NILU OR: 35/91

NILU OR : 35/91
REFERENCE : N-8427
DATE : SEPTEMBER 1992
ISBN : 82-425-0259-5

Long Range Transport of Oxidants and Nitrogen Compounds in the Atmosphere over Scandinavia

T. Krognes, J. Christensen, N.Z. Heidam,
O.H. Manscher, T. Koskinen, H Lättilä, F. Flatøy,
Ø. Hov, H. Areskoug and M. Ferm

NILU OR : 35/91
REFERENCE: N-8427
DATE : SEPTEMBER 1992
ISBN : 82-425-0259-5

LONG RANGE TRANSPORT OF OXIDANTS AND NITROGEN COMPOUNDS IN THE ATMOSPHERE OVER SCANDINAVIA

T. Krognes[1]
J. Christensen, N.Z. Heidam, O.H. Manscher[2]
T. Koskinen[3] H. Lättilä
F. Flatøy, Ø. Hov[4]
H. Areskoug[5]
M. Ferm[6]

[1] Norwegian institute for Air Research, Norway
[2] National Environmental Research Institute, Denmark
[3] Finnish Meteorological Institute, Finland
[4] University of Bergen, Norway
[5] Swedish Environmental Protection Agency, Sweden
[6] Swedish Environmental Research Institute, Sweden

NORWEGIAN INSTITUTE FOR AIR RESEARCH
P.O. BOX 64, N-2001 LILLESTRØM
NORWAY

CONTENTS

LONG RANGE TRANSPORT OF OXIDANTS AND NITROGEN COMPOUNDS IN THE ATMOSPHERE OVER SCANDINAVIA

1 INTRODUCTION

The atmospheric contents of oxidized nitrogen compounds are important to a large range of chemical processes in the atmosphere. Among these compounds are NO, NO_2, HNO_3-gas and PAN. They play an important role for the formation or destruction of ozone, for the oxidizing efficiency of the troposphere, for acidification of precipitation, and for eutrofication of lakes and rivers.

In order to quantify the occurrence of these compounds and with a view to establish a nitrogen budget, a measurement campaign was carried out at five rural stations in Scandinavia in the period from August to October 1989. In preceding measurement campaigns (Ferm et al., 1986; Ferm et al.l, 1987) methods for sampling and analysis of NO_2 have been tested. The 1989 campaign was the first to include PAN measurements. The measurement campaign is described in Chapter 2.

To evaluate the data in a comprehensive way a workshop with participants from all the participating laboratories was organized at Spåtind, Norway, in April 1990. At the workshop data were processed on a number of personal computers equipped with software for both statistical calculations and graphic presentation. A large number of overview tables and plots were generated and used as a basis for more detailed studies of selected time periods and of correlations between compounds. The workshop is described in Chapter 7.

After the workshop one group concentrated on describing in detail pollution episodes that had been identified in the data material (Chapters 3 and 4). Another group compared the measured concentrations to values computed by a version of the EMEP model that includes photooxidants (Chapter 5). Diurnal trends in the data material are described in Chapter 6. A similar campaign was performed in 1990. Results from this campaign are briefly commented in Appendix VI to VIII.

The following persons and institutions took part in the work:

DENMARK,
National Environmental Research Institute
Jesper Christensen
Niels Z. Heidam
Ole H. Manscher

FINLAND,
Finnish Meteorological Institute
Timo Koskinen
Heikki Lättilä

NORWAY,
University of Bergen
Frode Flatøy
Øystein Hov

Norwegian Institute of Air Research
Terje Krognes (editor)

SWEDEN,
Swedish Environmental Protection Agency
Hans Areskoug

Swedish Environmental Research Institute
Martin Ferm

The work was supported by the Nordic Council of Ministers (NMR).

2 THE MEASUREMENT CAMPAIGN

2.1 THE STATIONS

Groups from Denmark, Finland, Norway and Sweden participated in the campaign. All groups selected measurement stations far away from polluted urban areas, often called background stations. The names and positions of the stations are given in Table 2.1.

Table 2.1: Names and locations of the measurement stations. Also refer to the map in Fig. 2.1.

Station name	Country	Latitude	Longitude
Frederiksborg	Denmark	55°57'N	12°21'E
Rörvik	Sweden west	57°25'N	11°55'E
Aspvreten	Sweden east	58°48'N	17°39'E
Birkenes	Norway south	58°23'N	8°15'E
Utö	Finland south	59°47'N	21°23'E

Frederiksborg is in a forested area in the northern central region of Sjælland in Denmark. Rörvik is in a rural area on the western coast of Sweden south of Göteborg. Aspvreten is in a rural area on the east cost of Sweden, south of Stockholm. Birkenes is in a forested area in the southern part of Norway, approximately 30 km from the coast. Utö is a small island outside the south-west coast of Finland. The stations are indicated in the map on the next page (Figure 2.1).

2.2 TIME PERIOD

The measurement campaign was carried out from 1 August to 31 October 1989. The autumn period often has winds from the south-west. Therefore, polluted air parcels from the northern central Europe may sweep over Fredriksborg, Rörvik, Aspvreten

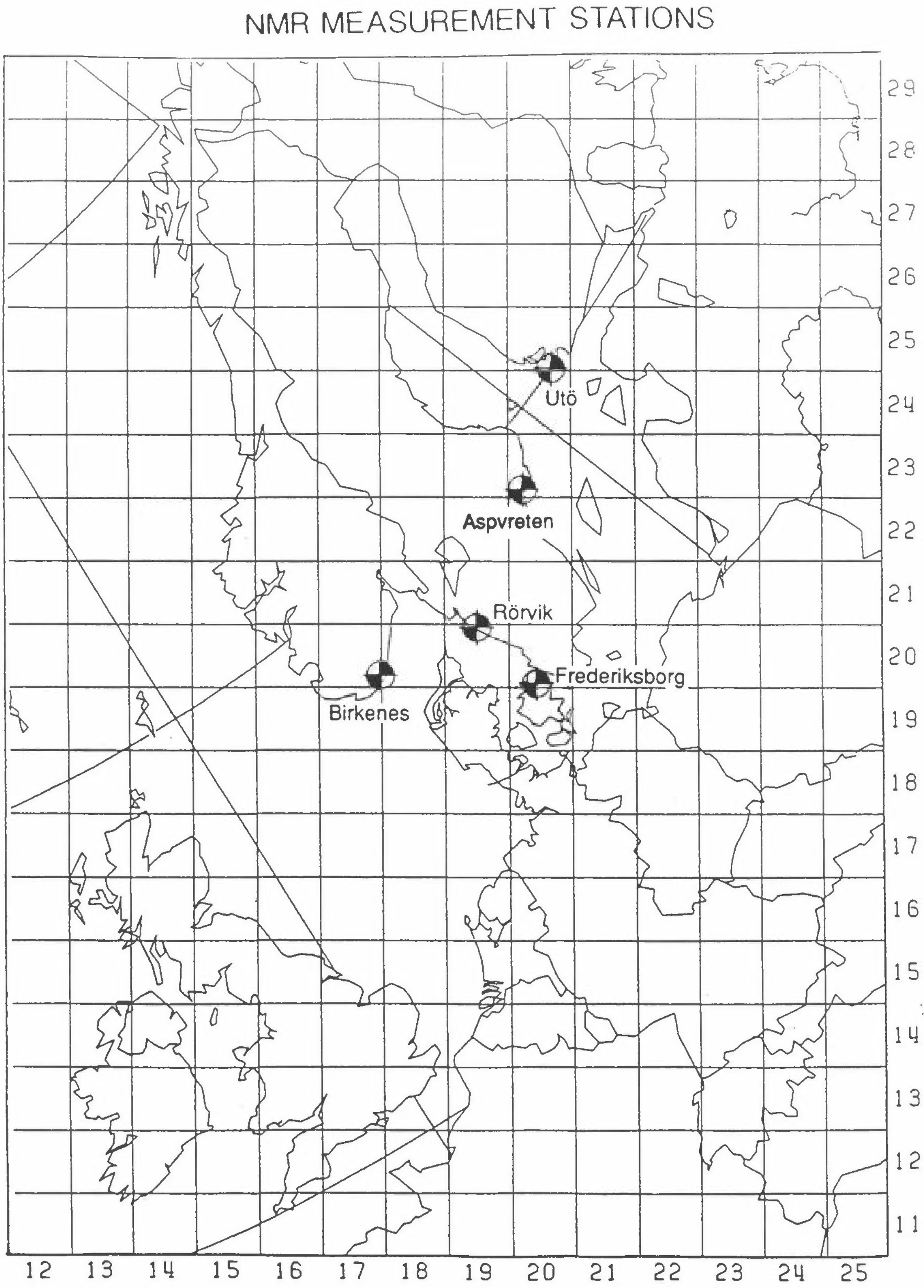


Fig. 2.1: Locations of the 5 rural stations that were used for the measurement campaign.

and Utö. The campaign allows for studies of the development of chemical processes in these parcels as they pass over several of the stations.

2.3 COMPONENT TABLE

The list below (Table 2.2) indicates the parameters that have been measured during the campaign. Not all these parameters were measured at all stations (see description of separate episodes for information of parameters included). The parameters measured as 24-hour mean values are EMEP parameters, and their EMEP parameter identification codes are given. Parameters measured on a 1 hour or 12 hour basis have been converted to 24 hour data. A complete listing of all 24 hour data is given in APPENDIX I.

Table 2.2: List of parameters included in the study.

PARAMETER	EMEP CODE	NAME	TYPE	UNIT	COMMENTS
Ozone		OZONE	1-hour	$\mu g/m^3$	Gas, continuous
Peroxyacetyl Nitrate		PAN	1-hour	$\mu g(N)/m^3$	Gas, 4 samples/hour
Nitrogen dioxide		NO2-KI	12-hour	$\mu g(N)/m^3$	Gas, potass.iodide
Nitrogen dioxide		NO2-DO	12-hour	$\mu g(N)/m^3$	Gas, DOAS
Sulphur dioxide	30	SO2	24-hour	$\mu g(N)/m^3$	Gas
Nitrogen dioxide	31	NO2	24-hour	$\mu g(N)/m^3$	Gas
Sulphate	40	SO4	24-hour	$\mu g(S)/m^3$	In aerosols
Total NO_3	80	TNO3	24-hour	$\mu g(N)/m^3$	Gases + particles
Ammonia + ammonium	81	TNH4	24-hour	$\mu g(N)/m^3$	Gases + particles

2.4 SAMPLING TECHNIQUES

The total nitrate (gaseous+particulate) concentration was measured using a Na_2CO_3 impregnated filter mounted in an open face filter holder. The total ammonium concentration was measured in a similar way using oxalic acid impregnated filters. All participating laboratories have previously made two field intercomparisons at Rörvik (1985 and 1986) and obtained good agreement between the laboratories and between this technique and cylindrical denuders (rel.S.D. of≈15% for total NO_3 and ≈20% for total NH_4^+). The detection limits were ≈0.15 μg (N)/m^3 for total NH_4^+ and ≈0.02 μg (N)/m^3 for total NO_3^-). The sampling techniques as well as the intercomparison have been published (Ferm et al., 1988).

Ozone was measured using real time instruments based on UV absorption. Intercomparisons have previously been made (Oyola and Areskoug, 1988). NO_2 was measured with a volumetric technique using impregnated glass filters (Sjödin and Ferm, 1988). The filters were impregnated with a methanol solution containing 10% KI, 1% $NaASO_2$ and 5% ethylene glycol. The trapped NO_2 was thereby reduced to NO_2^-. The filters were leached in water and analysed spectrophotometrically.

Particulate sulphate was sampled on W40 prefilters which were leached in water and analysed using ion chromatography. SO_2 was sampled behind this filter either on NaOH impregnated filters or with gas wash bottles containing a dilute H_2O_2 solution.

PAN (Peroxyacetyl Nitrate) is measured by a GC (Gas Chromatograph) with an ECD (Electron Capture Detector). In most cases a 6 port sampling valve with a 1-5 ml sample loop is used. NILU has designed an instrument that also employs an 8 port valve and an extra column. One column is connected for backflushing when the other is connected for sample separation. After each sample the 8 port valve will switch the separation column into backflush mode and vice versa.

A third valve allows the detector to be disconnected from the sample flow during the oxygen peak (which comes first in the chromatogram and severely overloads the detector). During this time the detector is instead connected to the backflush outlet flow, to maintain pressure and flow in the detector.

The column is a 1m x 2mm i.d. glass column packed with 5% CW400 on Chromosorb W-HP 80-100 mesh. The carrier gas is N_2 at approximately 20 sml/min. The detector has a simple pin-cup cylindrical geometry with a 10 mCi ^{63}NI foil and approximately 1 ml internal volume. Both the column and the detector are operated isothermally at 32.5°C. NILU has built 7 of these instruments, and all participants in the NMR campaign used the NILU PAN instruments.

3 SUMMARY OF MEASURED VALUES

The mean of all measured concentracions for all compounds and stations are given below. The concentrations were usually highest at Frederiksborg and lowest at Birkenes.

Table 3.1: Mean values of all components over the three campaign months.

		Frederiksborg	Rörvik	Aspvreten	Utö	Birkenes
Tot NO_{3-}	µg(N)/m^3	0.94	0.59	0.40	0.42	0.29
Tot NH^{4+}	µg(N)/m^3	2.09	1.07	0.84	0.71	0.56
NO_2 KI	µg(N)/m^3	3.18	1.48	0.62	0.88	0.79
PAN	µg(N)/m^3	0.23	0.18	0.11	0.10	0.09
SO_2	µg(S)/m^3	1.80	2.07	0.69	0.62	0.30
Part SO_4	µg(S)/m^3	1.46	1.06	0.96	1.04	0.52
O_3	µg O_3/m^3	43.3	55.0	57.8	65.9	42.2

The highest concentrations of nitrates and ammonium (sum of gaseous and particulate forms) and PAN were on average found at Frederiksborg, the station closest to the main sources in central Europe. The second highest concentrations were found at Rörvik, the lowest at Birkenes. Birkenes is often influenced by clean air from the North Atlantic. The concentrations at Utö and Aspvreten were roughly the same, and were between the values reported from Birkenes and Rörvik.

The spatial distribution of nitrogen dioxide was approximately the same as for the other nitrogen compounds, but Birkenes reported higher concentrations than Aspvreten.

4 EPISODE IDENTIFICATION AND DESCRIPTION

The measured concentrations may be grouped into "normal" values and "episode" values. Close to large pollution sources, local high pollution episodes would be expected. The stations used in this work reflect the background - they register episodes on a larger scale. Such episodes are not confined to one single station, they may be seen to propagate from station to station.

Four polluted and two clean episodes were identified by comparing plots of a single parameter from all the stations. Emphasis was given to the nitrogen compounds. Figure 4.1 shows the data material for total NO_3. Figure 4.2 gives a similar presentation of the PAN data. In these two figures the episodes given in Table 4.1 may clearly be distinguished. Similar overview plots for other components are given in Appendix II. Also wind trajectory data were used to interpret the episodes.

Table 4.1: Clean and polluted air episodes during the NMR-measurement campaign 1989.

Period	Type	Id. code
19-22 August	Polluted	EI
17-29 September	Polluted	EII
15-21 October	Polluted	EIII
26-29 October	Polluted	EIV
28-30 August	Clean	CI
29 Sept.-4 Oct.	Clean	CII

Episode EII was actually composed of two subepisodes. EIIa. 17.-23. September and EIIb. 26.-29. September.

A summary of the concentrations of the measured compounds within the different episodes and for the whole campaign is given in Tables 4.2.a - 4.2.g.

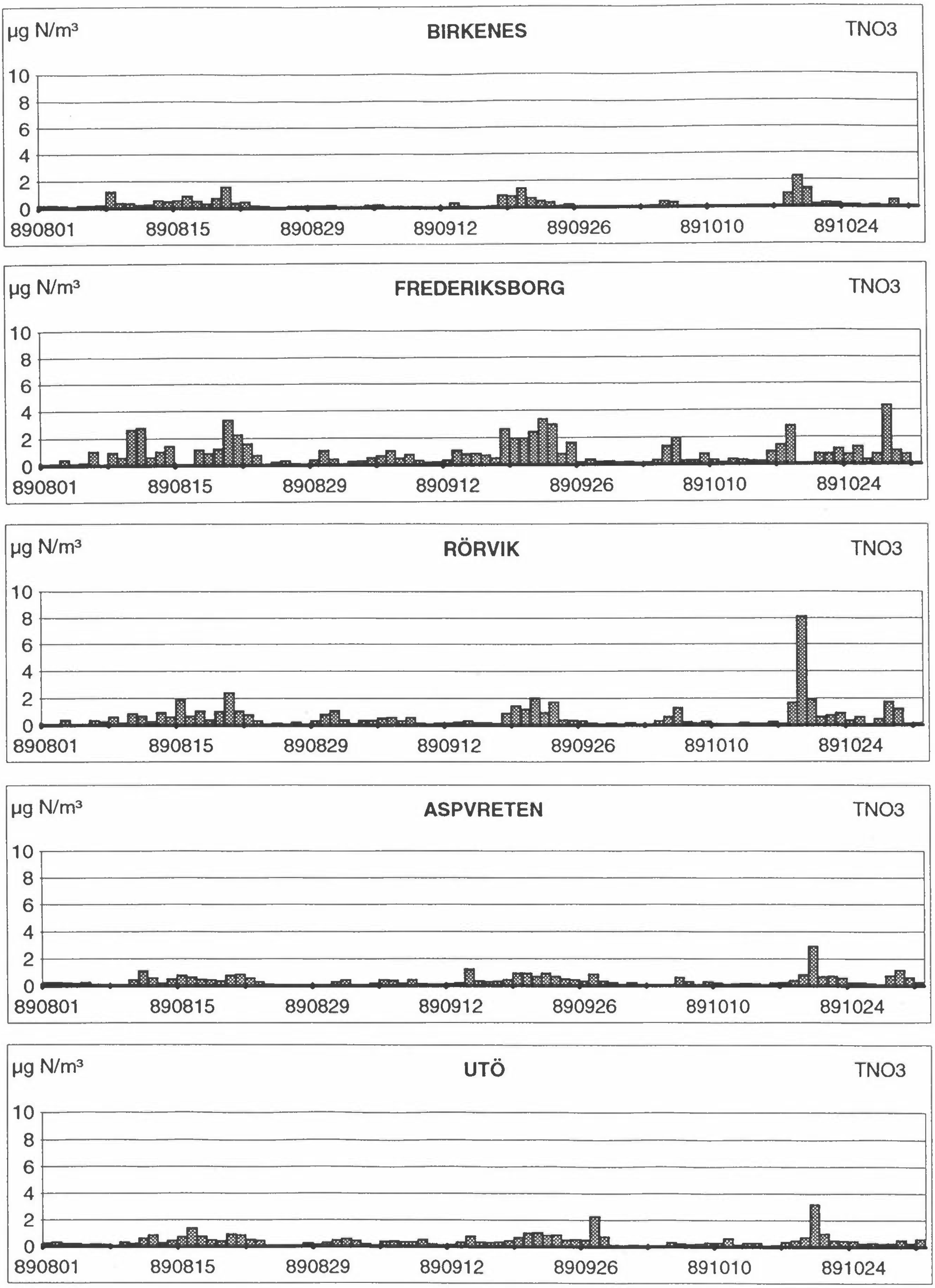


Figure 4.1: Daily average concentrations of total NO_3 at five stations during the NMR-campaign 1989.

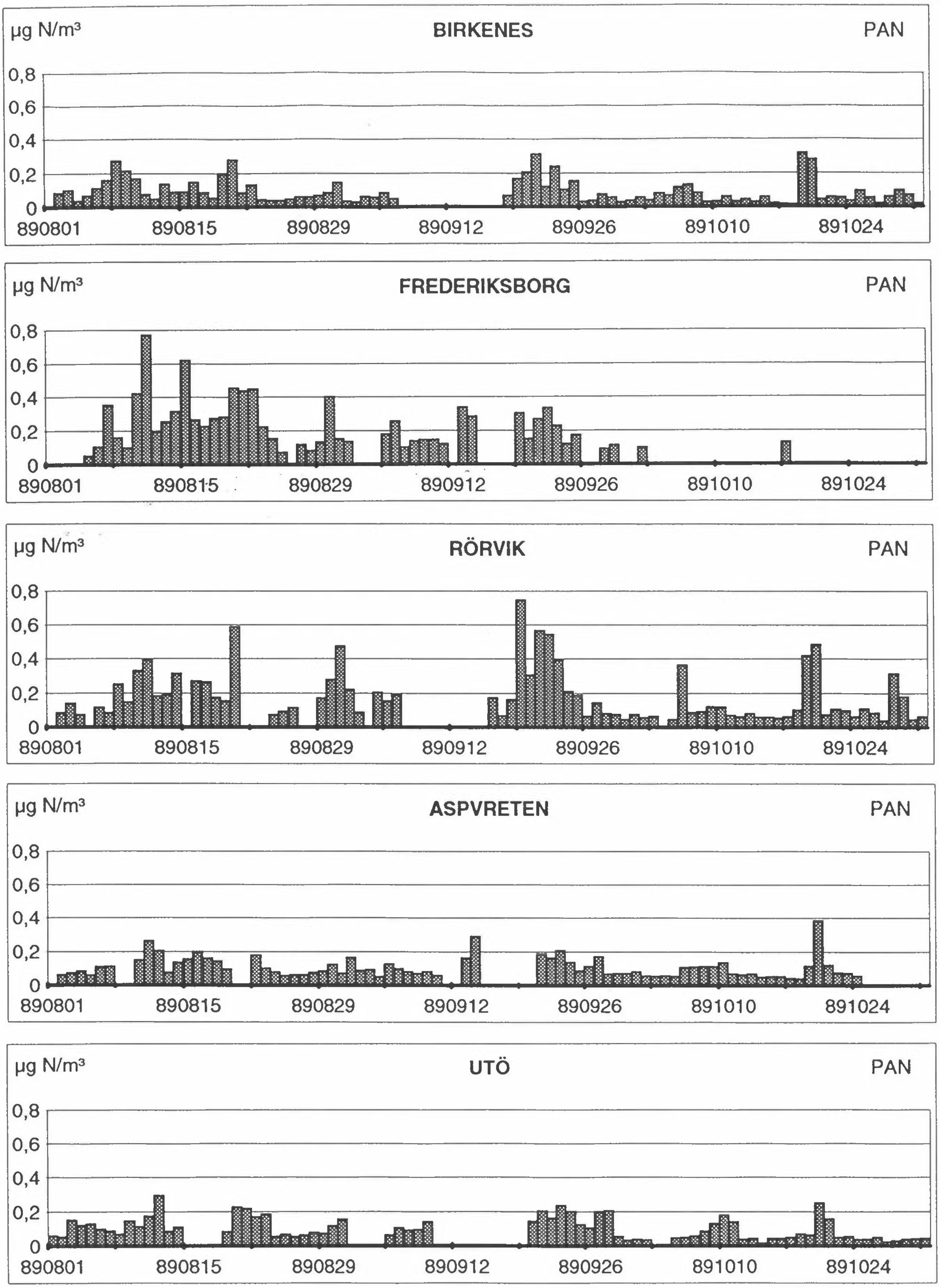


Figure 4.2: Daily average concentrations of PAN at five stations during the NMR-campaign 1989.

Table 4.2.a.: Average concentrations of total NO_3^- during the episodes, and for the whole campaign at each station.

If data are reported for less than 75% of an episode, episode average is not calculated for this station. The reported results are, however, included in the episode averages in the bottom line and in the campaign averages to the right.

Station	Tot NO_3^- Average concentrations (μg(N)/m^3)						
	Episodes						Whole campaign average
	Polluted				Clean		
	EI	EII	EIII	EIV	CI	CII	
Frederiksborg	1.82	2.06	-	1.61	-	0.18	0.94
Rörvik	1.09	1.07	1.81	-	0.37	0.12	0.59
Birkenes	0.65	0.61	0.69	0.18	0.14	0.04	0.29
Aspvreten	0.55	0.65	0.75	-	-	0.07	0.40
Utö	0.60	0.70	0.82	0.31	0.21	0.07	0.42
Episode average	0.94	1.02	1.05	0.76	0.33	0.10	0.52

Table 4.2.b.: Average concentrations of total NH_4^+ during the episodes and for the whole campaign at each station.
Expl. in Table 4.2.a.

Station	Tot NH_4^+ Average concentrations (μg(N)/m^3)						
	Episodes						Whole campaign average
	Polluted				Clean		
	EI	EII	EIII	EIV	CI	CII	
Frederiksborg	3.10	4.91	4.80	2.70	0.89	0.53	2.09
Rörvik	1.89	2.12	2.81	1.70	0.92	0.18	0.98
Birkenes	1.15	1.41	1.23	0.39	0.31	0.11	0.56
Aspvreten	1.27	1.62	1.61	0.91	0.41	0.23	0.84
Utö	1.13	1.26	1.01	0.20	0.35	0.08	0.71
Episode average	1.71	2.26	2.29	1.18	0.57	0.23	1.04

Table 4.2.c.: Average concentrations of SO_2 during the episodes and for the whole campaign at each station. Expl. in table 4.2.a.

Station	SO_2 Average concentrations (µg (S)/m^3)						
	Episodes						Whole campaign average
	Polluted				Clean		
	EI	EII	EIII	EIV	CI	CII	
Frederiksborg	3.62	4.35	5.61	3.14	0.68	0.21	1.80
Rörvik	2.98	3.94	3.39	3.50	1.80	1.38	2.07
Birkenes	0.54	0.69	0.38	0.30	0.22	0.08	0.30
Aspvreten	0.77	0.84	2.33	-	-	0.08	0.69
Utö	0.52	0.40	2.08	0.43	0.55	0.23	0.62
Episode average	1.69	2.04	2.76	1.76	0.75	0.40	1.10

Table 4.2.d.: Average concentrations of SO_4 during the episodes and for the whole campaign at each station. Expl. in Table 4.2.a.

Station	SO_4 Average concentrations (µg (S)/m^3)						
	Episodes						Whole campaign average
	Polluted				Clean		
	EI	EII	EIII	EIV	CI	CII	
Frederiksborg	-	-	-	-	-	-	-
Rörvik	2.10	2.69	2.18	1.24	0.48	0.26	1.06
Birkenes	0.98	1.60	0.76	0.36	0.28	0.09	0.52
Aspvreten	1.22	1.78	2.12	1.08	-	0.11	0.96
Utö	1.75	1.65	1.78	0.47	0.41	0.15	1.04
Episode average	1.44	1.87	1.65	0.74	0.36	0.15	0.89

Table 4.2.e.: Average concentrations of NO_2 during the episodes and for the whole campaign at each station. Expl. in Table 4.2.a.

Station	NO_2 Average concentrations ($\mu g(N)/m^3$)						
	Episodes						Whole campaign average
	Polluted				Clean		
	EI	EII	EIII	EIV	CI	CII	
Frederiksborg	2.94	4.67	4.96	4.16	2.67	1.81	3.01
Rörvik	1.07	1.79	2.84	1.88	1.60	1.14	1.48
Birkenes	1.71	1.35	2.06	1.05	1.32	0.67	0.62
Aspvreten	0.43	-	0.85	0.63	0.47	0.67	0.62
Utö	0.86	0.87	0.82	0.79	-	0.88	0.88
Episode average	1.44	1.98	2.31	1.70	1.40	1.04	1.41

Table 4.2.f.: Average concentrations of PAN during the episodes and for the whole campaign at each station. Expl. in Table 4.2.a.

Station	PAN Average concentrations ($\mu g(N)/m^3$)						
	Episodes						Whole campaign average
	Polluted				Clean		
	EI	EII	EIII	EIV	CI	CII	
Frederiksborg	0.37	-	-	-	0.20	-	0.23
Rörvik	-	0.37	0.18	0.15	-	0.06	0.18
Birkenes	0.14	0.17	0.10	0.06	0.07	0.05	0.09
Aspvreten	-	-	0.11	-	0.09	0.06	0.11
Utö	0.17	-	0.09	0.03	0.08	0.04	0.10
Episode average	0.23	0.24	0.14	0.08	0.13	0.07	0.13

Table 4.2.g.: Average concentrations of ozone during the episodes and for the whole campaign at each station. Expl. in Table 4.2.a.

Station	Ozone Average concentrations (µg $(O_3)/m^3$)						
	Episodes						Whole campaign average
	Polluted				Clean		
	EI	EII	EIII	EIV	CI	CII	
Frederiksborg	65	-	30	-	46	50	43
Rörvik	82	63	42	45	54	53	55
Birkenes	55	41	33	-	35	47	42
Aspvreten	78	66	-	-	59	57	58
Utö	-	79	59	62	70	67	60
Episode average	70	62	43	54	52	55	52

The average concentrations during the polluted periods divided by the average concentrations when there was no pronounced (neither high nor low concentrations) episode are given in the table below.

Table 4.3: Average episode concentrations divided by the no-episode averages.

	Frederiksborg	Rörvik	Aspvreten	Utö	Birkenes
Tot NO_3^-	2.22	2.89	1.95	2.01	2.37
Tot NH_4^+	2.43	2.65	2.34	1.87	2.62
NO_2 KI	1.44	1.36	1.05	0.93	1.51
PAN	1.09	1.50	1.18	1.41	1.44
SO_2	3.74	1.96	2.40	1.60	1.96
Part SO_4	2.34	2.48	2.46	2.33	2.33
O_3	1.12	1.04	1.03	1.08	0.96

Ozone, NO_2 and PAN exhibit less increased concentrations during episodes than the other compounds.

The average concentrations during the clean air periods divided by the average concentrations when there was no pronounced (neither high nor low concentrations) episode are given in the table below.

Table 4.4: Clean air episode averages divided by the no-episode averages.

	Frederiksborg	Rörvik	Aspvreten	Utö	Birkenes
Tot NO_3^-	0.45	0.53	0.22	0.34	0.35
Tot NH_4^+	0.43	0.70	0.47	0.29	0.46
NO_2 KI	0.74	0.97	0.99	0.93	0.80
PAN	0.71	0.70	0.70	0.65	0.69
SO_2	0.37	0.95	0.33	0.62	0.54
Part SO_4	0.52	0.44	0.27	0.31	0.41
O_3	~~0.98~~ 1,15	0.98	1.01	1.07	1.00

The ozone concentrations were not lower during these clean periods. NO_2 and PAN had less decreased concentrations than the other compounds. The correlation between the oxidized forms (Total NO_3, PAN and particulate SO_{4-}) and their precursors showed no clear pattern, because the NO_2 concentration was not correlated with the long-range transport and because the fraction of oxidized sulphur may have been high when the total concentration of sulphur was low.

During the campaign most of the oxidized nitrogen was nitrogen dioxide (68% on the average). Only a minor part was PAN (6%). The concentrations of other oxidized compounds than nitrate (particles) + nitric acid (gaseous), nitrogen dioxide and PAN were normally very low and not included in this calculation. The PAN fraction during polluted air episodes was approximately the same as the average for the campaign.

4.1 EPISODE EI, 19 TO 22 AUGUST

19th: Trajectories to all stations originated from the North Sea. The air masses that reached Frederiksborg and Rörvik had crossed England and received some SO_2. Birkenes experienced a small maximum in SO_4 due to air that passed over South-England.

20th: Frederiksborg and Rörvik received air that had passed over east Germany. The lower value at Rörvik reflects the longer transport.

21th: Rörvik received North Sea air that had passed over the Netherlands. Birkenes received air that had passed over England. The rest of the stations received air that had passed over eastern Europe. Aspvreten and Utö had a maximum in SO_4 probably due to air originating further east than the air reaching the other stations.

22nd: The episode was over and all stations had a drop in pollution concentrations. The trajectories were of North Sea origin.

4.2 EPISODE EII, 17 TO 29 SEPTEMBER

This long episode actually consists of two shorter episodes. One SO_2 episode at Frederiksberg and Rörvik is caused by air from Germany and the Netherlands. The measurements showed maximum values at the 21st. The other stations received North Sea air and were only to a small degree influenced by this episode.

The other episode was found in the SO_4 measurements at Aspvreten and Utö at the 27th, and was caused by "old" air masses from Poland moving slowly into Scandinavia and the Baltic Sea. The rest of the stations received North Sea air and did not show any episodic values.

The next day (28th) the concentrations fell sharply at Aspvreten, while Utö was still influenced by air from Poland and showed rather high concentration. The rest of the stations received North Sea air. At the 29th the episode was over and all stations received clean air. Since there are no SO_4 emissions, the measured SO_4 must originate from SO_2. This conversion takes a few days, mainly depending on the OH concentration.

Ammonium behaved in a similar manner as the SO_2 and was found in elevated concentrations at all stations during this episode. Nitrate behaved in a similar manner as the SO_4, but was not found in elevated concentrations at Rörvik or Birkenes during this episode.

4.3 EPISODE EIII, 15 TO 21 OCTOBER

In this period the winds were mostly southwesterly, with an air stream passing first Frederiksborg and Rörvik, then Aspvreten and finally Utö. From Frederiksborg to Utö the air parcels used between 18 and 24 hours.

This interesting occurrence can be observed in the SO_2 and nitrate measurements at the four stations. (Unfortunately SO_4 measurements were not available from Frederiksborg).

At the 19th October Frederiksborg and Rörvik experience a maximum in the SO_2, nitrate and ammonium concentrations. The next day (the 20th) the concentrations at Frederiksborg and Rörvik had fallen, while Aspvreten and Utö had a maximum in the same components, with approximately 40% lower values. This reflects the constant airflow taking place in the period. The 40% decrease in SO_2 between Frederiksborg and Aspvreten seems reasonable for a transport time of 18 hours.

4.4 EPISODE EIV, 26 TO 29 OCTOBER

The trajectories to Frederiksborg originated from continental Europe, while the other stations received North Sea air. A low pressure centre and a frontal system affected some of the trajectories a lot.

4.5 CLEAN AIR EPISODES 28 TO 30 AUGUST AND 29 SEPTEMBER TO 4 OCTOBER

All trajectories originated from the North Sea. The air reached the measurement stations without passing any heavily polluted areas.

5 THEORETICAL INTERPRETATION OF THE MEASUREMENTS DURING THE AUGUST-OCTOBER 1989 TIME PERIOD

5.1 MODEL DESCRIPTION

The model used is a version of the EMEP model incorporating photochemical oxidants. It is a one layer trajectory model for the atmospheric boundary layer. 96 h back trajectories from the 5 measuring sites were calculated every 6 h using winds for the 0.925 sigma-level (approx. 700 m) from the NWP model at The Norwegian Meteorological Institute. The concentration of each chemical compound in the model was calculated along the trajectories from the continuity equation.

$$\frac{Dc_i}{dt} = P_i - L_i c_i + \frac{E_i}{h} - \frac{v_g}{h} c_i - \frac{\lambda \; P6}{h} c_i \qquad (5.1)$$

Where c_i is the concentration, P and Lc_i the chemical production and loss terms, E_i is the emission (of SO_2, NO_x and NMHC), v_g is the dry removal velocity, h mixing height, λ is the scavenging coeffient and P6 is the 6-hourly rainfall amount. The 39x37 grid points EMEP model area is shown in Figure 5.1. The grid distance is 150 km at 60^0N latitude.

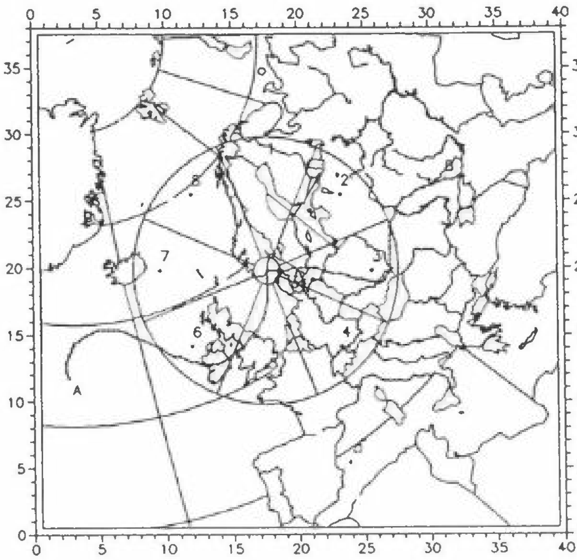


Figure 5.1: EMEP grid area with transport sector allocation example.

Emissions of SO_2, NO_x and NMHC were needed for Europe on the EMEP grid. The national figures used for anthropogenic emissions are shown in Table 5.1, representative for 1985. For most countries the data are based on officially submitted figures to the ECE Secretariat up to 31 August 1990 for NO_x, while for SO_2 the data are based on ECE information reported by Iversen et al., (Iversen et al., 1990).

Table 5.1: EMEP emissions, as for 1988.

	SO_2	NO_x	VOC
Albania	25	9	33
Austria	85	230	251
Belgium	225	281	339
Bulgaria	570	150	167
Czechoslovakia	1757	1127	400
Denmark	170	258	146
Finland	185	251	145
France	870	1615	1877
German Dem. Rep.	2500	955	550
Germany, Fed.Rep. of	1200	2950	2644
Greece	180	746	130
Hungary	710	262	166
Iceland	3	12	12
Ireland	69	68	77
Italy	1252	1595	1566
Luxembourg	7	19	13
Netherlands	138	544	459
Norway	49	203	174
Poland	2150	1500	700
Portugal	134	96	172
Romania	100	390	386
Spain	1603	950	843
Sweden	135	394	444
Switzerland	48	214	339
Turkey	161	175	263
USSR (European)	5550	3369	8056
United Kingdom	1780	2278	1760
Yugoslavia	725	190	291
Total	22199	20831	22403

Natural emissions of nonmethane hydrocarbons were estimated on the basis of the aggregate formulae for deciduous trees proposed by Lübkert and Schöpp (1989):

$$E_{iso} = 3.415\ fc \cdot 10^{0.1T-1.5} \qquad (5.2)$$

Where temperature T is in °C and fc is the forest coverage. The forest coverage in each EMEP grid cell was derived mainly from the IIASA forest cover data base (Lübkert and Schöpp, 1989). Only deciduous tree emission (isoprene) was considered, emissions from coniferous trees are made up mainly of terpenes and have probably only negligible influence on the atmospheric boundary layer chemistry outside the tree canopies, although different opinions can be found about this matter (see e.g. Cardelino and Chameides, 1990; Atherton and Penner, 1990).

In the calculations it was assumed that the anthropogenic NMHC emissions were represented as 30% ethane (by volume), 20% as butane (by volume), 20% (by volume) as ethene, 10% (by volume) as propene and 20% (by volume) as o-xylene.

5.2 MODEL CHEMISTRY AND PHYSICS

The chemical part of the model consists of about 100 chemical reactions involving 45 different chemical species. The emitted species are NO, NO_2, SO_2 CO, ethane, ethene, propene, n-butane, o-xylene and isoprene. A complete description of the chemistry in the model is given by Simpson and Hov (1990).

Photolysis rate coefficients D_i where index denotes species, were calculated on the basis of the equations:

$$D_i = a_i \cdot \exp(-\frac{b_i}{\cos\theta}) \cdot [1 - c_i\,(X_H\,cloud_H + X_M\,cloud_M + X_L\,cloud_L)] \quad (5.3)$$

θ is the solar zenith angle, $cloud_H$ is the fraction of the sky covered by high clouds, $cloud_M$ medium clouds and $cloud_L$ low clouds (cirrus, a mixture of altostratus and altocumulus, and stratus, respectively). The coefficeints a_i and b_i were calculated for every photolytic process for every 5^o latitude and for every month where the average ozone column for that latitude and season as specified by Hough and Woods (1988) on the basis of SBUV measurements on Nimbus 7 for the period 1978-1987. The radiation transfer and the photolysis rate coefficient calculation from the a_i and b_i values were derived following the procedure outlined by Hough (1988) where also the absorption cross section data and solar flux spectrally distributed at the outer edge of the atmosphere are specified and referenced. c_i describes the species specific dependence of photolysis rates on cloud cover, and is a function of the wavelength dependence of the transmission through clouds. The transmission of solar flux varies from 90% for cirrostratus (thus x_H=0.1 in the equation) to 50% for altostratus/altocumulus (X_M=0.5) and 25% for stratus (X_L=0.75), reflecting the different optical thickness for different cloud types (Hough 1988).

A set of concentrations from calculations involving only small amounts of anthropogenic emissions were applied as initial concentrations in the calculations (Table 5.2).

Two different sets of aloft concentrations were used, one over land and one over sea, the last set being slightly less polluted. The concentrations were established from the initial concentrations, adjusted on the basis of monthly averaged diurnal O_3 maximum observed at Birkenes, thus giving a set of aloft concentrations that varies with season. The measured monthly averaged diurnal O_3 maximum was found to have a rather smooth annual variation with a minimum in November/December (27.5 ppb) and a maximum in May (57.1 ppb).

Table 5.2: Initial concentrations used in the model.

NO	0.016	ppb	CH_4	1372.5	ppbC	C_2H_6	3.53	ppbC
NO_2	0.15	ppb	C_2H_4	0.038	ppbC	o-xylene	0.024	ppbC
SO_2	0.30	ppb	C_3H_6	0.003	ppbC	C_4H_{10}	0.455	ppbc
O_3	54.90	ppb	ΣHC	4.050	ppbC			

Exchange of pollutants between the boundary layer and the free troposphere in the model takes place at 12 GMT. It is a function of the difference in mixing height obtained from radiosonde reports and the mixing height calculated as the air parcel moves along the trajectory, which is calculated from

$$h(t_2) = h_1 + \int_{t_1}^{t_2} w(t)dt \qquad (5.4)$$

Where h_1 is the 12 GMT value, and w is the vertical velocity obtained from the NWP-model. The calculated mixing height one day later ($t_2=t_1+24h$) is $h(t_2)$, which can either be smaller or larger then the objectively analyzed mixing height h_2. If $h_2>h(t_2)$ there is dilution of boundary layer air and the concentration c_{ABL} of the boundary layer air is modified according to

$$c'_{ABL}(t_2) = C_{ABL}(t_2) \cdot \frac{h(t_2)}{h_2} + c_a \left(1 - \frac{h(t_2)}{h_2}\right) \qquad (5.5)$$

where c_a is the aloft (free tropospheric) concentration. If $h_2<h(t_2)$, then the atmospheric boundary layer (ABL) concentration is not modified (Eliassen and Saltbones, 1983).

Data for the wind (925mb), atmospheric stability, temperature, relative humidity, precipitation and cloud cover were provided from the numerical weather forecast model at the Norwegian Meteorological Institute and from observations. Radiosonde observations were objectively analyzed to give 12 GMT Eulerian fields, and over land observed precipitation amounts every 6h were adopted rather than calculated amounts, since the 150 km grid NWP model underpredicts in particular summer (convective) precipitation.

Dry deposition velocities used in the model, representative of 1 m height, and scavenging ratios, are given in Table 5.3. The dry deposition velocities applied in the model to the atmospheric boundary layer average concentrations, were modified on the basis of season, latitude and atmospheric stability according to the procedure outlined by Hov et al.(1988) and Iversen et al. (1989).

Table 5.3: Dry and wet deposition parameters employed in the model.

Summer daytime 1 m height dry deposition velocity (cm/s)						Washout coefficients			
Ozone	0.5	SO_2	0.8	NO_2	0.4	SO_2	$2.0 \cdot 10^5$	HNO_3	$1.4 \cdot 10^6$
PAN	0.2	HNO_3	diffusion controlled			H_2O_2	$1.4 \cdot 10^6$	CH_3O_2H	$1.4 \cdot 10^6$

5.3 TRANSPORT SECTOR ALLOCATION

In Figure 5.1 is shown the allocation of a transport sector (numbered 1-8) to a particular trajectory. If more than 50% of the coordinates of the trajectory between 1500 and 150 km of the receptor point lie within the same sector, the trajectory is allocated to that sector, otherwise undetermined (numbered 9).

5.4 RESULTS

Attention will be paid in particular to the episodes described in previous chapters.

In Figure 5.2 is shown an example of a 5 day trajectory for one episode. Similar examples for all episodes are given in Appendix III.

I Figure 5.3 is shown calculated and measured daily values for SO_2 at one station. Similar figures are given for all the 5 Nordic sites in Appendix III. At all sites, during the four episodes the calculated SO_2 concentrations are higher than, or comparable to, the measured concentrations, while the calculated concentrations are low during the clean air "episodes". This indicates that the general transport picture during the episodes is quite well understood.

In Figure 5.4 is shown a similar example for NO_2. Figures for all the 5 sites are given in Appendix III. Several of the peaks in SO_2 do not correspond to similar peaks in NO_2, see e.g. Birkenes 10 August, around 20 September and Aspvreten around 20 August. In general calculated values of NO_2 are lower than measured, while for SO_2 it is opposite.

In Figure 5.5 is shown the comparison of measurements and calculations for ozone for one site. Similar figures for all sites are given in Appendix III. It can be seen that episode EI also was a photochemical episode, particulary well shown at the two Swedish and the Danish site. Episode EII did not contain the same photochemical activity, while the content of primary pollutants was quite high (in particular at Frederiksborg). 15-21 October (EII) was characterized by low ozone values and high values of primary pollutants.

In Figure 5.6 is shown the comparison of measurements and calculations for PAN for one site. Similar figures for all sites are given in Appendix III. In non-episodic conditions the levels are typically 0.2 ppb, while the maximum hourly value approaches 3 ppb at Frederiksborg (11 August). There is a correlation between high ozone and high PAN.

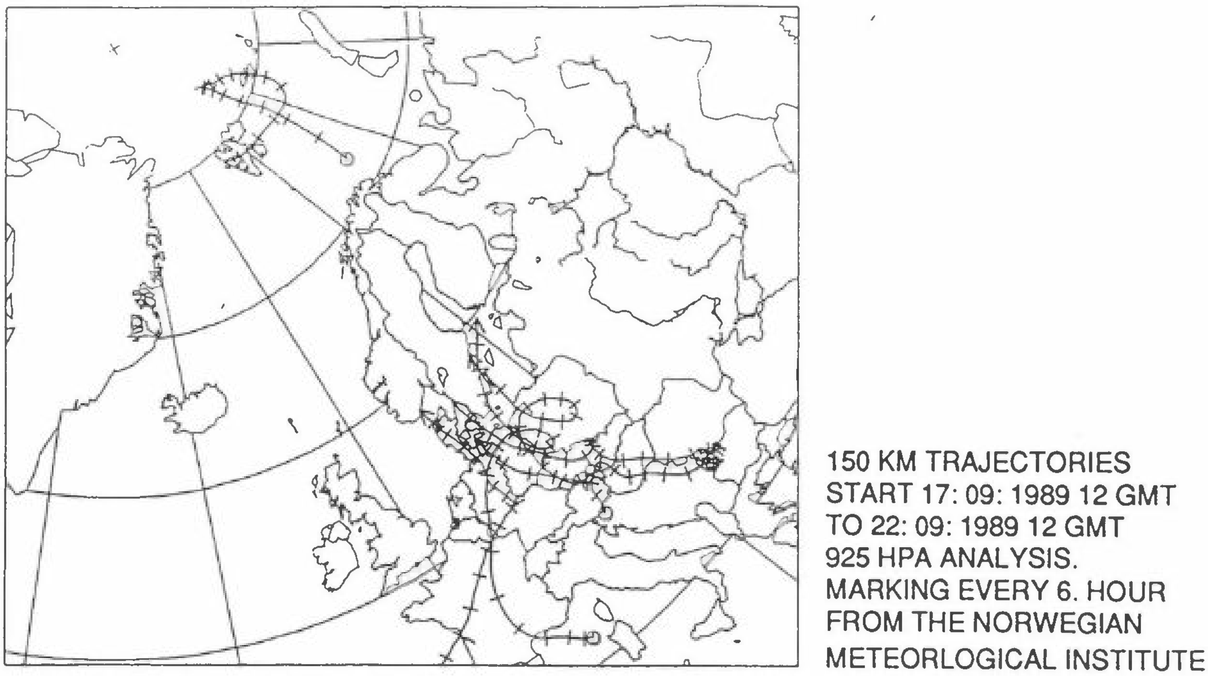


Figure 5.2: Example of 5 day trajectories during episode EII. Similar plots for both polluted and clean episodes are presented in Appendix III, Figures AIII.1.a - AIII.1.f.

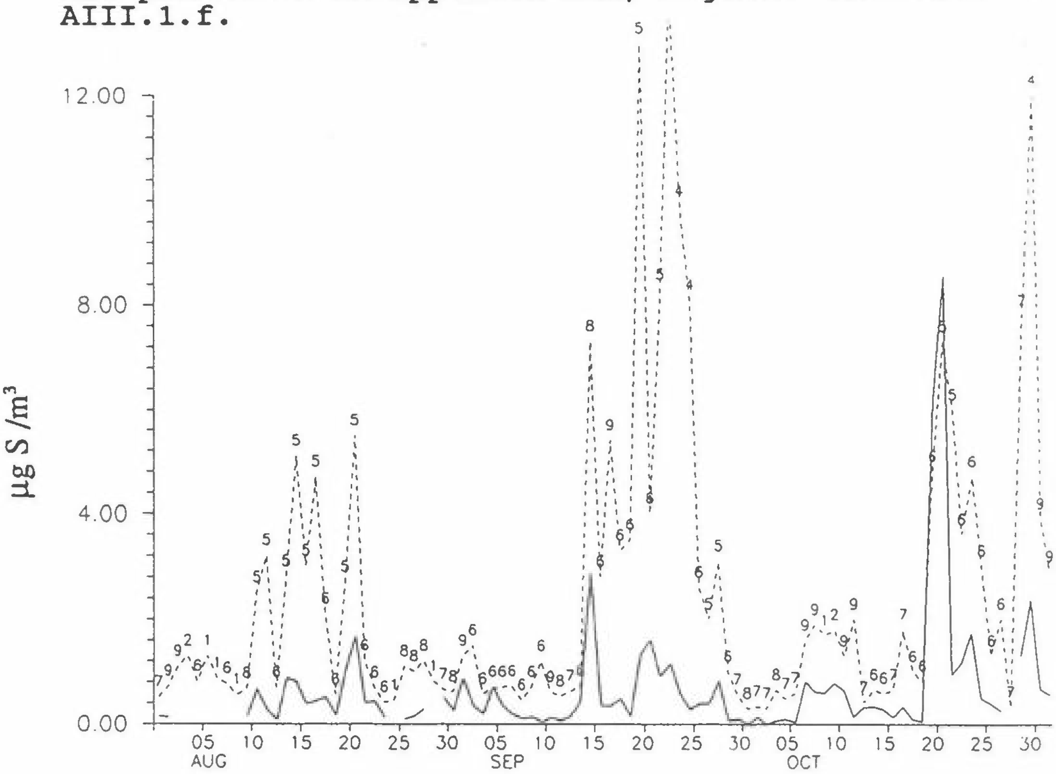
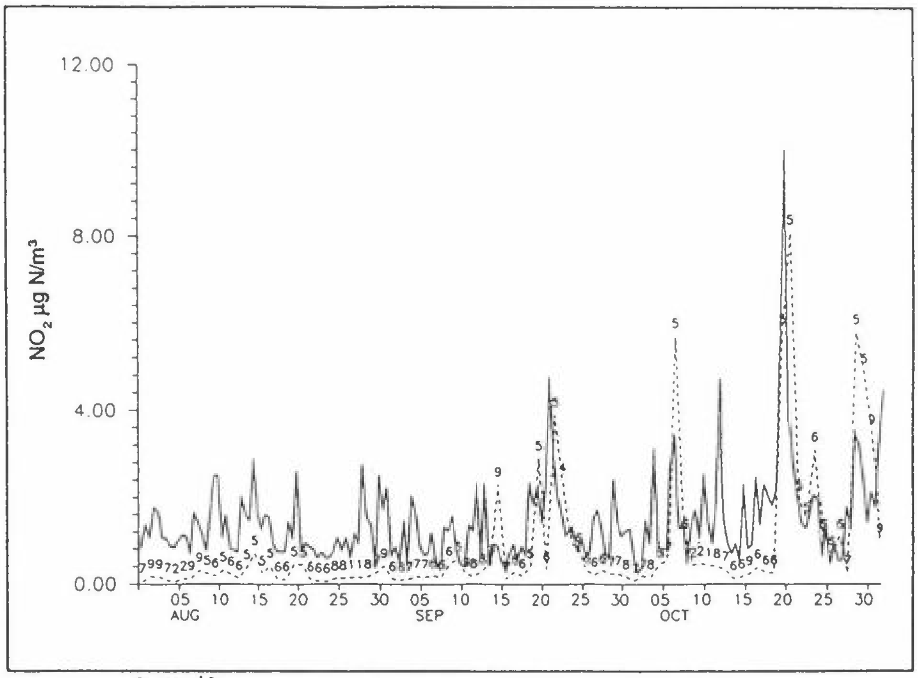
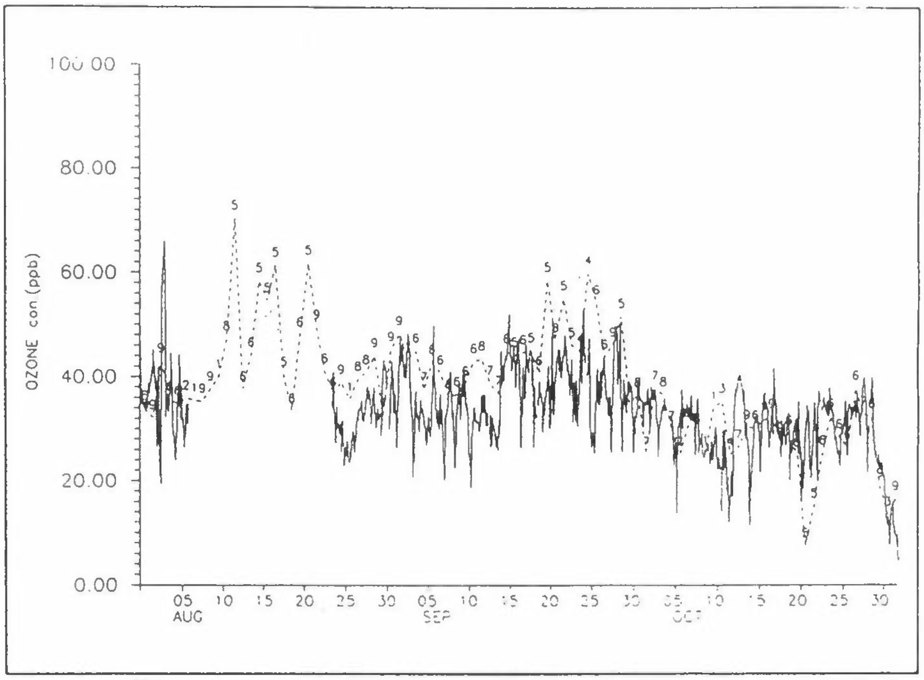


Figure 5.3: Examples of calculated (dashed) and measured (full line) concentrations of SO_2 on a daily basis, measured at Aspvreten. Transport sector allocation is indicated in the calculated concentration curve. Similar figures for all the stations are given in Appendix III, Figures AIII.2.a-AIII2.e.



