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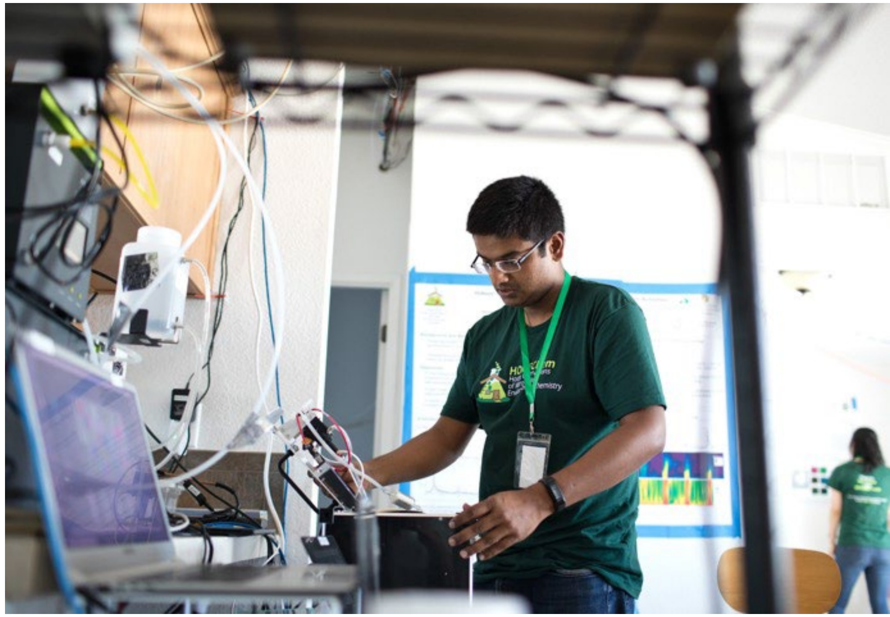
Indoor fine particulate matter ($PM_{2.5}$): Emissions, dynamics, and personal exposure



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President’s Council of Advisors on Science and Technology (PCAST) Meeting

