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Teledyne API Model 640 Field Comparison with the Thermo 1405DF and R&P 2025 FRM

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St. Louis Area Monitoring Agencies
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Model 640 Theory of Operation

The T640 Monitor is an optical aerosol spectrometer that converts optical measurements to mass measurements by determining sampled particle size via scattered light at the single particle level according to the Lorenz-Mie Theory.

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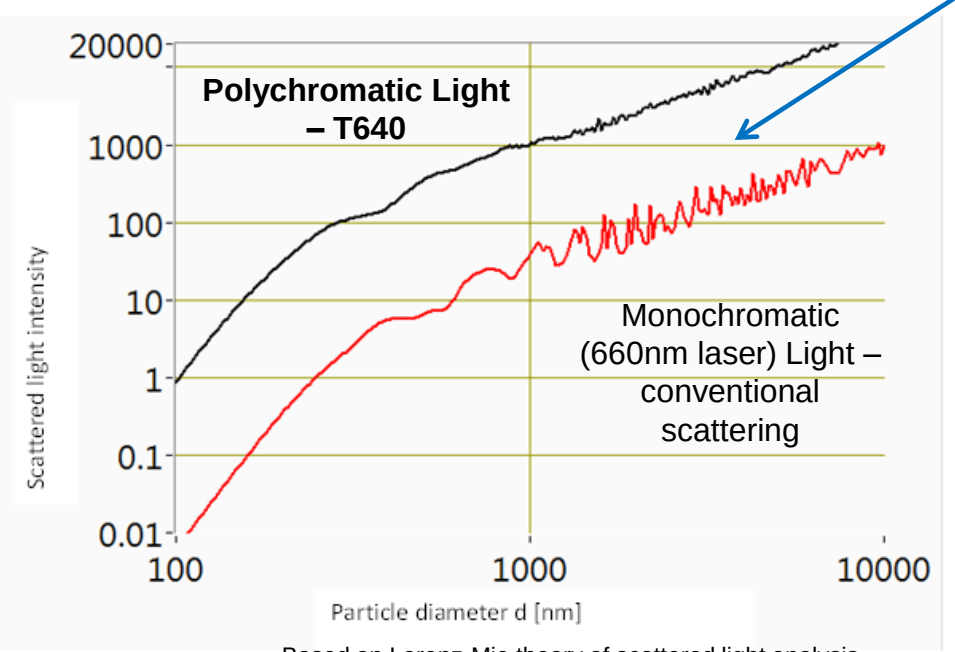
Theory of Operation

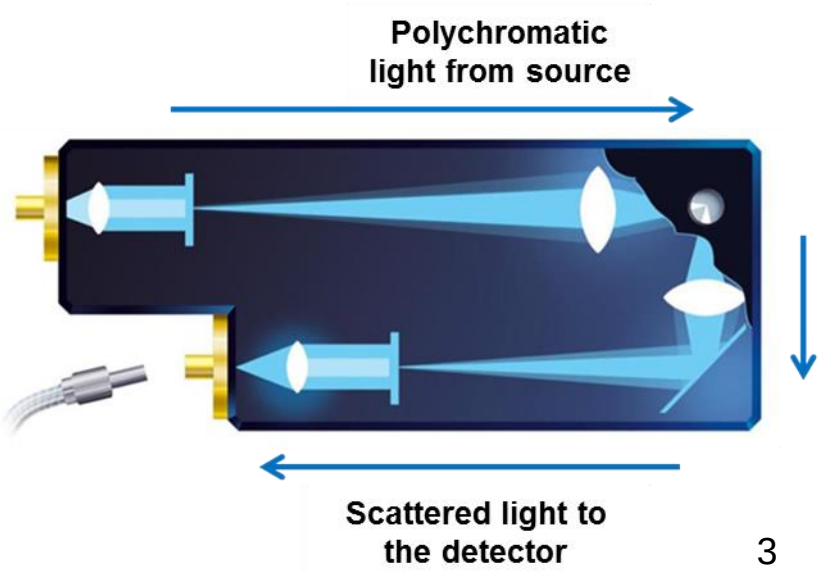
- Achieves a linear (non ambiguous) signal
- Provides both high resolution and wide particle size range
- PM Mass is calculated using a sophisticated mass conversion algorithm based upon years of proven ambient comparability assessments with Reference sampler data
- Only made possible with fundamentally accurate and high resolution particle size measurements

