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Development and application of a United States-wide correction for $PM_{2.5}$ data collected with the PurpleAir sensor

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1 Performance statistics equations

$$\text{RMSE} = \sqrt{\frac{1}{N}\sum_{d=1}^{N}(x_d - R_d)^2}$$

Eq. S1

$$\text{MBE} = \frac{1}{N}\sum_{d=1}^{N}(x_d) - \frac{1}{N}\sum_{d=1}^{N}(R_d)$$

Eq. S2

$$\text{MAE} = \frac{1}{N}\sum_{d=1}^{N}\text{abs}(x_d - R_d)$$

Eq. S3

where:

RMSE = root mean square error (μg m^{-3})

MBE= mean bias error (μg m^{-3})

MAE= mean absolute error (μg m^{-3})

M = number of identical sensors operated simultaneously during a field test

N = number of 24-hour periods during which all identical instruments are operating and returning valid averages over the duration of the field test

x_d = valid 24-hour averaged sensor $PM_{2.5}$ concentration for day *d* (μg/m^3)

R_d = valid 24-hour averaged FRM or FEM $PM_{2.5}$ concentration for day *d* (μg m^{-3})

2 Discussion of state by state performance

Uncorrected PurpleAir sensors in this work overestimate $PM_{2.5}$ in every state on average except for Florida (Figure S4); this typical overprediction is indicated by MBE greater than 0 μg m^{-3}. Figure S4 shows the state-by-state performance before and after correction. The MBE after correction is within 3 μg m^{-3} in each state with 24-hr RMSE ≤ 3.7 μg m^{-3}, showing large improvements from the initial dataset. The RMSE is reduced and the MBE moves closer to zero across all states except Alaska and Arizona where RMSE improves but MBE moves slightly further from 0 (AK MBE_{raw}=0.8 μg m^{-3}, $MBE_{corrected}$=-1.0 μg m^{-3}; AZ MBE_{raw}=0.4 μg m^{-3}, $MBE_{corrected}$=-0.5 μg m^{-3}) and Florida where correction slightly increases RMSE and increases underprediction (MBE_{raw}=-0.3 μg m^{-3}, $MBE_{corrected}$=-3.7 μg m^{-3}). It is important to note that the reported performance may not accurately summarize state-wide performance in states with less than a year of data (indicated in Figure S4 by states with white background labels) and in states with a single PurpleAir collocated at a single site. To illustrate, Florida is represented by a single PurpleAir sensor located at a single site for less than a year; the performance in Florida may be influenced by a different aerosol composition in Sarasota, Florida (e.g., higher sea salt contribution) or may be an issue unique to the FEM and PurpleAir running at the site.

3 Importance of QC procedures

We apply the final correction and consider the error with and without the QC procedures. There are limitations to this method since we are looking at the error after building a model based on the full dataset. However, these methods provide us with easily interpretable results. Future work could use sensitivity analysis to explore the importance of QC procedures and the most appropriate values (e.g. 90% completeness, 61% difference between channels) in greater detail.

We apply the selected correction to the data without excluding any times where the A and B channels disagree and do not take into account the number of points that are going into each daily average (i.e. completeness), we can begin to understand the importance of these criteria (Table S7). Using only the A or B channels, the RMSE is 87 and 161 µg m^{-3} respectively between the channel $PM_{2.5}$ data and the FRM or FEM data; there is no correlation between the A or B channel data and the FRM or FEM. Averaging the two channels slightly improves the comparison (RMSE=92 µg m^{-3}). Using the AB comparison and excluding points where they are different by 5 µg m^{-3} and 60% shows a large improvement in performance (RMSE A=4 µg m^{-3}, B=3 µg m^{-3}, AB_{avg}=4 µg m^{-3}) with a slight improvement in the worse performing channel when the two channels are averaged. We are unaware of a reason why the A and B sensors should respond differently so this is likely a random difference between the sensors in the A group and the B group. If we also add the 90% completeness criteria to the AB channel exclusion, we see a slight improvement in RMSE (RMSE=3 µg m^{-3}). In this work, we also excluded three PurpleAir sensors because there was overall poor agreement between the A and B channels even after excluding individual data points. When we exclude these three sensors, the overall performance changes very little (RMSE=3 µg m^{-3}).

Table S1. Details for each AQS site as reported in AQS.

AQS ID	Latitude	Longitude	Land use type	Location setting	Measurement scale	Network
02-090-0034	64.84569	-147.727	Commercial	Urban and center city	Neighborhood	CSN supplemental, NCORE
04-013-0019	33.48385	-112.143	Residential	Suburban	Neighborhood	
04-013-1004	33.56033	-112.066	Residential	Suburban	Neighborhood	
04-013-9812	33.4265	-112.118	Commercial	Urban and center city	Neighborhood	
06-067-0010	38.56844	-121.493	Residential	Urban and center city	Neighborhood	CSN supplemental
06-111-0007	34.21017	-118.871	Residential	Suburban	Neighborhood	
06-083-0011	34.42778	-119.691	Residential	Urban and center city	Neighborhood	
06-071-0306	34.51098	-117.326	Residential	Suburban	Neighborhood	
06-083-1008	34.94287	-120.436	Commercial	Urban and center city	Neighborhood	
06-111-2002	34.27632	-118.684	Residential	Suburban	Neighborhood	
06-083-2004	34.63782	-120.458	Commercial	Urban and center city	Neighborhood	
06-079-2007	35.04673	-120.588	Industrial	Rural	Neighborhood	
06-083-2011	34.44551	-119.828	Residential	Suburban	Urban scale	
06-111-3001	34.25239	-119.143	Residential	Rural	Neighborhood	
06-079-8002	35.49453	-120.666	Commercial	Suburban	Neighborhood, urban scale	
06-037-9033	34.67139	-118.131	Commercial	Urban and center city	Neighborhood	
08-031-0026	39.77949	-105.005	Residential	Urban and center city	Neighborhood	CSN STN, NCORE, proposed NCORE
10-003-2004	39.73944	-75.5581	Commercial	Urban and center city	Neighborhood	CSN supplemental, NCORE
12-115-0013	27.29056	-82.5072	Residential	Urban and center city	Neighborhood	
13-089-0002	33.6878	-84.2905	Residential	Suburban	Neighborhood	CSN STN, IMPROVE, NCORE, proposed NCORE
19-163-0015	41.53001	-90.5876	Residential	Urban and center city	Neighborhood	CSN supplemental, NCORE, proposed NCORE
19-163-0020	41.51208	-90.6240	Residential	Urban and center city	Neighborhood	
19-153-0030	41.60316	-93.6431	Commercial	Urban and center city	Neighborhood	
19-113-0040	41.97677	-91.6877	Residential	Urban and center city	Neighborhood	
19-103-2001	41.65723	-91.5035	Residential	Urban and center city	Neighborhood	
20-177-0013	39.02427	-95.7113	Residential	Urban and center city	Neighborhood	
30-063-0024	46.84218	-114.021	Residential	Suburban	Neighborhood	
37-067-0022	36.11069	-80.2264	Residential	Urban and center city	Neighborhood	CSN supplemental
40-109-1037	35.61413	-97.4751	Residential	Suburban	Urban scale	CSN supplemental
40-115-9007	36.9857	-94.8393	Residential	Rural	Neighborhood	

50-021-0002	43.60806	-72.9828	Commercial	Urban and center city	Neighborhood	
51-087-0014	37.55652	-77.4003	Residential	Suburban	Neighborhood	CSNSTN, NATTS, NCORE
53-033-0057	47.55975	-122.338	Industrial	Suburban	Neighborhood	CSN supplemental
53-061-1007	48.05432	-122.172	Residential	Suburban	Neighborhood	CSN supplemental
53-061-0005	47.8064	-122.317	Commercial	Suburban	Neighborhood	
55-087-0009	44.30738	-88.3952	Residential	Suburban	Urban scale	
55-079-0026	35.61413	-97.4751	Commercial	Urban and center city	Neighborhood, urban scale	
55-133-0027	43.02008	-88.2151	Residential	Urban and center city	Middle scale, neighborhood	
55-025-0041	43.10084	-89.3573	Commercial	Urban and center city	Urban scale	

Table S2. Details for each individual sensor summarized as median (min, max).

PA ID	PA name (not included for private sensors)	AQS site	Start Date	End Date	# of Days	FEM or FRM	FEM or FRM $PM_{2.5}$ ($\mu g\ m^{-3}$)	PA $PM_{2.5}$ ($\mu g\ m^{-3}$)	PA T (^oC)	PA RH (%)
DE1	Private	10-030-2004	7/27/2019	11/18/2019	205	both	7 (1,17)	9 (1,35)	25 (6,35)	51 (34,75)
AK2	Ncore 2	02-090-0034	11/7/2018	1/12/2019	54	FRM	12 (2,32)	10 (1,28)	-4 (-25,2)	53 (37,59)
AK4	Ncore 3	02-090-0034	1/15/2019	6/16/2019	189	FRM	4 (0,35)	4 (0,37)	6 (-20,24)	46 (22,71)
AK1	ADEC 1	02-090-0034	5/15/2019	9/30/2019	126	FRM	4 (0,60)	4 (0,131)	18 (7,29)	46 (21,76)
AZ4	Private	04-013-0019	11/9/2018	12/31/2019	435	both	7 (2,43)	5 (1,74)	26 (9,44)	25 (5,67)
AZ1	Private	04-013-1004	11/30/2018	2/18/2019	76	FEM	9 (2,26)	14 (1,43)	17 (10,22)	36 (22,65)
AZ3	Private	04-013-9812	11/9/2018	12/31/2019	384	FEM	8 (1,28)	5 (0,50)	25 (9,44)	26 (6,73)
CA10	MDAQMD_LAN1	06-037-9033	4/25/2018	7/25/2019	393	FEM	7 (-1,40)	6 (0,73)	25 (6,39)	21 (4,63)
CA1	AMTS_TESTINGA	06-067-0010	5/20/2018	12/29/2019	161	FRM	6 (1,109)	6 (0,250)	22 (9,36)	45 (23,77)
CA13	MDAQMD_VV1	06-071-0306	3/22/2018	7/24/2019	619	FEM	8 (1,33)	7 (0,73)	28 (6,42)	17 (4,56)
CA15	SCNP_21	06-079-2007	6/2/2018	1/4/2019	183	FEM	7 (-2,47)	9 (1,66)	18 (12,25)	66 (35,100)
CA2	Atascadero	06-079-8002	11/29/2017	10/23/2019	659	FEM	5 (-2,34)	5 (0,69)	19 (6,34)	48 (16,79)
CA16	SCPR_19	06-079-8002	5/2/2018	8/14/2018	105	FEM	6 (-1,19)	7 (2,17)	19 (16,26)	60 (42,65)
CA5	CARB_Smoke_SB CAPCD_Santa Barbara	06-083-0011	1/31/2019	10/30/2019	246	FEM	7 (1,23)	9 (1,25)	22 (11,29)	56 (26,74)
CA6	CARB_Smoke_SB CAPCD_Santa Maria	06-083-1008	1/31/2019	4/29/2019	86	FEM	4 (1,15)	4 (0,21)	18 (7,23)	54 (34,68)
CA4	CARB_Smoke_SB CAPCD_Lompoc	06-083-2004	11/15/2018	10/29/2019	282	FEM	4 (-2,30)	7 (1,69)	20 (12,29)	55 (22,78)
CA3	CARB_Smoke_SB CAPCD_Goleta	06-083-2011	1/24/2019	10/29/2019	265	FEM	5 (0,14)	8 (1,27)	22 (6,29)	55 (24,77)
CA19	VCAPCD_TO	06-111-0007	4/30/2019	10/29/2019	152	FEM	9 (2,15)	12 (1,28)	25 (17,32)	45 (3,60)
CA18	VCAPCD_SV	06-111-2002	11/9/2018	10/29/2019	398	FEM	9 (0,23)	10 (0,39)	25 (12,35)	37 (2,69)
CA17	VCAPCD_ER	06-111-3001	10/26/2018	10/29/2019	213	FEM	6 (0,24)	7 (0,47)	19 (11,30)	54 (8,72)
CO1	Private	08-031-0026	8/22/2019	11/18/2019	113	both	7 (2,25)	6 (1,45)	18 (-5,32)	33 (18,70)
FL1	SCG Air & Water Quality_EPA Air Sensor	12-115-0013	5/31/2019	9/30/2019	119	FEM	6 (3,17)	5 (1,25)	32 (29,35)	60 (49,73)
GA1	Private	13-089-0002	8/2/2019	11/18/2019	184	both	9 (3,18)	15 (5,34)	29 (5,36)	55 (44,77)

