Appendix: The extended global chemistry mechanism

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The Appendix describes the extended photochemical mechanism used in the IMPACT model for global tropospheric photochemistry [*Ito et al.*, 2005]. The mechanism is based on the GEOS-CHEM mechanism [*Evans et al., 2003*, version 5-07-8, available at http://www.env.leeds.ac.uk/~mat/GEOS-CHEM/geoschem_mech.pdf]. The extended mechanism includes all species and reactions from *Evans et al.*, 2003, except as noted or modified below.

Table A1 lists the additional species included in this mechanism. Table A2 lists the added and modified reactions.

Table A1

Additional species in the extended mechanism

The extended mechanism includes all species listed in *Evans et al.* [2003].

Symbol	**Formula** (a sample is given for lumped species)	**Description**
A3N2	$C_3H_7ONO_2$	Propane alkyl nitrate
A-DI	$C_6H_5OH(OH)CHO$	Product of decomposition of dicarbonyls
ACHO	C_6H_5CHO	Benzaldehyde
AD2P		ROOH from ADD2
ADAL	$CHOCH=C(CH_3)CHO$	dicarbonyl
ADBP		ROOH from ADDB
ADD2	$C_6H_5(CH_3)OH(OH)O_2$	Secondary aromatic RO2

ADDB	$C_6H_6(OH)OO$	RO2 from benzene
ADDT	$C_6H_5(CH_3)(OH)OO$	RO2 from toluene
ADDX	$C_6H_4(CH_3)_2(OH)OO$	RO2 from m-xylene
ADTP	$C_6H_5(CH_3)(OH)OOH$	ROOH from ADDT
ADXP	$C_6H_4(CH_3)_2(OH)OOH$	ROOH from ADDX
ALK7	C_7H_{16}	C_6-C_8 alkanes
AO0		radical product of AO1
AO1		radical product of AO2
AO2	$C_6H_5OH(OH)CO_3$	radical resulting from A-DI
AP	$C_6H_5OH(OH)C(O)OOH$	ROOH from AO2
APAN	$C_6H_5OH(OH)CO_3NO_2$	acyl peroxy nitrate from AO2
APIN	$C_{10}H_{16}$	α-pinene
ARO2	$C_6H_5CH_2O_2$	benzyl radical from toluene
ARP	$C_6H_5CH_2OOH$	ROOH from ARO2
BAP	$C_6H_5C(O)OOH$	ROOH from BCO3
BCO3	$C_6H_5CO_3$	acyl radical from benzene
BENZ	C_6H_6	benzene
BUO2	$HOC_4H_8O_2$	RO2 radical from *trans*-2-butene
BUP	HOC_4H_8OOH	ROOH from BUO2
BUTE	C_4H_8	*trans*-2-butene
CHO2	CH_2O_2	Criegee biradical
CRO2	CH_3CHO_2	Criegee biradical
CRES	$C_6H_4(CH_3)(OH)$	cresol
DAP	CHOCH=CHC(O)OOH	ROOH from DCO3
DCO1		radical product of DCO2
DCO2		radical product of DCO3
DCO3	$CHOCH=CHCO_3$	dicarbonyl acyl radical
DIAL	CHOCH=CHCHO	dicarbonyl
DMP	$C_6H_3OH(CH_3)_2$	dimethyl phenol
DPAN	$CHOCH=CHCO_3NO_2$	dicarbonyl PAN from DCO3
EO2	$HOC_2H_4O_2$	RO2 from ethene

EP	HOC_2H_4OOH	peroxide from ethene
ETHE	C_2H_4	ethene
IPO2		RO2 from IPRD
IPRD		misc. terpene reaction product
LIMO	$C_{10}H_{16}$	limonene
LIO2	$HOC_{10}H_{16}O_2$	RO2 from limonene
LIP	$HOC_{10}H_{16}OOH$	ROOH from limonene
MAO2		RO2 from MAO3 (methacrolein)
MDAL	$CH_3COCH=CHCHO$	dicarbonyl
NITP	$C_6H_5ONO_2$	benzyl nirate
PBZN	$C_6H_5CO_3NO_2$	acyl peroxy nitrate from benzene (BCO3)
PHEN	C_6H_5OH	phenol
PHO2	$C_6H_5O_2$	secondary RO2 from benzene
PHP	C_6H_5OOH	ROOH from PHO2
PIN2	$ONO_2C_{10}H_{16}O_2$	RO2 from terpenes+NO3
PINT	$ONO_2C_{10}H_{16}OOH$	ROOH from terpenes+NO3
PIO2	$HOC_{10}H_{16}O_2$	RO2 from α-pinene
PIP	$HOC_{10}H_{16}OOH$	ROOH from from α-pinene
POXY	C_6H_5O	aromatic radical
R3N1		RO2 from propane alkyl nitrate
R5N1		RO2 from R6N1
R6N1		RO2 from R7N1
R7N1		RO2 from C_6-C_8 alkyl nitrates
R7O2	$C_7H_{15}O_2$	RO2 from C_6-C_8 alkanes
R7O1		Secondary RO2 from R7O2
R7P	$C_7H_{15}OOH$	ROOH from C_6-C_8 alkanes
TOLU	$C_6H_5(CH_3)$	toluene (representing alkylbenzenes)
XAP	$CH_3COCH=CH(O)OOH$	ROOH from XCO3 (dicarbonyl)
XCO1		radical product of XCO2