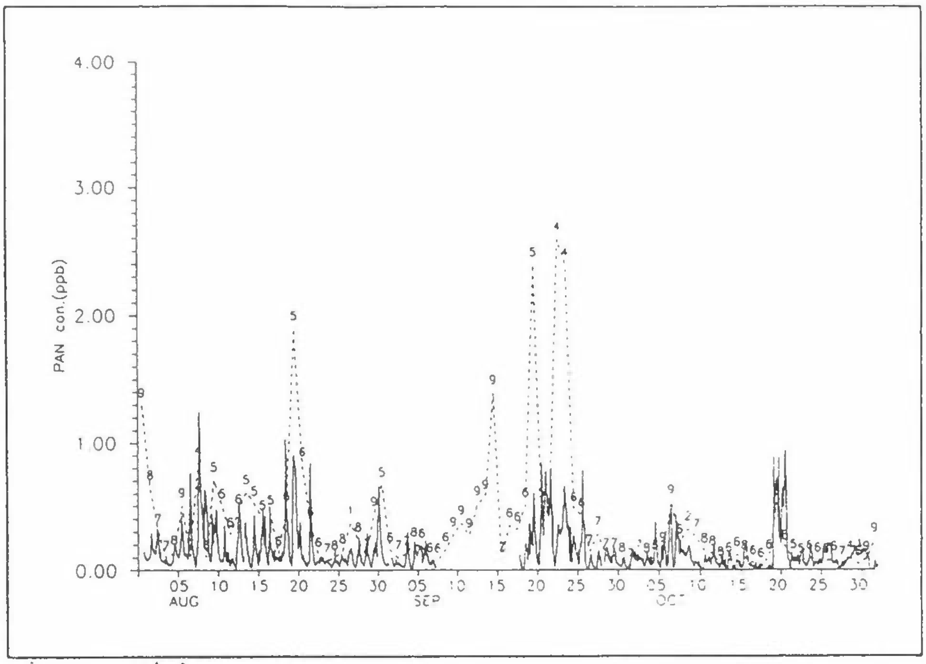
Rørvik

Figure 5.4: Examples of calculated (dashed) and measured (full line) concentrations of $SO_2 \rightarrow NO_2$ on a daily basis, measured at Rörvik. Transport sector allocation is indicated in the calculated concentration curve. Similar figures for all the stations are given in Appendix III, Figures AIII.3.a-AIII3.e.



Utø

Figure 5.5: Examples of calculated (dashed) and measured (full line) concentrations of ozone on a daily basis, measured at Utö. Transport sector allocation is indicated in the calculated concentration curve. Similar figures for all the stations are given in Appendix III, Figures AIII.3.a-AIII3.e.



Birkenes

Figure 5.6: Examples of calculated (dashed) and measured (full line) concentrations of PAN on a daily basis, measured at Birkenes. Transport sector allocation is indicated in the calculated concentration curve. Similar figures for all the stations are given in Appendix III, Figures AIII.3.a-AIII3.e.

6 DIURNAL VARIATIONS

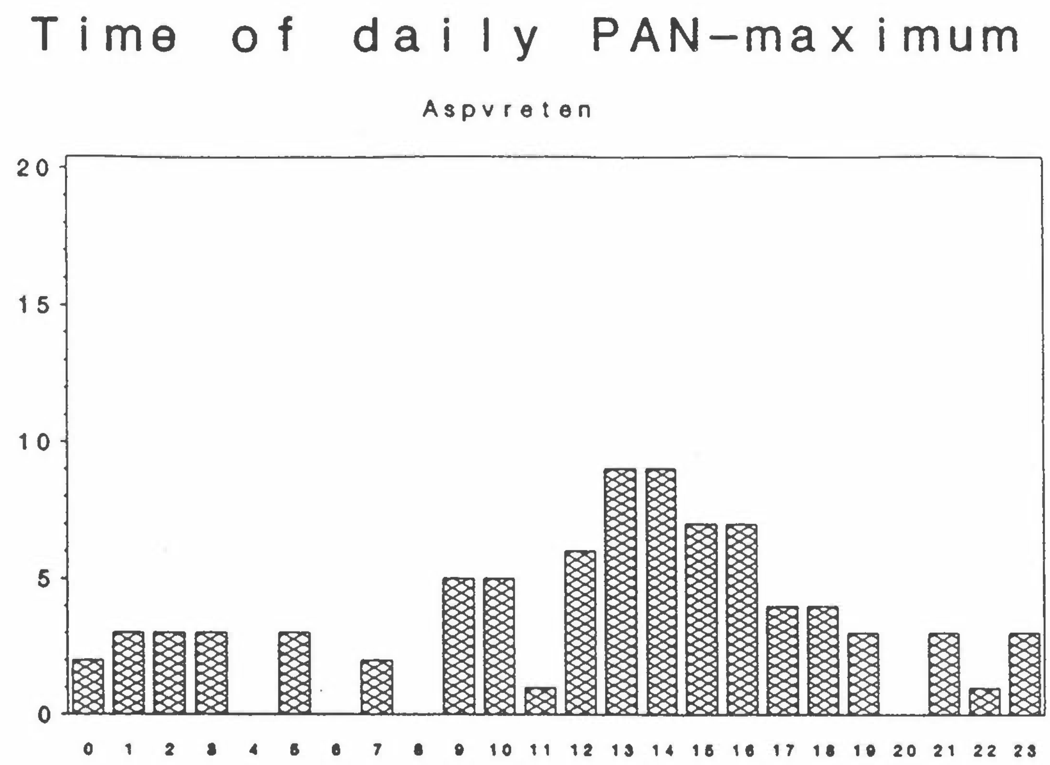
One way of analyzing the diurnal variation is to look at the time of the daily maximum. Figure 6.1 shows the number of occasions when the daily maximum falls at each of the 24 hours, using data from both normal, clean and polluted periods. The example shown in Fig. 6.1 is from Aspvreten. Ozone showed a distribution centered around the time of the solar noon. PAN had a broader distribution with a less well-defined maximum.

The diurnal variation was also analyzed by plotting (Fig. 6.2) the deviation from the daily mean averaged for each hour for each type of period (normal, clean and polluted). For ozone there was a broad maximum in the afternoon, but there was seemingly no difference between the polluted, the normal and the clean air periods. For PAN the variation was less pronounced, but the data from Aspvreten and Frederiksborg showed a larger deviation during the polluted episodes.

The mean value of the daily range, i.e. the difference between the maximum and minimum value, was also analyzed using all data. For ozone the mean was around 50 for 4 stations and 30 for Utö. For PAN the mean was 0.15 for Aspvreten, Birkenes and Utö and 0.3 for Frederiksborg and Rörvik. The distribution of the daily maxima did not change, when the lower 40% of the ranges were taken out. The covariation between ozone and PAN was analyzed by plotting the hour of the daily maximum and the maximum-values against each other. Data from Aspvreten are shown as an example in Fig. 6.3. The plot of the times shows very little correlation for all the stations, even when the data are separated into pollution and clean air periods. Thus there seems to be no systematic time lag between the occurrencies of daily maximal values of ozone and PAN. For the maximum values there was a tendency to high PAN concentration, when the ozone was high, but there were also high values of PAN with low ozone.

To study the variations of NO_2 between day and night, samples were collected through 12 h. The variation of NO_2 was analyzed by computing the natural logarithm of the ratio between the daytime and nighttime concentrations. A plot (Fig. 6.4) of these logarithms as a function of time shows only a fluctuation around a positive average. As a monthly average, the night-time concentration is between 0 and 30% higher than the day-time concentration (in October up to 20% lower). No connection was found between these fluctuations and the polluted or clean air episodes. It is therefore concluded that 12-hour samples of NO_2 do not contain significantly more information than 24-hour samples.

A complete set of figures can be found in Appendix IV.



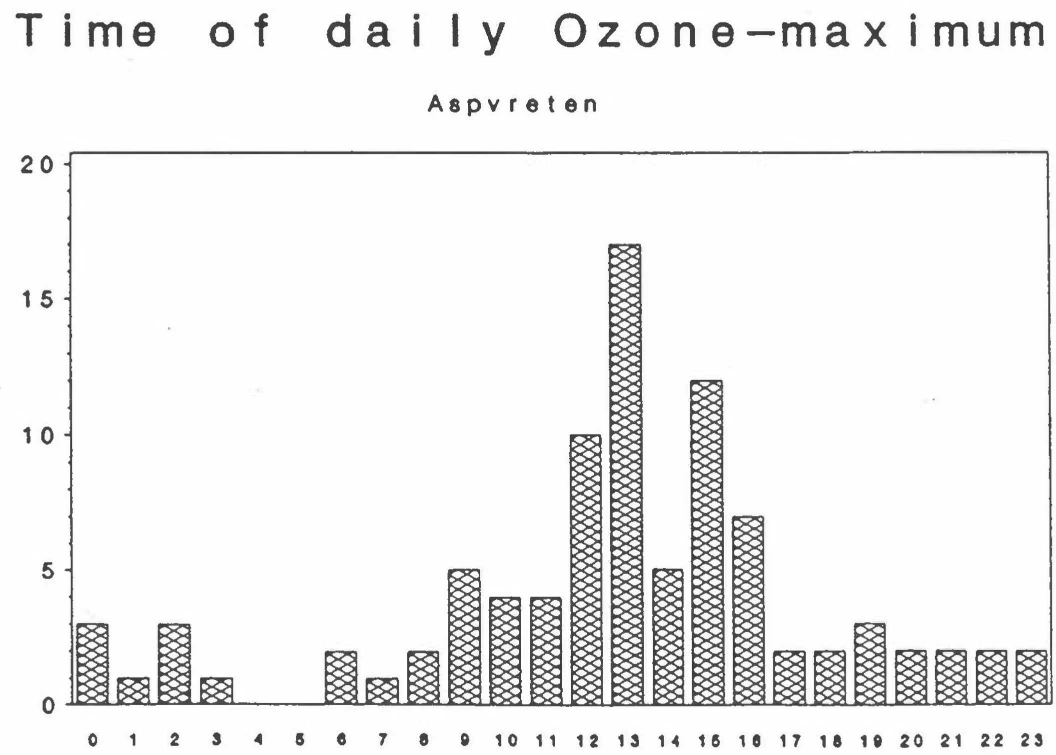
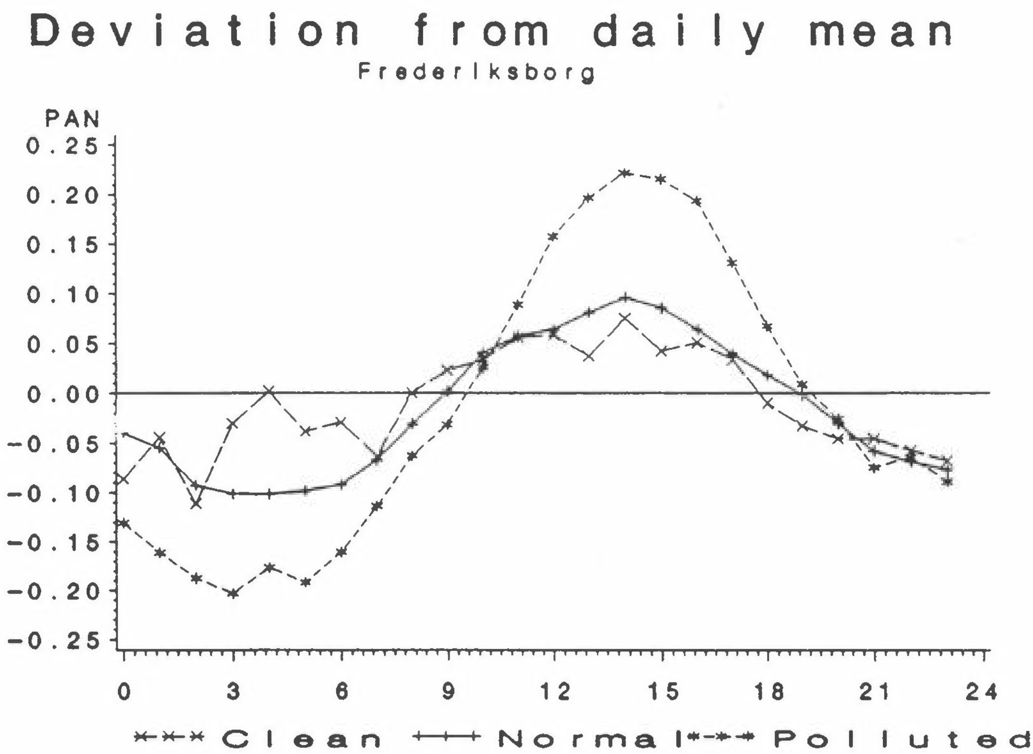


Figure 6.1: Time of daily PAN and ozone maxima at Aspvreten. Similar figures for the other stations are given in Appendix IV.



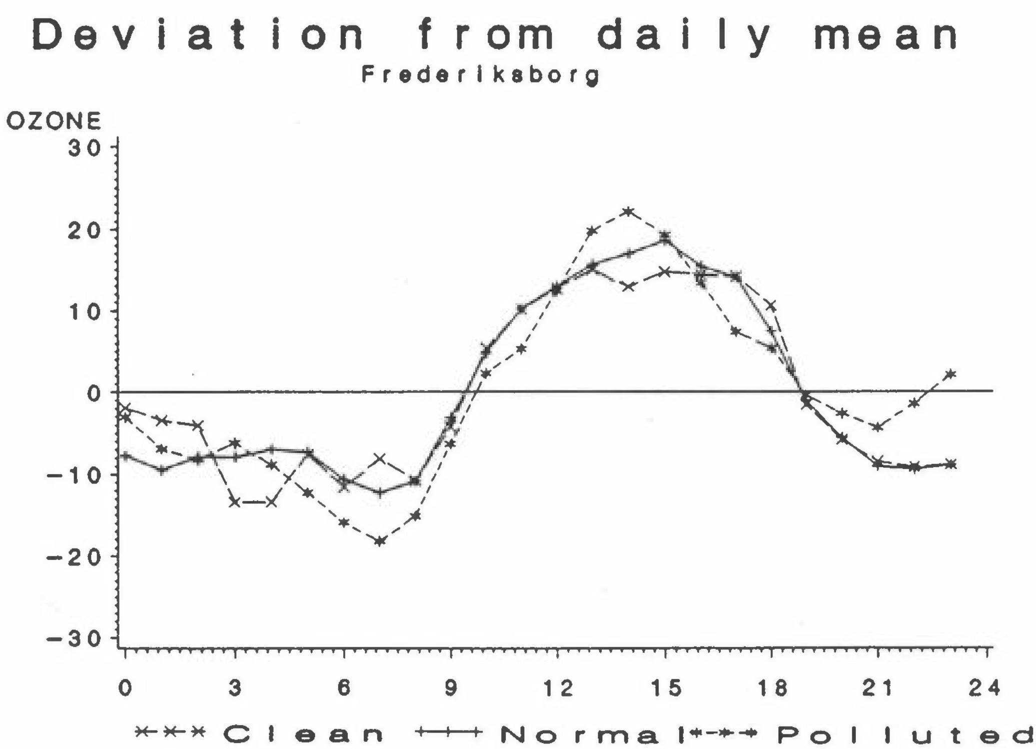
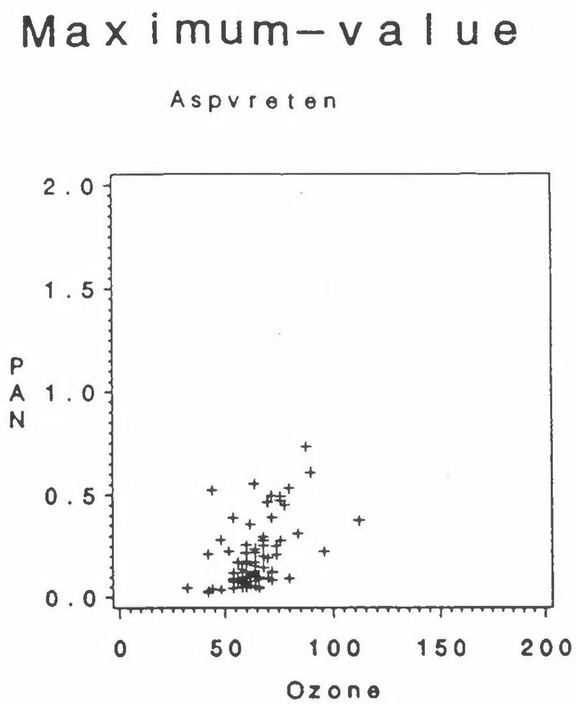


Figure 6.2: Deviation from daily mean of PAN and ozone at Frederiksborg. Similar figures for the other stations are given in Appendix IV.



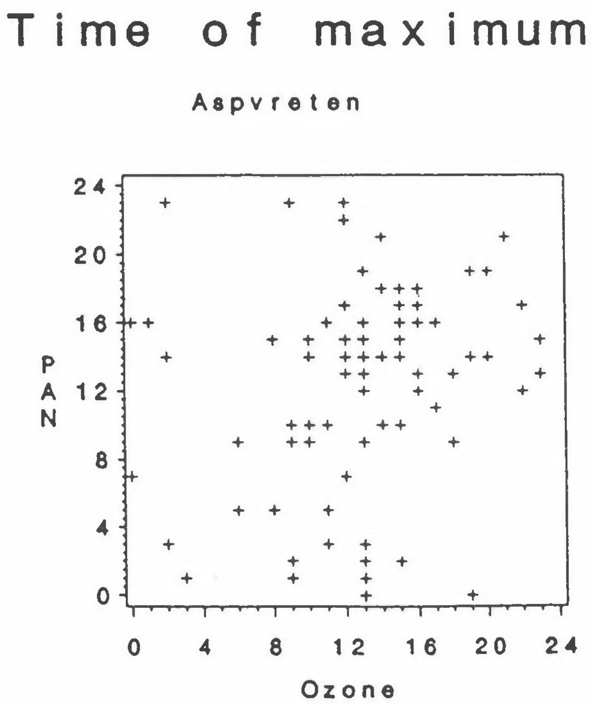


Figure 6.3: Maximum concentration in µg N/m^3 of PAN, and time of maximum for PAN at Aspvreten. Similar figures for the other stations are given in Appendix IV.

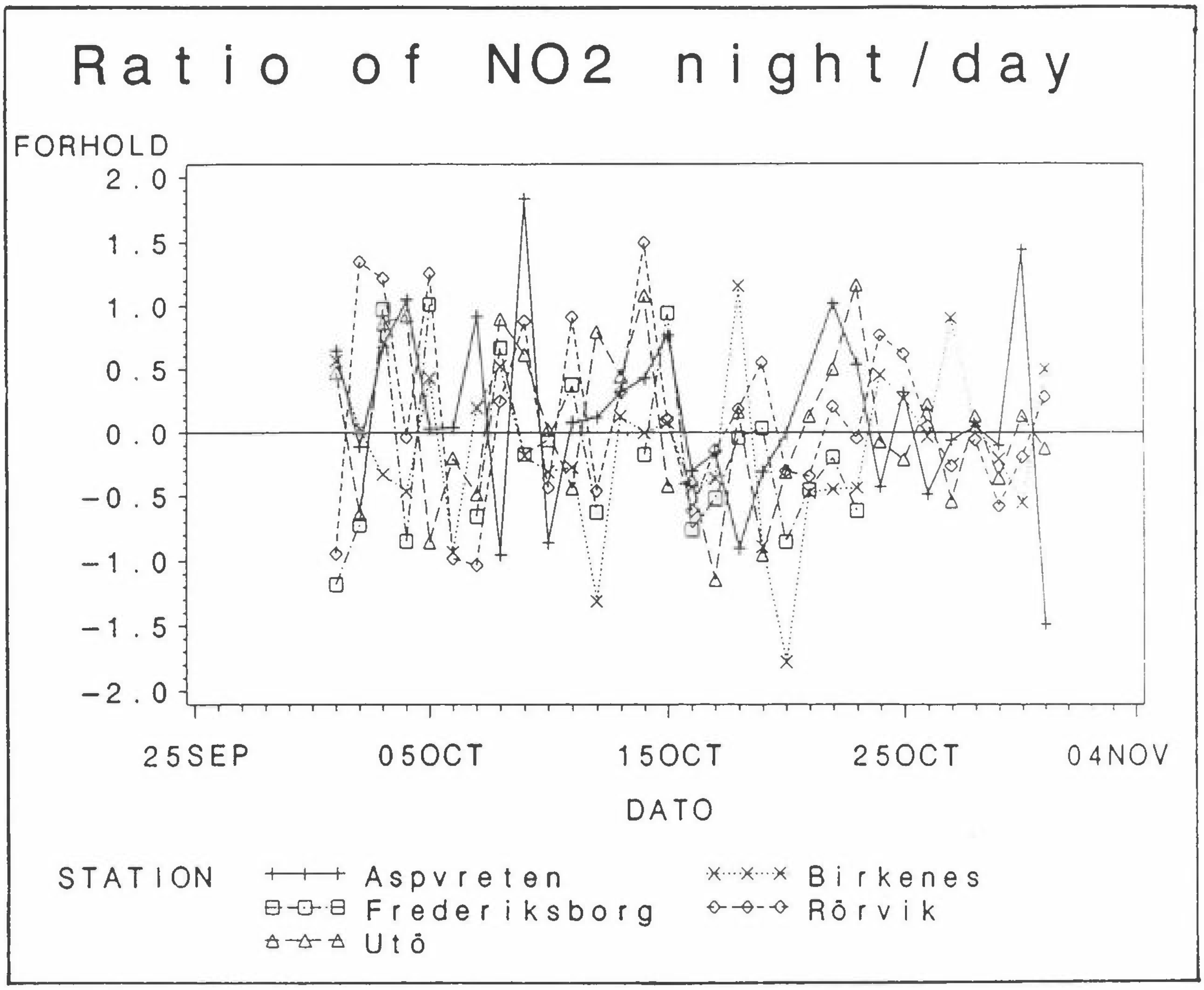


Figure 6.4: Natural logarithm of the ratio between NO_2 concentration at night and the preceeding day, for all stations in October 1989. Similar figures for August and September 1989 are found in Appendix IV.

7 FURTHER WORK

Further work will be carried out to analyse the measured and calculated data. This will be reported elsewhere, and includes

- Analysis of S-, N- and NMHC-budgets at the receptor points on a daily basis or shorter if the measurements have a better time resolution, including assessment of the role of dry and wet deposition along the trajectories in removing N- and S-compounds.
- Similar analysis on a monthly basis.
- Diurnal variation of PAN in different pollution regimes, based on the measured data.
- Comparison of measured and calculated NMHC at Birkenes and Rörvik, conclusions on emission inventory speciation and emission intensities.

8 THE WORKSHOP

8.1 PURPOSE

The NMR measurement campaigns yield large amounts of primary measurement data. In previous cooperative NMR projects, the participants have evaluated their own measurement data locally, and presented the final results to each other. To identify and describe episodes on an international scale, the participants needed to study measurement data from all the stations at an early point of time in the evaluation process. By organizing a workshop, the participants also had the possibility to compare and discuss the measurement data and plan the subsequent evaluation process.

The participants use different computer software for measurement data reduction and evaluation. Most measurement data processing has previously been performed by batch processing on large computers. The workshop was also intended to be a pilot project in measurement data exchange and evaluation using personal computers and interactive spreadsheet software.

8.2 EQUIPMENT AND SOFTWARE

Three personal computers were used for the workshop. The main data base was placed in an IBM PC/AT-compatible computer with an 80286 processor, an 80287 coprocessor, 4 Mb RAM, 40 Mb disc, 5 1/4" 1,2 Mb diskette drive, 3,5" 1,4 Mb diskette drive and a NEC P6+ pinwriter. Also available was a 80386- based computer with almost identical equipment. Both machines were running MS WINDOWS 2.11 and Microsoft EXCEL 2.10 spreadsheet. The main machine was also equipped with MS WORD for WINDOWS text processing program. The third PC was running the SAS database and graphical software.

8.3 PREPARATIONS

By the end of February 1990 the participants received a description of the data exchange formats and file formats required for efficient exchange of the measurement data. Measurement data were sent on diskettes in ASCII or EXCEL files. ASCII files were read into the spreadsheet, parsed, and saved as spreadsheet files. In some cases the measurement units were different from those previously agreed upon, and the data had to be converted. Deviations from a monotonous time scale were corrected. In some cases, the original tables were interrupted by month or day headings, that had to be removed. In other cases, missing data had been left out completely instead of being coded as missing. After these corrections, the files could be merged and column headings added. The file conversion process proved to be quite timeconsuming. Some measurement data were also converted and transferred to the data base on the first day of the workshop.

Based on the merged data files, some graphical representations were prepared before the workshop. When the data base had been completed on the first day of the workshop, these graphs could be quickly updated and printed out to present an overview of the measurement data material.

An extensive package of trajectory maps for air masses that arrived in the 5 stations had been prepared before the workshop. For each station the trajectories were plotted 5 days back, and for two arrival times every day. For periods that were expected to contain interesting episodes, the trajectories were computed for 4 arrival times per day. Precipitation and mixing heights were presented in grid maps for every day.

8.4 AGENDA

A detailed agenda was not made before the workshop. The participants needed to experiment with this form of cooperation. The participants settled into a rhythm with 3 - 4 hour work shifts totalling about 10 hours per day. The last hour before dinner every day was dedicated to a strategy meeting.

The first half day was used for travelling to the workshop. During the rest of this day the equipment was installed, and the last data were converted and entered into the data base. The next two days were full working days. On the last day we had a short work session, before packing the equipment.

8.5 PRELIMINARY RESULTS

In the overview plots episodes could easily be seen for each separate measurement station. Comparing similar plots from different stations quickly revealed large scale episodes. The trajectory maps were then used to confirm the assumptions and further characterize the identified episodes.

The next step was to create graphic representations of selected component concentrations during the episodes. Two different approaches were needed; simultaneous display of several components at one station, and simultaneous display of one component for several stations. In this phase we found that the data base needed re-structuring. Data base column headings should include lines of text that will automatically be included in the graphic representations as headings and comments. The efficiency of this phase was not as good as expected, due to speed limitations of computers and printers. We also found that some of the tasks should be automated by spreedsheet macro programs. There was not time to write these macros during the workshop. Graphic representations of statistical computations based on multiple parameters were more easily created on the spot in SAS, but transfer of data files to the SAS system caused some trouble in the beginning.

During the workshop, the participants were able to get the required overview of the data material. Furthermore, we learned how to structure the data for efficient handling in a spread-sheet program, and we learned how to exchange measurement data between the participants for spreadsheet use. The fundament for a common spreadsheet measurement data tool pack was built.

8.6 REPORTING

On the last day of the workshop an outline of the report was discussed and agreed upon. Tasks were distributed between the participants. The present report is intended for internal NMR use. A condensed version will be submitted for publication in an international journal.

9 CUSTOM CHARTING TOOLS

The charting facilities in a spreadsheet like EXCEL provide extensive possibilities for experimentation and prototyping. Data may be viewed in different ways and evaluated quickly. The spreadsheet also allows statistical computations to be prototyped and the results charted very quickly. Efficient use of these facilities however requires extensive knowledge of the software and its limitations. The main limitation is the lack of a relational database and its tools for selecting data that fulfil given criteria. Similar functions are available also in a spreadsheet, but these are not very powerful, and are complicated to use. Relational database programs presently do not include usable charting tools and spreadsheet functions. Computations must in many cases be written in a standard programming language, compiled, and linked to the database application. Results of a search must often be exported to a spreadsheet program for further computations and charting. Macro program facilities in the spreadsheets are extensive, but may be complicated to write and debug. Specialized statistical computation and charting packages like STATGRAPHICS have excellent statistical function libraries, good charting facilities, but no relational database support.

In short, relational database applications are easily automated, but do not have internal resources for computations and charting. Spreadsheet applications have extensive computation and charting facilities, but are difficult to automate. The NMR workshop was based on spreadsheets. An efficient way to structure the data and the computing sheets was found. After the workshop these results have been implemented in a functional tool pack.

10 DATA EXCHANGE FORMATS

In order to enter measurement data into a common spreadsheet database, file contents, file formats, and diskette formats according to the definitions below should be employed.

Diskettes should be 5,25" or 3,5", any density readable by a PC/AT, and readable by MS-DOS 3.0 or higher.

File formats may be common spreadsheet formats (*.XLS, *.WK1, *.WK2), dBASE II or III format (*.DBF) or ASCII. ASCII files must be space or tab delimited with straight columns, all text left or right justified in the columns. In ASCII files decimal points should be included in the correct positions.

The group has used three different file content definitions for 1-hour data, 12- hour data and 24-hour data, respectively.

10.1 1-HOUR DATA

PAN and ozone are reported as 1-hour data. One file should contain one column for each parameter and station. The column has a 7 line heading, and 1 line for each hour in the entire month. There should be no interruptions by day or week headings. The first heading line identifies both the station and the parameter. The station is identified by a two letter code and is separated from the parameter name by an underscore character. The next 3 lines are texts to be used in graphic representations, they give parameter name, measurement unit, and station name, respectively. The next 3 lines are free for future use if additional texts are needed.

The date and hour should be defined in two columns as shown below. These columns need not be complete. They will not be copied into the database, but serve to identify the measurement data for correct placement in the database.

All times are given in GMT (no daylight saving time or "summer time"). The first hour in the day is hour 00, the last is hour 23. Hour 00 starts at 23:30 the previous day and ends at 00:30. Missing data should be left as blank fields, or they may contain a dot (SAS format) or the EXCEL error message #N/A. The time column must be kept continuous even if many data elements are missing. Always include a line for each missing element.

A small part of such a file is shown in table 10.1 below (in an ASCII file there are no grid lines, but the text formatting may be identical). A list of parameters and corresponding units and number of decimals is given in Chapter 2.

Table 10.1: Example of 1-hour data file.

DATE	DAY	HOUR	BI_OZONE	BI_PAN	RV_OZONE
			Ozone	PAN	Ozone
			µg/m^3	µg N m^3	µg/m^3
			Birkenes	Birkenes	Rörvik
890901	1	00:00	40	0,023	65
890901	1	01:00	34	0,024	73
890901	1	02:00	38	0,020	67

10.2 12-HOUR DATA

NO2 is reported as 12-hour data in files that are very similar to the 1-hour data files above. Separate columns are dedicated to start date, start time, end date, and end time for each measurement data field. The half-hour shift that is employed for 1-hour data, is not used for 12-hour data. The measurement periods start at 06:00 GMT and 18:00 GMT.

Table 10.2: Example of 12-hour data file.

START	START	END	END	BI_NO2_KI
DATE	TIME	DATE	TIME	NO2-KI
	GMT		GMT	µg N/m.
				Birkenes
890801	06:00	890801	18:00	0,13
890801	18:00	890802	06:00	0,35
890802	06:00	890802	18:00	0,39

10.3 24-HOUR DATA

The remaining parameters (both for air and for precipitation) are available as 24- hour data. The file is equal to the EMEP reporting form except for the headings, the space between columns, and the decimal commas. The order of the columns is not significant. The columns may be sorted in the spreadsheet after merging. A small part of such a file is shown in table 10.3 below. (An ASCII equivalent would have all columns left or right justified, the spreadsheet commonly left justifies text and right justifies numbers.)

Table 10.3: Example of 24-hour data file.

DATE	BI_NO2	BI_HNO2	BI_SO2	BI_HNO3
	NO2	HNO2	SO2	HNO3
	µg N/m^3	µg N/m^3	µg S/m^3	µg N/m^3
	Birkenes	Birkenes	Birkenes	Birkenes
890801	0,44	0,292	0,073	0,153
890802	1,44		0,234	0,142
890803	0,44	0,241	0,137	0,091

11 NMR SPREADSHEET TOOL PACK

A number of graphic templates and macros were used for initial data presentation and evaluation. These were written under EXCEL version 2.1. The macros and templates are given in Appendix V. The macros automatically produce monthly overview plots of all data in the files.

12 REFERENCES

Atherton, C.S. and Penner, J. (1990) The effects of biogenic hydrocarbons on the transformation of nitrogen oxides in the troposphere. J. Geophys. Res., 95D, 14027-14038.

Cardelino, C.A. and Chameides, W.L., (1990) Natural hydrocarbons urbanization, and urban ozone. J. Geophys. Res., 95D, 13971-13979.

Eliassen, A. and Saltbones, J. (1983) Modelling of long-range transport of sulphur over Europe: A two-year model run and some model experiments. Atmos. Environ., 17, 1457-1473.

Ferm, M., Fuglesang, K., Areskoug, H., Hanssen, J.E. and Lättilä, H. (1987) Long-range transport of nitrogen and sulphur compounds. In: Proc. of the Fourth European Symposium on Physico-Chemical Behaviour of Atmospheric Pollutants. Stresa, Italy September 1986. Ed. by Angeletti, G. and Restelli, G., Dordrecht, Reidel. pp. 773-783.

Ferm, M., Areskoug, H., Grendahl, L., Hanssen, J.E., Heidam, N. and Lättilä, H. (1987) Simultaneous measurements of airborne ammonium and nitrate of 9 EMEP stations. In: Proc. of EMEP-Workshop on data analysis and precentation, Cologne, FRG, June 1987. Lillestrøm, Norwegian Institute for Air Research (EMEP/CCC Report 7/87).

Ferm, M., Areskoug, H., Hanssen, J.E., Hilberg G. and Lättilä, H. (1988) Field intercomparison of measurements techniques for total NH_4^+ and total NO_3^- in ambient air. Atmosp. Environ., 22, 2275-2281.

Hough, A.M. (1988) The calculation of photolysis rates for use in global tropospheric modelling studies. London HMSO, (AERE R 13259).

Hough, A.M. and Woods, K.J. (1988) Ozone concentrations in the global troposphere. An analysis of data from the SBUV instrument on the NIMBUS-7 satellite. London HMSO, (AERE R 13271).

Hov, Ø., Eliassen, A. and Simpson, D. (1988) Calculation of the distribution of NO_x compounds in Europe. In: Tropospheric ozone. Ed. by I.S.A. Isaksen. Dordrecht, Reidel. pp. 239-261.

Iversen, T., Saltbones, J., Sandnes, H., Eliassen, A. and Hov, Ø. (1989) Airborne transboundary transport of sulphur and nitrogen over Europe - Model descriptions and calculations. Oslo, The Norwegian Meteorological Institute (EMEP/MSC-W Report 2/89).

Iversen, T., Halvorsen, N.E., Saltbones, J., Sandnes, H. (1990) Calculated Budgets for Airborne Sulphur and Nitrogen in Europe. Oslo, The Norwegian Meteorological Institute (EMEP/MSC-W Report 2/90).

Lübkert, B. and Schöpp, W. (1989) A model to calculate natural VOC emissions from forests in Europe. IIASA Working Paper 89-082, A-2361 Laxenburg, Austria.

Oyola, P. and Areskoug, H. (1988) Nordic intercomparison of ozone and nitrogen dioxide measurement techniques. Stockholm, Swedish Environmental Protection Board. (SNV Report 3422).

Simpson, D. and Hov, Ø. (1990) Long period modelling of photochemical oxidants in Europe. Calculations for July 1985. The Norwegian Meteorological Institute, Oslo (EMEP/MSC-W Note 2/90).

Sjödin, Å. and Ferm, M. (1988) Development of a new manual technique for determination of NO_2 in urban and rural air. 23 pp. Gothenburg, Swedish Environmental Research Institute (IVL report L86/36 (in Swedish)).

APPENDIX I

NMR campaign 1989 - data files

All parameters are given as 24 hour means. Parameters measured on 12 hour or one-hour basis have been converted to 24 hour data and included in these files. The files are created in the EXCEL spreadsheet program.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	DATE	AS_NO2_D(	AS_NO2_K:	AS_OZONE	AS_PAN	AS_SO2	AS_SO4	AS_TNH4	AS_TNO3	BI_NO2	BI_NO2_K:	BI_OZONE	BI_PAN	BI_SO2	BI_SO4	BI_TNH4
2		NO2-DO	NO2-KI	OZONE	PAN	SO2	SO4	TNH4	TNO3	NO2	NO2-KI	OZONE	PAN	SO2	SO4	TNH4
3		µg N/m^3	µg N/m^3	µg/m^3	µg N/m^3	µg S/m^3	µg S/m^3	µg N/m^3	µg N/m^3	µg N/m^3	µg N/m^3	µg/m^3	µg N/m^3	µg S/m^3	µg S/m^3	µg N/m^3
4		ASPVRETEI	ASPVRETEI	ASPVRETEI	ASPVRETEI	ASPVRETEI	ASPVRETEI	ASPVRETEI	ASPVRETEI	BIRKENES	BIRKENES	BIRKENES	BIRKENES	BIRKENES	BIRKENES	BIRKENES
5																
6																
7																
8	890801		0,25	59		0,149	0,339	0,35	0,24	0,44	0,24	49		0,073	0,064	0,18
9	890802		0,36	60	0,059	0,130	0,473	0,56	0,23	1,44	1,32	48	0,083	0,234	0,078	0,31
10	890803		0,36	55	0,071			0,43	0,22	0,44	0,42	45	0,100	0,137	0,101	0,31
11	890804	1,04	0,45	52	0,084			0,24	0,15	0,44	0,27	56	0,036	0,019	0,043	0,16
12	890805		0,33	57	0,057			0,50	0,24	0,43	0,70	50	0,067	0,098	0,092	0,20
13	890806	1,01	0,49	57	0,108			0,64	0,11	0,85	0,65	46	0,109	0,248	0,129	0,34
14	890807	1,05	0,48	39	0,110					1,51	1,22	42	0,158	0,581	0,322	0,52
15	890808		0,39	49						1,72	1,37	46	0,271	0,418	1,816	2,30
16	890809		0,52	58						1,33	1,18	66	0,214	0,243	0,670	0,85
17	890810	1,64	0,48	56	0,146	0,169	1,102	1,02	0,40	1,08	0,89	47	0,165	0,334	1,010	0,68
18	890811		0,32	90	0,259	0,686	2,796	2,80	1,08	1,48	0,83	56	0,074	0,177	0,481	0,44
19	890812		0,42	71	0,203	0,289	1,026	1,21	0,54	0,75	0,48	48	0,046	0,094	0,241	0,24
20	890813	1,29	0,39	58	0,075	0,115	0,350	0,39	0,17	1,93	1,25	47	0,136	1,138	1,519	1,21
21	890814		0,43	63	0,133	0,895	1,300	1,13	0,48	1,51	0,92	37	0,088	0,254	0,531	0,74
22	890815		0,48	79	0,152	0,830	1,378	1,61	0,75	2,22	1,33	46	0,089	0,283	1,036	0,73
23	890816		0,40	87	0,195	0,399	1,466	1,61	0,62	2,21	1,37	52	0,147	2,081	1,440	0,99
24	890817		0,44	81	0,157	0,468	0,911	0,92	0,44	1,33	0,67	36	0,087	0,246	0,540	0,51
25	890818		0,46	70	0,140	0,538	0,641	0,62	0,43	1,33	0,36	53	0,053	0,165	0,306	0,21
26	890819		0,39	71	0,093	0,189	0,866	0,84	0,34	2,30	1,29	61	0,196	1,206	1,580	1,32
27	890820		0,29	79		1,054	1,697	1,71	0,77	2,77	1,48	49	0,276	0,878	2,464	3,23
28	890821		0,47	120		1,705	2,136	2,28	0,83	1,45	0,13	65	0,083	0,108	0,336	0,72
29	890822		0,54	69	0,177	0,430	1,039	1,11	0,54	1,23	0,62	52	0,130	0,453	0,408	0,36
30	890823			59	0,098	0,455	0,355	0,40	0,26	0,79	0,27	45	0,040	0,076	0,114	0,14
31	890824		0,56	59	0,078	0,149	0,086	0,18	0,11	0,99	0,17	54	0,036	0,060	0,069	0,10
32	890825		0,34	45	0,056			0,24	0,04	1,28	0,47	42	0,035	0,056		
33	890826		0,40	49	0,060	0,099	0,514	0,32	0,06	0,59	0,88	34	0,045	0,087		
34	890827			44	0,061	0,150	0,411	0,19	0,06	0,60	0,87	34	0,059	0,080	0,047	0,06
35	890828	1,58	0,72	55	0,075	0,282	0,525	0,52		0,60	0,63	33	0,058	0,082	0,364	0,35
36	890829	0,96	0,32	56	0,083			0,29		1,41	1,05	36	0,065	0,265	0,272	0,33
37	890830		0,38	64	0,122	0,532	0,256	0,41		1,96		34	0,082	0,303	0,206	0,24
38	890831	0,74	0,26	75	0,069	0,277	0,204	0,24	0,27	1,57		48	0,143	0,104	0,163	0,31
39																
40																

	A	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE
1	DATE	BI_TNO3	FB_NO2_K	FR_NO2	FR_OZONE	FR_PAN	FR_SO2	FR_TNH4	FR_TNO3	RV_NO2_K	RV_OZONE	RV_PAN	RV_SO2	RV_SO4	RV_TNH4	RV_TNO3
2		TNO3	NO2-KI	NO2	OZONE	PAN	SO2	TNH4	TNO3	NO2-KI	OZONE	PAN	SO2	SO4	TNH4	TNO3
3		µg N/m^3	µg N/m^3	µg N/m^3	µg/m^3	µg N/m^3	µg S/m^3	µg N/m^3	µg N/m^3	µg N/m^3	µg/m^3	µg N/m^3	µg S/m^3	µg S/m^3	µg N/m^3	µg N/m^3
4		BIRKENES	FREDERIK	FREDERIK	FREDERIK	FREDERIK	FREDERIK	FREDERIK	FREDERIK	RÖRVIK	RÖRVIK	RÖRVIK	RÖRVIK	RÖRVIK	RÖRVIK	RÖRVIK
5																
6																
7																
8	890801	0,16		0,20	39		0,610	0,44		1,12			0,7	0,19	0,30	0,01
9	890802	0,18		3,19	29		0,553	0,35	0,11	1,43	34	0,082	1,0	0,17	0,46	0,06
10	890803	0,14		0,22	31		0,314	0,82	0,41	1,38	47	0,138	1,5	0,40	0,71	0,38
11	890804	0,02		0,30	57		0,071	0,58	0,11	0,98	58	0,073	1,2	0,22	0,28	0,08
12	890805	0,16		0,14	57	0,049	0,091	0,57	0,16	0,93	55		0,9	0,39	0,72	0,05
13	890806	0,18		5,93	55	0,102	0,403	1,82	1,03	1,12	57	0,114	1,4	0,51	0,92	0,34
14	890807	0,21		0,51	40	0,353	0,087	0,76		1,18	58	0,084	1,0	0,73		0,23
15	890808	1,22		0,44	33	0,158	0,531	2,68	0,94	1,29	42	0,250	0,9	1,32		0,58
16	890809	0,37		2,27	37	0,095	0,215	1,44	0,55	1,23	62	0,145	0,8	1,22		0,15
17	890810	0,35		4,01	47	0,420	2,277	5,47	2,64	2,52	48	0,328	2,5	1,94		0,82
18	890811	0,22		3,74	77	0,770	2,891	5,89	2,75	1,34	73	0,396	2,1	1,46		0,65
19	890812	0,23		1,53	60	0,197	0,330	1,40	0,60	0,80	64	0,180	1,3	0,68		0,24
20	890813	0,57		3,54		0,251	3,370	2,42	0,99	1,39	71	0,188	2,8	1,35		0,92
21	890814	0,49		3,79		0,313	3,771	3,13	1,43	1,54	60	0,312	2,4	1,04	0,55	0,58
22	890815	0,54		3,29		0,620	0,000	0,02		2,27	63		2,7	1,78	2,76	1,86
23	890816	0,91		4,02		0,263	0,000	0,09		1,43	66	0,269	2,3	0,82	1,29	0,64
24	890817	0,52		2,27		0,224	1,478	2,32	1,15	1,23	60	0,264	3,2	1,21	1,18	1,05
25	890818	0,32		1,95		0,271	1,815	1,40	0,86	0,76	73	0,171	1,9	0,60	0,55	0,38
26	890819	0,73		3,58	52	0,280	1,454	1,98	1,19	1,11	74	0,153	2,7	1,24	1,27	0,99
27	890820	1,55		4,77	73	0,454	11,527	6,98	3,33	1,83	92	0,588	7,3	5,23	3,38	2,38
28	890821	0,39		2,57	89	0,437	2,924	3,00	2,24	0,88	97		2,7	1,64	2,64	1,04
29	890822	0,44	2,21	2,21	44	0,449	1,546	2,21	1,59	0,85	65		2,1	0,86	1,47	0,75
30	890823	0,15	1,56	1,56	60	0,221	0,635	1,35	0,73	0,68			0,1	1,53	0,67	0,29
31	890824	0,14	1,03	1,02	57	0,152	0,323	0,74		0,62	65	0,071	1,4	0,26	0,60	0,04
32	890825		2,36	2,37	45	0,069	0,299	0,36	0,21	0,93	58	0,091	1,4	1,06	0,52	0,12
33	890826		1,60	1,63	24		0,227	0,60	0,31	0,93	45	0,113	1,0	1,21	0,81	0,05
34	890827	0,13	1,16	1,16	32	0,116	0,128	0,47	0,11	0,90	45		0,9	1,33	0,83	0,22
35	890828	0,13	1,20	1,19	49	0,081	0,106	0,55		1,87	47		1,4	0,36	0,75	0,04
36	890829	0,14	2,68	2,71	44	0,131	0,198	0,62	0,38	1,48	53	0,169	2,0	0,40	0,87	0,29
37	890830	0,14	4,08	4,11	44	0,401	1,725	1,49	1,07	1,46	62	0,277	2,0	0,68	1,15	0,78
38	890831	0,16	3,94		57	0,148	1,281	0,74	0,41	1,99	69	0,473	2,5	0,93	1,63	1,08
39																
40																

	A	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ
1	DATE	UT_NO2_K:	UT_OZONE	UT_PAN	UT_SO2	UT_SO4	UT_TNH4	UT_TNO3					
2		NO2-KI	OZONE	PAN	SO2	SO4	TNH4	TNO3					
3		µg N/m³	µg/m³	µg N/m³	µg S/m³	µg S/m³	µg N/m³	µg N/m³					
4		UTÖ	UTÖ	UTÖ	UTÖ	UTÖ	UTÖ	UTÖ					
5													
6													
7													
8	890801	0,28	73	0,058	0,140	0,340	0,28	0,24		AS_NO2_DO	=$B$2:$B$38	RV_TNH4	=$AD$2:$AD$38
9	890802	0,73	78	0,052	0,610	0,670	0,41	0,30		AS_NO2_KI	=$C$2:$C$38	RV_TNO3	=$AE$2:$AE$38
10	890803	0,94	89	0,150	0,340	0,880	0,86	0,20		AS_OZONE	=$D$2:$D$38	UT_NO2_KI	=$AF$2:$AF$38
11	890804	0,55	73	0,119	0,240	0,610	0,42	0,21		AS_PAN	=$E$2:$E$38	UT_OZONE	=$AG$2:$AG$38
12	890805	0,69	66	0,128	0,470	0,880	0,67	0,13		AS_SO2	=$F$2:$F$38	UT_PAN	=$AH$2:$AH$38
13	890806	2,30	63	0,098	0,380	0,380	0,37	0,18		AS_SO4	=$G$2:$G$38	UT_SO2	=$AI$2:$AI$38
14	890807	2,35		0,085	0,620	0,310	0,52	0,15		AS_TNH4	=$H$2:$H$38	UT_SO4	=$AJ$2:$AJ$38
15	890808	0,84		0,067						AS_TNO3	=$I$2:$I$38	UT_TNH4	=$AK$2:$AK$38
16	890809	0,92		0,144	1,330	1,240	0,25	0,32		BI_NO2	=$J$2:$J$38	UT_TNO3	=$AL$2:$AL$38
17	890810	0,83		0,112	0,370	0,930	0,30	0,21		BI_NO2_KI	=$K$2:$K$38		
18	890811	0,72		0,170	1,050	1,230	0,94	0,60		BI_OZONE	=$L$2:$L$38		
19	890812	0,55		0,293	0,460	1,560	1,29	0,81		BI_PAN	=$M$2:$M$38		
20	890813	0,97		0,084	0,250	0,350	0,72	0,24		BI_SO2	=$N$2:$N$38		
21	890814	1,10		0,108	0,760	0,810	0,92	0,40		BI_SO4	=$O$2:$O$38		
22	890815	1,13			1,200	1,500	1,76	0,69		BI_TNH4	=$P$2:$P$38		
23	890816	1,35			0,660	2,540	2,38	1,36		BI_TNO3	=$Q$2:$Q$38		
24	890817	0,96			0,520	1,990	2,15	0,71		DATE	=$A$2:$A$38		
25	890818	0,62			0,370	0,800	0,59	0,44		FB_NO2_KI	=$R$2:$R$38		
26	890819	0,85		0,079	0,180	0,610	0,54	0,39		FR_NO2	=$S$2:$S$38		
27	890820	1,13		0,225	0,980	1,950	1,15	0,91		FR_OZONE	=$T$2:$T$38		
28	890821	0,87		0,216	0,740	3,420	2,19	0,81		FR_PAN	=$U$2:$U$38		
29	890822	0,77		0,167	0,360	2,110	1,15	0,47		FR_SO2	=$V$2:$V$38		
30	890823	0,67		0,183	0,330	0,680	0,60	0,43		FR_TNH4	=$W$2:$W$38		
31	890824	0,41		0,052	0,260	0,180	0,08	0,08		FR_TNO3	=$X$2:$X$38		
32	890825	0,71	57	0,064	0,280	0,220	0,17	0,07		Print_Area	=$B$1:$AQ$40		
33	890826	0,50	52	0,053	0,470	0,320	0,23	0,07		Print_Titles	=$A:$A		
34	890827		63	0,059	0,310	0,540	0,40	0,08		RV_NO2_KI	=$Y$2:$Y$38		
35	890828		70	0,075	0,430	0,830	0,33	0,23		RV_OZONE	=$Z$2:$Z$38		
36	890829	0,64	67	0,068	0,390	0,210	0,17	0,12		RV_PAN	=$AA$2:$AA$38		
37	890830	0,78	75	0,112	0,820	0,180	0,56	0,27		RV_SO2	=$AB$2:$AB$38		
38	890831	0,54	75	0,152	0,960	0,770	0,48	0,45		RV_SO4	=$AC$2:$AC$38		
39													
40													

