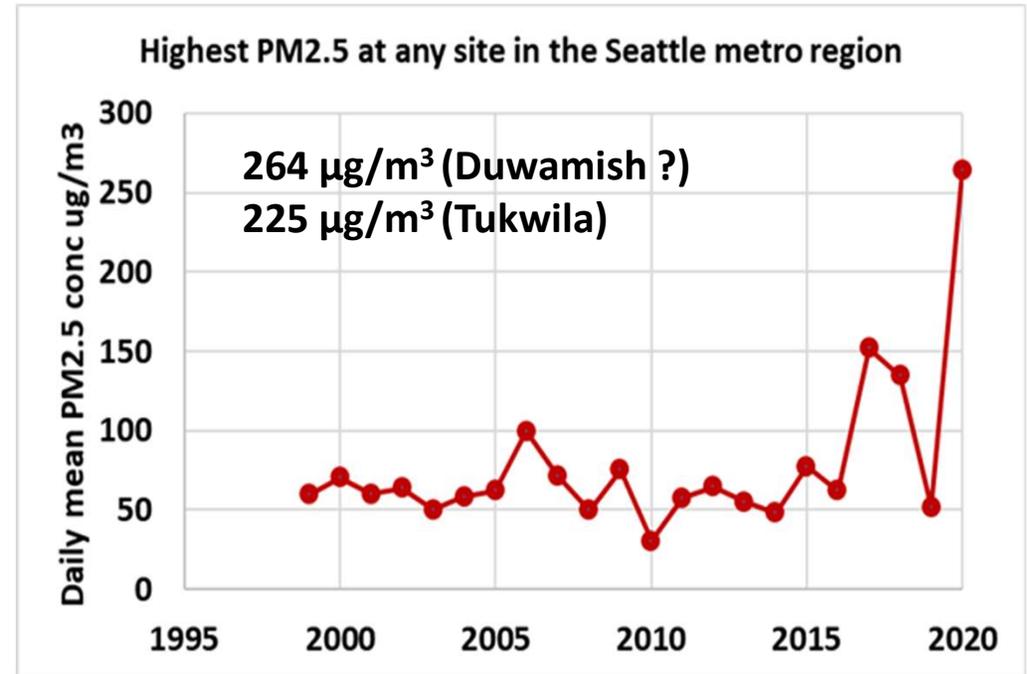# Indoor Air Quality during Smoke the Apocalypse of 2020

Seattle Space Needle webcam on September 14, 2020

Highest PM2.5 at any site in the Seattle metro region

264 μg/m³ (Duwamish ?)
225 μg/m³ (Tukwila)

Annual highest PM$_{2.5}$ at any site in the Seattle metro region since 1999

Goal: Keep the smoke out of my house!
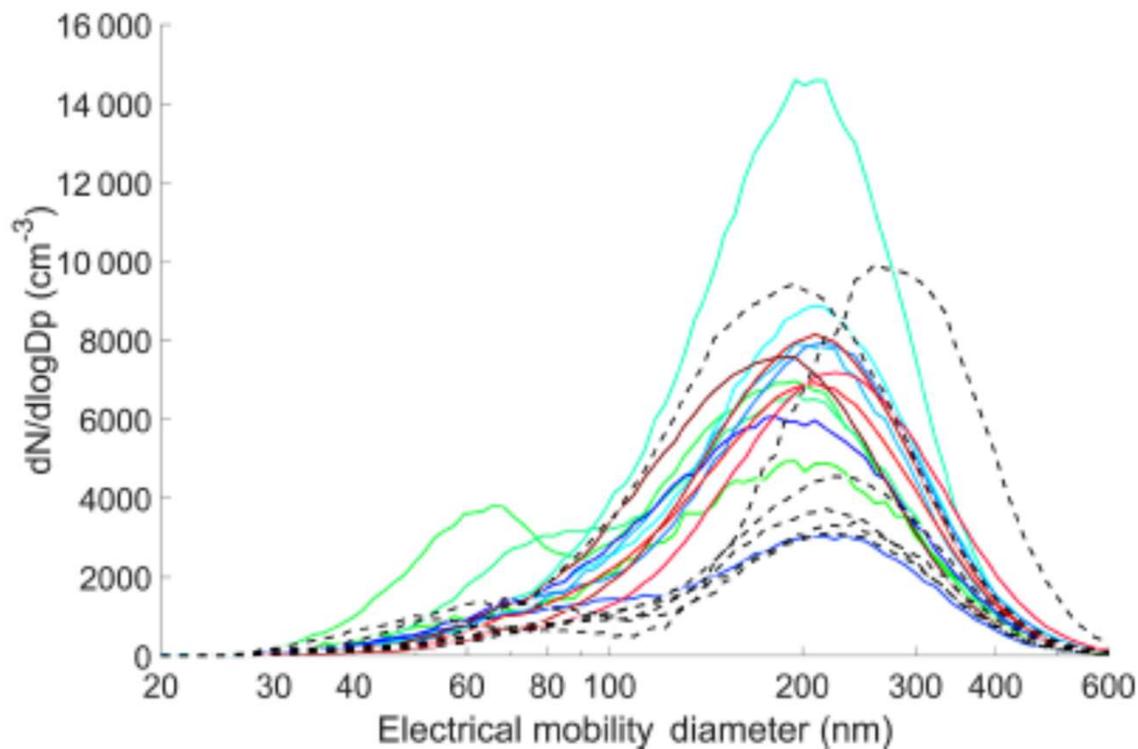Tools:

Three- box fans w/MERV-13

Two-PA sensors

**One-Handheld
5 bin particle counter**

https://pscleanair.gov/525/DIY-Air-Filter

Smoke size distributions at Mt. Bachelor
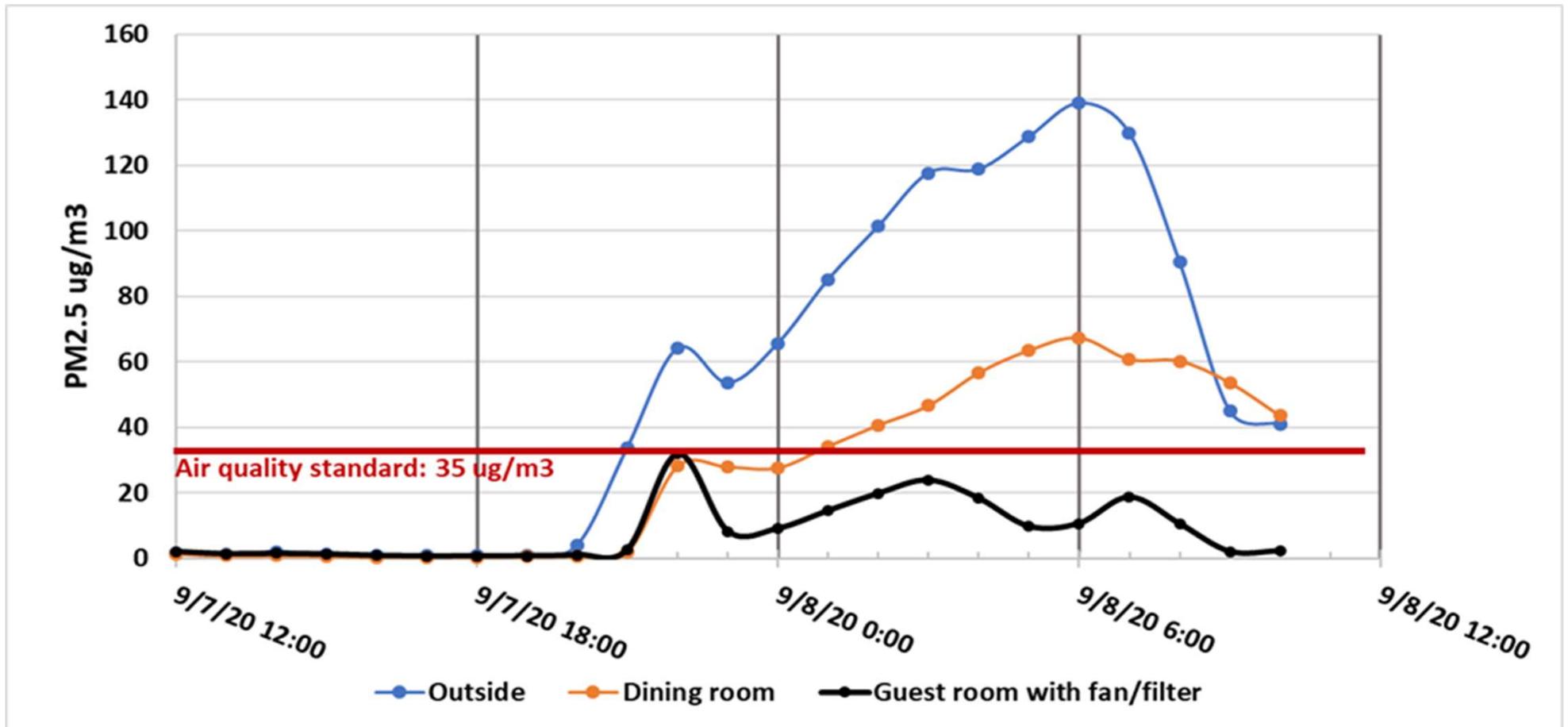
MERV rating chart

