

# Ozone Tagging with TOAST and CAM-chem

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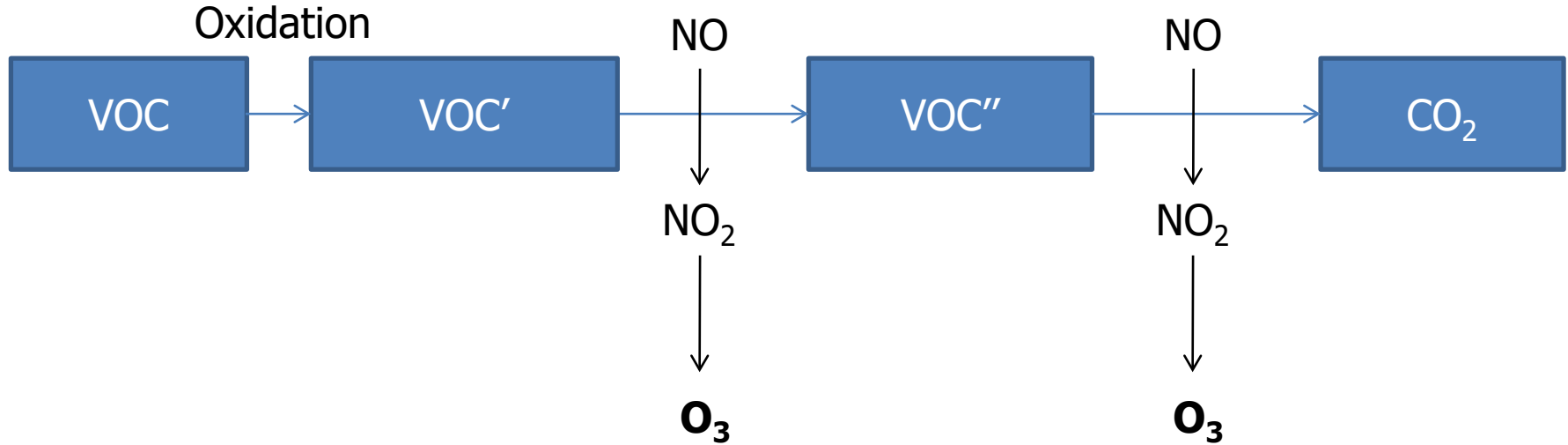
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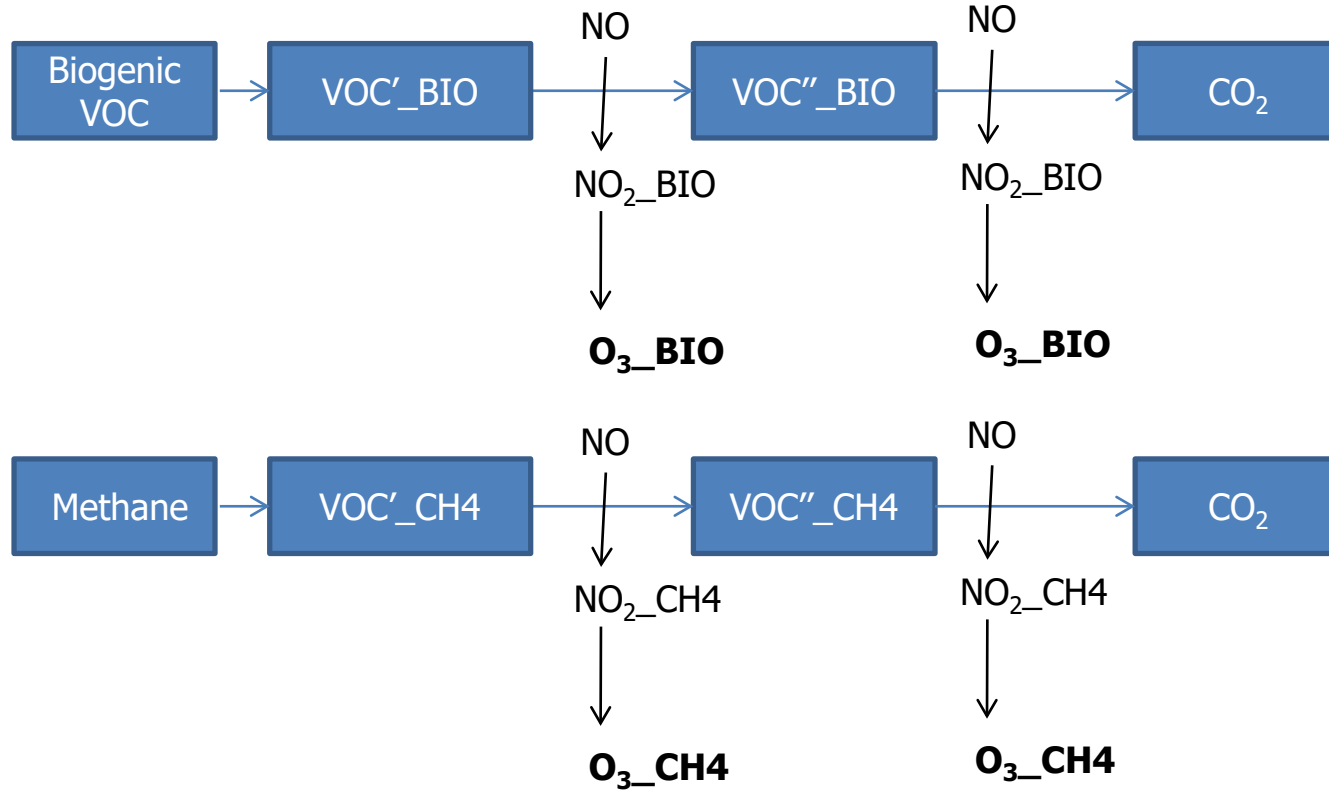
11. February 2021

