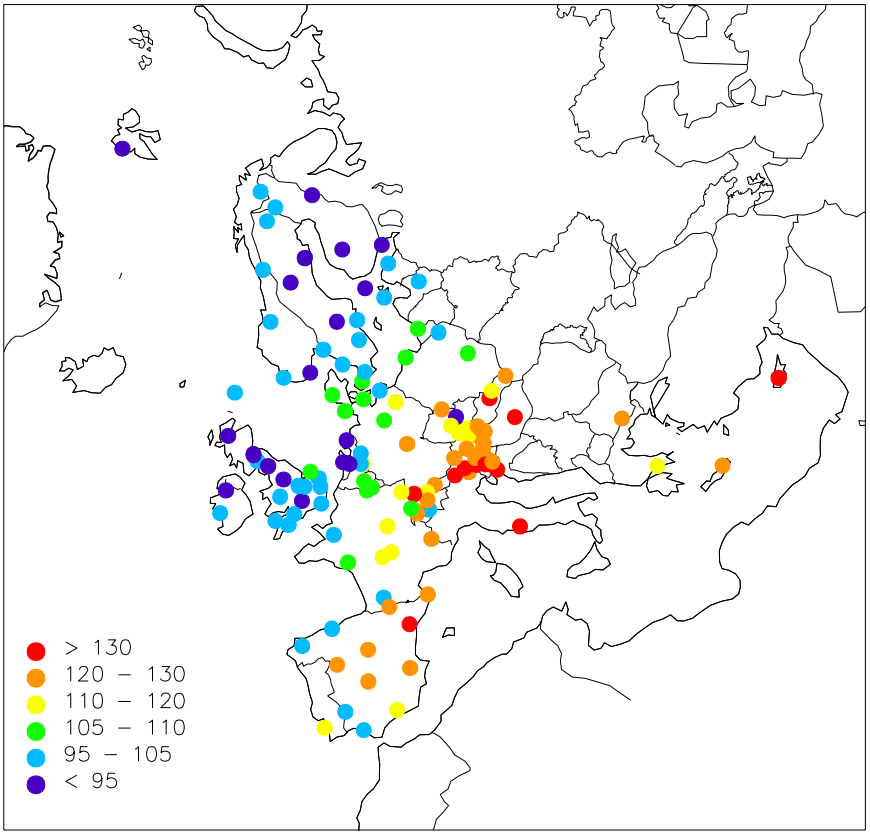
EMEP/CCC-Report 2/2011

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

Ozone measurements 2009

Anne-Gunn Hjellbrekke, Sverre Solberg and Ann Mari Fjæraa



95-percentile
April-September, µg/m^3

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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 2009 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.

EU has in the ozone directive (2002/3/EC) and the ambient 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, to be met by 1.1.2010, for human health is 120 μg/m^3 (8h mean) which 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.

EU's long-term objective for the protection of human health defines 120 μg/m^3 as the maximum daily 8-hour mean value to occur within a calendar year. The long-term objective for the protection of vegetation is defined as an AOT40 value of 6000 μg/m^{3}h for the period May-July. Community progress towards attaining the long-term objective using the year 2020 as a benchmark shall be reviewed.

Within UN-ECE scientific evidence has caused the former AOT40-based critical levels for vegetation (Gothenburg Protocol of 1999) to be replaced by stomatal flux-based critical levels. Flux based critical levels have been developed to reflect that the real impacts depend on the amount of the pollutant transported into the leaves, whereas AOT40 are only based on the concentration of ozone in the atmosphere at the top of the plant canopy (Mills et al., 2011). The flux-based levels were discussed and reviewed at several occasions, such as the LRTAP workshops in Gothenburg (2003) and Obergurgl (2005), and in Ispra (November, 2009) and as part of the ICP Vegetation3 Task Force Meeting in Tervuren (February, 2010).

New flux-based critical levels for various types of vegetation have been approved for inclusion in LRTAP Convention's modelling and mapping manual (LRTAP, 2010). The DO_3SE model is used to estimate the stomatal ozone flux as a function of the ozone concentration at the leaf boundary layer, the transfer of ozone across this boundary layer, the stomatal conductance to ozone and the ozone deposition to the leaf cuticle. The accumulated stomatal flux over a specified time interval is estimated by the parameter POD_Y (the Phytotoxic Ozone Dose over a threshold flux of Y nmol m^{-2} PLA s^{-1}). In this context, Y represents a detoxification threshold, below which it is assumed that any ozone absorbed by the plant will be detoxified. Thus, POD_Y can be described as the "effective dose" or "effective flux". POD_Y is the flux-based analogy to the concentration based AOT_x.

Concentration based critical levels (AOT_x) for estimating the risk of damage to vegetation are, however, still included where climatic data or suitable flux models are not available.

Flux based (POD_Y) and concentration based (AOT_x) critical levels have been identified for crops, forest, and (semi-)natural vegetation and are defined and described in detail in the "Modelling and mapping manual" (LRTAP, 2010). The concentration based critical level is 3000 ppb h (3-months period) for agricultural crops and (semi-)natural vegetation and 5000 ppb h (6-months period) for forest

trees. The former critical level for forest was 10 000 ppb h, and the new, lower level is seen as a clear improvement compared to the former level (LRTAP, 2010). The "Modelling and mapping manual" strongly recommends that the critical levels should be based on the concentrations at the canopy height whereas the measurements normally are taken at 2 m height above ground. When meteorological measurements are not available it is recommended to adjust the measured data to values relevant for the canopy height by applying a given vertical profile depending on the type of vegetation.

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 background EMEP sites during 2009 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 2009. In total 130 stations from 27 different countries reported data. One of these sites (Ispra), is operated by the Commission of the European communities in Italy.

Table 1: List of EMEP ozone monitoring stations in operation 2009.

Code	Station name	Country	Latitude	Longitude	Altitude
AM0001R	Amberd	Armenia	40 23 04 N	44 15 38 E	2080
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	51 27 27 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	35 02 20 N	33 03 29 E	532
CZ0001R	Svratouch	Czech Republic	49 44 00 N	16 03 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	Vilsandi	Estonia	58 23 00 N	21 49 00 E	6
ES0001R	San Pablo de los Montes	Spain	39 32 52 N	4 20 55 W	917
ES0007R	Viznar	Spain	37 14 00 N	3 32 00 W	1265
ES0008R	Niembro	Spain	43 26 32 N	4 51 01 W	134
ES0009R	Campisábalos	Spain	41 16 52 N	3 08 34 W	1360
ES0010R	Cabo de Creus	Spain	42 19 10 N	3 19 01 E	23
ES0011R	Barcarrola	Spain	38 28 33 N	6 55 22 W	393
ES0012R	Zarra	Spain	39 05 10 N	1 06 07 W	885
ES0013R	Penausende	Spain	41 17 00 N	5 52 00 W	985
ES0014R	Els Torms	Spain	41 24 00 N	0 43 00 E	470
ES0016R	O Saviñao	Spain	43 13 52 N	7 41 59 W	506
ES0017R	Doñana	Spain	37 01 49 N	6 19 54 W	5
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
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 28 00 E	1750
FR0017R	Montfranc	France	45 48 00 N	2 04 00 E	810

Table 1, cont.

Code	Station name	Country	Latitude	Longitude	Altitude
FR0018R	La Coulonche	France	48 38 00 N	0 27 00 W	309
FR0019R	Pic du Midi	France	42 56 12 N	0 08 31 E	2877
FR0030R	Puy de Dôme	France	45 46 00 N	2 57 00 E	1465
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
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
LT0015R	Preila	Lithuania	55 21 00 N	21 04 00 E	5
LV0010R	Rucava	Latvia	56 09 43 N	21 10 23 E	18
LV0016R	Zoseni	Latvia	57 08 07 N	25 54 20 E	188
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 58 12 N	4 55 48 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
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 20 N	11 04 41 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

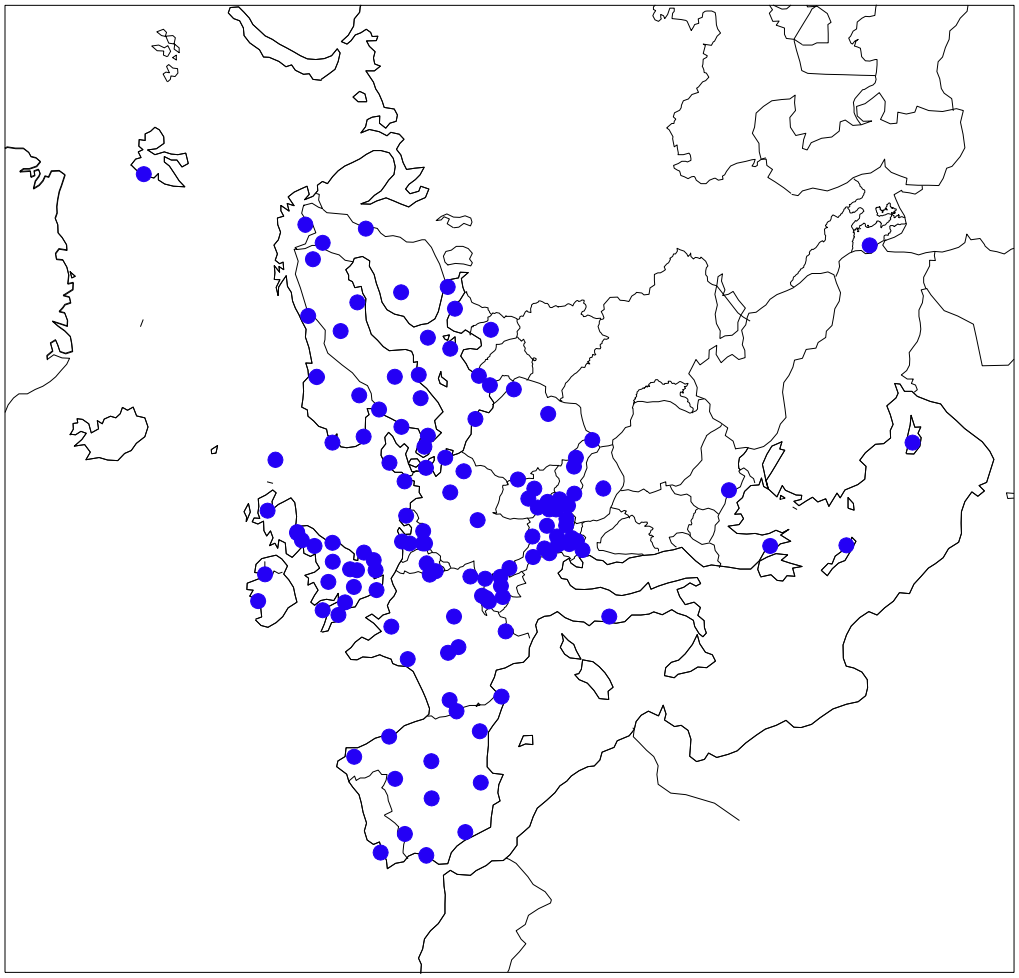

Figure 1: Location of the monitoring stations.

Until 10/09/2008, ozone has been measured at four different heights at Donon. Since 11/09/2008 ozone is measured at one sampling height, 3.5 m, at a new site next to the old deleted tower.

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 has been written for the GEOmon project (Henne et al., 2010). The report can be downloaded at http://geomon.empa.ch/index.php#data.

The UV absorption method is the only measurement method in use in 2009.

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 Jungfraujoch (-8°C, 653 mbar). 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
Armenia	unknown
Austria	2.0
Belgium	unknown
Bulgaria	unknown
Cyprus	unknown
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	unknown
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 slightly higher than previous years, 116 stations in 2009 compared to 103-105 in 2006-2008. 121 stations have data capture above 85%.

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.

Table 3: Data capture in per cent, 2009.

Code	Station	Data capture 2009
AM0001R	Amberd	39.6
AT0002R	Illmitz	94.1
AT0005R	Vorhegg	91.0
AT0030R	Pillersdorf bei Retz	94.0
AT0032R	Sulzberg	92.2
AT0034G	Sonnblick	95.5
AT0037R	Zillertaler Alpen	95.6
AT0038R	Gerlitzen	95.6
AT0040R	Masenberg	94.1
AT0041R	Haunsberg	94.9
AT0042R	Heidenreichstein	91.1
AT0043R	Forsthof	91.6
AT0044R	Graz Platte	95.2
AT0045R	Dunkelsteinerwald	95.1
AT0046R	Gänserndorf	95.5
AT0047R	Stixneusiedl	88.2
AT0048R	Zoebelboden	91.6
AT0049R	Grebenzen bei St. Lamprecht	89.0
BE0001R	Offagne	93.9
BE0032R	Eupen	93.7
BE0035R	Vezin	95.2
BG0053R	Rojen peak	93.8
CH0001G	Jungfraujoch	96.1
CH0002R	Payerne	95.2
CH0003R	Tänikon	95.3
CH0004R	Chaumont	95.4
CH0005R	Rigi	95.3
CY0002R	Ayia Marina	99.2
CZ0001R	Svratouch	98.4
CZ0003R	Košetice	96.8
DE0001R	Westerland	95.1
DE0002R	Langenbrügge	95.2
DE0003R	Schauinsland	96.0
DE0007R	Neuglobsow	94.8
DE0008R	Schmücke	94.9
DE0009R	Zingst	95.5
DK0005R	Keldsnor	77.8
DK0031R	Ulborg	77.8
DK0041R	Lille Valby	89.6
EE0009R	Lahemaa	98.5
EE0011R	Vilsandi	97.7
ES0001R	San Pablo de los Montes	99.4
ES0007R	Viznar	99.3
ES0008R	Niembro	98.6
ES0009R	Campisábalos	97.8
ES0010R	Cabo de Creus	98.5
ES0011R	Barcarrola	98.3
ES0012R	Zarra	97.5
ES0013R	Penausende	99.2
ES0014R	Els Torms	99.2
ES0016R	O Saviñao	98.6
ES0017R	Doñana	95.8

Table 3, cont.

Code	Station	Data capture 2009
FI0009R	Utö	97.9
FI0017R	Virolahti II	98.2
FI0022R	Oulanka	90.0
FI0037R	Ahtari II	97.9
FI0096G	Pallas (Sammaltunturi)	97.8
FR0008R	Donon	99.6
FR0009R	Revin	99.6
FR0010R	Morvan	96.6
FR0013R	Peyrusse Vieille	95.9
FR0014R	Montandon	97.1
FR0015R	La Tardière	99.1
FR0016R	Le Casset	99.9
FR0017R	Montfranc	96.7
FR0018R	La Coulonche	97.0
FR0019R	Pic du Midi	97.4
FR0030R	Puy de Dôme	95.6
GB0002R	Eskdalemuir	99.0
GB0006R	Lough Navar	94.0
GB0013R	Yarner Wood	92.0
GB0014R	High Muffles	52.8
GB0015R	Strath Vaich Dam	94.5
GB0031R	Aston Hill	96.8
GB0033R	Bush	97.8
GB0035R	Great Dun Fell	88.7
GB0036R	Harwell	98.7
GB0037R	Ladybower Res.	95.3
GB0038R	Lullington Heath	95.3
GB0039R	Sibton	95.8
GB0043R	Narberth	94.8
GB0045R	Wicken Fen	96.4
GB0048R	Auchencorth Moss	97.5
GB0049R	Weybourne	91.0
GB0050R	St. Osyth	98.2
GB0051R	Market Harborough	84.5
GB0052R	Lerwick	90.7
GB0053R	Charlton Mackrell	97.0
GR0001R	Aliartos	96.3
GR0002R	Finokalia	73.9
HU0002R	K-puszta	97.4
IE0031R	Mace Head	99.4
IT0001R	Montelibretti	96.3
LT0015R	Preila	93.9
LV0010R	Rucava	74.4
LV0016R	Zoseni	99.6
NL0007R	Eibergen	98.6
NL0009R	Kollumerwaard	95.5
NL0010R	Vredepeel	87.6
NL0011R	Cabauw	97.8
NL0091R	De Zilk	97.8

Table 3, cont.

Code	Station	Data capture 2009
NO0001R	Birkenes	96.0
NO0015R	Tustervatn	99.6
NO0039R	Kårvatn	99.6
NO0042G	Spitsbergen, Zeppelinfjell	99.1
NO0043R	Prestebakke	98.0
NO0052R	Sandve	99.8
NO0055R	Karasjok	97.2
NO0056R	Hurdal	35.9
NO0056R	Hurdal	63.4
PL0002R	Jarczew	96.3
PL0003R	Sniezka	98.4
PL0004R	Leba	98.9
PL0005R	Diabla Gora	94.8
PT0004R	Monte Velho	99.1
SE0005R	Bredkälen	99.9
SE0011R	Vavihill	97.4
SE0012R	Aspvreten	99.7
SE0013R	Esrange	99.9
SE0014R	Råö	99.8
SE0032R	Norra-Kvill	99.6
SE0035R	Vindeln	97.3
SE0039R	Grimsö	99.7
SI0008R	Iskrba	93.0
SI0031R	Zarodnje	94.0
SI0032R	Krvavec	93.4
SI0033R	Kovk	94.6
SK0002R	Chopok	99.7
SK0004R	Stará Lesná	99.4
SK0006R	Starina	99.4
SK0007R	Topolniky	23.5

5. Concentration summaries and episodes

Ozone levels during summer 2009 were as low as during summer 2008, and according to several indicators, were among the lowest since 1997 (EEA, 2010).

The highest one-hour ozone concentration was measured in the UK (St. Osyth, 258 $\mu g/m^3$, August 6) (Table 1.1, Annex 1). In total concentrations above 200 $\mu g/m^3$ were measured at five sites. The lowest maximum concentration was as usual measured in Norway (Zeppelinfjell, 109.7 $\mu g/m^3$).

Exceedence of the information threshold of 180 $\mu g/m^3$ was observed at six sites (Belgium, UK, Switzerland and Italy) (Figure 1.4, Annex 1). This is similar to 2008 and much lower that 2006 and 2007 (64 and 26 sites respectively). No exceedances have occurred in the northern part of Europe since the unusually warm summer in 2003 (Figure 2).

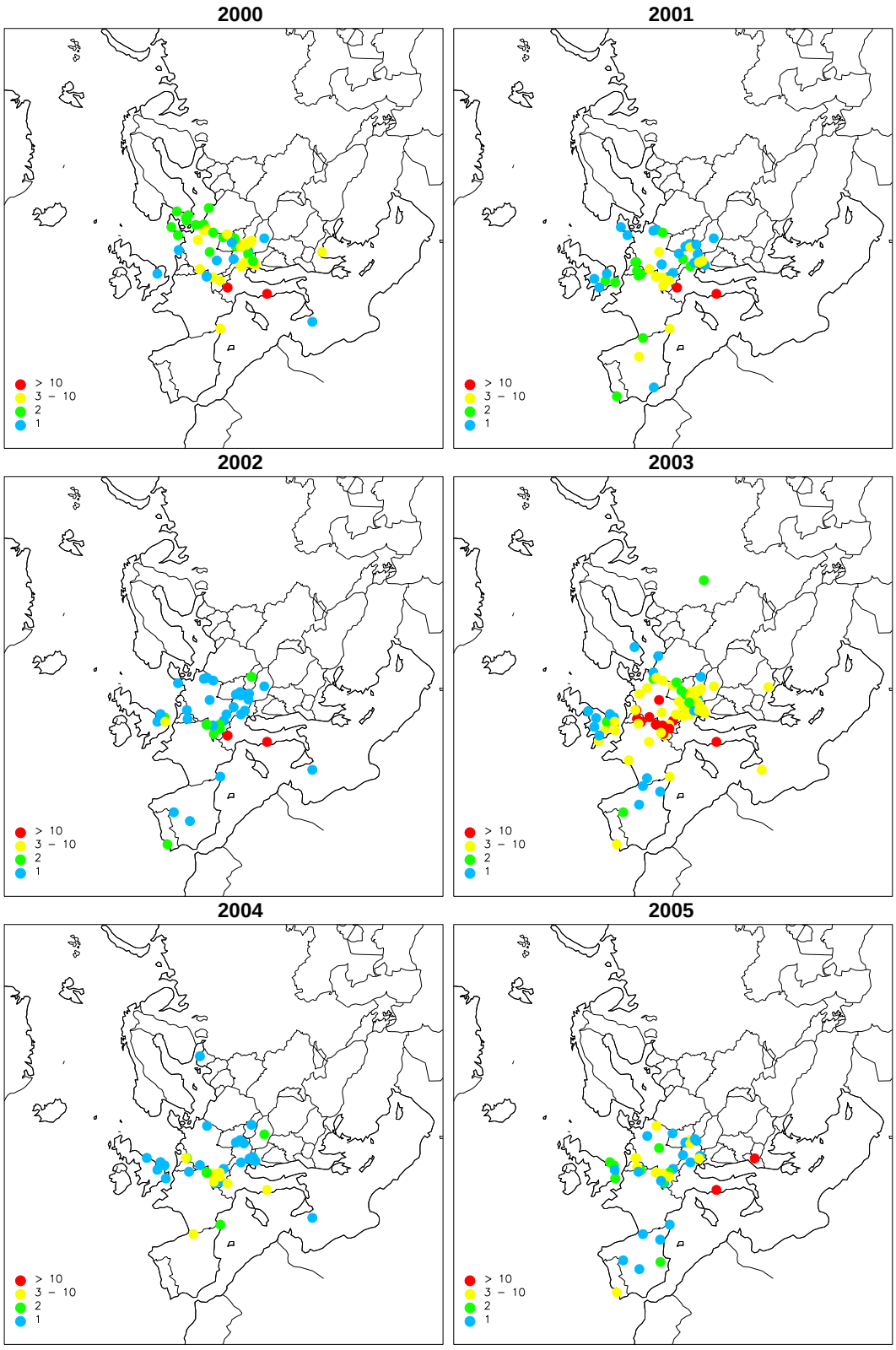

Figure 2: Number of exceedances of the threshold value of 180 μg/m^3 2000-2009. (Unit: number of days.) Stations with zero exceedances are not shown.

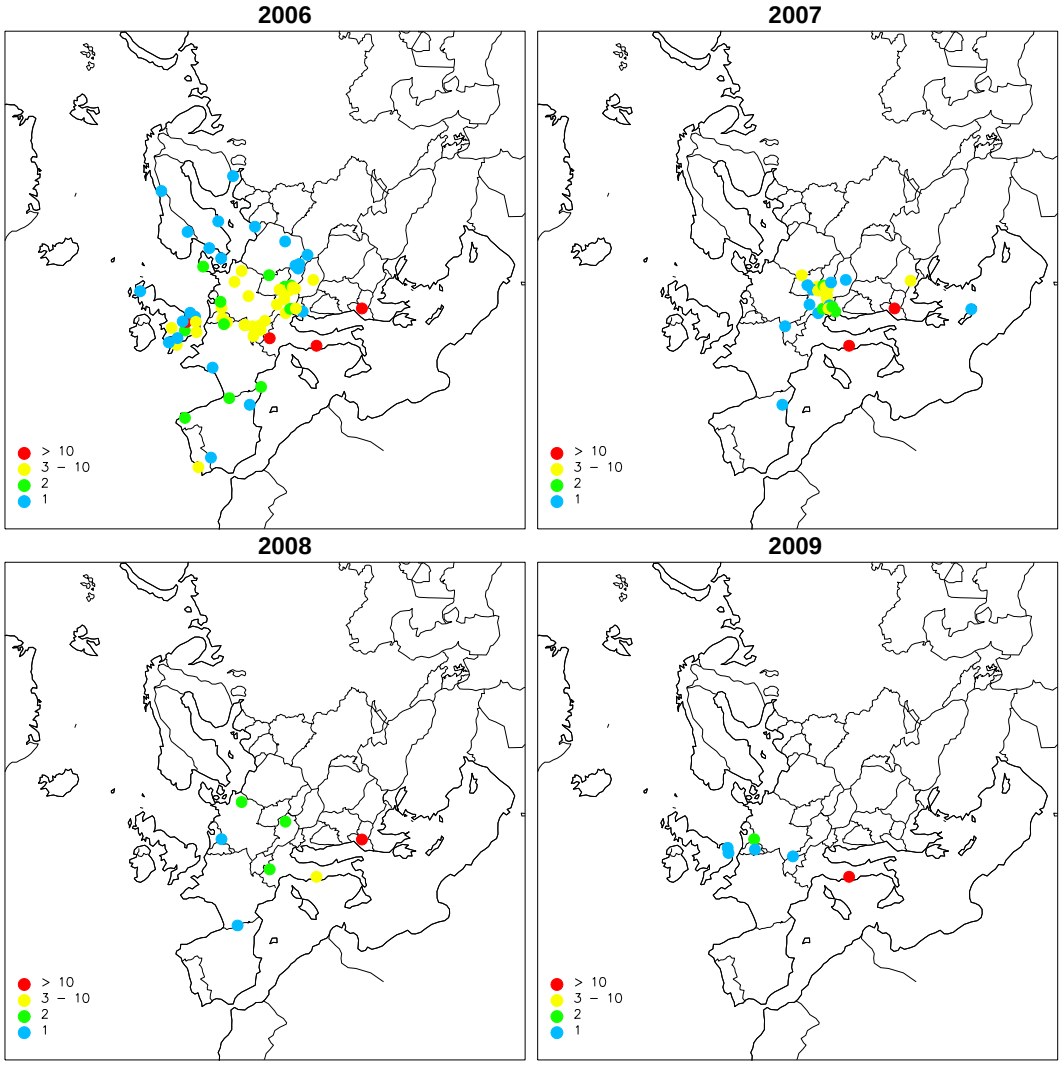

Figure 2, cont.

The one hour critical level for ozone formulated by the ECE for protection of vegetation (150 µg/m^3) was exceeded at 69 sites (Figure 1.3, Annex 1), compared to 81 sites in 2008 and 112 sites in 2003.

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 120 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 120-140 µg/m^3, and at its highest in Germany, France, Italy and Spain where the 99-persentile values are above 140 µg/m^3.

6. Calculation of AOT40

AOT40 and AOT60 for forest and agricultural corps for 2009 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. Low values are found in most parts of Northern Europe, while the highest values are found in Central Europe. Only one station, Krvavec in Slovakia, has AOT40 (May-July) values above 15 000 ppbh. The critical level for forest in April-September (5 000 ppbh) is exceeded at most sites in Central, Eastern and Southern Europe.

7. Seasonal variation

Monthly mean concentrations for 2009 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 1990-2009 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) 2009 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 June 24th, 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.

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12. List of participating institutions

Armenia	Environmental Impact Monitoring Centre
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
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	Center for Physical Sciences and Technology
Macedonia	Ministry of Environment and Physical Planning
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 μg/m^3 and maximum concentrations in 2009.

Code	Station	Total		>120		>150		>180		>200		Max concentrations	
		hours	days	hours	days	hours	days	hours	days	hours	days	μg/m^3	day(s)
AM0001R	Amberd	3470	149	593	72	4	2	0	0	0	0	153	24.03.2009
AT0002R	Illmitz	8241	365	299	65	3	1	0	0	0	0	155	25.05.2009
AT0005R	Vorhegg	7970	351	298	52	16	5	0	0	0	0	171	19.06.2009
AT0030R	Pillersdorf bei Retz	8237	362	184	44	17	6	0	0	0	0	179	22.07.2009
AT0032R	Sulzberg	8077	356	392	57	5	2	0	0	0	0	169	20.08.2009
AT0034G	Sonnblick	8366	365	875	92	4	2	0	0	0	0	155	03.07.2009
AT0037R	Zillertaler Alpen	8376	364	651	70	15	4	0	0	0	0	156	03.07.2009
AT0038R	Gerlitzen	8374	365	902	89	20	7	0	0	0	0	159	22.05.2009
AT0040R	Masenberg	8243	362	379	51	0	0	0	0	0	0	147	21.05.2009
AT0041R	Haunsberg	8315	365	291	51	3	1	0	0	0	0	162	26.05.2009
AT0042R	Heidenreichstein	7978	350	167	35	8	3	0	0	0	0	168	21.05.2009
AT0043R	Forsthof	8028	352	363	54	0	0	0	0	0	0	147	15.04.2009, 21.08.2009
AT0044R	Graz Platte	8343	364	550	67	0	0	0	0	0	0	146	15.04.2009
AT0045R	Dunkelsteinerwald	8335	365	208	44	4	2	0	0	0	0	159	20.08.2009
AT0046R	Gänserndorf	8364	365	233	50	5	4	0	0	0	0	159	14.07.2009
AT0047R	Stixneusiedl	7722	338	280	55	1	1	0	0	0	0	152	15.07.2009
AT0048R	Zoebelboden	8025	357	280	39	3	1	0	0	0	0	167	21.08.2009
AT0049R	Grebenzen bei St. Lamprecht	7799	344	449	49	0	0	0	0	0	0	147	15.04.2009
BE0001R	Offagne	8226	356	83	16	7	2	0	0	0	0	172	01.07.2009
BE0032R	Eupen	8205	355	125	23	20	7	2	2	0	0	186	07.08.2009
BE0035R	Vezin	8337	361	97	22	13	3	2	1	0	0	184	02.07.2009
BG0053R	Rojen peak	8217	365	503	62	0	0	0	0	0	0	142.8	02.08.2009
CH0001G	Jungfraujoch	8414	364	2	2	0	0	0	0	0	0	140.1	08.03.2009
CH0002R	Payerne	8341	365	230	54	7	3	0	0	0	0	164.8	19.08.2009
CH0003R	Tänikon	8350	365	205	51	8	3	2	1	1	1	201.5	20.08.2009
CH0004R	Chaumont	8358	365	471	59	19	4	0	0	0	0	166.6	19.08.2009
CH0005R	Rigi	8352	365	442	56	16	4	0	0	0	0	171	02.07.2009
CY0002R	Ayia Marina	8689	365	1151	122	4	4	0	0	0	0	156.8	07.09.2009
CZ0001R	Svratouch	8617	362	3	1	0	0	0	0	0	0	126.3	20.08.2009
CZ0003R	Košetice	8484	359	143	29	4	2	0	0	0	0	161	21.08.2009

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)
DE0001R	Westerland	8327	365	48	12	7	1	0	0	0	0	164.2	20.08.2009
DE0002R	Langenbrügge	8337	365	53	17	2	1	0	0	0	0	152.6	20.08.2009
DE0003R	Schauinsland	8409	365	720	78	39	8	0	0	0	0	178.9	20.08.2009
DE0007R	Neuglobsow	8302	365	117	29	2	2	0	0	0	0	152.1	01.09.2009
DE0008R	Schmücke	8314	365	210	34	0	0	0	0	0	0	149.6	20.08.2009
DE0009R	Zingst	8367	365	37	8	0	0	0	0	0	0	134.9	01.09.2009
DK0005R	Keldsnor	6813	327	50	12	6	1	0	0	0	0	163.9	20.08.2009
DK0031R	Ulborg	6813	327	50	12	6	1	0	0	0	0	163.9	20.08.2009
DK0041R	Lille Valby	7852	361	40	13	0	0	0	0	0	0	137.8	26.04.2009
EE0009R	Lahemaa	8627	362	39	6	0	0	0	0	0	0	141	27.04.2009
EE0011R	Vilsandi	8560	363	25	4	0	0	0	0	0	0	138	26.04.2009
ES0001R	San Pablo de los Montes	8709	365	490	60	0	0	0	0	0	0	142.3	03.10.2009
ES0007R	Viznar	8697	365	146	45	0	0	0	0	0	0	145.9	05.09.2009
ES0008R	Niembro	8635	365	70	16	0	0	0	0	0	0	135.3	03.04.2009
ES0009R	Campisábalos	8565	365	234	50	5	3	0	0	0	0	162.6	28.07.2009
ES0010R	Cabo de Creus	8630	365	277	51	4	2	0	0	0	0	154.6	30.06.2009
ES0011R	Barcarrola	8613	364	19	7	0	0	0	0	0	0	136.3	23.04.2009
ES0012R	Zarra	8542	362	315	75	3	1	0	0	0	0	155.3	24.04.2009
ES0013R	Penausende	8686	365	376	50	2	1	0	0	0	0	152	31.08.2009
ES0014R	Els Torms	8691	365	905	126	19	11	0	0	0	0	162.2	24.04.2009
ES0016R	O Saviñao	8640	365	92	21	2	1	0	0	0	0	155.4	23.04.2009
ES0017R	Doñana	8393	361	43	17	0	0	0	0	0	0	144.2	20.08.2009
FI0009R	Utö	8575	363	0	0	0	0	0	0	0	0	120	01.09.2009
FI0017R	Virolahti II	8606	365	10	2	0	0	0	0	0	0	127	26.04.2009
FI0022R	Oulanka	7880	338	3	1	0	0	0	0	0	0	126	26.04.2009
FI0037R	Ahtari II	8573	365	4	1	0	0	0	0	0	0	129	27.04.2009
FI0096G	Pallas (Sammaltunturi)	8565	365	10	3	0	0	0	0	0	0	127	25.04.2009
FR0008R	Donon	8729	365	152	31	7	2	0	0	0	0	172	19.08.2009
FR0009R	Revin	8724	365	104	19	8	2	0	0	0	0	163	07.08.2009
FR0010R	Morvan	8466	357	95	17	1	1	0	0	0	0	151	25.05.2009
FR0013R	Peyrusse Vieille	8399	356	21	8	0	0	0	0	0	0	125	18.03.2009, 24.04.2009
FR0014R	Montandon	8510	357	80	19	0	0	0	0	0	0	150	19.08.2009

