Supplemental Information of

Spatiotemporal Variability in the Oxidative Potential of Ambient Fine Particulate Matter in Midwestern United States

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Content	
Number of pages	12
Number of tables	5

Table S1. Dates of samples collection at five sampling sites.

Season	Week count	Sampling period	CHI	STL	IND	CMP	BON
Summer 2018	1	2018/5/22 – 2018/5/25	✓	✓	✓	✓	×
	2	2018/5/29 – 2018/6/1	✓	✓	✓	✓	×
	3	2018/6/5– 2018/6/8	✓	✓	✓	✓	✓
	4	2018/6/12– 2018/6/15	✓	✓	✓	✓	✓
	5	2018/6/19– 2018/6/22	✓	✓	✓	✓	×
	6	2018/6/26– 2018/6/29	✓	✓	✓	✓	✓
	7	2018/7/3– 2018/7/6	✓	✓	✓	✓	✓
	8	2018/7/10– 2018/7/13	✓	✓	✓	✓	×
	9	2018/7/17– 2018/7/20	✓	✓	✓	✓	×
	10	2018/7/24– 2018/7/27	×	✓	✓	✓	✓
	11	2018/7/31– 2018/8/3	✓	✓	✓	✓	✓
	12	2018/8/7– 2018/8/10	✓	✓	✓	✓	✓
	13	2018/8/14– 2018/8/17	✓	✓	✓	✓	✓
	14	2018/8/21– 2018/8/24	✓	✓	✓	✓	✓
	15	2018/8/28– 2018/8/31	✓	✓	✓	✓	✓
Fall 2018	16	2018/9/4– 2018/9/7	✓	✓	✓	✓	✓
	17	2018/9/11– 2018/9/14	✓	✓	✓	✓	✓
	18	2018/9/18– 2018/9/21	✓	✓	✓	✓	✓
	19	2018/9/25– 2018/9/28	×	✓	✓	✓	×
	20	2018/10/2– 2018/10/5	×	✓	✓	✓	×
	21	2018/10/9– 2018/10/12	✓	×	✓	✓	✓
	22	2018/10/16– 2018/10/19	✓	✓	✓	✓	✓
	23	2018/10/23– 2018/10/26	✓	✓	✓	✓	✓
	24	2018/10/30– 2018/11/2	✓	✓	✓	×	✓
	25	2018/11/6– 2018/11/9	✓	×	✓	✓	✓
	26	2018/11/13– 2018/11/16	✓	×	✓	✓	✓
	27	2018/11/20– 2018/11/23	✓	✓	✓	×	✓
	28	2018/11/27– 2018/11/30	✓	✓	✓	✓	✓
Winter 2018	29	2018/12/4– 2018/12/7	✓	✓	✓	✓	✓
	30	2018/12/11– 2018/12/14	×	✓	✓	✓	✓
	31	2018/12/18– 2018/12/21	×	✓	✓	✓	✓
	32	2018/12/25– 2018/12/28	×	✓	✓	✓	✓
	33	2019/1/1– 2019/1/4	×	✓	✓	✓	✓
	34	2019/1/8– 2019/1/11	×	✓	✓	✓	✓
	35	2019/1/15– 2019/1/18	×	✓	✓	✓	×
	36	2019/1/22– 2019/1/25	✓	✓	✓	✓	×
	37	2019/1/29– 2019/2/1	✓	✓	✓	✓	✓
	38	2019/2/5– 2019/2/8	✓	✓	✓	✓	✓
	39	2019/2/12– 2019/2/15	✓	✓	✓	✓	✓
	40	2019/2/19– 2019/2/22	✓	✓	✓	✓	✓
	41	2019/2/26– 2019/3/1	✓	✓	✓	✓	✓
Spring 2019	42	2019/3/5– 2019/3/8	✓	✓	✓	✓	✓
	43	2019/3/12– 2019/3/15	×	✓	✓	✓	✓
	44	2019/3/19– 2019/3/22	✓	✓	✓	✓	✓
	45	2019/3/26– 2019/3/29	✓	✓	✓	✓	✓
	46	2019/4/2– 2019/4/5	✓	✓	✓	✓	✓
	47	2019/4/9– 2019/4/12	✓	✓	✓	✓	✓
	48	2019/4/16– 2019/4/19	✓	✓	✓	×	✓
	49	2019/4/23– 2019/4/26	✓	✓	✓	✓	✓
	50	2019/4/30– 2019/5/3	✓	×	✓	✓	✓
	51	2019/5/7– 2019/5/10	✓	✓	✓	✓	✓
	52	2019/5/14– 2019/5/17	✓	×	✓	✓	✓
	53	2019/5/21– 2019/5/24	✓	×	✓	✓	✓
	54	2019/5/28– 2019/5/31	✓	×	✓	✓	✓

