

European Network on New Sensing Technologies for Air Pollution Control and Environmental Sustainability - *EuNetAir*

COST Action TD1105

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New Sensing Technologies for Air Quality Monitoring

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PARTICULATE MATTER SMART SENSORS VALIDATION IN REAL-WORLD CONDITIONS



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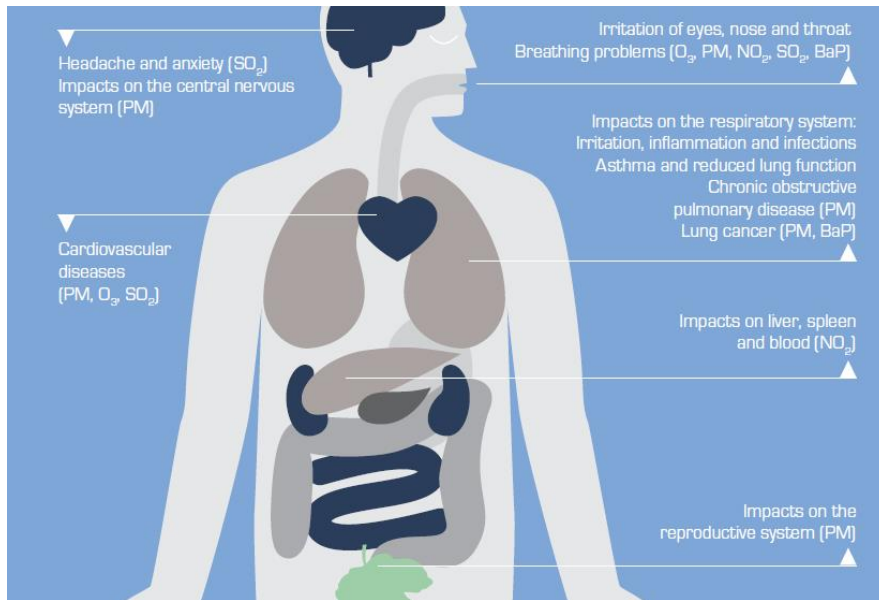
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 **cost**
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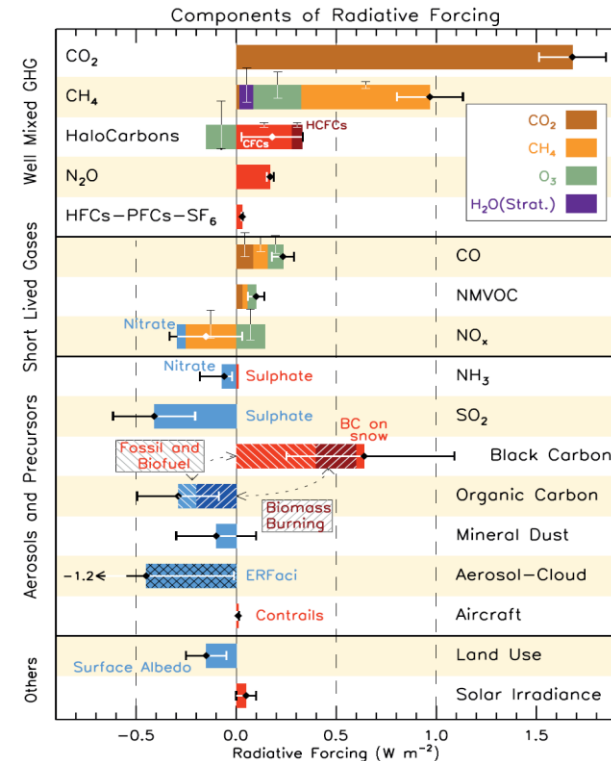


Motivation

- Particulate matter is a key pollutant for both health and climate impacts



EEA (2013)

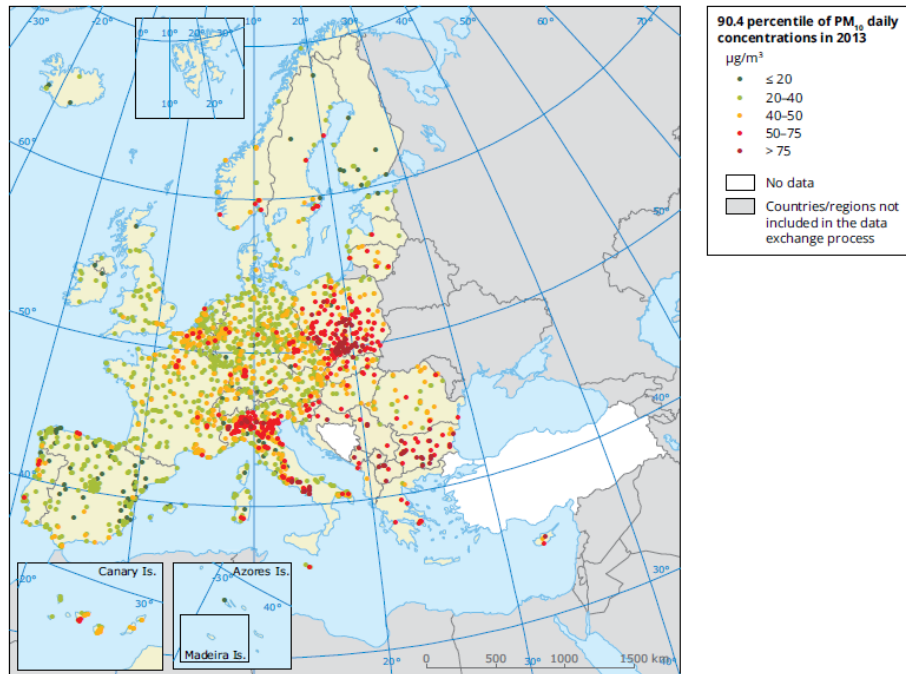


IPCC (2013)

