Understanding Volatile Organic Compounds: From Everyday Sources to the 2025 LA Fires

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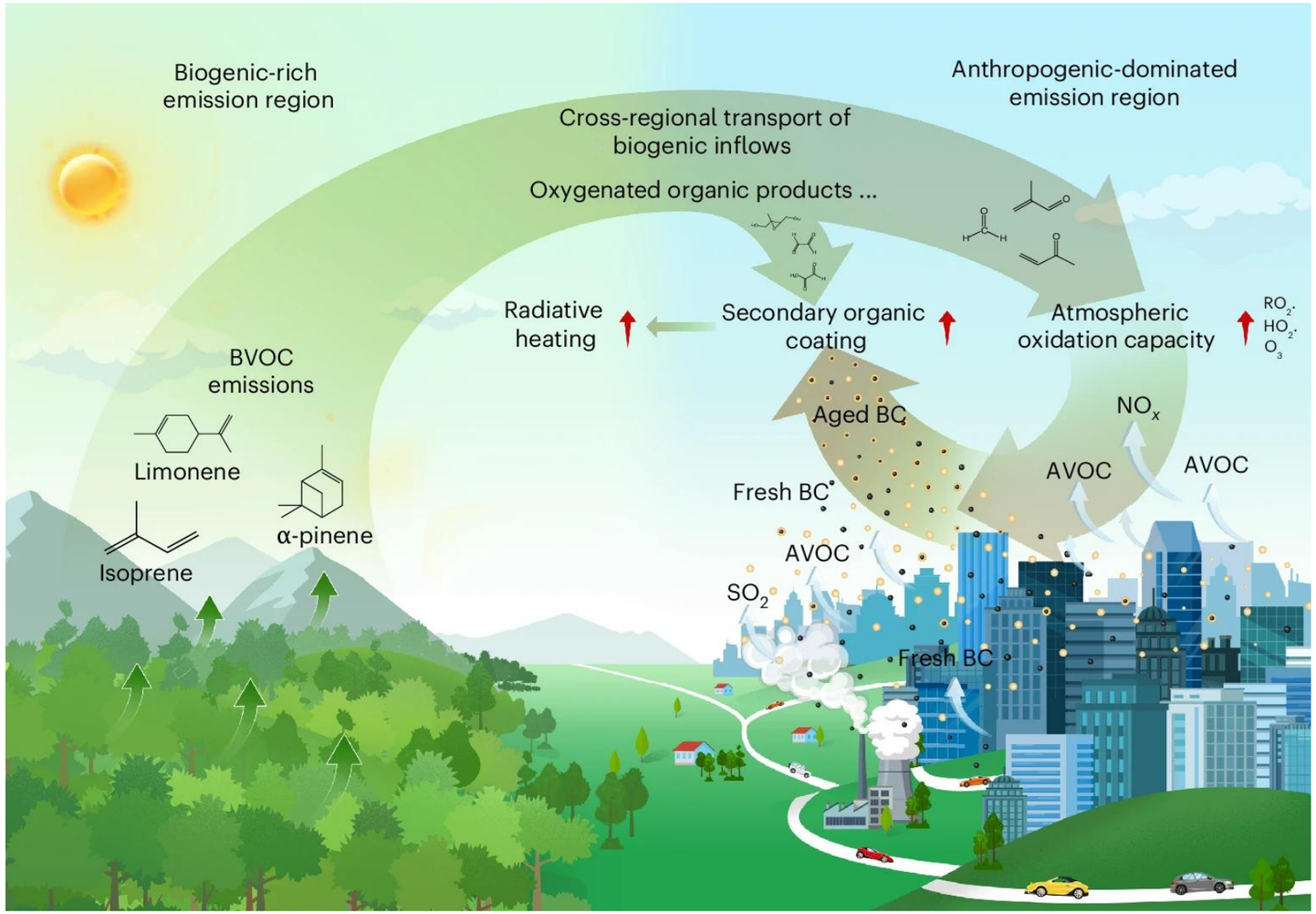
What Are Volatile Organic Compounds (VOCs)

- Organic compounds with **high vapor pressure** and **low water solubility**
- Readily emitted **as gases** at ambient conditions
- Biogenic vs anthropogenic
- This presentation focuses on **anthropogenic VOCs** due to their regulatory and public health relevance



Zhang et al., 2026

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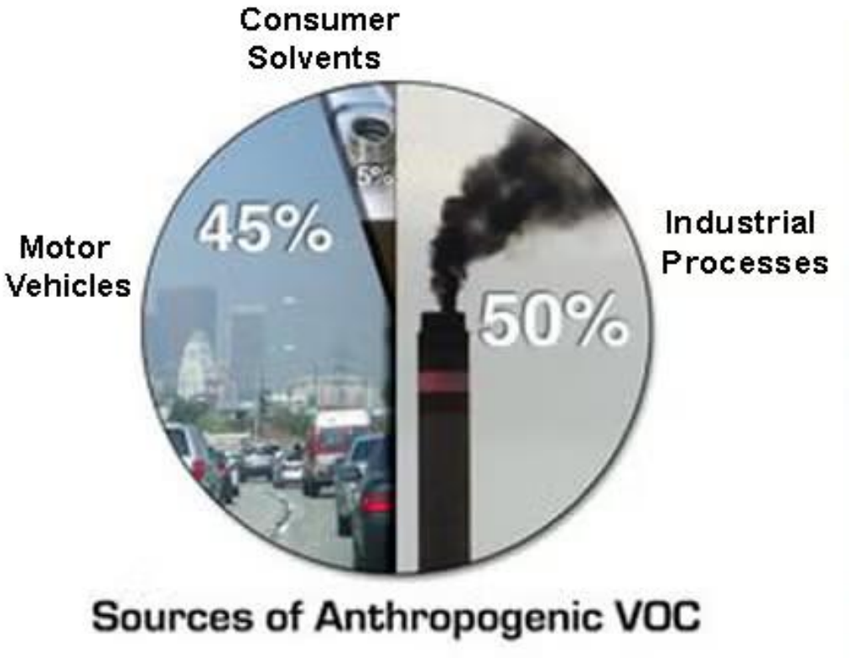
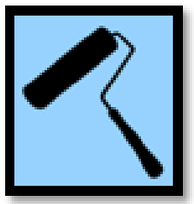
Indoor and Outdoor Sources of VOCs