The symbol ✓ denotes the collection of a sample, and the symbol × denotes no collection of the sample in that week (due to several reasons such as unfavorable weather conditions, broken sampler, etc.).

Table S2. Comparison of ambient $PM_{2.5}$ OP measured in our current study with those reported in the literatures. Asterisk - * indicates that the reported results are methanol-soluble OP, while all the other results (without the asterisk) are water-soluble OP.

(a) OP^{AA}

Reference	PM size fraction (µm)	Levels	Location	Location type	Sample size
Fang et al. (2016)[a]	≤ 2.5	0.2 - 5.2 $nmol \cdot min^{-1} \cdot m^{-3}$	Southeast US	Urban and rural	483
Mudway et al. (2005)[b]	≤ 2.5	0.012 ± 0.0001 $nmol \cdot min^{-1} \cdot \mu g^{-1}$	Eksaal, India	Biomass burning	3
Künzli et al. (2006)[b]	≤ 2.5	0.0096 ± 0.0025 $nmol \cdot min^{-1} \cdot \mu g^{-1}$	19 European cities	Urban	716
Szigeti et al. (2016)[b,c]	≤ 2.5	0.0017 – 0.04 $nmol \cdot min^{-1} \cdot \mu g^{-1}$	8 European cities	Urban	22
Godri et al. (2011)[b]	1.0 – 1.9	0.0058 ± 0.0025 $nmol \cdot min^{-1} \cdot \mu g^{-1}$	London, United Kingdom	Urban	14
Yu et al. (2020)	≤ 2.5	0.004 – 0.077 $nmol \cdot min^{-1} \cdot \mu g^{-1}$ median: 0.012 $nmol \cdot min^{-1} \cdot \mu g^{-1}$ 0.044 – 0.745 $nmol \cdot min^{-1} \cdot m^{-3}$ median: 0.160 $nmol \cdot min^{-1} \cdot m^{-3}$	Midwest US (5 sites)	Urban (4), rural (1)	54
This study	≤ 2.5	0.002 – 0.077 $nmol \cdot min^{-1} \cdot \mu g^{-1}$ median: 0.007 $nmol \cdot min^{-1} \cdot \mu g^{-1}$ 0.012 – 0.908 $nmol \cdot min^{-1} \cdot m^{-3}$ median: 0.078 $nmol \cdot min^{-1} \cdot m^{-3}$	Midwest US (5 sites)	Urban (4), rural (1)	189

[a] The study assessed OP^{AA} of ambient PM samples in an AA-only model (no other antioxidants involved).

[b] The composition of lung lining fluid (200 µM AA, 200 µM GSH and 200 µM UA) was different in these studies than the SLF used in our study. Moreover, total consumption of AA in 4 hours was reported, and we have estimated the rates assuming linear pattern of AA consumption with time.

[c] The author compared the OP activities between indoor air PM and outdoor air PM. Only the results of outdoor air PM were included in this table.

(b) OP^{GSH}

Reference	PM size fraction (µm)	Levels	Location	Location type	Sample size
Mudway et al. (2005)[a]	≤ 2.5	0.0083 ± 0.0002 nmol·min^{-1}·µg^{-1}	Eksaal, India	Biomass burning	3
Künzli et al. (2006)[a]	≤ 2.5	0.0041 ± 0.0017 nmol·min^{-1}·µg^{-1}	19 European cities	Urban	716
Szigeti et al. (2016)[a,b]	≤ 2.5	0 – 0.0275 nmol·min^{-1}·µg^{-1}	8 European cities	Urban	22
Godri et al. (2011)[a]	1.0 – 1.9	0.0042 ± 0.0033 nmol·min^{-1}·µg^{-1}	London, United Kingdom	Urban	14
Yu et al. (2020)	≤ 2.5	0.001 – 0.040 nmol·min^{-1}·µg^{-1} median: 0.010 nmol·min^{-1}·µg^{-1} 0.008 – 0.463 nmol·min^{-1}·m^{-3} median: 0.100 nmol·min^{-1}·m^{-3}	Midwest US (5 sites)	Urban (4), rural (1)	54
This study	≤ 2.5	0.002 – 0.035 nmol·min^{-1}·µg^{-1} median: 0.007 nmol·min^{-1}·µg^{-1} 0.013 – 0.419 nmol·min^{-1}·m^{-3} median: 0.074 nmol·min^{-1}·m^{-3}	Midwest US (5 sites)	Urban (4), rural (1)	208

