Supplemental Figures and Tables

Table S1. Summary of annotated events during the calibration period in both homes.

	Calibration Period, Location	**Sensors**	**Activities**	**Gravimetric Concentration[a] (MiniVol)**
Home I (built in 2002; 5 occupants)	20th - 25th May, 2016, Bedroom #1	Grimm DustTrak AirU (4) UMDS (10)	Cooking (kitchen), burning candle, using a humidifier and air purifier, Febreze™, hairspray	17.2 µg/m^3
Home II (built in 1942; 2 occupants)	15th - 21st October, 2016. Bedroom #1	Grimm (2), DustTrak UMDS (4)	Laundry, burning candle, cooking, vacuuming	19.7 µg/m^3

[a] Average concentration for the calibration period.

Table S2. Slopes of the linear regression model for indoor sources during calibration in home I[a].

	AirU (µg/m^3) vs. DustTrak (µg/m^3)	**UMDS (count per 0.01 ft^3) vs. DustTrak (µg/m^3)**	**AirU (µg/m^3) vs. GRIMM (µg/m^3)**	**UMDS (count per 0.01 ft^3) vs. GRIMM (µg/m^3)**
Cooking	0.539	82.3	1.99	302
Candle	0.467	97.2	1.89	380
Febreze ™	0.398	42.7	2.39	199
Hairspray	0.443	103	0.889	211
Unknown	0.094	43.5	0.0506	28.7

[a] UMDS count is the count of the small minus the large bin. The dependent variable (x) is the reference instrument.

Table S3. Slopes of the linear regression model of indoor sources during calibration in home II .

	UMDS (count per 0.01 ft^3) vs. DustTrak (µg/m^3)	**UMDS (count per 0.01 ft^3) vs. GRIMM 1 (µg/m^3)**	**UMDS (count per 0.01 ft^3) vs. GRIMM 2 (µg/m^3)**
Cooking	43.9	288	128
Candle	28.2	299	116
Vacuum	73.4	475	84.2
Unknown	72.1	562	234

[a] UMDS count is the count of the small minus the large bin. The dependent variable (x) is the reference instrument.

Table S4-a. Bias corrections obtained for individual sensors in home I. To obtain AirU $PM_{2.5}$ mass concentration ($\mu g/m^3$), multiply the raw $PM_{2.5}$ concentration by the following bias correction for each sensor. To obtain UMDS $PM_{2.5}$ mass concentration ($\mu g/m^3$), multiply the raw $PM_{2.5}$ count (small-large, per 0.01 ft^3) by the following bias correction for each sensor.

AirU corrected $PM_{2.5}$ ($\mu g/m^3$)	**UMDS corrected $PM_{2.5}$ ($\mu g/m^3$)**
AirU 2 ($\mu g/m^3$) * 1.46	UMDS 110 (count per 0.01 ft^3) * 4.85e-3
AirU 6 ($\mu g/m^3$) * 1.58	UMDS 113 [b] (count per 0.01 ft^3) * 4.56e-3
AirU 8 ($\mu g/m^3$) * 1.30	UMDS 115 (count per 0.01 ft^3) * 4.71e-3
AirU 3 ($\mu g/m^3$) * 1.56	UMDS 124 (count per 0.01 ft^3) * 4.97e-3

[a] UMDS 113 was not utilized in the calibration week. The average bias correction for all UMDSs was used for this sensor.

Table S4-b. Bias corrections obtained for individual sensors in home II. To obtain UMDS $PM_{2.5}$ mass concentration ($\mu g/m^3$), multiply the raw $PM_{2.5}$ count (small-large, per 0.01 ft^3) by the following bias correction for each sensor.

UMDS corrected $PM_{2.5}$ ($\mu g/m^3$)
UMDS 114 (count per 0.01 ft^3) * 5.29e-3
UMDS 116 (count per 0.01 ft^3) * 4.78e-3
UMDS 117 [a] (count per 0.01 ft^3) * 4.55e-3
UMDS 121 (count per 0.01 ft^3) * 4.64e-3
UMDS 124 [b] (count per 0.01 ft^3) * 1.43e-3

[a] The average bias correction was used for this sensor.
[b] The outdoor bias correction was used for this sensor.

Table S4-c. Correction factors for different indoor activity sources. Multiply this CF by the DustTrak $PM_{2.5}$ concentration to obtain the aerosol-corrected $PM_{2.5}$ concentration. These same factors is for the low-cost sensors after bias correction.

Source	**CF**
Candle	0.371
Cooking	0.133
Febreze, Hairspray and Unknown	1.33

Table S5. Coefficients of determination for the fitted linear model (R^2) between low-cost sensors in different rooms in home I and home II.

	Home I		Home II	
	AirU (R^2)	UMDS (R^2)	UMDS (R^2)	Slope
Living Room vs. Bedroom	0.933	0.02	0.712	0.644
Living Room vs. Kitchen	0.00	0.0389	0.974	0.832
Kitchen vs. Bedroom	0.011	0.00	0.678	0.731

Table S6. Range of Air Exchange Rates (AER) in different rooms in home I and home II.

