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Solar “brightening” impact on summer surface ozone between 1990 and 2010 in Europe – a model sensitivity study of the influence of the aerosol–radiation interactions

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Table S1. Dry extinction efficiencies and single-scattering albedos at 350 nm used in CAMx (Takemura et al., 2002; RAMBOLL-ENVIRON, 2016).

Species	**Dry extinction efficiency (m^2 μg^{-1})**	**Single-Scattering Albedo (SSA)**
$SO_4^{2-}, NH_4^+, NO_3^-$	$7 \cdot 10^{-6}$	0.99
POA, SOA	$7 \cdot 10^{-6}$	0.80
EC	$18 \cdot 10^{-6}$	0.25
FPRM, CPRM, FCRS, CCRS	$0.4 \cdot 10^{-6}$	0.70
NaCl	$1.5 \cdot 10^{-6}$	0.99

Table S2: Overview of solar radiation measurement stations from the BSRN network used for the model evaluation.

Site	**Longitude (deg)**	**Latitude (deg)**	**Elevation (m asl)**
Cabauw	4.93 E	51.97 N	0
Carpentras	5.06 E	44.08 N	100
Cener	1.60 W	42.82 N	471
Lindenberg	14.12 E	52.21 N	125
Palaiseau	2.21 E	48.71 N	156
Payerne	6.94 E	46.82 N	491
Toravere	26.46 E	58.25 N	70

Table S3: Overview of measurement stations used in the PM trend analysis.

Site	Type	Longitude (deg)	Latitude (deg)	Elevation (m asl)
Basel-Binningen (CH)	Background suburban	7.58 E	47.54 N	316
Payerne (CH)	Background rural	6.94 E	46.81 N	489
Zürich-Kaserne (CH)	Background urban	8.53 E	47.38 N	409
Den Haag-Rebecquestraat (NL)	Background urban	4.29 E	52.08 N	2
Vredepeel-Vredeweg (NL)	Background rural	5.85 E	51.54 N	28
Wieringerwerf-Medemblikkerweg (NL)	Background rural	5.05 E	52.80 N	-4

