

**UK Automatic Rural Network:
Ratification Report for January to June 1998**

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Centre for Optical and Environmental Metrology**

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Approved on behalf of Managing Director, NPL
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**UK Automatic Rural Network
Ratification Report for January to June 1998**

by

A M Woolley, B P Sweeney and D M Butterfield

1. INTRODUCTION

This report has been prepared for the Department of the Environment, Transport and the Regions by NPL under contract EPG 1/3/106. It covers the ratification of data in the Rural Network relating to the period January to June 1998. On the 1st of April 1998 the CMCU was changed from AEA-NETCEN to Stanger Science and Environment.

The ratified data capture percentages, specific problems at sites and time series data are presented. An inventory of Department equipment held by NPL and a list of equipment needing replacing or upgrading are also included.

2. RATIFICATION PROCEDURE

The data received by NPL from the CMCU were processed and scaled according to calibrations carried out by the Local Site Operators once a month, and by NPL on a three monthly basis. The results of these NPL field calibrations are reported to the Department separately e.g. NPLRS298 (13th July 1998) and NPLRS398 (15th September 1998).

During an NPL intercomparison ozone analyser accuracy is quantified with a transfer standard photometer, NO_x and SO₂ analyser calibration responses are measured with gas mixtures - certified against primary standard gases at NPL. Analyser linearities are determined by multi-point dilution of a high concentration mixture with zero air. Particulate analysers are calibrated with traceable pre-weighed masses, and sample and bypass flow rates are measured.

The data ratification process takes account of all relevant data from LSO's, NPL and Equipment Service Unit calibrations. The optimum time varying set of analyser response functions are determined and then applied to raw data to produce the ratified data set. The causes of gaps in the new data set are identified and periods for which analyser responses are seen to be unstable or changing rapidly are deleted.

3. DATA CAPTURE

The percentage data capture at each site for each pollutant is given in Table 1

Table 1. Data capture for January to June 1998

Site Name	Percentage Data Capture by Pollutant				
	O ₃	NO _x	SO ₂	PM ₁₀	Mean
Aston Hill	96				96
Bottesford	96				96
Bush	97				97
Eskdalemuir	97				97
Glazebury	88				88
Great Dun Fell	95				95
Harwell	93	72	91		85
High Muffles	98				98
Ladybower	91	92	83		89
Lough Navar	92			97	92
Lullington Heath	89	66	92		82
Narberth	88	63	87	89	79
Rochester	89	83	89	79	85
Sibton	98				98
Somerton	92				92
Strath Vaich	79				79
Teddington	95	100	100		98
Wicken Fen	95	90	96		94
Yarner Wood	88				88
Mean	92	81	91	88	

4. GENERIC REASONS FOR ABSENT RATIFIED DATA

We distinguish three general categories for ratified data loss:

4. ABSENT UNRATIFIED DATA

During periods of power failure, telecommunications failure, instrument calibration and repair, or other similar circumstances, clearly there is no "raw" data to ratify, and this will be reflected directly in the data capture. Such instances are described below as periods for which data was not received by the QA/QC Unit. Typically the reasons are not investigated, as this is more of a matter for the CMCU.

4.2 ISOLATED INSTRUMENT MALFUNCTIONS

From time to time most instruments will produce some data that cannot be ratified with sufficient confidence due to an analyser problem, leaking pipework etc that is not readily

apparent remotely. In these cases the problem is usually noticed at a visit by the LSO or QA/QC Unit, then reported and remedied. As LSO visits on the Rural Network are monthly (and QA/QC Unit visits quarterly) this can lead to periods of data lasting several weeks being deleted. The crucial elements in minimising data loss are experience in recognising the problems, clear communication of the problem to the CMCU, and prompt remedial action. To a limited extent the experience of these problems can be used to modify LSO, CMCU, ESU or QA/QC Unit procedures, or extend the training of LSOs. The problems with the NO_x analysers at Lullington Heath and Narberth fall into this category.

4.3 RECURRENT INSTRUMENT MALFUNCTIONS

In some instances, not common in established sites such as those in the Rural Network, the cause of ratified data loss is an underlying problem which can be predicted to recur, and preventative action can therefore be recommended. The problem with the drier at the Harwell site is the key instance of this in this period, and a replacement drier is recommended for purchase.

5. SPECIFIC PROBLEMS AT SITES

The sites with data capture of less than 90% for any pollutant are listed here and reasons are given for the absence of the data.

The data capture statistics for all Rural Network sites other than Teddington were affected because the QA/QC unit received no data between the 29th and 31st of January. This totalled 61 hours of data missing for each pollutant at each site.

Glazebury: (Ozone 88% data capture)

Data were not received by QA/QC unit between the 19th and 26th of February, totalling 164 hours of ozone data. Data were not received by QA/QC unit from the 20th to the 30th of March, totalling 242 hours of ozone data.

Harwell: (NO_x 72% data capture)

Indeterminate zero readings on the NO_x analyser resulted in the deletion of data between the 15th and 27th of February. The problem stopped when the drier on the ozone generator was replaced, but 303 hours of NO_x data were removed. NO_x data were again deleted between the 15th and 20th of April due to an indeterminate zero, totalling 127 hours. Excessive zero drift, also thought to be linked to the drier, was responsible for the deletion of all NO_x data for June - 720 hours were removed. The drier was changed at the next LSO visit (on 14th July), but a new Permapure unit is recommended for purchase (see Section 7).

Ladybower: (SO₂ 83% data capture)

Data were deleted between the 19th and 26th of February (162 hours of SO₂ data) due to a malfunctioning SO₂ analyser. A delay in repair of the analyser until the 18th of March led to a further data gap of 479 hours.

Lullington Heath: (Ozone 89%, NO_x 66% data capture)

Data were not received by the QA/QC unit from the 4th to the 8th of January, totalling 99 hours of all data, due to a power cut. The ozone analyser was carrying out a second auto-calibration for around two and a half out of the six months, which resulted in 53 hours of ozone data being invalid. Data were not received by QA/QC unit between the 13th and 17th of April due to a defective analyser, totalling 94 hours of ozone data. A fault in the NO_x analyser caused data to be deleted from the 14th of May until the instrument was serviced on the 13th of July. This resulted in the removal of 1142 hours of data from the ratification period. The fault was reported by the LSO on 12th June and was still present at the QA/QC Unit visit on 7th July.

Narberth: (Ozone 88%, NO_x 63 %, SO₂ 87%, PM₁₀ 89% data capture)

No data were received by QA/QC unit between the 1st and 4th and the 7th and 13th of January, totalling 237 hours of data for each pollutant. The NO_x data for the remaining parts of January were deleted due to an indeterminate zero and lack of calibration data, a further 744 hours of data. No NO_x data were received by the QA/QC unit during the following periods: 5th to 9th April (102 hours), 2nd to 6th May (114 hours), 29th to 31st May (62 hours) in addition to some smaller gaps. A fault occurred on the NO_x analyser on the 4th of June and was fixed by the ESU on the 6th. However, another fault occurred on the 15th of June and the ESU was unable to calibrate the analyser prior to repairing it on 19th June. Data was therefore deleted from the 1st to the 19th of June (totalling 443 hours) due to insufficient calibration data. SO₂ data were deleted following an ESU service visit on the 2nd and 3rd of June until the 7th of June due to an unstable zero, which totalled 78 hours (not including the service itself).

Rochester: (Ozone 89%, NO_x 83%, SO₂ 89%, PM₁₀ 79% data capture)

Data were not received by QA/QC unit from the 4th to the 7th of February, totalling 80 hours of all data. There were similar incidences between the 16th and 18th of March (48 hours) and the 10th and 13th of April (90 hours). The NO_x analyser sample line was not connected between the 15th and 27th of May which resulted in the deletion of 291 hours of NO_x data. PM₁₀ data were deleted between the 12th of February and the 2nd of March, and the 10th and 17th of April due to excessive noise - most likely because of a badly mounted filter.

Strath Vaich: (Ozone 79% data capture)

Data were not received by QA/QC unit between the 24th of February and the 10th of March totalling 339 hours of ozone data. This immediately followed a six-monthly service by the ESU and was most likely to be a fault with the source lamp over-ranging. Data were not received by QA/QC unit between the 20th and 22nd of March totalling 52 hours of ozone data. Data were not received by QA/QC unit between the 29th of April and the 3rd of May (95 hours), and between the 14th and 23rd of May (219 hours) in addition to a few smaller gaps. These missing segments were most likely due to a modem problem.

Yarner Wood: (Ozone 88% data capture)

Due to a short power cut in January, the ozone analyser was carrying out a second auto-calibration each day between the 5th of January and the 11th of February resulting in a total of 38 hours of invalid ozone data. A leak in the analyser caused 260 hours of ozone data to be deleted between the 5th and 16th of May.

6. INVENTORY

The DETR owned assets used for this work are as follows:

1 PC (486-66)
 NPL-developed ratification software
 Cylinders, regulators and measurement instruments with individual values of less than £1000

7. EQUIPMENT ISSUES

NPL would recommend that the following items are installed:

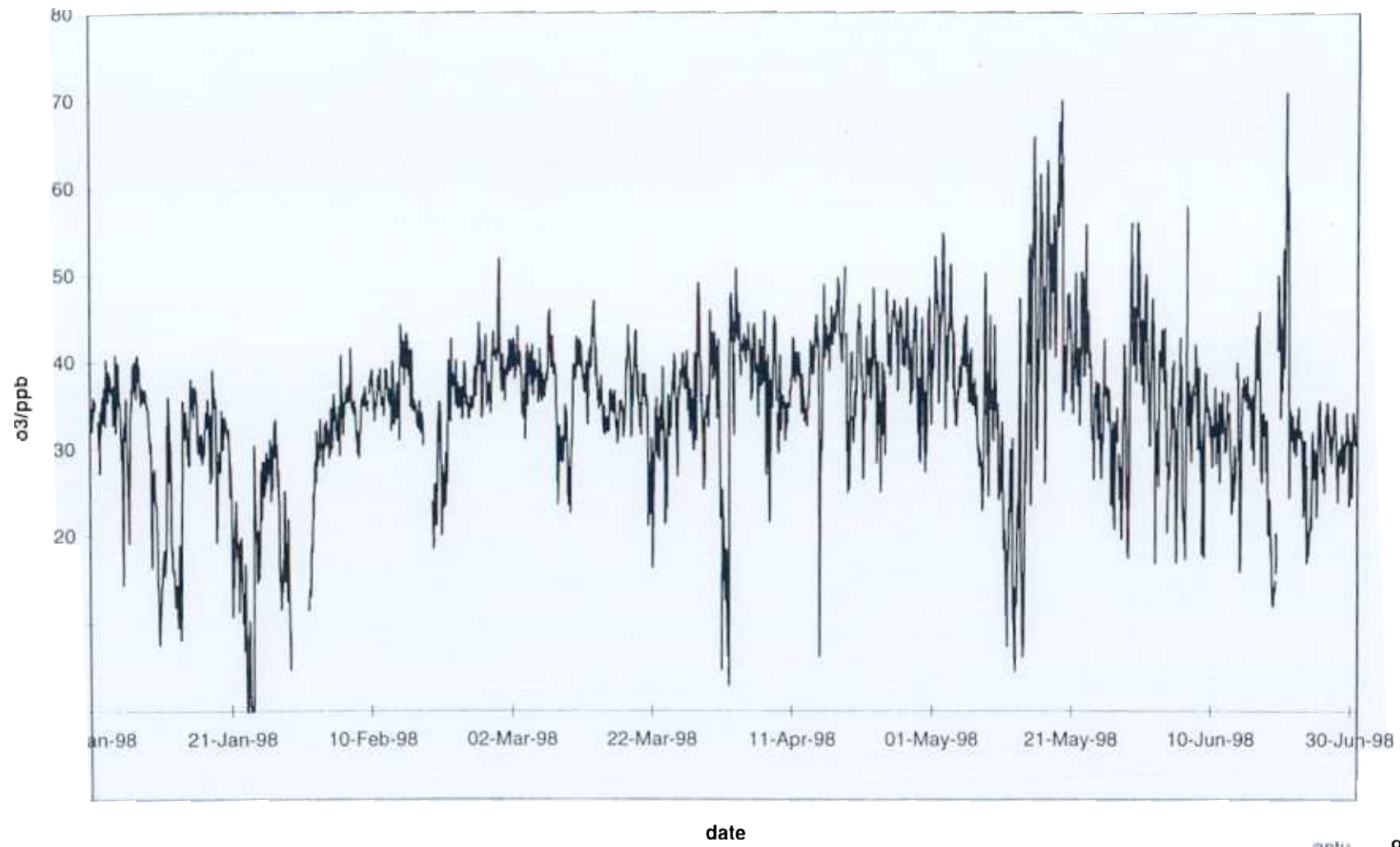
- Permapure dryer for Harwell NO_x analyser.
- 2. Chart recorders at Eskdalemuir, Bush, Dunslair Heights, Wicken Fen and Glazebury
- 3. Manifold flow sensor at Great Dun Fell.
- 4. SO₂ Auto-calibration unit at Ladybower.
- 5. Ozone Auto-calibration unit at Teddington

8. RATIFIED TIME SERIES DATA

The following pages contain hourly average data for each pollutant at each site for the period 1/1/98 to 30/6/98. They are in the order:

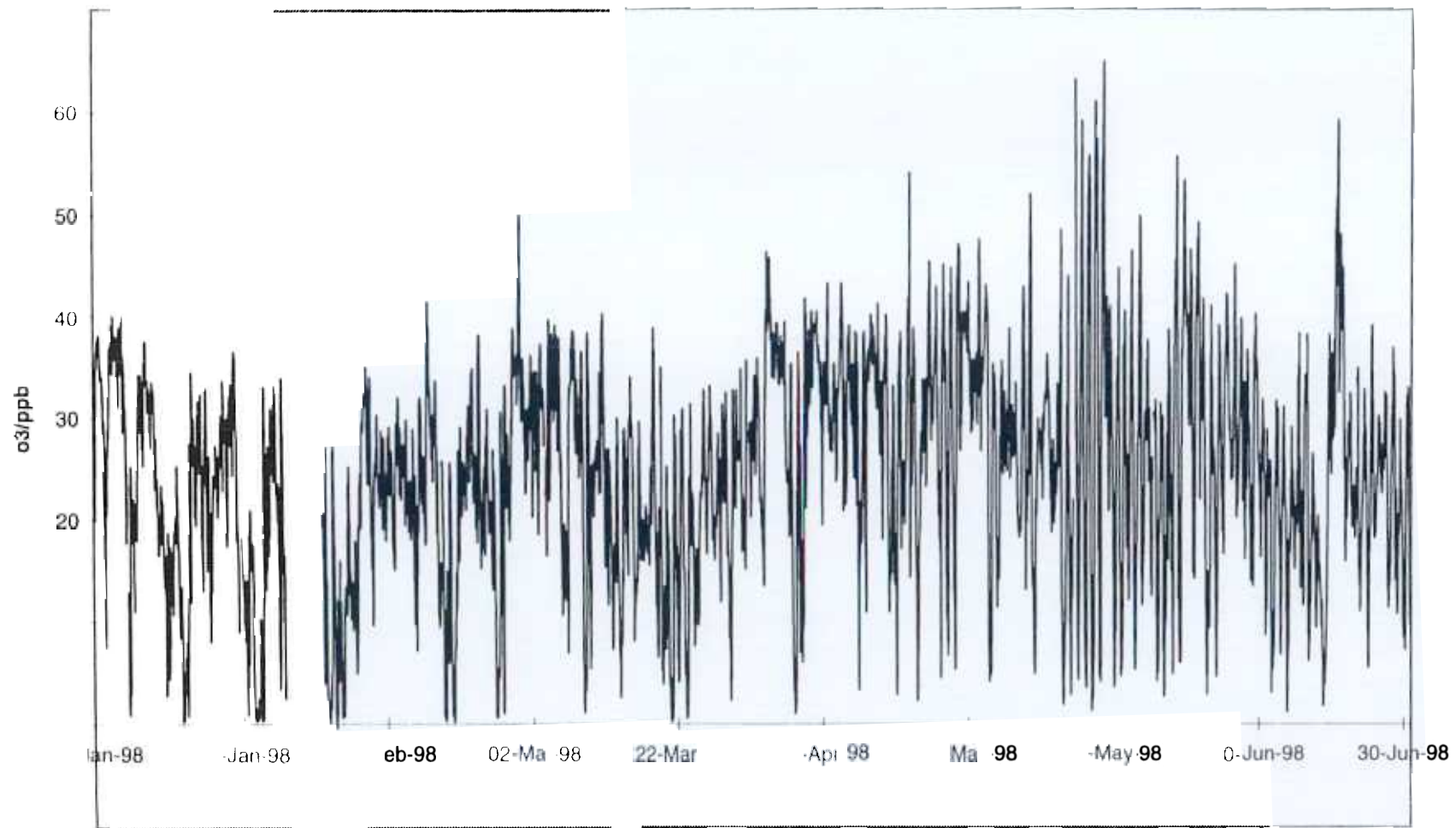
Ozone (blue pages)
 Nitric Oxide (yellow pages)
 Nitrogen Dioxide (green pages)
 Sulphur Dioxide (salmon pages)
 PM₁₀ (mauve pages)

