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D-region ion–neutral coupled chemistry (Sodankylä Ion Chemistry, SIC) within the Whole Atmosphere Community Climate Model (WACCM 4) – WACCM-SIC and WACCM-rSIC

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Number[1]	Reaction[2,3]	A[4]	n	E[5]	Source[1] [6]	Comments, recommendations
RPE(1)	$O^+ + e^- \rightarrow O + h\nu$	4×10^{-10}	0.7	0		
RPE(2)	$O_2^+ + e^- \rightarrow 2O$	1.9×10^{-7}	0.7	0	[2]	Rate coefficient measured over the temperature range of 100-1200K
RPE(3)	$O_4^+ + e^- \rightarrow 2O_2$	4.2×10^{-6}	0.48	0		Temperature interval is uncertain.
RPE(4)	$N^+ + e^- \rightarrow N + h\nu$	1×10^{-12}	0	0		
RPE(5)	$N_2^+ + e^- \rightarrow N + N(^2D)$	2.2×10^{-7}	0.39	0	[2]	Rate coefficient measured over the temperature range of 100-1200K.
RPE(6)	$NO^+ + e^- \rightarrow N + O$	7.0×10^{-8}	0.69	0	[2]	Rate coefficient measured over the temperature range of 100-1200K.
RPE(7)	$NO^+ + e^- \rightarrow N(^2D) + O$	2.8×10^{-7}	0.69	0	[2]	Rate coefficient measured over the temperature range of 100-1200K.
RPE(8)	$NO^+(N_2) + e^- \rightarrow NO + N_2$	1.5×10^{-6}	0.9	0	[3]	Not studied. Only estimated from $NO^+(NO)$ recombination based on Petrignani et al.[3]
RPE(9)	$NO^+(CO_2) + e^- \rightarrow NO + CO_2$	1.5×10^{-6}	0.9	0	[3]	Not studied. Only estimated from $NO^+(NO)$ recombination based on Petrignani et al.[3]
RPE(10)	$NO^+(H_2O) + e^- \rightarrow NO + H_2O$	1.5×10^{-6}	0.9	0	[3]	Not studied. Only estimated from $NO^+(NO)$ recombination based on Petrignani et al.[3]
RPE(11)	$NO^+(H_2O)_2 + e^- \rightarrow NO + 2H_2O$	2.8×10^{-6}	0	0	[4]	Data for all NO^+ water cluster ion reactions is estimated only for T=300K.
RPE(12)	$NO^+(H_2O)_3 + e^- \rightarrow NO + 3H_2O$	5×10^{-6}	0	0	[4]	
RPE(13)	$NO^+(H_2O)(N_2) + e^- \rightarrow NO + H_2O + N_2$	5×10^{-6}	0	0	[4]	
RPE(14)	$NO^+(H_2O)(CO_2) + e^- \rightarrow NO + H_2O + CO_2$	5×10^{-6}	0	0	[4]	
RPE(15)	$NO^+(H_2O)_2(N_2) + e^- \rightarrow NO + 2H_2O + N_2$	5×10^{-6}	0	0	[4]	
RPE(16)	$NO^+(H_2O)_2(CO_2) + e^- \rightarrow NO + 2H_2O + CO_2$	5×10^{-6}	0	0		Not studied. Assumed to be the same as for $NO^+(H_2O)_2(N_2)$.
RPE(17)	$O_2^+(H_2O) + e^- \rightarrow O_2 + H_2O$	4.2×10^{-6}	0.48	0	[4]	Not studied. Assumed to be the same as for O_4^+.
RPE(18)	$H_3O^+(OH) + e^- \rightarrow OH + H + H_2O$	1.4×10^{-6}	0.66	0	[4]	Not studied. Assumed to be the same as for $H^+(H_2O)_2$.
RPE(19)	$H^+(H_2O) + e^- \rightarrow H + H_2O$	7.6×10^{-7}	0.83	0	[5, 6]	Rate coefficients for all $H^+(H_2O)_n$ (n=1,...,6) cluster recombination were calculated over the temperature range of 10-2000K. For larger clusters at 298K.
RPE(20)	$H^+(H_2O)_2 + e^- \rightarrow H + 2H_2O$	1.4×10^{-6}	0.66	0	[6]	
RPE(21)	$H^+(H_2O)_3 + e^- \rightarrow H + 3H_2O$	2.5×10^{-6}	0.76	0	[6]	
RPE(22)	$H^+(H_2O)_4 + e^- \rightarrow H + 4H_2O$	5.5×10^{-7}	0.78	0	[7]	
RPE(23)	$H^+(H_2O)_5 + e^- \rightarrow H + 5H_2O$	3.8×10^{-6}	0.68	0	[6]	

RPE(24)	$H^+(H_2O)_6 + e^- \rightarrow H + 6H_2O$	3.2×10^{-6}	0.65	0	[6]	
RPE(25)	$H^+(H_2O)_7 + e^- \rightarrow H + 7H_2O$	1.3×10^{-6}	0	0	[6]	
RPE(26)	$H^+(H_2O)_8 + e^- \rightarrow H + 8H_2O$	7.8×10^{-7}	0	0	[6]	
RPE(27)	$H^+(H_2O)_2(CO_2) + e^- \rightarrow H + 2H_2O + CO_2$	2.5×10^{-6}	0.66	0		Not studied. Assumed to be the same as for $H^+(H_2O)_3$.
RPE(28)	$H^+(H_2O)_2(N_2) + e^- \rightarrow H + 2H_2O + N_2$	2.5×10^{-6}	0.66	0		Not studied. Assumed to be the same as for $H^+(H_2O)_3$.
RPE(29)	$H^+(H_2O)(CO_2) + e^- \rightarrow H + H_2O + CO_2$	2.5×10^{-6}	0.66	0		Not studied. Assumed to be the same as for $H^+(H_2O)_3$.
RPE(30)	**$O_2 + N_2 + e^- \rightarrow O_2^- + N_2$**	**1×10^{-31}**	**1.0**	**4.9×10^{3}**		**Temperature interval is uncertain.**
RPE(31)	**$O_3 + e^- \rightarrow O^- + O_2$**	**9.1×10^{-12}**	**1.46**	**0**		**Temperature interval is uncertain.**
RPE(32)	**$2O_2 + e^- \rightarrow O_2^- + O_2$**	**4×10^{-30}**	**0**	**1.3×10^{4}**		**Temperature interval is uncertain.**
PIR(1)	**$O^+ + O_2 \rightarrow O_2^+ + O$**	**1.6×10^{-11}**	**0.5**	**0**	**[8]**	**Rate coefficient was measured over the range of 300-1800K.**
PIR(2)	**$O^+ + N_2 \rightarrow NO^+ + N$**	**1.2×10^{-12}**	**1.0**	**0**		**Temperature interval is uncertain.**
PIR(3)	**$O^+ + N(^2D) \rightarrow N^+ + O$**	**1.3×10^{-10}**	**0**	**0**		
PIR(4)	**$O^+ + NO \rightarrow NO^+ + O$**	**8×10^{-13}**	**0**	**0**		
PIR(5)	**$O_2^+ + NO \rightarrow NO^+ + O_2$**	**4.4×10^{-10}**	**0**	**0**		
PIR(6)	**$O_2^+ + N_2 \rightarrow NO^+ + NO$**	**2×10^{-18}**	**0**	**0**		
PIR(7)	**$O_2^+ + O_2 + M \rightarrow O_4^+ + M$**	**3.5×10^{-30}**	**2.93**	**0**	**[9]**	**Rate coefficient was measured only for $M=O_2$ over the range of 51-340K.**
PIR(8)	$O_2^+ + H_2O + M \rightarrow O_2^+(H_2O) + M$	2.8×10^{-28}	0	0		
PIR(9)	$O_2^+ + N_2 + M \rightarrow O_2^+(N_2) + M$	1×10^{-30}	3.2	0	[10]	Rate coefficient was measured only for $M=N_2$ over the range of 100-180K
PIR(10)	**$O_2^+ + N \rightarrow NO^+ + O$**	**1×10^{-10}**	**0**	**0**		
PIR(11)	**$O_2^+ + N(^2D) \rightarrow N^+ + O_2$**	**2.5×10^{-10}**	**0**	**0**		
PIR(12)	**$O_2^+(H_2O) + H_2O \rightarrow H_3O^+(OH) + O_2$**	**9×10^{-10}**	**0**	**0**	**[11]**	**Rate coefficient was measured at 296K.**
PIR(13)	**$O_2^+(H_2O) + H_2O \rightarrow H^+(H_2O) + OH + O_2$**	**2.4×10^{-10}**	**0**	**0**	**[11]**	**Rate coefficient was measured at 296K.**
PIR(14)	$O_2^+(H_2O) + N_2 + M \rightarrow O_2^+(H_2O)(N_2) + M$	1×10^{-27}	0	0		
PIR(15)	$O_2^+(N_2) + O_2 \rightarrow O_4^+ + N_2$	5×10^{-10}	0	0		
PIR(16)	$O_2^+(N_2) + M \rightarrow O_2^+ + N_2 + M$	2.0×10^{-15}	3.2	2.2×10^{4}		Temperature interval is uncertain.
PIR(17)	$O_2^+(N_2) + CO_2 \rightarrow O_2^+(CO_2) + N_2$	1×10^{-9}	0	0	[12]	Not studied. Based on estimation only.
PIR(18)	$O_2^+(CO_2) + H_2O \rightarrow O_2^+(H_2O) + CO_2$	1×10^{-9}	0	0	[12]	Not studied. Based on estimation only.
PIR(19)	$O_2^+(H_2O)(N_2) + CO_2 \rightarrow O_2^+(H_2O)(CO_2) + N_2$	1×10^{-9}	0	0	[12]	Not studied. Based on estimation only.
PIR(20)	$O_2^+(H_2O)(N_2) + M \rightarrow O_2^+(H_2O) + N_2 + M$	7.7×10^{-13}	0	0		

