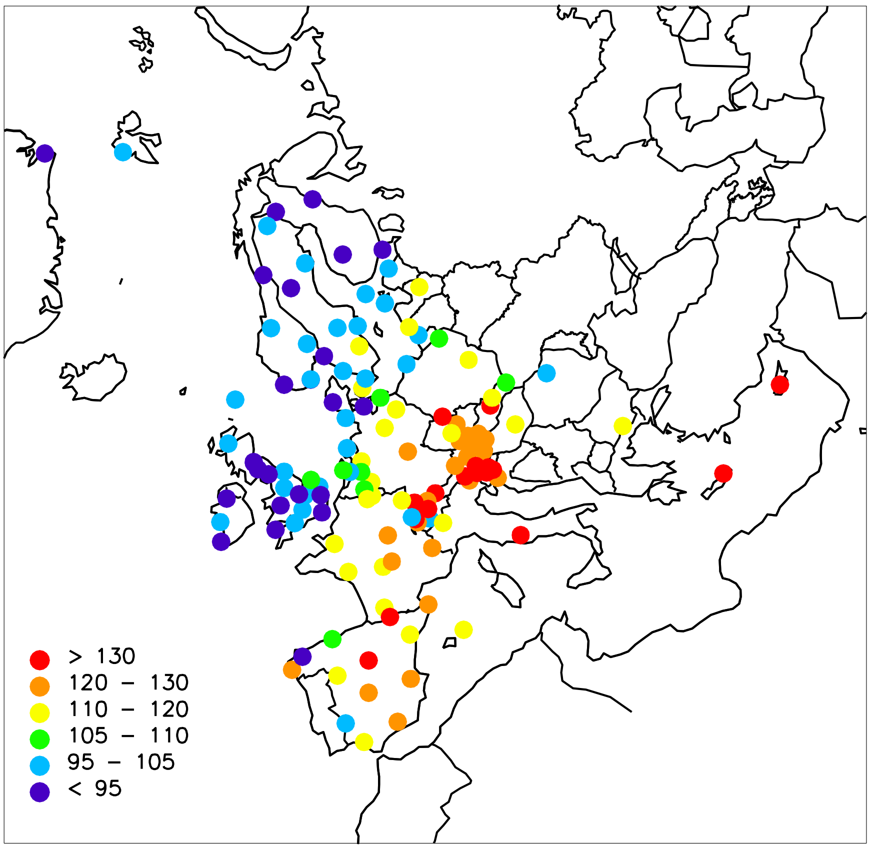
EMEP/CCC-Report 3/2013

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

Ozone measurements 2011

Anne-Gunn Hjellbrekke, Sverre Solberg and Ann Mari Fjæraa



95-percentile
April-September, µg/m³

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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 2011 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 2011 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 2011. In total 133 stations from 28 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 2011.

Code	Station name	Latitude	Longitude	Altitude
AM0001R	Amberd	40°23' 4"N	44°15'38"E	2080
AT0002R	Illmitz	47°46' 0"N	16°46' 0"E	117
AT0005R	Vorhegg	46°40'40"N	12°58'20"E	1020
AT0030R	Pillersdorf bei Retz	48°43'16"N	15°56'32"E	315
AT0032R	Sulzberg	47°31'45"N	9°55'36"E	1020
AT0034G	Sonnblick	47° 3'16"N	12°57'30"E	3106
AT0038R	Gerlitzen	46°41'37"N	13°54'54"E	1895
AT0040R	Masenberg	47°20'53"N	15°52'56"E	1170
AT0041R	Haunsberg	47°58'23"N	13° 0'58"E	730
AT0042R	Heidenreichstein	48°52'43"N	15° 2'48"E	570
AT0043R	Forsthof	48° 6'22"N	15°55'10"E	581
AT0045R	Dunkelsteinerwald	48°22'16"N	15°32'48"E	320
AT0046R	Gänserndorf	48°20' 5"N	16°43'50"E	161
AT0047R	Stixneusiedl	48° 3' 3"N	16°40'36"E	240
AT0048R	Zoebelboden	47°50'19"N	14°26'29"E	899
AT0049R	Grebenzen bei St. Lamprecht	47° 2'25"N	14°19'48"E	1648
BE0001R	Offagne	49°52'40"N	5°12'13"E	430
BE0032R	Eupen	50°37'45"N	6° 0' 3"E	295
BE0035R	Vezin	50°30'12"N	4°59'22"E	160
BG0053R	Rojen peak	41°41'45"N	24°44'19"E	1750
CH0001G	Jungfraujoch	46°32'51"N	7°59' 6"E	3578
CH0002R	Payerne	46°48'47"N	6°56'41"E	489
CH0003R	Tänikon	47°28'47"N	8°54'17"E	539
CH0004R	Chaumont	47° 2'59"N	6°58'46"E	1137
CH0005R	Rigi	47° 4' 3"N	8°27'50"E	1031
CY0002R	Ayia Marina	35° 2'20"N	33° 3'29"E	532
CZ0001R	Svratouch	49°44' 0"N	16° 3' 0"E	737
CZ0003R	Košetice	49°35' 0"N	15° 5' 0"E	534
DE0001R	Westerland	54°55'32"N	8°18'35"E	12
DE0002R	Waldhof	52°48' 8"N	10°45'34"E	74
DE0003R	Schauinsland	47°54'53"N	7°54'31"E	1205
DE0007R	Neuglobsow	53°10' 0"N	13° 2' 0"E	62
DE0008R	Schmücke	50°39' 0"N	10°46' 0"E	937
DE0009R	Zingst	54°26' 0"N	12°44' 0"E	1
DK0005R	Keldsnor	54°44' 0"N	10°44' 0"E	10
DK0010G	Nord, Greenland	81°36' 0"N	16°40'12"W	20
DK0012R	Risoe	55°41'36"N	12° 5' 8"E	3
DK0031R	Ulborg	56°17' 0"N	8°26' 0"E	10
EE0009R	Lahemaa	59°30' 0"N	25°54' 0"E	32
EE0011R	Vilsandi	58°23' 0"N	21°49' 0"E	6
ES0001R	San Pablo de los Montes	39°32'52"N	4°20'55"W	917
ES0005R	Noya	42°43'41"N	8°55'25"W	683
ES0006R	Mahón	39°52' 0"N	4°19' 0"E	78
ES0007R	Víznar	37°14' 0"N	3°32' 0"W	1265
ES0008R	Niembro	43°26'32"N	4°51' 1"W	134
ES0009R	Campisábalos	41°16'52"N	3° 8'34"W	1360
ES0010R	Cabo de Creus	42°19'10"N	3°19' 1"E	23
ES0011R	Barcarrola	38°28'33"N	6°55'22"W	393
ES0012R	Zarra	39° 5'10"N	1° 6' 7"W	885
ES0013R	Penausende	41°17' 0"N	5°52' 0"W	985
ES0014R	Els Torms	41°24' 0"N	0°43' 0"E	470
ES0016R	O Saviñao	43°13'52"N	7°41'59"W	506
ES0017R	Doñana	37° 1'49"N	6°19'54"W	5
FI0009R	Utö	59°46'45"N	21°22'38"E	7
FI0017R	Virolahti II	60°31'36"N	27°41'10"E	4
FI0022R	Oulanka	66°19'13"N	29°24' 6"E	310
FI0037R	Ähtäri II	62°35' 0"N	24°11' 0"E	180
FI0096G	Pallas (Sammaltunturi)	68° 0' 0"N	24° 9' 0"E	340
FR0008R	Donon	48°30' 0"N	7° 8' 0"E	775
FR0009R	Revin	49°54' 0"N	4°38' 0"E	390
FR0010R	Morvan	47°16' 0"N	4° 5' 0"E	620
FR0013R	Peyrusse Vieille	43°37' 0"N	0°11' 0"E	200
FR0014R	Montandon	47°18' 0"N	6°50' 0"E	836
FR0015R	La Tardière	46°39' 0"N	0°45' 0"W	133
FR0016R	Le Casset	45° 0' 0"N	6°28' 0"E	1750

Table 1, cont.

Code	Station name	Latitude	Longitude	Altitude
FR0017R	Montfranc	45°48' 0"N	2° 4' 0"E	810
FR0018R	La Coulonche	48°38' 0"N	0°27' 0"W	309
FR0019R	Pic du Midi	42°56'12"N	0° 8'31"E	2877
FR0030R	Puy de Dôme	45°46' 0"N	2°57' 0"E	1465
GB0002R	Eskdalemuir	55°18'47"N	3°12'15"W	243
GB0006R	Lough Navar	54°26'35"N	7°52'12"W	126
GB0013R	Yarner Wood	50°35'47"N	3°42'47"W	119
GB0014R	High Muffles	54°20' 4"N	0°48'27"W	267
GB0015R	Strath Vaich Dam	57°44' 4"N	4°46'28"W	270
GB0031R	Aston Hill	52°30'14"N	3° 1'59"W	370
GB0033R	Bush	55°51'31"N	3°12'18"W	180
GB0035R	Great Dun Fell	54°41' 0"N	2°27' 0"W	847
GB0036R	Harwell	51°34'23"N	1°19' 0"W	137
GB0037R	Ladybower Res.	53°23'56"N	1°45'12"W	420
GB0038R	Lullington Heath	50°47'34"N	0°10'46"E	120
GB0039R	Sibton	52°17'38"N	1°27'47"E	46
GB0043R	Narberth	51°14' 0"N	4°42' 0"W	160
GB0045R	Wicken Fen	52°17'54"N	0°17'34"W	5
GB0048R	Auchencorth Moss	55°47'31"N	3°14'34"W	260
GB0049R	Weybourne	52°57' 2"N	1° 7'19"E	16
GB0050R	St. Osyth	51°46'41"N	1° 4'56"E	8
GB0051R	Market Harborough	52°33'16"N	0°46'20"W	145
GB0052R	Lerwick	60° 8'21"N	1°11' 7"W	85
GB0053R	Charlton Mackrell	51° 3'22"N	2°41' 0"W	54
GR0001R	Aliartos	38°22' 0"N	23° 5' 0"E	110
GR0002R	Finokalia	35°19' 0"N	25°40' 0"E	250
HU0002R	K-puszta	46°58' 0"N	19°35' 0"E	125
IE0001R	Valentia Observatory	51°56'23"N	10°14'40"W	11
IE0031R	Mace Head	53°10' 0"N	9°30' 0"W	15
IT0001R	Montelibretti	42° 6' 0"N	12°38' 0"E	48
IT0004R	Ispra	45°48' 0"N	8°38' 0"E	209
LT0015R	Preila	55°21' 0"N	21° 4' 0"E	5
LV0010R	Rucava	56° 9'43"N	21°10'23"E	18
LV0016R	Zoseni	57° 8' 7"N	25°54'20"E	188
MK0007R	Lazaropole	41°32'10"N	20°41'38"E	1332
NL0007R	Eibergen	52° 5' 0"N	6°34' 0"E	20
NL0009R	Kollumerwaard	53°20' 2"N	6°16'38"E	1
NL0010R	Vredepeel	51°32'28"N	5°51'13"E	28
NL0011R	Cabauw Zijdeweg	51°58'13"N	4°55'35"E	1
NL0091R	De Zilk	52°18' 0"N	4°30' 0"E	4
NO0001R	Birkenes	58°23' 0"N	8°15' 0"E	190
NO0002R	Birkenes II	58°23'18"N	8°15' 7"E	219
NO0015R	Tustervatn	65°50' 0"N	13°55' 0"E	439
NO0039R	Kårvatn	62°47' 0"N	8°53' 0"E	210
NO0042G	Zeppelin mountain (Ny-Ålesund)	78°54'24"N	11°53'18"E	474
NO0043R	Prestebakke	59° 0' 0"N	11°32' 0"E	160
NO0052R	Sandve	59°12' 0"N	5°12' 0"E	15
NO0056R	Hurdal	60°22'20"N	11° 4'41"E	300
PL0002R	Jarczew	51°49' 0"N	21°59' 0"E	180
PL0003R	Sniezka	50°44' 0"N	15°44' 0"E	1603
PL0004R	Leba	54°45' 0"N	17°32' 0"E	2
PL0005R	Diabla Gora	54° 9' 0"N	22° 4' 0"E	157
RO0008R	Poiana Stampei	47°19'29"N	25° 8' 4"E	908
SE0005R	Bredkälen	63°51' 0"N	15°20' 0"E	404
SE0011R	Vavihill	56° 1' 0"N	13° 9' 0"E	175
SE0012R	Aspvreten	58°48' 0"N	17°23' 0"E	20
SE0013R	Esrange	67°53' 0"N	21° 4' 0"E	475
SE0014R	Råö	57°23'38"N	11°54'50"E	5
SE0032R	Norra-Kvill	57°49' 0"N	15°34' 0"E	261
SE0035R	Vindeln	64°15' 0"N	19°46' 0"E	225
SE0039R	Grimsö	59°43'40"N	15°28'19"E	132
SI0008R	Iskrba	45°34' 0"N	14°52' 0"E	520
SI0031R	Zarodnje	46°25'43"N	15° 0'12"E	770
SI0032R	Krvavec	46°17'58"N	14°32'19"E	1740
SI0033R	Kovk	46° 7'43"N	15° 6'50"E	600

Table 1, cont.

Code	Station name	Latitude	Longitude	Altitude
SK0002R	Chopok	48°56' 0"N	19°35' 0"E	2008
SK0004R	Stará Lesná	49° 9' 0"N	20°17' 0"E	808
SK0006R	Starina	49° 3' 0"N	22°16' 0"E	345

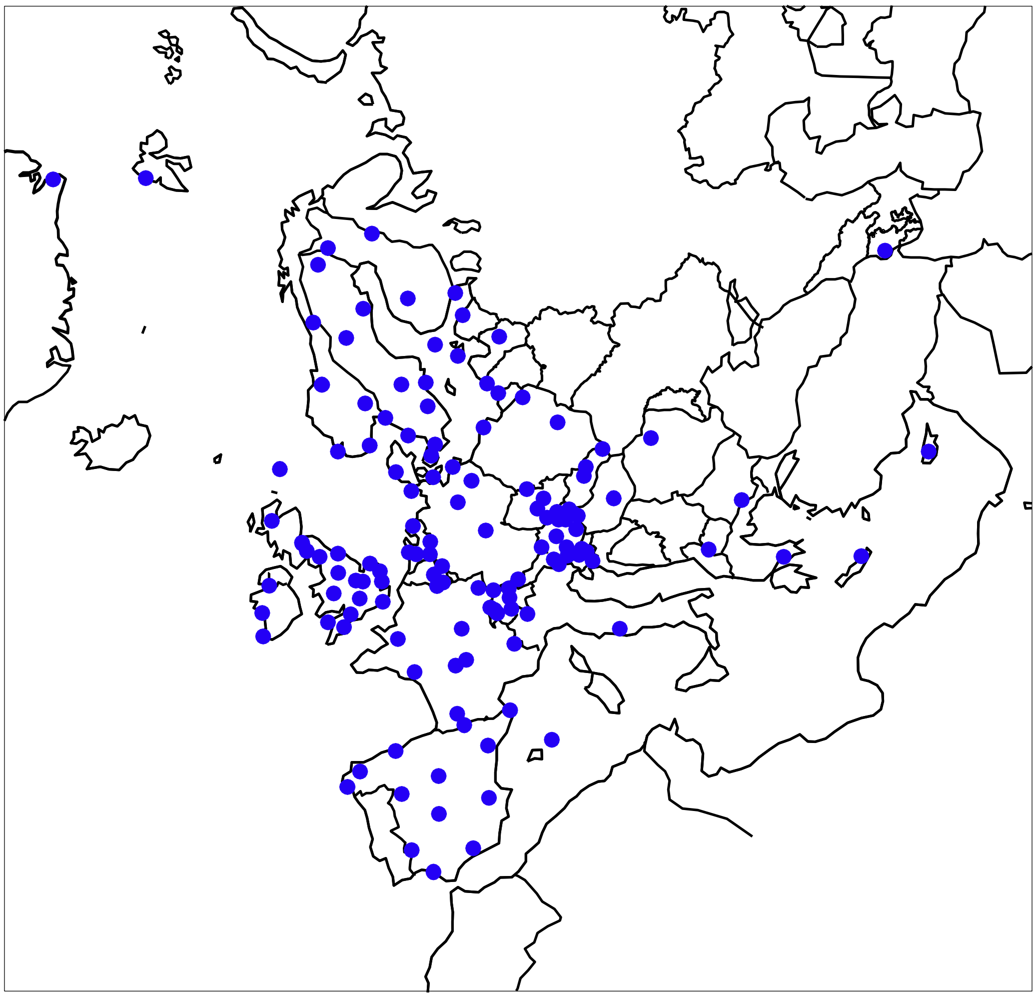

Figure 1: Location of the monitoring stations.

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 ozone section 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 2011.

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 – µg/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
Romania	unknown
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. 111 stations have a data capture above 90% and 124 above 85%.

Table 3: Data capture in per cent, 2011.

Code	Station	Data capture 2011
AM0001R	Amberd	55.2
AT0002R	Illmitz	95.3
AT0005R	Vorhegg	93.1
AT0030R	Pillersdorf bei Retz	91.9
AT0032R	Sulzberg	95.1
AT0034G	Sonnblick	86.1
AT0038R	Gerlitzen	88.7
AT0040R	Masenberg	94.2
AT0041R	Haunsberg	94.7
AT0042R	Heidenreichstein	94.7
AT0043R	Forsthof	94.3
AT0045R	Dunkelsteinerwald	95.2
AT0046R	Gänserndorf	95.5
AT0047R	Stixneusiedl	95.5
AT0048R	Zoebelboden	92.6
AT0049R	Grebenzen bei St. Lamprecht	93.7
BE0001R	Offagne	94.6
BE0032R	Eupen	93.7
BE0035R	Vezin	93.5
BG0053R	Rojen peak	95.1
CH0001G	Jungfraujoch	94.5
CH0002R	Payerne	95.3
CH0003R	Tänikon	95.3
CH0004R	Chaumont	95.4
CH0005R	Rigi	95.2
CY0002R	Ayia Marina	95.4
CZ0001R	Svratouch	98.0
CZ0003R	Košetice	94.4
DE0001R	Westerland	93.5
DE0002R	Waldhof	95.7
DE0003R	Schauinsland	95.3
DE0007R	Neuglobsow	95.7
DE0008R	Schmücke	94.8
DE0009R	Zingst	95.7
DK0005R	Keldsnor	87.2
DK0010G	Nord, Greenland	74.5
DK0012R	Risoe	85.8
DK0031R	Ulborg	89.1
EE0009R	Lahemaa	100.0
EE0011R	Vilsandi	100.0
ES0001R	San Pablo de los Montes	99.5
ES0005R	Noya	98.5
ES0006R	Mahón	98.3
ES0007R	Víznar	97.8
ES0008R	Niembro	98.6
ES0009R	Campisábalos	99.0
ES0010R	Cabo de Creus	98.3
ES0011R	Barcarrola	98.8
ES0012R	Zarra	98.9
ES0013R	Penausende	99.4

Table 3, cont.

Code	Station	Data capture 2011
ES0014R	Els Torms	99.4
ES0016R	O Saviñao	96.7
ES0017R	Doñana	98.5
FI0009R	Utö	94.5
FI0017R	Virolahti II	97.6
FI0022R	Oulanka	96.1
FI0037R	Ähtäri II	98.1
FI0096G	Pallas (Sammaltunturi)	98.6
FR0008R	Donon	97.8
FR0009R	Revin	95.7
FR0010R	Morvan	97.1
FR0013R	Peyrusse Vieille	97.6
FR0014R	Montandon	98.0
FR0015R	La Tardière	99.4
FR0016R	Le Casset	98.7
FR0017R	Montfranc	94.1
FR0018R	La Coulonche	98.2
FR0019R	Pic du Midi	94.5
FR0030R	Puy de Dôme	89.1
GB0002R	Eskdalemuir	93.1
GB0006R	Lough Navar	98.7
GB0013R	Yarner Wood	82.5
GB0014R	High Muffles	91.2
GB0015R	Strath Vaich Dam	96.9
GB0031R	Aston Hill	98.7
GB0033R	Bush	98.8
GB0035R	Great Dun Fell	94.5
GB0036R	Harwell	98.5
GB0037R	Ladybower Res.	98.2
GB0038R	Lullington Heath	99.2
GB0039R	Sibton	99.9
GB0043R	Narberth	95.4
GB0045R	Wicken Fen	89.4
GB0048R	Auchencorth Moss	99.5
GB0049R	Weybourne	97.6
GB0050R	St. Osyth	98.9
GB0051R	Market Harborough	88.7
GB0052R	Lerwick	98.7
GB0053R	Charlton Mackrell	93.4
GR0001R	Aliartos	59.0
GR0002R	Finokalia	89.0
HU0002R	K-puszta	89.6
IE0001R	Valentia Observatory	96.3
IE0031R	Mace Head	99.3
IT0001R	Montelibretti	97.8
IT0004R	Ispra	96.0
LT0015R	Preila	97.4
LV0010R	Rucava	84.0
LV0016R	Zoseni	85.3
MK0007R	Lazaropole	52.2

Table 3, cont.

Code	Station	Data capture 2011
NL0007R	Eibergen	98.7
NL0009R	Kollumerwaard	95.0
NL0010R	Vredepeel	96.3
NL0011R	Cabauw Zijdeweg	88.2
NL0091R	De Zilk	95.6
NO0001R	Birkenes	75.6
NO0002R	Birkenes II	86.1
NO0015R	Tustervatn	99.6
NO0039R	Kårvatn	98.5
NO0042G	Zeppelin mountain (Ny-Ålesund)	96.1
NO0043R	Prestebakke	99.8
NO0052R	Sandve	99.5
NO0056R	Hurdal	99.4
PL0002R	Jarczew	98.6
PL0003R	Sniezka	99.7
PL0004R	Leba	99.9
PL0005R	Diabla Gora	95.6
RO0008R	Poiana Stampei	83.0
SE0005R	Bredkälen	99.2
SE0011R	Vavihill	98.3
SE0012R	Aspvreten	93.2
SE0013R	Esrange	99.7
SE0014R	Råö	98.9
SE0032R	Norra-Kvill	99.3
SE0035R	Vindeln	96.5
SE0039R	Grimsö	99.1
SI0008R	Iskrba	69.7
SI0031R	Zarodnje	93.9
SI0032R	Krvavec	93.7
SI0033R	Kovk	95.5
SK0002R	Chopok	97.8
SK0004R	Stará Lesná	97.8
SK0006R	Starina	99.7

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

5. Concentration summaries and episodes

The summer ozone situation in Europe in 2011 was characterised by only short regional episodes followed by days with few or no exceedances (EEA, 2012). During the past decade, the summers of 2003 and 2006 had very large number of exceedances, principally due to very warm weather (EEA, 2011).

The highest one-hour ozone concentration in 2011 was measured at Eibergen in the Netherlands (229 $\mu g/m^3$, June 28) (Table 1.1, Annex 1). In total concentrations above 200 $\mu g/m^3$ were measured at seven sites. The lowest maximum concentrations were measured in Greenland (Nord, 91 $\mu g/m^3$) and the UK (Great Dun Fell, 104 $\mu g/m^3$).

Exceedance of the information threshold of 180 $\mu g/m^3$ was observed at 14 sites mainly in Central Europe (Figure 1.4, Annex 1). The unusual warm summers of 2003 and 2006 had 81 and 69 exceedances respectively.

The one hour critical level for ozone formulated by the ECE for protection of vegetation (150 $\mu g/m^3$) was exceeded at 86 sites (Figure 1.3, Annex 1), compared to 87 sites in 2010 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 $\mu g/m^3$. 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 $\mu g/m^3$, and at its highest in Germany, France, Italy and Spain where the 99-persentile values are above 140 $\mu g/m^3$.

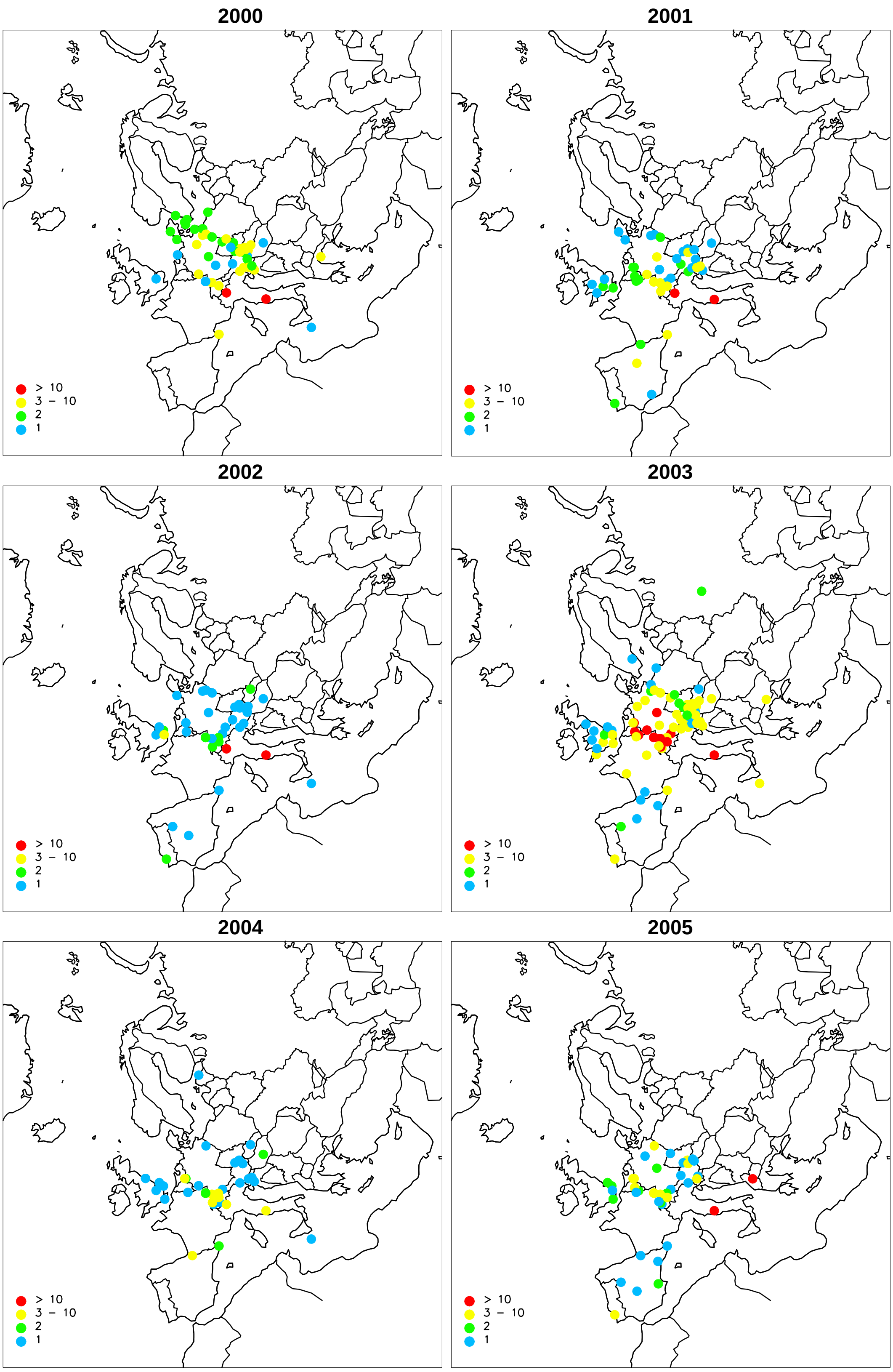

Figure 2: Number of exceedances of the threshold value of 180 $\mu g/m^3$ 2000-2011. (Unit: number of days.) Stations with zero exceedances are not shown.

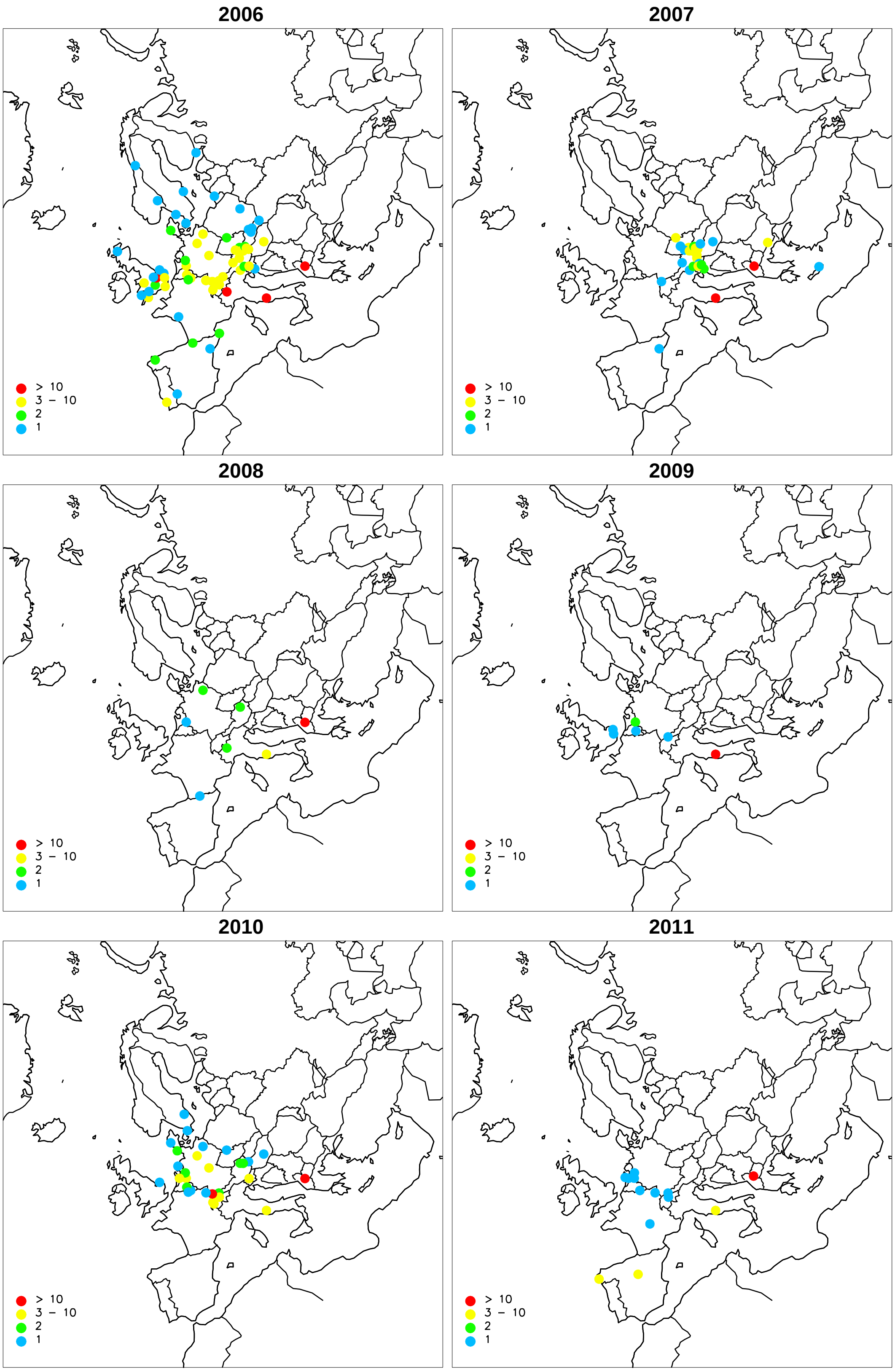

Figure 2, cont.

6. Calculation of AOT40

AOT40 and AOT60 for forest and agricultural crops for 2011 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. Three sites in Europe (Macedonia, Greece and Cyprus) have 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 2011 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 1990-2011 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.

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) 2011 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 July 19th, 2013.

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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Closer at home the secretarial work, and far beyond, has been performed by Ms. Kristine Aasarød. Rita Larsen Våler and Mona Waagsbø have been very helpful with data flow and database maintenance.

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	Department of Environmental Science, Aarhus University
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
Ireland	Environmental Protection Agency (EPA) Ricardo – AEA
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
Romania	National Environmental Protection Agency
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	Ricardo – AEA

Annex 1

Concentration summaries and episodes, tables and figures

Table 1.1: Number of hours (h) and days (d) exceeding 120, 150, 180 and 200 $\mu g/m^3$ and maximum concentrations in 2011.

Code	Station	Total		>120		>150		>180		>200		Max concentrations	
		hours	days	hours	days	hours	days	hours	days	hours	days	$\mu g/m^3$	day(s)
AM0001R	Amberd	4835	212	278	51	2	1	0	0	0	0	153.4	06.07.2011
AT0002R	Illmitz	8349	365	300	57	3	2	0	0	0	0	169	27.09.2011
AT0005R	Vorhegg	8154	361	342	52	25	7	0	0	0	0	172	25.08.2011
AT0030R	Pillersdorf bei Retz	8053	361	239	44	14	7	0	0	0	0	165	23.08.2011, 26.08.2011
AT0032R	Sulzberg	8333	365	493	51	63	9	0	0	0	0	176	06.07.2011
AT0034G	Sonnblick	7545	341	874	101	1	1	0	0	0	0	156	17.04.2011
AT0038R	Gerlitzen	7770	352	918	94	33	7	0	0	0	0	171	27.05.2011
AT0040R	Masenberg	8256	362	537	58	9	2	0	0	0	0	158	26.08.2011
AT0041R	Haunsberg	8297	363	302	45	25	5	0	0	0	0	172	06.07.2011
AT0042R	Heidenreichstein	8300	363	236	48	3	1	0	0	0	0	180	07.07.2011
AT0043R	Forsthof	8265	362	337	51	15	3	0	0	0	0	176	24.08.2011
AT0045R	Dunkelsteinerwald	8342	365	251	54	17	7	0	0	0	0	175	26.08.2011
AT0046R	Gänserndorf	8364	365	231	51	9	3	0	0	0	0	171	24.08.2011
AT0047R	Stixneusiedl	8366	365	249	46	4	1	0	0	0	0	168	24.08.2011
AT0048R	Zoebelboden	8114	361	256	36	25	4	0	0	0	0	164	12.05.2011
AT0049R	Grebenzen bei St. Lamprecht	8208	361	553	53	18	3	0	0	0	0	161	27.05.2011
BE0001R	Offagne	8291	359	140	24	14	4	2	1	0	0	183	28.06.2011
BE0032R	Eupen	8211	357	201	31	19	7	0	0	0	0	161	04.06.2011
BE0035R	Vezin	8192	354	125	24	21	5	0	0	0	0	170	04.06.2011
BG0053R	Rojen peak	8332	365	94	26	2	1	0	0	0	0	155.5	15.07.2011
CH0001G	Jungfraujoch	8279	362	11	6	0	0	0	0	0	0	136.7	04.07.2011
CH0002R	Payerne	8346	365	272	49	17	5	0	0	0	0	159.1	21.04.2011
CH0003R	Tänikon	8349	365	241	54	42	11	1	1	0	0	184.2	05.07.2011
CH0004R	Chaumont	8353	365	604	64	65	15	0	0	0	0	174.1	28.06.2011
CH0005R	Rigi	8341	365	553	64	75	15	3	1	0	0	186.2	11.05.2011
CY0002R	Ayia Marina	8359	360	891	106	2	2	0	0	0	0	154.3	04.08.2011
CZ0001R	Svratouch	8583	360	394	45	6	2	0	0	0	0	161	11.05.2011
CZ0003R	Košetice	8269	352	173	31	1	1	0	0	0	0	150.6	29.06.2011
DE0001R	Westerland	8192	362	39	12	0	0	0	0	0	0	140.9	06.05.2011
DE0002R	Waldhof	8387	365	206	36	8	4	0	0	0	0	158.3	26.08.2011
DE0003R	Schauinsland	8345	363	697	73	86	15	0	0	0	0	174	05.07.2011
DE0007R	Neuglobsow	8381	365	136	24	10	3	0	0	0	0	175.1	31.05.2011

Table 1.1, cont.