Aston 998



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Bottom 1998

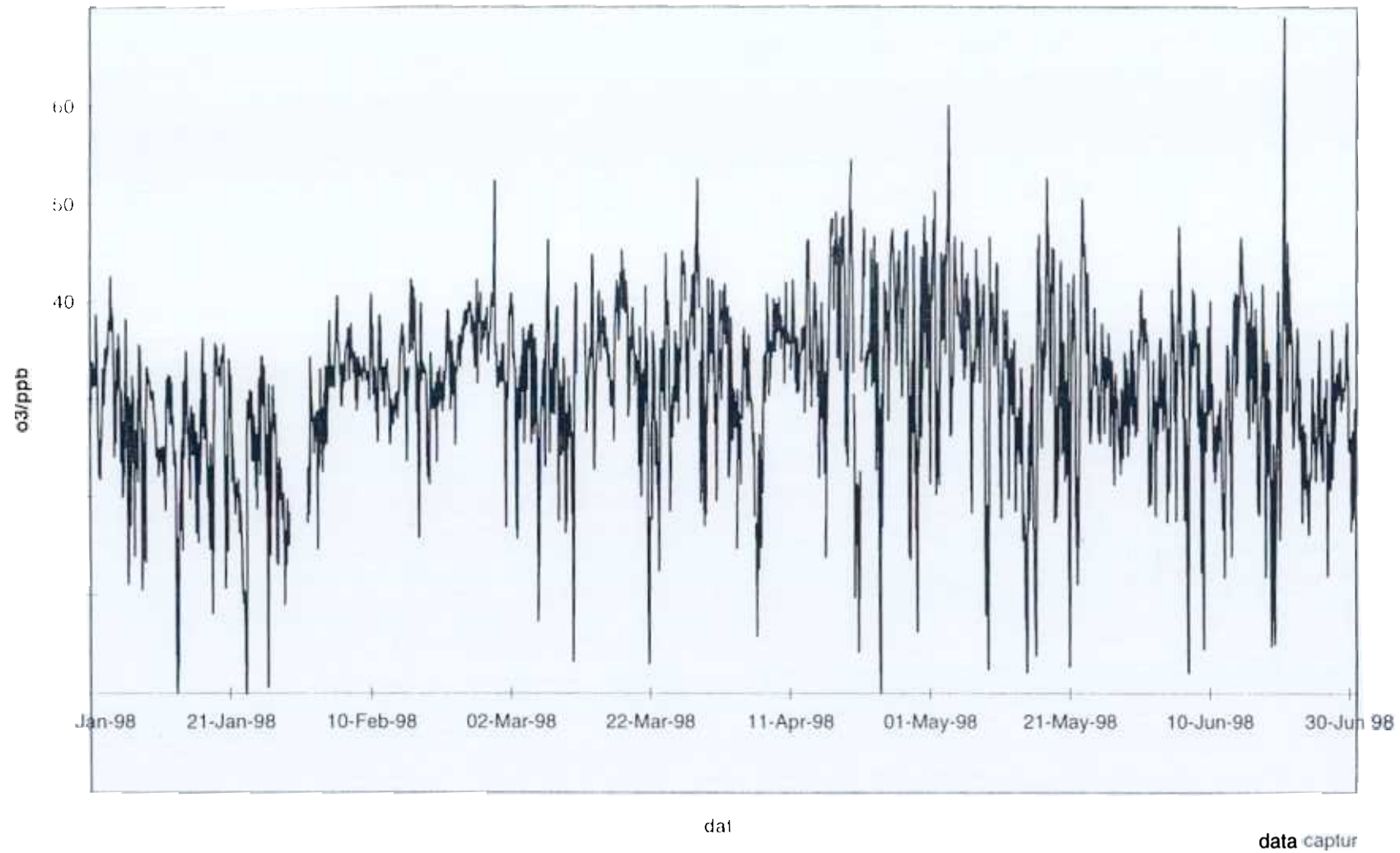


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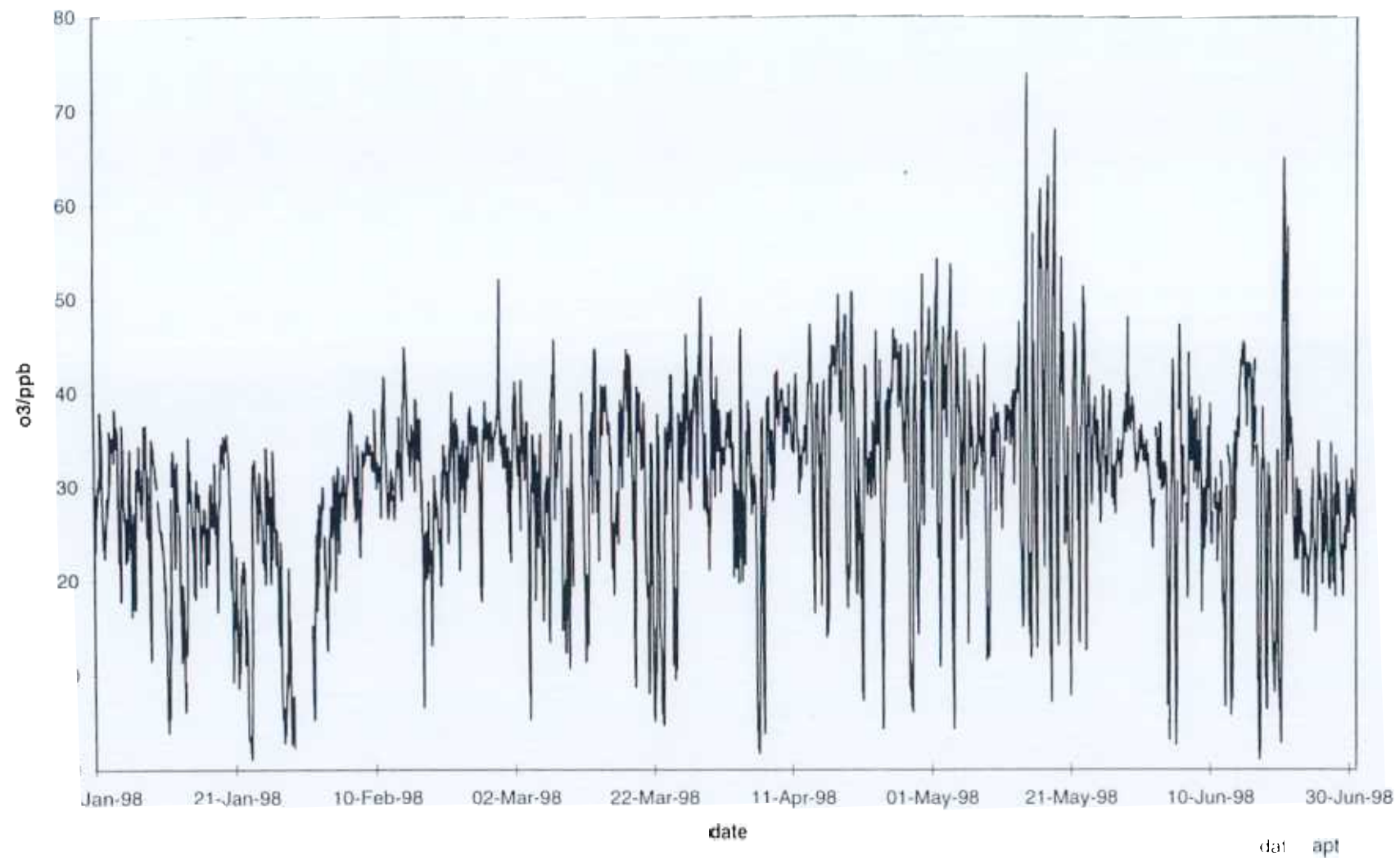
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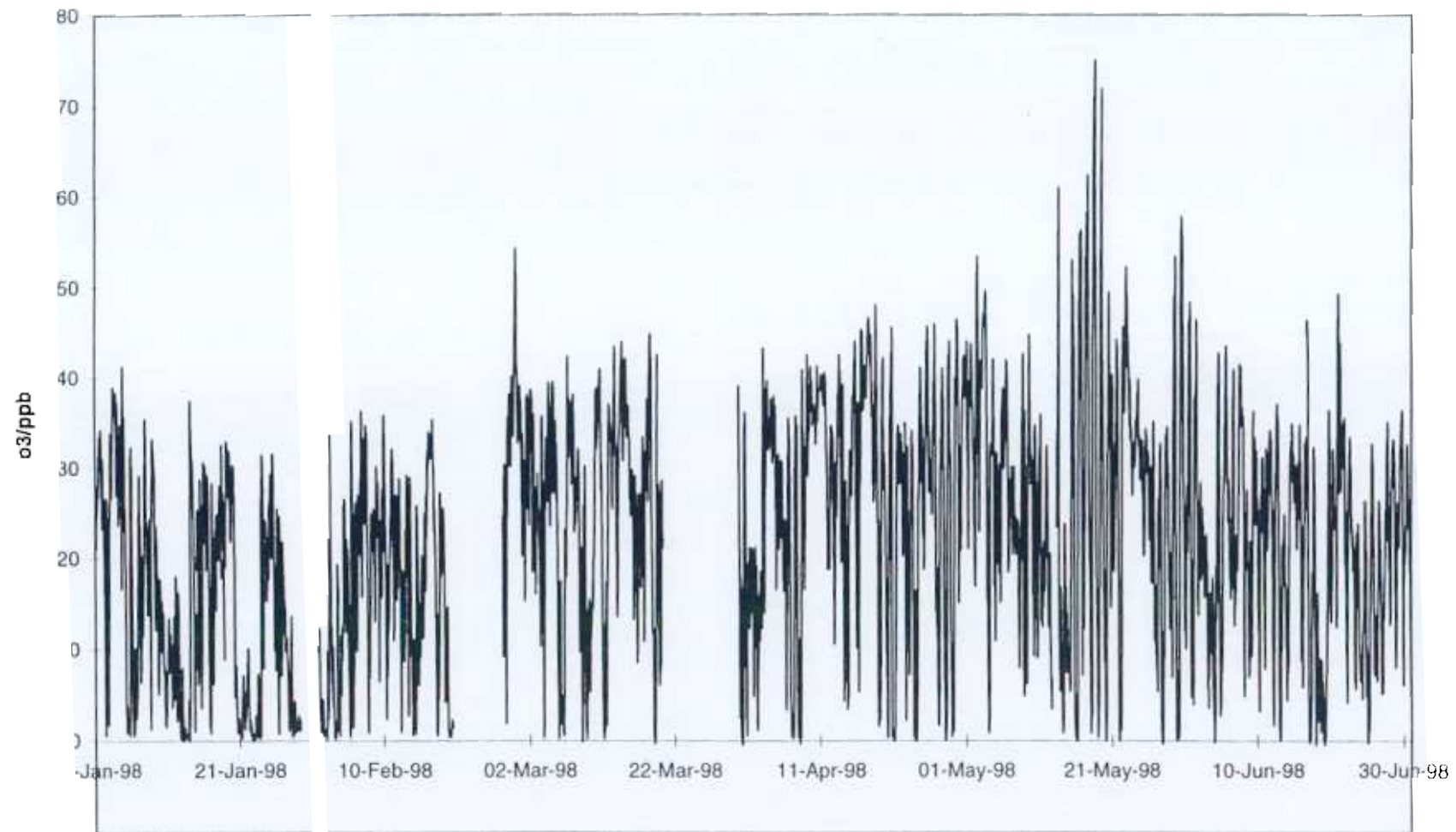
Bush 998



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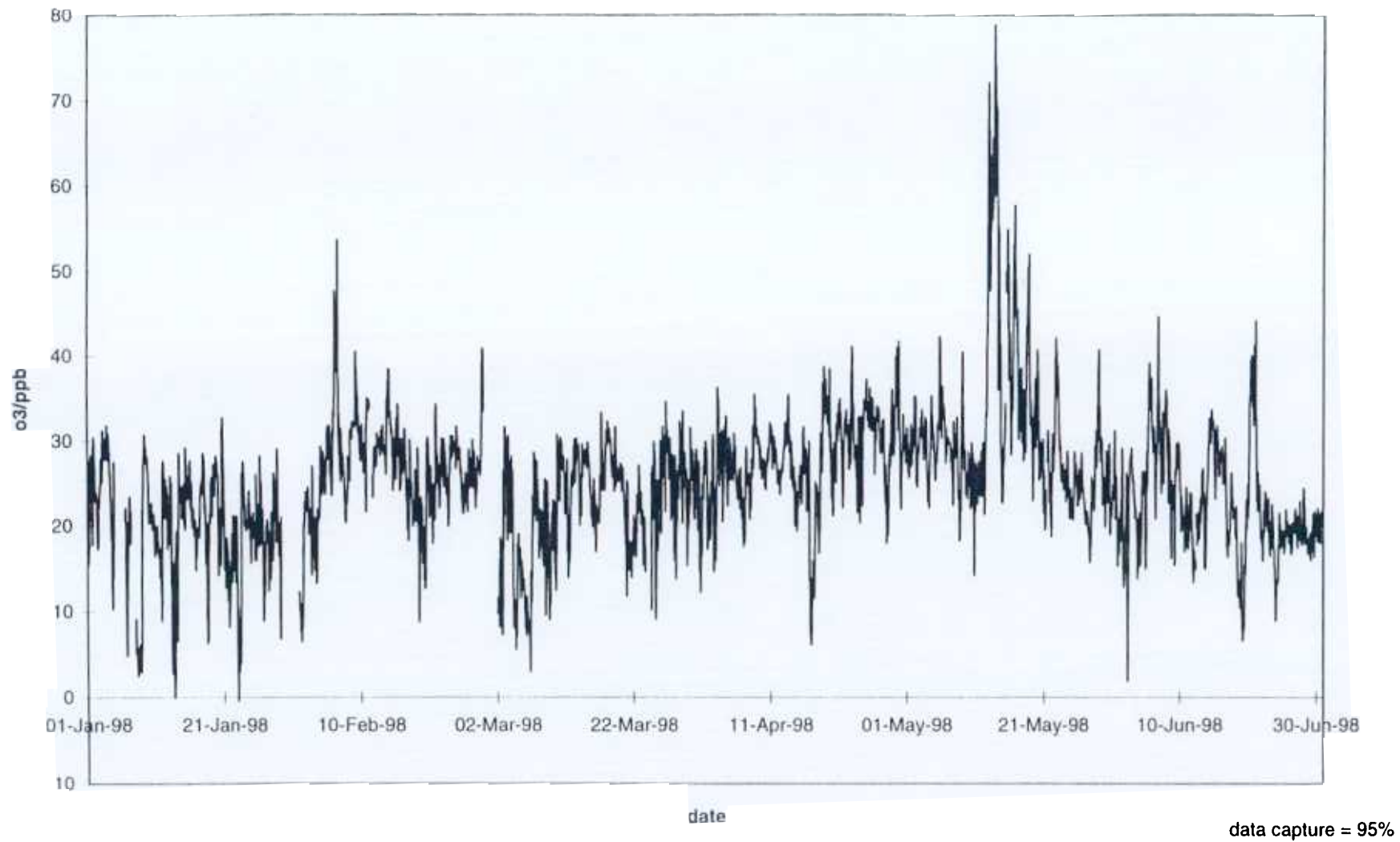


Glazebury 998

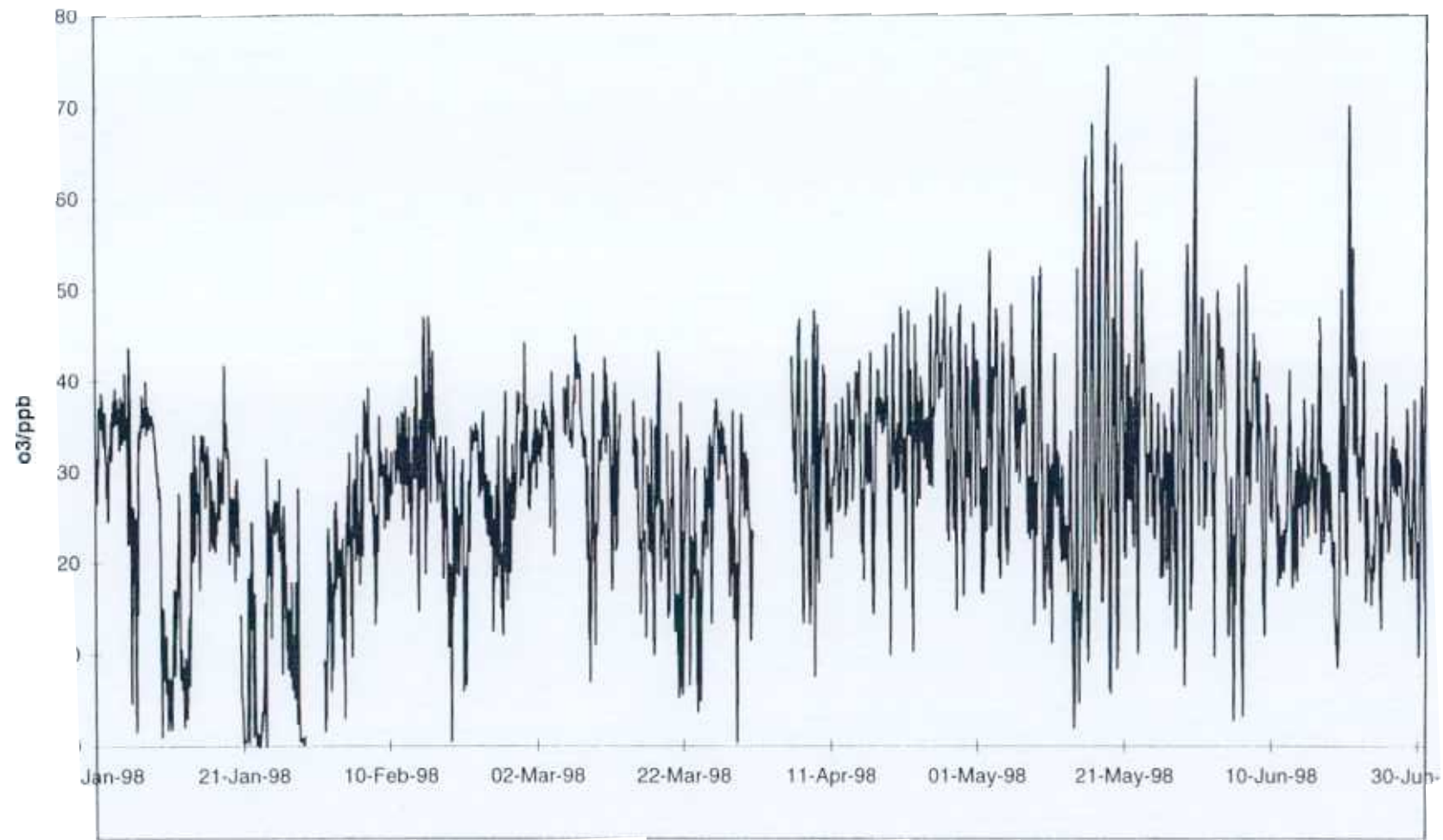


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Great Dun Fell 1998



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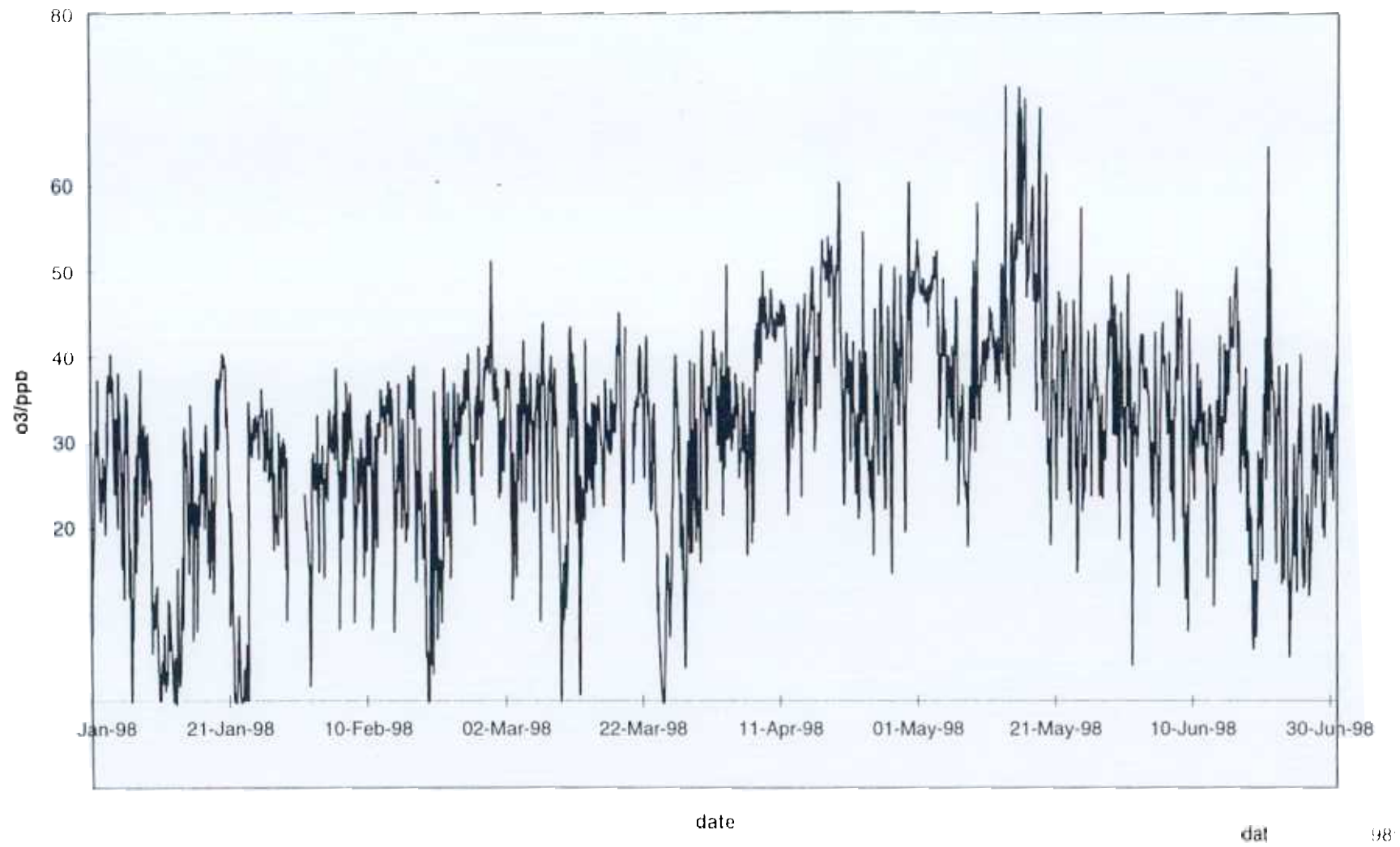


