Airborne Data Global Modeling Breakout / Tutorial

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Science questions that aircraft data might address

- Emissions – VOCs, NOx, NH_3, …
- Plume evolution – VOCs, reactive N, SOA, ozone formation
- Large-scale impact on oxidants
- CCN formation, cloud chemistry
- How does the inclusion/mixing of background air, or other sources impact plume chemistry?
- What is the interaction of a wildfire plume with urban emissions?
- When and where do the plumes mix down to surface?

- What information will the US campaigns provide that might benefit operational systems and global research?

Data Policies

- Although data is publicly available, acknowledge each PI for measurements used – co-authorship may be appropriate
- File headers have info about instrument, PI, etc.
- ”Merged” files combine all measurements into one file on same time, but headers of these files do not have all info of original, single PI files

NASA Aircraft data

NASA tropospheric chemistry archives

- https://www-air.larc.nasa.gov/index.html
- https://www-air.larc.nasa.gov/data.htm
- https://www-air.larc.nasa.gov/missions/merges/
- TAD: Toolsets for Airborne Data https://tad.larc.nasa.gov/index.php allows creation of custom merges (only desired variables); shows which compounds measured in which campaigns; but limited list of campaigns (ARCPAC, ARCTAS, CalNex, DISCOVER-AQ, INTEX-A,-B NEAQS-ITCT2004, TexAQS)