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	DATE	AS_NO2_D(	AS_NO2_K:	AS_OZONE	AS_PAN	AS_SO2	AS_SO4	AS_TNH4	AS_TNO3	BI_NO2	BI_NO2_K:	BI_OZONE	BI_PAN	BI_SO2	BI_SO4	BI_TNH4
2		NO2-DO	NO2-KI	OZONE	PAN	SO2	SO4	TNH4	TNO3	NO2	NO2-KI	OZONE	PAN	SO2	SO4	TNH4
3		µg N/m³	µg N/m³	µg/m³	µg N/m³	µg S/m³	µg S/m³	µg N/m³	µg N/m³	µg N/m³	µg N/m³	µg/m³	µg N/m³	µg S/m³	µg S/m³	µg N/m³
4		ASPVRETEI	ASPVRETEI	ASPVRETEI	ASPVRETEI	ASPVRETEI	ASPVRETEI	ASPVRETEI	ASPVRETEI	BIRKENES	BIRKENES	BIRKENES	BIRKENES	BIRKENES	BIRKENES	BIRKENES
5																
6																
7																
8	890901	0,76	0,49	75	0,163	0,889	0,674	0,60	0,40	1,02	0,61	42	0,033	0,065		
9	890902	0,56	0,42	47	0,085	0,379	0,287	0,29		0,80	0,47	35	0,027	0,051		
10	890903	0,62	0,50	47	0,091	0,217	0,322	0,27		0,99	0,65	31	0,060	0,176	0,090	0,20
11	890904	0,59	0,46	51	0,049	0,732	0,111	0,19	0,16	0,96	0,50	35	0,054	0,154	0,368	0,44
12	890905	0,93	0,70	60	0,124	0,376	0,724	0,70	0,43	0,43	0,22	53	0,083	0,100	0,828	0,29
13	890906	0,94	0,67	50	0,098	0,211	0,556	0,51	0,38	0,89	0,38	46	0,048	0,045	0,195	0,17
14	890907	0,74	0,60	62	0,080	0,142	0,191	0,21	0,18	0,87	0,74	42		0,073	0,196	0,16
15	890908	1,63	1,07	32	0,070	0,156	0,332	0,29	0,41	1,18	0,63	31		0,082	0,121	0,15
16	890909	1,80	1,08	31	0,079	0,072	0,117	0,20	0,14	1,02	0,65	31		0,091	0,098	0,13
17	890910	1,37	0,91	53	0,057	0,146	0,057	0,15	0,11	0,76	0,62	40		0,154	0,054	0,18
18	890911	0,78	0,61	45		0,096	0,062	0,10	0,11	0,82	0,66	32		0,133	0,058	0,15
19	890912	1,04	0,67	48		0,170	0,150	0,24	0,14	0,90	0,51	33		0,167	0,057	0,31
20	890913	0,76	0,52	72	0,161	0,467	0,285	0,36	0,22	1,18	0,82	46		0,452	0,649	0,75
21	890914		0,70	79	0,287	2,889	2,620	2,75	1,22	0,98	0,67	52		0,255	0,856	0,65
22	890915	1,44	0,90			0,366	0,658	0,73	0,33	0,72	0,40	53		0,068	0,068	0,10
23	890916	0,61	0,44			0,366	0,787	0,67	0,26	0,42	0,36	33		0,158	0,237	0,11
24	890917	0,77	0,36			0,507	0,496	0,38	0,29	0,42	0,34	29		0,121	0,193	0,09
25	890918	0,71	0,47	49		0,175	0,685	0,49	0,43	1,94	1,90	29	0,066	0,399	1,219	1,63
26	890919		0,46	81		1,361	2,836	2,75	0,89	1,25	1,19	46	0,165	0,518	1,300	1,47
27	890920		0,70	77		1,629	0,946	1,00	0,90	2,04	1,70	54	0,204	1,152	1,060	1,16
28	890921	0,85		60	0,184	0,926	1,738	1,82	0,64	1,38	1,50	55	0,311	0,979	1,649	1,08
29	890922	0,91		64	0,161	1,171	1,682	1,86	0,89	1,21	0,92	29	0,119	0,922	4,067	3,03
30	890923	0,46		81	0,206	0,603	3,517	2,47	0,64	1,74	1,59	35	0,238	1,328	2,905	2,28
31	890924	0,97		51	0,134	0,310	2,305	2,16	0,47	0,84	0,55	48	0,104	0,110	0,416	0,54
32	890925	0,79	0,58	51	0,087	0,414	0,792	0,90	0,42	0,94	0,63	48	0,152	0,963	0,827	0,72
33	890926	0,63	0,43	52	0,109	0,414	1,685	1,26	0,32	0,72	0,51	31	0,029	0,159	0,038	0,20
34	890927	0,97	0,76	60	0,168	0,856	4,819	4,71	0,83	0,42	0,57	27	0,035	0,041	0,096	0,23
35	890928	1,62	0,93	33	0,065	0,097	0,336	0,23	0,32	0,42	0,31	43	0,075	0,020	0,065	0,16
36	890929	1,30	0,87	49	0,069	0,120	0,153	0,15	0,19	0,73	0,23	48	0,055	0,021	0,084	0,05
37	890930		0,39	67	0,068	0,032	0,130	0,37	0,00	0,42	0,37	46	0,027	0,030	0,052	0,11
38																
39																
40																

EM_09.XLS Page 2 11.9.92 12:27

	A	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE
1	DATE	BI_TNO3	FB_NO2_K:	FR_NO2	FR_OZONE	FR_PAN	FR_SO2	FR_TNH4	FR_TNO3	RV_NO2_K:	RV_OZONE	RV_PAN	RV_SO2	RV_SO4	RV_TNH4	RV_TNO3
2		TNO3	NO2-KI	NO2	OZONE	PAN	SO2	TNH4	TNO3	NO2-KI	OZONE	PAN	SO2	SO4	TNH4	TNO3
3		µg N/m³	µg N/m³	µg N/m³	µg/m³	µg N/m³	µg S/m³	µg N/m³	µg N/m³	µg N/m³	µg/m³	µg N/m³	µg S/m³	µg S/m³	µg N/m³	µg N/m³
4		BIRKENES	FREDERIK:	FREDERIK:	FREDERIK:	FREDERIK:	FREDERIK:	FREDERIK:	FREDERIK:	RÖRVIK	RÖRVIK	RÖRVIK	RÖRVIK	RÖRVIK	RÖRVIK	RÖRVIK
5																
6																
7																
8	890901		5,16	5,54	35	0,133	0,000			0,77	59	0,218	2,2	0,35	0,62	0,39
9	890902		2,80	2,93	27		0,194	0,61	0,24	1,00	51	0,087	1,2	0,34	0,17	0,11
10	890903	0,05	2,06	2,06	25		0,119	0,49	0,28	1,24	33		1,9	0,39	0,14	0,33
11	890904	0,18	2,65	2,67	24		0,451	0,79	0,52	1,26	52	0,201	1,9	0,41	0,20	0,34
12	890905	0,20	2,73	2,74	19	0,177	0,913	1,83	0,66	0,70	66	0,153	1,6	0,80	0,93	0,52
13	890906	0,06	2,45	2,44		0,255	1,191	2,43	1,05	0,90	56	0,189	1,5	0,80	1,00	0,55
14	890907	0,11	2,35	2,37		0,100	0,385	0,73	0,48	0,83			1,3	0,40	0,51	0,29
15	890908	0,02	4,37	4,34	17	0,136	0,709	0,96	0,76	1,42			1,3	0,54	0,67	0,55
16	890909	0,09	1,59	1,61	38	0,144	0,386	0,93	0,31	0,67	41		0,9	0,43	0,55	0,15
17	890910	0,02	1,66	1,66	48	0,144	0,589	0,63	0,16	0,90	49		0,7	0,18	0,14	0,01
18	890911	0,02	1,95	1,95	45	0,119	0,224	0,51	0,19	1,81	52		1,2	0,16	0,20	0,13
19	890912	0,05	2,79	2,81	29		0,487	0,68	0,36	1,47	43		1,4	0,34	0,33	0,13
20	890913	0,34	3,53	3,52	41	0,338	3,500	2,68	1,07	0,67	52		1,5	0,79	0,78	0,21
21	890914	0,10	3,57	3,53	49	0,282	1,379	2,58	0,78	0,74	69		1,8	1,55	1,80	0,29
22	890915	0,02	2,53	2,52	47		0,754	1,76	0,82	0,53	74		0,8	0,39	0,32	0,17
23	890916	0,08	2,97	2,97			0,761	1,17	0,68	0,75	71	0,172	1,1	0,65	0,40	0,16
24	890917	0,09	2,61	2,60			1,174	1,40	0,48	0,77	59	0,066	0,8	0,44	0,34	0,10
25	890918	0,90	7,79	7,74			2,625	4,68	2,63	2,10	59	0,160	2,3	1,76	1,20	0,87
26	890919	0,81	4,73	4,68		0,302	6,273	4,62	1,93	1,84		0,744	7,4	2,93	1,33	1,43
27	890920	1,42	4,09	4,10		0,148	2,484	3,01	1,92	3,55	71	0,304	4,8	1,52	1,85	1,17
28	890921	0,68	6,80	6,71		0,264	11,851	5,47	2,42	2,53	64	0,564	7,0	3,81	1,90	1,99
29	890922	0,48	5,36	5,32		0,331	8,559	9,75	3,36	1,38	64	0,543	6,0	6,44	6,45	0,92
30	890923	0,38	3,34	3,30		0,228	1,655	8,21	2,97	1,25	53	0,393	2,0	4,03	0,00	1,69
31	890924	0,11	2,86	2,89		0,119	0,180	2,17	0,79	0,90	67	0,208	1,2	0,58	3,90	0,37
32	890925	0,20	4,41	4,40		0,172	2,284	3,46	1,62	0,74	64	0,185	1,8	0,90	0,00	0,35
33	890926	0,06	2,38	2,39			0,084	0,36	0,18	1,64	53	0,063	0,9	0,24	0,00	0,32
34	890927	0,07	3,19	3,20			0,296	0,85	0,39	1,03	38	0,142	1,2	0,33	0,00	0,14
35	890928	0,04	1,58	1,59		0,090	0,286	0,39	0,19	1,52	69	0,080	1,1	0,19	0,00	0,08
36	890929	0,05	2,34	2,35	31	0,112	0,182	0,42	0,24	1,27	38	0,074	2,7	0,30	0,00	0,14
37	890930	0,02	1,66	1,67	36		0,206	0,41	0,12	1,25	54	0,045	1,4	0,19		0,00
38																
39																
40																

	A	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ
1	DATE	UT_NO2_K	UT_OZONE	UT_PAN	UT_SO2	UT_SO4	UT_TNH4	UT_TNO3					
2		NO2-KI	OZONE	PAN	SO2	SO4	TNH4	TNO3					
3		µg N/m^3	µg/m^3	µg N/m^3	µg S/m^3	µg S/m^3	µg N/m^3	µg N/m^3					
4		UTÖ	UTÖ	UTÖ	UTÖ	UTÖ	UTÖ	UTÖ					
5													
6													
7													
8	890901	0,32	78		1,130	1,130	0,69	0,55		AS_NO2_DO	=$B$2:$B$38	RV_TNH4	=$AD$2:$AD$38
9	890902	0,80	84		0,560	0,810	0,51	0,43		AS_NO2_KI	=$C$2:$C$38	RV_TNO3	=$AE$2:$AE$38
10	890903	0,72	62		0,300	0,190	0,30	0,18		AS_OZONE	=$D$2:$D$38	UT_NO2_KI	=$AF$2:$AF$38
11	890904	0,92	63		0,190	0,090	0,10	0,05		AS_PAN	=$E$2:$E$38	UT_OZONE	=$AG$2:$AG$38
12	890905	0,47	70	0,061	0,310	0,520	0,49	0,35		AS_SO2	=$F$2:$F$38	UT_PAN	=$AH$2:$AH$38
13	890906	0,77	62	0,104	0,230	0,580	0,40	0,37		AS_SO4	=$G$2:$G$38	UT_SO2	=$AI$2:$AI$38
14	890907	0,70	68	0,088	0,240	0,230	0,30	0,30		AS_TNH4	=$H$2:$H$38	UT_SO4	=$AJ$2:$AJ$38
15	890908	1,10	64	0,091	0,290	0,200	0,22	0,30		AS_TNO3	=$I$2:$I$38	UT_TNH4	=$AK$2:$AK$38
16	890909	1,16	71	0,139	0,650	0,340	0,50	0,47		BI_NO2	=$J$2:$J$38	UT_TNO3	=$AL$2:$AL$38
17	890910	0,44	58		0,740	0,200	0,31	0,16		BI_NO2_KI	=$K$2:$K$38		
18	890911	0,63	67		0,400	0,140	0,18	0,10		BI_OZONE	=$L$2:$L$38		
19	890912	1,54	61		0,280	0,200	0,22	0,15		BI_PAN	=$M$2:$M$38		
20	890913	1,26	63		0,310	0,340	0,31	0,32		BI_SO2	=$N$2:$N$38		
21	890914	0,44	89		0,960	1,300	1,16	0,75		BI_SO4	=$O$2:$O$38		
22	890915	0,47	86		0,290	1,880	0,99	0,31		BI_TNH4	=$P$2:$P$38		
23	890916	0,28	76		0,410	1,130	0,56	0,27		BI_TNO3	=$Q$2:$Q$38		
24	890917	0,58	82		0,120	0,670	0,60	0,31		DATE	=$A$2:$A$38		
25	890918	0,57	70		0,180	0,510	0,40	0,41		FB_NO2_KI	=$R$2:$R$38		
26	890919	0,61	70		0,440	2,030	1,73	0,66		FR_NO2	=$S$2:$S$38		
27	890920	0,92	81	0,142	0,500	1,130	0,76	1,00		FR_OZONE	=$T$2:$T$38		
28	890921	0,94	87	0,203	0,530	1,510	1,83	1,03		FR_PAN	=$U$2:$U$38		
29	890922	1,50	76	0,161	0,610	1,760	1,57	0,83		FR_SO2	=$V$2:$V$38		
30	890923	1,15	80	0,234	0,420	2,250	1,69	0,86		FR_TNH4	=$W$2:$W$38		
31	890924	0,67	82	0,198	0,430	3,340	1,52	0,48		FR_TNO3	=$X$2:$X$38		
32	890925	1,03	66	0,122	0,290	1,450	0,78	0,51		Print_Area	=$B$1:$AQ$40		
33	890926	0,75	78	0,103	0,240	1,410	0,99	0,49		Print_Titles	=$A:$A		
34	890927	0,71	77	0,198	1,030	9,540	4,40	2,25		RV_NO2_KI	=$Y$2:$Y$38		
35	890928	1,23	77	0,202	0,860	2,900	2,08	0,72		RV_OZONE	=$Z$2:$Z$38		
36	890929	0,55	72	0,052	0,100	0,160	0,03	0,09		RV_PAN	=$AA$2:$AA$38		
37	890930	0,86	69	0,030	0,180	0,100	0,05	0,04		RV_SO2	=$AB$2:$AB$38		
38										RV_SO4	=$AC$2:$AC$38		
39													
40													

EM_10.XLS Page 1 11.9.92 12:37

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	DATE	AS_NO2_D	AS_NO2_K	AS_OZONE	AS_PAN	AS_SO2	AS_SO4	AS_TNH4	AS_TNO3	BI_NO2	BI_NO2_K	BI_OZONE	BI_PAN	BI_SO2	BI_SO4	BI_TNH4
2		NO2-DO	NO2-KI	OZONE	PAN	SO2	SO4	TNH4	TNO3	NO2	NO2-KI	OZONE	PAN	SO2	SO4	TNH4
3		µg N/m³	µg N/m³	µg/m³	µg N/m³	µg S/m3	µg S/m3	µg N/m3	µg N/m3	µg N/m3	µg N/m³	µg/m³	µg N/m³	µg S/m3	µg S/m3	µg N/m3
4		ASPVRETE	ASPVRETE	ASPVRETE	ASPVRETE	ASPVRETE	ASPVRETE	ASPVRETE	ASPVRETE	BIRKENES	BIRKENES	BIRKENES	BIRKENES	BIRKENES	BIRKENES	BIRKENES
5																
6																
7																
8	891001	1,46	0,86	56	0,080	0,162	0,233	0,38	0,20	0,40	0,18	48	0,037	0,032	0,155	0,13
9	891002	0,35	0,37	64	0,056	0,000	0,019	0,15	0,02	0,42	0,29	63	0,056	0,019	0,093	0,08
10	891003	1,00	0,67	63	0,052	0,071	0,030	0,09	0,00	0,41	0,49	44	0,038	0,100	0,020	0,11
11	891004	1,70	0,87	46	0,055	0,091	0,106	0,24	0,00	1,64	1,21	31	0,080	0,293	0,138	0,15
12	891005	0,60	0,56	39	0,051	0,036	0,112	0,17	0,00	1,47	1,03	29	0,066	0,333	0,793	0,71
13	891006	0,32	0,45	57	0,104	0,808	0,223	0,68	0,59	1,42	1,07	27	0,117	0,387	0,457	0,64
14	891007	0,83	0,58	72	0,106	0,615	0,347	0,32	0,28	0,70	0,76	49	0,130	0,245	0,311	0,28
15	891008	1,57	0,90	52	0,112	0,589	0,857	0,41	0,00	0,80	0,77	44	0,079	0,402	0,382	0,28
16	891009		1,16	48	0,111	0,766	1,057	0,96	0,26	0,39	0,39	32	0,028	0,038	0,090	0,11
17	891010		1,27	39	0,135	0,640	0,775	0,70	0,21	0,40	0,59	37	0,030	0,134	0,039	0,09
18	891011	1,10	0,70	48	0,069	0,142	0,150	0,14	0,09	0,40	0,37	46	0,059	0,036	0,063	0,12
19	891012	0,79	0,55	66	0,064	0,320	0,144	0,19	0,14	0,93	0,76	34	0,030	0,157	0,134	0,13
20	891013	1,14	0,74	56	0,069	0,340	0,223	0,20	0,18	0,43	0,31	38	0,041	0,028	0,075	0,08
21	891014		0,61	46	0,050	0,277	0,187	0,23	0,12	0,43	0,34	38	0,027	0,025	0,059	0,11
22	891015		0,89	46	0,051	0,128	0,085	0,13	0,06	0,42	0,38	44	0,056	0,060	0,126	0,06
23	891016		1,25	43	0,053	0,330	0,461	0,35	0,19	0,74	0,69	32	0,018	0,068	0,145	0,07
24	891017		0,86	22	0,040	0,102	0,395	0,39	0,24	0,67	0,66	23	0,013	0,036	0,201	0,22
25	891018	1,07	0,41	30	0,038	0,064	0,590	0,49	0,37	1,25	1,15	18	0,011	0,205	0,945	1,84
26	891019		1,00	43	0,114	6,192	5,047	2,73	0,80	5,67	4,52	28	0,316	1,345	2,138	3,72
27	891020		1,15		0,384	8,549	7,609	6,63	2,90	4,33	2,81	40	0,276	0,678	1,452	2,39
28	891021		0,37		0,118	0,942	0,630	0,53	0,67	1,31	0,76	46	0,041	0,276	0,336	0,31
29	891022		0,96		0,074	1,157	0,670	0,55	0,69	1,27	0,73	50	0,055	0,695	0,393	0,20
30	891023		0,83		0,072	1,742	0,616	0,55	0,54	1,20	0,73	51	0,052	0,309	0,438	0,26
31	891024		0,62		0,056	0,494	0,353	0,27	0,22	0,88	0,43	54	0,032	0,069	0,177	0,12
32	891025	0,94	0,54			0,386		0,39	0,22	0,72	0,38	64	0,093	0,104	0,491	0,18
33	891026	1,04	0,52			0,253	0,245	0,21	0,14	0,40	0,34		0,053	0,021	0,069	0,07
34	891027	1,43	0,83				0,106	0,10		0,94	0,78		0,020	0,279	0,164	0,15
35	891028	1,04	0,57			1,299	1,159	1,00	0,72	1,43	1,25	39	0,059	0,523	0,464	0,33
36	891029	1,21	0,60			2,377	2,825	2,31	1,14	1,42	1,11	39	0,097	0,381	0,743	1,02
37	891030	2,50	1,25			0,669	1,378	1,28	0,57	0,42	0,56	39	0,068	0,140	0,244	0,21
38	891031	2,49	1,44			0,562	1,763	0,79	0,24	0,65	0,72	9	0,019	0,241	0,253	0,32
39																
40																

	A	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE
1	DATE	BI_TNO3	FB_NO2_K	FR_NO2	FR_OZONE	FR_PAN	FR_SO2	FR_TNH4	FR_TNO3	RV_NO2_K	RV_OZONE	RV_PAN	RV_SO2	RV_SO4	RV_TNH4	RV_TNO3
2		TNO3	NO2-KI	NO2	OZONE	PAN	SO2	TNH4	TNO3	NO2-KI	OZONE	PAN	SO2	SO4	TNH4	TNO3
3		µg N/m3	µg N/m³	µg N/m3	µg/m³	µg N/m³	µg S/m3	µg N/m3	µg N/m3	µg N/m³	µg/m³	µg N/m³	µg S/m3	µg S/m3	µg N/m3	µg N/m3
4		BIRKENES	FREDERIKS	FREDERIKS	FREDERIKS	FREDERIKS	FREDERIKS	FREDERIKS	FREDERIKS	RÖRVIK	RÖRVIK	RÖRVIK	RÖRVIK	RÖRVIK	RÖRVIK	RÖRVIK
5																
6																
7																
8	891001	0,04	1,49	1,47	40		0,371	0,67	0,18	0,47	60	0,076	1,2	0,38	0,05	0,16
9	891002	0,02	0,73	0,73	72	0,096	0,189	0,48	0,09	0,95	70	0,056	0,8	0,20	0,31	0,05
10	891003	0,02	2,07	2,09	69		0,095	0,30	0,15	2,03	60	0,064	1,3	0,13	0,23	0,07
11	891004	0,09	2,59	2,57			0,225	0,89	0,31	0,85	34		0,9	0,36	0,51	0,30
12	891005	0,41	5,34	5,39			2,912	3,52	1,35	1,81	58	0,043	1,4	0,87	1,23	0,61
13	891006	0,33					6,139	4,23	1,92	2,35	43	0,364	6,4	2,09	2,38	1,27
14	891007	0,08	1,93	1,92			0,250	0,83	0,27	0,91	38	0,085	1,8	0,52	0,55	0,24
15	891008	0,06	2,31	2,32			0,302	1,08	0,26	1,54	44	0,091	0,9	0,70	0,51	0,12
16	891009	0,02	3,82	3,82			0,538	1,74	0,75	1,80	36	0,120	1,0	1,09	0,54	0,28
17	891010	0,02	2,20	2,21			0,418	1,02	0,32	1,19	39	0,119	0,9	0,55	0,09	0,10
18	891011	0,02	1,46	1,47			0,105	0,39	0,13	3,33	44	0,070	1,0	0,28	0,00	0,07
19	891012	0,05	3,29	3,27	45		0,683	0,87	0,38	1,21	44	0,060	1,1	0,46	0,20	0,08
20	891013	0,02			43		0,501	0,71	0,31	0,81	60	0,080	1,4	0,41	0,45	0,18
21	891014	0,02	2,14	2,14	44		0,398	0,63	0,24	1,42	59	0,059	0,9	0,24	0,27	0,09
22	891015	0,02	2,00	2,01	27		0,387	0,48	0,21	0,86	41	0,057	1,3	0,28	0,35	0,09
23	891016	0,02	4,73	4,82	28		1,666	1,96	0,93	1,92	47	0,051	1,1	0,70	0,46	0,23
24	891017	0,02	2,93	4,00	35	0,128	1,340	3,41	1,42	2,17	48	0,060	1,1	1,11	1,53	0,09
25	891018	0,97	4,71	2,45	32		10,470	5,94	2,82	1,98	39	0,099	2,2	2,41	2,54	1,65
26	891019	2,24	11,73	11,73	28		16,129	13,88		7,91	38	0,417	10,5	7,15	10,21	8,10
27	891020	1,35	6,77	6,70			7,823	6,01		3,28	35	0,485	5,4	2,91	3,94	1,89
28	891021	0,18	3,06	3,03			1,478	1,89	0,76	1,74	48	0,071	2,1	0,73	0,66	0,62
29	891022	0,26	3,39	3,03			1,286	2,21	0,77	1,46	52	0,105	1,6	0,69	0,87	0,73
30	891023	0,23	5,04	5,05			2,080	2,13	1,15	2,03	53	0,098	2,5	0,58	1,03	0,90
31	891024	0,15					1,853	1,24	0,73	1,03	59	0,061	1,9	0,61	0,42	0,33
32	891025	0,14		3,82			2,059	2,68	1,29	0,70	57	0,107	1,5	1,04	0,49	0,57
33	891026	0,02		2,03			0,594	0,65	0,33	0,57	62	0,083	1,2	0,46	0,32	
34	891027	0,14		3,27			2,215	1,09	0,77	1,60	49	0,040	2,4	0,34	0,42	0,45
35	891028	0,04		7,32			8,498	7,37	4,32	3,37	34	0,313	8,0	3,36	5,09	1,74
36	891029	0,51		4,03			1,273	1,69	1,01	1,98	35	0,177	2,4	0,80	0,97	1,19
37	891030	0,02		0,06			0,502	1,69	0,74	1,97		0,045	1,5	0,80	0,76	0,11
38	891031	0,05								3,94		0,060	1,6	0,73	0,63	0,15
39																
40																

	A	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ
1	DATE	UT_NO2_K:	UT_OZONE	UT_PAN	UT_SO2	UT_SO4	UT_TNH4	UT_TNO3					
2		NO2-KI	OZONE	PAN	SO2	SO4	TNH4	TNO3					
3		µg N/m³	µg/m³	µg N/m³	µg S/m3	µg S/m3	µg N/m3	µg N/m3					
4		UTÖ	UTÖ	UTÖ	UTÖ	UTÖ	UTÖ	UTÖ					
5													
6													
7													
8	891001	0,98	69	0,036	0,200	0,180	0,08	0,09		AS_NO2_DO	=$B$2:$B$38	RV_TNH4	=$AD$2:$AD$38
9	891002	0,41	69	0,032	0,330	0,180	0,18	0,05		AS_NO2_KI	=$C$2:$C$38	RV_TNO3	=$AE$2:$AE$38
10	891003	0,85	65		0,290	0,210	0,04	0,07		AS_OZONE	=$D$2:$D$38	UT_NO2_KI	=$AF$2:$AF$38
11	891004	1,66	59		0,260	0,080	0,11	0,06		AS_PAN	=$E$2:$E$38	UT_OZONE	=$AG$2:$AG$38
12	891005	1,13	60	0,045	1,470	0,340	0,31	0,32		AS_SO2	=$F$2:$F$38	UT_PAN	=$AH$2:$AH$38
13	891006	0,76	68	0,047	1,150	0,250	0,04	0,19		AS_SO4	=$G$2:$G$38	UT_SO2	=$AI$2:$AI$38
14	891007	0,78	62	0,056	0,200	0,380	0,12	0,14		AS_TNH4	=$H$2:$H$38	UT_SO4	=$AJ$2:$AJ$38
15	891008	0,57	52	0,083	0,570	0,740	0,29	0,16		AS_TNO3	=$I$2:$I$38	UT_TNH4	=$AK$2:$AK$38
16	891009	0,47	52	0,127	1,060	1,000	0,71	0,28		BI_NO2	=$J$2:$J$38	UT_TNO3	=$AL$2:$AL$38
17	891010	0,80	47	0,177	0,910	1,200	1,46	0,27		BI_NO2_KI	=$K$2:$K$38		
18	891011	1,20	39	0,137	1,290	2,560	0,47	0,62		BI_OZONE	=$L$2:$L$38		
19	891012	0,37	77	0,037	0,120	0,160	0,08	0,13		BI_PAN	=$M$2:$M$38		
20	891013	1,27	55	0,042	0,170	0,220	0,22	0,26		BI_SO2	=$N$2:$N$38		
21	891014	1,09	58	0,013	0,160	0,220	0,24	0,26		BI_SO4	=$O$2:$O$38		
22	891015	0,75	64	0,040	0,200	0,100	0,31	0,06		BI_TNH4	=$P$2:$P$38		
23	891016	0,58	66	0,043	0,170	0,200	0,11	0,11		BI_TNO3	=$Q$2:$Q$38		
24	891017	1,29	59	0,046	0,450	0,330	0,41	0,34		DATE	=$A$2:$A$38		
25	891018	0,80	56	0,067	0,180	0,430	0,16	0,44		FB_NO2_KI	=$R$2:$R$38		
26	891019	0,49	59	0,061	7,030	0,840	1,36	0,68		FR_NO2	=$S$2:$S$38		
27	891020	0,88	53	0,249	5,740	9,040	3,48	3,18		FR_OZONE	=$T$2:$T$38		
28	891021	1,00	54	0,154	0,800	1,510	1,25	0,96		FR_PAN	=$U$2:$U$38		
29	891022	0,69	70	0,046	0,440	0,650	0,47	0,44		FR_SO2	=$V$2:$V$38		
30	891023	0,95	67	0,053	0,360	0,580	0,41	0,40		FR_TNH4	=$W$2:$W$38		
31	891024	1,03	54	0,036	0,380	0,620	0,77	0,43		FR_TNO3	=$X$2:$X$38		
32	891025	0,76	64	0,036	0,240	0,550	0,69	0,23		Print_Area	=$B$1:$AQ$40		
33	891026	0,93	67	0,047	0,220	0,450	0,18	0,27		Print_Titles	=$A:$A		
34	891027	0,38	69	0,021	0,220	0,130	0,32	0,22		RV_NO2_KI	=$Y$2:$Y$38		
35	891028	1,00	63	0,027	0,460	0,260	0,05	0,25		RV_OZONE	=$Z$2:$Z$38		
36	891029	0,88	47	0,036	0,830	1,050	0,25	0,49		RV_PAN	=$AA$2:$AA$38		
37	891030	1,63	27	0,039	0,440	0,920	0,66	0,24		RV_SO2	=$AB$2:$AB$38		
38	891031	2,90	20	0,042	0,230	2,070	0,99	0,55		RV_SO4	=$AC$2:$AC$38		
39													
40													

APPENDIX II

Overview plots of chemical parameters

Fig. AII.1: SO_2
Fig. AII.2: SO_4
Fig. AII.3: NO_2
Fig. AII.4: Total NO_3
Fig. AII.5: Total NH_4
Fig. AII.6: Ozone
Fig. AII.7: PAN

The plots for total NO_3 and PAN are also given as figures 4.1 and 4.2 in the report.

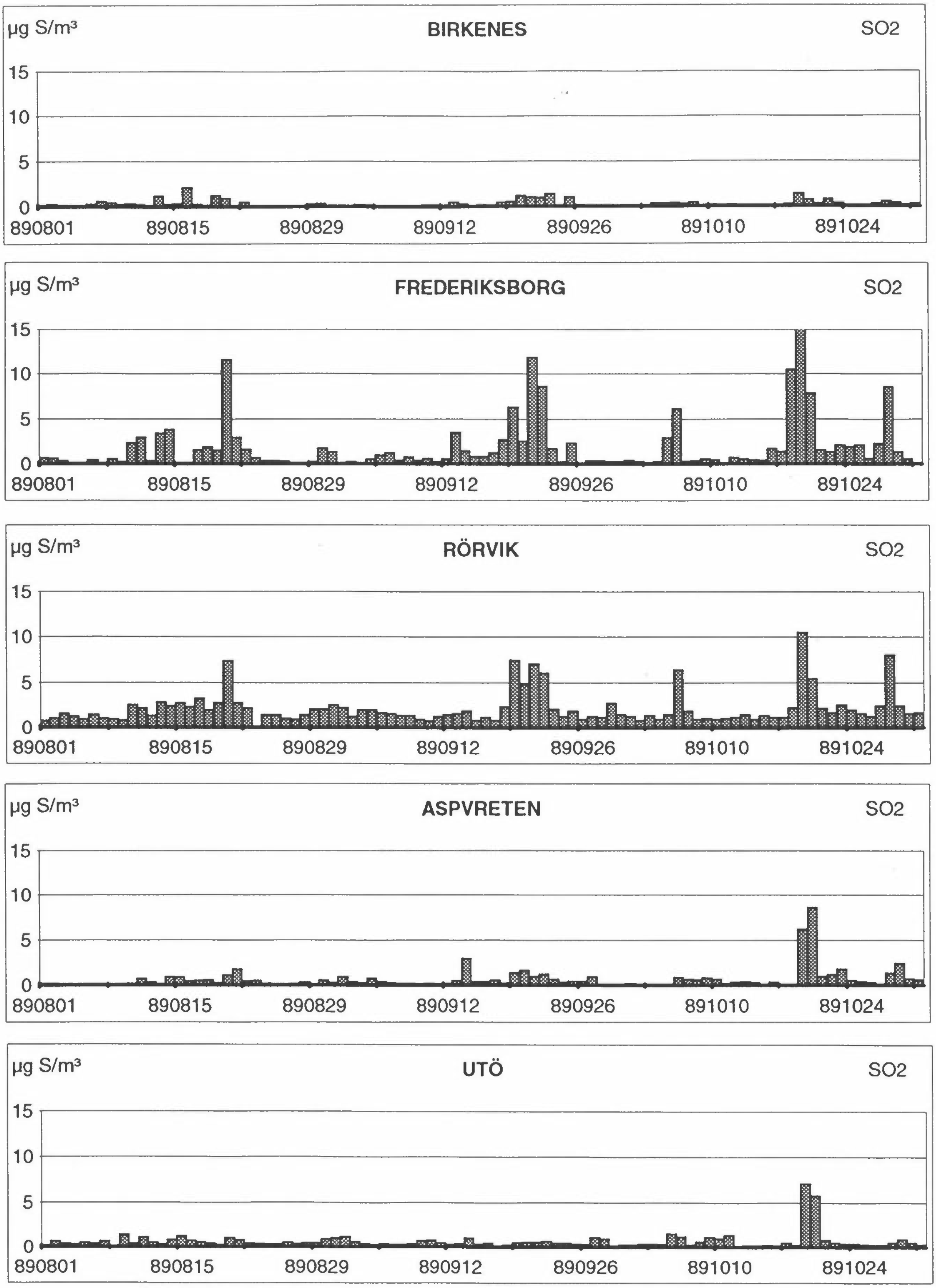
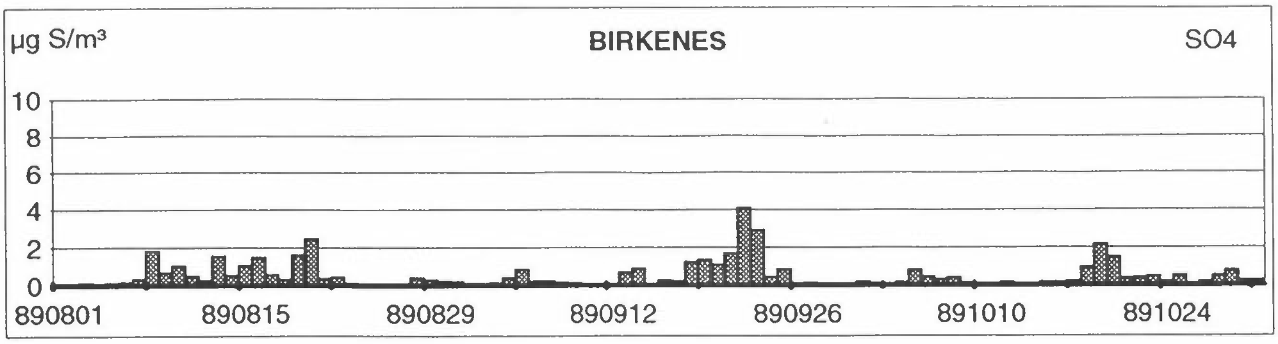


Fig. AII.1: Overview plots for SO_2



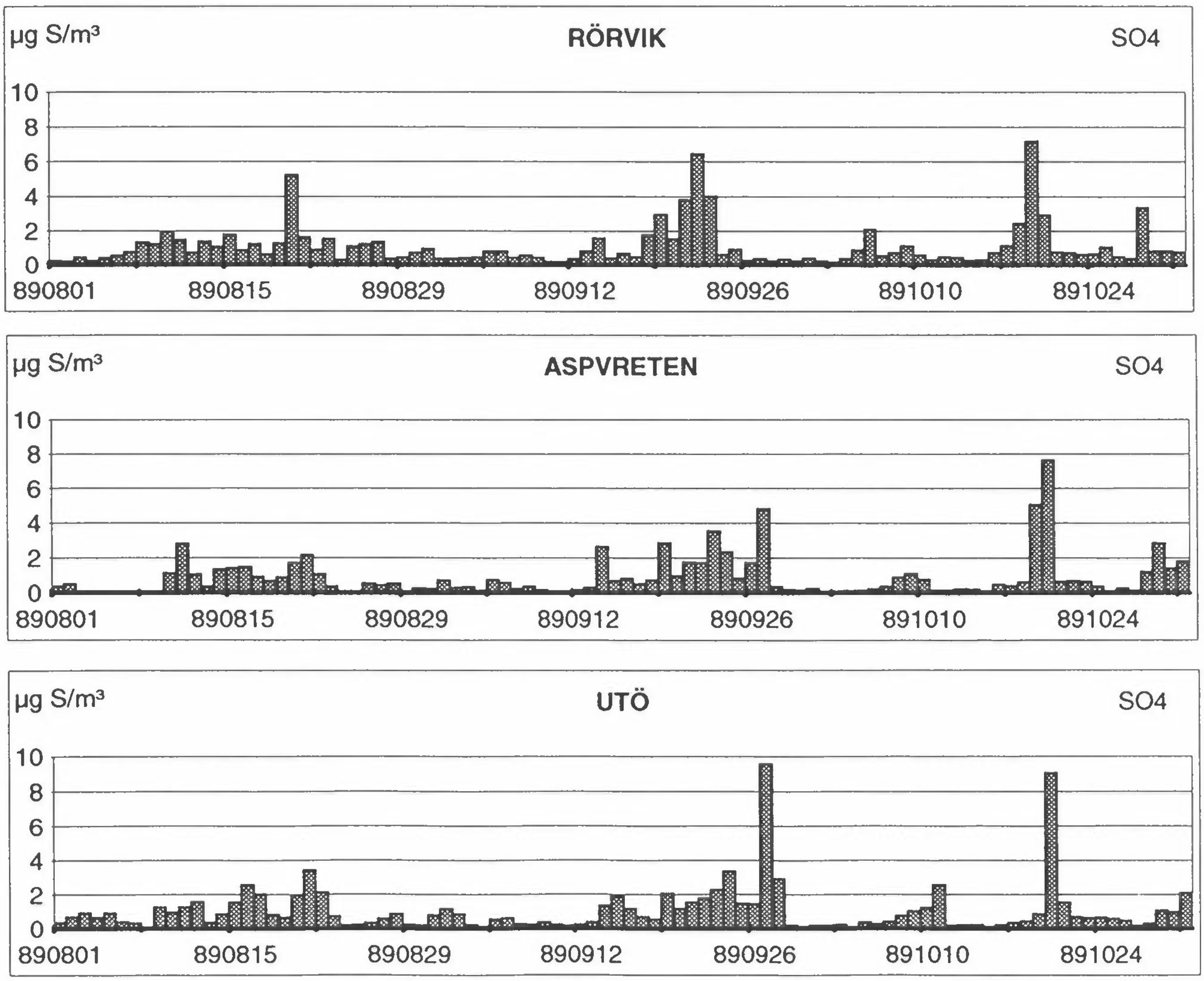


Fig. AII.2: Overview plots for SO_4.

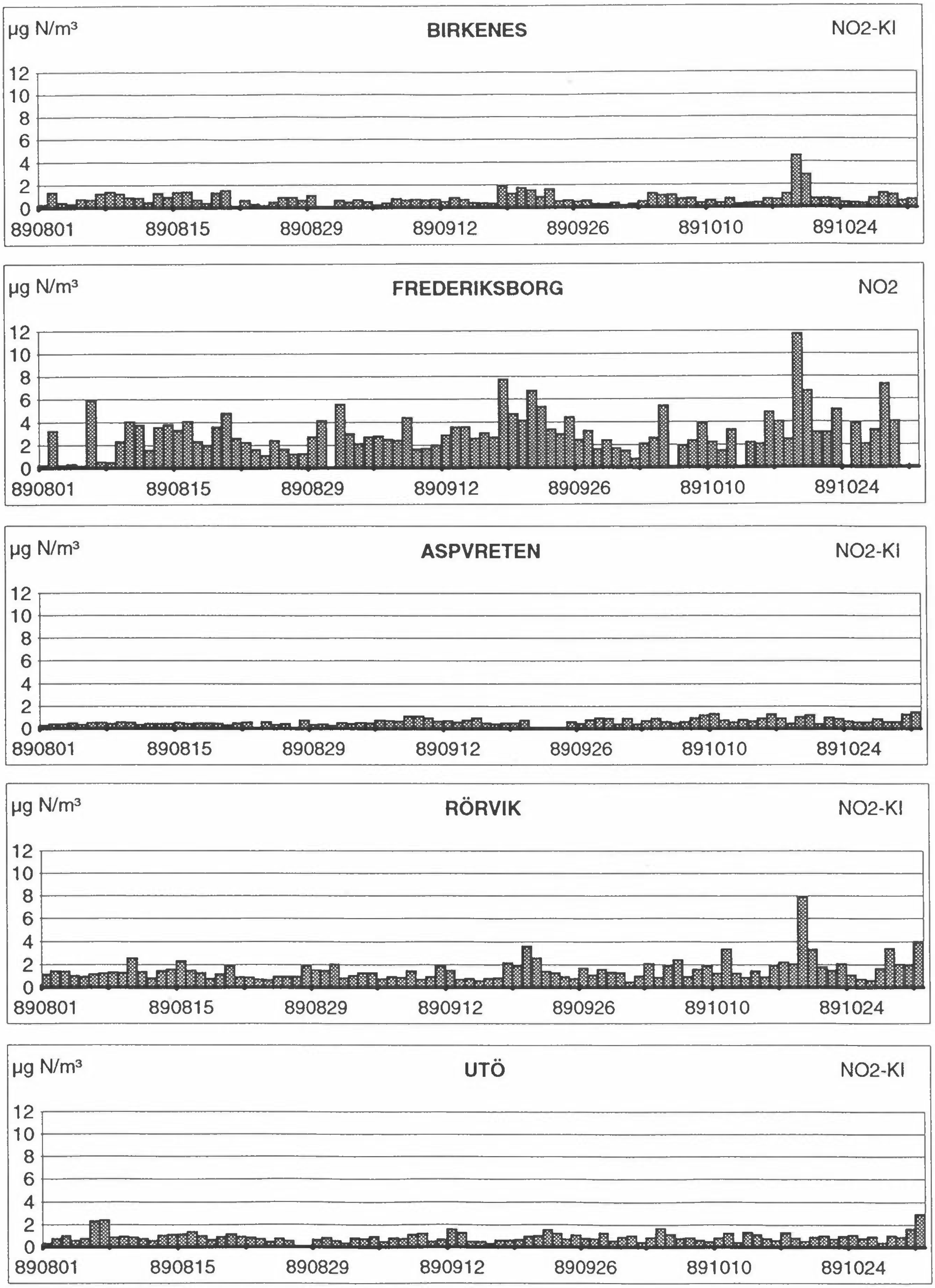
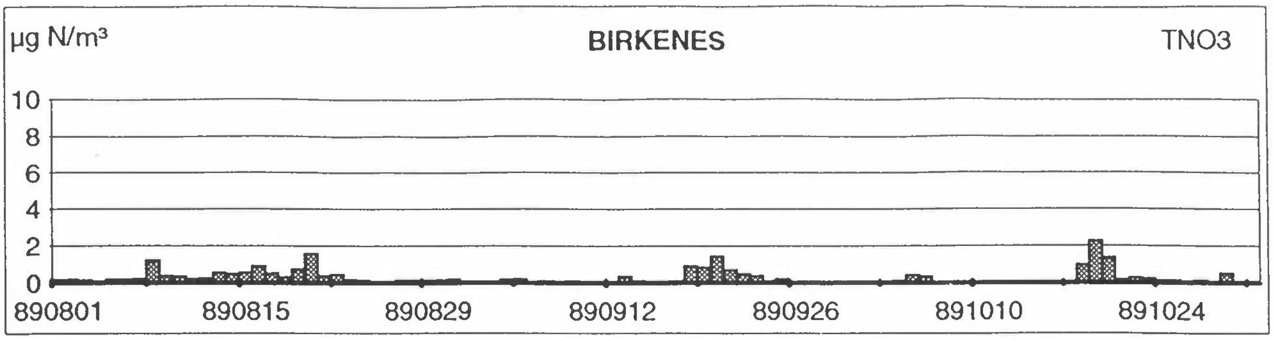
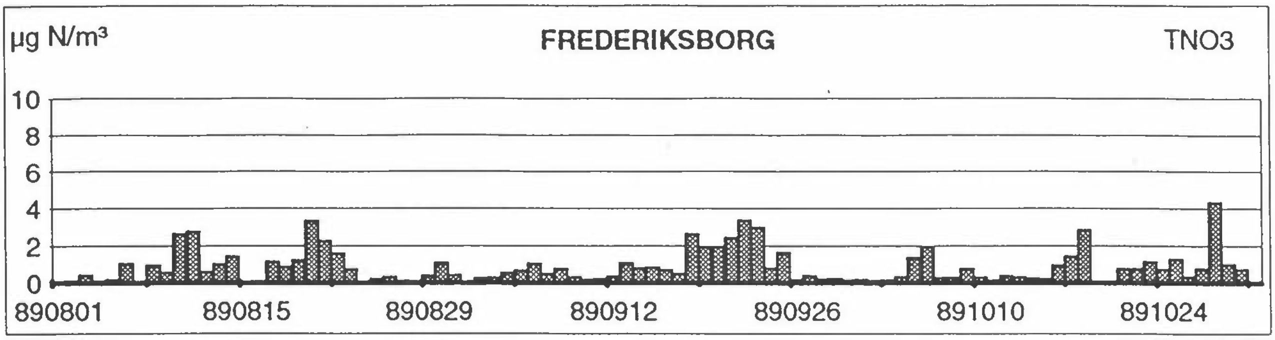
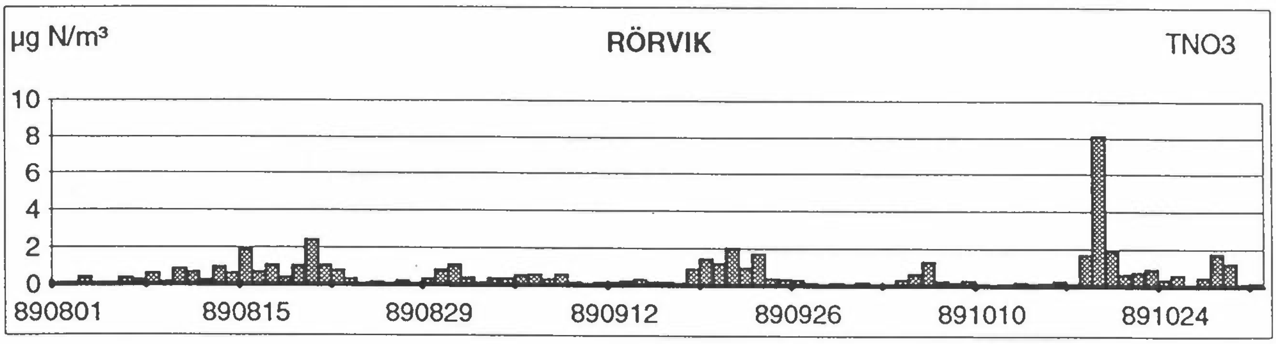
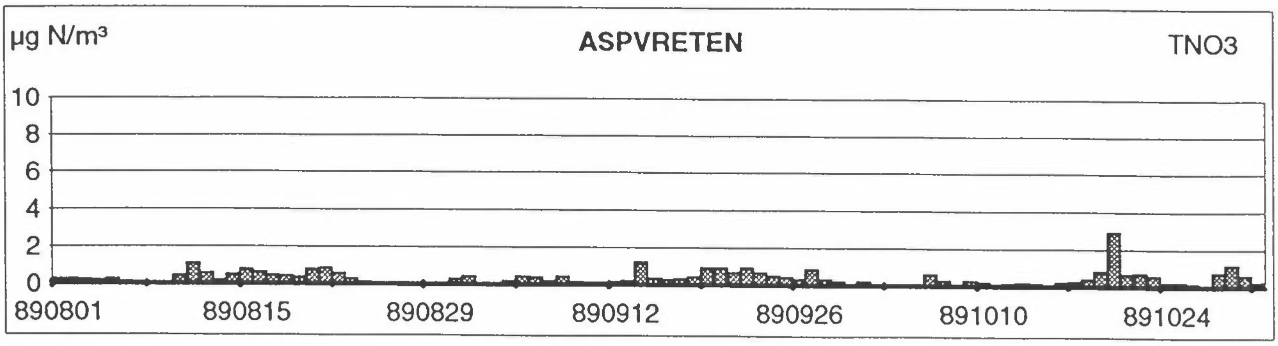


Fig. AII.3: Overview plots for NO_2.









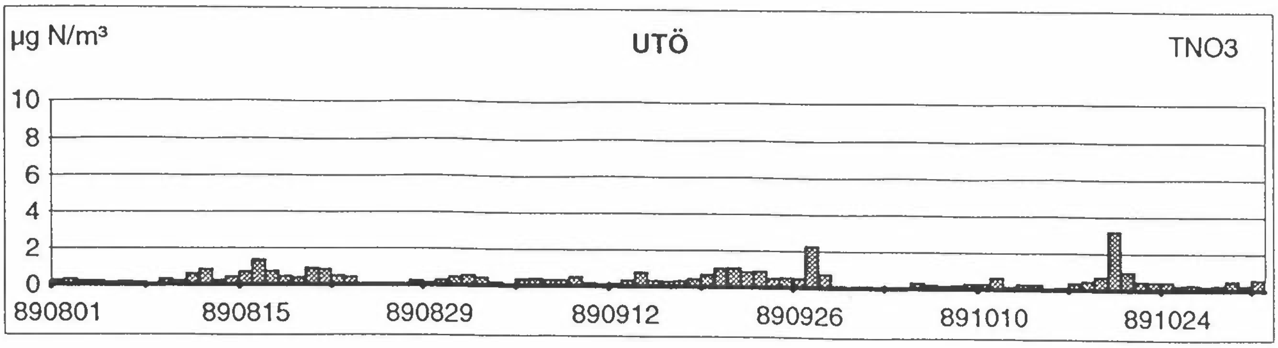


Fig. AII.4: Overview plots for total NO_3.