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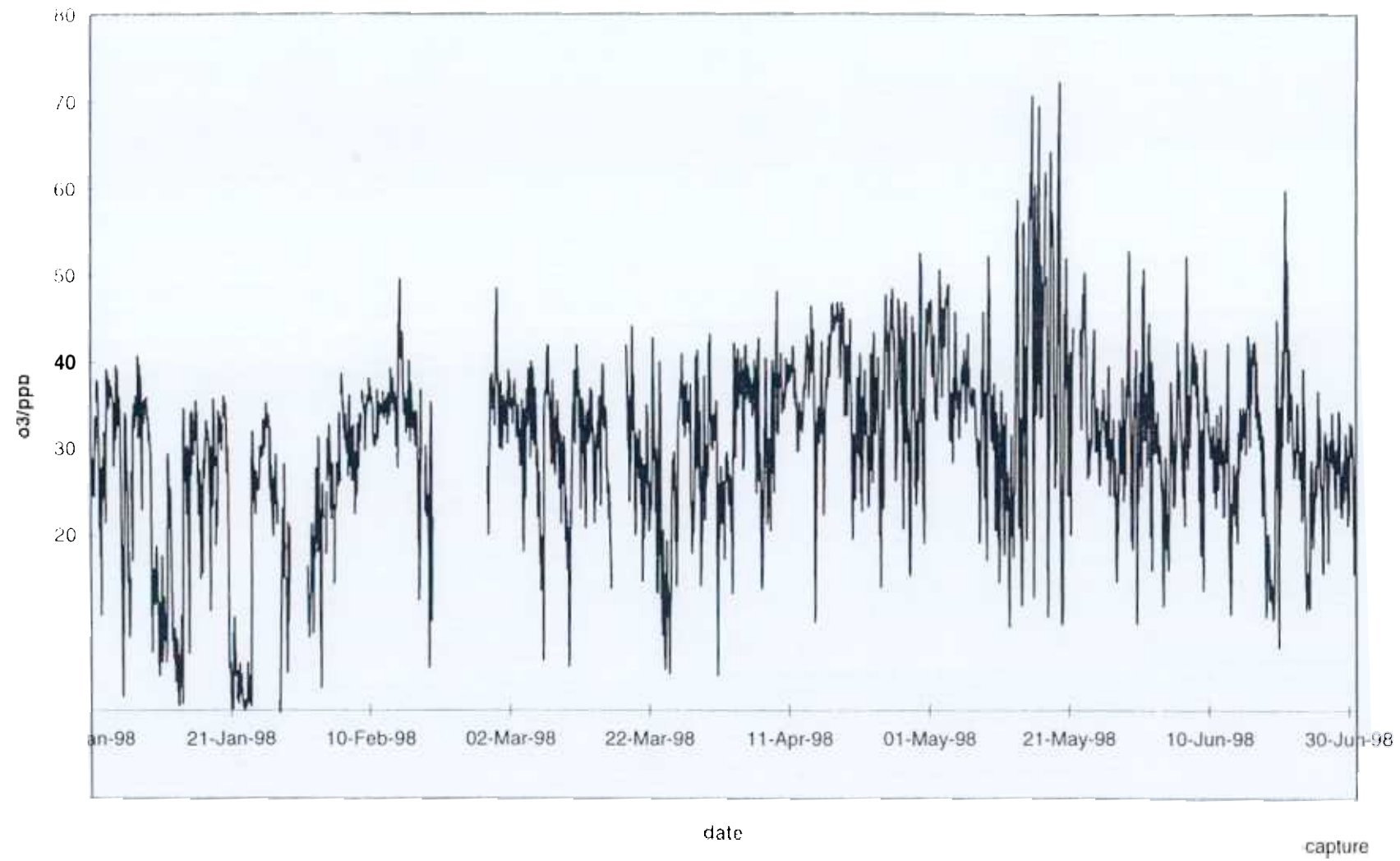
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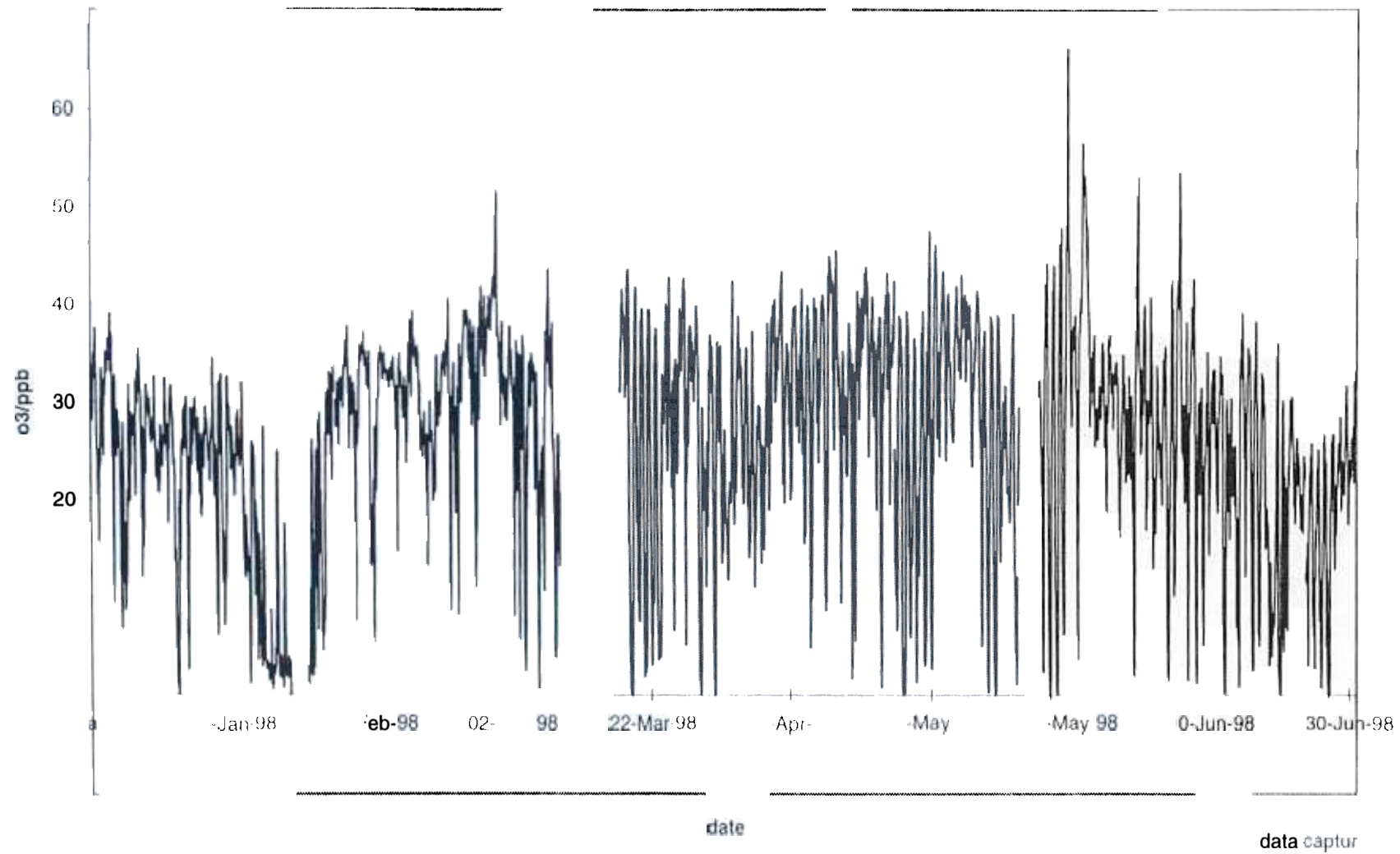
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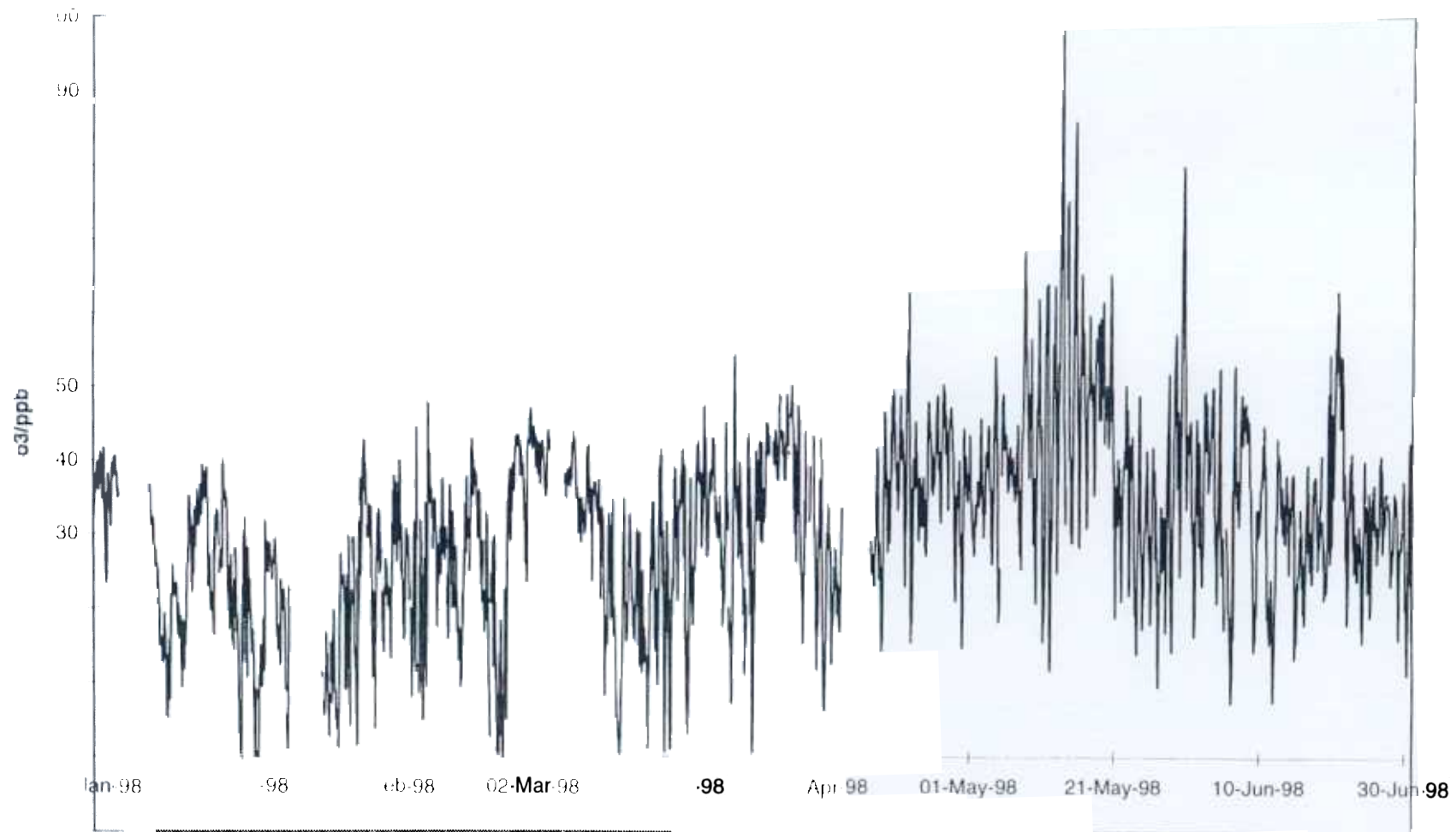
Ladybower 998



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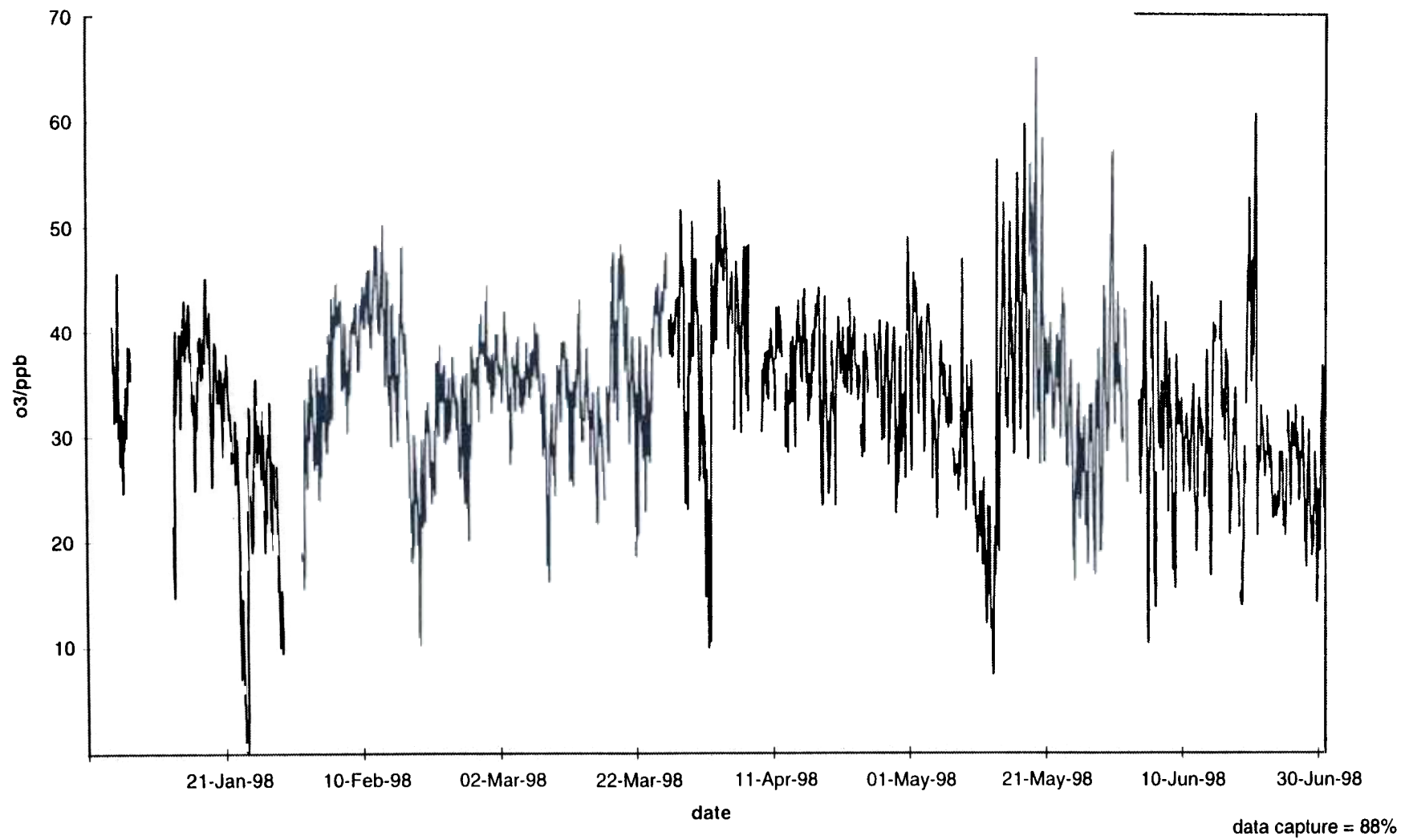


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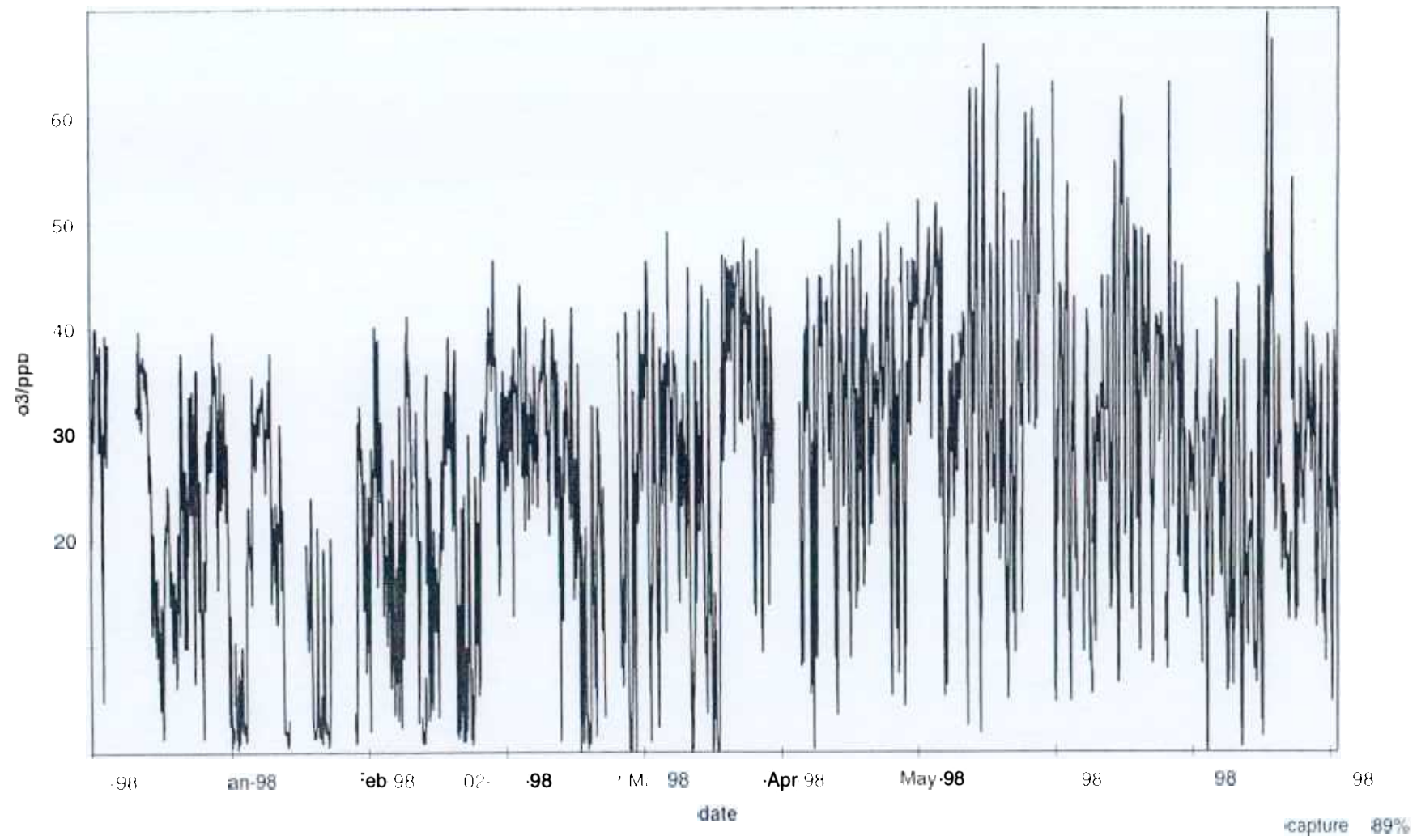
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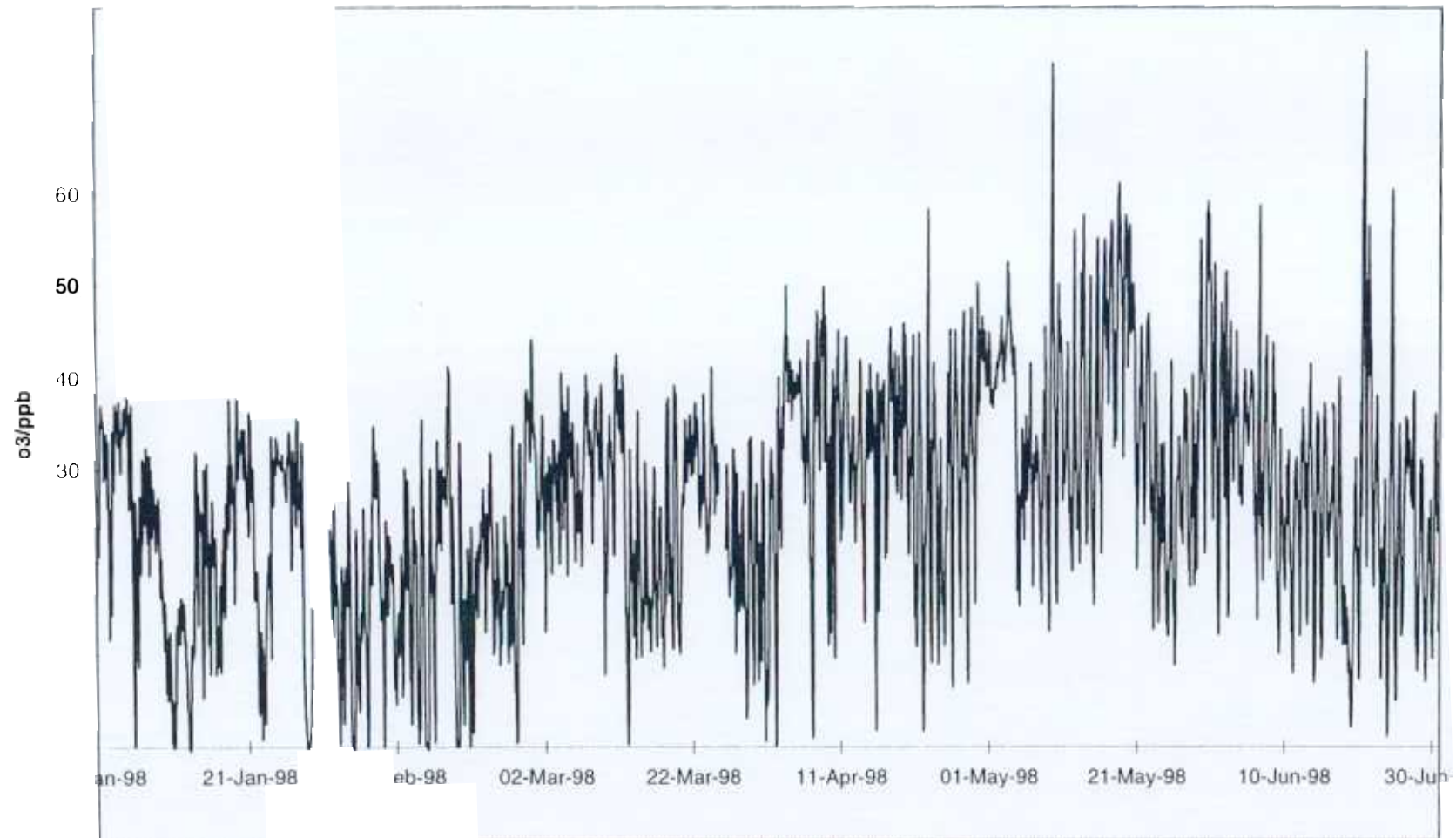
Narberth 1998



