

Performance of Continuous PM_{2.5} Monitors at a Monitoring Site in Ottawa, Canada

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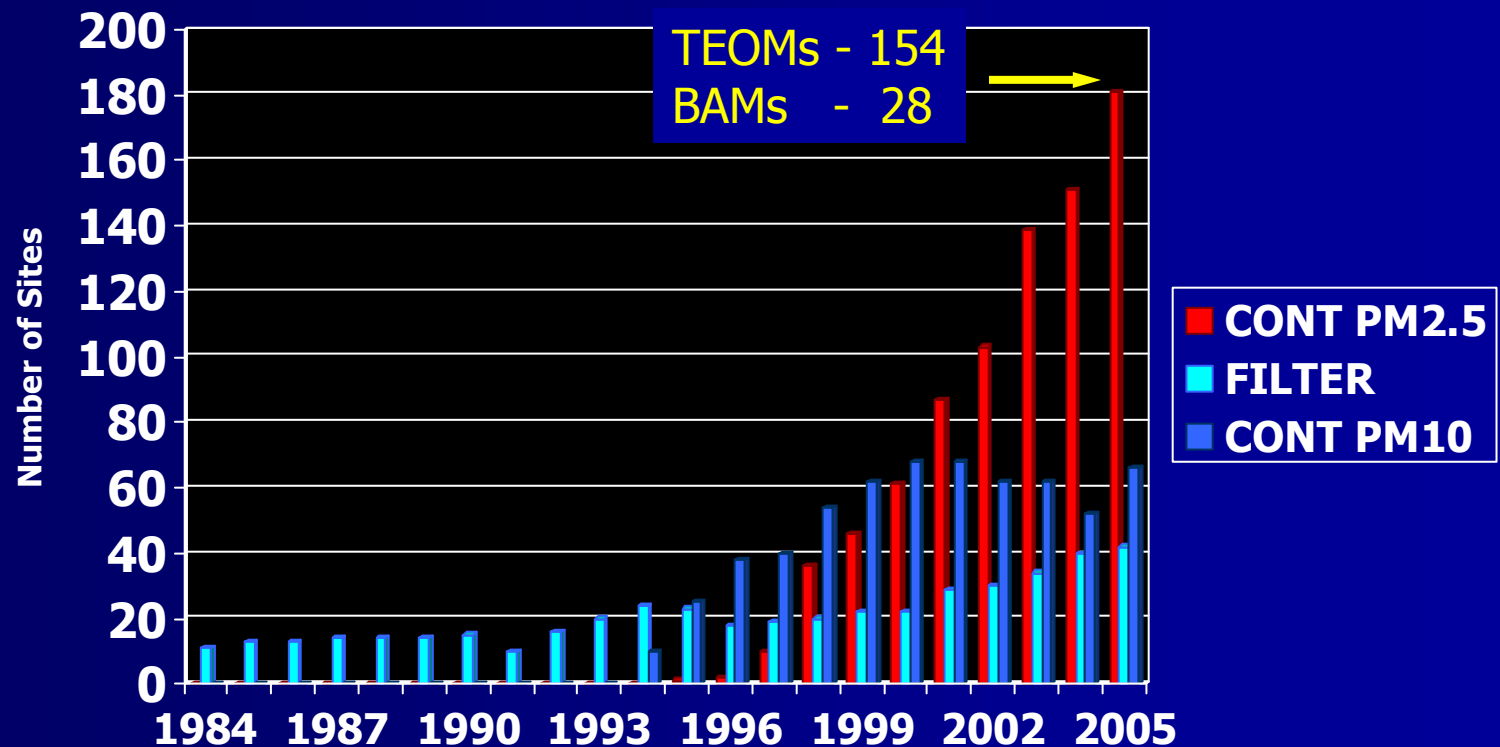
National Air Monitoring Conference, November 2006



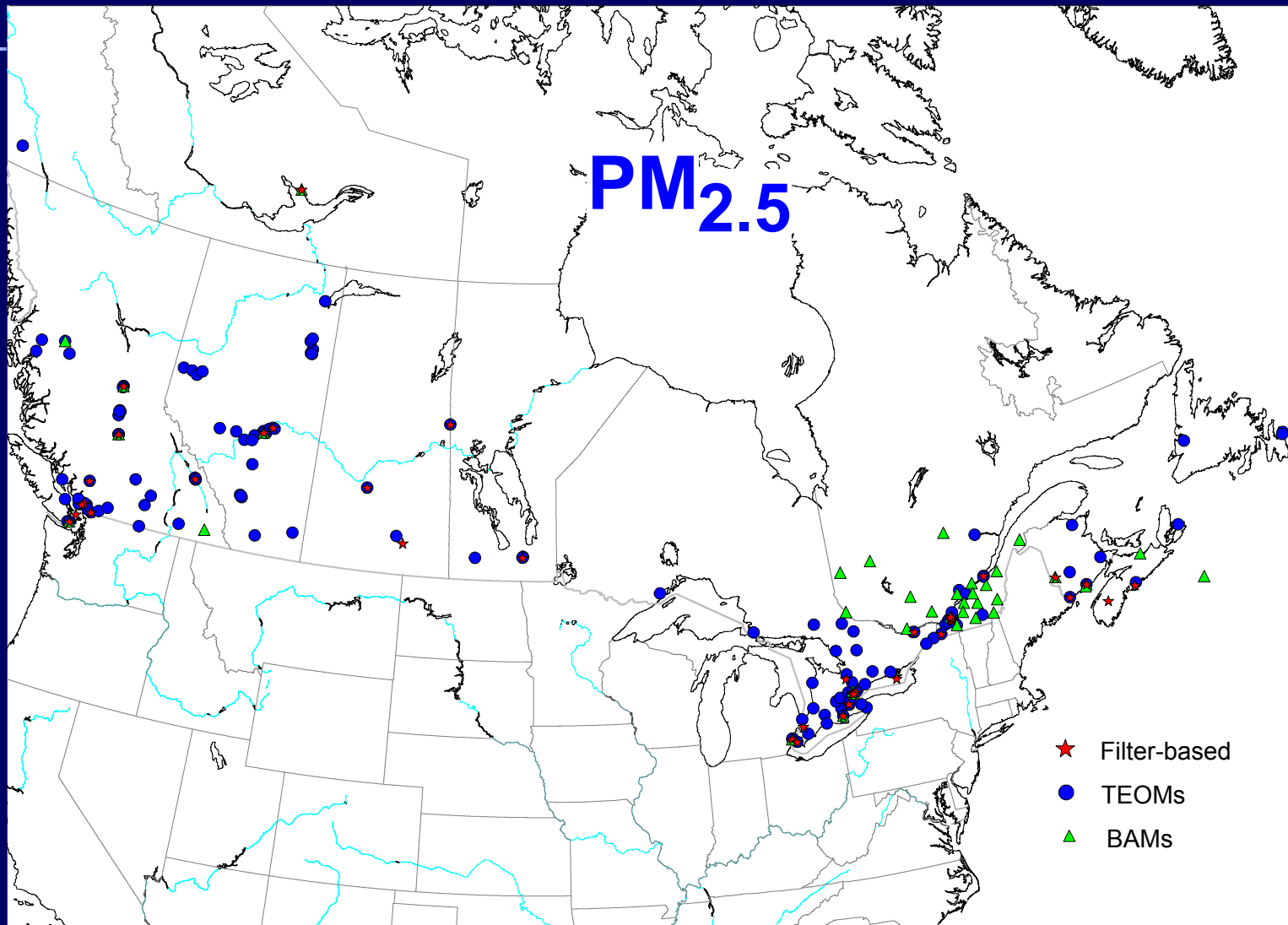
**Environment
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Canada**

Growth in PM_{2.5} Monitoring in Canadian National Air Pollution Surveillance (NAPS) Network



Existing PM_{2.5} Monitoring Sites in Canada (2005) reporting to NAPS



US EPA: National Ambient Air Quality Standards for PM Final Rule

October 16, 2006

Limits for Equivalency

- Slope: 1 ± 0.1
- Intercept: -2.0 to 2.0
- Correlation Coefficient: 0.93 to 0.95
(depends on range of concentrations measured)
- Precision: < 15%

