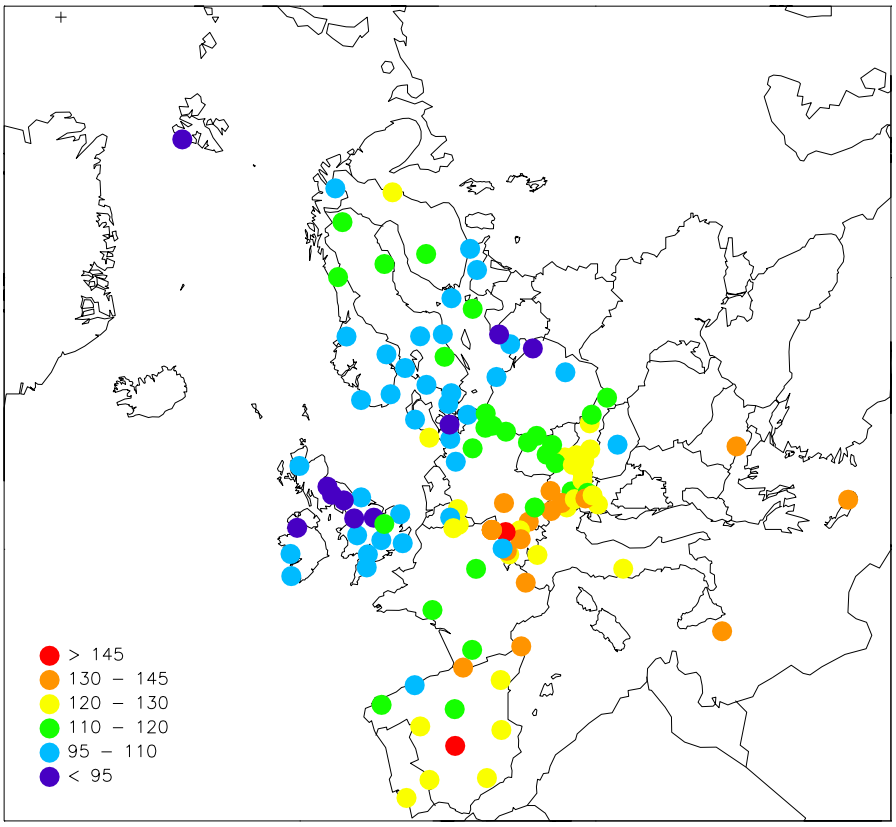
EMEP/CCC-Report 2/2007

EMEP Co-operative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe

Ozone measurements 2005

Ann Mari Fjæraa and Anne-Gunn Hjellbrekke



Norwegian Institute for Air Research
PO Box 100, NO-2027 Kjeller, Norway
Chemical Co-ordinating Centre of EMEP (CCC)

NILU : EMEP/CCC-Report 2/2007
REFERENCE : O-99074
DATE : AUGUST 2007

EMEP Co-operative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe

Ozone measurements 2005

Ann Mari Fjæraa and Anne-Gunn Hjellbrekke

Norwegian Institute for Air Research
P.O. Box 100, N-2027 Kjeller, Norway

Contents

Page

List of tables and figures **5**
1. Introduction **7**
2. Critical levels **7**
3. Measurement network **9**
4. Data completeness **14**
5. Concentration summaries and episodes **17**
6. Calculation of AOT40 ..... **17**
7. Seasonal variation **18**
8. Diurnal variation **18**
9. Update **19**
10. References **19**
11. List of participating institutions **21**
Annex 1 Concentration summaries and episodes, tables and figures **23**
Annex 2 AOT40 and AOT60, figures and tables **33**
Annex 3 Seasonal variation **41**
Annex 4 Diurnal variation, April–September 2005 ..... **77**
Annex 5 List of data reports **93**

List of tables and figures

Page

Table 1: List of EMEP ozone monitoring stations in operation 2005. 10
Table 2: Conversion factor ppb – μg/m^3 13
Table 3: Data capture in per cent, 2005. 14

Table 1.1: Number of hours (h) and days (d) exceeding 120, 150, 180 and 200 μg/m^3 and maximum concentrations in 2005. 25
Table 1.2: Percentiles of hourly ozone values April–September 2005. 29

Table 2.1: AOT40 and AOT60 April–September 2005 (daylight hours). 37
Table 2.2: AOT40 and AOT60 May–July 2005 (daylight hours). 39

Table 3.1: Monthly mean concentrations 2005 (μg/m^3). 43
Table 3.2: Monthly data capture 2005 (μg/m^3). 47

Figure 1: Location of the monitoring stations. 12

Figure 1.1: Ozone April–September 2005. 99-percentiles (μg/m^3). 31
Figure 1.2: Ozone April–September 2005. 95-percentiles (μg/m^3). 31
Figure 1.3: Number of exceedances of the threshold value of 150 μg/m^3. (Unit: number of days). 32
Figure 1.4: Number of exceedances of the threshold value of 180 μg/m^3. (Unit: number of days). 32

Figure 2.1: AOT40 (ppbh) April–September 2005 (daylight hours). 35
Figure 2.2: AOT40 (ppbh) May, June and July 2005 (daylight hours). 35
Figure 2.3: AOT60 (ppbh) April-September 2005 (daylight hours). 36
Figure 2.4: AOT60 (ppbh) May, June and July 2005 (daylight hours). 36

Figure 3.1: Seasonal variation, 1990–2005. 52

Figure 4.1: Diurnal variation, April–September 2005. 79

Ozone measurements 2005

1. Introduction

Ozone is a natural constituent of the atmosphere and plays a vital role in many atmospheric processes. However, man made emissions of volatile organic compounds and nitrogen oxides have increased the photochemical formation of ozone in the troposphere. Until the end of the 1960s the problem was basically believed to be one of the big cities and their immediate surroundings. In the 1970s, however, it was found that the problem of photochemical oxidant formation is much more widespread. The ongoing monitoring of ozone at rural sites throughout Europe shows that episodes of high concentrations of ground-level ozone occur over most parts of the continent every summer. During these episodes the ozone concentrations can reach values above ambient air quality standards over large regions and lead to adverse effects for human health and vegetation. Historical records of ozone measurements in Europe and North America indicate that in the last part of the nineteenth century the values were only about half of the average surface ozone concentrations measured in the same regions during the last 10-15 years (Bojkov, 1986; Volz and Kley, 1988).

The formation of ozone is due to a large number of photochemical reactions taking place in the atmosphere and depends on the temperature, humidity and solar radiation as well as the primary emissions of nitrogen oxides and volatile organic compounds. Together with the non-linear relationships between the primary emissions and the ozone formation, these effects complicates the abatement strategies for ground-level ozone and makes photochemical models crucial in addition to the monitoring data.

The 1999 Gothenburg Protocol is designed for a joint abatement of acidification, eutrophication and ground-level ozone. It has been estimated that once the Protocol is implemented, the number of days with excessive ozone levels will be halved and that the exposure of vegetation to excessive ozone levels will be 44% down on 1990.

2. Critical levels

Ozone concentrations vary widely from region to region, with the time of year, and with time of day. Typically, high concentrations of ozone are observed in periods with anticyclonic conditions. Such episodes may lead to adverse environmental effects such as impact on human health, agricultural crops, forests and materials. National authorities and international organisations have therefore formulated critical levels for ozone.

The critical levels defined by ECE for protection of vegetation are 150 $\mu g/m^3$ for hourly mean, 60 $\mu g/m^3$ for eight-hour mean and 50 $\mu g/m^3$ for seven-hour mean (9 a.m.-4 p.m.) averaged over the growing season (April-September). In EU the ozone directive (Directive 2002/3/EC) has defined a number of target values and

long-term objectives for the protection of vegetation and human health. The target value for human health for 2010 is that 120 g/m^3 (8h mean) is not to be exceeded on more than 25 days per year averaged over 3 years. For protection of vegetation AOT40 (May-July) should not exceed 18,000 g/m^{3}h averaged over five years. In addition information should be given to the population when hourly means exceed 180 µg/m^3 and an alert warning should be issued if hourly means exceed 240 µg/m^3.

The critical level formulated by WHO for protection of health is 120 µg/m^3 for eight-hour mean.

In defining the harmful effects of ozone exposure to plants, attention must be given to the physiological response to ozone. Ozone is generally taken up through the stomata, and reacts with a number of enzymes and antioxidants. Several studies have shown that plants respond by reduced carbon dioxide uptake, and other symptoms of damage to the respiration system, for ozone exposure above a certain threshold (e.g. Forberg et al., 1987). This concentration threshold varies between plant species, cultivars, and phenological development.

Previously recommended critical levels for ozone based on seven-hour mean concentrations in the growing season do not take into account the existence of such a threshold, and have been criticised because the effects on vegetation of a generally high concentration level of ozone may be less harmful than the exposure to short-term and episodic high concentrations, which may cause permanent damage to the cell tissue.

Within the framework of the UN-ECE Convention on long-range transboundary air pollution, workshops held at Egham, UK (Ashmore and Wilson, 1992) and at Bern, Switzerland (Führer and Achermann, 1994) have recommended that critical levels for ozone exposure should be based on the accumulated exposure in ppb hours over a concentration threshold during the growing season (AOT). The Egham workshop was not able to decide conclusively on the threshold concentration or the accumulated dose corresponding to the critical loads, but the Bern workshop made specific recommendations to use a threshold of 40 ppb. The critical levels were revised at a UN-ECE workshop in Kuopio, Finland (Kärenlampi and Skärby, 1996) with minor changes to the Bern recommendations and are defined as:

- Critical level for agricultural crops: The AOT40 for crops is calculated as an accumulated ozone exposure above a threshold of 40 ppb for a period of three months during daylight hours, defined as those hours the mean global radiation is 50 W/m2 or greater. The AOT40 value for comparison with the critical level should be calculated as the highest running three months sum during the period when crops are grown. If a fixed period is required for modelling assessment the period May to July should be used. Data from open-top chamber experiments indicate that an AOT40 of 3000 ppbh corresponds to a 5% yield loss for wheat. This value is only applicable when soil moisture is not limiting because of sufficient precipitation or irrigation. Short term critical level for crops: The critical levels are defined as:

  - 500 ppbh over five days for high (water) vapour pressure deficit conditions
  - 200 ppbh over five days for low (water) vapour pressure deficit conditions.

  As for the long term critical level, the short term critical levels refer to daylight hours only and should not be applied when soil moisture is limiting.

- For natural vegetation, since the sensitivity of the most sensitive species is considered to be similar to that of the most sensitive crops, the same long term critical level as for agricultural crops is used.

- Critical level for forests: AOT40 of 10 000 ppbh, calculated for daylight hours only, defined as for crops, during a six months period from April to September.

Although these critical loads are based on relatively strong experimental evidence, changes in the formulations may be expected when more information is available on the response of different plants to ozone exposure. The vegetation periods above are defined as being typical of climatic conditions in Northern Europe whereas other vegetation periods may be more appropriate for other areas, such as Southern Europe and Northern Scandinavia.

The critical levels are considered to be suitable for exceedance mapping and integrated assessment modelling, but should not be used for economic assessment of crop or biomass losses. For these purposes, it is needed to take into account different species and modifying factors such as (water) vapour pressure deficit, soil moisture content, nutritional status, altitude, other pollutants etc.

Work is currently in progress to revise the critical levels for ozone (level II) and was the focus of a UNECE Workshop in Gothenburg, November 2002. Although substantial progress was made, no final recommendations have yet been defined.

3. Measurement network

Surface ozone measurements have been a part of the EMEP extended (voluntary) measurement activities since the third phase (1 January 1984–31 December 1986). Due to the lack of funds, the systematic collection and checking of data within EMEP, did not start until 1 January 1987. The measurement of ozone data within the EMEP region was a continuation of the OECD's oxidant data collection programme OXIDATE. Ozone data from the OXIDATE project have been reported in three reports (Grennfelt and Schjoldager, 1984; Grennfelt et al., 1988 and 1989).

This report presents surface ozone data measured at rural and background EMEP sites during 2005 with emphasis on statistical summaries and geographical distributions. Earlier reports are listed in Annex 5.

Table 1 and Figure 1 show the location of the monitoring stations reporting data from whole or part of 2005. In total 125 stations in 27 different countries reported data. One of these sites (Ispra) is operated by the Commission of the European Communities in Italy.

Table 1: List of EMEP ozone monitoring stations in operation 2005.

Code	Station	Country	Latitude	Longitude	Altitude (m)
AT0002R	Illmitz	Austria	47 46 00 N	16 46 00 E	117
AT0005R	Vorhegg	Austria	46 40 40 N	12 58 20 E	1020
AT0030R	Pillersdorf bei Retz	Austria	48 43 16 N	15 56 32 E	315
AT0032R	Sulzberg	Austria	47 31 45 N	9 55 36 E	1020
AT0033R	Stolzalpe bei Murau	Austria	47 07 45 N	14 12 14 E	1302
AT0034G	Sonnblick	Austria	47 03 16 N	12 57 30 E	3106
AT0037R	Zillertaler Alpen	Austria	47 08 13 N	11 52 12 E	1970
AT0038R	Gerlitzen	Austria	46 41 37 N	13 54 54 E	1895
AT0040R	Masenberg	Austria	47 20 53 N	15 52 56 E	1170
AT0041R	Haunsberg	Austria	47 58 23 N	13 00 58 E	730
AT0042R	Heidenreichstein	Austria	48 52 43 N	15 02 48 E	570
AT0043R	Forsthof	Austria	48 06 22 N	15 55 10 E	581
AT0044R	Graz Platte	Austria	47 06 47 N	15 28 14 E	651
AT0045R	Dunkelsteinerwald	Austria	48 22 16 N	15 32 48 E	320
AT0046R	Gänserndorf	Austria	48 20 05 N	16 43 50 E	161
AT0047R	Stixneusiedl	Austria	48 03 03 N	16 40 36 E	240
BE0001R	Offagne	Belgium	49 52 40 N	5 12 13 E	430
BE0032R	Eupen	Belgium	50 37 46 N	6 00 10 E	295
BE0035R	Vezin	Belgium	50 30 12 N	4 59 22 E	160
BG0053R	Rojen peak	Bulgaria	41 41 45 N	24 44 19 E	1750
CH0002R	Payerne	Switzerland	46 48 47 N	6 56 41 E	489
CH0003R	Tänikon	Switzerland	47 28 47 N	8 54 17 E	539
CH0004R	Chaumont	Switzerland	47 02 59 N	6 58 46 E	1137
CH0005R	Rigi	Switzerland	47 04 03 N	8 27 50 E	1031
CY0002R	Ayia Marina	Cyprus	33 02 21 N	33 03 29 E	532
CZ0001R	Svratouch	Czech Republic	49 44 00 N	16 02 00 E	737
CZ0003R	Košetice	Czech Republic	49 35 00 N	15 05 00 E	534
DE0001R	Westerland	Germany	54 55 32 N	8 18 35 E	12
DE0002R	Langenbrügge	Germany	52 48 08 N	10 45 34 E	74
DE0003R	Schauinsland	Germany	47 54 53 N	7 54 31 E	1205
DE0007R	Neuglobsow	Germany	53 10 00 N	13 02 00 E	62
DE0008R	Schmücke	Germany	50 39 00 N	10 46 00 E	937
DE0009R	Zingst	Germany	54 26 00 N	12 44 00 E	1
DE0012R	Bassum	Germany	52 51 00 N	8 42 00 E	52
DE0026R	Ueckermünde	Germany	53 45 00 N	14 04 00 E	1
DE0035R	Lückendorf	Germany	50 50 00 N	14 46 00 E	490
DE0039R	Aukrug	Germany	54 04 29 N	9 47 34 E	15
DE0045R	Schorfheide	Germany	52 58 00 N	13 39 00 E	70
DE0047R	Falkenberg	Germany	52 10 00 N	14 07 00 E	73
DK0005R	Keldsnor	Denmark	54 44 00 N	10 44 00 E	10
DK0031R	Ulborg	Denmark	56 17 00 N	8 26 00 E	10
DK0041R	Lille Valby	Denmark	55 41 13 N	12 07 34 E	10
EE0009R	Lahemaa	Estonia	59 30 00 N	25 54 00 E	32
EE0011R	Vilsandy	Estonia	58 23 00 N	21 49 00 E	6
ES0007R	Víznar	Spain	37 14 00 N	3 32 00 W	1265
ES0008R	Niembro	Spain	43 26 32 N	4 51 01 W	134
ES0009R	Campisábalos	Spain	41 16 52 N	3 08 34 W	1360
ES0010R	Cabo de Creus	Spain	42 19 10 N	3 19 01 E	23
ES0011R	Barcarrola	Spain	38 28 33 N	6 55 22 W	393
ES0012R	Zarra	Spain	39 05 10 N	1 06 07 W	885
ES0013R	Penausende	Spain	41 17 00 N	5 52 00 W	985
ES0014R	Els Torms	Spain	41 24 00 N	0 43 00 E	470
ES0015R	Risco Llamo	Spain	39 31 00 N	4 21 00 W	1241
ES0016R	O Saviñao	Spain	43 13 52 N	7 41 59 W	506
FI0009R	Utö	Finland	59 46 45 N	21 22 38 E	7
FI0017R	Virolahti II	Finland	60 31 36 N	27 41 10 E	4
FI0022R	Oulanka	Finland	66 19 13 N	29 24 06 E	310
FI0037R	Ahtari II	Finland	62 35 00 N	24 11 00 E	180

Table 1, cont.

Code	Station	Country	Latitude	Longitude	Altitude (m)
FR0008R	Donon	France	48 30 00 N	7 08 00 E	775
FR0009R	Revin	France	49 54 00 N	4 38 00 E	390
FR0010R	Morvan	France	47 16 00 N	4 05 00 E	620
FR0012R	Iraty	France	43 02 00 N	1 05 00 W	1300
FR0013R	Peyrusse Vieille	France	43 37 00 N	0 11 00 E	200
FR0014R	Montandon	France	47 18 00 N	6 50 00 E	836
FR0015R	La Tardière	France	46 39 00 N	0 45 00 W	133
FR0016R	Le Casset	France	45 00 00 N	6 31 00 E	1750
FR0017R	Montfranc	France	46 08 00 N	1 23 00 E	497
GB0002R	Eskdalemuir	United Kingdom	55 18 47 N	3 12 15 W	243
GB0006R	Lough Navar	United Kingdom	54 26 35 N	7 52 12 W	126
GB0013R	Yarner Wood	United Kingdom	50 35 47 N	3 42 47 W	119
GB0014R	High Muffles	United Kingdom	54 20 04 N	0 48 27 W	267
GB0015R	Strath Vaich Dam	United Kingdom	57 44 04 N	4 46 28 W	270
GB0031R	Aston Hill	United Kingdom	52 30 14 N	3 01 59 W	370
GB0032R	Bottesford	United Kingdom	52 55 46 N	0 48 55 W	32
GB0033R	Bush	United Kingdom	55 51 31 N	3 12 18 W	180
GB0034R	Glazebury	United Kingdom	53 27 31 N	2 27 59 W	21
GB0035R	Great Dun Fell	United Kingdom	54 41 00 N	2 27 00 W	847
GB0036R	Harwell	United Kingdom	51 34 23 N	1 19 00 W	137
GB0037R	Ladybower Res.	United Kingdom	53 23 56 N	1 45 12 W	420
GB0038R	Lullington Heath	United Kingdom	50 47 34 N	0 10 46 E	120
GB0039R	Sibton	United Kingdom	52 17 38 N	1 27 47 E	46
GB0043R	Narberth	United Kingdom	51 14 00 N	4 42 00 W	160
GB0044R	Somerton	United Kingdom	51 13 52 N	3 02 53 W	55
GB0045R	Wicken Fen	United Kingdom	52 17 54 N	0 17 34 W	5
GR0001R	Aliartos	Greece	38 22 00 N	23 05 00 E	110
GR0002R	Finokalia	Greece	35 19 00 N	25 40 00 E	0
HU0002R	K-puszta	Hungary	46 58 00 N	19 35 00 E	125
IE0001R	Valentia Observatory	Ireland	51 56 23 N	10 14 40 W	11
IE0031R	Mace Head	Ireland	53 10 00 N	9 30 00 W	15
IT0001R	Montelibretti	Italy	42 06 00 N	12 38 00 E	48
IT0004R	Ispra	Italy	45 48 00 N	8 38 00 E	209
LT0015R	Preila	Lithuania	55 21 00 N	21 04 00 E	5
LV0010R	Rucava	Latvia	56 13 00 N	21 13 00 E	5
MT0001R	Giordan Lighthouse	Malta	36 06 00 N	14 12 00 E	160
NL0009R	Kollumerwaard	The Netherlands	53 20 02 N	6 16 38 E	1
NL0010R	Vredepeel	The Netherlands	51 32 28 N	5 51 13 E	28
NO0001R	Birkenes	Norway	58 23 00 N	8 15 00 E	190
NO0015R	Tustervatn	Norway	65 50 00 N	13 55 00 E	439
NO0039R	Kårvatn	Norway	62 47 00 N	8 53 00 E	210
NO0042G	Spitsbergen, Zeppelinfjell	Norway	78 54 00 N	11 53 00 E	474
NO0043R	Prestebakke	Norway	59 00 00 N	11 32 00 E	160
NO0052R	Sandve	Norway	59 12 00 N	5 12 00 E	15
NO0055R	Karasjok	Norway	69 28 00 N	25 13 00 E	333
NO0056R	Hurdal	Norway	60 22 00 N	11 04 00 E	300
PL0002R	Jarczew	Poland	51 49 00 N	21 59 00 E	180
PL0003R	Sniezka	Poland	50 44 00 N	15 44 00 E	1603
PL0004R	Leba	Poland	54 45 00 N	17 32 00 E	2
PL0005R	Diabla Gora	Poland	54 09 00 N	22 04 00 E	157
PT0004R	Monte Velho	Portugal	38 05 00 N	8 48 00 W	43
SE0005R	Bredkälen	Sweden	63 51 00 N	15 20 00 E	404
SE0011R	Vavihill	Sweden	56 01 00 N	13 09 00 E	175
SE0012R	Aspvreten	Sweden	58 48 00 N	17 23 00 E	20
SE0013R	Esrange	Sweden	67 53 00 N	21 04 00 E	475
SE0014R	Råö	Sweden	57 23 38 N	11 54 50 E	5
SE0032R	Norra-Kvill	Sweden	57 49 00 N	15 34 00 E	261

Table 1, cont.

Code	Station	Country	Latitude	Longitude	Altitude (m)
SE0035R	Vindeln	Sweden	64 15 00 N	19 46 00 E	225
SE0039R	Grimsö	Sweden	59 43 40 N	15 28 19 E	132
SI0008R	Iskrba	Slovenia	45 34 00 N	14 52 00 E	520
SI0031R	Zarodnje	Slovenia	46 25 43 N	15 00 12 E	770
SI0032R	Krvavec	Slovenia	46 17 58 N	14 32 19 E	1740
SI0033R	Kovk	Slovenia	46 07 43 N	15 06 50 E	600
SK0002R	Chopok	Slovakia	48 56 00 N	19 35 00 E	2008
SK0004R	Stará Lesná	Slovakia	49 09 00 N	20 17 00 E	808
SK0005R	Liesek	Slovakia	49 22 00 N	19 41 00 E	892
SK0006R	Starina	Slovakia	49 03 00 N	22 16 00 E	345
SK0007R	Topolniky	Slovakia	47 57 36 N	17 51 38 E	113

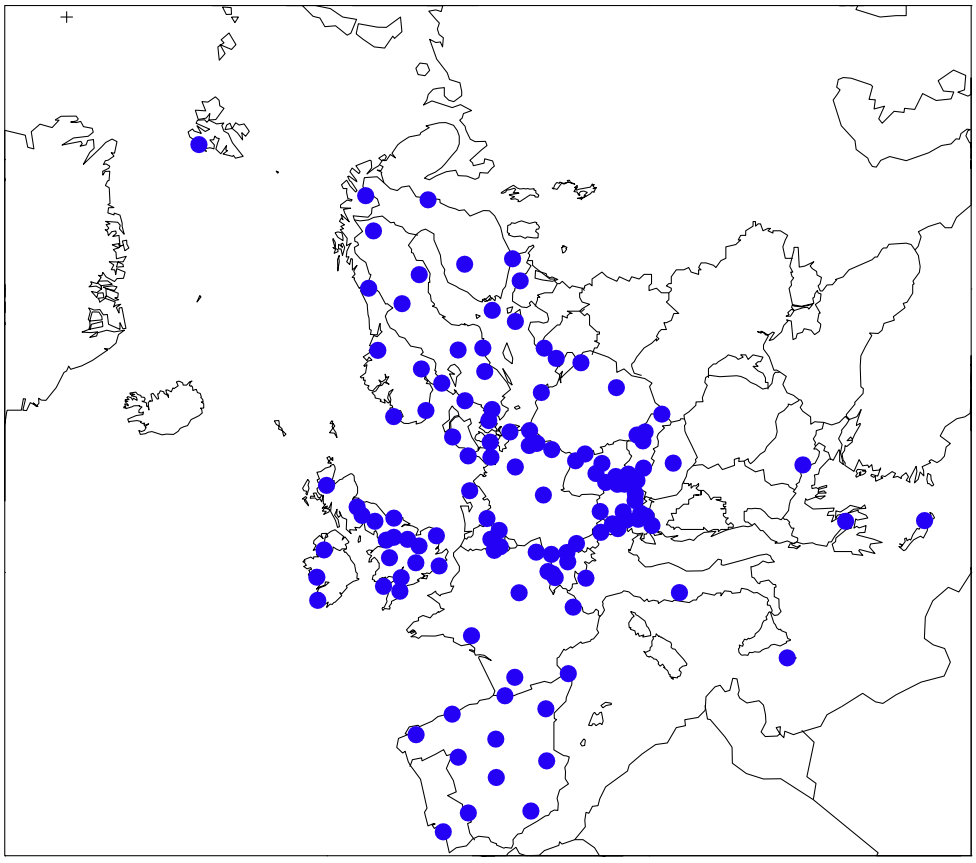


Figure 1: Location of the monitoring stations.

At Donon (FR08) the measurements are taken at four different heights above the ground:

FR08A: 8.6 m, ground level
FR08B: 17.6 m, half height of the trees
FR08C: 31.2 m, canopy of the trees
FR08D: 45.2 m, approximately 15 m above the trees.

The ozone sites are situated mainly in Central, Western and Northern Europe and the network of density is insufficient in the Eastern and Mediterranean parts of Europe.

The monitoring stations have been selected by the countries, and only a small number of them are regular EMEP sites. Information about the ozone data quality, calibration and maintenance procedures was in 2000 collected from the participants (Aas et al., 2000).

The UV absorption method was the only measurement method in use in 2005.

All data presented in this report are given in µg/m^3. The conversion factor used to calculate from ppb to µg/m^3 is given in Table 2. Most countries use a conversion factor of 2.0, which corresponds to 20°C and 1013 hPa. Switzerland uses the mean annual conditions at the stations (9°C and 950 mbar at Payerne, Tänikon, Rigi, Chaumont and Sion). A number of countries report ozone data in ppb, and in this case the data are converted to µg/m3 by multiplying by 2.0 at the CCC.

Table 2: Conversion factor ppb – µg/m^3.

Country	Conversion factor
Austria	2.0
Belgium	unknown
Cyprus	
Czech Republic	2.0
Denmark	2.0
Estonia	2.14
Finland	2.0
France	2.0
Germany	2.0
Greece (Aliartos)	1.96
Greece (Finokalia)	reported in ppb
Hungary	2.0
Ireland (Mace Head)	reported in ppb
Italy (Ispra)	2.0
Italy (Montelibretti)	reported in ppb
Latvia	2.0
Lithuania	2.0
Netherlands	2.0
Norway	2.0
Poland	2.0
Portugal	1.96
Russia	2.0
Slovakia	reported in ppb
Slovenia	2.0
Spain	2.0
Sweden	2.0
Switzerland	1.96
United Kingdom	reported in ppb

4. Data completeness

The annual data capture (number of valid measurements in per cent of the total number of measurements) for each station is given in Table 3. The capture was in general good, except from in Germany, where 6 stations had a data capture below 85%. In 2005 108 stations had capture above 90%. Five sites were below 75%.

Table 3: Data capture in per cent, 2005.

Code	Station	Data capture 2005
AT0002R	Illmitz	91.5
AT0005R	Vorhegg	89.0
AT0030R	Pillersdorf bei Retz	95.2
AT0032R	Sulzberg	95.4
AT0033R	Stolzalpe bei Murau	93.8
AT0034G	Sonnblick	94.3
AT0037R	Zillertaler Alpen	95.7
AT0038R	Gerlitzen	95.8
AT0040R	Masenberg	95.4
AT0041R	Haunsberg	94.8
AT0042R	Heidenreichstein	93.9
AT0043R	Forsthof	95.7
AT0044R	Graz Platte	88.7
AT0045R	Dunkelsteinerwald	94.9
AT0046R	Gänserndorf	95.5
AT0047R	Stixneusiedl	95.0
BE0001R	Offagne	89.0
BE0032R	Eupen	89.6
BE0035R	Vezin	89.0
BG0053R	Rojen peak	98.0
CH0002R	Payerne	95.4
CH0003R	Tänikon	95.2
CH0004R	Chaumont	95.3
CH0005R	Rigi	94.9
CY0002R	Ayia Marina	92.5
CZ0001R	Svratouch	99.7
CZ0003R	Košetice	99.1
DE0001R	Westerland	96.4
DE0002R	Langenbrügge	95.5
DE0003R	Schauinsland	93.8
DE0007R	Neuglobsow	91.8
DE0008R	Schmücke	84.3
DE0009R	Zingst	95.8
DE0026R	Ueckermünde	76.9
DE0035R	Lückendorf	70.9
DE0039R	Aukrug	77.3
DE0045R	Schorfheide	74.4
DE0047R	Falkenberg	73.2
DK0005R	Keldsnor	91.9
DK0031R	Ulborg	94.8
DK0041R	Lille Valby	96.4
EE0009R	Lahemaa	97.5
EE0011R	Vilsandy	93.6

Table 3, cont.

Code	Station	Data capture 2005
ES0007R	Víznar	95.8
ES0008R	Niembro	97.6
ES0009R	Campisábalos	94.7
ES0010R	Cabo de Creus	97.8
ES0011R	Barcarrola	97.1
ES0012R	Zarra	94.6
ES0013R	Penausende	97.9
ES0014R	Els Torms	97.5
ES0015R	Risco Llamo	94.8
ES0016R	O Saviñao	96.7
FI0009R	Utö	97.1
FI0017R	Virolahti II	98.2
FI0022R	Oulanka	97.7
FI0037R	Ahtari II	93.3
FR0008R	Donon A	95.2
FR0008R	Donon B	96.4
FR0008R	Donon C	98.0
FR0008R	Donon D	97.9
FR0009R	Revin	89.2
FR0010R	Morvan	86.7
FR0012R	Iraty	92.8
FR0013R	Peyrusse Vieille	98.1
FR0014R	Montandon	90.0
FR0015R	La Tardière	98.3
FR0016R	Le Casset	94.9
FR0017R	Montfranc	98.1
GB0002R	Eskdalemuir	96.0
GB0006R	Lough Navar	98.3
GB0013R	Yarner Wood	96.4
GB0014R	High Muffles	93.3
GB0015R	Strath Vaich Dam	92.7
GB0031R	Aston Hill	98.8
GB0032R	Bottesford	99.3
GB0033R	Bush	98.1
GB0034R	Glazebury	98.3
GB0035R	Great Dun Fell	99.4
GB0036R	Harwell	97.9
GB0037R	Ladybower Res.	96.5
GB0038R	Lullington Heath	98.2
GB0039R	Sibton	91.3
GB0043R	Narberth	60.5
GB0044R	Somerton	95.4
GB0045R	Wicken Fen	89.7
GR0001R	Aliartos	99.3
GR0002R	Finokalia	65.5
HU0002R	K-puszta	82.2
IE0001R	Valentia Observatory	99.0
IE0031R	Mace Head	99.1
IT0001R	Montelibretti	97.0
IT0004R	Ispra	95.0
LT0015R	Preila	95.2
LV0010R	Rucava	88.8
MT0001R	Giordan ligthouse	86.8

Table 3, cont.

Code	Station	Data capture 2005
NL0009R	Kollumerwaard	93.0
NL0010R	Vredepeel	99.1
NO0001R	Birkenes	98.6
NO0015R	Tustervatn	99.2
NO0039R	Kårvatn	99.6
NO0042G	Spitsbergen, Zeppelinfjell	98.9
NO0043R	Prestebakke	99.7
NO0052R	Sandve	99.5
NO0055R	Karasjok	99.7
NO0056R	Hurdal	99.6
PL0002R	Jarczew	99.3
PL0003R	Sniezka	94.9
PL0004R	Leba	100.0
PL0005R	Diabla Gora	97.1
PT0004R	Monte Velho	41.1
SE0005R	Bredkälen	98.6
SE0011R	Vavihill	96.5
SE0012R	Aspvreten	96.8
SE0013R	Esrange	99.8
SE0014R	Råö	98.5
SE0032R	Norra-Kvill	94.4
SE0035R	Vindeln	99.6
SE0039R	Grimsö	99.1
SI0008R	Iskrba	94.1
SI0031R	Zarodnje	95.0
SI0032R	Krvavec	97.3
SI0033R	Kovk	91.4
SK0002R	Chopok	97.3
SK0004R	Stará Lesná	99.8
SK0005R	Liesek	95.4
SK0006R	Starina	95.4
SK0007R	Topolniky	96.1

Missing data in the measurement series may be critical, especially in summer when the highest ozone concentrations occur. In particular calculations of AOT40 values may be strongly affected by missing data, and a correction is necessary in order to obtain comparable calculations. In the mapping of AOT40, a 85% data capture has been required and an adjustment proportional to the number of missing data has been applied, i.e. exposure index divided by the fraction of data available. This correction will give a good approximation when the missing data are randomly scattered throughout the dataset, but a better correction is needed for larger gaps in the dataset. Calculations of percentiles are less sensitive to missing data, and a data capture of 75% has been regarded as sufficient for the mapping.

5. Concentration summaries and episodes

Table 1.1 in Annex 1 shows the extreme concentrations for 2005. The number of hours and days the ozone concentrations exceeded 120, 150, 180 and 200 µg/m^3 and the maxima are given. The highest hourly mean values were found at Montelibretti, Italy (264 µg/m^3, 3rd August), Eupen, Belgium (237 µg/m^3, 24th June) and Vredepeel, The Netherlands (230.6 µg/m^3, 24th June).

Values above 200 µg/m^3 were during 2005 measured at 12 sites in Central Europe, compared to 44 sites in 2003 and six sites in 2004. The lowest maximum values were observed at Spitsbergen, Norway (106.5 µg/m^3, 21st April).

The one hour critical level for ozone formulated by the ECE for protection of vegetation, 150 µg/m^3, was in 2005 exceeded at 88 sites in Central and Southern Europe (Figure 1.3, Annex 1). At four sites the limit was exceeded 20 days or more.

Figure 1.4 in Annex 1 shows the number of exceedances of the threshold value of 180 µg/m^3 formulated by the EU for informing the public. At Montelibretti, the threshold value was exceeded 11 days, while seven additional sites measured above 180 µg/m^3 for at least four days. In total values above 180 µg/m3 were measured at 36 sites.

Table 1.2 in Annex 1 shows the 25-, 50-, 75-, 90-, 95-, 98- and 99-percentiles for the period April-September. Graphical distributions of the 99-percentile and 95-percentile are shown in Figure 1.1 and Figure 1.2 in Annex 1.

The lowest values are found in Scandinavia, United Kingdom and the Baltics where the 99-percentile is below 130 µg/m^3. The concentrations are higher in Central Europe, where the 99-percentile generally ranges from 130-160 µg/m^3. A few sites in Central Europe, including Ispra, had values above 160 µg/m^3.

