CH TECHNOLOGIES (USA)

Ambient Air Quality Monitoring Instruments for Fine and Ultra-Fine Airborne Particulates - Initial Results with Two New Instruments

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Westwood, NJ

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Overview of the Study

- A fine dust monitor Fidas 200 and an ultrafine particulate monitor Naneos Partecor were co-located with a $PM_{2.5}$ Beta Attenuation Monitor at the NJDEP Photochemical Assessment Monitoring (PAM) Site at the Rutgers Horticulture Research Farm 3 (East Brunswick, NJ)
- Data was collected by Air Monitors, Ltd. Gen II data logger for real-time transmission to an air quality monitoring network http://www.envirologger.net
- Fidas 200, Partector and the data logger were mounted within a custom made weather tight cabinet, which was placed on the roof of the PAM Site monitoring trailer
- Sampling was carried out with standard environmental inlets (Sigma II and BGI Mini-PM);
- Measurements carried out in the period November 6, 2015 – March 12, 2016

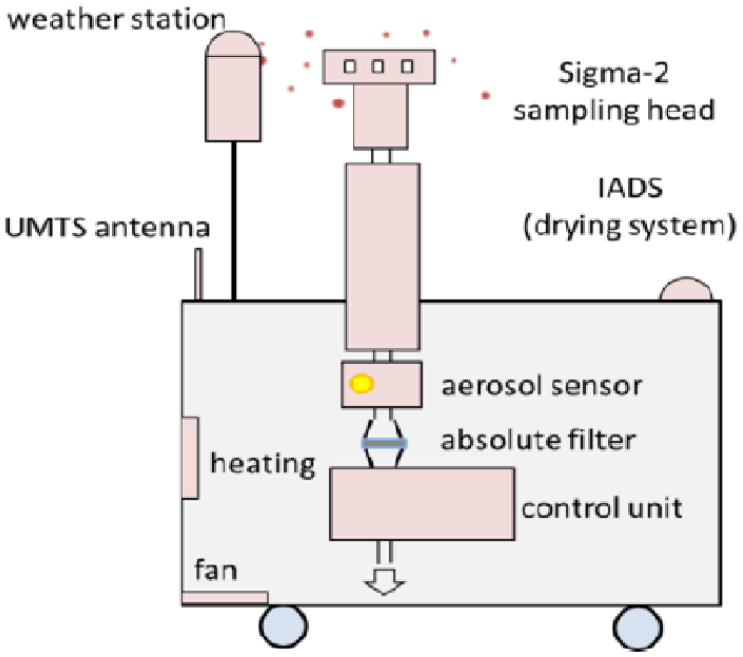
PAM Site Background

- Located at 68 Ryders Lane, Rutgers University Horticulture Research Farm 3, East Brunswick, NJ, about 3,600 feet northwest of I-95 and 2,800 southeast of Route 1
- Designed to measure pollutants and particulates in the atmosphere, as well as track and record the corresponding upper and lower air conditions
- Joint-operation between the New Jersey Department of Environmental Protection (NJDEP) and the Department of Environmental Sciences (DES) at Rutgers University (http://pamsite.rutgers.edu).
- Mixed rural/urban background site
- Monitored air pollutants: O_3, NO_x, $PM_{2.5}$

