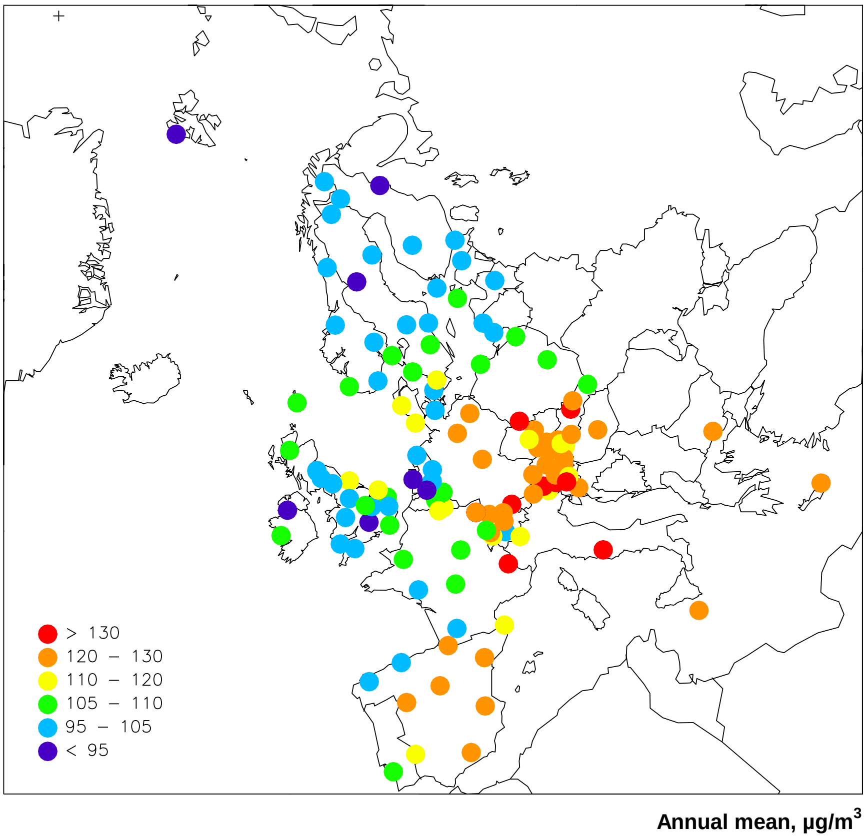
EMEP/CCC-Report 2/2010

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

Ozone measurements 2008

Ann Mari Fjæraa and Anne-Gunn Hjellbrekke



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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.

The EMEP ozone data from 2008 are presented in this report, which aims to give a short summary of the measurement data. A complete set of data, including raw data, annual statistics and monthly means, can be downloaded from the web at http://ebas.nilu.no and at http://www.nilu.no/projects/ccc

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 µg/m^3 for hourly mean, 60 µg/m^3 for eight-hour mean and 50 µg/m^3 for seven-hour mean (9 a.m. - 4 p.m.) averaged over the growing season (April-September). EU has in the ozone directive (2002/3/EC) and air quality directive (2008/50/EC) defined a number of target values and long-term objectives for the protection of vegetation and human health. The target value for human health is that 120 µg/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 µg/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, this is also the long term objectives in EU.

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 2008 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 2008. In total 126 stations from 27 different countries reported data. One of these sites (Ispra), is operated by the Commission of the European communities in Italy. Note that the cypriotic site is outside the map domain shown in Figure 1.

Table 1: List of EMEP ozone monitoring stations in operation 2008.

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
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
AT0048R	Zoebelboden	Austria	47 50 19 N	14 26 29 E	899
AT0049R	Grebenzen bei St. Lamprecht	Austria	47 02 25 N	14 19 48 E	1648
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
CH0001G	Jungfraujoch	Switzerland	46 32 51 N	7 59 06 E	3578
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
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

Table 1, cont.

Code	Station	Country	Latitude	Longitude	Altitude (m)
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
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
FI0096G	Pallas/Sammaltunturi	Finland	68 00 00 N	24 09 00 E	340
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	45 48 00 N	2 04 00 E	810
FR0018R	La Coulonche	France	48 38 00 N	0 27 00 W	309
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
GB0033R	Bush	United Kingdom	55 51 31 N	3 12 18 W	180
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
GB0048R	Auchencorth Moss	United Kingdom	55 47 36 N	3 14 41 W	260
GB0049R	Weybourne	United Kingdom	52 57 02 N	1 07 19 E	16
GB0050R	St. Osyth	United Kingdom	51 46 41 N	1 04 56 E	8
GB0051R	Market Harborough	United Kingdom	52 33 16 N	0 46 20 W	145
GB0052R	Lerwick	United Kingdom	60 08 21 N	1 11 07 W	85
GB0053R	Charlton Mackrell	United Kingdom	51 03 22 N	2 41 00 W	54
GR0001R	Aliartos	Greece	38 22 00 N	23 05 00 E	110
GR0002R	Finokalia	Greece	35 19 00 N	25 40 00 E	250
HU0002R	K-puszta	Hungary	46 58 00 N	19 35 00 E	125
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
LV0016R	Zoseni	Latvia	57 08 00 N	25 55 00 E	183
MT0001R	Giordan lighthouse	Malta	36 06 00 N	14 12 00 E	160
NL0007R	Eibergen	The Netherlands	52 05 00 N	6 34 00 E	20
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
NL0011R	Cabauw	The Netherlands	51 18 00 N	4 55 37 E	60
NL0091R	De Zilk	The Netherlands	52 18 00 N	4 30 00 E	4
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

Table 1, cont.

Code	Station	Country	Latitude	Longitude	Altitude (m)
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
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
SK0006R	Starina	Slovakia	49 03 00 N	22 16 00 E	345
SK0007R	Topolniky	Slovakia	47 57 36 N	17 51 38 E	113

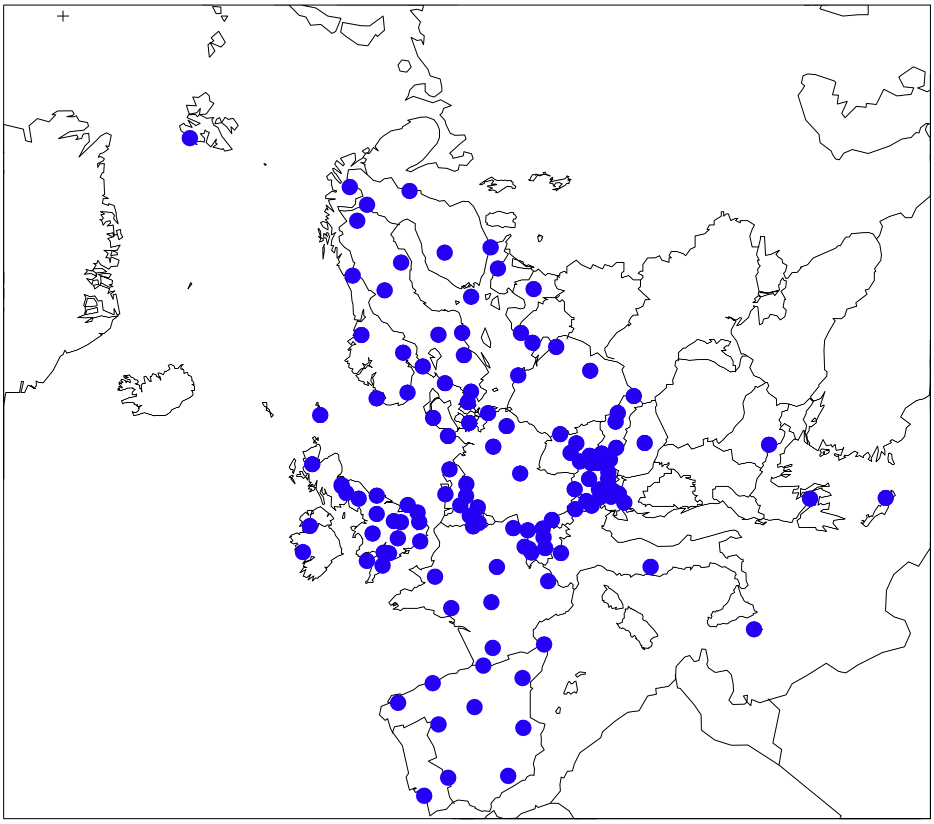

Figure 1: Location of the monitoring stations.

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.

As in earlier years, the ozone concentrations reported for the Greek station GR0001 Aliartos show lower concentrations during the whole year compared to other EMEP sites, monthly means are between 10.86 µg/m^3 and 77.36 µg/m^3. Furthermore, monitoring of NO_2 at the site reveal monthly mean concentrations in 2008 between 9.23 µg/m^3 and 20.12 µg/m^3. These findings indicate that the site is significantly influenced by nearby anthropogenic emissions, presumably from the Athens region, and thus not well suited as a regional background site for surface ozone. The ozone data from GR0001 is therefore not included in this report.

Until 10/09/2009, O_3 has been measured at 4 levels of Donon site tower. Since 11/09/08 O_3 is measured at one sampling height, 3.5 m, in a new site right next the old deleted tower.

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 are selected by the countries. Most of the stations are recognised as EMEP ozone stations. Information about the ozone data quality, calibration and maintenance procedures was in 2000 collected from the participants (Aas et al., 2000). An updated document, ”Overview of the routines for calibration and maintenance”, is also available under link “ozone at http://www.nilu.no/projects/ccc/emepdata.html.

A report on station representativeness is also written for the GEOmon project. This report is found at http://geomon.empa.ch/index.php#data. This is published by (Henne et al., 2010).

The UV absorption method is the only measurement method in use in 2008.
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/m^3 by multiplying by 2.0 at the CCC.

Table 2: Conversion factor ppb – $\mu g/m^3$.

Country	Conversion factor
Austria	2.0
Belgium	unknown
Bulgaria	
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
Malta	
Netherlands	2.0
Norway	2.0
Poland	2.0
Portugal	1.96
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 data capture is in general good. The number of stations with data capture above 90% is in the same range as in earlier years, 105, compared to 104 stations in 2007 and 103 stations in 2006. 113 stations have data capture above 85%, while 10 stations have data capture below 75%, which is somewhat higher than for 2007, which was 7.

Table 3: Data capture in per cent, 2008.

Code	Station	Data capture 2008
AT0002R	Illmitz	94.0
AT0005R	Vorhegg	90.4
AT0030R	Pillersdorf bei Retz	94.3
AT0032R	Sulzberg	95.3
AT0034G	Sonnblick	93.1
AT0037R	Zillertaler Alpen	95.6
AT0038R	Gerlitzen	95.6
AT0040R	Masenberg	94.2
AT0041R	Haunsberg	95.2
AT0042R	Heidenreichstein	95.5
AT0043R	Forsthof	95.0
AT0044R	Graz Platte	88.0
AT0045R	Dunkelsteinerwald	94.4
AT0046R	Gänserndorf	95.1
AT0047R	Stixneusiedl	95.5
AT0048R	Zoebelboden	94.0
AT0049R	Grebenzen bei St. Lamprecht	93.0
BE0001R	Offagne	95.6
BE0032R	Eupen	92.3
BE0035R	Vezin	94.7
BG0053R	Rojen peak	93.6
CH0001G	Jungfraujoch	96.6
CH0002R	Payerne	93.4
CH0003R	Tänikon	95.4
CH0004R	Chaumont	95.5
CH0005R	Rigi	95.0
CY0002R	Ayia Marina	98.5
CZ0001R	Svratouch	99.6
CZ0003R	Košetice	98.5
DE0001R	Westerland	95.5
DE0002R	Langenbrügge	95.2
DE0003R	Schauinsland	95.9
DE0007R	Neuglobsow	95.5
DE0008R	Schmücke	95.6
DE0009R	Zingst	94.8
DK0005R	Keldsnor	98.4
DK0031R	Ulborg	87.9
DK0041R	Lille Valby	99.1
EE0009R	Lahemaa	97.6
EE0011R	Vilsandi	99.6
ES0007R	Viznar	96.3
ES0008R	Niembro	98.9
ES0009R	Campisábalos	96.2
ES0010R	Cabo de Creus	96.9
ES0011R	Barcarrola	96.7
ES0012R	Zarra	96.2
ES0013R	Penausende	99.2
ES0014R	Els Torms	98.1
ES0016R	O Saviñao	98.9

Table 3, cont.

Code	Station	Data capture 2008
FI0009R	Utö	98.3
FI0017R	Virolahti II	98.2
FI0022R	Oulanka	98.2
FI0037R	Ahtari II	98.3
FI0096G	Pallas (Sammaltunturi)	97.4
FR0008R	Donon A	67.2
FR0008R	Donon B	68.2
FR0008R	Donon C	68.2
FR0008R	Donon D	67.3
FR0008R	Donon E	30.3
FR0009R	Revin	99.5
FR0010R	Morvan	84.8
FR0012R	Iraty	96.4
FR0013R	Peyrusse Vieille	95.8
FR0014R	Montandon	99.5
FR0015R	La Tardière	98.1
FR0016R	Le Casset	89.2
FR0017R	Montfranc	97.9
FR0018R	La Coulonche	96.3
GB0002R	Eskdalemuir	90.0
GB0006R	Lough Navar	96.2
GB0013R	Yarner Wood	88.8
GB0014R	High Muffles	87.9
GB0015R	Strath Vaich Dam	84.7
GB0031R	Aston Hill	84.3
GB0033R	Bush	97.5
GB0035R	Great Dun Fell	95.4
GB0036R	Harwell	97.7
GB0037R	Ladybower Res.	98.2
GB0038R	Lullington Heath	98.3
GB0039R	Sibton	68.8
GB0043R	Narberth	72.0
GB0044R	Somerton	16.9
GB0045R	Wicken Fen	89.7
GB0048R	Auchencorth Moss	97.7
GB0049R	Weybourne	97.3
GB0050R	St. Osyth	89.8
GB0051R	Market Harborough	98.6
GB0052R	Lerwick	96.1
GB0053R	Charlton Mackrell	32.5
GR0002R	Finokalia	71.4
HU0002R	K-puszta	96.6
IE0031R	Mace Head	99.9
IT0001R	Montelibretti	97.0
IT0004R	Ispra	82.3
LT0015R	Preila	96.4
LV0010R	Rucava	81.1
LV0016R	Zoseni	80.1
MT0001R	Giordan lighthouse	78.8
NL0007R	Eibergen	98.8
NL0009R	Kollumerwaard	97.8

Table 3, cont.

Code	Station	Data capture 2008
NL0010R	Vredepeel	99.2
NL0011R	Cabauw	99.2
NL0091R	De Zilk	84.6
NO0001R	Birkenes	98.6
NO0015R	Tustervatn	99.6
NO0039R	Kårvatn	97.0
NO0042G	Spitsbergen, Zeppelinfjell	96.9
NO0043R	Prestebakke	99.8
NO0052R	Sandve	99.6
NO0055R	Karasjok	99.8
NO0056R	Hurdal	99.4
PL0002R	Jarczew	99.1
PL0003R	Sniezka	96.4
PL0004R	Leba	100.0
PL0005R	Diabla Gora	99.2
PT0004R	Monte Velho	89.0
SE0005R	Bredkälen	96.8
SE0011R	Vavihill	97.7
SE0012R	Aspvreten	95.5
SE0013R	Esrange	97.8
SE0014R	Råö	99.6
SE0032R	Norra-Kvill	99.0
SE0035R	Vindeln	98.0
SE0039R	Grimsö	99.0
SI0008R	Iskrba	94.8
SI0031R	Zarodnje	95.1
SI0032R	Krvavec	90.9
SI0033R	Kovk	77.9
SK0002R	Chopok	98.3
SK0004R	Stará Lesná	99.7
SK0006R	Starina	97.4
SK0007R	Topolniky	99.4

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 data capture of 85% are required and an adjustment proportional to the number of missing data are applied, i.e. exposure index divided by the fraction of data available. This correction gives 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% is regarded as sufficient for the mapping.

5. Concentration summaries and episodes

According to several indicators, ozone levels during the summer of 2008 are registered as the lowest since 1997. (EEA, 2009) This is in contrast to the summer of 2007, which must be seen as one of the warmest summers ever registered in Europe with exceedances of the threshold value (180 µg/m^3) was exceed at 25 sites in Central Europe.

In the summer of 2008 the information threshold value (180 µg/m^3) was exceeded at only 5 sites. These 5 highest one-hour ozone concentrations were observed at Montelibretti in Italy 26 June (204.4 µg/m^3), Dunkelsteinerwald in Austria 2 July (202.0 µg/m^3), at Neuglobsow in Germany 1 August (198.4 µg/m^3), at Ispra in Italy at 26 June (189.0 µg/m^3) and in Eupen in Belgium 10 June (186.0 µg/m^3).

Ozone levels during the summer of 2008 were, like 2007, among the lowest in the past decade. No exceedances of the information threshold value (180 µg/m^3) occurred in the northern part of Europe and Scandinavia. The target value to protect human health (120 µg/m^3) was, however, exceeded at almost all stations in Europe in 2008 (124 stations), even to a higher degree than 2007, which until then was the year when the occurrence of exceedances was the second highest in the last decade in Europe, (EEA, 2008).

Table 1.1 in Annex 1 shows the extreme concentrations for 2008. The number of hours and days the ozone concentrations exceeded 120, 150, 180 and 200 µg/m^3 and the highest measured concentration measured at each station are given.

Only two stations measured an hourly maximum value above 200 µg/m^3 in 2008, Montelibretti in Italy, 204.4 µg/m^3 26 June and Dunkelsteinerwald in Austria, 202.0 µg/m^3 at 2 July. The lowest hourly maximum was measured in Somerton in UK, 96.0 µg/m^3 at 2 March. Somerton did, however, only measure in the January-March period. The lowest maximum value for a station that measured throughout the year was Zeppelinfjell, Norway, with 109.8 µg/m^3 19 May.

The one hour critical level for ozone formulated by the ECE for protection of vegetation, 150 µg/m^3, was in 2008 exceeded at 79 sites, this is around 60% of all stations. This is higher than in 2007 when 50% of the stations measured values exceeded 150 µg/m^3, but still lower than in 2006 when almost all measuring stations had values above the 150 µg/m^3 limit. (Figure 1.3, Annex 1). At 7 sites the limit was exceeded 10 days or more, which is significantly lower than both in 2007 (3 sites with 20 days or more above limit) and in 2006 (22 stations with 20 days or more above limit).

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 the public. The threshold value was in 2008 exceeded at only 5 stations, Montelibretti in Italy; 5 days, Dunkelsteinerwald in Austria; 2 days, Neuglobsow in Germany; 2 days, Ispra in Italy; 2 days and Eupen in Belgium; 1 day. This is lower than 2007 and 2006, when the numbers of sites with exceeded the 180 ug/m3 limit was 24 and 65 sites, respectively.

Table 1.2 in Annex 1 shows the 25-, 50-, 75-, 90-, 95-, 98- and 99-precentiles for the period April-September for stations with data capture higher than 75%. Graphical distributions of the 99-percentiles and 95-percentiles are shown in

Figure 1.1 and 1.2 in Annex 1. The lowest values are found in northern parts of Scandinavia and United Kingdom, and in the Baltics, where the 99-percentiles are below 130 µg/m^3. The concentrations are higher in Denmark, southern parts of United Kingdom and in the Alps region where the 99-percentiles generally ranges from 130-140 µg/m^3, and at its highest in Germany, France, Italy and Spain where the 99-persentile values are above 140 µg/m^3. Only two sites have a 99-percentile above 150 µg/m^3; Montelibretti in Italy with 159.0 ng/m^3 and Donon in France 152.0 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 forest and agricultural corps for 2008 are shown in Table 2.1 and Table 2.2 in Annex 2, and the corresponding geographical distributions of AOT40 and AOT60 are shown in Figure 2.1–2.4. The maps of AOT40 show a general increasing gradient from west to east and from north to south. The 2008 AOT values are in general lower than the 2007 values for Europe as a whole. In 2008 there are no AOT values above 25 000 ppbh. Low values are found in most parts of Northern Europe, while the highest values are found in France and Germany. Only two stations, Krvavec in Slovakia and Montelibretti in Italy, have AOT40 (May-July) values above 15 000 ppbh. The critical level for forest in April-September (10 000 ppbh) is exceeded at 29 Central and South European stations. The limit are not exceeded in Scandinavia, in the UK or in the Baltic region.

7. Seasonal variation

Monthly mean concentrations for 2008 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 1990-2008 are given in Figure 3.1 in Annex 3. The seasonal variation of ozone shows a 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. A general tendency for all stations is that the summer maximum in 2008 is a bit lower than in the years before.

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) 2008 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. Zeppelin-fjellet 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 30.April, 2010.

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, http://ebas.nilu.no and http://www.nilu.no/projects/ccc/index.html.

10. References

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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
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 $\mu g/m^3$ and maximum concentrations in 2008.

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)
AT0002R	Illmitz	8253	366	169	40	4	3	0	0	0	0	172	24.06.2008
AT0005R	Vorhegg	7944	350	152	32	4	2	0	0	0	0	165	25.06.2008
AT0030R	Pillersdorf bei Retz	8284	364	217	45	8	5	0	0	0	0	163	25.06.2008
AT0032R	Sulzberg	8372	365	601	66	26	10	0	0	0	0	164	15.05.2008
AT0034G	Sonnblick	8180	357	788	75	0	0	0	0	0	0	149	11.06.2008
AT0037R	Zillertaler Alpen	8395	366	353	47	2	1	0	0	0	0	160	11.06.2008
AT0038R	Gerlitzen	8396	366	685	77	6	2	0	0	0	0	156	11.07.2008
AT0040R	Masenberg	8272	366	263	41	0	0	0	0	0	0	147	12.07.2008
AT0041R	Haunsberg	8358	366	236	42	4	1	0	0	0	0	156	15.05.2008
AT0042R	Heidenreichstein	8388	366	233	43	4	3	0	0	0	0	163	30.05.2008
AT0043R	Forsthof	8347	366	243	43	7	5	0	0	0	0	166	28.05.2008
AT0044R	Graz Platte	7725	349	311	52	0	0	0	0	0	0	147	12.07.2008
AT0045R	Dunkelsteinerwald	8289	363	208	45	15	6	4	2	1	1	202	02.07.2008
AT0046R	Gänserndorf	8354	366	230	53	1	1	0	0	0	0	152	30.07.2008
AT0047R	Stixneusiedl	8388	366	171	43	3	1	0	0	0	0	164	30.07.2008
AT0048R	Zoebelboden	8258	366	224	33	5	2	0	0	0	0	164	27.05.2008
AT0049R	Grebenzen bei St. Lamprecht	8169	363	356	50	2	2	0	0	0	0	155	30.05.2008
BE0001R	Offagne	8398	362	140	23	12	2	0	0	0	0	176	09.06.2008
BE0032R	Eupen	8107	363	90	24	11	4	1	1	0	0	186	10.06.2008
BE0035R	Vezin	8319	362	96	22	6	2	0	0	0	0	155	09.06.2008
BG0053R	Rojen peak	8217	349	357	45	14	2	0	0	0	0	162.6	15.08.2008
CH0001G	Jungfraujoch	8481	364	8	5	0	0	0	0	0	0	138.5	06.03.2008
CH0002R	Payerne	8200	362	188	41	6	4	0	0	0	0	154.4	09.05.2008
CH0003R	Tänikon	8380	366	242	48	19	7	0	0	0	0	165.6	23.06.2008
CH0004R	Chaumont	8387	366	413	47	20	5	0	0	0	0	161.5	08.05.2008
CH0005R	Rigi	8341	366	422	55	35	10	0	0	0	0	166.4	24.06.2008
CY0002R	Ayia Marina	8652	364	75	21	0	0	0	0	0	0	137.2	06.09.2008
CZ0001R	Svratouch	8751	366	241	41	17	3	0	0	0	0	173.8	02.07.2008
CZ0003R	Košetice	8648	362	169	33	6	1	0	0	0	0	160	02.07.2008
DE0001R	Westerland	8385	366	94	19	5	1	0	0	0	0	157.9	02.07.2008
DE0002R	Langenbrügge	8359	366	289	42	38	8	0	0	0	0	178.9	30.05.2008, 03.07.2008
DE0003R	Schauinsland	8419	366	399	45	9	6	0	0	0	0	161.5	02.07.2008

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)
DE0007R	Neuglobsow	8392	366	293	43	28	7	3	2	0	0	198.4	01.08.2008
DE0008R	Schmücke	8394	366	443	46	28	6	0	0	0	0	172.9	10.06.2008
DE0009R	Zingst	8329	366	68	13	0	0	0	0	0	0	140.4	02.06.2008
DK0005R	Keldsnor	8642	366	32	12	0	0	0	0	0	0	137.2	03.07.2008
DK0031R	Ulborg	7723	333	156	18	0	0	0	0	0	0	149.7	30.05.2008
DK0041R	Lille Valby	8705	366	75	17	0	0	0	0	0	0	137.1	28.04.2008
EE0009R	Lahemaa	8575	362	78	13	0	0	0	0	0	0	145	04.04.2008
EE0011R	Vilsandi	8750	366	59	12	0	0	0	0	0	0	145	26.04.2008
ES0007R	Viznar	8456	364	404	72	7	3	0	0	0	0	176.2	27.06.2008
ES0008R	Niembro	8689	366	7	5	0	0	0	0	0	0	126.7	11.06.2008
ES0009R	Campisábalos	8452	365	413	77	34	15	0	0	0	0	173.3	30.07.2008
ES0010R	Cabo de Creus	8509	359	112	22	8	4	0	0	0	0	173.1	21.06.2008
ES0011R	Barcarrola	8491	359	171	29	4	1	0	0	0	0	154.5	28.06.2008
ES0012R	Zarra	8448	359	421	58	16	7	0	0	0	0	172.9	18.07.2008
ES0013R	Penausende	8716	366	370	54	2	1	0	0	0	0	151.9	05.08.2008
ES0014R	Els Torms	8619	366	380	63	4	3	0	0	0	0	157.8	28.08.2008
ES0016R	O Saviñao	8685	366	110	18	0	0	0	0	0	0	136.5	27.01.2008
FI0009R	Utö	8633	366	30	6	0	0	0	0	0	0	133	19.06.2008
FI0017R	Virolahti II	8629	366	55	11	2	1	0	0	0	0	153	01.04.2008
FI0022R	Oulanka	8623	366	0	0	0	0	0	0	0	0	112	29.03.2008
FI0037R	Ahtari II	8634	366	33	5	0	0	0	0	0	0	147	02.04.2008
FI0096G	Pallas (Sammaltunturi)	8553	364	20	2	0	0	0	0	0	0	145	01.05.2008
FR0008R	Donon A	5900	252	425	49	37	8	0	0	0	0	171	10.06.2008
FR0008R	Donon B	5988	252	482	50	41	8	0	0	0	0	174	10.06.2008
FR0008R	Donon C	5992	252	504	52	44	10	0	0	0	0	174	10.06.2008
FR0008R	Donon D	5914	252	355	46	31	8	0	0	0	0	165	01.07.2008
FR0008R	Donon E	2660	112	0	0	0	0	0	0	0	0	110	12.10.2008
FR0009R	Revin	8736	366	149	24	15	5	0	0	0	0	168	10.06.2008
FR0010R	Morvan	7449	314	71	9	0	0	0	0	0	0	150	31.07.2008
FR0012R	Iraty	8471	363	222	36	0	0	0	0	0	0	146	09.08.2008
FR0013R	Peyrusse Vieille	8417	357	25	6	5	1	0	0	0	0	169	23.07.2008

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	8742	366	58	13	0	0	0	0	0	0	149	09.05.2008
FR0015R	La Tardière	8618	363	59	14	6	1	0	0	0	0	169	10.06.2008
FR0016R	Le Casset	7833	332	580	59	43	3	0	0	0	0	161	09.05.2008
FR0017R	Montfranc	8599	365	57	11	0	0	0	0	0	0	131	24.07.2008
FR0018R	La Coulonche	8459	357	59	9	2	1	0	0	0	0	153	23.07.2008
GB0002R	Eskdalemuir	7903	347	68	11	4	1	0	0	0	0	156	08.05.2008
GB0006R	Lough Navar	8453	359	21	4	0	0	0	0	0	0	138	08.05.2008
GB0013R	Yarner Wood	7795	347	57	10	7	1	0	0	0	0	174	11.05.2008
GB0014R	High Muffles	7721	333	110	20	5	1	0	0	0	0	158	30.04.2008
GB0015R	Strath Vaich Dam	7435	324	53	7	3	1	0	0	0	0	158	09.05.2008
GB0031R	Aston Hill	7402	315	57	9	6	2	0	0	0	0	174	11.05.2008
GB0033R	Bush	8567	363	22	4	0	0	0	0	0	0	136	08.05.2008
GB0035R	Great Dun Fell	8376	366	61	6	1	1	0	0	0	0	156	11.05.2008
GB0036R	Harwell	8583	363	29	7	1	1	0	0	0	0	152	11.05.2008
GB0037R	Ladybower Res.	8622	364	54	12	8	2	0	0	0	0	170	11.05.2008
GB0038R	Lullington Heath	8630	366	106	19	4	1	0	0	0	0	164	28.07.2008
GB0039R	Sibton	6041	254	101	22	9	6	0	0	0	0	166	31.07.2008
GB0043R	Narberth	6323	269	45	7	0	0	0	0	0	0	148	07.05.2008, 08.05.2008
GB0044R	Somerton	1482	66	0	0	0	0	0	0	0	0	96	02.03.2008
GB0045R	Wicken Fen	7877	334	108	18	6	3	0	0	0	0	162	10.05.2008
GB0048R	Auchencorth Moss	8584	361	31	4	0	0	0	0	0	0	142	31.05.2008
GB0049R	Weybourne	8546	362	151	19	15	4	0	0	0	0	162	21.04.2008
GB0050R	St. Osyth	7891	337	39	9	0	0	0	0	0	0	150	11.05.2008
GB0051R	Market Harborough	8656	366	94	18	9	4	0	0	0	0	170	11.05.2008
GB0052R	Lerwick	8443	357	44	6	0	0	0	0	0	0	146	08.05.2008
GB0053R	Charlton Mackrell	2851	120	0	0	0	0	0	0	0	0	100	19.09.2008
GR0002R	Finokalia	6272	272	565	72	1	1	0	0	0	0	153	21.07.2008
HU0002R	K-puszta	8483	356	423	79	14	4	0	0	0	0	173	14.08.2008
IE0031R	Mace Head	8772	366	33	9	0	0	0	0	0	0	148	13.05.2008
IT0001R	Montelibretti	8524	358	422	94	71	28	7	5	1	1	204.4	26.06.2008
IT0004R	Ispra	7226	316	168	47	26	9	2	2	0	0	189	26.06.2008
LT0015R	Preila	8469	357	9	3	0	0	0	0	0	0	145	20.06.2008

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)
LV0010R	Rucava	7123	304	49	11	0	0	0	0	0	0	147	19.06.2008
LV0016R	Zoseni	7037	296	26	4	0	0	0	0	0	0	135	29.04.2008
MT0001R	Giordan lighthouse	6921	296	412	68	3	3	0	0	0	0	153.4	30.08.2008
NL0007R	Eibergen	8674	365	45	10	6	2	0	0	0	0	159.1	02.07.2008
NL0009R	Kollumerwaard	8590	361	44	10	2	1	0	0	0	0	156.9	02.07.2008
NL0010R	Vredepeel	8715	366	65	16	0	0	0	0	0	0	147.4	31.07.2008
NL0011R	Cabauw	8716	366	31	9	2	1	0	0	0	0	151.8	31.07.2008
NL0091R	De Zilk	7433	314	30	8	0	0	0	0	0	0	143.4	10.05.2008
NO0001R	Birkenes	8661	366	60	12	8	2	0	0	0	0	159.8	11.05.2008
NO0015R	Tustervatn	8751	366	49	6	0	0	0	0	0	0	136.8	11.05.2008
NO0039R	Kårvatn	8521	364	44	6	0	0	0	0	0	0	132.6	29.04.2008
NO0042G	Spitsbergen, Zeppelinfjell	8514	365	0	0	0	0	0	0	0	0	109.8	19.05.2008
NO0043R	Prestebakke	8765	366	84	12	3	1	0	0	0	0	155.1	10.05.2008
NO0052R	Sandve	8747	366	58	10	3	1	0	0	0	0	155.8	10.05.2008
NO0055R	Karasjok	8762	366	6	2	0	0	0	0	0	0	123.2	03.05.2008
NO0056R	Hurdal	8732	366	50	10	0	0	0	0	0	0	139.4	11.05.2008
PL0002R	Jarczew	8702	365	75	18	0	0	0	0	0	0	137	10.06.2008
PL0003R	Sniezka	8469	356	625	69	30	7	0	0	0	0	171	03.07.2008
PL0004R	Leba	8779	366	75	15	0	0	0	0	0	0	140	28.04.2008
PL0005R	Diabla Gora	8713	364	49	13	5	1	0	0	0	0	154	01.04.2008
PT0004R	Monte Velho	7820	331	62	21	5	2	0	0	0	0	167	04.04.2008
SE0005R	Bredkälen	8505	357	5	2	0	0	0	0	0	0	127	09.05.2008
SE0011R	Vavihill	8577	362	94	13	1	1	0	0	0	0	155	28.04.2008
SE0012R	Aspvreten	8385	358	37	8	0	0	0	0	0	0	135	19.06.2008
SE0013R	Esrange	8593	360	19	3	0	0	0	0	0	0	148	01.05.2008
SE0014R	Råö	8745	366	59	11	0	0	0	0	0	0	146	28.04.2008
SE0032R	Norra-Kvill	8695	366	62	9	2	1	0	0	0	0	155	11.05.2008
SE0035R	Vindeln	8609	364	9	2	0	0	0	0	0	0	128	30.04.2008
SE0039R	Grimsö	8699	366	27	5	0	0	0	0	0	0	142	11.05.2008

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)
SI0008R	Iskrba	8325	366	280	55	2	2	0	0	0	0	154	11.07.2008
SI0031R	Zarodnje	8350	366	90	15	0	0	0	0	0	0	148	24.06.2008
SI0032R	Krvavec	7982	358	881	96	31	11	0	0	0	0	169	12.09.2008
SI0033R	Kovk	6842	318	164	30	0	0	0	0	0	0	147	11.07.2008
SK0002R	Chopok	8636	363	884	99	9	5	0	0	0	0	176	06.03.2008
SK0004R	Starß Lesnß	8756	366	306	57	3	1	0	0	0	0	158	15.08.2008
SK0006R	Starina	8558	365	57	17	0	0	0	0	0	0	138	31.03.2008
SK0007R	Topolniky	8731	366	333	69	4	3	0	0	0	0	155.3	27.05.2008

Table 1.2: Percentiles of hourly ozone values April–September 2008.

