Sensing Dust in the Desert: PM_{10} Projects and Lessons Learned in the Extreme Environment of Phoenix, AZ

Ronald Pope, PhD
Atmospheric Scientist
Planning & Analysis Division

“Valley of the Sun”

Summer Haboob

Winter Inversion

Mean Annual Rainfall: 8”
Mean Precipitation Days: 36
Annual Sunny Days: >300

July Mean High:
106 °F
(record high 122 °F)

December Mean Low:
L: 45 °F
(record low 16 °F)

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RECENT PROJECTS

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Citizen Science Projects

- Community-Based Approach to Improving Air Pollution Monitoring in SW Tribal Communities (2014 Proposal)
  - 7 Parameters
  - 5 low-cost portable sensors

Salt River Pima-Maricopa Indian Community

Arizona State University

- ASU Low Cost Sensor Co-Location Validation Project with Field Testing at The Boulder Ridge Community
  - 2 Parameters (PM10 & PM2.5)
  - 5 low-cost portable sensors
  - Collocation with FEM sites

scistarter
Science we can do together.

Arizona State University

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Outreach and Education Projects

Maricopa County Air Quality Education Kiosks

Sensor: AQMesh

Parameters: PM_{10}, $PM_{2.5}$, Ozone, NO_2

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Up in the Air: An Air Pollution Education with Kids Making Sense

Sensor: AirBeam2

Parameters: PM_{10}, $PM_{2.5}$, PM_1

KIDS MAKING SENSE

Phoenix as a Testbed for Air Quality Sensors (P-TAQS)

EPA Office of Research and Development: NERL
Maricopa County Air Quality Department

Phase 1

- A year-long collocation of PurpleAir sensors with FEM monitors (TEOM).
- MCAQD conducted a winter fireplace smoke study in 2018-2019 as part of Phase 1.
  - 10 PurpleAir Sites
  - Focused on $PM_{2.5}$, but also collected PM_{10}

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Phoenix as a Testbed for Air Quality Sensors (P-TAQS)

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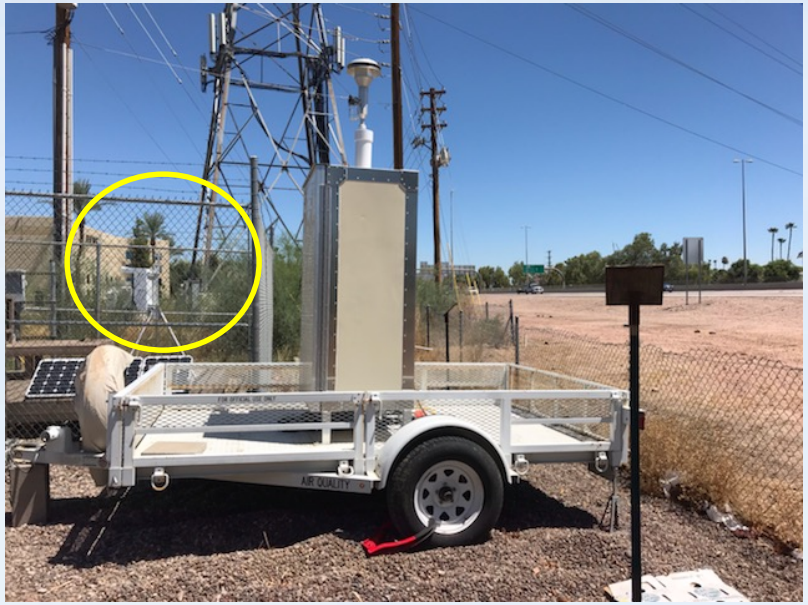

Phase 2

- A larger field study using sensors in a distributive network.
  - 21 PurpleAir Air Sites, some with solar
  - Mobile FEM (T640) for QA