6. Calculation of AOT40

According to the workshop on critical levels for ozone in Europe, held in Kuopio, 1996, the AOT40 values for forest and agricultural crops are accumulated during daylight hours only, defined as hours with mean global radiation, a simple approach have been used for the calculations in this report, defining daylight hours as solar zenith angle less than 80°.

AOT40 and AOT60 for forests and agricultural crops for 2005 are shown in Tables 2.1 and 2.2 in Annex 2, and the corresponding geographical distributions of AOT40 and AOT60 are shown in Figures 2.1-2.4. The maps of AOT40 show a general increasing gradient from west to east and from north to south. The lowest values are found in Scandinavia, in the Baltic region and in Ireland and in the United Kingdom, while the highest values are found in Spain, Austria and Italy.

The maps show that the exceedances for critical levels are considerable. The critical level for forest (10 000 ppbh) is exceeded in Austria, Switzerland, Italy

and France, in the Czech Republic, Slovenia and Slovakia, and on Malta. Some stations in Italy, France and Austria had AOT40 values above 15 000 ppth. The critical level for agricultural crops, 3000 ppbh, was in 2005 exceeded at most European stations except stations in Scandinavia and in Ireland and the UK.

The ozone concentrations reported for the Greek station GR0001 Aliartos showed very much lower concentrations during the whole year compared to other EMEP sites. Furthermore, the NO_2 monthly means concentration at the site looks higher than expected. These findings indicate that the site is significant influenced by nearby anthropogenic emissions, and thus not well suited as a regional background station site for surface ozone. The AOT data from GR0001 is therefore not included in the report.

7. Seasonal variation

Monthly mean concentrations for 2005 are given in Table 3.1 and monthly data capture in Table 3.2 in Annex 3. The concentrations show a clear pattern with maximum values during spring or early summer and minimum in winter. The seasonal variation is the net result of a number of processes such as dry deposition, photochemical loss (titration with NO_x) and formation, and varying influx from the stratosphere as well as varying background ozone concentrations.

Plots of the seasonal variations 1990-2005 are given in Figure 3.1 in Annex 3.

The seasonal variation of ozone shows characteristics, which seem to be bound by the geographical location of the station (Roemer et al., 1996). In Central and Alpine Europe the variation is characterised by a broad summer maximum with high monthly means from May to August. A springtime maximum in April and May followed by a gradual decline to a minimum in November-December is found for sites in England, the Netherlands and the southern parts of Scandinavia and Finland. A spring maximum followed by a minimum in the summer is generally found in Ireland, Scotland and the northern parts of Scandinavia and Finland.

8. Diurnal variation

In addition to the seasonal variation, ozone concentrations show a variation on a shorter time scale. The diurnal variation is a result of the variation in vertical mixing, surface dry deposition and photochemistry. Thus, coastal and mountain sites away from NO_x sources generally show the least diurnal cycles, whereas diurnal cycles will be most pronounced at inland sites in spring and summer. The average diurnal variation of surface ozone for summer (April-September) 2005 is shown in Annex 4. In general the lowest concentrations are found in early morning and the highest in the afternoon.

The most pronounced diurnal variation is found at the rural sites in Central Europe e.g. sites in Austria, Switzerland, most of the German sites and Ispra in Italy.

Typical for those sites is a more marked peak in the diurnal cycle with a characteristic maximum around mid-afternoon. The pronounced diurnal peak during the summer months is due to photochemical generation of ozone during daytime as a result of higher temperature and insolation during this time of the day. However, during the night, more stable atmospheric conditions and nocturnal inversions prevent the vertical mixing and the transport of ozone from the free troposphere into the boundary layer.

A weaker diurnal variation is observed at the coastal and island stations and at the remote sites in Norway and Sweden. Mace Head, situated on the west coast of Ireland, has roughly the same average concentrations as the rural sites in Central Europe but almost no diurnal variation due to remoteness from source areas and prevailing westerly winds. Zeppelinfjellet at Spitsbergen shows no diurnal variation. Elevated sites like Chaumont and Krvavec show a weaker diurnal cycle and the average concentration level is also high, due to influence of air from the free troposphere.

9. Update

The data compiled in this report represent the quality assured and quality controlled data at present. If errors are detected in the future, the data will be corrected in the database. It is important that users make certain they have access to the most recent version of the data. For the data presented here, the latest alteration was 4 July, 2007.

Complete data sets are available upon request to the CCC (e-mail: anne-gunn.hjellbrekke@nilu.no). Information about the EMEP network and measurement data is also available on the web at http://www.emep.int and http://www.nilu.no/projects/ccc/index.html.

10. References

Aas, W., Hjellbrekke, A.-G. and Schaug, J. (2000) Data quality 1998, quality assurance and field comparisons. Kjeller, Norwegian Institute for Air Research (EMEP/CCC-Report 6/2000).

Ashmore, M.R. and Wilson, R.B., eds. (1992) Critical levels of air pollutants for Europe. Background papers prepared for UN-ECE workshop on critical levels Egham, UK. London, Department of the Environment.

Bojkov, R.D. (1986) Surface ozone during the second half of the nineteenth century. *J. Clim. Appl. Meteorol., 25*, 343-352.

Forberg, E., Aarnes, H., Nilsen, S. and Semb, A. (1987) Effect of ozone on net photosynthesis in oat (*Avena sativa*) and duckweed (*Lemna gibba*). *Environ. Poll., 47*, 285-291.

Führer, J. and Achermann, B., eds. (1994) Critical levels for ozone. A UN-ECE workshop report. Bern, Swiss Federal Station for Agricultural Chemistry.

Grennfelt, P., Hoem, K., Saltbones, J. and Schjoldager, J. (1989) Oxidant data collection in OECD-Europe 1985-87 (OXIDATE). Report on ozone, nitrogen dioxide and peroxyacetyl nitrate. October 1986-March 1987, April-September 1987 and October-December 1987. Lillestrøm (NILU OR 63/89).

Grennfelt, P., Saltbones, J. and Schjoldager, J. (1988) Oxidant data collection in OECD-Europe 1985-87 (OXIDATE). Report on ozone, nitrogen dioxide and peroxyacetyl nitrate. October 1985 – March 1986 and April – September 1986. Lillestrøm (NILU OR 31/88).

Grennfelt, P. and Schjoldager, J. (1984) Photochemical oxidants in the troposphere: a mounting menace. *Ambio, 13*, 61-67.

Kärenlampi, L. and Skärby, L., eds. (1996) Critical levels for ozone in Europe. Testing and finalizing the concepts. UN-ECE Workshop Report. Kuopio, University of Kuopio.

Roemer, M., Boersen, G., Builtjes, P. and Esser, P. (1996) The budget of ozone and precursors over Europe calculated with the LOTOS-model. In: *Trends of tropospheric ozone over Europe*. Ed. by M. Roemer. Amsterdam. pp. 93-116.

Volz, A. and Kley, D. (1988) Evaluation of the Montsouris series of ozone measurements made in the nineteenth century. *Nature, 332*, 240-242.

11. List of participating institutions

Austria	Umweltbundesamt Provincial Government of Tyrol Provincial Government of Carinthia Environment Institute Vorarlberg Provincial Government Styria Provincial Government Salzburg Provincial Government Lower Austria
Belgium	CELINE – IRCEL
Bulgaria	Executive Environment Agency
Commission of the European Communities	Joint Research Center. Ispra Establishment
Cyprus	Ministry of Labour and Social Insurance
Czech Republic	Czech Hydrometeorological Institute
Denmark	National Environmental Research Institute (DMI)
Estonia	Estonian Environmental Research Laboratory Ltd.
Finland	Finnish Meteorological Institute (FMI)
France	l' Ecole des Mines de Douai Laboratories Wolff
Germany	Umweltbundesamt
Greece	Environmental Chemical Processes Laboratory, University of Crete Ministry of Environmental Physical Planning and Public Works
Hungary	Meteorological Service, Institute for Atmospheric Physics, Dep. for Air Chemistry
Italy	C.N.R. Istituto Inquinamento Atmosferico
Latvia	Latvian Environment, Geology and Meteorology Agency
Lithuania	Environmental Physics and Chemistry Laboratory, Institute of Physics
Malta	University of Malta
Netherlands	National Institute for Public Health and Environmental Protection (RIVM)
Norway	Norwegian Institute for Air Research (NILU)
Poland	Institute of Meteorology and Water Management Institute of Environmental Protection
Portugal	Instituto de Meteorologica
Russian Federation	Institute of Global Climate and Ecology
Slovakia	Slovak Hydrometeorological Institute
Slovenia	Hydrometeorological Institute of Slovenia
Spain	Dirección General de Calidad y Evaluacíon Ambiental
Sweden	Swedish Environmental Research Institute (IVL)
Switzerland	Swiss Federal Laboratory of Testing Materials and Research (EMPA)
United Kingdom	AEA Technology

Annex 1

Concentration summaries and episodes, tables and figures

Table 1.1: Number of hours (h) and days (d) exceeding 120, 150, 180 and 200 μg/m^3 and maximum concentrations in 2005.

Code	Station	Total		>120		>150		>180		>200		Max concentrations	
		hours	days	hours	days	hours	days	hours	days	hours	days	μg/m^3	day(s)
AT0002R	Illmitz	8015	352	504	84	18	8	0	0	0	0	169.0	22.06.2005
AT0005R	Vorhegg	7800	344	395	59	45	12	3	1	0	0	199.0	30.05.2005
AT0030R	Pillersdorf bei Retz	8338	365	396	62	32	10	4	4	0	0	197.0	27.05.2005
AT0032R	Sulzberg	8356	362	580	61	89	11	4	1	0	0	182.0	15.07.2005
AT0033R	Stolzalpe bei Murau	8216	361	233	44	0	0	0	0	0	0	147.0	30.07.2005
AT0034G	Sonnblick	8263	365	1269	122	26	7	0	0	0	0	164.0	11.11.2005
AT0037R	Zillertaler Alpen	8387	365	717	65	5	1	0	0	0	0	158.0	23.06.2005
AT0038R	Gerlitzen	8396	365	681	70	15	5	0	0	0	0	173.0	28.07.2005
AT0040R	Masenberg	8358	365	683	69	19	6	0	0	0	0	161.0	21.06.2005
AT0041R	Haunsberg	8301	364	402	55	45	11	3	1	0	0	187.0	22.06.2005
AT0042R	Heidenreichstein	8229	360	347	55	15	6	1	1	0	0	181.0	03.06.2005
AT0043R	Forsthof	8381	365	478	64	10	7	0	0	0	0	175.0	02.05.2005
AT0044R	Graz Platte	7770	340	656	75	7	2	0	0	0	0	158.0	03.05.2005
AT0045R	Dunkelsteinerwald	8313	364	285	52	48	16	4	4	0	0	199.0	27.05.2005
AT0046R	Gänserndorf	8368	365	361	68	27	10	1	1	0	0	183.0	03.05.2005
AT0047R	Stixneusiedl	8325	365	402	67	15	7	2	1	0	0	187.0	03.05.2005
BE0001R	Offagne	7798	355	222	34	63	12	2	2	0	0	183.0	25.06.2005
BE0032R	Eupen	7853	358	216	33	58	12	15	6	5	2	219.0	24.06.2005
BE0035R	Vezin	7794	356	192	37	67	14	14	3	7	2	237.0	24.06.2005
BG0053R	Rojen peak	8583	364	369	53	4	3	0	0	0	0	151.7	01.07.2005
CH0002R	Payerne	8355	365	336	59	72	16	2	1	0	0	184.5	23.06.2005
CH0003R	Tänikon	8342	365	298	59	59	12	4	2	0	0	198.9	22.06.2005
CH0004R	Chaumont	8348	365	793	77	137	20	6	2	0	0	189.9	23.06.2005
CH0005R	Rigi	8317	365	720	76	117	18	22	5	5	2	207.6	22.06.2005
CY0002R	Ayia Marina	8103	343	1272	137	4	1	0	0	0	0	155.1	17.06.2005
CZ0001R	Svratouch	8730	365	237	41	1	1	0	0	0	0	150.4	16.07.2005
CZ0003R	Košetice	8680	365	375	55	11	4	0	0	0	0	158.6	16.06.2005
DE0001R	Westerland	8446	365	78	20	2	1	0	0	0	0	176.0	24.06.2005
DE0002R	Langenbrügge	8364	365	200	37	34	9	2	1	0	0	184.0	15.07.2005
DE0003R	Schauinsland	8214	362	861	78	183	24	25	5	4	1	217.0	23.06.2005
DE0007R	Neuglobsow	8043	365	131	30	20	8	0	0	0	0	172.0	27.05.2005
DE0008R	Schmücke	7386	332	426	44	61	10	4	2	0	0	196.0	25.06.2005
DE0009R	Zingst	8394	365	148	26	2	1	0	0	0	0	156.0	15.04.2005

Table 1.1, cont.

Code	Station	Total		>120		>150		>180		>200		Max concentrations	
		hours	days	hours	days	hours	days	hours	days	hours	days	μg/m^3	day(s)
DE0026R	Ueckermünde	6738	294	73	15	5	2	0	0	0	0	168.0	15.07.2005
DE0035R	Lückendorf	6212	283	347	56	31	9	2	1	0	0	190.0	15.07.2005
DE0039R	Aukrug	6770	296	68	16	7	2	0	0	0	0	176.0	28.05.2005
DE0045R	Schorfheide	6515	297	280	46	66	12	17	4	3	1	209.0	15.07.2005
DE0047R	Falkenberg	6412	283	146	29	17	5	0	0	0	0	175.0	15.07.2005
DK0005R	Keldsnor	8053	343	27	9	0	0	0	0	0	0	140.3	15.07.2005
DK0031R	Ulborg	8308	351	59	15	3	2	0	0	0	0	161.2	28.05.2005
DK0041R	Lille Valby	8443	362	65	17	2	1	0	0	0	0	156.3	24.06.2005
EE0009R	Lahemaa	8537	359	32	5	1	1	0	0	0	0	151.0	05.04.2005
EE0011R	Vilsandy	8200	349	81	17	4	1	0	0	0	0	166.0	16.07.2005
ES0007R	Víznar	8393	363	808	111	30	14	0	0	0	0	177.8	23.07.2005
ES0008R	Niembro	8548	365	116	26	4	2	0	0	0	0	170.7	18.06.2005
ES0009R	Campisábalos	8298	365	570	80	52	17	0	0	0	0	170.1	15.07.2005
ES0010R	Cabo de Creus	8571	365	620	84	53	15	1	1	1	1	201.3	18.06.2005
ES0011R	Barcarrola	8504	363	417	67	50	12	0	0	0	0	177.1	20.08.2005
ES0012R	Zarra	8284	362	571	87	39	13	3	2	0	0	195.2	23.07.2005
ES0013R	Penausende	8576	365	590	70	47	14	6	1	2	1	211.5	21.07.2005
ES0014R	Els Torms	8540	364	720	91	30	13	1	1	0	0	180.4	21.06.2005
ES0015R	Risco Llamo	8306	362	662	74	30	9	4	1	2	1	208.8	22.07.2005
ES0016R	O Saviñao	8474	364	109	26	4	3	0	0	0	0	161.5	05.08.2005
FI0009R	Utö	8504	363	60	9	0	0	0	0	0	0	143.0	16.07.2005
FI0017R	Virolahti II	8598	363	210	31	18	4	0	0	0	0	164.0	12.05.2005
FI0022R	Oulanka	8558	364	12	2	0	0	0	0	0	0	137.0	05.04.2005
FI0037R	Ahtari II	8171	345	65	9	6	1	0	0	0	0	159.0	04.04.2005
FR0008R	Donon	8339	365	590	168	136	59	10	7	1	1	206.0	08.10.2005
FR0008R	Donon	8449	365	653	173	153	61	12	7	2	2	214.0	23.09.2005
FR0008R	Donon	8583	365	697	176	186	75	15	10	4	4	219.0	23.09.2005
FR0008R	Donon	8573	365	603	161	153	57	12	8	4	4	214.0	23.09.2005
FR0009R	Revin	7811	333	166	25	22	6	1	1	0	0	181.0	25.06.2005
FR0010R	Morvan	7593	325	239	35	13	4	0	0	0	0	179.0	27.05.2005
FR0012R	Iraty	8129	343	671	78	45	13	1	1	0	0	184.0	13.09.2005
FR0013R	Peyrusse Vieille	8596	361	168	32	15	4	0	0	0	0	173.0	22.06.2005

Table 1.1, cont.

Code	Station	Total		>120		>150		>180		>200		Max concentrations	
		hours	days	hours	days	hours	days	hours	days	hours	days	$\mu g/m^3$	day(s)
FR0014R	Montandon	7886	337	137	22	10	2	1	1	0	0	183.0	22.06.2005
FR0015R	La Tardière	8612	362	204	30	32	7	0	0	0	0	169.0	16.07.2005
FR0016R	Le Casset	8313	354	390	48	28	5	0	0	0	0	174.0	16.07.2005
FR0017R	Montfranc	8596	364	373	39	8	2	0	0	0	0	156.0	16.07.2005
GB0002R	Eskdalemuir	8409	354	2	1	0	0	0	0	0	0	128.0	31.08.2005
GB0006R	Lough Navar	8613	362	6	1	0	0	0	0	0	0	140.0	25.04.2005
GB0013R	Yarner Wood	8443	358	45	11	1	1	0	0	0	0	154.0	28.06.2005
GB0014R	High Muffles	8177	348	32	11	0	0	0	0	0	0	150.0	31.08.2005
GB0015R	Strath Vaich Dam	8117	345	7	2	0	0	0	0	0	0	126.0	25.04.2005
GB0031R	Aston Hill	8657	365	54	13	3	1	0	0	0	0	158.0	27.05.2005
GB0032R	Bottesford	8700	365	45	13	2	1	0	0	0	0	170.0	31.08.2005
GB0033R	Bush	8591	365	2	1	0	0	0	0	0	0	128.0	12.07.2005
GB0034R	Glazebury	8615	365	24	10	0	0	0	0	0	0	134.0	02.04.2005, 09.07.2005, 11.07.2005
GB0035R	Great Dun Fell	8704	365	10	5	0	0	0	0	0	0	136.0	25.04.2005
GB0036R	Harwell	8580	363	33	12	0	0	0	0	0	0	148.0	27.05.2005
GB0037R	Ladybower Res.	8453	359	5	2	0	0	0	0	0	0	128.0	02.04.2005
GB0038R	Lullington Heath	8605	365	141	22	45	8	6	2	1	1	202.0	27.05.2005
GB0039R	Sibton	7996	340	195	39	31	7	8	2	0	0	190.0	23.06.2005, 24.06.2005
GB0043R	Narberth	5299	227	0	0	0	0	0	0	0	0	110.0	03.09.2005, 15.10.2005
GB0044R	Somerton	8361	362	41	14	1	1	0	0	0	0	152.0	27.05.2005
GB0045R	Wicken Fen	7858	333	85	17	23	6	0	0	0	0	178.0	31.08.2005
GR0001R	Aliartos	8698	365	0	0	0	0	0	0	0	0	115.0	01.04.2005
GR0002R	Finokalia	5741	254	1731	127	34	8	0	0	0	0	161.9	22.07.2005
HU0002R	K-puszta	7200	309	74	18	0	0	0	0	0	0	140.0	04.06.2005
IE0001R	Valentia Observatory	8676	365	18	2	0	0	0	0	0	0	133.8	19.03.2005
IE0031R	Mace Head	8683	365	1	1	0	0	0	0	0	0	124.0	25.04.2005
IT0001R	Montelibretti	8494	357	613	114	145	39	28	11	11	5	264.0	03.08.2005
IT0004R	Ispra	8321	359	280	66	69	22	0	0	0	0	176.2	25.05.2005
LT0015R	Preila	8339	354	101	21	4	2	0	0	0	0	160.0	04.04.2005
LV0010R	Rucava	7783	331	13	4	0	0	0	0	0	0	143.0	25.06.2005
MT0001R	Giordan lighthouse	7601	323	1173	118	41	15	0	0	0	0	170.8	01.05.2005

Table 1.1, cont.

Code	Station	Total		>120		>150		>180		>200		Max concentrations	
		hours	days	hours	days	hours	days	hours	days	hours	days	$\mu g/m^3$	day(s)
NL0009R	Kollumerwaard	8151	343	35	9	1	1	0	0	0	0	176.1	20.06.2005
NL0010R	Vredepeel	8683	364	125	27	33	7	17	3	6	1	230.6	24.06.2005
NO0001R	Birkenes	8633	365	23	7	0	0	0	0	0	0	131.2	06.09.2005
NO0015R	Tustervatn	8693	365	3	2	0	0	0	0	0	0	123.2	17.06.2005
NO0039R	Kårvatn	8725	365	6	3	0	0	0	0	0	0	121.3	28.04.2005
NO0042G	Spitsbergen, Zeppelinfjell	8665	364	0	0	0	0	0	0	0	0	106.5	21.04.2005
NO0043R	Prestebakke	8733	365	35	7	0	0	0	0	0	0	144.0	06.09.2005
NO0052R	Sandve	8715	365	11	2	0	0	0	0	0	0	129.7	03.04.2005
NO0055R	Karasjok	8737	365	5	1	0	0	0	0	0	0	126.3	04.04.2005
NO0056R	Hurdal	8729	365	16	3	0	0	0	0	0	0	140.5	03.04.2005
PL0002R	Jarczew	8699	364	73	21	0	0	0	0	0	0	145.0	30.08.2005
PL0003R	Sniezka	8309	349	218	41	7	2	0	0	0	0	168.0	25.06.2005
PL0004R	Leba	8757	365	73	15	0	0	0	0	0	0	150.0	15.07.2005
PL0005R	Diabla Gora	8508	356	145	28	2	1	0	0	0	0	159.0	29.05.2005
PT0004R	Monte Velho	3602	152	164	27	53	13	7	3	0	0	199.0	05.08.2005, 23.08.2005
SE0005R	Bredkälen	8637	362	10	1	0	0	0	0	0	0	144.0	04.04.2005
SE0011R	Vavihill	8455	357	49	9	0	0	0	0	0	0	143.0	24.06.2005
SE0012R	Aspvreten	8479	362	59	11	0	0	0	0	0	0	135.0	01.05.2005
SE0013R	Esrange	8744	365	0	0	0	0	0	0	0	0	104.0	04.04.2005
SE0014R	Råö	8629	362	36	9	0	0	0	0	0	0	138.0	03.04.2005
SE0032R	Norra-Kvill	8266	353	46	9	0	0	0	0	0	0	136.0	04.04.2005
SE0035R	Vindeln	8728	365	7	2	0	0	0	0	0	0	126.0	04.04.2005
SE0039R	Grimsö	8684	364	52	9	0	0	0	0	0	0	140.0	04.04.2005
SI0008R	Iskrba	8240	364	546	75	28	9	0	0	0	0	170.0	28.07.2005
SI0031R	Zarodnje	8326	365	480	67	12	5	3	1	0	0	187.0	25.06.2005
SI0032R	Krvavec	8521	365	1122	114	74	16	7	3	0	0	189.0	25.06.2005
SI0033R	Kovk	8007	356	396	61	15	5	0	0	0	0	164.0	23.06.2005
SK0002R	Chopok	8524	363	1068	96	57	12	0	0	0	0	168.0	07.04.2005
SK0004R	Stará Lesná	8745	365	296	46	5	1	0	0	0	0	153.0	07.04.2005
SK0005R	Liesek	8353	351	316	65	15	3	0	0	0	0	162.0	20.04.2005
SK0006R	Starina	8354	360	396	61	44	12	0	0	0	0	176.0	07.04.2005
SK0007R	Topolniky	8422	361	386	65	10	5	0	0	0	0	164.0	03.05.2005

Table 1.2: Percentiles of hourly ozone values April–September 2005.

Code	Station	25%	50%	75%	90%	95%	98%	99%	Data capture
AT0002R	Illmitz	57.0	76.0	99.0	121.0	131.0	139.4	145.0	95.1
AT0005R	Vorhegg	61.0	83.0	103.0	118.0	130.0	144.0	152.4	94.7
AT0030R	Pillersdorf bei Retz	64.0	80.0	99.0	117.0	127.0	138.2	147.0	95.4
AT0032R	Sulzberg	71.0	87.0	106.0	125.0	137.0	152.6	159.3	95.0
AT0033R	Stolzalpe bei Murau	55.0	77.0	95.0	111.0	120.0	127.0	131.0	95.1
AT0034G	Sonnblick	99.0	111.0	122.0	132.0	138.0	143.0	147.0	94.3
AT0037R	Zillertaler Alpen	84.0	97.0	112.0	126.0	132.0	138.0	143.0	95.7
AT0038R	Gerlitzen	88.0	102.0	114.0	126.0	131.0	137.0	142.0	95.7
AT0040R	Masenberg	81.0	96.0	111.0	126.6	134.0	141.0	145.1	95.5
AT0041R	Haunsberg	67.0	83.0	102.0	118.0	131.0	144.0	151.0	94.1
AT0042R	Heidenreichstein	53.0	74.0	96.0	114.0	125.0	135.0	140.2	95.1
AT0043R	Forsthof	66.0	83.0	102.0	120.0	129.0	137.0	141.0	95.6
AT0044R	Graz Platte	75.0	94.0	109.0	126.0	133.0	140.0	143.0	95.4
AT0045R	Dunkelsteinerwald	49.0	67.0	91.0	112.0	126.0	143.0	153.2	94.3
AT0046R	Gänserndorf	49.0	69.0	92.0	114.0	125.0	137.0	144.0	95.5
AT0047R	Stixneusiedl	55.0	74.0	98.0	118.0	127.0	136.0	141.0	95.2
BE0001R	Offagne	50.0	66.0	87.0	108.0	123.0	145.0	158.1	88.5
BE0032R	Eupen	43.0	62.0	84.0	108.0	122.0	144.5	160.0	90.5
BE0035R	Vezin	29.0	53.0	77.0	101.0	119.0	143.0	160.1	90.8
BG0053R	Rojen peak	80.8	95.1	106.8	116.9	122.5	128.1	131.1	97.8
CH0002R	Payerne	48.2	68.8	91.6	114.7	129.1	147.0	155.5	95.4
CH0003R	Tänikon	47.2	68.1	88.9	112.0	126.1	140.6	156.6	95.1
CH0004R	Chaumont	80.8	94.7	112.7	131.7	144.4	153.9	160.1	95.2
CH0005R	Rigi	78.7	93.1	110.4	129.8	142.1	154.9	168.6	94.5
CY0002R	Ayia Marina	102.8	112.3	121.5	129.0	133.7	139.4	142.0	96.1
CZ0001R	Svratouch	59.9	77.0	96.0	111.7	118.9	126.5	130.7	99.7
CZ0003R	Košetice	57.3	75.2	97.0	115.7	124.3	133.0	138.3	99.1
DE0001R	Westerland	65.0	77.0	91.0	102.0	110.0	120.0	127.0	95.7
DE0002R	Langenbrügge	42.0	63.0	84.0	105.0	120.0	136.0	148.0	95.4
DE0003R	Schauinsland	82.0	98.0	116.0	136.0	148.0	164.0	174.0	94.8
DE0007R	Neuglobsow	41.0	62.0	82.0	102.0	112.0	126.4	134.7	91.7
DE0008R	Schmücke	68.0	85.0	105.0	123.0	134.0	149.9	159.0	77.5
DE0009R	Zingst	55.0	70.0	89.0	107.0	116.0	127.0	133.0	95.7
DE0026R	Ueckermünde	48.0	66.0	84.0	99.0	109.0	119.9	126.0	93.4
DE0035R	Lückendorf	61.0	80.0	100.0	117.0	126.0	140.0	148.0	87.4
DE0039R	Aukrug	36.0	56.0	76.0	92.0	104.0	117.0	127.0	95.9
DE0045R	Schorfheide	46.0	67.0	87.0	111.0	126.0	144.6	162.8	91.5
DE0047R	Falkenberg	46.0	64.0	85.0	105.0	116.0	130.0	138.0	91.3
DK0005R	Keldsnor	51.8	64.6	77.7	91.5	99.9	109.9	115.7	84.2
DK0031R	Ulborg	56.9	68.7	82.2	95.3	104.1	115.7	124.1	95.9
DK0041R	Lille Valby	49.3	66.7	82.2	96.3	106.4	116.5	124.2	95.2
EE0009R	Lahemaa	44.0	61.0	76.0	91.0	98.0	107.4	117.2	95.1
EE0011R	Vilsandy	62.0	72.0	84.0	96.0	108.0	120.0	129.0	96.3
ES0007R	Víznar	89.2	102.4	115.5	127.2	134.4	142.2	147.1	96.6
ES0008R	Niembro	58.0	72.8	88.3	101.9	111.1	122.9	131.0	97.9
ES0009R	Campisábalos	72.8	89.7	106.9	124.6	135.5	146.6	152.1	93.5
ES0010R	Cabo de Creus	83.0	95.3	110.4	123.5	132.1	143.5	152.8	97.4
ES0011R	Barcarrola	58.9	78.4	100.1	119.4	129.9	142.6	153.0	96.1
ES0012R	Zarra	83.0	96.1	110.6	124.8	131.2	140.9	149.7	91.5
ES0013R	Penausende	70.2	87.1	105.1	124.3	135.0	143.6	151.1	98.5
ES0014R	Els Torms	78.6	95.2	112.3	128.5	135.6	142.4	148.0	97.2
ES0015R	Risco Llamo	84.0	97.7	113.1	125.5	132.9	140.6	145.9	94.7
ES0016R	O Saviñao	42.5	55.5	68.8	84.2	102.2	123.6	131.7	96.9
FI0009R	Utö	62.0	73.0	86.0	98.0	106.0	116.0	123.0	98.4
FI0017R	Virolahti II	51.0	68.0	86.3	107.0	119.0	131.0	138.0	98.8
FI0022R	Oulanka	47.0	62.0	77.0	91.0	98.0	103.4	108.0	98.6
FI0037R	Ahtari II	51.0	65.0	82.0	97.0	104.0	117.0	121.0	99.3
FR0008R	Donon A	59.0	72.0	90.0	113.0	127.0	146.5	156.0	96.2
FR0008R	Donon B	61.0	74.0	93.0	116.7	130.0	151.5	160.0	97.3
FR0008R	Donon C	62.0	75.0	95.0	118.0	130.0	154.0	162.0	97.6
FR0008R	Donon D	61.0	74.0	92.0	114.0	128.0	150.0	160.0	97.4
FR0009R	Revin	47.0	63.0	85.0	106.0	119.0	135.9	144.0	79.8
FR0010R	Morvan	57.0	75.0	97.0	116.0	125.0	138.6	147.0	74.5
FR0012R	Iraty	76.0	96.0	109.0	123.0	135.0	146.0	150.0	99.0
FR0013R	Peyrusse Vieille	58.0	74.0	91.0	107.0	118.0	127.0	136.4	97.0
FR0014R	Montandon	47.0	64.0	81.0	102.0	113.0	129.0	134.2	97.5
FR0015R	La Tardière	54.0	71.0	88.0	106.0	119.0	135.0	146.0	98.3
FR0016R	Le Casset	74.0	89.0	103.0	120.0	129.0	139.0	147.0	92.2
FR0017R	Montfranc	74.0	88.0	102.0	119.0	128.0	137.0	141.0	97.0

Table 1.2, cont.

Code	Station	25%	50%	75%	90%	95%	98%	99%	Data capture
GB0002R	Eskdalemuir	42.0	54.0	66.0	74.0	80.0	88.0	92.9	99.1
GB0006R	Lough Navar	34.0	48.0	66.0	80.0	86.0	92.0	98.0	97.1
GB0013R	Yarner Wood	46.0	60.0	74.0	88.0	96.0	110.0	122.0	98.2
GB0014R	High Muffles	48.0	62.0	78.0	94.0	104.0	112.0	118.0	97.2
GB0015R	Strath Vaich Dam	54.0	64.0	80.0	94.0	98.0	106.0	113.2	89.7
GB0031R	Aston Hill	60.0	72.0	86.0	96.0	104.0	116.0	124.0	98.2
GB0032R	Bottesford	34.0	52.0	70.0	84.0	94.0	108.0	122.0	99.0
GB0033R	Bush	44.0	54.0	66.0	78.0	84.0	88.0	94.0	97.8
GB0034R	Glazebury	32.0	54.0	72.0	88.0	94.0	102.0	112.0	97.7
GB0035R	Great Dun Fell	54.0	64.0	76.0	86.0	94.0	102.0	112.0	99.6
GB0036R	Harwell	38.0	54.0	68.0	82.0	90.0	104.0	116.0	98.5
GB0037R	Ladybower Res.	38.0	50.0	66.0	76.0	82.0	92.0	102.2	95.4
GB0038R	Lullington Heath	50.0	66.0	82.0	96.0	110.0	136.0	152.0	98.2
GB0039R	Sibton	44.0	64.0	84.0	106.0	120.0	137.9	148.0	91.1
GB0043R	Narberth	48.0	58.0	68.0	78.0	84.0	92.0	96.0	46.0
GB0044R	Somerton	42.0	58.0	74.0	88.0	96.0	110.0	120.0	96.7
GB0045R	Wicken Fen	36.0	56.0	76.0	92.0	102.0	118.5	140.0	98.7
GR0001R	Aliartos	13.0	32.0	55.0	72.0	83.0	94.0	101.0	99.7
GR0002R	Finokalia	108.8	118.6	127.8	135.6	140.0	146.4	149.9	80.6
HU0002R	K-puszta	38.0	54.0	78.0	99.0	110.0	120.0	124.0	74.0
IE0001R	Valentia Observatory	50.2	64.4	81.0	94.0	97.9	102.8	106.4	99.0
IE0031R	Mace Head	58.0	70.0	82.0	94.0	98.0	102.0	104.0	98.5
IT0001R	Montelibretti	29.5	63.9	102.9	127.8	142.4	160.1	171.6	97.5
IT0004R	Ispra	30.7	56.6	82.7	109.2	126.8	146.4	157.8	96.5
LT0015R	Preila	57.0	73.0	85.0	98.0	107.0	120.0	126.0	98.2
LV0010R	Rucava	37.0	55.0	70.0	82.0	91.0	103.0	109.2	99.7
MT0001R	Giordan lighthouse	98.8	110.2	121.0	130.1	137.6	145.0	149.8	98.0
NL0009R	Kollumerwaard	38.9	55.8	74.2	89.4	96.4	108.8	118.2	96.1
NL0010R	Vredepeel	27.0	48.5	70.8	92.3	107.1	128.3	143.5	99.2
NO0001R	Birkenes	44.8	62.4	76.2	91.2	97.7	106.4	115.8	99.0
NO0015R	Tustervatn	53.7	64.3	83.8	94.8	101.1	108.4	113.0	99.3
NO0039R	Kårvatn	31.7	53.3	74.6	91.1	97.1	106.9	114.1	99.6
NO0042G	Spitsbergen, Zeppelinfjell	52.2	60.4	73.9	91.9	97.0	100.0	101.0	98.4
NO0043R	Prestebakke	49.3	63.0	77.0	90.8	99.8	109.9	118.3	99.9
NO0052R	Sandve	56.8	67.6	82.3	92.0	97.7	109.1	113.5	99.4
NO0055R	Karasjok	47.4	58.9	76.3	89.7	96.0	99.8	102.8	99.7
NO0056R	Hurdal	41.3	57.5	72.5	87.4	94.5	105.1	111.0	99.5
PL0002R	Jarczew	46.0	64.0	83.0	99.0	109.0	119.0	124.0	98.8
PL0003R	Sniezka	64.5	83.0	98.0	112.0	120.0	128.0	133.0	90.6
PL0004R	Leba	54.0	71.0	86.0	99.0	105.0	116.0	126.1	99.9
PL0005R	Diabla Gora	48.0	69.0	86.0	102.0	112.0	125.0	130.0	94.6
PT0004R	Monte Velho	41.0	62.0	94.0	121.0	141.2	159.0	168.8	32.2
SE0005R	Bredkälen	42.0	54.0	73.0	88.0	95.0	101.0	106.0	97.3
SE0011R	Vavihill	52.0	66.0	83.0	96.0	105.0	114.0	122.0	99.6
SE0012R	Aspvreten	48.0	67.0	86.0	98.0	107.7	117.0	123.0	97.1
SE0013R	Esrange	45.0	56.0	70.0	81.0	87.0	92.0	93.0	99.8
SE0014R	Råö	57.0	70.0	83.0	95.0	103.0	112.0	119.0	99.8
SE0032R	Norra-Kvill	53.0	67.0	84.0	97.0	106.0	116.0	121.0	94.9
SE0035R	Vindeln	41.0	57.0	74.0	89.0	96.0	102.0	107.3	99.6
SE0039R	Grimsö	44.0	60.0	77.0	92.0	100.0	112.0	121.0	98.7
SI0008R	Iskrba	19.0	63.0	99.0	122.0	131.0	142.0	147.0	93.9
SI0031R	Zarodnje	72.0	88.0	105.0	121.0	129.0	136.8	142.0	94.7
SI0032R	Krvavec	96.0	108.0	120.0	132.0	140.0	149.0	160.0	98.4
SI0033R	Kovk	68.0	85.0	102.0	118.0	127.0	136.0	143.0	94.6
SK0002R	Chopok	93.0	105.0	119.0	132.0	138.0	146.0	152.0	96.5
SK0004R	Stará Lesná	57.0	80.0	98.0	114.0	122.0	131.0	139.0	100.0
SK0005R	Liesek	51.0	70.0	93.0	113.0	122.0	129.0	138.0	99.6
SK0006R	Starina	47.0	67.0	90.0	110.0	123.0	135.0	147.0	98.4
SK0007R	Topolniky	47.0	68.0	92.0	114.0	127.0	138.0	141.3	95.0

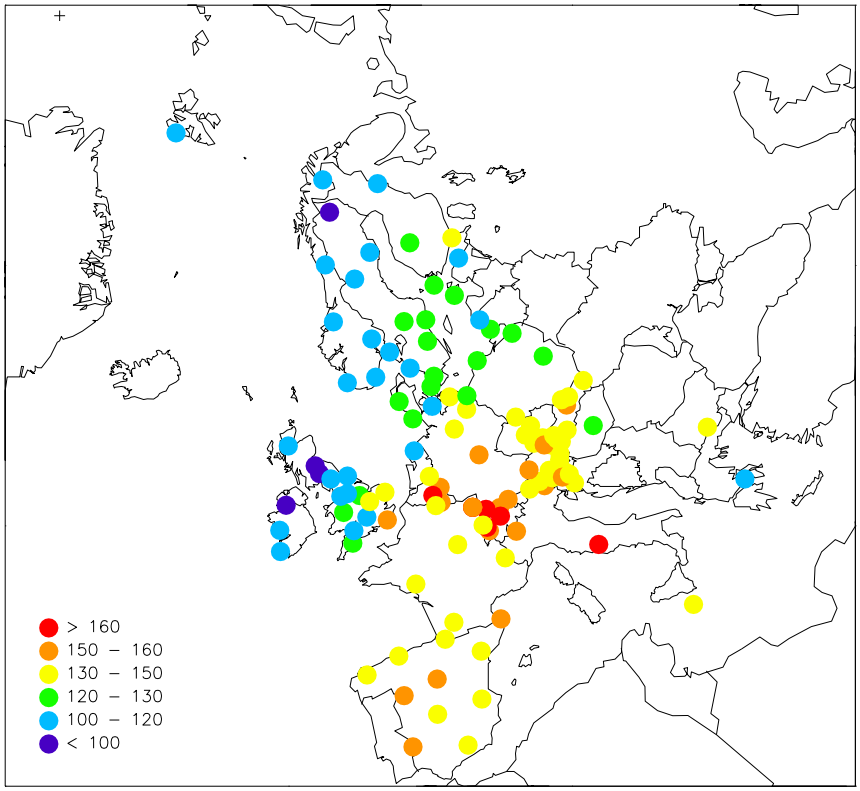


Figure 1.1: Ozone April–September 2005. 99-percentiles (μg/m^3).