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)
FR0015R	La Tardière	8681	365	92	22	1	1	0	0	0	0	157	01.07.2009
FR0016R	Le Casset	8747	365	658	71	2	1	0	0	0	0	156	30.07.2009
FR0017R	Montfranc	8473	360	114	21	0	0	0	0	0	0	140	10.09.2009
FR0018R	La Coulonche	8495	358	47	9	4	2	0	0	0	0	160	01.07.2009, 02.07.2009
FR0019R	Pic du Midi	8534	363	300	51	6	4	0	0	0	0	163.1	15.10.2009
FR0030R	Puy de Dôme	8377	359	116	24	1	1	0	0	0	0	156.4	23.03.2009
GB0002R	Eskdalemuir	8673	365	12	3	0	0	0	0	0	0	132	25.04.2009
GB0006R	Lough Navar	8238	347	0	0	0	0	0	0	0	0	110	26.06.2009
GB0013R	Yarner Wood	8059	345	45	10	0	0	0	0	0	0	142	03.06.2009, 25.06.2009
GB0014R	High Muffles	4624	197	107	17	12	3	0	0	0	0	178	02.06.2009
GB0015R	Strath Vaich Dam	8276	354	3	1	0	0	0	0	0	0	124	24.04.2009
GB0031R	Aston Hill	8476	364	52	12	0	0	0	0	0	0	142	02.07.2009
GB0033R	Bush	8570	361	0	0	0	0	0	0	0	0	120	02.07.2009
GB0035R	Great Dun Fell	7766	331	3	1	0	0	0	0	0	0	132	01.07.2009
GB0036R	Harwell	8643	364	27	4	6	1	0	0	0	0	168	02.07.2009
GB0037R	Ladybower Res.	8352	352	14	3	0	0	0	0	0	0	146	01.07.2009
GB0038R	Lullington Heath	8352	354	13	3	3	1	0	0	0	0	166	02.07.2009
GB0039R	Sibton	8388	354	26	7	5	1	3	1	0	0	200	06.08.2009
GB0043R	Narberth	8308	357	20	5	0	0	0	0	0	0	150	02.06.2009
GB0045R	Wicken Fen	8444	357	41	12	3	1	0	0	0	0	158	02.07.2009
GB0048R	Auchencorth Moss	8541	363	3	1	0	0	0	0	0	0	128	01.06.2009
GB0049R	Weybourne	7974	337	86	20	7	4	0	0	0	0	172	12.10.2009
GB0050R	St. Osyth	8600	365	15	6	6	2	5	1	4	1	258	06.08.2009
GB0051R	Market Harborough	7405	316	9	4	1	1	0	0	0	0	152	08.05.2009
GB0052R	Lerwick	7948	335	6	4	0	0	0	0	0	0	124	25.04.2009
GB0053R	Charlton Mackrell	8500	359	21	6	0	0	0	0	0	0	132	01.07.2009
GR0001R	Aliartos	8434	356	145	29	0	0	0	0	0	0	148	05.08.2009, 20.08.2009
GR0002R	Finokalia	6474	292	451	60	0	0	0	0	0	0	144.5	18.06.2009
HU0002R	K-puszta	8533	358	473	79	40	12	0	0	0	0	172	31.07.2009
IE0031R	Mace Head	8710	364	4	2	0	0	0	0	0	0	130	01.06.2009
IT0001R	Montelibretti	8437	361	618	113	135	48	19	11	1	1	206.3	22.05.2009
LT0015R	Preila	8230	351	60	12	0	0	0	0	0	0	149.1	28.04.2009

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	6519	275	4	1	0	0	0	0	0	0	134	26.05.2009
LV0016R	Zoseni	8723	365	54	7	2	1	0	0	0	0	153	29.04.2009
NL0007R	Eibergen	8633	362	55	13	4	1	0	0	0	0	173.8	20.08.2009
NL0009R	Kollumerwaard	8365	353	35	7	4	2	0	0	0	0	165.9	20.08.2009
NL0010R	Vredepeel	7676	326	14	6	0	0	0	0	0	0	136.4	19.08.2009
NL0011R	Cabauw	8569	360	47	10	12	4	0	0	0	0	168.5	20.08.2009
NL0091R	De Zilk	8568	362	21	5	1	1	0	0	0	0	153.3	06.08.2009
NO0001R	Birkenes	8409	357	0	0	0	0	0	0	0	0	119.2	26.04.2009
NO0015R	Tustervatn	8726	365	32	3	0	0	0	0	0	0	132.8	25.04.2009
NO0039R	Kårvatn	8728	365	41	8	0	0	0	0	0	0	135.5	01.05.2009
NO0042G	Spitsbergen, Zeppelinfjell	8680	365	0	0	0	0	0	0	0	0	109.7	08.05.2009
NO0043R	Prestebakke	8583	360	23	5	0	0	0	0	0	0	136.3	20.08.2009
NO0052R	Sandve	8741	365	24	6	0	0	0	0	0	0	141.5	20.08.2009
NO0055R	Karasjok	8517	357	0	0	0	0	0	0	0	0	118.8	02.05.2009
NO0056R	Hurdal	3149	132	6	2	0	0	0	0	0	0	125.5	25.04.2009
NO0056R	Hurdal	5558	234	0	0	0	0	0	0	0	0	116.8	20.08.2009
PL0002R	Jarczew	8440	365	57	14	1	1	0	0	0	0	152	30.04.2009
PL0003R	Sniezka	8617	360	364	51	0	0	0	0	0	0	144	30.04.2009, 01.05.2009
PL0004R	Leba	8664	363	100	20	0	0	0	0	0	0	148	29.04.2009
PL0005R	Diabla Gora	8301	348	44	10	0	0	0	0	0	0	146	29.04.2009
PT0004R	Monte Velho	8682	364	178	42	2	2	0	0	0	0	154	17.06.2009
SE0005R	Bredkälen	8748	365	15	4	0	0	0	0	0	0	131	01.05.2009
SE0011R	Vavihill	8530	362	22	7	0	0	0	0	0	0	133	29.04.2009
SE0012R	Aspvreten	8736	365	11	3	0	0	0	0	0	0	130	26.04.2009
SE0013R	Esrange	8750	365	11	3	0	0	0	0	0	0	127	26.04.2009
SE0014R	Råö	8739	365	29	6	0	0	0	0	0	0	141	04.07.2009
SE0032R	Norra-Kvill	8728	365	50	8	0	0	0	0	0	0	143	26.04.2009
SE0035R	Vindeln	8523	360	5	2	0	0	0	0	0	0	126	26.04.2009
SE0039R	Grimsö	8730	365	15	4	0	0	0	0	0	0	125	26.04.2009, 27.04.2009

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)
SI0008R	Iskrba	8150	358	414	64	11	4	0	0	0	0	158	22.08.2009
SI0031R	Zarodnje	8237	364	422	54	2	2	0	0	0	0	155	22.05.2009
SI0032R	Krvavec	8179	365	1225	117	65	19	0	0	0	0	169	26.05.2009
SI0033R	Kovk	8286	365	327	50	8	3	0	0	0	0	159	21.08.2009
SK0002R	Chopok	8738	365	814	88	14	6	0	0	0	0	162	03.04.2009
SK0004R	Stará Lesná	8707	365	167	34	0	0	0	0	0	0	141	22.05.2009
SK0006R	Starina	8708	365	357	72	4	2	0	0	0	0	160	02.08.2009
SK0007R	Topolniky	2060	87	0	0	0	0	0	0	0	0	110	28.03.2009, 29.03.2009

Table 1.2: Percentiles of hourly ozone values April–September 2009.

Code	Station	25%	50%	75%	90%	95%	98%	99%	Data capture
AM0001R	Amberd	99.8	109.4	118.2	125.6	129.4	134.4	137.2	40.1
AT0002R	Illmitz	56.0	75.0	97.0	116.0	125.0	133.0	138.0	93.8
AT0005R	Vorhegg	60.0	79.0	99.0	115.0	125.0	134.0	140.0	91.8
AT0030R	Pillersdorf bei Retz	60.0	77.0	94.0	110.0	119.0	132.0	138.0	95.3
AT0032R	Sulzberg	75.0	89.0	105.0	120.0	127.0	133.4	138.0	94.0
AT0034G	Sonnblick	96.0	107.0	117.0	127.0	133.0	140.0	143.0	95.7
AT0037R	Zillertaler Alpen	86.0	100.0	113.0	126.0	132.0	139.0	144.2	95.2
AT0038R	Gerlitzen	93.0	106.0	118.0	130.0	136.0	143.0	147.0	95.6
AT0040R	Masenberg	80.0	94.0	108.0	120.0	126.0	132.4	136.0	92.9
AT0041R	Haunsberg	66.0	83.0	101.0	117.0	124.0	130.0	134.0	95.4
AT0042R	Heidenreichstein	51.0	72.0	93.0	110.0	118.0	128.0	135.0	94.1
AT0043R	Forsthof	68.0	84.0	101.0	119.0	126.0	133.0	137.0	95.2
AT0044R	Graz Platte	79.0	95.0	111.0	123.0	129.0	136.0	138.0	94.8
AT0045R	Dunkelsteinerwald	44.0	65.0	88.0	110.0	120.0	131.0	138.0	95.2
AT0046R	Gänserndorf	50.0	70.0	91.0	112.0	122.2	134.0	140.0	95.5
AT0047R	Stixneusiedl	56.0	75.0	95.0	115.0	123.0	131.0	135.0	95.5
AT0048R	Zoebelboden	69.0	84.0	101.0	116.0	123.0	129.0	132.0	93.4
AT0049R	Grebenzen bei St. Lamprecht	82.0	96.0	109.0	122.0	130.0	134.0	137.0	91.9
BE0001R	Offagne	47.0	64.0	83.0	99.0	109.0	120.0	128.3	97.3
BE0032R	Eupen	37.0	57.0	78.0	99.0	111.0	126.0	139.0	95.4
BE0035R	Vezin	29.0	51.0	75.0	97.0	109.0	122.0	131.2	97.3
BG0053R	Rojen peak	91.8	102.9	113.0	121.8	126.9	132.5	134.6	93.2
CH0001G	Jungfraujoch	74.3	81.6	89.2	96.4	99.7	103.3	105.8	95.4
CH0002R	Payerne	45.5	69.1	91.8	111.5	120.8	130.8	136.3	95.1
CH0003R	Tänikon	42.6	65.6	89.1	108.4	119.8	130.9	136.8	95.4
CH0004R	Chaumont	78.8	93.8	108.8	121.2	129.7	138.3	144.8	95.4
CH0005R	Rigi	76.1	91.0	105.7	121.1	128.7	137.0	141.5	95.4
CY0002R	Ayia Marina	100.3	111.1	120.3	127.6	132.2	137.9	140.7	99.4
CZ0001R	Svratouch	48.3	62.4	77.0	88.5	94.2	101.9	107.0	99.1
CZ0003R	Košetice	54.7	73.0	91.2	107.1	115.9	123.8	129.7	97.5
DE0001R	Westerland	65.6	75.9	88.3	100.8	106.8	113.9	121.6	95.1
DE0002R	Langenbrügge	44.6	63.2	81.8	99.7	109.4	116.5	121.6	94.8
DE0003R	Schauinsland	84.2	99.1	113.5	128.3	135.1	144.3	149.2	96.0
DE0007R	Neuglobsow	48.4	67.4	86.0	103.1	113.3	123.3	129.3	93.8
DE0008R	Schmücke	64.2	80.4	98.0	113.3	120.1	126.8	130.7	94.6
DE0009R	Zingst	54.5	68.4	81.8	94.4	101.9	113.2	119.4	95.7
DK0005R	Keldsnor	60.7	73.0	86.5	98.4	105.7	115.3	123.6	81.3
DK0031R	Ulborg	60.7	73.0	86.5	98.4	105.7	115.3	123.6	81.3
DK0041R	Lille Valby	54.9	69.7	83.4	97.5	105.2	114.6	120.2	88.4
EE0009R	Lahemaa	42.0	59.0	76.0	91.0	97.0	108.0	120.0	97.8
EE0011R	Vilsandi	62.0	72.0	83.0	93.0	101.0	110.0	116.6	98.8
ES0001R	San Pablo de los Montes	83.0	96.2	108.5	119.2	124.3	127.9	130.7	99.4
ES0007R	Viznar	79.3	90.7	102.2	111.6	117.2	123.6	128.8	99.1
ES0008R	Niembro	56.2	69.2	85.3	95.6	102.6	113.5	121.8	97.8
ES0009R	Campisábalos	71.6	86.7	100.4	113.1	120.3	128.6	134.2	98.2
ES0010R	Cabo de Creus	64.3	86.6	102.6	114.7	121.8	130.3	135.8	99.0
ES0011R	Barcarrola	48.9	65.1	80.3	93.3	100.9	110.1	114.7	98.2
ES0012R	Zarra	81.8	92.9	104.5	115.4	121.6	128.0	131.9	96.2
ES0013R	Penausende	69.5	86.6	102.3	116.4	126.5	133.0	136.8	99.5
ES0014R	Els Torms	88.7	102.5	116.2	126.0	132.5	138.9	144.1	99.2
ES0016R	O Saviñao	45.9	60.9	77.8	93.0	103.6	114.0	123.6	99.5
ES0017R	Doñana	44.8	64.2	81.1	96.9	104.8	114.8	120.1	96.8
FI0009R	Utö	56.0	66.0	77.0	86.0	92.0	101.0	105.0	97.3
FI0017R	Virolahti II	39.0	56.0	70.0	81.0	89.0	99.0	106.0	98.3
FI0022R	Oulanka	29.0	44.0	69.0	87.0	92.0	97.0	104.0	96.8
FI0037R	Ahtari II	42.0	56.0	73.0	86.0	93.0	100.0	107.0	98.2
FI0096G	Pallas (Sammaltunturi)	55.0	65.0	82.0	93.0	99.0	104.0	111.0	98.1
FR0008R	Donon	62.0	78.0	94.0	108.0	116.0	126.0	136.0	99.5
FR0009R	Revin	48.0	64.0	82.0	100.0	110.0	122.6	131.0	99.5
FR0010R	Morvan	54.0	73.0	89.0	104.0	113.0	122.0	129.1	99.9
FR0013R	Peyrusse Vieille	49.0	64.0	79.0	93.0	101.0	112.0	116.0	94.8
FR0014R	Montandon	49.0	66.0	83.0	99.0	110.0	120.0	129.0	95.1
FR0015R	La Tardière	52.0	68.0	84.0	100.0	110.0	121.0	126.0	99.8
FR0016R	Le Casset	89.0	100.0	113.0	123.0	128.0	134.0	137.0	99.8
FR0017R	Montfranc	68.0	82.0	96.0	108.0	114.0	123.0	127.0	96.4
FR0018R	La Coulonche	53.0	66.0	80.0	94.0	102.0	111.0	122.0	97.9
FR0019R	Pic du Midi	85.4	97.2	108.2	116.5	121.8	129.8	135.1	96.4
FR0030R	Puy de Dôme	73.1	88.5	101.0	110.8	115.6	121.8	126.4	98.5

Table 1.2, cont.

Code	Station	25%	50%	75%	90%	95%	98%	99%	Data capture
GB0002R	Eskdalemuir	42.0	56.0	78.0	92.0	98.0	106.0	110.0	99.3
GB0006R	Lough Navar	34.0	48.0	58.0	69.4	76.0	84.0	90.0	88.8
GB0013R	Yarner Wood	48.0	62.0	78.0	92.0	98.0	114.0	122.0	96.6
GB0014R	High Muffles	64.0	78.0	92.0	110.0	120.8	138.0	144.0	49.0
GB0015R	Strath Vaich Dam	54.0	64.0	78.0	90.0	94.0	100.0	102.0	93.0
GB0031R	Aston Hill	52.0	64.0	82.0	94.0	102.0	114.0	124.0	97.6
GB0033R	Bush	46.0	56.0	70.0	83.6	88.0	94.0	98.0	97.9
GB0035R	Great Dun Fell	46.0	56.0	70.0	80.0	86.0	94.0	98.0	94.9
GB0036R	Harwell	38.0	52.0	67.0	82.0	90.0	104.0	110.0	98.8
GB0037R	Ladybower Res.	44.0	56.0	70.0	82.0	88.0	96.0	102.0	91.6
GB0038R	Lullington Heath	48.0	62.0	76.0	90.0	98.0	106.0	110.0	91.6
GB0039R	Sibton	44.0	58.0	76.0	88.0	96.0	104.0	114.0	99.1
GB0043R	Narberth	44.0	56.0	78.0	90.0	98.0	108.0	118.0	97.2
GB0045R	Wicken Fen	36.0	56.0	74.0	92.0	102.0	112.0	121.5	93.9
GB0048R	Auchencorth Moss	46.0	56.0	70.0	84.0	90.0	96.0	102.0	95.3
GB0049R	Weybourne	58.0	74.0	90.0	102.0	110.0	120.0	128.0	85.7
GB0050R	St. Osyth	46.0	60.0	76.0	90.0	96.0	106.0	110.0	98.5
GB0051R	Market Harborough	44.0	62.0	80.0	94.0	102.0	110.0	116.0	75.1
GB0052R	Lerwick	56.0	66.0	86.0	96.0	102.0	108.0	114.0	98.8
GB0053R	Charlton Mackrell	42.0	56.0	74.0	88.0	96.0	106.0	114.0	98.6
GR0001R	Aliartos	33.0	59.0	81.0	105.0	117.0	125.0	129.0	97.7
GR0002R	Finokalia	94.1	103.2	113.0	122.3	126.2	129.6	131.7	76.0
HU0002R	K-puszta	49.0	76.0	102.0	122.0	132.0	143.0	150.0	95.0
IE0031R	Mace Head	60.0	70.0	84.0	96.0	100.0	106.0	110.0	100.0
IT0001R	Montelibretti	36.1	68.8	104.9	128.0	141.4	157.0	168.2	96.8
LT0015R	Preila	61.3	74.5	87.2	99.0	105.4	116.3	123.7	96.9
LV0010R	Rucava	40.0	58.0	73.0	86.0	92.0	100.0	106.7	71.3
LV0016R	Zoseni	45.0	58.0	75.0	94.0	103.0	114.0	123.1	99.8
NL0007R	Eibergen	26.9	46.2	70.0	88.5	100.1	113.9	123.7	97.5
NL0009R	Kollumerwaard	41.8	58.3	73.5	86.2	93.8	106.0	117.2	92.2
NL0010R	Vredepeel	25.6	45.6	68.2	86.7	97.2	107.0	113.6	77.3
NL0011R	Cabauw	29.5	47.0	62.9	77.8	89.3	105.7	122.6	96.6
NL0091R	De Zilk	39.5	55.0	70.9	86.4	94.9	103.5	110.7	98.9
NO0001R	Birkenes	31.8	48.2	64.2	78.0	85.6	92.1	97.1	93.7
NO0015R	Tustervatn	51.8	64.2	81.8	94.3	99.2	106.8	114.6	99.6
NO0039R	Kårvatn	28.5	50.9	69.8	90.1	97.8	109.2	119.8	99.5
NO0042G	Spitsbergen, Zeppelinfjell	50.5	60.1	67.6	87.9	93.3	97.5	99.2	98.9
NO0043R	Prestebakke	48.8	61.9	77.3	89.3	96.8	106.3	113.1	99.2
NO0052R	Sandve	56.2	67.8	81.9	92.0	96.8	106.3	114.8	99.8
NO0055R	Karasjok	46.9	59.2	77.2	92.9	97.1	101.2	104.9	94.8
NO0056R	Hurdal	50.3	68.2	83.2	93.1	98.9	106.9	115.4	22.6
NO0056R	Hurdal	42.4	54.7	67.4	78.6	83.4	90.7	95.1	76.5
PL0002R	Jarczew	42.0	62.0	82.0	99.0	109.0	118.0	123.0	97.3
PL0003R	Sniezka	78.0	92.0	106.0	118.0	126.0	133.0	136.0	100.0
PL0004R	Leba	57.0	71.0	85.0	98.0	109.0	122.0	131.0	100.0
PL0005R	Diabla Gora	41.0	60.0	76.0	90.0	102.0	115.0	122.0	93.6
PT0004R	Monte Velho	52.0	71.0	87.0	102.0	115.0	127.2	133.0	99.9
SE0005R	Bredkälen	42.0	55.0	72.0	86.0	93.0	101.0	112.0	99.8
SE0011R	Vavihill	50.0	64.0	79.0	92.0	100.0	108.0	113.5	99.0
SE0012R	Aspvreten	46.0	61.0	77.0	89.0	97.0	105.0	110.0	100.0
SE0013R	Esrange	52.0	63.0	79.0	94.0	99.0	103.0	112.0	99.9
SE0014R	Råö	59.0	68.0	81.0	91.0	100.0	111.0	118.0	99.8
SE0032R	Norra-Kvill	57.0	68.0	83.0	96.0	102.0	113.0	122.0	99.9
SE0035R	Vindeln	39.0	56.0	73.0	88.0	93.0	98.0	103.0	99.7
SE0039R	Grimsö	36.0	52.0	69.0	84.0	92.0	100.0	107.3	99.5
SI0008R	Iskrba	14.0	63.0	98.0	121.0	131.0	139.0	142.0	91.0
SI0031R	Zarodnje	74.0	90.0	107.0	121.0	129.0	135.0	139.0	93.8
SI0032R	Krvavec	96.0	110.0	123.0	137.0	142.0	148.4	153.0	94.0
SI0033R	Kovk	71.0	87.0	103.0	118.0	125.0	135.0	140.0	94.8
SK0002R	Chopok	93.0	105.0	117.0	126.0	133.0	140.0	144.0	99.6
SK0004R	Stará Lesná	51.0	72.0	91.0	108.0	118.0	125.0	128.0	99.8
SK0006R	Starina	49.0	72.0	97.0	117.0	127.0	136.0	139.0	99.7

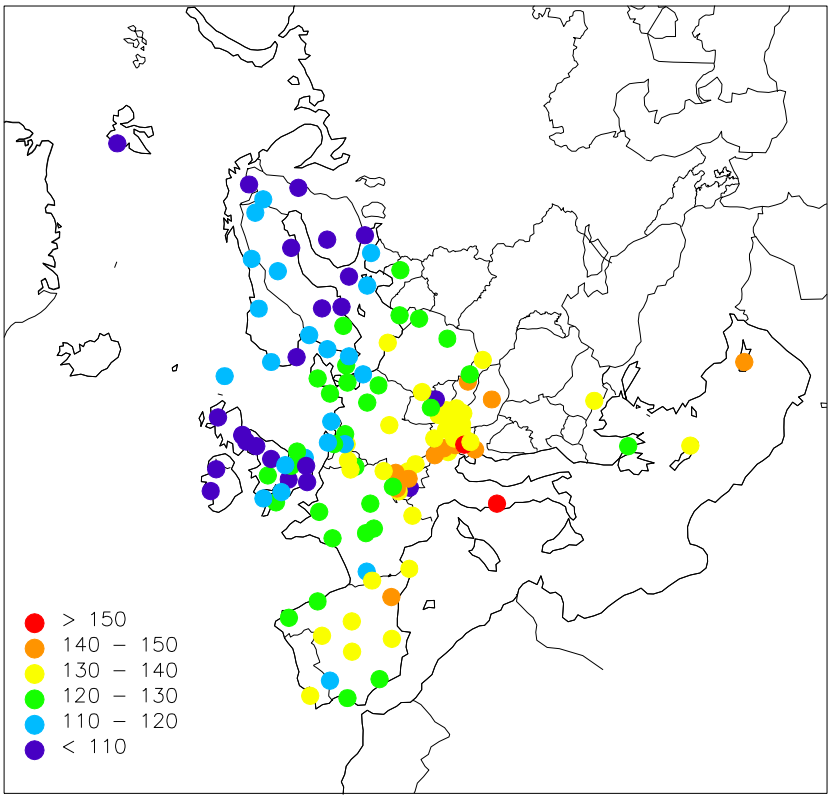


Figure 1.1: Ozone April–September 2009. 99-percentiles (μg/m^3).

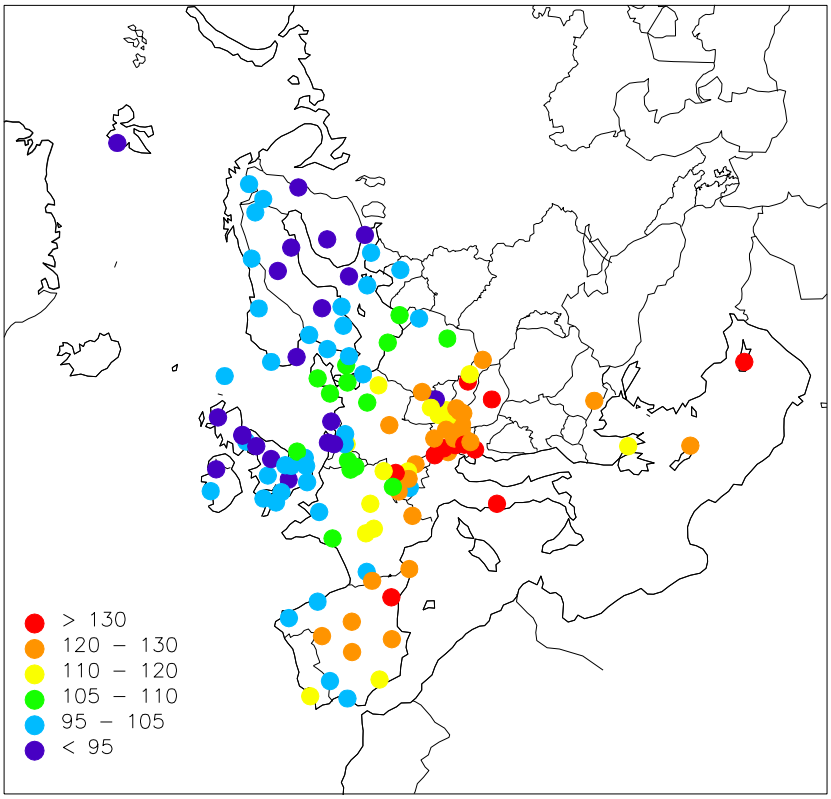


Figure 1.2: Ozone April–September 2009. 95-percentiles (μg/m^3).

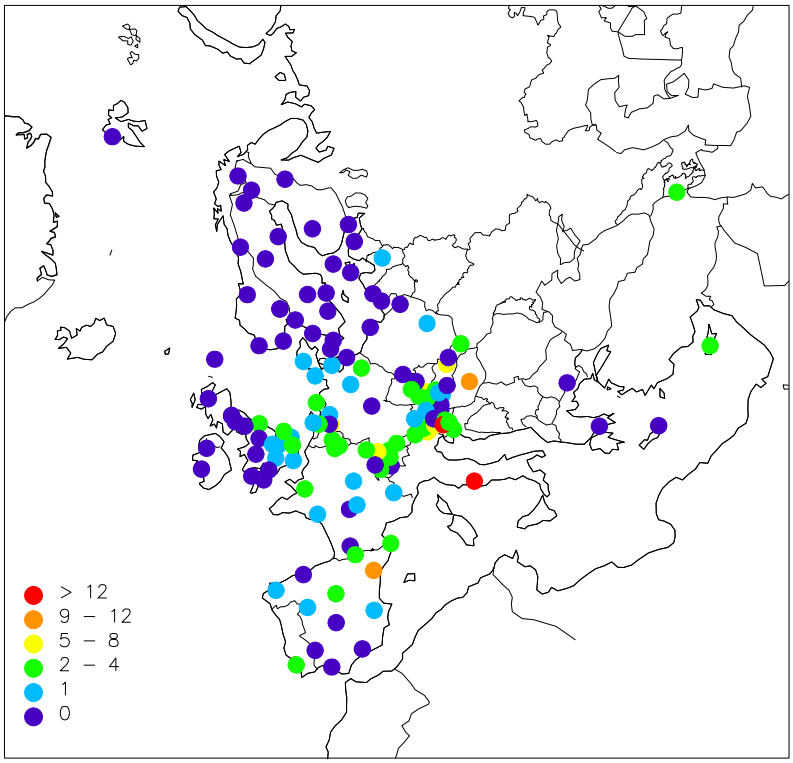


Figure 1.3: Number of exceedances of the threshold value of 150 μg/m^3. (Unit: number of days).

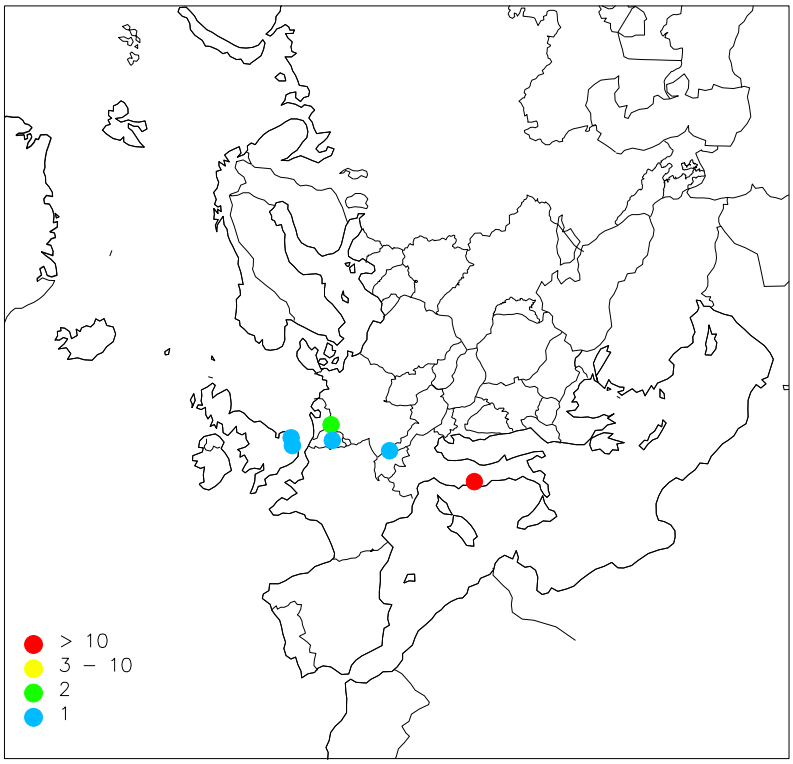


Figure 1.4: Number of exceedances of the threshold value of 180 μg/m^3. (Unit: number of days). Stations with zero exceedances are not shown.

Annex 2

AOT40 and AOT60, figures and tables

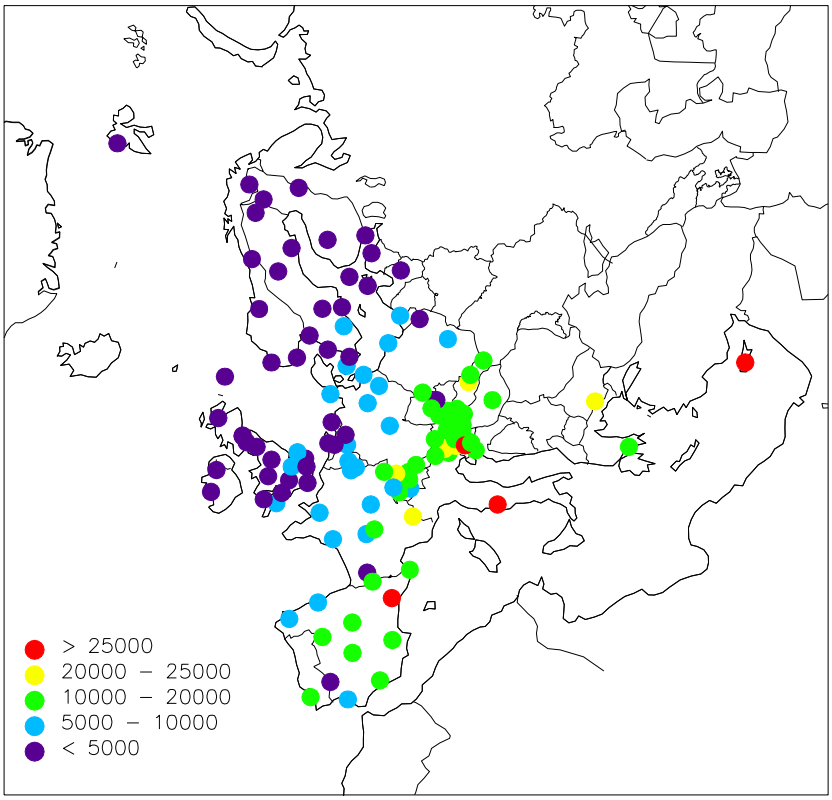


Figure 2.1: AOT40 (ppbh) April–September 2009 (daylight hours).

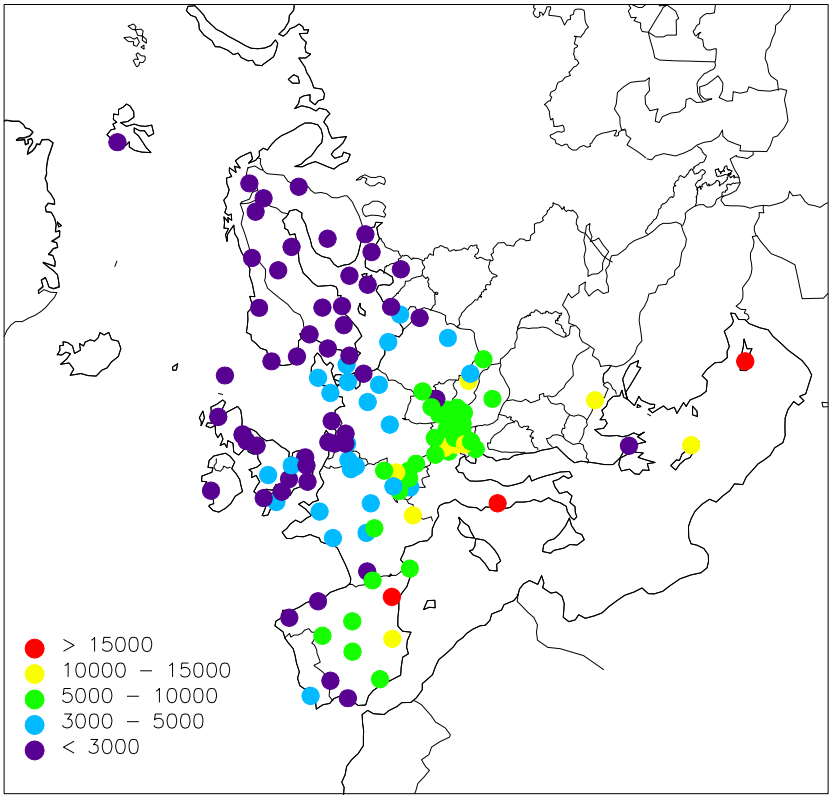


Figure 2.2: AOT40 (ppbh) May, June and July 2009 (daylight hours).