	Home I (hr^{-1})	Home II (hr^{-1})
Living Room	0.27-0.67	0.51-2.10
Kitchen	0.36-2.76	0.54-2.66
Bedroom	1.30-1.96	0.33-1.86

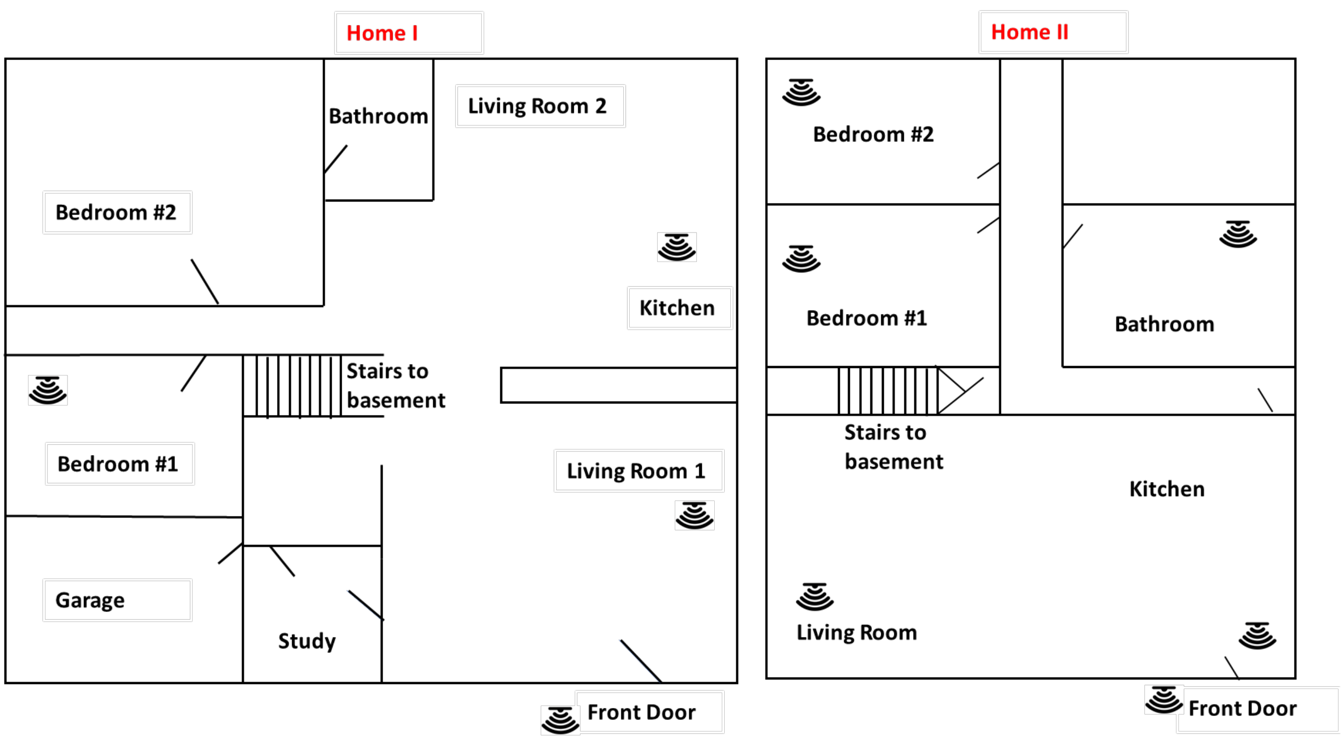


Fig. S1. Top view showing the floor plan with location of sensors in home I and home II. All sensors were placed on a table approximately 0.75-80 m above the ground and at least 0.3 m away from the nearest wall. The network icon indicates the location of the sensor in the room.