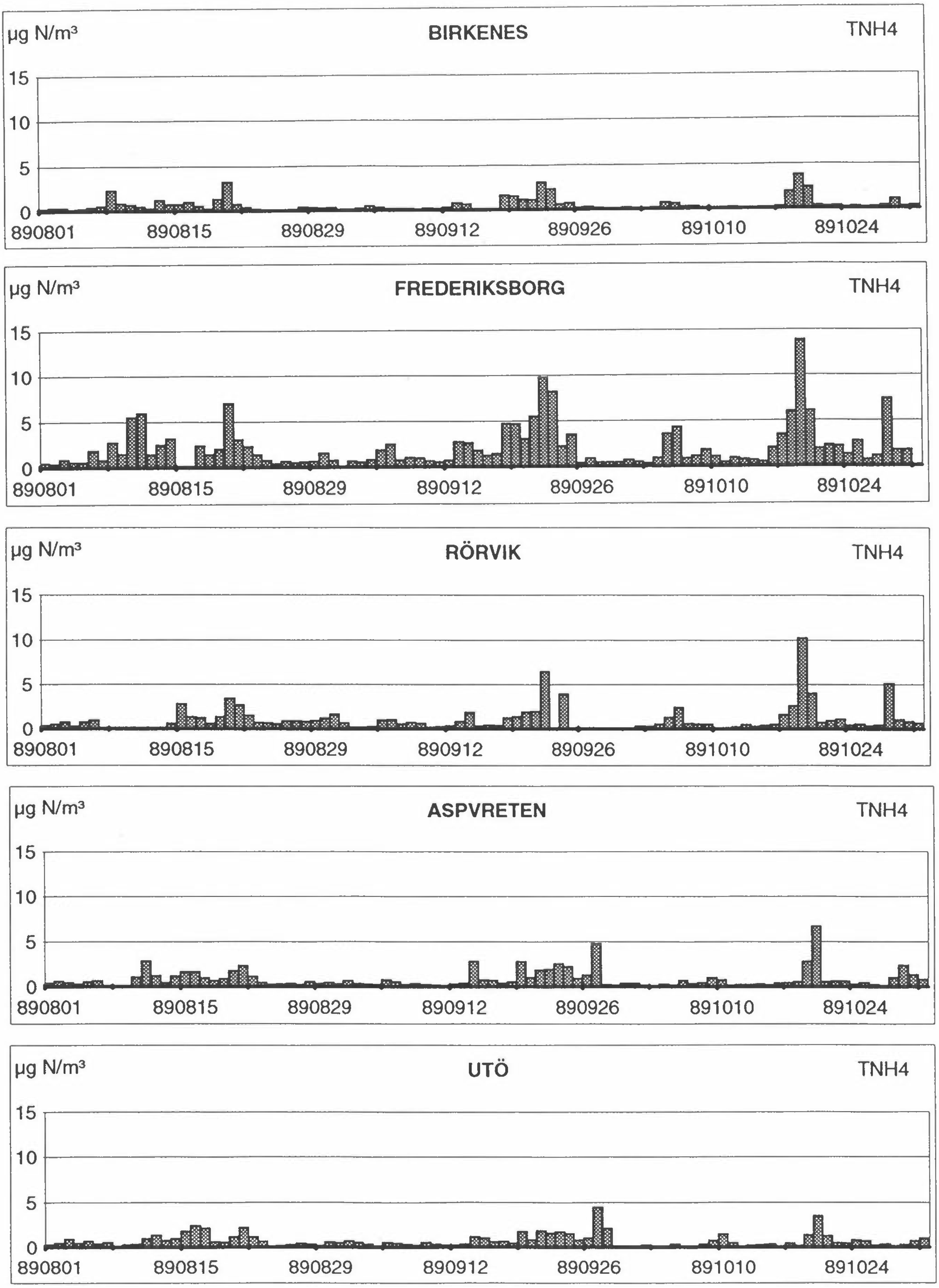


Fig. AII.5: Overview plots for total NH_4.

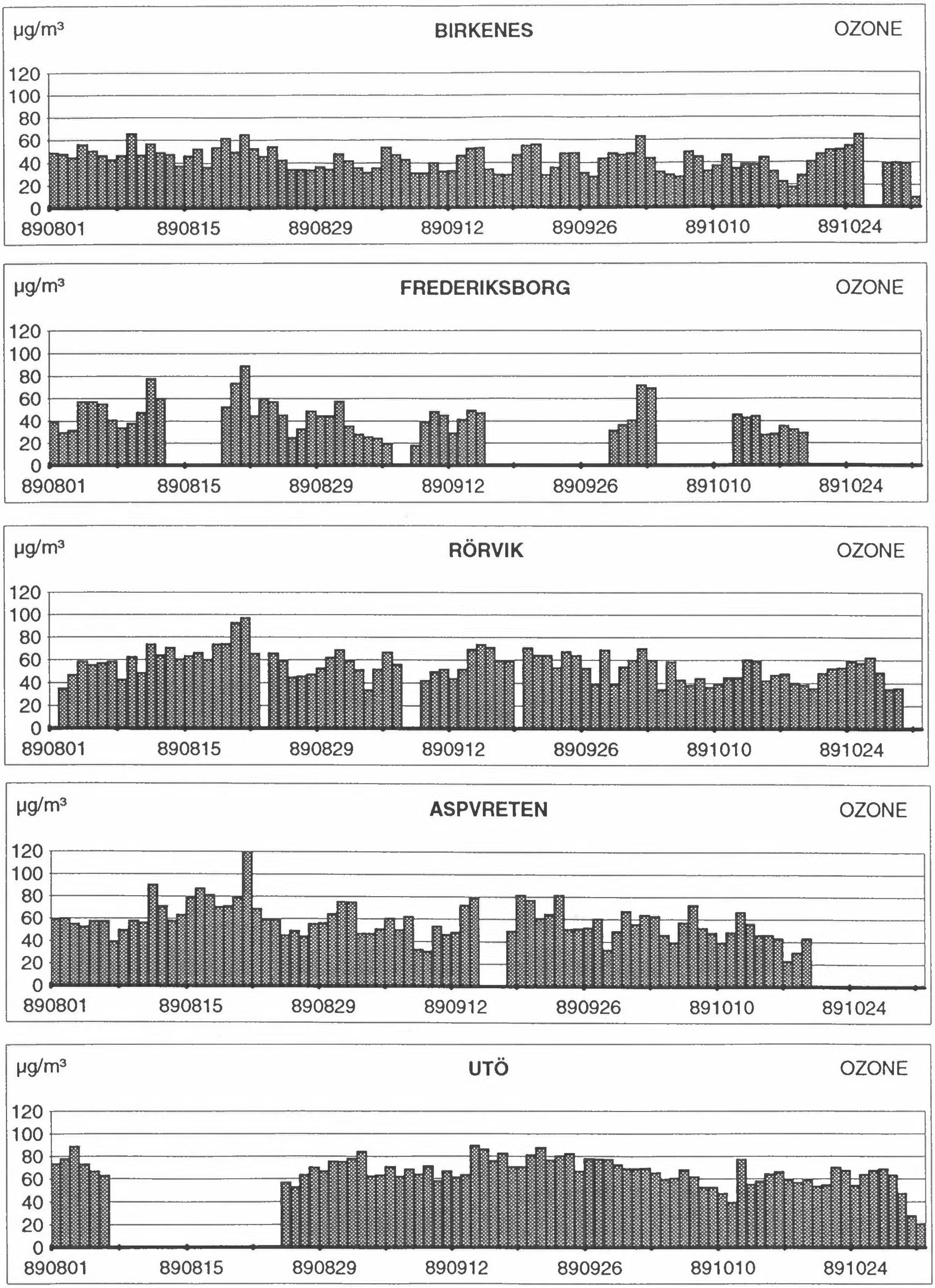


Fig. AII.6: Overview plots for ozone.

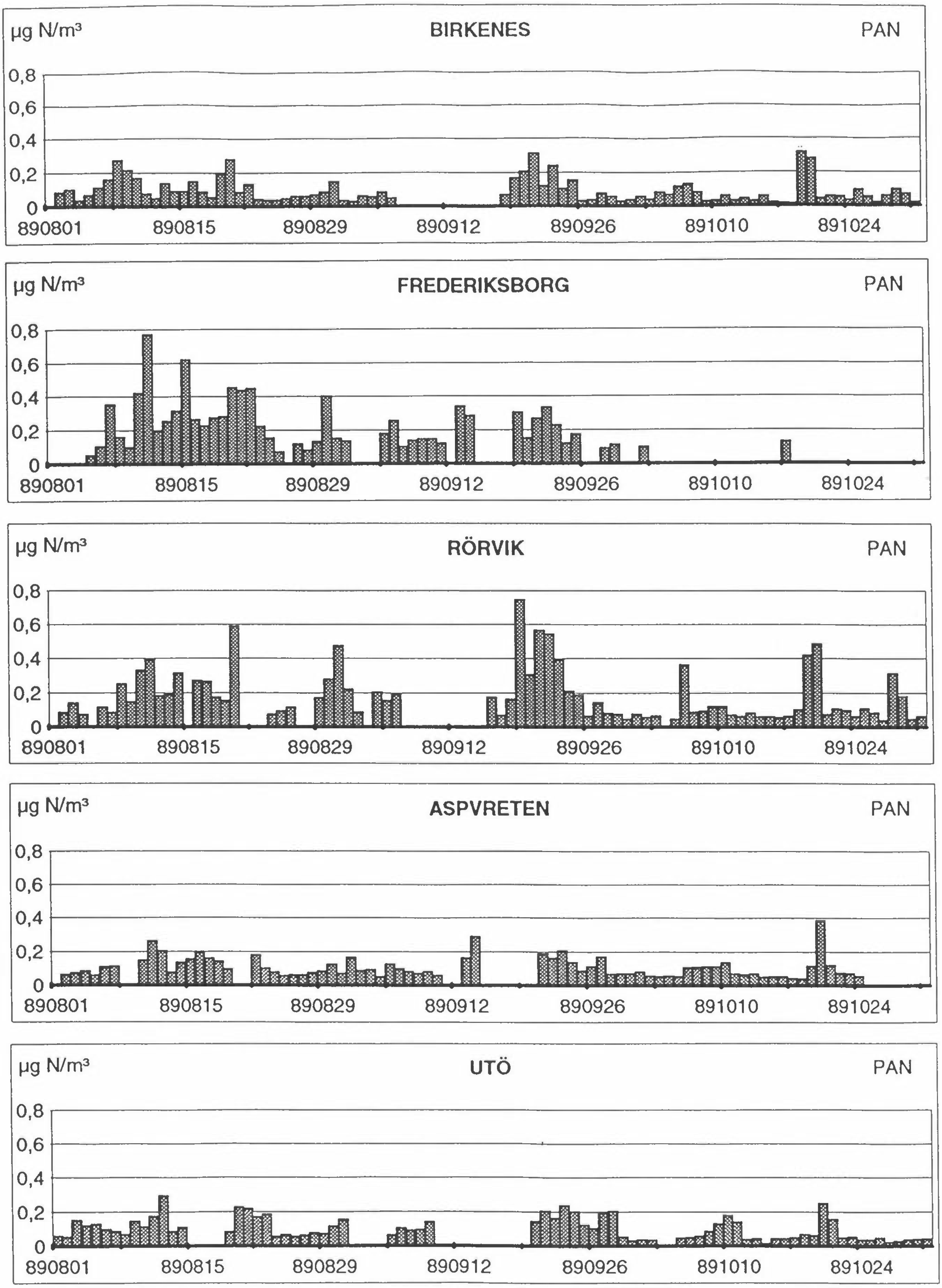
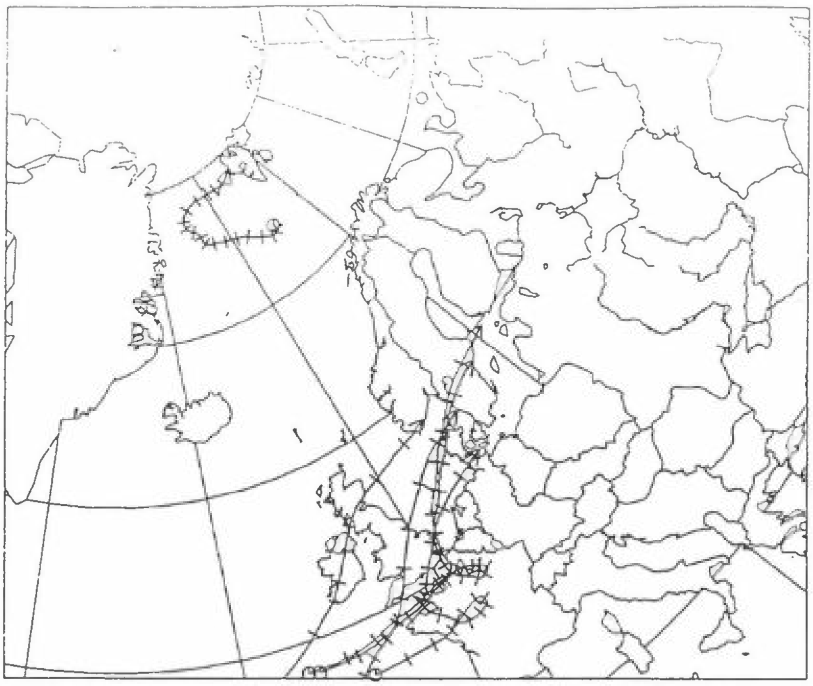


Fig. AII.7: Overview plots for PAN.

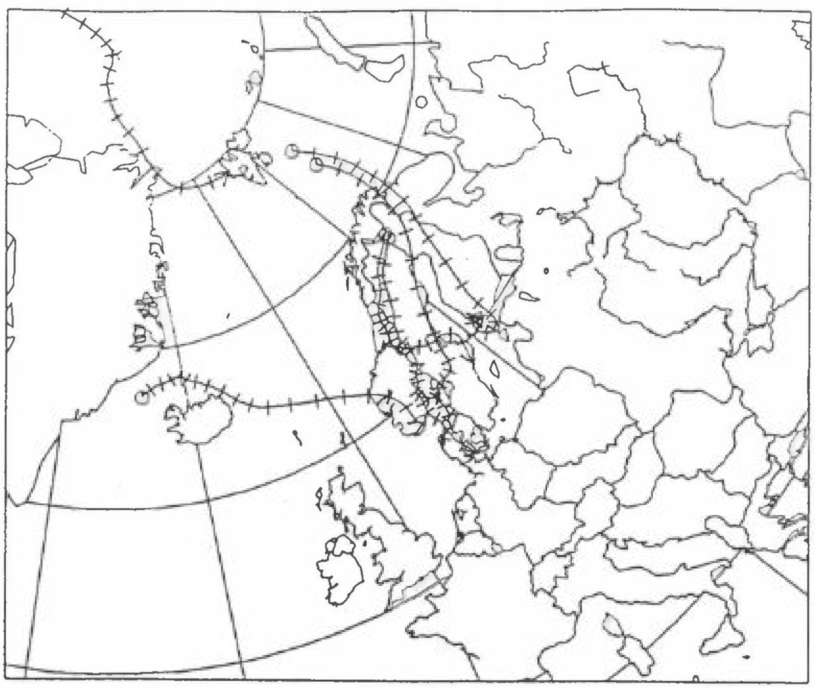
APPENDIX III

Results from model calculations.



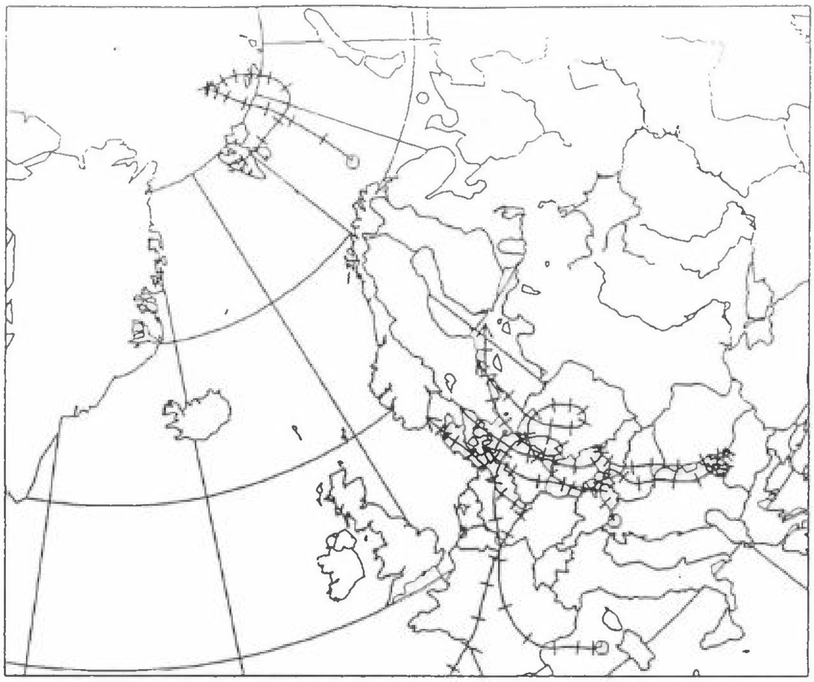
150 KM TRAJECTORIES
START 16: 08: 1989 12 GMT
TO 21: 08: 1989 12 GMT
925 HPA ANALYSIS.
MARKING EVERY 6. HOUR
FROM THE NORWEGIAN
METEORLOGICAL INSTITUTE

Figure AIII.1.a: Example of 5 day trajectories during episode EI.



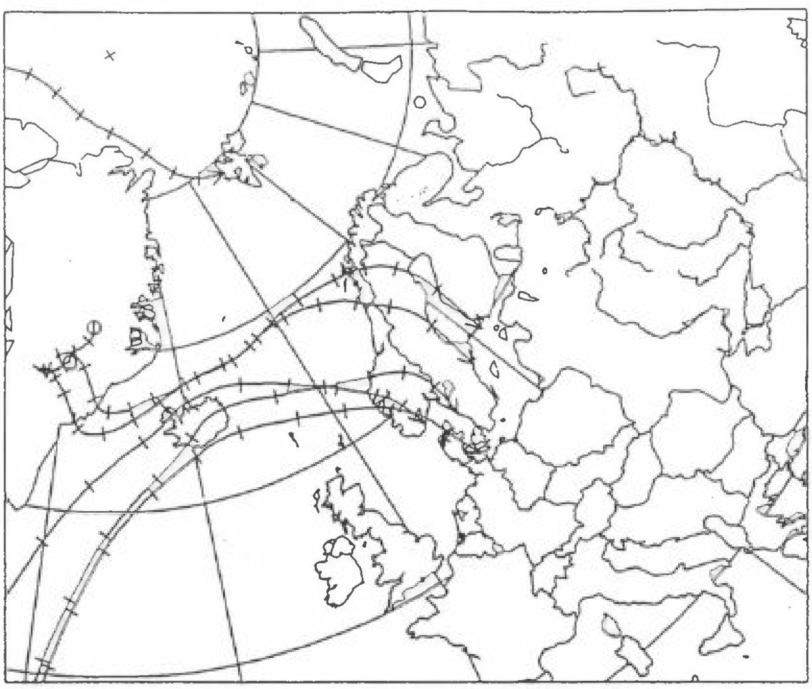
150 KM TRAJECTORIES
START 24: 08: 1989 12 GMT
TO 29: 08: 1989 12 GMT
925 HPA ANALYSIS.
MARKING EVERY 6. HOUR
FROM THE NORWEGIAN
METEORLOGICAL INSTITUTE

Figure AIII.1.b: Example of 5 day trajectories during clean air episode CI.



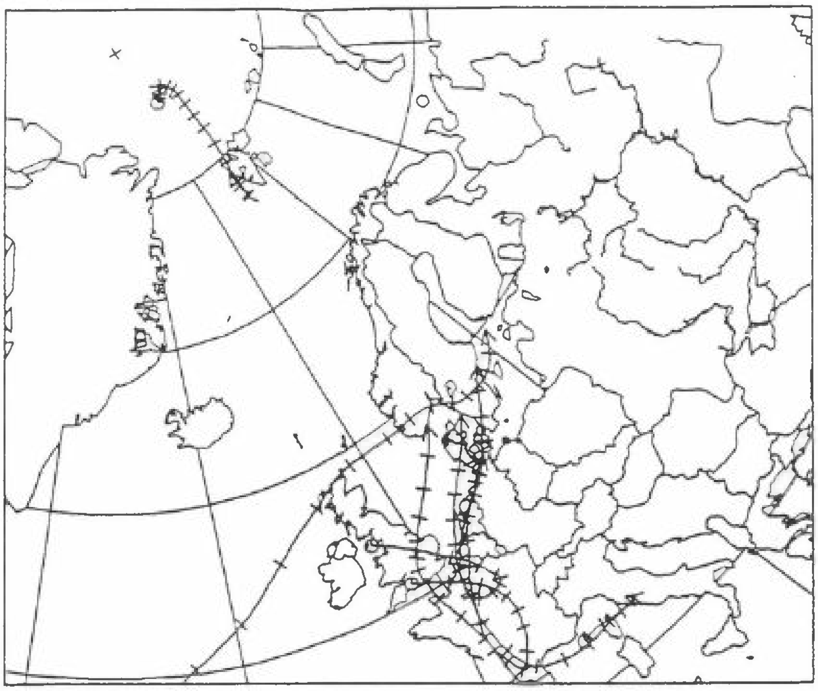
150 KM TRAJECTORIES
START 17: 09: 1989 12 GMT
TO 22: 09: 1989 12 GMT
925 HPA ANALYSIS.
MARKING EVERY 6. HOUR
FROM THE NORWEGIAN
METEORLOGICAL INSTITUTE

Figure AIII.1.c: Example of 5 day trajectories during episode EII.



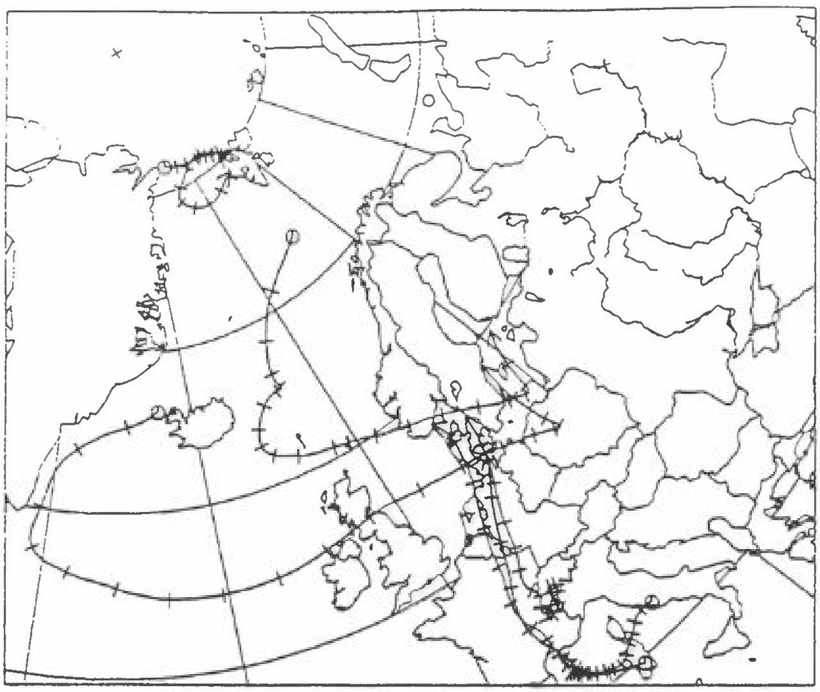
150 KM TRAJECTORIES
START 25: 09: 1989 12 GMT
TO 30: 09: 1989 12 GMT
925 HPA ANALYSIS.
MARKING EVERY 6. HOUR
FROM THE NORWEGIAN
METEORLOGICAL INSTITUTE

Figure AIII.1.d: Example of 5 day trajectories during clean air episode CII.



150 KM TRAJECTORIES
START 14: 10: 1989 12 GMT
TO 19: 10: 1989 12 GMT
925 HPA ANALYSIS.
MARKING EVERY 6. HOUR
FROM THE NORWEGIAN
METEORLOGICAL INSTITUTE

Figure AIII.1.e: Example of 5 day trajectories during episode EIII.



150 KM TRAJECTORIES
START 23: 10: 1989 12 GMT
TO 28: 10: 1989 12 GMT
925 HPA ANALYSIS.
MARKING EVERY 6. HOUR
FROM THE NORWEGIAN
METEORLOGICAL INSTITUTE

Figure AIII.1.f: Example of 5 day trajectories during episode EIV.

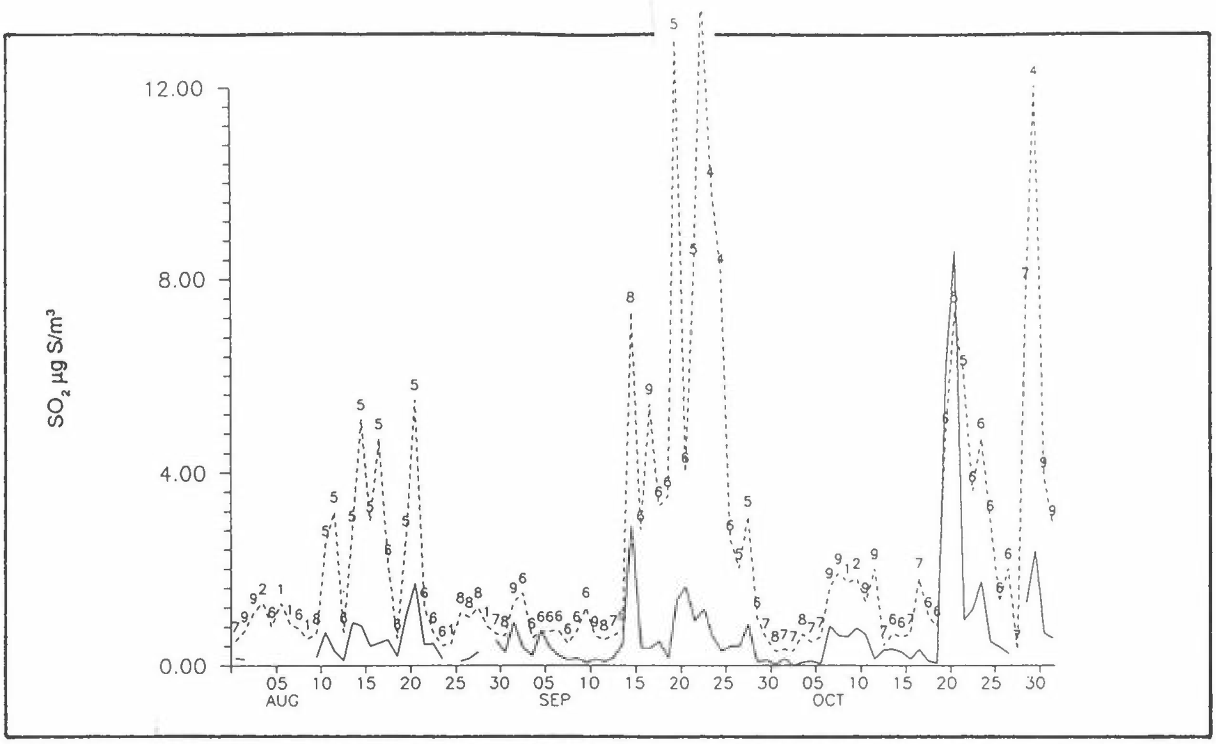


Figure AIII.2.a: Calculated (dashed) and measured (full line) concentrations of SO_2 on a daily basis, measured at Aspvreten. Transport sector allocation is indicated in the calculated curve.

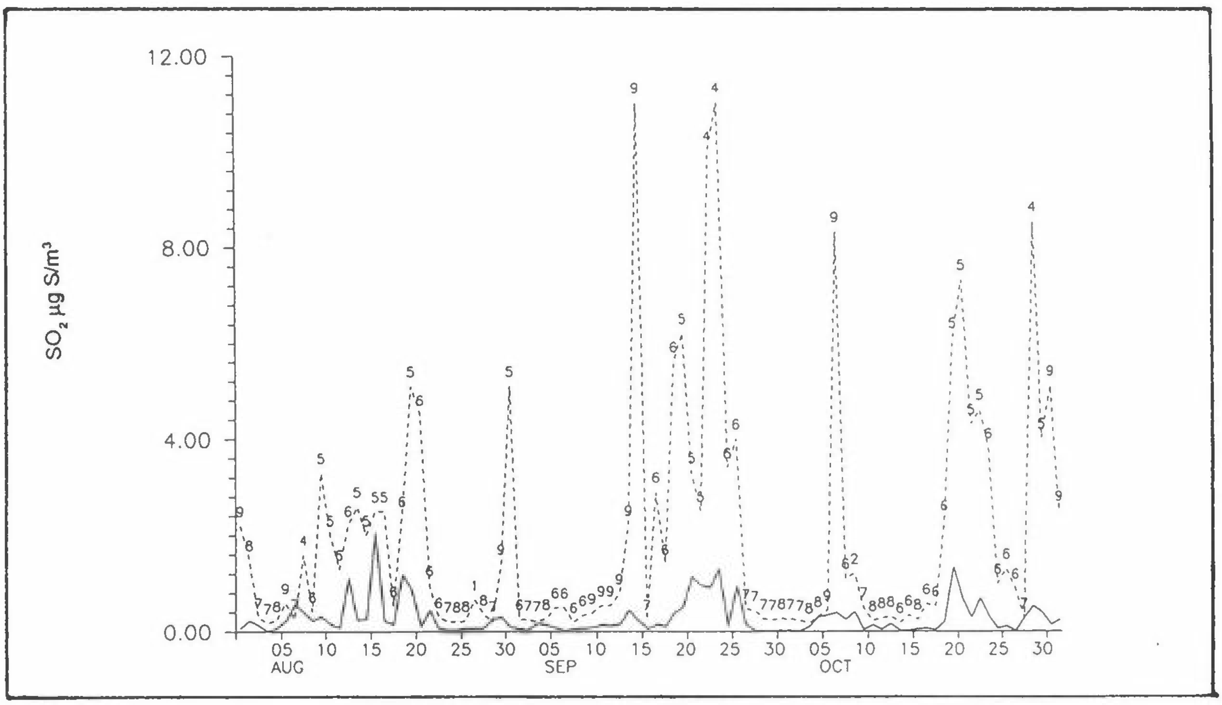


Figure AIII.2.b: Calculated (dashed) and measured (full line) concentrations of SO_2 on a daily basis, measured at Birkenes. Transport sector allocation is indicated in the calculated curve.

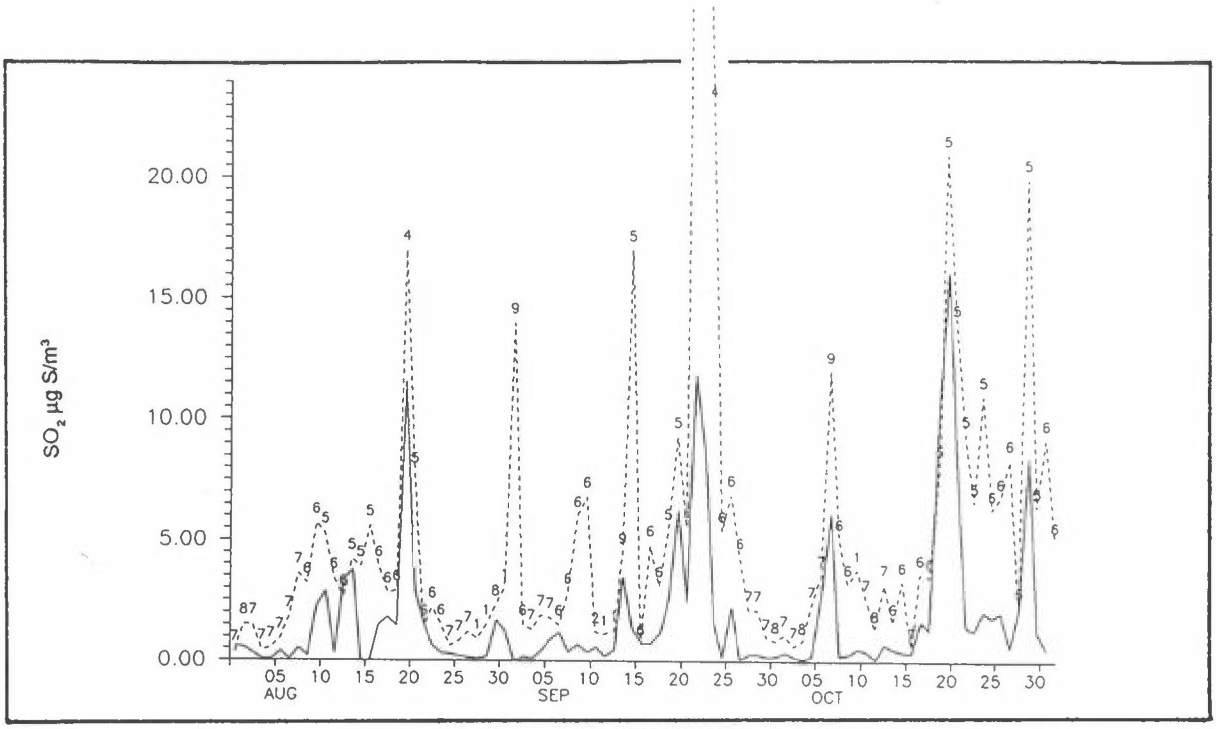


Figure AIII.2.c: Calculated (dashed) and measured (full line) concentrations of SO_2 on a daily basis, measured at Frederiksborg. Transport sector allocation is indicated in the calculated curve.

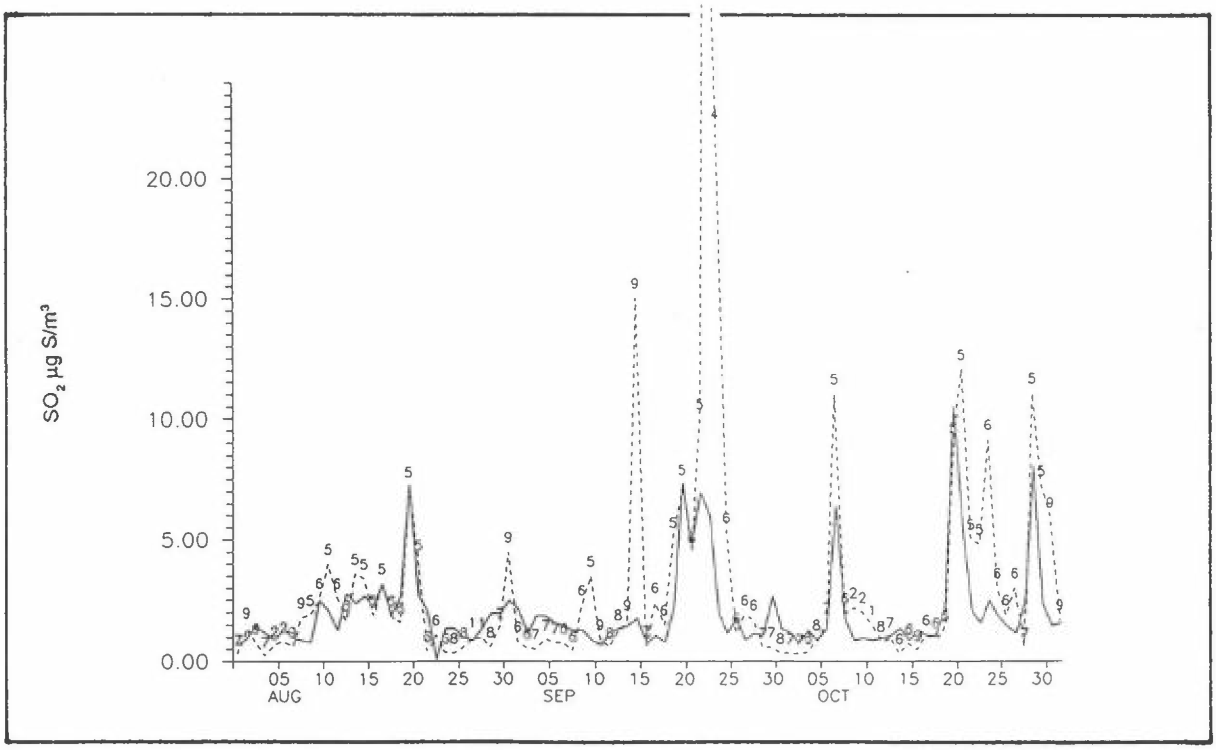


Figure AIII.2.d: Calculated (dashed) and measured (full line) concentrations of SO_2 on a daily basis, measured at Rörvik. Transport sector allocation is indicated in the calculated curve.

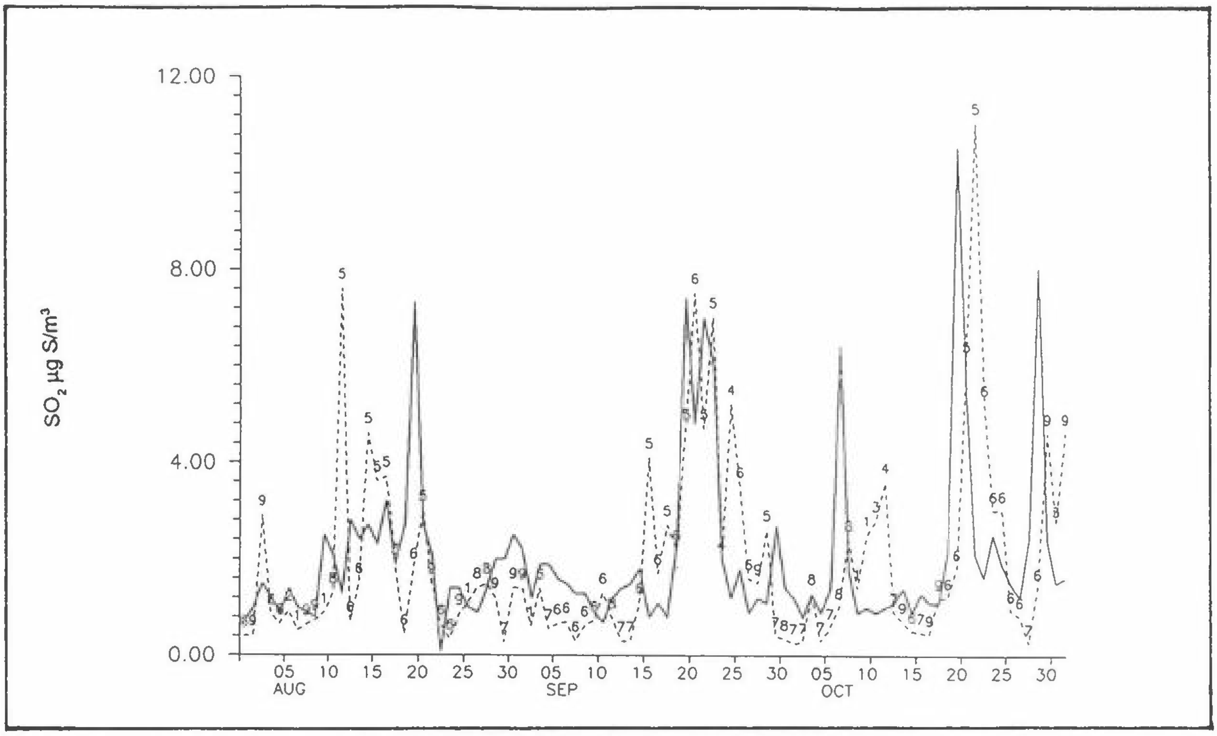


Figure AIII.2.e: Calculated (dashed) and measured (full line) concentrations of SO_2 on a daily basis, measured at Utö. Transport sector allocation is indicated in the calculated curve.

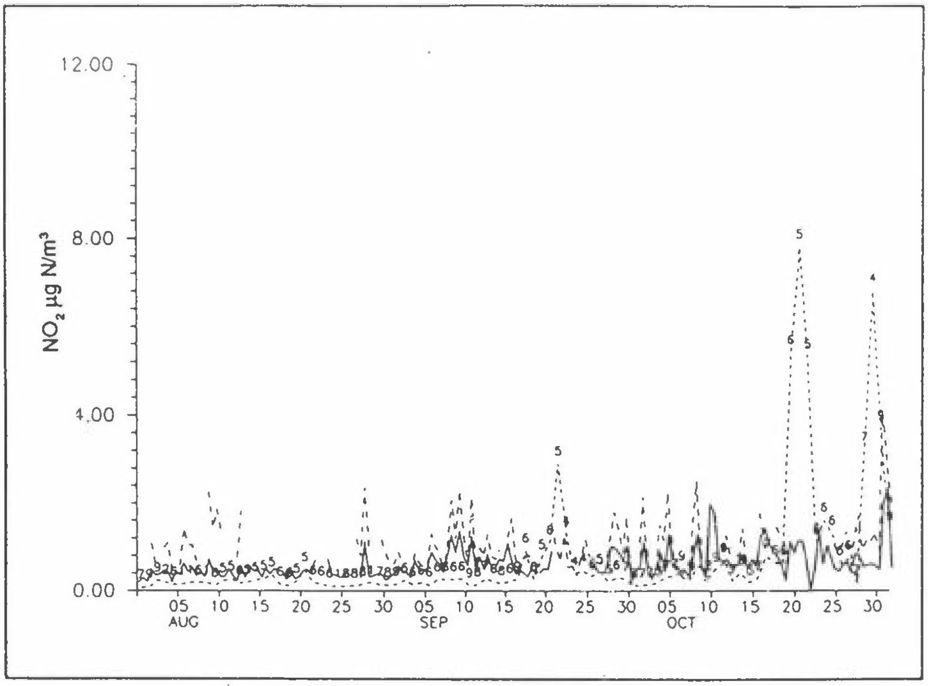


Figure AIII.3.a: Calculated (dashed) and measured (full line) concentrations of NO_2 on a daily basis, measured at Aspvreten. Transport sector allocation is indicated in the calculated curve.

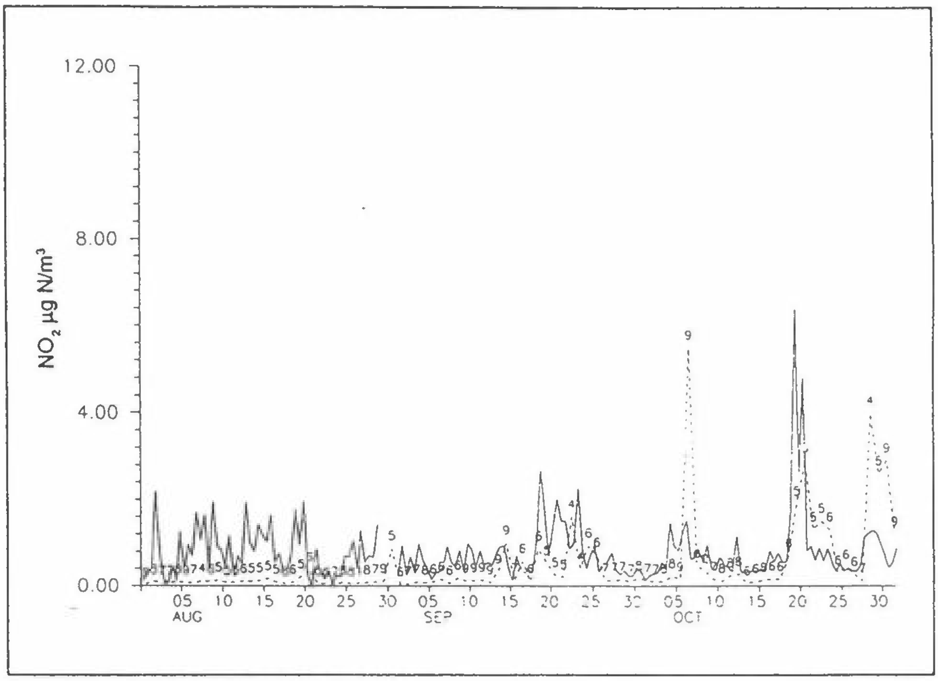


Figure AIII.3.b: Calculated (dashed) and measured (full line) concentrations of NO_2 on a daily basis, measured at Birkenes. Transport sector allocation is indicated in the calculated curve.

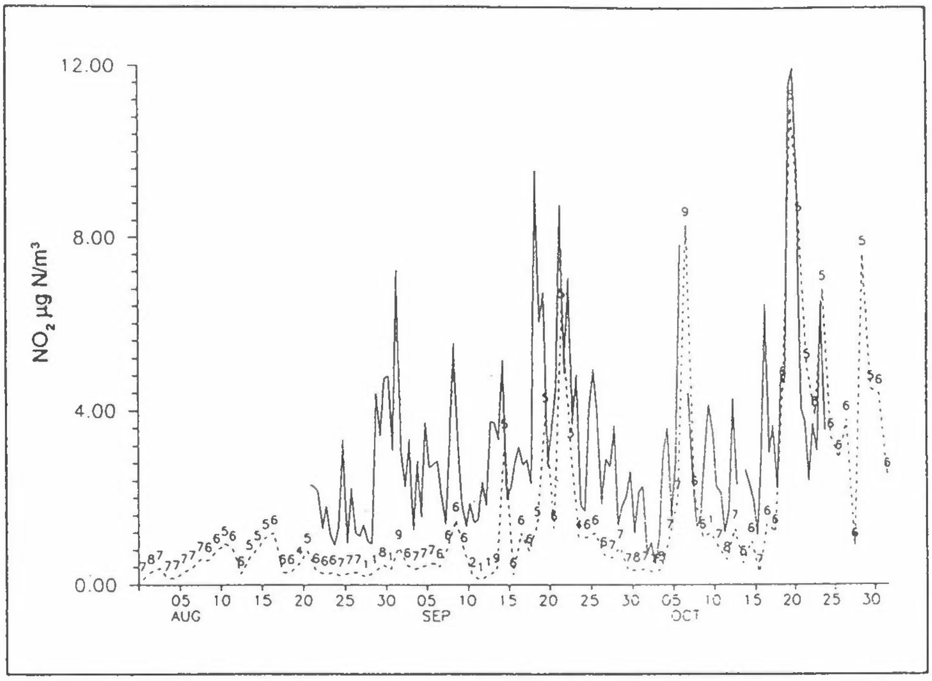


Figure AIII.3.c: Calculated (dashed) and measured (full line) concentrations of NO_2 on a daily basis, measured at Frederiksborg. Transport sector allocation is indicated in the calculated curve.

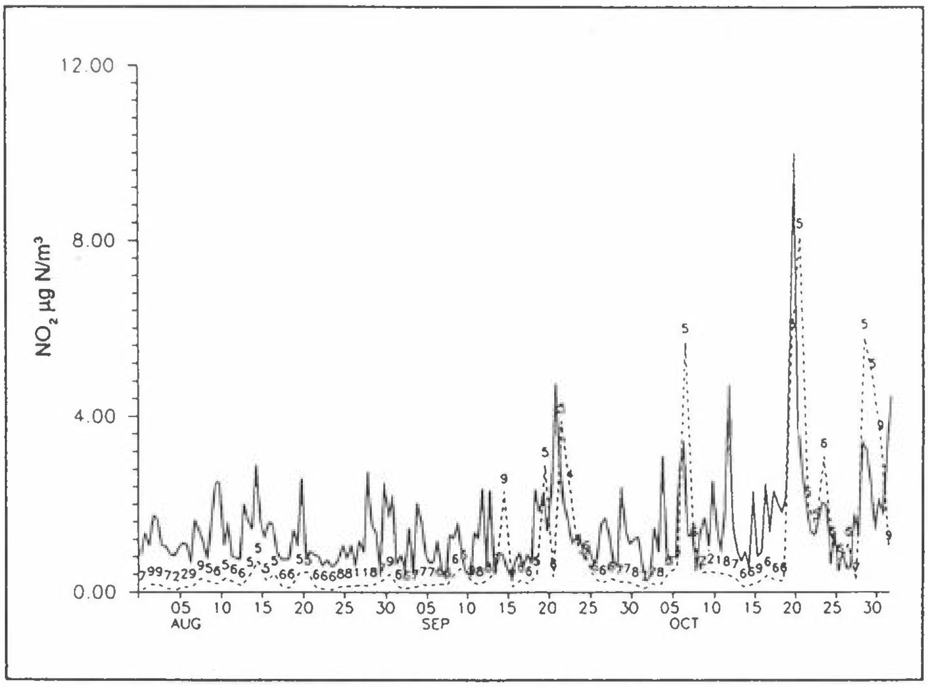


Figure AIII.3.d: Calculated (dashed) and measured (full line) concentrations of NO_2 on a daily basis, measured at Rörvik. Transport sector allocation is indicated in the calculated curve.

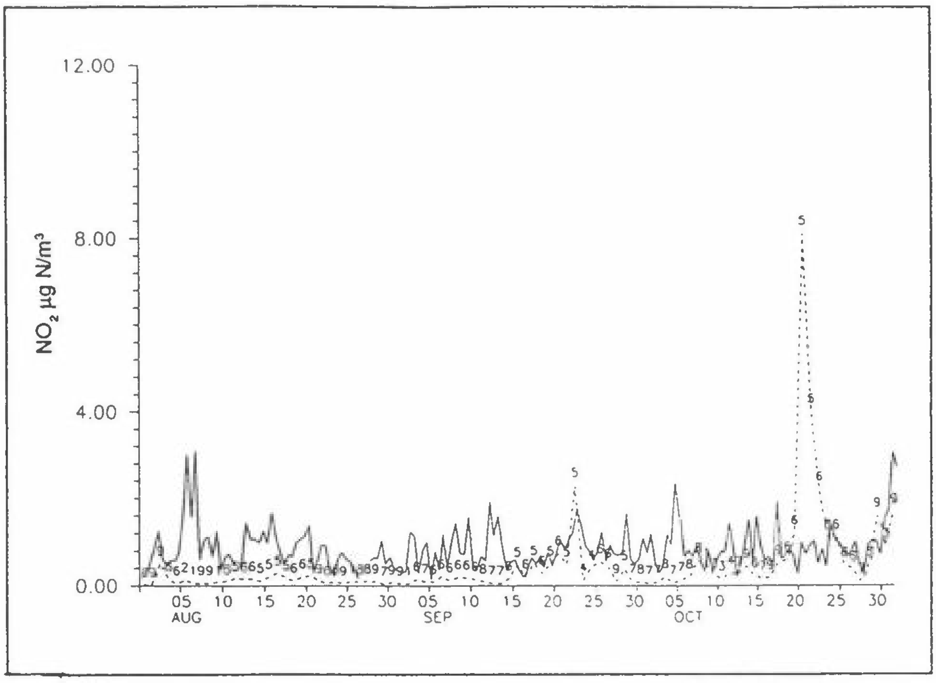


Figure AIII.3.e: Calculated (dashed) and measured (full line) concentrations of NO_2 on a daily basis, measured at Utö. Transport sector allocation is indicated in the calculated curve.

