

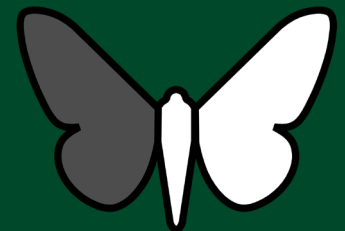
Combustion-focused Air Quality Monitoring with Sensor Networks

Julien Caubel¹, Xiaoliang Wang², Troy Cados¹,
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1. Distributed Sensing Technologies, CA
2. Desert Research Institute, NV

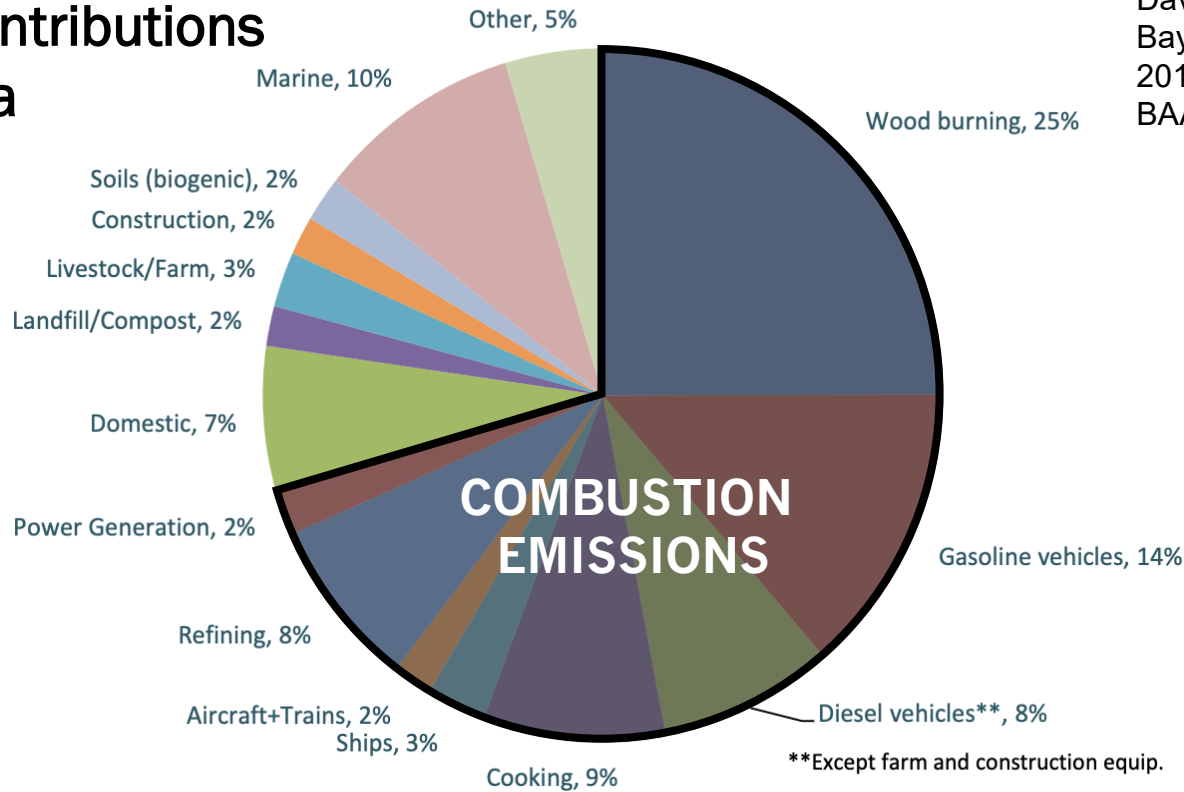


National Ambient Air Monitoring Conference
August 24, 2022



Urban PM dominated by combustion

PM source contributions in SF Bay Area



David Fairley. Sources of Bay Area Fine Particles: 2010 Update and Trends. BAAQMD. 2012.

- Combustion emissions are harmful to human health and environment
- Targeted monitoring of combustion emissions to inform public policy



Black carbon (BC) as combustion proxy

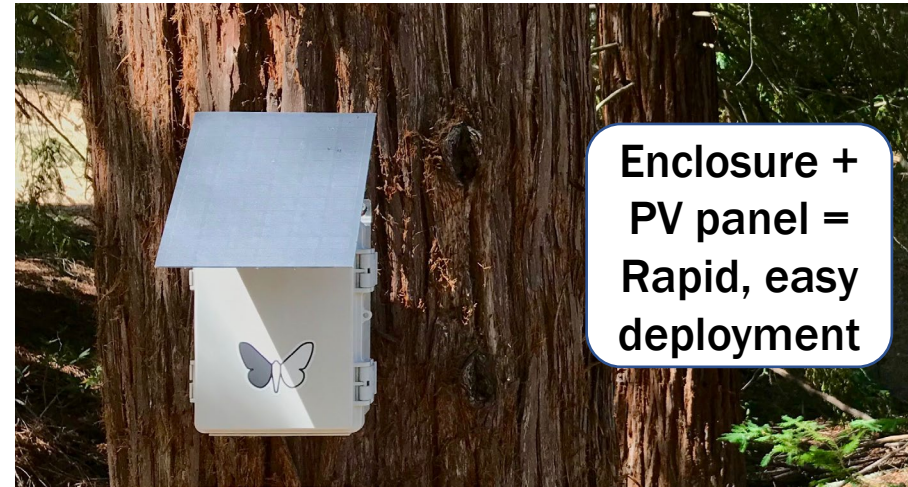
- BC is light-absorbing portion of PM pollution
- Emitted ONLY during incomplete combustion
- BC detected = Something is burning upwind (always!)



