Supporting Information:

Chemical Composition of Toluene and Cresol Secondary Organic Aerosol: Effect of NO_x Level

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Environmental Chamber Experimental Details

Hydroxyl radicals were produced through the photolysis of hydrogen peroxide (50% weight solution, Sigma Aldrich), which was introduced into the environmental chamber using filtered air flowing at 5 L min^{-1} through a glass trap immersed in a 35 °C water bath over the course of 1.5 to 2 h. The environmental chamber black lights' peak wavelength is 350 nm. To minimize self-reaction of peroxy radicals (RO_2+RO_2) and promote the reaction of peroxy radicals with HO_2 radicals (RO_2+HO_2) under low-NO conditions, 220 μL of H_2O_2 solution was injected to reach a concentration of 4 ppm. Under high-NO conditions, 110 μL of H_2O_2 solution was injected to reach a concentration of 2 ppm; less H_2O_2 was necessary to achieve a dominant RO_2+NO regime. For high-NO conditions, an initial injection of 100 ppb was performed prior to the initiation of photooxidation, and a continuous flow of 50 ppb h^{-1} was used to maintain an RO_2+NO-dominant regime throughout the course of the experiment. Seed aerosol was produced by the atomization of aqueous solutions of inorganic salts. Ammonium sulfate (>99.9%, Sigma Aldrich), sodium chloride (>99%, Sigma Aldrich), sodium sulfate (>99%, Sigma Aldrich), and magnesium sulfate (>99%, Sigma Aldrich) with sulfuric acid (18 M, Sigma Aldrich) were used in seed aerosol preparations. Ammonium sulfate was prepared at a concentration of 0.015 M for

the majority of experiments, and at a concentration of 0.06 M for a high seed surface area experiment; the rest of the seed solutions were prepared at concentrations of 0.03 M.

Master Chemical Mechanism for non-Cresol Pathways for Toluene Photooxidation

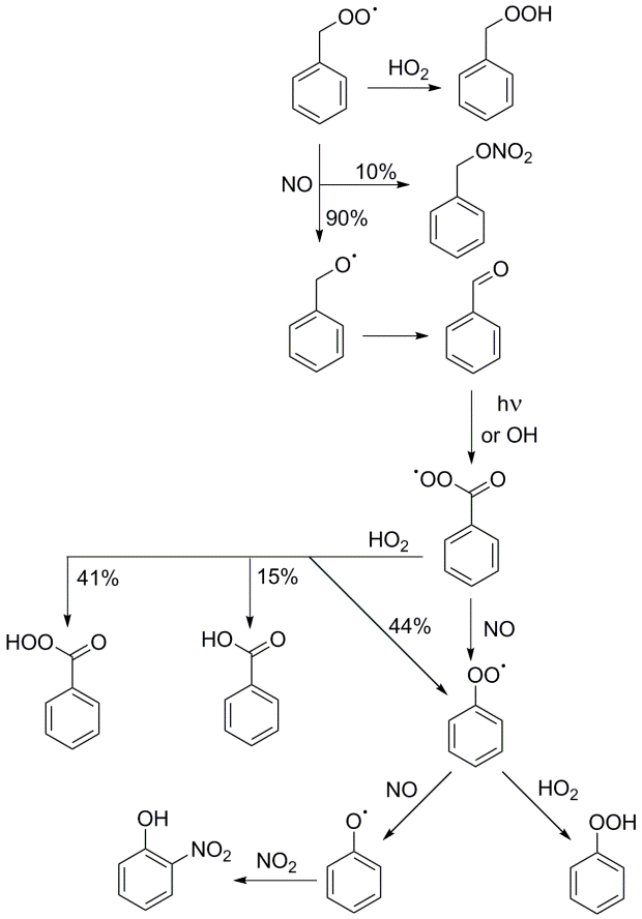


Figure S1. MCM mechanism for the gas-phase oxidation of the benzyl peroxy radical under low- and high-NO conditions.[1]

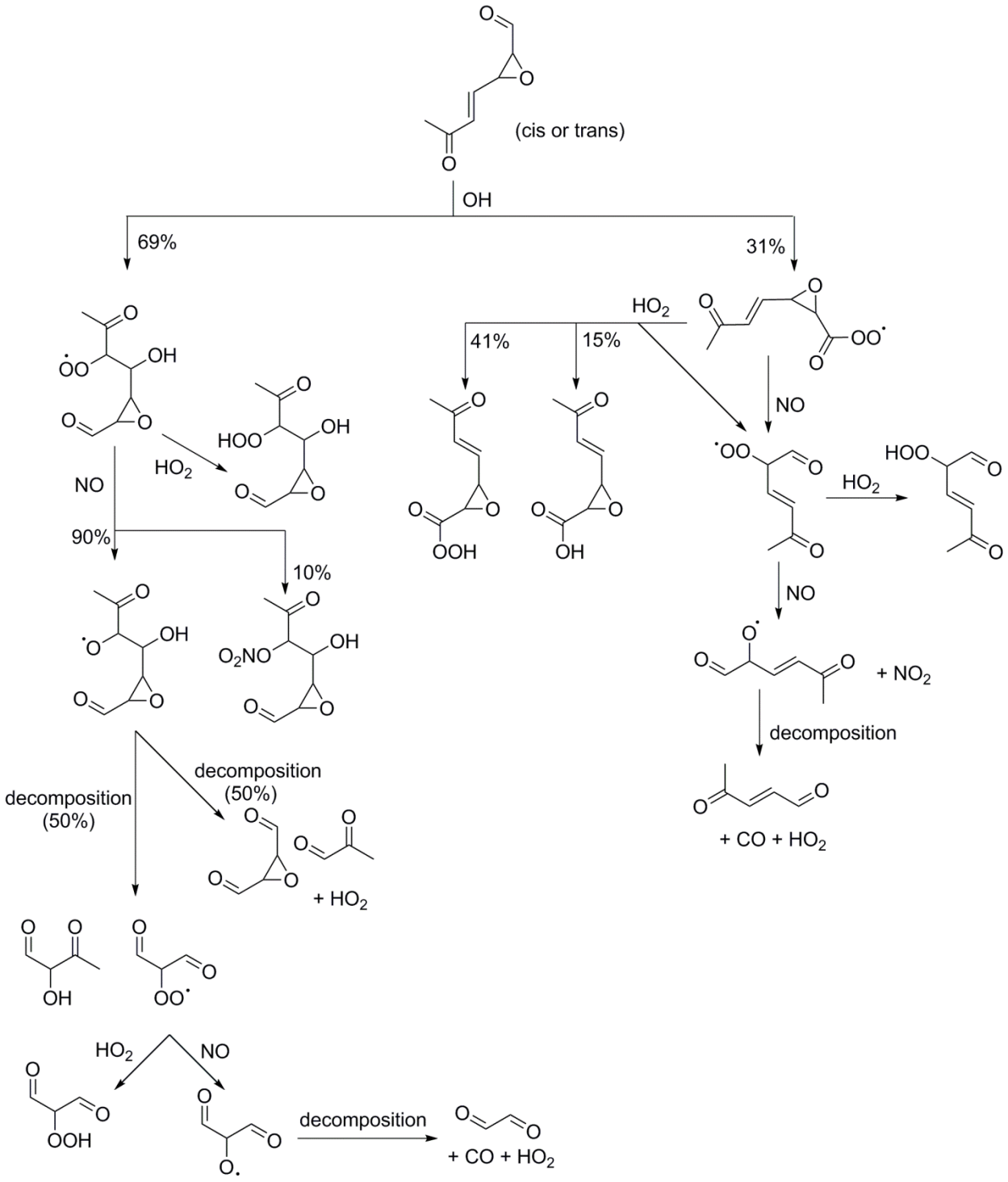


Figure S2. MCM mechanism for the gas-phase oxidation of the toluene-derived epoxy muconaldehyde under low- and high-NO conditions.[1]

DART-HR-MS Analysis of SOA Collected by Filtration

Standards & Sampling Material

A mass calibrant and independent quality assurance quality control (QA/QC) compounds were run with each sample set to ensure mass accuracy to within 5 mDa. The mass calibrant used for positive mode was polyethylene glycol (average molecular weight of 600 amu, PEG-600; Acros Organics, Geel, Belgium) which was dissolved in methanol. The independent QA/QC compound used is reserpine, which was purchased from Sigma-Aldrich, which was diluted in methanol. The mass calibrant for negative mode was a mixture of fatty acids including (at approximately 100 µg per fatty acid): hexanoic acid, octanoic acid, decanoic, acid, dodecanoic acid, myristic acid, palmitic acid, stearic acid, eicosanoic acid, docosanoic acid, and tetracosanoic acid; dissolved in 2 mL of hexane. An individual sample of hexadecanoic acid was sampled as a QA/QC compound.

Tweezers were used to introduce the samples into the DART gas stream. Before analysis, the tweezers were rinsed with acetone, and were introduced into the gas stream to vaporize any contaminants which may have been present on them.

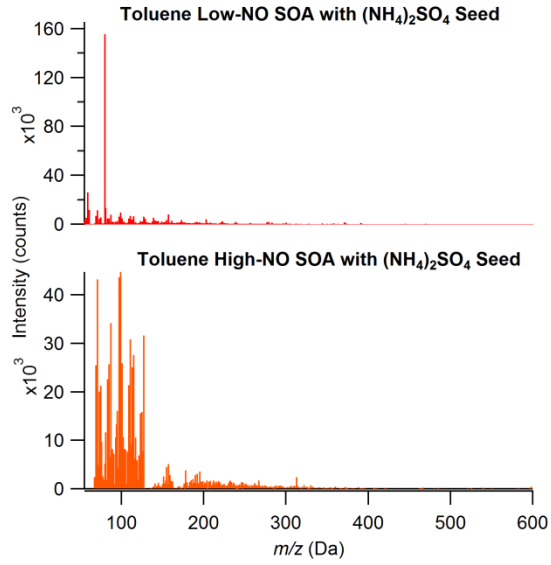
A ~1 cm strip was cut from each sample substrate for testing. The cutting was tested in triplicate, with each sampling being from a different are of the substrate.

Development of Mass Calibration Mixtures

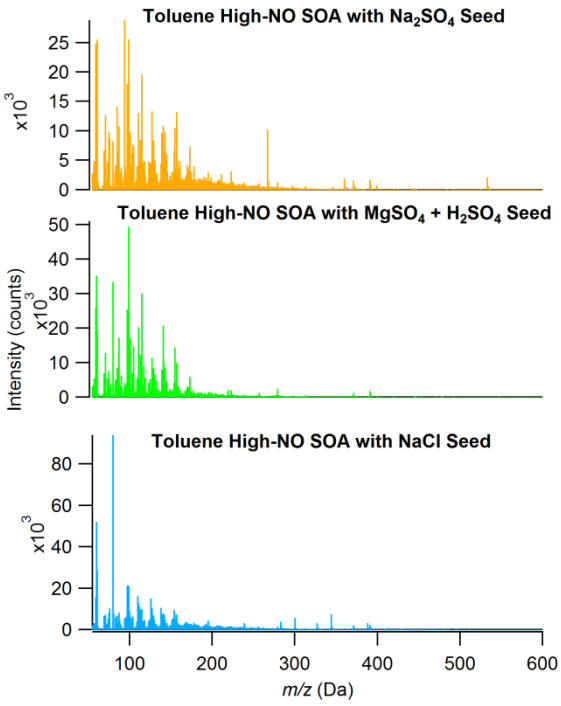
In these studies, a solution of PEG-600 (50 µL in 10 mL of methanol) was used to calibrate the mass spectrometer for each run. PEG-600 provided a series of $[M+H]^+$ and $[M+H_3O]^+$ ions in positive mode, allowing for tuning peaks in the range of 61-679 Da. In negative mode $[M+OH]^-$ peaks were used, providing a tuning range of 75-675 Da. Acceptable calibration was determined if the calibration Mass Center software produced a residual value of

59 >9 x 10^{-12}. To ensure proper calibration, a solution of reserpine (5 mg in 10 mL of methanol) or
60 linoleic acid (20 µL in 10 mL of methanol) was analyzed subsequent to the PEG-600 in every
61 sample run. Reserpine produces a protonated molecule peak at 609.281 Da in positive mode.
62 Linoleic acid, which produces a deprotonated molecule peak at 279.232 Da was used in negative
63 mode to ensure accurate calibration. Calibration was deemed sufficient if the mass of the above
64 listed peaks fell within ± 0.005 Da of the theoretical value.
65 *Parameters for AccuTOF-DART*
66 The instrument which was used in the study was a JEOL (Tokyo, Japan) AccuTOF™
67 mass spectrometer (JMS-T100LC) coupled with an IonSense (Saugus, MA, USA) DART®
68 source. Ultra-pure helium was used as the ionizing gas with a flow rate of 1.75 L min^{-1}. For all
69 analyses, the DART® source was set to a needle voltage of ±3.5 kV. Electrode 1 and electrode 2
70 voltages were both set to ±150 V. Mass spectrometer settings include: an orifice 1 voltage of
71 ±20 V, orifice 2 voltage of ±5 V, a ring lens voltage of ±5 V, a peaks voltage of 1500 V, a mass
72 range of 50 – 1500 m/z at 0.5 seconds per scan. A helium gas stream temperature of 325 °C was
73 also employed.
74

DART-HR-MS Mass Spectra for Toluene and o-, m-, and p-Cresol SOA



a)



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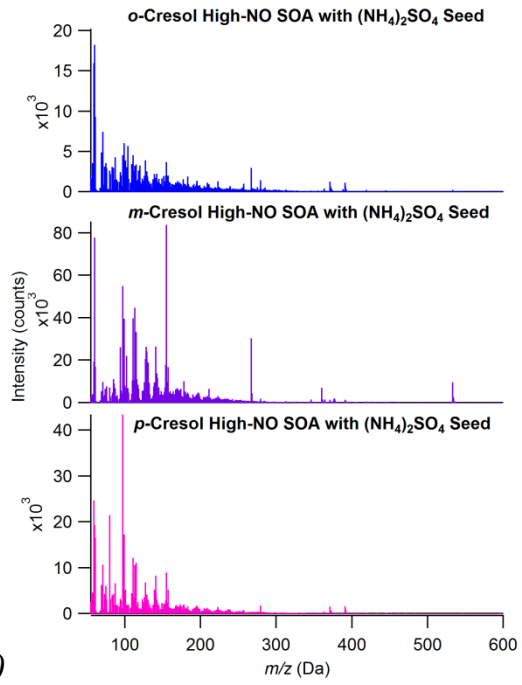

c)

Figure S3. (+)-DART-HR-MS mass spectra for toluene and cresol SOA.