PAM Site View

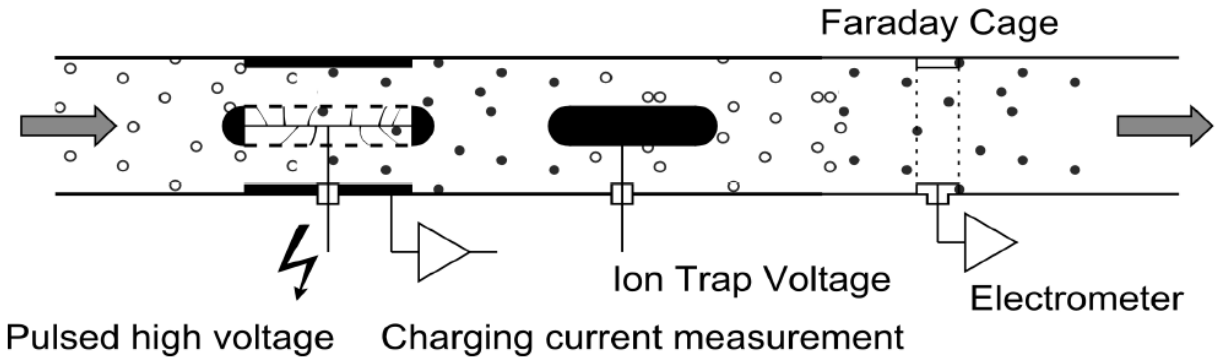
Fidas Measurement Method

- Measurement technology of optical light scattering of single particles Process Control Systems
- Provides continuous and simultaneous measurements of PM_1, $PM_{2.5}$, PM_4, PM_{10}, TSP (PM_{total}) and the Particle Number concentration
- Particle size range of 0.18 – 18 µm
- Mass concentrations up to 1,500 µg/m^3 or number concentrations of up to 20,000 particle/cm^3.
