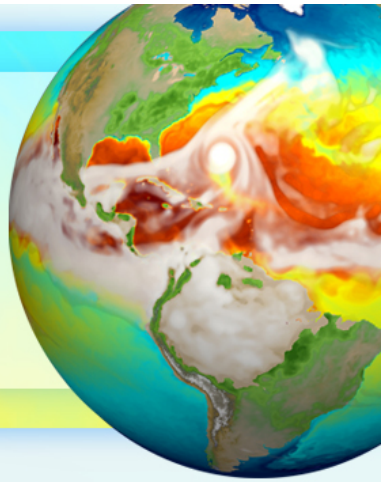

The Influence of Global Fire Emissions on Tropospheric Chemistry in the Energy Exascale Earth System Model (E3SM)

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EESM PI meeting, August 6, 2024

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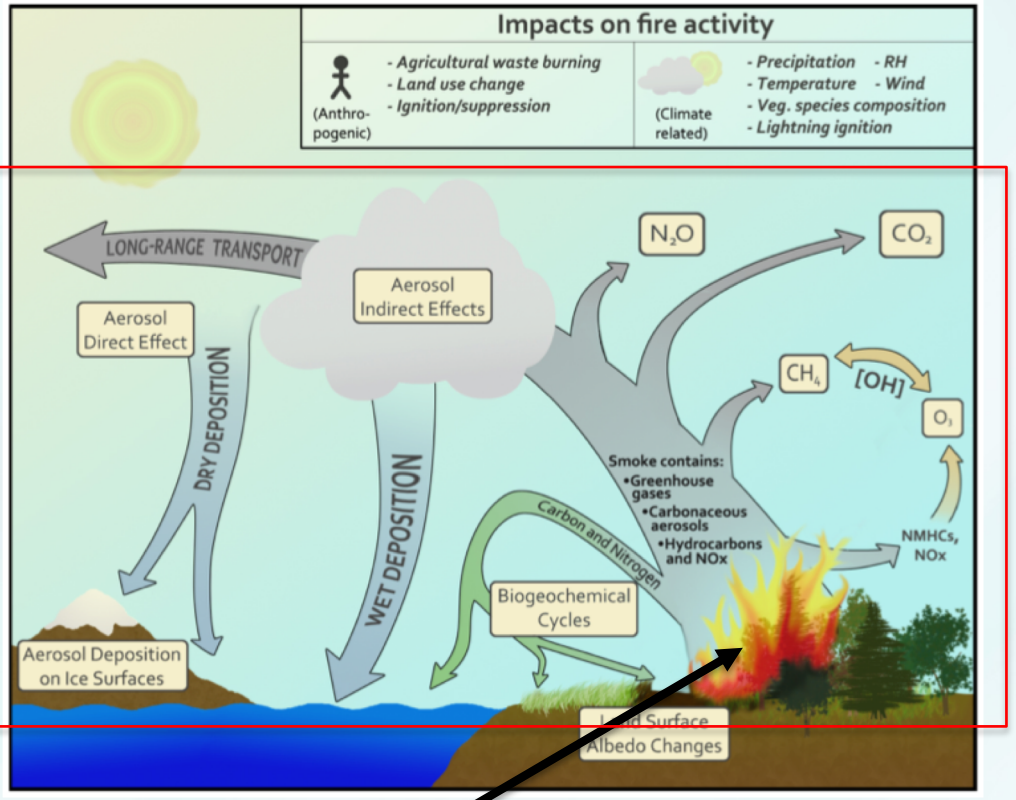
E3SM Energy Exascale Earth System Model