PIR(21)	$O_2^+(H_2O)(CO_2) + H_2O \rightarrow O_2^+(H_2O)_2 + CO_2$	5×10^{-10}	0	0		
PIR(22)	$O_2^+(H_2O)(CO_2) + H_2O \rightarrow H_3O^+(OH)(CO_2) + O_2$	5×10^{-10}	0	0		
PIR(23)	$O_2^+(H_2O)_2 + H_2O \rightarrow H_3O^+(OH)(H_2O) + O_2$	1.3×10^{-9}	0	0		
PIR(24)	$O_4^+ + O_2(^1D_g) \rightarrow O_2^+ + 2O_2$	1.5×10^{-10}	0	0	[13]	Not studied, based on estimation only
PIR(25)	$O_4^+ + H_2O \rightarrow O_2^+(H_2O) + O_2$	1.2×10^{-9}	0	0	[14]	Rate coefficient was measured at 300K. Uncertainty of measurement >50%.
PIR(26)	$O_4^+ + O \rightarrow O_2^+ + O_3$	3×10^{-10}	0	0		Uncertainty of data >67%.
PIR(27)	$O_4^+ + M \rightarrow O_2^+ + O_2 + M$	4×10^{-29}	0	0	[15]	Rate coefficient was measured only for M=$N_2$for 297K.
PIR(28)	$N^+ + O_2 \rightarrow NO^+ + O$	2.6×10^{-10}	0	0	[16, 17]	
PIR(29)	$N^+ + O_2 \rightarrow O_2^+ + N$	1.1×10^{-10}	0	0	[16, 17]	
PIR(30)	$N^+ + O_2 \rightarrow O^+ + NO$	2.7×10^{-10}	0	0	[16, 17]	
PIR(31)	$N^+ + O \rightarrow O^+ + N$	5×10^{-13}	0	0	[16, 17]	
PIR(32)	$N^+ + O_2 \rightarrow O_2^+ + N(^2D)$	2×10^{-10}	0	0		
PIR(33)	$N_2^+ + O \rightarrow NO^+ + N(^2D)$	1.4×10^{-10}	0.44	0	[18]	Rate coefficient measured at (295±5)K with 40% error
PIR(34)	$N_2^+ + O \rightarrow N^+ + NO$	9.8×10^{-12}	0.23	0	[18]	Rate coefficient at measured at (295±5)K with 40% error
PIR(35)	$N_2^+ + O_2 \rightarrow O_2^+ + N_2$	5×10^{-11}	0.8	0		
PIR(36)	$N_2^+ + NO \rightarrow NO^+ + N_2$	3.3×10^{-10}	0	0		
PIR(37)	$NO^+ + N_2 + M \rightarrow NO^+(N_2) + M$	3×10^{-31}	4.3	0	[10]	Rate coefficient was measured only for M=N_2 over the range of 100-180K
PIR(38)	$NO^+ + CO_2 + M \rightarrow NO^+(CO_2) + M$	1.4×10^{-29}	4.0	0	[10]	Rate coefficient was measured only for M=N_2 over the range of 100-180K
PIR(39)	$NO^+ + H_2O + M \rightarrow NO^+(H_2O) + M$	9.2×10^{-30}	2.83	0	[19]	Measured only for M=He over the temperature range of 150-300K.
PIR(40)	$NO^+(N_2) + CO_2 \rightarrow NO^+(CO_2) + N_2$	1×10^{-9}	0	0	[12]	Not studied. Based on estimation only.
PIR(41)	$NO^+(N_2) + H_2O \rightarrow NO^+(H_2O) + N_2$	1×10^{-9}	0	0	[12]	Not studied. Based on estimation only.
PIR(42)	$NO^+(N_2) + M \rightarrow NO^+ + N_2 + M$	2.3×10^{-20}	4.3	1.7×10^{4}		Measured only for M=He over the temperature range of 150-300K
PIR(43)	$NO^+(CO_2) + H_2O \rightarrow NO^+(H_2O) + N_2$	1×10^{-9}	0	0	[12]	Not studied. Based on estimation only.
PIR(44)	$NO^+(CO_2) + M \rightarrow NO^+ + CO_2 + M$	1×10^{-20}	5.0	2.3×10^{4}	[4]	Measured only for M=He over the temperature range of 150-300K
PIR(45)	$NO^+(H_2O) + HO_2 \rightarrow H^+(H_2O) + NO_3$	1×10^{-9}	0	0	[11]	Data is only upper limit estimation.
PIR(46)	$NO^+(H_2O) + OH \rightarrow H^+(H_2O) + NO_2$	1×10^{-10}	0	0		Data is only upper limit estimation. Uncertainty of data: 30%
PIR(47)	$NO^+(H_2O) + H \rightarrow H^+(H_2O) + NO$	7×10^{-12}	0	0		Data is only upper limit estimation. Uncertainty of data: 30%
PIR(48)	$NO^+(H_2O) + H_2O + M \rightarrow NO^+(H_2O)_2 + M$	7.1×10^{-31}	4.7	0	[19]	Measured for M=He over the temperature range of 150-300K with 40% error.

