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Supplement of

Organic peroxide and OH formation in aerosol and cloud water: laboratory evidence for this aqueous chemistry

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Table S1. Reactions and rate/equilibrium constants used in the full kinetic model of unified glyoxal/methylglyoxal + OH

	Reactions	Rate constants ($M^{1-n}\ s^{-1}$)	Ref
1	$H_2O_2 \rightarrow 2OH$	1.1e-4×Trans[a]	T, e
2	$OH + H_2O_2 \rightarrow HO_2 + H_2O$	2.7e7	T
3	$HO_2 + H_2O_2 \rightarrow OH + H_2O + O_2$	3.7	T
4	$2\ HO_2 \rightarrow H_2O_2 + O_2$	8.3e5	T
5	$OH + HO_2 \rightarrow H_2O + O_2$	7.1e9	T
6	$HO_2 + O_2^- + H^+ \rightarrow H_2O_2 + O_2$	1e8	T
7	$2OH \rightarrow H_2O_2$	5.5e9	T
8	$OH + O_2^- \rightarrow OH^- + O_2$	1e10	T
9	$O_{2g} \leftrightarrow O_2$	K_{eq} = 1.3e-3 k_r = 5.3e2	T, W
10	$CO_{2g} \leftrightarrow CO_2$	K_{eq} = 3.4e-2 k_r = 5.3e2	T, W
11	$CO_2 \leftrightarrow H^+ + HCO_3^-$	K_{eq} = 4.3e-7 k_r = 5.6e4	T
12	$HCO_3^- \rightarrow H^+ + CO_3^{-2}$	K_{eq} = 4.69e-11 k_r = 5.0e10	T
13	$CO_2^- + O_2 \rightarrow O_2^- + CO_2$	2.4e9	T
14	$HCO_3^- + OH \rightarrow CO_3^- + H_2O$	1e7	T
15	$CO_3^- + O_2^- \rightarrow CO_3^{-2} + O_2$	6.5e8	T
16	$CO_3^- + HCO_2^- \rightarrow HCO_3^- + CO_2^-$	1.5e5	T
17	$CO_3^- + H_2O_2 \rightarrow HCO_3^- + HO_2$	8e5	T
18	GCOLAC + OH → GCOLAC* + H2O	6.0e8	T
19	GCOLAC* + O_2 → GCOLACOO*	1e6	G, L’
20	GCOLACOO* → GLYAC + HO_2	5e1	C
21	2GCOLACOO* → 2GCOLACO* + O_2	3e8*0.95	L’, e
22	2GCOLACOO* → GLYAC + OXLAC + O_2	3e8*0.05	L’, e
23	GCOLACO* → HCO_2H + CO_2	I	Gi, e
24	GCOLACO* → GLYAC*	1e7	Gi, e
25	GCOLAC ↔ H^+ + $GCOLAC^-$	K_{eq} = 1.48e-4 k_r = 2.0e10	T
26	$GCOLAC^-$ + OH → $GCOLAC^{*-}$ + H_2O	6.0e8	T
27	$GCOLAC^{*-}$ + O_2 → $GCOLACOO^{*-}$	1e6	G, L’
28	$GCOLACOO^{*-}$ → $GLYAC^-$ + HO_2	5e1	C
29	$2GCOLACROO^{*-}$ → $2GCOLACO^{*-}$ + O_2	3e8×0.95	L’, e
30	2 $GCOLACROO^{*-}$ → $GLYAC^-$ + $OXLAC^-$+ O_2	3e8×0.05	L’, e
31	$GCOLACO^{*-}$ → HCO_2H + CO_2^-	I	Gi, e
32	$GCOLACO^{*-}$→ $GLYAC^{*-}$	1e7	Gi, e
33	GLY + OH → GLY* + H_2O	1.1e9	T
34	GLY* + O_2 → GLYOO*	1e6	G, L’
35	GLYOO* → GLYAC + HO_2	5e1	C
36	2GLYOO* → 2*CHOHOH + 2CO_2 + O_2 + 2H_2O	3e8	L’
37	*CHOHOH + O_2 → HCO_2H + HO_2	5e6	G, L’
38	GLYAC + OH → GLYAC* + H_2O	3.62e8	T
39	GLYAC* + O_2 → GLYACOO*	1e6	G, L’
40	GLYACOO* → OXLAC + HO_2	5e1	C
41	2GLYACOO* → 2CO_2 + 2COOH	3e8	L’
42	*COOH + O_2 → CO_2 + HO_2	5e6	G, L’