| MERV VALUE	The filter will trap Average Particle Size Efficiency 0.3 - 1.0 Micron	The filter will trap Average Particle Size Efficiency 1.0 - 3.0 Micron	The filter will trap Average Particle Size Efficiency 3.0 - 10.0 Micron
MERV 1	-	-	Less than 20%
MERV 2	-	-	Less than 20%
MERV 3	-	-	Less than 20%
MERV 4	-	-	Less than 20%
MERV 5	-	-	20% - 34%
MERV 6	-	-	35% - 49%
MERV 7	-	-	50% - 69%
MERV 8	-	-	70% - 85%
MERV 9	-	Less than 50%	85% or better
MERV 10	-	50% - 64%	85% or better
MERV 11	-	65% - 79%	85% or better
MERV 12	-	80% - 89%	90% or better
MERV 13	Less than 75%	90% or better	90% or better
MERV 14	75% - 84%	90% or better	90% or better
MERV 15	85% - 94%	90% or better	90% or better
MERV 16	95% or better	90% or better	90% or better

Recirc vs vent mode

Recirc mode

Vent mode
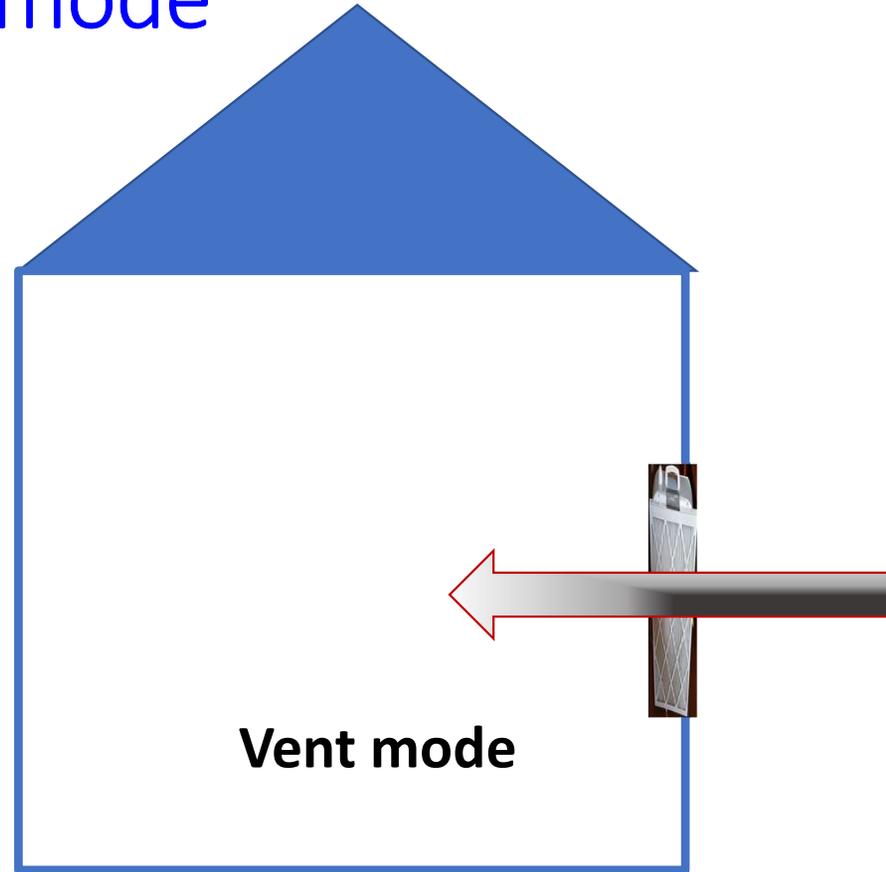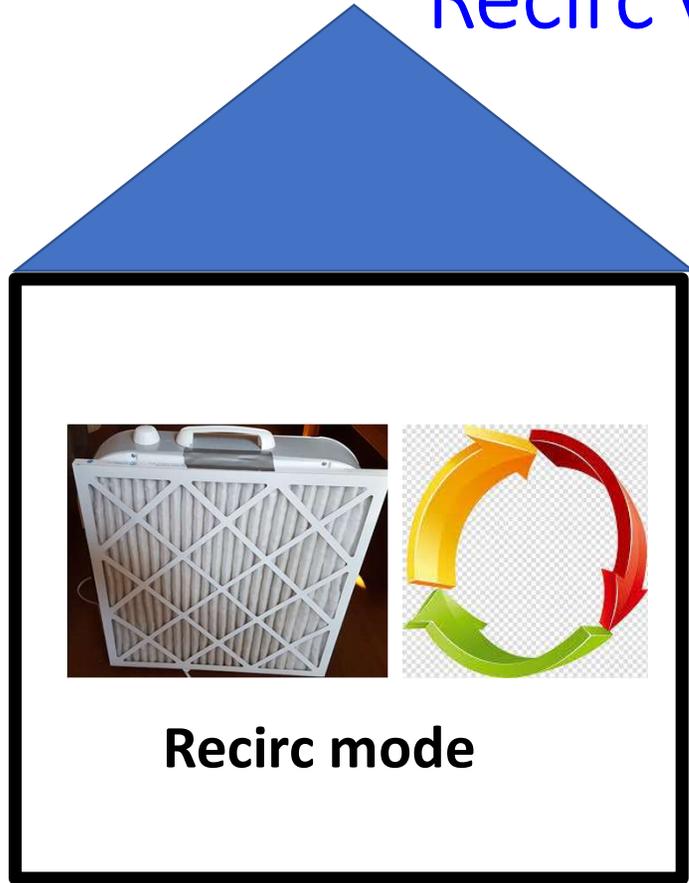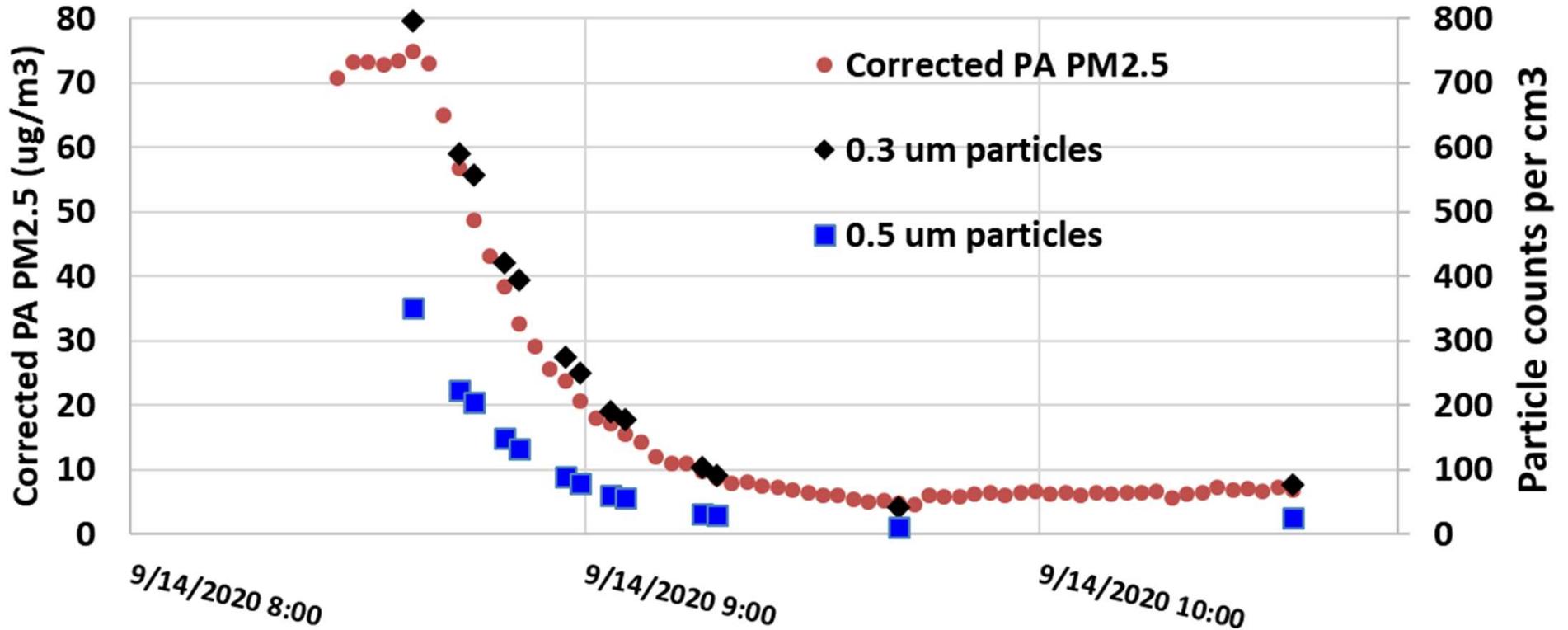
Smoke first arrives on the evening of 9/7/2020