Outdoor VOC Sources



Indoor VOC Sources

		
Activities	Home & Personal Care Products	Building Materials
• Cooking • Smoking • Driving • Dry Cleaning • Photocopiers • Burning Wood • Space Heaters • Cutting Grass • Weed Eating	• Cleaning & Polishing Products • Air Fresheners • Fuel Oil & Gasoline • Cosmetics • Moth Balls • Drain Cleaners • Deodorants • Fertilizers	• Paints • Varnishes • Adhesives • Carpets • Vinyl Flooring • Solvents • Upholstery Fabrics • Composite Wood Products

Source: UCNR; U.S. EPA

Health Effects of VOCs Exposure

- Exposure to VOCs can irritate the **eyes, nose, and throat**; cause breathing difficulties and nausea; and damage the **central nervous system and other organs**. Some VOCs are known or suspected to cause **cancer**.
- At present, not much is known about what health effects occur from the levels of VOCs usually found in homes (U.S. EPA).

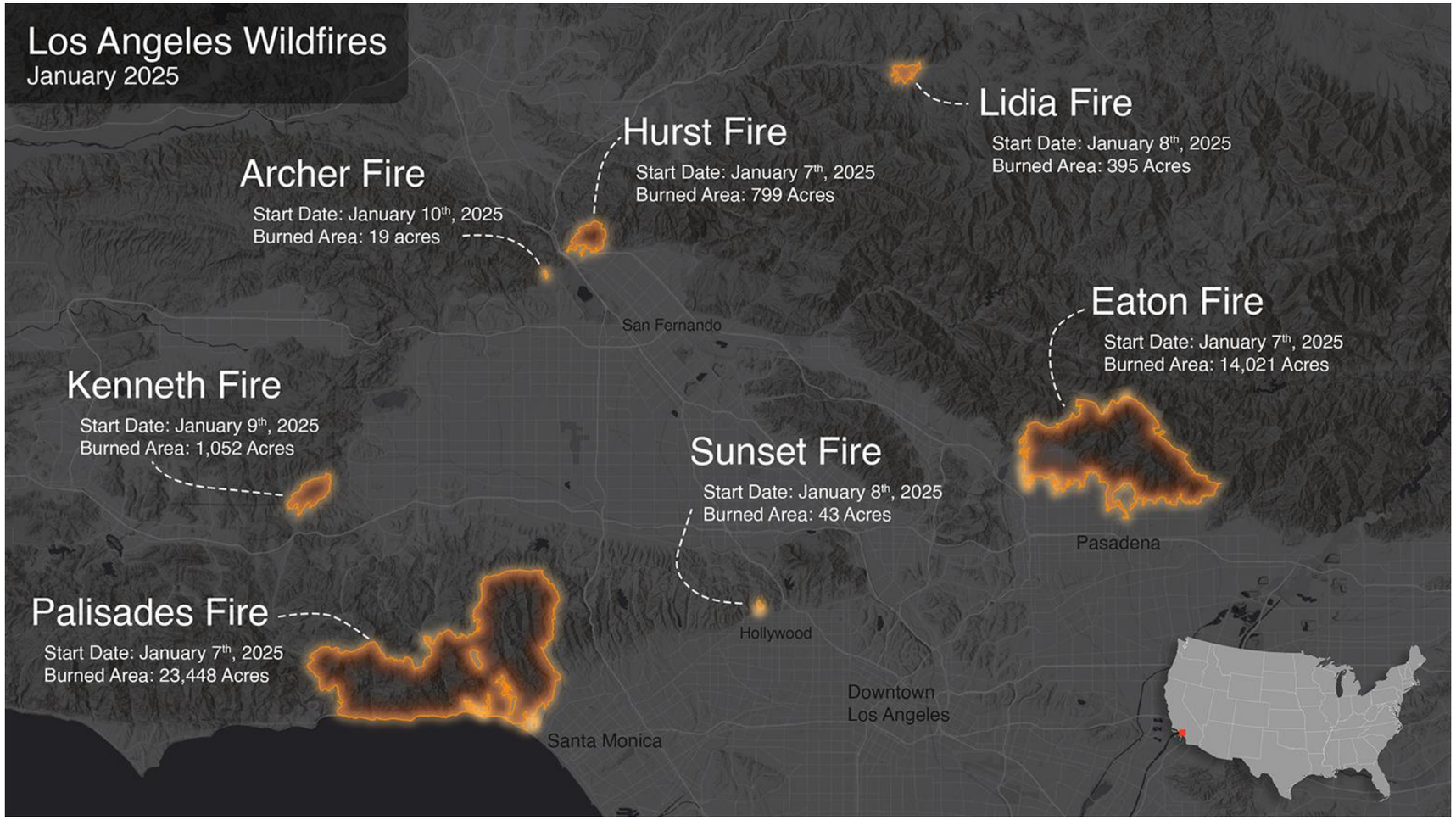


Zhou et al., 2023

2025 Los Angeles Wildfires

- The Los Angeles urban wildfires (LA Fires), which began on **January 7, 2025**, have become one of the most destructive disasters in U.S. history.
- Fast-moving LA Fires killed **31 people**, destroyed some **16,000 structures**, and caused more than $130 billion in damage.