43	$GLYAC \leftrightarrow H^+ + GLYAC^-$	K_{eq} = 3.47e-4 K_r = 2.0e10	T
44	$GLYAC^- + OH \rightarrow GLYAC*^- + H_2O$	1.28e7	T
45	$GLYAC^- + OH \rightarrow GLYAC* + OH^-$	2.9e9	T
46	$GLYAC*^- + O_2 \rightarrow GLYACOO*^-$	1e6	G, L’
47	$GLYACOO*^- \rightarrow OXLAC^- + HO_2$	1e2	C, L’
48	$2GLYACOO*^- \rightarrow 2CO_2^- + 2*COOH$	3e8	L’
49	$MGLY + OH \rightarrow MGLY* + H_2O$	7.0e8×0.92	T
50	$MGLY + OH \rightarrow *MGLY + H_2O$	7.0e8×0.08	T
51	$MGLY* + O_2 \rightarrow MGLYOO*$	1e6	G, L’
52	$MGLYOO* \rightarrow PYRAC + HO_2$	5e1	C
53	$2MGLYOO* \rightarrow 2CO_2 + 2CH_3CO_2H + O_2$	3e8	L’
54	$*MGLY + O_2 \rightarrow *OOMGLY$	1e6	G, L’
55	$2*OOMGLY \rightarrow 2*OMGLY + O_2$	3e8×0.95	L’, e
56	$2*OOMGLY \rightarrow HOMGLY + OMGLY + O_2$	3e8×0.05	L’, e
57	*OMGLY → HCHO + GLY*	I	Gi, e
58	*OMGLY → *HOMGLY	1e7	Gi, e
59	$HOMGLY + OH \rightarrow *HOMGLY + H_2O$	4.10e7	M
60	$*HOMGLY + O_2 \rightarrow *OOHOMGLY$	1e6	G, L’
61	$*OOHOMGLY \rightarrow OMGLY + HO_2$	5e1	C
62	$OMGLY + OH \rightarrow *OMGLY + H_2O$	6.17e9	M
63	$*OMGLY + O_2 \rightarrow *OOOMGLY$	5e1	C
64	GLY* + *CHOHOH → C3D	1.3e9	G, L’
65	2GLY* → C4D	1.3e9	G, L’
66	GLY* + *COOH → C3D	1.3e9	G, L’
67	GLYAC* + *COOH → C3D	1.3e9	G, L’
68	GLYAC* + *CHOHOH → C3D	1.3e9	G, L’
69	2GLYAC* → C4D	1.3e9	G, L’
70	GLYAC* + GLY* → C4D	1.3e9	G, L’
71	$GLYAC*^- + GLY* \rightarrow C4D$	1.3e9	G, L’
72	$GLYAC*^- + GLYAC* \rightarrow C4D$	1.3e9	G, L’
73	$2GLYAC*^- \rightarrow C4D$	1.3e9	G, L’
74	$GLYAC*^- + *COOH \rightarrow C3D$	1.3e9	G, L’
75	$GLYAC*^- + *CHOHOH \rightarrow C3D$	1.3e9	G, L’
76	$GLYCOL*^1 + *CHOHOH \rightarrow C3D$	1.3e9	G, L’
77	$GLYCOL*^1 + GLY* \rightarrow C4D$	1.3e9	G, L’
78	$GLYCOL*^1 + *COOH \rightarrow C3D$	1.3e9	G, L’
79	$GLYCOL*^1 + GLYAC* \rightarrow C4D$	1.3e9	G, L’
80	$GLYCOL*^1 + GLYAC*^- \rightarrow C4D$	1.3e9	G, L’
81	$GLYCOL*^2 + *CHOHOH \rightarrow C3D$	1.3e9	G, L’
82	$GLYCOL*^2 + GLY* \rightarrow C4D$	1.3e9	G, L’
83	$GLYCOL*^2 + *COOH \rightarrow C3D$	1.3e9	G, L’
84	$GLYCOL*^2 + GLYAC* \rightarrow C4D$	1.3e9	G, L’
85	GCOLAC* + *CHOHOH → C3D	1.3e9	G, L’
86	GCOLAC* + GLY* → C4D	1.3e9	G, L’
87	GCOLAC* + *COOH → C3D	1.3e9	G, L’
88	GCOLAC* + GLYAC* → C4D	1.3e9	G, L’
89	$GCOLAC* + GLYAC*^- \rightarrow C4D$	1.3e9	G, L’
90	$GCOLAC* + GLYCOL*^1 \rightarrow C4D$	1.3e9	G, L’
91	$GCOLAC* + GLYCOL*^2 \rightarrow C4D$	1.3e9	G, L’