[a] The composition of lung lining fluid (200 µM AA, 200 µM GSH and 200 µM UA) was different in these studies than the SLF used in our study. Moreover, total consumption of GSH in 4 hours was reported, and we have estimated the rates assuming linear pattern of GSH consumption with time.

[b] The author compared the OP activities between indoor air PM and outdoor air PM. Only the results of outdoor air PM were included in this table.

(c) OP$^{OH\text{-}SLF}$

Reference	PM size fraction (µm)	Levels	Location	Location type	Sample size
Vidrio et al. (2009)[a]	≤ 2.5	0.253 ± 0.135 pmol·min^{-1}·µg^{-1}	Davis, CA	Urban	~90
Ma et al. (2015)[a]	≤ 2.5	0.092 ± 0.019 pmol·min^{-1}·µg^{-1}	Guangzhou, China	Urban	72
Yu et al. (2020)	≤ 2.5	0.085 – 0.967 pmol·min^{-1}·µg^{-1} median: 0.307 pmol·min^{-1}·µg^{-1} 0.857 – 7.884 pmol·min^{-1}·m^{-3} median: 3.559 pmol·min^{-1}·m^{-3}	Midwest US (5 sites)	Urban (4), rural (1)	54
This study	≤ 2.5	0.040 – 1.217 pmol·min^{-1}·µg^{-1} median: 0.142 pmol·min^{-1}·µg^{-1} 0.269 – 12.13 pmol·min^{-1}·m^{-3} median: 1.449 pmol·min^{-1}·m^{-3}	Midwest US (5 sites)	Urban (4), rural (1)	194

[a] The SLF used in these studies had the same composition as ours (200 µM AA, 100 µM GSH, 100 µM UA and 300 µM CA). However, total •OH generated in 24 hours was reported, and we have estimated the rates assuming linear pattern of •OH generation with time.

(d) OP^{DTT}

Reference	PM size fraction (µm)	Levels	Location	Location type	Sample size
Fang et al. (2014)	≤ 2.5	0.010 – 0.097 nmol·min^{-1}·µg^{-1} median: 0.024 – 0.041 nmol·min^{-1}·µg^{-1} 0.05 – 0.81 nmol·min^{-1}·m^{-3} median: 0.23 – 0.31 nmol·min^{-1}·m^{-3}	Southeast US	Urban and rural	503
Xiong et al. (2017)	≤ 2.5	0.1 – 0.18 nmol·min^{-1}·m^{-3}	Urbana, IL	Urban	10
Cho et al. (2005)	≤ 2.5	0.013 – 0.047 nmol·min^{-1}·µg^{-1} median: 0.029 nmol·min^{-1}·µg^{-1}	Los Angeles basin, CA	Urban	11
Charrier and Anastasio (2012)	≤ 2.5	0.02 – 0.061 nmol·min^{-1}·µg^{-1} median: 0.029 nmol·min^{-1}·µg^{-1}	San Joaquin, CA	Urban, rural	6
Gao et al. (2017)	≤ 2.5	0.09 – 0.30 nmol·min^{-1}·m^{-3} median: 0.19 nmol·min^{-1}·m^{-3}	Atlanta, GA (2 sites)	Urban	66
Gao et al. (2020)	≤ 2.5	0.005 – 0.070 nmol·min^{-1}·µg^{-1} average: 0.024 nmol·min^{-1}·µg^{-1} 0.05 – 0.48 nmol·min^{-1}·m^{-3} average: 0.22 nmol·min^{-1}·m^{-3}	Atlanta, GA	Urban	349
Hu et al. (2008)	0.25 – 2.5	0.014 – 0.024 nmol·min^{-1}·µg^{-1} median: 0.019 nmol·min^{-1}·µg^{-1} 0.10 – 0.16 nmol·min^{-1}·m^{-3} median: 0.14 nmol·min^{-1}·m^{-3}	Los Angeles harbor, CA	Urban	6
Yu et al. (2020)	≤ 2.5	0.004 – 0.193 nmol·min^{-1}·µg^{-1} median: 0.014 nmol·min^{-1}·µg^{-1} 0.041 – 1.282 nmol·min^{-1}·m^{-3} median: 0.146 nmol·min^{-1}·m^{-3}	Midwest US (5 sites)	Urban (4), rural (1)	54
Verma et al. (2012)*	≤ 2.5	0.020 – 0.054 nmol·min^{-1}·µg^{-1} median: 0.034 nmol·min^{-1}·µg^{-1}	Atlanta, GA	Urban	8
Gao et al. (2017)*	≤ 2.5	0.14 – 0.47 nmol·min^{-1}·m^{-3} median: 0.30 nmol·min^{-1}·m^{-3}	Atlanta, GA (2 sites)	Urban	66