IA8	Private	19-103-2001	1/1/2019	1/13/2020	1031	both	7 (1,31)	11 (1,54)	11 (-21,34)	56 (28,80)
IA9	Private	19-103-2001	1/1/2019	1/13/2020	1028	both	7 (1,31)	11 (1,58)	11 (-20,35)	57 (29,100)
IA1	Private	19-113-0040	4/27/2018	1/13/2020	1865	both	7 (-1,28)	12 (0,56)	18 (-21,36)	47 (20,68)
IA2	Private	19-113-0040	5/5/2018	1/13/2020	1827	both	7 (-1,28)	11 (0,50)	17 (-23,35)	51 (26,71)
IA3	Private	19-153-0030	9/26/2017	1/13/2020	2473	both	6 (-1,27)	10 (0,63)	11 (-23,36)	55 (25,100)
IA4	Private	19-153-0030	2/2/2019	1/13/2020	999	both	6 (0,27)	10 (1,53)	16 (-13,36)	56 (30,82)
IA10	Private	19-163-0015	1/1/2019	6/14/2019	481	both	8 (1,29)	16 (2,64)	10 (-26,29)	57 (33,79)
IA11	Private	19-163-0015	1/1/2019	1/13/2020	1005	both	8 (1,36)	13 (1,69)	14 (-27,34)	53 (24,77)
IA12	Private	19-163-0020	5/29/2019	12/31/2019	198	FRM	7 (2,31)	11 (1,64)	22 (-7,34)	59 (42,85)
KS1	PAKNI_65	20-177-0013	3/13/2019	9/30/2019	124	FEM	9 (2,33)	11 (0,49)	25 (10,34)	53 (30,71)
KS2	PAKNI_B5	20-177-0013	3/13/2019	9/30/2019	111	FEM	8 (3,33)	11 (1,49)	25 (11,33)	53 (30,70)
KS3	PAKNI_E2	20-177-0013	3/13/2019	9/28/2019	71	FEM	9 (3,33)	10 (1,50)	22 (9,33)	51 (31,70)
MT1	EPA 92B4	30-063-0024	12/3/2019	12/10/2019	8	FEM	10 (5,15)	22 (6,36)	4 (2,6)	54 (42,62)
NC4	Clean Air Carolina Forsyth County	37-067-0022	3/25/2018	10/24/2019	700	both	7 (0,20)	13 (1,43)	25 (-1,35)	48 (16,79)
OK1	Private	40-109-1037	8/3/2019	11/18/2019	120	both	10 (4,23)	10 (1,32)	30 (1,38)	51 (29,78)
OK3	Quapaw Picher_Netta	40-115-9007	7/10/2019	9/30/2019	70	FEM	8 (1,25)	14 (1,35)	30 (24,33)	64 (53,86)
VT1	Rutland Courthouse	50-021-0002	3/30/2019	9/30/2019	146	both	6 (2,18)	8 (1,31)	24 (12,34)	52 (36,71)
VA1	East Henrico	51-087-0014	10/27/2019	12/29/2019	30	FRM	5 (2,20)	10 (2,41)	12 (8,25)	48 (35,65)
WA1	Duwamish	53-033-0057	10/16/2017	10/28/2019	561	FEM	7 (1,35)	8 (1,80)	14 (-1,30)	59 (26,81)
WA2	Lynnwood	53-061-0005	12/4/2017	8/6/2018	235	FEM	3 (1,26)	6 (0,89)	12 (1,27)	64 (35,84)
WA3	Marysville 7th	53-061-1007	10/25/2018	9/25/2019	239	FEM	7 (0,41)	9 (1,81)	12 (-2,23)	67 (36,81)
WI4	Private	55-025-0041	1/19/2019	10/24/2019	185	both	6 (2,32)	9 (1,58)	-142 (-142,9)	47 (35,63)
WI5	Private	55-025-0041	5/5/2019	5/7/2019	3	FEM	5 (3,7)	7 (3,9)	16 (14,18)	55 (41,56)
WI1	Private	55-079-0026	7/24/2019	11/18/2019	115	FEM	7 (2,21)	10 (1,50)	22 (-6,33)	57 (37,82)
WI2	Private	55-087-0009	1/6/2019	10/24/2019	450	FEM	6 (1,30)	9 (1,64)	19 (-18,32)	55 (31,78)
WI3	Private	55-087-0009	3/30/2019	4/4/2019	12	FEM	5 (3,11)	5 (2,23)	5 (1,7)	42 (35,63)
WI6	Private	55-133-0027	1/1/2019	3/27/2019	46	both	10 (4,25)	15 (3,55)	0 (-21,11)	54 (34,72)

Table S3. FRM comparability by collecting agency

State	AQS	Organization	FRM/FRM precision: organization comparison (goal ≤10%)	FRM/FRM bias: organization comparison (goal ≤10%)	Field blank avg (µg)	monthly precision (+/-)
AK	02-090-0034	Alaska DEC	8%	NA	7.6	<30%
CA	06-067-0010	California Air Resources Board	8%	-6.30%	2	<15%
CO	08-031-0026	Colorado DPHE	7%	-10.5%	5	<15%
DE	10-003-2004	Delaware DNR	7%	-10.1%	2	<10%
GA	13-089-0002	Georgia Air Protection Branch	8%	-11.6%	3	<26%
IA	19-113-0040	Linn County Health Department	4.80%	-1%	5	<10%
IA	19-153-0030	Polk County Physical Planning	4%	-0.60%	4	<10%
NC	37-067-0022	Forsyth County EAD	5.10%	-11%	5	<10%
OK	40-109-1037	Oklahoma Dept. Of EQAQD	6%	-22.0%*	1	<18%
WI	55-025-0041, 55-133-0027	Wisconsin Dept Of Natural Resources, Air Monitoring Section	4.80%	1.10%	4	<10%
AZ	04-013-2019	Maricopa County Air Quality	NA	NA	NA	NA
IA	19-163-0015, 19-163-0020, 19-103-2001	Iowa DNR	NA	NA	NA	NA
VT	50-021-0002	Vermont AEC	NA	NA	0	NA

*Driven by a single point

Table S4. Available FEM comparability assessments

State	County	AQS	poc	monitor	slope	int	R	Ratio	FRM $PM_{2.5}$	Most Recent year
OK	Oklahoma	40-109-1037	3	T640	0.98	2.35	0.89	1.30	7.3	2019
IA	Johnson	19-103-2001	3	T640	1.01	1.76	0.96	1.24	7.8	2020
IA	Scott	19-163-0015	3	T640	1.02	1.5	0.95	1.21	8.0	2020
IA	Johnson	19-103-2001	4	T640	1.00	1.69	0.97	1.21	7.9	2020
CO	Denver	08-031-0026	3	T640	1.01	1.11	0.97	1.17	6.8	2019
GA	DeKalb	13-089-0002	3	T640x	0.99	1.31	0.95	1.15	8.4	2019
IA	Linn	19-113-0040	3	T640	0.91	1.91	0.98	1.15	8.0	2020
IA	Scott	19-163-0015	4	T640	0.96	1.44	0.95	1.14	8.0	2020
VT	Rutland	50-021-0002	4	T640	0.99	0.93	0.99	1.13	6.6	2019
NC	Forsyth	37-67-0022	3	T640x	0.90	1.66	0.89	1.13	7.4	2019
CA	Ventura	06-111-0007	3	BAM1020	1.18	-1.12	0.93	1.09	8.8	2014
DE	New Castle	10-3-2004	6	T640	0.94	1.17	0.97	1.09	7.7	2019
CA	Ventura	06-111-2002	3	BAM1020	1.09	-0.28	0.9	1.05	8.4	2014
WI	Milwaukee	55-079-0026	3	T640x	0.91	1.19	0.97	1.05	8.6	2018
FL	Sarasota	12-115-0013	3	T640	0.82	1.48	0.96	1.05	6.5	2018
IA	Polk	19-153-0030	3	BAM1022	1.00	0.24	0.96	1.04	7.1	2019
WI	Waukesha	55-133-0027	3	T640x	0.88	1.28	0.96	1.03	8.7	2019
WI	Dane	55-25-0041	3	T640	0.90	0.85	0.95	1.01	7.8	2019
AZ	Maricopa	04-13-0019	3	TEOM1405	1.03	-0.29	0.98	1.00	8.9	2019
CA	Ventura	06-111-3001	3	BAM1020	1.07	-0.63	0.86	1.00	8.8	2014
IA	Linn	19-113-0040	3	BAM1020	0.89	0.61	0.93	0.97	8.1	2019
IA	Linn	19-113-0040	4	BAM1020	0.86	0.77	0.93	0.96	8.3	2020
WA	Snohomish	53-061-1007	3	1405	0.96	-0.06	0.99	0.95	7.2	2012
IA	Polk	19-153-0030	4	BAM1022	0.92	0.02	0.94	0.92	7.2	2019
WI	Outagamie	55-087-0009	3	BAM1020	0.95	-0.26	0.95	0.91	6.5	2017