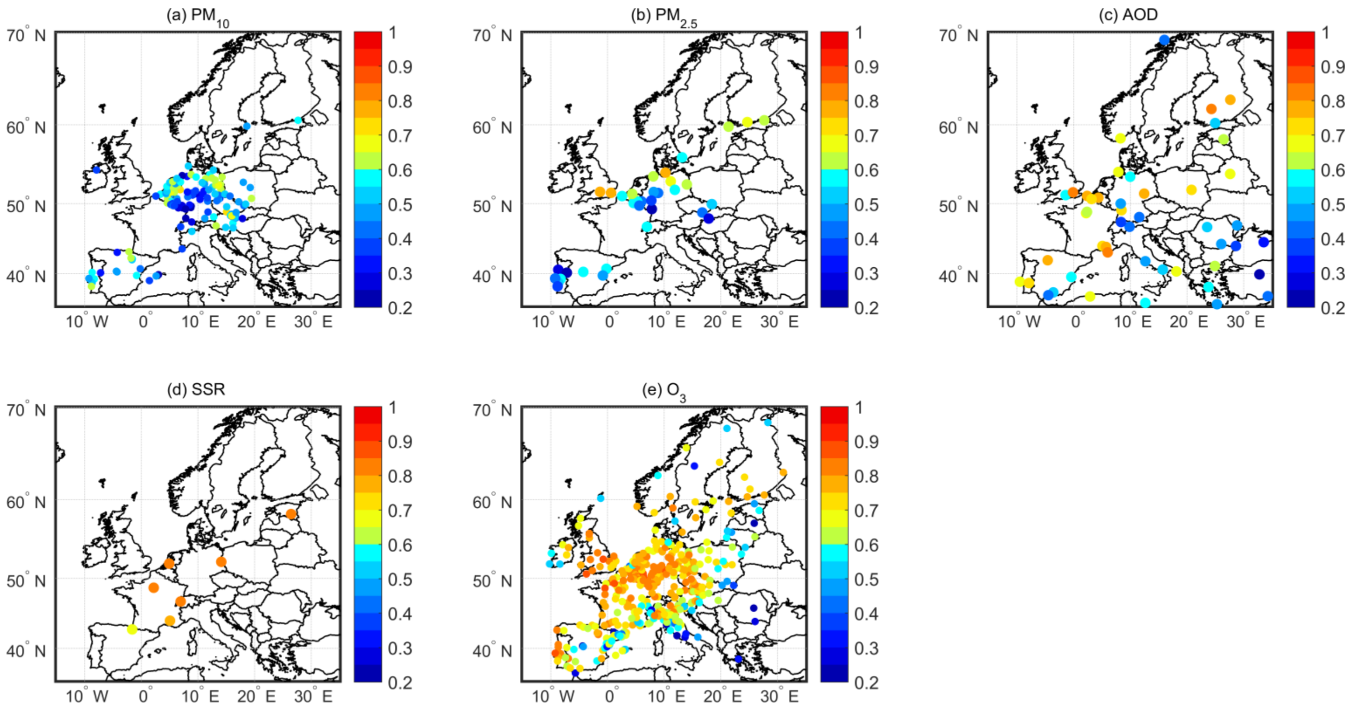

Figure S1. Correlation coefficient (*r*) between model and observations for daily average a) surface PM_{10} concentrations, b) surface $PM_{2.5}$ concentrations, c) AOD, d) SSR, and e) surface O_3 concentrations, for the BASE scenario in summer 2010. The definition of *r* is given in Table 3.