(d) (Continued)

Reference	PM size fraction (µm)	Levels	Location	Location type	Sample size
Gao et al. (2020)*	≤ 2.5	0.012 – 0.116 $nmol \cdot min^{-1} \cdot \mu g^{-1}$ average: 0.027 $nmol \cdot min^{-1} \cdot \mu g^{-1}$ 0.13 – 0.58 $nmol \cdot min^{-1} \cdot m^{-3}$ average: 0.28 $nmol \cdot min^{-1} \cdot m^{-3}$	Atlanta, GA	Urban	349
This study	≤ 2.5	0.004 – 0.032 $nmol \cdot min^{-1} \cdot \mu g^{-1}$ median: 0.014 $nmol \cdot min^{-1} \cdot \mu g^{-1}$ 0.029 – 0.561 $nmol \cdot min^{-1} \cdot m^{-3}$ median: 0.150 $nmol \cdot min^{-1} \cdot m^{-3}$	Midwest US (5 sites)	Urban (4), rural (1)	218
This study*	≤ 2.5	0.004 – 0.042 $nmol \cdot min^{-1} \cdot \mu g^{-1}$ median: 0.021 $nmol \cdot min^{-1} \cdot \mu g^{-1}$ 0.031 – 0.639 $nmol \cdot min^{-1} \cdot m^{-3}$ median: 0.234 $nmol \cdot min^{-1} \cdot m^{-3}$	Midwest US (5 sites)	Urban (4), rural (1)	235

Asterisk - * indicates that the reported results are methanol-soluble OP^{DTT}.

(e) $OP^{OH\text{-}DTT}$

Reference	PM size fraction (µm)	Levels	Location	Location type	Sample size
Xiong et al. (2017)	≤ 2.5	0.2 – 0.6 $pmol \cdot min^{-1} \cdot m^{-3}$	Urbana, IL	Urban	10
Yu et al. (2018)	≤ 2.5	0.2 – 1.1 $pmol \cdot min^{-1} \cdot m^{-3}$	Urbana, IL	Urban	10
Yu et al. (2020)	≤ 2.5	0.034 – 0.357 $pmol \cdot min^{-1} \cdot \mu g^{-1}$ median: 0.082 $pmol \cdot min^{-1} \cdot \mu g^{-1}$ 0.360 – 4.152 $pmol \cdot min^{-1} \cdot m^{-3}$ median: 1.054 $pmol \cdot min^{-1} \cdot m^{-3}$	Midwest US (5 sites)	Urban (4), rural (1)	54
This study	≤ 2.5	0.004 – 0.357 $pmol \cdot min^{-1} \cdot \mu g^{-1}$ median: 0.065 $pmol \cdot min^{-1} \cdot \mu g^{-1}$ 0.022 – 3.565 $pmol \cdot min^{-1} \cdot m^{-3}$ median: 0.722 $pmol \cdot min^{-1} \cdot m^{-3}$	Midwest US (5 sites)	Urban (4), rural (1)	240

Table S3. Results of 1-way ANOVA test for assessing the temporal and spatial variability of mass-normalized and volume-normalized OP endpoints for water-soluble $PM_{2.5}$ samples.