Code	Station	25%	50%	75%	90%	95%	98%	99%	Data capture
AT0002R	Illmitz	52.0	72.0	93.0	110.0	118.0	128.0	134.0	94.1
AT0005R	Vorhegg	58.0	75.0	94.0	110.0	117.9	126.0	134.0	88.8
AT0030R	Pillersdorf bei Retz	59.0	75.0	94.0	111.0	121.0	130.0	135.0	94.8
AT0032R	Sulzberg	78.0	93.0	110.0	125.0	133.0	143.8	148.0	95.8
AT0034G	Sonnblick	92.0	104.0	116.0	126.0	131.0	136.0	139.0	95.6
AT0037R	Zillertaler Alpen	80.0	94.0	109.0	118.0	124.0	131.0	133.0	95.9
AT0038R	Gerlitzen	87.5	104.0	115.0	125.0	132.0	138.0	142.0	95.7
AT0040R	Masenberg	77.0	91.0	105.0	116.0	122.9	129.0	133.0	93.8
AT0041R	Haunsberg	64.0	81.0	98.0	113.0	121.0	129.0	135.0	95.5
AT0042R	Heidenreichstein	50.0	73.0	94.0	113.0	122.0	130.0	138.0	95.6
AT0043R	Forsthof	64.0	82.0	99.0	114.0	122.0	131.0	138.0	95.0
AT0044R	Graz Platte	73.0	91.0	107.0	118.0	124.0	130.0	133.0	90.8
AT0045R	Dunkelsteinerwald	44.0	63.0	85.0	107.0	121.0	131.0	139.0	93.4
AT0046R	Gänserndorf	47.0	66.0	89.0	110.0	122.0	131.0	136.0	94.9
AT0047R	Stixneusiedl	52.0	71.5	93.0	111.0	119.0	129.0	136.0	95.6
AT0048R	Zoebelboden	71.0	85.0	100.0	114.0	121.0	129.0	135.0	93.7
AT0049R	Grebenzen bei St. Lamprecht	82.0	96.0	110.0	119.0	125.0	132.0	135.0	92.5
BE0001R	Offagne	48.0	64.0	82.0	101.0	114.0	127.0	135.0	96.4
BE0032R	Eupen	42.0	59.0	76.0	95.0	109.0	122.0	129.0	91.5
BE0035R	Vezin	29.0	49.0	70.0	91.0	105.7	122.0	130.0	94.8
BG0053R	Rojen peak	81.9	94.8	105.8	118.9	126.1	134.1	139.4	88.4
CH0001G	Jungfraujoch	72.2	79.0	86.5	95.4	100.0	104.8	107.5	97.2
CH0002R	Payerne	42.7	64.2	87.0	107.2	119.1	129.8	138.8	95.2
CH0003R	Tänikon	44.4	65.9	88.5	110.1	122.6	134.8	144.7	95.4
CH0004R	Chaumont	75.4	89.2	104.4	119.8	128.9	138.2	144.4	95.4
CH0005R	Rigi	74.3	90.0	104.6	120.2	129.3	142.6	148.9	94.7
CY0002R	Ayia Marina	82.3	88.8	95.9	104.1	110.3	117.7	122.2	99.0
CZ0001R	Svratouch	62.4	79.0	98.8	113.3	121.3	129.4	135.1	99.8
CZ0003R	Košetice	55.9	72.6	93.0	108.9	117.1	125.1	129.8	99.7
DE0001R	Westerland	66.1	79.7	91.4	103.1	111.0	121.1	128.8	95.4
DE0002R	Langenbrügge	42.2	64.4	87.8	112.4	126.9	137.9	147.9	95.6
DE0003R	Schauinsland	74.1	88.3	103.3	119.2	127.7	135.2	140.9	96.0
DE0007R	Neuglobsow	42.2	68.3	92.1	113.2	126.3	139.1	146.6	95.7
DE0008R	Schmücke	62.6	81.3	101.5	120.8	129.6	139.7	146.0	95.7
DE0009R	Zingst	49.7	65.9	82.3	95.9	104.1	116.7	124.2	95.2
DK0005R	Keldsnor	53.5	66.3	81.4	95.6	103.4	112.8	117.3	99.0
DK0031R	Ulborg	61.3	74.5	91.3	107.3	118.1	131.7	137.3	80.2
DK0041R	Lille Valby	45.8	63.8	80.6	95.9	104.8	118.8	123.6	99.5
EE0009R	Lahemaa	40.0	58.0	77.0	95.0	103.0	118.0	129.0	99.2
EE0011R	Vilsandi	61.0	75.0	88.0	99.0	107.0	116.0	122.0	99.5
ES0007R	Viznar	80.8	94.2	106.2	118.6	124.7	133.2	138.6	97.7
ES0008R	Niembro	61.2	74.8	87.2	98.6	104.2	109.8	113.2	99.0
ES0009R	Campisábalos	72.4	89.8	104.1	119.3	128.4	138.6	148.0	95.2
ES0010R	Cabo de Creus	74.6	86.3	96.8	108.0	114.5	122.5	127.1	96.1
ES0011R	Barcarrola	53.3	73.3	91.8	106.3	116.9	126.8	132.2	98.0
ES0012R	Zarra	79.7	92.8	106.2	120.1	127.4	136.4	143.6	94.7
ES0013R	Penausende	71.2	88.8	103.5	117.6	126.3	133.8	138.4	99.3
ES0014R	Els Torms	75.7	91.3	105.7	118.4	127.1	134.1	139.0	99.0
ES0016R	O Saviñao	46.3	63.1	79.8	93.9	102.8	113.0	120.3	98.9
FI0009R	Utö	58.0	72.0	87.0	99.0	105.0	110.0	115.0	97.9
FI0017R	Virolahti II	40.0	57.0	75.0	90.0	99.0	112.0	121.0	97.8
FI0022R	Oulanka	43.0	56.0	75.0	85.0	91.0	95.0	97.0	98.1
FI0037R	Ahtari II	43.0	58.0	76.0	93.0	99.0	107.0	118.0	98.1
FI0096G	Pallas (Sammaltunturi)	53.0	62.0	82.0	94.0	98.0	102.0	113.0	97.8
FR0008R	Donon A	70.0	84.0	103.0	122.0	132.0	142.0	150.0	87.0
FR0008R	Donon B	72.0	86.0	105.0	124.0	134.0	146.0	152.0	88.3
FR0008R	Donon C	72.0	87.0	105.0	125.0	135.0	146.0	152.0	88.3
FR0008R	Donon D	67.0	81.0	100.0	120.0	130.0	142.0	148.0	87.3
FR0009R	Revin	47.0	62.0	82.0	101.0	116.0	126.0	138.2	99.7
FR0010R	Morvan	54.0	68.0	85.0	98.0	109.0	123.0	132.0	72.0
FR0012R	Iraty	74.0	88.0	101.0	113.0	121.0	130.0	134.0	97.5
FR0013R	Peyrusse Vieille	48.0	63.0	80.0	93.0	100.0	109.0	114.1	95.4
FR0014R	Montandon	47.0	63.0	80.0	96.0	106.0	118.0	124.0	99.4
FR0015R	La Tardière	50.0	65.0	81.0	96.0	105.0	116.0	123.0	96.4
FR0016R	Le Casset	89.0	101.0	113.0	126.0	134.0	145.0	152.0	79.7

Table 1.2, cont.

Code	Station	25%	50%	75%	90%	95%	98%	99%	Data capture
FR0017R	Montfranc	62.0	74.0	89.0	102.0	109.0	118.0	122.0	97.6
FR0018R	La Coulonche	59.0	70.0	83.0	98.0	108.0	117.0	123.0	94.2
GB0002R	Eskdalemuir	44.0	58.0	76.0	92.0	102.0	118.0	130.0	87.0
GB0006R	Lough Navar	34.0	48.0	64.0	80.0	88.0	98.0	104.9	99.1
GB0013R	Yarner Wood	50.0	62.0	76.0	92.0	102.0	116.0	128.0	93.3
GB0014R	High Muffles	42.0	60.0	82.0	102.0	112.0	122.0	126.0	93.3
GB0015R	Strath Vaich Dam	58.0	70.0	90.0	102.0	108.0	116.0	126.0	92.2
GB0031R	Aston Hill	58.0	70.0	86.0	96.0	104.0	114.3	128.0	94.3
GB0033R	Bush	46.0	58.0	76.0	90.0	96.0	105.1	112.0	96.1
GB0035R	Great Dun Fell	44.0	58.0	76.0	90.0	100.0	116.0	128.0	93.9
GB0036R	Harwell	40.0	52.0	68.0	84.0	92.0	108.0	116.0	98.6
GB0037R	Ladybower Res.	48.0	62.0	78.0	92.0	100.0	112.0	126.0	97.9
GB0038R	Lullington Heath	50.0	62.0	78.0	96.0	106.0	124.0	132.0	98.7
GB0039R	Sibton	46.0	64.0	82.0	98.0	110.0	124.0	134.0	90.5
GB0043R	Narberth	50.0	62.0	78.0	92.0	100.0	112.0	124.0	95.1
GB0045R	Wicken Fen	36.5	56.0	74.0	92.0	104.0	124.0	132.0	98.7
GB0048R	Auchencorth Moss	48	62	78	94	102	110	116	99.6
GB0049R	Weybourne	54	70	88	106	114	128	138	96.0
GB0050R	St. Osyth	46	62	80	94	104	114	122	80.5
GB0051R	Market Harborough	46	62	78	96	106	124	132	99.0
GB0052R	Lerwick	60	72	88	100	108	114	122	93.1
GR0002R	Finokalia	94.7	105.2	114.4	122.2	127.3	133.5	137.6	93.3
HU0002R	K-puszta	46.0	73.0	102.0	120.0	127.0	134.0	140.0	100.0
IE0031R	Mace Head	64.0	74.0	86.5	100.0	106.0	114.0	118.2	100.0
IT0001R	Montelibretti	29.6	60.2	95.6	118.9	131.2	146.8	159.0	100.0
IT0004R	Ispra	20.2	45.8	73.8	99.1	116.3	131.4	142.2	93.6
LT0015R	Preila	51.0	67.0	79.0	91.0	97.0	105.0	110.0	97.0
LV0010R	Rucava	42.0	64.0	82.0	96.0	105.0	115.0	121.0	93.3
LV0016R	Zoseni	39.0	54.0	71.0	88.0	96.0	108.0	115.0	86.4
MT0001R	Giordan lighthouse	91.6	102.2	112.2	120.4	126.4	135.0	137.8	86.4
NL0007R	Eibergen	26.6	43.7	63.1	82.8	99.9	111.8	120.6	98.2
NL0009R	Kollumerwaard	38.7	55.1	74.1	90.6	99.8	112.1	121.1	97.3
NL0010R	Vredepeel	26.0	43.6	63.4	84.0	99.4	114.9	125.6	99.7
NL0011R	Cabauw	26.1	43.1	61.2	77.1	92.2	107.9	115.8	99.5
NL0091R	De Zilk	34.6	50.8	65.8	84.8	94.3	109.8	116.4	93.9
NO0001R	Birkenes	34.1	55.0	75.3	92.5	102.3	116.3	124.0	98.5
NO0015R	Tustervatn	49.7	63.0	86.2	99.2	103.6	113.0	121.1	99.7
NO0039R	Kårvatn	29.4	50.4	70.4	89.0	96.4	107.7	120.9	94.8
NO0042G	Spitsbergen, Zeppelinfjell	53.7	62.0	73.8	88.5	94.0	98.9	102.0	95.4
NO0043R	Prestebakke	46.0	61.2	78.9	96.1	107.0	120.0	126.2	99.7
NO0052R	Sandve	59.2	71.3	85.2	97.3	105.8	115.6	124.2	99.3
NO0055R	Karasjok	49.5	61.1	80.8	93.6	98.7	102.9	105.6	99.7
NO0056R	Hurdal	35.3	52.5	71.3	89.3	99.0	112.9	121.6	99.7
PL0002R	Jarczew	39.0	59.0	83.0	100.0	109.0	118.3	124.0	98.7
PL0003R	Sniezka	82.0	99.0	113.0	125.0	131.0	139.0	146.0	96.1
PL0004R	Leba	55.0	73.0	88.0	100.9	108.0	119.0	126.0	100.0
PL0005R	Diabla Gora	43.0	61.0	81.0	98.0	107.0	116.0	120.0	100.0
PT0004R	Monte Velho	43.0	67.0	86.0	98.0	107.0	116.0	123.0	99.9
SE0005R	Bredkälen	39.0	53.0	71.3	86.0	91.0	96.0	99.0	94.6
SE0011R	Vavihill	42.0	63.0	84.0	100.0	111.0	122.0	131.0	98.6
SE0012R	Aspvreten	44.0	64.0	82.0	97.0	104.0	113.0	119.0	99.1
SE0013R	Esrange	49.0	61.0	84.0	97.0	101.0	107.0	114.0	99.9
SE0014R	Råö	57.0	70.0	84.0	97.0	107.0	117.0	123.0	99.8
SE0032R	Norra-Kvill	51.0	66.0	87.0	101.0	109.0	118.0	124.0	99.6
SE0035R	Vindeln	36.0	53.0	74.0	91.0	97.0	102.0	108.0	97.6
SE0039R	Grimsö	38.0	56.0	76.0	93.0	101.7	111.0	116.0	99.4
SI0008R	Iskrba	15.0	63.0	97.0	114.0	122.0	130.0	135.0	94.7
SI0031R	Zarodnje	64.0	81.0	95.0	106.0	112.0	121.0	127.0	95.5
SI0032R	Krvavec	93.0	108.0	119.0	129.0	136.0	145.0	149.0	89.9
SK0002R	Chopok	95.0	106.0	118.0	128.0	133.0	139.0	143.0	97.0
SK0004R	Stará Lesná	57.0	80.0	101.0	116.0	123.0	130.3	134.0	99.8
SK0006R	Starina	42.0	64.0	87.0	102.0	110.0	117.0	120.0	97.9
SK0007R	Topolniky	51.6	70.9	96.8	115.8	126.1	134.8	139.4	99.1

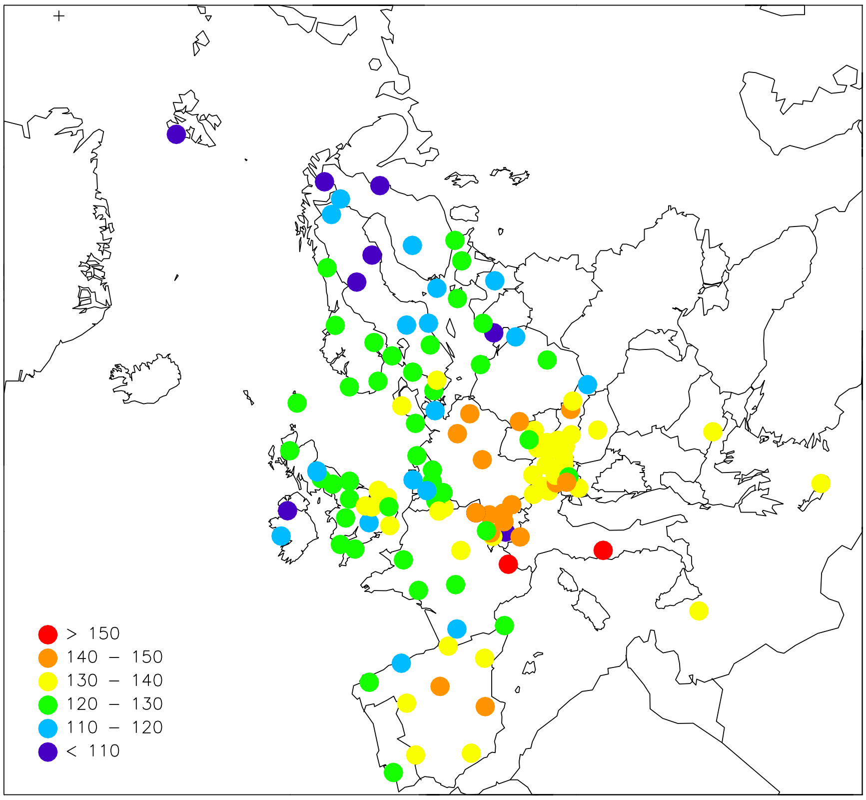


Figure 1.1: Ozone April–September 2008. 99-percentiles (μg/m³).

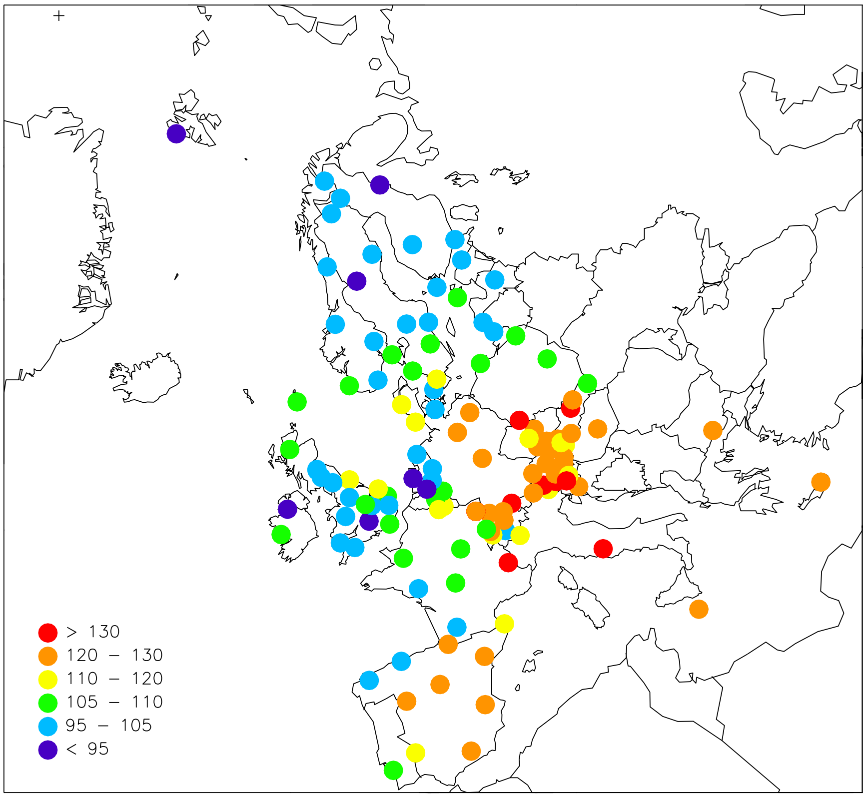


Figure 1.2: Ozone April–September 2008. 95-percentiles (μg/m³).

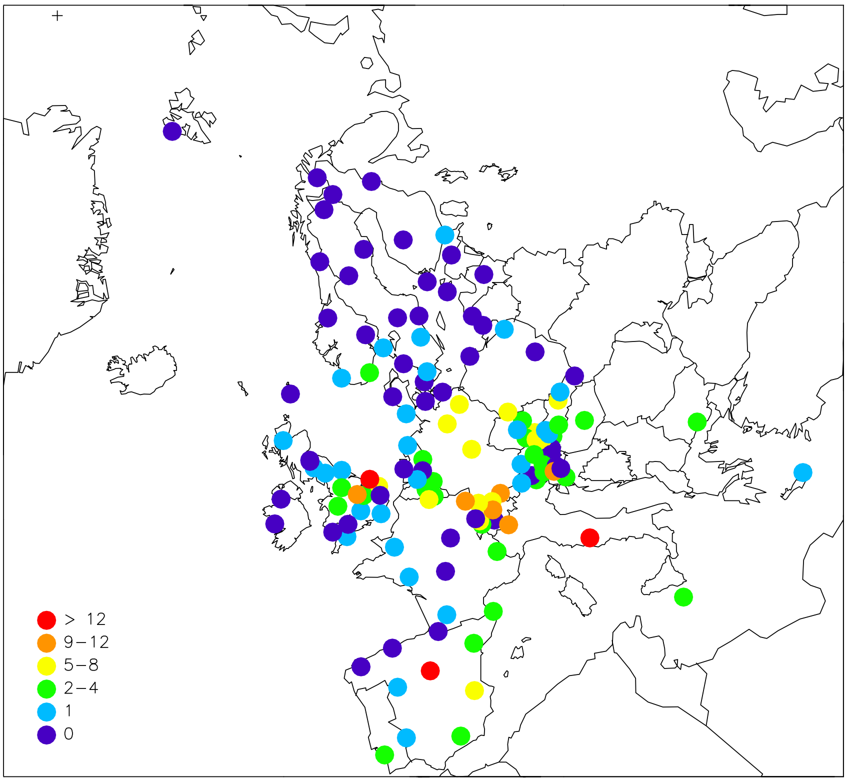


Figure 1.3: Number of exceedances of the threshold value of 150 µg/m³. (Unit: number of days).

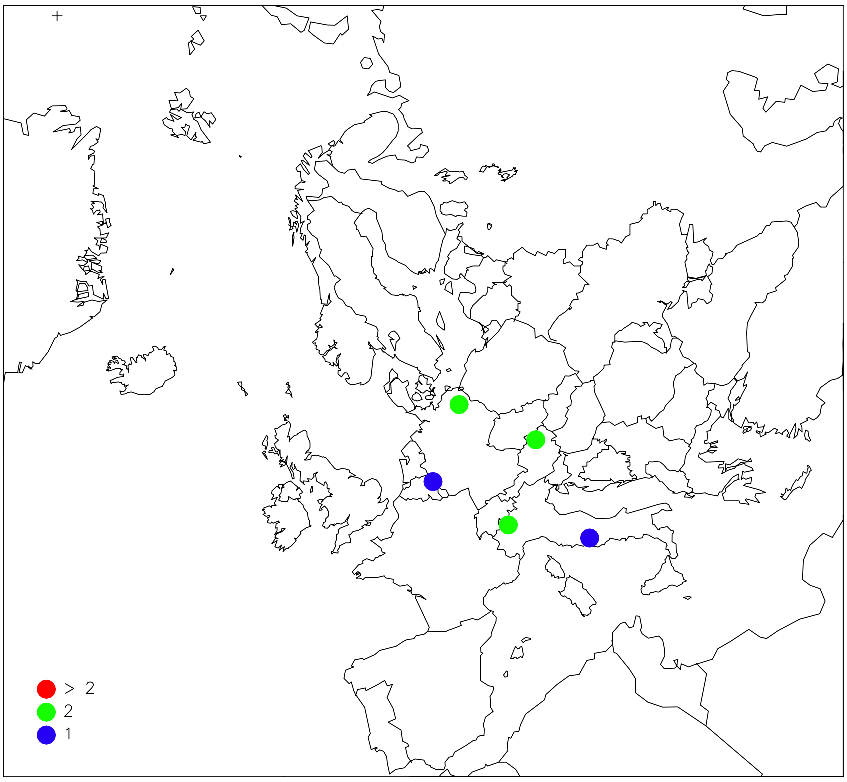


Figure 1.4: Number of exceedances of the threshold value of 180 µg/m³. (Unit: number of days). The stations with 0 exceedances are removed before plotting.

Annex 2

AOT40 and AOT60, figures and tables

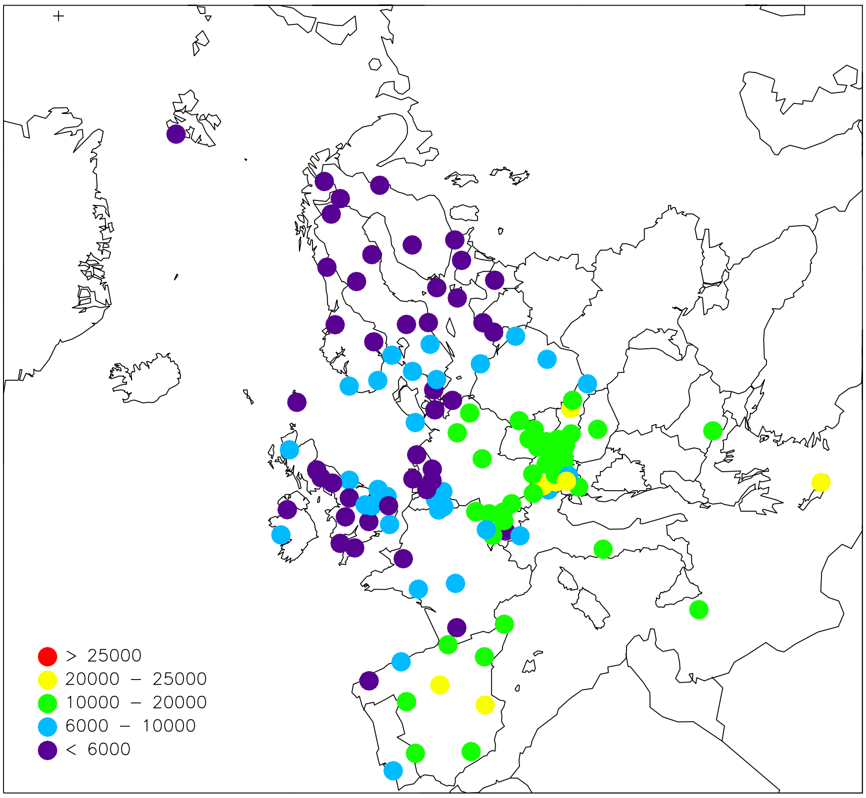


Figure 2.1: AOT40 (ppbh) April–September 2008 (daylight hours).

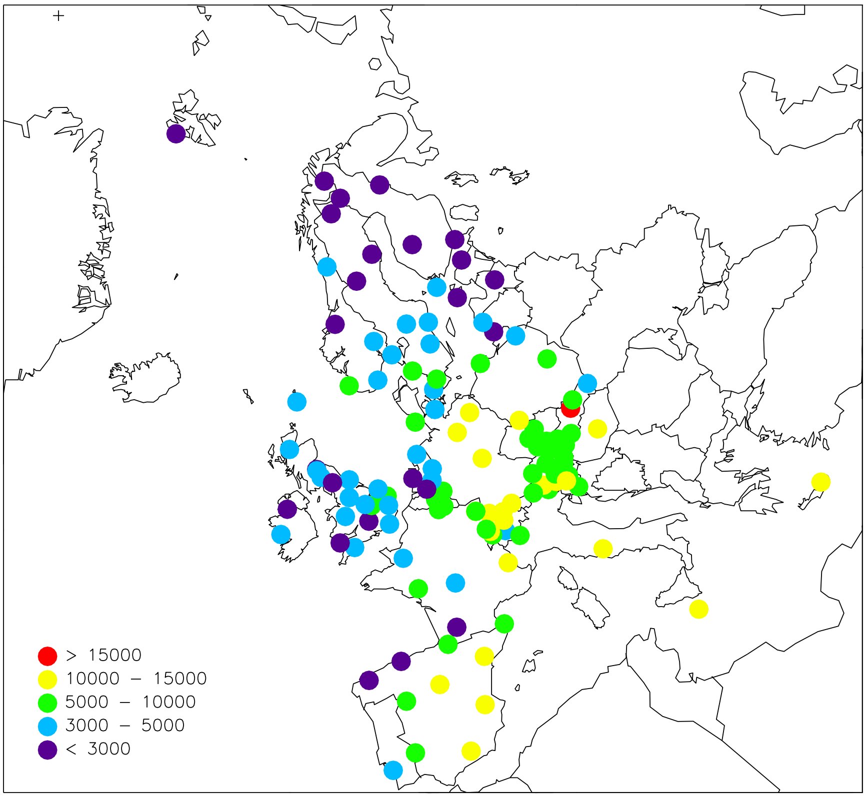


Figure 2.2: AOT40 (ppbh) May, June and July 2008 (daylight hours).

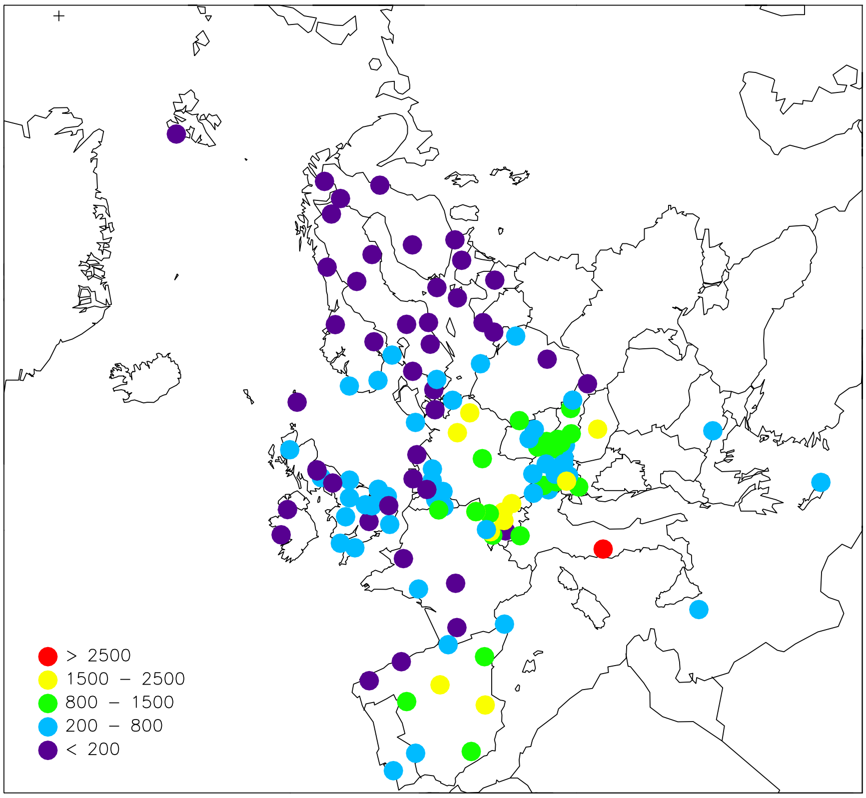


Figure 2.3: AOT60 (ppbh) April-September 2008 (daylight hours).

