



KING'S
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Site Operation & Data Validation

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Site Operation

Local Site Operator (LSO) is core to whole process

- Most frequent visitor to site
 - *25 LSO calibrations per site (>4000 sent to us in 2006)*
 - *2 Services*
 - *1 - 4 Audits*
 - *Repair visits (<2 per instrument on average 2006)*
- Provides the results which scale the whole data set
- Audits/Engineers visits only snap shots – it's the LSO calibrations which provides the history of response
- Can report on local influences, building works, road works etc

Small local issue at Greenwich 7



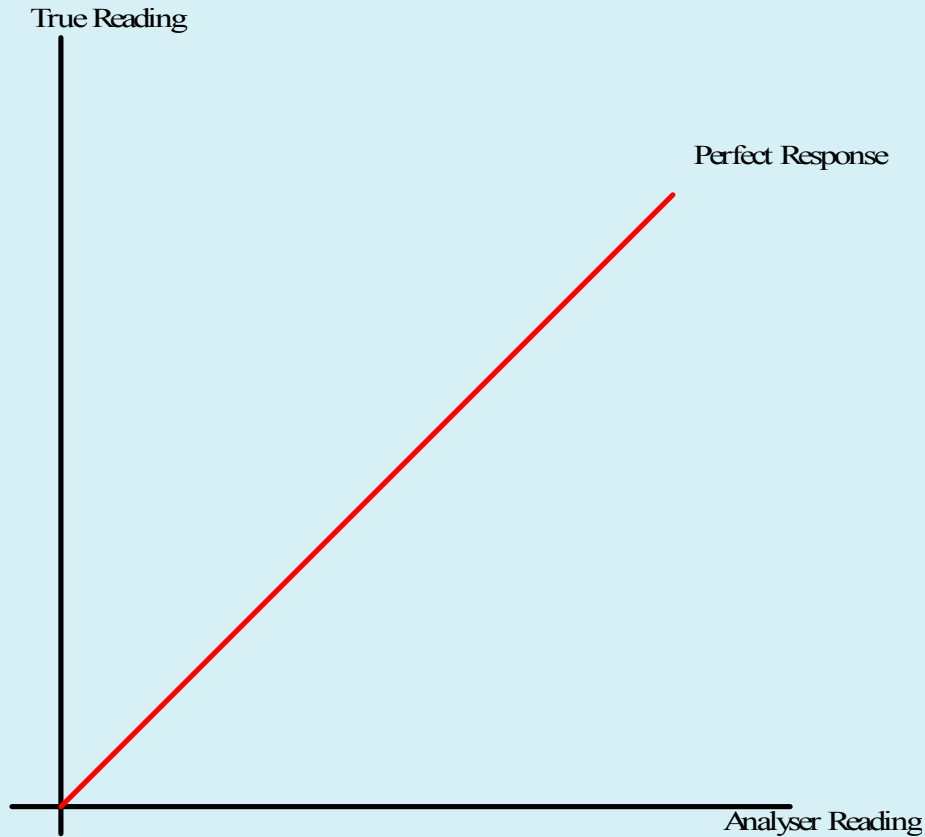
Advantages of a human on site

- Site Operator's Tools
 - *Brain*
 - Identify and investigate if something unusual
 - *Eyes*
 - Spot unstable readings
 - *Ears*
 - Hear pump bearings failing
 - *Nose*
 - Smell ozone scrubber failure
 - *Skin*
 - Feel if it's too hot or cold.

What is involved in a site visit ?

- Ensure site working normally as found
 - *Site not physically damaged*
 - *Power on*
 - *Site at right temperature (are you comfortable? low 20s)*
 - *Communications working*
 - *Sampling system intake working*
 - *Ambient readings look sensible (Location & Weather)*
 - *Analyser within parameters (Diagnostics Check) and no faults*
 - *Date and Time correct (GMT)*
 - *Regulators and gas cylinders OK*
- Confirm analyser's response
 - *Baseline/Zero*
 - *Response to calibration gas*
- Provide routine service
 - *Cleaning of PM sampling head*
 - *Replacement of filters*
- Ensure site working normally as left
 - *Analyser within parameters (Diagnostics Check), sampling and no faults*