Table S5. FEM comparability assessments-not available

State	County	AQS	poc	monitor	Notes:
AZ	Maricopa	x4-13-9812x	3	TEOM1405	Not on list
AZ	Maricopa	x4-13-1004x	3	TEOM1405	Not on list
CA	Los Angeles	x6-37-9033x	1	BAM1020	Not on list
CA	San Bernardino	x6-71-306x	2	BAM1020	Not on list
CA	San Bernardino	x6-71-306x	1	BAM1020	Not on list
CA	San Luis Obispo	x6-79-8002x	3	BAM1020	Not on list
CA	San Luis Obispo	x6-79-2007x	1	BAM1020	Not on list
CA	Santa Barbara	x6-83-2004x	1	BAM1020	Not on list
CA	Santa Barbara	x6-83-2011x	1	BAM1020	Not on list
CA	Santa Barbara	x6-83-11x	3	BAM1020	Not on list
CA	Santa Barbara	x6-83-1008x	3	BAM1020	Not on list
CA	Ventura	x6-111-2002x	4	BAM1020	Not on list
KS	Shawnee	x20-177-13x	2	T640	Report will not generate
MT	Missoula	x30-63-24x	3	BAM1020	Not on list
OK	Ottawa	x40-115-9007x	1	T640	Not on list
WA	King	x53-33-57x	3	1405	Not on list
WA	King	x53-33-57x	5	BAM1020	Not on list
WA	Snohomish	x53-61-5x	3	TEOM1400	Not on list
WA	Snohomish	x53-61-1007x	5	BAM1020	Not on list
WI	Outagamie	x55-87-9x	3	T640	Not on list
WI	Outagamie	x55-87-9x	4	T640	Not on list

Table S6. Summary of comparison between A and B channels and AB channel averages and the FEM or FRM data. Table includes the average of the Channel A $PM_{2.5}$ data (A), mean bias error (MBE), normalized mean bias error (NMBE), slope and intercept (B=A*s+i and AB=FM*s+i), Pearson correlation (r), Spearman correlation (ρ), the number of 24-hr averages (N), and the percent of the dataset removed based on the 24-hr A B exclusion criteria (rem). Highlighted rows were removed because the A and B channels were more than 25% different on average after removing individual 24-hr averages that met the exclusion criteria.

	Before 24-hr point removal												After 24-hr point removal											
	A B compare							FEM or FRM compare					A B comparison							FEM or FRM compare					
ID	A	MBE	NMBE	s	i	r	ρ	s	i	r	ρ	N	A	MBE	NMBE	s	i	r	ρ	s	i	r	ρ	N	rem
avg	13	-3	3%	0.97	2	0.84	0.94	1.91	0	0.80	0.85	396	11	0	2%	0.99	0	0.98	0.98	1.80	-3	0.88	0.85	388	3%
med	12	0	4%	1.01	0	1.00	0.99	1.84	-3	0.90	0.88	203	12	0	4%	1.01	0	1.00	1.00	1.88	-3	0.92	0.88	194	0%
min	5	-216	-181%	-0.28	-1	-0.10	-0.06	0.03	-10	0.00	0.38	3	5	-3	-49%	0.58	-1	0.76	0.74	0.24	-10	0.38	0.43	3	0%
max	46	40	150%	2.33	31	1.00	1.00	12.54	61	0.99	1.00	2476	23	3	45%	1.26	3	1.00	1.00	3.49	8	0.99	1.00	2473	47%
AK1	10	0	-1%	0.97	0	1.00	0.99	2.24	-4	1.00	0.93	126	10	0	-1%	0.97	0	1.00	0.99	2.24	-4	1.00	0.93	126	0%
AK2	14	3	26%	1.04	3	0.51	0.69	0.62	4	0.68	0.82	71	10	-1	-7%	0.82	1	0.86	0.89	0.59	3	0.85	0.88	54	24%
AK3	8	-7	-57%	0.57	0	0.99	0.99	1.22	-4	0.95	0.93	227	5	-3	-49%	0.66	0	0.99	0.99	1.00	-4	0.95	0.92	205	10%
AK4	7	-2	-21%	0.75	1	0.99	1.00	1.29	-1	0.97	0.94	189	7	-2	-21%	0.75	1	0.99	1.00	1.29	-1	0.97	0.94	189	0%
AZ1	16	0	3%	1.01	0	1.00	0.99	1.77	-2	0.96	0.97	76	16	0	3%	1.01	0	1.00	0.99	1.77	-2	0.96	0.97	76	0%
AZ3	10	1	6%	1.02	0	1.00	1.00	1.68	-6	0.90	0.88	385	10	1	6%	1.02	0	1.00	1.00	1.68	-6	0.90	0.88	384	0%
AZ4	11	1	7%	1.06	0	1.00	1.00	1.78	-6	0.97	0.93	435	11	1	7%	1.06	0	1.00	1.00	1.78	-6	0.97	0.93	435	0%
CA1	13	-1	-10%	0.94	-1	1.00	1.00	2.36	-8	0.98	0.84	161	13	-1	-10%	0.94	-1	1.00	1.00	2.36	-8	0.98	0.84	161	0%
CA10	8	1	10%	1.08	0	1.00	1.00	1.40	-2	0.80	0.73	393	8	1	10%	1.08	0	1.00	1.00	1.40	-2	0.80	0.73	393	0%
CA13	8	1	9%	1.09	0	1.00	1.00	1.51	-5	0.80	0.77	619	8	1	9%	1.09	0	1.00	1.00	1.51	-5	0.80	0.77	619	0%
CA16	12	-1	-11%	0.93	0	1.00	0.99	1.00	4	0.69	0.59	183	12	-1	-11%	0.93	0	1.00	0.99	1.00	4	0.69	0.59	183	0%
CA18	10	0	1%	1.04	0	1.00	1.00	1.86	-3	0.91	0.86	213	10	0	1%	1.04	0	1.00	1.00	1.86	-3	0.91	0.86	213	0%
CA19	12	1	6%	1.05	0	1.00	1.00	1.74	-4	0.88	0.89	398	12	1	6%	1.05	0	1.00	1.00	1.74	-4	0.88	0.89	398	0%
CA2	8	-1	-9%	0.93	0	0.99	0.98	1.88	-2	0.86	0.75	661	8	-1	-9%	0.93	0	0.99	0.99	1.88	-2	0.86	0.76	659	0%
CA20	12	0	4%	1.07	0	1.00	1.00	1.57	-2	0.75	0.71	152	12	0	4%	1.07	0	1.00	1.00	1.57	-2	0.75	0.71	152	0%
CA3	10	2	24%	1.32	0	0.40	0.96	1.63	1	0.49	0.78	269	9	1	14%	1.07	1	0.98	0.97	1.40	1	0.76	0.78	265	1%
CA4	46	40	150%	2.33	31	0.04	0.75	0.78	23	0.02	0.64	339	9	2	23%	1.01	2	0.97	0.91	1.63	0	0.85	0.75	282	17%
CA5	9	0	4%	1.02	0	0.98	0.98	0.93	3	0.65	0.75	246	9	0	4%	1.02	0	0.98	0.98	0.93	3	0.65	0.75	246	0%
CA6	5	-1	-25%	0.93	-1	0.94	0.87	0.83	1	0.69	0.77	88	5	-1	-23%	0.95	-1	0.95	0.90	0.85	1	0.70	0.80	86	2%
CA7	8	-5	-49%	0.29	4	0.45	0.45	0.22	9	0.33	0.38	201	9	-3	-27%	0.58	2	0.76	0.75	0.24	8	0.38	0.43	129	36%

CO1	8	1	8%	1.12	0	1.00	1.00	1.97	-6	0.96	0.87	113	8	1	8%	1.12	0	1.00	1.00	1.97	-6	0.96	0.87	113	0%
DE1	11	-1	-7%	0.95	0	1.00	1.00	2.24	-5	0.92	0.92	205	11	-1	-7%	0.95	0	1.00	1.00	2.24	-5	0.92	0.92	205	0%
FL1	7	0	-4%	0.98	0	1.00	1.00	0.99	0	0.69	0.81	119	7	0	-4%	0.98	0	1.00	1.00	0.99	0	0.69	0.81	119	0%
GA1	16	1	8%	0.78	5	0.90	0.85	1.98	-2	0.91	0.88	200	16	1	4%	0.85	3	0.94	0.93	2.10	-3	0.92	0.90	184	8%
IA1	14	1	6%	1.04	0	0.99	0.99	1.87	-2	0.89	0.85	1869	14	1	6%	1.05	0	0.99	0.99	1.87	-2	0.89	0.85	1865	0%
IA10	41	26	92%	1.67	15	0.12	0.97	1.71	12	0.11	0.86	493	18	3	17%	1.24	-1	0.99	0.99	2.25	-4	0.91	0.90	481	2%
IA11	17	3	18%	1.25	-1	0.99	0.99	2.23	-4	0.93	0.9	1005	17	3	18%	1.25	-1	0.99	0.99	2.23	-4	0.93	0.90	1005	0%
IA12	14	0	-1%	1.01	0	1.00	1.00	1.98	-3	0.93	0.91	198	14	0	-1%	1.01	0	1.00	1.00	1.98	-3	0.93	0.91	198	0%
IA2	13	-1	-5%	0.89	1	0.98	0.98	1.81	-1	0.89	0.85	1827	13	-1	-5%	0.89	1	0.98	0.98	1.81	-1	0.89	0.85	1827	0%
IA3	12	1	6%	1.09	0	0.98	0.99	2.14	-3	0.90	0.88	2476	12	1	6%	1.08	0	0.99	0.99	2.14	-3	0.90	0.88	2473	0%
IA4	12	1	13%	0.96	2	0.90	0.96	1.90	-2	0.90	0.88	1013	12	2	16%	1.10	1	0.96	0.97	1.88	-2	0.91	0.88	999	1%
IA8	14	1	4%	1.00	1	1.00	1.00	2.01	-4	0.93	0.9	1031	14	1	4%	1.00	1	1.00	1.00	2.01	-4	0.93	0.90	1031	0%
IA9	15	1	10%	1.12	0	0.99	0.99	1.97	-3	0.93	0.9	1028	15	1	10%	1.12	0	0.99	0.99	1.97	-3	0.93	0.90	1028	0%
KS1	12	0	1%	1.02	0	1.00	1.00	1.72	-3	0.95	0.94	124	12	0	1%	1.02	0	1.00	1.00	1.72	-3	0.95	0.94	124	0%
KS2	13	2	14%	0.99	2	0.57	0.97	1.67	-2	0.77	0.91	113	12	1	5%	1.04	0	1.00	1.00	1.74	-4	0.95	0.94	111	2%
KS3	12	0	-3%	0.98	0	1.00	1.00	1.79	-4	0.95	0.92	71	12	0	-3%	0.98	0	1.00	1.00	1.79	-4	0.95	0.92	71	0%
MT1	23	0	0%	0.99	0	1.00	1.00	3.22	-10	0.98	0.98	8	23	0	0%	0.99	0	1.00	1.00	3.22	-10	0.98	0.98	8	0%
NC4	15	1	6%	1.04	0	0.82	0.95	2.10	-3	0.85	0.92	715	14	1	4%	1.00	1	0.96	0.97	2.06	-2	0.90	0.92	700	2%
OK1	11	2	22%	1.19	1	0.90	0.87	1.36	-3	0.86	0.82	127	11	2	18%	1.26	-1	0.97	0.96	1.38	-3	0.86	0.81	120	6%
OK3	15	1	5%	1.06	0	1.00	1.00	1.19	5	0.77	0.8	70	15	1	5%	1.06	0	1.00	1.00	1.19	5	0.77	0.80	70	0%
VA1	12	0	-3%	0.97	0	1.00	1.00	2.32	-3	0.97	0.86	30	12	0	-3%	0.97	0	1.00	1.00	2.32	-3	0.97	0.86	30	0%
VT1	10	0	5%	1.03	0	1.00	1.00	2.15	-5	0.96	0.95	146	10	0	5%	1.03	0	1.00	1.00	2.15	-5	0.96	0.95	146	0%
WA1	11	0	4%	1.07	0	1.00	1.00	1.90	-4	0.92	0.85	561	11	0	4%	1.07	0	1.00	1.00	1.90	-4	0.92	0.85	561	0%
WA2	12	-216	-181%	0.00	12	0.02	0.97	12.54	61	0.09	0.8	246	12	0	-2%	0.99	0	1.00	0.99	3.49	-4	0.84	0.81	235	4%
WA3	15	-39	-112%	0.00	15	-0.03	0.94	0.03	35	0.00	0.87	243	16	-1	-5%	0.95	0	1.00	0.99	2.25	-3	0.97	0.93	239	2%
WA5	9	8	143%	-0.28	10	-0.10	-0.06	0.58	1	0.76	0.63	338	5	2	45%	0.65	3	0.89	0.74	0.71	1	0.46	0.43	179	47%
WI1	11	0	3%	1.00	0	1.00	1.00	2.11	-5	0.93	0.94	115	11	0	3%	1.00	0	1.00	1.00	2.11	-5	0.93	0.94	115	0%
WI2	13	2	19%	1.03	2	0.54	0.98	2.03	-3	0.74	0.93	454	12	1	11%	1.09	0	1.00	1.00	2.09	-4	0.95	0.95	450	1%
WI3	9	0	-5%	0.94	0	1.00	1.00	2.64	-8	0.99	0.99	12	9	0	-5%	0.94	0	1.00	1.00	2.64	-8	0.99	0.99	12	0%
WI4	11	0	-1%	0.95	0	1.00	1.00	2.24	-4	0.92	0.88	185	11	0	-1%	0.95	0	1.00	1.00	2.24	-4	0.92	0.88	185	0%
WI5	6	0	3%	1.02	0	1.00	1.00	2.04	-4	0.99	1	3	6	0	3%	1.02	0	1.00	1.00	2.04	-4	0.99	1.00	3	0%
WI6	17	0	-2%	0.96	0	0.99	0.99	2.37	-8	0.92	0.88	46	17	0	-2%	0.96	0	0.99	0.99	2.37	-8	0.92	0.88	46	0%