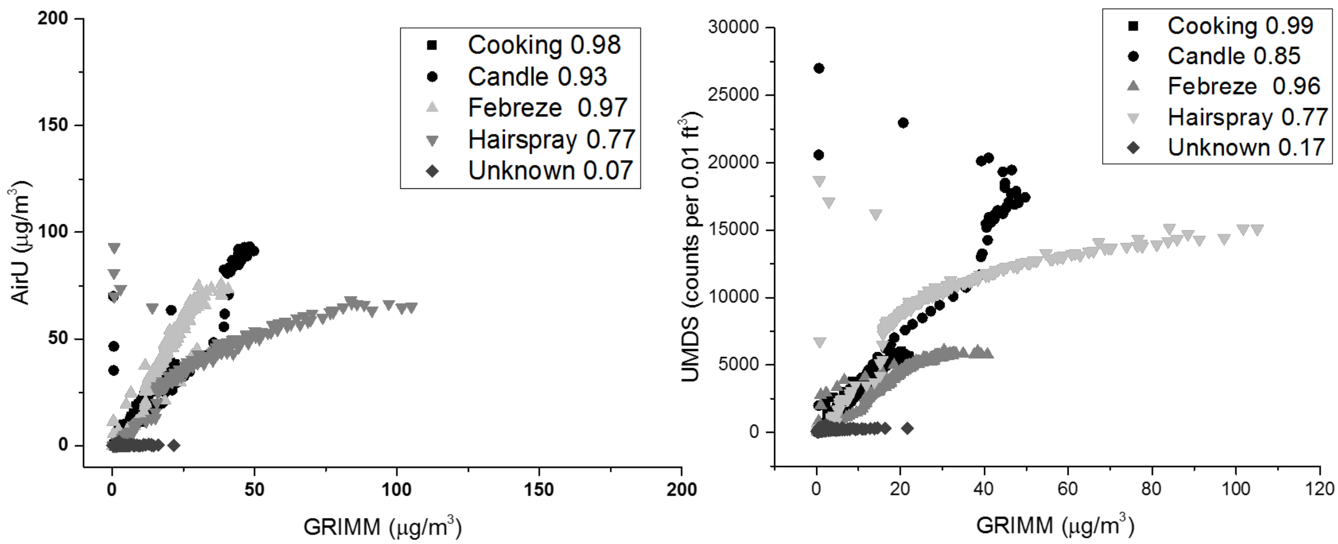
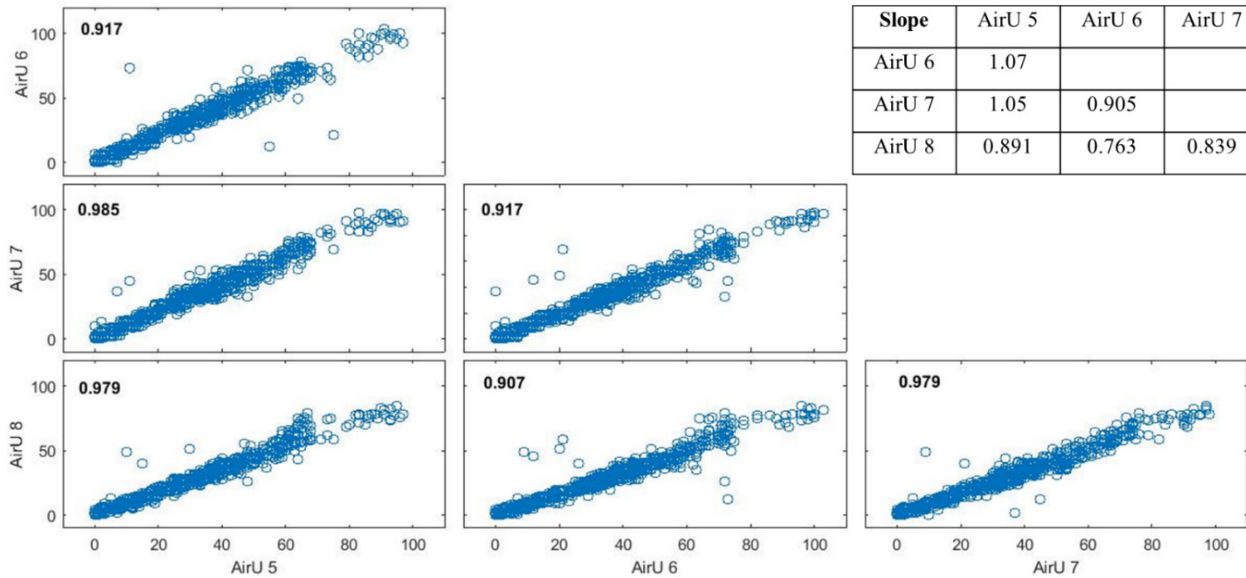
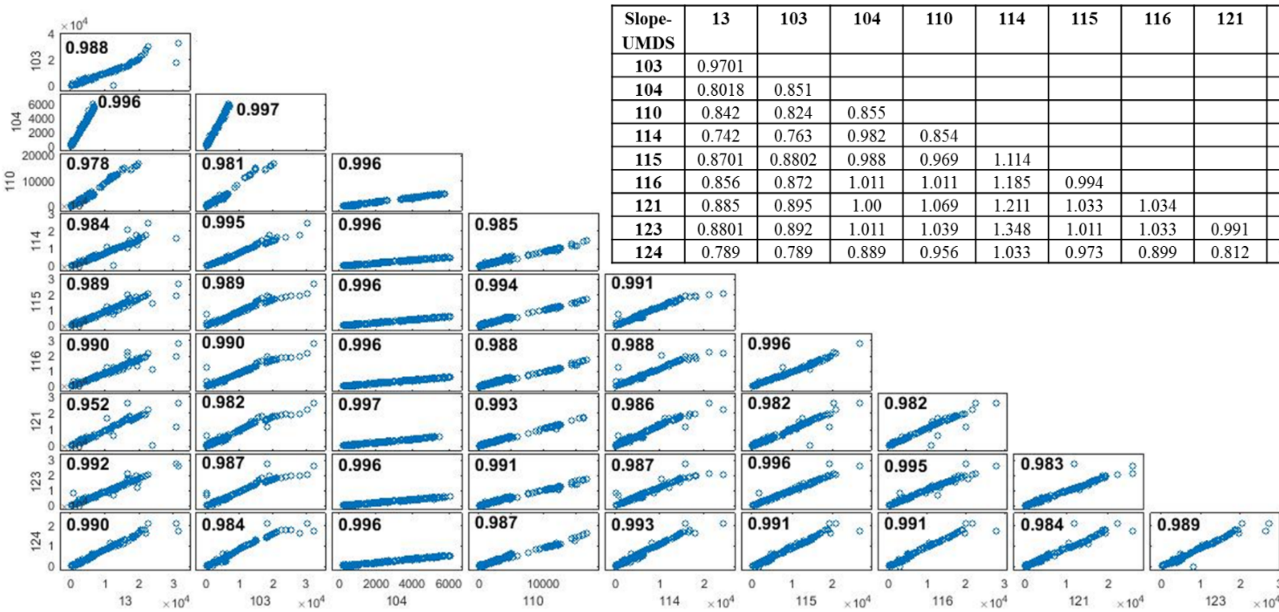


Fig. S2. Scatter plots and coefficients of determination (R^2) from the linear regression (low-cost sensor and GRIMM) for 5-minute rolling average of $PM_{2.5}$ concentrations ($\mu g/m^3$) for several types of aerosols measured with a GRIMM (uncorrected), average of 4 AirUs (uncorrected) and average of 10 UMDS, uncorrected ($PM_{2.5}$ count, small minus large bin, per 0.01 ft^3) during 20th - 25th May, 2016 (home I).