- Equivalent method for measuring $PM_{2.5}$ and PM_{10} in Europe and UK.



Partector Measurement Method

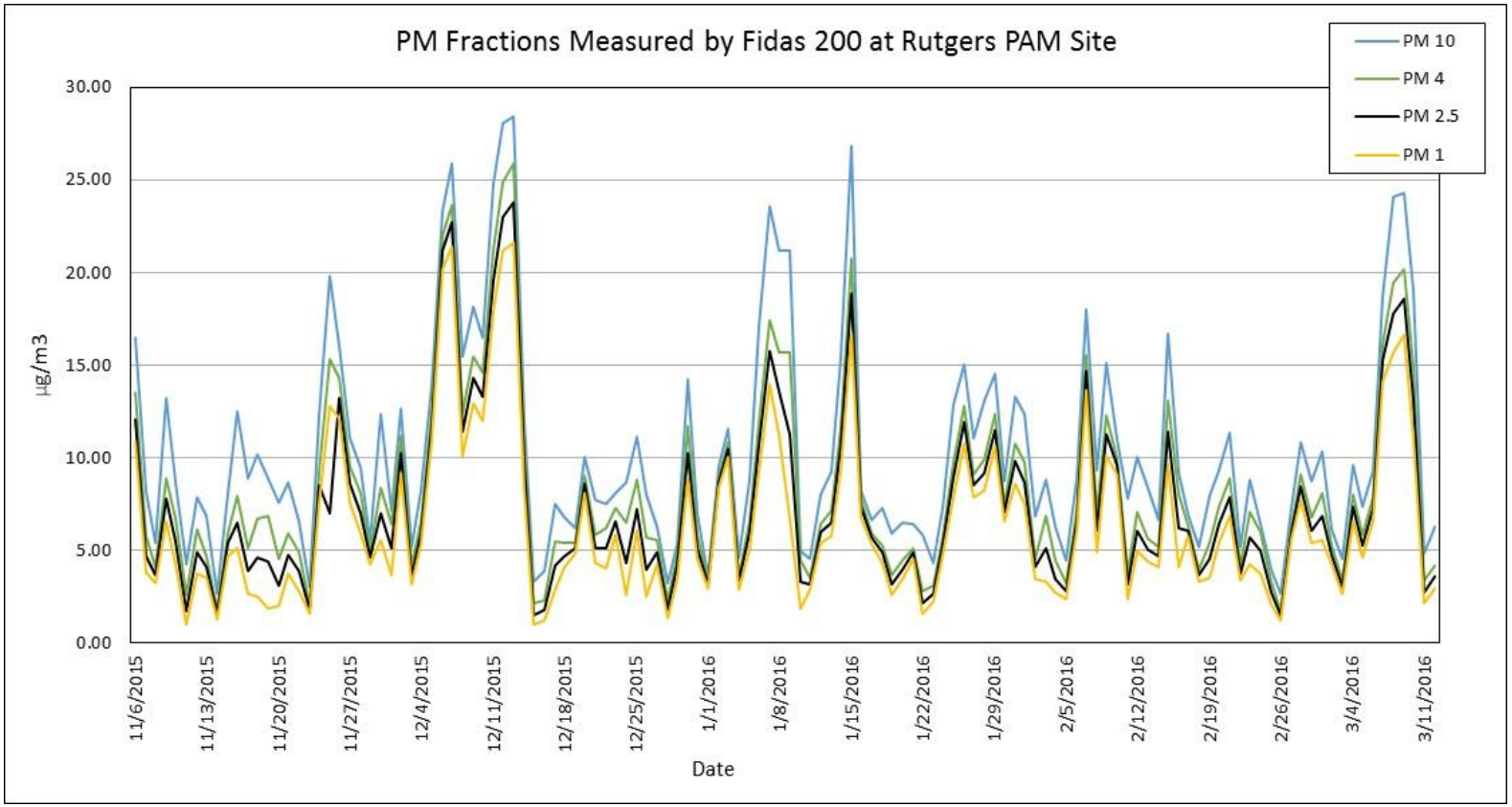
- Pulsed (on/off) unipolar diffusion charging to create clouds of charged nanoparticles
- Accurate detection range 20 nm – 300 nm
- Cigarette Smoke Testing
- Drug research and Development
- Filter Testing
- Environmental Monitoring