92	GCOLAC* + GCOLAC* → C4D	1.3e9	G, L'
93	GCOLAC*$^-$ + *CHOHOH → C3D	1.3e9	G, L'
94	GCOLAC*$^-$ + GLY* → C4D	1.3e9	G, L'
95	GCOLAC*$^-$ + *COOH → C3D	1.3e9	G, L'
96	GCOLAC*$^-$ + GLYAC* → C4D	1.3e9	G, L'
97	GCOLAC*$^-$ + GLYAC*$^-$ → C4D	1.3e9	G, L'
98	GCOLAC*$^-$ + GLYAC*$^-$ → C4D	1.3e9	G, L'
99	GCOLAC*$^-$ + GLYCOL*^{1} → C4D	1.3e9	G, L'
100	GCOLAC*$^-$ + GLYCOL*^{2} → C4D	1.3e9	G, L'
101	GCOLAC*$^-$ + GCOLAC* → C4D	1.3e9	G, L'
102	2 GCOLAC*$^-$ → C4D	1.3e9	G, L'
103	2MGLY* → C6D	1.3e9	G, L'
104	MGLY* + *CHOHOH → C4D	1.3e9	G, L'
105	MGLY* + GLY* → C5D	1.3e9	G, L'
106	MGLY* + *COOH → C4D	1.3e9	G, L'
107	MGLY* + GLYAC* → C5D	1.3e9	G, L'
108	MGLY* + GLYAC*$^-$ → C5D	1.3e9	G, L'
109	MGLY* + GLYCOL*^{1} → C5D	1.3e9	G, L'
110	MGLY* + GLYCOL*^{2} → C5D	1.3e9	G, L'
111	MGLY* + GCOLAC* → C5D	1.3e9	G, L'
112	MGLY* + GCOLAC*$^-$ → C5D	1.3e9	G, L'
113	MGLY* + CH_3CO* → C5D	1.3e9	G, L'
114	MGLY* + *HOPYRAC → C6D	1.3e9	G, L'
115	2*HOPYRAC → C6D	1.3e9	G, L'
116	MGLY* + *HOPYRAC$^-$ → C6D	1.3e9	G, L'
117	*HOPYRAC$^-$ + *HOPYRAC$^-$ → C6D	1.3e9	G, L'
118	*HOPYRAC + *HOPYRAC$^-$ → C6D	1.3e9	G, L'
119	CH_3CO* + *HOPYRAC → C6D	1.3e9	G, L'
120	CH_3CO* + *HOPYRAC$^-$ → C6D	1.3e9	G, L'
121	2LA* → C6D	1.3e9	G, L'
122	LA* + MGLY* → C6D	1.3e9	G, L'
123	LA* + *CHOHOH → C4D	1.3e9	G, L'
124	LA* + GLY* → C5D	1.3e9	G, L'
125	LA* + *COOH → C4D	1.3e9	G, L'
126	LA* + GLYAC* → C5D	1.3e9	G, L'
127	LA* + GLYAC*$^-$ → C5D	1.3e9	G, L'
128	LA* + GLYCOL*^{1} → C5D	1.3e9	G, L'
129	LA* + GLYCOL*^{2} → C5D	1.3e9	G, L'
130	LA* + GCOLAC* → C5D	1.3e9	G, L'
131	LA* + GCOLAC*$^-$ → C5D	1.3e9	G, L'
132	LA* + CH_3CO* → C5D	1.3e9	G, L'
133	2CH_3CO* → C4D	1.3e9	G, L'
134	LA* + *HOPYRAC → C6D	1.3e9	G, L'
135	LA* + *HOPYRAC$^-$ → C6D	1.3e9	G, L'
136	OXLAC + OH → COOH + CO_2 + H_2O	1.4e6	T
137	OXLAC ↔ H^+ + OXLAC$^-$	K_{eq} = 5.67e-2 k_r = 5.0e10	T
138	OXLAC$^-$ + OH → COOH + CO_2^- + H_2O	2.0e7	T, L'
139	OXLAC$^-$ ↔ H^+ + OXLAC^{-2}	K_{eq} = 5.42e-5 k_r = 5e10	T
140	OXLAC^{-2} + OH → *COOH + CO_2^- + OH^-	4.0e7	T, L'