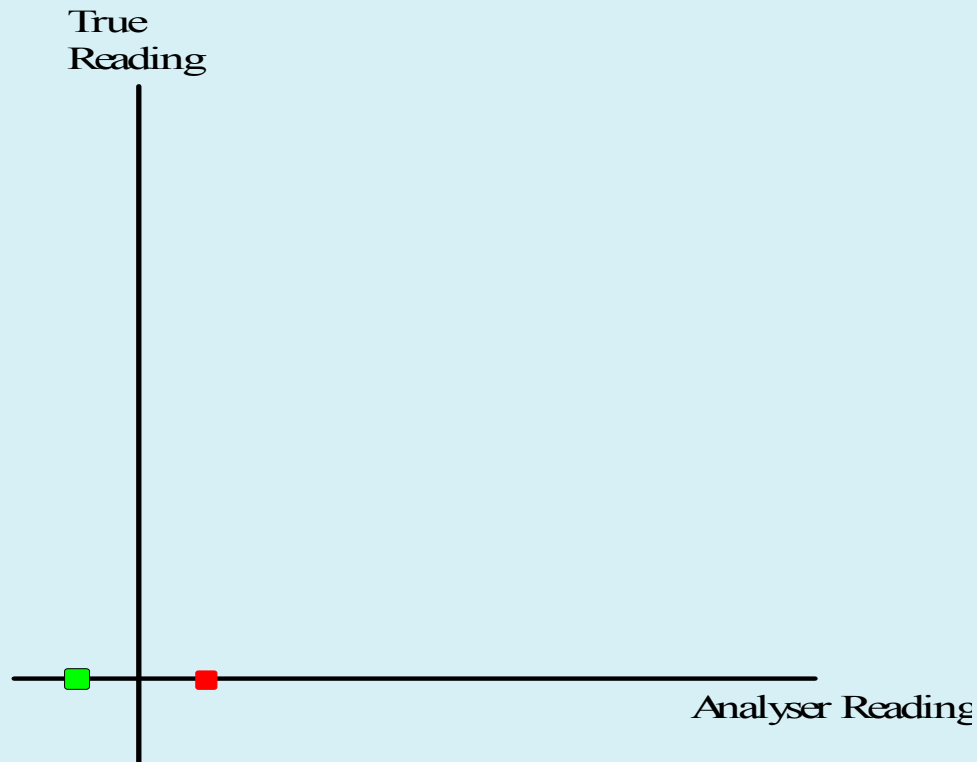
Perfect Analyser Response



- Ideal 1:1 response going through zero
- Never achieved other than immediately following a good service
- LSO calibration provides the real response

Baseline Establishment

1. Activate zero system (Scrubber/Zero air cyl.)
2. Disconnect sample line and connect scrubber
 - Result may be +ve or -ve



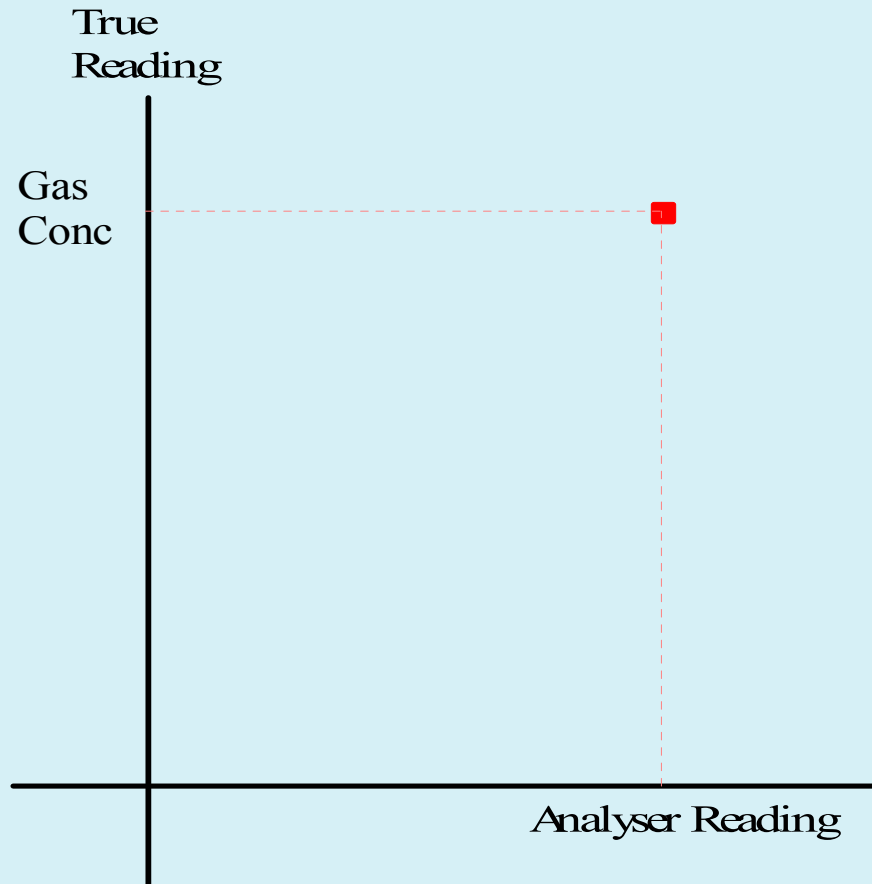
Baseline Establishment

HINTS:

- Ensure you are actually using the zero source
 - *If using zero air watch the regulator gauge while enabling zero.*
- How does baseline relate to ambient ?
 - *Roadside \Leftrightarrow Baseline $<$ ambient*
 - *Background/Rural \Leftrightarrow Baseline $< \cong$ ambient*

Span gas response

1. Activate automatic span system which uses gas cylinder (except O₃)
2. Disconnect sample line and connect span gas cylinder