Note: only values greater than $3 \mu\text{g}/\text{m}^3$
are included

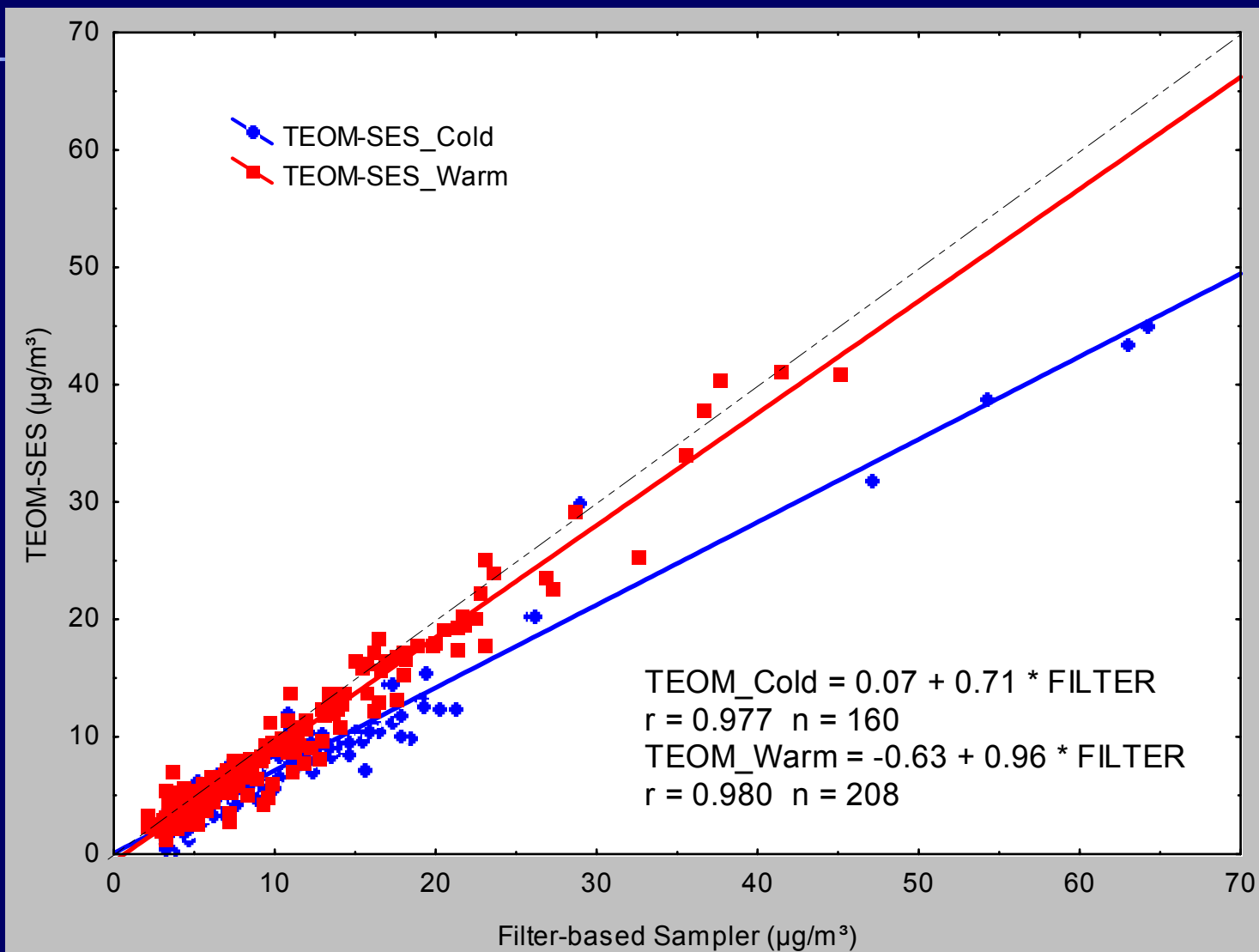
Ottawa Monitoring Site

- Study Period: May 2004 – present
378 days of data for 1 or more continuous instruments with filter-based data
- 24h PM_{2.5} *Max*: 64 µg/m³ *98th Perc*: 37 µg/m³
Mean: 10.0 µg/m³
- Temperature Range: -27°C to 29°C
- Filter based samplers: R&P Partisol FRM and R&P Partisol Sequential Dichot

Ottawa Monitoring Site

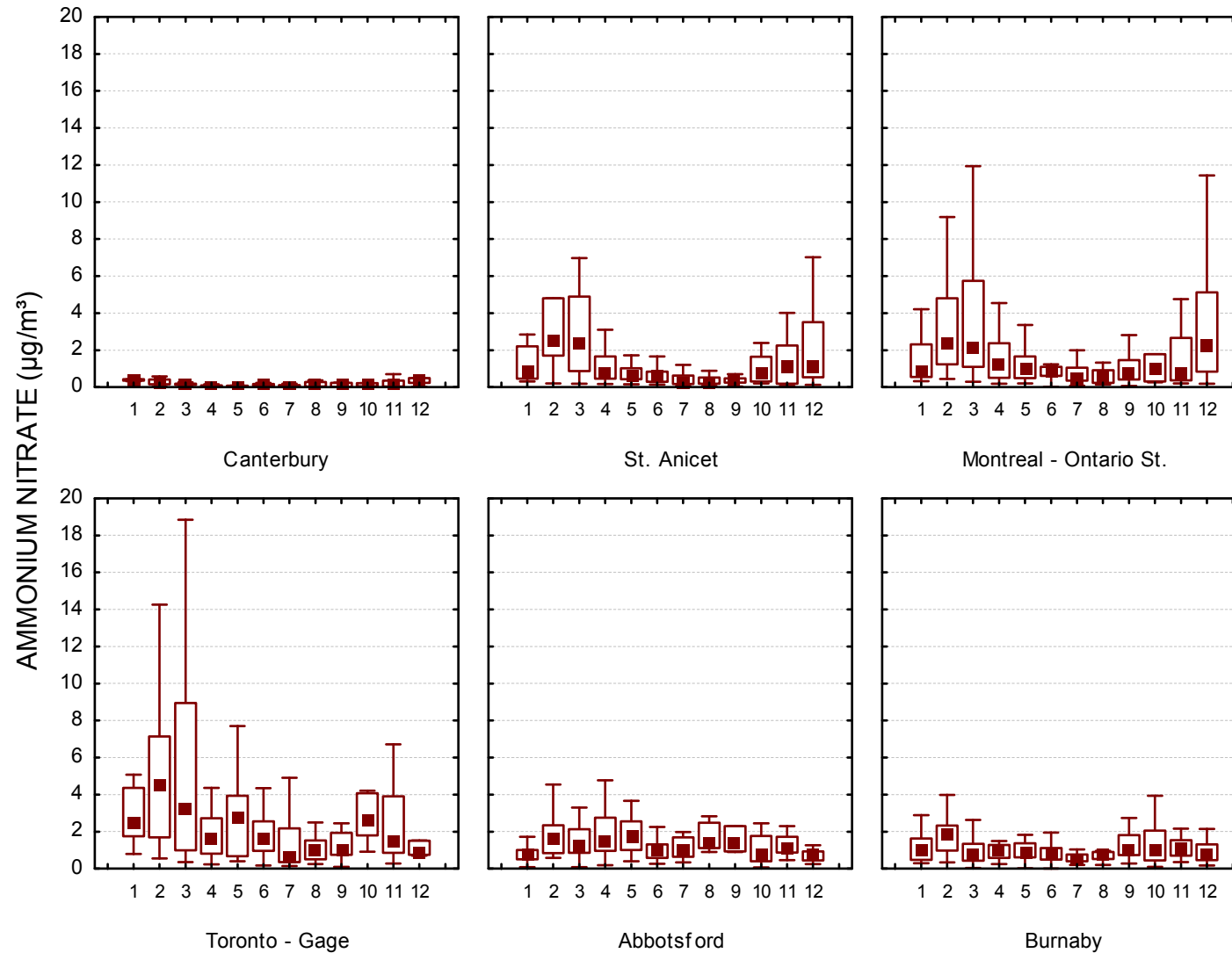
- Met-One BAM 1020 May 2004
- R&P 1400AB TEOM (40 °C) May 2004
- TEOM SES (30 °C) May 2004
- TEOM FDMS July 2004
- GRIMM 180 (PM₁₀, PM_{2.5}, PM_{1.0}) Oct. 2005
- Thermo SHARP 5030 June 2006

Linear regression results for 24h data – TEOM-SES Ottawa (2004-2006)



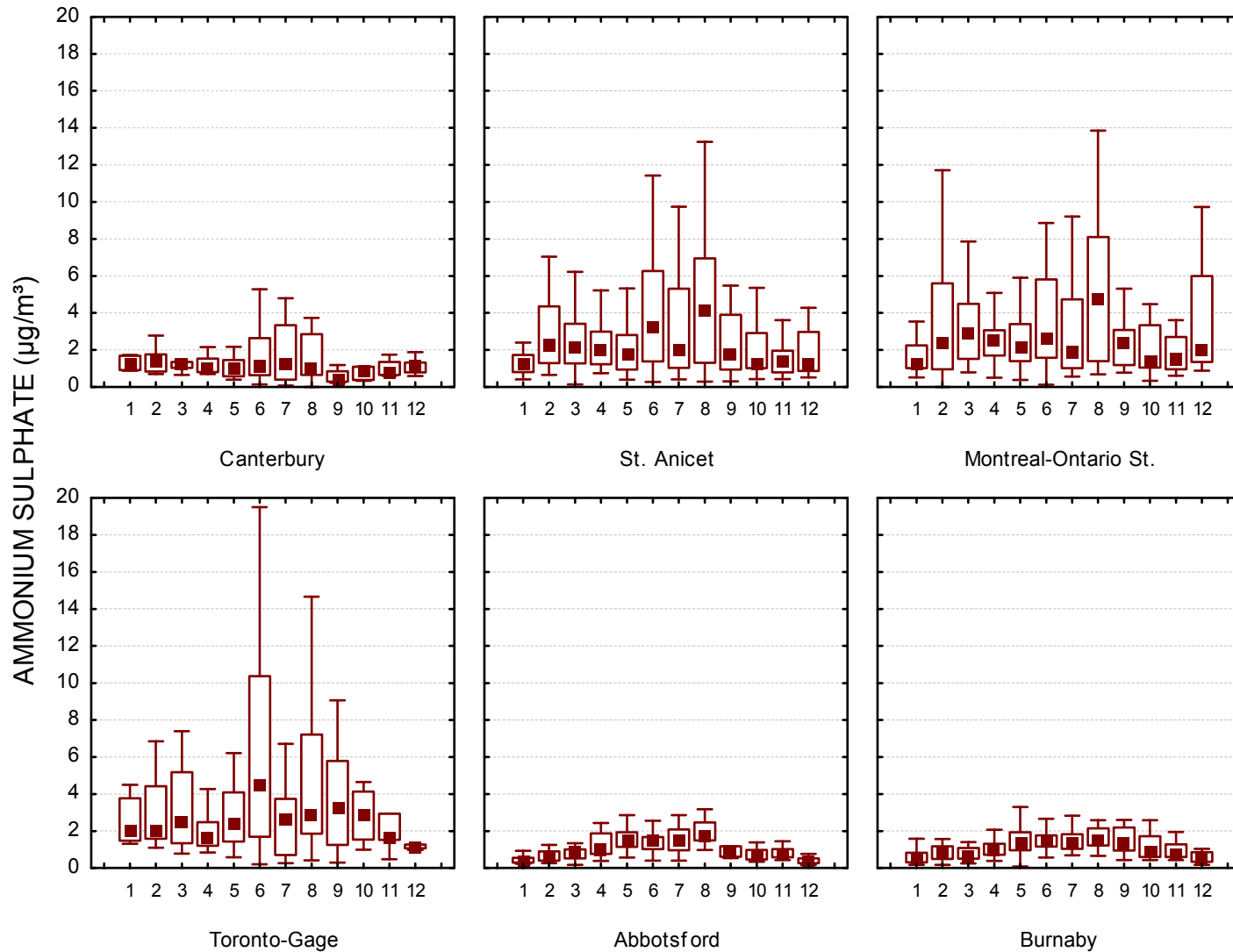
Seasonal Variations in Ammonium Nitrate at Canadian Sites (2004 - 2005)

(Median, 25th and 75th percentile, non-outlier min and max)



Seasonal Variations in Ammonium Sulphate at Canadian Sites (2004 - 2005)

(Median, 25th and 75th percentile, non-outlier min and max)