Slope	AirU 5	AirU 6	AirU 7
AirU 6	1.07		
AirU 7	1.05	0.905	
AirU 8	0.891	0.763	0.839

Fig. S3. Scatter plots and coefficients of determination (R^2) from the linear regression for 1-minute $PM_{2.5}$ concentrations ($\mu g/m^3$) for 4 AirU sensors (uncorrected) during 20th - 25th May, 2016 (home I). The top right corner of the figure shows the slopes of linear regression of the fitted model (columns are the x-axes).



Slope-UMDS	13	103	104	110	114	115	116	121	123
103	0.9701								
104	0.8018	0.851							
110	0.842	0.824	0.855						
114	0.742	0.763	0.982	0.854					
115	0.8701	0.8802	0.988	0.969	1.114				
116	0.856	0.872	1.011	1.011	1.185	0.994			
121	0.885	0.895	1.00	1.069	1.211	1.033	1.034		
123	0.8801	0.892	1.011	1.039	1.348	1.011	1.033	0.991	
124	0.789	0.789	0.889	0.956	1.033	0.973	0.899	0.812	0.9073

Fig. S4. Scatter plots and coefficients of determination (R^2) from the linear regression for 1-minute UMDS $PM_{2.5}$ count (small minus large bin, per 0.01 ft^3) between each sensor (uncorrected) during 20th - 25th May, 2016 (home I). The top right corner of the figure shows the slopes of linear regression of the fitted model (columns are the x-axes).

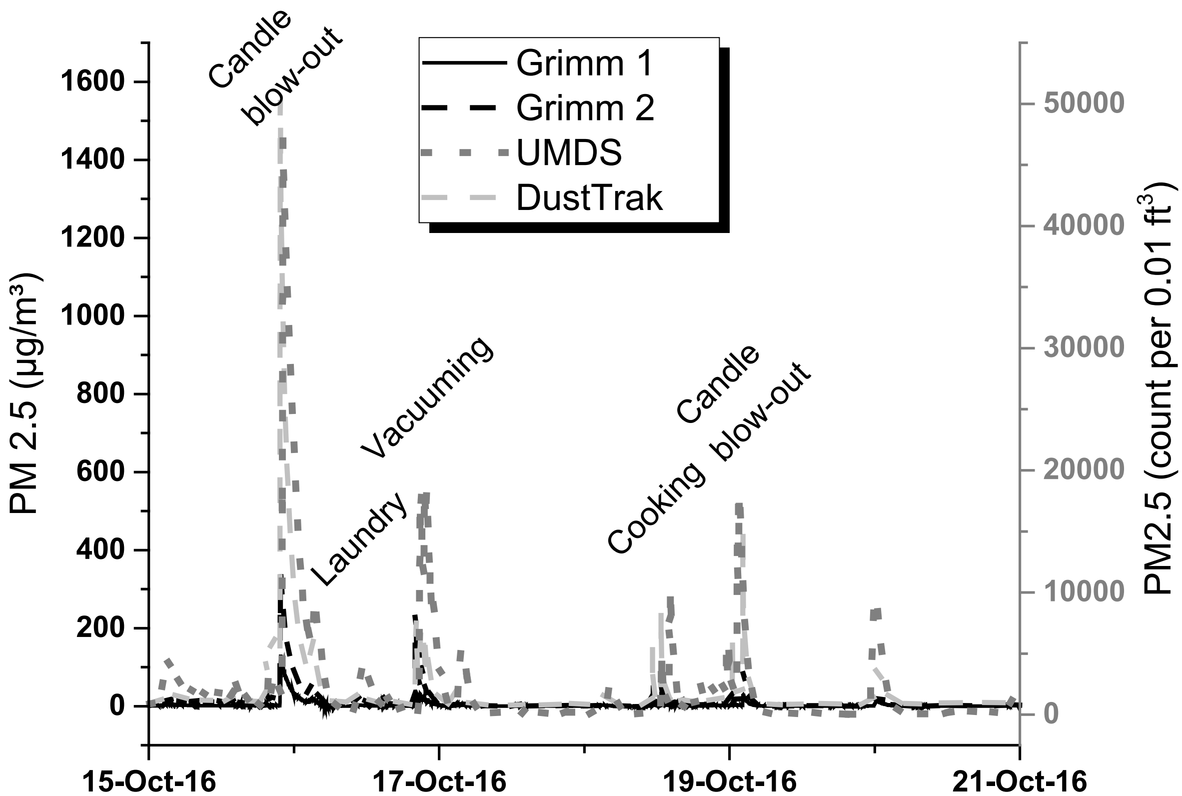


Fig. S5. Comparison of co-located 5-minute rolling average of $PM_{2.5}$ concentrations (µg/m^3) measured by two GRIMM, DustTrak, and the average of four UMDS ($PM_{2.5}$ count, small minus large bins, per 0.01 ft^3) for the calibration period of 15th-21st October 2016 (home II). The concentrations measured by all sensors were uncorrected, raw data.