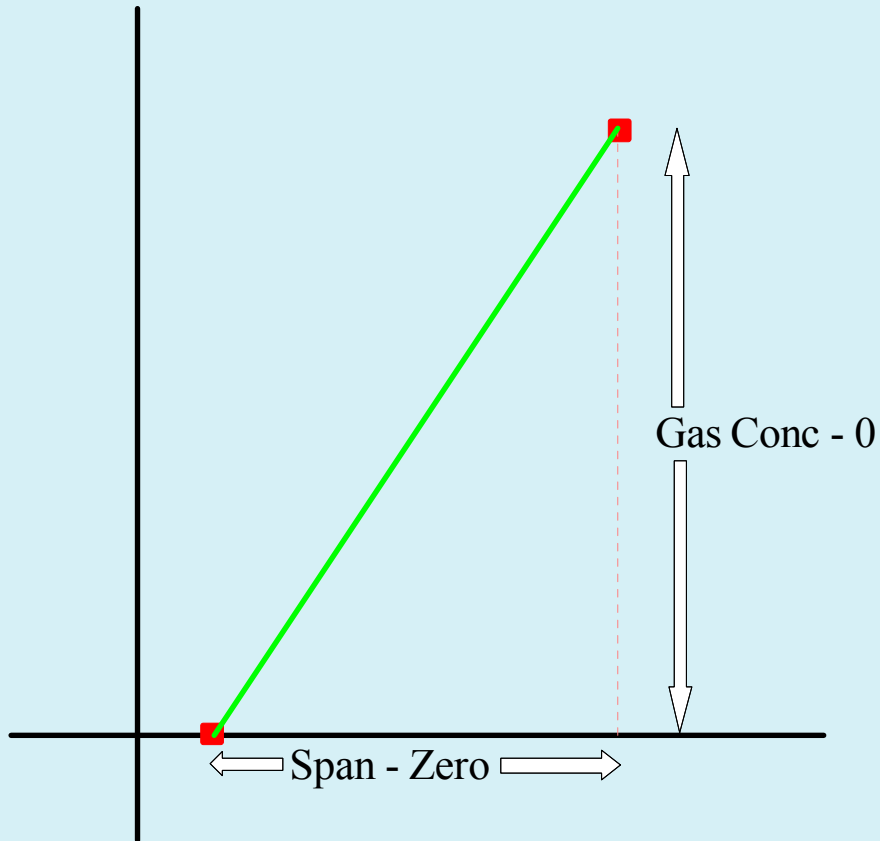


Span Gas Response

HINTS:

- Check you are actually using gas source & it's on.
 - *watch the regulator gauge while enabling span.*
- Check outlet gas pressure is sufficient for your system , usually 1.5-2.5 bar
- Check response recorded is to correct gas
 - *check you are not using the permeation tube if fitted*
- Response >> Zero
- Response > Ambient

Response Calculation



- Analyser response or Scaling Factor (SF)

$$SF = \frac{\text{Gas Concentration}}{\text{Span} - \text{Zero}}$$

- Need to know the correct cylinder !
- “True” reading = (Analyser Reading - zero) * SF

The NO₂ Issue

NO_X analysers only measure NO not NO₂

- So how do they measure NO₂
 1. *Measure ambient NO*
 2. *Convert ambient NO₂ ⇌ NO*
- NO_X = NO + (NO converted from NO₂)
- Use NO gas to calibrate response of both NO_X & NO channels
- Can use NO₂ gas only to check efficiency of NO₂ ⇌ NO conversion (also checked at audit)

Particulate Analysers

- No calibration by LSO
 - *Diagnostics to check working correctly as found*
 - *Routine inlet cleaning*
 - Use correct products
 - Water, cotton buds, lint free wipes, silicon grease
 - **NOT** toilet roll and Vaseline
 - A dirty inlet head leads to erratic data
 - *Routine replacement of filters or tape*
 - *Diagnostics to check working correctly as left*

HINTS:

- TEOM
 - *Seat filter with “the weight of a large orange”*
 - *Noise should be ≤ 0.050*
- FDMS
 - *Only difference in routine operation is that there is an additional filter which needs changing.*
- BAM
 - *Ensure tape wrapped around central core a couple of times not just taped on.*

