Ricardo
Energy & Environment

PM analyser replacement

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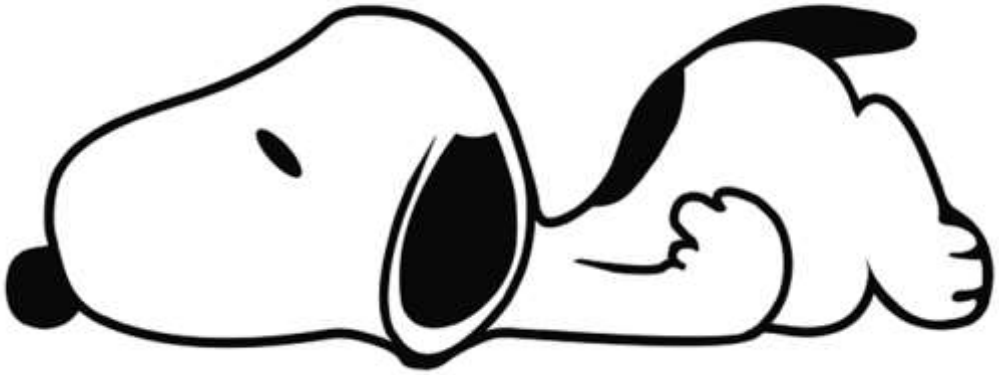
SAQD annual seminar, 12 Feb 2019

Agenda

- The problem with changing analysers
- 2 specific examples: Noise and analyser limitations
- What does this mean for you?



Buying a new analyser brings interesting challenges

If you're buying a new analyser, it's likely to be replacing an OLD one, or because you can measure $PM_{10/2.5}$ with a single analyser.

- The performance of the old analyser is probably poor
- The operating principles (especially for PM analysers) might be significantly different
- Established QA/QC vs learning new procedures