Measured Chemical Compositions for Toluene and o-, m-, and p-Cresol SOA

Table S1: Chemical composition measured by (+)-DART-HR-MS of toluene SOA generated under low-NO conditions with $(NH_4)_2SO_4$ seed. Abundance is defined as $((C_A/C_{IS})/\sum(C_A/C_{IS}))$.

m/z (Da)	Abundance	C	H	N	O	Category	Smiles	P_{vap} (atm)
59.0491	1.21E-12	3	6		1	$C_xH_yO_1$	CC(C)=O	3.87E-01
61.0284	4.71E-11	2	4		2	$C_xH_yO_2$	CC(O)=O	4.49E-03
71.0491	2.94E-12	4	6		1	$C_xH_yO_1$	CC=CC=O	8.30E-02
73.0648	5.62E-13	3	4		2	$C_xH_yO_2$	CC(C=O)=O	1.90E-01
75.0441	1.49E-11	3	6		2	$C_xH_yO_2$	CC(CO)=O	6.92E-03
80.0495	1.18E-10	5	5	1		C_xH_yN	C1=NC=CC=C1	2.63E-02
85.0284	3.99E-11	4	4		2	$C_xH_yO_2$	O=CC=CC=O	3.42E-03
87.0441	2.79E-11	4	6		2	$C_xH_yO_2$	O=CCCC=O	6.19E-03
97.0284	1.64E-11	5	4		2	$C_xH_yO_2$	O=CC1=CC=CO1	7.54E-03
99.0441	2.02E-10	5	6		2	$C_xH_yO_2$	CC(C=CC=O)=O	1.12E-03
101.0597	6.31E-12	5	8		2	$C_xH_yO_2$	CC1CCC(O1)=O	2.17E-02
111.0441	7.8E-11	6	6		2	$C_xH_yO_2$	O=CC1=CC=C(C)O1	2.46E-03
115.0390	2.89E-07	5	6		3	$C_xH_yO_3$	CC(C=CC(O)=O)=O	5.26E-07
123.0441	1.03E-08	7	6		2	$C_xH_yO_2$	O=C(C=C1)C=C(C)C1=O	8.12E-06
125.0597	3.64E-08	7	8		2	$C_xH_yO_2$	CC1=C(O)C=CC=C1O	2.29E-06
127.0390	3.8E-07	6	6		3	$C_xH_yO_3$	O=CC1=C(O)C=C(C)O1	5.26E-07
129.0546	2.22E-07	6	8		3	$C_xH_yO_3$	O=CC1=CCC(O1)(O)C	5.26E-07
139.0390	2.67E-07	7	6		3	$C_xH_yO_3$	O=C1C(C)=CC(C(O)=C1)=O	5.26E-07
141.0546	1.58E-05	7	8		3	$C_xH_yO_3$	CC1=C(O)C=CC(O)=C1O	5.77E-09
143.0339	2.73E-05	6	6		4	$C_xH_yO_4$	O=C(O)C=CC=CC(O)=O	3.29E-09
155.0339	1.33E-05	7	6		4	$C_xH_yO_4$	O=C1C(C)=C(O)C(C(O)=C1)=O	8.26E-09
157.0495	0.007994	7	8		4	$C_xH_yO_4$	CC1=C(O)C(O)=CC(O)=C1O	2.35E-11
173.0445	0.991948	7	8		5	$C_xH_yO_{5+}$	CC1=C(O)C(O)=C(O)C(O)=C1O	8.99E-14
195.1380	3.06E-07	10	18		2	$C_xH_yO_2$	O=C(OCC(C)=O)C1=CC=CC=C1O	2.29E-07

Table S2: Chemical composition measured by (+)-DART-HR-MS of toluene SOA generated under high-NO conditions with $(NH_4)_2SO_4$ seed. Abundance is defined as $((C_A/C_{IS})/\sum(C_A/C_{IS}))$. Compounds marked with an asterisk (*) indicate they are also detected in *o*-cresol SOA.

m/z (Da)	Abundance	C	H	N	O	Category	Smiles	P_{vap} (atm)
69.0692	4.17E-10	4	4		1	$C_xH_yO_1$	O1C=CC=C1	2.05E-01
71.0487	1.75E-09	4	6		1	*$C_xH_yO_1$	CC=CC=O	8.30E-02
72.0485	1.79E-06	3	5	1	1	$C_xH_yNO_1$	C=CC(N)=O	9.20E-06
73.0635	3.55E-10	3	4		2	$C_xH_yO_2$	CC(C=O)=O	1.90E-01
75.0433	1.03E-08	3	6		2	*$C_xH_yO_2$	CC(CO)=O	6.92E-03
76.0395	1.34E-01	*2*	5	1	2	$C_xH_yNO_2$	NCC(O)=O	2.42E-10
80.0496	6.62E-10	5	5	1		*CHN	C1=NC=CC=C1	2.63E-02
83.0838	1.14E-09	5	6		1	$C_xH_yO_1$	CC1=CC=CO1	6.70E-02
85.0297	2.53E-08	4	4		2	*$C_xH_yO_2$	O=CC=CC=O	3.42E-03
87.0439	1.86E-08	4	6		2	*$C_xH_yO_2$	O=CCCC=O	6.19E-03
89.0581	4.26E-08	4	8		2	*$C_xH_yO_2$	O=CCCCO	6.48E-04

91.0540	2.13E-06	3	6		3	$C_xH_yO_3$	OC(C(O)=O)C	1.13E-05
93.0391	2.57E-09	6	4		1	$C_xH_yO_1$	C12=C(O2)C=CC=C1	1.39E-02
95.0815	2.67E-08	6	6		1	$C_xH_yO_1$	OC1=CC=CC=C1	2.02E-03
96.0480	4.19E-05	5	5	1	1	$C_xH_yNO_1$	O=C1C=CC=CN1	3.38E-07
97.0327	3.15E-07	5	4		2	$C_xH_yO_2$	O=C1C=CC(C1)=O	4.67E-04
99.0453	1.10E-08	5	6		2	$C_xH_yO_2$	CC1=CCC(O1)=O	1.37E-02
100.0452	8.82E-05	4	5	1	2	$C_xH_yNO_2$	O=C(N1)CCC1=O	4.71E-07
101.0576	4.06E-08	4	4		3	$C_xH_yO_3$	O=C1CCC(O1)=O	2.15E-03
102.0896	1.90E-09	4	7	1	2	$C_xH_yNO_2$	O=C(OCC)C=N	1.89E-02
103.0428	5.81E-08	4	6		3	$C_xH_yO_3$	O=C1C(O)CCO1	4.80E-04
104.0371	8.01E-10	3	5	1	3	$C_xH_yNO_3$	C=CC(ON(=O)=O)	2.60E-02
105.0228	1.23E-05	3	4		4	$C_xH_yO_4$	OCC(C(O)=O)=O	2.22E-06
107.0655	1.41E-08	7	6		1	$C_xH_yO_1$	O=CC1=CC=CC=C1	1.83E-03
109.1014	1.09E-07	7	8		1	$C_xH_yO_1$	OC1=C(C)C=CC=C1	6.61E-04
110.0612	2.73E-08	6	7	1	1	$C_xH_yNO_1$	OC1=CC=C(C)N=C1	7.24E-04
111.0475	2.84E-07	6	6		2	$C_xH_yO_2$	O=CC=CC=CC=O	3.66E-04
112.0432	4.35E-08	5	5	1	2	$C_xH_yNO_2$	O=C(N1)C=C(C)C1=O	7.03E-04
113.0534	1.72E-07	6	8		2	$C_xH_yO_2$	O=CCCC=CC=O	4.92E-04
114.0581	1.46E-06	5	7	1	2	$C_xH_yNO_2$	OC(C1=NCCC1)=O	2.57E-05
115.0418	1.41E-07	6	10		2	$C_xH_yO_2$	O=CCCCCC=O	6.62E-04
117.0570	1.86E-07	5	8		3	$C_xH_yO_3$	O=C1C(C)CC(O)O1	1.91E-04
118.0527	1.73E-09	4	7	1	3	$C_xH_yNO_3$	O=C(O)C(O)CC=N	8.50E-03
119.0670	7.35E-07	4	6		4	$C_xH_yO_4$	OC(C(O)C=O)C=O	2.68E-05
123.0470	1.89E-06	7	6		2	$C_xH_yO_2$	O=CC1=C(O)C=CC=C1	2.77E-05
124.0470	6.62E-08	6	5	1	2	$C_xH_yNO_2$	O=N(C1=CC=CC=C1)O	2.87E-04
125.0675	2.32E-05	7	8		2	$C_xH_yO_2$	CC1=C(O)C=CC=C1O	2.29E-06
126.0564	2.28E-05	6	7	1	2	$C_xH_yNO_2$	OC1=NC(O)=CC(C)=C1	1.15E-06
127.0431	3.29E-03	6	6		3	$C_xH_yO_3$	OC1=C(O)C=CC=C1O	3.24E-08
138.0429	1.49E-04	7	7	1	2	$C_xH_yNO_2$	CC1=C(N(O)=O)C=CC=C1	6.57E-09
139.0281	2.72E-05	7	6		3	$C_xH_yO_3$	OC1=CC=CC=C1C(O)=O	5.80E-08
140.0237	1.55E-09	6	5	1	3	$C_xH_yNO_3$	O=N(OC1=CC=CC=C1)O	9.08E-04
141.0431	3.54E-04	7	8		3	$C_xH_yO_3$	OC1=C(O)C(C)=CC=C1O	1.06E-08
147.0526	4.17E-05	5	6		5	$C_xH_yO_{5+}$	O=C(O)C(CCC(O)=O)=O	3.95E-08
154.0417	9.18E-04	7	7	1	3	$C_xH_yNO_3$	CC1=C(O)C(ON(=O)=O)=CC=C1O	6.57E-09
155.0286	1.07E-01	7	6		4	$C_xH_yO_4$	O=C(O)C1=C(O)C=CC(O)=C1	1.41E-10
157.0420	7.29E-01	7	8		4	$C_xH_yO_4$	CC1=C(O)C(O)=CC(O)=C1O	2.35E-11
159.0583	3.45E-03	7	10		4	$C_xH_yO_4$	CC(C=O)C(O)=C(O)C=CO	2.82E-09
184.0624	1.99E-02	7	4	1	5	$C_xH_yNO_{5+}$	OC1=C(C(O)=O)C=C([N+]([O-])=O)C=C1	1.24E-10
199.0941	1.30E-03	7	6	2	5	$C_xH_yN_2O_z$	CC1=C(O)C([N+]([O-])=O)=CC([N+]([O-])=O)=C1	3.95E-09

Table S3: Chemical composition measured by (+)-DART-HR-MS of toluene SOA generated under high-NO conditions with Na_2SO_4 seed. Abundance is defined as $((C_A/C_{IS})/\sum(C_A/C_{IS}))$.

m/z (Da)	Abundance	C	H	N	O	Category	Smiles	P_{vap} (atm)
61.0295	2.32E-11	2	4		2	$C_xH_yO_2$	CC(O)=O	4.49E-03
69.0690	1.45E-13	4	4		1	$C_xH_yO_1$	O1C=CC=C1	2.05E-01
70.0295	6.73E-14	3	3	1	1	$C_xH_yNO_1$	C1=NC=CO1	1.03E-01
71.0483	7.34E-13	4	6		1	$C_xH_yO_1$	CC=CC=O	8.30E-02
72.0465	1.05E-09	3	5	1	1	$C_xH_yNO_1$	C=CC(N)=O	9.20E-06
73.0622	1.50E-13	4	8		1	$C_xH_yO_1$	C1CCCO1	2.05E-01