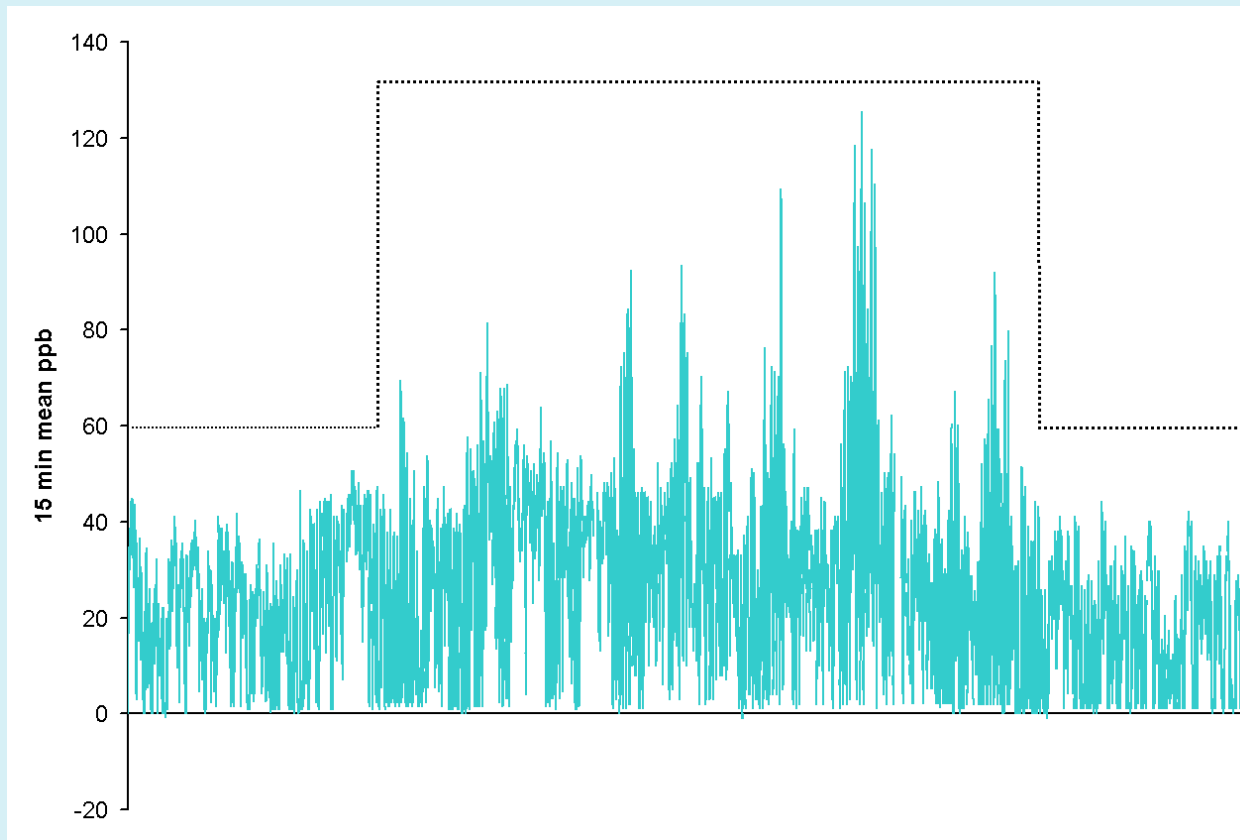
Data Validation

- Automatic scaling and sensibility checks
- Manual checks of every data point

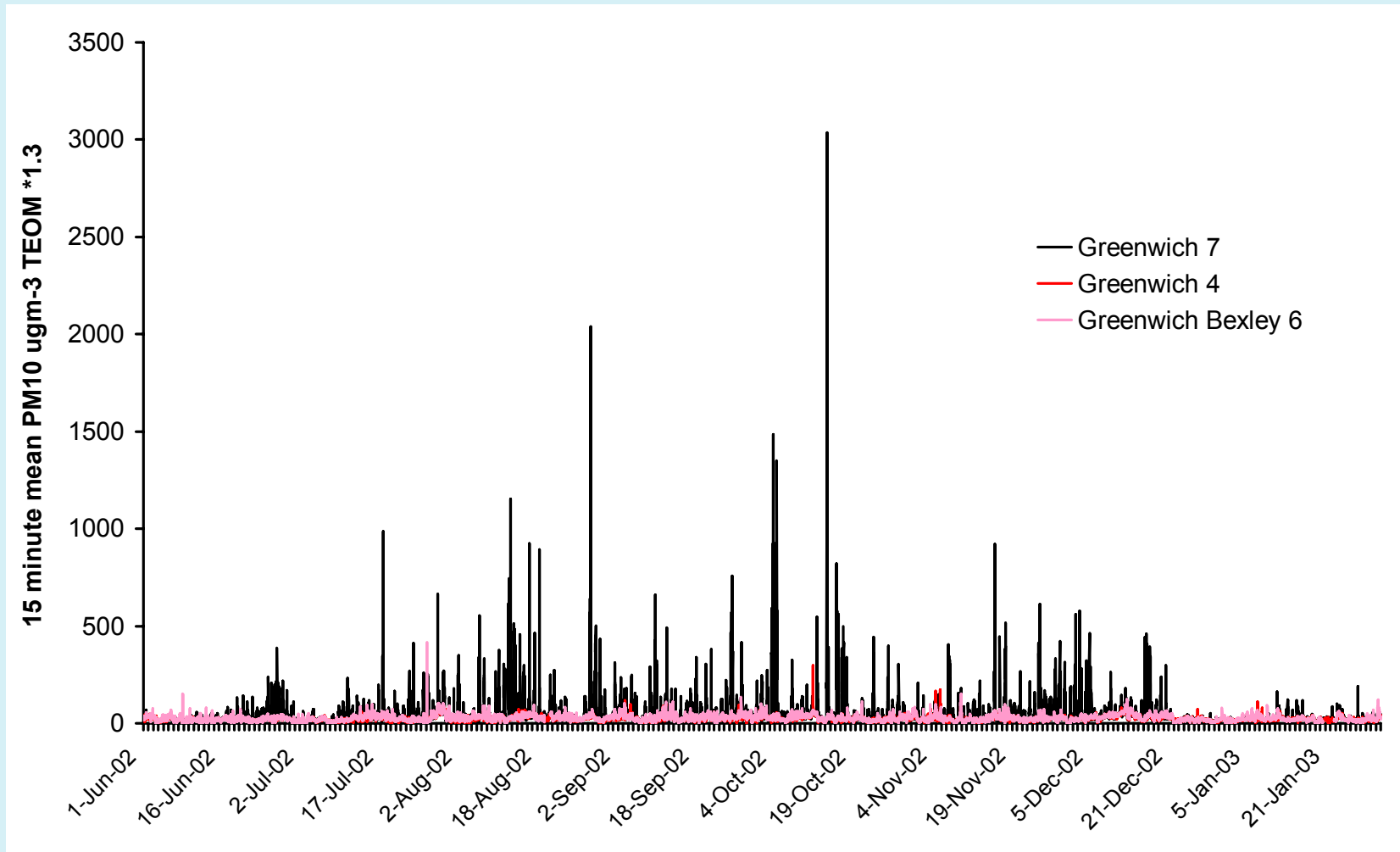
Data Validation - automatic

1. Within normal range checks and logger range adjustments
 - *e.g CO 0-50 ppm, NOX 0-1000 ppb logger range*
2. Application of automatic analyser error flags
3. Application of calibration factors
4. Scaled data now in database
5. Sensibility checks
 - *Within sensible range for season*
 - *CO, NO₂, O₃ compared to network average*
 - *Absolute peaks*
 - Difficult to not 'catch' real peaks
6. Data now appears on hourly web pages and hourly data feeds

