

# Grills and Grilles: Traffic and Cooking as Drivers for PM Spatial Variations

Albert Presto

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CACES



**Carnegie  
Mellon  
University**

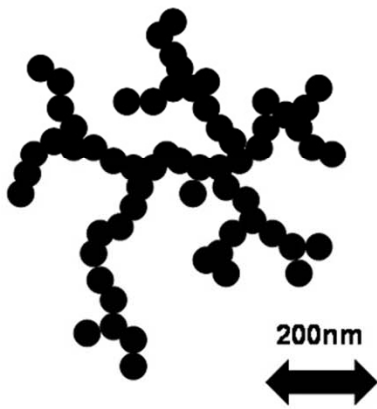
## Take-home points

- Local emissions of organic aerosol and black carbon are the major drivers for PM spatial variations
- Secondary organics are also spatially variable, though less than primary emissions
- Particles near sources are externally mixed



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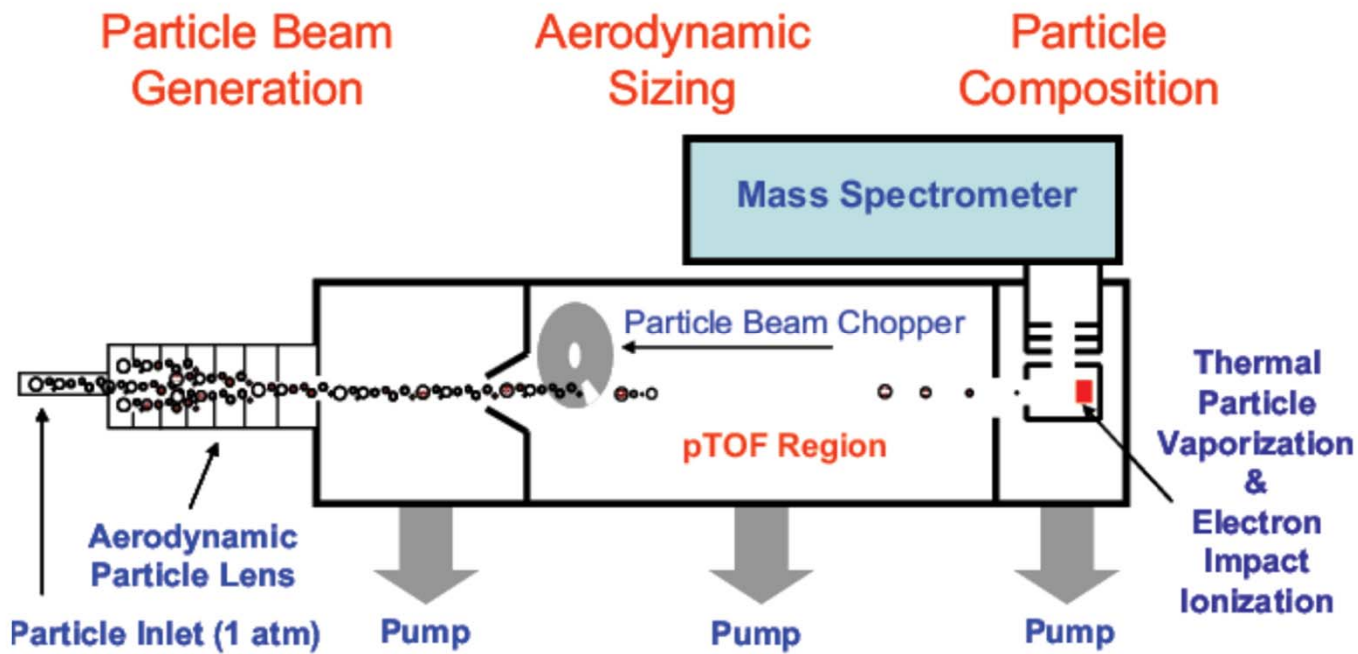
# What are these particles made from?



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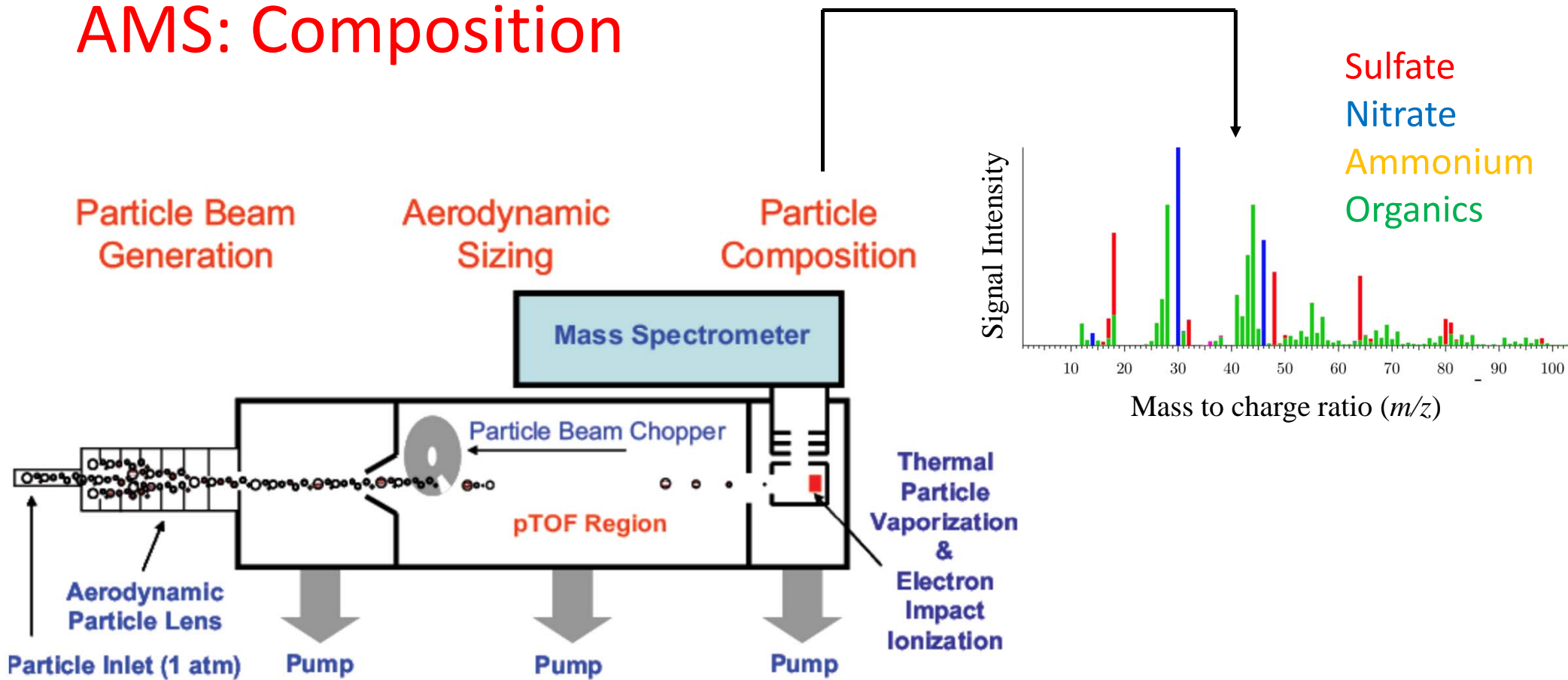
# Aerosol Mass Spectrometer (AMS)



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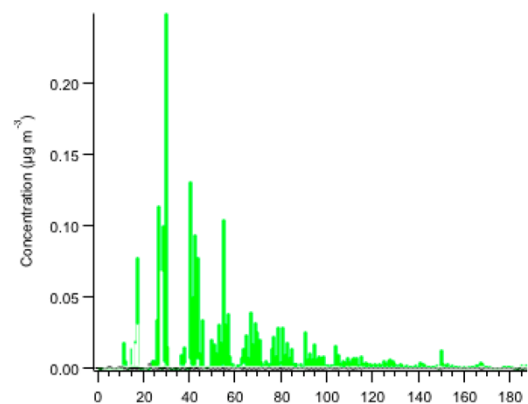