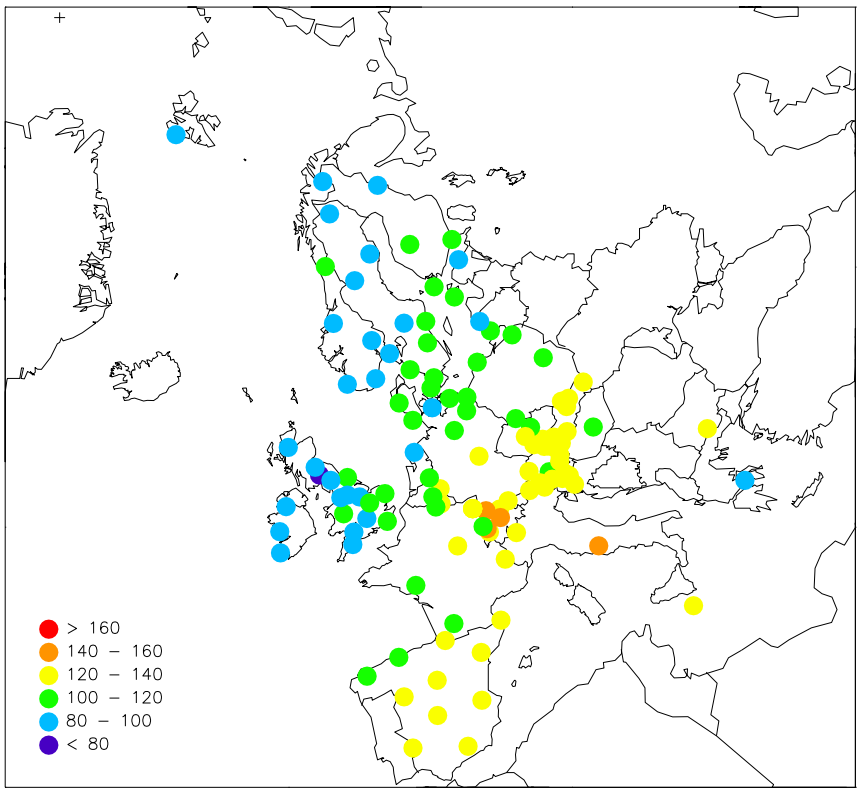


Figure 1.2: Ozone April–September 2005. 95-percentiles (μg/m^3).

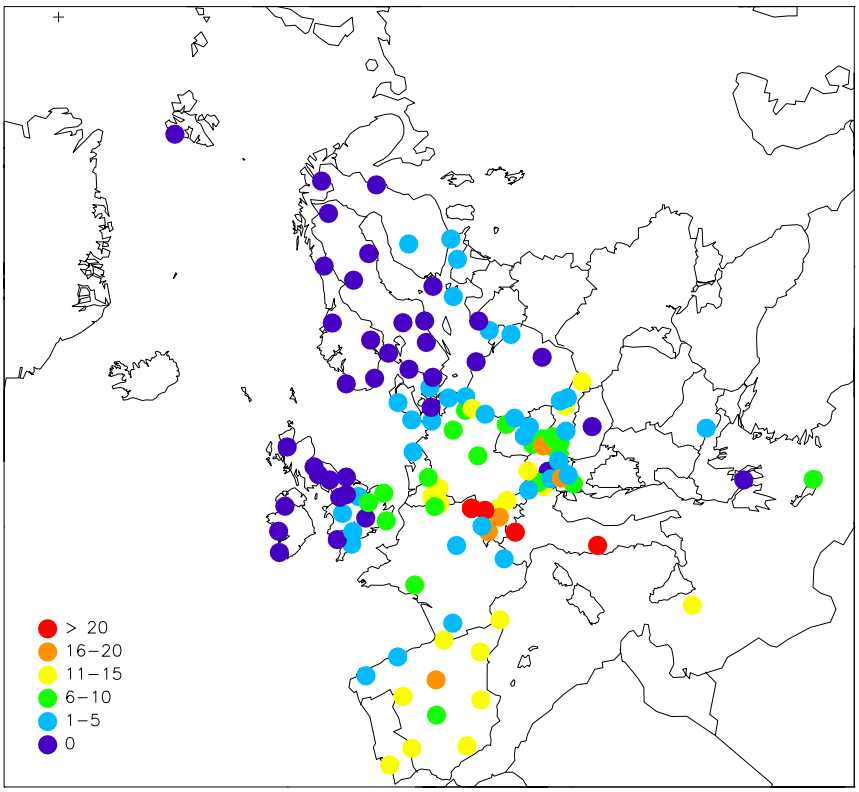


Figure 1.3: Number of exceedances of the threshold value of 150 µg/m^3. (Unit: number of days).

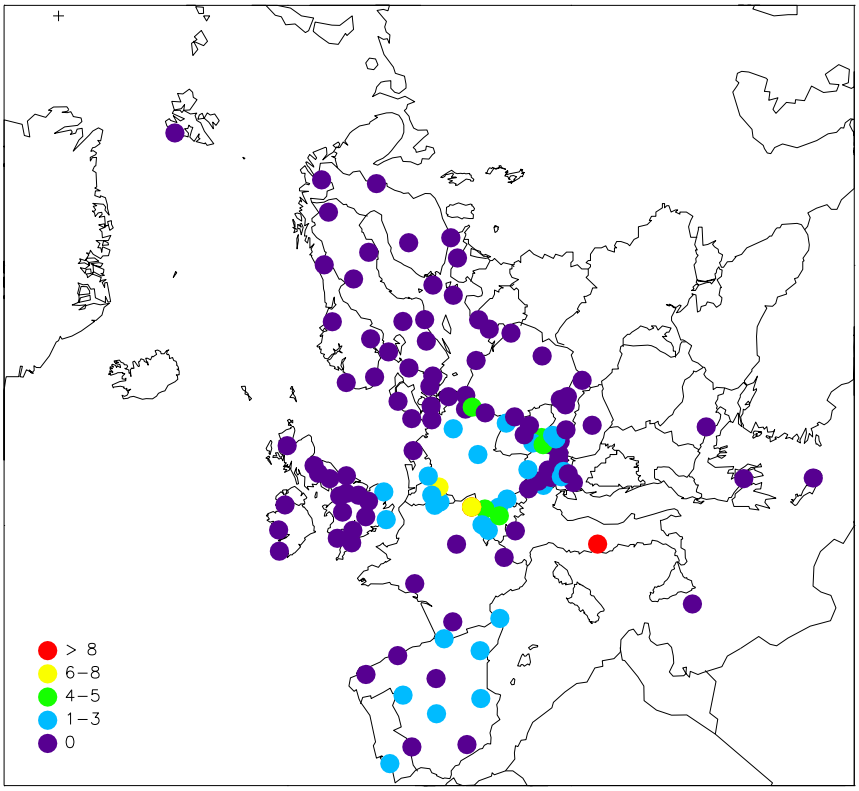


Figure 1.4: Number of exceedances of the threshold value of 180 µg/m^3. (Unit: number of days).

Annex 2

AOT40 and AOT60, figures and tables

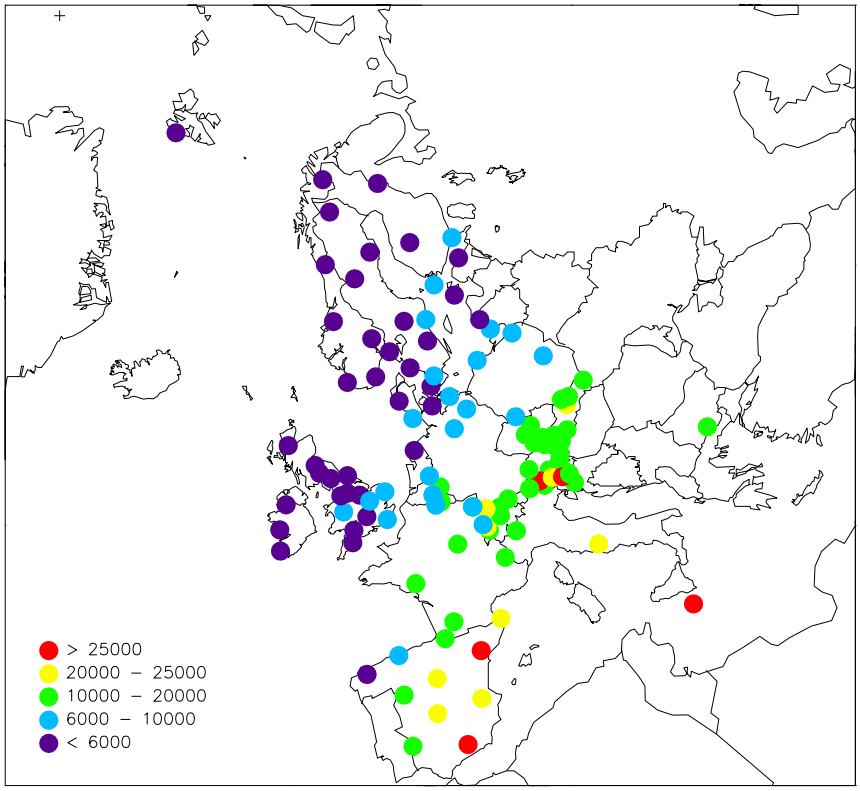


Figure 2.1: AOT40 (ppbh) April–September 2005 (daylight hours).

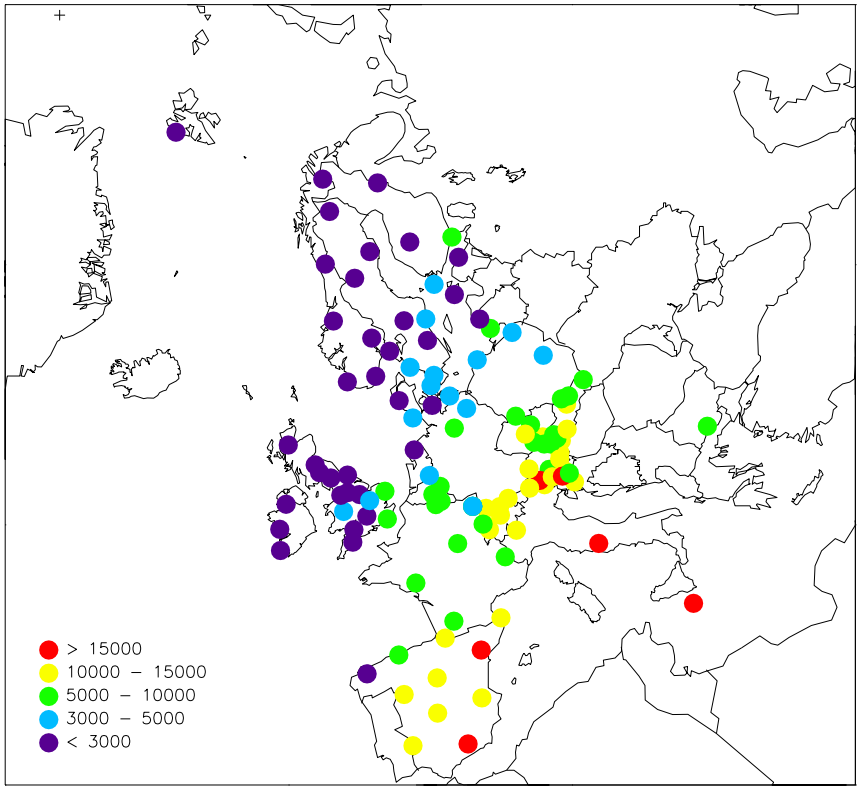


Figure 2.2: AOT40 (ppbh) May, June and July 2005 (daylight hours).

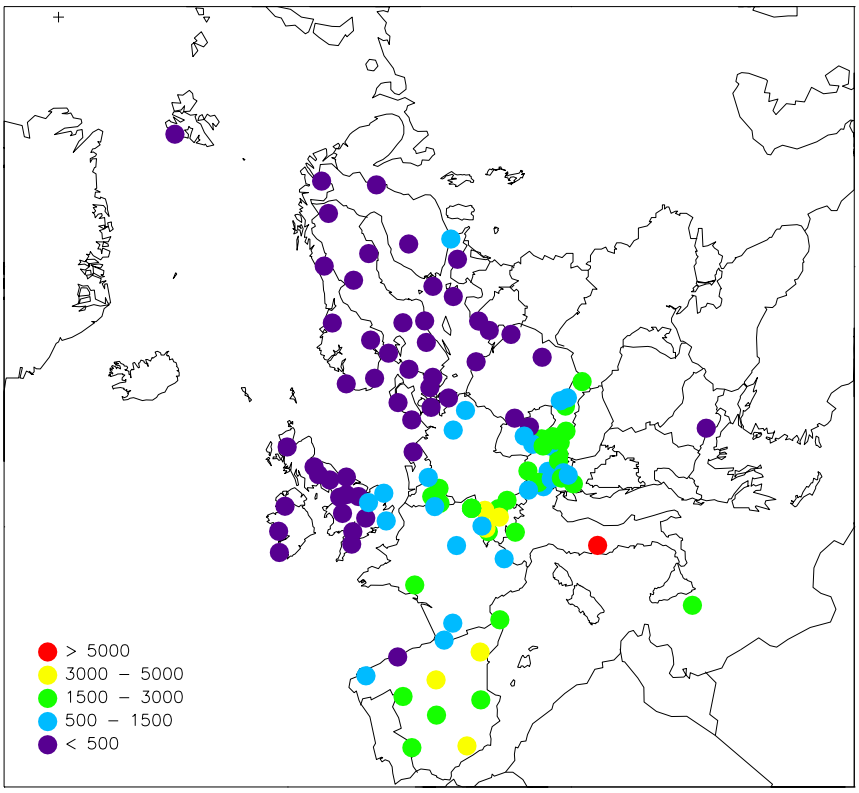


Figure 2.3: AOT60 (ppbh) April-September 2005 (daylight hours).

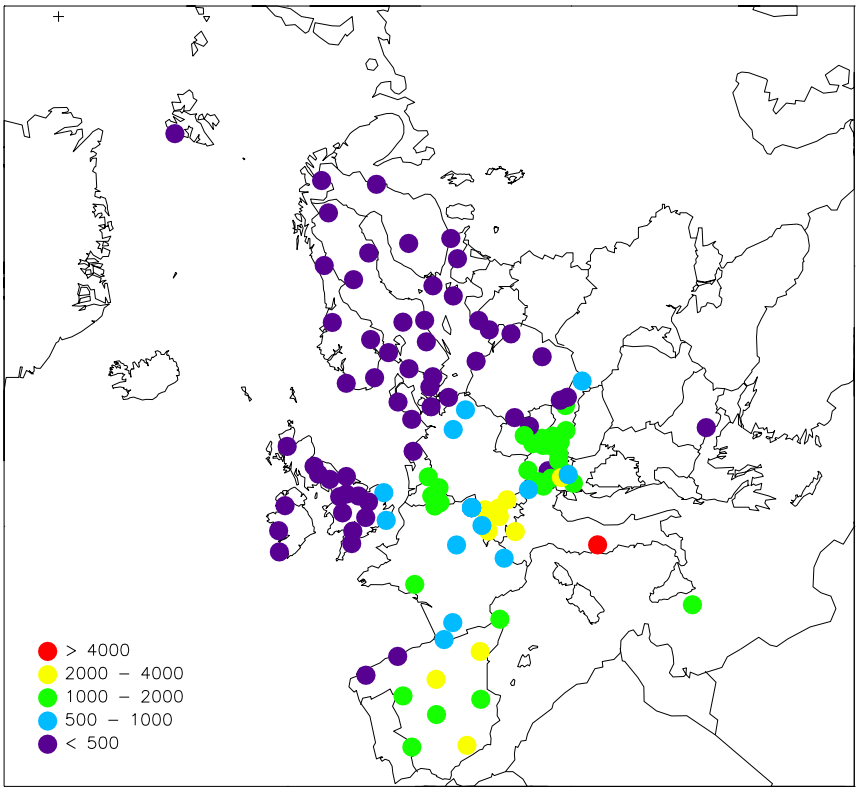


Figure 2.4: AOT60 (ppbh) May, June and July 2005 (daylight hours).

Table 2.1: AOT40 and AOT60 April–September 2005 (daylight hours).

Code	Station	AOT40	AOT40 corrected	AOT60	AOT60 corrected	Data capture
AT0002R	Illmitz	17224	18366	2397	2556	94
AT0005R	Vorhegg	14589	15962	1393	1524	91
AT0030R	Pillersdorf bei Retz	15094	16166	1805	1933	93
AT0032R	Sulzberg	15998	16653	2316	2410	96
AT0033R	Stolzalpe bei Murau	12572	13633	545	590	92
AT0034G	Sonnblick	28418	30673	2408	2599	93
AT0037R	Zillertaler Alpen	17660	18519	1071	1123	95
AT0038R	Gerlitzen	21153	21922	1207	1250	96
AT0040R	Masenberg	18802	19843	1787	1886	95
AT0041R	Haunsberg	14107	15133	1804	1935	93
AT0042R	Heidenreichstein	13868	14610	1207	1271	95
AT0043R	Forsthof	13590	14290	1293	1360	95
AT0044R	Graz Platte	16909	17809	1660	1748	95
AT0045R	Dunkelsteinerwald	13476	14367	1969	2099	94
AT0046R	Gänserndorf	14131	14792	1738	1819	96
AT0047R	Stixneusiedl	14388	15200	1675	1770	95
BE0001R	Offagne	11243	12809	1932	2201	88
BE0032R	Eupen	10205	11479	1937	2179	89
BE0035R	Vezin	9943	11075	2156	2401	90
BG0053R	Rojen peak	14583	15013	255	262	97
CH0002R	Payerne	16202	17031	2894	3042	95
CH0003R	Tänikon	14956	15753	2700	2844	95
CH0004R	Chaumont	21127	22266	3445	3630	95
CH0005R	Rigi	19831	21175	3742	3995	94
CY0002R	Ayia Marina	28739	29753	1755	1817	97
CZ0001R	Svratouch	11966	12001	489	491	100
CZ0003R	Košetice	15741	15918	1322	1337	99
DE0001R	Westerland	7466	7857	285	299	95
DE0002R	Langenbrügge	9636	10180	1382	1460	95
DE0003R	Schauinsland	21557	22485	3706	3865	96
DE0007R	Neuglobsow	8385	9171	748	818	91
DE0008R	Schmücke	12343	15503	1468	1843	80
DE0009R	Zingst	8250	8667	468	491	95
DE0026R	Ueckermünde	6859	7316	345	367	94
DE0035R	Lückendorf	13156	15110	1436	1649	87
DE0039R	Aukrug	5435	5678	412	430	96
DE0045R	Schorfheide	12362	13491	2355	2570	92
DE0047R	Falkenberg	9946	10844	928	1011	92
DK0005R	Keldsnor	2620	3157	82	99	83
DK0031R	Ulborg	5010	5222	176	183	96
DK0041R	Lille Valby	5458	5749	242	255	95
EE0009R	Lahemaa	1539	1631	22	24	94
EE0011R	Vilsandy	2890	2994	89	92	97
ES0007R	Víznar	26500	27832	3291	3456	95
ES0008R	Niembro	7843	8086	438	452	97
ES0009R	Campisábalos	24208	25619	3302	3494	94
ES0010R	Cabo de Creus	21415	22287	2235	2326	96
ES0011R	Barcarrola	19586	20541	2463	2583	95
ES0012R	Zarra	22432	25105	2591	2899	89
ES0013R	Penausende	19806	20297	2510	2573	98
ES0014R	Els Torms	25197	26159	3147	3267	96
ES0015R	Risco Llamo	20547	22010	1731	1854	93
ES0016R	O Saviñao	4724	4933	580	606	96
FI0009R	Utö	6226	6332	144	146	98
FI0017R	Virolahti II	9006	9102	734	741	99
FI0022R	Oulanka	2962	2990	21	21	99
FI0037R	Ahtari II	5716	5760	163	164	99
FR0008R	Donon A	9021	9376	1275	1325	96
FR0008R	Donon B	10235	10530	1642	1689	97
FR0008R	Donon C	10799	11071	1778	1822	98
FR0008R	Donon D	9695	9954	1518	1558	97
FR0009R	Revin	8227	10404	1118	1414	79
FR0010R	Morvan	11528	15508	1099	1478	74
FR0012R	Iraty	16558	16869	1386	1412	98
FR0013R	Peyrusse Vieille	10135	10475	751	776	97

Table 2.1, cont.

Code	Station	AOT40	AOT40 corrected	AOT60	AOT60 corrected	Data capture
FR0014R	Montandon	8612	8776	761	776	98
FR0015R	La Tardière	12124	12371	1528	1559	98
FR0016R	Le Casset	15063	16059	1181	1259	94
FR0017R	Montfranc	13750	14413	1063	1114	95
GB0002R	Eskdalemuir	819	830	6	6	99
GB0006R	Lough Navar	1406	1448	35	36	97
GB0013R	Yarner Wood	3886	3987	154	158	97
GB0014R	High Muffles	4959	5132	113	117	97
GB0015R	Strath Vaich Dam	3855	4373	13	15	88
GB0031R	Aston Hill	6373	6521	215	220	98
GB0032R	Bottesford	3629	3686	317	322	98
GB0033R	Bush	900	924	5	5	97
GB0034R	Glazebury	3409	3523	83	86	97
GB0035R	Great Dun Fell	1928	1940	0	0	99
GB0036R	Harwell	2971	3047	144	148	97
GB0037R	Ladybower Res.	1177	1249	9	10	94
GB0038R	Lullington Heath	7661	7839	1163	1190	98
GB0039R	Sibton	9588	10635	1291	1432	90
GB0043R	Narberth	228	540	0	0	42
GB0044R	Somerton	4250	4448	201	210	96
GB0045R	Wicken Fen	6309	6430	784	799	98
GR0001R	Aliartos	905	911	0	0	99
GR0002R	Finokalia	32184	39823	4213	5213	81
HU0002R	K-puszta	6210	8406	153	206	74
IE0001R	Valentia Observatory	3383	3430	0	0	99
IE0031R	Mace Head	3591	3632	2	2	99
IT0001R	Montelibretti	24307	24990	5953	6120	97
IT0004R	Ispra	12917	13350	2518	2602	97
LT0015R	Preila	7033	7187	317	323	98
LV0010R	Rucava	1667	1674	36	36	100
MT0001R	Giordan lighthouse	27861	28589	2366	2428	97
NL0009R	Kollumerwaard	3888	4045	204	212	96
NL0010R	Vredepeel	6509	6590	1127	1141	99
NO0001R	Birkenes	4815	4905	59	60	98
NO0015R	Tustervatn	4004	4046	2	2	99
NO0039R	Kårvatn	4514	4546	2	2	99
NO0042G	Spitsbergen, Zeppelinfjell	2072	2126	0	0	97
NO0043R	Prestebakke	4387	4396	82	82	100
NO0052R	Sandve	4075	4121	18	18	99
NO0055R	Karasjok	2057	2065	3	3	100
NO0056R	Hurdal	3062	3086	33	33	99
PL0002R	Jarczew	8984	9105	258	261	99
PL0003R	Sniezka	9158	9951	341	370	92
PL0004R	Leba	7775	7783	277	277	100
PL0005R	Diabla Gora	9428	9963	500	528	95
PT0004R	Monte Velho	6120	20374	1529	5091	30
SE0005R	Bredkälen	2385	2445	64	65	98
SE0011R	Vavihill	6370	6419	165	166	99
SE0012R	Aspvreten	6537	6731	106	109	97
SE0013R	Esrange	835	837	0	0	100
SE0014R	Råö	5259	5277	70	70	100
SE0032R	Norra-Kvill	5226	5490	65	68	95
SE0035R	Vindeln	3630	3650	5	5	99
SE0039R	Grimsö	4496	4569	92	93	98
SI0008R	Iskrba	15826	16978	1882	2018	93
SI0031R	Zarodnje	16189	16518	1390	1418	98
SI0032R	Krvavec	27148	27785	2650	2712	98
SI0033R	Kovk	14438	15295	1104	1170	94
SK0002R	Chopok	24271	25075	2168	2239	97
SK0004R	Stará Lesná	16148	16148	791	791	100
SK0005R	Liesek	15260	15373	982	989	99
SK0006R	Starina	13210	13428	1621	1647	98
SK0007R	Topolniky	15812	16513	1809	1889	96

Table 2.2: AOT40 and AOT60 May–July 2005 (daylight hours).

Code	Station	AOT40	AOT40 corrected	AOT60	AOT60 corrected	Data capture
AT0002R	Illmitz	11842	12617	1828	1947	94
AT0005R	Vorhegg	10536	11431	1226	1330	92
AT0030R	Pillersdorf bei Retz	10074	10737	1519	1619	94
AT0032R	Sulzberg	12220	12551	2030	2085	97
AT0033R	Stolzalpe bei Murau	8709	9344	403	432	93
AT0034G	Sonnblick	16909	18409	1612	1755	92
AT0037R	Zillertaler Alpen	11339	11815	749	781	96
AT0038R	Gerlitzen	13915	14327	1076	1107	97
AT0040R	Masenberg	12276	12860	1275	1336	95
AT0041R	Haunsberg	10484	11070	1692	1786	95
AT0042R	Heidenreichstein	9255	9700	1018	1066	95
AT0043R	Forsthof	9359	9766	1013	1057	96
AT0044R	Graz Platte	11741	12511	1426	1520	94
AT0045R	Dunkelsteinerwald	9362	10056	1673	1797	93
AT0046R	Gänserndorf	9217	9644	1300	1360	96
AT0047R	Stixneusiedl	9723	10319	1258	1335	94
BE0001R	Offagne	8417	9292	1770	1954	91
BE0032R	Eupen	7609	8211	1851	1997	93
BE0035R	Vezin	7510	8342	1982	2201	90
BG0053R	Rojen peak	8082	8382	178	185	96
CH0002R	Payerne	11305	11909	2460	2591	95
CH0003R	Tänikon	10516	11079	2303	2426	95
CH0004R	Chaumont	14302	15052	2969	3125	95
CH0005R	Rigi	13680	14679	3228	3464	93
CY0002R	Ayia Marina	16559	16575	1268	1269	100
CZ0001R	Svratouch	7593	7633	356	358	99
CZ0003R	Košetice	10192	10219	1040	1043	100
DE0001R	Westerland	4561	4800	194	204	95
DE0002R	Langenbrügge	5564	5833	886	929	95
DE0003R	Schauinsland	13611	14435	3105	3293	94
DE0007R	Neuglobsow	4859	5323	541	592	91
DE0008R	Schmücke	9809	10366	1394	1473	95
DE0009R	Zingst	4201	4387	117	122	96
DE0026R	Ueckermünde	4439	4836	320	348	92
DE0035R	Lückendorf	8681	10041	1257	1453	86
DE0039R	Aukrug	2782	2886	263	273	96
DE0045R	Schorfheide	8029	8793	1870	2048	91
DE0047R	Falkenberg	6512	6809	756	790	96
DK0005R	Keldsnor	1713	2086	81	99	82
DK0031R	Ulborg	2976	3027	131	133	98
DK0041R	Lille Valby	4076	4257	218	228	96
EE0009R	Lahemaa	818	882	0	0	93
EE0011R	Vilsandy	2622	2651	89	90	99
ES0007R	Víznar	15539	16510	2135	2269	94
ES0008R	Niembro	5073	5187	392	400	98
ES0009R	Campisábalos	14472	15293	2044	2160	95
ES0010R	Cabo de Creus	13146	13759	1824	1909	96
ES0011R	Barcarrola	10435	11071	1165	1236	94
ES0012R	Zarra	13175	15400	1905	2226	86
ES0013R	Penausende	12131	12461	1786	1834	97
ES0014R	Els Torms	16403	16758	2531	2586	98
ES0015R	Risco Llamo	13637	14407	1495	1579	95
ES0016R	O Saviñao	2649	2741	375	388	97
FI0009R	Utö	4096	4192	92	94	98
FI0017R	Virolahti II	5085	5138	417	421	99
FI0022R	Oulanka	1208	1228	0	0	98
FI0037R	Ahtari II	2374	2405	1	1	99
FR0008R	Donon A	4136	4319	472	492	96
FR0008R	Donon B	4840	5026	638	662	96
FR0008R	Donon C	5011	5175	651	672	97
FR0008R	Donon D	4544	4705	578	599	97
FR0009R	Revin	6446	7231	1029	1154	89
FR0010R	Morvan	8103	9683	978	1168	84
FR0012R	Iraty	10093	10286	868	885	98
FR0013R	Peyrusse Vieille	7088	7317	726	749	97

Table 2.2, cont.

Code	Station	AOT40	AOT40 corrected	AOT60	AOT60 corrected	Data capture
FR0014R	Montandon	6316	6438	761	776	98
FR0015R	La Tardière	8065	8153	1280	1293	99
FR0016R	Le Casset	8645	8772	1000	1014	99
FR0017R	Montfranc	11487	12202	983	1044	94
GB0002R	Eskdalemuir	355	361	0	0	98
GB0006R	Lough Navar	829	830	0	0	100
GB0013R	Yarner Wood	2446	2539	143	148	96
GB0014R	High Muffles	2574	2688	23	24	96
GB0015R	Strath Vaich Dam	1420	1797	0	0	79
GB0031R	Aston Hill	3953	3988	136	137	99
GB0032R	Bottesford	2024	2063	136	139	98
GB0033R	Bush	427	435	5	5	98
GB0034R	Glazebury	1757	1771	30	30	99
GB0035R	Great Dun Fell	1038	1041	0	0	100
GB0036R	Harwell	1761	1796	88	90	98
GB0037R	Ladybower Res.	758	809	2	2	94
GB0038R	Lullington Heath	5040	5116	933	947	99
GB0039R	Sibton	5014	6056	840	1015	83
GB0043R	Narberth	38	178	0	0	21
GB0044R	Somerton	2490	2600	142	148	96
GB0045R	Wicken Fen	3681	3763	413	422	98
GR0001R	Aliartos	286	289	0	0	99
GR0002R	Finokalia	19556	22730	2973	3455	86
HU0002R	K-puszta	5764	6966	153	184	83
IE0001R	Valentia Observatory	1575	1615	0	0	98
IE0031R	Mace Head	1770	1805	0	0	98
IT0001R	Montelibretti	15303	16128	4123	4345	95
IT0004R	Ispra	10116	10419	2288	2356	97
LT0015R	Preila	5017	5115	201	205	98
LV0010R	Rucava	1076	1079	31	31	100
MT0001R	Giordan lighthouse	17191	17345	1888	1905	99
NL0009R	Kollumerwaard	2657	2671	184	185	99
NL0010R	Vredepeel	4740	4849	1026	1049	98
NO0001R	Birkenes	2277	2312	14	14	98
NO0015R	Tustervatn	1408	1418	2	2	99
NO0039R	Kårvatn	1781	1795	0	0	99
NO0042G	Spitsbergen, Zeppelinfjell	1006	1041	0	0	97
NO0043R	Prestebakke	2266	2270	16	16	100
NO0052R	Sandve	1644	1666	0	0	99
NO0055R	Karasjok	745	748	0	0	100
NO0056R	Hurdal	1647	1653	25	25	100
PL0002R	Jarczew	4423	4517	108	110	98
PL0003R	Sniezka	5756	5756	280	280	100
PL0004R	Leba	4662	4662	135	134	100
PL0005R	Diabla Gora	4319	4318	208	208	100
SE0005R	Bredkälen	606	615	0	0	99
SE0011R	Vavihill	3721	3743	103	103	99
SE0012R	Aspvreten	4113	4177	42	43	98
SE0013R	Esrange	134	134	0	0	100
SE0014R	Råö	3360	3366	34	34	100
SE0032R	Norra-Kvill	2426	2633	5	5	92
SE0035R	Vindeln	1490	1494	0	0	100
SE0039R	Grimsö	2037	2089	30	30	98
SI0008R	Iskrba	10190	10920	1383	1482	93
SI0031R	Zarodnje	11161	11354	1164	1184	98
SI0032R	Krvavec	17372	17529	2162	2182	99
SI0033R	Kovk	9764	10301	881	929	95
SK0002R	Chopok	14379	14851	1076	1111	97
SK0004R	Stará Lesná	9086	9086	306	306	100
SK0005R	Liesek	9152	9185	440	442	100
SK0006R	Starina	6870	7081	655	675	97
SK0007R	Topolniky	10415	10653	1241	1269	98

Annex 3

Seasonal variation

Table 3.1: Monthly mean concentrations 2005 ($\mu g/m^3$).