Source: NASA



Overview of Our Research on LA Fires



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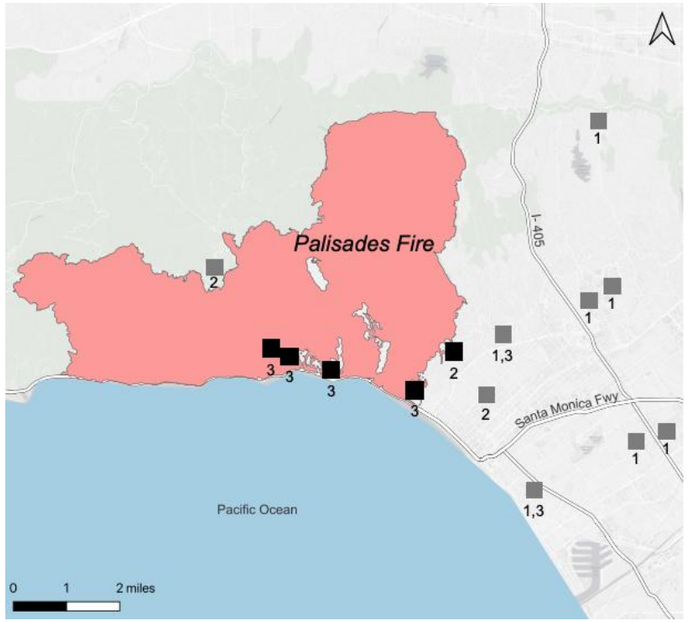
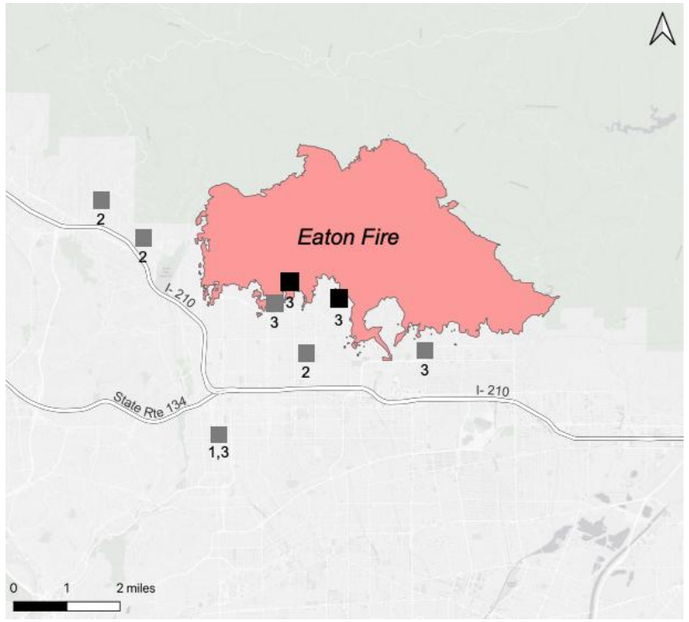
Indoor and Outdoor Air Sampling (N=25)

- Phase 1: active burning period with less than 50% containment (January 8–15, 2025)
- Phase 2: active burning period with more than 50% containment (January 24–31, 2025)
- Phase 3: post-fire period (February 11–18, 2025)





Paired indoor and outdoor air sampling locations



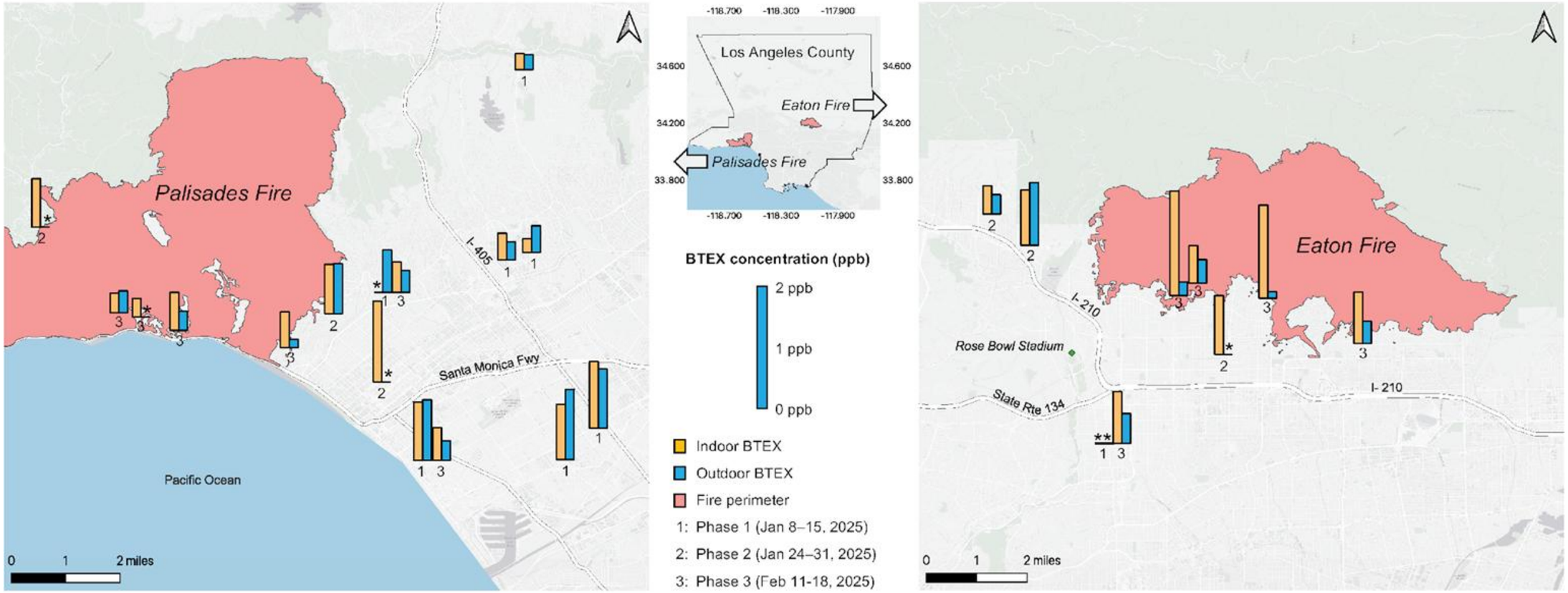
VOCs: diffusion tube



$PM_{2.5}$: UPAS sampler

VOCs Linger Indoors Long After Flames Are Extinguished

- **Eaton Fire residences experienced higher** indoor benzene, toluene, ethylbenzene, and xylenes (BTEX) concentrations



Yao et al., (2026) Indoor and outdoor volatile organic compound levels during and after the 2025 Los Angeles wildfires. Environmental Science & Technology Letters, 13(1):70-75.

