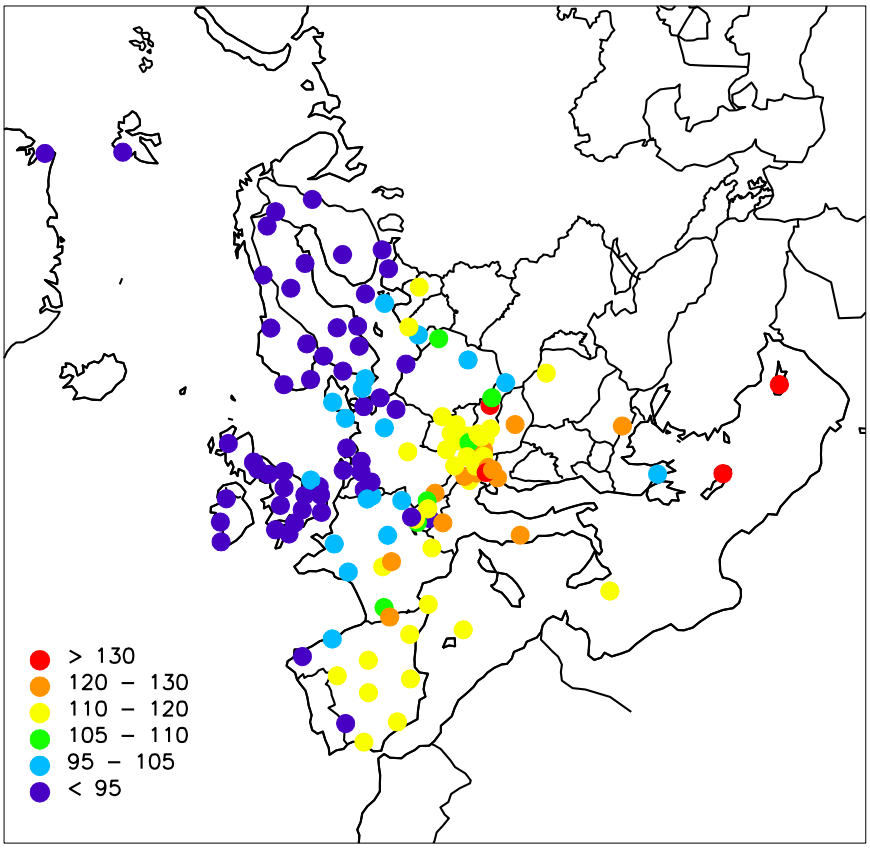
EMEP/CCC-Report 2/2014

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

Ozone measurements 2012

Anne-Gunn Hjellbrekke and Sverre Solberg



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 EMEP ozone data from 2012 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 defined certain threshold levels for ozone. Within WHO these are called “air quality guidelines”, within EU “target value”, “long-term objective” etc. and within UN-ECE “critical levels”. The values of the various threshold levels vary among these organisations and, additionally, the health based indicators are normally based on concentration ($\mu g/m^3$) whereas those related to vegetation are based on mixing ratio (ppb). An overview of various levels relevant for vegetation and human health is given in Table 1 and Table 2, respectively.

Table 1: Limit values for the protection of vegetation.

AOT40 (ppb hours)	Period	Reference	Comment
3000	3 months	CLRTAP (2011)	Critical level for crops and natural vegetation [1)]
5000	1 April - 1 Oct	CLRTAP (2011)	Critical level for forest [1)]
6000	3.5 months	CLRTAP (2011)	Critical level for horticultural crops
9000	1 May – 1 Aug	EU (2008)	EU's target value for vegetation [2,3)]
3000	1 May - 1 Aug	EU (2008)	EU's long-term objective for vegetation [2,3)]

1) ECE's AOT values should be based on the hours with global incoming radiation > 50 W/m^2
2) EU's AOT values should be based on the period 08-20 CET
3) The EU directive uses $\mu g/m^3$ and a factor 2 $\mu g/m^3$ = 1 ppb

Table 2: Limit values for the protection of human health.

Value ($\mu g/m^3$)	Averaging time (hours)	Ref	Description
180	1	EU (2008)	EU's information threshold
240	1	EU (2008)	EU's alert threshold
120	8[1)]	EU (2008)	EU's target value. 8-hour mean value not to be exceeded on more than 25 days per year averaged over 3 years. To be fulfilled by 1.1.2010
120	8[1)]	EU (2008)	EU's long-term objective.
100	8[1)]	WHO (2006)	WHO's air quality guideline (global update 2005)

[1)] The highest 8-hour running mean value for each day calculated such that the 8-hour periods are assigned to the day on which the period ends.

Within UN-ECE scientific evidence has suggested that AOT40-based critical levels for vegetation (Gothenburg Protocol of 1999) should 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). 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.

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 (CLRTAP, 2011). 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.

Furthermore, the period for calculation of AOT40 should reflect the true growing season and should thus be adapted to the climate of the various regions in Europe, like specified in the Mapping Manual (CLRTAP, 2011). This leads to large

differences in the applied period, from March-May in East Mediterranean to June-August in North Europe, which in turn has major consequences for the calculated AOT values. Since the aim of the present report is to document the general status of the ozone levels and not to provide any effect based calculations, the same 3-months period (May-July) is used for all stations. This also corresponds to the period stated in the EU directive. Moreover, no adjustment of the measured values to take the canopy height into account is done in this report. The measurement data are used directly.

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.

WHO has also defined certain air quality guidelines for the protection of human health and provided a global update of these levels including a new guideline for ground-level ozone in 2005 (WHO, 2006). Additionally, within both WHO, EU and UN-ECE the parameter SOMO35, defined as the sum of maximum 8-hour ozone levels over 35 ppb, is used as an indicator for health effects without any specified threshold level.

New flux-based critical levels for various types of vegetation have been approved for inclusion in LRTAP Convention's modelling and mapping manual (CLRTAP, 2011). 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.

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 2012 with emphasis on statistical summaries and geographical distributions. Earlier reports are listed in Annex 5.

Table 3 and Figure 1 show the location of the monitoring stations reporting data from whole or part of 2012. In total 135 stations from 29 different countries reported data. One of these sites (Ispra), is operated by the Commission of the European communities in Italy.

Table 3: List of EMEP ozone monitoring stations in operation 2012.

Code	Station name	Latitude	Longitude	Altitude
AM0001R	Amberd	40°23'04"N	044°15'38"E	2080
AT0002R	Illmitz	47°46'00"N	016°46'00"E	117
AT0005R	Vorhegg	46°40'40"N	012°58'20"E	1020
AT0030R	Pillersdorf bei Retz	48°43'16"N	015°56'32"E	315
AT0032R	Sulzberg	47°31'45"N	009°55'36"E	1020
AT0034G	Sonnblick	47°03'16"N	012°57'30"E	3106
AT0038R	Gerlitzen	46°41'37"N	013°54'54"E	1895
AT0040R	Masenberg	47°20'53"N	015°52'56"E	1170
AT0041R	Haunsberg	47°58'23"N	013°00'58"E	730
AT0042R	Heidenreichstein	48°52'43"N	015°02'48"E	570
AT0043R	Forsthof	48°06'22"N	015°55'10"E	581
AT0044R	Graz Platte	47°06'47"N	015°28'14"E	651
AT0045R	Dunkelsteinerwald	48°22'16"N	015°32'48"E	320
AT0046R	Gänserndorf	48°20'05"N	016°43'50"E	161
AT0047R	Stixneusiedl	48°03'03"N	016°40'36"E	240
AT0048R	Zoebelboden	47°50'19"N	014°26'29"E	899
AT0049R	Grebenzen bei St. Lamprecht	47°02'25"N	014°19'48"E	1648
BE0001R	Offagne	49°52'40"N	005°12'13"E	430
BE0032R	Eupen	50°37'46"N	006°00'04"E	295
BE0035R	Vezin	50°30'12"N	004°59'22"E	160
BG0053R	Rojen peak	41°41'45"N	024°44'19"E	1750
CH0001G	Jungfraujoch	46°32'51"N	007°59'06"E	3578
CH0002R	Payerne	46°48'47"N	006°56'41"E	489
CH0003R	Tänikon	47°28'47"N	008°54'17"E	539
CH0004R	Chaumont	47°02'59"N	006°58'46"E	1137
CH0005R	Rigi	47°04'03"N	008°27'50"E	1031
CY0002R	Ayia Marina	35°02'21"N	033°03'29"E	532
CZ0001R	Svratouch	49°44'00"N	016°03'00"E	737
CZ0003R	Košetice	49°35'00"N	015°05'00"E	534
CZ0005R	Churanov	49°04'00"N	013°36'00"E	1118
DE0001R	Westerland	54°55'32"N	008°18'35"E	12
DE0002R	Waldhof	52°48'08"N	010°45'34"E	74
DE0003R	Schauinsland	47°54'53"N	007°54'31"E	1205
DE0007R	Neuglobsow	53°10'00"N	013°02'00"E	62
DE0008R	Schmücke	50°39'00"N	010°46'00"E	937
DE0009R	Zingst	54°26'00"N	012°44'00"E	1
DK0005R	Keldsnor	54°44'00"N	010°44'00"E	10
DK0010G	Nord, Greenland	81°36'00"N	016°40'12"W	20
DK0012R	Risoe	55°41'37"N	012°05'09"E	3
DK0031R	Ulborg	56°17'00"N	008°26'00"E	10

Table 3, cont.

Code	Station name	Latitude	Longitude	Altitude
EE0009R	Lahemaa	59°30'00"N	025°54'00"E	32
EE0011R	Vilsandi	58°23'00"N	021°49'00"E	6
ES0001R	San Pablo de los Montes	39°32'52"N	004°20'55"W	917
ES0006R	Mahón	39°52'00"N	004°19'00"E	78
ES0007R	Víznar	37°14'00"N	003°32'00"W	1265
ES0008R	Niembro	43°26'32"N	004°51'01"W	134
ES0009R	Campisábalos	41°16'52"N	003°08'34"W	1360
ES0010R	Cabo de Creus	42°19'10"N	003°19'01"E	23
ES0011R	Barcarrota	38°28'33"N	006°55'22"W	393
ES0012R	Zarra	39°05'10"N	001°06'07"W	885
ES0013R	Penausende	41°17'00"N	005°52'00"W	985
ES0014R	Els Torms	41°24'00"N	000°43'00"E	470
ES0016R	O Saviñao	43°13'52"N	007°41'59"W	506
ES0017R	Doñana	37°01'50"N	006°19'55"W	5
FI0009R	Utö	59°46'45"N	021°22'38"E	7
FI0017R	Virolahti II	60°31'36"N	027°41'10"E	4
FI0022R	Oulanka	66°19'13"N	029°24'06"E	310
FI0037R	Ähtäri II	62°35'00"N	024°11'00"E	180
FI0096G	Pallas (Sammaltunturi)	68°00'00"N	024°09'00"E	340
FR0008R	Donon	48°30'00"N	007°08'00"E	775
FR0009R	Revin	49°54'00"N	004°38'00"E	390
FR0010R	Morvan	47°16'00"N	004°05'00"E	620
FR0013R	Peyrusse Vieille	43°37'00"N	000°11'00"E	200
FR0014R	Montandon	47°18'00"N	006°50'00"E	836
FR0015R	La Tardière	46°39'00"N	000°45'00"W	133
FR0016R	Le Casset	45°00'00"N	006°28'00"E	1750
FR0017R	Montfranc	45°48'00"N	002°04'00"E	810
FR0018R	La Coulonche	48°38'00"N	000°27'00"W	309
FR0019R	Pic du Midi	42°56'12"N	000°08'31"E	2877
FR0030R	Puy de Dôme	45°46'00"N	002°57'00"E	1465
GB0002R	Eskdalemuir	55°18'47"N	003°12'15"W	243
GB0006R	Lough Navar	54°26'35"N	007°52'12"W	126
GB0013R	Yarner Wood	50°35'47"N	003°42'47"W	119
GB0014R	High Muffles	54°20'04"N	000°48'27"W	267
GB0015R	Strath Vaich Dam	57°44'04"N	004°46'28"W	270
GB0031R	Aston Hill	52°30'14"N	003°01'59"W	370
GB0033R	Bush	55°51'31"N	003°12'18"W	180
GB0035R	Great Dun Fell	54°41'00"N	002°27'00"W	847
GB0036R	Harwell	51°34'23"N	001°19'00"W	137
GB0037R	Ladybower Res.	53°23'56"N	001°45'12"W	420
GB0038R	Lullington Heath	50°47'34"N	000°10'46"E	120
GB0039R	Sibton	52°17'38"N	001°27'47"E	46
GB0043R	Narberth	51°14'00"N	004°42'00"W	160
GB0045R	Wicken Fen	52°17'54"N	000°17'34"W	5
GB0048R	Auchencorth Moss	55°47'32"N	003°14'34"W	260
GB0049R	Weybourne	52°57'02"N	001°07'19"E	16
GB0050R	St. Osyth	51°46'41"N	001°04'56"E	8
GB0052R	Lerwick	60°08'21"N	001°11'07"W	85
GB0053R	Charlton Mackrell	51°03'23"N	002°41'00"W	54
GR0001R	Aliartos	38°22'00"N	023°05'00"E	110
GR0002R	Finokalia	35°19'00"N	025°40'00"E	250
HU0002R	K-puszta	46°58'00"N	019°35'00"E	125
IE0001R	Valentia Observatory	51°56'23"N	010°14'40"W	11
IE0031R	Mace Head	53°10'00"N	009°30'00"W	15
IT0001R	Montelibretti	42°06'00"N	012°38'00"E	48
IT0004R	Ispra	45°48'00"N	008°38'00"E	209
LT0015R	Preila	55°21'00"N	021°04'00"E	5
LV0010R	Rucava	56°09'43"N	021°10'23"E	18
LV0016R	Zoseni	57°08'07"N	025°54'20"E	188
MK0007R	Lazaropole	41°32'10"N	020°41'38"E	1332
MT0001R	Giordan lighthouse	36°04'24"N	014°13'09"E	167
NL0007R	Eibergen	52°05'00"N	006°34'00"E	20
NL0009R	Kollumerwaard	53°20'02"N	006°16'38"E	1
NL0010R	Vredepeel	51°32'28"N	005°51'13"E	28
NL0091R	De Zilk	52°18'00"N	004°30'00"E	4
NL0644R	Cabauw Wielsekade	51°58'28"N	004°55'25"E	1

Table 3, cont.

Code	Station name	Latitude	Longitude	Altitude
NO0001R	Birkenes	58°23'00"N	008°15'00"E	190
NO0002R	Birkenes II	58°23'19"N	008°15'07"E	219
NO0015R	Tustervatn	65°50'00"N	013°55'00"E	439
NO0039R	Kårvatn	62°47'00"N	008°53'00"E	210
NO0042G	Zeppelin mountain (Ny-Ålesund)	78°54'24"N	011°53'18"E	474
NO0043R	Prestebakke	59°00'00"N	011°32'00"E	160
NO0052R	Sandve	59°12'00"N	005°12'00"E	15
NO0056R	Hurdal	60°22'21"N	011°04'41"E	300
PL0002R	Jarczew	51°49'00"N	021°59'00"E	180
PL0003R	Sniezka	50°44'00"N	015°44'00"E	1603
PL0004R	Leba	54°45'00"N	017°32'00"E	2
PL0005R	Diabla Gora	54°09'00"N	022°04'00"E	157
RO0008R	Poiana Stampei	47°19'29"N	025°08'05"E	908
SE0005R	Bredkälen	63°51'00"N	015°20'00"E	404
SE0011R	Vavihill	56°01'00"N	013°09'00"E	175
SE0012R	Aspvreten	58°48'00"N	017°23'00"E	20
SE0013R	Esrange	67°53'00"N	021°04'00"E	475
SE0014R	Råö	57°23'38"N	011°54'50"E	5
SE0032R	Norra-Kvill	57°49'00"N	015°34'00"E	261
SE0035R	Vindeln	64°15'00"N	019°46'00"E	225
SE0039R	Grimsö	59°43'41"N	015°28'19"E	132
SI0008R	Iskrba	45°34'00"N	014°52'00"E	520
SI0031R	Zarodnje	46°25'43"N	015°00'12"E	770
SI0032R	Krvavec	46°17'58"N	014°32'19"E	1740
SI0033R	Kovk	46°07'43"N	015°06'50"E	600
SK0002R	Chopok	48°56'00"N	019°35'00"E	2008
SK0004R	Stará Lesná	49°09'00"N	020°17'00"E	808
SK0006R	Starina	49°03'00"N	022°16'00"E	345
SK0007R	Topolniky	47°57'36"N	017°51'38"E	113

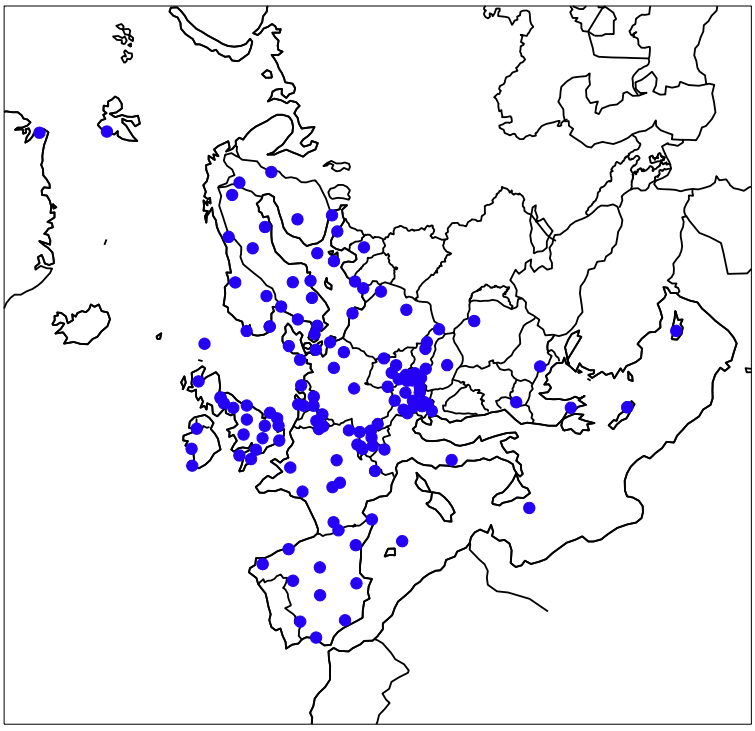

Figure 1: Location of the monitoring stations.

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. 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 2012.

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 4. 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 4: 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 5. The data capture is in general good. 120 stations have a data capture above 90% and 124 above 85%.

Table 5: Data capture in per cent, 2012.

Code	Station	Data capture 2012
AM0001R	Amberd	34.7
AT0002R	Illmitz	95.3
AT0005R	Vorhegg	92.8
AT0030R	Pillersdorf bei Retz	93.7
AT0032R	Sulzberg	94.7
AT0034G	Sonnblick	92.0
AT0038R	Gerlitzen	95.4
AT0040R	Masenberg	94.4
AT0041R	Haunsberg	95.5
AT0042R	Heidenreichstein	95.4
AT0043R	Forsthof	95.2
AT0044R	Graz Platte	95.5
AT0045R	Dunkelsteinerwald	95.0
AT0046R	Gänserndorf	95.1
AT0047R	Stixneusiedl	95.0
AT0048R	Zoebelboden	94.2
AT0049R	Grebenzen bei St. Lamprecht	94.0
BE0001R	Offagne	92.2
BE0032R	Eupen	93.5
BE0035R	Vezin	92.7
BG0053R	Rojen peak	92.3
CH0001G	Jungfraujoch	96.7
CH0002R	Payerne	95.3
CH0003R	Tänikon	93.9
CH0004R	Chaumont	95.3
CH0005R	Rigi	95.7
CY0002R	Ayia Marina	92.7
CZ0001R	Svratouch	99.5
CZ0003R	Košetice	97.7
CZ0005R	Churanov	98.9
DE0001R	Westerland	94.9
DE0002R	Waldhof	95.4
DE0003R	Schauinsland	71.2
DE0007R	Neuglobsow	95.2
DE0008R	Schmücke	95.3
DE0009R	Zingst	95.8
DK0005R	Keldsnor	87.6
DK0010G	Nord, Greenland	88.7
DK0012R	Risoe	90.4
DK0031R	Ulborg	85.3
EE0009R	Lahemaa	99.0
EE0011R	Vilsandi	95.7

Table 5, cont.

Code	Station	Data capture 2012
ES0001R	San Pablo de los Montes	98.8
ES0006R	Mahón	98.1
ES0007R	Víznar	95.5
ES0008R	Niembro	95.4
ES0009R	Campisábalos	97.1
ES0010R	Cabo de Creus	96.8
ES0011R	Barcarrota	97.3
ES0012R	Zarra	99.3
ES0013R	Penausende	98.1
ES0014R	Els Torms	97.6
ES0016R	O Saviñao	98.7
ES0017R	Doñana	96.7
FI0009R	Utö	97.4
FI0017R	Virolahti II	98.0
FI0022R	Oulanka	94.6
FI0037R	Ähtäri II	97.0
FI0096G	Pallas (Sammaltunturi)	96.9
FR0008R	Donon	98.9
FR0009R	Revin	99.5
FR0010R	Morvan	94.4
FR0013R	Peyrusse Vieille	86.3
FR0014R	Montandon	98.0
FR0015R	La Tardière	99.1
FR0016R	Le Casset	98.9
FR0017R	Montfranc	95.3
FR0018R	La Coulonche	95.8
FR0019R	Pic du Midi	94.8
FR0030R	Puy de Dôme	94.8
GB0002R	Eskdalemuir	99.3
GB0006R	Lough Navar	95.9
GB0013R	Yarner Wood	90.8
GB0014R	High Muffles	96.7
GB0015R	Strath Vaich Dam	98.0
GB0031R	Aston Hill	99.1
GB0033R	Bush	99.2
GB0035R	Great Dun Fell	79.6
GB0036R	Harwell	98.6
GB0037R	Ladybower Res.	99.0
GB0038R	Lullington Heath	99.1
GB0039R	Sibton	99.8
GB0043R	Narberth	97.1
GB0045R	Wicken Fen	97.0
GB0048R	Auchencorth Moss	99.2
GB0049R	Weybourne	99.9
GB0050R	St. Osyth	98.4
GB0052R	Lerwick	74.2
GB0053R	Charlton Mackrell	99.6
GR0001R	Aliartos	99.1
GR0002R	Finokalia	93.2
HU0002R	K-puszta	82.5
IE0001R	Valentia Observatory	96.9
IE0031R	Mace Head	97.0

Table 5, cont.

Code	Station	Data capture 2012
IT0001R	Montelibretti	99.2
IT0004R	Ispra	99.3
LT0015R	Preila	97.6
LV0010R	Rucava	93.8
LV0016R	Zoseni	99.1
MK0007R	Lazaropole	10.0
MT0001R	Giordan lighthouse	92.5
NL0007R	Eibergen	95.6
NL0009R	Kollumerwaard	97.3
NL0010R	Vredepeel	94.2
NL0091R	De Zilk	95.6
NL0644R	Cabauw Wielsekade	60.6
NO0001R	Birkenes	35.3
NO0002R	Birkenes II	79.8
NO0015R	Tustervatn	99.5
NO0039R	Kårvatn	97.8
NO0042G	Zeppelin mountain (Ny-Ålesund)	97.5
NO0043R	Prestebakke	98.8
NO0052R	Sandve	98.8
NO0056R	Hurdal	99.6
PL0002R	Jarczew	99.5
PL0003R	Sniezka	99.7
PL0004R	Leba	98.8
PL0005R	Diabla Gora	99.8
RO0008R	Poiana Stampei	76.4
SE0005R	Bredkälen	99.7
SE0011R	Vavihill	97.9
SE0012R	Aspvreten	98.0
SE0013R	Esrange	92.6
SE0014R	Råö	99.1
SE0032R	Norra-Kvill	91.3
SE0035R	Vindeln	97.0
SE0039R	Grimsö	99.8
SI0008R	Iskrba	94.4
SI0031R	Zarodnje	94.6
SI0032R	Krvavec	94.3
SI0033R	Kovk	91.0
SK0002R	Chopok	96.6
SK0004R	Stará Lesná	96.8
SK0006R	Starina	98.4
SK0007R	Topolniky	81.1

Missing data in the measurement series may be critical, especially in summer when the highest ozone concentrations occur. In particular calculations of AOT40 values may be strongly affected by missing data, and a correction is necessary in order to obtain comparable calculations. In the mapping of AOT40, a 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 of 2012 was characterised by short regional ozone episodes with few exceedances of thresholds between min-June and end of August. There were only three larger episodes this summer (EEA, 2013). 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 2012 was measured at Vezin in Belgium (212 μg/m^3, July 25) (Table 1.1, Annex 1). In total concentrations above 200 μg/m^3 were measured at seven sites. The lowest maximum concentrations were measured at Spitsbergen (Zeppelin mountain, Ny-Ålesund, 106 μg/m^3) and in the Northern Finland (Pallas, 110 μg/m^3).

Exceedances of the information threshold of 180 μg/m^3 were observed at 22 sites mainly in Central Europe (Figure 1.4, Annex 1). The unusual warm summers of 2003 and 2006 had 81 and 69 exceedances respectively.

Table 1.2 in Annex 1 shows the 25-, 50-, 75-, 90-, 95-, 98- and 99-percentiles for the period April-September. Graphical distributions of the 99-percentiles and 95-percentiles for stations with data capture higher than 75% 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 Baltic region, where the 99-percentiles are below 110 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 110-130 μg/m^3, and at its highest in Germany, France, Italy and Spain where the 99-percentile values are above 130 μg/m^3.

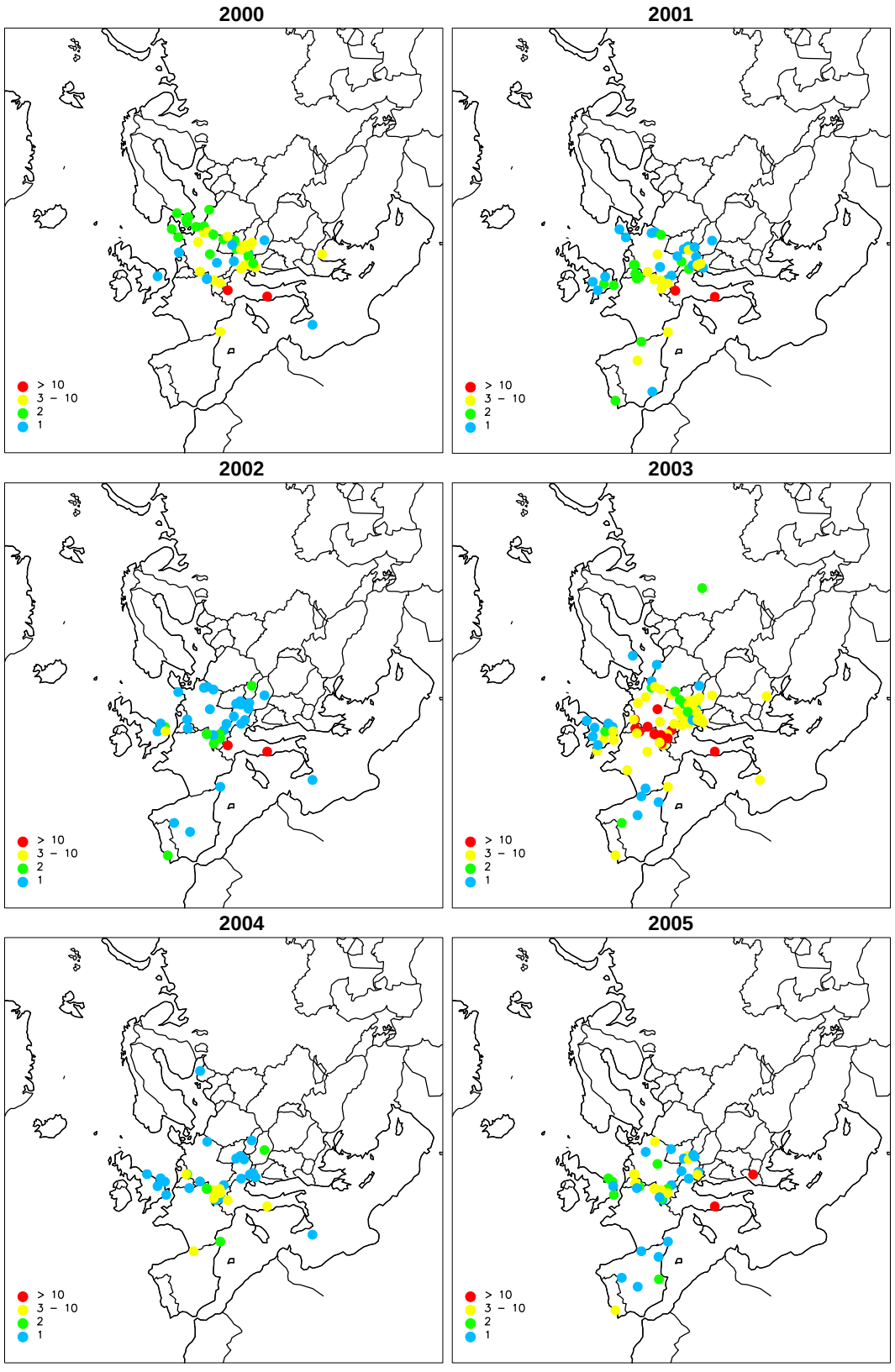

Figure 2: Number of exceedances of the threshold value of 180 µg/m^3 2000-2012. (Unit: number of days.) Stations with zero exceedances are not shown.

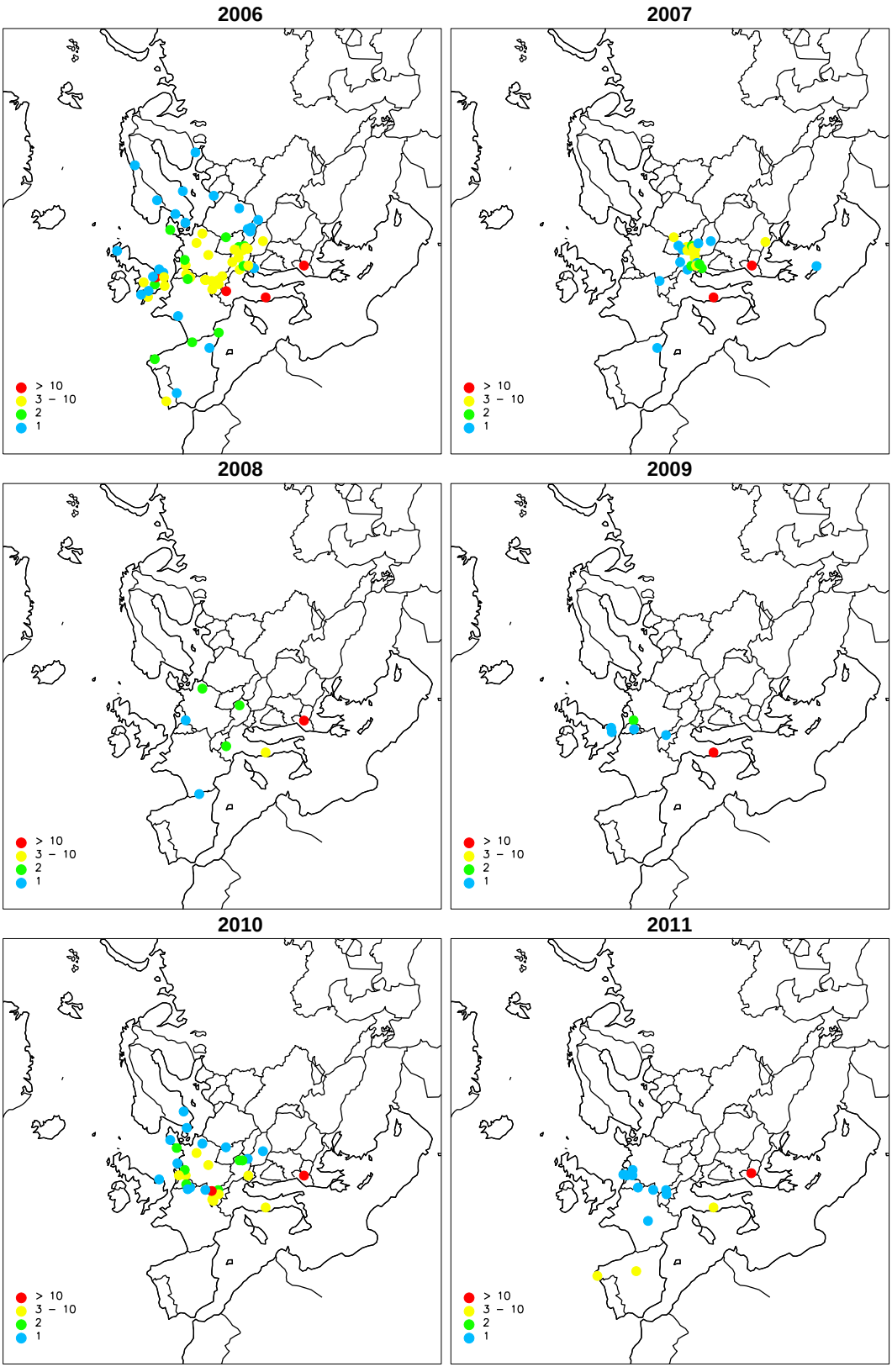

Figure 2, cont.

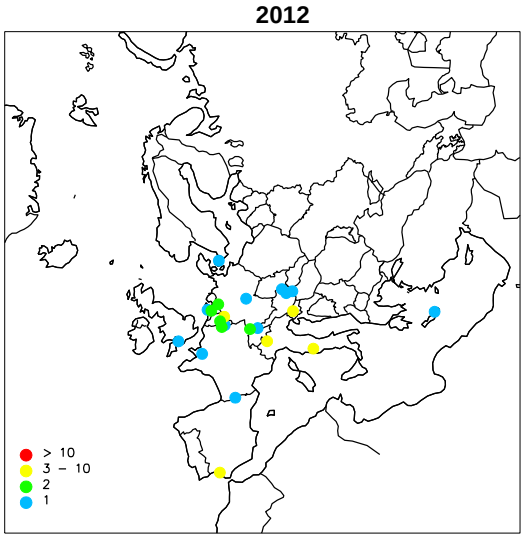

Figure 2, cont.

6. Calculation of AOT40

AOT40 and AOT60 for forest and agricultural crops for 2012 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. Four sites in Europe (Macedonia, Greece and Cyprus) have AOT40 (May-July) values above 15 000 ppbh. The critical level for forest (5 000 ppbh) is exceeded at most sites in Central, Eastern and Southern Europe.

7. Seasonal variation

Monthly mean concentrations for 2012 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 1990-2012 are given in Figure 3.1 in Annex 3. The seasonal variation of ozone shows characteristics, which seem to be bound by the geographical location of the station (Roemer et al., 1996). In Central and Alpine Europe the variation is characterised by a broad summer maximum with high monthly means from May to August. A springtime maximum in April and May followed by a gradual decline to a minimum in November-December is found for sites in England, the Netherlands and the southern parts of Scandinavia and Finland. A spring maximum followed by a minimum in the summer is generally found in Ireland, Scotland and the northern parts of Scandinavia and Finland.

8. Diurnal variation

In addition to the seasonal variation, ozone concentrations show a variation on a shorter time scale. The diurnal variation is a result of the variation in vertical mixing, surface dry deposition and photochemistry. Thus, coastal and mountain sites away from NO_x sources generally show the least diurnal cycles, whereas diurnal cycles will be most pronounced at inland sites in spring and summer. The average diurnal variation of surface ozone for summer (April-September) 2012 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 the diurnal cycle of the mixing height and photochemical generation of ozone during daytime. During the night, more stable atmospheric conditions and nocturnal inversions prevent the vertical mixing and the transport of ozone from the free troposphere into the boundary layer. A weaker diurnal variation is observed at the coastal and island stations and at the remote sites in Norway and Sweden. Mace Head, situated on the west coast of Ireland, has roughly the same average concentrations as the rural sites in Central Europe but almost no diurnal variation due to remoteness from source areas and prevailing westerly winds. Zeppelinfjellet at Spitsbergen shows no diurnal variation. Elevated sites like Chaumont and Krvavec show a weaker diurnal cycle and the average concentration level is also high, due to influence of air from the free troposphere.