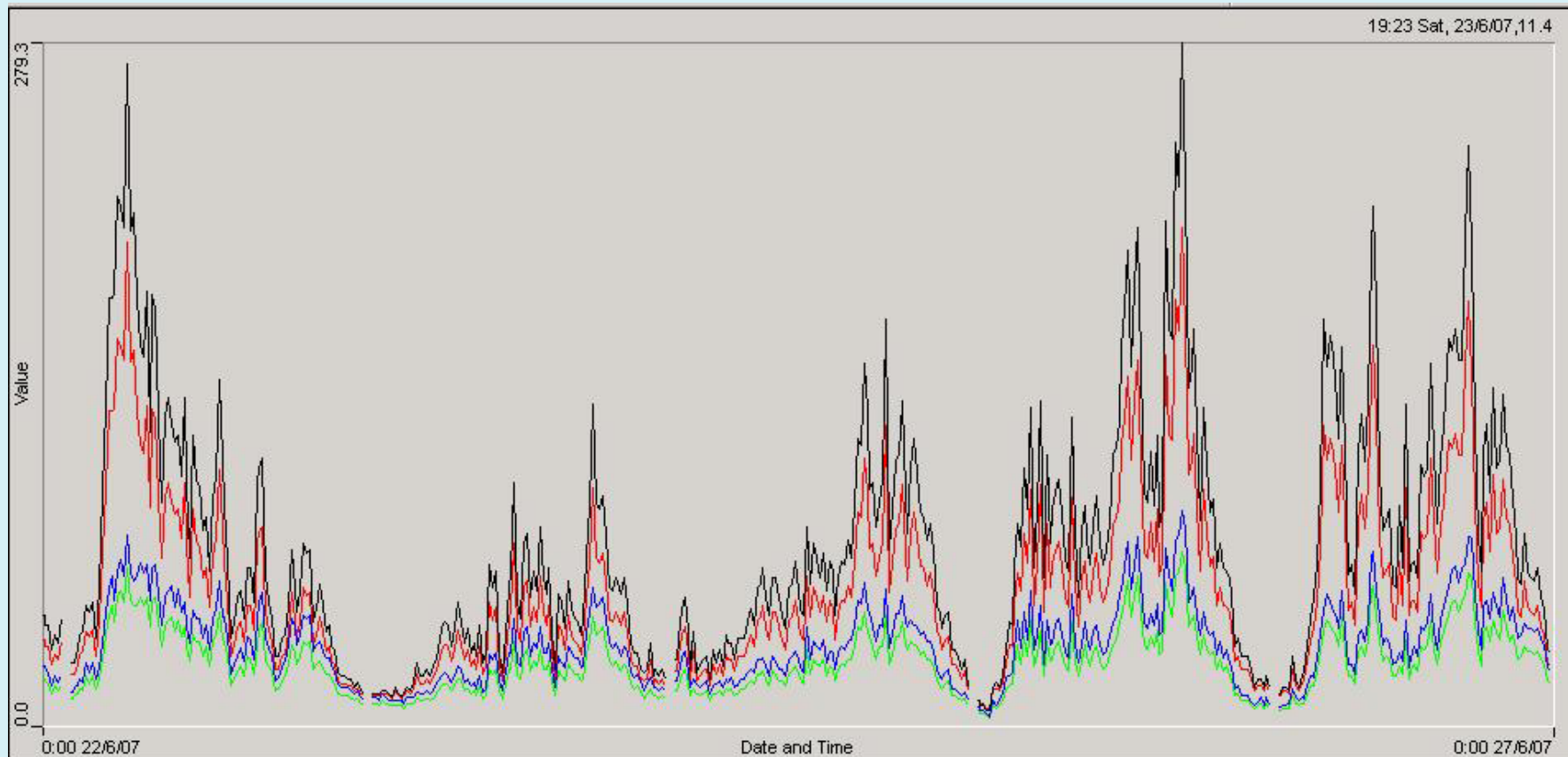
Automatic Sensible Range Checks – Seasonal O₃ at Sevenoaks Scaled measurements 2003