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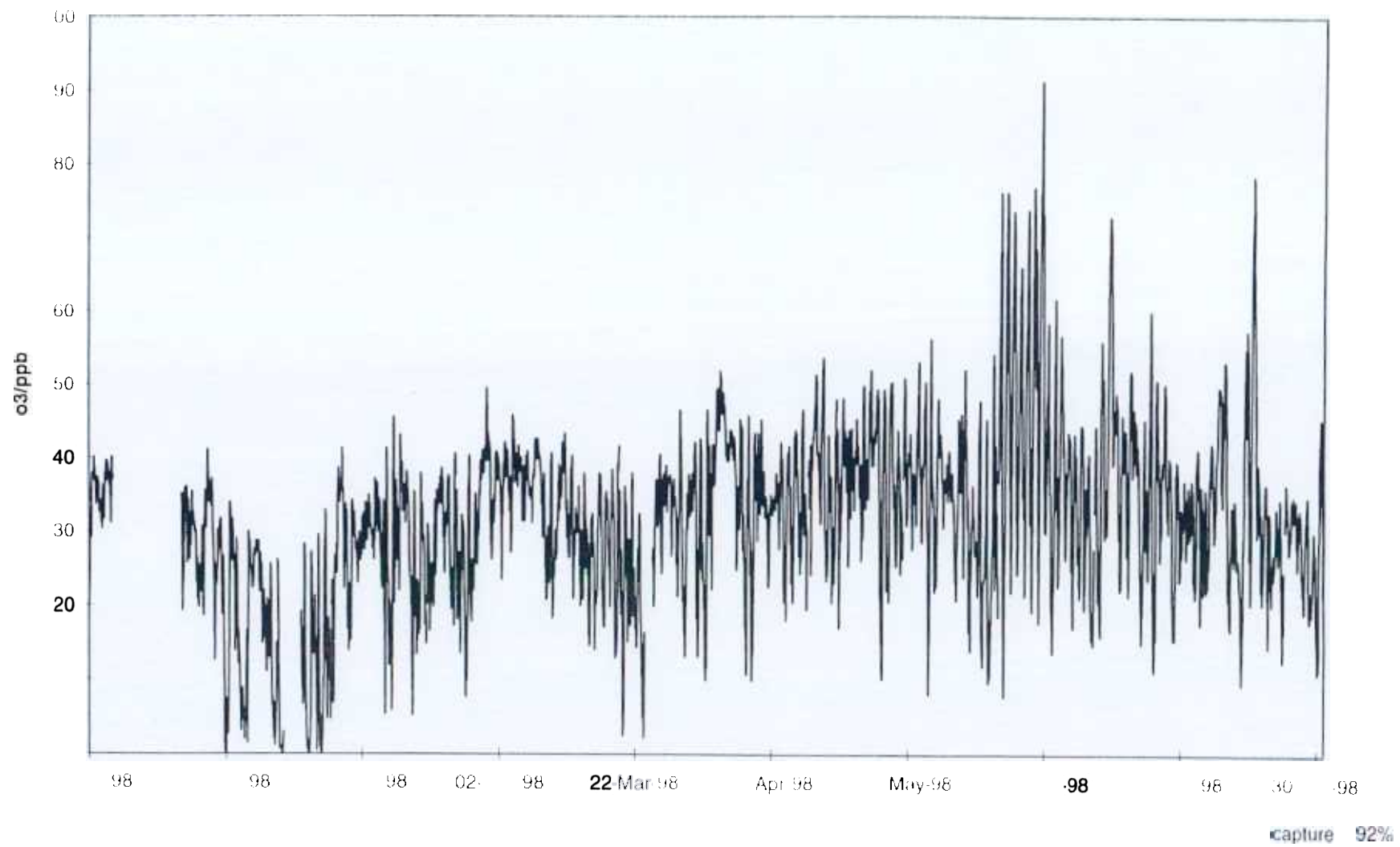


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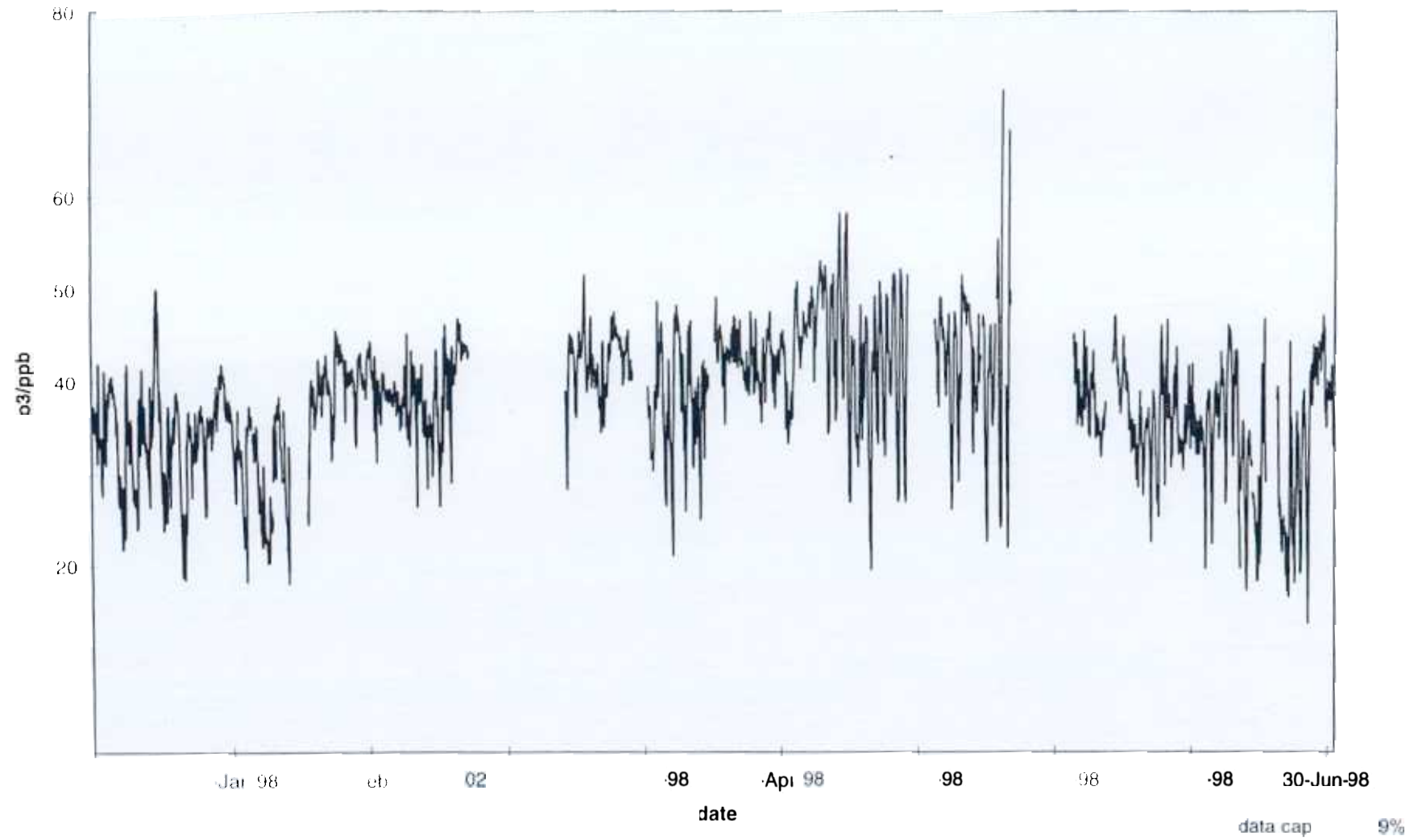
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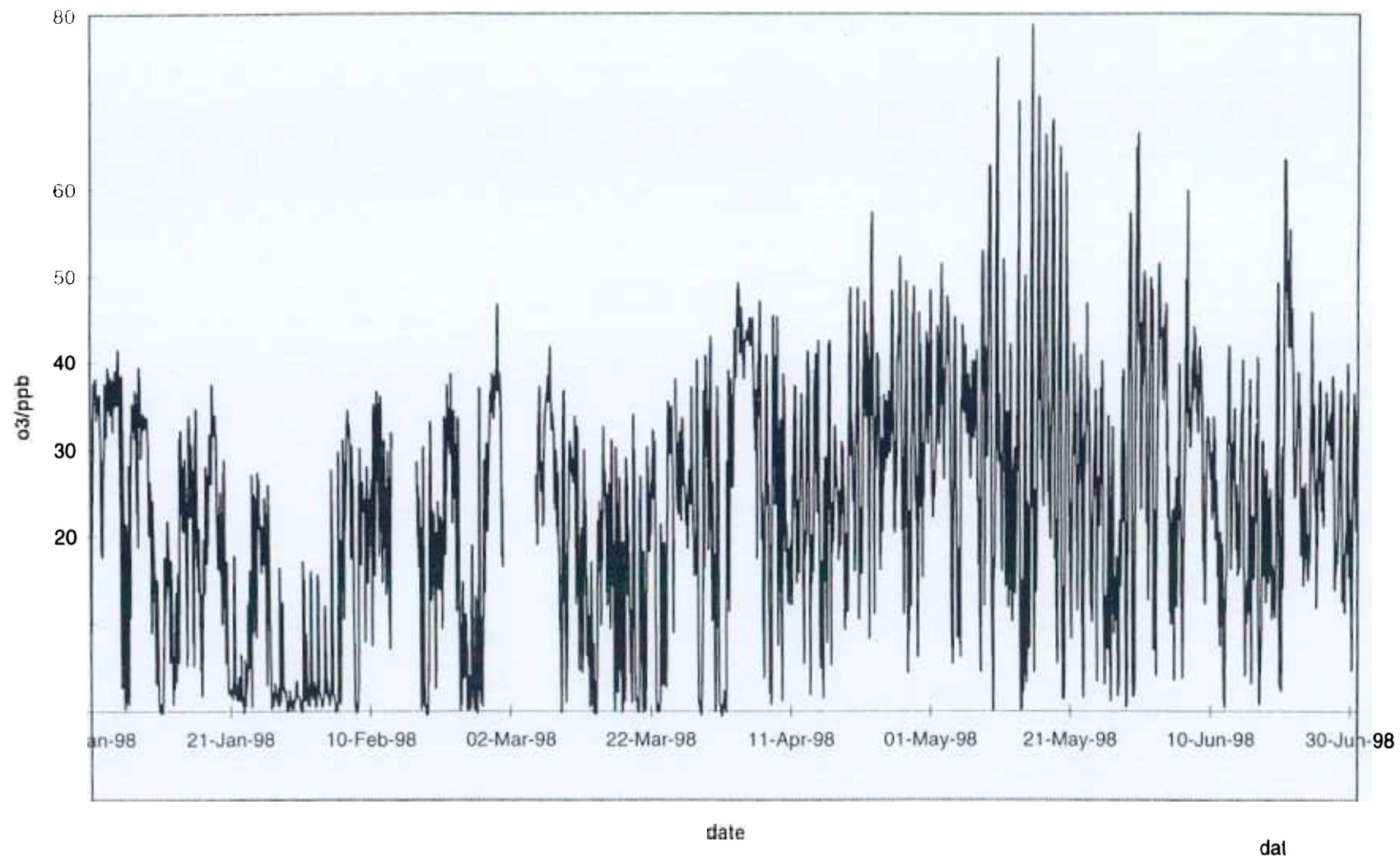


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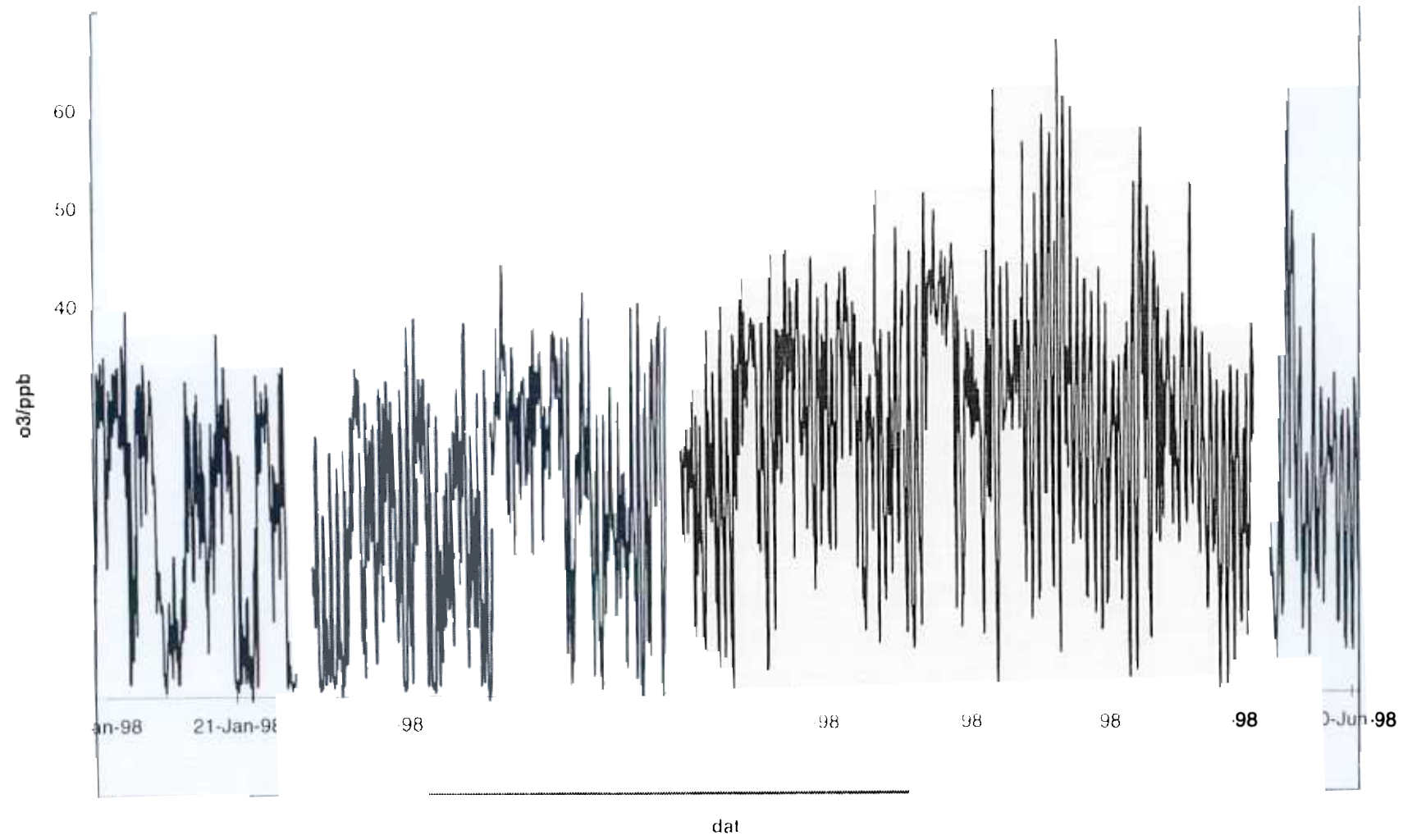
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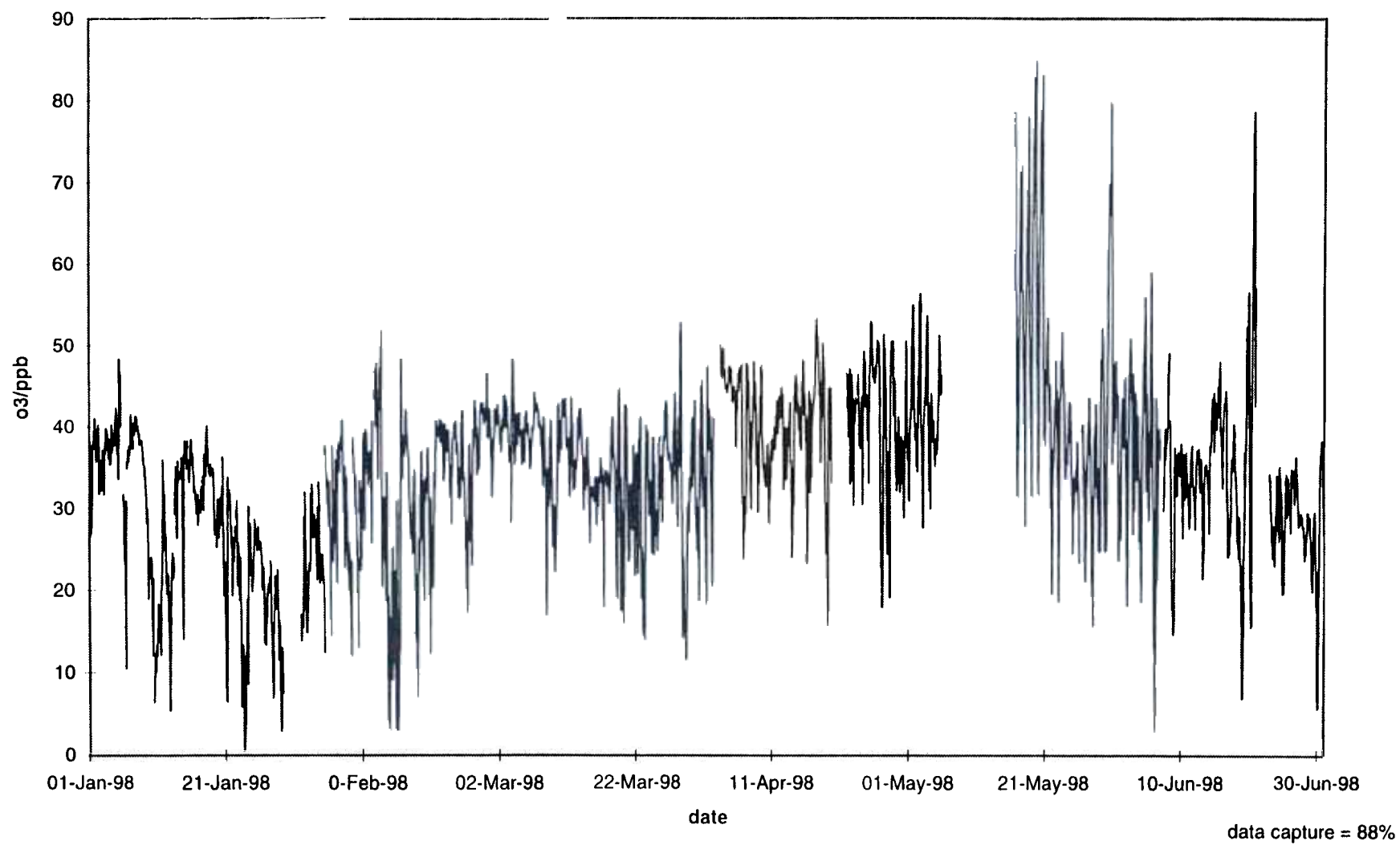
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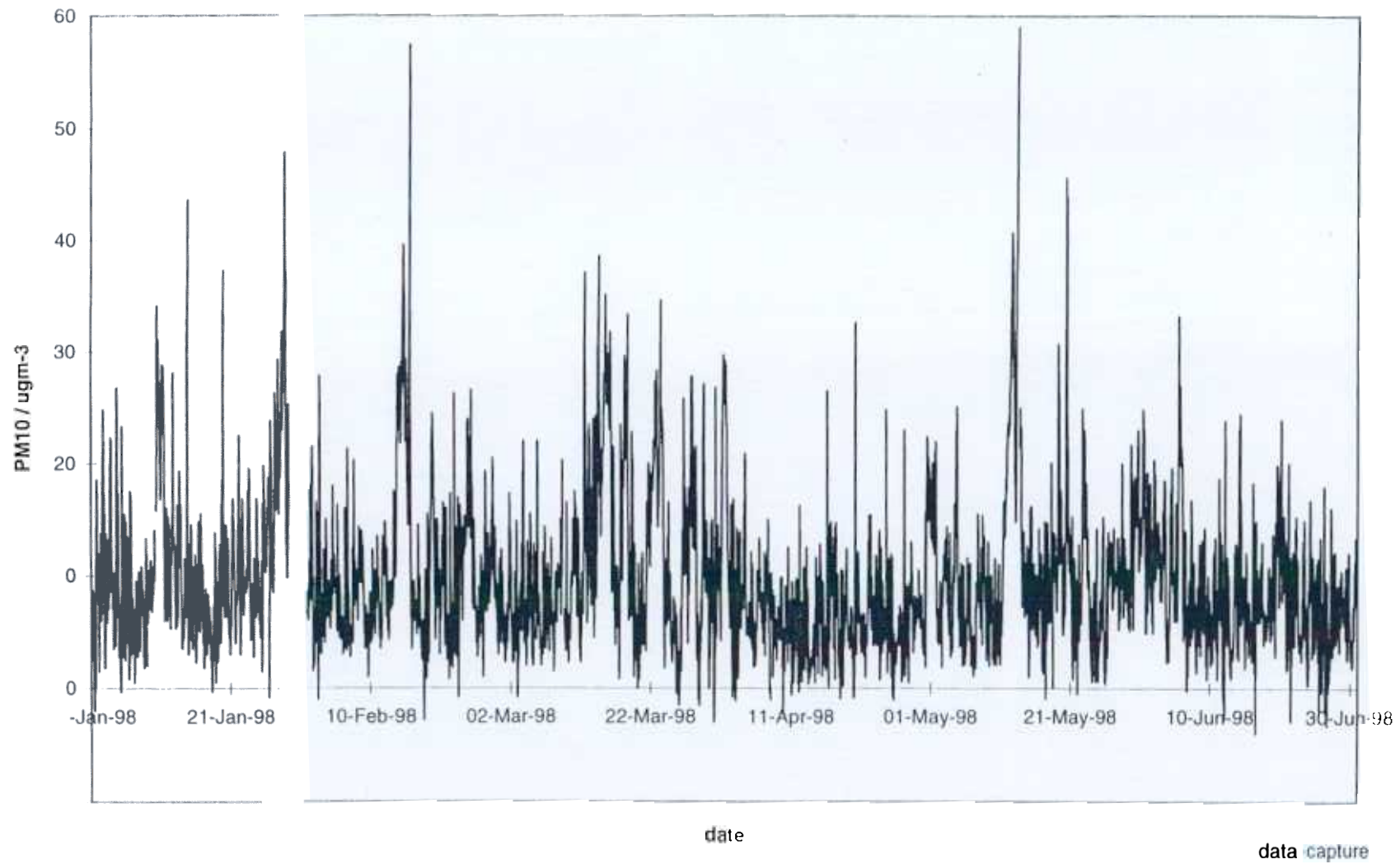
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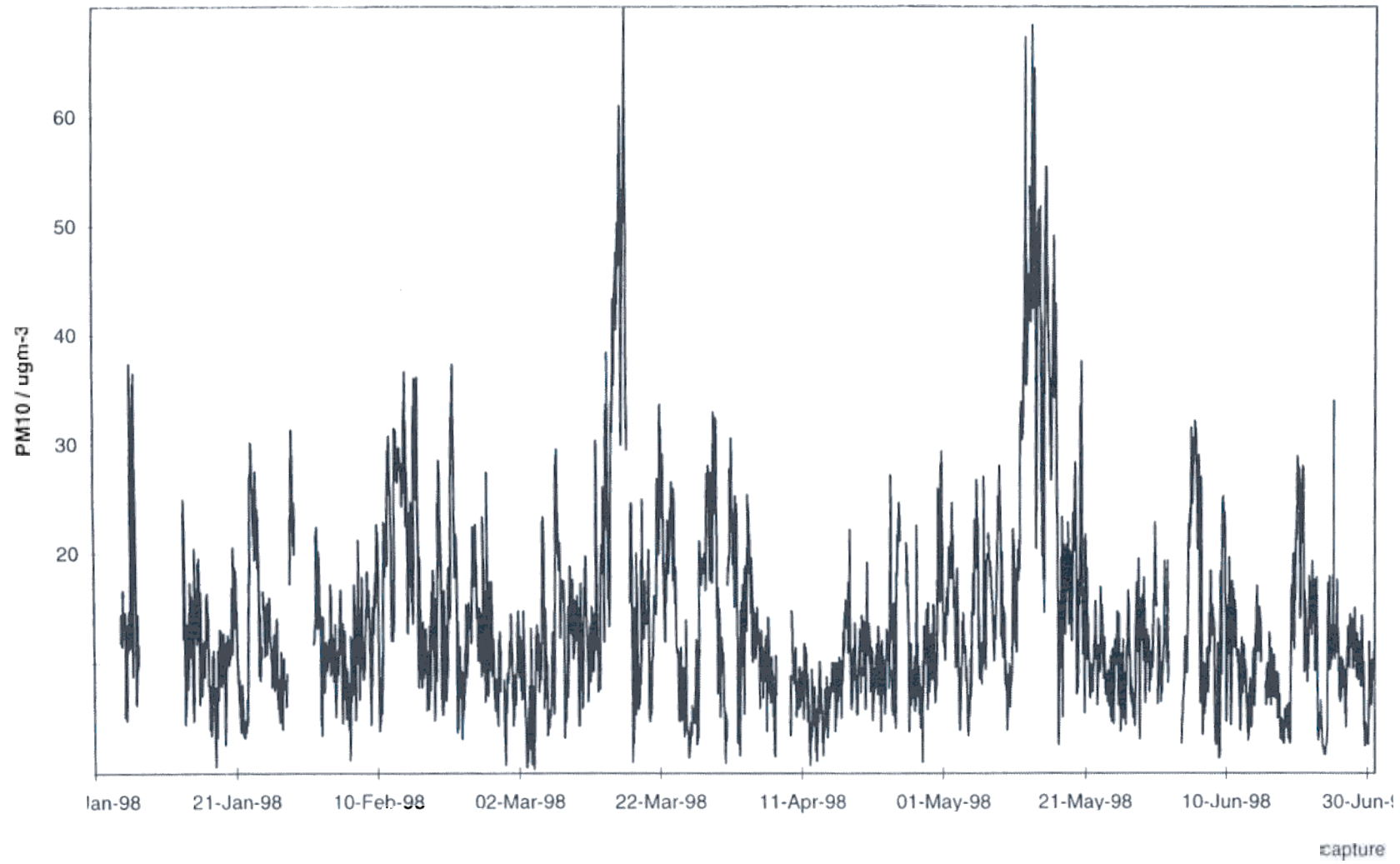
Yarner Wood 1998



