Measurement of Volatile Organic Compounds in samples collected in the areas surrounding the All American Asphalt facility

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03/03/2021

Sample Collection

During sampling, evacuated 2 liter electropolished stainless steel canisters are filled by slightly opening a bellows valve, allowing about a 1 minute collection of an air sample

VOC Analysis

- After collection, cans are analyzed at UCI using a multi-column/detector Gas Chromatography (GC) system;
- The first GC is equipped with two different column combinations output to an electron capture detector (ECD) and a flame ionization detector (FID);
- The second GC is output to an FID;
- The third GC is equipped with two different column combinations and output to a quadrupole mass spectrometer detector (working in SIM mode) and an ECD.
- The different combinations allow the identification and quantification of different classes of compounds.

- The measurement precision, detection limits and accuracy vary by compound: The limit of detection is 3 pptv for all hydrocarbons; The accuracy of our measurements is 5% for the non-methane hydrocarbons (30% for acetone); The measurement precision is 2%-5% NMHCs (30% for acetone).
- A complete description of the GC parameters and analytical methods are given elsewhere (Simpson et al., 2020)*

**Simpson, I.J., Characterization, sources and reactivity of volatile organic compounds (VOCs) in Seoul and surrounding regions during KORUS-AQ. Elementa – Science of the antrhropocene, 2020, 8*

Measured VOCs

Total of 93 species

Sulfur
Halogenated
Alkyl Nitrates
Alkanes
Alkyne
Alkenes
Aromatics
OVOC

OCS	$CHBrCl_2$	2,2-Dimethylbutane	trans-2-Pentene
DMS	$CHBr_2Cl$	2,3-Dimethylbutane	cis-2-Pentene
CFC-12	$CHBr_3$	2-Methylpentane	3-Methyl-1-Butene
CFC-11	1,2-Dichloroethane	3-Methylpentane	2-Methyl-1-Butene
CFC-113	Methyl Nitrate	2-Methylhexane	2-Methyl-2-Butene
CFC-114	Ethyl Nitrate	3-Methylhexane	alpha-Pinene
Halon-1211	i-Propyl Nitrate	2,4-Dimethylpentane	beta-Pinene
Halon-1301	n-Propyl Nitrate	2,3-Dimethylpentane	Benzene
HFC-152a	2-Butyl Nitrate	2,2,4-Trimethylpentane	Toluene
HFC-134a	2-Pentyl Nitrate	2,3,4-Trimethylpentane	Ethylbenzene
HCFC-22	3-Pentyl Nitrate	Cyclopentane	m-Xylene + p-Xylene
HCFC-142b	3-Methyl-2-Butyl Nitrate	Cyclohexane	o-Xylene
HCFC-141b	Ethane	Methylcyclopentane	Styrene
HFC-365mfc	Propane	Methylcyclohexane	i-Propylbenzene
$CHCl_3$	i-Butane	Ethyne	n-Propylbenzene
CH_3CCl_3	n-Butane	Ethene	3-Ethyltoluene
CCl_4	i-Pentane	Propene	4-Ethyltoluene
CH_2Cl_2	n-Pentane	1-Butene	2-Ethyltoluene
C_2HCl_3	n-Hexane	i-Butene	1,3,5-Trimethylbenzene
C_2Cl_4	n-Heptane	trans-2-Butene	1,2,4-Trimethylbenzene
CH_3Cl	n-Octane	cis-2-Butene	Acetone
CH_3Br	n-Nonane	1,3-Butadiene	
CH_3I	n-Decane	1-Pentene	
$CH2Br_2$	n-Undecane	Isoprene	