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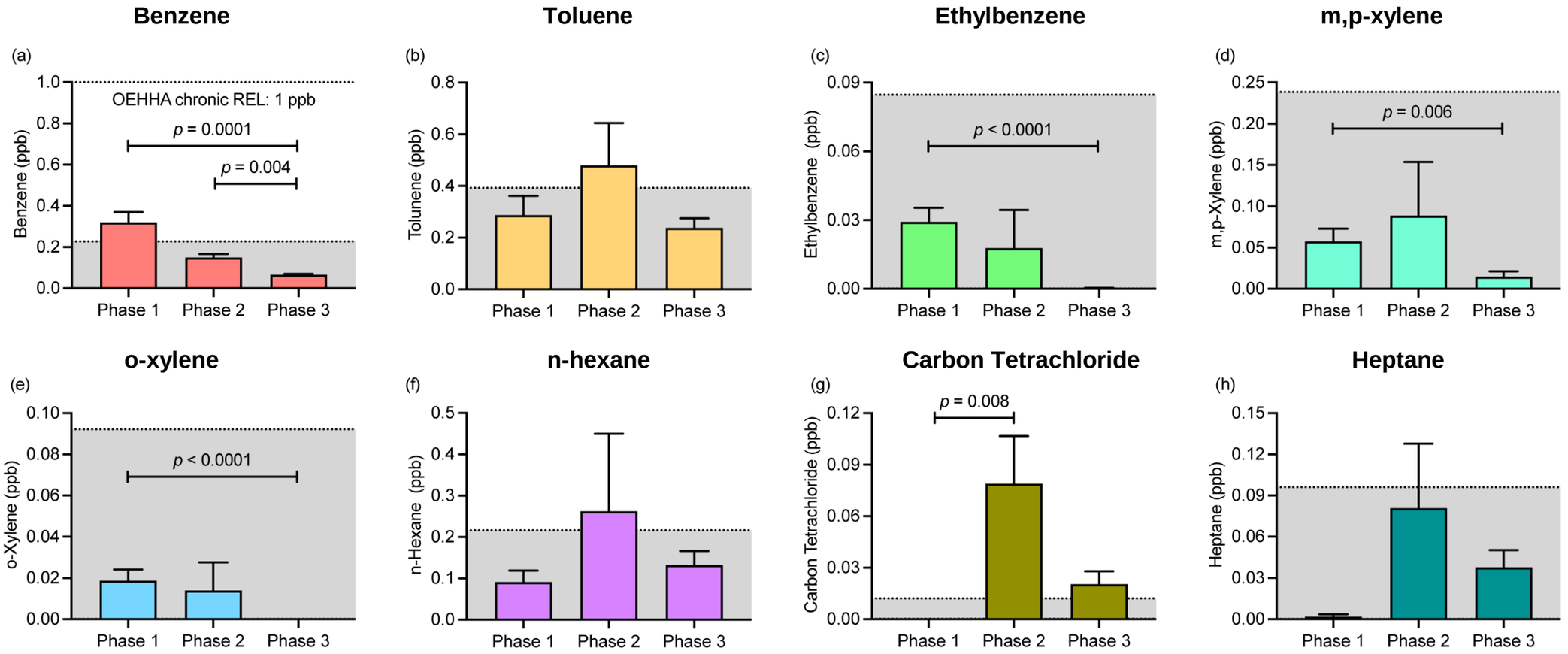
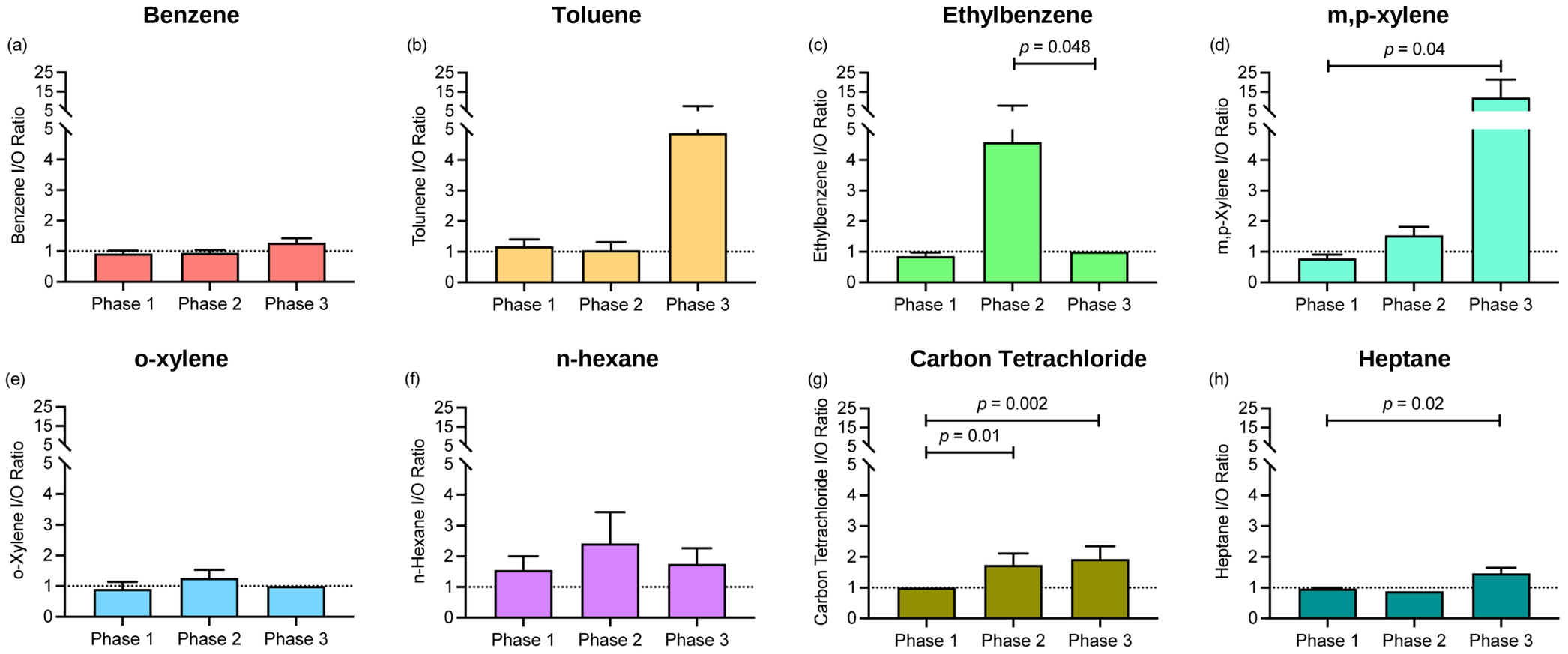
Outdoor VOC Concentrations