Code	Station	Total		>120		>150		>180		>200		Max concentrations	
		hours	days	hours	days	hours	days	hours	days	hours	days	$\mu g/m^3$	day(s)
DE0008R	Schmücke	8307	363	338	45	5	2	0	0	0	0	157.6	30.05.2011
DE0009R	Zingst	8382	365	66	15	2	1	0	0	0	0	153.1	10.05.2011
DK0005R	Keldsnor	7635	354	16	3	0	0	0	0	0	0	139.8	26.04.2011
DK0010G	Nord, Greenland	6524	303	0	0	0	0	0	0	0	0	91.4	04.05.2011
DK0012R	Risoe	7512	359	116	20	0	0	0	0	0	0	147.7	06.06.2011
DK0031R	Ulborg	7802	362	12	4	0	0	0	0	0	0	131.4	21.08.2011
EE0009R	Lahemaa	8760	365	48	8	6	1	0	0	0	0	174	02.07.2011
EE0011R	Vilsandi	8760	365	13	4	0	0	0	0	0	0	125	26.04.2011
ES0001R	San Pablo de los Montes	8713	365	315	52	1	1	0	0	0	0	155.9	04.08.2011
ES0005R	Noya	8626	364	398	48	40	6	9	3	1	1	201.6	02.07.2011
ES0006R	Mahón	8611	365	130	26	0	0	0	0	0	0	146.5	07.07.2011
ES0007R	Víznar	8568	365	340	80	2	1	0	0	0	0	152.4	05.07.2011
ES0008R	Niembro	8636	365	83	16	2	1	0	0	0	0	155.1	02.10.2011
ES0009R	Campisábalos	8670	365	511	69	40	13	6	3	0	0	191.4	09.09.2011
ES0010R	Cabo de Creus	8614	364	389	55	16	6	0	0	0	0	175.7	01.10.2011
ES0011R	Barcarrola	8654	364	2	1	0	0	0	0	0	0	128.9	24.06.2011
ES0012R	Zarra	8666	365	263	58	0	0	0	0	0	0	146.3	07.04.2011
ES0013R	Penausende	8709	365	227	42	7	3	0	0	0	0	178.7	13.08.2011
ES0014R	Els Torms	8710	365	199	45	1	1	0	0	0	0	157.4	26.05.2011
ES0016R	O Saviñao	8472	360	6	3	0	0	0	0	0	0	125.7	26.06.2011
ES0017R	Doñana	8626	363	119	37	1	1	0	0	0	0	151.3	07.09.2011
FI0009R	Utö	8276	355	16	6	0	0	0	0	0	0	133	10.06.2011
FI0017R	Virolahti II	8546	362	11	5	0	0	0	0	0	0	138	02.07.2011
FI0022R	Oulanka	8420	360	2	1	0	0	0	0	0	0	121	09.05.2011
FI0037R	Ähtäri II	8596	361	1	1	0	0	0	0	0	0	124	01.06.2011
FI0096G	Pallas (Sammaltunturi)	8639	364	0	0	0	0	0	0	0	0	116	09.05.2011
FR0008R	Donon	8563	360	207	23	16	5	1	1	1	1	207	28.06.2011
FR0009R	Revin	8384	355	154	20	9	4	0	0	0	0	168	04.06.2011
FR0010R	Morvan	8504	362	283	33	7	2	0	0	0	0	156	22.04.2011
FR0013R	Peyrusse Vieille	8548	360	81	19	0	0	0	0	0	0	135	02.07.2011
FR0014R	Montandon	8582	365	60	15	0	0	0	0	0	0	141	05.07.2011
FR0015R	La Tardière	8709	365	123	24	0	0	0	0	0	0	145	03.06.2011

Table 1.1, cont.

Code	Station	Total		>120		>150		>180		>200		Max concentrations	
		hours	days	hours	days	hours	days	hours	days	hours	days	$\mu g/m^3$	day(s)
FR0016R	Le Casset	8642	365	334	42	2	2	0	0	0	0	153	03.07.2011
FR0017R	Montfranc	8241	353	202	29	0	0	0	0	0	0	139	01.10.2011
FR0018R	La Coulonche	8598	365	254	31	9	3	0	0	0	0	167	25.04.2011
FR0019R	Pic du Midi	8276	352	775	124	17	5	0	0	0	0	169	04.05.2011
FR0030R	Puy de Dôme	7809	336	508	52	4	2	1	1	0	0	199	07.07.2011
GB0002R	Eskdalemuir	8153	344	20	5	3	1	0	0	0	0	164	22.04.2011
GB0006R	Lough Navar	8642	364	22	5	0	0	0	0	0	0	136	21.04.2011
GB0013R	Yarner Wood	7230	307	32	6	3	1	0	0	0	0	164	21.04.2011
GB0014R	High Muffles	7991	338	82	9	29	3	0	0	0	0	168	21.04.2011, 22.04.2011
GB0015R	Strath Vaich Dam	8489	355	17	2	3	1	0	0	0	0	160	22.04.2011
GB0031R	Aston Hill	8643	363	36	7	0	0	0	0	0	0	140	21.04.2011
GB0033R	Bush	8657	365	4	2	0	0	0	0	0	0	132	30.09.2011
GB0035R	Great Dun Fell	8278	362	0	0	0	0	0	0	0	0	104	30.09.2011
GB0036R	Harwell	8628	363	50	12	0	0	0	0	0	0	146	23.04.2011
GB0037R	Ladybower Res.	8598	364	24	4	0	0	0	0	0	0	150	22.04.2011
GB0038R	Lullington Heath	8688	365	46	8	0	0	0	0	0	0	148	24.04.2011
GB0039R	Sibton	8748	365	54	12	3	2	0	0	0	0	174	07.05.2011
GB0043R	Narberth	8356	352	16	4	0	0	0	0	0	0	146	21.04.2011
GB0045R	Wicken Fen	7830	332	35	11	6	2	0	0	0	0	164	23.04.2011
GB0048R	Auchencorth Moss	8716	365	7	2	0	0	0	0	0	0	142	22.04.2011
GB0049R	Weybourne	8554	358	85	17	3	2	0	0	0	0	164	03.08.2011
GB0050R	St. Osyth	8663	365	17	7	1	1	0	0	0	0	154	24.04.2011
GB0051R	Market Harborough	7773	330	5	1	0	0	0	0	0	0	128	23.04.2011
GB0052R	Lerwick	8643	364	35	4	0	0	0	0	0	0	140	22.04.2011, 23.04.2011
GB0053R	Charlton Mackrell	8179	346	56	14	2	1	0	0	0	0	158	21.04.2011
GR0001R	Aliartos	5172	228	27	11	0	0	0	0	0	0	129	02.07.2011, 23.07.2011
GR0002R	Finokalia	7796	346	2362	161	176	30	0	0	0	0	178	02.09.2011
HU0002R	K-puszta	7848	331	156	36	5	2	0	0	0	0	164	11.07.2011
IE0001R	Valentia Observatory	8440	358	11	2	0	0	0	0	0	0	149.2	21.04.2011
IE0031R	Mace Head	8696	364	11	2	0	0	0	0	0	0	130	22.04.2011
IT0001R	Montelibretti	8566	363	545	116	77	31	9	4	1	1	203.2	26.08.2011
IT0004R	Ispra	8406	357	171	45	19	8	0	0	0	0	162.9	28.06.2011

Table 1.1, cont.

Code	Station	Total		>120		>150		>180		>200		Max concentrations	
		hours	days	hours	days	hours	days	hours	days	hours	days	$\mu g/m^3$	day(s)
LT0015R	Preila	8532	362	21	8	0	0	0	0	0	0	135.7	12.05.2011
LV0010R	Rucava	7361	312	127	22	2	1	0	0	0	0	154	26.04.2011
LV0016R	Zoseni	7476	314	179	27	7	2	0	0	0	0	161	26.04.2011
MK0007R	Lazaropole	4570	206	2492	145	813	87	68	13	7	3	206	16.07.2011
NL0007R	Eibergen	8648	365	167	25	46	9	6	1	3	1	229.2	28.06.2011
NL0009R	Kollumerwaard	8321	354	58	11	4	2	0	0	0	0	157.9	28.06.2011
NL0010R	Vredepeel	8435	362	140	23	13	3	6	1	3	1	214.4	28.06.2011
NL0011R	Cabauw Zijdeweg	7724	326	99	19	12	6	3	1	1	1	201.1	28.06.2011
NL0091R	De Zilk	8377	359	113	21	24	7	2	1	0	0	199.2	28.06.2011
NO0001R	Birkenes	6622	280	38	7	4	1	0	0	0	0	170.3	25.04.2011
NO0002R	Birkenes II	7541	321	78	11	4	1	0	0	0	0	168.4	25.04.2011
NO0015R	Tustervatn	8728	365	6	2	0	0	0	0	0	0	121.4	10.05.2011
NO0039R	Kårvatn	8632	365	19	5	0	0	0	0	0	0	137	07.05.2011
NO0042G	Zeppelin mountain (Ny-Ålesund)	8419	357	18	2	0	0	0	0	0	0	134.4	25.04.2011
NO0043R	Prestebakke	8740	365	50	6	0	0	0	0	0	0	149	11.05.2011
NO0052R	Sandve	8714	365	33	5	0	0	0	0	0	0	135.2	07.05.2011
NO0056R	Hurdal	8710	365	51	6	3	1	0	0	0	0	150.6	11.05.2011
PL0002R	Jarczew	8636	364	129	29	2	1	0	0	0	0	151	27.04.2011
PL0003R	Sniezka	8730	365	1019	112	75	16	0	0	0	0	169	23.08.2011
PL0004R	Leba	8754	365	43	10	0	0	0	0	0	0	150	21.04.2011
PL0005R	Diabla Gora	8378	351	127	20	8	3	0	0	0	0	158	25.04.2011
RO0008R	Poiana Stampei	7268	323	19	4	0	0	0	0	0	0	134	14.03.2011
SE0005R	Bredkälen	8690	365	0	0	0	0	0	0	0	0	118	25.04.2011, 09.05.2011
SE0011R	Vavihill	8608	361	37	8	0	0	0	0	0	0	146	10.05.2011
SE0012R	Aspvreten	8168	353	26	3	0	0	0	0	0	0	137	07.06.2011
SE0013R	Esrange	8735	365	22	3	0	0	0	0	0	0	133	24.04.2011
SE0014R	Råö	8663	363	51	11	4	1	0	0	0	0	158	06.06.2011
SE0032R	Norra-Kvill	8698	365	133	18	6	1	0	0	0	0	161	31.05.2011
SE0035R	Vindeln	8454	357	14	3	0	0	0	0	0	0	130	09.05.2011
SE0039R	Grimsö	8683	364	67	11	0	0	0	0	0	0	150	21.04.2011

Table 1.1, cont.

Code	Station	Total		>120		>150		>180		>200		Max concentrations	
		hours	days	hours	days	hours	days	hours	days	hours	days	$\mu g/m^3$	day(s)
SI0008R	Iskrba	6107	268	294	54	12	3	0	0	0	0	167	25.08.2011
SI0031R	Zarodnje	8225	364	563	75	31	6	0	0	0	0	172	25.08.2011
SI0032R	Krvavec	8208	365	854	89	14	5	0	0	0	0	161	12.05.2011
SI0033R	Kovk	8362	365	612	86	24	7	0	0	0	0	177	12.05.2011
SK0002R	Chopok	8568	365	962	111	6	4	0	0	0	0	165.9	26.05.2011
SK0004R	Stará Lesná	8563	359	186	36	0	0	0	0	0	0	139.6	22.04.2011
SK0006R	Starina	8738	365	88	16	0	0	0	0	0	0	142.4	22.04.2011

Table 1.2: Percentiles of hourly ozone values April–September 2011.

Code	Station	25%	50%	75%	90%	95%	98%	99%	Data capture
AM0001R	Amberd	90.0	101.4	112.2	122.0	128.2	134.4	139.3	48.5
AT0002R	Illmitz	59.0	75.0	94.0	114.0	125.0	134.0	138.0	95.3
AT0005R	Vorhegg	63.0	81.0	99.0	116.0	126.0	139.0	146.0	93.1
AT0030R	Pillersdorf bei Retz	62.0	78.0	95.0	113.0	122.0	134.0	139.0	90.6
AT0032R	Sulzberg	76.0	90.0	107.0	123.0	134.0	147.0	155.0	95.1
AT0034G	Sonnblick	94.0	106.0	117.0	128.0	134.5	141.0	143.0	93.1
AT0038R	Gerlitzen	92.0	105.0	118.0	131.0	137.0	143.0	149.0	92.3
AT0040R	Masenberg	80.0	93.0	108.0	123.0	130.0	137.0	142.0	93.2
AT0041R	Haunsberg	66.0	81.0	99.0	115.0	126.0	138.0	145.0	93.8
AT0042R	Heidenreichstein	51.0	73.0	94.0	112.0	122.0	131.0	136.7	93.9
AT0043R	Forsthof	69.0	83.0	100.0	117.0	128.0	137.0	144.0	93.2
AT0045R	Dunkelsteinerwald	48.0	69.0	90.0	110.0	123.0	132.3	141.2	95.2
AT0046R	Gänserndorf	53.0	71.0	91.0	112.0	121.0	131.0	136.0	95.5
AT0047R	Stixneusiedl	58.0	74.0	94.0	112.0	122.2	131.0	136.0	95.5
AT0048R	Zoebelboden	70.0	84.0	99.0	114.0	123.0	133.0	143.0	91.4
AT0049R	Grebenzen bei St. Lamprecht	85.0	97.0	109.0	124.0	131.0	137.0	141.0	91.8
BE0001R	Offagne	43.0	61.0	82.0	101.0	113.0	126.0	135.9	95.9
BE0032R	Eupen	44.0	60.0	82.0	103.0	119.0	134.0	145.0	94.7
BE0035R	Vezin	30.0	50.0	71.0	93.0	108.0	126.6	136.0	96.1
BG0053R	Rojen peak	84.7	93.9	103.3	111.7	116.3	120.6	124.1	95.3
CH0001G	Jungfraujoch	71.5	80.2	89.2	96.7	101.4	107.1	110.1	97.1
CH0002R	Payerne	44.0	68.2	90.9	112.1	124.8	138.9	142.5	95.3
CH0003R	Tänikon	44.6	65.2	88.4	110.3	123.0	139.3	150.2	95.3
CH0004R	Chaumont	77.0	93.8	109.9	126.5	139.4	147.5	153.0	95.3
CH0005R	Rigi	75.0	89.9	107.0	124.6	138.2	149.1	154.6	95.3
CY0002R	Ayia Marina	98.2	108.1	117.8	125.5	130.1	135.4	139.8	97.3
CZ0001R	Svratouch	69.2	86.7	104.7	118.6	126.9	133.5	137.1	99.8
CZ0003R	Košetice	53.1	71.6	90.0	106.1	116.7	128.3	132.3	95.3
DE0001R	Westerland	64.8	75.8	86.1	96.1	103.7	113.4	119.8	95.1
DE0002R	Waldhof	45.3	62.4	85.8	106.4	118.9	136.8	142.4	95.7
DE0003R	Schauinsland	80.2	96.2	111.8	129.1	141.5	150.6	156.6	94.6
DE0007R	Neuglobsow	38.8	59.1	80.8	99.3	110.9	127.8	135.6	95.8
DE0008R	Schmücke	64.3	82.5	101.9	116.7	126.1	135.4	140.5	94.0
DE0009R	Zingst	50.6	66.1	82.6	96.3	106.9	117.8	124.8	95.9
DK0005R	Keldsnor	33.8	45.3	61.2	80.3	91.2	102.8	110.7	85.4
DK0010G	Nord, Greenland	38.5	49.0	56.3	66.9	73.6	80.8	85.2	82.0
DK0012R	Risoe	53.9	69.9	85.2	98.9	112.3	127.8	134.5	87.9
DK0031R	Ulborg	46.6	57.0	67.6	78.3	88.1	106.7	113.4	87.6
EE0009R	Lahemaa	39.0	60.0	79.0	94.0	103.0	113.1	122.0	100.0
EE0011R	Vilsandi	62.0	74.0	86.0	97.0	103.0	111.0	114.1	100.0
ES0001R	San Pablo de los Montes	82.8	95.6	106.7	116.2	122.3	128.6	131.2	99.5
ES0005R	Noya	61.7	77.9	94.6	113.3	125.5	135.1	141.4	98.0
ES0006R	Mahón	75.7	87.8	98.7	108.9	116.1	122.3	126.0	97.5
ES0007R	Víznar	84.3	94.9	106.6	117.3	123.6	130.8	136.0	97.7
ES0008R	Niembro	57.5	70.7	85.9	99.5	107.0	114.4	120.9	98.4
ES0009R	Campisábalos	72.7	89.4	104.1	120.6	130.8	140.9	149.8	98.7
ES0010R	Cabo de Creus	74.4	88.7	104.4	117.1	124.8	133.3	138.8	98.6
ES0011R	Barcarrola	42.6	60.5	77.6	90.3	97.3	103.6	107.5	98.0
ES0012R	Zarra	82.4	93.2	105.3	115.3	121.2	128.0	132.4	99.3
ES0013R	Penausende	68.0	85.6	101.3	112.6	119.8	128.0	132.9	99.4
ES0014R	Els Torms	72.1	86.5	100.6	112.4	119.0	126.8	132.1	99.6
ES0016R	O Saviñao	38.2	52.5	69.2	83.7	93.9	103.2	108.4	95.3
ES0017R	Doñana	49.3	73.3	93.0	106.6	113.4	120.9	125.8	99.4
FI0009R	Utö	60.0	72.0	81.0	91.0	98.0	107.0	113.0	94.6
FI0017R	Virolahti II	36.0	55.0	69.0	81.0	88.0	96.0	108.0	97.2
FI0022R	Oulanka	43.0	57.0	75.0	89.0	94.0	100.0	103.0	95.4
FI0037R	Ähtäri II	39.0	56.0	74.0	87.0	95.0	103.0	108.0	96.4
FI0096G	Pallas (Sammaltunturi)	50.0	59.0	70.0	78.0	82.0	86.0	90.0	98.5
FR0008R	Donon	51.0	66.0	84.0	105.0	120.0	138.0	145.0	95.7
FR0009R	Revin	46.0	61.0	83.0	103.0	114.0	129.0	135.0	97.5
FR0010R	Morvan	54.0	71.0	91.0	111.0	125.0	134.0	140.0	95.8
FR0013R	Peyrusse Vieille	58.0	75.0	93.0	107.0	114.0	120.0	124.0	95.3
FR0014R	Montandon	42.0	60.0	77.0	94.0	103.0	116.0	124.0	98.7
FR0015R	La Tardière	50.0	68.0	86.0	103.0	113.0	123.0	132.0	99.4
FR0016R	Le Casset	79.0	92.0	106.0	117.0	125.0	134.0	137.1	97.5
FR0017R	Montfranc	69.0	84.0	99.0	114.0	119.0	124.0	127.0	89.9
FR0018R	La Coulonche	60.0	76.0	93.0	110.0	120.0	129.8	136.0	98.1

Table 1.2, cont.

Code	Station	25%	50%	75%	90%	95%	98%	99%	Data capture
FR0019R	Pic du Midi	95.0	108.0	117.0	126.0	131.1	137.8	144.0	90.1
FR0030R	Puy de Dôme	77.0	93.0	109.0	122.0	128.0	134.0	138.0	85.2
GB0002R	Eskdalemuir	42.0	56.0	68.0	84.0	92.0	102.0	112.0	87.0
GB0006R	Lough Navar	36.0	52.0	68.0	82.0	90.0	104.0	114.0	98.7
GB0013R	Yarner Wood	54.0	66.0	80.0	92.0	102.0	112.0	124.0	72.5
GB0014R	High Muffles	50.0	64.0	80.0	94.0	104.0	124.5	146.3	83.9
GB0015R	Strath Vaich Dam	52.0	64.0	78.0	92.0	98.0	104.0	108.0	99.7
GB0031R	Aston Hill	52.0	62.0	72.0	84.0	94.0	106.0	118.0	98.2
GB0033R	Bush	46.0	58.0	72.0	86.0	92.0	100.0	104.0	99.2
GB0035R	Great Dun Fell	44.0	52.0	64.0	72.0	74.8	81.5	86.0	93.6
GB0036R	Harwell	48.0	60.0	74.0	88.0	98.0	110.0	122.0	98.5
GB0037R	Ladybower Res.	48.0	60.0	74.0	86.0	96.0	107.6	114.0	98.1
GB0038R	Lullington Heath	42.0	52.0	64.0	80.0	94.0	112.0	120.0	99.2
GB0039R	Sibton	44.0	58.0	74.0	92.0	100.0	112.0	124.0	99.8
GB0043R	Narberth	46.0	56.0	68.0	82.0	92.0	106.0	112.0	98.8
GB0045R	Wicken Fen	32.0	48.0	66.0	88.0	100.0	110.0	120.0	81.5
GB0048R	Auchencorth Moss	44.0	56.0	68.0	80.0	88.0	94.0	100.0	99.3
GB0049R	Weybourne	56.0	68.0	84.0	100.0	110.0	118.0	130.0	100.0
GB0050R	St. Osyth	42.0	56.0	70.0	84.0	92.0	102.0	110.0	98.6
GB0051R	Market Harborough	32.0	42.0	56.0	70.8	80.0	94.0	102.0	82.8
GB0052R	Lerwick	56.0	66.0	82.0	92.0	98.0	106.0	120.0	99.3
GB0053R	Charlton Mackrell	48.0	62.0	76.0	92.0	100.0	114.0	122.0	89.2
GR0001R	Aliartos	47.0	77.0	99.5	109.0	113.0	118.0	120.0	63.3
GR0002R	Finokalia	109.2	122.2	132.8	142.4	148.6	154.8	159.8	93.8
HU0002R	K-puszta	42.0	67.0	93.0	112.0	119.0	128.0	132.2	79.3
IE0001R	Valentia Observatory	54.4	64.4	73.8	85.0	91.0	98.8	107.3	94.0
IE0031R	Mace Head	60.0	68.0	82.0	94.0	100.0	108.0	110.0	99.0
IT0001R	Montelibretti	31.3	64.3	101.6	123.8	135.1	148.0	158.1	98.1
IT0004R	Ispra	23.5	46.2	73.8	100.4	116.0	131.5	139.8	93.3
LT0015R	Preila	54.7	67.4	81.4	92.7	98.6	107.2	114.0	96.1
LV0010R	Rucava	55.0	74.0	93.0	107.0	116.0	125.1	130.0	88.7
LV0016R	Zoseni	46.0	62.0	83.0	105.0	118.0	132.0	138.0	90.9
MK0007R	Lazaropole	109.0	137.0	154.0	167.0	175.0	184.9	191.9	52.5
NL0007R	Eibergen	31.5	50.2	72.5	96.3	112.0	138.1	151.2	98.4
NL0009R	Kollumerwaard	43.3	59.0	74.9	89.2	96.2	111.3	124.1	96.7
NL0010R	Vredepeel	30.1	48.8	69.6	91.4	106.5	130.0	141.4	96.6
NL0011R	Cabauw Zijdeweg	29.9	46.8	64.5	83.7	98.3	122.6	133.4	99.6
NL0091R	De Zilk	42.7	59.9	76.5	92.7	105.0	125.1	143.4	98.9
NO0001R	Birkenes	38.4	55.8	72.3	87.6	94.8	105.8	119.2	96.2
NO0002R	Birkenes II	53.4	67.0	83.0	96.2	102.0	120.0	131.0	89.5
NO0015R	Tustervatn	43.5	57.2	75.2	88.7	94.1	99.7	103.3	99.6
NO0039R	Kårvatn	28.4	47.8	69.1	89.0	98.5	106.7	114.0	99.5
NO0042G	Zeppelin mountain (Ny-Ålesund)	49.2	59.0	68.3	87.6	95.6	99.3	106.1	92.7
NO0043R	Prestebakke	47.5	60.5	74.9	86.1	94.0	107.1	121.4	99.9
NO0052R	Sandve	54.5	65.1	78.3	88.8	94.5	110.5	116.6	99.7
NO0056R	Hurdal	41.8	56.8	74.2	89.6	97.5	106.9	124.4	99.7
PL0002R	Jarczew	41.0	61.0	82.0	101.0	112.4	122.0	128.1	97.7
PL0003R	Sniezka	83.0	100.0	118.0	133.0	140.0	149.0	154.1	100.0
PL0004R	Leba	53.0	68.0	83.0	94.0	102.0	113.0	120.0	100.0
PL0005R	Diabla Gora	47.0	64.0	81.0	99.0	110.0	124.0	132.0	96.2
RO0008R	Poiana Stampei	28.2	53.2	74.9	90.6	98.2	104.9	109.5	86.0
SE0005R	Bredkälen	45.0	58.0	74.0	88.0	94.4	102.0	107.3	99.5
SE0011R	Vavihill	49.0	64.0	78.0	93.0	103.0	112.9	118.9	98.0
SE0012R	Aspvreten	47.0	65.0	80.0	91.0	99.0	109.0	115.5	92.2
SE0013R	Esrange	46.0	60.0	81.0	96.0	101.0	107.0	114.3	99.5
SE0014R	Råö	59.0	69.0	82.0	95.0	102.0	113.0	125.9	98.0
SE0032R	Norra-Kvill	57.0	71.0	90.0	104.0	115.0	125.0	135.0	99.3
SE0035R	Vindeln	41.0	58.0	77.0	92.0	98.0	106.0	112.0	97.8
SE0039R	Grimsö	46.0	63.0	82.0	95.0	103.0	116.0	126.0	98.9
SI0008R	Iskrba	13.0	63.0	95.0	116.0	126.0	134.0	141.0	91.1
SI0031R	Zarodnje	76.0	92.0	109.0	124.0	132.0	141.0	147.6	94.2
SI0032R	Krvavec	90.0	102.0	116.0	128.0	134.0	141.4	145.0	94.0
SI0033R	Kovk	77.0	93.0	110.0	125.0	131.0	140.0	146.0	95.4
SK0002R	Chopok	94.0	105.2	117.6	126.2	131.7	137.4	140.2	95.9
SK0004R	Stará Lesná	48.2	72.9	96.2	109.6	117.0	123.8	128.1	99.7
SK0006R	Starina	43.7	63.7	84.1	99.9	108.9	117.6	124.0	99.8

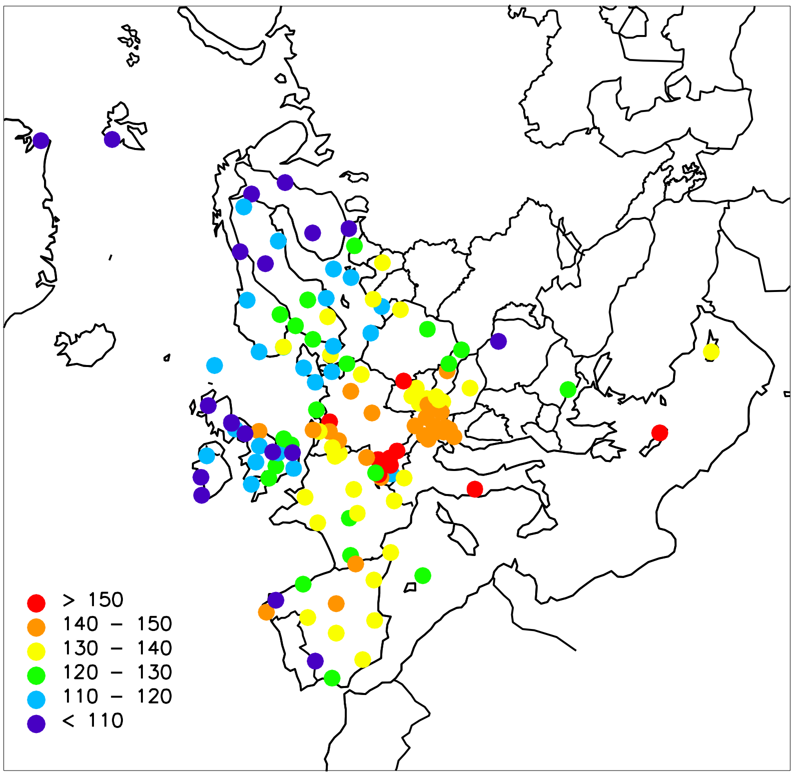


Figure 1.1: Ozone April–September 2011. 99-percentiles (µg/m³).

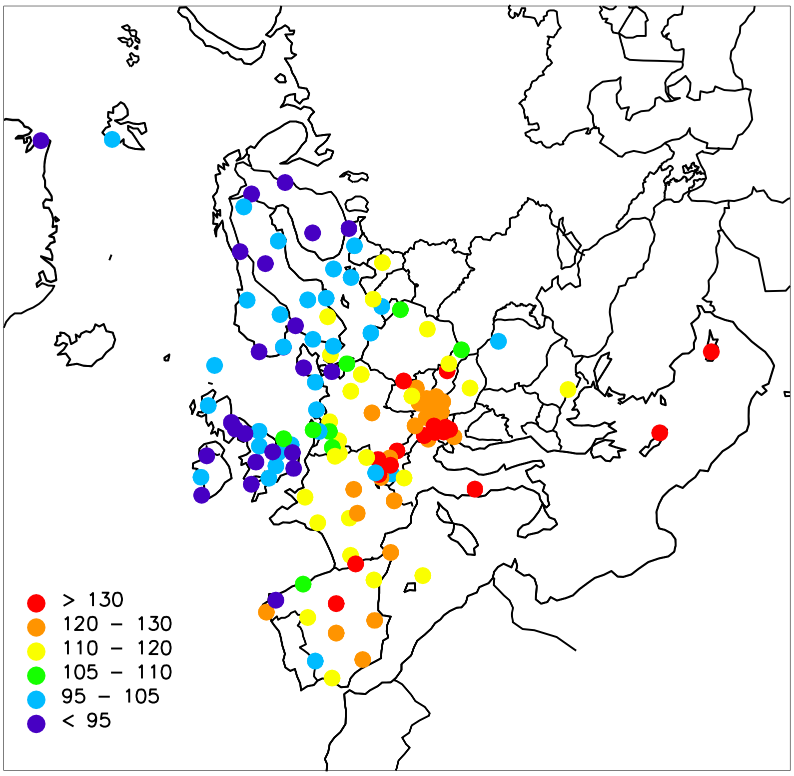


Figure 1.2: Ozone April–September 2011. 95-percentiles (µg/m³).

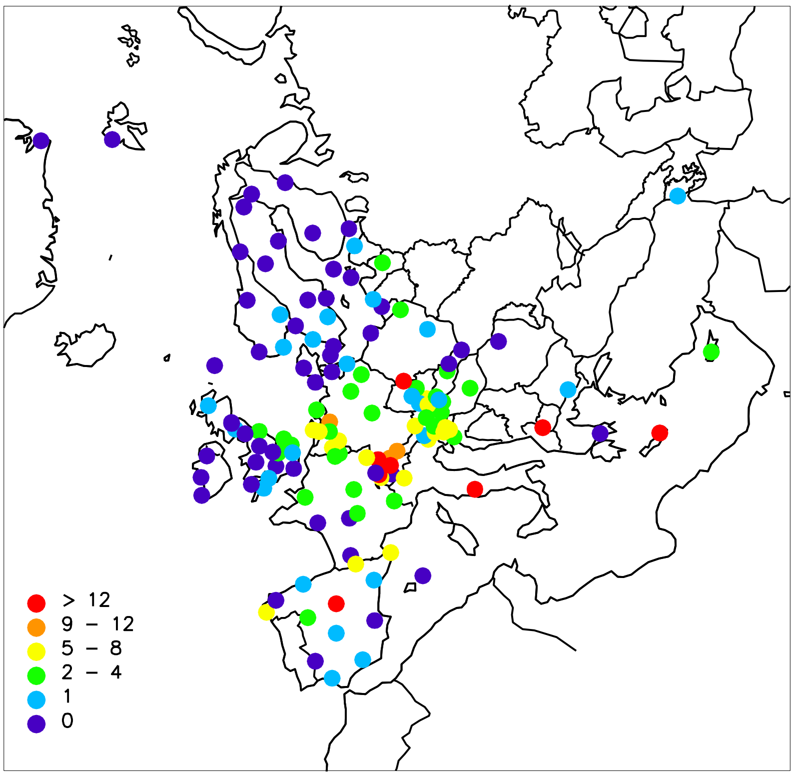


Figure 1.3: Number of exceedances of the threshold value of 150 μg/m³. (Unit: number of days).

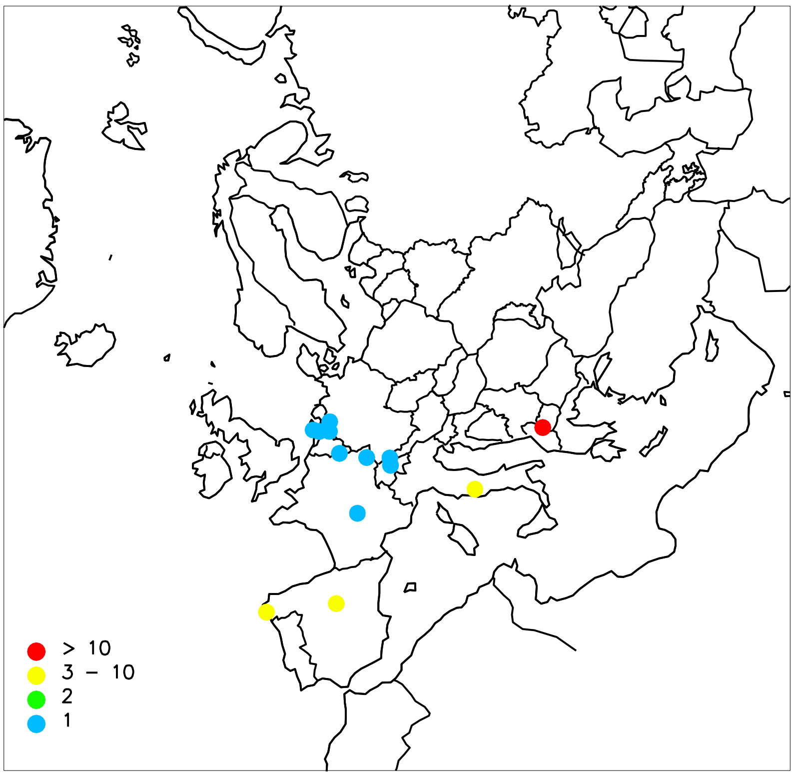


Figure 1.4: Number of exceedances of the threshold value of 180 μg/m³. (Unit: number of days). Stations with zero exceedances are not shown.