Automatic Checks – Peaks, PM₁₀ at Greenwich 7



Automatic Checks – Scaled NO_2 at Swiss Cottage

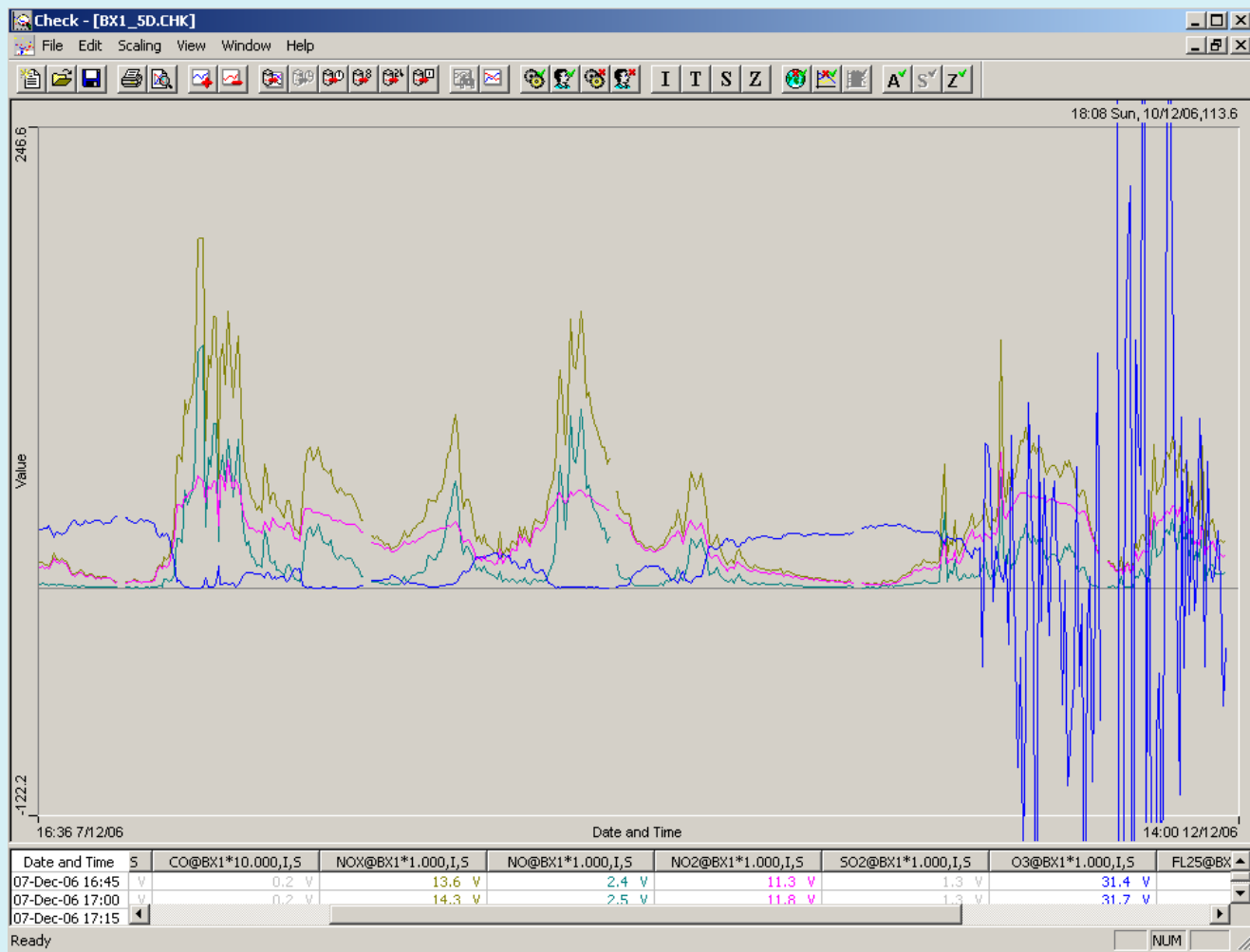


Date and Time	NOX@CD1*1.000,I,R	NOX@CD1*1.000,I,S	NO2@CD1*1.000,I,R	NO2@CD1*1.000,I,S
25-Jun-07 16:15	68.0 V	90.3 V	33.0 V	41.9 V
25-Jun-07 16:30	89.0 V	119.5 V	40.0 V	50.5 V
25-Jun-07 16:45	62.0 V	82.0 V	30.0 V	37.9 V
25-Jun-07 17:00	67.0 V	88.9 V	31.0 V	39.0 V
25-Jun-07 17:15	152.0 V	207.0 V	59.0 V	73.4 V
25-Jun-07 17:30	120.0 V	162.6 V	50.0 V	62.7 V
25-Jun-07 17:45	117.0 V	158.4 V	45.0 V	55.6 V
25-Jun-07 18:00	175.0 V	239.0 V	62.0 V	76.0 V
25-Jun-07 18:15	162.0 V	220.9 V	63.0 V	78.5 V