Table S7. Performance by data cleaning methods and corrections. Data cleaning methods include excluding 24-hr averages where <90% of measurements are available (completeness), comparison of the A and B channels where data is excluded when the A and B channels are different by both 5 µg m^{-3} and 60% (AB), and the removal of 3 sensors that had poor agreement in the A and B channel after excluding 24-hr problematic points (problem sensors, details in section 4.1). Performance is compared for the individual channels (i.e. A, B) and also as the average of the A and B channels (AB-shaded rows). Statistics include the percent mean bias error (PMBE=MBE/average FM) linear regression slope (s) and intercept (i), and Lin's concordance correlation coefficient (CCC).

QA criteria	Correction	Channels	RMSE (µg m^{-3})	MAE (µg m^{-3})	MBE (µg m^{-3})	PMBE (%)	s	i	R^2	Pearson r	Spearman ρ	CCC	N	Mean FM (µg m^{-3})	Mean PA (µg m^{-3})
None	None	AB cf_atm	155	17	16	194%	0.99	16	0	0.04	0.8	0	56541	8	24
	None	AB cf_1	99	11	10	121%	1.24	8	0.01	0.08	0.83	0.01	56541	8	18
	US	A	87	7	5	60%	0.87	6	0	0.06	0.85	0.01	55299	8	13
	US	B	161	12	8	102%	0.28	14	0	0.01	0.7	0	55299	8	16
	US	AB	92	9	7	81%	0.57	10	0	0.04	0.8	0.01	55299	8	15
	LRAPA	AB	49	5	0	2%	0.62	3	0.01	0.08	0.83	0.02	56541	8	8
	AQ&U	AB	77	9	8	104%	0.97	9	0.01	0.08	0.83	0.01	56541	8	17
	Woodsmoke (Robinson 2020)	AB	85	9	6	68%	0.55	9	0	0.04	0.80	0.01	56541	8	14
Completeness	None	AB cf_atm	64	7	6	80%	1.49	2	0.02	0.13	0.82	0.02	20721	8	14
	None	AB cf_1	43	6	5	65%	1.27	3	0.03	0.16	0.82	0.04	20721	8	13
	US	A	30	3	1	11%	0.9	2	0.03	0.16	0.86	0.06	20554	8	9
	US	B	69	4	2	20%	0.86	3	0	0.07	0.84	0.01	20554	8	9
	US	AB	38	3	1	16%	0.88	2	0.02	0.13	0.86	0.04	20554	8	9
AB	None	AB cf_atm	9	6	5	64%	1.8	-1	0.71	0.84	0.84	0.56	52108	8	13
	None	AB cf_1	9	6	5	64%	1.57	1	0.66	0.81	0.85	0.56	52108	8	13
	US	A	4	2	1	8%	1.09	0	0.71	0.84	0.87	0.81	50866	8	9
	US	B	3	2	0	-2%	1.03	0	0.74	0.86	0.86	0.84	50866	8	8
	US	AB	4	2	0	3%	1.06	0	0.73	0.86	0.87	0.84	50866	8	8
AB, completeness	None	AB cf_atm	9	6	5	67%	1.56	1	0.66	0.81	0.86	0.56	46598	8	13
	None	AB cf_1	9	6	5	67%	1.78	-1	0.71	0.84	0.85	0.56	46598	8	13
	US	A	3	2	1	6%	0.97	1	0.72	0.85	0.88	0.84	45374	8	9
	US	B	3	2	0	-3%	0.91	1	0.75	0.86	0.88	0.86	45374	8	8
	US	AB	3	2	0	2%	0.94	1	0.74	0.86	0.88	0.86	45374	8	8
	None	AB cf_atm	8	5	4	53%	1.69	-1	0.73	0.86	0.83	0.61	20293	8	12
	None	AB cf_1	7	5	4	48%	1.45	0	0.7	0.84	0.83	0.64	20293	8	12

	US	A	3	2	0	-1%	0.89	1	0.74	0.86	0.86	0.86	20126	8	8
	US	B	3	2	0	-5%	0.89	0	0.78	0.88	0.87	0.88	20126	8	7
	US	AB	3	2	0	-3%	0.89	1	0.77	0.88	0.87	0.88	20126	8	8
AB, completeness, problem sensors	LRAPA	AB	4	3	-3	-34%	0.72	-1	0.7	0.84	0.83	0.72	20293	8	5
	AQ&U	AB	6	4	4	49%	1.13	3	0.7	0.84	0.83	0.67	20293	8	12
	Woodsmoke (Robinson 2020)	AB	3	2	-1	-12%	0.80	1	0.70	0.84	0.83	0.82	20293	8	7

Table S8. Summary of the performance parameters for the full dataset correction, and corrections built and tested using leave one state out (LOSO) and leaving out 12 random weeks, leave out by date (LOBD). Spearman correlation, root mean squared error (RMSE), and mean bias error (MBE) are summarized as median (min, max).MBE for "ALL" does not improve since building a model on the full dataset and applying it will always result in an MBE of 0 whether it is a linear or more complex model.

Correction Model	Dataset	R^2 (Train dataset)	Spearman correlation (Test dataset)	RMSE (μg m^{-3}) (Test dataset)	MBE (μg m^{-3}) (Test dataset)	MAE (μg m^{-3}) (Test dataset)
0Raw	ALL		0.86	7.5	4.3	5.3
1Linear	ALL	0.78	0.86	2.9	0	2.1
2+RH	ALL	0.83	0.89	2.5	0	1.7
3+D*T	ALL	0.83	0.9	2.5	0	1.8
4+RH*T*D	ALL	0.84	0.9	2.5	0	1.7
5PM*RH	ALL	0.84	0.9	2.5	0	1.7
6PM*RH*T	ALL	0.84	0.9	2.5	0	1.7
7PM*RH*D*T	ALL	0.84	0.9	2.4	0	1.7
0Raw	LOBD		0.85 (0.59,0.94)	7.4 (4.4,12.7)	4.2 (1.4,8.8)	5.2 (3.1,9.4)
1Linear	LOBD	0.78 (0.75,0.8)	0.85 (0.59,0.94)	2.9 (2,6.1)	0 (-1.3,2.3)	2.1 (1.5,3.6)
2+RH	LOBD	0.83 (0.81,0.85)	0.89 (0.76,0.95)	2.5 (1.8,5.5)	0 (-0.9,1.3)	1.8 (1.4,3.2)
3+D*T	LOBD	0.83 (0.81,0.85)	0.89 (0.74,0.95)	2.5 (1.8,5.5)	0 (-0.9,1.3)	1.8 (1.4,3.3)
4+RH*T*D	LOBD	0.84 (0.81,0.85)	0.89 (0.76,0.95)	2.5 (1.8,5.4)	0 (-1,1.2)	1.8 (1.4,3.2)
5PM*RH	LOBD	0.84 (0.81,0.85)	0.89 (0.77,0.95)	2.5 (1.7,4.9)	0 (-0.8,1.4)	1.7 (1.3,3)
6PM*RH*T	LOBD	0.84 (0.82,0.85)	0.89 (0.77,0.95)	2.5 (1.7,4.7)	0 (-0.9,1.3)	1.7 (1.3,2.9)
7PM*RH*D*T	LOBD	0.84 (0.82,0.86)	0.89 (0.77,0.95)	2.5 (1.7,74.6)	0 (-2.8,2.8)	1.7 (1.3,6.6)
0Raw	LOSO		0.9 (0.71,0.98)	5.5 (3.2,12.9)	2.8 (-0.3,11.3)	4.1 (2.1,11.3)
1Linear	LOSO	0.78 (0.73,0.81)	0.9 (0.71,0.98)	3 (1,4.1)	-0.3 (-2.4,3.2)	2.0 (0.9,3.3)
2+RH	LOSO	0.83 (0.78,0.85)	0.92 (0.78,0.98)	2.1 (1,3.8)	-0.5 (-3,2.8)	1.6 (0.9,3.0)
3+D*T	LOSO	0.83 (0.79,0.85)	0.91 (0.76,0.98)	2.3 (1.2,3.6)	-0.5 (-2,2.5)	1.7 (1,2.6)
4+RH*T*D	LOSO	0.84 (0.79,0.85)	0.91 (0.77,0.98)	2.4 (1.1,3.6)	-0.3 (-2.7,2.5)	1.7 (0.9,2.8)
5PM*RH	LOSO	0.84 (0.79,0.86)	0.93 (0.79,0.98)	2.1 (1,3.7)	-0.5 (-2.8,2.6)	1.6 (0.8,2.8)
6PM*RH*T	LOSO	0.84 (0.79,0.86)	0.92 (0.78,0.98)	2.2 (1,3.9)	-0.4 (-2.9,2.5)	1.7 (0.9,2.9)
7PM*RH*D*T	LOSO	0.84 (0.8,0.87)	0.92 (0.77,0.98)	2.4 (1.1,10.1)	-0.3 (-3.2,2.1)	1.8 (0.9,3.3)

