



Calibration of citizen sensor networks using a mobile air monitoring platform

A collaboration between Aclima and CARB

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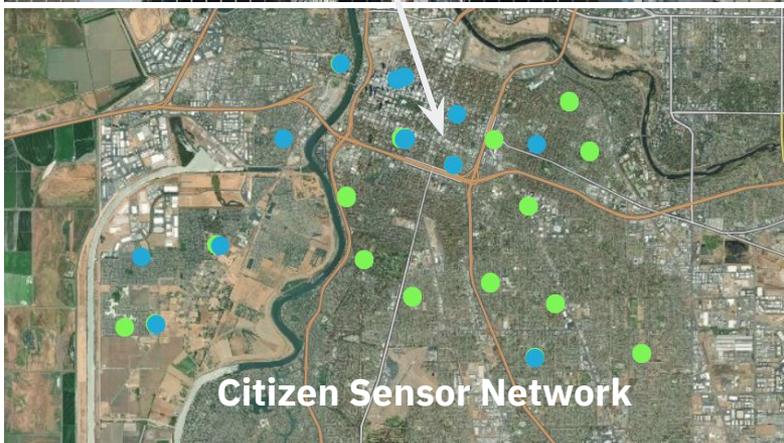
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Outline

- Project Description and Motivation
- Factors impacting mobile vs stationary comparisons
 - Aggregation time
 - Distance
- Validation exercise: mobile calibration of Purple Air (PA-II) sensors located at regulatory site

ACLIMA PATENT US10605633B2: *Distributed Sensor Calibration*

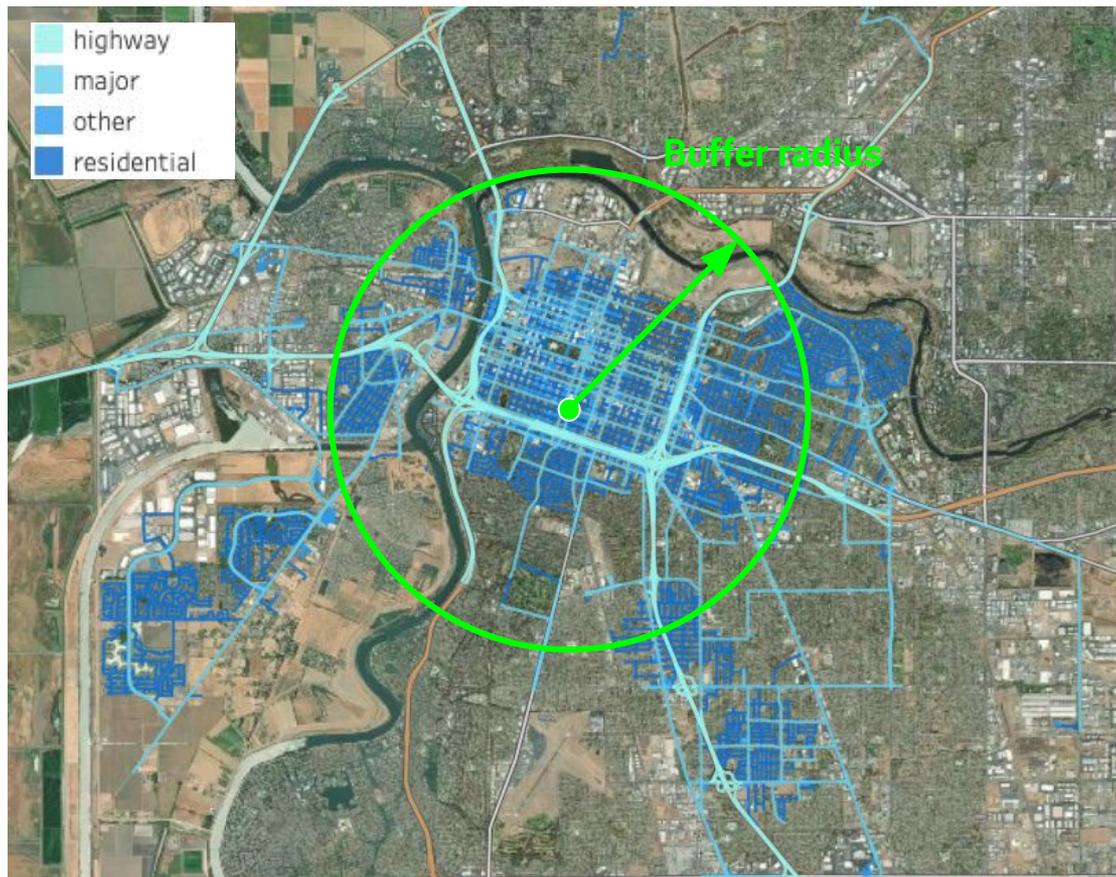
Project Description: Fall/Winter 2020-2021