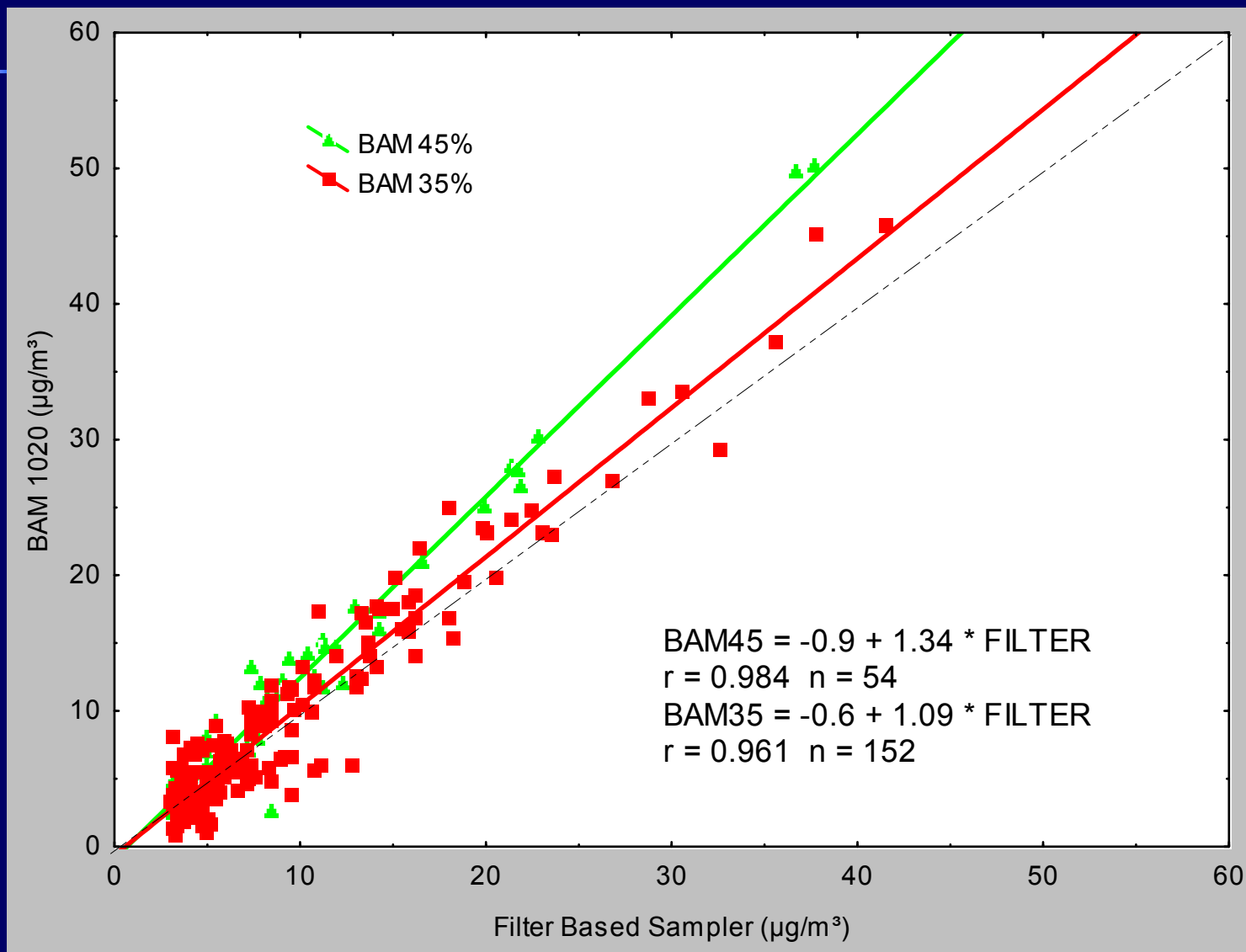


Met-One BAM 1020

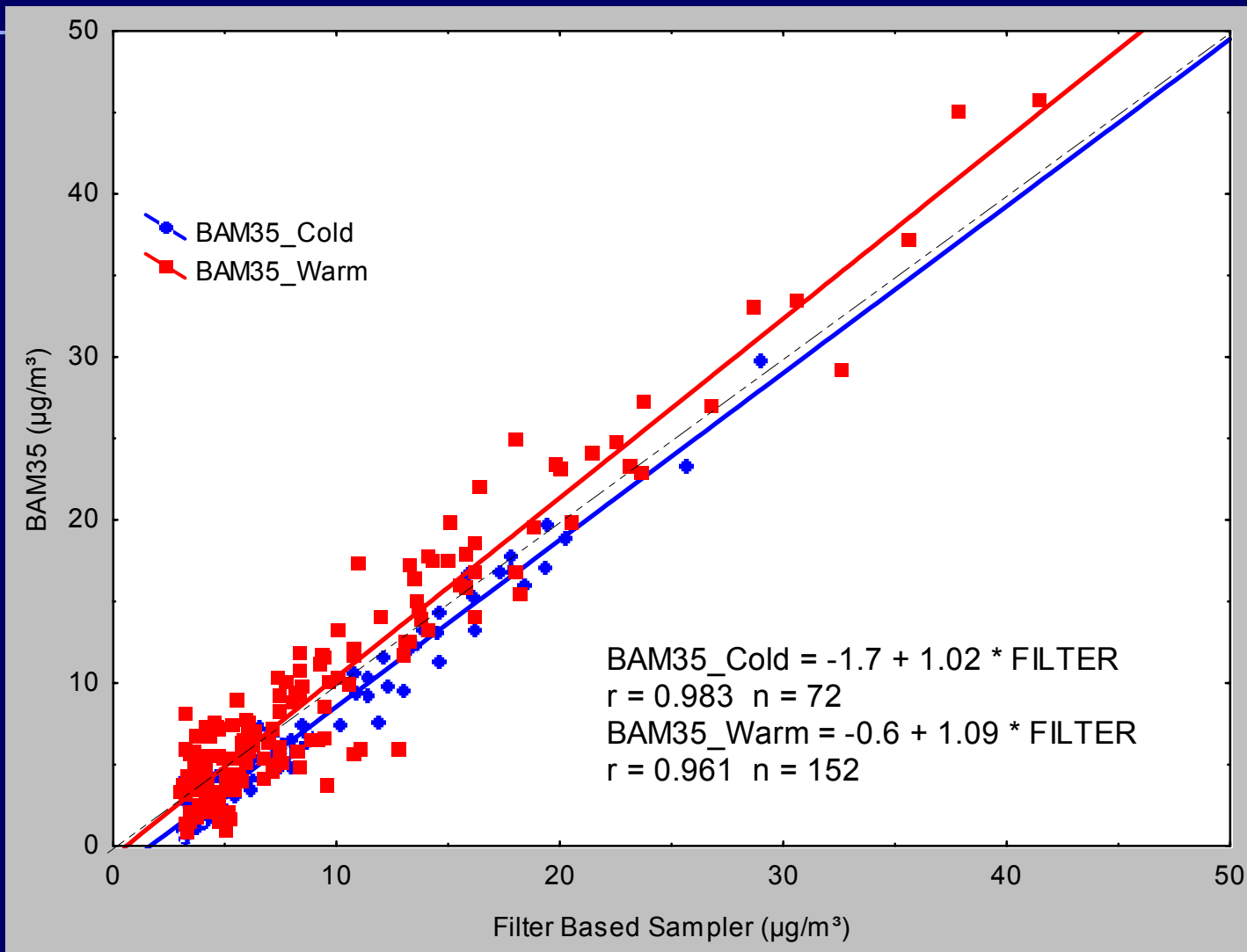


- low-level C^{14} radiation source
- uses beta-ray attenuation and a filter tape system
- inlet is heated but filter is at ambient (station) temperature
- humidity problems in early units caused higher readings in the summer
- 'smart heater' is turned on by a relative humidity sensor
- hourly average output

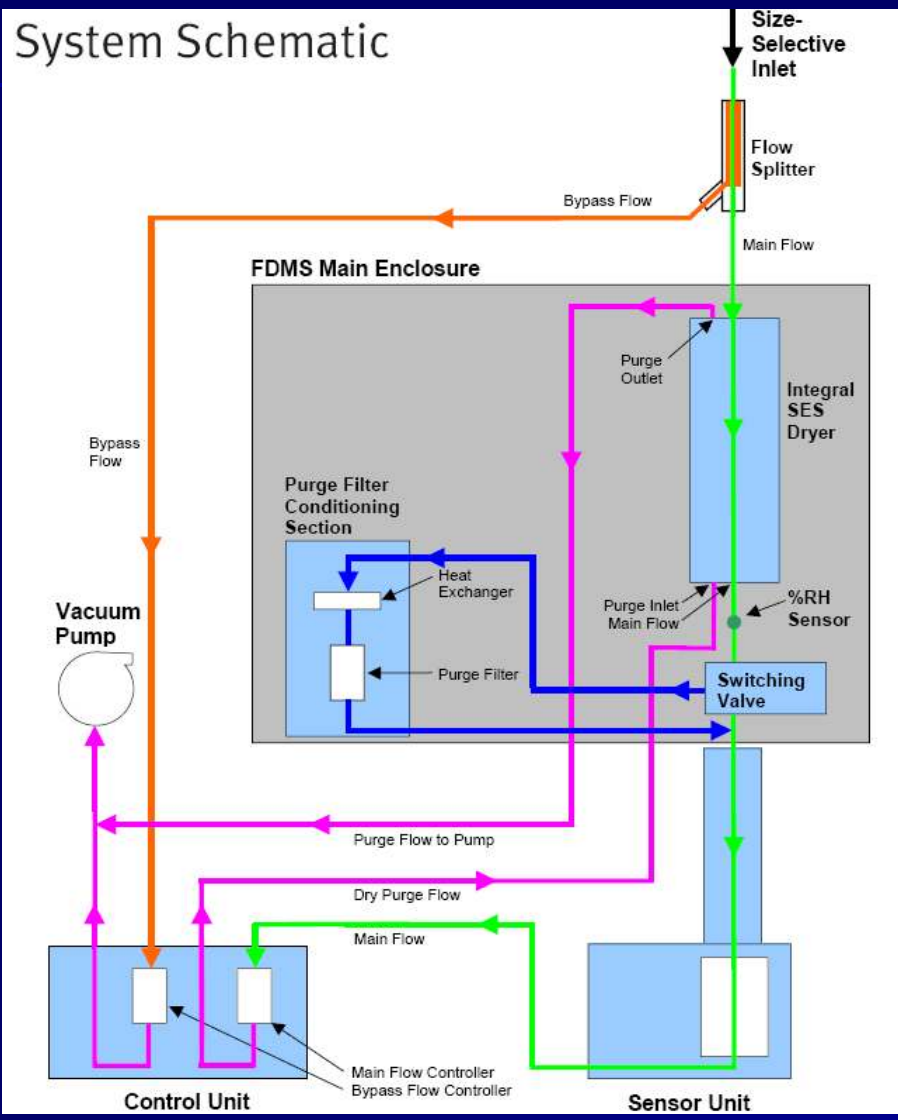
Linear regression results for 24h data BAM Ottawa (Warm Seasons 2004-2006)