Distributed BC sensing: ObservAir

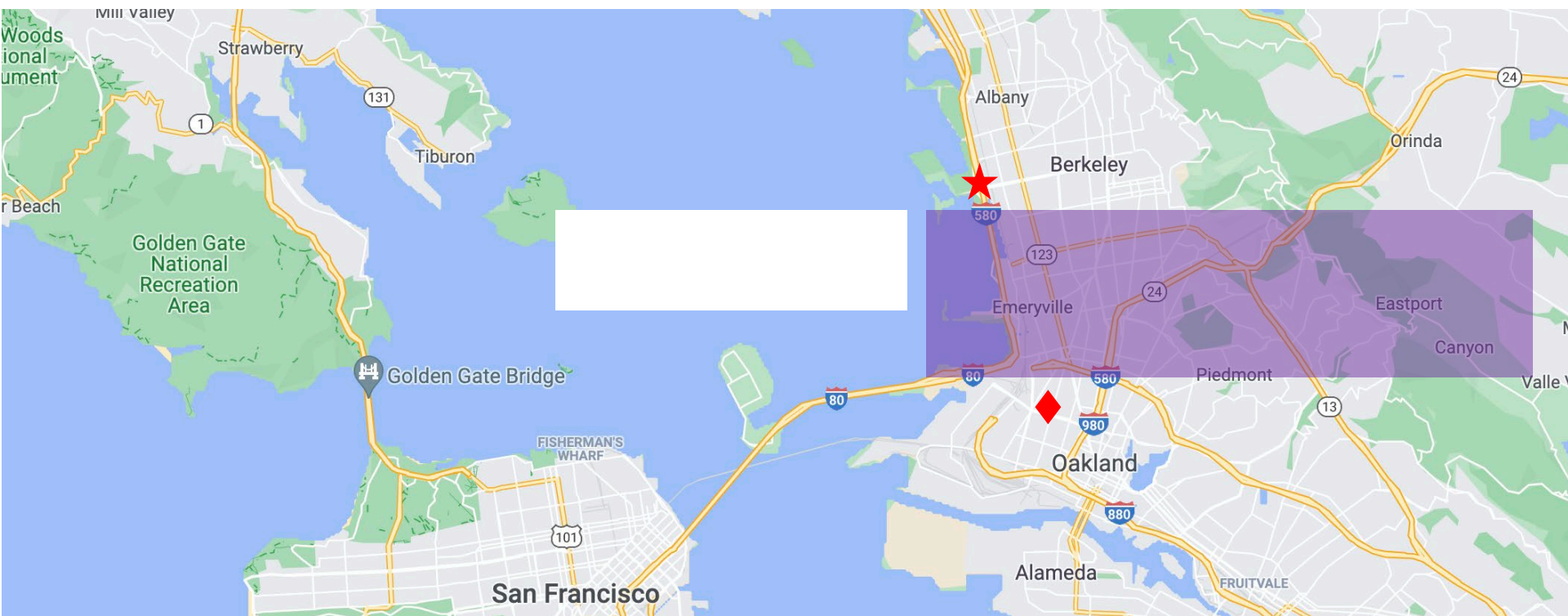
Absorption photometer monitors BC concentrations:

- **Accuracy anywhere:** Patented features maintain data quality in tough environments
- **Modular:** Monitor CO, NO₂, PM, and other pollutants
- **Low maintenance:** Filter change every 2 to 4 weeks
- **Live data:** Dedicated mobile app + web dashboard