# AMS: Composition



# Factor analysis to identify organic aerosol sources

## Organic aerosol mass spectra



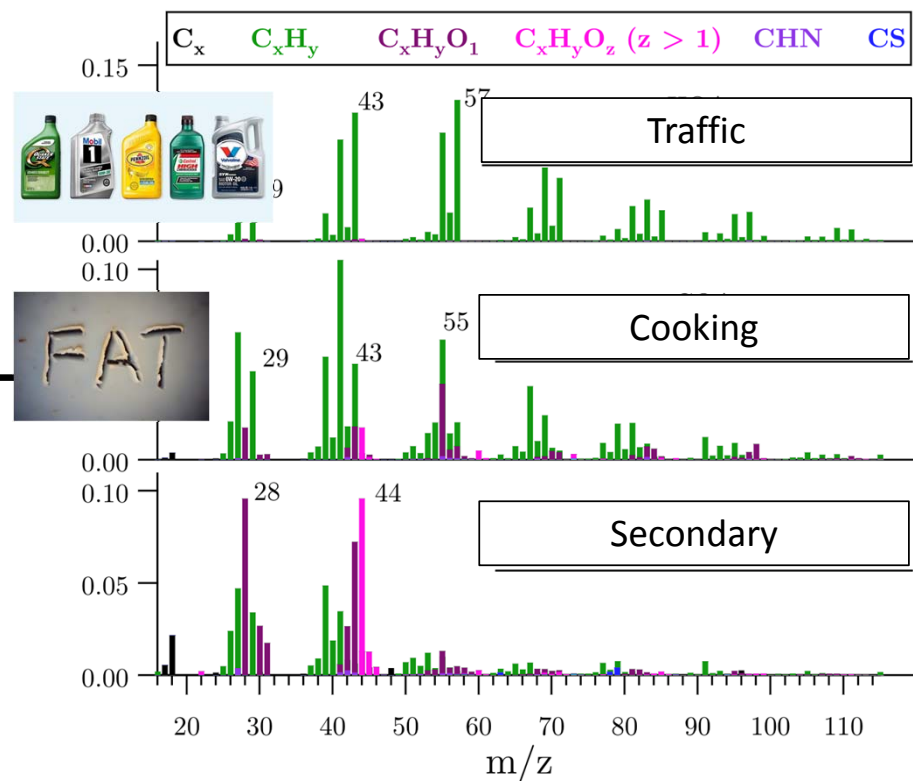
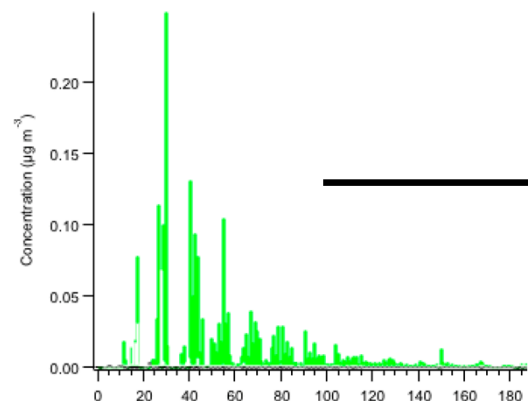
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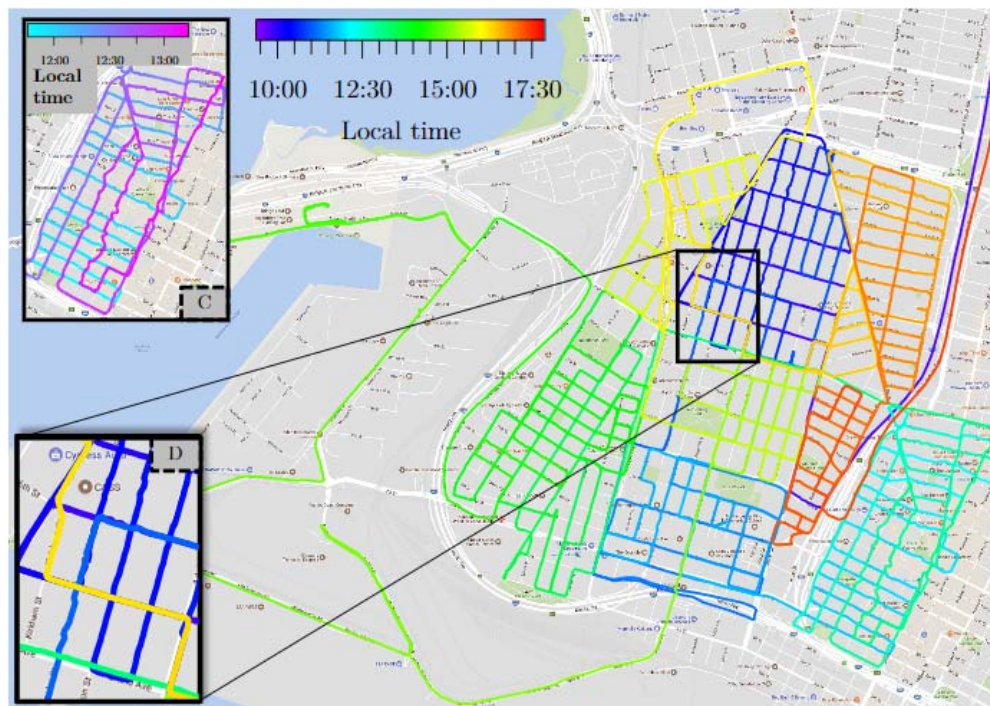
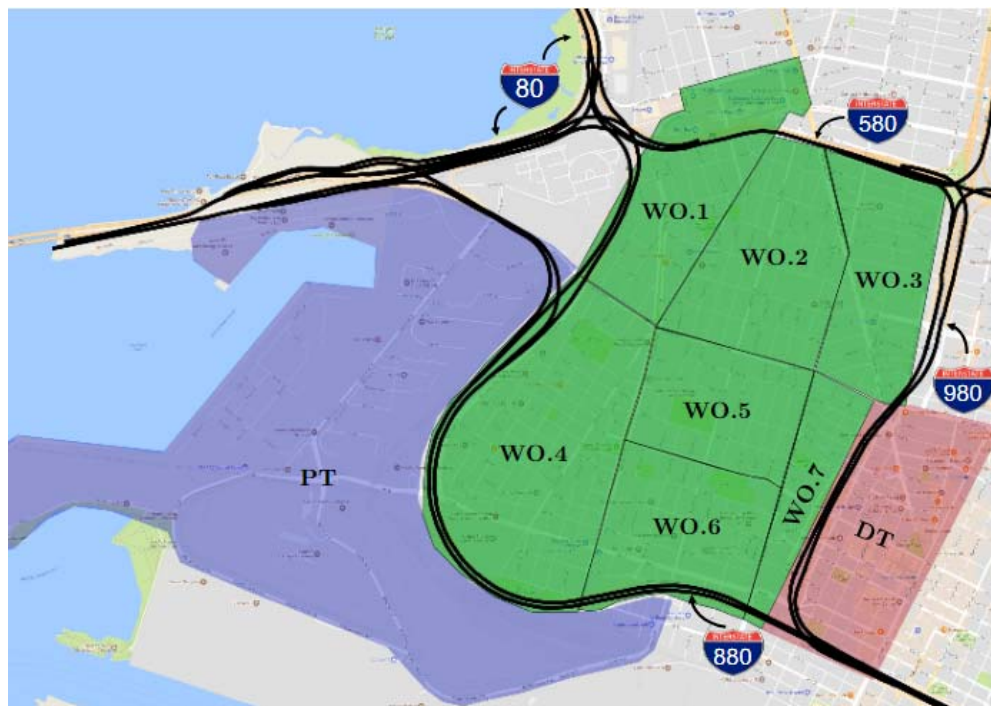
# Factor analysis to identify organic aerosol sources