Annex 2

AOT40 and AOT60, figures and tables

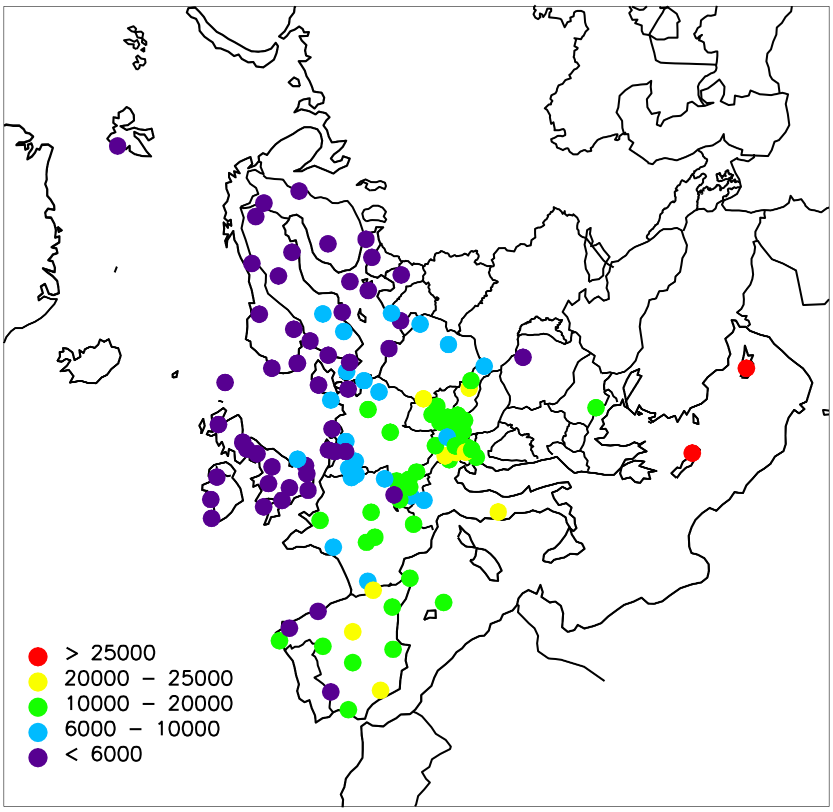


Figure 2.1: AOT40 (ppbh) April–September 2011 (daylight hours).

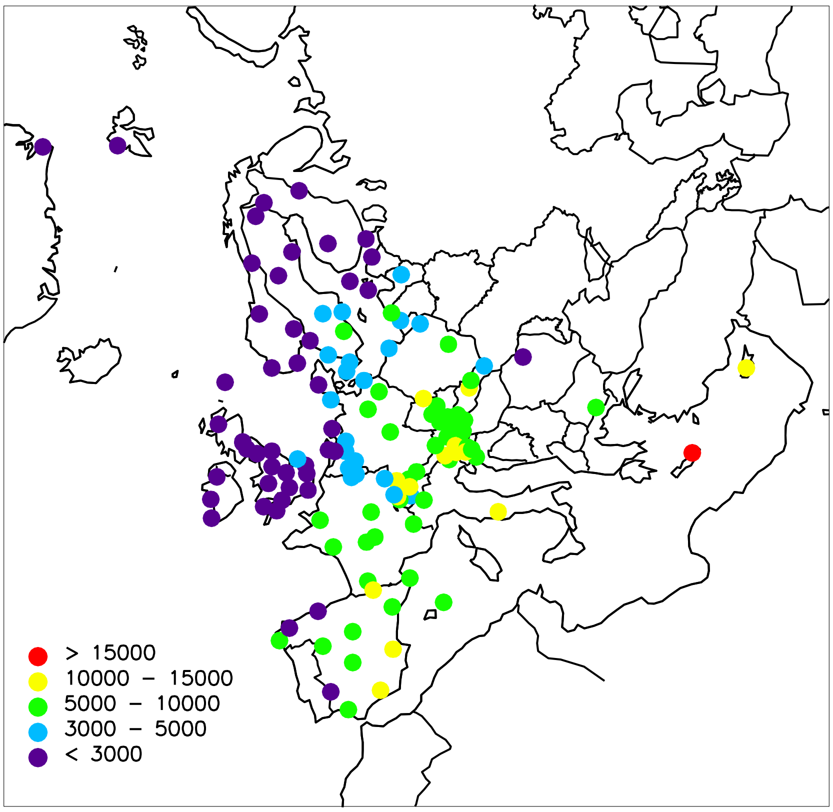


Figure 2.2: AOT40 (ppbh) May, June and July 2011 (daylight hours).

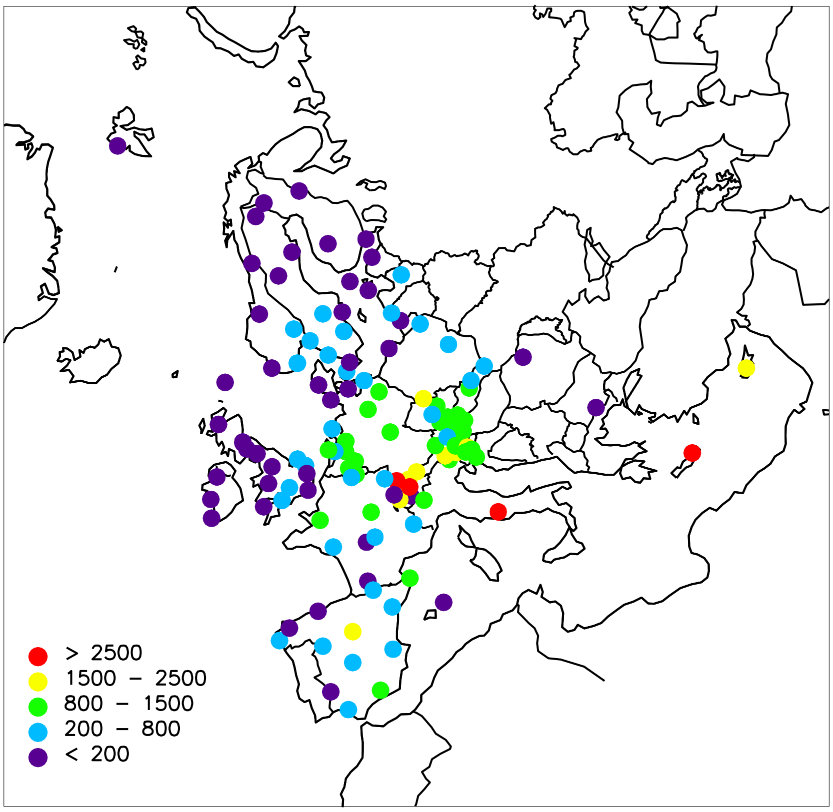


Figure 2.3: AOT60 (ppbh) April-September 2011 (daylight hours).

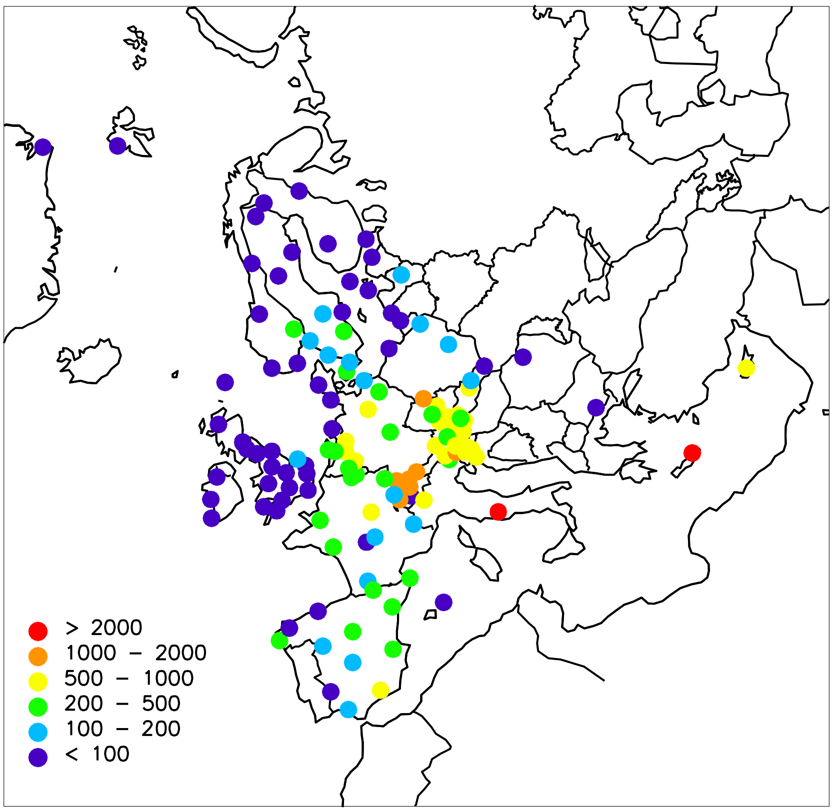


Figure 2.4: AOT60 (ppbh) May, June and July 2011 (daylight hours).

Table 2.1: AOT40 and AOT60 April–September 2011(daylight hours).

Code	Station	AOT40	AOT40 corrected	AOT60	AOT60 corrected	Data capture
AT0002R	Illmitz	14289	15277	1293	1382	94
AT0005R	Vorhegg	12208	13193	842	909	93
AT0030R	Pillersdorf bei Retz	12012	13337	1133	1258	90
AT0032R	Sulzberg	16342	16562	1884	1909	99
AT0034G	Sonnblick	23554	25169	1534	1640	94
AT0038R	Gerlitzen	21842	23868	1786	1952	92
AT0040R	Masenberg	16535	17825	1238	1334	93
AT0041R	Haunsberg	11956	12880	1200	1293	93
AT0042R	Heidenreichstein	12547	13321	908	963	94
AT0043R	Forsthof	12523	13541	1072	1160	92
AT0045R	Dunkelsteinerwald	12072	12732	1178	1243	95
AT0046R	Gänserndorf	13031	13661	1104	1157	95
AT0047R	Stixneusiedl	12710	13345	1026	1077	95
AT0048R	Zoebelboden	9522	10754	588	665	89
AT0049R	Grebenzen bei St. Lamprecht	16323	17939	953	1047	91
BE0001R	Offagne	8684	9092	843	883	96
BE0032R	Eupen	8639	9092	1134	1194	95
BE0035R	Vezin	6770	7087	838	877	96
BG0053R	Rojen peak	13391	13551	20	20	99
CH0001G	Jungfraujoch	6358	6558	18	19	97
CH0002R	Payerne	14517	15308	1912	2016	95
CH0003R	Tänikon	13865	14589	2071	2179	95
CH0004R	Chaumont	18567	19487	2226	2337	95
CH0005R	Rigi	17423	18342	2657	2797	95
CY0002R	Ayia Marina	29617	30618	1699	1757	97
CZ0001R	Svratouch	16221	16292	1177	1183	100
CZ0003R	Košetice	10973	11554	614	646	95
DE0001R	Westerland	6181	6550	140	148	94
DE0002R	Waldhof	11144	11684	1261	1322	95
DE0003R	Schauinsland	19176	20272	2516	2660	95
DE0007R	Neuglobsow	8660	9044	816	852	96
DE0008R	Schmücke	13472	14355	996	1061	94
DE0009R	Zingst	6058	6313	203	212	96
DK0005R	Keldsnor	1375	1522	45	50	90
DK0012R	Risoe	7143	7668	540	580	93
DK0031R	Ulborg	1521	1636	15	16	93
EE0009R	Lahemaa	2381	2381	17	17	100
EE0011R	Vilsandi	2396	2396	0	0	100
ES0001R	San Pablo de los Montes	17658	17844	360	364	99
ES0005R	Noya	10237	10485	706	723	98
ES0006R	Mahón	13120	13590	184	191	97
ES0007R	Víznar	20601	20892	1131	1147	99
ES0008R	Niembro	5431	5594	104	107	97
ES0009R	Campisábalos	22030	22510	2373	2425	98
ES0010R	Cabo de Creus	15458	15826	815	834	98
ES0011R	Barcarrola	4633	4693	8	8	99
ES0012R	Zarra	19750	19860	659	663	99
ES0013R	Penausende	15023	15218	657	665	99
ES0014R	Els Torms	16443	16526	586	589	99
ES0016R	O Saviñao	2561	2629	4	4	97
ES0017R	Doñana	12370	12538	332	336	99
FI0009R	Utö	3348	3541	37	39	95
FI0017R	Virolahti II	1475	1520	16	17	97
FI0022R	Oulanka	2180	2287	0	0	95
FI0037R	Ähtäri II	2186	2294	2	2	95
FI0096G	Pallas (Sammaltunturi)	518	525	0	0	99
FR0008R	Donon	6944	7311	695	732	95
FR0009R	Revin	7972	8185	724	744	97
FR0010R	Morvan	11809	12175	1098	1132	97
FR0013R	Peyrusse Vieille	9600	10093	179	188	95
FR0014R	Montandon	5910	6034	192	196	98
FR0015R	La Tardière	9942	10025	504	508	99
FR0016R	Le Casset	17026	17651	726	753	96
FR0017R	Montfranc	10736	11974	174	194	90
FR0018R	La Coulonche	10941	11229	834	856	97

Table 2.1, cont.

Code	Station	AOT40	AOT40 corrected	AOT60	AOT60 corrected	Data capture
FR0019R	Pic du Midi	20555	23103	714	802	89
FR0030R	Puy de Dôme	13314	15490	584	680	86
GB0002R	Eskdalemuir	2437	2832	133	155	86
GB0006R	Lough Navar	2584	2623	64	65	99
GB0015R	Strath Vaich Dam	3606	3620	125	125	100
GB0031R	Aston Hill	2179	2216	57	58	98
GB0033R	Bush	2428	2454	11	11	99
GB0035R	Great Dun Fell	132	138	0	0	96
GB0036R	Harwell	4168	4238	202	205	98
GB0037R	Ladybower Res.	3312	3375	134	137	98
GB0038R	Lullington Heath	2200	2223	95	96	99
GB0039R	Sibton	5191	5209	356	357	100
GB0043R	Narberth	2048	2074	79	80	99
GB0048R	Auchencorth Moss	1561	1575	1	1	99
GB0049R	Weybourne	6864	6871	381	381	100
GB0050R	St. Osyth	2795	2835	101	102	99
GB0052R	Lerwick	3805	3833	47	47	99
GB0053R	Charlton Mackrell	4543	5065	224	250	90
GR0002R	Finokalia	39630	42290	7593	8103	94
IE0001R	Valentia Observatory	1636	1752	28	30	93
IE0031R	Mace Head	3580	3619	18	18	99
IT0001R	Montelibretti	22436	22960	3953	4045	98
IT0004R	Ispra	9465	10240	1112	1204	92
LT0015R	Preila	3579	3698	43	44	97
LV0010R	Rucava	7816	8727	312	348	90
LV0016R	Zoseni	5295	5763	403	439	92
NL0007R	Eibergen	7263	7313	1409	1419	99
NL0009R	Kollumerwaard	4224	4374	383	397	97
NL0010R	Vredepeel	5832	5931	987	1004	98
NL0011R	Cabauw Zijdeweg	4419	4456	724	730	99
NL0091R	De Zilk	5802	5862	930	939	99
NO0001R	Birkenes	3947	4106	220	228	96
NO0002R	Birkenes II	5730	6541	335	383	88
NO0015R	Tustervatn	2189	2202	2	2	99
NO0039R	Kårvatn	4138	4148	48	48	100
NO0042G	Zeppelin mountain (Ny-Ålesund)	1432	1592	14	16	90
NO0043R	Prestebakke	3414	3421	259	260	100
NO0052R	Sandve	3217	3229	85	85	100
NO0056R	Hurdal	3744	3764	266	268	99
PL0002R	Jarczew	9956	10146	466	475	98
PL0003R	Sniezka	21989	22000	2401	2402	100
PL0004R	Leba	5676	5679	195	195	100
PL0005R	Diabla Gora	6758	7010	462	479	96
RO0008R	Poiana Stampei	2582	3036	13	15	85
SE0005R	Bredkälen	2668	2675	0	0	100
SE0011R	Vavihill	5330	5441	167	170	98
SE0012R	Aspvreten	4032	4365	80	86	92
SE0013R	Esrange	3959	3976	44	44	100
SE0014R	Råö	5457	5578	268	273	98
SE0032R	Norra-Kvill	8916	9028	537	544	99
SE0035R	Vindeln	4097	4207	28	28	97
SE0039R	Grimsö	6191	6245	274	276	99
SI0008R	Iskrba	14432	15885	1222	1344	91
SI0031R	Zarodnje	16373	16790	1664	1706	98
SI0032R	Krvavec	20163	21539	1372	1466	94
SI0033R	Kovk	16728	17604	1334	1404	95
SK0002R	Chopok	23389	24488	1181	1236	96
SK0004R	Stará Lesná	12735	12735	379	379	100
SK0006R	Starina	8805	8813	221	221	100

Table 2.2: AOT40 and AOT60 May–July 2011 (daylight hours).

Code	Station	AOT40	AOT40 corrected	AOT60	AOT60 corrected	Data capture
AT0002R	Illmitz	8650	9079	742	779	95
AT0005R	Vorhegg	6976	7386	386	408	94
AT0030R	Pillersdorf bei Retz	7189	7744	618	666	93
AT0032R	Sulzberg	9828	9945	1324	1339	99
AT0034G	Sonnblick	13748	14623	856	911	94
AT0038R	Gerlitzen	13194	14671	1132	1259	90
AT0040R	Masenberg	9733	10093	714	741	96
AT0041R	Haunsberg	7382	8046	730	795	92
AT0042R	Heidenreichstein	7372	7800	531	562	95
AT0043R	Forsthof	7236	7963	560	616	91
AT0045R	Dunkelsteinerwald	6985	7370	618	653	95
AT0046R	Gänserndorf	7222	7564	568	594	95
AT0047R	Stixneusiedl	7294	7648	488	512	95
AT0048R	Zoebelboden	5488	6262	354	405	88
AT0049R	Grebenzen bei St. Lamprecht	10630	11171	622	653	95
BE0001R	Offagne	4566	4738	344	356	96
BE0032R	Eupen	4907	5125	670	700	96
BE0035R	Vezin	3636	3759	330	341	97
BG0053R	Rojen peak	8209	8292	7	7	99
CH0001G	Jungfraujoch	3900	4047	9	9	96
CH0002R	Payerne	8096	8496	1101	1156	95
CH0003R	Tänikon	8446	8848	1374	1439	95
CH0004R	Chaumont	10301	10852	1283	1351	95
CH0005R	Rigi	10084	10574	1690	1772	95
CY0002R	Ayia Marina	14259	15123	712	755	94
CZ0001R	Svratouch	9417	9442	585	587	100
CZ0003R	Košetice	6759	7155	304	322	94
DE0001R	Westerland	4135	4302	99	103	96
DE0002R	Waldhof	7088	7424	745	780	95
DE0003R	Schauinsland	11434	11886	1680	1746	96
DE0007R	Neuglobsow	5498	5753	463	484	96
DE0008R	Schmücke	7891	8364	396	419	94
DE0009R	Zingst	4236	4445	191	201	95
DK0010G	Nord, Greenland	119	127	0	0	93
DK0012R	Risoe	4763	5220	362	397	91
DK0031R	Ulborg	431	463	0	0	93
EE0009R	Lahemaa	1670	1670	13	13	100
EE0011R	Vilsandi	1535	1535	0	0	100
ES0001R	San Pablo de los Montes	9215	9309	136	138	99
ES0005R	Noya	5955	6104	406	416	98
ES0006R	Mahón	7301	7685	48	51	95
ES0007R	Víznar	11442	11649	684	696	98
ES0008R	Niembro	1859	1925	0	0	97
ES0009R	Campisábalos	8320	8525	225	231	98
ES0010R	Cabo de Creus	7906	8078	251	257	98
ES0011R	Barcarrola	2550	2605	8	8	98
ES0012R	Zarra	10085	10182	339	342	99
ES0013R	Penausende	7608	7713	192	195	99
ES0014R	Els Torms	8314	8355	277	278	100
ES0016R	O Saviñao	1179	1216	3	3	97
ES0017R	Doñana	7422	7491	181	183	99
FI0009R	Utö	2565	2714	37	39	95
FI0017R	Virolahti II	904	945	16	17	96
FI0022R	Oulanka	1052	1094	0	0	96
FI0037R	Ähtäri II	1532	1656	2	2	92
FI0096G	Pallas (Sammaltunturi)	394	403	0	0	98
FR0008R	Donon	3798	4152	368	403	91
FR0009R	Revin	4358	4438	299	305	98
FR0010R	Morvan	7314	7505	578	593	97
FR0013R	Peyrusse Vieille	5584	5951	148	157	94
FR0014R	Montandon	3109	3202	140	144	97
FR0015R	La Tardière	5836	5883	334	336	99
FR0016R	Le Casset	8932	9491	194	206	94
FR0017R	Montfranc	5592	5690	51	52	98
FR0018R	La Coulonche	5360	5481	288	295	98

Table 2.2, cont.

Code	Station	AOT40	AOT40 corrected	AOT60	AOT60 corrected	Data capture
FR0019R	Pic du Midi	11837	12050	342	349	98
FR0030R	Puy de Dôme	6550	6946	160	169	94
GB0002R	Eskdalemuir	805	928	1	1	87
GB0006R	Lough Navar	862	868	17	17	99
GB0013R	Yarner Wood	1429	1448	2	2	99
GB0014R	High Muffles	1902	1905	33	33	100
GB0015R	Strath Vaich Dam	1089	1091	0	0	100
GB0031R	Aston Hill	776	776	8	8	100
GB0033R	Bush	1281	1287	0	0	100
GB0035R	Great Dun Fell	60	63	0	0	95
GB0036R	Harwell	2034	2036	30	30	100
GB0037R	Ladybower Res.	1381	1401	14	14	99
GB0038R	Lullington Heath	682	685	2	2	100
GB0039R	Sibton	2636	2641	93	93	100
GB0043R	Narberth	590	591	0	0	100
GB0048R	Auchencorth Moss	842	843	0	0	100
GB0049R	Weybourne	4248	4248	196	196	100
GB0050R	St. Osyth	1545	1563	3	3	99
GB0051R	Market Harborough	349	350	0	0	100
GB0052R	Lerwick	1917	1917	39	39	100
GB0053R	Charlton Mackrell	2233	2233	9	9	100
GR0002R	Finokalia	23202	23487	4621	4677	99
IE0001R	Valentia Observatory	467	515	0	0	91
IE0031R	Mace Head	1495	1525	0	0	98
IT0001R	Montelibretti	12279	12655	2079	2143	97
IT0004R	Ispra	5651	6059	707	758	93
LT0015R	Preila	3083	3138	43	44	98
LV0010R	Rucava	5384	5441	76	77	99
LV0016R	Zoseni	3216	3216	130	130	100
NL0007R	Eibergen	4050	4094	640	647	99
NL0009R	Kollumerwaard	1984	2110	93	98	94
NL0010R	Vredepeel	3241	3256	531	533	100
NL0011R	Cabauw Zijdeweg	2256	2268	334	336	99
NL0091R	De Zilk	2914	2924	315	317	100
NO0001R	Birkenes	1558	1574	31	31	99
NO0015R	Tustervatn	943	949	2	2	99
NO0039R	Kårvatn	1997	1999	34	34	100
NO0042G	Zeppelin mountain (Ny-Ålesund)	449	517	0	0	87
NO0043R	Prestebakke	1807	1810	145	145	100
NO0052R	Sandve	1837	1846	46	46	99
NO0056R	Hurdal	1999	2008	203	204	100
PL0002R	Jarczew	5424	5596	148	153	97
PL0003R	Sniezka	13820	13820	1438	1438	100
PL0004R	Leba	3508	3508	86	86	100
PL0005R	Diabla Gora	4006	4006	105	105	100
RO0008R	Poiana Stampei	1356	1482	0	0	92
SE0005R	Bredkälen	1302	1308	0	0	99
SE0011R	Vavihill	3596	3691	154	158	97
SE0012R	Aspvreten	3033	3316	80	87	91
SE0013R	Esrange	1633	1645	34	35	99
SE0014R	Råö	3817	3891	190	194	98
SE0032R	Norra-Kvill	6144	6213	385	389	99
SE0035R	Vindeln	2162	2251	28	29	96
SE0039R	Grimsö	4070	4081	163	163	100
SI0008R	Iskrba	7910	8864	563	631	89
SI0031R	Zarodnje	9258	9522	778	800	97
SI0032R	Krvavec	11006	11779	612	656	93
SI0033R	Kovk	9010	9488	520	547	95
SK0002R	Chopok	13945	14636	751	788	95
SK0004R	Stará Lesná	7275	7275	153	153	100
SK0006R	Starina	4711	4719	7	7	100

Annex 3

Seasonal variation

Table 3.1: Monthly mean concentrations 2011 (μg/m³).

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
AM0001R	Amberd	83.7	97.8	-	-	-	101.4	106.8	98.3	98.6	80.3	85.2	91.5
AT0002R	Illmitz	38.7	49.1	65.2	80.1	87.5	80.9	78.3	68.8	65.0	45.2	30.6	32.9
AT0005R	Vorhegg	63.9	68.8	88.2	96.2	94.1	69.4	85.5	76.4	67.4	53.0	47.2	56.5
AT0030R	Pillersdorf bei Retz	43.6	52.9	67.9	84.1	90.5	81.1	75.9	74.1	69.7	48.8	34.6	38.6
AT0032R	Sulzberg	59.8	63.6	78.0	101.0	105.2	87.5	90.7	91.8	77.0	64.0	58.5	63.4
AT0034G	Sonnblick	88.6	98.5	109.7	113.2	116.7	101.3	108.1	100.8	95.4	91.4	94.8	82.2
AT0038R	Gerlitzen	82.4	90.8	101.6	108.5	117.9	102.7	108.8	99.7	93.7	76.5	85.1	70.7
AT0040R	Masenberg	68.0	71.6	87.3	102.7	108.0	90.9	90.2	87.1	84.6	62.4	71.5	59.8
AT0041R	Haunsberg	55.5	54.4	76.3	92.1	96.4	80.5	84.1	81.4	64.4	49.3	30.2	54.8
AT0042R	Heidenreichstein	47.6	55.9	67.5	81.3	86.0	75.2	68.4	68.5	56.2	45.0	38.1	47.3
AT0043R	Forsthof	49.7	57.8	76.4	89.5	96.2	87.6	82.4	81.0	75.6	54.4	34.5	50.3
AT0045R	Dunkelsteinerwald	38.9	49.5	60.4	75.4	81.5	72.5	70.6	66.4	55.1	40.1	24.9	38.2
AT0046R	Gänserndorf	36.7	45.4	58.5	75.1	80.6	75.1	72.6	69.7	60.4	40.3	30.6	30.1
AT0047R	Stixneusiedl	38.9	47.3	64.7	78.0	84.6	77.4	77.2	72.9	66.7	46.0	32.4	35.6
AT0048R	Zoebelboden	63.6	64.2	83.6	97.0	99.8	82.9	82.9	80.2	69.4	58.3	54.8	62.6
AT0049R	Grebenzen bei St. Lamprecht	79.0	87.7	99.3	105.5	110.9	94.0	97.9	89.3	87.1	74.5	81.5	70.1
BE0001R	Offagne	43.3	40.7	57.0	77.8	78.1	64.9	57.3	52.7	49.0	40.1	20.2	48.7
BE0032R	Eupen	37.3	43.9	41.4	75.5	76.3	66.4	56.2	56.7	52.7	46.5	26.1	44.5
BE0035R	Vezin	32.5	37.8	40.5	59.3	63.8	57.5	49.2	42.5	38.0	29.3	17.7	41.8
BG0053R	Rojen peak	69.8	75.8	89.1	91.1	97.7	89.8	98.2	90.0	96.4	72.1	82.2	75.8
CH0001G	Jungfraujoch	66.5	71.5	79.7	86.6	84.5	80.3	81.2	76.6	72.2	67.1	67.9	59.5
CH0002R	Payerne	33.9	33.8	52.7	77.8	78.2	67.0	68.8	69.0	51.8	30.0	10.1	45.0
CH0003R	Tänikon	38.2	29.7	51.3	71.6	80.1	69.7	70.3	66.8	48.3	30.5	7.6	50.9
CH0004R	Chaumont	64.2	74.0	81.7	108.6	108.6	89.3	90.0	91.4	82.8	66.6	71.0	67.2
CH0005R	Rigi	61.6	68.5	77.2	101.8	105.1	85.8	90.7	92.1	77.8	65.2	63.9	69.0
CY0002R	Ayia Marina	74.6	89.9	93.7	98.7	101.5	106.0	109.0	114.8	114.0	96.7	84.5	85.1
CZ0001R	Svratouch	41.2	40.1	41.0	94.1	97.8	90.0	80.8	82.5	74.6	57.1	51.1	48.1
CZ0003R	Košetice	51.3	55.6	70.6	78.9	84.3	77.3	68.7	66.9	57.9	49.8	38.4	46.9
DE0001R	Westerland	52.7	59.6	64.5	76.7	81.7	83.3	73.6	70.5	62.6	53.1	34.4	68.1
DE0002R	Waldhof	46.2	50.3	57.2	77.6	80.3	70.7	62.6	56.7	44.8	37.6	19.2	47.5
DE0003R	Schauinsland	75.0	81.5	84.9	106.7	110.1	96.0	92.4	93.7	84.6	75.5	78.5	66.1
DE0007R	Neuglobsow	42.2	59.2	62.8	78.3	75.8	66.9	55.8	46.1	37.8	32.6	19.2	43.3
DE0008R	Schmücke	59.7	55.8	74.3	92.6	99.1	82.9	76.0	80.2	71.5	61.3	59.5	49.2
DE0009R	Zingst	46.7	66.7	66.3	75.0	79.5	75.2	62.9	59.1	49.7	43.8	29.6	47.8

Table 3.1, cont.

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
DK0005R	Keldsnor	43.7	65.1	64.6	73.1	64.8	51.5	39.7	36.5	37.1	45.6	32.1	52.2
DK0010G	Nord, Greenland	62.9	65.9	57.7	46.9	38.1	54.2	42.2	46.4	53.1	63.6	57.9	59.3
DK0012R	Risoe	44.1	66.7	67.2	76.1	79.8	83.6	65.9	62.9	53.8	47.4	35.3	50.4
DK0031R	Ulborg	48.4	54.2	58.0	67.9	64.3	58.0	46.7	52.3	59.1	56.4	38.7	61.0
EE0009R	Lahemaa	50.3	59.3	79.1	74.9	74.7	65.1	60.8	46.3	31.8	45.0	38.3	43.7
EE0011R	Vilsandi	61.3	73.1	82.6	80.2	81.6	69.5	77.0	72.0	59.7	57.3	51.5	55.5
ES0001R	San Pablo de los Montes	67.0	84.3	85.5	92.7	91.2	94.3	96.5	93.5	97.9	88.7	66.1	64.3
ES0005R	Noya	67.0	83.3	84.6	98.0	87.5	82.8	70.7	67.2	71.8	94.2	75.2	74.9
ES0006R	Mahón	64.8	76.6	85.7	96.7	93.9	87.0	83.9	78.6	84.4	83.8	75.1	60.3
ES0007R	Víznar	67.2	81.2	87.5	90.8	89.5	98.9	101.2	94.5	96.9	88.0	68.9	65.4
ES0008R	Niembro	55.7	72.8	81.3	91.4	75.7	69.3	59.5	61.5	75.8	71.0	60.3	60.7
ES0009R	Campisábalos	59.9	74.1	81.6	86.7	83.1	81.6	78.3	96.5	102.8	86.8	73.5	66.2
ES0010R	Cabo de Creus	54.5	69.0	82.7	104.3	99.9	82.9	85.2	80.9	83.8	80.1	71.4	61.0
ES0011R	Barcarrola	45.5	53.5	60.4	63.7	64.2	61.5	64.0	53.2	53.7	57.4	43.3	32.3
ES0012R	Zarra	66.1	80.8	89.6	100.2	97.0	94.1	88.4	92.2	90.3	84.1	68.6	60.8
ES0013R	Penausende	55.6	75.9	78.7	86.7	87.4	84.8	80.5	81.3	85.7	79.6	60.0	57.0
ES0014R	Els Torms	42.2	65.4	78.5	90.4	92.7	82.7	84.1	85.0	82.3	69.9	46.9	46.7
ES0016R	O Saviñao	43.6	56.2	61.3	73.5	61.3	56.9	45.7	45.8	45.4	59.8	41.1	38.3
ES0017R	Doñana	41.3	54.0	64.3	72.1	73.0	77.0	74.5	64.2	63.6	67.7	49.3	39.0
FI0009R	Utö	58.3	65.4	75.8	73.8	74.8	75.8	75.5	72.0	57.1	54.4	52.7	57.9
FI0017R	Virolahti II	42.6	55.4	71.4	65.7	61.6	55.2	52.0	44.4	37.0	42.9	42.7	52.4
FI0022R	Oulanka	56.4	68.2	84.0	82.4	73.0	60.7	52.4	43.8	41.9	45.8	53.1	49.3
FI0037R	Ähtäri II	51.0	58.5	78.8	73.8	74.9	62.0	49.7	39.7	38.2	44.7	44.8	49.2
FI0096G	Pallas (Sammaltunturi)	54.3	52.5	70.7	73.9	59.9	61.1	62.9	50.5	51.5	53.1	60.2	57.6
FR0008R	Donon	52.8	50.7	64.3	84.6	85.2	67.1	61.5	63.7	55.8	48.9	44.4	59.0
FR0009R	Revin	46.0	44.2	58.7	80.8	81.5	67.0	57.4	54.1	53.0	46.3	23.7	49.3
FR0010R	Morvan	56.4	57.3	70.2	87.0	87.3	74.6	68.3	59.9	59.4	50.7	51.8	59.5
FR0013R	Peyrusse Vieille	49.2	67.7	76.9	91.0	86.9	72.4	72.2	65.2	67.9	62.2	46.4	58.4
FR0014R	Montandon	41.0	39.9	51.1	66.1	66.6	59.6	57.6	62.1	51.6	41.2	31.8	51.7
FR0015R	La Tardière	45.6	54.4	63.1	83.4	80.6	69.2	67.0	55.1	56.4	54.5	44.2	52.8
FR0016R	Le Casset	85.6	96.5	103.0	113.1	102.2	88.0	87.0	87.1	79.3	72.4	74.8	70.9
FR0017R	Montfranc	61.8	72.6	81.5	97.1	93.7	78.0	78.8	78.3	76.6	72.9	69.6	68.5
FR0018R	La Coulonche	56.8	65.6	68.4	93.8	86.2	70.3	74.4	71.4	67.6	61.2	48.4	63.3
FR0019R	Pic du Midi	90.7	99.0	106.8	112.9	112.4	103.8	98.8	107.8	97.9	94.4	87.6	85.2
FR0030R	Puy de Dôme	81.4	93.2	94.7	106.5	101.3	86.4	82.9	80.2	116.7	87.3	84.1	78.1

Table 3.1, cont.