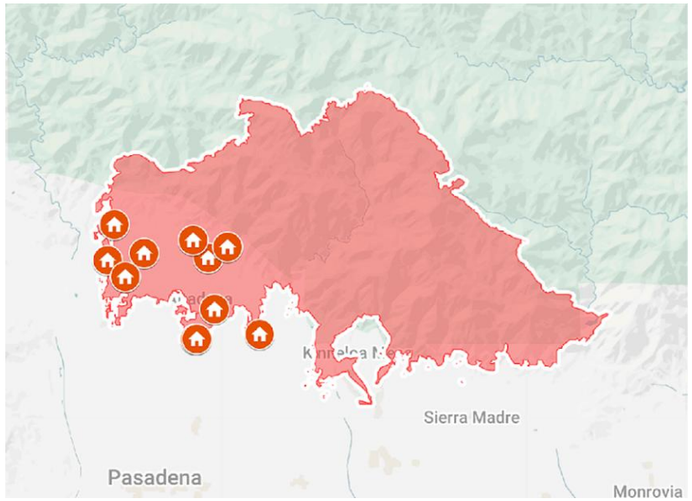
The gray area represents the range of two-week average outdoor VOC concentrations before the fires (October and November 2024) at 17 locations. OEHHA: California Office of Environmental Health Hazard Assessment; REL: Reference Exposure Level.

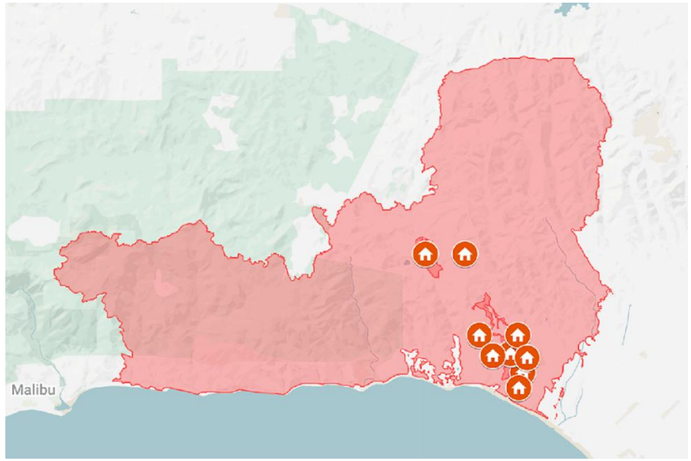
Indoor-to-Outdoor (I/O) Ratios of VOCs



The dotted line represents an I/O ratio of one.

Smoke Impacted Soft Household Items (N=244)





- 108 items from 10 Eaton fire impacted homes
- 104 items from 10 Palisades fire impacted homes
- 32 items from five control homes