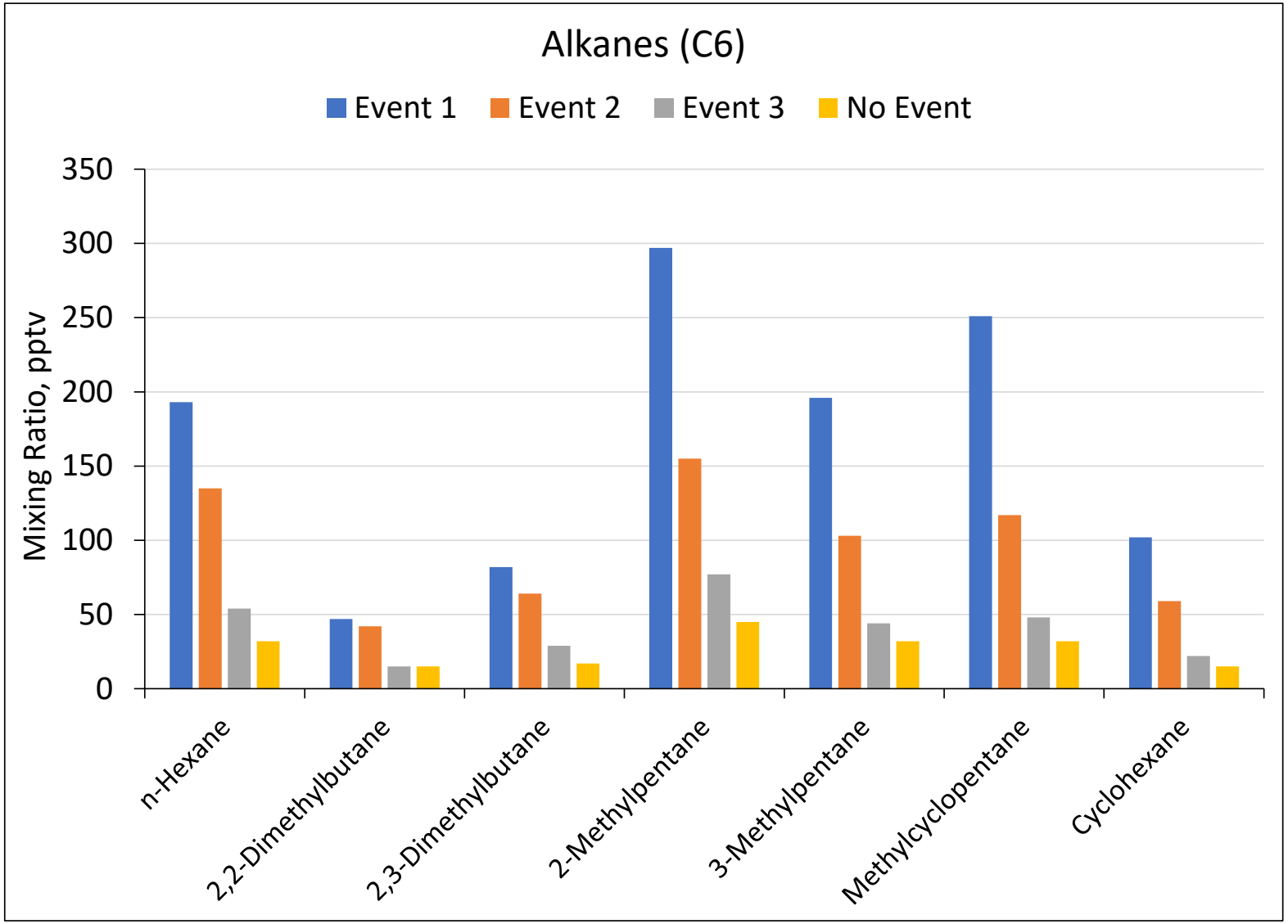
Samples collected

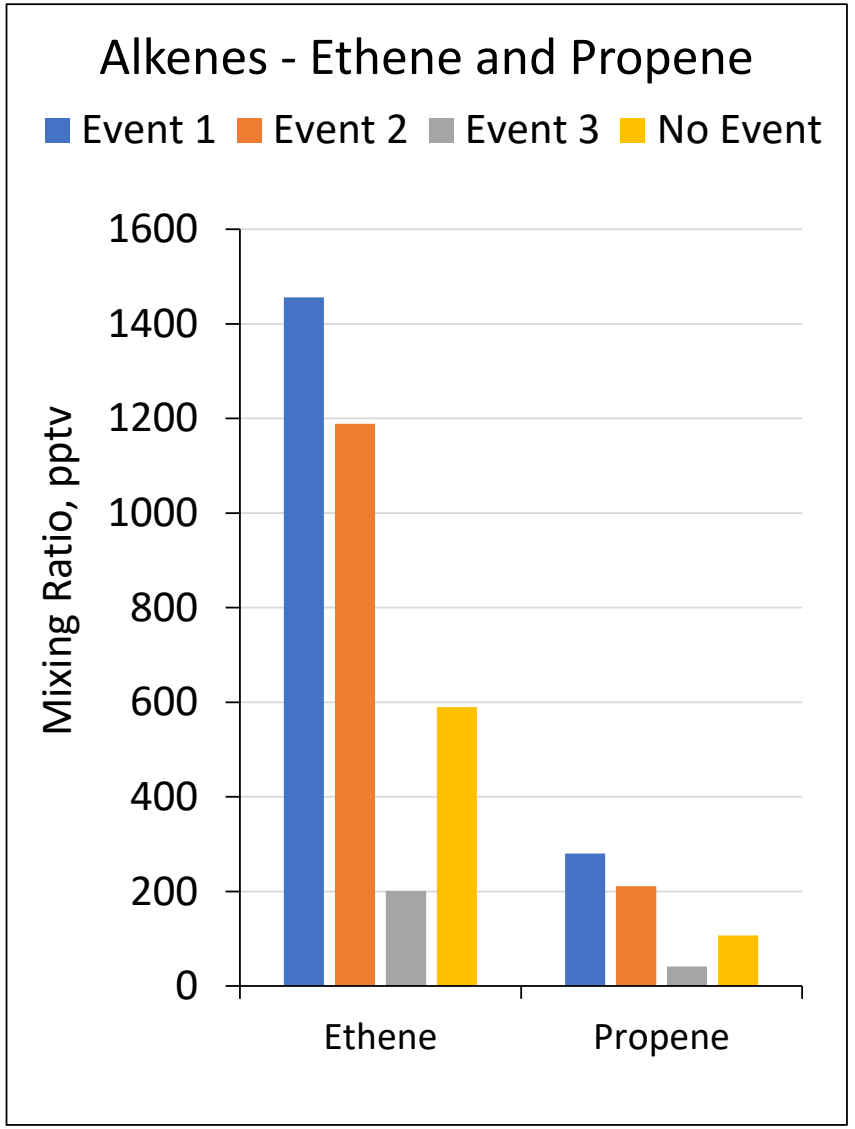
1. 12/16/2020 at 21:20; Eastwood (Irvine); sample collected during a “Chemical Odor” event (indicated as “**Event 1**”);
2. 12/18/2020 at 21:20; Eastwood (Irvine); sample collected to be used as “Background” (indicated as “**No event**”);
3. 1/9/2021 at 7:50; Eastwood (Irvine); sample collected during a “Asphalt Odor” event (indicated as “**Event 2**”);
4. 1/21/2021; at 12:24; Orchard Hills (Irvine); sample collected when AtmoTube reading was about 5 ppm (indicated as “**Event 3**”).