Table S9. Significant difference between performance statistics on the test datasets (as summarized in Table S8) summarized as significantly "improve", "worsen", or no change "—". A Shapiro test was first used to determine whether the metrics were likely normally or non-normally distributed. Most of the LOBD metrics were non-normally distributed while most of the LOSO statistics were normally distributed. Wilcoxon signed rank tests were used for the non-normally distributed comparisons while t-test (paired, 2 tailed) were run for the normally distributed metrics. For tests where results were marginal, both tests were run. We compare the raw to linear corrected metrics (0Raw: 1lin) and see significant improvement across most, next we compare the linear to additive RH model (1Lin: 2+RH) and see significant improvement across most metrics. Next, we compare the additive RH model to the 3:D*T model, it does not significantly change the LOSO metrics and improves some and worsens some of the LOBD metrics and so we determine that it is not a better model. Then we compare the additive RH (2) model to the additive T*RH*D model (4) and it does not significantly improve metrics. Then we compare the additive RH model to the multiplicative RH model (2+RH:4:PM*RH) finding no improvement in most of the LOSO metrics suggesting it is not a significantly better model. Lastly, we do the same with the additive RH model and PM*RH*T model which shows no LOSO metric improvement. In the end the additive RH model appears to provide the most significant improvement.

		0:1	1:2	2:3	2:4	2:5	5:6	5:7	4:5	1:5
LOBD	MAE	improve	improve	worsen	worse	improve	--	worsen	improve	improve
			- (t-test significant)		worsen	--	worsen	worsen		improve
	MBE	improve		worsen					improve	
	RMSE	improve	improve	--	--	improve	--	--	--	improve
	spearman	--	improve	--	--	improve	--	--	--	improve
LOSO	MAE	improve	--	--	--	improve (t-test & wilcox)	--	--	--	--
	MBE	improve	--	--	--	--	--	--	--	--
	RMSE	improve	improve (not t-test)	--	--	--	--	--	--	improve
	spearman	--	--	--	--	--	--	--	--	--

Table S10. Summary of correction parameters built and tested using leave one site out (LOSO) and leaving out 12 random weeks, leave out by date (LOBD). The results of the multiple model builds are reported as median (min, max) where i is the intercept and s_1-s_{15} are the coefficients for the increasingly complex models as defined in the 7 proposed correction equations (Section 4.1.2).

Model	withholding	i	s1	s2	s3	s4	s5	s6	s7	s8
1Linear	LOBD	-3 (-3,-3)	1.91 (1.84,1.95)							
2+RH	LOBD	-11 (-11,-10)	1.91 (1.85,1.94)	0.16 (0.16,0.17)						
3+D*T	LOBD	2 (1,3)	1.92 (1.86,1.95)	0.47 (0.39,0.51)	-0.37 (-0.4,-0.33)	-0.006 (-0.007,-0.002)				
4+RH*T*D	LOBD	-40 (-47,-32)	1.91 (1.84,1.95)	0.44 (0.37,0.51)	0.53 (0.38,0.67)	-0.37 (-0.823,-0.083)	0.021 (0.015,0.026)	-0.0249 (-0.0292,-0.0205)	-0.0151 (-0.0209,-0.003)	0.00021 (4e-05,0.00034)
5PM*RH	LOBD	-7 (-8,-4)	1.44 (1.02,1.55)	0.09 (0.04,0.11)	0.01 (0.01,0.02)					
6PM*RH*T	LOBD	-2 (-6,1)	0.87 (0.36,1.35)	0 (-0.05,0.06)	-0.25 (-0.35,-0.01)	0.019 (0.012,0.027)	0.028 (-0.003,0.044)	0.0042 (2e-04, 0.0058)	-5e-04 (-7e-04, 0)	
7PM*RH*D*T	LOBD	-3 (-48,16)	-3.4 (-7.06,4.5)	0.02 (-0.18,0.46)	-0.14 (-0.53,0.87)	-0.266 (-1.502,0.506)	0.058 (-0.02,0.095)	0.096 (-0.0805,0.1668)	0.0019 (-0.0085,0.0265)	-0.05622 (-0.18023,0.16455)
1Linear	LOSO	-3 (-3,-3)	1.91 (1.72,1.98)							
2+RH	LOSO	-11 (-11,-10)	1.91 (1.77,1.97)	0.16 (0.14,0.17)						
3+D*T	LOSO	2 (1,2)	1.92 (1.79,1.98)	0.47 (0.41,0.52)	-0.37 (-0.39,-0.29)	-0.006 (-0.007,-0.003)				
4+RH*T*D	LOSO	-40 (-46,-28)	1.91 (1.79,1.97)	0.44 (0.31,0.5)	0.53 (0.28,0.64)	-0.39 (-0.766,0.045)	0.021 (0.014,0.025)	-0.0249 (-0.0264,-0.02)	-0.0147 (-0.0224,-0.0066)	0.00021 (6e-05,0.00033)
5PM*RH	LOSO	-7 (-8,-6)	1.42 (1.24,1.52)	0.09 (0.05,0.1)	0.01 (0.01,0.01)					
6PM*RH*T	LOSO	-2 (-4,0)	0.87 (0.5,1.28)	0 (-0.04,0.04)	-0.25 (-0.33,-0.14)	0.019 (0.013,0.024)	0.028 (0.01,0.041)	0.0042 (0.0029,0.0062)	-5e-04 (-8e-04,-3e-04)	
7PM*RH*D*T	LOSO	-4 (-28,2)	-3.38 (-4.55,1.73)	0.03 (-0.06,0.27)	-0.13 (-0.27,0.51)	-0.285 (-0.905,0.154)	0.057 (0.008,0.069)	0.095 (-0.0274,0.1186)	0.002 (-0.0014,0.014)	-0.05561 (-0.13135,0.08928)

Model	withholding	s9	s10	s11	s12	s13	s14	s15
7PM*RH*D*T	LOBD	0.00594 (-0.01764, 0.01417)	0.00277 (-0.014, 0.01094)	0.00304 (-0.00143, 0.0051)	-0.00407 (-0.00592, 0.00017)	-0.00133 (-0.00261, 0.00104)	-6e-05 (-0.00021, 0.00023)	2e-05 (-2e-05, 5e-05)
7PM*RH*D*T	LOSO	0.00576 (-0.00879, 0.01465)	0.00265 (-0.00625, 0.01252)	0.00303 (0.00027, 0.00367)	-0.00406 (-0.00513, -0.00122)	-0.00133 (-0.00169, 0.00023)	-6e-05 (-0.00023, 8e-05)	2e-05 (0, 2e-05)

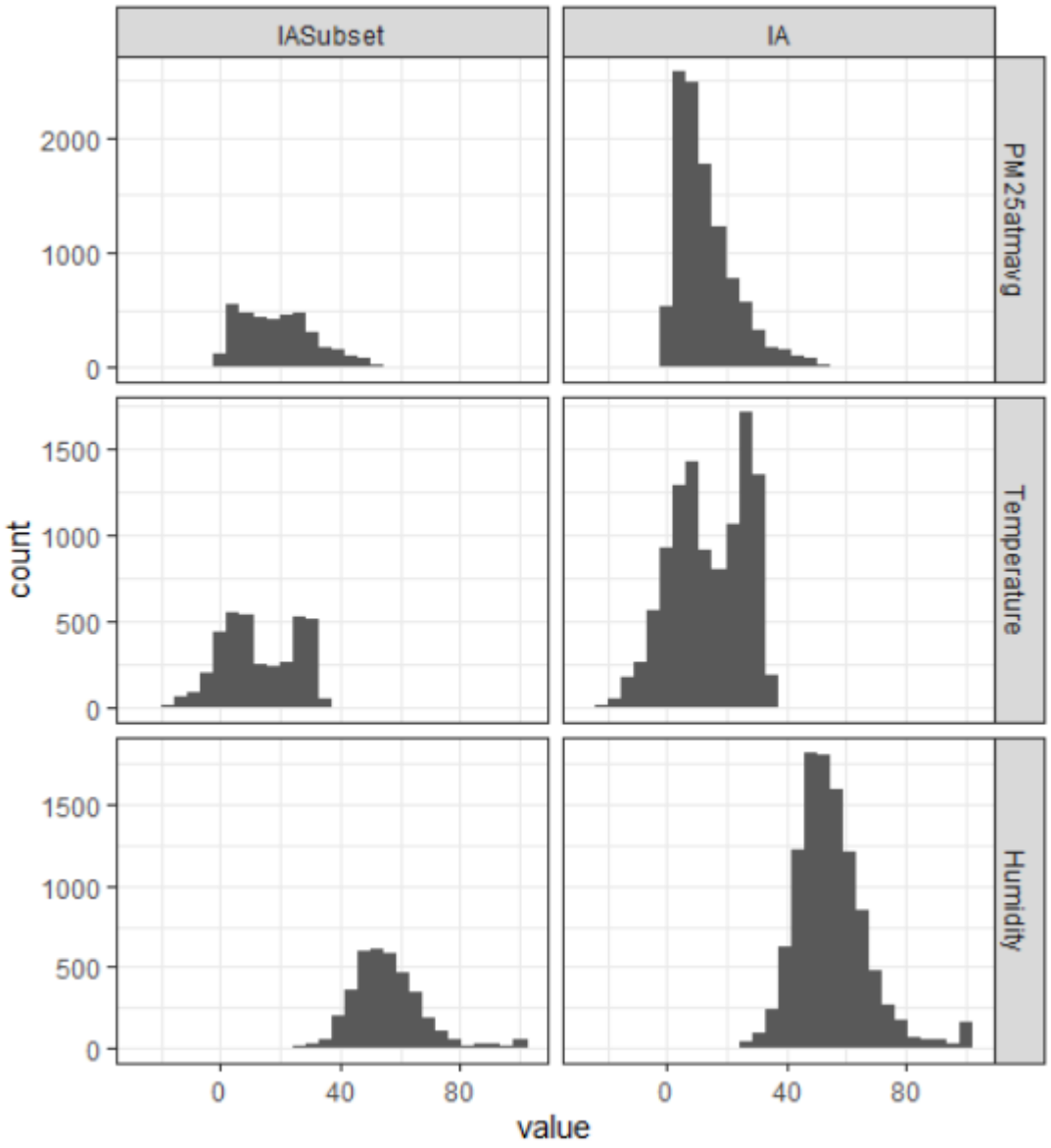

Figure S1. Distribution of subset of Iowa data used in the analysis and the full set of data from Iowa.