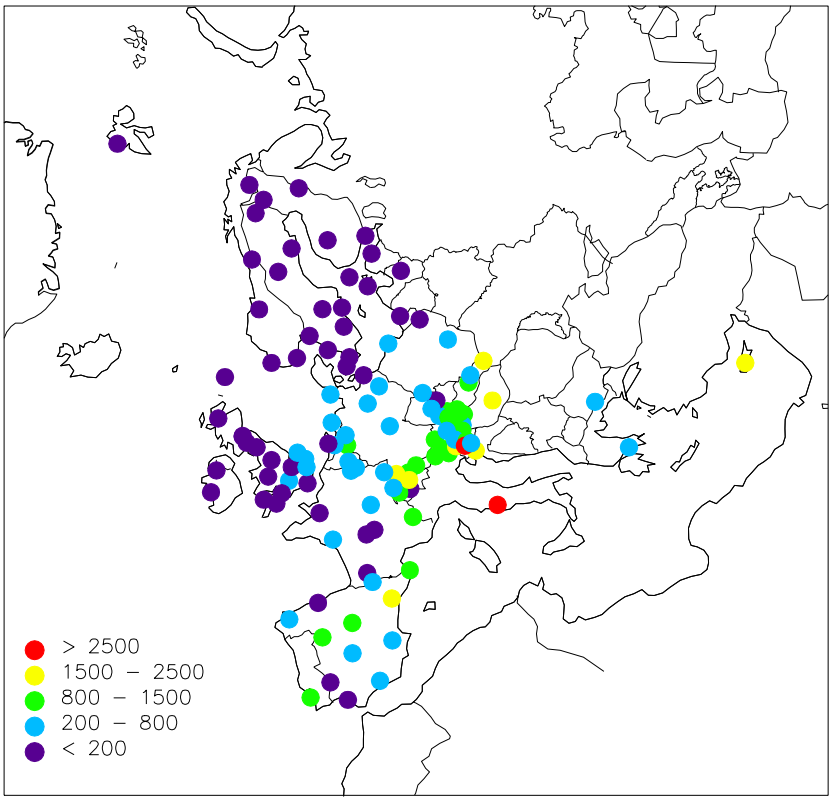


Figure 2.3: AOT60 (ppbh) April-September 2009 (daylight hours).

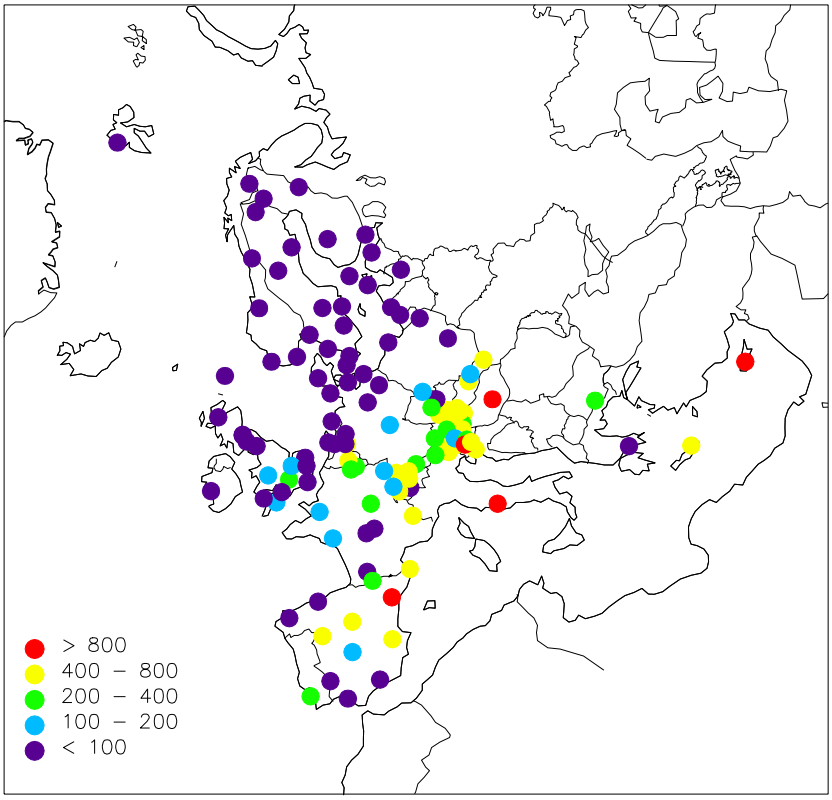


Figure 2.4: AOT60 (ppbh) May, June and July 2009 (daylight hours).

Table 2.1: AOT40 and AOT60 April–September 2009 (daylight hours).

Code	Station	AOT40	AOT40 corrected	AOT60	AOT60 corrected	Data capture
AT0002R	Illmitz	16208	17410	1308	1405	93
AT0005R	Vorhegg	13734	14962	1096	1194	92
AT0030R	Pillersdorf bei Retz	13238	14164	1126	1205	93
AT0032R	Sulzberg	15542	16031	976	1007	97
AT0034G	Sonnblick	24964	26156	1454	1523	95
AT0037R	Zillertaler Alpen	19219	19596	1230	1254	98
AT0038R	Gerlitzen	23698	24824	1716	1797	95
AT0040R	Masenberg	15800	17322	673	738	91
AT0041R	Haunsberg	13931	14728	894	945	95
AT0042R	Heidenreichstein	12920	13689	794	842	94
AT0043R	Forsthof	14200	14924	970	1019	95
AT0044R	Graz Platte	16626	17502	1159	1220	95
AT0045R	Dunkelsteinerwald	12922	13595	1094	1151	95
AT0046R	Gänserndorf	14825	15542	1390	1457	95
AT0047R	Stixneusiedl	14781	15504	1082	1135	95
AT0048R	Zoebelboden	11416	12691	562	624	90
AT0049R	Grebenzen bei St. Lamprecht	15157	16873	707	787	90
BE0001R	Offagne	8220	8484	504	521	97
BE0032R	Eupen	7294	7724	852	903	94
BE0035R	Vezin	7598	7846	652	674	97
BG0053R	Rojen peak	21763	22634	642	668	96
CH0001G	Jungfraujoch	6026	6308	0	0	96
CH0002R	Payerne	13927	14648	1209	1272	95
CH0003R	Tänikon	12956	13583	1318	1382	95
CH0004R	Chaumont	16948	17751	1284	1345	95
CH0005R	Rigi	15820	16587	1538	1612	95
CY0002R	Ayia Marina	31821	32031	2040	2054	99
CZ0001R	Svratouch	2937	2960	6	6	99
CZ0003R	Košetice	11485	11834	488	503	97
DE0001R	Westerland	7554	7943	202	212	95
DE0002R	Langenbrügge	8063	8598	239	255	94
DE0003R	Schauinsland	20721	21063	1861	1891	98
DE0007R	Neuglobsow	9862	10708	497	539	92
DE0008R	Schmücke	9901	10534	361	384	94
DE0009R	Zingst	5539	5791	119	124	96
DK0041R	Lille Valby	6712	7017	102	107	96
EE0009R	Lahemaa	1719	1764	8	8	97
EE0011R	Vilsandi	1774	1798	0	0	99
ES0001R	San Pablo de los Montes	18716	18980	499	506	99
ES0007R	Viznar	15462	15618	492	497	99
ES0008R	Niembro	5584	5717	93	95	98
ES0009R	Campisábalos	18854	19168	822	836	98
ES0010R	Cabo de Creus	15199	15428	869	882	99
ES0011R	Barcarrola	4997	5132	28	28	97
ES0012R	Zarra	19063	19934	736	769	96
ES0013R	Penausende	16913	17056	1069	1078	99
ES0014R	Els Torms	27547	27799	2257	2278	99
ES0016R	O Saviñao	5562	5614	213	215	99
ES0017R	Doñana	6509	6746	90	94	96
FI0009R	Utö	1928	2004	0	0	96
FI0017R	Virolahti II	1820	1845	6	6	99
FI0022R	Oulanka	1651	1698	6	6	97
FI0037R	Ahtari II	2185	2219	5	5	98
FI0096G	Pallas (Sammaltunturi)	3306	3340	2	2	99
FR0008R	Donon	10522	10627	460	465	99
FR0009R	Revin	7894	7934	532	534	100
FR0010R	Morvan	9660	9679	398	399	100
FR0013R	Peyrusse Vieille	4102	4336	6	7	95
FR0014R	Montandon	7765	8083	400	416	96
FR0015R	La Tardière	8780	8811	352	354	100
FR0016R	Le Casset	24128	24211	1214	1218	100
FR0017R	Montfranc	9816	10300	164	173	95
FR0018R	La Coulonche	5412	5561	198	203	97
FR0019R	Pic du Midi	15115	15746	327	341	96
FR0030R	Puy de Dôme	10663	10900	133	135	98

Table 2.1, cont.

Code	Station	AOT40	AOT40 corrected	AOT60	AOT60 corrected	Data capture
GB0002R	Eskdalemuir	4326	4364	29	29	99
GB0006R	Lough Navar	420	480	0	0	88
GB0013R	Yarner Wood	5208	5444	152	159	96
GB0015R	Strath Vaich Dam	2800	3062	4	4	91
GB0031R	Aston Hill	4625	4700	180	183	98
GB0033R	Bush	1611	1656	0	0	97
GB0035R	Great Dun Fell	893	941	13	14	95
GB0036R	Harwell	2856	2906	220	224	98
GB0037R	Ladybower Res.	1790	1982	62	69	90
GB0038R	Lullington Heath	3438	3775	96	105	91
GB0039R	Sibton	4365	4399	262	264	99
GB0043R	Narberth	3807	3953	111	115	96
GB0045R	Wicken Fen	5411	5827	191	206	93
GB0048R	Auchencorth Moss	2153	2284	7	7	94
GB0049R	Weybourne	7762	9247	253	301	84
GB0050R	St. Osyth	4333	4431	288	295	98
GB0052R	Lerwick	4994	5072	6	6	98
GB0053R	Charlton Mackrell	3949	4015	59	60	98
GR0001R	Aliartos	10036	10301	672	689	97
HU0002R	K-puszta	18098	19156	2359	2497	94
IE0031R	Mace Head	4603	4607	11	11	100
IT0001R	Montelibretti	27229	27880	5788	5926	98
LT0015R	Preila	6506	6708	184	189	97
LV0016R	Zoseni	2827	2831	88	88	100
NL0007R	Eibergen	4441	4576	320	329	97
NL0009R	Kollumerwaard	3252	3502	230	248	93
NL0011R	Cabauw	2567	2678	370	386	96
NL0091R	De Zilk	3045	3093	116	118	98
NO0001R	Birkenes	1341	1444	0	0	93
NO0015R	Tustervatn	4112	4145	42	42	99
NO0039R	Kårvatn	4035	4077	102	103	99
NO0042G	Spitsbergen, Zeppelinfjell	1721	1757	0	0	98
NO0043R	Prestebakke	3877	3938	72	73	98
NO0052R	Sandve	4268	4276	78	78	100
NO0055R	Karasjok	2487	2667	0	0	93
PL0002R	Jarczew	8361	8616	242	249	97
PL0003R	Sniezka	13950	13950	490	490	100
PL0004R	Leba	7594	7594	366	366	100
PL0005R	Diabla Gora	3664	3882	144	153	94
PT0004R	Monte Velho	10917	10928	885	886	100
SE0005R	Bredkälen	2272	2282	20	20	100
SE0011R	Vavihill	4532	4608	57	58	98
SE0012R	Aspvreten	3172	3172	5	5	100
SE0013R	Esrange	3272	3277	20	20	100
SE0014R	Råö	4626	4642	116	116	100
SE0032R	Norra-Kvill	5129	5139	120	120	100
SE0035R	Vindeln	2798	2811	9	9	100
SE0039R	Grimsö	2498	2518	23	23	99
SI0008R	Iskrba	15487	17173	1732	1921	90
SI0031R	Zarodnje	14812	15160	1009	1033	98
SI0032R	Krvavec	25800	27955	2702	2928	92
SI0033R	Kovk	12544	13242	681	719	95
SK0002R	Chopok	24060	24155	1324	1330	100
SK0004R	Stará Lesná	10642	10652	344	345	100
SK0006R	Starina	16555	16596	1606	1610	100

Table 2.2: AOT40 and AOT60 May–July 2009 (daylight hours).

Code	Station	AOT40	AOT40 corrected	AOT60	AOT60 corrected	Data capture
AT0002R	Illmitz	8598	9284	642	693	93
AT0005R	Vorhegg	8788	9137	656	682	96
AT0030R	Pillersdorf bei Retz	6562	7054	640	688	93
AT0032R	Sulzberg	7986	8233	359	370	97
AT0034G	Sonnblick	13454	14078	651	681	96
AT0037R	Zillertaler Alpen	9556	9618	349	351	99
AT0038R	Gerlitzen	13014	13563	770	803	96
AT0040R	Masenberg	8076	8772	260	283	92
AT0041R	Haunsberg	7098	7480	336	355	95
AT0042R	Heidenreichstein	6332	6648	414	434	95
AT0043R	Forsthof	7350	7727	411	432	95
AT0044R	Graz Platte	8245	8828	446	478	93
AT0045R	Dunkelsteinerwald	6716	7086	510	538	95
AT0046R	Gänserndorf	7256	7600	656	687	95
AT0047R	Stixneusiedl	7476	7852	474	498	95
AT0048R	Zoebelboden	5833	6550	245	275	89
AT0049R	Grebenzen bei St. Lamprecht	8482	9667	172	195	88
BE0001R	Offagne	3953	4090	268	277	97
BE0032R	Eupen	3730	4038	479	518	92
BE0035R	Vezin	4018	4142	442	456	97
BG0053R	Rojen peak	14289	14790	342	354	97
CH0001G	Jungfraujoch	3055	3152	0	0	97
CH0002R	Payerne	7585	8060	485	516	94
CH0003R	Tänikon	7012	7325	550	575	96
CH0004R	Chaumont	8562	8994	408	429	95
CH0005R	Rigi	8599	9042	719	756	95
CY0002R	Ayia Marina	17012	17195	1149	1162	99
CZ0001R	Svratouch	1079	1079	0	0	100
CZ0003R	Košetice	5151	5423	237	249	95
DE0001R	Westerland	4603	4794	56	58	96
DE0002R	Langenbrügge	3833	4052	20	22	95
DE0003R	Schauinsland	10893	11084	708	720	98
DE0007R	Neuglobsow	4043	4416	52	57	92
DE0008R	Schmücke	4604	4898	108	115	94
DE0009R	Zingst	2318	2426	29	31	96
DK0005R	Keldsnor	3904	4159	70	74	94
DK0031R	Ulborg	3923	4166	71	75	94
DK0041R	Lille Valby	3128	3234	7	7	97
EE0009R	Lahemaa	916	959	0	0	96
EE0011R	Vilsandi	993	995	0	0	100
ES0001R	San Pablo de los Montes	9480	9676	164	168	98
ES0007R	Viznar	6722	6798	58	59	99
ES0008R	Niembro	1812	1856	8	9	98
ES0009R	Campisábalos	9664	9837	488	496	98
ES0010R	Cabo de Creus	8775	8966	699	714	98
ES0011R	Barcarrola	2943	3066	5	6	96
ES0012R	Zarra	10130	10257	422	428	99
ES0013R	Penausende	8103	8163	465	469	99
ES0014R	Els Torms	16837	16968	1654	1667	99
ES0016R	O Saviñao	2291	2312	93	94	99
ES0017R	Doñana	2989	3090	41	42	97
FI0009R	Utö	860	916	0	0	94
FI0017R	Virolahti II	1068	1074	0	0	99
FI0022R	Oulanka	448	460	0	0	97
FI0037R	Ahtari II	1342	1364	0	0	98
FI0096G	Pallas (Sammaltunturi)	1312	1326	1	1	99
FR0008R	Donon	5029	5075	104	104	99
FR0009R	Revin	3864	3870	285	286	100
FR0010R	Morvan	4124	4135	208	208	100
FR0013R	Peyrusse Vieille	1962	2013	6	6	97
FR0014R	Montandon	3761	3788	170	172	99
FR0015R	La Tardière	4147	4166	124	125	100
FR0016R	Le Casset	12248	12304	600	602	100
FR0017R	Montfranc	4964	5348	73	79	93
FR0018R	La Coulonche	3126	3271	151	158	96

Table 2.2, cont.

Code	Station	AOT40	AOT40 corrected	AOT60	AOT60 corrected	Data capture
FR0019R	Pic du Midi	8692	8958	269	277	97
FR0030R	Puy de Dôme	5146	5292	74	76	97
GB0002R	Eskdalemuir	2496	2503	17	17	100
GB0013R	Yarner Wood	3488	3568	152	155	98
GB0015R	Strath Vaich Dam	1161	1340	0	0	87
GB0031R	Aston Hill	3130	3195	174	178	98
GB0033R	Bush	836	872	0	0	96
GB0035R	Great Dun Fell	660	662	13	13	100
GB0036R	Harwell	2026	2044	220	222	99
GB0038R	Lullington Heath	2140	2224	82	85	96
GB0039R	Sibton	2729	2763	50	51	99
GB0043R	Narberth	2476	2562	100	103	97
GB0045R	Wicken Fen	3651	4165	154	176	88
GB0048R	Auchencorth Moss	1189	1318	7	8	90
GB0050R	St. Osyth	2820	2830	51	51	100
GB0052R	Lerwick	2689	2729	0	0	99
GB0053R	Charlton Mackrell	2832	2842	59	59	100
GR0001R	Aliartos	2752	2881	77	81	96
GR0002R	Finokalia	12597	14884	671	792	85
HU0002R	K-puszta	8618	9594	1140	1269	90
IE0031R	Mace Head	2520	2522	11	11	100
IT0001R	Montelibretti	16638	17147	3884	4003	97
LT0015R	Preila	3578	3668	12	12	98
LV0010R	Rucava	1423	1523	14	15	93
LV0016R	Zoseni	860	862	8	8	100
MK0007R	Lazaropole	30834	32588	11693	12358	95
NL0007R	Eibergen	1596	1644	20	20	97
NL0009R	Kollumerwaard	1238	1331	30	32	93
NL0010R	Vredepeel	1591	1604	5	5	99
NL0011R	Cabauw	592	638	0	0	93
NL0091R	De Zilk	1517	1557	27	27	97
NO0001R	Birkenes	538	615	0	0	88
NO0015R	Tustervatn	1695	1710	10	10	99
NO0039R	Kårvatn	1606	1631	57	58	98
NO0042G	Spitsbergen, Zeppelinfjell	1301	1335	0	0	97
NO0043R	Prestebakke	1747	1781	0	0	98
NO0052R	Sandve	2558	2567	27	27	100
NO0055R	Karasjok	818	916	0	0	89
PL0002R	Jarczew	3415	3494	22	23	98
PL0003R	Sniezka	6686	6686	147	147	100
PL0004R	Leba	3460	3460	67	67	100
PL0005R	Diabla Gora	1596	1596	1	1	100
PT0004R	Monte Velho	4478	4482	351	351	100
SE0005R	Bredkälen	997	1001	15	15	100
SE0011R	Vavihill	1881	1889	19	19	100
SE0012R	Aspvreten	1639	1639	0	0	100
SE0013R	Esrange	1320	1324	0	0	100
SE0014R	Råö	2828	2842	82	83	99
SE0032R	Norra-Kvill	2191	2199	8	8	100
SE0035R	Vindeln	1282	1287	2	2	100
SE0039R	Grimsö	1023	1028	0	1	99
SI0008R	Iskrba	8147	9483	726	846	86
SI0031R	Zarodnje	7587	7607	400	401	100
SI0032R	Krvavec	13302	14250	1258	1347	93
SI0033R	Kovk	7052	7398	495	519	95
SK0002R	Chopok	13807	13845	588	589	100
SK0004R	Stará Lesná	4997	5002	114	114	100
SK0006R	Starina	8666	8689	728	730	100

Annex 3

Seasonal variation

Table 3.1: Monthly mean concentrations 2009 ($\mu g/m^3$).

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
AM0001R	Amberd	-	-	121.4	111.0	109.0	106.0	-	-	-	71.8	76.6	75.6
AT0002R	Illmitz	32.9	50.4	65.1	84.8	82.5	77.1	79.1	75.2	61.3	40.5	26.5	31.3
AT0005R	Vorhegg	58.8	71.3	87.7	88.2	89.4	82.1	79.9	76.9	60.4	50.1	45.5	52.6
AT0030R	Pillersdorf bei Retz	36.7	48.6	64.9	90.1	81.2	74.7	76.3	79.1	66.5	40.5	26.2	26.1
AT0032R	Sulzberg	65.4	72.1	84.2	104.1	94.9	92.2	87.2	92.9	71.7	61.7	60.8	62.7
AT0034G	Sonnblick	89.6	84.3	98.9	118.3	109.8	107.1	103.9	105.5	97.3	84.2	84.2	82.8
AT0037R	Zillertaler Alpen	80.6	82.5	96.6	117.0	105.2	99.7	93.2	99.0	86.0	76.1	77.3	73.6
AT0038R	Gerlitzen	78.9	77.9	93.0	116.3	112.5	103.6	103.5	103.2	94.9	75.3	76.0	71.7
AT0040R	Masenberg	68.2	65.4	82.2	110.6	95.4	89.8	93.8	88.6	84.8	58.7	59.3	56.9
AT0041R	Haunsberg	44.2	60.1	74.8	100.3	85.4	85.0	83.1	83.3	65.8	44.7	46.0	46.7
AT0042R	Heidenreichstein	41.5	49.4	65.6	90.2	76.0	71.0	67.3	70.3	55.2	40.6	35.9	37.2
AT0043R	Forsthof	36.6	46.5	79.3	102.5	85.9	82.9	86.8	82.9	70.0	46.0	38.0	40.8
AT0044R	Graz Platte	37.5	58.4	78.4	108.4	95.1	84.4	93.2	94.8	87.0	55.9	39.4	42.0
AT0045R	Dunkelsteinerwald	28.7	48.5	63.5	77.7	71.8	71.4	68.6	65.5	47.7	36.6	24.2	27.7
AT0046R	Gänserndorf	29.4	45.0	60.2	81.0	73.3	67.4	72.2	72.5	59.4	35.9	27.3	28.0
AT0047R	Stixneusiedl	36.6	54.2	62.4	85.4	79.5	72.6	78.6	76.3	63.7	38.7	29.5	31.2
AT0048R	Zoebelboden	56.3	65.5	79.7	105.1	87.2	85.7	84.4	81.4	67.5	53.7	54.9	57.8
AT0049R	Grebenzen bei St. Lamprecht	80.4	76.5	88.8	112.3	101.3	96.0	96.6	90.6	80.1	70.9	72.8	70.5
BE0001R	Offagne	38.2	42.7	62.0	73.2	69.1	73.3	61.3	66.4	47.1	35.3	49.3	44.2
BE0032R	Eupen	35.5	36.6	52.0	59.1	60.4	64.4	62.5	66.6	39.4	34.3	52.5	39.9
BE0035R	Vezin	27.1	31.8	49.6	55.1	55.2	64.2	54.8	55.6	37.6	27.9	43.7	31.9
BG0053R	Rojen peak	67.3	69.9	74.9	92.5	97.1	109.4	115.9	108.7	85.2	66.3	69.1	58.3
CH0001G	Jungfraujoch	65.9	63.9	74.3	86.4	82.1	81.6	79.9	84.0	76.4	67.3	62.9	63.9
CH0002R	Payerne	32.1	42.4	64.4	71.1	70.6	76.5	68.6	74.4	53.9	36.3	34.6	32.7
CH0003R	Tänikon	27.6	45.2	61.6	71.9	69.6	76.5	68.1	69.5	45.8	35.3	32.5	35.4
CH0004R	Chaumont	66.9	71.2	86.1	101.7	95.6	94.8	90.0	99.9	80.5	67.8	63.9	59.9
CH0005R	Rigi	62.3	70.5	86.7	99.7	94.4	93.7	89.7	95.2	69.5	63.1	64.1	64.2
CY0002R	Ayia Marina	79.7	87.2	97.7	113.5	110.8	107.5	115.0	112.5	100.9	91.2	84.7	77.4
CZ0001R	Svratouch	32.7	30.6	37.2	61.8	56.9	53.2	70.5	74.6	61.1	34.6	29.5	26.2
CZ0003R	Košetice	42.2	49.9	65.2	89.6	78.6	71.3	67.5	72.7	60.7	39.8	42.1	39.7
DE0001R	Westerland	43.3	52.2	68.6	79.1	86.6	79.6	79.3	74.3	64.2	51.4	42.4	34.9
DE0002R	Langenbrügge	28.7	33.9	50.7	74.2	70.5	62.5	59.5	64.8	51.4	32.1	32.2	27.3
DE0003R	Schauinsland	77.8	74.2	85.7	108.9	102.6	100.9	92.2	103.9	86.7	71.2	71.0	67.9
DE0007R	Neuglobsow	29.4	42.2	57.9	81.3	71.7	68.2	62.0	68.0	53.9	36.3	28.7	31.4

Table 3.1, cont.

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
DE0008R	Schmücke	53.4	50.6	66.7	94.1	84.3	79.9	76.4	85.9	66.4	46.8	44.5	46.9
DE0009R	Zingst	39.4	44.7	59.1	81.4	74.6	67.5	63.7	66.7	56.6	44.8	30.4	34.3
DK0005R	Keldsnor	48.0	49.3	68.9	79.6	82.5	74.8	72.5	67.5	61.6	41.7	40.5	42.6
DK0031R	Ulborg	48.0	49.3	68.9	79.6	82.5	74.8	72.5	67.5	61.6	41.7	40.5	42.6
DK0041R	Lille Valby	39.9	48.1	64.2	75.7	75.8	67.7	66.6	67.6	57.8	44.5	38.8	37.4
EE0009R	Lahemaa	46.3	53.7	72.6	78.4	73.1	58.1	50.7	43.2	46.8	38.2	36.2	36.3
EE0011R	Vilsandi	53.1	57.2	75.0	80.4	83.2	69.7	68.7	65.5	68.4	48.6	43.8	43.0
ES0001R	San Pablo de los Montes	63.1	77.1	91.6	95.9	92.6	88.8	103.2	93.5	99.5	87.4	75.0	70.1
ES0007R	Viznar	68.9	75.3	77.3	87.4	87.3	83.2	90.5	100.9	91.4	77.3	64.9	58.6
ES0008R	Niembro	61.9	68.9	85.6	90.7	76.9	65.5	58.4	61.4	75.5	57.7	62.8	59.6
ES0009R	Campisábalos	69.4	68.5	80.8	89.0	87.8	81.0	85.0	89.2	80.7	63.5	61.8	63.4
ES0010R	Cabo de Creus	50.1	68.8	74.4	84.5	83.2	88.4	78.9	77.0	83.1	63.7	64.5	65.4
ES0011R	Barcarrola	50.7	59.2	69.2	69.6	79.7	59.1	65.0	63.0	50.5	44.6	44.3	52.4
ES0012R	Zarra	59.2	74.4	93.8	92.5	96.3	91.9	89.3	96.3	92.7	73.2	63.8	63.1
ES0013R	Penausende	63.2	68.8	85.6	94.1	94.2	79.4	78.0	86.2	83.8	63.8	61.5	61.7
ES0014R	Els Torms	51.0	67.6	95.4	92.3	106.0	112.5	106.9	95.4	96.8	72.7	61.4	52.4
ES0016R	O Saviñao	50.7	54.7	75.9	78.1	71.3	58.1	50.4	57.6	61.3	44.2	53.7	50.7
ES0017R	Doñana	50.4	59.9	57.0	68.2	74.4	55.2	58.9	64.1	56.5	37.0	42.5	45.0
FI0009R	Utö	53.1	56.9	70.8	74.8	76.5	61.9	59.5	65.2	62.5	48.6	45.8	45.1
FI0017R	Virolahti II	42.5	46.2	63.9	71.0	68.7	49.3	51.5	40.3	43.8	33.2	32.7	29.6
FI0022R	Oulanka	56.0	64.4	77.7	86.0	68.6	48.2	31.2	31.5	31.4	37.6	31.1	47.0
FI0037R	Ahtari II	45.3	58.3	72.9	76.9	75.6	55.4	42.9	44.2	47.1	40.2	37.0	36.5
FI0096G	Pallas (Sammaltunturi)	63.8	72.6	83.8	92.6	81.6	64.2	55.0	60.0	56.7	54.3	46.1	58.0
FR0008R	Donon	50.0	53.4	71.1	85.8	76.0	82.5	74.5	83.9	66.6	48.8	59.2	52.5
FR0009R	Revin	37.1	46.7	66.8	74.5	68.2	74.3	60.6	71.5	49.5	36.9	46.7	41.2
FR0010R	Morvan	57.1	56.9	75.8	88.9	75.0	78.1	62.2	67.9	56.1	52.9	63.4	56.4
FR0013R	Peyrusse Vieille	48.5	64.7	80.9	77.6	62.0	67.1	60.0	58.0	64.9	51.1	52.8	45.5
FR0014R	Montandon	44.1	47.0	61.7	67.9	66.9	71.5	64.5	74.4	49.5	42.6	48.3	45.7
FR0015R	La Tardière	42.4	51.7	71.3	73.6	71.1	75.1	59.0	65.8	68.1	47.8	50.2	43.1
FR0016R	Le Casset	89.0	87.7	102.7	111.9	100.5	97.7	101.4	102.5	90.1	80.3	75.4	81.1
FR0017R	Montfranc	68.1	69.2	85.9	90.8	82.0	88.9	74.2	81.0	78.4	69.2	66.6	60.1
FR0018R	La Coulonche	49.3	56.1	76.3	77.2	75.1	74.4	59.8	59.8	60.2	47.2	59.1	50.7
FR0019R	Pic du Midi	83.3	82.9	87.3	85.8	91.1	102.8	97.9	105.0	100.1	85.4	83.0	88.2
FR0030R	Puy de Dôme	78.8	75.0	88.6	100.1	89.6	90.4	78.4	81.5	81.5	74.0	72.4	66.3

Table 3.1, cont.

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
GB0002R	Eskdalemuir	48.5	57.3	69.0	73.7	76.1	64.3	52.9	42.6	40.1	37.5	57.2	55.1
GB0006R	Lough Navar	41.5	46.5	58.9	59.2	43.5	50.0	40.9	36.4	43.2	40.0	52.2	44.6
GB0013R	Yarner Wood	48.6	56.4	75.1	79.1	76.3	70.7	53.9	46.9	52.8	47.4	72.9	56.5
GB0014R	High Muffles	32.8	51.1	68.7	76.9	78.4	80.1	-	-	-	-	-	45.5
GB0015R	Strath Vaich Dam	68.6	78.9	83.2	81.9	79.5	66.4	54.9	52.5	59.6	58.0	66.2	56.3
GB0031R	Aston Hill	58.5	62.6	81.0	83.4	78.6	77.4	61.4	47.2	52.5	50.7	57.3	53.6
GB0033R	Bush	50.7	60.0	71.4	72.2	72.1	57.7	51.1	46.6	48.1	43.4	51.4	49.3
GB0035R	Great Dun Fell	50.9	54.6	71.9	74.1	69.6	64.5	51.6	41.0	49.4	45.8	55.2	53.5
GB0036R	Harwell	35.8	39.1	59.3	59.6	64.1	61.0	47.0	42.7	48.7	38.2	54.5	42.9
GB0037R	Ladybower Res.	43.8	49.2	65.8	67.6	69.4	66.8	52.9	44.1	47.0	35.9	53.9	51.1
GB0038R	Lullington Heath	49.9	48.1	69.0	67.6	71.3	67.3	54.8	56.7	52.6	45.0	62.5	48.2
GB0039R	Sibton	35.2	38.3	54.0	61.1	71.2	70.3	51.1	56.2	50.2	37.8	47.5	42.3
GB0043R	Narberth	57.4	60.4	77.3	81.4	75.8	68.0	49.3	42.5	49.0	49.4	58.9	55.9
GB0045R	Wicken Fen	40.0	45.7	60.3	64.4	70.2	67.7	48.8	46.0	42.9	29.9	43.4	35.8
GB0048R	Auchencorth Moss	53.0	53.3	67.1	75.2	72.2	60.0	52.0	45.6	42.9	43.4	51.7	51.8
GB0049R	Weybourne	52.8	59.6	75.1	83.9	81.6	86.5	65.5	66.1	62.4	55.6	59.4	59.3
GB0050R	St. Osyth	37.7	39.6	54.7	56.9	67.8	70.4	58.1	59.6	49.8	34.6	49.6	39.1
GB0051R	Market Harborough	43.4	50.2	63.7	71.2	77.1	76.9	-	44.7	46.0	32.8	47.5	39.3
GB0052R	Lerwick	65.6	78.9	87.3	90.7	86.3	67.2	60.7	55.5	58.5	59.8	64.1	63.6
GB0053R	Charlton Mackrell	45.6	49.7	65.5	71.0	72.3	65.7	51.4	45.4	42.4	43.9	61.4	44.8
GR0001R	Aliartos	24.0	33.3	43.9	47.6	54.8	58.2	58.1	81.5	55.9	44.6	31.7	33.0
GR0002R	Finokalia	71.9	75.8	89.3	103.3	109.3	106.0	98.9	107.6	98.1	84.7	73.3	69.2
HU0002R	K-puszta	33.2	52.8	63.5	91.9	87.5	58.1	73.0	74.1	66.4	41.2	29.5	28.5
IE0031R	Mace Head	72.8	79.4	91.4	90.8	83.1	72.7	60.9	58.7	65.9	66.3	76.5	70.9
IT0001R	Montelibretti	34.2	47.4	48.5	62.9	73.6	77.7	78.3	81.3	58.9	44.0	26.1	31.5
LT0015R	Preila	45.1	44.4	59.6	80.9	83.3	70.3	73.5	68.9	65.9	47.3	32.7	34.3
LV0010R	Rucava	51.0	52.0	62.1	43.7	74.0	60.8	58.0	36.4	61.9	37.6	24.9	-
LV0016R	Zoseni	51.2	59.1	86.2	89.9	74.8	55.6	48.9	45.7	47.2	42.0	42.2	46.9
NL0007R	Eibergen	19.4	29.2	49.3	58.0	58.0	51.0	43.9	51.9	32.3	22.3	30.9	22.7
NL0009R	Kollumerwaard	27.4	39.1	57.7	57.8	64.5	68.2	51.7	57.2	47.3	34.3	34.8	28.2
NL0010R	Vredepeel	20.3	27.5	46.1	51.9	57.3	56.5	38.6	43.4	22.9	19.5	32.2	20.1
NL0011R	Cabauw	15.5	22.3	38.3	42.4	51.0	53.1	46.3	54.3	36.3	23.8	34.1	21.5
NL0091R	De Zilk	24.2	36.4	53.6	54.9	63.9	66.3	50.4	54.4	39.2	28.3	37.1	25.3

Table 3.1, cont.