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
GB0002R	Eskdalemuir	53.9	54.4	51.1	70.3	70.9	53.9	49.0	40.2	46.9	49.4	42.9	55.5
GB0006R	Lough Navar	45.3	54.5	53.9	70.0	70.5	48.3	40.7	35.1	46.4	48.1	47.5	60.4
GB0013R	Yarner Wood	58.0	68.1	62.7	82.6	72.1	59.8	59.6	44.4	50.6	48.6	46.7	60.8
GB0014R	High Muffles	58.2	54.6	63.1	83.5	74.9	63.0	60.5	58.9	46.0	42.2	36.7	55.1
GB0015R	Strath Vaich Dam	48.7	48.8	71.4	87.9	77.0	68.0	50.0	52.8	56.8	63.8	61.3	71.6
GB0031R	Aston Hill	59.4	59.3	61.1	79.4	72.0	58.5	59.5	52.1	58.2	60.7	48.0	67.7
GB0033R	Bush	61.2	58.4	62.4	73.3	72.9	61.0	52.4	44.1	53.4	55.1	49.3	61.6
GB0035R	Great Dun Fell	66.5	53.2	62.6	65.7	61.0	55.9	53.5	42.5	46.2	49.2	43.3	51.1
GB0036R	Harwell	46.3	52.7	49.8	72.0	72.9	58.9	59.6	50.8	52.0	51.8	33.5	59.2
GB0037R	Ladybower Res.	57.4	55.6	59.1	78.8	73.4	59.7	59.7	48.0	47.0	46.8	35.1	53.2
GB0038R	Lullington Heath	38.2	40.0	47.0	69.9	60.4	51.6	51.9	47.0	49.7	47.5	33.9	48.2
GB0039R	Sibton	50.3	45.6	57.4	70.8	72.5	59.3	58.7	52.7	49.4	50.1	34.1	51.9
GB0043R	Narberth	60.3	65.5	58.1	77.4	67.2	55.6	52.1	43.9	53.8	60.5	60.1	70.4
GB0045R	Wicken Fen	37.7	40.1	48.5	65.0	61.3	45.1	54.9	41.1	39.2	39.5	22.4	33.3
GB0048R	Auchencorth Moss	57.5	56.9	59.0	69.2	68.8	57.8	53.2	42.2	51.8	53.0	49.0	57.1
GB0049R	Weybourne	62.3	55.2	74.8	78.4	82.7	69.5	70.7	63.2	57.7	58.1	56.4	56.3
GB0050R	St. Osyth	46.1	44.3	49.1	62.1	67.6	57.4	56.9	49.0	45.4	45.1	31.2	48.6
GB0051R	Market Harborough	34.5	32.8	44.2	55.2	47.3	40.6	45.6	35.5	32.7	32.8	18.2	28.4
GB0052R	Lerwick	76.3	74.5	80.6	87.5	82.5	68.6	57.7	57.8	56.9	61.9	59.2	67.8
GB0053R	Charlton Mackrell	47.0	59.3	56.2	78.0	73.2	58.0	59.5	48.4	56.2	56.3	44.4	62.4
GR0001R	Aliartos	34.8	52.1	-	64.8	63.5	72.7	79.3	74.8	70.7	50.9	27.9	33.1
GR0002R	Finokalia	86.1	96.6	98.4	104.2	114.4	124.5	124.6	130.7	128.3	99.3	84.5	78.2
HU0002R	K-puszta	37.6	51.0	64.7	74.1	73.2	70.2	68.8	62.3	58.4	43.4	34.6	28.6
IE0001R	Valentia Observatory	56.5	69.7	66.9	74.5	78.5	61.3	54.0	55.4	65.2	70.1	74.7	73.4
IE0031R	Mace Head	72.4	82.1	80.1	88.9	84.5	69.5	57.6	58.3	65.0	70.5	69.3	77.3
IT0001R	Montelibretti	24.0	47.6	56.9	61.9	70.8	69.9	69.5	73.8	61.9	46.0	26.4	30.1
IT0004R	Ispra	6.3	12.2	28.0	66.8	69.8	48.4	48.8	41.9	36.6	27.9	15.6	17.0
LT0015R	Preila	57.9	68.3	66.3	72.4	81.9	78.2	58.6	55.6	57.7	43.6	23.7	34.2
LV0010R	Rucava	55.9	66.2	62.9	85.6	81.9	86.5	67.4	48.6	61.3	43.3	59.2	69.8
LV0016R	Zoseni	59.1	64.9	-	98.2	86.5	66.0	54.3	55.5	49.2	42.4	34.4	60.4
MK0007R	Lazaropole	103.1	120.9	123.2	139.7	136.8	142.4	145.9	140.7	95.7	-	51.2	50.6

Table 3.1, cont.

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NL0007R	Eibergen	33.7	31.0	44.9	70.2	70.7	56.1	52.9	41.0	34.1	26.6	10.9	37.5
NL0009R	Kollumerwaard	45.8	33.3	53.3	70.9	69.2	64.1	58.1	52.0	43.6	39.4	16.7	53.7
NL0010R	Vredepeel	34.0	29.5	41.8	62.5	63.7	55.2	51.6	41.9	33.8	26.1	8.9	38.7
NL0011R	Cabauw Zijdeweg	31.4	28.6	36.0	59.8	61.0	54.5	48.9	37.8	32.3	25.5	5.8	-
NL0091R	De Zilk	38.3	31.9	43.3	68.7	70.8	65.9	60.2	52.5	42.3	34.9	14.3	49.8
NO0001R	Birkenes	-	-	82.3	68.8	69.1	62.3	44.3	41.4	43.2	42.5	31.4	49.8
NO0002R	Birkenes II	68.3	71.1	83.0	83.2	79.5	72.2	58.3	54.5	54.7	54.4	30.6	57.0
NO0015R	Tustervatn	64.9	71.1	80.5	87.4	75.7	57.9	46.7	42.0	45.8	59.2	62.5	63.0
NO0039R	Kårvatn	63.7	74.8	84.0	71.3	67.1	49.5	38.6	37.6	33.3	49.9	41.1	58.6
NO0042G	Zeppelin mountain (Ny-Ålesund)	78.7	82.9	77.2	80.0	63.2	57.4	46.9	52.4	61.9	67.9	73.1	64.8
NO0043R	Prestebakke	51.0	61.7	73.5	73.6	76.1	65.4	51.3	48.5	50.3	49.2	38.9	50.3
NO0052R	Sandve	61.0	67.6	73.6	74.1	79.6	66.6	56.3	56.8	61.8	63.7	51.1	65.7
NO0056R	Hurdal	54.9	64.2	75.4	77.0	75.6	61.5	50.0	44.8	42.6	43.0	29.4	50.2
PL0002R	Jarczew	42.5	61.0	71.5	75.8	71.8	69.5	53.5	57.2	48.3	37.9	25.6	29.1
PL0003R	Sniezka	60.8	86.4	94.6	98.3	113.2	106.0	95.0	97.4	86.8	65.9	69.5	49.8
PL0004R	Leba	52.6	69.6	73.1	78.8	79.9	74.5	62.4	57.6	53.5	46.8	32.5	44.4
PL0005R	Diabla Gora	54.7	73.3	81.7	83.3	76.1	72.2	54.6	56.0	48.6	42.6	31.4	39.3
RO0008R	Poiana Stampei	54.3	69.1	74.1	67.2	57.4	61.4	42.4	36.9	46.3	44.3	49.4	47.5
SE0005R	Bredkälen	73.0	73.2	84.5	84.2	70.7	61.2	56.3	44.5	43.2	45.3	43.7	52.5
SE0011R	Vavihill	43.1	68.6	66.6	70.0	74.2	74.4	57.9	59.3	52.4	47.8	39.1	51.3
SE0012R	Aspvreten	51.8	66.3	71.0	66.4	74.8	71.0	63.6	52.0	45.8	40.7	36.7	46.8
SE0013R	Esrange	72.1	71.9	87.4	94.5	75.9	64.3	56.9	44.2	47.6	50.6	60.5	58.0
SE0014R	Råö	50.3	70.8	68.5	69.7	80.6	76.7	65.6	63.9	62.1	55.2	34.9	49.4
SE0032R	Norra-Kvill	66.7	81.3	82.3	86.1	92.1	86.9	63.1	58.7	55.4	51.6	43.8	52.8
SE0035R	Vindeln	60.5	62.7	84.1	84.0	71.0	59.5	57.2	38.1	39.1	37.5	37.9	47.5
SE0039R	Grimsö	63.2	75.2	79.1	74.3	79.8	70.7	61.0	48.9	43.6	43.7	40.6	49.0
SI0008R	Iskrba	35.0	-	-	60.5	62.6	60.3	64.3	57.8	48.6	37.5	31.5	38.1
SI0031R	Zarodnje	49.6	52.6	83.3	96.8	101.6	87.2	91.1	89.0	88.2	57.6	37.4	52.6
SI0032R	Krvavec	80.9	88.0	100.3	105.9	109.8	96.6	103.8	101.0	100.8	82.4	95.3	74.0
SI0033R	Kovk	52.5	57.6	84.1	100.1	102.2	84.5	87.1	90.3	91.7	56.0	36.7	39.2
SK0002R	Chopok	84.8	94.1	102.9	109.4	114.7	105.3	102.2	98.3	98.5	79.4	94.4	76.6
SK0004R	Stará Lesná	56.0	66.2	78.8	91.8	89.0	75.7	61.8	57.6	57.9	51.4	50.0	46.4
SK0006R	Starina	51.1	66.6	76.8	83.9	75.2	68.9	53.4	52.5	55.0	49.8	46.0	40.0

Table 3.2: Monthly data capture 2011 ($\mu g/m^3$).

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
AM0001R	Amberd	99	20	0	0	0	45	91	98	56	99	67	82
AT0002R	Illmitz	95	96	95	95	96	95	95	95	95	95	95	96
AT0005R	Vorhegg	88	89	95	95	95	95	95	93	85	95	96	95
AT0030R	Pillersdorf bei Retz	96	89	94	96	90	96	96	70	96	96	96	89
AT0032R	Sulzberg	95	95	95	94	95	95	95	95	96	95	96	95
AT0034G	Sonnblick	96	84	93	96	93	96	96	83	96	86	93	24
AT0038R	Gerlitzen	65	92	92	91	83	95	95	94	96	89	88	87
AT0040R	Masenberg	96	96	95	96	96	96	96	95	82	95	95	95
AT0041R	Haunsberg	96	96	96	95	96	96	85	96	96	95	96	96
AT0042R	Heidenreichstein	96	96	95	90	92	95	95	96	95	96	96	95
AT0043R	Forsthof	95	95	95	96	82	95	95	96	95	96	96	95
AT0045R	Dunkelsteinerwald	96	95	95	96	95	95	95	95	95	95	95	96
AT0046R	Gänserndorf	95	96	96	95	95	96	96	96	95	95	95	96
AT0047R	Stixneusiedl	95	96	95	95	95	96	95	96	96	95	96	96
AT0048R	Zoebelboden	95	94	90	86	87	94	94	94	95	95	95	94
AT0049R	Grebenzen bei St. Lamprecht	96	96	96	95	96	95	95	74	96	95	96	96
BE0001R	Offagne	97	97	87	97	97	96	98	97	91	84	97	97
BE0032R	Eupen	98	98	83	88	97	96	96	94	98	84	97	98
BE0035R	Vezin	97	97	84	98	97	97	98	90	97	96	74	97
BG0053R	Rojen peak	95	95	95	95	95	95	95	95	95	94	95	95
CH0001G	Jungfraujoch	97	86	89	97	97	97	96	98	98	87	95	97
CH0002R	Payerne	95	96	95	95	95	96	95	95	95	95	94	96
CH0003R	Tänikon	95	95	95	96	96	95	96	95	95	96	96	95
CH0004R	Chaumont	96	96	95	96	95	95	95	95	95	95	95	95
CH0005R	Rigi	95	95	95	95	95	96	96	96	95	95	95	95
CY0002R	Ayia Marina	83	98	99	100	97	92	96	99	100	99	98	83
CZ0001R	Svratouch	100	79	100	100	100	100	100	99	100	99	100	98
CZ0003R	Košetice	100	90	100	88	86	99	98	100	100	81	91	100
DE0001R	Westerland	96	96	88	100	100	95	95	85	96	94	85	92
DE0002R	Waldhof	96	96	96	95	96	95	96	96	96	96	96	96
DE0003R	Schauinsland	96	96	96	96	96	96	96	88	96	96	96	96
DE0007R	Neuglobsow	96	96	96	96	96	96	96	96	95	95	95	96
DE0008R	Schmücke	95	96	96	92	90	96	96	95	96	95	96	96
DE0009R	Zingst	96	96	96	96	96	95	96	96	96	95	94	95
DK0005R	Keldsnor	91	92	89	91	56	92	92	91	91	88	89	86

Table 3.2, cont.

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
DK0010G	Nord, Greenland	91	91	79	91	91	88	91	44	88	18	44	79
DK0012R	Risoe	89	91	89	91	92	88	82	83	92	86	83	63
DK0031R	Ulborg	92	92	90	92	92	82	91	83	86	89	89	91
EE0009R	Lahemaa	100	100	100	100	100	100	100	100	100	100	100	100
EE0011R	Vilsandi	100	100	100	100	100	100	100	100	100	100	100	100
ES0001R	San Pablo de los Montes	99	100	99	99	99	99	100	100	100	99	99	99
ES0005R	Noya	99	99	99	93	98	99	100	99	99	99	99	99
ES0006R	Mahón	99	99	99	99	94	96	99	100	97	99	99	99
ES0007R	Víznar	100	97	99	100	98	95	97	98	99	100	99	93
ES0008R	Niembro	99	98	99	99	97	97	99	99	98	99	99	99
ES0009R	Campisábalos	100	99	100	99	99	98	97	99	99	99	98	99
ES0010R	Cabo de Creus	100	100	99	98	100	99	97	98	99	92	100	99
ES0011R	Barcarrola	99	100	100	100	94	96	100	99	100	99	100	99
ES0012R	Zarra	97	100	99	100	99	99	99	99	99	97	99	99
ES0013R	Penausende	99	100	99	99	100	99	99	100	100	99	100	100
ES0014R	Els Torms	100	99	99	100	100	100	99	100	99	100	100	99
ES0016R	O Saviñao	100	92	98	97	79	99	99	98	100	99	99	99
ES0017R	Doñana	100	98	99	99	99	100	100	99	99	99	99	90
FI0009R	Utö	94	96	100	100	100	93	90	89	97	100	100	77
FI0017R	Virolahti II	95	96	98	98	87	100	100	99	99	99	100	99
FI0022R	Oulanka	99	97	100	100	99	99	87	88	100	99	100	85
FI0037R	Ähtäri II	99	100	100	100	99	96	84	99	100	100	100	100
FI0096G	Pallas (Sammaltunturi)	97	99	98	99	99	94	100	100	100	99	100	100
FR0008R	Donon	100	100	100	99	99	91	85	100	100	100	100	100
FR0009R	Revin	100	100	100	90	100	97	98	100	100	86	82	97
FR0010R	Morvan	98	98	99	90	98	92	99	98	98	98	98	98
FR0013R	Peyrusse Vieille	100	100	100	89	97	85	100	100	100	100	100	100
FR0014R	Montandon	98	95	100	100	96	97	100	99	100	100	99	91
FR0015R	La Tardière	99	100	100	100	99	99	100	100	99	100	100	99
FR0016R	Le Casset	100	100	100	99	95	98	92	100	100	99	100	99
FR0017R	Montfranc	96	96	99	96	98	99	99	51	98	99	99	99
FR0018R	La Coulonche	100	100	100	99	100	96	98	96	100	97	96	96
FR0019R	Pic du Midi	100	99	95	92	98	98	99	55	99	99	100	100
FR0030R	Puy de Dôme	99	93	98	99	95	93	98	98	28	99	71	99

Table 3.2, cont.

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
GB0002R	Eskdalemuir	100	100	96	100	68	95	97	63	100	100	100	100
GB0006R	Lough Navar	99	99	97	99	99	100	100	99	95	98	100	99
GB0013R	Yarner Wood	100	99	96	100	100	100	96	11	28	96	100	67
GB0014R	High Muffles	100	100	92	100	100	100	100	27	78	100	100	100
GB0015R	Strath Vaich Dam	100	64	100	100	99	100	100	99	100	98	100	100
GB0031R	Aston Hill	100	100	96	100	100	100	100	100	90	100	100	100
GB0033R	Bush	96	100	95	100	100	100	99	96	100	100	100	100
GB0035R	Great Dun Fell	97	96	96	92	84	97	97	96	95	97	96	90
GB0036R	Harwell	100	99	93	98	100	100	100	93	100	100	100	100
GB0037R	Ladybower Res.	100	99	93	100	100	96	100	100	93	100	99	99
GB0038R	Lullington Heath	100	99	98	100	100	99	100	96	100	100	100	98
GB0039R	Sibton	100	100	100	100	100	100	100	100	100	100	100	100
GB0043R	Narberth	100	95	100	100	100	100	100	100	93	100	100	58
GB0045R	Wicken Fen	100	99	96	100	99	73	21	97	100	100	90	100
GB0048R	Auchencorth Moss	99	99	100	100	100	100	100	97	100	100	100	100
GB0049R	Weybourne	100	100	73	100	100	100	100	100	100	100	100	100
GB0050R	St. Osyth	100	98	100	100	100	99	97	98	98	99	99	100
GB0051R	Market Harborough	100	78	96	100	100	100	100	49	48	100	97	96
GB0052R	Lerwick	100	98	96	100	100	100	100	100	96	94	100	100
GB0053R	Charlton Mackrell	100	100	88	100	100	100	100	51	85	100	98	100
GR0001R	Aliartos	54	76	0	38	55	65	100	98	22	61	53	85
GR0002R	Finokalia	98	97	72	99	99	100	98	91	76	78	75	86
HU0002R	K-puszta	100	100	100	100	46	34	96	100	100	100	100	100
IE0001R	Valentia Observatory	100	95	100	98	74	99	99	98	96	100	99	98
IE0031R	Mace Head	100	100	98	100	100	100	94	100	100	100	99	100
IT0001R	Montelibretti	100	100	100	100	97	95	100	97	100	99	98	88
IT0004R	Ispra	99	99	98	79	99	99	85	99	99	98	100	98
LT0015R	Preila	100	100	99	91	97	96	99	94	100	96	100	97
LV0010R	Rucava	84	100	100	100	100	100	97	58	78	10	88	97
LV0016R	Zoseni	100	80	0	45	100	100	100	100	100	100	100	100
MK0007R	Lazaropole	87	99	96	78	75	26	20	30	88	0	28	5

Table 3.2, cont.

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NL0007R	Eibergen	100	100	99	100	98	99	98	97	98	99	97	100
NL0009R	Kollumerwaard	76	93	92	99	82	100	99	100	100	99	100	100
NL0010R	Vredepeel	98	98	81	92	100	99	98	94	97	100	100	100
NL0011R	Cabauw Zijdeweg	97	99	99	99	100	99	100	99	100	99	68	0
NL0091R	De Zilk	93	91	82	99	100	100	100	99	96	99	96	94
NO0001R	Birkenes	0	0	30	99	99	100	100	82	98	99	97	99
NO0002R	Birkenes II	100	100	99	100	99	78	65	96	100	99	51	47
NO0015R	Tustervatn	100	100	99	100	100	100	99	100	100	100	100	99
NO0039R	Kårvatn	97	100	100	100	100	100	99	100	99	100	93	95
NO0042G	Zeppelin mountain (Ny-Ålesund)	100	100	100	100	89	100	72	97	100	100	99	99
NO0043R	Prestebakke	99	100	100	100	100	100	100	100	100	100	100	100
NO0052R	Sandve	98	99	100	100	99	100	100	99	100	100	99	99
NO0056R	Hurdal	100	99	100	100	100	100	100	100	99	100	100	97
PL0002R	Jarczew	100	100	99	99	90	100	98	100	100	99	99	99
PL0003R	Sniezka	97	100	100	100	100	100	100	100	100	99	100	100
PL0004R	Leba	100	99	100	100	100	100	100	100	100	100	100	100
PL0005R	Diabla Gora	100	100	100	80	100	100	100	97	100	100	70	100
RO0008R	Poiana Stampei	87	95	82	91	91	89	96	53	96	79	77	61
SE0005R	Bredkälen	100	95	100	100	99	100	99	99	99	100	100	98
SE0011R	Vavihill	92	100	100	98	92	100	100	100	98	100	100	100
SE0012R	Aspvreten	85	100	100	100	85	91	96	94	87	95	87	99
SE0013R	Esrange	100	100	100	100	100	99	100	99	99	100	100	100
SE0014R	Råö	100	99	100	100	99	100	95	94	99	100	100	100
SE0032R	Norra-Kvill	99	100	100	99	99	100	100	100	99	99	100	98
SE0035R	Vindeln	100	99	100	99	100	90	99	100	99	75	98	99
SE0039R	Grimsö	99	100	97	95	100	100	100	100	99	100	100	100
SI0008R	Iskrba	1	0	0	85	95	78	96	96	96	94	96	96
SI0031R	Zarodnje	95	90	94	92	95	93	94	95	95	95	94	94
SI0032R	Krvavec	94	93	94	94	94	95	94	93	95	92	95	93
SI0033R	Kovk	96	95	96	94	96	96	95	96	96	95	95	95
SK0002R	Chopok	99	100	100	94	96	95	96	97	97	100	100	99
SK0004R	Stará Lesná	100	83	92	100	100	100	100	100	100	99	100	100
SK0006R	Starina	100	99	99	100	100	100	99	100	100	100	100	100

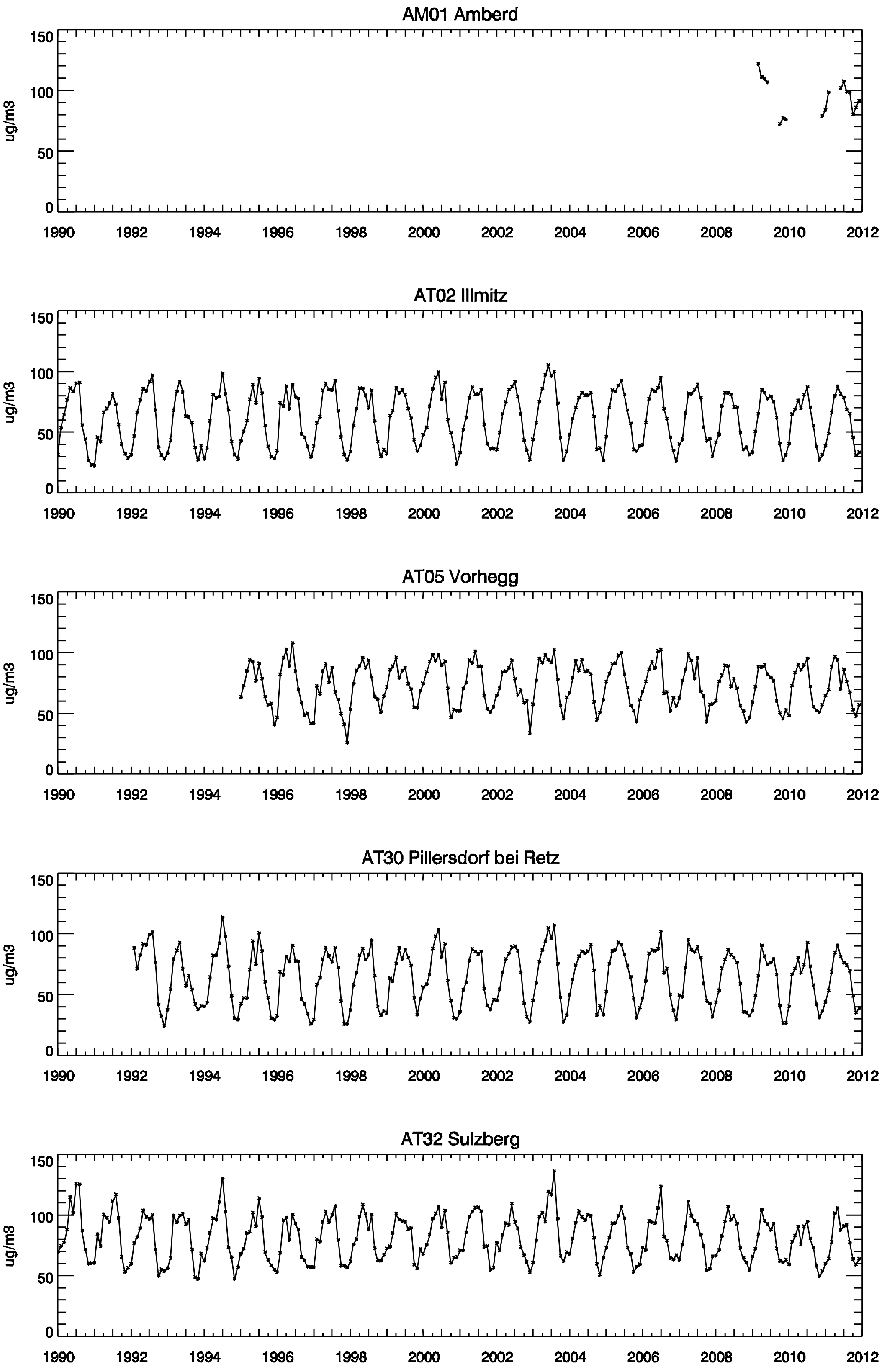


Figure 3.1: Seasonal variation, 1990–2011.

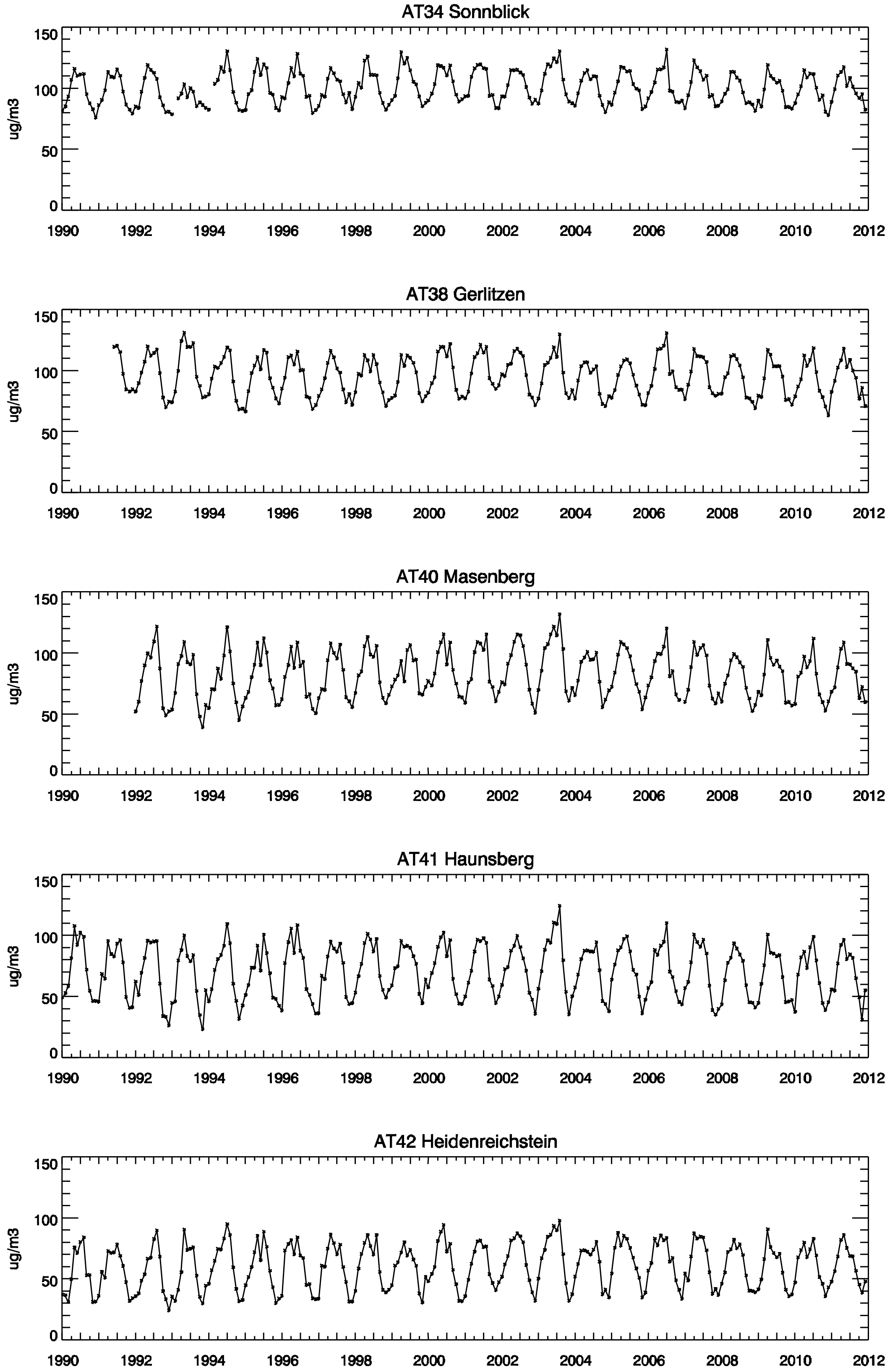


Figure 3.1, cont.

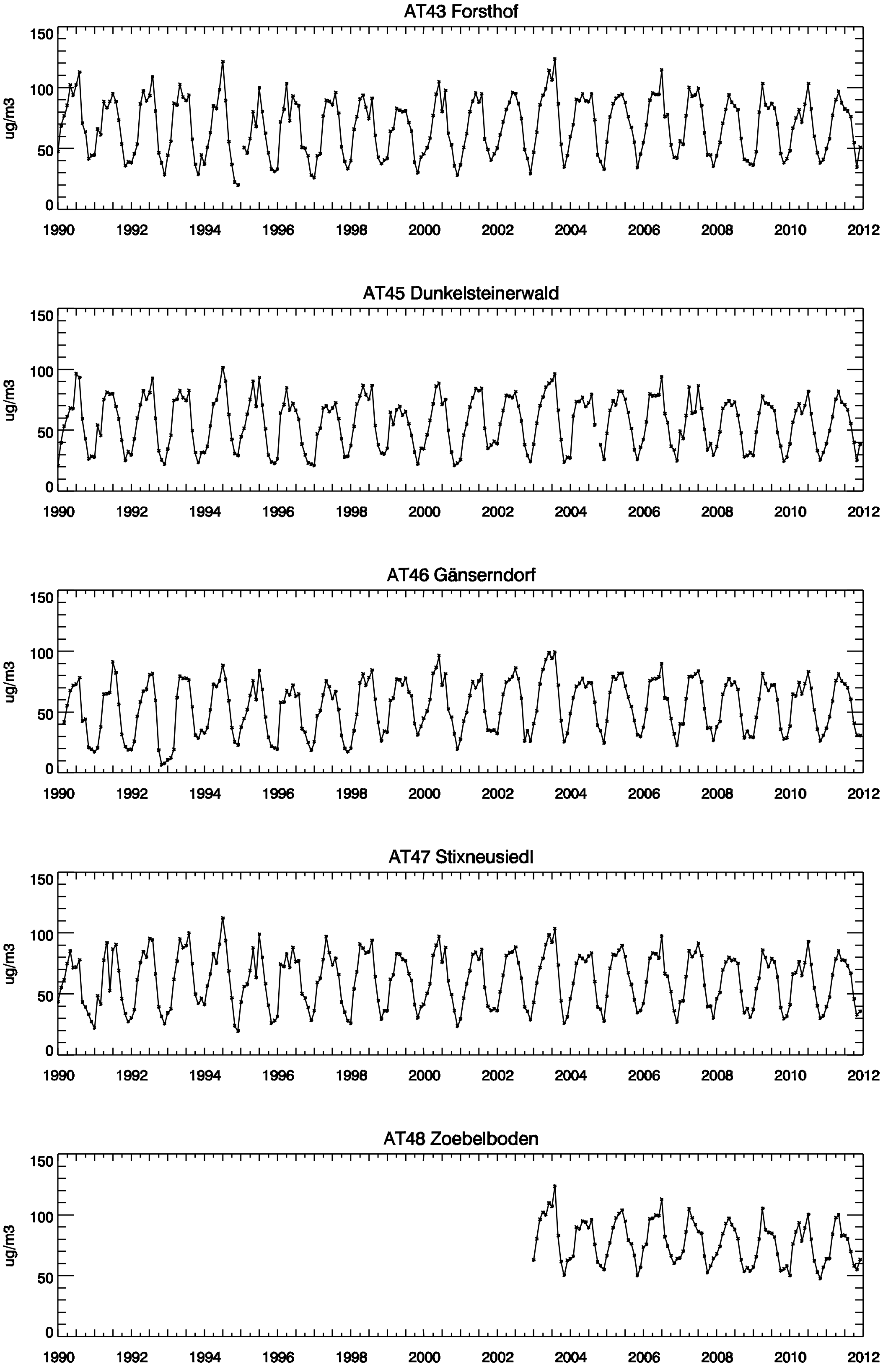


Figure 3.1, cont.

