

Supplement of
An Improved Representation of Fire Non-Methane Organic Gases (NMOGs) in Models:
Emissions to Reactivity

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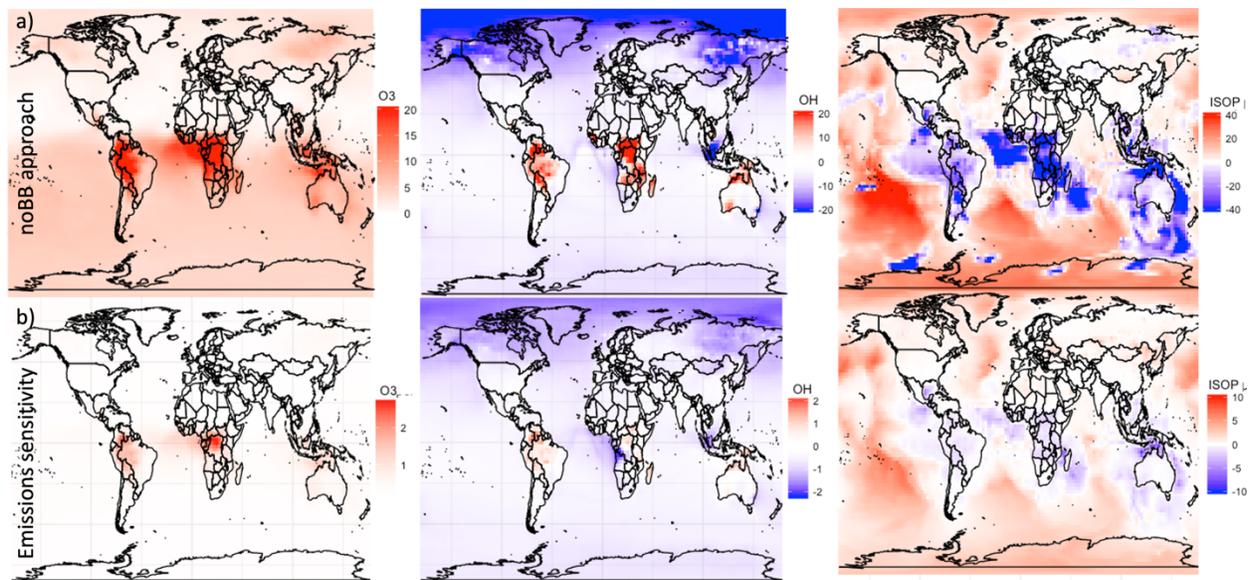


Fig S1: Annual 2019 surface mean ozone, OH, and ISOP (isoprene) concentration percent differences attributed to fires using two approaches a) subtracting out no fire simulation versus b) emissions sensitivity runs of 1.05 and 0.95 times fire emissions scaled up to equal an 100% perturbation