IAQ improvement on Sunday 9/13/2020 with one box fan in each room

Kitchen/Dining room (open, ca 200 m3)
Guest room (ca 50 m3)

y-axis: PA Corrected PM2.5 (ug/m3)
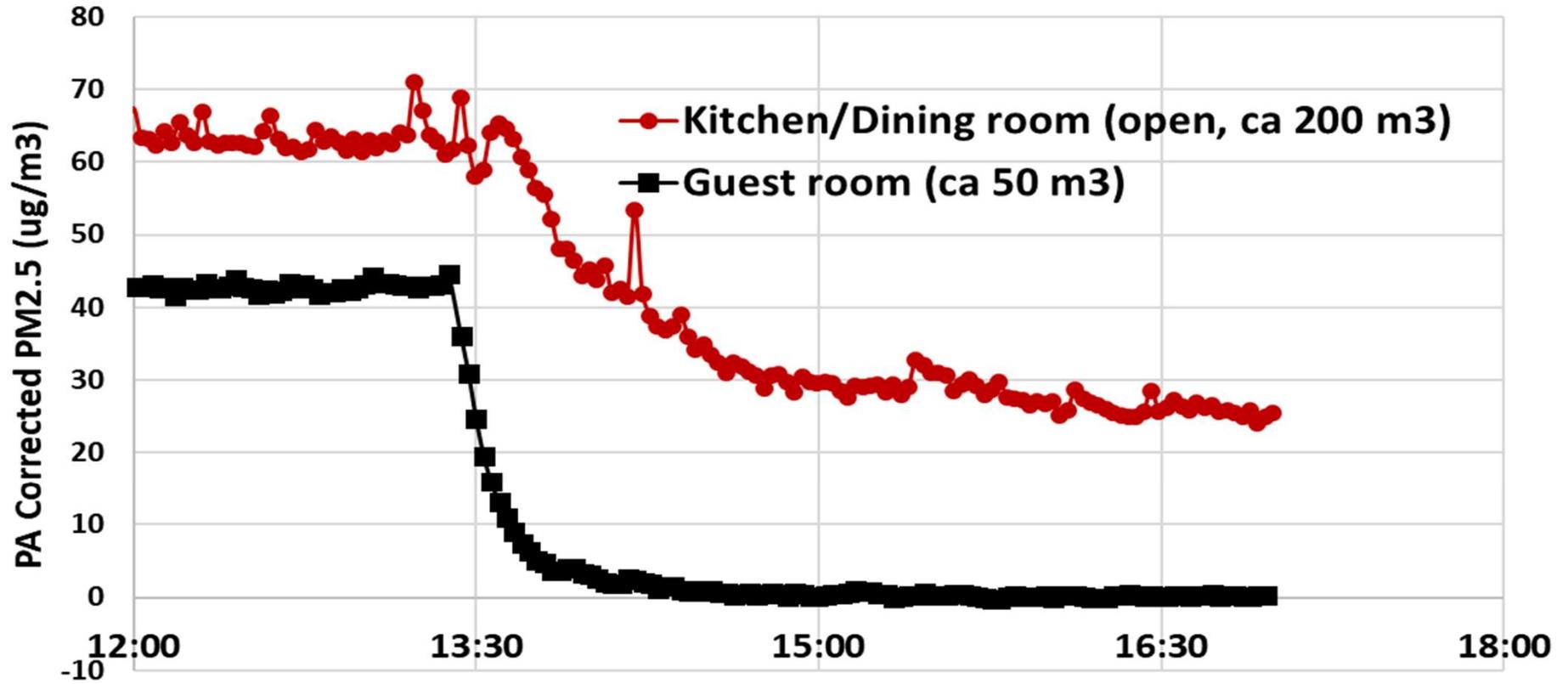
IAQ tests on Monday 9/14/2020 with boxfan filter in guest room

MERV-13 comparing indoor/outdoor air

Particle diameter	% reduction
0.3-0.4 um (approx.)	84.0
<0.5 um	87.9
<1.0 um	88.9
<2.5 um	85.4
<5.0 um	81.8

This is a "one-pass" test, meaning that the air passed thru the filter only one time. This gives an idea of how effective the MERV-13 is in reducing $PM_{2.5}$ if using the filters in a window to draw in outside air.

