Table S1. Initial Temperatures (T, in K) and mixing ratios (ppbv) used for the EPA Chamber Simulations. Note HONO initial concentration is set at 0.05 ppbv for all runs. PRO = propene, t-BUT = trans-2-butene, BUT = n-butane, OCT = octane, TOL = toluene, and XYL = m-xylene.

Case	T	NO	NO_2	CO	HCHO	C_2H_4	PRO	t-BUT	BUT	OCT	TOL	XYL
96A	303.9	64.13	45.14	0	21.73	12.29	9.907	7.779	62.03	16.15	15.96	15.13
96B	303.9	64.25	46.83	0	21.66	12.29	9.907	7.779	62.03	16.15	15.96	15.13
97A	303.7	3.107	2.175	0	12.2	8.386	7.605	6.649	52	11.16	10.59	9.833
97B	303.7	3.168	2.039	0	12.05	8.208	7.566	6.513	52	11.28	10.65	10.08
80A	303.6	62.54	29.69	0	112.3	76.64	61.63	58.43	365.7	96.88	90.98	86.35
80B	303.6	62.54	29.69	0	112.3	76.64	61.63	58.43	365.7	96.88	90.98	86.35
81A	303.5	33.47	16.43	0	59.27	41.41	31.91	29.46	187.1	60.08	50.47	46.97
81B	303.5	33.5	16.51	0	59.01	41.42	32.23	29.31	185.7	60.08	49.91	46.7
128A	302.6	30.59	17.03	0	10.98	8.751	8.258	7.124	53.93	12.17	11.67	11.57
83A	303.5	31.69	16.17	20.67	18.32	26.02	14.68	12.97	88.29	24	20.23	19.19
84B	303.5	33.61	17.51	20.67	24.72	16.34	16.79	15.32	100.4	29	24.23	22.94
110B	303.4	19.57	11.91	20.67	0	9.763	8.834	7.81	58.71	12.99	12.43	12.7
114A	302.7	19.88	10.9	20.67	21	8.219	7.473	6.664	50.45	12.67	11.9	11.51
127B	302.8	18.65	10.37	20.67	11.82	8.636	8.025	6.791	52.78	11.88	11.33	11.18
137A	303.4	18.29	10.28	20.67	11.01	8.845	8.476	7.335	55.43	12.17	11.35	13.29
143A	303.5	18.41	10.26	20.67	0.1523	8.688	8.126	6.791	51.84	11.48	10.95	10.84
143B	303.5	18.5	10.3	20.67	0	8.782	8.134	7.053	52.82	11.89	11.39	11.21
151B	303.7	18.23	11.39	20.67	10.12	8.292	7.683	6.77	50.22	12.66	11.57	11.95
163B	303.9	14.87	8.699	20.67	10.79	7.781	7.341	6.468	48.11	11.94	11.51	11.29
167A	304.1	18.02	11.05	20.67	10.87	8.48	8.111	7.113	52.25	12.31	11.57	11.64
168B	303.9	18.16	10.83	20.67	10.87	8.677	8.168	6.921	51.06	12.09	11.26	11.62
226A	304.7	19.56	11.3	45.65	0	9.064	8.274	8.5	47.09	13.15	12.89	12.73
226B	304.7	19.5	11.37	41.32	0	9.22	8.481	8.849	47.81	13.46	13.05	13.37
229B	303.3	20.18	11.62	41.32	0	10.26	9.799	9.776	56.15	15.27	14.1	15.51
230A	302.6	20.68	12.53	41.32	0	9.08	8.81	9.089	50.51	14.29	13.25	14
100A	303.6	3.07	2.254	41.32	9.2	5.34	4.65	3.885	35	6.899	5.851	5.581
180B	304.8	31.64	19.92	41.32	33	34.38	32.62	34.36	186.6	51.03	48.85	47.51
181B	305.1	13.17	10.8	41.32	32	35.49	32.88	34.78	188.1	47.84	45.71	44.52
182B	304.6	30.15	22.52	41.32	15	18.16	16.85	17.89	98.27	23.83	22.59	22.21
188B	304.4	7.546	6.216	41.32	8	8.663	8.183	8.404	49.4	11.87	11.27	11.07
189B	302.0	7.754	5.641	41.32	16.5	16.94	15.63	16.35	91.4	21.89	20.93	20.17
190B	304.4	63.32	34.07	41.32	10.5	8.578	7.998	8.121	49.63	12.94	12.43	12
191B	301.8	8.104	4.7	41.32	4	4.211	4.15	4.184	27.14	6.464	6.162	6.154
192B	304.0	3.916	3.08	41.32	6	8.259	7.881	8.252	48.32	10.46	9.853	9.844
193B	304.4	32	15.67	41.32	4	4.619	4.461	4.337	28.08	6.068	5.762	5.749
197B	304.9	64.16	39.59	41.32	43	34.03	31.52	33.29	183	44.37	42.29	41.4
113A	303.1	44.42	24.84	41.32	0	16.32	14.88	12.91	91.75	24	22.9	22.59
180A	304.8	31.61	20.22	41.32	33	34.38	32.62	34.36	186.6	51.03	48.85	47.51