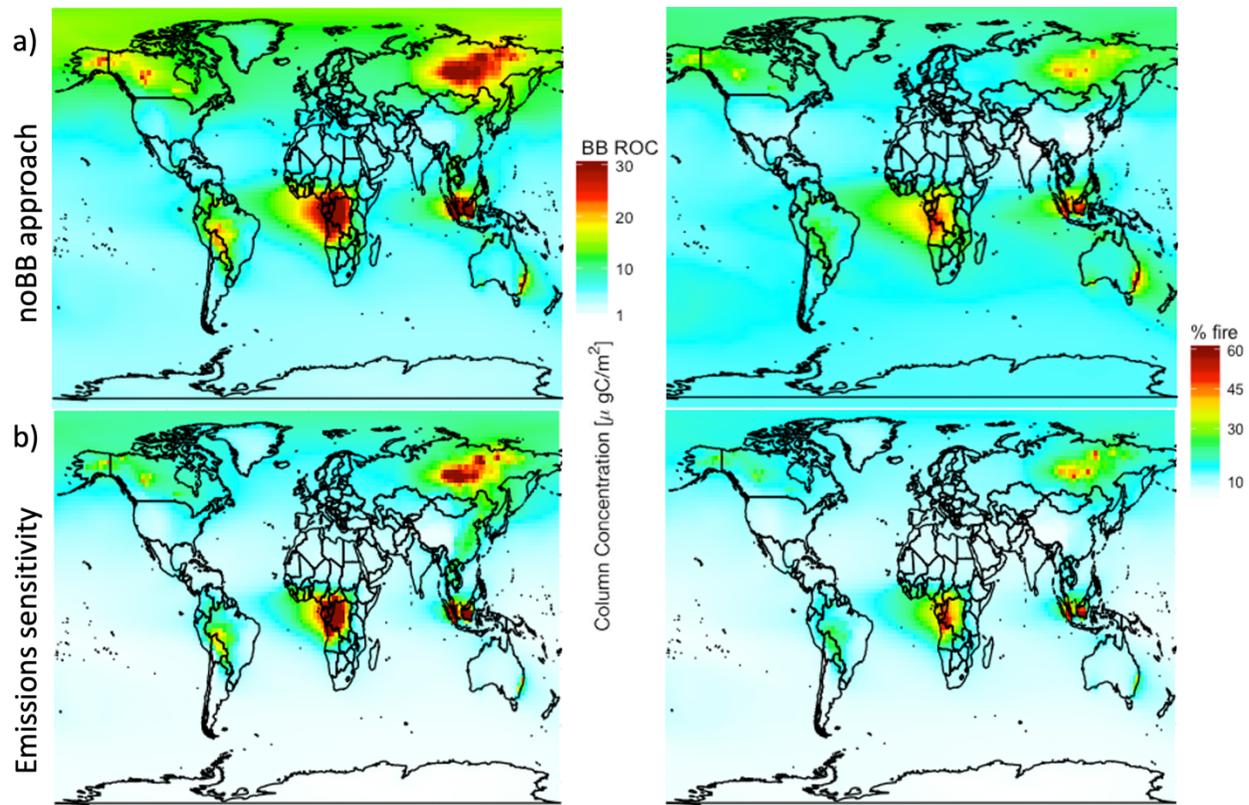


Fig S2: Annual 2019 mean simulated ROC column concentrations and percent ROC attributed to fires using two approaches a) subtracting out no fire simulation versus b) emissions sensitivity runs of 1.05 and 0.95 times fire emissions scaled up to equal an 100% perturbation