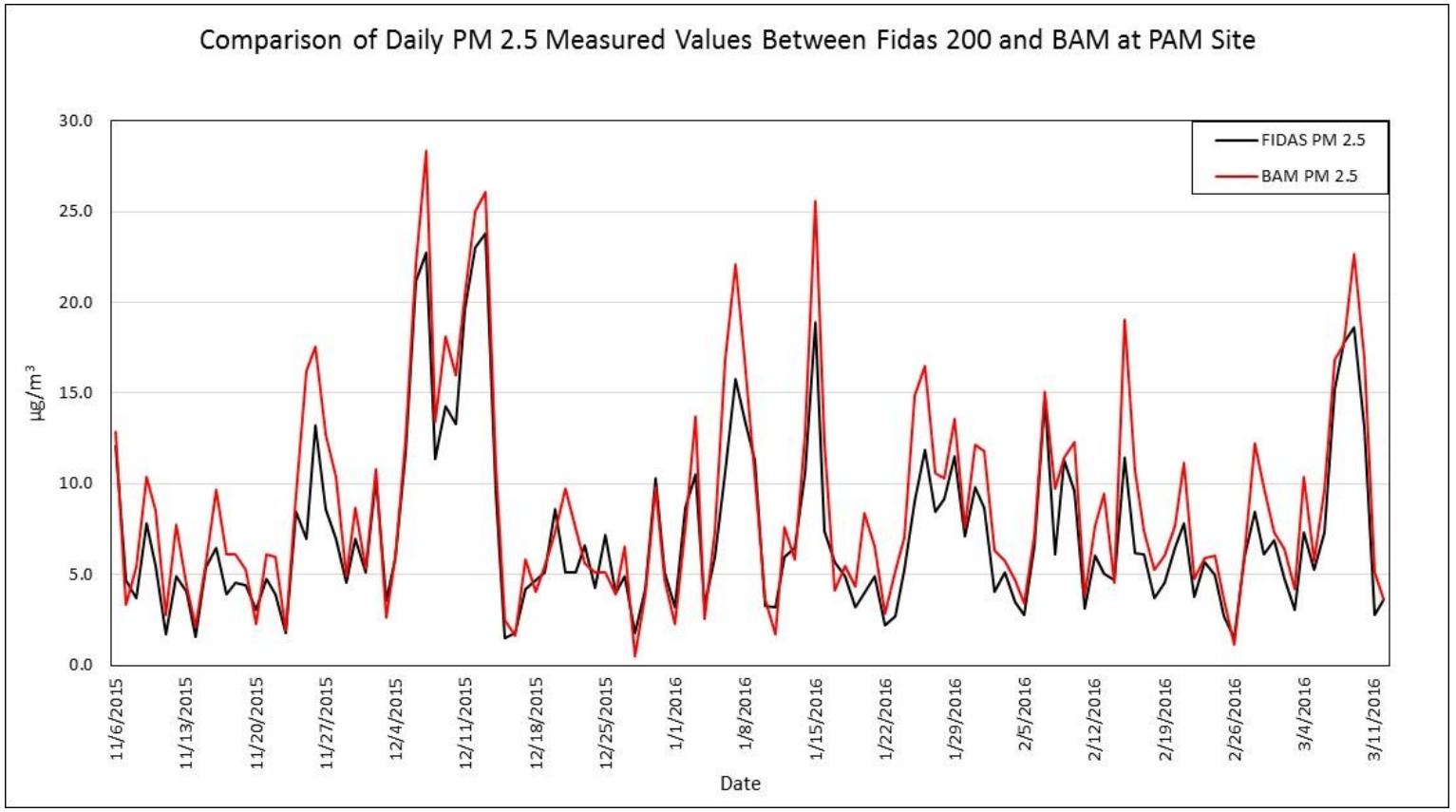
Summary of Measurements at the PAM Site

	PM_{10} ($\mu g/m^3$)	PM_4 ($\mu g/m^3$)	PM_1 ($\mu g/m^3$)	$PM_{2.5}$ FIDAS ($\mu g/m^3$)	$PM_{2.5}$ BAM ($\mu g/m^3$)	Particle Count	LDSA ($\mu m^2/m^3$)
Daily Average	10.44	8.34	6.43	7.36	8.99	207.07	22.53
Daily Average Max	28.45	25.89	21.64	23.80	28.35	648.97	73.94
Daily Average Min	2.64	1.71	1.03	1.48	0.55	21.71	3.79

