

EPA NAQC 2005 San Francisco, CA

From Nanograms to Milligrams:

The Aethalometer™ AE-90
for direct Tailpipe Emissions Measurement
of Carbonaceous Aerosol Particles

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Diesel Exhaust - *Listed Air Toxic*

Toxic Components : *Specific Compounds*
require *Specific Chemical Analyses*

Accompanying components may permit more
rapid detection by optical means:

Black Soot and ***UV-Absorbing Material***

Analytical Premise

Optically-absorbing material is a *surrogate tracer* for diesel exhaust.

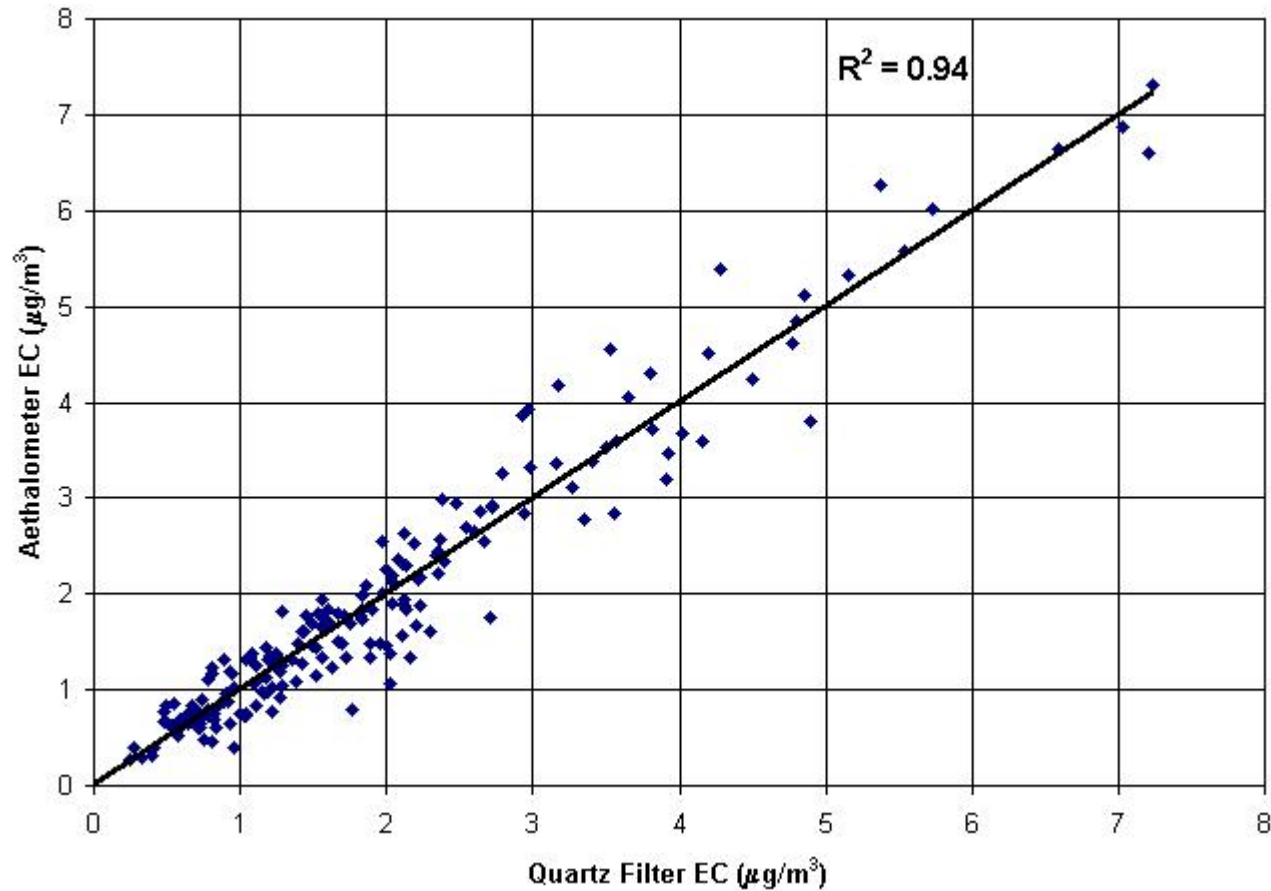
- “Black” carbon (‘BC’, ‘EC’)
- “UV-absorbing material” (‘UVPM’)

Optical analysis is fast, sensitive, can be performed in real time or on filter samples.

