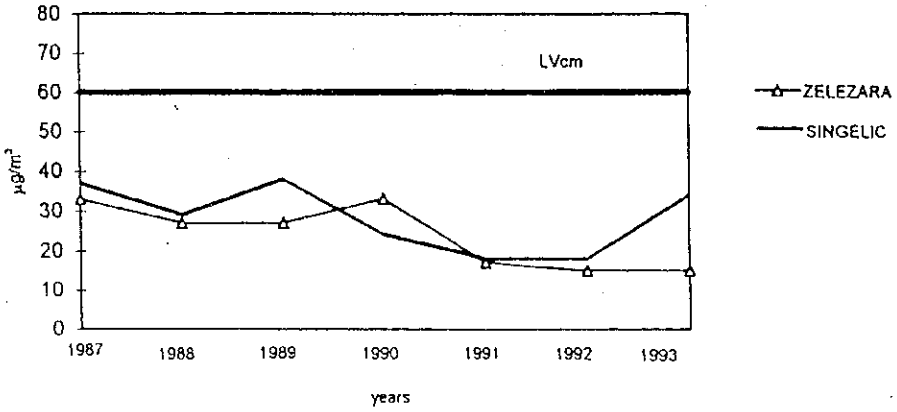


Figure D3.16 Average Annual Quantity of Smoke

Table D3.18 Review on the Concentration of Smoke

Year	Concentration of smoke µg/m³					
	Settlement Zelezarnica			Settlement Singelic		
	Average	Maximum	Minimum	Average	Maximum	Minimum
1987	33	375	1	37	165	3
1988	27	79	0	29	102	1
1989	27	178	0	38	201	0
1990	33	107	4	24	221	4
1991	17	87	2	18	73	6
1992	15	42	3	18	32	2
1993	15	81	4	34	101	5

Table D3.19 Air Quality Level in Veles for SO_2 (1996)

Month	Measurement sites	Average concentration (mg/m^3)	Minimum - maximum (mg/m^3)	No. of days above the MPC*
January	1.Nova naselba	0.071	0.034-0.117	0
	2.Biro za vrabotuv	0.071	0.036-0.120	0
February	1	0.091	0.051-0.196	2
	2	0.089	0.048-0.165	2
March	1	0.083	0.027-0.115	0
	2	0.065	0.034-0.135	0
April	1	0.065	0.032-0.104	0
	2	0.055	0.031-0.083	0
May	1	0.071	0.035-0.115	0
	2	0.076	0.036-0.109	0
June	1	0.084	0.070-0.114	0
	2	0.070	0.043-0.085	0
July	1	0.085	0.052-0.132	0
	2	0.062	0.027-0.132	0
August	1	0.074	0.023-0.118	0
	2	0.072	0.022-0.234	2
September	1	0.046	0.008-0.110	0
	2	0.031	0.004-0.280	1
October	1	0.062	0.029-0.134	0
	2	0.071	0.030-0.154	1
November	1	0.067	0.031-0.165	1
	2	0.054	0.038-0.071	0
December	1	0.083	0.031-0.165	4
	2	0.061	0.022-0.132	0
Total - 1996	1	0.070	0.008-0.196	7
	2	0.064	0.004-0.280	6

*MPC - maximum permited concentration (0.150 mg/m^3)

Source : IPH

Table D3.20 Air Quality Level in Veles for Smoke (1996)

Month	Measurement sites	Average concentration (mg/m^3)	Minimum - maximum (mg/m^3)	No. of days above the MPC*
January	1	0.056	0.015-0.098	14
	2	0.043	0.012-0.091	8
February	1	0.063	0.029-0.162	15
	2	0.043	0.017-0.096	7
March	1	0.038	0.016-0.072	7
	2	0.038	0.020-0.080	6
April	1	0.024	0.016-0.053	1
	2	0.032	0.019-0.059	2
May	1	0.016	0.005-0.028	0
	2	0.021	0.002-0.035	0
June	1	0.014	0.008-0.021	0
	2	0.017	0.009-0.028	0
July	1	0.014	0.008-0.028	0
	2	0.017	0.004-0.017	0
August	1	0.013	0.007-0.033	0
	2	0.017	0.005-0.035	0
September	1	0.017	0.011-0.035	0
	2	0.025	0.015-0.073	2
October	1	0.029	0.008-0.082	3
	2	0.044	0.012-0.178	7
November	1	0.043	0.007-0.098	7
	2	0.068	0.026-0.159	11
December	1	0.046	0.017-0.191	8
	2	0.074	0.031-0.202	14
Total - 1996	1	0.031	0.005-0.191	55
	2	0.036	0.002-0.202	57

*MPC - maximum permited concentration (0.050 mg/m^3)

Source : IPH

Table D3.21 Air Quality Level in Veles for Dust (1996)

Month	Measurement sites	Average monthly concentration (mg/m^2)	Minimum - maximum (mg/m^2)	No. of days above the MPC*
I-XII dust total	Nova naselba	199.1	0.0-1079.0	1
	Biro za vrabotuv.	148.7	0.0-269.0	0
	Zdraven dom	177.0	29.7-641.0	2
	Tashevik	146.1	51.7-268.1	0
	Rechani	160.5	45.4-405.5	1
	v.Bashino	165.3	49.1-366.0	2
I-XII dust pH	Nova naselba	7.1	6.3-7.7	
	Biro za vrabotuv.	6.9	6.3-7.5	
	Zdraven dom	6.8	6.1-7.3	
	Tashevik	7.2	6.5-7.7	
	Rechani	6.7	5.9-7.4	
	V.Bashino	6.9	6.2-7.6	