9. Update

The data compiled in this report represent the quality assured and quality controlled data at present. If errors are detected in the future, the data will be corrected in the database. It is important that users make certain they have access to the most recent version of the data. For the data presented here, the latest alteration was August 21st, 2014..

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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A large number of co-workers in participating countries have been involved in the many steps of collection of EMEP's measurement data. A list of participating institutes can be seen below. The staff at CCC wishes to express their gratitude and appreciation for continued good co-operation and efforts.

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 μg/m^3 and maximum concentrations in 2012.

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	3044	139	701	75	41	13	0	0	0	0	173.8	23.02.2012
AT0002R	Illmitz	8370	366	346	62	16	5	3	1	0	0	187	19.06.2012
AT0005R	Vorhegg	8155	360	290	52	11	4	0	0	0	0	170	21.06.2012
AT0030R	Pillersdorf bei Retz	8229	362	301	59	26	8	1	1	0	0	191	20.08.2012
AT0032R	Sulzberg	8316	365	538	65	45	11	0	0	0	0	171	20.08.2012
AT0034G	Sonnblick	8080	354	774	100	1	1	0	0	0	0	155	03.09.2012
AT0038R	Gerlitzen	8379	366	705	80	7	2	0	0	0	0	177	20.06.2012
AT0040R	Masenberg	8294	364	535	75	10	2	0	0	0	0	157	30.06.2012
AT0041R	Haunsberg	8388	366	215	34	9	4	0	0	0	0	170	26.07.2012
AT0042R	Heidenreichstein	8379	366	210	48	9	4	0	0	0	0	157	27.07.2012
AT0043R	Forsthof	8366	366	520	68	22	7	2	1	0	0	194	20.08.2012
AT0044R	Graz Platte	8386	366	205	45	0	0	0	0	0	0	150	30.06.2012
AT0045R	Dunkelsteinerwald	8342	366	210	46	18	7	0	0	0	0	175	20.08.2012
AT0046R	Gänserndorf	8357	365	278	52	13	7	0	0	0	0	171	19.06.2012
AT0047R	Stixneusiedl	8342	365	406	72	19	7	0	0	0	0	167	19.06.2012
AT0048R	Zoebelboden	8278	366	138	28	2	1	0	0	0	0	151	18.06.2012
AT0049R	Grebenzen bei St. Lamprecht	8259	361	369	57	0	0	0	0	0	0	147	27.07.2012
BE0001R	Offagne	8096	353	88	15	22	2	8	1	0	0	192.5	26.07.2012
BE0032R	Eupen	8211	358	82	15	23	3	12	3	2	1	200.5	26.07.2012
BE0035R	Vezin	8140	356	61	11	22	4	9	2	1	1	212.5	25.07.2012
BG0053R	Rojen peak	8108	362	416	59	0	0	0	0	0	0	143.8	05.08.2012
CH0001G	Jungfraujoch	8497	366	7	4	0	0	0	0	0	0	139.1	05.06.2012
CH0002R	Payerne	8371	366	178	35	9	2	0	0	0	0	167.5	27.07.2012
CH0003R	Tänikon	8246	363	182	39	19	7	1	1	0	0	186.8	20.08.2012
CH0004R	Chaumont	8372	366	379	45	27	3	0	0	0	0	176.5	26.07.2012
CH0005R	Rigi	8406	366	384	48	24	7	0	0	0	0	163.5	27.07.2012
CY0002R	Ayia Marina	8146	359	1205	120	36	12	0	0	0	0	176.1	25.07.2012
CZ0001R	Svratouch	8744	366	193	38	0	0	0	0	0	0	142.6	16.08.2012
CZ0003R	Košetice	8582	361	185	37	4	1	0	0	0	0	161.4	27.07.2012
CZ0005R	Churanov	8691	365	136	35	1	1	0	0	0	0	155.6	24.11.2012

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	8337	366	66	12	5	2	0	0	0	0	171.8	18.08.2012
DE0002R	Waldhof	8379	366	123	21	27	7	0	0	0	0	177.4	27.07.2012
DE0003R	Schauinsland	6255	278	429	52	84	11	9	2	2	1	206.5	26.07.2012
DE0007R	Neuglobsow	8365	366	42	11	2	1	0	0	0	0	161.1	28.04.2012
DE0008R	Schmücke	8368	366	272	31	51	6	2	1	0	0	190.1	27.07.2012
DE0009R	Zingst	8413	366	63	12	6	2	0	0	0	0	162	19.08.2012
DK0005R	Keldsnor	7699	357	42	9	6	3	0	0	0	0	157.6	20.08.2012
DK0010G	Nord, Greenland	7787	360	0	0	0	0	0	0	0	0	95.6	01.06.2012
DK0012R	Risoe	7942	366	73	15	11	3	1	1	0	0	185	20.08.2012
DK0031R	Ulborg	7494	346	49	10	21	3	0	0	0	0	176.7	18.08.2012
EE0009R	Lahemaa	8692	365	0	0	0	0	0	0	0	0	120	29.07.2012
EE0011R	Vilsandi	8403	361	22	7	0	0	0	0	0	0	133	24.07.2012
ES0001R	San Pablo de los Montes	8682	365	236	37	0	0	0	0	0	0	144.8	23.06.2012
ES0006R	Mahón	8617	366	219	43	25	5	0	0	0	0	162.9	06.09.2012
ES0007R	Víznar	8388	366	264	65	2	2	0	0	0	0	151.6	13.07.2012
ES0008R	Niembro	8378	356	58	12	0	0	0	0	0	0	143.2	08.09.2012
ES0009R	Campisábalos	8530	366	204	50	7	4	0	0	0	0	163.1	30.07.2012
ES0010R	Cabo de Creus	8506	364	159	33	9	3	0	0	0	0	171.2	20.06.2012
ES0011R	Barcarrota	8547	364	4	2	0	0	0	0	0	0	122.8	23.06.2012
ES0012R	Zarra	8720	366	359	81	1	1	0	0	0	0	150.5	24.05.2012
ES0013R	Penausende	8614	366	272	44	3	2	0	0	0	0	154.9	09.08.2012
ES0014R	Els Torms	8576	366	276	56	2	1	0	0	0	0	156.6	14.03.2012
ES0016R	O Saviñao	8672	366	38	9	1	1	0	0	0	0	153.9	07.09.2012
ES0017R	Doñana	8492	364	305	58	42	12	3	3	0	0	182.5	10.08.2012
FI0009R	Utö	8558	362	6	2	0	0	0	0	0	0	138	24.07.2012
FI0017R	Virolahti II	8609	365	5	2	0	0	0	0	0	0	124	09.05.2012
FI0022R	Oulanka	8313	355	0	0	0	0	0	0	0	0	119	16.05.2012
FI0037R	Ähtäri II	8522	358	1	1	0	0	0	0	0	0	124	12.04.2012
FI0096G	Pallas (Sammaltunturi)	8510	358	0	0	0	0	0	0	0	0	110	16.05.2012

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)
FR0008R	Donon	8684	365	127	23	1	1	0	0	0	0	155	25.07.2012
FR0009R	Revin	8737	366	107	14	30	3	9	2	0	0	198	25.07.2012
FR0010R	Morvan	8294	361	78	19	0	0	0	0	0	0	149	18.08.2012
FR0013R	Peyrusse Vieille	7581	320	153	26	3	1	0	0	0	0	157	26.07.2012
FR0014R	Montandon	8611	363	17	6	0	0	0	0	0	0	138	26.07.2012
FR0015R	La Tardière	8709	365	68	16	4	1	0	0	0	0	161	26.07.2012
FR0016R	Le Casset	8683	364	211	39	0	0	0	0	0	0	146	16.05.2012
FR0017R	Montfranc	8374	358	177	21	0	0	0	0	0	0	150	26.07.2012
FR0018R	La Coulonche	8413	356	115	17	22	4	1	1	0	0	181	25.07.2012
FR0019R	Pic du Midi	8324	351	842	111	13	7	2	1	0	0	193	16.05.2012
FR0030R	Puy de Dôme	8325	358	432	51	7	3	0	0	0	0	167	26.07.2012
GB0002R	Eskdalemuir	8723	366	11	3	0	0	0	0	0	0	144	28.05.2012
GB0006R	Lough Navar	8420	354	15	3	3	1	0	0	0	0	156	27.05.2012
GB0013R	Yarner Wood	7972	337	49	8	19	3	0	0	0	0	180	26.05.2012
GB0014R	High Muffles	8491	361	25	6	0	0	0	0	0	0	144	28.05.2012
GB0015R	Strath Vaich Dam	8605	361	6	2	0	0	0	0	0	0	122	25.03.2012
GB0031R	Aston Hill	8703	366	17	3	0	0	0	0	0	0	144	27.05.2012
GB0033R	Bush	8717	366	1	1	0	0	0	0	0	0	122	26.05.2012
GB0035R	Great Dun Fell	6988	298	0	0	0	0	0	0	0	0	110	09.09.2012
GB0036R	Harwell	8659	364	56	10	13	3	0	0	0	0	174	26.07.2012
GB0037R	Ladybower Res.	8700	366	17	5	4	1	0	0	0	0	158	28.05.2012
GB0038R	Lullington Heath	8703	366	53	8	5	1	0	0	0	0	160	25.07.2012
GB0039R	Sibton	8764	366	45	8	13	2	0	0	0	0	168	25.07.2012
GB0043R	Narberth	8530	361	29	4	0	0	0	0	0	0	142	26.05.2012
GB0045R	Wicken Fen	8523	360	30	5	7	1	0	0	0	0	164	25.07.2012
GB0048R	Auchencorth Moss	8718	366	0	0	0	0	0	0	0	0	112	25.05.2012
GB0049R	Weybourne	8777	366	29	6	0	0	0	0	0	0	140	28.03.2012
GB0050R	St. Osyth	8642	366	36	11	7	1	0	0	0	0	174	25.07.2012
GB0052R	Lerwick	6518	275	0	0	0	0	0	0	0	0	120	23.05.2012
GB0053R	Charlton Mackrell	8745	366	35	6	7	1	1	1	0	0	182	26.07.2012
GR0001R	Aliartos	8708	366	36	11	0	0	0	0	0	0	131.1	12.07.2012
GR0002R	Finokalia	8191	349	1871	125	128	22	1	1	0	0	180	03.08.2012

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)
HU0002R	K-puszta	7248	303	530	83	29	13	0	0	0	0	164	07.07.2012
IE0001R	Valentia Observatory	8508	360	30	3	1	1	0	0	0	0	151.8	25.05.2012
IE0031R	Mace Head	8520	358	17	4	0	0	0	0	0	0	130	26.05.2012
IT0001R	Montelibretti	8717	365	557	105	114	34	20	9	4	3	209.4	17.06.2012
IT0004R	Ispra	8722	365	552	107	130	36	17	8	3	2	204.6	27.07.2012
LT0015R	Preila	8572	364	32	13	0	0	0	0	0	0	138.9	21.08.2012
LV0010R	Rucava	8238	347	148	35	0	0	0	0	0	0	147	10.05.2012
LV0016R	Zoseni	8707	365	213	35	1	1	0	0	0	0	152	27.04.2012
MK0007R	Lazaropole	881	38	0	0	0	0	0	0	0	0	112	13.01.2012
MT0001R	Giordan lighthouse	8127	363	137	27	2	1	0	0	0	0	154	20.08.2012
NL0007R	Eibergen	8395	358	112	21	23	6	3	2	0	0	184.3	19.08.2012
NL0009R	Kollumerwaard	8551	363	37	12	2	1	0	0	0	0	156.6	19.08.2012
NL0010R	Vredepeel	8271	364	78	15	15	3	0	0	0	0	176.8	27.07.2012
NL0091R	De Zilk	8400	360	51	12	12	3	2	1	1	1	201.5	19.08.2012
NL0644R	Cabauw Wielsekade	5319	232	68	14	13	3	2	2	0	0	188.1	19.08.2012
NO0001R	Birkenes	3104	131	0	0	0	0	0	0	0	0	119	02.05.2012
NO0002R	Birkenes II	7013	301	12	3	0	0	0	0	0	0	129.6	25.05.2012
NO0015R	Tustervatn	8738	366	0	0	0	0	0	0	0	0	115.6	27.05.2012
NO0039R	Kårvatn	8588	362	2	1	0	0	0	0	0	0	121.4	27.05.2012
NO0042G	Zeppelin mountain (Ny-Ålesund)	8563	360	0	0	0	0	0	0	0	0	106.2	17.03.2012
NO0043R	Prestebakke	8675	366	5	2	0	0	0	0	0	0	125.4	21.05.2012
NO0052R	Sandve	8675	366	6	2	0	0	0	0	0	0	127.4	25.05.2012
NO0056R	Hurdal	8749	366	0	0	0	0	0	0	0	0	117.6	23.05.2012
PL0002R	Jarczew	8741	366	129	29	8	2	0	0	0	0	159	27.04.2012
PL0003R	Sniezka	8756	366	400	56	3	1	0	0	0	0	156	23.08.2012
PL0004R	Leba	8680	365	29	8	0	0	0	0	0	0	146	19.08.2012
PL0005R	Diabla Gora	8768	366	211	41	17	5	0	0	0	0	171	28.07.2012
RO0008R	Poiana Stampei	6709	299	162	35	0	0	0	0	0	0	148.7	21.06.2012

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)
SE0005R	Bredkälen	8757	366	2	1	0	0	0	0	0	0	132	27.05.2012
SE0011R	Vavihill	8597	360	66	13	4	2	0	0	0	0	162	20.08.2012
SE0012R	Aspvreten	8611	365	6	3	0	0	0	0	0	0	126	09.05.2012
SE0013R	Esrange	8138	342	0	0	0	0	0	0	0	0	113	26.04.2012
SE0014R	Råö	8708	366	19	5	0	0	0	0	0	0	144	24.07.2012
SE0032R	Norra-Kvill	8023	337	24	6	0	0	0	0	0	0	140	24.07.2012
SE0035R	Vindeln	8524	359	3	1	0	0	0	0	0	0	139	27.05.2012
SE0039R	Grimsö	8770	366	11	1	0	0	0	0	0	0	150	25.07.2012
SI0008R	Iskrba	8295	366	439	76	14	4	0	0	0	0	172	22.08.2012
SI0031R	Zarodnje	8310	366	613	84	28	7	0	0	0	0	168	20.06.2012
SI0032R	Krvavec	8283	366	1410	122	114	28	10	5	1	1	203	23.08.2012
SI0033R	Kovk	7997	358	491	67	27	9	0	0	0	0	177	22.08.2012
SK0002R	Chopok	8484	362	996	98	12	5	0	0	0	0	168	12.05.2012
SK0004R	Stará Lesná	8501	360	145	21	0	0	0	0	0	0	145	29.04.2012
SK0006R	Starina	8641	364	72	16	0	0	0	0	0	0	144	29.04.2012
SK0007R	Topolniky	7120	303	268	51	7	6	0	0	0	0	164	22.08.2012

Table 1.2: Percentiles of hourly ozone values April–September 2012.

Code	Station	25%	50%	75%	90%	95%	98%	99%	Data capture
AM0001R	Amberd	96.0	106.2	117.4	131.4	138.0	142.9	146.2	29.9
AT0002R	Illmitz	57.0	75.0	96.0	116.0	128.0	136.0	141.0	95.2
AT0005R	Vorhegg	64.0	81.5	99.0	114.0	124.0	132.2	142.1	90.8
AT0030R	Pillersdorf bei Retz	63.0	79.0	98.0	115.0	125.0	137.0	144.0	93.9
AT0032R	Sulzberg	80.0	95.0	110.0	124.0	132.4	143.0	152.0	94.5
AT0034G	Sonnblick	97.0	108.0	117.0	126.0	131.0	137.0	140.2	95.2
AT0038R	Gerlitzen	91.0	104.0	115.0	126.0	132.1	139.0	143.0	95.1
AT0040R	Masenberg	79.0	96.0	111.0	122.0	129.0	135.0	140.0	95.6
AT0041R	Haunsberg	69.0	84.0	99.0	112.0	121.0	130.0	138.0	95.6
AT0042R	Heidenreichstein	53.0	74.0	94.0	113.0	120.0	128.0	135.0	95.3
AT0043R	Forsthof	70.0	88.0	107.0	123.0	131.0	138.0	144.0	95.3
AT0044R	Graz Platte	57.0	79.0	100.0	114.0	120.0	128.0	133.0	95.6
AT0045R	Dunkelsteinerwald	50.0	68.0	88.0	110.0	120.0	132.0	139.0	95.0
AT0046R	Gänserndorf	53.0	71.0	93.0	114.0	124.0	133.0	139.0	95.6
AT0047R	Stixneusiedl	61.0	78.0	100.0	120.0	128.0	137.0	145.0	94.6
AT0048R	Zoebelboden	69.0	84.0	98.0	110.0	117.0	125.0	131.0	94.5
AT0049R	Grebenzen bei St. Lamprecht	84.0	97.0	109.0	120.0	125.0	131.0	135.0	92.5
BE0001R	Offagne	46.0	61.5	77.5	92.5	105.5	121.0	136.5	93.4
BE0032R	Eupen	42.5	59.5	76.5	92.0	103.0	120.0	131.1	95.2
BE0035R	Vezin	23.0	44.2	65.0	84.5	95.0	110.5	129.0	95.8
BG0053R	Rojen peak	72.9	95.4	108.2	117.8	123.5	130.9	134.7	92.5
CH0001G	Jungfraujoch	74.2	81.3	87.3	93.6	97.8	103.8	106.8	96.8
CH0002R	Payerne	48.0	68.3	88.0	105.5	117.3	128.6	134.2	95.3
CH0003R	Tänikon	46.5	67.7	87.0	105.8	118.0	131.7	139.8	92.6
CH0004R	Chaumont	75.7	89.0	102.4	117.9	128.3	137.9	144.8	95.4
CH0005R	Rigi	75.8	90.1	104.1	118.7	128.7	138.4	144.9	94.9
CY0002R	Ayia Marina	99.0	109.7	121.3	130.7	137.4	144.6	149.1	94.8
CZ0001R	Svratouch	66.8	81.4	98.6	111.3	117.7	125.5	129.9	99.8
CZ0003R	Košetice	57.3	73.6	91.4	110.7	118.4	125.1	130.1	97.3
CZ0005R	Churanov	69.0	82.4	96.6	109.7	115.3	121.3	126.1	99.2
DE0001R	Westerland	69.3	79.2	89.8	99.8	107.0	117.3	127.5	94.2
DE0002R	Waldhof	44.1	64.3	83.1	99.5	110.4	128.1	140.9	95.8
DE0003R	Schauinsland	82.9	95.7	110.6	124.8	137.4	156.8	166.1	70.9
DE0007R	Neuglobsow	36.5	58.0	76.8	93.6	103.3	112.9	119.5	95.0
DE0008R	Schmücke	67.1	81.4	96.9	113.9	125.8	139.9	156.1	95.5
DE0009R	Zingst	56.2	70.0	82.9	94.4	102.7	116.1	126.1	95.9
DK0005R	Keldsnor	59.0	69.6	80.0	90.3	98.4	111.3	123.1	85.2
DK0010G	Nord, Greenland	45.3	53.9	63.9	73.4	78.1	82.0	83.2	87.1
DK0012R	Risoe	62.0	74.0	85.9	96.4	103.9	118.1	129.8	91.5
DK0031R	Ulborg	61.9	71.9	83.9	94.8	101.1	114.8	127.1	87.5
EE0009R	Lahemaa	43.0	62.0	78.0	91.0	96.0	102.0	106.0	98.3
EE0011R	Vilsandi	65.0	76.0	88.0	98.0	104.0	111.0	117.0	95.7
ES0001R	San Pablo de los Montes	80.7	94.3	104.7	113.8	119.9	127.3	132.5	98.8
ES0006R	Mahón	81.2	93.3	103.4	112.4	118.4	129.0	137.8	98.4
ES0007R	Víznar	82.8	94.2	105.2	115.7	121.7	129.2	133.9	95.1
ES0008R	Niembro	59.1	69.7	83.0	94.2	101.7	111.3	120.8	92.7
ES0009R	Campisábalos	66.6	83.6	97.8	109.6	118.0	127.2	133.5	96.7
ES0010R	Cabo de Creus	76.1	87.4	98.7	109.1	115.3	122.8	129.9	95.7
ES0011R	Barcarrota	45.2	62.5	78.6	89.8	97.8	103.4	108.3	97.5
ES0012R	Zarra	83.7	94.4	105.7	115.5	121.8	128.3	132.4	99.4
ES0013R	Penausende	67.5	83.0	96.2	111.1	121.2	128.8	132.5	98.0
ES0014R	Els Torms	72.3	87.2	101.8	113.9	120.3	128.1	134.6	99.3
ES0016R	O Saviñao	45.4	59.1	72.8	83.4	93.9	109.8	119.3	99.1
ES0017R	Doñana	58.3	79.8	97.7	112.5	124.0	136.0	149.0	96.7
FI0009R	Utö	63.0	73.0	82.0	90.0	95.5	103.0	108.0	95.8
FI0017R	Virolahti II	41.0	60.0	79.0	92.0	99.0	106.0	111.0	99.0
FI0022R	Oulanka	43.0	56.0	76.0	87.0	92.0	99.0	105.0	98.8
FI0037R	Ähtäri II	40.0	54.0	70.0	84.0	91.0	96.0	99.5	94.5
FI0096G	Pallas (Sammaltunturi)	53.0	62.0	81.0	90.0	93.0	98.0	102.0	99.2
FR0008R	Donon	59.0	72.0	86.0	101.0	113.0	124.0	132.0	99.7
FR0009R	Revin	47.0	61.0	78.0	94.0	106.0	124.4	138.0	99.7
FR0010R	Morvan	58.0	73.0	87.0	102.0	111.0	119.0	126.0	94.5
FR0013R	Peyrusse Vieille	61.0	75.0	89.0	103.0	113.0	124.0	130.0	93.9
FR0014R	Montandon	43.0	61.0	75.0	90.0	99.1	109.0	114.0	99.2
FR0015R	La Tardière	51.0	67.0	83.0	97.0	105.0	118.0	125.0	99.0
FR0016R	Le Casset	86.0	97.0	108.0	115.0	120.0	126.0	129.0	97.9
FR0017R	Montfranc	71.0	85.0	99.0	110.0	119.0	128.0	132.0	92.0

Table 1.2, cont.

Code	Station	25%	50%	75%	90%	95%	98%	99%	Data capture
FR0018R	La Coulonche	58.0	71.0	85.0	98.0	107.6	125.0	143.0	99.0
FR0019R	Pic du Midi	95.0	105.0	116.0	125.0	131.0	137.0	143.0	98.5
FR0030R	Puy de Dôme	79.0	91.0	103.0	117.0	124.0	132.0	137.0	96.7
GB0002R	Eskdalemuir	40.0	52.0	66.0	80.0	86.0	96.0	102.0	99.9
GB0006R	Lough Navar	36.0	54.0	70.0	84.0	90.0	98.0	103.0	92.2
GB0013R	Yarner Wood	46.0	60.0	78.0	92.0	100.0	108.0	124.0	90.7
GB0014R	High Muffles	46.0	62.0	80.0	94.0	102.0	114.0	118.0	94.2
GB0015R	Strath Vaich Dam	56.0	64.0	78.0	89.8	94.0	100.0	104.0	96.3
GB0031R	Aston Hill	54.0	64.0	76.0	86.0	92.0	100.0	108.0	99.2
GB0033R	Bush	50.0	60.0	76.0	86.0	92.0	100.0	104.0	99.3
GB0035R	Great Dun Fell	50.0	58.0	64.0	72.0	78.0	84.0	92.0	60.9
GB0036R	Harwell	46.0	60.0	74.0	86.0	94.0	112.0	125.5	98.5
GB0037R	Ladybower Res.	42.0	52.0	64.0	74.0	80.0	94.2	107.1	98.9
GB0038R	Lullington Heath	42.0	54.0	66.0	78.0	90.0	112.0	126.0	99.2
GB0039R	Sibton	40.0	58.0	72.0	84.0	92.0	110.0	122.0	99.7
GB0043R	Narberth	52.0	62.0	72.0	80.0	86.0	96.0	111.3	96.4
GB0045R	Wicken Fen	28.0	46.0	64.0	78.0	88.0	102.0	115.0	99.0
GB0048R	Auchencorth Moss	48.0	58.0	72.0	82.0	88.0	94.0	98.0	98.8
GB0049R	Weybourne	50.0	64.0	80.0	96.0	102.0	108.0	116.0	99.9
GB0050R	St. Osyth	44.0	58.0	72.5	84.2	92.0	108.0	116.0	97.9
GB0052R	Lerwick	52.0	62.0	78.0	86.0	92.0	100.0	106.0	99.7
GB0053R	Charlton Mackrell	44.0	56.0	70.0	82.0	90.0	100.0	114.0	99.9
GR0001R	Aliartos	41.1	71.1	92.1	103.1	109.1	114.1	118.1	99.5
GR0002R	Finokalia	104.9	117.9	128.5	138.2	145.7	153.4	159.2	94.8
HU0002R	K-puszta	52.0	76.5	103.8	124.0	134.0	142.1	148.0	97.8
IE0001R	Valentia Observatory	53.2	63.9	75.3	89.4	93.8	100.1	113.3	96.2
IE0031R	Mace Head	60.0	70.0	82.0	92.0	98.0	104.0	108.0	95.5
IT0001R	Montelibretti	36.2	67.8	99.5	123.9	137.7	154.3	165.7	99.9
IT0004R	Ispra	36.3	67.5	94.6	124.7	141.1	157.1	168.7	100.0
LT0015R	Preila	64.1	76.1	88.3	98.9	105.4	112.8	117.2	97.4
LV0010R	Rucava	57.0	76.0	98.0	112.0	118.0	123.0	128.0	98.5
LV0016R	Zoseni	54.0	75.0	96.0	111.0	118.6	126.0	132.0	99.9
MT0001R	Giordan lighthouse	84.2	92.0	102.1	110.6	116.5	124.5	127.8	94.8
NL0007R	Eibergen	33.8	52.2	71.3	90.4	103.5	124.1	137.8	98.0
NL0009R	Kollumerwaard	44.3	60.1	75.5	88.1	96.5	108.3	118.5	96.8
NL0010R	Vredepeel	32.7	51.1	69.6	86.6	98.4	118.7	132.4	94.5
NL0091R	De Zilk	42.6	60.1	73.3	86.6	94.2	110.5	123.2	98.4
NL0644R	Cabauw Wielsekade	33.5	50.0	67.9	84.9	99.0	121.0	132.6	72.5
NO0001R	Birkenes	58.8	74.0	85.0	90.6	93.4	97.7	102.2	21.2
NO0002R	Birkenes II	53.0	65.3	79.0	90.2	95.0	103.8	111.7	88.6
NO0015R	Tustervatn	49.2	61.8	80.8	92.3	95.7	100.1	103.5	99.5
NO0039R	Kårvatn	33.0	52.8	75.0	91.7	96.8	104.0	107.4	98.4
NO0042G	Zeppelin mountain (Ny-Ålesund)	49.5	57.4	69.6	84.0	89.2	93.7	97.4	95.2
NO0043R	Prestebakke	50.8	62.2	75.0	85.8	91.5	100.0	107.3	98.2
NO0052R	Sandve	62.0	71.2	82.6	90.4	94.9	101.4	107.5	99.0
NO0056R	Hurdal	39.3	53.9	70.0	82.4	87.6	92.4	97.2	99.8
PL0002R	Jarczew	45.0	64.0	83.0	103.0	114.0	125.0	133.4	99.3
PL0003R	Sniezka	79.0	92.0	107.0	119.0	125.8	132.0	136.0	99.8
PL0004R	Leba	56.0	69.0	82.0	94.0	101.0	110.0	117.6	98.8
PL0005R	Diabla Gora	45.0	70.5	91.0	109.0	120.0	133.0	140.0	100.0
RO0008R	Poiana Stampei	37.8	67.3	94.5	113.3	120.0	127.9	130.8	74.2
SE0005R	Bredkälen	41.0	55.0	72.0	87.0	91.0	96.0	99.0	99.8
SE0011R	Vavihill	53.0	68.0	83.0	96.0	104.0	117.0	127.7	95.9
SE0012R	Aspvreten	43.0	60.0	76.0	87.0	94.0	102.0	105.0	98.8
SE0013R	Esrange	51.0	60.0	73.0	88.0	92.0	95.0	97.0	85.4
SE0014R	Råö	64.0	74.0	84.2	94.0	100.0	107.0	114.0	99.0
SE0032R	Norra-Kvill	59.0	70.0	83.0	94.0	102.0	111.2	118.0	86.2
SE0035R	Vindeln	41.0	58.0	74.0	88.0	92.0	96.0	99.0	94.2
SE0039R	Grimsö	43.0	60.0	75.0	86.0	92.0	98.0	102.0	99.8
SI0008R	Iskrba	25.0	73.0	102.0	120.0	128.0	136.0	141.0	94.6
SI0031R	Zarodnje	77.0	95.0	112.0	125.0	132.0	141.0	146.0	94.8
SI0032R	Krvavec	98.0	110.0	125.0	137.0	146.0	153.8	167.0	94.7
SI0033R	Kovk	77.0	93.0	109.0	122.0	130.0	139.0	148.0	92.2
SK0002R	Chopok	95.0	108.0	119.0	131.0	136.0	140.0	143.0	95.0
SK0004R	Stará Lesná	50.0	72.0	91.0	107.0	115.0	125.0	130.3	94.9
SK0006R	Starina	47.0	65.0	84.0	100.0	107.0	117.0	125.0	98.5
SK0007R	Topolniky	42.0	63.0	88.0	111.4	124.0	134.0	140.8	98.2

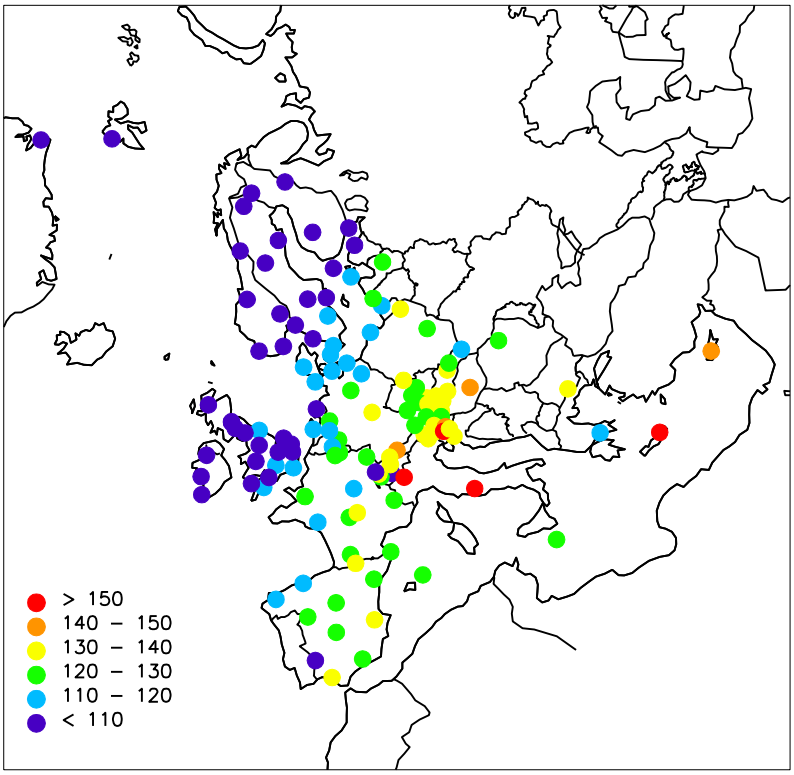


Figure 1.1: Ozone April–September 2012. 99-percentiles (μg/m^3).

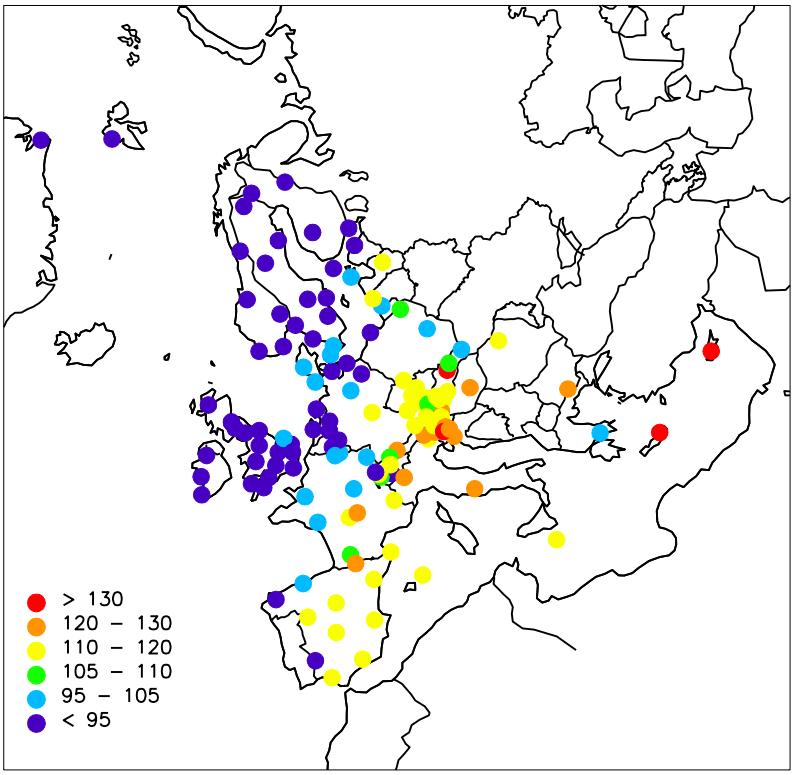


Figure 1.2: Ozone April–September 2012. 95-percentiles (μg/m^3).

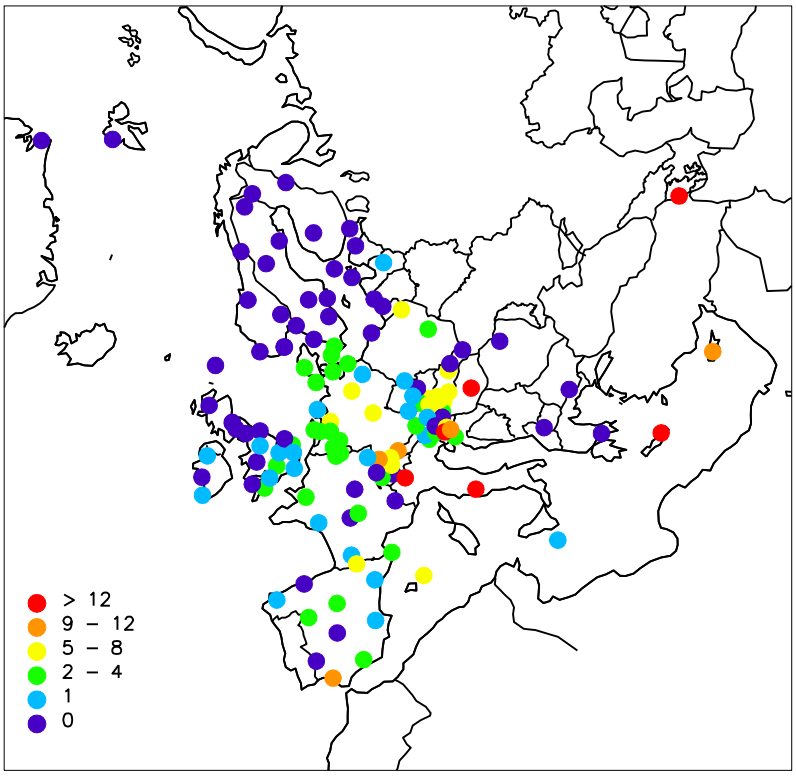


Figure 1.3: Number of exceedances of the threshold value of 150 µg/m^3. (Unit: number of days).