PIR(49)	$NO^+(H_2O) + N_2 + M \rightarrow NO^+(H_2O)(N_2) + M$	7.1×10^{-33}	4.4	0	[19]	Measured for M=He over the temperature range of 150-300K with 40% error.
PIR(50)	$NO^+(H_2O) + CO_2 + M \rightarrow NO^+(H_2O)(CO_2) + M$	7×10^{-30}	5.0	0	[19]	Measured for M=N_2 over the temperature range of 225-300K.
PIR(51)	**$NO^+(H_2O)_2 + H_2O + M \rightarrow NO^+(H_2O)_3 + M$**	**7.1×10^{-29}**	**4.7**	**0**	**[19]**	**Measured for M=He over the temperature range of 150-300K with 40% error.**
PIR(52)	$NO^+(H_2O)_2 + N_2 + M \rightarrow NO^+(H_2O)_2(N_2) + M$	1.6×10^{-32}	4.4	0		Measured for M=He over the temperature range of 150-300K.
PIR(53)	$NO^+(H_2O)_2 + CO_2 + M \rightarrow NO^+(H_2O)_2(CO_2) + M$	7×10^{-30}	3.0	0		Measured for M=N_2 over the temperature range of 225-300K.
PIR(54)	**$NO^+(H_2O)_3 + H_2O \rightarrow H^+(H_2O)_3 + HNO_2$**	**7×10^{-11}**	**0**	**0**	**[19]**	
PIR(55)	$NO^+(H_2O)(N_2) + H_2O \rightarrow NO^+(H_2O)_2 + N_2$	1×10^{-9}	0	0	[12]	Not studied. Based on estimation only.
PIR(56)	$NO^+(H_2O)(N_2) + CO_2 \rightarrow NO^+(H_2O)(CO_2) + N_2$	7.1×10^{-10}	0	0	[4]	
PIR(57)	$NO^+(H_2O)(N_2) + M \rightarrow NO^+(H_2O) + N_2 + M$	2.6×10^{-21}	5.4	1.7×10^{4}	[4]	Not studied. Based on estimation only.
PIR(58)	$NO^+(H_2O)(CO_2) + H_2O \rightarrow NO^+(H_2O)_2 + CO_2$	1×10^{-9}	0	0	[12]	Not studied. Based on estimation only.
PIR(59)	$NO^+(H_2O)(CO_2) + M \rightarrow NO^+(H_2O) + CO_2 + M$	1.5×10^{-18}	5.0	3.3×10^{4}	[4]	Not studied. Based on estimation only.
PIR(60)	$NO^+(H_2O)_2(N_2) + H_2O \rightarrow NO^+(H_2O)_3 + N_2$	1×10^{-9}	0	0	[12]	Not studied. Based on estimation only.
PIR(61)	$NO^+(H_2O)_2(N_2) + CO_2 \rightarrow NO^+(H_2O)_2(CO_2) + N_2$	6.9×10^{-10}	0	0	[4]	
PIR(62)	$NO^+(H_2O)_2(N_2) + M \rightarrow NO^+(H_2O)_2 + N_2 + M$	2.6×10^{-21}	5.4	1.5×10^{4}	[4]	Not studied. Based on estimation only.
PIR(63)	$NO^+(H_2O)_2(CO_2) + H_2O \rightarrow NO^+(H_2O)_3 + CO_2$	1×10^{-9}	0	0	[12]	Not studied. Based on estimation only.
PIR(64)	$NO^+(H_2O)_2(CO_2) + M \rightarrow NO^+(H_2O)_2 + CO_2 + M$	1.5×10^{-18}	5.0	2.7×10^{4}		Not studied. Based on estimation only.
PIR(65)	**$H^+(H_2O) + H_2O + M \rightarrow H^+(H_2O)_2 + M$**	**5.2×10^{-27}**	**4.0**	**0**	**[20]**	**Measured for M=O_2 over the temperature range of 23-170K with 50% error.**
PIR(66)	**$H^+(H_2O) + CO_2 + M \rightarrow H^+(H_2O)(CO_2) + M$**	**4.8×10^{-28}**	**4.0**	**0**	**[21, 22]**	**Measured for M=CH_4 over the temperature range of 318-813K**
PIR(67)	**$H^+(H_2O) + N_2 + M \rightarrow H^+(H_2O)(N_2) + M$**	**2×10^{-31}**	**4.0**	**0**	**[21, 22]**	**Measured for M=CH_4 over the temperature range of 318-813K**
PIR(68)	**$H^+(H_2O)_2 + M \rightarrow H^+(H_2O) + H_2O + M$**	**5.7×10^{-15}**	**5.0**	**1.3×10^{5}**	**[21, 22]**	**Measured for M=CH_4 over the temperature range of 346-497K**
PIR(69)	**$H^+(H_2O)_2 + H_2O + M \rightarrow H^+(H_2O)_3 + M$**	**1.3×10^{-27}**	**7.5**	**0**	**[21, 22]**	**Measured for M=CH_4 over the temperature range of 346-497K**
PIR(70)	**$H^+(H_2O)_2 + CO_2 + M \rightarrow H^+(H_2O)_2(CO_2) + M$**	**4.8×10^{-28}**	**4.0**	**0**	**[21, 22]**	**Measured for M=CH_4 over the temperature range of 346-497K**
PIR(71)	**$H^+(H_2O)_2 + N_2 + M \rightarrow H^+(H_2O)_2(N_2) + M$**	**2×10^{-31}**	**4.0**	**0**	**[21, 22]**	**Measured for M=CH_4 over the temperature range of 346-497K**
PIR(72)	**$H^+(H_2O)_3 + M \rightarrow H^+(H_2O)_2 + H_2O + M$**	**1.3×10^{-24}**	**8.5**	**8.5×10^{4}**	**[21, 22]**	**Measured for M=CH_4 over the temperature range of 346-497K**
PIR(73)	**$H^+(H_2O)_3 + H_2O + M \rightarrow H^+(H_2O)_4 + M$**	**2×10^{-27}**	**8.1**	**0**	**[21, 22]**	**Measured for M=CH_4 over the temperature range of 215-400K**
PIR(74)	**$H^+(H_2O)_4 + M \rightarrow H^+(H_2O)_3 + H_2O + M$**	**2.4×10^{-24}**	**9.1**	**7.4×10^{4}**	**[21, 22]**	**Measured for M=CH_4 over the temperature range of 205-310K**
PIR(75)	**$H^+(H_2O)_4 + H_2O + M \rightarrow H^+(H_2O)_5 + M$**	**2.6×10^{-28}**	**14.0**	**0**	**[21, 22]**	**Measured for M=CH_4 over the temperature range of 205-310K**
PIR(76)	**$H^+(H_2O)_5 + M \rightarrow H^+(H_2O)_4 + H_2O + M$**	**8×10^{-41}**	**15.0**	**5.3×10^{4}**	**[21, 22]**	**Measured for M=CH_4 over the**