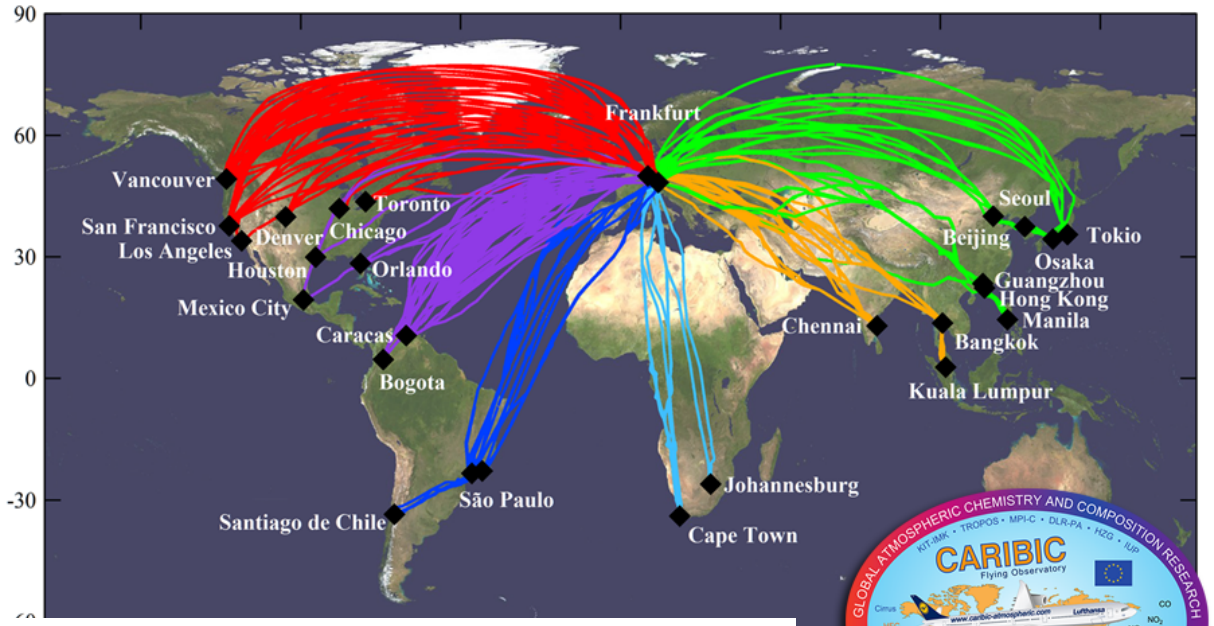
NOAA aircraft data

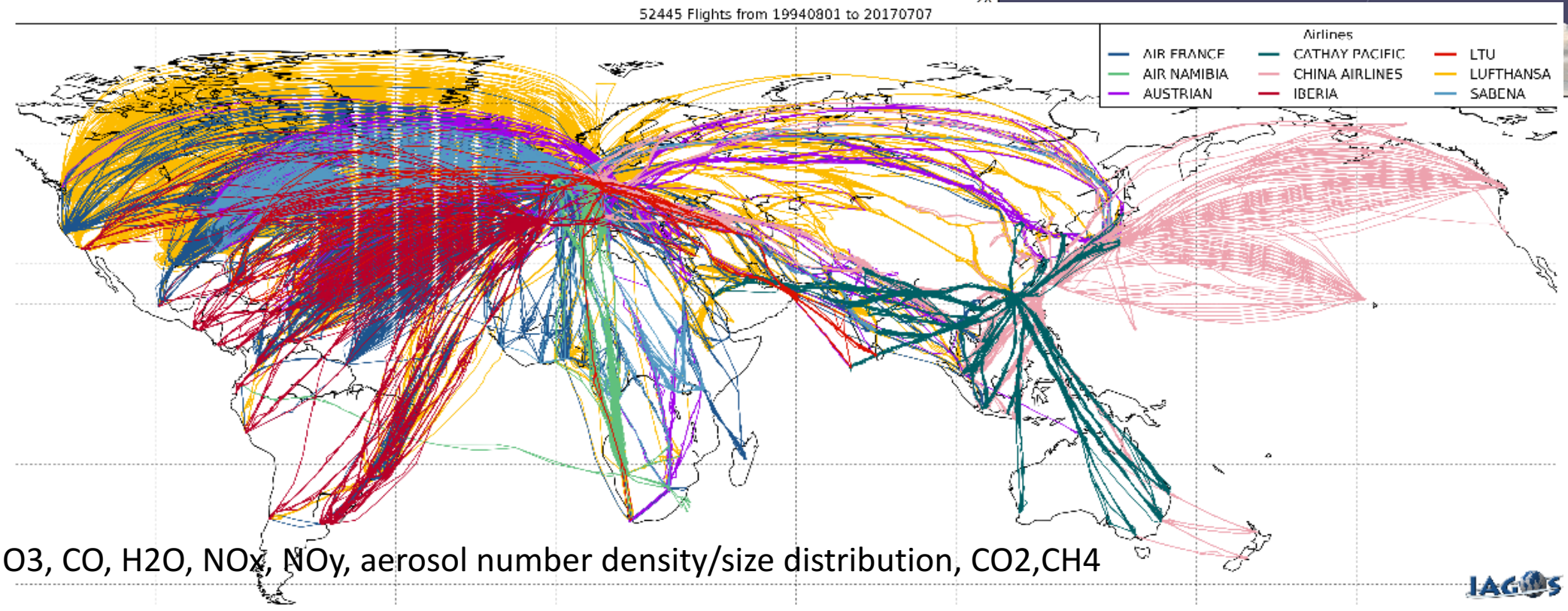
- https://www.esrl.noaa.gov/csd/groups/csd7/measurements/
- https://www.esrl.noaa.gov/csd/groups/csd7/measurements/modellers.html

- ARCPAC: https://www.esrl.noaa.gov/csd/groups/csd7/measurements/2008ARCPAC/P3/
- SENEX: https://www.esrl.noaa.gov/csd/projects/senex/