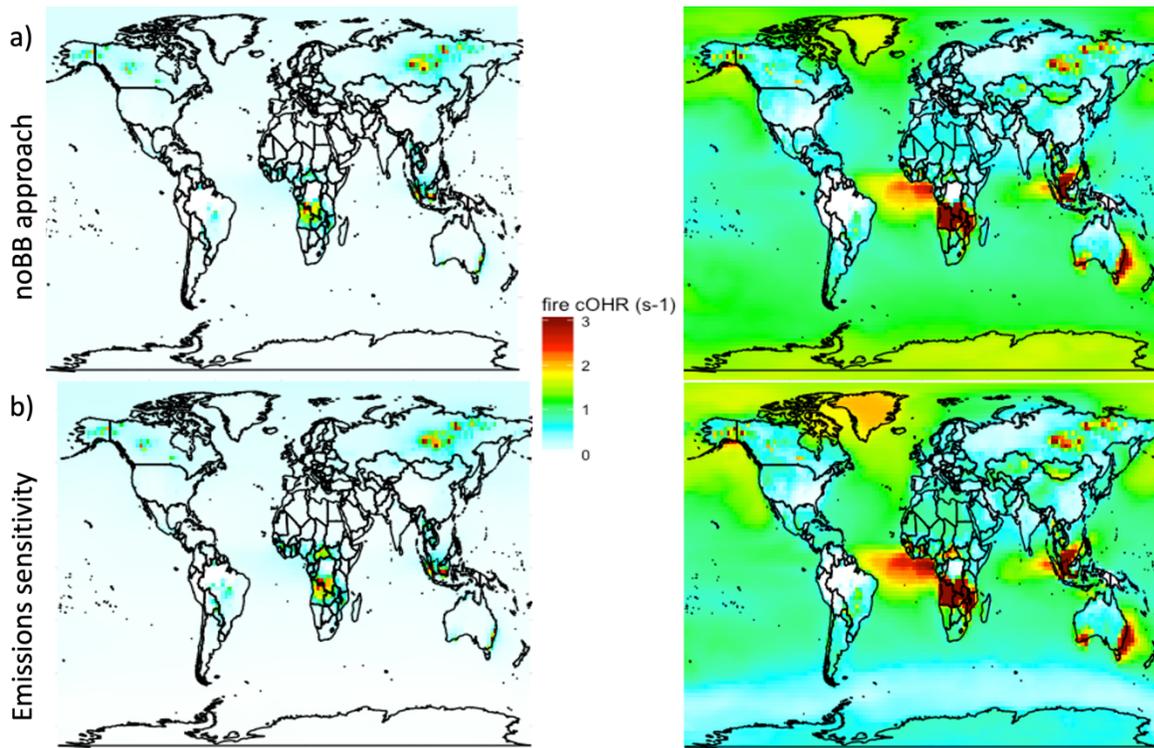
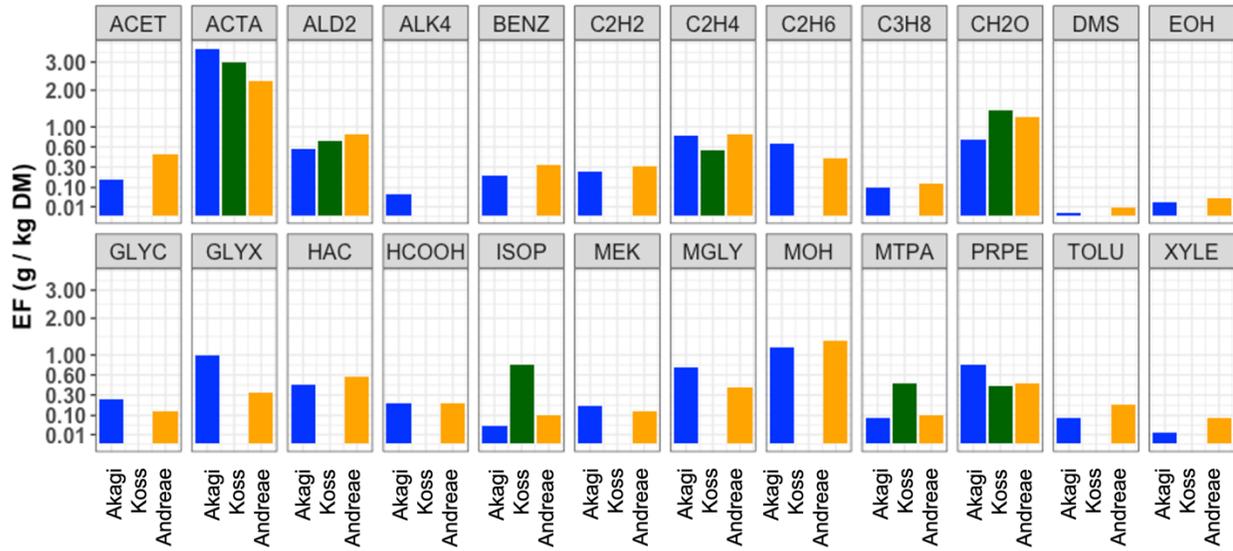
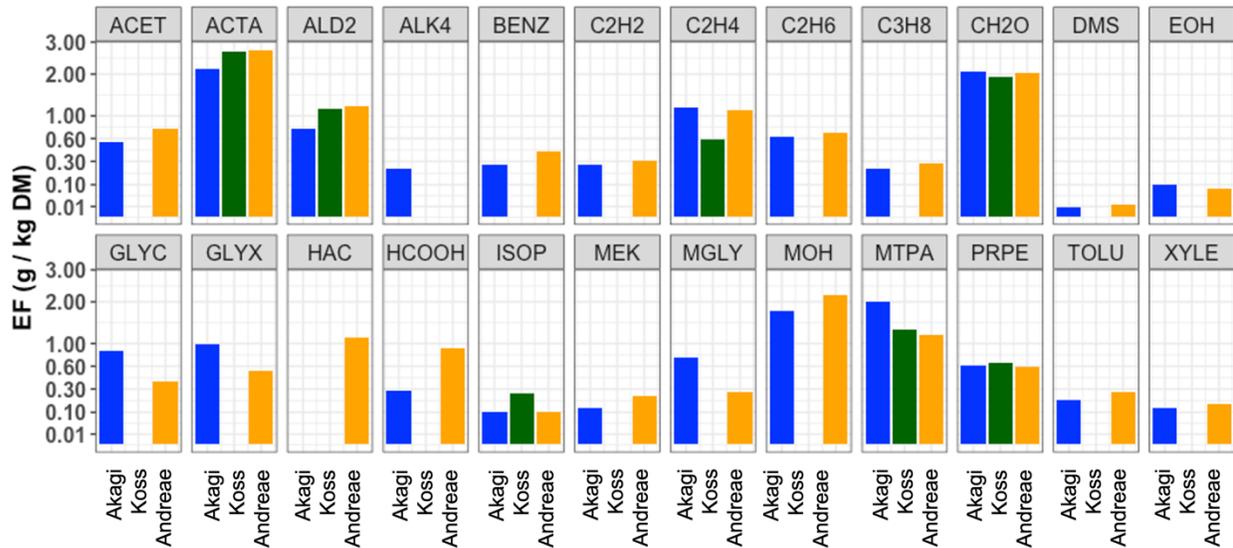


