Low-Cost Sensors Study in Middle Tennessee

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Overview of TDEC's Sensor Study

Multi-year (2020-22) evaluation of sensors to inform our agency of how they can be used to characterize air quality

4 Middle Tennessee Monitoring Sites

1 background site

3 urban sites

Near-Road Site

Sensors Evaluation Criteria

- ***Intercomparison with Regulatory Monitors***

- ***Performance during Special Air Quality Events (dust storms, wildfires, etc)***

- Sensor Degradation

Sensor Selection Criteria

- Likelihood of purchase by the public was our primary focus.

  - Inexpensive (< $2000)

  - Easy data accessibility

  - Weatherproof (no shelter required)

  - Proven accuracy in previous lab or field settings (AQ-SPEC)

Sensors Evaluated in the Study

PM2.5 Sensors

Purple Air

AQ Egg

Clarity Node

Gaseous Sensors
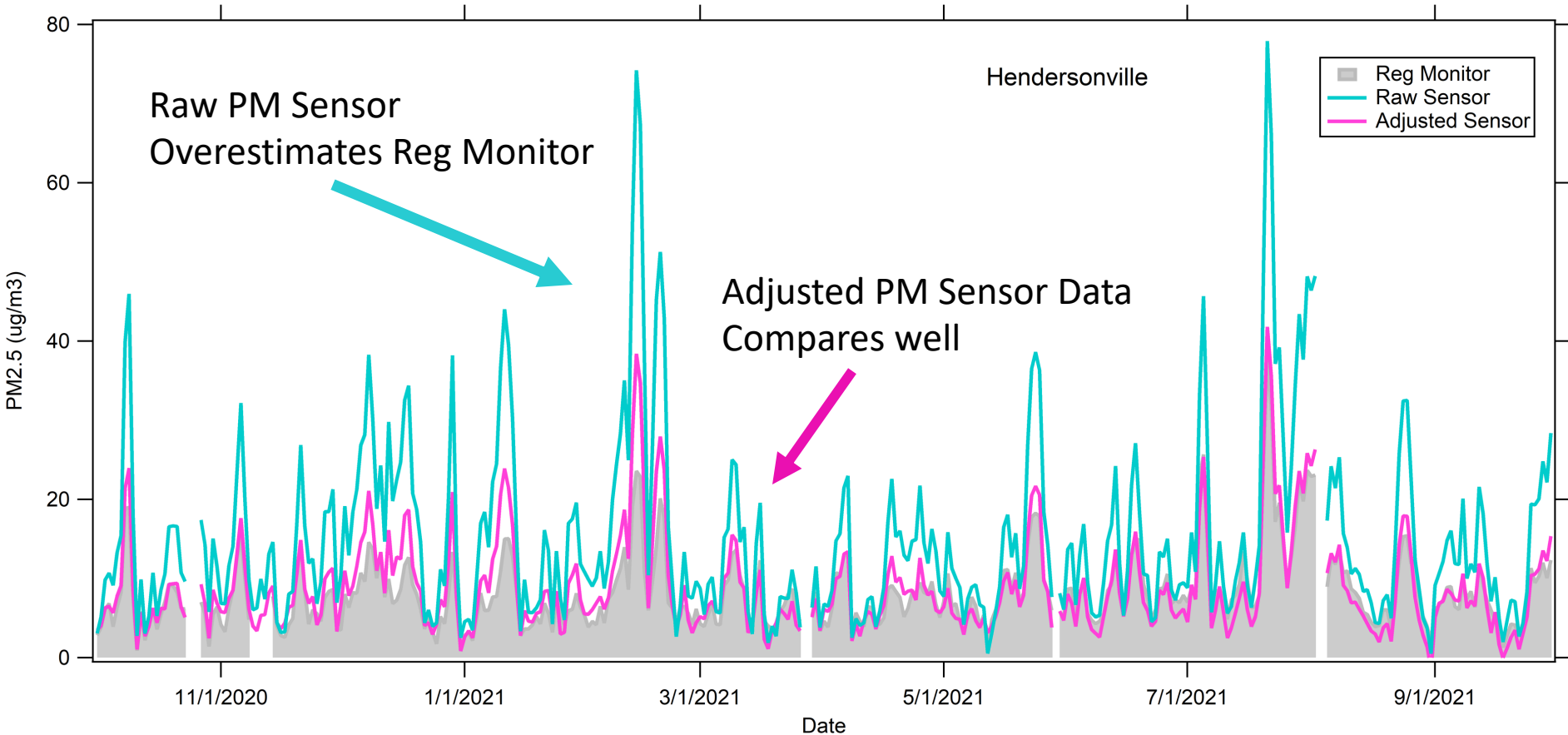
AQ Egg (O3, SO2, NO2)