Smoke Scope: Pilot Study

5 ObservAir units deployed in East SF Bay for 2 weeks
(September 14 to October 1, 2021)



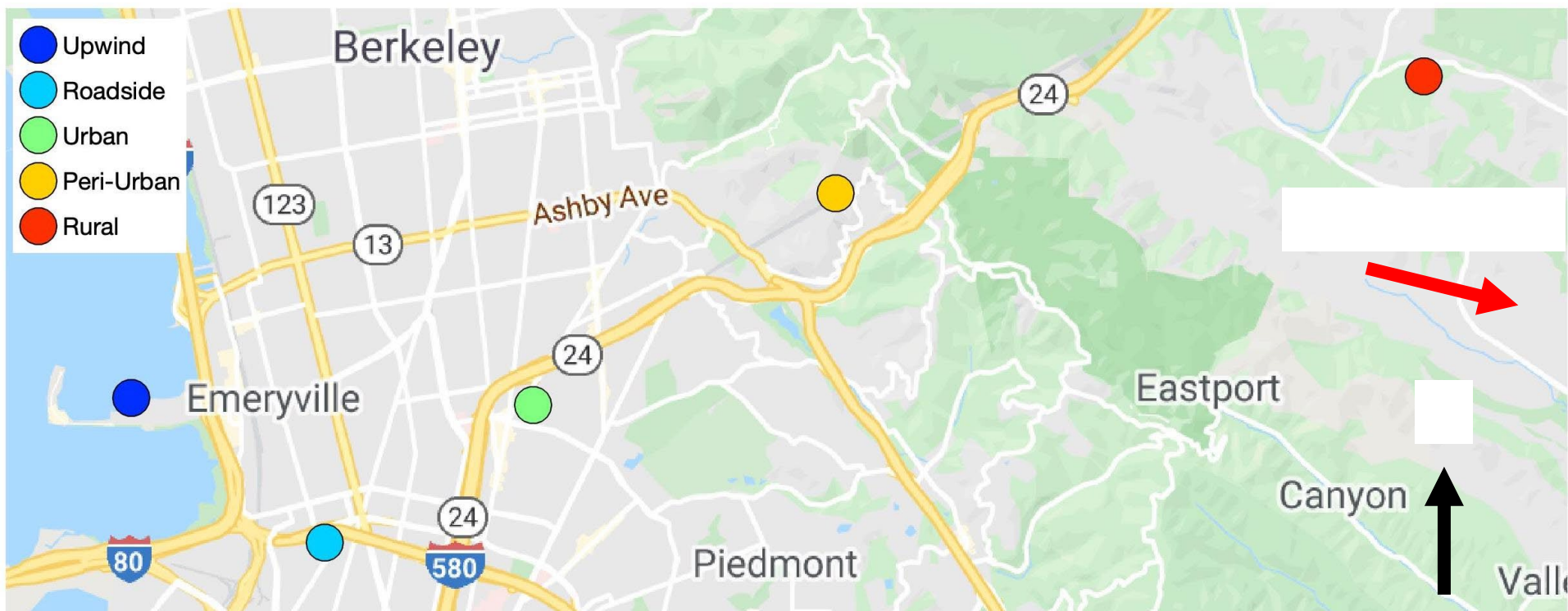
★ = Roadside AQ station

◆ = Residential (urban) AQ station

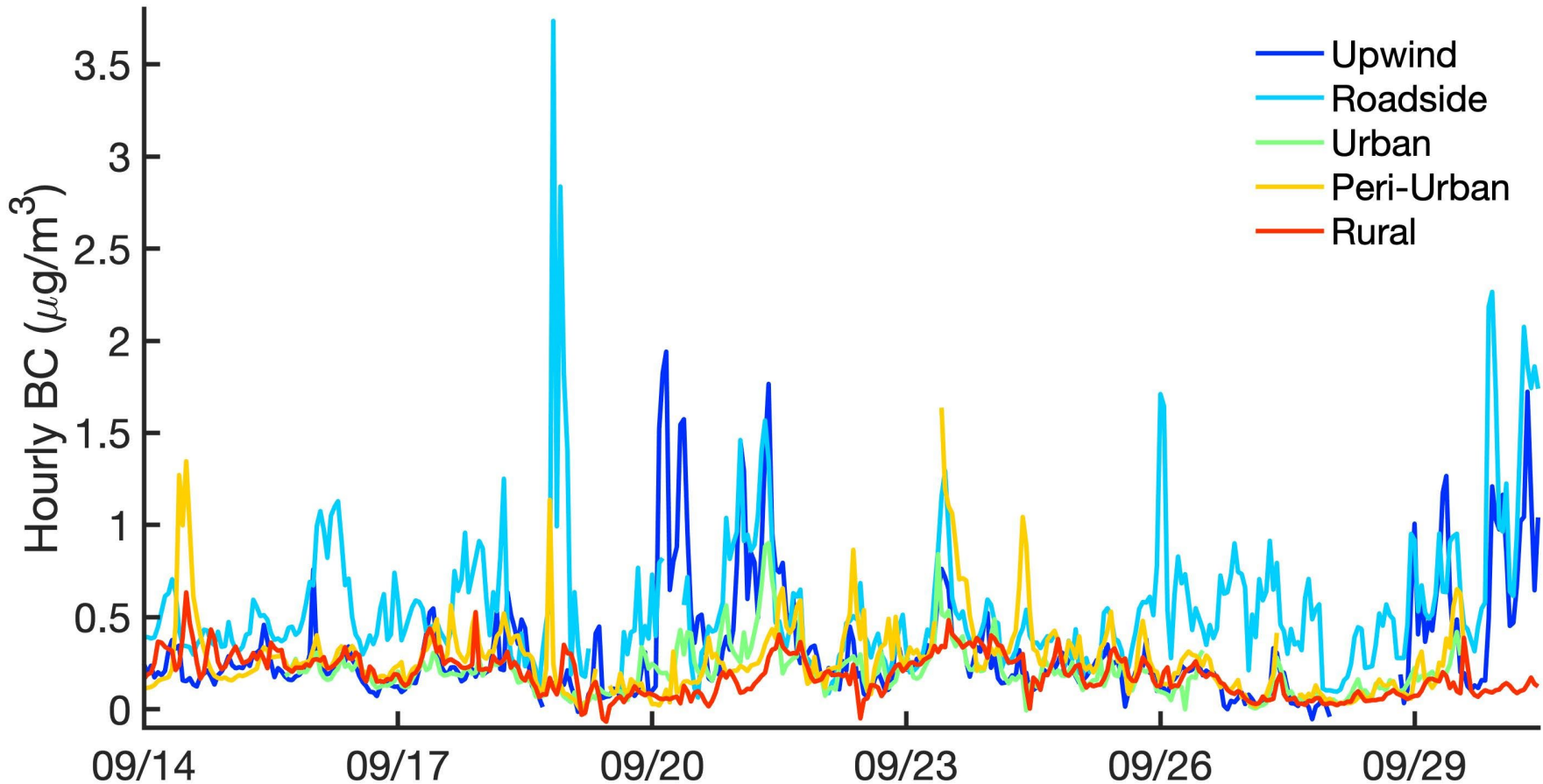


Smoke Scope: Pilot Study

- BC monitored at all 5 sites
- CO also monitored at Roadside, Urban, and Rural sites