141	LA + OH → LA* + H_2O	4.3e8	H
142	LA* + O_2 → LAOO*	1e6	G, L’
143	LAROO* → PYRAC + HO_2	5e1	C
144	LA ↔ LA^- + H^+	K_{eq} = 1.38e-4 k_r = 5.0e10	E&C
145	LA^- + OH → LA^{*-} + H_2O	3e8	B
146	LA^{*-} + O_2 → $LAOO^{*-}$	1e6	G, L’
147	$LAOO^{*-}$ → $PYRAC^-$ + HO_2	5e1	C
148	PYRAC + OH → PYRAC* + H_2O	6.0e7×0.85	T
149	PYRAC + OH → CH_3CO* + CO_2 + H_2O	6.0e7×0.15	T
150	CH_3CO* + O_2 → $CH_3C(O)OO$*	1e6	G, L’
151	CH3C(O)OO* → CH_3CO_2H + HO_2	5e1	C
152	2CH3C(O)OO* → 2$CH_3C(O)O$* + O_2	3e8	L’
153	$CH_3C(O)O$* → CO_2 + HCHO	1e7	Gi
154	PYRAC* + O_2 → PYRACOO*	1e6	G, L’
144	2PYRACOO* → 2PYRACO* + O_2	3e8×0.95	L’, e
145	2PYRACOO* → HOPYRAC + OPYRAC + O_2	3e8×0.15	L’, e
146	PYRACO* → HCHO + GLYAC*	I	Gi, e
147	PYRACO* → *HOPYRAC	1e7	Gi, e
148	HOPYRAC + OH → *HOPYRAC + H_2O	3.6e8	H
149	*HOPYRAC + O_2 → *OOHOPYRAC	1e6	G, L’
150	*OOHOPYRAC → OPYRAC + HO_2	5e1	C
151	OPYRAC + OH → *OPYRAC + H_2O	5e7	e
152	*OPYRAC + O_2 → *OO(O)PYRAC	1e6	G, L’
153	*OO(O)PYRAC → MOXLAC + HO_2	5e1	C
154	PYRAC ↔ $PYRAC^-$ + H^+	K_{eq} = 3.2e-3 k_r = 2e10	T
155	$PYRAC^-$ + OH → $PYRAC^{*-}$ + H_2O	6.0e7×0.95	T
156	$PYRAC^-$ + OH → CH3CO* + CO_2 + OH^-	6.0e7×0.05	T
157	$PYRAC^{*-}$ + O_2 → $PYRACOO^{*-}$	5e1	C
158	2$PYRACOO^{*-}$ → 2$PYRACO^{*-}$ + O_2	3e8×0.95	L’, e
159	2$PYRACOO^{*-}$ → $HOPYRAC^-$ + $OPYRAC^-$ + O_2	3e8×0.05	L’, e
160	$PYRACO^{*-}$ → HCHO + $GLYAC^{*-}$ + O_2	I	Gi, e
161	$PYRACO^{*-}$ → *$HOPYRAC^-$	1e7	Gi, e
162	HOPYRAC ↔ $HOPYRAC^-$ + H^+	K_{eq} = 3.2e-3 k_r = 2e10	e
163	OPYRAC ↔ $OPYRAC^-$ + H^+	K_{eq} = 3.2e-3 k_r = 2e10	e
164	$HOPYRAC^-$ + OH → *$HOPYRAC^-$ + H_2O	2.6e9	H
165	*$HOPYRAC^-$ + O_2 → *$OOHOPYRAC^-$	1e6	G, L’
166	*$OOHOPYRAC^-$ → $OPYRAC^-$ + HO_2	5e1	C
167	$OPYRAC^-$ + OH → *$OPYRAC^-$ + H_2O	5e7	M
168	*$OPYRAC^-$ + O2 → *$OO(O)PYRAC^-$	1e6	G, L’
169	*$OO(O)PYRAC^-$ → $MOXLAC^-$ + HO_2	5e1	C
170	MOXLAC + OH → GLYAC* + CO_2 + H_2O	5.7e7	Gl
171	$MOXLAC^-$ + OH → $GLYAC^{*-}$ + CO_2 + H_2O	7.85e7	e
172	$MOXLAC^{-2}$ + OH → $GLYAC^{*-}$ + CO_2 + OH^-	1.0e8	H
173	MOXLAC ↔ $MOXLAC^-$ + H^+	K_{eq} = 3.16e-3 k_r = 5e10	H
174	$MOXLAC^-$ ↔ $MOXLAC^{-2}$ + H^+	K_{eq} = 1.5e-2	V