In "recirc mode", the windows are closed and air passes thru the filters multiple times. Higher reductions are possible, but the house tends to get stuffy.

Notes on PA conversion: Map data are not correctly corrected

Eugene Amazon Park reg site and South Eugene HS PA site

9/17/20, hr 16 PDT

Legend: —●— Reg data   —●— PA (EPA corrected)   —■— PA Lrapa corrected
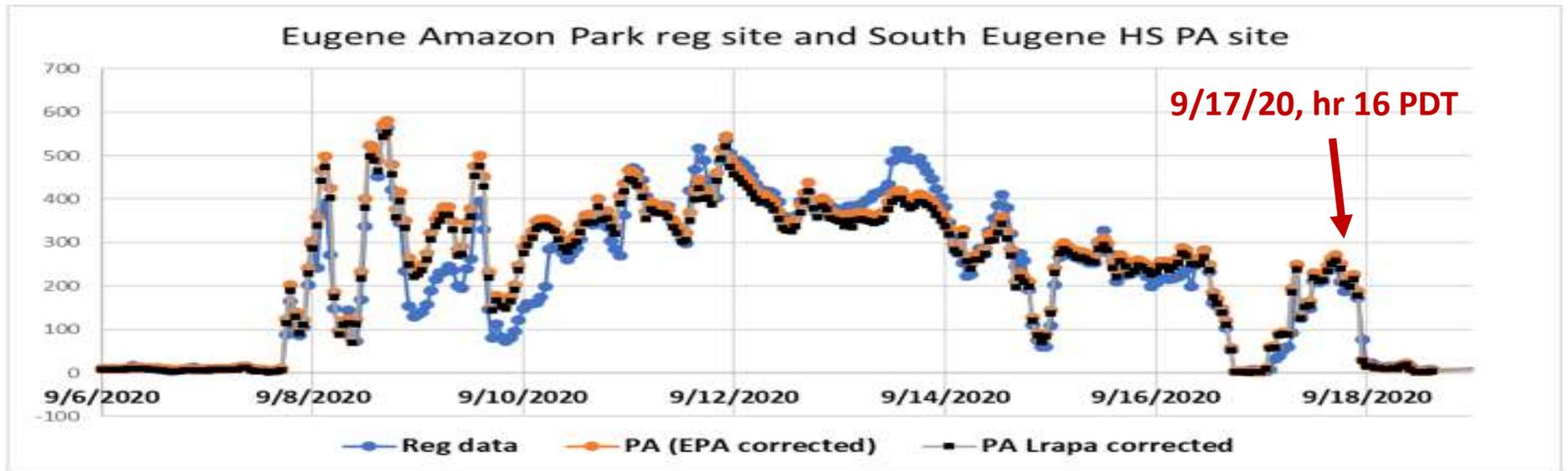
Slope	PA-LRPA vs Reg	0.965	1.002
R2	PA-EPA vs Reg	0.950	0.949

Online (map) data is not reported correctly on PA website, but if you download the data and start from CF=1 get very similar results with LRAPA or EPA correction.

➢ On 9/17/20@ hr 16 PDT. PA raw (map) = 344 ug/m3 raw and 172 ug/m3 using the LRAPA correction.

➢ At same time, get 251 ug/m3 using LRAPA correction and downloaded data.   Nearest regulatory site is 258 ug/m3

Summary

- Combination of in-home sensors with box fan/filter is very helpful to reduce in-home exposures to smoke.

- MERV-13 does reduce sub-micron (0.3-0.5 μm) smoke particles effectively in one pass (80-85%).

- Using filters in "recirc mode" is most effective but house gets stuffy.   I also tested filter/fans with outside air and this was fine when outside $PM_{2.5}$ got down to about 50 $\mu g/m^3$.

- Corrected PA sensors track well with sub-micron particle counts.

- I need a caption for this cartoon! Submit your entry at ScienceNorthwest.com