Table S2. Off-gassing, wall reaction, and selected photolysis rates used for the EPA Chamber Simulations.

Reaction	**Rate (s^{-1})**
OffGas → HONO	5.5424×10^{-8} (Chamber A)
OffGas → HONO	3.6805×10^{-8} (Chamber B)
OffGas → HCHO	8.33×10^{-8}
O_3 → Wall O_3	1.8×10^{-6}
NO_2 → 0.2 HONO + 0.8 Wall NO_X	2.67×10^{-6}
N_2O_5 → Wall NO_X	4.67×10^{-5}
NO_2 → NO + O	4.333×10^{-3}
O_3 → O^{1D} + O_2	2.947×10^{-6}
O_3 → O + O_2	8.6667×10^{-4}
HONO → 0.9 OH + 0.9 NO + 0.1 HO_2 + 0.1 NO_2	8.6667×10^{-4}
NO_3 → NO + O_2	8.233×10^{-3}
HCHO → HO_2 + HO_2 + CO	4.767×10^{-6}
Acetaldehyde → CH_3O_2 + HO_2 + CO	$5{,}776\times10^{-7}$
Acetone → CH_3CO_3 + CH_3O_2	4.767×10^{-8}
MGLY → CH_3CO_3 + CO + HO_2	6.5×10^{-5}

Table S3. Initial and background trace gas concentrations for the ASP simulations of the Williams Fire smoke plume. Only compounds with non-zero values are listed. "GEOS-Chem" refers to the GEOS-Chem model output from the study of Fischer et al., 2014.

Species	Initial Conc. (ppbv)	Background Conc. (ppbv)	Initial Conc. Source	Background Conc. Source
CO	1.00E+04	1.29E+02	Akagi et al., 2012	-
CO_2	5.28E+05	3.90E+05	Akagi et al., 2012	Approximate
Trace	1.00E+03	0.00E+00	-	-
NO	1.14E+02	1.50E-02	Akagi et al., 2012	GEOS-Chem
NO_2	2.27E+02	3.90E-02	Akagi et al., 2012	GEOS-Chem
O_3	0.00E+00	5.00E+01	Akagi et al., 2012	Akagi et al., 2012
H_2O_2	7.55E-01	7.55E-01	-	GEOS-Chem
HONO	3.95E+01	0.00E+00	Akagi et al., 2012	-
SO_2	3.79E+01	1.20E-01	Akagi et al., 2011 (chaparral)	GEOS-Chem
HNO_3	4.10E-01	4.10E-01	-	GEOS-Chem
H_2SO_4	1.00E-04	0.00E+00	-	-
HCl	1.95E+01	1.00E-05	Akagi et al., 2011 (chaparral)	-
NH_3	3.79E+02	9.60E-04	Akagi et al., 2012	GEOS-Chem
H_2	3.74E+03	1.00E-05	Akagi et al., 2011 (savannah)	-
C_1 Parent Compounds				
CH_4	2.76E+03	1.90E+03	Akagi et al., 2012	Approximate
HCHO	1.63E+02	3.30E-01	Akagi et al., 2012	GEOS-Chem
Methanol	1.65E+02	0.00E+00	Akagi et al., 2012	-
Formic Acid	6.50E+00	0.00E+00	Akagi et al., 2012	-
HCN	1.28E+02	0.00E+00	Akagi et al., 2012	-
C_2 Parent Compounds				
Ethylene	1.26E+02	0.00E+00	Akagi et al., 2012	-
Ethane	5.28E+01	0.00E+00	Akagi et al., 2011 (chaparral)	-
Acetaldehyde	5.70E+01	0.00E+00	Akagi et al., 2011 (savannah)	-
Ethanol	9.87E-01	0.00E+00	Andreae and Merlet, 2001 with 2009 updates (savannah)	-
Acetic Acid	1.39E+02	0.00E+00	Akagi et al., 2012	-
Glyoxal	8.52E+01	0.00E+00	Andreae and Merlet, 2001 with 2009 updates (savannah)	-
Acetylene	2.68E+01	0.00E+00	Akagi et al., 2012	