74.0586	1.62E-09	3	7	1	1	$C_xH_yNO_1$	C1=NCCO1	9.20E-06
75.0435	8.82E-12	3	6		2	$C_xH_yO_2$	CCC(O)=O	4.49E-03
76.0392	1.39E-04	2	5	1	2	$C_xH_yNO_2$	NCC(O)=O	2.42E-10
80.0493	1.53E-12	5	5	1		CHN	C1=NC=CC=C1	2.00E-02
83.0817	5.12E-13	5	6		1	$C_xH_yO_1$	CC1=CC=CO1	6.70E-02
85.0290	1.94E-11	4	4		2	$C_xH_yO_2$	O=CC=CC=O	3.42E-03
87.0424	1.08E-11	4	6		2	$C_xH_yO_2$	O=CCCC=O	6.19E-03
89.0399	1.90E-09	3	4		3	$C_xH_yO_3$	OC(C(O)=O)C	1.13E-05
93.0408	8.61E-13	6	4		1	$C_xH_yO_1$	C12=C(O2)C=CC=C1	1.39E-02
95.0667	1.55E-11	6	6		1	$C_xH_yO_1$	OC1=CC=CC=C1	2.02E-03
97.0319	2.33E-10	5	4		2	$*C_xH_yO_2$	O=C1C=CC(C1)=O	4.67E-04
98.0499	1.18E-11	4	5	2	1	$C_xH_yN_2O_z$	O=C(N1)CCC1=O	2.15E-03
99.0449	8.68E-12	5	6		2	$*C_xH_yO_2$	CC1=CCC(O1)=O	1.37E-02
100.0424	7.35E-08	4	5	1	2	$*C_xH_yNO_2$	O=C(N1)CCC1=O	4.71E-07
101.0288	2.73E-11	4	4		3	$C_xH_yO_3$	O=C1CCC(O1)=O	2.15E-03
102.0563	1.28E-12	4	7	1	2	$*C_xH_yNO_2$	O=C(OCC)C=N	1.89E-02
103.0419	5.57E-11	4	6		3	$C_xH_yO_3$	O=C1C(O)CCO1	4.80E-04
104.0360	1.19E-12	3	5	1	3	$*C_xH_yNO_3$	C=CC(ON(=O)=O)	2.60E-02
105.0208	1.54E-08	3	4		4	$C_xH_yO_4$	OCC(C(O)=O)=O	2.22E-06
107.0623	5.40E-12	7	6		1	$C_xH_yO_1$	O=CC1=CC=CC=C1	1.83E-03
110.0604	2.01E-11	6	7	1	1	$C_xH_yNO_1$	OC1=CC=C(C)N=C1	7.24E-04
111.0463	1.81E-10	6	6		2	$*C_xH_yO_2$	O=CC=CC=CC=O	3.66E-04
113.0461	1.24E-10	6	8		2	$*C_xH_yO_2$	O=CCCC=CC=O	4.92E-04
114.0550	1.22E-09	5	7	1	2	$*C_xH_yNO_2$	OC(C1=NCCC1)=O	2.57E-05
115.0409	1.90E-11	5	6		3	$C_xH_yO_3$	O=C1C=C(OC)CO1	4.48E-03
117.0539	1.61E-10	5	8		3	$C_xH_yO_3$	O=C1C(C)CC(O)O1	1.91E-04
118.0517	2.29E-12	4	7	1	3	$*C_xH_yNO_3$	CC=CC(ON(=O)=O)	8.50E-03
121.0767	1.18E-09	7	4		2	$C_xH_yO_2$	O=C(C=C1C)C=CC1=O	8.12E-06
123.0461	1.07E-09	7	6		2	$*C_xH_yO_2$	O=CC1=C(O)C=CC=C1	2.77E-05
126.0555	2.00E-08	6	7	1	2	$*C_xH_yNO_2$	OC1=NC(O)=CC(C)=C1	1.15E-06
127.0423	2.32E-06	6	6		3	$C_xH_yO_3$	OC1=C(O)C=CC=C1O	3.24E-08
128.0388	2.01E-10	5	5	1	3	$C_xH_yNO_3$	CC1=CC(N(O)=O)=CO1	1.44E-04
129.0534	1.48E-06	6	8		3	$C_xH_yO_3$	OC1=C(O)C=CC=C1O	3.24E-08
130.0518	9.07E-11	5	7	1	3	$C_xH_yNO_3$	CC1OC=C(N(O)=O)C1	2.27E-04
131.0391	7.73E-11	5	6		4	$C_xH_yO_4$	O=C1CC(OC)C(O1)=O	3.64E-04
132.0622	3.95E-11	5	9	1	3	$C_xH_yNO_3$	CC1OCC(N(O)=O)C1	3.60E-04
133.0524	4.59E-11	5	8		4	$C_xH_yO_4$	O=C1CC(OC)C(O1)=O	3.64E-04
138.0557	3.23E-06	7	7	1	2	$*C_xH_yNO_2$	CC1=C(N(O)=O)C=CC=C1	6.57E-09
139.0415	5.49E-07	7	6		3	$*C_xH_yO_3$	OC1=C(C=O)C(O)=CC=C1	9.59E-08
141.0544	5.51E-06	7	8		3	$C_xH_yO_3$	OC1=C(O)C(C)=CC=C1O	1.06E-08
142.0516	3.42E-11	6	7	1	3	$C_xH_yNO_3$	O=N(OC1=CC=CC=C1)O	9.08E-04
143.0370	1.59E-05	6	6		4	$C_xH_yO_4$	O=C(O)C=CC=CC(O)=O	3.29E-09
145.0509	9.26E-06	6	8		4	$C_xH_yO_4$	O=C(O)C=CC=CC(O)=O	3.29E-09
146.0484	1.13E-08	5	7	1	4	$C_xH_yNO_4$	O=CC(O)C(N=O)CC=O	1.35E-06
147.0545	4.03E-06	8	6	2	1	$C_xH_yN_2O_z$	O=C(C)NC1=CC=CC=C1	3.04E-09
148.0586	2.25E-07	5	9	1	4	$C_xH_yNO_4$	O=CC(O)C(N=O)CCO	4.04E-08
149.0337	9.22E-08	7	4	2	2	$C_xH_yNO_2$	CC1=CC(N=O)=CC(N=O)=C1	2.01E-07
152.0686	1.23E-09	8	9	1	2	$C_xH_yNO_2$	OC1=CC=C(NC(C)=O)C=C1	1.44E-05
153.0611	1.10E-07	7	8	2	2	$C_xH_yN_2O_z$	CC1=CC(N=O)=CC(N=O)=C1	2.01E-07
154.0511	4.70E-06	7	7	1	3	$C_xH_yNO_3$	CC1=C(O)C(ON(=O)=O)=CC=C1O	6.57E-09
155.0397	4.21E-04	7	6		4	$*C_xH_yO_4$	O=C(O)C1=C(O)C=CC(O)=C1	1.41E-10

157.0504	2.76E-03	7	8		4	*$C_xH_yO_4$	CC1=C(O)C(O)=CC(O)=C1O	2.35E-11
158.0487	6.11E-09	6	7	1	4	$C_xH_yNO_4$	OC1=CC(ON(O)=O)=CC=C1	4.33E-06
159.0467	3.90E-09	10	6		2	$C_xH_yO_2$	O=C(C1=C2C=CC=C1)C=CC2=O	8.12E-06
160.0607	3.60E-09	6	9	1	4	$C_xH_yNO_4$	OC1=CC(ON(O)=O)=CC=C1	4.33E-06
161.0475	1.93E-06	6	8		5	$C_xH_yO_{5+}$	O=CC(O)C(O)C(O)=CC=O	1.34E-08
164.0597	2.75E-07	5	9	1	5	$C_xH_yNO_{5+}$	O=CC(O)C(N(O)=O)CCO	4.04E-08
165.0593	6.84E-10	9	8		3	$C_xH_yO_3$	O=CC1=C(OC)C=CC=C1OC	2.10E-05
167.0682	9.11E-10	9	10		3	$C_xH_yO_3$	O=CC1=C(OC)C=CC=C1OC	2.10E-05
168.0610	1.52E-09	8	9	1	3	$C_xH_yNO_3$	CC1=C(OC)C=CC(N(O)=O)=C1	1.00E-05
169.0591	5.32E-06	7	8	2	3	$C_xH_yN_2O_z$	CC1=C(O)C(N=O)=CC(N=O)=C1	3.95E-09
170.0479	3.85E-07	7	7	1	4	$C_xH_yNO_4$	OC1=CC(ON(O)=O)=CC=C1C	5.93E-08
171.0431	3.72E-09	11	6		2	$C_xH_yO_2$	O=C(C1=C2C=CC(C)=C1)C=CC2=O	8.12E-06
172.0585	1.18E-08	7	9	1	4	$C_xH_yNO_4$	OC1=CC(ON(O)=O)=CC=C1C	1.42E-06
173.0473	4.21E-01	7	8		5	$C_xH_yO_{5+}$	CC1=C(O)C(O)=C(O)C(O)=C1O	8.99E-14
174.0686	1.24E-08	7	11	1	4	$C_xH_yNO_4$	OC1=CC(ON(O)=O)=CC=C1C	1.42E-06
175.0654	1.98E-01	7	10		5	$C_xH_yO_{5+}$	CC1=C(O)C(O)=C(O)C(O)=C1O	8.99E-14
177.0571	2.56E-09	10	8		3	$C_xH_yO_3$	O=CC1=C(OC=C)C=CC=C1OC	6.85E-06
178.0703	4.31E-08	6	11	1	5	$C_xH_yNO_{5+}$	O=CCC(ON(O)=O)CCCO	4.69E-07
179.0706	1.88E-09	10	10		3	$C_xH_yO_3$	O=CC1=C(OC=C)C=CC=C1OC	6.85E-06
180.0679	3.71E-09	9	9	1	3	$C_xH_yNO_3$	CC1=C(OC=C)C=CC(N(O)=O)=C1	3.28E-06
181.0651	6.06E-09	8	8	2	3	$C_xH_yN_2O_z$	O=C(C)NC1=CC=C(N(O)=O)C=C1	2.05E-06
183.0784	8.72E-09	8	10	2	3	$C_xH_yN_2O_z$	CC1=CC=C(N(O)=O)C=C1NC=O	2.05E-06
184.0623	1.10E-09	8	9	1	4	$C_xH_yNO_4$	CC1=CC=C(ON(O)=O)C=C1OC	1.00E-05
185.0631	8.24E-08	7	8	2	4	$C_xH_yN_2O_z$	CC1=CC(N(O)=O)=CC(N(O)=O)=C1	2.01E-07
186.0504	6.43E-08	6	7	3	4	$C_xH_yN_2O_z$	CC1=NC(N(O)=O)=CC(N(O)=O)=C1	2.01E-07
187.0626	1.52E-01	8	10		5	$C_xH_yO_{5+}$	CC1=C(O)C(O)=C(O)C(O)=C1OC	8.99E-14
188.0608	1.39E-06	7	9	1	5	$C_xH_yNO_{5+}$	CC1=C(O)C(ON(O)=O)=CC=C1O	6.57E-09
189.0518	2.83E-06	6	8	2	5	$C_xH_yN_2O_z$	OC1=C(N(O)=O)C=CC(N(O)=O)=C1	9.29E-09
190.0713	1.84E-06	7	11	1	5	$C_xH_yNO_{5+}$	CC1=C(O)C(ON (O)=O)=CC=C1O	6.57E-09
192.0828	1.81E-06	7	13	1	5	$C_xH_yNO_{5+}$	CC1=C(O)C(ON(O)=O)=CC=C1O	6.57E-09
193.0737	3.33E-02	7	12		6	$C_xH_yO_{5+}$	CC(C(C(O)C1O)O)=C(O)C1O	3.18E-13
194.0700	1.10E-04	6	11	1	6	$C_xH_yNO_{5+}$	OC1=C(O)C(ON(O)=O)=CC=C1O	9.39E-11
196.0650	3.21E-09	9	9	1	4	$C_xH_yNO_4$	CC1=CC=C(ON(O)=O)C=C1OC=C	3.28E-06
199.0618	1.91E-01	9	10		5	$C_xH_yO_{5+}$	CC1=C(O)C(O)=C(O)C(O)=C1OC=C	8.99E-14
202.0709	5.01E-08	8	11	1	5	$C_xH_yNO_{5+}$	CC1=C(O)C=C(ON(O)=O)C=C1OC	1.52E-07
267.1719	5.15E-06	14	22	2	3	$C_xH_yNO_3$	CC(OC(N=O)=CCCC(C)C=O)C=CCCC	9.81E-09

Table S4: Chemical composition measured by (+)-DART-HR-MS of toluene SOA generated under high-NO conditions with NaCl seed. Abundance is defined as $((C_A/C_{IS})/\sum(C_A/C_{IS}))$.

m/z (Da)	Abundance	C	H	N	O	Category	Smiles	P_{vap} (atm)
71.0486	1.33E-10	4	6		1	$C_xH_yO_1$	CC=CC=O	8.30E-02
74.0597	1.01E-06	3	7	1	1	$C_xH_yNO_1$	C1=NCCO1	9.20E-06
75.0442	2.41E-09	3	6		2	$C_xH_yO_2$	CCC(O)=O	4.49E-03
76.0391	5.36E-02	2	5	1	2	$C_xH_yNO_2$	NCC(O)=O	2.42E-10
80.0497	6.17E-09	5	5	1		CHN	C1=NC=CC=C1	2.00E-02
83.0607	6.29E-10	4	6	2		CHN	C1N=CC=NC1	2.00E-02
84.0450	2.61E-10	4	5	1	1	$C_xH_yNO_1$	C1=CNC=CO1	3.35E-02
85.0308	3.85E-09	4	4		2	$C_xH_yO_2$	O=CC=CC=O	3.42E-03

