Supplementary material for

Modelling organic aerosol over Europe in summer conditions with the VBS-GECKO parameterization: sensitivity to secondary organic compound properties and IVOC emissions

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Table S1 – The H^{2}O mechanism

Reactions	Kinetic rate parameters (s^{-1} or $molecule^{-1}.cm^3.s^{-1}$)
ISOP + OH → ISOR + OH	$2.54 \times 10^{-11} \times \exp(408/T)$
ISOP + NO3 → ISON + NO3	$3.03 \times 10^{-12} \times \exp(-448/T)$
ISOR + HO2 → 0.282 BiPER + 0.030 BiDER + HO2	$2.05 \times 10^{-13} \times \exp(1300/T)$
ISOR + C2O3 → 0.026 BiMT + 0.219 MACR + C2O3	$8.40 \times 10^{-14} \times \exp(221/T)$
ISOR + MeO2 → 0.026 BiMT + 0.219 MACR + MeO2	$3.40 \times 10^{-14} \times \exp(221/T)$
ISOR + NO → 0.418 MACR + 0.046 ISON + NO	$2.43 \times 10^{-12} \times \exp(360/T)$
ISOR + NO3 → 0.438 MACR + NO3	1.20×10^{-12}
ISON + OH → OH	1.30×10^{-11}
ISON + NO3 → 0.074 BiNIT3 + NO3	6.61×10^{-13}
MACR + NO → NO	$2.54 \times 10^{-12} \times \exp(360/T)$
MACR + HO2 → HO2	$1.82 \times 10^{-13} \times \exp(1300/T)$
MACR + MeO2 → MeO2	$3.40 \times 10^{-14} \times \exp(221/T)$
MACR + NO2 → MPAN + NO2	$2.80 \times 10^{-12} \times \exp(181/T)$
MPAN → MACR	$1.60 \times 10^{16} \times \exp(-13486/T)$
MPAN + OH → 0.067 BiMGA + 0.047 BiNGA + OH	3.20×10^{-11}
MPAN + NO3 → 0.067 BiMGA + 0.047 BiNGA + NO3	3.20×10^{-11}
BiPER + hν → Degradation products	k = 50 × kinetic of photolysis of H_2O_2
API + OH → 0.30 BiA0D + 0.17 BiA1D + 0.10 BiA2D + OH	$1.21 \times 10^{-11} \times \exp(440/T)$
API + O3 → 0.18 BiA0D + 0.16 BiA1D + 0.05 BiA2D + O3	$5.00 \times 10^{-16} \times \exp(-530/T)$
API + NO3 → 0.70 BiA0D + 0.10 BiNIT + NO3	$1.19 \times 10^{-12} \times \exp(-490/T)$
BPI + OH → 0.07 BiA0D + 0.08 BiA1D + 0.06 BiA2D + OH	$2.38 \times 10^{-11} \times \exp(357/T)$
BPI + O3 → 0.09 BiA0D + 0.13 BiA1D + 0.04 BiA2D + O3	1.50×10^{-17}
BPI + NO3 → 0.02 BiA0D + 0.63 BiNIT + NO3	2.51×10^{-12}
LIM + OH → 0.35 BiA0D + 0.20 BiA1D + 0.0035 BiA2D + OH	$4.20 \times 10^{-11} \times \exp(401/T)$
LIM + O3 → 0.09 BiA0D + 0.10 BiA1D + O3	$2.95 \times 10^{-15} \times \exp(783/T)$
LIM + NO3 → 0.69 BiA0D + 0.27 BiNIT + NO3	1.22×10^{-11}
HUM + OH → 0.74 BiBmP + 0.26 BiBlP + OH	2.93×10^{-10}
TOL + OH → ... + 0.25 TOLP	$1.80 \times 10^{-12} \times \exp(355/T)$
TOLP + HO2 → 0.78 AnClP + HO2	$3.75 \times 10^{-13} \times \exp(980/T)$
TOLP + C2O3 → 0.78 AnClP + C2O3	$7.40 \times 10^{-13} \times \exp(765/T)$
TOLP + MeO2 → 0.78 AnClP + MeO2	$3.56 \times 10^{-14} \times \exp(708/T)$
TOLP + NO → 0.097 AnBlP + 0.748 AnBmP + NO	$2.70 \times 10^{-12} \times \exp(360/T)$
TOLP + NO3 → 0.097 AnBlP + 0.748 AnBmP + NO3	1.2×10^{-12}
XYL + OH → ... + 0.274 XYLP	$1.70 \times 10^{-11} \times \exp(116/T)$
XYLP + HO2 → 0.71 AnClP + HO2	$3.75 \times 10^{-13} \times \exp(980/T)$
XYLP + C2O3 → 0.71 AnClP + C2O3	$7.40 \times 10^{-13} \times \exp(765/T)$
XYLP + MeO2 → 0.71 AnClP + MeO2	$3.56 \times 10^{-14} \times \exp(708/T)$
XYLP + NO → 0.063 AnBlP + 0.424 AnBmP + NO	$2.70 \times 10^{-12} \times \exp(360/T)$
XYLP + NO3 → 0.063 AnBlP + 0.424 AnBmP + NO3	1.2×10^{-12}
POAlP + OH → SOAlP	2.0×10^{-11}
POAmP + OH → SOAmP	2.0×10^{-11}
POAhP + OH → SOAhP	2.0×10^{-11}
BOAlP + OH → BSOAlP	2.0×10^{-11}
BOAmP + OH → BSOAmP	2.0×10^{-11}
BOAhP + OH → BSOAhP	2.0×10^{-11}