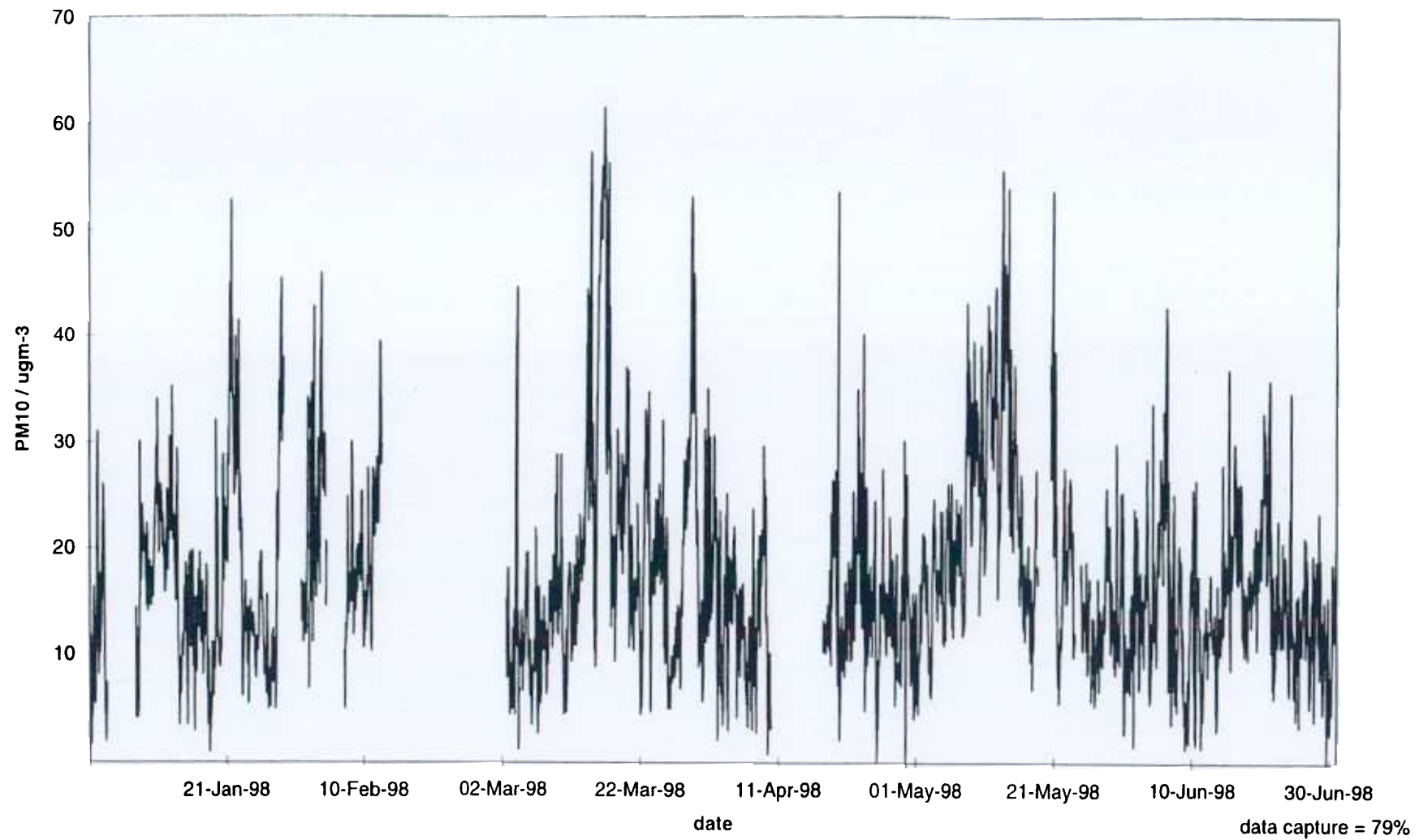
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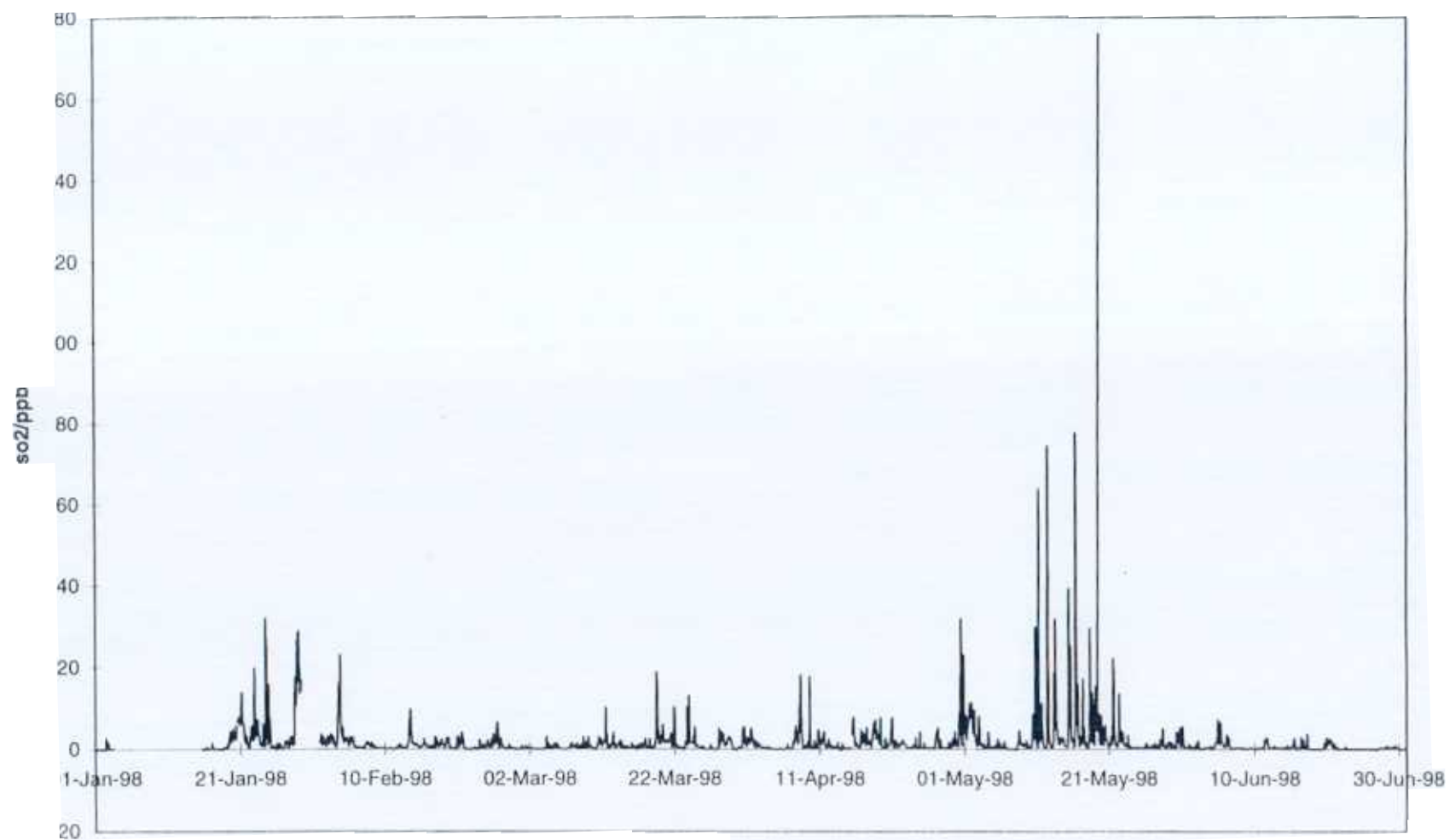
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Rochester 1998



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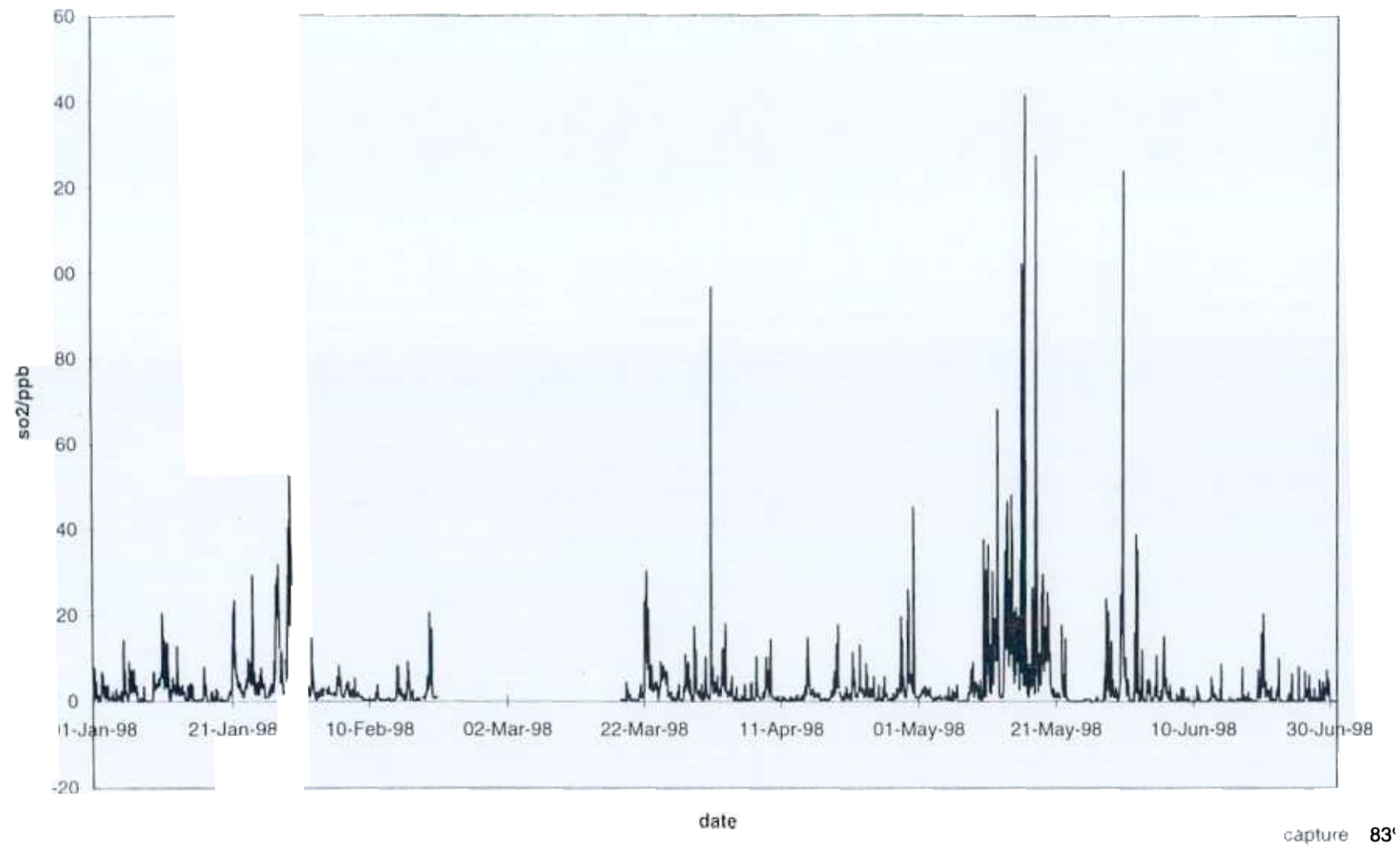


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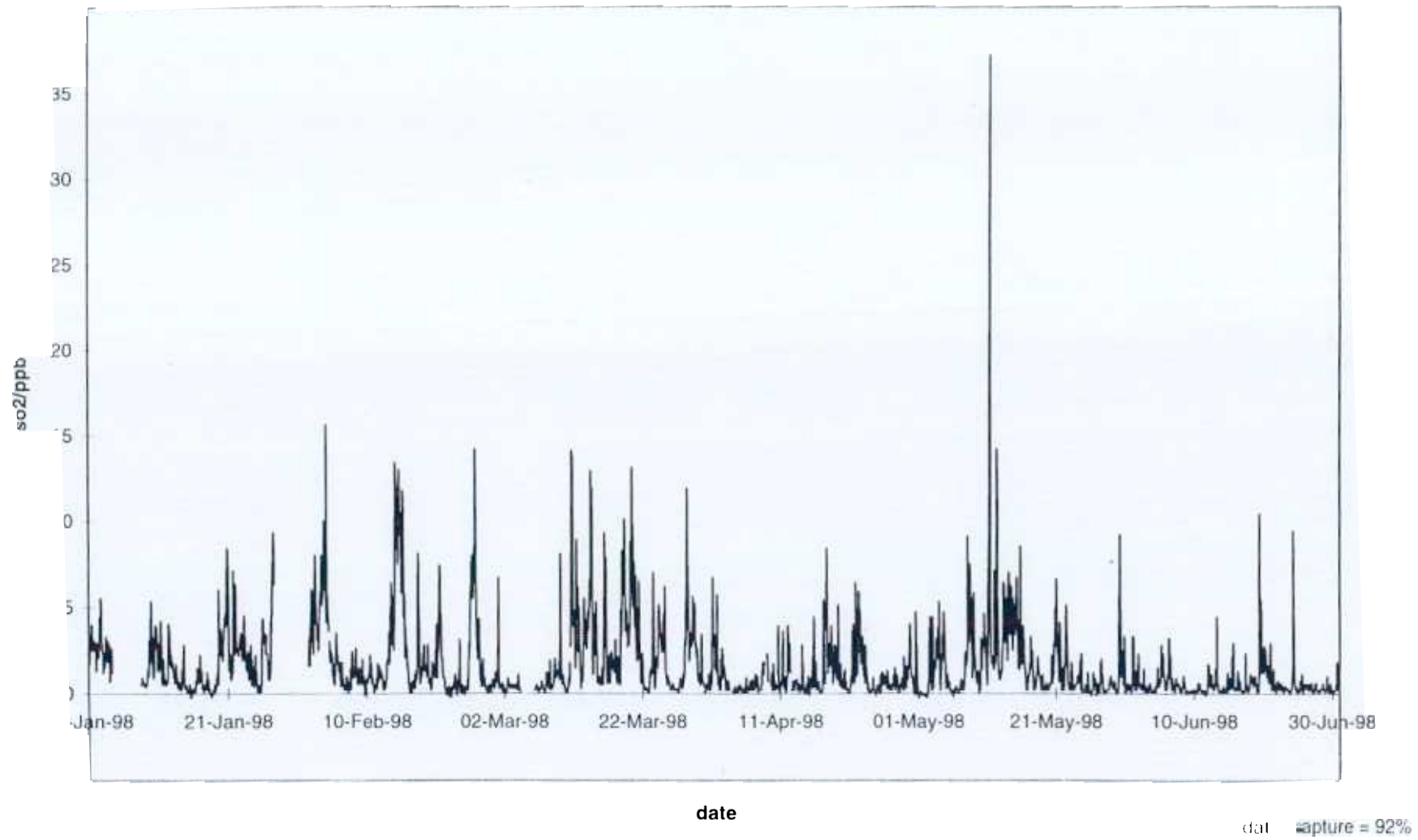
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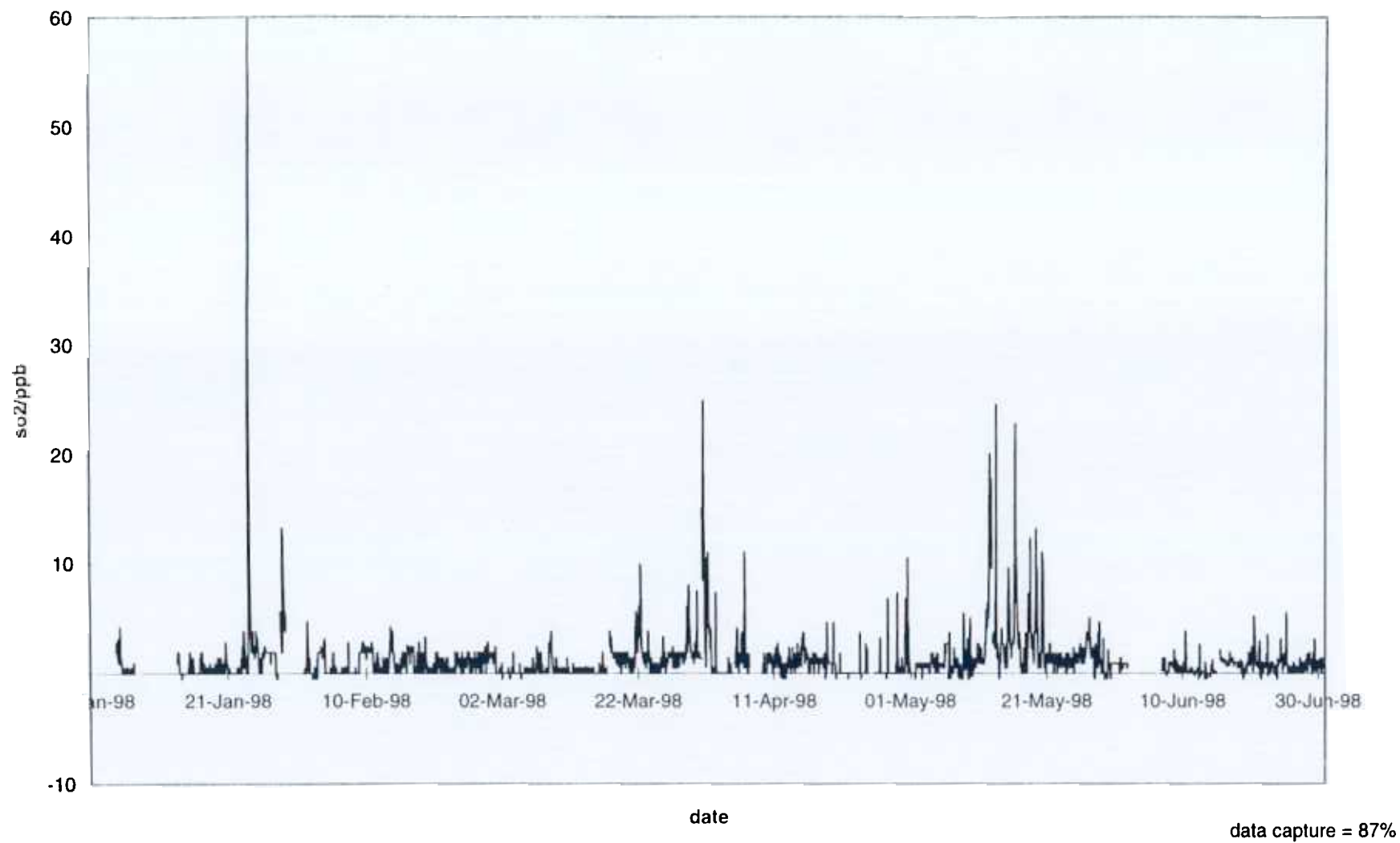