XCO2		radical product of XCO3
XCO3	$CH_3COCH=CHCO_3$	dicarbonyl acyl radical
XPAN	$CH_3COCH=CHCO_3NO_2$	dicarbonyl PAN from XCO3
XYLE	$C_6H_4(CH_3)_2$	m-xylene (representing dialkylbenzenes)
YAP	$CHOCH=C(CH_3)C(O)OOH$	ROOH from YCO3 (dicarbonyl)
YCO1		radical product of YCO2
YCO2		radical product of YCO3
YCO3	$CHOCH=C(CH_3)CO_3$	dicarbonyl acyl radical
YPAN	$CHOCH=C(CH_3)CO_3NO_2$	dicarbonyl PAN from YCO3
ZAP	$CHOC(CH_3)=CHC(O)OOH$	ROOH from ZCO3 (dicarbonyl)
ZCO1		radical product of ZCO2
ZCO2		radical product of ZCO3
ZCO3	$CHOC(CH_3)=CHCO_3$	dicarbonyl acyl radical
ZPAN	$CHOC(CH_3)=CHCO_3NO_2$	dicarbonyl PAN from ZCO3

Table A2

Additional and modified reactions in the extended mechanism

The extended mechanism includes all reactions listed in *Evans et al.* [2003], except for the reactions replaced by modified forms in the table.

Abbreviations: HPL= High Pressure Limit. LPL=Low Pressure Limit. T=Temperature. Units are molec $cm^{-3}s^{-1}$ for reactions involving two species and s^{-1} for reactants involving a single species.

Reaction	**Rate constant**	**References**	**Notes**
Isoprene and products			
RIO2 + NO => 1.0 ISN2	K*Yn where Yn is the nitrate yield based on carbon number (=5.). K=2.7E-12 exp(350/T)	IUPAC, 2003; Sprengnether, 2002	modified reaction; same rate as *Evans*, 2003.
RIO1 + NO => 1.0 ISN2	K*Yn where Yn is the nitrate yield based on carbon number (=5.). K=2.7E-12 exp(350/T)	IUPAC, 2003; Sprengnether, 2002	modified reaction; same rate as *Evans*, 2003.
VRO2 + NO =>1.0 ISN2	K*Yn where Yn is the nitrate yield based on carbon number (=4.). K=2.7E-12 exp(350/T)	IUPAC,2003	modified reaction; same rate as *Evans*, 2003.
MRO2 + NO =>1.0 ISN2	K*Yn where Yn is the nitrate yield based on carbon number (=4.). K=2.700E-12 exp(350/T)	IUPAC, 2003	modified reaction; same rate as *Evans*, 2003.

INO2 +NO => 0.05 MVK + 0.1 MACR + 0.15 HCHO+ 0.85 ISN2 + 1.15 NO2 + 0.8 HO2	2.7E-12 exp(350/T)	Tyndall, 2001 ETO2+NO	same rate as *Evans et al.*, 2003, ISN2 replaces HNO3
ISN2 + OH => 1.0 ISN1	3.210e-11	Paulson and Seinfeld, 1992; Treves and Rudich, 2003	added reaction
RIP + OH => 0.5 IAO2 + 0.4 RIO2 + 0.2 RIO1	8.0E-12 exp(380/T)	Paulson and Seinfeld, 1992; IUPAC 2003 rate for MACR	Rate based on MACR+OH rather than MP+OH
IAP + OH => 0.5 OH + 0.18 HAC + 0.5 IAO2 + 0.335 CO + 0.13 GLYC + 0.29 MGLY	8.0E-12 exp(380/T)	Paulson and Seinfeld, 1992; IUPAC 2003 rate for MACR	RCHO product replaced by equiv. products of IAO2+NO
ISNP + OH => 0.5 OH + 0.5 MGLY + 0.5 ISN1 + 0.5 NO2	8.0E-12 exp(380/T)	Paulson and Seinfeld, 1992; IUPAC 2003 rate for MACR	RCHO product replaced by equiv. products of ISN1+NO
VRP + OH => 0.5 OH + 0.5MGLY + 0.5 VRO2 + 0.14 HCHO + 0.36 GLYC	8.0E-12 exp(380/T)	Paulson and Seinfeld, 1992; IUPAC 2003 rate for MACR	RCHO product replaced by equiv. products of VRO2+NO