Data Validation - manual

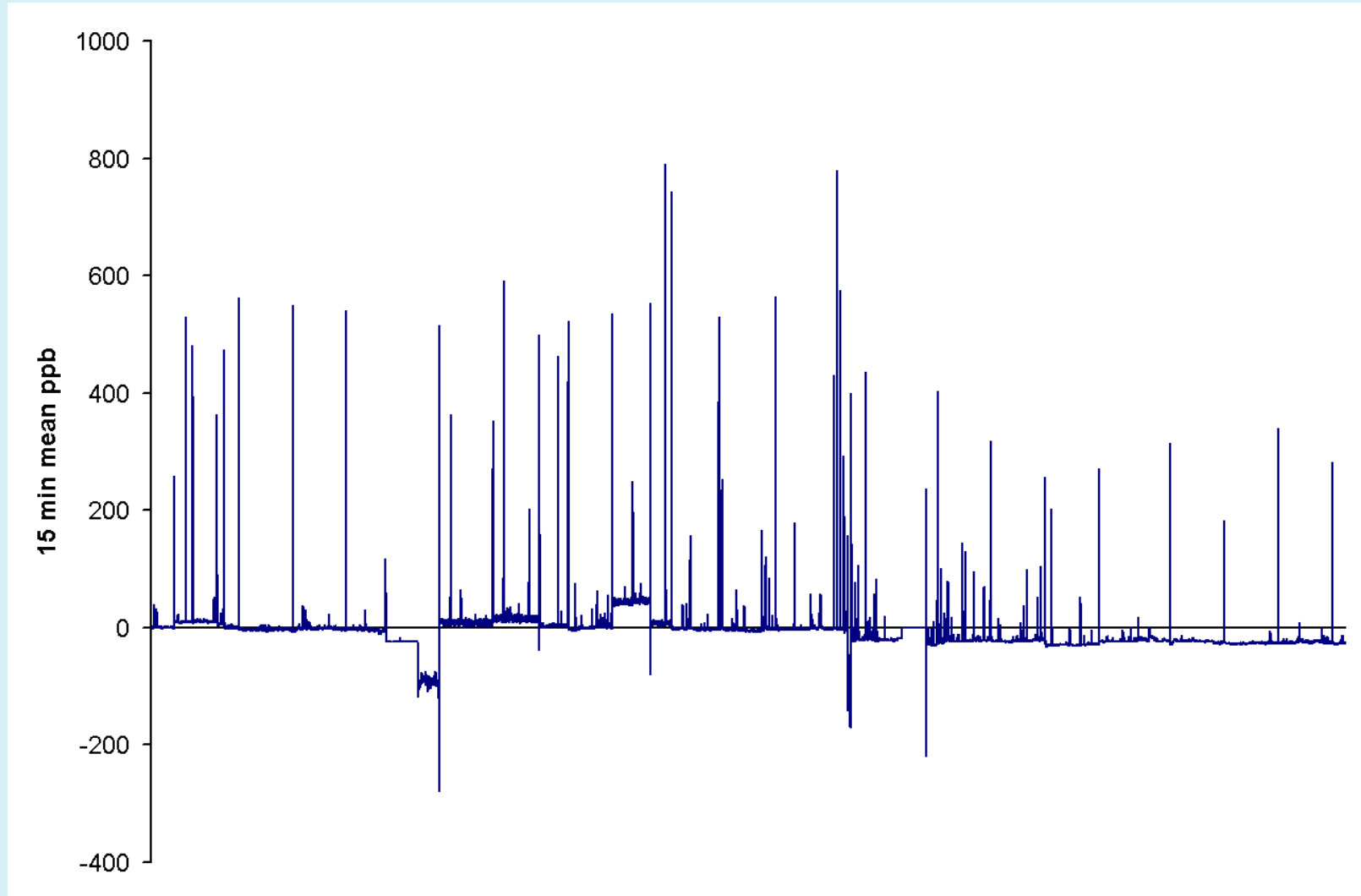
1. Manual check every morning
 - *Diurnal variation*
 - *Matches meteorology*
 - *Pollutants at each site tracking each other as we would expect*
 - e.g.
 - $\text{NO}_2 \downarrow$ when $\text{O}_3 \uparrow$
 - O_3 and PM_{10} rising during photochemical episodes
 - *Behaviour compared to other sites in networks*
 - may be compared to 5 or more other sites on a daily basis
 - on Sunday compared with all similar local sites, e.g. all roadside NO_2 sites in NW London
 - *Knowledge of local issues*
2. User confirms or sets data status flags
3. Data now disseminated for daily web page, weekly reports, web graphing