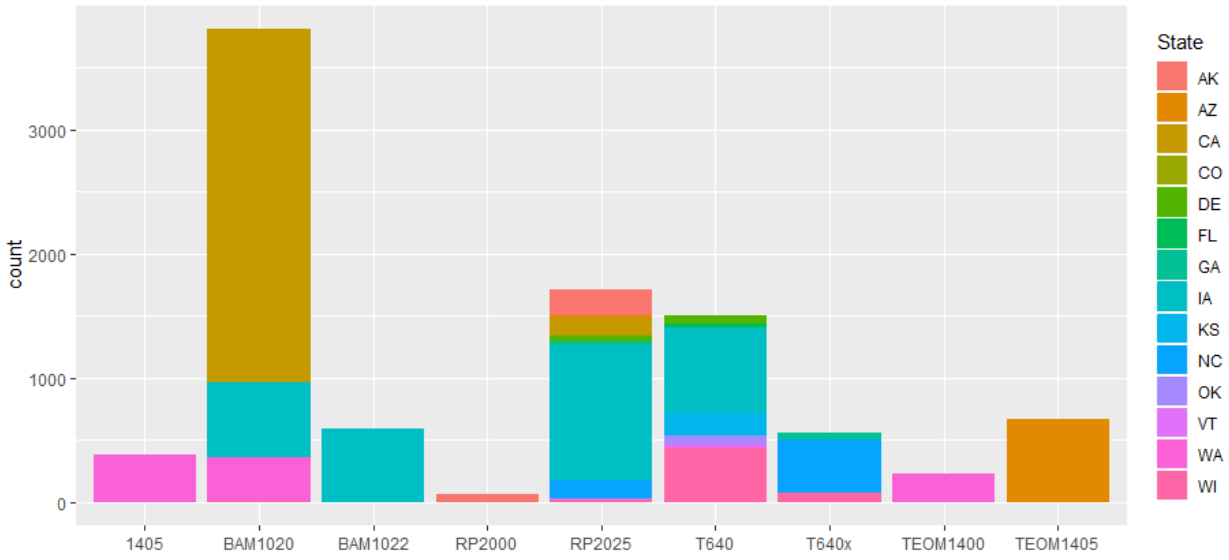

Figure S2. Frequency of FEM and FRM types (random sample from IA taken so equivalent points to CA)

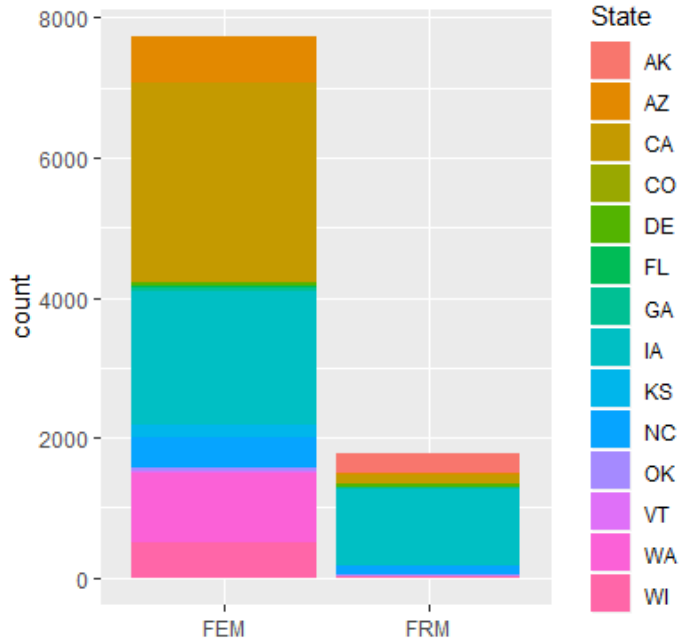

Figure S3. 24-hr paired measurements by FEM and FRM by state. (Random sample from IA taken so equivalent points to CA)

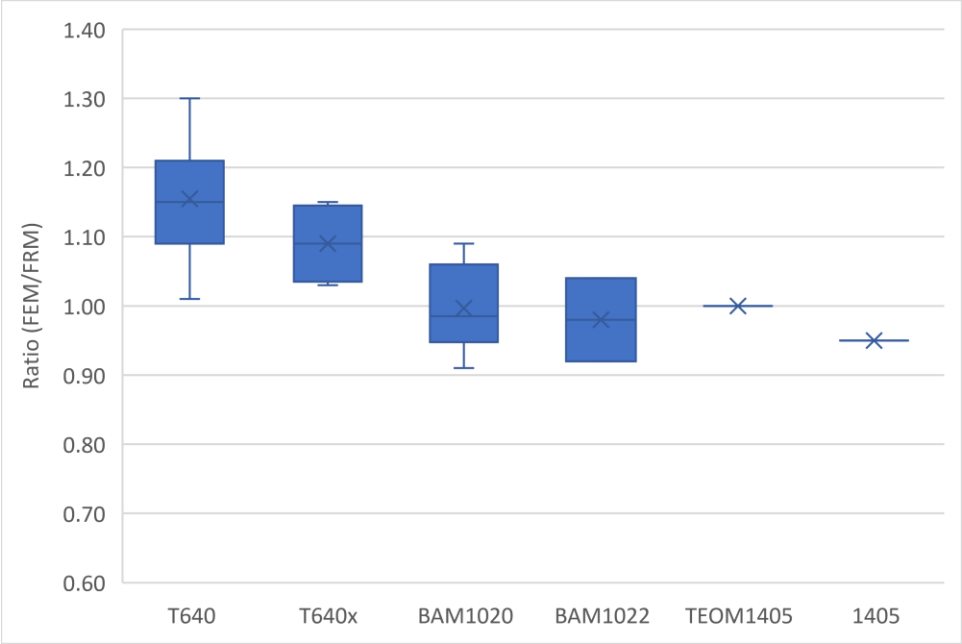

Figure S4. Ratios of FEM/FRM by monitory type included in PurpleAir correction dataset.