		k_r = 5e10	
175	$CH_3CO_2H + OH \rightarrow *CH_2CO_2H + H_2O$	1.36e7	T
176	$CH_3CO_2H + OH \rightarrow CO_2 + HCHO + HO_2 + H_2O$	2.40e6	T
177	$*CH_2CO_2H + O_2 \rightarrow *OOCH_2CO_2H$	1e6	G, L'
178	$2*OOCH_2CO_2H \rightarrow 2*OCH_2CO_2H + O_2$	3e8*0.95	L', e
179	$2*OOCH_2CO_2H \rightarrow$ GLYAC + GCOLAC + O_2	3e8*0.05	L', e
180	$*OCH_2CO_2H \rightarrow 2CO_2 + 2HCHO$	I	Gi, e
181	$*OCH_2CO_2H \rightarrow$ GCOLAC*	1e7	Gi, e
182	$CH_3CO_2H \leftrightarrow CH_3CO_2^- + H^+$	K_{eq} = 1.75e-5 k_r = 5.0e10	T
183	$CH_3CO_2^- + OH \rightarrow *CH_2CO_2^- + H_2O$	7.23e7	T
184	$CH_2CO_2^- + OH \rightarrow CO_2 + HCHO + HO_2 + OH^-$	1.28e7	T
185	$*CH_2CO_2^- + O_2 \rightarrow *OOCH_2CO_2^-$	1e6	G, L'
186	$2*OOCH_2CO_2n1 \rightarrow 2*OCH_2CO_2 + O_2$	3e8×0.95	L', e
187	$2*OOCH_2CO_2^- \rightarrow GLYAC^- + GCOLAC^- + O2$	3e8×0.05	L', e
188	$*OCH_2CO_2^- \rightarrow 2CO_2^- + 2HCHO$	I	Gi, e
189	$*OCH_2CO_2^- \rightarrow GCOLAC*^-$	1e7	Gi, e
190	$H_2O \leftrightarrow H^+ + OH^-$	K_{eq} = 1.0e-14 k_r = 1.4e11	T
191	$HO_2 \leftrightarrow H^+ + O_2^-$	K_{eq} = 1.6e-5 k_r = 5.0e10	T
192	$HCO_2H + OH \rightarrow *COOH + H_2O$	1e8	T
193	$HCO_2^- + OH \rightarrow CO_2^- + H_2O$	2.4e9	T
194	$HCO_2H \leftrightarrow H^+ + HCO_2^-$	K_{eq} = 1.77e-4 k_r = 5.0e10	T
195	GLYAC + $H_2O_2 \rightarrow HCO_2H + CO_2 + H_2O$	0.3	T
196	PYRAC + $H_2O_2 \rightarrow CH_2CO_2H + H_2O + CO_2$	0.11	T
197	$PYRAC^- + H_2O_2 \rightarrow CH_2CO_2^- + H_2O + CO_2$	0.11	T
198	MOXLAC + $H_2O_2 \rightarrow$ OXLAC + $CO_2 + H_2O$	0.5	T
199	$MOXLAC^- + H_2O_2 \rightarrow OXLAC^- + CO_2 + H_2O$	0.5	T
200	$HCO_2H + OH \rightarrow COOH + H_2O$	1e8	T
201	$HCO_2^- + OH \rightarrow CO_2^- + H_2O$	2.4e9	T
202	$HCO_2H \leftrightarrow H^+ + HCO_2^-$	K_{eq} = 1.77e-4 k_r = 5.0e10	T
203	2*CHOHOH $\rightarrow$ GLY	1.3e9	G, L'
204	*CHOHOH + *COOH $\rightarrow$ GLYAC	1.3e9	G, L'
205	2*COOH $\rightarrow$ OXLAC	1.3e9	G, L'
206	C3D $\leftrightarrow$ MA + H2O	K_{eq} = 1e5 k_r = 1e-8	L'
207	MA + OH $\rightarrow$ C3D* + H_2O	1.6e7	E
208	TA + OH $\rightarrow$ C4D* + H_2O	3.1e8	M
209	2*COOH $\rightarrow$ OXLAC	1.3e9	G, L'
210	CO_2^- + *COOH $\rightarrow OXLAC^-$	1.3e9	G, L'
211	$2CO_2^- \rightarrow OXLAC^{-2}$	1.3e9	G, L'
212	$PYRAC^- \rightarrow 0.45CH_3CO_2^-$ [b]	1e-4 [b]	C, e
213	GCOLACOO* + $HO_2 \rightarrow$ GCOLACOOH + O_2	3e6 [c]	e
214	$GCOLACOO*^- + HO_2 \rightarrow GCOLACOOH^- + O_2$	3e6 [c]	e
215	*OOMGLY + $HO_2 \rightarrow$ HOOMGLY + O_2	3e6 [c]	e
216	PYRACOO* + $HO_2 \rightarrow$ PYRACOOH + O_2	3e6 [c]	e
217	$PYRACOO*^- + HO_2 \rightarrow PYRACOOH^- + O_2$	3e6 [c]	e
218	*OOCH2COOH + $HO_2 \rightarrow$ HOOCH2COOH + O_2	3e6 [c]	e

219	$*OOCH2COO^- + HO_2 \rightarrow HOOCH2COO^- + O_2$	3e6 [c]	e
220	GCOLACOOH + OH $\rightarrow$ products	6e8[d]	e
221	$GCOLACOOH^-$ + OH $\rightarrow$ products	6e8[d]	e
222	HOOMGLY + OH $\rightarrow$ products	7e8[d]	e
223	PYRACOOH + OH $\rightarrow$ products	6e7[d]	e
224	$PYRACOOH^-$ + OH $\rightarrow$ products	6e7[d]	e
225	HOOCH2COOH + OH $\rightarrow$ products	1.4e7[d]	e
226	MGLY $\leftrightarrow$ DeMGLY[e]	K_{eq} = 2700 k_r = 6	M S
227	DeMGLY + OH $\rightarrow$ MGLY* + H_2O	7e8×0.92[f]	T
228	DeMGLY + OH $\rightarrow$ *MGLY + H_2O	7e8×0.08[f]	T
229	ROOH + DeMGLY $\leftrightarrow$ PHA	K_{eq} = 6.25 k_r = 1.6e-4	T'
230	ROOH $\rightarrow$ RO* + OH	k = 1.1e-4 [h]	e
231	PHA + OH $\rightarrow$ products	7e8[g]	T
232	$OH_g \leftrightarrow OH$	K_{eq} = 30[i] k_r = 3.5e5[j]	L W
233	$HO_{2g} \leftrightarrow HO_2$	K_{eq} = 4e3[k] k_r = 4.2e5[l]	L W
234	$ROOH_g$[m] $\leftrightarrow$ ROOH	Keq = 1000 [n] kr = 5.7e2[o]	L W