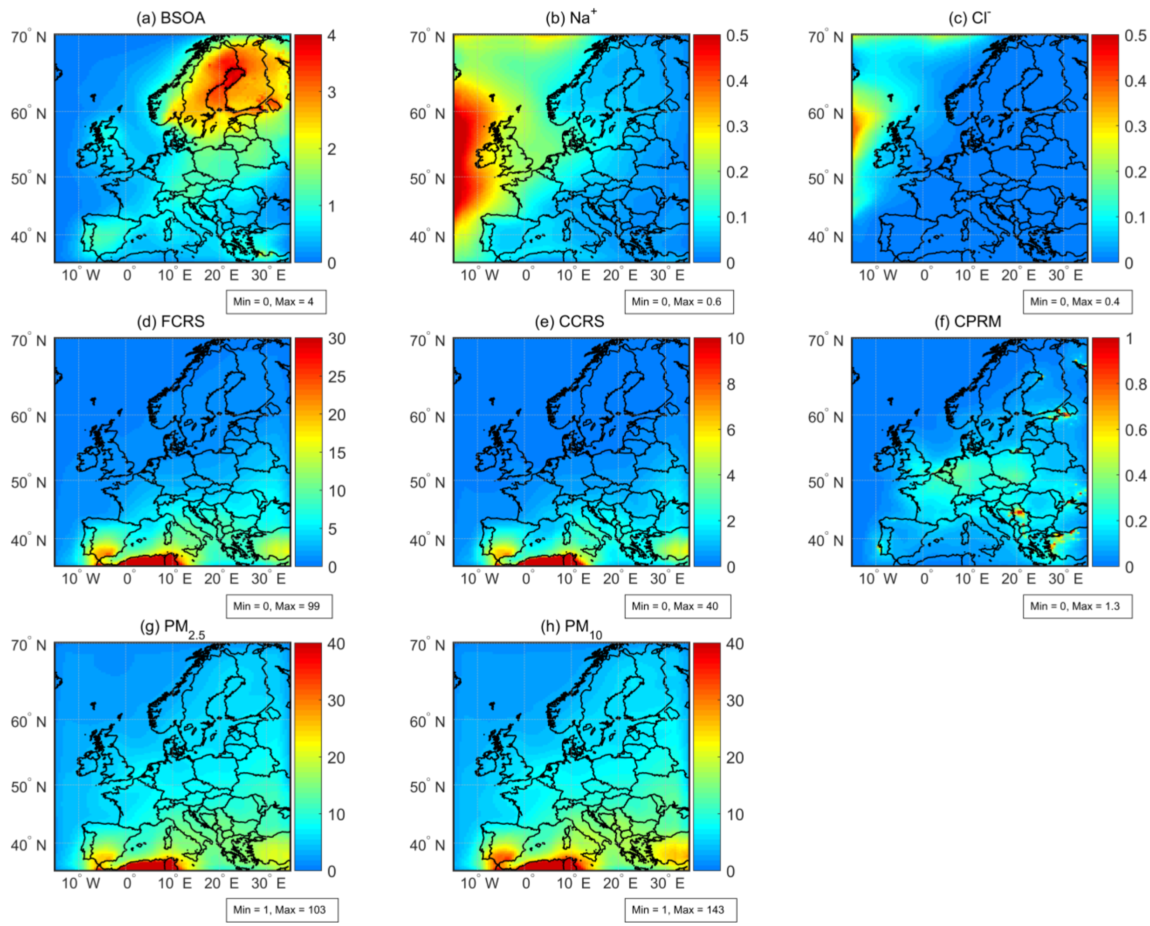

Figure S2. Seasonal daytime (10:00–18:00 LMT) mean concentrations (µg m^{-3}) of (a) biogenic secondary organic aerosol (BSOA), (b) sodium (Na^{+}), (c) chloride (Cl^{-}), (d) fine crustal aerosols (FCRS), (e) coarse crustal aerosol (CCRS), (f) coarse other primary aerosols (CPRM), (g) $PM_{2.5}$ and (h) PM_{10}, for the BASE scenario in summer 2010.