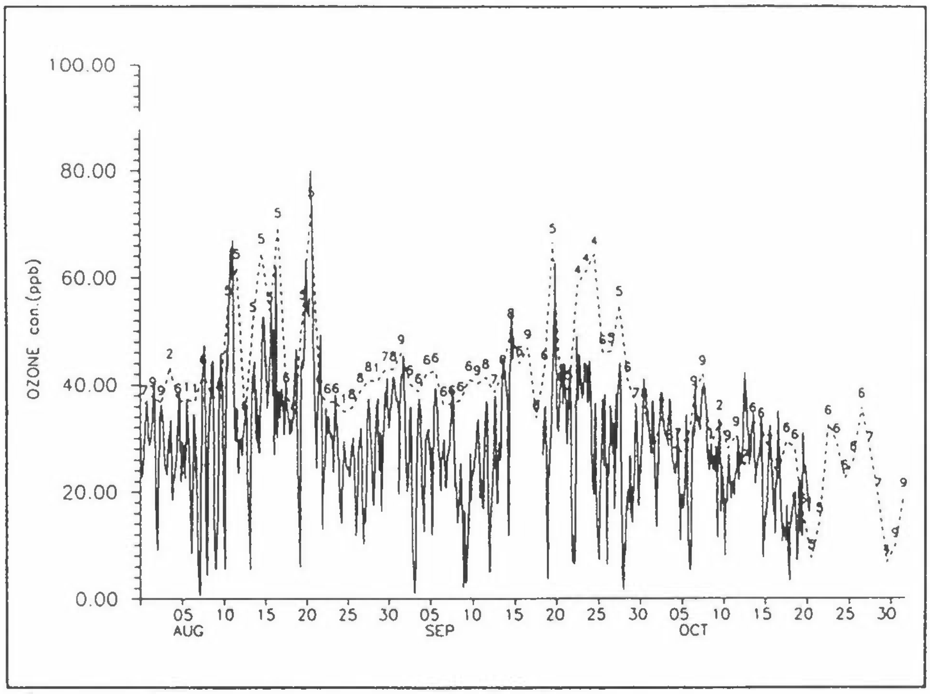


Figure AIII.4.a: Calculated (dashed) and measured (full line) concentrations of ozone on a daily basis, measured at Aspvreten. Transport sector allocation is indicated in the calculated curve.

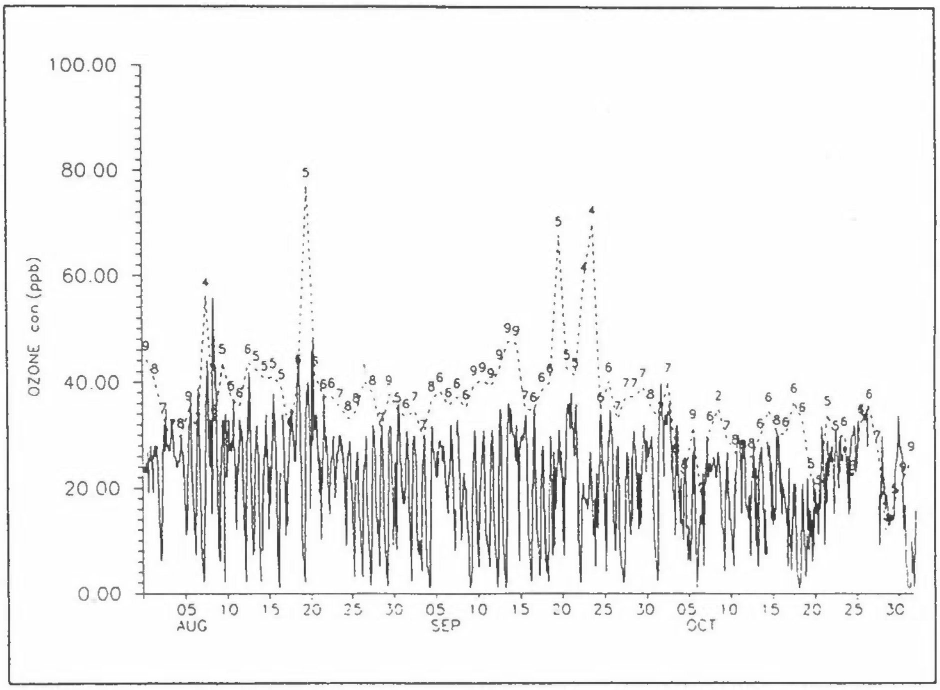


Figure AIII.4.b: Calculated (dashed) and measured (full line) concentrations of ozone on a daily basis, measured at Birkenes. Transport sector allocation is indicated in the calculated curve.

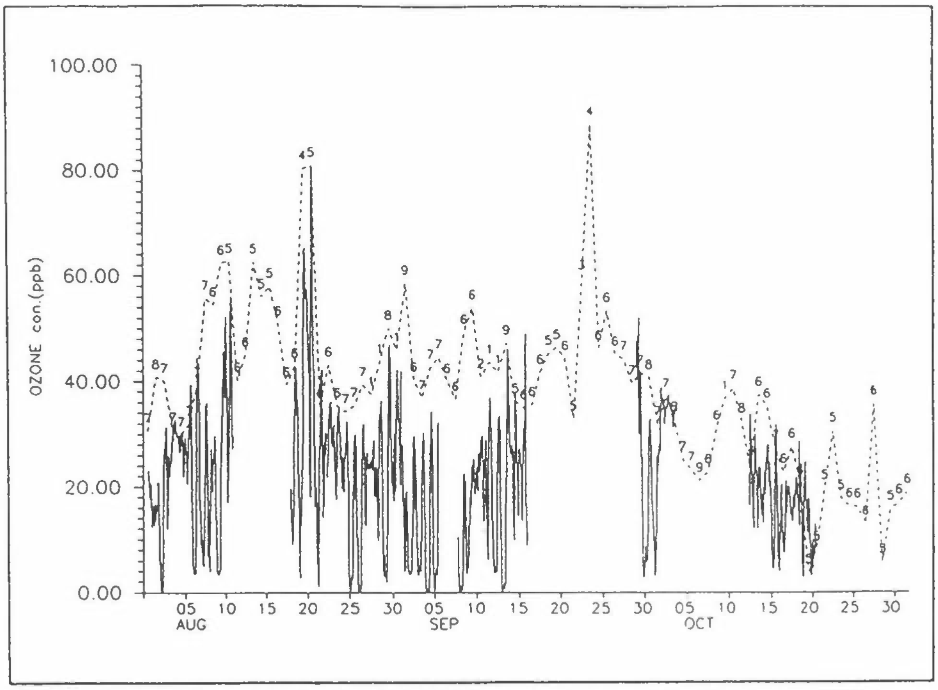


Figure AIII.4.c: Calculated (dashed) and measured (full line) concentrations of ozone on a daily basis, measured at Frederiksborg. Transport sector allocation is indicated in the calculated curve.

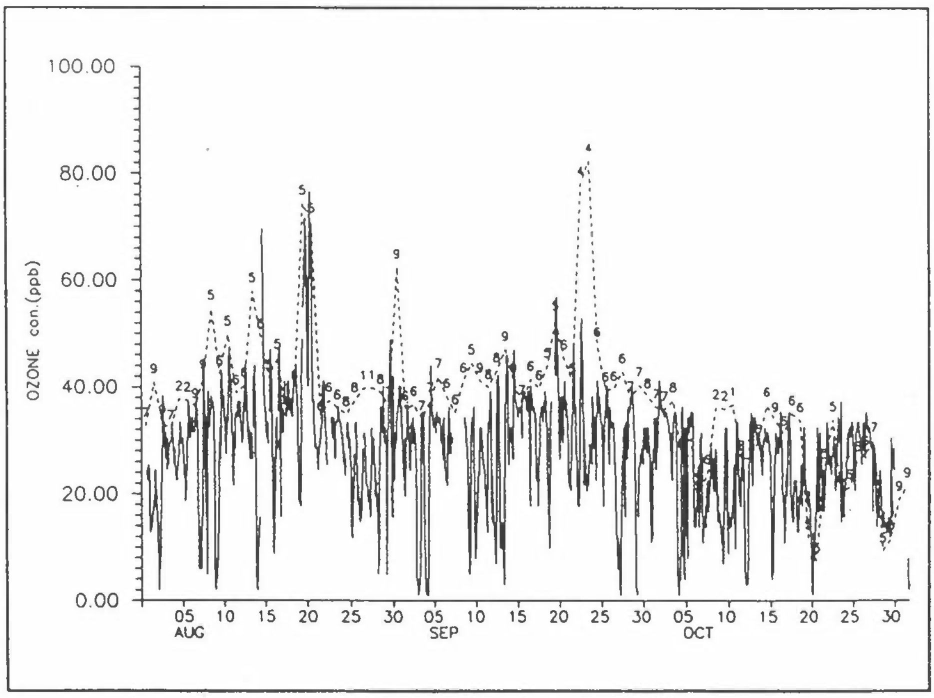


Figure AIII.4.d: Calculated (dashed) and measured (full line) concentrations of ozone on a daily basis, measured at Rörvik. Transport sector allocation is indicated in the calculated curve.

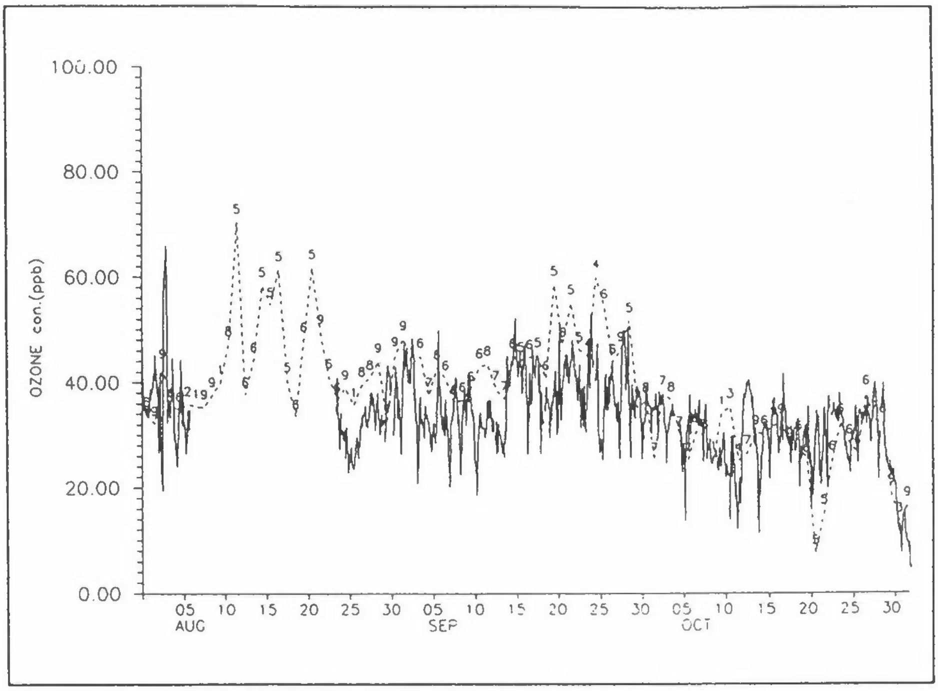


Figure AIII.4.e: Calculated (dashed) and measured (full line) concentrations of ozone on a daily basis, measured at Utö. Transport sector allocation is indicated in the calculated curve.

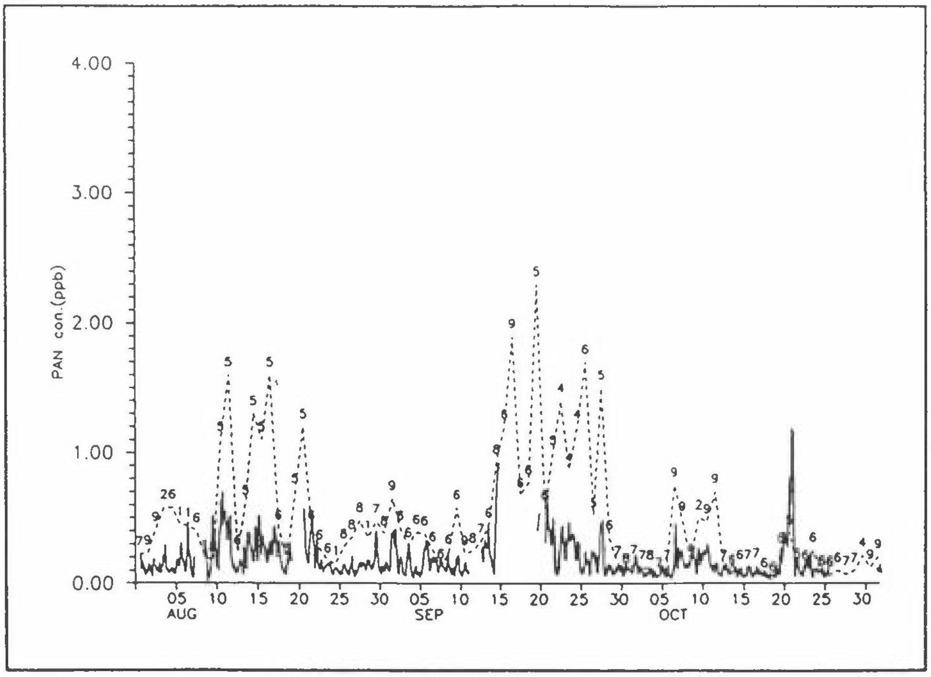


Figure AIII.5.a: Calculated (dashed) and measured (full line) concentrations of PAN on a daily basis, measured at Aspvreten. Transport sector allocation is indicated in the calculated curve.

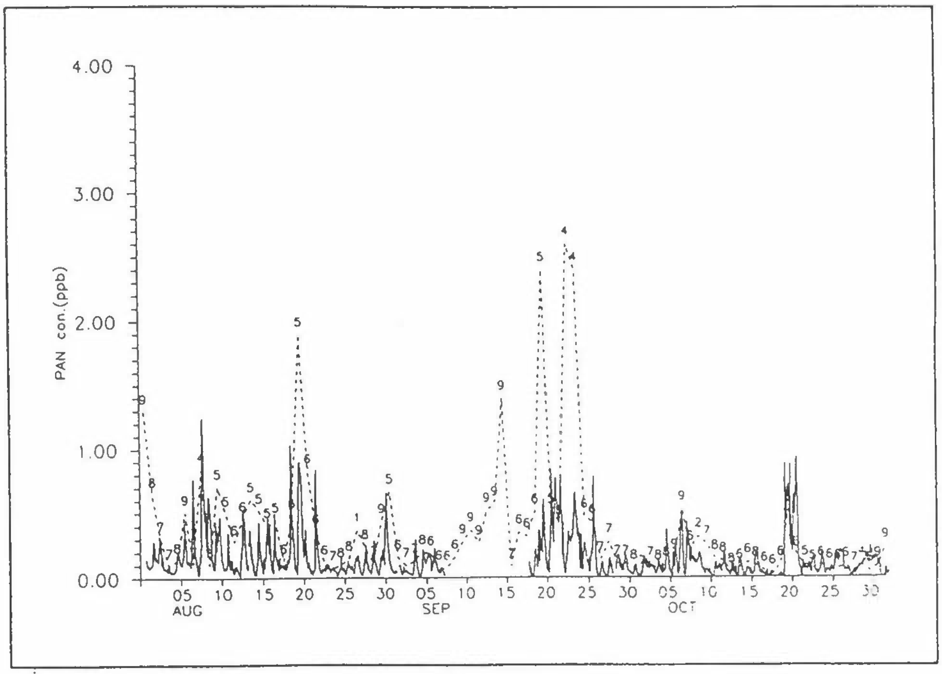


Figure AIII.5.b: Calculated (dashed) and measured (full line) concentrations of PAN on a daily basis, measured at Birkenes. Transport sector allocation is indicated in the calculated curve.

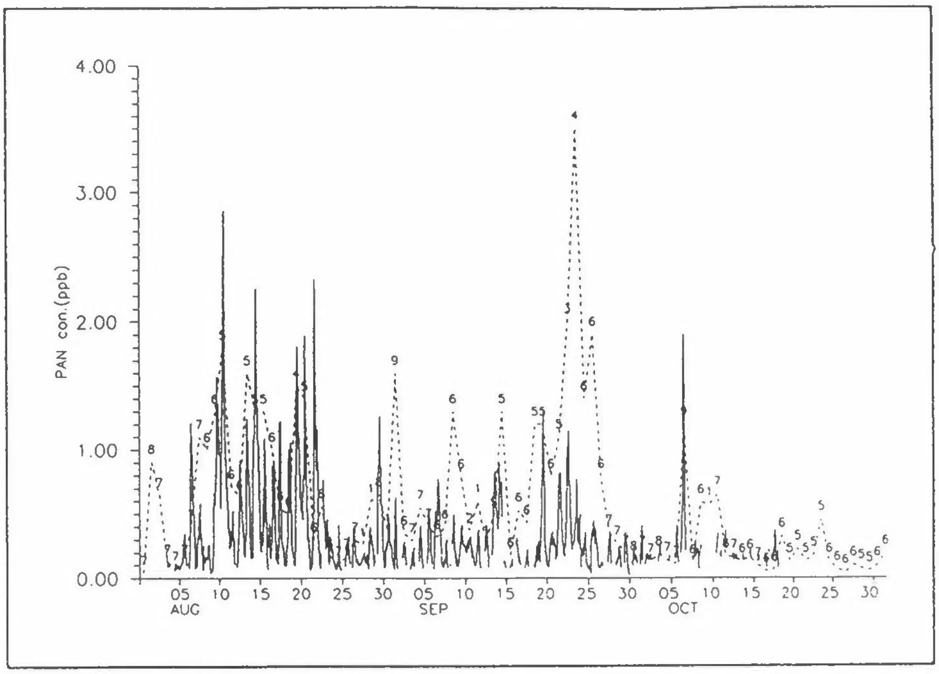


Figure AIII.5.c: Calculated (dashed) and measured (full line) concentrations of PAN on a daily basis, measured at Frederiksborg. Transport sector allocation is indicated in the calculated curve.

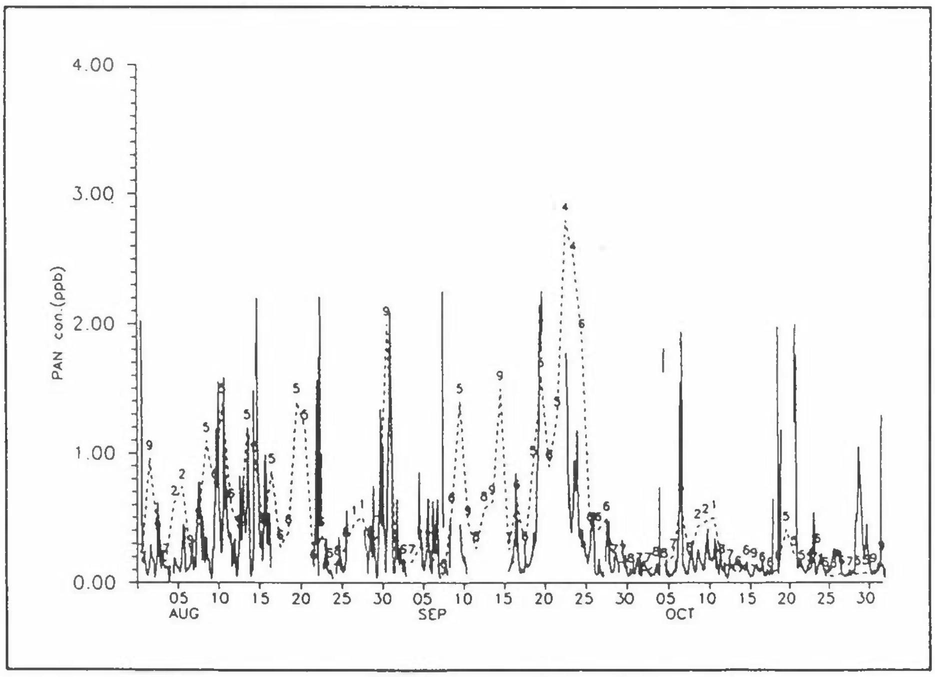


Figure AIII.5.d: Calculated (dashed) and measured (full line) concentrations of PAN on a daily basis, measured at Rörvik. Transport sector allocation is indicated in the calculated curve.

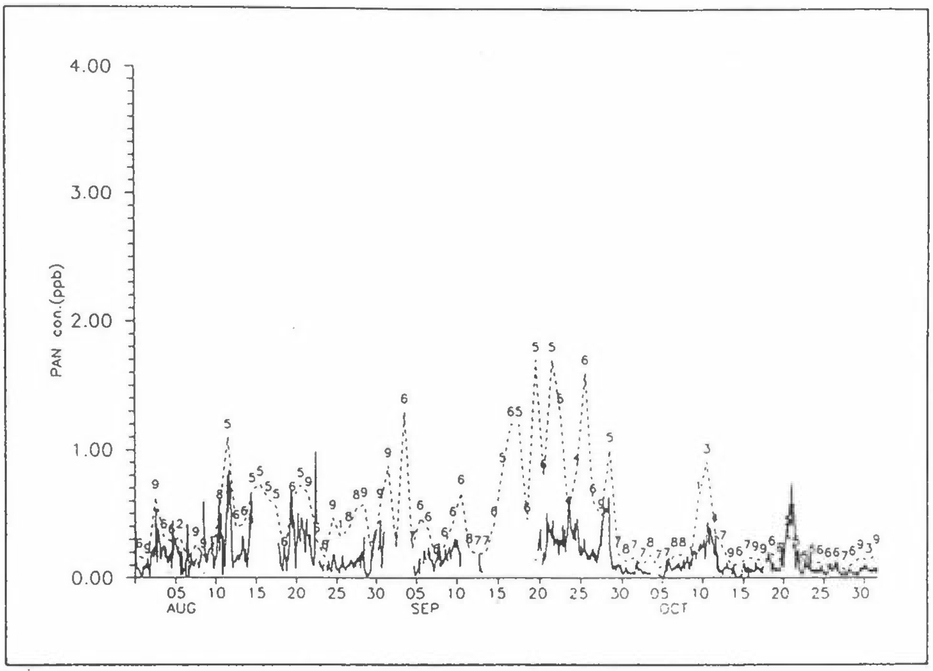
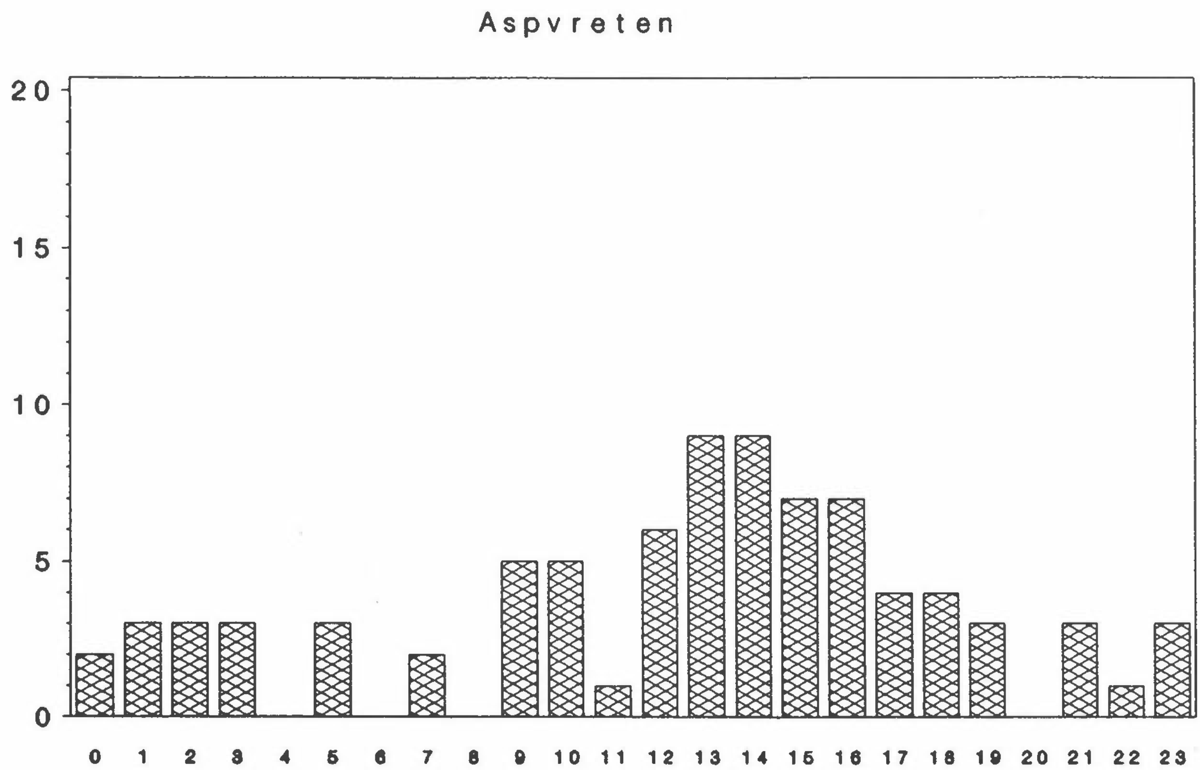


Figure AIII.5.e: Calculated (dashed) and measured (full line) concentrations of PAN on a daily basis, measured at Utö. Transport sector allocation is indicated in the calculated curve.

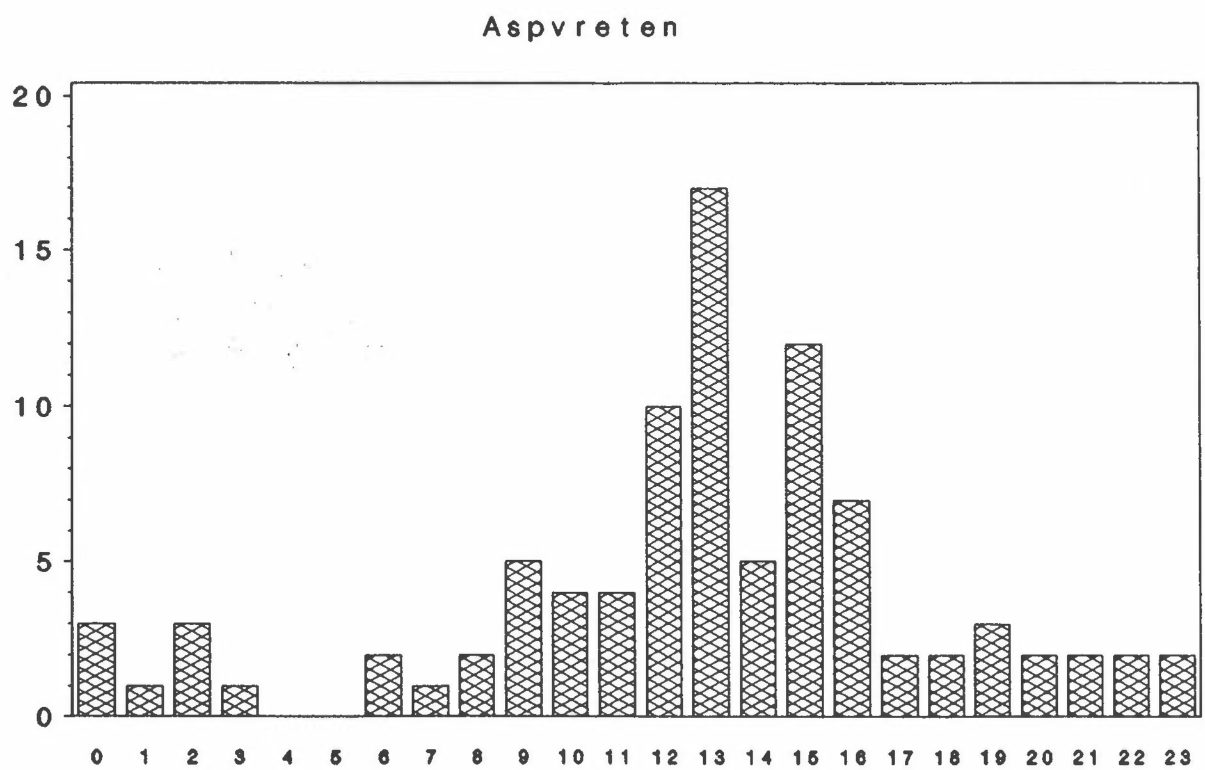
APPENDIX IV

Complete set of figures displaying
diurnal variations in the data material.
See Chapter 6 for explanations.

Time of daily PAN-maximum

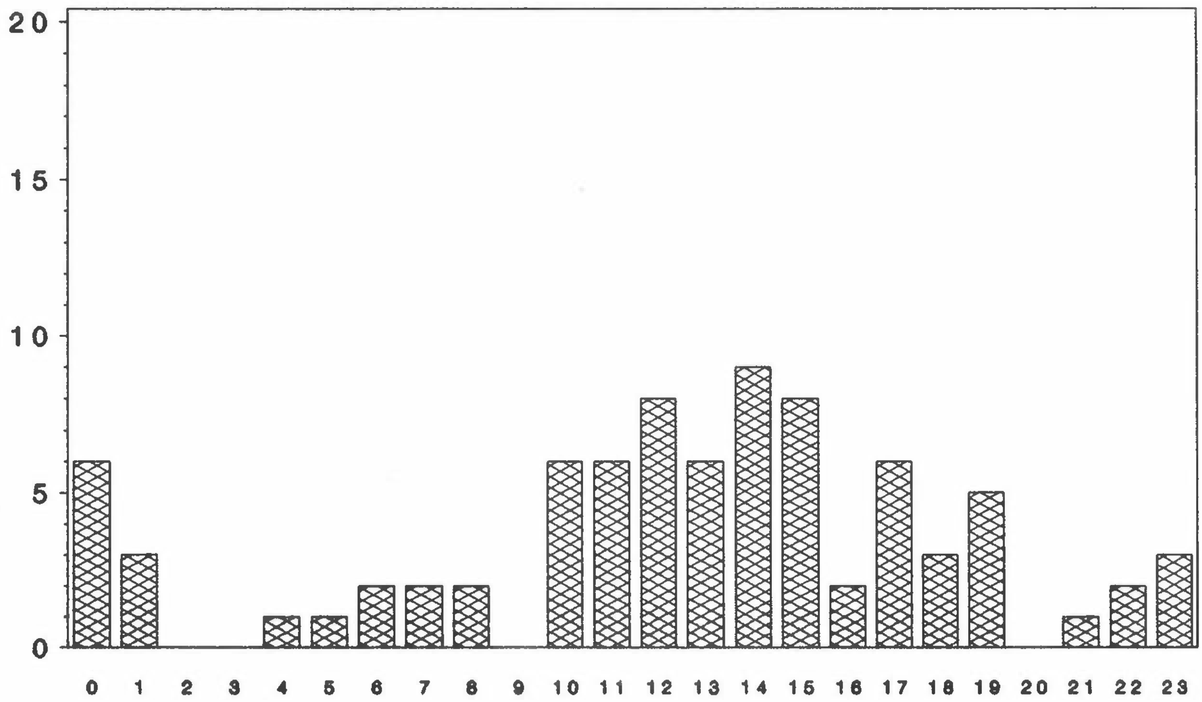


Time of daily Ozone-maximum



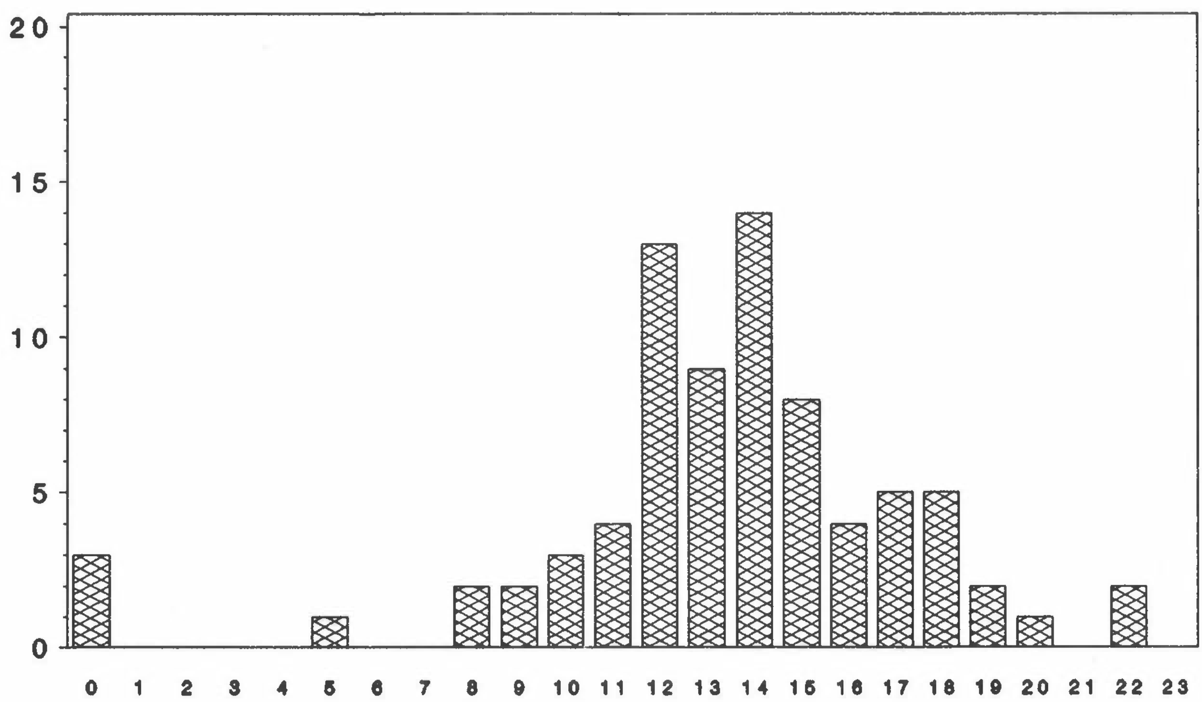
Time of daily PAN-maximum

Birkenes



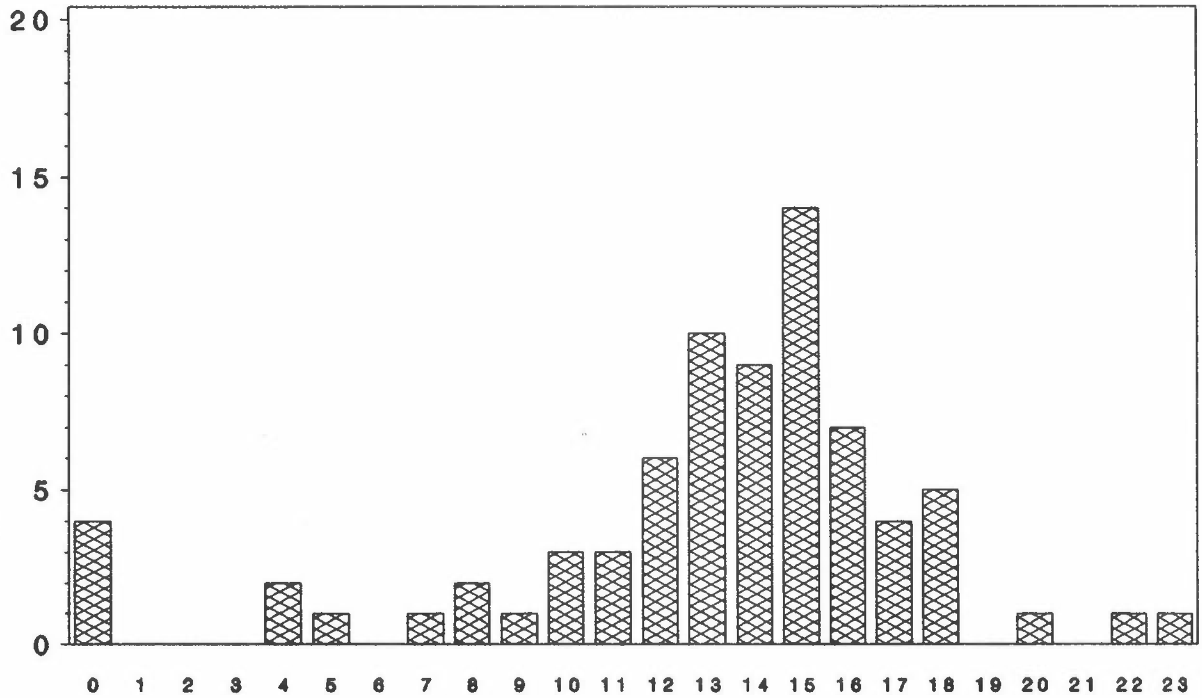
Time of daily Ozone-maximum

Birkenes



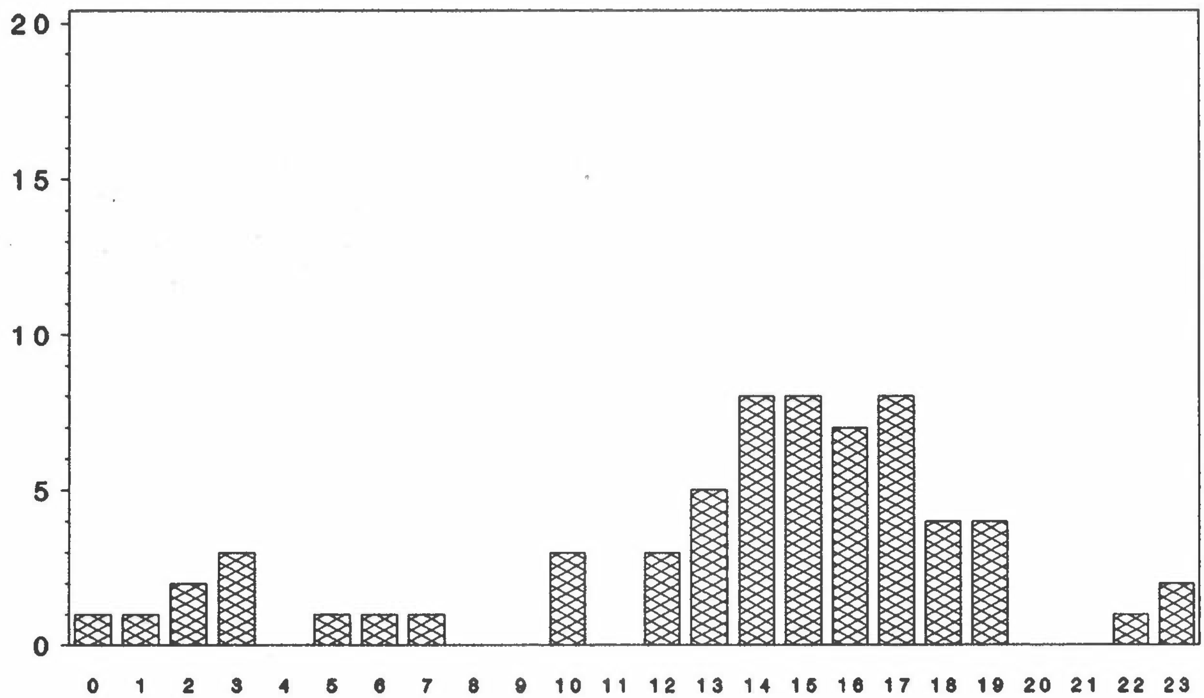
Time of daily PAN-maximum

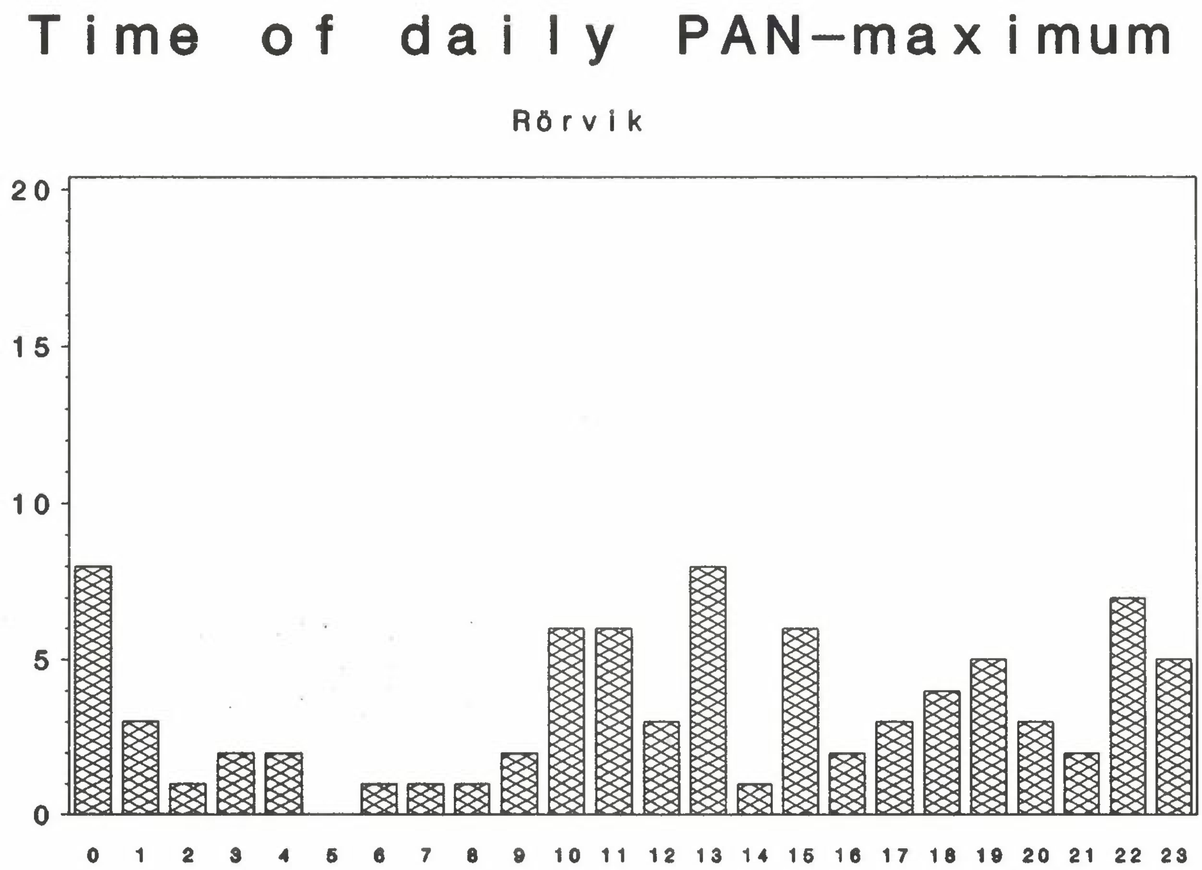
Frederiksborg

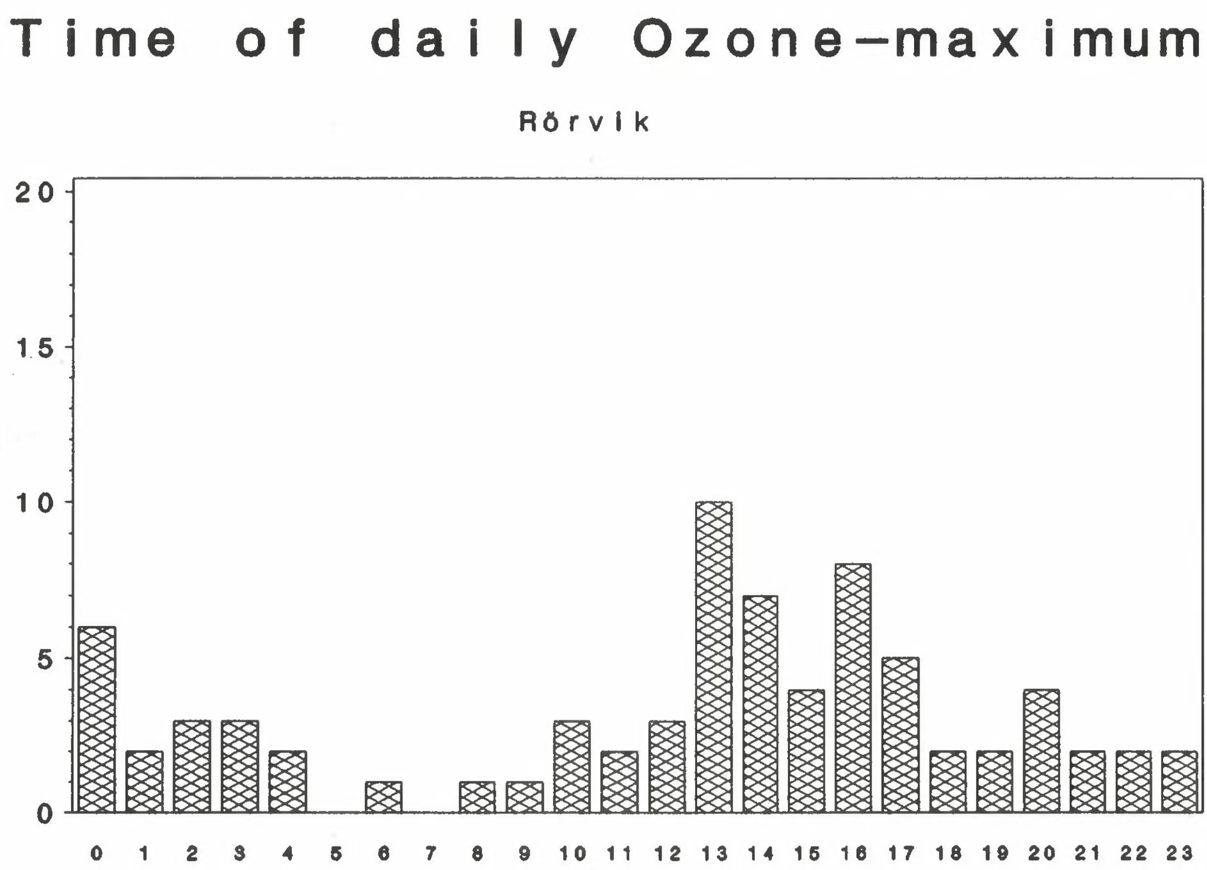


Time of daily Ozone-maximum

Frederiksborg

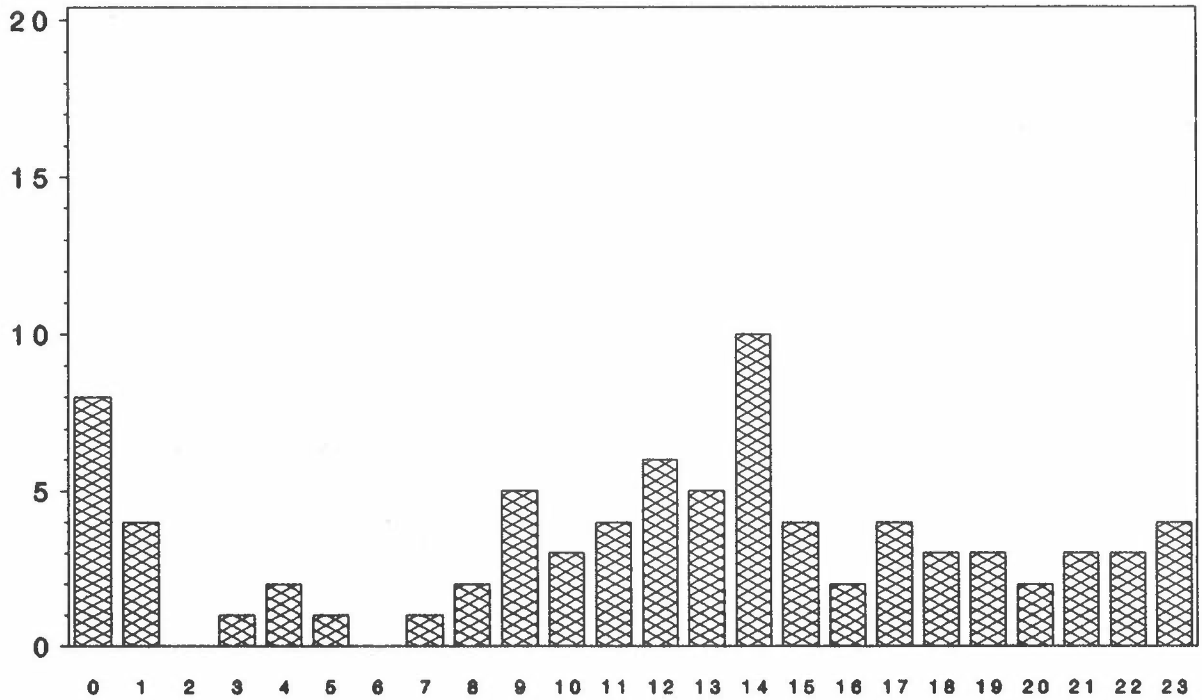



Time of daily PAN-maximum
Rörvik
20
15
10
5
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23


Time of daily Ozone-maximum
Rörvik
20
15
10
5
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

