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

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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)

Summer Haboob

Winter Inversion
Citizen Science Projects

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

• 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
Outreach and Education Projects

Maricopa County Air Quality Education Kiosks
Sensor: AQMesh
Parameters: PM$_{10}$, PM$_{2.5}$, Ozone, NO$_2$

Up in the Air: An Air Pollution Education with Kids Making Sense
Sensor: AirBeam2
Parameters: PM$_{10}$, PM$_{2.5}$, PM$_1$
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\textsubscript{2.5}, but also collected PM\textsubscript{10}
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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
LESSONS LEARNED AND DATA QUALITY QUESTIONS
• 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).
• 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\textsubscript{10} sample, the worse job that PurpleAir did in measuring PM\textsubscript{2.5} ($r^2 = .91$ vs .78)
• **Accuracy and Survivability Questions about Sensors**
  – Over a range of values?
  – At extreme values (>1000 µg/m³)?
  – 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)
Thank you

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