

A comparative study of PM analysers to establish equivalency with a reference sampler

B.Sc. (Honours) in Environmental Science and Sustainable Technology



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Project Background

Particulate Matter

Particulate matter are small particles suspended in ambient air and are typically named according to their size.

PM10:

These are fractions of particulate matter that are 10µm in diameter and less.

PM2.5:

These are fractions of particulate matter that are 2.5µm in diameter and less

These particles are emitted into the atmosphere through the combustion of solid fuels such as coal and wood. Diesel engines are also a large contributor to PM in ambient air.

Reference samplers

Reference samplers measure PM gravimetrically as stipulated in EN:12341. PM is trapped in filters and weighed. MTU currently operate and maintain two Leckel 47/50 reference samplers. These samplers do not provide real-time data

MTU currently operate and maintain two reference samplers. The Leckel 47/50 2010 and The Leckel 47/50 2017.

Equivalent Instruments

The CAFÉ directive states that instruments that are deemed to be equivalent to the reference method may be used in place of the reference method.

The most common equivalent instruments use beta attenuation or optical scattering. MTU operate two equivalent methods in the BAM-1020 and the FIDAS 200.



Demonstrating Equivalence

Annex 1 of the CAFÉ Directive stipulates that an equivalent method must have a maximum expanded uncertainty of 25%. 'The Guide to The Demonstration of Equivalence' (GDE) is a de facto standard outlining the tests required to prove equivalence

Project Scope

The primary objective of this project was to compare the PM analysers at MTU to the reference instruments and determine if they demonstrated equivalency as per the GDE.



Project Plan

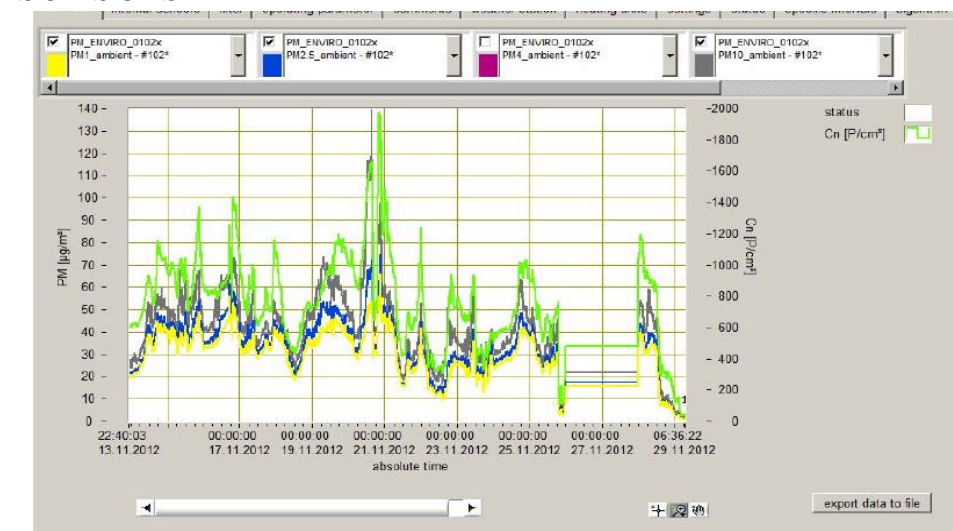


Gather Data

BAM-1020 data was gathered from EPA.ie
Leckel 47/50 data was provided by The Department of Physical Sciences.

FIDAS Data was gathered from PDAnalyse software.

PurpleAir.com provided data for uncertified sensors



Analyse Data

Data was analysed in a special Excel spreadsheet used to determine equivalence.

This spreadsheet utilised formulas outlined in the GDE to determine the expanded relative uncertainty of the equivalent samplers.