(a) Temporal variability

Sampling Site	Endpoint	F value	Significantly different group(s)
Chicago, IL (CHI)	$OP^{AA}m$	1.12	
	$OP^{AA}v$	0.69	
	$OP^{GSH}m$	3.19*	Summer 2018, Fall 2018, Spring 2019, Winter 2018
	$OP^{GSH}v$	0.78	
	$OP^{OH\text{-}SLF}m$	21.84**	Summer 2018, Fall 2018, Spring 2019, Winter 2018
	$OP^{OH\text{-}SLF}v$	17.72**	Summer 2018, Fall 2018, Spring 2019, Winter 2018
	$OP^{DTT}m$	2.67	Summer 2018, Fall 2018, Spring 2019
	$OP^{DTT}v$	1.03	
	$OP^{OH\text{-}DTT}m$	7.26**	Summer 2018, Winter 2018, Fall 2018, Spring 2019
	$OP^{OH\text{-}DTT}v$	6.68**	Summer 2018, Fall 2018, Spring 2019
St. Louis, MO (STL)	$OP^{AA}m$	1.37	
	$OP^{AA}v$	1.48	
	$OP^{GSH}m$	1.74	Spring 2019, Fall 2018
	$OP^{GSH}v$	1.40	
	$OP^{OH\text{-}SLF}m$	4.25**	Summer 2018, Winter 2018, Spring 2019
	$OP^{OH\text{-}SLF}v$	5.33**	Summer 2018, Fall 2018, Winter 2018, Spring 2019
	$OP^{DTT}m$	1.83	
	$OP^{DTT}v$	0.56	
	$OP^{OH\text{-}DTT}m$	0.12	
	$OP^{OH\text{-}DTT}v$	0.17	
Indianapolis, IN (IND)	$OP^{AA}m$	2.02	Summer 2018, Fall 2018
	$OP^{AA}v$	2.11	Summer 2018, Spring 2019, Fall 2018
	$OP^{GSH}m$	0.53	
	$OP^{GSH}v$	0.49	
	$OP^{OH\text{-}SLF}m$	3.16*	Summer 2018, Winter 2018, Spring 2019
	$OP^{OH\text{-}SLF}v$	2.75*	Summer 2018, Winter 2018, Spring 2019
	$OP^{DTT}m$	1.29	
	$OP^{DTT}v$	0.33	
	$OP^{OH\text{-}DTT}m$	4.28**	Summer 2018, Winter 2018, Fall 2018, Spring 2019
	$OP^{OH\text{-}DTT}v$	2.57	Summer 2018, Winter 2018, Fall 2018
Champaign, IL (CMP)	$OP^{AA}m$	2.59	Summer 2018, Winter 2018
	$OP^{AA}v$	2.77*	Summer 2018, Winter 2018
	$OP^{GSH}m$	3.44*	Spring 2019, Summer 2018, Winter 2018
	$OP^{GSH}v$	4.92**	Spring 2019, Summer 2018, Winter 2018, Fall 2018
	$OP^{OH\text{-}SLF}m$	5.47**	Summer 2018, Fall 2018, Winter 2018
	$OP^{OH\text{-}SLF}v$	7.59**	Summer 2018, Spring 2019, Fall 2018, Winter 2018
	$OP^{DTT}m$	0.70	
	$OP^{DTT}v$	1.55	
	$OP^{OH\text{-}DTT}m$	8.06**	Summer 2018, Winter 2018, Fall 2018, Spring 2019
	$OP^{OH\text{-}DTT}v$	6.18**	Summer 2018, Winter 2018, Spring 2019, Fall 2018
Bondville, IL (BON)	$OP^{AA}m$	5.26**	Summer 2018, Spring 2019, Fall 2018, Winter 2018
	$OP^{AA}v$	8.17**	Summer 2018, Spring 2019, Fall 2018, Winter 2018
	$OP^{GSH}m$	8.16**	Summer 2018, Spring 2019, Fall 2018, Winter 2018
	$OP^{GSH}v$	13.81**	Summer 2018, Spring 2019, Fall 2018, Winter 2018
	$OP^{OH\text{-}SLF}m$	16.82**	Summer 2018, Spring 2019, Fall 2018, Winter 2018
	$OP^{OH\text{-}SLF}v$	17.33**	Summer 2018, Spring 2019, Fall 2018, Winter 2018
	$OP^{DTT}m$	3.15*	Summer 2018, Spring 2019
	$OP^{DTT}v$	3.37*	Summer 2018, Winter 2018, Spring 2019
	$OP^{OH\text{-}DTT}m$	2.10	Winter 2018, Fall 2018
	$OP^{OH\text{-}DTT}v$	1.34	