MRP + OH => 0.5 OH + 0.415 HAC + 0.5 MRO2 + 0.085 MGLY + 0.415 CO + 0.085 HCHO	8.0E-12 exp(380/T)	Paulson and Seinfeld, 1992; IUPAC 2003 rate for MACR	RCHO product replaced by equiv. products of MRO2+NO
MAOP + OH => 0.5 OH + 1.0 HCHO + 0.5 MAO3	8.0E-12 exp(380/T)	Paulson and Seinfeld, 1992; IUPAC 2003 rate for MACR	RCHO product replaced by equiv. products of IAO2+NO
Terpenes and products			
APIN + OH => 1.0 PIO2	1.210E-11 exp(444/T)	Stockwell, 1997	
PIO2 + NO => 0.8 ALD2 + 0.8MEK + 0.2 PINT + 0.8 HO2 + 0.8 NO2	4.901E-12 exp(180/T)	Stockwell, 1997	
PIO2 + HO2 => 1.0 PIP	7.4E-13 exp(700/T)	Stockwell, 1997, Tyndall, 2001	
APIN + O3 => 0.065 ALD2 + 0.53 MEK + 0.14 CO + 0.2 EO2 + 0.42 KO2 + 0.85 OH + 0.1 HO2 + 0.02 H2O2	1.010E-15 exp(-732/T)	Stockwell, 1997	
APIN + NO3 => 0.1 INO2 + 0.9 PIN2	1.190E-12 exp(490/T)	Stockwell, 1997	

PIN2 + NO => 0.287 HCHO + 1.24 ALD2 + 0.464 MEK + 2.000 NO2	4.901E-12 -180.	Stockwell, 1997	
PIN2 + HO2 => 1.0 ISNP	3.0E-12	Stockwell, 1997	
PINT + OH => 1.0 ISNR	3.210E-11	Treves and Rudich, 2003	Equivalent to hydroxyalkyl nitrate from isoprene
LIMO + OH => 1.0 LIO2	1.710E-10	Stockwell, 1997	
LIO2 + NO => 0.4 IPRD + 0.25BUTE + 0.25 HCHO + 0.65 HO2 + 0.65 NO2 + 0.35 PINT	4.901E-12 exp(180/T)	Stockwell, 1997	lumped products changed to equivalents
LIO2 + HO2 => 1.0 LIP	7.4E-13 exp(700/T)	Stockwell, 1997, Tyndall, 2001	
LIMO+O3 => 0.04 HCHO + 0.46 PRPE + 0.14 CO + 0.16 EO2 + 0.42 KO2 + 0.85 OH + 0.1 HO2 + 0.02 H2O2 + 0.79 MACR + 0.08 HCOOH	2.000E-16	Stockwell, 1997	
LIMO + NO3 => 0.13 INO2 + 0.87 PIN2	1.220E-11	Stockwell, 1997	
IPRD + OH => 1.0 IPO2	6.190E-11	Carter, 1996	

IPO2 + NO => 0.418 CO + 1.0 NO2 + 0.687 HO2 + 0.125 GLYC + 0.124 GLYX + 0.062 RCHO +0.145 MGLY + 0.48 HAC + 0.313 MAO3	4.901E-12 exp(180/T)	Carter, 1996	
IPO2 + HO2 => 1.0 MRP	7.4E-13 exp(700/T)	Carter, 1996, Tyndall, 2001	
PIP + OH => 0.5PIO2 + 1.0 HO2 + 0.5 ALD2 + 0.5 MEK	3.8E-12 exp(200/T)	Stockwell, 1997; JPL 2003	
PIP + O3 => 0.7 HCHO	8.0E-21	Stockwell,1997	
LIP + OH => 0.5 LIO2 + 1.0 HO2 + 0.3 IPRD + 0.19 BUTE + 0.19 HCHO	3.8E-12 exp(200/T)	Stockwell, 1997; JPL 2003	MACR replaced by IPRD (MACR is exact spec.)
LIP + O3 => 0.7 HCHO	8.0E-21	Stockwell,1997	
PIP + hν => 1.0 HAC + 1.0 OH + 1.0 HO2	5.0E-04 j_{NO2}	Stockwell, 1997	
LIP + hν => 1.0 HAC + 1.0 OH + 1.0 HO2	5.0E-04 j_{NO2}	Stockwell, 1997	
Alkanes and alkenes			
ALK7 + OH => 1.0 R7O2	2.000E-11 exp(-359/T)	Lurmann et al., 1986	
R7O2 + NO => 0.75 R7O1 + 0.25 R4O2 + 0.25 MEK + 1.0 NO2	K*(1-Yn) where Yn is the nitrate yield based on carbon number (=7.). K=4.901E-12 exp(180/T)	Lurmann et al., 1986	

