

# Perspectives from Lab, Network, and Field Measurements

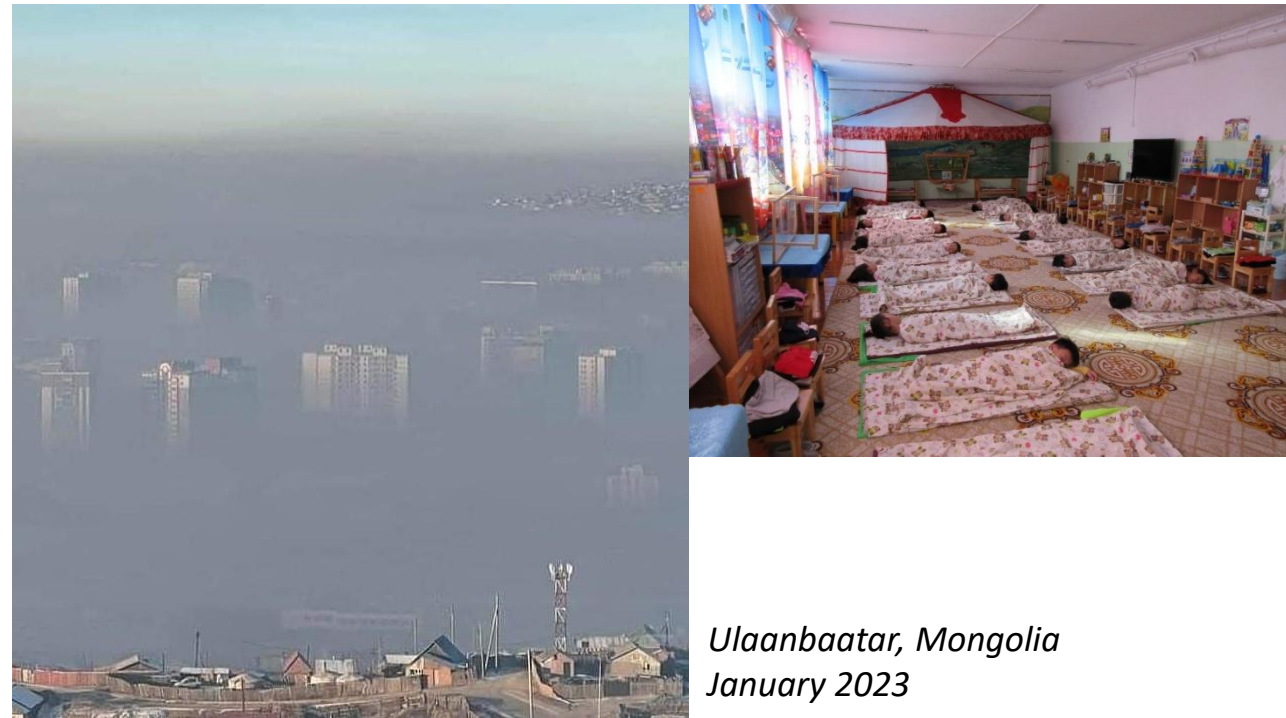
Title implies “Everything but the Kitchen Sink”...



... so here's the Kitchen Sink!

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Washington University in St. Louis / USA*