C_3 Parent Compounds				
Propene	4.74E+01	0.00E+00	Akagi et al., 2012	-
Propane	1.78E+01	0.00E+00	Akagi et al., 2011 (chaparral)	-
Acrolein	5.92E+00	0.00E+00	Andreae and Merlet, 2001 with 2009 updates (savannah)	-
Propanal	6.42E-01	0.00E+00	Andreae and Merlet, 2001 with 2009 updates (savannah)	-
Acetone	1.21E+01	0.00E+00	Akagi et al., 2011 (savannah)	-
n-Propanol	1.84E+00	0.00E+00	Andreae and Merlet, 2001 with 2009 updates (savannah)	-
Methyl Glyoxal	4.47E+01	0.00E+00	Andreae and Merlet, 2001 with 2009 updates (savannah)	-
C_4 Parent Compounds				
Butadiene	4.23E+00	0.00E+00	Akagi et al., 2011 (savannah)	-
1-Butene	3.34E+00	0.00E+00	Akagi et al., 2011 (savannah)	-
cis-2-Butene	6.80E-01	0.00E+00	Akagi et al., 2011 (savannah)	-
trans-2-Butene	8.55E-01	0.00E+00	Akagi et al., 2011 (savannah)	-
i-Butene	1.89E+00	0.00E+00	Akagi et al., 2011 (savannah)	-
n-Butane	9.87E+00	0.00E+00	Akagi et al., 2011 (chaparral)	-
i-Butane	3.23E-01	0.00E+00	Akagi et al., 2011 (savannah)	-
Butanal	3.34E+00	0.00E+00	Andreae and Merlet, 2001 with 2009 updates (savannah)	-
MEK	1.53E+01	0.00E+00	Andreae and Merlet, 2001 with 2009 updates (savannah)	-
n-Butanol	5.00E-01	0.00E+00	Andreae and Merlet, 2001 with 2009 updates (savannah)	-
Lumped Parent Compounds				
FURAN	2.02E+01	0.00E+00	Akagi et al., 2012	-
ISOP	2.53E+00	0.00E+00	Akagi et al., 2011 (savannah)	-