R7O2 + NO => 1.0 R7N2	K*Yn where Yn is the nitrate yield based on carbon number (=7.). K=4.901E-12 exp(180/T)	Lurmann et al., 1986	
R7O1 + NO => 1.0 RCHO + 1.0 NO2 + 1.0 HO2	K*(1-Yn) where Yn is the nitrate yield based on carbon number (=7.). K=4.901E-12 exp(180/T)	Lurmann et al., 1986	
R7O1 + NO => 1.0 R7N2	K*Yn where Yn is the nitrate yield based on carbon number (=7.). K=4.901E-12 exp(180/T)	Lurmann et al., 1986	
ALK7 + NO3 => 1.0 R7O2 + 1.0 HNO3	6.000E-17	Lurmann et al., 1986	
R7N2 + OH => 1.0 R7N1	4.901E-12 exp(180/T)	Lurmann et al., 1986	
R7N1 + NO => 0.11 R6N1 + 0.65 R5N1 + 0.65 ALD2 + 0.11 HCHO +0.48 RCHO + 1.24 NO2	4.901E-12 exp(180/T)	Lurmann et al., 1986	
R6N1 + NO => 1.0 R5N1 + 1.0 HCHO + 1.0 NO2	4.901E-12 exp(180/T)	Lurmann et al., 1986	
R5N1 + NO => 1.0 HCHO + 1.0 RCHO + 2.0 NO2	4.901E-12 exp(180/T)	Lurmann et al., 1986	

R7O2 + HO2 => 1.0 R7P	7.4E-13 exp(700/T)	Tyndall, 2001	
R7N1 + HO2 => 1.0 R7N2	7.4E-13 exp(700/T)	Tyndall, 2001	
R6N1 + HO2 => 1.0 R7N2	7.4E-13 exp(700/T)	Tyndall, 2001	
R5N1+HO2 => 1.0 R4N2	7.4E-13 exp(700/T)	Tyndall, 2001	
ETHE + OH => 1.0 EO2	LPL: $7E\text{-}29(T/300)^{-3.1}$ HPL:9E-12	IUPAC, 2003	
EO2 + NO => 1.6 HCHO + 0.20 GLYC + 1.0 NO2 + 1.0 HO2	9.000E-12	Lurmann et al., 1986	
EO2 + HO2 => 1.0 EP	7.4E-13 exp(700/T)	Tyndall, 2001	
ETHE + O3 => 1.0 HCHO + 0.4 CHO2 + 0.2 HO2 + 0.06 CH4 + 0.42 CO + 0.2 OH	9.500E-15 exp(-2580/T)	IUPAC, 2003	
BUTE + OH => 1.0 BUO2	1.100e-11 exp(549/T)	Lurmann, 1986	
BUO2 + NO => 1.8 ALD2 + 0.1 R4N2 + 0.9 NO2 + 0.9 HO2	4.901E-12 exp(180/T)	Lurmann et al., 1986	
BUO2 + HO2 => 1.0 BUP	7.4E-13 exp(700/T)	Tyndall, 2001	
BUTE + O3 => 1.0 ALD2 + 0.4 CRO2 + 0.25 HO2 + 0.6 OH + 0.35 MO2	7.5E-15 exp(-1050/T)	Lurmann et al., 1986	

CHO2 + NO => 1.0 HCHO + 1.0 NO2	7.0e-12	Lurmann, 1986	
CHO2 + NO2 => 1.0 HCHO + 1.0 NO3	7.0e-13	Lurmann, 1986	
CHO2+H2O =>1.0 HCOOH	4.0E-18	Lurmann, 1986	
CRO2 + NO => 1.0 ALD2 + 1.0NO2	7.0e-12	Lurmann, 1986	
CRO2 + NO2 => 1.0 ALD2 + 1.0 NO3	7.0e-13	Lurmann, 1986	
CRO2+H2O =>1.0 HCOOH	4.0E-18	Lurmann, 1986	
SO2 + CHO2 => 1.0 HCHO + 1.0 HSO4	7.0E-14	Lurmann, 1986	
SO2 + CRO2 => 1.0 ALD2 + 1.0 HSO4	7.0E-14	Lurmann, 1986	
CHO2 + HCHO => products	1.360e-14	Lurmann, 1986	
CHO2 + ALD2 => products	1.360e-14	Lurmann, 1986	
CRO2 + HCHO => products	1.360e-14	Lurmann, 1986	
CRO2 + ALD2 => products	1.360e-14	Lurmann, 1986	
R7P + OH => 0.5 R7O2 + 0.5RCHO + 0.5 OH	3.8E-12 exp(200/T)	JPL 2003	
EP + OH => 0.5 EO2 + 0.5 GLYC + 0.5 OH	3.8E-12 exp(200/T)	JPL 2003	
BUP + OH => 0.5BUO2 + 0.5 RCHO + 1.0 HO2	3.8E-12 exp(200/T)	JPL 2003	