						temperature range of 205-257K
PIR(77)	**$H^+(H_2O)_5 + H_2O + M \rightarrow H^+(H_2O)_6 + M$**	**3.3×10^{-29}**	**15.3**	**0**	**[21, 22]**	**Measured for M=CH_4 over the temperature range of 205-257K**
PIR(78)	$H^+(H_2O)_6 + M \rightarrow H^+(H_2O)_5 + H_2O + M$	1.6×10^{-43}	16.3	4.8×10^{4}	[4]	Not studied. Based on estimation only.
PIR(79)	$H^+(H_2O)_6 + H_2O + M \rightarrow H^+(H2O)7 + M$	9×10^{-28}	15.3	0	[4]	Not studied. Based on estimation only.
PIR(80)	$H^+(H_2O)_7 + M \rightarrow H^+(H_2O)_6 + H_2O + M$	1.6×10^{-43}	16.3	4.8×10^{4}	[4]	Not studied. Based on estimation only.
PIR(81)	$H^+(H_2O)_7 + H_2O + M \rightarrow H^+(H_2O)_8 + M$	9×10^{-28}	15.3	0	[4]	Not studied. Based on estimation only.
PIR(82)	$H^+(H_2O)_8 + M \rightarrow H^+(H_2O)_7 + H_2O + M$	1.6×10^{-43}	16.3	4.8×10^{4}	[4]	Not studied. Based on estimation only.
PIR(83)	$H^+(H_2O)_2(CO_2) + H_2O \rightarrow H^+(H_2O)_3 + CO_2$	1×10^{-9}	0	0		
PIR(84)	$H^+(H_2O)_2(CO_2) + M \rightarrow H^+(H_2O)_2 + CO_2 + M$	2.4×10^{-10}	5.0	5.1×10^{4}		Temperature regime not specified.
PIR(85)	$H^+(H_2O)_2(N_2) + CO_2 \rightarrow H^+(H_2O)_2(CO_2) + N_2$	1×10^{-9}	0	0		
PIR(86)	$H^+(H_2O)_2(N_2) + M \rightarrow H^+(H_2O)_2 + N_2 + M$	1.2×10^{-8}	5.4	2.2×10^{4}		Temperature regime not specified.
PIR(87)	$H^+(H_2O)_2(N_2) + H_2O \rightarrow H^+(H_2O)_3 + N_2$	1.2×10^{-8}	5.4	2.2×10^{4}		Temperature regime not specified.
PIR(88)	$H^+(H_2O)(CO_2) + H_2O \rightarrow H^+(H_2O)_2 + CO_2$	1×10^{-9}	0	0		
PIR(89)	$H^+(H_2O)(CO_2) + M \rightarrow H^+(H_2O) + CO_2 + M$	2.2×10^{-15}	5.0	6.4×10^{4}		Temperature regime not specified.
PIR(90)	$H^+(H_2O)(N_2) + CO_2 \rightarrow H^+(H_2O)(CO_2) + N_2$	1×10^{-9}	0	0		
PIR(91)	$H^+(H_2O)(N_2) + M \rightarrow H^+(H_2O) + N_2 + M$	7.5×10^{-22}	5.4	2.3×10^{4}		Temperature regime not specified.
PIR(92)	**$H_3O^+(OH) + H_2O \rightarrow H^+(H_2O)_2 + OH$**	**2×10^{-9}**	**0**	**0**	**[23]**	**Rate coefficient was measured at 296K.**
PIR(93)	**$H_3O^+(OH) + O_2 + M \rightarrow O_2{}^+(H_2O)_2 + M$**	**3.4×10^{-30}**	**4.0**	**0**	**[24]**	**Rate coefficient was measured at 337K for M=O_2.**
PIR(94)	$H_3O^+(OH)(H_2O) + H_2O \rightarrow H^+(H_2O)_3 + OH$	1.9×10^{-9}	0	0		
PIR(95)	$H_3O^+(OH)(CO_2) + H_2O \rightarrow H^+(H_2O)_2(CO_2) + OH$	5×10^{-10}	0	0		
PIR(96)	$H_3O^+(OH)(CO_2) + H_2O \rightarrow H^+(H_2O) + OH + CO_2$	5×10^{-10}	0	0		
PIR(97)	**$H^+(H_2O)_2 + N_2O_5 \rightarrow HNO_3 + H^+(H_2O)(HNO_3)$**	**8×10^{-10}**	**0**	**0**	**[25]**	
PIR(98)	**$H^+(H_2O)_3 + N_2O_5 \rightarrow HNO_3 + H^+(H_2O)_2(HNO_3)$**	**4.5×10^{-11}**	**0**	**0**	**[25]**	
PIR(99)	$H^+(H_2O)_4 + N_2O_5 \rightarrow HNO_3 + H^+(H_2O)_3(HNO_3)$	4×10^{-12}	0	0	[25]	
PIR(100)	$H^+(H_2O)_5 + N_2O_5 \rightarrow HNO_3 + H^+(H_2O)_4(HNO_3)$	7×10^{-12}	0	0	[25]	
PIR(101)	$H^+(H_2O)_6 + N_2O_5 \rightarrow HNO_3 + H^+(H_2O)_5(HNO_3)$	1.4×10^{-11}	0	0	[25]	
PIR(102)	$H^+(H_2O)(HNO_3) + H_2O \rightarrow H^+(H_2O)_2 + HNO_3$	1×10^{-9}	0	0	[25]	
PIR(103)	$H^+(H_2O)_2(HNO_3) + H_2O \rightarrow H^+(H_2O)_3 + HNO_3$	1×10^{-9}	0	0	[25]	
PIR(104)	$H^+(H_2O)_3(HNO_3) + H_2O \rightarrow H^+(H_2O)_4 + HNO_3$	1×10^{-9}	0	0	[25]	