*Ulaanbaatar, Mongolia  
January 2023*

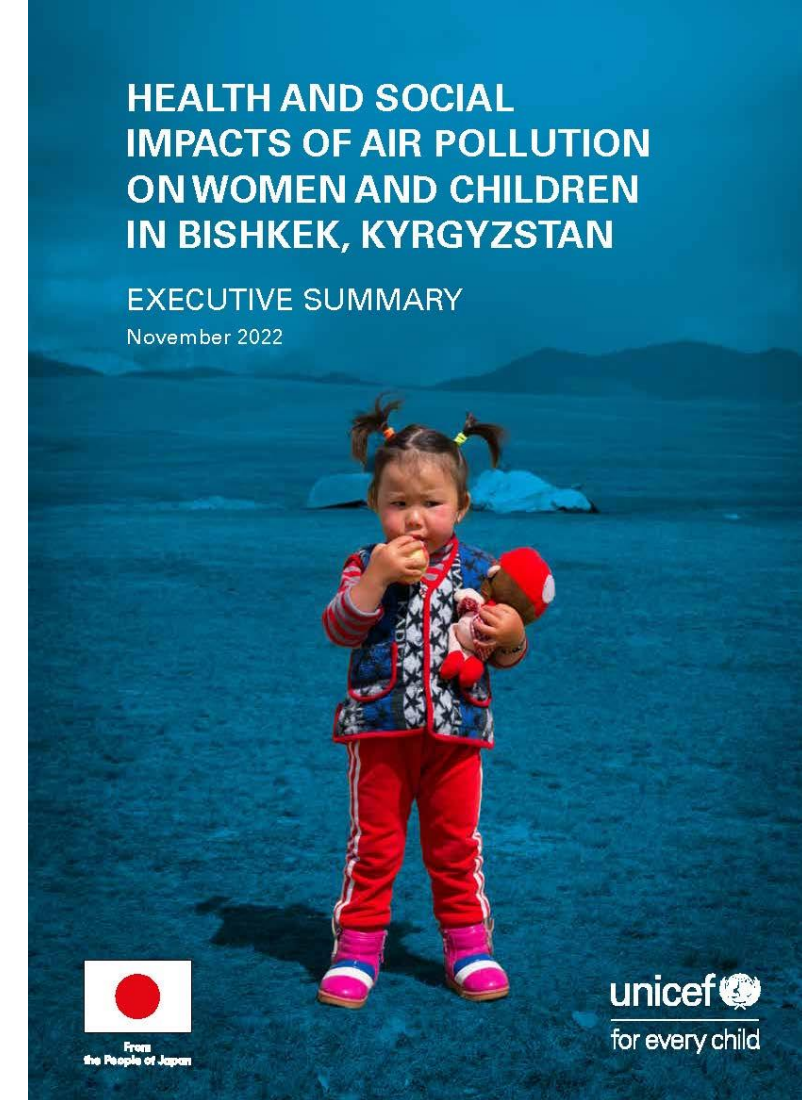
# Our Work in Asia

- **Mongolia**

- Heating stove replacement program impact assessment (US Gov't)
- Forecasting health impacts of air pollution control scenarios (Mongolian Gov't)
- Children's exposures to air pollution (UNICEF)... [Zhiyao Li dissertation](#)

- **Central Asia**

- US State Department Air Quality Fellow supporting US Embassy Tashkent
- Central Asian Universities Air Quality Knowledge Hub (US State Dept through American Councils)
- Air Quality Conceptual Models for Uzbekistan (McDonnell Academy Global Incubator Seed Grant)... [Xuan to Tashkent, June 2023](#)
- Health and social impacts of air pollution in Bishkek, Kyrgyzstan (UNICEF)
- Feasibility of air quality low-cost sensor networks in Tajikistan (UNEP – pending)