IAGOS and CARIBIC

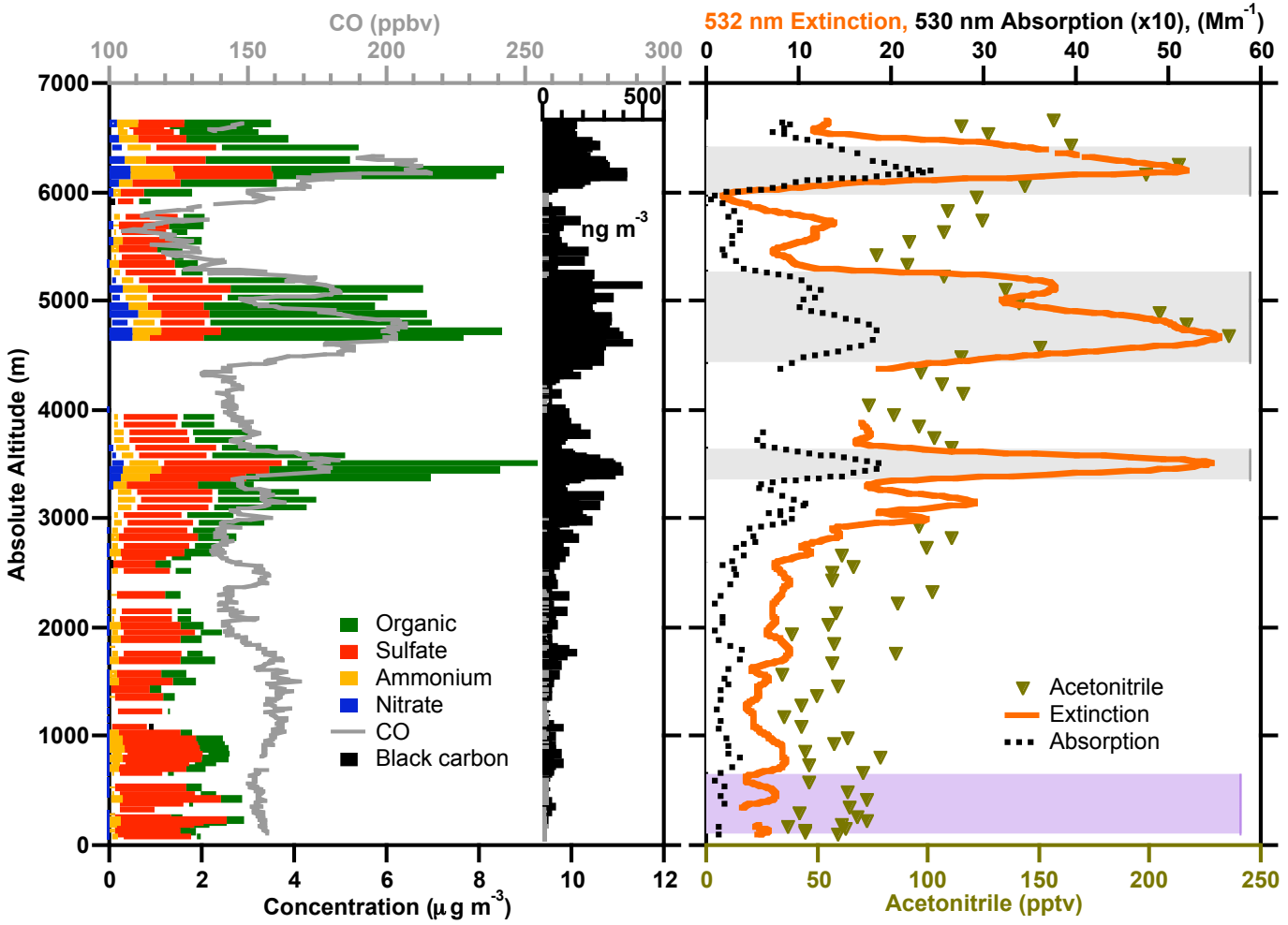
- Commercial aircraft measurements
- http://iagos.sedoo.fr/
- Limited payload, but numerous profiles near airports





O3, CO, H2O, NOx, NOy, aerosol number density/size distribution, CO2,CH4

ARCPAC – NOAA P3 - Vertical profile measured at 73°N on 2008/04/18



CO layers show biomass burning plumes
sulfate present throughout column
layers dominated by organic
<5% soot