This tool calculated key indicators of equivalent samplers performance using orthogonal regression. These included:

- Between sampler uncertainty
- Bias at Limit Value
- Expanded Relative Uncertainty



Meteorological Data Comparison

Investigate the ambient temperature, pressure and humidity monitoring capabilities and compare to the nearest Met Station (Cork Airport)

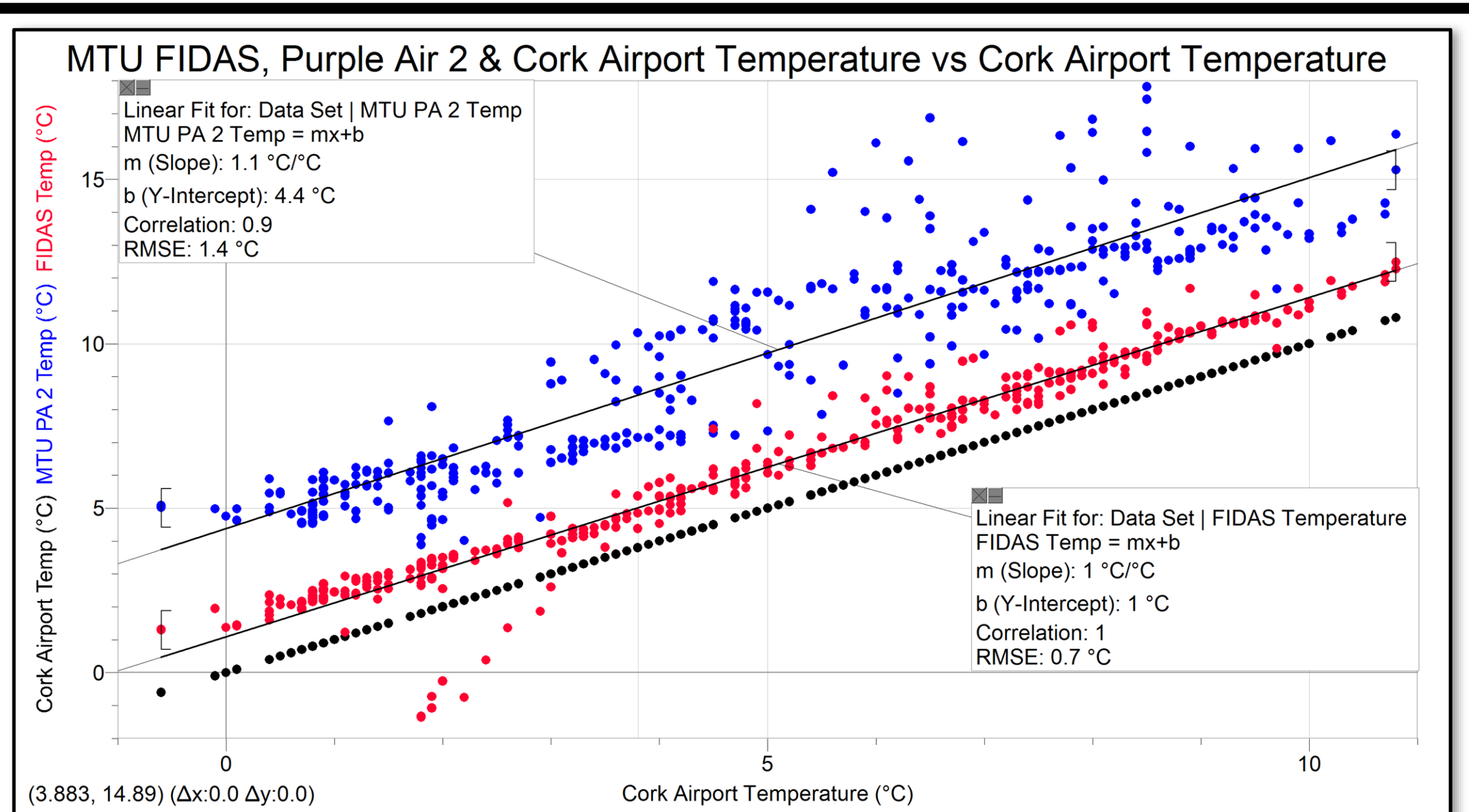
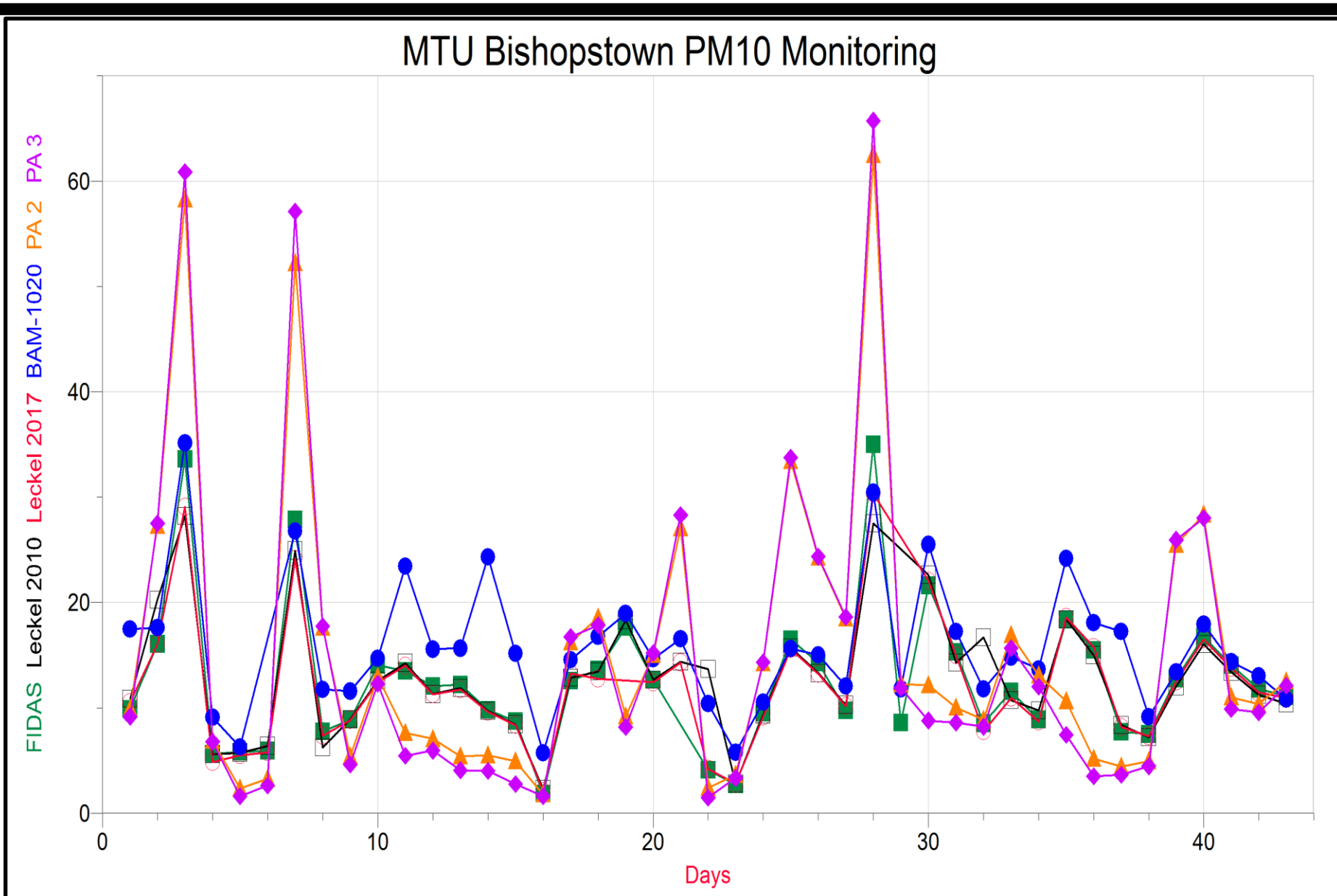
Determine if Equivalence has been Demonstrated

Utilise the Excel Equivalence tool to determine if equivalence has been demonstrated as per the requirements of the GDE

Irish Standard
I.S. EN 12341:2014

Ambient air - Standard gravimetric measurement method for the determination of the PM10 or PM2,5 mass concentration of suspended particulate matter

Results



References

- PurpleAir Logo - <https://www2.purpleair.com/>
- SEVEN LECKEL Logo - <https://www.leckel.de/>
- Palas Logo - <https://www.palas.de/en/>
- EPA Logo - <http://www.epa.ie/>
- Met One Logo - <https://metone.com/>