(b) Spatial variability

Season	Endpoint	F value	Significantly different group(s)
Summer 2018	$OP^{AA}m$	8.60**	CMP, BON, CHI, STL, IND
	$OP^{AA}v$	5.28**	CMP, CHI, STL, IND
	$OP^{GSH}m$	28.41**	CMP, BON, CHI, STL, IND
	$OP^{GSH}v$	9.30**	CMP, BON, CHI, STL, IND
	$OP^{OH\text{-}SLF}m$	8.60**	CHI, CMP, BON, STL, IND
	$OP^{OH\text{-}SLF}v$	4.83**	CMP, CHI, STL, IND
	$OP^{DTT}m$	6.97**	CMP, STL, IND
	$OP^{DTT}v$	2.21	CMP, STL, IND
	$OP^{OH\text{-}DTT}m$	5.92**	CHI, IND, CMP, BON, STL
	$OP^{OH\text{-}DTT}v$	4.70**	CHI, STL, IND, CMP, BON
Fall 2018	$OP^{AA}m$	12.08**	CMP, CHI, STL, IND, BON
	$OP^{AA}v$	3.81**	CMP, STL, IND, BON
	$OP^{GSH}m$	27.05**	CMP, CHI, BON, IND, STL
	$OP^{GSH}v$	4.07**	CMP, CHI, STL, IND
	$OP^{OH\text{-}SLF}m$	1.46	CMP, IND
	$OP^{OH\text{-}SLF}v$	0.46	
	$OP^{DTT}m$	13.39**	CMP, CHI, BON, STL, IND
	$OP^{DTT}v$	0.51	
	$OP^{OH\text{-}DTT}m$	3.52*	CHI, STL, IND, BON, CMP
	$OP^{OH\text{-}DTT}v$	4.00**	CHI, STL, IND, BON, CMP
Winter 2018	$OP^{AA}m$	2.21	CMP, CHI, STL, IND, BON
	$OP^{AA}v$	1.95	CMP, STL, IND, BON
	$OP^{GSH}m$	15.75**	CMP, CHI, STL, IND, BON
	$OP^{GSH}v$	12.37**	CMP, CHI, STL, IND, BON
	$OP^{OH\text{-}SLF}m$	2.23	CMP, CHI
	$OP^{OH\text{-}SLF}v$	1.78	STL, BON
	$OP^{DTT}m$	4.33**	CMP, STL, IND
	$OP^{DTT}v$	3.23*	CHI, STL, IND, BON
	$OP^{OH\text{-}DTT}m$	2.60*	IND, BON, STL
	$OP^{OH\text{-}DTT}v$	2.49*	CHI, IND, STL, CMP
Spring 2019	$OP^{AA}m$	5.20**	CMP, CHI, STL, IND, BON
	$OP^{AA}v$	4.92**	CMP, CHI, STL, IND, BON
	$OP^{GSH}m$	14.59**	CMP, CHI, STL, IND, BON
	$OP^{GSH}v$	10.74**	CMP, CHI, STL, IND, BON
	$OP^{OH\text{-}SLF}m$	3.20*	CMP, CHI, STL, IND, BON
	$OP^{OH\text{-}SLF}v$	3.19*	CMP, CHI, STL, IND, BON
	$OP^{DTT}m$	10.78**	CMP, CHI, BON, STL
	$OP^{DTT}v$	6.04**	CMP, CHI, STL, IND, BON
	$OP^{OH\text{-}DTT}m$	2.57*	IND, BON, CMP
	$OP^{OH\text{-}DTT}v$	1.89	STL, IND, CMP

Asterisks - * and ** indicate significant ($P < 0.05$) and very significant ($P < 0.01$) differences, respectively.

