

Table S1. Wavelength ranges for photolysis calculations

species	wavelength range(nm)	species	wavelength range(nm)	species	wavelength range(nm)
O ₃	117.54-827.50	O ₂	80.0-240.0	N ₂	56.36-98.78
NO ₂	240.964- 662.50	NO ₂	403-691	N ₂ O	160-240
N ₂ O ₅	200-420	NO	56.36-239.89	HO ₂ NO ₂	175-350
CH ₃ OOH	205-365	CH ₂ O	226-375	HNO ₃	192-350
HONO	184-396	H ₂ O ₂	190-260	H ₂ O	175.5-189.3
CH ₃ O ₂	205.0-295.0	CH ₃ OH	120-230		

Table S2 used reactions

O + O ₂ + M → O ₃ + M	O + O ₃ → O ₂ + O ₂ (¹ Δ _g)	O ₃ + O ₃ → O ₂ + O ₂ + O ₂
O ₃ + O ₃ → O + O ₂ + O ₃	O ₃ + O → O + O ₂ + O	O ₂ (¹ Δ _g) + O ₃ → O ₂ + O ₂ + O
O(¹ D) + O ₃ → O ₂ + O ₂	O(¹ D) + O ₃ → O ₂ (¹ Δ _g) + O ₂	O(¹ D) + O ₃ → O ₂ + O + O
O + O ₂ + O → O ₃ + O	O(¹ D) + O + O ₂ → O ₂ + O ₂	O + O + O ₂ → O ₂ + O ₂
O + O + O → O ₂ + O	O ₃ + O → O ₂ + O ₂	O ₃ + O ₂ → O ₂ + O + O ₂
O(¹ D) + O ₂ → O + O ₂	O(¹ D) + O → O + O	O ₂ (¹ Δ _g) + O → O ₂ + O
O ₂ (¹ Δ _g) + O ₂ → O ₂ + O ₂	O(¹ D) + O ₂ → O + O ₂ (¹ Δ _g)	O(¹ D) + N ₂ + M → N ₂ O + M
N ₂ O + O(¹ D) → N ₂ + O ₂	N ₂ O + O(¹ D) → NO + NO	NO + NO ₃ → NO ₂ + NO ₂
NO ₃ + NO ₃ → 2NO ₂ + O ₂	NO + O ₃ → NO ₂ + O ₂	NO ₂ + O → NO + O ₂
N + O ₂ → NO + O	N + O ₃ → NO + O ₂	N + NO → N ₂ + O
NO + O + M → NO ₂ + M	NO ₂ + O ₃ → NO ₃ + O ₂	NO + NO ₂ → N ₂ O ₃
O + NO ₂ + M → NO ₃ + M	NO ₂ + NO ₃ + M → N ₂ O ₅ + M	N + NO ₂ → N ₂ O + O
O + NO ₃ → O ₂ + NO ₂	O + N ₂ O ₅ → 2NO ₂ + O ₂	N ₂ O ₃ → NO + NO ₂
O ₂ (¹ Δ _g) + N ₂ O → NO + NO ₂ → N ₂ + O ₃ → N ₂ O ₃ → O ₂ + N ₂ O	O ₂ (¹ Δ _g) + N → NO + O	O ₂ (¹ Δ _g) + N ₂ → O ₂ + N ₂
	O + OH → O ₂ + H	O + N → NO
	O(¹ D) + N → NO	O + HO ₂ → OH + O ₂
	O + H ₂ O ₂ → OH + HO ₂	H + O ₂ + M = HO ₂ + M
H + O ₃ → OH + O ₂	H + HO ₂ → 2 OH	H + HO ₂ → O + H ₂ O
H + HO ₂ → H ₂ + O ₂	OH + O ₃ → HO ₂ + O ₂	OH + H ₂ → H ₂ O + H
OH + OH → H ₂ O + O	OH + OH + M → H ₂ O ₂ + M	OH + HO ₂ → H ₂ O + O ₂
OH + H ₂ O ₂ → H ₂ O + HO ₂	HO ₂ + O ₃ → OH + 2O ₂	HO ₂ + HO ₂ → H ₂ O ₂ + O ₂
HO ₂ + HO ₂ + M → H ₂ O ₂ + O ₂ + M	O + HNO ₃ → OH + NO ₃	O + HO ₂ NO ₂ → OH + NO ₂ + O ₂
H + NO ₂ → OH + NO	OH + NO + M → HONO + M	OH + NO ₂ + M → HNO ₃ + M
OH + NO ₂ + M → HOONO + M	OH + NO ₃ → HO ₂ + NO ₂	OH + HONO → H ₂ O + NO ₂
O + HNO ₃ → OH + NO ₃	OH + HNO ₃ → H ₂ O + NO ₃	OH + HO ₂ NO ₂ → H ₂ O + NO ₂ + O ₂
HO ₂ + NO → NO ₂ + OH	HO ₂ + NO ₂ + M → HO ₂ NO ₂ + M	HO ₂ NO ₂ + M → NO ₂ + HO ₂ + M
HO ₂ + NO ₂ → HONO + O ₂	HO ₂ + NO ₃ → OH + NO ₂ + O ₂	O ₃ + HONO → O ₂ + HNO ₃
N ₂ O ₅ + H ₂ O → 2HNO ₃	→ HNO ₃ + O ₂	H ₂ O + O(¹ D) → OH + OH
CH ₄ + O(¹ D) → CH ₃ + OH → CH ₃ O + H → CH ₂ O + H ₂	CH ₄ + OH → CH ₃ + H ₂ O	CH ₃ O + O ₂ → CH ₂ O(HCHO) + HO ₂
	CH ₃ + O ₂ + M → CH ₃ O ₂ + M	CH ₃ O ₂ + NO → CH ₃ O + NO ₂
	CH ₂ O + OH → CHO + H ₂ O	O(¹ D) + H ₂ → OH + H
CH ₃ O ₂ + O ₃ → CH ₃ O + 2O ₂	CH ₃ O ₂ + CH ₃ O ₂ → CH ₃ O + CH ₃ O + O ₂	CH ₃ + O ₃ → CH ₃ O + O ₂
CH ₃ O ₂ + HO ₂ → CH ₃ OOH + O ₂	→ CH ₃ OH + CH ₂ O + O	CHO + O ₂ → HO ₂ + CO
CO + OH + M → CO ₂ + H + M	OH + CH ₃ OH → CH ₂ OH + H ₂ O	CH ₂ OH + O ₂ → CH ₂ O + HO ₂
OH + CH ₃ OOH → CH ₃ O ₂ + H ₂ O		