MOTIVATION: Proof of concept for simultaneous mobile air quality mapping and citizen sensor network calibration

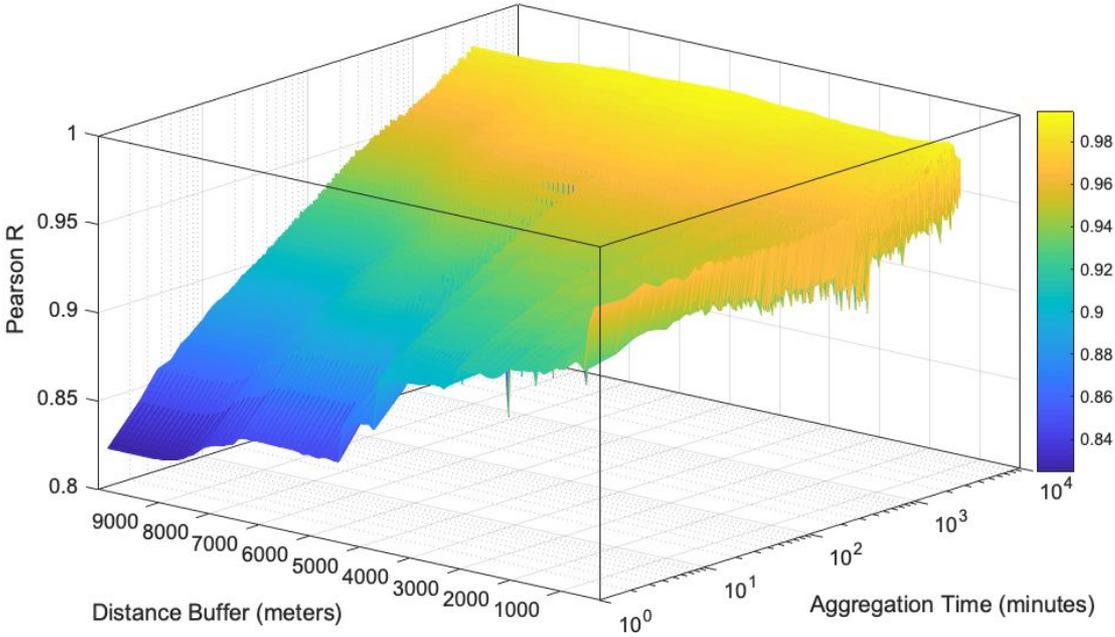
Many Factors Impacting Collocation

- Road type
- Mobile to stationary distance buffer
- Stationary vs mobile
- Temporal aggregation
- Time of day balance
- Number of collocations