Table S4. Results of 1-way ANOVA test for assessing the temporal and spatial variability of mass-normalized and volume-normalized OP endpoints for methanol-soluble $PM_{2.5}$ samples.

(a) Temporal variability

Sampling Site	Endpoint	F value	Significantly different group(s)
Chicago, IL (CHI)	$\mathrm{OP^{AA}m}$	1.03	
	$\mathrm{OP^{AA}v}$	0.07	
	$\mathrm{OP^{GSH}m}$	1.41	
	$\mathrm{OP^{GSH}v}$	0.28	
	$\mathrm{OP^{OH\text{-}SLF}m}$	1.68	Summer 2018, Spring 2019
	$\mathrm{OP^{OH\text{-}SLF}v}$	0.99	
	$\mathrm{OP^{DTT}m}$	4.27*	Summer 2018, Fall 2018, Winter 2019
	$\mathrm{OP^{DTT}v}$	1.53	
	$\mathrm{OP^{OH\text{-}DTT}m}$	3.84*	Summer 2018, Fall 2018, Winter 2018, Spring 2019
	$\mathrm{OP^{OH\text{-}DTT}v}$	3.37*	Summer 2018, Fall 2018
St. Louis, MO (STL)	$\mathrm{OP^{AA}m}$	2.16	Fall 2018, Spring 2019
	$\mathrm{OP^{AA}v}$	3.41*	Summer 2018, Fall 2018, Spring 2019
	$\mathrm{OP^{GSH}m}$	3.62*	Fall 2018, Summer 2018, Winter 2018, Spring 2019
	$\mathrm{OP^{GSH}v}$	1.92	Fall 2018, Spring 2019
	$\mathrm{OP^{OH\text{-}SLF}m}$	1.05	
	$\mathrm{OP^{OH\text{-}SLF}v}$	1.23	
	$\mathrm{OP^{DTT}m}$	1.14	
	$\mathrm{OP^{DTT}v}$	1.87	Summer 2018, Winter 2019
	$\mathrm{OP^{OH\text{-}DTT}m}$	0.50	
	$\mathrm{OP^{OH\text{-}DTT}v}$	1.11	
Indianapolis, IN (IND)	$\mathrm{OP^{AA}m}$	2.42	Summer 2018, Spring 2019
	$\mathrm{OP^{AA}v}$	1.39	
	$\mathrm{OP^{GSH}m}$	2.15*	Fall 2018, Spring 2019
	$\mathrm{OP^{GSH}v}$	0.63	
	$\mathrm{OP^{OH\text{-}SLF}m}$	3.49*	Fall 2018, Spring 2019, Winter 2018
	$\mathrm{OP^{OH\text{-}SLF}v}$	2.41	Fall 2018, Winter 2018
	$\mathrm{OP^{DTT}m}$	1.42	
	$\mathrm{OP^{DTT}v}$	0.94	
	$\mathrm{OP^{OH\text{-}DTT}m}$	0.20	
	$\mathrm{OP^{OH\text{-}DTT}v}$	0.67	
Champaign, IL (CMP)	$\mathrm{OP^{AA}m}$	1.64	Summer 2018, Winter 2018
	$\mathrm{OP^{AA}v}$	2.95*	Summer 2018, Fall 2018, Winter 2018
	$\mathrm{OP^{GSH}m}$	1.42	
	$\mathrm{OP^{GSH}v}$	0.03	
	$\mathrm{OP^{OH\text{-}SLF}m}$	1.00	
	$\mathrm{OP^{OH\text{-}SLF}v}$	1.22	
	$\mathrm{OP^{DTT}m}$	3.73*	Summer 2018, Winter 2018
	$\mathrm{OP^{DTT}v}$	2.93*	Summer 2018, Fall 2018, Winter 2018
	$\mathrm{OP^{OH\text{-}DTT}m}$	0.08	
	$\mathrm{OP^{OH\text{-}DTT}v}$	0.59	
Bondville, IL (BON)	$\mathrm{OP^{AA}m}$	8.76**	Summer 2018, Fall 2018, Spring 2019, Winter 2018
	$\mathrm{OP^{AA}v}$	9.27**	Summer 2018, Fall 2018, Spring 2019, Winter 2018
	$\mathrm{OP^{GSH}m}$	1.51	
	$\mathrm{OP^{GSH}v}$	1.58	Summer 2018, Winter 2018
	$\mathrm{OP^{OH\text{-}SLF}m}$	4.30**	Summer 2018, Spring 2019, Winter 2018
	$\mathrm{OP^{OH\text{-}SLF}v}$	4.70**	Summer 2018, Spring 2019, Winter 2018
	$\mathrm{OP^{DTT}m}$	2.95*	Summer 2018, Spring 2019, Winter 2018
	$\mathrm{OP^{DTT}v}$	4.28**	Summer 2018, Fall 2018, Spring 2019, Winter 2018
	$\mathrm{OP^{OH\text{-}DTT}m}$	2.24	
	$\mathrm{OP^{OH\text{-}DTT}v}$	1.64	