PIR(105)	$H^+(H_2O)_4(HNO_3) + H_2O \rightarrow H^+(H_2O)_5 + HNO_3$	1×10^{-9}	0	0	[25]
PIR(106)	$H^+(H_2O)_5(HNO_3) + H_2O \rightarrow H^+(H_2O)_6 + HNO_3$	1×10^{-9}	0	0	[25]
	$H^+(CH_3CN)(H_2O) + H^+(H_2O)_2 \rightarrow$				
PIR(107)	$H^+(CH_3CN)(HNO_3) + HNO_3$	7×10^{-12}	0	0	[25]
	$H^+(CH_3CN)(HNO_3) + H_2O \rightarrow$				
PIR(108)	$H^+(CH_3CN)(H_2O) + HNO_3$	1×10^{-9}	0	0	[25]
	$H^+(CH_3CN)(H_2O)_2 + N_2O_5 \rightarrow$				
PIR(109)	$H^+(CH_3CN)(H_2O)(HNO_3) + HNO_3$	7×10^{-12}	0	0	[25]
	$H^+(CH_3CN)(H_2O)(HNO_3) + H_2O \rightarrow$				
PIR(110)	$H^+(CH_3CN)(H_2O)_2 + HNO_3$	1×10^{-9}	0	0	[25]
	$H^+(CH_3CN)(H_2O)_3 + N_2O_5 \rightarrow$				
PIR(111)	$H^+(CH_3CN)\ (H_2O)_2HNO_3$	7×10^{-12}	0	0	[25]
	$H^+(CH_3CN)(H_2O)_2HNO_3 + H_2O \rightarrow$				
PIR(112)	$H^+(CH_3CN)\ (H_2O)_3 + HNO_3$	1×10^{-9}	0	0	[25]
	$H^+(CH_3CN)(H_2O)_4 + N_2O_5 \rightarrow$				
PIR(113)	$H^+(CH_3CN)\ (H_2O)_3HNO_3$	7×10^{-12}	0	0	[25]
	$H^+(CH_3CN)(H_2O)_3HNO_3 + H_2O \rightarrow$				
PIR(114)	$H^+(CH_3CN)(H_2O)_4 + HNO_3$	1×10^{-9}	0	0	[25]
	$H^+(CH_3CN)(H_2O)_5 + N_2O_5 \rightarrow$				
PIR(115)	$H^+(CH_3CN)(H_2O)_4HNO_3$	7×10^{-12}	0	0	[25]
	$H^+(CH_3CN)(H_2O)_4HNO_3 + H_2O \rightarrow$				
PIR(116)	$H^+(CH_3CN)(H_2O)_5 + HNO_3$	1×10^{-9}	0	0	[25]
PIR(117)	$H^+(H_2O) + CH_3CN \rightarrow H^+(CH_3CN) + H_2O$	9.6×10^{-8}	0.5	0	
PIR(118)	$H^+(H_2O)_2 + CH_3CN \rightarrow H^+(CH_3CN)(H_2O) + H_2O$	7.8×10^{-8}	0.5	0	
PIR(119)	$H^+(H_2O)_3 + CH_3CN \rightarrow H^+(CH_3CN)(H_2O)_2 + H_2O$	7.1×10^{-8}	0.5	0	
PIR(120)	$H^+(H_2O)_4 + CH_3CN \rightarrow H^+(CH_3CN)(H_2O)_3 + H_2O$	6.7×10^{-8}	0.5	0	
PIR(121)	$H^+(H_2O)_5 + CH_3CN \rightarrow H^+(CH_3CN)(H_2O)_4 + H_2O$	6.5×10^{-8}	0.5	0	
PIR(122)	$H^+(H_2O)_6 + CH_3CN \rightarrow H^+(CH_3CN)(H_2O)_5 + H_2O$	6.3×10^{-8}	0.5	0	
PIR(123)	$H^+(H_2O)_7 + CH_3CN \rightarrow H^+(CH_3CN)(H_2O)_6 + H_2O$	6.2×10^{-8}	0.5	0	

PIR(124)	$H^+(H_2O)_8 + CH_3CN \rightarrow H^+(CH_3CN)(H_2O)_7 + H_2O$	6.2×10^{-8}	0.5	0		
PIR(125)	$O_2^+(H_2O) \rightarrow O_2^+ + H_2O$	4.2×10^{-1}	0	0		
NPD(1)	$O_3^- + h\nu \rightarrow O^- + O_2$	4.7×10^{-1}	0	0		
NPD(2)	$O_4^- + h\nu \rightarrow O_2^- + O_2$	2.4×10^{-1}	0	0		
NPD(3)	$CO_3^- + h\nu \rightarrow O^- + CO_2$	1.5×10^{-1}	0	0		
NPD(4)	$CO_4^- + h\nu \rightarrow O_2^- + CO_2$	6.2×10^{-3}	0	0		
NPD(5)	$CO_3^-(H_2O) + h\nu \rightarrow CO_3^- + H_2O$	1	0	0		
PDE(1)	$O^- + h\nu \rightarrow O + e^-$	1.4	0	0		
PDE(2)	$O_2^- + h\nu \rightarrow O_2 + e^-$	3.8×10^{-1}	0	0		
PDE(3)	$O_3^- + h\nu \rightarrow O_3 + e^-$	4.7×10^{-2}	0	0		
PDE(4)	$OH^- + h\nu \rightarrow OH + e^-$	1.1	0	0		
PDE(5)	$CO_3^- + h\nu \rightarrow CO_3 + e^-$	2.2×10^{-2}	0	0		
PDE(6)	$NO_2^- + h\nu \rightarrow NO_2 + e^-$	8×10^{-4}	0	0		
PDE(7)	$NO_3^- + h\nu \rightarrow NO_3 + e^-$	5.2×10^{-2}	0	0		
EDA(1)	$O^- + O \rightarrow O_2 + e^-$	1.9×10^{-10}	0	0		
EDA(2)	$O^- + NO \rightarrow NO_2 + e^-$	3×10^{-10}	0.83	0		
EDA(3)	$O^- + O_2(^1D_g) \rightarrow O_3 + e^-$	3×10^{-10}	0	0		
EDA(4)	$O^- + M \rightarrow O + M + e^-$	5×10^{-13}	0	0		
EDA(5)	$O^- + H_2 \rightarrow H_2O + e^-$	5.8×10^{-10}	0	0		Rate coefficient measured at 298K with 25% uncertainty.
EDA(6)	$O_2^- + O \rightarrow O_3 + e^-$	1.5×10^{-10}	0	0		Rate coefficient measured at 298K.
EDA(7)	$O_2^- + O_2(^1D_g) \rightarrow 2O_2 + e^-$	2×10^{-10}	0	0	[26]	Rate coefficient measured at 298K.
EDA(8)	$O_2^- + N_2 \rightarrow N_2 + O_2 + e^-$	1.9×10^{-12}	-1.5	4.1×10^{4}		Temperature interval is uncertain.
EDA(9)	$O_2^- + H \rightarrow HO_2 + e^-$	1.4×10^{-9}	0	0		
EDA(10)	$O_3^- + O \rightarrow 2O_2 + e^-$	1×10^{-10}	0	0		
EDA(11)	$O_3^- + O_3 \rightarrow 3O_2 + e^-$	1×10^{-10}	0	0		
EDA(12)	$OH^- + O \rightarrow HO_2 + e^-$	2×10^{-10}	0	0		
EDA(13)	$OH^- + H \rightarrow H_2O + e^-$	1.4×10^{-9}	0	0		
EDA(14)	$Cl^- + H \rightarrow HCl + e^-$	9.6×10^{-10}	0	0		
NIR(1)	$O^- + O_3 \rightarrow O_3^- + O$	8×10^{-10}	0	0		
NIR(2)	$O^- + 2O_2 \rightarrow O_3^- + O_2$	1.0×10^{-30}	0	0	[27]	Rate coefficient is measured at 300K. Uncertainty of measurement: 30%.