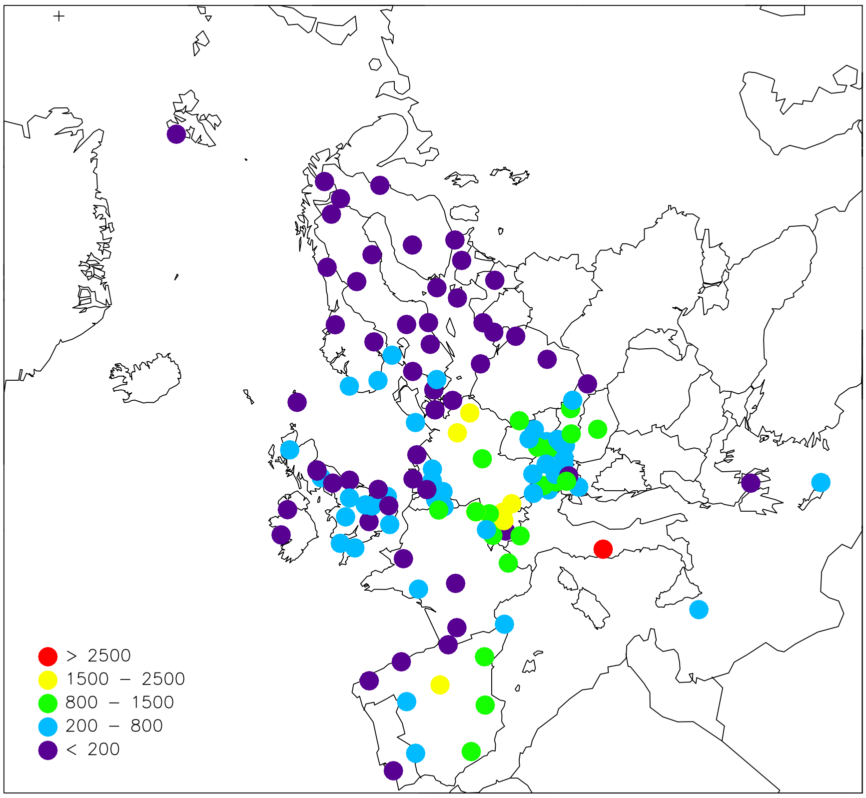


Figure 2.4: AOT60 (ppbh) May, June and July 2008 (daylight hours).

Table 2.1: AOT40 and AOT60 April–September 2008 (daylight hours).

Code	Station	AOT40	AOT40 corrected	AOT60	AOT60 corrected	Data capture
AT0002R	Illmitz	13088	13935	782	832	94
AT0005R	Vorhegg	9333	10672	270	308	87
AT0030R	Pillersdorf bei Retz	13685	14750	1036	1117	93
AT0032R	Sulzberg	19901	20118	2433	2460	99
AT0034G	Sonnblick	22682	23765	1094	1146	95
AT0037R	Zillertaler Alpen	15162	15467	531	542	98
AT0038R	Gerlitzen	21547	22722	1150	1212	95
AT0040R	Masenberg	15017	16080	493	527	93
AT0041R	Haunsberg	13128	13737	701	734	96
AT0042R	Heidenreichstein	14572	15267	1014	1062	95
AT0043R	Forsthof	13052	13808	901	953	95
AT0044R	Graz Platte	14405	15922	691	763	90
AT0045R	Dunkelsteinerwald	12177	13098	1264	1359	93
AT0046R	Gänserndorf	14018	14756	1108	1166	95
AT0047R	Stixneusiedl	13719	14354	844	883	96
AT0048R	Zoebelboden	10564	11484	424	460	92
AT0049R	Grebenzen bei St. Lamprecht	14946	16584	401	444	90
BE0001R	Offagne	8150	8511	794	829	96
BE0032R	Eupen	6281	6968	565	627	90
BE0035R	Vezin	6211	6612	489	521	94
BG0053R	Rojen peak	13785	15852	419	482	87
CH0001G	Jungfraujoch	5314	5484	3	3	97
CH0002R	Payerne	11740	12399	1104	1166	95
CH0003R	Tänikon	13228	13883	1800	1889	95
CH0004R	Chaumont	15631	16423	1575	1655	95
CH0005R	Rigi	15949	16905	1904	2018	94
CY0002R	Ayia Marina	12177	12301	137	138	99
CZ0001R	Svratouch	13173	13173	696	696	100
CZ0003R	Košetice	13070	13102	553	554	100
DE0001R	Westerland	9417	9855	385	403	96
DE0002R	Langenbrügge	13343	14010	1970	2069	95
DE0003R	Schauinsland	14140	14409	1033	1052	98
DE0007R	Neuglobsow	14645	15363	2030	2129	95
DE0008R	Schmücke	13588	14211	1347	1408	96
DE0009R	Zingst	5789	6089	231	242	95
DK0005R	Keldsnor	4397	4453	73	74	99
DK0041R	Lille Valby	5772	5803	182	183	99
EE0009R	Lahemaa	2552	2583	50	51	99
EE0011R	Vilsandi	3253	3286	8	8	99
ES0007R	Viznar	17621	18165	1290	1330	97
ES0008R	Niembro	6022	6137	4	4	98
ES0009R	Campisábalos	21601	22494	2072	2158	96
ES0010R	Cabo de Creus	11465	11919	376	391	96
ES0011R	Barcarrola	13023	13200	670	679	99
ES0012R	Zarra	20146	20606	1736	1775	98
ES0013R	Penausende	16696	16913	969	982	99
ES0014R	Els Torms	19934	20116	1308	1320	99
ES0016R	O Saviñao	5451	5530	85	86	99
FI0009R	Utö	5942	6031	48	48	99
FI0017R	Virolahti II	4280	4334	108	109	99
FI0022R	Oulanka	1661	1675	0	0	99
FI0037R	Ahtari II	4538	4582	129	130	99
FI0096G	Pallas (Sammaltunturi)	3727	3783	61	62	99
FR0008R	Donon A	13486	13656	1479	1498	99
FR0008R	Donon B	14507	14681	1782	1803	99
FR0008R	Donon C	14839	14993	1871	1890	99
FR0008R	Donon D	11418	11536	1079	1090	99
FR0009R	Revin	8277	8330	864	870	99
FR0012R	Iraty	10225	10529	254	261	97
FR0013R	Peyrusse Vieille	3956	4160	73	76	95
FR0014R	Montandon	6696	6772	244	247	99
FR0015R	La Tardière	6956	7220	327	339	96
FR0017R	Montfranc	7091	7339	76	79	97
FR0018R	La Coulonche	5834	6201	200	213	94

Table 2.1, cont.

Code	Station	AOT40	AOT40 corrected	AOT60	AOT60 corrected	Data capture
GB0002R	Eskdalemuir	4828	5475	414	470	88
GB0006R	Lough Navar	2177	2198	105	106	99
GB0013R	Yarner Wood	5151	5483	442	470	94
GB0014R	High Muffles	7522	8040	353	377	94
GB0015R	Strath Vaich Dam	7660	8387	366	401	91
GB0031R	Aston Hill	5483	5921	326	352	93
GB0033R	Bush	3647	3844	82	86	95
GB0035R	Great Dun Fell	2950	3100	169	178	95
GB0036R	Harwell	3552	3608	194	197	98
GB0037R	Ladybower Res.	4505	4612	422	432	98
GB0038R	Lullington Heath	6167	6267	542	551	98
GB0039R	Sibton	7170	7749	622	672	93
GB0043R	Narberth	4017	4254	281	298	94
GB0045R	Wicken Fen	6573	6676	638	648	98
GB0048R	Auchencorth Moss	5217	5247	181	182	99
GB0049R	Weybourne	7085	7366	497	517	96
GB0050R	St. Osyth	4392	5505	164	206	80
GB0051R	Market Harborough	6302	6382	603	611	99
GB0052R	Lerwick	5855	6375	181	197	92
GR0002R	Finokalia	21988	23829	681	738	92
HU0002R	K-puszta	18480	18480	1659	1658	100
IE0031R	Mace Head	6439	6445	141	141	100
IT0001R	Montelibretti	19517	19517	3355	3355	100
IT0004R	Ispra	9250	9856	1228	1308	94
LT0015R	Preila	3413	3519	56	57	97
LV0010R	Rucava	4944	5302	138	148	93
LV0016R	Zoseni	1925	2203	27	31	87
MT0001R	Giordan lighthouse	18928	22068	588	686	86
NL0007R	Eibergen	3582	3638	231	235	98
NL0009R	Kollumerwaard	4371	4497	192	197	97
NL0010R	Vredepeel	4071	4083	288	289	100
NL0011R	Cabauw	2699	2725	157	159	99
NL0091R	De Zilk	2849	3030	119	127	94
NO0001R	Birkenes	6062	6230	327	336	97
NO0015R	Tustervatn	5855	5878	95	95	100
NO0039R	Kårvatn	4080	4229	126	131	96
NO0042G	Spitsbergen, Zeppelinfjell	2117	2229	0	0	95
NO0043R	Prestebakke	6522	6554	245	246	100
NO0052R	Sandve	7559	7615	281	283	99
NO0055R	Karasjok	3650	3660	3	3	100
NO0056R	Hurdal	4117	4141	133	134	99
PL0002R	Jarczew	9212	9383	180	183	98
PL0003R	Sniezka	19197	19968	1043	1085	96
PL0004R	Leba	9049	9048	278	278	100
PL0005R	Diabla Gora	7852	7852	265	265	100
PT0004R	Monte Velho	9206	9215	353	353	100
SE0005R	Bredkälen	2188	2316	12	13	94
SE0011R	Vavihill	7761	7894	388	394	98
SE0012R	Aspvreten	5924	5967	47	47	99
SE0013R	Esrange	4419	4427	78	78	100
SE0014R	Råö	6595	6617	187	187	100
SE0032R	Norra-Kvill	7117	7158	198	199	99
SE0035R	Vindeln	3700	3792	19	19	98
SE0039R	Grimsö	4693	4718	122	122	99
SI0008R	Iskrba	15453	16605	994	1068	93
SI0031R	Zarodnje	8910	8945	225	225	100
SI0032R	Krvavec	23553	26383	1817	2035	89
SK0002R	Chopok	24962	25736	1431	1475	97
SK0004R	Stará Lesná	14279	14300	673	674	100
SK0006R	Starina	7479	7576	37	37	99
SK0007R	Topolniky	15176	15349	1318	1333	99

Table 2.2: AOT40 and AOT60 May–July 2008 (daylight hours).

Code	Station	AOT40	AOT40 corrected	AOT60	AOT60 corrected	Data capture
AT0002R	Illmitz	8215	8871	612	660	93
AT0005R	Vorhegg	6094	6618	221	239	92
AT0030R	Pillersdorf bei Retz	9007	9683	752	808	93
AT0032R	Sulzberg	13868	14008	2164	2185	99
AT0034G	Sonnblick	13833	14655	853	903	94
AT0037R	Zillertaler Alpen	9162	9195	373	374	100
AT0038R	Gerlitzen	14224	14964	943	992	95
AT0040R	Masenberg	9950	10643	432	462	93
AT0041R	Haunsberg	9440	9911	670	703	95
AT0042R	Heidenreichstein	9835	10309	829	869	95
AT0043R	Forsthof	8985	9508	765	810	94
AT0044R	Graz Platte	9597	10275	549	588	93
AT0045R	Dunkelsteinerwald	8088	8865	1015	1112	91
AT0046R	Gänserndorf	8987	9483	800	844	95
AT0047R	Stixneusiedl	8703	9108	575	601	96
AT0048R	Zoebelboden	7493	8075	361	388	93
AT0049R	Grebenzen bei St. Lamprecht	9553	10691	323	361	89
BE0001R	Offagne	6728	7067	783	822	95
BE0032R	Eupen	5402	5987	565	626	90
BE0035R	Vezin	5195	5611	489	528	93
CH0001G	Jungfraujoch	3808	3936	3	3	97
CH0002R	Payerne	8364	8827	1054	1112	95
CH0003R	Tänikon	10125	10587	1702	1780	96
CH0004R	Chaumont	10745	11286	1435	1507	95
CH0005R	Rigi	11754	12538	1817	1938	94
CY0002R	Ayia Marina	4796	4848	0	0	99
CZ0001R	Svratouch	8953	8953	540	540	100
CZ0003R	Košetice	8712	8735	459	460	100
DE0001R	Westerland	7444	7849	385	406	95
DE0002R	Langenbrügge	11187	11771	1907	2007	95
DE0003R	Schauinsland	10509	10732	959	980	98
DE0007R	Neuglobsow	11214	11822	1641	1730	95
DE0008R	Schmücke	10875	11493	1297	1371	95
DE0009R	Zingst	4173	4351	134	140	96
DK0005R	Keldsnor	3608	3689	60	61	98
DK0041R	Lille Valby	4614	4614	149	149	100
EE0009R	Lahemaa	1429	1455	2	2	98
EE0011R	Vilsandi	1997	2034	0	0	98
ES0007R	Viznar	10392	10901	1011	1060	95
ES0008R	Niembro	2853	2908	0	0	98
ES0009R	Campisábalos	12684	13134	1571	1626	97
ES0010R	Cabo de Creus	7479	7535	373	376	99
ES0011R	Barcarrola	8296	8373	615	620	99
ES0012R	Zarra	12375	12531	1479	1498	99
ES0013R	Penausende	9350	9454	709	717	99
ES0014R	Els Torms	11837	11882	1055	1059	100
ES0016R	O Saviñao	2663	2693	62	63	99
FI0009R	Utö	4678	4795	44	45	98
FI0017R	Virolahti II	2737	2768	46	46	99
FI0022R	Oulanka	1016	1025	0	0	99
FI0037R	Ahtari II	2840	2876	16	16	99
FI0096G	Pallas (Sammaltunturi)	2314	2357	59	60	98
FR0008R	Donon A	10845	10924	1386	1396	99
FR0008R	Donon B	11697	11782	1667	1679	99
FR0008R	Donon C	11915	11980	1746	1755	99
FR0008R	Donon D	9262	9312	1021	1026	99
FR0009R	Revin	6490	6537	860	866	99
FR0012R	Iraty	5821	5967	168	172	98
FR0013R	Peyrusse Vieille	2216	2433	67	74	91
FR0014R	Montandon	5410	5445	244	246	99
FR0015R	La Tardière	5308	5336	327	329	99
FR0016R	Le Casset	14493	14519	1416	1419	100
FR0017R	Montfranc	4838	5034	76	79	96
FR0018R	La Coulonche	3974	4343	200	219	91

Table 2.2, cont.

Code	Station	AOT40	AOT40 corrected	AOT60	AOT60 corrected	Data capture
GB0002R	Eskdalemuir	4257	4545	414	442	94
GB0006R	Lough Navar	1847	1854	105	105	100
GB0013R	Yarner Wood	3531	3735	442	468	95
GB0014R	High Muffles	4220	4624	102	112	91
GB0015R	Strath Vaich Dam	4126	4791	366	425	86
GB0031R	Aston Hill	3716	4196	326	368	89
GB0033R	Bush	2477	2519	82	83	98
GB0035R	Great Dun Fell	2642	2705	169	173	98
GB0036R	Harwell	2953	2963	194	195	100
GB0037R	Ladybower Res.	3939	3956	422	424	100
GB0038R	Lullington Heath	4681	4722	514	519	99
GB0039R	Sibton	5836	5851	618	620	100
GB0043R	Narberth	2888	3118	281	303	93
GB0045R	Wicken Fen	5551	5595	638	643	99
GB0048R	Auchencorth Moss	3764	3797	181	183	99
GB0049R	Weybourne	4476	4539	188	191	99
GB0050R	St. Osyth	3249	3813	157	184	85
GB0051R	Market Harborough	4961	5067	603	616	98
GB0052R	Lerwick	3746	4237	166	188	88
GR0002R	Finokalia	12725	13300	312	326	96
HU0002R	K-puszta	10633	10632	820	820	100
IE0031R	Mace Head	3908	3911	140	140	100
IT0001R	Montelibretti	11896	11896	2533	2533	100
IT0004R	Ispra	6538	6671	1045	1066	98
LT0015R	Preila	2450	2518	52	53	97
LV0010R	Rucava	3506	3914	38	42	90
LV0016R	Zoseni	1367	1375	2	2	99
MT0001R	Giordan lighthouse	10812	12240	437	495	88
NL0007R	Eibergen	3285	3379	231	238	97
NL0009R	Kollumerwaard	3728	3903	192	201	96
NL0010R	Vredepeel	3602	3602	288	288	100
NL0011R	Cabauw	2521	2555	157	159	99
NL0091R	De Zilk	2383	2525	119	127	94
NO0001R	Birkenes	4865	4997	327	336	97
NO0015R	Tustervatn	3480	3491	56	56	100
NO0039R	Kårvatn	2265	2293	71	72	99
NO0042G	Spitsbergen, Zeppelinfjell	1488	1576	0	0	94
NO0043R	Prestebakke	4926	4939	207	207	100
NO0052R	Sandve	5820	5856	281	282	99
NO0055R	Karasjok	2477	2481	3	3	100
NO0056R	Hurdal	3272	3298	129	130	99
PL0002R	Jarczew	5466	5577	80	81	98
PL0003R	Sniezka	13764	13764	823	822	100
PL0004R	Leba	6497	6497	157	156	100
PL0005R	Diabla Gora	4841	4841	84	84	100
PT0004R	Monte Velho	4923	4932	139	139	100
SE0005R	Bredkälen	1349	1463	12	13	92
SE0011R	Vavihill	5574	5721	247	254	97
SE0012R	Aspvreten	4234	4241	25	25	100
SE0013R	Esrange	2725	2734	75	75	100
SE0014R	Råö	5033	5033	81	81	100
SE0032R	Norra-Kvill	4566	4581	98	98	100
SE0035R	Vindeln	2343	2355	3	3	100
SE0039R	Grimsö	3069	3069	63	62	100
SI0008R	Iskrba	8493	9110	583	625	93
SI0031R	Zarodnje	6009	6036	194	194	100
SI0032R	Krvavec	13944	15903	1166	1330	88
SK0002R	Chopok	15146	16018	976	1032	95
SK0004R	Stará Lesná	8161	8183	250	250	100
SK0006R	Starina	4366	4393	9	9	99
SK0007R	Topolniky	9517	9673	947	963	98

Annex 3

Seasonal variation

Table 3.1: Monthly mean concentrations 2008 ($\mu g/m^3$).

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
AT0002R	Illmitz	41.1	47.6	71.0	81.6	82.5	80.9	71.0	70.0	49.6	35.4	37.5	31.5
AT0005R	Vorhegg	59.9	76.3	80.6	88.7	88.4	71.7	78.0	70.2	55.9	51.6	42.5	45.6
AT0030R	Pillersdorf bei Retz	43.0	52.9	70.9	78.2	86.4	82.3	80.7	75.9	58.7	35.3	34.8	32.0
AT0032R	Sulzberg	66.7	71.2	82.0	94.5	106.3	96.1	99.2	92.8	72.4	64.3	60.8	54.8
AT0034G	Sonnblick	88.8	95.4	98.4	113.1	112.9	108.5	106.0	96.1	87.1	87.9	86.1	81.1
AT0037R	Zillertaler Alpen	82.6	88.8	89.0	105.0	104.1	94.1	94.2	86.8	75.4	75.1	78.5	70.5
AT0038R	Gerlitzen	81.1	93.8	97.0	111.3	112.1	109.2	103.6	94.1	77.7	77.0	74.1	69.0
AT0040R	Masenberg	60.1	74.1	81.6	93.5	98.7	96.6	92.4	88.2	71.0	62.3	52.2	57.2
AT0041R	Haunsberg	43.3	62.8	77.4	81.5	93.4	89.3	84.5	79.1	59.2	44.9	44.3	41.1
AT0042R	Heidenreichstein	45.9	54.7	71.8	73.7	82.2	74.6	77.9	69.0	52.3	40.2	39.6	38.5
AT0043R	Forsthof	43.9	54.3	70.0	82.1	94.0	87.8	84.4	81.6	58.3	41.1	40.0	36.7
AT0044R	Graz Platte	42.3	65.0	76.3	92.9	97.1	91.2	91.8	88.9	68.8	52.3	44.7	39.2
AT0045R	Dunkelsteinerwald	35.7	48.0	67.3	71.4	74.0	70.4	72.6	61.9	47.8	27.7	28.9	31.2
AT0046R	Gänserndorf	37.6	42.2	64.0	71.9	77.1	72.4	74.5	68.1	47.6	28.9	34.3	29.2
AT0047R	Stixneusiedl	45.8	50.9	68.8	75.6	79.4	76.9	77.6	74.7	51.9	34.4	37.4	30.5
AT0048R	Zoebelboden	67.2	73.9	83.9	92.1	97.0	91.6	88.2	80.0	63.1	53.2	56.2	53.9
AT0049R	Grebenzen bei St. Lamprecht	76.4	88.5	91.4	105.9	106.0	100.8	97.3	87.3	76.4	75.1	74.3	69.4
BE0001R	Offagne	49.3	54.0	70.4	70.4	84.4	71.0	69.1	55.5	47.2	38.2	37.1	33.3
BE0032R	Eupen	50.4	47.0	64.3	62.3	76.9	64.9	63.0	56.5	38.3	37.7	35.6	27.0
BE0035R	Vezin	45.0	39.5	62.1	54.8	65.4	55.7	52.1	46.1	32.8	27.3	28.1	20.3
BG0053R	Rojen peak	79.0	83.8	74.9	83.2	95.1	95.0	98.1	110.9	82.8	75.1	61.0	56.1
CH0001G	Jungfraujoch	64.6	69.2	73.7	83.5	86.8	79.5	81.5	74.4	72.2	65.7	63.3	59.6
CH0002R	Payerne	32.4	40.1	71.8	70.9	73.6	70.1	72.9	62.1	45.1	32.8	26.7	24.8
CH0003R	Tänikon	37.0	43.8	72.0	71.4	78.9	74.8	75.9	61.9	41.5	35.5	24.5	26.5
CH0004R	Chaumont	71.2	73.2	86.5	96.9	103.2	90.8	96.5	84.4	70.1	66.3	59.6	57.6
CH0005R	Rigi	71.5	70.2	87.9	95.4	103.1	93.3	97.4	83.9	62.2	58.4	57.8	51.6
CY0002R	Ayia Marina	85.6	94.6	84.7	79.9	86.3	85.0	90.4	93.4	100.7	98.4	93.9	80.0
CZ0001R	Svratouch	45.1	55.4	74.5	78.7	88.0	91.0	86.5	80.1	53.8	39.4	38.2	32.0
CZ0003R	Košetice	48.2	57.0	74.1	75.1	82.7	77.8	76.7	73.8	56.5	40.7	40.9	36.5
DE0001R	Westerland	53.9	57.0	78.3	82.4	95.4	86.8	78.3	71.1	59.9	60.0	48.7	40.7
DE0002R	Langenbrügge	43.5	41.0	66.6	70.4	89.9	80.1	66.0	52.0	41.6	29.9	25.8	22.6
DE0003R	Schauinsland	67.4	66.5	70.9	92.3	104.2	92.0	92.9	82.8	70.3	73.9	70.5	65.3
DE0007R	Neuglobsow	41.2	47.0	67.9	74.0	88.9	81.1	66.3	56.5	45.3	29.3	28.9	25.4
DE0008R	Schmücke	52.0	62.2	76.0	80.5	99.1	95.2	91.6	74.3	56.9	46.4	44.2	44.8
DE0009R	Zingst	40.5	47.8	69.3	74.9	82.6	73.7	61.4	54.7	48.4	33.7	36.6	30.9

Table 3.1, cont.

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
DK0005R	Keldsnor	46.4	52.4	69.4	72.8	87.7	75.7	63.1	54.4	52.5	45.6	42.3	36.2
DK0009R	Storebaelt	109.5	70.7	69.9	77.0	73.6	-	-	-	-	-	-	-
DK0031R	Ulborg	55.8	60.4	76.9	81.1	96.9	83.5	66.2	61.6	56.1	57.4	51.6	40.9
DK0041R	Lille Valby	45.2	50.8	66.6	69.0	77.4	72.5	61.2	54.7	44.0	44.1	39.0	31.5
EE0009R	Lahemaa	52.5	54.3	69.9	76.1	75.8	66.5	47.8	46.6	36.4	44.6	43.6	36.9
EE0011R	Vilsandi	53.4	58.2	75.0	84.2	86.9	82.3	71.3	69.2	51.7	57.1	52.0	43.7
ES0007R	Viznar	70.7	81.2	85.2	89.7	82.2	101.6	101.8	103.0	82.5	84.3	80.2	74.1
ES0008R	Niembro	59.5	61.0	82.1	86.1	84.6	69.5	67.6	64.3	74.5	63.2	59.1	55.0
ES0009R	Campisábalos	60.7	78.7	80.5	97.5	88.7	90.0	91.6	87.5	77.7	62.5	59.9	62.1
ES0010R	Cabo de Creus	58.7	73.2	73.7	89.7	94.7	89.4	85.3	74.7	82.1	67.5	57.7	44.9
ES0011R	Barcarrola	43.1	58.6	58.5	73.0	67.1	81.6	77.4	72.9	60.6	51.3	46.0	43.1
ES0012R	Zarra	65.0	77.5	70.3	97.7	93.9	98.3	98.0	95.1	76.5	67.9	58.7	59.0
ES0013R	Penausende	73.6	76.1	93.5	100.5	91.1	85.5	86.9	82.8	79.1	68.2	57.8	58.4
ES0014R	Els Torms	48.7	71.1	82.7	93.7	95.2	87.3	95.9	89.4	83.9	62.8	51.1	44.6
ES0016R	O Saviñao	69.5	67.1	77.9	80.9	74.1	58.9	57.8	55.6	55.9	49.3	44.7	43.8
FI0009R	Utö	56.0	61.6	75.4	79.7	90.7	84.5	67.1	60.4	54.9	53.4	50.3	45.5
FI0017R	Virolahti II	51.5	53.7	67.6	72.6	73.8	63.8	50.0	46.2	37.5	40.9	40.9	37.8
FI0022R	Oulanka	47.4	65.9	75.2	78.0	74.8	61.4	48.4	40.5	43.7	41.6	48.9	43.1
FI0037R	Ahtari II	48.5	58.6	75.0	77.1	82.2	64.0	52.2	42.0	40.5	42.9	44.5	39.0
FI0096G	Pallas (Sammaltunturi)	60.5	74.8	80.2	85.9	86.5	66.3	59.4	51.0	52.2	49.7	59.7	56.3
FR0008R	Donon A	63.0	65.0	75.0	81.2	103.0	87.6	94.1	77.5	68.4	-	-	-
FR0008R	Donon B	63.7	65.6	74.8	81.5	104.8	89.8	96.0	79.4	69.9	-	-	-
FR0008R	Donon C	64.1	65.9	75.7	82.9	105.7	90.7	96.8	80.0	70.8	-	-	-
FR0008R	Donon D	61.5	63.9	73.8	79.1	100.5	83.8	90.6	74.4	65.4	-	-	-
FR0008R	Donon E	-	-	-	-	-	-	-	-	45.4	56.1	49.4	39.7
FR0009R	Revin	48.4	52.1	71.2	74.9	86.4	69.7	62.7	54.5	45.7	39.5	36.6	31.8
FR0010R	Morvan	56.4	63.0	73.7	78.4	80.7	66.1	115.8	59.3	54.7	51.4	50.8	44.1
FR0012R	Iraty	74.1	84.6	89.2	99.6	99.7	85.7	85.2	76.8	81.8	73.2	69.1	65.2
FR0013R	Peyrusse Vieille	47.8	65.3	72.0	77.0	62.4	58.3	66.8	57.1	61.1	50.3	52.7	59.5
FR0014R	Montandon	47.4	51.4	68.7	69.4	72.8	65.3	70.0	59.3	46.7	44.8	37.1	35.1
FR0015R	La Tardière	48.1	53.9	69.6	71.7	77.9	68.2	64.8	53.8	54.9	49.4	42.1	38.2
FR0016R	Le Casset	84.1	93.1	99.7	109.7	109.5	99.0	101.2	94.7	81.1	72.7	77.6	77.1
FR0017R	Montfranc	66.2	71.3	67.1	83.3	90.1	74.4	76.9	65.0	65.7	60.9	55.1	54.7
FR0018R	La Coulonche	63.5	59.3	80.6	80.6	88.4	72.9	68.5	62.2	59.2	54.6	47.9	45.1

Table 3.1, cont.

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
GB0002R	Eskdalemuir	57.0	55.3	74.8	75.9	85.8	61.3	55.8	45.2	45.5	50.5	48.2	42.5
GB0006R	Lough Navar	54.1	51.4	64.2	64.7	69.1	47.9	40.3	35.1	35.4	40.9	44.4	38.7
GB0013R	Yarner Wood	57.5	54.8	73.8	75.8	79.1	64.3	59.3	52.7	51.3	54.0	51.8	48.5
GB0014R	High Muffles	52.5	39.0	77.0	91.6	91.4	62.1	57.8	43.4	45.6	43.1	42.5	34.3
GB0015R	Strath Vaich Dam	69.1	80.7	97.6	96.3	85.4	64.5	69.9	60.1	56.9	63.5	62.9	59.2
GB0031R	Aston Hill	80.1	86.1	82.8	85.6	90.1	74.1	61.5	59.9	60.6	61.7	57.8	57.3
GB0033R	Bush	57.4	55.0	77.6	77.3	80.1	62.0	52.3	45.2	40.7	51.3	47.4	43.5
GB0035R	Great Dun Fell	59.0	60.9	71.4	74.7	88.2	63.2	51.0	42.0	44.5	46.1	46.0	51.0
GB0036R	Harwell	54.9	38.4	67.1	63.1	66.8	57.9	54.2	44.3	38.2	42.4	38.5	32.4
GB0037R	Ladybower Res.	54.6	51.0	71.2	72.6	86.4	66.8	59.1	47.1	45.3	50.0	49.3	44.1
GB0038R	Lullington Heath	63.1	47.8	73.2	71.3	81.3	65.3	63.0	55.4	52.1	53.1	45.3	36.7
GB0039R	Sibton	50.2	41.8	67.5	72.8	81.9	67.7	60.8	51.9	47.5	-	-	-
GB0043R	Narberth	-	-	-	79.7	82.7	66.3	56.6	50.2	53.6	59.0	57.8	53.1
GB0044R	Somerton	56.9	41.5	67.4	-	-	56.1	-	-	-	-	-	-
GB0045R	Wicken Fen	-	36.5	65.0	62.2	77.3	58.9	55.3	45.8	42.1	39.6	39.5	33.5
GB0048R	Auchencorth Moss	61.0	58.6	76.5	79.3	87.3	64.3	55.8	49.1	47.8	52.7	46.4	47.2
GB0049R	Weybourne	57.5	47.4	72.7	81.5	88.5	71.0	60.7	56.4	68.0	54.0	54.4	50.0
GB0050R	St. Osyth	54.0	43.1	70.3	68.5	78.4	66.4	56.0	57.9	45.4	39.0	40.0	30.7
GB0051R	Market Harborough	55.2	45.2	69.4	73.1	86.8	64.3	59.6	47.6	49.5	45.5	44.1	36.8
GB0052R	Lerwick	60.2	70.6	81.5	90.2	87.3	75.1	65.6	60.8	62.8	63.5	62.0	60.0
GR0002R	Finokalia	-	58.8	59.7	95.6	106.5	103.4	110.8	112.8	93.3	82.3	70.6	71.2
HU0002R	K-puszta	41.6	59.6	68.9	78.9	80.1	75.5	76.7	76.4	50.0	42.5	34.6	35.4
IE0031R	Mace Head	79.7	72.8	90.3	91.7	90.9	74.2	63.9	65.4	67.6	72.9	70.3	68.8
IT0001R	Montelibretti	24.4	42.3	52.6	70.4	59.6	65.9	73.6	67.4	48.9	40.4	23.8	25.7
IT0004R	Ispra	11.5	18.2	51.7	59.1	52.5	49.5	57.7	48.4	27.9	18.1	6.6	9.8
LT0015R	Preila	42.8	53.1	60.1	67.6	63.5	81.3	70.4	62.7	45.1	46.6	40.3	35.8
LV0010R	Rucava	44.4	47.0	61.2	71.0	71.2	75.5	59.0	57.4	39.7	44.8	20.7	60.2
LV0016R	Zoseni	48.4	54.9	62.6	81.1	74.6	64.0	45.0	49.8	40.1	49.4	49.1	43.3
MT0001R	Giordan lighthouse	78.2	81.5	102.8	108.3	107.7	102.1	99.6	97.4	93.5	86.5	84.6	84.7
NL0007R	Eibergen	28.9	27.0	48.1	51.6	62.8	50.6	47.1	38.6	29.6	18.8	19.8	13.6
NL0009R	Kollumerwaard	43.2	39.3	68.1	64.5	78.2	65.5	52.9	43.2	38.6	33.8	30.4	23.4
NL0010R	Vredepeel	31.8	28.5	52.3	50.0	61.7	53.9	46.5	39.6	27.6	20.6	21.6	13.8
NL0011R	Cabauw	30.0	23.4	48.1	46.0	61.9	49.3	47.2	38.1	27.5	20.6	19.1	13.1
NL0091R	De Zilk	39.7	30.7	65.9	59.8	70.6	56.6	49.7	41.5	31.2	30.3	8.2	28.3

Table 3.1, cont.