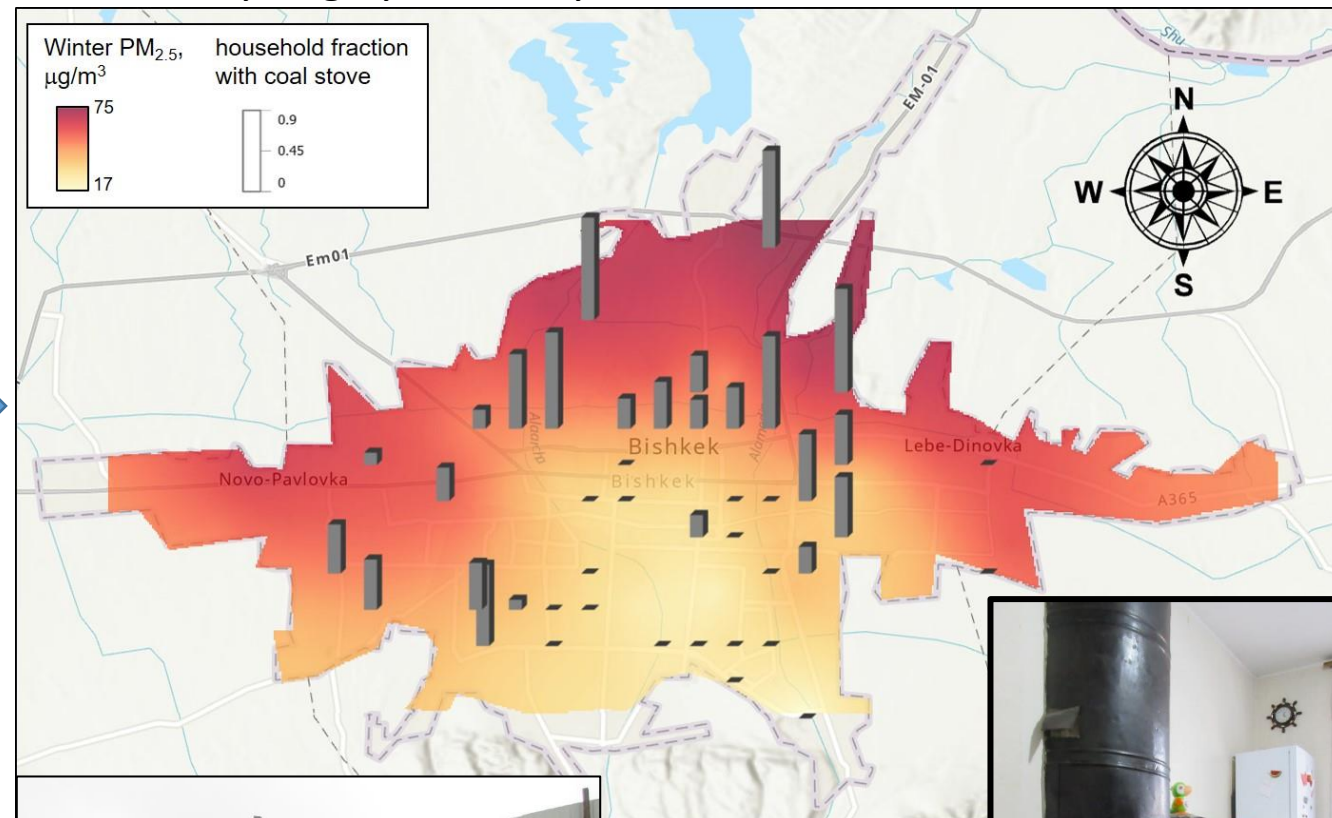
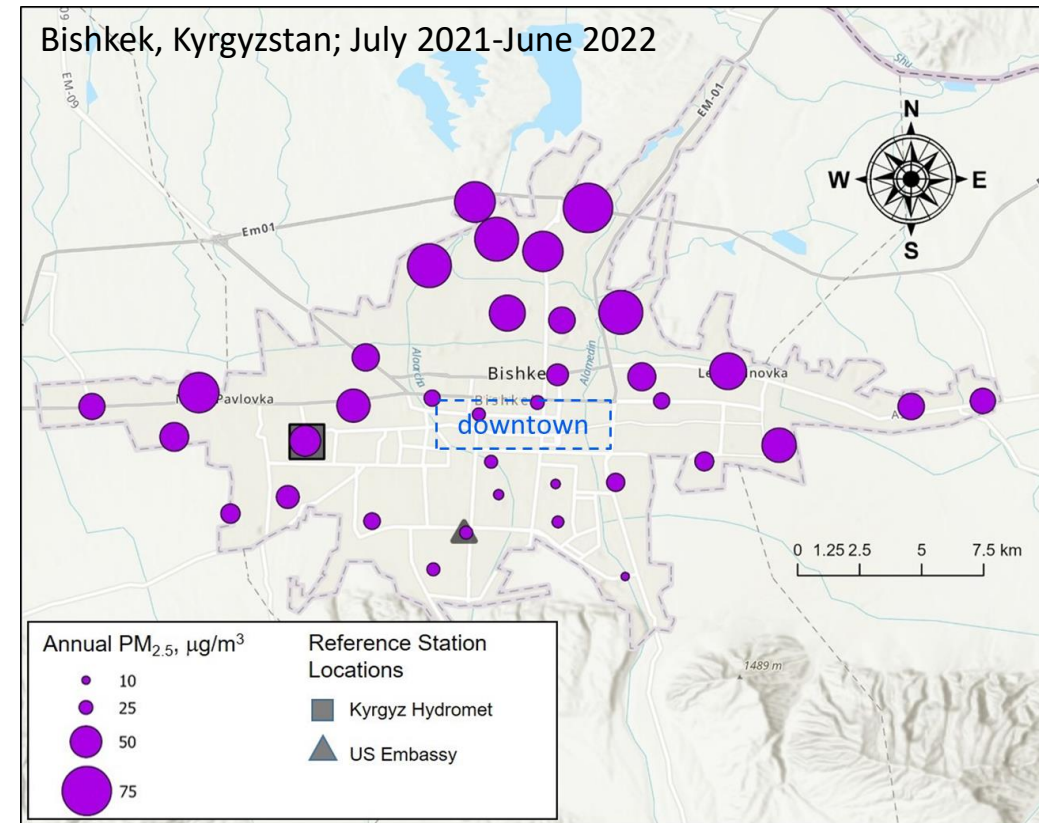
UNICEF Kyrgyzstan Project with:

- M-Vector
- Rufus Edwards, University of California-Irvine
- Rahat Sabyrbekov, American University in Central Asia



# High intraurban variability in many Central Asian cities...

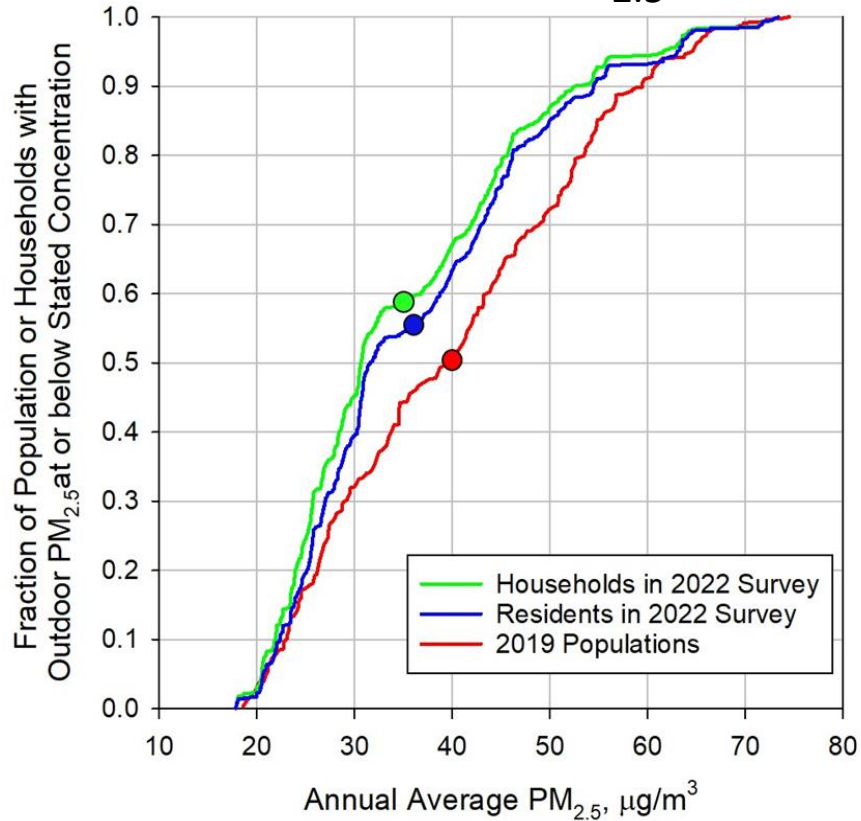
... variability largely driven by residential coal combustion