Table S2 – The VBS-GECKO mechanism as implemented in the ref-VBS-GECKO configuration of CHIMERE.

Reactions	Kinetic rate parameters (s^{-1} or $molecule^{-1}.cm^3.s^{-1}$)	Notes
ISOP + OH → ISOR + OH	$2.54 \times 10^{-11} \times \exp(408/T)$	
ISOP + NO3 → ISON + NO3	$3.03 \times 10^{-12} \times \exp(-448/T)$	
ISOR + HO2 → 0.282 BiPER + 0.030 BiDER + HO2	$2.05 \times 10^{-13} \times \exp(1300/T)$	
ISOR + C2O3 → 0.026 BiMT + 0.219 MACR + C2O3	$8.40 \times 10^{-14} \times \exp(221/T)$	
ISOR + MeO2 → 0.026 BiMT + 0.219 MACR + MeO2	$3.40 \times 10^{-14} \times \exp(221/T)$	
ISOR + NO → 0.418 MACR + 0.046 ISON + NO	$2.43 \times 10^{-12} \times \exp(360/T)$	
ISOR + NO3 → 0.438 MACR + NO3	1.20×10^{-12}	
ISON + OH → OH	1.30×10^{-11}	
ISON + NO3 → 0.074 BiNIT3 + NO3	6.61×10^{-13}	
MACR + NO → NO	$2.54 \times 10^{-12} \times \exp(360/T)$	
MACR + HO2 → HO2	$1.82 \times 10^{-13} \times \exp(1300/T)$	
MACR + MeO2 → MeO2	$3.40 \times 10^{-14} \times \exp(221/T)$	
MACR + NO2 → MPAN + NO2	$2.80 \times 10^{-12} \times \exp(181/T)$	
MPAN → MACR	$1.60 \times 10^{16} \times \exp(-13486/T)$	
MPAN + OH → 0.067 BiMGA + 0.047 BiNGA + OH	3.20×10^{-11}	
MPAN + NO3 → 0.067 BiMGA + 0.047 BiNGA + NO3	3.20×10^{-11}	
BiPER + hν → Degradation products	k = 50 × kinetic of photolysis of H_2O_2	
APINEN + OH → a_1 BIO1B1 + a_2 BIO1B2 + a_3 BIO1B3 + a_4 BIO1B4 + a_5 BIO1B5 + a_6 BIO1B6 + a_7 BIO1B7 + OH	$1.21 \times 10^{-11} \times \exp(440/T)$	*
APINEN + O3 → a_1 BIO1B1 + a_2 BIO1B2 + a_3 BIO1B3 + a_4 BIO1B4 + a_5 BIO1B5 + a_6 BIO1B6 + a_7 BIO1B7 + O3	$5.00 \times 10^{-16} \times \exp(-530/T)$	*
APINEN + NO3 → a_1 BIO1B1 + a_2 BIO1B2 + a_3 BIO1B3 + a_4 BIO1B4 + a_5 BIO1B5 + a_6 BIO1B6 + a_7 BIO1B7 + NO3	$1.19 \times 10^{-12} \times \exp(-490/T)$	*
BIO1B(1-6) + OH → a_1 BIO1B1 + a_2 BIO1B2 + a_3 BIO1B3 + a_4 BIO1B4 + a_5 BIO1B5 + a_6 BIO1B6 + a_7 BIO1B7 + OH	4.0×10^{-11}	*
BIO1B(1-6) + hν → Degradation products	k = 11.5 × kinetic of photolysis of acetone	
BPINEN + OH → a_1 BIO2B1 + a_2 BIO2B2 + a_3 BIO2B3 + a_4 BIO2B4 + a_5 BIO2B5 + a_6 BIO2B6 + a_7 BIO2B7+ OH	$2.38 \times 10^{-11} \times \exp(357/T)$	*
BPINEN + O3 → a_1 BIO2B1 + a_2 BIO2B2 + a_3 BIO2B3 + a_4 BIO2B4 + a_5 BIO2B5 + a_6 BIO2B6 + a_7 BIO2B7 + O3	1.50×10^{-17}	*