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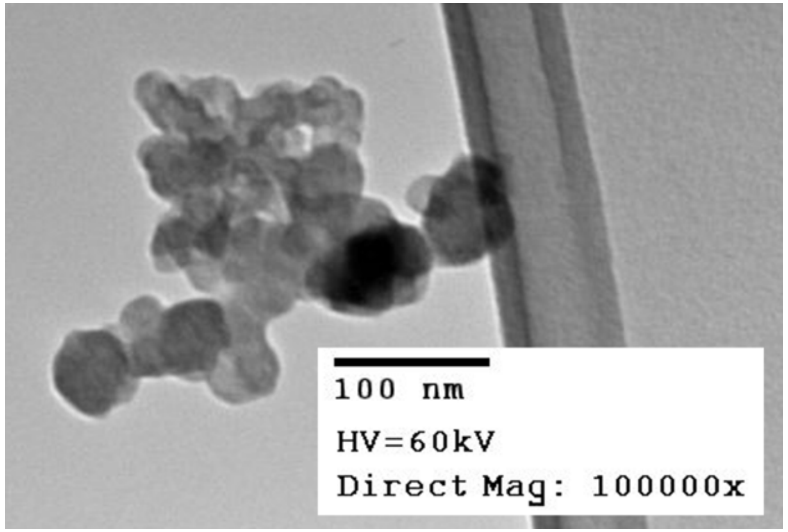
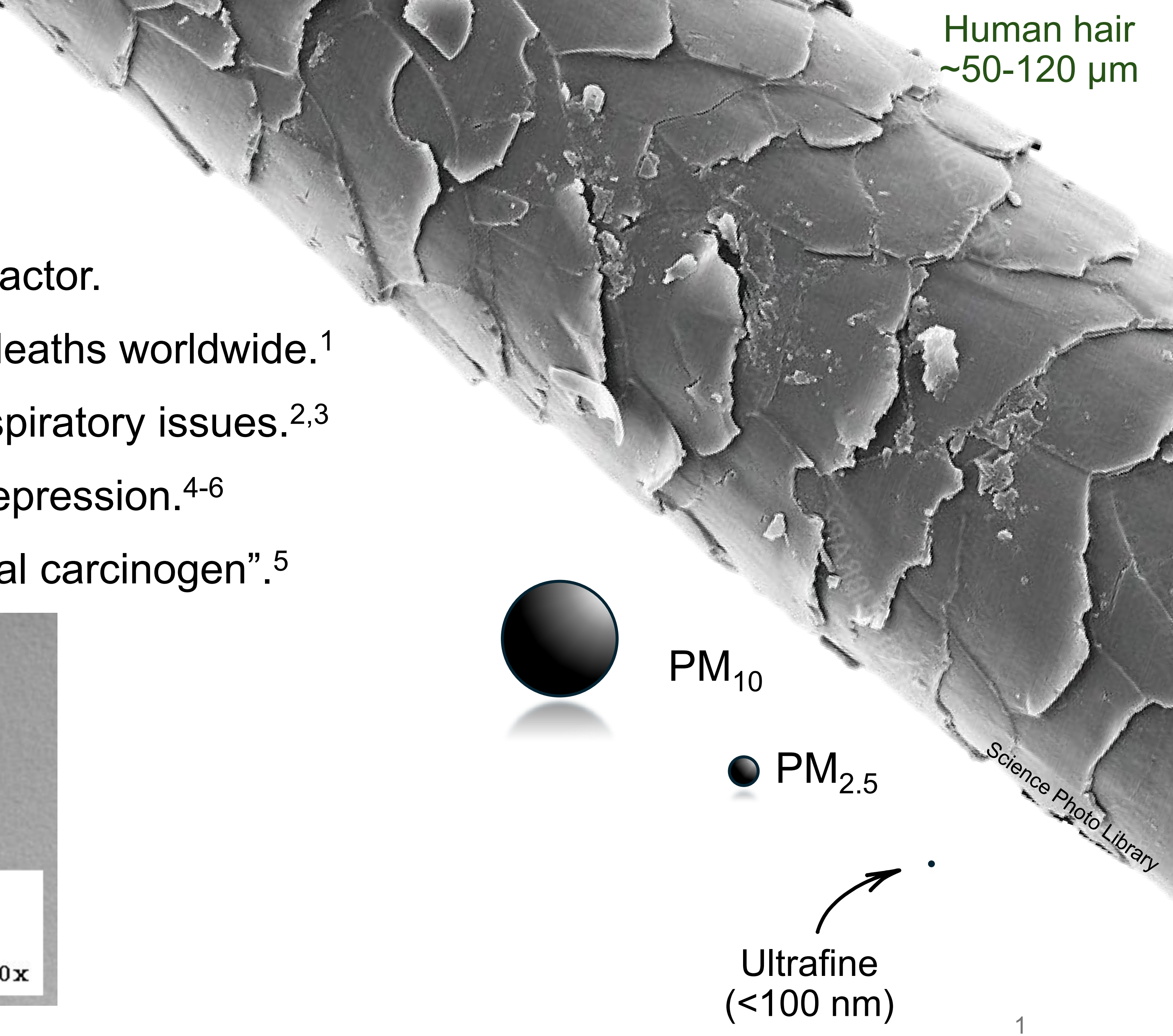
Fine Particulate Matter ($PM_{2.5}$)

- World's leading environmental risk factor.
- Responsible for > 8 million annual deaths worldwide.[1]
- Exacerbates cardiovascular and respiratory issues.[2,3]
- Tied to brain ageing, anxiety, and depression.[4-6]
- "The most widespread environmental carcinogen".[5]