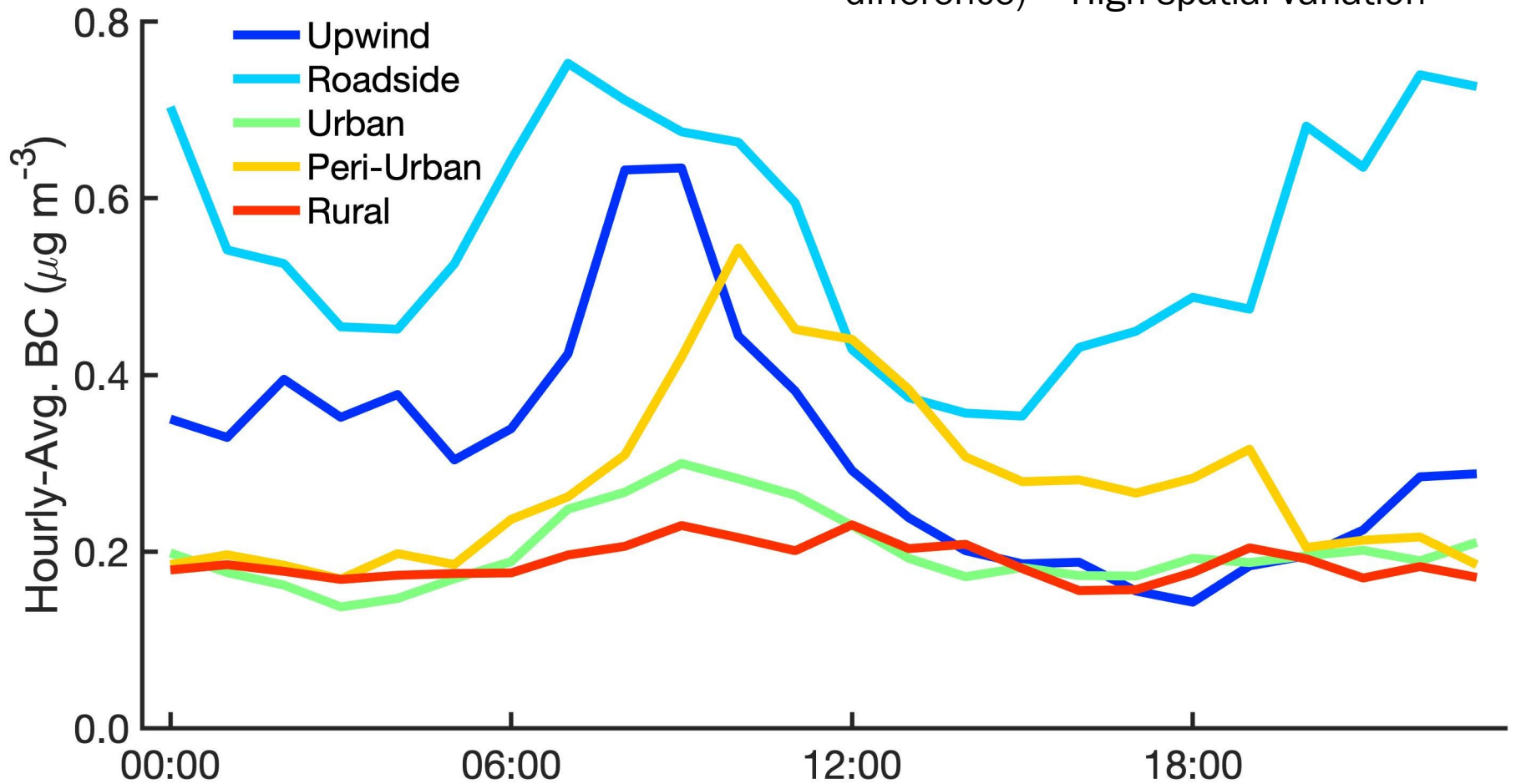


SmokeScope: Hourly black carbon

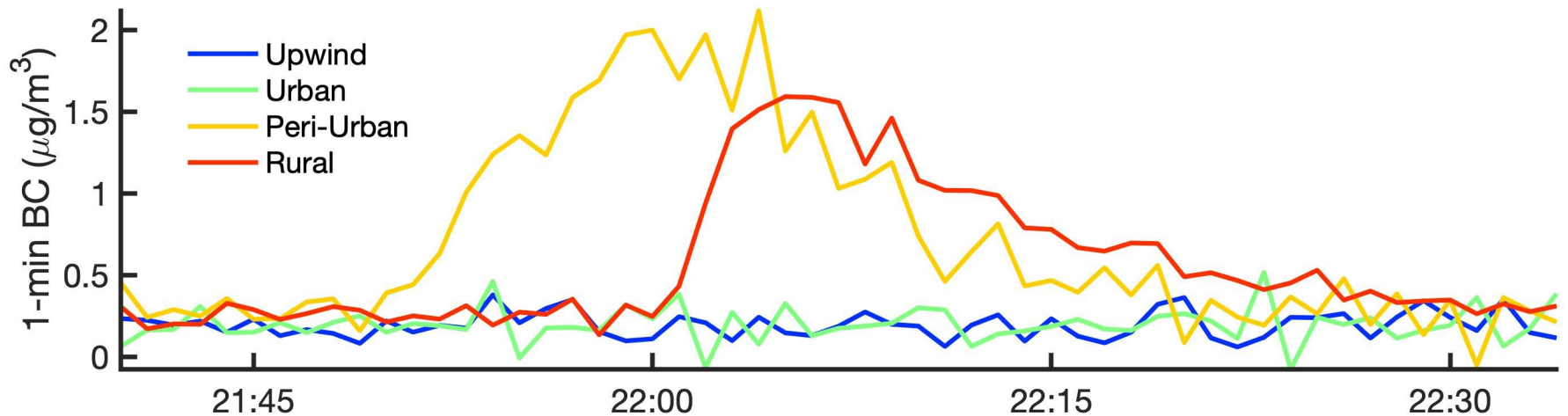
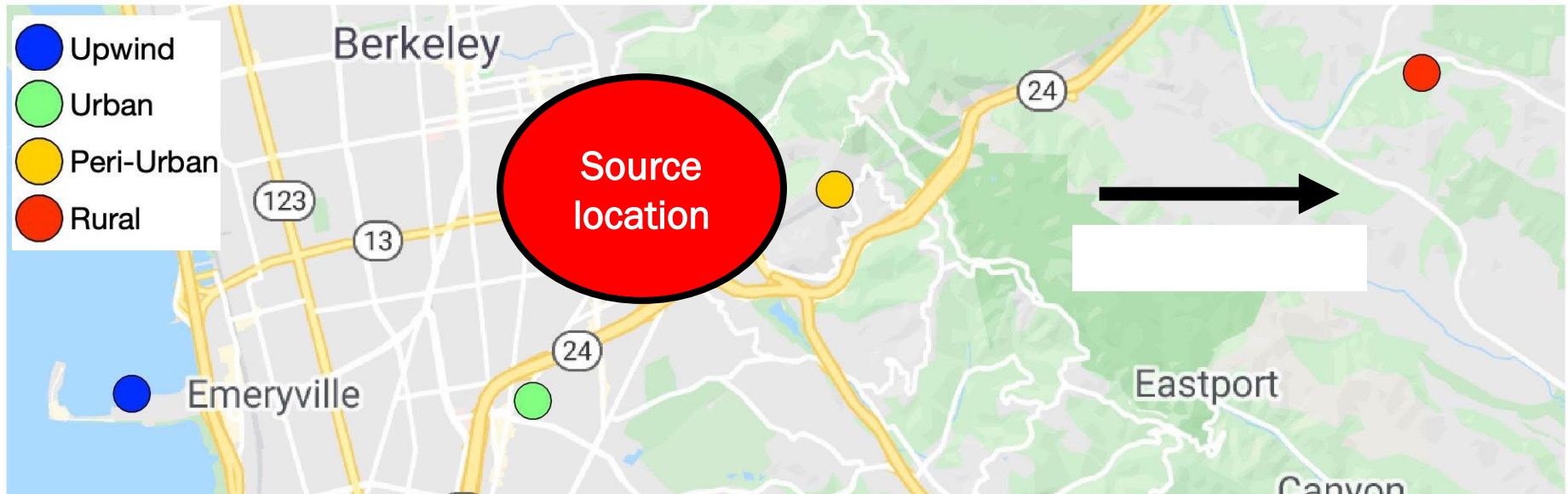


