



Use of low-cost sensors for measuring outdoor pollutant infiltration in low-income single family homes of Colorado

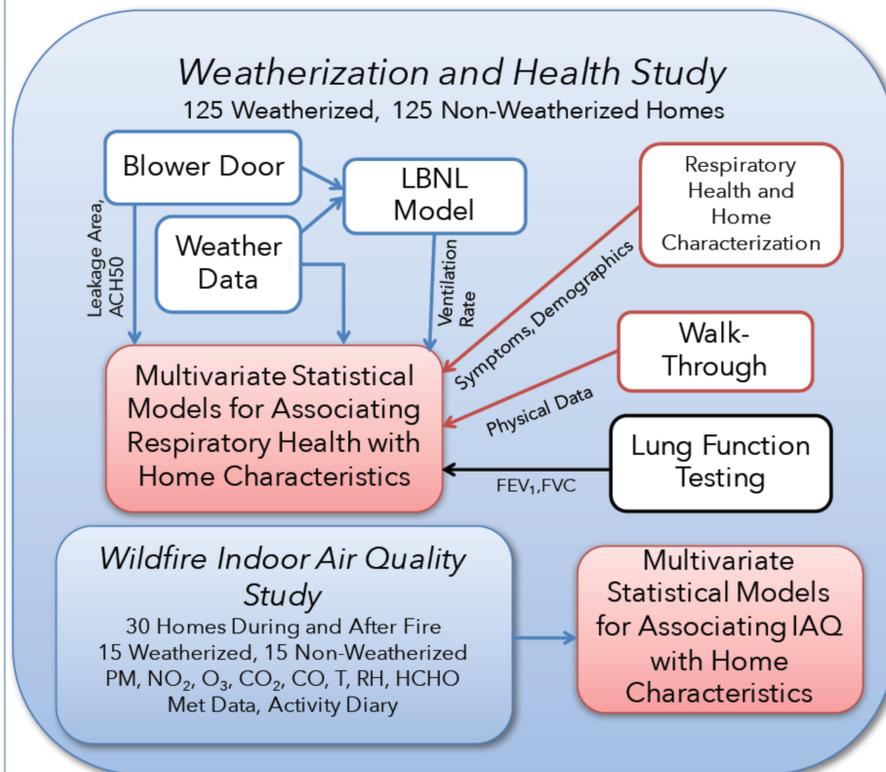
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Research Questions

- Is home weatherization, and associated changes in air exchange rates related to respiratory health?
- Does home weatherization protect occupants against outdoor pollutants?

Study Design



Instruments and Methods Used

Parameters measured	Instruments/Methods
Building air-tightness (ACH50)	Blower door testing
PM _{2.5}	Dylos 1700 OPCs
Black Carbon	MicroAeth AE51 aethalometers
O ₃ , CO, CO ₂ , Temp., RH, Baro.P	Y-Pods (CU Boulder Hannigan grp)
NO ₂	Ogawa passive diffusive samplers
HCHO	SKC Umex-100 passive badges
Meteorological data	Y-Pods, monitoring sites, NOAA

Field Data Collection Procedure

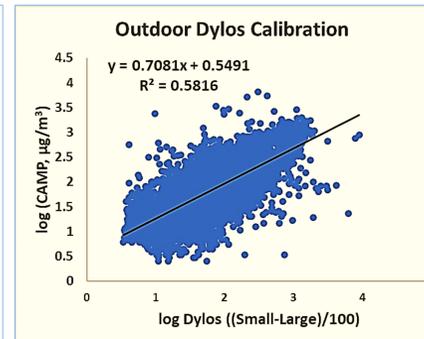
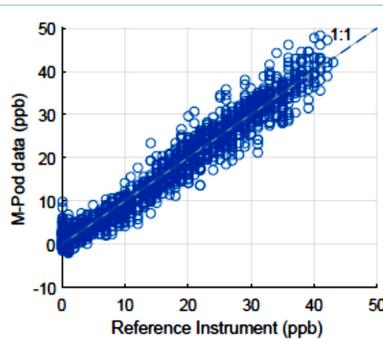


- Homes are recruited through Xcel Energy
- Blower door tests are performed and low and high ACH homes are identified along with the degree of weatherization activities performed
- Instruments are deployed during wildfire season to ensure maximum ambient levels of outdoor air pollution
- Up to 5 homes are tested at a time, instruments are set up both indoors and outdoors
- Sampling period = 2-3 days
- Sample size = 30 homes