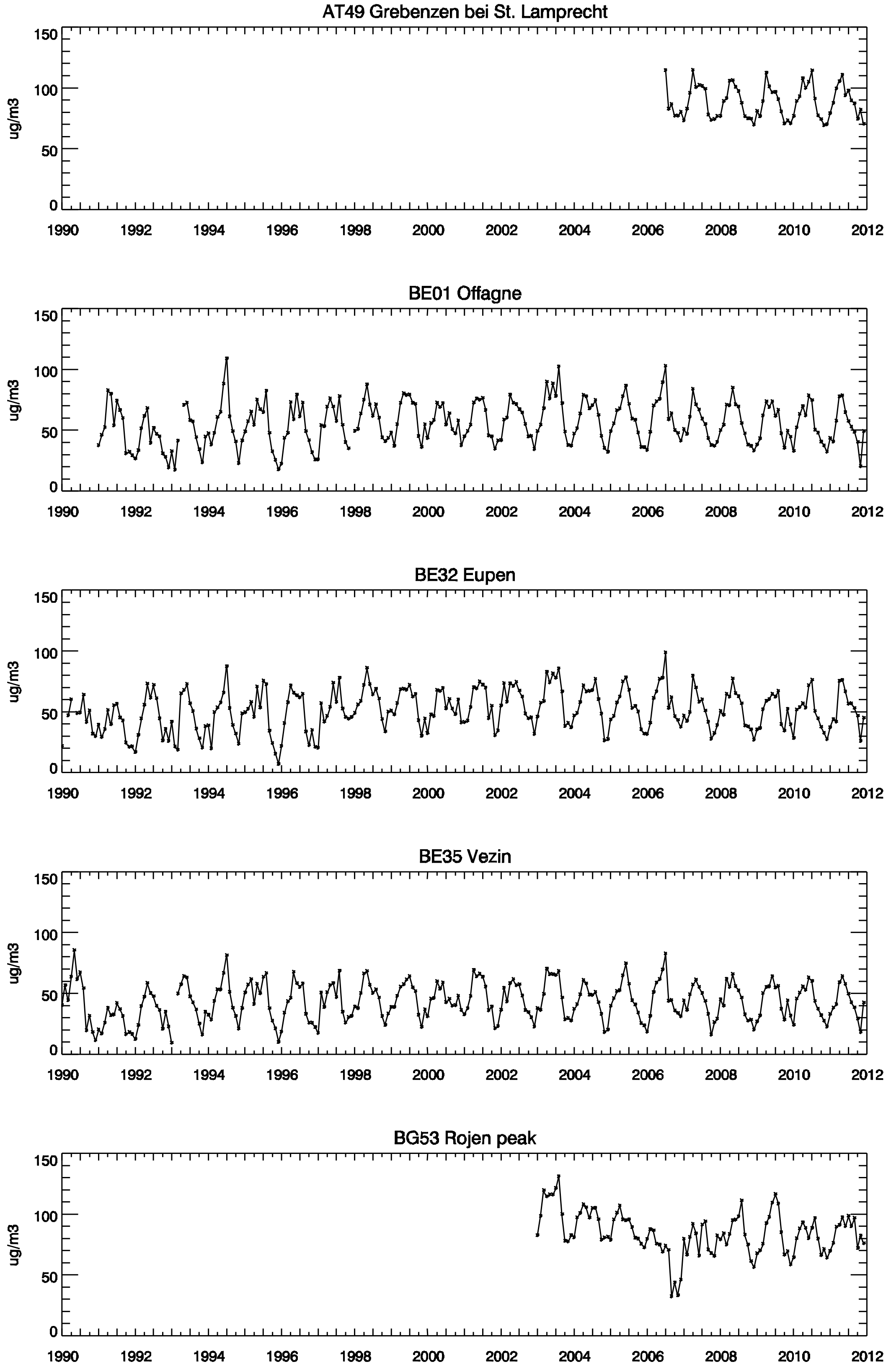
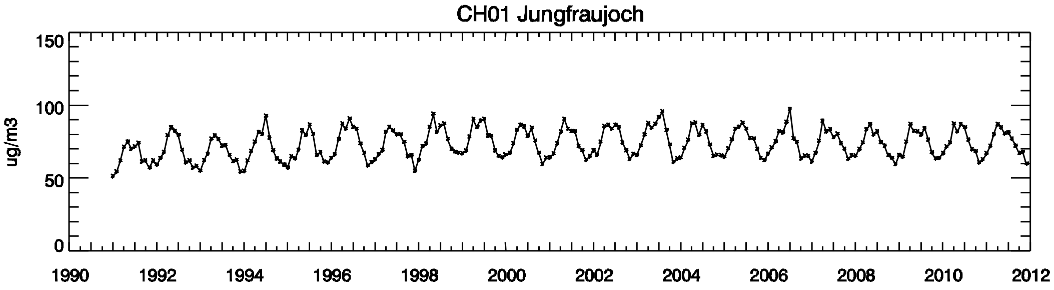
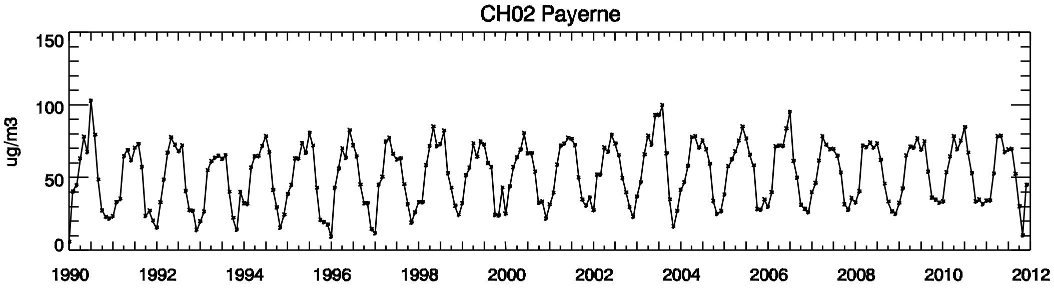
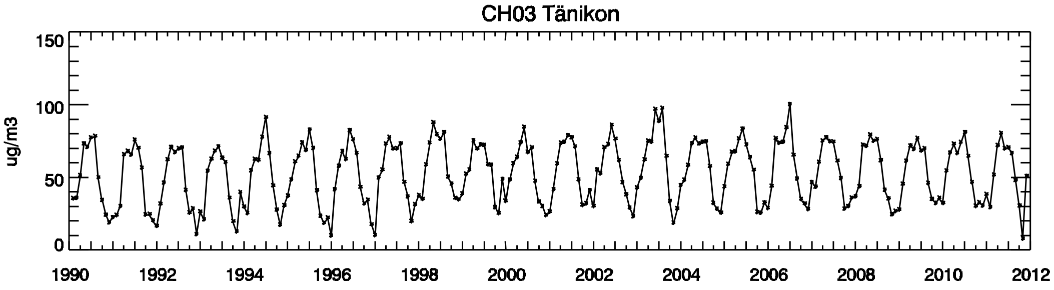
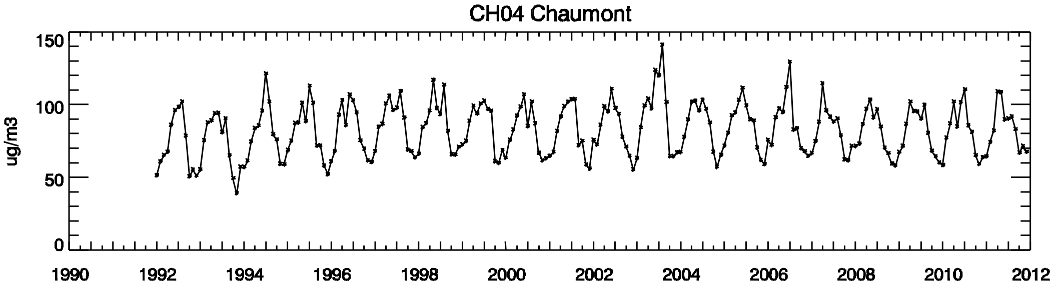


Figure 3.1, cont.









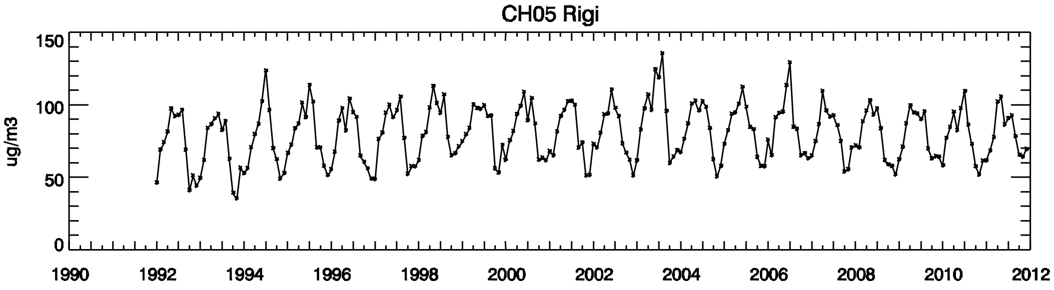


Figure 3.1, cont.

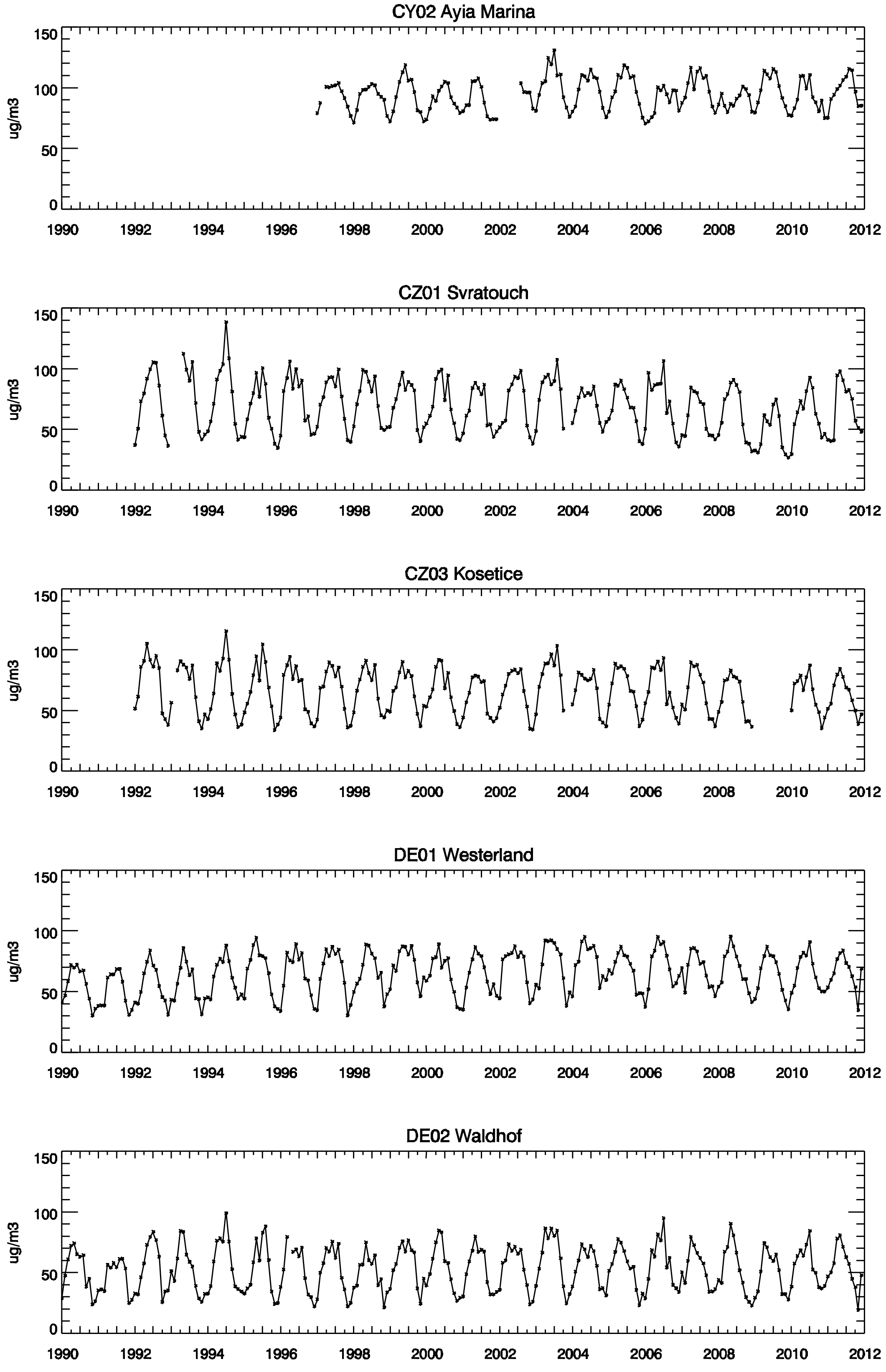
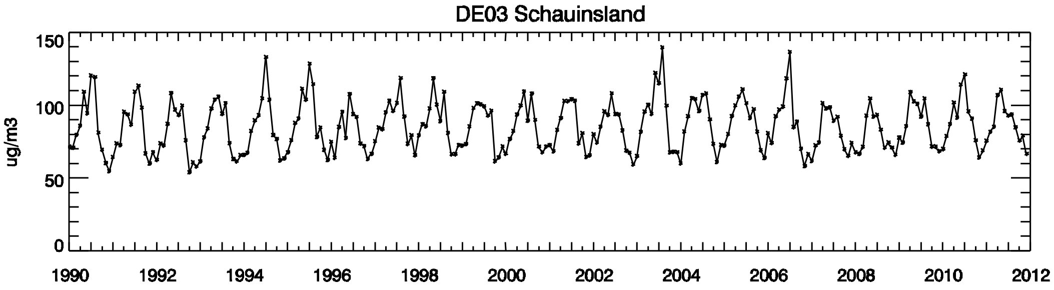
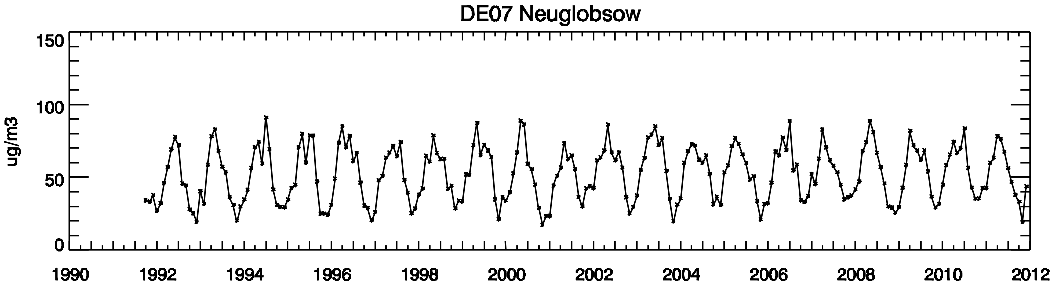
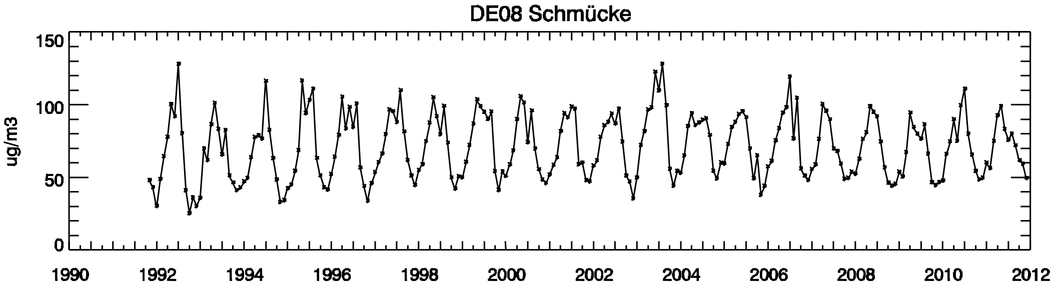
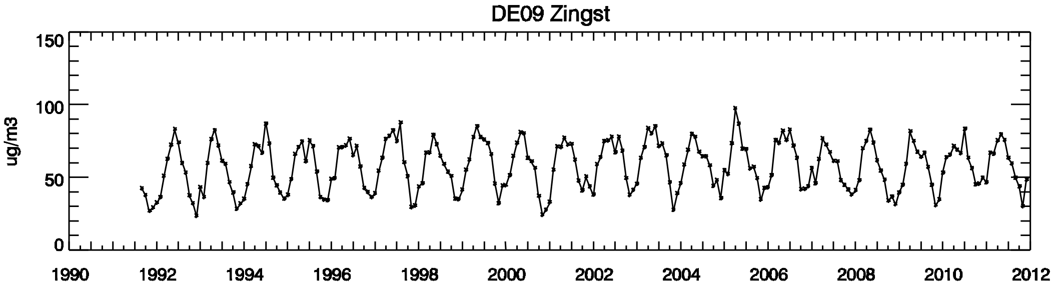


Figure 3.1, cont.









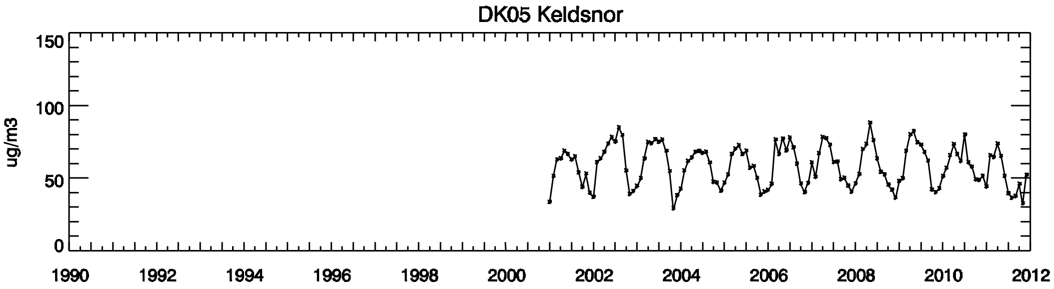


Figure 3.1, cont.

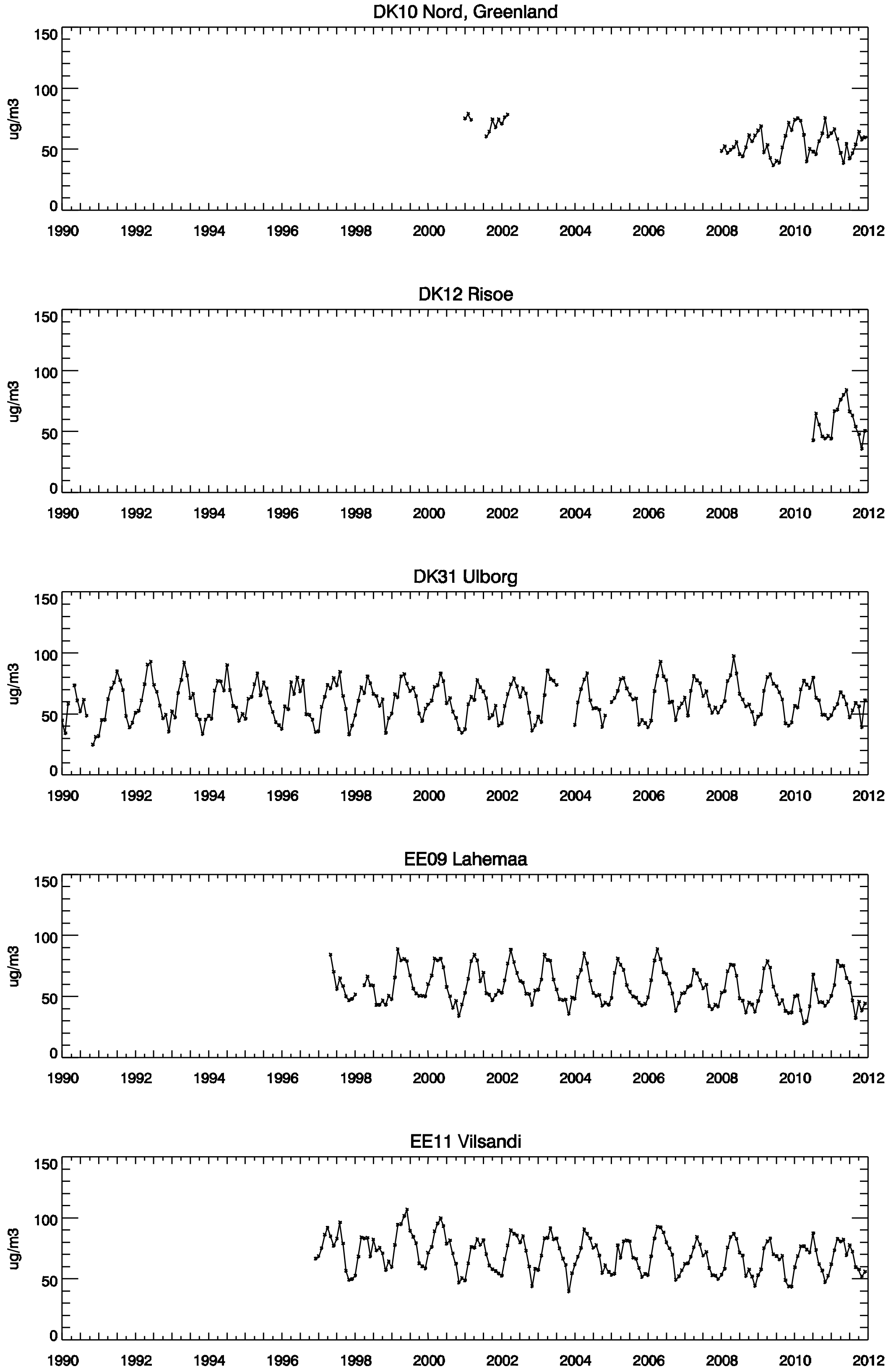


Figure 3.1, cont.

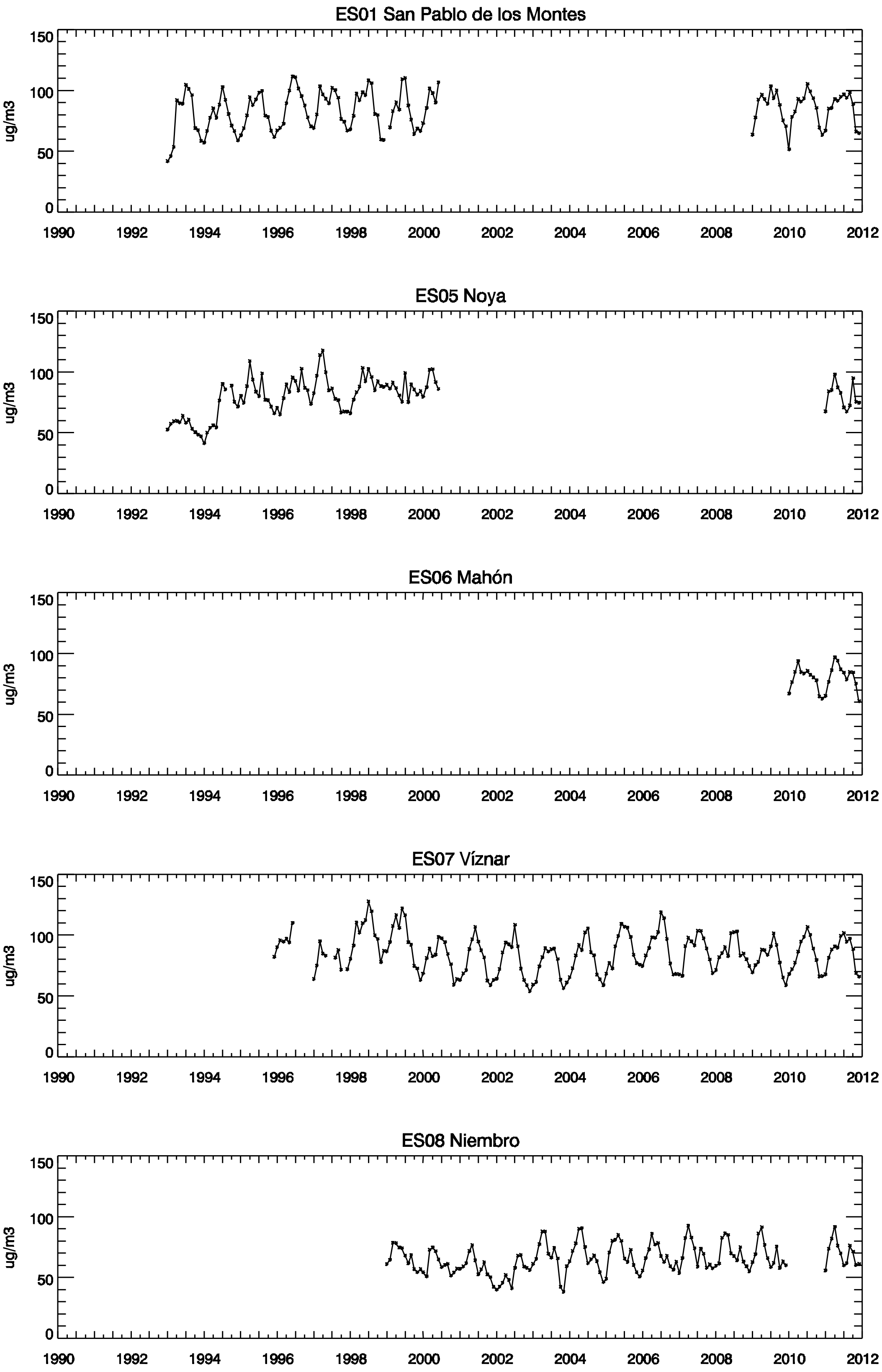


Figure 3.1, cont.

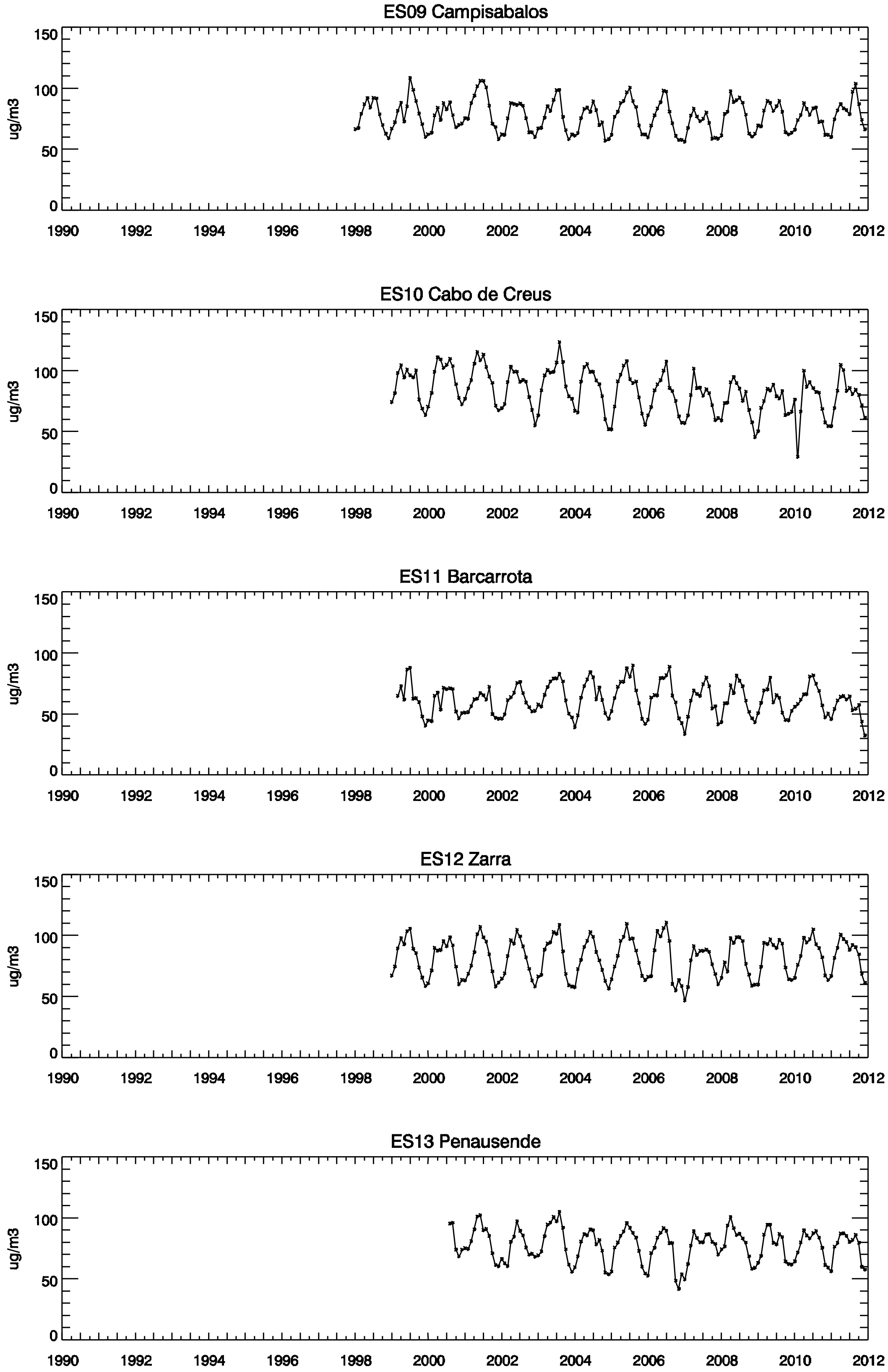


Figure 3.1, cont.

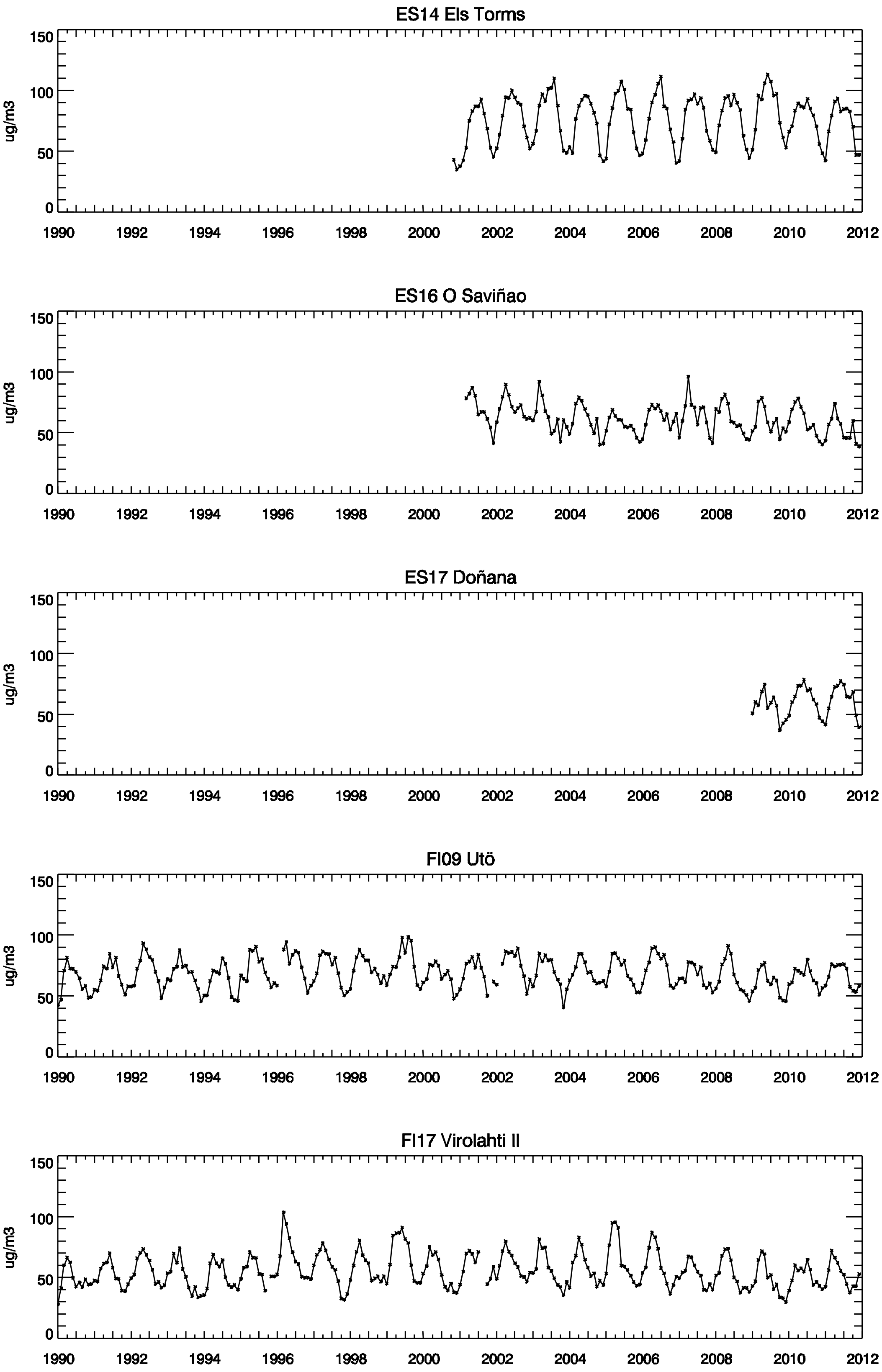


Figure 3.1, cont.

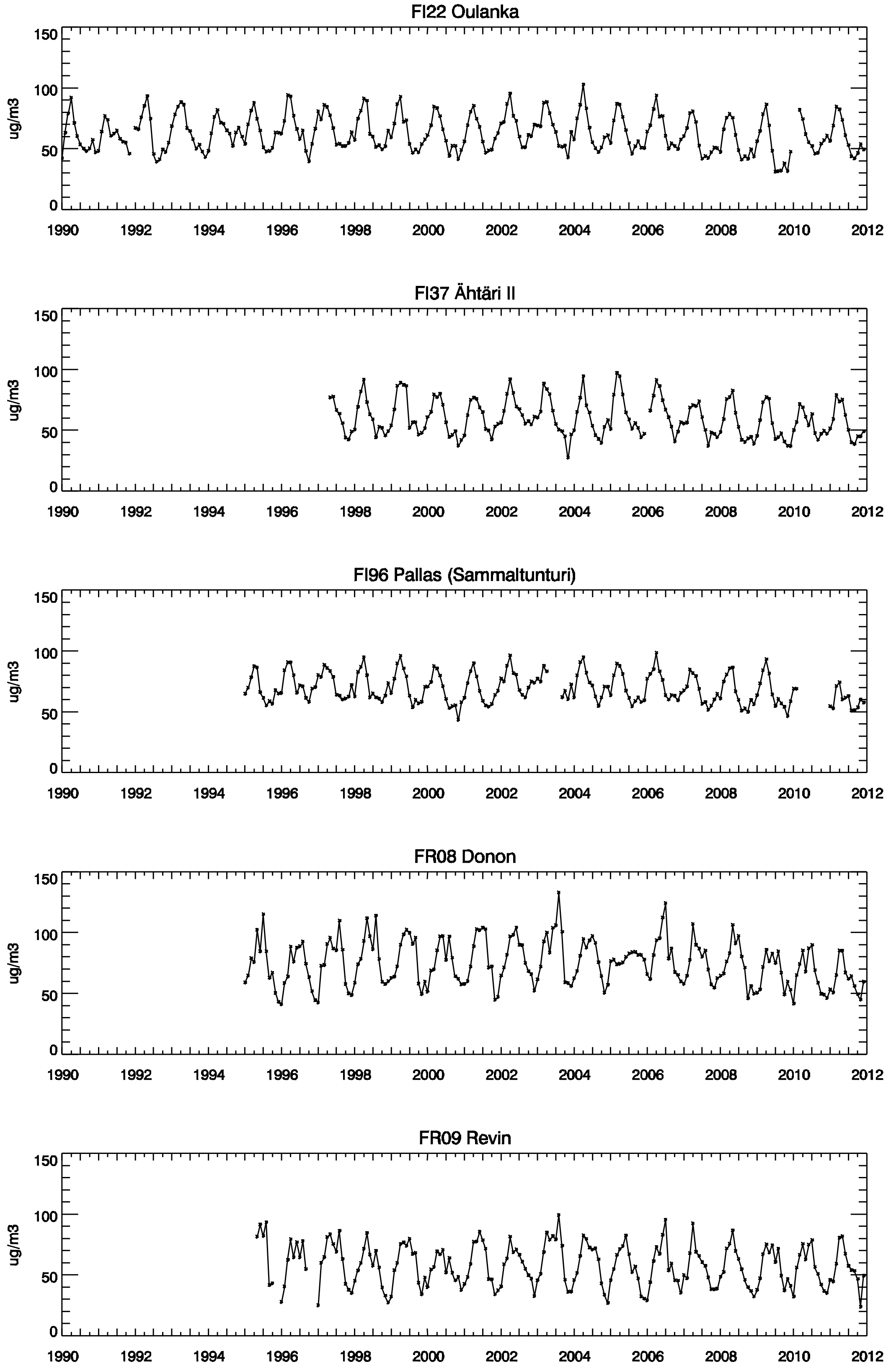
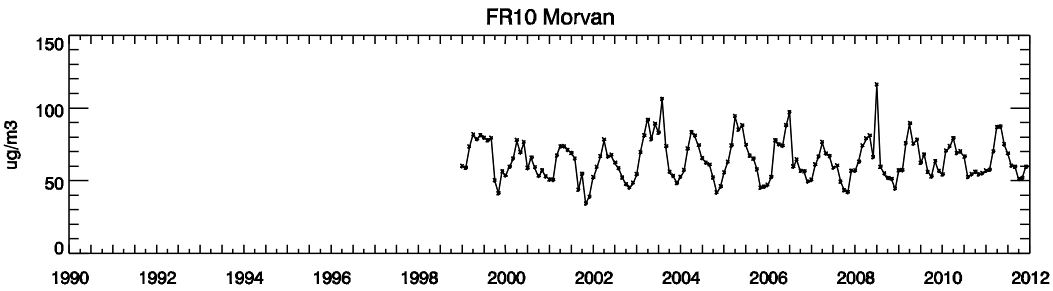
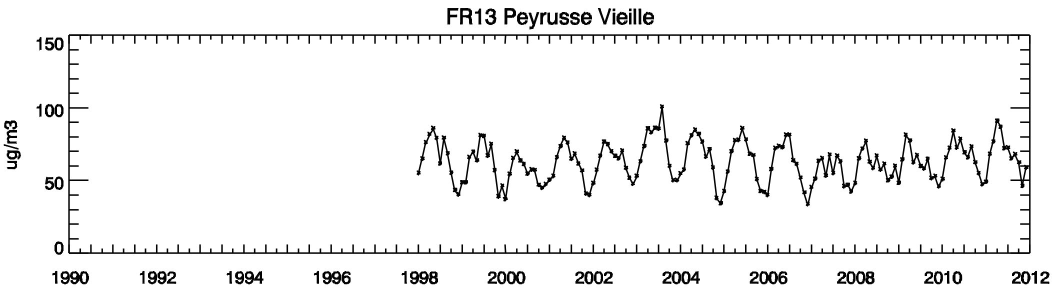
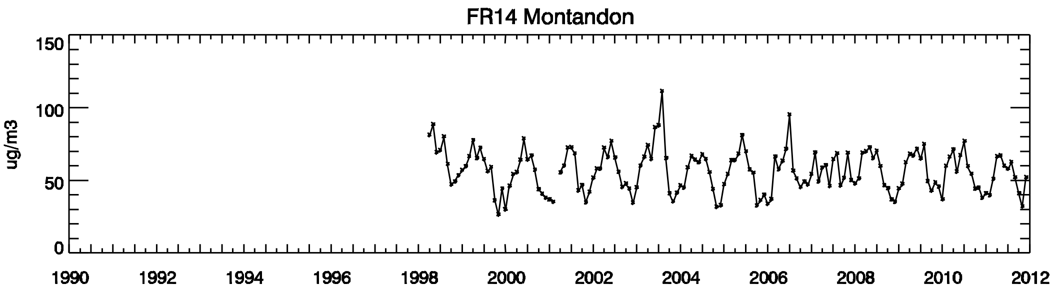
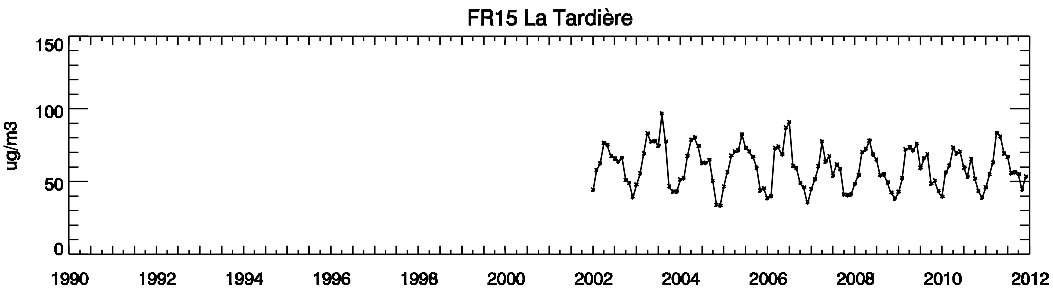


Figure 3.1, cont.