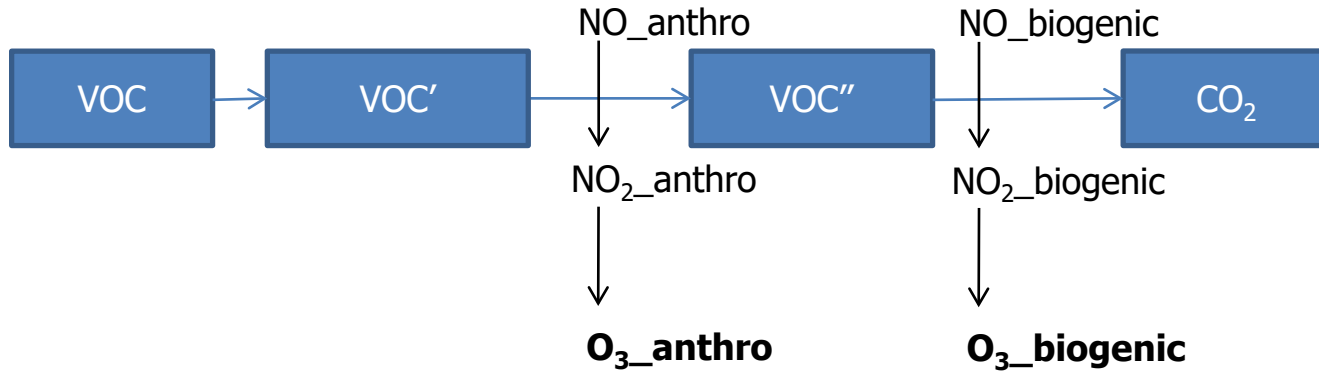
- Quick intro to ozone tagging with TOAST
  - Tropospheric Ozone Attribution of Sources with Tagging
  
- HTAP source attribution for 2010: ozone and PAN
  
  
- Next steps

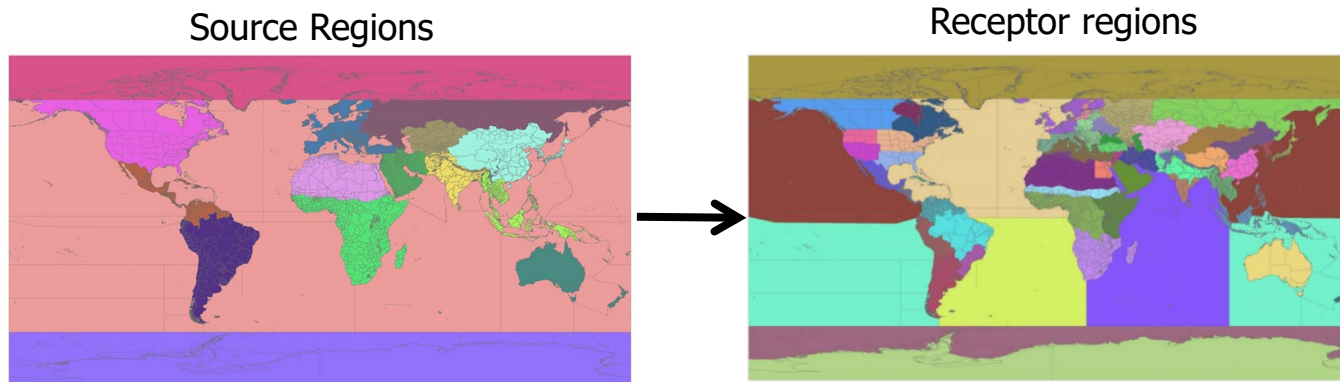
# Generalised tropospheric ozone production