Middlebrook, Bahreini, Holloway, Schwarz, Spackman, Gao

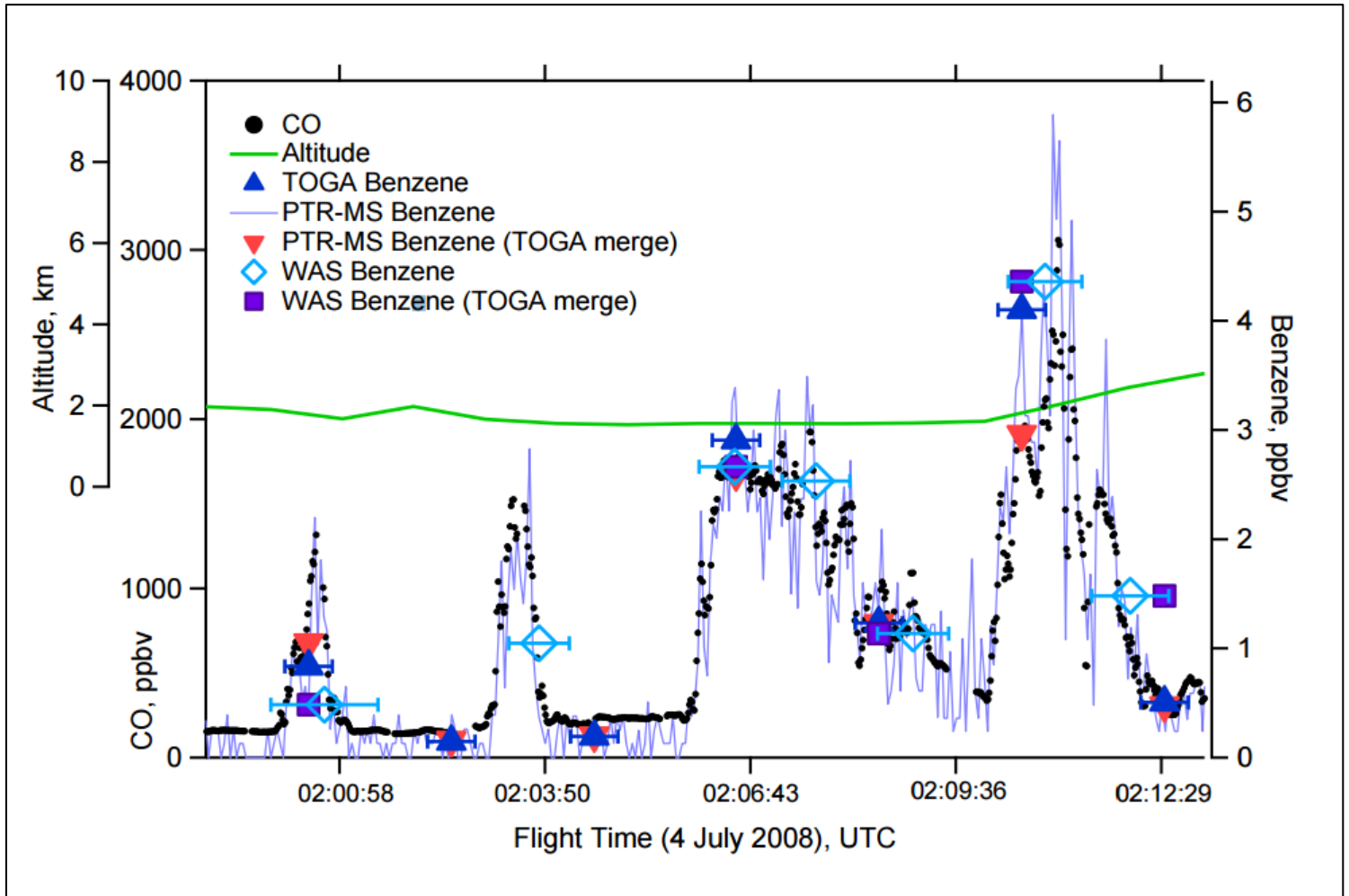
acetonitrile layers show biomass burning plumes
extinction and absorption enhanced in layers