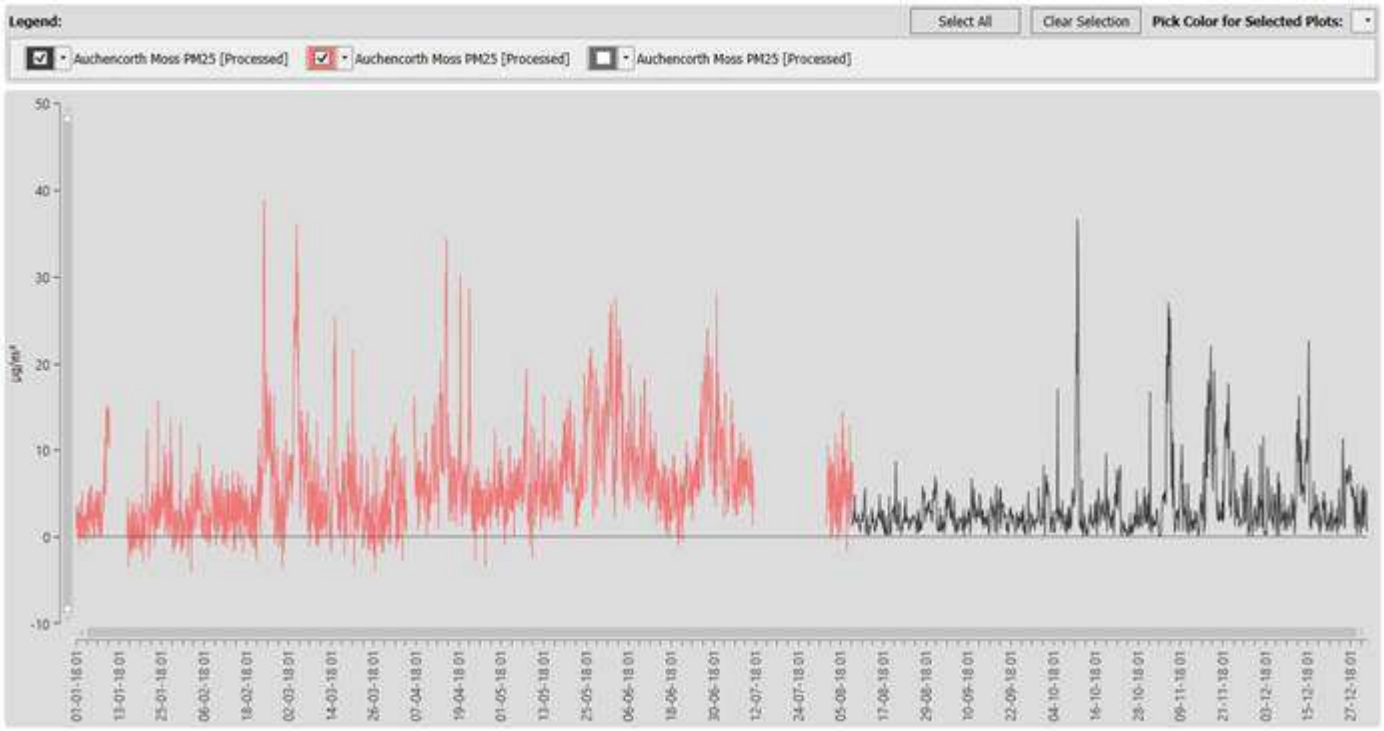
Noise

Auchencorth Moss, before and after.

FDMS – where's the baseline?

Work within 3 µg/m3 baseline

Positive bias between old and new – maybe up to 3 µg/m3

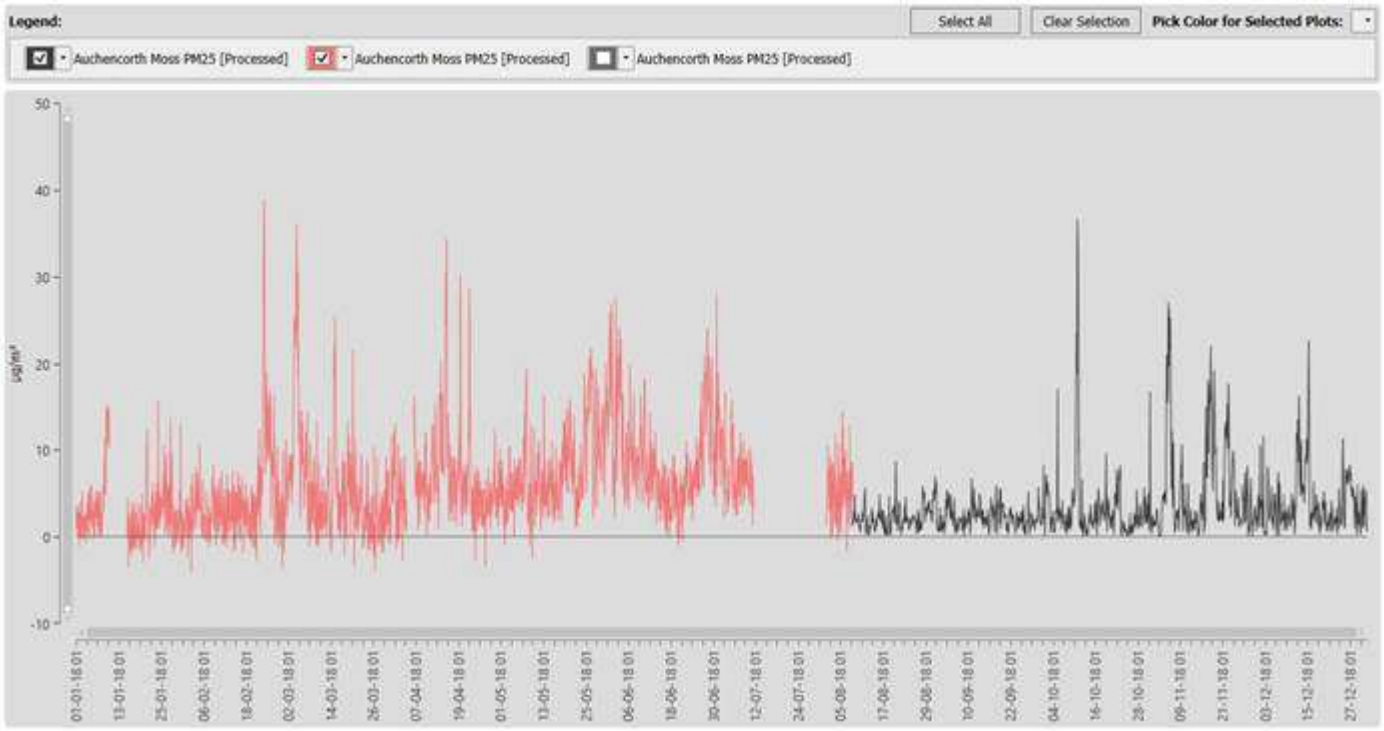


Noise

Not unique to PM – was also seen for SO_2 and CO

Have to accept data is different, draw a line and move on.