2 additional canisters have been collected but not analyzed yet

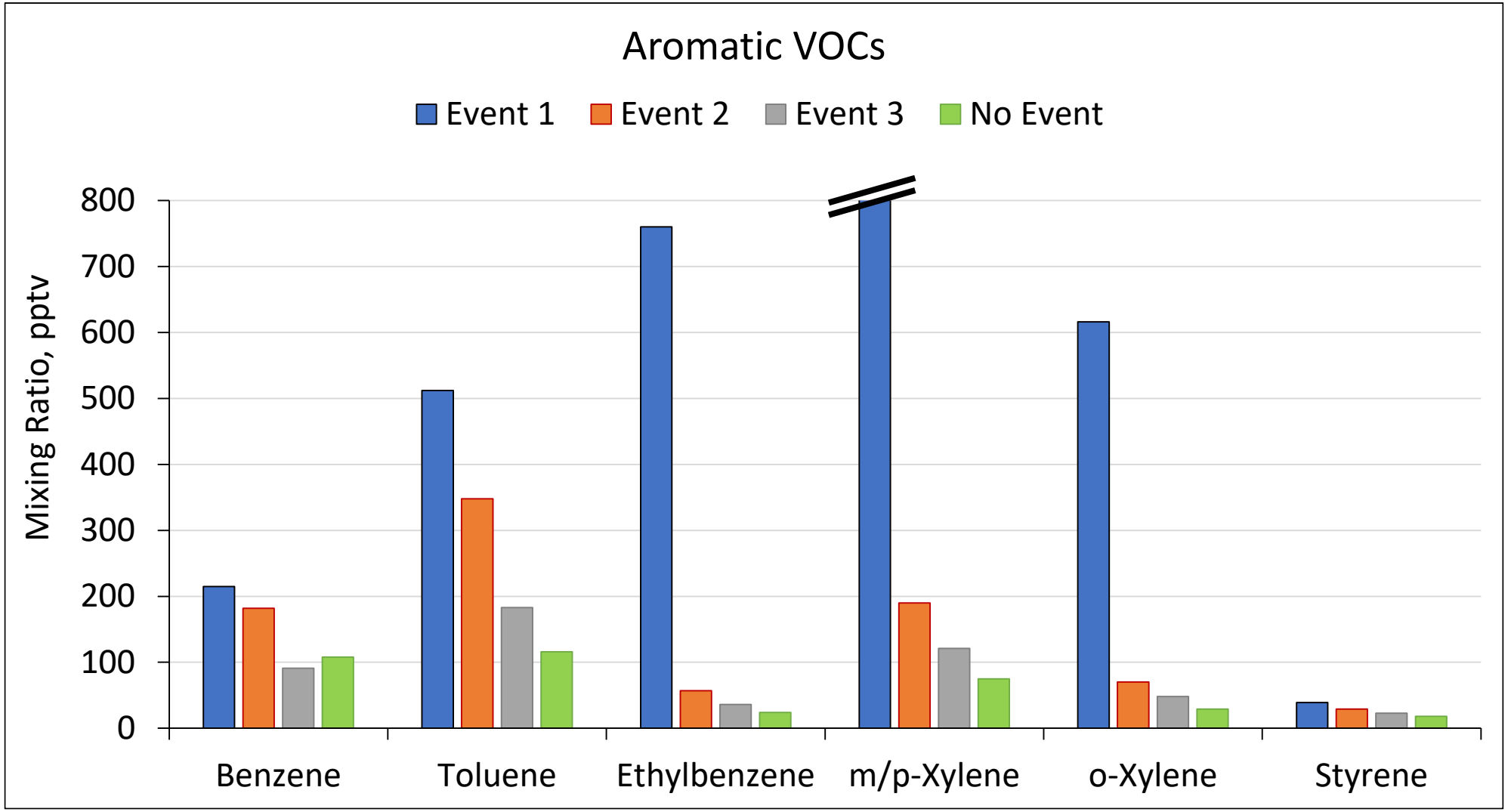
2 more canisters are available to the resident for further collection