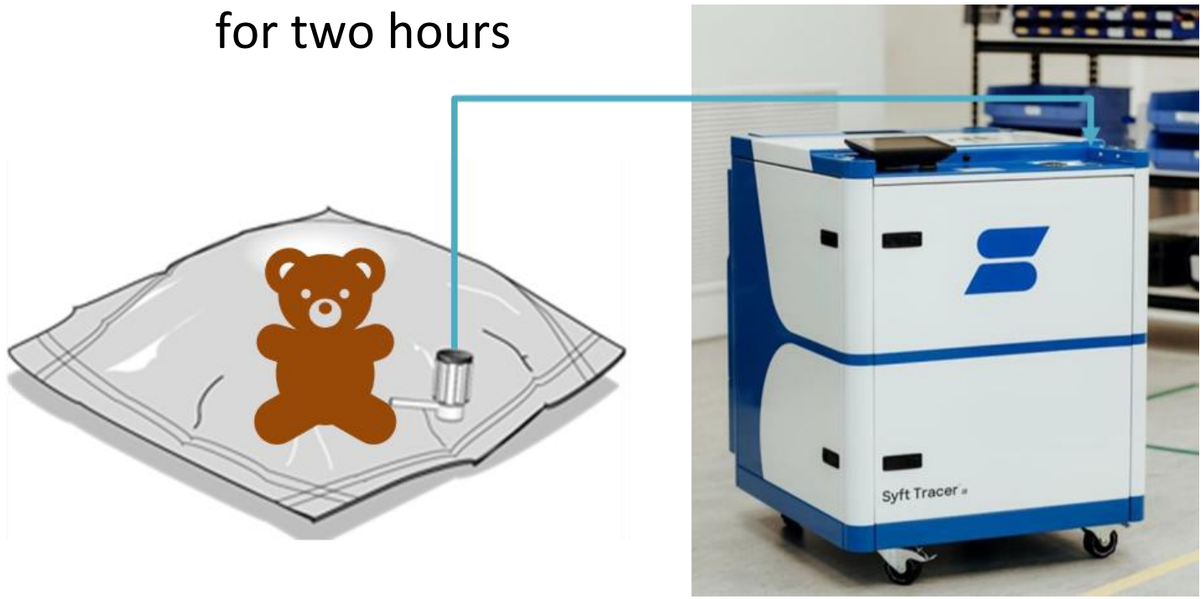






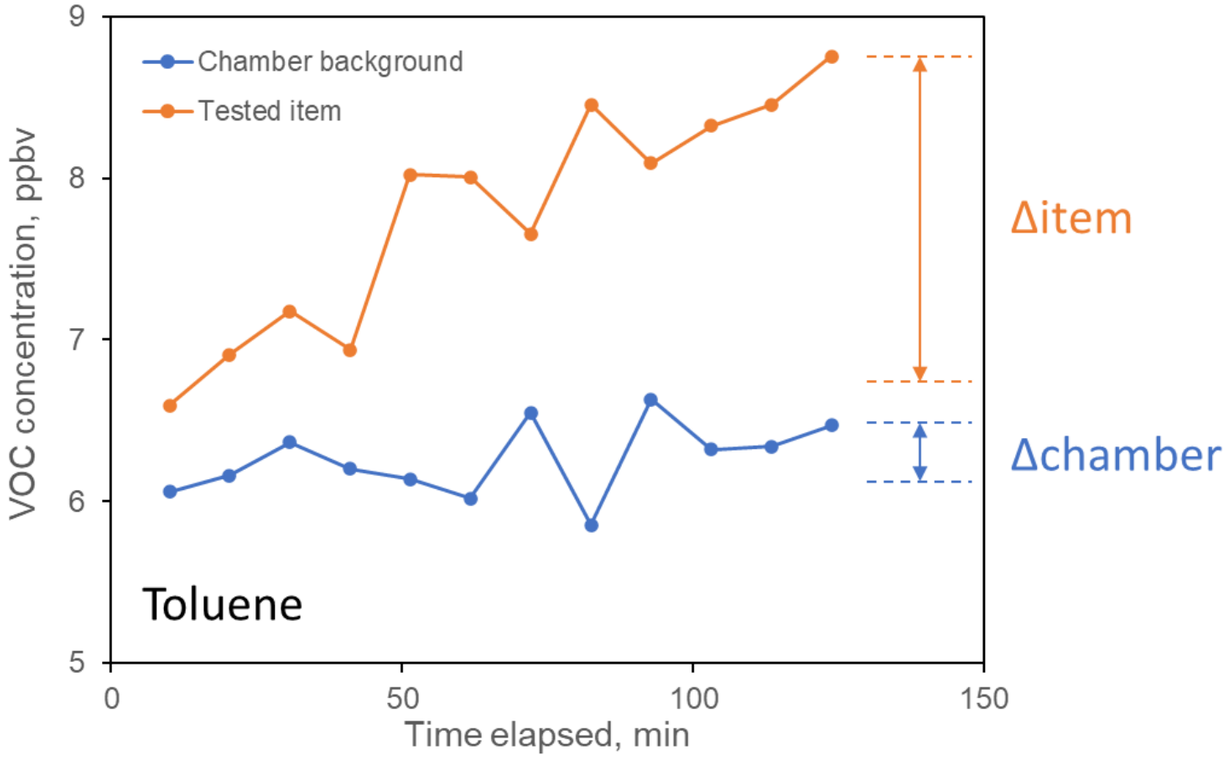
VOC Emissions from Soft Household Items

Offgassing in 50 L UltraZero Air for two hours



30 Fire related VOCs are analyzed using a selected-ion flow-tube mass spectrometry (SIFT-MS)

Two-hour Test

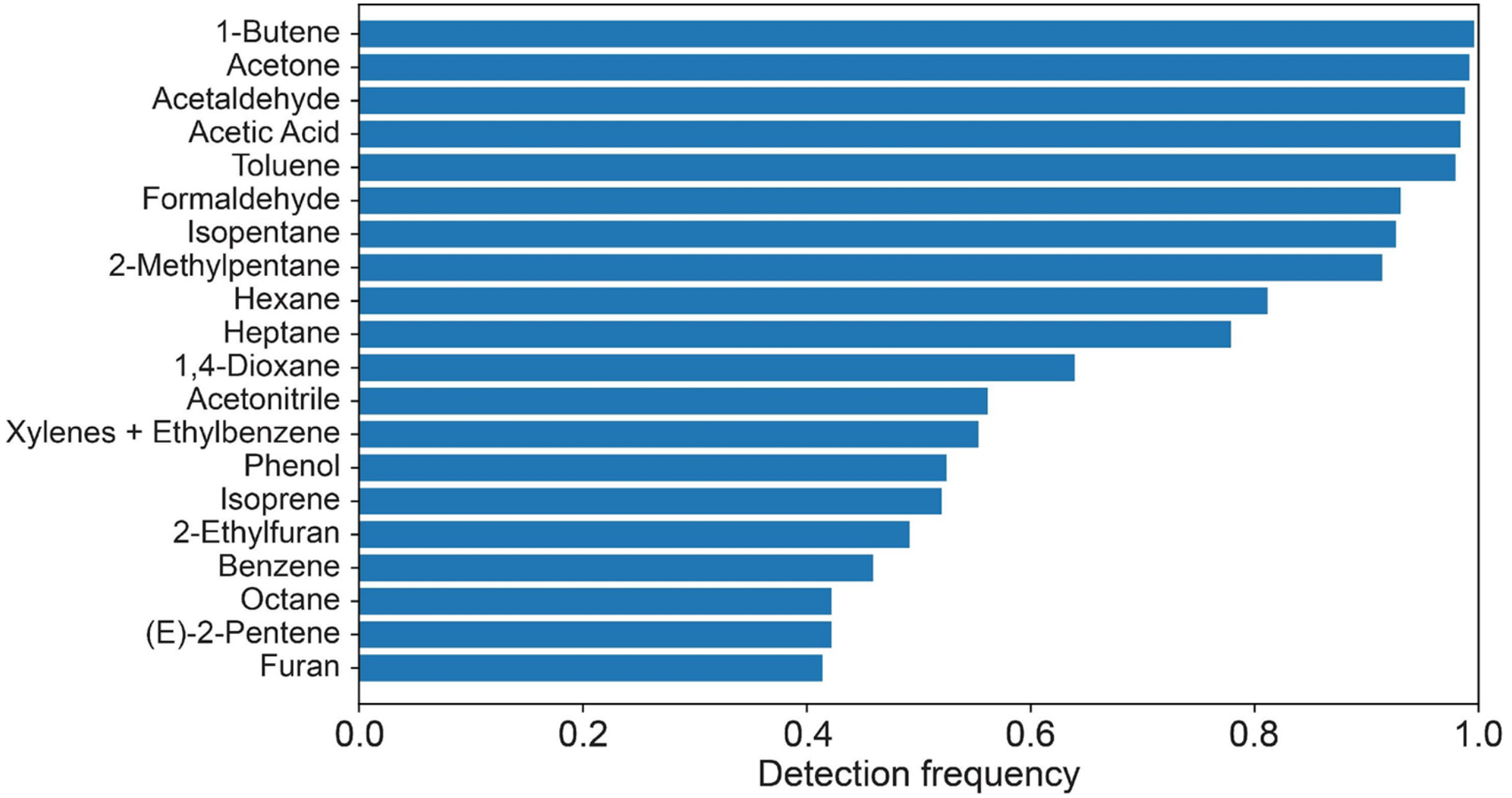


background-corrected concentration = Δitem - Δchamber