Motivation

- Particulate matter is a key pollutant for both health and climate impacts

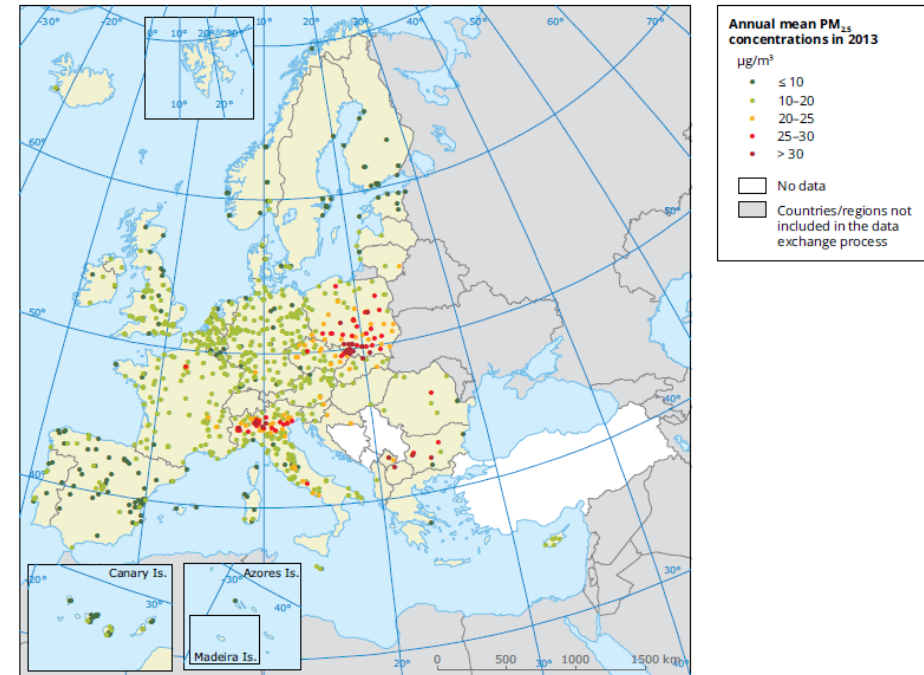
Map 3.1 Concentrations of PM₁₀ in 2013



Notes: The map shows the 90.4 percentile of the data records in one year, representing the 36th highest value in a complete series. It is related to the PM₁₀ daily limit value, allowing 35 exceedances over 1 year of the 50 μg/m³ threshold. The red and dark-red dots indicate stations with exceedances of this daily limit value. Only stations with > 75% of valid data have been included in the map.

Source: Based on Air Quality e-reporting database (EEA, 2015a).

Map 3.2 Concentrations of PM_{2.5} in 2013



Notes: The dark-red dots indicate stations reporting exceedances of the EU annual target value (25 μg/m³) plus at least 5 μg/m³.
The red dots indicate stations reporting exceedances of the EU annual target value (25 μg/m³).
The orange dots indicate stations reporting exceedances of the 2020 EU indicative annual limit value (20 μg/m³).
The light-green dots indicate stations reporting exceedances of the WHO AQG for PM_{2.5} (10 μg/m³).
The dark-green dots indicate stations reporting values below the WHO AQG for PM_{2.5} (10 μg/m³).
Only stations with > 75 % of valid data have been included in the map.

Source: Based on Air Quality e-reporting database (EEA, 2015a).

EEA (2015)

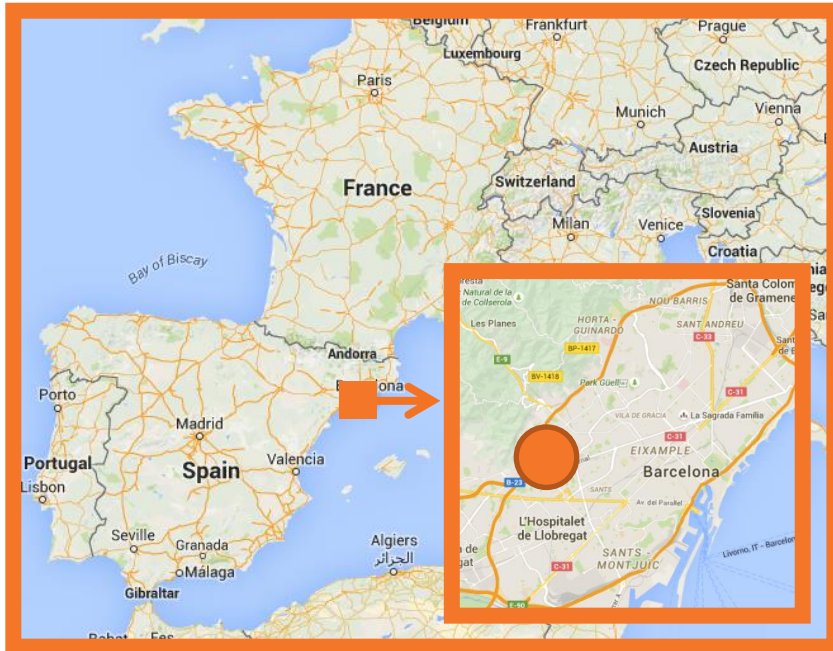
Motivation

- Particulate matter is a key pollutant for both health and climate impacts
- Research instrumentation is usually expensive, difficult to operate and limited to static operation
- Portable low-cost monitors and sensors are a useful tool to complement existing research instrumentation and air quality monitoring networks
- Assessment of their field performance found large divergences between sensor and reference data

AIM: assess the field performance of current low-cost sensors for particulate matter monitoring under real-world conditions

Methodology

- Urban background site in Barcelona, with aerosol concentrations typical of the urban background in the Mediterranean region.