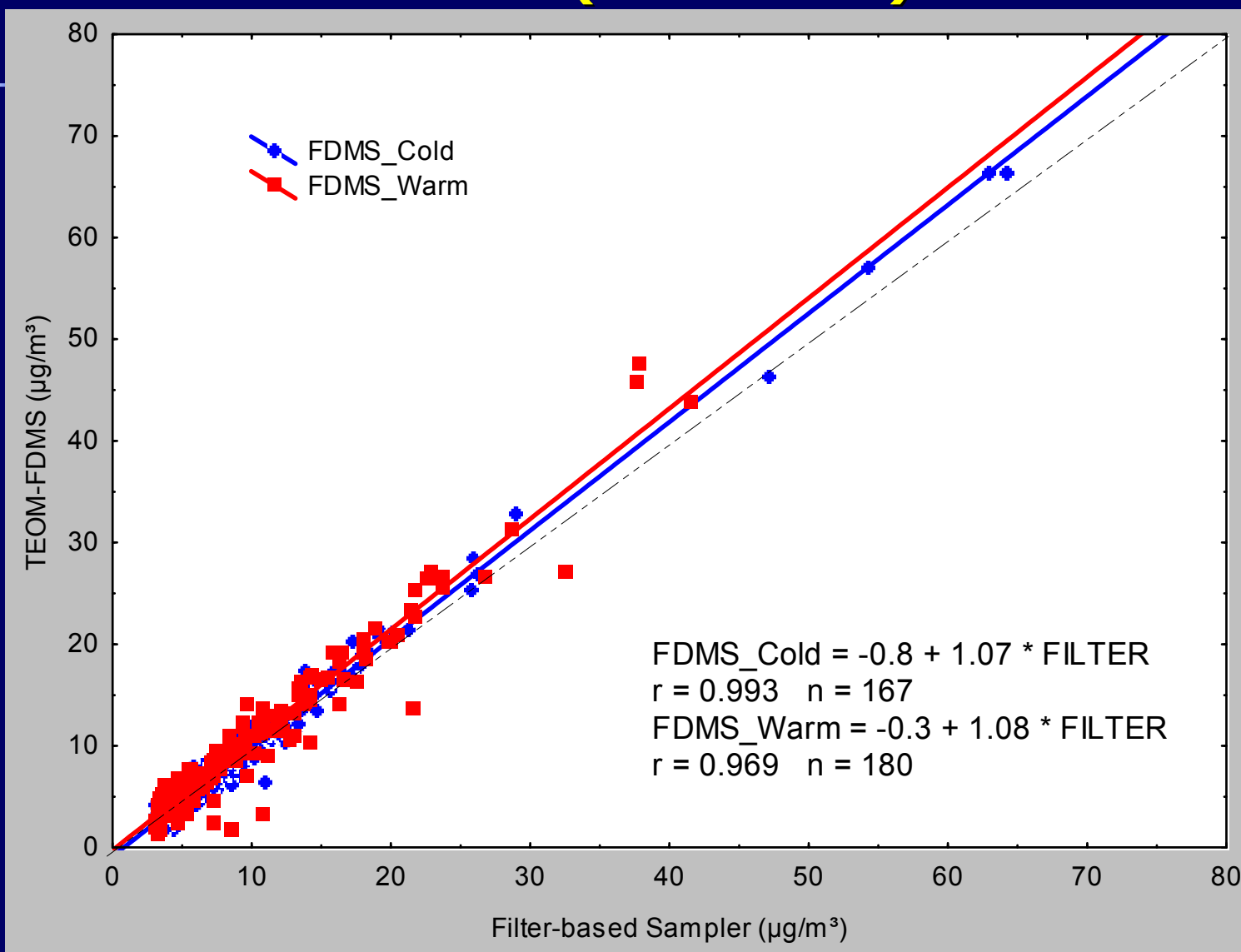
Linear regression results for 24h data BAM with 35% Humidity Setting Ottawa (2005-2006)



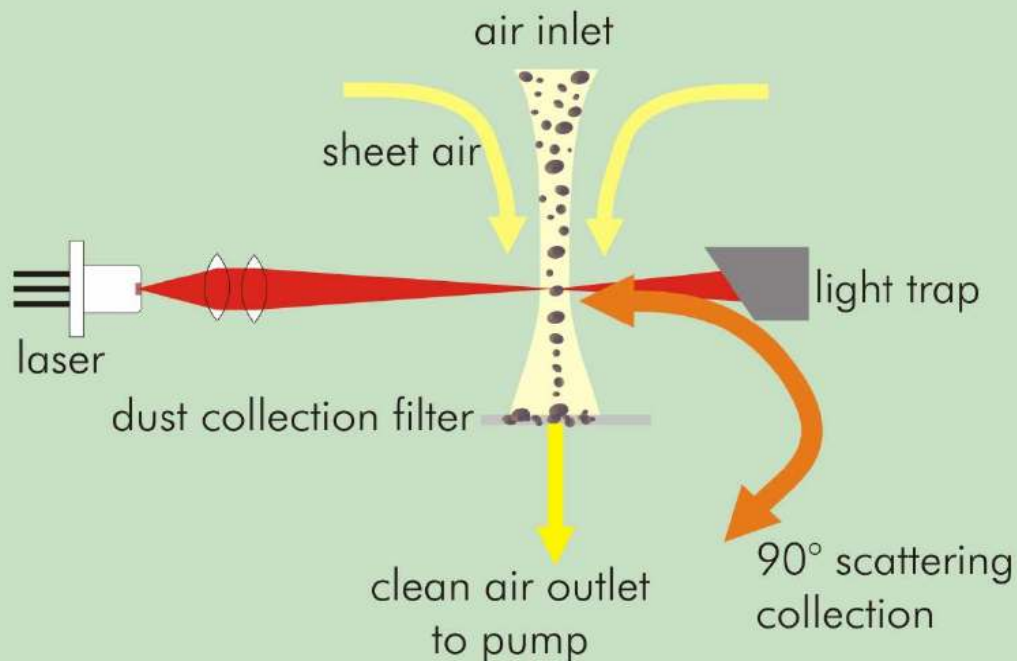
TEOM-FDMS



Linear regression results for 24h data TEOM-FDMS Ottawa (2004-2006)