R7P + hν => 1.0 RCHO + 1.0 OH + 1.0 HO2	5.0E-04 j_{NO2}	Lurmann, 1986	
EP + hν => 1.0 GLYC + 1.0 OH + 1.0 HO2	5.0E-04 j_{NO2}	Lurmann, 1986	
BUP + hν => 1.0 RCHO + 1.0 OH + 1.0 HO2	5.0E-04 j_{NO2}	Lurmann, 1986	
Aromatics			
BENZ + OH => 0.25 PHEN + 0.75 ADDB + 0.25 HO2	2.330E-12 exp(-193/T)	Lurmann, 1986; Atkinson and Arey, 2003	
ADDB + NO => 1.0 DIAL + 1.0 GLYX + 1.0 NO2 + 1.0 HO2	4.901E-12 exp(180/T)	Lurmann,1986	
TOLU +OH => 0.16 CRES + 0.08 ARO2 + 0.76 ADDT + 0.16 HO2	1.180E-12 exp(338/T)	Lurmann, 1986	
ARO2 + NO => 0.9 ACHO + 0.1 R4N2 + 0.9 NO2 + 0.9 HO2	4.901E-12 exp(180/T)	Lurmann,1986	
ADDT + NO => 0.8 MGLY + 0.8 DIAL + 0.2 GLYX + 0.05 MDAL + 0.15 ADAL + 1.0 NO2 + 1.0 HO2	4.901E-12 exp(180/T)	Lurmann,1986	

XYLE + OH =>0.83 ADDX + 0.17 DMP + 0.17 HO2	2.400e-11	Lurmann, 1986	
ADDX + NO => 1.0 MGLY + 0.5 MDAL + 0.5 ADAL + 1.0 NO2 + 1.0 HO2	4.901E-12 exp(180/T)	Lurmann,1986	
PHEN + OH => 0.9 ADD2 + 0.1 POXY	2.800E-11	Lurmann, 1986	
CRES + OH => 0.9 ADD2 + 0.1 POXY	4.250E-11	Lurmann, 1986	
DMP + OH => 0.9 ADD2 + 0.1 POXY	7.000E-11	Lurmann, 1986	
POXY + NO2 => 1.0NITP	1.500E-11	Lurmann, 1986	
ADD2 + NO => 1.0 A-DI + 1.0NO2 + 1.0 HO2	4.901E-12 exp(180/T)	Lurmann, 1986	
A-DI + OH => 1.0 AO2	1.500e-11	Lurmann, 1986	
AO2 + NO2 => 1.0 APAN	4.700e-12	Lurmann, 1986	
APAN => 1.0 AO2 + 1.0 NO2	1.950E+16 exp(-13543/T)	Lurmann, 1986	
AO2 + NO => 1.0 AO1 + 1.0 NO2	2.0E-11	Lurmann, 1986	
AO1 + NO => 1.0 AO0 + 1.0 NO2	2.0E-11	Lurmann, 1986	
AO0 + NO => 1.0GLYX + 1.0 CO + 1.0 NO2 + 1.0 HO2	2.0E-11	Lurmann, 1986	

PHEN + NO3 => 1.0 POXY + 1.0 HNO3	2.0E-12	Lurmann, 1986	
CRES + NO3 => 1.0 POXY + 1.0 HNO3	1.0E-11	Lurmann, 1986	
DMP + NO3 => 1.0 POXY + 1.0 HNO3	1.5E-11	Lurmann, 1986	
NITP + NO3 => 1.0 R4N2 + 1.0 HNO3	1.0E-11	Lurmann, 1986	modified to conserve reactive nitrogen
DIAL + OH => 1.0 DCO3	3.0E-11	Lurmann, 1986	
MDAL+ OH => 1.0 XCO3	1.5E-11	Lurmann, 1986	
ADAL+ OH => 0.5 YCO3 + 0.5 ZCO3	3.0E-11	Lurmann, 1986	
DCO3+ NO2 => 1.0 DPAN	4.700E-12	Lurmann, 1986	
XCO3+ NO2 => 1.0 DPAN	4.700E-12	Lurmann, 1986	
YCO3+ NO2 => 1.0 DPAN	4.700E-12	Lurmann, 1986	
ZCO3+ NO2 => 1.0 DPAN	4.700E-12	Lurmann, 1986	
DPAN => 1.0 DCO3 + 1.0 NO2	1.950E+16 exp(-13543/T)	Lurmann, 1986	
XPAN => 1.0 XCO3 + 1.0 NO2	1.950E+16 exp(-13543/T)	Lurmann, 1986	
YPAN => 1.0 YCO3 + 1.0 NO2	1.950E+16 exp(-13543/T)	Lurmann, 1986	