NIR(3)	$O^- + H_2O \rightarrow OH^- + OH$	6×10^{-13}	0	0		Data is only upper limit estimation.
NIR(4)	$O^- + NO_2 \rightarrow NO_2^- + O$	1.2×10^{-9}	0	0	[28]	Rate coefficient is measured at 300K. Uncertainty of measurement: 10%.
NIR(5)	$O^- + CO_2 + M \rightarrow CO_3^- + M$	3.4×10^{-28}	0	0	[15]	Rate coefficient is measured at 298K. M=O_2 Uncertainty of measurement: 30%.
NIR(6)	$O^- + H_2 \rightarrow OH^- + H$	4.1×10^{-11}	0	0	[29]	
NIR(7)	$O^- + HCl \rightarrow Cl^- + OH$	2.0×10^{-9}	0	0	[15]	Rate coefficient is measured at 289K. Uncertainty of measurement: 30%.
NIR(8)	$O^- + Cl \rightarrow Cl^- + O$	1×10^{-10}	0	0		
NIR(9)	$O^- + ClO \rightarrow Cl^- + O_2$	1×10^{-10}	0	0		
NIR(10)	$O^- + CH_4 \rightarrow OH^- + CH_3$	1×10^{-10}	0	0		
NIR(11)	$O^- + HNO_3 \rightarrow NO_3^- + OH$	3.6×10^{-9}	0	0		
NIR(12)	$O^- + H_2O + M \rightarrow O^-(H_2O) + M$	1.4×10^{-28}	0	0	[15]	Rate coefficient is measured at 298K. M=O_2Uncertainty of measurement: 50%.
NIR(13)	$O^-(H_2O) + O_2 \rightarrow O_3^- + H2O$	6.2×10^{-11}	0	0		
NIR(14)	$O_2^- + O \rightarrow O^- + O_2$	1.8×10^{-10}	0	0	[30]	
NIR(15)	$O_2^- + O_3 \rightarrow O_3^- + O_2$	7×10^{-10}	0	0	[15]	Rate coefficient is measured at 298K. Uncertainty of measurement: 40%.
NIR(16)	$O_2^- + CO_2 + O_2 \rightarrow CO_4^- + O_2$	4.7×10^{-29}	0	0	[15]	Rate coefficient is measured at 298K. Uncertainty of measurement: 30%.
NIR(17)	$O_2^- + NO_2 \rightarrow NO_2^- + O_2$	8×10^{-10}	0	0	[15]	Rate coefficient is measured at 298K.
NIR(18)	$O_2^- + O_2 + M \rightarrow O_4^- + M$	3×10^{-31}	0	0	[31, 32]	Estimatedfor M=O_2 over the temperature range of 200-500K. Uncertainty of measurement: >15%.
NIR(19)	$O_2^- + H_2O + M \rightarrow O_2^-(H_2O) + M$	2.2×10^{-28}	0	0	[31, 32]	Estimatedfor M=O_2 over the temperature range of 200-500K
NIR(20)	$O_2^- + HCl \rightarrow Cl^- + HO_2$	1.6×10^{-9}	0	0	[15]	Rate coefficient is measured at 289K. Uncertainty of measurement: 30%.
NIR(21)	$O_2^- + Cl \rightarrow Cl^- + O_2$	1×10^{-10}	0	0		
NIR(22)	$O_2^- + ClO \rightarrow ClO^- + O_2$	1×10^{-10}	0	0		
NIR(23)	$O_2^- + HNO_3 \rightarrow NO_3^- + HO_2$	2.9×10^{-9}	0	0		
NIR(24)	$O_2^-(H_2O) + CO_2 \rightarrow CO_4^- + H_2O$	5.8×10^{-10}	0	0		
NIR(25)	$O_2^-(H_2O) + NO \rightarrow NO_3^- + H_2O$	2×10^{-10}	0	0		
NIR(26)	$O_2^-(H_2O) + O_3 \rightarrow O_3^- + O_2 + H_2O$	8×10^{-10}	0	0		
NIR(27)	$O_2^-(H_2O) + H_2O + M \rightarrow O_2^-(H_2O)_2 + M$	5.4×10^{-28}	0	0		
NIR(28)	$O_2^-(H_2O) + NO_2 \rightarrow NO_2^- + H_2O + O_2$	9×10^{-10}	0	0		
NIR(29)	$O_2^-(H_2O) + M \rightarrow O_2^- + H_2O + M$	1.3×10^{-4}	-1.0	7.7×10^{4}		Temperature interval is uncertain.

NIR(30)	$O_2^-(H_2O)_2 + M \rightarrow O_2^-(H_2O) + H_2O + M$	4×10^{-10}	-1.0	7.2×10^{4}		Temperature interval is uncertain.
NIR(31)	$O_2^-(H_2O)_2 + NO_2 \rightarrow NO_2^-(H_2O) + H_2O + O_2$	9×10^{-10}	0	0		
NIR(32)	$O_2^-(H_2O)_2 + O_3 \rightarrow O_3^-(H_2O) + O_2 + H_2O$	7.8×10^{-10}	0	0		
NIR(33)	**$O_3^- + O \rightarrow O_2^- + O_2$**	**2.5×10^{-10}**	**0**	**0**	**[15]**	**Rate coefficient is measured at 298K. Uncertainty of measurement: 75%.**
NIR(34)	**$O_3^- + H \rightarrow OH^- + O_2$**	**8.4×10^{-10}**	**0**	**0**	**[15]**	**Rate coefficient is measured at 298K. Uncertainty of measurement: 40%.**
NIR(35)	**$O_3^- + CO_2 \rightarrow CO_3^- + O_2$**	**5.5×10^{-10}**	**0**	**0**	**[15]**	**Rate coefficient is measured at 298K. Uncertainty of measurement: 30%.**
NIR(36)	**$O_3^- + NO \rightarrow NO_3^- + O$**	**1×10^{-12}**	**2.15**	**0**	**[33]**	**Rate coefficient measured over the temperature range of 100-500K**
NIR(37)	**$O_3^- + NO_2 \rightarrow NO_3^- + O_2$**	**2.5×10^{-11}**	**0.79**	**0**	**[33]**	**Rate coefficient measured over the temperature range of 200-500K.**
NIR(38)	$O_3^- + H_2O + M \rightarrow O_3^-(H_2O) + M$	2.7×10^{-28}	0	0		
NIR(39)	**$O_3^- + NO_2 \rightarrow NO_2^- + O_3$**	**7.5×10^{-11}**	**0.79**	**0**	**[33]**	**Rate coefficient measured over the temperature range of 200-500K**
NIR(40)	**$O_3^- + NO \rightarrow NO_2^- + O_2$**	**1×10^{-12}**	**2.15**	**0**	**[33]**	**Rate coefficient measured over the temperature range of 100-500K**
NIR(41)	$O_3^-(H_2O) + CO_2 \rightarrow CO_3^- + H_2O + O_2$	1.7×10^{-10}	0	0		
NIR(42)	$O_3^-(H_2O) + CO_2 \rightarrow CO_3^-(H_2O) + O_2$	1.7×10^{-10}	0	0		
NIR(43)	**$O_4^- + O \rightarrow O_3^- + O_2$**	**4×10^{-10}**	**0**	**0**	**[15]**	**Rate coefficient is measured at 298K. Uncertainty of measurement: 75%.**
NIR(44)	**$O_4^- + CO_2 \rightarrow CO_4^- + O_2$**	**4.3×10^{-10}**	**0**	**0**	**[15]**	**Rate coefficient is measured at 298K. Uncertainty of measurement: 30%.**
NIR(45)	$O_4^- + NO \rightarrow NO_3^{-*} + O_2$	2.5×10^{-10}	0	0	[15]	Rate coefficient is measured at 298K. Uncertainty of measurement: 30%.
NIR(46)	$O_4^- + H_2O \rightarrow O_2^-(H_2O) + O_2$	1.5×10^{-9}	0	0	[15]	Rate coefficient estimated for 298K.
NIR(47)	**$OH^- + O_3 \rightarrow O_2^- + OH$**	**9×10^{-10}**	**0**	**0**	**[15]**	**Rate coefficient is measured at 298K. Uncertainty of measurement: 75%.**
NIR(48)	**$OH^- + NO_2 \rightarrow NO_2^- + OH$**	**1.1×10^{-9}**	**0**	**0**	**[15]**	**Rate coefficient is measured at 298K Uncertainty of measurement: 45%.**
NIR(49)	**$OH^- + CO_2 + M \rightarrow HCO_3^- + M$**	**7.6×10^{-28}**	**0**	**0**	**[15]**	**Rate coefficient is measured at 298K. Uncertainty of measurement: 30%.**
NIR(50)	**$OH^- + HCl \rightarrow Cl^- + H_2O$**	**1×10^{-9}**	**0**	**0**		**Rate coefficient estimated for 298K**
NIR(51)	$OH^- + H_2O + M \rightarrow OH^-(H_2O) + M$	2.5×10^{-28}	0	0	[15]	Rate coefficient is measured at 298K. Uncertainty of measurement: 50%.
NIR(52)	**$OH^- + Cl \rightarrow Cl^- + OH$**	**1×10^{-10}**	**0**	**0**		
NIR(53)	**$OH^- + ClO \rightarrow ClO^- + OH$**	**1×10^{-10}**	**0**	**0**		
NIR(54)	**$CO_3^- + O \rightarrow O_2^- + CO_2$**	**1.1×10^{-10}**	**0**	**0**	**[15]**	**Rate coefficient is measured at 298K. Uncertainty of measurement: 75%.**
NIR(55)	**$CO_3^- + O_2 \rightarrow O_3^- + CO_2$**	**6×10^{-15}**	**0**	**0**	**[33]**	**Value is only upper limit estimation.**
NIR(56)	**$CO_3^- + H \rightarrow OH^- + CO_2$**	**1.7×10^{-10}**	**0**	**0**	**[15]**	**Rate coefficient is measured at 298K. Uncertainty of measurement: 40%.**
NIR(57)	**$CO_3^- + NO \rightarrow NO_2^- + CO_2$**	**1×10^{-10}**	**0**	**0**	**[33]**	
NIR(58)	**$CO_3^- + NO_2 \rightarrow NO_3^- + CO_2$**	**2×10^{-10}**	**0**	**0**	**[15]**	**Rate coefficient is measured at 298K.**