But keep the differences in mind for later…



FDMS average Jan – Jul 6.4 µg/m^3
FIDAS average Aug – Dec 3.4 µg/m^3

Analyser limitations

FDMS – extraordinarily temperamental… but it measures the mass collected directly

BAM – fairly temperamental! Quite sensitive to moisture and questions about response to different particles

FIDAS – quite well behaved, but uses optical method to measure particles… may cause underestimation

Analyser limitations BAM

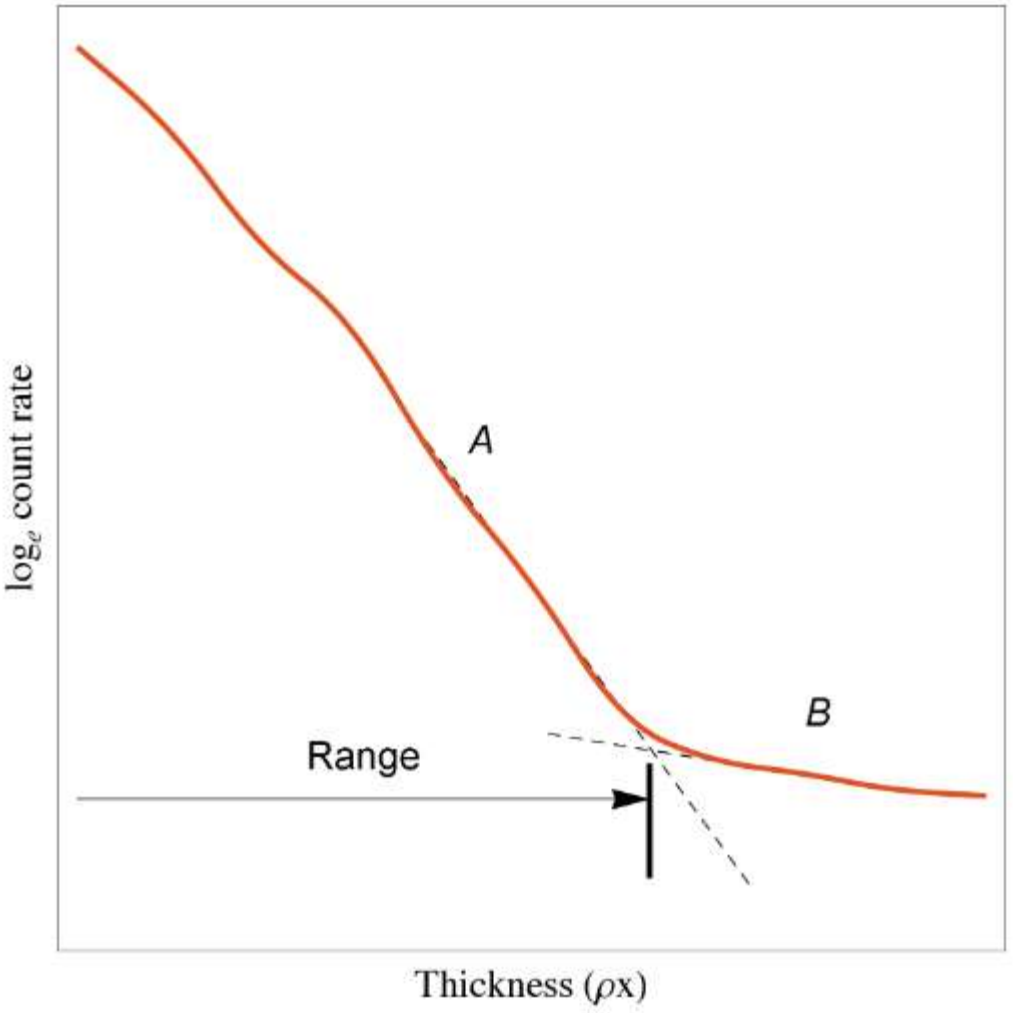
Samples onto a filter for 40 to 50 minutes every hour, then 10-20 minutes analysing the sample.