*MPC - maximum permited concentration (300 mg/m^2)

Source : IPH

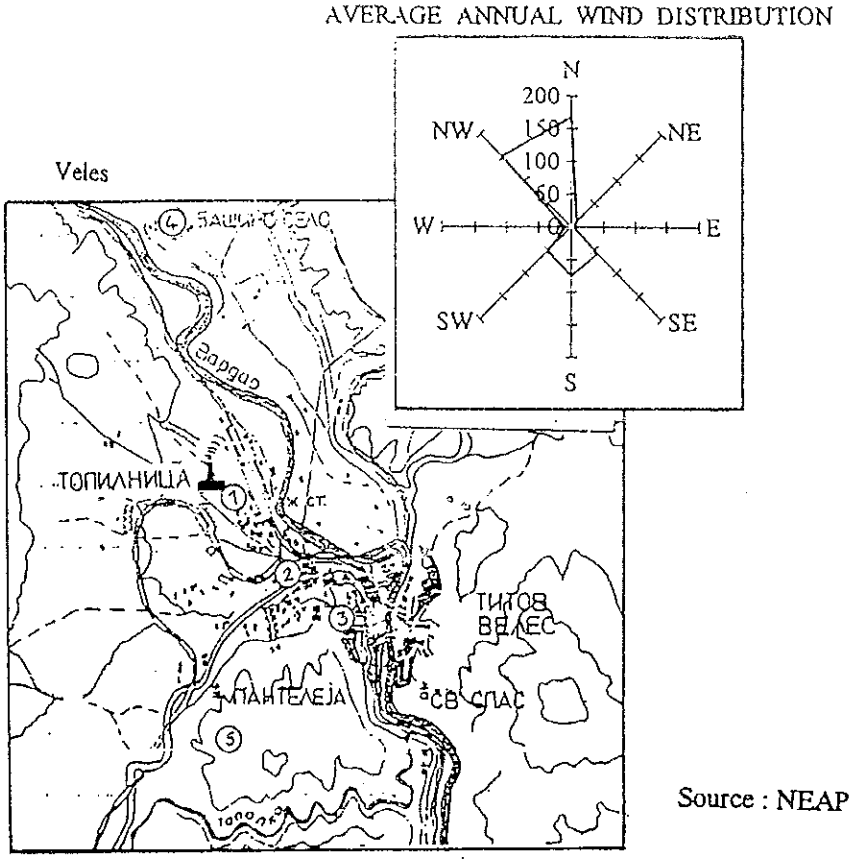


Figure D3.17 The Measuring Points Disposion

Table D3.22 The Survey Results of SO_2 and Black Smoke in Veles City

SO_2

	meteo station (1)					industrial school (2) (Assembly)					Teke (3)					Basino village (4)					Filter station(5)				
	$\bar{C}$	%	C_{98}	MPC	C_{max}	$\bar{C}$	%	C_{98}	MPC	C_{max}	$\bar{C}$	%	C_{98}	MPC	C_{max}	$\bar{C}$	%	C_{98}	MPC	C_{max}	$\bar{C}$	%	C_{98}	MPC	C_{max}
1984	116	99	288	107	436	64	99	197	17	311	63	92	284	42	354	40	99	172	17	248					
1985	193	86	593	178	681	166	99	534	168	1636	118	99	511	91	804	39	100	217	26	684					
1986	117	92	400	94	971																				
1987	116	99	424	94	869																				
1988	145	94	675	111	955																				
1990						73	62	368	50	557															
1991						91	96	315	60	611															
1992						83	99	309	50	492															
1993						62	98	265	20	465											91	76	363	59	418
1994						45	97	215	23	384											64	97	363	47	405

black smoke

	meteo station (1)					industrial school (2) (Assembly)					Teke (3)					Basino village (4)					Filter station(5)				
	$\bar{C}$	%	C_{98}	MPC	C_{max}	$\bar{C}$	%	C_{98}	MPC	C_{max}	$\bar{C}$	%	C_{98}	MPC	C_{max}	$\bar{C}$	%	C_{98}	MPC	C_{max}	$\bar{C}$	%	C_{98}	MPC	C_{max}
1984	20	99	60	16	77	21	99	57	18	102	32	100	111	94	135	16	98	54	13	117					
1985	27	91	108	48	180	26	99	96	42	127	29	100	110	57	145	17	100	61	20	178					
1986	24	93	100	30	130																				
1987	21	99	68	21	160																				
1988	23	94	87	20	207																				
1990						17	62	93	33	123															
1991						23	97	86	14	493															
1992						12	98	46	5	134															
1993						13	57	66	10	185											10	76	30	1	63
1994						17	97	74	14	116											11	97	47	5	179

$\bar{C}$ - average annual concentration $\mu g/m^3$
C_{98} - 98-percentile value
% - % of realisation
MP - number of days > MPC = 150 (50)
C_{max} - max. annual value $\mu g/m^3$

Source : NEAP