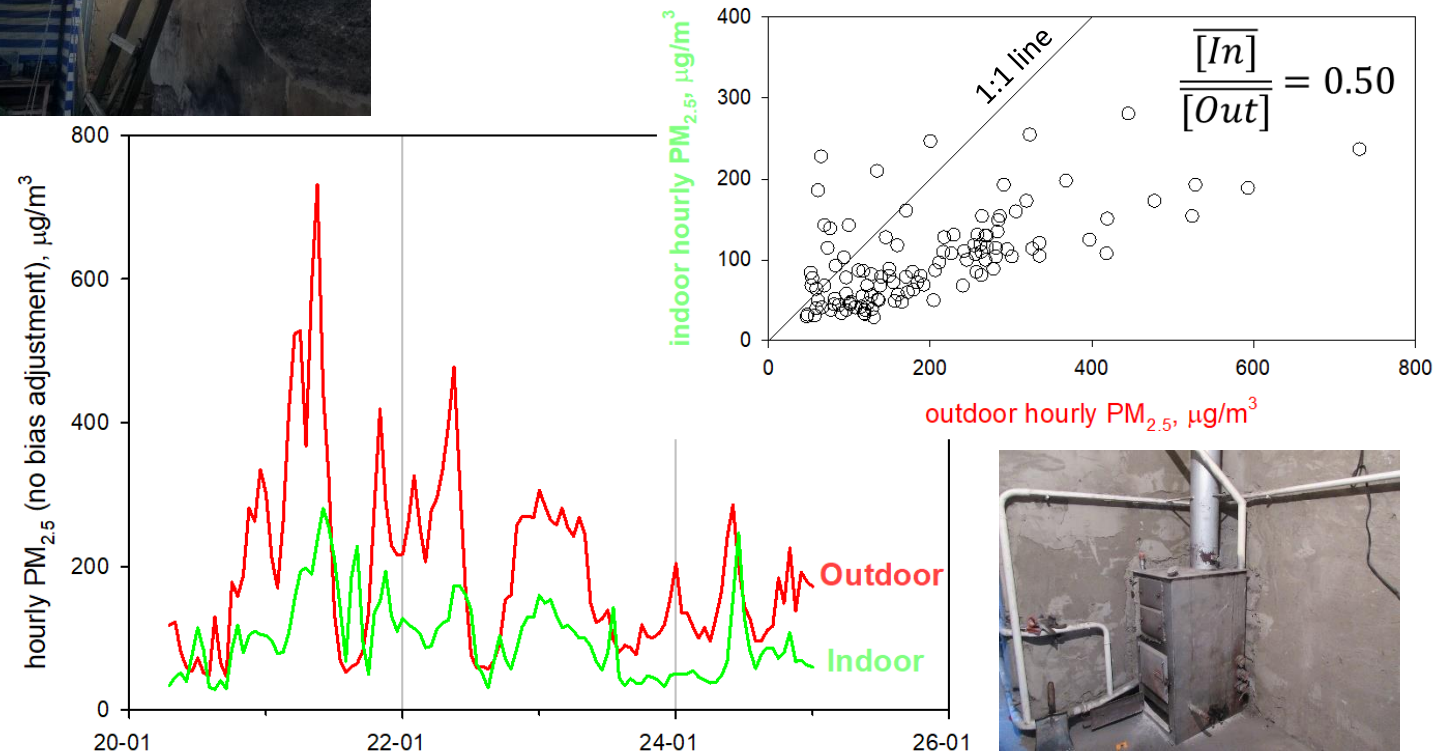
*KyrgyzHydromet/Asian Development Bank low-cost sensor network*