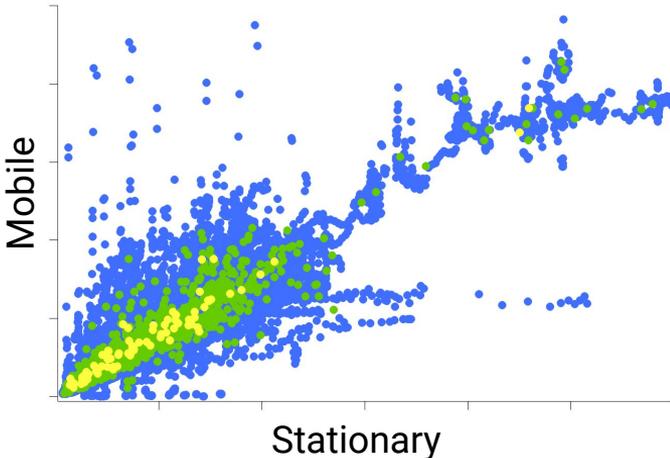


Key finding: Correlation Depends on Distance and Aggregation Scale

Mobile AMN vs Stationary T640 Reference



5000 m buffer
Daily, hourly, and 1 minute aggregation

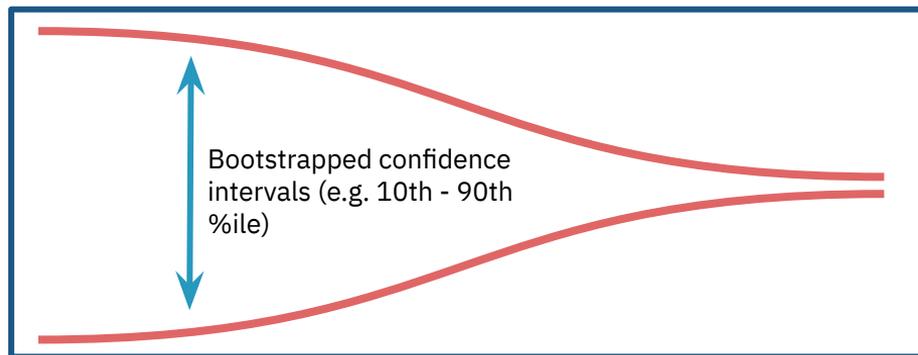


Includes mobile collocation only

Validation Strategy

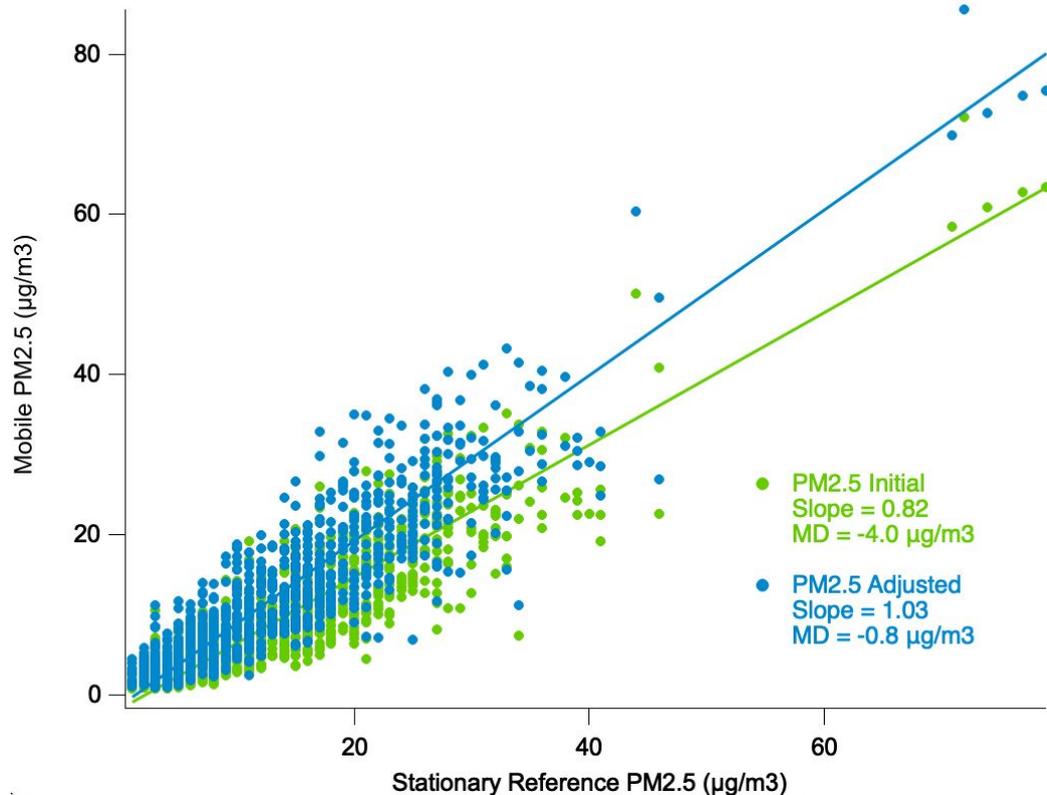
Name	Transfer Source	Test Sensor	Reference	N (1-hr collocations)	Notes
Mobile 1	BAM	Aclima Mobile Node	BAM	1100	In situ (buffer distance = 3000 m)
BAM	BAM	PA-II (15 sensors)	BAM	1100	In situ; mimics a "Portable BAM"
Mobile 2	Mobile Node	PA-II (15 sensors)	BAM	1100	In situ (buffer distance = 3000 m)
US EPA	BAM	PA-II (15 sensors)	BAM	n/a	Barkjohn et al., 2020
PRE	BAM	PA-II (15 sensors)	BAM	2-4 weeks continuous	Pre-deployment