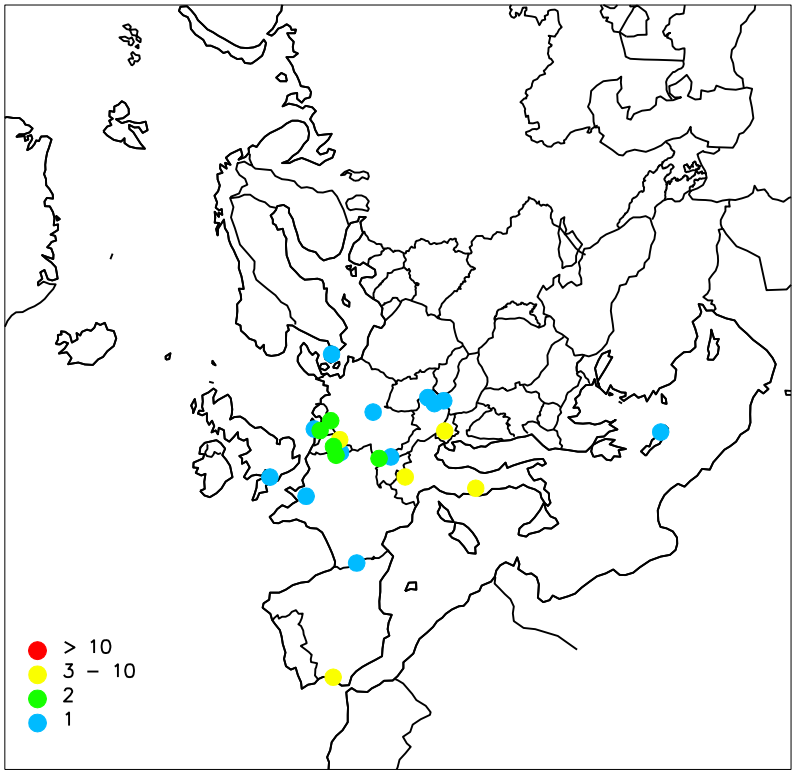


Figure 1.4: Number of exceedances of the threshold value of 180 µg/m^3. (Unit: number of days). Stations with zero exceedances are not shown.

Annex 2

AOT40 and AOT60, figures and tables

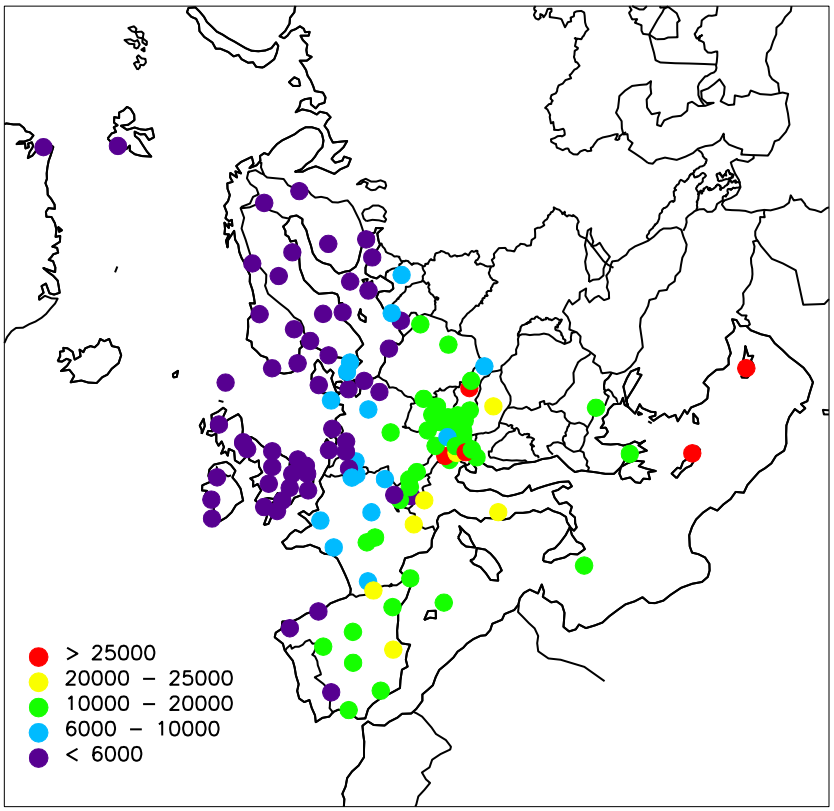


Figure 2.1: AOT40 (ppbh) April–September 2012 (daylight hours).

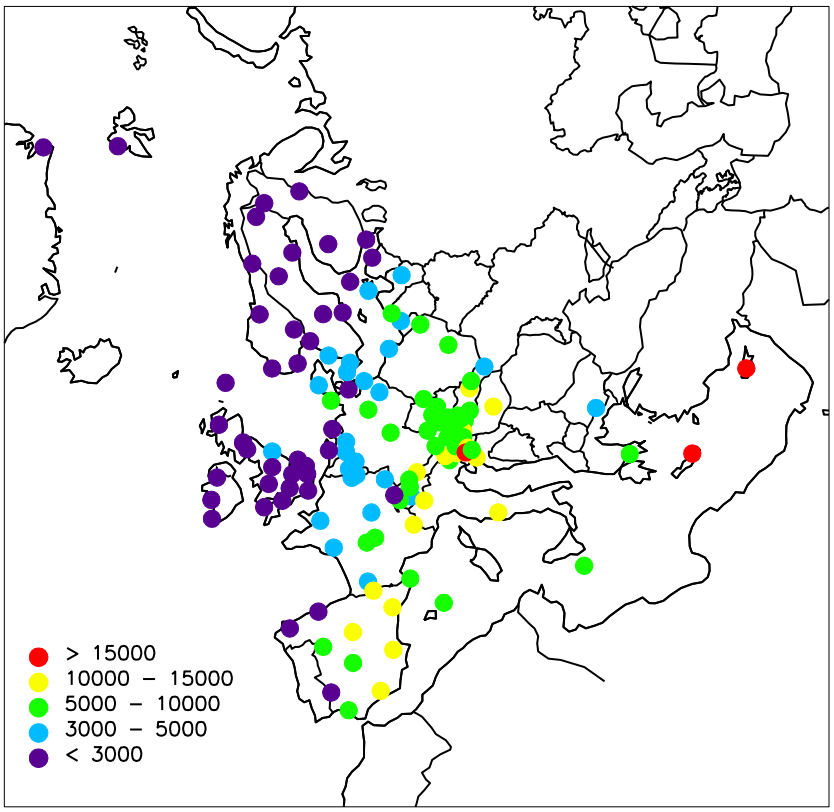


Figure 2.2: AOT40 (ppbh) May, June and July 2012 (daylight hours).

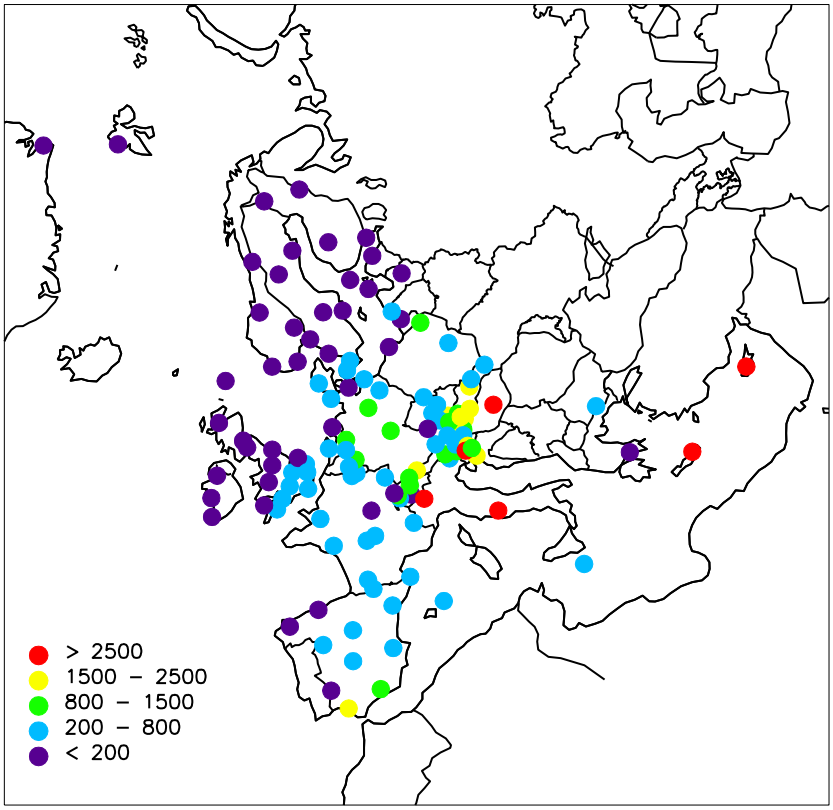


Figure 2.3: AOT60 (ppbh) April-September 2012 (daylight hours).

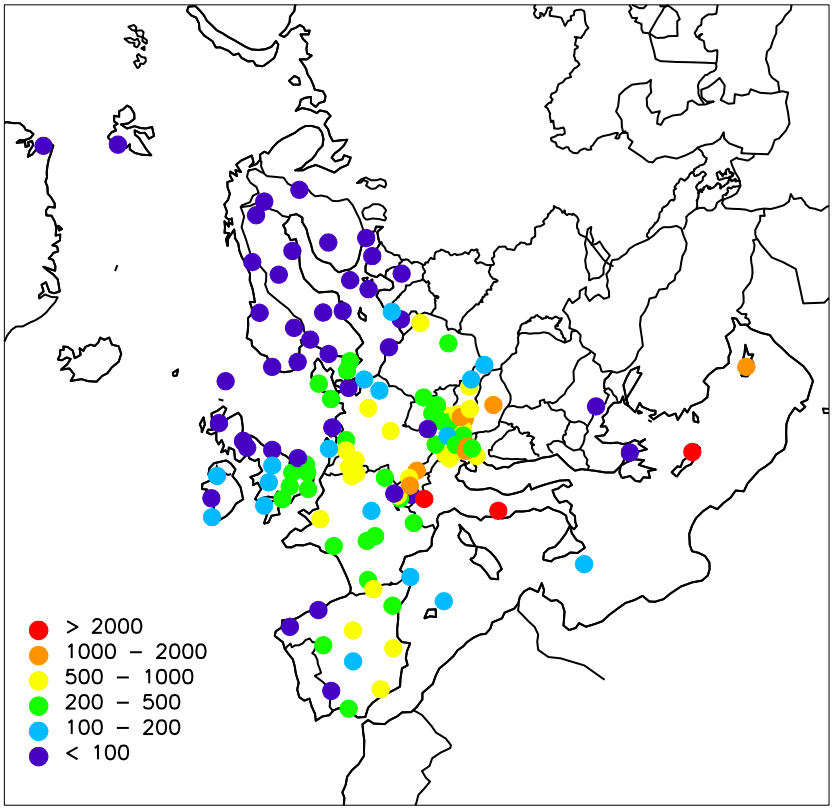


Figure 2.4: AOT60 (ppbh) May, June and July 2012 (daylight hours).

Table 2.1: AOT40 and AOT60 April–September 2012 (daylight hours).

Code	Station	AOT40	AOT40 corrected	AOT60	AOT60 corrected	Data capture
AM0001R	Amberd	8304	26379	623	1979	32
AT0002R	Illmitz	15581	16624	1856	1980	94
AT0005R	Vorhegg	11434	12821	658	738	89
AT0030R	Pillersdorf bei Retz	14083	15203	1552	1675	93
AT0032R	Sulzberg	18707	18977	1682	1706	99
AT0034G	Sonnblick	25103	26783	1154	1231	94
AT0038R	Gerlitzen	21790	23038	1103	1166	95
AT0040R	Masenberg	17850	18666	1004	1050	96
AT0041R	Haunsberg	12194	12793	718	753	95
AT0042R	Heidenreichstein	12642	13319	717	755	95
AT0043R	Forsthof	15760	16597	1600	1685	95
AT0044R	Graz Platte	11432	11998	459	482	95
AT0045R	Dunkelsteinerwald	11325	11994	1053	1115	94
AT0046R	Gänserndorf	13793	14446	1312	1374	96
AT0047R	Stixneusiedl	15718	16614	1868	1974	95
AT0048R	Zoebelboden	9614	10385	235	253	93
AT0049R	Grebenzen bei St. Lamprecht	15219	16600	317	345	92
BE0001R	Offagne	6532	7009	695	746	93
BE0032R	Eupen	6052	6402	882	933	95
BE0035R	Vezin	4575	4797	777	814	95
BG0053R	Rojen peak	14364	15150	363	383	95
CH0001G	Jungfraujoch	4609	4776	23	23	97
CH0002R	Payerne	10402	10946	743	782	95
CH0003R	Tänikon	10757	11707	1129	1229	92
CH0004R	Chaumont	13261	13919	1040	1092	95
CH0005R	Rigi	14380	15242	1435	1521	94
CY0002R	Ayia Marina	31774	33962	3387	3620	94
CZ0001R	Svratouch	12562	12623	458	460	100
CZ0003R	Košetice	12574	12899	615	631	98
CZ0005R	Churanov	12162	12312	184	186	99
DE0001R	Westerland	7621	8101	344	366	94
DE0002R	Waldhof	9071	9490	990	1036	96
DE0003R	Schauinsland	13944	19464	1700	2373	72
DE0007R	Neuglobsow	5895	6270	238	254	94
DE0008R	Schmücke	11703	12328	1122	1182	95
DE0009R	Zingst	5944	6213	307	320	96
DK0005R	Keldsnor	3217	3552	173	191	91
DK0010G	Nord, Greenland	108	115	0	0	94
DK0012R	Risoe	6591	6804	485	501	97
DK0031R	Ulborg	5218	5595	283	304	93
EE0009R	Lahemaa	2675	2722	0	0	98
EE0011R	Vilsandi	4449	4717	1	1	94
ES0001R	San Pablo de los Montes	16913	17177	352	358	99
ES0006R	Mahón	17729	18077	776	792	98
ES0007R	Víznar	19967	20626	941	972	97
ES0008R	Niembro	4459	4595	107	110	97
ES0009R	Campisábalos	16152	16836	758	790	96
ES0010R	Cabo de Creus	12444	13129	259	273	95
ES0011R	Barcarrota	4496	4606	3	3	98
ES0012R	Zarra	20407	20562	783	789	99
ES0013R	Penausende	12766	13109	598	614	97
ES0014R	Els Torms	16459	16686	558	566	99
ES0016R	O Saviñao	3058	3096	113	115	99
ES0017R	Doñana	16425	16830	1639	1680	98
FI0009R	Utö	2363	2487	0	0	95
FI0017R	Virolahti II	3417	3455	2	2	99
FI0022R	Oulanka	1896	1913	0	0	99
FI0037R	Ähtäri II	1096	1167	0	0	94
FI0096G	Pallas (Sammaltunturi)	2447	2464	0	0	99
FR0008R	Donon	7031	7069	265	266	100
FR0009R	Revin	6006	6021	697	698	100
FR0010R	Morvan	8126	8499	199	208	96
FR0013R	Peyrusse Vieille	8126	8668	429	458	94
FR0014R	Montandon	4119	4168	54	54	99
FR0015R	La Tardière	7215	7315	363	368	99
FR0016R	Le Casset	20035	20519	350	358	98
FR0017R	Montfranc	11874	13016	407	446	91

Table 2.1, cont.

Code	Station	AOT40	AOT40 corrected	AOT60	AOT60 corrected	Data capture
FR0018R	La Coulonche	7211	7317	638	647	99
FR0019R	Pic du Midi	22028	22315	744	754	99
FR0030R	Puy de Dôme	13524	14031	636	660	96
GB0002R	Eskdalemuir	1702	1706	61	61	100
GB0006R	Lough Navar	2371	2537	132	141	93
GB0013R	Yarner Wood	4436	4919	461	511	90
GB0014R	High Muffles	4465	4734	90	95	94
GB0015R	Strath Vaich Dam	2820	2946	0	0	96
GB0031R	Aston Hill	2431	2454	102	103	99
GB0033R	Bush	2472	2493	1	1	99
GB0035R	Great Dun Fell	257	417	0	0	62
GB0036R	Harwell	4002	4081	474	483	98
GB0037R	Ladybower Res.	1472	1491	142	144	99
GB0038R	Lullington Heath	2050	2070	233	235	99
GB0039R	Sibton	3285	3304	428	431	99
GB0043R	Narberth	1676	1741	134	139	96
GB0045R	Wicken Fen	2507	2541	292	296	99
GB0048R	Auchencorth Moss	1543	1566	0	0	99
GB0049R	Weybourne	4212	4218	94	94	100
GB0050R	St. Osyth	3132	3222	279	287	97
GB0052R	Lerwick	2271	2285	0	0	99
GB0053R	Charlton Mackrell	2792	2795	343	343	100
GR0001R	Aliartos	11758	11787	48	48	100
GR0002R	Finokalia	33420	35345	4272	4518	95
HU0002R	K-puszta	20338	20831	2822	2890	98
IE0001R	Valentia Observatory	2347	2436	103	107	96
IE0031R	Mace Head	3569	3744	39	41	95
IT0001R	Montelibretti	22725	22759	4744	4751	100
IT0004R	Ispra	23216	23239	5510	5515	100
LT0015R	Preila	5501	5683	27	27	97
LV0010R	Rucava	9786	9974	210	214	98
LV0016R	Zoseni	7845	7868	118	118	100
MT0001R	Giordan lighthouse	16134	16461	351	358	98
NL0007R	Eibergen	5510	5595	846	860	99
NL0009R	Kollumerwaard	3573	3700	177	184	97
NL0010R	Vredepeel	4308	4553	599	633	95
NL0091R	De Zilk	3713	3773	419	425	98
NL0644R	Cabauw Wielsekade	3471	4798	554	765	72
NO0001R	Birkenes	1021	1692	0	0	60
NO0002R	Birkenes II	3289	3741	30	34	88
NO0015R	Tustervatn	3246	3276	0	0	99
NO0039R	Kårvatn	3821	3916	1	1	98
NO0042G	Zeppelin mountain (Ny-Ålesund)	1174	1221	0	0	96
NO0043R	Prestebakke	2605	2676	5	6	97
NO0052R	Sandve	3926	3970	14	14	99
NO0056R	Hurdal	1486	1489	0	0	100
PL0002R	Jarczew	10744	10813	711	715	99
PL0003R	Sniezka	14451	14521	410	412	100
PL0004R	Leba	5820	5882	108	109	99
PL0005R	Diabla Gora	13927	13927	1336	1336	100
RO0008R	Poiana Stampei	7425	10216	274	377	73
SE0005R	Bredkälen	1872	1878	0	0	100
SE0011R	Vavihill	6630	6962	368	386	95
SE0012R	Aspvreten	2534	2561	8	8	99
SE0013R	Esrange	1517	1785	0	0	85
SE0014R	Råö	5155	5215	58	59	99
SE0032R	Norra-Kvill	4428	5264	69	82	84
SE0035R	Vindeln	2154	2274	0	0	95
SE0039R	Grimsö	2660	2670	87	87	100
SI0008R	Iskrba	17898	19012	1574	1672	94
SI0031R	Zarodnje	18530	18721	1713	1730	99
SI0032R	Krvavec	28064	29854	3388	3604	94
SI0033R	Kovk	15805	17215	941	1024	92

Table 2.1, cont.

Code	Station	AOT40	AOT40 corrected	AOT60	AOT60 corrected	Data capture
SK0002R	Chopok	25177	26171	1633	1698	96
SK0004R	Stará Lesná	11133	11747	413	435	95
SK0006R	Starina	9013	9166	271	276	98
SK0007R	Topolniky	14609	14644	1507	1510	100

Table 2.2: AOT40 and AOT60 May–July 2012 (daylight hours).

Code	Station	AOT40	AOT40 corrected	AOT60	AOT60 corrected	Data capture
AM0001R	Amberd	5556	11933	263	565	47
AT0002R	Illmitz	8974	9626	1198	1285	93
AT0005R	Vorhegg	7911	9048	571	653	87
AT0030R	Pillersdorf bei Retz	8161	9058	908	1008	90
AT0032R	Sulzberg	11515	11772	1169	1195	98
AT0034G	Sonnblick	14705	15624	815	866	94
AT0038R	Gerlitzen	13760	14586	824	874	94
AT0040R	Masenberg	10761	11284	673	706	95
AT0041R	Haunsberg	7264	7640	494	519	95
AT0042R	Heidenreichstein	7575	7947	487	510	95
AT0043R	Forsthof	9432	9935	935	985	95
AT0044R	Graz Platte	7098	7409	260	271	96
AT0045R	Dunkelsteinerwald	6263	6633	468	495	94
AT0046R	Gänserndorf	8578	8968	965	1008	96
AT0047R	Stixneusiedl	9258	9900	1138	1216	94
AT0048R	Zoebelboden	6273	6683	195	207	94
AT0049R	Grebenzen bei St. Lamprecht	9388	10580	269	303	89
BE0001R	Offagne	4166	4641	693	772	90
BE0032R	Eupen	3818	4080	854	913	94
BE0035R	Vezin	3359	3472	777	803	97
BG0053R	Rojen peak	4486	4864	23	24	92
CH0001G	Jungfraujoch	3354	3457	23	23	97
CH0002R	Payerne	5929	6258	485	512	95
CH0003R	Tänikon	6510	7306	793	890	89
CH0004R	Chaumont	7474	7829	781	818	96
CH0005R	Rigi	8493	9051	1038	1106	94
CY0002R	Ayia Marina	16042	17592	1385	1518	91
CZ0001R	Svratouch	7349	7356	282	282	100
CZ0003R	Košetice	7381	7526	406	414	98
CZ0005R	Churanov	6715	6867	99	101	98
DE0001R	Westerland	5050	5439	254	274	93
DE0002R	Waldhof	5977	6236	786	821	96
DE0003R	Schauinsland	6708	9835	1006	1475	68
DE0007R	Neuglobsow	3400	3634	141	151	94
DE0008R	Schmücke	6763	7155	729	771	95
DE0009R	Zingst	3734	3896	145	152	96
DK0005R	Keldsnor	1859	2115	80	90	88
DK0010G	Nord, Greenland	92	98	0	0	94
DK0012R	Risoe	4112	4310	255	267	95
DK0031R	Ulborg	3513	3877	247	273	91
EE0009R	Lahemaa	1687	1738	0	0	97
EE0011R	Vilsandi	3157	3495	1	1	90
ES0001R	San Pablo de los Montes	9190	9337	111	112	98
ES0006R	Mahón	7214	7288	140	141	99
ES0007R	Víznar	12733	12938	823	836	98
ES0008R	Niembro	2505	2535	38	39	99
ES0009R	Campisábalos	10645	11011	664	687	97
ES0010R	Cabo de Creus	7131	7484	184	193	95
ES0011R	Barcarrota	2734	2765	3	3	99
ES0012R	Zarra	11500	11577	518	521	99
ES0013R	Penausende	7289	7363	392	396	99
ES0014R	Els Torms	10312	10473	384	390	99
ES0016R	O Saviñao	918	928	3	3	99
ES0017R	Doñana	7503	7698	387	397	98

Table 2.2, cont.

Code	Station	AOT40	AOT40 corrected	AOT60	AOT60 corrected	Data capture
FI0009R	Utö	1784	1957	0	0	91
FI0017R	Virolahti II	1812	1822	1	1	99
FI0022R	Oulanka	1104	1104	0	0	100
FI0037R	Ähtäri II	426	472	0	0	90
FI0096G	Pallas (Sammaltunturi)	1344	1345	0	0	100
FR0008R	Donon	4123	4134	243	244	100
FR0009R	Revin	3873	3891	687	690	100
FR0010R	Morvan	4306	4460	124	128	97
FR0013R	Peyrusse Vieille	4365	4562	274	286	96
FR0014R	Montandon	2615	2631	54	54	99
FR0015R	La Tardière	3605	3637	308	311	99
FR0016R	Le Casset	11488	11551	220	221	100
FR0017R	Montfranc	5651	6562	244	283	86
FR0018R	La Coulonche	4349	4407	587	594	99
FR0019R	Pic du Midi	11762	11817	503	505	100
FR0030R	Puy de Dôme	6640	6921	439	457	96
GB0002R	Eskdalemuir	1240	1240	61	61	100
GB0006R	Lough Navar	1392	1392	132	132	100
GB0013R	Yarner Wood	2685	3184	457	542	84
GB0014R	High Muffles	3219	3361	74	77	96
GB0015R	Strath Vaich Dam	1807	1807	0	0	100
GB0031R	Aston Hill	1576	1579	102	102	100
GB0033R	Bush	1487	1487	1	1	100
GB0035R	Great Dun Fell	91	137	0	0	66
GB0036R	Harwell	2797	2812	462	464	100
GB0037R	Ladybower Res.	1278	1300	142	144	98
GB0038R	Lullington Heath	1661	1661	233	233	100
GB0039R	Sibton	2028	2032	282	283	100
GB0043R	Narberth	1077	1100	111	113	98
GB0045R	Wicken Fen	1903	1911	292	293	100
GB0048R	Auchencorth Moss	931	932	0	0	100
GB0049R	Weybourne	2451	2455	48	48	100
GB0050R	St. Osyth	1920	1995	217	225	96
GB0052R	Lerwick	1674	1674	0	0	100
GB0053R	Charlton Mackrell	1875	1877	337	337	100
GR0001R	Aliartos	6935	6961	20	21	100
GR0002R	Finokalia	21569	21589	2905	2908	100
HU0002R	K-puszta	11478	12001	1605	1678	96
IE0001R	Valentia Observatory	1197	1215	103	104	99
IE0031R	Mace Head	1630	1776	39	43	92
IT0001R	Montelibretti	14650	14691	3330	3339	100
IT0004R	Ispra	14800	14827	3517	3524	100
LT0015R	Preila	3474	3551	8	8	98
LV0010R	Rucava	6178	6367	155	160	97
LV0016R	Zoseni	4574	4578	51	51	100
MT0001R	Giordan lighthouse	9282	9479	199	203	98
NL0007R	Eibergen	3331	3343	457	459	100
NL0009R	Kollumerwaard	2182	2196	44	44	99
NL0010R	Vredepeel	3011	3122	502	520	97
NL0091R	De Zilk	2063	2116	118	121	98
NL0644R	Cabauw Wielsekade	2436	3143	339	437	78
NO0001R	Birkenes	375	1235	0	0	30
NO0002R	Birkenes II	2380	2662	30	33	89
NO0015R	Tustervatn	1533	1546	0	0	99
NO0039R	Kårvatn	1884	1943	1	1	97
NO0042G	Zeppelin mountain (Ny-Ålesund)	972	979	0	0	99
NO0043R	Prestebakke	1862	1932	5	6	96
NO0052R	Sandve	2438	2459	14	14	99
NO0056R	Hurdal	981	984	0	0	100
PL0002R	Jarczew	5871	5941	266	269	99
PL0003R	Sniezka	8756	8779	246	247	100
PL0004R	Leba	3118	3118	16	16	100
PL0005R	Diabla Gora	8875	8875	796	796	100

Table 2.2, cont.

Code	Station	AOT40	AOT40 corrected	AOT60	AOT60 corrected	Data capture
RO0008R	Poiana Stampei	4967	7076	174	248	70
SE0005R	Bredkälen	828	831	0	0	100
SE0011R	Vavihill	4716	5156	279	305	92
SE0012R	Aspvreten	1843	1847	8	8	100
SE0013R	Esrange	267	288	0	0	92
SE0014R	Råö	3751	3764	58	58	100
SE0032R	Norra-Kvill	2916	4059	66	92	72
SE0035R	Vindeln	1087	1155	0	0	94
SE0039R	Grimsö	1742	1746	87	87	100
SI0008R	Iskrba	10028	10715	837	894	94
SI0031R	Zarodnje	11237	11359	1088	1100	99
SI0032R	Krvavec	15610	16611	1748	1860	94
SI0033R	Kovk	9261	9670	472	493	96
SK0002R	Chopok	14934	14974	914	916	100
SK0004R	Stará Lesná	5536	6118	189	209	91
SK0006R	Starina	4344	4395	136	137	99
SK0007R	Topolniky	7130	7156	819	822	100

Annex 3

Seasonal variation

Table 3.1: Monthly mean concentrations 2012 ($\mu g/m^3$).

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
AM0001R	Amberd	87.3	116.8	112.2	119.9	96.7	103.0	111.4	119.8	-	-	-	-
AT0002R	Illmitz	48.7	54.1	66.6	77.1	90.2	83.9	64.8	78.2	67.3	42.9	28.9	31.8
AT0005R	Vorhegg	65.7	76.5	83.9	83.9	93.5	90.8	82.0	81.4	59.9	45.2	41.8	57.9
AT0030R	Pillersdorf bei Retz	53.2	57.0	69.0	79.4	92.5	82.4	77.7	90.9	66.9	47.1	32.6	33.2
AT0032R	Sulzberg	58.3	63.4	83.0	87.1	109.8	97.8	93.5	102.0	82.0	61.4	56.6	66.8
AT0034G	Sonnblick	82.5	89.6	102.9	108.4	114.9	105.6	108.9	105.0	99.7	82.2	91.2	84.0
AT0038R	Gerlitzen	72.4	80.8	94.4	100.2	108.3	106.4	109.9	105.4	91.4	75.8	76.6	73.5
AT0040R	Masenberg	63.6	75.5	82.7	89.8	103.9	95.0	97.5	102.0	81.8	60.9	51.2	57.5
AT0041R	Haunsberg	54.7	60.4	64.5	82.2	93.8	87.0	81.1	93.9	66.5	42.4	31.7	51.8
AT0042R	Heidenreichstein	55.6	56.8	61.6	78.1	87.3	77.0	68.3	74.0	54.1	43.3	33.6	39.2
AT0043R	Forsthof	57.7	59.9	70.5	83.1	99.4	92.9	87.8	97.2	72.4	47.8	35.0	43.2
AT0044R	Graz Platte	41.6	55.1	70.5	77.8	88.5	80.4	75.0	84.3	58.2	28.4	21.8	22.0
AT0045R	Dunkelsteinerwald	49.0	50.5	59.1	70.0	77.8	68.5	68.6	81.6	54.0	37.1	23.9	31.7
AT0046R	Gänserndorf	42.8	46.7	57.2	70.2	83.6	75.7	73.2	78.1	60.9	38.6	26.9	29.6
AT0047R	Stixneusiedl	47.2	51.0	62.8	76.5	90.6	82.7	77.6	86.6	68.4	41.8	28.5	30.8
AT0048R	Zoebelboden	64.8	67.2	74.0	87.8	98.4	86.8	77.4	87.1	64.9	50.3	48.9	62.9
AT0049R	Grebenzen bei St. Lamprecht	71.3	80.0	91.2	97.0	103.7	98.6	100.6	97.0	85.1	69.9	72.8	70.0
BE0001R	Offagne	41.5	36.8	51.0	71.0	74.1	56.9	64.3	60.8	50.0	43.6	35.8	46.8
BE0032R	Eupen	33.6	25.9	36.7	65.1	67.1	56.5	62.2	61.7	45.7	39.1	42.6	43.5
BE0035R	Vezin	32.7	26.4	38.8	58.4	56.9	43.8	45.8	40.5	27.7	26.4	25.9	39.9
BG0053R	Rojen peak	74.2	89.1	102.0	100.0	75.8	56.8	102.2	111.9	95.1	83.4	72.2	72.4
CH0001G	Jungfraujoch	59.4	67.2	75.0	80.3	87.2	78.8	81.0	79.3	77.2	63.4	66.6	63.5
CH0002R	Payerne	38.2	42.8	56.5	72.8	76.4	69.1	68.3	70.7	52.0	30.4	25.5	44.1
CH0003R	Tänikon	41.5	47.6	47.7	67.0	79.3	72.3	66.8	73.4	50.8	29.0	24.2	46.9
CH0004R	Chaumont	60.6	68.7	85.2	88.9	100.3	85.7	87.7	97.9	81.6	61.7	65.7	68.7
CH0005R	Rigi	59.0	65.6	84.7	87.5	101.9	92.2	87.9	96.9	76.2	59.6	62.5	70.9
CY0002R	Ayia Marina	71.9	93.0	97.9	102.0	102.1	113.6	110.9	123.5	107.9	98.2	82.0	81.2
CZ0001R	Svratouch	56.7	58.5	73.3	80.9	93.4	80.6	80.1	91.0	69.6	48.1	34.7	35.5
CZ0003R	Košetice	53.1	53.8	64.2	80.2	87.5	75.0	68.6	77.6	59.2	45.2	37.4	42.2
CZ0005R	Churanov	58.3	59.5	74.5	83.3	94.1	82.1	69.9	91.9	75.4	64.2	58.9	79.7
DE0001R	Westerland	56.8	60.8	68.7	82.4	88.0	79.2	78.1	77.4	70.2	57.9	43.2	44.6
DE0002R	Waldhof	46.3	47.4	58.5	68.3	78.6	64.7	63.4	62.8	47.9	39.6	28.5	33.6
DE0003R	Schauinsland	61.2	69.1	77.7	95.3	97.5	102.0	94.0	109.3	89.1	75.5	-	82.4
DE0007R	Neuglobsow	46.3	54.3	58.8	70.3	60.7	65.6	57.8	50.0	41.1	31.8	24.2	28.7

Table 3.1, cont.