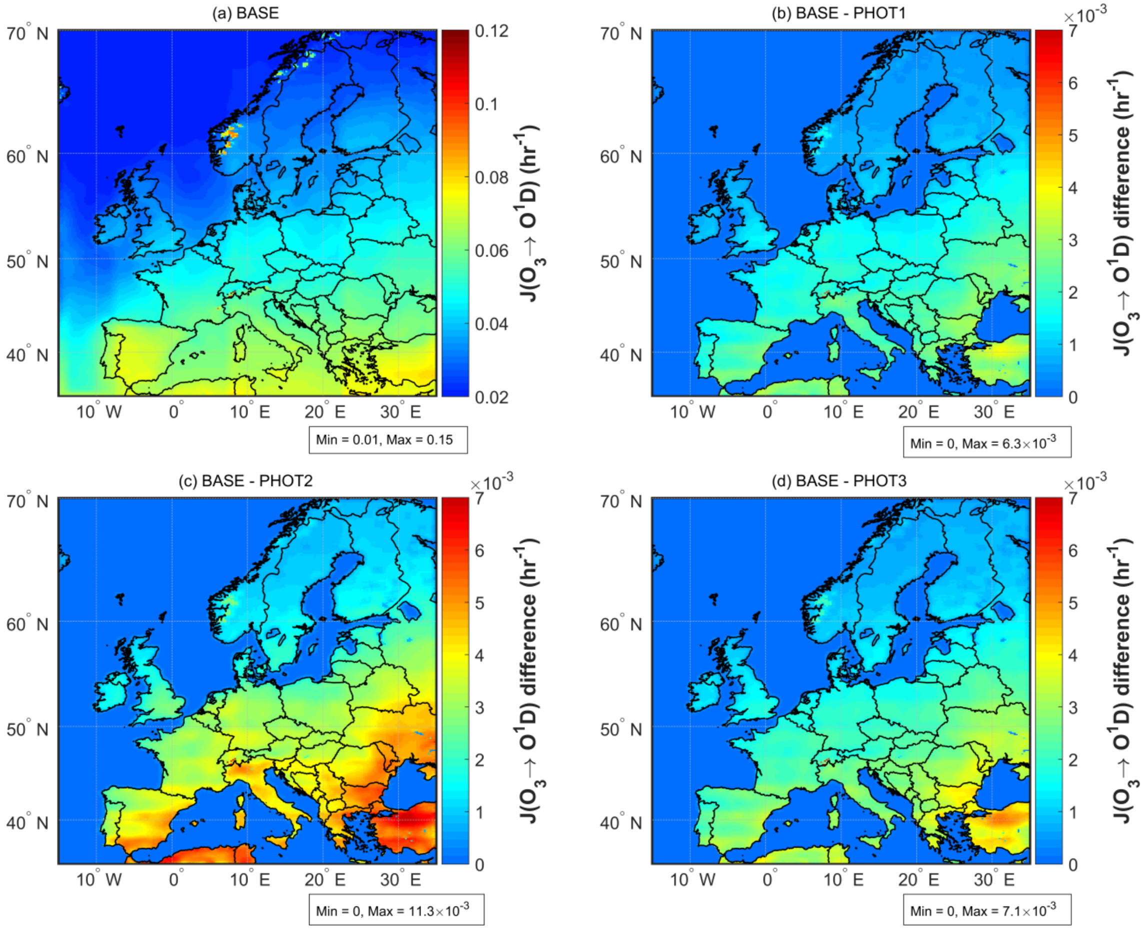

Figure S3. Seasonal daytime (10:00–18:00 LMT) mean $J(O_3 \rightarrow O^1D)$ at ground level for the BASE scenario (a) and $J(O_3 \rightarrow O^1D)$ differences between the BASE scenario and PHOT1, PHOT2 and PHOT3 scenarios (b-d), respectively, in summer 2010. Note the different color scale between panel (a) and panels (b-d).