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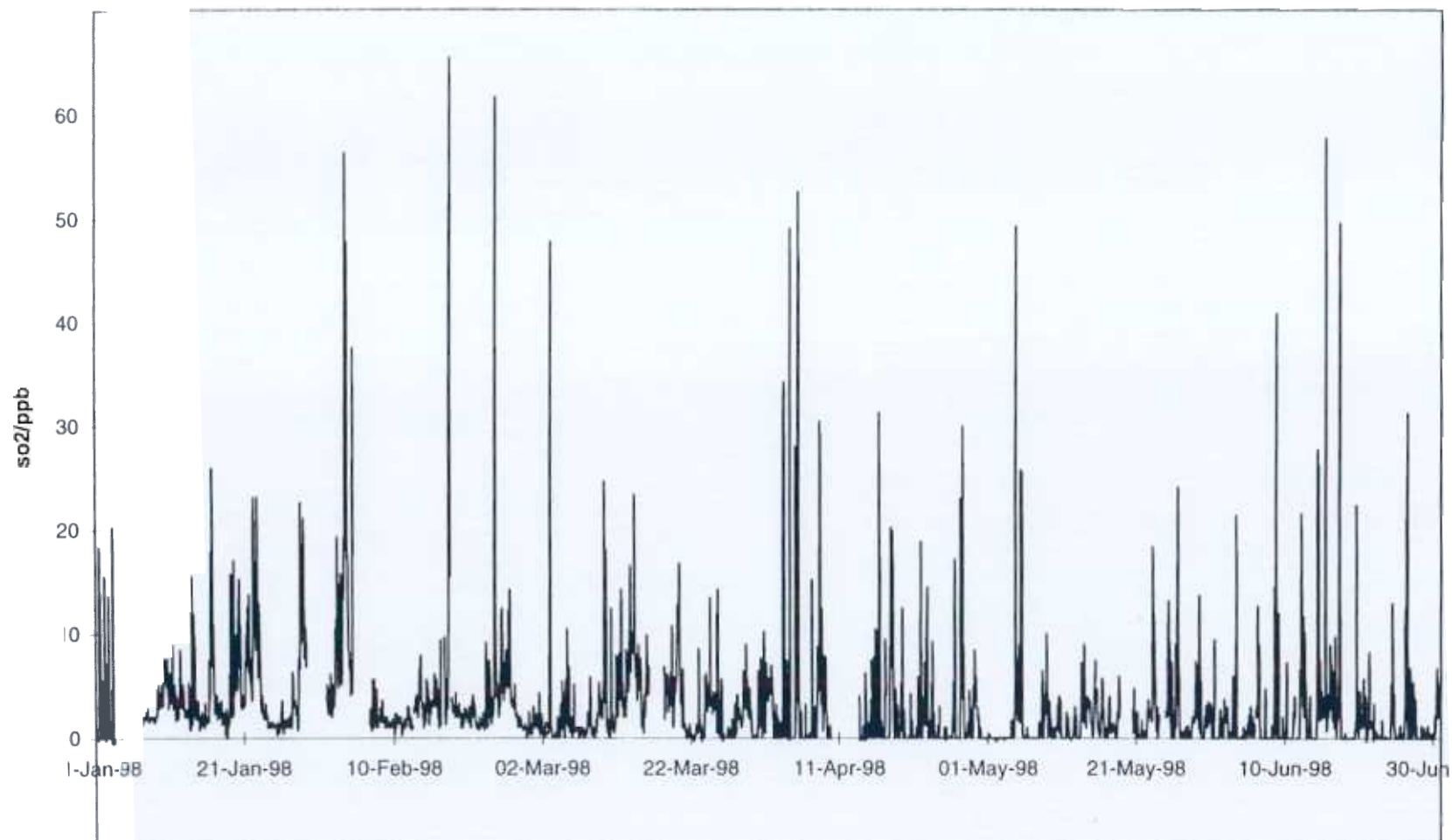
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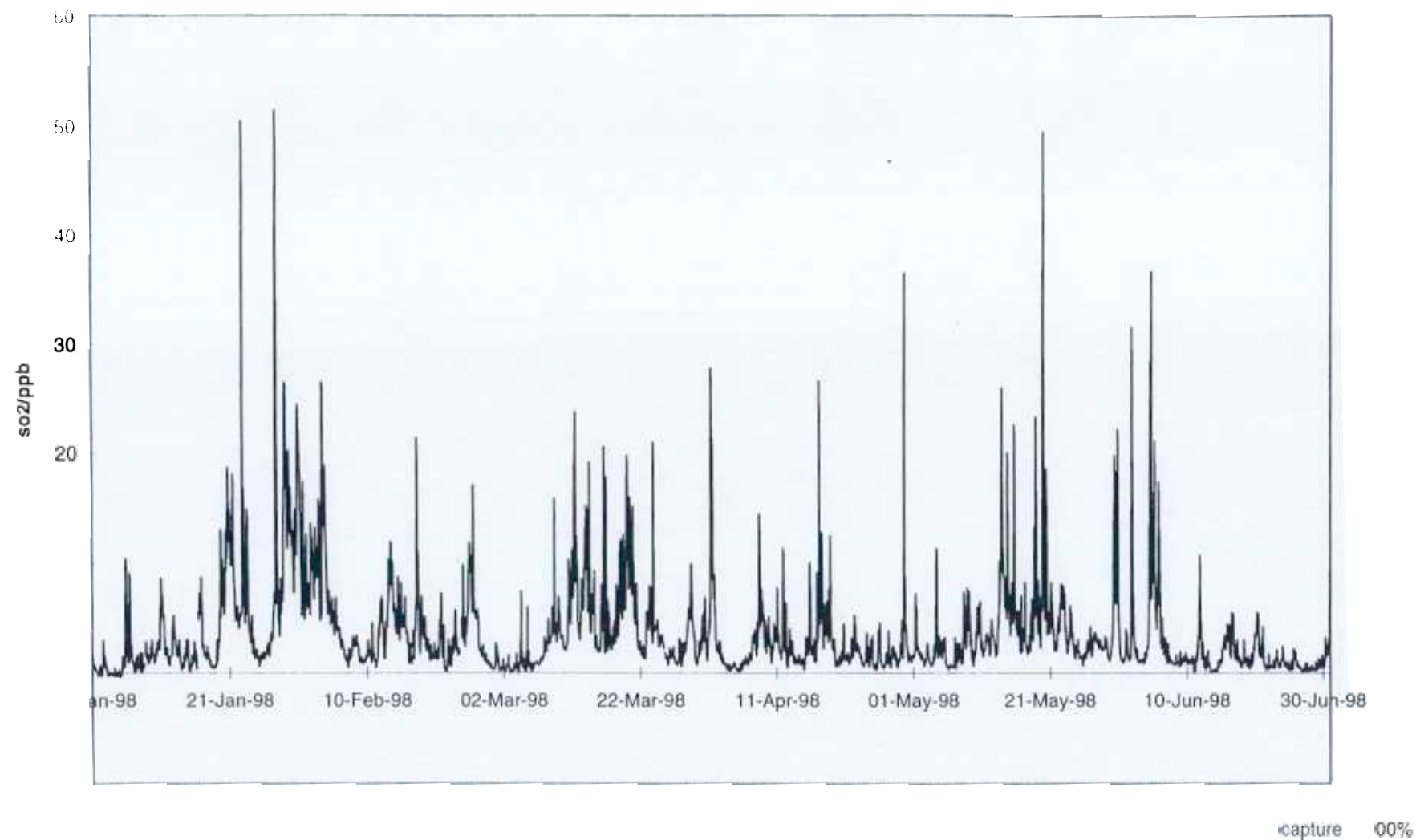


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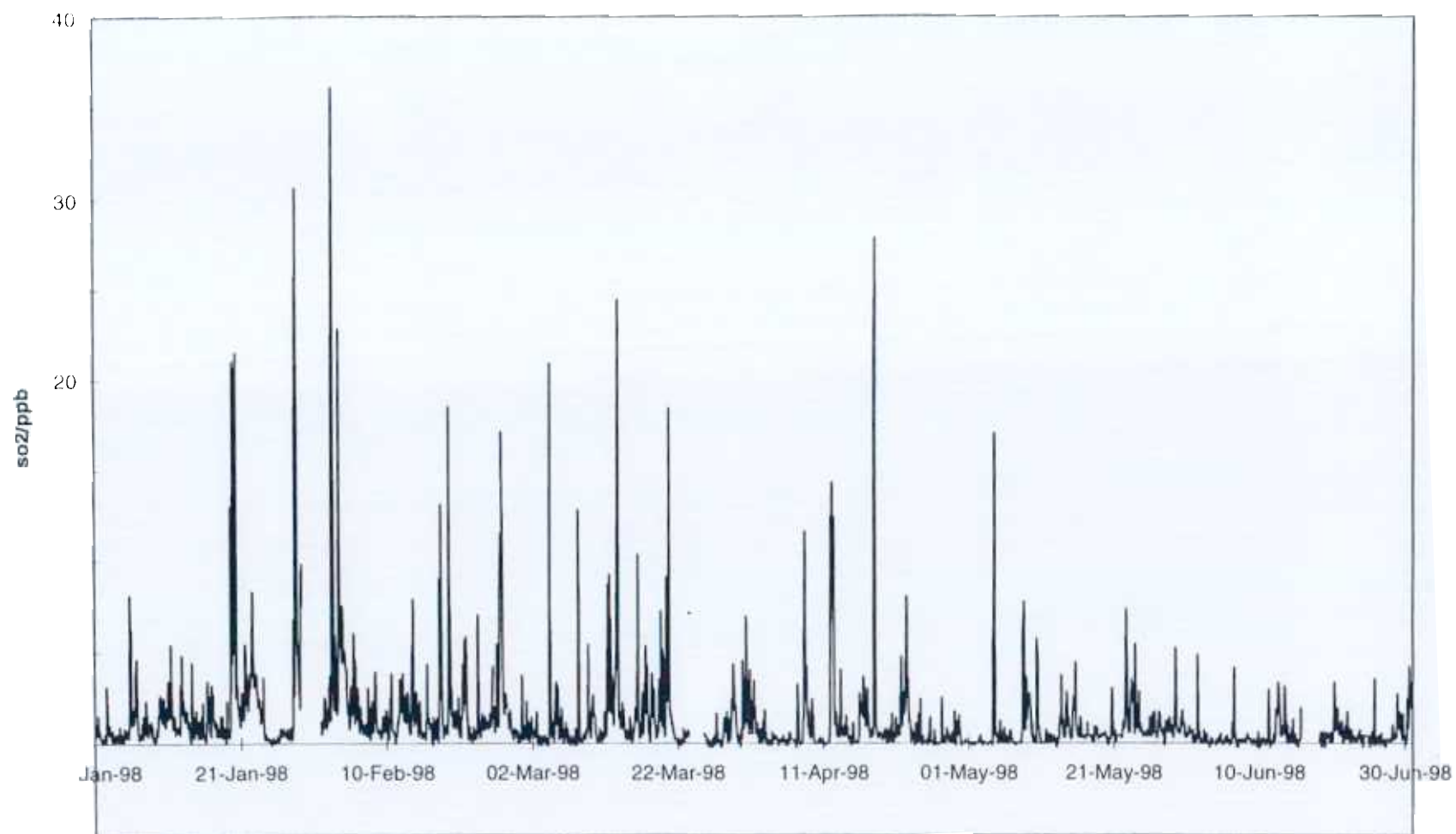


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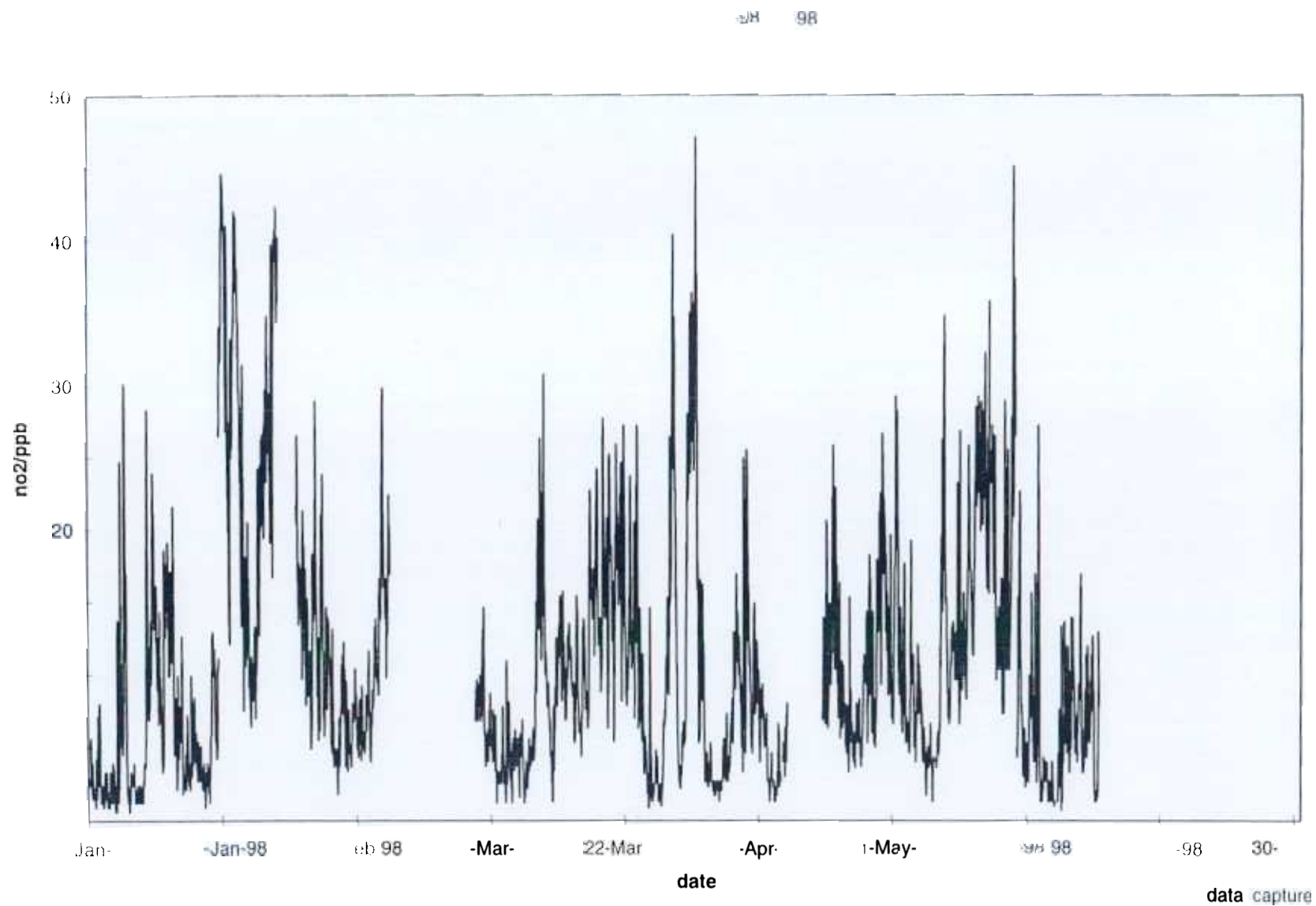


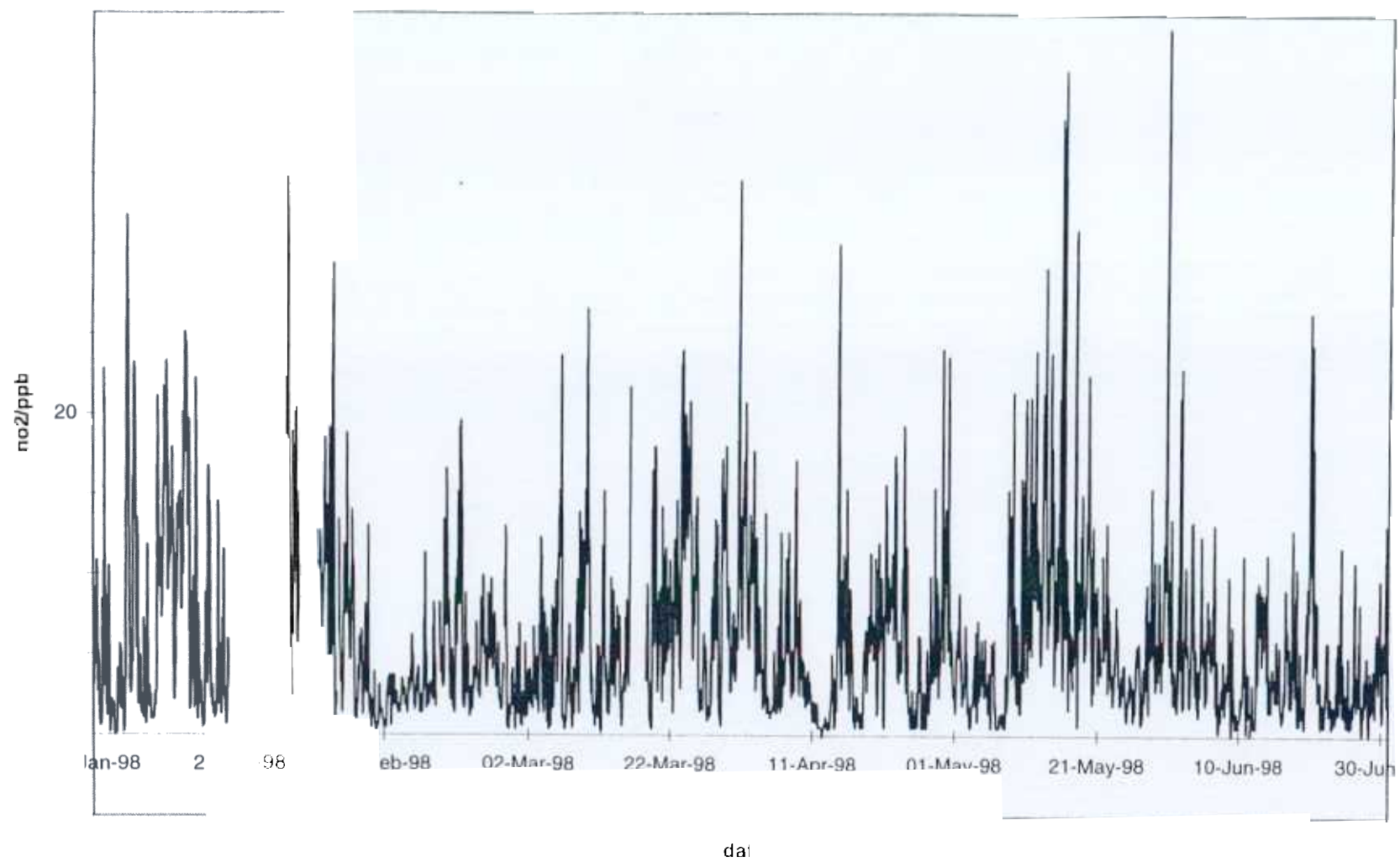
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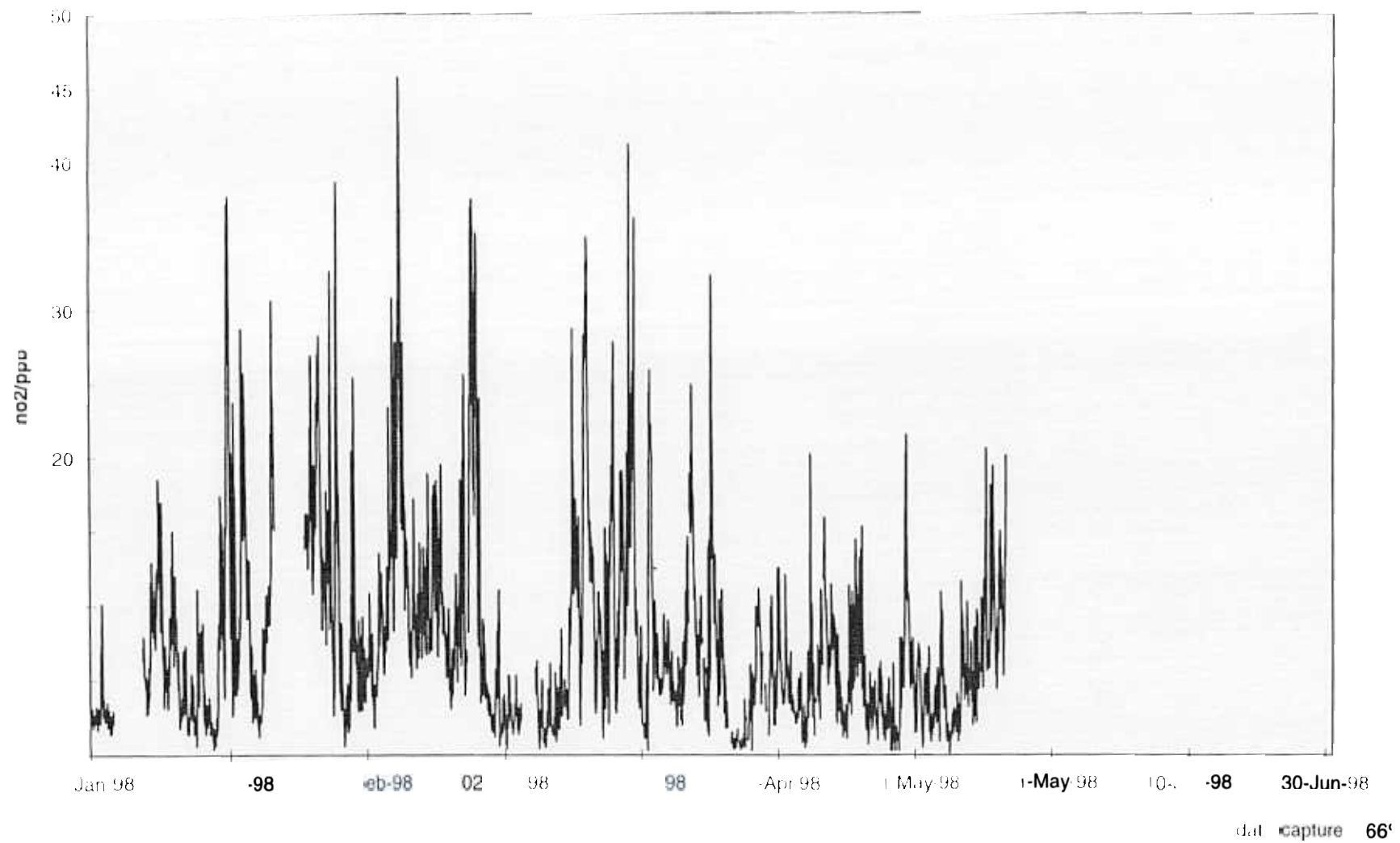
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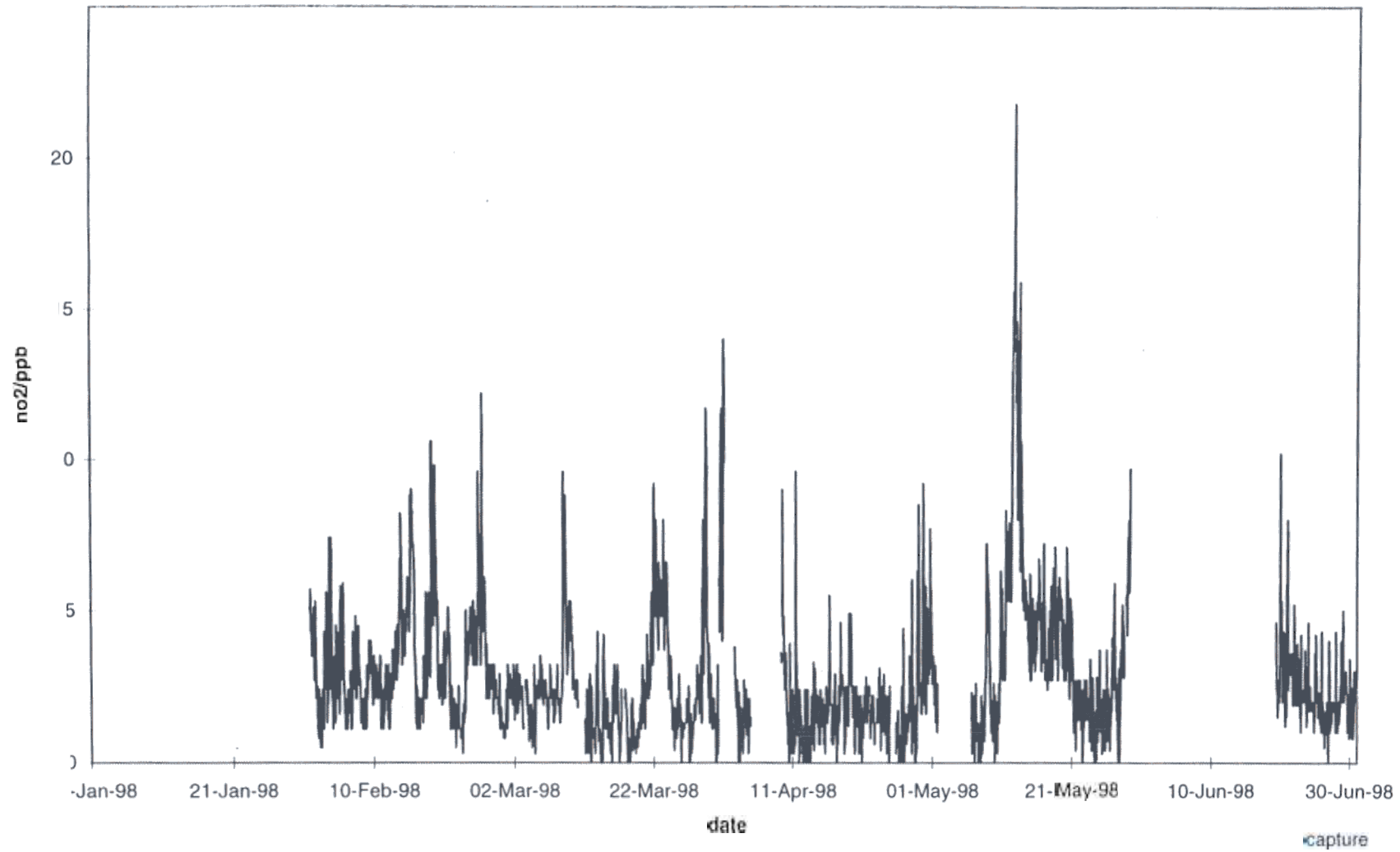