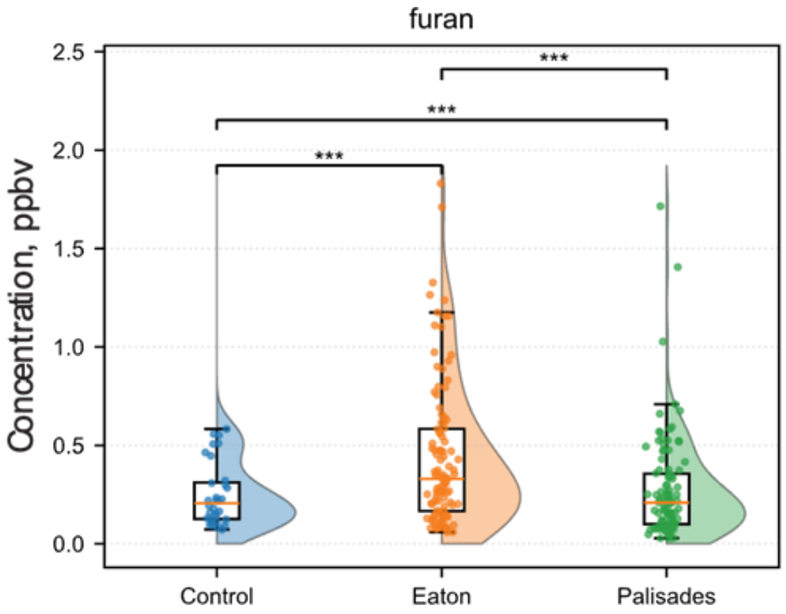
Results do not represent exposure levels

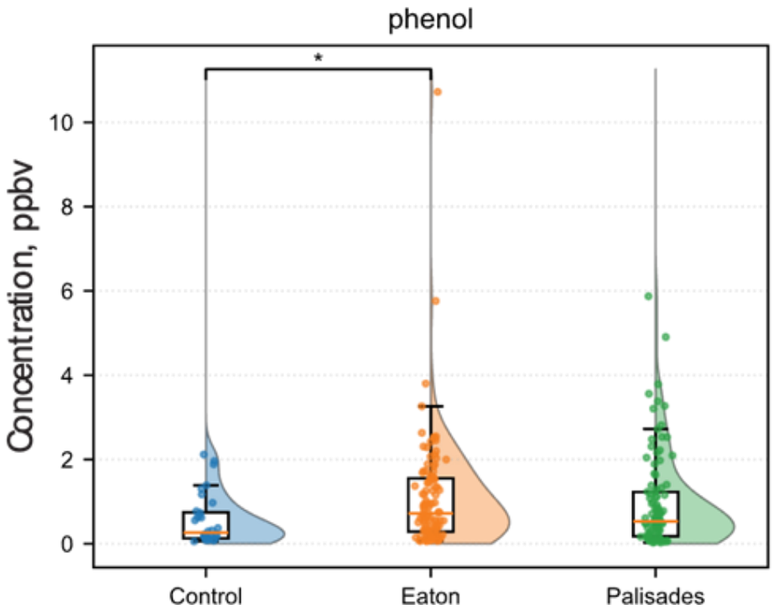
Soft Household Items Emit Diverse Toxic VOCs

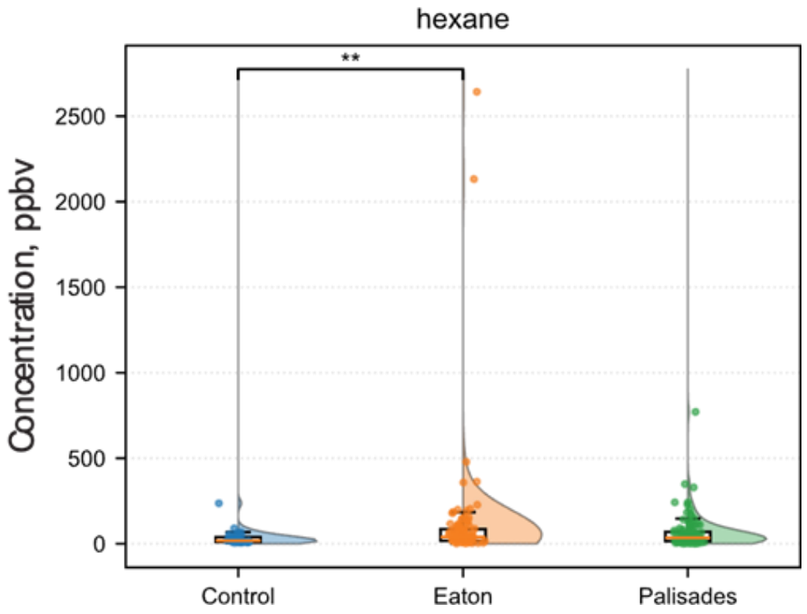
- Nine VOCs were detected in more than 80% of the collected soft household items, and 20 VOCs were detected in more than 40% of the items.