BPINEN + NO3 → a_1 BIO2B1 + a_2 BIO2B2 + a_3 BIO2B3 + a_4 BIO2B4 + a_5 BIO2B5 + a_6 BIO2B6 + a_7 BIO2B7 + NO3	2.51×10^{-12}	*
BIO2B(1-6) + OH → a_1 BIO2B1 + a_2 BIO2B2 + a_3 BIO2B3 + a_4 BIO2B4 + a_5 BIO2B5 + a_6 BIO2B6 + a_7 BIO2B7 + OH	4.0×10^{-11}	*
BIO2B(1-6) + hν → Degradation products	k = 23.5 × kinetic of photolysis of acetone	
LIMONE + OH → a_1 BIO3B1 + a_2 BIO3B2 + a_3 BIO3B3 + a_4 BIO3B4 + a_5 BIO3B5 + a_6 BIO3B6 + a_7 BIO3B7 + OH	$4.20 \times 10^{-11} \times \exp(401/T)$	*
LIMONE + O3 → a_1 BIO3B1 + a_2 BIO3B2 + a_3 BIO3B3 + a_4 BIO3B4 + a_5 BIO3B5 + a_6 BIO3B6 + a_7 BIO3B7 + O3	$2.95 \times 10^{-15} \times \exp(783/T)$	*
LIMONE + NO3 → a_1 BIO3B1 + a_2 BIO3B2 + a_3 BIO3B3 + a_4 BIO3B4 + a_5 BIO3B5 + a_6 BIO3B6 + a_7 BIO3B7 + NO3	1.22×10^{-11}	*
BIO3B(1-6) + OH → a_1 BIO3B1 + a_2 BIO3B2 + a_3 BIO3B3 + a_4 BIO3B4 + a_5 BIO3B5 + a_6 BIO3B6 + a_7 BIO3B7 + OH	4.0×10^{-11}	*
BIO3B(1-6) + hν → Degradation products	k = 23.3 × kinetic of photolysis of acetone	
OCIMEN + OH → a_1 BIO3B1 + a_2 BIO3B2 + a_3 BIO3B3 + a_4 BIO3B4 + a_5 BIO3B5 + a_6 BIO3B6 + a_7 BIO3B7 + OH	$5.10 \times 10^{-8} / T$	*
OCIMEN + O3 → a_1 BIO3B1 + a_2 BIO3B2 + a_3 BIO3B3 + a_4 BIO3B4 + a_5 BIO3B5 + a_6 BIO3B6 + a_7 BIO3B7 + O3	$7.50 \times 10^{-14} / T$	*
OCIMEN + NO3 → a_1 BIO3B1 + a_2 BIO3B2 + a_3 BIO3B3 + a_4 BIO3B4 + a_5 BIO3B5 + a_6 BIO3B6 + a_7 BIO3B7 + NO3	$4.30 \times 10^{-9} / T$	*
HUM + OH → 0.74 BiBmP + 0.26 BiBlP + OH	2.93×10^{-10}	
BENZEN + OH → a_1 ARO1B1 + a_2 ARO1B2 + a_3 ARO1B3 + a_4 ARO1B4 + a_5 ARO1B5 + a_6 ARO1B6 + a_7 ARO1B7 + OH	1.216×10^{-12}	*
ARO1B(1-6) + OH → a_1 ARO1B1 + a_2 ARO1B2 + a_3 ARO1B3 + a_4 ARO1B4 + a_5 ARO1B5 + a_6 ARO1B6 + a_7 ARO1B7 + OH	4.0×10^{-11}	*
ARO1B(1-6) + hν → Degradation products	k = 1.50 × kinetic of photolysis of acetone	
TOLUEN + OH → a_1 ARO2B1 + a_2 ARO2B2 + a_3 ARO2B3 + a_4 ARO2B4 + a_5 ARO2B5 + a_6 ARO2B6 + a_7 ARO2B7 + OH	5.639×10^{-12}	*
ARO2B(1-6) + OH → a_1 ARO2B1 + a_2 ARO2B2 + a_3 ARO2B3 + a_4 ARO2B4 + a_5 ARO2B5 + a_6 ARO2B6 + a_7 ARO2B7 + OH	4.0×10^{-11}	*
ARO2B(1-6) + hν → Degradation products	k = 19.9 × kinetic of photolysis of acetone	
OXYLEN + OH → a_1 ARO3B1 + a_2 ARO3B2 + a_3 ARO3B3 + a_4 ARO3B4 + a_5 ARO3B5 + a_6 ARO3B6 + a_7 ARO3B7 + OH	1.360×10^{-11}	*