Clarity Node (NO2)

Collocated Regulatory Monitors

| Pollutant	Hendersonville	Near Road	Lockeland	Loretto
PM	FEM (BAM 1022)	FEM (BAM 1022)	FEM (BAM 1022 & T640x)	FEM (BAM 1022)
NO2		FRM (Thermo 42i)		
O3	FRM (T400)			
SO2		FRM (Thermo 43i)		

Results: PM Sensors Performed Well
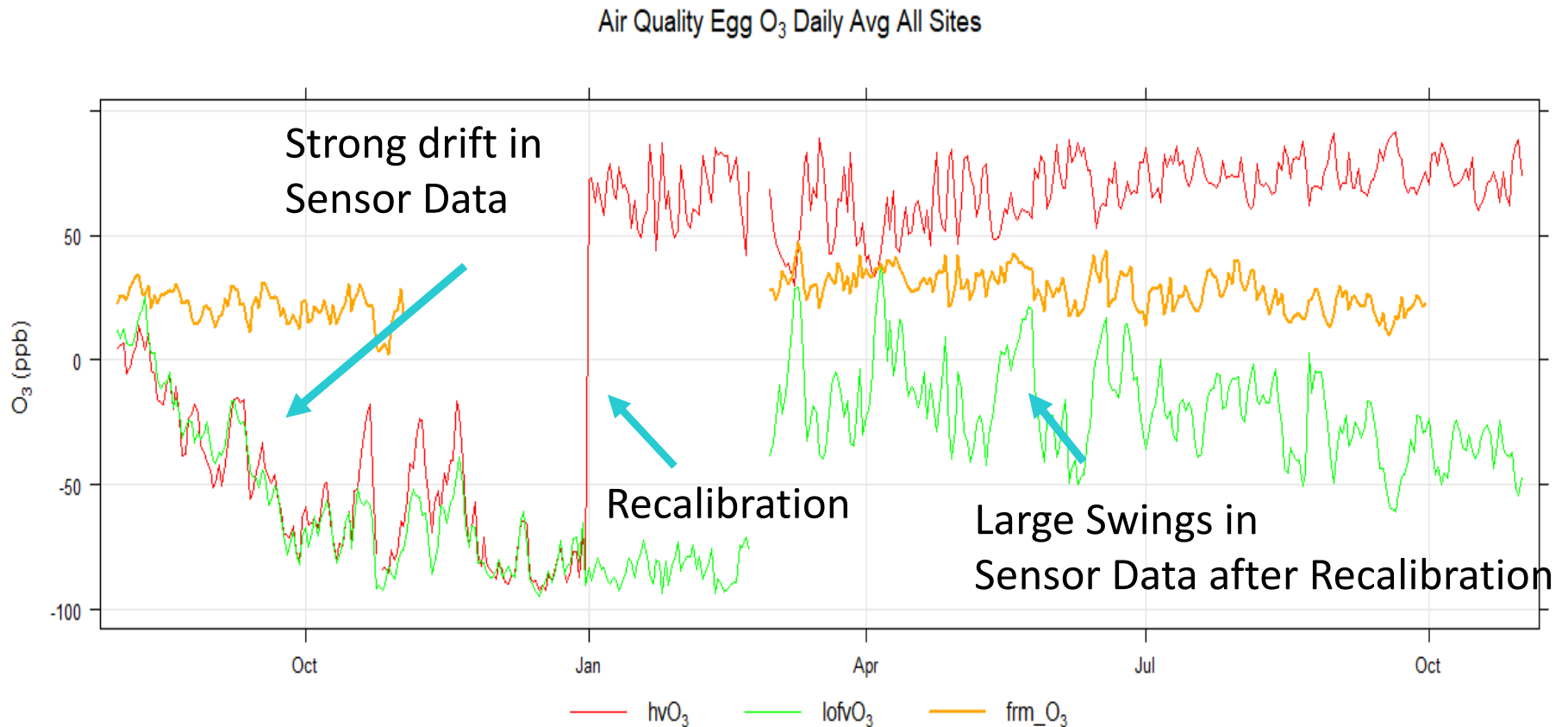
Purple Air Results (Sept 2020 to Oct 2021)