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
DE0008R	Schmücke	54.1	52.6	68.3	80.0	93.6	78.4	82.1	93.6	73.8	57.1	48.3	51.0
DE0009R	Zingst	51.5	58.0	57.2	76.0	78.4	74.7	66.5	68.6	54.3	47.5	33.0	40.0
DK0005R	Keldsnor	52.9	57.0	58.8	72.7	76.8	70.3	67.6	70.6	60.1	49.6	37.1	43.8
DK0010G	Nord, Greenland	60.2	65.0	53.9	55.5	42.7	56.4	48.6	51.1	64.9	66.1	67.8	69.2
DK0012R	Risoe	50.3	53.6	63.3	76.2	81.7	76.3	73.7	72.3	62.3	49.3	40.2	43.1
DK0031R	Ulborg	58.1	64.7	68.8	80.9	84.5	75.0	70.3	68.9	62.5	54.8	44.2	47.7
EE0009R	Lahemaa	46.8	61.6	70.7	78.0	70.4	62.6	59.2	43.7	47.9	41.4	44.1	43.7
EE0011R	Vilsandi	54.0	64.6	69.6	83.9	82.8	78.4	80.2	68.0	65.4	56.9	52.1	47.1
ES0001R	San Pablo de los Montes	63.4	80.7	93.4	89.1	92.5	87.0	98.9	99.1	86.1	74.6	63.4	65.2
ES0006R	Mahón	61.5	73.4	91.6	92.3	91.7	85.0	84.8	95.7	106.4	91.5	84.1	77.2
ES0007R	Víznar	70.1	83.2	92.9	86.3	95.9	94.1	102.6	92.8	89.3	75.6	61.7	67.7
ES0008R	Niembro	56.4	67.3	81.2	84.8	77.0	66.7	65.5	67.5	71.3	57.3	59.6	60.4
ES0009R	Campisábalos	60.6	76.0	85.0	88.4	84.3	85.1	86.4	76.1	71.9	60.7	64.5	55.8
ES0010R	Cabo de Creus	58.8	61.2	90.1	89.6	96.7	85.9	83.5	81.3	86.9	70.9	57.2	60.2
ES0011R	Barcarrota	33.9	53.9	62.7	64.0	62.4	60.3	65.7	63.5	55.0	45.3	44.3	35.4
ES0012R	Zarra	61.7	79.8	97.4	90.2	98.6	95.2	94.3	91.2	99.5	77.0	63.9	64.9
ES0013R	Penausende	54.0	69.9	87.0	84.3	83.4	77.4	84.9	84.4	81.4	72.1	62.3	62.9
ES0014R	Els Torms	44.8	66.9	86.4	85.3	93.3	93.5	89.1	76.2	84.2	67.6	50.0	54.6
ES0016R	O Saviñao	33.0	50.4	68.6	69.4	59.6	52.2	53.1	56.8	68.3	46.9	32.2	31.0
ES0017R	Doñana	42.7	63.1	68.4	85.1	78.6	71.7	81.7	81.6	67.7	64.6	58.1	48.1
FI0009R	Utö	52.9	62.2	70.3	75.9	78.1	76.3	74.5	69.6	62.4	58.8	57.9	51.7
FI0017R	Virolahti II	48.8	60.8	75.9	81.8	72.6	59.4	54.4	41.2	46.8	42.7	43.8	38.4
FI0022R	Oulanka	52.0	62.0	82.0	83.1	77.9	52.8	51.2	44.4	42.5	44.8	52.6	49.7
FI0037R	Ähtäri II	42.0	58.3	74.7	78.8	71.6	55.2	49.6	36.9	42.1	41.5	45.0	38.6
FI0096G	Pallas (Sammaltunturi)	52.8	69.0	83.6	86.9	83.0	63.1	55.3	53.8	53.9	56.2	58.4	54.3
FR0008R	Donon	48.6	51.3	65.8	75.9	83.8	66.8	69.3	76.0	69.2	48.5	50.6	63.9
FR0009R	Revin	43.5	40.6	56.6	70.8	75.7	54.2	62.8	62.9	57.0	42.3	36.8	48.9
FR0010R	Morvan	52.3	52.9	70.3	82.3	83.6	63.3	65.9	69.7	67.3	55.3	49.4	58.4
FR0013R	Peyrusse Vieille	54.0	48.5	86.3	79.3	78.9	71.6	74.6	74.1	76.8	55.1	50.5	56.4
FR0014R	Montandon	41.1	41.3	54.5	61.4	63.5	64.6	55.0	60.8	54.7	39.1	39.7	53.5
FR0015R	La Tardière	46.3	52.2	65.4	74.5	75.8	60.8	62.0	64.0	65.6	45.2	44.4	54.2
FR0016R	Le Casset	75.2	82.2	90.6	89.6	104.3	92.0	96.6	101.6	92.1	72.1	75.3	83.2
FR0017R	Montfranc	60.4	62.5	87.3	92.1	95.7	76.0	79.1	86.5	84.6	64.4	65.4	66.3
FR0018R	La Coulonche	57.4	56.9	68.0	82.0	81.6	68.3	68.5	68.0	67.4	48.7	50.8	61.4

Table 3.1, cont.

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
FR0019R	Pic du Midi	83.7	92.5	110.5	104.9	107.6	100.8	106.6	104.1	106.0	90.1	92.1	99.1
FR0030R	Puy de Dôme	76.8	83.3	103.0	94.7	100.0	83.8	87.1	93.6	92.6	73.7	76.0	76.9
GB0002R	Eskdalemuir	49.4	50.7	57.8	67.7	71.3	51.2	39.3	45.2	44.8	37.4	46.6	47.8
GB0006R	Lough Navar	54.0	54.8	57.9	69.2	65.5	50.4	38.3	43.4	44.6	38.0	46.5	48.5
GB0013R	Yarner Wood	57.0	60.5	69.4	80.8	76.8	64.8	52.9	47.4	47.8	43.4	50.7	58.8
GB0014R	High Muffles	52.6	56.3	58.6	77.3	88.7	63.5	50.2	52.0	49.6	46.9	45.7	49.6
GB0015R	Strath Vaich Dam	65.2	69.9	78.6	78.8	80.4	66.4	56.9	56.9	59.9	57.7	67.0	63.5
GB0031R	Aston Hill	57.9	60.5	66.5	79.1	75.6	63.3	54.9	58.2	57.1	51.6	59.5	60.7
GB0033R	Bush	55.6	58.1	65.5	77.3	76.6	60.5	48.8	53.6	54.8	46.7	58.4	54.4
GB0035R	Great Dun Fell	42.6	44.5	51.5	60.8	61.8	46.2	-	-	59.4	58.9	62.0	63.9
GB0036R	Harwell	49.7	49.0	50.0	71.6	70.9	60.7	56.2	54.5	52.4	44.7	46.2	50.8
GB0037R	Ladybower Res.	46.0	48.3	49.6	61.8	67.9	49.9	44.3	44.5	47.3	40.0	44.7	45.6
GB0038R	Lullington Heath	40.7	38.4	45.8	64.4	62.5	51.6	54.1	48.4	50.9	40.9	41.9	46.9
GB0039R	Sibton	47.4	48.8	47.9	67.2	70.1	58.6	48.7	54.2	46.8	43.5	38.9	44.3
GB0043R	Narberth	56.3	58.2	62.7	70.1	68.2	58.9	52.7	61.4	59.4	50.5	59.8	63.5
GB0045R	Wicken Fen	27.9	28.2	30.6	51.4	60.6	49.0	42.5	42.3	36.7	33.2	30.5	43.8
GB0048R	Auchencorth Moss	52.6	51.9	61.1	74.1	72.5	59.2	47.6	52.5	51.0	47.0	54.8	52.0
GB0049R	Weybourne	54.4	61.3	58.2	79.6	81.7	65.2	56.7	58.1	52.9	51.7	47.9	50.3
GB0050R	St. Osyth	41.7	42.2	42.1	68.0	69.6	60.5	52.9	54.4	47.7	43.7	39.3	45.0
GB0052R	Lerwick	64.1	65.4	66.7	80.2	81.5	64.6	52.9	57.6	52.3	58.5	66.7	69.0
GB0053R	Charlton Mackrell	47.4	39.4	43.4	65.2	64.9	54.6	53.7	52.8	53.8	46.5	50.0	54.6
GR0001R	Aliartos	33.8	47.3	53.5	66.4	65.3	75.9	73.7	71.0	48.3	31.7	28.6	26.8
GR0002R	Finokalia	81.2	86.8	91.5	95.5	114.2	121.1	129.5	127.4	107.0	92.0	81.4	76.6
HU0002R	K-puszta	-	-	67.9	76.7	78.1	75.4	85.8	82.4	63.5	44.7	31.0	33.4
IE0001R	Valentia Observatory	68.1	68.2	76.5	84.3	73.2	62.0	51.8	60.0	60.5	59.5	70.0	73.9
IE0031R	Mace Head	69.6	74.8	80.4	88.2	80.3	65.5	57.0	64.6	67.1	64.4	76.2	73.9
IT0001R	Montelibretti	28.1	53.3	60.3	61.6	65.5	81.8	80.0	77.5	51.7	36.2	27.2	27.9
IT0004R	Ispra	20.3	34.8	54.9	66.1	78.0	75.2	75.1	71.7	46.4	21.8	19.3	18.4
LT0015R	Preila	42.6	61.7	73.1	86.8	83.1	77.6	70.1	64.3	65.2	49.3	41.5	41.5
LV0010R	Rucava	67.5	78.7	85.3	98.7	93.5	82.0	68.4	54.6	57.3	41.1	45.3	49.0
LV0016R	Zoseni	66.1	77.3	91.9	98.6	86.1	75.1	71.6	54.7	58.3	53.7	55.8	63.4
MK0007R	Lazaropole	90.5	86.7	-	-	-	-	-	-	-	-	-	-
MT0001R	Giordan lighthouse	66.7	80.0	88.7	90.0	98.7	90.2	95.5	95.3	87.3	74.9	72.4	72.1

Table 3.1, cont.

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NL0007R	Eibergen	33.8	35.0	42.7	58.7	66.6	52.2	54.2	53.5	38.1	26.0	17.4	31.3
NL0009R	Kollumerwaard	46.4	48.5	49.3	64.7	70.5	63.4	56.6	58.2	49.6	40.5	29.4	40.1
NL0010R	Vredepeel	31.0	29.2	35.7	56.9	61.5	53.0	54.4	48.4	37.7	29.0	20.6	31.8
NL0091R	De Zilk	38.0	36.7	40.8	62.0	65.9	59.7	57.1	54.3	50.5	35.1	25.6	39.1
NL0644R	Cabauw Wielsekade	-	-	-	-	69.8	55.8	55.5	49.5	38.1	27.9	21.0	30.8
NO0001R	Birkenes	46.6	60.0	63.5	70.6	67.9	-	-	-	-	-	-	-
NO0002R	Birkenes II	55.6	66.8	72.0	78.0	84.8	66.6	57.9	56.8	53.7	51.0	-	49.7
NO0015R	Tustervatn	60.4	74.4	86.4	88.9	82.9	63.8	48.1	46.9	51.5	54.4	64.5	57.0
NO0039R	Kårvatn	60.9	69.8	75.2	82.3	73.6	56.0	36.2	33.9	37.5	42.7	50.8	55.6
NO0042G	Zeppelin mountain (Ny-Ålesund)	71.1	75.9	85.6	68.1	72.7	59.5	49.6	50.2	62.9	68.1	70.0	71.3
NO0043R	Prestebakke	46.7	58.7	65.7	72.3	76.1	63.6	58.6	53.0	50.0	41.9	45.9	46.7
NO0052R	Sandve	59.8	67.8	68.8	80.4	80.0	72.4	64.5	65.3	61.8	57.5	57.9	58.3
NO0056R	Hurdal	46.7	49.4	68.2	70.4	73.2	56.5	43.5	41.7	41.7	36.7	37.5	40.7
PL0002R	Jarczew	40.7	56.9	64.1	75.8	71.8	65.0	66.6	60.7	49.8	35.9	27.8	34.6
PL0003R	Sniezka	60.4	66.1	81.9	95.6	101.6	92.1	91.3	92.9	82.2	75.0	62.9	64.7
PL0004R	Leba	49.4	57.5	58.3	80.9	79.3	68.5	63.7	62.6	57.0	47.4	34.0	42.1
PL0005R	Diabla Gora	45.6	60.9	64.8	79.3	80.1	75.2	70.0	65.5	41.2	45.7	28.8	42.0
RO0008R	Poiana Stampei	54.7	50.5	57.1	73.4	76.9	73.0	72.6	62.4	49.8	48.9	33.3	50.7
SE0005R	Bredkälen	51.9	68.9	82.5	80.6	73.6	59.4	45.4	42.8	39.2	39.7	42.5	47.2
SE0011R	Vavihill	52.2	60.8	64.0	78.3	84.2	69.8	69.0	58.8	50.5	46.2	40.0	47.4
SE0012R	Aspvreten	46.8	54.9	64.6	71.1	72.2	58.1	55.0	47.4	44.4	36.1	40.4	46.2
SE0013R	Esrange	53.0	67.5	85.2	86.3	68.8	52.7	55.9	51.9	55.0	52.6	59.6	56.1
SE0014R	Råö	50.7	58.0	61.4	75.8	84.1	76.4	73.4	68.1	64.1	52.4	48.0	45.2
SE0032R	Norra-Kvill	50.4	60.3	71.6	78.4	84.4	66.4	71.2	64.9	60.0	50.6	47.7	50.5
SE0035R	Vindeln	44.7	59.9	81.3	79.7	72.0	54.0	48.4	37.7	43.0	43.3	48.4	49.2
SE0039R	Grimsö	47.6	58.6	67.1	73.2	72.4	57.6	54.2	45.4	47.1	39.9	45.3	48.2
SI0008R	Iskrba	40.3	60.3	62.4	78.0	65.4	72.2	69.3	68.7	44.5	32.7	38.7	34.0
SI0031R	Zarodnje	60.0	77.3	84.6	93.1	101.4	97.3	96.4	101.8	77.5	47.3	45.0	51.1
SI0032R	Krvavec	74.3	86.3	98.7	102.7	110.9	113.8	114.8	122.2	106.4	90.4	86.5	84.5
SI0033R	Kovk	47.3	72.5	84.2	88.6	98.0	95.8	91.4	107.9	78.2	51.0	43.5	42.3
SK0002R	Chopok	73.1	87.6	95.4	110.2	113.4	106.5	109.7	104.9	95.9	78.1	76.3	73.2
SK0004R	Stará Lesná	57.2	58.2	69.4	85.8	86.2	64.1	64.9	63.8	62.1	50.9	48.7	49.4
SK0006R	Starina	49.9	78.6	72.9	75.5	73.2	61.9	62.7	64.8	58.2	43.7	43.3	44.4
SK0007R	Topolniky	47.2	49.1	58.5	70.0	56.9	56.8	75.1	77.8	59.5	40.0	-	-

Table 3.2: Monthly data capture 2012 ($\mu g/m^3$).

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
AM0001R	Amberd	43	100	97	42	43	47	46	2	0	0	0	0
AT0002R	Illmitz	96	96	95	95	95	95	95	95	95	96	95	95
AT0005R	Vorhegg	95	95	94	95	95	73	95	91	95	95	95	95
AT0030R	Pillersdorf bei Retz	85	95	95	95	88	95	95	95	95	96	95	95
AT0032R	Sulzberg	95	95	92	94	96	91	94	96	96	95	96	96
AT0034G	Sonnblick	58	93	96	96	95	96	93	94	96	96	94	96
AT0038R	Gerlitzen	96	96	96	96	96	96	95	92	96	96	96	96
AT0040R	Masenberg	95	95	96	95	95	96	95	96	96	95	84	95
AT0041R	Haunsberg	95	96	95	96	96	96	96	96	96	95	95	96
AT0042R	Heidenreichstein	96	96	95	95	96	95	95	95	96	96	96	96
AT0043R	Forsthof	95	96	96	95	95	95	96	95	95	95	95	95
AT0044R	Graz Platte	95	96	95	96	96	96	96	95	96	96	95	96
AT0045R	Dunkelsteinerwald	95	95	95	95	95	95	95	96	95	95	95	95
AT0046R	Gänserndorf	95	91	95	95	96	96	96	96	96	96	95	96
AT0047R	Stixneusiedl	95	95	95	95	90	95	96	96	96	96	96	95
AT0048R	Zoebelboden	95	95	91	95	95	95	94	93	95	94	95	95
AT0049R	Grebenzen bei St. Lamprecht	96	95	96	96	78	96	95	95	96	95	96	96
BE0001R	Offagne	98	83	97	97	83	96	89	98	98	73	98	97
BE0032R	Eupen	98	92	84	95	97	98	88	96	98	83	97	98
BE0035R	Vezin	97	98	84	97	97	97	97	90	97	70	94	96
BG0053R	Rojen peak	79	94	95	94	93	86	91	95	96	96	95	95
CH0001G	Jungfraujoch	93	97	98	96	96	97	98	97	98	98	97	98
CH0002R	Payerne	95	96	95	95	95	95	95	95	95	95	96	95
CH0003R	Tänikon	95	95	95	95	79	95	95	96	96	94	95	96
CH0004R	Chaumont	95	95	95	96	95	95	96	95	95	95	95	95
CH0005R	Rigi	95	95	95	95	95	94	95	95	95	95	99	99
CY0002R	Ayia Marina	87	82	90	96	95	99	83	95	100	99	89	97
CZ0001R	Svratouch	100	100	100	100	100	100	100	100	100	99	97	100
CZ0003R	Košetice	100	98	100	90	100	95	99	100	100	95	95	100
CZ0005R	Churanov	100	99	100	100	100	100	95	100	100	100	93	100
DE0001R	Westerland	97	95	96	95	96	96	86	96	96	95	96	96
DE0002R	Waldhof	96	95	96	96	96	96	96	95	96	95	96	93
DE0003R	Schauinsland	96	96	92	58	96	12	96	96	64	87	0	57
DE0007R	Neuglobsow	96	95	96	96	95	95	95	95	95	96	94	96

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
DE0008R	Schmücke	96	94	95	96	96	96	95	96	95	96	94	96
DE0009R	Zingst	96	96	96	96	96	95	96	96	96	96	95	96
DK0005R	Keldsnor	91	90	86	85	92	85	74	92	85	92	91	91
DK0010G	Nord, Greenland	91	91	90	88	86	92	92	85	80	88	92	89
DK0012R	Risoe	79	91	91	92	92	91	92	92	92	92	92	92
DK0031R	Ulborg	72	61	92	86	74	92	92	91	92	92	91	91
EE0009R	Lahemaa	100	100	100	100	100	100	91	100	100	100	99	100
EE0011R	Vilsandi	99	95	96	99	96	82	99	99	99	99	99	86
ES0001R	San Pablo de los Montes	99	100	100	99	99	99	98	99	99	99	100	96
ES0006R	Mahón	94	99	99	98	99	99	100	99	95	99	98	99
ES0007R	Víznar	84	100	99	96	91	100	100	92	93	97	98	98
ES0008R	Niembro	99	99	99	71	99	100	99	98	88	98	95	99
ES0009R	Campisábalos	100	99	99	99	96	99	96	97	93	92	98	98
ES0010R	Cabo de Creus	100	100	100	99	96	98	95	88	99	97	93	99
ES0011R	Barcarrota	100	99	99	99	94	99	100	99	94	89	98	99
ES0012R	Zarra	100	99	100	99	99	100	99	100	99	98	99	99
ES0013R	Penausende	100	99	99	98	100	100	99	98	93	96	98	98
ES0014R	Els Torms	99	100	100	99	99	99	99	100	99	95	97	86
ES0016R	O Saviñao	100	99	99	99	99	100	99	100	98	97	99	95
ES0017R	Doñana	96	92	100	100	100	100	88	97	98	99	97	96
FI0009R	Utö	100	97	100	100	89	89	96	100	100	98	99	100
FI0017R	Virolahti II	95	99	100	100	99	100	100	100	96	99	98	92
FI0022R	Oulanka	65	98	91	98	100	100	100	96	99	97	95	98
FI0037R	Ähtäri II	100	100	100	100	70	100	100	100	98	99	99	100
FI0096G	Pallas (Sammaltunturi)	99	100	96	97	100	100	100	100	99	100	100	73
FR0008R	Donon	100	100	100	99	100	100	100	100	100	98	98	93
FR0009R	Revin	99	98	100	100	100	100	100	100	100	100	100	100
FR0010R	Morvan	94	93	99	87	94	94	98	95	98	90	93	98
FR0013R	Peyrusse Vieille	100	10	60	100	100	89	100	86	89	99	100	100
FR0014R	Montandon	100	99	100	99	100	100	100	98	99	99	93	91
FR0015R	La Tardière	99	100	99	100	100	100	99	96	100	100	100	97
FR0016R	Le Casset	100	100	100	99	100	100	100	90	100	100	100	100
FR0017R	Montfranc	100	99	95	97	78	82	99	97	99	100	100	100
FR0018R	La Coulonche	97	99	99	100	100	99	98	100	96	74	88	100
FR0019R	Pic du Midi	100	100	61	100	100	100	100	100	93	100	87	99
FR0030R	Puy de Dôme	98	99	97	98	91	99	99	99	94	95	84	85

Table 3.2, cont.

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
GB0002R	Eskdalemuir	100	96	100	100	100	100	100	100	100	96	100	100
GB0006R	Lough Navar	99	99	100	100	100	100	100	90	63	100	100	100
GB0013R	Yarner Wood	50	96	100	100	100	83	69	96	97	100	100	100
GB0014R	High Muffles	100	96	100	93	100	89	99	96	88	100	100	100
GB0015R	Strath Vaich Dam	100	98	100	100	100	100	100	79	100	100	100	100
GB0031R	Aston Hill	100	96	100	100	100	100	99	96	100	100	99	100
GB0033R	Bush	100	95	100	100	100	100	100	96	100	100	100	100
GB0035R	Great Dun Fell	95	97	100	97	97	97	0	0	78	100	99	99
GB0036R	Harwell	93	100	100	99	99	100	100	93	100	100	100	100
GB0037R	Ladybower Res.	96	100	100	100	100	100	96	100	98	100	100	100
GB0038R	Lullington Heath	98	98	100	99	100	100	100	96	100	100	100	98
GB0039R	Sibton	100	100	100	100	100	100	100	100	99	100	100	100
GB0043R	Narberth	100	96	92	87	100	100	96	96	100	99	100	100
GB0045R	Wicken Fen	100	96	100	99	100	100	100	96	100	99	100	77
GB0048R	Auchencorth Moss	100	98	100	100	100	100	100	94	99	100	100	100
GB0049R	Weybourne	100	100	100	100	100	100	100	100	100	100	100	100
GB0050R	St. Osyth	98	96	100	100	95	100	96	97	100	100	100	100
GB0052R	Lerwick	100	45	8	100	100	100	100	98	100	99	15	24
GB0053R	Charlton Mackrell	100	99	99	100	100	100	100	100	100	98	99	100
GR0001R	Aliartos	100	99	100	98	100	99	100	100	100	100	98	96
GR0002R	Finokalia	89	89	84	78	100	100	100	99	91	100	90	99
HU0002R	K-puszta	0	0	100	100	98	88	100	100	100	100	100	100
IE0001R	Valentia Observatory	100	96	90	81	100	98	99	100	100	100	100	100
IE0031R	Mace Head	99	97	100	100	100	100	76	99	99	100	99	96
IT0001R	Montelibretti	100	100	100	100	100	100	100	100	100	100	96	96
IT0004R	Ispra	93	100	100	100	100	100	100	100	100	100	100	100
LT0015R	Preila	100	98	100	96	98	100	97	94	100	92	100	96
LV0010R	Rucava	100	100	99	100	94	99	100	99	100	61	78	97
LV0016R	Zoseni	100	98	98	100	100	100	100	100	99	98	99	97
MK0007R	Lazaropole	86	35	0	0	0	0	0	0	0	0	0	0
MT0001R	Giordan lighthouse	95	96	89	95	95	94	95	95	95	88	92	81

Table 3.2, cont.

Code	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NL0007R	Eibergen	100	90	99	100	100	100	99	100	90	93	78	99
NL0009R	Kollumerwaard	97	96	95	82	99	100	100	100	100	100	100	100
NL0010R	Vredepeel	100	98	99	99	96	94	100	88	89	78	93	96
NL0091R	De Zilk	100	98	100	99	100	99	95	98	99	78	87	95
NL0644R	Cabauw Wielsekade	0	0	0	0	60	95	79	100	100	94	100	97
NO0001R	Birkenes	100	100	100	98	31	0	0	0	0	0	0	0
NO0002R	Birkenes II	98	99	99	80	68	100	100	87	97	41	0	89
NO0015R	Tustervatn	99	99	100	100	100	100	99	100	99	100	99	99
NO0039R	Kårvatn	100	100	86	99	99	94	99	100	99	100	99	100
NO0042G	Zeppelin mountain (Ny-Ålesund)	100	100	100	77	100	99	100	96	100	100	100	100
NO0043R	Prestebakke	100	98	100	99	94	98	99	99	100	100	100	100
NO0052R	Sandve	100	99	100	100	100	99	100	100	96	95	99	98
NO0056R	Hurdal	98	100	100	100	100	100	100	100	100	99	100	99
PL0002R	Jarczew	100	100	100	100	100	100	96	100	100	98	100	100
PL0003R	Sniezka	100	100	100	100	100	100	100	100	99	100	99	99
PL0004R	Leba	100	100	100	100	100	100	100	99	94	99	94	100
PL0005R	Diabla Gora	100	100	100	100	100	100	100	100	100	100	100	98
RO0008R	Poiana Stampei	70	72	82	58	67	54	91	87	88	90	67	90
SE0005R	Bredkälen	99	99	100	100	100	99	100	100	100	100	100	99
SE0011R	Vavihill	100	100	100	100	100	100	77	100	100	100	100	100
SE0012R	Aspvreten	96	100	100	100	100	100	100	99	94	100	95	92
SE0013R	Esrange	100	100	100	98	76	100	100	40	100	100	100	100
SE0014R	Råö	100	96	100	100	100	100	100	95	100	100	100	100
SE0032R	Norra-Kvill	100	100	100	100	100	28	88	100	100	80	100	100
SE0035R	Vindeln	100	100	100	97	100	100	81	88	100	100	100	100
SE0039R	Grimsö	100	100	100	99	100	100	100	100	100	100	100	100
SI0008R	Iskrba	96	96	96	94	93	96	95	96	94	91	91	96
SI0031R	Zarodnje	93	95	95	96	95	95	95	96	93	93	95	96
SI0032R	Krvavec	95	95	89	95	94	94	95	95	95	95	95	95
SI0033R	Kovk	75	95	95	96	96	95	96	82	89	93	86	96
SK0002R	Chopok	100	100	100	100	100	99	99	79	94	98	99	94
SK0004R	Stará Lesná	100	100	100	99	99	91	81	100	100	99	99	94
SK0006R	Starina	100	100	100	100	100	100	97	95	100	100	100	91
SK0007R	Topolniky	98	97	98	98	98	97	98	100	98	91	0	0

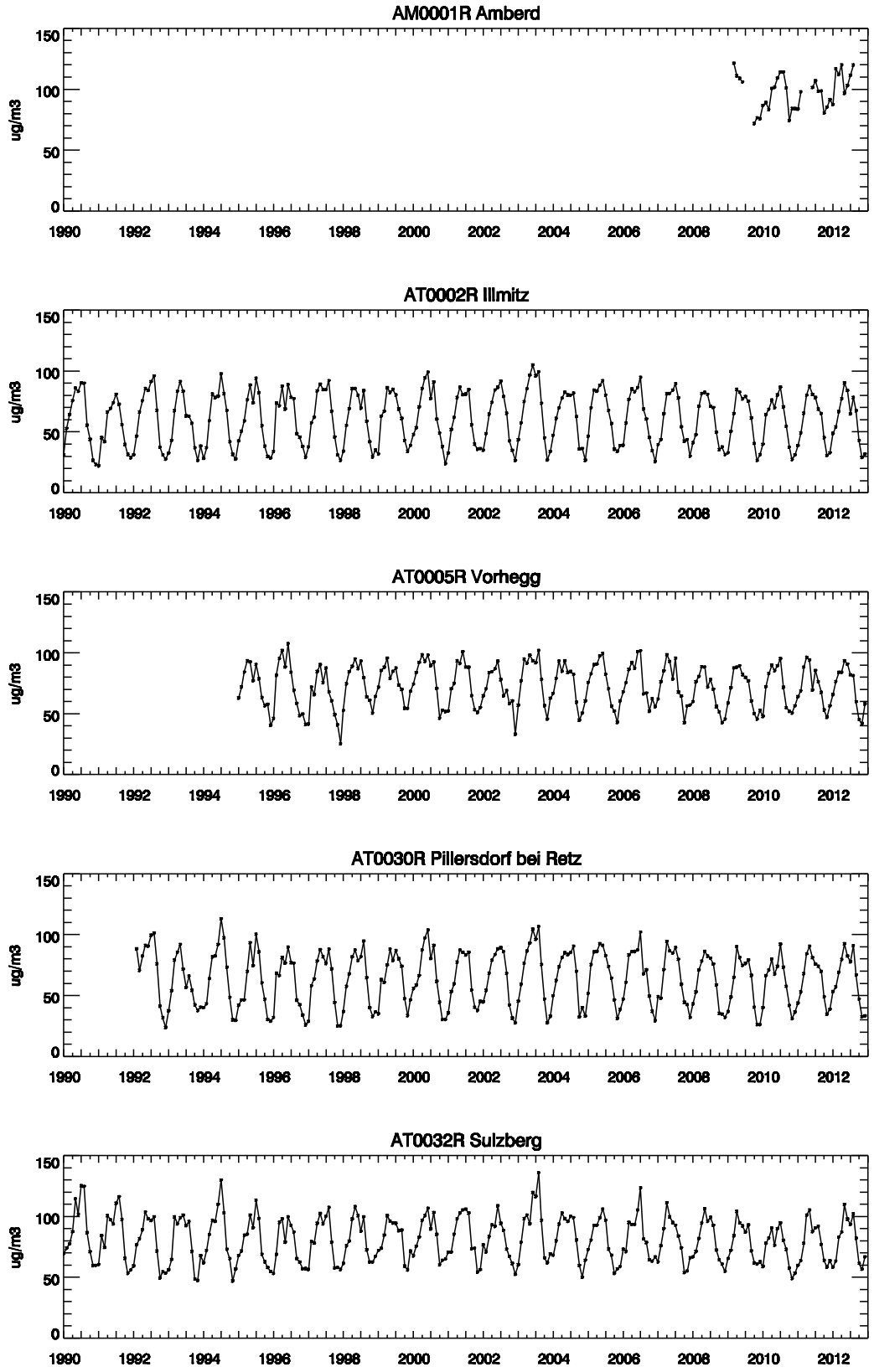


Figure 3.1: Seasonal variation, 1990–2012.

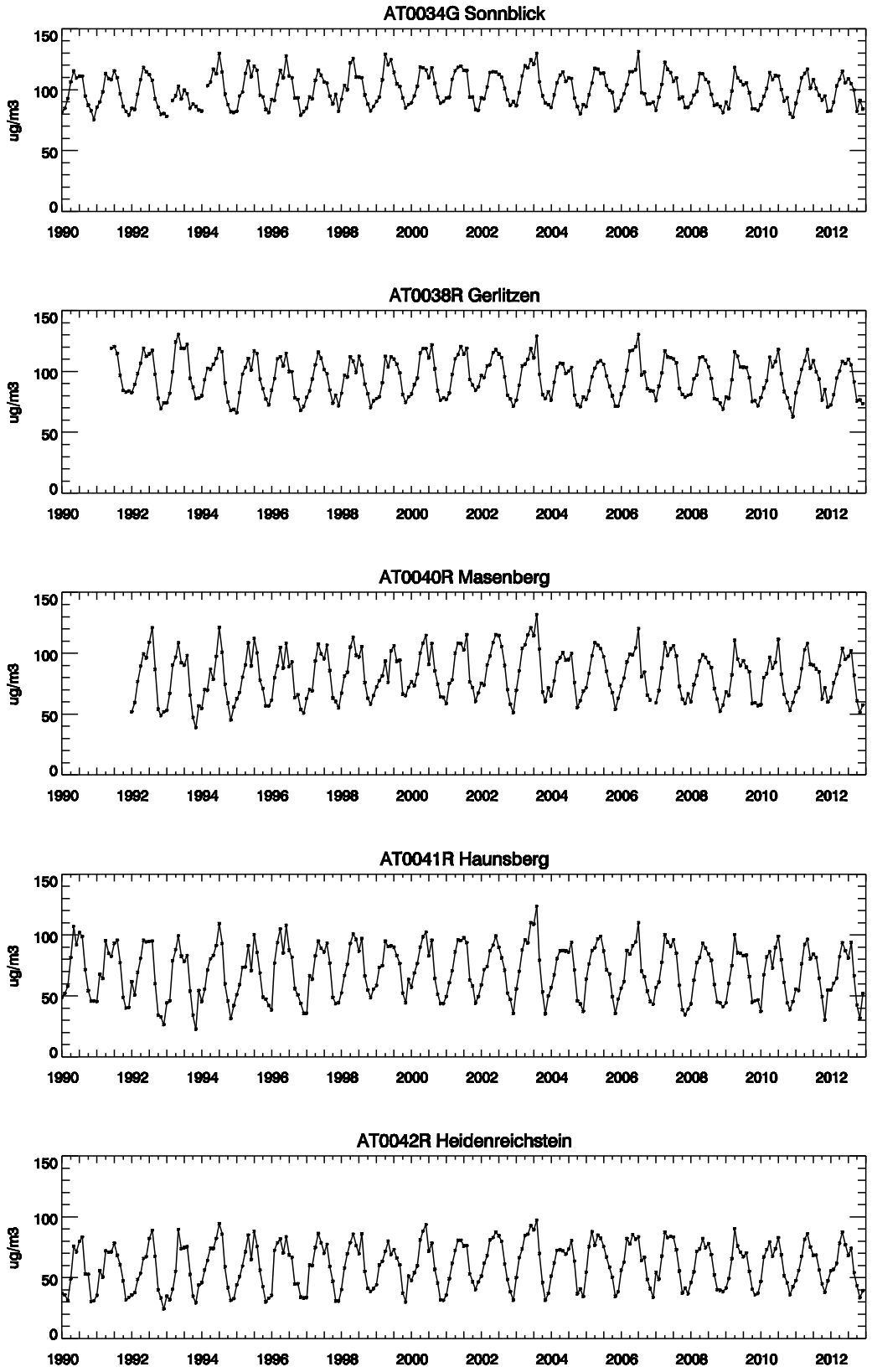


Figure 3.1, cont.

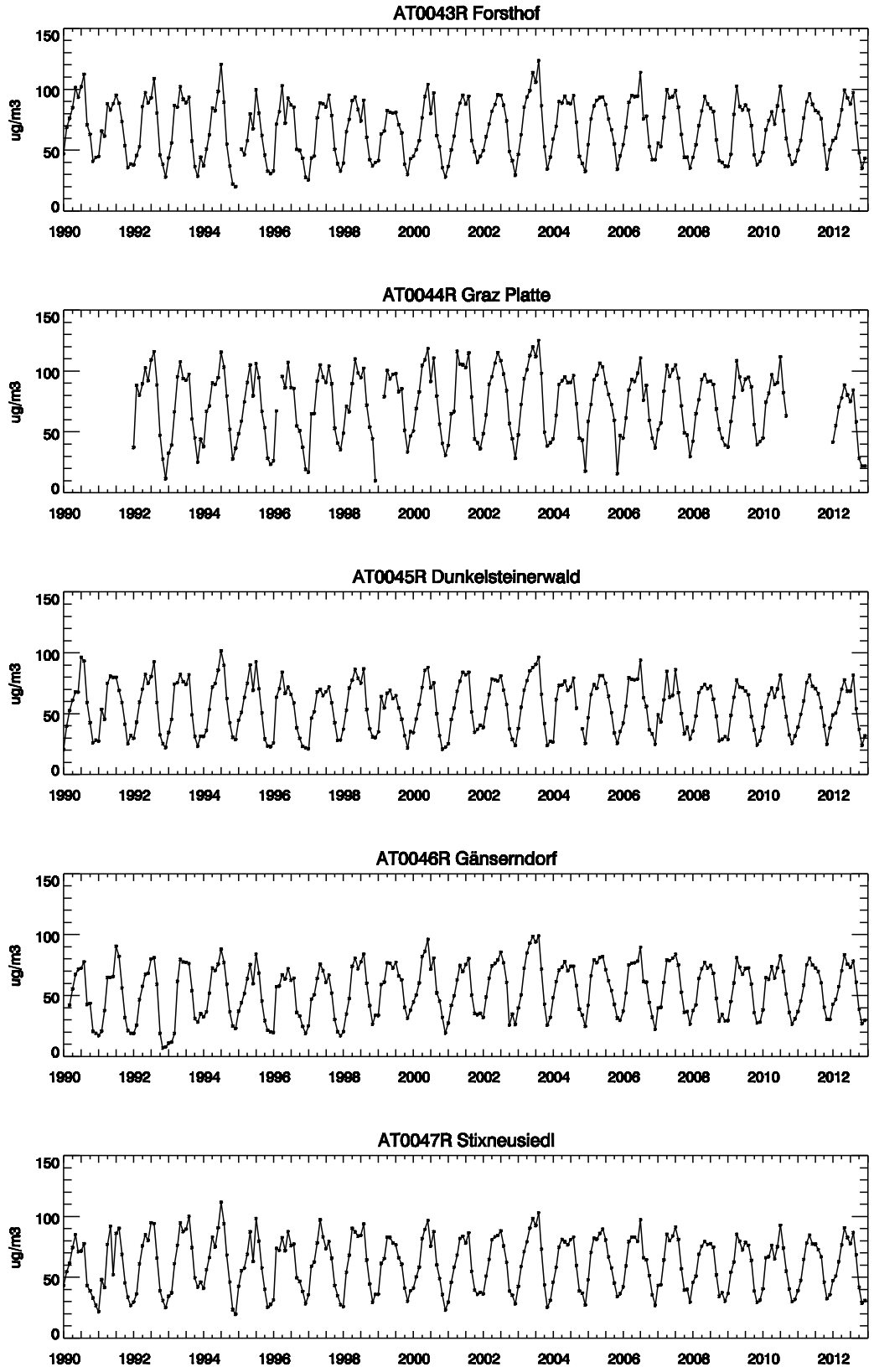


Figure 3.1, cont.