AQ Profiles

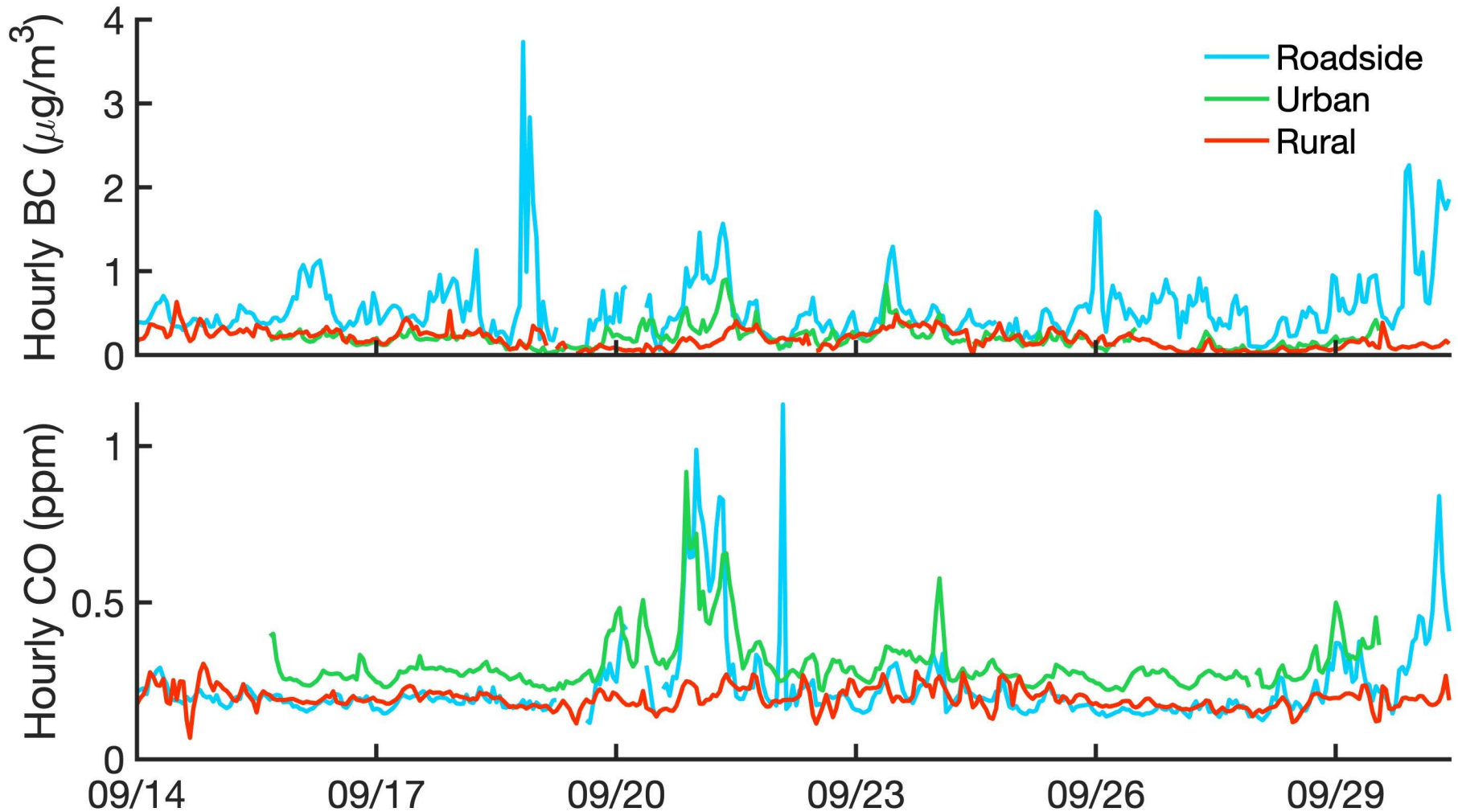
- Roadside highest; Rural lowest
- Bimodal time trend reflects traffic
- Distinct BC trends at each site (up to 4x difference) = High spatial variation