ARO3B(1-6) + OH → a_1 ARO3B1 + a_2 ARO3B2 + a_3 ARO3B3 + a_4 ARO3B4 + a_5 ARO3B5 + a_6 ARO3B6 + a_7 ARO3B7 + OH	4.0×10^{-11}	*
ARO3B(1-6) + hν → Degradation products	k = 2.30 × kinetic of photolysis of acetone	
MXYLEN + OH → a_1 ARO4B1 + a_2 ARO4B2 + a_3 ARO4B3 + a_4 ARO4B4 + a_5 ARO4B5 + a_6 ARO4B6 + a_7 ARO4B7 + OH	2.305×10^{-11}	*
ARO4B(1-6) + OH → a_1 ARO4B1 + a_2 ARO4B2 + a_3 ARO4B3 + a_4 ARO4B4 + a_5 ARO4B5 + a_6 ARO4B6 + a_7 ARO4B7 + OH	4.0×10^{-11}	*
ARO4B(1-6) + hν → Degradation products	k = 2.59 × kinetic of photolysis of acetone	
PXYLEN + OH → a_1 ARO5B1 + a_2 ARO5B2 + a_3 ARO5B3 + a_4 ARO5B4 + a_5 ARO5B5 + a_6 ARO5B6 + a_7 ARO5B7 + OH	1.431×10^{-11}	*
ARO5B(1-6) + OH → a_1 ARO5B1 + a_2 ARO5B2 + a_3 ARO5B3 + a_4 ARO5B4 + a_5 ARO5B5 + a_6 ARO5B6 + a_7 ARO5B7 + OH	4.0×10^{-11}	*
ARO5B(1-6) + hν → Degradation products	k = 16.4 × kinetic of photolysis of acetone	
ALC10 + OH → a_1 ALC1B1 + a_2 ALC1B2 + a_3 ALC1B3 + a_4 ALC1B4 + a_5 ALC1B5 + a_6 ALC1B6 + a_7 ALC1B7 + OH	1.099×10^{-11}	*
ALC1B(1-6) + OH → a_1 ALC1B1 + a_2 ALC1B2 + a_3 ALC1B3 + a_4 ALC1B4 + a_5 ALC1B5 + a_6 ALC1B6 + a_7 ALC1B7 + OH	4.0×10^{-11}	*
ALC1B(1-6) + hν → Degradation products	k = 19.1 × kinetic of photolysis of acetone	
ALC14 + OH → a_1 ALC2B1 + a_2 ALC2B2 + a_3 ALC2B3 + a_4 ALC2B4 + a_5 ALC2B5 + a_6 ALC2B6 + a_7 ALC2B7 + OH	1.678×10^{-11}	*
ALC2B(1-6) + OH → a_1 ALC2B1 + a_2 ALC2B2 + a_3 ALC2B3 + a_4 ALC2B4 + a_5 ALC2B5 + a_6 ALC2B6 + a_7 ALC2B7 + OH	4.0×10^{-11}	*
ALC2B(1-6) + hν → Degradation products	k = 19.4 × kinetic of photolysis of acetone	
ENE10 + OH → a_1 ENE1B1 + a_2 ENE1B2 + a_3 ENE1B3 + a_4 ENE1B4 + a_5 ENE1B5 + a_6 ENE1B6 + a_7 ENE1B7 + OH	4.402×10^{-11}	*
ENE10 + O3 → a_1 ENE1B1 + a_2 ENE1B2 + a_3 ENE1B3 + a_4 ENE1B4 + a_5 ENE1B5 + a_6 ENE1B6 + a_7 ENE1B7 + O3	9.290×10^{-18}	*
ENE10 + NO3 → a_1 ENE1B1 + a_2 ENE1B2 + a_3 ENE1B3 + a_4 ENE1B4 + a_5 ENE1B5 + a_6 ENE1B6 + a_7 ENE1B7 + NO3	0.265×10^{-13}	*
ENE1B(1-6) + OH → a_1 ENE1B1 + a_2 ENE1B2 + a_3 ENE1B3 + a_4 ENE1B4 + a_5 ENE1B5 + a_6 ENE1B6 + a_7 ENE1B7 + OH	4.0×10^{-11}	*
ENE1B(1-6) + hν → Degradation products	k = 17.6 × kinetic of photolysis of acetone	
POAlP + OH → SOAlP	2.0×10^{-11}	
POAmP + OH → SOAmP	2.0×10^{-11}	
POAhP + OH → SOAhP	2.0×10^{-11}	
BOAlP + OH → BSOAlP	2.0×10^{-11}	
BOAmP + OH → BSOAmP	2.0×10^{-11}	
BOAhP + OH → BSOAhP	2.0×10^{-11}	