86.0582	2.06E-10	4	7	1	1	$C_xH_yNO_1$	C1=CNC=CO1	3.35E-02
87.0447	2.06E-09	4	6		2	$C_xH_yO_2$	O=CCCC=O	6.19E-03
88.0405	2.93E-02	3	5	1	2	$C_xH_yNO_2$	OC(C=CN)=O	2.42E-10
94.0654	3.57E-10	6	7	1		CHN	CC1=NC=CC=C1	2.00E-02
95.0628	4.11E-10	5	6	2		CHN	CC1=NC=CN=C1	2.00E-02
96.0460	6.69E-09	5	5	1	1	$C_xH_yNO_1$	OC1=CC=CN=C1	1.32E-03
97.0644	1.92E-08	6	8		1	$C_xH_yO_1$	OC1=CC=CC=C1	2.02E-03
98.0612	1.03E-08	5	7	1	1	$C_xH_yNO_1$	OC1=CC=CN=C1	1.32E-03
99.0459	2.33E-09	5	6		2	$C_xH_yO_2$	CC1=CCC(O1)=O	1.37E-02
100.0420	3.18E-05	4	5	1	2	$C_xH_yNO_2$	O=C(N1)CCC1=O	4.71E-07
102.0570	5.40E-10	4	7	1	2	$C_xH_yNO_2$	O=C(OCC)C=N	1.89E-02
104.0364	3.44E-10	3	5	1	3	$C_xH_yNO_3$	C=CC(ON(=O)=O)	2.60E-02
110.0612	2.92E-08	6	7	1	1	$C_xH_yNO_1$	OC1=CC=C(C)N=C1	7.24E-04
112.0424	6.50E-07	5	5	1	2	$C_xH_yNO_2$	OC(C1=NCCC1)=O	2.57E-05
113.0574	4.26E-08	6	8		2	$C_xH_yO_2$	O=CCCC=CC=O	4.92E-04
114.0567	5.26E-07	5	7	1	2	$C_xH_yNO_2$	OC(C1=NCCC1)=O	2.57E-05
117.0574	3.87E-08	5	8		3	CxHyO3	O=C1C(C)CC(O)O1	1.91E-04
118.0520	9.87E-10	4	7	1	3	$C_xH_yNO_3$	CC=CC(ON(=O)=O)	8.50E-03
126.0565	1.82E-05	6	7	1	2	$C_xH_yNO_2$	OC1=NC(O)=CC(C)=C1	1.15E-06
129.0563	3.77E-04	6	8		3	CxHyO3	OC1=C(O)C=CC=C1O	3.24E-08
130.0528	3.47E-08	5	7	1	3	$C_xH_yNO_3$	CC1OC=C(N(O)=O)C1	2.27E-04
138.0563	2.37E-03	7	7	1	2	$C_xH_yNO_2$	CC1=C(N(O)=O)C=CC=C1	6.57E-09
139.0474	2.14E-07	6	6	2	2	$C_xH_yN_2O_z$	CC1=NC=CC(N(O)=O)=C1	7.43E-05
141.0580	1.50E-03	7	8		3	CxHyO3	OC1=C(O)C(C)=CC=C1O	1.06E-08
142.0522	1.24E-08	6	7	1	3	$C_xH_yNO_3$	O=N (OC1=CC=CC=C1)O	9.08E-04
143.0435	3.93E-06	5	6	2	3	$C_xH_yN_2O_z$	OC1C=C(N(O)=O)C=NC1	2.82E-06
149.0560	1.14E-09	9	8		2	$C_xH_yO_2$	O=C(OC=C)C1=CC=CC=C1	6.19E-03
152.0717	6.51E-07	8	9	1	2	$C_xH_yNO_2$	OC1=CC=C(NC(C)=O)C=C1	1.44E-05
153.0670	4.77E-05	7	8	2	2	$C_xH_yN_2O_z$	CC1=CC(N=O)=CC(N=O)=C1	2.01E-07
154.0521	2.33E-03	7	7	1	3	$C_xH_yNO_3$	CC1=C(O)C(ON(=O)=O)=CC=C1O	6.57E-09
155.0446	2.44E-05	6	6	2	3	$C_xH_yN_2O_z$	OC1=C(C)N=CC(N(O)=O)=C1	7.09E-07
156.0636	1.41E-03	7	9	1	3	$C_xH_yNO_3$	CC1=C(O)C(ON(=O)=O)=CC=C1O	6.57E-09
157.0529	6.31E-01	7	8		4	CxHyO4	CC1=C(O)C(O)=CC(O)=C1O	2.35E-11
159.0688	2.68E-01	7	10		4	CxHyO4	CC1=C(O)C(O)=CC(O)=C1O	2.35E-11
168.0675	8.15E-07	8	9	1	3	$C_xH_yNO_3$	CC1=C(OC)C=CC(N(O)=O)=C1	1.00E-05
171.0670	9.92E-03	8	10		4	$C_xH_yO_4$	CC1=C(C(O)=CC(O)=C1O)OC	8.36E-10
173.0544	9.91E-08	6	8	2	2	$C_xH_yN_2O_z$	CC1=NC=CC(N(O)=O)=C1	7.43E-05
175.0777	1.91E-07	11	10		2	$C_xH_yO_2$	O=C(OC=CC=C)C1=CC=CC=C1	3.34E-05
178.0718	1.44E-05	6	11	1	5	$C_xH_yNO_{5+}$	O=CCC(ON(O)=O)CCCO	4.69E-07

Table S5: Chemical composition measured by (+)-DART-HR-MS of toluene SOA generated under high-NO conditions with $MgSO_4$ + H_2SO_4 seed. Abundance is defined as $((C_A/C_{IS})/\sum(C_A/C_{IS}))$.

m/z (Da)	Abundance	C	H	N	O	Category	Smiles	P_{vap} (atm)
61.02876	3.43E-11	2	4		2	$C_xH_yO_2$	CC(O)=O	4.49E-03
71.04839	1.51E-12	4	6		1	$C_xH_yO_1$	O1C=CC=C1	8.30E-02
73.06233	3.63E-13	3	3		2	$C_xH_yO_2$	CC(C=O)=O	1.90E-01
74.0596	5.85E-09	3	7	1	1	$C_xH_yNO_1$	C1=NCCO1	9.20E-06
75.04341	9.47E-12	3	6		2	$C_xH_yO_2$	CC(CO)=O	6.92E-03
76.03938	1.19E-04	2	5	1	2	$C_xH_yNO_2$	NCC(O)=O	2.42E-10

80.0496	1.34E-11	5	5	1		CHN	C1=NC=CC=C1	2.00E-02
83.08333	9.88E-13	5	6		1	$C_xH_yO_1$	CC1=CC=CO1	6.70E-02
85.0292	2.84E-11	4	4		2	$C_xH_yO_2$	O=CC=CC=O	3.42E-03
86.05703	7.81E-13	4	7	1	1	$C_xH_yNO_1$	C1=CNC=CO1	3.35E-02
87.04151	3.74E-11	4	6		2	$C_xH_yO_2$	O=CCCC=O	6.19E-03
88.04571	9.27E-05	3	5	1	2	$C_xH_yNO_2$	O=C(C)C(N)=O	2.42E-10
89.05108	7.44E-11	4	8		2	$C_xH_yO_2$	O=CCCCO	6.48E-04
91.05025	2.63E-09	3	6		3	$C_xH_yO_3$	OC(C(O)=O)C	1.13E-05
94.0651	1.68E-11	6	7		1	$C_xH_yO_1$	OC1=CC=CC=C1	2.02E-03
95.06317	2.40E-11	6	6		1	$C_xH_yO_1$	OC1=CC=CC=C1	2.02E-03
97.03422	6.88E-10	5	4		2	$C_xH_yO_2$	O=C1C=CC(C1)=O	4.67E-04
98.05791	3.85E-08	5	7	1	4	$C_xH_yNO_4$	O=CC(O)C(N=O)CC=O	1.35E-06
99.04468	3.19E-11	5	6		2	$C_xH_yO_2$	CC1=CCC(O1)=O	1.37E-02
100.0442	1.61E-07	4	5	1	2	$C_xH_yNO_2$	O=C(N1)CCC1=O	4.71E-07
101.0258	8.45E-11	4	4		3	$C_xH_yO_3$	O=C1CCC(O1)=O	2.15E-03
102.0737	2.18E-12	4	7	1	2	$C_xH_yNO_2$	O=C(OCC)C=N	1.89E-02
103.0407	1.26E-10	4	6		3	$C_xH_yO_3$	O=C1C(O)CCO1	4.80E-04
104.0359	2.18E-12	3	5	1	3	$C_xH_yNO_3$	C=CC(ON(=O)=O)	2.60E-02
105.02	5.93E-08	3	4		4	$C_xH_yO_4$	OCC(C(O)=O)=O	2.22E-06
107.0572	1.27E-11	7	6		1	$C_xH_yO_1$	O=CC1=CC=CC=C1	1.83E-03
109.101	9.78E-11	7	8		1	$C_xH_yO_1$	OC1=C(C)C=CC=C1	6.61E-04
111.0455	6.79E-10	6	6		2	$C_xH_yNO_2$	O=N(C1=CC=CC=C1)O	2.87E-04
112.0433	6.16E-11	5	5	1	2	$C_xH_yNO_2$	O=C(N1)C=C(C)C1=O	7.03E-04
113.0481	3.49E-10	6	8		2	$C_xH_yO_2$	O=CCCC=CC=O	4.92E-04
114.0694	3.42E-09	5	7	1	2	$C_xH_yNO_2$	OC(C1=NCCC1)=O	2.57E-05
115.0403	3.93E-10	6	10		2	$C_xH_yO_2$	O=CCCCCC=O	6.62E-04
117.0548	5.00E-10	5	8		3	$C_xH_yO_3$	O=C1C(C)CC(O)O1	1.91E-04
118.0522	3.53E-12	4	7	1	3	$C_xH_yNO_3$	CC=CC(ON(=O)=O)	8.50E-03
119.0361	2.08E-09	4	6		4	$C_xH_yO_4$	OC(C(O)C=O)C=O	2.68E-05
123.0442	2.00E-09	7	6		2	$C_xH_yO_2$	O=CC1=C(O)C=CC=C1	2.77E-05
125.0584	3.20E-08	7	8		2	$C_xH_yO_2$	CC1=C(O)C=CC=C1O	2.29E-06
126.0558	2.39E-08	6	7	1	2	$C_xH_yNO_2$	OC1=NC(O)=CC(C)=C1	1.15E-06
127.0416	4.51E-06	6	6		3	$C_xH_yO_3$	OC1=C(O)C=CC=C1O	3.24E-08
128.0372	4.58E-10	5	5	1	3	$C_xH_yNO_3$	CC1=CC(N(O)=O)=CO1	1.44E-04
129.054	3.04E-06	6	8		3	$C_xH_yO_3$	OC1=C(O)C=CC=C1O	3.24E-08
130.0524	1.32E-10	5	7	1	3	$C_xH_yNO_3$	CC1OC=C(N(O)=O)C1	2.27E-04
131.0374	1.92E-10	5	6		4	$C_xH_yO_4$	O=C1CC(OC)C(O1)=O	3.64E-04
133.0506	1.35E-10	5	8		4	$C_xH_yO_4$	O=C1CC(OC)C(O1)=O	3.64E-04
139.0409	9.50E-07	7	6		3	$C_xH_yO_3$	OC1=C(C=O)C(O)=CC=C1	9.59E-08
140.0378	5.64E-11	6	5	1	3	$C_xH_yNO_3$	O=N(OC1=CC=CC=C1)O	9.08E-04
141.0547	1.91E-05	7	8		3	$C_xH_yO_3$	OC1=C(O)C(C)=CC=C1O	1.06E-08
142.0519	8.72E-11	6	7	1	3	$C_xH_yNO_3$	O=N(OC1=CC=CC=C1)O	9.08E-04
143.0382	3.29E-05	6	6		4	$C_xH_yO_4$	O=C(O)C=CC=CC(O)=O	3.29E-09
145.0507	1.53E-05	6	8		4	$C_xH_yO_4$	O=C(O)C=CC=CC(O)=O	3.29E-09
149.0345	1.95E-07	7	4	2	2	$C_xH_yN_2O_z$	CC1=C(N=O)C=CC=C1N=O	2.01E-07
154.0507	6.40E-06	7	7	1	3	$C_xH_yNO_3$	CC1=C(O)C(ON(=O)=O)=CC=C1O	6.57E-09
155.0365	1.09E-03	7	6		4	$C_xH_yO_4$	O=C(O)C1=C(O)C=CC(O)=C1	1.41E-10
157.0503	4.57E-03	7	8		4	$C_xH_yO_4$	CC1=C(O)C(O)=CC(O)=C1O	2.35E-11
158.0485	9.14E-09	6	7	1	4	$C_xH_yNO_4$	OC1=CC(ON(O)=O)=CC=C1	4.33E-06
159.0442	2.65E-03	7	10		4	$C_xH_yO_4$	CC1=C(O)C(O)=CC(O)=C1O	2.35E-11
161.0502	2.13E-06	6	8		5	$C_xH_yO_{5+}$	O=CC(O)C(O)C(O)=CC=O	1.34E-08

167.0706	6.93E-09	9	10		3	$C_xH_yO_3$	CC1=C(OC(C)=O)C=CC=C1O	4.72E-06
169.0593	1.92E-07	7	8	2	3	$C_xH_yN_2O_z$	CC1=CC(N=O)=CC(N=O)=C1	2.01E-07
170.0476	5.90E-07	7	7	1	4	$C_xH_yNO_4$	OC1=CC(ON(O)=O)=CC=C1C	5.93E-08
171.0454	7.52E-10	6	6	2	4	$C_xH_yN_2O_z$	CC1=NC=CC(N(O)=O)=C1	7.43E-05
172.0564	1.56E-08	7	9	1	4	$C_xH_yNO_4$	OC1=CC(ON(O)=O)=CC=C1C	1.42E-06
173.0465	7.45E-01	7	8		5	$C_xH_yO_{5+}$	CC1=C(O)C(O)=C(O)C(O)=C1O	8.99E-14
175.0647	2.47E-01	7	10		5	$C_xH_yO_{5+}$	CC1=C(O)C(O)=C(O)C(O)=C1O	8.99E-14
185.0866	7.10E-05	9	12		4	$C_xH_yO_4$	CC1=CC(O)=C(C(O)=C1OCC)O	3.70E-10

Table S6: Chemical composition measured by (+)-DART-HR-MS of *o*-cresol SOA generated under high-NO conditions with $(NH_4)_2SO_4$ seed. Abundance is defined as $((C_A/C_{IS})/\sum(C_A/C_{IS}))$.