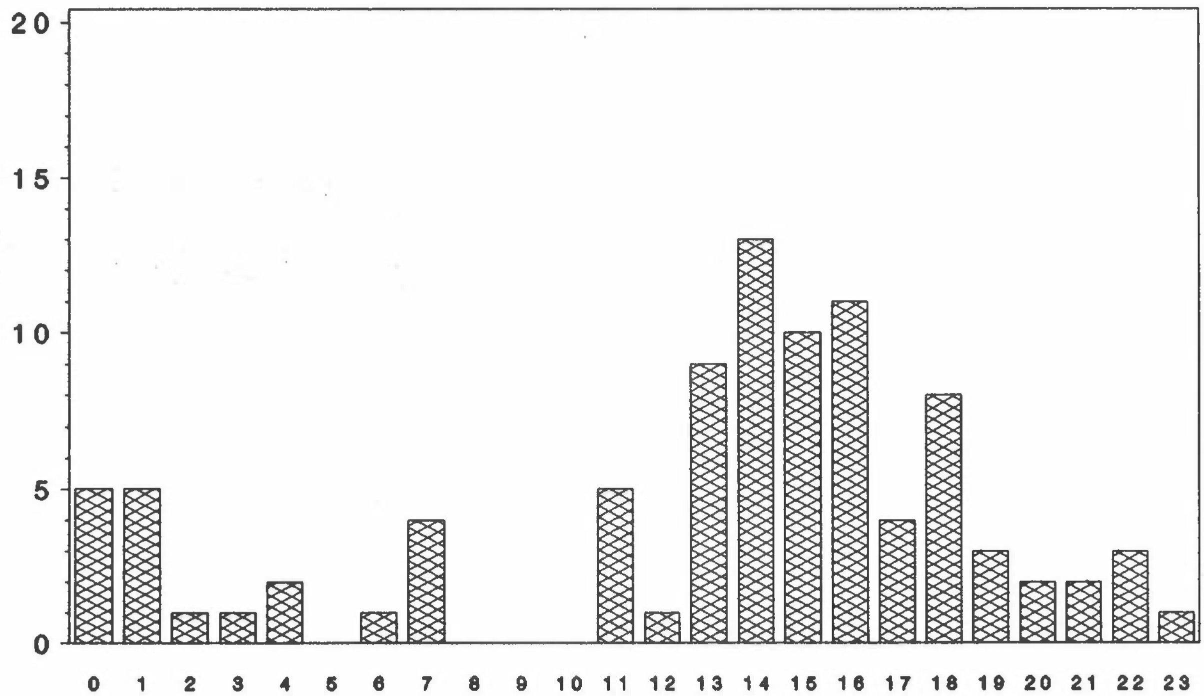
Time of daily PAN-maximum

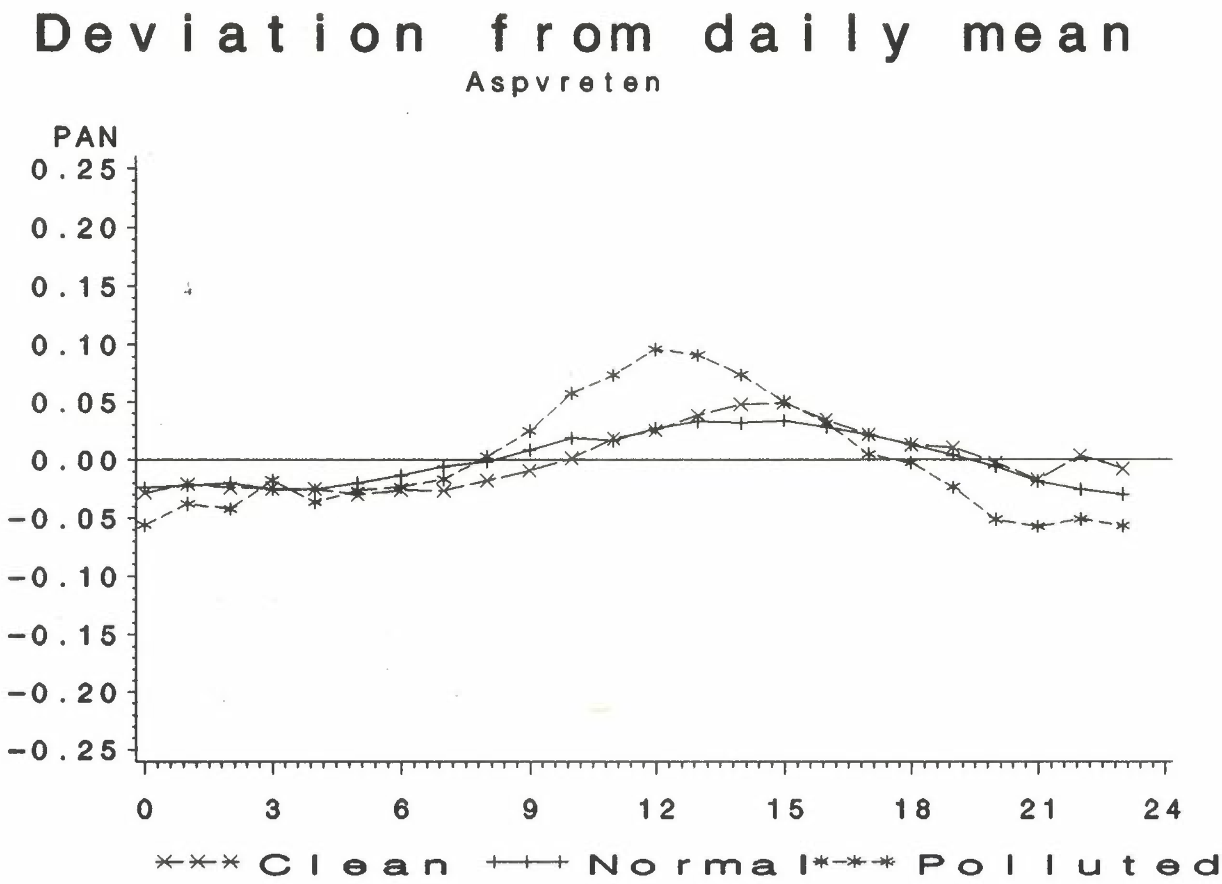
Utö



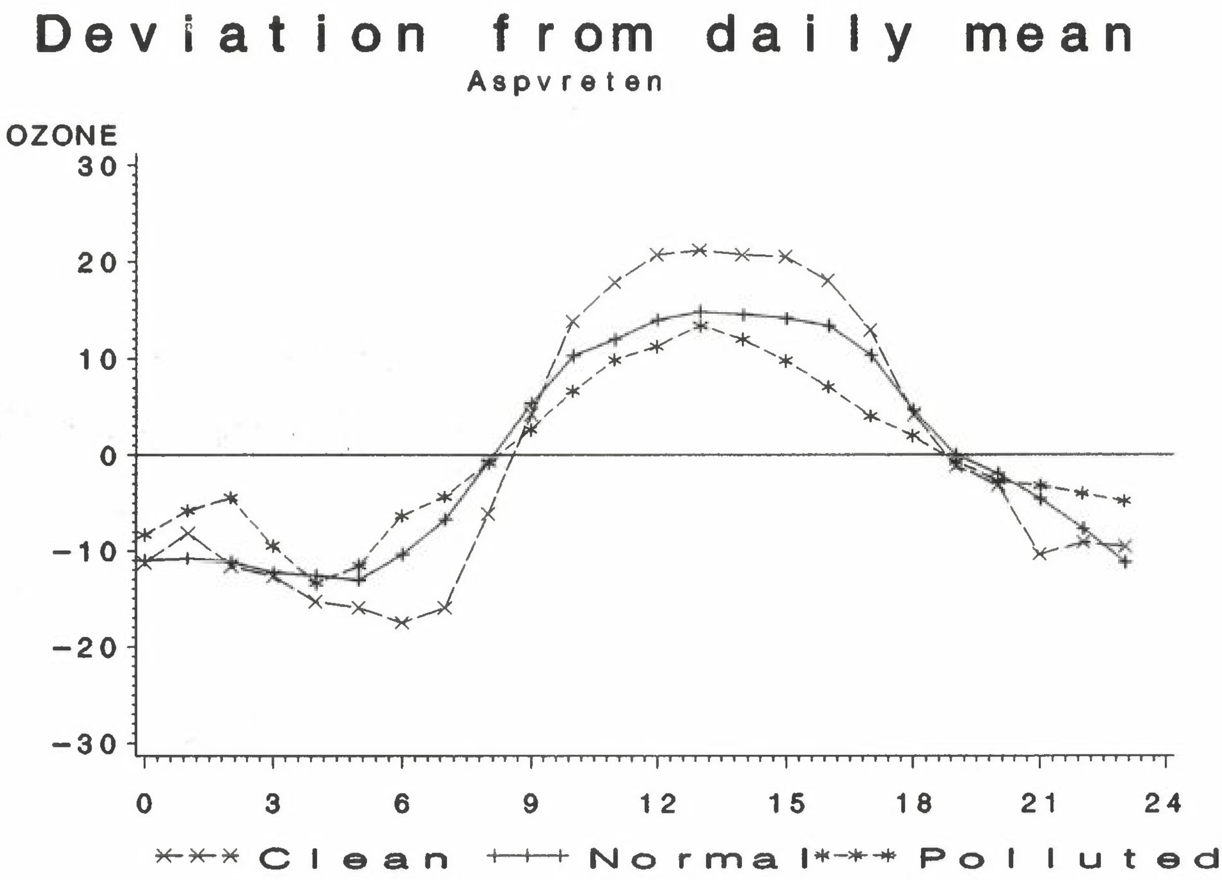
Time of daily Ozone-maximum

Utö

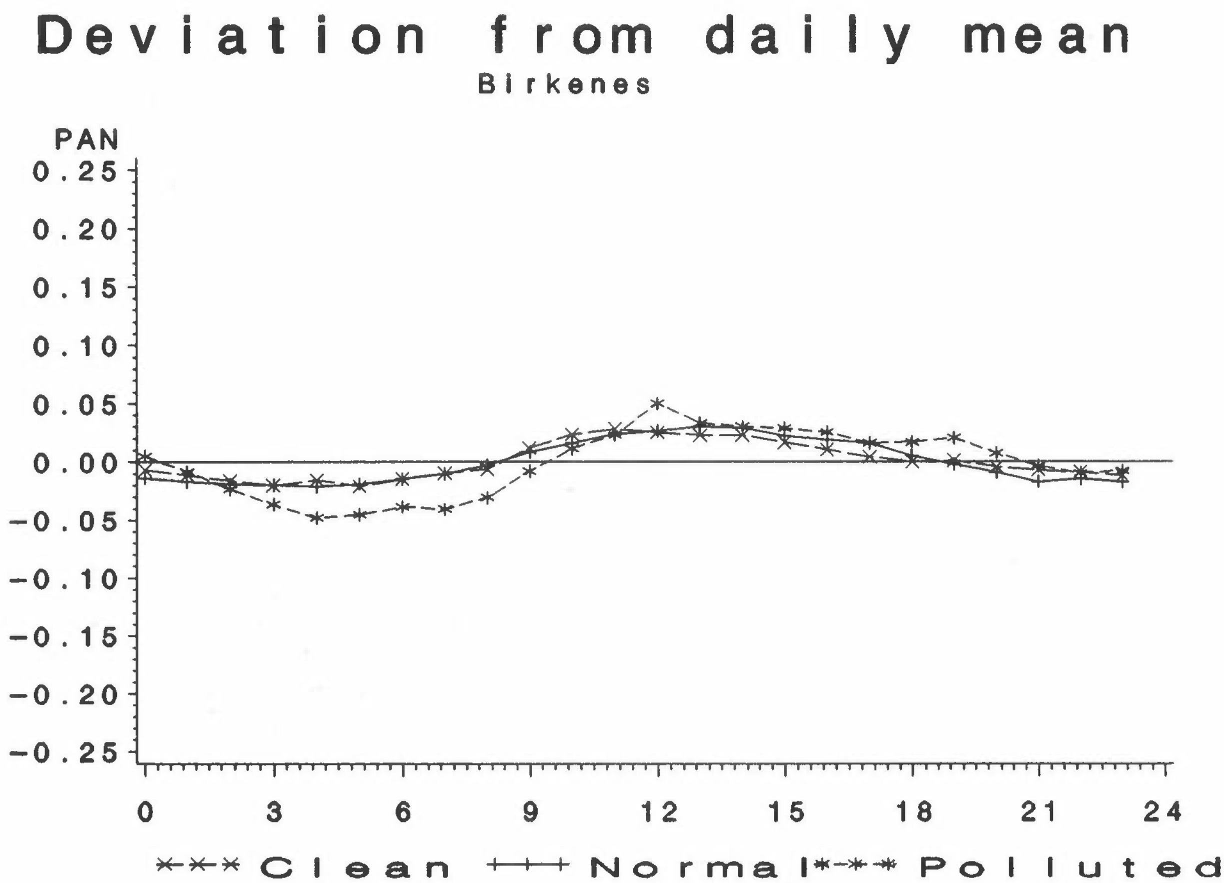


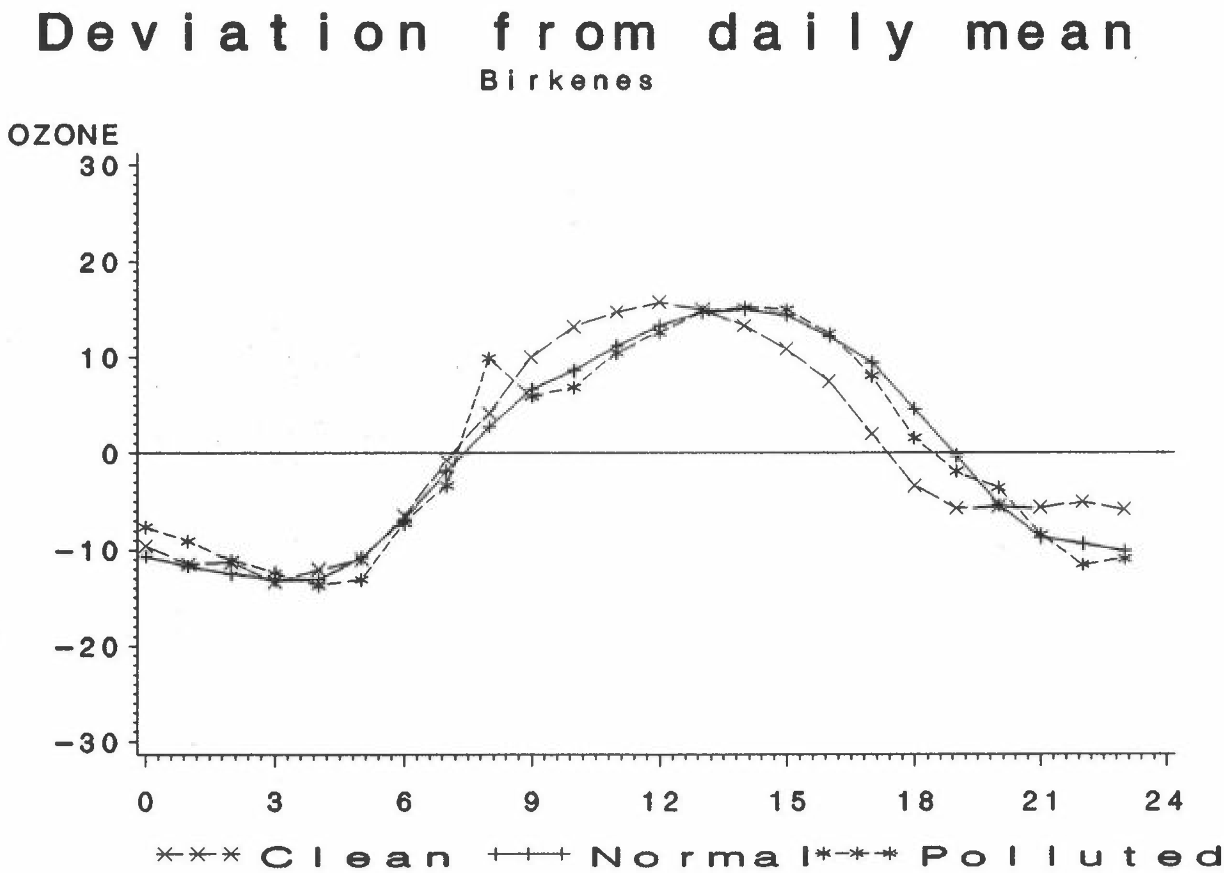


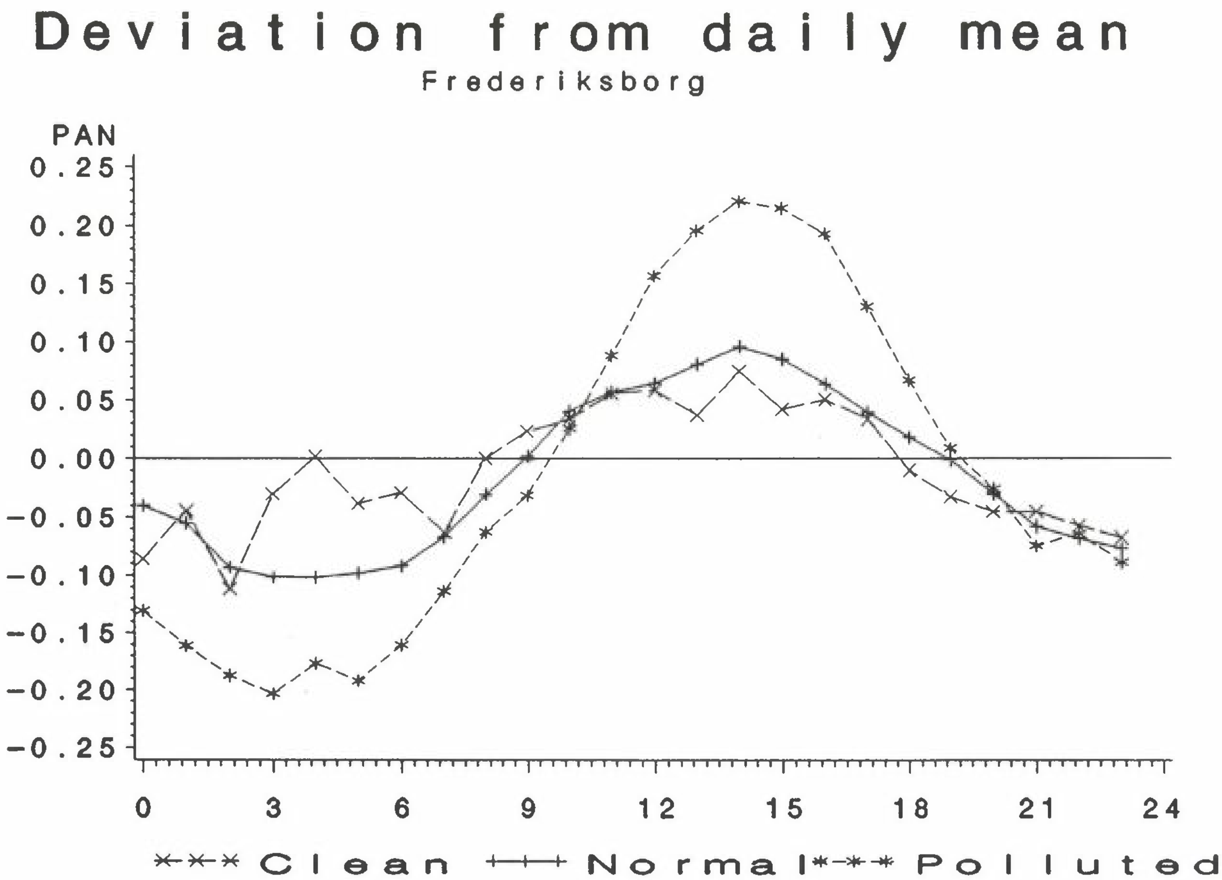
Deviation from daily mean
Aspvreten
PAN
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
-0.20
-0.25
0
3
6
9
12
15
18
21
24
Clean
Normal
Polluted

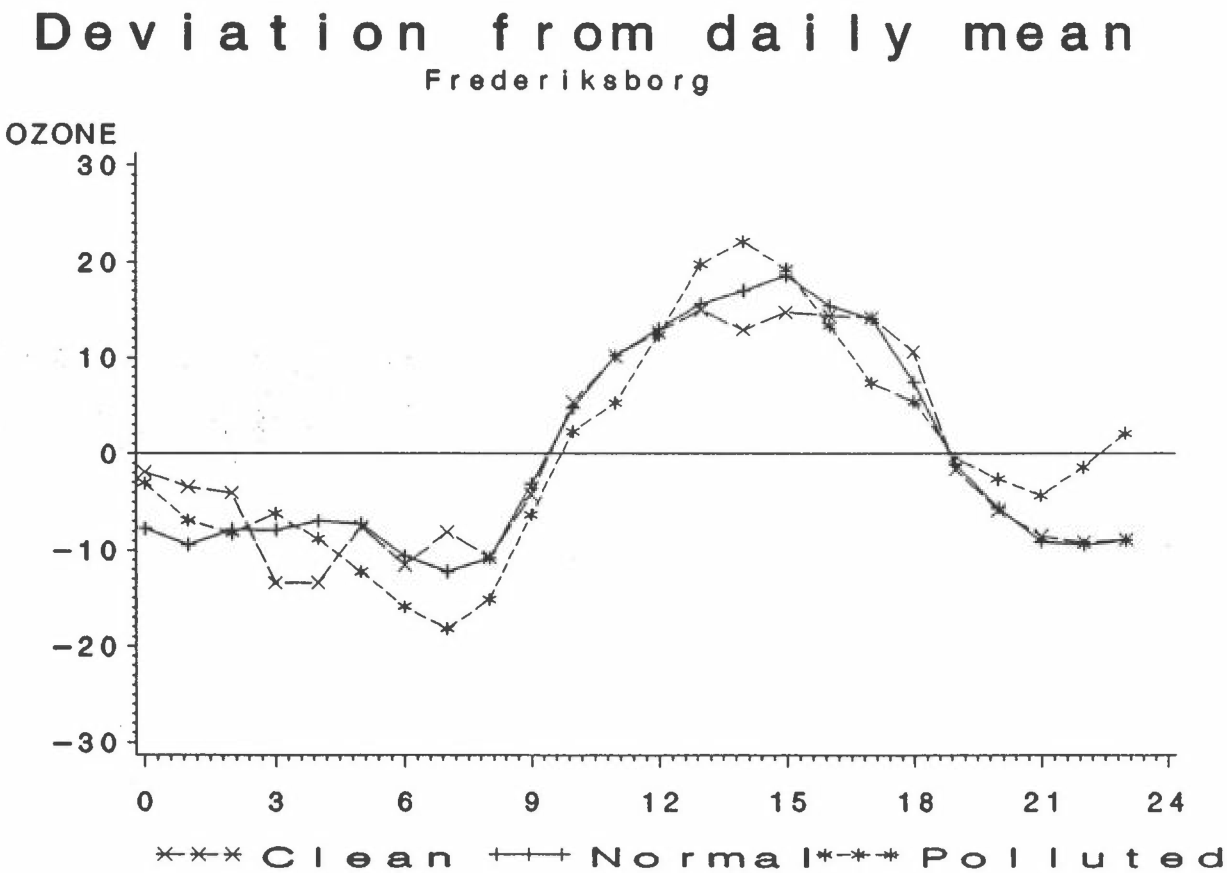


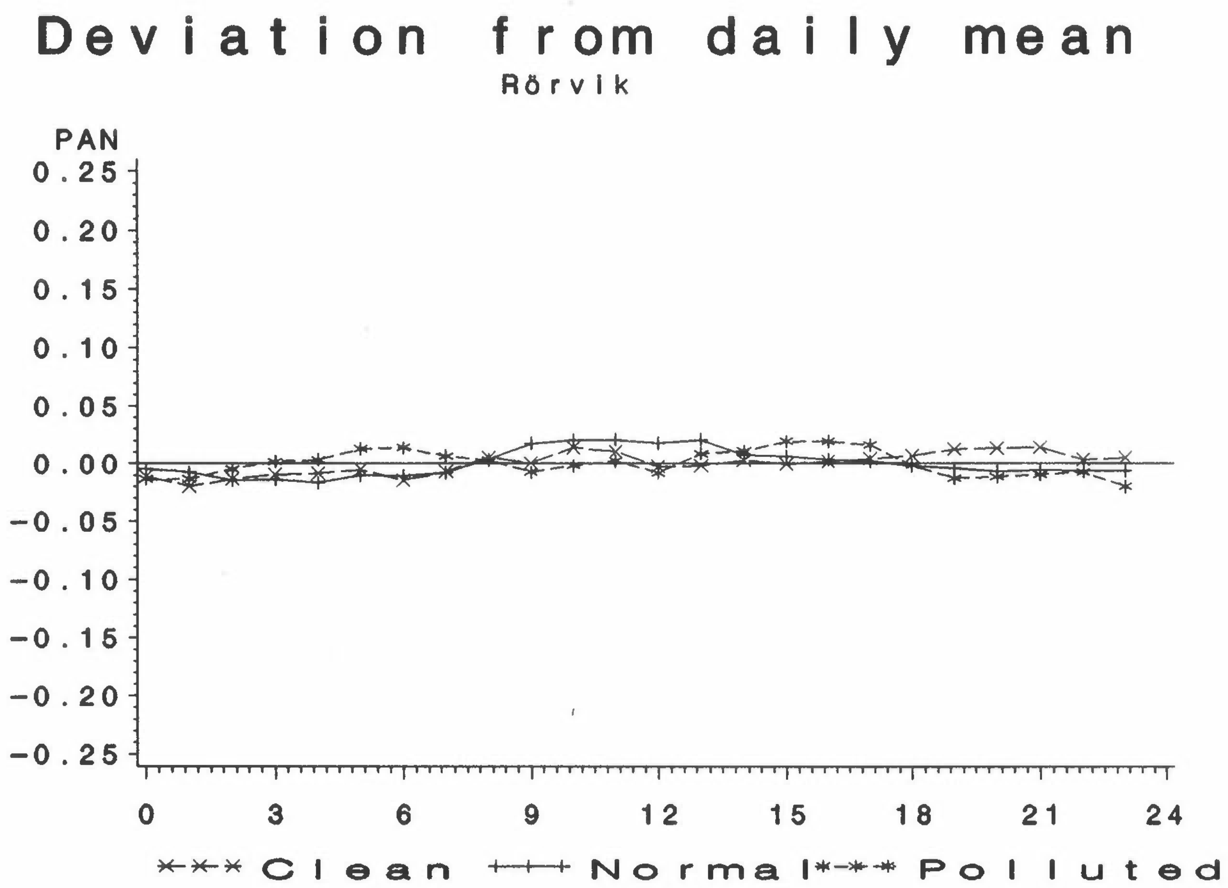
Deviation from daily mean
Aspvreten
OZONE
30
20
10
0
-10
-20
-30
0
3
6
9
12
15
18
21
24
Clean
Normal
Polluted

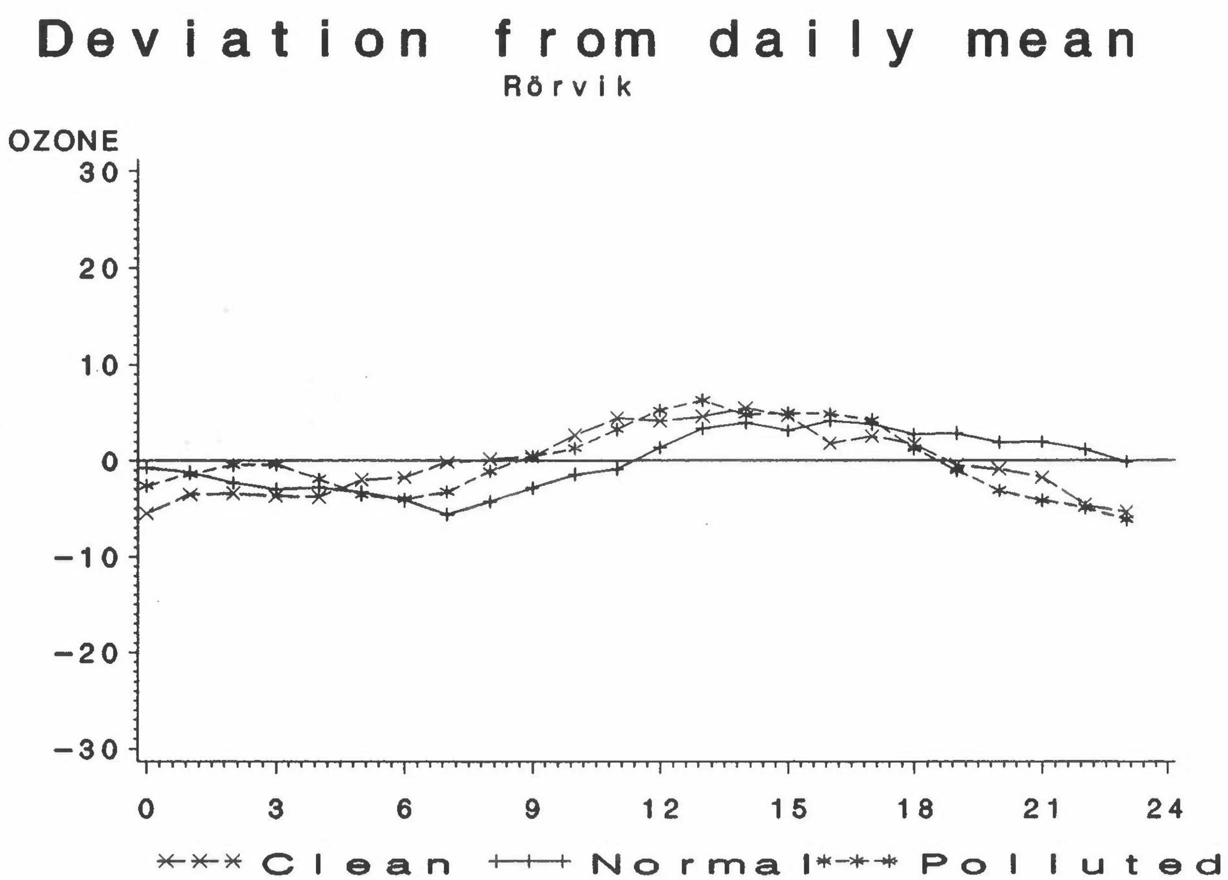

Deviation from daily mean
Birkenes
PAN
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
-0.20
-0.25
0
3
6
9
12
15
18
21
24
Clean
Normal
Polluted

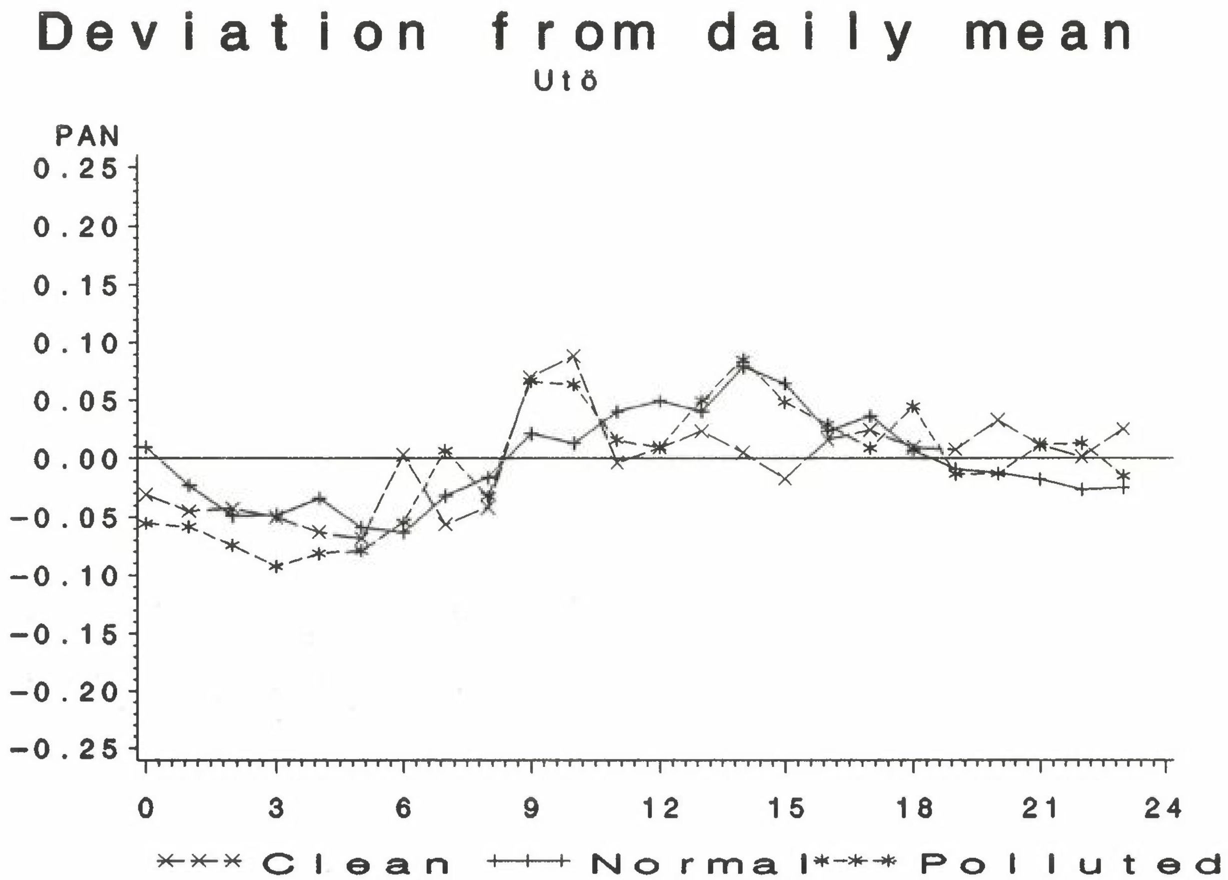

Deviation from daily mean
Birkenes
OZONE
30
20
10
0
-10
-20
-30
0
3
6
9
12
15
18
21
24
Clean
Normal
Polluted


Deviation from daily mean
Frederiksborg
PAN
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
-0.20
-0.25
0
3
6
9
12
15
18
21
24
Clean
Normal
Polluted

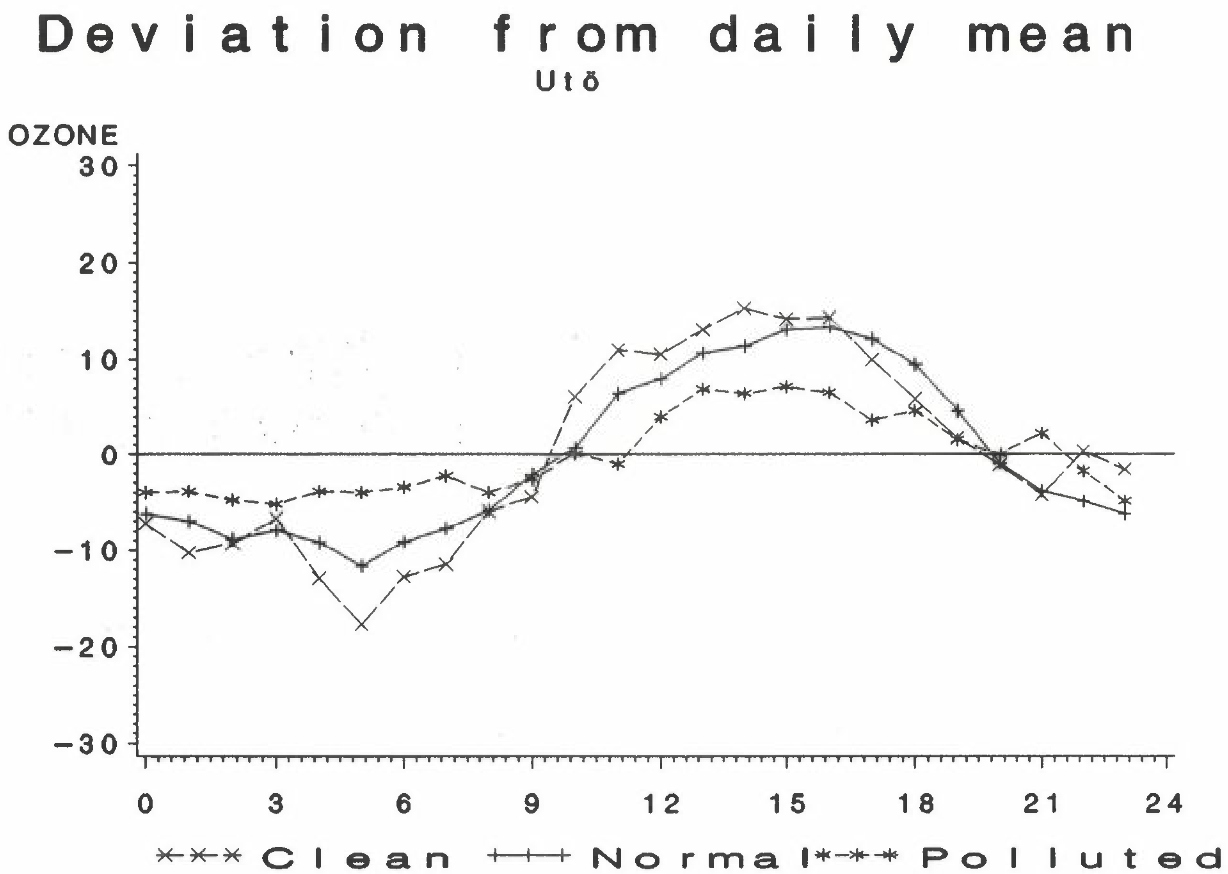

Deviation from daily mean
Frederiksborg
OZONE
30
20
10
0
-10
-20
-30
0
3
6
9
12
15
18
21
24
Clean
Normal
Polluted


Deviation from daily mean
Rörvik
PAN
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
-0.20
-0.25
0
3
6
9
12
15
18
21
24
Clean
Normal
Polluted


Deviation from daily mean
Rörvik
OZONE
30
20
10
0
-10
-20
-30
0
3
6
9
12
15
18
21
24
Clean
Normal
Polluted



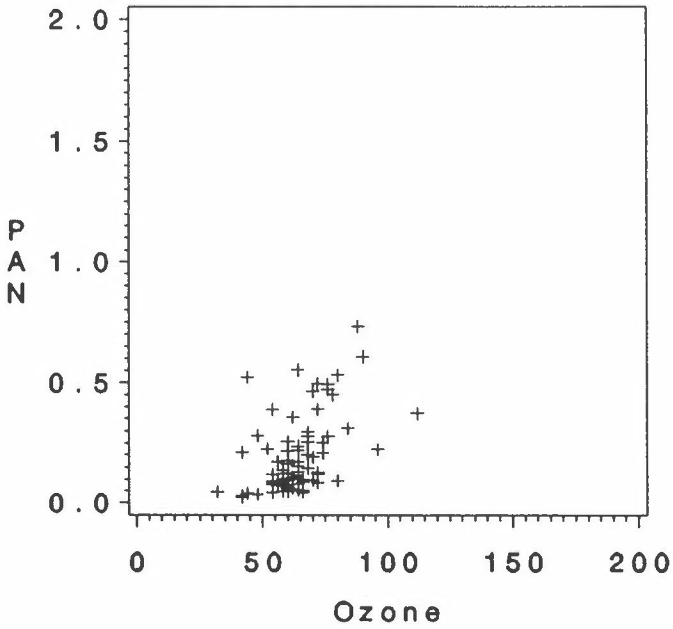
Deviation from daily mean
Utö
PAN
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
-0.20
-0.25
0
3
6
9
12
15
18
21
24
Clean
Normal
Polluted



Deviation from daily mean
Utö
OZONE
30
20
10
0
-10
-20
-30
0
3
6
9
12
15
18
21
24
Clean
Normal
Polluted