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
AT0002R	Illmitz	46.3	69.7	84.3	83.5	88.3	92.1	80.2	67.6	56.9	35.7	34.1	38.7
AT0005R	Vorhegg	75.7	82.7	90.2	90.7	97.4	99.4	82.3	70.5	56.2	52.2	42.9	60.4
AT0030R	Pillersdorf bei Retz	51.6	75.2	85.7	86.2	92.6	91.2	82.7	73.7	64.3	46.5	31.1	38.4
AT0032R	Sulzberg	72.8	80.5	92.7	92.8	98.9	106.1	96.9	73.4	68.2	53.3	56.9	58.7
AT0033R	Stolzalpe bei Murau	72.2	82.1	82.9	86.0	89.7	88.6	72.9	59.9	53.4	49.5	45.6	62.0
AT0034G	Sonnblick	86.0	95.7	105.3	117.3	116.8	113.2	113.5	103.4	99.2	97.8	82.5	84.6
AT0037R	Zillertaler Alpen	83.5	90.6	99.9	107.2	107.1	104.4	99.6	85.4	83.1	82.1	73.9	76.8
AT0038R	Gerlitzen	77.0	83.9	95.7	102.6	107.5	108.9	105.8	96.2	87.7	79.9	71.5	71.5
AT0040R	Masenberg	71.5	83.4	97.9	108.6	106.6	103.6	97.1	85.2	74.1	67.7	54.0	62.9
AT0041R	Haunsberg	63.7	76.1	87.2	89.5	96.9	98.9	86.8	71.4	67.9	49.3	35.6	47.4
AT0042R	Heidenreichstein	54.5	75.4	87.7	76.7	84.9	82.4	75.5	67.0	58.6	50.4	34.7	38.3
AT0043R	Forsthof	54.5	75.5	86.2	91.0	93.2	93.7	87.3	75.6	66.8	55.0	34.3	45.2
AT0044R	Graz Platte	58.6	72.4	92.8	96.7	106.5	103.3	90.1	80.9	72.5	59.5	15.7	47.0
AT0045R	Dunkelsteinerwald	46.6	65.6	73.8	70.9	81.4	81.2	75.1	64.3	50.8	34.1	25.8	35.3
AT0046R	Gänserndorf	41.9	66.0	79.2	76.9	81.1	81.9	71.2	62.2	54.2	42.6	31.4	29.6
AT0047R	Stixneusiedl	47.8	70.4	82.1	81.4	86.0	89.6	80.6	66.8	57.7	45.3	34.1	36.4
BE0001R	Offagne	49.1	55.1	65.9	67.3	77.8	86.7	71.0	59.6	58.5	47.6	35.9	36.1
BE0032R	Eupen	43.5	46.0	57.5	62.6	74.3	78.2	68.1	52.9	54.7	50.3	35.3	31.5
BE0035R	Vezin	39.3	45.6	51.5	52.2	64.6	74.1	57.4	44.3	40.9	33.9	25.2	23.9
BG0053R	Rojen peak	79.1	94.9	100.5	106.6	95.9	94.9	95.6	89.4	80.6	79.8	75.6	72.1
CH0002R	Payerne	38.1	57.3	62.3	67.5	74.8	84.5	76.7	65.6	58.0	27.9	27.6	34.3
CH0003R	Tänikon	43.4	58.8	66.9	67.6	76.4	83.6	72.8	63.8	55.0	25.6	25.6	32.7
CH0004R	Chaumont	71.8	80.4	92.2	94.7	102.5	111.2	99.5	89.9	88.5	70.0	61.7	59.3
CH0005R	Rigi	73.0	82.3	93.4	94.6	100.8	111.7	98.1	84.9	82.8	64.1	57.7	57.3
CY0002R	Ayia Marina	80.2	91.5	96.4	109.9	108.4	118.4	116.3	108.2	109.0	95.9	86.2	75.4
CZ0001R	Svratouch	58.6	64.9	87.1	85.8	89.9	82.8	75.7	67.7	67.4	56.8	40.4	37.4
CZ0003R	Košetice	54.2	71.6	88.2	84.7	86.5	83.9	78.4	65.6	65.0	53.2	36.6	41.9
DE0001R	Westerland	67.1	64.9	73.7	81.1	86.4	79.5	78.8	72.6	67.3	46.7	48.5	48.0
DE0002R	Langenbrügge	51.0	56.5	66.8	77.0	74.5	67.3	58.9	52.8	54.7	35.8	23.2	32.2
DE0003R	Schauinsland	72.2	79.4	92.5	99.3	105.7	110.2	100.7	91.1	96.6	81.3	68.5	63.7
DE0007R	Neuglobsow	52.5	57.4	70.8	76.3	72.5	65.4	59.3	48.3	50.2	32.9	20.5	31.6
DE0008R	Schmücke	59.1	72.5	84.7	88.1	92.9	95.6	91.0	70.0	48.9	64.5	38.1	43.7
DE0009R	Zingst	55.0	51.9	72.9	97.0	86.8	69.8	69.3	55.6	56.9	49.1	34.2	42.7
DE0026R	Ueckermünde	50.7	58.3	61.4	79.2	83.9	66.7	64.8	50.7	54.4	39.7	-	-
DE0035R	Lückendorf	52.6	65.8	85.4	87.8	96.6	89.6	81.7	66.9	68.1	63.9	-	-
DE0039R	Aukrug	50.7	56.6	63.5	69.5	66.2	60.6	53.7	44.1	39.5	27.4	-	-

Table 3.1, cont.

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
DE0045R	Schorfheide	52.4	56.5	66.1	76.6	78.1	72.8	70.8	51.9	55.8	44.0	-	-
DE0047R	Falkenberg	49.7	57.1	69.9	73.7	75.7	71.9	65.3	50.8	56.0	45.4	-	-
DK0005R	Keldsnor	46.1	51.8	66.8	69.9	72.2	66.8	68.5	57.3	58.0	49.9	38.6	40.3
DK0031R	Ulborg	59.7	62.6	69.0	77.8	79.0	70.9	66.1	61.3	62.3	40.8	44.9	42.6
DK0041R	Lille Valby	52.0	57.0	63.3	69.6	78.6	77.1	63.8	53.3	51.3	39.5	29.2	40.8
EE0009R	Lahemaa	48.5	68.6	80.7	75.7	71.6	58.9	53.5	50.0	48.5	44.6	42.2	43.5
EE0011R	Vilsandy	53.2	53.6	77.5	67.5	80.5	80.9	80.2	66.9	66.1	58.5	51.4	54.1
ES0007R	Víznar	67.4	77.2	72.1	90.7	99.1	109.4	106.6	106.2	98.5	83.3	77.1	75.3
ES0008R	Niembro	48.6	70.4	79.8	81.1	84.6	79.7	65.1	62.7	72.2	60.4	54.1	50.7
ES0009R	Campisábalos	61.7	76.3	80.4	87.2	89.3	96.1	99.8	89.0	83.9	68.9	61.7	62.0
ES0010R	Cabo de Creus	51.2	69.9	90.5	96.3	103.3	107.8	92.8	89.9	90.7	77.4	64.3	55.2
ES0011R	Barcarrola	51.9	62.9	71.7	75.9	75.7	87.6	80.1	89.3	68.7	58.4	46.0	41.4
ES0012R	Zarra	63.5	73.9	82.7	94.9	98.7	108.8	96.8	97.0	87.2	77.2	67.0	63.5
ES0013R	Penausende	55.6	75.0	79.2	85.2	88.7	95.7	92.0	87.2	83.7	72.8	59.7	54.1
ES0014R	Els Torms	43.5	71.4	84.7	97.4	99.2	107.4	100.1	84.4	83.8	65.2	51.8	46.1
ES0015R	Risco Llamo	77.0	77.9	84.4	89.7	96.7	107.0	107.6	99.5	87.0	71.3	67.1	68.1
ES0016R	O Saviñao	51.0	62.3	68.5	63.4	60.7	60.1	55.1	53.9	55.7	52.7	46.1	42.1
FI0009R	Utö	57.3	69.5	84.9	84.7	80.5	75.8	78.4	66.2	63.6	59.1	52.4	52.6
FI0017R	Virolahti II	52.7	76.4	94.3	95.3	90.8	59.1	58.4	55.8	51.6	45.9	42.9	44.2
FI0022R	Oulanka	54.5	72.4	87.0	85.8	75.6	64.8	54.8	45.8	51.5	56.2	50.4	50.1
FI0037R	Ahtari II	50.6	78.7	97.2	94.0	78.8	64.0	59.1	51.1	55.5	51.4	44.3	46.7
FR0008R	Donon	73.4	74.2	71.1	70.8	71.6	76.3	79.5	80.1	80.0	77.8	77.9	75.1
FR0008R	Donon	74.5	75.7	72.0	72.6	74.3	79.1	81.3	81.5	81.5	79.6	79.1	75.6
FR0008R	Donon	76.1	77.3	73.9	73.9	74.9	79.6	82.2	83.3	83.7	81.5	81.1	77.7
FR0008R	Donon	74.3	75.3	71.7	72.1	73.7	78.4	80.8	81.3	81.3	79.3	78.8	75.5
FR0009R	Revin	45.5	54.6	66.0	71.3	73.5	82.5	66.5	51.8	56.3	46.8	31.8	30.3
FR0010R	Morvan	55.0	62.4	74.3	93.7	85.2	87.6	74.1	67.4	65.2	58.0	45.0	46.0
FR0012R	Iraty	73.4	88.3	103.4	105.7	103.7	103.4	88.5	79.5	86.7	82.1	74.7	77.0
FR0013R	Peyrusse Vieille	42.2	56.0	70.3	77.2	77.7	85.7	77.8	68.4	66.9	50.5	42.6	41.7
FR0014R	Montandon	46.9	54.0	64.0	63.9	67.9	81.2	69.4	57.5	54.9	32.8	35.9	39.9
FR0015R	La Tardière	45.7	56.4	67.3	70.1	71.4	82.3	73.2	70.4	66.6	59.5	43.6	44.9
FR0016R	Le Casset	79.4	82.7	79.8	80.7	80.8	79.4	111.1	100.4	84.1	77.6	77.1	87.8
FR0017R	Montfranc	59.4	69.0	81.6	89.5	93.4	94.9	88.4	82.0	84.5	72.5	59.9	57.1
GB0002R	Eskdalemuir	55.1	56.4	55.3	65.1	62.1	46.9	45.8	40.4	53.7	44.8	41.7	35.9
GB0006R	Lough Navar	70.4	65.9	62.6	67.9	65.5	50.4	42.0	34.2	35.2	36.0	34.8	36.0

Table 3.1, cont.

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
GB0013R	Yarner Wood	65.0	63.8	65.5	72.0	70.7	62.4	55.3	51.4	52.6	53.2	65.2	50.7
GB0014R	High Muffles	64.0	65.5	74.4	78.6	77.1	61.3	60.0	50.8	54.8	44.5	47.3	46.3
GB0015R	Strath Vaich Dam	66.2	81.6	81.6	90.3	84.2	63.6	51.9	51.3	62.7	60.6	60.0	56.8
GB0031R	Aston Hill	72.0	70.9	74.5	81.7	85.4	72.0	68.2	63.2	68.5	62.0	67.7	58.8
GB0032R	Bottesford	48.5	45.9	49.7	60.7	60.9	52.7	48.0	42.8	49.4	41.6	37.1	30.5
GB0033R	Bush	59.5	60.4	60.1	70.2	65.4	51.3	46.6	42.7	52.9	54.1	52.6	45.7
GB0034R	Glazebury	51.7	47.5	55.3	63.7	66.0	46.7	46.9	41.6	42.2	36.0	30.9	24.5
GB0035R	Great Dun Fell	57.1	60.1	63.9	74.3	77.5	62.0	59.6	53.0	62.7	52.8	54.5	48.7
GB0036R	Harwell	58.0	50.7	52.3	57.6	64.7	54.6	50.2	47.3	49.7	41.2	41.0	37.7
GB0037R	Ladybower Res.	58.8	54.4	61.2	63.2	63.7	51.5	53.2	35.6	39.6	35.1	40.2	38.4
GB0038R	Lullington Heath	63.7	54.5	55.2	69.4	76.3	73.9	63.7	55.3	61.2	50.7	44.7	41.9
GB0039R	Sibton	61.3	63.6	63.9	79.9	82.1	73.1	59.2	53.4	55.0	45.2	39.3	35.9
GB0043R	Narberth	-	62.0	67.3	65.5	61.8	-	-	53.2	51.4	62.8	71.4	62.5
GB0044R	Somerton	57.0	54.3	58.2	68.1	69.6	59.2	54.7	50.2	53.4	51.5	41.9	38.3
GB0045R	Wicken Fen	54.9	49.2	51.6	57.8	66.9	62.1	56.5	48.1	51.0	45.1	35.5	46.8
GR0001R	Aliartos	20.0	47.6	46.4	57.1	40.3	39.3	33.9	27.0	19.3	22.6	18.0	20.6
GR0002R	Finokalia	93.7	-	111.4	117.6	117.8	120.4	123.9	119.3	108.6	105.2	93.8	88.9
HU0002R	K-puszta	45.2	68.3	61.6	54.2	72.9	72.1	58.8	42.0	42.1	35.9	37.9	38.1
IE0001R	Valentia Observatory	74.4	72.7	81.3	86.2	84.1	60.9	49.0	48.2	59.3	69.1	64.5	63.8
IE0031R	Mace Head	79.0	77.6	79.5	87.4	85.0	66.5	55.6	56.3	67.7	70.1	69.0	68.4
IT0001R	Montelibretti	25.7	43.8	56.1	58.3	61.6	73.4	89.0	74.3	55.1	33.2	24.5	31.2
IT0004R	Ispra	23.0	37.0	48.6	61.4	70.7	70.8	67.4	52.6	37.3	18.0	11.6	12.8
LT0015R	Preila	51.6	70.0	87.4	76.6	82.0	75.2	75.2	61.4	57.9	56.7	42.2	37.3
LV0010R	Rucava	40.8	59.7	64.8	64.6	67.7	57.6	51.2	40.7	40.6	35.3	30.8	32.8
MT0001R	Giordan lighthouse	91.2	100.0	93.2	109.0	121.1	112.0	110.4	100.6	102.8	89.2	89.3	78.4
NL0009R	Kollumerwaard	52.4	56.4	66.0	61.9	72.6	65.9	50.9	46.8	43.3	26.6	31.5	34.9
NL0010R	Vredepeel	35.3	40.2	43.1	49.5	61.8	65.2	50.7	41.3	37.1	22.6	19.7	20.7
NO0001R	Birkenes	59.2	65.2	71.9	73.4	70.2	63.4	58.4	46.5	48.9	38.8	43.8	48.1
NO0015R	Tustervatn	73.7	79.7	84.8	95.9	79.9	65.5	51.2	51.3	60.1	60.4	62.5	64.3
NO0039R	Kårvatn	69.6	71.1	80.2	81.9	69.2	56.5	41.4	30.6	39.5	39.0	47.3	62.5
NO0042G	Spitsbergen, Zeppelinfjell	68.4	79.0	84.4	79.5	67.8	64.9	52.8	55.0	61.3	71.5	71.6	66.7
NO0043R	Prestebakke	59.5	65.0	72.9	80.7	70.2	64.5	60.4	49.3	54.1	43.7	45.7	42.9
NO0052R	Sandve	66.4	67.3	73.9	83.9	79.0	69.2	59.3	56.3	66.5	56.0	53.8	56.9
NO0055R	Karasjok	61.5	79.2	88.4	86.5	78.3	61.7	50.6	44.9	50.4	58.4	56.6	60.6
NO0056R	Hurdal	57.2	63.0	70.6	75.1	64.8	63.4	55.2	43.8	42.8	30.0	39.4	42.0

Table 3.1, cont.

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PL0002R	Jarczew	45.7	64.9	76.9	72.4	72.0	63.7	67.8	58.2	57.6	36.0	24.7	29.9
PL0003R	Sniezka	59.1	63.8	85.9	80.7	90.7	77.7	73.9	78.8	76.0	78.3	66.9	64.0
PL0004R	Leba	55.0	67.3	80.0	83.1	80.5	72.6	69.0	58.0	55.9	49.4	35.5	40.8
PL0005R	Diabla Gora	60.2	66.8	77.8	87.0	70.8	65.6	66.8	58.1	52.0	43.2	32.3	37.4
PT0004R	Monte Velho	-	-	-	-	-	-	-	74.3	62.2	59.6	48.8	49.3
SE0005R	Bredkälen	67.3	75.1	83.8	88.9	64.5	60.3	50.3	37.4	46.5	45.4	35.8	41.5
SE0011R	Vavihill	53.8	58.5	76.5	83.0	77.2	69.3	67.2	54.0	56.8	51.3	39.0	42.8
SE0012R	Aspvreten	54.2	65.4	76.7	83.5	79.0	65.3	66.2	49.7	53.2	49.9	41.6	43.4
SE0013R	Esrange	61.1	69.5	76.6	78.6	66.6	56.9	52.1	43.5	47.2	51.6	50.4	53.9
SE0014R	Råö	56.7	62.0	71.7	79.8	80.3	69.4	67.8	60.6	60.6	51.9	44.8	44.6
SE0032R	Norra-Kvill	57.7	65.4	80.0	89.8	82.6	65.0	66.4	49.4	58.1	48.5	42.5	45.2
SE0035R	Vindeln	54.7	63.6	79.6	81.1	68.7	58.4	50.4	40.3	41.1	39.1	34.2	39.9
SE0039R	Grimsö	56.3	61.4	73.9	80.5	68.7	61.5	57.3	44.0	48.7	38.3	38.4	37.9
SI0008R	Iskrba	39.9	72.0	78.9	84.1	66.6	70.0	59.3	47.4	43.2	37.3	36.7	39.0
SI0031R	Zarodnje	56.8	76.0	92.8	95.9	97.9	100.1	90.5	77.5	70.6	57.9	34.9	49.1
SI0032R	Krvavec	82.8	91.9	105.4	113.7	113.1	114.6	114.3	100.1	91.6	88.4	76.0	75.5
SI0033R	Kovk	57.6	77.8	92.7	96.4	93.4	95.7	83.9	69.2	66.2	57.3	33.7	43.4
SK0002R	Chopok	80.1	90.9	107.9	120.7	114.9	108.2	103.9	95.4	92.0	88.3	76.8	70.8
SK0004R	Stará Lesná	55.1	77.4	91.1	94.3	82.6	80.1	76.3	69.3	66.7	55.0	49.5	48.0
SK0005R	Liesek	62.4	75.7	94.8	85.8	82.6	80.1	70.6	57.5	55.4	46.3	45.0	46.4
SK0006R	Starina	53.6	87.9	102.8	96.2	82.4	72.0	54.8	57.5	56.1	43.5	46.1	46.2
SK0007R	Topolniky	41.6	68.6	83.1	80.3	83.4	80.0	69.9	56.4	52.4	44.7	30.8	33.2

Table 3.2: Monthly data capture 2005 ($\mu g/m^3$).

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
AT0002R	Illmitz	96	96	95	95	95	96	95	95	95	52	95	94
AT0005R	Vorhegg	96	95	95	95	95	94	95	93	95	49	71	95
AT0030R	Pillersdorf bei Retz	95	96	93	95	95	96	95	95	96	95	95	95
AT0032R	Sulzberg	96	96	95	84	96	100	98	96	96	96	96	96
AT0033R	Stolzalpe bei Murau	95	95	79	96	94	95	95	95	95	95	95	95
AT0034G	Sonnblick	94	95	94	95	90	94	96	96	96	92	95	96
AT0037R	Zillertaler Alpen	96	96	96	96	96	96	96	94	96	96	95	96
AT0038R	Gerlitzen	96	96	96	96	96	96	95	96	95	96	96	96
AT0040R	Masenberg	95	95	95	95	96	95	96	96	96	95	96	96
AT0041R	Haunsberg	96	96	95	87	96	95	95	95	96	95	95	96
AT0042R	Heidenreichstein	96	96	95	96	96	95	96	93	95	96	96	79
AT0043R	Forsthof	96	96	95	95	96	95	96	96	96	96	96	96
AT0044R	Graz Platte	96	96	95	96	96	95	95	96	96	96	49	60
AT0045R	Dunkelsteinerwald	96	95	95	95	96	95	89	96	95	95	96	96
AT0046R	Gänserndorf	96	96	96	95	96	96	95	96	96	95	96	96
AT0047R	Stixneusiedl	96	96	96	95	96	94	96	95	96	96	91	96
BE0001R	Offagne	91	91	92	69	94	90	91	91	95	93	82	88
BE0032R	Eupen	91	90	92	74	96	92	94	95	92	82	89	89
BE0035R	Vezin	91	89	67	90	92	90	92	89	92	85	95	95
BG0053R	Rojen peak	97	95	100	99	98	98	94	98	100	99	99	99
CH0002R	Payerne	95	96	95	95	96	95	95	96	95	95	95	96
CH0003R	Tänikon	96	95	95	95	95	95	95	95	95	95	95	96
CH0004R	Chaumont	95	95	95	95	95	95	95	95	95	96	95	95
CH0005R	Rigi	95	96	95	95	95	92	95	95	95	96	95	95
CY0002R	Ayia Marina	100	100	77	86	99	100	99	98	94	99	99	59
CZ0001R	Svratouch	99	100	100	100	100	99	100	100	100	100	100	99
CZ0003R	Košetice	99	100	97	99	100	100	100	100	96	100	100	100
DE0001R	Westerland	95	100	100	96	96	96	96	96	95	96	96	96
DE0002R	Langenbrügge	96	96	95	95	96	96	95	95	96	96	95	96
DE0003R	Schauinsland	96	96	91	96	96	89	96	96	96	86	95	94

Table 3.2, cont.

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
DE0007R	Neuglobsow	92	92	92	92	92	92	92	92	92	92	92	92
DE0008R	Schmücke	92	91	89	96	96	96	95	71	11	91	92	92
DE0009R	Zingst	96	96	96	95	95	96	96	96	95	96	96	96
DE0026R	Ueckermünde	96	96	96	96	81	96	96	96	96	76	0	0
DE0035R	Lückendorf	92	92	92	92	73	92	92	92	84	52	0	0
DE0039R	Aukrug	96	77	96	96	96	96	96	96	96	82	0	0
DE0045R	Schorfheide	92	92	88	90	92	92	92	92	92	72	0	0
DE0047R	Falkenberg	96	96	87	96	96	96	96	69	96	54	0	0
DK0005R	Keldsnor	100	100	100	79	76	73	100	93	83	100	99	100
DK0031R	Ulborg	68	100	100	100	100	96	100	100	79	100	100	97
DK0041R	Lille Valby	100	98	100	97	97	91	100	92	94	99	97	92
EE0009R	Lahemaa	100	100	100	100	99	80	99	93	100	100	100	100
EE0011R	Vilsandy	91	91	100	100	100	100	97	83	98	100	69	95
ES0007R	Víznar	94	97	97	97	97	89	99	98	97	94	91	98
ES0008R	Niembro	96	99	92	95	97	99	99	99	98	98	99	100
ES0009R	Campisábalos	94	93	96	96	98	92	90	92	93	98	98	97
ES0010R	Cabo de Creus	99	99	99	99	99	99	92	99	96	99	95	99
ES0011R	Barcarrola	99	99	99	99	95	97	89	98	99	94	99	99
ES0012R	Zarra	99	98	98	99	94	93	82	87	95	94	99	98
ES0013R	Penausende	97	98	93	99	99	97	99	99	99	98	98	100
ES0014R	Els Torms	99	92	98	97	99	97	98	98	94	100	99	99
ES0015R	Risco Llamo	91	99	95	90	99	95	94	95	97	95	92	98
ES0016R	O Saviñao	99	98	98	95	95	96	99	97	99	99	87	99
FI0009R	Utö	100	92	92	100	98	95	100	100	97	97	97	97
FI0017R	Virolahti II	94	100	100	100	97	100	100	100	96	100	91	100
FI0022R	Oulanka	90	100	100	100	99	93	100	100	100	100	97	94
FI0037R	Ahtari II	100	94	100	100	98	99	100	99	100	96	96	38

Table 3.2, cont.

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
FR0008R	Donon A	97	97	97	97	96	96	94	97	97	97	97	81
FR0008R	Donon B	99	99	98	98	96	97	96	98	98	98	98	82
FR0008R	Donon C	99	99	98	98	97	97	96	98	98	98	98	98
FR0008R	Donon D	99	99	98	98	97	97	96	98	98	98	98	98
FR0009R	Revin	100	95	99	59	92	90	87	51	100	98	99	100
FR0010R	Morvan	99	96	100	18	69	100	85	74	100	100	99	100
FR0012R	Iraty	42	87	99	99	99	99	98	99	99	94	98	99
FR0013R	Peyrusse Vieille	100	99	99	92	92	99	100	100	100	100	100	98
FR0014R	Montandon	98	98	98	98	98	95	98	98	97	53	50	98
FR0015R	La Tardière	99	100	91	93	100	98	100	100	100	100	100	100
FR0016R	Le Casset	98	98	99	89	98	98	96	74	98	98	98	95
FR0017R	Montfranc	99	99	100	98	99	97	89	99	100	100	98	99
GB0002R	Eskdalemuir	100	100	99	100	99	97	100	99	100	99	100	61
GB0006R	Lough Navar	99	100	99	100	100	100	100	84	99	100	99	100
GB0013R	Yarner Wood	99	96	99	100	95	100	96	99	99	100	72	100
GB0014R	High Muffles	94	99	53	96	100	89	100	100	98	93	100	100
GB0015R	Strath Vaich Dam	87	100	100	100	63	76	100	100	100	89	98	100
GB0031R	Aston Hill	99	100	99	96	99	100	99	100	95	99	99	99
GB0032R	Bottesford	99	100	100	100	100	96	100	99	99	99	99	100
GB0033R	Bush	100	98	94	96	99	97	100	99	96	99	100	99
GB0034R	Glazebury	99	96	100	100	100	99	99	88	100	100	99	100
GB0035R	Great Dun Fell	96	100	99	99	100	100	100	100	100	99	100	100
GB0036R	Harwell	88	99	99	99	100	98	99	96	99	100	99	99
GB0037R	Ladybower Res.	99	92	100	96	99	84	99	96	98	100	100	95
GB0038R	Lullington Heath	98	95	98	97	99	99	100	99	96	99	99	99
GB0039R	Sibton	88	96	100	100	72	77	99	100	100	100	78	87
GB0043R	Narberth	0	70	94	96	65	0	0	18	100	99	89	99
GB0044R	Somerton	91	86	93	94	99	96	95	96	100	97	97	99
GB0045R	Wicken Fen	99	96	99	99	99	100	96	99	99	95	91	5
GR0001R	Aliartos	96	99	99	99	99	100	100	100	100	100	99	99
GR0002R	Finokalia	43	0	23	46	67	94	99	88	88	100	82	50

Table 3.2, cont.

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HU0002R	K-puszta	78	100	88	66	83	96	69	31	100	79	100	99
IE0001R	Valentia Observatory	99	96	100	100	97	97	100	100	100	100	100	100
IE0031R	Mace Head	99	100	100	99	95	99	98	100	100	100	100	100
IT0001R	Montelibretti	100	100	90	100	97	99	90	100	100	97	100	92
IT0004R	Ispra	100	100	100	99	100	94	94	100	92	96	95	71
LT0015R	Preila	90	100	90	95	95	100	100	100	98	91	82	100
LV0010R	Rucava	93	4	71	100	100	100	99	100	100	96	99	98
MT0001R	Giordan lighthouse	100	29	34	100	100	100	98	90	100	97	93	96
NL0009R	Kollumerwaard	97	100	47	78	100	99	100	100	99	100	98	100
NL0010R	Vredepeel	100	100	100	100	97	100	98	100	100	100	95	99
NO0001R	Birkenes	97	95	99	99	100	98	99	99	98	99	99	99
NO0015R	Tustervatn	99	99	100	99	100	99	100	100	99	99	100	98
NO0039R	Kårvatn	99	100	100	100	100	99	99	100	100	99	100	100
NO0042G	Spitsbergen, Zeppelinfjell	100	100	99	100	100	93	99	100	99	99	100	99
NO0043R	Prestebakke	99	100	100	100	100	100	100	100	100	100	99	100
NO0052R	Sandve	98	100	100	100	100	98	100	100	100	100	100	100
NO0055R	Karasjok	100	100	100	100	100	100	99	100	100	99	100	100
NO0056R	Hurdal	100	99	100	99	100	100	100	100	99	100	100	100
PL0002R	Jarczew	100	100	99	100	100	100	94	100	100	100	100	99
PL0003R	Sniezka	100	95	100	100	100	100	99	92	51	100	100	100
PL0004R	Leba	100	100	100	100	100	100	100	100	100	100	100	100
PL0005R	Diabla Gora	100	100	100	100	100	100	100	68	100	100	98	100
PT0004R	Monte Velho	0	0	0	0	0	0	0	94	100	97	100	100
SE0005R	Bredkälen	99	100	100	88	99	100	97	100	99	100	100	100
SE0011R	Vavihill	65	98	99	99	100	99	100	100	100	99	100	100
SE0012R	Aspvreten	91	95	100	93	99	100	97	100	94	100	100	93
SE0013R	Esrange	99	100	100	100	99	100	100	100	99	100	100	100
SE0014R	Råö	99	100	100	99	100	100	100	100	100	85	100	100
SE0032R	Norra-Kvill	74	94	99	99	100	71	100	99	100	100	96	100

Table 3.2, cont.

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SE0035R	Vindeln	99	100	100	100	100	100	100	98	99	100	100	99
SE0039R	Grimsö	98	100	100	100	99	100	94	100	99	99	100	100
SI0008R	Iskrba	95	95	95	96	94	94	95	90	95	91	95	93
SI0031R	Zarodnje	96	96	96	93	94	95	96	94	96	95	95	96
SI0032R	Krvavec	99	98	97	100	99	99	100	99	93	92	95	96
SI0033R	Kovk	94	96	67	94	96	94	95	94	96	95	84	92
SK0002R	Chopok	100	98	97	99	98	97	98	99	88	98	96	99
SK0004R	Stará Lesná	98	100	100	100	100	100	100	100	100	100	100	100
SK0005R	Liesek	52	99	100	100	100	100	99	100	98	99	99	99
SK0006R	Starina	100	82	100	100	99	97	97	100	98	83	95	93
SK0007R	Topolniky	99	100	99	98	99	94	100	88	91	96	90	100

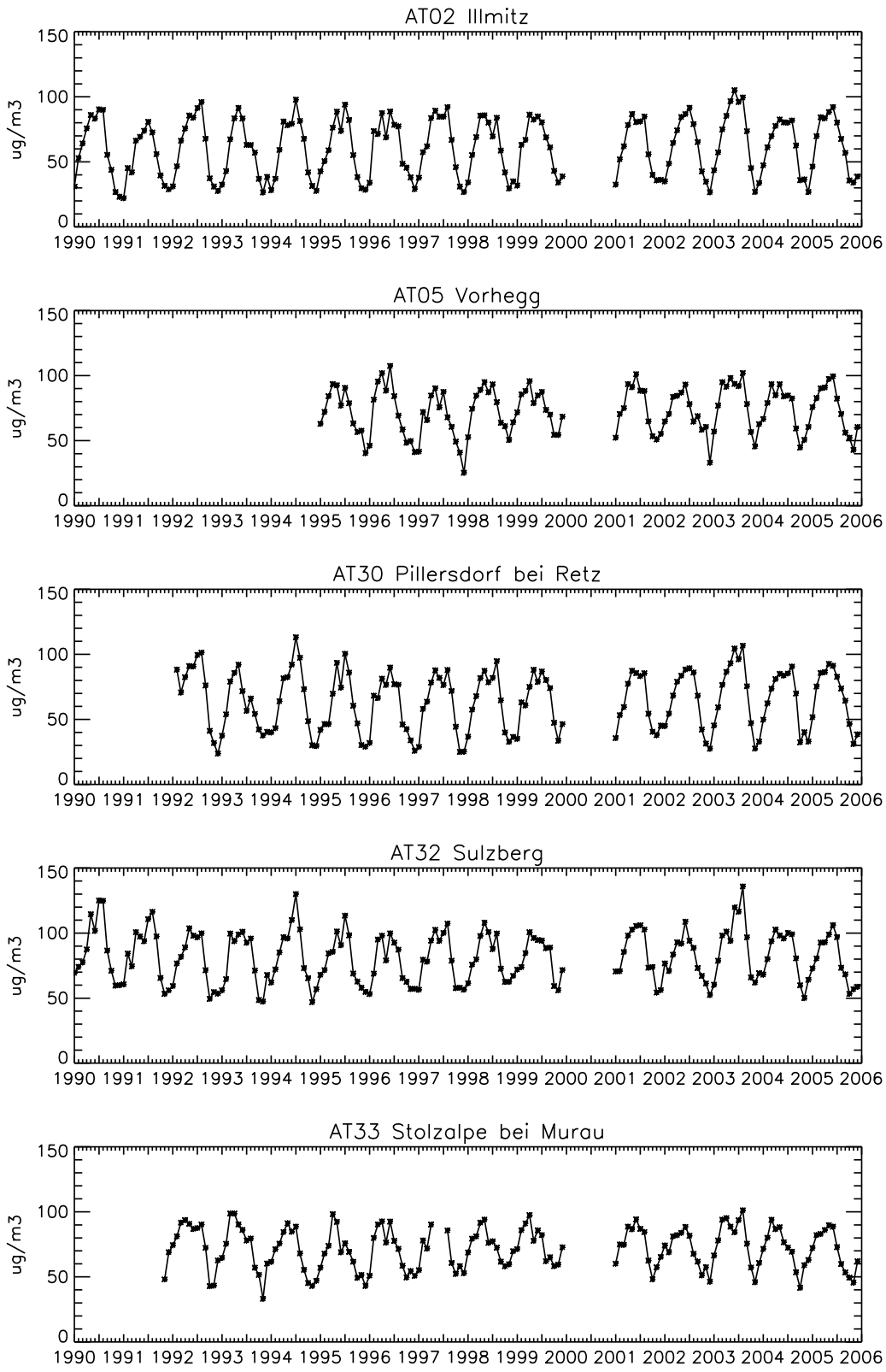


Figure 3.1: Seasonal variation, 1990–2005.