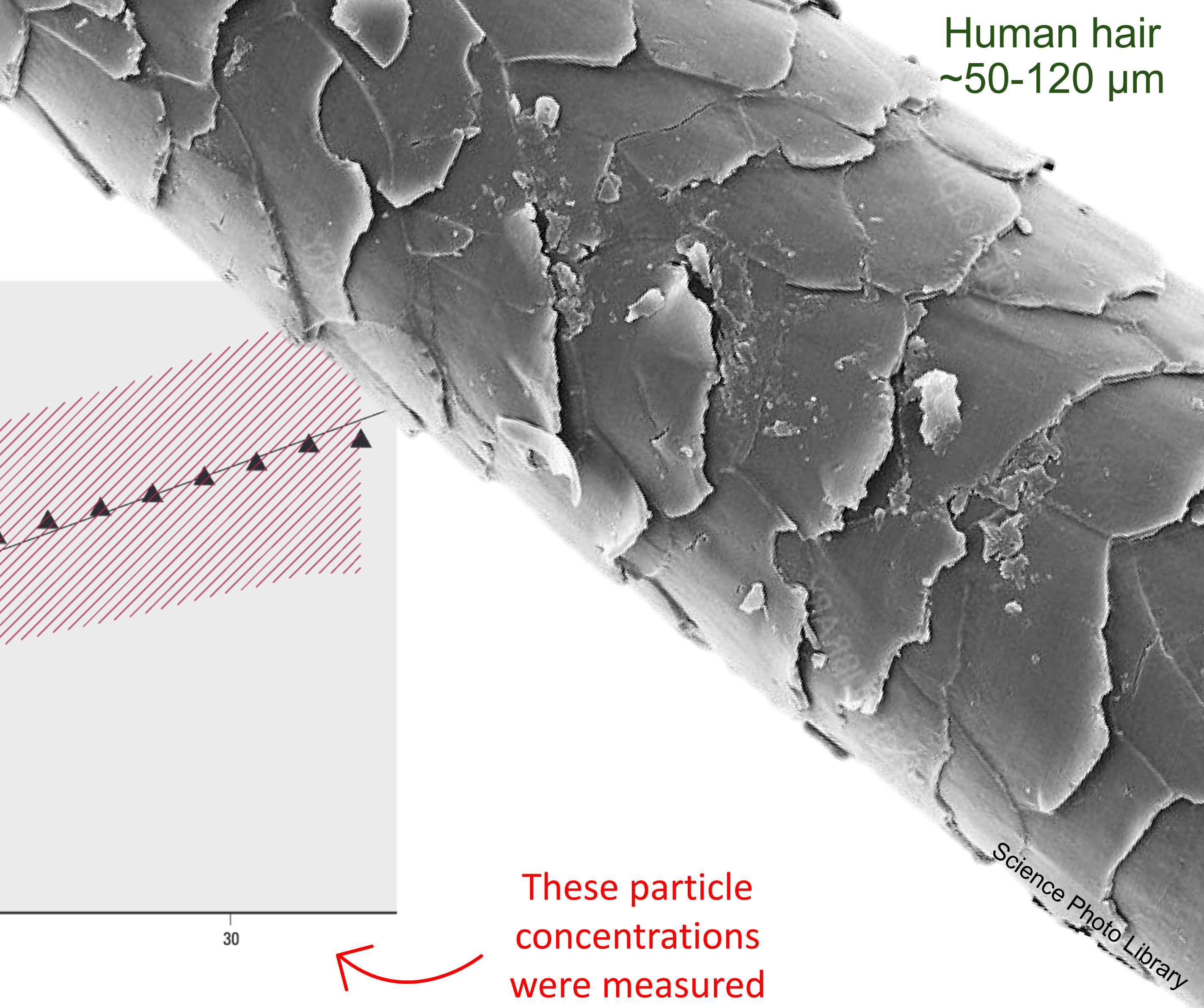




Fine Particulate Matter ($PM_{2.5}$)