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NO0001R	Birkenes	45.5	52.4	66.3	60.8	65.0	50.4	40.6	38.6	36.2	30.9	36.5	34.9
NO0015R	Tustervatn	67.4	73.5	88.3	94.0	81.4	62.5	51.9	50.0	55.5	54.0	50.6	61.2
NO0039R	Kårvatn	66.5	63.1	82.7	73.7	67.0	51.0	40.1	38.2	33.5	40.5	47.9	52.7
NO0042G	Spitsbergen, Zeppelinfjell	68.3	80.6	77.2	62.7	73.7	55.7	53.1	56.2	59.3	64.4	68.9	72.7
NO0043R	Prestebakke	48.5	48.9	71.7	78.5	75.2	61.6	54.9	54.0	49.2	37.9	47.2	41.1
NO0052R	Sandve	58.0	60.9	74.6	77.7	80.1	68.0	65.1	64.1	56.0	52.1	55.0	51.6
NO0055R	Karasjok	65.0	73.2	88.3	90.6	76.9	59.7	43.3	48.5	50.0	50.3	43.3	59.0
NO0056R	Hurdal	47.9	45.7	69.3	63.4	73.0	-	-	-	-	-	-	-
NO0056R	Hurdal	-	-	-	-	67.6	64.2	51.1	48.5	49.5	39.7	40.5	44.9
PL0002R	Jarczew	38.3	49.1	64.3	80.9	71.2	58.9	58.8	55.5	52.0	32.7	30.0	37.7
PL0003R	Sniezka	69.8	64.0	77.5	111.3	96.2	86.0	88.5	89.4	80.7	62.7	63.4	59.7
PL0004R	Leba	51.8	54.0	70.9	86.9	80.0	69.4	67.0	67.3	58.6	47.9	38.0	36.9
PL0005R	Diabla Gora	41.6	47.9	69.3	82.3	70.1	54.4	55.9	50.0	48.2	35.1	28.5	33.9
PT0004R	Monte Velho	52.6	59.5	73.1	76.8	76.1	62.4	61.3	64.2	78.1	55.2	54.8	52.7
SE0005R	Bredkälen	57.6	63.7	80.3	80.5	75.5	59.5	43.9	42.6	42.6	36.8	37.0	49.5
SE0011R	Vavihill	44.3	48.7	61.5	84.1	66.6	65.0	61.1	58.6	52.3	40.4	39.1	41.3
SE0012R	Aspvreten	46.6	51.1	69.8	72.7	70.7	60.0	56.1	52.4	46.3	36.7	40.1	40.8
SE0013R	Esrange	64.2	72.1	85.4	91.8	79.1	62.6	49.6	54.3	56.2	53.4	45.5	60.3
SE0014R	Råö	48.6	43.9	62.8	74.0	76.3	68.8	75.2	64.1	57.7	45.3	45.4	40.7
SE0032R	Norra-Kvill	47.9	55.5	70.6	91.1	82.1	69.1	61.1	61.7	57.1	47.3	46.1	45.3
SE0035R	Vindeln	48.8	58.0	73.6	79.8	68.4	54.2	44.5	40.6	41.1	37.8	34.8	41.9
SE0039R	Grimsö	46.1	49.6	67.5	69.2	66.8	53.4	44.1	41.4	38.2	33.5	36.8	37.6
SI0008R	Iskrba	40.6	48.4	66.8	65.3	68.5	70.7	54.5	58.3	46.2	38.5	40.3	39.8
SI0031R	Zarodnje	42.8	59.5	80.1	101.9	93.6	84.3	86.8	95.1	80.6	53.0	41.3	44.1
SI0032R	Krvavec	83.7	81.6	96.8	120.7	115.8	104.7	106.8	111.9	101.2	77.9	77.8	74.7
SI0033R	Kovk	44.4	53.0	68.1	90.1	90.4	79.8	88.0	89.6	80.8	55.5	34.7	40.2
SK0002R	Chopok	81.3	75.1	87.8	116.5	113.5	106.2	99.7	99.3	93.1	68.2	75.3	73.0
SK0004R	Stará Lesná	51.7	57.0	71.3	95.0	81.7	72.2	63.5	64.6	55.4	42.6	39.9	43.2
SK0006R	Starina	43.7	57.5	62.4	85.4	78.6	69.9	74.4	70.8	62.1	39.6	29.8	33.8
SK0007R	Topolniky	46.3	60.8	72.7	-	-	-	-	-	-	-	-	-

Table 3.2: Monthly data capture 2009 ($\mu g/m^3$).

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
AM0001R	Amberd	0	0	54	80	98	63	0	0	0	1	100	78
AT0002R	Illmitz	94	95	94	94	95	94	94	94	91	93	95	94
AT0005R	Vorhegg	95	96	96	94	96	95	95	76	94	95	95	65
AT0030R	Pillersdorf bei Retz	96	95	87	95	95	95	95	96	96	89	95	96
AT0032R	Sulzberg	77	82	96	89	91	96	95	96	96	95	96	96
AT0034G	Sonnblick	95	96	96	96	96	95	95	96	96	95	96	93
AT0037R	Zillertaler Alpen	96	96	96	96	96	96	96	90	96	96	96	96
AT0038R	Gerlitzen	96	96	95	96	96	95	96	96	95	96	96	96
AT0040R	Masenberg	96	96	95	95	95	95	90	86	96	95	95	95
AT0041R	Haunsberg	95	96	95	96	95	95	95	96	96	96	89	95
AT0042R	Heidenreichstein	52	96	96	87	96	95	95	96	96	96	95	95
AT0043R	Forsthof	96	95	52	95	95	95	94	95	96	96	95	95
AT0044R	Graz Platte	96	95	96	96	96	91	96	95	96	96	96	96
AT0045R	Dunkelsteinerwald	95	95	94	96	95	95	94	95	95	95	95	95
AT0046R	Gänserndorf	96	96	95	96	95	96	96	96	95	95	95	95
AT0047R	Stixneusiedl	41	60	96	96	96	95	95	96	95	96	95	95
AT0048R	Zoebelboden	95	93	95	94	94	87	95	95	95	91	86	79
AT0049R	Grebenzen bei St. Lamprecht	96	95	60	94	96	95	76	96	95	76	95	96
BE0001R	Offagne	98	93	84	97	98	98	96	97	98	79	92	97
BE0032R	Eupen	98	97	87	97	92	91	97	98	98	80	93	98
BE0035R	Vezin	96	94	86	97	97	97	98	97	97	87	98	97
BG0053R	Rojen peak	96	94	92	94	94	93	94	89	95	95	95	95
CH0001G	Jungfraujoch	96	98	96	95	97	97	98	88	98	97	97	96
CH0002R	Payerne	96	96	95	96	95	95	94	95	95	95	96	95
CH0003R	Tänikon	95	96	94	95	96	96	95	95	95	96	95	96
CH0004R	Chaumont	96	95	95	95	96	96	95	96	96	95	95	95
CH0005R	Rigi	95	95	96	95	95	95	95	95	96	95	96	95
CY0002R	Ayia Marina	99	99	100	100	100	97	100	100	100	99	100	97
CZ0001R	Svratouch	100	100	96	100	100	100	100	95	100	100	89	100
CZ0003R	Košetice	94	100	97	99	100	86	100	100	100	86	100	100
DE0001R	Westerland	96	96	93	95	96	96	96	92	96	96	95	94
DE0002R	Langenbrügge	95	96	95	94	95	95	95	94	95	96	96	96
DE0003R	Schauinsland	96	96	96	96	96	96	96	96	96	96	96	96
DE0007R	Neuglobsow	96	96	96	95	96	96	89	91	96	96	96	96

Table 3.2, cont.

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
DE0008R	Schmücke	96	96	96	95	93	94	96	95	95	93	96	96
DE0009R	Zingst	94	95	95	96	96	96	96	95	96	96	96	96
DK0005R	Keldsnor	91	91	92	92	92	91	79	71	63	7	74	92
DK0031R	Ulborg	91	91	92	92	92	91	79	71	63	7	74	92
DK0041R	Lille Valby	92	92	91	92	91	88	92	92	76	88	92	91
EE0009R	Lahemaa	99	100	99	100	100	87	100	100	100	100	98	100
EE0011R	Vilsandi	100	100	94	100	100	100	100	94	100	100	98	89
ES0001R	San Pablo de los Montes	100	100	99	100	100	99	99	100	100	100	99	99
ES0007R	Viznar	100	99	99	99	100	99	97	100	100	100	100	100
ES0008R	Niembro	99	100	99	98	96	99	99	98	97	99	99	99
ES0009R	Campisábalos	93	100	97	98	98	97	100	97	99	99	100	96
ES0010R	Cabo de Creus	98	96	98	100	99	100	97	99	99	97	100	100
ES0011R	Barcarrola	95	99	99	99	95	96	100	100	99	98	99	100
ES0012R	Zarra	96	99	100	82	98	99	99	99	99	99	100	100
ES0013R	Penausende	100	100	97	100	99	99	100	100	99	100	100	97
ES0014R	Els Torms	99	100	99	100	100	99	100	98	100	99	99	100
ES0016R	O Saviñao	96	99	99	99	100	99	99	100	100	98	94	100
ES0017R	Doñana	81	96	100	96	100	97	94	97	97	99	96	97
FI0009R	Utö	100	94	100	100	99	90	96	99	100	99	99	99
FI0017R	Virolahti II	96	99	98	99	98	99	99	96	100	100	99	98
FI0022R	Oulanka	93	98	95	98	92	99	99	96	97	100	100	14
FI0037R	Ahtari II	97	99	95	99	96	99	99	100	97	98	98	99
FI0096G	Pallas (Sammaltunturi)	98	97	98	98	97	99	98	99	98	99	97	96
FR0008R	Donon	100	99	100	99	100	99	100	99	100	99	100	100
FR0009R	Revin	100	100	100	97	100	100	100	100	100	100	98	100
FR0010R	Morvan	100	93	77	100	100	100	100	100	100	99	92	99
FR0013R	Peyrusse Vieille	92	99	99	76	100	100	94	99	100	96	96	100
FR0014R	Montandon	100	98	100	100	99	100	100	100	72	98	100	100
FR0015R	La Tardière	96	95	100	100	100	100	100	100	100	100	100	100
FR0016R	Le Casset	100	100	100	100	99	100	100	100	100	100	99	100
FR0017R	Montfranc	99	98	99	99	99	86	95	99	99	99	91	96
FR0018R	La Coulonche	100	100	100	100	92	99	98	100	99	100	79	98
FR0019R	Pic du Midi	98	97	97	100	97	96	98	88	100	98	100	99
FR0030R	Puy de Dôme	99	98	98	98	98	97	98	100	99	98	99	65

Table 3.2, cont.

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
GB0002R	Eskdalemuir	96	99	100	100	100	100	100	97	100	99	98	100
GB0006R	Lough Navar	100	100	97	100	98	65	86	84	100	100	100	100
GB0013R	Yarner Wood	66	100	96	99	100	100	96	85	100	99	76	88
GB0014R	High Muffles	91	96	80	100	99	96	0	0	0	0	0	75
GB0015R	Strath Vaich Dam	89	87	100	96	80	97	87	99	100	100	99	100
GB0031R	Aston Hill	99	100	91	100	100	100	96	96	95	95	95	96
GB0033R	Bush	87	100	100	100	100	99	90	100	100	100	100	100
GB0035R	Great Dun Fell	89	92	24	77	100	100	100	96	96	100	94	96
GB0036R	Harwell	99	99	93	100	100	99	99	95	99	100	100	100
GB0037R	Ladybower Res.	99	96	100	100	100	64	88	99	99	100	100	100
GB0038R	Lullington Heath	100	99	99	96	99	100	93	66	97	100	98	99
GB0039R	Sibton	72	96	87	100	97	100	98	100	100	100	100	100
GB0043R	Narberth	91	100	91	97	98	92	100	95	100	92	97	85
GB0045R	Wicken Fen	96	100	99	99	100	71	93	100	100	100	100	100
GB0048R	Auchencorth Moss	99	100	100	99	87	94	92	100	100	100	100	100
GB0049R	Weybourne	100	100	98	100	55	99	62	100	100	100	93	88
GB0050R	St. Osyth	100	99	95	92	100	100	99	100	100	95	99	99
GB0051R	Market Harborough	96	100	74	100	99	71	0	84	99	96	99	100
GB0052R	Lerwick	100	100	99	100	100	100	97	97	100	73	24	100
GB0053R	Charlton Mackrell	100	96	100	100	100	100	100	99	93	78	100	100
GR0001R	Aliartos	100	100	100	99	88	100	99	100	100	85	86	99
GR0002R	Finokalia	56	61	87	75	95	84	78	44	81	74	52	99
HU0002R	K-puszta	99	100	100	100	84	86	100	100	100	100	100	100
IE0031R	Mace Head	100	100	100	100	100	100	100	100	100	100	100	94
IT0001R	Montelibretti	100	100	100	95	97	98	92	100	99	87	89	99
LT0015R	Preila	92	100	86	100	100	100	93	95	93	91	86	91
LV0010R	Rucava	99	100	100	13	82	100	99	100	32	98	70	0
LV0016R	Zoseni	100	100	100	100	100	100	99	100	100	100	100	96
NL0007R	Eibergen	99	100	100	99	100	93	99	94	99	100	99	100
NL0009R	Kollumerwaard	100	100	99	93	100	97	82	100	82	99	99	97
NL0010R	Vredepeel	100	99	99	100	99	98	98	21	48	91	99	99
NL0011R	Cabauw	99	100	100	100	100	99	83	100	100	95	100	100
NL0091R	De Zilk	97	99	100	100	99	100	95	100	100	94	94	97

Table 3.2, cont.

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NO0001R	Birkenes	96	100	100	100	69	100	95	100	99	100	97	97
NO0015R	Tustervatn	99	100	100	100	100	99	100	99	100	100	100	100
NO0039R	Kårvatn	100	99	100	100	100	100	98	100	100	100	100	100
NO0042G	Spitsbergen, Zeppelinfjell	99	99	99	99	99	99	97	100	100	99	100	99
NO0043R	Prestebakke	100	99	82	99	99	99	99	100	100	100	100	100
NO0052R	Sandve	99	100	100	100	100	100	100	100	100	100	100	100
NO0055R	Karasjok	100	99	99	99	100	99	71	100	100	100	100	100
NO0056R	Hurdal	100	100	100	100	37	0	0	0	0	0	0	0
NO0056R	Hurdal	0	0	0	0	61	97	100	99	100	100	100	100
PL0002R	Jarczew	94	98	94	92	100	100	93	99	100	97	89	100
PL0003R	Sniezka	100	100	81	100	100	100	100	100	100	100	100	100
PL0004R	Leba	100	97	100	100	100	100	100	100	100	90	100	100
PL0005R	Diabla Gora	100	100	100	61	100	100	100	100	100	76	100	100
PT0004R	Monte Velho	100	89	100	100	100	100	100	100	100	100	100	100
SE0005R	Bredkälen	100	100	100	100	100	100	100	100	99	100	100	100
SE0011R	Vavihill	90	91	100	95	99	100	100	100	100	93	100	100
SE0012R	Aspvreten	100	100	100	100	100	100	100	100	100	100	97	100
SE0013R	Esrange	99	100	100	100	100	100	100	100	100	100	100	100
SE0014R	Råö	100	99	100	100	100	100	100	99	100	99	100	100
SE0032R	Norra-Kvill	100	100	100	100	100	100	100	100	100	99	100	97
SE0035R	Vindeln	100	99	100	100	100	100	99	100	99	100	77	94
SE0039R	Grimsö	99	100	99	100	99	100	100	99	99	100	100	100
SI0008R	Iskrba	93	94	96	95	95	77	88	94	96	96	96	96
SI0031R	Zarodnje	93	96	96	93	96	96	94	89	95	95	96	90
SI0032R	Krvavec	93	96	93	95	95	91	94	93	95	91	91	93
SI0033R	Kovk	94	96	89	96	94	93	96	94	96	96	95	96
SK0002R	Chopok	100	100	100	100	100	98	100	99	100	100	100	100
SK0004R	Stará Lesná	99	100	100	100	100	100	100	100	100	99	96	100
SK0006R	Starina	99	99	99	100	100	100	100	100	99	99	98	100
SK0007R	Topolniky	94	100	92	0	0	0	0	0	0	0	0	0

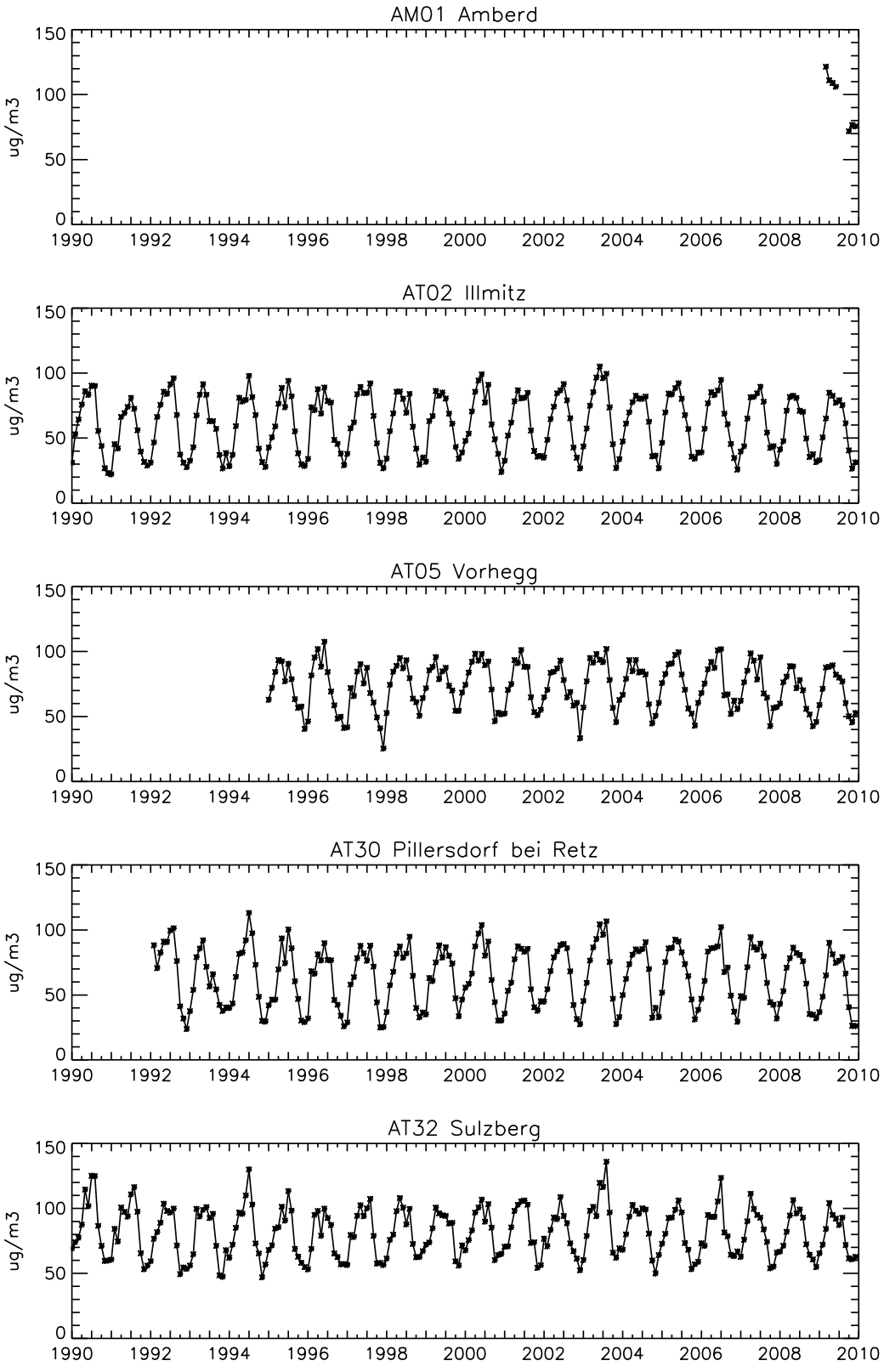


Figure 3.1: Seasonal variation, 1990–2009.

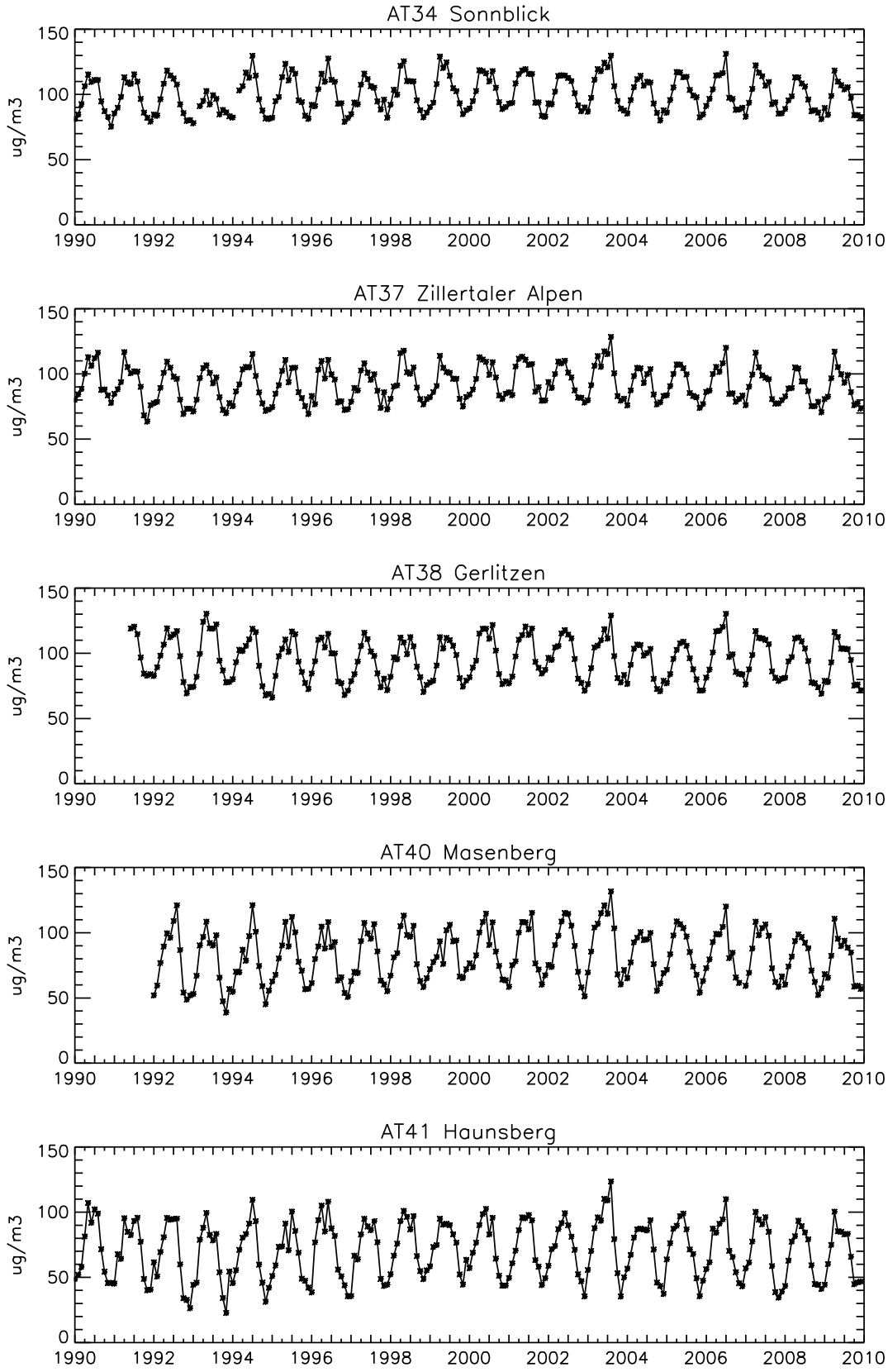


Figure 3.1, cont.

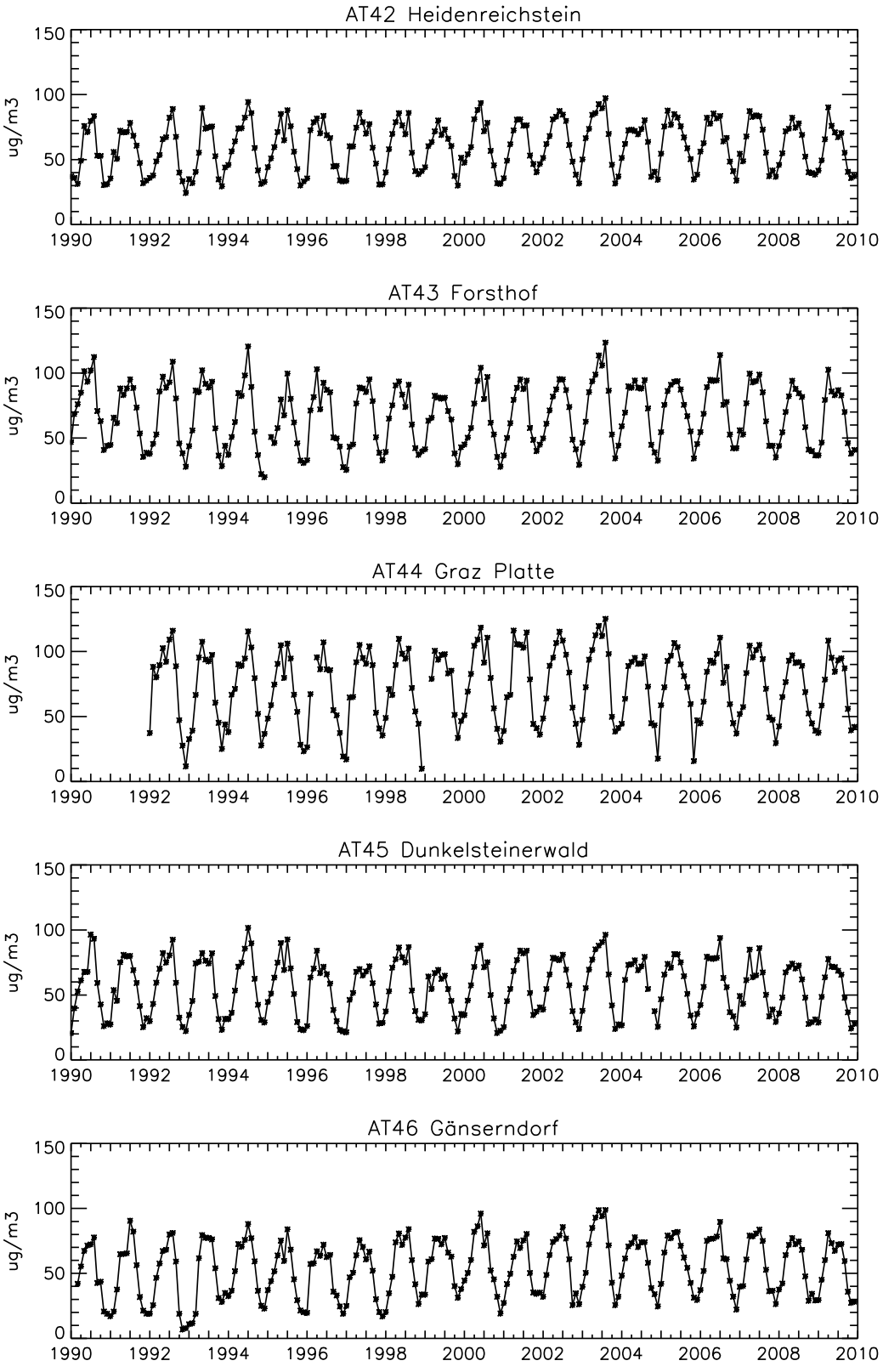


Figure 3.1, cont.

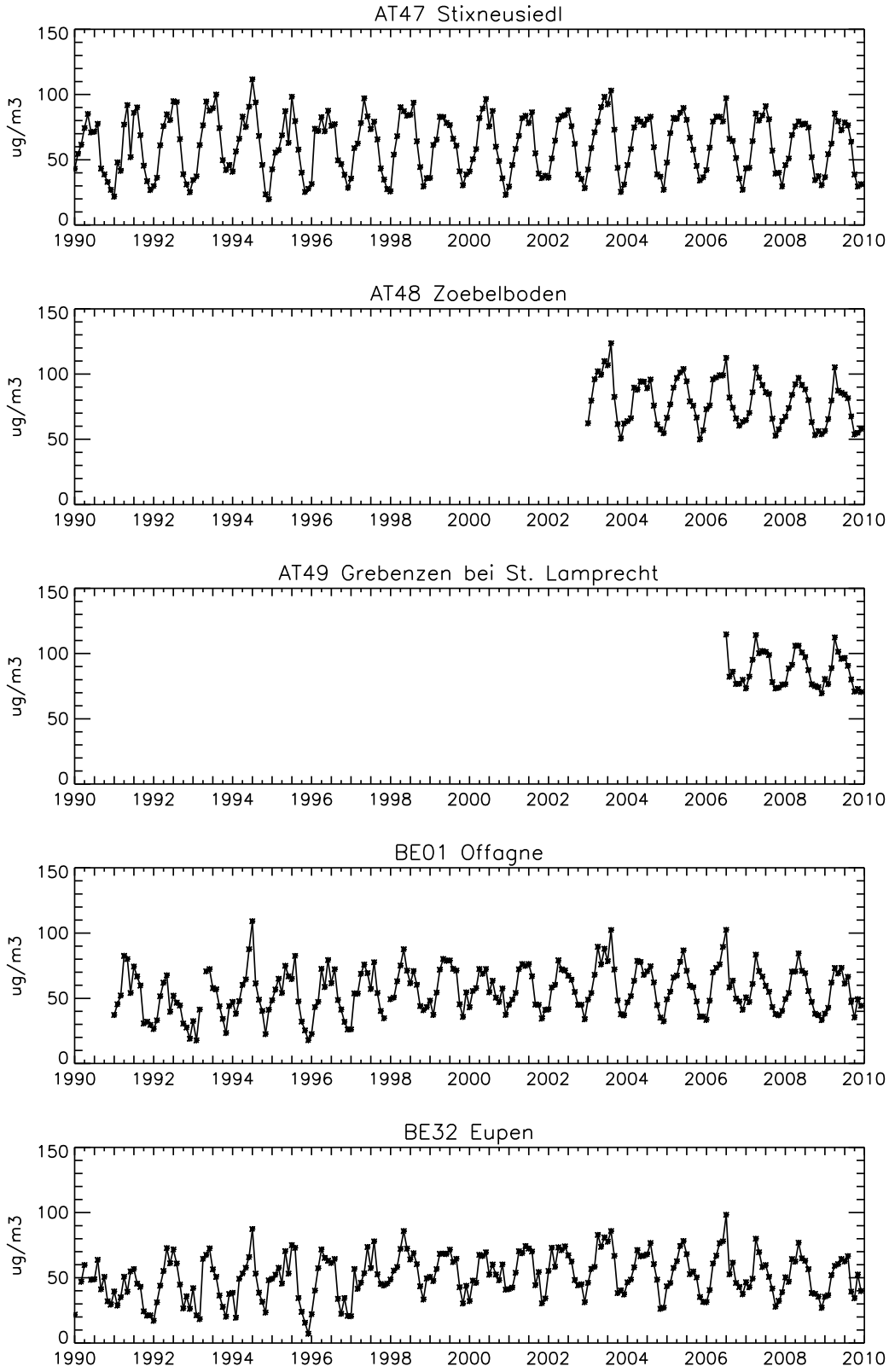


Figure 3.1, cont.