Very sensitive to absorbtion of water on filter (heated inlet important)

May become non linear at high concentrations / denser particles

Challenges with persistent leaks

Signal output can be very noisy

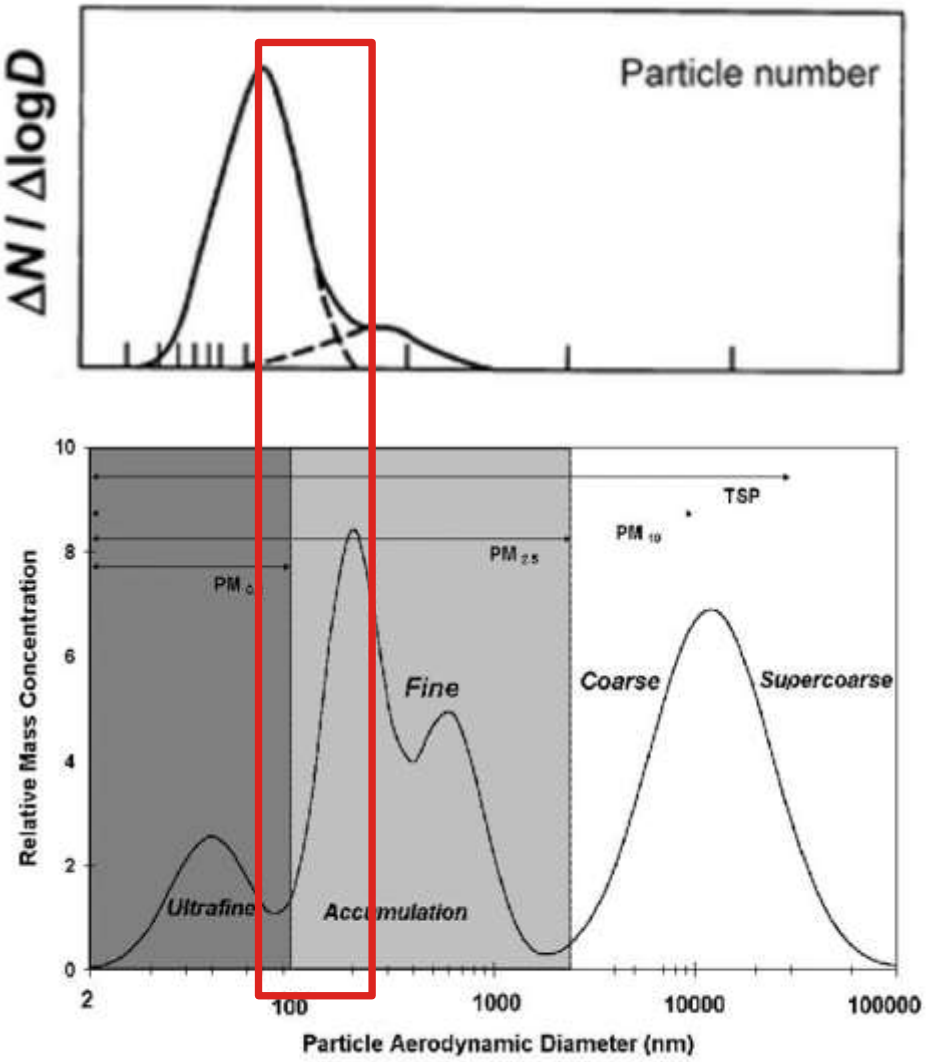


Analyser limitations FIDAS

Analyser counts particles in the size range 0.18 to 18um in lots of different size bins

Assumes particles are a predetermined shape, colour and density in each bin.

Assumes a contribution of particles <0.18um to the total mass



Comparison studies, 2017/2018

Exploring relationships between FDMS, FIDAS and BAM at:

- Kerb (MRD)
- Road (Brum A4540)
- UB (N.Ken)
- Industrial (PT)

Interesting findings…

Focus on FIDAS.