Sample Results – Selected Alkanes and Alkenes

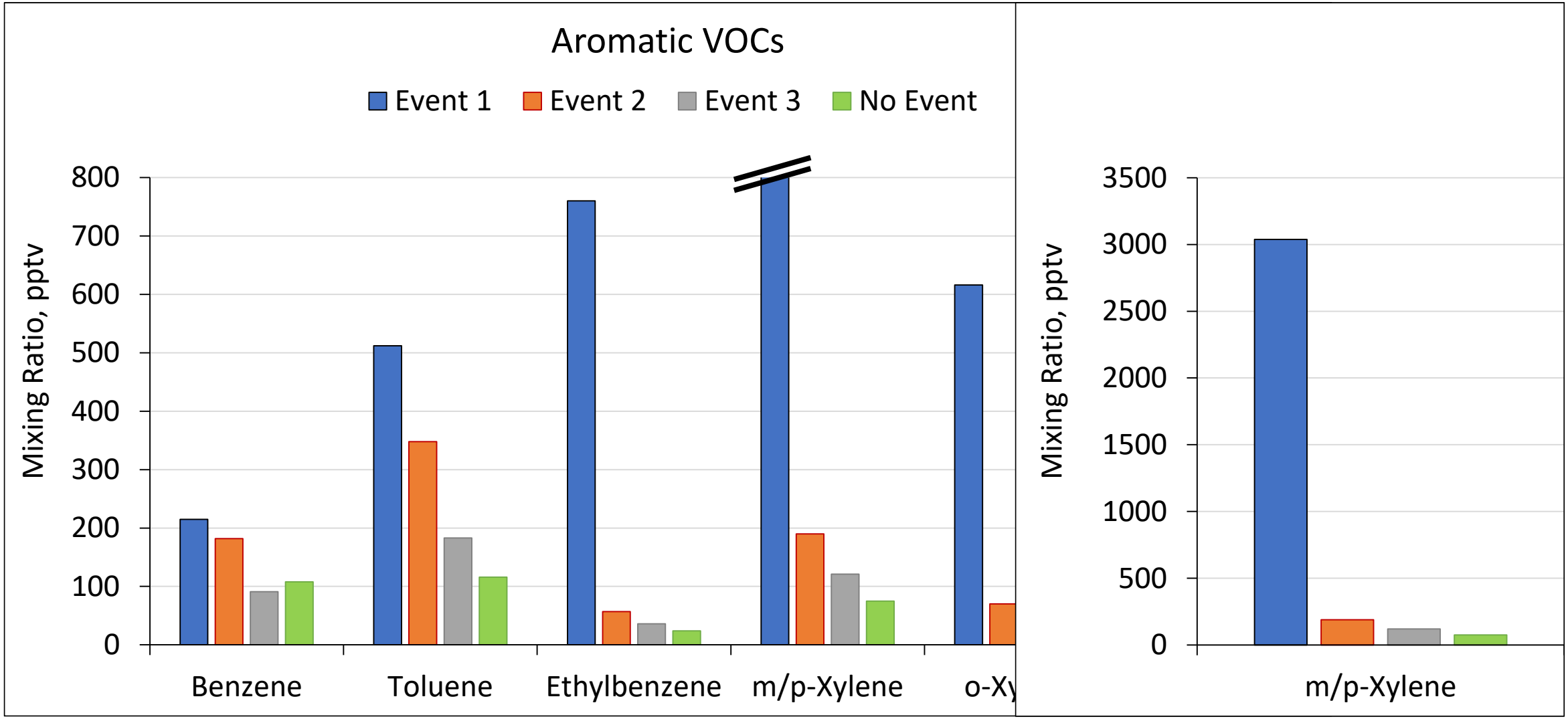




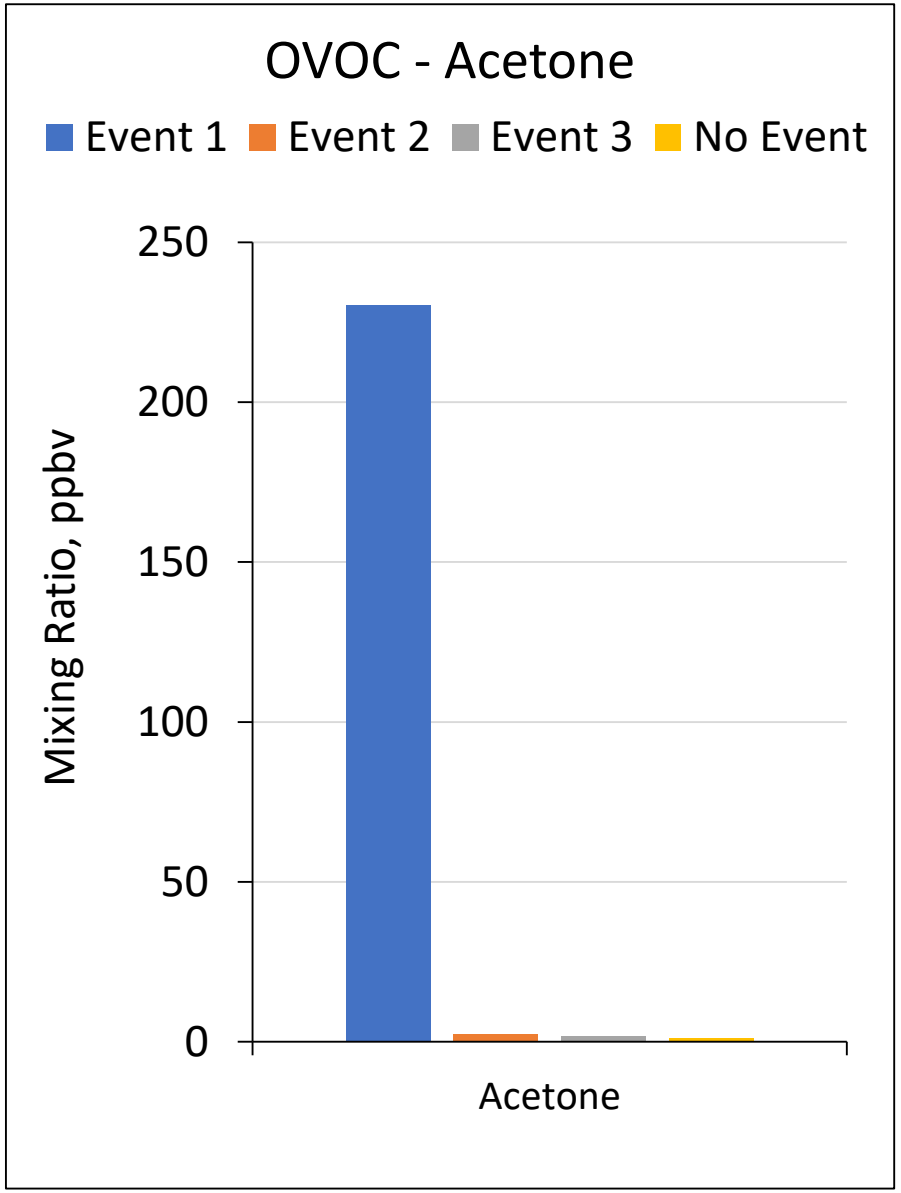
Sample Results – Aromatics