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NO0001R	Birkenes	61.1	61.6	69.6	64.7	74.2	69.0	48.2	39.1	33.8	44.5	44.3	36.5
NO0015R	Tustervatn	67.9	81.9	85.6	93.9	88.0	67.3	52.4	46.7	52.1	59.6	61.8	63.0
NO0039R	Kårvatn	61.3	66.8	78.4	75.8	67.0	53.0	38.2	34.2	29.4	39.2	45.6	56.9
NO0042G	Spitsbergen, Zeppelinfjell	74.9	83.4	73.8	68.3	81.2	60.8	55.7	55.0	62.2	67.2	66.1	70.1
NO0043R	Prestebakke	56.2	58.0	68.2	73.7	78.6	75.3	57.8	48.4	41.7	47.9	45.4	37.6
NO0052R	Sandve	62.2	65.7	77.0	81.8	85.1	77.9	68.1	61.2	55.0	60.3	54.8	49.4
NO0055R	Karasjok	61.4	72.9	80.2	84.5	87.9	64.0	55.5	46.7	48.8	44.9	56.6	56.0
NO0056R	Hurdal	50.1	53.8	67.7	67.4	74.2	64.7	50.6	35.5	30.1	38.8	36.4	39.0
PL0002R	Jarczew	43.1	46.2	64.5	65.8	66.0	73.1	59.6	63.2	42.2	36.8	33.9	33.8
PL0003R	Sniezka	73.8	79.9	90.1	103.9	110.2	108.7	99.9	87.3	68.3	60.2	57.8	56.2
PL0004R	Leba	58.0	63.6	78.7	83.0	83.2	81.4	65.7	64.8	50.8	47.0	44.1	30.0
PL0005R	Diabla Gora	46.7	52.9	73.3	71.7	68.8	71.1	58.5	58.6	39.8	36.7	36.0	30.6
PT0004R	Monte Velho	45.1	54.8	67.0	70.3	75.3	61.4	54.9	55.8	64.7	51.3	60.8	53.0
SE0005R	Bredkälen	59.4	70.8	73.5	78.3	77.5	60.6	49.2	37.4	39.2	44.0	48.8	50.0
SE0011R	Vavihill	45.9	54.5	72.1	82.4	92.3	71.3	57.3	45.6	35.8	31.3	34.3	29.5
SE0012R	Aspvreten	49.3	57.3	68.1	73.1	79.5	72.1	58.7	50.0	44.7	39.8	40.1	36.9
SE0013R	Esrange	62.8	76.5	81.4	88.1	89.1	65.5	56.4	45.9	49.6	45.9	53.1	57.3
SE0014R	Råö	51.6	56.3	69.3	76.7	82.9	80.5	67.3	61.1	51.0	58.8	46.3	37.4
SE0032R	Norra-Kvill	53.3	59.2	72.8	89.7	91.1	77.3	56.0	51.6	51.1	51.0	46.3	39.6
SE0035R	Vindeln	48.6	59.8	72.4	74.9	75.8	58.1	43.4	33.7	31.2	32.5	40.6	37.5
SE0039R	Grims÷	50.5	57.6	66.3	71.9	74.8	68.0	50.9	39.5	35.0	37.4	36.2	35.5
SI0008R	Iskrba	37.4	61.8	70.4	74.2	67.1	55.1	59.2	54.9	46.8	28.6	17.4	23.0
SI0031R	Zarodnje	43.8	63.1	75.5	85.3	86.5	80.8	84.7	77.1	62.7	49.0	37.8	37.3
SI0032R	Krvavec	79.7	92.4	96.8	112.2	112.0	110.1	108.8	107.7	83.8	84.3	79.1	73.6
SI0033R	Kovk	50.7	70.4	67.0	79.5	101.0	76.7	82.8	69.3	54.6	46.4	34.4	34.1
SK0002R	Chopok	68.6	81.1	93.2	109.3	112.9	112.7	107.7	104.9	83.7	84.0	75.6	74.2
SK0004R	Stará Lesná	61.1	68.6	82.6	93.1	85.7	80.9	83.9	70.1	60.6	60.9	83.7	61.4
SK0006R	Starina	56.6	59.4	73.6	81.6	70.8	69.9	67.0	57.8	44.2	47.8	43.9	42.1
SK0007R	Topolniky	39.5	42.6	68.9	74.9	78.8	79.4	78.0	75.0	60.2	46.2	42.1	43.8

Table 3.2: Monthly data capture 2008 ($\mu g/m^3$).

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
AT0002R	Illmitz	94	95	94	95	93	95	94	93	95	91	95	94
AT0005R	Vorhegg	94	95	77	95	96	95	94	58	96	95	96	94
AT0030R	Pillersdorf bei Retz	95	87	94	96	96	94	94	95	95	95	96	95
AT0032R	Sulzberg	91	96	96	96	96	96	96	96	96	95	95	95
AT0034G	Sonnblick	65	96	96	96	94	95	96	96	96	96	96	94
AT0037R	Zillertaler Alpen	96	95	92	96	96	97	96	94	96	96	96	96
AT0038R	Gerlitzen	96	96	95	96	95	96	96	96	96	96	96	96
AT0040R	Masenberg	92	95	95	96	93	95	92	94	93	96	95	94
AT0041R	Haunsberg	94	96	92	95	95	96	96	96	95	96	96	95
AT0042R	Heidenreichstein	95	95	96	95	96	96	96	96	96	95	96	96
AT0043R	Forsthof	95	95	95	94	95	95	96	95	95	95	95	95
AT0044R	Graz Platte	93	93	83	92	90	94	96	83	90	94	50	96
AT0045R	Dunkelsteinerwald	96	95	95	95	83	95	95	96	95	95	95	96
AT0046R	Gänserndorf	95	95	95	95	96	95	93	95	96	95	96	95
AT0047R	Stixneusiedl	96	95	95	96	96	95	96	96	96	96	96	95
AT0048R	Zoebelboden	95	95	91	93	95	93	92	95	95	95	96	95
AT0049R	Grebenzen bei St. Lamprecht	95	96	96	96	92	88	95	96	89	92	87	96
BE0001R	Offagne	97	82	99	97	97	92	98	97	98	97	98	97
BE0032R	Eupen	98	81	94	82	82	94	97	97	97	98	92	96
BE0035R	Vezin	97	83	96	97	88	97	97	95	95	95	98	98
BG0053R	Rojen peak	99	100	99	99	99	75	60	99	98	99	98	97
CH0001G	Jungfraujoch	97	97	97	97	97	97	97	98	97	97	90	97
CH0002R	Payerne	95	96	74	95	95	95	95	95	95	95	95	95
CH0003R	Tänikon	95	95	96	95	96	96	96	95	96	95	95	96
CH0004R	Chaumont	95	94	96	95	95	95	95	95	96	97	95	95
CH0005R	Rigi	95	95	96	95	96	91	95	96	96	95	95	95
CY0002R	Ayia Marina	100	100	99	99	99	98	99	100	98	91	100	99
CZ0001R	Svratouch	100	100	97	100	100	99	100	100	100	100	100	100
CZ0003R	Košetice	84	100	100	100	100	100	100	99	100	100	100	100
DE0001R	Westerland	96	96	95	94	96	94	96	96	96	95	95	96
DE0002R	Langenbrügge	93	96	93	95	96	96	95	96	96	96	95	95
DE0003R	Schauinsland	96	96	96	96	96	96	96	96	96	95	95	96
DE0007R	Neuglobsow	95	96	96	96	96	95	96	95	96	94	96	96
DE0008R	Schmücke	96	95	96	96	96	95	96	96	96	95	96	96
DE0009R	Zingst	96	96	94	94	96	96	96	96	93	96	95	90

Table 3.2, cont.

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
DK0005R	Keldsnor	97	100	97	100	99	100	95	100	100	94	100	100
DK0009R	Storebaelt	100	100	100	100	23	0	0	0	0	0	0	0
DK0031R	Ulborg	100	100	95	98	98	85	66	95	39	95	85	100
DK0041R	Lille Valby	100	100	98	100	100	100	100	100	97	97	98	100
EE0009R	Lahemaa	100	100	99	100	99	96	100	100	100	86	92	100
EE0011R	Vilsandi	100	100	99	100	99	99	99	100	100	100	100	100
ES0007R	Viznar	99	100	76	99	100	97	91	99	99	99	96	99
ES0008R	Niembro	98	100	98	100	98	99	99	98	99	99	99	99
ES0009R	Campisábalos	93	92	100	91	96	94	98	99	94	99	100	100
ES0010R	Cabo de Creus	89	100	100	99	100	100	100	80	99	100	100	98
ES0011R	Barcarrola	94	97	83	97	95	100	100	100	97	100	100	100
ES0012R	Zarra	99	100	91	95	99	99	100	91	86	98	99	100
ES0013R	Penausende	98	100	99	99	100	99	99	100	99	100	99	99
ES0014R	Els Torms	92	94	99	97	99	99	99	100	100	99	100	100
ES0016R	O Saviñao	95	100	100	99	99	99	99	97	99	100	100	100
FI0009R	Utö	100	98	100	100	100	100	93	97	98	98	98	99
FI0017R	Virolahti II	98	100	100	100	98	98	97	98	96	98	98	99
FI0022R	Oulanka	98	100	99	99	100	96	98	98	97	97	98	99
FI0037R	Ahtari II	96	100	100	100	99	98	97	98	97	98	99	98
FI0096G	Pallas (Sammaltunturi)	97	100	100	100	100	97	96	98	96	98	89	98
FR0008R	Donon A	89	98	98	98	99	98	97	99	31	0	0	0
FR0008R	Donon B	91	100	100	99	100	100	99	100	31	0	0	0
FR0008R	Donon C	91	100	100	99	100	100	98	100	32	0	0	0
FR0008R	Donon D	90	98	98	97	99	99	97	99	32	0	0	0
FR0008R	Donon E	0	0	0	0	0	0	0	0	64	99	100	100
FR0009R	Revin	97	99	100	100	100	100	99	100	100	100	100	100
FR0010R	Morvan	100	100	100	100	100	31	2	100	100	87	100	100
FR0012R	Iraty	98	99	99	97	96	99	99	97	99	98	99	80
FR0013R	Peyrusse Vieille	95	86	100	100	99	73	100	100	100	100	98	99
FR0014R	Montandon	100	100	100	99	99	100	100	99	100	100	99	100
FR0015R	La Tardière	100	100	100	99	100	100	100	85	96	100	100	100
FR0016R	Le Casset	98	98	99	97	99	98	99	37	48	99	98	100
FR0017R	Montfranc	99	100	99	98	91	99	99	99	99	99	99	93
FR0018R	La Coulonche	92	100	100	100	77	99	97	97	95	100	100	99

Table 3.2, cont.

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
GB0002R	Eskdalemuir	99	93	67	57	91	88	97	88	100	100	99	100
GB0006R	Lough Navar	97	99	100	99	100	100	100	98	98	97	88	79
GB0013R	Yarner Wood	94	72	87	100	94	94	93	88	91	90	73	89
GB0014R	High Muffles	99	29	78	91	74	100	96	100	99	93	100	92
GB0015R	Strath Vaich Dam	71	63	99	100	90	81	88	100	94	77	90	62
GB0031R	Aston Hill	27	17	100	100	98	97	75	98	99	100	100	100
GB0033R	Bush	100	99	96	99	100	99	98	86	95	99	100	99
GB0035R	Great Dun Fell	99	99	97	98	99	97	96	97	75	96	92	98
GB0036R	Harwell	100	92	93	100	100	100	100	99	93	97	100	99
GB0037R	Ladybower Res.	95	96	100	100	100	100	100	100	88	100	100	100
GB0038R	Lullington Heath	100	96	96	99	100	99	100	100	95	98	98	99
GB0039R	Sibton	100	100	85	89	100	100	100	100	54	0	0	0
GB0043R	Narberth	0	0	0	93	90	99	91	98	100	100	92	100
GB0044R	Somerton	100	88	12	0	0	6	0	0	0	0	0	0
GB0045R	Wicken Fen	0	89	97	98	100	100	99	100	96	99	100	99
GB0048R	Auchencorth Moss	100	99	78	99	100	99	100	100	100	100	100	99
GB0049R	Weybourne	100	100	93	99	96	100	98	88	95	99	100	100
GB0050R	St. Osyth	100	99	96	100	100	99	59	32	96	100	100	100
GB0051R	Market Harborough	96	100	100	100	100	100	96	100	99	100	97	97
GB0052R	Lerwick	98	99	100	98	100	100	68	95	99	100	100	99
GR0002R	Finokalia	0	49	0	77	100	89	100	95	99	97	89	62
HU0002R	K-puszta	100	62	98	100	100	100	100	100	100	97	100	100
IE0031R	Mace Head	100	100	100	100	100	100	100	100	100	100	100	99
IT0001R	Montelibretti	100	100	100	100	100	100	100	100	100	100	88	76
IT0004R	Ispra	100	97	89	94	100	99	97	100	72	93	9	38
LT0015R	Preila	85	100	96	100	98	100	94	91	99	95	99	100
LV0010R	Rucava	99	76	84	96	98	96	73	97	99	100	47	8
LV0016R	Zoseni	15	100	30	18	99	100	100	100	100	100	100	100
MT0001R	Giordan lighthouse	92	68	63	100	99	73	94	53	100	96	75	34
NL0007R	Eibergen	99	99	100	100	99	100	92	100	99	100	98	100
NL0009R	Kollumerwaard	99	96	98	100	100	100	86	99	99	99	98	100
NL0010R	Vredepeel	99	96	100	99	100	100	100	99	100	100	97	99
NL0011R	Cabauw	99	100	100	100	100	99	99	99	100	100	98	97
NL0091R	De Zilk	77	78	82	92	86	96	100	98	90	78	39	97

Table 3.2, cont.

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NO0001R	Birkenes	98	99	98	99	100	98	97	99	98	99	100	99
NO0015R	Tustervatn	100	99	100	100	100	99	99	100	99	100	100	99
NO0039R	Kårvatn	100	100	98	100	100	99	99	91	80	98	100	100
NO0042G	Spitsbergen, Zeppelinfjell	96	97	99	97	96	91	98	97	93	99	100	100
NO0043R	Prestebakke	100	100	100	100	100	100	100	99	100	100	100	100
NO0052R	Sandve	100	100	100	100	100	99	100	98	99	100	100	100
NO0055R	Karasjok	100	100	99	100	100	100	100	100	99	100	100	100
NO0056R	Hurdal	100	99	100	100	100	99	100	100	100	100	96	100
PL0002R	Jarczew	98	100	100	98	95	99	100	100	100	99	100	99
PL0003R	Sniezka	85	100	100	100	100	100	100	82	94	96	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	100	100	91	100	100
PT0004R	Monte Velho	10	60	99	100	100	100	100	100	100	100	100	100
SE0005R	Bredkälen	99	100	100	93	76	99	100	100	100	98	98	99
SE0011R	Vavihill	99	99	100	99	93	100	100	99	100	98	99	85
SE0012R	Aspvreten	89	78	94	100	100	100	100	98	96	100	92	97
SE0013R	Esrange	78	100	100	100	100	99	100	100	100	99	98	99
SE0014R	Råö	100	100	100	99	100	100	100	100	99	99	99	99
SE0032R	Norra-Kvill	98	96	100	100	100	99	100	99	100	98	99	99
SE0035R	Vindeln	99	99	99	99	100	99	100	88	100	99	99	96
SE0039R	Grimsö	98	100	100	97	100	100	100	100	99	97	98	99
SI0008R	Iskrba	95	96	95	95	94	95	94	95	94	91	96	96
SI0031R	Zarodnje	91	94	96	96	96	96	95	96	95	96	95	96
SI0032R	Krvavec	93	95	95	95	95	91	79	87	93	92	82	94
SI0033R	Kovk	93	96	95	85	60	85	48	9	95	94	92	86
SK0002R	Chopok	99	99	100	100	98	85	100	100	100	100	100	100
SK0004R	Stará Lesná	99	100	100	100	100	100	99	100	100	98	100	100
SK0006R	Starina	91	100	91	92	96	100	100	100	100	100	100	100
SK0007R	Topolniky	100	99	99	99	99	99	97	99	100	100	100	100

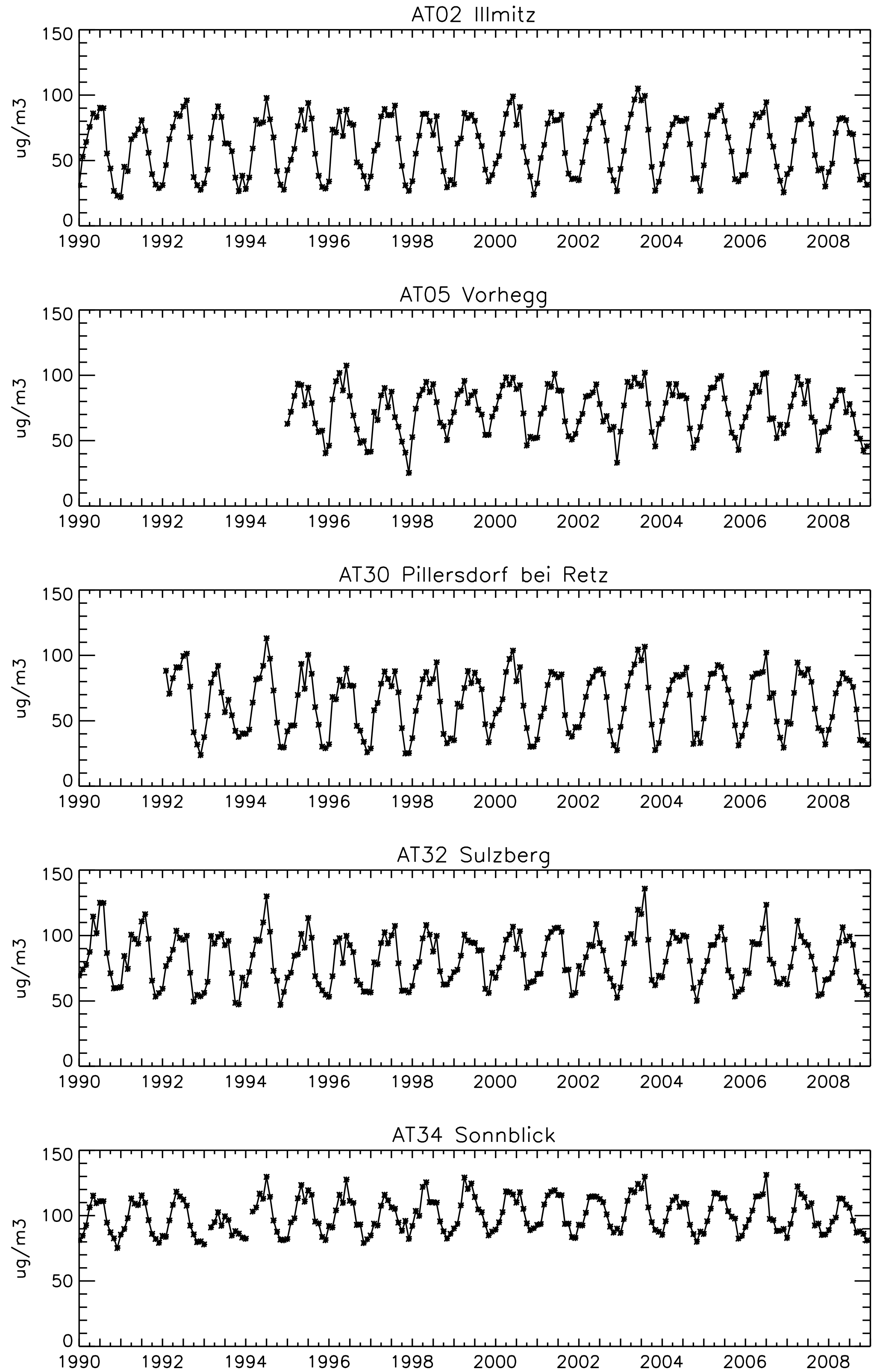


Figure 3.1: Seasonal variation, 1990–2008.

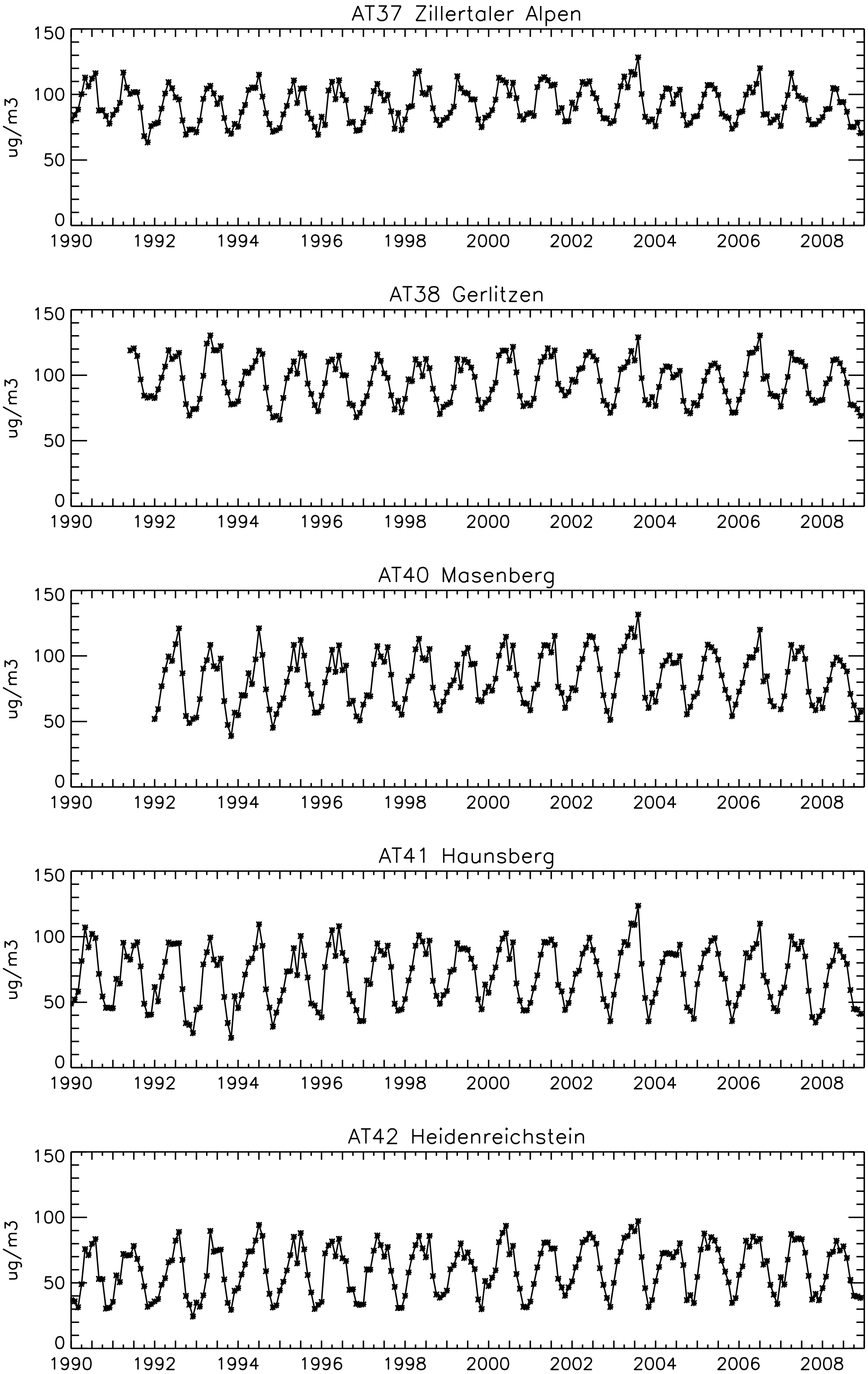


Figure 3.1, cont.

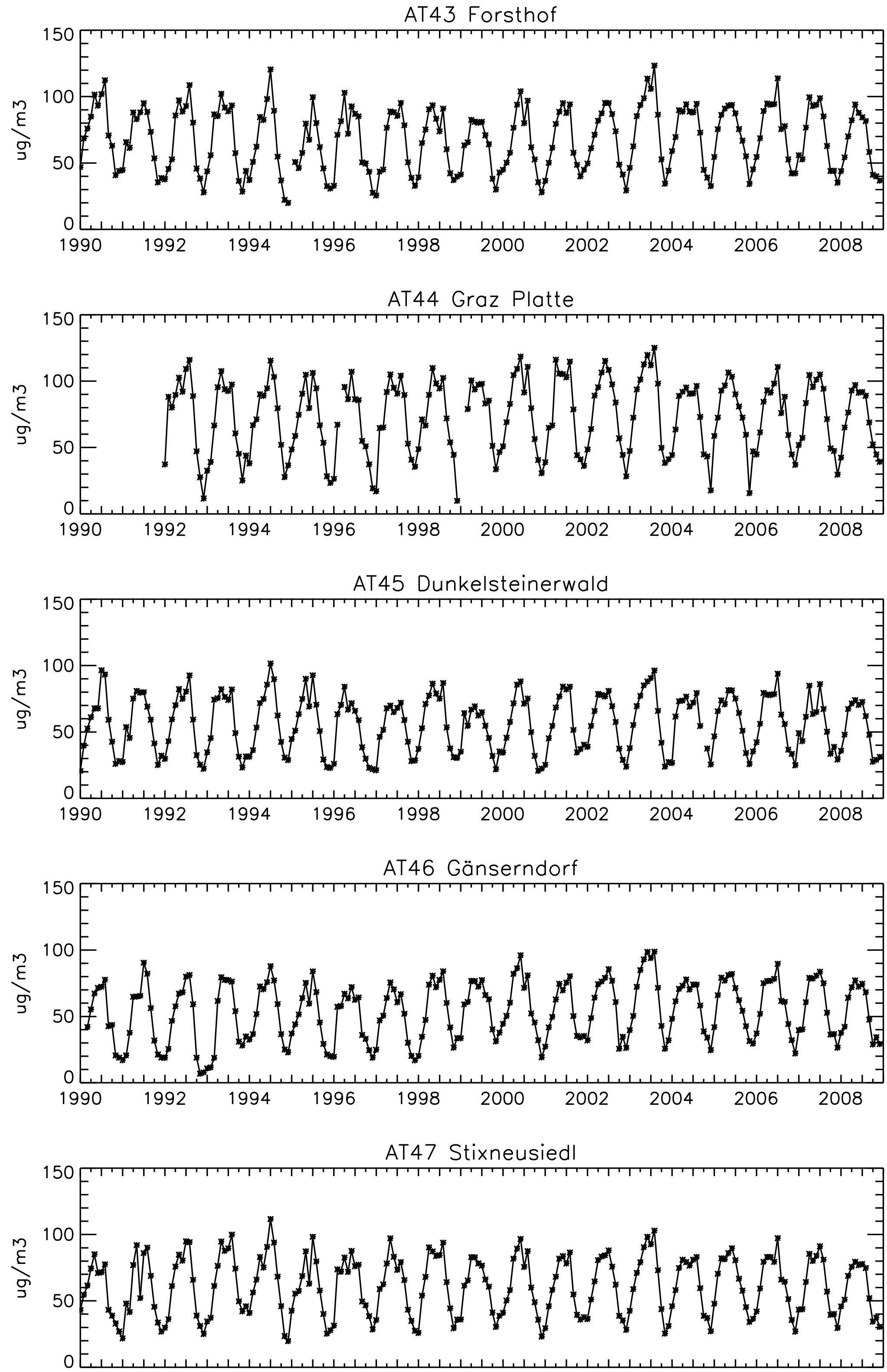
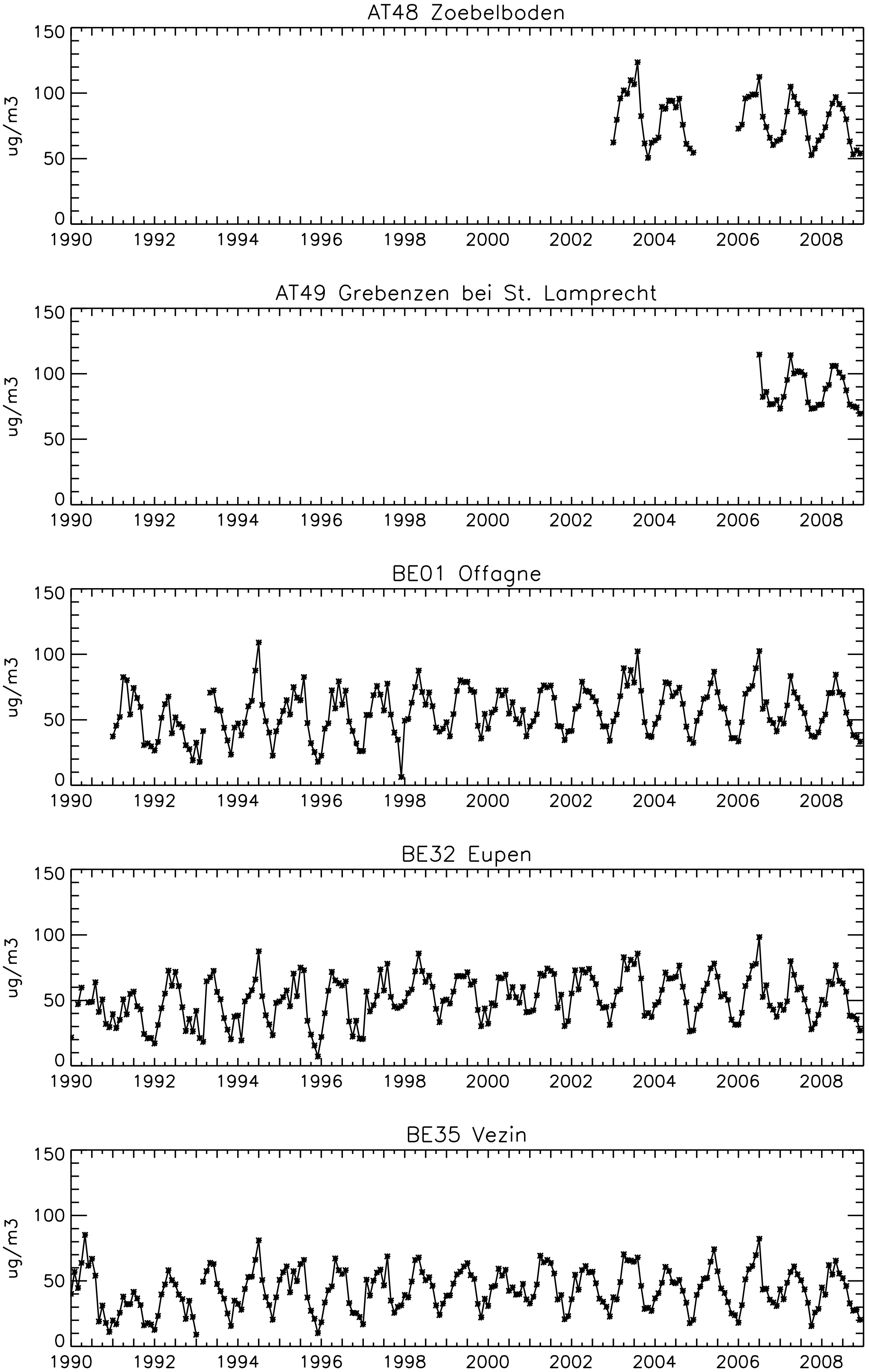


Figure 3.1, cont.