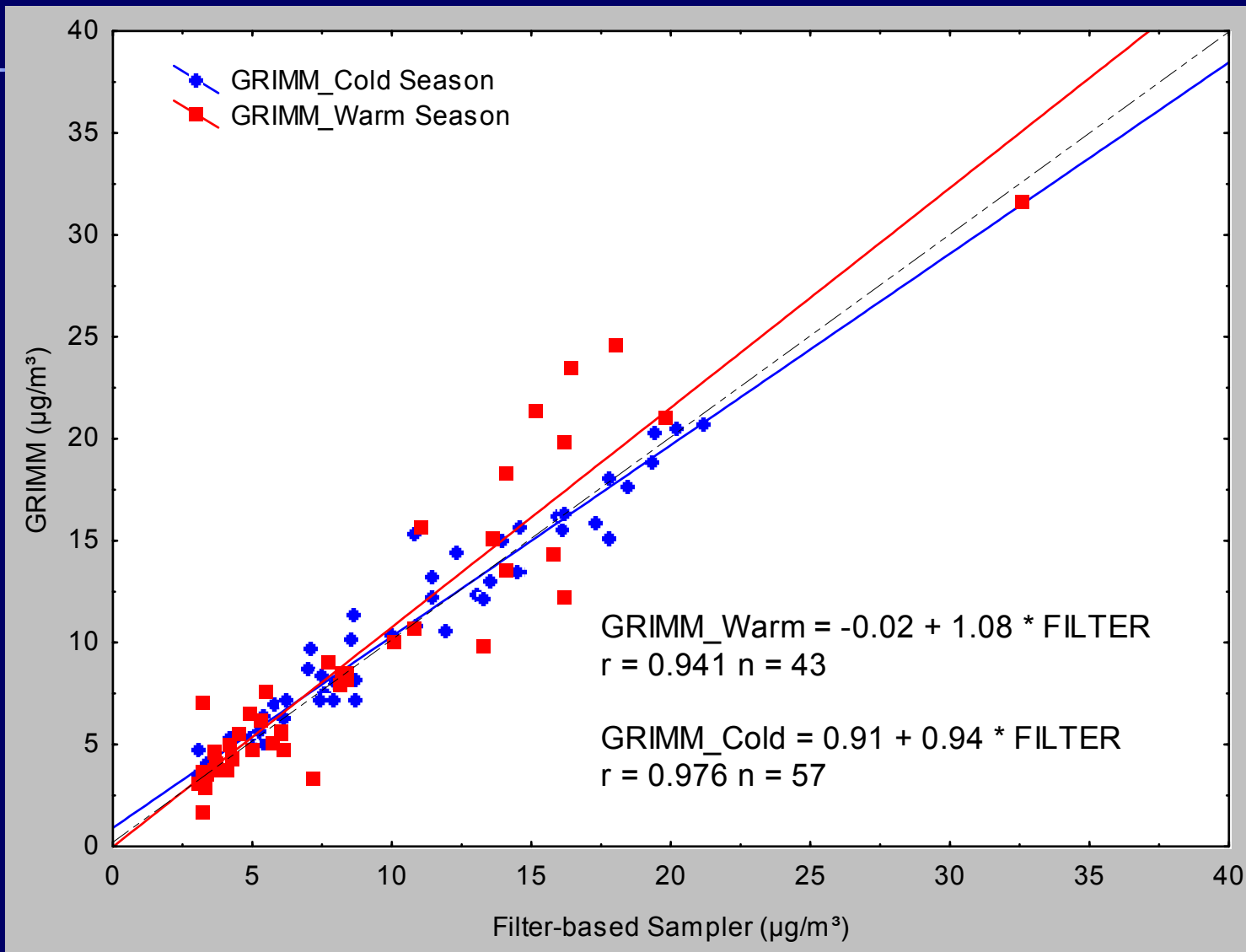


Grimm 180 Multi-channel Aerosol Spectrometer

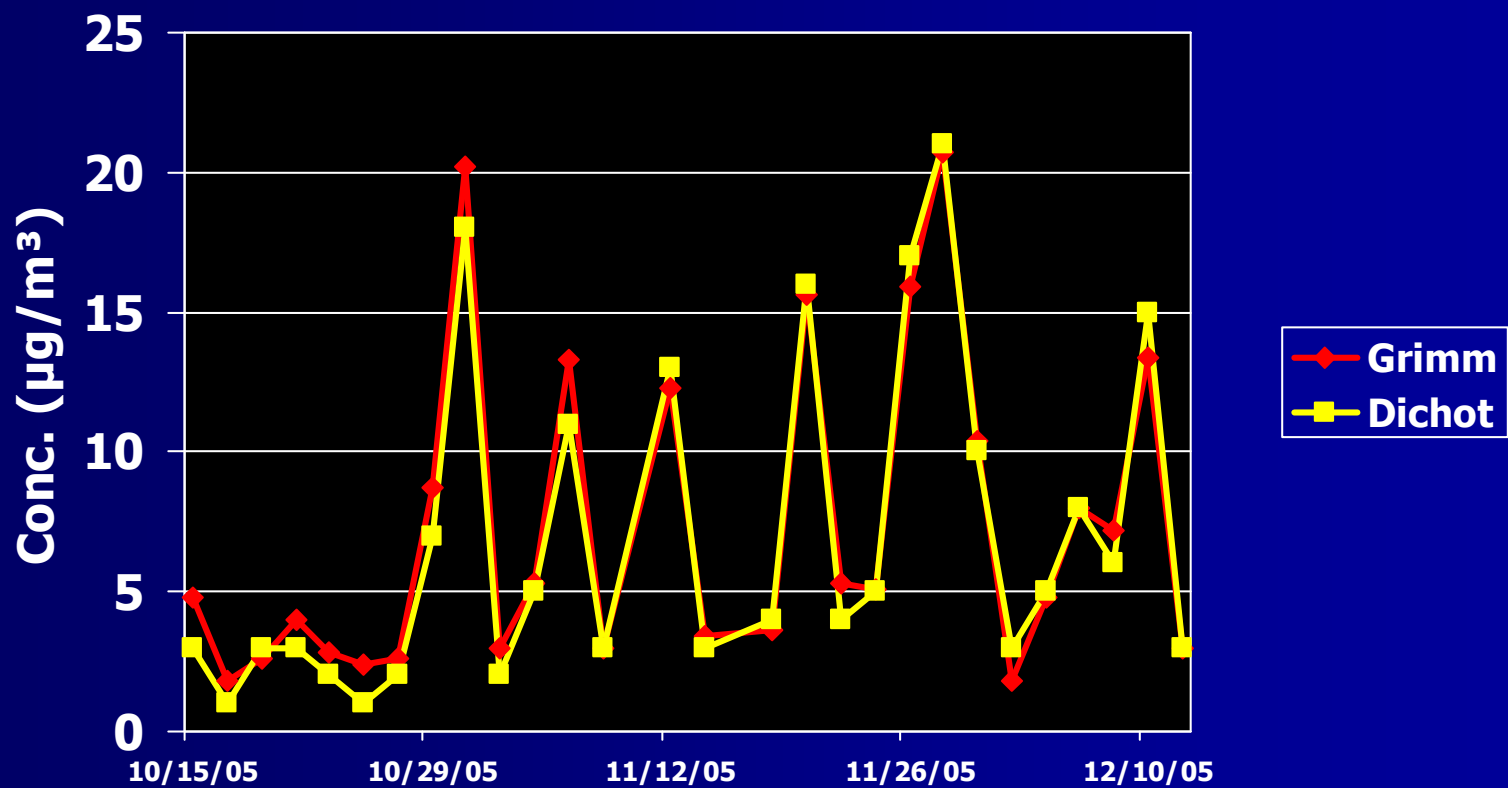


Simultaneous measurement of $PM_{1.0}$, $PM_{2.5}$ and PM_{10}
Particle counts by size (31 channels) and mass determination using algorithms
No size cut on inlet – moisture control using Nafion dryer
Truly continuous (real-time)

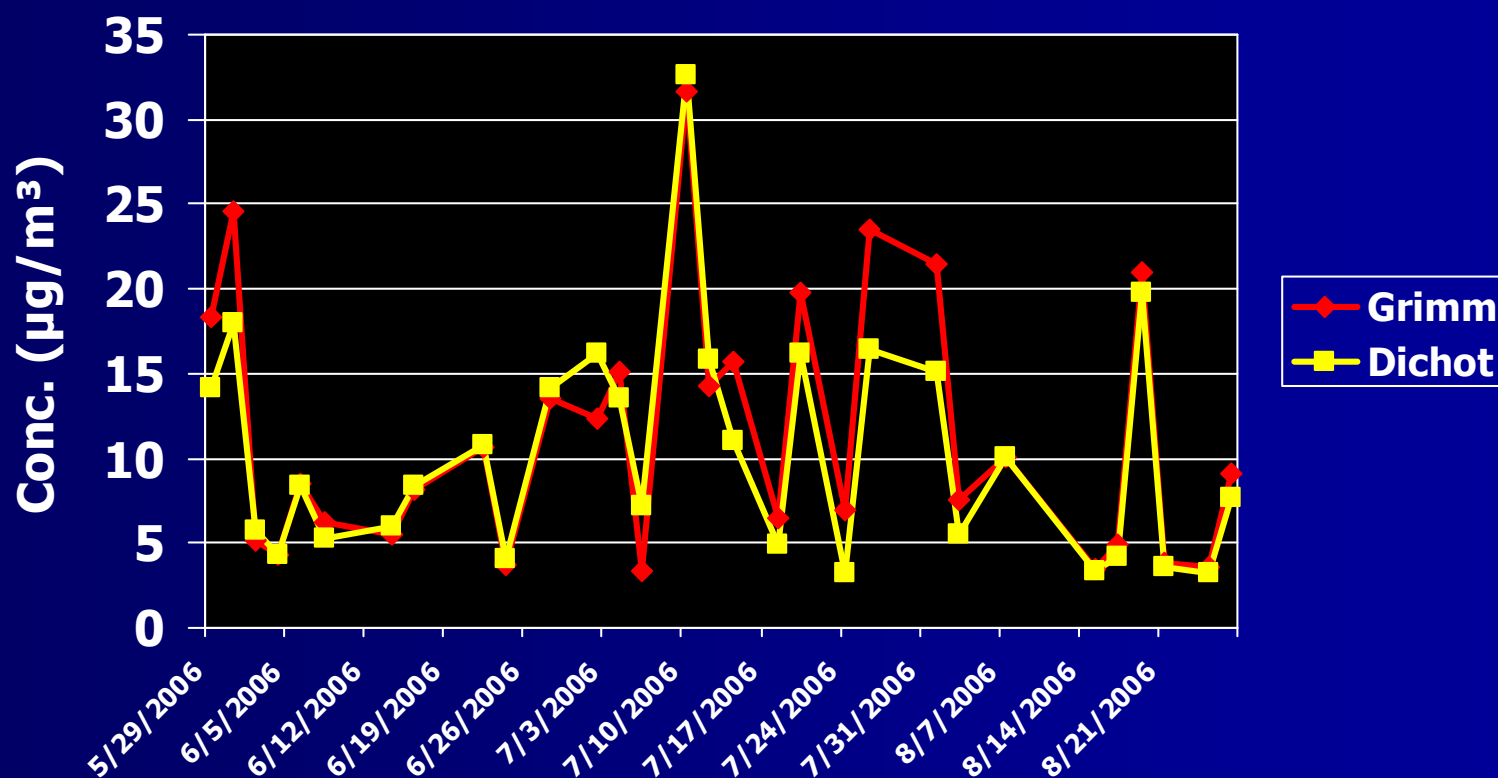
Results for 24h data: Grimm 180 (Ottawa) Oct. 2005 – Sep. 2006