Optical particle counter GRIMM 180, corrected with gravimetric PM



Methodology

- Sensors tested were laser-based sensors for particle number
- Inter-comparison exercises carried out for periods ranging between 1 month and >1 year
- Parameters evaluated: comparability between units, correlation with reference data, and stability over time

Dylos DC1700



Airbeam



Pod (AQMesh)



Results

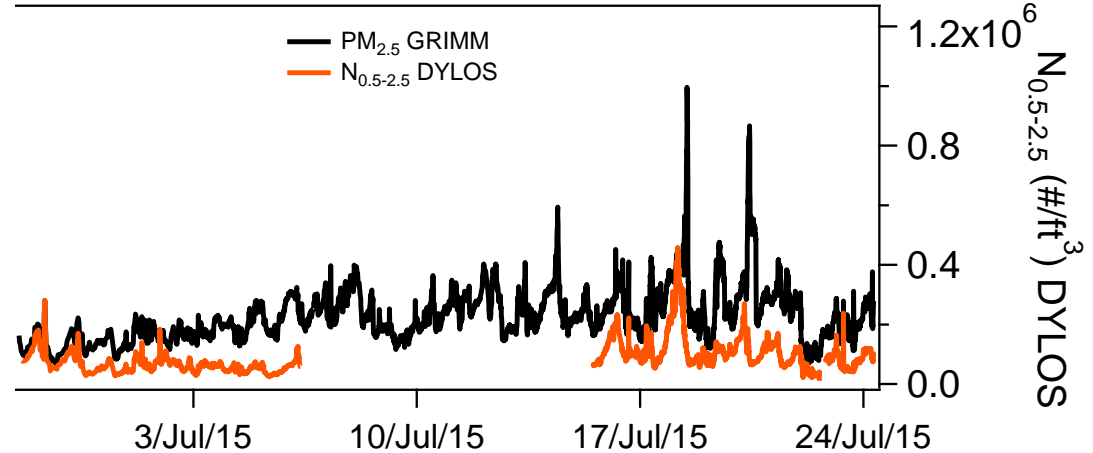
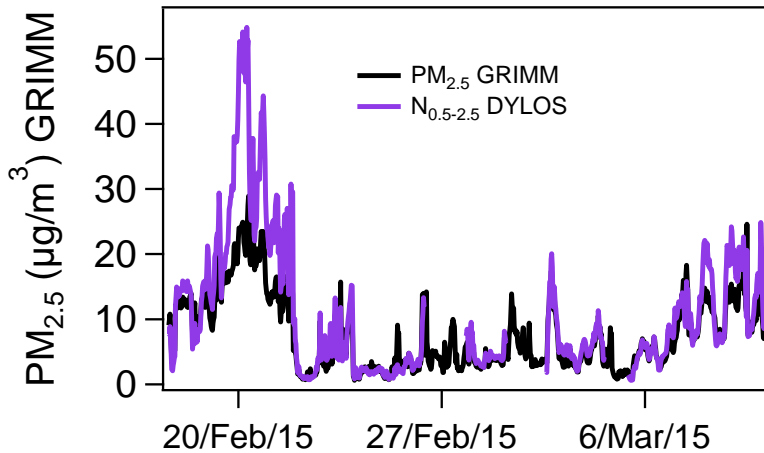
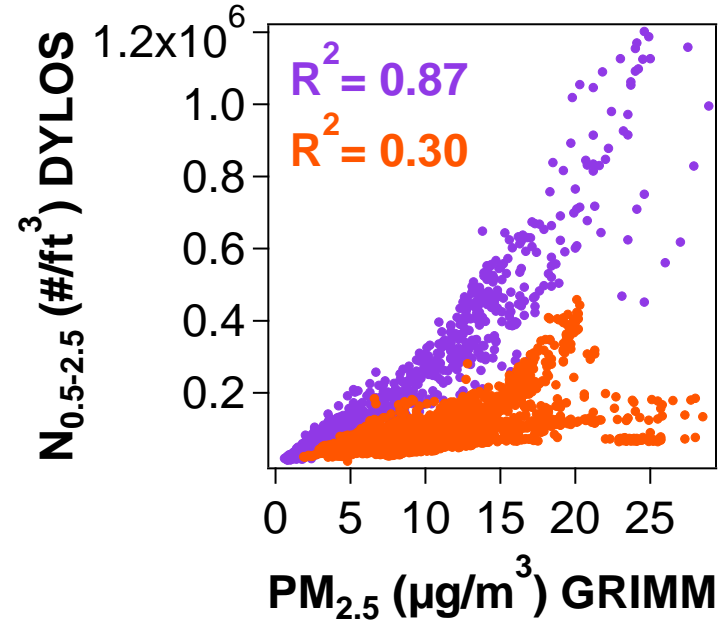
- It measures:
 - $N_{>0.5\mu\text{m}}$
 - $N_{>2.5\mu\text{m}}$
 - $N_{0.5-2.5}$ can be calculated
 - This parameter is a proxy for PM_{2.5}
 - Time resolution: 1 min
 - Averaged to 5min or to 30min
- 3 units
 - >1 year



Results



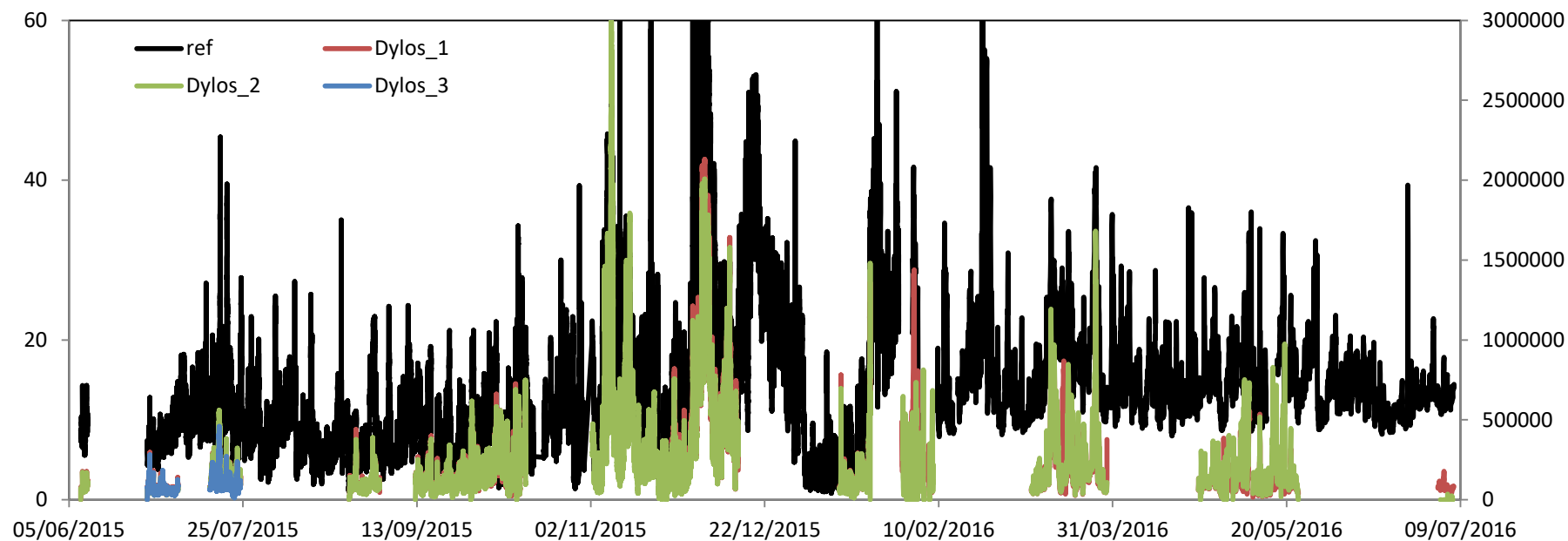
- First period
- (1 unit)