EARTH SYSTEM MODEL DEVELOPMENT ESMD

RUBISCO

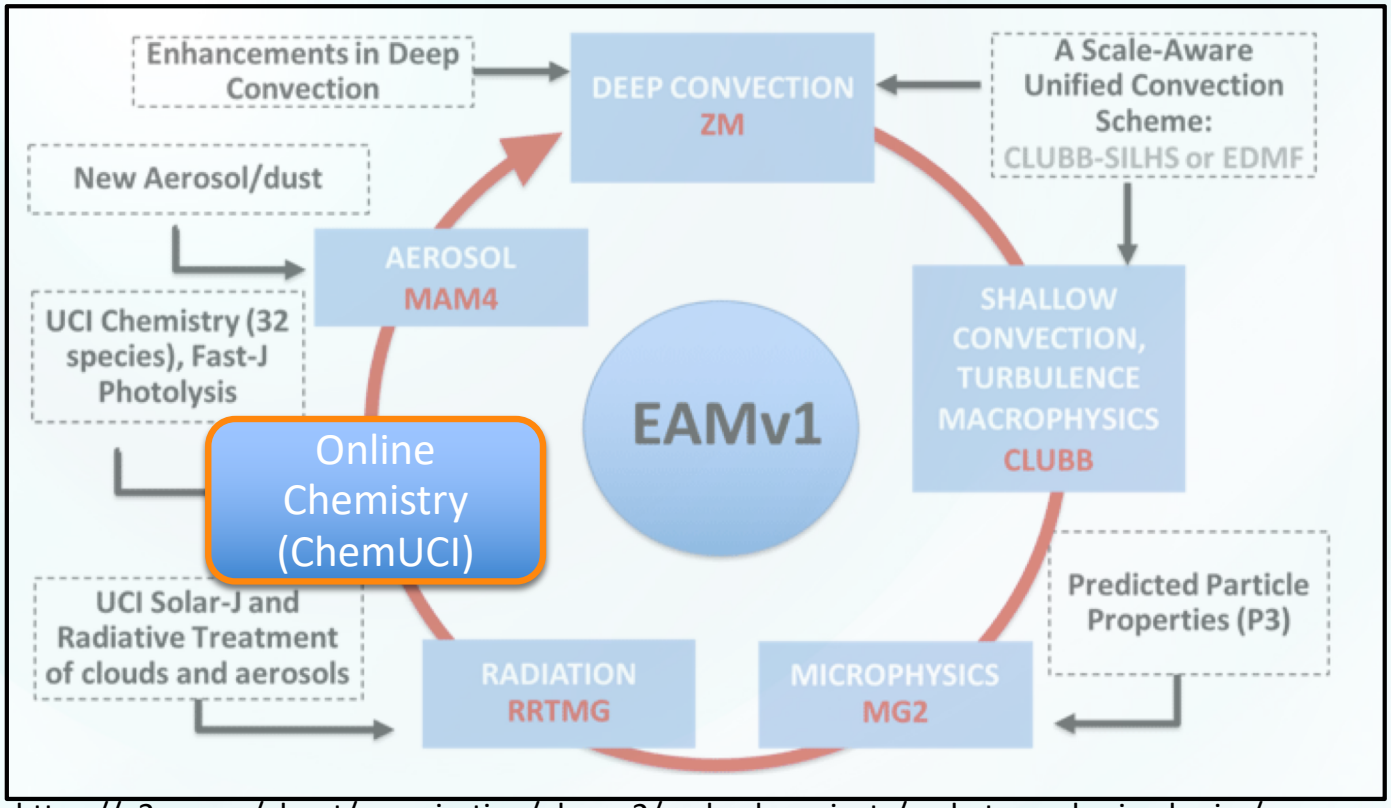
U.S. DEPARTMENT OF ENERGY

How do wildfires impact tropospheric chemistry?



Ward et al. (2012)

Numerical Experiments

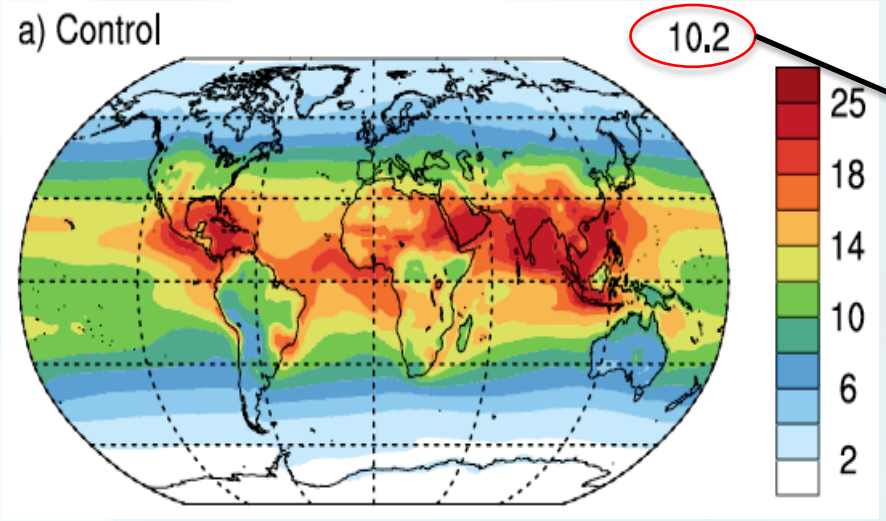


https://e3sm.org/about/organization/phase-2/ngd-sub-projects/ngd-atmospheric-physics/