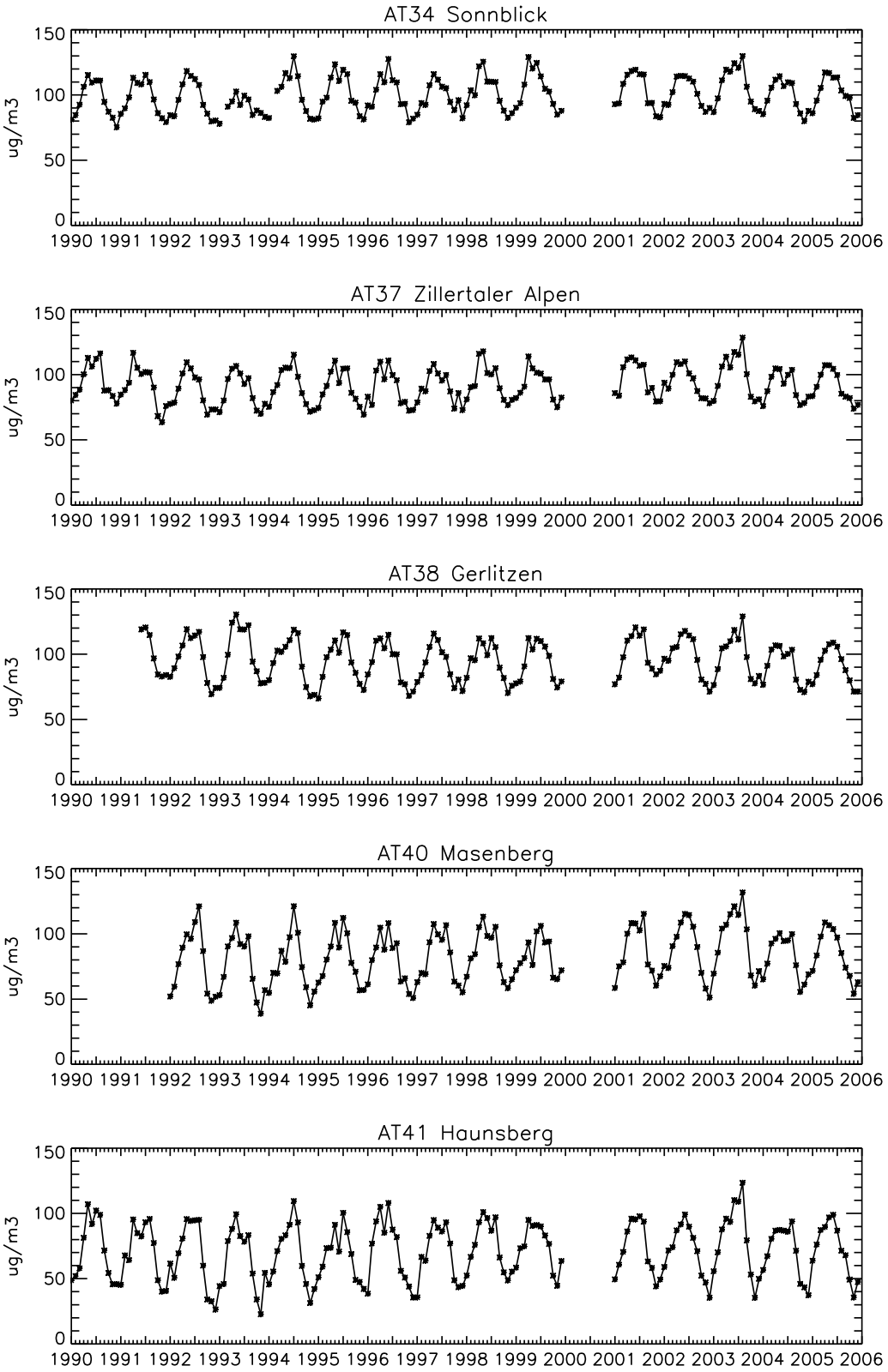


Figure 3.1, cont.

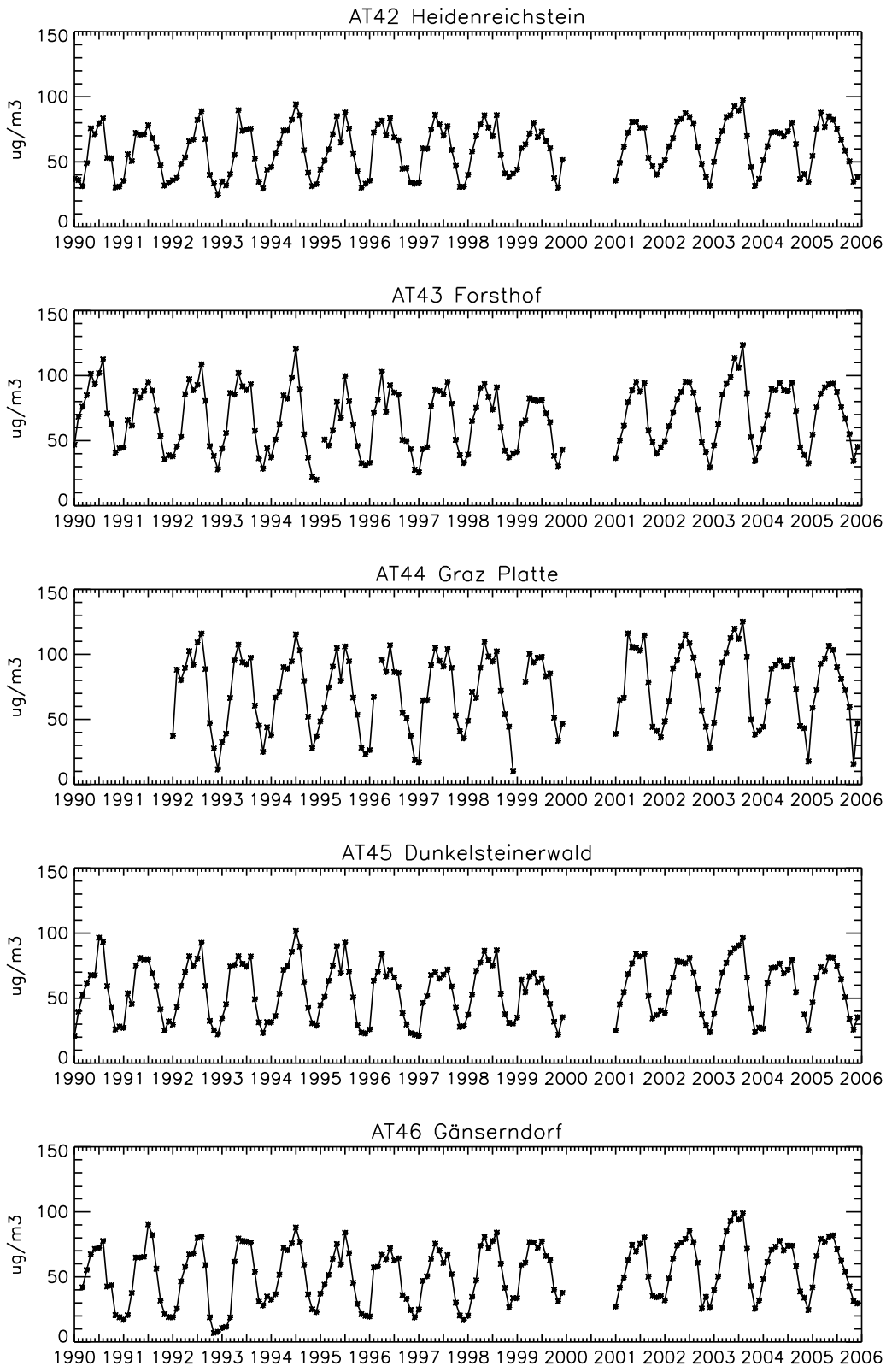


Figure 3.1, cont.

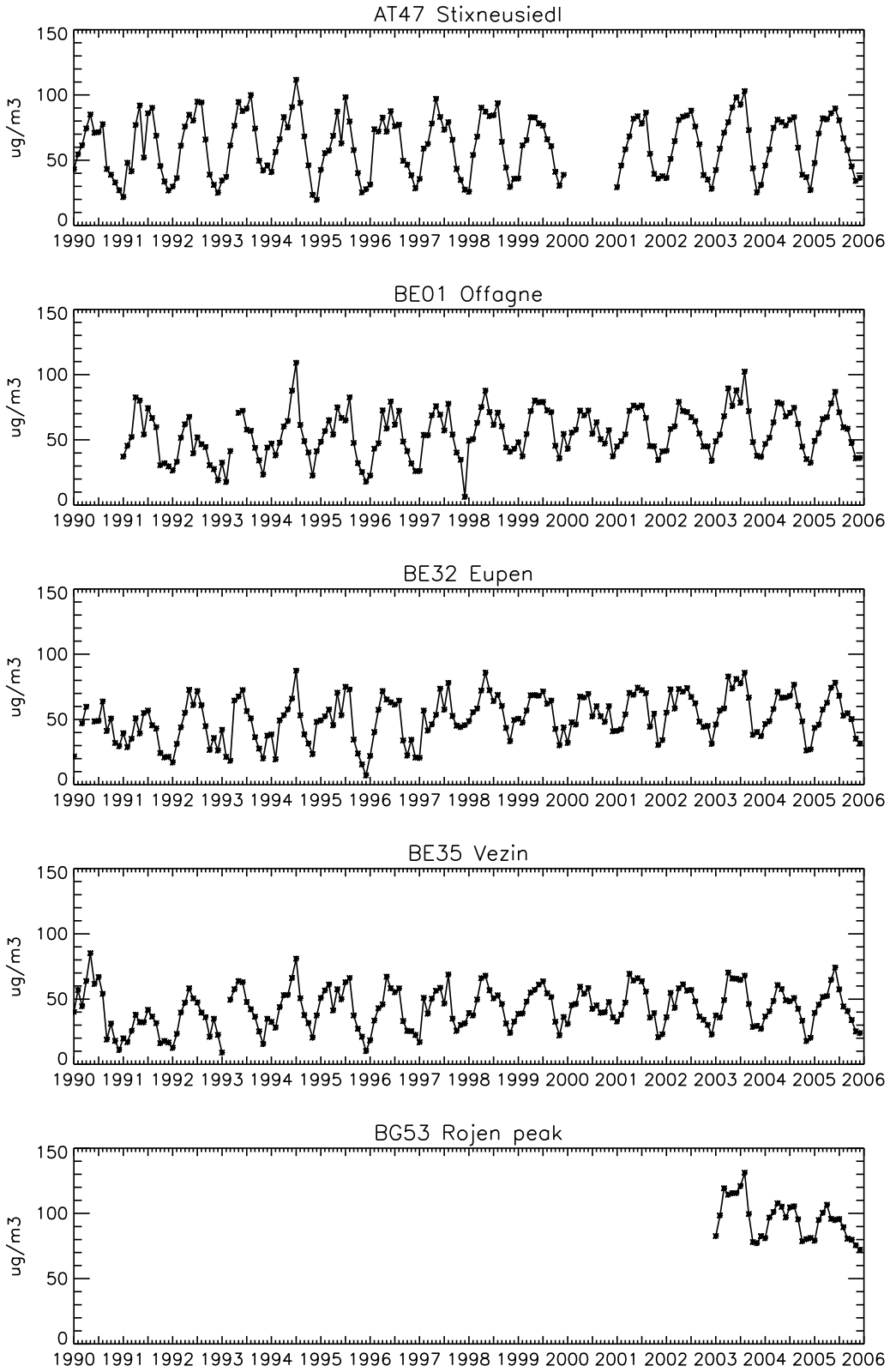


Figure 3.1, cont.

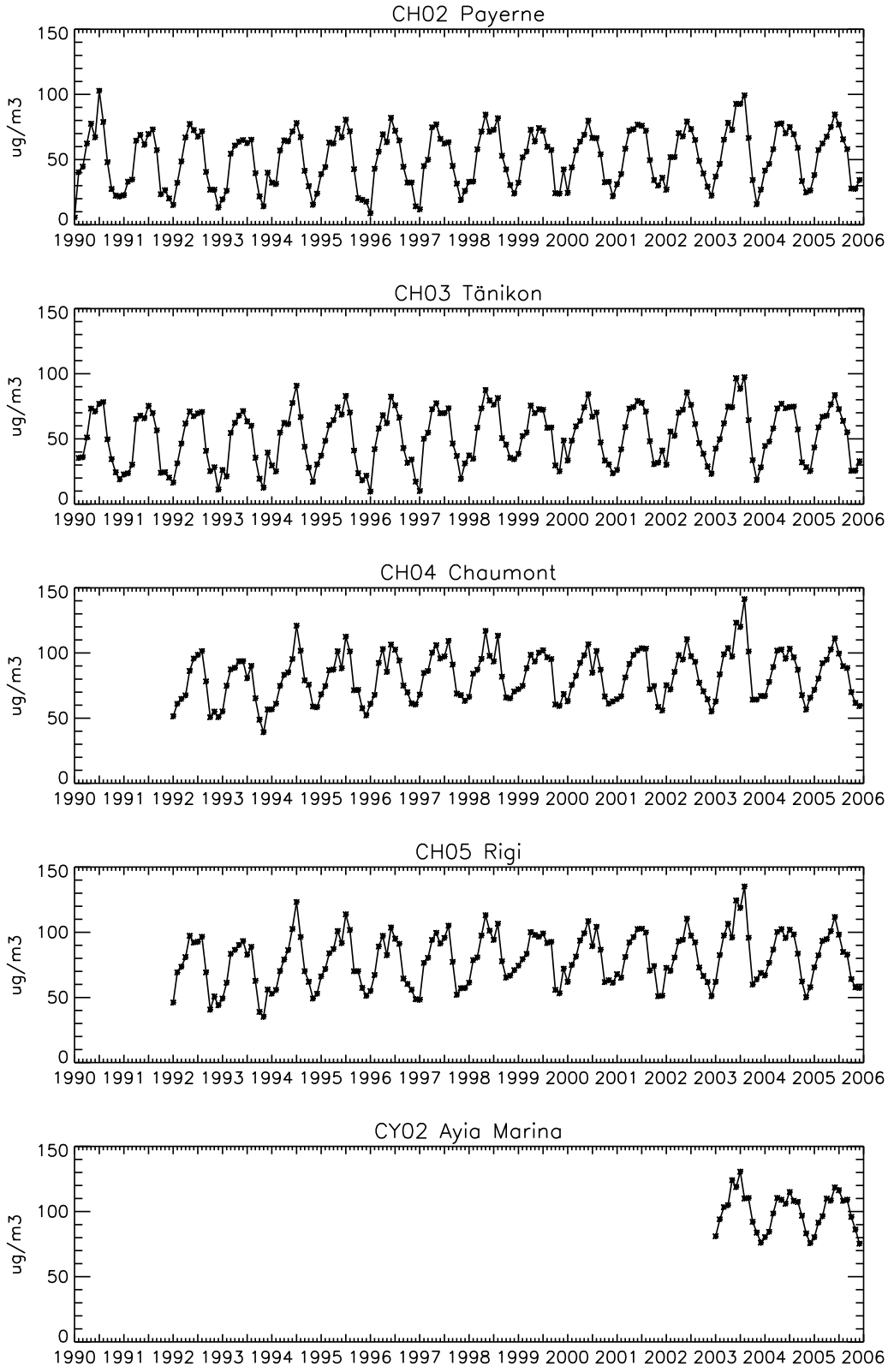


Figure 3.1, cont.

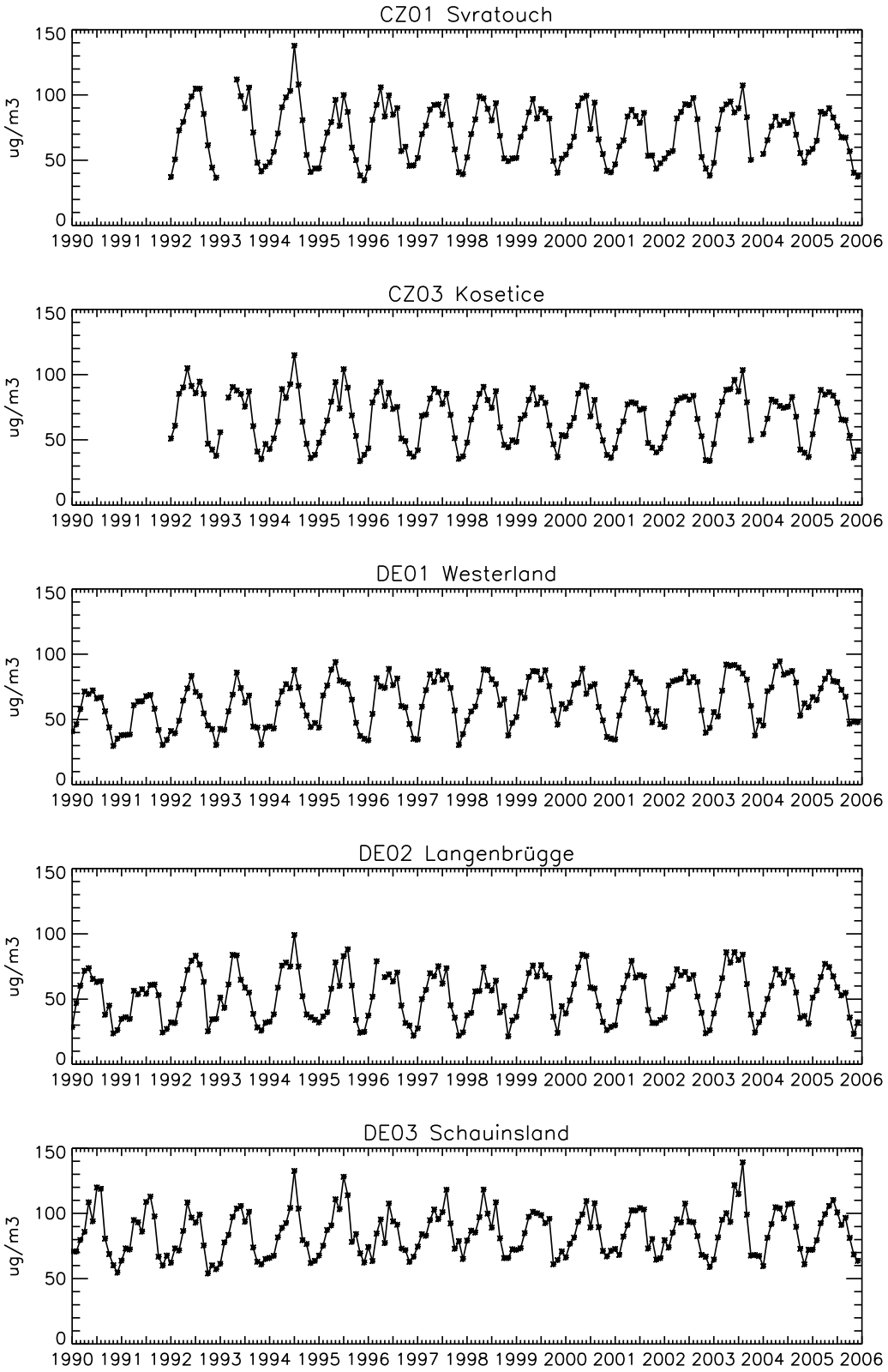


Figure 3.1, cont.

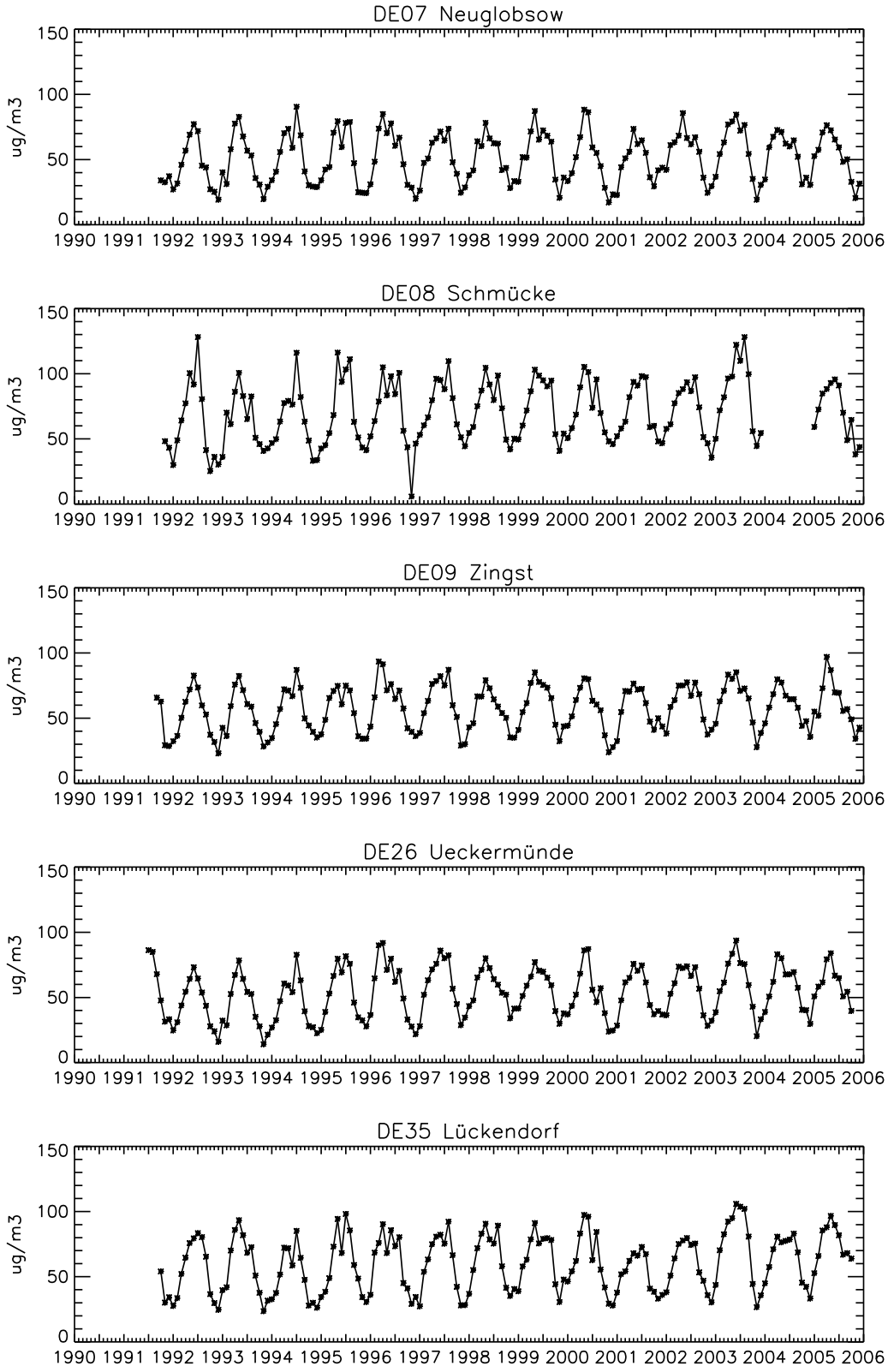


Figure 3.1, cont.

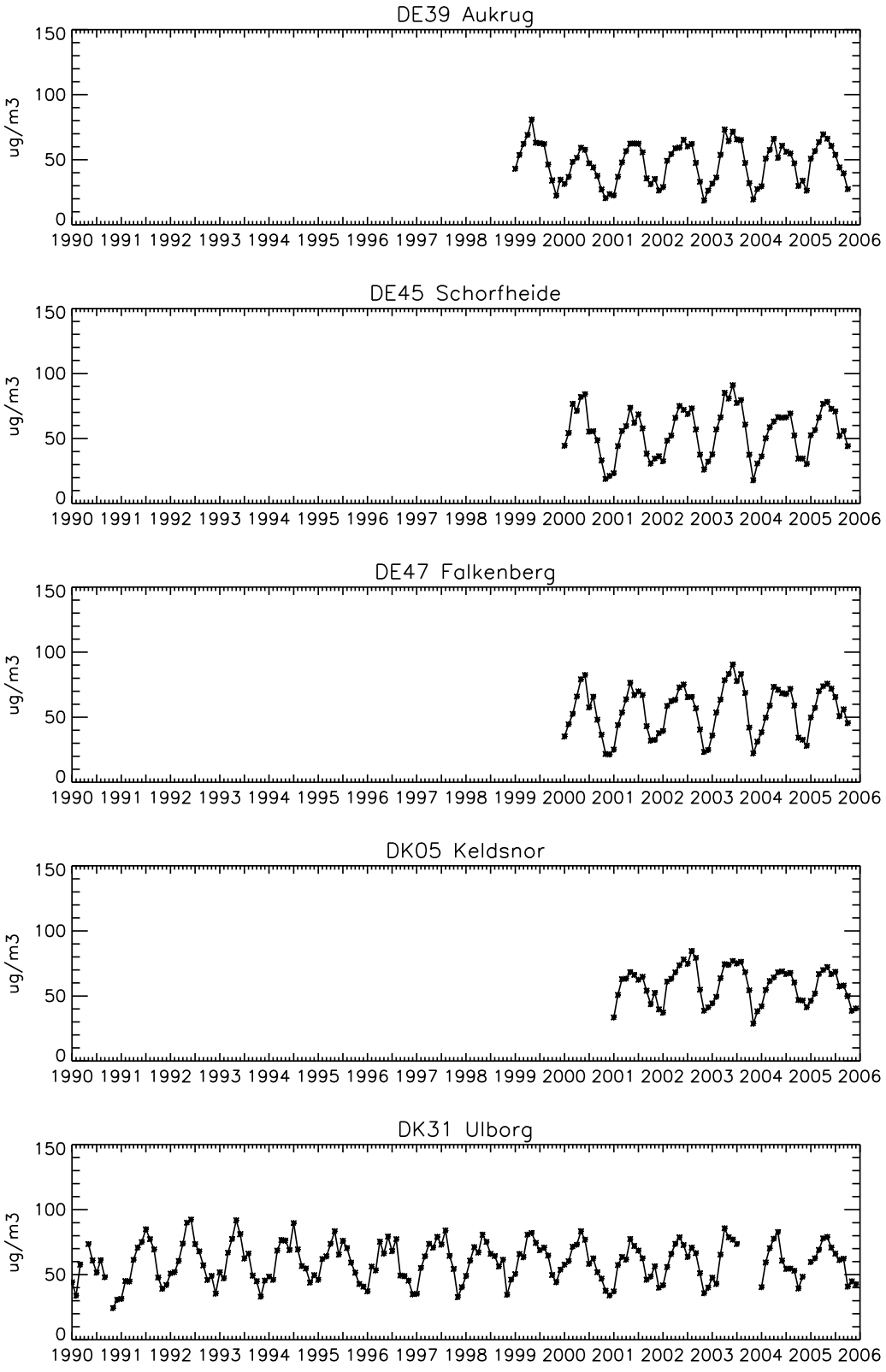


Figure 3.1, cont.

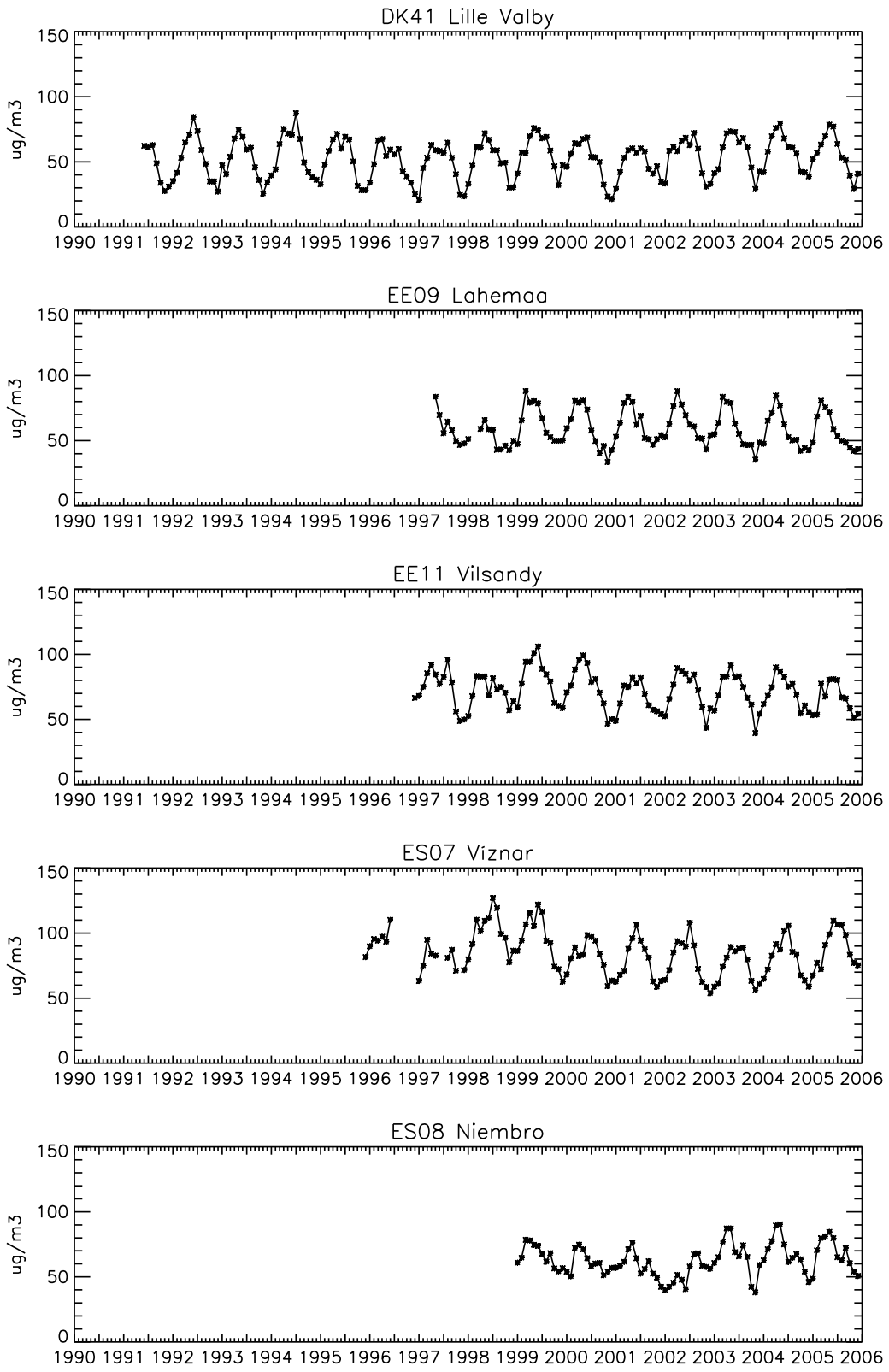


Figure 3.1, cont.

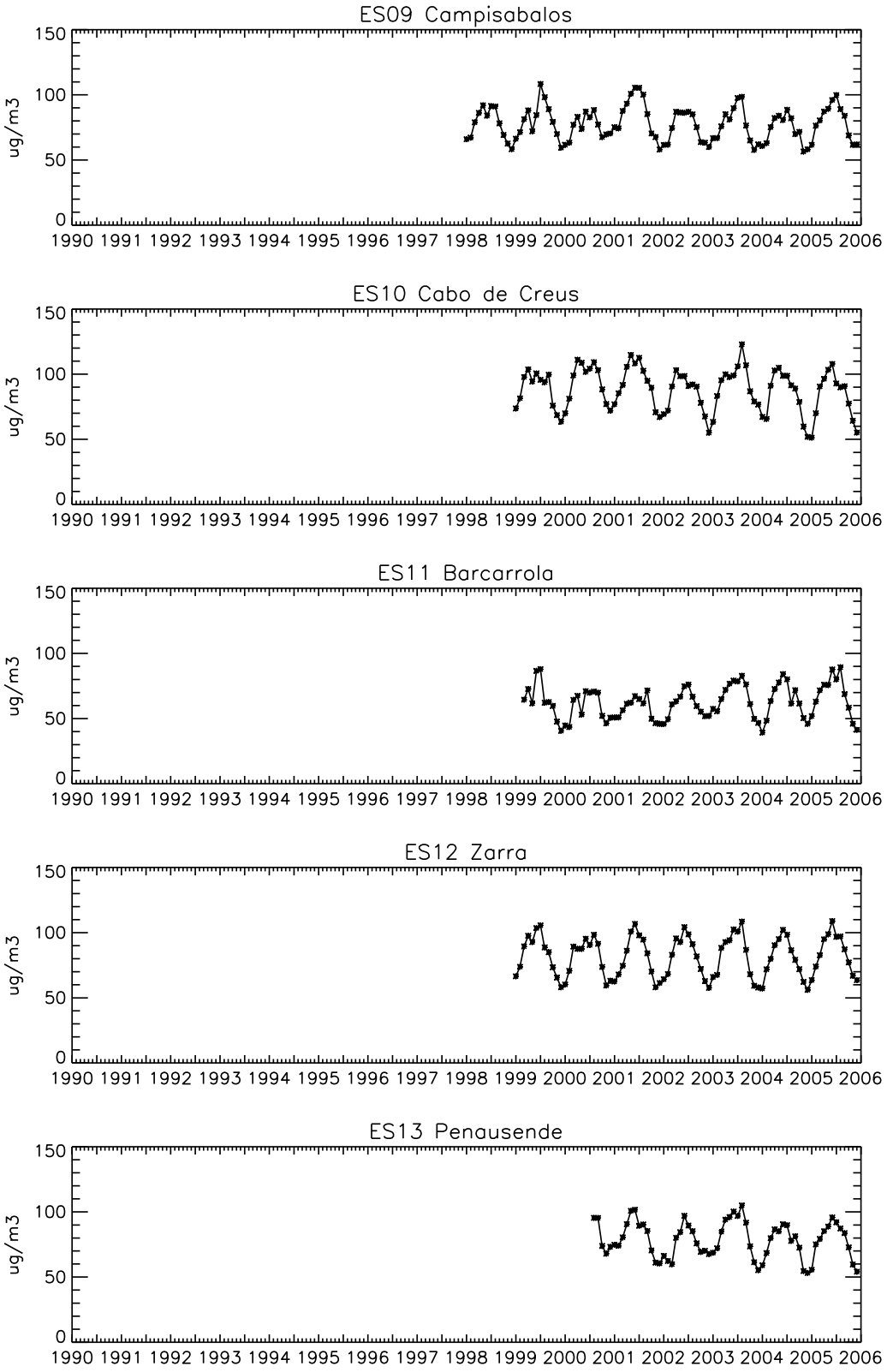


Figure 3.1, cont.

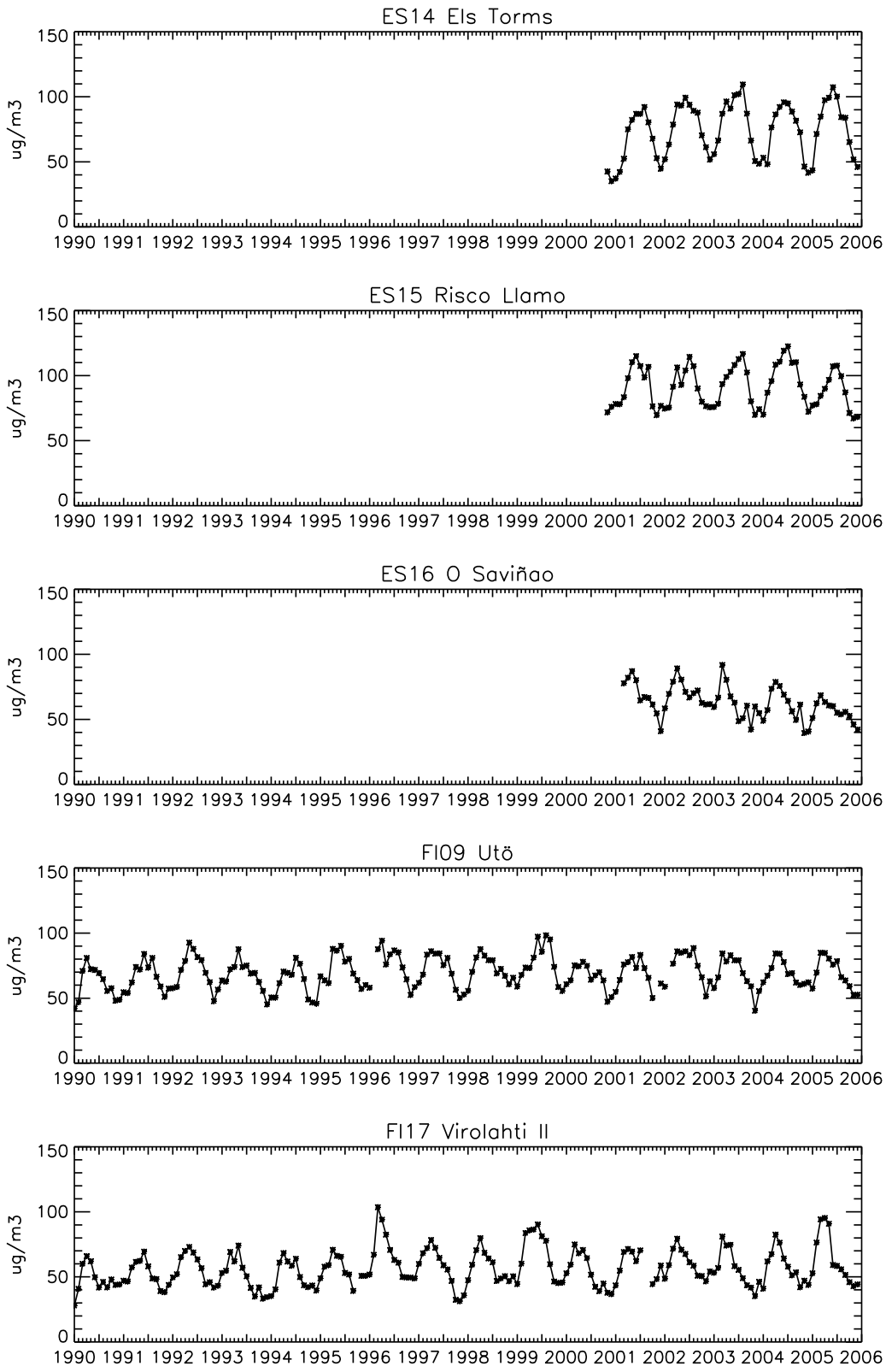


Figure 3.1, cont.