m/z (Da)	Abundance	C	H	N	O	Category	Smiles	P_{vap} (atm)
59.04897	1.04E-07	3	6		1	$C_xH_yO_1$	CC(C)=O	3.87E-01
71.04891	2.65E-07	4	6		1	$C_xH_yO_1$	O=CC(C)=C	8.30E-02
73.06351	8.76E-08	4	8		1	$C_xH_yO_1$	CC(CC)=O	1.27E-01
75.04392	2.15E-06	3	6		2	$C_xH_yO_2$	CCC(O)=O	4.49E-03
80.04964	3.34E-07	5	5	1		CHN	C1=NC=CC=C1	0.02
85.03067	4.04E-06	4	4		2	$C_xH_yO_2$	O=CC=CC=O	3.42E-03
87.04418	2.56E-06	4	6		2	$C_xH_yO_2$	O=CCCC=O	6.19E-03
89.05853	8.10E-06	4	8		2	$C_xH_yO_2$	O=CCCCO	6.48E-04
93.0419	9.58E-06	5	4		2	$C_xH_yO_2$	O=C1C=CC(C1)=O	4.67E-04
97.03836	1.07E-05	4	4	2	1	$C_xH_yN_2O_z$	O=C(N1)CCC1=O	2.15E-03
99.04724	1.81E-06	5	6		2	$C_xH_yO_2$	CC1=CCC(O1)=O	1.37E-02
100.0428	2.30E-02	4	5	1	2	$C_xH_yNO_2$	O=C(N1)CCC1=O	4.71E-07
101.0582	1.21E-06	5	8		2	$C_xH_yO_2$	O=C1CCCCO1	1.37E-02
102.0582	6.09E-07	4	7	1	2	$C_xH_yNO_2$	O=C(OCC)C=N	1.89E-02
104.036	5.92E-07	3	5	1	3	$C_xH_yNO_3$	C=CC(ON(=O)=O)	2.60E-02
107.0699	5.86E-04	4	10		3	$C_xH_yO_3$	OCCOCCO	8.37E-06
110.0621	6.62E-06	6	7	1	1	$C_xH_yNO_1$	OC1=CC=C(C)N=C1	0.000724
111.048	5.43E-05	6	6		2	$C_xH_yO_2$	O=CC=CC=CC=O	3.66E-04
112.0444	2.62E-04	5	5	1	2	$C_xH_yNO_2$	OC(C1=NCCC1)=O	2.57E-05
113.0577	2.97E-05	6	8		2	$C_xH_yO_2$	O=CCCC=CC=O	4.92E-04
114.0575	3.56E-04	5	7	1	2	$C_xH_yNO_2$	OC(C1=NCCC1)=O	2.57E-05
115.0445	2.96E-06	5	6		3	$C_xH_yO_3$	O=C1C=C(OC)CO1	4.48E-03
117.0619	2.04E-03	4	8	2	2	$C_xH_yN_2O_z$	ON=C(C)C(C)=NO	3.30E-06
118.0519	8.54E-07	4	7	1	3	$C_xH_yNO_3$	CC=CC(ON(=O)=O)	8.50E-03
119.0665	5.11E-06	5	10		3	$C_xH_yO_3$	CCOC(C(C)O)=O	9.92E-04
123.0476	3.20E-04	7	6		2	$C_xH_yO_2$	O=CC1=C(O)C=CC=C1	2.77E-05
125.0725	4.62E-02	6	8	2	1	$C_xH_yN_2O_z$	CC1=NC(N(O)=O)=CC(N(O)=O)=C1	2.01E-07
126.0569	5.51E-03	6	7	1	2	$C_xH_yNO_2$	OC1=NC(O)=CC(C)=C1	1.15E-06
127.0443	6.47E-01	6	6		3	$C_xH_yO_3$	OC1=C(O)C=CC=C1O	3.24E-08
128.0661	4.40E-04	6	9	1	2	$C_xH_yNO_2$	N=CCC=C(O)CC=O	2.00E-05
129.0592	3.33E-01	6	8		3	$C_xH_yO_3$	OC1=C(O)C=CC=C1O	3.24E-08
130.0532	2.76E-05	5	7	1	3	$C_xH_yNO_3$	CC1OC=C(N(O)=O)C1	2.27E-04
132.0652	1.14E-05	5	9	1	3	$C_xH_yNO_3$	CC1OCC(N(O)=O)C1	3.60E-04
136.0604	1.73E-06	4	9	1	4	$C_xH_yNO_4$	O=N(O)OCCC(O)C	1.84E-03
138.0569	7.55E-01	7	7	1	2	$C_xH_yNO_2$	CC1=C(N(O)=O)C=CC=C1	6.57E-09
139.0457	1.29E-01	7	6		3	$C_xH_yO_3$	OC1=C(C=O)C(O)=CC=C1	9.59E-08
140.0655	4.97E-05	7	9	1	2	$C_xH_yNO_2$	CC(C=CC1)=CC1N(O)=O	1.49E-04

141.0624	1.01E+00	6	8	2	2	$C_xH_yN_2O_z$	OC1=C(N(O)=O)C=CC(N(O)=O)=C1	9.29E-09
142.0521	8.14E-06	6	7	1	3	$C_xH_yNO_3$	O=N(OC1=CC=CC=C1)O	9.08E-04
143.0724	3.27E+00	7	10		3	$C_xH_yO_3$	CC(C=O)C(O)=C(O)C=CO	2.82E-09
144.0658	5.37E-04	6	9	1	3	$C_xH_yNO_3$	OC1CC(N(O)=O)CC=C1	6.86E-06
145.054	2.06E+00	6	8		4	$C_xH_yO_4$	O=C(O)C=CC=CC(O)=O	3.29E-09
147.0693	2.70E-02	6	10		4	$C_xH_yO_4$	O=CCC(O)C(O)CC=O	1.48E-07
149.0301	5.43E-04	8	4		3	$C_xH_yO_3$	O=C1C2=CC=CC=C2C(O1)=O	1.55E-05
152.0727	3.31E-04	8	9	1	2	$C_xH_yNO_2$	OC1=CC=C(NC(C)=O)C=C1	1.44E-05
153.0922	2.81E-04	9	12		2	$C_xH_yO_2$	CC1=C(OCC)C(O)=CC=C1	3.01E-05
154.055	1.21E+00	7	7	1	3	$C_xH_yNO_3$	CC1=C(O)C(ON(=O)=O)=CC=C1O	6.57E-09
155.0409	1.17E+02	7	6		4	$C_xH_yO_4$	O=C(O)C1=C(O)C=CC(O)=C1	1.41E-10
156.0622	1.10E+00	7	9	1	3	$C_xH_yNO_3$	CC1=C(O)C(ON(=O)=O)=CC=C1O	6.57E-09
157.0534	4.41E+02	7	8		4	$C_xH_yO_4$	CC1=C(O)C(O)=CC(O)=C1O	2.35E-11
158.052	1.50E-03	6	7	1	4	$C_xH_yNO_4$	OC1=CC(ON(O)=O)=CC=C1	4.33E-06
159.1065	1.32E-05	8	14		3	$C_xH_yO_3$	CC(C)C(OC(C(C)C)=O)=O	5.01E-04
160.0636	9.29E-04	6	9	1	4	$C_xH_yNO_4$	OC1=CC(ON(O)=O)=CC=C1	4.33E-06
161.0699	2.03E-03	9	8	2	1	$C_xH_yN_2O_z$	OC1=CC=C(C2=NC=CN2)C=C1	1.89E-06
162.0724	5.26E-01	6	11	1	4	$C_xH_yNO_4$	N=CC(O)C(O)C(O)CC=O	7.54E-09
164.065	1.21E-04	9	9	1	2	$C_xH_yNO_2$	O=C(C)C1=NC(C(C)=O)=CC=C1	3.06E-05
167.072	3.50E-04	9	10		3	$C_xH_yO_3$	O=CC1=C(OC)C=CC=C1OC	2.10E-05
168.0662	5.40E-04	8	9	1	3	$C_xH_yNO_3$	CC1=C(OC)C=CC(N(O)=O)=C1	1.00E-05
169.0824	9.86E-04	9	12		3	$C_xH_yO_3$	CC1=C(OC)C=C(O)C=C1OC	7.56E-06
171.0693	7.12E+03	7	6		5	$C_xH_yO_{5+}$	OC1=C(C=O)C(O)=CC(O)=C1O	9.84E-13
172.0635	3.57E-03	7	9	1	4	$C_xH_yNO_4$	OC1=CC(ON(O)=O)=CC=C1C	1.42E-06
174.0764	2.89E-03	7	11	1	4	$C_xH_yNO_4$	OC1=CC(ON(O)=O)=CC=C1C	1.42E-06
175.0752	6.61E-04	11	10		2	$C_xH_yO_2$	CC1=C(OC=CC(C)=O)C=CC=C1	6.85E-06
178.0689	9.50E-03	6	11	1	5	$C_xH_yNO_{5+}$	O=CCC(ON(O)=O)CCCO	4.69E-07
179.0758	1.04E-03	10	10		3	$C_xH_yO_3$	OC(C1=C(OC)C=CC=C1OC)=C	4.94E-06
180.0687	1.40E-03	9	9	1	3	$C_xH_yNO_3$	CC1=C(OC=C)C=CC(N(O)=O)=C1	3.28E-06
185.0965	4.52E-04	13	12		1	$C_xH_yO_1$	CC1=CC(OC2=CC=CC=C2)=CC=C1	1.11E-05
187.0794	6.88E-03	12	10		2	$C_xH_yO_2$	OC(C=C1)=CC=C1OC2=CC=CC=C2	5.11E-07
189.0916	5.78E-03	12	12		2	$C_xH_yO_2$	OC1C=CC(OC2=CC=CC=C2)=CC1	5.11E-07
190.0757	5.01E-01	7	11	1	5	$C_xH_yNO_{5+}$	CC1=C(O)C(ON(O)=O)=CC=C1O	6.57E-09
193.0865	7.73E-04	11	12		3	$C_xH_yO_3$	CC1=C(OCC(CC=O)=O)C=CC=C1	5.72E-06
195.1377	2.02E-04	12	18		2	$C_xH_yO_2$	CC(OC1=CC=CC=C1OC(C)C)C	4.38E-05
196.0688	1.27E-03	9	9	1	4	$C_xH_yNO_4$	CC1=CC=C(ON(O)=O)C=C1OC=C	3.28E-06
197.074	4.48E-01	12	8	2	1	$C_xH_yN_2O_z$	N=CC1=CC=C(N=C1)C2=CC=C(O)C=C2	1.07E-08
198.0689	1.11E-03	9	11	1	4	$C_xH_yNO_4$	CC1=CC=C(C=C1OCC)ON(O)=O	3.28E-06
199.1665	8.32E-05	12	22		2	$C_xH_yO_2$	CC(OC1C(OC(C)C)=CCCC1)C	6.94E-05
201.0986	3.15E-01	12	12	2	1	$C_xH_yN_2O_z$	N=CC1=CC=C(N=C1)C2=CC=C(O)C=C2	1.07E-08
205.0858	1.40E-02	12	12		3	$C_xH_yO_3$	CC1=C(OCC(C=CC=O)=O)C=CC=C1	3.04E-07
215.1248	1.07E+00	11	18		4	$C_xH_yO_4$	CC1CC(O)C=CC1OC(O)CCC=O	3.11E-09
217.137	4.15E-02	13	16	2	1	$C_xH_yN_2O_z$	N=CC1=CC=C(N=C1)C2=CC=C(OC)C=C2	7.57E-08
221.1425	2.19E-02	10	20		5	$C_xH_yO_{5+}$	O1CCOCCOCCOCCOCC1	1.79E-07
225.078	3.56E+01	11	12		5	$C_xH_yO_{5+}$	OC1=C(OCC)C(OC=C)=C(C=O)C(O)=C1	1.17E-10
227.1329	5.83E+00	12	18		4	$C_xH_yO_4$	CC1=CC(O)C=CC1OC(O)CCCC=O	6.42E-10
231.1549	5.48E+00	12	22		4	$C_xH_yO_4$	CC1CC(O)CCC1OC(O)CCCC=O	4.71E-10
233.1337	5.06E+02	11	20		5	$C_xH_yO_{5+}$	CC1CC(O)CC(O)C1OC(O)CCC=O	4.68E-12
371.3153	5.63E+02	22	42		4	$C_xH_yO_4$	CC1CCCCC1OCCCOC(O)CCCCOC2CCCCC2C	5.58E-12

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Table S7: Chemical composition measured by (+)-DART-HR-MS of *m*-cresol SOA generated under high-NO conditions with $(NH_4)_2SO_4$ seed. Abundance is defined as $((C_A/C_{IS})/\sum(C_A/C_{IS}))$.