Analytical Method - Optical Absorption



Optical vs. chemical analyses



“Harvard 6 Cities Study”

Analytical Instrument : Aethalometer™

While continuously collecting sample,
measures *optical absorption* in real time
at 2 wavelengths (880 nm and 370 nm UV)

Converts *optical absorption* to
mass concentration of BC and UVPM

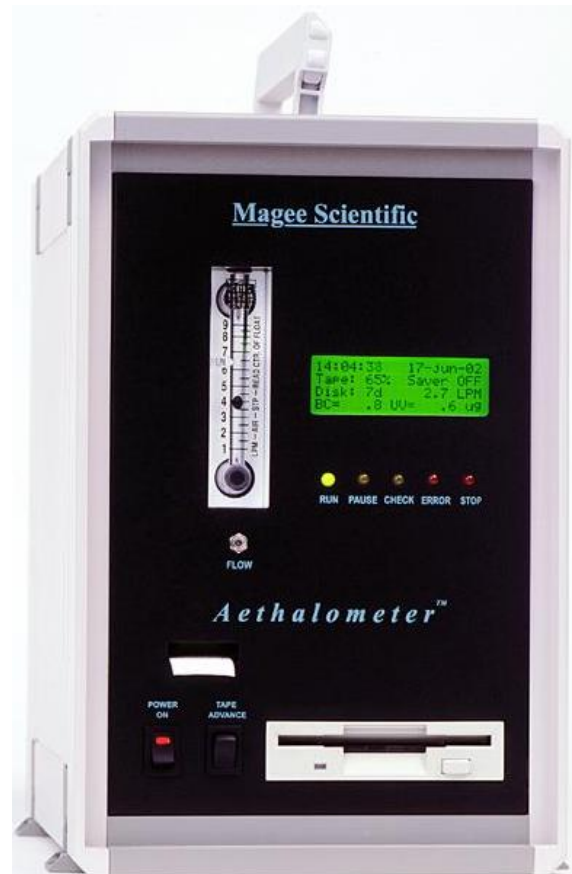
Real-time data: 1 second / 1 minute / 1 hour