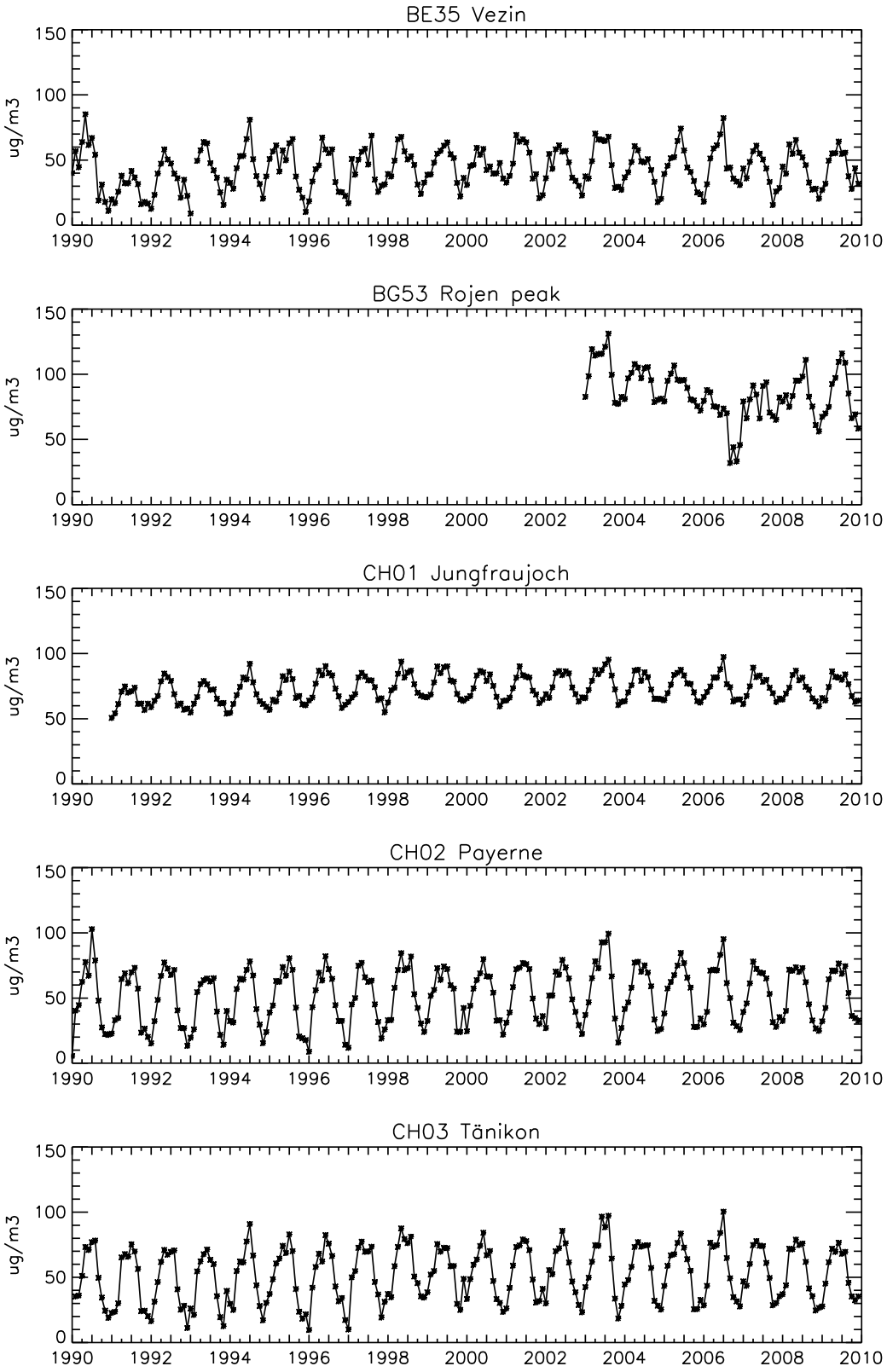
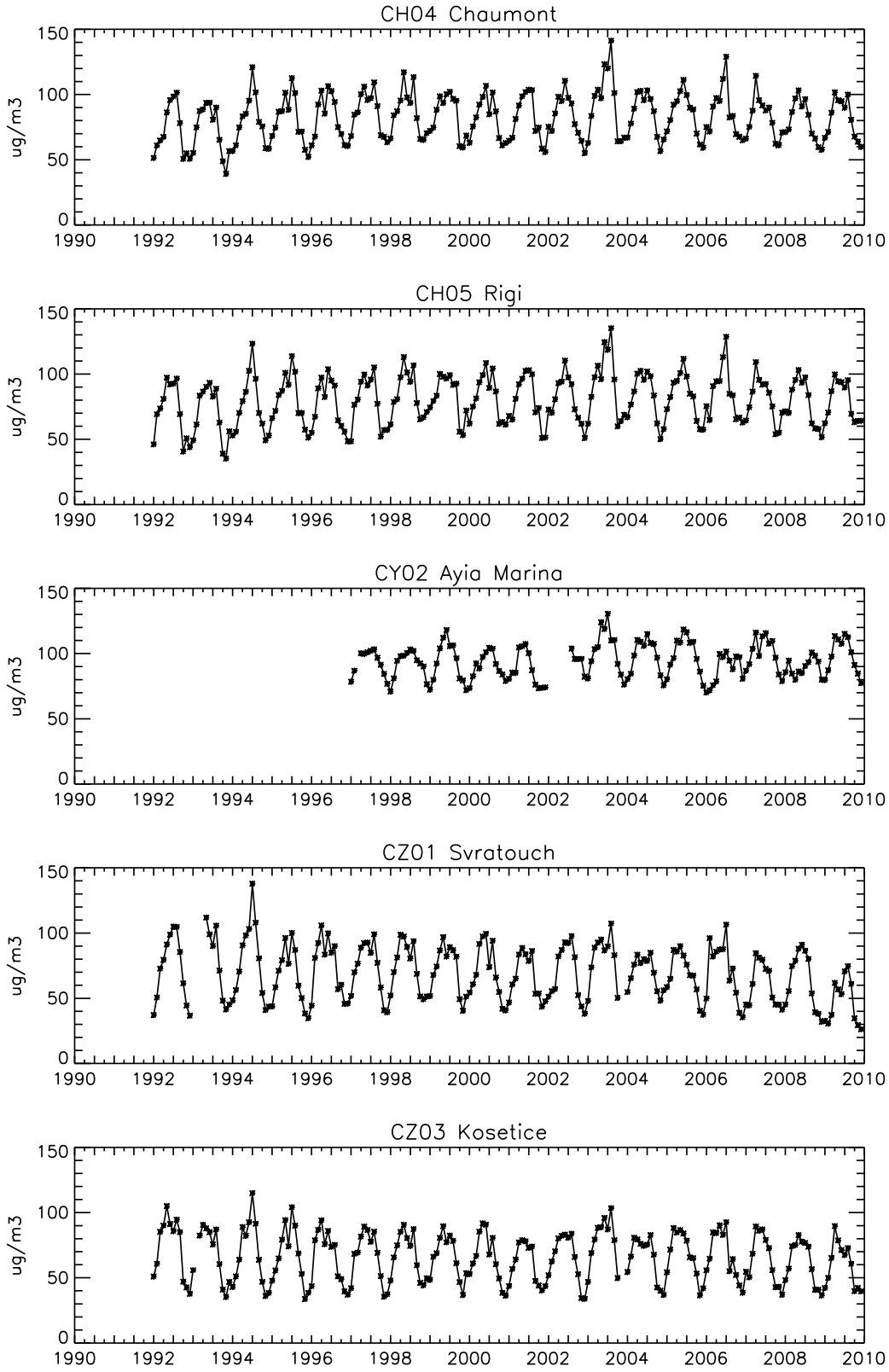


Figure 3.1, cont.



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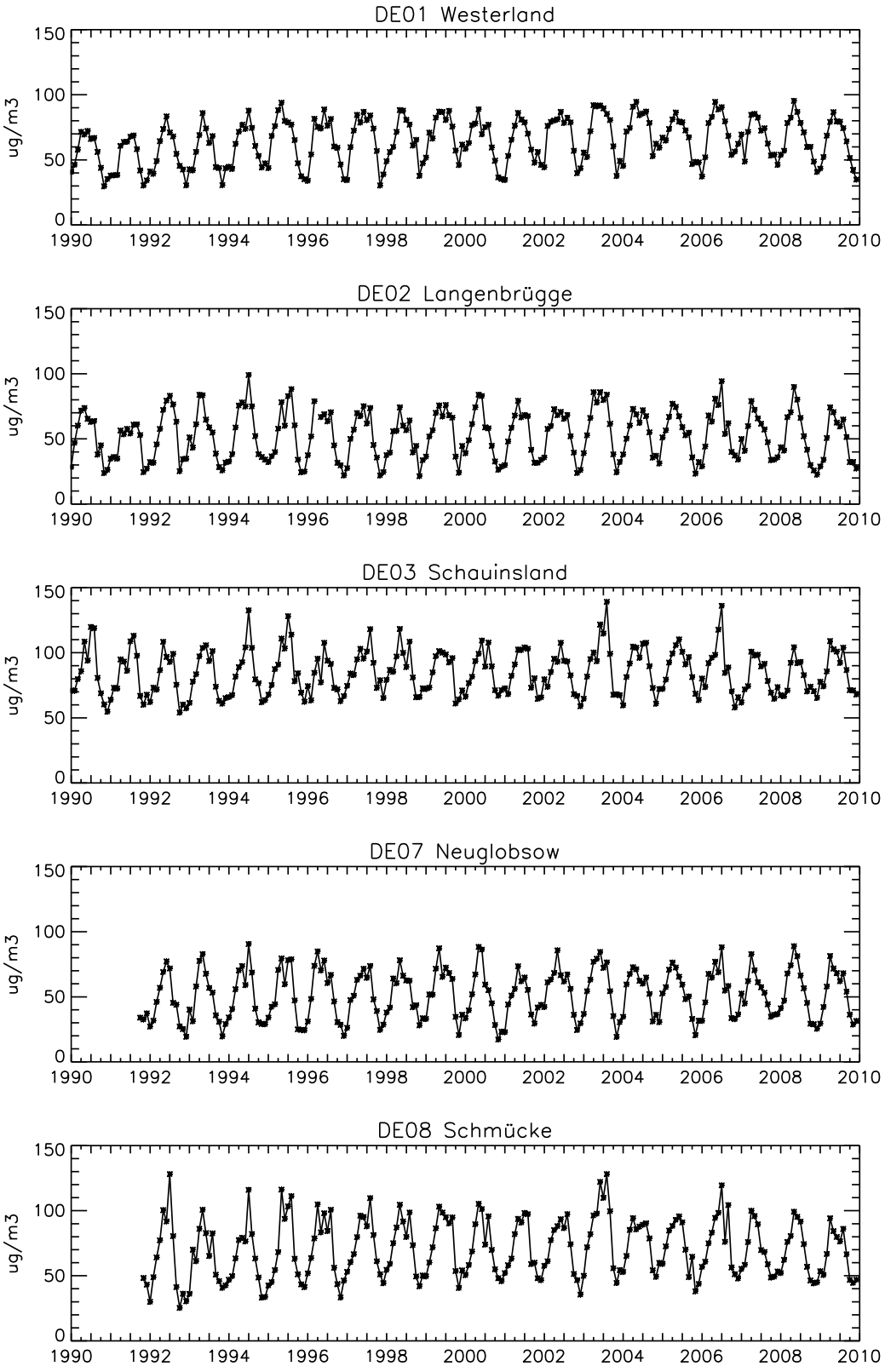


Figure 3.1, cont.

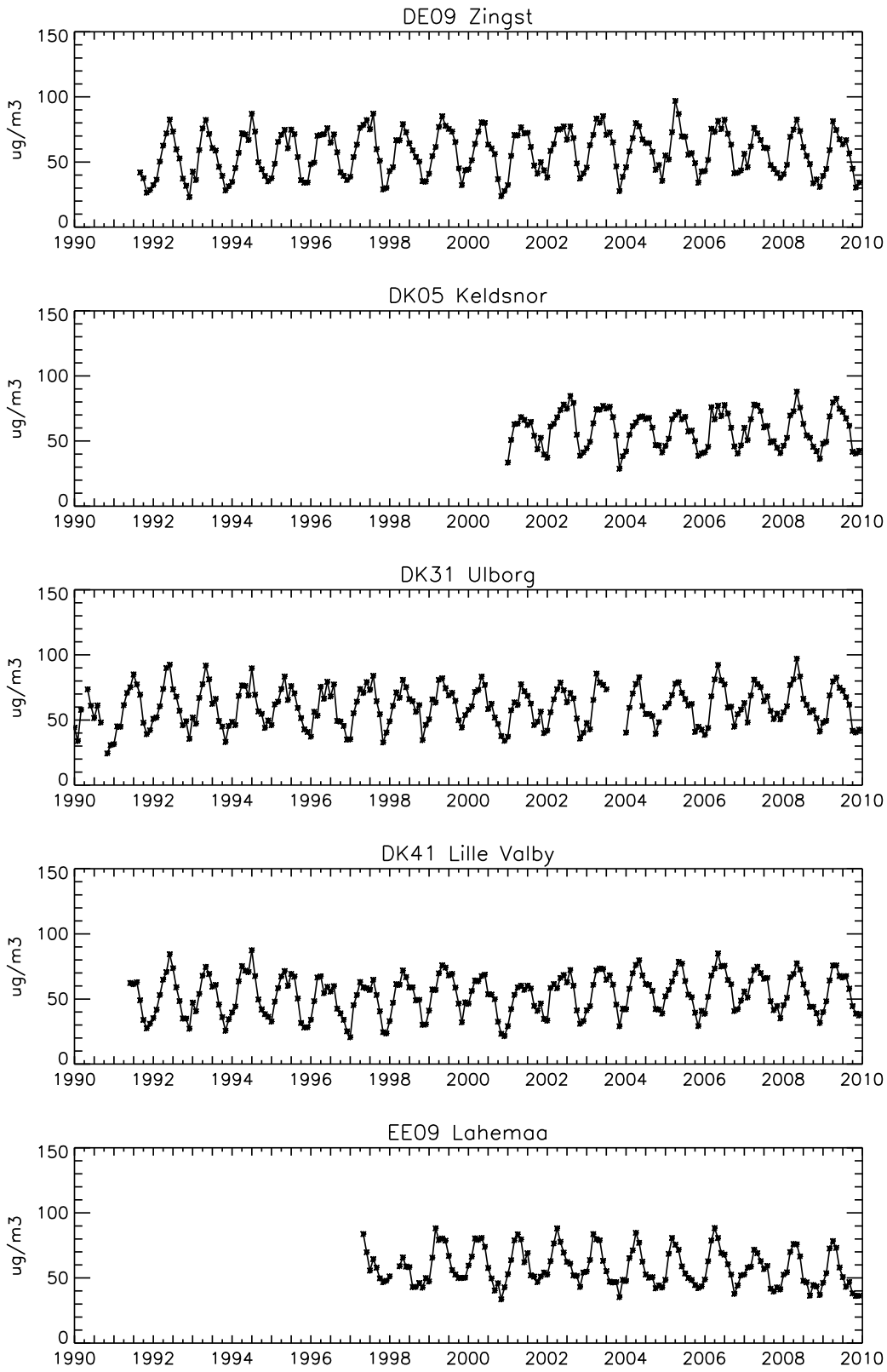


Figure 3.1, cont.

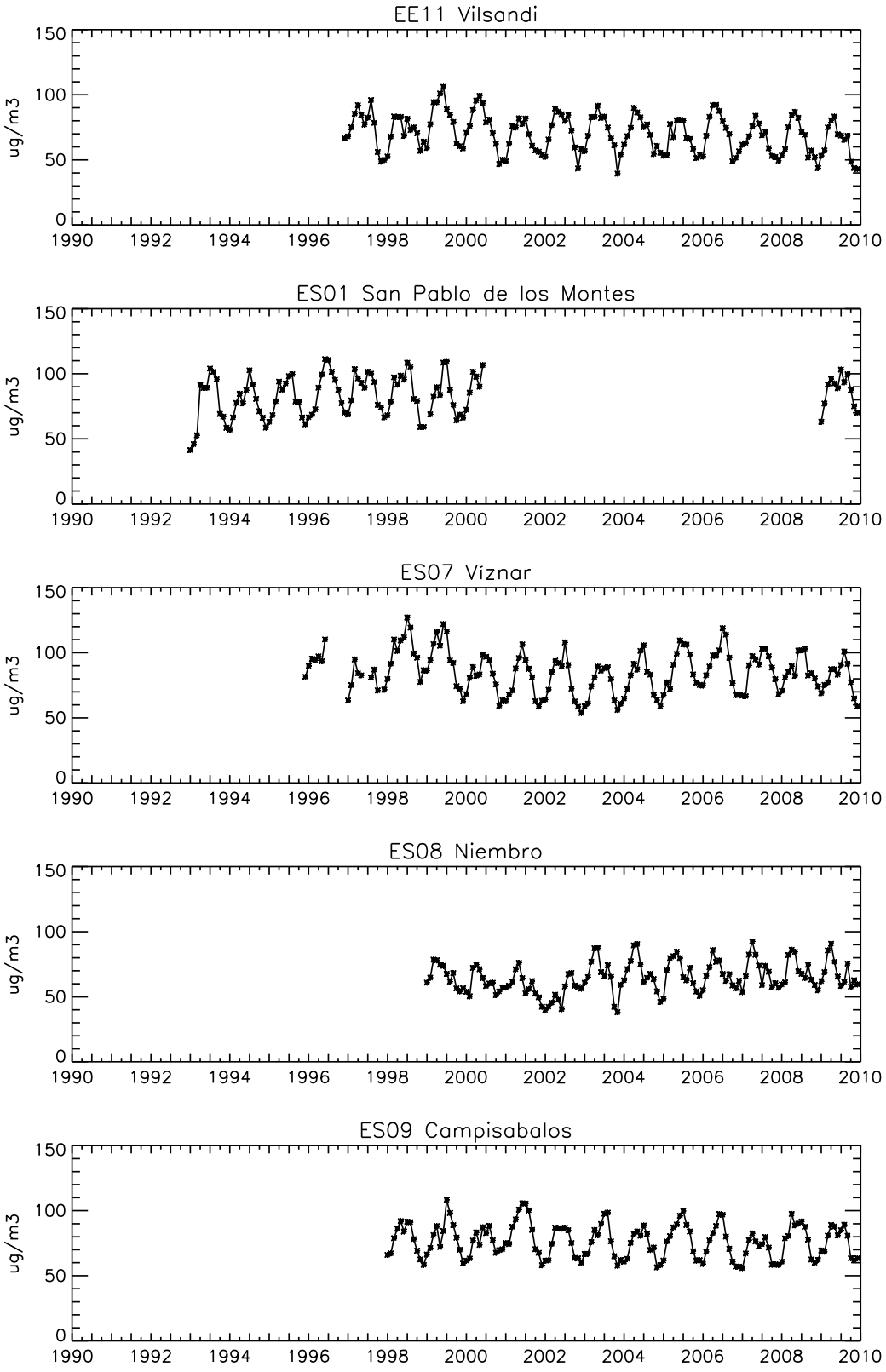
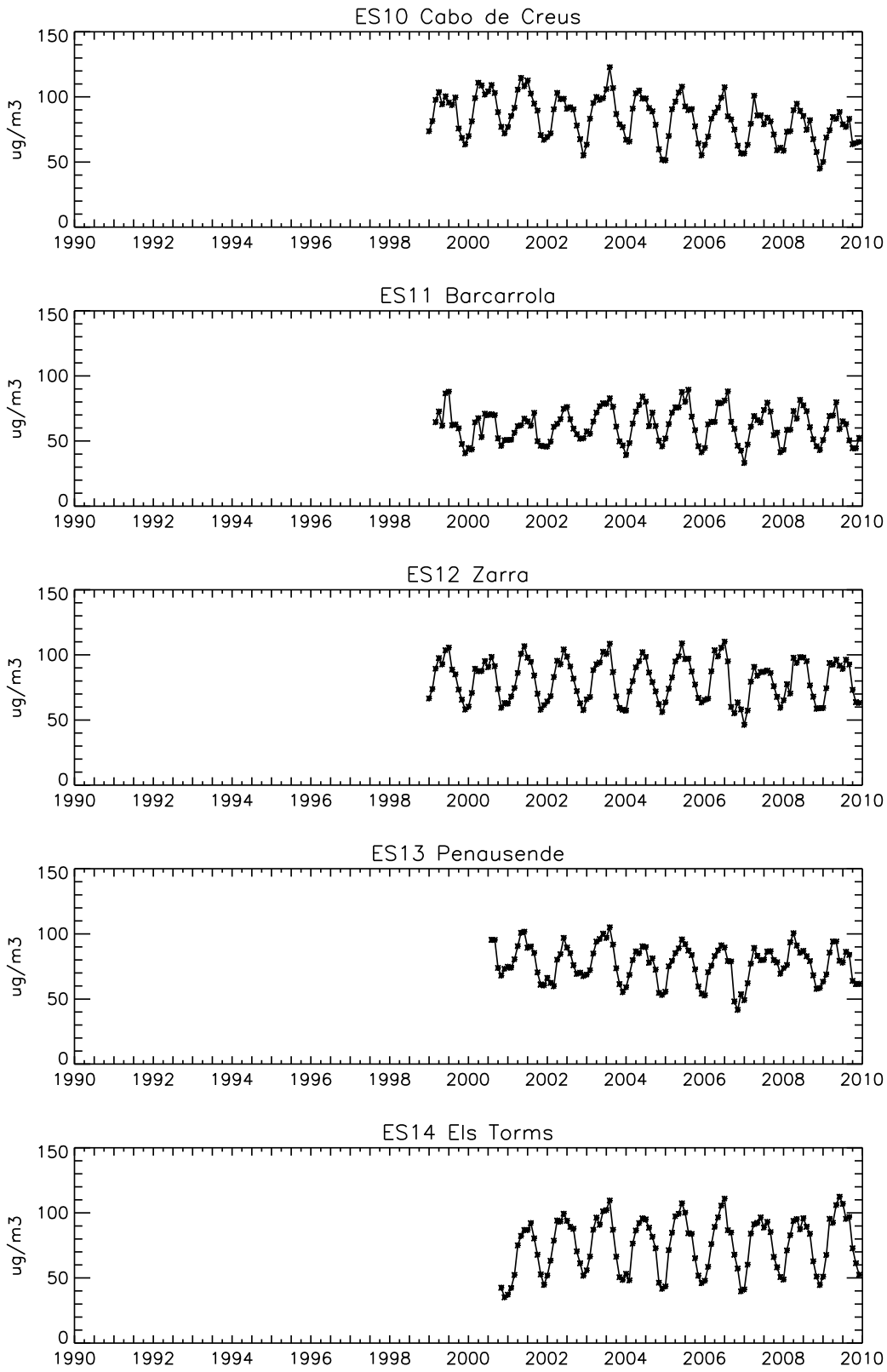


Figure 3.1, cont.



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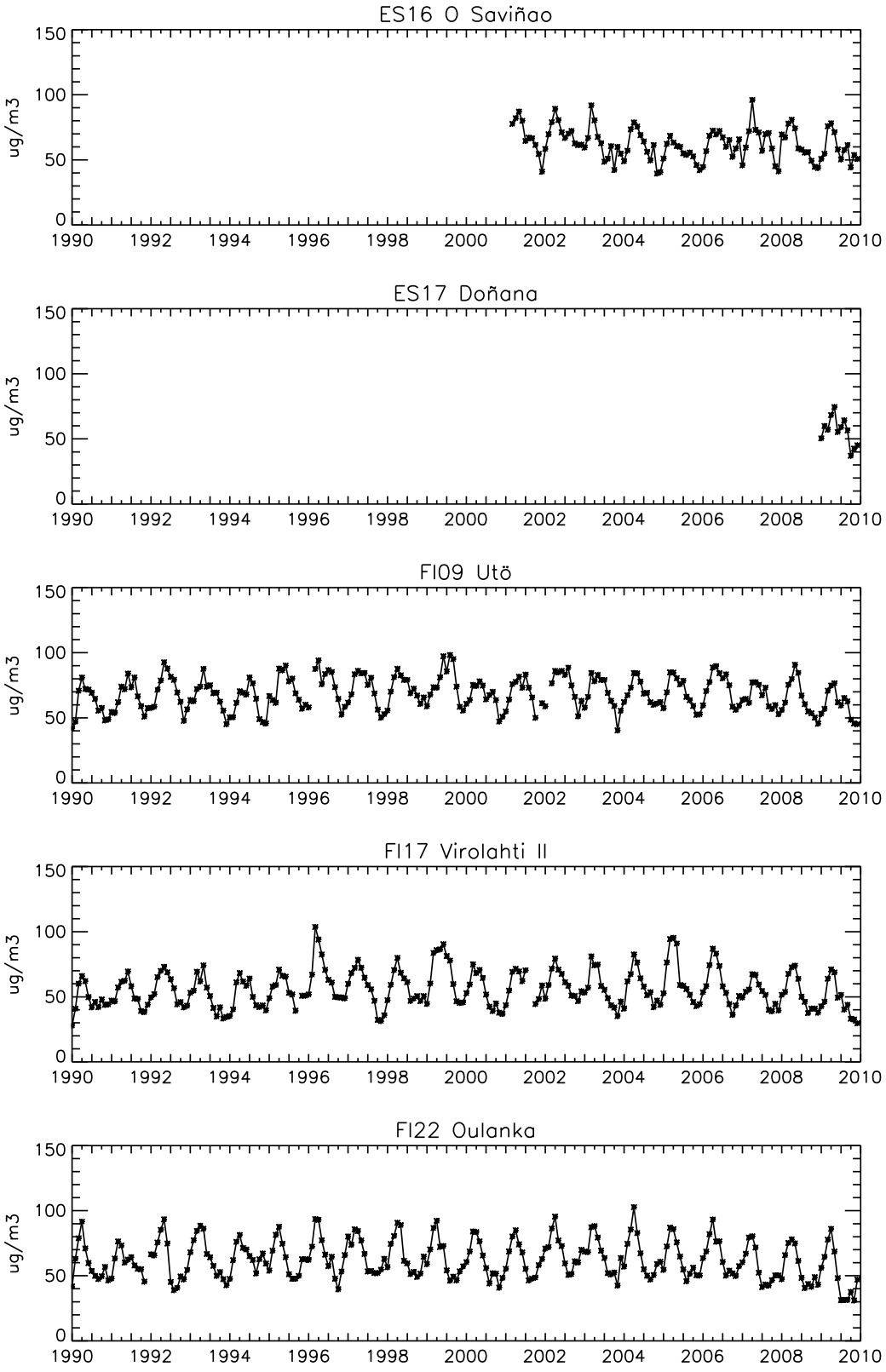

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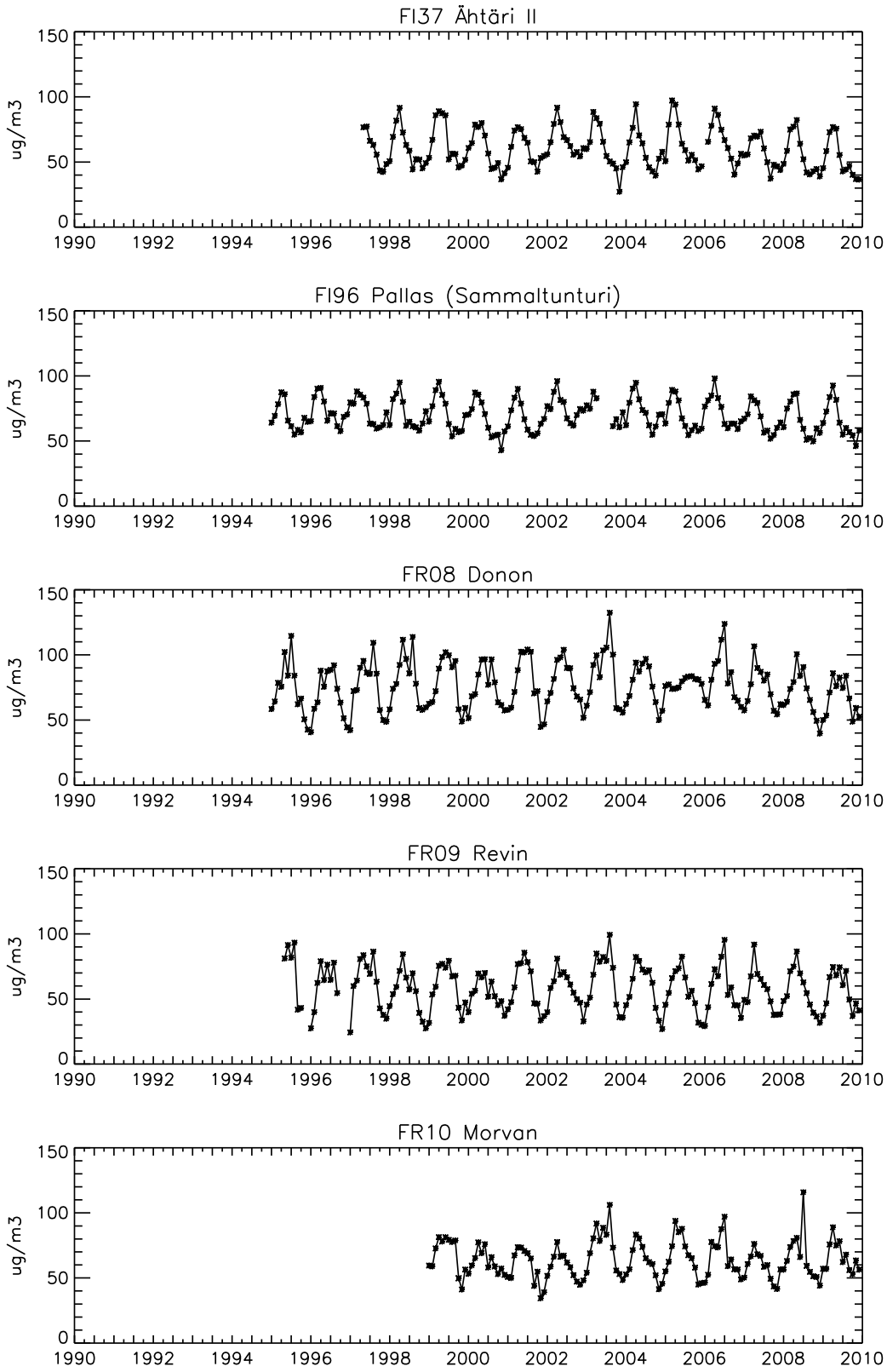


Figure 3.1, cont.