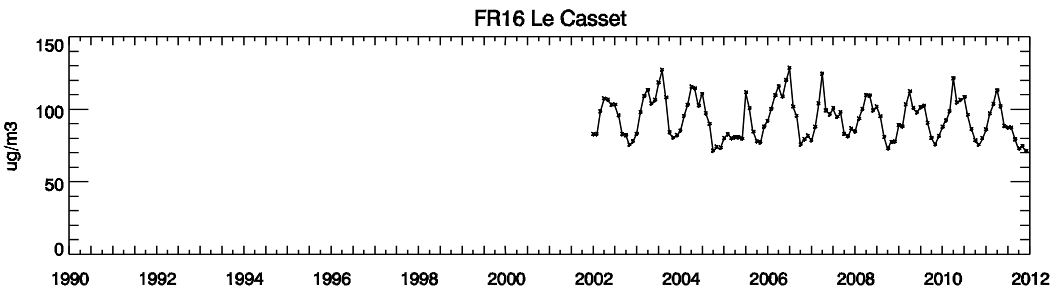


Figure 3.1, cont.

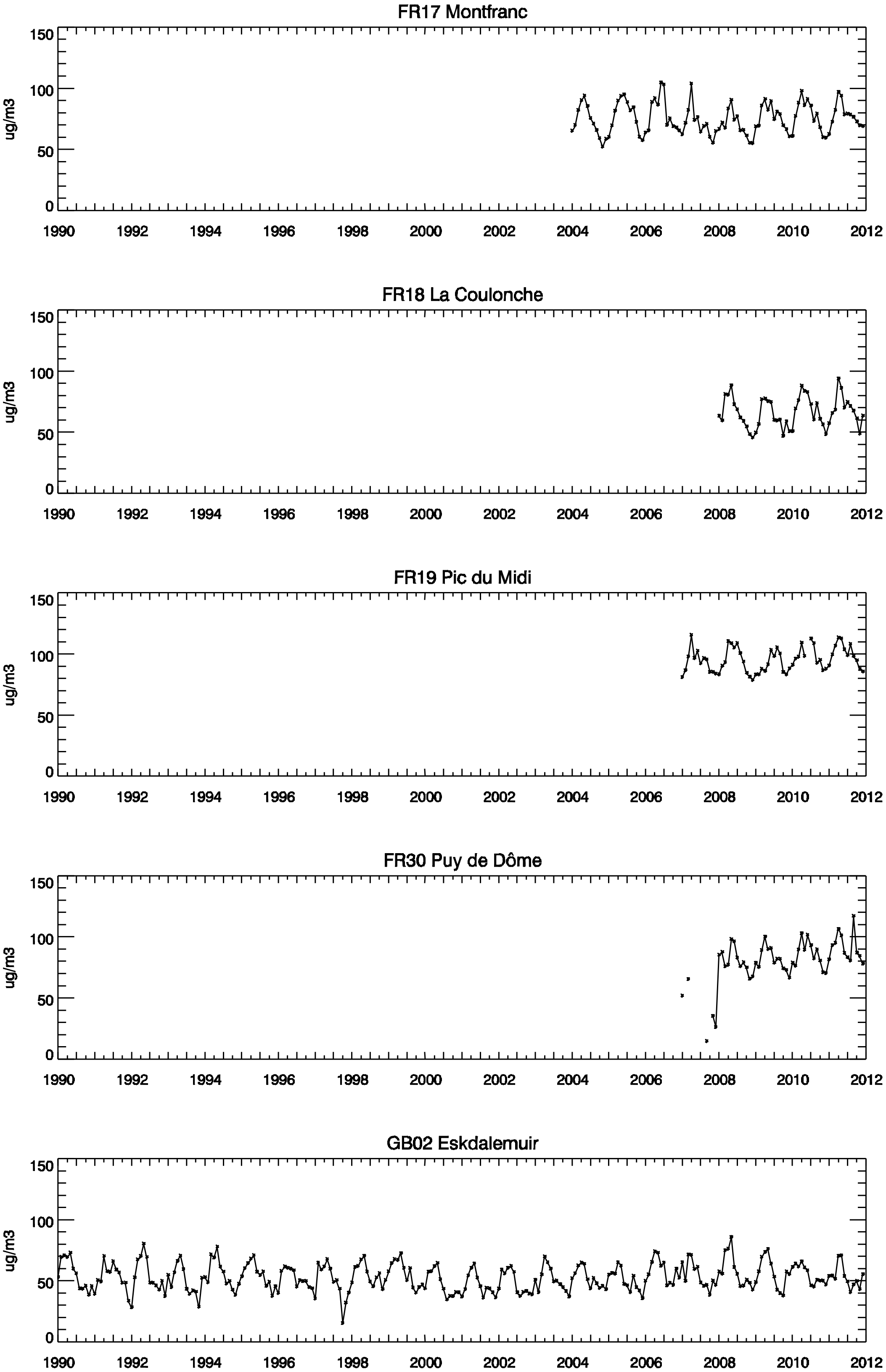


Figure 3.1, cont.

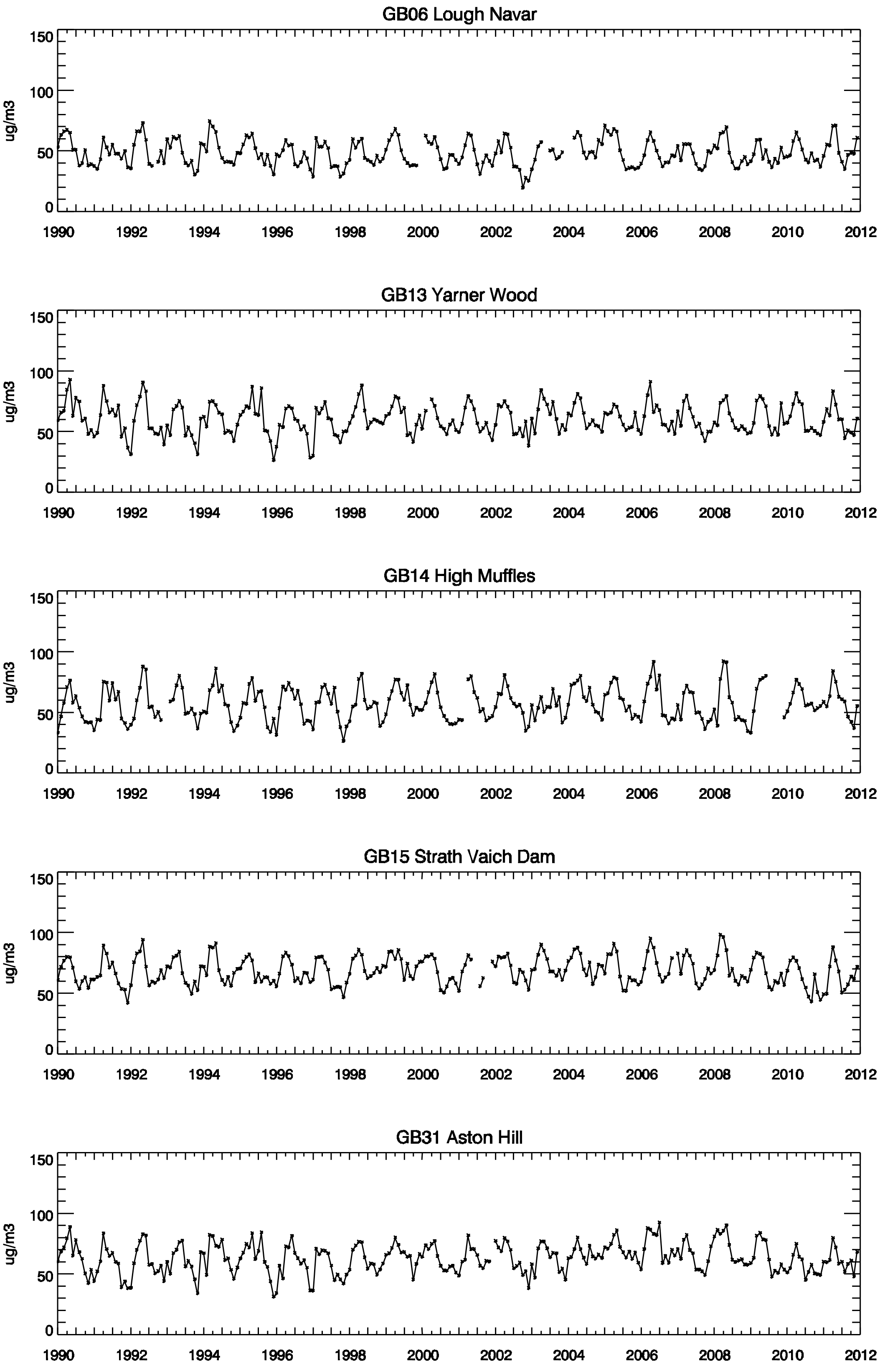


Figure 3.1, cont.

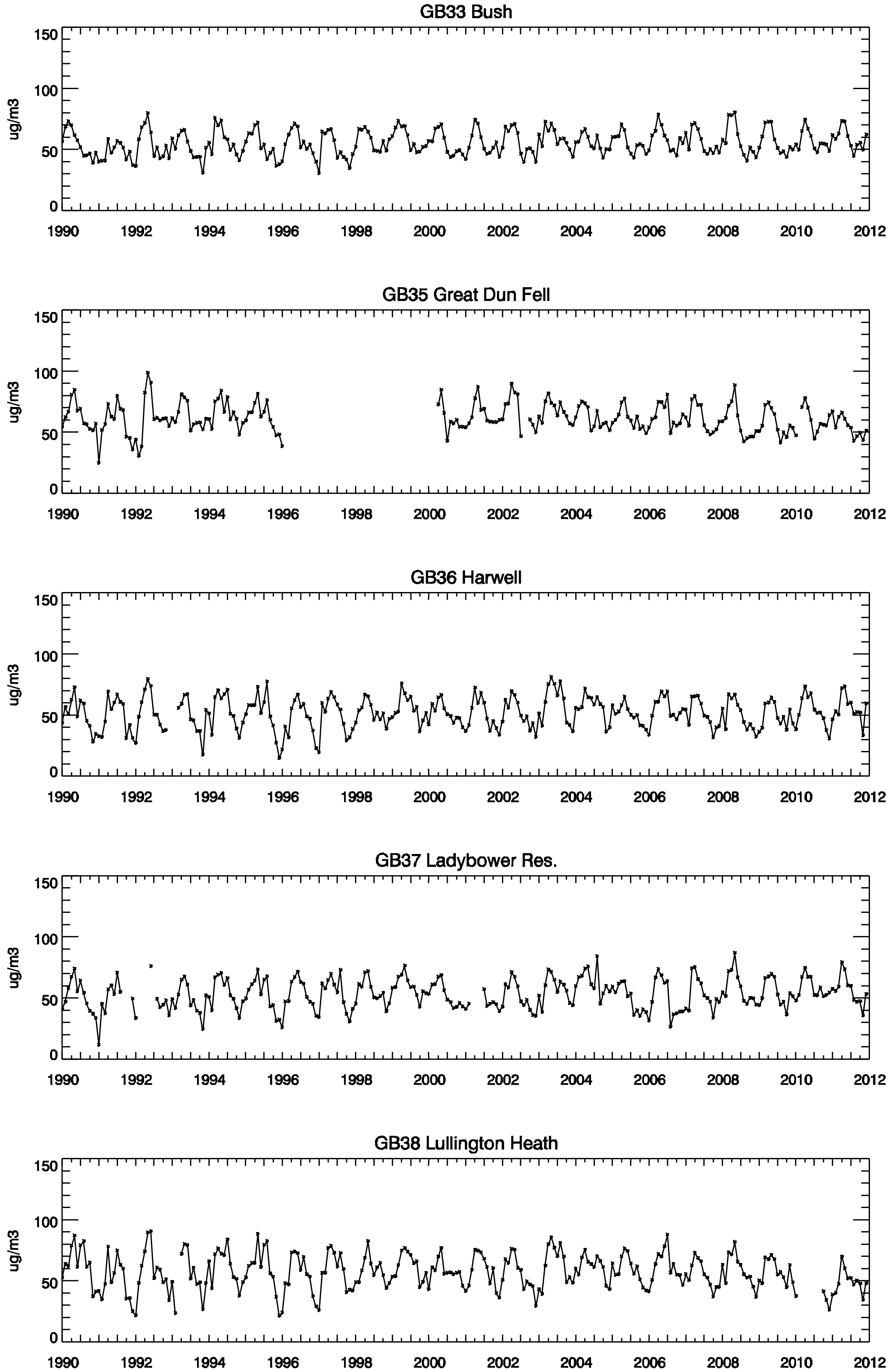


Figure 3.1, cont.

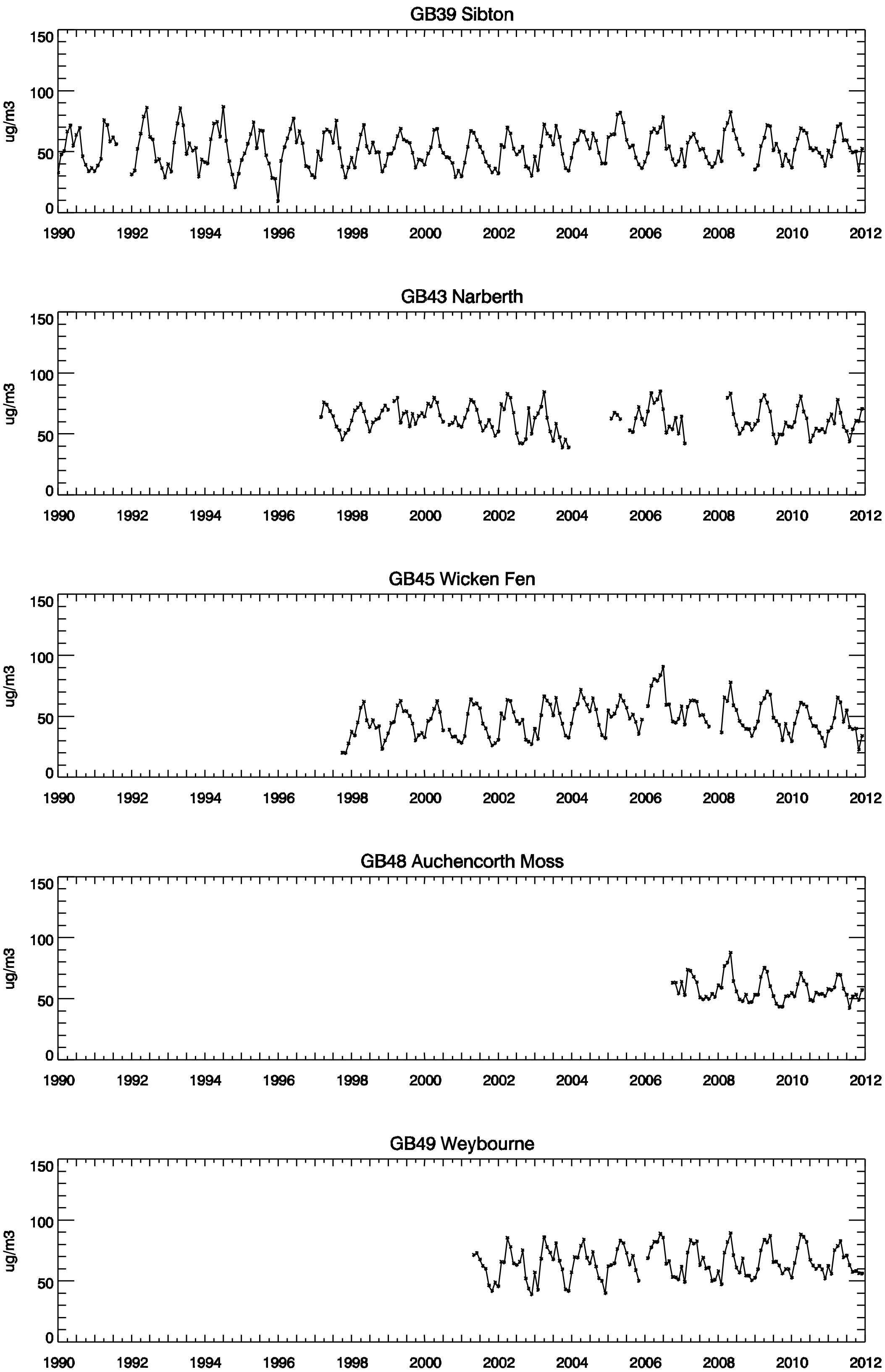


Figure 3.1, cont.

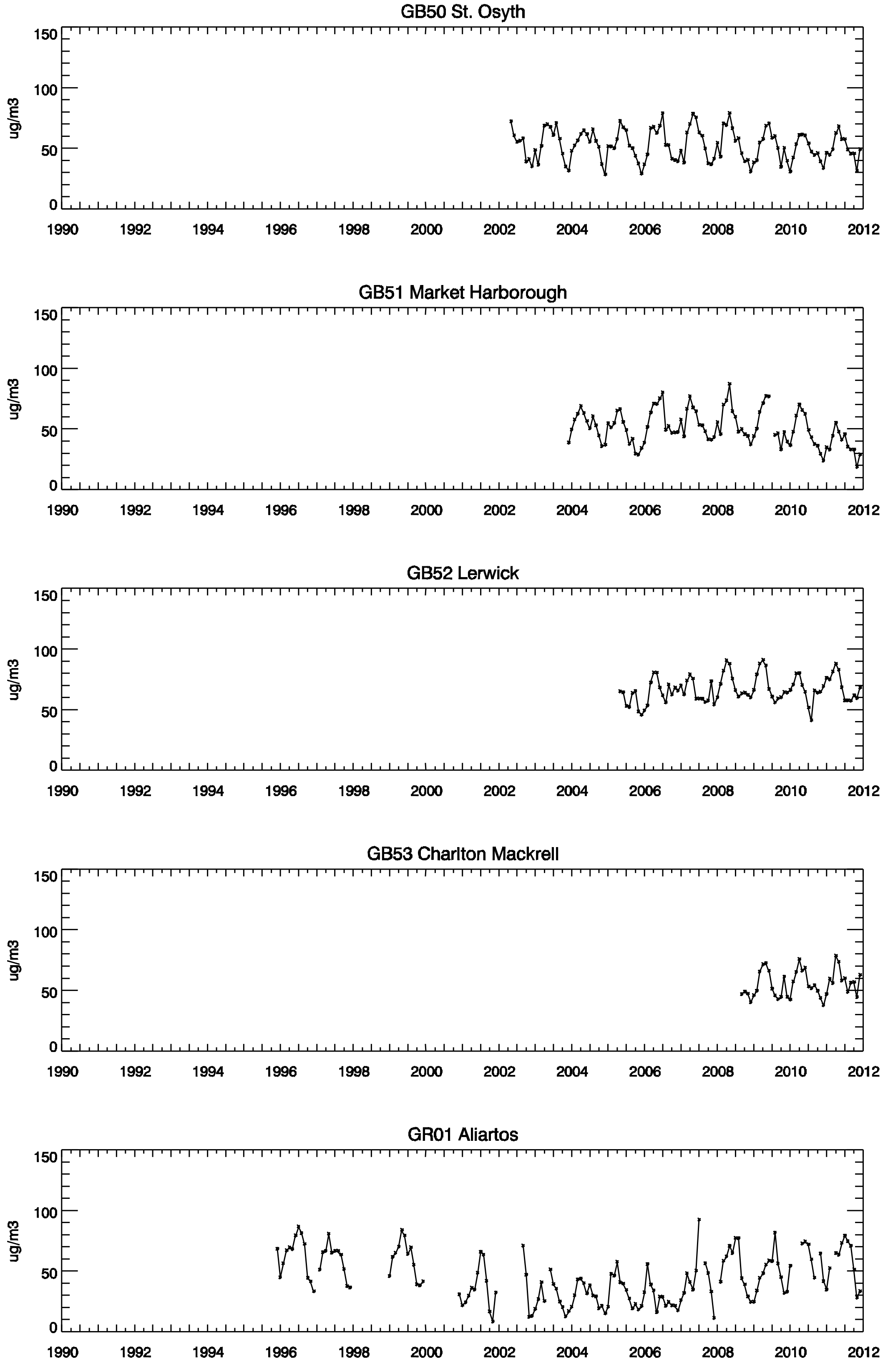


Figure 3.1, cont.

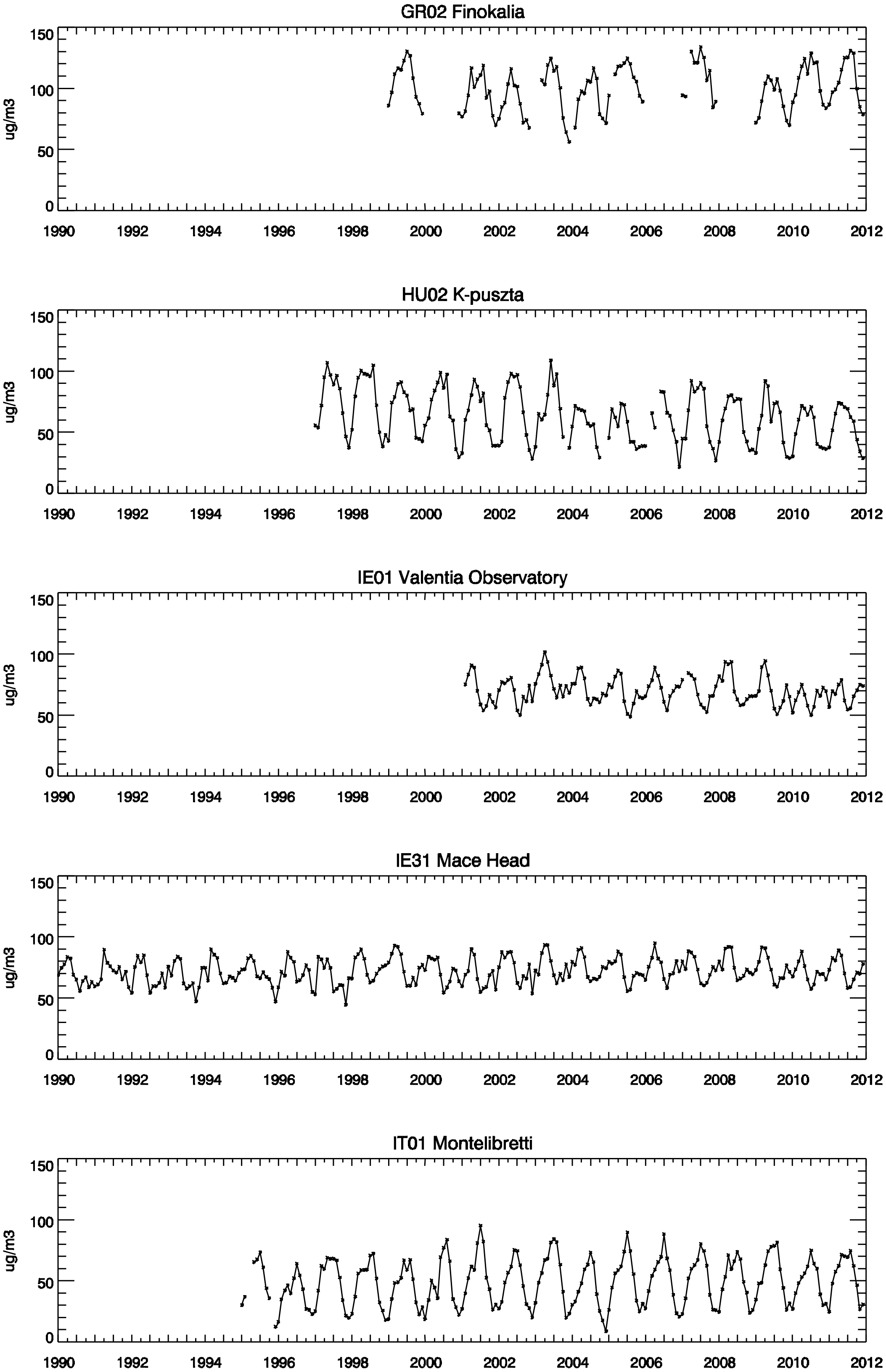


Figure 3.1, cont.

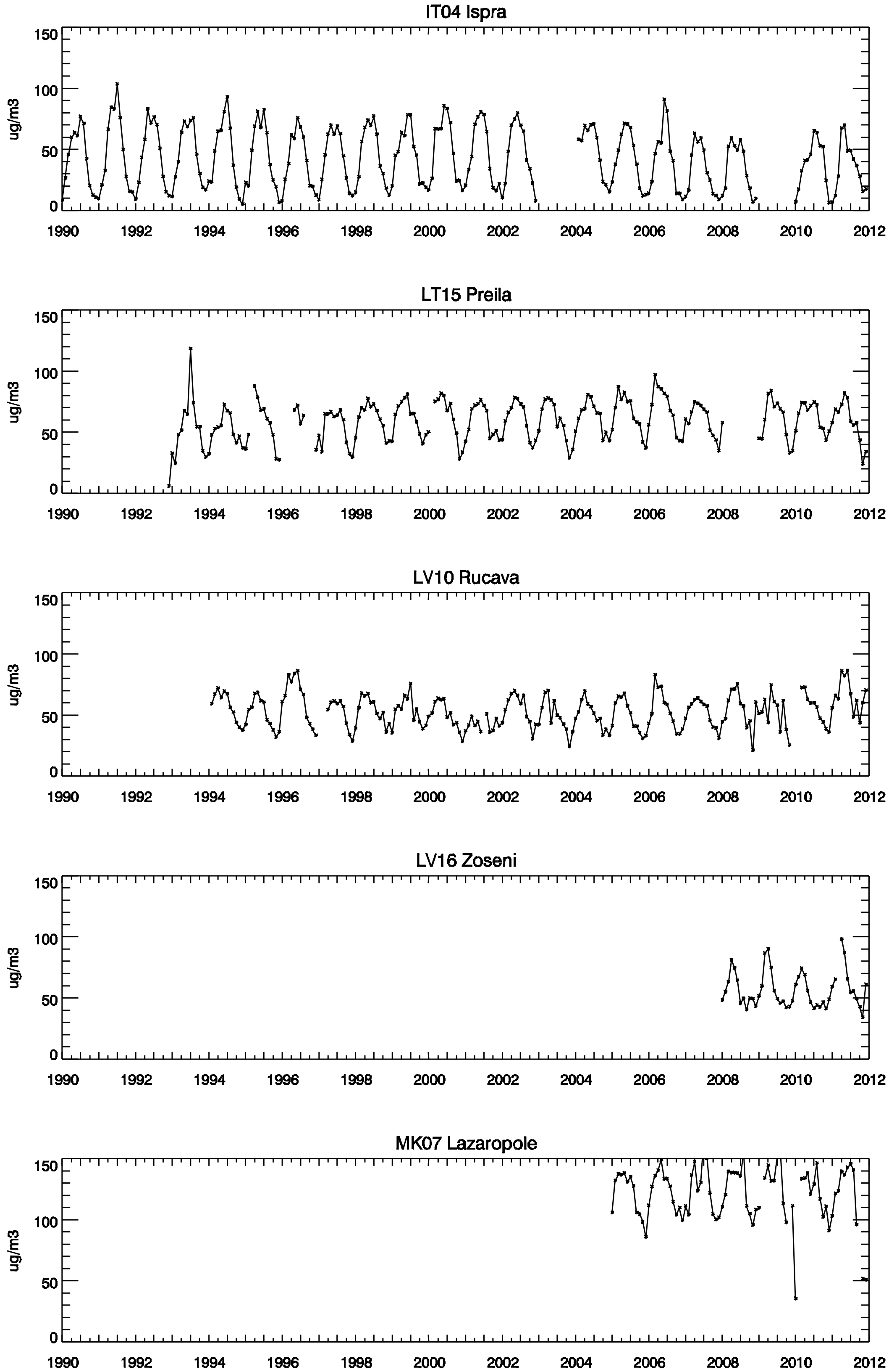


Figure 3.1, cont.

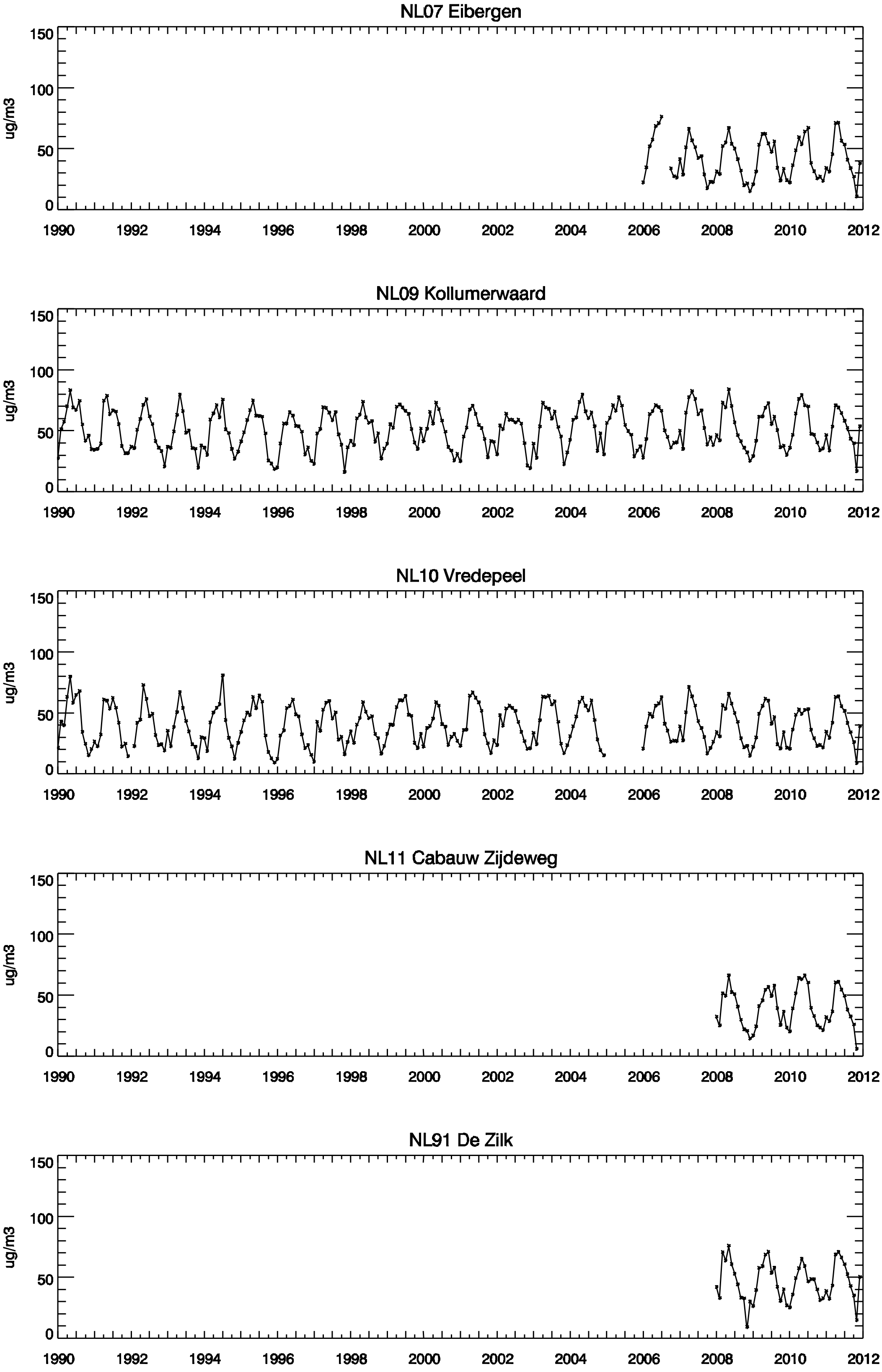


Figure 3.1, cont.

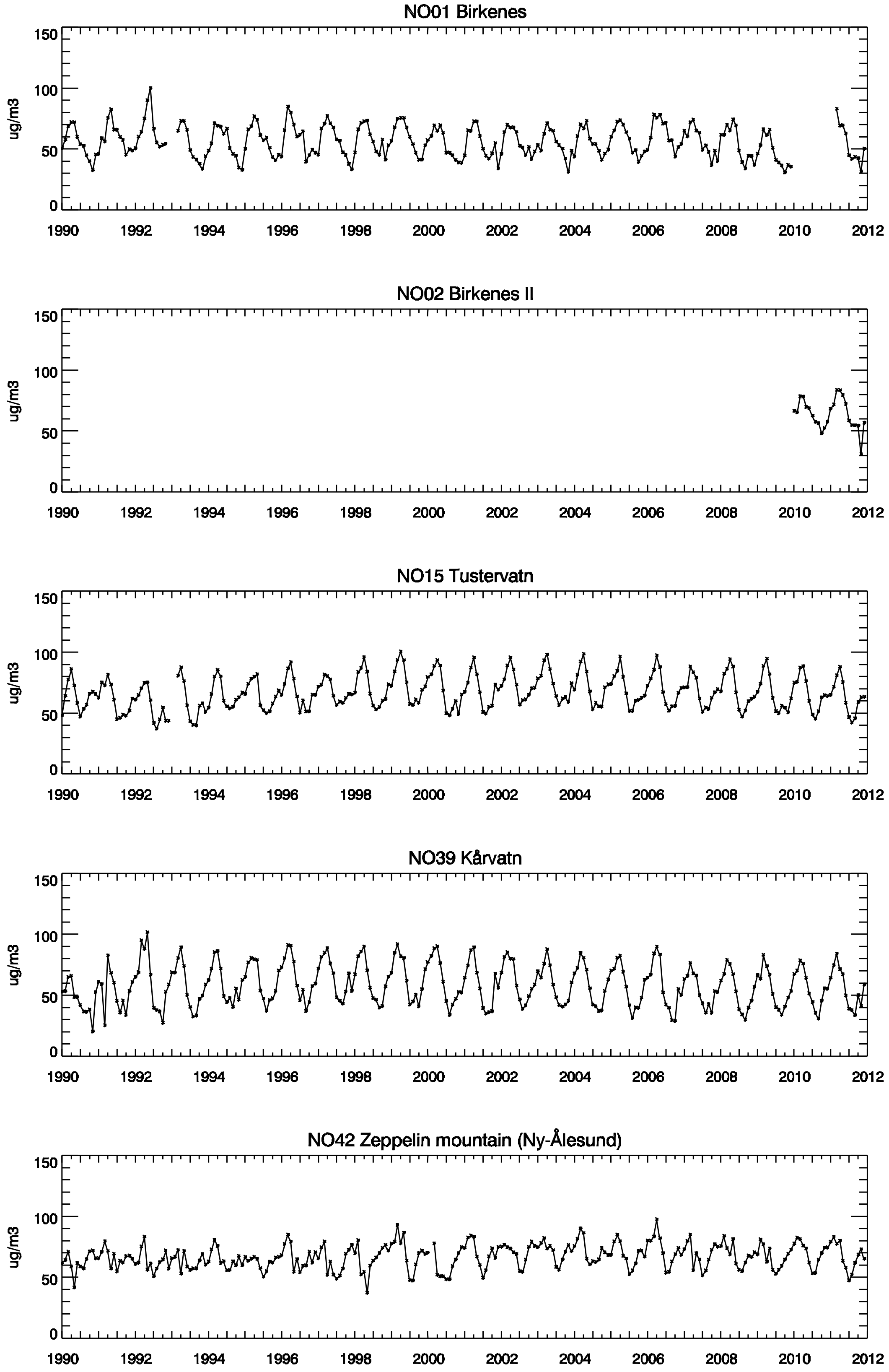


Figure 3.1, cont.