Analytical Instrument : Aethalometer™



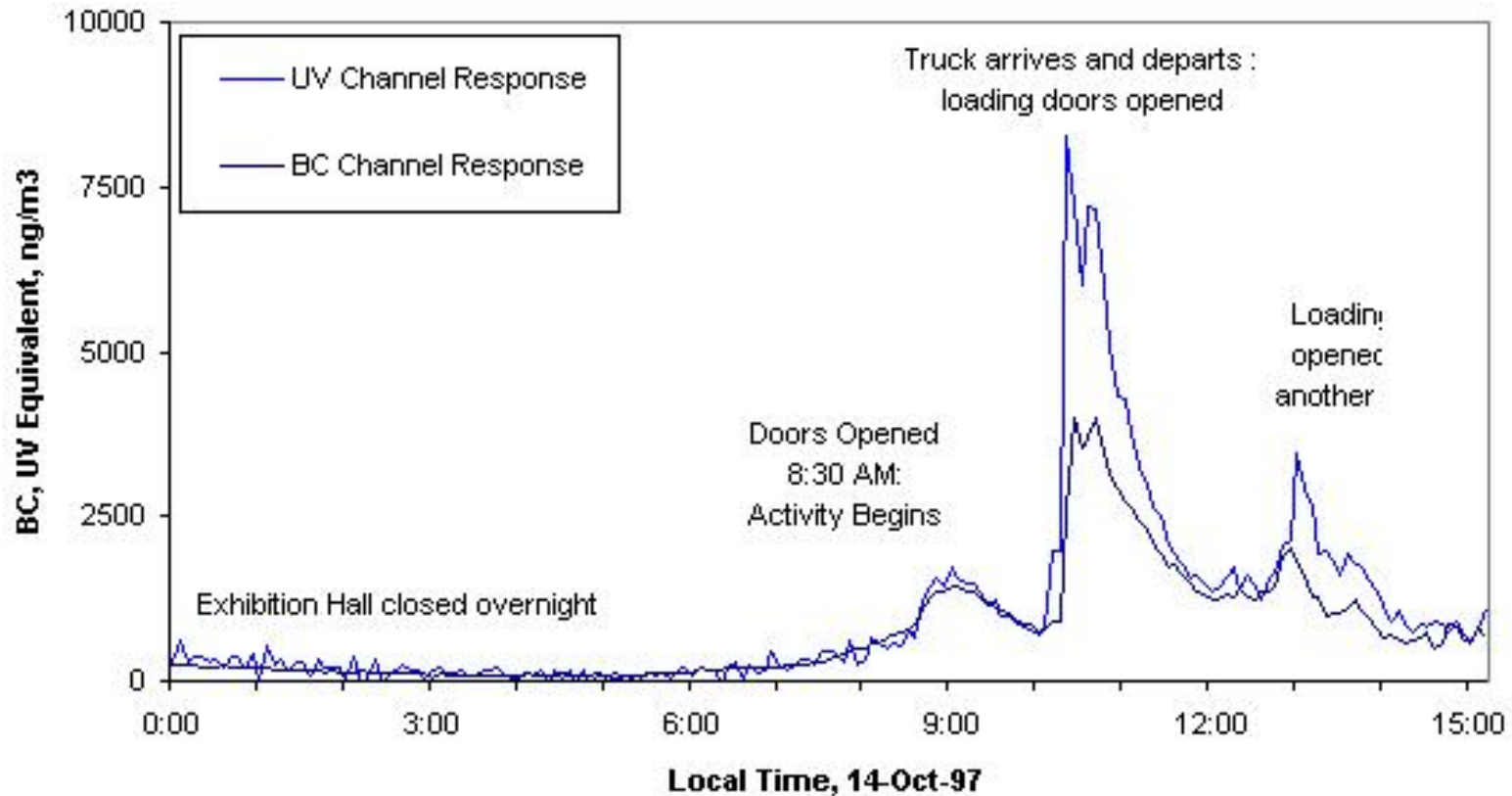
19-inch rack mount model