Reactions in italic are taken from the H^2O mechanism

* the VB(1-7) are formed according to RRR and reactive species dependent a_x stoichiometric coefficients (cf Lannuque et al., 2018)

Table S3 – The VBS-GECKO mechanism for IVOC and SVOC as implemented in CHIMERE.

Reactions	Kinetic rate parameters (s^{-1} or $molecule^{-1}.cm^3.s^{-1}$)	Notes
ALC14 + OH → a_1 ALC2B1 + a_2 ALC2B2 + a_3 ALC2B3 + a_4 ALC2B4 + a_5 ALC2B5 + a_6 ALC2B6 + a_7 ALC2B7 + OH	1.678×10^{-11}	*
ALC2B(1-6) + OH → a_1 ALC2B1 + a_2 ALC2B2 + a_3 ALC2B3 + a_4 ALC2B4 + a_5 ALC2B5 + a_6 ALC2B6 + a_7 ALC2B7 + OH	4.0×10^{-11}	*
ALC2B(1-6) + hν → Degradation products	k = 19.4 × kinetic of photolysis of aceton	
ALC18 + OH → a_1 ALC3B1 + a_2 ALC3B2 + a_3 ALC3B3 + a_4 ALC3B4 + a_5 ALC3B5 + a_6 ALC3B6 + a_7 ALC3B7 + OH	2.244×10^{-11}	*
ALC3Bq1-6) + OH → a_1 ALC3B1 + a_2 ALC3B2 + a_3 ALC3B3 + a_4 ALC3B4 + a_5 ALC3B5 + a_6 ALC3B6 + a_7 ALC3B7 + OH	4.0×10^{-11}	*
ALC3B(1-6) + hν → Degradation products	k = 6.39 × kinetic of photolysis of aceton	
ALC22 + OH → a_1 ALC4B1 + a_2 ALC4B2 + a_3 ALC4B3 + a_4 ALC4B4 + a_5 ALC4B5 + a_6 ALC4B6 + a_7 ALC4B7 + OH	2.811×10^{-11}	*
ALC4B(1-6) + OH → a_1 ALC4B1 + a_2 ALC4B2 + a_3 ALC4B3 + a_4 ALC4B4 + a_5 ALC4B5 + a_6 ALC4B6 + a_7 ALC4B7 + OH	4.0×10^{-11}	*
ALC4B(1-6) + hν → Degradation products	k = 6.25 × kinetic of photolysis of aceton	
ALC26 + OH → a_1 ALC5B1 + a_2 ALC5B2 + a_3 ALC5B3 + a_4 ALC5B4 + a_5 ALC5B5 + a_6 ALC5B6 + a_7 ALC5B7 + OH	3.377×10^{-11}	*
ALC5B(1-6) + OH → a_1 ALC5B1 + a_2 ALC5B2 + a_3 ALC5B3 + a_4 ALC5B4 + a_5 ALC5B5 + a_6 ALC5B6 + a_7 ALC5B7 + OH	4.0×10^{-11}	*
ALC5B(1-6) + hν → Degradation products	k = 0.00 × kinetic of photolysis of aceton	
ENE14 + OH → a_1 ENE2B1 + a_2 ENE2B2 + a_3 ENE2B3 + a_4 ENE2B4 + a_5 ENE2B5 + a_6 ENE2B6 + a_7 ENE2B7 + OH	4.970×10^{-11}	*
ENE14 + O3 → a_1 ENE2B1 + a_2 ENE2B2 + a_3 ENE2B3 + a_4 ENE2B4 + a_5 ENE2B5 + a_6 ENE2B6 + a_7 ENE2B7 + O3	1.011×10^{-17}	*
ENE14 + NO3 → $_1$ ENE2B1 + a_2 ENE2B2 + a_3 ENE2B3 + a_4 ENE2B4 + a_5 ENE2B5 + a_6 ENE2B6 + a_7 ENE2B7 + NO3	0.305×10^{-13}	*