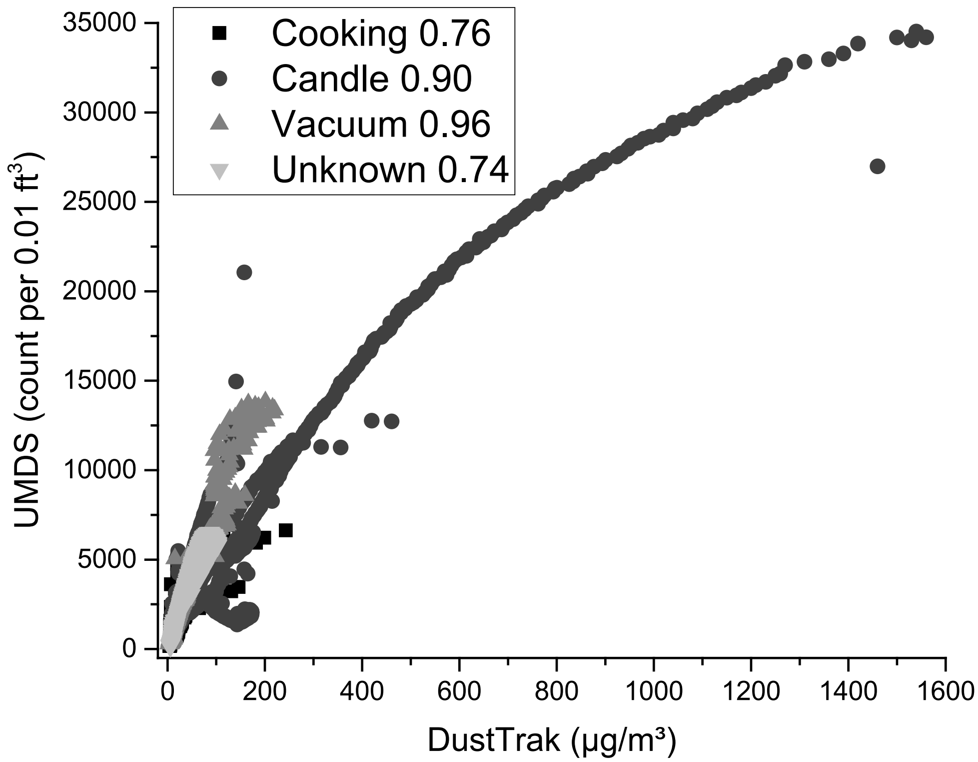


Fig. S6. Scatter plots and coefficients of determination (R^2) from the linear regression (UMDS and DustTrak) for 5-minute rolling average of $PM_{2.5}$ concentrations (μg/m^3) measured with a DustTrak (uncorrected), average of 4 UMDS, uncorrected ($PM_{2.5}$ count, small minus large bins, per 0.01 ft^3) during 15th – 21st October, 2016 (home II).

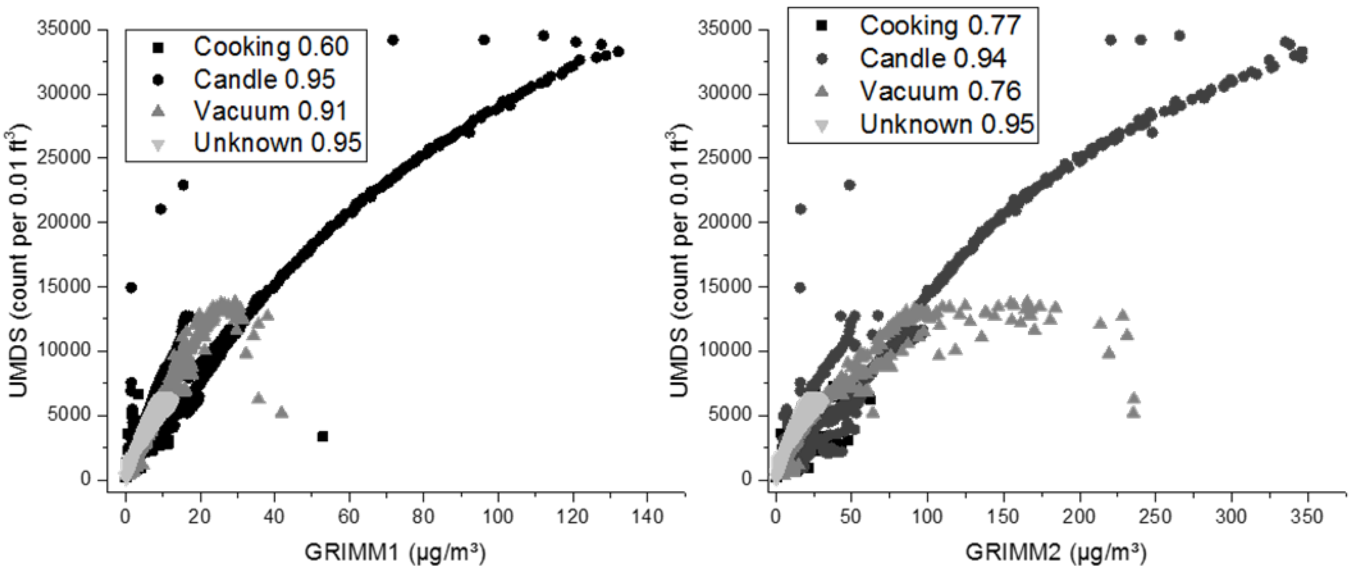
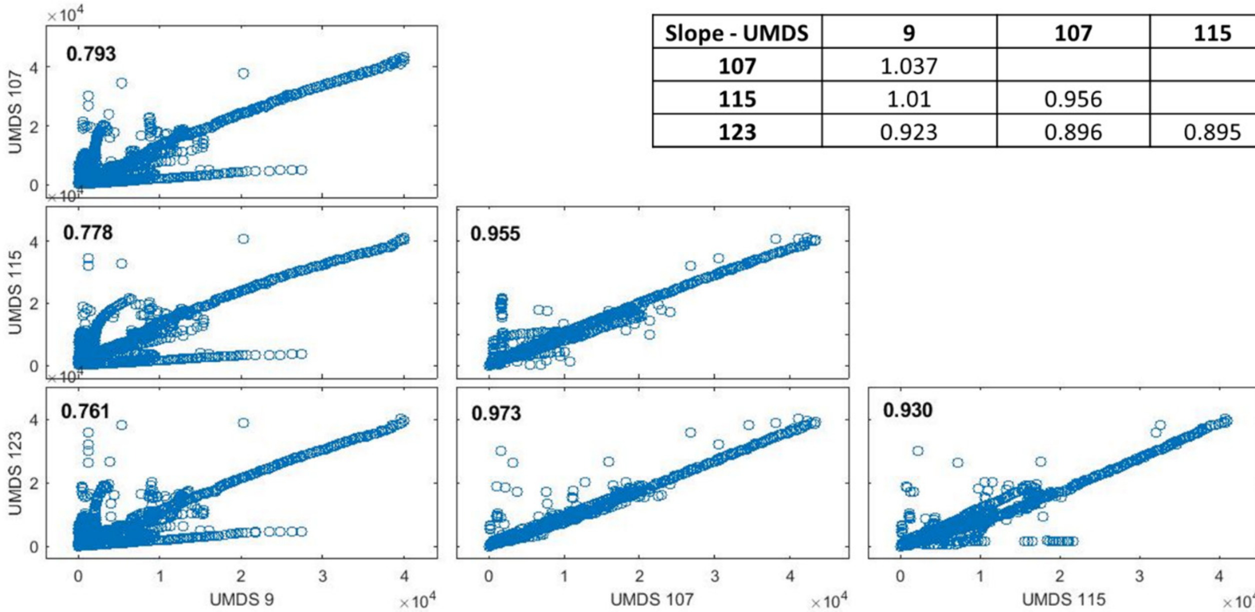


