



Supplement of

Sensitivity of tropospheric loads and lifetimes of short lived pollutants to fire emissions

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S1 List of non methane volatile organic carbon compounds (NMVOC) taken into account in the emission database

NMVOC speciation in anthropogenic emissions considered in this study:

- Acetone (C_3H_6O)
- Acetylene (C₂H₂)
- Ethylene (C_2H_4)
- Ethane (C_2H_6)
- Propane (C₃H₈)
- Formaldehyde (CH₂O)
- Acetaldehyde (CH₃CHO)
- Benzene (C₆H₆)
- Toluene (C₇H₈)
- Xylene (C_8H_{10})
- Propene (C₃H₆)
- Butane (C₄H₁₀)
- Methanol (CH₃OH)
- Methyl-ethyl-ketone (CH₃C(O)CH₂CH₃)
- Formic acid (HCOOH)
- Acetic acid (CH₃COOH)

NMVOC speciation in biomass burning emissions considered in this study:

- Acetone (C₃H₆O)
- Acetylene (C₂H₂)
- Ethylene (C_2H_4)
- Ethane (C₂H₆)
- Propane (C₃H₈)
- Formaldehyde (CH₂O)
- Acetaldehyde (CH₃CHO)
- Dimethyl sulfide ((CH₃)₂S)
- Glyoxal (CHOCHO)
- Propene (C₃H₆)
- Butane (C₄H₁₀)
- Methanol (CH₃OH)
- Methyl-ethyl-ketone (CH₃C(O)CH₂CH₃)
- Toluene (C₇H₈)
- Xylene (C₈H₁₀)
- Benzene (C₆H₆)
- Formic acid (HCOOH)
- Acetic acid (CH₃COOH)



Fig. S 1 Locations of measurements used for comparison with model results. The measured pollutant and the number of measuring stations are provided in the title of each panel.



Fig. S 2 Spatial distribution of annual mean BC emissions (kgBC \cdot m⁻²s⁻¹ as provided by the a) ECLIPSE, b) FINN and c) ACCMIP inventories



Fig. S 3 Distribution of the calculated annual mean tropospheric load of selected species (provided in the title of each panel) for the base case scenario of the model (S0.0). Areas with black indicate that the maximum value is out of the colorbar. Units are kg m⁻².



Fig. S 4 Percent difference of the computed annual mean tropospheric load of BC for the different emission scenarios from the base case. The scenarios are explained in Table 4 of the manuscript. The numbers below the colorbar are the minimum and maximum percent differences for the $3^{\circ}x2^{\circ}$ tropospheric columns.



Fig. S 5 Percent differences of the computed tropospheric loads of BC (a), SO_4^{2-} (b), NO_3^{-} (c), HNO_3 (d), NH_4^+ (e) attributed to wild fire emissions (calculated as (S4.0-S0.0)/S0.0 x 100). The scales are from -90% to 90%; minimum and maximum differences for the 3°x2° tropospheric columns are printed under each panel.



Fig. S 6 Scatter plot of daily mean model results for simulations SX.0 using ACCMIP, FINN, GFEDV3 and GFEDV3_ECLIPSE biomass burning emissions against ozonesondes. For these comparisons both observations and model results have been interpolated to 50hPa pressure intervals as explained in the text.



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Fig. S 7. Comparisons of simulated CO (left column) and O_3 (right column) against TES observations in the region between 800-400 hPa for all grid boxes with available observations. Comparison is made on daily mean basis. Details are provided in text and in Myriokefalitakis et al. (in preparation).



Fig. S 8 Distribution of percent difference of computed annual mean tropospheric loads of CO (a), O_3 (b), NH_4^+ (c), NO_3^- (d), HNO_3 (e), and isoprene (f) attributed to wild fire emission height injection, calculated as (S0.1-S0.0)/S0.0x100. The scale is from -30% to 30%; minimum and maximum differences in the 3°x2° model columns are printed under each panel's colorbar.



Fig. S 9 Spatial distribution of percent difference of computed tropospheric lifetimes of CO (a), O_3 (b), NH_4^+ (c), NO_3^- (d), HNO_3 (e), and isoprene (f) attributed to wild fire emission height injection, calculated as (S0.1-S0.0)/S0.0x100. The scale is from -30% to 30%; minimum and maximum differences in the 3°x2° model columns, as well as global mean tropospheric lifetime for each pollutant calculated for the base case simulation (S0.0) are printed under each panel's colorbar.



Fig. S 10 Spatial distribution of percentage differences of the computed annual mean tropospheric loads of OC for the different emission databases (see Table 4) from the base case (S0.0). Minimum and maximum differences in the 3°x2° model columns are printed under each panel's colorbar.



Fig. S 11 Spatial distribution of annual mean percent changes in the aerosol yield from isoprene emissions as computed comparing simulations S4 and S0 ((S4-S0)/S0x100). The aerosol yield is calculated as the ratio of the annual mean tropospheric load of isoprene-SOA to the annual isoprene emissions.



Fig. S 12: (a) Tropospheric lifetime of NO_y due to deposition losses for the S0.0 simulation and (b) absolute difference in NO_y lifetime between S4.0 and S0.0, units are days.