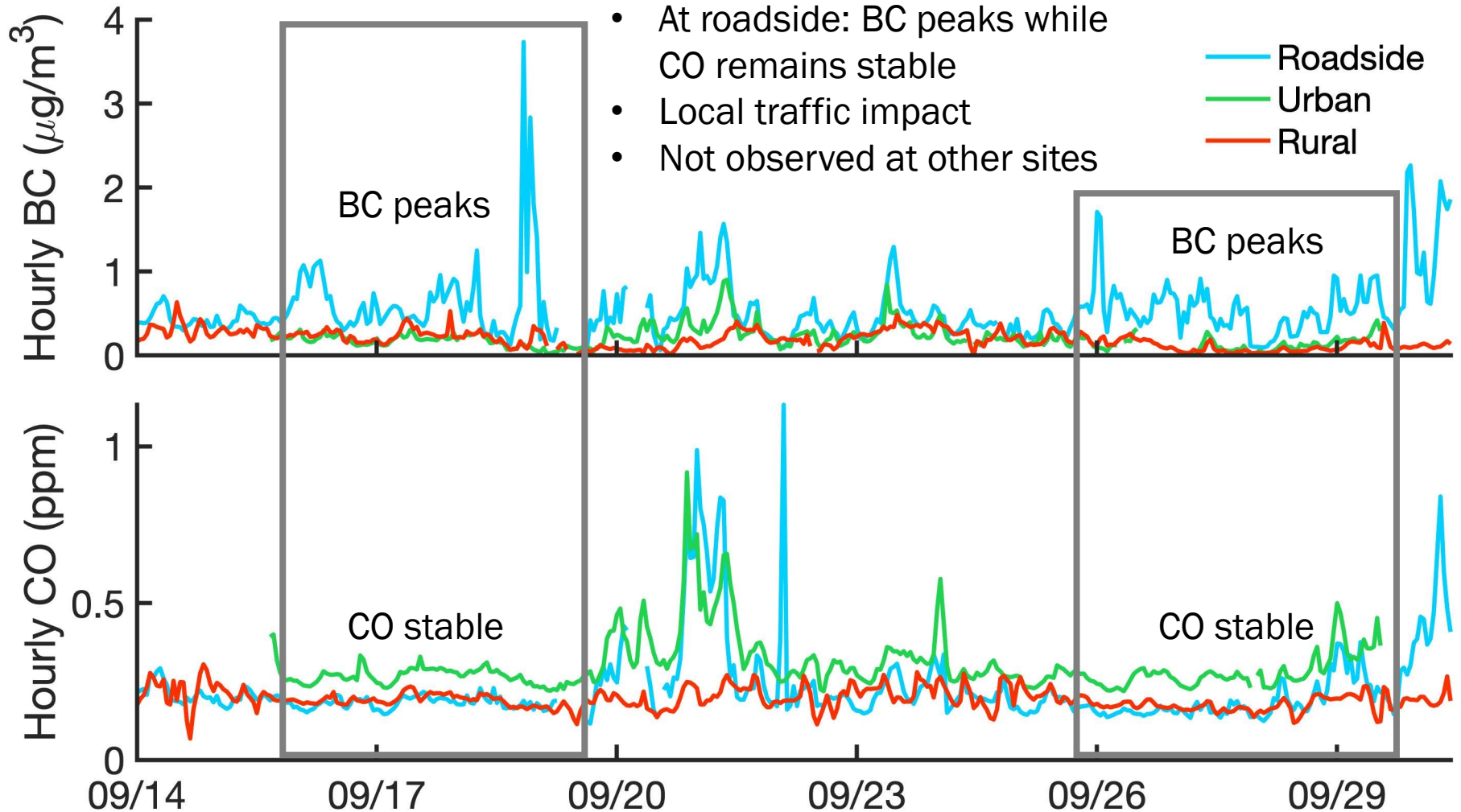
Rapid detection and tracking



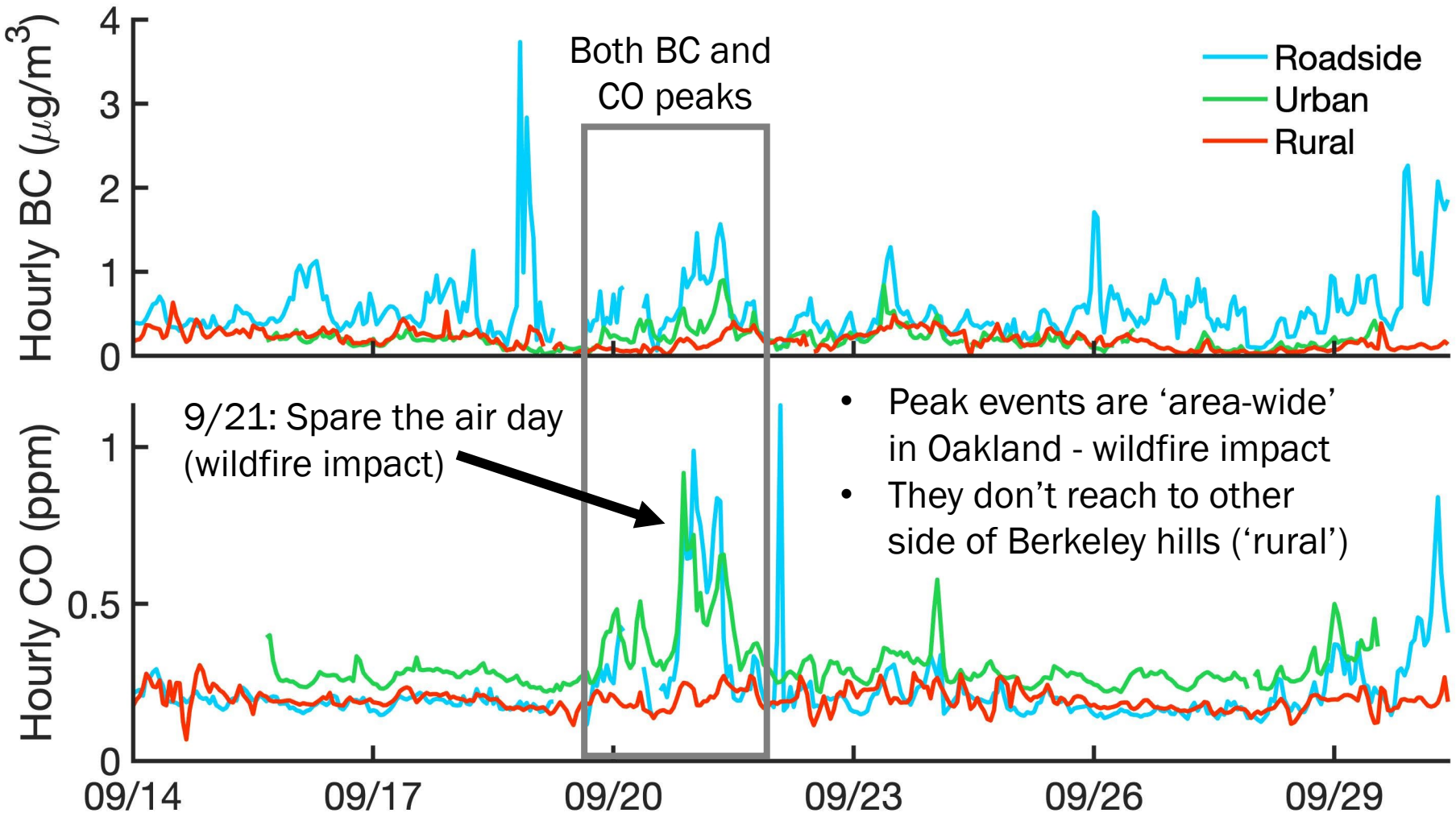
BC + CO = Source apportionment



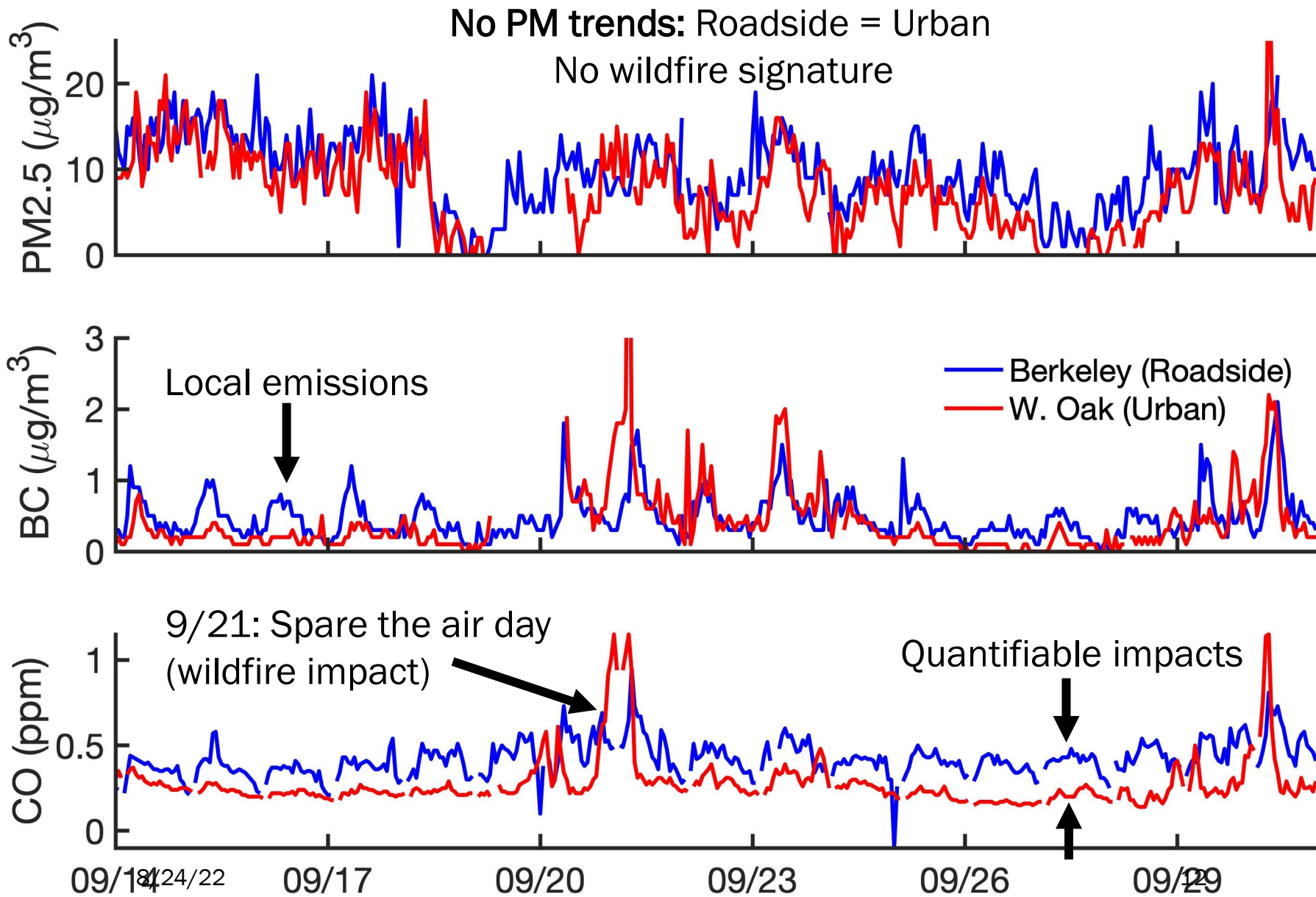
Local emission events: BC peaks only



Regional emission events: BC + CO peaks



Regulatory (BAAQMD) data nearby



Combustion-focused AQ monitoring

1. Develop actionable + accurate AQ profiles

- Monitor strong combustion proxy: Black carbon
- High spatiotemporal resolution required: Distributed network