ENE2B(1-6) + OH → a_1 ENE2B1 + a_2 ENE2B2 + a_3 ENE2B3 + a_4 ENE2B4 + a_5 ENE2B5 + a_6 ENE2B6 + a_7 ENE2B7 + OH	4.0×10^{-11}	*
ENE2B(1-6) + hν → Degradation products	k = 9.26 × kinetic of photolysis of aceton	
ENE18 + OH → a_1 ENE3B1 + a_2 ENE3B2 + a_3 ENE3B3 + a_4 ENE3B4 + a_5 ENE3B5 + a_6 ENE3B6 + a_7 ENE3B7 + OH	5.537×10^{-11}	*
ENE18 + O3 → a_1 ENE3B1 + a_2 ENE3B2 + a_3 ENE3B3 + a_4 ENE3B4 + a_5 ENE3B5 + a_6 ENE3B6 + a_7 ENE3B7 + O3	1.011×10^{-17}	*
ENE18 + NO3 → a_1 ENE3B1 + a_2 ENE3B2 + a_3 ENE3B3 + a_4 ENE3B4 + a_5 ENE3B5 + a_6 ENE3B6 + a_7 ENE3B7 + NO3	0.326×10^{-13}	*
ENE3B(1-6) + OH → a_1 ENE3B1 + a_2 ENE3B2 + a_3 ENE3B3 + a_4 ENE3B4 + a_5 ENE3B5 + a_6 ENE3B6 + a_7 ENE3B7 + OH	4.0×10^{-11}	*
ENE3B(1-6) + hν → Degradation products	k = 2.74 × kinetic of photolysis of aceton	
ENE22 + OH → a_1 ENE4B1 + a_2 ENE4B2 + a_3 ENE4B3 + a_4 ENE4B4 + a_5 ENE4B5 + a_6 ENE4B6 + a_7 ENE4B7 + OH	6.105×10^{-11}	*
ENE22 + O3 → a_1 ENE4B1 + a_2 ENE4B2 + a_3 ENE4B3 + a_4 ENE4B4 + a_5 ENE4B5 + a_6 ENE4B6 + a_7 ENE4B7 + O3	1.011×10^{-17}	*
ENE22 + NO3 → a_1 ENE4B1 + a_2 ENE4B2 + a_3 ENE4B3 + a_4 ENE4B4 + a_5 ENE4B5 + a_6 ENE4B6 + a_7 ENE4B7 + NO3	0.337×10^{-13}	*
ENE4B(1-6) + OH → a_1 ENE4B1 + a_2 ENE4B2 + a_3 ENE4B3 + a_4 ENE4B4 + a_5 ENE4B5 + a_6 ENE4B6 + a_7 ENE4B7 + OH	4.0×10^{-11}	*
ENE4B(1-6) + hν → Degradation products	k = 6.13 × kinetic of photolysis of aceton	
ENE26 + OH → a_1 ENE5B1 + a_2 ENE5B2 + a_3 ENE5B3 + a_4 ENE5B4 + a_5 ENE5B5 + a_6 ENE5B6 + a_7 ENE5B7 + OH	6.673×10^{-11}	*
ENE26 + O3 → a_1 ENE5B1 + a_2 ENE5B2 + a_3 ENE5B3 + a_4 ENE5B4 + a_5 ENE5B5 + a_6 ENE5B6 + a_7 ENE5B7 + O3	1.011×10^{-17}	*
ENE26 + NO3 → a_1 ENE5B1 + a_2 ENE5B2 + a_3 ENE5B3 + a_4 ENE5B4 + a_5 ENE5B5 + a_6 ENE5B6 + a_7 ENE5B7 + NO3	0.343×10^{-13}	*
ENE5B(1-6) + OH → a_1 ENE5B1 + a_2 ENE5B2 + a_3 ENE5B3 + a_4 ENE5B4 + a_5 ENE5B5 + a_6 ENE5B6 + a_7 ENE5B7 + OH	4.0×10^{-11}	*
ENE5B(1-6) + hν → Degradation products	k = 0.00 × kinetic of photolysis of aceton	

Reactions in italic are already in the ref-VBS-GECKO configuration of CHIMERE

* the VB(1-7) are formed according to RRR and reactive species dependent a_x stoichiometric coefficients (cf Lannuque et al., 2018)