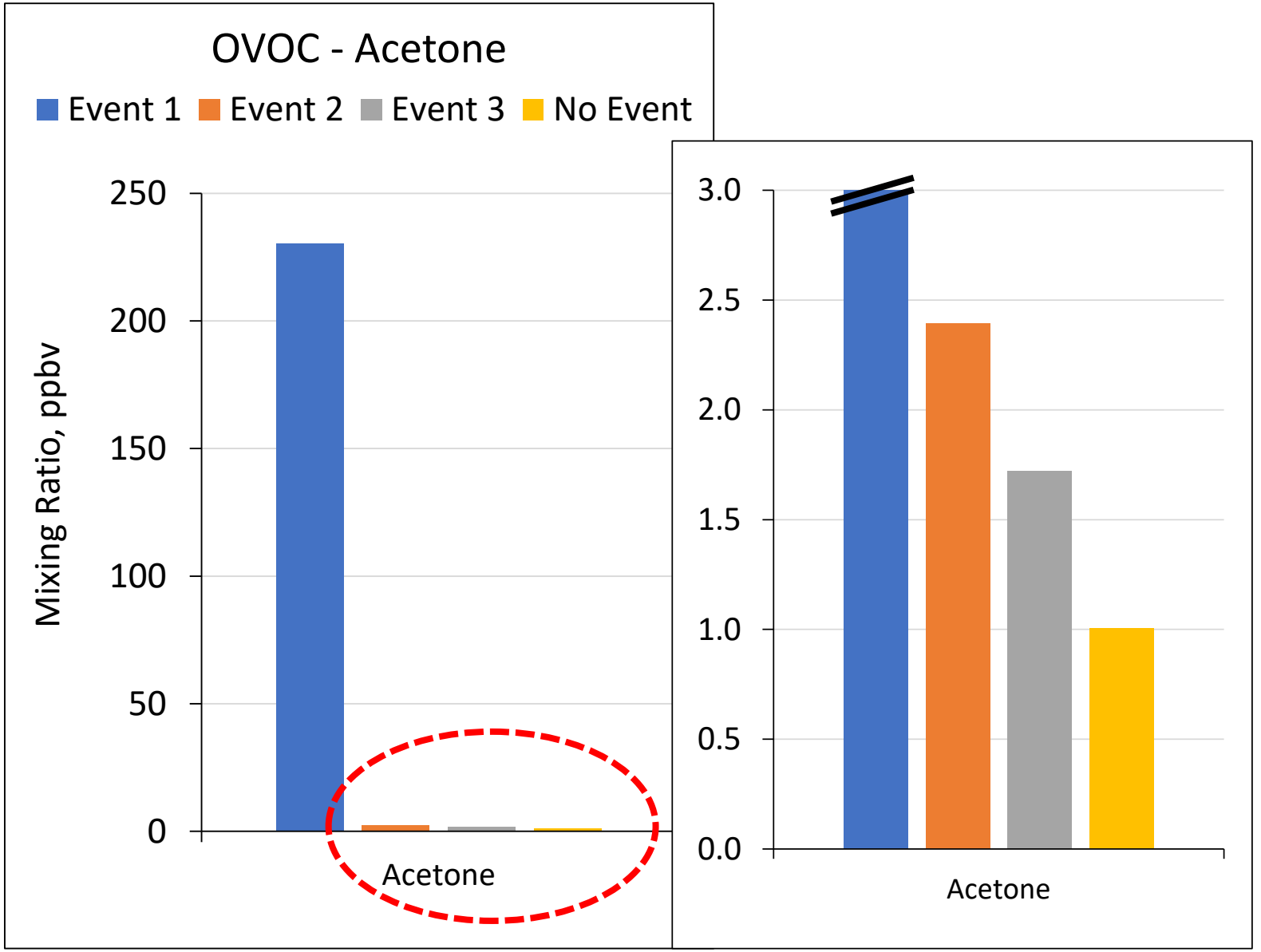
Sample Results – Aromatics

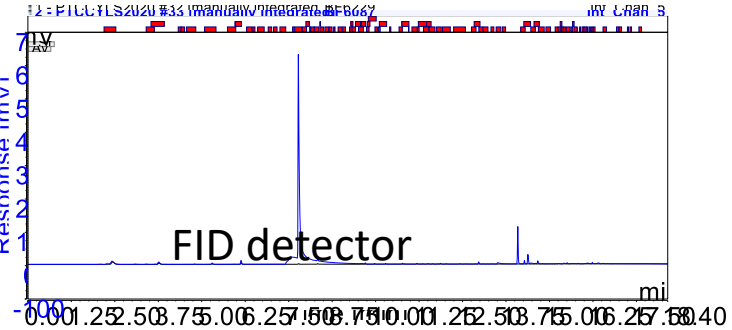


Sample Results – OVOC Acetone



Sample Results – OVOC Acetone





Acetone

Unknown MW 145

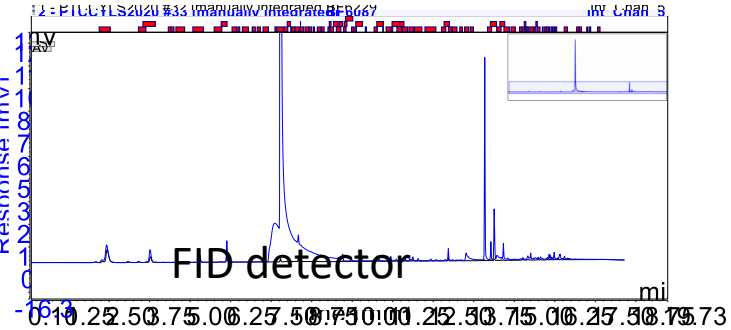
m/p-Xylene

Ethylbenzene

o-Xylene

Ethanol

N-Butyl Acetate ?