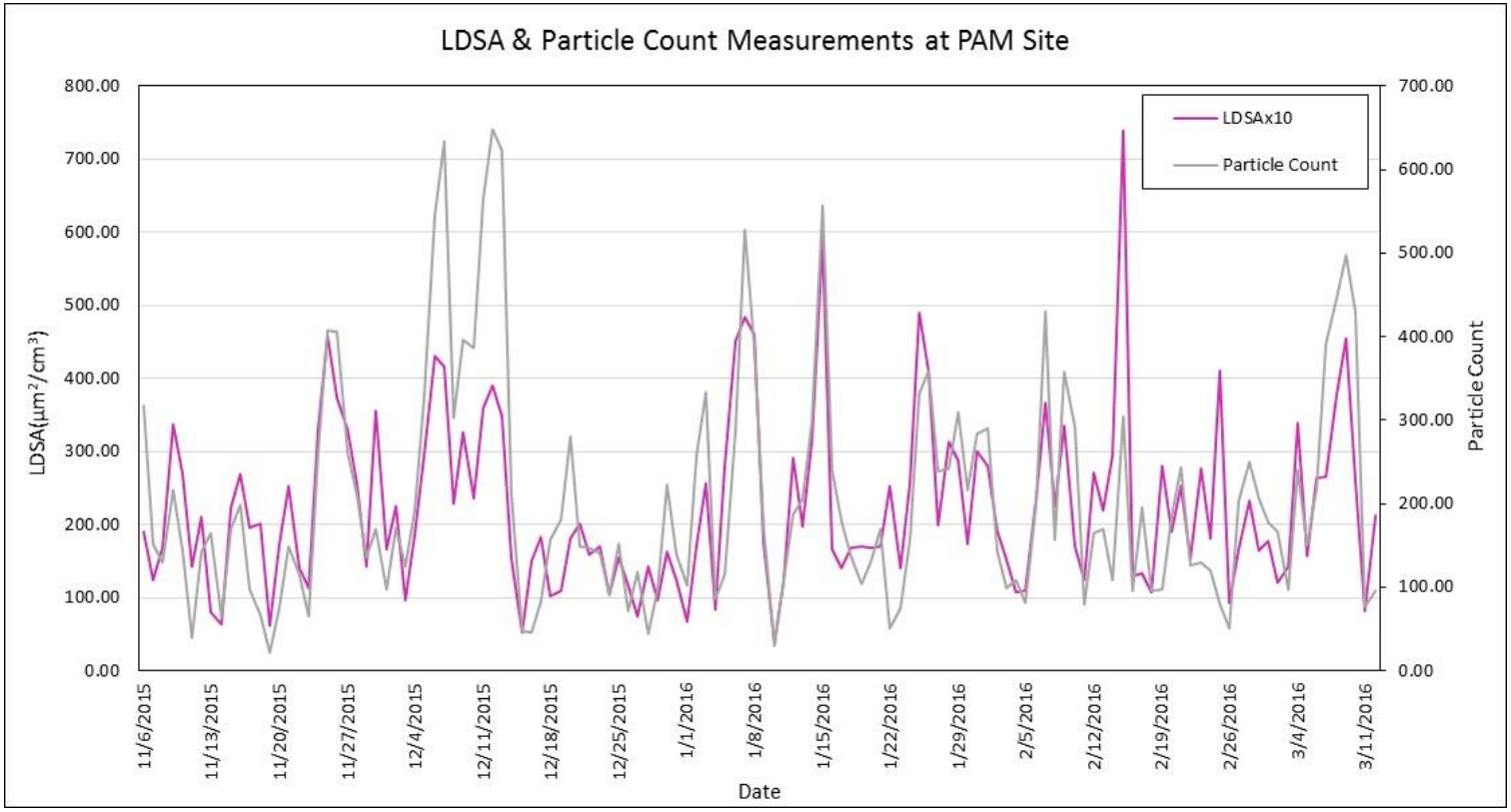
Fidas 200 Measurements Overview



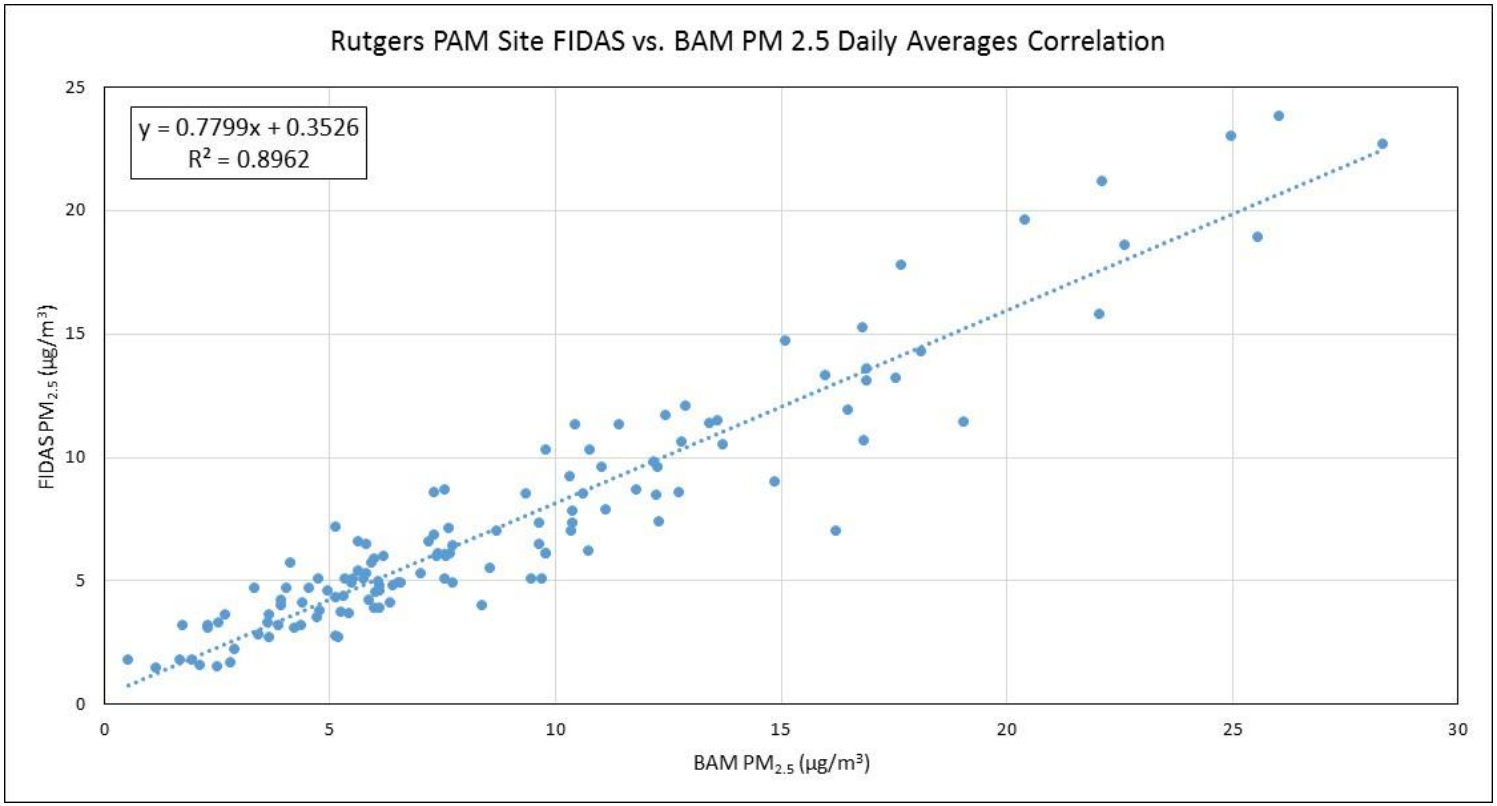
Comparison of $PM_{2.5}$ Measurements



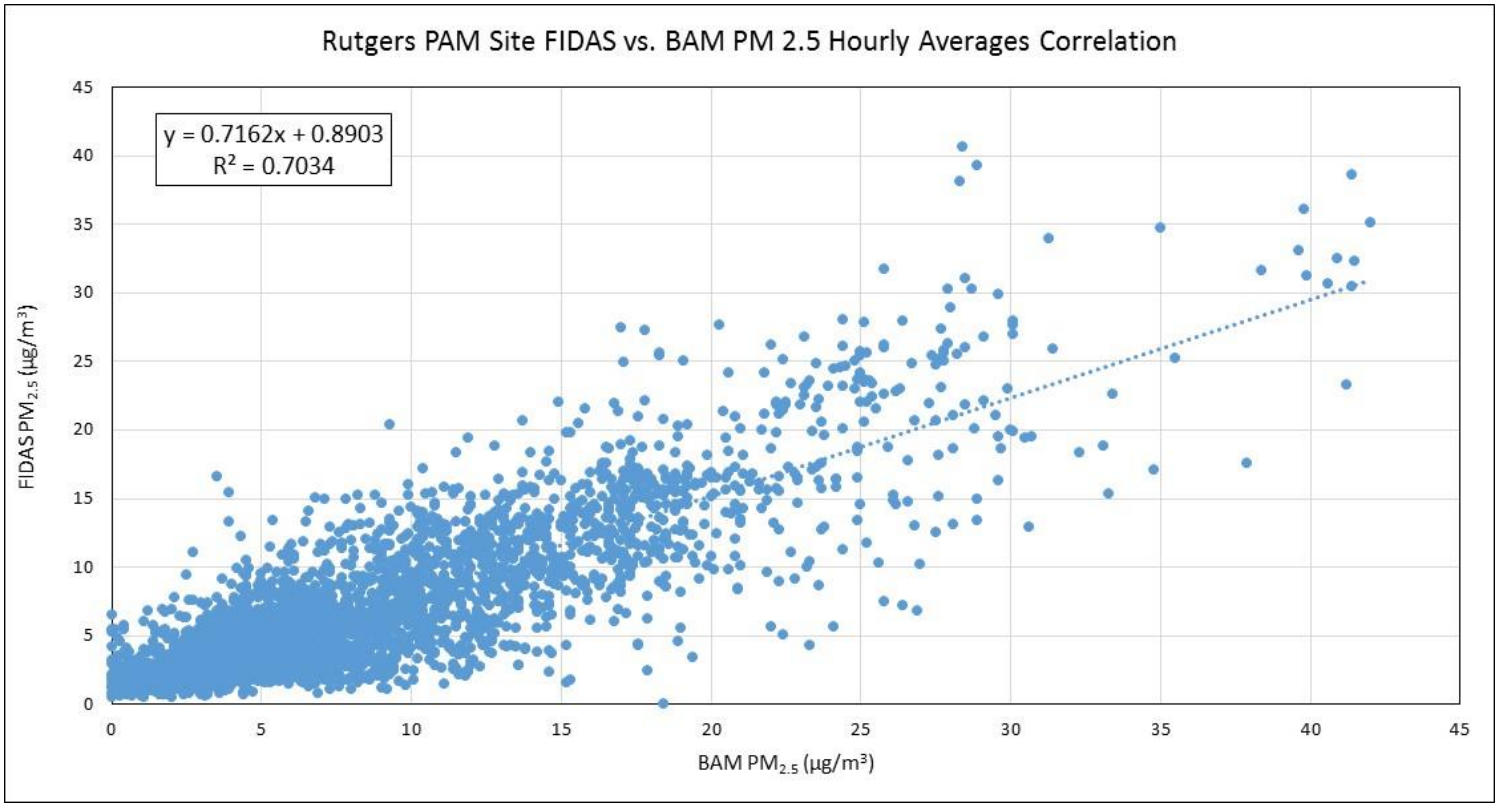
LDSA and Particle Count Measurements



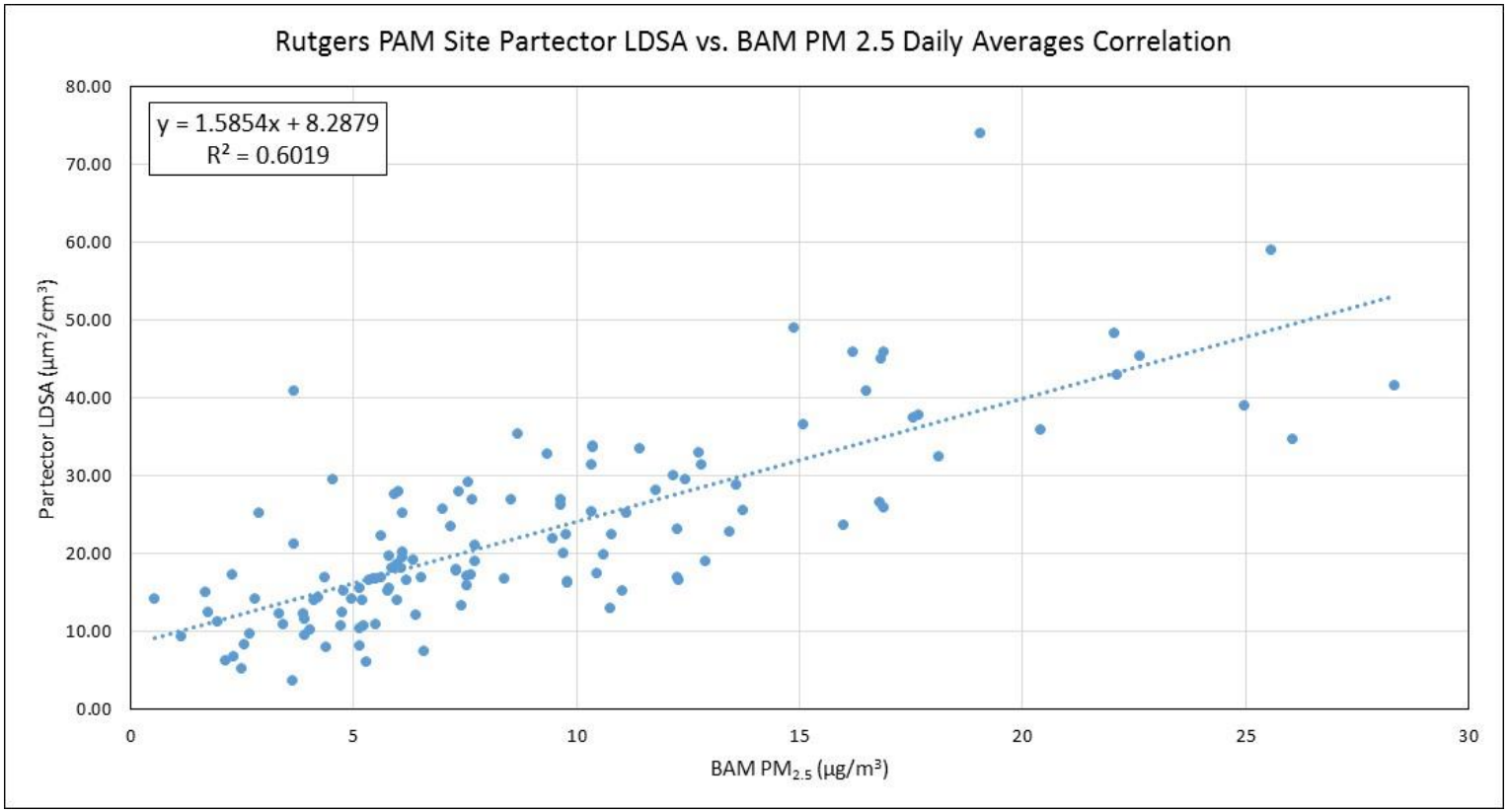
Correlation of $PM_{2.5}$ Daily Averages



Correlation of PM2.5 Hourly Averages



Correlation of LDSA with $PM_{2.5}$ Daily Averages



Main Conclusions of the Study – Fidas 200