NIR(59)	$CO_3^- + HCl \rightarrow Cl^- + OH + CO_2$	3×10^{-11}	0	0	[15]	Value is only upper limit estimation.
NIR(60)	$CO_3^- + H_2O + M \rightarrow CO_3^-(H_2O) + M$	1×10^{-28}	0	0	[15]	Rate coefficient is measured at 298K. Uncertainty of measurement: 50%.
NIR(61)	$CO_3^- + Cl \rightarrow Cl^- + CO_2 + O$	1×10^{-10}	0	0		
NIR(62)	$CO_3^- + Cl \rightarrow ClO^- + CO_2$	1×10^{-10}	0	0		
NIR(63)	$CO_3^- + ClO \rightarrow Cl^- + CO_2 + O_2$	1×10^{-11}	0	0		
NIR(64)	$CO_3^- + HNO_3 \rightarrow NO_3^- + CO_2 + OH$	3.5×10^{-10}	0	0		
NIR(65)	$CO_3^-(H_2O) + NO \rightarrow NO_2^- + H_2O + CO_2$	3.5×10^{-12}	0	0	[33]	
NIR(66)	$CO_3^-(H_2O) + NO_2 \rightarrow NO_3^- + H_2O + CO_2$	4×10^{-11}	0	0	[33]	
NIR(67)	$CO_3^-(H_2O) + H_2O + M \rightarrow CO_3^-(H_2O)_2 + M$	1×10^{-28}	0	0		Reaction not studied. Parameters are assumed to be equal to $CO_3^- + H_2O + M$.
NIR(68)	$CO_3^-(H_2O) + NO_2 \rightarrow NO_3^-(H_2O) + CO_2$	4×10^{-11}	0	0		
NIR(69)	$CO_3^-(H_2O) + NO \rightarrow NO_2^-(H_2O) + CO_2$	3.5×10^{-12}	0	0		
NIR(70)	$CO_3^-(H_2O) + M \rightarrow CO_3^- + H_2O + M$	7.2×10^{-4}	1.0	5.8×10^{4}		Temperature interval is uncertain.
NIR(71)	$CO_3^-(H_2O)_2 + M \rightarrow CO_3^-(H_2O) + H_2O + M$	6.5×10^{-3}	1.0	5.6×10^{4}		Temperature interval is uncertain.
NIR(72)	$CO_4^- + O_3 \rightarrow O_3^- + O_2 + CO_2$	1.3×10^{-10}	0	0	[15]	Rate coefficient is measured at 298K. Uncertainty of measurement: 75%.
NIR(73)	$CO_4^- + H \rightarrow CO_3^- + OH$	2.2×10^{-10}	0	0	[15]	Rate coefficient is measured at 298K. Uncertainty of measurement: 40%.
NIR(74)	$CO_4^- + O \rightarrow CO_3^- + O_2$	1.4×10^{-10}	0	0	[15]	Rate coefficient is measured at 298K. Uncertainty of measurement: 75%.
NIR(75)	$CO_4^- + NO \rightarrow NO_3^{*-} + CO_2$	4.8×10^{-11}	0	0	[15]	Rate coefficient is measured at 298K.
NIR(76)	$CO_4^- + H_2O \rightarrow O_2^-(H_2O) + CO_2$	2.5×10^{-10}	0	0		
NIR(77)	$CO_4^- + HCl \rightarrow Cl^- + HO_2 + CO_2$	1.2×10^{-9}	0	0	[15]	Rate coefficient is measured at 298K. Uncertainty of measurement: 30%.
NIR(78)	$CO_4^- + Cl \rightarrow Cl^- + O_2 + CO_2$	1×10^{-10}	0	0		
NIR(79)	$CO_4^- + ClO \rightarrow ClO^- + O_2 + CO_2$	1×10^{-10}	0	0		
NIR(80)	$NO_2^- + H \rightarrow OH^- + NO$	3×10^{-10}	0	0	[15]	Rate coefficient is measured at 298K. Uncertainty of measurement: 30%.
NIR(81)	$NO_2^- + NO_2 \rightarrow NO_3^- + NO$	2×10^{-13}	0	0	[15]	Value is only upper limit estimation.
NIR(82)	$NO_2^- + O_3 \rightarrow NO_3^- + O_2$	1.2×10^{-13}	0	0	[15]	Rate coefficient is measured at 298K. Uncertainty of measurement: 40%.
NIR(83)	$NO_2^- + HCl \rightarrow Cl^- + HNO_2$	1.4×10^{-9}	0	0	[15]	Rate coefficient is measured at 289K. Uncertainty of measurement: 30%.
NIR(84)	$NO_2^- + Cl \rightarrow Cl^- + NO_2$	1×10^{-10}	0	0		
NIR(85)	$NO_2^- + ClO \rightarrow Cl^- + NO_3$	1×10^{-10}	0	0		
NIR(86)	$NO_2^- + HNO_3 \rightarrow NO_3^- + HNO_2$	1.6×10^{-9}	0	0		
NIR(87)	$NO_2^- + H_2O + M \rightarrow NO_2^-(H_2O) + M$	1.6×10^{-28}	0	0	[15]	Rate coefficient is measured at 298K. Uncertainty of measurement: 50%.