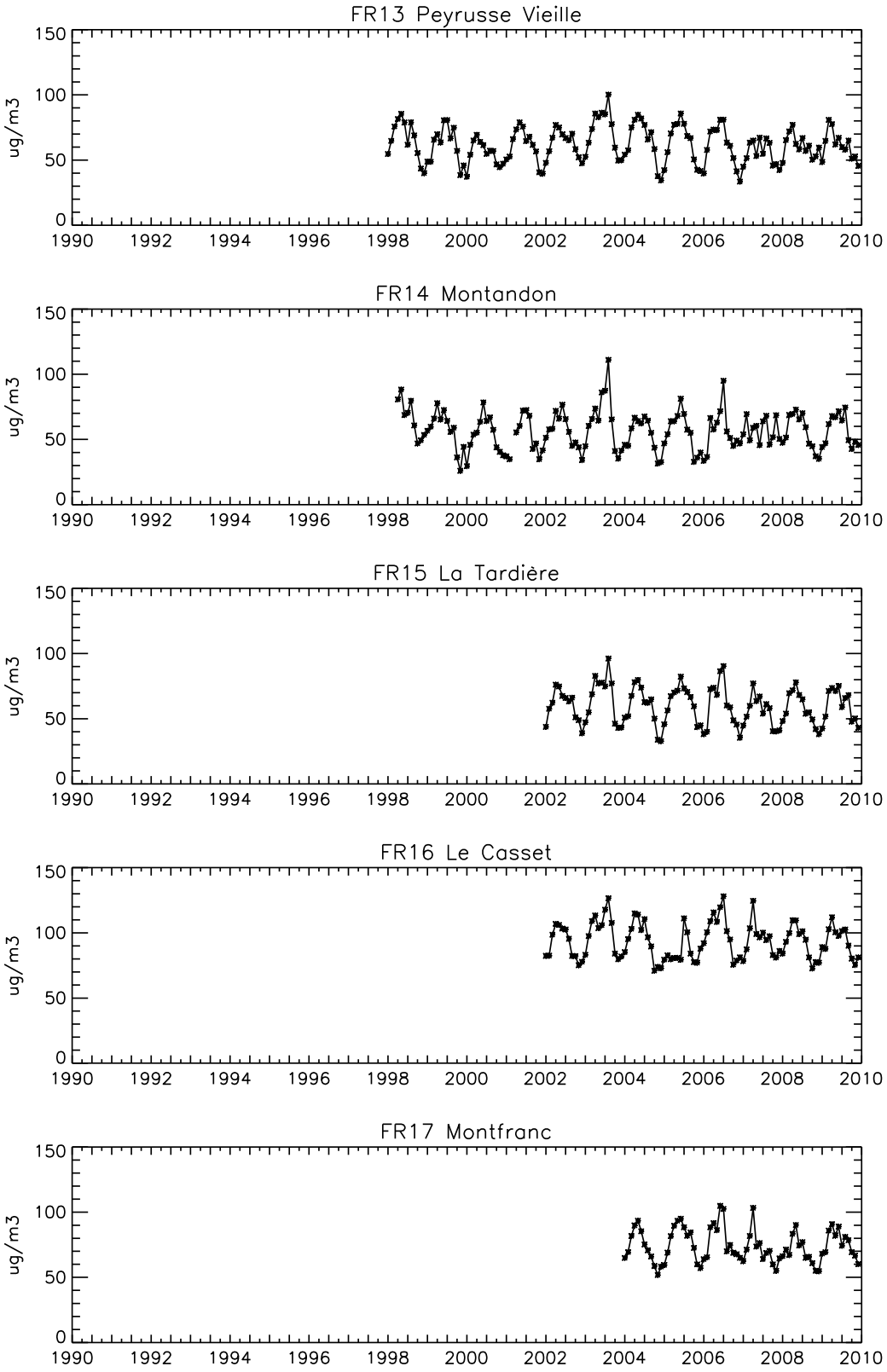
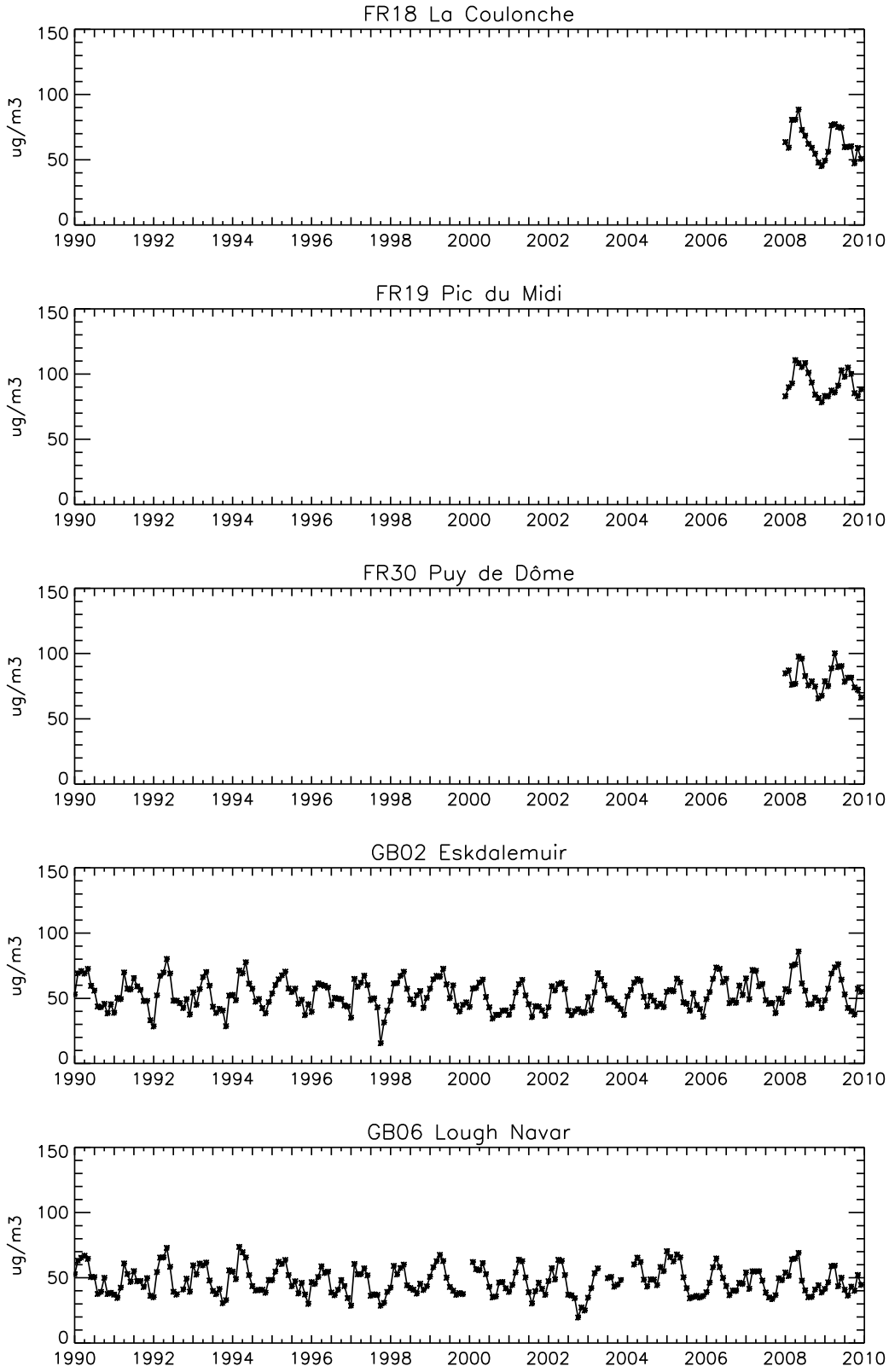


Figure 3.1, cont.



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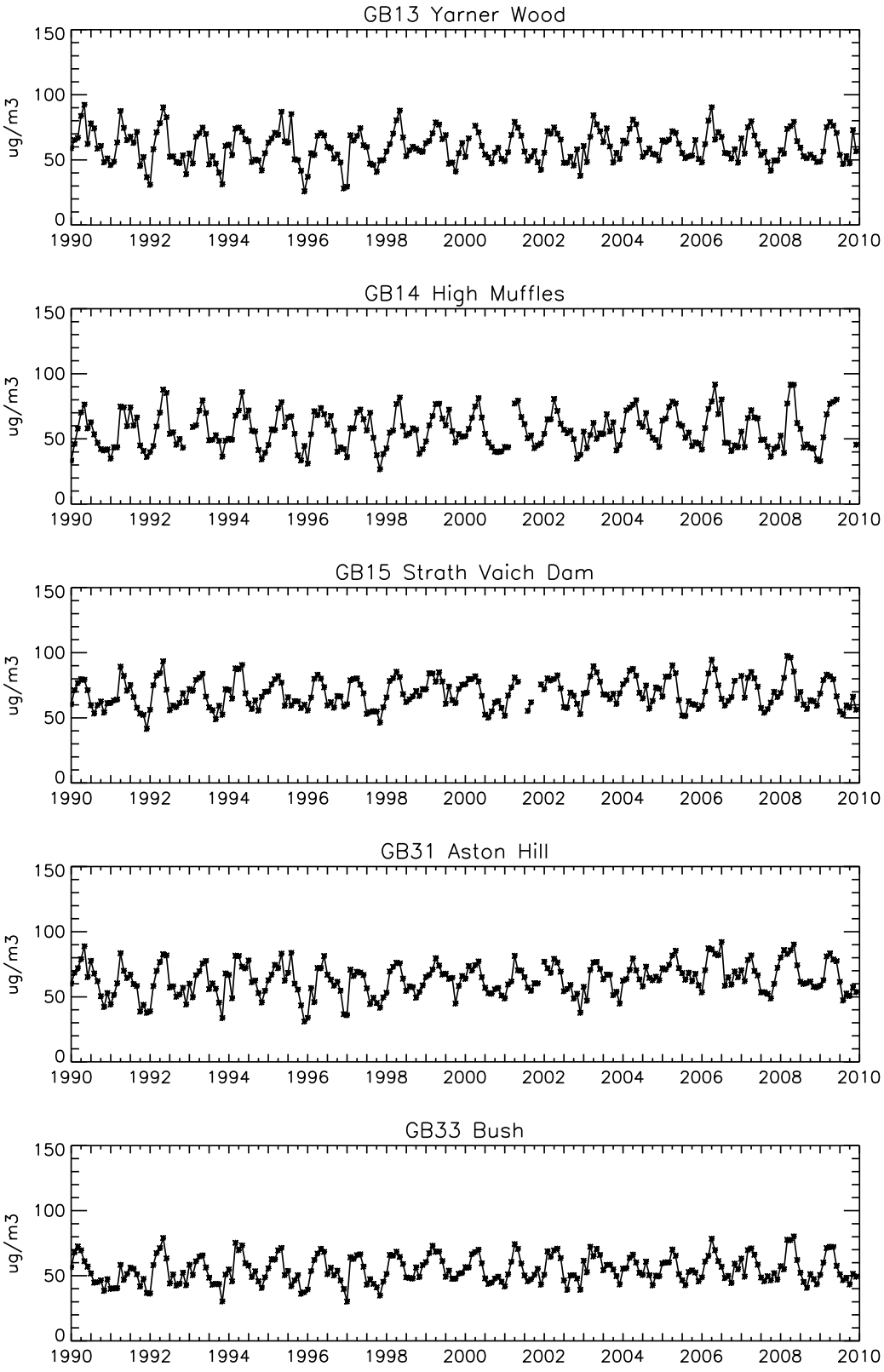

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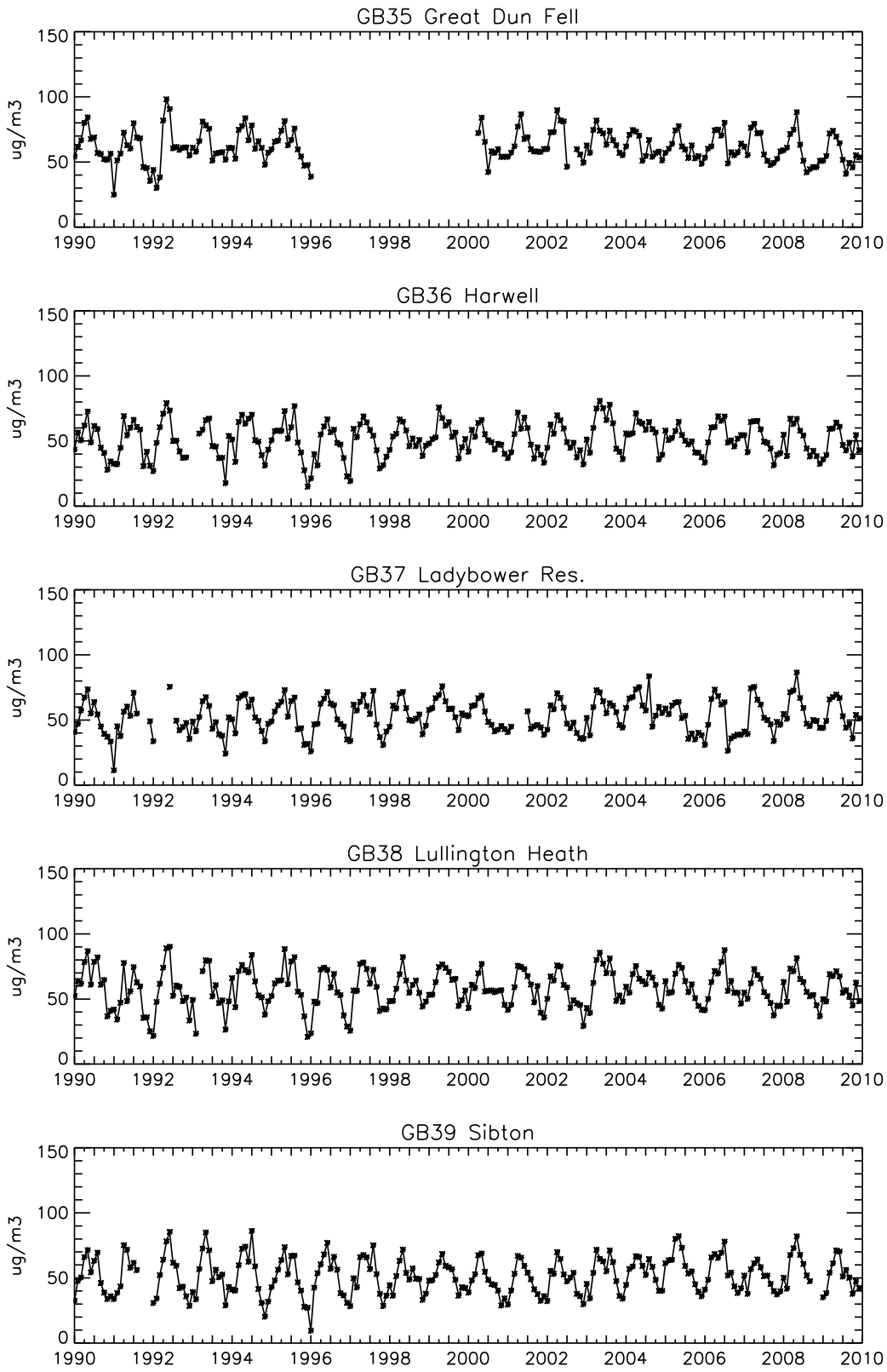
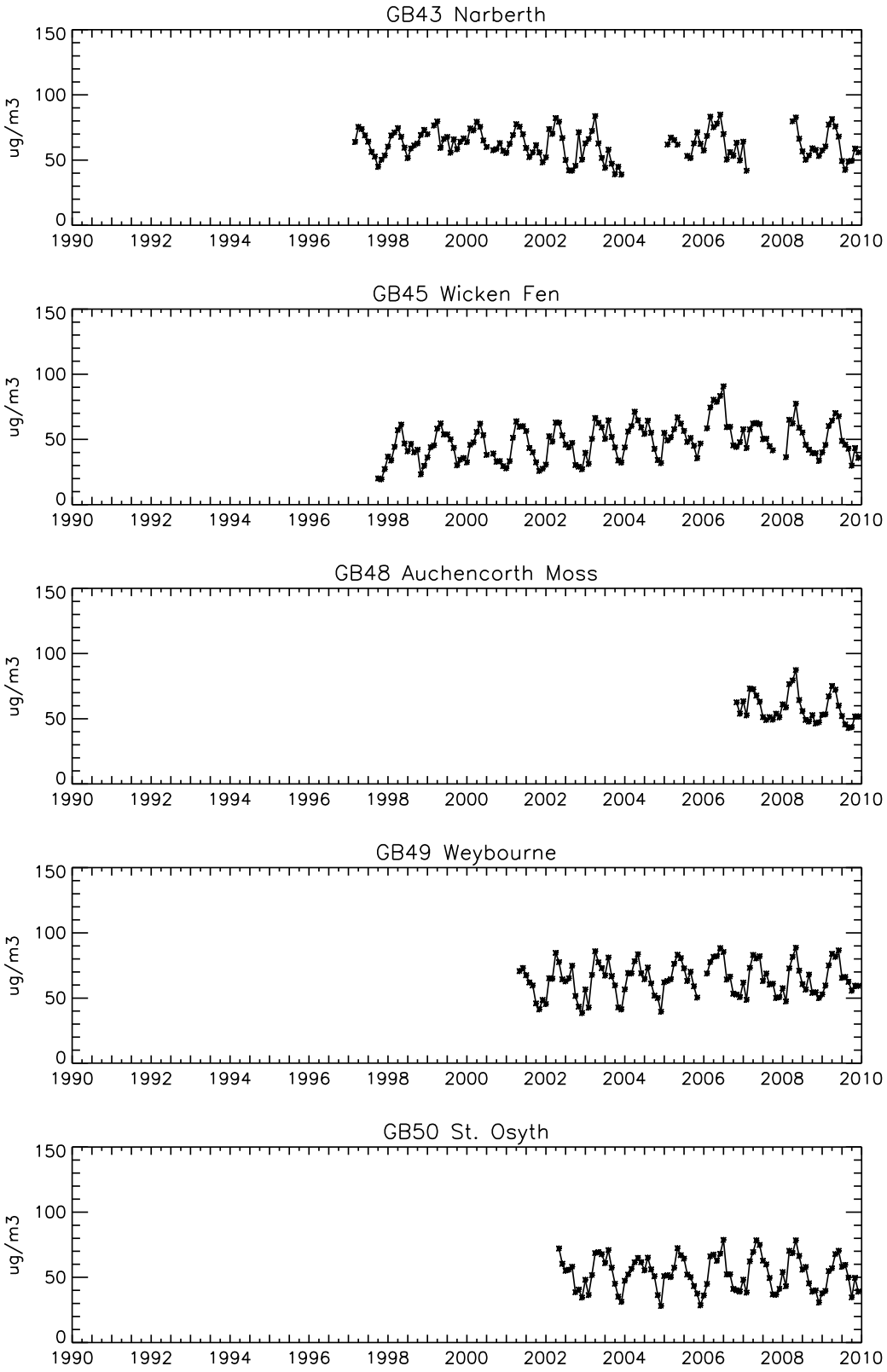


Figure 3.1, cont.



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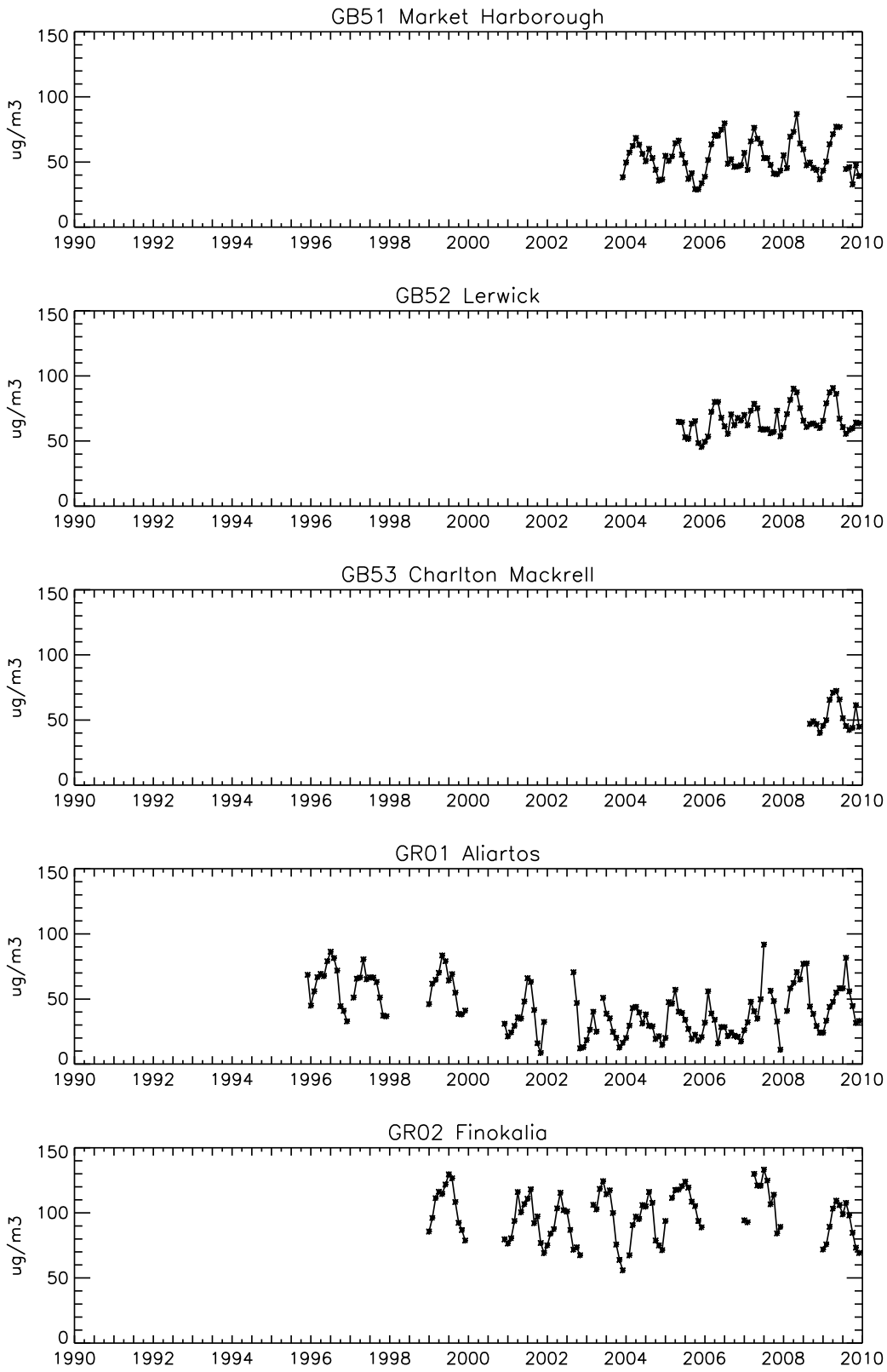

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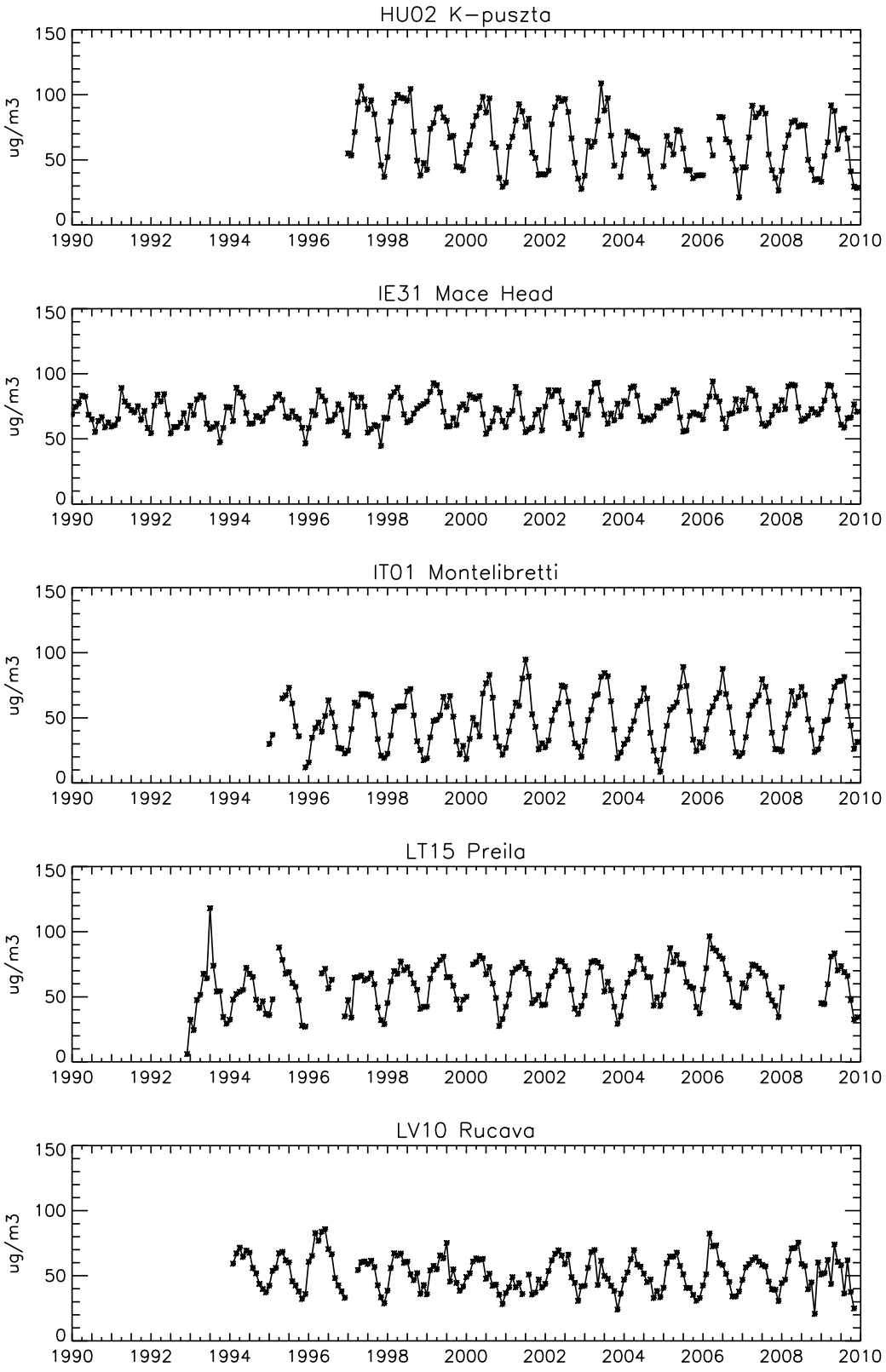

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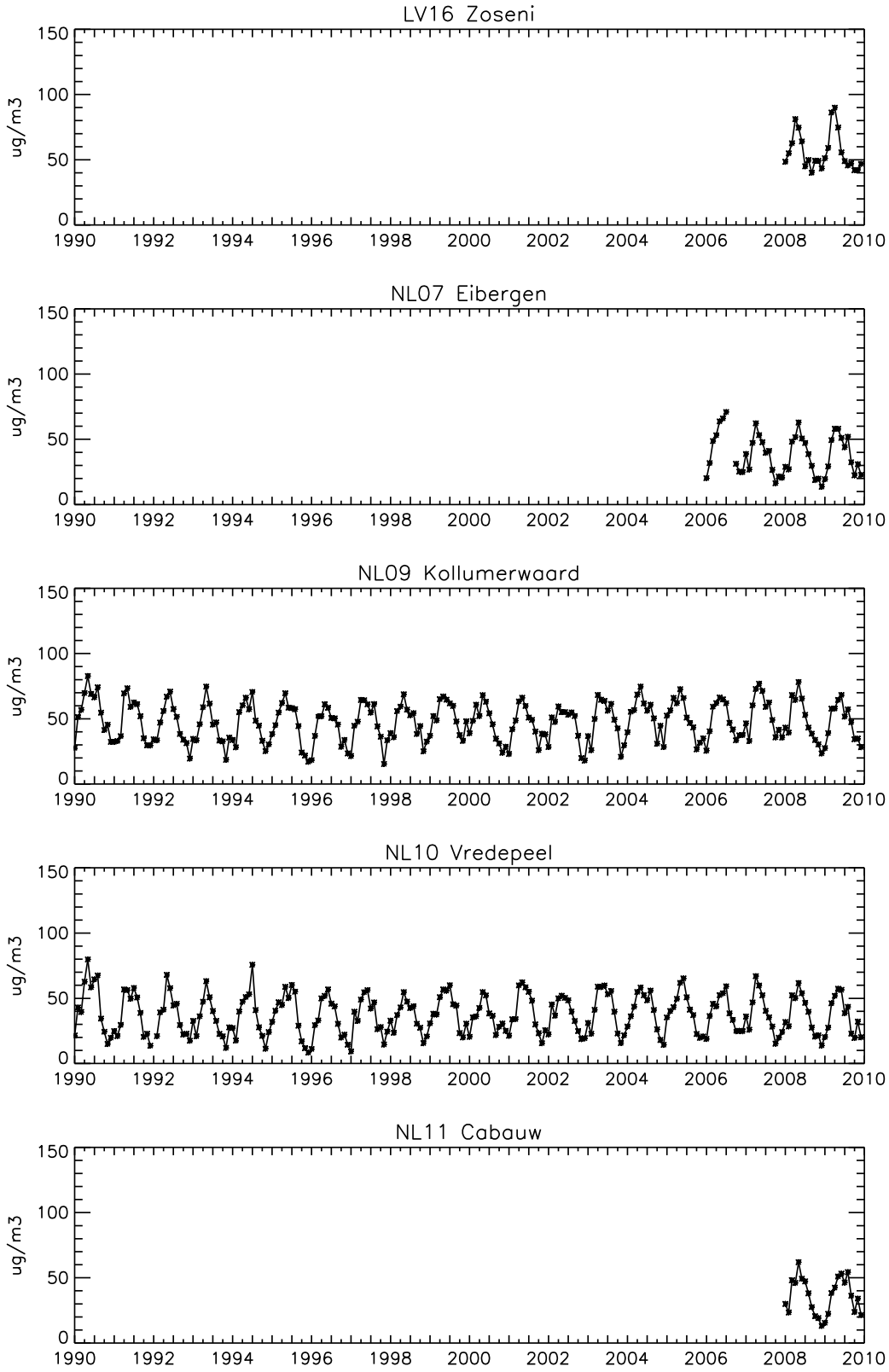

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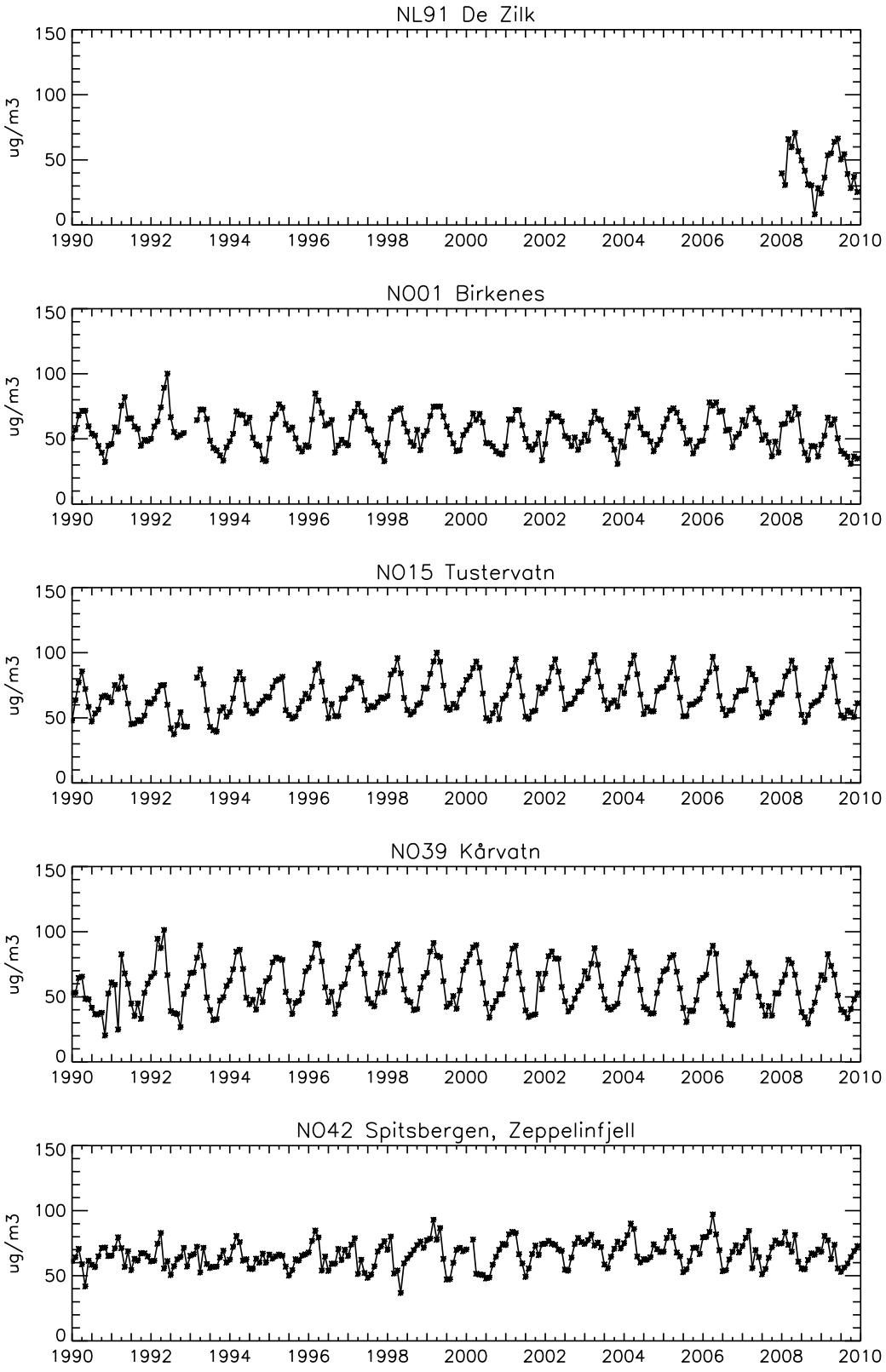