2. Distinguish different types of emission events

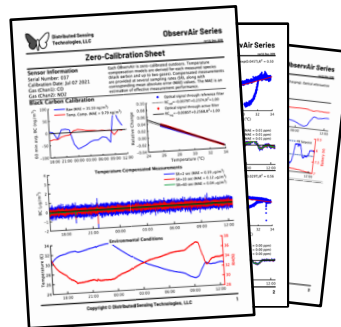
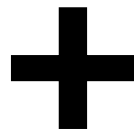
- Contribution from point sources vs. area-wide AQ events

3. Real time source detection and impact tracking

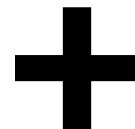
- Protect human health and inform public policy



Combustion proxy

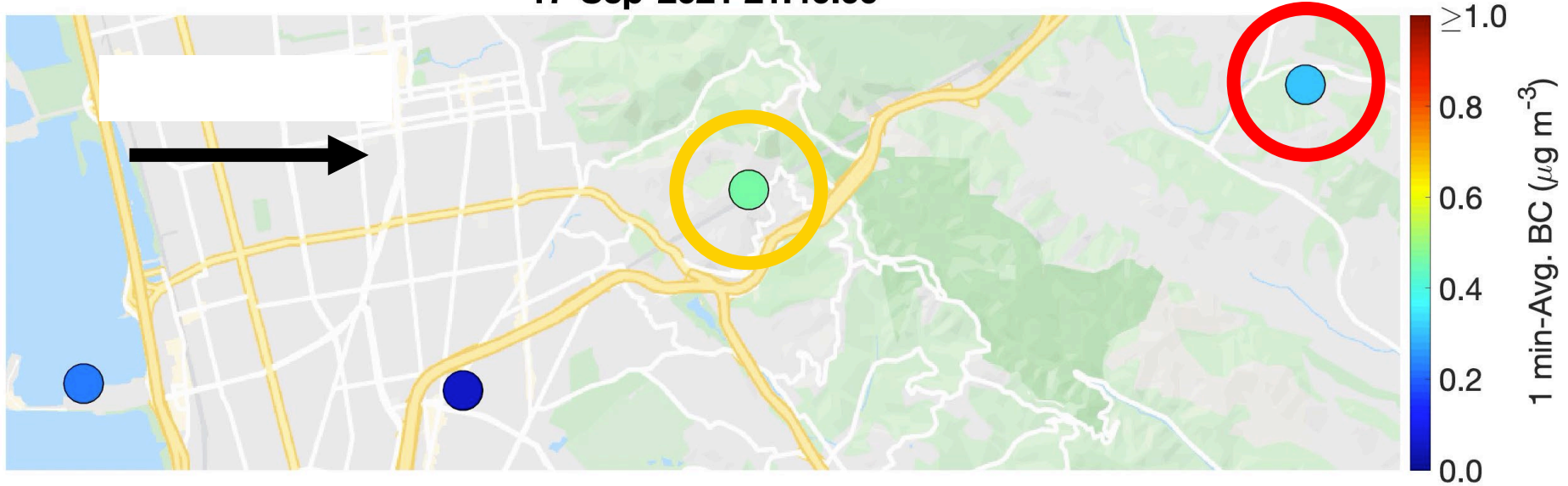


Accurate data



High Res. Mapping

17-Sep-2021 21:40:00



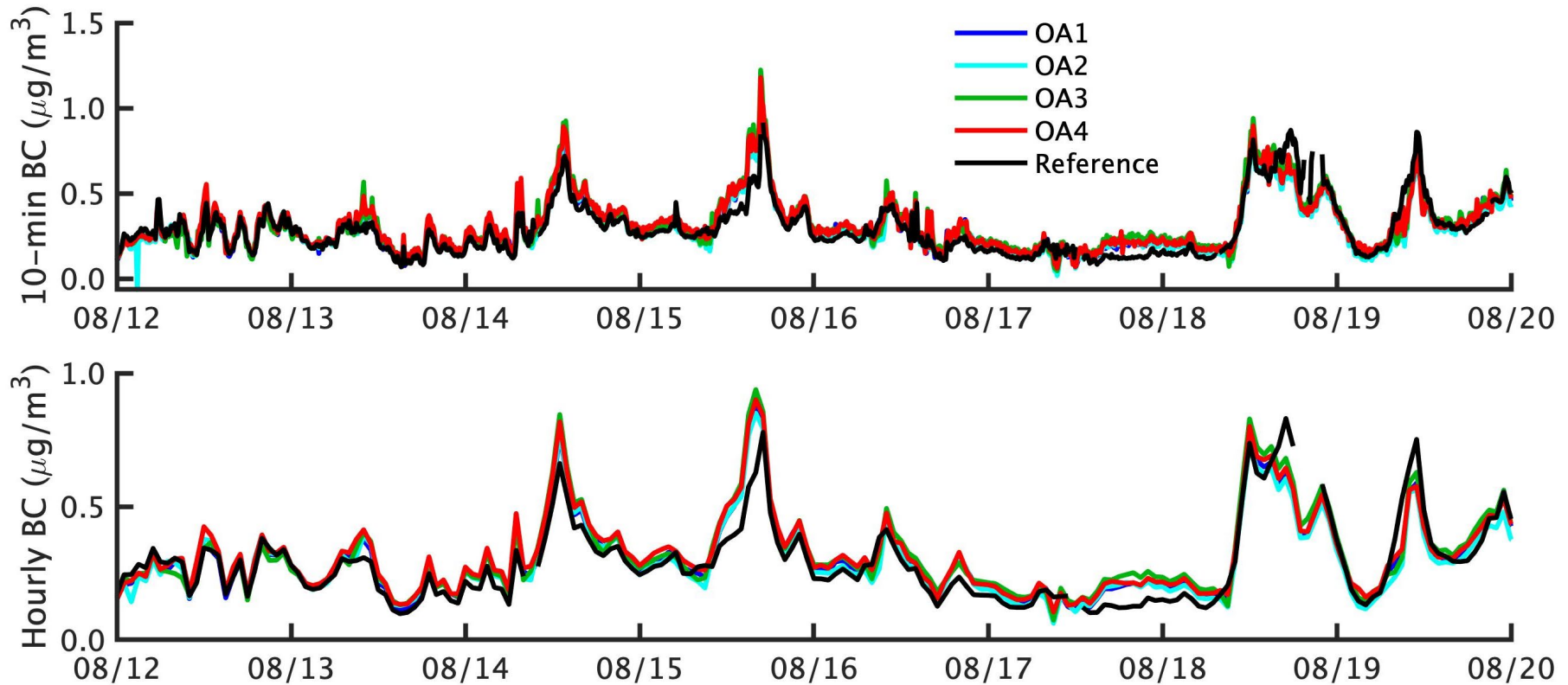
Thank you!