Instrument Calibrations

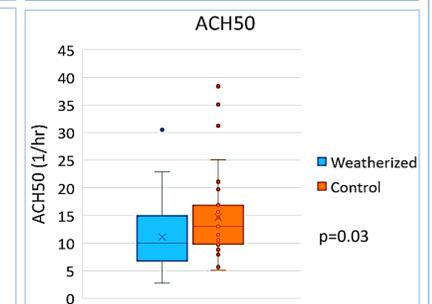
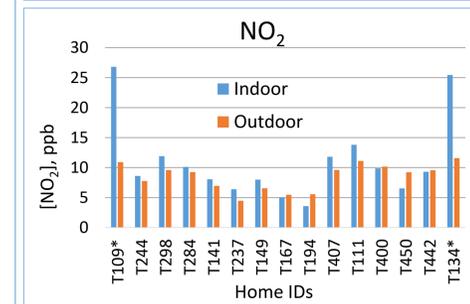
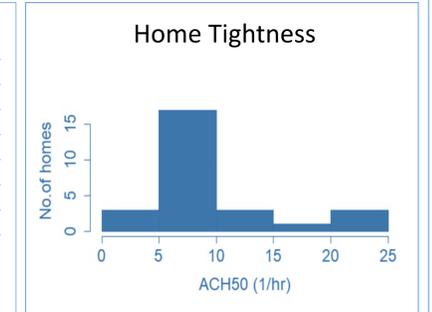
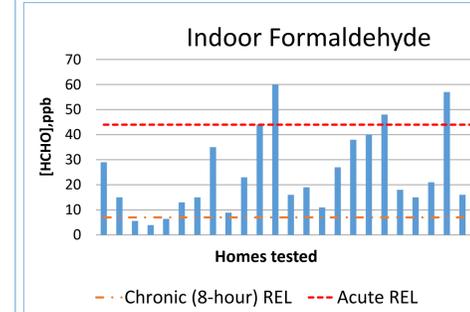
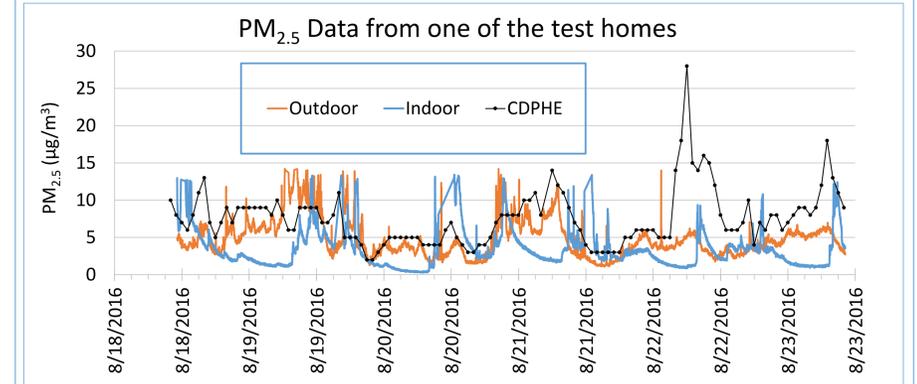


- Co-location calibrations are done for Y-Pods and Dylos 1700s for about a week at the CDPHE Air Monitoring Station (CAMP), Denver
- Calibrations generated for mid-sampling season under similar atmospheric conditions
- Cross-sensitivities checked with abs. humidity, Temp., Time and minimized selecting appropriate empirical models for electrochemical sensor signals in Y-Pod



- Co-location calibrations are crucial for Y-Pods to get usable data
- CO₂ data is calibrated using co-location with a LI-COR in the lab
- Dylos PM_{2.5} number concentration roughly scales linearly with reference (GRIMM FEM) mass concentration

Results



Discussions

- Outdoor pollution is mostly higher during wildfire season compared to normal conditions hence lower air exchange rates are desirable during these times, but indoor pollution sources must also be reduced within the homes at the same time
- Pollutant infiltration can be significantly altered by proper advising and informing occupants about better practices as well as with the degree of home weatherization improvements
- Low-cost monitors played a key role in larger deployments in this study, but they require significant knowledge, time and skill
- For low-concentration pollutants like HCHO and NO₂ real time monitors have a room for improvement in accuracy and LOD

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