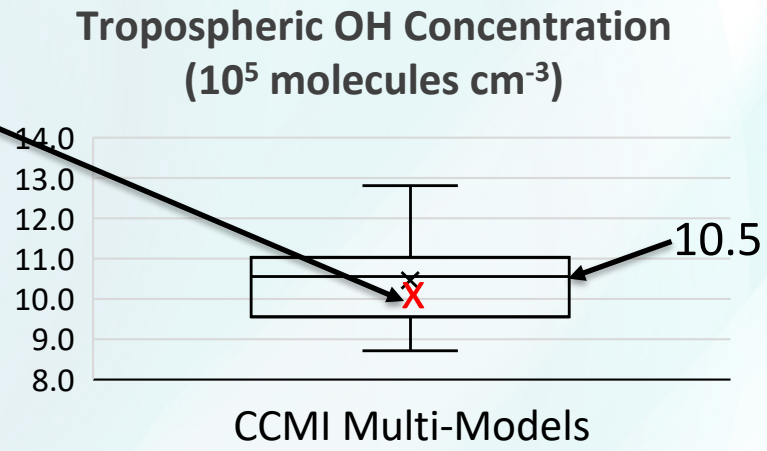
Experiment	Sources of trace gases and aerosols
Control	Non-fire sources + fire emissions from the GFED4s data
No fire	Non-fire sources

- Model: E3SMv2-ChemUCI
- Duration: 1997-2021

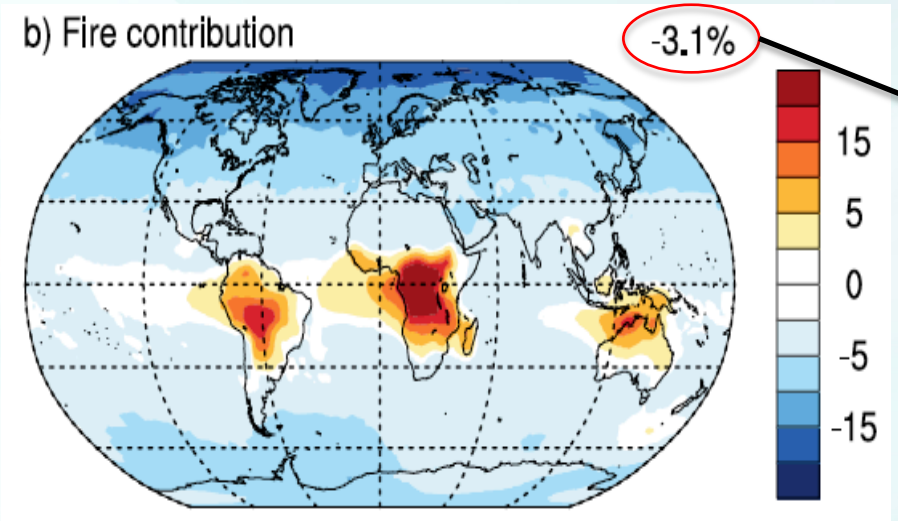
Decreases of tropospheric OH from wildfires suggest a significant CH_4 emission impact