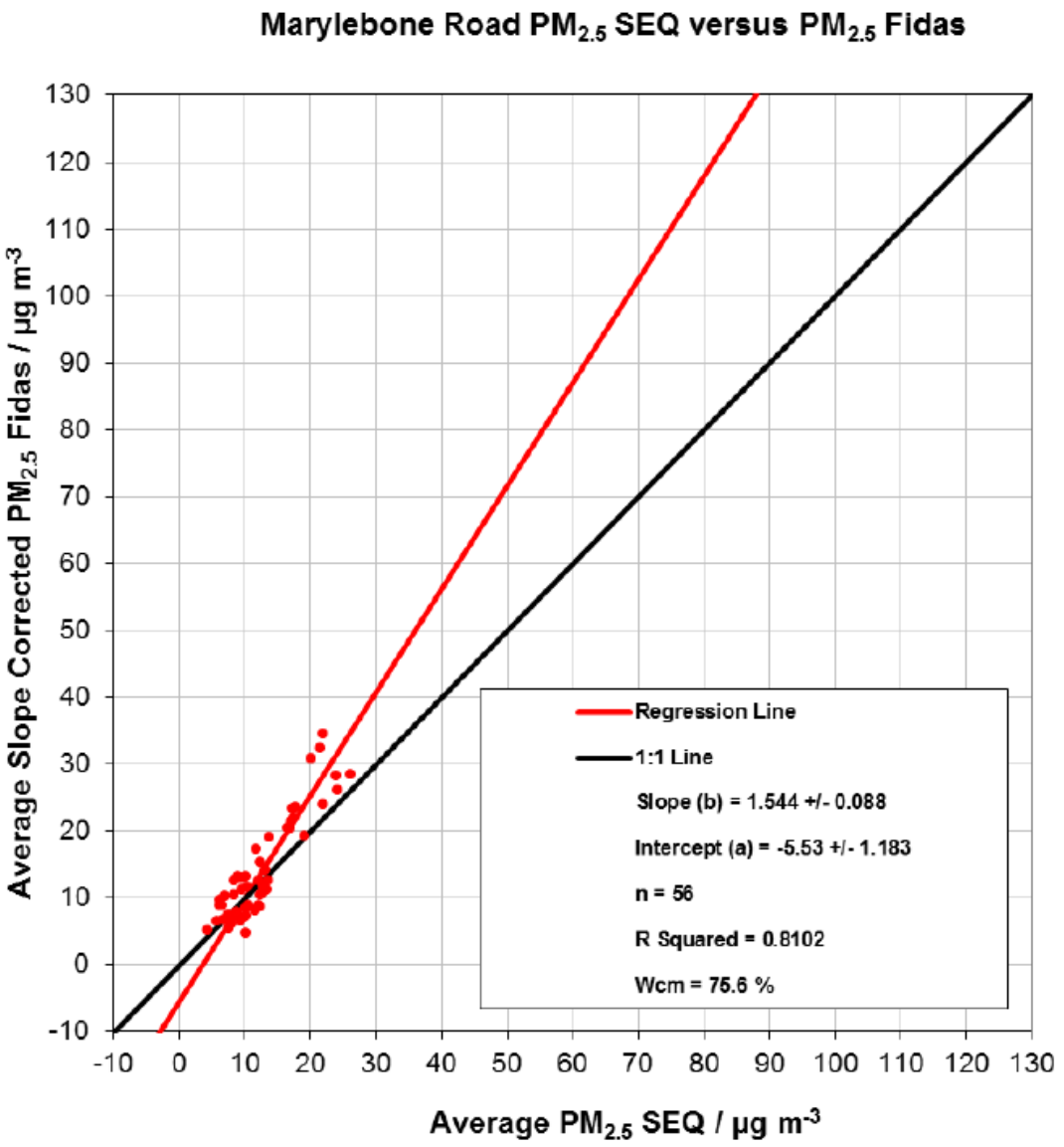
FIDAS comparison study, 2017/2018 (2)

Found that UB comparison is OK for PM_{10} and $PM_{2.5}$

PM_{10} is OK at MRD, but $PM_{2.5}$ shows FIDAS underreads compared to Reference and FDMS.

Seems to be due to the FIDAS not measuring the finest particles, which has most effect on the $PM_{2.5}$ fraction

(good correlation with BC concentrations)



FIDAS comparison study, 2017/2018 (3)