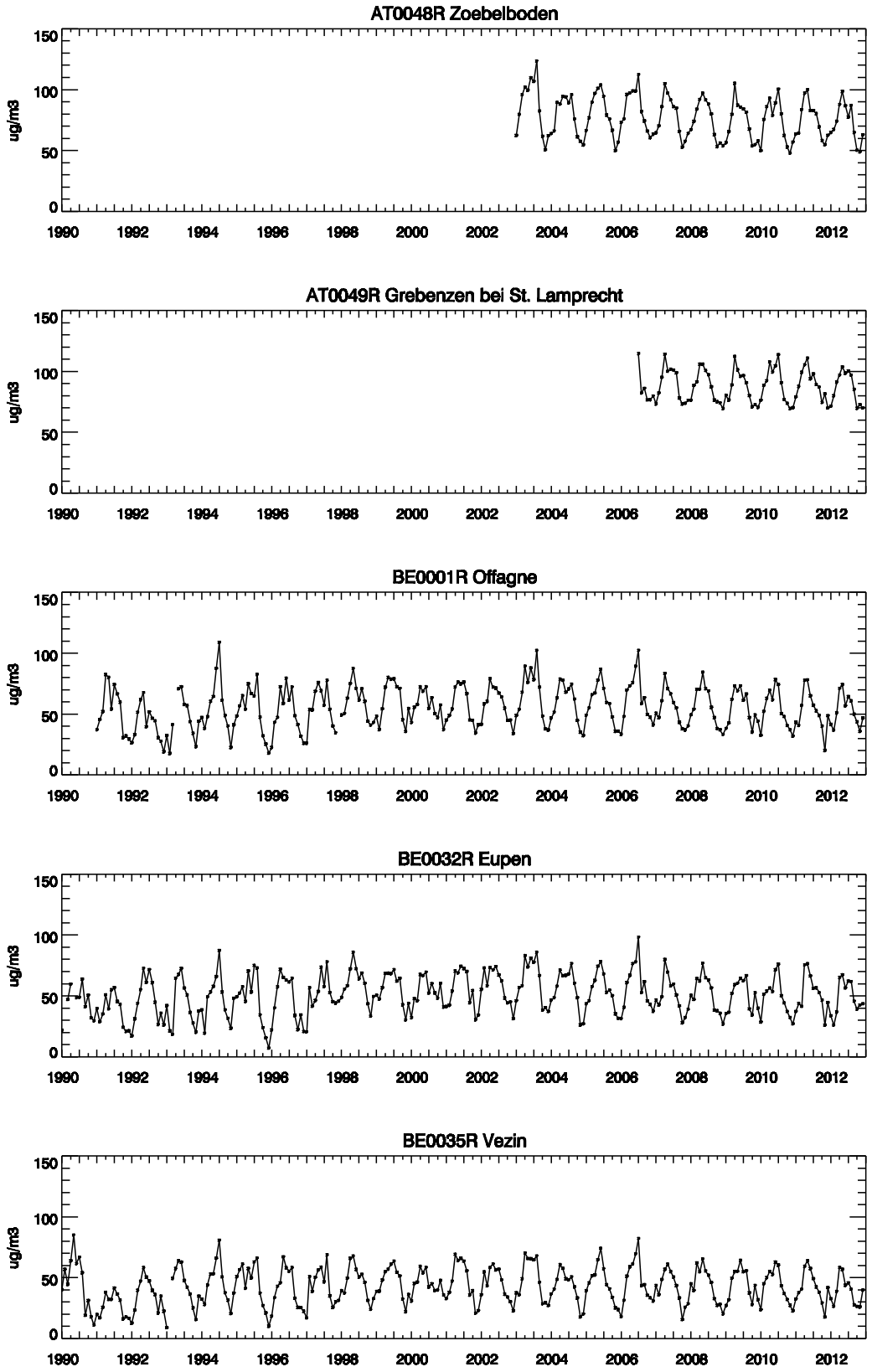


Figure 3.1, cont.

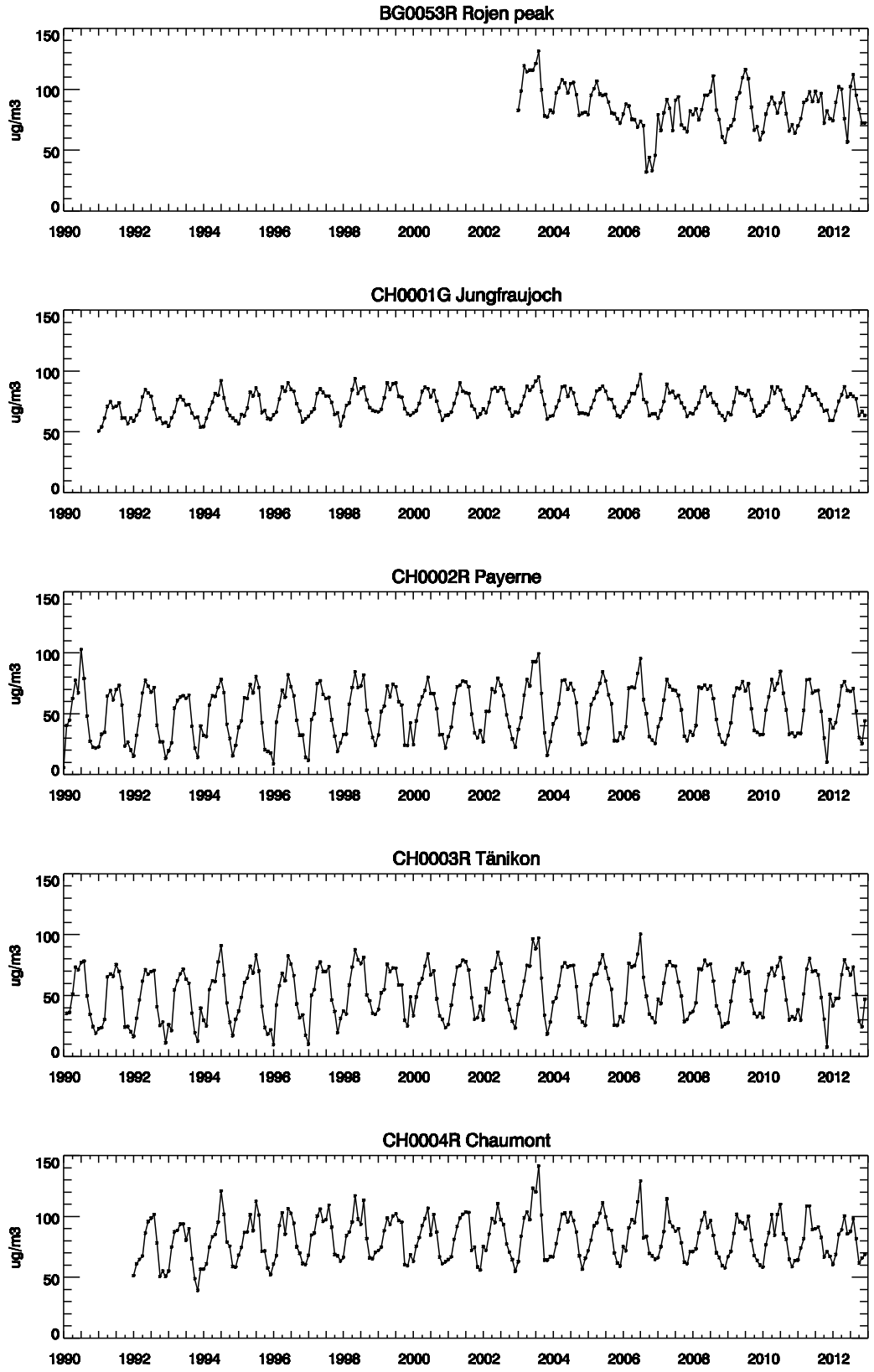


Figure 3.1, cont.

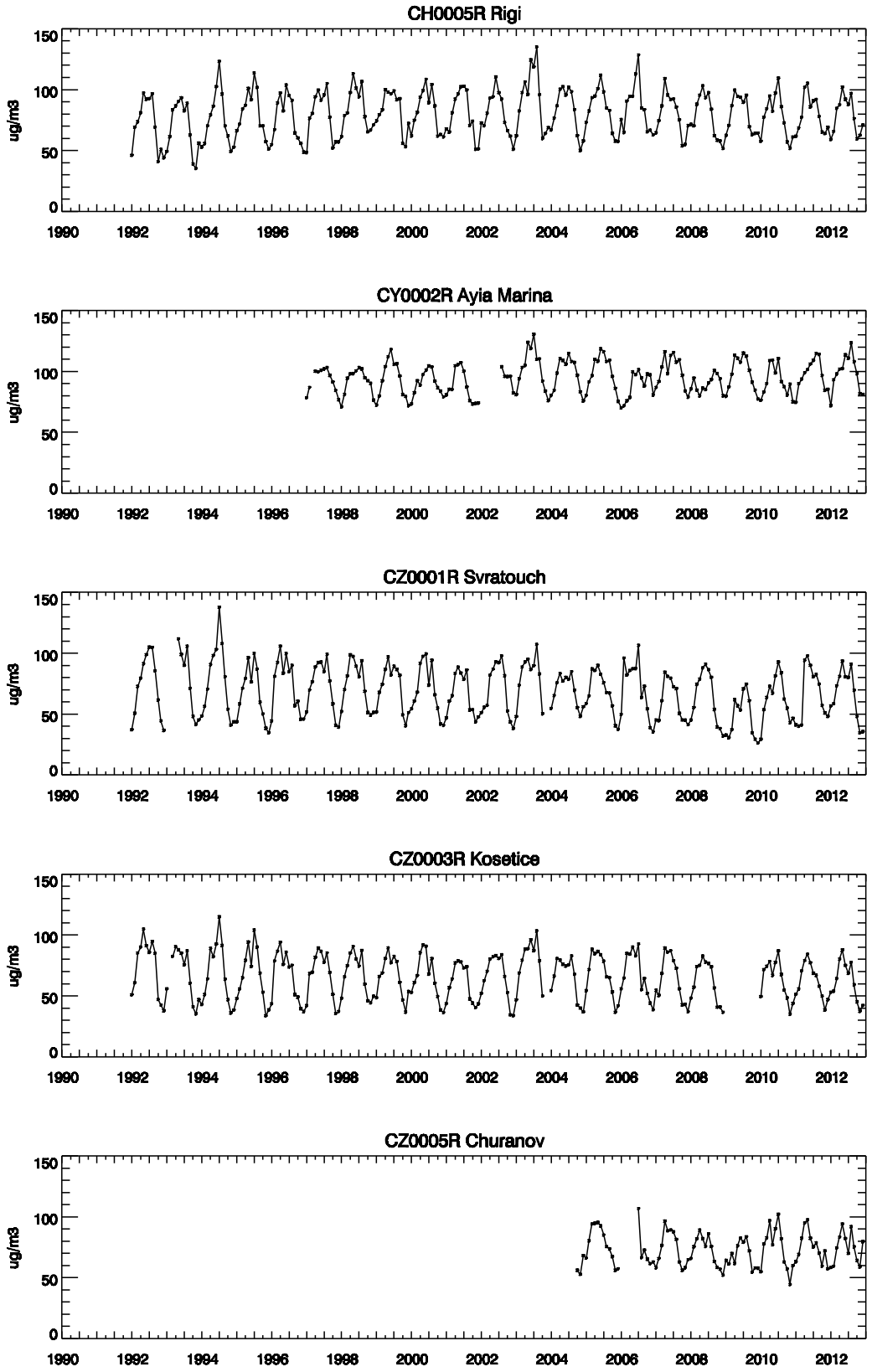


Figure 3.1, cont.

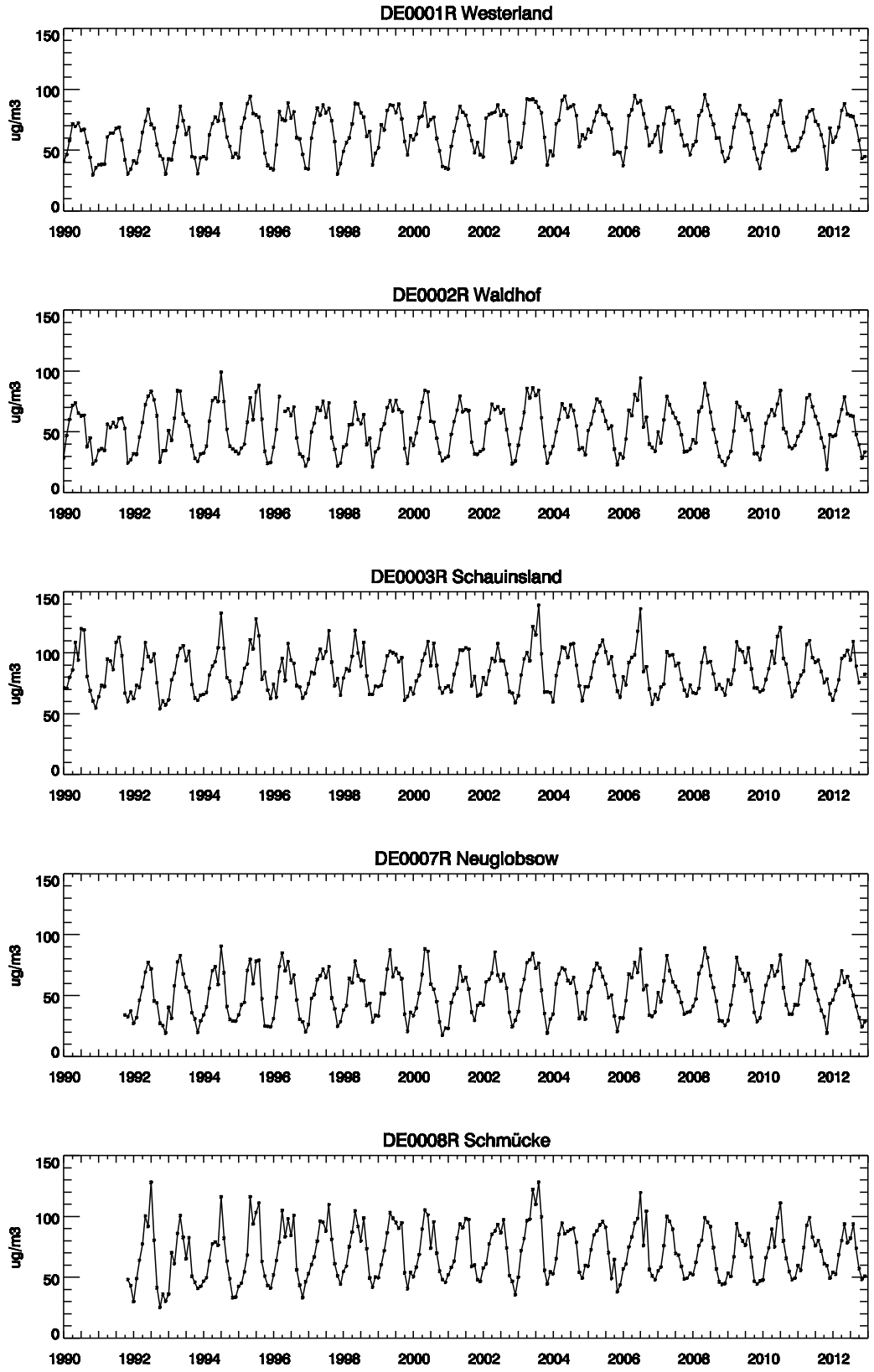


Figure 3.1, cont.

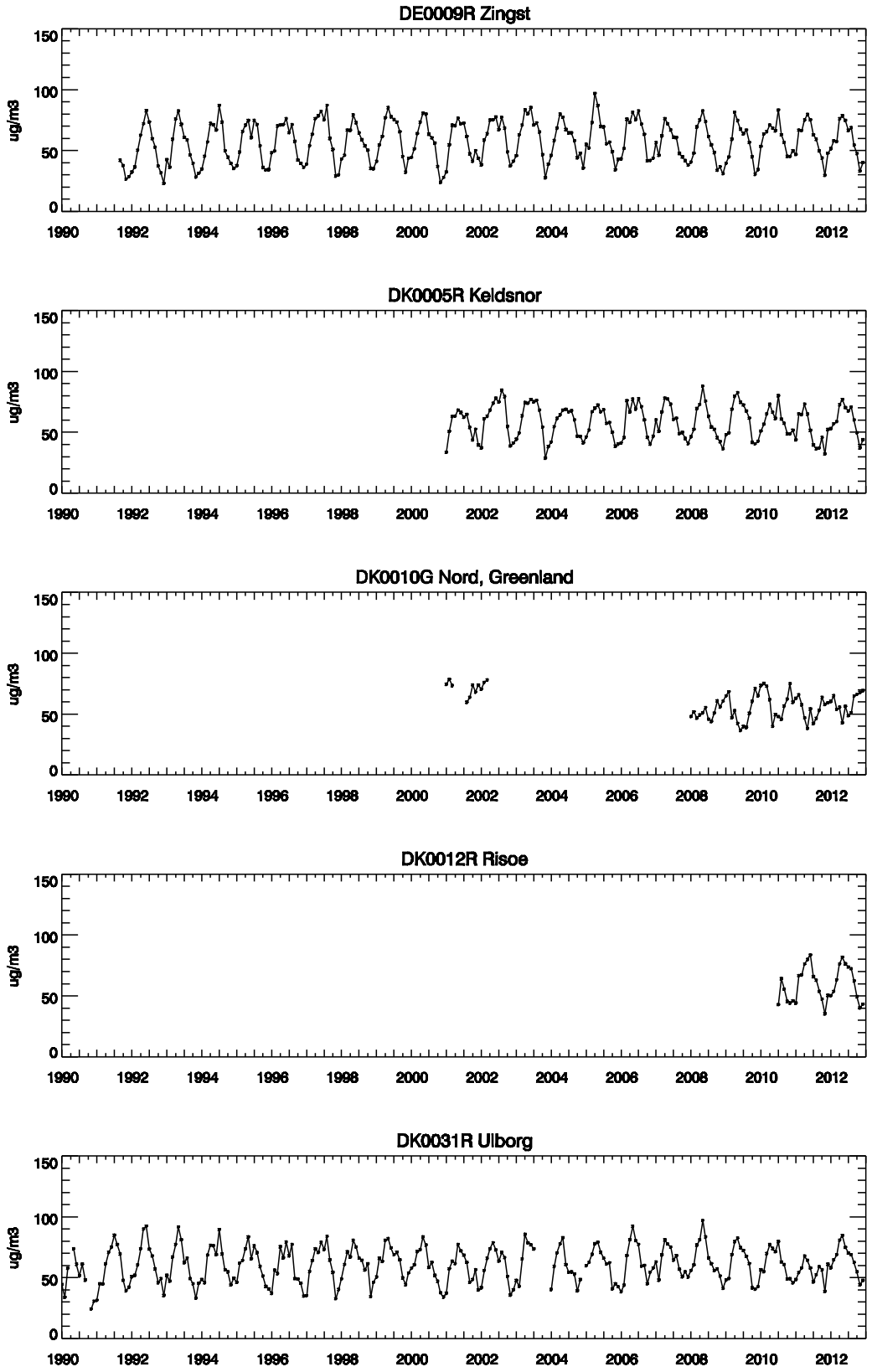


Figure 3.1, cont.

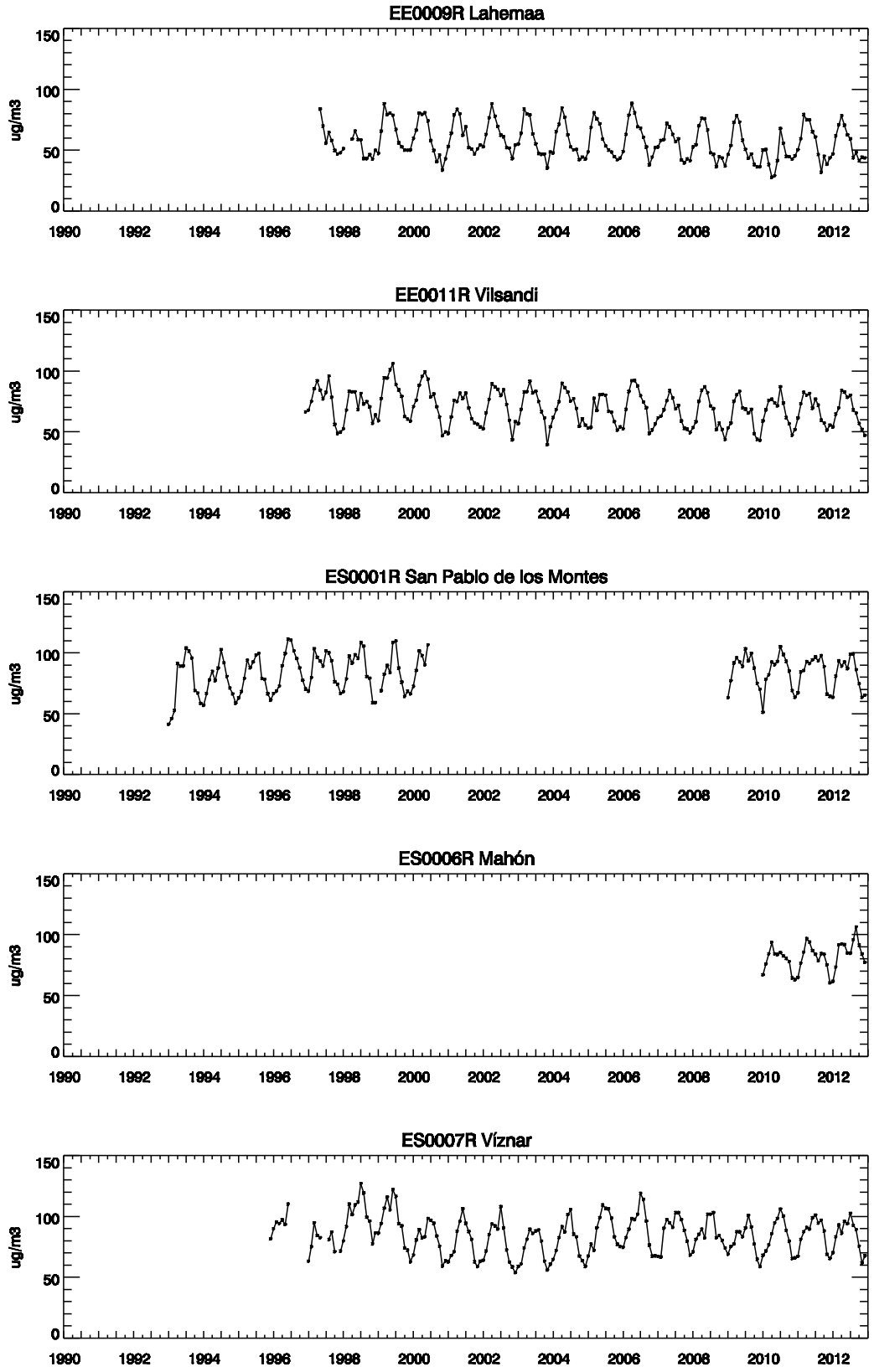


Figure 3.1, cont.

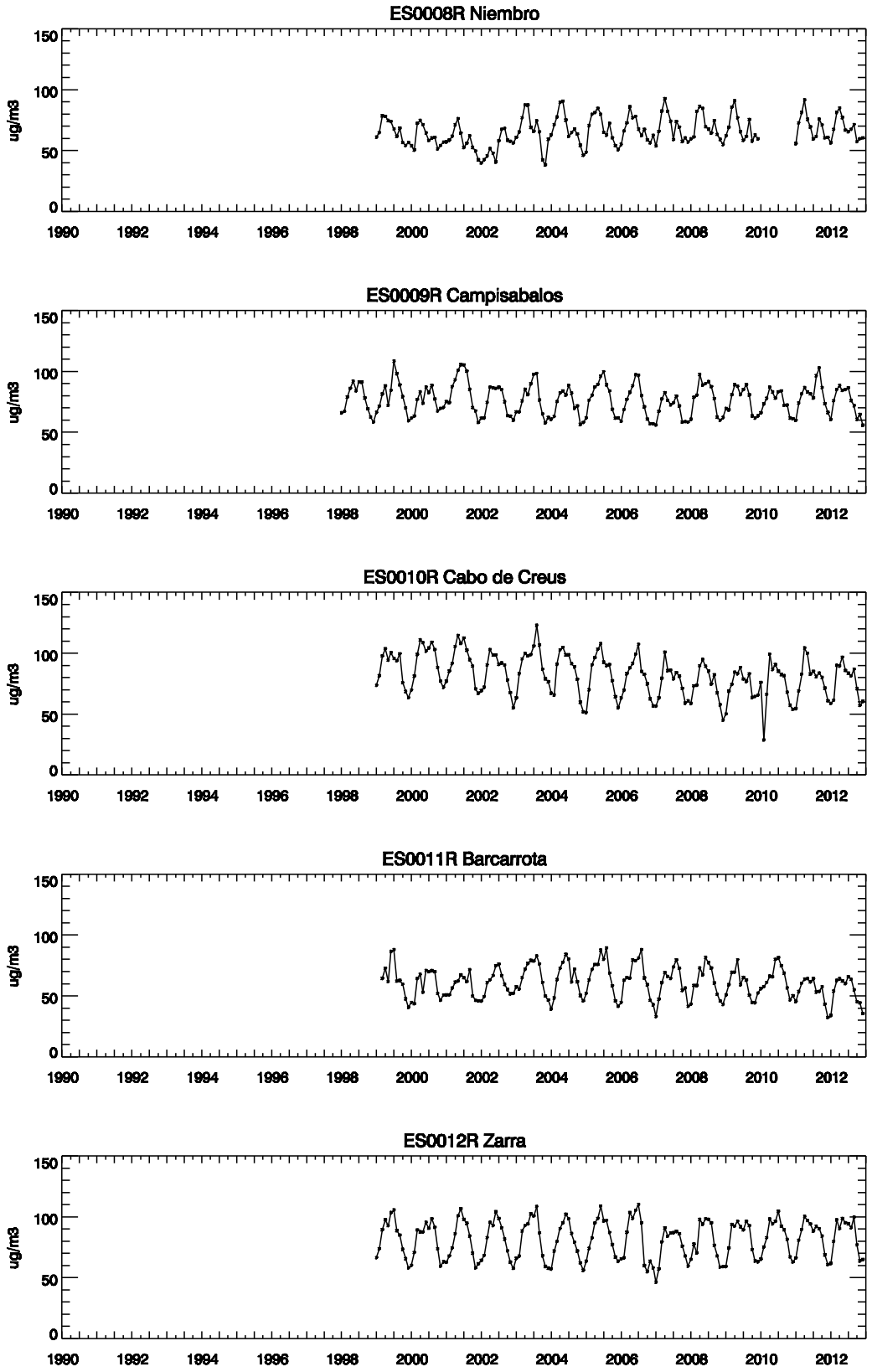


Figure 3.1, cont.

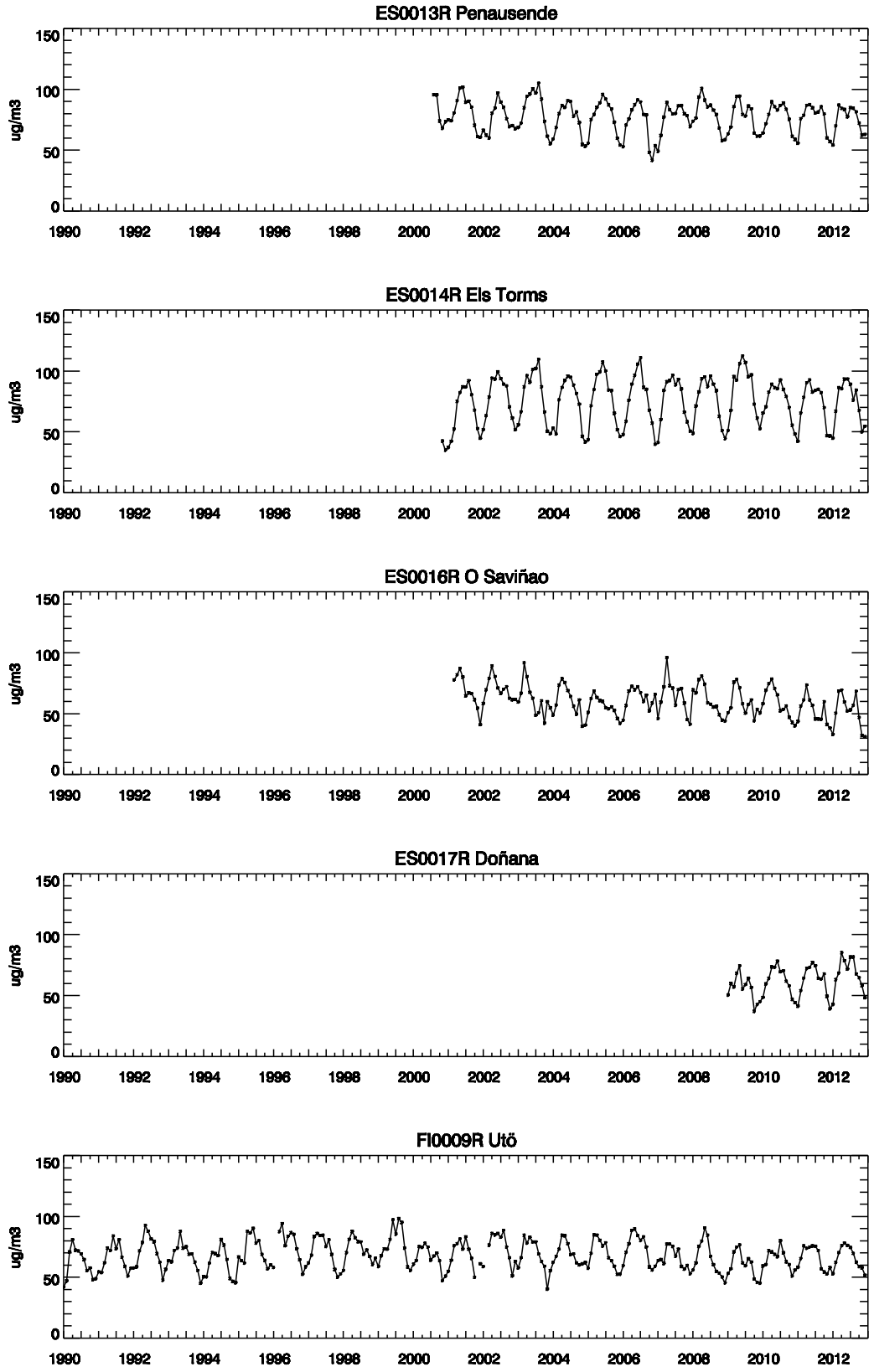


Figure 3.1, cont.

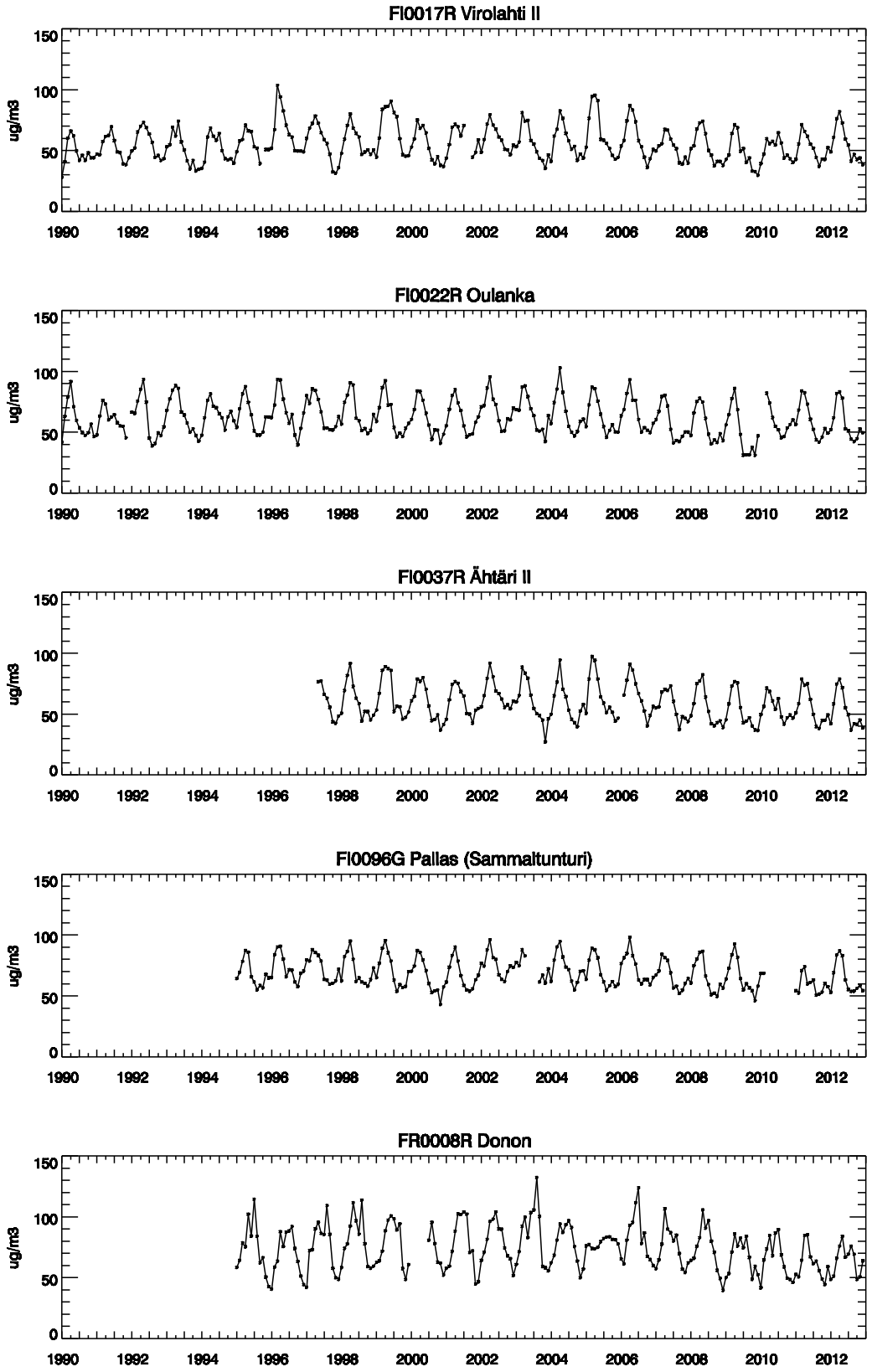


Figure 3.1, cont.