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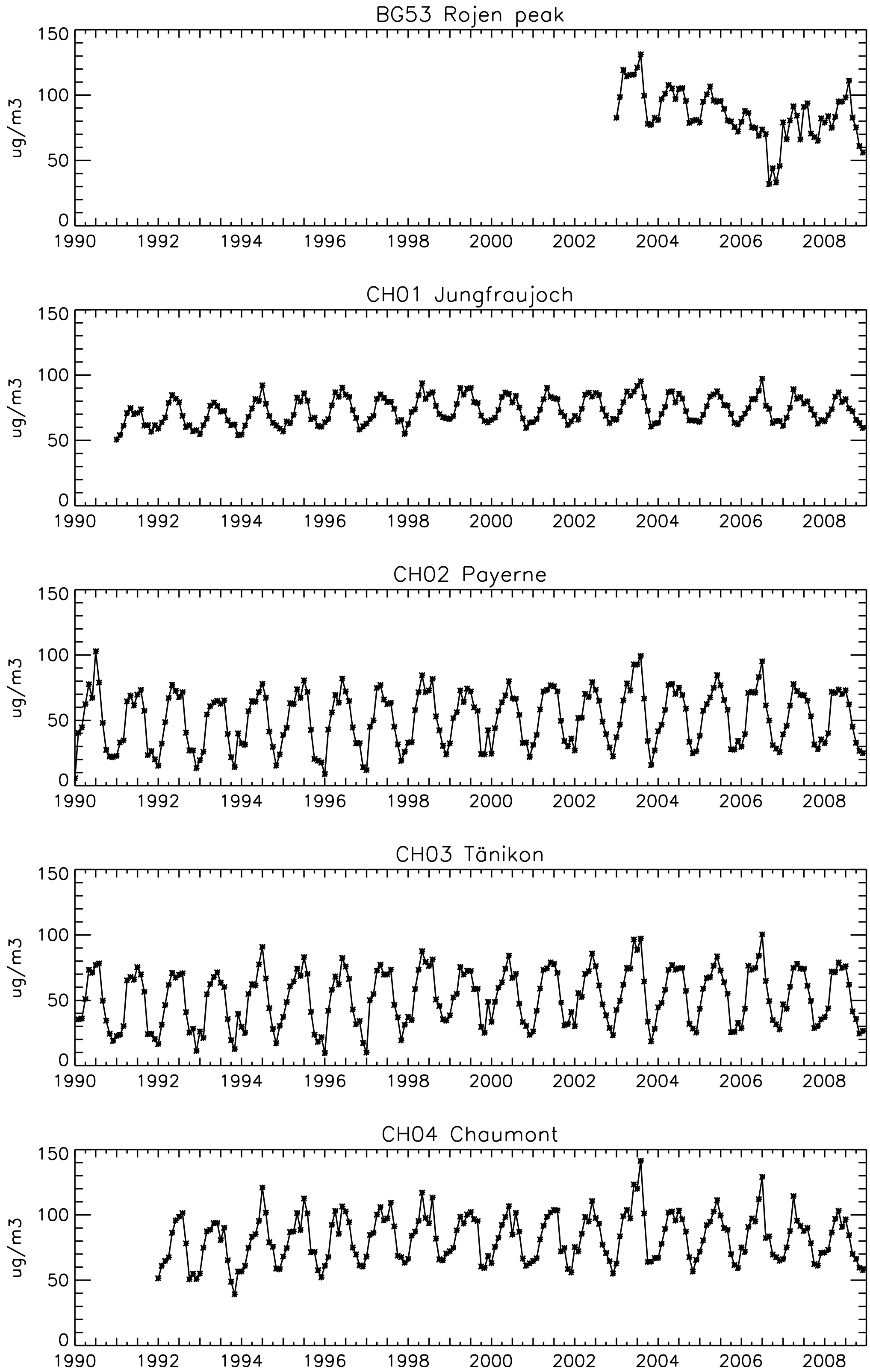

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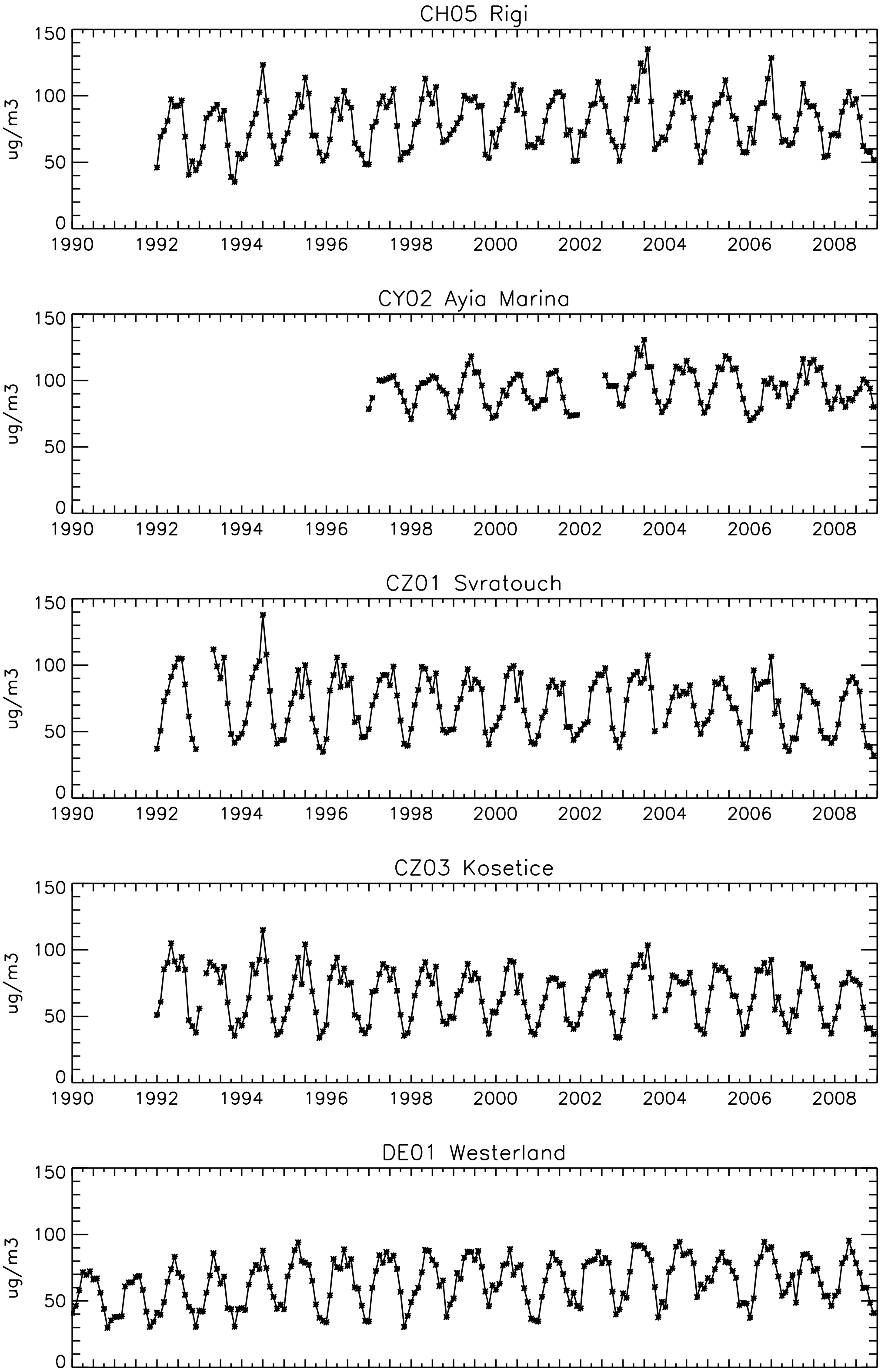

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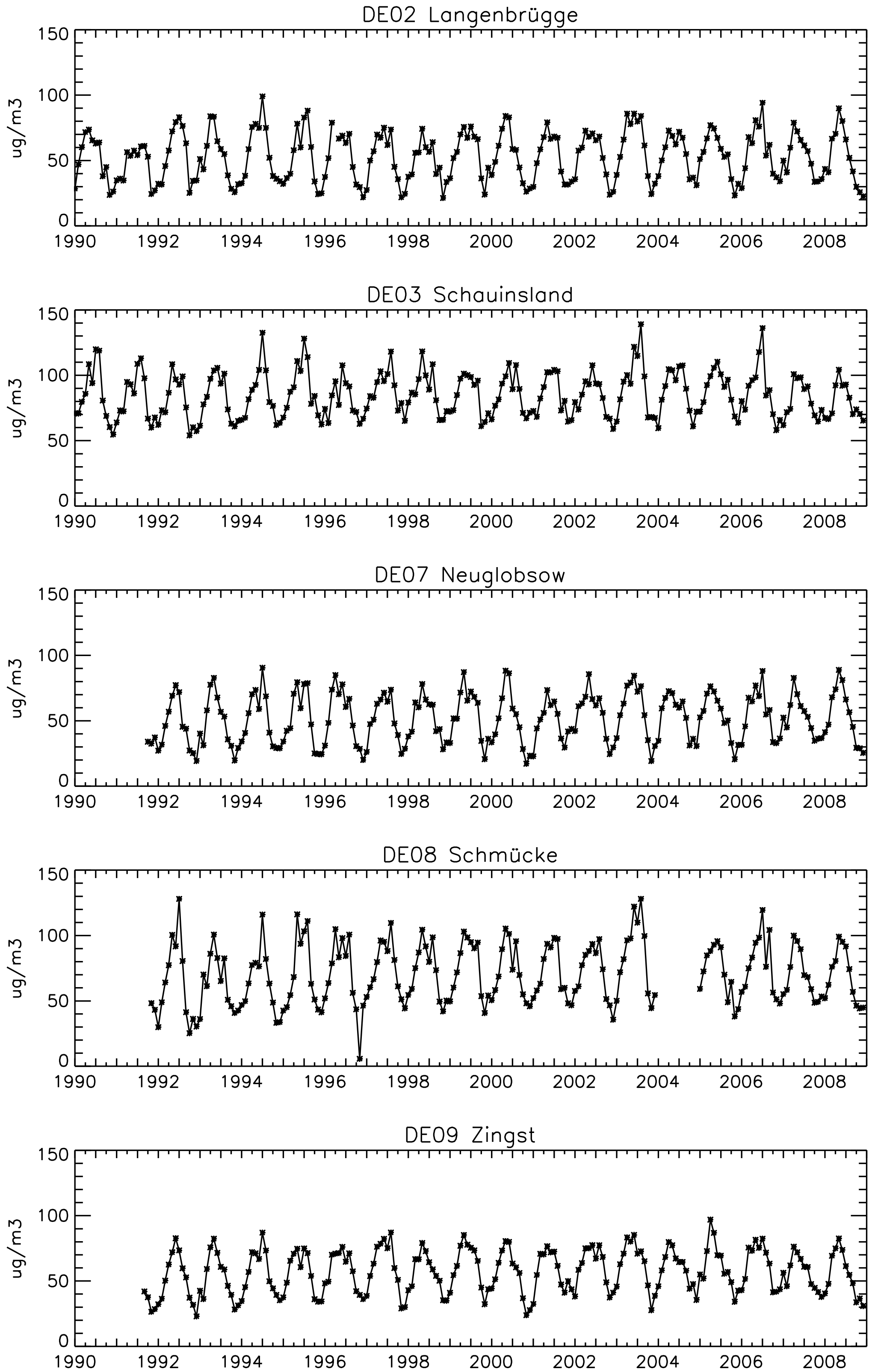

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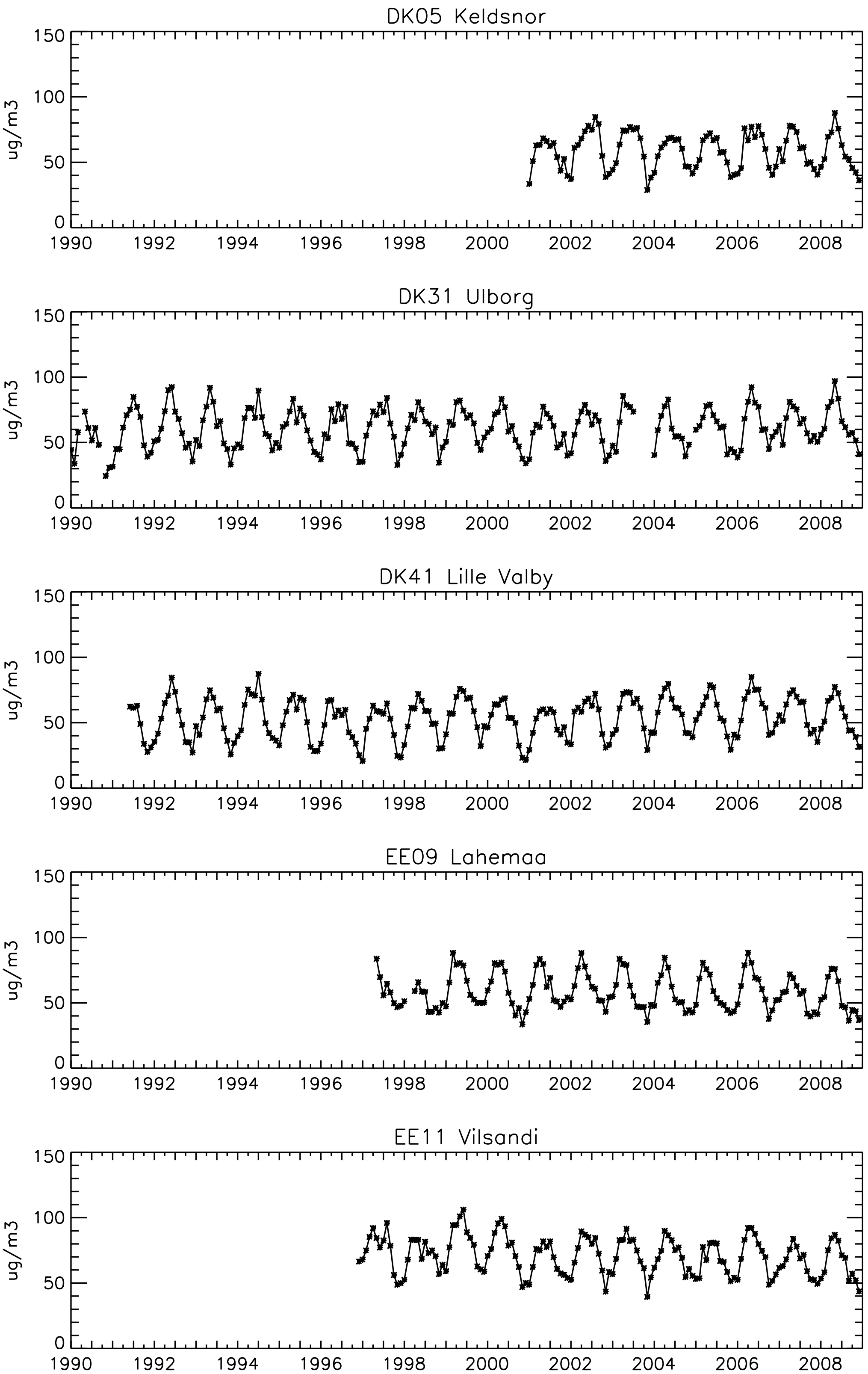

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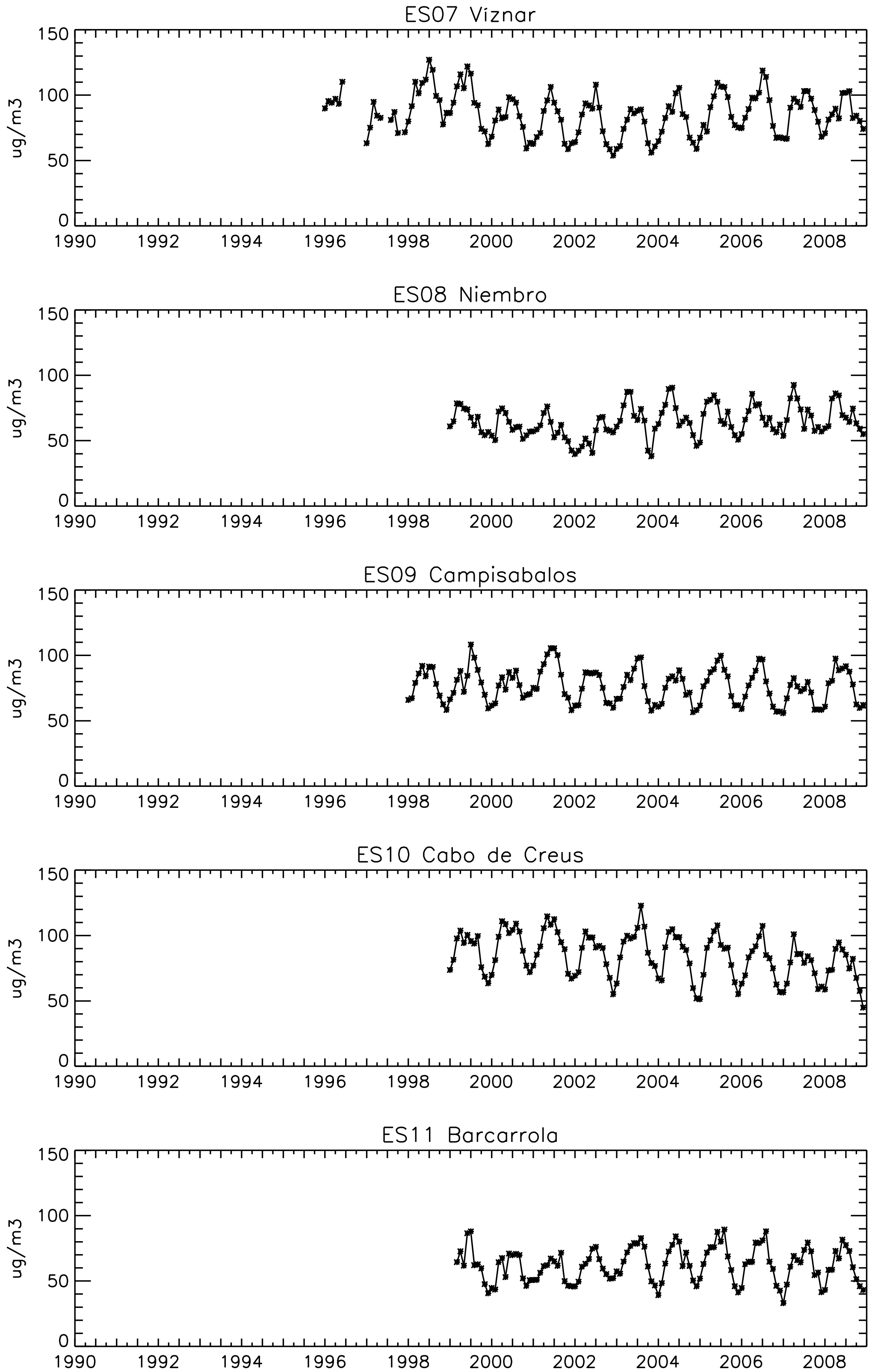

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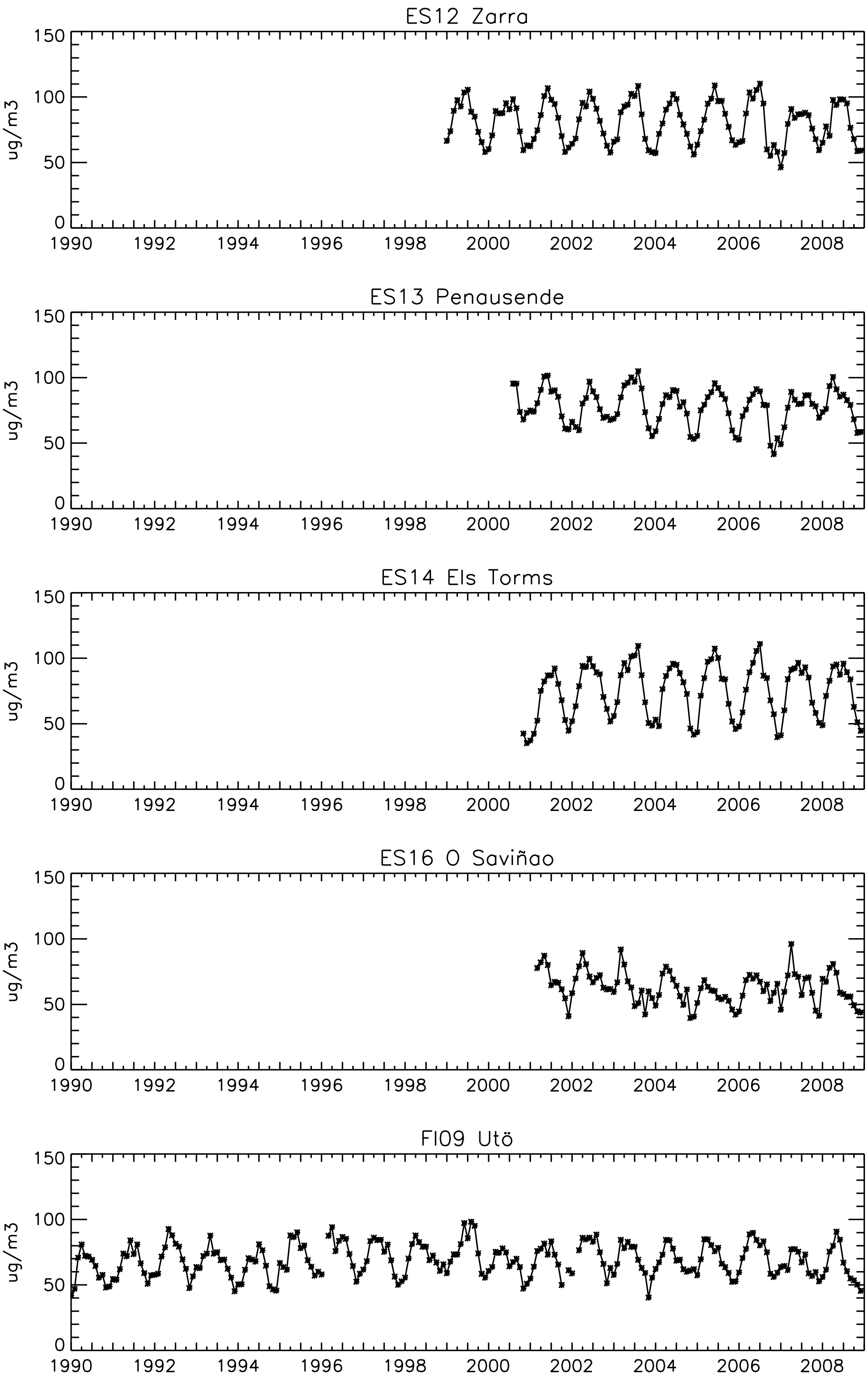

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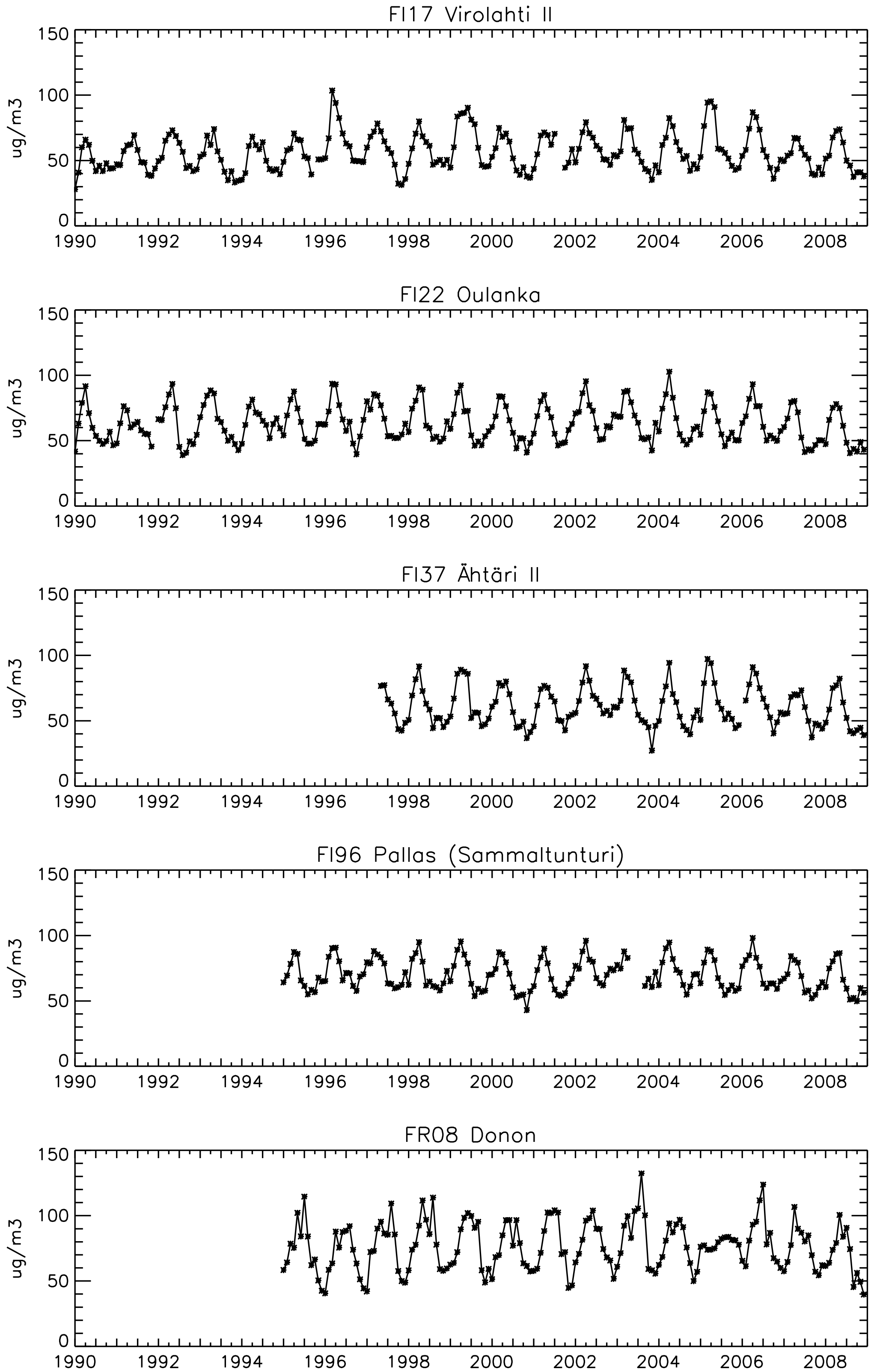

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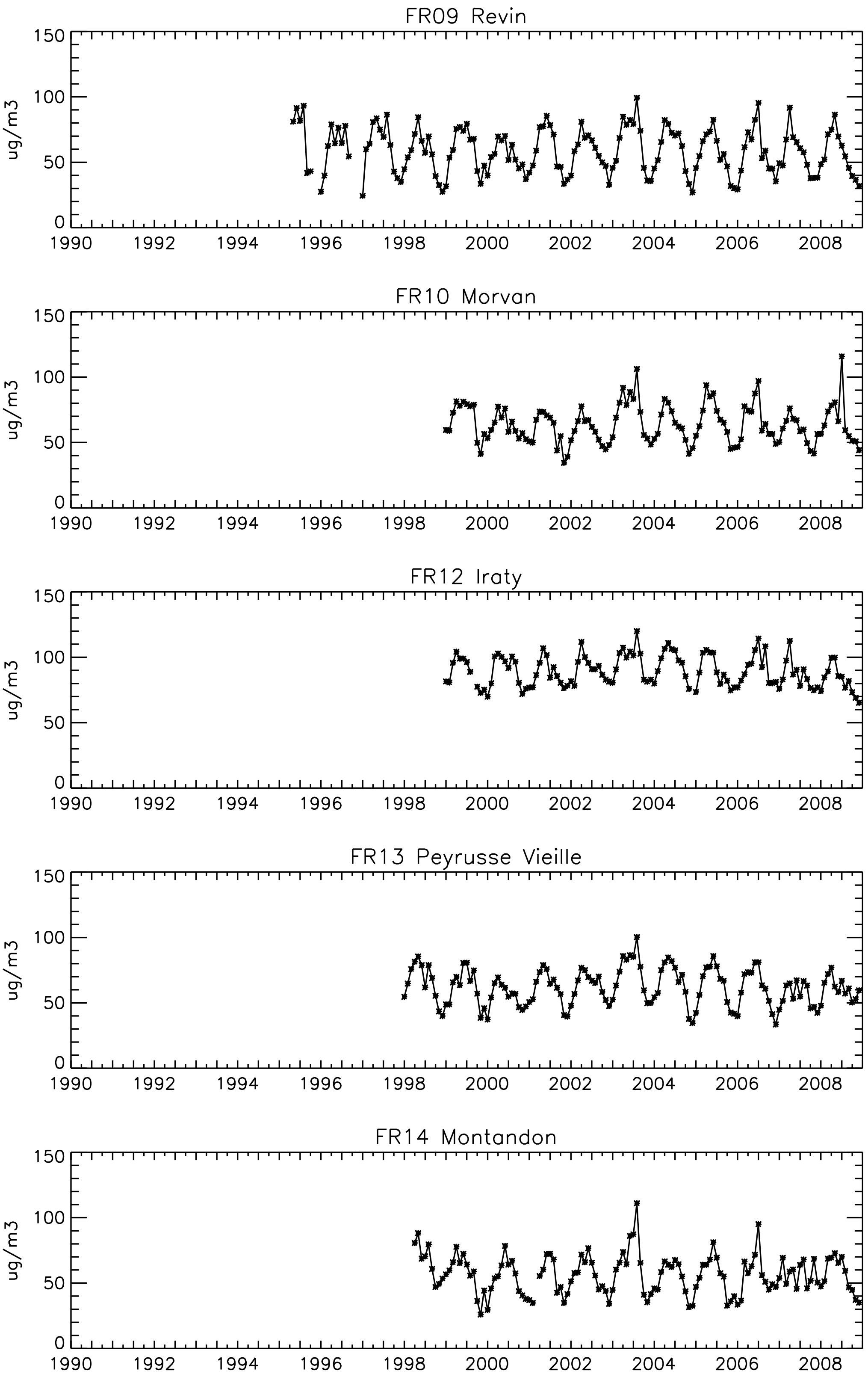

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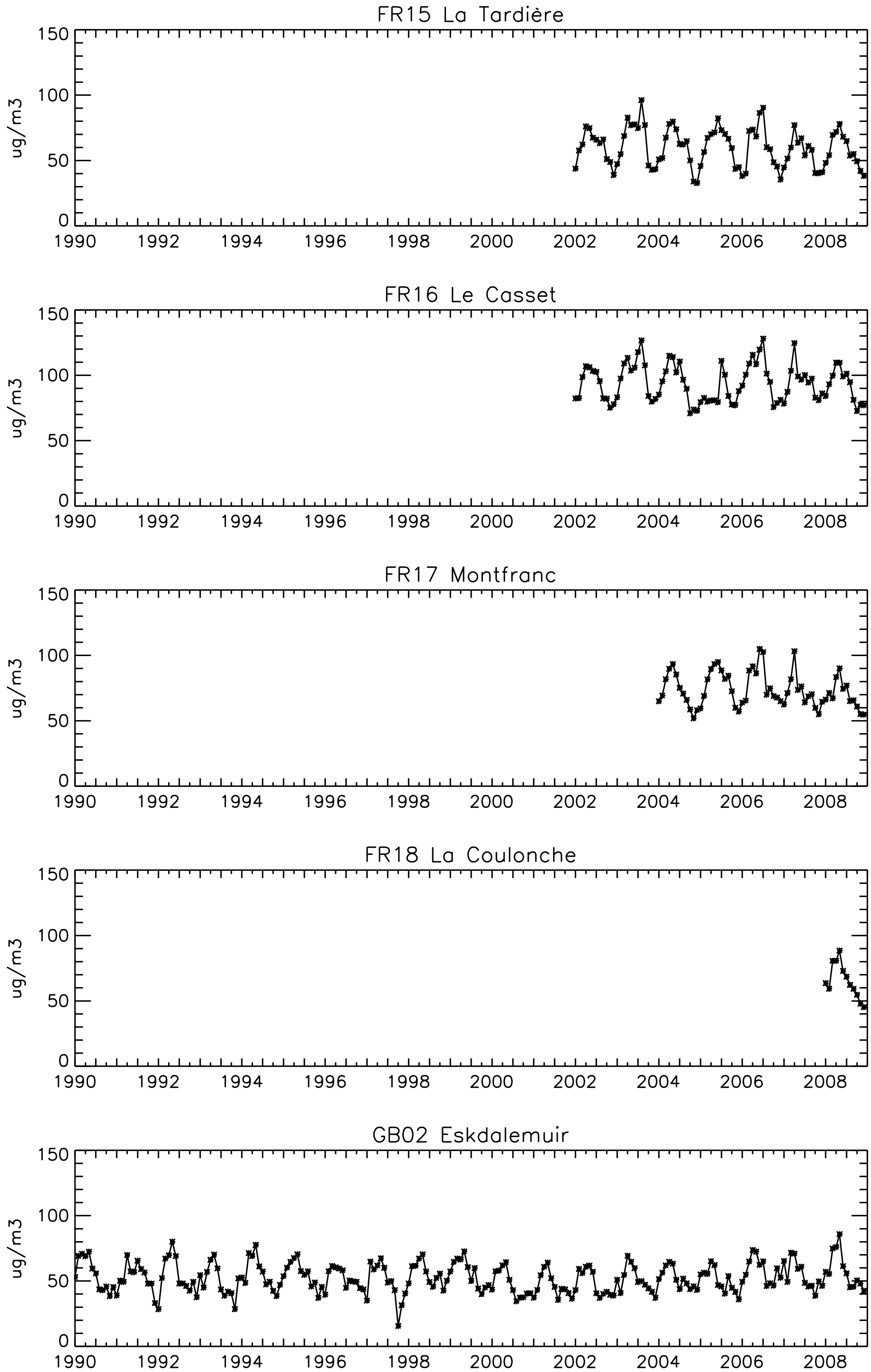

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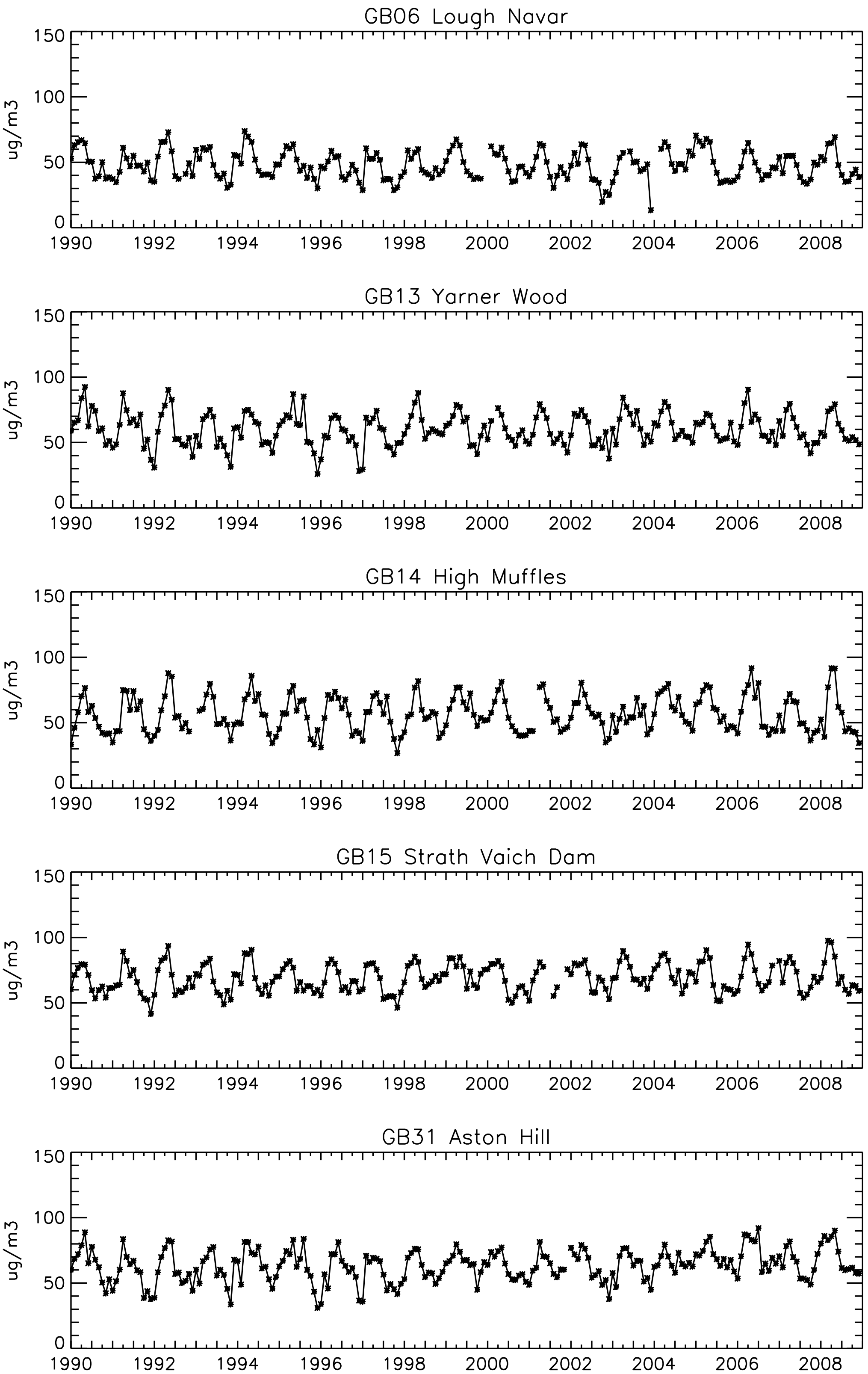


Figure 3.1, cont.