$PM_{2.5}$

Human hair
~50-120 µm



These people were actually indoors

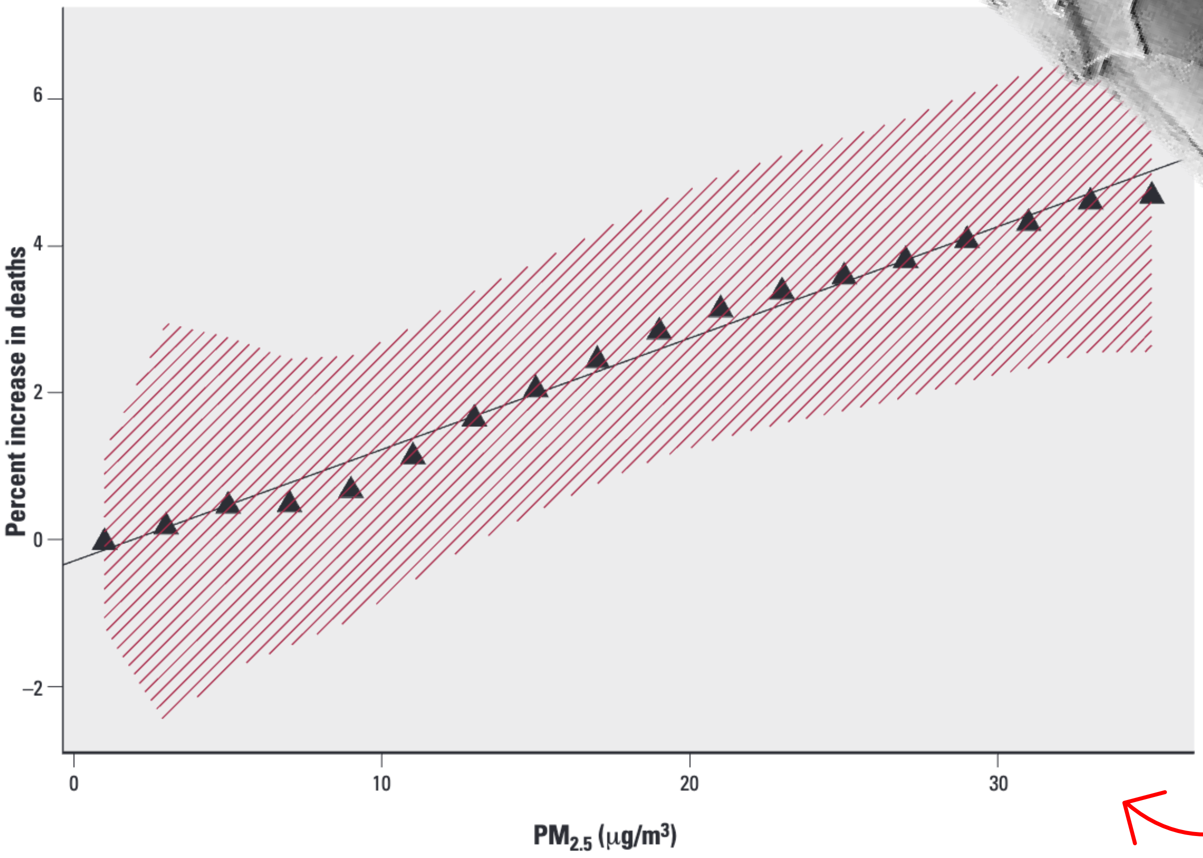


Figure 1. Overall estimated dose–response relation between total $PM_{2.5}$ and daily deaths in six U.S. cities. The estimate is obtained by combining the estimated smoothed curves in each of the cities, after controlling for weather, season, and day of the week. The shaded area indicates the pointwise 95% confidence intervals at each point. The line shown is a least-squares regression line through the estimated points.

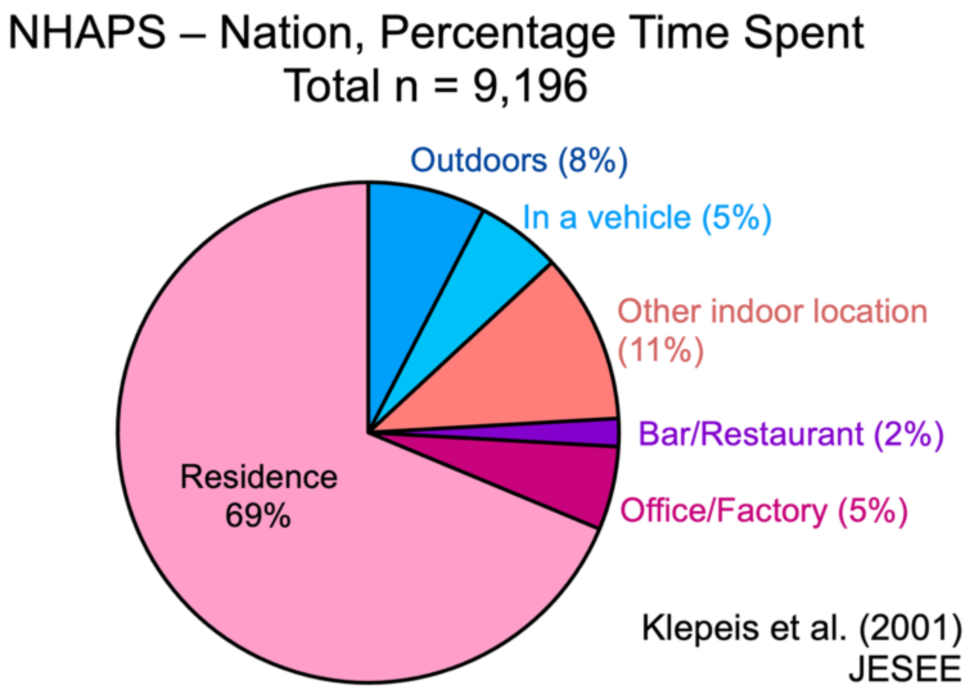
These particle concentrations were measured outdoors

Schwartz (EHP, 2002)

There is a continued need to understand chemical and physical processes in indoor environments

- We spend ~90% of our time indoors.