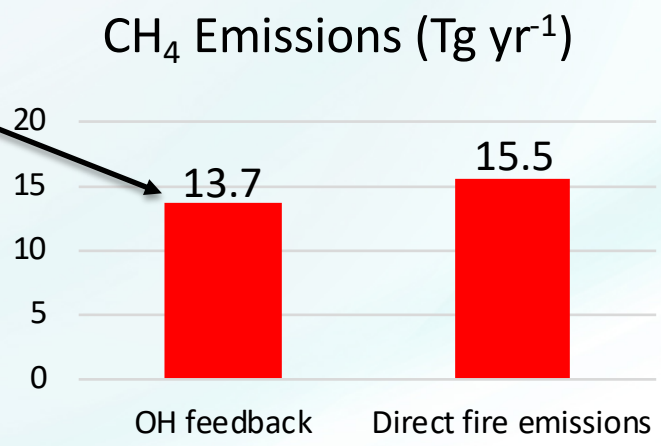


Units: 10^5 molecules cm^{-3}

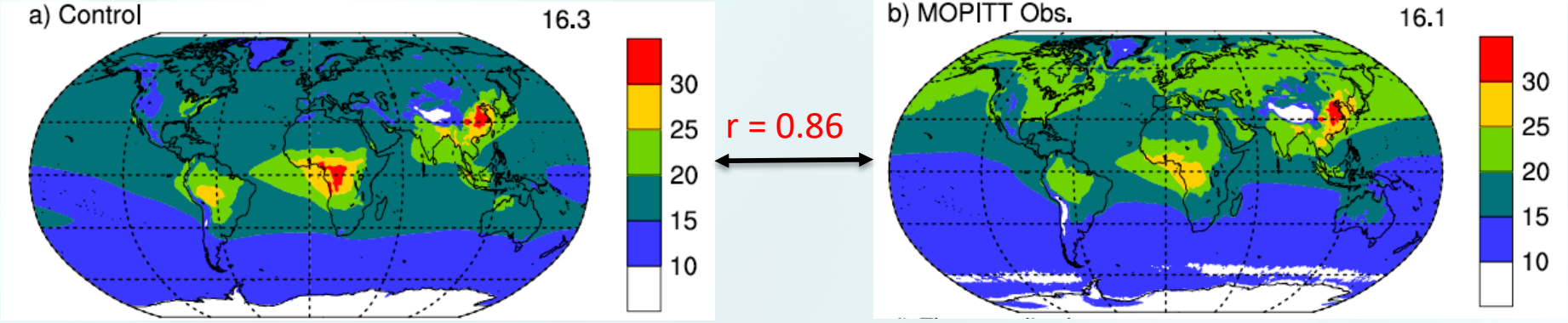


Zhao et al., 2019

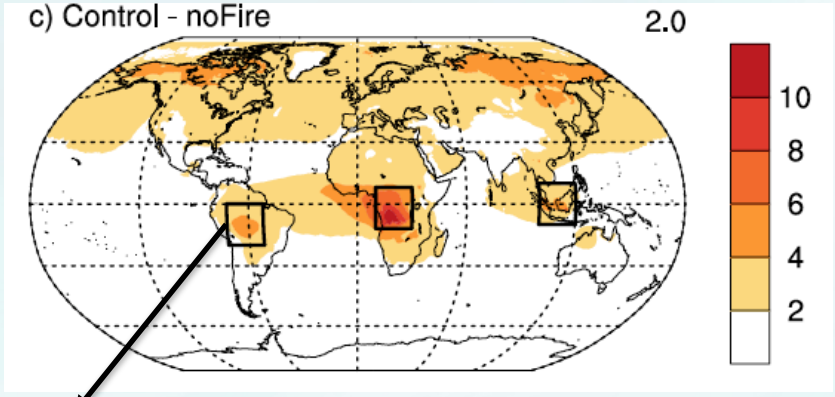


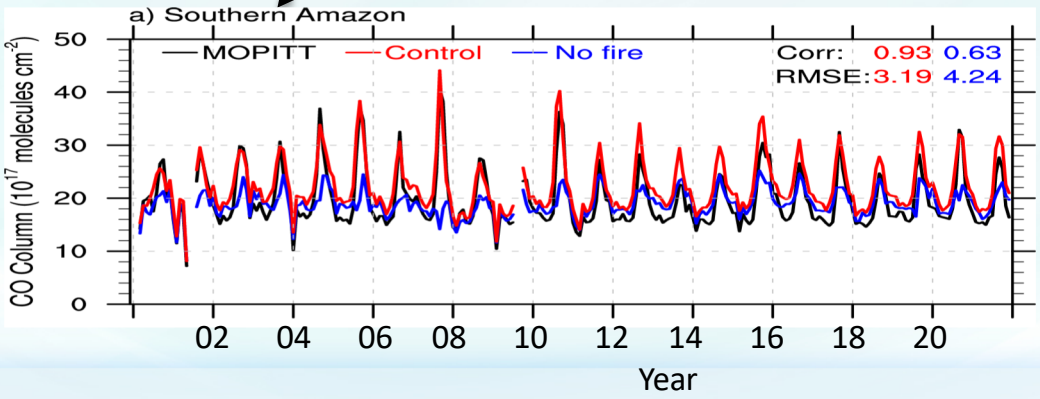


Wildfires considerably increase CO in the globe



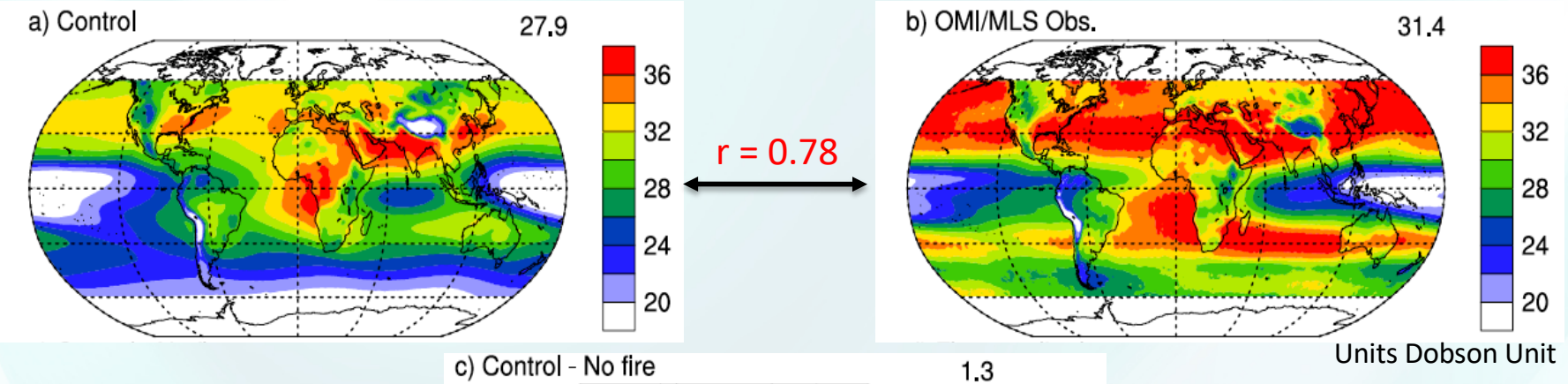
Units: 10^{17} molecules cm^{-2}

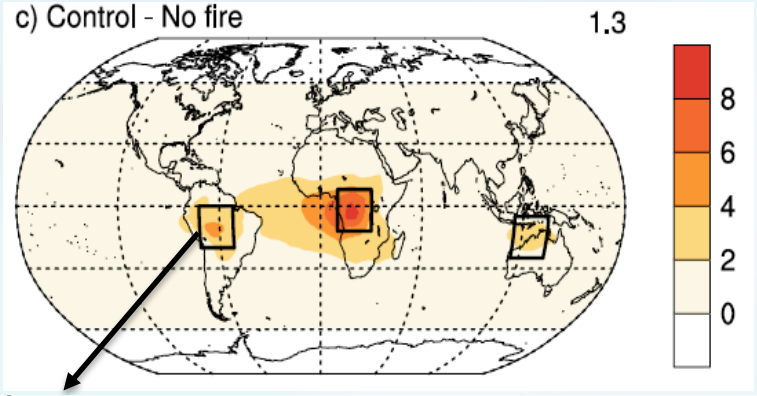


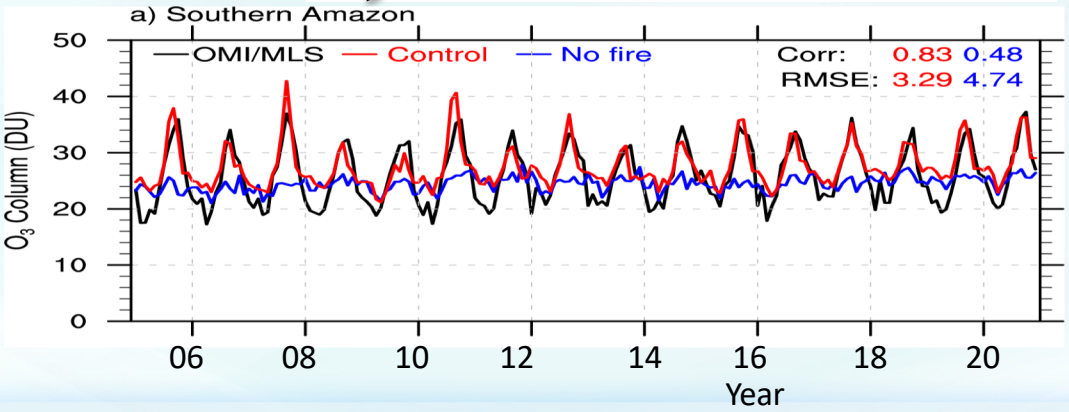


The control simulation explains 86% of the MOPITT column CO temporal variations in the southern Amazon.

Wildfires increase O_3 worldwide







The control simulation explains 70% of the OMI/MLS column O_3 temporal variations in the southern Amazon.

Summary

- E3SMv2-ChemUCI fully coupled model well simulates tropospheric key constituents compared with the satellite observations.
- The overall decreases of global average tropospheric OH from wildfires suggest a significant CH_4 emission impact.
- Wildfires increase CO and O_3 worldwide with largest enhancement in tropical regions.