Fig. S7. Scatter plots and coefficients of determination (R^2) from the linear regression (UMDS and GRIMMs) for 5-minute rolling average of $PM_{2.5}$ concentrations (µg/m^3) measured with 2 GRIMMs (uncorrected) and the average of 4 UMDS, uncorrected ($PM_{2.5}$ count, small minus large bins, per 0.01 ft^3) during 15th – 21st October, 2016 (home II).



Slope - UMDS	9	107	115
107	1.037		
115	1.01	0.956	
123	0.923	0.896	0.895

Fig. S8. Scatter plots and coefficients of determination (R^2) from the linear regression for 1-minute UMDS $PM_{2.5}$ count (small minus large bin, per 0.01 ft^3) during 15^{th} – 21^{st} October, 2016 (home II). The top right corner of the figure shows the slopes of linear regression of the fitted model (columns are the x-axes).

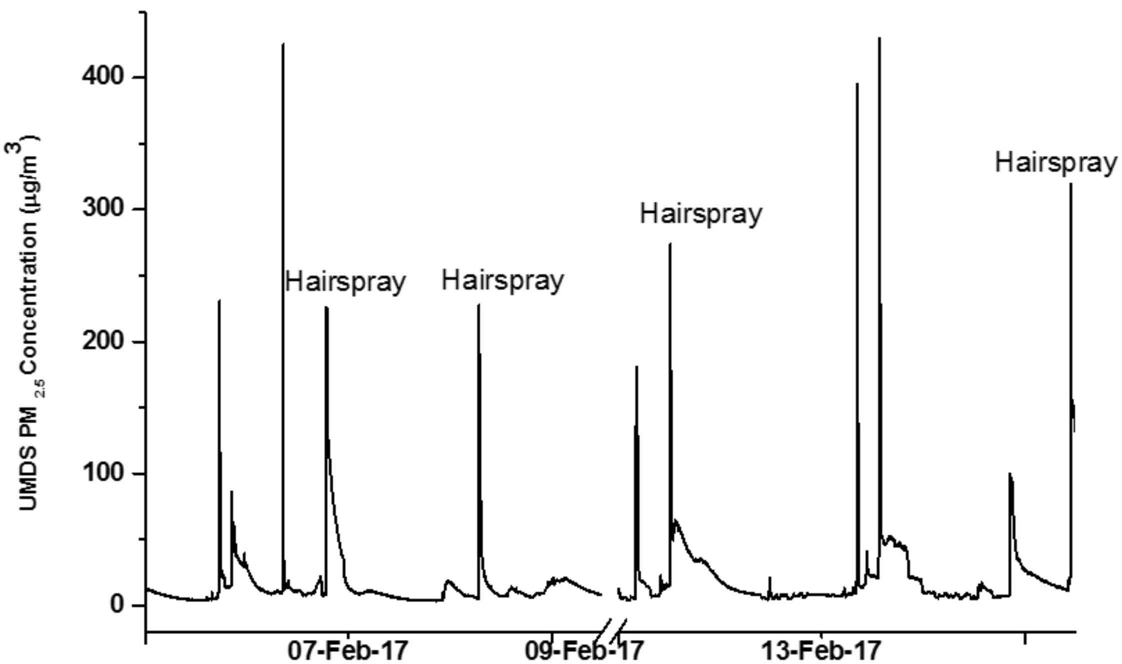


Fig. S9. $PM_{2.5}$ levels in the bathroom when using a hairspray product (home II) as measured by a UMDS sensor bias corrected with a CF from the calibration week (Table S4-b).