Scattering vs Particle Size



Based on Lorenz-Mie theory of scattered light analysis

Uncertainty



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Sampling System

- The inlet for the 640 allows complete transmission of all particle sizes
- The 640X has a standard PM10 inlet
- The IADS removes volatile components
- Gets counted by the optical particle sensor
- Air goes through the flow sensor and pump control

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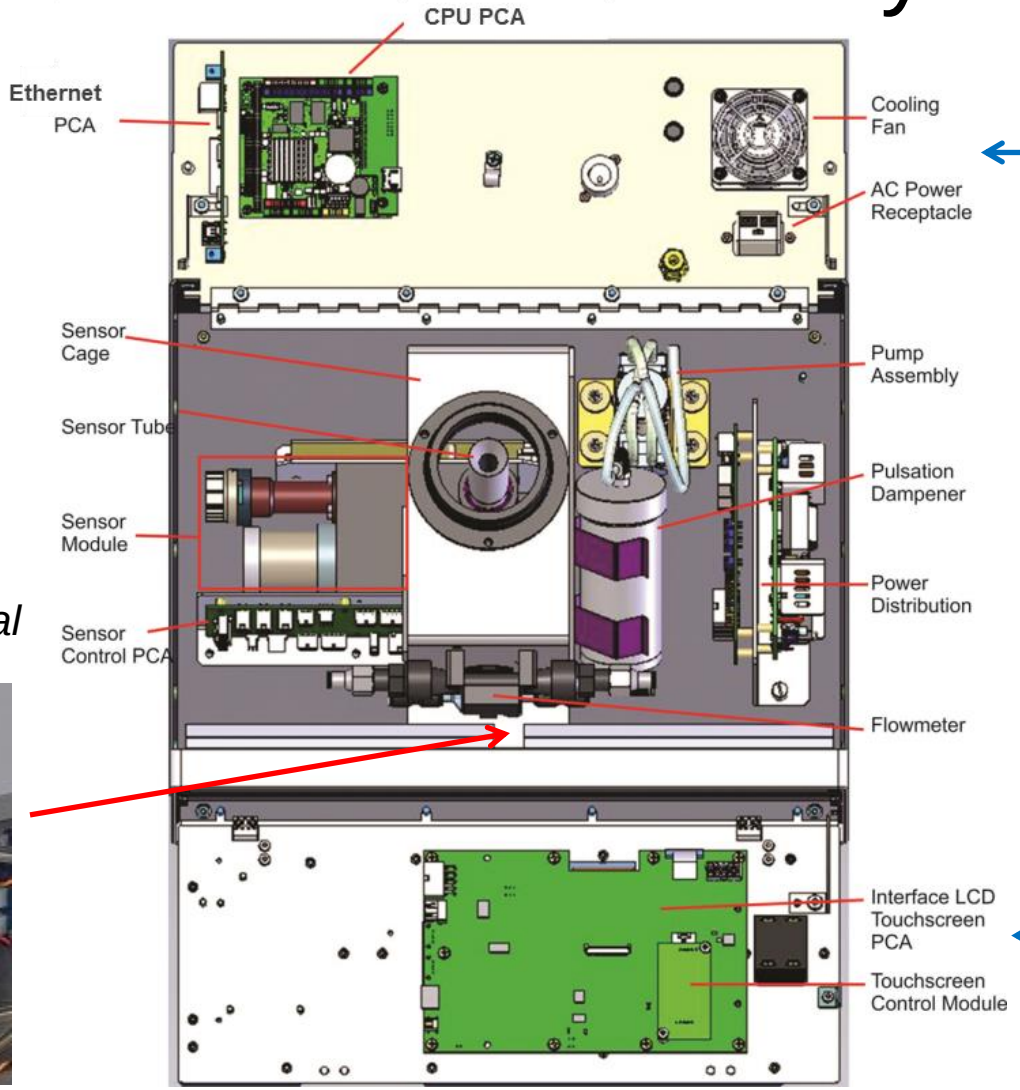
Model T640 Internal Layout