Table S3 Ozone vertical distribution at 1 × velocity after 1400 days

height (km)	at midnight m ⁻³	at 3:00 P.M. m ⁻³
500	1.42134630e-91	5.46704531e-91
460	1.42816324e-83	1.60345604e-83
420	1.71683296e-75	6.59903537e-76
380	3.37156673e-67	7.22257609e-68
340	7.92195840e-59	3.38804950e-60
300	8.85490714e-51	2.12280989e-52
260	8.04734963e-43	1.29705563e-44
220	6.18744540e-35	7.64140712e-37
190	3.06065445e-27	3.05402623e-29
170	8.52421895e-20	7.22937353e-22
150	2.04980836e-12	1.52479549e-14
130	4.05558584e-05	2.72045025e-07
110	5.99609317e+02	3.71785371e+00
94	3.97327231e+09	2.39397464e+07
82	2.24501213e+15	2.36107299e+13
70	1.48437232e+14	4.03263124e+15
62	7.10762071e+13	1.17761990e+16
57	2.54592306e+13	1.89062300e+16
53	7.08117519e+12	2.63751076e+16
50	1.63269844e+12	3.19106390e+16
45	7.80919448e+09	4.95834501e+16
41	4.82161143e+12	8.89877743e+16
37	2.40286902e+15	2.21200180e+17
35	1.27888370e+17	3.83937806e+17
33	5.03390143e+17	7.35303916e+17
32	8.79599907e+17	1.06901684e+18
31	1.45858067e+18	1.59113938e+18
30	2.24277879e+18	2.33151870e+18
29	3.09387698e+18	3.18793679e+18
28	3.76027877e+18	3.90942134e+18
27	4.07549729e+18	4.25494441e+18
25	4.16694370e+18	4.38451014e+18
23	3.65612423e+18	3.86611100e+18
21	3.04812120e+18	3.23614730e+18
19	2.49422516e+18	2.69244219e+18
18	2.20363820e+18	2.38885165e+18
17	1.95030849e+18	2.12926995e+18
16	1.71521031e+18	1.89895429e+18
15	1.46626297e+18	1.67538492e+18
13	9.14749177e+17	9.29798225e+17
11	8.45842069e+17	8.56880482e+17
9	7.90400351e+17	8.07347869e+17

7	7.05440441e+17	7.31180748e+17
5	5.94336565e+17	6.16635589e+17
2	4.83031864e+17	4.87728519e+17
1	4.92589091e+17	5.10175857e+17
0	4.88780314e+17	5.07466220e+17

Fig. s1 The reaction kinetics parameters for the reaction $2\text{O}_3 \rightarrow 3\text{O}_2$

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$$\text{O}_3 + \text{O}_3 \rightarrow \text{O}_2 + \text{O}_2 + \text{O}_2$$

Rate expression: $k(T) = A (T/298 \text{ K})^n e^{-E_a/RT}$

Rate expression units:

First order: s^{-1}

Second order: $\text{cm}^3/\text{molecule s}$

Third order: $\text{cm}^6/\text{molecule}^2 \text{ s}$

$R = 8.314472\text{E-}03 \text{ kJ / mole K}$

Energy Units

Pressure Units

Base Volume Unit

Evaluation Temperature

kJ

Pa

cm

298.0

Molecular Units

Temperature Units

Reference Temperature

Molecule

K

298.0

Use the Plot checkboxes to select data for plotting. Plot selected data using the "Create Plot" button. Click the squib to see extra information about a particular rate constant. Additional [help](#) is available.

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2nd order

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Plot	Squib	Temp [K]	A	Ea [kJ/mole]	k(298.00 K)	Order
☐	1959PSH/MOR402	393 - 443	7.47E-12	77.41		2
☐	1933GLI/SCH323-348	353 - 383	2.66E-07	129		2

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