ZPAN => 1.0 ZCO3 + 1.0 NO2	1.950E+16 exp(-13543/T)	Lurmann, 1986	
DCO3 + NO => 1.0 DCO2 + 1.0 NO2	2.0E-11	Lurmann, 1986	
DCO2 + NO => 1.0 DCO1 + 1.0 NO2	2.0E-11	Lurmann, 1986	
DCO1 + NO => 1.0 GLYX + 1.0 CO + 1.0 NO2 + 1.0 HO2	2.0E-11	Lurmann, 1986	
XCO3 + NO => 1.0 XCO2 + 1.0 NO2	2.0E-11	Lurmann, 1986	
XCO2 + NO => 1.0 XCO1 + 1.0 NO2	2.0E-11	Lurmann, 1986	
XCO1 + NO => 0.5 MGLY + 0.5 MCO3 + 0.5 GLYX + 1.000 CO + 1.000 NO2 + 0.500 HO2 + 1.0 CO + 1.0 NO2 + 0.5 HO2	2.0E-11	Lurmann, 1986	
YCO3 + NO => 1.0 YCO2 + 1.0 NO2	2.0E-11	Lurmann, 1986	
YCO2 + NO => 1.0 YCO1 + 1.0 NO2	2.0E-11	Lurmann, 1986	
YCO1 + NO => 0.5 MGLY + 0.5 MCO3 + 0.5 GLYX + 2.0 CO + 1.0 NO2 + 0.5 HO2 + 1.0 NO2+ 0.5 HO2	2.0E-11	Lurmann, 1986	

ZCO3 + NO => 1.0 ZCO2 + 1.0 NO2	2.0E-11	Lurmann, 1986	
ZCO2 + NO => 1.0 ZCO1 + 1.0 NO2	2.0E-11	Lurmann, 1986	
ZCO1 + NO => 1.0 MGLY + 1.0 CO + 1.0 NO2 + 1.0 HO2	2.0E-11	Lurmann, 1986	
DIAL + hν => 1.0 DCO3 + 1.0 HO2	5.0E-03 j_{NO2}	Lurmann, 1986	
MDAL +hν =>0.5 DCO3 +0.5 XCO3 + 0.5 MCO3 + 0.5 HO2	3.0E-02 j_{NO2}	Lurmann, 1986	
ADAL + hν =>0.5 YCO3 + 0.5 ZCO3 + 1.0 HO2	3.0E-02 j_{NO2}	Lurmann, 1986	
ACHO+OH => 1.0BCO3	1.2E-11	Lurmann, 1986	
BCO3+NO2=>1.0 PBZN	4.7E-12	Lurmann, 1986	
PBZN => 1.0 BCO3 + 1.0 NO2	1.95E+16exp(-13543/T)	Lurmann, 1986	
BCO3 + NO =>1.0 PHO2 + 1.0 NO2	2.0E-11	Lurmann, 1986	
PHO2 +NO =>1.0 POXY + 1.0NO2	2.0E-11	Lurmann, 1986	
ADDB+HO2=>1.0 ADBP	7.4E-13 exp(700/T)	Tyndall, 2001	
ARO2 +HO2 => 1.0ARP	7.4E-13 exp(700/T)	Tyndall, 2001	
ADDT+HO2=>1.0 ADTP	7.4E-13 exp(700/T)	Tyndall, 2001	
ADDX+HO2=>1.0ADXP	7.4E-13 exp(700/T)	Tyndall, 2001	
ADD2+HO2=>1.0 AD2P	7.4E-13 exp(700/T)	Tyndall, 2001	
AO2 + HO2 => 0.75 AP + 0.25 EOH + 0.25 O3	7.4E-13 exp(700/T)	Tyndall, 2001	Plus identical reaction for AO1, AO0

DCO3+ HO2=>0.75 DAP + 0.25 EOH + 0.25 O3	7.4E-13 exp(700/T)	Tyndall, 2001	Plus identical reaction for DCO2, DCO1
XCO3+ HO2=>0.75 XAP + 0.25 EOH + 0.25 O3	7.4E-13 exp(700/T)	Tyndall, 2001	Plus identical reaction for XCO2, XCO1
YCO3+ HO2=>0.75 YAP + 0.25 EOH + 0.25 O3	7.4E-13 exp(700/T)	Tyndall, 2001	Plus identical reaction for YCO2, YCO1
ZCO3+ HO2=>0.75 ZAP + 0.25 EOH + 0.25 O3	7.4E-13 exp(700/T)	Tyndall, 2001	Plus identical reaction for ZCO2, ZCO1
PHO2+ HO2=>0.75 PHP + 0.25 EOH + 0.25 O3	7.4E-13 exp(700/T)	Tyndall, 2001	
ADBP+OH =>1.0 ADDB	3.8E-12 exp(200/T)	JPL 2003	
ARP+OH =>1.0 ARO2	3.8E-12 exp(200/T)	JPL 2003	
ADTP+OH =>1.0 ADDT	3.8E-12 exp(200/T)	JPL 2003	
ADXP+OH=>1.0 ADDX	3.8E-12 exp(200/T)	JPL 2003	
AD2P+OH =>1.0 ADD2	3.8E-12 exp(200/T)	JPL 2003	
BAP+OH =>1.0 BCO3	3.8E-12 exp(200/T)	JPL 2003	
PHP+OH =>1.0 PHO2	3.8E-12 exp(200/T)	JPL 2003	
AP+OH => 0.5 AO2 + 0.5 RCHO + 0.5 OH	3.8E-12 exp(200/T)	JPL 2003	
AP+OH => 0.5 AO2 + 0.5 RCHO + 0.5 OH	3.8E-12 exp(200/T)	JPL 2003	
DAP+OH => 0.5 DCO3 + 0.5 RCHO + 0.5 OH	3.8E-12 exp(200/T)	JPL 2003	
XAP+OH => 0.5 XCO3 + 0.5 RCHO + 0.5 OH	3.8E-12 exp(200/T)	JPL 2003	
YAP+OH => 0.5 YCO3 + 0.5 RCHO + 0.5 OH	3.8E-12 exp(200/T)	JPL 2003	