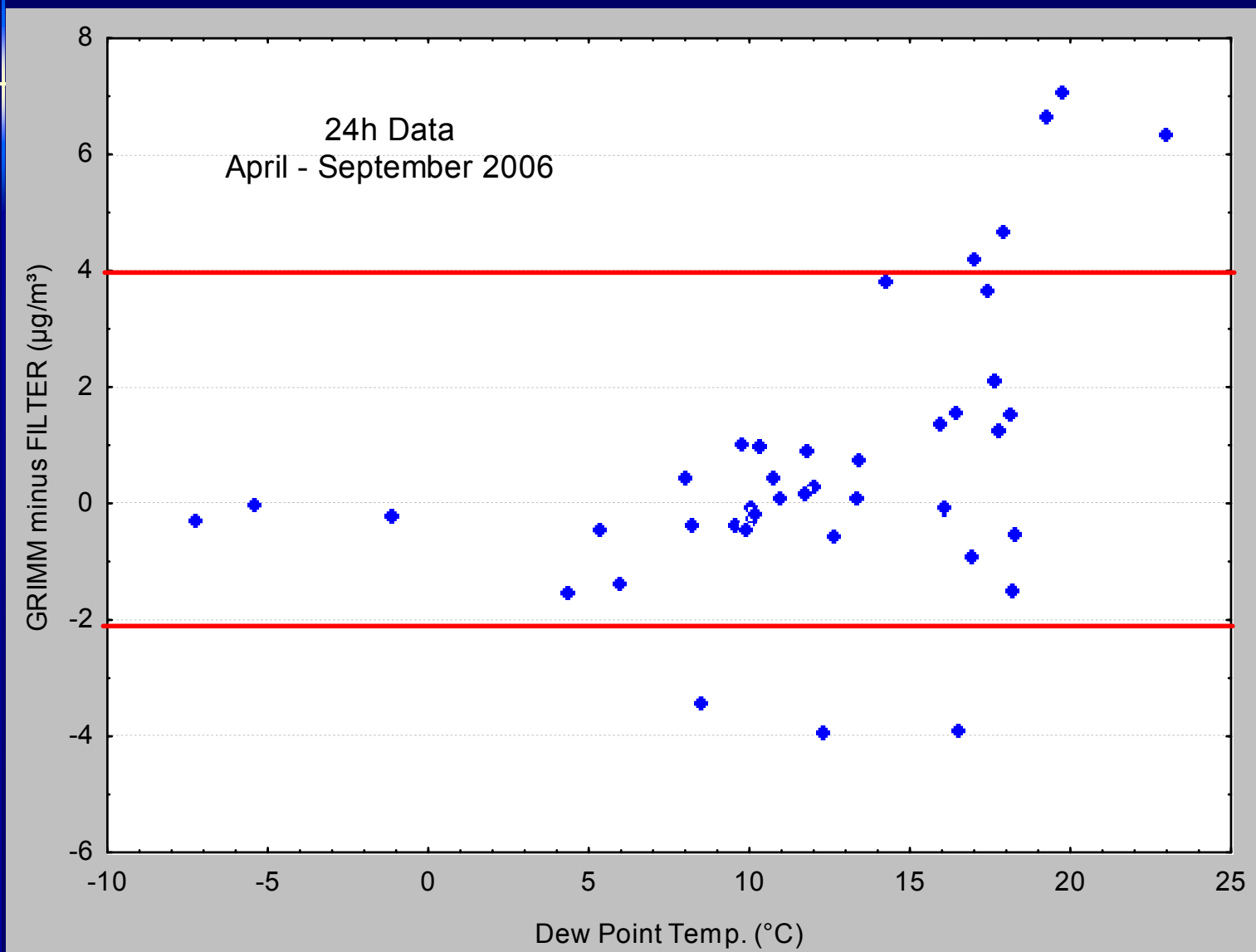
Grimm 180 Results – Ottawa Winter 2005



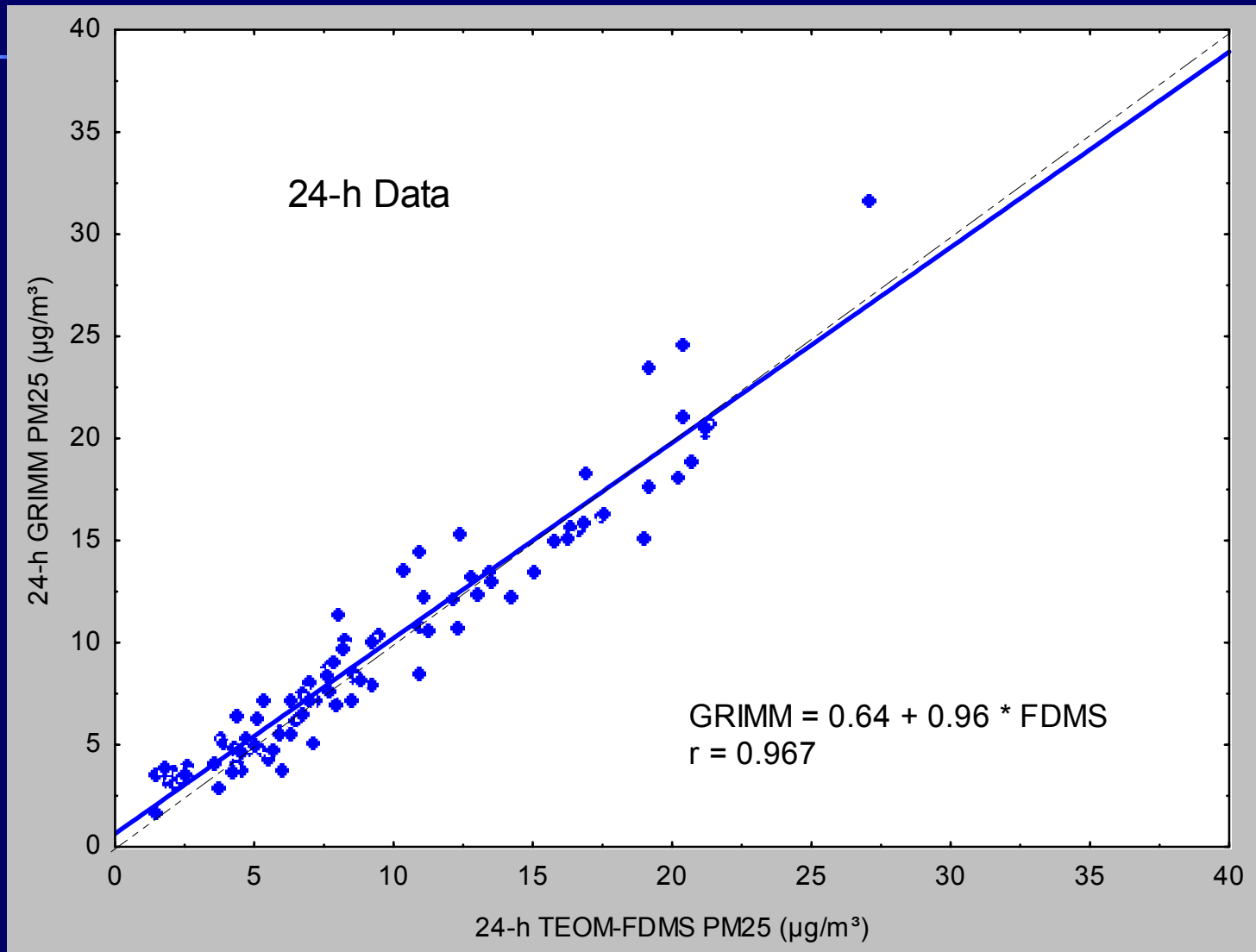
Grimm 180 Results – Ottawa Summer 2006



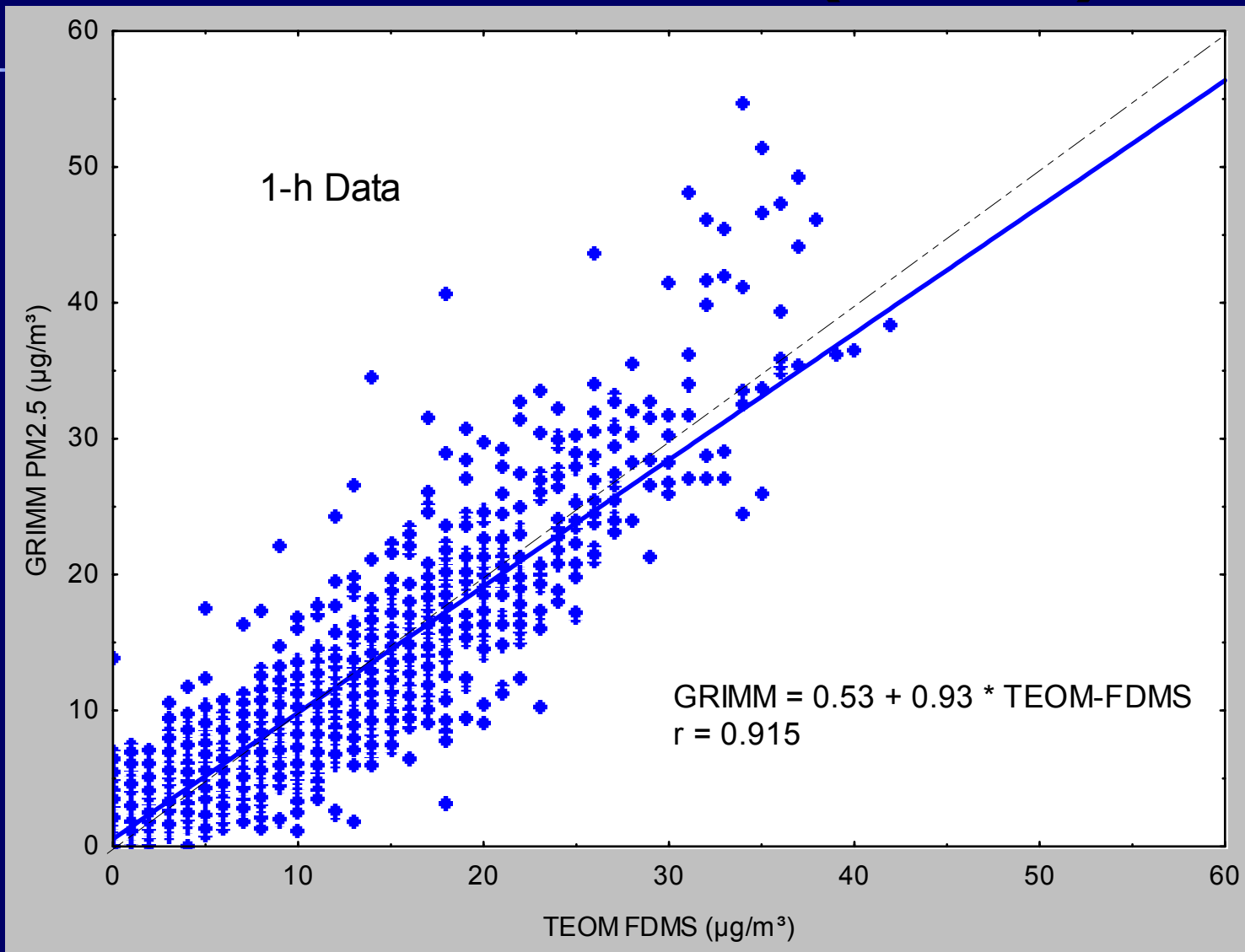
Humidity Effects on Grimm 180 (Ottawa)?