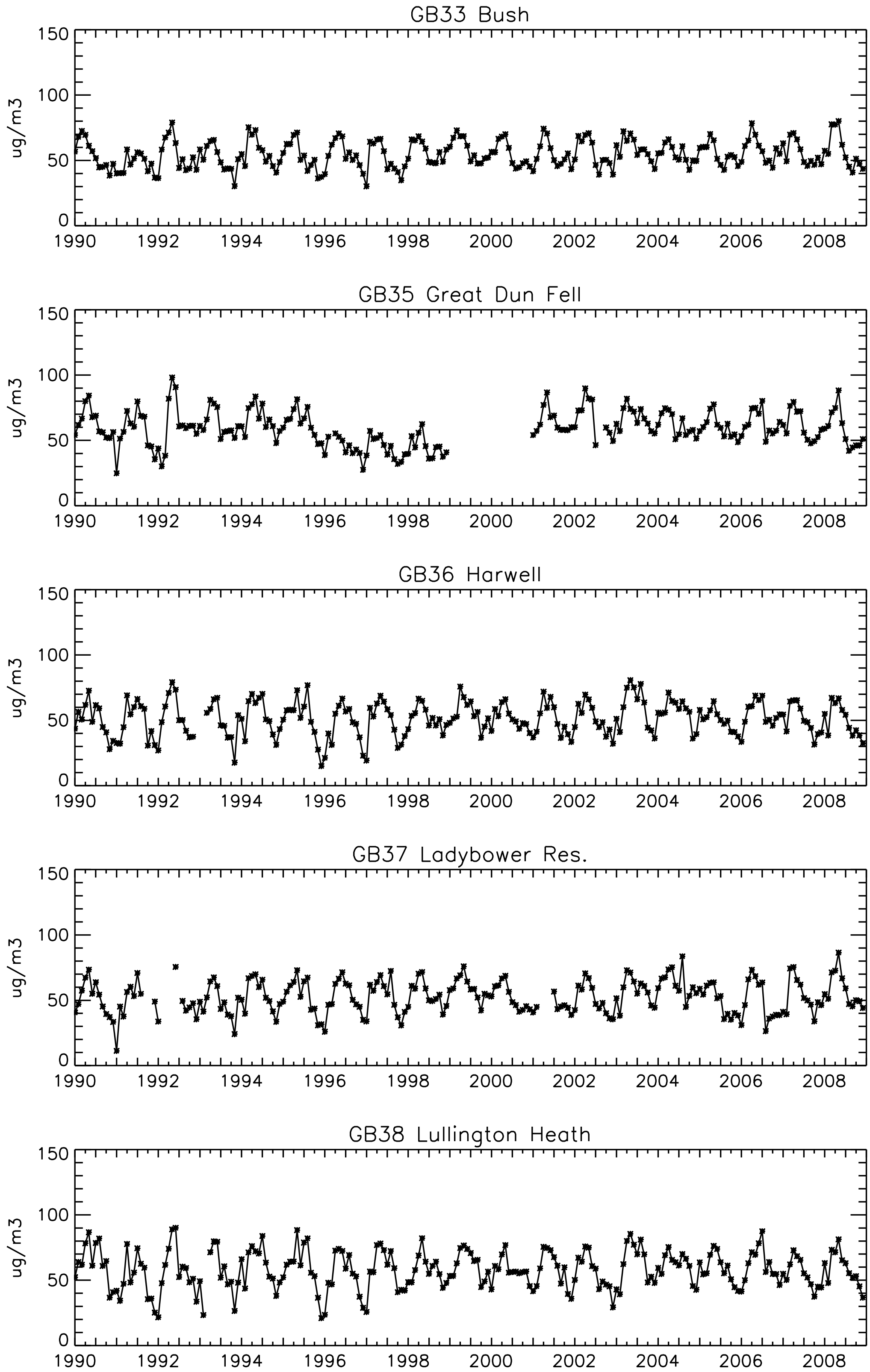
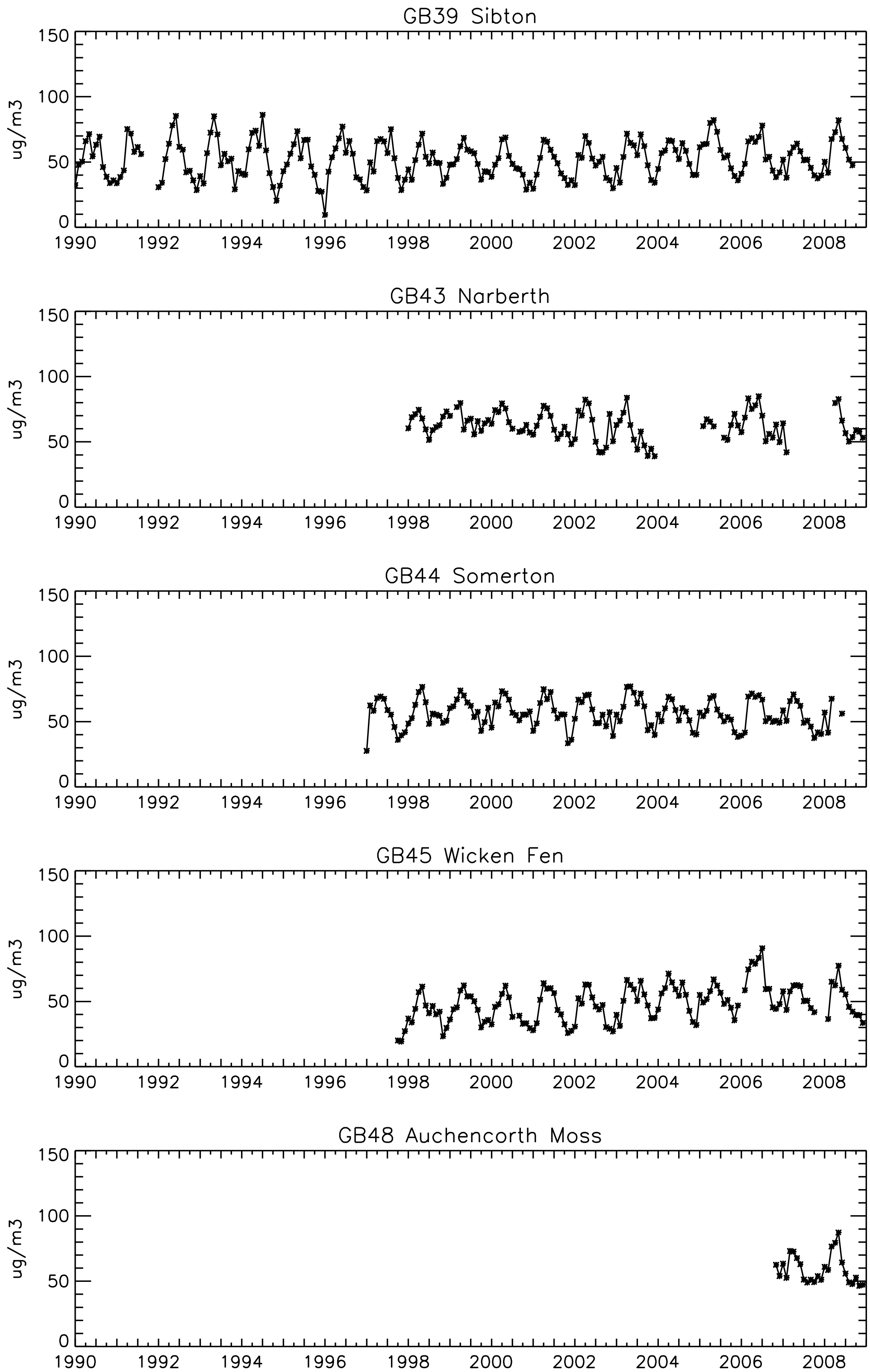


Figure 3.1, cont.



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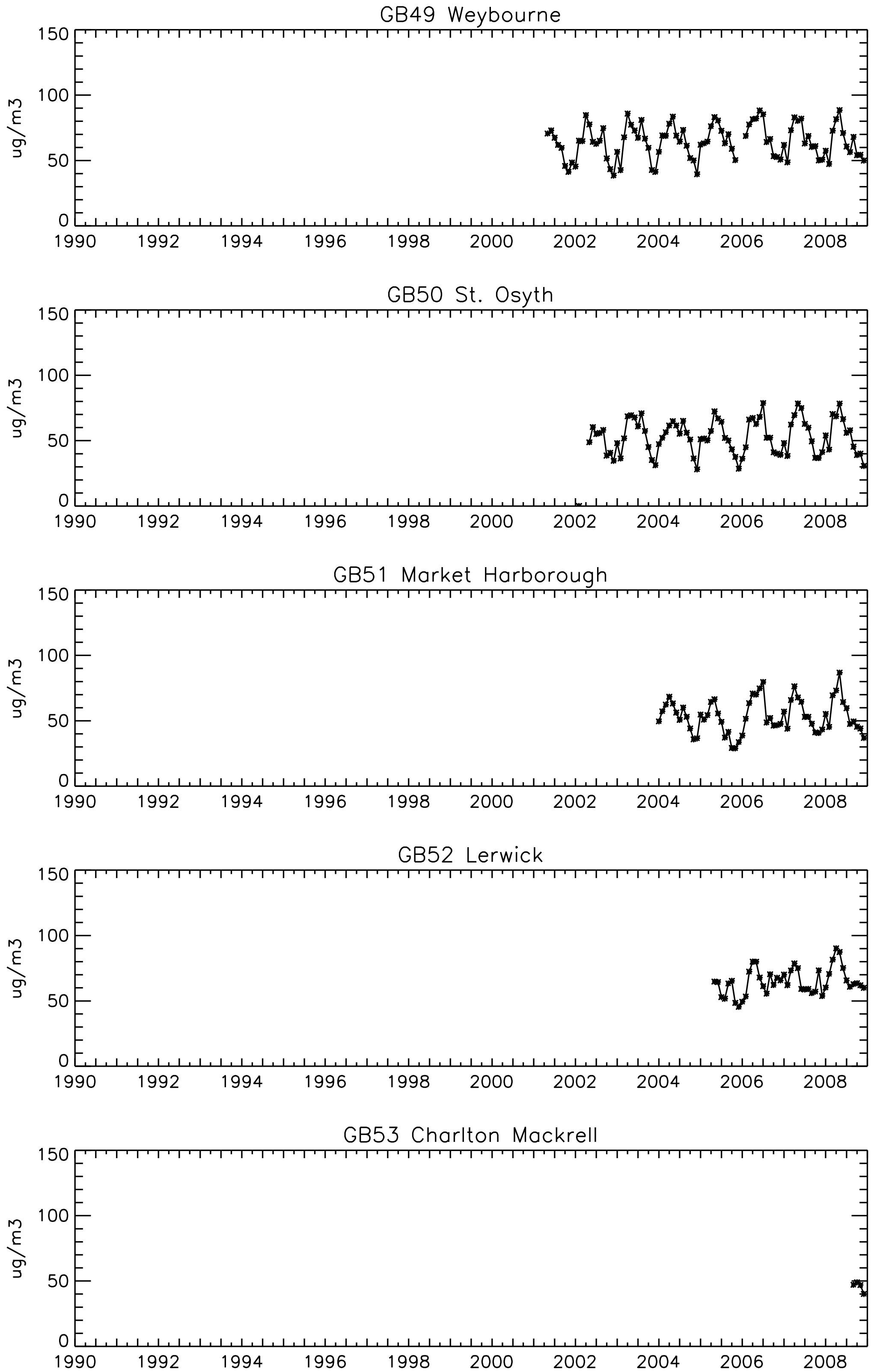

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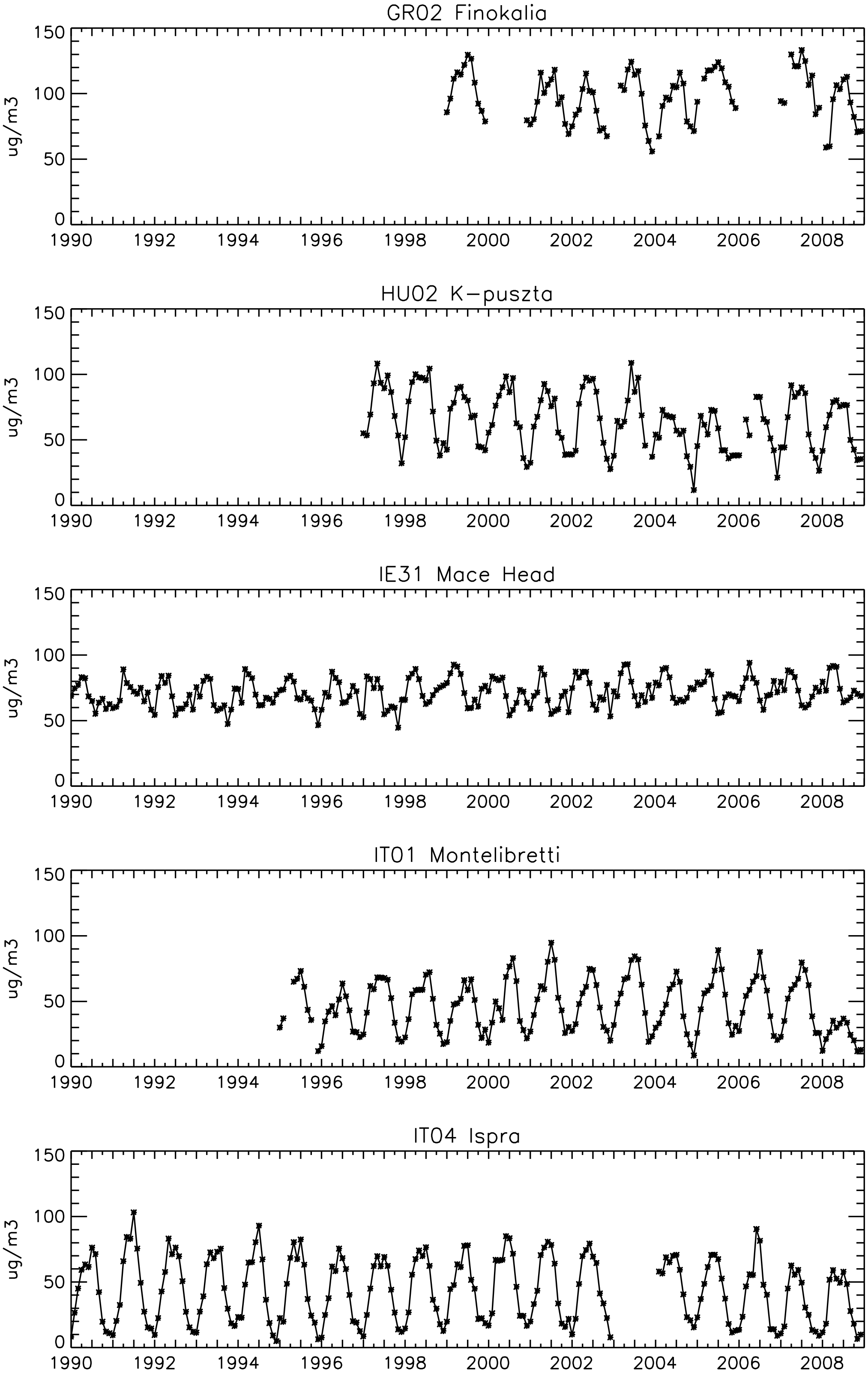

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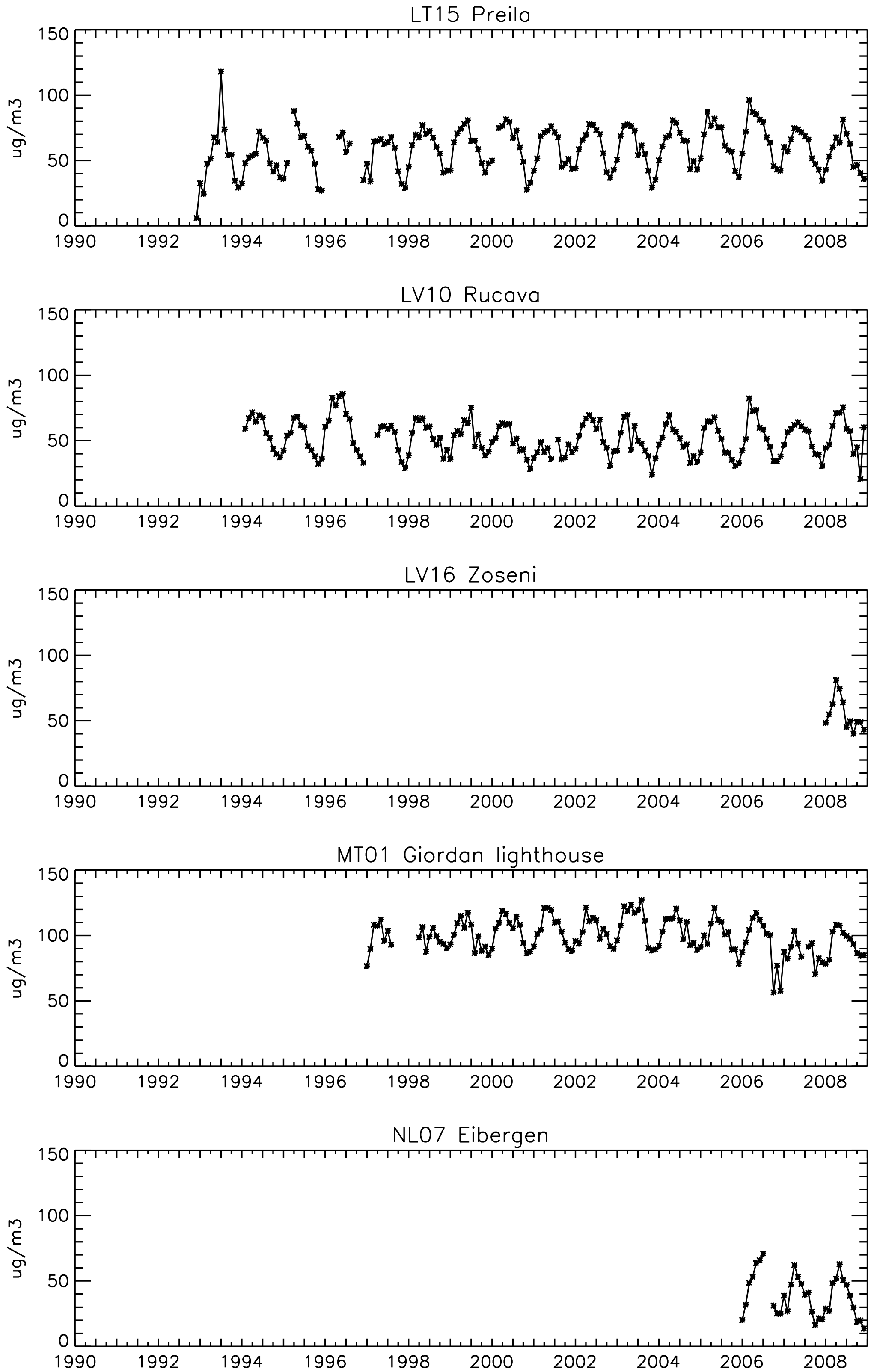

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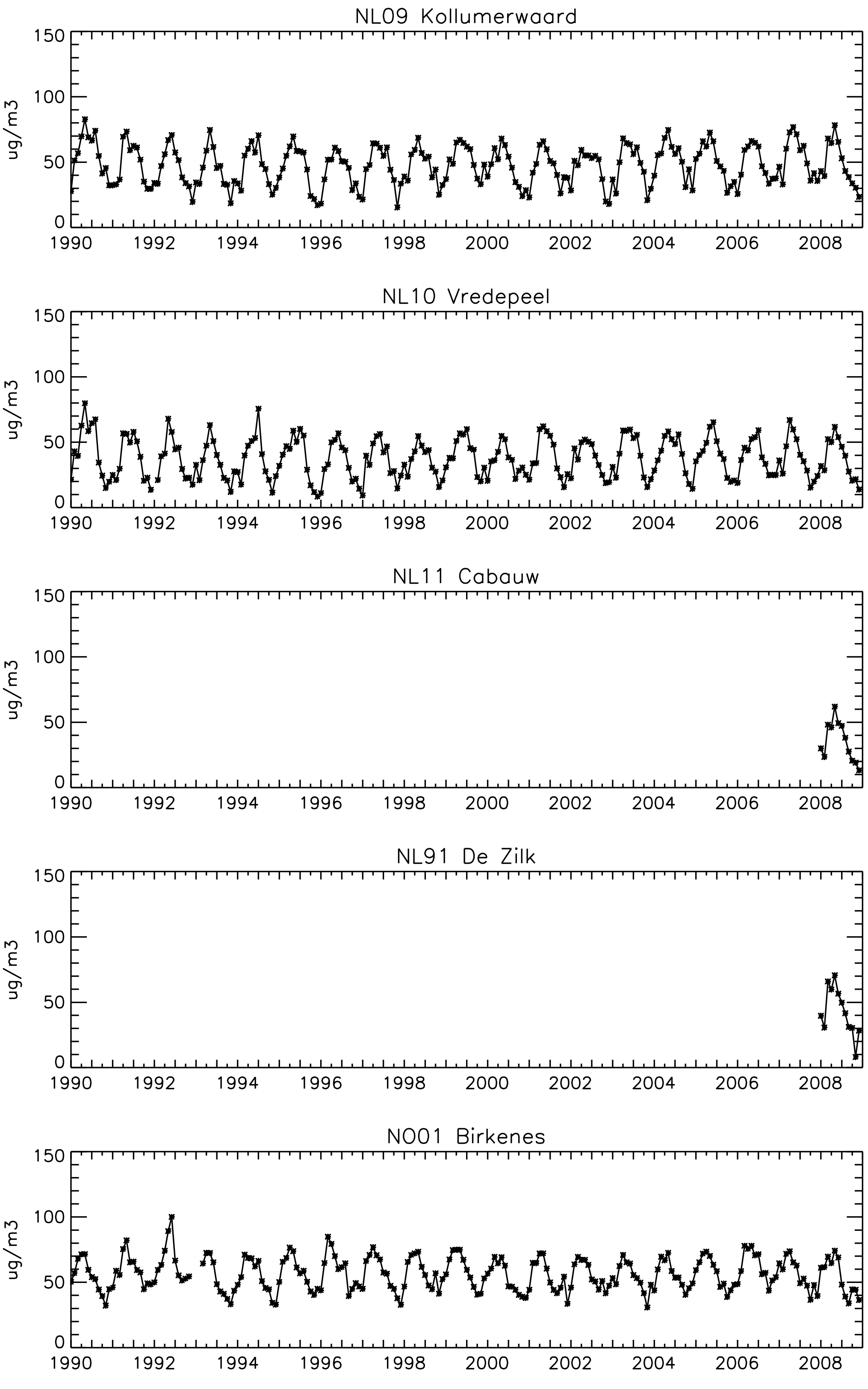

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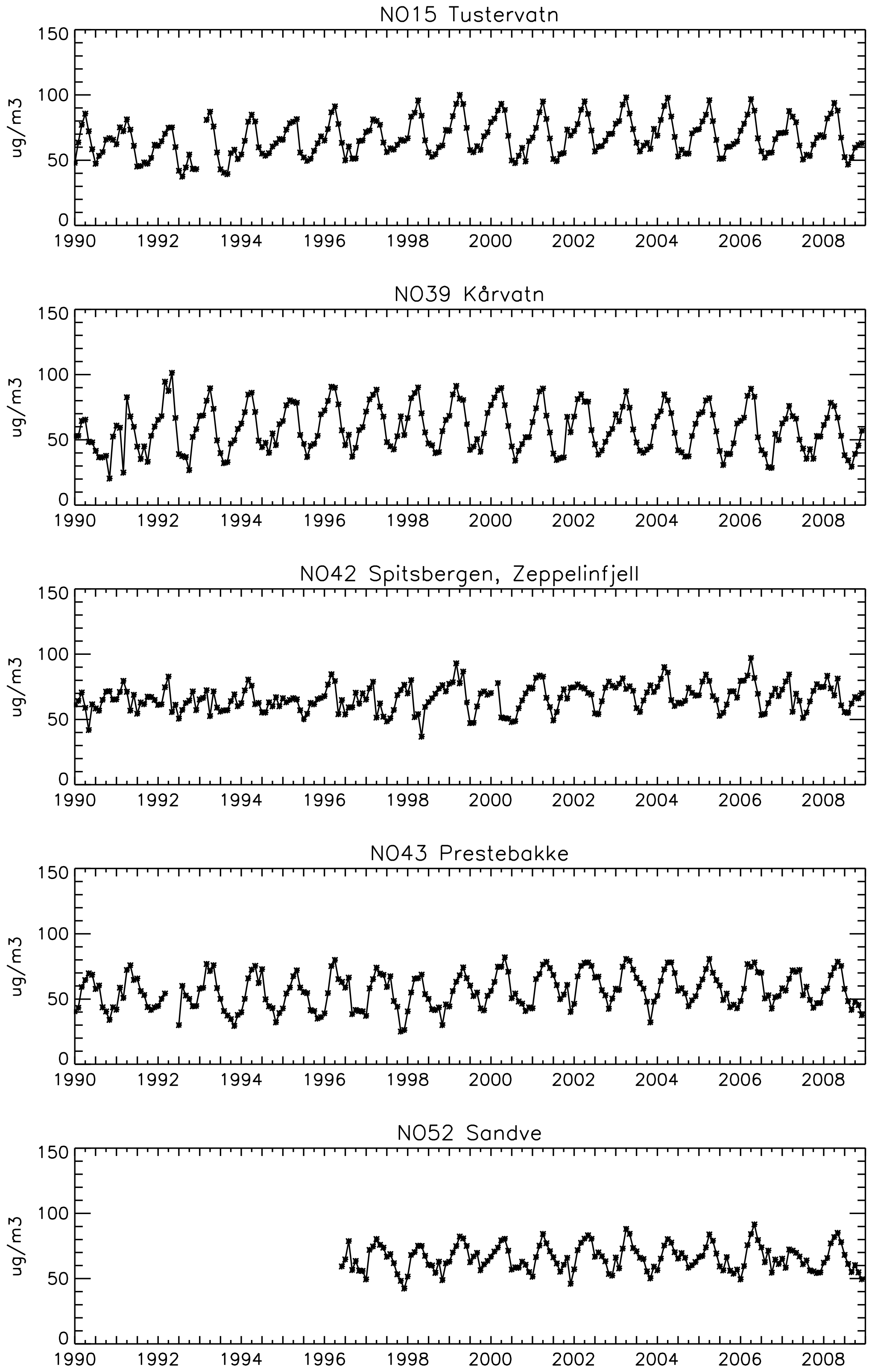

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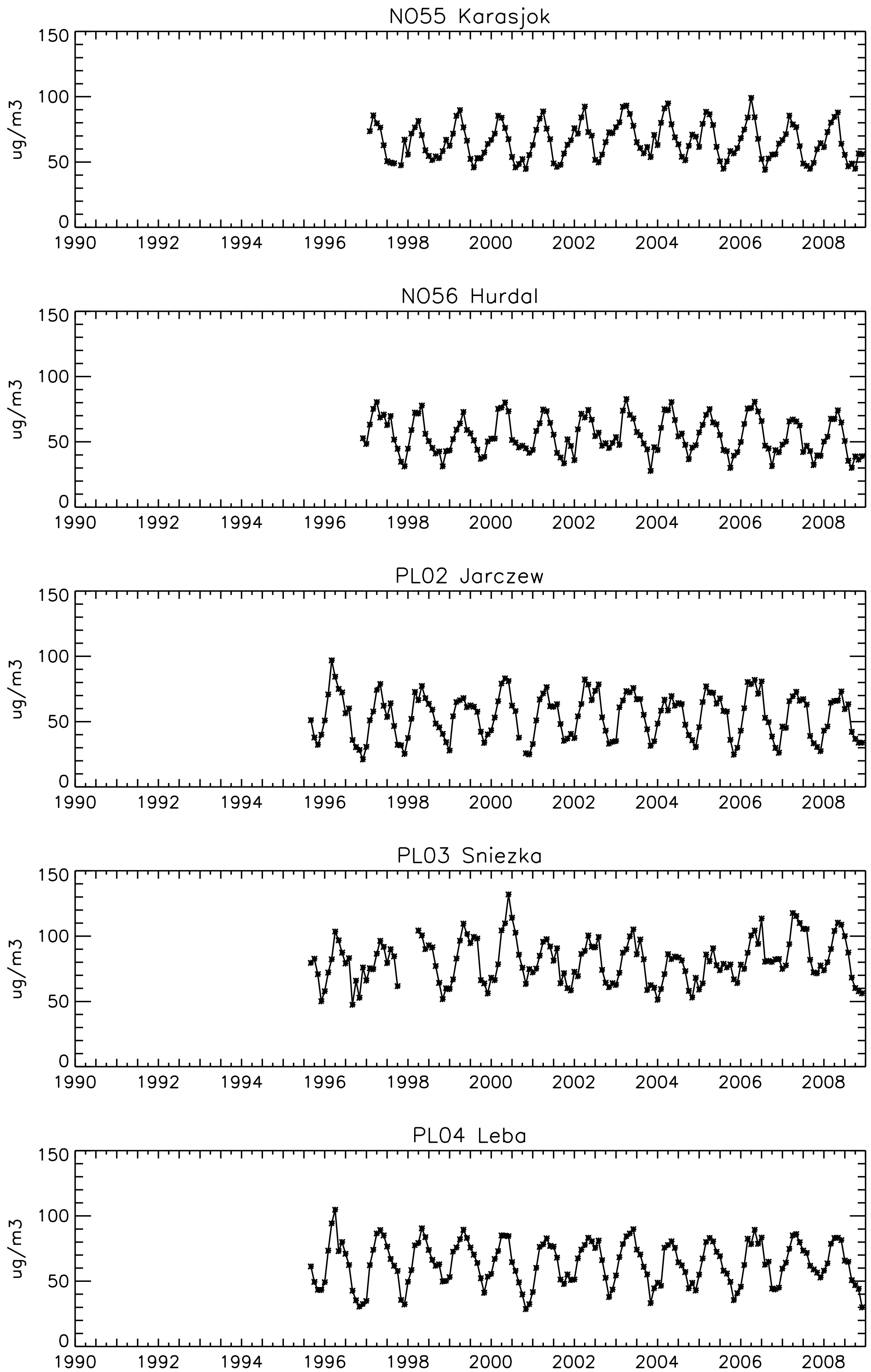