de Gouw, Warneke, Lack

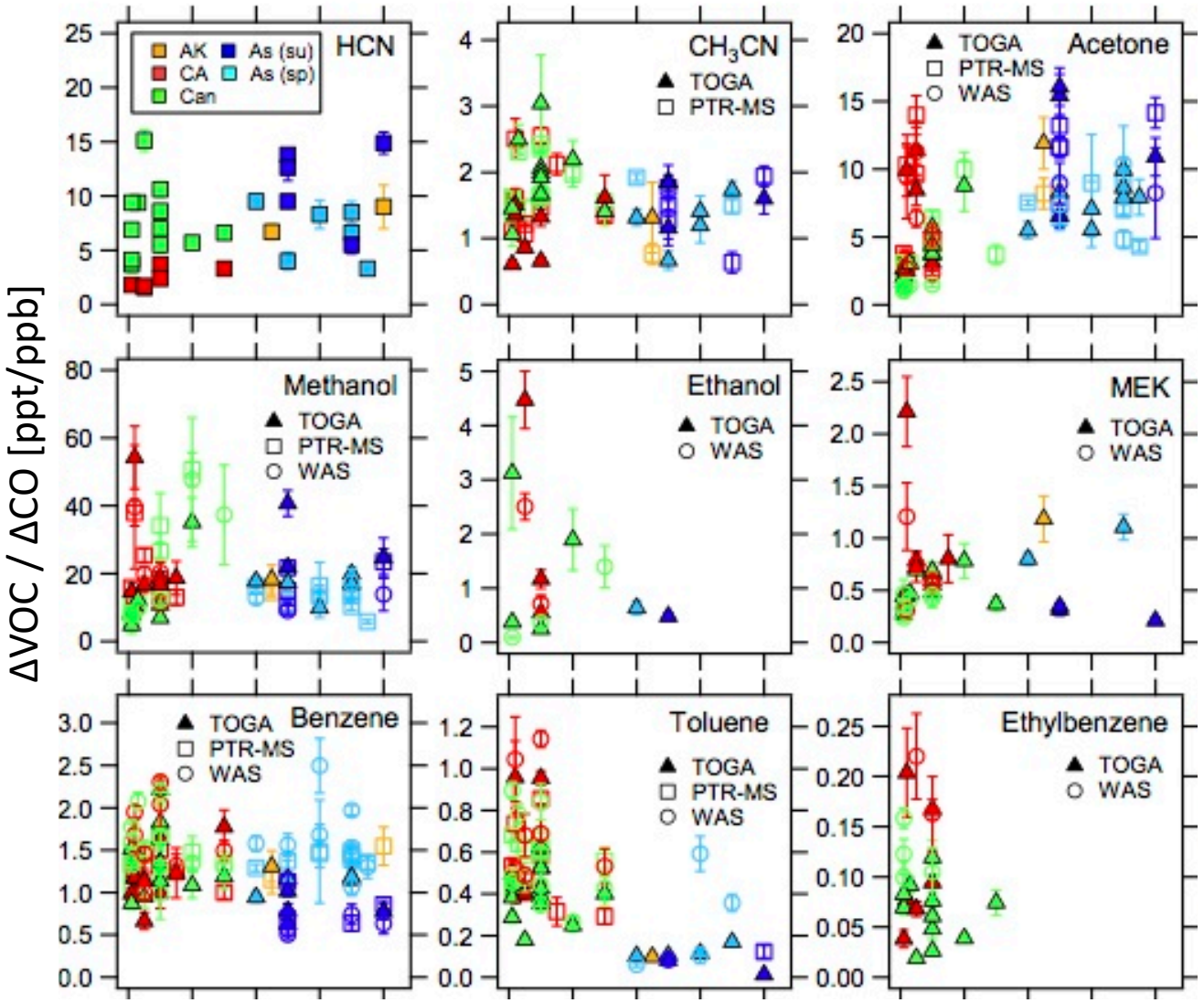
Time series of plume encounters

Easy to visually identify plumes – CO and VOCs peak simultaneously …

But it is a huge effort to quantify enhancement ratios



Fire Emissions - Observed Enhancement Ratios from ARCTAS DC-8 observations [Hornbrook, Apel, et al., ACP, 2011]