“Portable” Aethalometer™



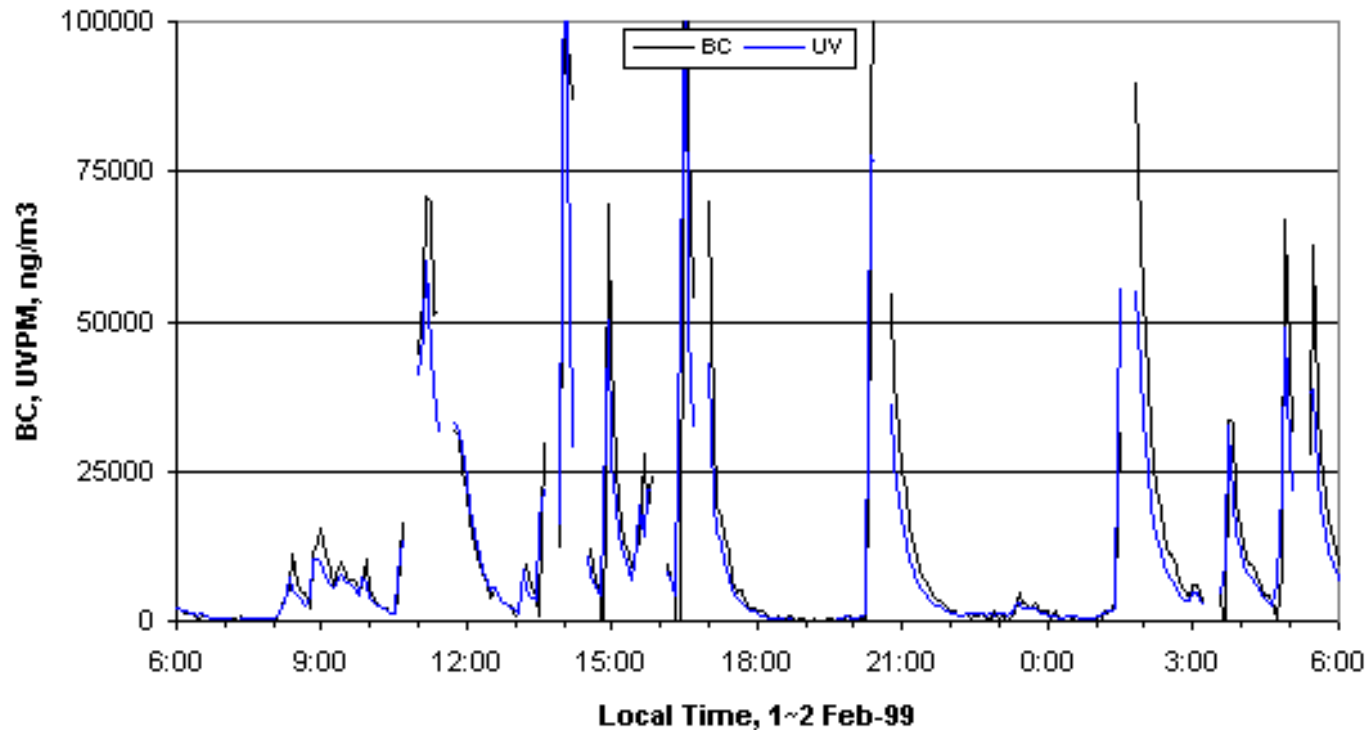
Battery-powered: 1-, 2- or 7-wave optics