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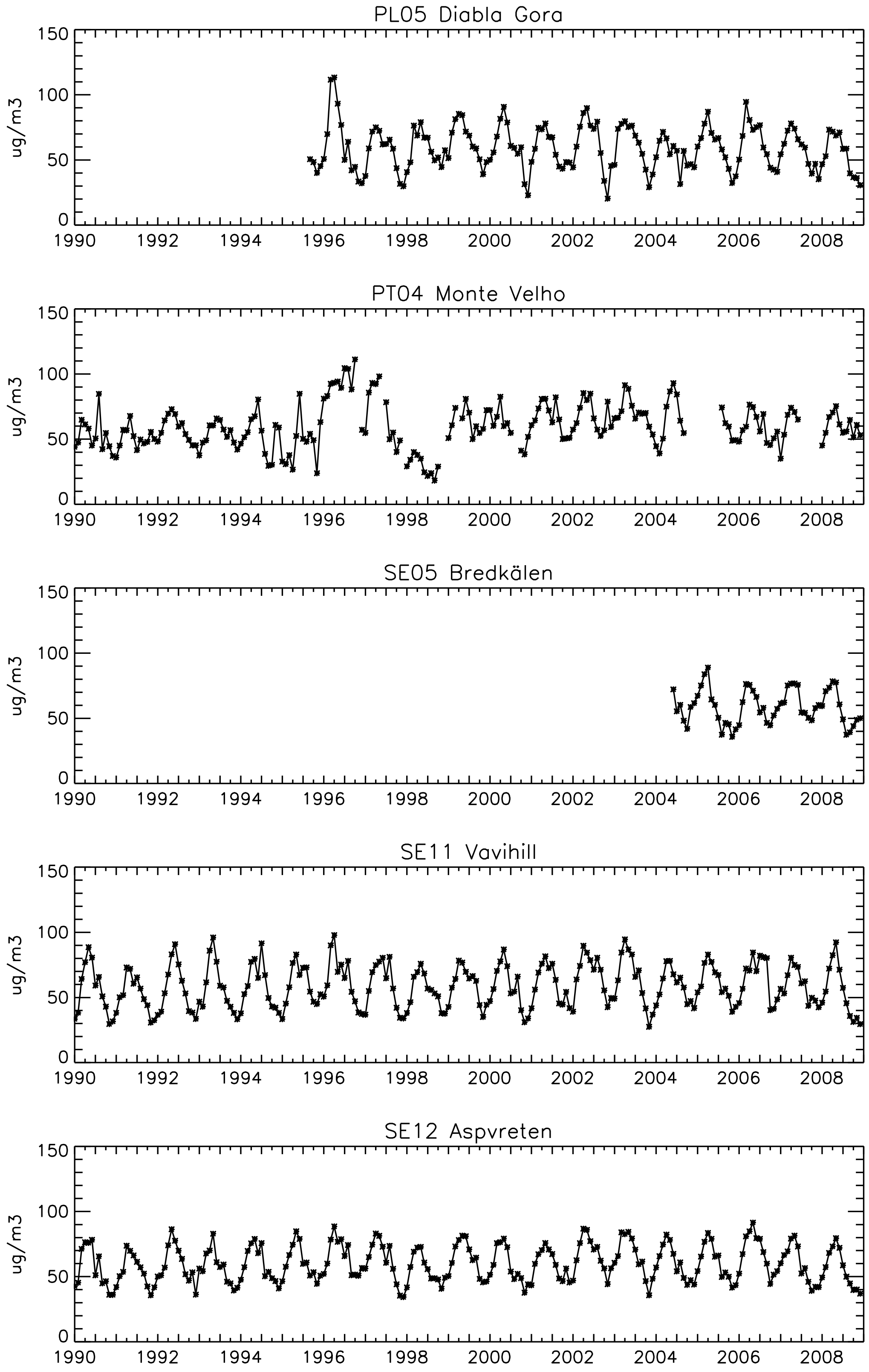

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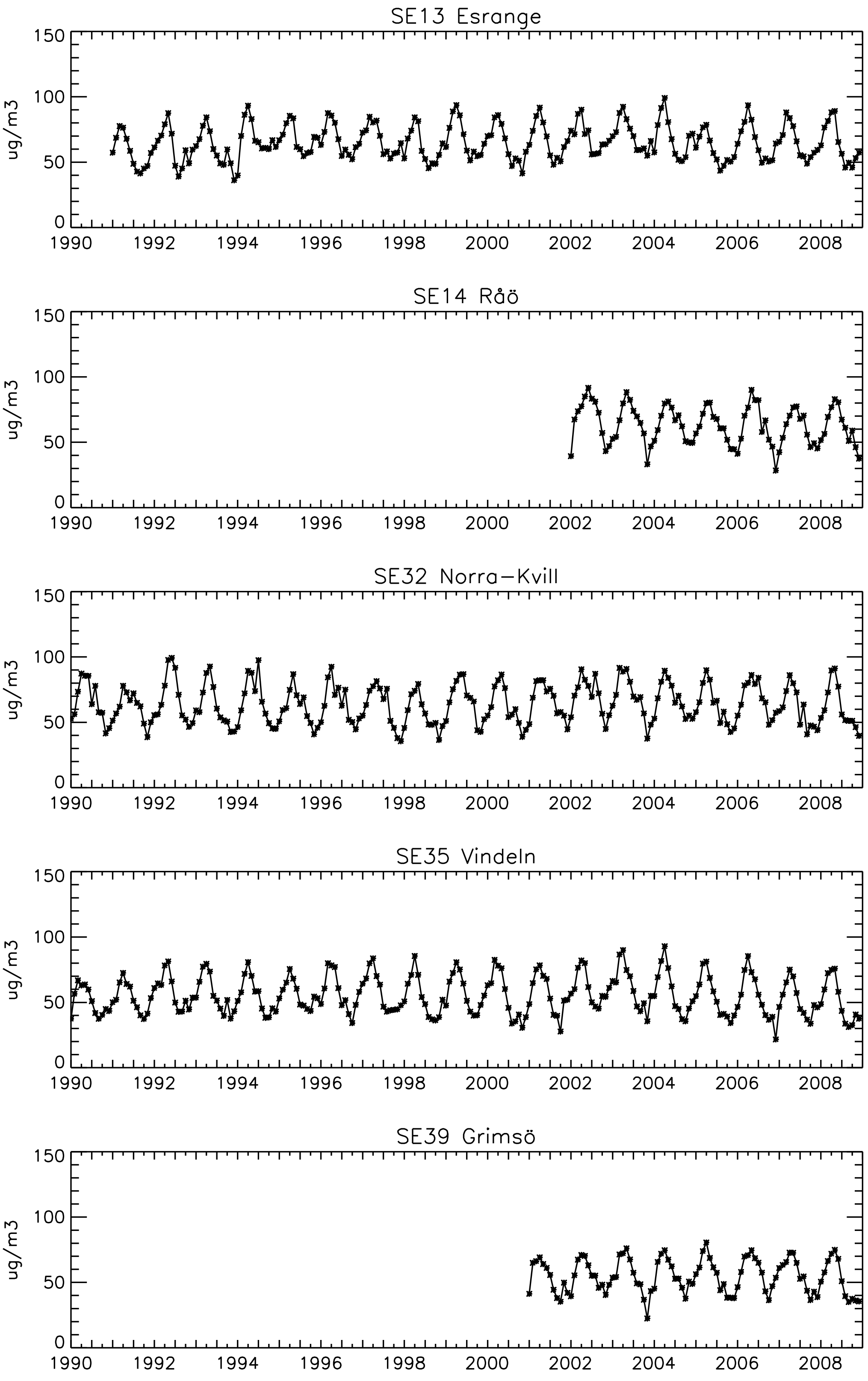

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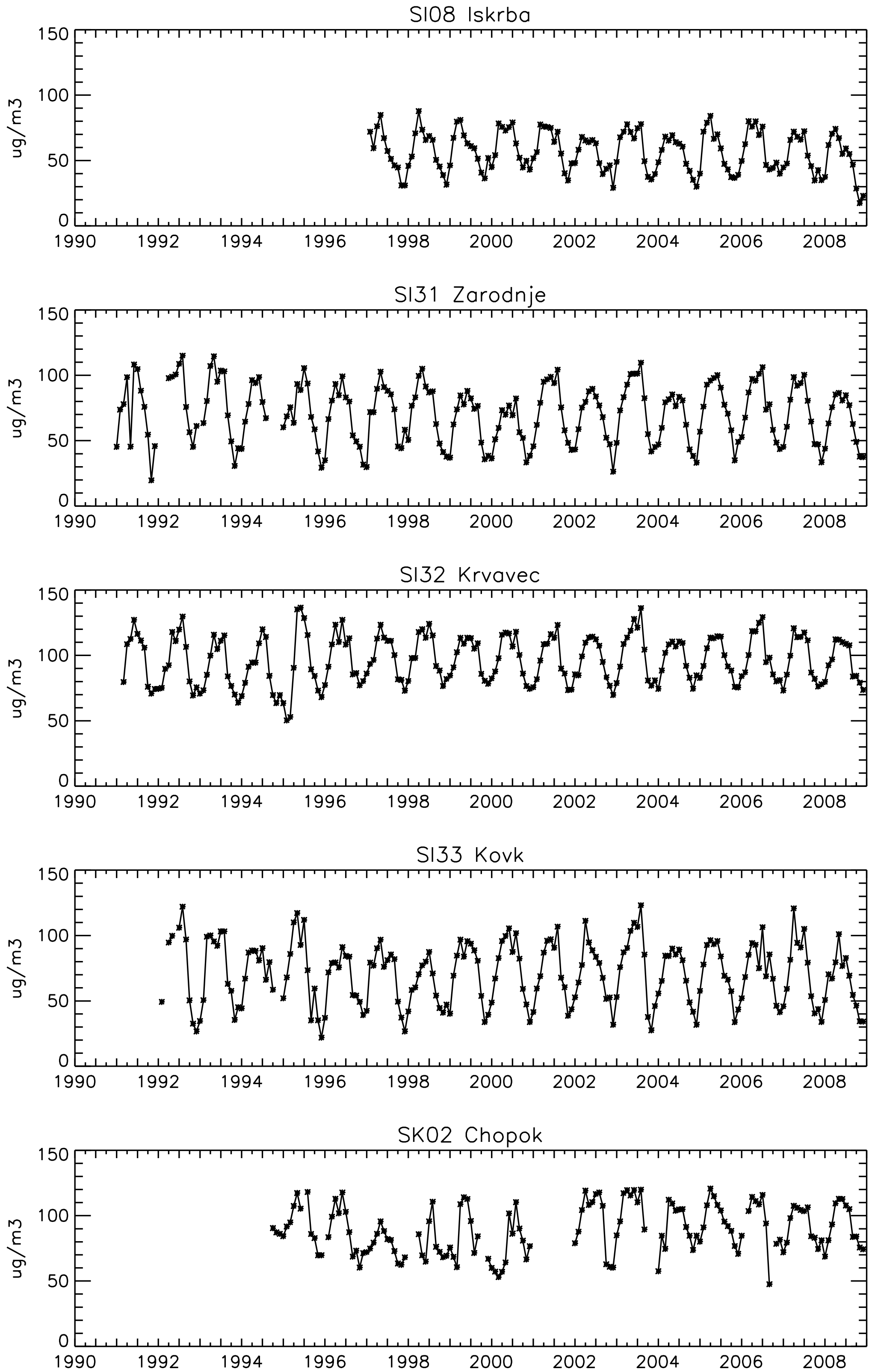

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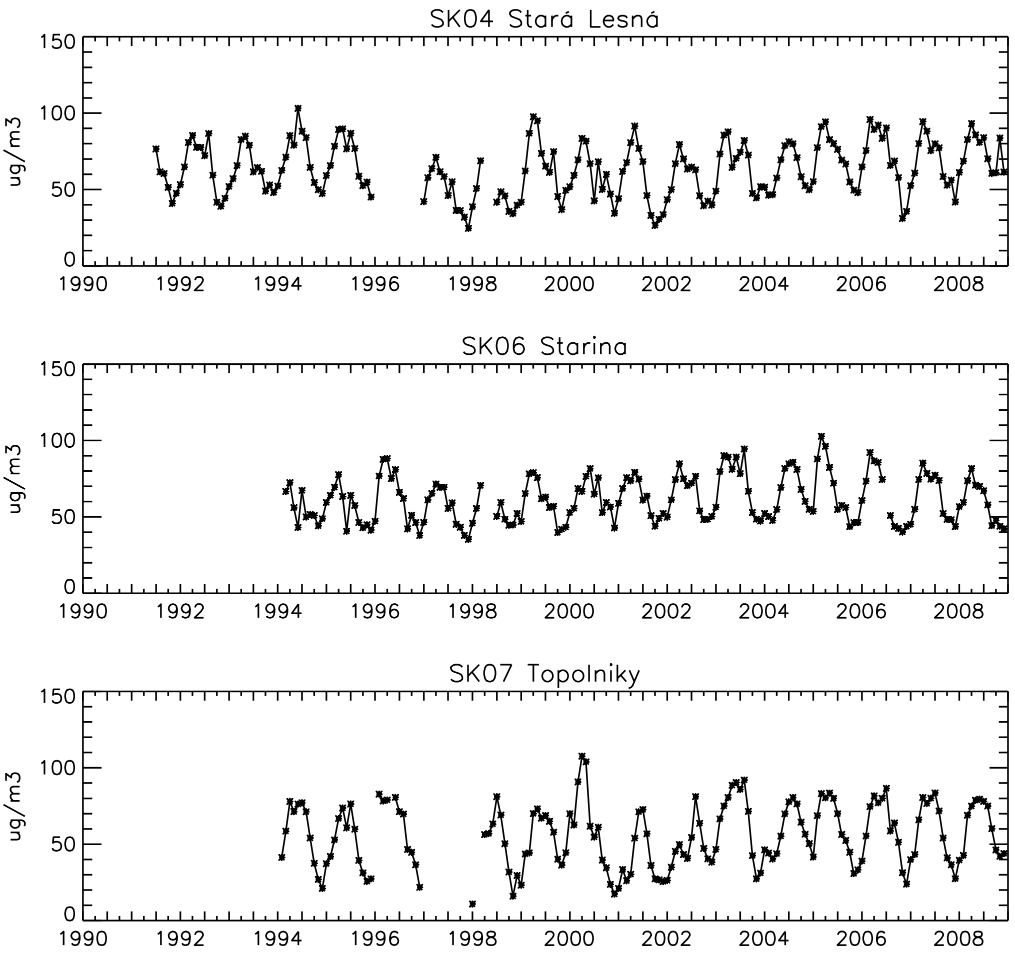


Figure 3.1, cont.

Annex 4

Diurnal variation, April–September 2008

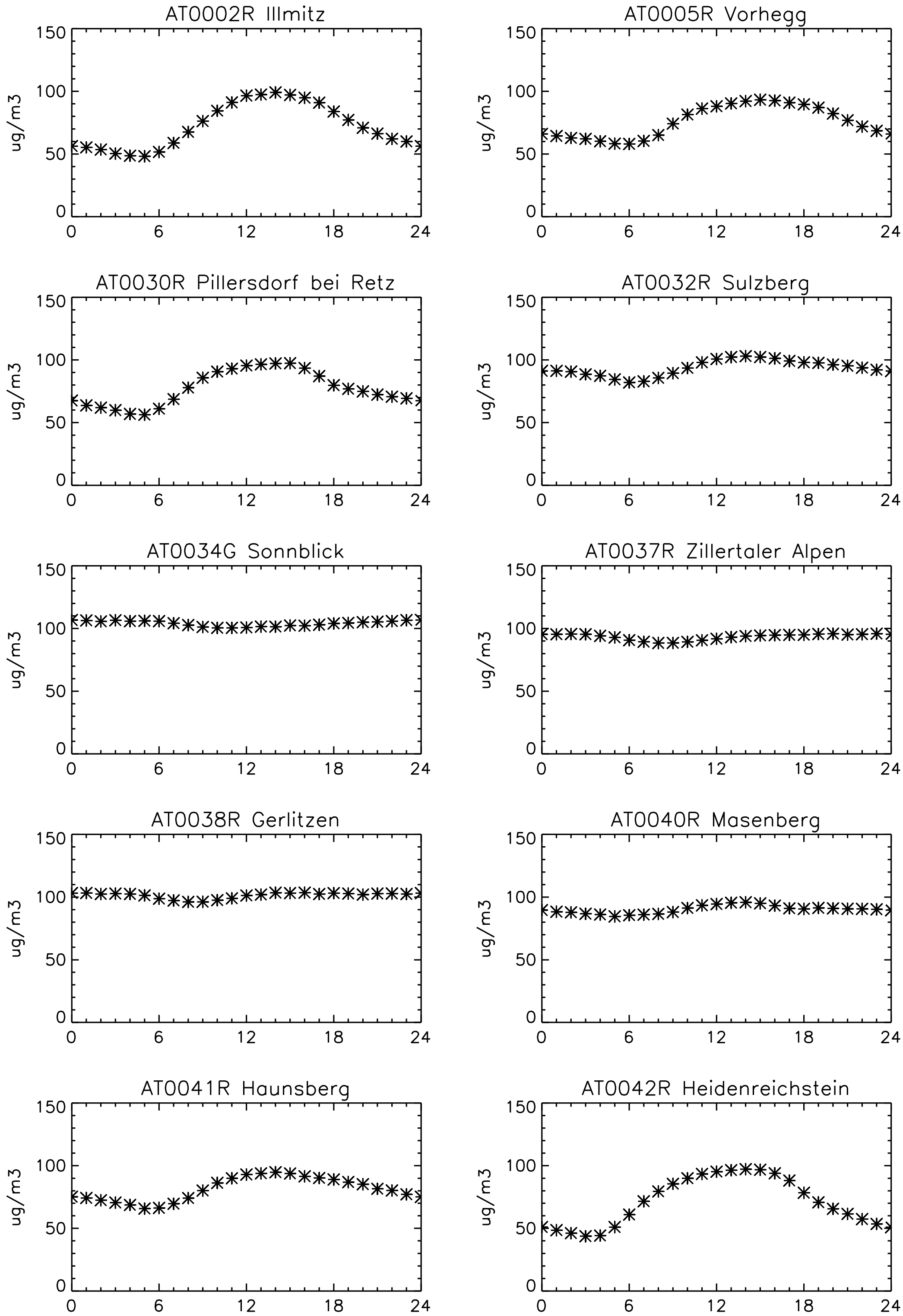


Figure 4.1: Diurnal variation, April–September 2008.

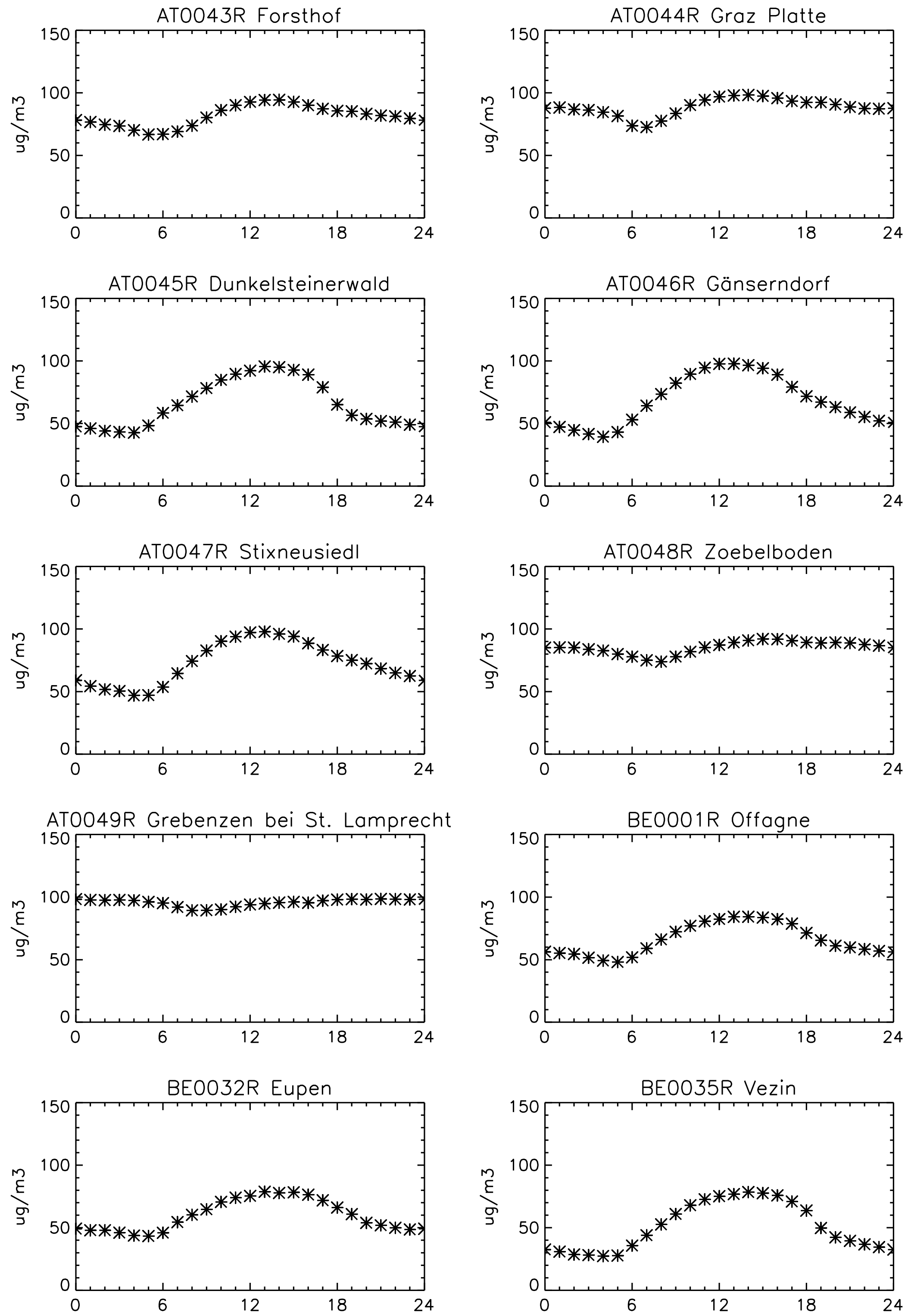


Figure 4.1, cont.

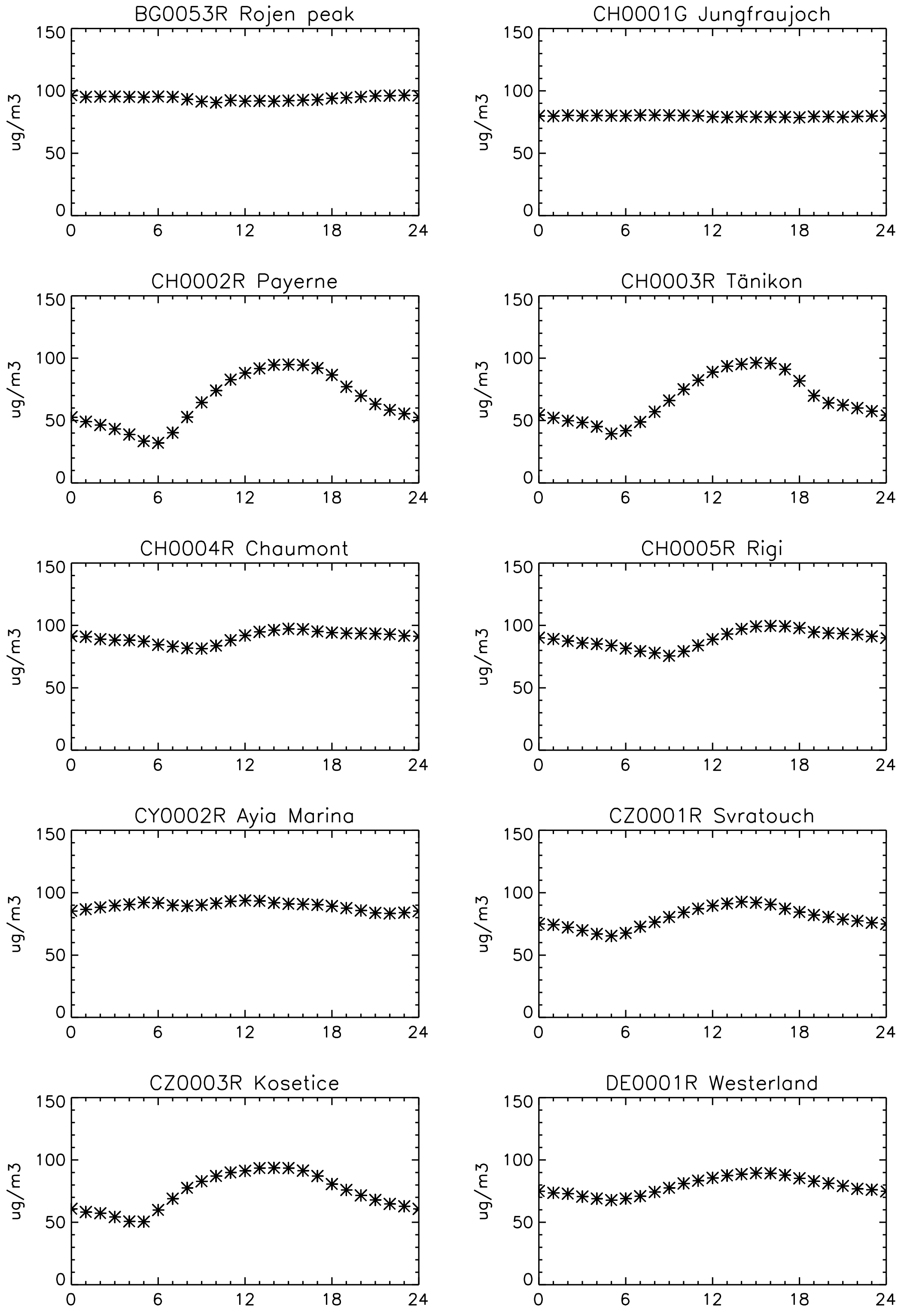


Figure 4.1, cont.

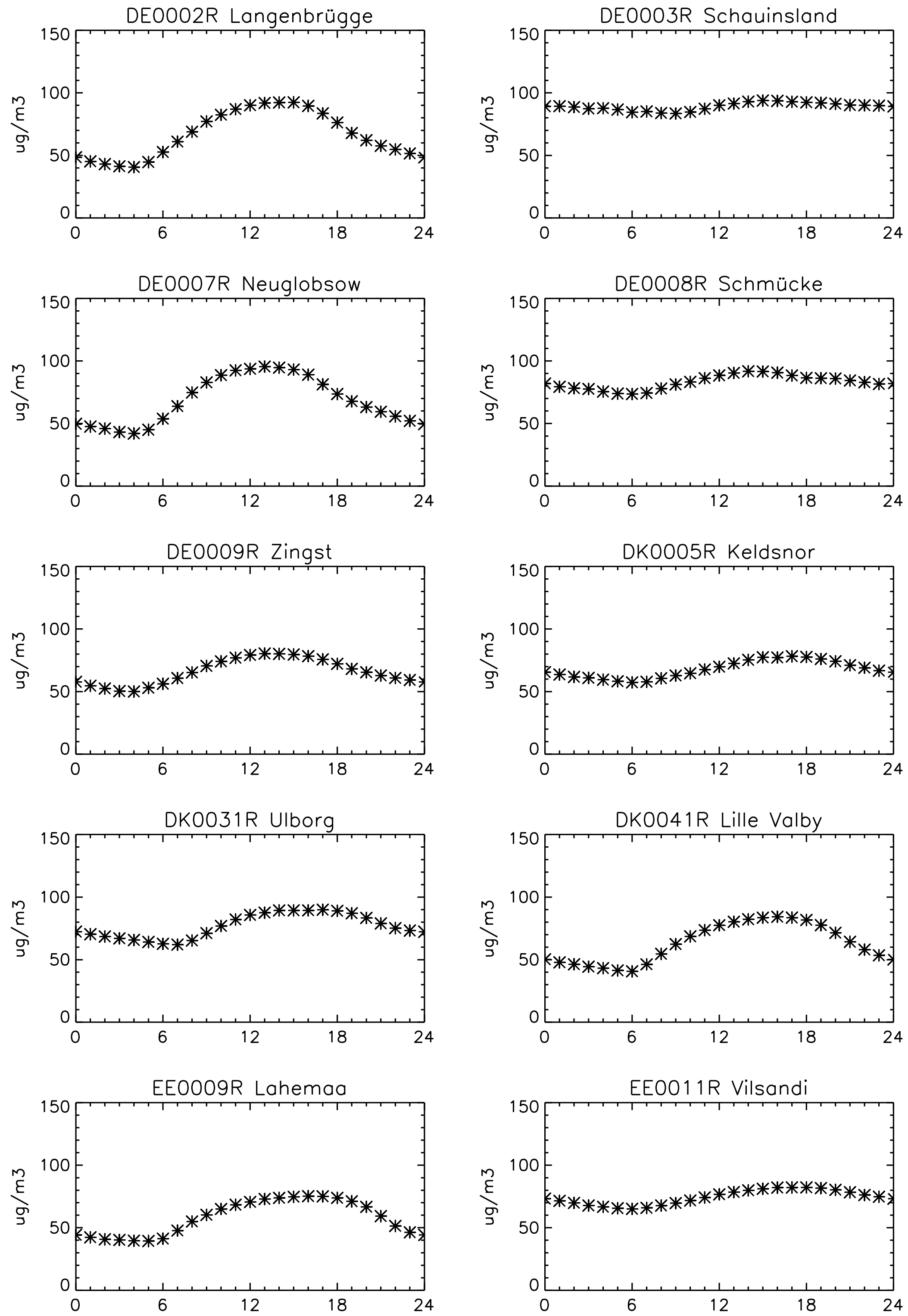


Figure 4.1, cont.