Fig S3: Annual 2019 mean surface OHR and percent OHR attributed to fires using two approaches a) subtracting out no fire simulation versus b) emissions sensitivity runs of 1.05 and 0.95 times fire emissions scaled up to equal an 100% perturbation

a) Savanna, grassland, shrub



b) Temperate forest



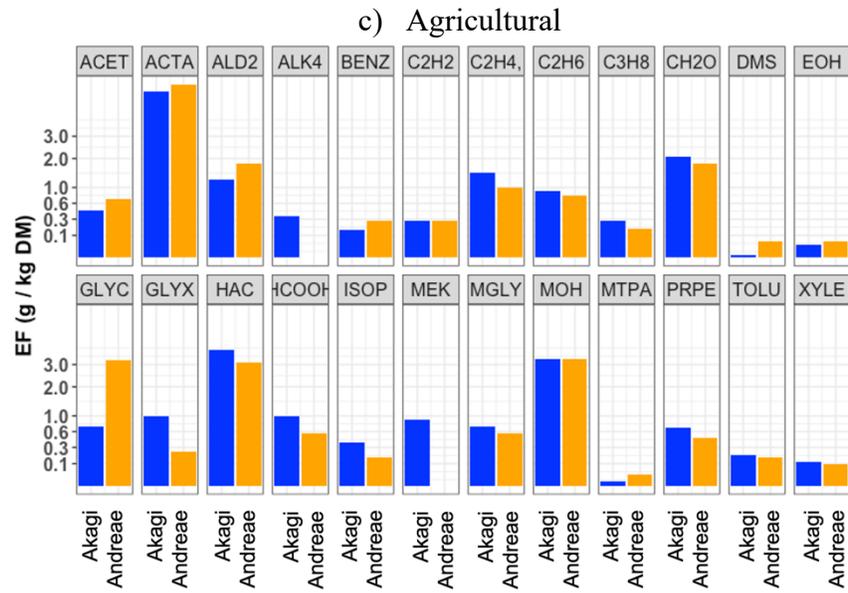


Fig S4: Emission factors of common NMOGs from the Akagi et al. (2011) in dark blue, Koss et al. (2018) in green, and Andreae 2019 paper in orange for a) savanna, grassland, shrub fuel types, b) temperate forests, and c) agricultural fires