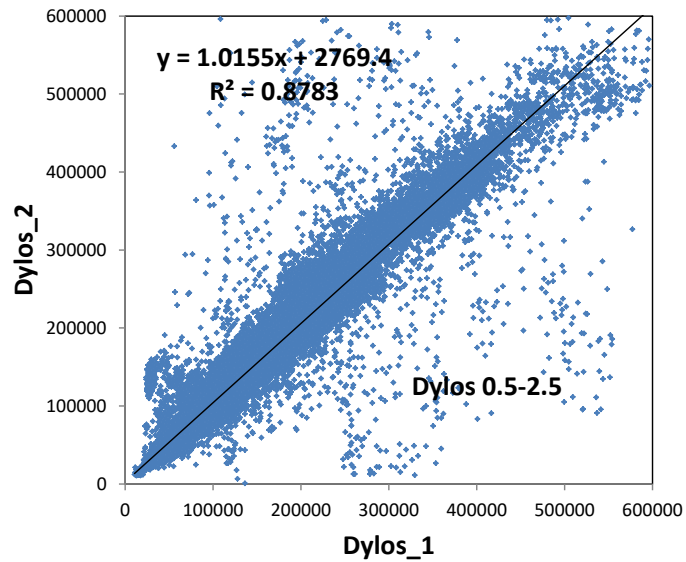
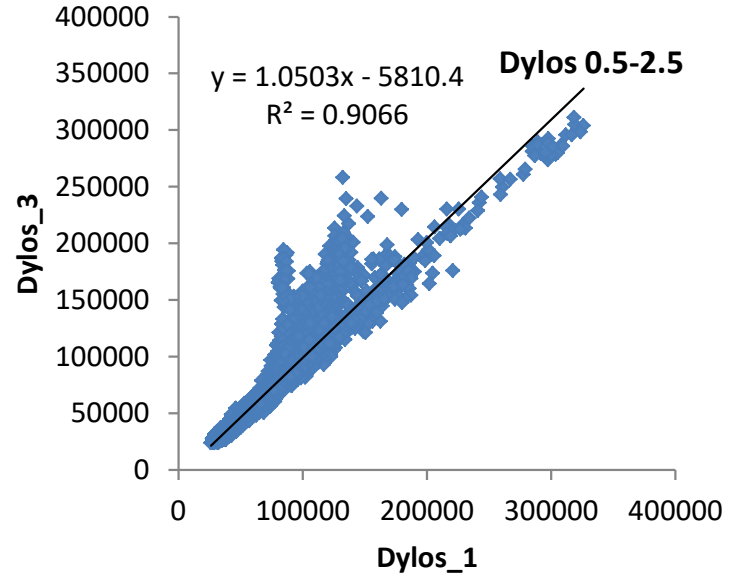
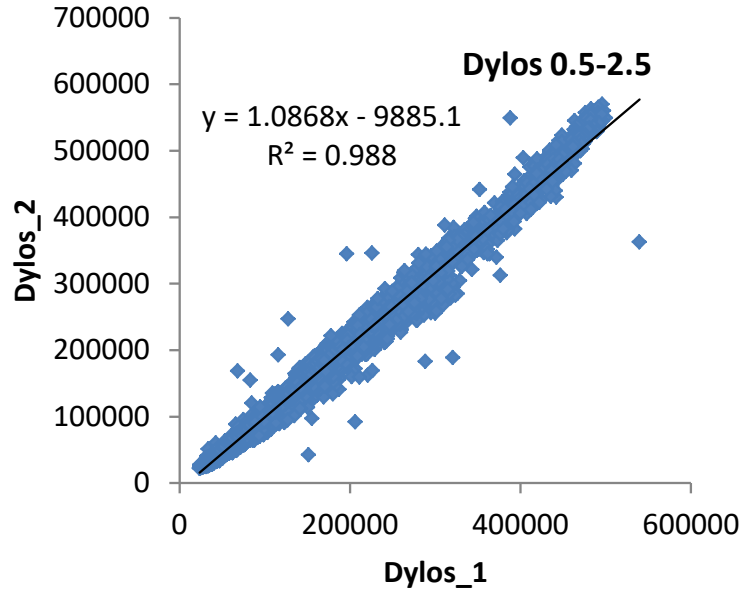
Results



- Most recent period (one year)
- (3 units)