# Attribution of ozone to VOC precursors





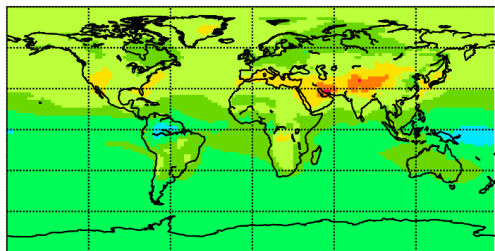


- 2010 HTAP emissions
- Two model runs: NO<sub>x</sub> tagged and VOC tagged
- CAM4-chem (CESM 1.2.2)
- 1.9x2.5 degrees
- 2010 Specified Dynamics: GEOS5

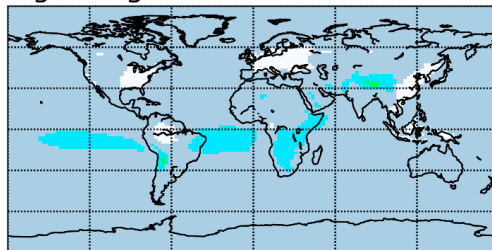
Technical description of TOAST: <https://www.geosci-model-dev.net/11/2825/2018/>  
Application to ozone source attribution: <https://acp.copernicus.org/articles/20/10707/2020/>

# 2010 annual average surface ozone: NO<sub>x</sub> tagged

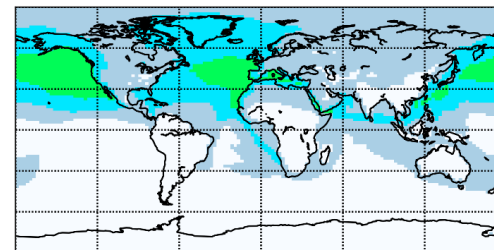
Total surface ozone



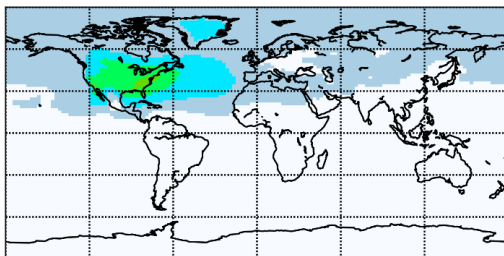
Lightning



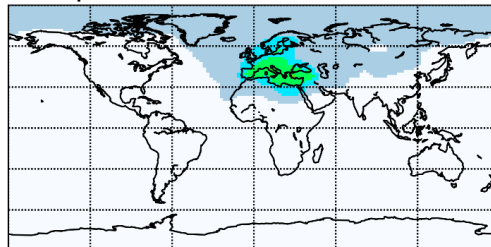
Oceanic Sources



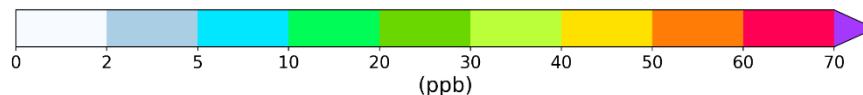
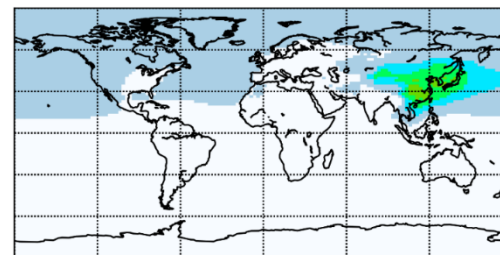
North America