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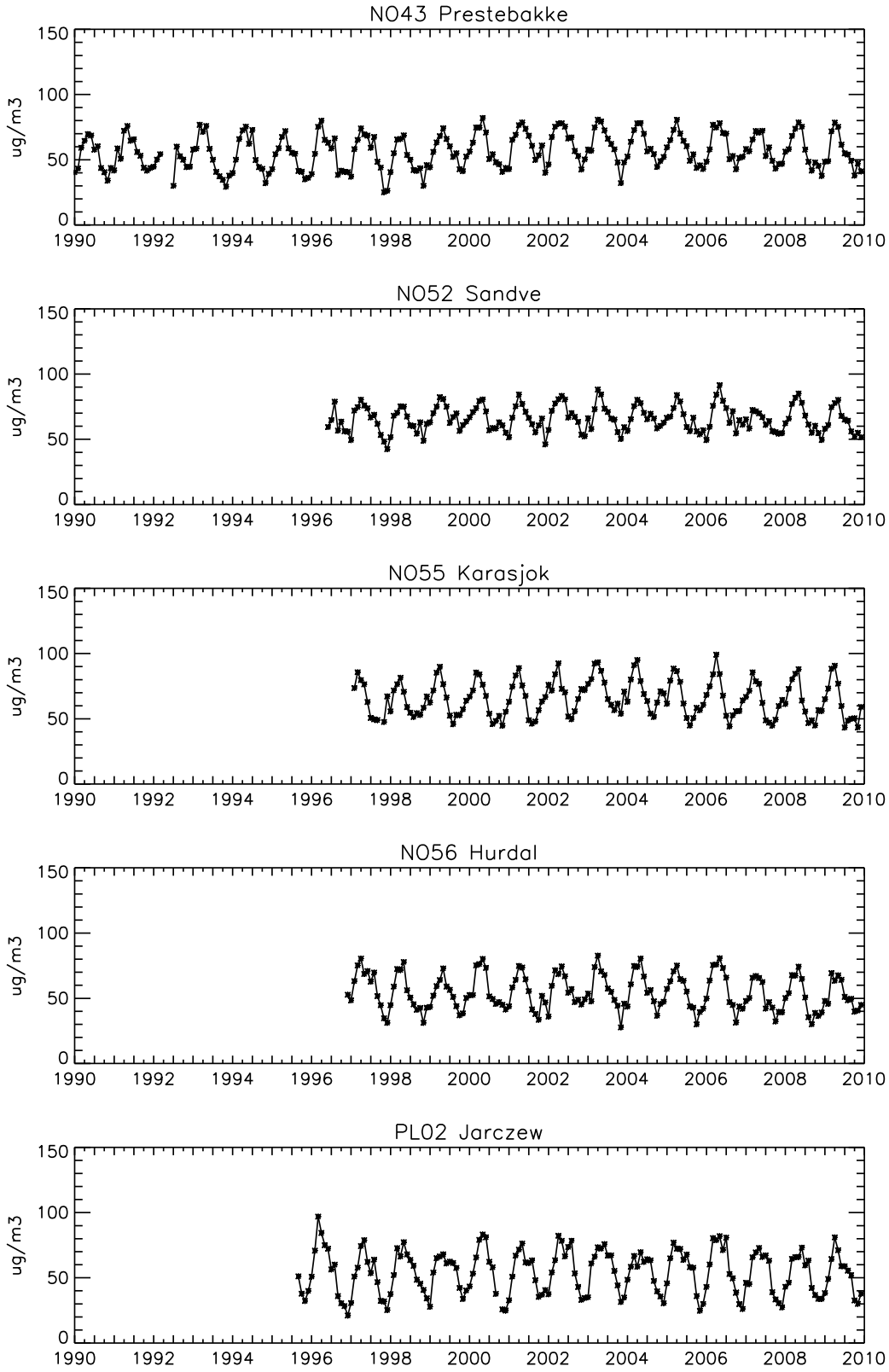

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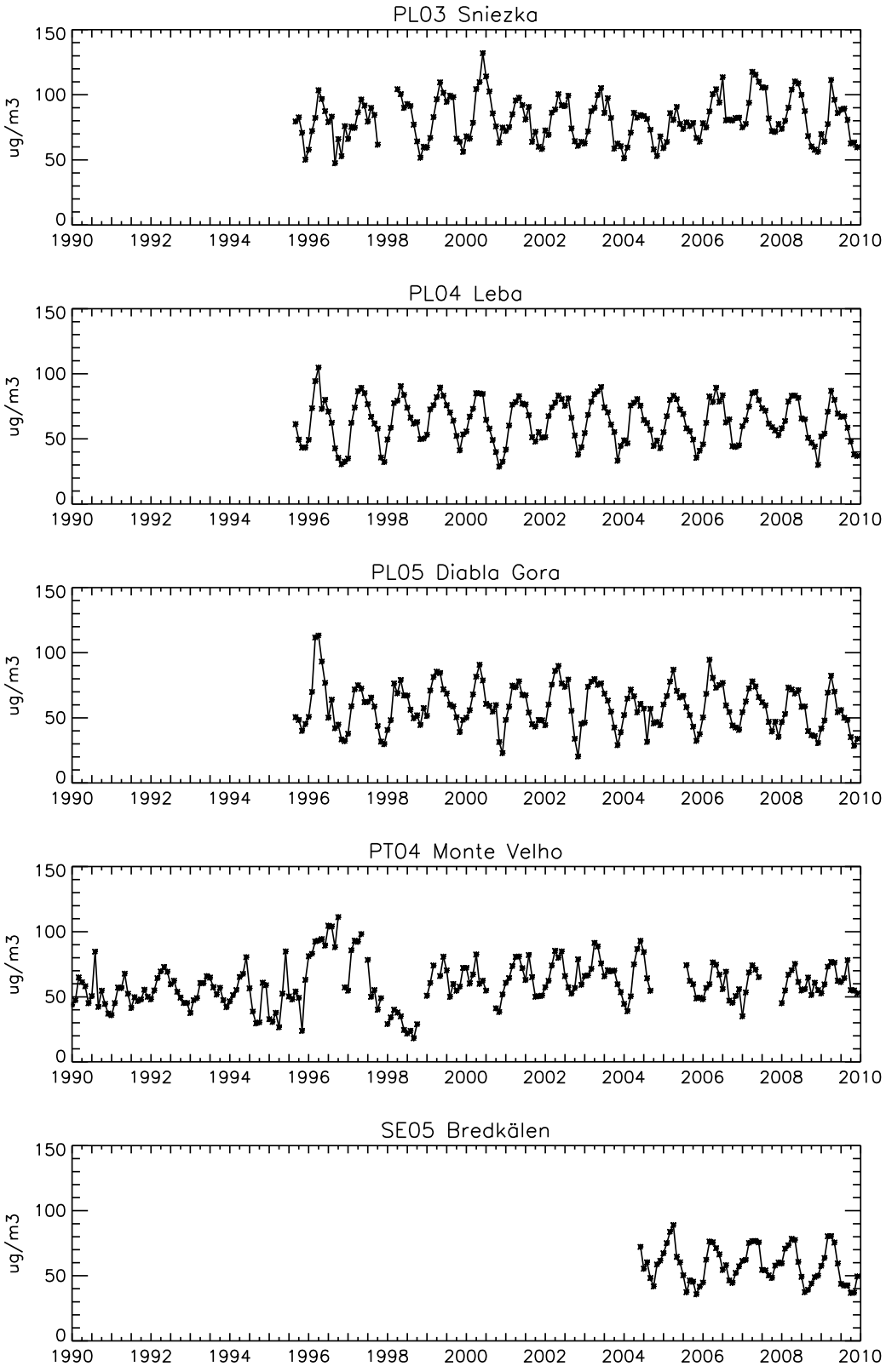

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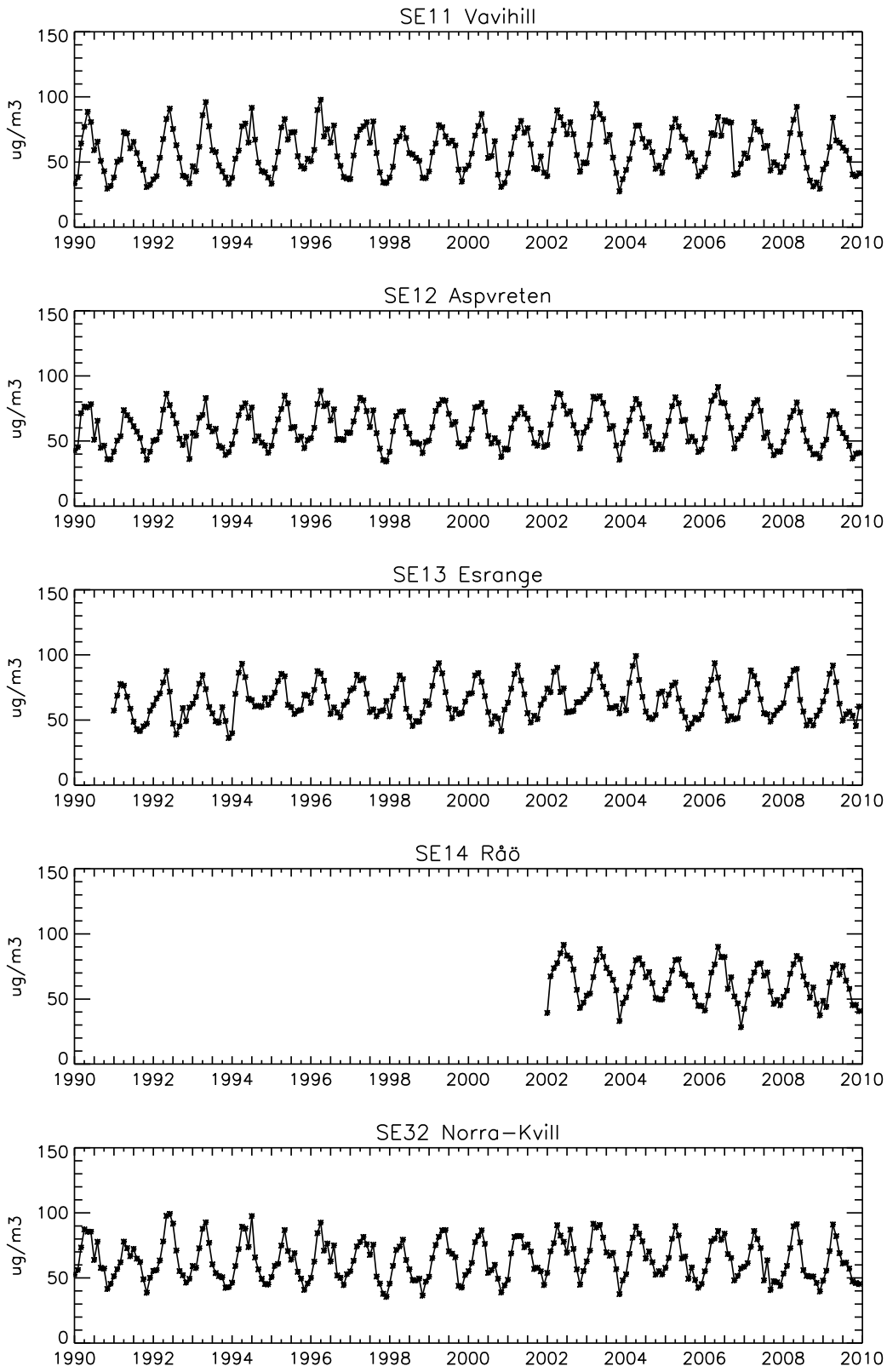

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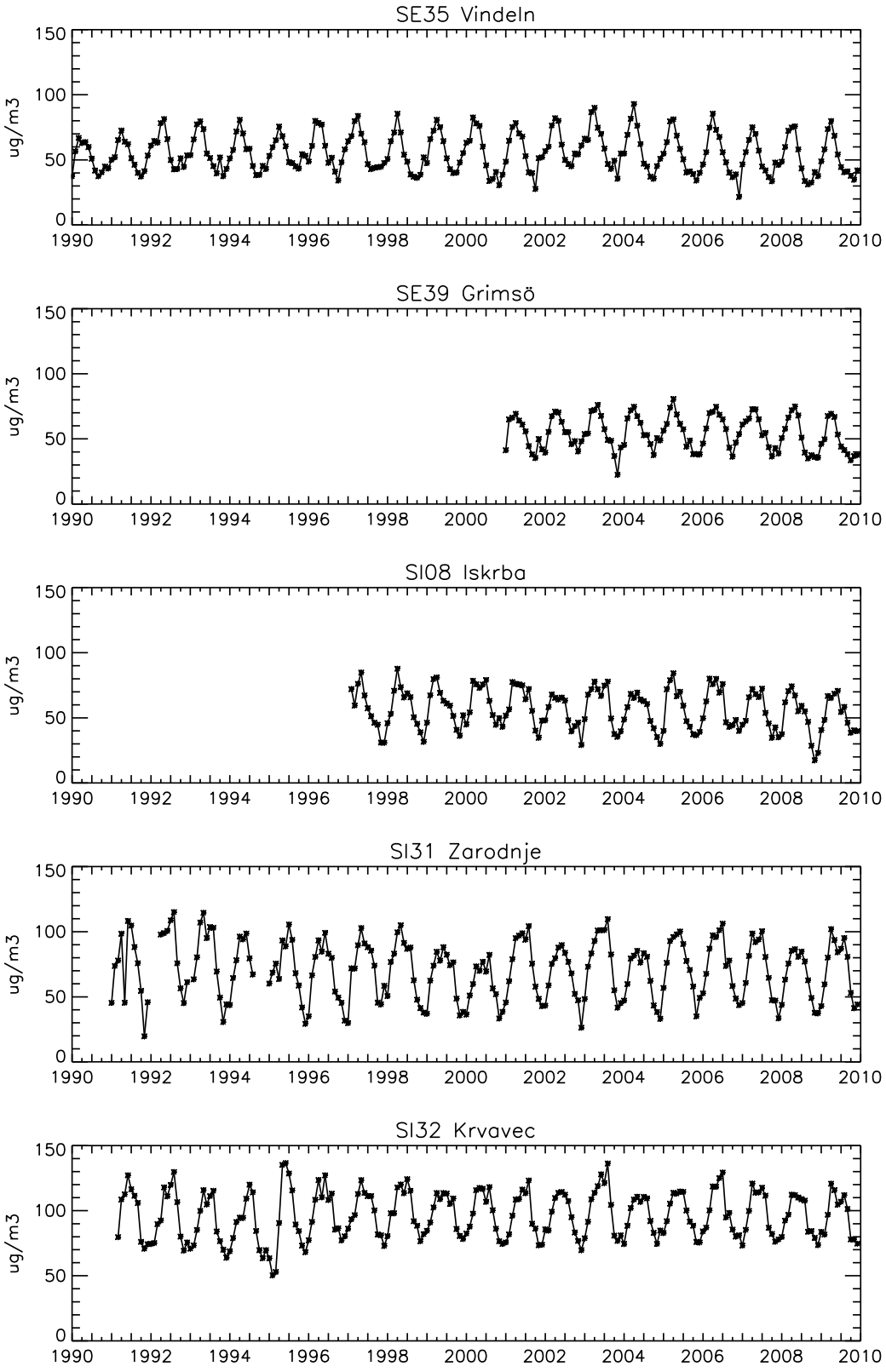


Figure 3.1, cont.

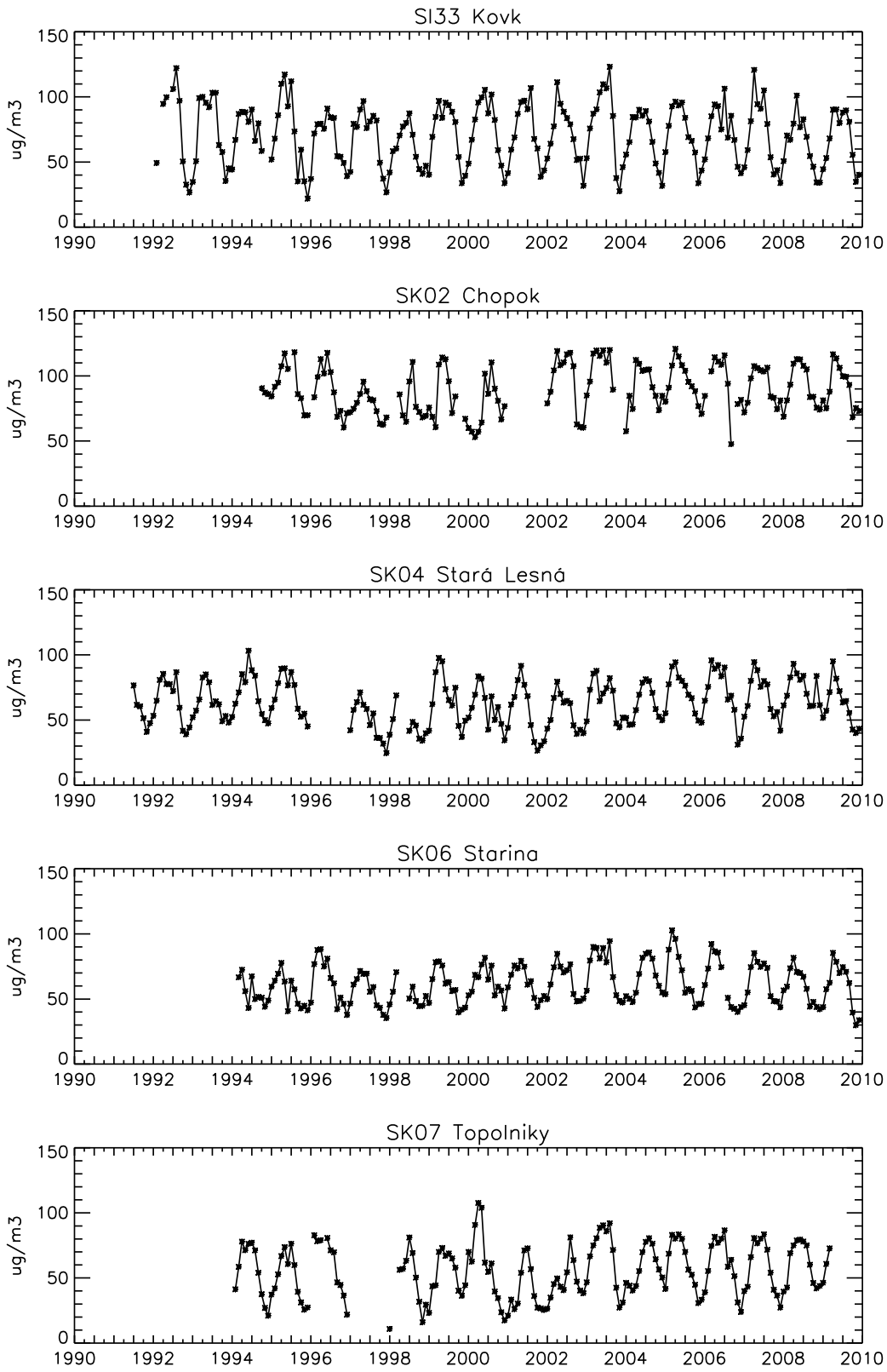


Figure 3.1, cont.

Annex 4

Diurnal variation, April–September 2009

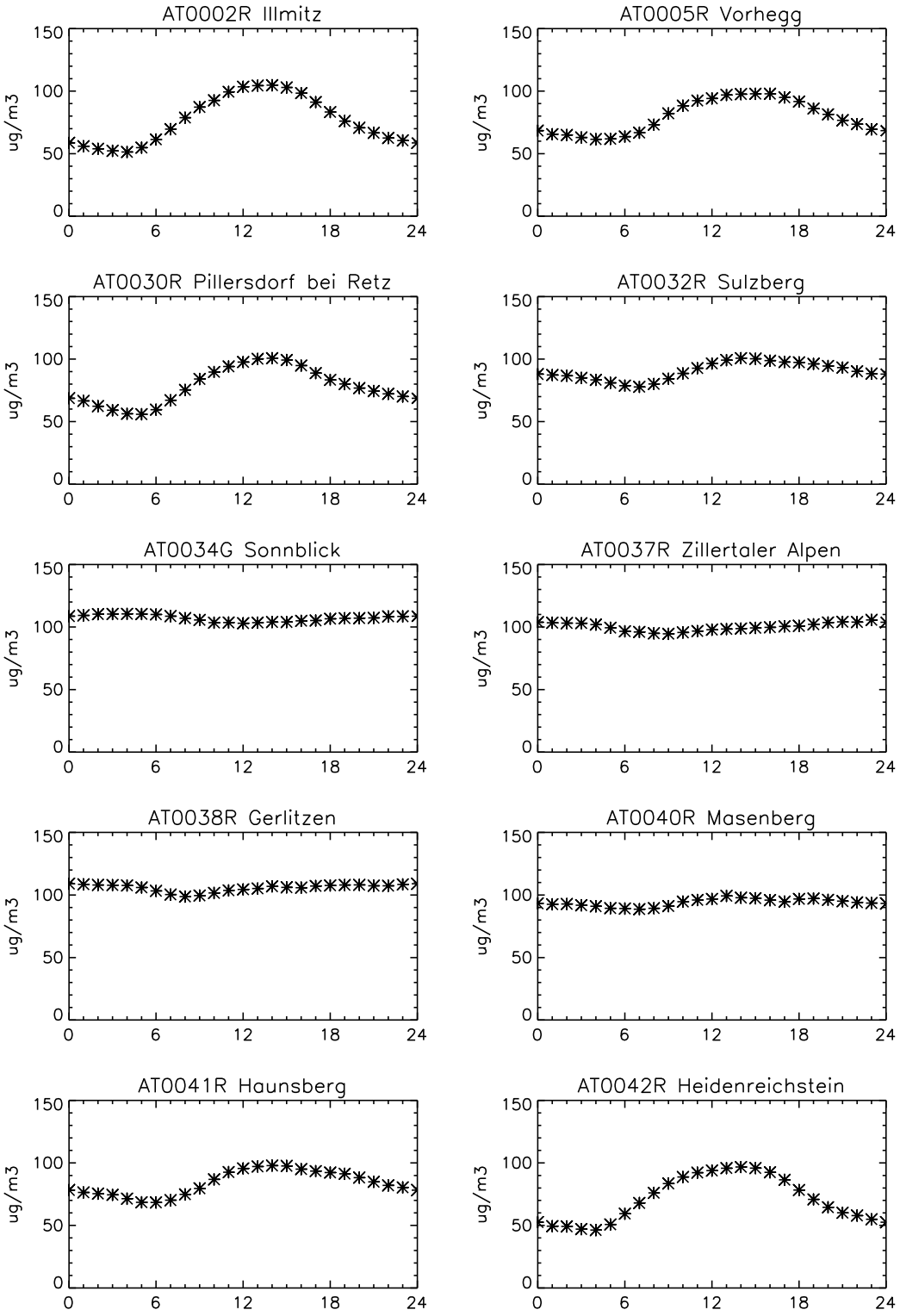


Figure 4.1: Diurnal variation, April–September 2009.

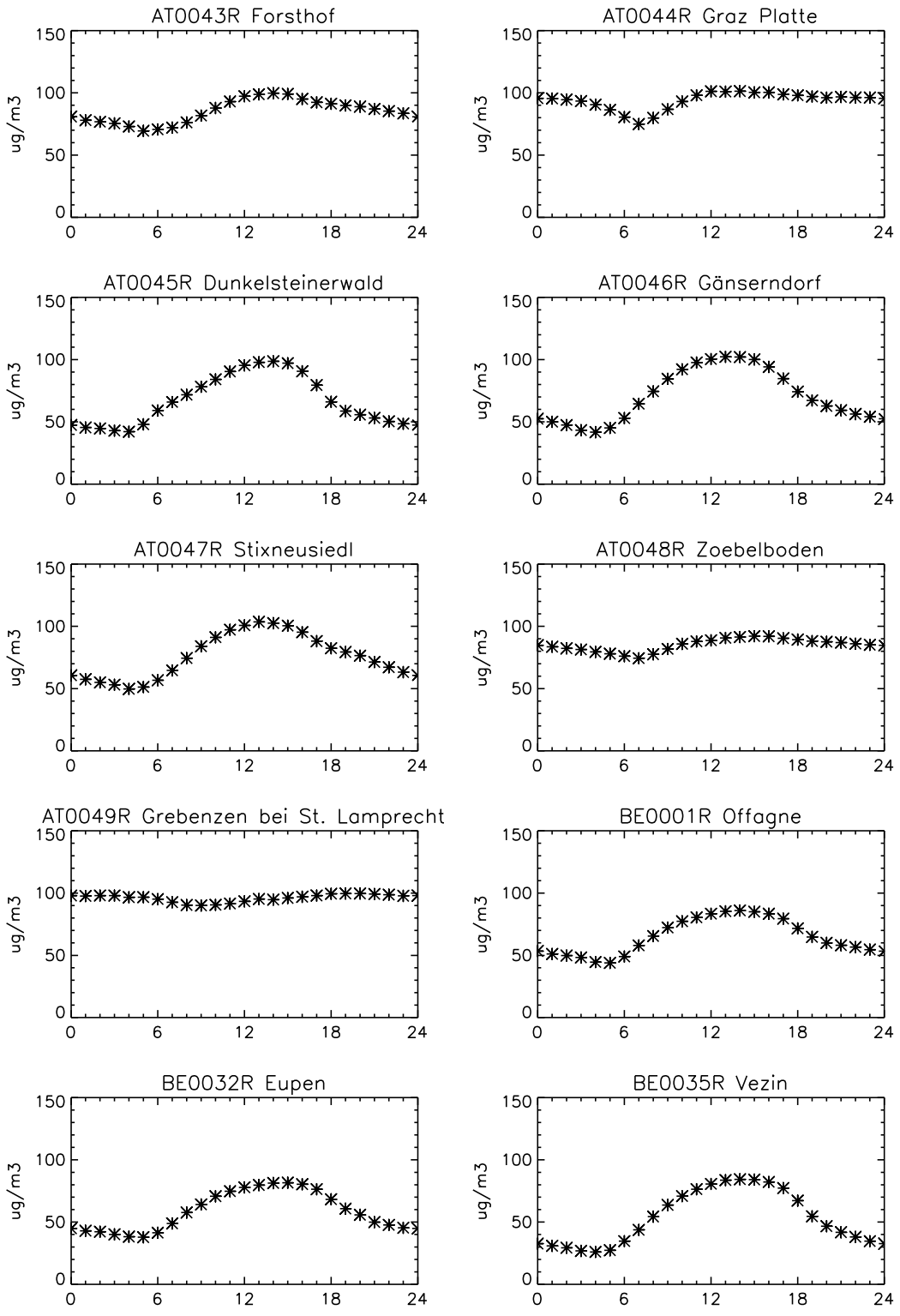
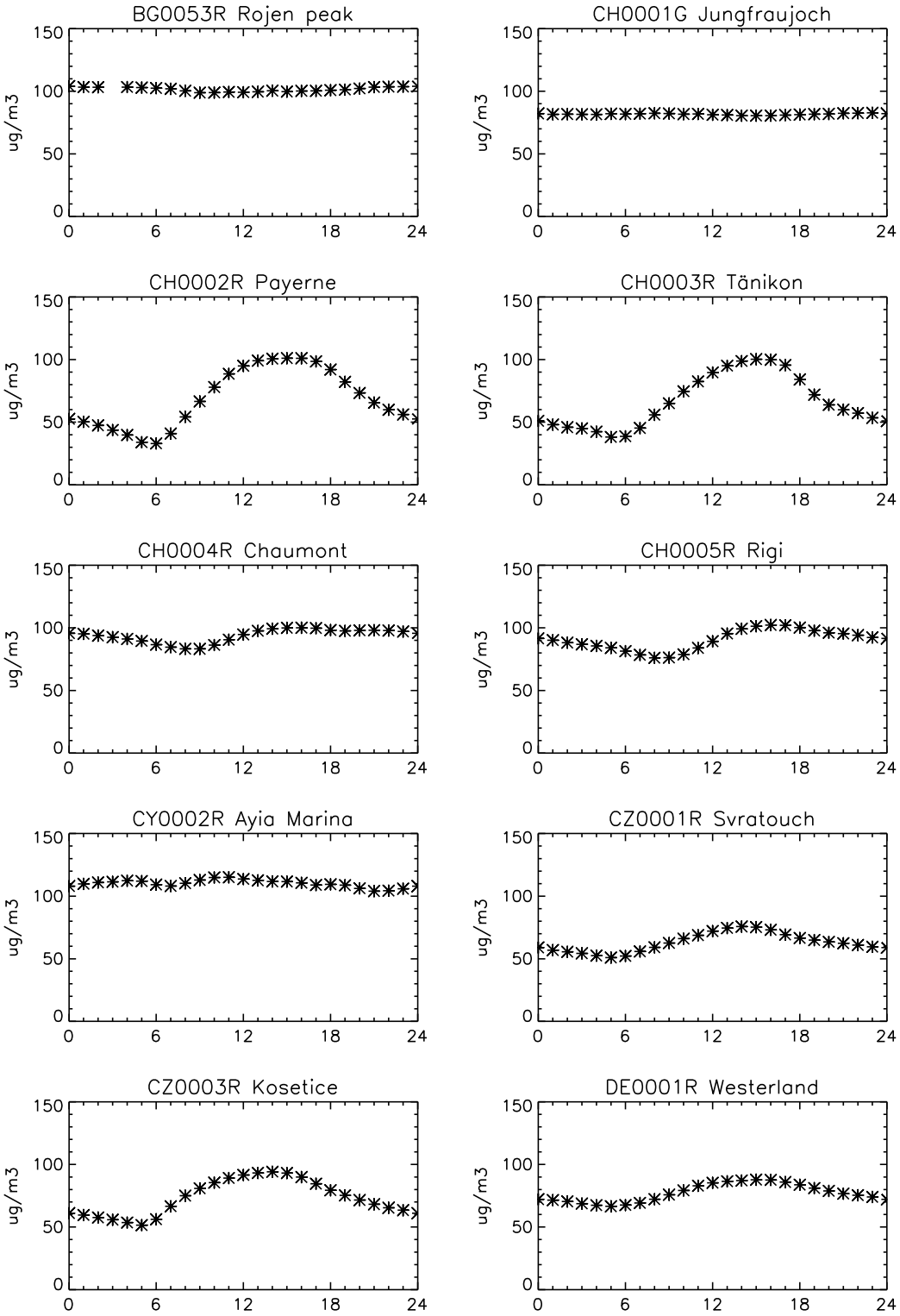


Figure 4.1, cont.