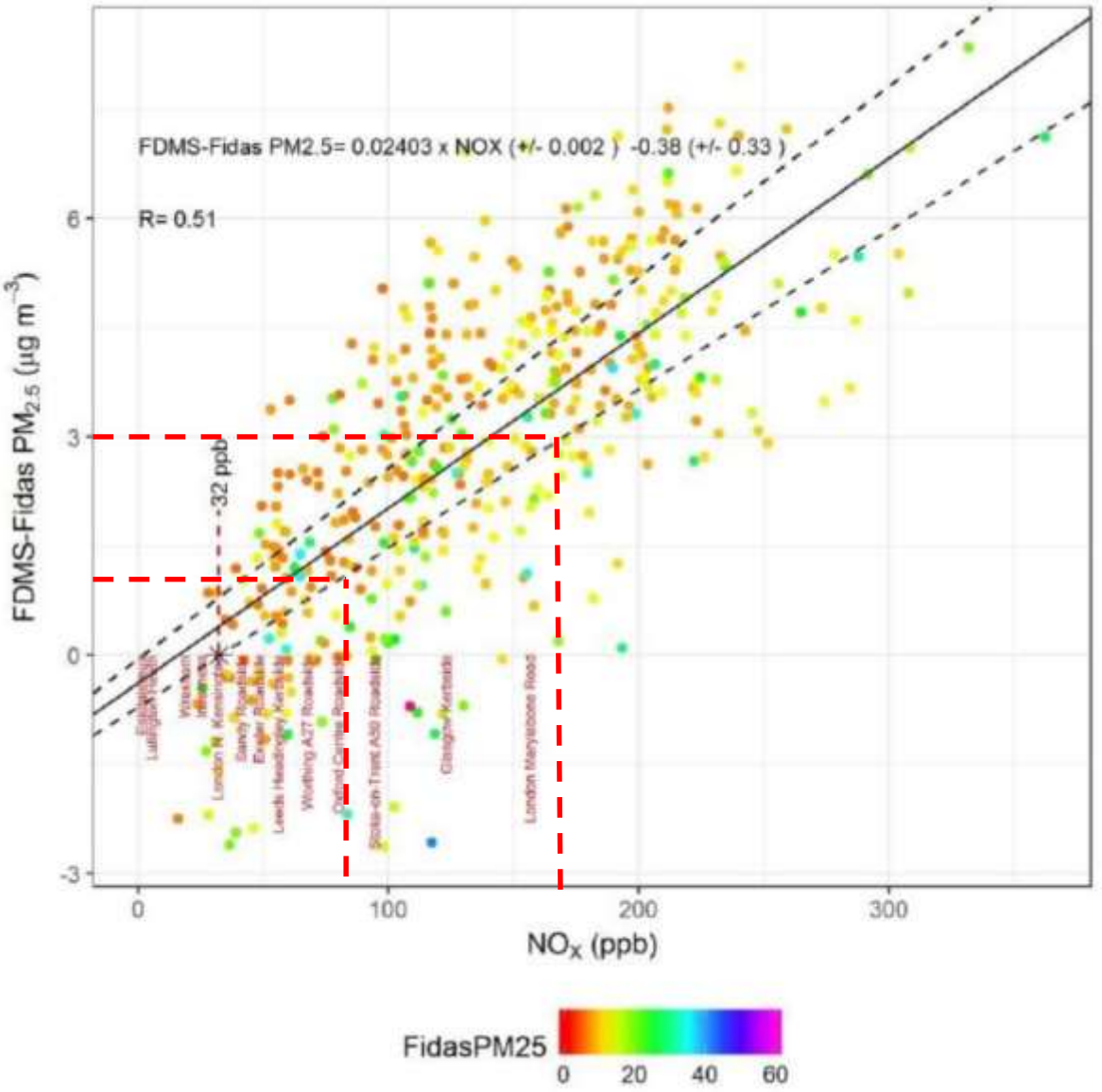
Relationship between apparent underread and NOx concentrations at station.

Plot shows if NOx below 32ppb, FIDAS and FDMS are statistically indistinguishable.

(But lots of uncertainty around this, and work is ongoing).

e.g. Birmingham A4540 NOx in 2017 was 60ppb, but no difference between FIDAS and FDMS.

Proximity to road most important? Need more info…



New FIDAS analysers – what to do?

If annual mean NOx is below ~60ppb, very unlikely that "missing" particles will have a significant effect on measured concentrations.

More likely that clearer zero processing is the major contributor to drop in concentrations.

Site	Ann. NOx ppb (2018)
South Lanarkshire Rutherglen	52
Aberdeen Wellington Road	55
East Dunbartonshire Bearsden	57
Dundee Meadowside	58
Dundee Lochee Road	59
Inverness Academy Street	59
Perth Atholl Street	61
Falkirk West Bridge Street	63
Dundee Seagate	64
Edinburgh Nicolson Street	68
Edinburgh St John's Road	68
Edinburgh Queensferry Road	71
Glasgow Kerbside	103

PM_{10} revocation?

Recommendations:

- If a Local Authority has the appropriate amount of historic data showing that they are consistently measuring PM_{10} concentrations well below the annual objective, and this was measured with instruments other than FIDAS, then they can proceed with applying for revocation.

- If a Local Authority has historical FIDAS PM_{10} data below 14 µg/m^3 and prior to FIDAS monitoring, PM_{10} is consistently below 18 µg/m^3, then they can proceed with applying for revocation.

(can't turn off the FIDAS if $PM_{2.5}$ measurements are still needed…)

- It would be interesting to run FIDAS / BAM / FDMS comparisons at Scottish sites, where co-location is possible.

Questions?