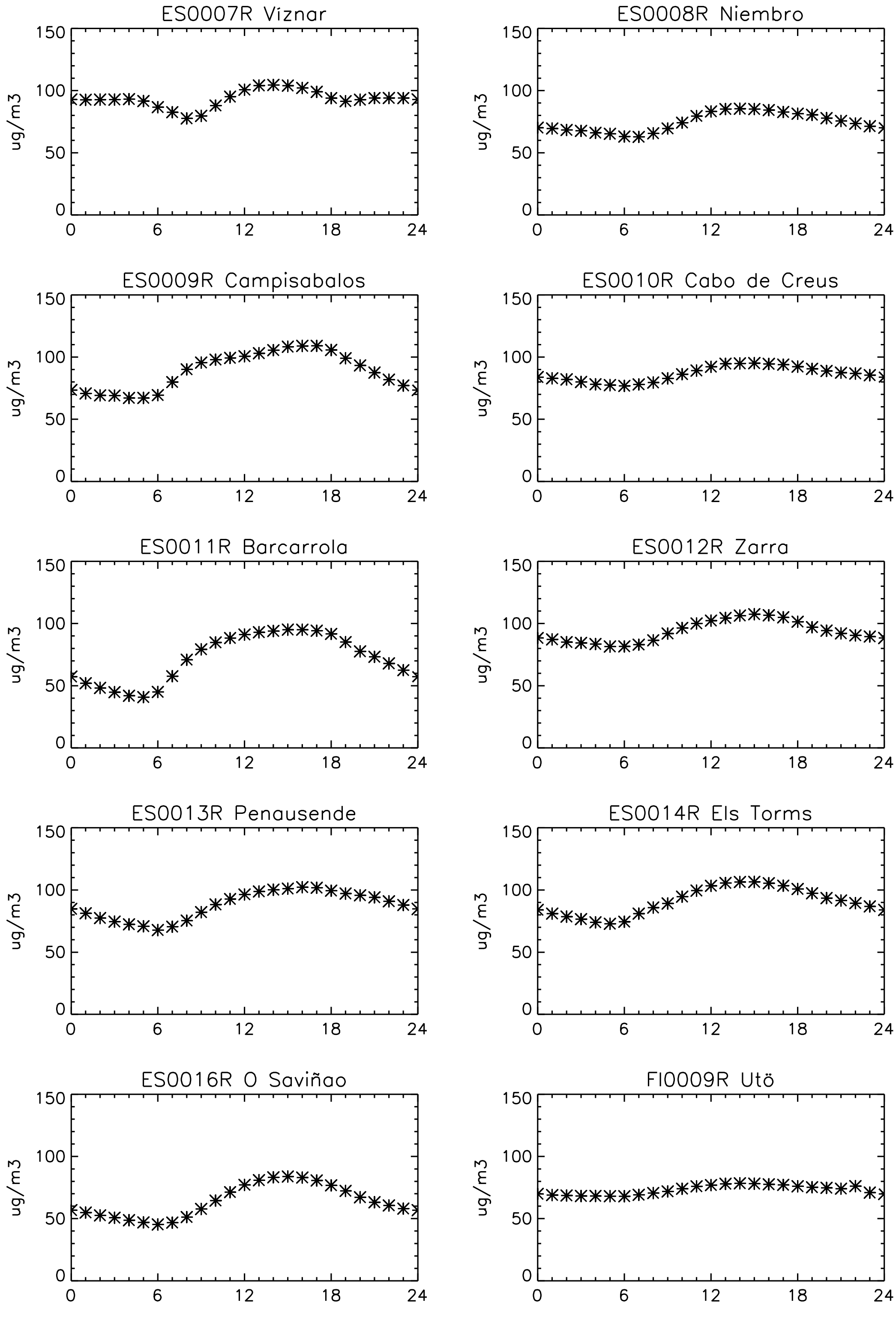
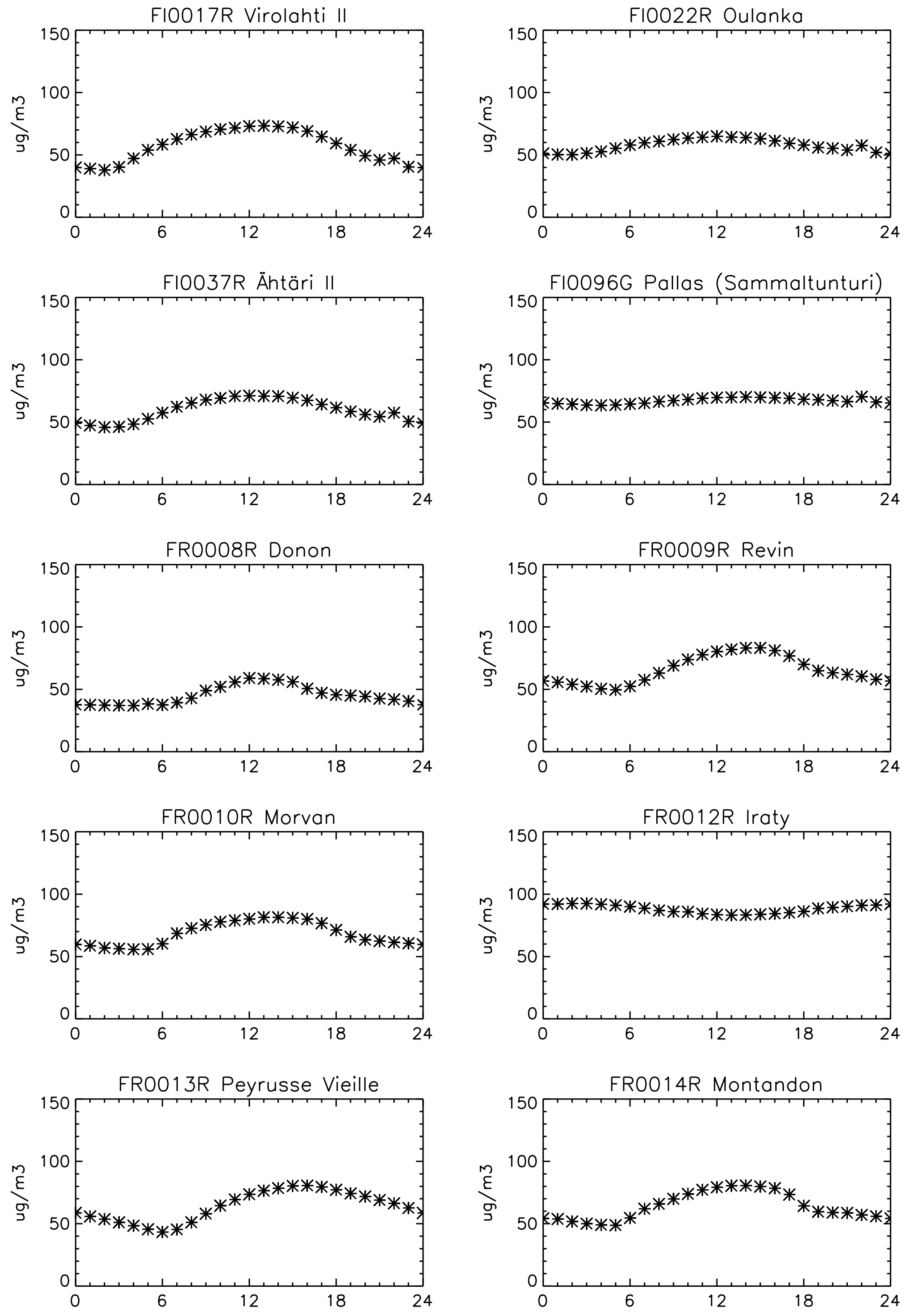


Figure 4.1, cont.



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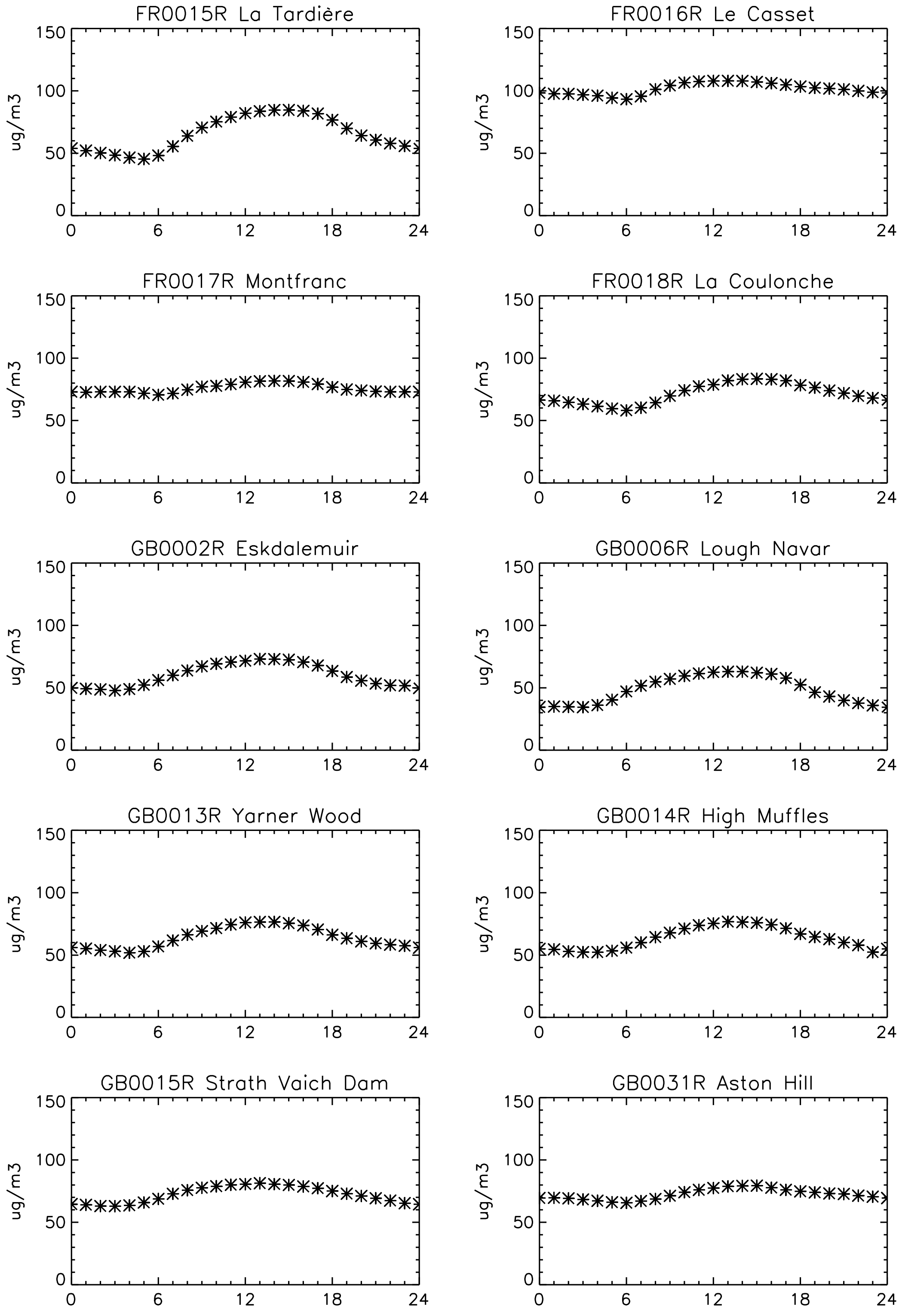

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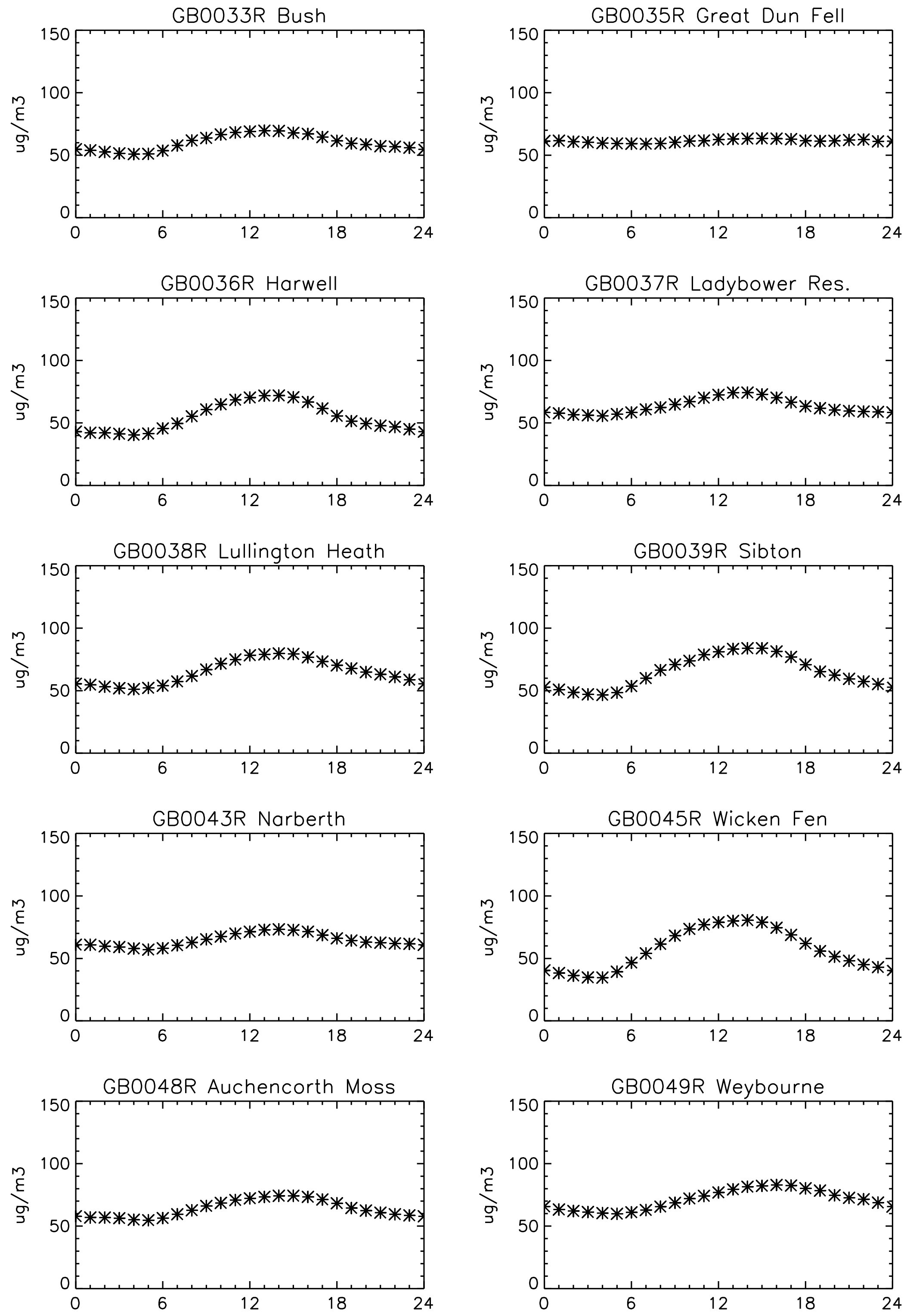

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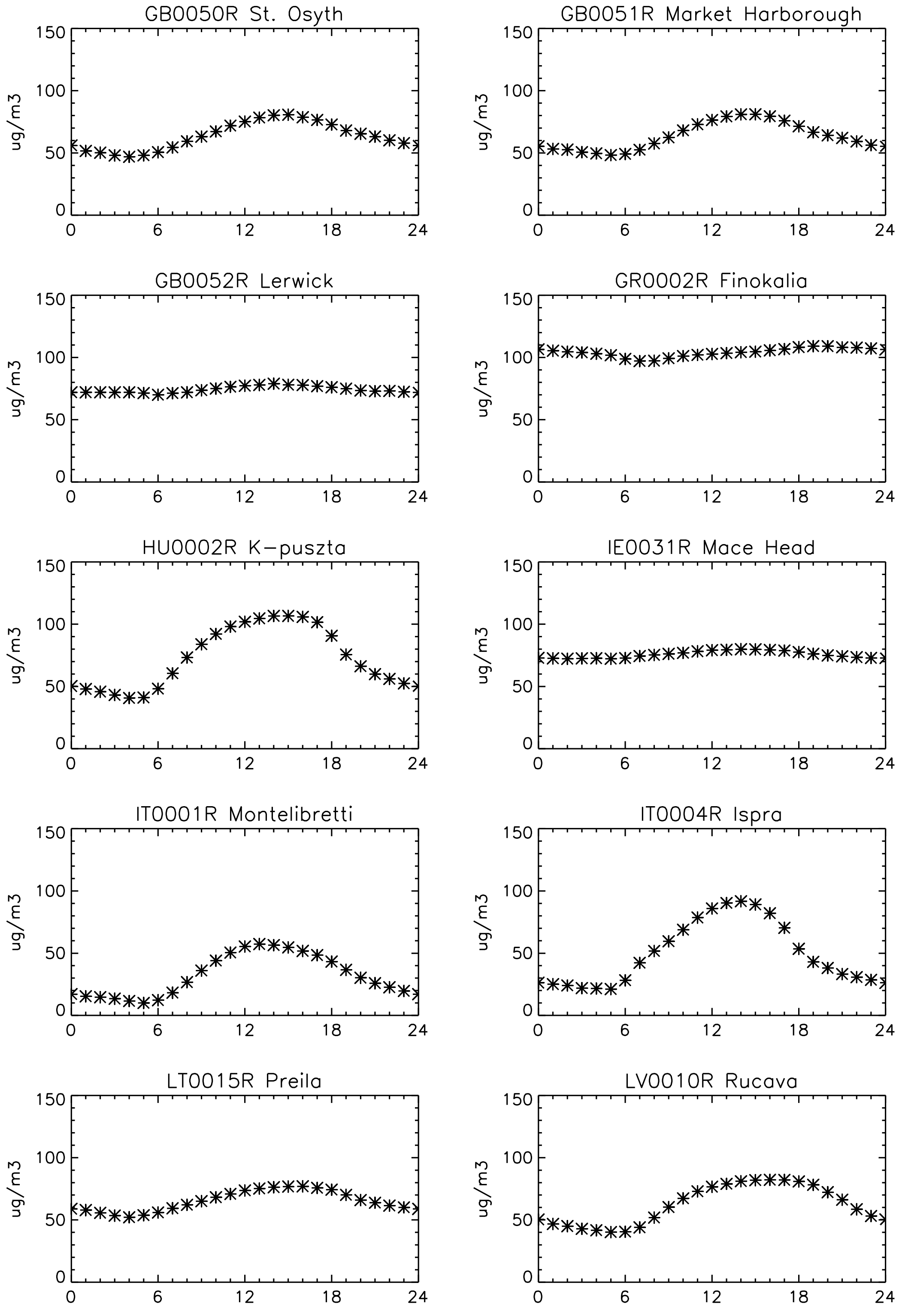

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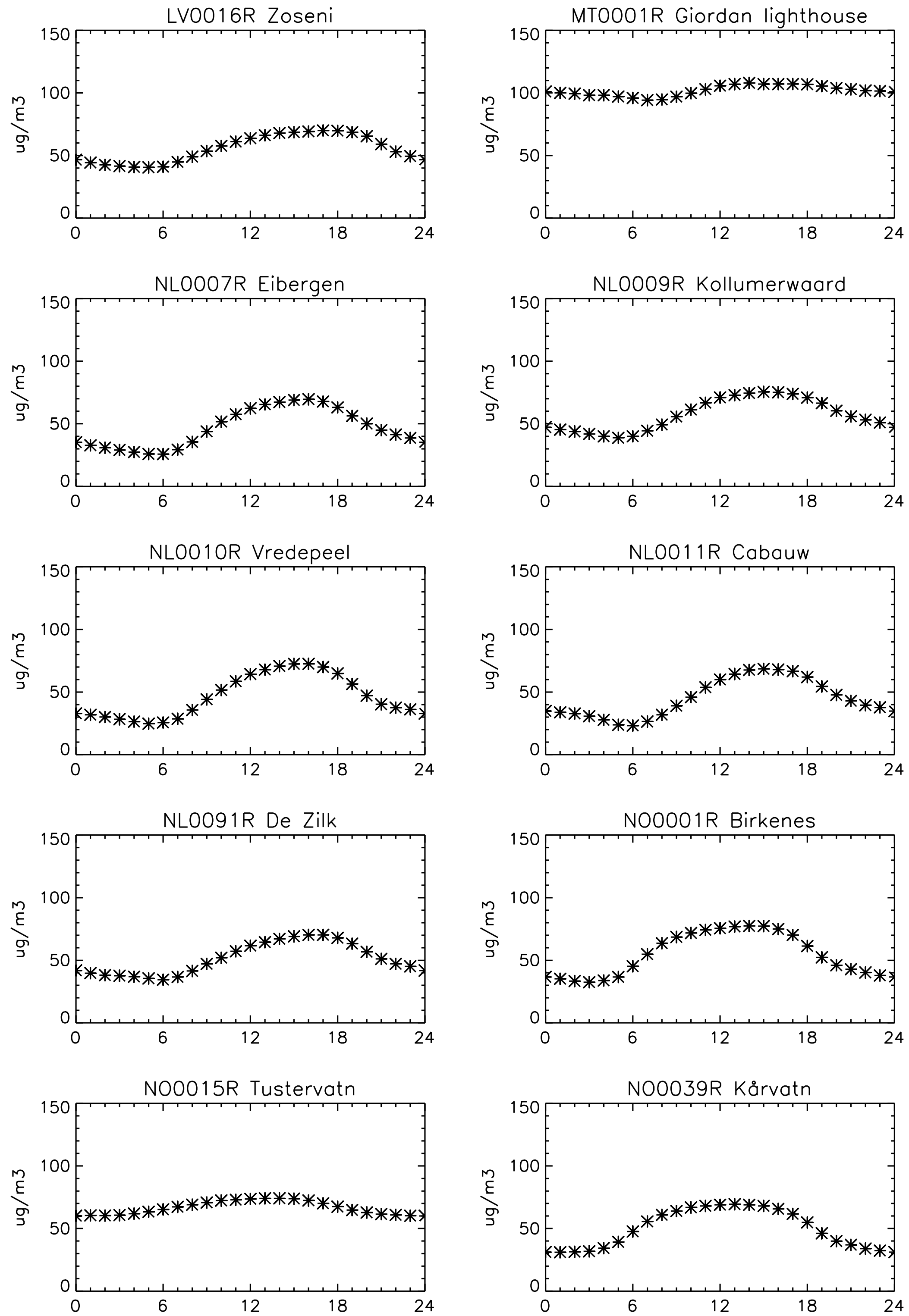

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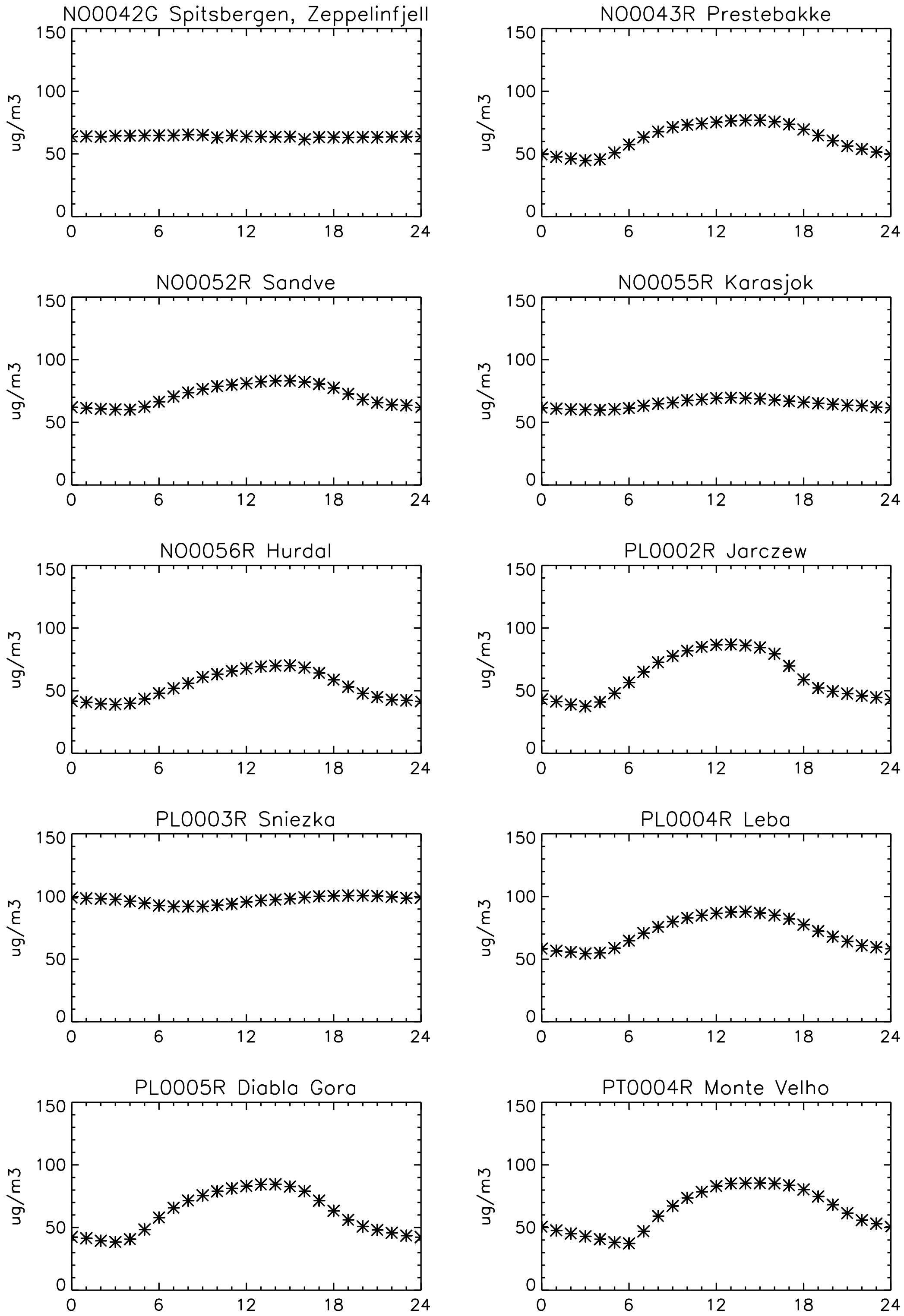

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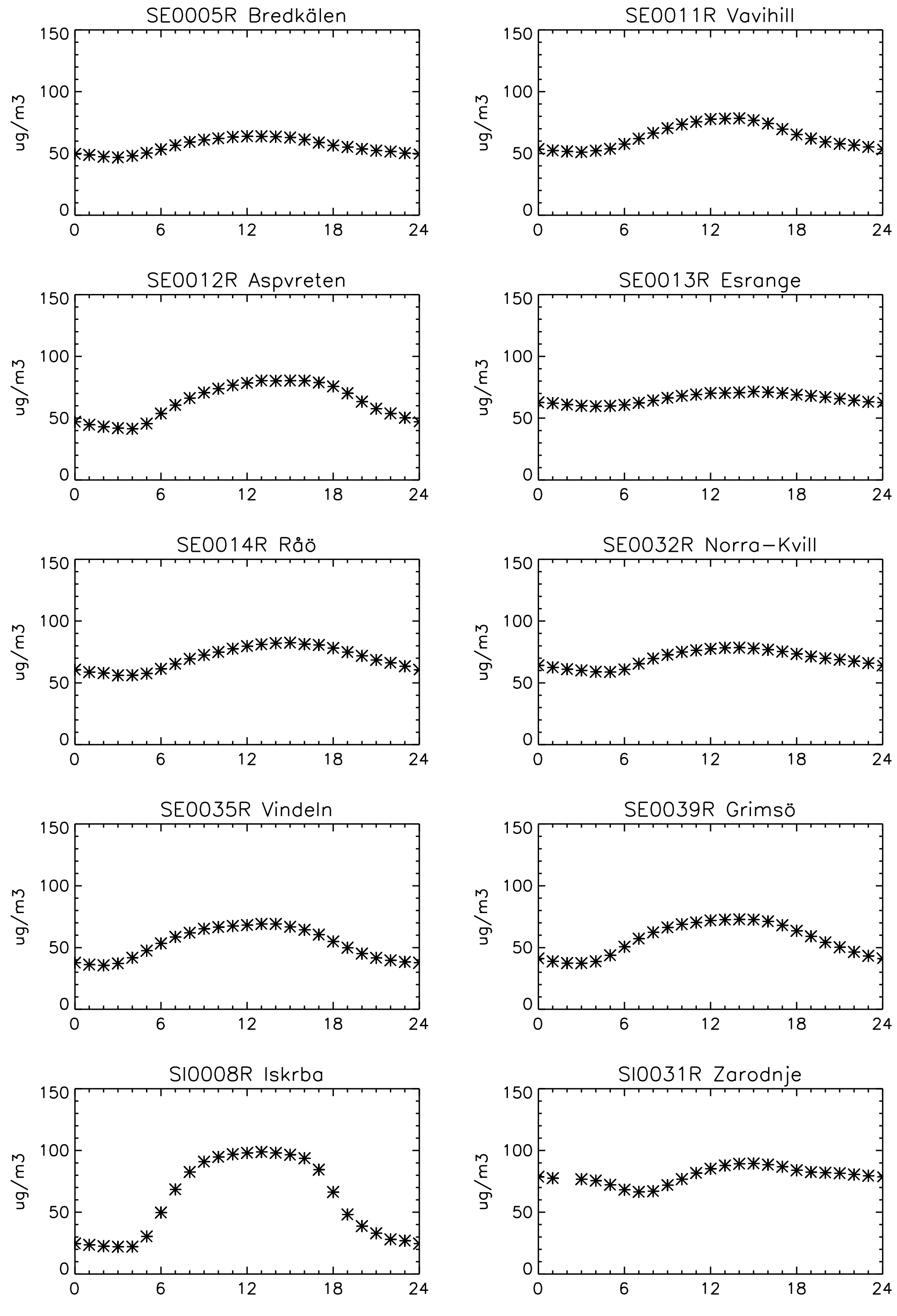

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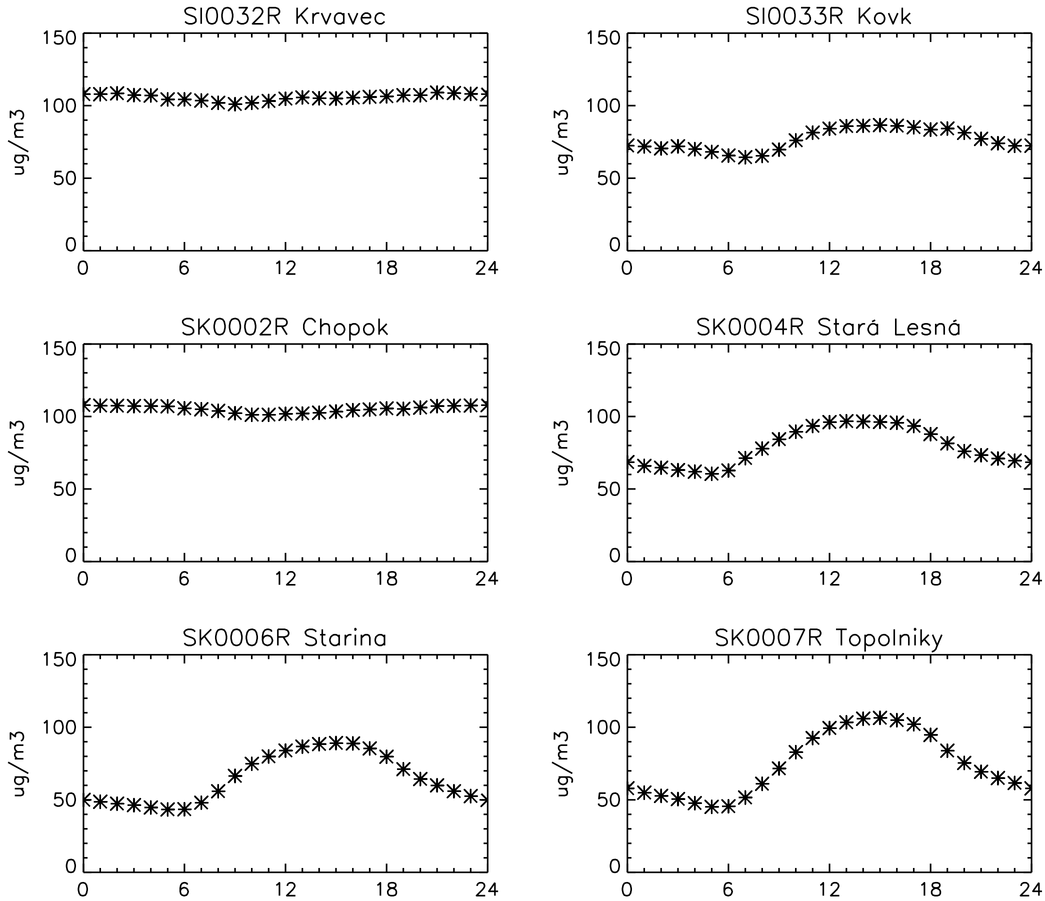

Figure 4.1, cont.

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.

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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.

Ozone measurements 2006.
EMEP/CCC-Report 2/2008 by A.M. Fjæraa and A.-G. Hjellbrekke.
Kjeller, Norwegian Institute for Air Research, 2008.

Ozone measurements 2007.
EMEP/CCC-Report 2/2009 by A.M. Fjæraa and A.-G. Hjellbrekke.
Kjeller, Norwegian Institute for Air Research, 2009.

Ozone measurements 2008.
EMEP/CCC-Report 2/2010 by A.M. Fjæraa and A.-G. Hjellbrekke.
Kjeller, Norwegian Institute for Air Research, 2010.