## Source-resolved spectra

Organic aerosol mass spectra

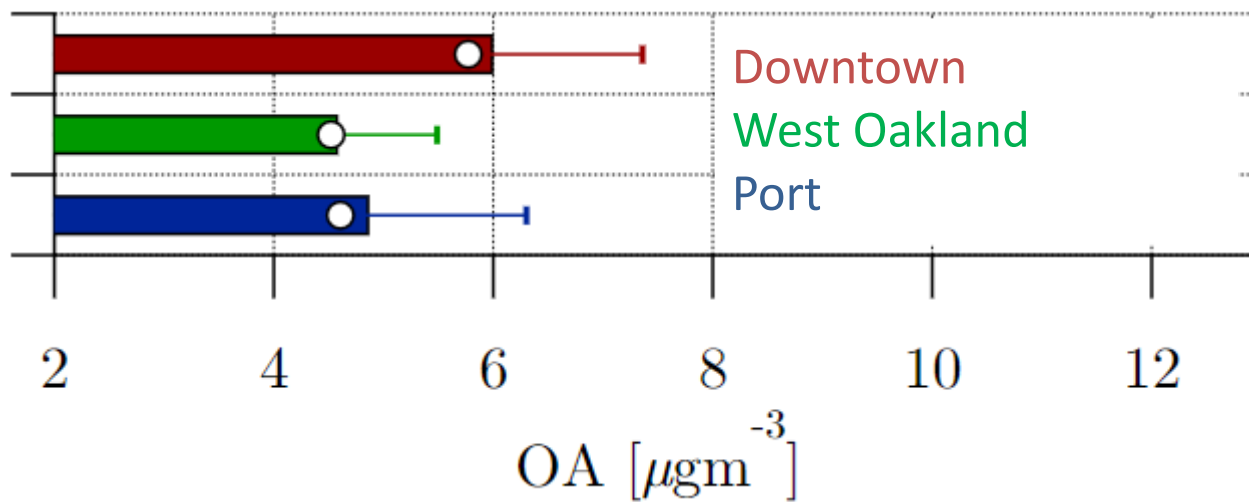


# Mobile sampling in Oakland

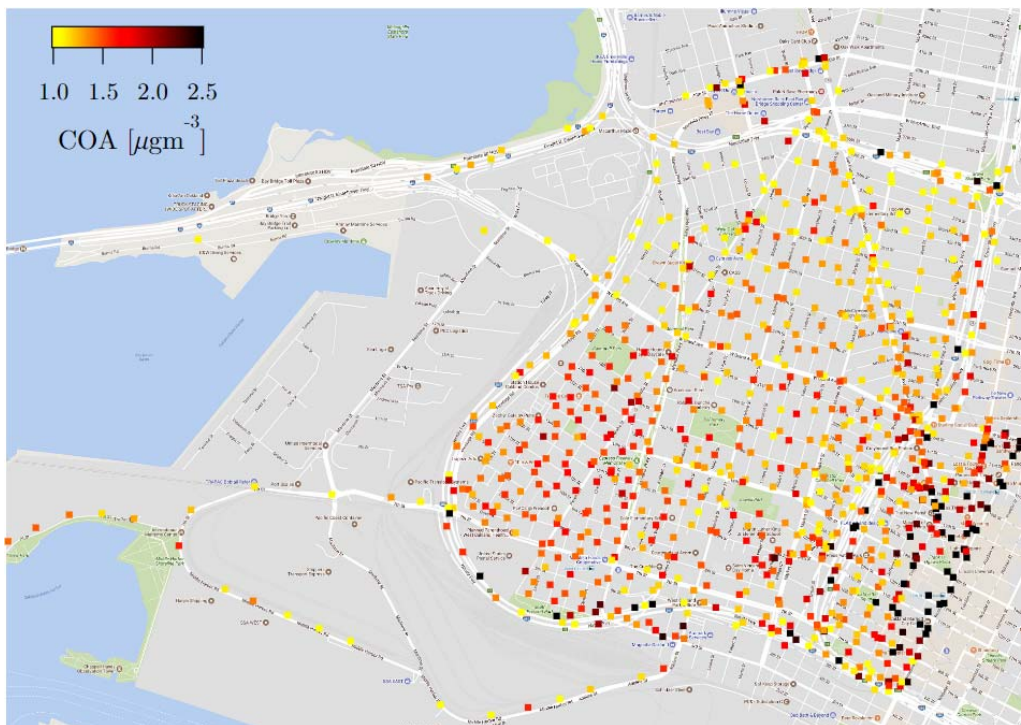




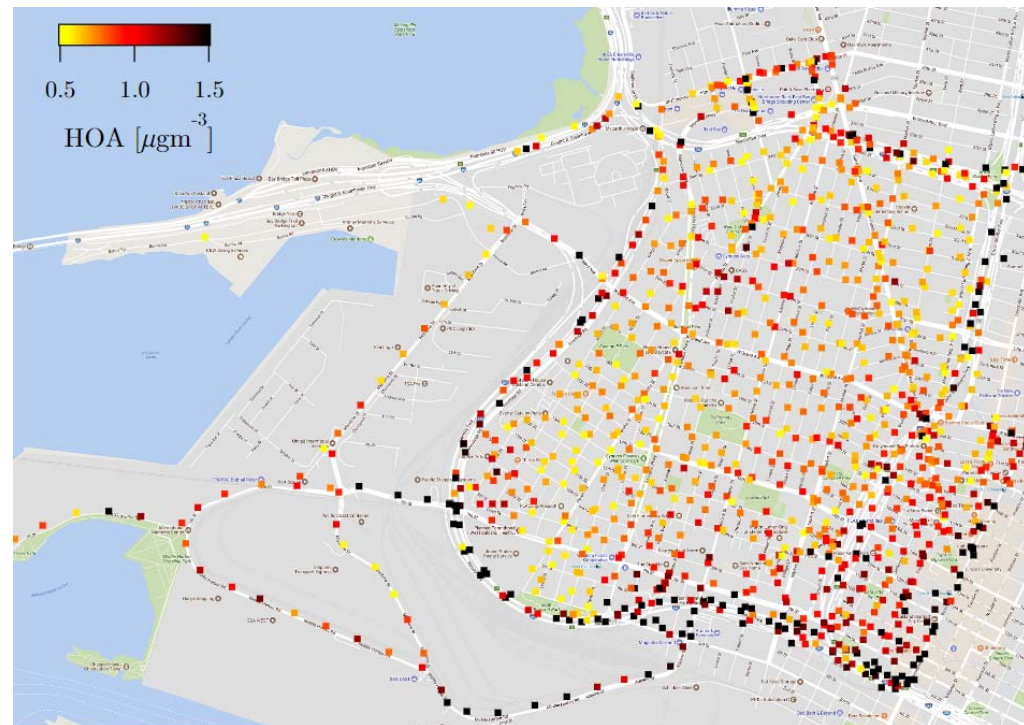
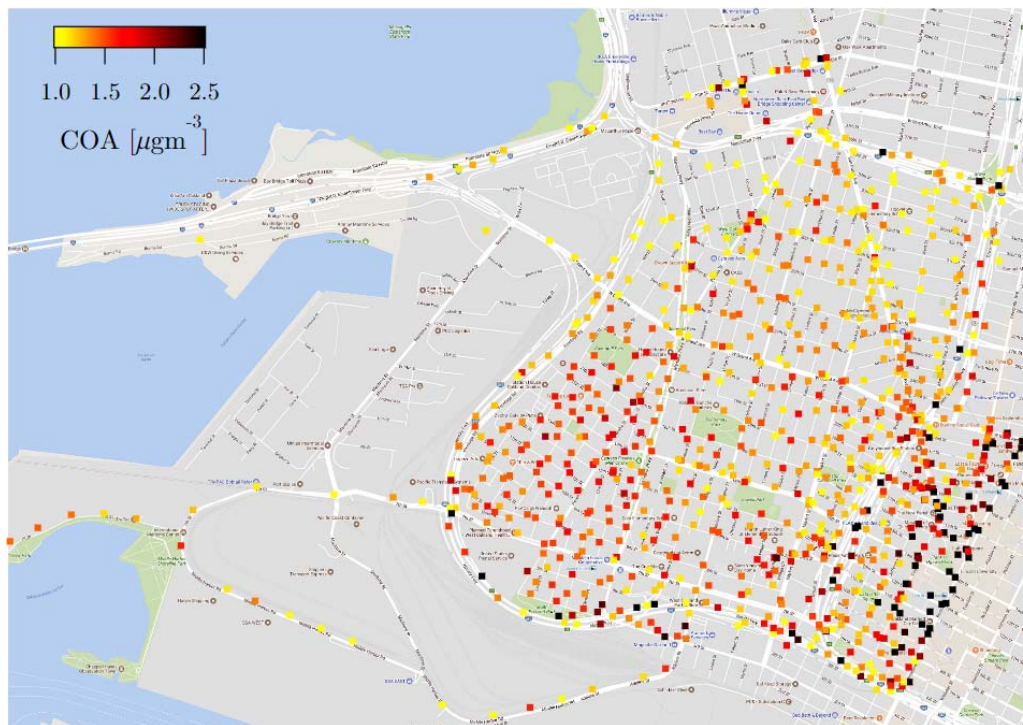
# PM is highest in downtown Oakland