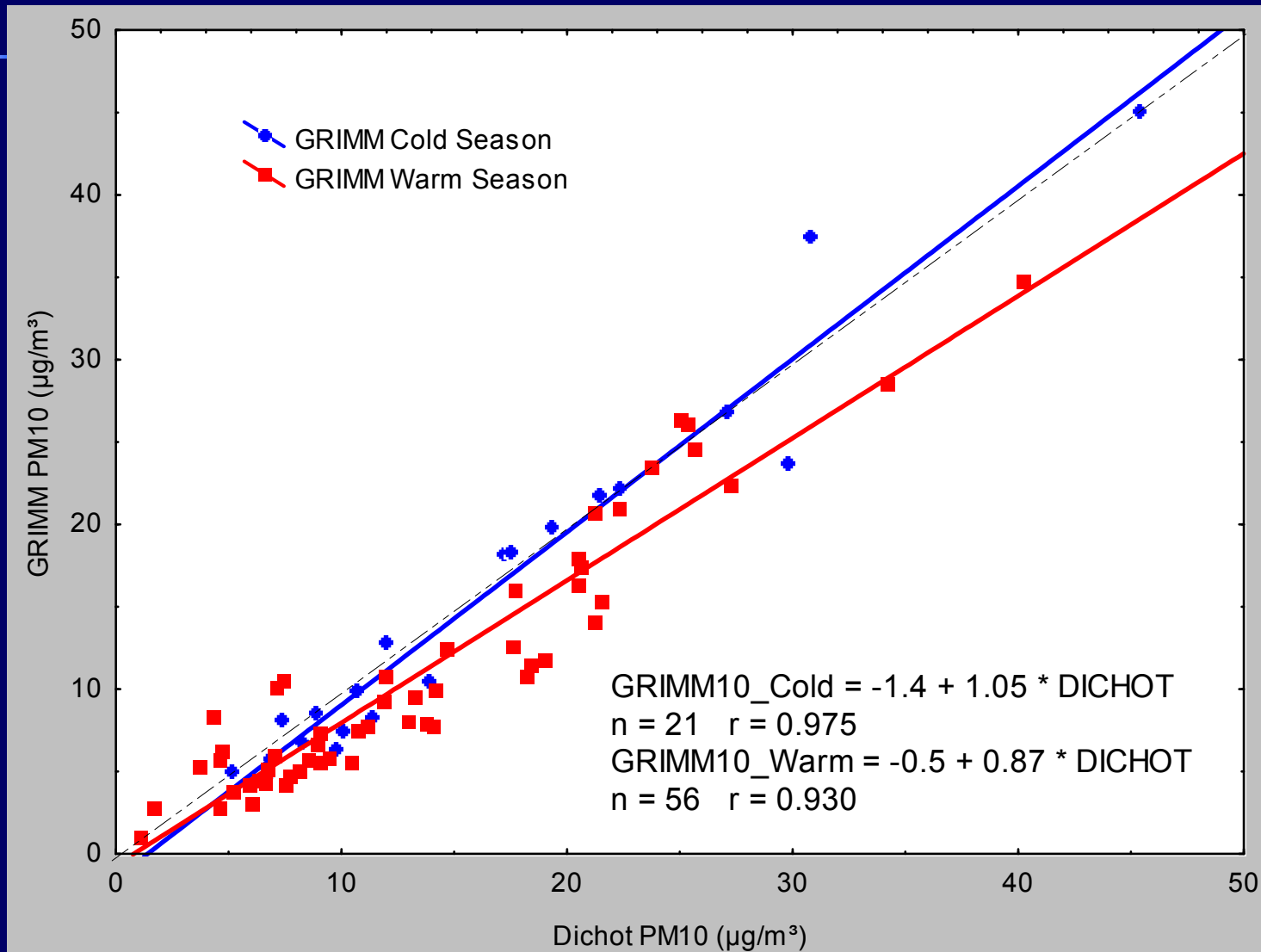
Linear regression results for 24h data: GRIMM and TEOM-FDMS (Ottawa)



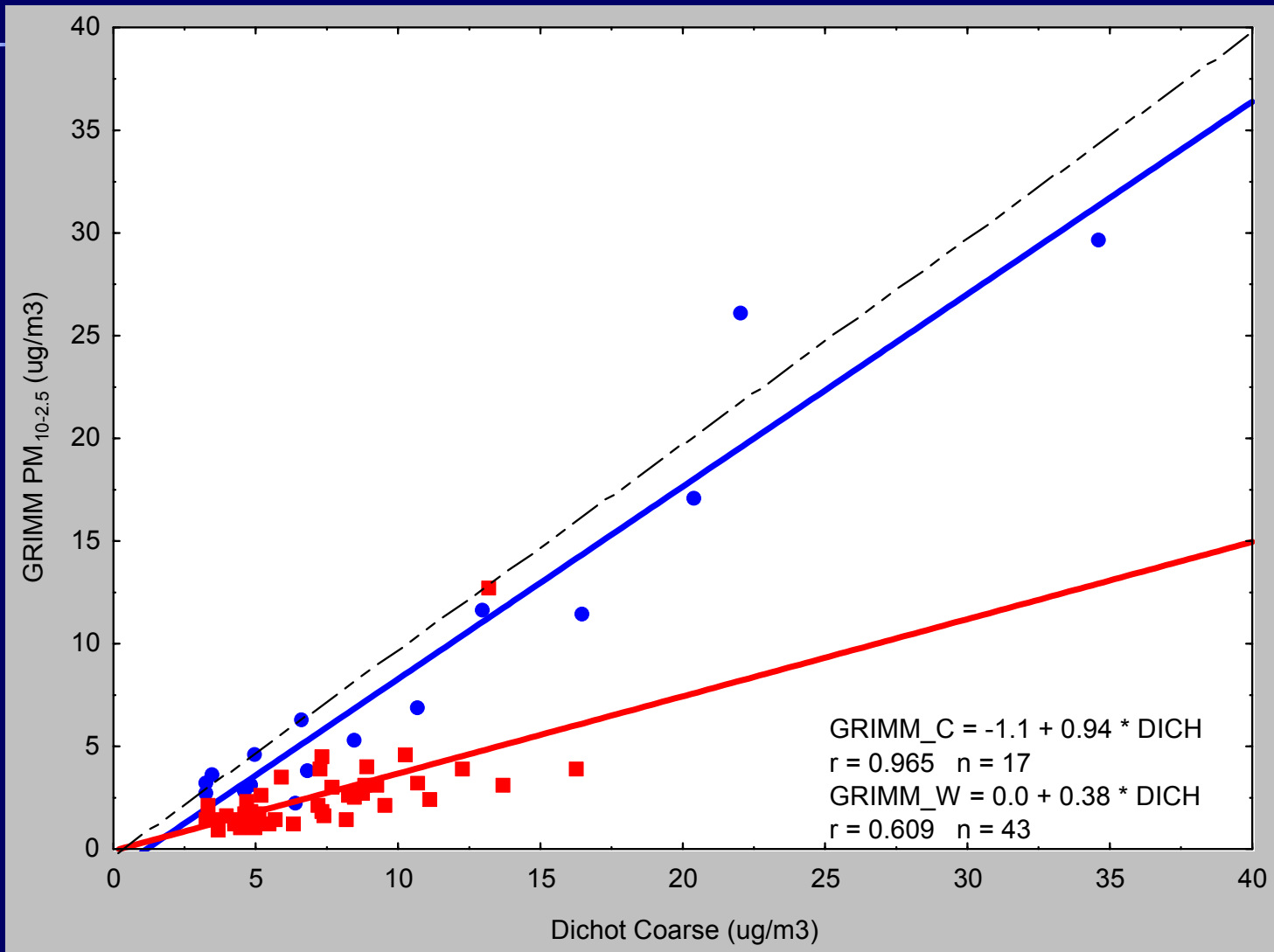
Linear regression results for 1h data: GRIMM and TEOM-FDMS (Ottawa)



Linear regression results for 24h data: GRIMM PM₁₀ (Ottawa Jan. – Sep. 2006)

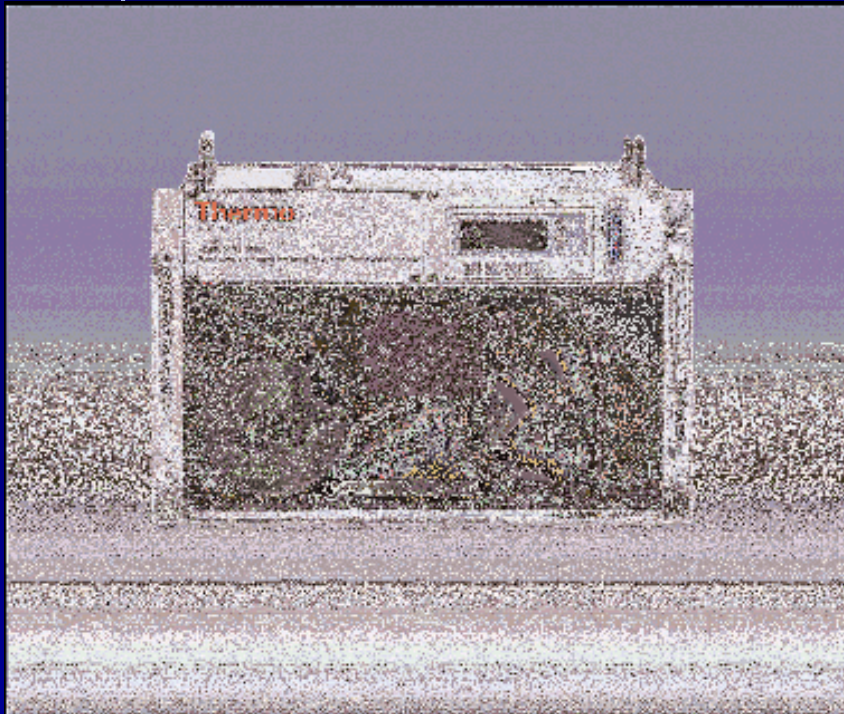


Linear regression results for 24h data: GRIMM PM_{10-2.5} (Ottawa Jan. – Sep. 2006)