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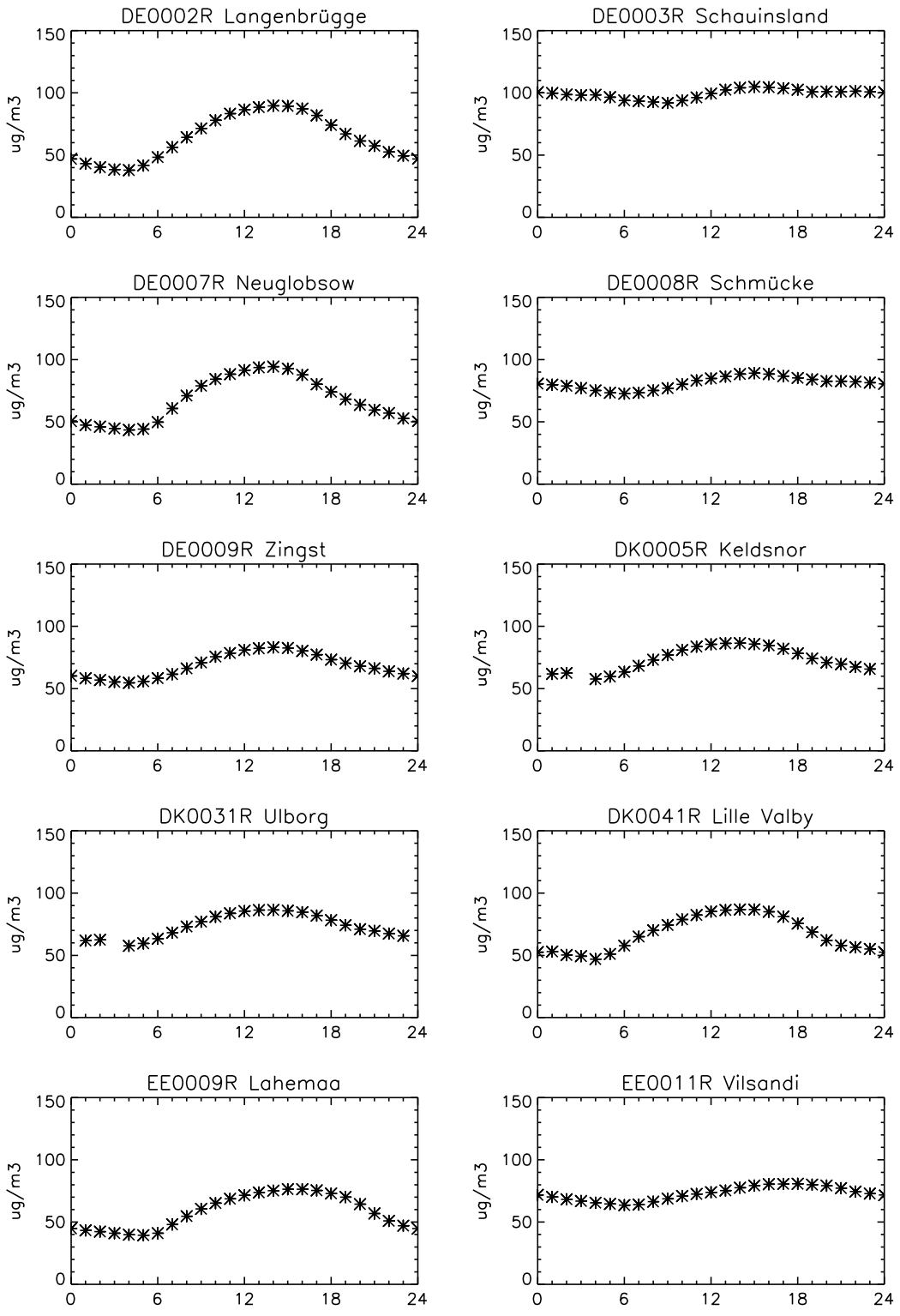

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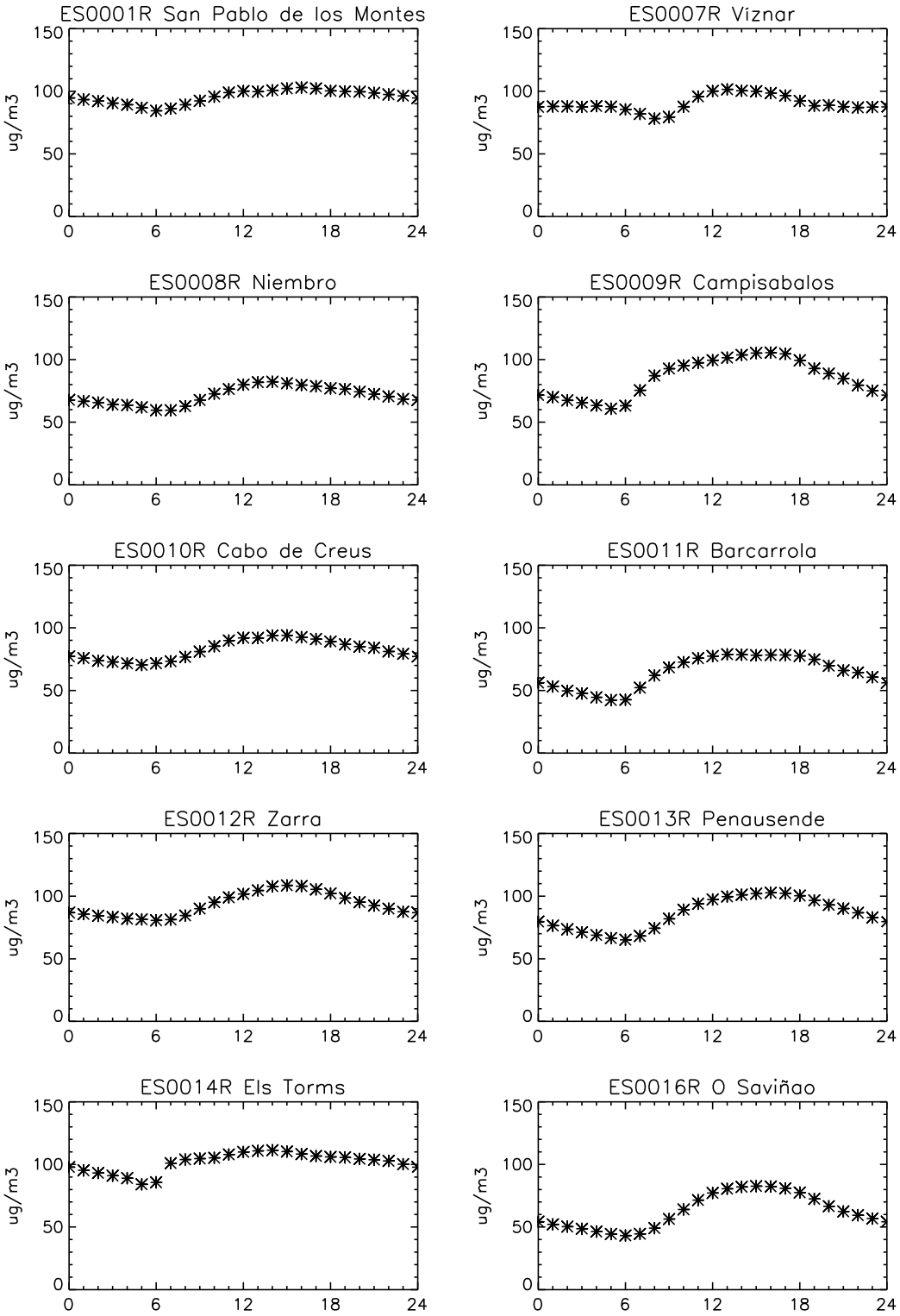

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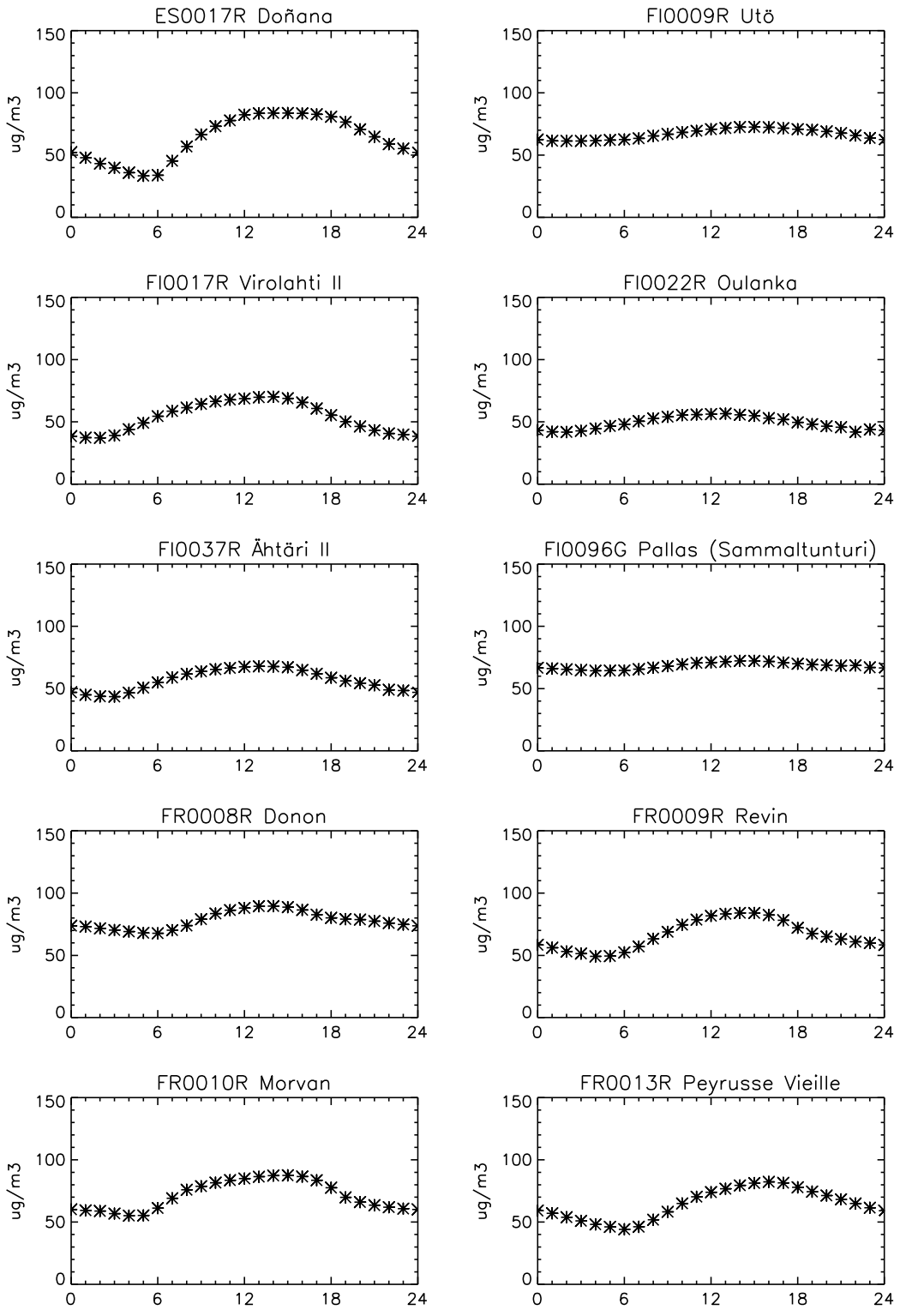

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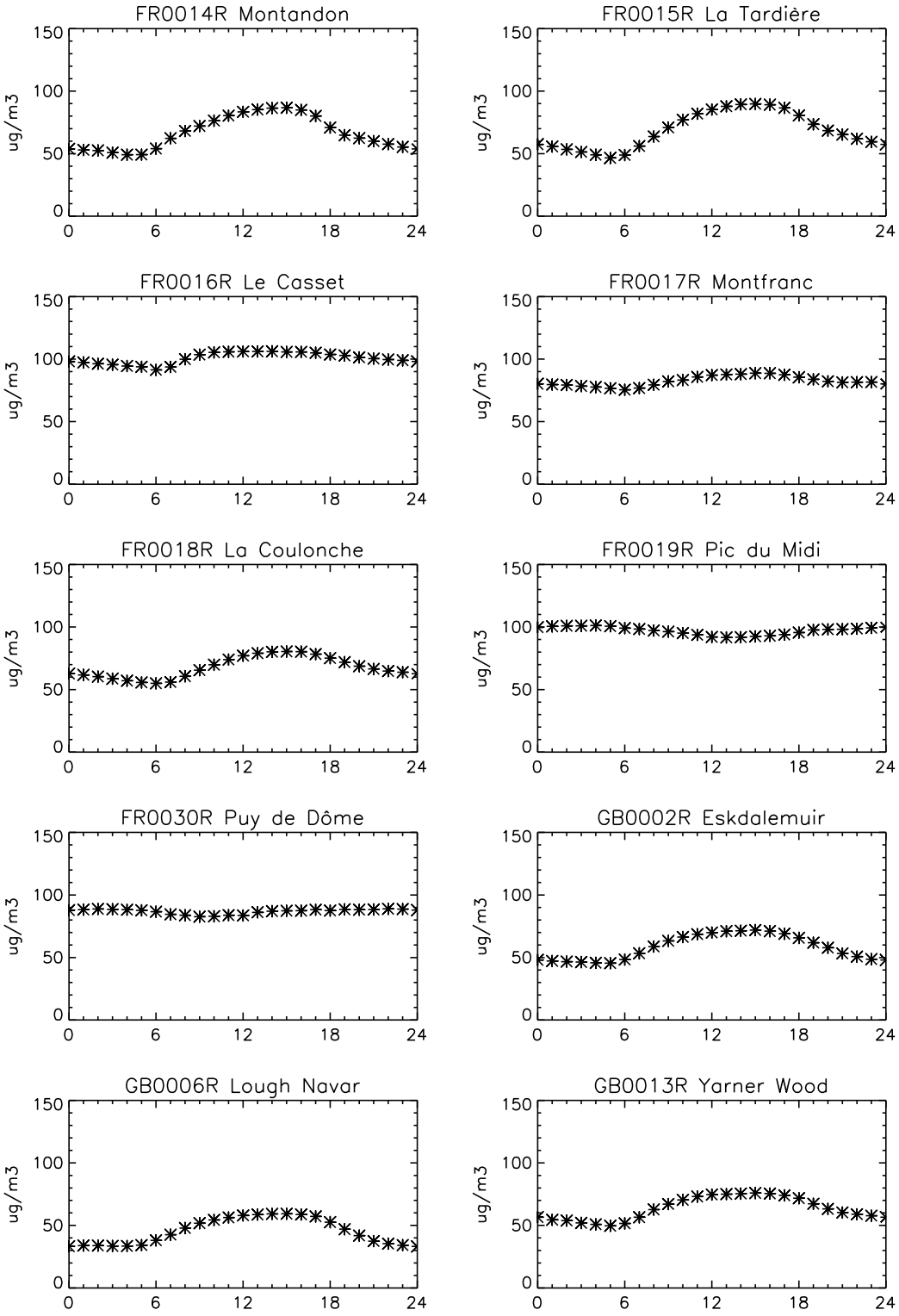

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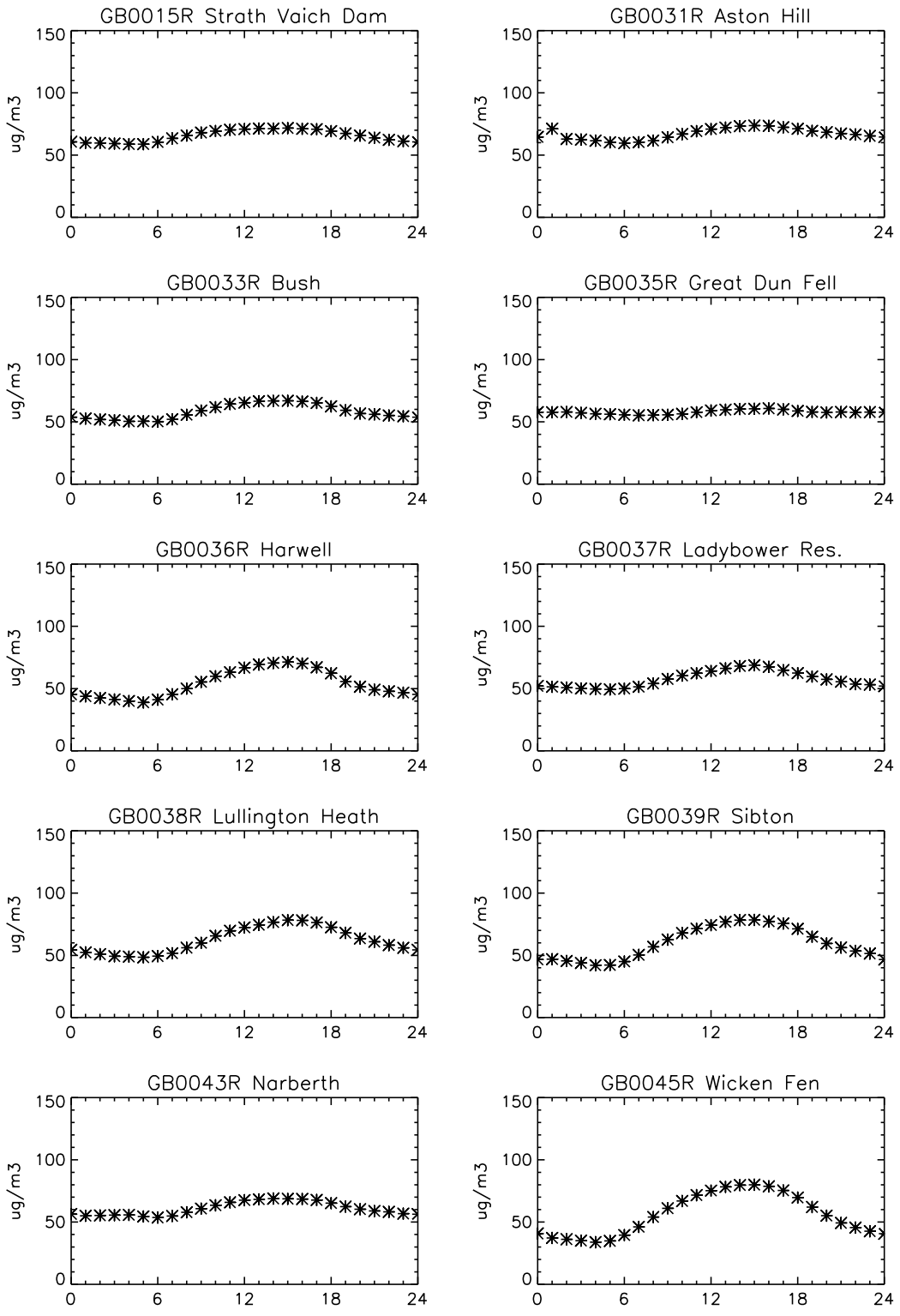

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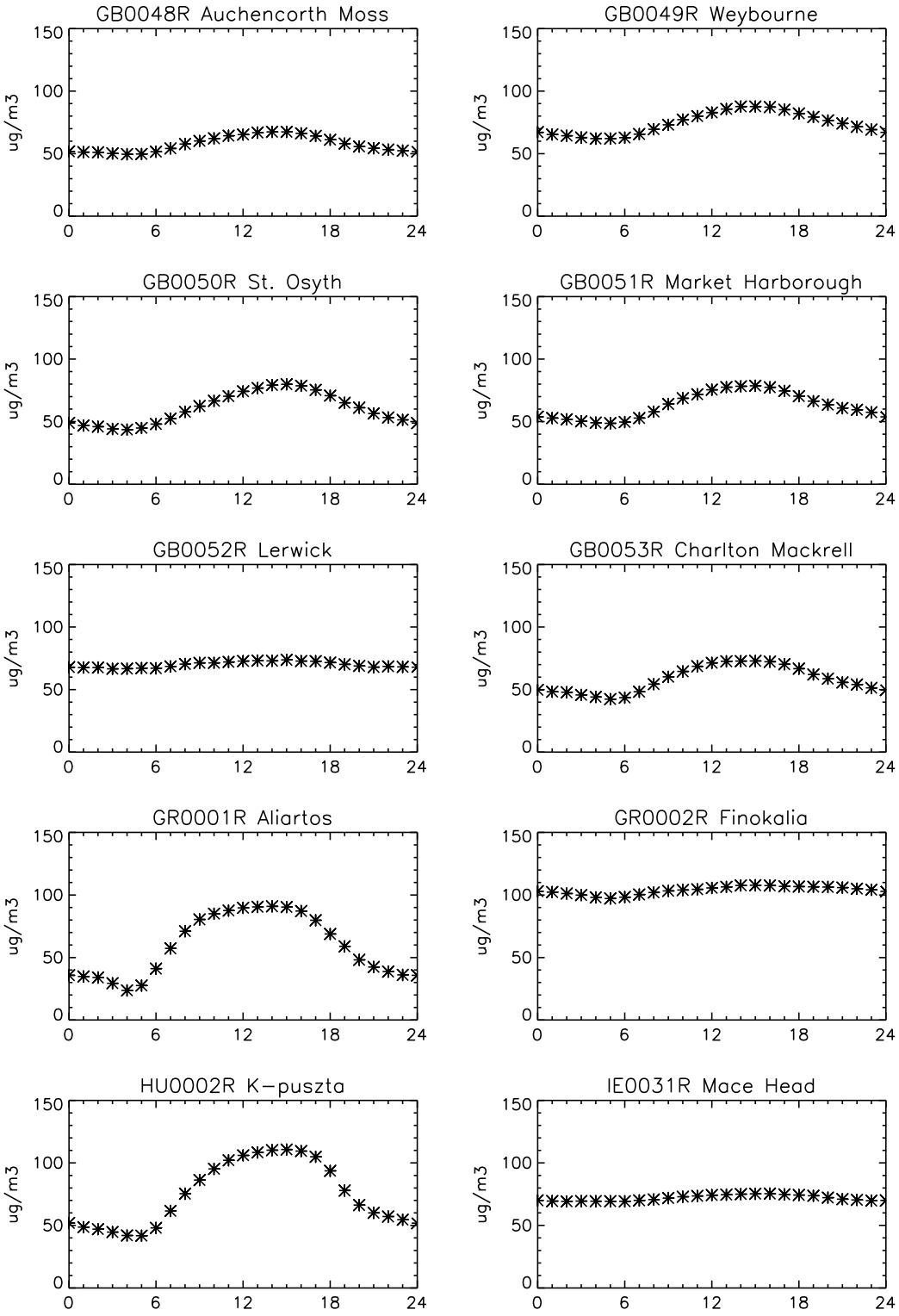

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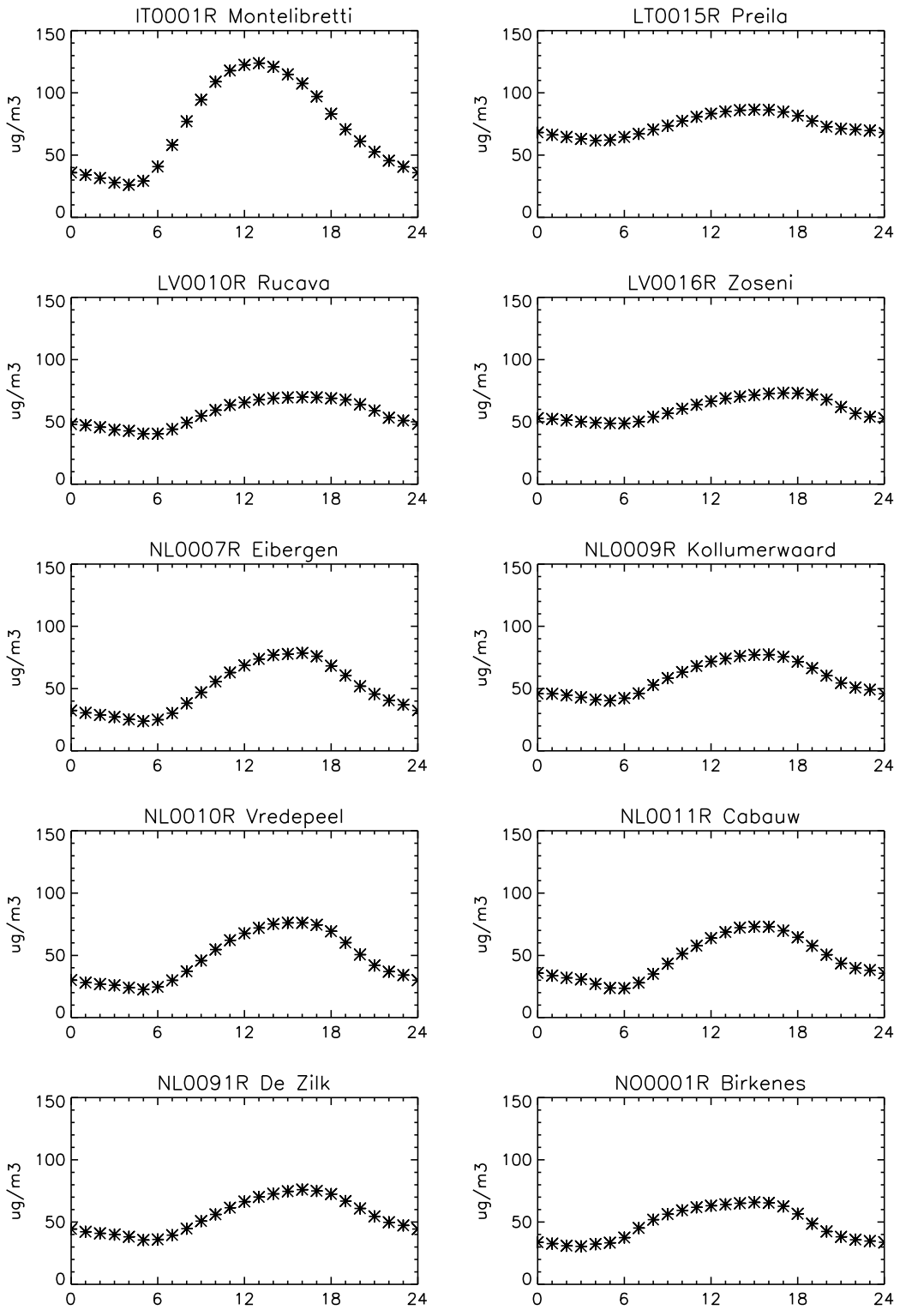

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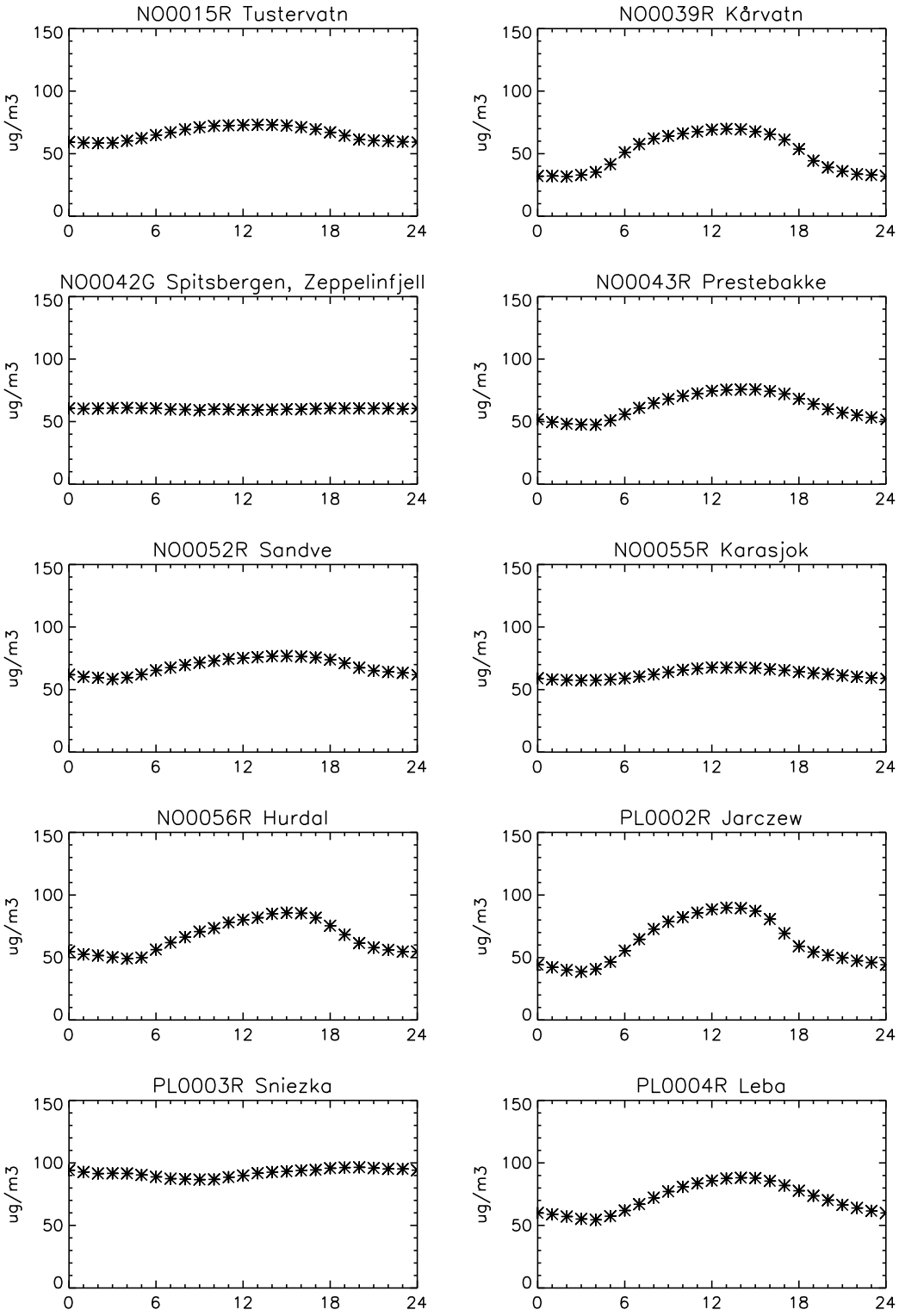

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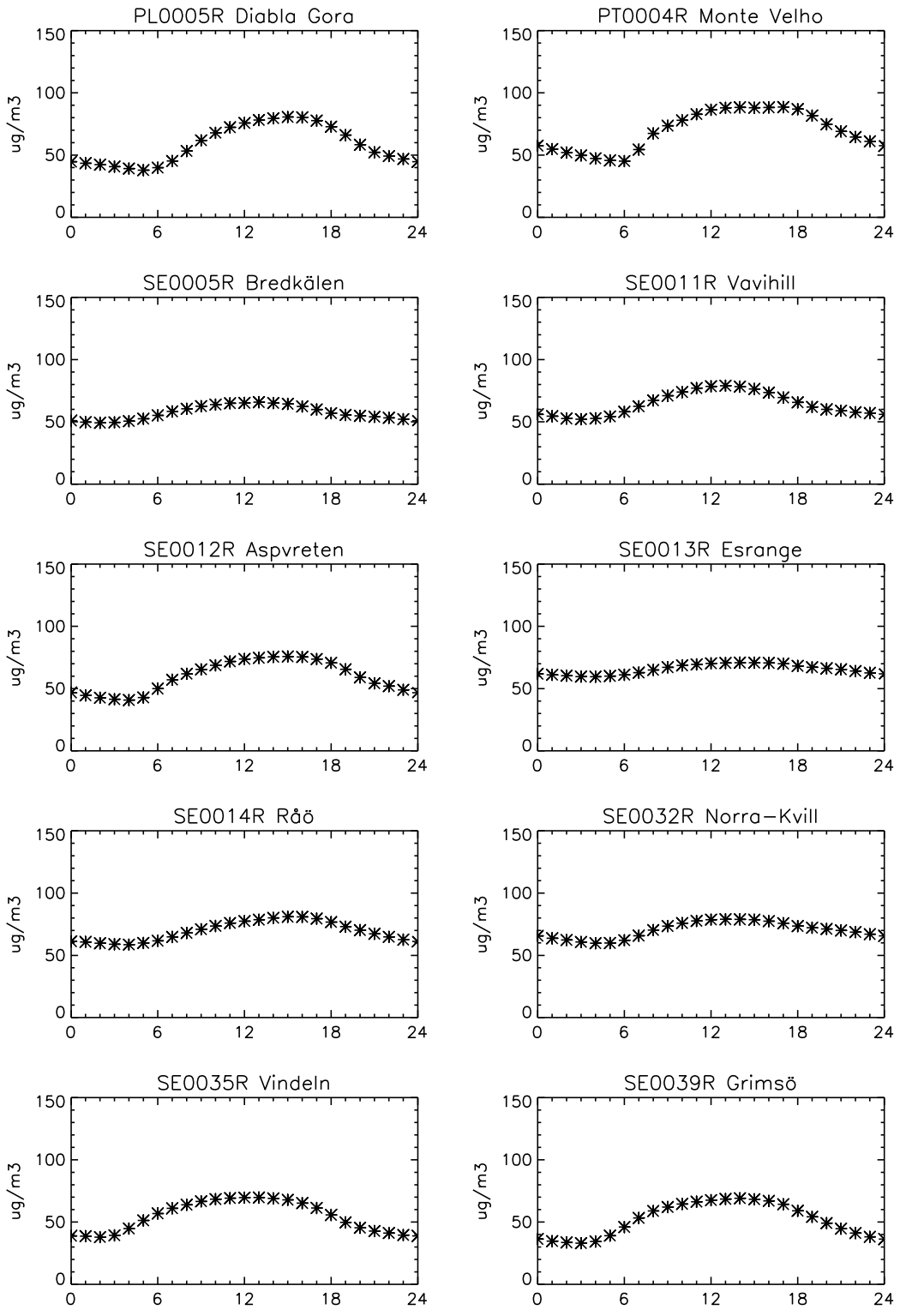

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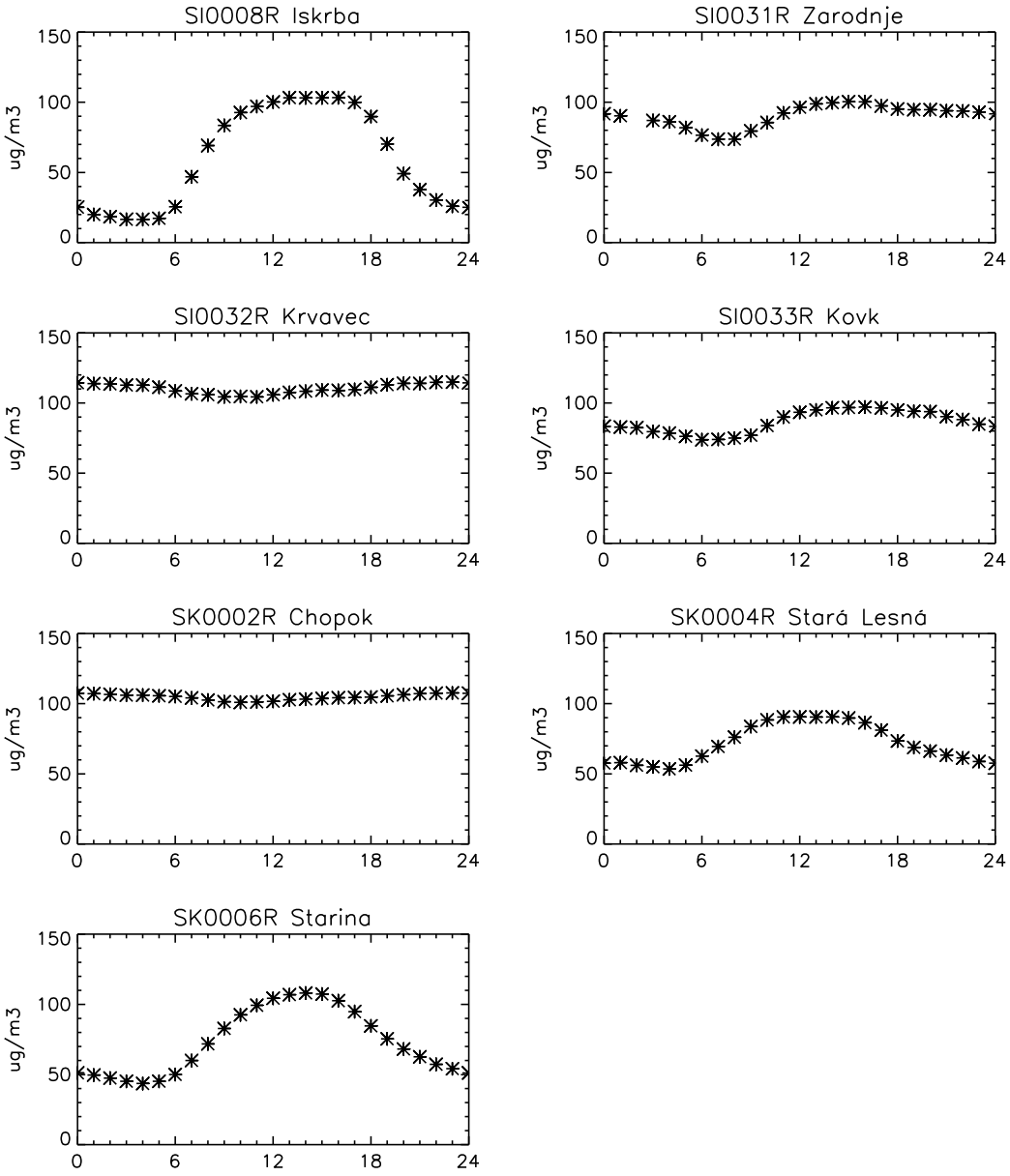

Figure 4.1, cont.

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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Kjeller, Norwegian Institute for Air Research, 1998.

Ozone measurements 1997.
EMEP/CCC-Report 2/99 by A.-G. Hjellbrekke.
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Ozone measurements 1998.
EMEP/CCC-Report 5/2000 by A.-G. Hjellbrekke.
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EMEP/CCC-Report 1/2001 by A.-G. Hjellbrekke and S. Solberg.
Kjeller, Norwegian Institute for Air Research, 2001.

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

Ozone measurements 2001.
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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.

Ozone measurements 2009.
EMEP/CCC-Report 2/2011 by A.-G. Hjellbrekke, S. Solberg and A.M. Fjæraa.
Kjeller, Norwegian Institute for Air Research, 2011.