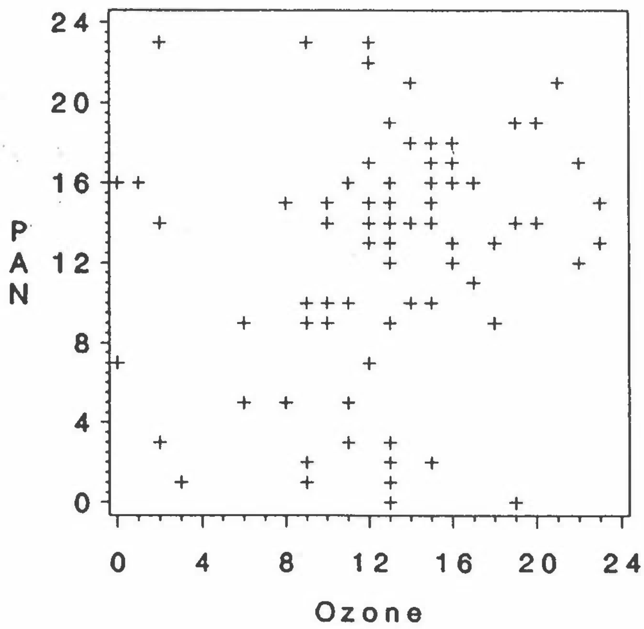
Maximum-value

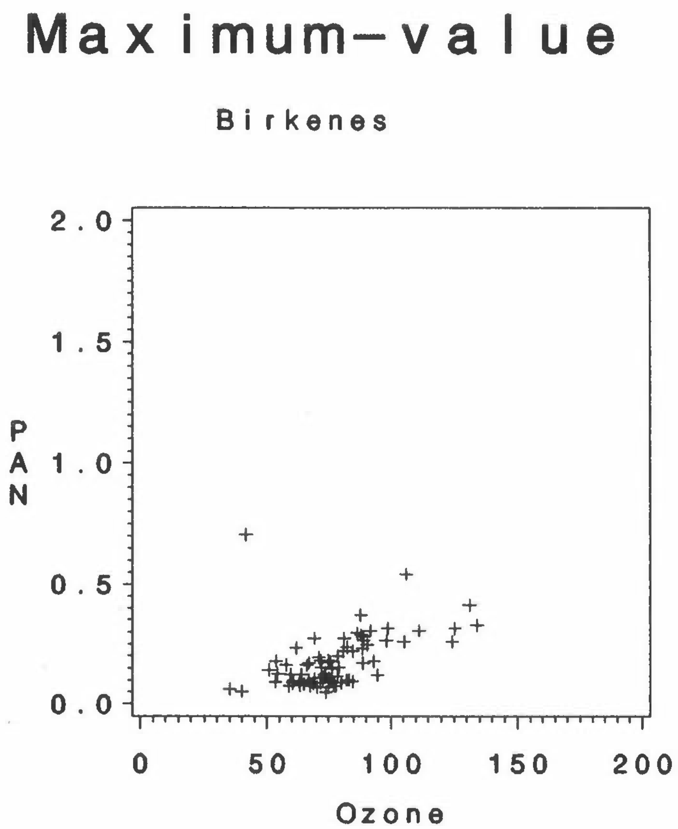
Aspvreten

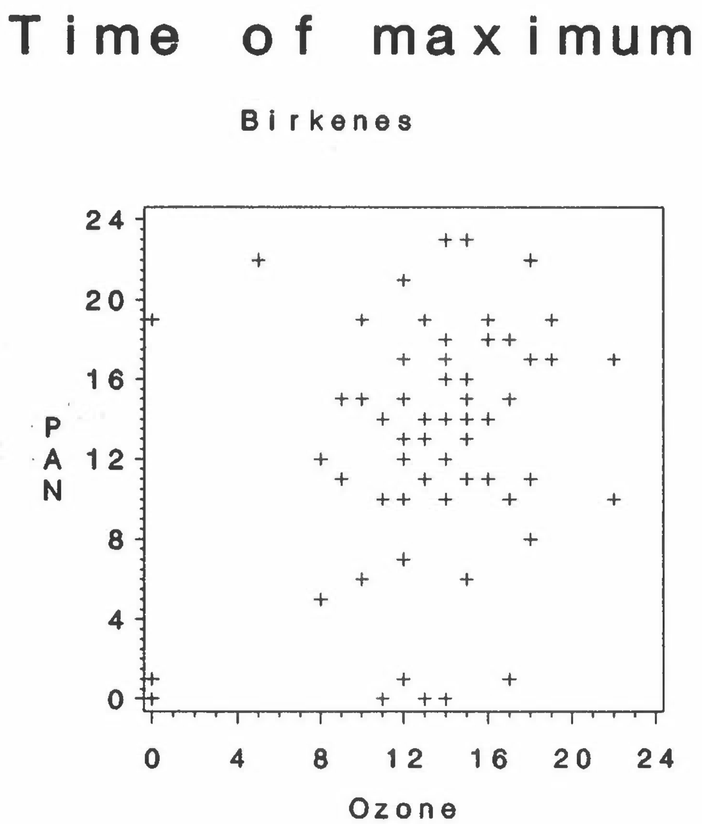


Time of maximum

Aspvreten

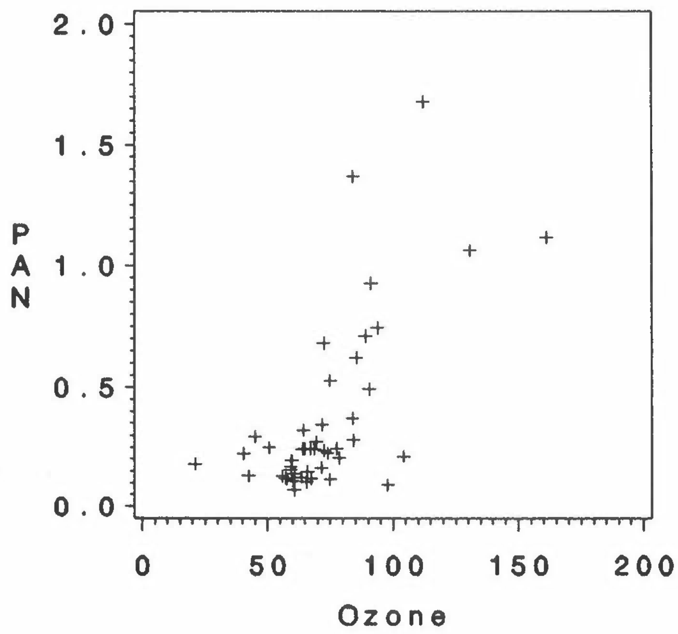



Maximum-value
Birkenes
2.0
1.5
1.0
0.5
0.0
PAN
0
50
100
150
200
Ozone


Time of maximum
Birkenes
24
20
16
12
8
4
0
PAN
0
4
8
12
16
20
24
Ozone

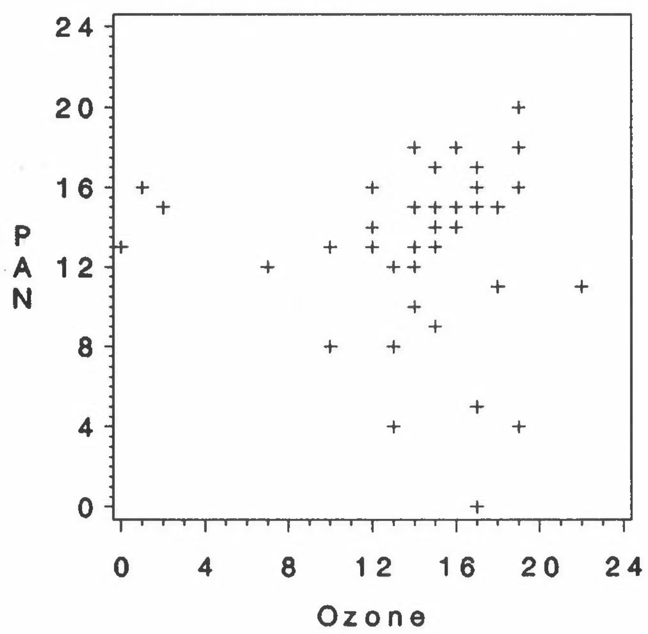
Maximum-value

Frederiksborg



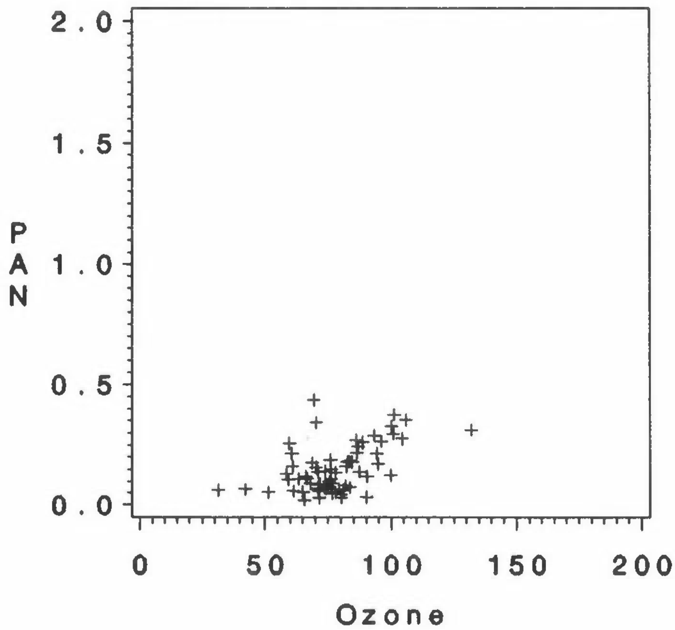
Time of maximum

Frederiksborg



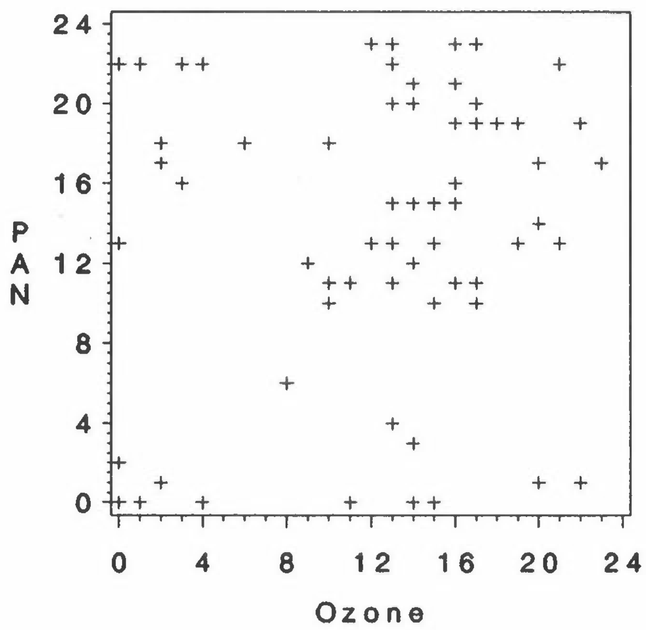
Maximum-value

Rörvik



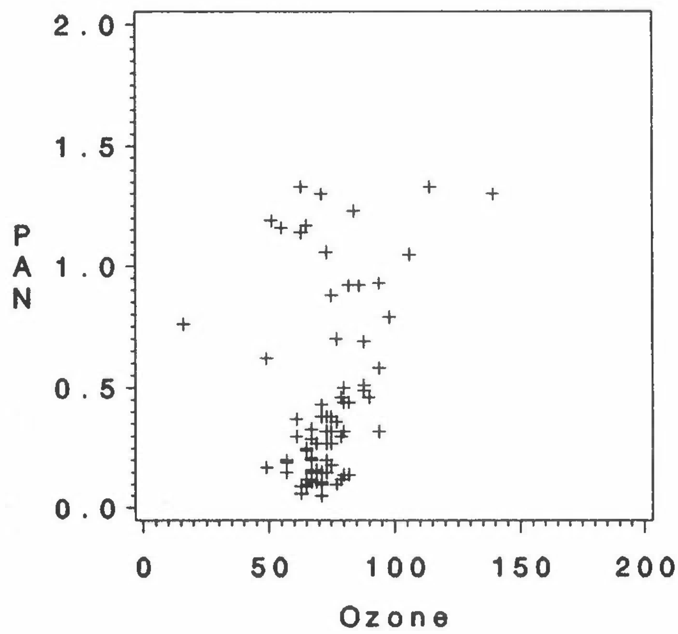
Time of maximum

Rörvik



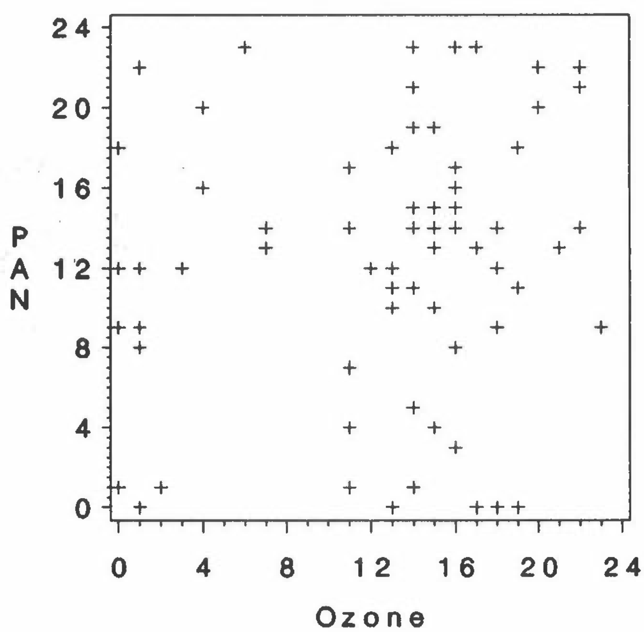
Maximum-value

Utö

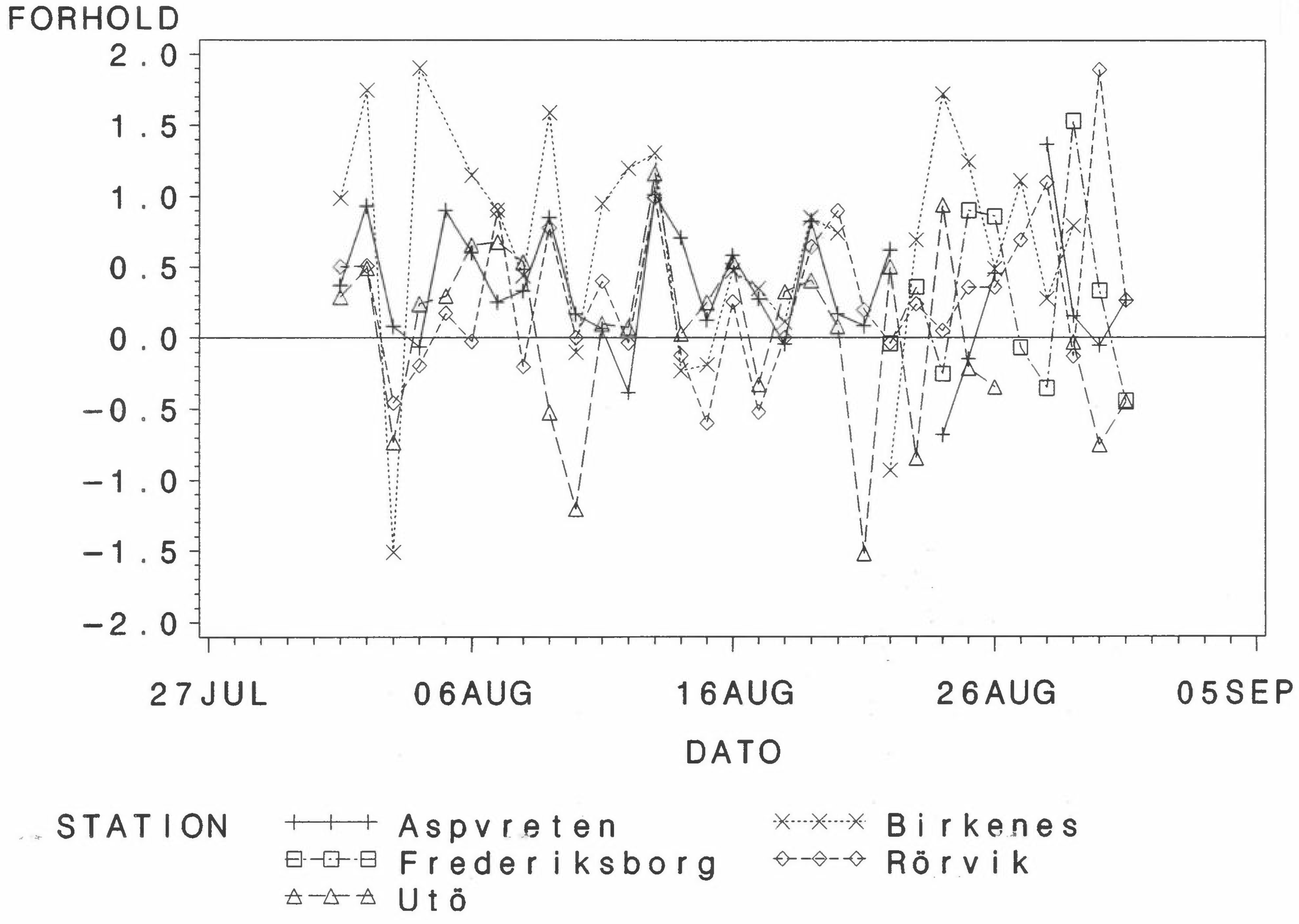


Time of maximum

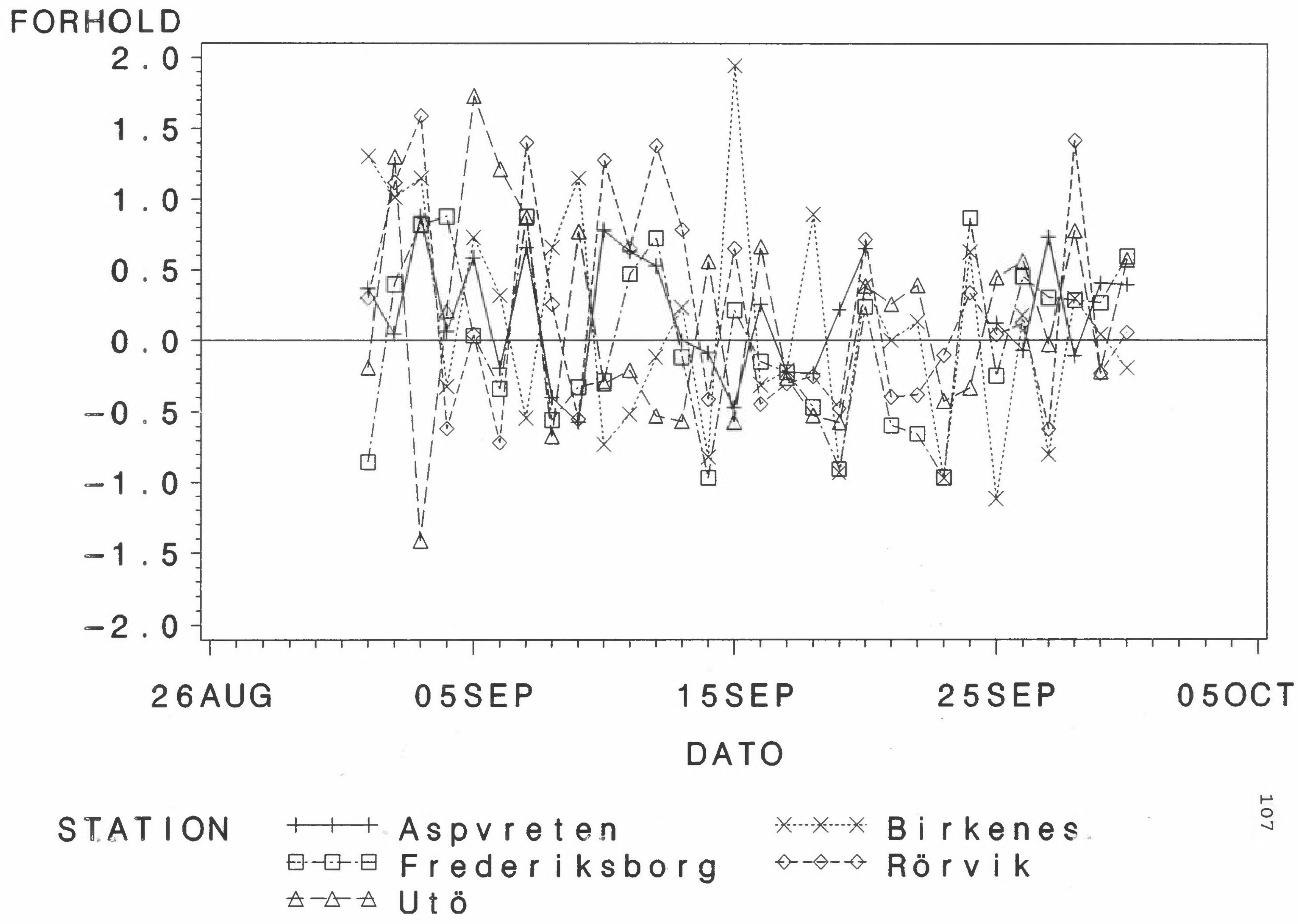
Utö



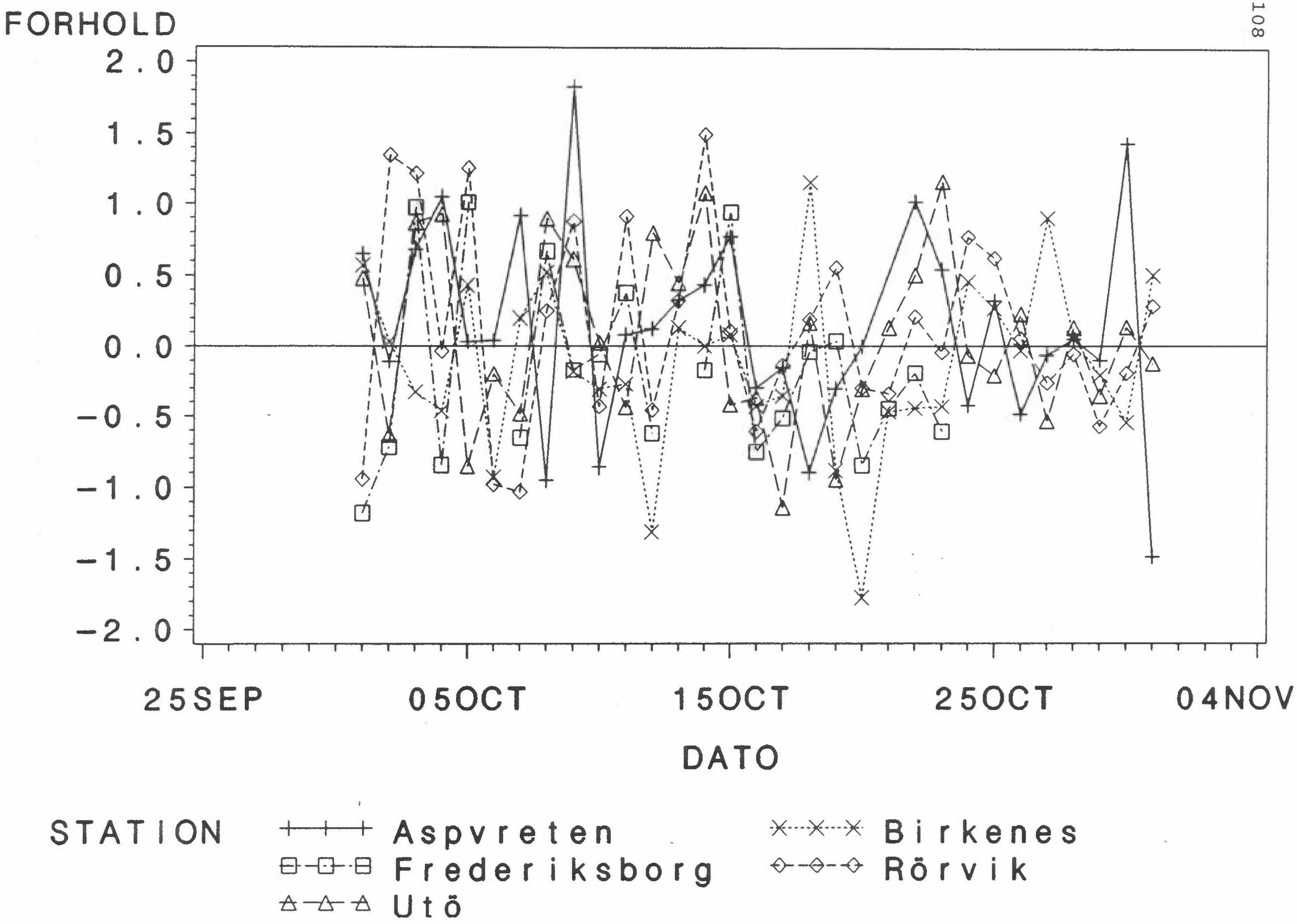
Ratio of NO2 night/day



Ratio of NO2 night/day

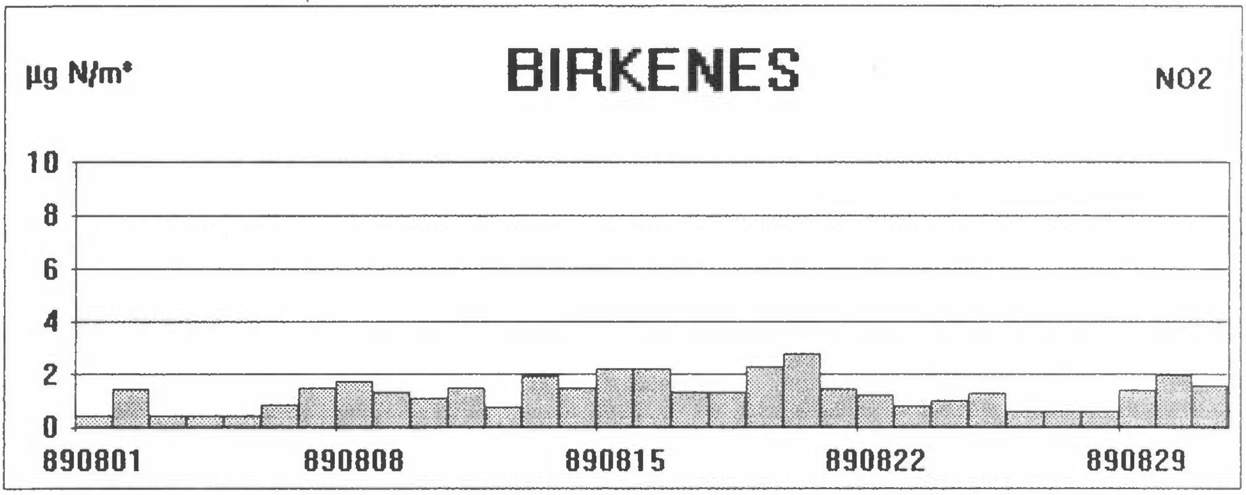


Ratio of NO2 night/day



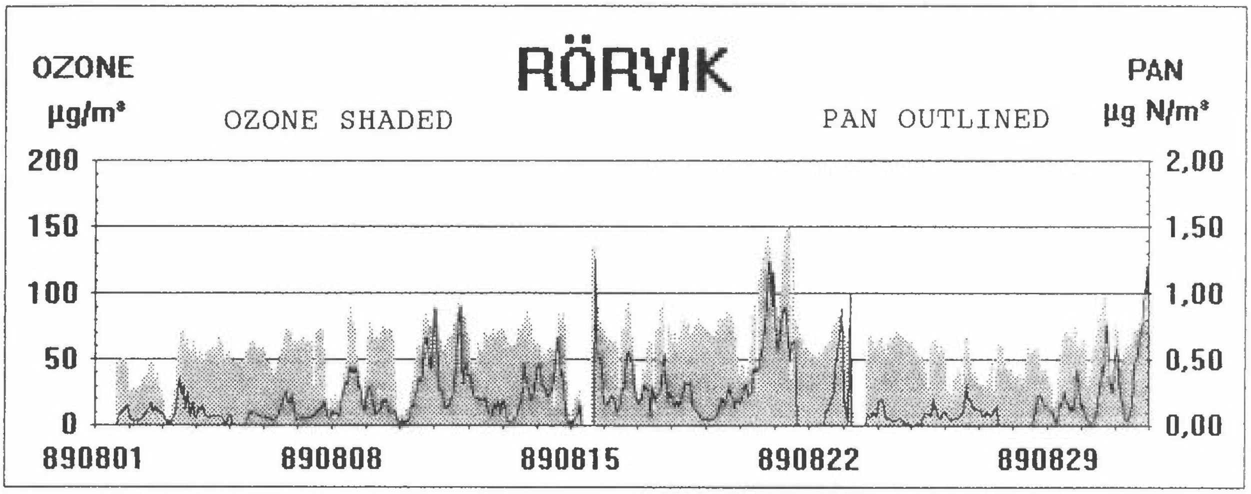
APPENDIX V

Spreadsheet toolpack listings


µg N/m³
BIRKENES
NO2
10
8
6
4
2
0
890801
890808
890815
890822
890829

	1	2	3	4	5	6	7
1	NMR EMEP-DATA GRAPHICS MACRO				BI	SO2	20
2	Generates pictures similar to the one contained in the				FR	NO2	10
3	template file defined below. Generates one picture for each				RV	NH3	5
4	month from FIRST to LAST, each station in the list in column				AS	SO4	10
5	E, and each parameter listed in column F. Edit these				UT	NH4	5
6	columns and input variables in the list below before starting				SLUTT	TNO3	5
7	the macro. (Variable names are written in capitals.)					TNH4	10
8						SLUTT	
9							
10							
11							
12	CTRL A	Keys used to start the macro.					
13							
14	INPUT VARIABLES:						
15							
16	EMEP_1.XLC	GR_MAL name of graphics templ.					
17	EMEP_GR.XLS	BER_MAL name of calc sheet					
18	EMEP_	CORE of month file name					
19	8	FIRST month to be handled					
20	8	LAST month to be handled					
21							
22							
23	COMPUTED VARIABLES:						
24							
25		MONTH loop counter					
26	1	STNR loop counter					
27	BI	STCODE 2 character station code					
28	4	PARCOUNT parameter counter					
29	SO4	PARNAME parameter name					
30	EMEP_08.XLS	MFILE complete name of month fil					
31	TRUE	AVAILABLE TRUE if parameter					
32		is found					
33	NAME LIST:						
34							
35	AVAILABLE	=$A$31	0				
36	BER_MAL	=$A$17	0				
37	CORE	=$A$18	0				
38	FIRST	=$A$19	0				
39	GR_MAL	=$A$16	0				
40	LAST	=$A$20	0				
41	MFILE	=$A$30	0				
42	MONTH	=8	0				
43	PARCOUNT	=$A$28	0				
44	PARLIST	=$F:$F	0				
45	PARNAME	=$A$29	0				
46	SCALE	=$G:$G	0				
47	START	=$A$53	2	a			
48	STCODE	=$A$27	0				
49	STLIST	=$E:$E	0				
50	STNR	=$A$26	0				
51							
52							
53	START						
54							
55	=CALCULATION(3;FALSE;;;TRUE;;)						
56	=OPEN(BER_MAL;0;TRUE)						
57	=MOVE(200;1)						
58	=SIZE(150;50)						
59	=OPEN(GR_MAL;0;TRUE)						
60	=SIZE(410;180)						
61	=MOVE(1;80)						
62	=PAGE.SETUP("&F";"Page &P &D &T";0,5;1;1;1;1)						
63							
64							
65	=FOR("MONTH";FIRST;LAST)						

	1	2	3	4	5	6	7
66							
67	=SET.VALUE(MFILE;CORE&TEXT(MONTH;"00")&".XLS")						
68	=OPEN(MFILE)						
69	=MOVE(360;1)						
70	=SIZE(100;50)						
71	=SET.VALUE(STNR;1)						
72	=SET.VALUE(STCODE;INDEX(STLIST;STNR))						
73							
74	=WHILE(NOT(STCODE="SLUTT"))						
75	=ACTIVATE(BER_MAL)						
76	=SELECT("STASJON")						
77	=FORMULA("=EMEPMAC1.XLM!STCODE")						
78	=SELECT("FIL")						
79	=FORMULA("=EMEPMAC1.XLM!MFILE")						
80	=SET.VALUE(PARCOUNT;1)						
81	=SET.VALUE(PARNAME;INDEX(PARLIST;PARCOUNT))						
82							
83	=WHILE(NOT(PARNAME="SLUTT"))						
84	=ACTIVATE(BER_MAL)						
85	=SELECT("PARAM")						
86	=FORMULA("=EMEPMAC1.XLM!PARNAME")						
87	=CALCULATE.DOCUMENT()						
88	=ACTIVATE(GR_MAL)						
89	=SELECT("Axis 1")						
90	=SCALE(0;INDEX(SCALE;PARCOUNT))						
91							
92							
93	=SET.VALUE(AVAILABLE;'C:\NMR\KAMP89\HOUR24\EMEP_GR.XLS'!TES	COMMAND DOES NOT ACCEPT					
94	=IF(AVAILABLE;PRINT(1;;;1;FALSE;FALSE;1))	NAME BER_MAL!?!					
95	=SET.VALUE(PARCOUNT;PARCOUNT+1)						
96	=SET.VALUE(PARNAME;INDEX(PARLIST;PARCOUNT))						
97							
98	=NEXT()						
99							
100	=SET.VALUE(STNR;STNR+1)						
101	=SET.VALUE(STCODE;INDEX(STLIST;STNR))						
102							
103	=NEXT()						
104							
105	=ACTIVATE(MFILE)						
106	=CLOSE(FALSE)						
107							
108	=NEXT()						
109							
110	=ACTIVATE(BER_MAL)						
111	=CLOSE(FALSE)						
112	=ACTIVATE(GR_MAL)						
113	=CLOSE(FALSE)						
114	=CALCULATION(1;FALSE;;;TRUE;;)						
115							
116	=RETURN()						


RÖRVIK
OZONE
µg/m³
OZONE SHADED
PAN OUTLINED
PAN
µg N/m³
200
150
100
50
0
2,00
1,50
1,00
0,50
0,00
890801
890808
890815
890822
890829

	A	B	C	D	E
1	NMR TIMEDATA GRAFIKKMACRO				BI
2	Genererer grafer av samme sort som				FR
3	den som er navngitt nedenfor.				RV
4	Genererer grafer for måned FIRST til				AS
5	LAST for alle stasjoner i listen i kolonne E.				UT
6	Input -data skrives i første kolonne				SLUTT
7	til venstre for variabelnavnene				
8	(variabelnavnene er skrevet med store				
9	bokstaver). Rediger også stasjons-				
10	listen i kolonne E før kjøring.				
11					
12	CTRL A	Tastetrykk for start av macroen			
13					
14	INPUT VARIABLE:				
15					
16	HG_1.XLC	GR_MAL navn på grafikk-mal			
17	HOUR_GR.XLS	BER_MAL navn på beregningsark			
18	HOUR_	CORE i månedsfilnavn			
19	8	FIRST måned som behandles			
20	10	LAST måned som behandles			
21					
22					
23	BEREGNEDE VARIABLE:				
24					
25		MONTH løkketeller			
26	6	STNR løkketeller			
27	SLUTT	STCODE 2 bokst. stasjonskode			
28	HOUR_10.XLS	MFILE komplett navn på månedsfil			
29					
30					
31	NAVNELISTE:				
32					
33	BER_MAL	=$A$17	0		
34	CORE	=$A$18	0		
35	FIRST	=$A$19	0		
36	GR_MAL	=$A$16	0		
37	LAST	=$A$20	0		
38	MFILE	=$A$28	0		
39	MONTH	=8	0		
40	START	=$A$46	2	a	
41	STCODE	=$A$27	0		
42	STLIST	=$E:$E	0		
43	STNR	=$A$26	0		
44					
45					
46	START				
47					
48	=CALCULATION(3;FALSE;;;TRUE;;)				
49	=OPEN(BER_MAL;0;TRUE)				
50	=MOVE(200;1)				
51	=SIZE(150;50)				
52	=OPEN(GR_MAL;0;TRUE)				
53	=SIZE(410;180)				
54	=MOVE(1;80)				
55	=PAGE.SETUP("&F";"Page &P &D &T";0,5;1;1;1;1)				
56					
57					

	A	B	C	D	E
58	=FOR("MONTH";FIRST;LAST)				
59					
60	=SET.VALUE(MFILE;CORE&TEXT(MONTH;"00")&".XLS")				
61	=OPEN(MFILE)				
62	=MOVE(360;1)				
63	=SIZE(100;50)				
64	=SET.VALUE(STNR;1)				
65	=SET.VALUE(STCODE;INDEX(STLIST;STNR))				
66					
67	=WHILE(NOT(STCODE="SLUTT"))				
68	=ACTIVATE(BER_MAL)				
69	=SELECT("STASJON")				
70	=FORMULA("=HOURMAC1.XLM!STCODE")				
71	=SELECT("FIL")				
72	=FORMULA("=HOURMAC1.XLM!MFILE")				
73	=CALCULATE.DOCUMENT()				
74	=ACTIVATE(GR_MAL)				
75	=PRINT(1;;;1;FALSE;FALSE;1)				
76	=SET.VALUE(STNR;STNR+1)				
77	=SET.VALUE(STCODE;INDEX(STLIST;STNR))				
78					
79	=NEXT()				
80					
81	=ACTIVATE(MFILE)				
82	=CLOSE(FALSE)				
83					
84	=NEXT()				
85					
86	=ACTIVATE(BER_MAL)				
87	=CLOSE(FALSE)				
88	=ACTIVATE(GR_MAL)				
89	=CLOSE(FALSE)				
90	=CALCULATION(1;FALSE;;;TRUE;;)				
91					
92	=RETURN()				

APPENDIX VI

Short comment to measurement
data from the 1990 campaign

SHORT COMMENTS TO THE 1990 CAMPAIGN

The 1990 campaign was performed in March, April and May. The spring time concentrations of oxidants and nitrogen compounds differ from the autumn concentrations (the 1989 campaign was performed in August, September and October). The PAN episodes in the 1990 campaign have concentrations up to 3 times the maximum found in the 1989 campaign. Also for total NH_4 significantly higher concentrations have been found during the 1990 campaign.

An episode of high pollution concentrations was registered from 16-19 March. Detailed evaluation of the episodes has not been performed. The data files are listed in Appendix VII. Overview plots are given in Appendix VIII.

APPENDIX VII

Data listings, 1990 campaign

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	DATE	AS_NO2	AS_OZONE	AS_PAN	AS_SO2	AS_SO4	AS_TNH4	AS_TNO3	BI_NO2	BI_NO2_KI	BI_OZONE	BI_PAN	BI_SO2	BI_SO4	BI_TNH4	BI_TNO3
2		NO2	OZONE	PAN	SO2	SO4	TNH4	TNO3	NO2	NO2-KI	OZONE	PAN	SO2	SO4	TNH4	TNO3
3		µg N/m³	µg/m³	µg N/m³	µg S/m³	µg S/m³	µg N/m³	µg N/m³	µg N/m³	µg N/m³	µg/m³	µg N/m³	µg S/m³	µg S/m³	µg N/m³	µg N/m³
4		ASPVRETEN	ASPVRETEN	ASPVRETEN	ASPVRETEN	ASPVRETEN	ASPVRETEN	ASPVRETEN	BIRKENES	BIRKENES	BIRKENES	BIRKENES	BIRKENES	BIRKENES	BIRKENES	BIRKENES
5																
6																
7																
8	900301	2,76			0,329	0,360	0,29	0,02	-0,37		74	0,45	0,127	0,164	0,10	0,04
9	900302	0,87			0,188	0,121	0,06	0,02	-0,36		75	0,54	0,073	0,172	0,05	0,04
10	900303	0,97			0,330	0,020	0,18	0,02	-0,40		66	0,37	0,095	0,196	0,13	0,12
11	900304	1,22			0,140	0,140	0,05	0,02	-0,40		73	0,35	0,105	0,281	0,05	0,07
12	900305	1,33			0,111	0,159	0,01		-0,41		78		0,068	0,185	0,04	0,05
13	900306	1,48			0,030	0,051	0,01	0,28	-0,40		77	0,41	0,045	0,222	0,04	0,04
14	900307	1,69			0,284	0,149	0,04	0,22	-0,41		65	0,25	0,141	0,269	0,04	0,06
15	900308	2,41			0,298	0,296	0,04	0,32	-0,41		76	0,39				
16	900309	1,23	67		0,989	0,173	0,02	0,04	-0,38		75	0,34	0,060	0,120	0,04	0,02
17	900310	0,99	67		0,294	0,020	0,09	0,07	-0,37		59	0,33	0,144	0,244	0,14	0,08
18	900311	1,04	68		0,138	0,139	0,01	0,02	-0,41		47	0,18	0,034	0,205	0,08	0,05
19	900312	0,82	74		0,135	0,139	0,20	0,02	-0,40		81	0,38	-0,020	0,243	0,05	0,06
20	900313	0,98	70		0,072	0,207	0,18	0,06	0,79		70	0,33	0,208	0,315	0,16	0,20
21	900314	1,46	71		1,034	0,443	0,41	0,31	2,89		51	0,41	1,432	1,442	1,43	1,09
22	900315	2,94	64		4,249	1,673	1,95	1,26	3,50		54	0,42	2,516	1,264	0,85	0,65
23	900316	2,59	60		1,687	1,682	1,94	0,90	2,89		54	0,34	1,850	2,253	1,90	1,08
24	900317	2,10	94		5,063	2,118	6,27	4,05	4,24		58	1,97	9,532	2,798	5,78	3,62
25	900318	1,64	110		3,273	2,703	6,00	3,37	2,31		74	2,10	1,336	2,787	7,51	4,91
26	900319	1,84	89		1,708	2,187	4,43	2,11	0,89		66	0,55	0,379	0,820	0,74	0,53
27	900320	1,01	71		0,343	0,463	0,31	0,34	0,98		74	0,32	0,727	0,652	0,35	0,23
28	900321	1,88	60		0,919	1,091	2,25	1,18	1,67		64	0,44	0,534	0,654	0,28	0,26
29	900322	1,27	69		0,216	0,376	0,42	0,23	-0,41		73	0,30	0,035	0,127	0,03	0,04
30	900323	1,50	69		0,410	0,286	0,34	0,13	0,94		77	0,32	0,047	0,319	0,13	0,13
31	900324	1,12	70		0,149	0,512	0,37	0,18	-0,40		77	0,31	0,051	0,204	0,03	0,09
32	900325	1,70	64		0,257	0,421	0,26	0,09	-0,38		76	0,27	0,027	0,031	0,03	0,02
33	900326	1,51	51		0,205	0,404	0,31	0,11	0,81		53	0,23	0,175	0,101	0,02	0,09
34	900327	0,59	80		0,593	0,563	0,01	0,16	0,86		50	0,27	0,376	0,436	0,14	0,26
35	900328	0,94	65		0,916	0,985	0,87	0,23	1,27		44	0,56	0,386	0,817	0,94	0,57
36	900329	1,66	74				1,15		0,62		58	0,40	0,213	0,739	0,33	0,23
37	900330	0,96	66		0,030	0,696	0,39	0,23	0,90		77	0,31	0,049	0,187	0,03	0,09
38	900331	0,73	78		0,298	0,243	0,01	0,16	-0,42		75	0,20	0,035	0,716	0,26	0,13

	1	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1	DATE	FR_NO2	FR_OZONE	FR_PAN	FR_SO2	FR_TNH4	FR_TNO3	RV_NO2	RV_NO2_CI	RV_OZONE	RV_PAN	RV_SO2	RV_SO4	RV_TNH4	RV_TNO3	UT_NO2
2		NO2	OZONE	PAN	SO2	TNH4	TNO3	NO2	NO2-CL	OZONE	PAN	SO2	SO4	TNH4	TNO3	NO2
3		µg N/m^3	µg/m^3	µg N/m^3	µg S/m^3	µg N/m^3	µg N/m^3	µg N/m^3	µg N/m^3	µg/m^3	µg N/m^3	µg S/m^3	µg S/m^3	µg N/m^3	µg N/m^3	µg N/m^3
4		FREDERIKS	FREDERIKS	FREDERIKS	FREDERIKS	FREDERIKS	FREDERIKS	RÖRVIK	RÖRVIK	RÖRVIK	RÖRVIK	RÖRVIK	RÖRVIK	RÖRVIK	RÖRVIK	UTÖ
5																
6																
7																
8	900301	1,43			0,426	0,20	0,12	2,3		50	0,048	1,3	1,10	0,19	0,22	1,70
9	900302	0,75			0,297	0,13	0,05	1,3		61	0,032	1,7	1,03	0,16	0,24	1,18
10	900303	1,91			1,601	0,72	0,44	1,2		63	0,074	1,8	1,31	0,51	0,02	0,98
11	900304	1,45			1,404	0,17	0,07	0,6		70		1,2	1,39	0,28	0,14	1,82
12	900305	1,79			1,379	0,70	0,30	0,5		75	0,036	1,4	1,42	0,29	0,02	0,66
13	900306	1,81			0,376	0,19	0,12	0,4		73	0,031	0,9	1,17	0,03	0,05	
14	900307	4,02			1,802	1,68	0,92	1,3		62		0,9	1,40	0,49	0,24	1,08
15	900308	4,64			6,159	4,62	2,43	1,6	3,15	61	0,071	2,3	1,86	0,18	0,72	1,44
16	900309	1,97			0,520	0,63	0,39	0,5	0,65	70	0,076	1,2	1,11	0,15	0,04	2,08
17	900310				0,915	0,74	0,41	2	3,62	52	0,070	0,9	1,51	0,61	0,46	1,47
18	900311	1,99			1,410	1,31	0,53	0,2	1,79	67	0,021	1,3	1,59	0,56	0,13	0,58
19	900312	2,62			0,228	0,32	0,11	0,3	0,53	75		1,0	1,20	0,06	0,03	1,14
20	900313	10,16			2,001	0,77	0,51	3,7	3,44	53	0,051	1,0	1,04	0,31	0,04	1,82
21	900314	7,83			6,450	3,88	1,80	2,4	3,85	47	0,143	5,8	1,80	2,79	1,21	
22	900315	5,06			3,258	4,67	3,14	3,3	3,17	56	0,171	3,8	2,36	1,27	1,84	
23	900316	5,48			4,250	6,83	4,86	2,4	5,99	65	0,257	3,1	2,26	1,02	2,76	1,89
24	900317	5,81			4,874	19,06	13,55	4,6		83	1,129	5,1	4,43	10,78	11,76	1,74
25	900318	5,64				14,64	8,44	3,6	5,23	98	1,062	5,1	5,32	6,77	5,19	1,40
26	900319	4,99			1,283	6,91	3,52	3,5	6,78	65	0,349	2,7	2,91	5,06	2,73	1,52
27	900320	3,43			4,605	3,90	2,31	1,7	2,58	65	0,067	2,3	1,66	1,57	0,61	1,33
28	900321	5,35			3,905	6,79	3,12	3,7	3,16	47	0,047	2,8	3,17	4,31	0,29	1,68
29	900322	2,04			1,286	1,21	0,66	0,7	1,27	70	0,027	0,1	1,40	0,48	0,14	1,16
30	900323	2,66			3,175	2,66	1,46	1,6	2,53	65	0,029	0,1	1,30	0,00	0,58	1,16
31	900324	1,84			1,565	1,42	0,59	0,6	0,89	73	0,019	0,1	1,05	0,82	0,21	1,06
32	900325	1,46			0,362	0,34	0,17	1,3	2,10	61		0,1	0,82	0,34	0	2,17
33	900326	3,08			0,443	0,95	0,42	2,6	3,25	50	0,037	1,1	1,17	0,31	0,11	1,43
34	900327	5,64			1,436	1,24	0,66	3,8	3,48	56	0,055	1,8	1,41	0,89	0,65	0,94
35	900328	3,80			0,594	2,22	1,10	2,5	2,38	58	0,087	1,2	1,52	0,92	0,31	1,67
36	900329	3,48			1,797	3,44	1,68	1,4	1,93	79	0,102	2,0	1,87	1,23	1,15	1,05
37	900330	2,24			0,562	1,06	0,55	1,2	1,75	75	0,035	1,0	1,48	0,67	0,15	1,22
38	900331	1,64			0,494	2,50	1,28	1,5	1,99	71	0,023	0,8	2,17	1,68	0,51	2,35

EM_9003.XLS Page 3 16.9.92 9:24

	1	32	33	34	35	36	37	38	39	40	41	42
1	DATE	UT_OZONE	UT_PAN	UT_SO2	UT_SO4	UT_TNH4	UT_TNO3					
2		OZONE	PAN	SO2	SO4	TNH4	TNO3					
3		µg/m³	µg N/m³	µg S/m³	µg S/m³	µg N/m³	µg N/m³					
4		UTÖ	UTÖ	UTÖ	UTÖ	UTÖ	UTÖ					
5												
6												
7												
8	900301	57		1,260	0,587	0,22	0,32		AS_NO2	=R2C2:R38C2	RV_TNO3	=R2C30:R38C30
9	900302	72		0,606	0,321	0,11	0,14		AS_OZONE	=R2C3:R38C3	UT_NO2	=R2C31:R38C31
10	900303	72		0,240	0,190	0,11	0,07		AS_PAN	=R2C4:R38C4	UT_OZONE	=R2C32:R38C32
11	900304	64		0,232	0,269	0,12	0,13		AS_SO2	=R2C5:R38C5	UT_PAN	=R2C33:R38C33
12	900305	79		0,109	0,436	0,14	0,12		AS_SO4	=R2C6:R38C6	UT_SO2	=R2C34:R38C34
13	900306	78		0,147	0,188	0,07	0,04		AS_TNH4	=R2C7:R38C7	UT_SO4	=R2C35:R38C35
14	900307	69		0,178	0,251	0,16	0,12		AS_TNO3	=R2C8:R38C8	UT_TNH4	=R2C36:R38C36
15	900308	76		0,014	0,677	0,13	0,19		BI_NO2	=R2C9:R38C9	UT_TNO3	=R2C37:R38C37
16	900309	66		0,668	1,556	1,29	0,99		BI_NO2_KI	=R2C10:R38C10		
17	900310	77		0,137	0,192	0,06	0,06		BI_OZONE	=R2C11:R38C11		
18	900311	79		0,220	0,173	0,10	0,04		BI_PAN	=R2C12:R38C12		
19	900312	73		0,136	0,248	0,12	0,12		BI_SO2	=R2C13:R38C13		
20	900313	72		0,606	0,292	0,09	0,09		BI_SO4	=R2C14:R38C14		
21	900314	78		0,830	0,441	0,15	0,18		BI_TNH4	=R2C15:R38C15		
22	900315			1,625	1,522	1,60	0,97		BI_TNO3	=R2C16:R38C16		
23	900316	61		0,493	2,208	1,39	0,97		DATE	=R2C1:R38C1		
24	900317	78		1,023	2,536	1,79	1,83		FR_NO2	=R2C17:R38C17		
25	900318	124		1,034	3,093	4,11	5,83		FR_OZONE	=R2C18:R38C18		
26	900319	112		1,394	4,308	3,39	3,83		FR_PAN	=R2C19:R38C19		
27	900320	78		0,177	0,480	0,36	0,33		FR_SO2	=R2C20:R38C20		
28	900321	70		0,424	1,343	1,42	1,22		FR_TNH4	=R2C21:R38C21		
29	900322	73		0,164	0,625	0,41	0,34		FR_TNO3	=R2C22:R38C22		
30	900323	79		0,187	0,220	0,13	0,11		Print_Area	=R8C2:R38C42		
31	900324	77		0,155	0,708	0,39	0,24		Print_Titles	=C1;R1:R7		
32	900325	69		0,333	0,328	0,15	0,10		RV_NO2	=R2C23:R38C23		
33	900326	67		1,132	0,777	1,17	0,13		RV_NO2_CL	=R2C24:R38C24		
34	900327	77		1,692	0,894	1,91	0,22		RV_OZONE	=R2C25:R38C25		
35	900328	73		1,097	1,397	1,94	0,45		RV_PAN	=R2C26:R38C26		
36	900329	78	0,150	0,430	1,229	0,98	0,65		RV_SO2	=R2C27:R38C27		
37	900330	84	0,067	0,265	0,522	1,00	0,30		RV_SO4	=R2C28:R38C28		
38	900331	78	0,072	0,251	0,286	0,69	0,12		RV_TNH4	=R2C29:R38C29		

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	DATE	AS_NO2	AS_OZONE	AS_PAN	AS_SO2	AS_SO4	AS_TNH4	AS_TNO3	BI_NO2	BI_NO2_KI	BI_OZONE	BI_PAN	BI_SO2	BI_SO4	BI_TNH4	BI_TNO3
2		NO2	OZONE	PAN	SO2	SO4	TNH4	TNO3	NO2	NO2-KI	OZONE	PAN	SO2	SO4	TNH4	TNO3
3		µg N/m³	µg/m³	µg N/m³	µg S/m³	µg S/m³	µg N/m³	µg N/m³	µg N/m³	µg N/m³	µg/m³	µg N/m³	µg S/m³	µg S/m³	µg N/m³	µg N/m³
4		ASPVRETEN	ASPVRETEN	ASPVRETEN	ASPVRETEN	ASPVRETEN	ASPVRETEN	ASPVRETEN	BIRKENES	BIRKENES	BIRKENES	BIRKENES	BIRKENES	BIRKENES	BIRKENES	BIRKENES
5																
6																
7																
8	900401	0,89	72		1,115	2,652	1,47	0,38	1,53		57	0,69	4,479	2,580	1,34	0,49
9	900402	1,16	80		1,474	1,992	2,55	1,39	2,28		69	1,58	1,194	2,550	2,37	0,93
10	900403	1,36	76		0,799	1,563	2,59	1,26	-0,39		78	0,91	0,107	0,270	0,13	0,09
11	900404	0,82	67		0,283	0,283	0,29	0,04	-0,38		78	0,51	0,063	0,145	0,05	0,04
12	900405	1,12	78		0,501	0,300	0,44	0,24	1,32		76	0,55	1,238	0,504	0,21	0,30
13	900406	1,09	74		1,769	0,774	0,67	0,44	-0,40		75	0,38	0,056	0,130	0,11	0,11
14	900407	0,93	64		0,513	0,355	0,23	0,09	-0,39		62	0,42	0,242	0,120	0,12	0,06
15	900408	1,09	74		0,436	0,279	0,44	0,11	-0,39		62	0,40	0,099	0,243	0,20	0,11
16	900409	1,63	75		0,592	0,519	0,84	0,50	0,79		76	0,62	0,573	0,657	0,34	0,22
17	900410	1,29	82		1,567	1,117	1,47	0,96	0,73		72	0,35	0,138	0,323	0,13	0,13
18	900411	1,18	59		0,149	2,795	4,06	2,25	-0,37		70	0,26	0,036	0,063	0,10	0,04
19	900412	0,84	73		4,679	2,974	1,94	0,80	0,96		47	0,38	0,419	1,019	0,68	0,46
20	900413	1,72	55		1,537	1,196	1,54	1,27	2,85		55		0,313	1,123	1,26	0,45
21	900414	1,24	91		3,309	3,013	3,46	1,64	3,28		50		0,534	1,221	1,41	0,81
22	900415	1,50	98		3,650	3,913	3,77	1,35	2,23		77		0,709	1,008	1,43	0,75
23	900416	0,70	73		0,648	0,600	0,52	0,42	1,46		73		0,060	0,390	0,20	0,18
24	900417	0,61	82		0,368	1,192		0,56	1,62		51		0,092	0,262	0,16	0,14
25	900418	1,29	68		2,229	2,663	2,01	0,53	2,22		59		0,726	1,053	1,40	0,85
26	900419	1,59	84		2,085	1,872	1,77	0,71	2,37		88		1,426	1,503	1,43	0,52
27	900420	3,12	74		1,948	1,733	1,83	0,71	2,14		89		0,898	1,621	1,10	0,14
28	900421	2,15	83		2,875	2,215	1,88	0,71	1,96		90		0,462	1,435	1,26	0,16
29	900422	1,09	66		1,718	1,770	1,50	0,61	1,97		84		0,756	2,018	1,66	0,24
30	900423	1,40	81		2,060	1,754	1,74	0,71	2,07		74		0,439	1,821	1,57	0,21
31	900424	1,38	108		1,267	2,040	2,03	0,47	2,13		82		0,372	1,869	1,75	0,22
32	900425	1,33	88		0,829	2,006	2,09	0,47	3,23		89		0,809	1,969	4,36	0,35
33	900426		120		1,628	2,636	2,56	0,94	2,53		67		0,200	0,657	1,43	0,23
34	900427		67		0,170	0,350	0,29	0,24	0,74		64		0,040	0,149	1,58	0,05
35	900428		67		0,339	0,285	0,28	0,23	-0,41		71		0,073	0,635	1,07	0,15
36	900429		59		0,308	0,993	1,07	0,30	-0,43		64		0,038	0,163	1,57	0,04
37	900430	0,65	70				0,33	0,28	-0,42		68		0,038	0,166	1,83	0,07
38																

EM_9004.XLS Page 2 16.9.92 9:39

	1	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1	DATE	FR_NO2	FR_OZONE	FR_PAN	FR_SO2	FR_TNH4	FR_TNO3	RV_NO2	RV_NO2_CI	RV_OZONE	RV_PAN	RV_SO2	RV_SO4	RV_TNH4	RV_TNO3	UT_NO2
2		NO2	OZONE	PAN	SO2	TNH4	TNO3	NO2	NO2-CL	OZONE	PAN	SO2	SO4	TNH4	TNO3	NO2
3		µg N/m³	µg/m³	µg N/m³	µg S/m³	µg N/m³	µg N/m³	µg N/m³	µg N/m³	µg/m³	µg N/m³	µg S/m³	µg S/m³	µg N/m³	µg N/m³	µg N/m³
4		FREDERIKS	FREDERIKS	FREDERIKS	FREDERIKS	FREDERIKS	FREDERIKS	RÖRVIK	RÖRVIK	RÖRVIK	RÖRVIK	RÖRVIK	RÖRVIK	RÖRVIK	RÖRVIK	UTÖ
5																
6																
7																
8	900401	4,15			2,343	3,76	2,11	2,3	3,29	56	0,106	1,1	2,55	2,49	2,14	1,84
9	900402	5,04			5,386	9,67	5,36	3,8	5,08	91	0,661	3,5	4,23	7,23	5,15	
10	900403	1,60			1,194	1,56	0,75	1,0	1,32	76	0,152	1,0	1,58	0,62	0,47	
11	900404	3,04			0,336	0,54	0,11	1,1	1,44	66	0,063	0,7	1,16	0,06	0,03	1,07
12	900405	2,60			0,586	0,95	0,50	0,6	1,12	85	0,122	1,6		3,91	2,03	1,06
13	900406	2,97			1,455	2,64	1,62	1,7	2,70	71	0,199	1,6		4,62	2,14	1,12
14	900407	1,69			0,395	0,64	0,30	0,8	1,40	68	0,059	0,8		1,17	0,90	
15	900408	5,33			1,045	0,92	0,33	0,5	0,91	79	0,069	1,1		0,48	0,31	
16	900409	3,97			3,155	1,88	1,08	0,8	1,43	86	0,147	0,9	1,43	1,27	0,54	1,46
17	900410	4,30			3,118	4,35	3,02	1,8	3,11	74	0,217	1,4	1,93	2,69	1,56	1,19
18	900411	1,84			0,220	1,01	0,48	1,5	2,56	48	0,104	0,5	1,74	0,82	0,17	1,76
19	900412	2,92			0,673	3,31	1,96	1,8	2,86	57	0,120	0,8	2,32	1,58	1,36	1,92
20	900413	7,83			4,421	9,47	4,48	5,4	3,14	46	0,218	2,8	5,04			1,39
21	900414	3,96				4,82	2,18	1,4	2,05	79	0,395	3,7	3,90			1,19
22	900415	2,15			2,030	2,78	1,41	0,6	0,96	79	0,204	1,1	2,96			
23	900416	2,34			0,380	0,99	0,48	0,2	0,54	80	0,039	0,4	1,48			1,14
24	900417	4,41			1,722	2,62	1,54	1,0	1,50	82	0,166	1,2	1,76	1,90	0,94	1,98
25	900418	5,95			2,824	1,36	0,95	1,2	1,70	72	0,108	1,9	1,83	0,68	0,52	2,69
26	900419	2,93			2,671	3,91	1,10	1,5	1,19	83	0,185	1,4	2,23	1,39	0,42	
27	900420	2,82			2,728	4,51	1,00	0,8	1,01	80		1,2	2,93	2,23	0,25	
28	900421	2,28			2,344	3,25	0,94	0,8	0,84	95		1,3	2,83	2,31	0,39	
29	900422	2,19			1,677	3,35	0,97	1,3	1,55	97		1,3	2,76	1,90	0,38	
30	900423	2,84			1,833	3,16	0,72	1,8	1,82	103	0,422	1,4	3,18	1,69	0,52	
31	900424							1,0	1,16	109	0,390	1,1	2,81	2,39	0,15	
32	900425	4,31			1,631	2,29	0,77	3,4	2,55	89	0,325	0,9	2,44	2,23	0,67	
33	900426	3,26			2,587	3,43	1,76	2,6	1,56	89	0,326	2,2	2,63	2,27	0,39	
34	900427	0,94			0,224	0,34	0,14	0,9	1,14	57	0,025	0,6	1,06	0,26	0,09	
35	900428	1,14			1,695	1,32	0,85	0,7	0,85	76	0,117	0,9	1,58	0,75	0,27	
36	900429	2,40			1,985	2,95	1,46	1,3	1,34	60	0,179	1,4	1,87	1,44	0,91	
37	900430	1,93			1,032	0,63	0,61	2,4	2,14	51	0,036	0,8	1,45		0,49	
38																

	1	32	33	34	35	36	37	38	39	40	41	42
1	DATE	UT_OZONE	UT_PAN	UT_SO2	UT_SO4	UT_TNH4	UT_TNO3					
2		OZONE	PAN	SO2	SO4	TNH4	TNO3					
3		µg/m³	µg N/m³	µg S/m³	µg S/m³	µg N/m³	µg N/m³					
4		UTÖ	UTÖ	UTÖ	UTÖ	UTÖ	UTÖ					
5												
6												
7												
8	900401	80	0,063	0,225	0,221	0,12	0,09		AS_NO2	=R2C2:R38C2	RV_TNO3	=R2C30:R38C30
9	900402	84	0,147	0,324	0,539	0,37	0,38		AS_OZONE	=R2C3:R38C3	UT_NO2	=R2C31:R38C31
10	900403	106	0,319	0,593	3,428	3,16	2,08		AS_PAN	=R2C4:R38C4	UT_OZONE	=R2C32:R38C32
11	900404	81	0,128	0,156	0,401	0,23	0,16		AS_SO2	=R2C5:R38C5	UT_PAN	=R2C33:R38C33
12	900405	85	0,152	0,219	0,358	0,16	0,13		AS_SO4	=R2C6:R38C6	UT_SO2	=R2C34:R38C34
13	900406	85	0,188	0,405	0,677	0,59	0,54		AS_TNH4	=R2C7:R38C7	UT_SO4	=R2C35:R38C35
14	900407	73	0,158	0,381	0,382	0,10	0,09		AS_TNO3	=R2C8:R38C8	UT_TNH4	=R2C36:R38C36
15	900408	78	0,186	0,310	0,287	0,17	0,11		BI_NO2	=R2C9:R38C9	UT_TNO3	=R2C37:R38C37
16	900409	83	0,197	0,283	0,447	0,32	0,36		BI_NO2_KI	=R2C10:R38C10		
17	900410	104	0,415	0,482	0,884	1,26	1,09		BI_OZONE	=R2C11:R38C11		
18	900411	105	0,606	1,297	1,674	1,61	1,30		BI_PAN	=R2C12:R38C12		
19	900412	98	0,723	2,994	2,932	1,67	1,49		BI_SO2	=R2C13:R38C13		
20	900413	86	0,381	0,201	0,844	0,58	0,37		BI_SO4	=R2C14:R38C14		
21	900414	81	0,442	0,140	1,246	0,89	0,63		BI_TNH4	=R2C15:R38C15		
22	900415	79	0,500	0,979	2,075	1,80	1,02		BI_TNO3	=R2C16:R38C16		
23	900416	87	0,443	0,531	1,976	1,71	0,86		DATE	=R2C1:R38C1		
24	900417	87	0,398	0,588	1,696	1,51	0,90		FR_NO2	=R2C17:R38C17		
25	900418	79	0,469	0,874	1,788	1,65	1,10		FR_OZONE	=R2C18:R38C18		
26	900419	85	0,340	1,261	1,707	1,22	0,57		FR_PAN	=R2C19:R38C19		
27	900420	70		1,012	2,315	1,62	0,59		FR_SO2	=R2C20:R38C20		
28	900421	84		1,090	1,986	1,52	0,36		FR_TNH4	=R2C21:R38C21		
29	900422	87		1,646	1,508	0,98	0,46		FR_TNO3	=R2C22:R38C22		
30	900423	108		2,486	1,636	0,77	0,50		Print_Area	=R8C2:R38C42		
31	900424	111	0,901	1,402	1,955	1,23	0,46		Print_Titles	=C1;R1:R7		
32	900425	99	1,210	1,836	2,599	2,06	0,95		RV_NO2	=R2C23:R38C23		
33	900426	105	0,925	0,661	1,441	1,50	0,43		RV_NO2_CL	=R2C24:R38C24		
34	900427	98	0,720	0,296	1,578	0,87	0,79		RV_OZONE	=R2C25:R38C25		
35	900428	60	0,278	0,130	0,129	0,19	0,06		RV_PAN	=R2C26:R38C26		
36	900429	64	0,317	0,235	0,843	0,44	0,35		RV_SO2	=R2C27:R38C27		
37	900430	48	0,413	0,243	0,493	0,56	0,34		RV_SO4	=R2C28:R38C28		
38									RV_TNH4	=R2C29:R38C29		