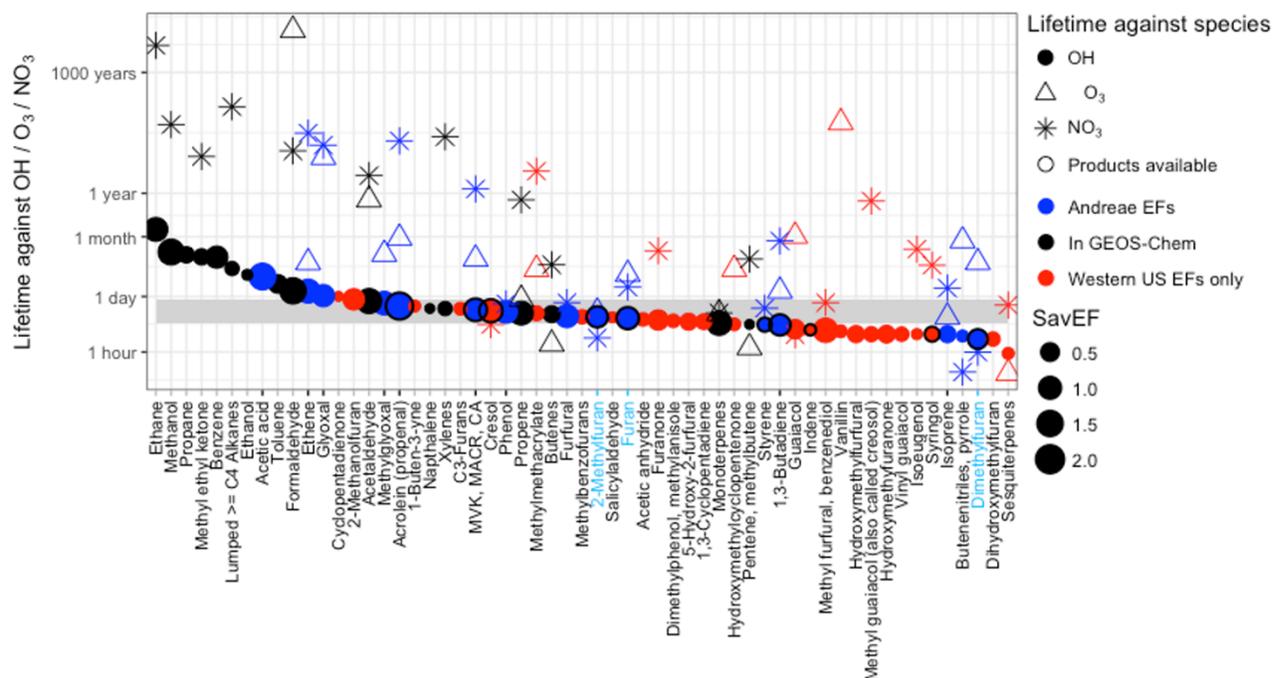


Fig S5: Following Coggon et al. (2019), the species responsible for 95% of OHR in addition to species already represented as emitted from fires in GFED4s in GEOS-Chem are plotted in descending order of their lifetime against OH, NO₃, and O₃. Those already in GEOS-Chem are in black, species not yet in GEOS-Chem but where emissions factors were available in Andreae 2019 are in blue, and species that are only available for western US fuel types from Koss et al. (2018) are in red. The circles are sized by their relative savanna and grassland emission factor in g species / kg DM burned. The grey horizontal box represents an approximate physical lifetime against transport out of a nested 0.5° × 0.625° grid box (~5 hours) and a 2x2.5 grid box (~20 hours).

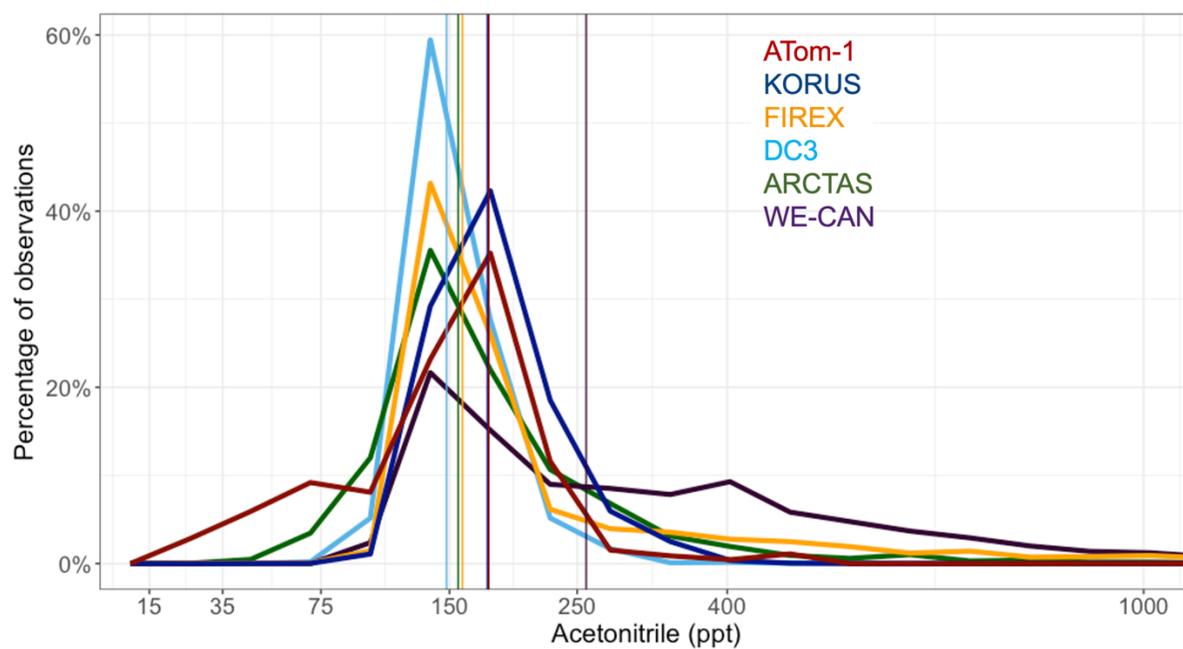


Figure S6: Percentage of observations by their acetonitrile concentrations for the first intensive of ATom from July to August 2016 (dark red), KORUS from April to June 2016 (dark blue), FIREX from July to September 2019 (orange), DC3 in May to June 2012 (light blue), ARCTAS in June to July 2008 (green), and WE-CAN in July to September 2018 (purple).