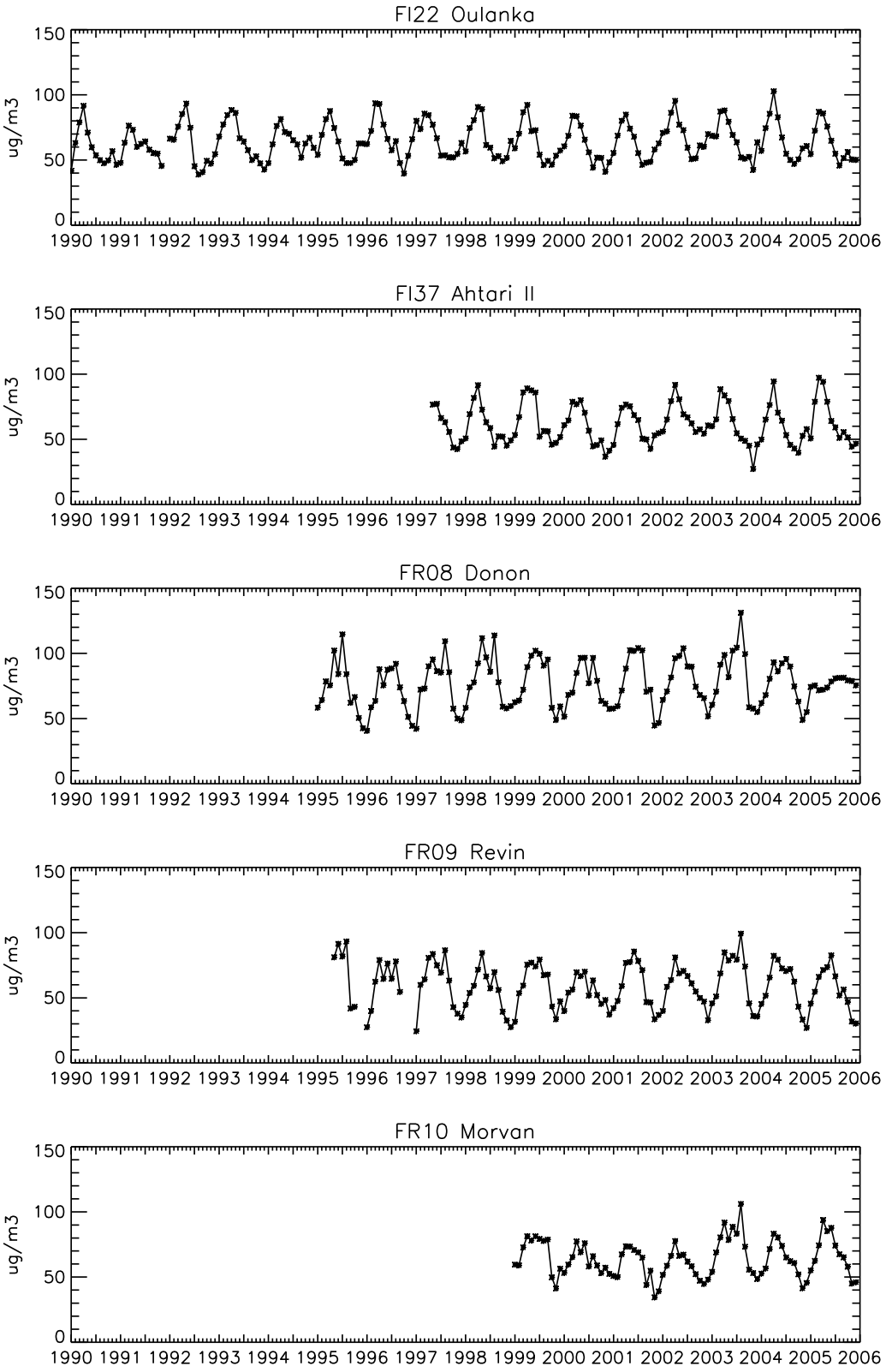


Figure 3.1, cont.

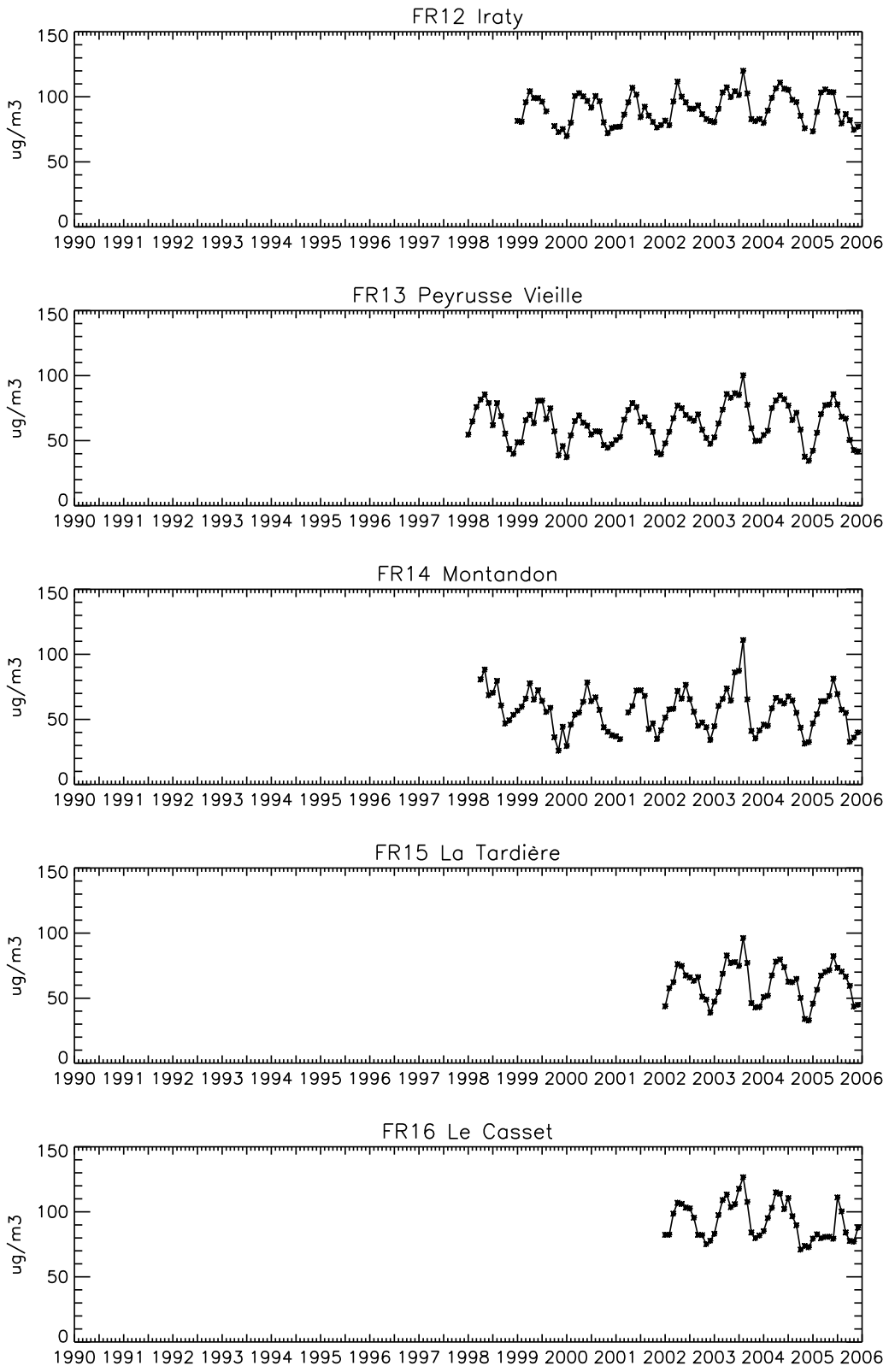


Figure 3.1, cont.

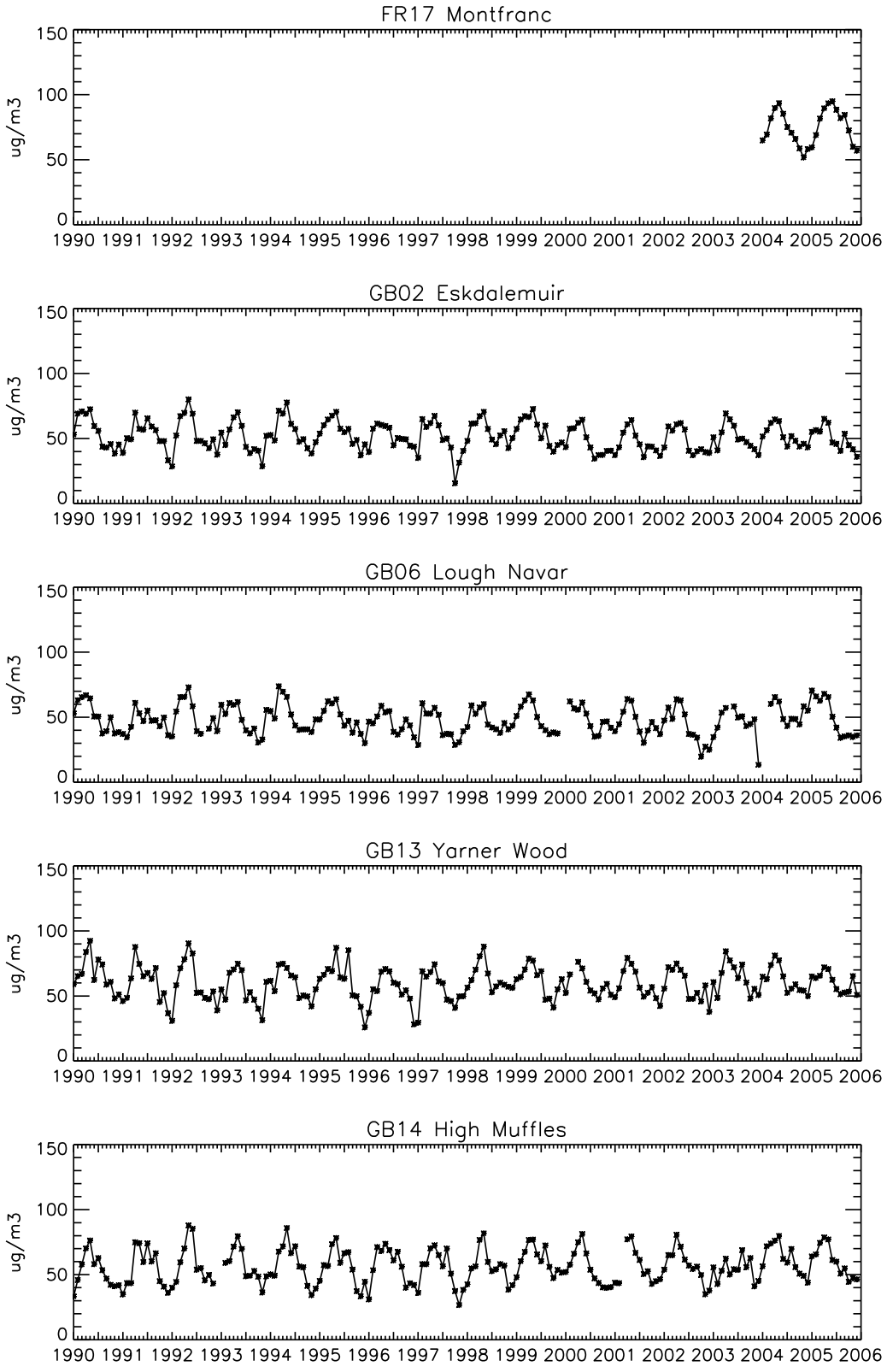


Figure 3.1, cont.

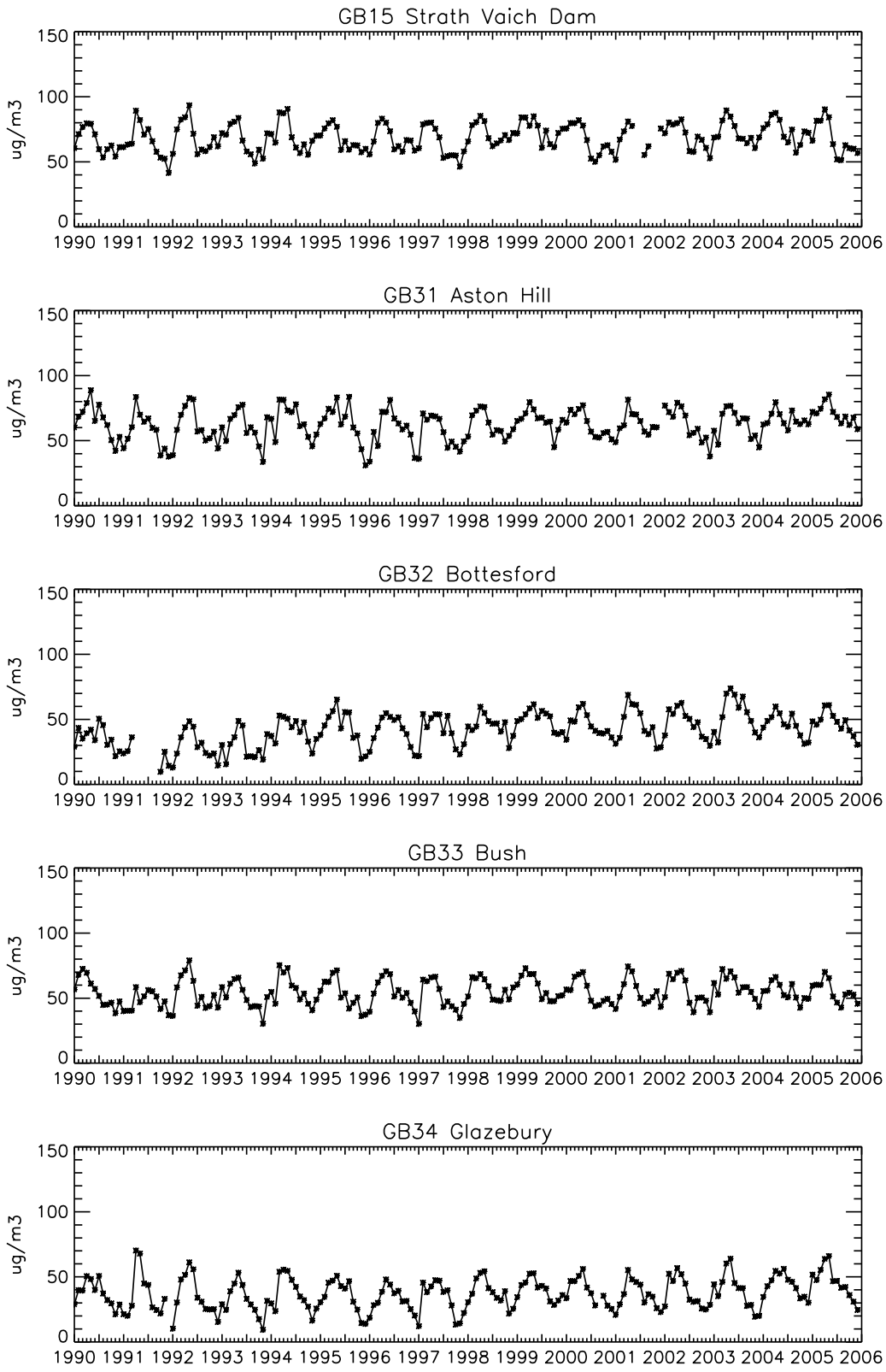


Figure 3.1, cont.

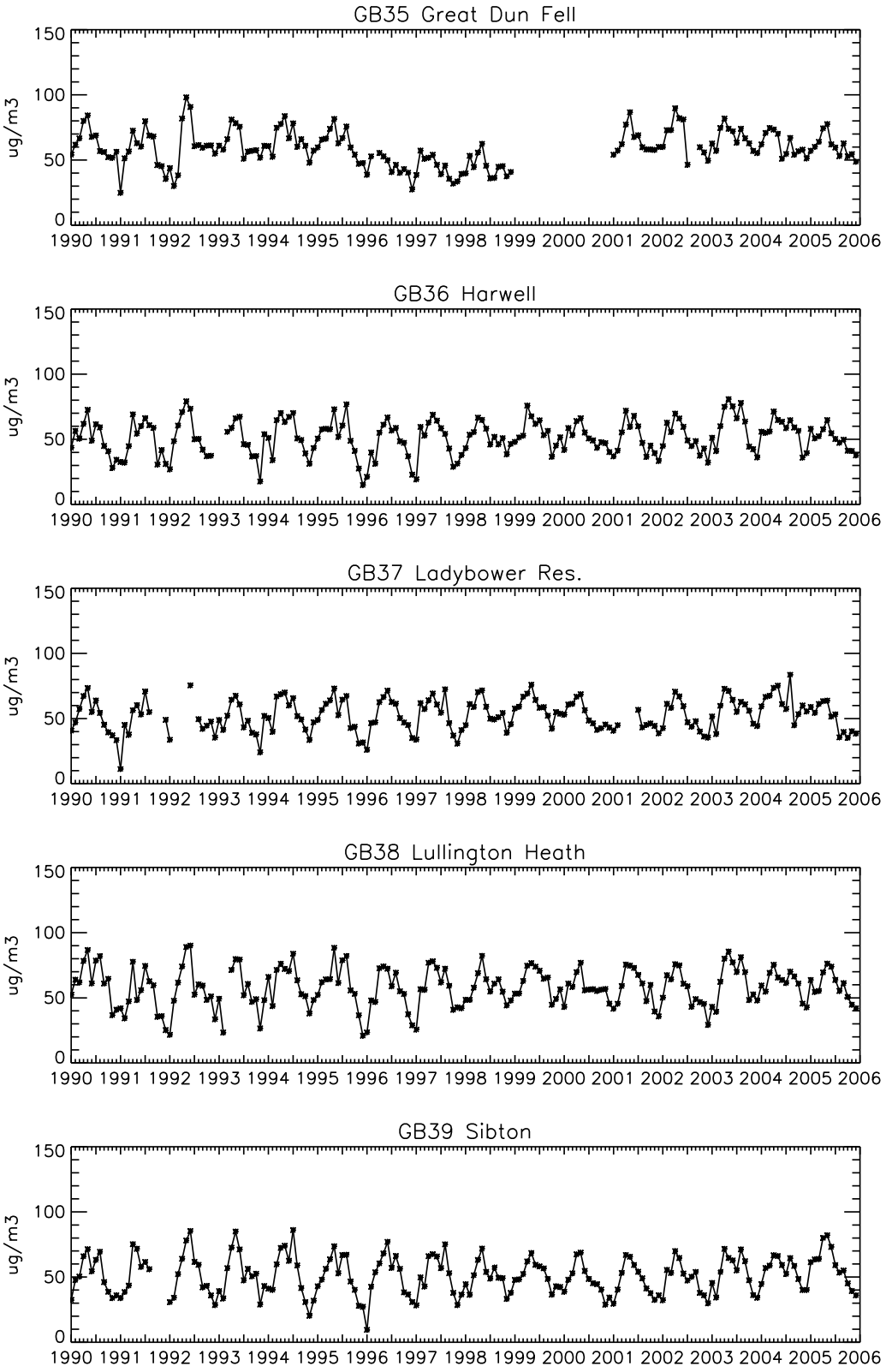


Figure 3.1, cont.

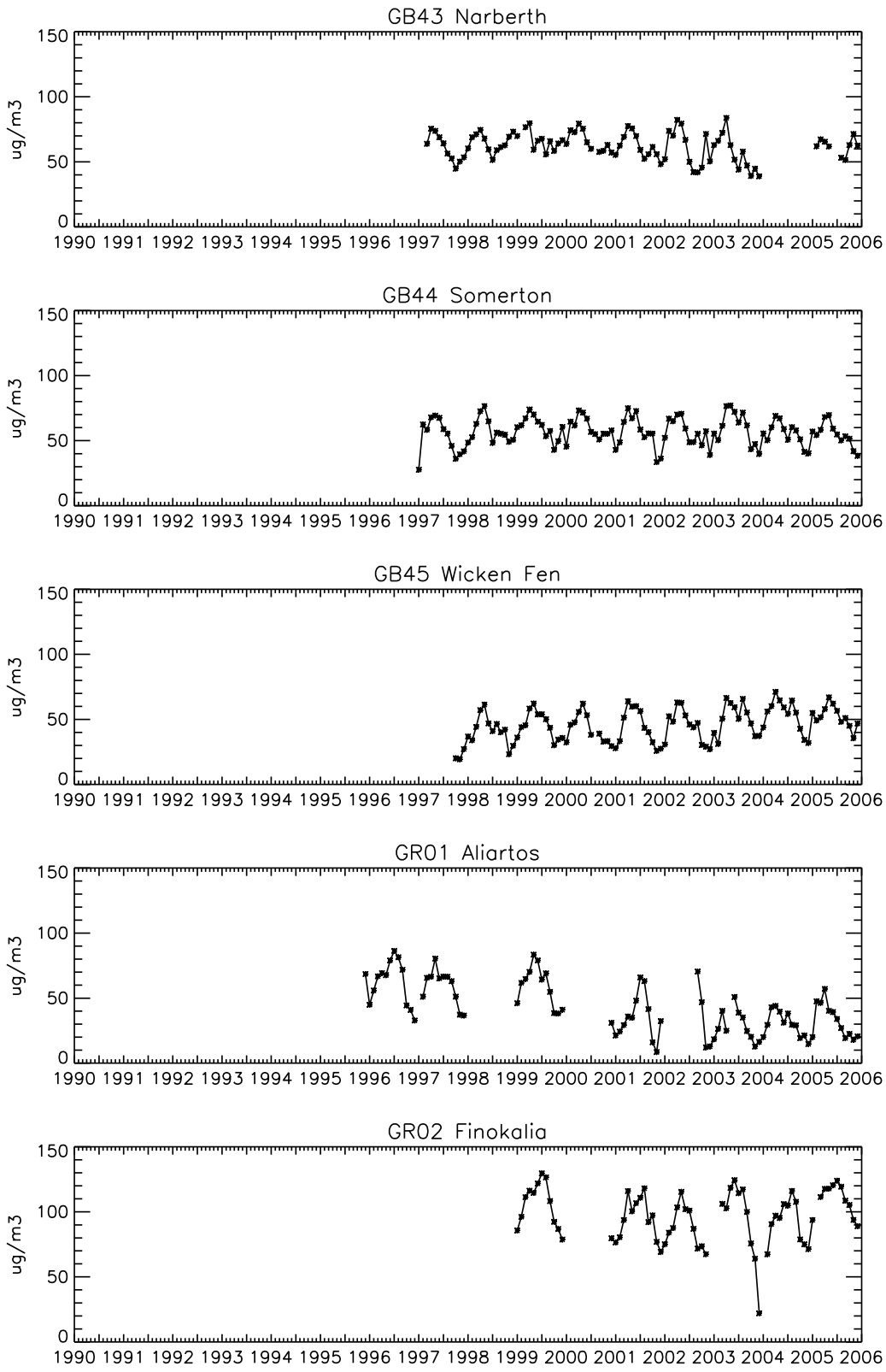


Figure 3.1, cont.

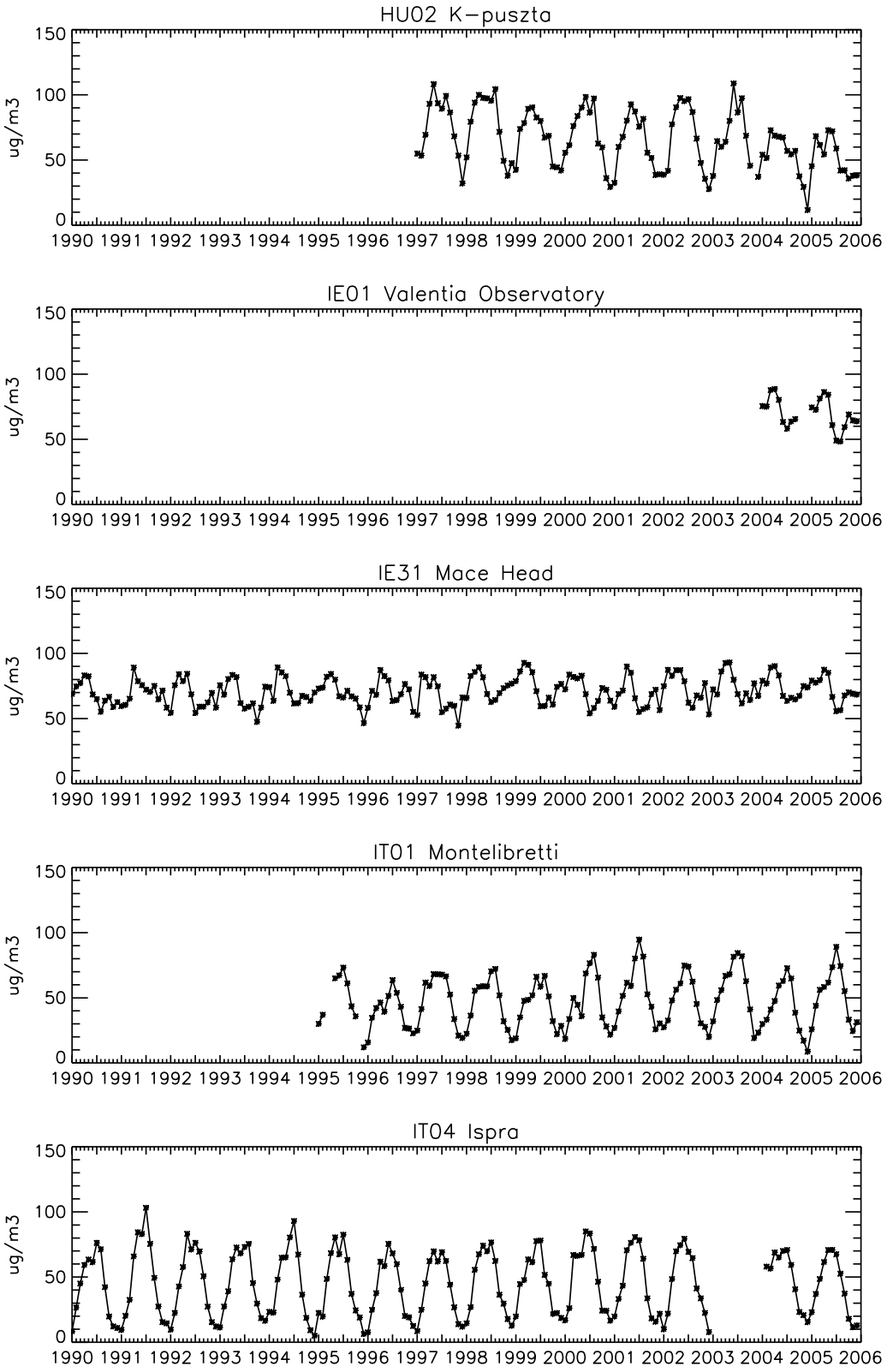


Figure 3.1, cont.

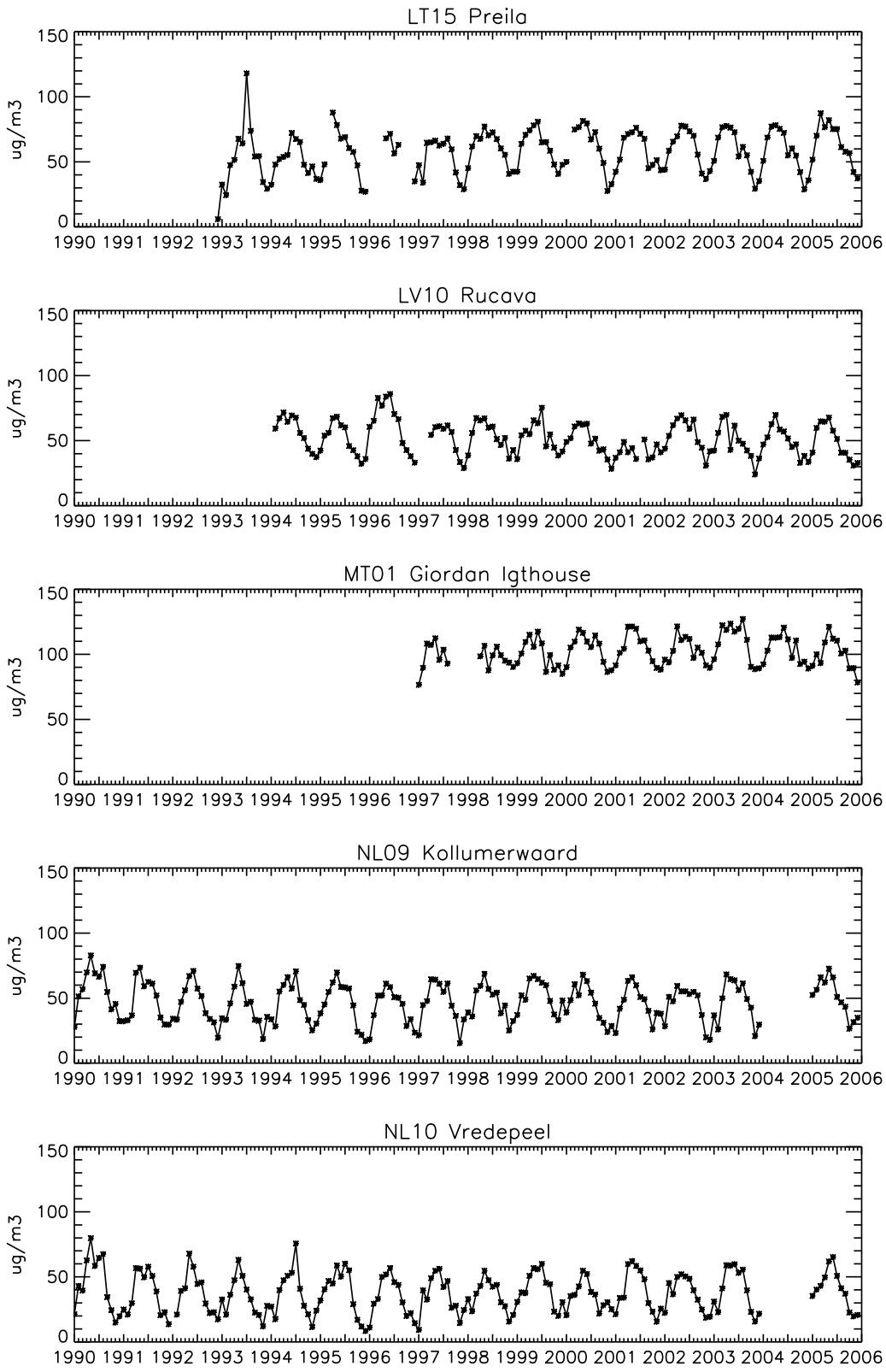


Figure 3.1, cont.

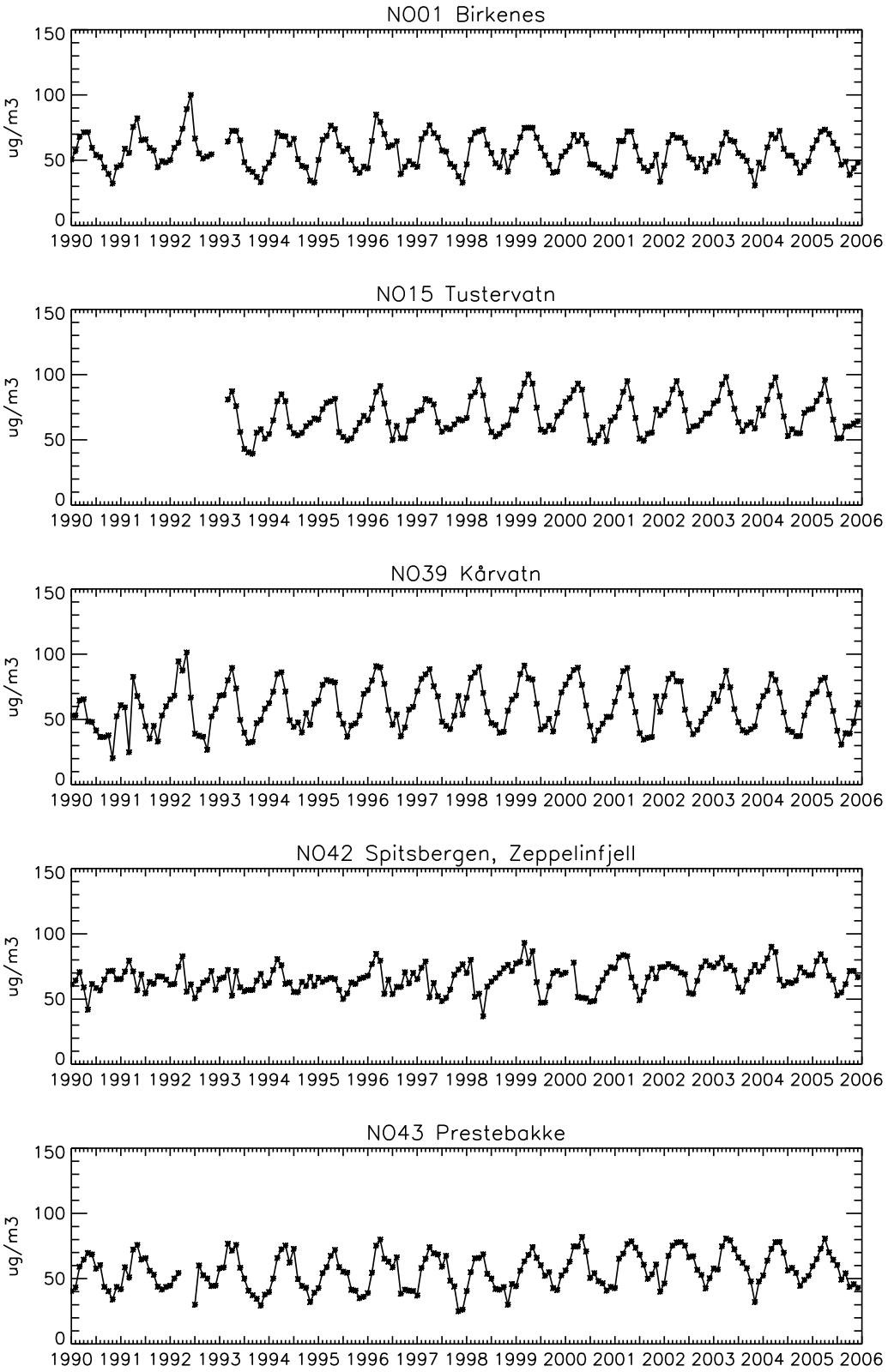


Figure 3.1, cont.