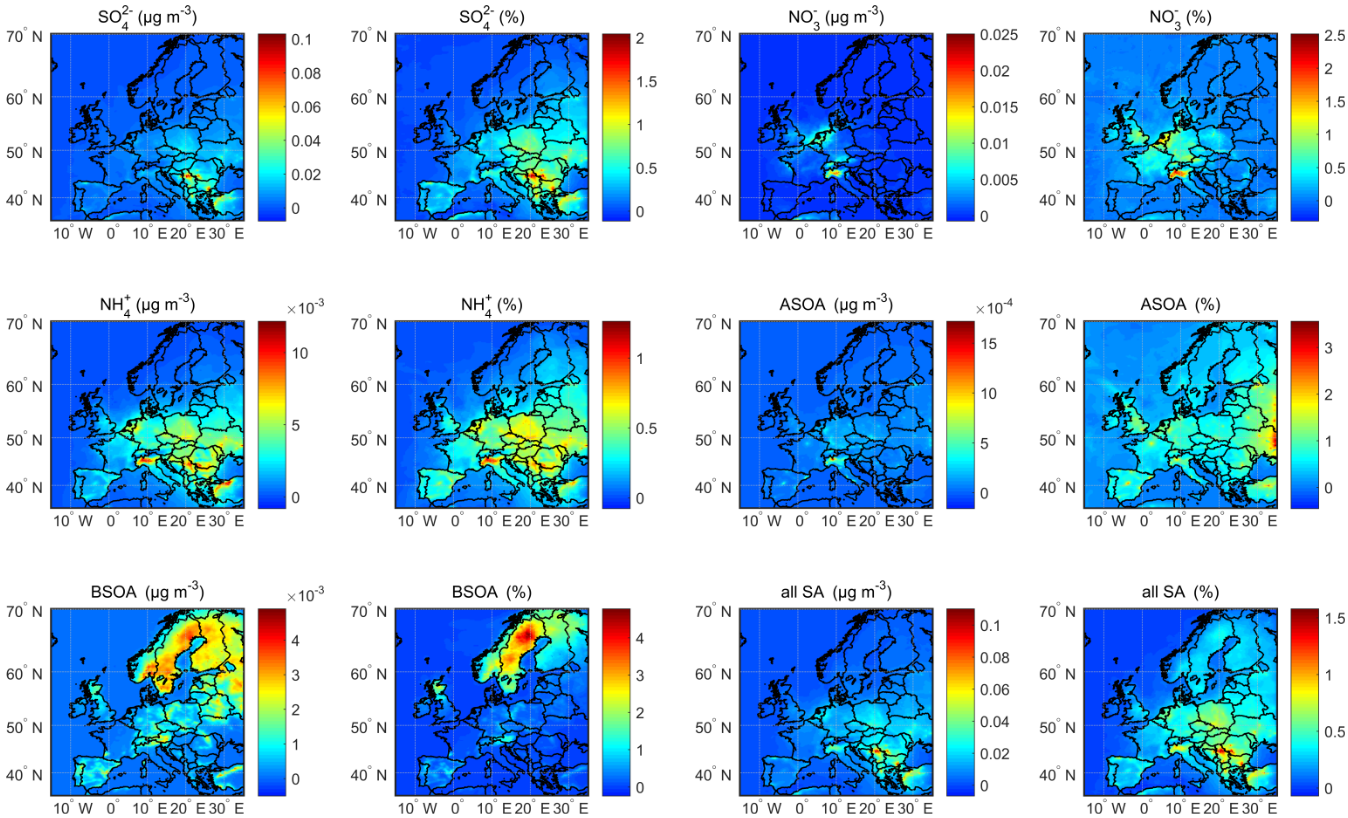

Figure S4. Seasonal daytime (10:00–18:00 LMT) mean differences for all secondary aerosol (SA) species between the BASE scenario and PHOT1 scenario in summer 2010. The PM species that are illustrated are: sulfate (SO_4^{2-}), ammonium (NH_4^+), nitrate (NO_3^-) and anthropogenic and biogenic secondary organic aerosols (ASOA and BSOA respectively), as well as the total secondary aerosol (all SA).