m/z (Da)	Abundance	C	H	N	O	Category	Smies	P_{vap} (atm)
71.0487	2.70E-15	4	6		1	$C_xH_yO_1$	CC=CC=O	8.30E-02
73.0626	5.43E-16	4	8		1	$C_xH_yO_1$	C1CCCO1	2.05E-01
74.0597	1.56E-11	3	7	1	1	$C_xH_yNO_1$	C1=NCCO1	9.20E-06
75.0440	1.81E-14	3	6		2	$C_xH_yO_2$	CC(CO)=O	6.92E-03
76.0392	6.53E-07	2	5	1	2	$C_xH_yNO_2$	NCC(O)=O	2.42E-10
80.0494	7.16E-15	5	5	1		CHN	C1=NC=CC=C1	2.00E-02
84.0450	3.37E-15	4	5	1	1	$C_xH_yNO_1$	C1=CNC=CO1	3.35E-02
85.0295	8.64E-14	4	4		2	$C_xH_yO_2$	O=CC=CC=O	3.42E-03
86.0598	6.42E-15	4	7	1	1	$C_xH_yNO_1$	C1=CNC=CO1	3.35E-02
87.0431	3.81E-14	4	6		2	$C_xH_yO_2$	O=CCCC=O	6.19E-03
90.0516	1.03E-13	3	7	1	2	$C_xH_yNO_2$	OC1NCOC1	1.18E-03
94.0657	2.70E-14	6	7	1		CHN	CC1=NC=CC=C1	2.00E-02
95.0584	9.68E-15	5	6	2		CHN	CC1=NC=CN=C1	2.00E-02
97.0637	7.92E-13	6	8		1	$C_xH_yO_1$	OC1=CC=CC=C1	2.02E-03
98.0617	3.64E-13	5	7	1	1	$C_xH_yNO_1$	OC1=CC=CN=C1	1.32E-03
99.0454	6.84E-14	5	6		2	$C_xH_yO_2$	CC1=CCC(O1)=O	1.37E-02
102.0563	2.52E-14	4	7	1	2	$C_xH_yNO_2$	O=C(OCC)C=N	1.89E-02
104.0366	6.23E-15	3	5	1	3	$C_xH_yNO_3$	C=CC(ON(=O)=O)	2.60E-02
105.0209	5.22E-11	3	4		4	$C_xH_yO_4$	OCC(C(O)=O)=O	2.22E-06
110.0614	3.04E-13	6	7	1	1	$C_xH_yNO_1$	OC1=CC=C(C)N=C1	7.24E-04
111.0462	2.47E-12	6	6		2	$C_xH_yO_2$	O=CC=CC=CC=O	3.66E-04
112.0446	4.10E-13	5	5	1	2	$C_xH_yNO_2$	O=C(N1)C=C(C)C1=O	7.03E-04
113.0580	2.64E-12	6	8		2	$C_xH_yO_2$	O=CCCC=CC=O	4.92E-04
114.0572	1.96E-11	5	7	1	2	$C_xH_yNO_2$	OC(C1=NCCC1)=O	2.57E-05
115.0411	1.67E-13	5	6		3	$C_xH_yO_3$	O=C1C=C(OC)CO1	4.48E-03
116.0694	1.15E-11	5	9	1	2	$C_xH_yNO_2$	O=C(O)C1CCCN1	2.57E-05
117.0567	1.20E-12	5	8		3	$C_xH_yO_3$	O=C1C(C)CC(O)O1	1.91E-04
118.0521	1.73E-14	4	7	1	3	$C_xH_yNO_3$	CC=CC(ON(=O)=O)	8.50E-03
123.0467	6.09E-12	7	6		2	$C_xH_yO_2$	O=CC1=C(O)C=CC=C1	2.77E-05
125.0607	8.60E-11	7	8		2	$C_xH_yO_2$	CC1=C(O)C=CC=C1O	2.29E-06
126.0565	1.94E-10	6	7	1	2	$C_xH_yNO_2$	OC1=NC(O)=CC(C)=C1	1.15E-06
127.0425	1.74E-08	6	6		3	$C_xH_yO_3$	OC1=C(O)C=CC=C1O	3.24E-08
128.0698	3.72E-10	6	9	1	2	$C_xH_yNO_2$	OC(C1)=NC(O)=CC1C	1.82E-06
129.0567	1.76E-08	6	8		3	$C_xH_yO_3$	OC1=C(O)C=CC=C1O	3.24E-08
130.0552	1.17E-12	5	7	1	3	$C_xH_yNO_3$	CC1OC=C(N(O)=O)C1	2.27E-04
131.0367	1.33E-12	5	6		4	$C_xH_yO_4$	O=C1CC(OC)C(O1)=O	3.64E-04
132.0653	6.15E-13	5	9	1	3	$C_xH_yNO_3$	CC1OCC(N(O)=O)C1	3.60E-04
133.0538	3.02E-13	5	8		4	$C_xH_yO_4$	O=C1CC(OC)C(O1)=O	3.64E-04
137.0568	7.11E-10	7	8	2	1	$C_xH_yN_2O_z$	CC1=CC(N=O)=CC(N=O)=C1	2.01E-07
138.0561	2.86E-08	7	7	1	2	$C_xH_yNO_2$	CC1=C(N(O)=O)C=CC=C1	6.57E-09
139.0450	5.45E-09	7	6		3	$C_xH_yO_3$	OC1=CC=CC=C1C(O)=O	5.80E-08
140.0669	2.95E-12	7	9	1	2	$C_xH_yNO_2$	CC1=C(CCC=C1)N(O)=O	9.39E-05
141.0555	6.23E-08	7	8		3	$C_xH_yO_3$	OC1=C(O)C(C)=CC=C1O	1.06E-08
142.0527	3.79E-13	6	7	1	3	$C_xH_yNO_3$	O=N (OC1=CC=CC=C1)O	9.08E-04
143.0381	1.05E-07	6	6		4	$C_xH_yO_4$	O=C(O)C=CC=CC(O)=O	3.29E-09
144.0652	1.49E-13	6	9	1	3	$C_xH_yNO_3$	O=N(O)OC1=CCCC=C1	9.08E-04
145.0524	5.45E-08	6	8		4	$C_xH_yO_4$	O=C(O)C=CC=CC(O)=O	3.29E-09

148.0622	3.35E-09	5	9	1	4	$C_xH_yNO_4$	O=CC(O)C(N=O)CCO	4.04E-08
149.0476	1.73E-06	5	8		5	$C_xH_yO_{5+}$	OC1OC(CO)=C(O)C1O	6.50E-11
151.0858	2.33E-11	8	10	2	1	$C_xH_yN_2O_z$	CC(N=O)=CC=CC=CC=N	6.43E-06
152.0710	9.80E-12	8	9	1	2	$C_xH_yNO_2$	OC1=CC=C(NC(C)=O)C=C1	1.44E-05
153.0667	1.37E-09	7	8	2	2	$C_xH_yN_2O_z$	CC1=CC(N=O)=CC(N=O)=C1	2.01E-07
154.0536	7.58E-08	7	7	1	3	$C_xH_yNO_3$	CC1=C(O)C(ON(=O)=O)=CC=C1O	6.57E-09
155.0361	1.46E-05	7	6		4	$C_xH_yO_4$	O=C(O)C1=C(O)C=CC(O)=C1	1.41E-10
157.0509	1.86E-05	7	8		4	$C_xH_yO_4$	CC1=C(O)C(O)=CC(O)=C1O	2.35E-11
159.0669	5.58E-08	7	10		4	$C_xH_yO_4$	CC(C=O)C(O)=C(O)C=CO	2.82E-09
160.0631	3.10E-11	6	9	1	4	$C_xH_yNO_4$	OC1=CC(ON(O)=O)=CC=C1	4.33E-06
161.0498	9.42E-09	6	8		5	$C_xH_yO_{5+}$	O=CC(O)C(O)C(O)=CC=O	1.34E-08
162.0737	2.94E-11	6	11	1	4	$C_xH_yNO_4$	OC1CCCC(ON(O)=O)C1	4.00E-06
163.0712	8.11E-08	5	10	2	4	$C_xH_yN_2O_z$	COC(C(NC(N)=O)CO)=O	1.33E-09
164.0553	4.88E-09	5	9	1	5	$C_xH_yNO_{5+}$	O=CC(O)C(N(O)=O)CCO	4.04E-08
165.0657	5.21E-11	8	8	2	2	$C_xH_yN_2O_z$	O=C(C)NC1=CC=C(N(O)=O)C=C1	2.05E-06
167.0714	9.28E-12	9	10		3	CxHyO3	O=CC1=C(OC)C=CC=C1OC	2.10E-05
168.0673	1.65E-11	8	9	1	3	$C_xH_yNO_3$	CC1=C(OC)C=CC(N(O)=O)=C1	1.00E-05
169.0612	8.22E-08	7	8	2	3	$C_xH_yN_2O_z$	CC1=C(N=O)C=C(N=O)C=C1O	3.04E-09
170.0557	1.09E-09	6	7	3	3	$C_xH_yN_2O_z$	CC1=NC(N(O)=O)=CC(N(O)=O)=C1	2.01E-07
171.0610	2.56E-07	8	10		4	$C_xH_yO_4$	CC1=C(C(O)=CC(O)=C1O)OC	8.36E-10
172.0642	1.22E-10	7	9	1	4	$C_xH_yNO_4$	OC1=CC(ON(O)=O)=CC=C1C	1.42E-06
173.0568	1.71E-08	6	8	2	4	$C_xH_yN_2O_z$	OC1=C(N(O)=O)C=CC(N(O)=O)=C1	9.29E-09
174.0765	1.21E-10	7	11	1	4	$C_xH_yNO_4$	OC1=CC(ON(O)=O)=CC=C1C	1.42E-06
177.0664	3.25E-10	9	8	2	2	$C_xH_yN_2O_z$	O=C1N=C(N)OC1C2=CC=CC=C2	3.86E-07
178.0682	6.02E-10	6	11	1	5	$C_xH_yNO_{5+}$	O=CCC(ON(O)=O)CCCO	4.69E-07
179.0709	1.72E-11	10	10		3	CxHyO3	O=CC1=C(OC=C)C=CC=C1OC	6.85E-06
180.0678	4.63E-11	9	9	1	3	$C_xH_yNO_3$	CC1=C(OC=C)C=CC(N(O)=O)=C1	3.28E-06
181.0752	6.52E-10	7	8	2	2	$C_xH_yN_2O_z$	CC1=C(N=O)C=C(N=O)C=C1	2.01E-07
183.0726	8.08E-11	8	10	2	3	$C_xH_yN_2O_z$	CC1=CC=C(N(O)=O)C=C1NC=O	2.05E-06
185.0754	4.00E-07	9	12		4	$C_xH_yO_4$	CC1=C(OCC)C(O)=CC(O)=C1O	2.73E-10
190.0737	1.71E-08	7	11	1	5	$C_xH_yNO_{5+}$	CC1=C(O)C(ON(O)=O)=CC=C1O	6.57E-09
195.0857	9.68E-01	7	14		6	$C_xH_yO_{5+}$	OC1C(O)C(O)C(O)C(O)C(O)C1CO	1.85E-16
197.0738	1.61E-08	12	8	2	1	$C_xH_yN_2O_z$	N=CC1=CC=C(N=C1)C2=CC=C(O)C=C2	1.07E-08
198.0744	4.30E-11	9	11	1	4	$C_xH_yNO_4$	CC1=CC=C(ON(O)=O)C=C1OC=C	3.28E-06
207.0737	1.57E-09	10	10	2	3	$C_xH_yN_2O_z$	OC1=C2C=C(OC)C(OC)=CC2=NC=N1	6.61E-08
209.0813	4.07E-06	11	12		4	$C_xH_yO_4$	CC1=C(OC=CC=C)C(O)=CC(O)=C1O	2.92E-11
223.0799	3.17E-02	8	14		7	$C_xH_yO_{5+}$	OC1C(O)C(O)C(O)C(O)C1COC=O	4.14E-15

Table S8: Chemical composition measured by (+)-DART-HR-MS of *p*-cresol SOA generated under high-NO conditions with $(NH_4)_2SO_4$ seed. Abundance is defined as $((C_A/C_{IS})/\sum(C_A/C_{IS}))$.

m/z (Da)	Abundance	C	H	N	O	Category	Smiles	P_{vap} (atm)
71.0490	1.75E-13	4	6		1	$C_xH_yO_1$	CC=CC=O	8.30E-02
73.0637	3.50E-14	4	8		1	$C_xH_yO_1$	C1CCCO1	2.05E-01
75.0440	1.08E-12	3	6		2	$C_xH_yO_2$	CC(CO)=O	6.92E-03
80.0499	1.28E-12	5	5	1		CHN	C1=NC=CC=C1	2.00E-02
85.0306	2.65E-12	4	4		2	$C_xH_yO_2$	O=CC=CC=O	3.42E-03
87.0443	1.73E-12	4	6		2	$C_xH_yO_2$	O=CCCC=O	6.19E-03
94.0656	2.04E-13	6	7	1		CHN	CC1=NC=CC=C1	2.00E-02
97.0654	3.17E-11	6	8		1	$C_xH_yO_1$	OC1=CC=CC=C1	2.02E-03