[a]Trans = Transmittance = $10^{-18.4 \times 0.80 \times [H_2O_2]}$; * = radical (e.g., glyoxal* = glyoxal radical); *[n] = radical type n (e.g., GLYCOLAC*[1] = glycolic acid radical type 1); O* (or *O) = alkoxy radical ; OO* (or *OO) = peroxy radical; CnD = C_n dimer (e.g., C2D = C_2 dimer); X_g = X in the gas phase (e.g., $O_{2g} = O_2$ in the gas phase); MGLY = methylglyoxal, PYRAC = pyruvic acid, GLYAC = glyoxylic acid, GLYCOL = glycolaldehyde, GLYCOLAC = glycolic acid, LA = lactic acid, MOXLAC = mesoxalic acid, OXLAC = oxalic acid; n = n^{th} order; K_{eq} = the equilibrium constant (M), k_r = the reverse rate constant for corresponding K_{eq}., Thus, the forward rate constant can be calculated by $K_{eq} \times k_r$; (g) = in the gas phase; I (= the decomposition rate constant from alkoxy radicals) = 5e6 s^{-1} for ~10μM acetic acid/methylglyoxal, 8e6 s^{-1} for ~10^2 μM acetic acid/methylglyoxal, and 2e7 s^{-1} for ~10^3μM acetic acid/ 3.2e7 s^{-1} for ~10^3μM methylglyoxal; [b] PYRAC is assumed to photolyze to produce only 45% acetic acid with 5 times slower than the literature value (Carlton et al., 2006). [c] The rate constant for ROO* + HO_2 is assumed to be similar to that for $HO_2 + HO_2$ (ROO* = peroxy radical). [d] The rate constant for ROOH + OH is assumed to be that of the parent organic compound + OH (e.g. GCOLAC + OH for GCOLACOOH + OH). [d] DeMGLY = dehydrated MGLY (containing an aldehyde moiety). Therefore, MGLY is a hydrated form of methylglyoxal. [f] The rate constant for DeMGLY + OH is assumed to be the same as that for MGLY + OH. [g]The rate constant for PHA + OH is assumed to be the same as that for MGLY + OH. [h]The ROOH photolysis rate is assumed to be the same as the H2O2 photolysis rate. [i]Henry's law constant for OH. [j]diffusion-controlled transfer coefficient for OH. However, these h and j values are changed to maintain ~1e-14 M of OH; otherwise, OH is ~1e-12 M. [k]Henry's law constant for OH_2. [l]diffusion-controlled transfer coefficient for OH_2. [m]It is assumed that $[ROOH]_g$ = 1ppb. [n]Henry's law constant for ROOH. [o]diffusion-controlled transfer coefficient for ROOH (based on the estimation by Lim et al, 2005).

Reference

T = Tan et al., 2009, 2010 and 2012
G = Guzman et al., JPCA, 2006
C = Carter et al., JPC, 1979
H = Herrmann et al., AE, 2005
E = Ervens et al., PCCP, 2003
M = Monod et al., AE, 2005, 2008
L = Lim et al.,EST, 2005
L' = Lim et al., ACP, 2010
W = Warneck, PCCP, 1999

E&C = Eyal and Canari, Ind. Eng. Chem. Res., 1995
B = Buxton et al., JPCRD, 1988
Gi = Gilbert et al., 1976 and 1981
V = Volgger et al., J. Chrom. A, 1997
e = Estimation
S = Sareen et al., PNAS, 2013
T' = Tran and Ziemann, unpublished data, 2006