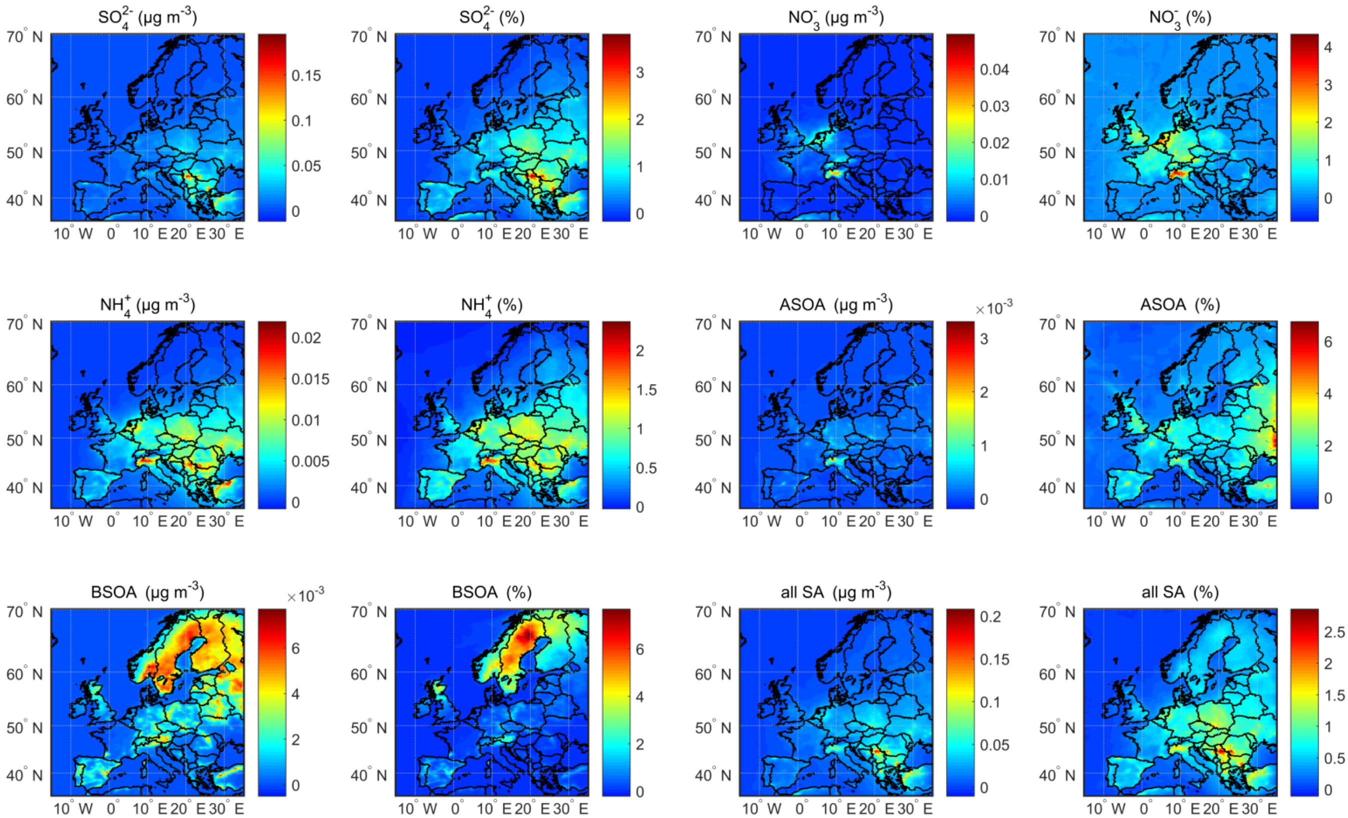

Figure S5. Seasonal daytime (10:00–18:00 LMT) mean differences for all secondary aerosol (SA) species between the BASE scenario and PHOT2 scenario in summer 2010. The PM species that are illustrated are: sulfate (SO_4^{2-}), ammonium (NH_4^+), nitrate (NO_3^-) and anthropogenic and biogenic secondary organic aerosols (ASOA and BSOA respectively), as well as the total secondary aerosol (all SA).

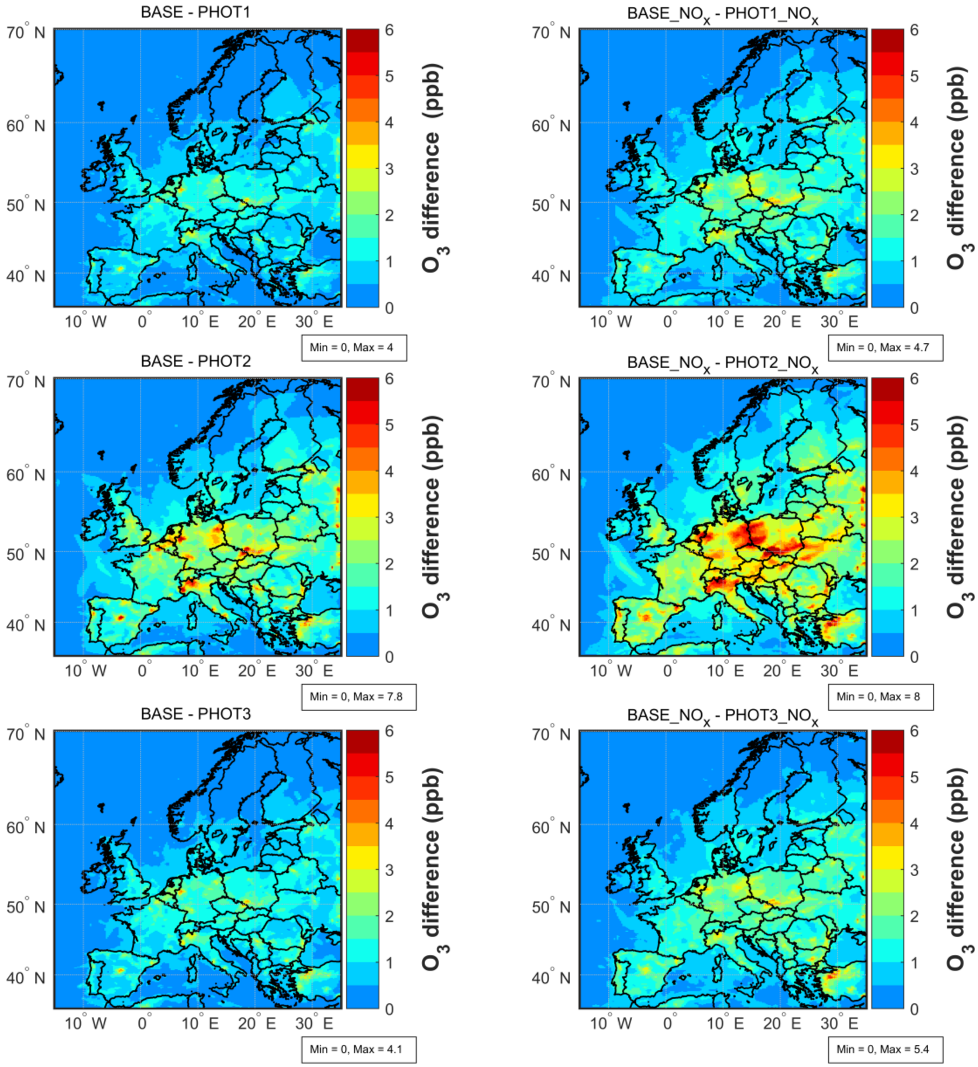

Figure S6. Largest hourly difference in O_3 mixing ratios between the BASE and PHOT1, PHOT2, PHOT3 scenarios (left panels) as well as between the BASE_NO$_x$ and PHOT1_NO$_x$, PHOT2_NO$_x$, PHOT3_NO$_x$ scenarios (right panels), in summer 2010.