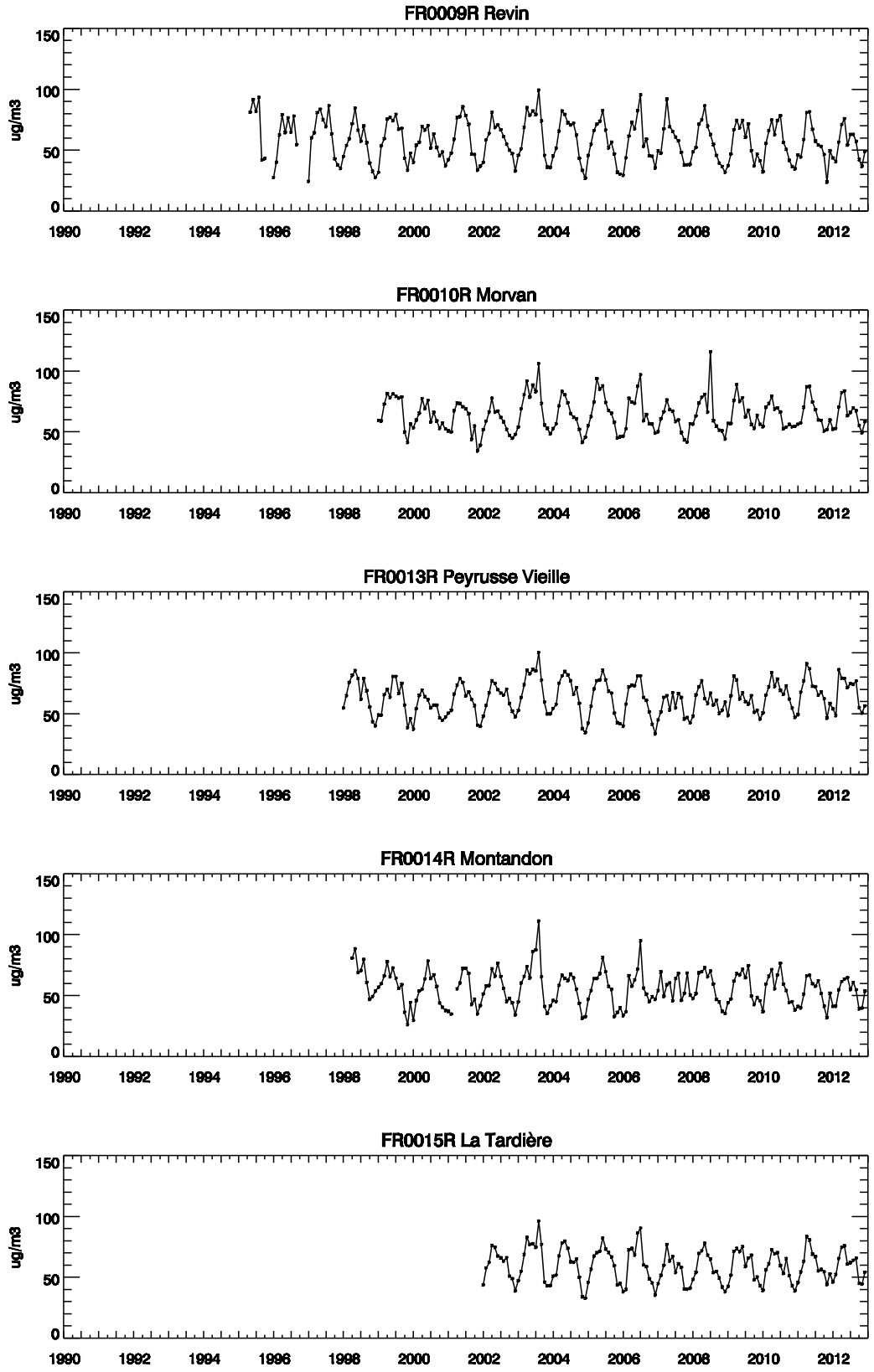


Figure 3.1, cont.

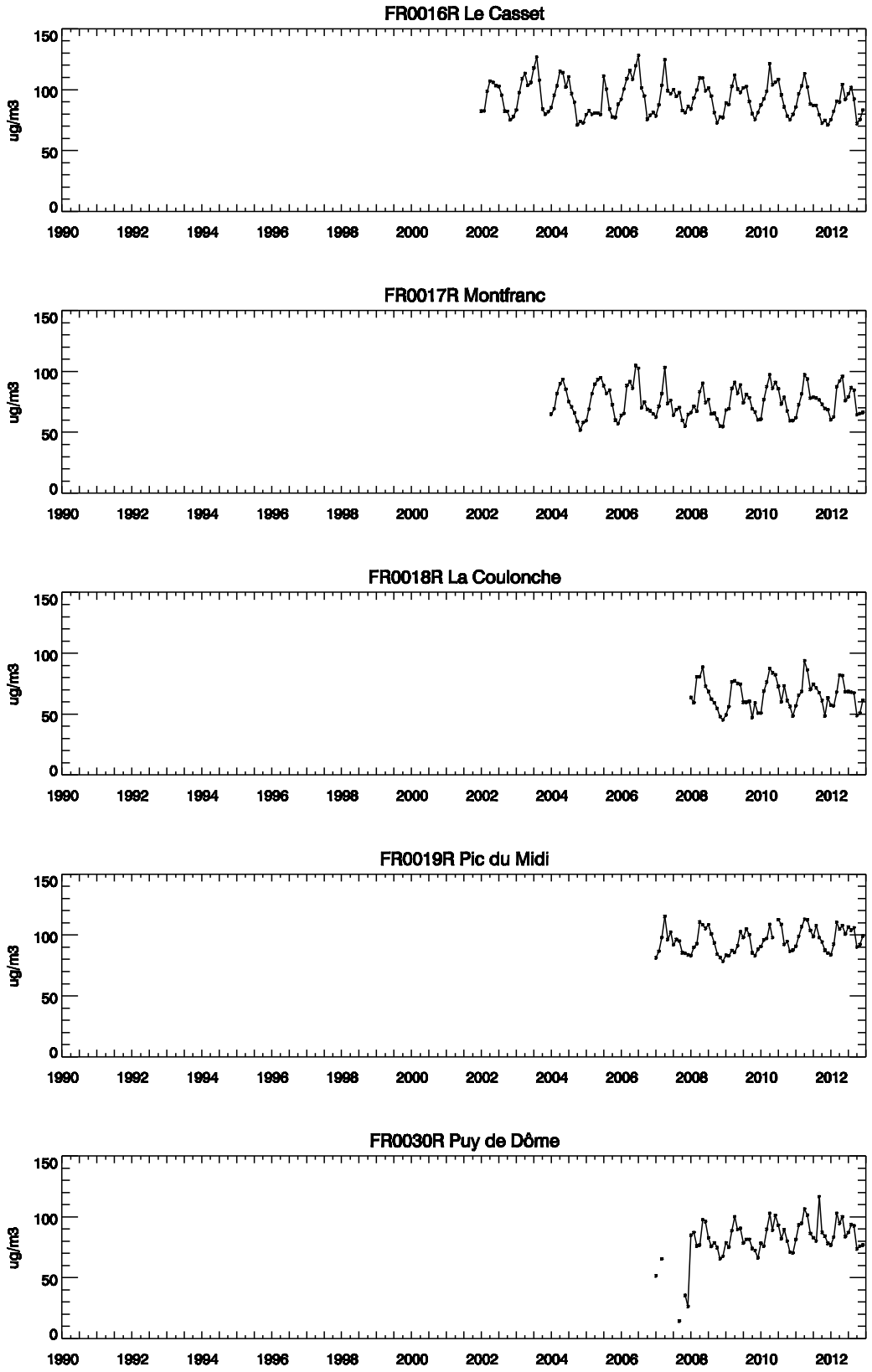


Figure 3.1, cont.

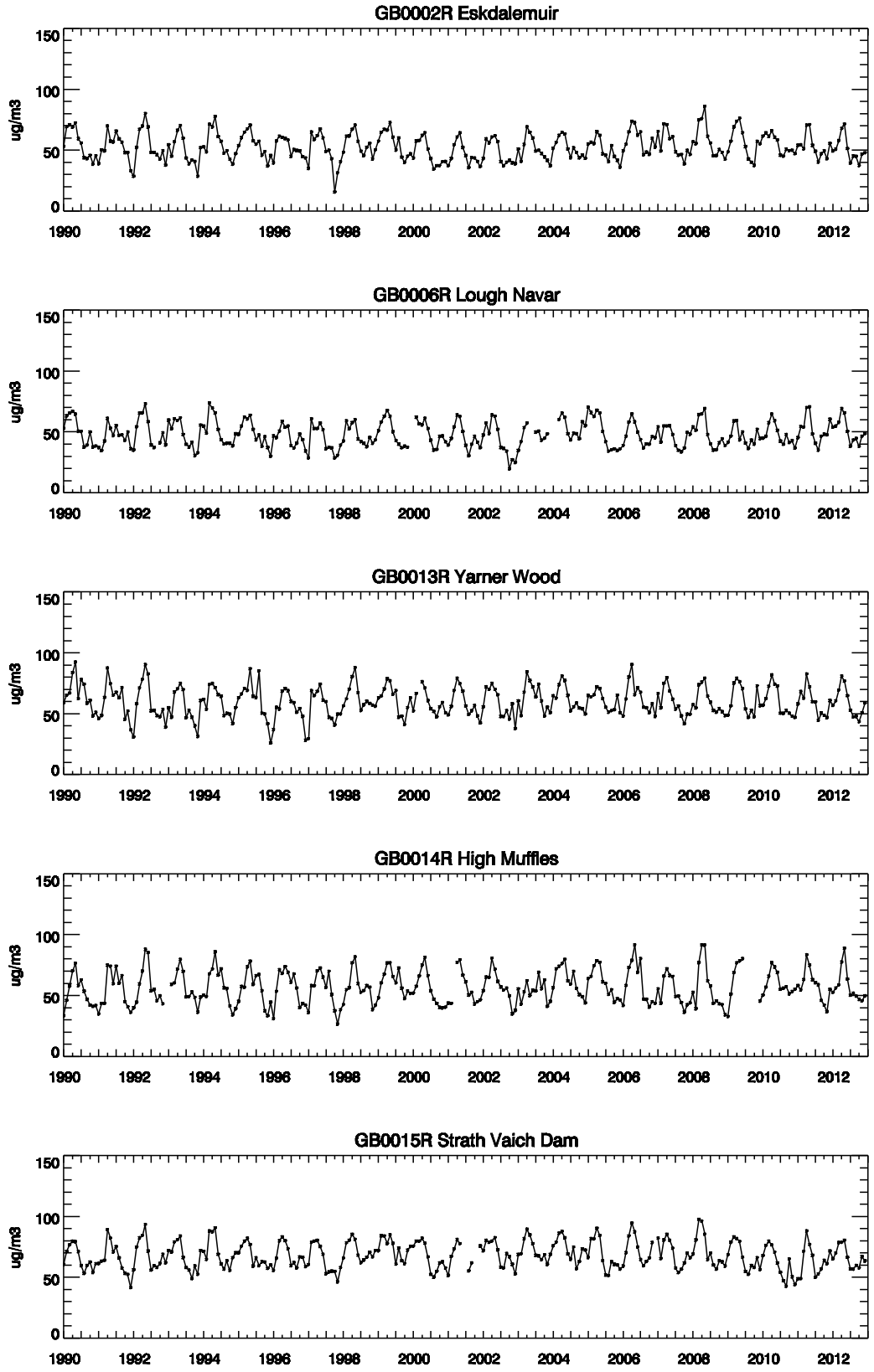


Figure 3.1, cont.

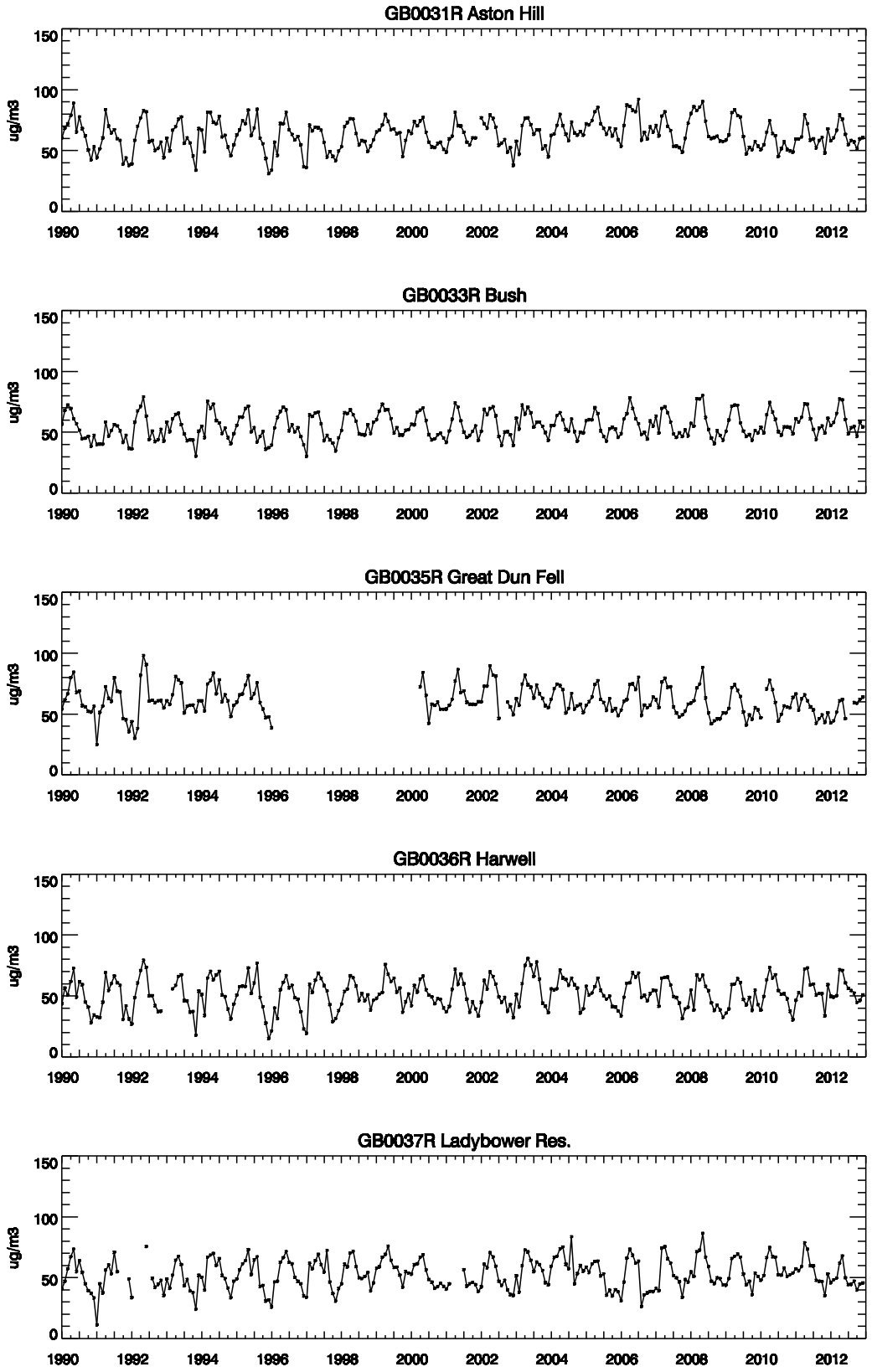


Figure 3.1, cont.

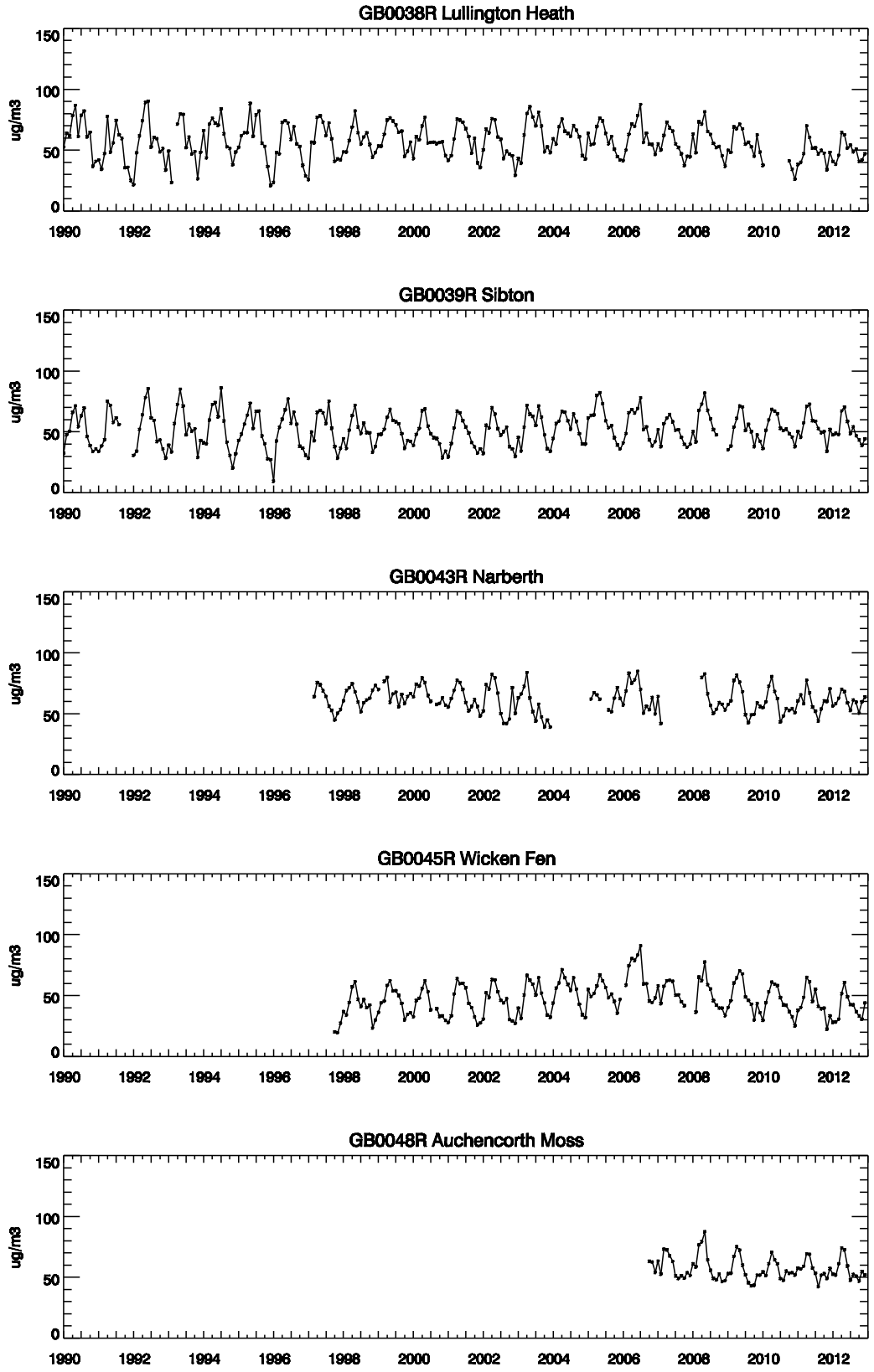


Figure 3.1, cont.

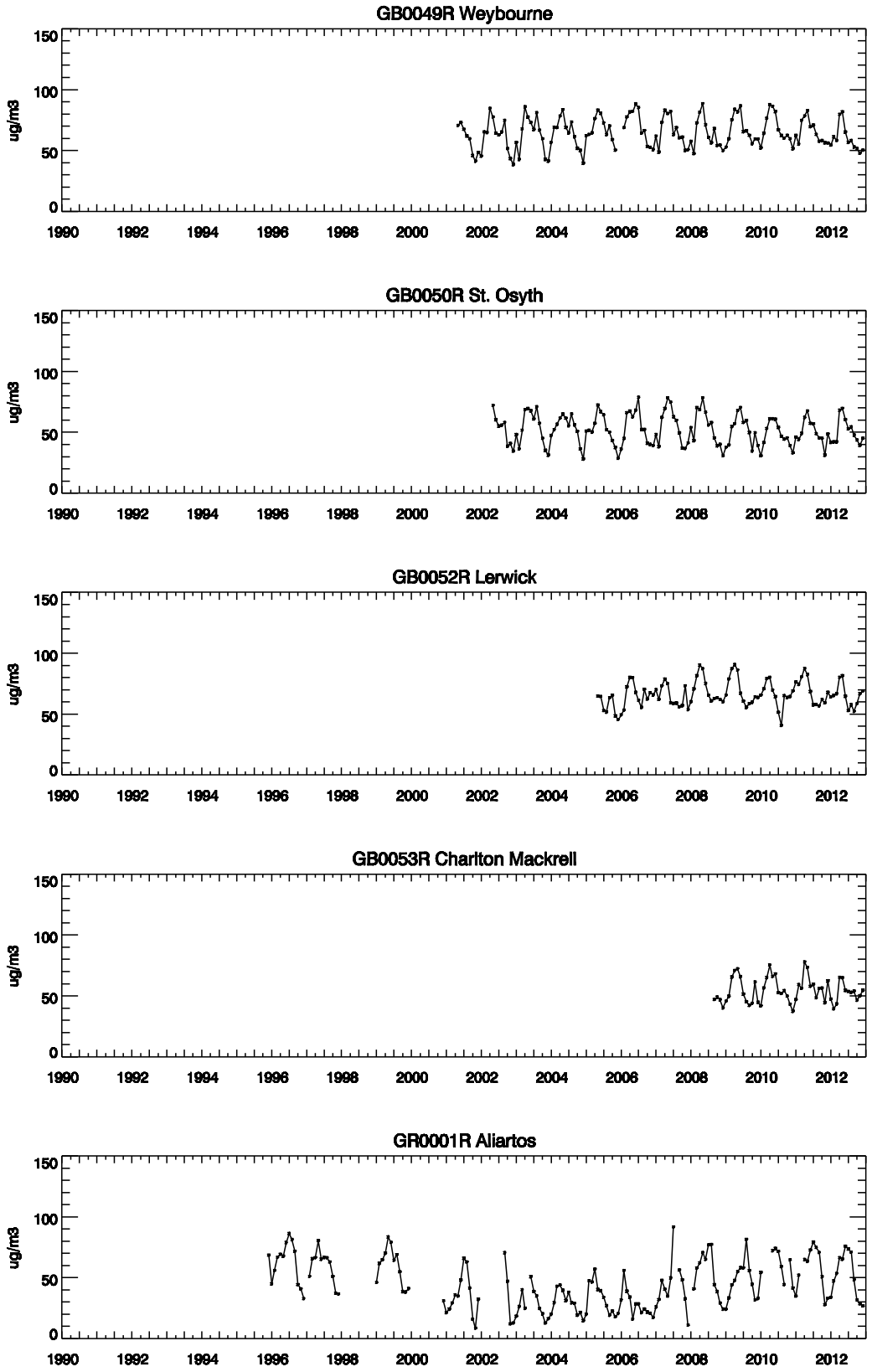


Figure 3.1, cont.

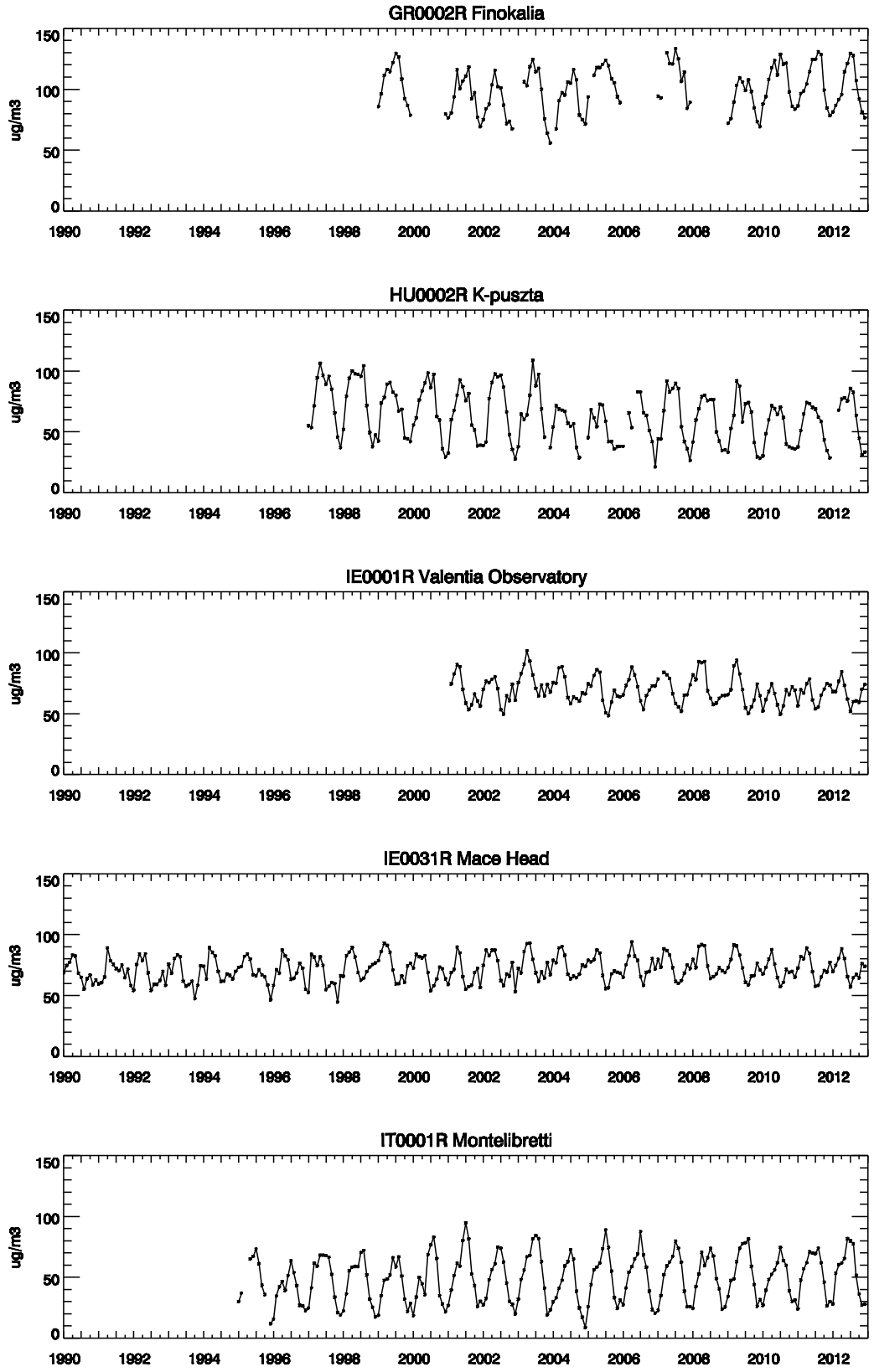


Figure 3.1, cont.

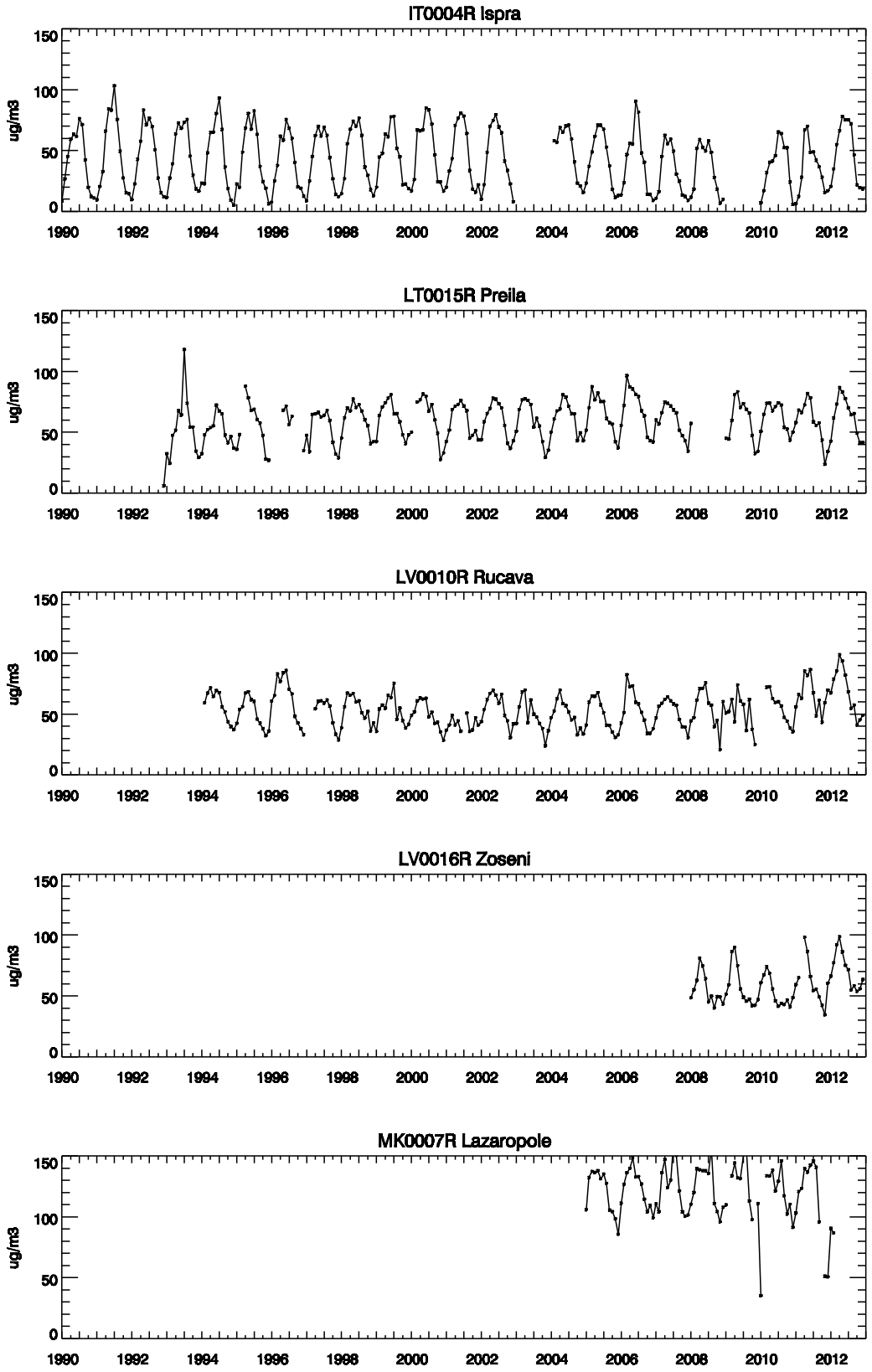


Figure 3.1, cont.

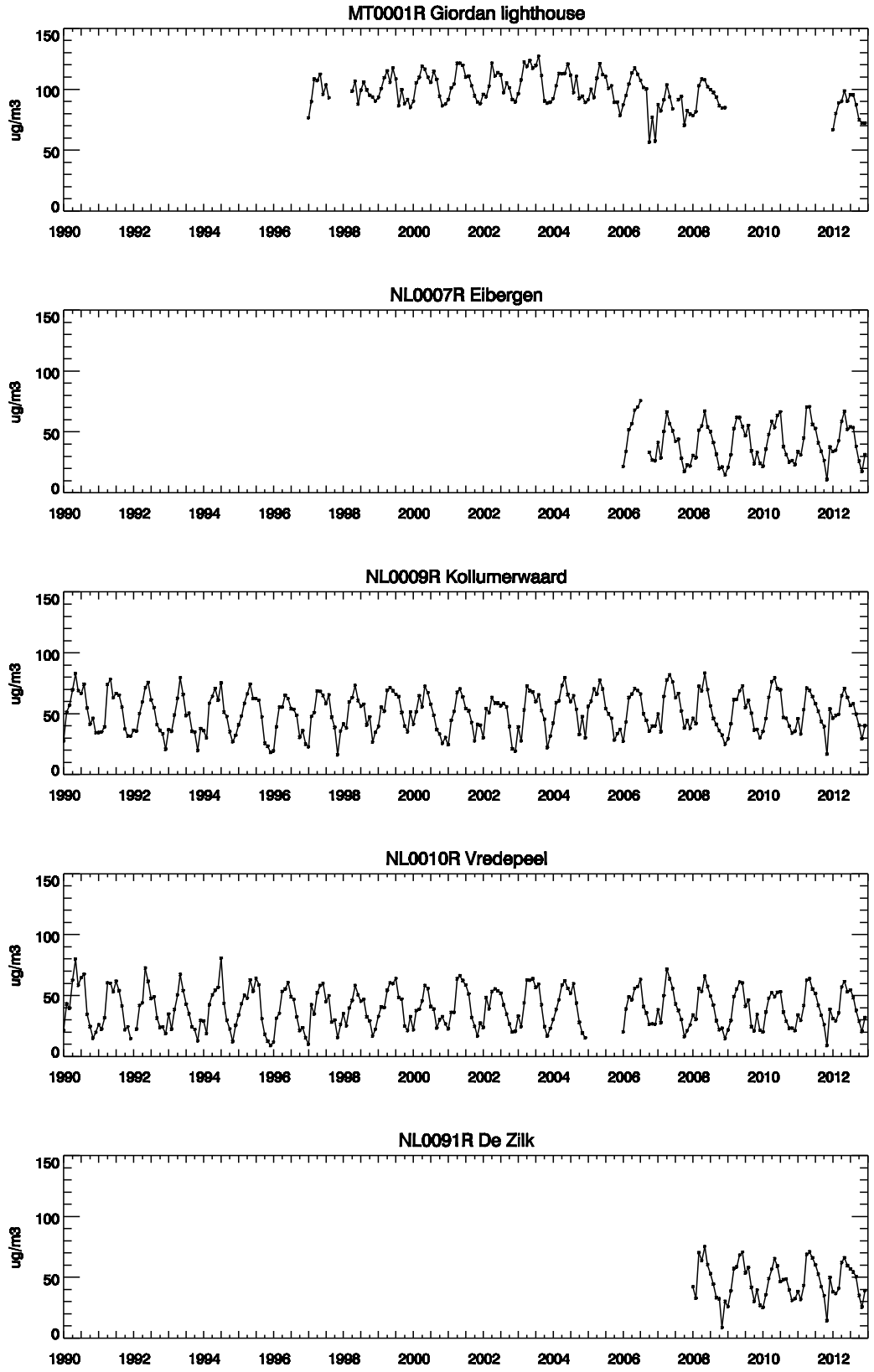


Figure 3.1, cont.

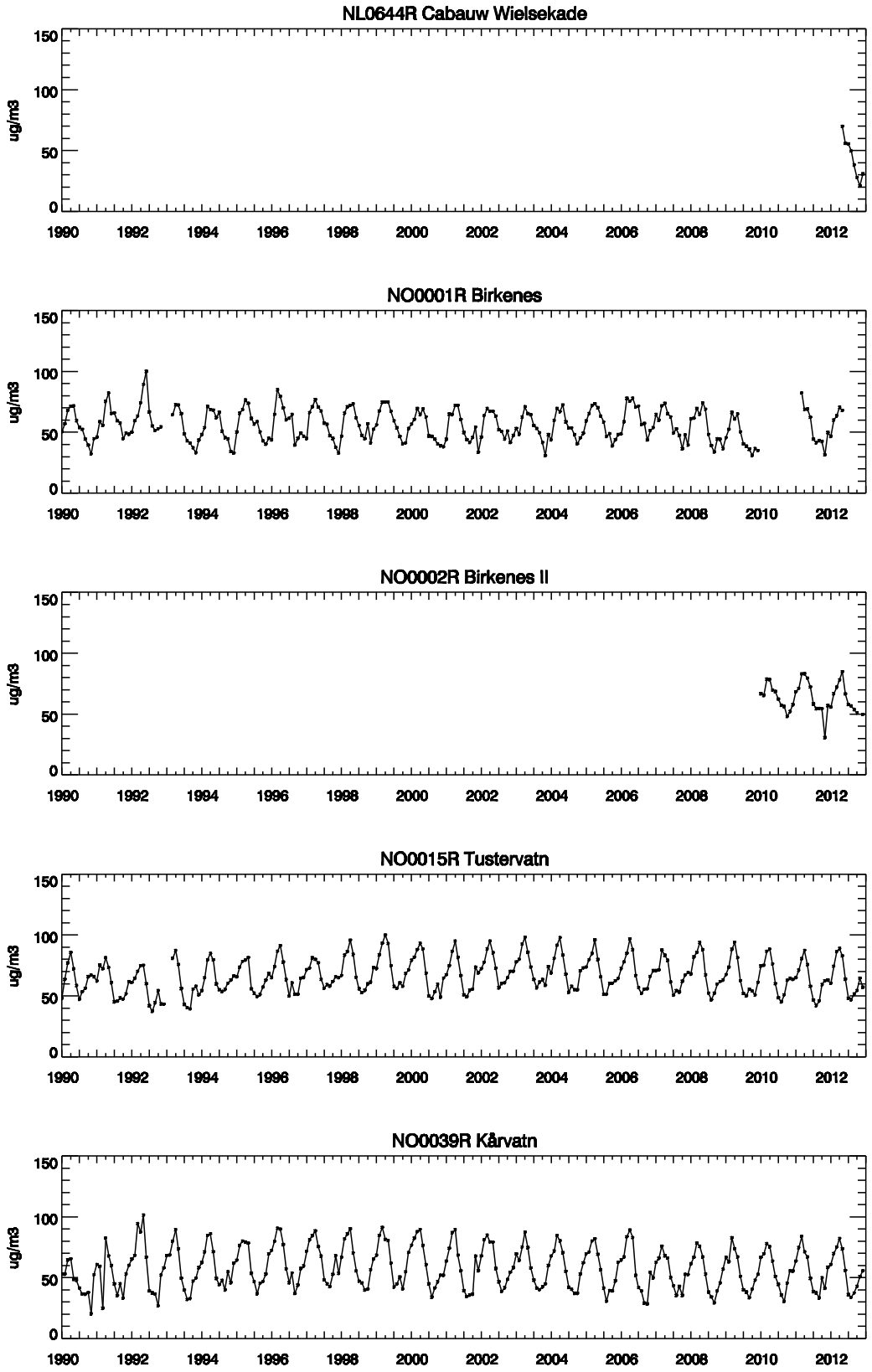


Figure 3.1, cont.