Europe

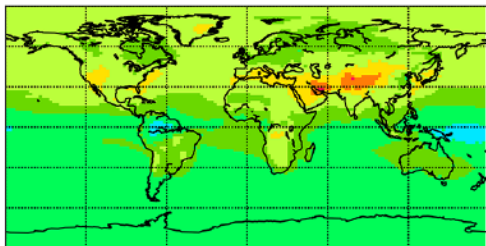


East Asia

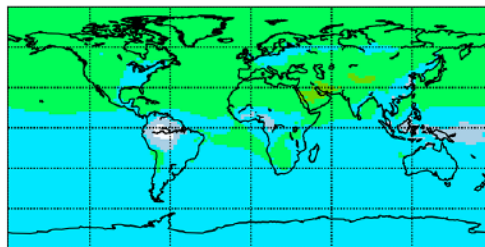


# 2010 annual average surface ozone: VOC tagged

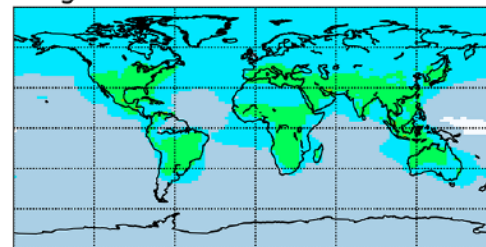
Total surface ozone



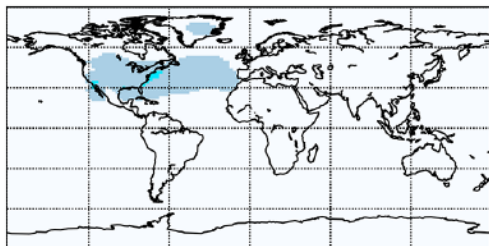
Methane



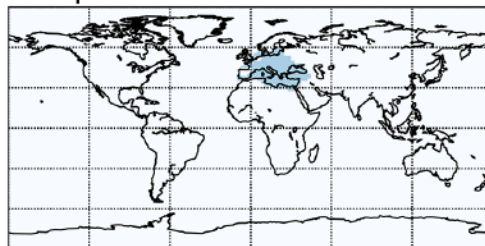
Biogenic



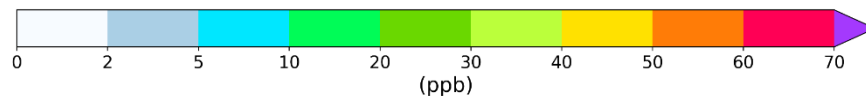
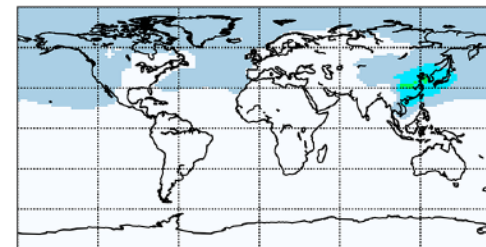
North America