Diesel indoors: truck in exhibition hall

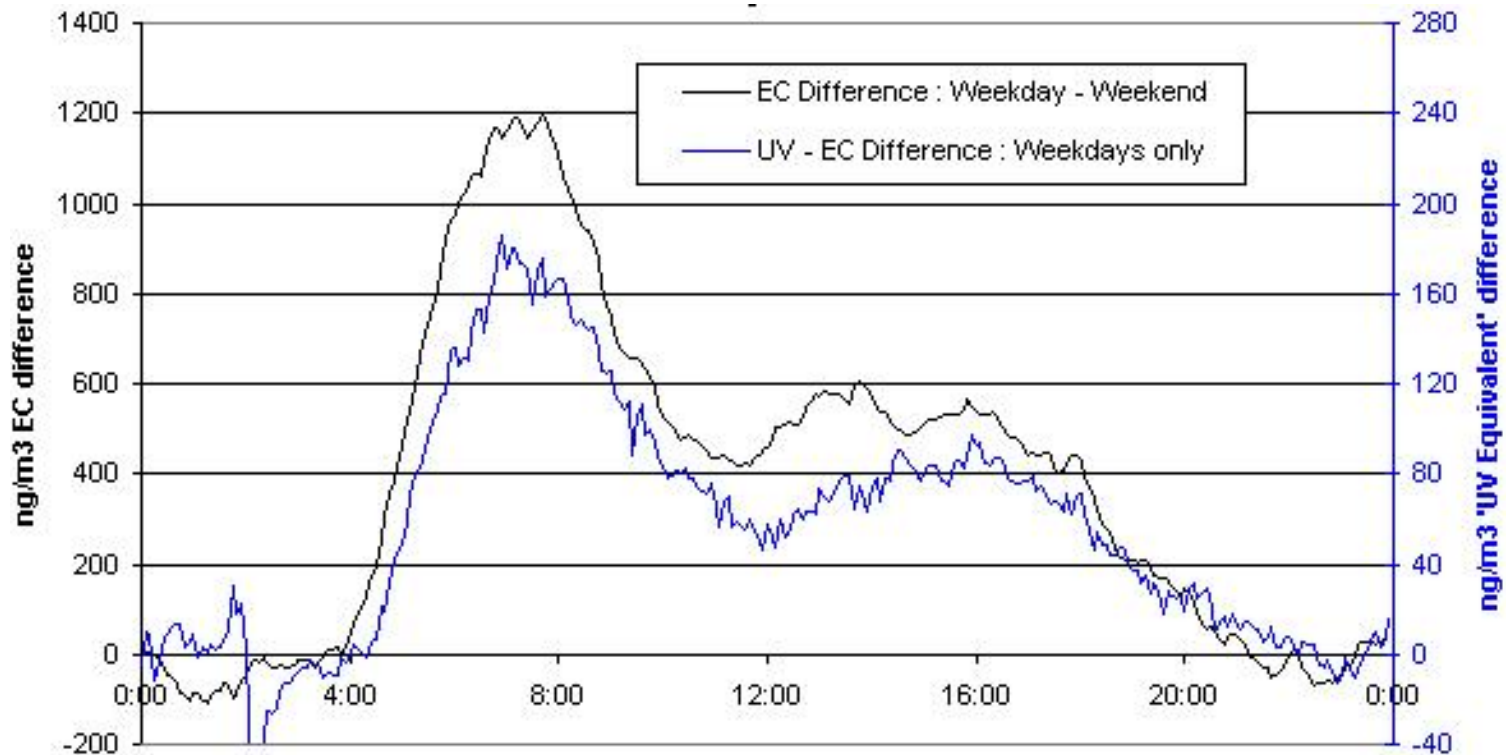


A Diesel Repair Garage ... in Antarctica

Particulate Monitoring in Vehicle Maintenance Facility
McMurdo Station, 1~2 Feb-99