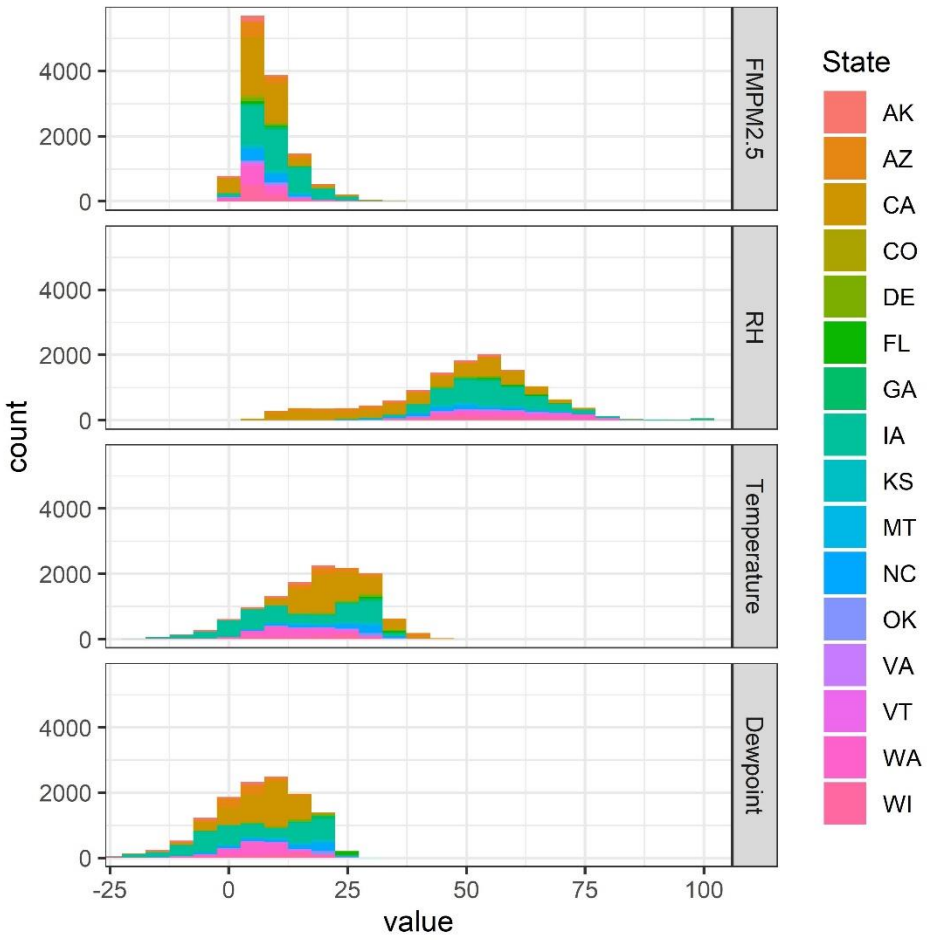

Figure S5. Distribution of full dataset after subsetting Iowa

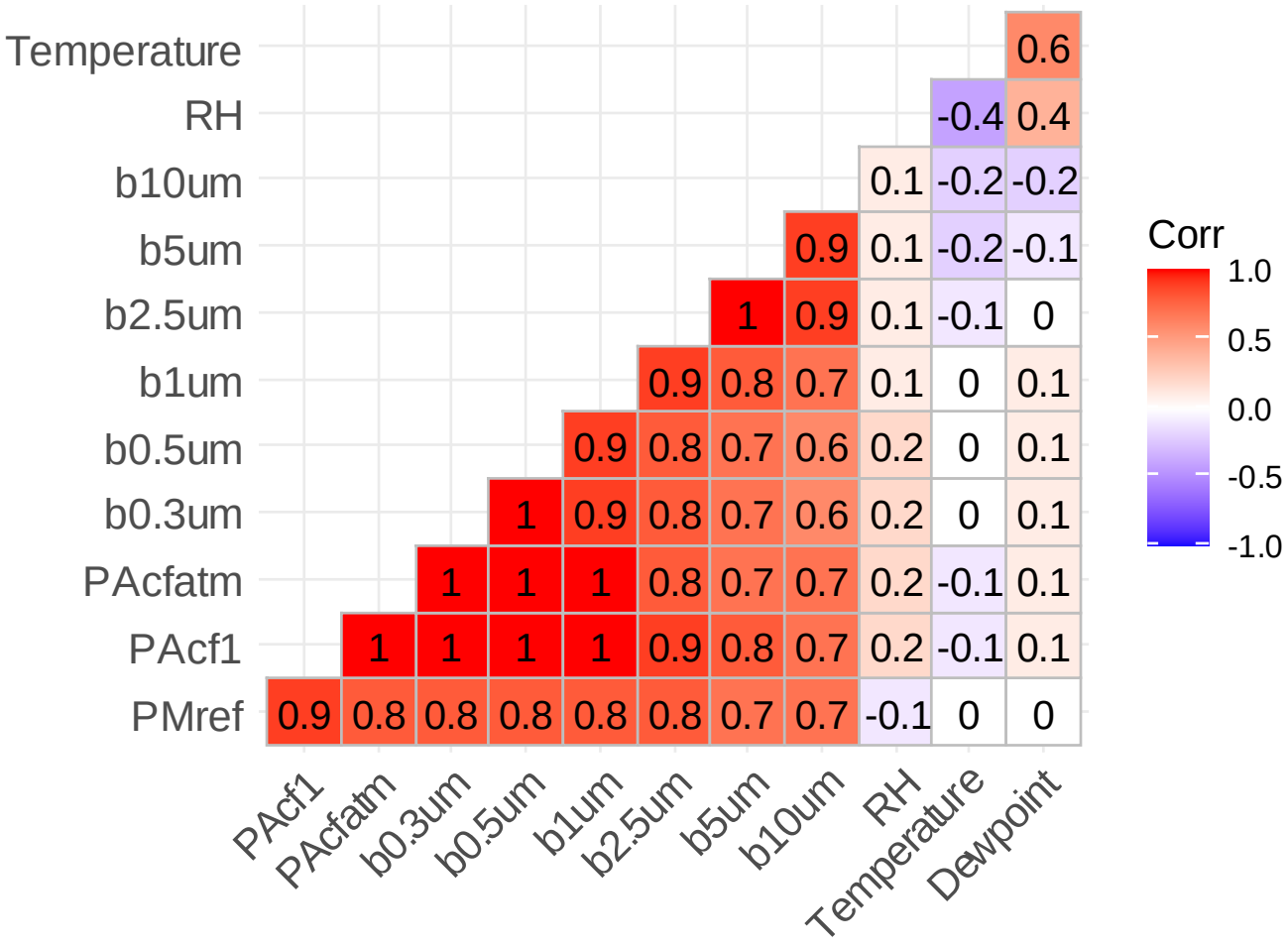

Figure S6. Correlogram showing the pearson correlation (Corr) between considered correction input variables.

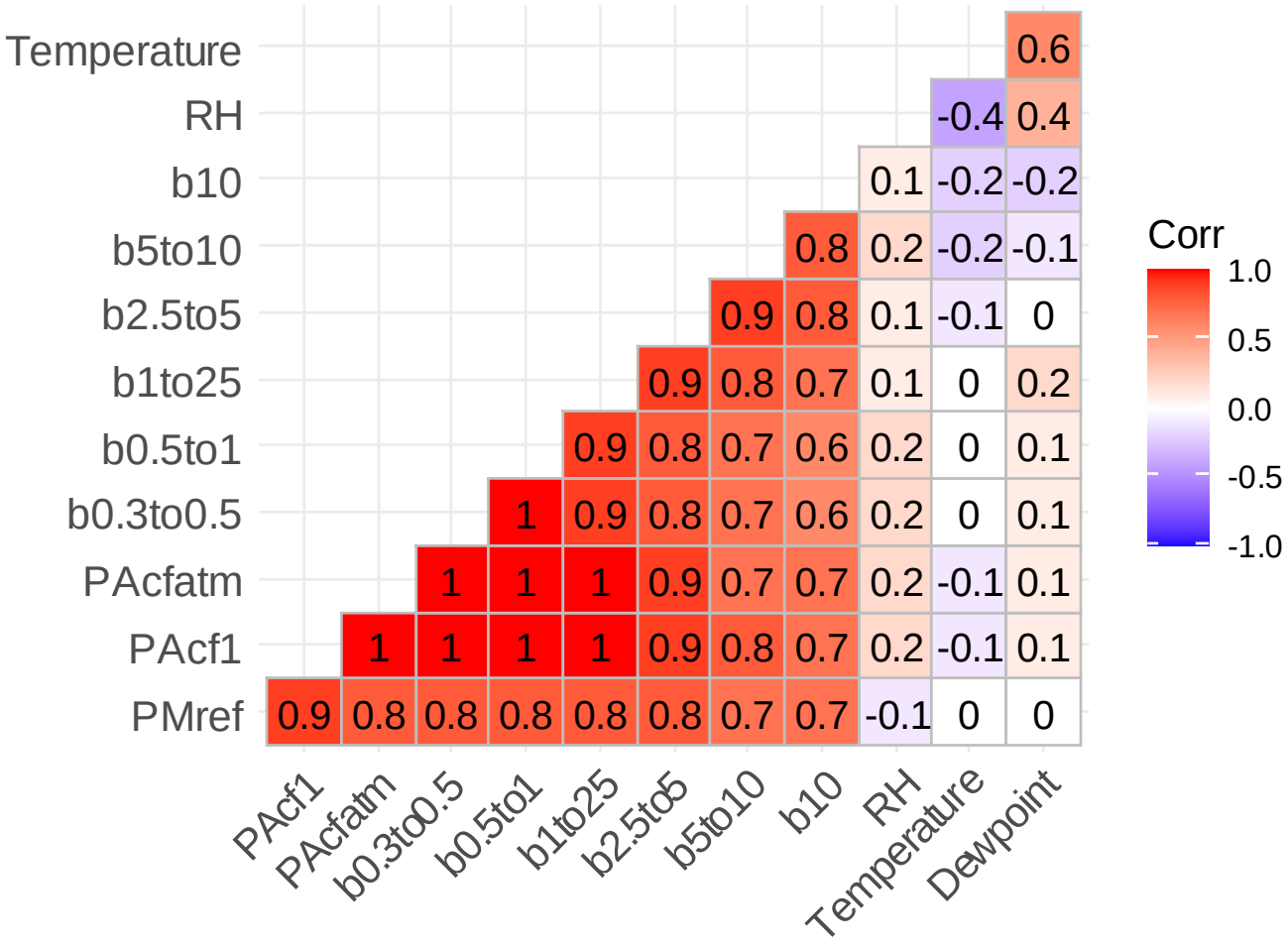

Figure S7. Correlogram showing the pearson correlation (Corr) between considered correction input variables including the difference between bins (e.g. b0.3to0.5 = bin<0.3 - bin<0.5).

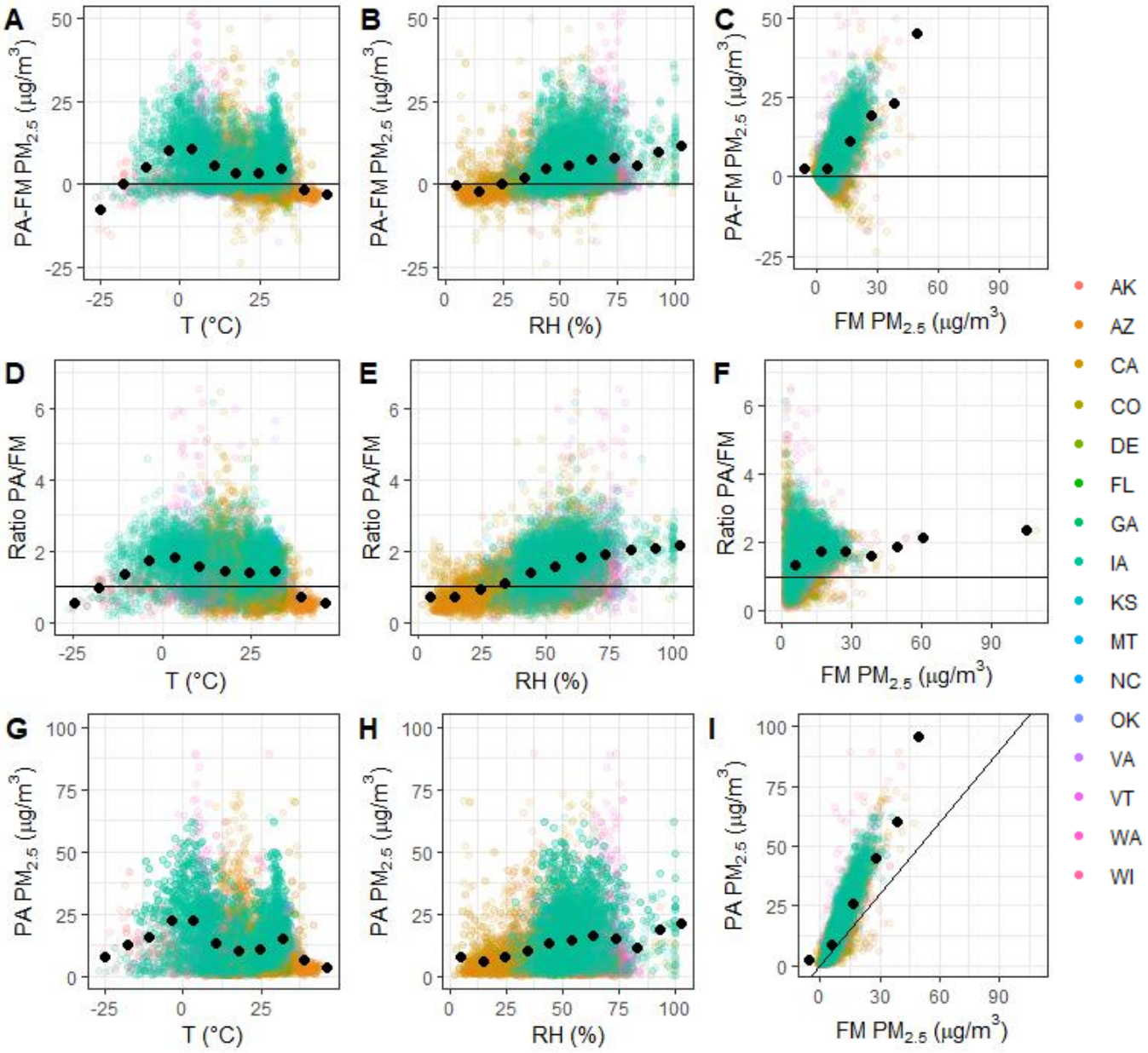

Figure S8. Error and ratio between uncorrected cf_1 PurpleAir (PA) and federal equivalent or reference method measurements (FM) along with raw PurpleAir $PM_{2.5}$ as influenced by temperature, relative humidity, and FEM or FRM $PM_{2.5}$ concentration. Black points indicate averages in 10 bins. Note that there are limited points in the high concentration bins.