Europe

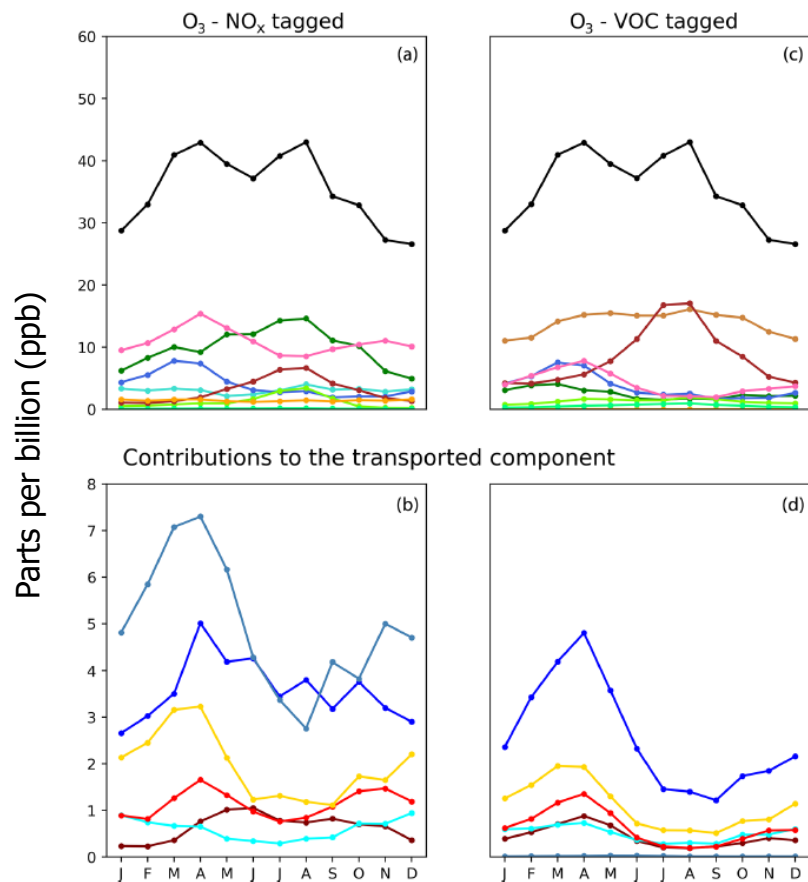


East Asia

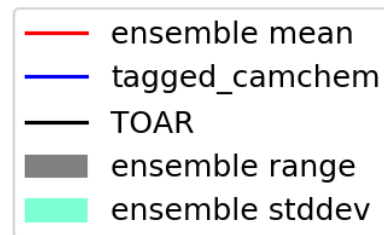
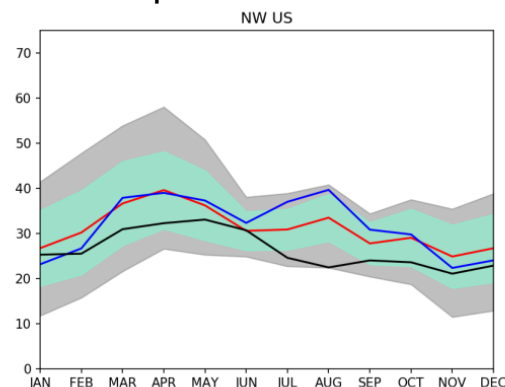




