Experience of global small sensor co-location comparison studies and applications with AQMesh

Tom Townend
AQMesh Product Manager

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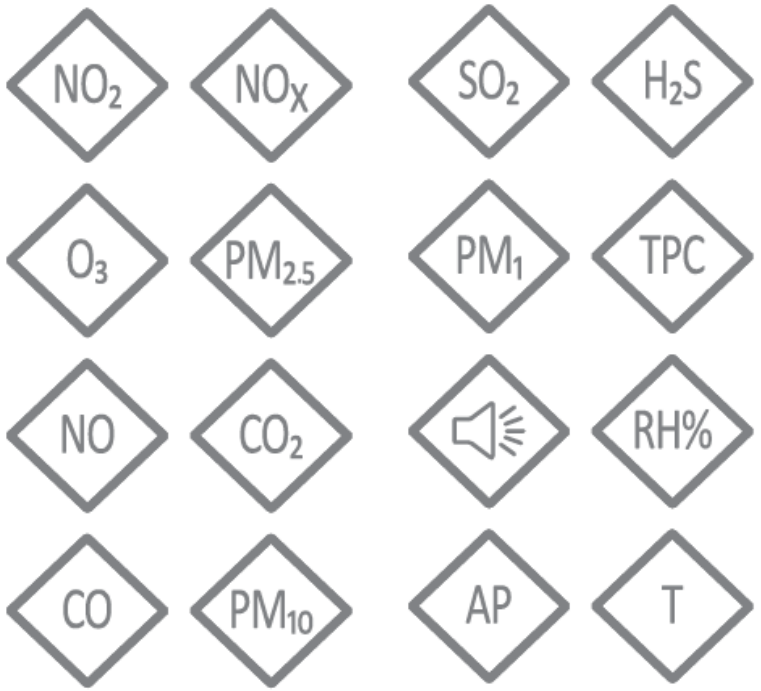
Market drivers for improving performance

- Be the best small sensor system on the market
- Consistent high performance will mean confidence in the product from a range of different users

AQMesh focuses on:

- Quality of data
  - Precision
  - “Out of box” accuracy
  - QA/QC
- Ease of use
  - Simple operation
  - Simple to achieve accurate, high quality data
- Customer support
  - Experienced and dedicated global distributor network
  - High quality and responsive technical support from AQMesh



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Challenges

- Expectations put onto small sensor systems
  - FEM quality data
  - Working in any environment consistently
  - Zero or minimal maintenance or calibration (scaling) requir
  - Very low cost
- Data confidence flags
  - Redacting data
- Repeatability
- Traceable processing
- Clarity for users vs. IP protection
- Differentiation from the competition

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Performance: DQIs we use

DQI		Why used
R^2	Pearson's co-efficient squared	Good indicator of precision of one data set to another. However, provides no indication of accuracy between the two. Can be skewed positively or negatively by a small number of outlying values
RMSE	Root Mean Square Error	Robust measurement of the deviation of the sample used, but not widely understood by the average user due to its method of weighting negatively any larger variances
MAE	Mean Absolute Error	Easy to understand for users without a high level of statistical knowledge, as a linear indicator of accuracy, i.e. not weighted

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Performance: DQIs we use

However, if not explained carefully all are potentially misleading based on…

- Sample size,
- Averaging interval,
- Data capture within averaging periods,
- Confidence in how data has been treated,
- Pollutant range measured,
- Etc.

We need industry wide agreement on how these or other DQIs are used for fair comparison of products