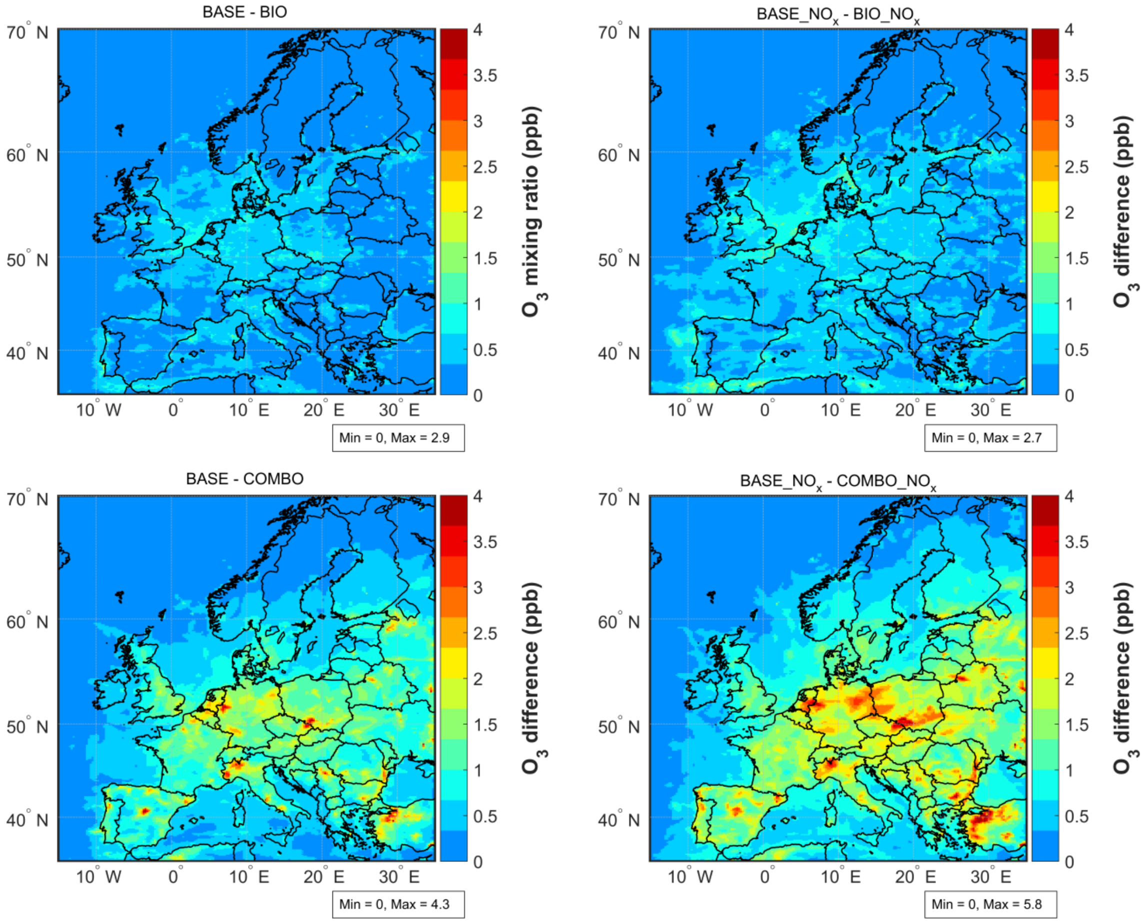

Figure S7. Largest hourly difference in O_3 mixing ratios between the BASE and BIO, COMBO scenarios (left panels) as well as between the BASE_NO_x and BIO_NO_x, COMBO_NO_x scenarios (right panels), in summer 2010.