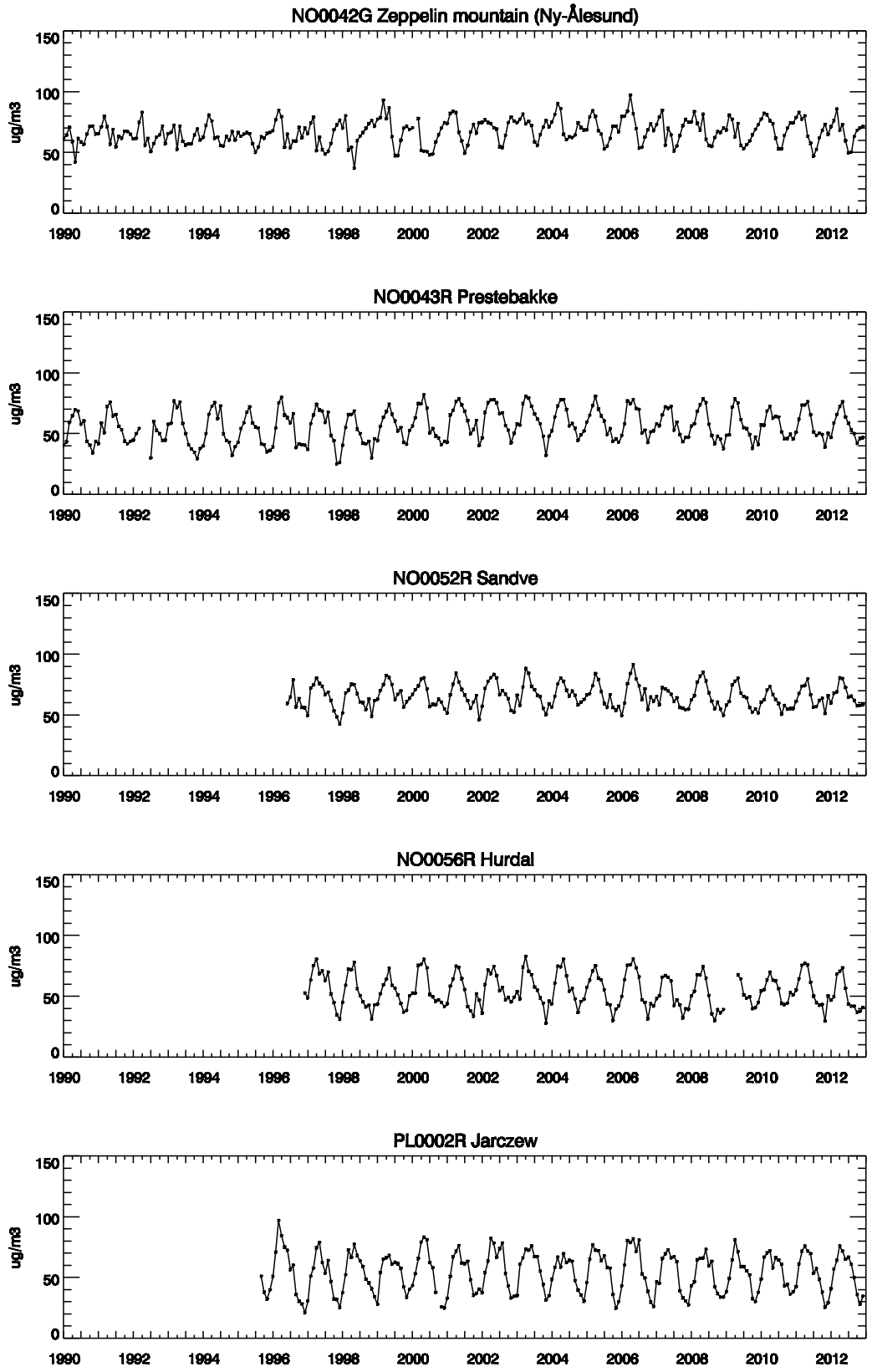


Figure 3.1, cont.

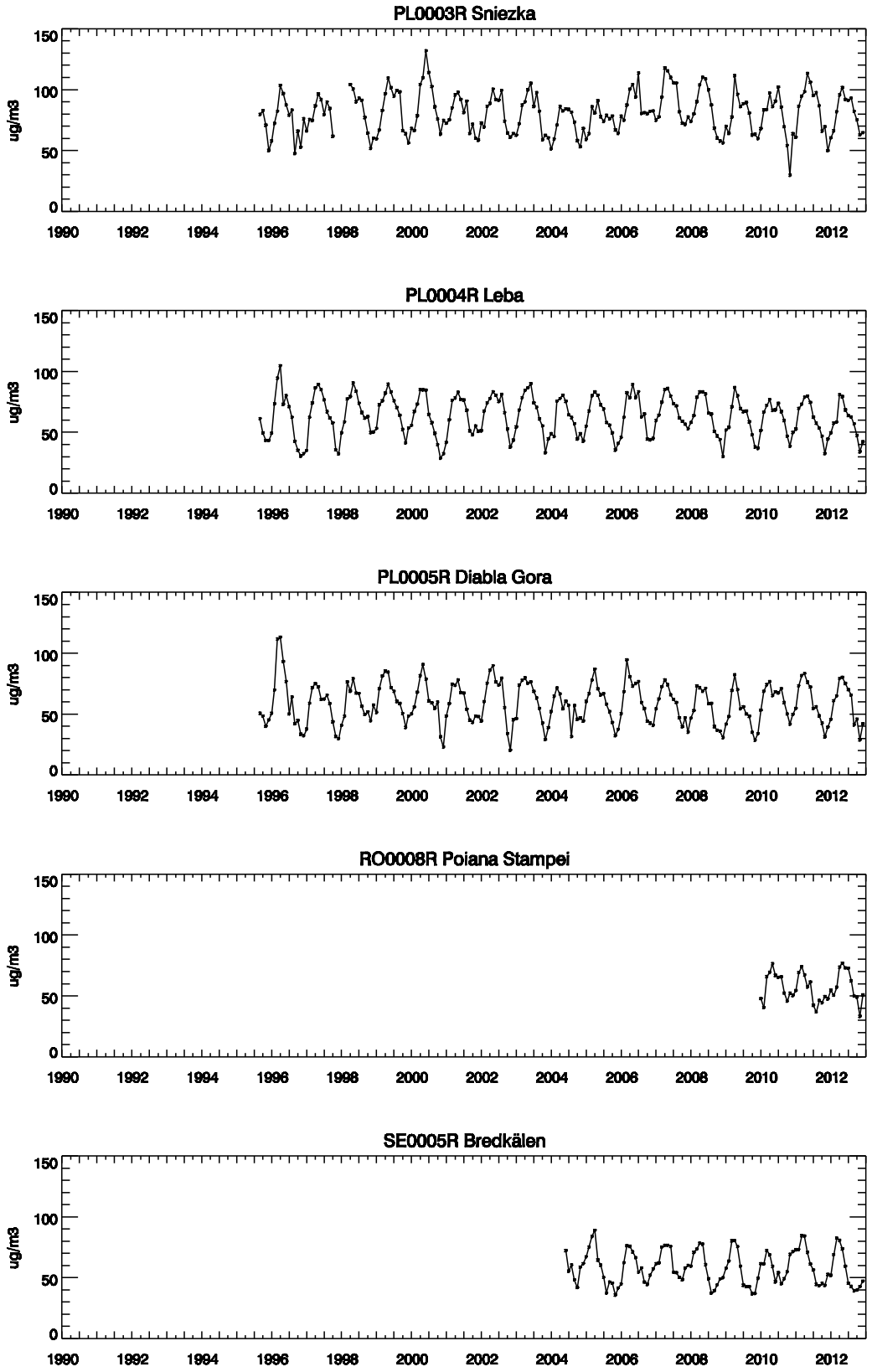


Figure 3.1, cont.

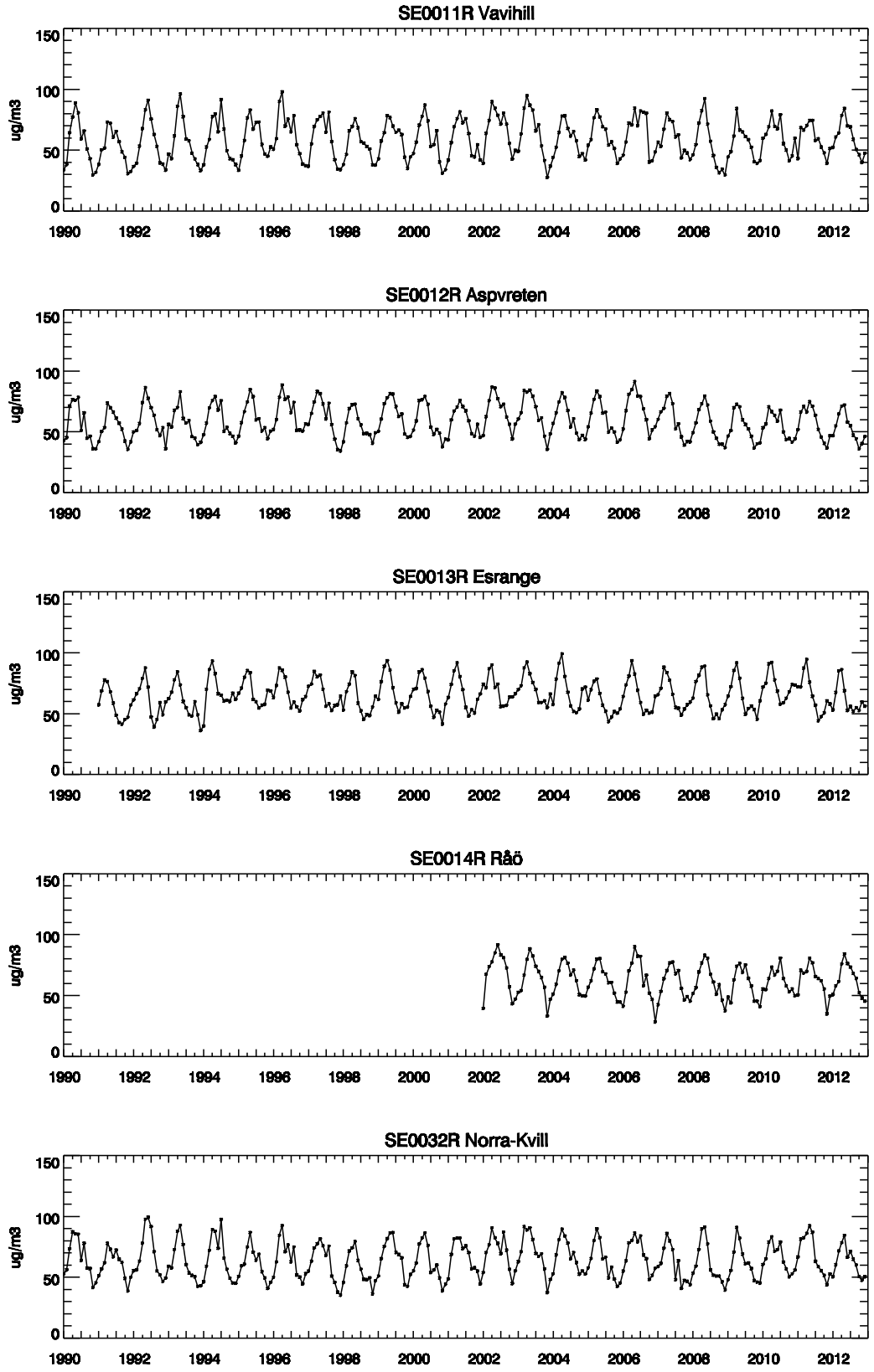


Figure 3.1, cont.

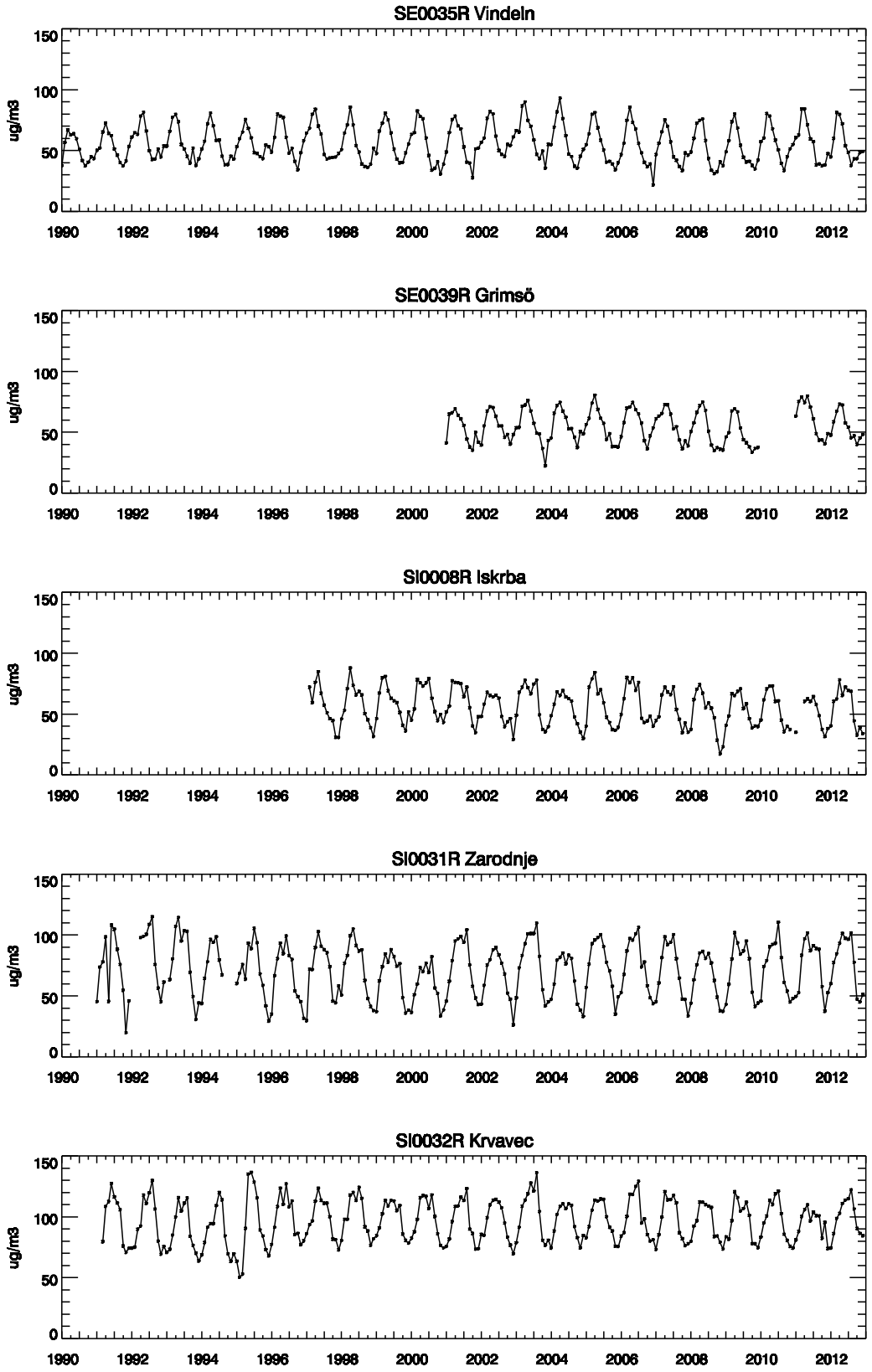


Figure 3.1, cont.

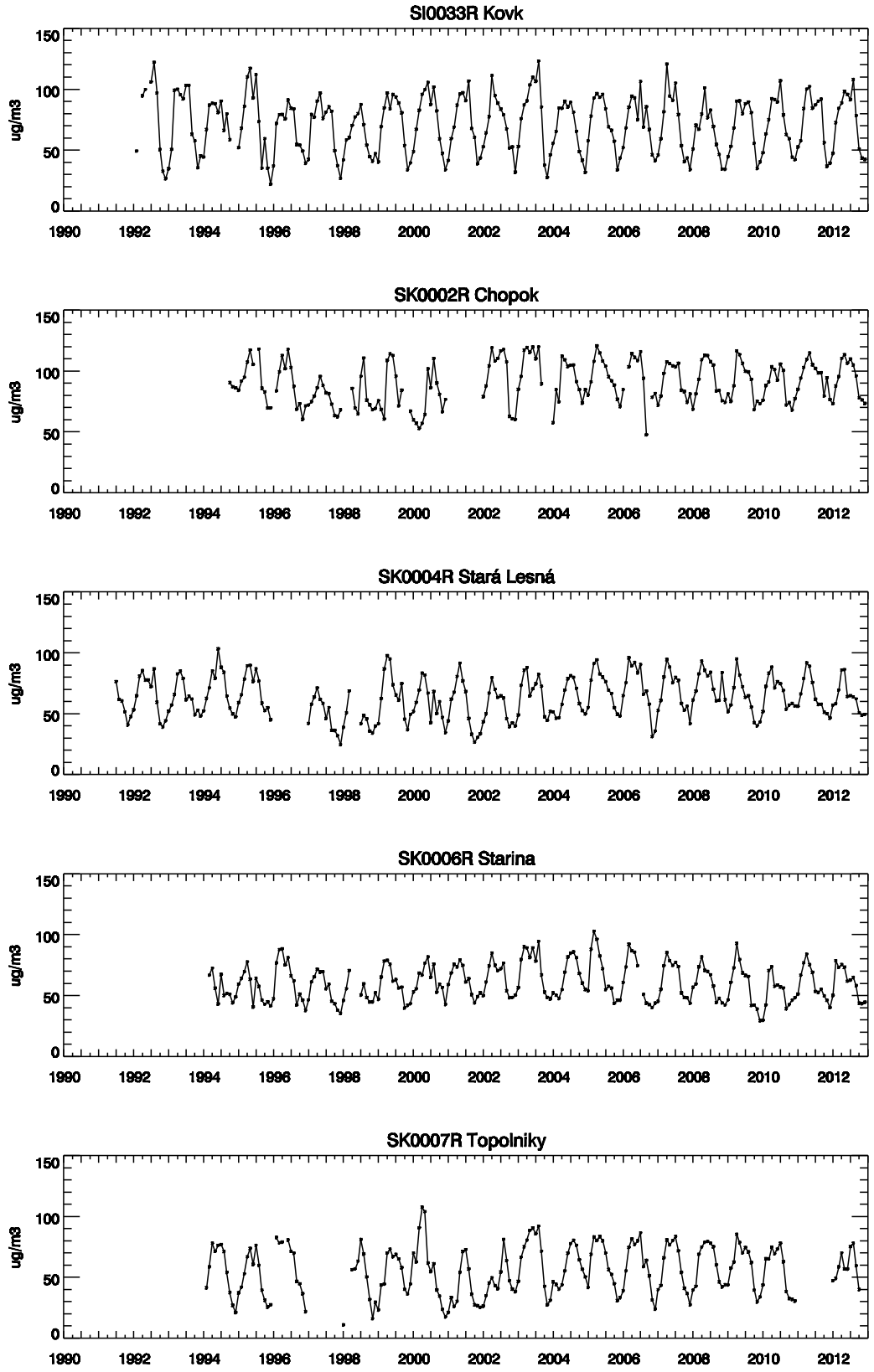


Figure 3.1, cont.

Annex 4

Diurnal variation, April–September 2012

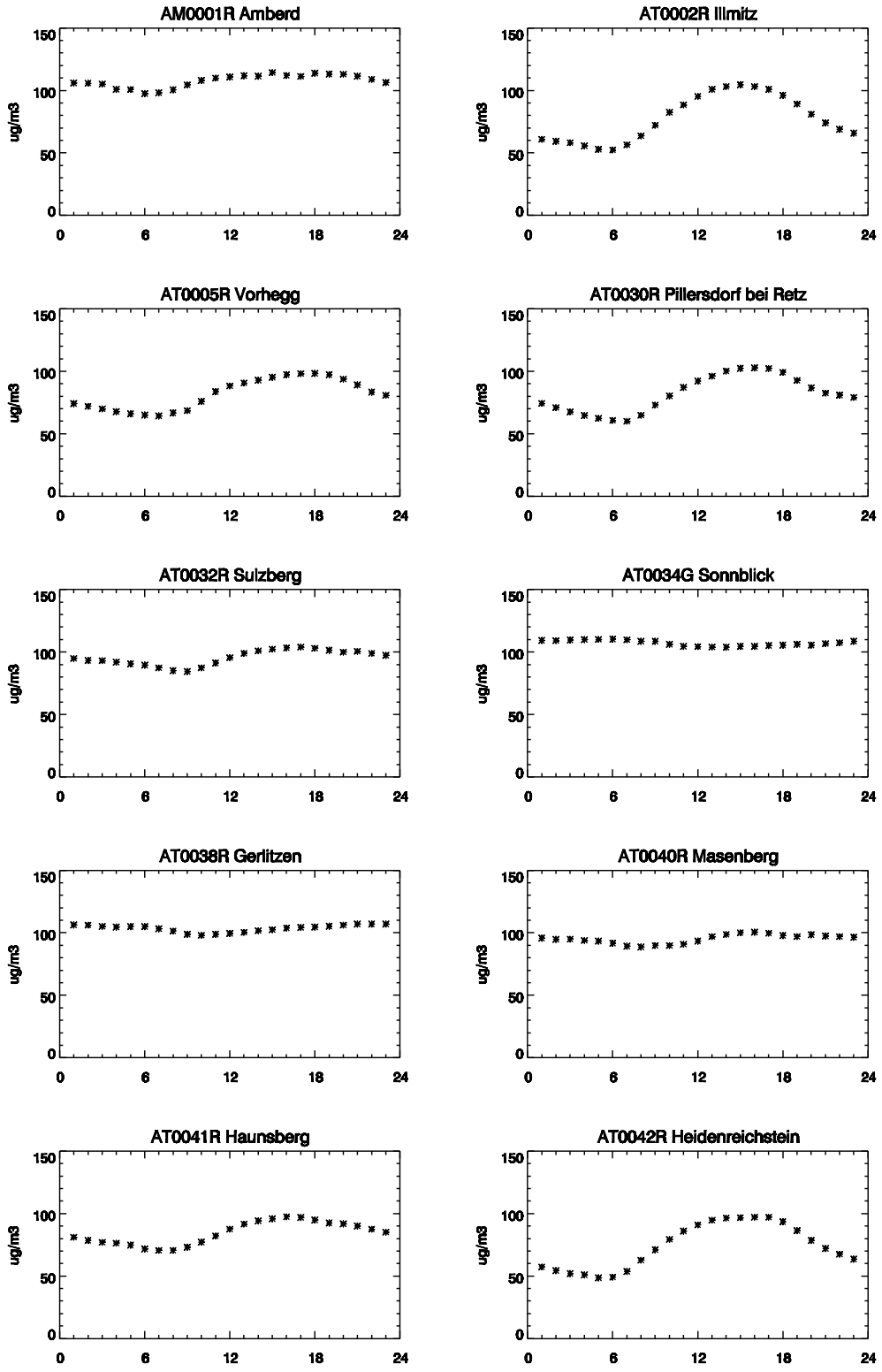


Figure 4.1: Diurnal variation, April–September 2012.

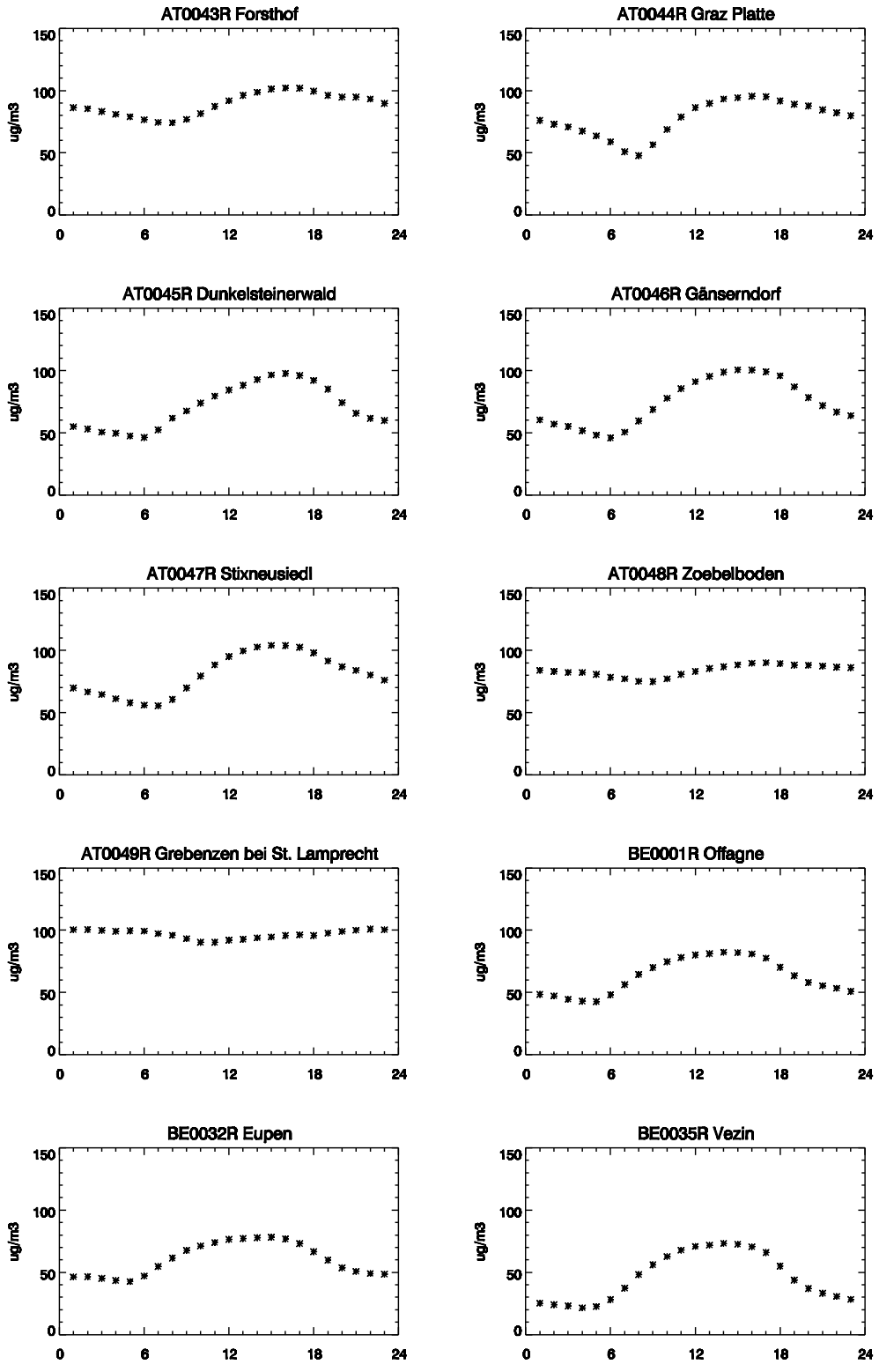
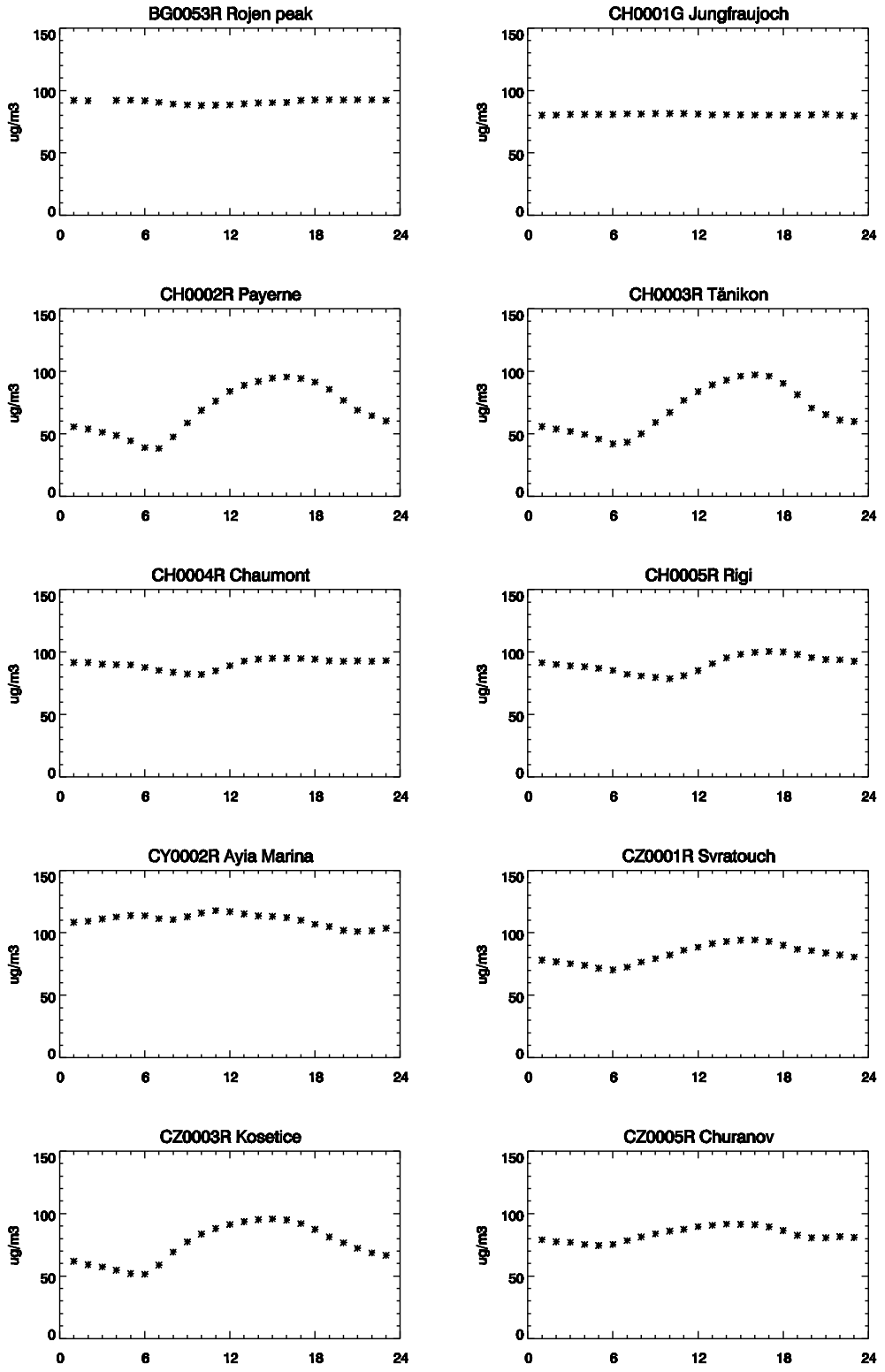


Figure 4.1, cont.