EM_9005.XLS Page 1 16.9.92 9:42

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	DATE	AS_NO2	AS_OZONE	AS_PAN	AS_SO2	AS_SO4	AS_TNH4	AS_TNO3	BI_NO2	BI_NO2_KI	BI_OZONE	BI_PAN	BI_SO2	BI_SO4	BI_TNH4	BI_TNO3
2		NO2	OZONE	PAN	SO2	SO4	TNH4	TNO3	NO2	NO2-KI	OZONE	PAN	SO2	SO4	TNH4	TNO3
3		µg N/m^3	µg/m^3	µg N/m^3	µg S/m^3	µg S/m^3	µg N/m^3	µg N/m^3	µg N/m^3	µg N/m^3	µg/m^3	µg N/m^3	µg S/m^3	µg S/m^3	µg N/m^3	µg N/m^3
4		ASPVRETEN	ASPVRETEN	ASPVRETEN	ASPVRETEN	ASPVRETEN	ASPVRETEN	ASPVRETEN	BIRKENES	BIRKENES	BIRKENES	BIRKENES	BIRKENES	BIRKENES	BIRKENES	BIRKENES
5																
6																
7																
8	900501	0,57	55		0,235	0,166	0,22	0,12	-0,42		37		0,227	0,075	1,48	0,07
9	900502	0,99	67		1,032	0,245	0,30	0,16	1,03		40		0,539	0,185	1,72	0,14
10	900503	1,17	83		0,879	0,437	0,56	0,48	-0,41		58		0,061	0,074	3,49	0,07
11	900504	1,20	84		1,960	1,559	1,48	0,47	1,56		62		0,483	0,426	2,87	0,11
12	900505	0,87	99		2,304	0,637	1,06	0,50	1,18		96		1,203	1,163	2,81	0,28
13	900506	0,88	115		1,696	1,749	2,00	0,50	1,71		111		2,038	3,271	5,12	0,79
14	900507	0,69	117		0,428	1,839	1,48	0,37	1,75		114		1,819	3,968	5,29	0,47
15	900508	0,73			0,330	0,622	0,56	0,27	1,80		115		1,548	4,732	7,50	0,63
16	900509	1,07			1,098	0,424	0,58	0,31	1,38		79		0,805	2,859	3,91	0,24
17	900510	1,15	100		1,166	2,398	1,82	0,58	1,68		60		1,213	3,007	6,69	0,52
18	900511	2,57	60		0,352	0,268	0,30	0,30	1,17		76		0,341	1,450	1,89	0,23
19	900512	0,79	83		0,705	0,390	0,26	0,28	1,26		60		0,243	0,348	1,13	0,16
20	900513	0,46	82		0,616	0,705	0,82	0,30	-0,41		77		0,285	0,523	1,54	0,17
21	900514		64		0,057	1,385	0,71	0,23	1,07		58		0,213	0,614	1,78	0,11
22	900515		78		0,030	1,003	1,15	0,40	-0,43		59		0,171	0,835	1,70	0,24
23	900516		70		0,634	1,712	1,42	0,46	-0,43		87		0,464	1,525	0,90	0,17
24	900517	1,06	55		0,100	0,334	0,23	0,16	-0,43		54		0,096	0,301	0,35	0,11
25	900518	0,77	68		0,110	0,198	0,16	0,12	0,92		58		0,200	0,148	0,48	0,13
26	900519	0,51	61		0,030	0,259	0,22	0,05	-0,43		63		0,189	0,380	0,47	0,24
27	900520	0,58	71		0,122	0,326	0,26	0,11	-0,41		70		0,066	0,375	0,37	0,19
28	900521	0,91	81		0,279	0,571	0,69	0,36	0,67		76		0,056	0,221	0,31	0,08
29	900522	0,56	79		0,178	0,376	0,36	0,12	0,64		57		0,309	0,301	0,40	0,22
30	900523	0,50	82		0,230	0,810	0,85	0,35	-0,43		50		0,095	0,269	0,19	0,09
31	900524	0,54	73		0,252	0,257	0,28	0,13	-0,42		68		0,031	0,104	0,19	0,05
32	900525	0,81	57		0,072	0,158	0,19	0,07	-0,41		73		0,042	0,160	0,18	0,05
33	900526	0,66	64		0,142	0,128	0,11	0,06	-0,41		80		0,042	0,232	0,20	0,09
34	900527	1,08	65		0,272	0,239	0,20	0,25	-0,41		69		0,046	0,081	0,18	0,04
35	900528	1,52	87		0,354	0,543	0,29	0,16	0,93		53		0,204	0,074	0,31	0,08
36	900529	0,61			0,461	1,006	0,25	0,17	0,87		63		0,159	0,319	0,45	0,13
37	900530	0,66	88		0,497	0,977	0,54	0,02	1,34		83		2,419	5,013	2,56	0,53
38	900531	1,13	119		4,886	1,159	2,53	0,79	0,87		86		0,825	2,370	1,54	0,29

	1	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1	DATE	FR_NO2	FR_OZONE	FR_PAN	FR_SO2	FR_TNH4	FR_TNO3	RV_NO2	RV_NO2_CI	RV_OZONE	RV_PAN	RV_SO2	RV_SO4	RV_TNH4	RV_TNO3	UT_NO2
2		NO2	OZONE	PAN	SO2	TNH4	TNO3	NO2	NO2-CL	OZONE	PAN	SO2	SO4	TNH4	TNO3	NO2
3		µg N/m³	µg/m³	µg N/m³	µg S/m³	µg N/m³	µg N/m³	µg N/m³	µg N/m³	µg/m³	µg N/m³	µg S/m³	µg S/m³	µg N/m³	µg N/m³	µg N/m³
4		FREDERIKS	FREDERIKS	FREDERIKS	FREDERIKS	FREDERIKS	FREDERIKS	RÖRVIK	RÖRVIK	RÖRVIK	RÖRVIK	RÖRVIK	RÖRVIK	RÖRVIK	RÖRVIK	UTÖ
5																
6																
7																
8	900501	3,94			1,266	0,38	0,34	3,2	2,74	44	0,066	1,3	1,09	0,57	0,16	
9	900502	5,17			1,231	0,73	0,73	4,1	2,82	41	0,082	1,4	1,27	1,10	0,83	
10	900503	3,32			2,120	2,20	1,58	2,2	2,27		0,101	1,0	1,55	1,26	0,72	
11	900504	2,27			1,389	1,64	0,93	3,0	2,76		0,139	1,3	1,73	1,26	1,19	
12	900505	2,74			0,907	0,88	0,43	2,1	2,21	56	0,132	1,1	1,85	0,04	1,37	
13	900506	3,79			1,269	2,06	1,03	2,6	2,63	73	0,151	2,4	2,26	0,17	0,96	
14	900507	7,82			2,301	2,55	1,13	2,8	2,79	98	0,273	2,9	3,80	0,22	1,08	
15	900508	9,33			2,580	3,07	1,26	1,7	1,55	119	0,357	2,1	5,19	2,42	1,50	
16	900509	5,71			2,435	5,19	1,80	1,8	1,89	82	0,290	0,7	6,93	2,52	0,78	
17	900510	5,45			5,672	6,24	1,16	2,5	2,36	68	0,238	1,4	0,89	2,33	1,54	
18	900511	2,69						1,2	1,13	67	0,432	1,6	3,04	3,57	2,12	
19	900512	2,24						0,5	0,60	62	0,087	0,6	1,30	1,20	0,32	
20	900513	1,93						0,7	0,02	47	0,095	0,5		0,81	0,09	
21	900514	2,70						1,5	0,02	61	0,195	0,6	2,77	0,61	0,32	
22	900515	2,63			0,699	2,46	1,03	0,7	0,02	84	0,082	0,8	2,51	1,54	0,45	
23	900516	2,51			1,587	3,42	1,40	1,2	0,37	85	0,258	1,7	3,64	2,26	1,30	
24	900517	1,21			0,274	0,50	0,24	1,2	0,02	43		0,4	1,13	0,16	0,19	
25	900518	1,54			0,277	0,59	0,39	1,0	0,02	53		0,4	4,42	0,42	0,17	1,96
26	900519	2,65			0,333	0,37	0,21	1,4	0,02	61		0,6	1,22	0,46	0,08	4,34
27	900520	2,82			0,796	0,92	0,56	0,8	0,02	80	0,079	0,9	1,40	0,72	0,56	1,31
28	900521	1,68			0,962	1,15	0,72	0,7	0,45	53		0,3	1,25	0,49	0,19	
29	900522	3,00			0,435	0,89	0,56	0,7	0,02	63	0,031	0,4	1,16	0,18	0,32	
30	900523	1,41			0,917	1,22	0,63	0,4		78		0,6	1,66	0,37	0,13	
31	900524	0,85			0,256	0,44	0,20	0,3		71		0,7	1,11	0,11	0,05	
32	900525	1,01			0,341	0,40	0,20	0,2		75		0,8	1,13	0,05	0,14	
33	900526	0,59			0,237	0,46	0,17	0,2		77		0,4	1,15	0,05	0,10	
34	900527	1,12			0,136	0,25	0,10	1,6		54		0,6	1,00	0,00	0,08	
35	900528	1,50			0,426	0,61	0,25	1,6				0,9	1,28	0,22	0,19	
36	900529	2,81			0,409	0,54	0,37	1,2			0,037	0,9	1,38	0,38	0,37	
37	900530	4,18			2,252	3,30	1,65	0,9			0,207	2,0	3,48	2,42	1,62	
38	900531	3,18			3,615	4,59	1,03	1,1	0,66			1,3	4,18	3,36	1,97	

	1	32	33	34	35	36	37	38	39	40	41	42
1	DATE	UT_OZONE	UT_PAN	UT_SO2	UT_SO4	UT_TNH4	UT_TNO3					
2		OZONE	PAN	SO2	SO4	TNH4	TNO3					
3		$\mu g/m^3$	$\mu g\ N/m^3$	$\mu g\ S/m^3$	$\mu g\ S/m^3$	$\mu g\ N/m^3$	$\mu g\ N/m^3$					
4		UTÖ	UTÖ	UTÖ	UTÖ	UTÖ	UTÖ					
5												
6												
7												
8	900501			0,348	0,138	0,18	0,13		AS_NO2	=R2C2:R38C2	RV_TNO3	=R2C30:R38C30
9	900502	65	0,333	0,556	0,189	0,36	0,20		AS_OZONE	=R2C3:R38C3	UT_NO2	=R2C31:R38C31
10	900503	79	0,390	1,385	1,293	0,98	0,47		AS_PAN	=R2C4:R38C4	UT_OZONE	=R2C32:R38C32
11	900504	85	0,315	0,467	1,075	0,77	0,25		AS_SO2	=R2C5:R38C5	UT_PAN	=R2C33:R38C33
12	900505	96	0,445	0,471	2,130	1,46	0,47		AS_SO4	=R2C6:R38C6	UT_SO2	=R2C34:R38C34
13	900506	103	0,597	0,754	2,694	1,76	0,59		AS_TNH4	=R2C7:R38C7	UT_SO4	=R2C35:R38C35
14	900507	78	0,292	0,380	1,409	0,91	0,19		AS_TNO3	=R2C8:R7C8	UT_TNH4	=R2C36:R38C36
15	900508	85	0,411	0,411	0,311	0,73	0,23		BI_NO2	=R2C9:R38C9	UT_TNO3	=R2C37:R38C37
16	900509	76	0,301	0,357	0,400	0,31	0,17		BI_NO2_KI	=R2C10:R38C10		
17	900510	104	0,452	0,459	1,568	0,67	0,36		BI_OZONE	=R2C11:R38C11		
18	900511	59	0,419	0,458	0,444	0,29	0,15		BI_PAN	=R2C12:R38C12		
19	900512	71	0,538	0,855	0,336	0,29	0,21		BI_SO2	=R2C13:R38C13		
20	900513	78	0,630	0,316	0,665	0,60	0,29		BI_SO4	=R2C14:R38C14		
21	900514	67	0,696	0,382	0,706	0,24	0,44		BI_TNH4	=R2C15:R38C15		
22	900515	77	0,515	0,370	1,433	0,61	0,26		BI_TNO3	=R2C16:R38C16		
23	900516	53	0,504	0,178	0,540	0,39	0,24		DATE	=R2C1:R38C1		
24	900517	58	0,374	0,271	0,210	0,17	0,10		FR_NO2	=R2C17:R38C17		
25	900518	70	0,376	0,176	0,154	0,14	0,06		FR_OZONE	=R2C18:R38C18		
26	900519	54	0,380	0,253	0,253	0,13	0,06		FR_PAN	=R2C19:R38C19		
27	900520	68	0,362	0,150	0,317	0,19	0,09		FR_SO2	=R2C20:R38C20		
28	900521	83	0,427	0,219	0,450	0,42	0,32		FR_TNH4	=R2C21:R38C21		
29	900522	77	0,419	0,405	0,554	0,30	0,23		FR_TNO3	=R2C22:R38C22		
30	900523	84	0,369	0,239	0,472	0,28	0,28		Print_Area	=R8C2:R38C42		
31	900524	78	0,341	0,311	1,030	0,64	0,44		Print_Titles	=C1;R1:R7		
32	900525	71	0,368	0,404	0,551	0,31	0,27		RV_NO2	=R2C23:R38C23		
33	900526	63	0,242	0,132	0,158	0,15	0,07		RV_NO2_CL	=R2C24:R38C24		
34	900527	70	0,247	0,252	0,107	0,13	0,10		RV_OZONE	=R2C25:R38C25		
35	900528	77	0,351	0,486	0,458	0,20	0,19		RV_PAN	=R2C26:R38C26		
36	900529	81	0,268	0,556	0,494	0,26	0,19		RV_SO2	=R2C27:R38C27		
37	900530	94	0,318	0,358	0,584	0,23	0,22		RV_SO4	=R2C28:R38C28		
38	900531	105	0,619	0,360	1,807	1,28	0,34		RV_TNH4	=R2C29:R38C29		

APPENDIX VIII

Overview plots, 1990 campaign

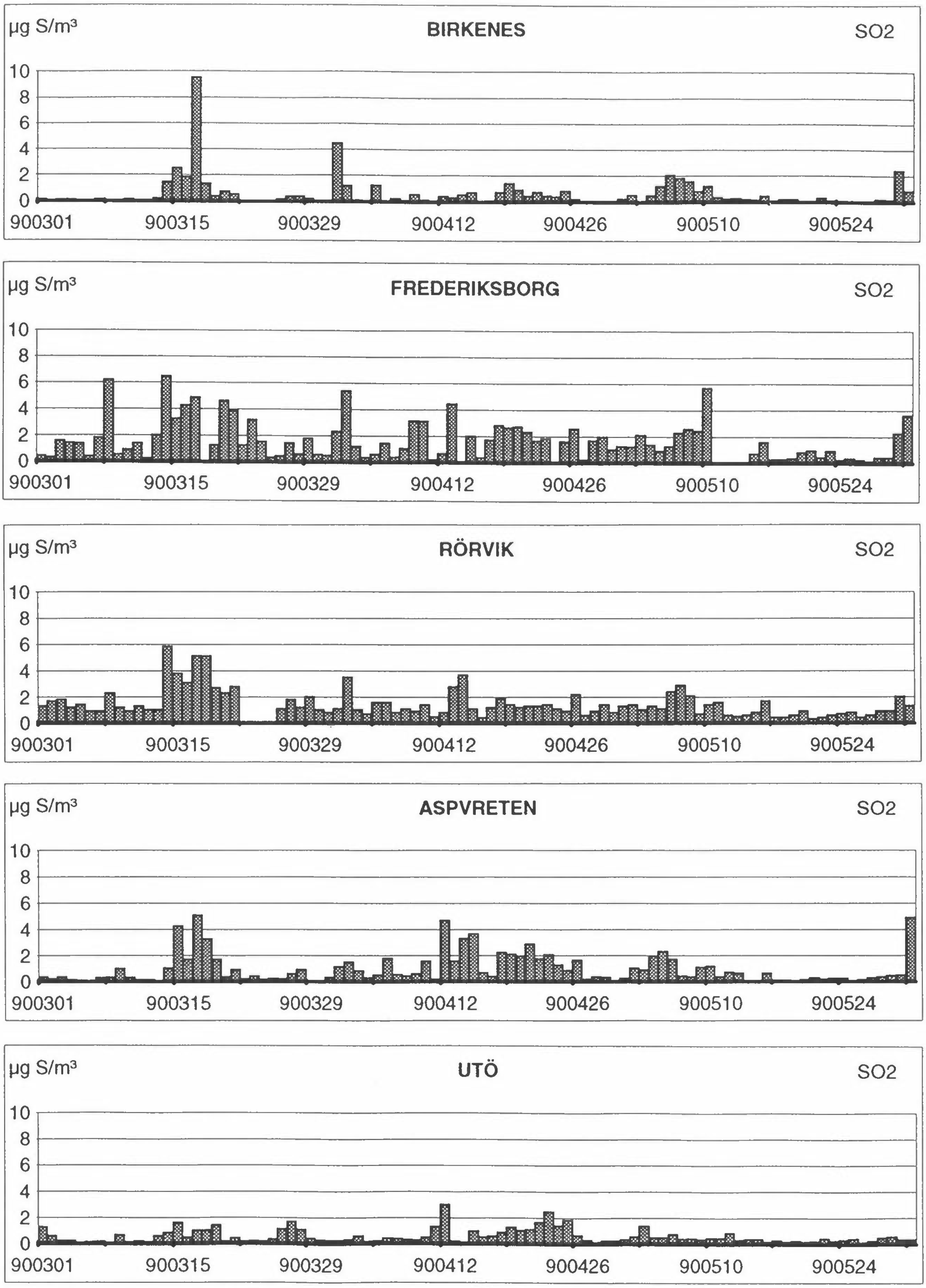
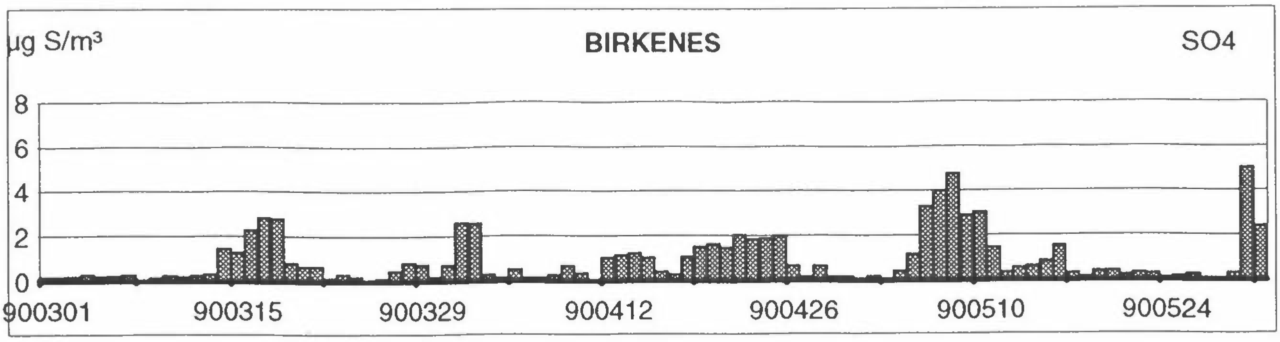
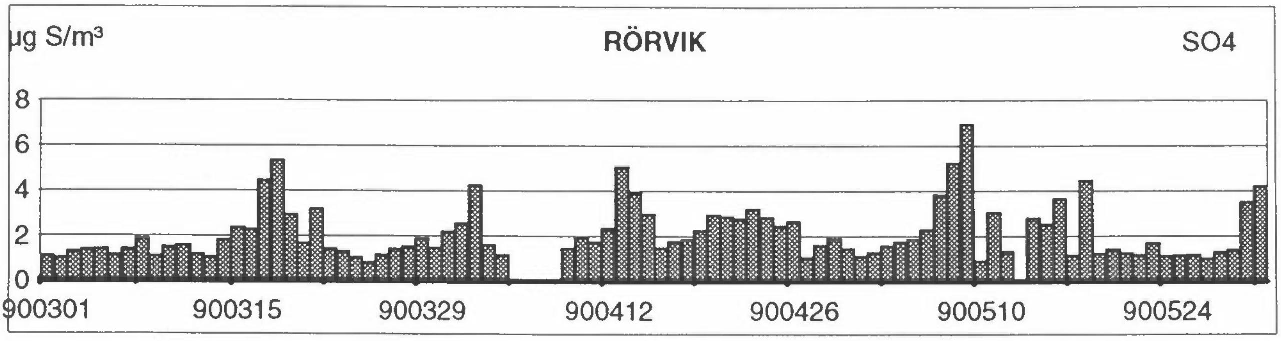
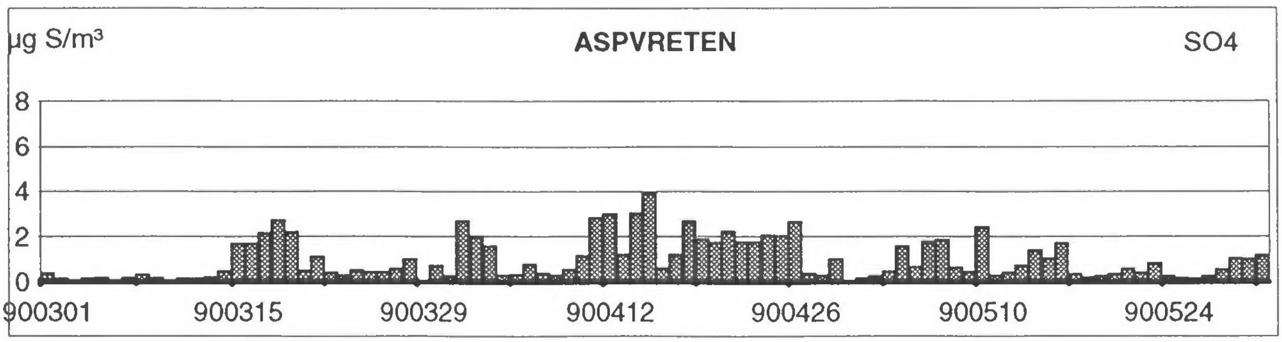


Fig. AVIII.1: Overview plots for SO_2 from the 1990 campaign.







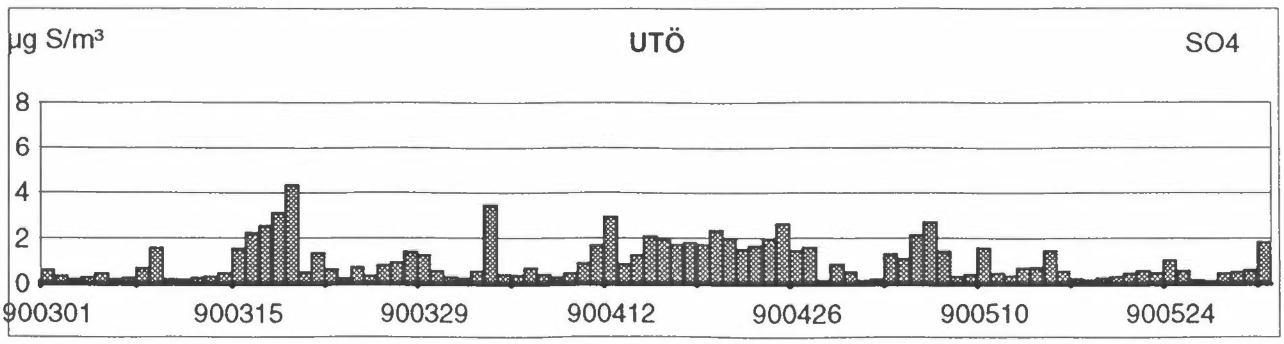
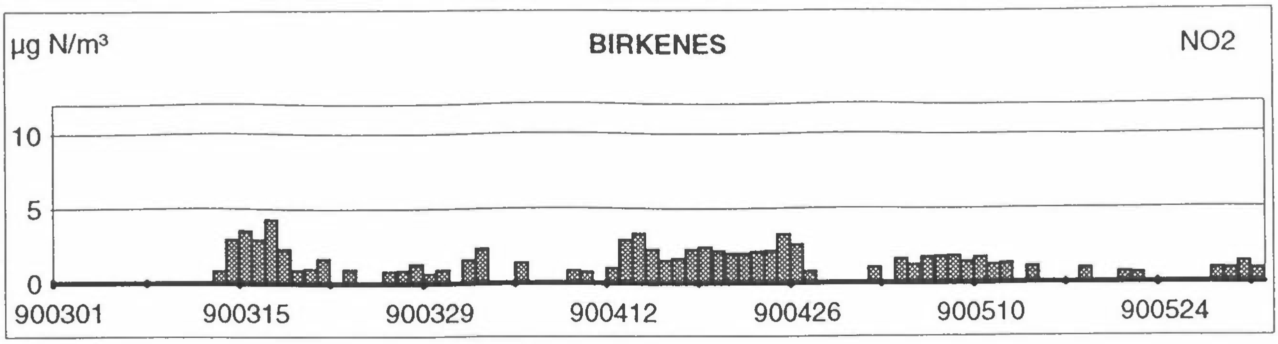
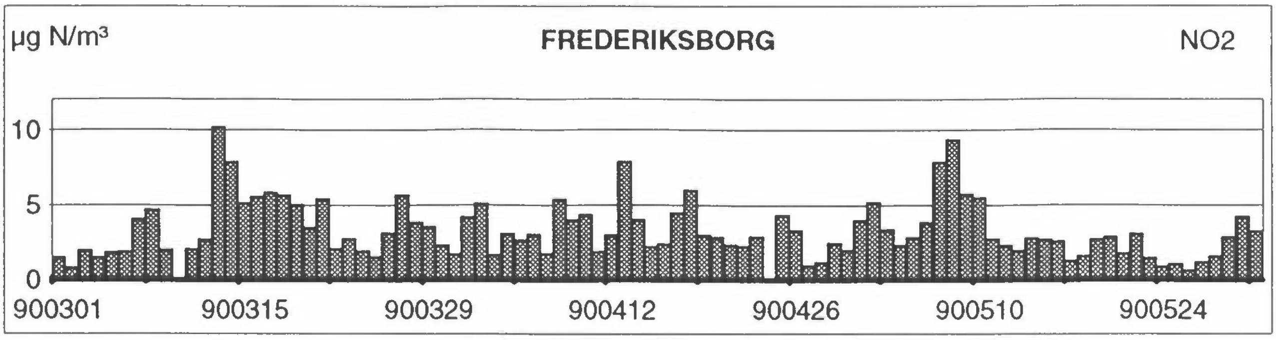
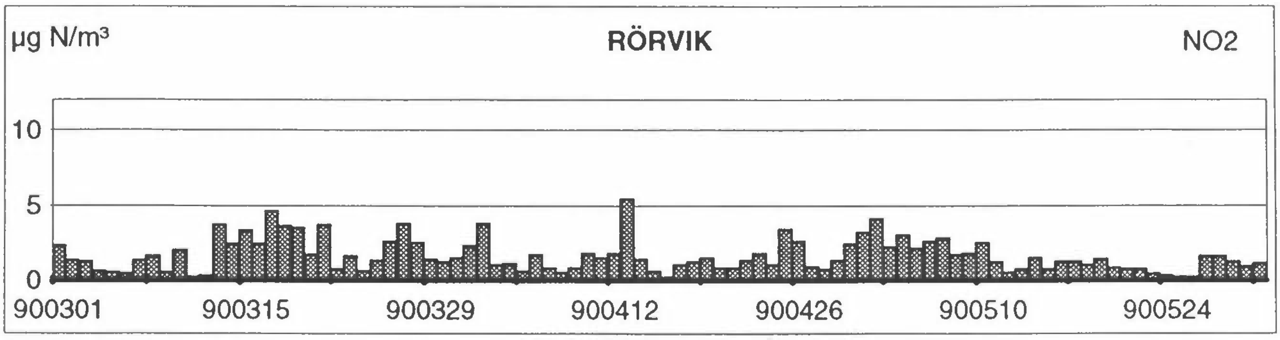
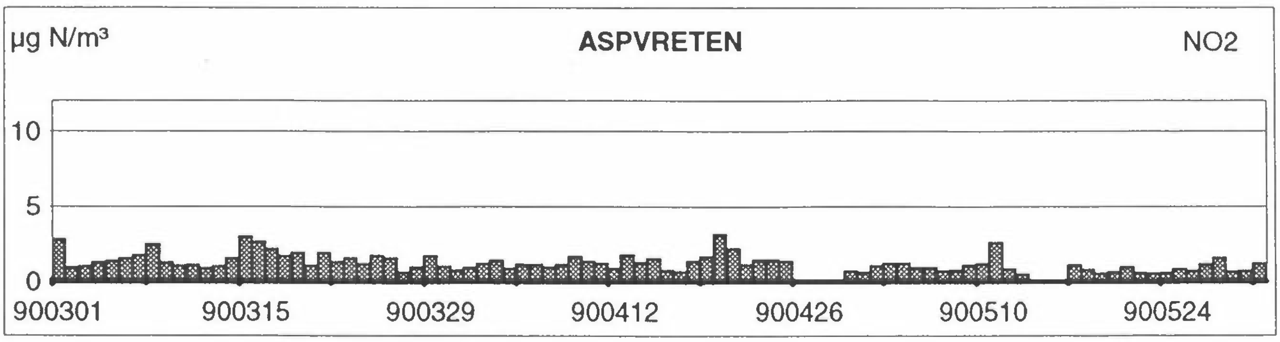


Fig. AVIII.2: Overview plots for SO_4 from the 1990 campaign.









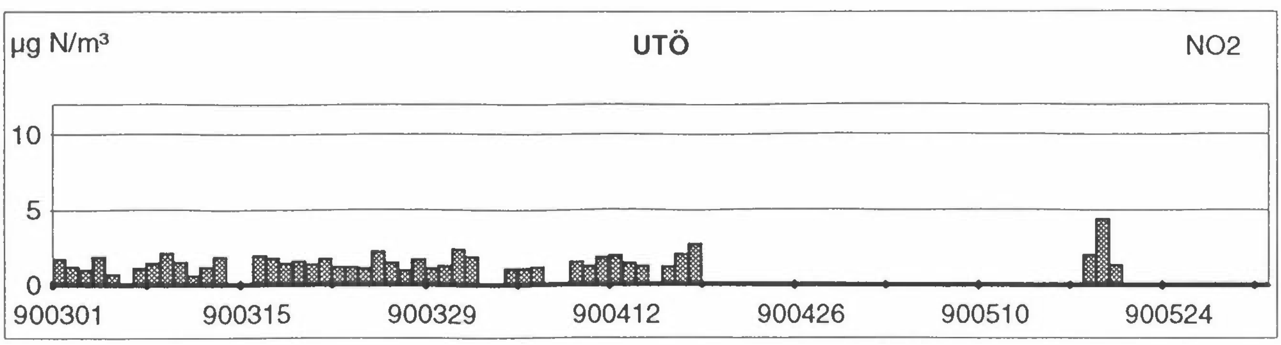


Fig. AVIII.3: Overview plots for NO_2 from the 1990 campaign.

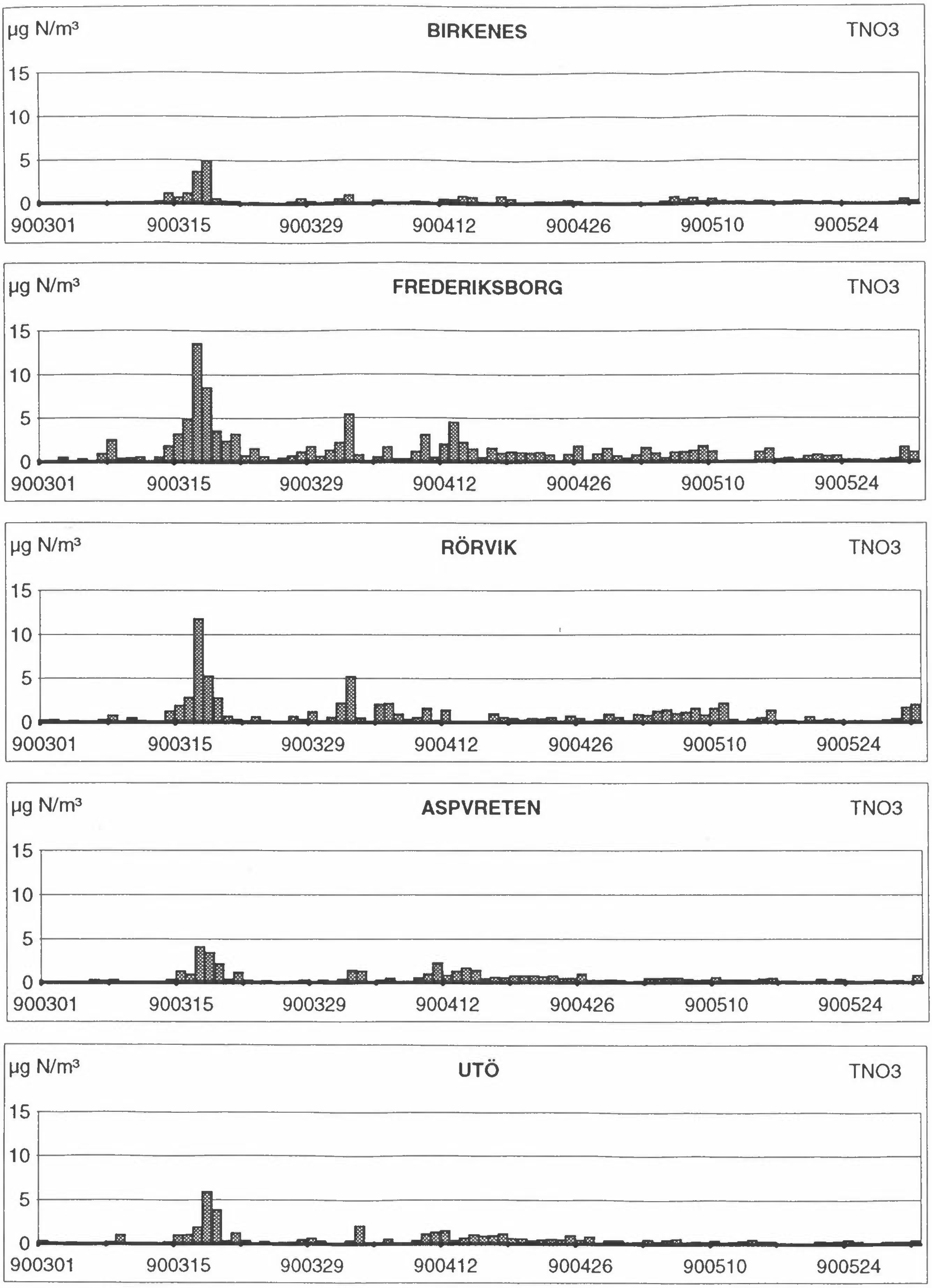
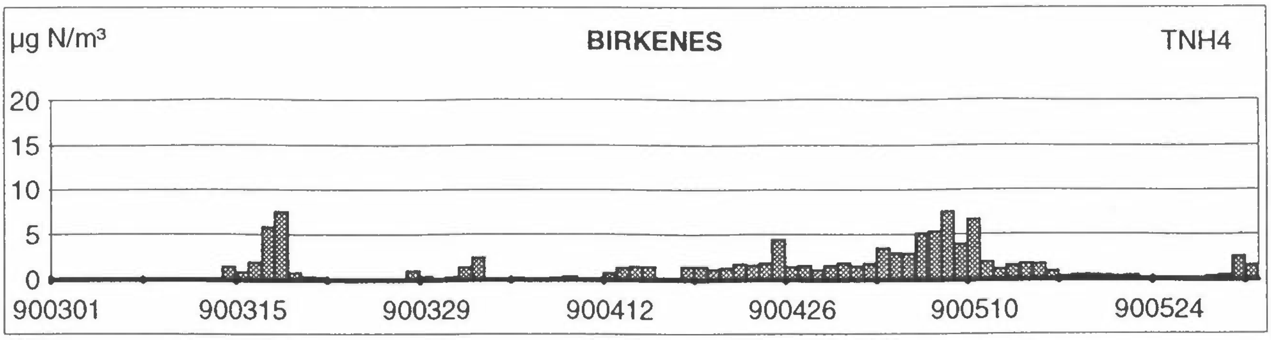
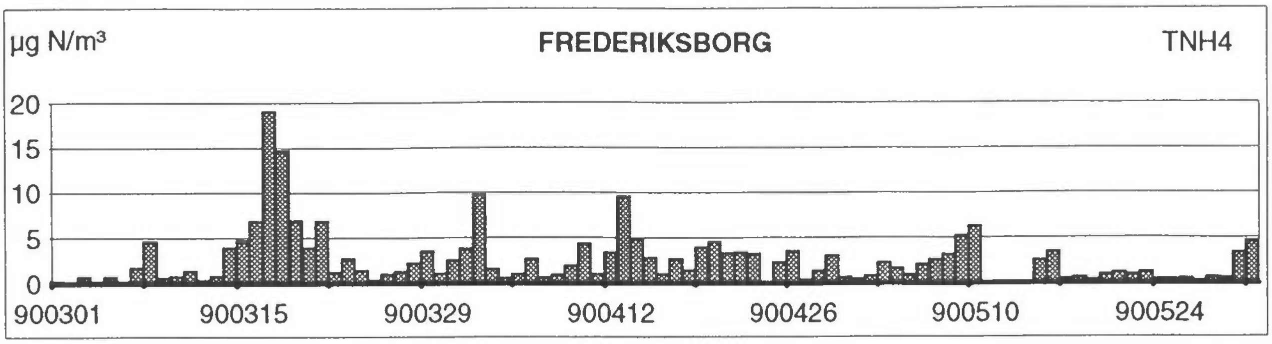
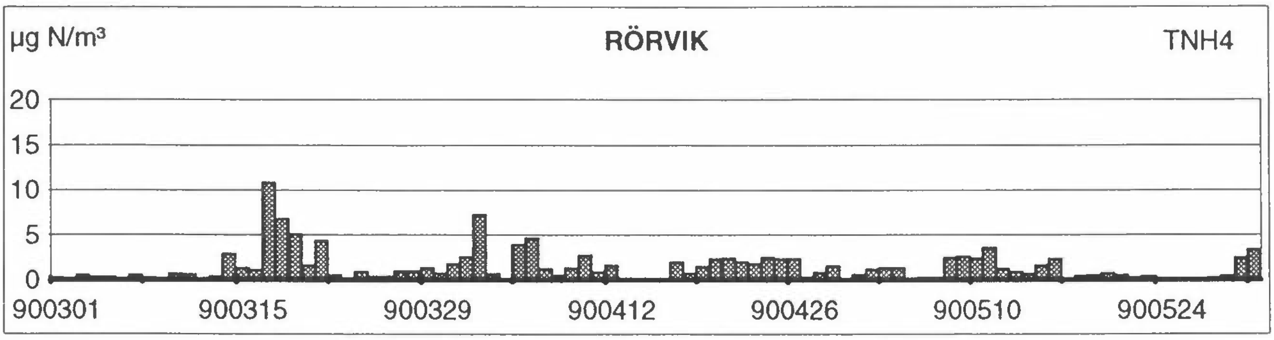
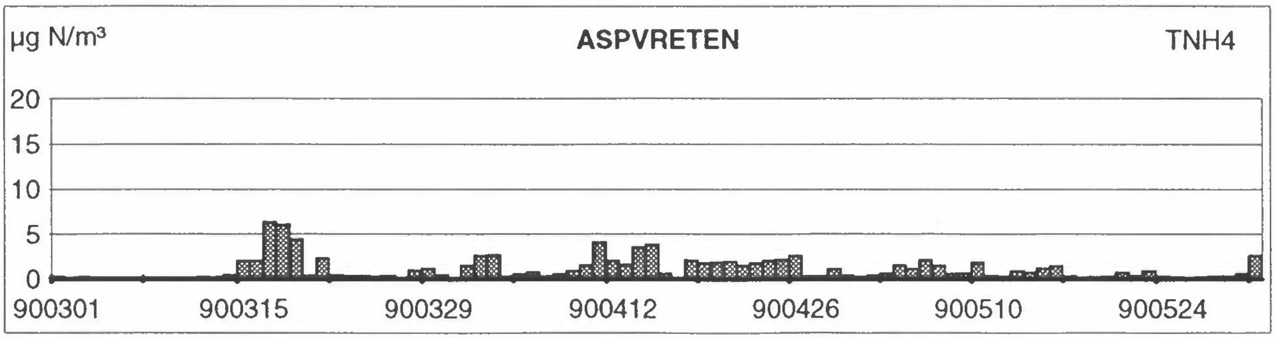


Fig. AVIII.4: Overview plots for total NO_3 from the 1990 campaign.









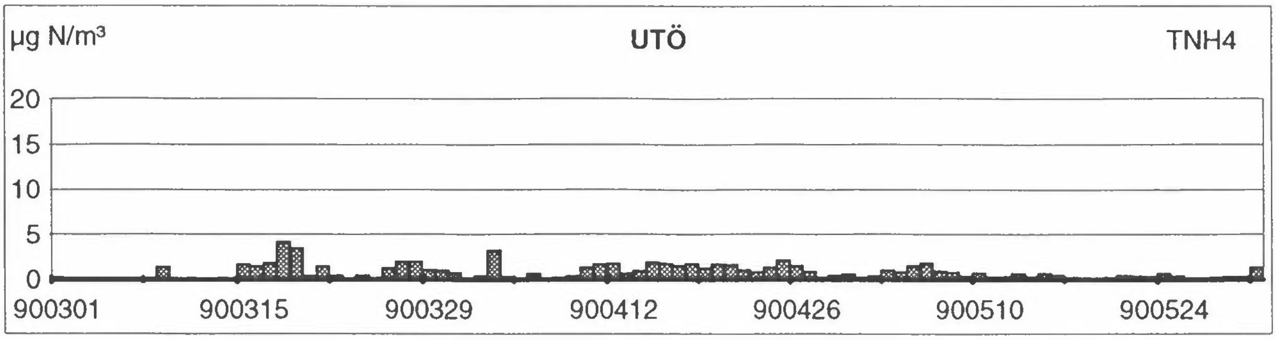
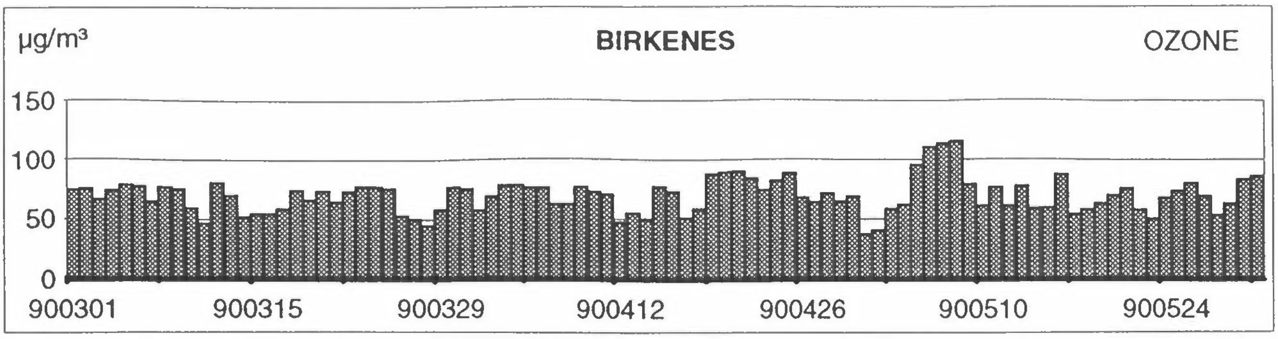
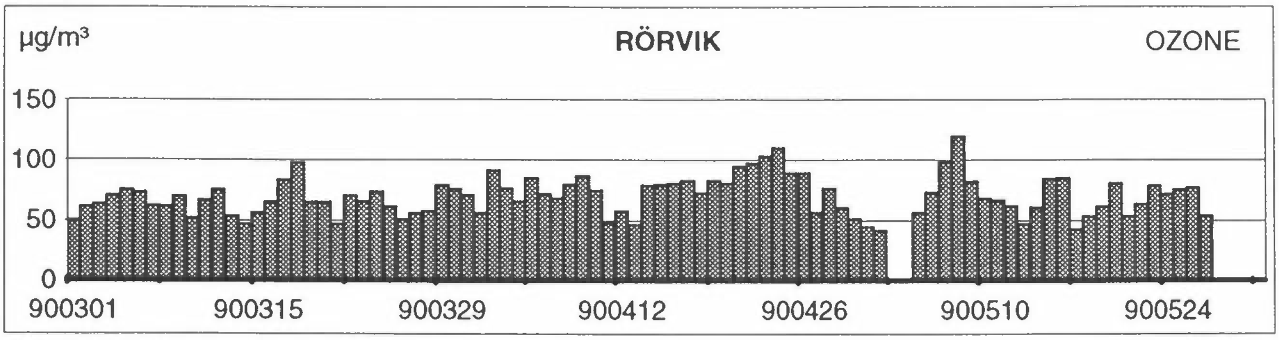
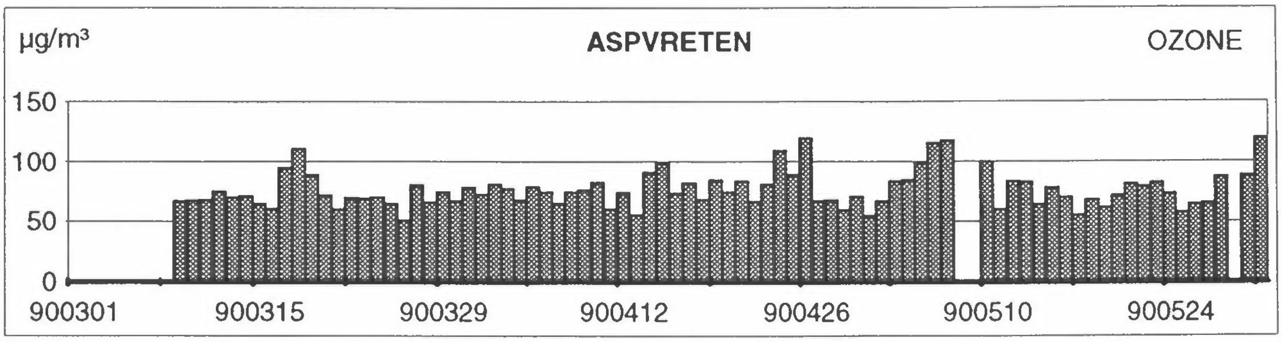


Fig. AVIII.5: Overview plots for total NH_4 from the 1990 campaign.







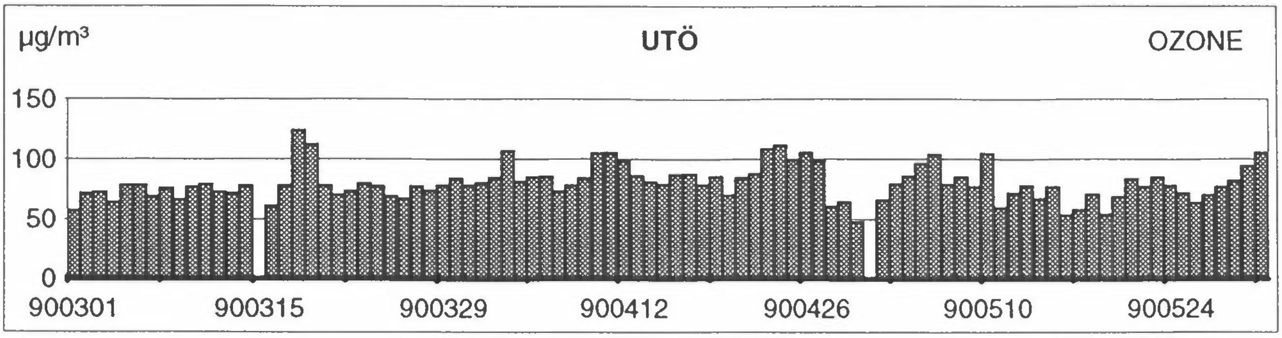
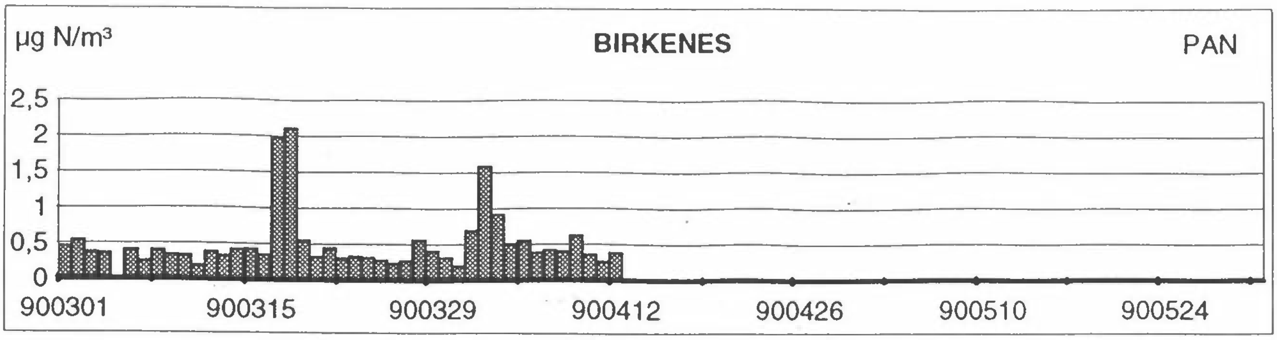
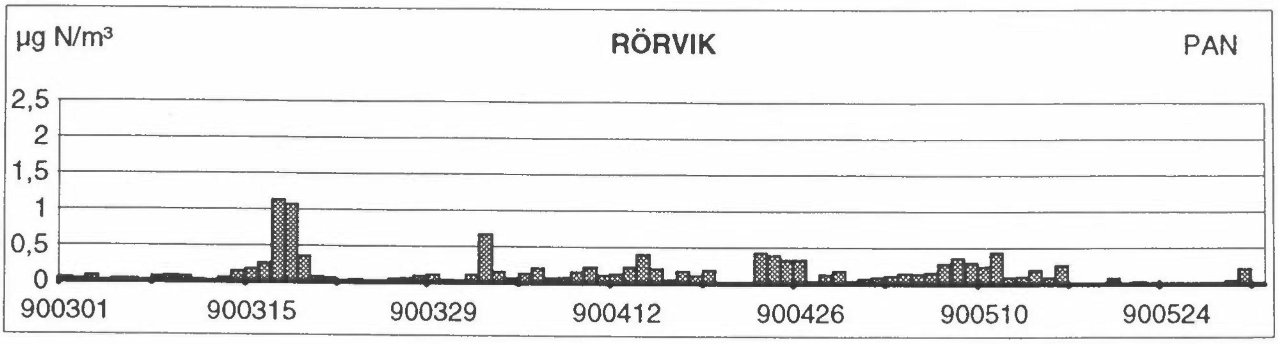


Fig. AVIII.6: Overview plots for ozone from the 1990 campaign.





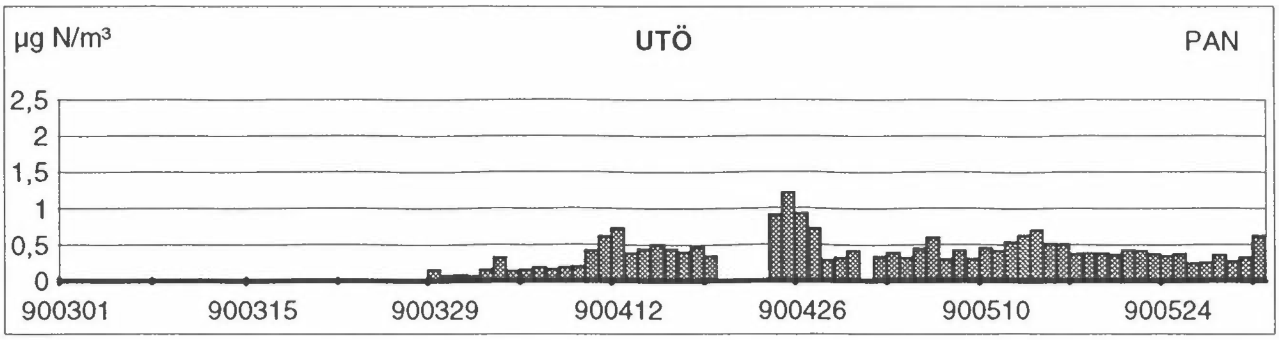


Fig. AVIII.7: Overview plots for PAN from the 1990 campaign.

NORSK INSTITUTT FOR LUFTFORSKNING (NILU)
NORWEGIAN INSTITUTE FOR AIR RESEARCH
POSTBOKS 64, N-2001 LILLESTRØM

RAPPORTTYPE OPPDRAGSRAPPORT	RAPPORTNR. OR 35/91	ISBN-82-425-0259-5	
DATO 16/9-92	ANSV. SIGN. P. Berg	ANT. SIDER 143	PRIS NOK 180,-
TITTEL Long range transport of oxidants and nitrogen compounds in the atmosphere over Scandinavia		PROSJEKTLEDER T.Krognes	
		NILU PROSJEKT NR. N-8427	
FORFATTER(E) T. Krognes		TILGJENGELIGHET *	
		OPPDRAGSGIVERS REF.	
OPPDRAGSGIVER (NAVN OG ADRESSE) NMR			
STIKKORD Nitrogen	Transport	Modelling	
REFERAT			

TITLE
ABSTRACT

* Kategorier: Åpen - kan bestilles fra NILU A
Må bestilles gjennom oppdragsgiver B
Kan ikke utleveres C