Results: Clarity Node NO2 Gaseous Sensors Performed Well, but are Biased

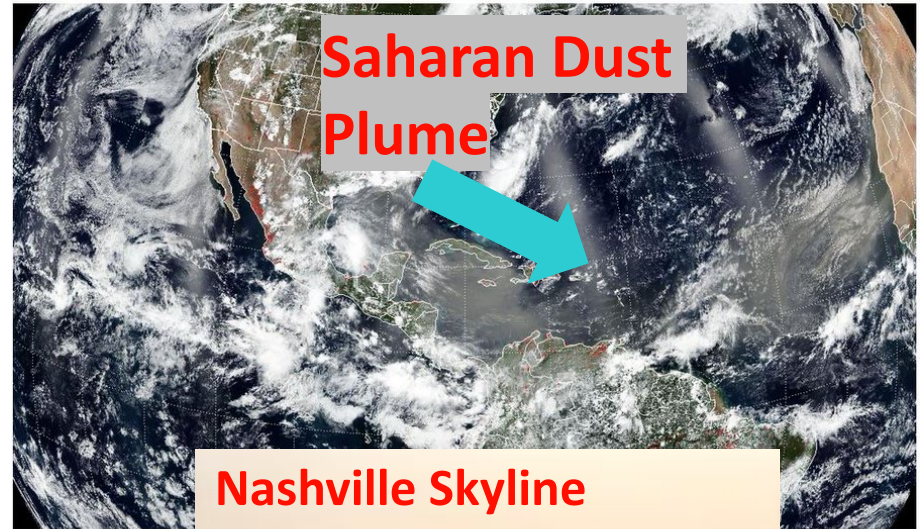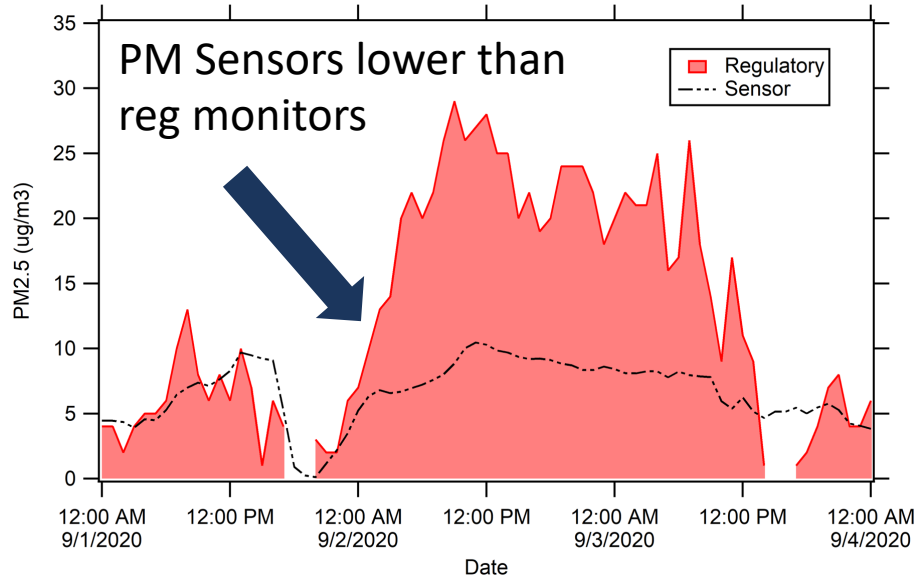Sensors Track Variability, but bias high