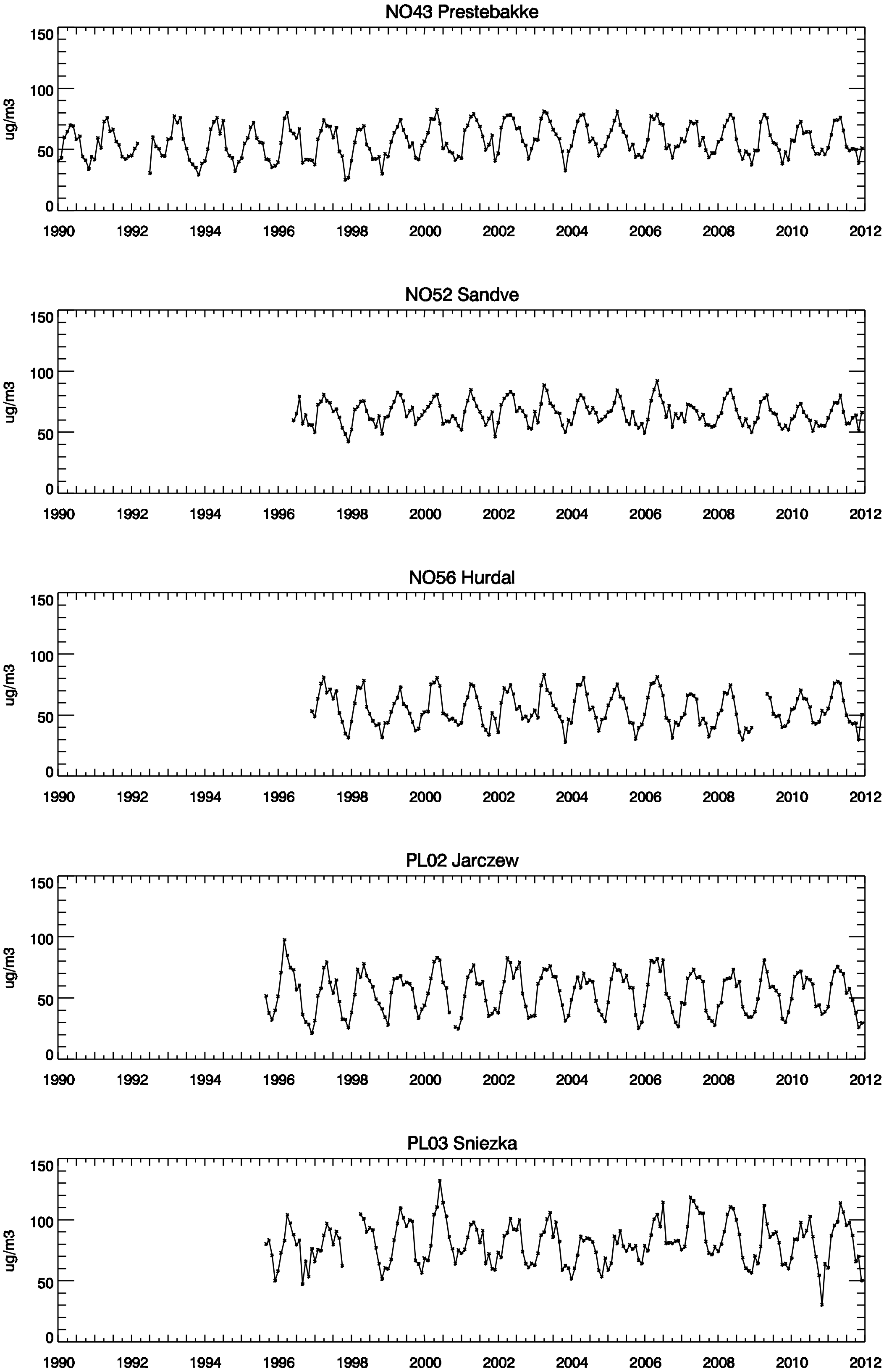


Figure 3.1, cont.

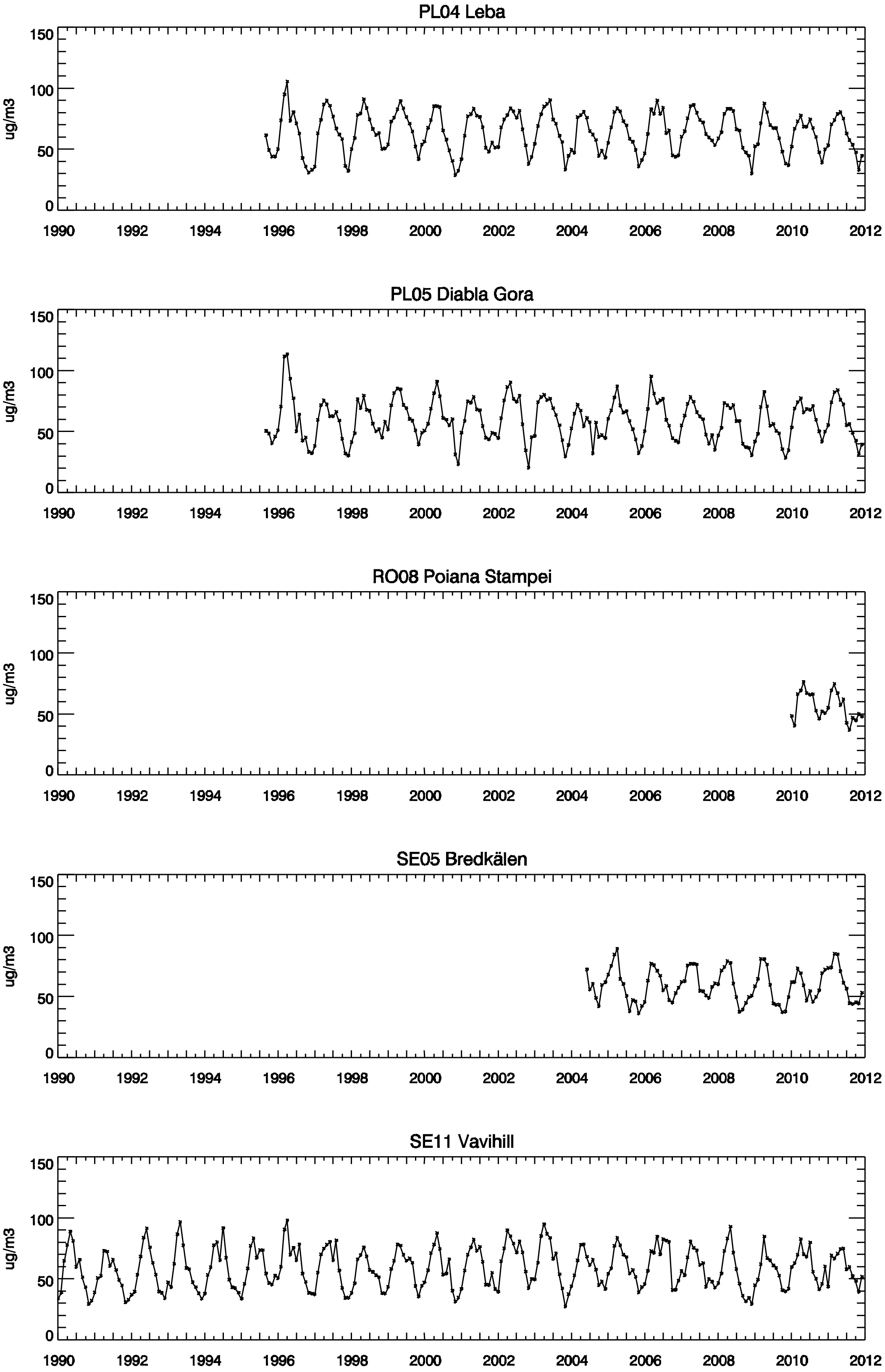


Figure 3.1, cont.

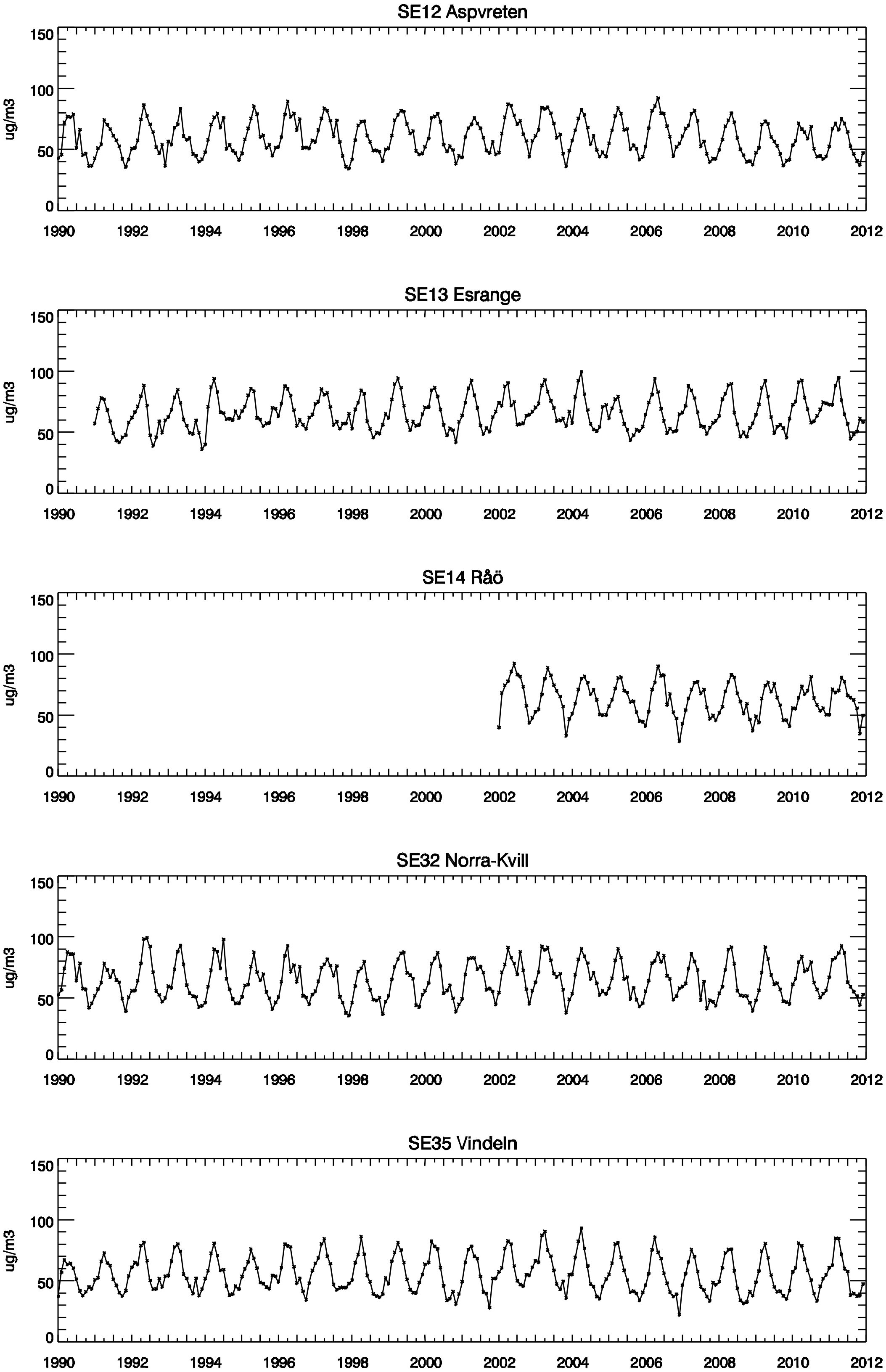


Figure 3.1, cont.

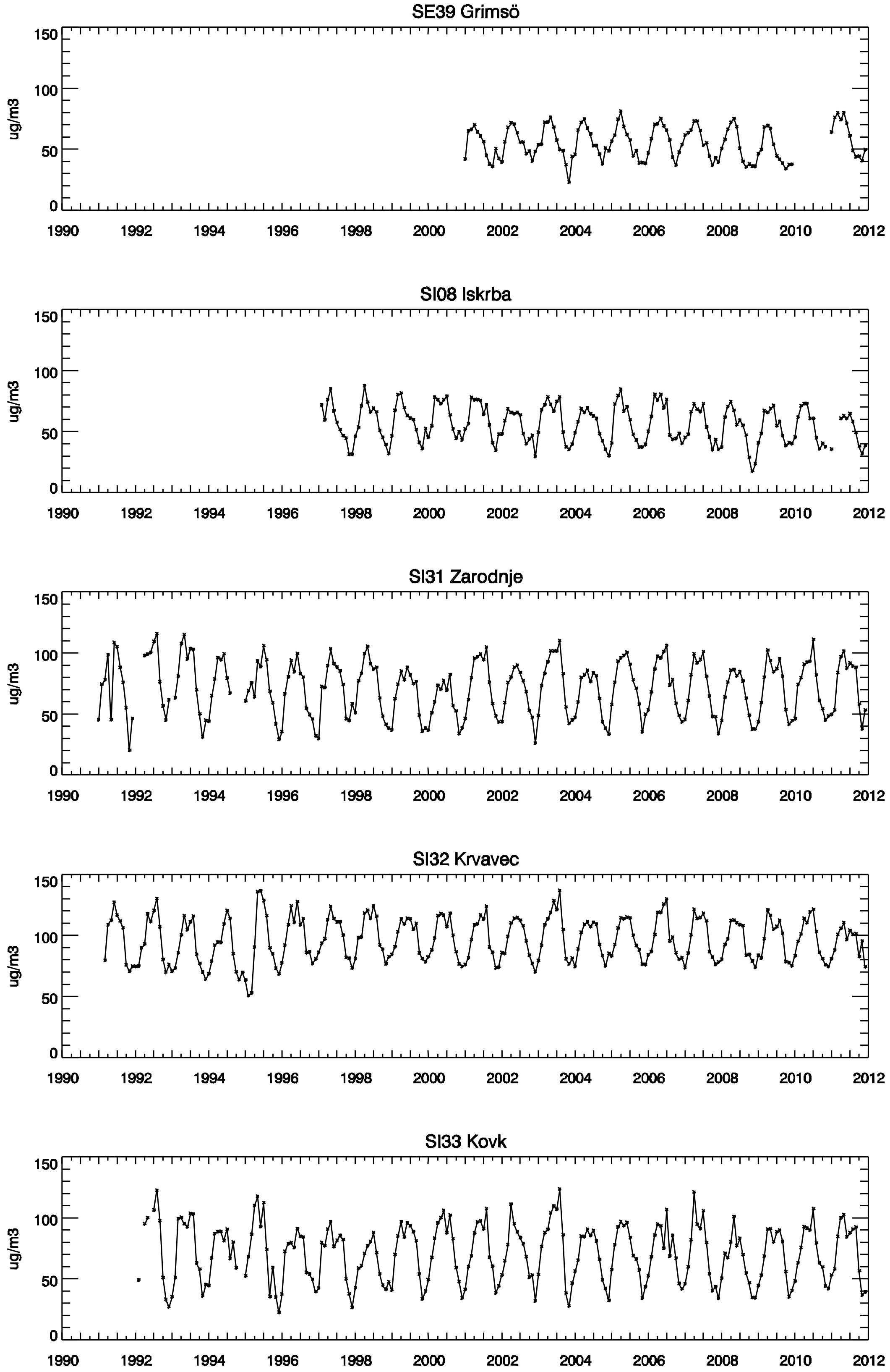


Figure 3.1, cont.

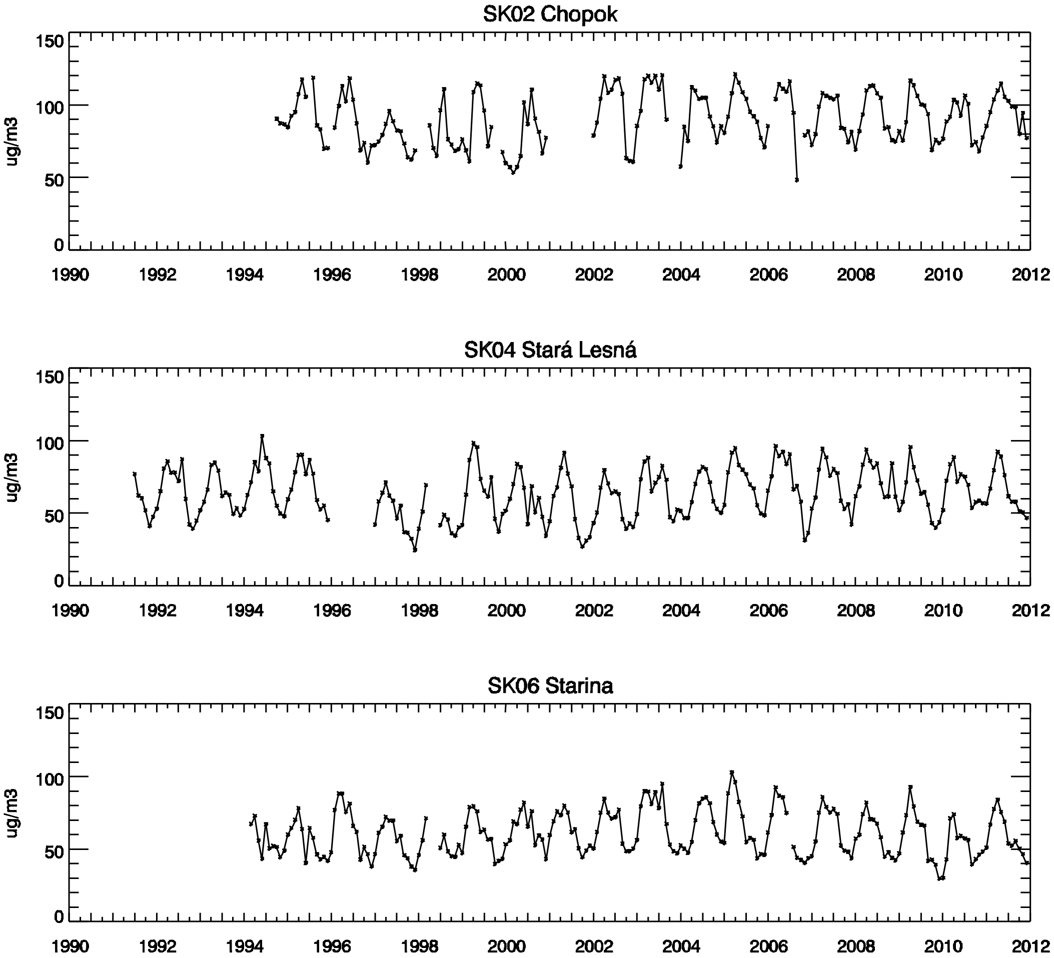


Figure 3.1, cont.

Annex 4

Diurnal variation, April–September 2011

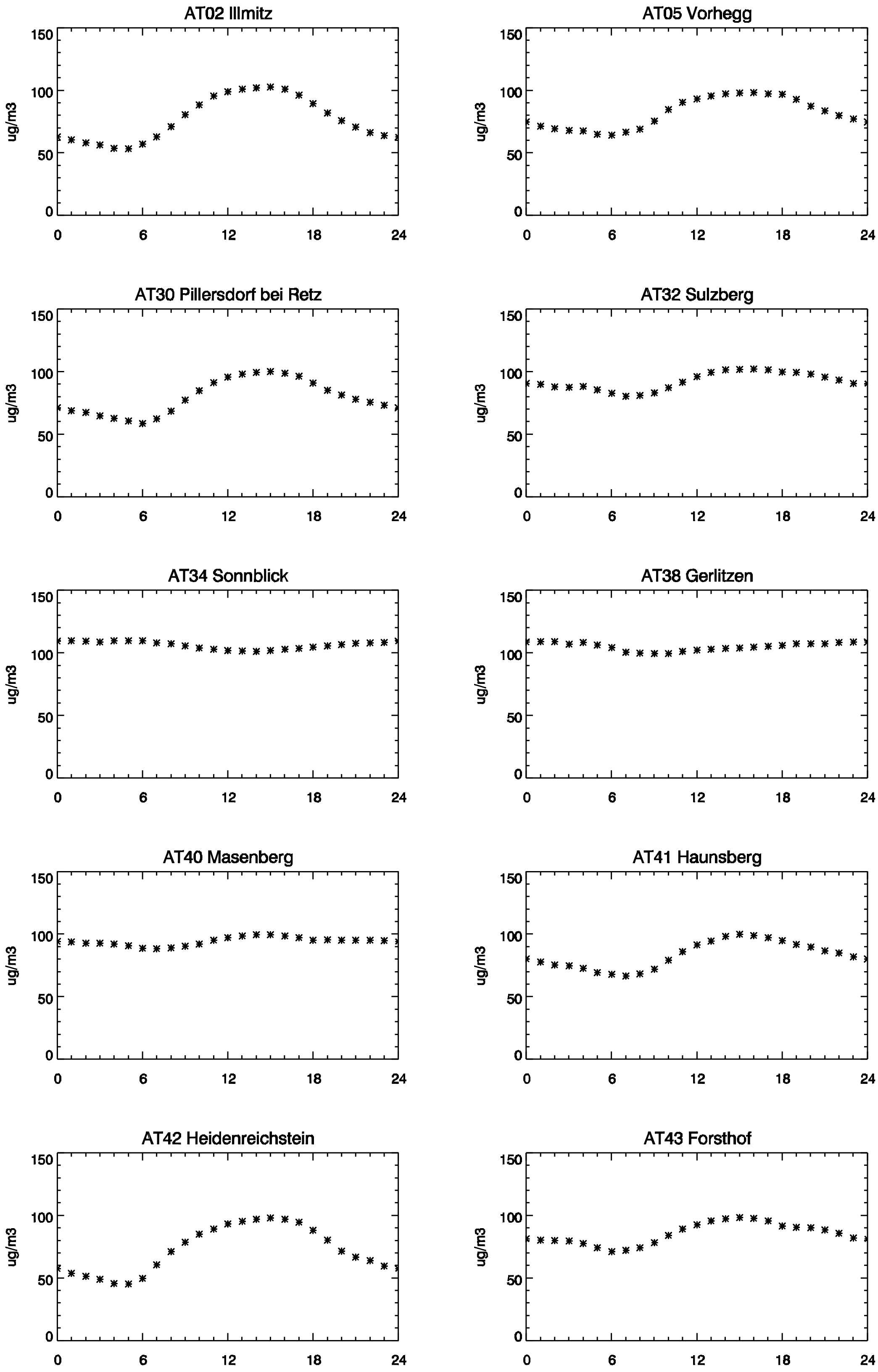


Figure 4.1: Diurnal variation, April–September 2011.

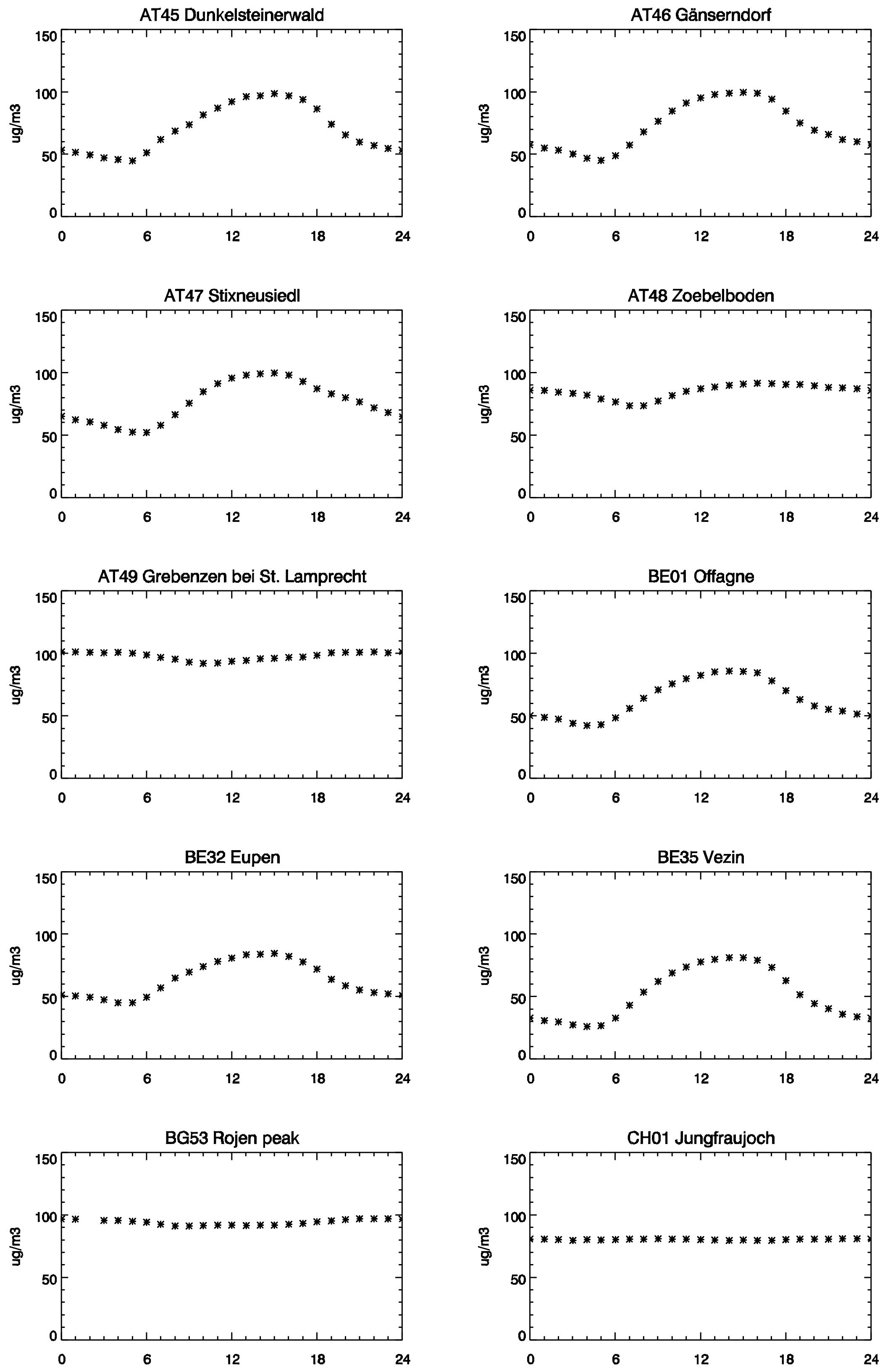


Figure 4.1, cont.

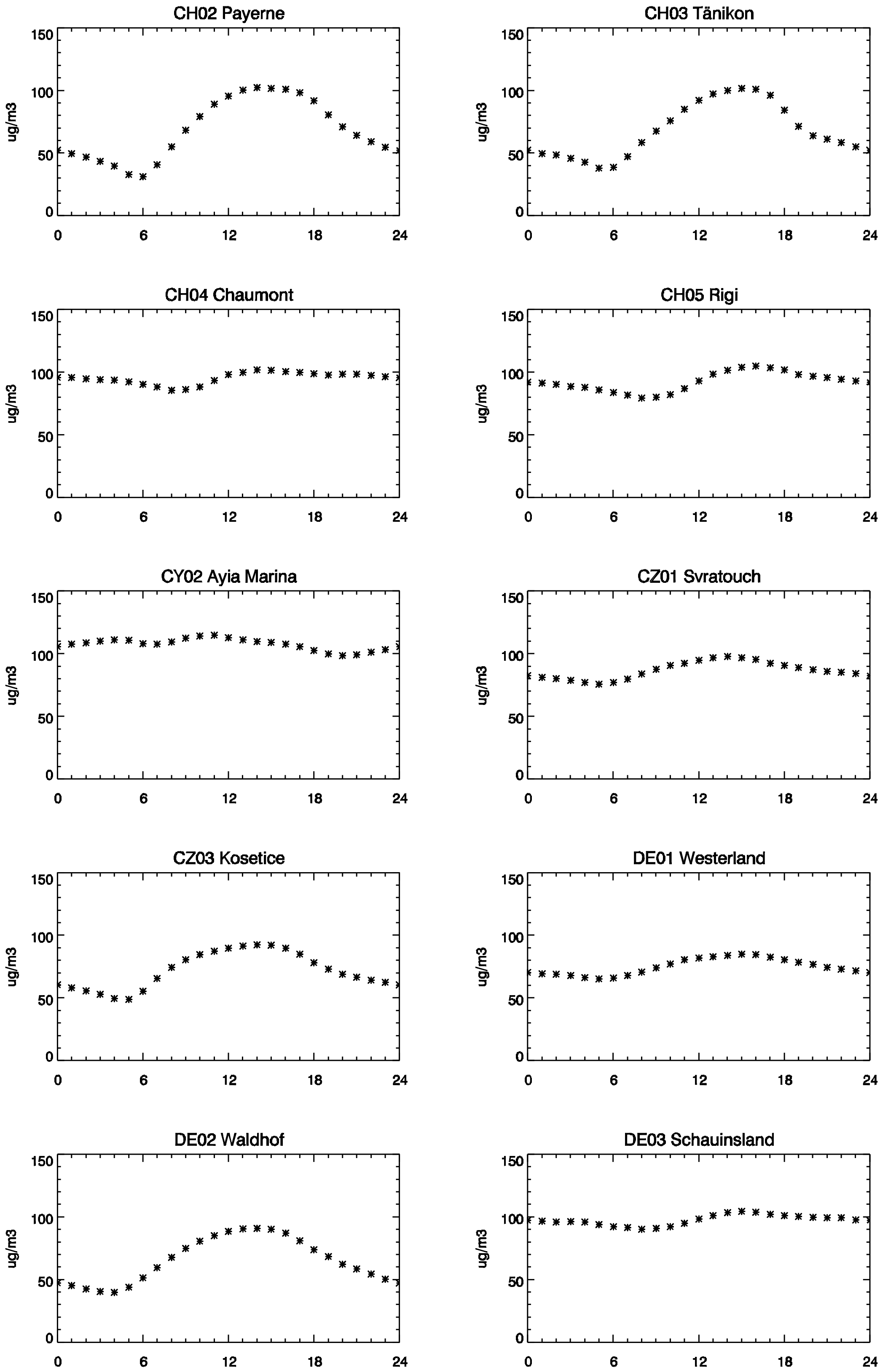


Figure 4.1, cont.

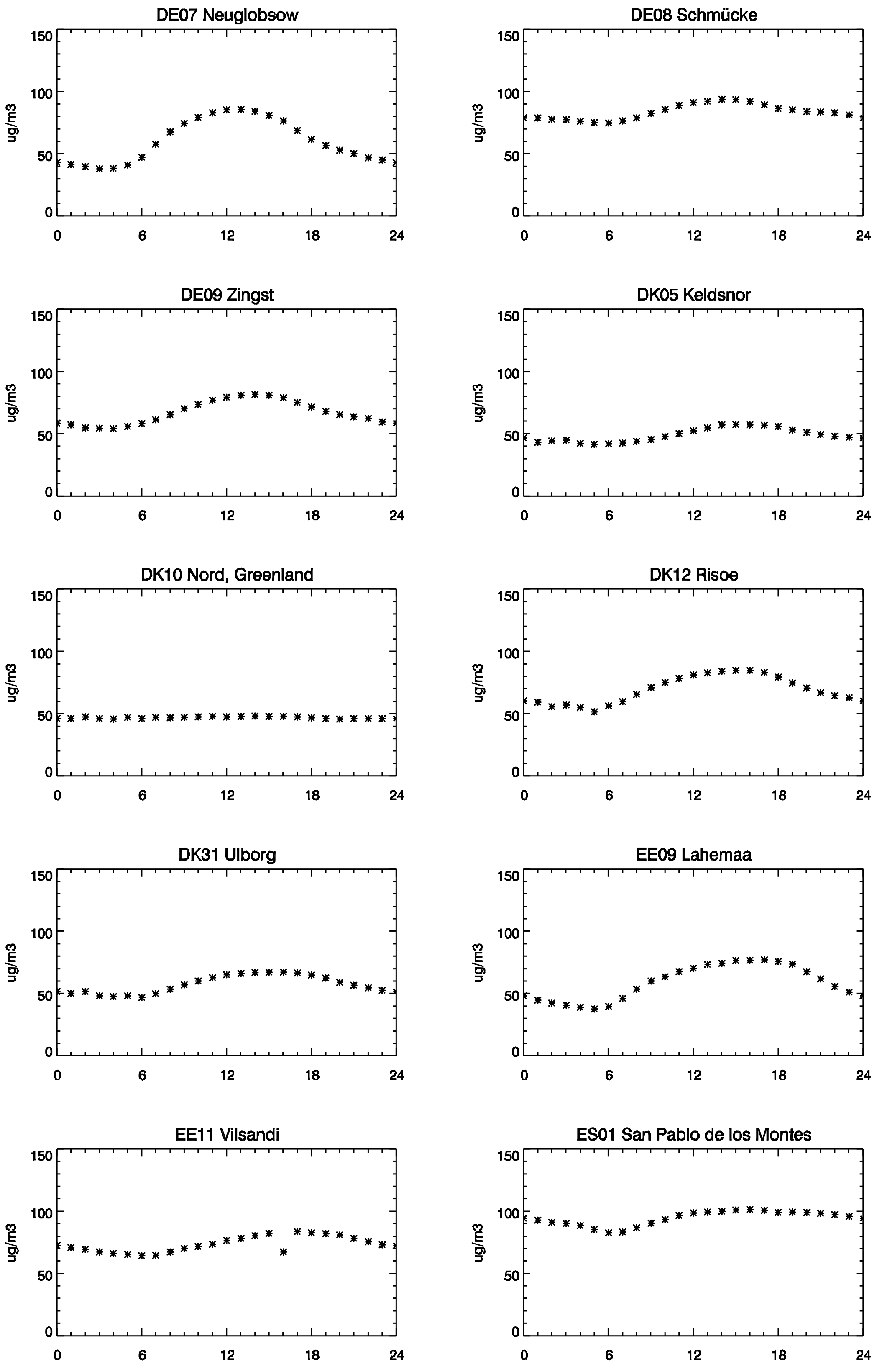


Figure 4.1, cont.