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LESSONS LEARNED AND DATA QUALITY QUESTIONS

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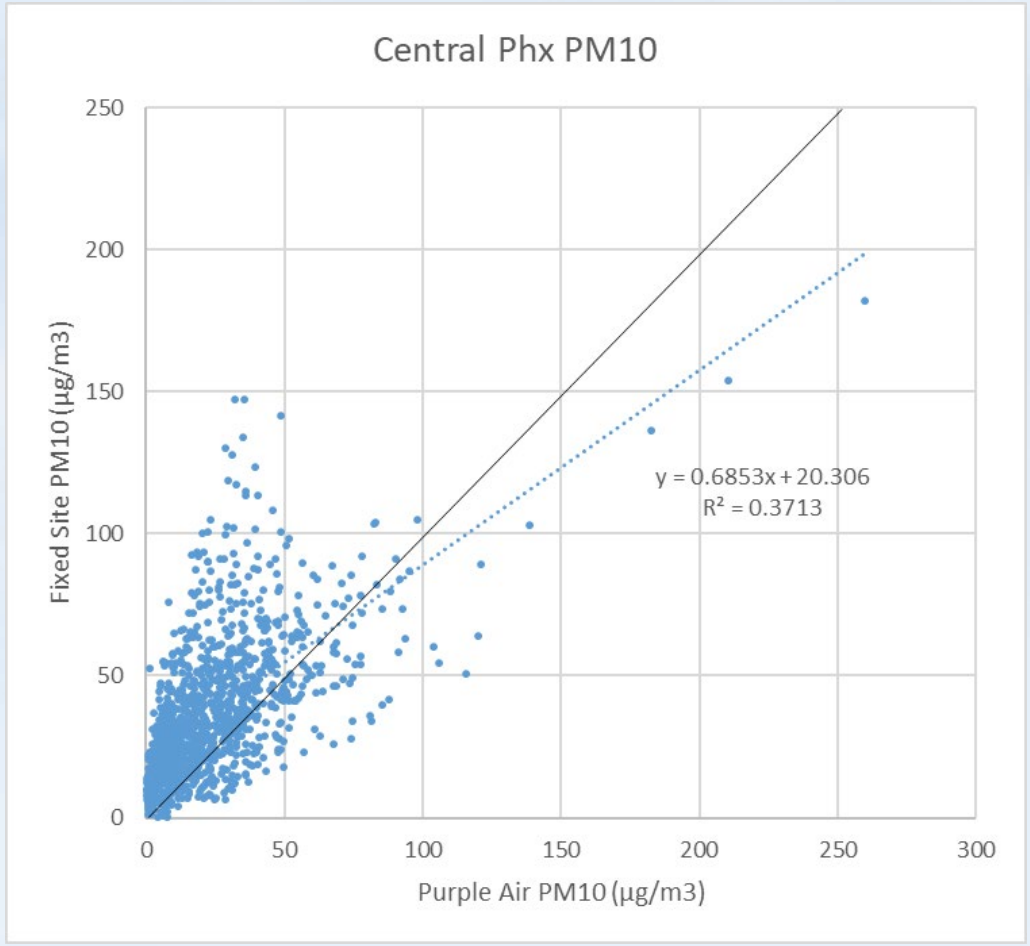
- PurpleAir $PM_{2.5}$ were fairly precise (r^2 = .91 at West Phoenix), but accuracy was off. We used a correction factor (0.59) to correct.

- PurpleAir PM_{10} had far lower P&A performance (r^2 = .37 at Central Phoenix).



PurpleAir PM_{10} vs. Fixed Site PM_{10} (TEOM)