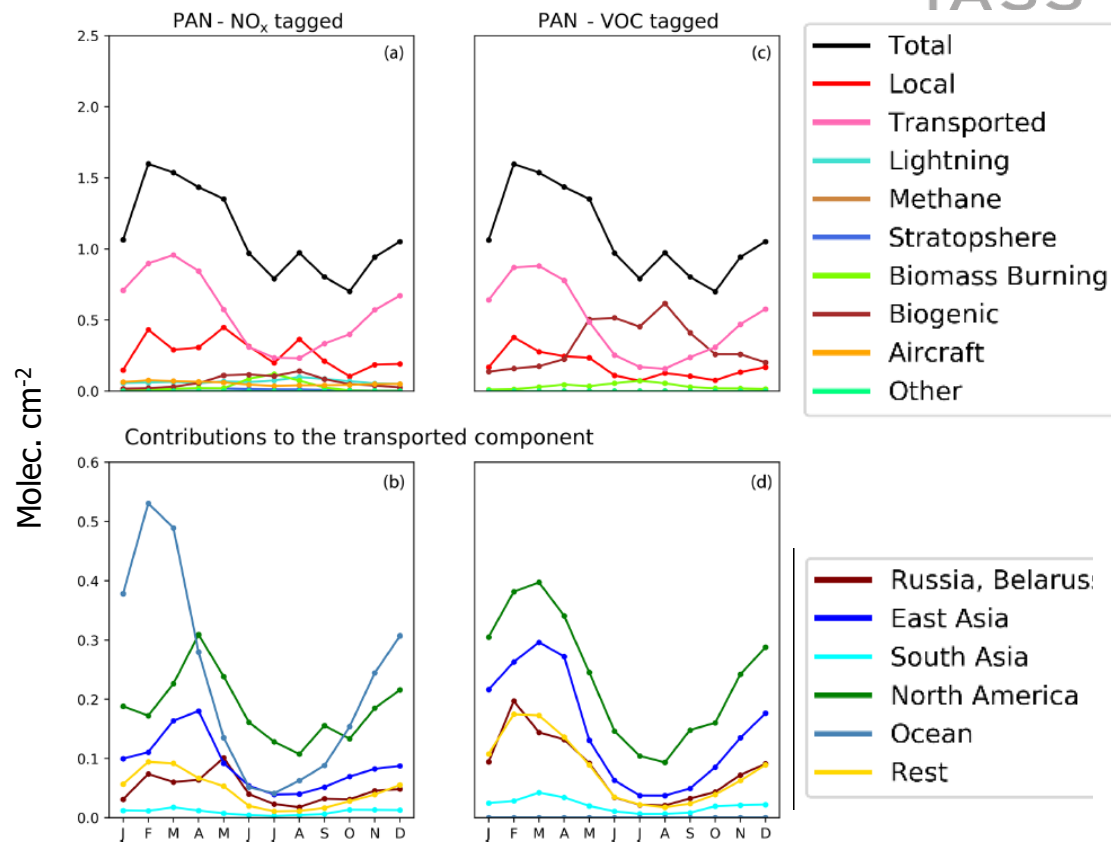
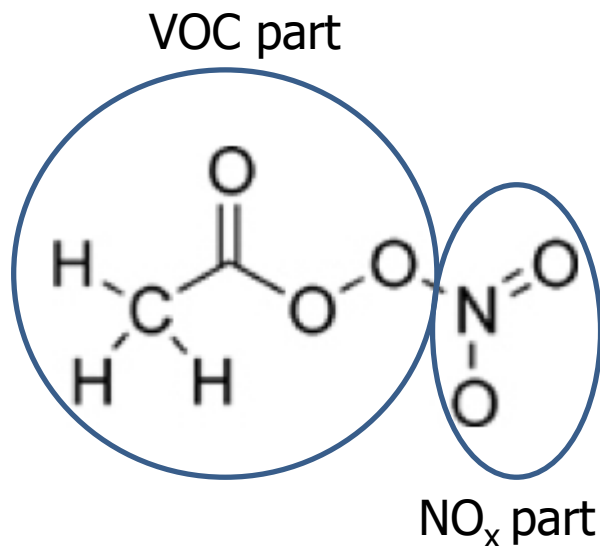
# 2010 surface monthly mean ozone in NW United States