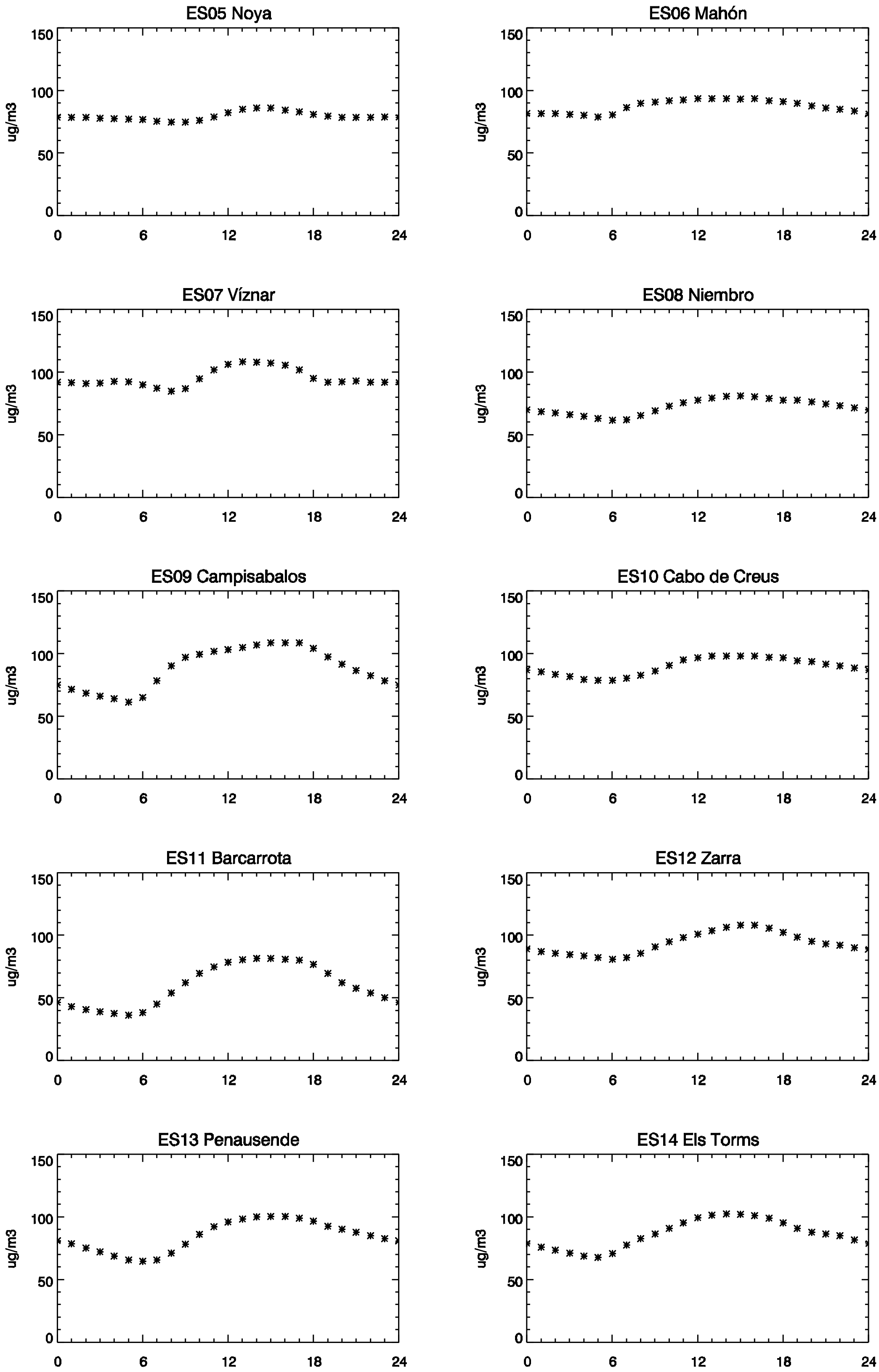


Figure 4.1, cont.

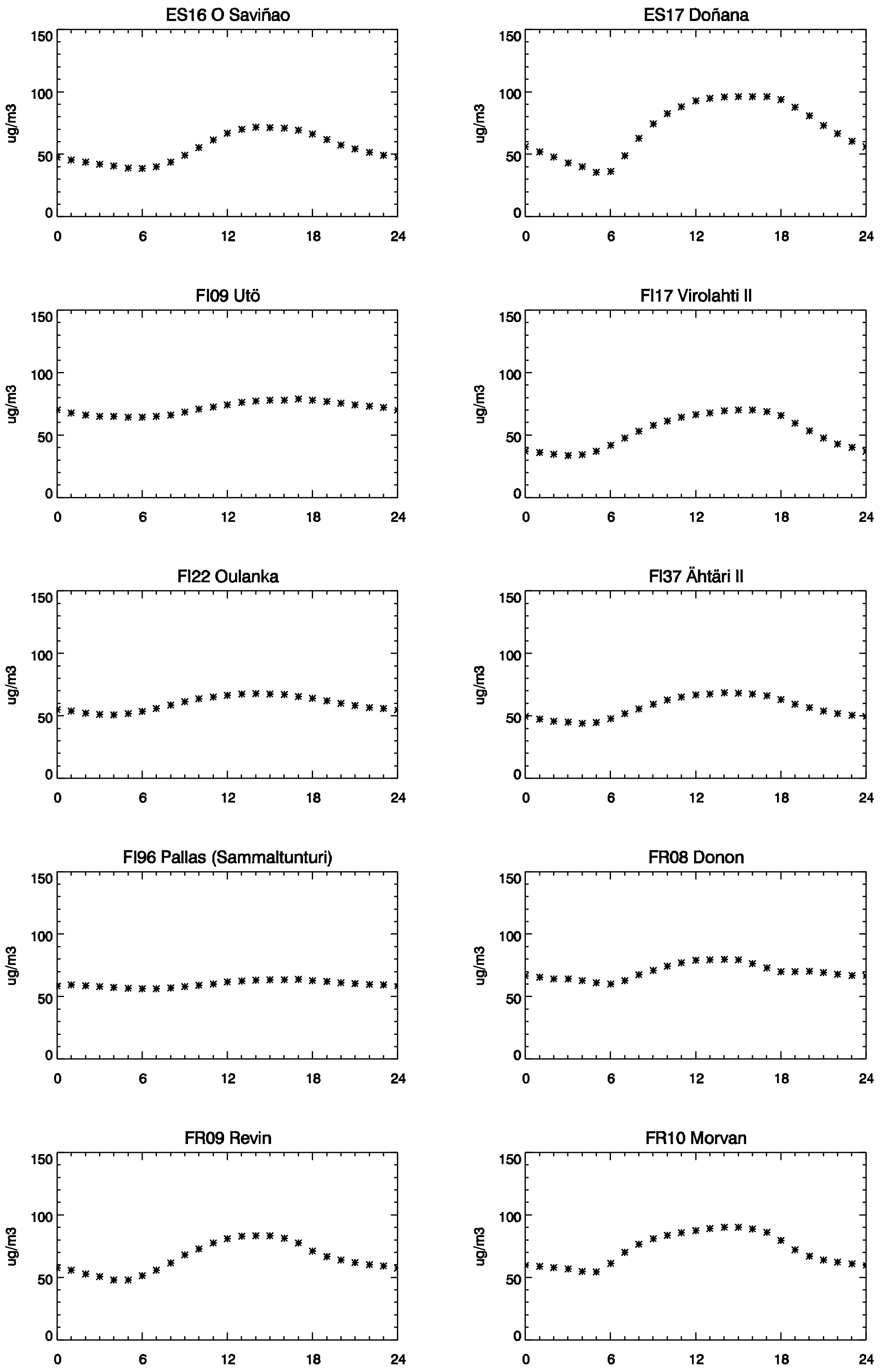


Figure 4.1, cont.

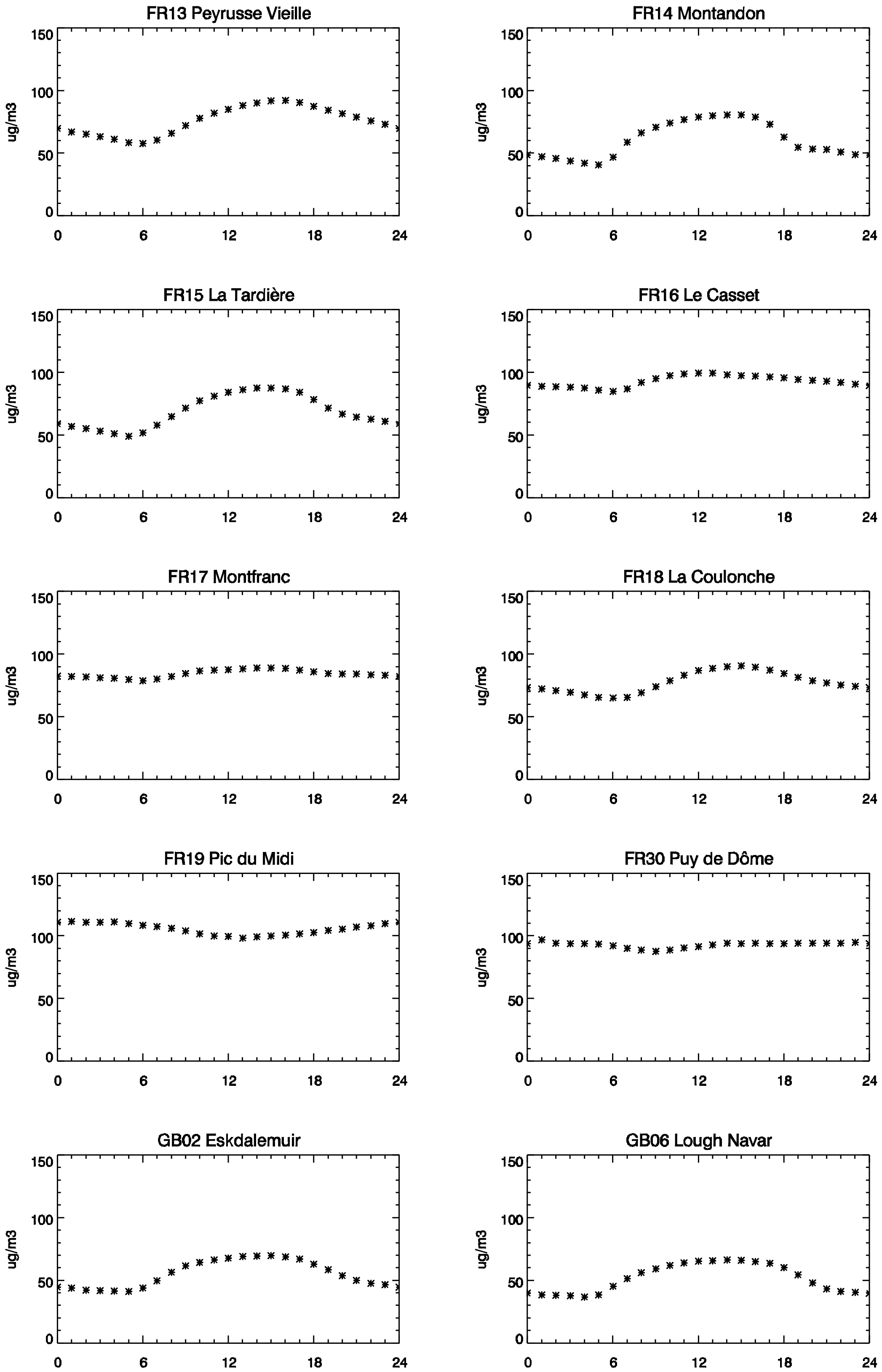


Figure 4.1, cont.

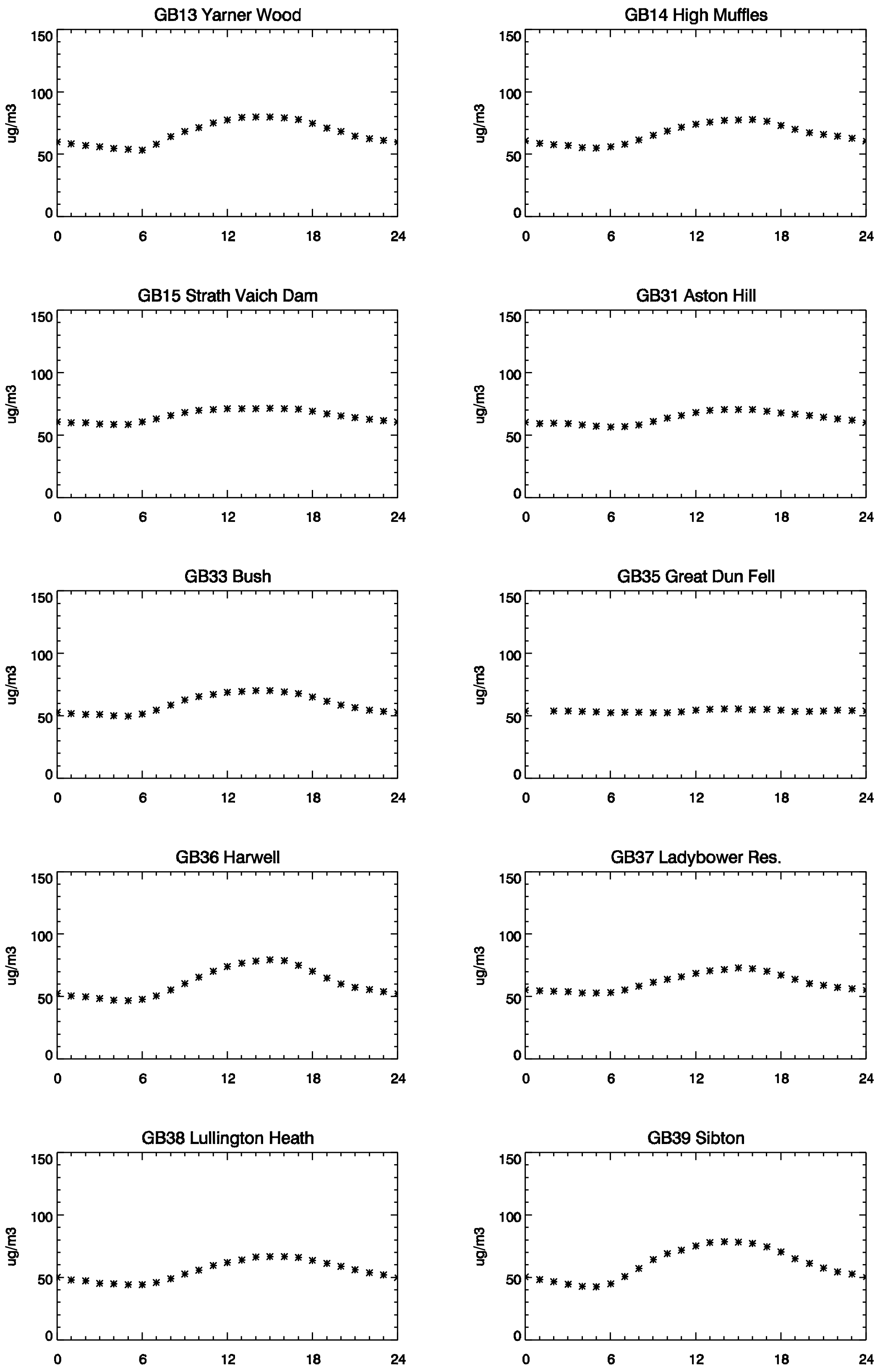


Figure 4.1, cont.

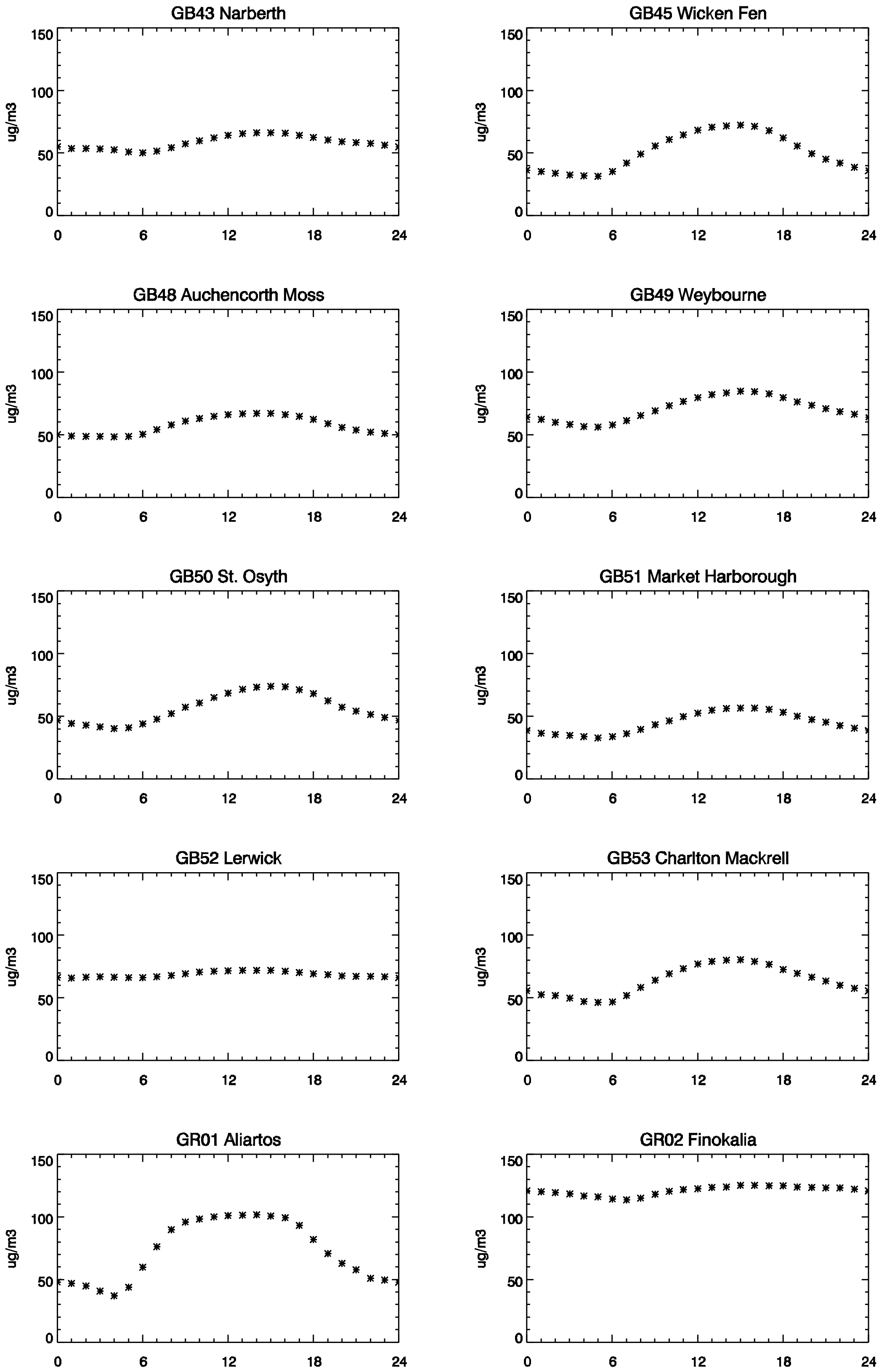


Figure 4.1, cont.

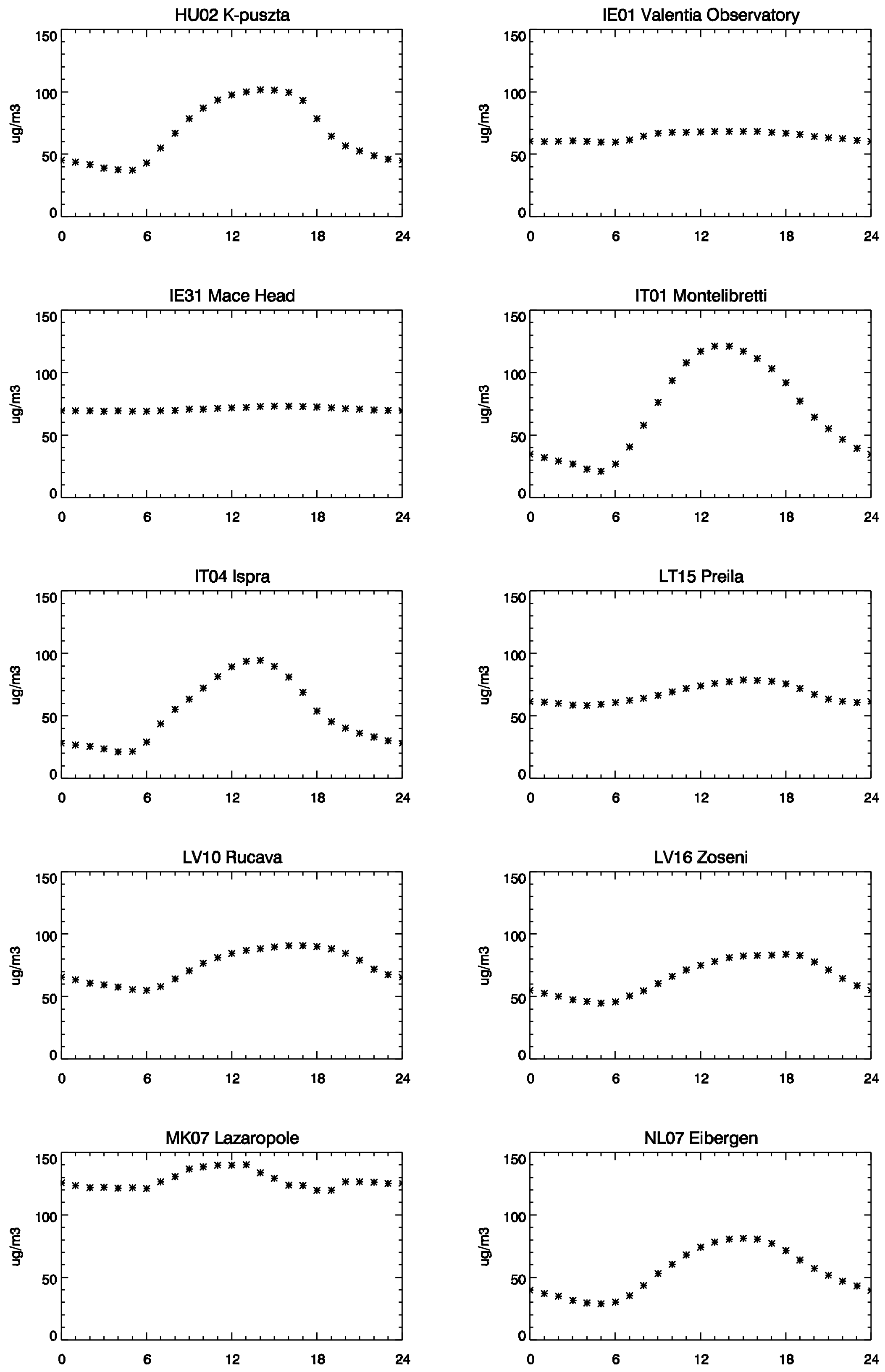


Figure 4.1, cont.

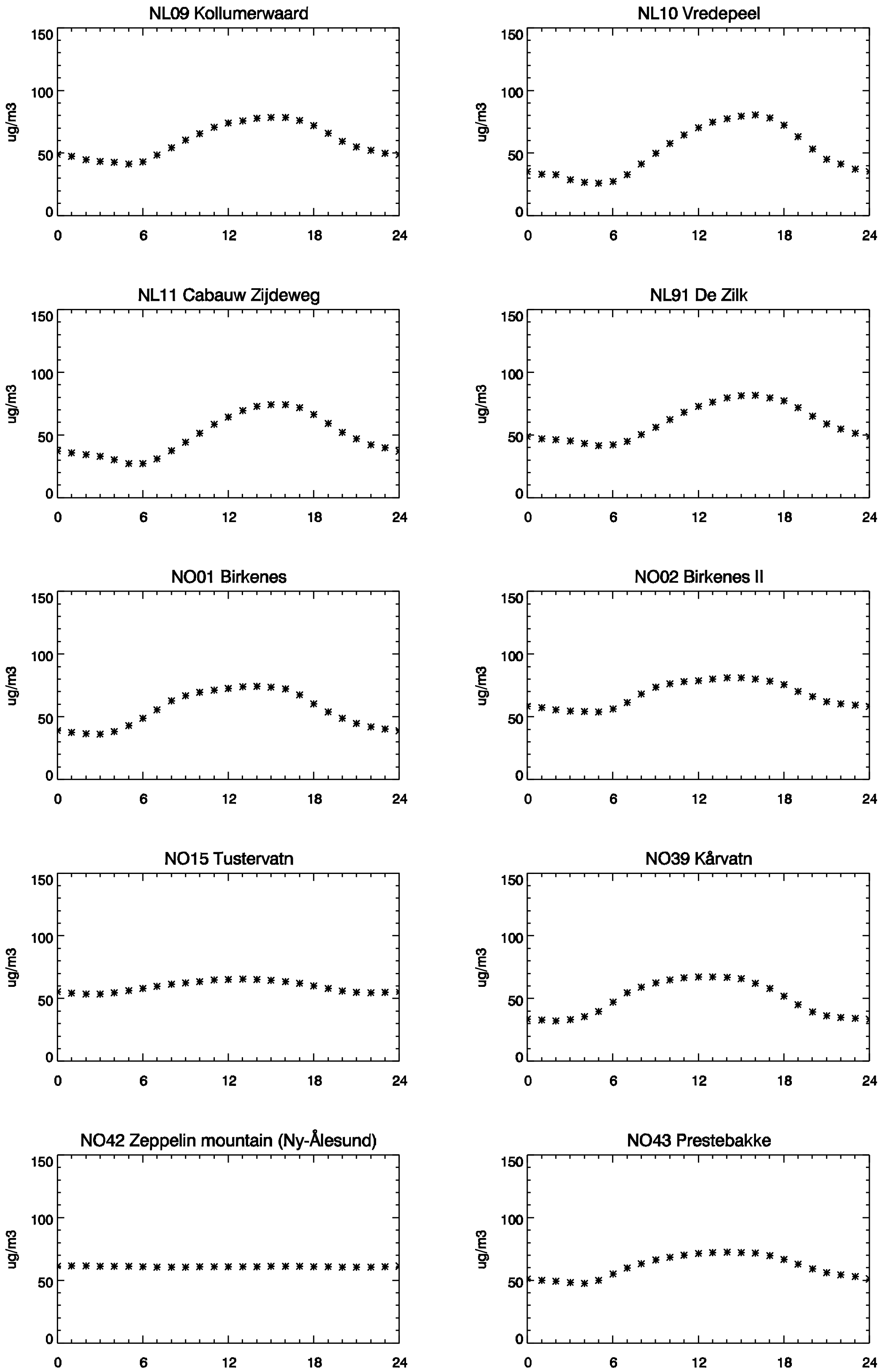


Figure 4.1, cont.

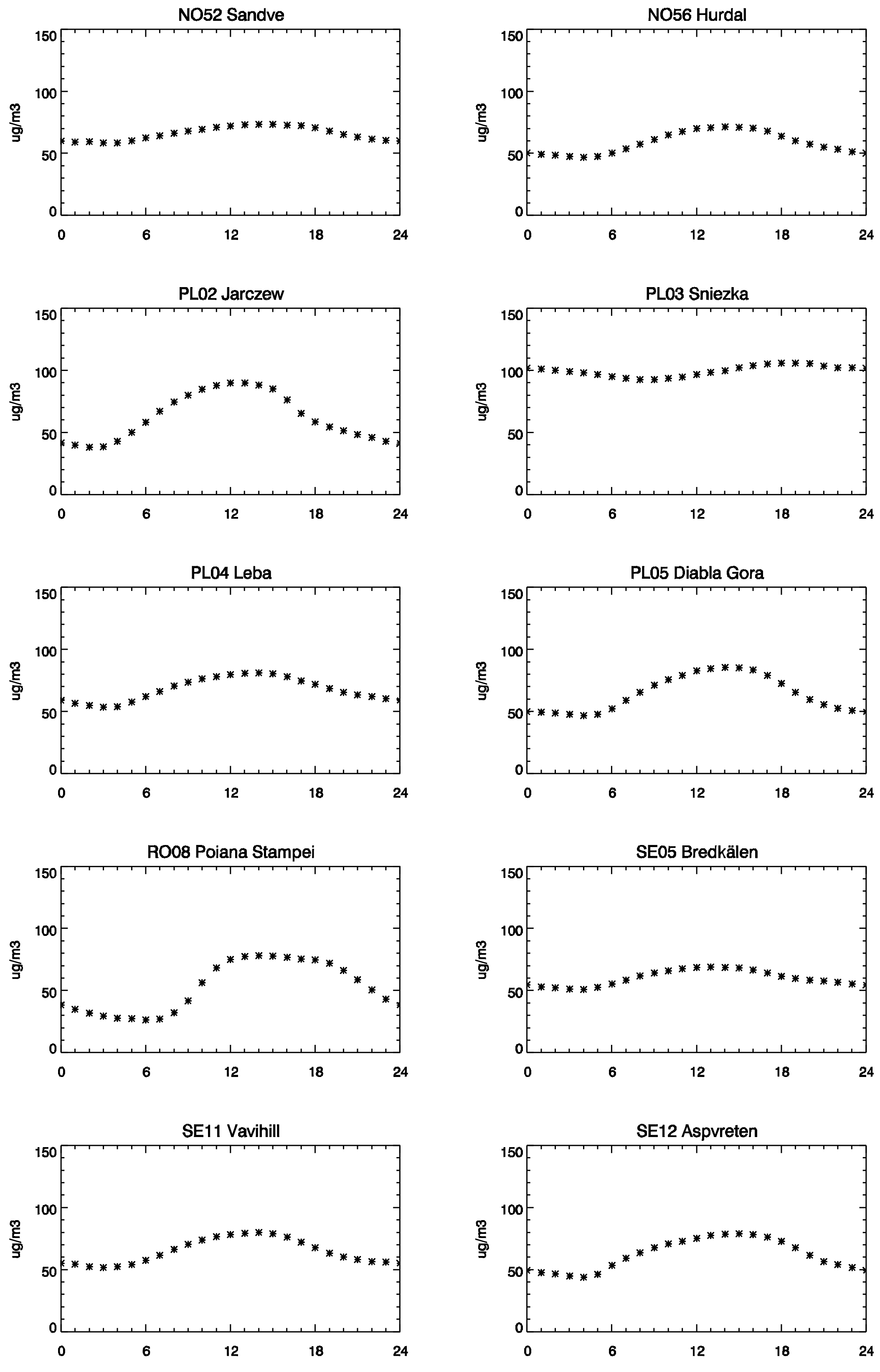


Figure 4.1, cont.

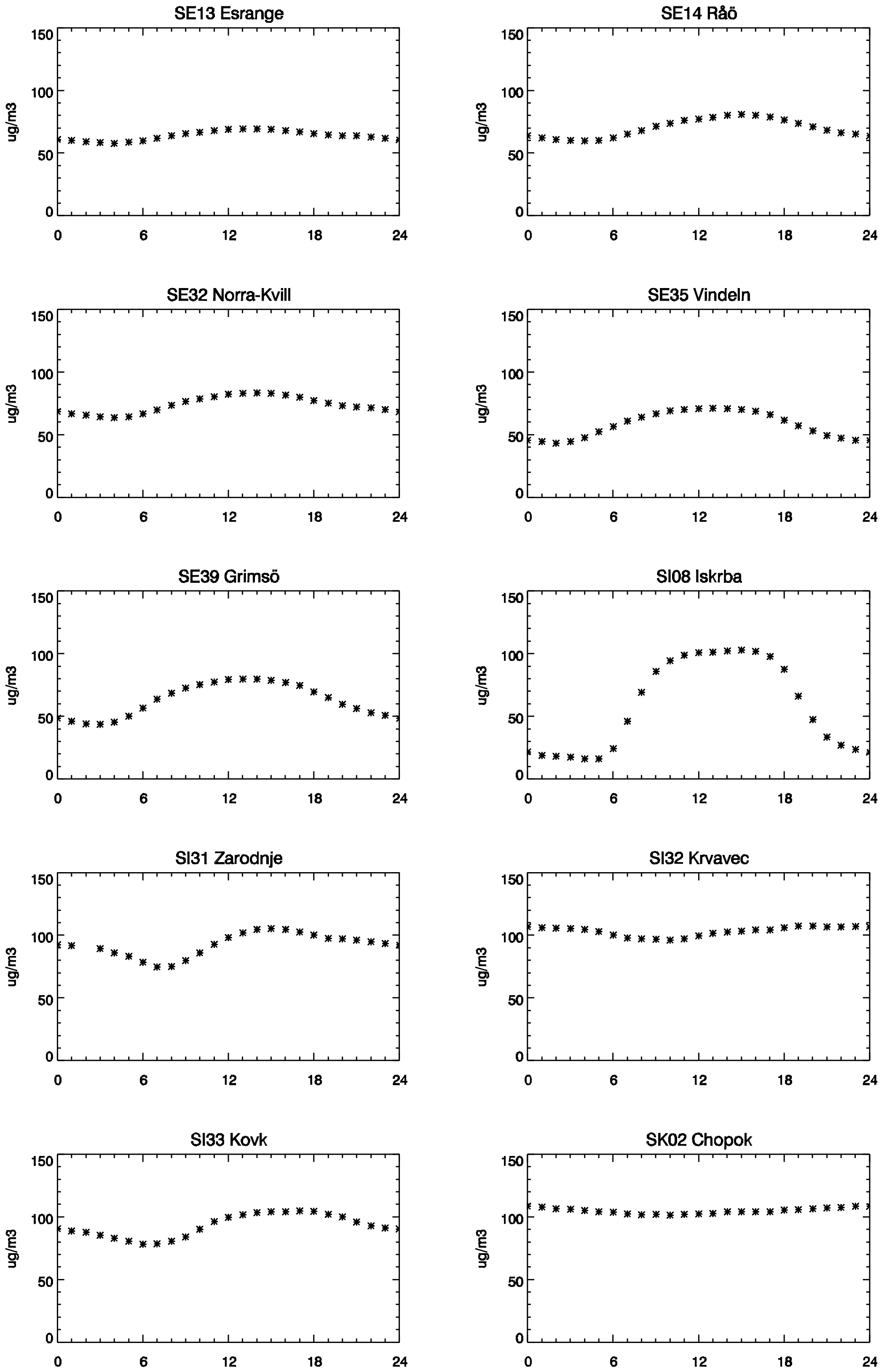


Figure 4.1, cont.

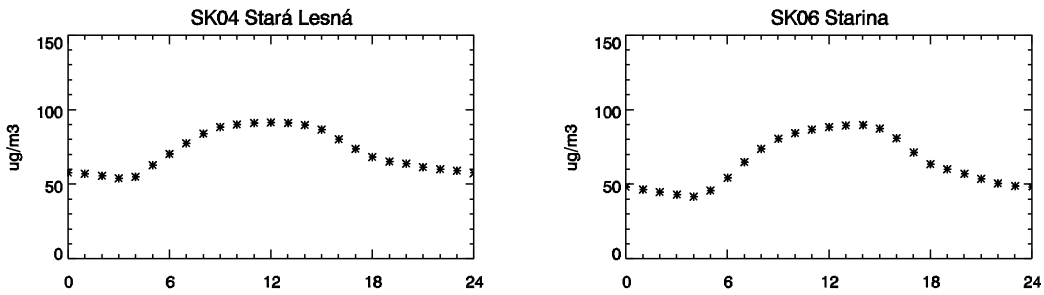


Figure 4.1, cont.

Annex 5

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