Rear panel folded down

Front panel folded down

<u>6 month</u> exchange interval

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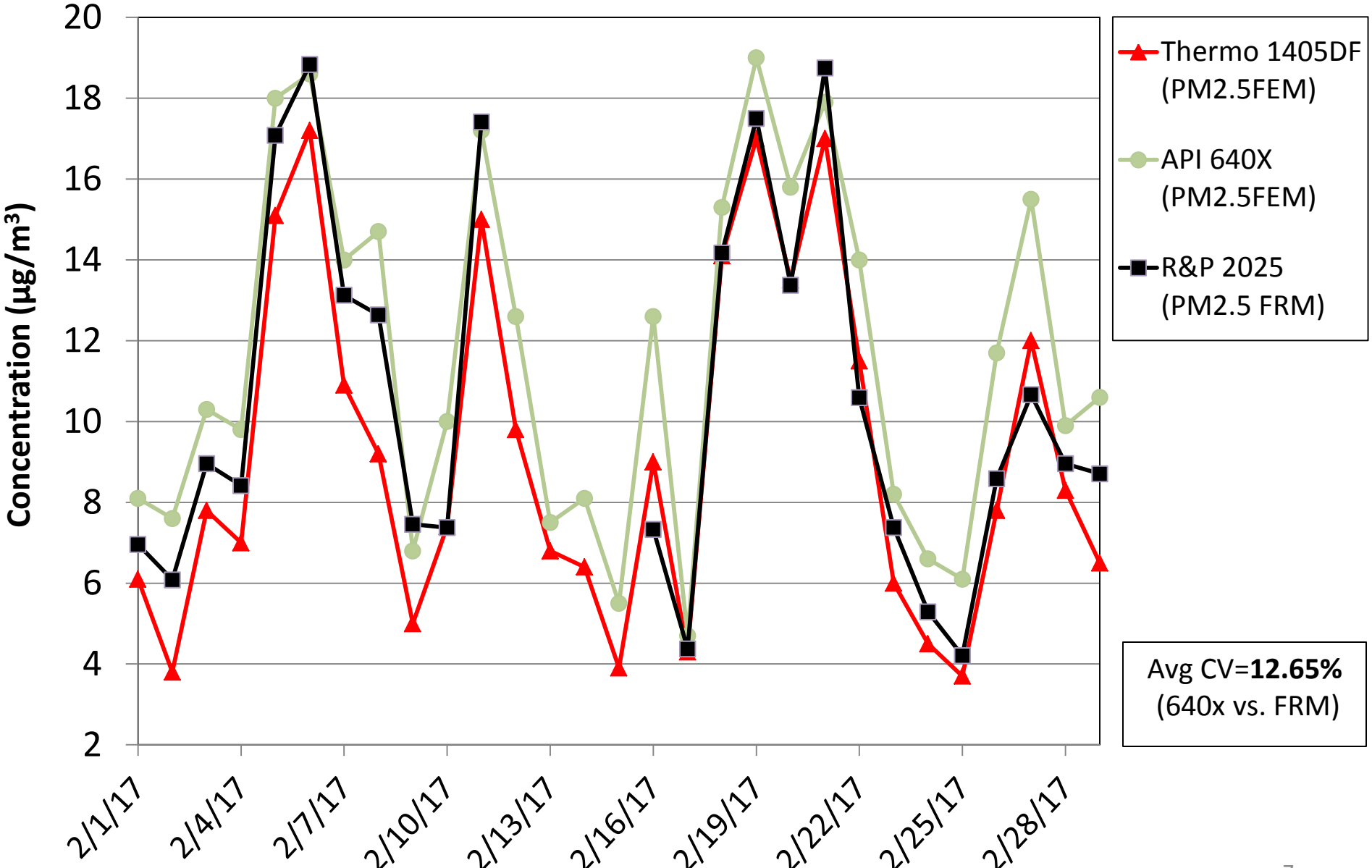
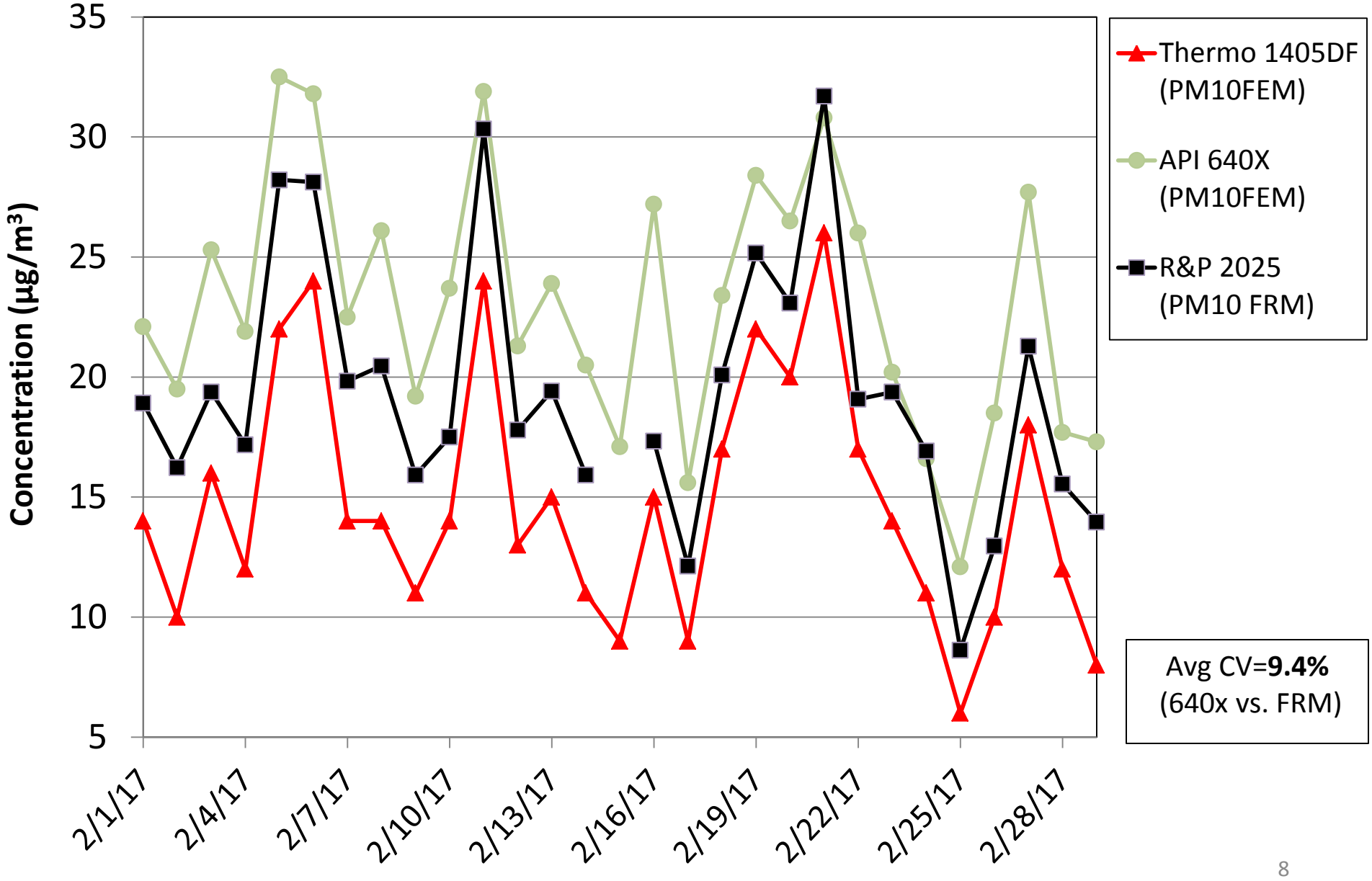
API 640X and Thermo 1405DF