FID detector

Comparison with other US urban centers

Table 2 (*continued*)

City	Ethene	Propene	1-Butene[c]	*i*-Butene[a,b]	Isoprene	Ethyne	Benzene	Toluene	Ethylbenzene	*o*-Xylene	*m*-Xylene[a]	*p*-Xylene[a]
Baltimore	750 (230)	190 (57)	32 (8)		510 (230)	890 (220)	190 (45)	1540 (880)	130 (49)	210 (85)	200 (43)	100 (43)
Baton Rouge	570 (210)	81 (47)	19 (13)	53 (240)	1160 (710)	520 (170)	150 (30)	540 (150)	20 (9)	18 (11)	27 (20)	19 (12)
Birmingham	540 (380)	130 (130)	22 (14)	69 (37)	1070 (720)	610 (360)	170 (100)	460 (300)	39 (35)	37 (35)	71 (73)	40 (44)
Boston	330 (31)	73 (31)	19 (6)	72 (31)	1000 (720)	420 (82)	93 (24)	220 (61)	21 (7)	18 (7)	29 (13)	16 (7)
Charleston	380 (150)	90 (33)	15 (6)	38 (15)	1820 (850)	300 (95)	84 (33)	120 (55)	21 (10)	20 (7)	32 (12)	16 (16)
Charlotte	320 (130)	78 (36)	14 (27)	49 (27)	1310 (570)	260 (84)	60 (24)	210 (75)	28 (14)	21 (10)	38 (22)	21 (10)
Chicago	1290 (460)	340 (120)	15 (5)		370 (340)	920 (260)	230 (60)	1430 (860)	180 (130)	260 (210)		
Cleveland	370 (170)	76 (38)	20 (10)	46 (17)	760 (480)	500 (210)	130 (41)	250 (140)	33 (20)	31 (20)	48 (38)	33 (26)
Denver	540 (350)	130 (92)	22 (13)	54 (33)	570 (330)	430 (310)	130 (67)	280 (180)	26 (17)	22 (12)	39 (26)	18 (11)
Detroit	1660 (1050)	430 (300)	76 (43)	110 (58)	170 (150)	1510 (950)	470 (270)	1190 (740)	160 (130)	170 (140)	280 (200)	150 (140)
El Paso	370 (250)	96 (65)	24 (13)	62 (18)	47 (75)	430 (250)	150 (71)	330 (200)	34 (27)	34 (32)	51 (50)	29 (27)
Fresno	860 (690)	170 (150)	39 (23)	120 (110)	710 (800)	1260 (650)	210 (86)	500 (390)	45 (34)	49 (44)	67 (54)	46 (46)
Houston	840 (680)	190 (92)	13 (11)		1240 (550)	500 (260)	160 (71)	660 (340)	110 (120)	210 (200)		
Knoxville	740 (370)	170 (99)	22 (8)	46 (21)	920 (1110)	690 (330)	140 (55)	300 (140)	79 (31)	58 (51)	88 (91)	44 (40)
Las Vegas	520 (400)	200 (120)	46 (19)		84 (79)	540 (420)	150 (76)	330 (190)	47 (39)	85 (72)	89 (87)	37 (30)
Los Angeles	2430 (1360)	490 (280)	65 (35)	130 (99)	270 (130)	2380 (1480)	480 (240)	1380 (720)	210 (140)	200 (130)	410 (290)	210 (170)
Milwaukee	560 (300)	140 (75)	27 (9)	74 (23)	120 (160)	630 (240)	180 (63)	630 (220)	33 (18)	32 (20)	59 (40)	31 (21)
New York City (1999)	1090 (550)	320 (160)	27 (24)		350 (430)	1050 (560)	210 (110)	1240 (760)	260 (250)	370 (370)		
New York City (2003)	750 (430)	250 (140)	41 (28)	120 (93)	740 (440)	640 (250)	190 (93)	880 (680)	370 (220)	260 (220)	550 (530)	270 (260)
Oklahoma City	560 (210)	180 (57)	22 (11)		870 (610)	520 (200)	190 (66)	1070 (950)	260 (470)	370 (700)		
Philadelphia (2000)	1150 (990)	390 (330)	53 (32)		330 (200)	990 (760)	190 (130)	730 (660)	130 (72)	210 (120)	230 (140)	100 (58)
Philadelphia (2004)	1310 (840)	500 (370)	110 (81)	230 (140)	270 (94)	820 (390)	230 (120)	470 (220)	68 (43)	83 (57)	130 (110)	76 (53)
Phoenix	260 (190)	68 (49)	15 (8)	65 (39)	270 (270)	330 (150)	77 (32)	160 (96)	13 (7)	16 (12)	23 (19)	15 (10)
Pittsburgh	400 (200)	81 (41)	18 (6)	33 (11)	1410 (910)	450 (150)	96 (37)	260 (140)	23 (14)	28 (20)	46 (32)	28 (21)
Providence	390 (280)	98 (63)	21 (12)	61 (30)	2590 (1610)	520 (270)	120 (51)	300 (220)	28 (23)	32 (29)	54 (49)	15 (14)
Richmond	390 (300)	100 (73)	22 (11)	96 (60)	740 (360)	390 (300)	110 (63)	190 (160)	30 (26)	26 (25)	34 (31)	29 (30)
Saint Louis	430 (170)	110 (55)	23 (9)	100 (57)	1250 (1060)	430 (110)	120 (28)	370 (110)	34 (16)	39 (13)	76 (32)	33 (12)
Salt Lake City (1999)	1060 (890)	310 (270)	470 (420)	1360 (1070)	340 (240)	1170 (1110)	130 (99)	190 (150)				
Salt Lake City (2004)	1110 (720)	220 (150)	59 (22)	120 (49)	400 (430)	930 (600)	290 (180)	890 (700)	97 (80)	110 (90)	120 (100)	94 (61)
San Diego	1570 (950)	390 (240)	580 (700)	1550 (760)	250 (140)	680 (430)	120 (75)	200 (130)	160 (140)	91 (82)		
Washington, D.C.	930 (830)	250 (220)	38 (31)	140 (110)	1630 (1290)	910 (680)	190 (130)	420 (420)	53 (54)	51 (58)	86 (100)	45 (53)