The National Human Activity Pattern Survey



There is a continued need to understand chemical and physical processes in indoor environments

- We spend ~90% of our time indoors.
- Our buildings are becoming more airtight.

↓ energy consumption.
↓ penetration of outdoor pollutants.
↑ exposure to pollutants of indoor sources.

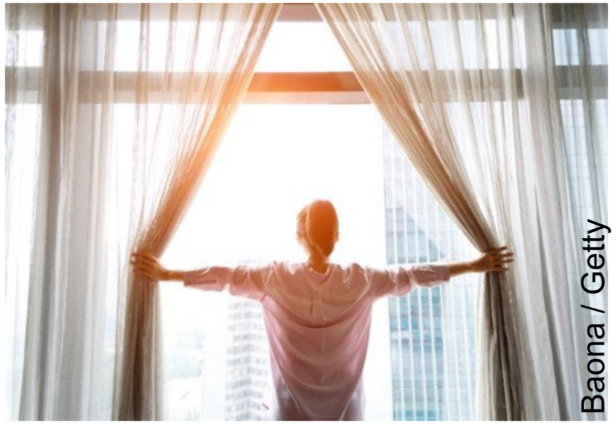
There is a continued need to understand chemical and physical processes in indoor environments

- We spend ~90% of our time indoors.
- Our buildings are becoming more airtight.
- Indoor processes likely differ from outdoor processes.




Different sources
(at closer proximity to receptor)

Different surfaces
(prevalence and type)

Different oxidants
(less sun, more cleaners)

Vance Research Group

Experimental research group with laboratory and field expertise in the physical properties of particulate matter (e.g., size distributions, volatility, density, optical properties, etc.).

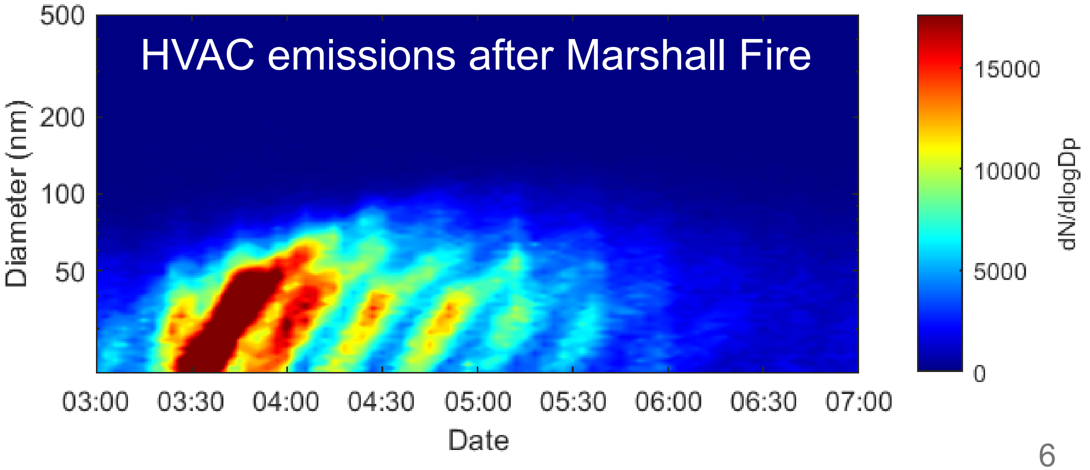
Study emissions, transport and fate in indoor environment

↓

Inform decisions to reduce exposure

↓

Protect human health and the environment



Two Collaborative Indoor Chemistry Field Campaigns:

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ALFRED P. SLOAN FOUNDATION

HOMEChem

UT Austin, Summer 2018

- 20+ research groups (13 universities in US + Canada) + 5 industrial and governmental partners.
- Focus on cooking, cleaning, human occupancy and use of personal care products.