ALD	7.22E-01	2.00E-02	Andreae and Merlet, 2001 with 2009 updates (savannah)	GEOS-Chem
API	3.26E+01	0.00E+00	Akagi et al., 2013	-
BALD	1.25E+00	0.00E+00	Andreae and Merlet, 2001 with 2009 updates (savannah)	-
BEN	1.11E+01	0.00E+00	Akagi et al., 2011 (savannah)	
DIEN	1.20E+00	0.00E+00	Andreae and Merlet, 2001 with 2009 updates (savannah)	
HC_5	2.38E+00	1.08E+00	Akagi et al., 2011 (savannah)	GEOS-Chem
KET	1.58E+00	0.00E+00	Andreae and Merlet, 2001 with 2009 updates (savannah)	
LIM	3.26E+01	0.00E+00	Akagi et al., 2013	-
OLI	2.14E+00	0.00E+00	Akagi et al., 2011 (savannah)	
OLT	8.75E-01	0.00E+00	Akagi et al., 2011 (savannah)	
PHEN	1.46E+01	0.00E+00	Akagi et al., 2012	-
ROH	1.70E+00	0.00E+00	Andreae and Merlet, 2001 with 2009 updates (savannah)	
TOL	4.07E+00	0.00E+00	Akagi et al., 2011 (savannah)	
XYM	3.15E-01	0.00E+00	Akagi et al., 2011 (savannah)	
XYP	8.59E-02	0.00E+00	Akagi et al., 2011 (savannah)	
XYO	1.62E-01	0.00E+00	Akagi et al., 2011 (savannah)	
Highly oxygenated VOCs				
$HOCH_2CHO$	1.85E-01	0.00E+00	Akagi et al., 2012	-
ACETOL	2.68E+01	0.00E+00	Akagi et al., 2011 (savannah)	-
BIACET	2.79E+01	0.00E+00	Andreae and Merlet, 2001 with 2009 updates (savannah)	-
Organic Nitrates				
PAN	6.61E+00	3.00E-02	Akagi et al., 2012	GEOS-Chem
PPN	3.20E-03	3.20E-03	GEOS-Chem	GEOS-Chem
CH_3NO_3	2.91E-02	0.00E+00	Akagi et al., 2011 (savannah)	-

VBS compounds				
$SVOC_3$	2.60E-03	0.00E+00	Grieshop et al., 2009a[a]	-
$SVOC_4$	4.37E-02	0.00E+00	Grieshop et al., 2009a[a]	-
$SVOC_5$	1.20E+00	0.00E+00	Grieshop et al., 2009a[a]	-
$SVOC_6$	1.03E+01	0.00E+00	Grieshop et al., 2009a[a]	-
$SVOC_7$	9.31E+00	0.00E+00	Grieshop et al., 2009a[a]	-
$SVOC_8$	2.17E+02	0.00E+00	Akagi et al., 2011[b] (savannah)	

[a] The POA volatility distribution of Grieshop et al. (2009a) is used for the relative total mass fractions of these species, as described in the text and shown in Table 1.
[b] Derived from the Akagi et al. (2011) estimate of the emissions of unidentified NMOCs in Savannah fire smoke, as described in the text and shown in Table 1.

Table S4. Initial and background aerosol mass concentrations for the ASP simulations of the Williams Fire smoke plume. Only compounds with non-zero values are listed. Italics is used for compounds that are components of modeled OA.

Species	**Initial Conc. ($\mu g/m^3$)[a]**	**Background Conc. ($\mu g/m^3$)[a]**	**Initial Conc. Source**	**Background Conc. Source**
OA	849	1.335	Akagi et al., 2012	GEOS-Chem
$SVOC_3$	*103.4*	-	*Grieshop et al. (2009a)*[b]	-
$SVOC_4$	*144.2*	-	*Grieshop et al. (2009a)*	-
$SVOC_5$	*326.4*	-	*Grieshop et al. (2009a)*	-
$SVOC_6$	*228.5*	-	*Grieshop et al. (2009a)*	-
$SVOC_7$	*16.7*	-	*Grieshop et al. (2009a)*	-
$SVOC_8$	*29.8*		*Akagi et al. (2011)*[c]	
CPD3[d]	-	*1.335*	-	*GEOS-Chem*
BC	187	0.357	Akagi et al., 2012	GEOS-Chem
K	1.86	-	Amount needed to neutralize anions	-
NH_4	14.3	1.291	Akagi et al., 2012	GEOS-Chem
SO_4	0.855	6.603	Akagi et al., 2012	GEOS-Chem
NO_3	30.4	0.174	Akagi et al., 2012	GEOS-Chem
Cl	11.9	-	Akagi et al., 2012	-

[a]Values at the temperature and pressure of the plume (T = 288.4 K, P = 880 hPa)
[b] The POA volatility distribution of Grieshop et al. (2009a) is used for the relative total mass fractions of these species, as described in the text and shown in Table 1.
[c] Derived from the Akagi et al. (2011) estimate of the emissions of unidentified NMOCs in Savannah fire smoke, as described in the text and shown in Table 1.
[d]Extremely low volatility humic-like species, see Alvarado, 2008.