ZAP+OH => 0.5 ZCO3 + 0.5 RCHO + 0.5 OH	3.8E-12 exp(200/T)	JPL 2003	
ADTP +hν=> 1.0 RCHO + 1.0 OH + 1.0 HO2	1.0E-03 j_{NO2}	Lurmann, 1986	Plus identical reaction for ADXP, AD2P, BAP and PHP
APAN, DPAN + OH =>1.0 GLYX + 1.0 NO2	4.0E-14	JPL, 2003	Identical reaction for APAN, DPAN
XPAN+OH =>0.5 MGLY + 0.5 GLYX + 1.0 NO2	4.0E-14	JPL, 2003	
YPAN, ZPAN + OH => 1.00 MGLY + 1.0 NO2	4.0E-14	JPL, 2003	Identical reaction for YPAN, ZPAN
PBZN + OH =>1.0 POXY + 1.0 NO2	4.0E-14	JPL, 2003	
IPAN + OH =>1.0 HCHO + 1.0 NO2	4.0E-14	JPL, 2003	
Additional RO2-RO2 reactions			
MO2+R7O2=> 1.0 HCHO + 1.0 HO2 +0.35 RCHO+ 0.07 ALD2 + 0.14 ACET + 0.28 MEK	8.37E-14	Tyndall, 2001 MO2+MO2, Atkinson, 1997 RO2+RO2	see note in *Evans et al.*, 2003
MO2+EO2=> 1.0 HCHO + 1.0 HO2 +0.55 HCHO+0.45 ALD2	5.92E-13	Tyndall, 2001 MO2+MO2, Atkinson, 1997 RO2+RO2	see note in *Evans et al.*, 2003

MO2+BUO2=> 1.0 HCHO + 1.0 HO2 +0.19 MEK+0.93 ALD2	5.92E-13	Tyndall, 2001 MO2+MO2, Atkinson, 1997 RO2+RO2	see note in *Evans et al.*,, 2003
MO2+ADDT=> 1.0 HCHO + 1.0 HO2 +0.16GLYX+ 0.17MGLY +0.92 HO2+ 0.05 MCO3 +0.56 DIAL+0.035MDAL + 0.105 ADAL	3.56E-14 exp(708/T)	Stockwell, 1997	
MO2+ADDX=> 1.0 HCHO + 1.0 HO2 +0.45 MGLY+0.4 MDAL +1.0 HO2 +0.406 ADAL	3.56E-14 exp(708/T)	Stockwell, 1997	
MO2+PIO2=> 1.0 HCHO + 1.0 HO2 +1.0 ALD2 + 1.0 MEK + 1.0 HO2	3.56E-14 exp(708/T)	Stockwell, 1997	
MO2+LIO2=> 1.0 HCHO + 1.0 HO2 +0.6 IPRD + 0.38 BUTE + 0.38 HCHO + 1.0 HO2	3.56E-14 exp(708/T)	Stockwell, 1997	
MCO3 + R7O2 => 0.5 HCOOH + 0.5 HO2 + 0.5 MO2 +0.1 ALD2 + 0.4 RCHO +0.19 ACET + 0.39 MEK	1.85E-12 exp(500/T)	Stockwell, 1997; Tyndall MCO3+MO2, as in *Evans*, 2003	