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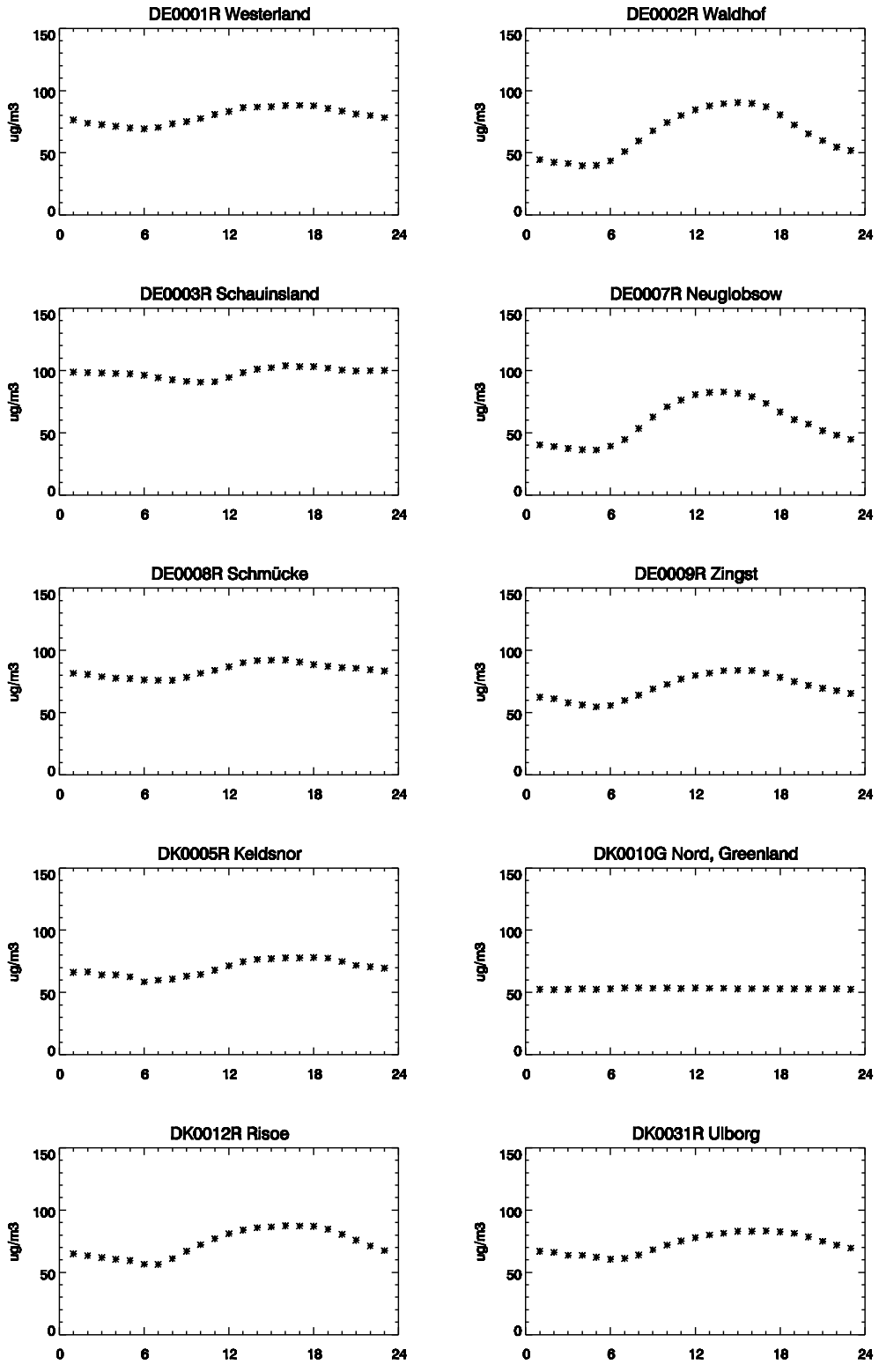

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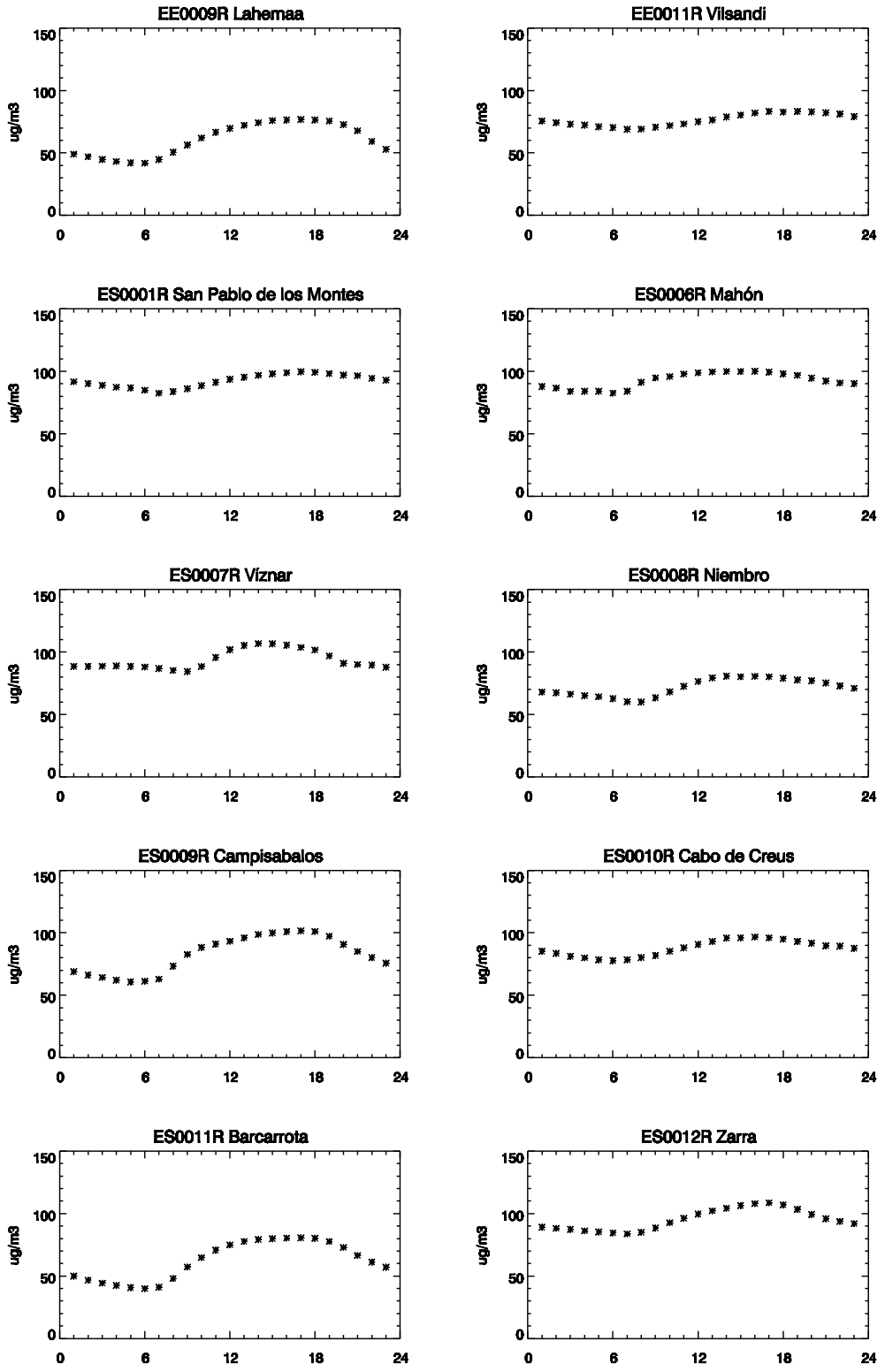

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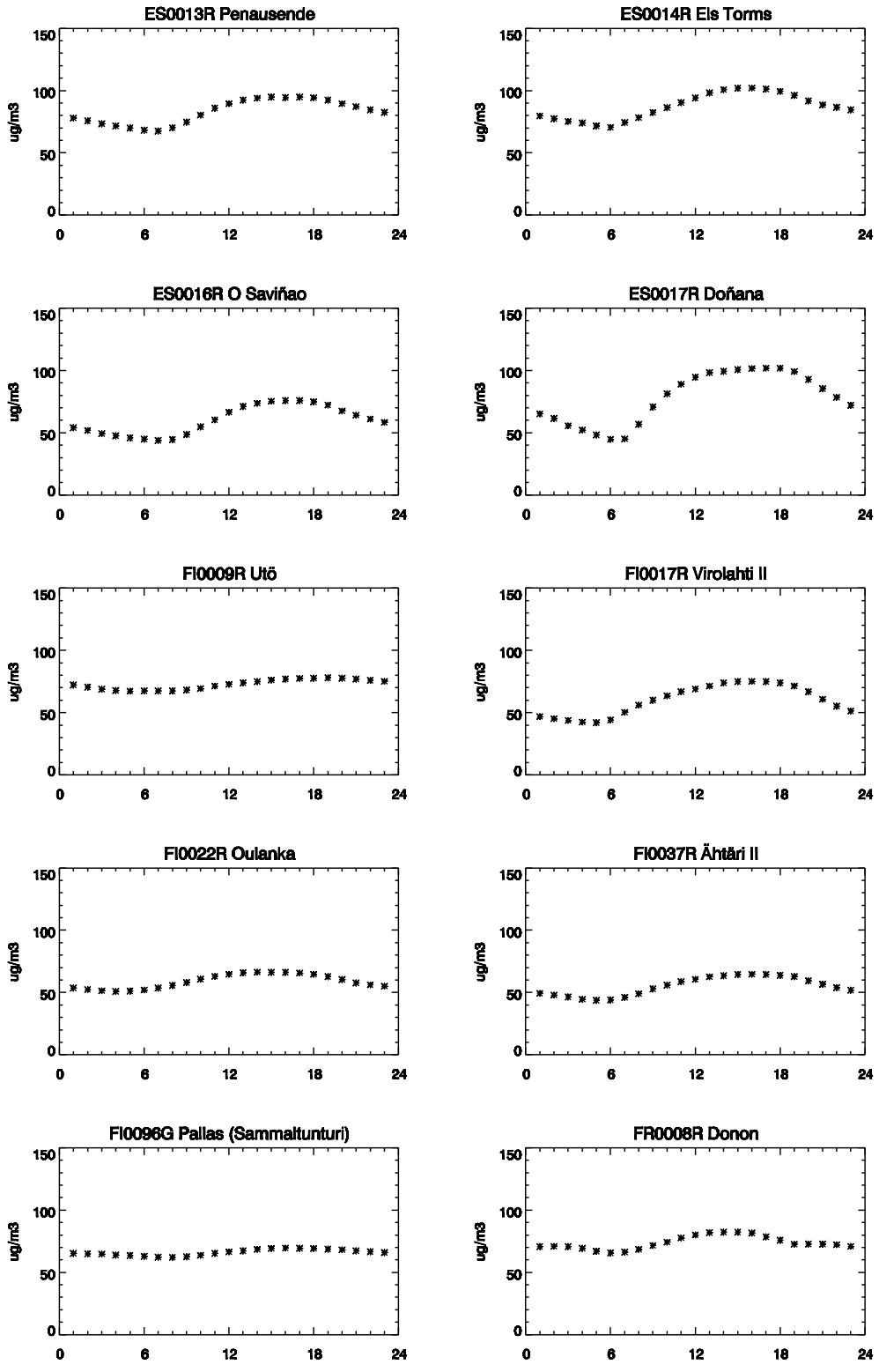

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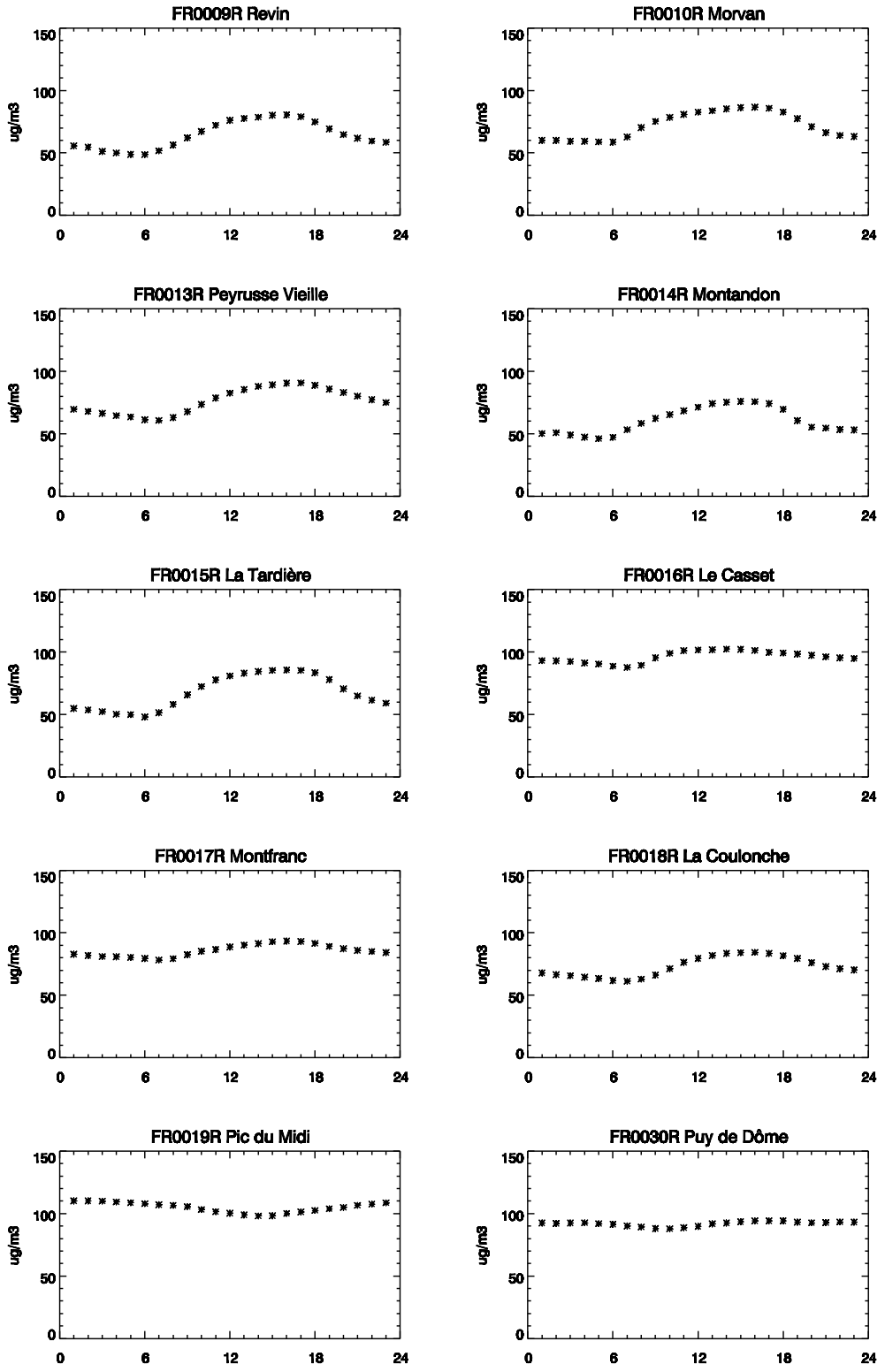

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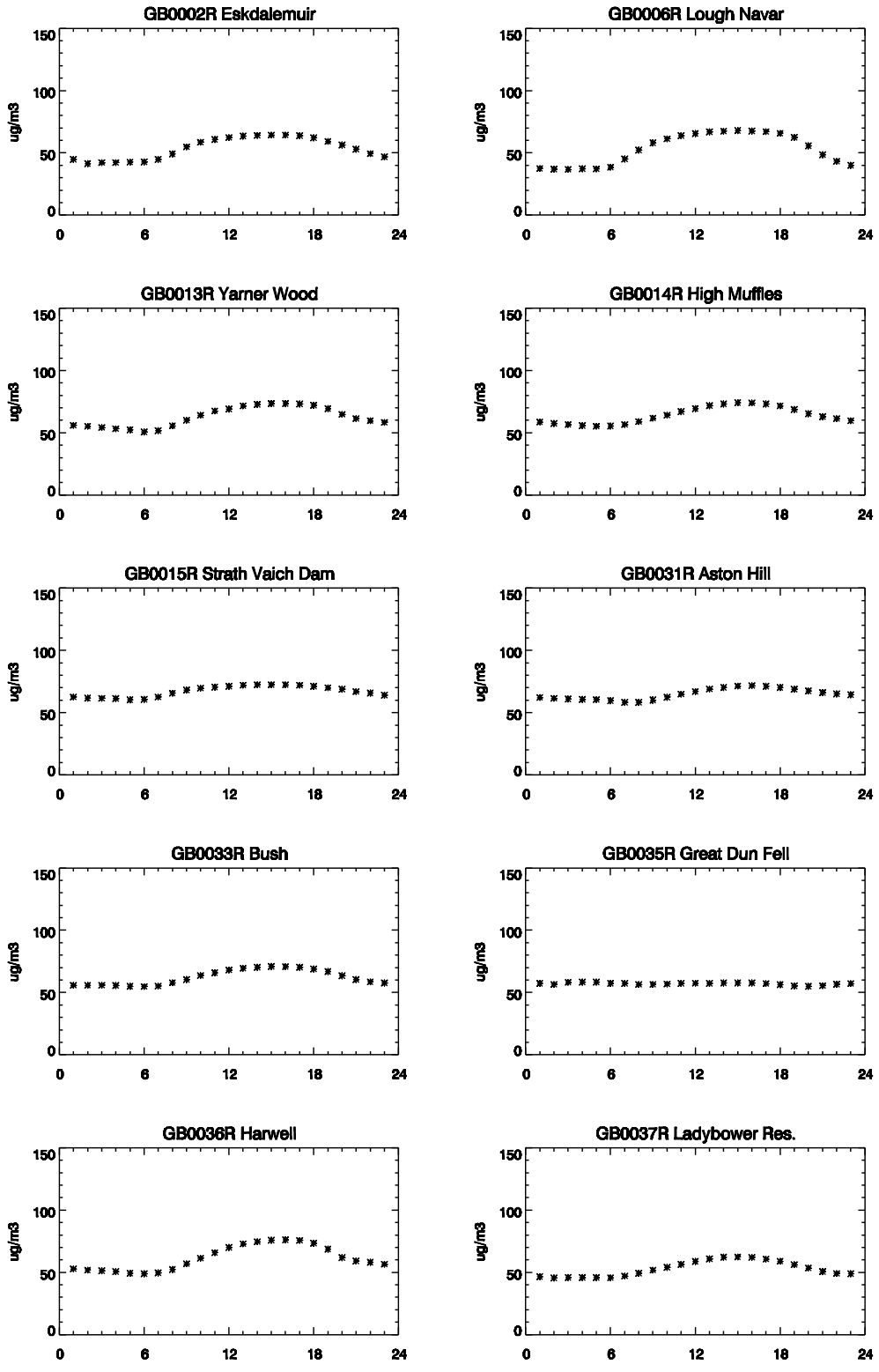

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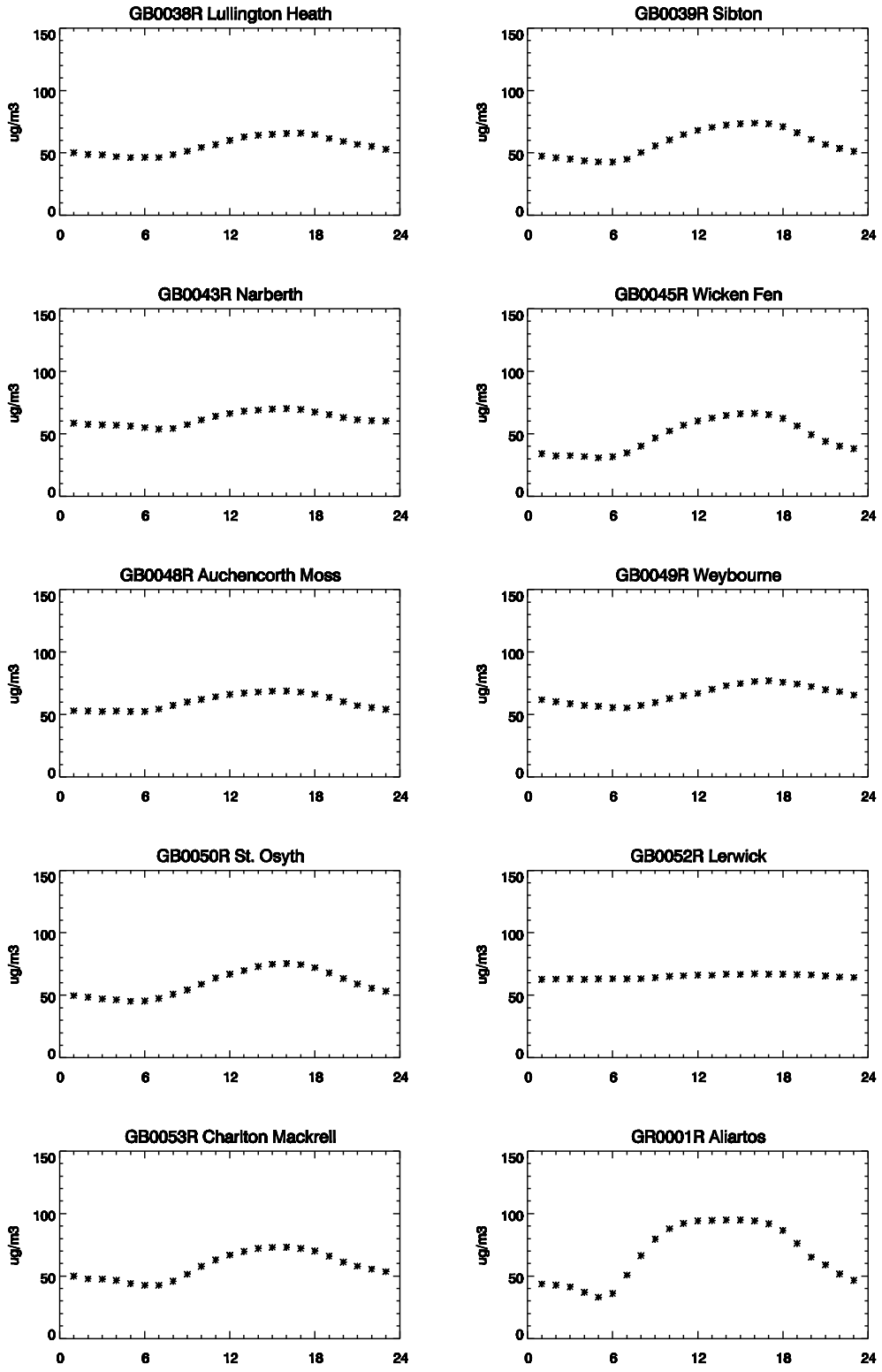

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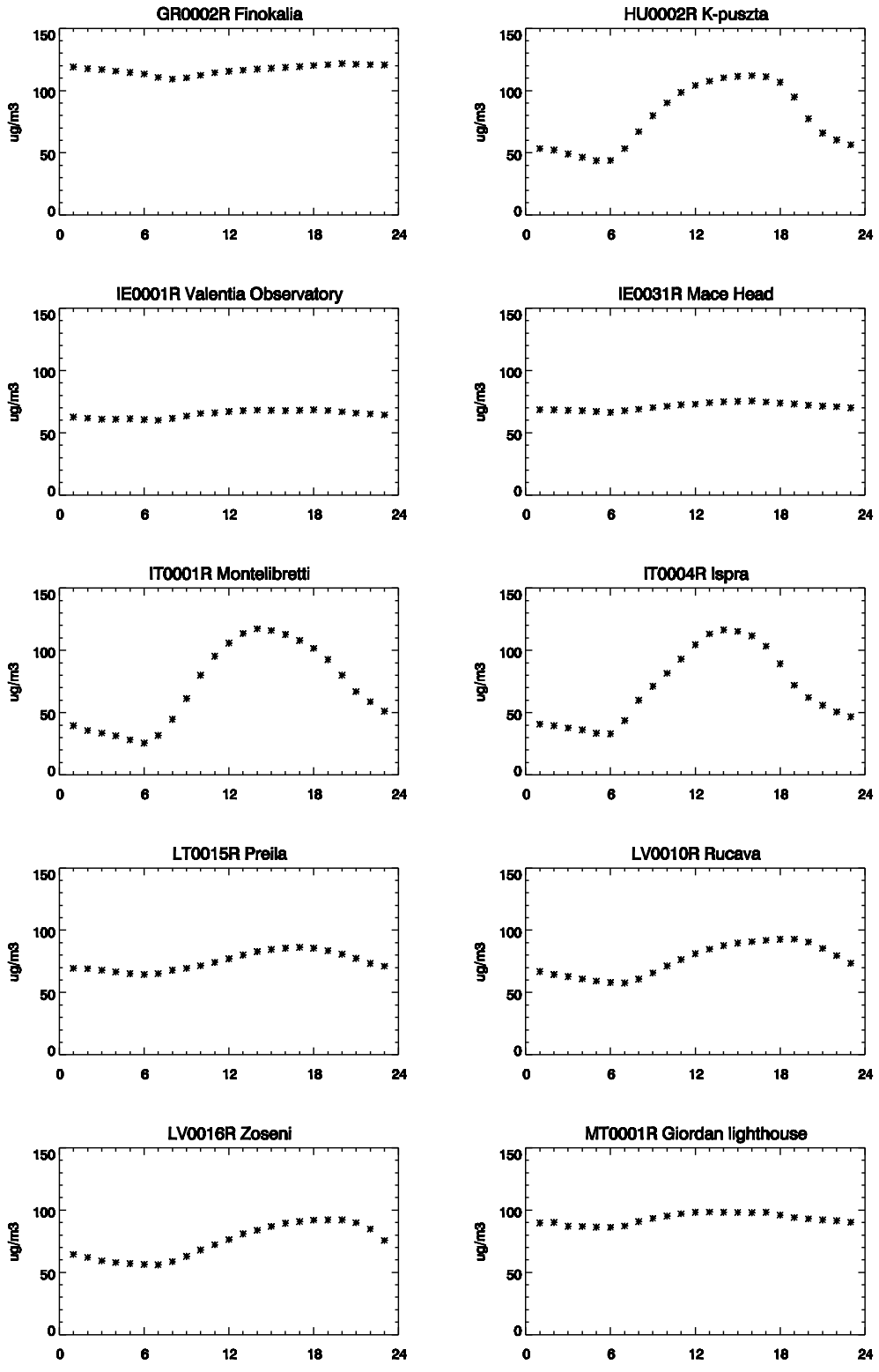

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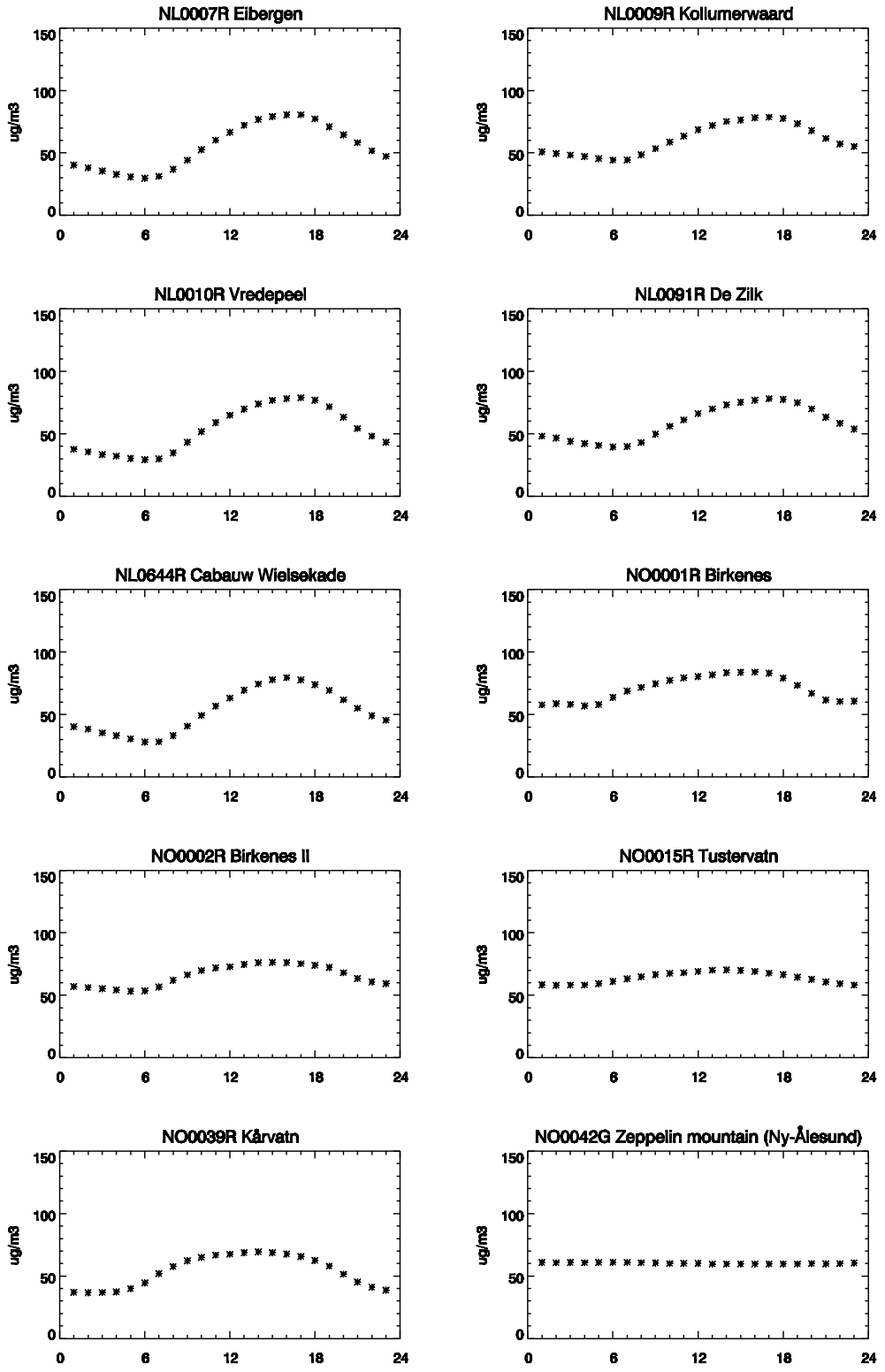

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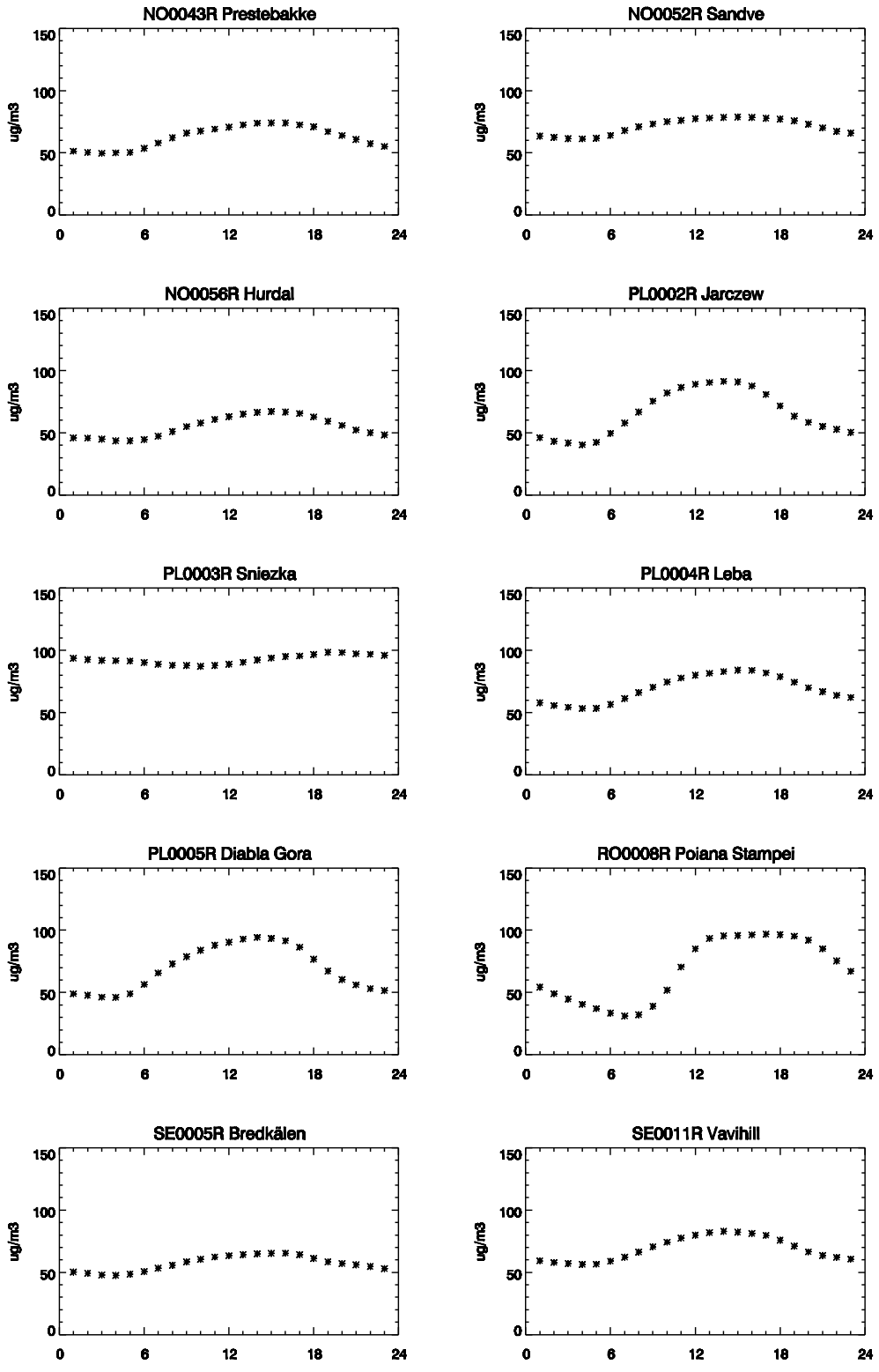

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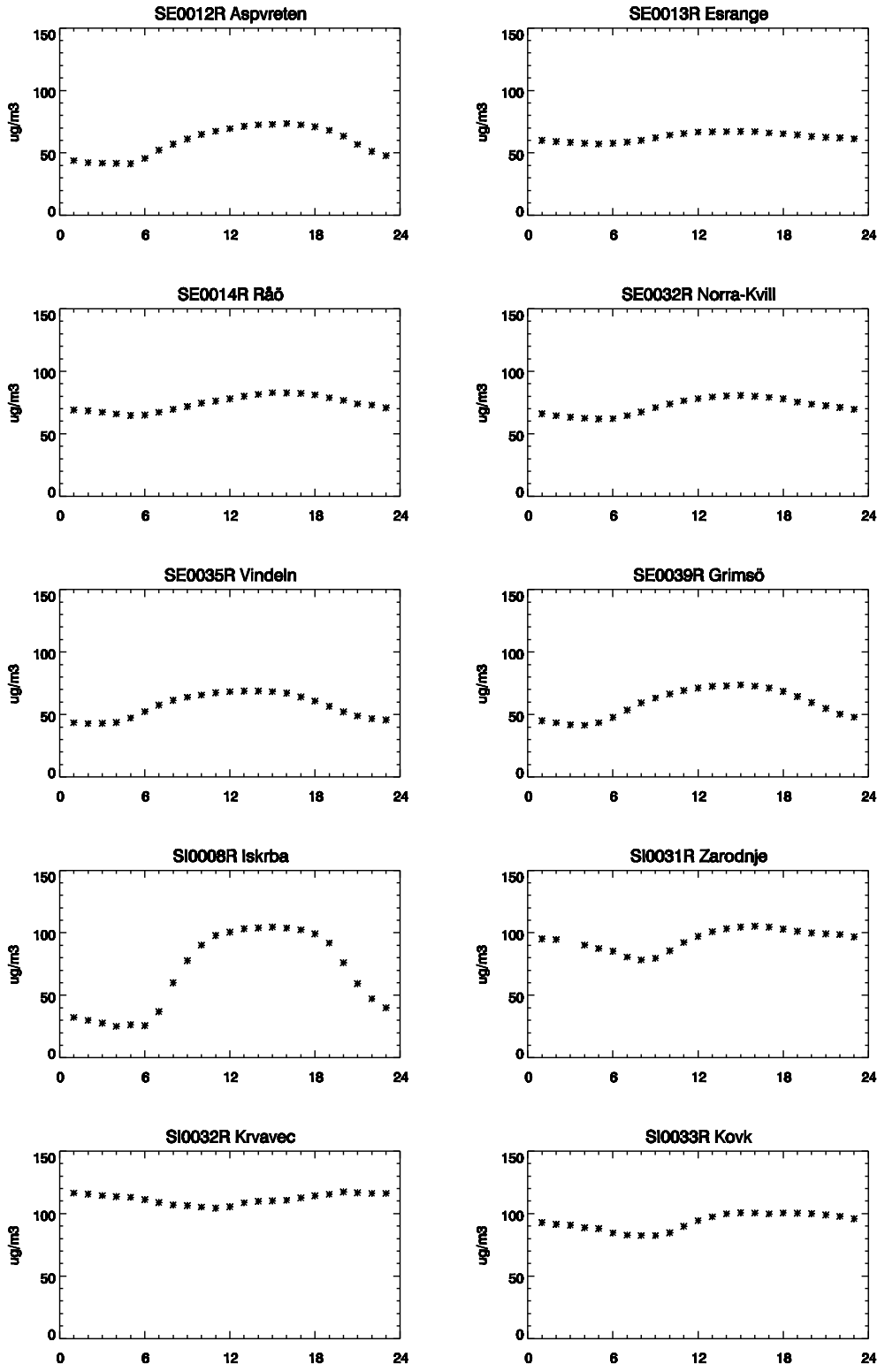

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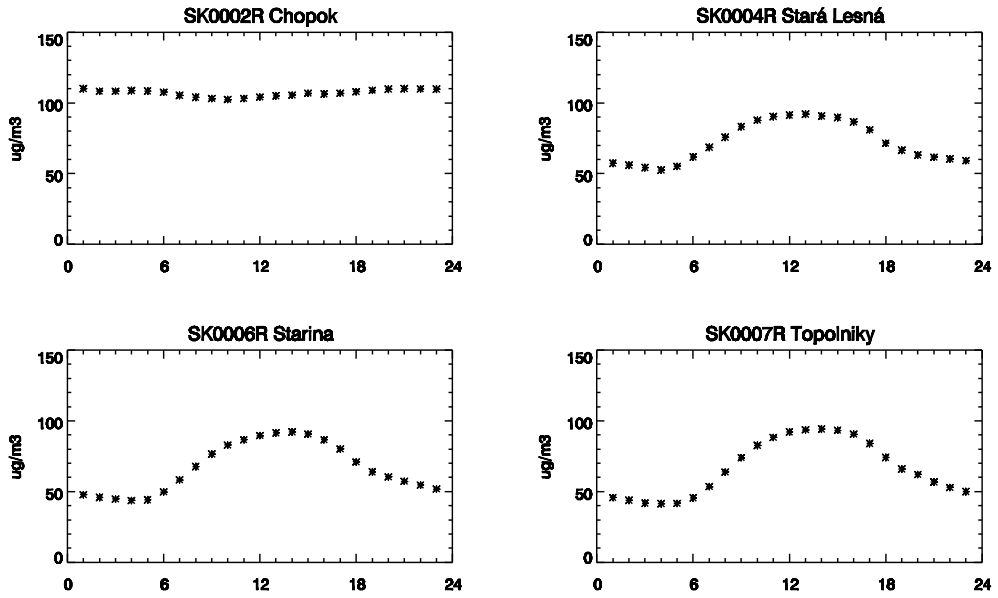

Figure 4.1, cont.

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.
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