# Cooking PM is highest downtown

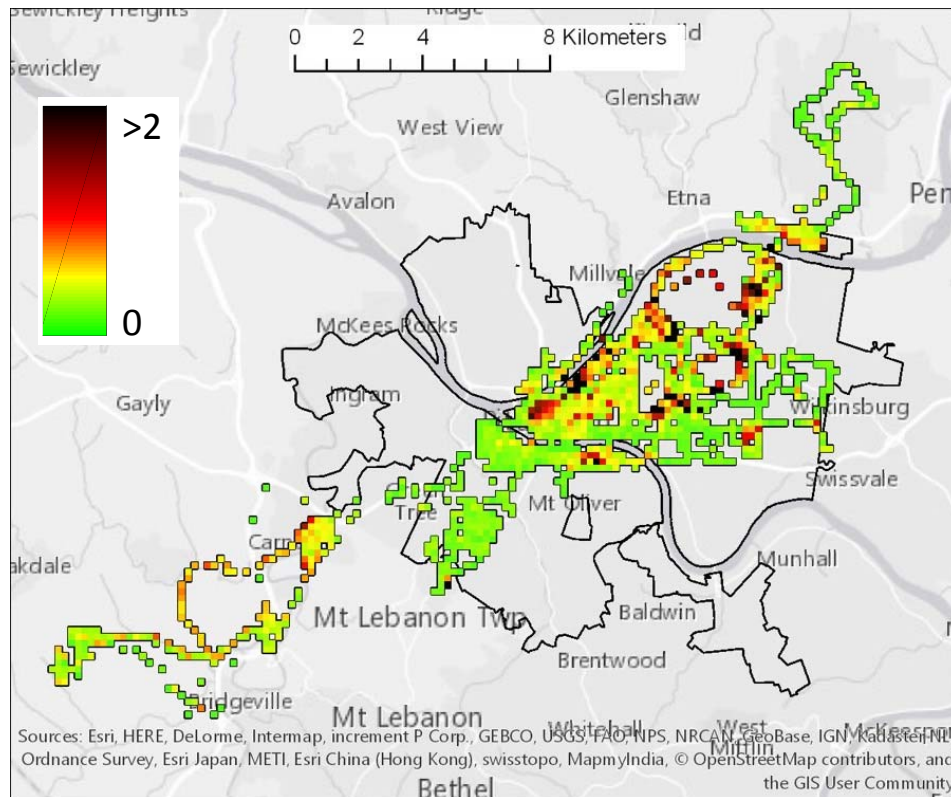


# Cooking OA > Traffic OA



# A similar story in Pittsburgh

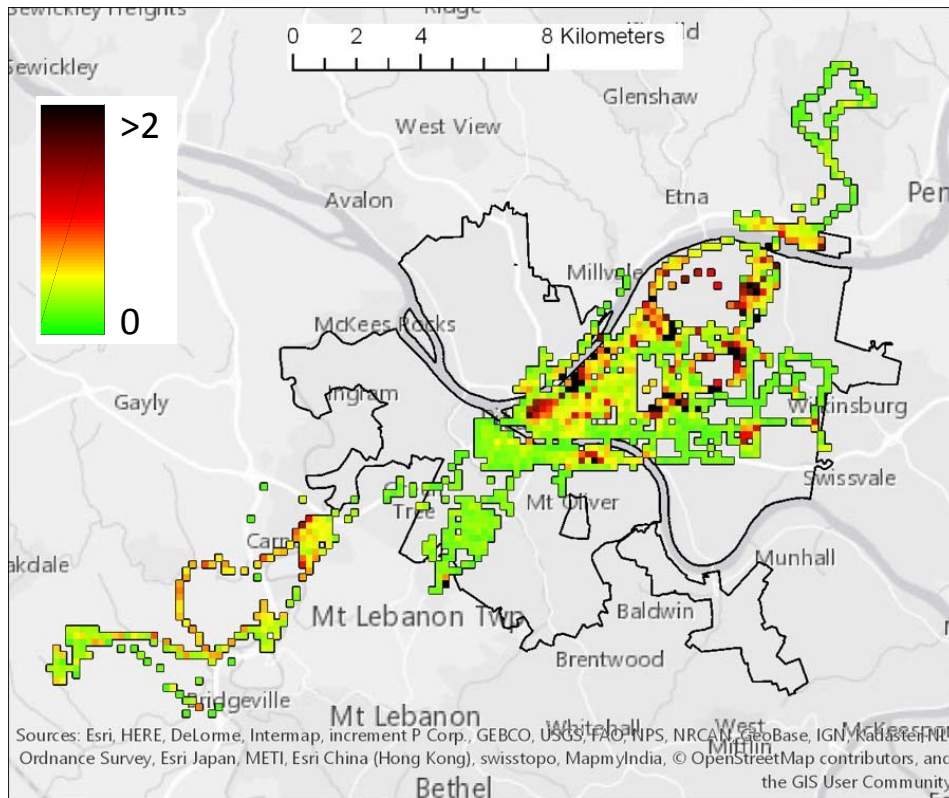
Cooking OA [ $\mu\text{g m}^{-3}$ ]