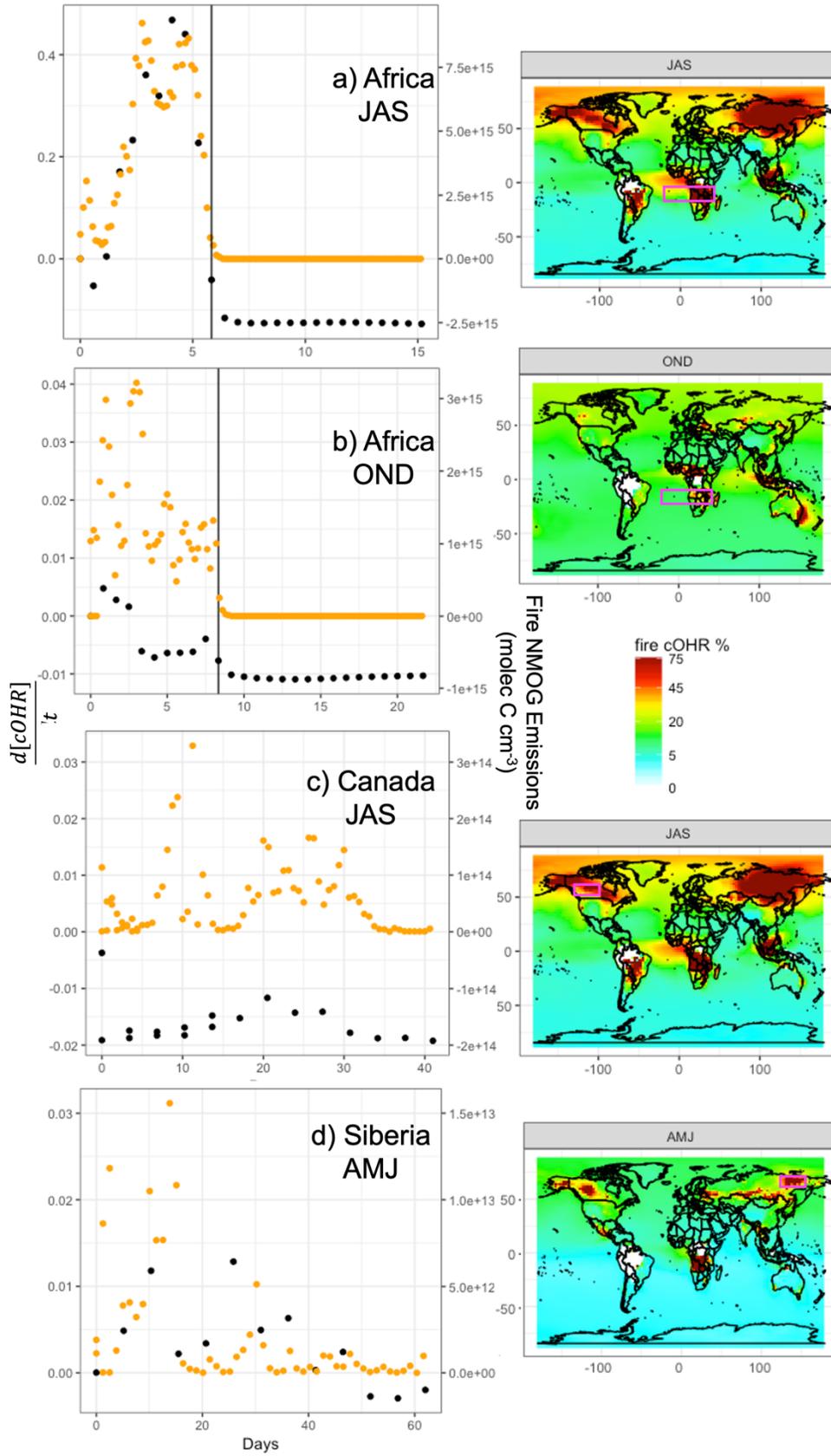


Figure S8: The simulated decay of cOHR (black) in outflow from fires in (a) Africa during July, August, September (JAS), (b) Africa during October, November, December (OND), (c) Canada in JAS, and (d) Siberia in April, May, June (AMJ). Distance is converted to time using zonal average wind speeds. Fire NMOG emissions are also plotted in orange. For the Africa plots, the approximate Atlantic coastline edge is indicated with a black vertical line. In the right column, we show the seasonal average contribution from fires to cOHR and box the regions of interest in magenta.