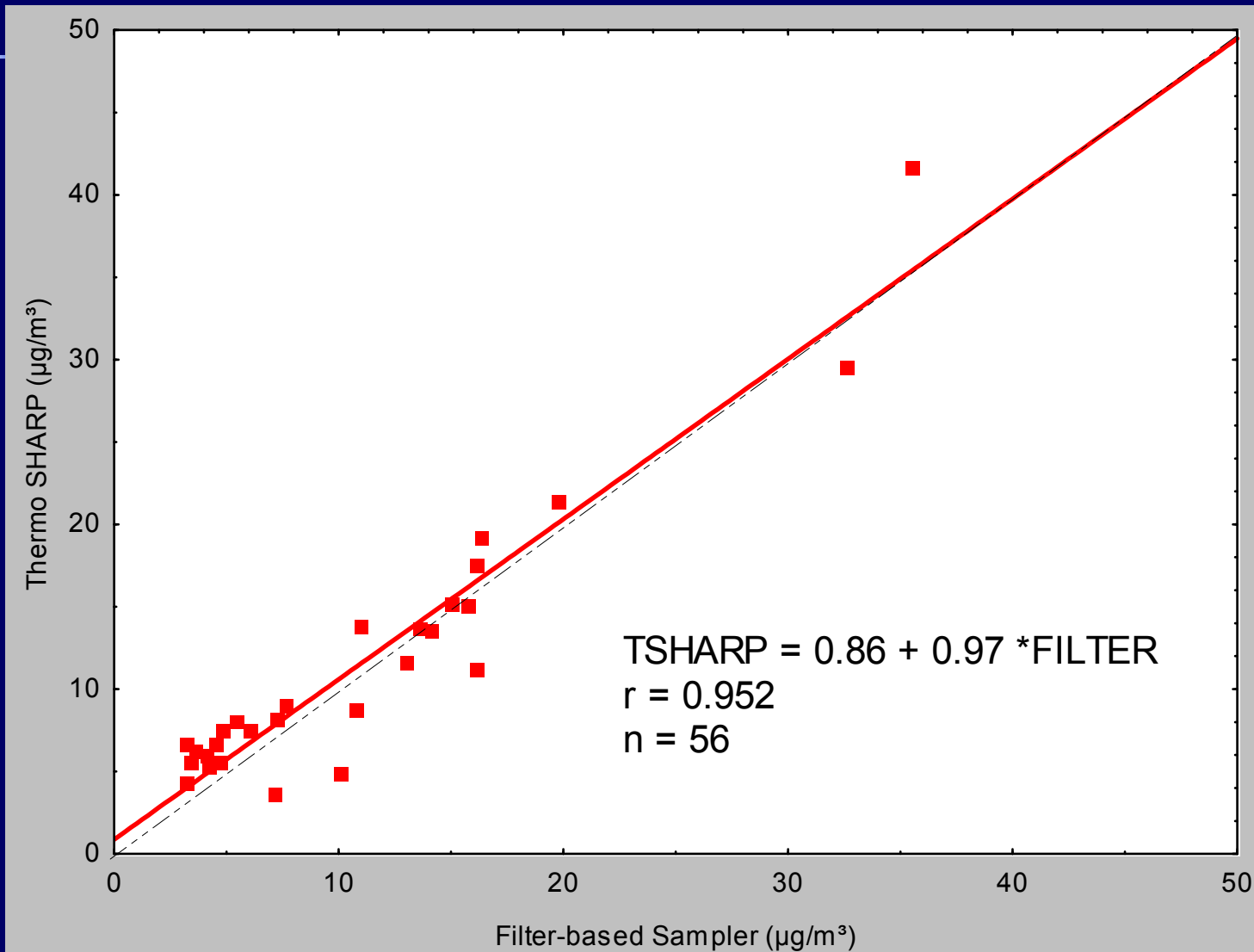
Thermo SHARP 5030

Synchronized Hybrid Ambient Real-time Particulate Monitor

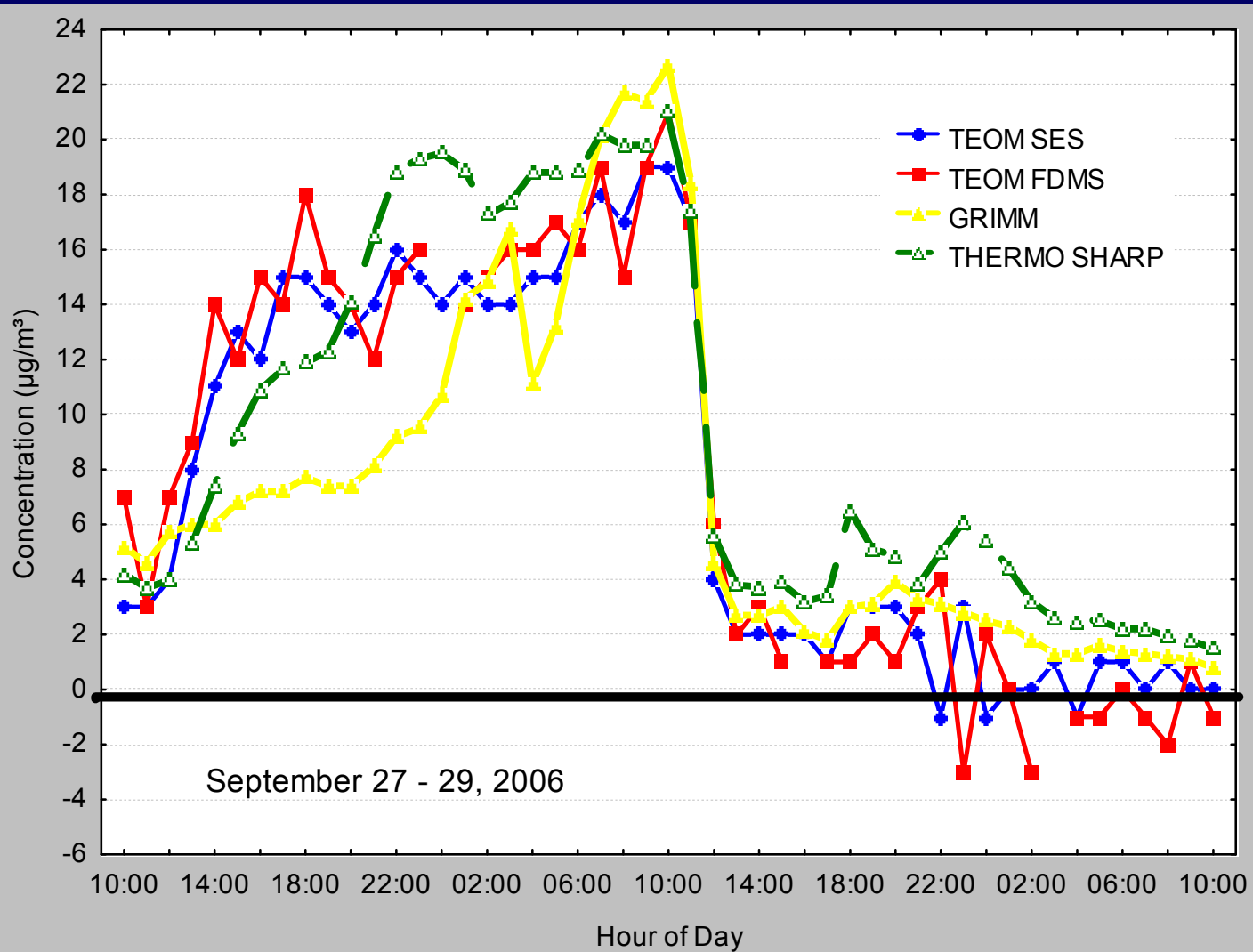


- Truly continuous (real-time)
- Combination nephelometer & beta-ray attenuation
- Light scattering photometer is continuously calibrated by beta attenuation mass sensor
- Intelligent Moisture Reduction (IMR) System heating the inlet tube; threshold is set at 40%

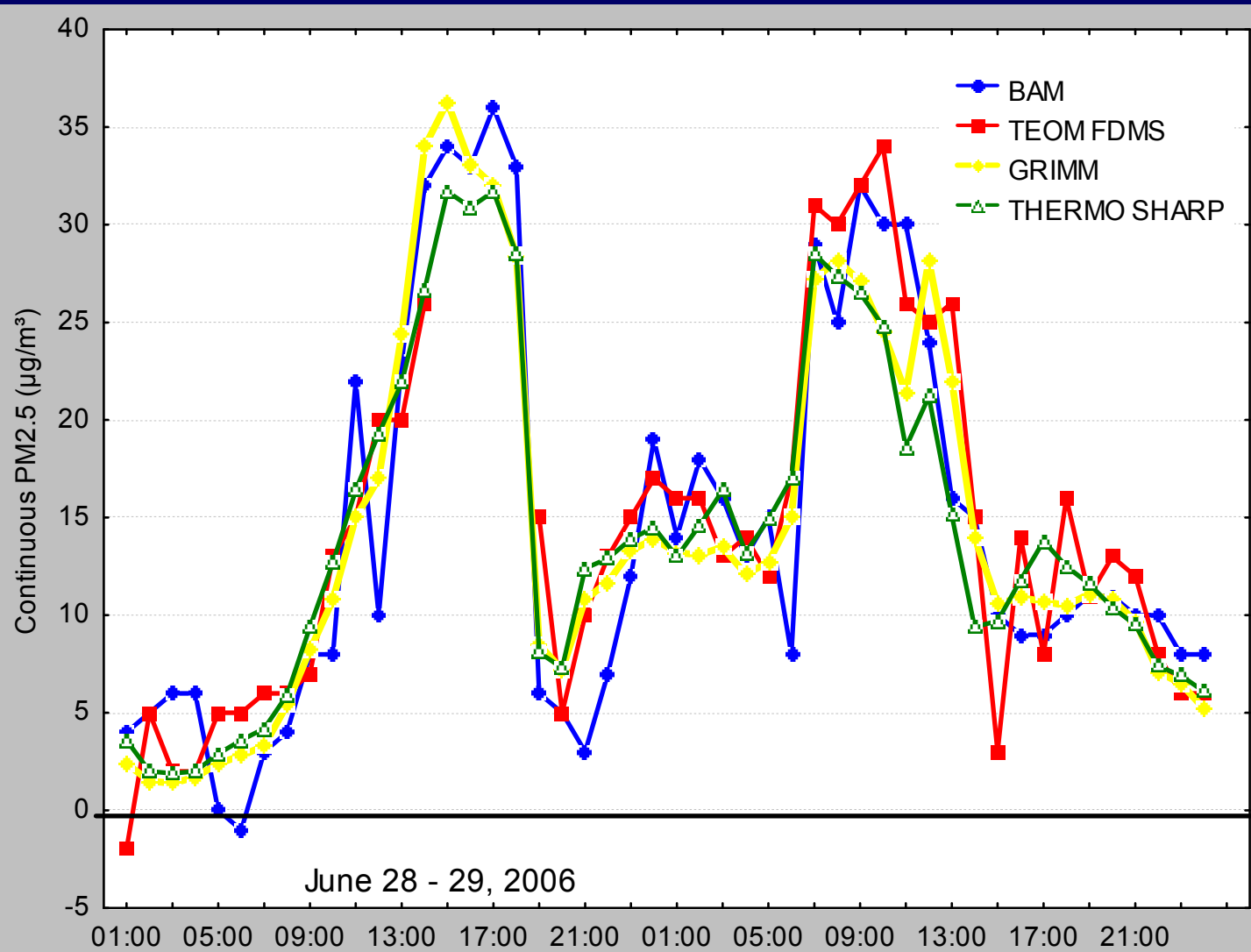
Linear regression results for 24h data: Sharp 5030 (Ottawa Jun. – Sep. 2006)



Performance During Air Mass Change (Ottawa September 2006)



Performance During Air Mass Change (Ottawa June 2006)



Cost Comparisons for Continuous PM_{2.5} Instruments (Canadian\$):

- | | |
|---|----------|
| ▪ Met-One BAM 1020 | \$24,000 |
| ▪ R&P 1400AB TEOM | \$26,500 |
| ▪ R&P SES Kit | \$ 4,750 |
| ▪ R&P 8500 FDMS Kit | \$10,700 |
| ▪ GRIMM 180 (PM ₁₀ , PM _{2.5} , PM _{1.0}) | \$32,000 |
| ▪ Thermo SHARP 5030 | \$23,700 |