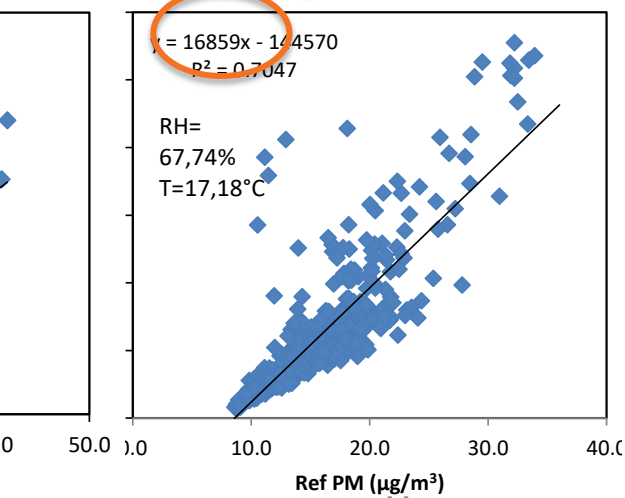
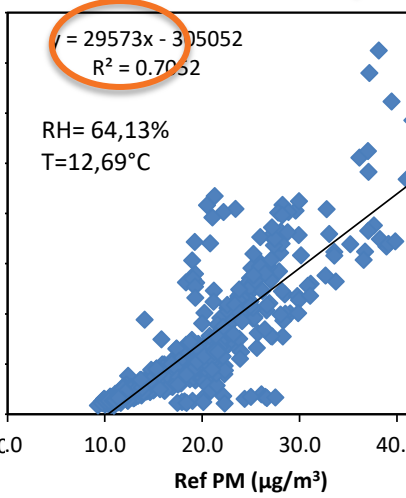
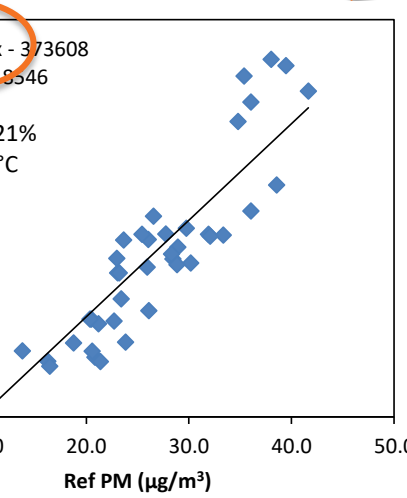
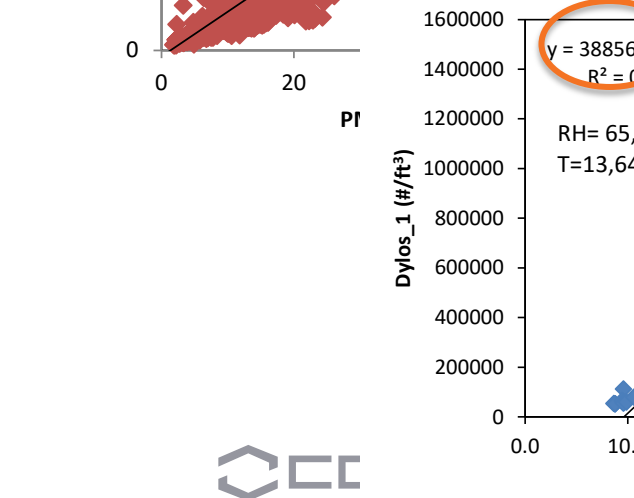
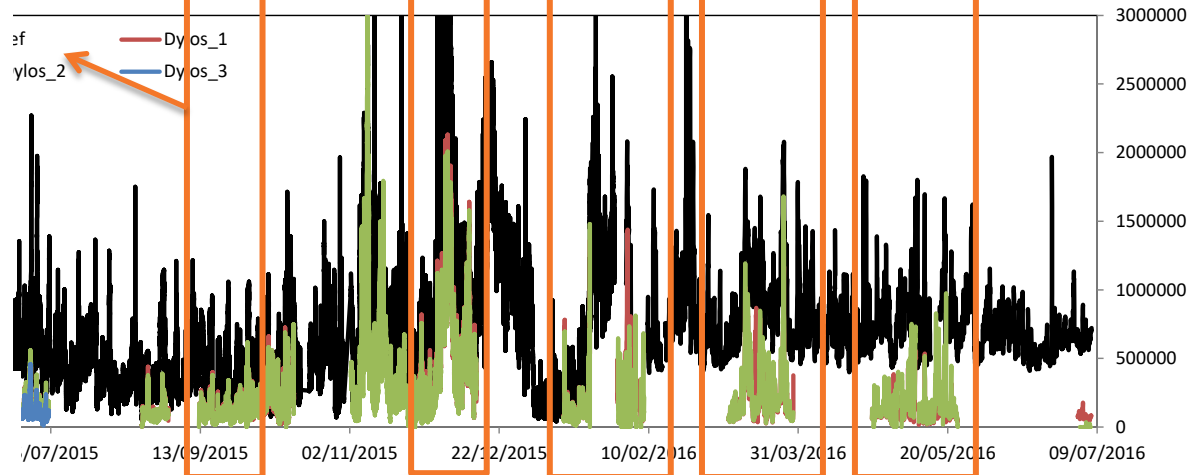
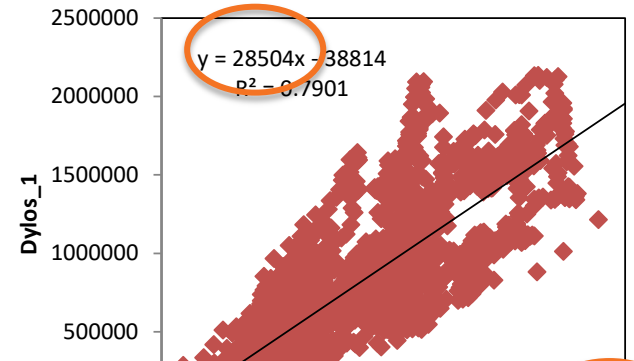
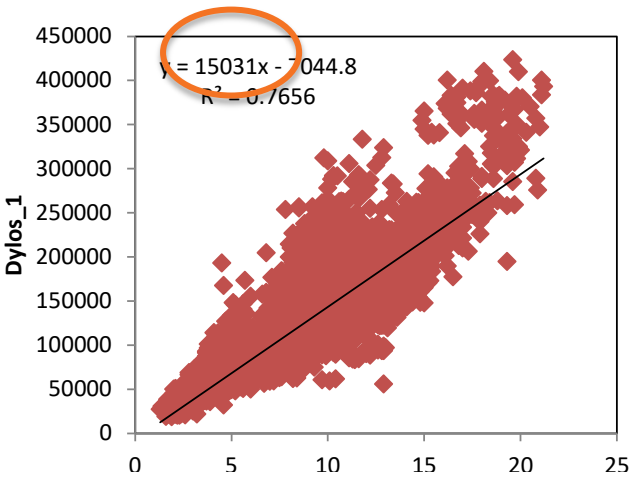