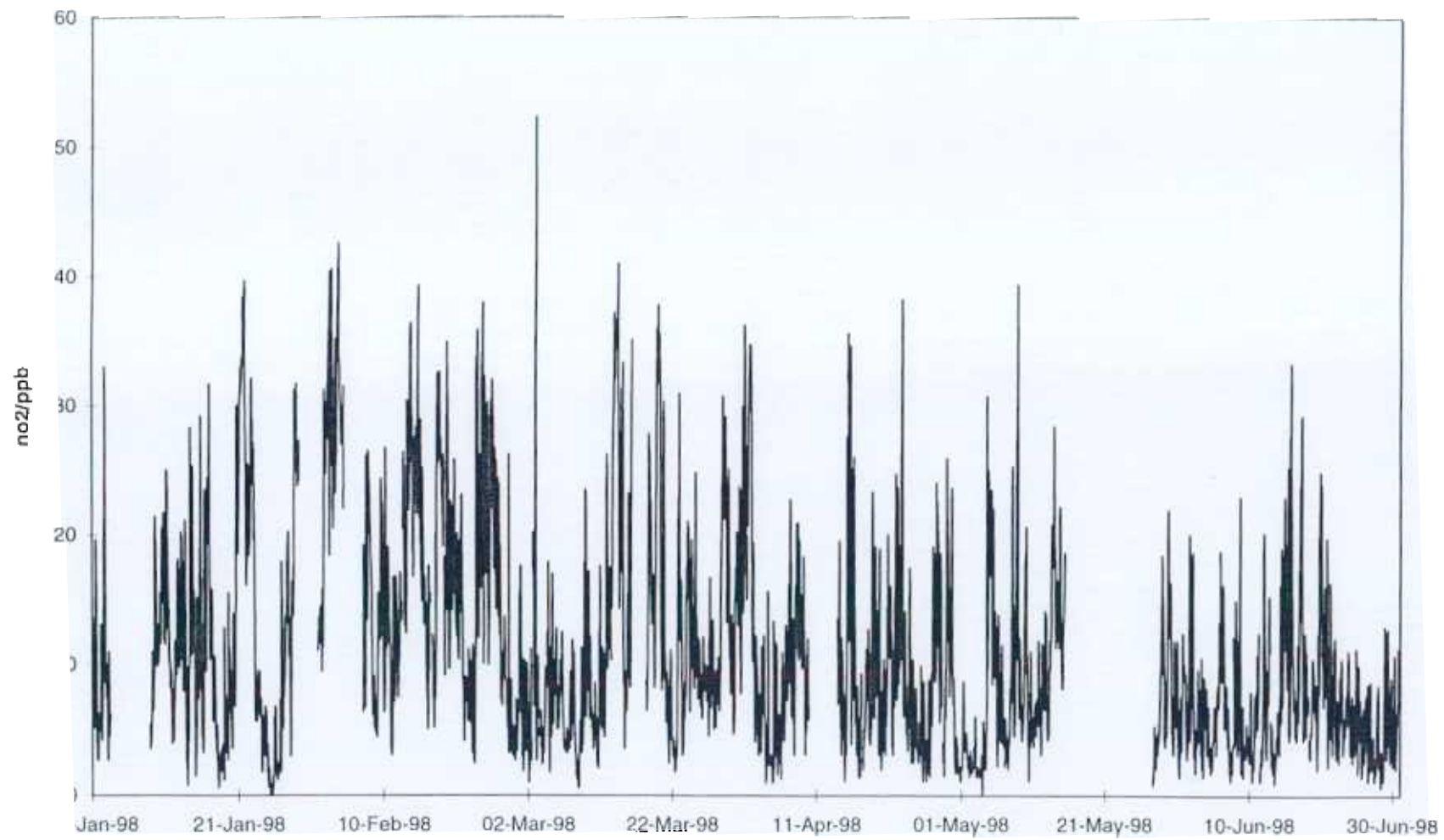
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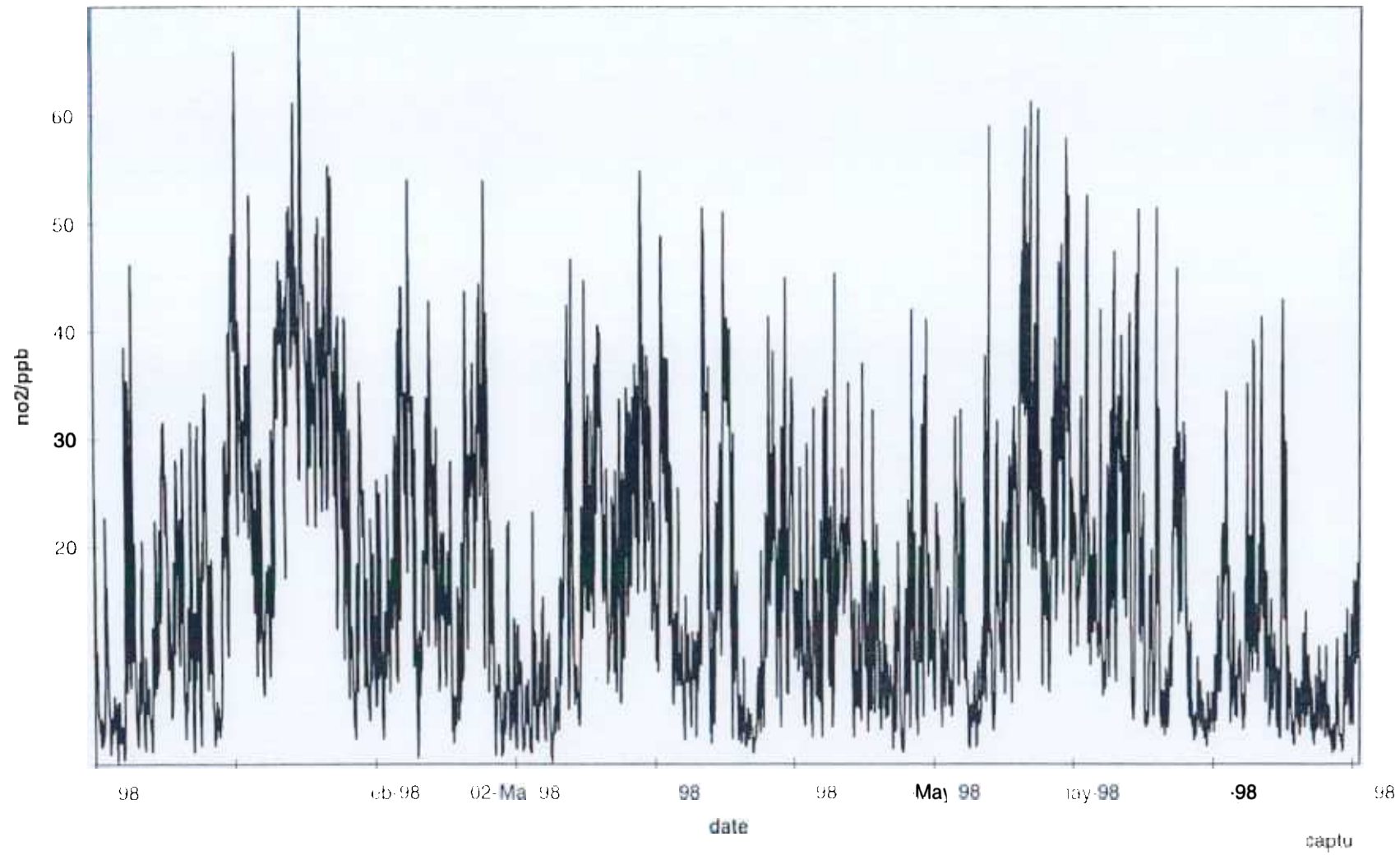


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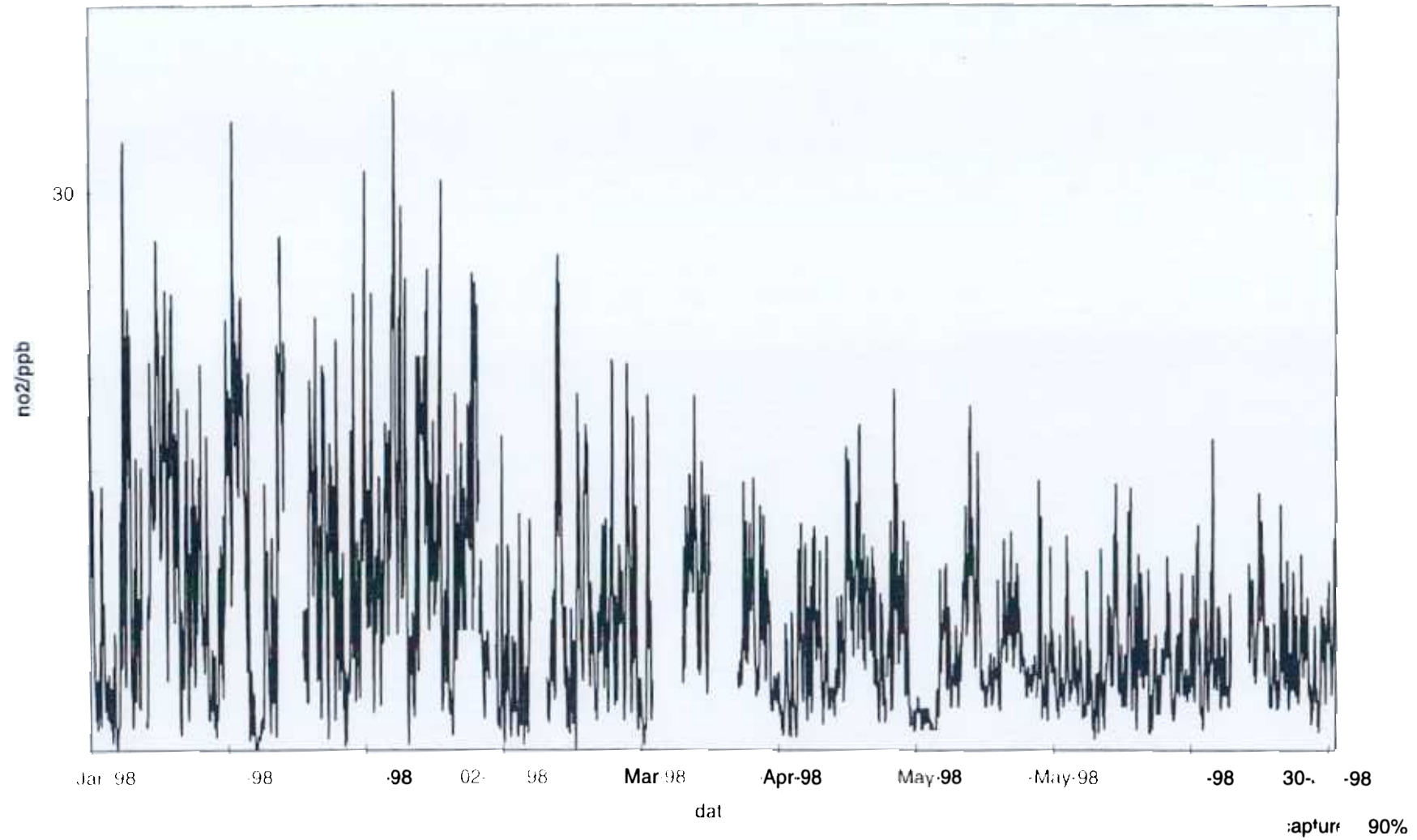


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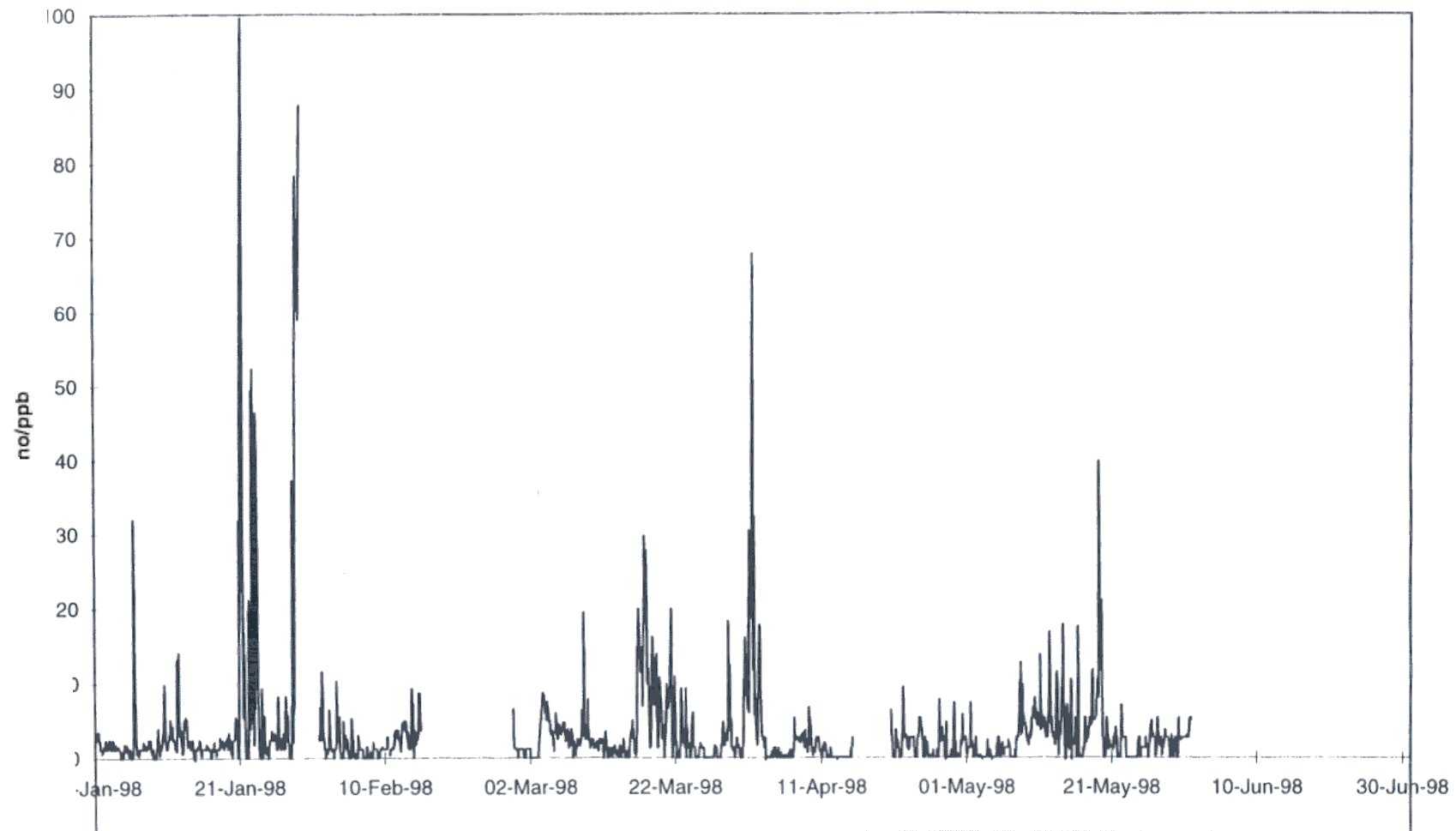