Near Rd Daily Max NO$_2$
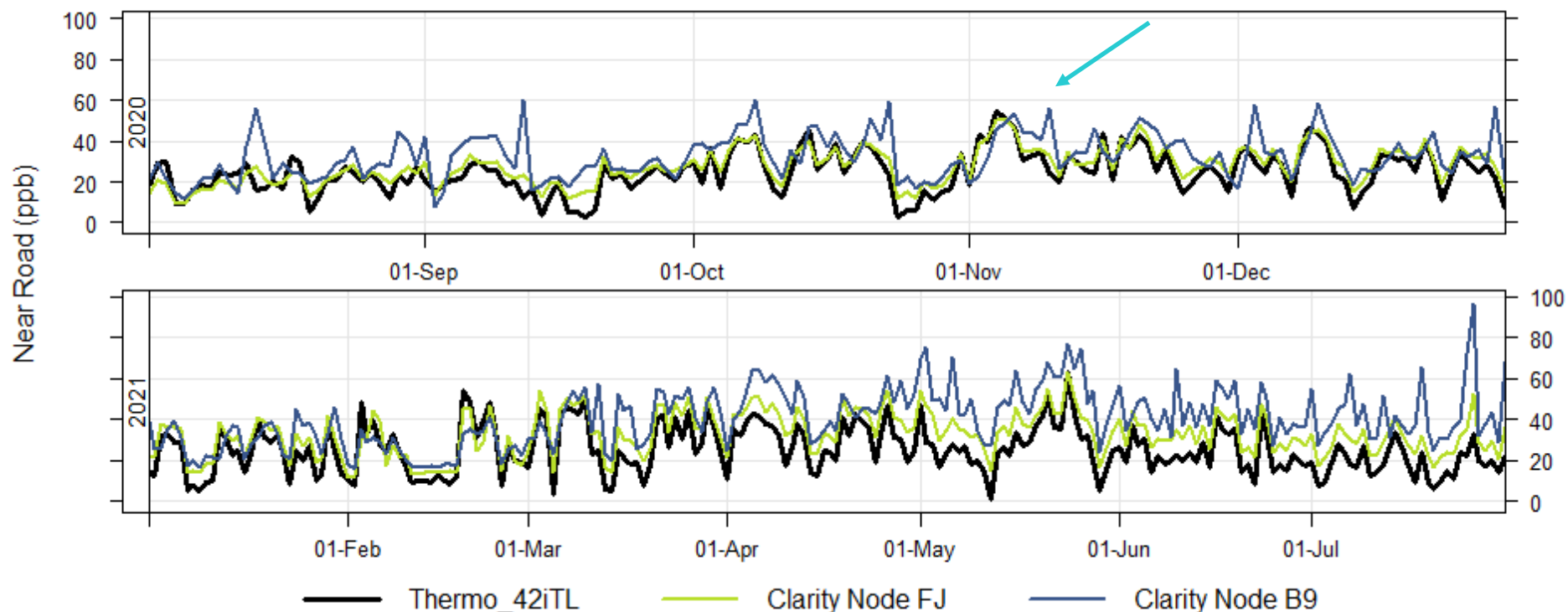
Results: Other Gas Sensors Did Not Perform Well

Air Quality Egg O₃ Daily Avg All Sites

Results: Sensor Performance Impacted during Some Special Events (only PM2.5)

PM Sensors lower than reg monitors

Saharan Dust Plume

PM Sensors track well with reg monitors

Nashville Skyline Wildfire Impacts July 2021
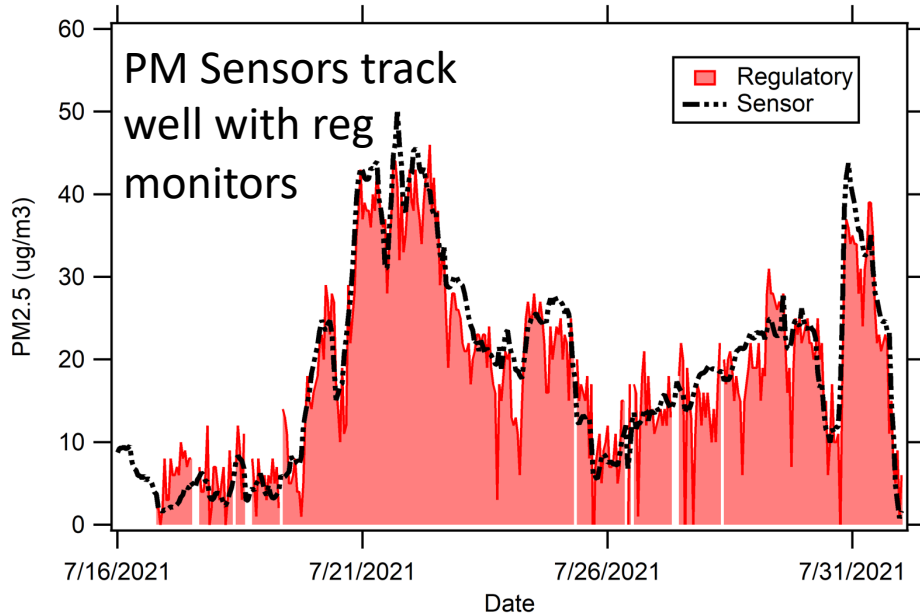
What's Next?

- Goal: Determining the role of sensors in AQ Management
  - *Not accepted for regulatory applications, but can be used to supplement regulatory data*
  - Examples of supplementary regulatory applications
    - Investigating Exceptional PM Events (Wildfires)
    - AQ Forecasting
    - Preliminary complaint response

- What is TDEC doing to achieve this goal?
  - Deploying PM2.5 sensors at all regulatory PM and O3 sites
    - Assisting Data Validation
    - More multipollutant information
  - Testing Gaseous Sensors?

Study Resources

- Check out our <u>Story Map</u> for more detailed results.

Acknowledgements to the Sensors Team

Commissioner & Dep Commissioner Site Visit (March 2021)

APC Team (pictured left to right): Alvin Pratt, Kyle Spangle, Brad King, Michelle Oakes, Larry Yocom
Not pictured: Director Michelle Owenby

Collaborators

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