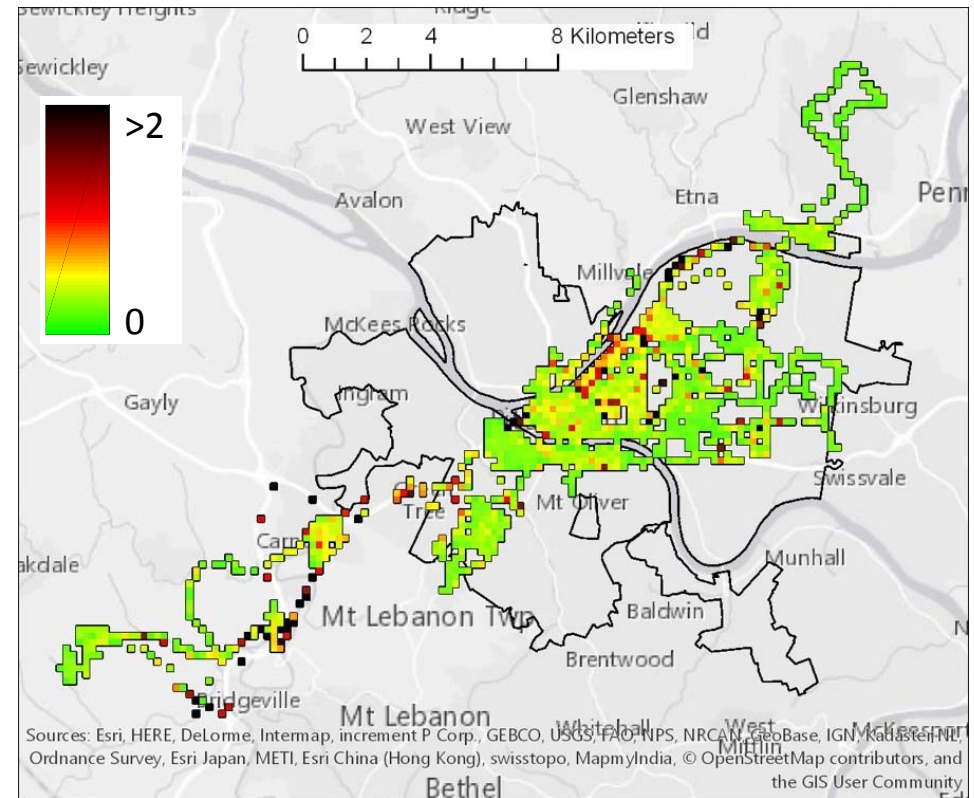


# A similar story in Pittsburgh

## Cooking OA [ $\mu\text{g m}^{-3}$ ]

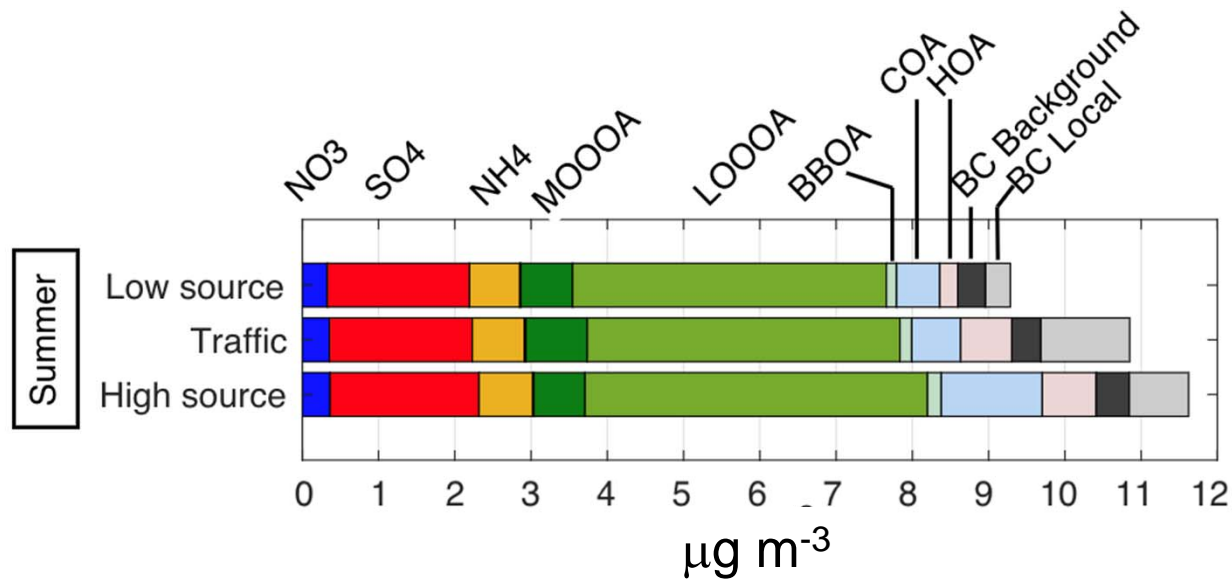


## Traffic OA [ $\mu\text{g m}^{-3}$ ]

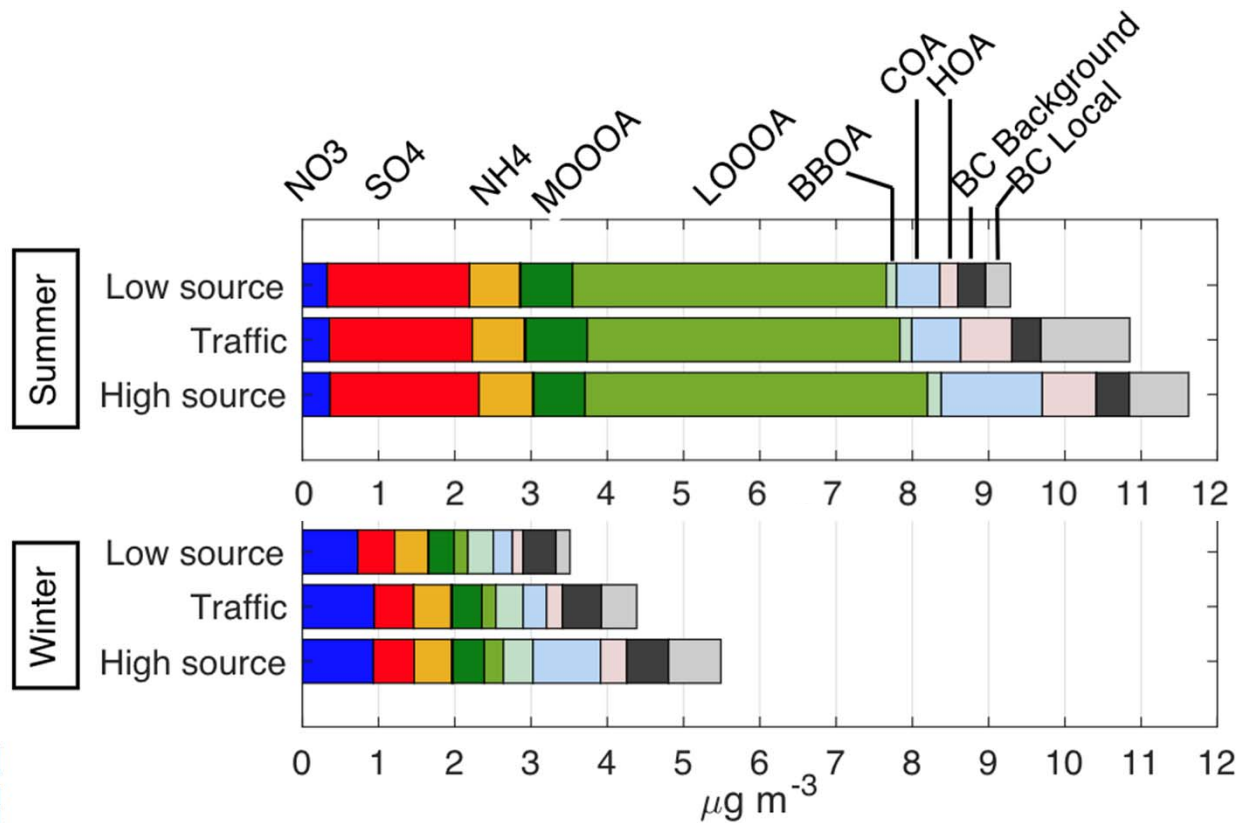




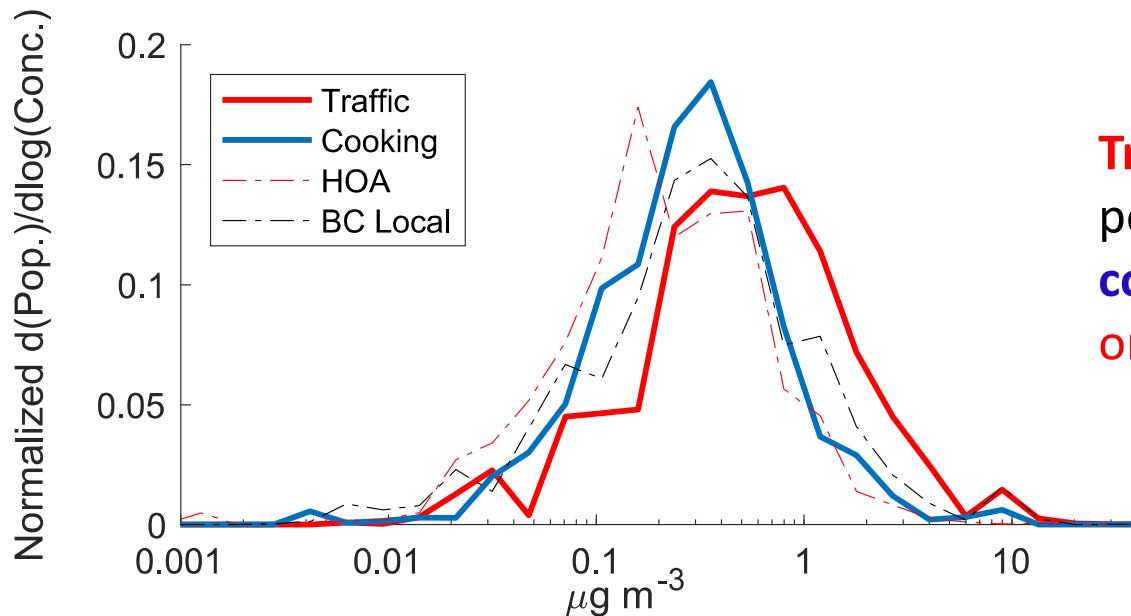
# Restaurant and traffic lead to an increase of $2 \mu\text{g m}^{-3}$ to $\text{PM}_{10}$ concentration



# Restaurant and traffic lead to an increase of $2 \mu\text{g m}^{-3}$ to $\text{PM}_1$ concentration

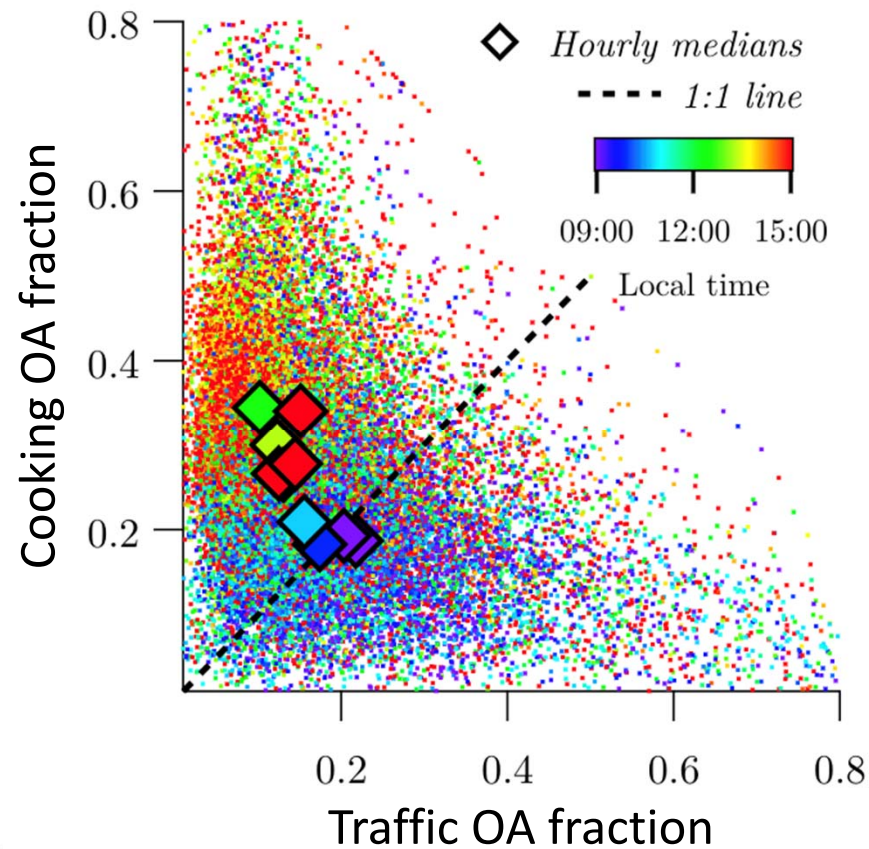


# Population PM exposures: Cooking and traffic



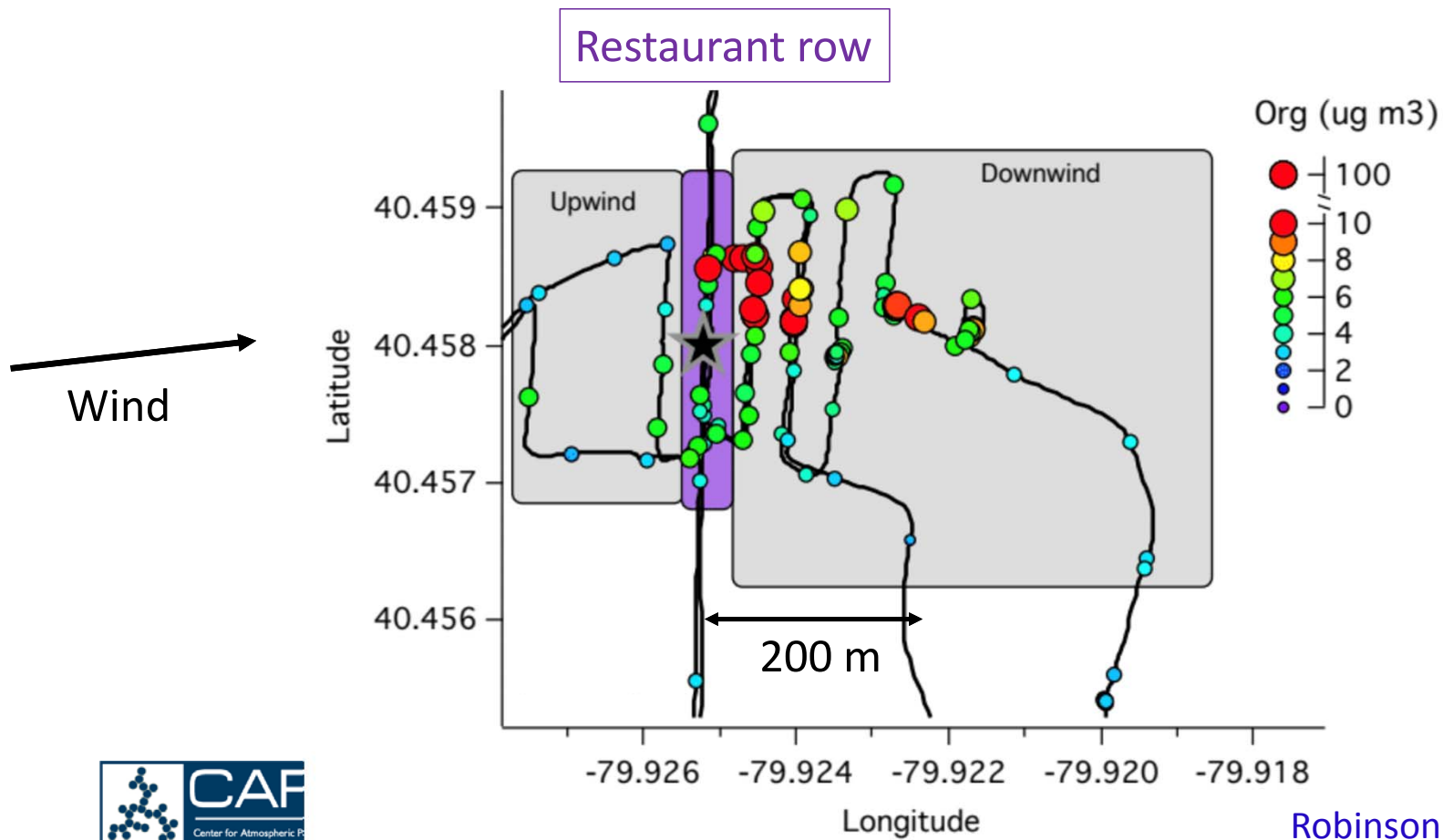
**Traffic** contributes slightly more to population PM exposures than **cooking** because it contributes both **organic aerosol** and **black carbon**.