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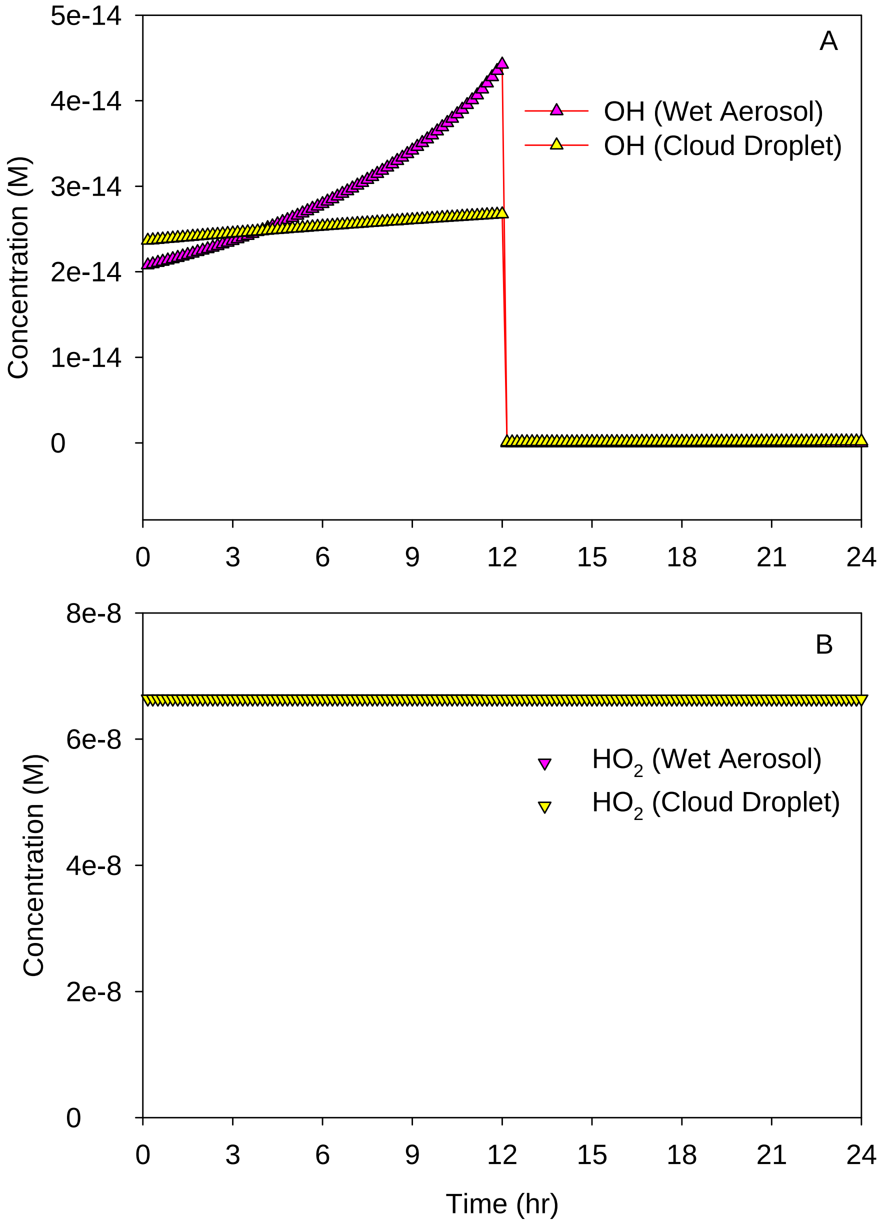

Fig. S1. The atmospheric simulated concentrations of OH (A) and HO_2 (B) in wet aerosols and cloud droplets for 24 hours (The first 12 hrs are daytime)