NIR(88)	$NO_2^-(H_2O) + M \rightarrow NO_2^- + H_2O + M$	5.7×10^{-4}	1.0	6.3×10^{4}		Temperature interval is uncertain.
NIR(89)	$NO_3^- + O \rightarrow NO_2^- + O_2$	1×10^{-11}	0	0	[15]	Upper limit estimation for 298K.
NIR(90)	$NO_3^- + O_3 \rightarrow NO_2^- + 2O_2$	1×10^{-13}	0	0	[15]	Upper limit estimation for 298K.
NIR(91)	$NO_3^- + H_2O + M \rightarrow NO_3^-(H_2O) + M$	7.5×10^{-29}	0	0	[34]	Rate coefficient is measured at 300K.
NIR(92)	$NO_3^- + HCl \rightarrow Cl^- + HNO_3$	1×10^{-12}	0	0	[15]	Upper limit estimation for 298K.
NIR(93)	$NO_3^- + HCl + M \rightarrow NO_3^-(HCl) + M$	5.2×10^{-28}	-2.62	0	[35]	Rate coefficient is measured over the temperature range of 153-300K. Uncertainty of measurement: 30-50%
NIR(94)	$NO_3^- + HNO_3 + M \rightarrow NO_3^-(HNO_3) + M$	1.4×10^{-26}	0	0		
NIR(95)	$NO_3^-(H_2O) + M \rightarrow NO_3^- + H_2O + M$	1×10^{-3}	1.0	6.0×10^{4}	[4]	
NIR(96)	$NO_3^-(H_2O) + H_2O + M \rightarrow NO_3^-(H_2O)_2 + M$	1.6×10^{-28}	0	0		Reaction not studied. Parameters are assumed to be equal to $NO_3^- + H_2O + M$.
NIR(97)	$NO_3^-(H_2O) + N_2O_5 \rightarrow NO_3^-(HNO_3) + HNO_3$	7×10^{-10}	0	0		
NIR(98)	$NO_3^-(H_2O)_2 + M \rightarrow NO_3^-(H_2O) + H_2O + M$	1.5×10^{-2}	1.0	5.9×10^{4}		
NIR(99)	$NO_3^-(H_2O)_2 + N_2O_5 \rightarrow$ $NO_3^-(HNO_3) + HNO_3 + H_2O$	7×10^{-10}	0	0		
NIR(100)	$NO_3^-(H_2O) + HNO_3 \rightarrow NO_3^-(HNO_3) + H_2O$	1.6×10^{-9}	0	0		
NIR(101)	$NO_3^-(HNO_3) + M \rightarrow NO_3^- + HNO_3 + M$	6×10^{-3}	1.0	1.0×10^{5}		
NIR(102)	$NO_3^-(HNO_3) + HNO_3 + M \rightarrow NO_3^-(HNO_3)_2 + M$	1×10^{-26}	0	0		
NIR(103)	$NO_3^-(HNO_3)_2 + M \rightarrow NO_3^-(HNO_3) + HNO_3 + M$	3.6×10^{1}	1.0	6.6×10^{4}		
NIR(104)	$NO_3^-(HCl) + HNO_3 \rightarrow NO_3^-(HNO_3) + HCl$	7.6×10^{-10}	0	0		
NIR(105)	$NO_3^{-*} + CO_2 \rightarrow CO_3^- + NO_2$	1×10^{-11}	0	0		
NIR(106)	$NO_3^{-*} + H \rightarrow NO_2^- + OH$	7.2×10^{-10}	0	0		
NIR(107)	$NO_3^{-*} + NO \rightarrow NO_2^- + NO_2$	1×10^{-12}	0	0		
NIR(108)	$NO_3^{-*} + HCl \rightarrow Cl^- + HNO_3$	1×10^{-12}	0	0		
NIR(109)	$NO_3^{-*} + Cl \rightarrow Cl^- + NO + O_2$	1×10^{-10}	0	0		
NIR(110)	$NO_3^{-*} + ClO \rightarrow Cl^- + NO_2 + O_2$	1×10^{-11}	0	0		
NIR(111)	$HCO_3^- + Cl \rightarrow Cl^- + OH + CO_2$	1×10^{-10}	0	0		
NIR(112)	$HCO_3^- + ClO \rightarrow Cl^- + HO_2 + CO_2$	1×10^{-9}	0	0		
NIR(113)	$Cl^- + NO_2 \rightarrow NO_2^- + Cl$	6×10^{-12}	0	0	[15]	Data is only upper limit estimation for 298K.
NIR(114)	$Cl^- + H_2O + M \rightarrow Cl^-(H_2O) + M$	2×10^{-29}	0	0	[15]	Data is only upper limit estimation for 298K.Uncertainty of measurement: 50%
NIR(115)	$Cl^- + HNO_3 \rightarrow NO_3^- + HCl$	2.8×10^{-9}	0	0		

NIR(116)	$Cl^- + CO_2 + M \rightarrow Cl^-(CO_2) + M$	4×10^{-29}	2.1	0	[4]	
NIR(117)	**$Cl^- + HCl + M \rightarrow Cl^-(HCl) + M$**	**1×10^{-27}**	**0**	**0**		
NIR(118)	**$Cl^-(H_2O) + M \rightarrow Cl^- + H_2O + M$**	**2×10^{-8}**	**0**	**5.4×10^{4}**	**[15]**	
NIR(119)	**$Cl^-(H_2O) + HCl \rightarrow Cl^-(HCl) + H_2O$**	**1.3×10^{-9}**	**0**	**0**	**[36]**	**Rate coefficient measured only at 298K.**
NIR(120)	$Cl^-(CO_2) + M \rightarrow Cl^- + CO_2 + M$	2.6×10^{-5}	3.0	3.3×10^{4}	[4]	
NIR(121)	**$Cl^-(HCl) + M \rightarrow Cl^- + HCl + M$**	**3.3×10^{-3}**	**1.0**	**9.9×10^{4}**		
NIR(122)	**$ClO^- + NO \rightarrow Cl^- + NO_2$**	**2.9×10^{-11}**	**0**	**0**		
NIR(123)	**$ClO^- + NO \rightarrow Cl + NO_2^-$**	**2.9×10^{-12}**	**0**	**0**		
NIR(124)	**$ClO^- + O \rightarrow Cl^- + O_2$**	**2×10^{-10}**	**0**	**0**		**Rate coefficient is measured at 298K.**
IIR[7]	$X^+ + Y^- \rightarrow$ Products	1×10^{-6}	0.5	0		Due to the lack of available data, the same values are estimated to all ion-ion reactions.

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1 RPE: Recombination of positive ions with electrons
PIR: Positive ion reaction
NPD: Negative ion photodissociation
PDE: Photodetachment of electrons from negative ions
EDA: Electron detachment from negative ions
NIR: Negative ion reaction
IIR: Ion-ion reaction

2 Rate coefficients are expressed in the form $k = A\,(300/T)^n\,(-E/RT)$

3 Shaded reactions corresponds to the reactions in the reduced model.

4 Units are in $(cm^3\ molecule^{-1}\ s^{-1})^{(m-1)}$ where *m* is the reaction order. For three body reactions the values are corrected for $M=N_2$ by a factor of (Molar mass of X / Molar mass of N_2 (28 g mol^{-1})) - X is reported third body.

5 Units are in $Jmol^{-1}$

6 All rate coefficients are taken from Turunen*et al.*, 1996 unless indicated.

7 Ion-ion recombination reactions. X^+: positive ion, Y^-: negative ion, Products on the right hand side labels the sum of neutral products.