MCO3 + EO2 => 0.5 HCOOH + 0.5 HO2 + 0.5 MO2 +0. HCHO + 0.6 ALD2	1.85E-12 exp(500/T)	Stockwell, 1997; Tyndall MCO3+MO2, as in *Evans et al,*, 2003	
MCO3 + BUO2 => 0.5 HCOOH + 0.5 HO2 + 0.5 MO2 +0.569MEK+0.941 ALD2	1.85E-12 exp(500/T)	Stockwell, 1997; Tyndall MCO3+MO2, as in *Evans et al.*, 2003	
MCO3 + ADDT => 0.5 HCOOH + 0.5 HO2 + 0.5 MO2 +0.65 GLYX+0.35MGLY + 0.05 MDAL +0.15ADAL + 0.8 DIAL	1.85E-12 exp(500/T)	Lurmann, 1986; Tyndall, 2001 MCO3+MO2, as in *Evans et al,*, 2003	
MCO3 + ADDX => 0.5 HCOOH + 0.5 HO2 + 0.5 MO2 +0.37GLYX+0.63 MGLY +0.5 MDAL + 0.5 ADAL	1.85E-12 exp(500/T)	Lurmann, 1986; Tyndall, 2001 MCO3+MO2, as in *Evans et al.,* 2003	
MCO3 + PIO2 => 0.5 HCOOH + 0.5 HO2 + 0.5 MO2 +1.0 ALD2 + 1.0 MEK	1.85E-12 exp(500/T)	Stockwell, 1997; Tyndall, 2001 MCO3+MO2, as in *Evans et al.,* 2003	

MCO3 + LIO2 => 0.5 HCOOH + 0.5 HO2 + 0.5 MO2 +0.6 IPRD + 0.4 BUTE + 0.4 HCHO	1.85E-12 exp(500/T)	Stockwell, 1997; Tyndall, 2001 MCO3+MO2, as in *Evans et al.,* 2003	
RIO2 + RIO2 => 0.68 MVK + 0.39 MACR + 0.93 IPRD + 1.07HCHO + 1.38 HO2	4.2E-13	Paulson, 1992	
IPO2 + IPO2 => 0.82CO +1.374HO2+0.626 MAO3 + 0.250 GLYC+ 0.248 GLYX + 0.124 RCHO + 0.29 MGLY + 0.96 HAC	4.2E-13	Stockwell, 1997	
VRO2 + VRO2 => 1.4 HO2 + 2.0 MGLY + 1.4 HCHO	1.4E-12	Paulson, 1992	
MRO2 + MRO2 => 1.4 HO2 + 2.0 MGLY + 1.4 HCHO	1.4E-12	Paulson, 1992	
RIO2+IPO2, VRO2, MRO2=> products	average of two RO2-RO2 self-reactions		products equivalent to RO2-RO2 self-reactions
EO2 + EO2 =>1.2 GLYC + 1.2 HO2 + 0.4 EOH+ 0.4 ALD2	1.0E-12	Lurmann, 1986	

PO2 +PO2 =>1.2 RCHO + 1.2 HO2 + 0.4 EOH + 0.4 ALD2	1.0E-12	Lurmann, 1986	
KO2 + KO2 =>2.0 ALD2 + 0.44 ACET	1.0E-12	Lurmann, 1986	
RCO3+RCO3=> 2.0 ETO2	2.5E-12 exp(500/T)	Tyndall, 2001 MCO3 rate	
MAO3+MAO3=> 2.0 MAO2	2.5E-12 exp(500/T)	Tyndall, 2001 MCO3 rate	
MO2 + MAO3 => 0.85 MAO2 + 0.15 EOH + 1.0 HCHO	1.85E-12 exp(500/T)	Tyndall, 2001 MCO3+MO2, as in *Evans et al.,* 2003	
MCO3 + MAO3 => 1.0 MAO2 + 1.0 MO2	2.5E-12 exp(500/T)	Tyndall, 2001 MCO3 rate	
DCO3+DCO3=> 2.0 DCO1	2.5E-12 exp(500/T)	Tyndall, 2001 MCO3 rate	Plus equivalent reactions for AO2, XCO3, YCO3, ZCO3, BCO3
MO2 + DCO3 => 0.85 DCO1 + 0.15 EOH + 1.0 HCHO	1.85E-12 exp(500/T)	Tyndall, 2001, as in *Evans et al.,* 2003	Plus equivalent reactions of MO2 with AO2, XCO3, YCO3, ZCO3, BCO3

MCO3 + DCO3 => 1.0 DCO1 + 1.0 MO2	2.5E-12 exp(500/T)	Tyndall, 2001 MCO3 rate	Plus equivalent reactions of MCO3 with AO2, XCO3, YCO3, ZCO3, BCO3
Other added reactions			
RCOOH + OH => 1.0 ETO2 + 1.0 CO2	4.0E-13 exp(200/T)	JPL 2003	added by analogy to ACTA+OH
PAN + OH => 1.0 HCHO + 1.0 NO2	4.0E-14	JPL, 2003	
PPN + OH => 1.0 ALD2 + 1.0 NO2	7.5E-12 exp(-651/T)	Kasting, 1986	
DMS + OH => 1.0 SO2 + 1.0 MO2 + 1.0 HCHO	1.2E-11 exp(-260/T)	JPL 2003	
DMS + NO3 => 1.0 SO2 + 1.0 MO2 + 1.0 HCHO + 1.0 HNO3	1.9E-13 exp(500/T)	JPL 2003	
SO2 + OH => 1.0 HSO4 + 1.0 HO2	LPL: $3E\text{-}31(T/300)^{-3.3}$ HPL:1.5E-12	JPL 2003	

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