# From Ambient Concentrations to Exposures

population exposures to outdoor PM<sub>2.5</sub>




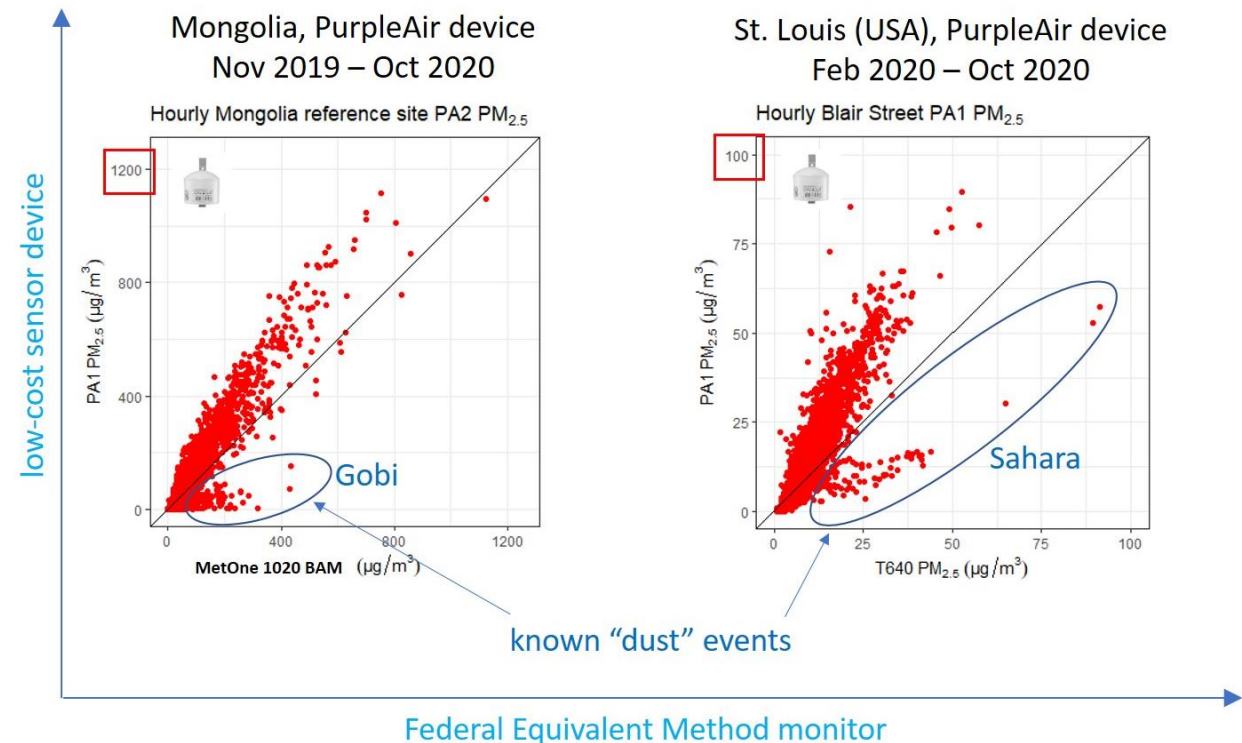
indoor versus outdoor PM<sub>2.5</sub>



ambient PM<sub>2.5</sub> concentrations, PM<sub>2.5</sub> indoor/outdoor ratios, and time-activity data → **exposures**

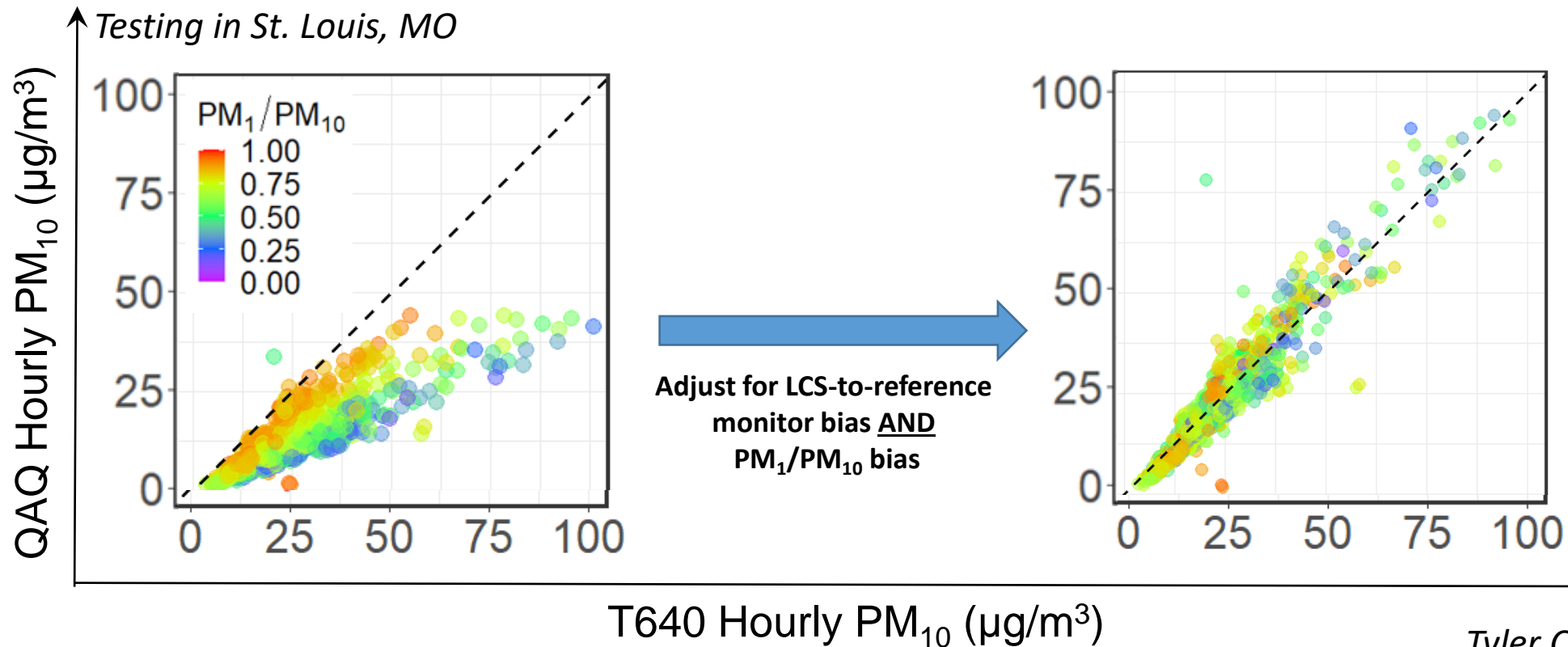
# Reflection #1 – “Low-Cost Sensors” (LCS)