Eaton Items Emit Higher Levels of Toxic VOCs





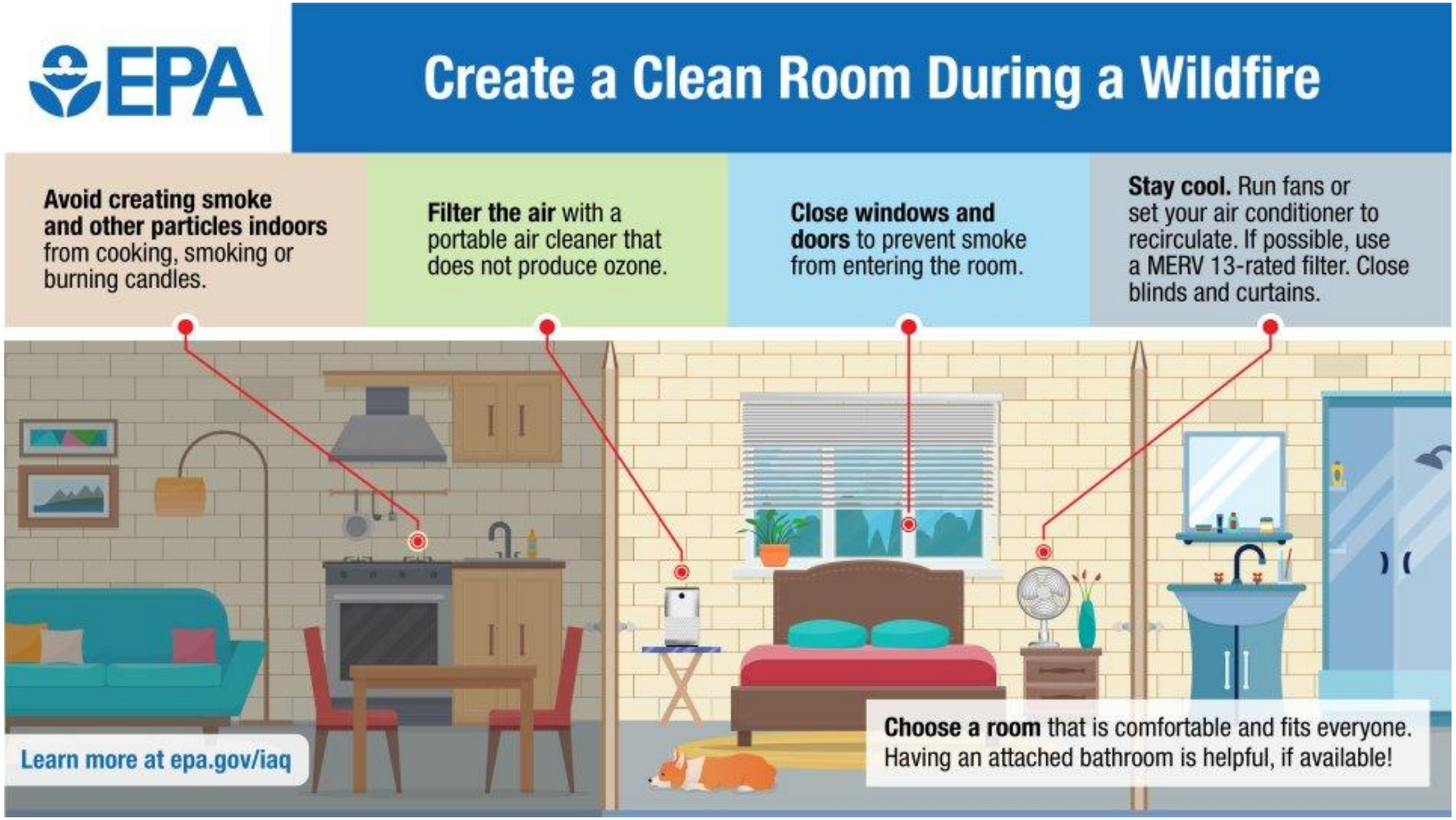


Furan: Probable human **carcinogen** and a marker of wildfire emissions, commonly detected in fresh smoke

Phenol: Airborne **irritant** from burning wood and synthetic materials that can persist indoors post-wildfire

Hexane: Neurotoxic VOC indicative of burned vehicles, fuels, and building materials

Strategies to Reduce Exposures During a Wildfire



Community Needs and Research Priorities Post-Fires

- ❖ Communities lack clear, evidence-based guidance on what post-wildfire home remediation strategies effectively improve indoor air quality
- ✓ **Research Need:** Evaluate various remediation methods to quantify their effectiveness in reducing key wildfire-related indoor pollutants

- ❖ Lack of guidance on how to remediate ubiquitous household soft items
- ✓ **Research Need:** Test and determine effective remediation methods for household soft items

- ❖ Uncertainty remains about the safety of returning home after remediation
- ✓ **Research Need:** Identify priority indicators and benchmarks to support re-occupancy decisions

Acknowledgement

LA Fire Health Study Field Team



Funding Sources

LA FIRE HEALTH STUDY

The Spiegel Family Fund is committed to philanthropy in California and beyond. Through dedication to the arts, education, housing and human rights, the Fund supports organizations that contribute to human progress.

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Community Action Project Los Angeles

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