Results



2 months

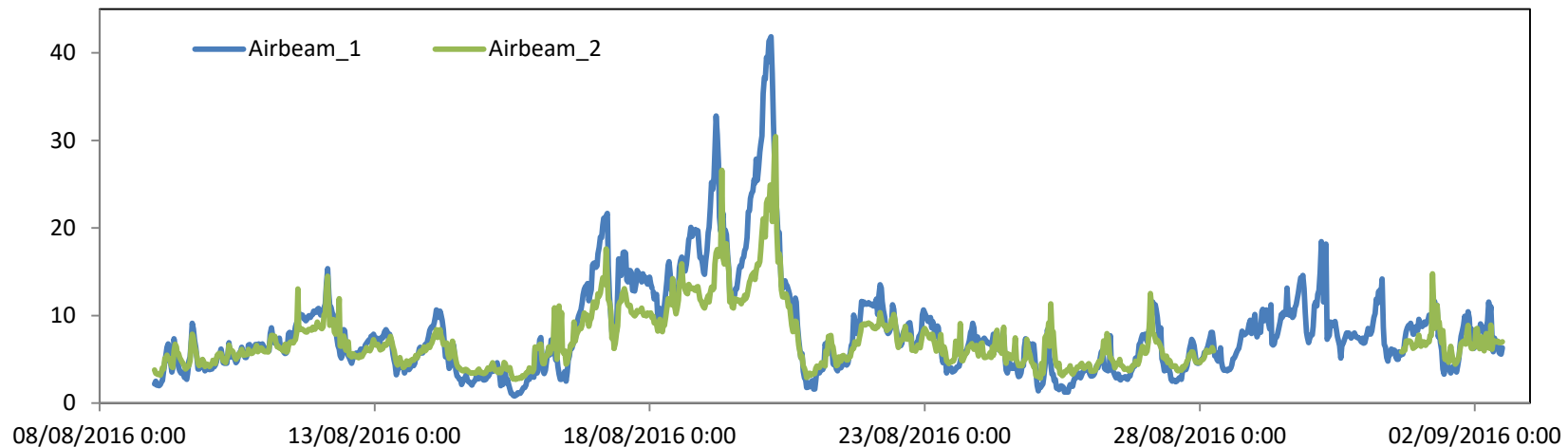
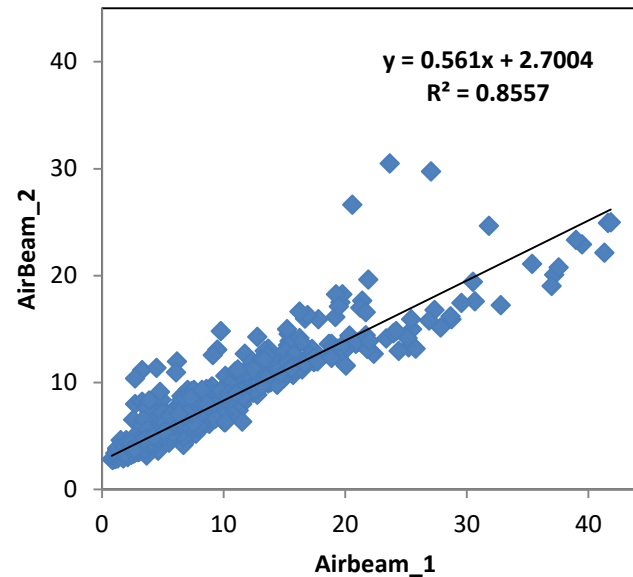
Results