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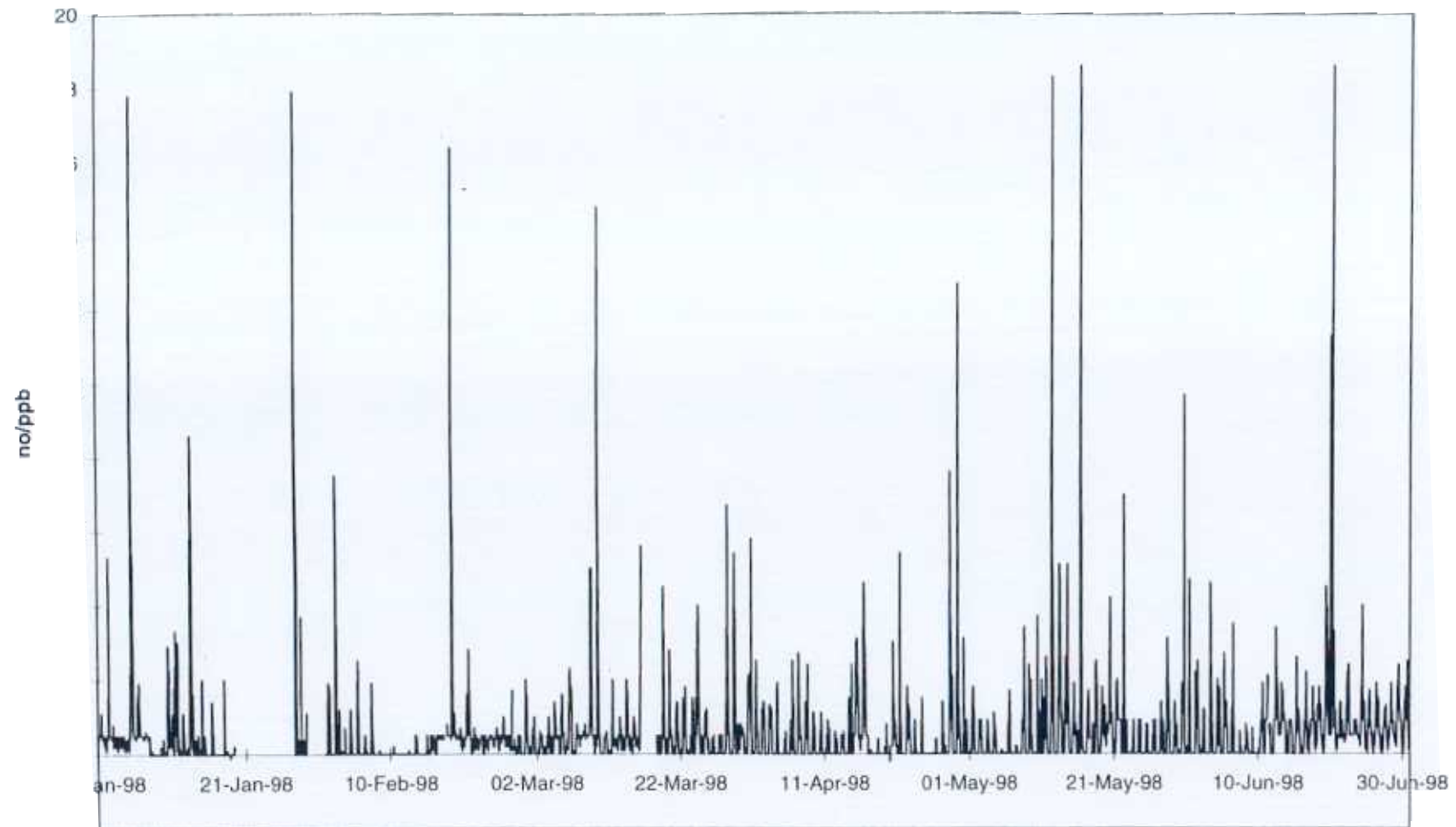
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Harwell 998



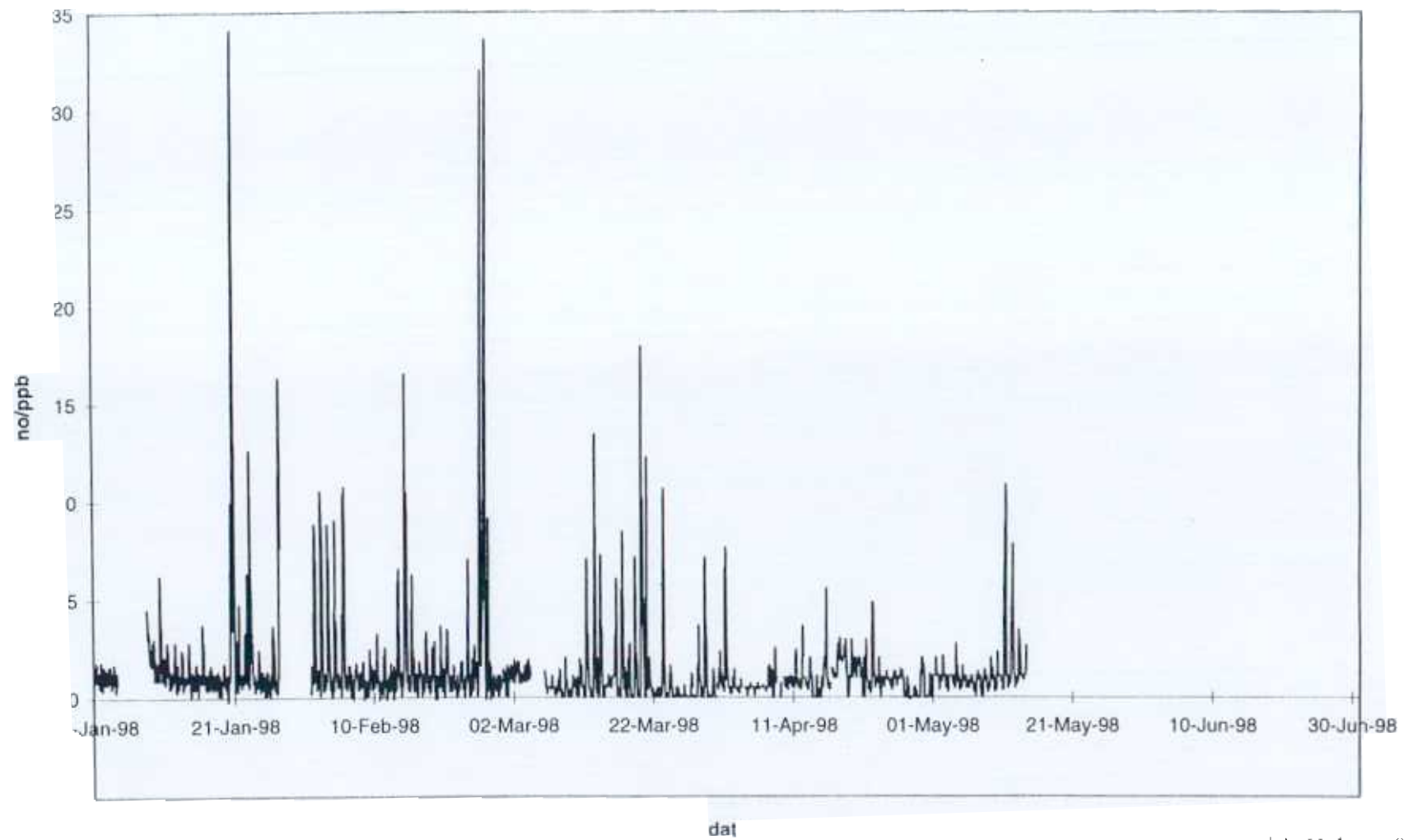
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Ladybower 998



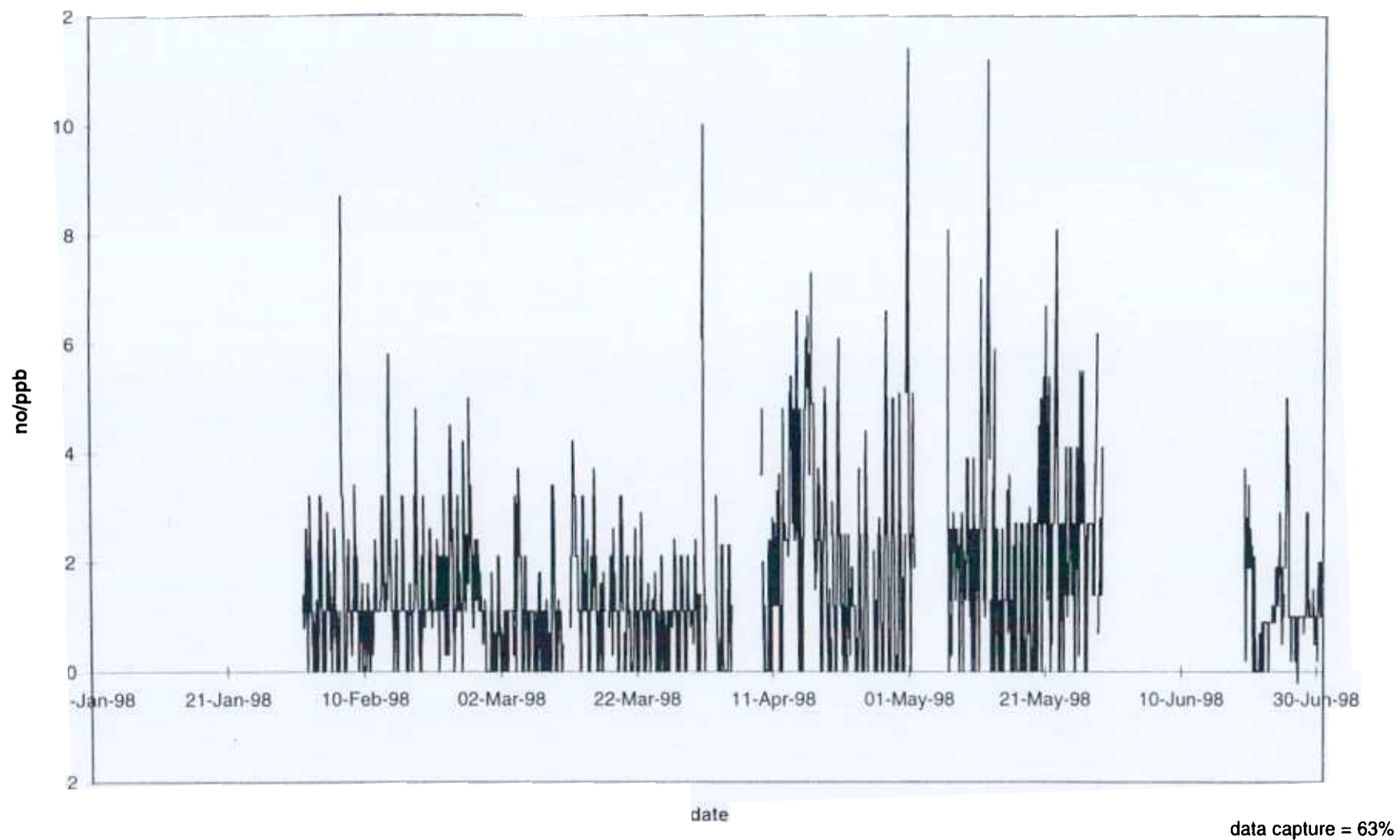
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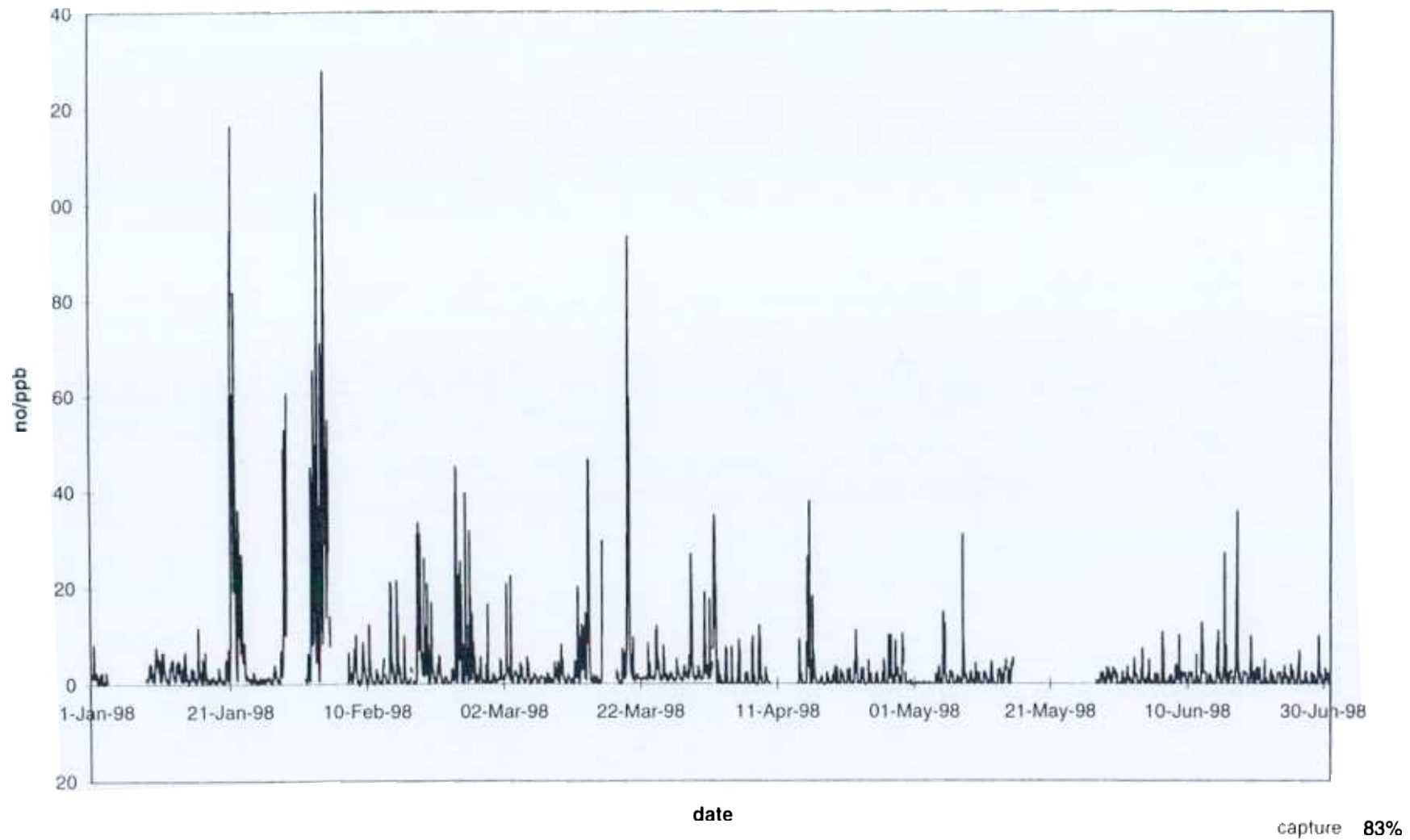


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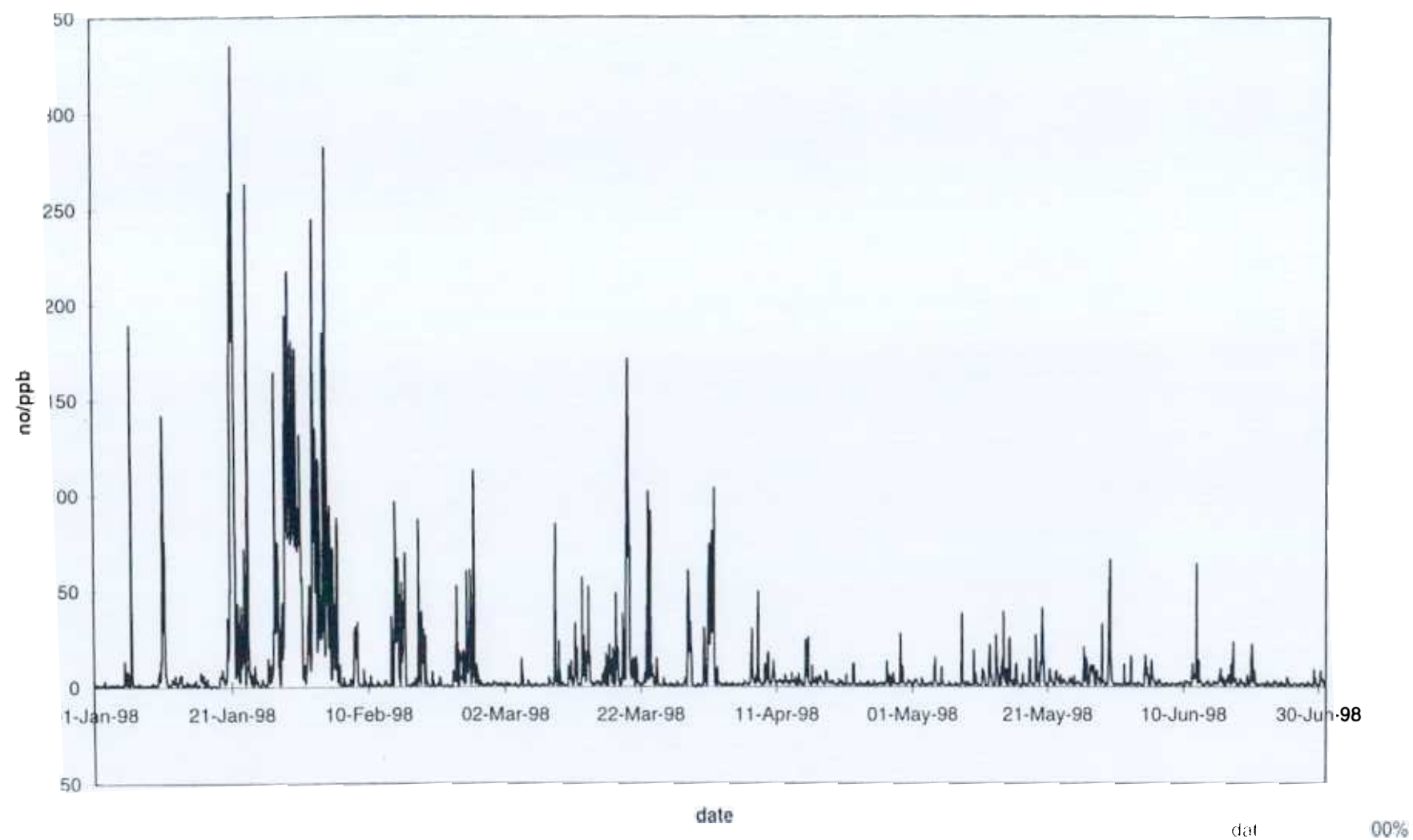
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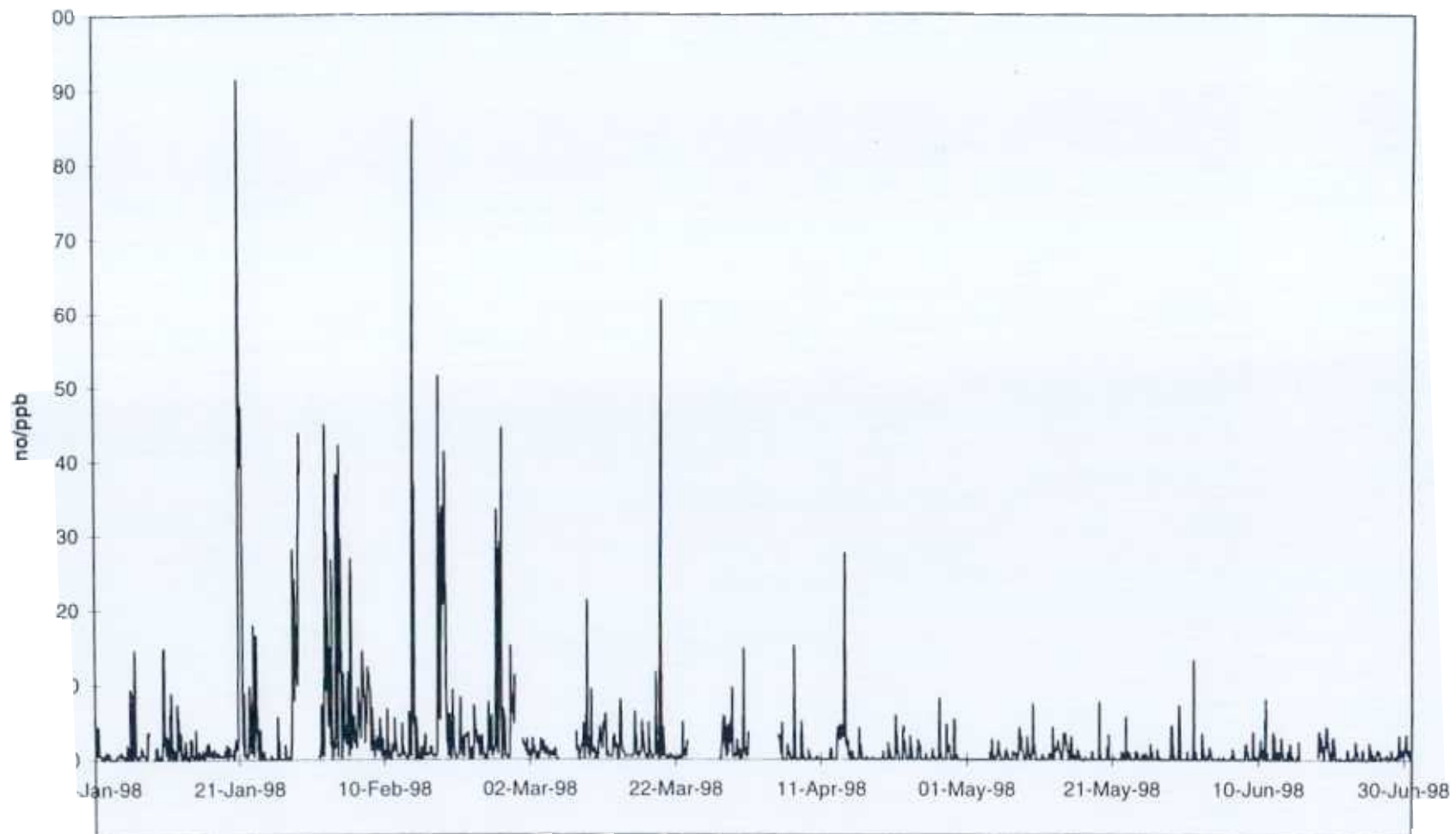
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Teddington 998



Wicken Fen 998



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data capture 90%