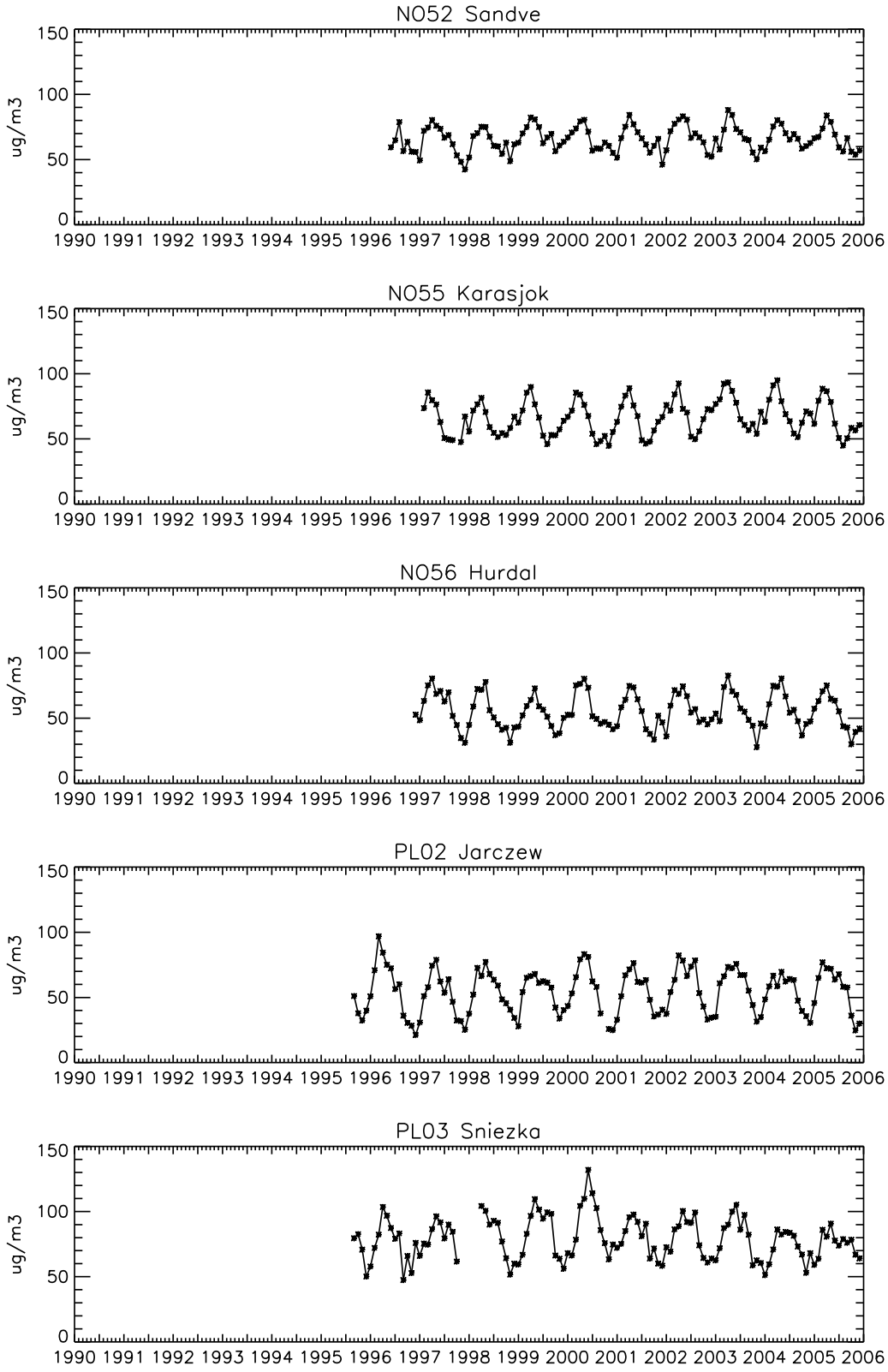


Figure 3.1, cont.

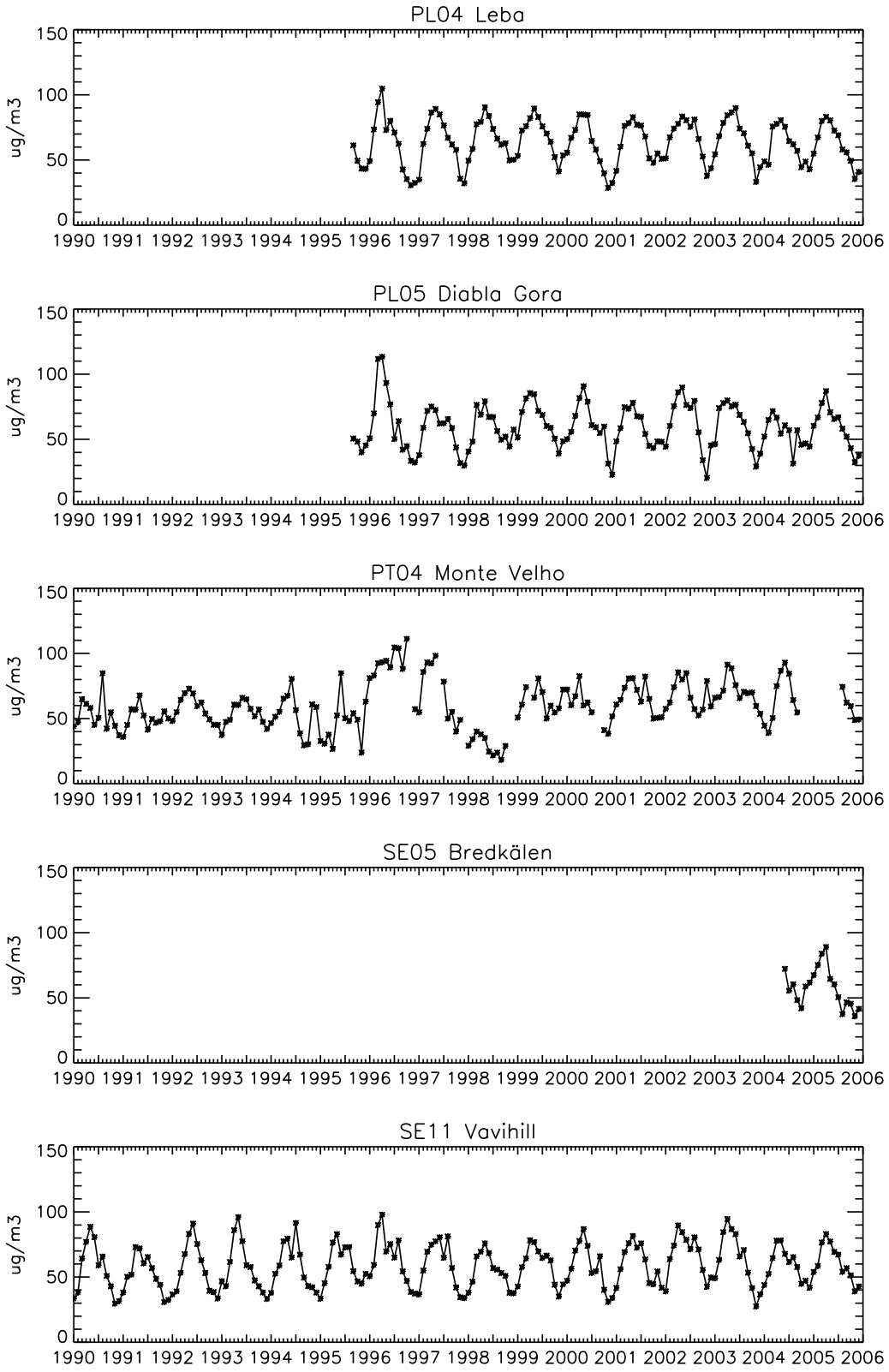


Figure 3.1, cont.

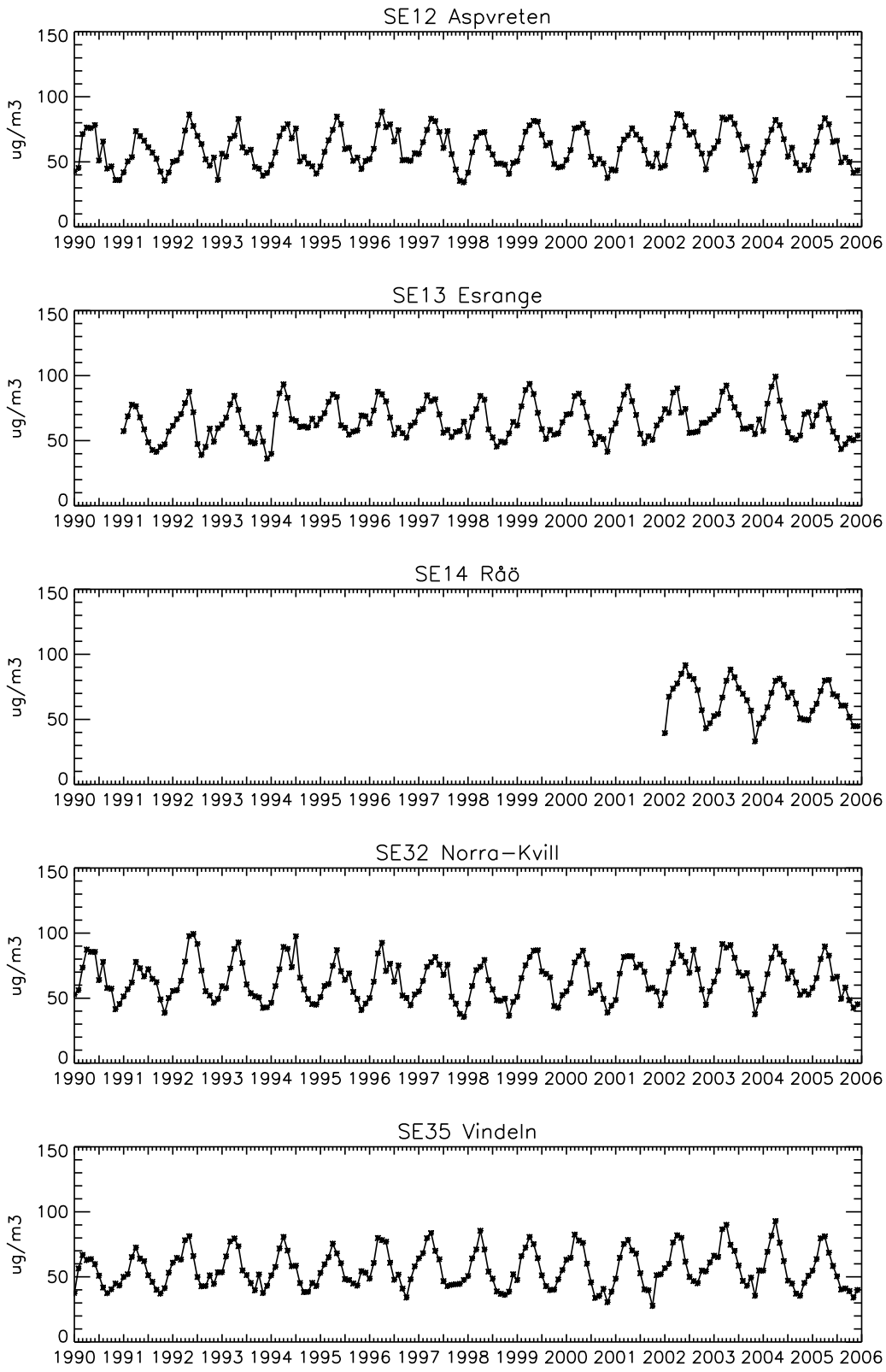


Figure 3.1, cont.

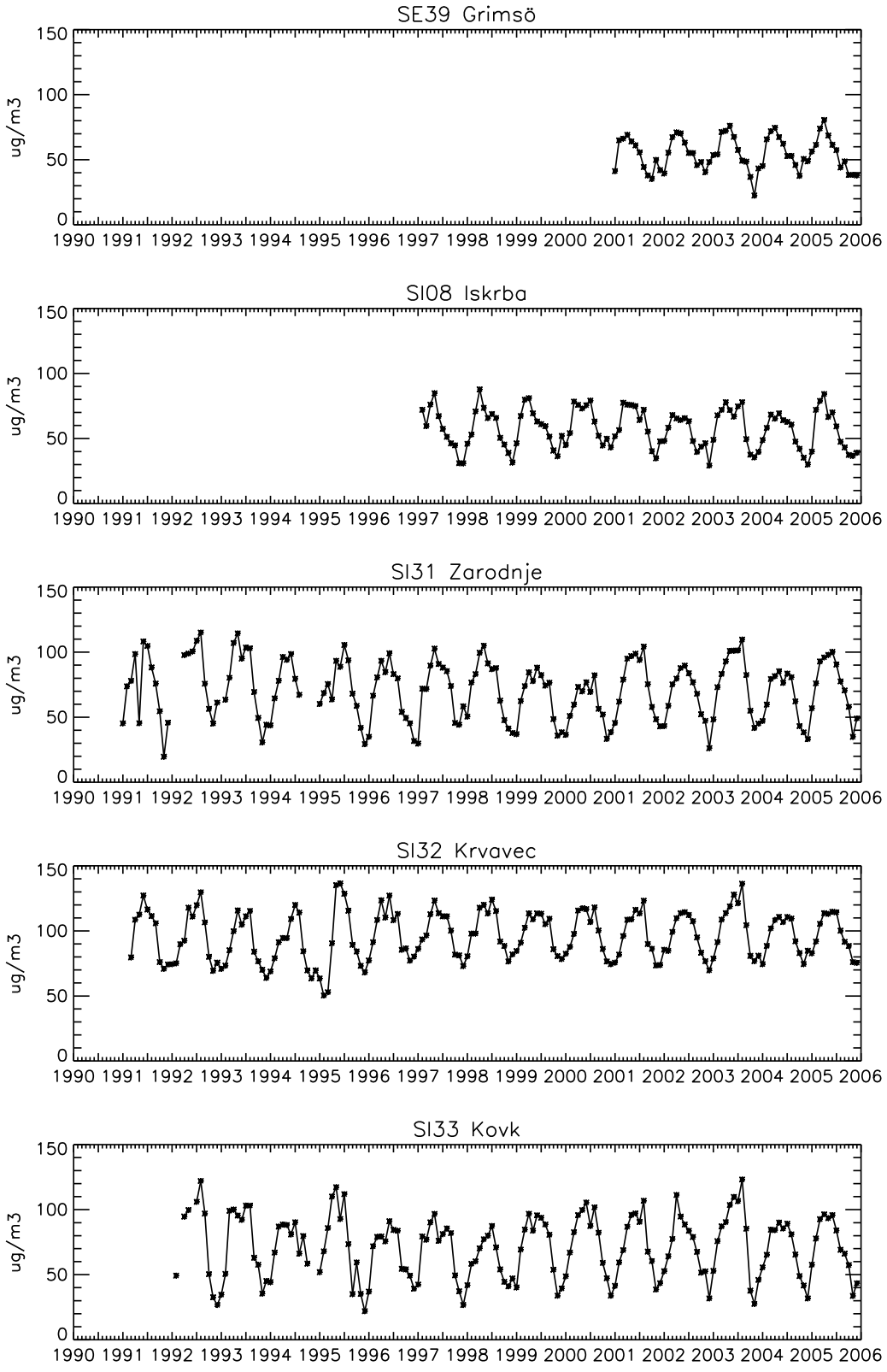


Figure 3.1, cont.

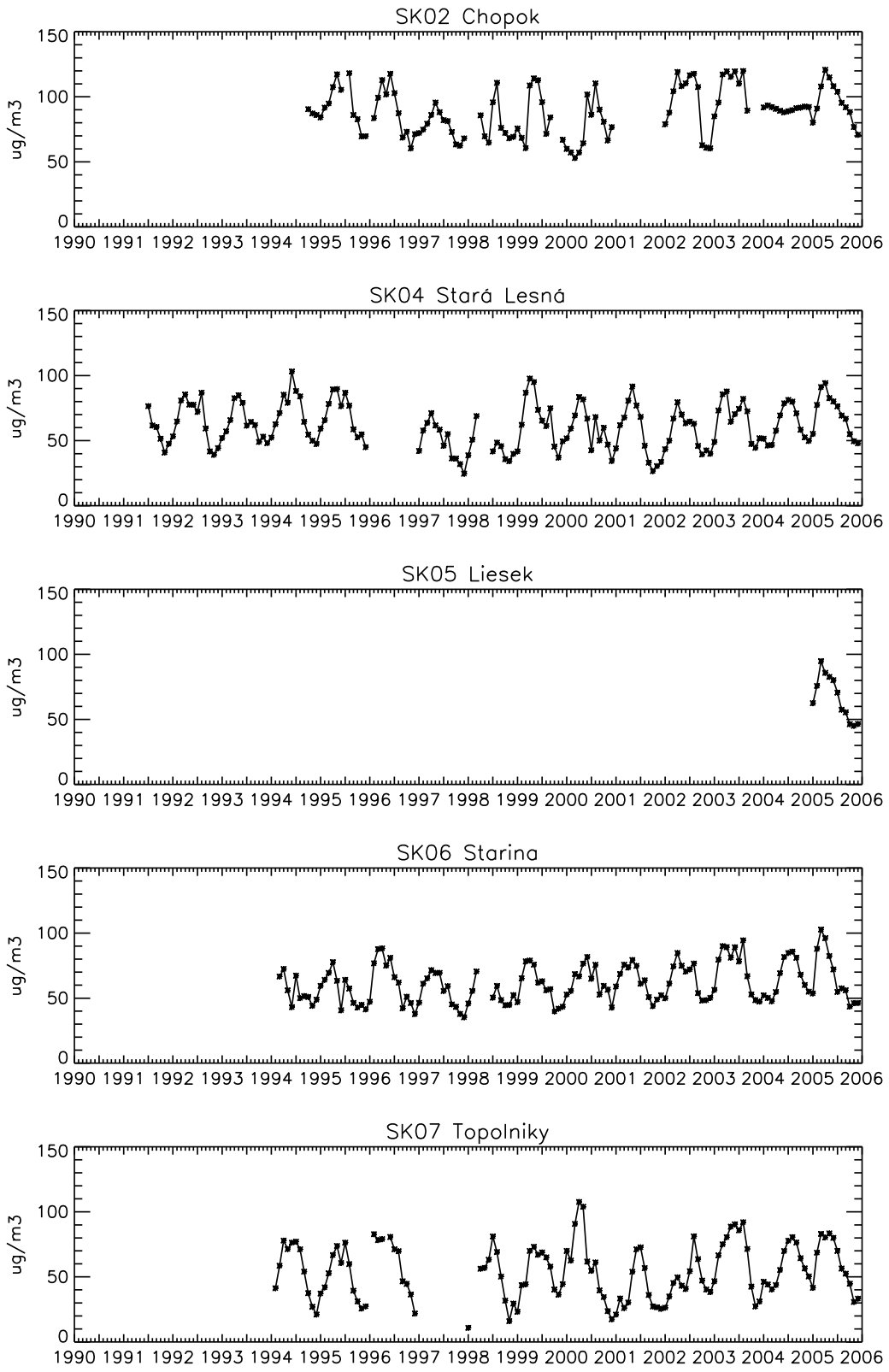


Figure 3.1, cont.

Annex 4

Diurnal variation, April–September 2005

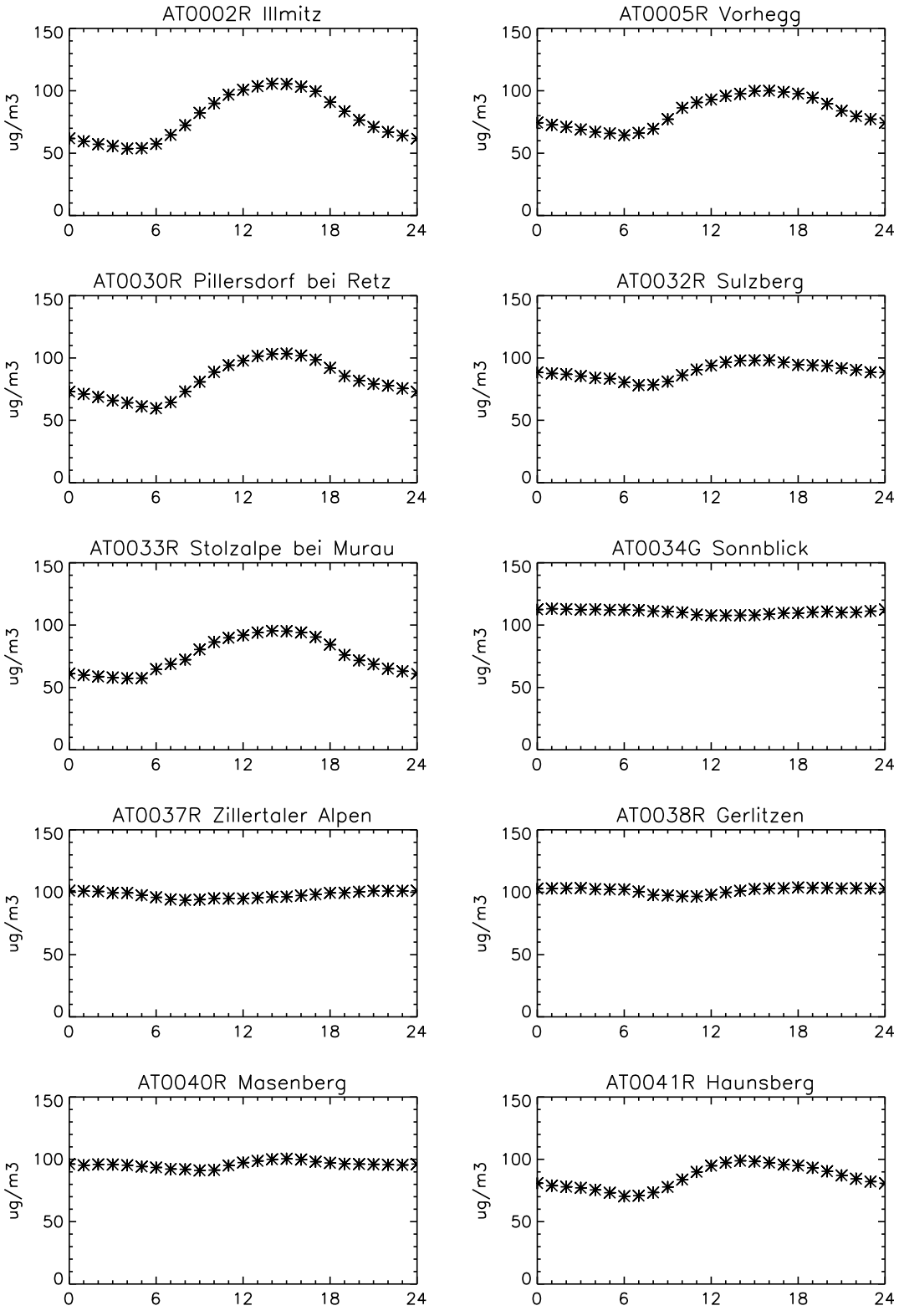


Figure 4.1: Diurnal variation, April–September 2005.

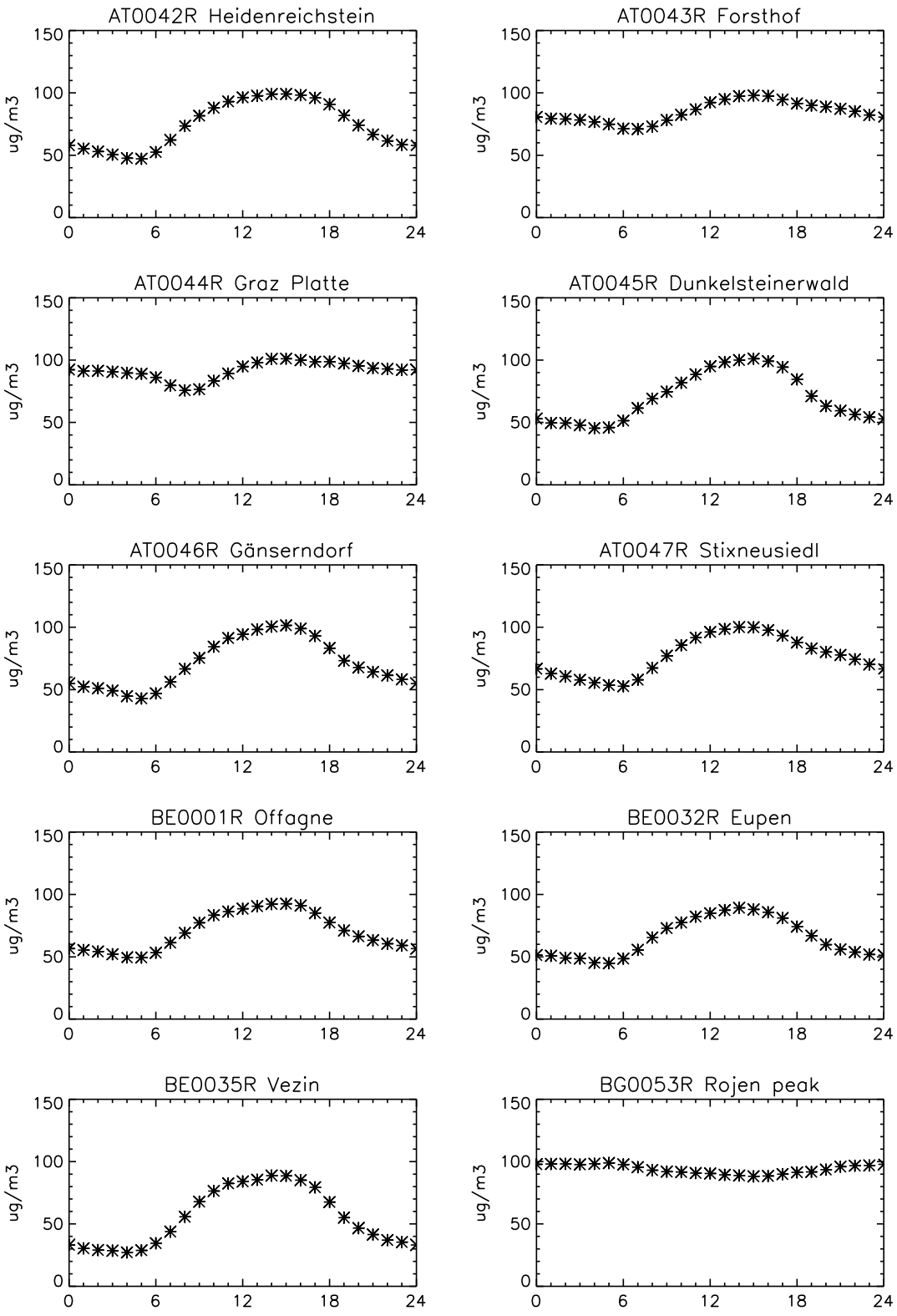


Figure 4.1, cont.

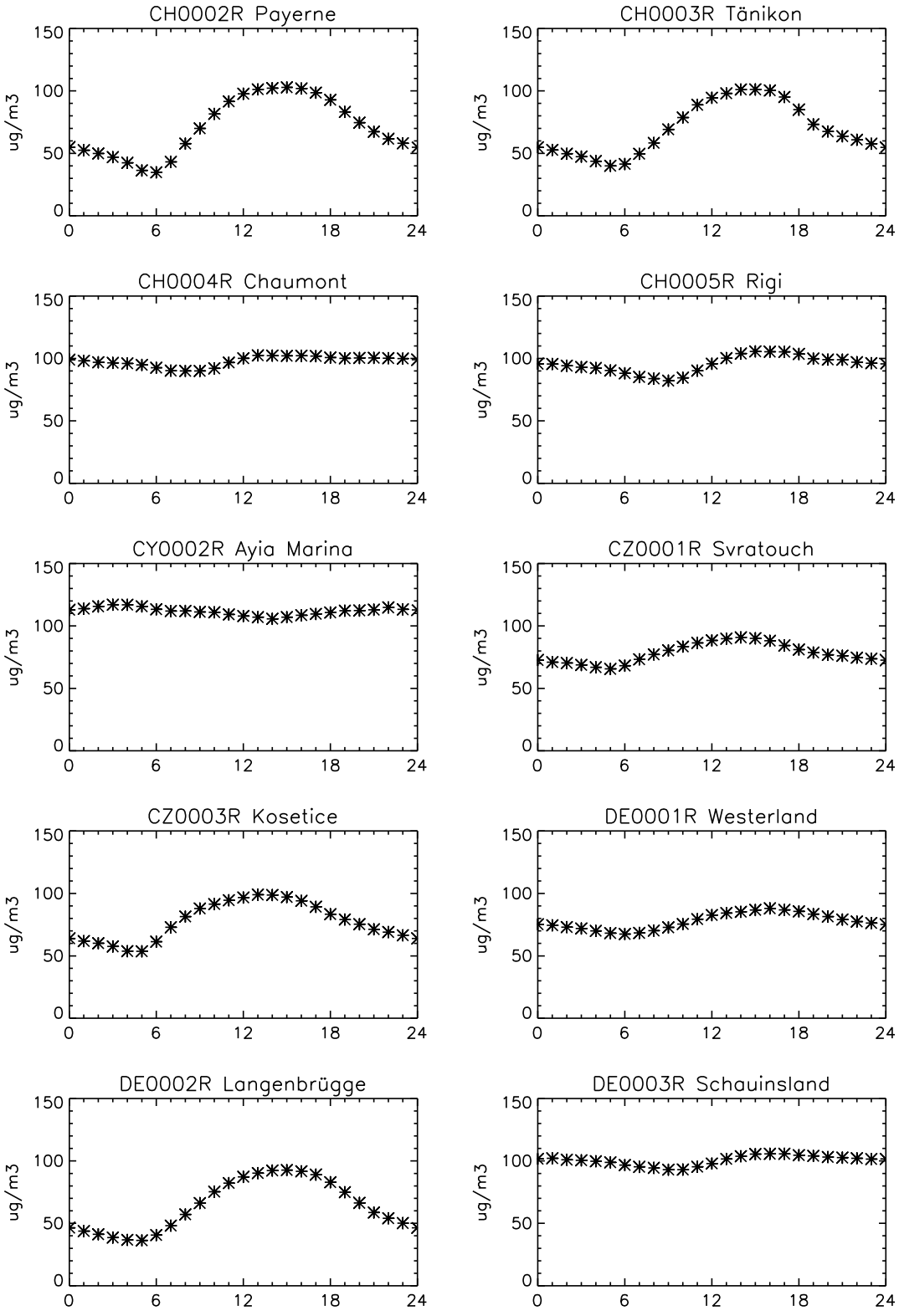


Figure 4.1, cont.

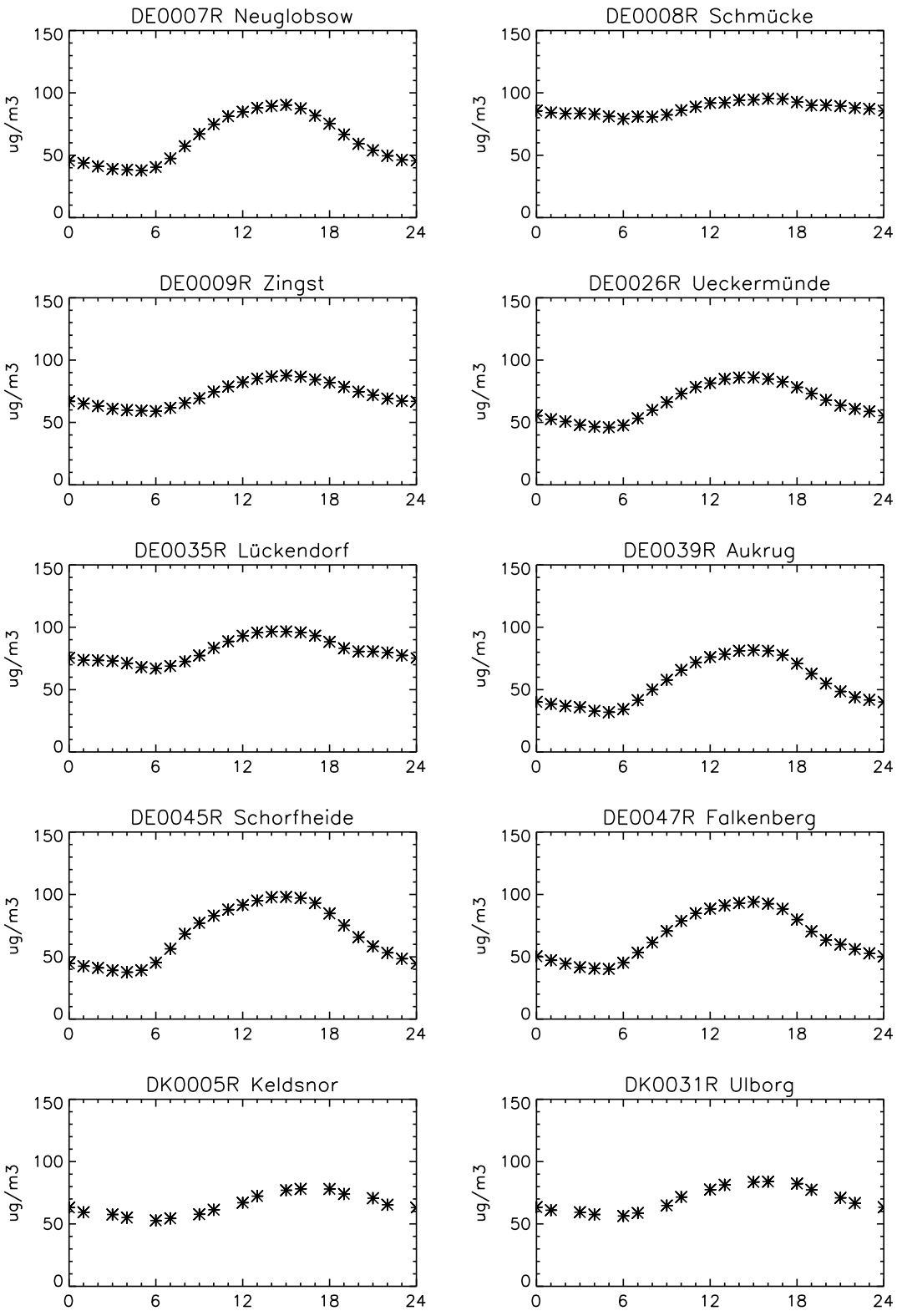


Figure 4.1, cont.