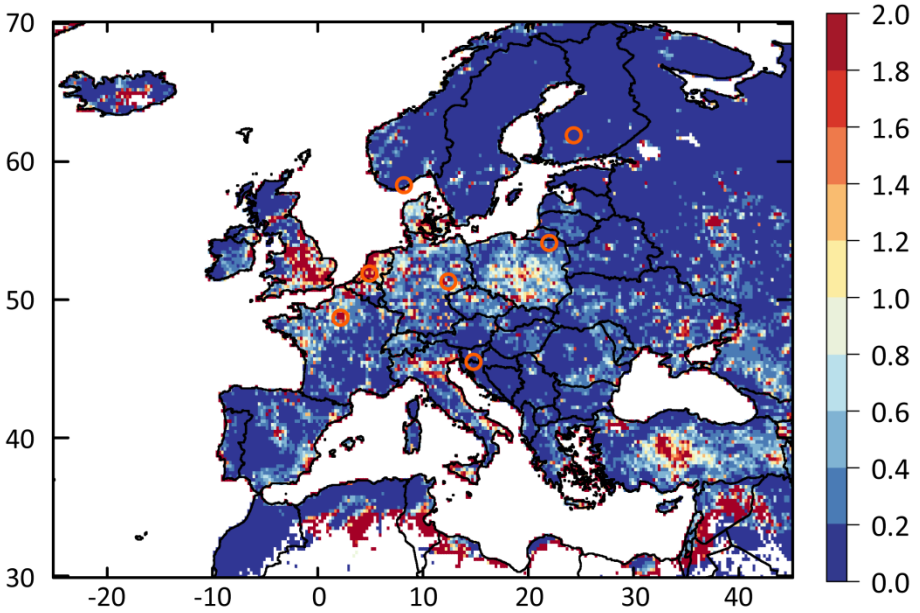

Figure S1 – Mean simulated emission$_{toluene}$/emission$_{\alpha\text{-pinene}}$ ratio for July-August 2013 over Europe. Circles represent stations used for time series comparison. White pixels represent limit values of the ratio (typically when at least one of the emission fluxes is null).