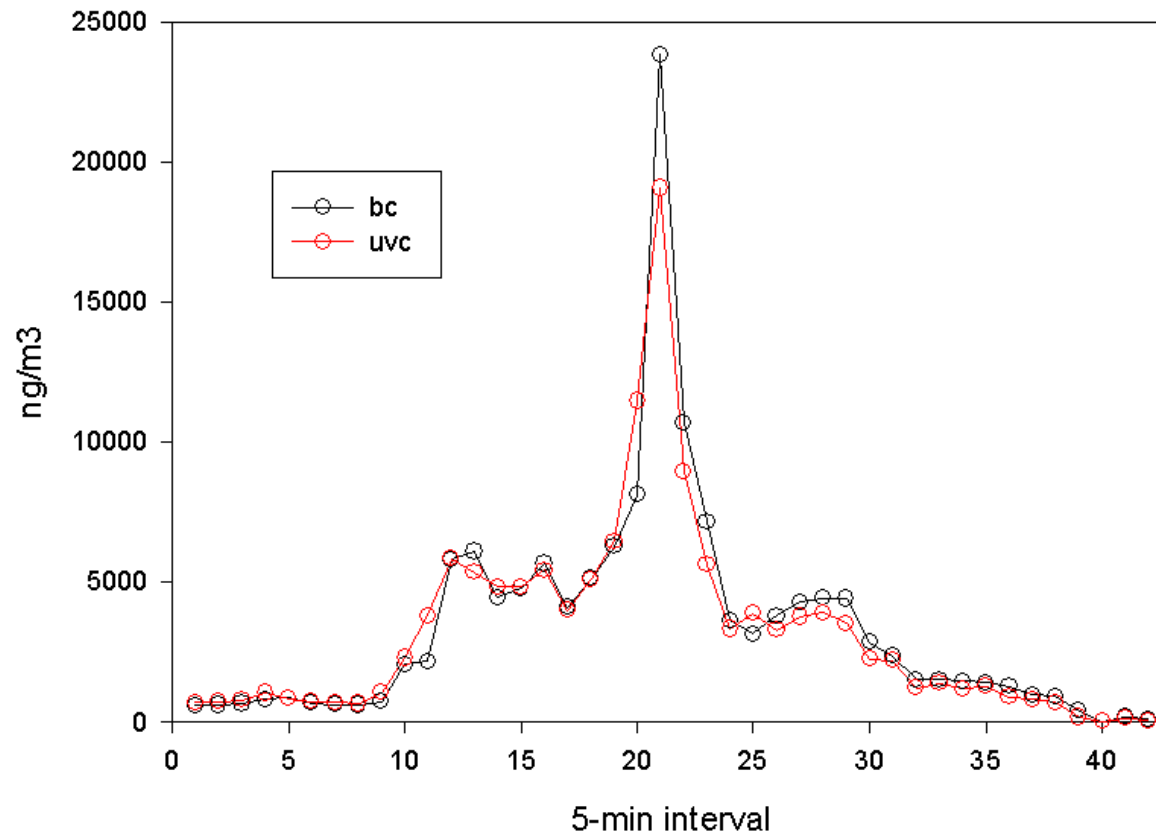


Bus Yard Exhaust - community impact



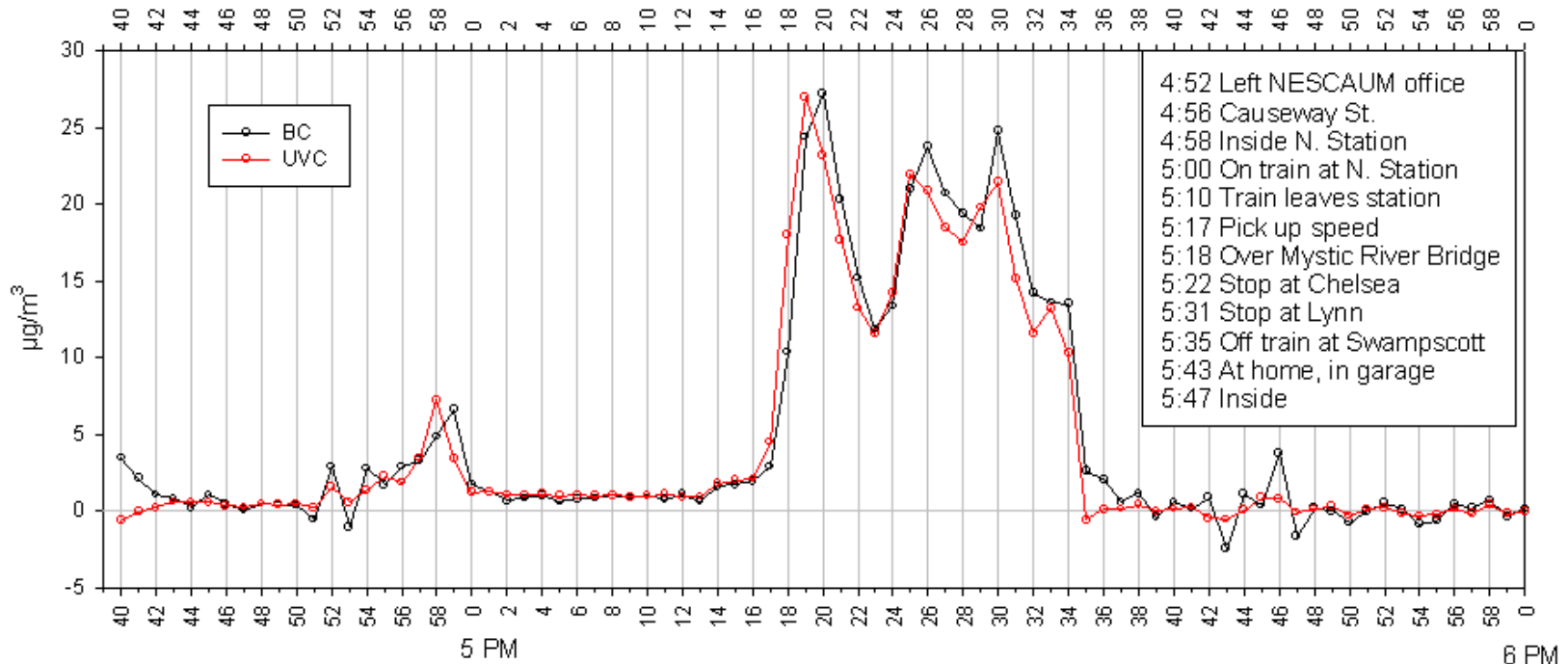
On The Bus in Boston

Boston School Bus Depot 4:00-7:25 am EDT, 5/22/02



On The Train in Boston

1-Minute Aethalometer BC and UV-C, May 8, 2002
Commuter Rail - Car behind engine, outbound