VOC observations from several instruments (TOGA, PTRMS, WAS)
Correlated with CO measurements

Plume age calculated from HC ratios

Enhancement ratios from fires in:
Alaska
California
Canada
Asia – spring
Asia – summer

3D chemical models

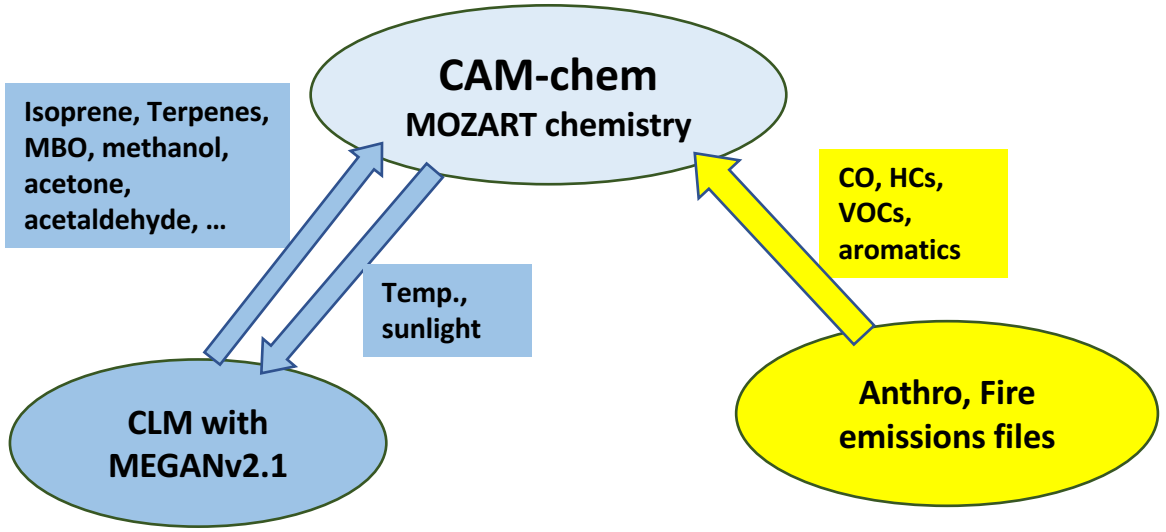
- Chemical transport models – driven by meteorology from another source
- Coupled chemistry-climate models - simulate meteorology
- CESM/CAM-chem – free-running climate model or nudged to GEOS5/MERRA meteorology

CAM-chem:
Community Atmosphere Model with Chemistry

Jean-François Lamarque, Simone Tilmes, Doug Kinnision, Louisa Emmons, university and national lab colleagues

Component of CESM: Community Earth System Model, coupled to Community Land Model (CLM)

Participated in model inter-comparisons: CCMI, HTAP



Chemical forecasts

- MOZART forecasts: https://www.acom.ucar.edu/acresp/forecast/
- NASA GMAO GEOS5 forecasts with tracers: https://portal.nccs.nasa.gov/cgi-fp/fp_2d_chem.cgi
- Copernicus http://www.gmes-atmosphere.eu/d/services/gac/nrt/nrt_fields!Carbon%20monoxide!Surface!36!Global!macc!od!enfo!nrt_fields!latest!!/

Viewing global model output

- MOZART forecasts: https://www.acom.ucar.edu/acresp/forecast/
- NASA GMAO GEOS5 forecasts with tracers: https://portal.nccs.nasa.gov/cgi-fp/fp_2d_chem.cgi
- Panoply: https://www.giss.nasa.gov/tools/panoply/ (download program to run locally to view your own files)