- Nephelometer-based LCS now well understood
- $PM_{2.5}$  measurements
  - Accumulation mode truncation (cannot see the small particles)
  - Insensitivity above  $\sim 1 \mu m$  (cannot quantify the large particles)
- $PM_{10}$  measurements (and dust contributions to  $PM_{2.5}$  )
  - Interpret AQ-SPEC test results with extreme caution!



# Reflection #1 – “Low-Cost Sensors” (LCS) for PM<sub>10</sub>

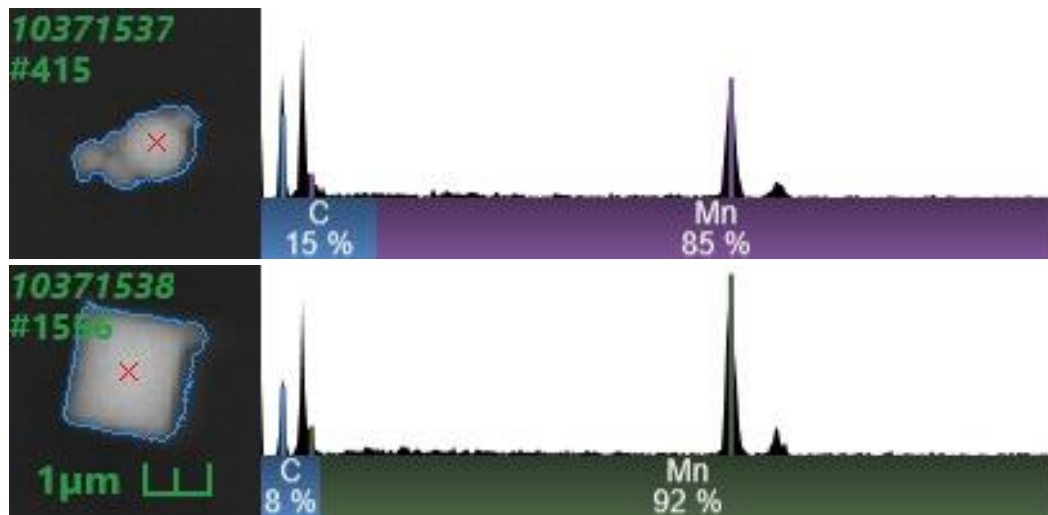
- Many issues, e.g., particle size and wind speed dependent aspiration efficiency
- QuantAQ (QAQ) Modulair-PM
  - Two LCS – nephelometer and optical particle counter
  - Not a low-cost device, ~\$1,500 + \$300/year