Mean Difference (MD) or
Centered Root Mean
Square Difference
(CRMSD)



Number of 1-hr collocations

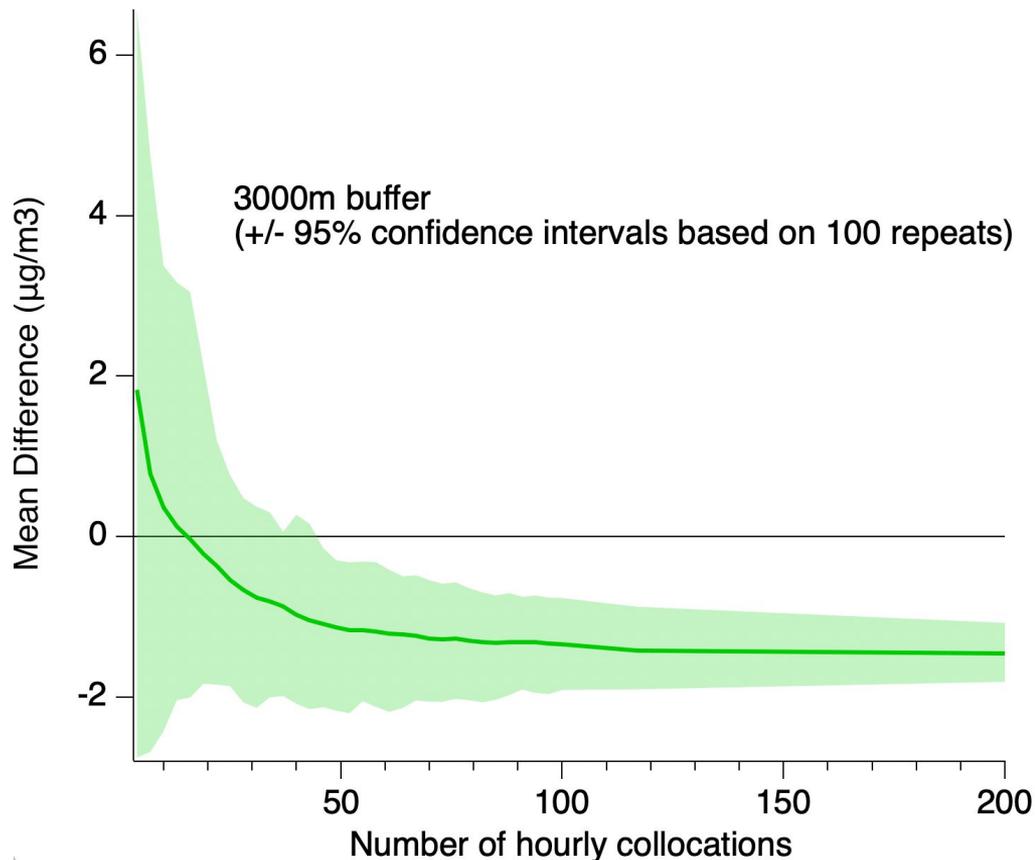
Stationary to Mobile Calibration



Regional aerosol mixture impacts Aclima Mobile Node PM2.5 Counts to Mass Conversion