- The results confirm that the Fidas 200's $PM_{2.5}$ measurement results are equivalent to those delivered by the Thermo Fisher Beta Gauge Monitor (BG), a US Federal Equivalent Method
- The hourly average time series obtained from the device had a completeness of 99.97% over the 127 days of the study.
- Fidas 200 has a lower ownership cost than other FEM and FRM devices

Instrument	Cost of Purchase	# REQD	Total Cost	Cost Over 5 Years	FIDAS SAVES
TEOM 1405F	$34,628.2	2	$69,256	$82,191	$55,381
TEOM/FDMS 1405 DF	$41,362.7	1	$41,363	$50,785	$23,976
FIDAS 200	$24,337.6	1	$24,338	$26,809	-
BAM 1020	$18,256.0	2	$36,512	$57,143	$30,333

Main Conclusions of the Study – Partector

- The Partector delivered reliable performance without the need for maintenance during the entire measurement period
- Ultrafines are a variable sub-population of various ambient PM fractions so no robust associations with PM fractions were expected
- The LDSA measurements show modest correlation at best with various PM fractions measured by Fidas 200 and slightly better correlation with BAM $PM_{2.5}$ measurements.
- Given the ultrafine range that it measures, the small size and low ownership cost, we believe that the Partector is highly suited for stationary as well as mobile monitoring of airborne nanoparticles

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