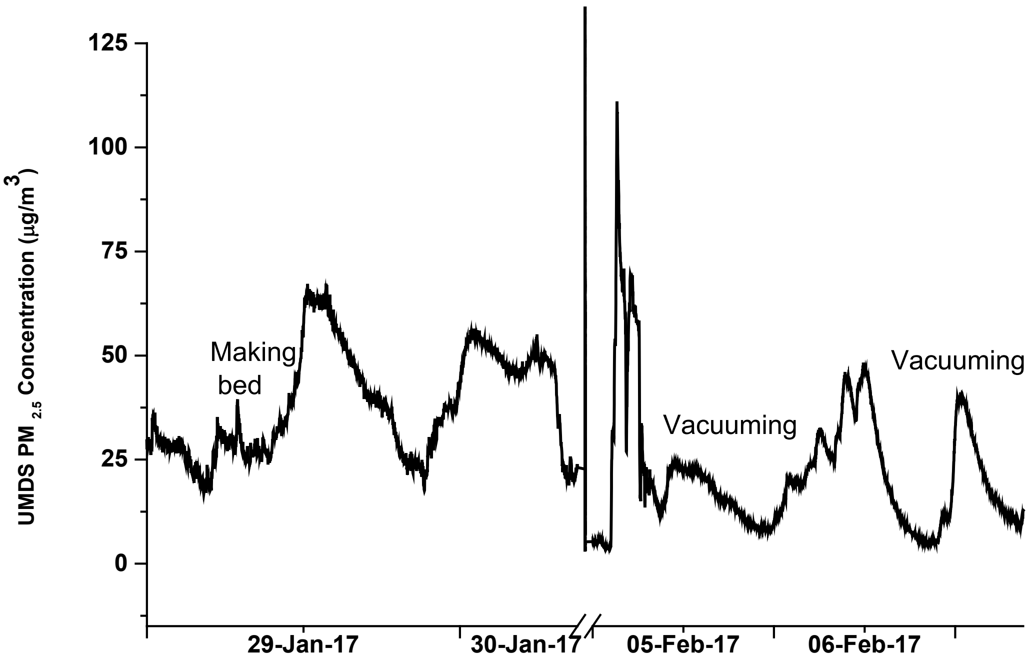


Fig. S10. $PM_{2.5}$ levels in the bedroom during cleaning activities (home II) as measured by a UMDS sensor bias corrected with a CF from the calibration week (Table S4-b).

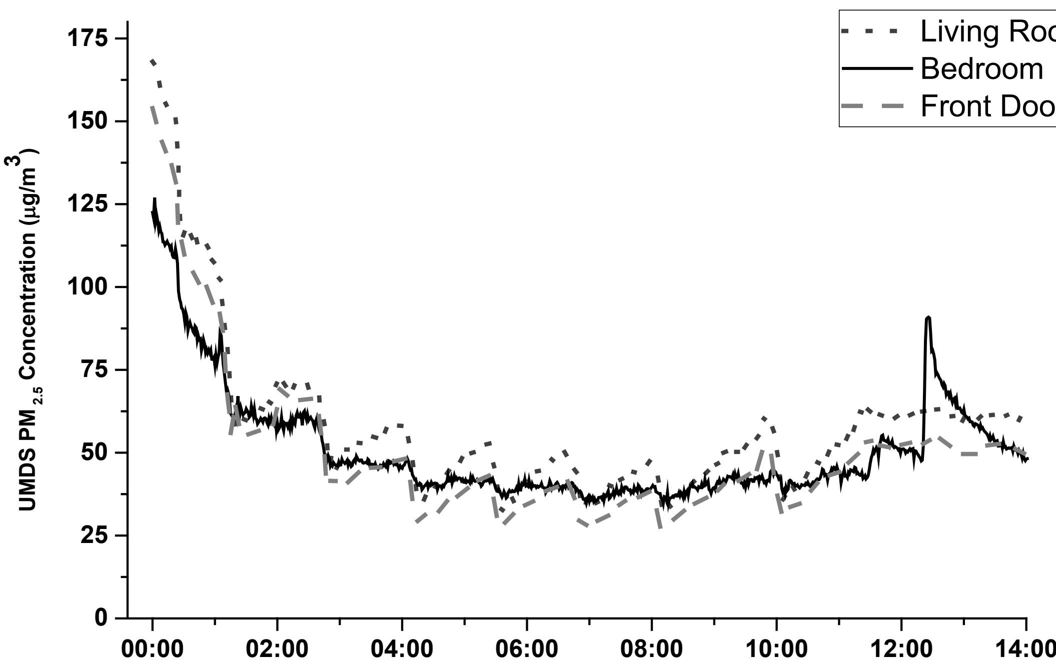


Fig. S11. Change in $PM_{2.5}$ levels caused by the furnace (30th January, 2017) (home II). Sensors were individually bias corrected with a CF from the calibration week (Table S4-b).