# Reflection #2 – “Computer-Controlled SEM (CCSEM)”

Discussed at 2022 Spartan Meeting



Carbon is from the substrate, not the PM

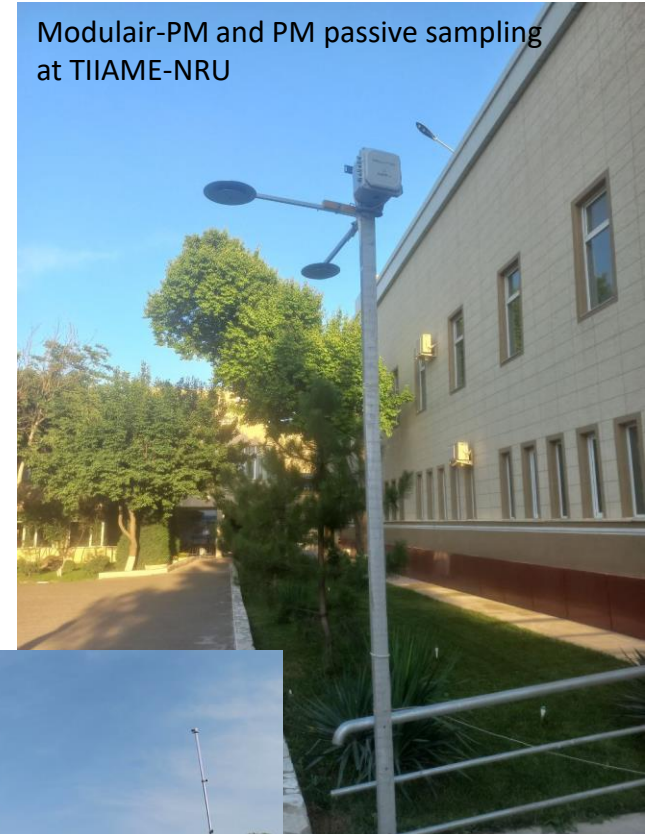
Mass Distribution by Average Diameter (microns)

Classes	Mass %	0.2	1.0	2.5	5.0	10.0	20.0	50.0
		-	-	-	-	-	-	-
		1.0	2.5	5.0	10.0	20.0	50.0	75.0
Mn-Si-S-Ca	1.7	0.0	0.0	2.4	5.8	31.6	60.2	0.0
Mn-Si-S-Fe	4.3	0.0	0.0	0.1	0.6	13.4	85.9	0.0
Mn-S-Si	0.2	0.0	2.2	4.6	29.7	63.5	0.0	0.0
Mn-S-Ca	0.1	0.0	1.0	3.3	95.7	0.0	0.0	0.0
Mn(Si-Al)	0.0	0.0	3.3	96.7	0.0	0.0	0.0	0.0
Mn-Fe-Cl	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Si-Al (Mn)	0.2	0.0	0.2	3.1	10.2	86.6	0.0	0.0
Fe-Si-Mn	0.1	0.0	0.0	17.4	82.6	0.0	0.0	0.0
Fe-S-Mn	0.0	1.0	31.2	67.9	0.0	0.0	0.0	0.0
Mn-S	0.5	0.0	0.6	5.7	27.9	65.8	0.0	0.0
Mn(Fe)	0.1	0.1	3.2	1.7	95.0	0.0	0.0	0.0
Fe(Mn)	0.0	0.0	5.8	94.2	0.0	0.0	0.0	0.0
Mn-Cl	0.0	1.5	41.1	57.5	0.0	0.0	0.0	0.0
Mn-rich	0.0	7.2	92.8	0.0	0.0	0.0	0.0	0.0
Mn-bearing	0.4	0.0	0.2	2.5	19.7	77.6	0.0	0.0
Other	92.4	0.0	0.2	1.0	4.5	15.8	78.6	0.0
<b>Totals</b>	<b>100.0</b>	<b>0.0</b>	<b>0.2</b>	<b>1.0</b>	<b>4.8</b>	<b>16.7</b>	<b>77.3</b>	<b>0.0</b>

# Reflection #2 – “Computer-Controlled SEM (CCSEM)”

Following the 2022 Spartan meeting...

- Improvement to substrates, now better measure carbon (RJ Lee Group, USEPA)
- Access to considerable time on USEPA’s CCSEM
- **Tashkent, Uzbekistan**
  - Two-week integrated sampling
  - Collected ten (10) samples in Tashkent
  - Will be collecting samples in Bukhara and Nukus (near Aralkum Desert)
  - **CCSEM analysis in August 2023**



**Perhaps CCSEM of interest for  
Select Spartan sites?**



# Spartan Core Measurements and Ancillary Projects (Measurements)