Baker, A.K., Beyersdorf, A.J., Doezema, L.A., Katzenstein, A., Meinardi, S., Simpson, I.J., Blake, D.R., Rowland, F.S.: Measurements of nonmethane hydrocarbons in 28 United States cities. Atmospheric Environment, 42, 170-182 (2008). http://dx.doi.org/10.1016/j.atmosenv.2007.09.007.

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Charleston	380 (150)	90 (33)	15 (6)	38 (15)	1820 (850)	300 (95)	84 (33)	120 (55)	21 (10)	20 (7)	32 (12)	16 (16)
Charlotte												21 (10)
Chicago												
Cleveland												33 (26)
Denver												18 (11)
Detroit												50 (140)
El Paso												29 (27)
Fresno												46 (46)
Houston												
Knoxville												44 (40)
Las Vegas												37 (30)
Los Angeles												210 (170)
Milwaukee												31 (21)
New York City (19												
New York City (20												270 (260)
Oklahoma City												
Philadelphia (2000)	1150 (990)	390 (330)	53 (32)		330 (200)	990 (760)	190 (130)	730 (660)	130 (72)	210 (120)	230 (140)	100 (58)
Philadelphia (2004)	1310 (840)	500 (370)	110 (81)	230 (140)	270 (94)	820 (390)	230 (120)	470 (220)	68 (43)	83 (57)	130 (110)	76 (53)
Phoenix	260 (190)	68 (49)	15 (8)	65 (39)	270 (270)	330 (150)	77 (32)	160 (96)	13 (7)	16 (12)	23 (19)	15 (10)
Pittsburgh	400 (200)	81 (41)	18 (6)	33 (11)	1410 (910)	450 (150)	96 (37)	260 (140)	23 (14)	28 (20)	46 (32)	28 (21)
Providence	390 (280)	98 (63)	21 (12)	61 (30)	2590 (1610)	520 (270)	120 (51)	300 (220)	28 (23)	32 (29)	54 (49)	15 (14)
Richmond	390 (300)	100 (73)	22 (11)	96 (60)	740 (360)	390 (300)	110 (63)	190 (160)	30 (26)	26 (25)	34 (31)	29 (30)
Saint Louis	430 (170)	110 (55)	23 (9)	100 (57)	1250 (1060)	430 (110)	120 (28)	370 (110)	34 (16)	39 (13)	76 (32)	33 (12)
Salt Lake City (1999)	1060 (890)	310 (270)	470 (420)	1360 (1070)	340 (240)	1170 (1110)	130 (99)	190 (150)				
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San Diego	1570 (950)	390 (240)	580 (700)	1550 (760)	250 (140)	680 (430)	120 (75)	200 (130)	160 (140)	91 (82)		
Washington, D.C.	930 (830)	250 (220)	38 (31)	140 (110)	1630 (1290)	910 (680)	190 (130)	420 (420)	53 (54)	51 (58)	86 (100)	45 (53)

VOC	Event 1	Event 2	Event 3	No Event	Phoenix	New York
Ethylbenzene	760	57	36	24	13	370
m+p-Xylene	3,038	190	121	75	38	820
o-Xylene	616	70	48	29	16	260

Data in pptv; Mixing ratios for Phoenix and New York are calculated as mean of 21 and 20 samples, respectively.

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Conclusions

- More samples are needed to characterize the composition of the air surrounding of the All American Asphalt area;
- Sampling should include both “event” episodes AND “non-event” (i.e. local background) episodes;
- Preliminary results looking at 3 samples collected during some “event” episodes show enhanced levels on one samples while the other two samples were overall typical of urban areas;
- All data are available at:

https://sites.uci.edu/rowlandblakelab/all-american-asphalt-uci-whole-air-sampling/