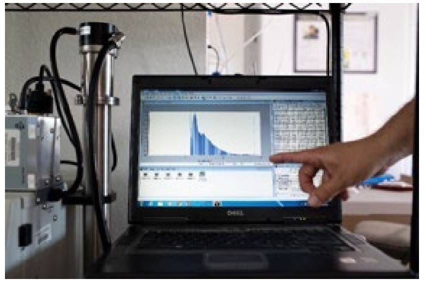
CASA

NIST Maryland, Spring 2022

- 14+ research groups from 12 universities + NIST.
- Controlled additions of products and compounds: acid/base, smoke, cooking, air and surface cleaning.

A few millions of USD of funding involved, excluding instrumentation.

Challenges and creative approaches



- Facilitating interdisciplinary efforts in Indoor Air Quality and Indoor Chemistry by pursuing other funding sources.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY — NSF — FULBRIGHT Scholar Program — ALFRED P. SLOAN FOUNDATION

- Difficulty tying aerosol science and engineering to environmental health research, given limited funding agency scope and lack of cooperative funding opportunities (e.g., NSF vs NIH).

- Keeping a relatively small research group given funding uncertainties and difficulty recruiting talent for PhD studies due to changing culture post-pandemic.

- Navigating 3-year funding cycles and 5+ year PhD cycles.

- Planning and redistributing funds to cover graduate student salary increases and inflation.

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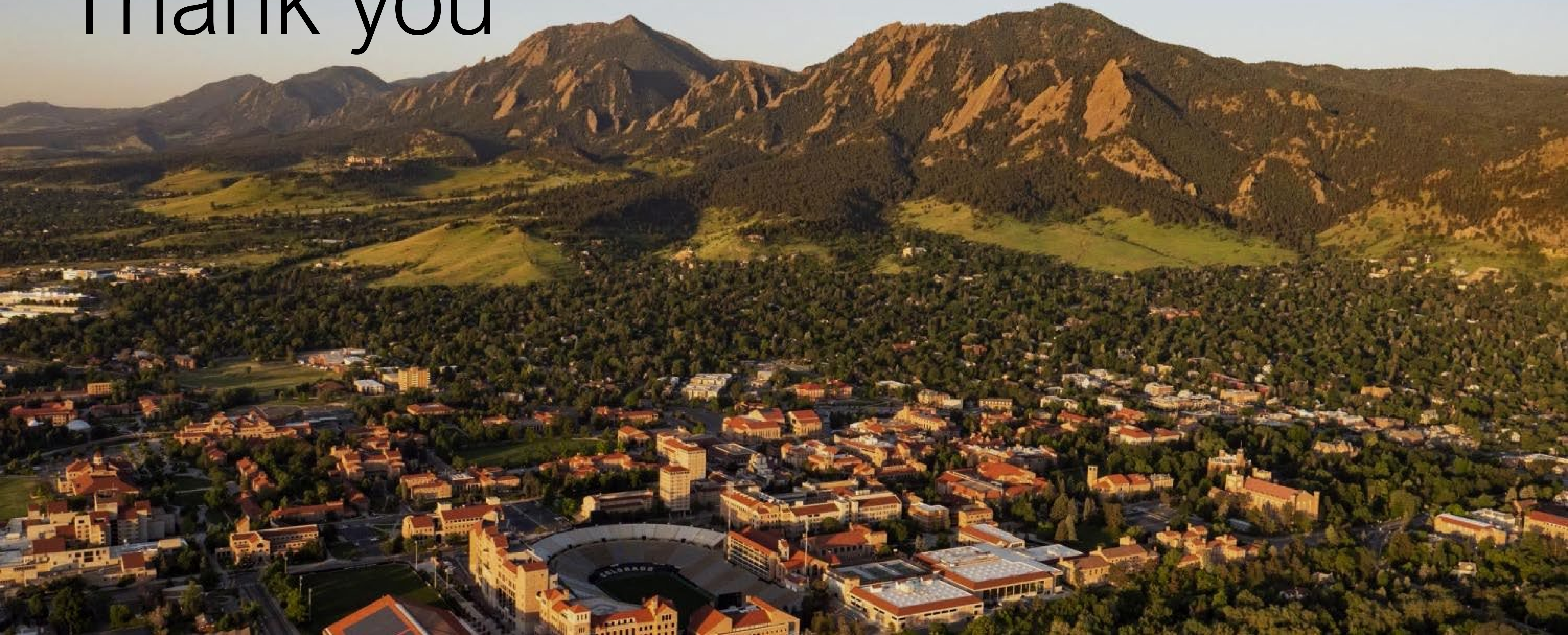
Thank you



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