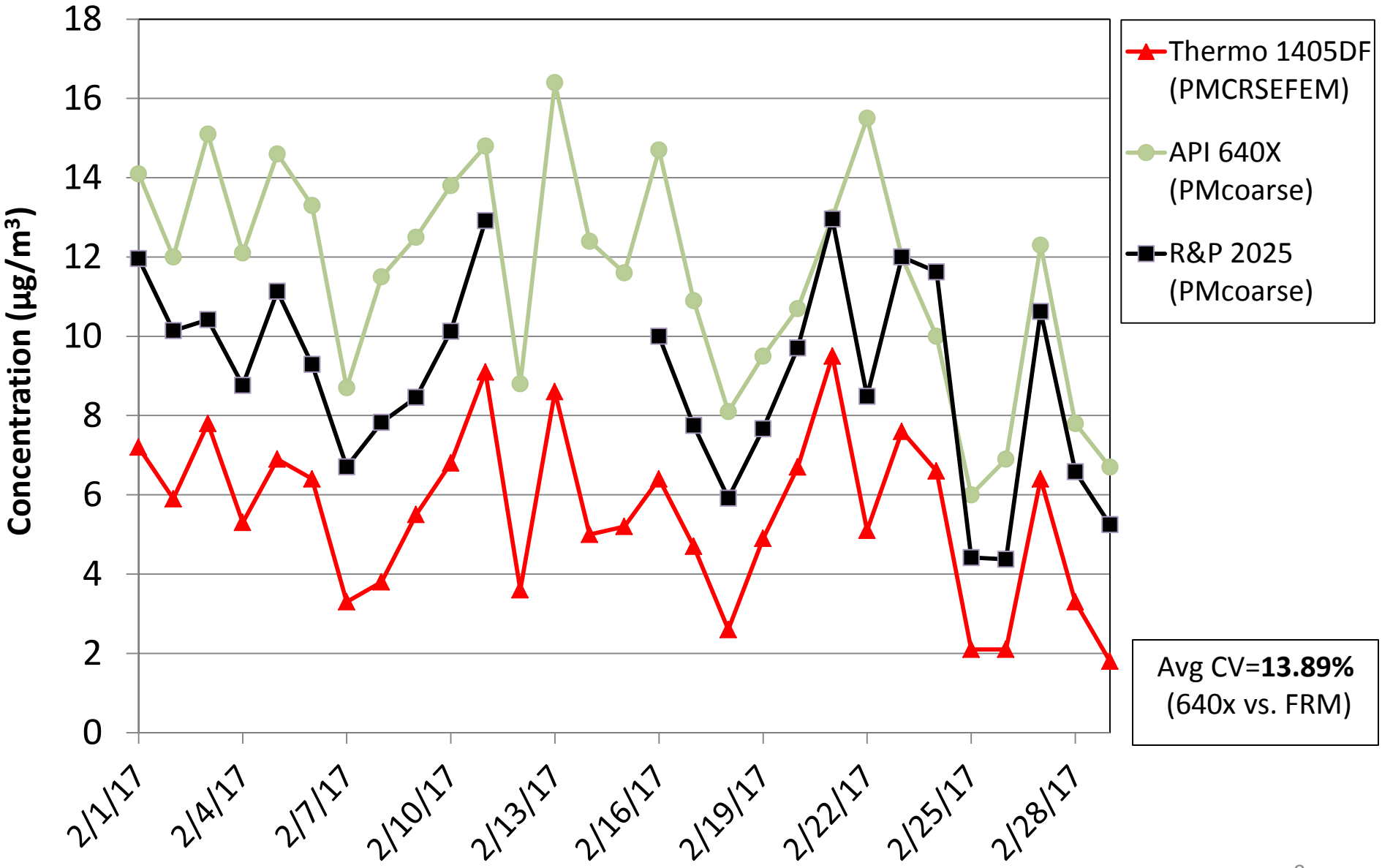
PM2.5 Comparison

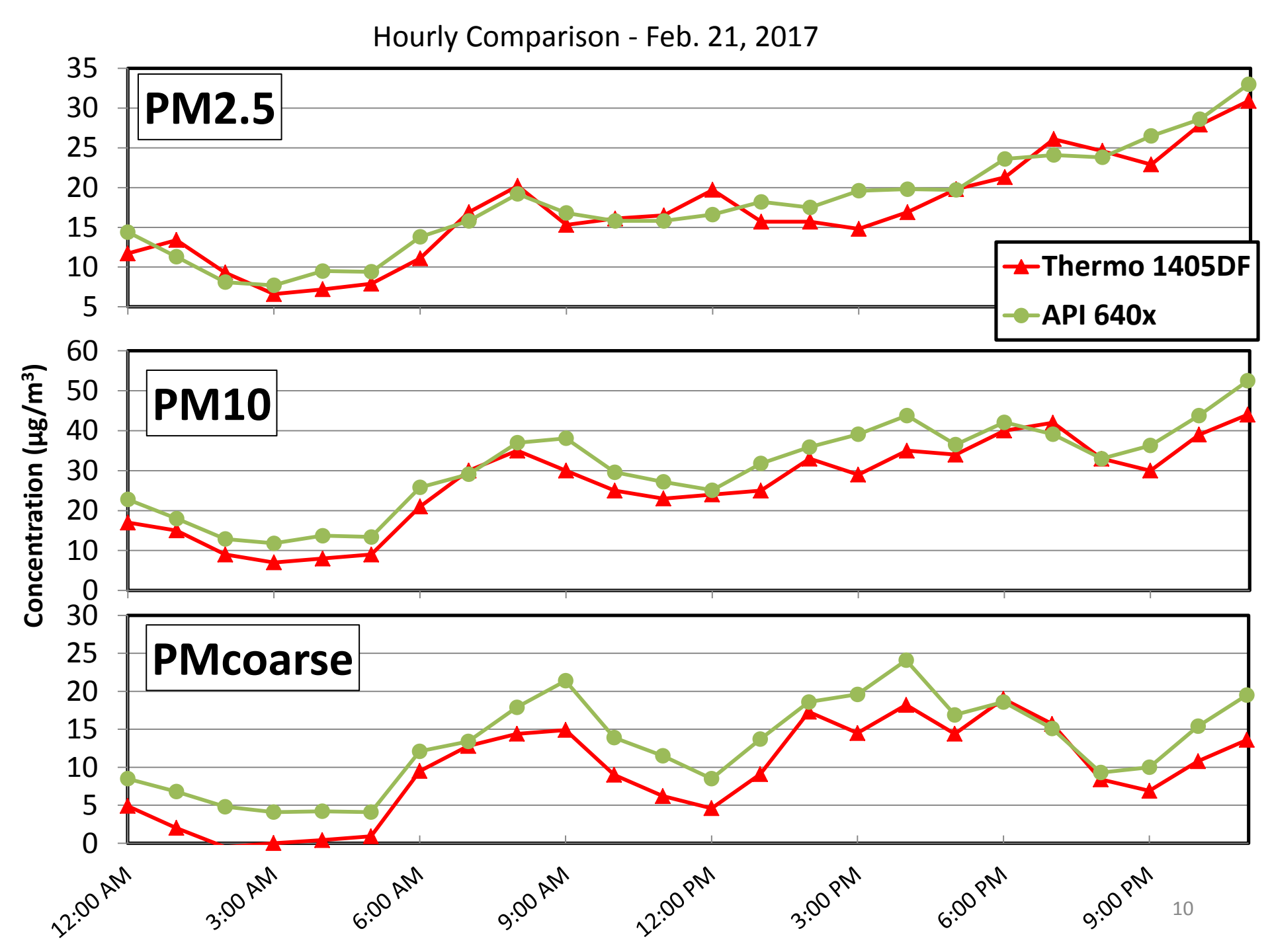


PM10 Comparison



PMcoarse Comparison




Hourly Comparison - Feb. 21, 2017
PM2.5
PM10
PMcoarse
Thermo 1405DF
API 640x
Concentration (µg/m³)
35
30
25
20
15
10
5
60
50
40
30
20
10
0
30
25
20
15
10
5
0
12:00 AM
3:00 AM
6:00 AM
9:00 AM
12:00 PM
3:00 PM
6:00 PM
9:00 PM

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1405DF vs. 640X Consumables Cost

Thermo 1405DF

- Nafion Dryer Refurb. $1200/yr.
- Tapered Element Filters $420/yr.
- Cooler Filters $36/yr.
- Inline filters $100/yr.
- Pump Rebuild kit $50/yr.
- $1806/yr and $7224/4yr.

API 640X

- Internal Pump $1006/3-4 yr. life span
- External Pump rebuild kit $125/every 2 yr.
- Spandust bottle $500/every 2 yr.
- LED Lightsource $3000/every 4 yr. (Has not gone out yet)
- Disposable filters $140/yr.
- $5311 every 4 years

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Pros of the API 640

- Easier to install instrument
- Less time to perform check and you get data quicker after check is completed (10 min)
- Less moving parts to break
- Maintenance takes less time
- Full 2 year warranty
- Operating range is 0-50 deg. Celsius
- 640 samples continuous, DF only half time
- Only weighs 20 lbs. DF weighs approx. 50 lbs.

Cons of the API 640

- New and different instrument so it will take some time to learn
- Learning curve to see if it is running correctly and if the data looks good
- It will take some time to build up a supply of spare parts

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640 and 640x Comparison all FEM

640

- 5.0 Lpm PM2.5 monitor
- Cost $26,000
- 1405 in PM10 cost $16K
- 1405F in PM2.5 cost $26K

640X

- 16.7 Lpm PM2.5 monitor
- 16.7 Lpm PM10-2.5 monitor
- 16.7 Lpm PM10 monitor
- Cost $37,000
- 1405DF cost $35,000

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References:

1) Teledyne Advanced Pollution Instrumentation Model T640 PM Mass Monitor Instruction Manual. 2016

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Acknowledgement's

- API for loaning us the instrument so we could test it out. Joe Bester and Tim Morphy
- Satchel Gaddie for data preparation
- Everyone else in the section for installation, preparing extra filters and performing extra checks at Blair St. site