julien@dstech.io

Supplemental Slides

Regulatory grade performance

Ambient collocation with Magee Scientific AE33 (8 days)

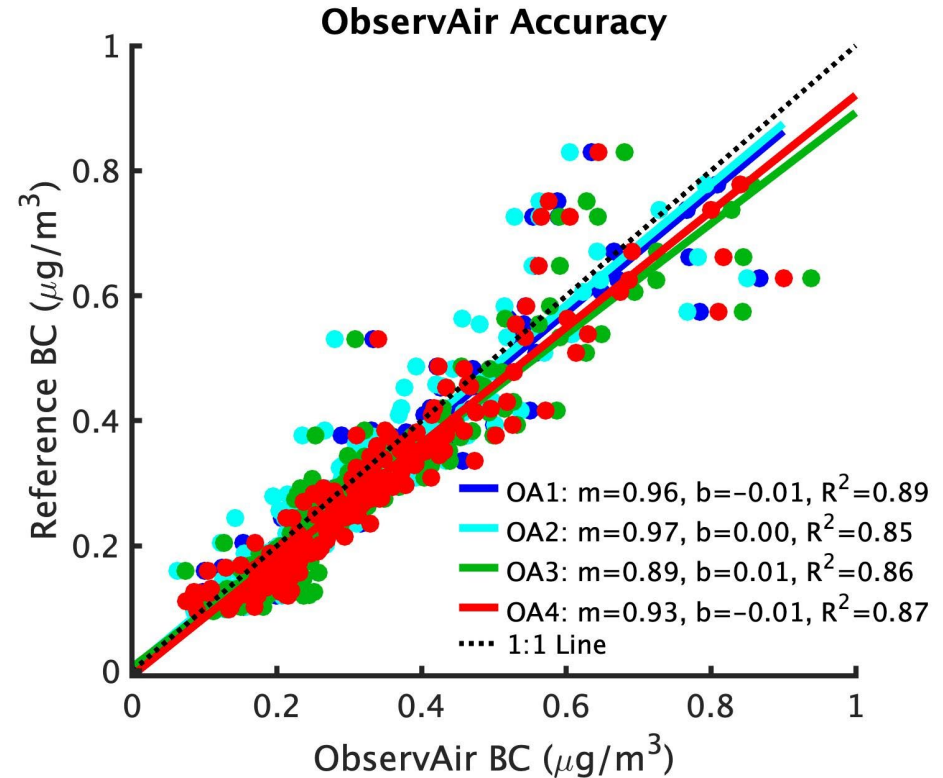
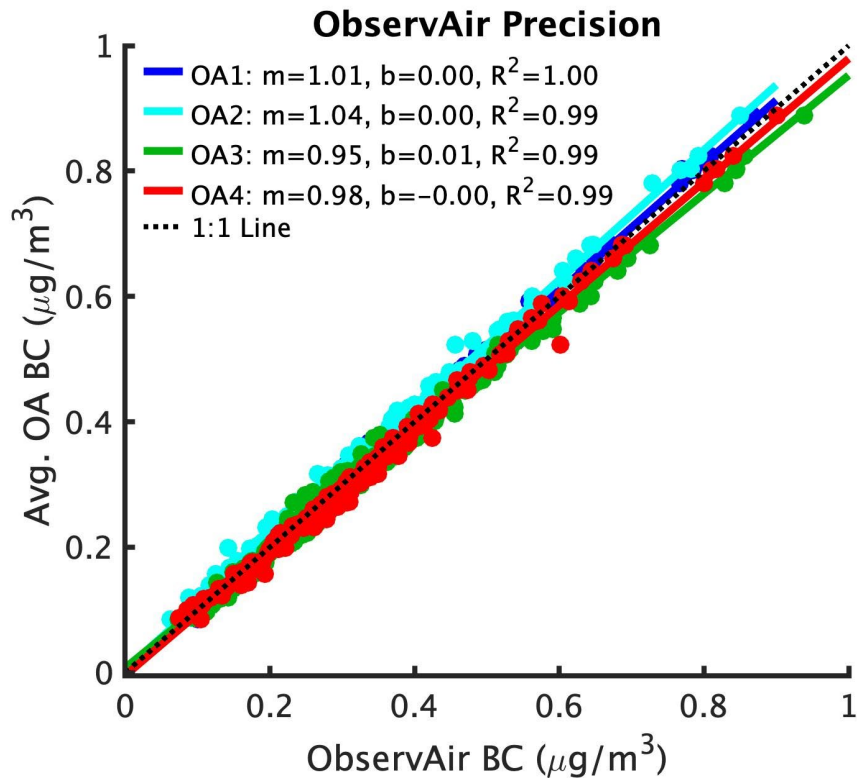


(2021)



Regulatory grade performance

High precision and accuracy enable network deployment



Hourly average data shown.



Filter replacement

ObservAir Filter Life (days)					
	Average BC ($\mu\text{g}/\text{m}^3$)				
Flow rate (ccm)		0.3	1	5	10
	15	113	33.9	6.8	3.4
	50	33.9	10.2	2.0	1.0
	100	17.0	5.1	1.0	0.5
	150	11.3	3.4	0.7	0.3



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