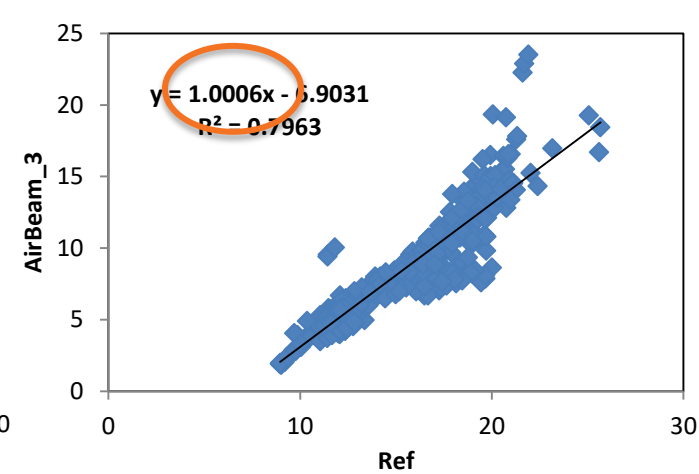
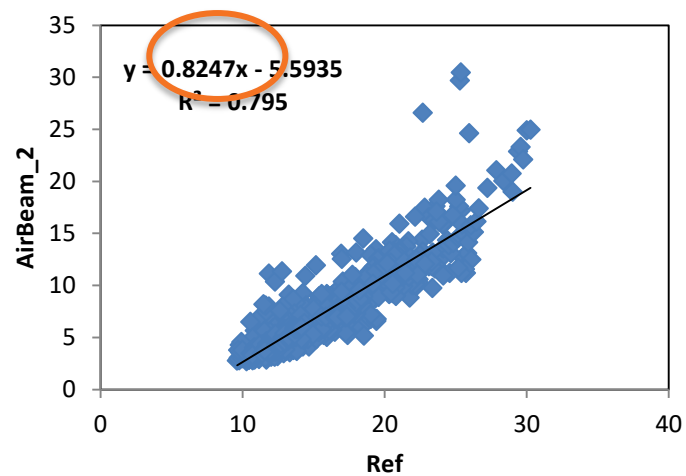
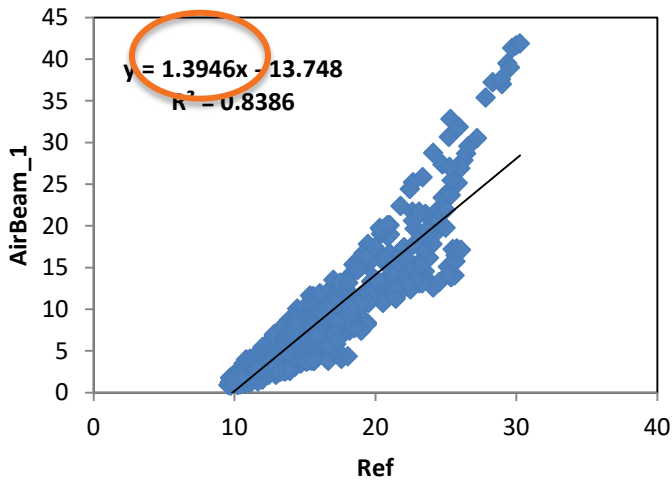
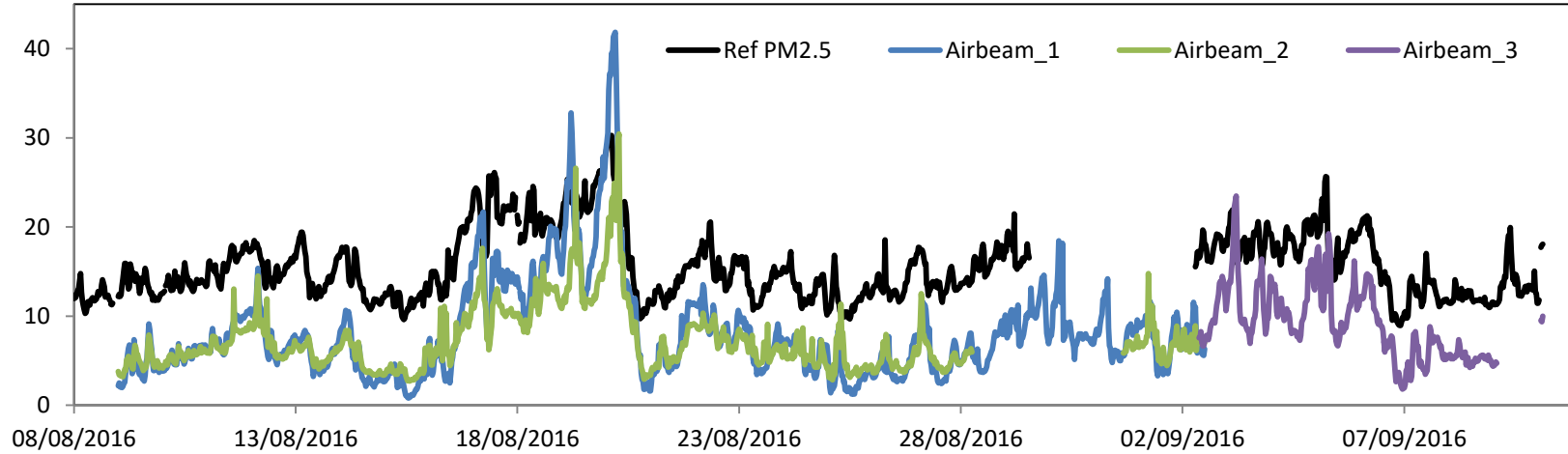
Results



- PM2.5
- Time resolution Airbeam: 5min
- Averaged to 30min
- 3 units
- 1 month

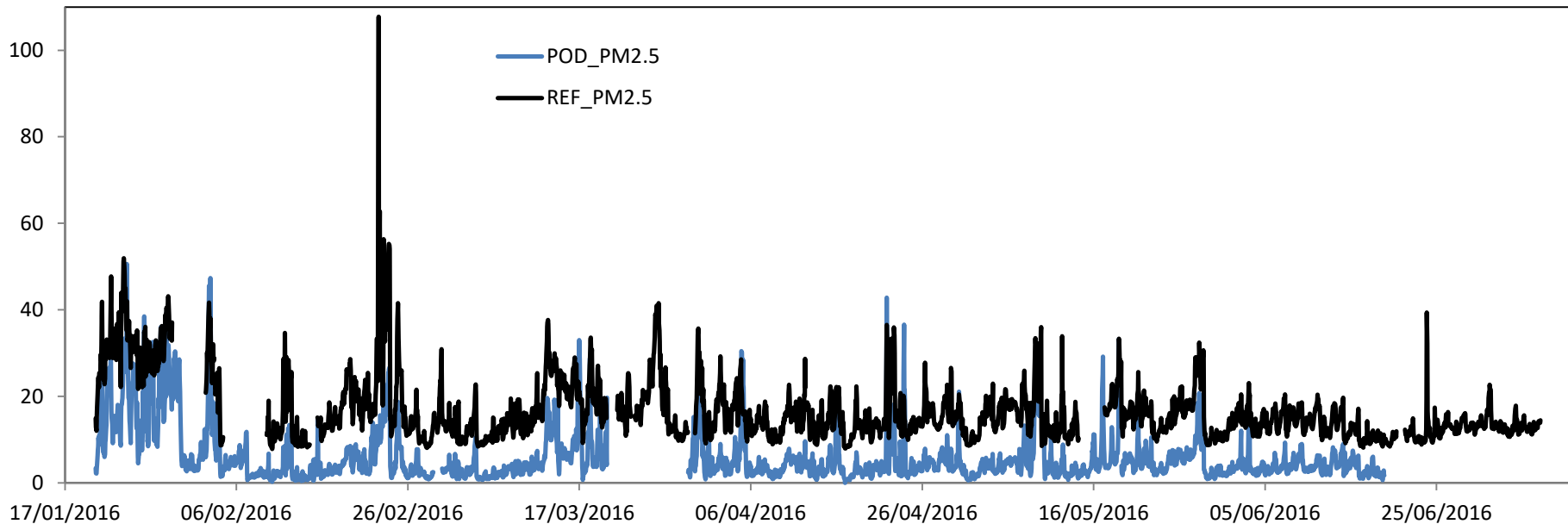
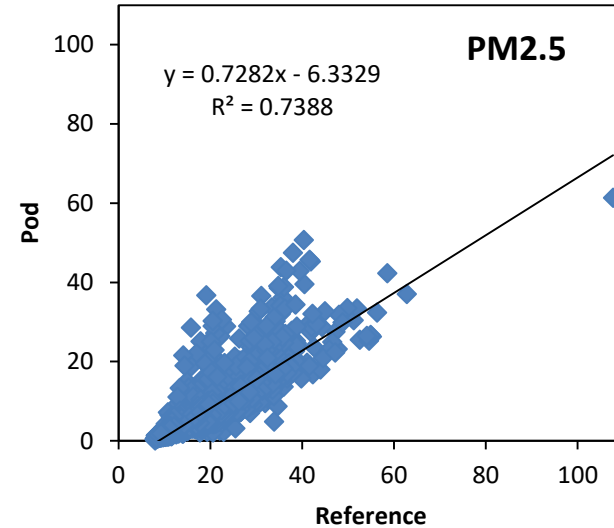