(b) Spatial variability

Season	Endpoint	F value	Significantly different group(s)
Summer 2018	$OP^{AA}m$	1.17	BON, STL
	$OP^{AA}v$	0.13	
	$OP^{GSH}m$	2.00	CMP, STL, IND
	$OP^{GSH}v$	0.40	
	$OP^{OH\text{-}SLF}m$	2.80*	CHI, CMP, IND, STL
	$OP^{OH\text{-}SLF}v$	1.67	CHI, CMP, IND
	$OP^{DTT}m$	0.74	
	$OP^{DTT}v$	0.46	
	$OP^{OH\text{-}DTT}m$	3.75**	CHI, STL, CMP
	$OP^{OH\text{-}DTT}v$	3.11*	CHI, IND, STL, CMP
Fall 2018	$OP^{AA}m$	0.62	
	$OP^{AA}v$	2.40	STL, CMP, BON
	$OP^{GSH}m$	2.55*	CMP, STL, BON, IND
	$OP^{GSH}v$	1.05	
	$OP^{OH\text{-}SLF}m$	0.81	
	$OP^{OH\text{-}SLF}v$	0.97	
	$OP^{DTT}m$	0.33	
	$OP^{DTT}v$	2.50*	STL, CMP, BON
	$OP^{OH\text{-}DTT}m$	1.99	IND, STL, CMP
	$OP^{OH\text{-}DTT}v$	2.28	IND, CMP, BON
Winter 2018	$OP^{AA}m$	1.06	
	$OP^{AA}v$	3.62**	CHI, STL, IND, BON
	$OP^{GSH}m$	6.31**	CMP, CHI, BON, STL, IND
	$OP^{GSH}v$	2.86*	CHI, CMP, IND, BON
	$OP^{OH\text{-}SLF}m$	1.79	CHI, BON, STL
	$OP^{OH\text{-}SLF}v$	3.21*	CHI, IND, CMP, STL, BON
	$OP^{DTT}m$	0.86	
	$OP^{DTT}v$	2.45*	CHI, STL, CMP, BON
	$OP^{OH\text{-}DTT}m$	2.21	IND, CMP, BON, STL
	$OP^{OH\text{-}DTT}v$	2.67*	CHI, IND, CMP, BON
Spring 2019	$OP^{AA}m$	1.60	
	$OP^{AA}v$	2.46*	CHI, CMP, BON
	$OP^{GSH}m$	7.44**	CMP, CHI, IND, STL
	$OP^{GSH}v$	4.33**	CMP, CHI, BON, IND, STL
	$OP^{OH\text{-}SLF}m$	0.46	
	$OP^{OH\text{-}SLF}v$	0.60	
	$OP^{DTT}m$	0.79	
	$OP^{DTT}v$	1.93	CHI, BON
	$OP^{OH\text{-}DTT}m$	2.15	BON, IND, CMP
	$OP^{OH\text{-}DTT}v$	1.63	IND, CMP

Asterisks - * and ** indicate significant ($P < 0.05$) and very significant ($P < 0.01$) differences, respectively.

Table S5. Seasonal median of the ratio of methanol-soluble OPv to water-soluble OPv (M/W^{OP}) for OP$^{OH\text{-}SLF}$v at five sampling sites.

	CHI	STL	IND	CMP	BON
Summer 2018	2.1	2.6	2.0	1.1	2.0
Fall 2018	3.5	4.9	5.5	2.7	4.6
Winter 2018	9.4	2.9	3.3	3.2	3.9
Spring 2019	3.2	2.7	7.2	4.1	3.9

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