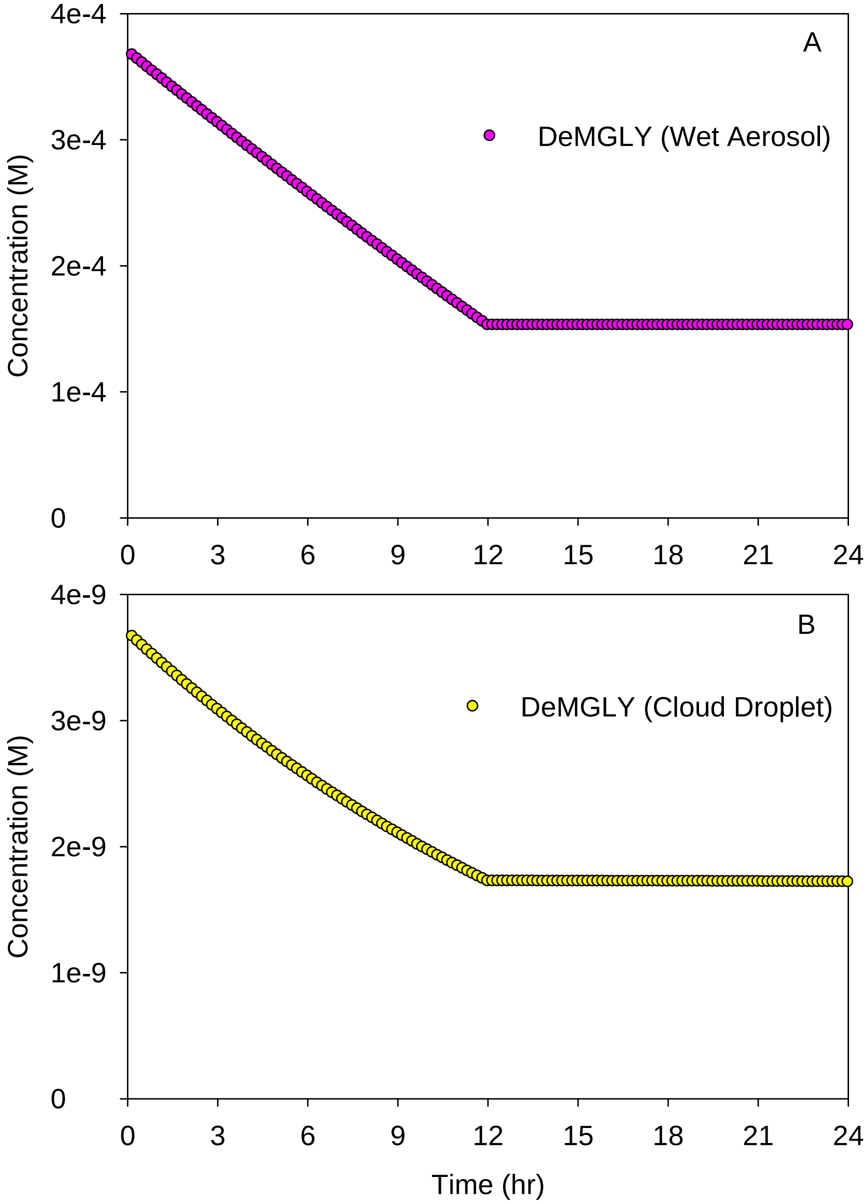

Fig. S2. The atmospheric simulated concentrations of DeMGLY (dehydrated methylglyoxal) in wet aerosols (A) and cloud droplets (B) for 24 hours (The first 12 hrs are daytime)

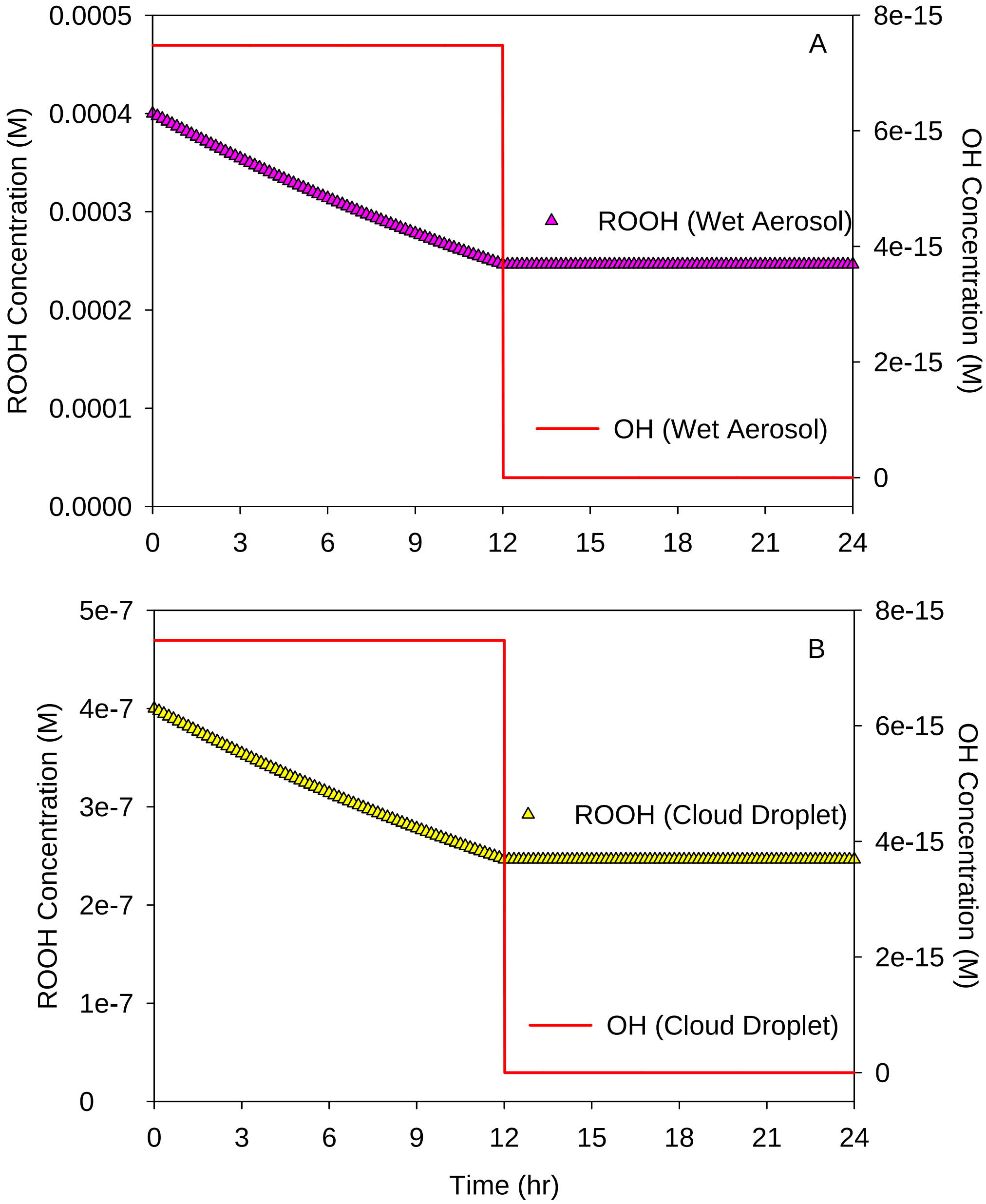

Fig. S3. The atmospheric simulated concentrations of ROOH and OH in wet aerosols (A) and cloud droplets (B) for 24 hours (The first 12 hrs are daytime)