99.0464	1.94E-12	5	6		2	$C_xH_yO_2$	CC1=CCC(O1)=O	1.37E-02
101.0584	1.62E-12	5	8		2	$C_xH_yO_2$	CC=CCC(O)=O	6.19E-03
110.0618	1.01E-11	6	7	1	1	$C_xH_yNO_1$	N=CC=CC=CC=O	3.66E-04
111.0469	5.29E-11	6	6		2	$C_xH_yO_2$	O=CC=CC=CC=O	3.66E-04
113.0585	3.87E-11	6	8		2	$C_xH_yO_2$	O=CCCC=CC=O	4.92E-04
114.0581	2.80E-10	5	7	1	2	$C_xH_yNO_2$	OC(C1=NCCC1)=O	2.57E-05
115.0418	3.60E-12	5	6		3	$C_xH_yO_3$	O=C1C=C(OC)CO1	4.48E-03
123.0472	2.32E-10	7	6		2	$C_xH_yO_2$	O=CC1=C(O)C=CC=C1	2.77E-05
125.0630	2.77E-09	7	8		2	$C_xH_yO_2$	CC1=C(O)C=CC=C1O	2.29E-06
126.0566	4.35E-09	6	7	1	2	$C_xH_yNO_2$	OC1=NC(O)=CC(C)=C1	1.15E-06
129.0572	3.91E-11	6	8		3	$C_xH_yO_3$	O=C1C(C)CC(O)O1	1.91E-04
138.0559	5.08E-07	7	7	1	2	$C_xH_yNO_2$	CC1=C(N(O)=O)C=CC=C1	6.57E-09
141.0562	4.05E-07	7	8		3	$C_xH_yO_3$	OC1=C(O)C=CC=C1O	3.24E-08
142.0533	5.07E-12	6	7	1	3	$C_xH_yNO_3$	O=N(OC1=CC=CC=C1)O	9.08E-04
143.0420	5.47E-11	5	6	2	3	$C_xH_yN_2O_z$	N=CC(C(O)C(C=O)=N)=O	1.14E-04
145.0531	9.91E-07	6	8		4	CxHyO4	O=C(O)C=CC=CC(O)=O	3.29E-09
149.0304	2.55E-08	7	4	2	2	$C_xH_yN_2O_z$	CC1=C(N=O)C=CC=C1N=O	2.01E-07
154.0544	7.72E-07	7	7	1	3	$C_xH_yNO_3$	CC1=C(O)C(ON(=O)=O)=CC=C1O	6.57E-09
155.0384	1.11E-04	7	6		4	$C_xH_yO_4$	O=C(O)C1=C(O)C=CC(O)=C1	1.41E-10
157.0515	4.04E-04	7	8		4	$C_xH_yO_4$	CC1=C(O)C(O)=CC(O)=C1O	2.35E-11
159.0630	1.34E-06	7	10		4	$C_xH_yO_4$	CC(C=O)C(O)=C(O)C=CO	2.82E-09
167.0660	2.20E-10	9	10		3	$C_xH_yO_3$	O=CC1=C(OC)C=CC=C1OC	2.10E-05
171.0619	5.39E-06	8	10		4	$C_xH_yO_4$	CC1=C(C(O)=CC(O)=C1O)OC	8.36E-10
173.0514	2.24E-08	6	8	2	4	$C_xH_yN_2O_z$	CC1=NC(N(O)=O)=CC(N(O)=O)=C1	2.01E-07
175.1008	1.53E-06	8	14		4	$C_xH_yO_4$	CC(C(OC)C(CC1O)O)=C1O	2.42E-09
178.0700	7.86E-09	6	11	1	5	$C_xH_yNO_{5+}$	O=CCC(ON(O)=O)CCCO	4.69E-07
179.0726	5.02E-10	10	10		3	$C_xH_yO_3$	O=CC1=C(OC=C)C=CC=C1OC	6.85E-06
183.0803	1.89E-09	8	10	2	3	$C_xH_yN_2O_z$	CC1=CC=C(N(O)=O)C=C1NC=O	2.05E-06
191.0814	5.50E-08	10	10	2	2	$C_xH_yN_2O_z$	OC1=C2C=C(OC)C(OC)=CC2=NC=N1	6.61E-08
193.0883	7.05E-10	11	12		3	$C_xH_yO_3$	CC1=C(OCC(CC=O)=O)C=CC=C1	5.72E-06
195.1313	1.92E-06	7	8	2	4	$C_xH_yN_2O_z$	CC1=C(N=O)C=C(N=O)C=C1O	3.04E-09
199.0679	5.07E-10	8	10	2	4	$C_xH_yN_2O_z$	CC(N=O)=CC=CC=CC=N	6.43E-06
207.0769	4.86E-08	10	10	2	3	$C_xH_yN_2O_z$	OC1=C2C=C(OC)C(OC)=CC2=NC=N1	6.61E-08
209.0831	1.23E-04	11	12		4	$C_xH_yO_4$	CC1=C(OC=CC=C)C(O)=CC(O)=C1O	2.92E-11
223.0787	9.99E-01	8	14		7	$C_xH_yO_{5+}$	OC1C(O)C(O)C(O)C(O)C1COC=O	4.14E-15

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107

Annotated van Krevelen Diagrams of DART-HR-MS and HR-AMS Data for Toluene and Cresol SOA

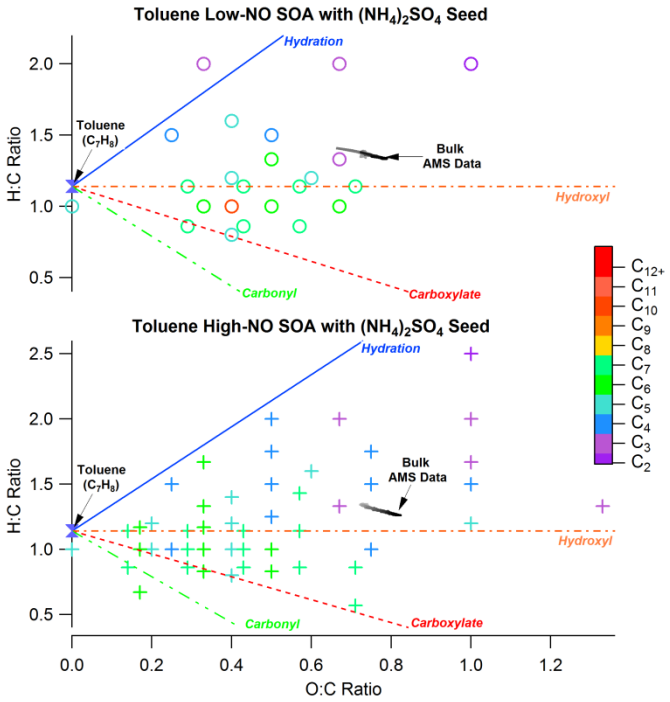
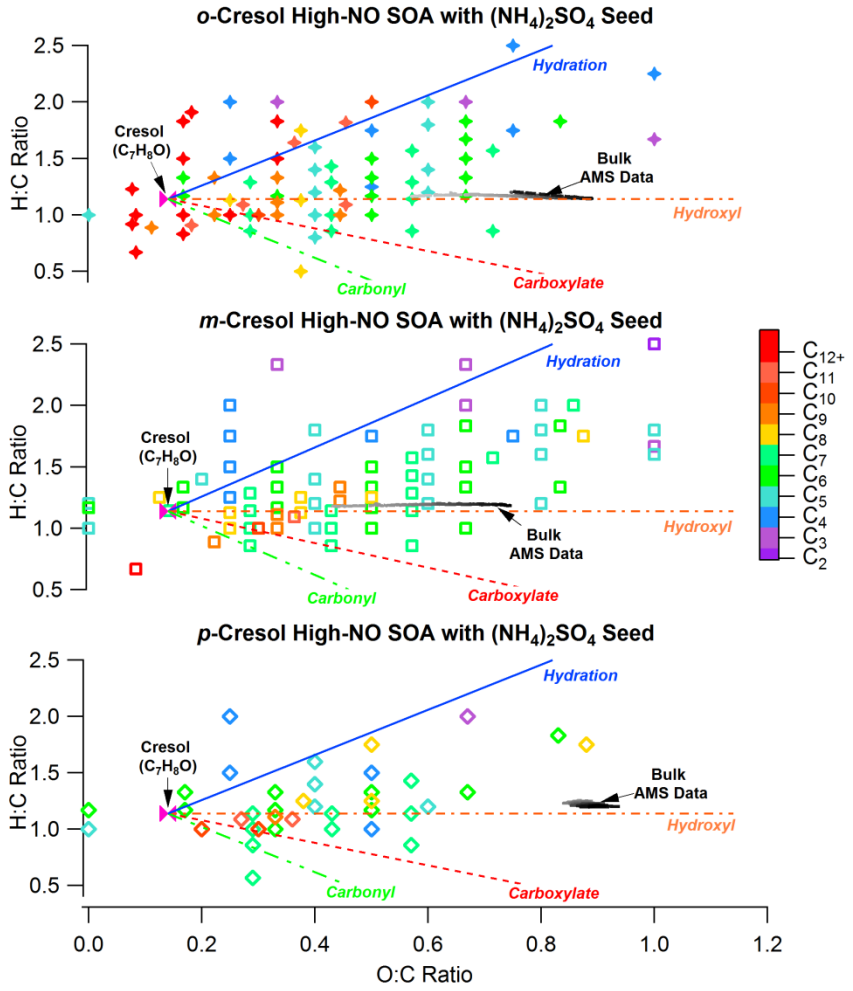


Figure S4. Chemical composition of toluene SOA produced under low- and high-NO conditions with $(NH_4)_2SO_4$ seed, as measured by offline DART-HR-MS, are displayed in van Krevelen space. Data markers are colored by the molecular formula carbon number and sized by the logarithm of the mixing ratio for each molecular formula. The bulk SOA H:C and O:C elemental ratios derived from HR-AMS measurements are shown in grayscale.



117

118 **Figure S5**. Chemical composition of cresol SOA produced under high-NO conditions with
119 $(NH_4)_2SO_4$ seed, as measured by offline DART-HR-MS, are displayed in van Krevelen space.
120 Data markers are colored by the molecular formula carbon number and sized by the logarithm of
121 the mixing ratio for each molecular formula. The bulk SOA H:C and O:C elemental ratios
122 derived from HR-AMS measurements are shown in grayscale.

123

124 ## *PMF Analysis Details*

125 Positive matrix factorization (PMF) was performed on AMS data collected from toluene
126 and *o*-cresol high-NO experiments. PMF analysis was conducted in two ways. First, each
127 experiment was analyzed separately to explore the number of factors that could explain the
128 variations in AMS spectra for a single experimental condition. Second, the data from each

experiment was combined into a unified PMF analysis to determine if common factors could be resolved from toluene and o-cresol SOA formation. The results from both analyses were compared to assess the reliability of using PMF on a unified dataset. The same factors were resolved with both methods. The following discussion focuses on the PMF solution for the unified toluene and o-cresol SOA dataset.

PMF analysis was performed using the PMF evaluation tool v. 2.04 in Igor Pro V6.36. The organic signal matrix and corresponding errors were calculated via the procedures outlined by Ulbrich et al.[2] Organic fragments with an average signal-to-noise ratio (SNR) lower than 0.2 were removed from analysis. Fragments with an average SNR between 0.2 and 2 were down-weighted by increasing their corresponding errors by a factor of 3 as recommended by Paatero and Hopke.[3] The time series of the remaining ion fragments were analyzed for significant trends. Ion fragments with time series trends that did not change significantly from the average background signal (< 3σ) were removed from analysis. The PMF solution space was explored for seven factors with 1-10 seeds and -1< f_{peak} <1. The number of factors was chosen to minimize the goodness of fit parameter, $Q/Q_{expected}$.

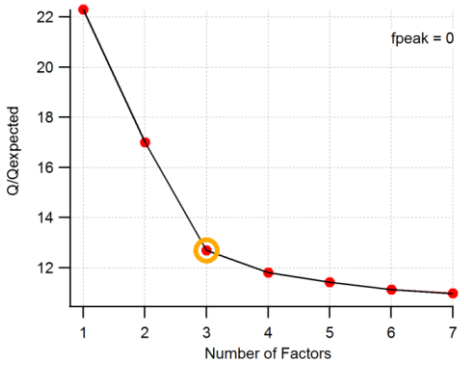


Figure S6. $Q/Q_{expected}$ vs. the number of factors. The chosen solution is highlighted by the yellow circle.

Figure S6 demonstrates that solutions with factor spaces > 3, do not change significantly with respect to $Q/Q_{expected}$. As discussed by Craven et al., a sufficient number of factors is determined when the solution does not drastically improve with an increase in the number of factors fit to the data.[4]

Figures S7 and S8 further justify the choice of a 3-factor solution. Figure S8 visualizes the solution optimization by plotting the absolute residual:error ratio as a function of *m/z* and time. Pixels with a ratio < 1 are colored red whereas those with a ratio > 1 are colored blue. Data are sufficiently fit when no clear structure is observed, or subsequent factors do not improve the randomness of the pixels. A one-factor fit exhibits clear structure in the solution space, indicating that additional factors are needed to explain the variation in the data. This structure disappears when three factors are fit to the data, and no clear improvement is seen when four or more factors are fitted, suggesting that a three-factor solution is sufficient to capture data variation. As discussed by Craven et al., these factors in chamber studies represent time series of groups or fractions of ions that can be connected to different events like gas-particle partitioning and specific generations of gas-phase oxidation.[4]

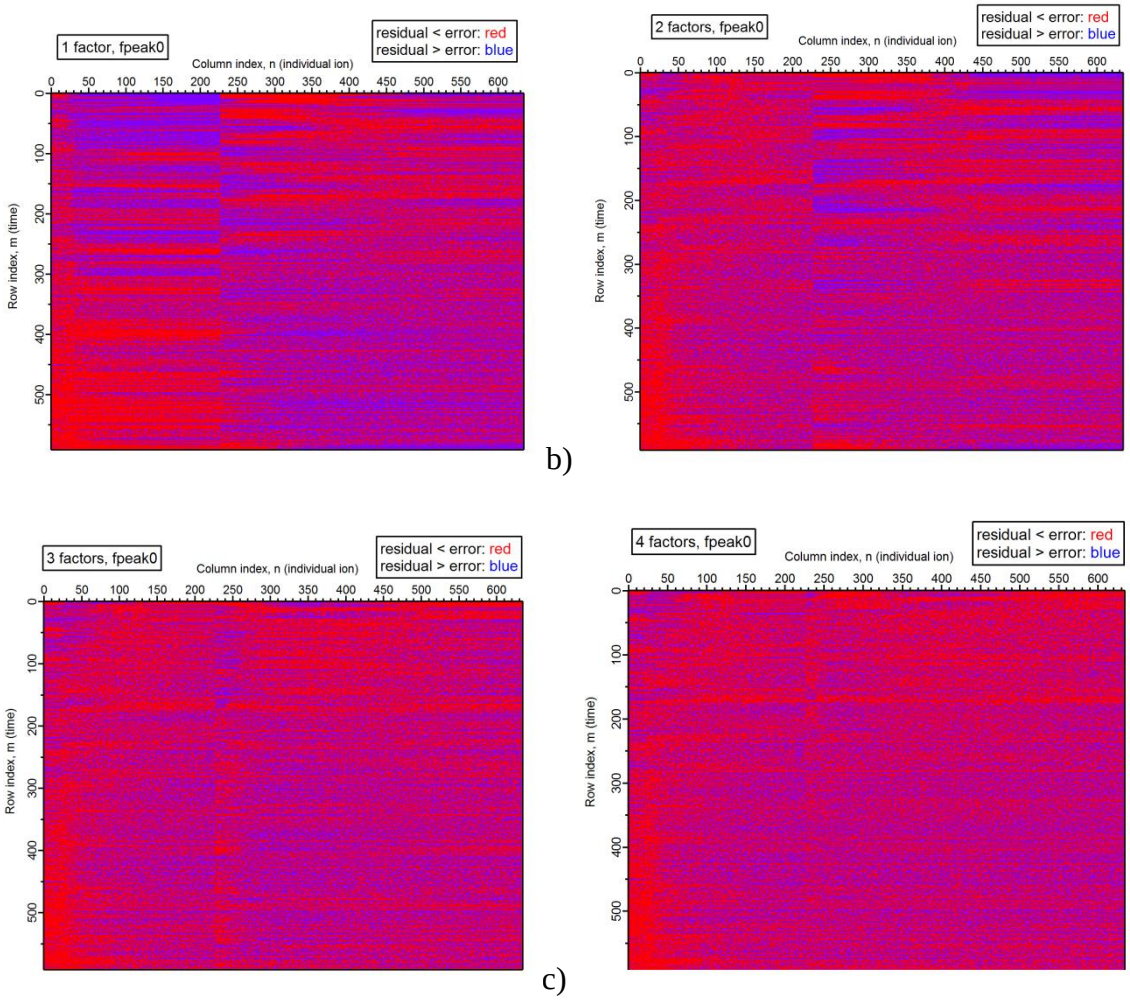


Figure S7. Maps for the one (panel a), two (panel b), three (panel c), and four (panel d) factor solutions. A red dot symbolizes where the residual$_{i\,j}$ > error$_{i\,j}$. A blue dot symbolizes where the residual$_{i\,j}$ < -error$_{i\,j}$.