Direct Tailpipe Emissions Analysis

- **The Need:**

On-the-spot analysis for tailpipe BC & UV

- **The Problem:**

Concentrations are too high for analysis based on continuous collection

New Instrument: Aethalometer “Tailpipe Tester”



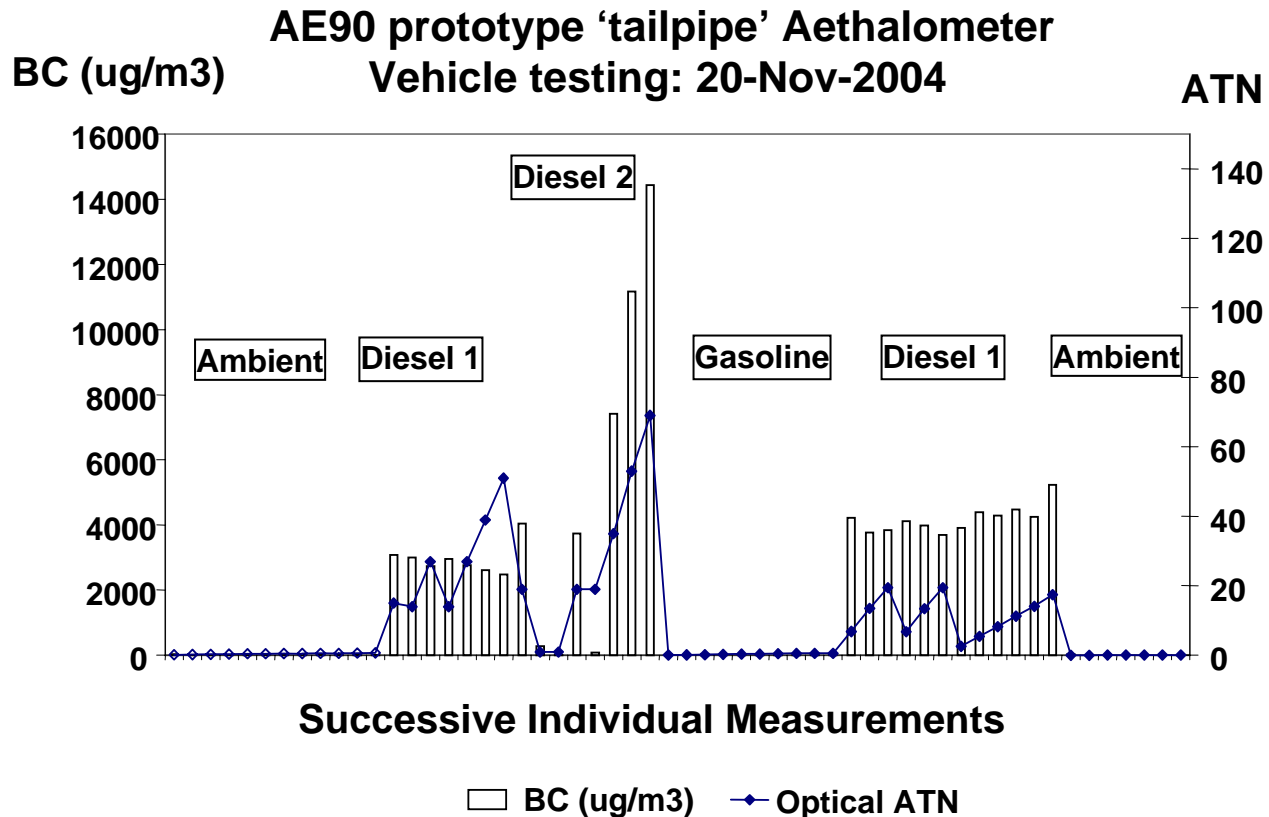
Model ‘AE90’:

Constructed in same chassis, identical optical analysis

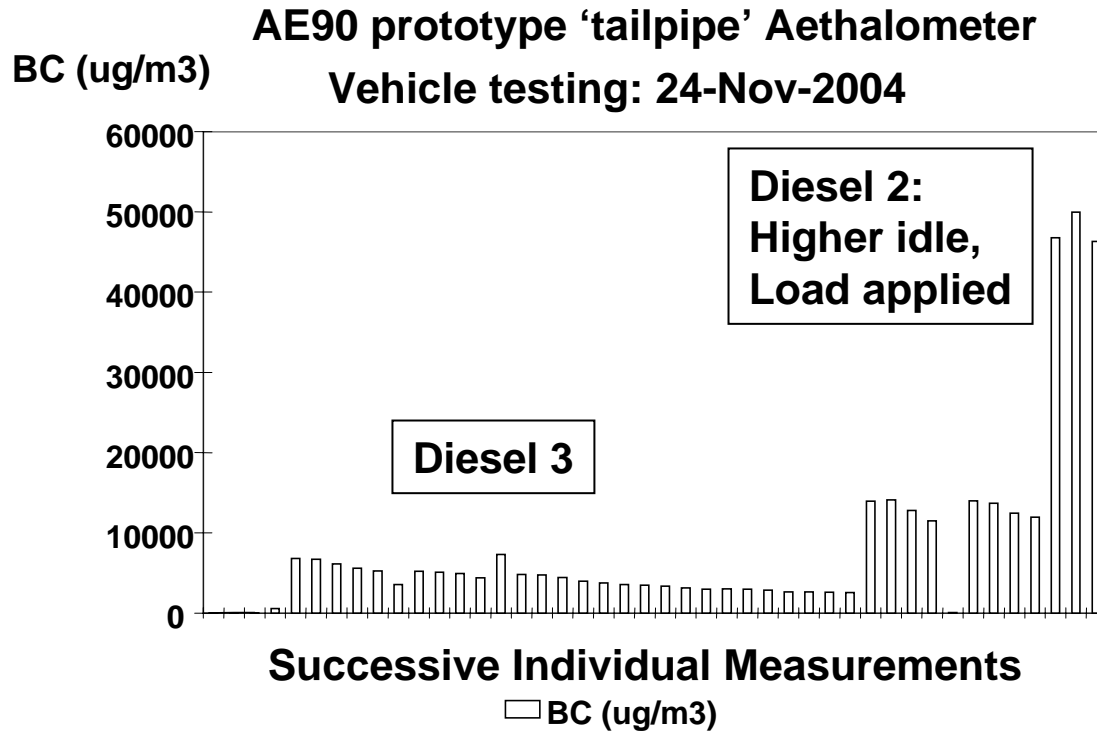
Methodology:

- Pull sample continuously through heated probe inserted into tailpipe.
- Bypass internally until ready for data.
- Switch sample stream through filter spot for a few seconds only.
- After collection, dry with warm filtered air.
- Perform optical analysis ‘on the spot’.

Results : 3 to 15 mg/m³



Results : 10 to 50 mg/m³



Applications: Captive fleet testing

- Identify ‘High Emitters’ for remedial action
- Test effectiveness of engine tune-up:
 reduce source strength at exhaust manifold
- Test effectiveness of emissions reduction equipment (filters, catalytic converters etc.)
 reduce final emissions from tailpipe

Applications: on-road vehicles

- Spot checks - identify 'High Emitters'
- Response to complaints
- Test trucks at highway inspection stations
- Routine vehicle testing for annual certification

Applications: Engine Manufacturers

- Engine R&D testbed measurements
- Real-time response to changing engine operation conditions
- Test effectiveness of fuel additives or downstream emissions clean-up devices

Summary

Black Carbon and *UV-Absorbing Carbon* are good surrogates for diesel exhaust.

The ‘Tailpipe Tester’ **AE-90** Aethalometer uses the established optical analysis method to measure *BC* and *UVPM* directly in the exhaust stream, ‘on the spot’.

Acknowledgments

Harvard School of Public Health

National Institute of Chemistry, Slovenia

For further information:

[www . mageesci . com](http://www.mageesci.com)