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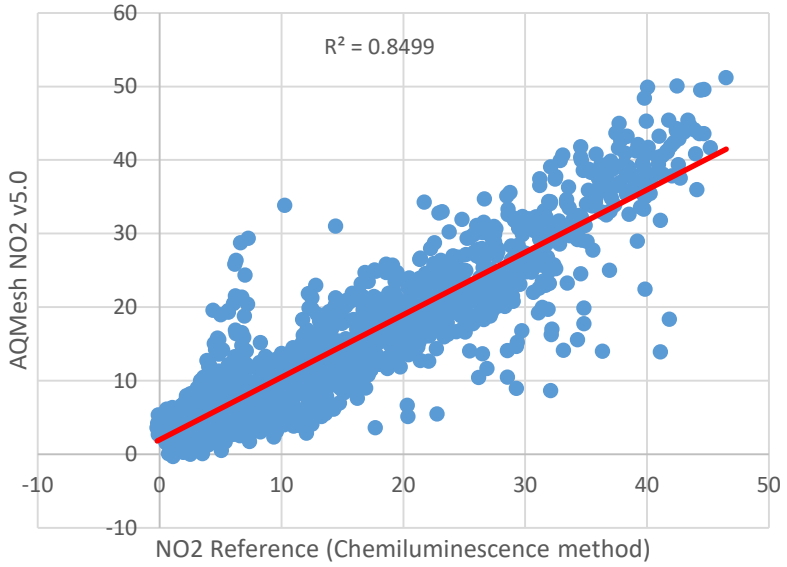
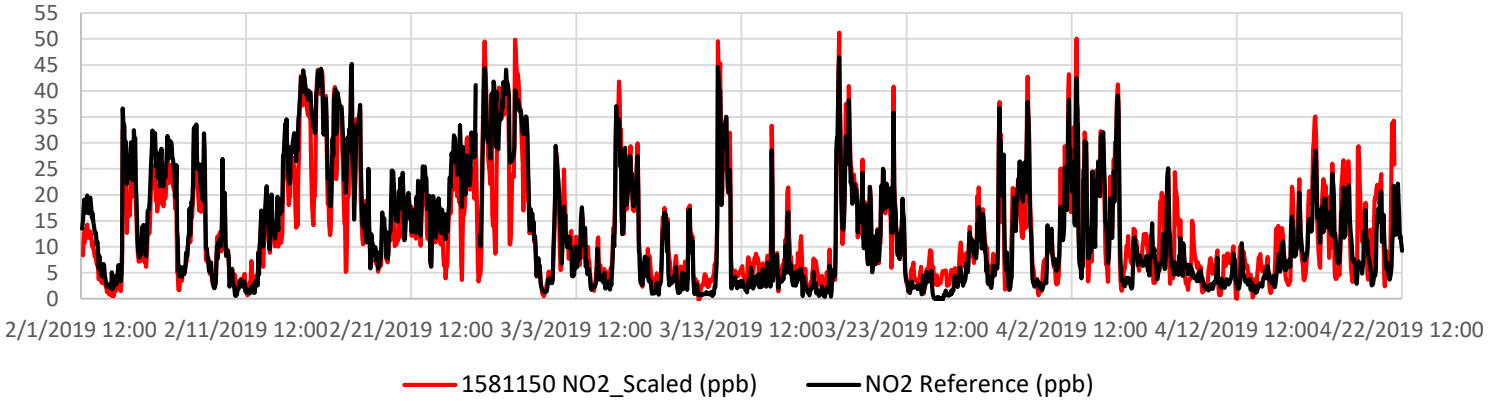
Co-location results – NO2 in Netherlands



- Tested over 3 months within 1m of reference inlet
- R2 of 0.85 to FEM (unratified)
- MAE of 3.06ppb
- RMSE of 4.29ppb
- Temperatures range from -2 deg C to +28 deg C



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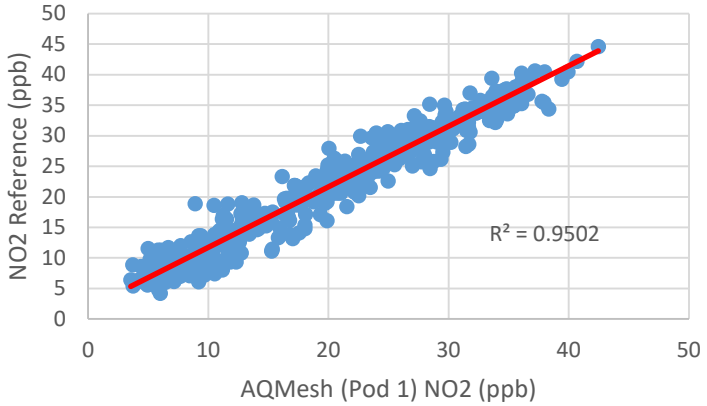
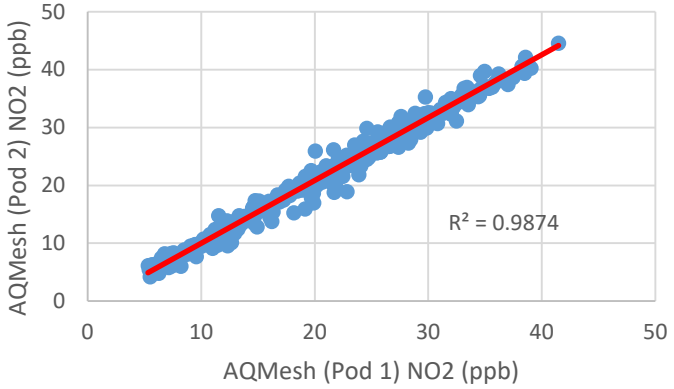
Co-location results – NO2 in San Bernadino

- Tested over 1 month within 1m of reference inlet
- R2 of 0.92 and 0.95 to FEM
- MAE of 2.14ppb and 2.23ppb
- RMSE of 2.78ppb and 2.74ppb
- Temperatures range from -2 deg C to +39 deg C





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Standards and certifications

Hopes

- Standards will provide differentiation between small sensor systems
- Will help set expectations for users and show what SSS are capable of
- Internationally recognized standards
- Defined rules for presenting DQI results

Fears

- Testing will be cost prohibitive to small sensor systems and their price point
- Expectations will be too high (FEM standard)
- Test process will not be suitable for SSS

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Potential developments

We will always look to make continual improvements to the data quality of our products and in the near future we will be focussing on: -

- Improvement of gas algorithm corrections below LOC – Gases <10ppb
- Better “out of box” accuracy in a wider range of environments and target gas levels, reducing the need for local “calibrations” – Gases and PM
- Make data QA/QC simple and robust for users so that data can be trusted by third parties therefore reducing the effort required with potentially very large amounts of data

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Thanks and Questions?

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