# PM sources vary temporally



Data for Oakland, CA

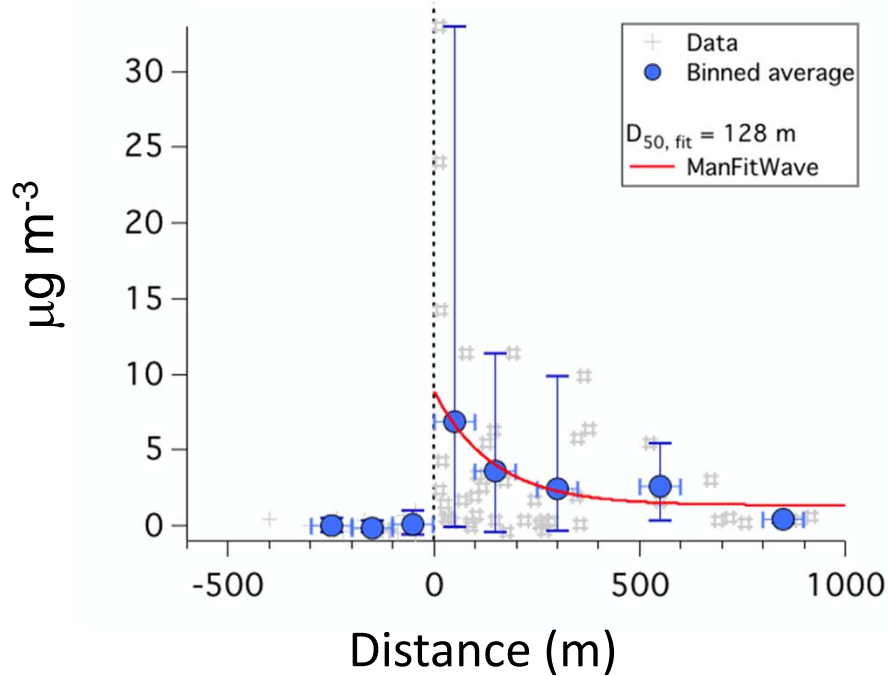
# Cooking sources generate large plumes



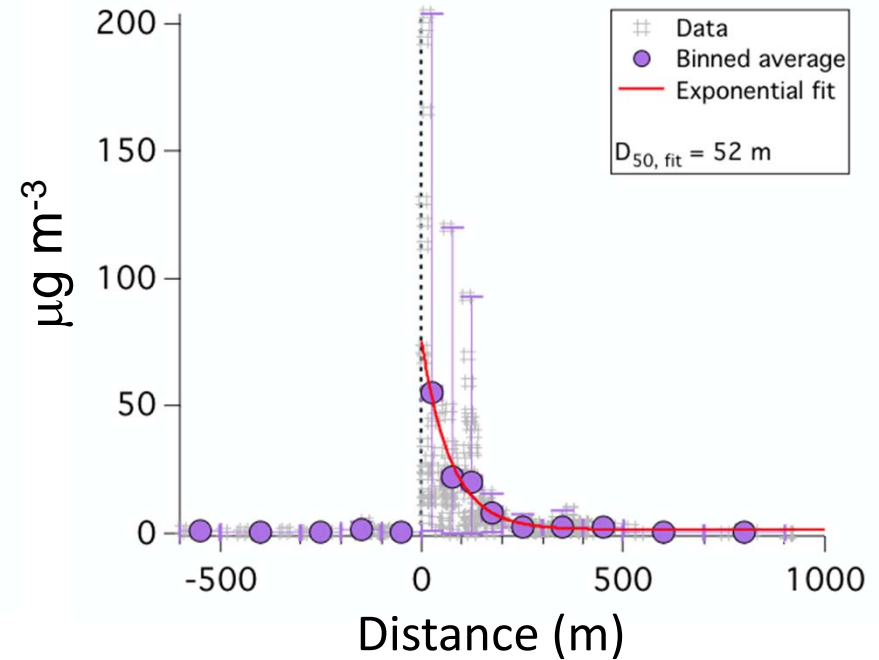


# Restaurant plumes extend 50-300 m

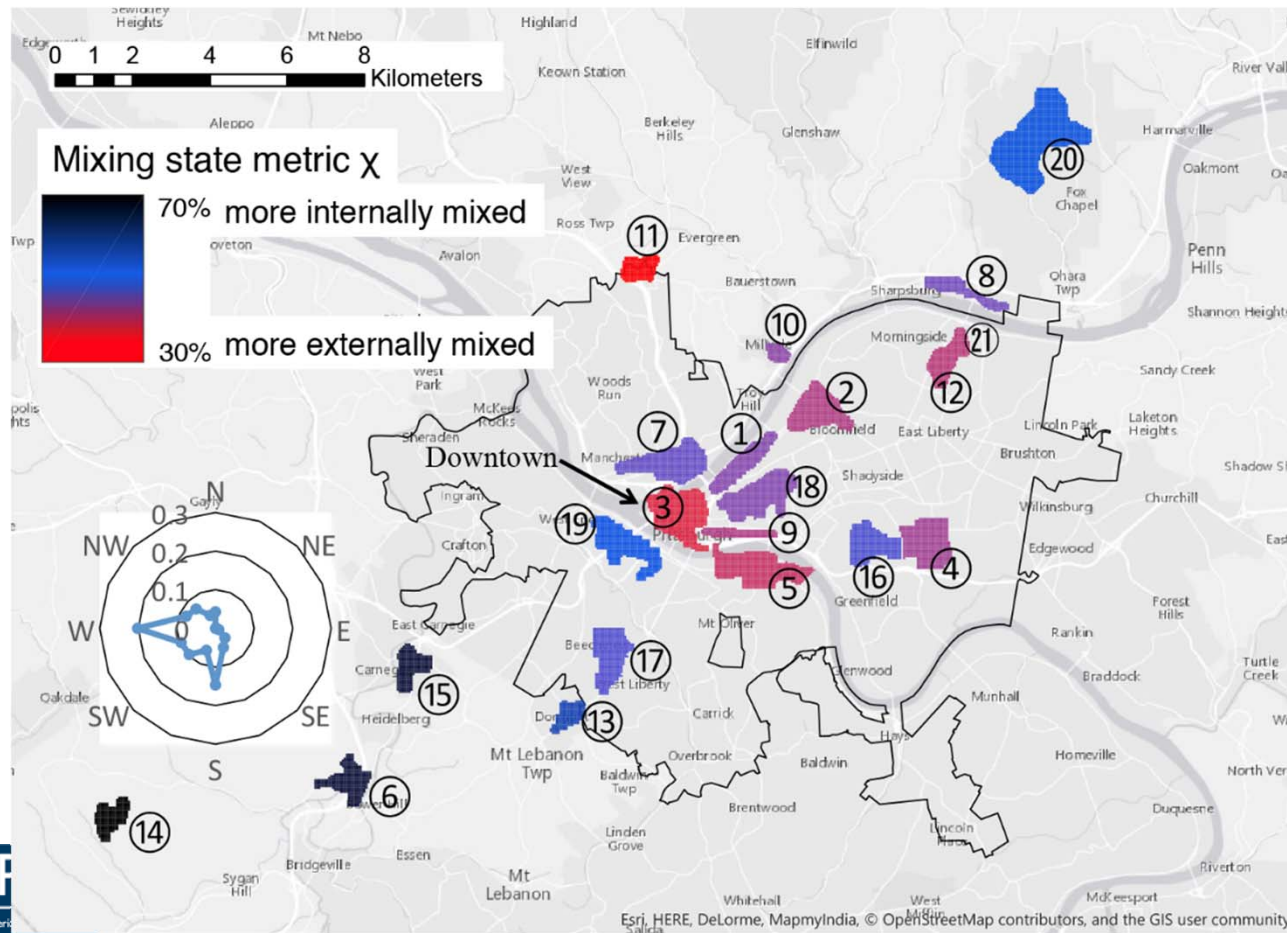
**(B)** Restaurant cluster 2, 2016/11/21