Data Validation – how we see it



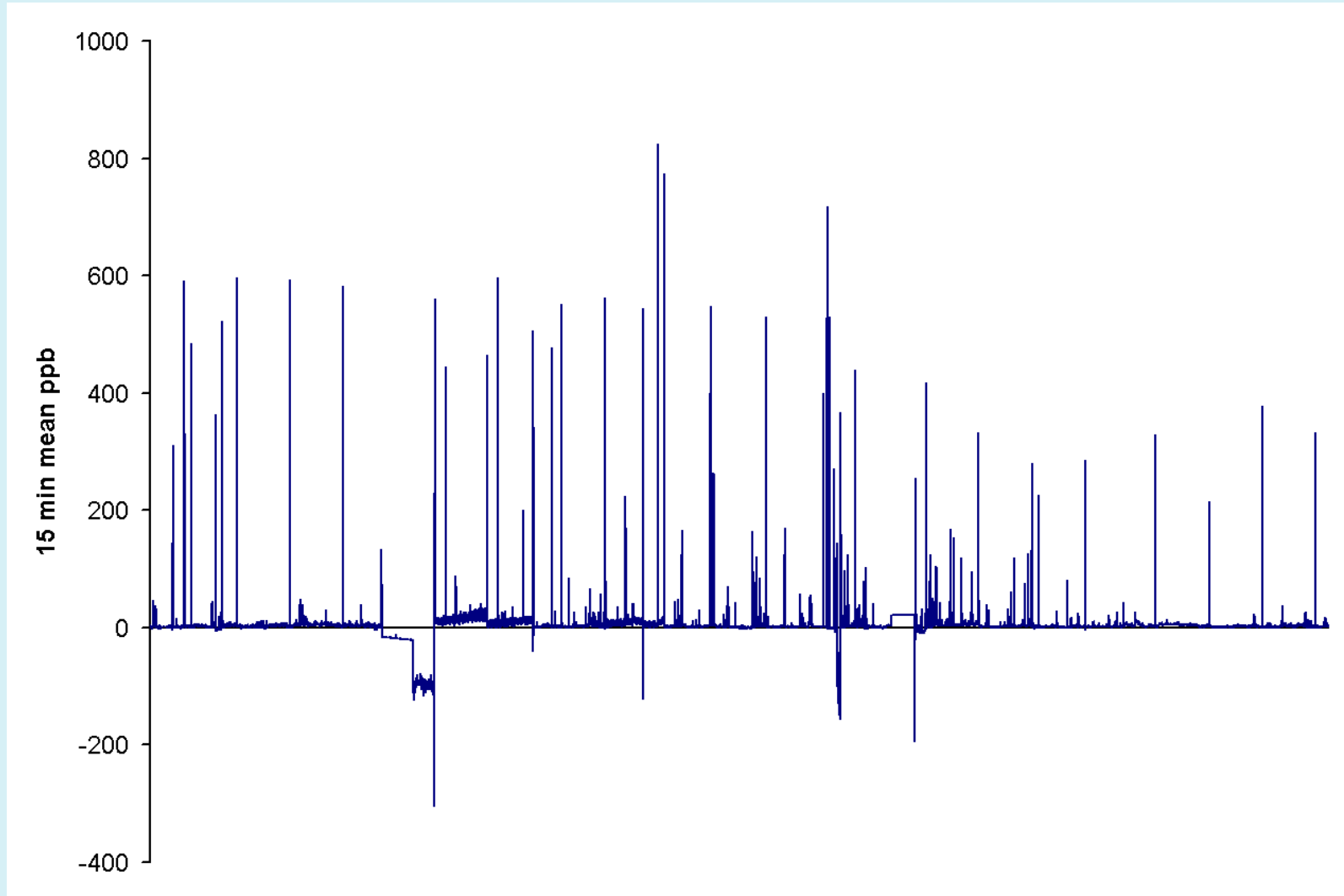
Data Validation – SO₂ at Bedford

Raw measurements 2005



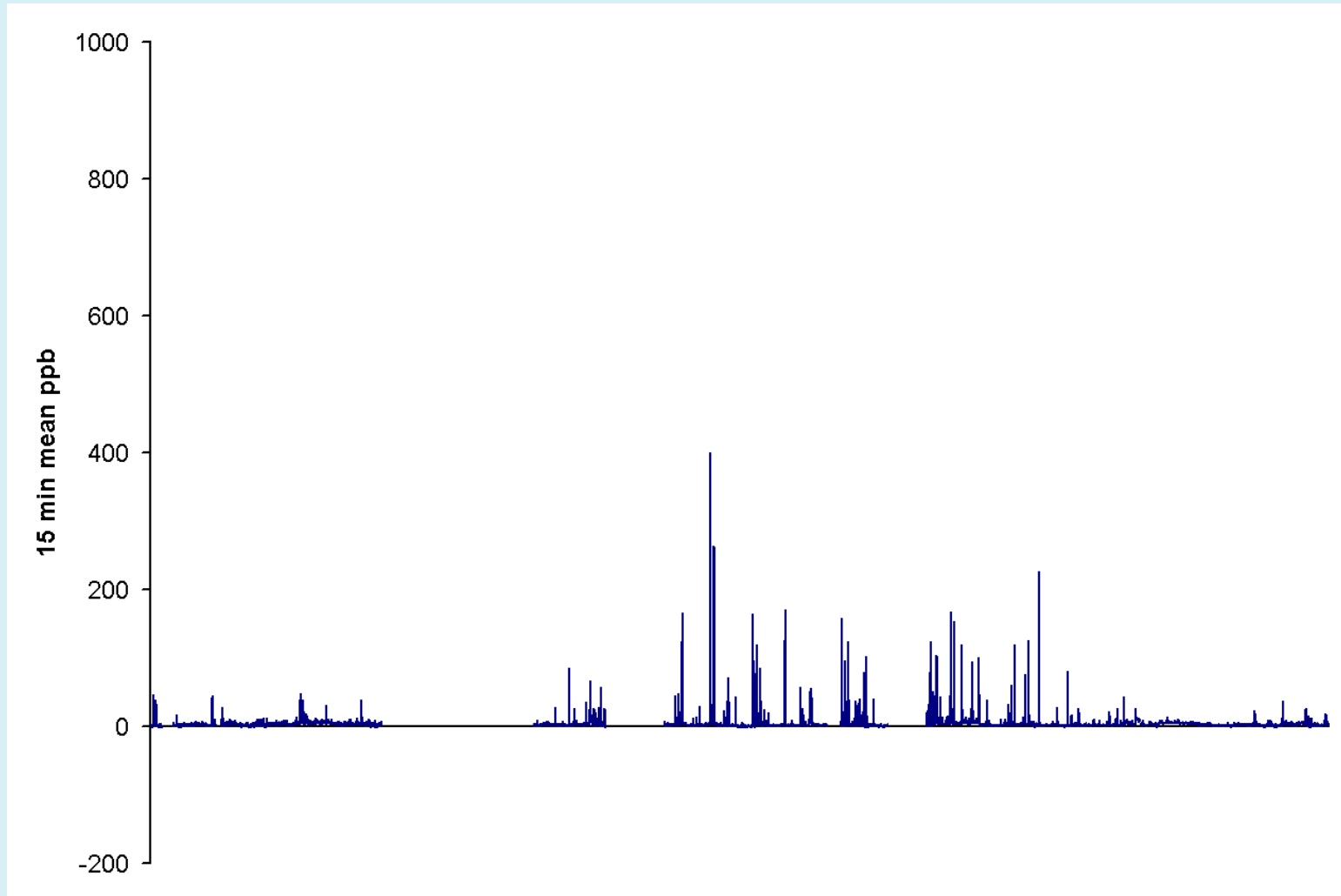
Data Validation– SO₂ at Bedford

Scaled measurements 2005



Data Validation– SO₂ at Bedford

Scaled valid measurements 2005



Summary

- Site Operator calibrations are vital – scaled data can not be produced without them.
- Only someone on site can fully identify local issues.
- Data needs to be filtered and scaled before it is meaningful.