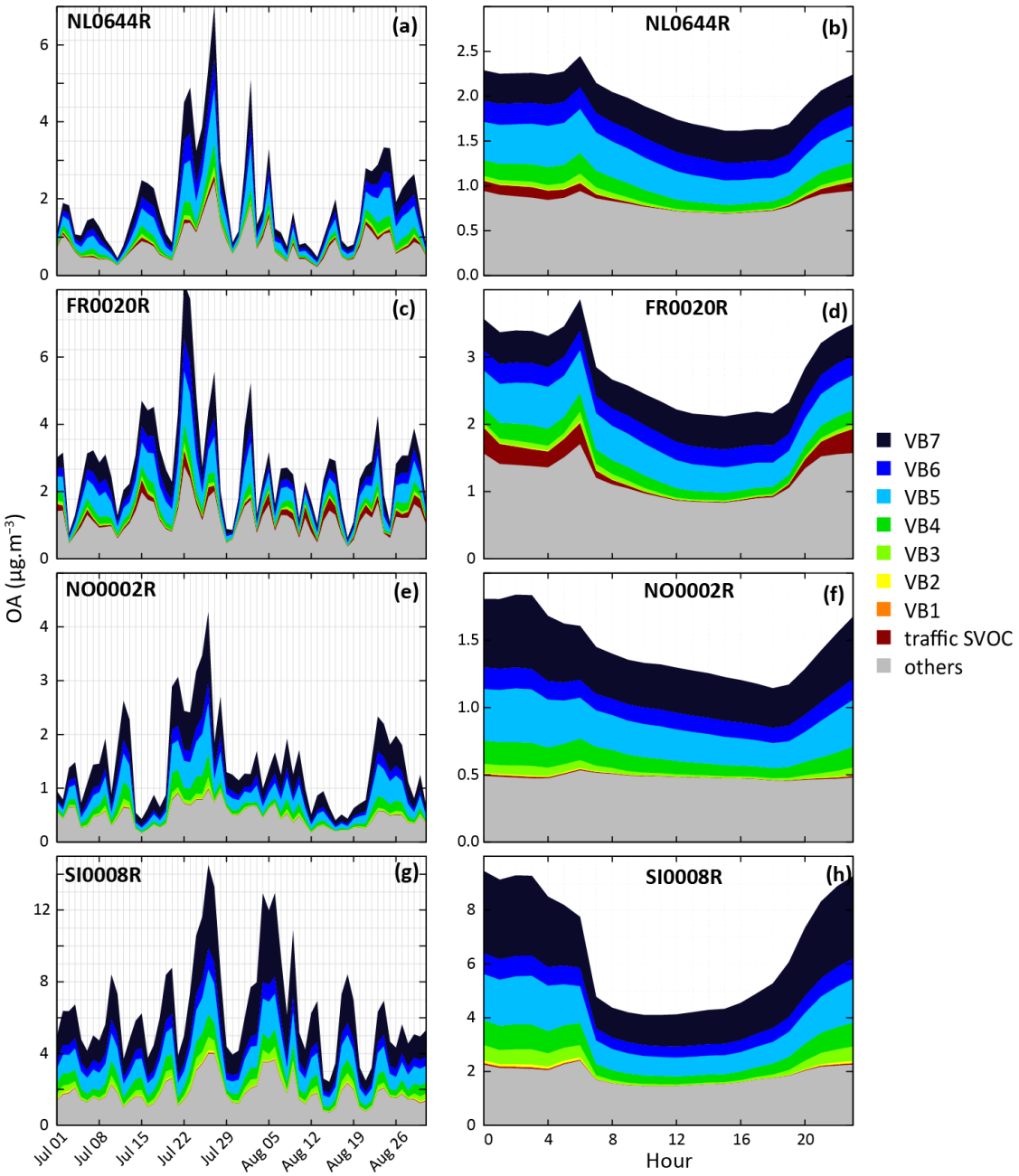

Figure S2 – Evolution of simulated OA concentrations and distribution function of volatility bins with the $IVOC_{30VOC}$ model configuration (from the less volatile one VB7, to the more volatile VB1). Panels b, d, f and h present mean daily profiles. Results are shown at two stations influenced by anthropogenic sources in Netherland (NL0644R, a and b) and in France (FR0020R, c and d) and at two stations influenced by biogenic sources in Norway (NL0002R, e and f) and Slovenia (SI0008R, g and h). "Traffic SVOC" includes C_{14} to C_{26} emitted VBS-GECKO alkanes and alkenes and "others" includes all species from H^2O mechanism.

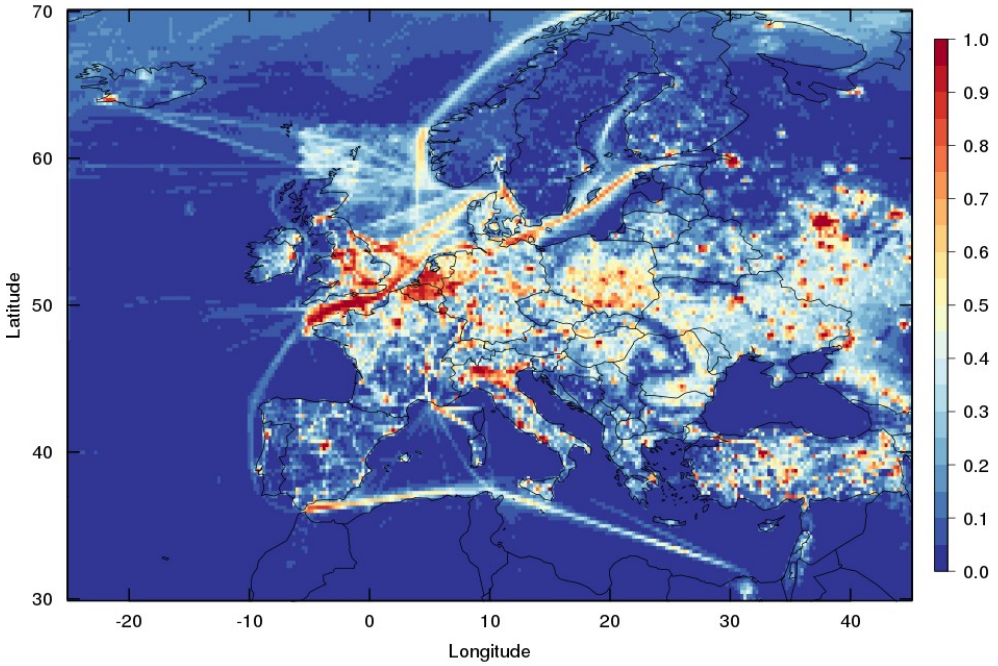

Figure S3 – Mean RRR over Europe during the two-month period for the ref-VBS-GECKO model configuration.