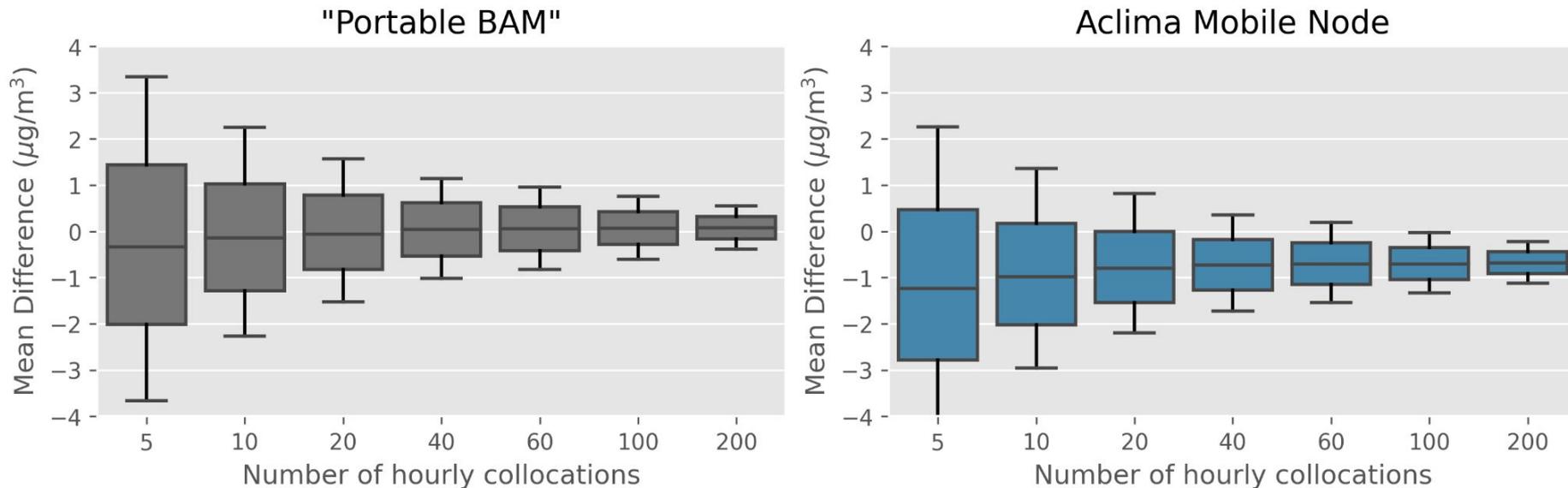
Residual offset of approx. -1 µg/m³ after adjustment

Stationary to Mobile Calibration



Optimal number of hourly collocations for stationary to mobile calibration: n~40 hrs