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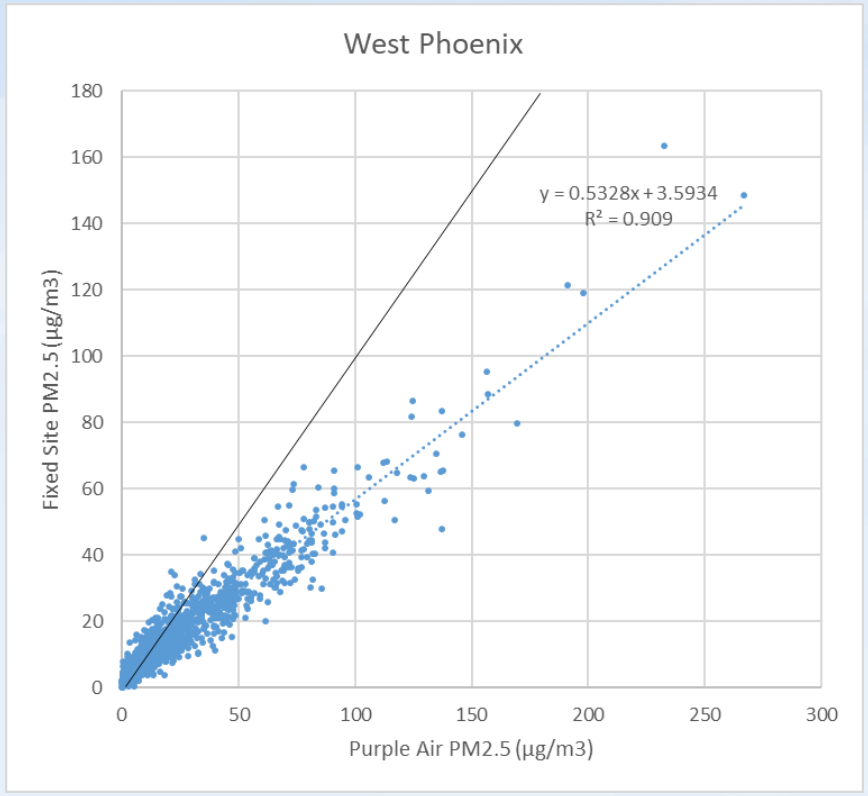
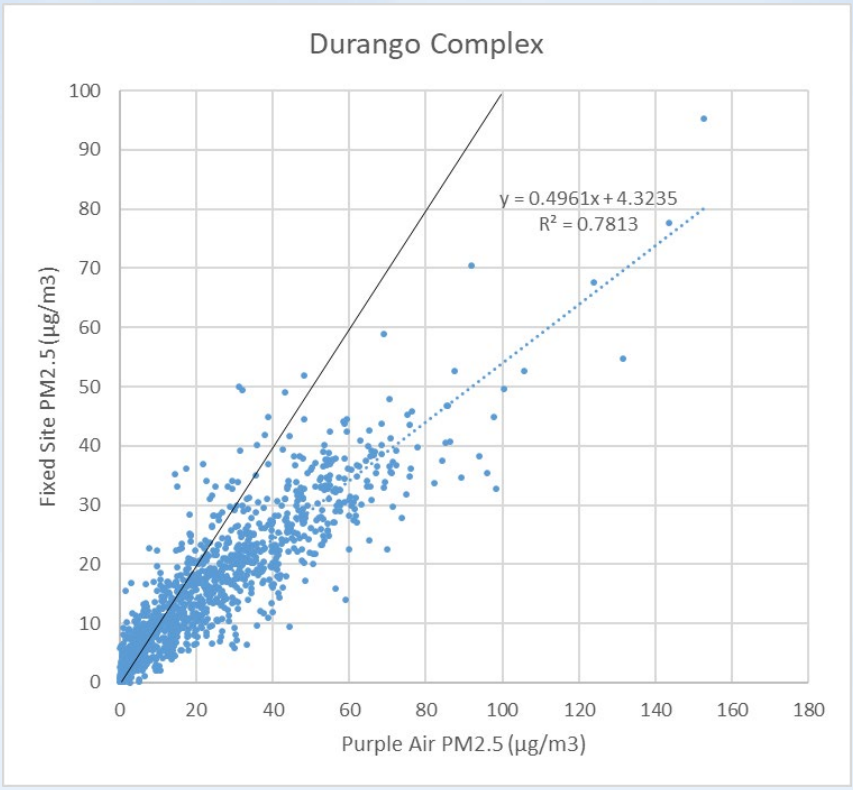
- Data quality degraded with higher particulate concentrations.
- Sensors collocated at sites with greater amount of crustal material, as noted by using PM Coarse, have lower data quality.
  - The larger the coarse portion of the PM_{10} sample, the worse job that PurpleAir did in measuring $PM_{2.5}$ (r^2 = .91 vs .78)

Lesser Crustal Component in PM_{10}



PurpleAir $PM_{2.5}$ vs. Fixed Site $PM_{2.5}$ (TEOM)

Greater Crustal Component in PM_{10}



- Accuracy and Survivability Questions about Sensors
  - Over a range of values?
  - At extreme values (>1000 µg/m^3)?
  - At various temperatures or environmental extremes?
  - Various particle sources?
  - At different time scales?
  - Long-term performance?

- Data Issues
  - Consistency between low-cost sensor and regulatory data (e.g. 80 second data vs 60 second data)

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Thank you

Ron Pope
ron.pope@maricopa.gov