**(D)** Restaurant cluster 3, 2016/12/14



# Particle populations near sources are externally mixed



Ye et al, *ES&T*, 2018

# Take-home points

- Local emissions of organic aerosol and black carbon are the major drivers for PM spatial variations
  - Cooking OA > Traffic OA
  - Traffic is more important to overall exposure because of BC
- Secondary organics are also spatially variable, though less than primary emissions
  - Enhanced in downtown/high-source areas
- Particles near sources are externally mixed
  - PM mass and mixing state vary together



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# Acknowledgments

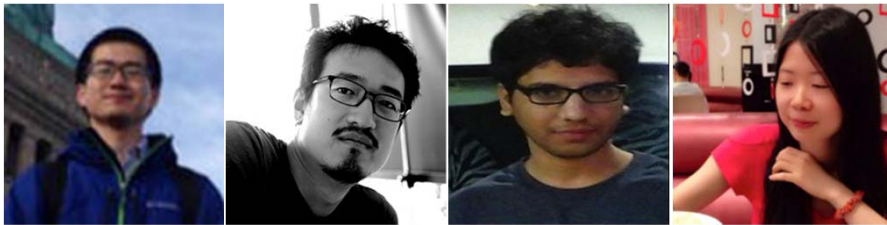
Postdocs



Collaborators



PhD students



Funding Sources



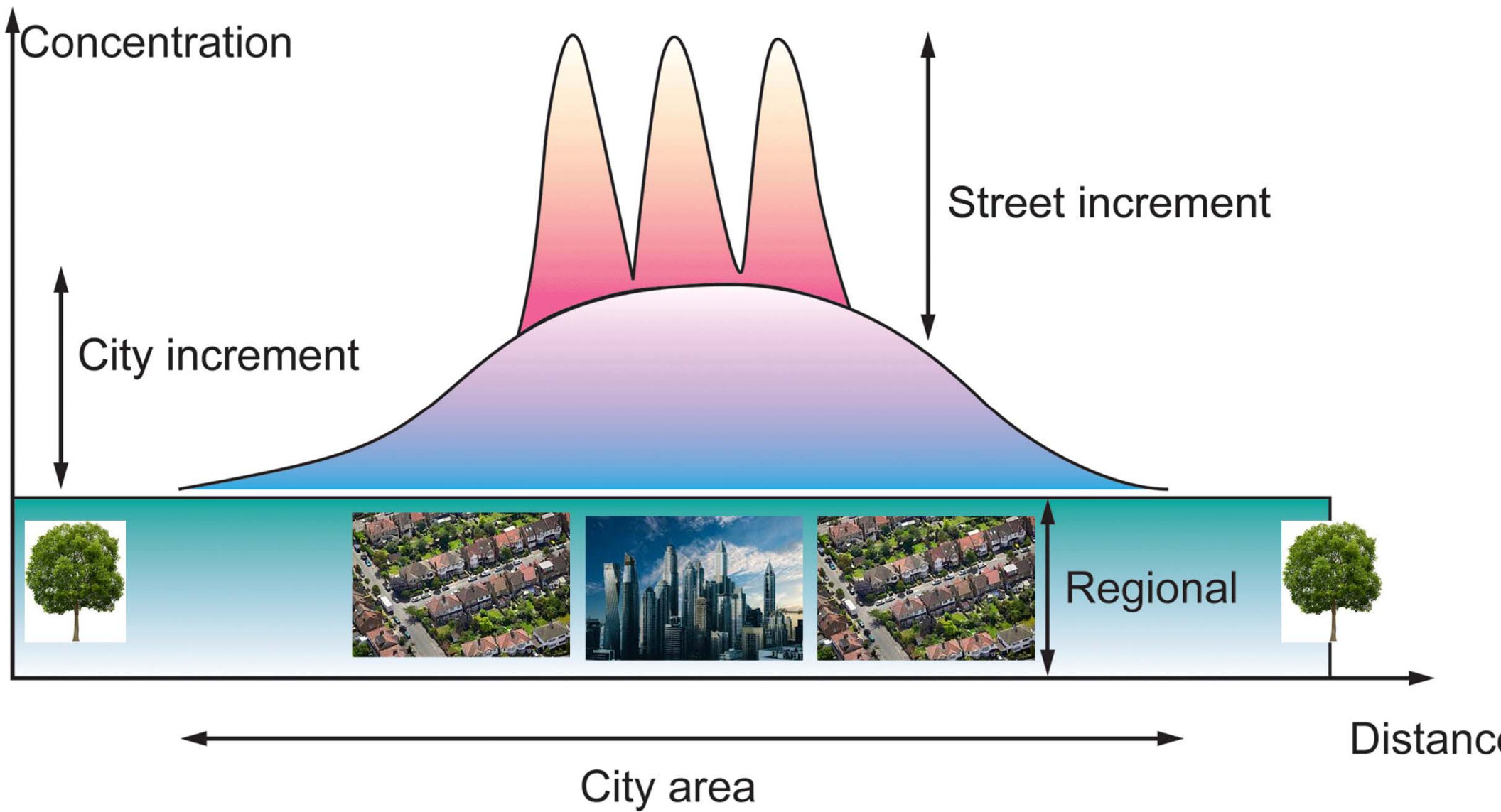
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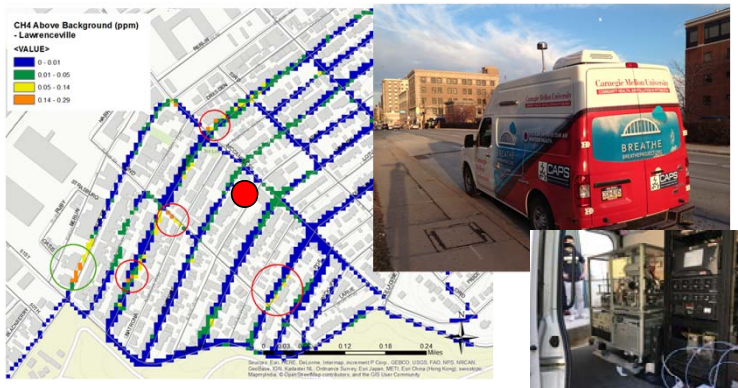
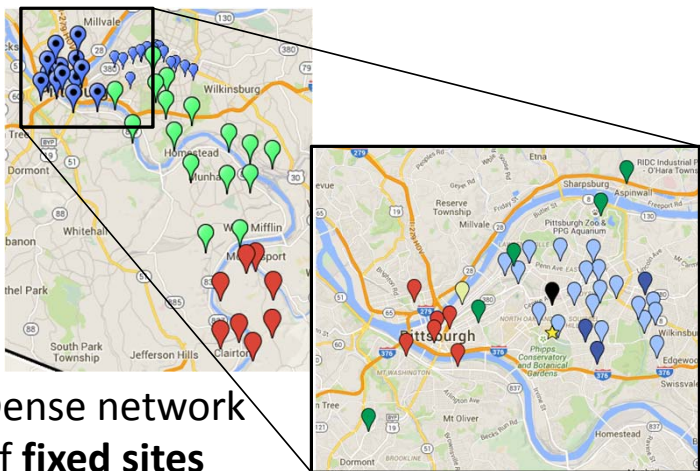




# Air Quality Observatory

## Goals:

1. Identify determinants of spatial and temporal pollutant patterns. Link to **modifiable factors** and **sources**.
2. Develop a **mechanistic** understanding of how pollutant transformations affect ambient concentrations
3. Locally **evaluate** and corroborate national-scale models of air pollution
4. Investigate sampling design for spatially resolved air pollutant measurement (mobile + hierarchy of fixed sites)