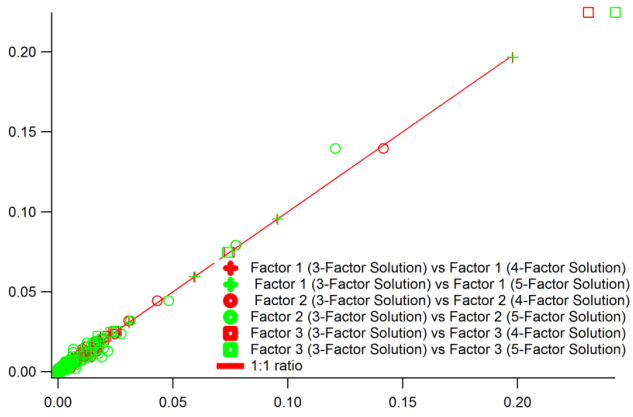


Figure S8. Comparisons of factors 1, 2, and 3 mass spectra between three-factor and four- or five-factor solutions.

Figure S8 reiterates the conclusions drawn from Figure S7. When the mass spectra of a 3-factor solution are compared to those of 4 and 5-factor solutions, we find that factors 1, 2, and 3 do not change significantly with increasing factor spaces. Thus, the resolved factors are robustly resolved in higher factor spaces without significant splitting or reallocation of information amongst factors 1, 2, and 3.

For a given number of factors, there could be multiple solutions that yield an equal fit. To investigate the robustness of the 3-factor solution, one may explore how the solution changes as a function of seed and f_{peak}.[4] A detailed discussion about solution robustness in field measurement data is provided in Coggon et al.[5] In the solution discussed here, $Q/Q_{expected}$ was relatively uniform over all explored seed and f_{peak} values (Figure S9).

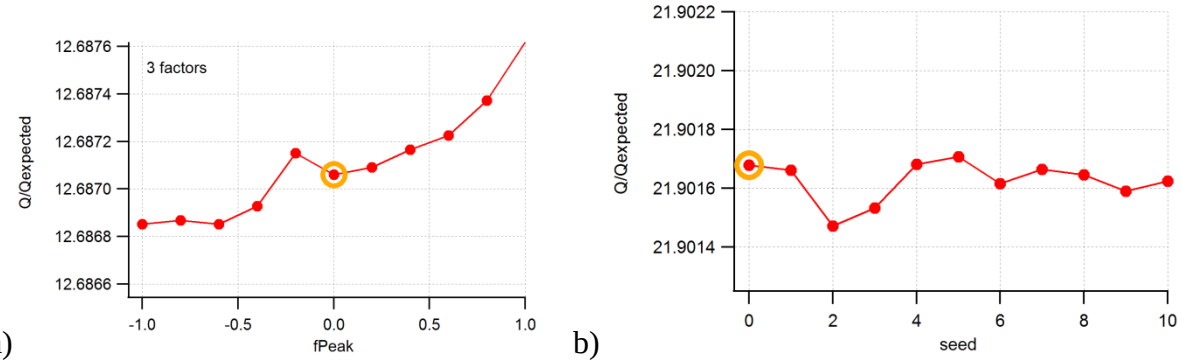


Figure S9. $Q/Q_{expected}$ vs. *fpeak* values (panel a) and vs. seed number (panel b).

This can be further verified by studying how the factor profiles vary as a function of f_{peak}. In Figure S10, we compare a 3-factor solution at f_{peak} = 0, seed = 0 to the same factor space at all other f_{peak} values. In general, the studied systems change very little with respect to f_{peak}, suggesting that the solution at f_{peak} = 0, seed = 0 exhibits little rotational ambiguity and thus, it is sufficiently robust within the range of explored parameters.

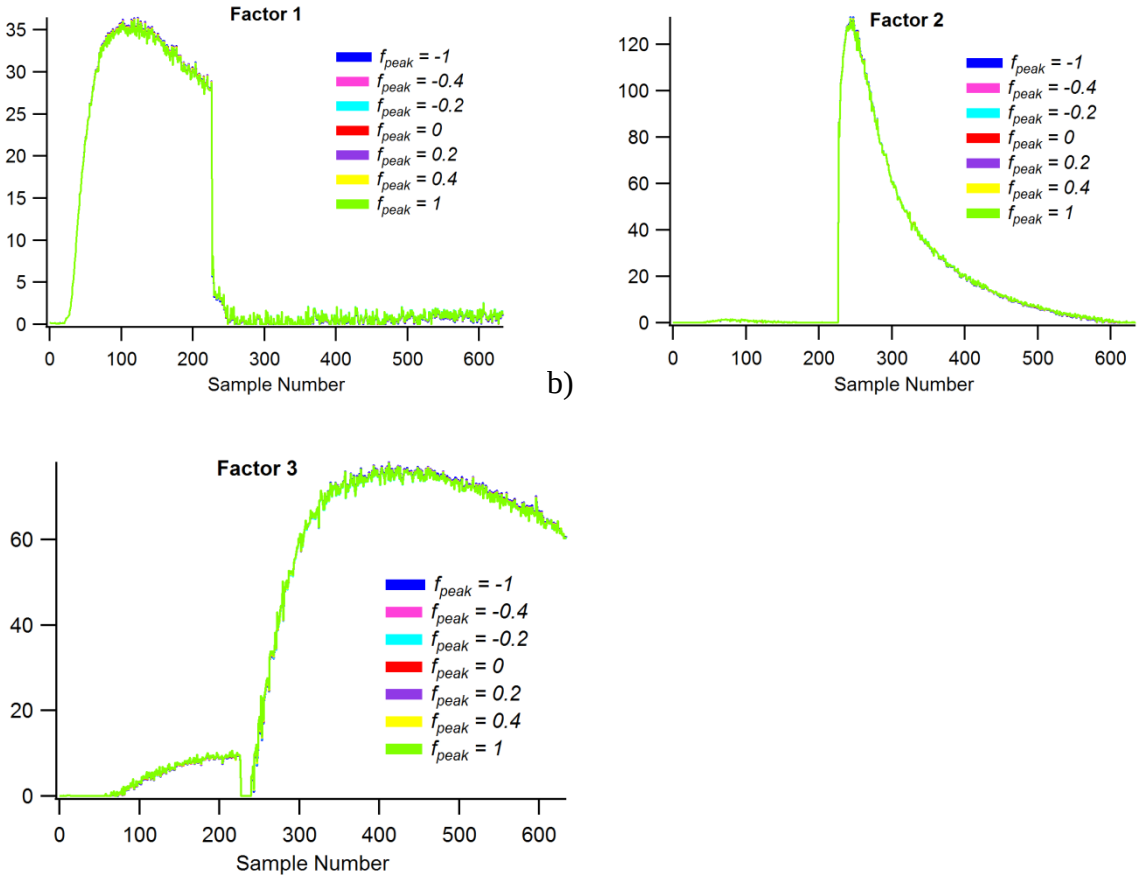
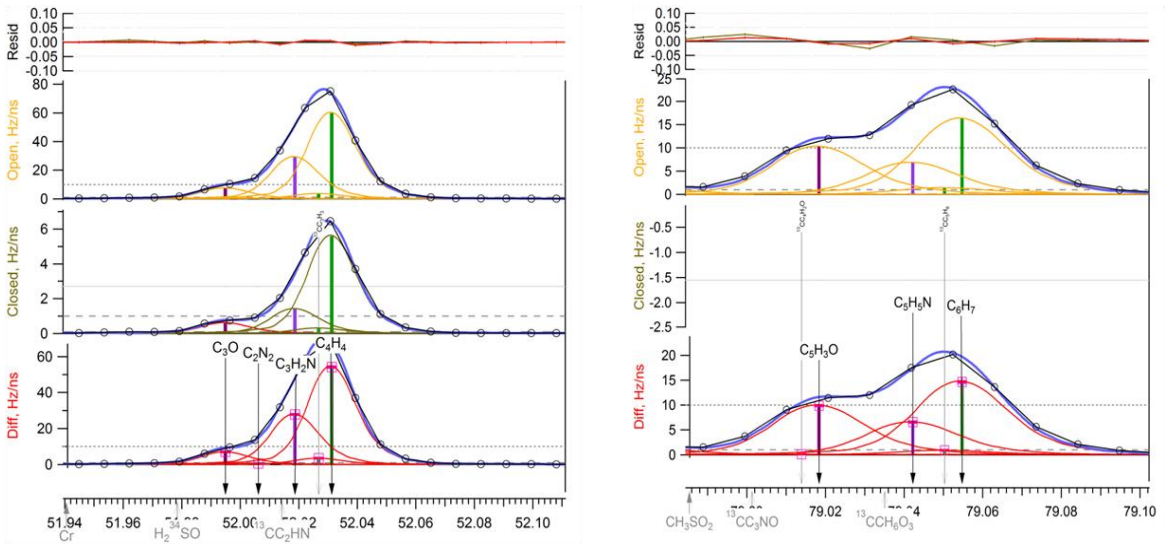


Figure S10. Factor profiles for a 3-factor solution with varying f_{peak} values. Factor 1 is shown in panel (a). Factor 2 is shown in panel (b). Factor 3 is shown in panel (c).

HR-AMS Data Supporting Pyridine Identification

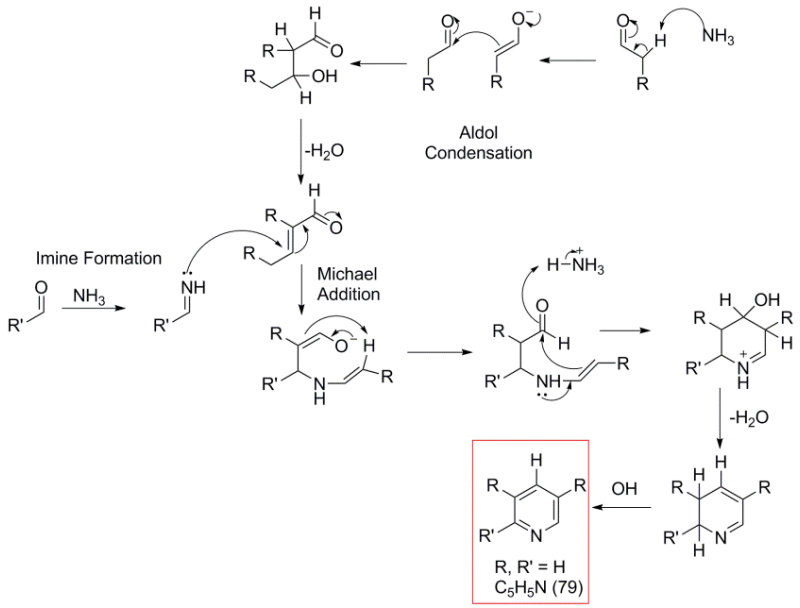
Pyridine is in both the ammonium sulfate-seeded and the nucleation case, and it is found in both DART-HR-MS and HR-AMS measurements. We speculate that ammonia is present in the chamber in some capacity, perhaps originating from ammonium sulfate deposited on the chamber walls; we have no means to monitor for ammonia in the gas phase.



198

199 **Figure S11**. High-resolution mass spectra of the molecular ion and major fragment of pyridine,
200 by HR-AMS.

201 Pyridine forms a molecular ion ($C_5H_5N^+$, *m/z* 79) and a fragment ion ($C_3H_2N^+$, *m/z* 52) under EI-
202 MS conditions; both were found by HR-AMS analysis (Figure S11). The most probable
203 mechanism for pyridine formation under seeded conditions in a photooxidizing environment is
204 one analogous to the traditional Chichibabin synthesis (Figure S12).[6]



205

206 **Figure S12**. Variation of Chichibabin synthesis of pyridine, proposed for toluene low-NO SOA
207 with ammonium sulfate seed aerosol.

Supporting Information References

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