Results

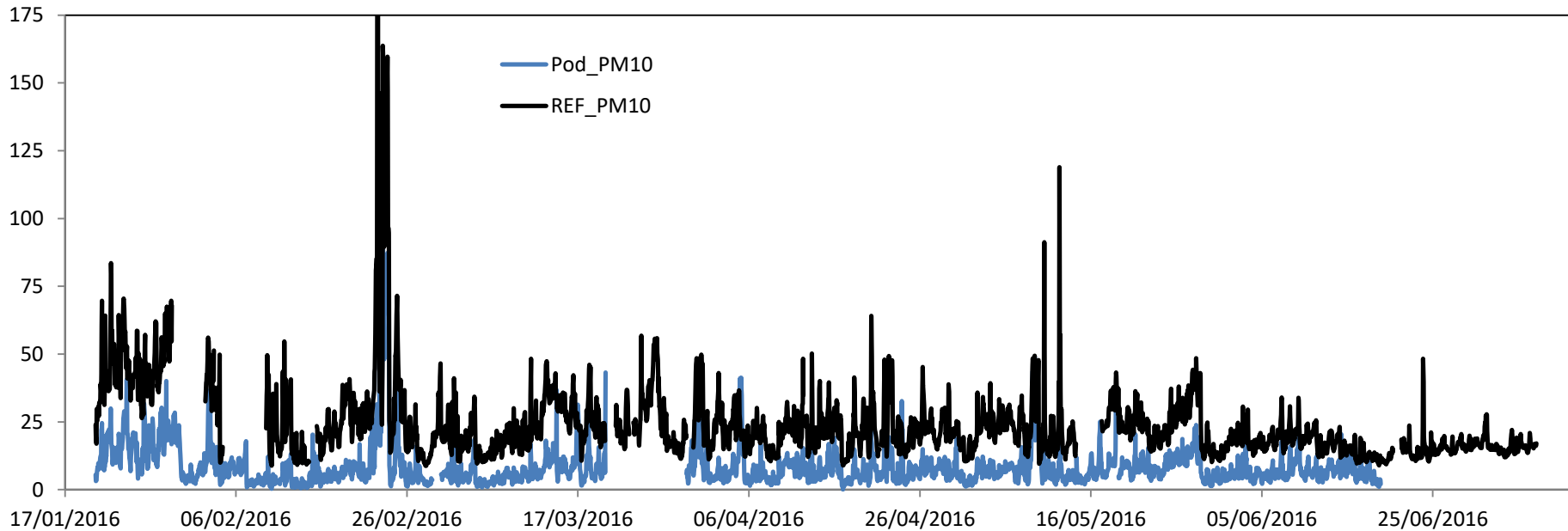
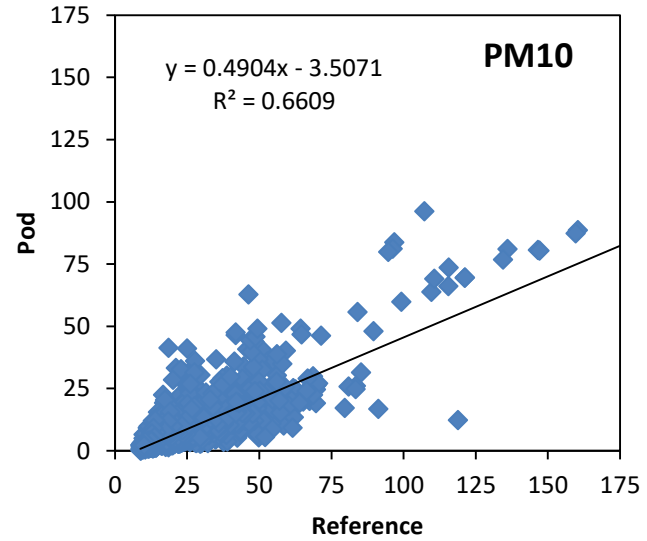


Results

- PM2.5 and PM10
- Time resolution pod: 15min
- Averaged to 1h for comparison
- 1 unit
- 5.5 months



Results



Conclusions

	Dylos DC1700	Airbeam	Pod-AQMesh
Parameters measured	N>0.5, N>2.5	PM2.5	PM2.5, PM10
Agreement between units ($R^2 > 0.9$) slope	✓ ✓	✓ x	Not tested
Agreement with reference ($R^2 > 0.7$)	✓	✓	✓ ?
Stability over time	1-2 months Correction factor changes over time	Not tested	>4 months
Requirements	Cleaning and cross-check with reference		Cross-check with reference to identify outliers

- Further testing and improvement of sensor technologies and data processing required
- Use for AQ assessment feasible, provided quality assurance procedures are implemented and limitations are considered

THANK YOU FOR YOUR ATTENTION

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Acknowledgements:



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de Catalunya**



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DE ESPAÑA

MINISTERIO
DE AGRICULTURA, ALIMENTACIÓN
Y MEDIO AMBIENTE



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