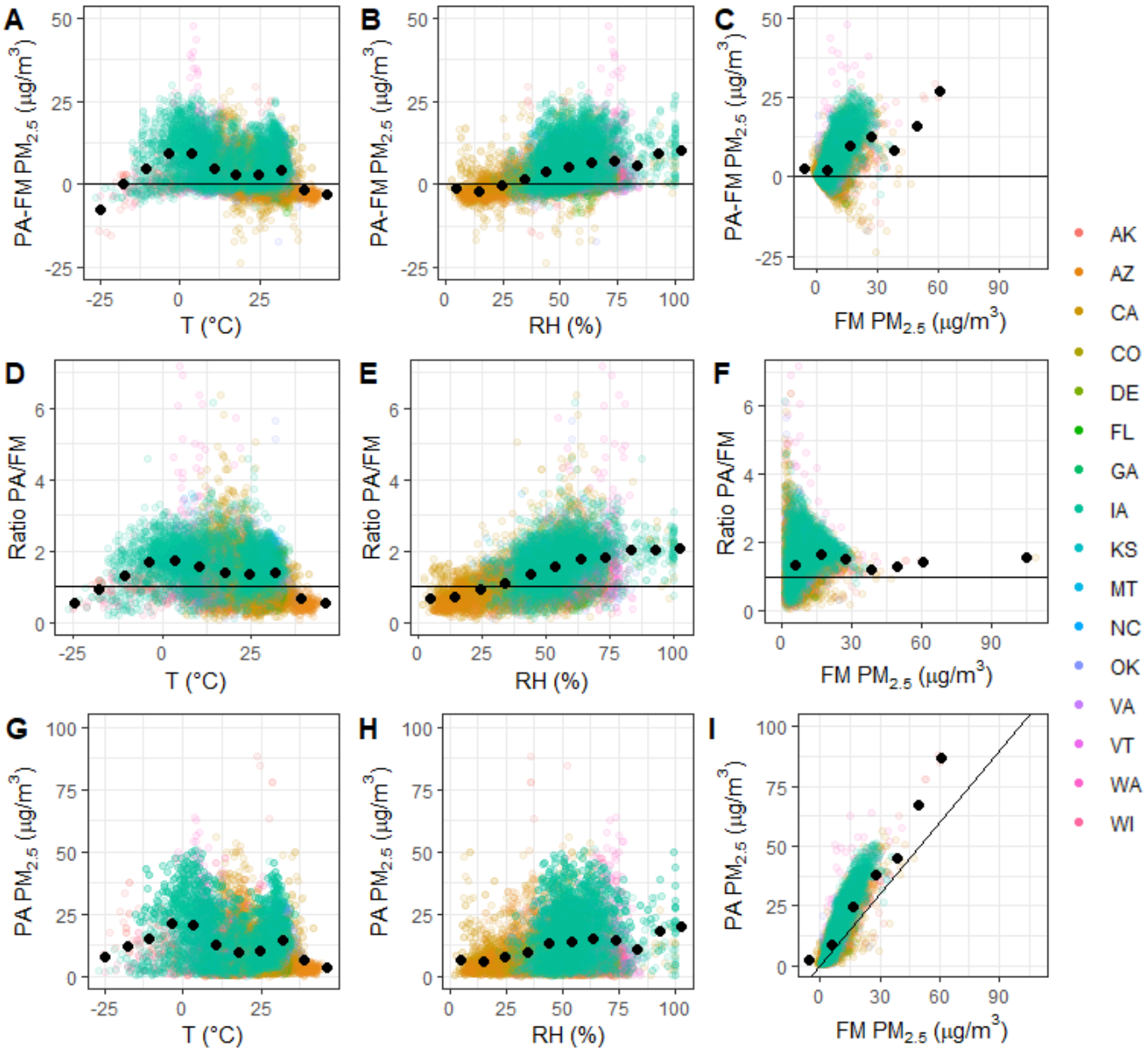

Figure S9. Error and ratio between raw cf_atm PurpleAir (PA) and federal equivalent or reference method measurements (FM) along with raw PurpleAir $PM_{2.5}$ as influenced by temperature, relative humidity, and FEM or FRM $PM_{2.5}$ concentration. Black points indicate averages in 10 bins. Note that there are limited points in high concentration bins leading to greater uncertainty.

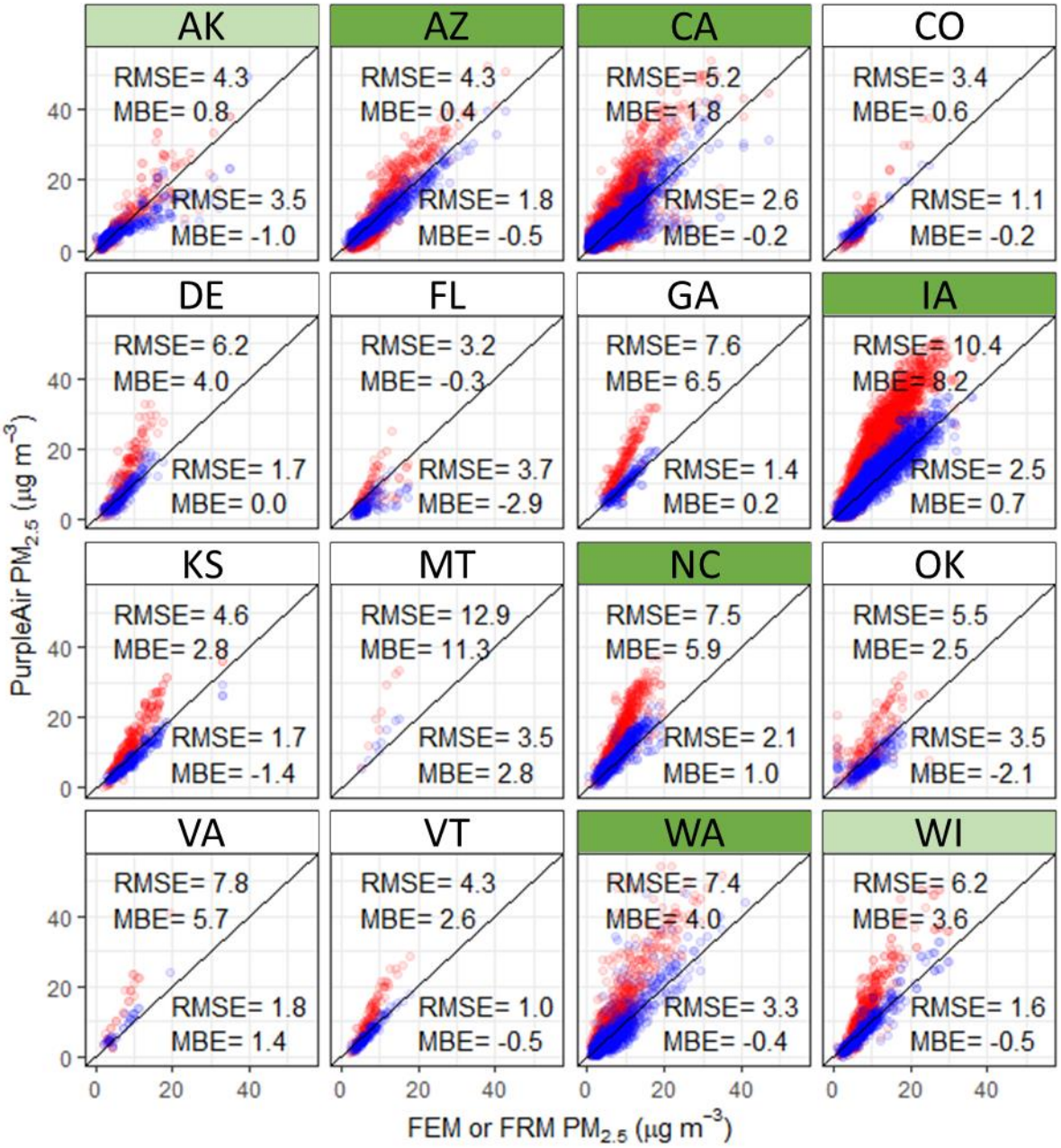

Figure S10. Raw [cf_atm] PurpleAir $PM_{2.5}$ as shown on PurpleAir.com (red) and final corrected data (blue) with the RMSE and MBE in µg m^{-3} reported in the top left corner for the raw data and the lower right for the corrected data. States with at least 1 year of data have green plot labels with light green labels indicating almost 1 year (>10 months).

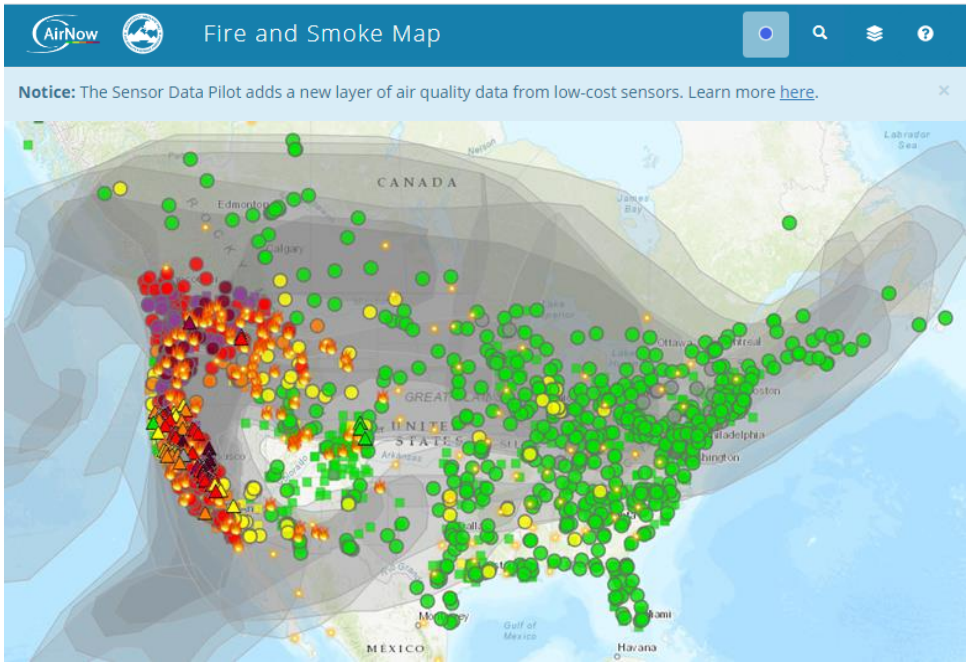

Figure S11. AirNow Fire and Smoke Map (fire.airnow.gov)