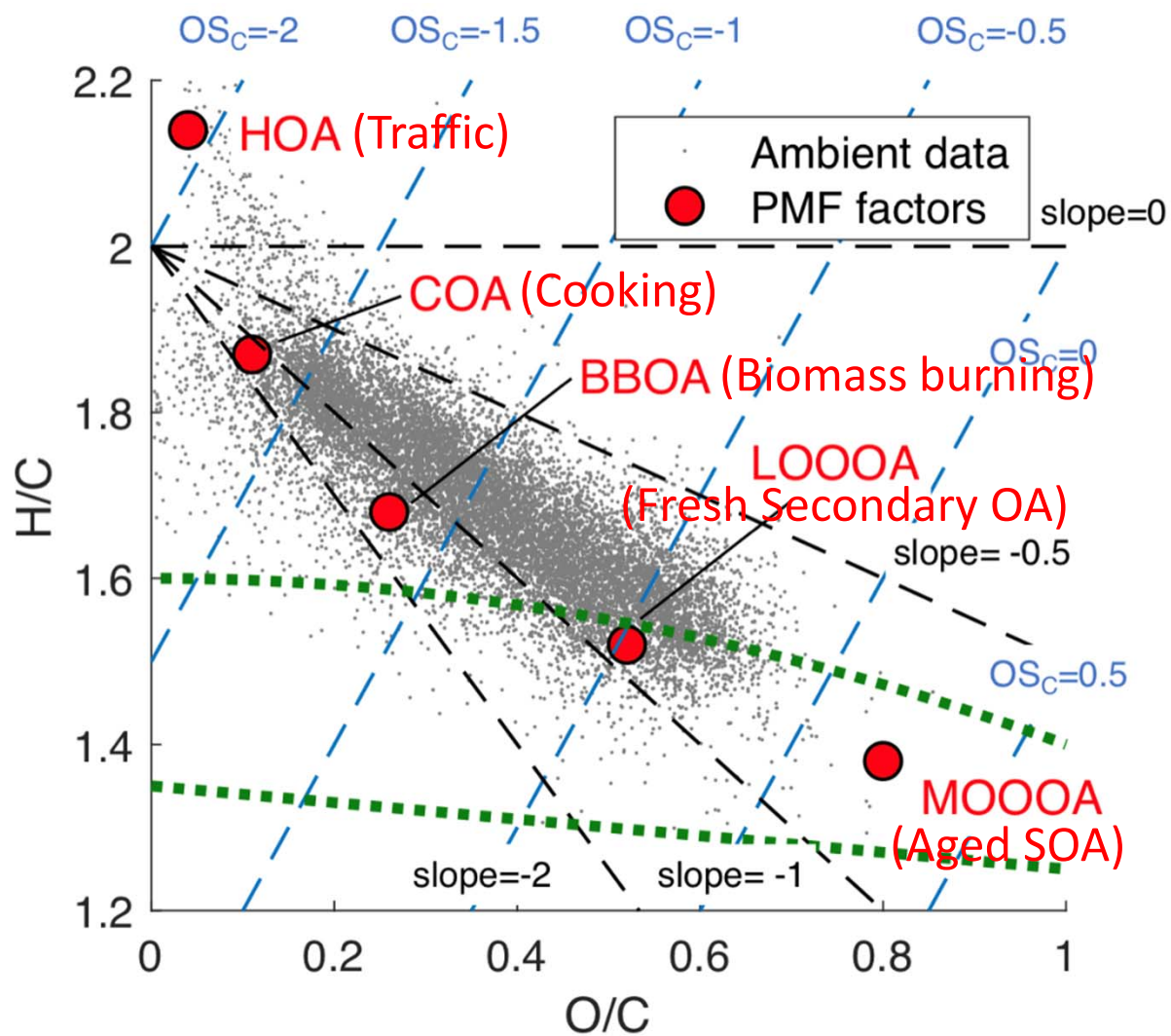


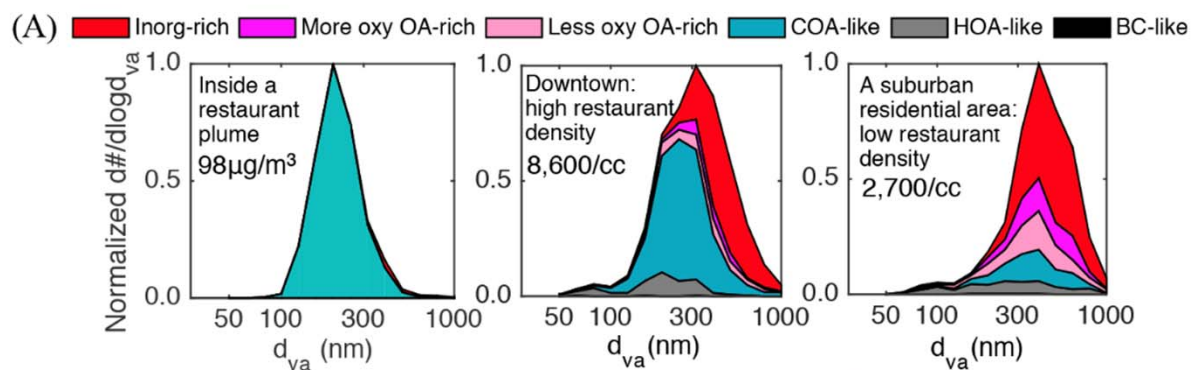
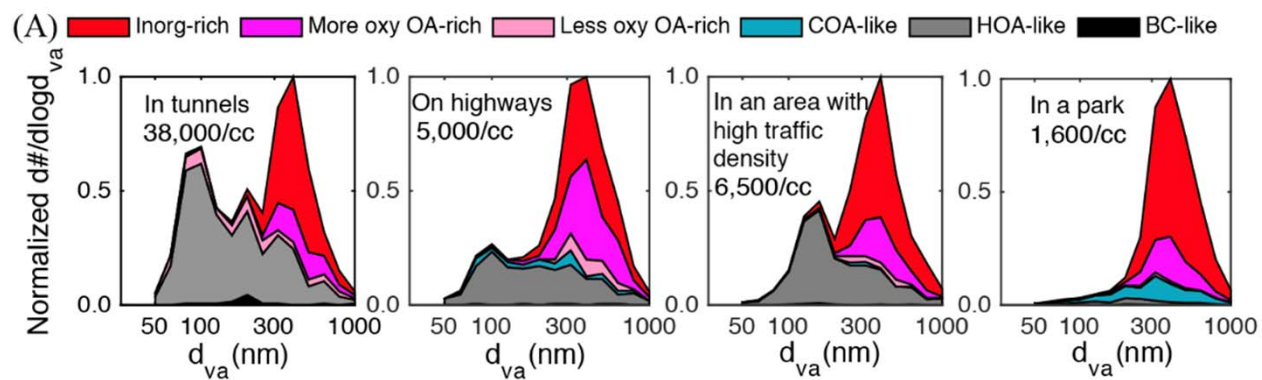
Mobile sampling to quantify block by block **sources** and **exposure**.



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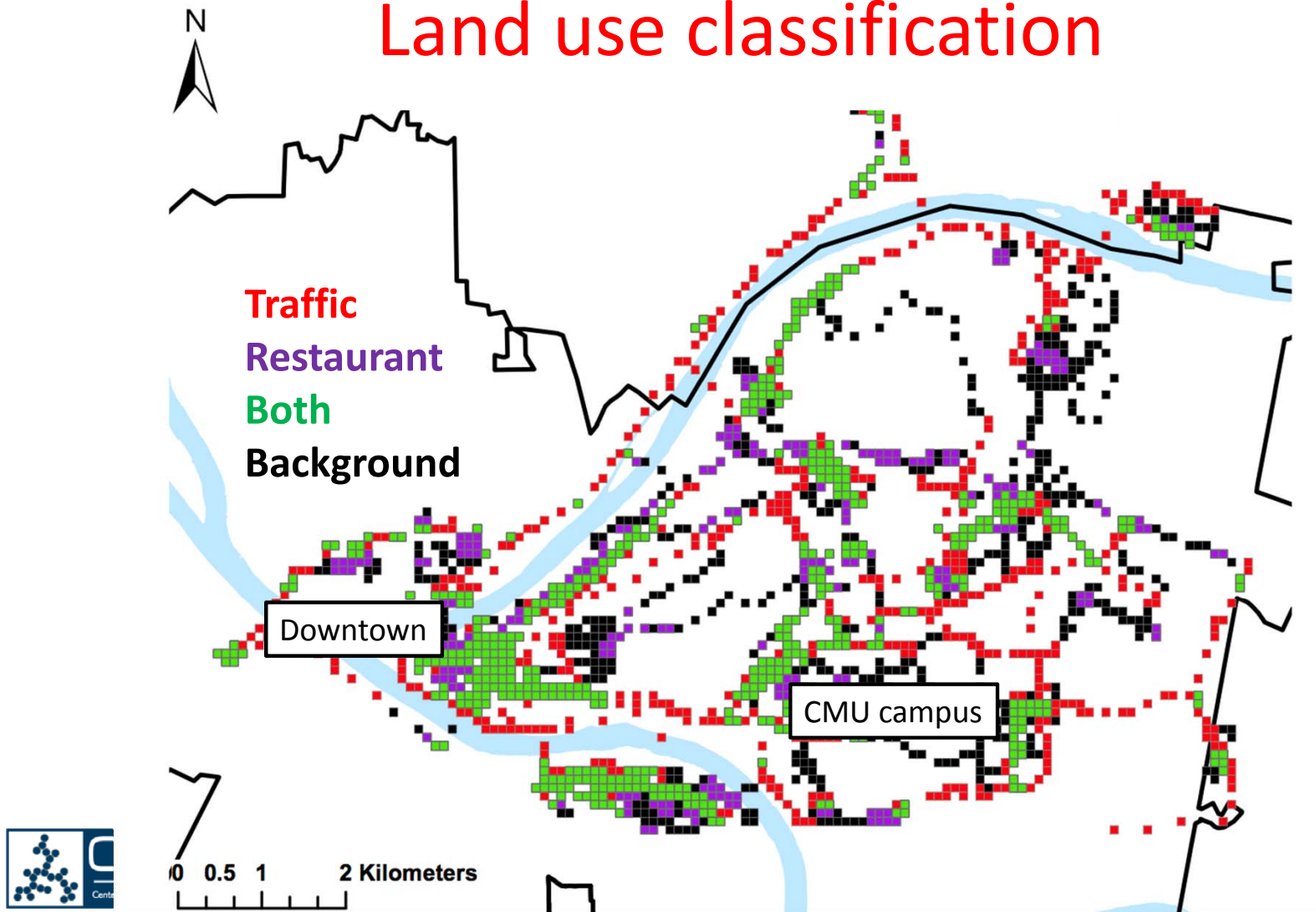
# PMF source apportionment







# Land use classification



# Summertime PM<sub>1</sub>