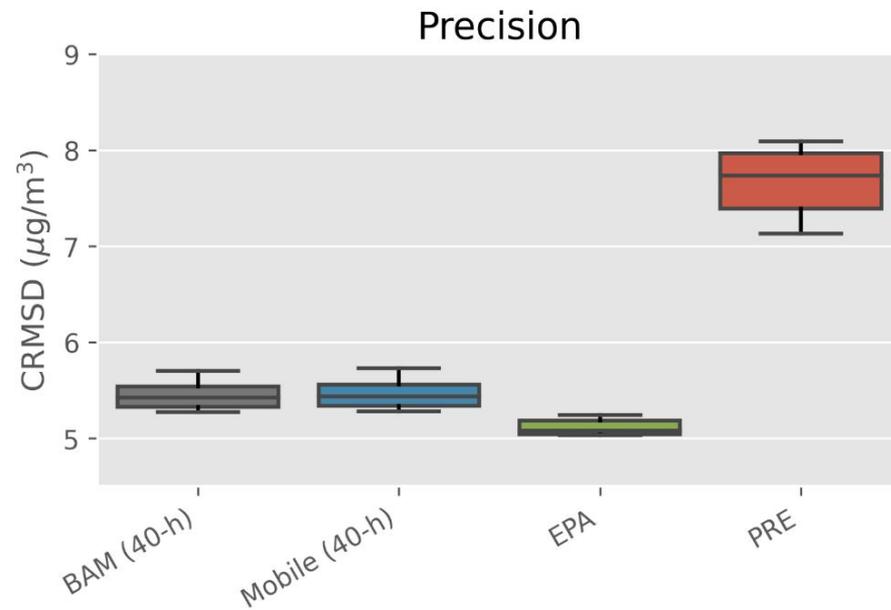
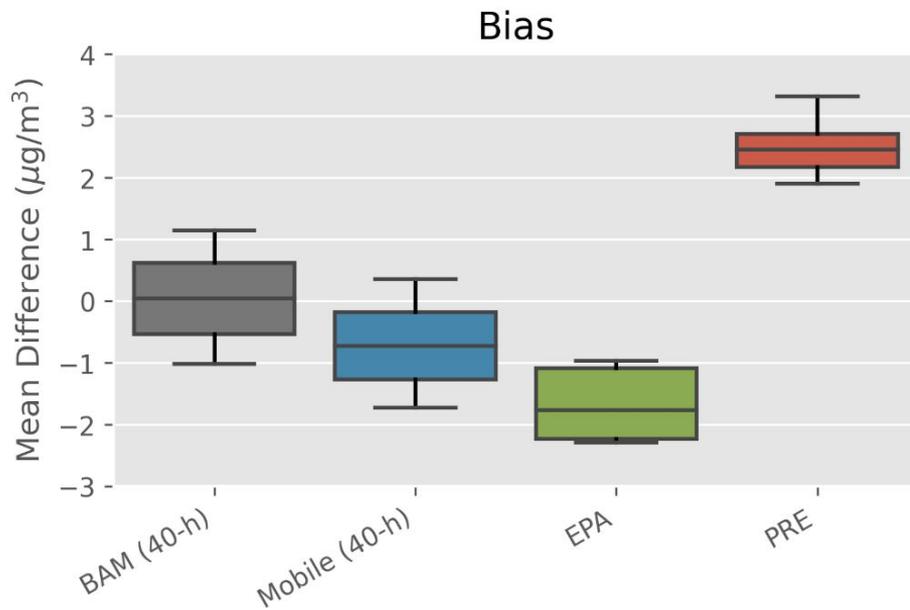
Preliminary Validation Results: PA-II Calibration Transfer



Comparable performance at 40 or more collocation hours for mobile node vs hypothetical "portable BAM"

Preliminary Validation Results: Comparison with Standard Methods

40 hours of mobile calibration offers improved performance over pre-deployment calibration and comparable performance to direct collocation with BAM



Topics for Further Exploration

- Could this method work as a “real-time” adjustment?
- How does the trade-off between buffer distance and number of collocation hours vary with location?
- How does the method perform in highly variable conditions?

Summary

- We have demonstrated that calibration transfer from a regulatory site across a network of citizen sensors using a mobile platform is feasible for PM2.5
- We have presented a viable strategy for validating performance of calibration transfer
- Approximately equivalent performance to a direct collocation with regulatory BAM with approximately 40 distinct hours collected within 1000 m of each site