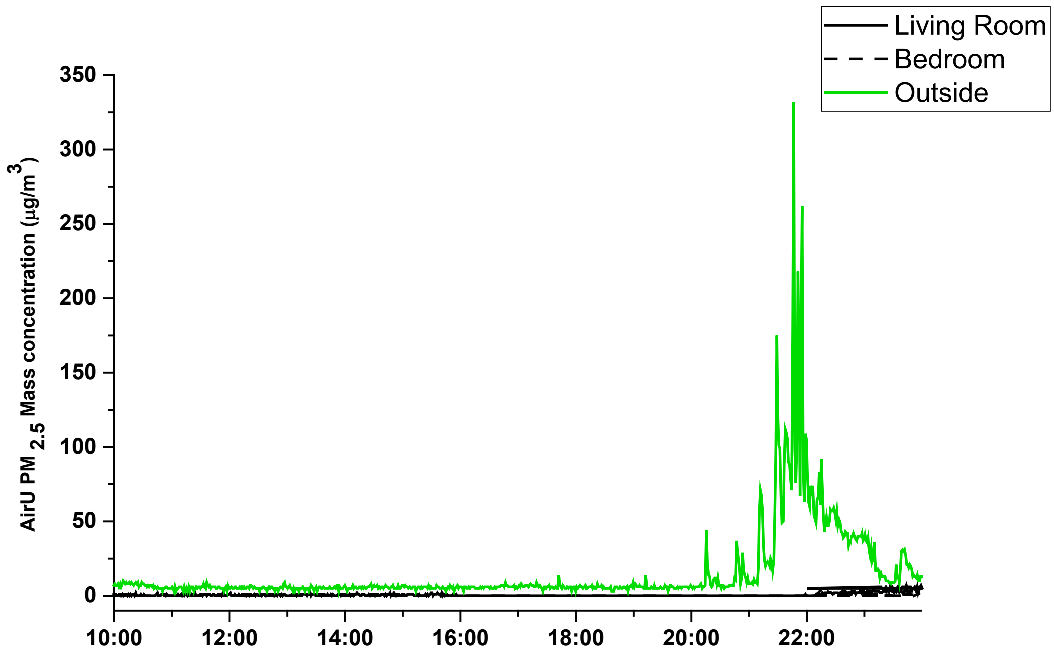


Fig. S12. Outdoor and indoor $PM_{2.5}$ levels as measured by the AirU sensor on the 4th of July, 2016 (home I). Sensors were individually bias corrected with a CF from the calibration week (Table S4-a).

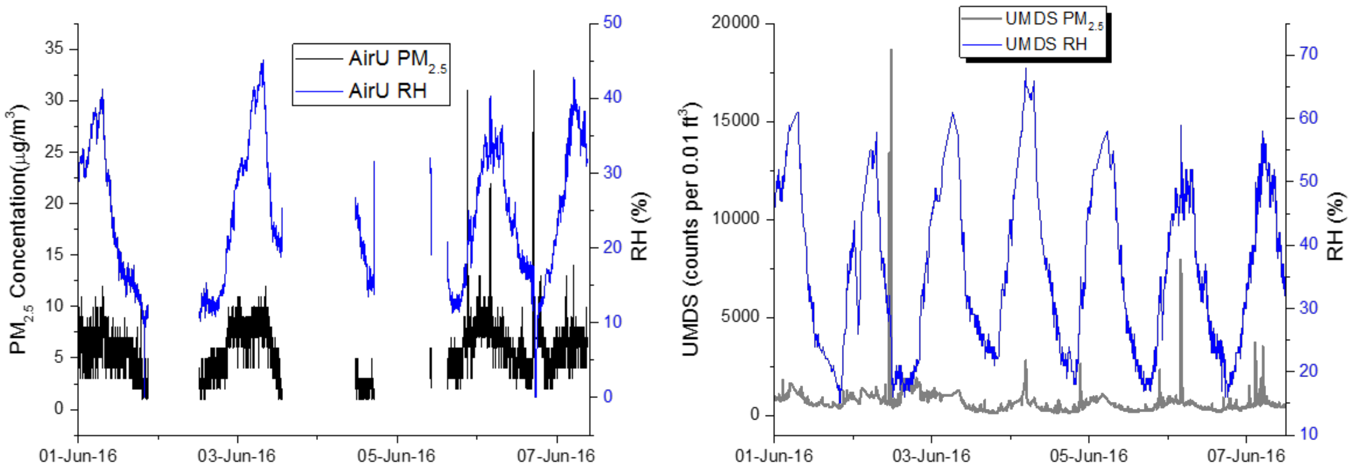


Fig. S13. Comparison of $PM_{2.5}$ concentrations from the AirU and UMDS sensors with relative humidity (RH) measured by the respective sensors (home I). The UMDS and the AirU were located within 0.5 m of each other. Although the exact RH measurements from the two sensors do not agree with each other, the trends are consistent with high-quality RH measurements (from MesoWest, 2018 and Weather Underground, 2018) in the vicinity. The gaps in the left panel indicate the missing data from the AirU.

REFERENCES

MesoWest, 2018. MesoWest Data. URL http://mesowest.utah.edu/ (accessed 4.9.18).

Weather Underground (www.wunderground.com), 2018. Salt Lake City, UT Forecast. URL https://www.wunderground.com/weather/us/ut/salt-lake-city (accessed 4.9.18).