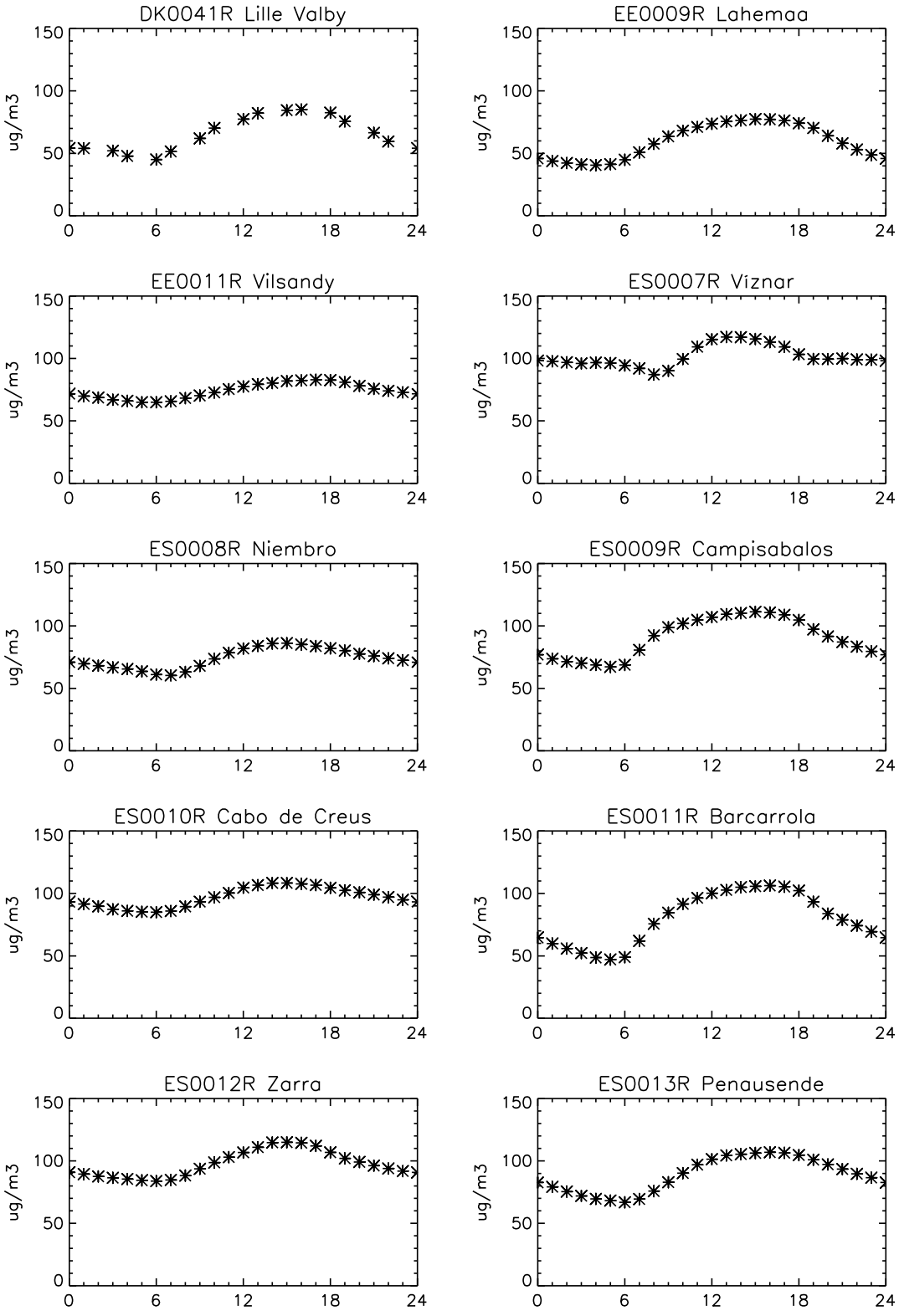


Figure 4.1, cont.

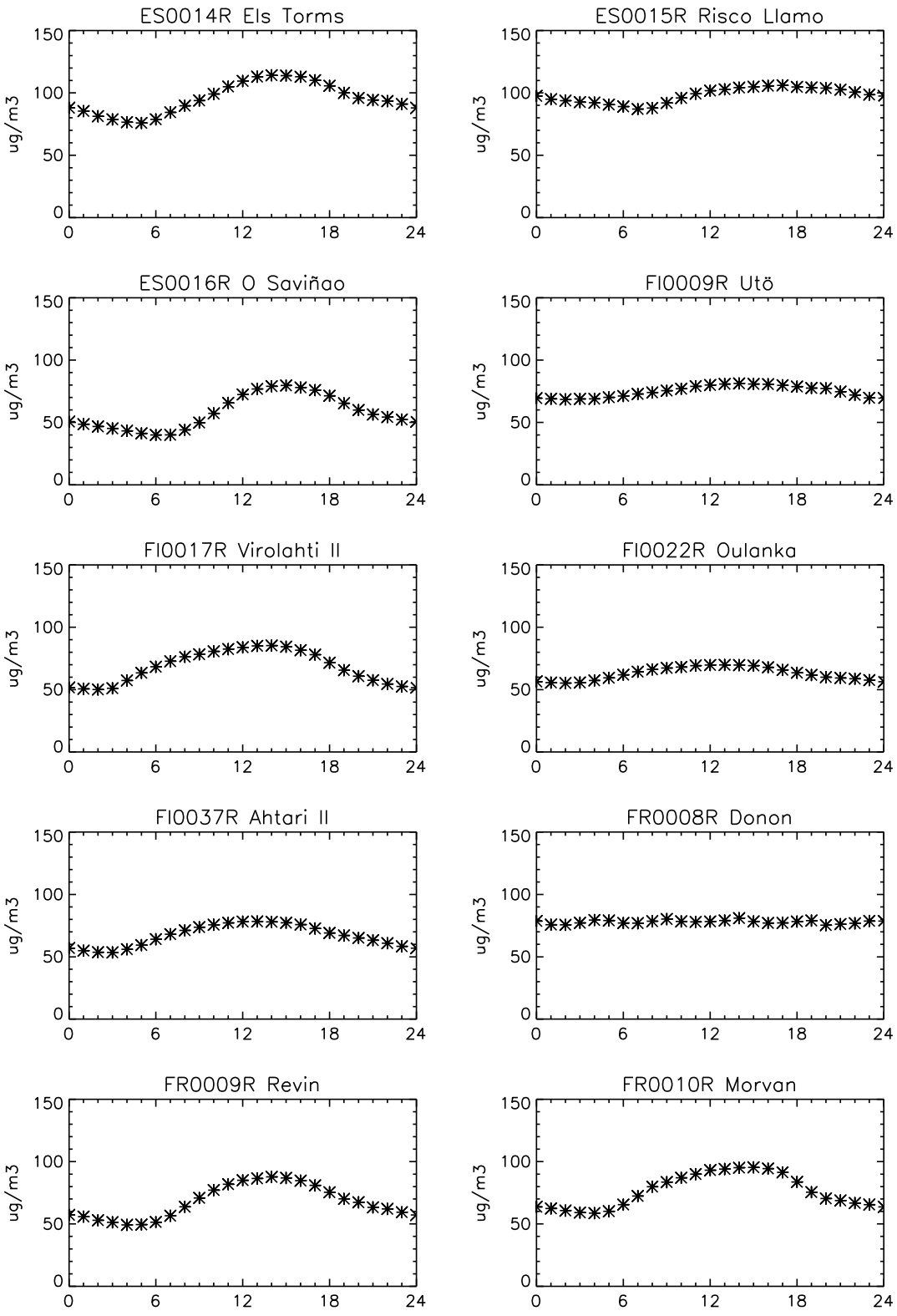


Figure 4.1, cont.

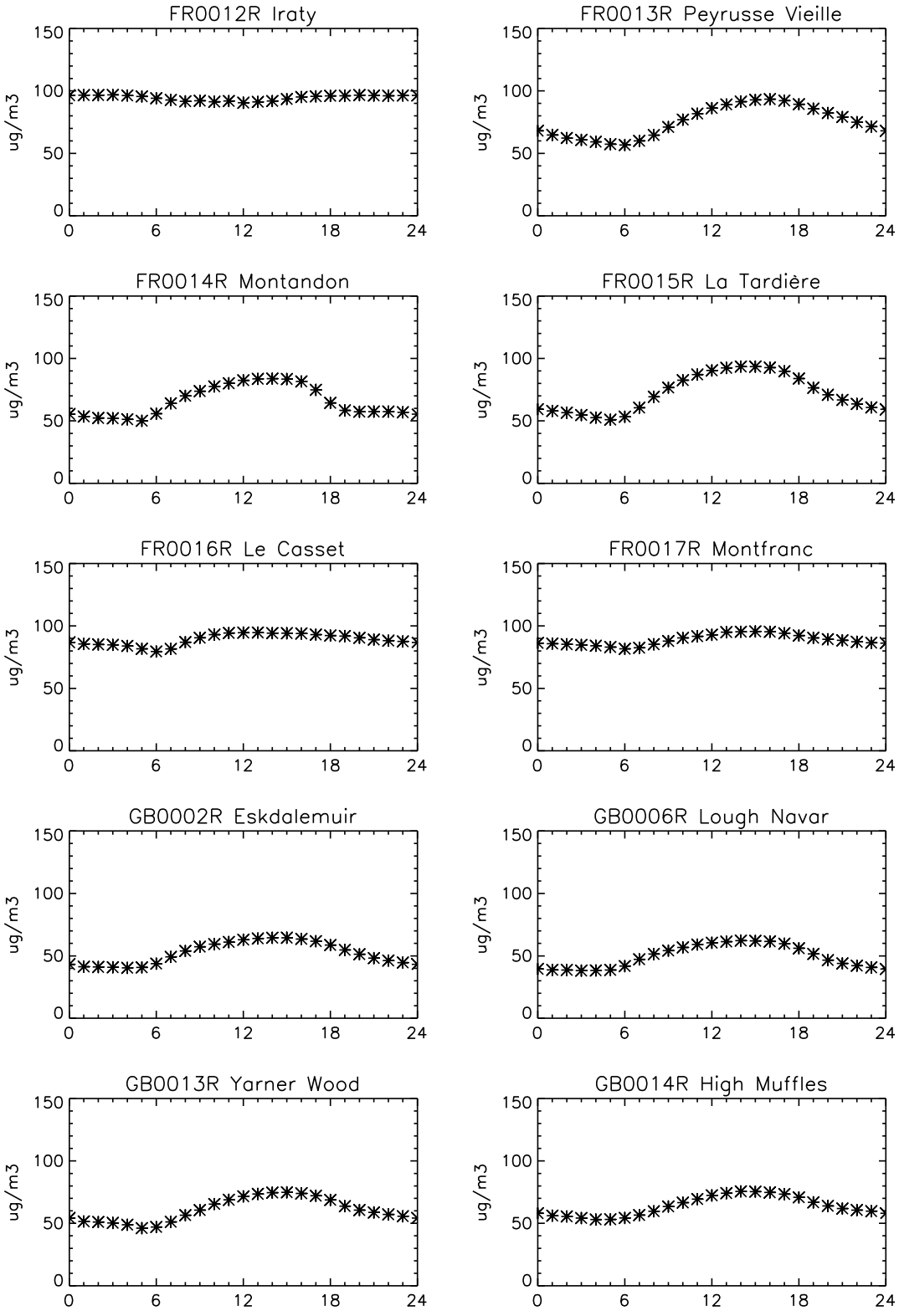


Figure 4.1, cont.

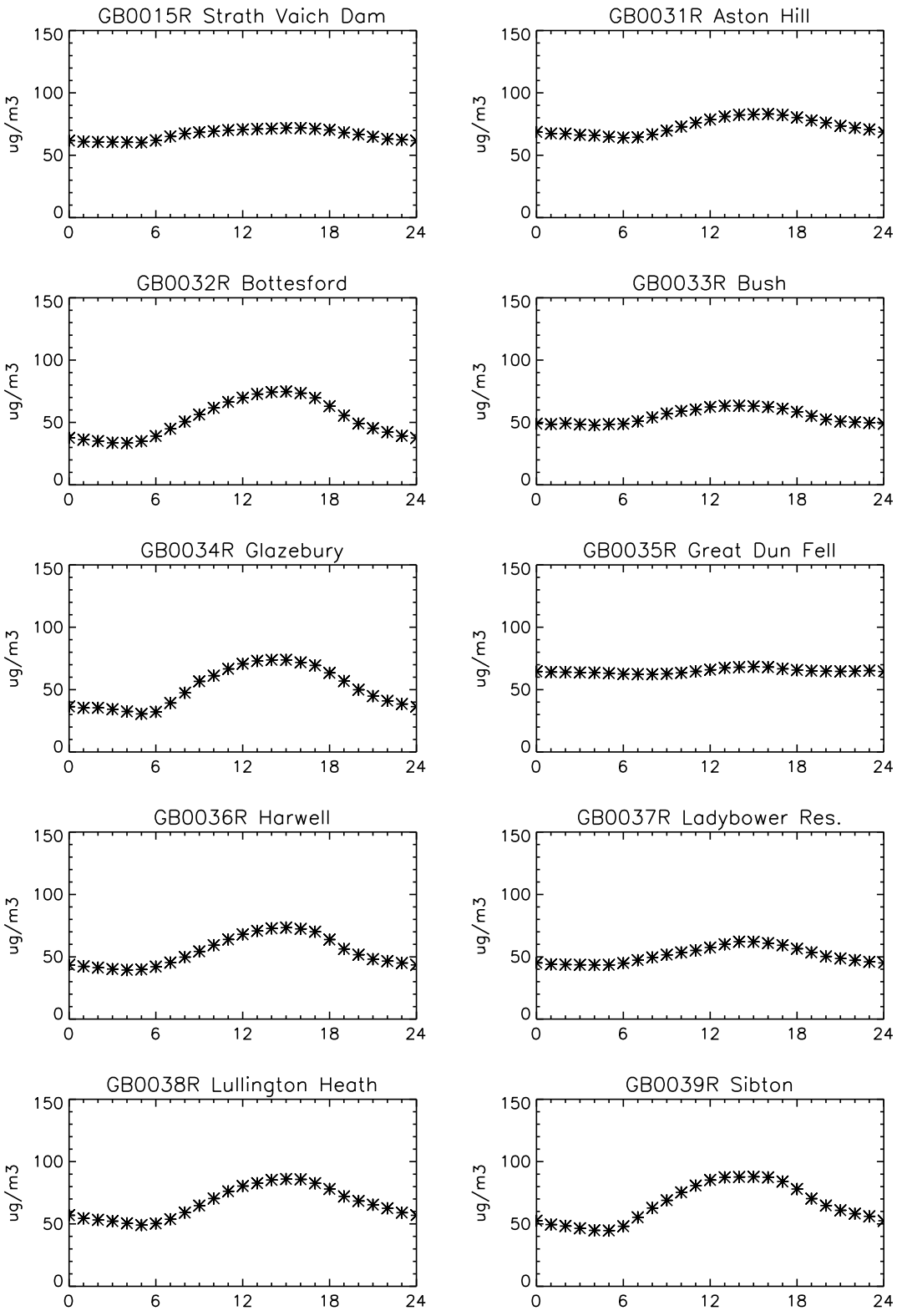


Figure 4.1, cont.

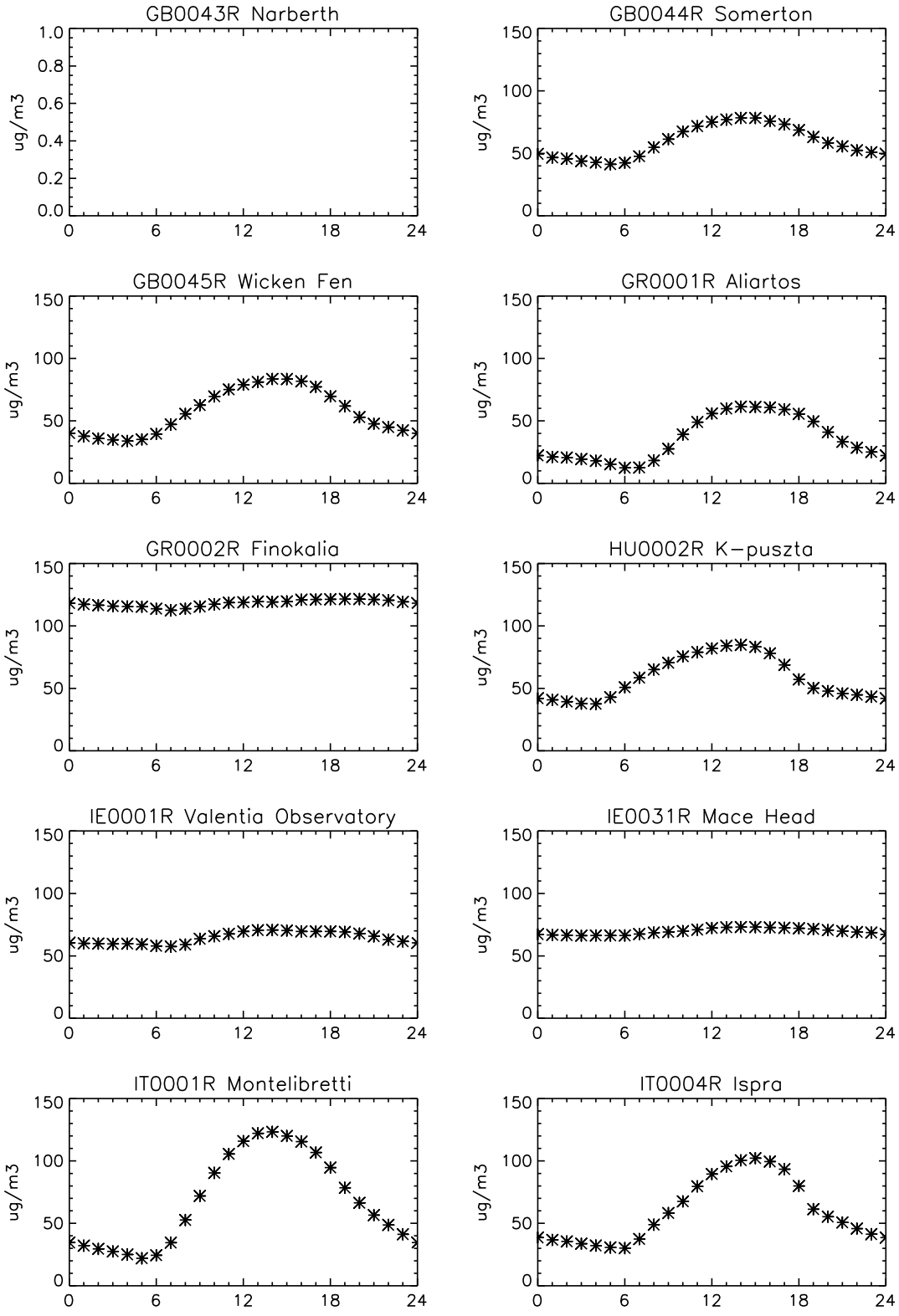


Figure 4.1, cont.

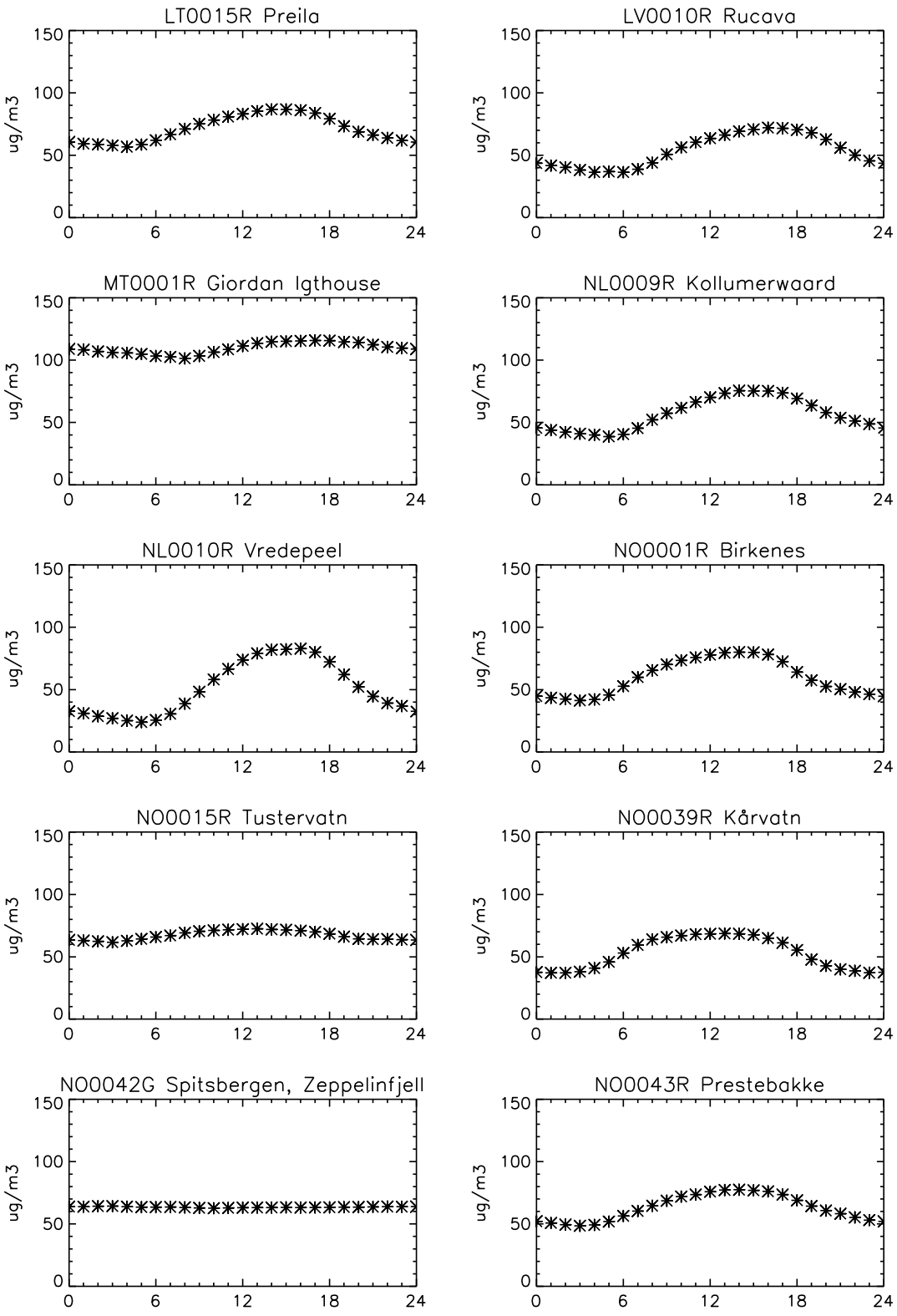


Figure 4.1, cont.

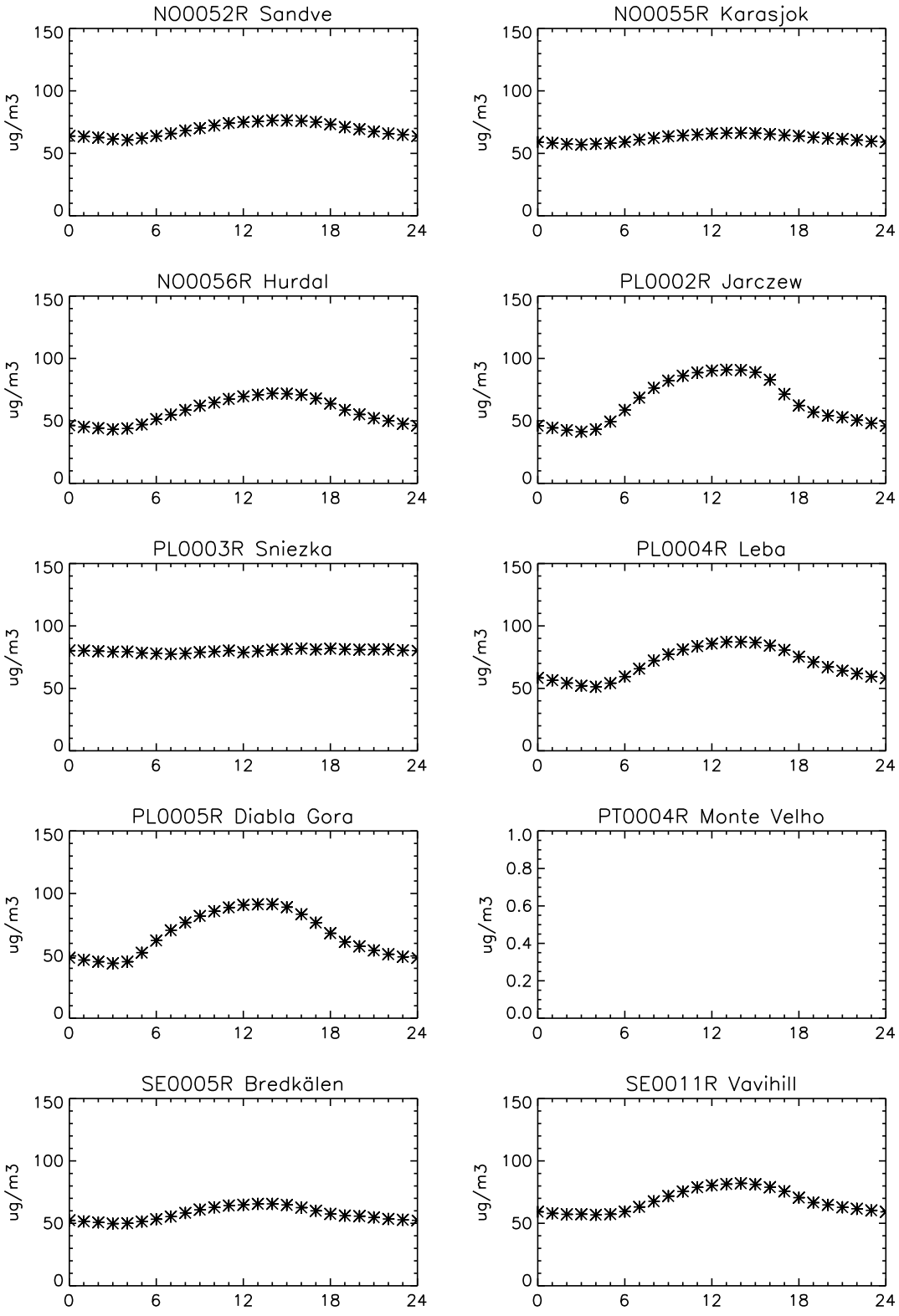


Figure 4.1, cont.

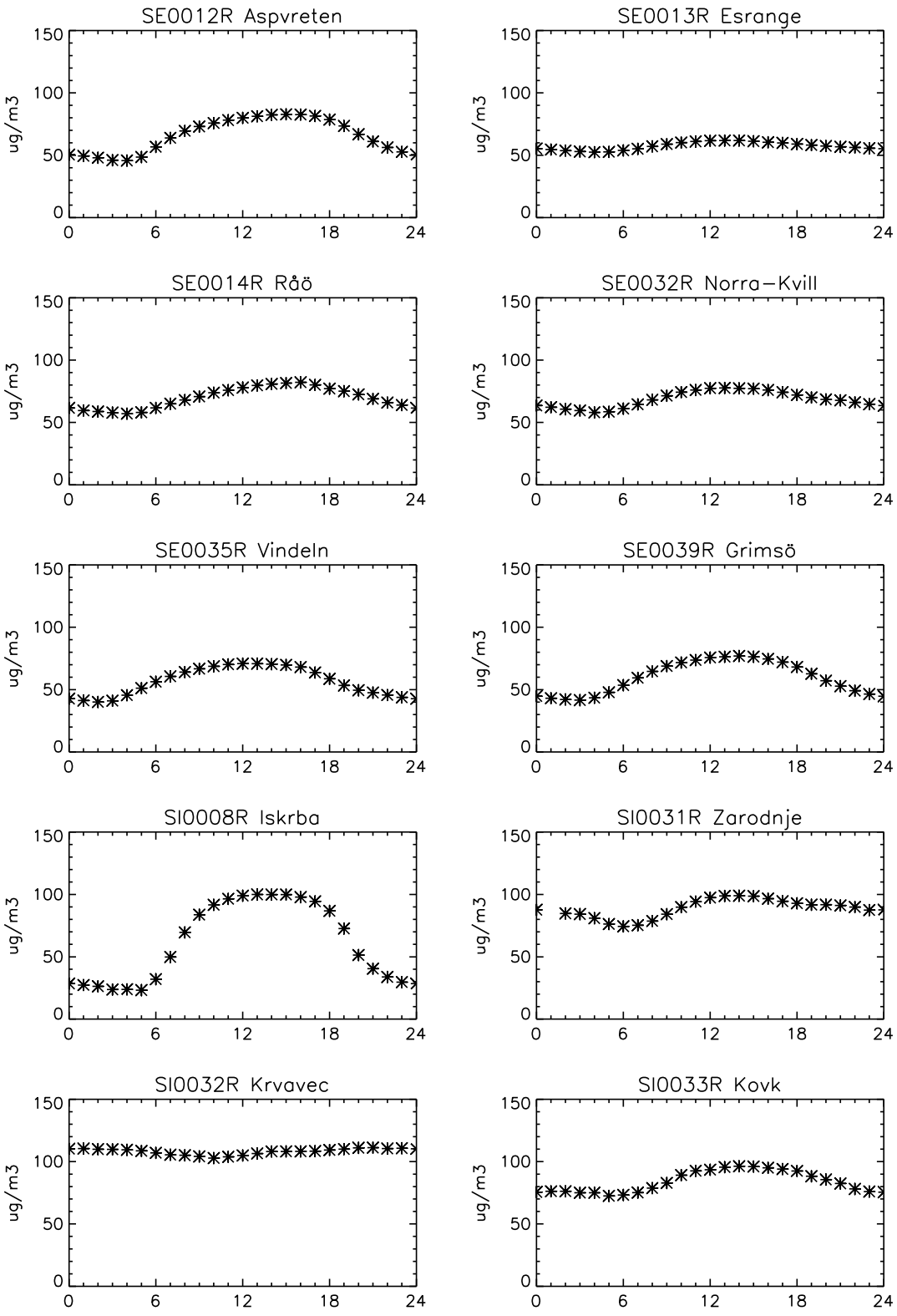


Figure 4.1, cont.

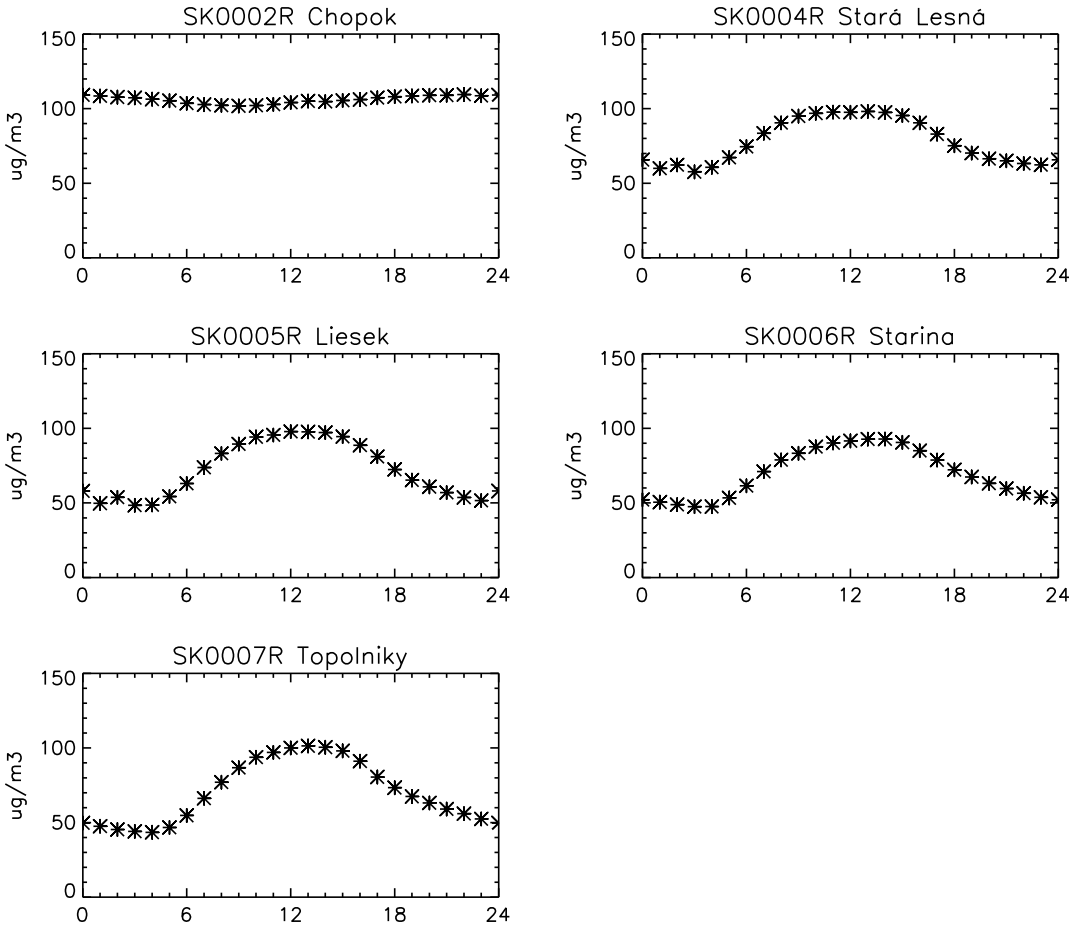


Figure 4.1, cont.

Annex 5

List of data reports

Ozone measurements in the ECE region January 1985–December 1985. Report no. 1.
EMEP/CCC-Report 3/89 by U. Feister and U. Pedersen.
Potsdam/Lillestrøm, Meteorological Service of the GDR/Norwegian Institute for Air Research, 1989.

Ozone measurements January 1986–December 1986. Report no. 2.
EMEP/CCC-Report 8/90 by U. Feister, U. Pedersen, E. Schulz and S. Hechler.
Lillestrøm, Norwegian Institute for Air Research, 1990.

Ozone data report 1988.
EMEP/CCC-Report 1/92 by U. Pedersen.
Lillestrøm, Norwegian Institute for Air Research, 1992.

Ozone data report 1989.
EMEP/CCC-Report 2/93 by U. Pedersen and I.M. Kvalvågnes.
Lillestrøm, Norwegian Institute for Air Research, 1993.

Ozone measurements 1990–1992.
EMEP/CCC-Report 4/95 by A.-G. Hjellbrekke.
Kjeller, Norwegian Institute for Air Research, 1995.

Ozone measurements 1993–1994.
EMEP/CCC-Report 1/96 by A.-G. Hjellbrekke.
Kjeller, Norwegian Institute for Air Research, 1996.

Ozone measurements 1995.
EMEP/CCC-Report 3/97 by A.-G. Hjellbrekke.
Kjeller, Norwegian Institute for Air Research, 1997.

Ozone measurements 1996.
EMEP/CCC-Report 3/98 by A.-G. Hjellbrekke.
Kjeller, Norwegian Institute for Air Research, 1998.

Ozone measurements 1997.
EMEP/CCC-Report 2/99 by A.-G. Hjellbrekke.
Kjeller, Norwegian Institute for Air Research, 1999.

Ozone measurements 1998.
EMEP/CCC-Report 5/2000 by A.-G. Hjellbrekke.
Kjeller, Norwegian Institute for Air Research, 2000.

Ozone measurements 1999.
EMEP/CCC-Report 1/2001 by A.-G. Hjellbrekke and S. Solberg.
Kjeller, Norwegian Institute for Air Research, 2001.

Ozone measurements 2000.
EMEP/CCC-Report 5/2002 by A.-G. Hjellbrekke and S. Solberg.
Kjeller, Norwegian Institute for Air Research, 2002.

Ozone measurements 2001.
EMEP/CCC-Report 4/2003 by A.-G. Hjellbrekke and S. Solberg.
Kjeller, Norwegian Institute for Air Research, 2003.

Ozone measurements 2002.
EMEP/CCC-Report 2/2004 by A.-G. Hjellbrekke and S. Solberg.
Kjeller, Norwegian Institute for Air Research, 2004.

Ozone measurements 2003.
EMEP/CCC-Report 4/2005 by A.-G. Hjellbrekke and S. Solberg.
Kjeller, Norwegian Institute for Air Research, 2005.

Ozone measurements 2004.
EMEP/CCC-Report 2/2006 by A.M. Fjæraa.
Kjeller, Norwegian Institute for Air Research, 2006.

Ozone measurements 2005.
EMEP/CCC-Report 2/2007 by A.M. Fjæraa and A.-G. Hjellbrekke.
Kjeller, Norwegian Institute for Air Research, 2007.