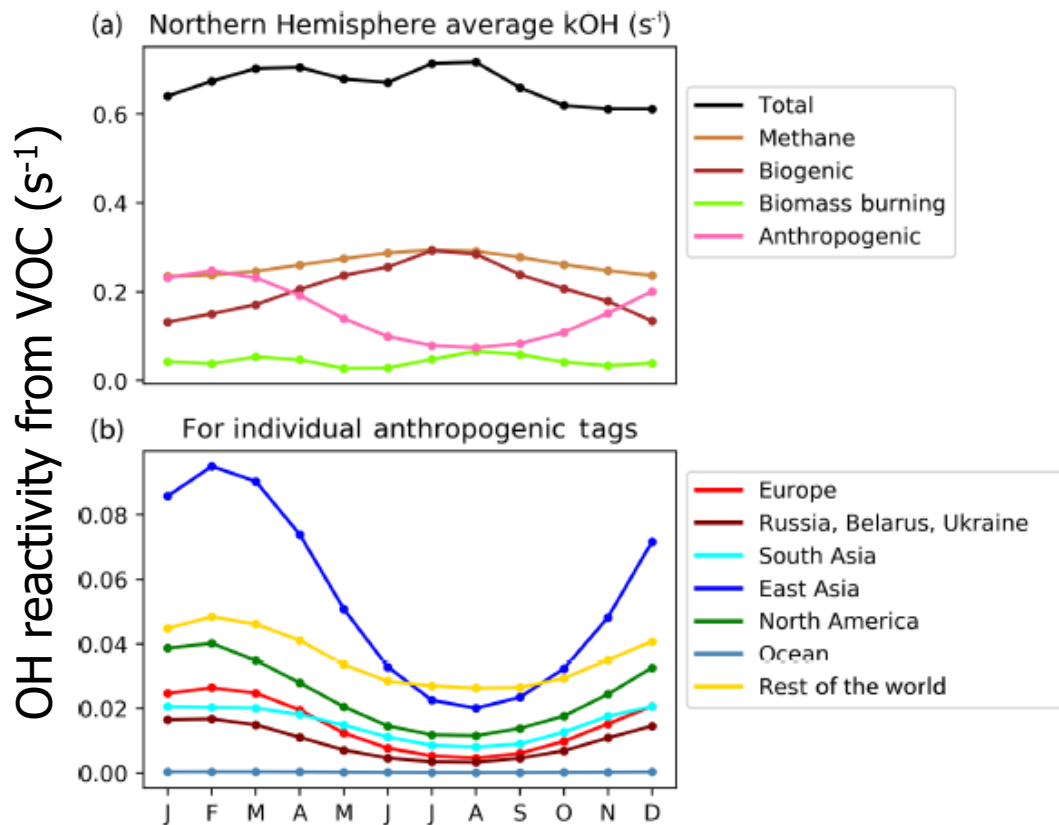
## Comparison with TOAR



# 2010 lower tropospheric monthly mean PAN in NW Europe

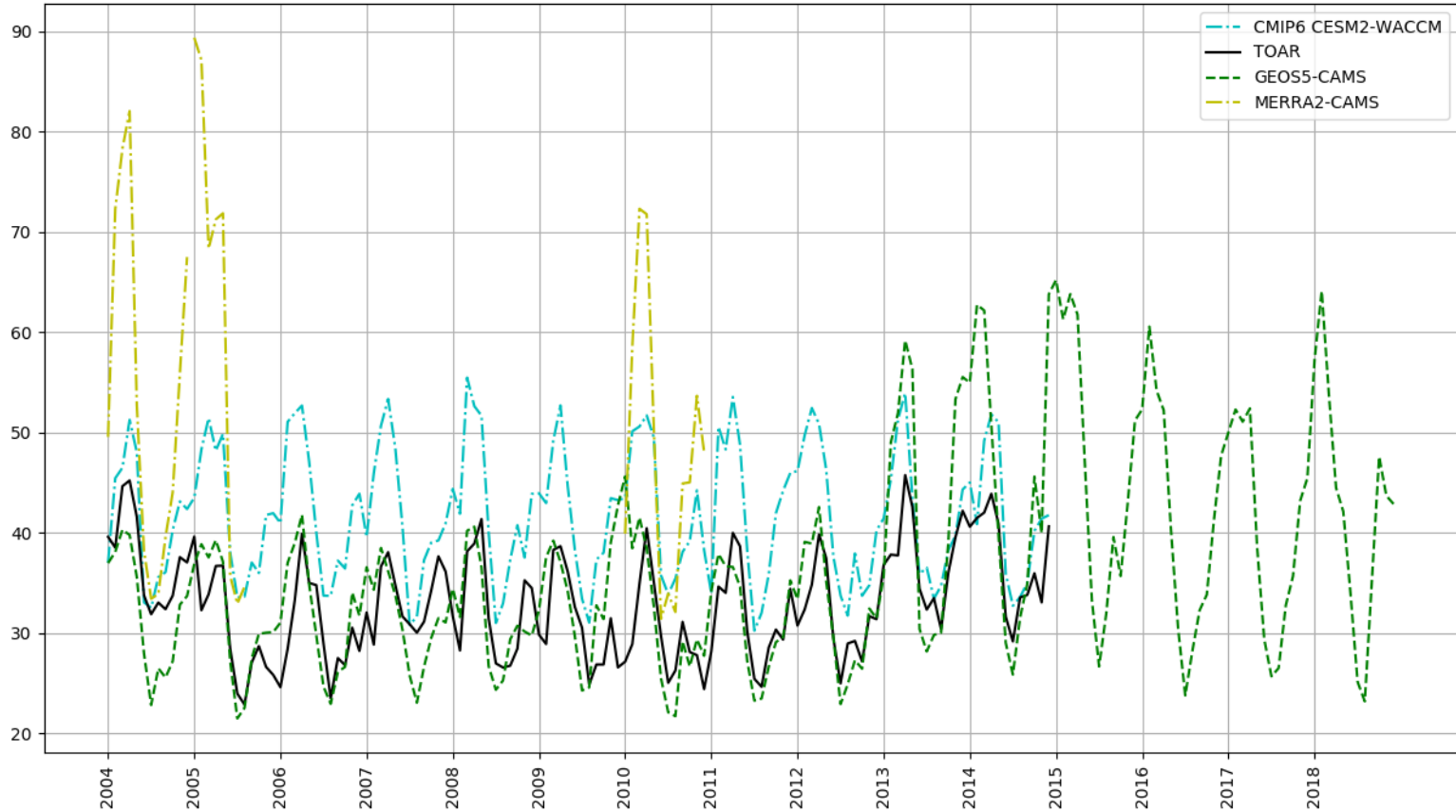


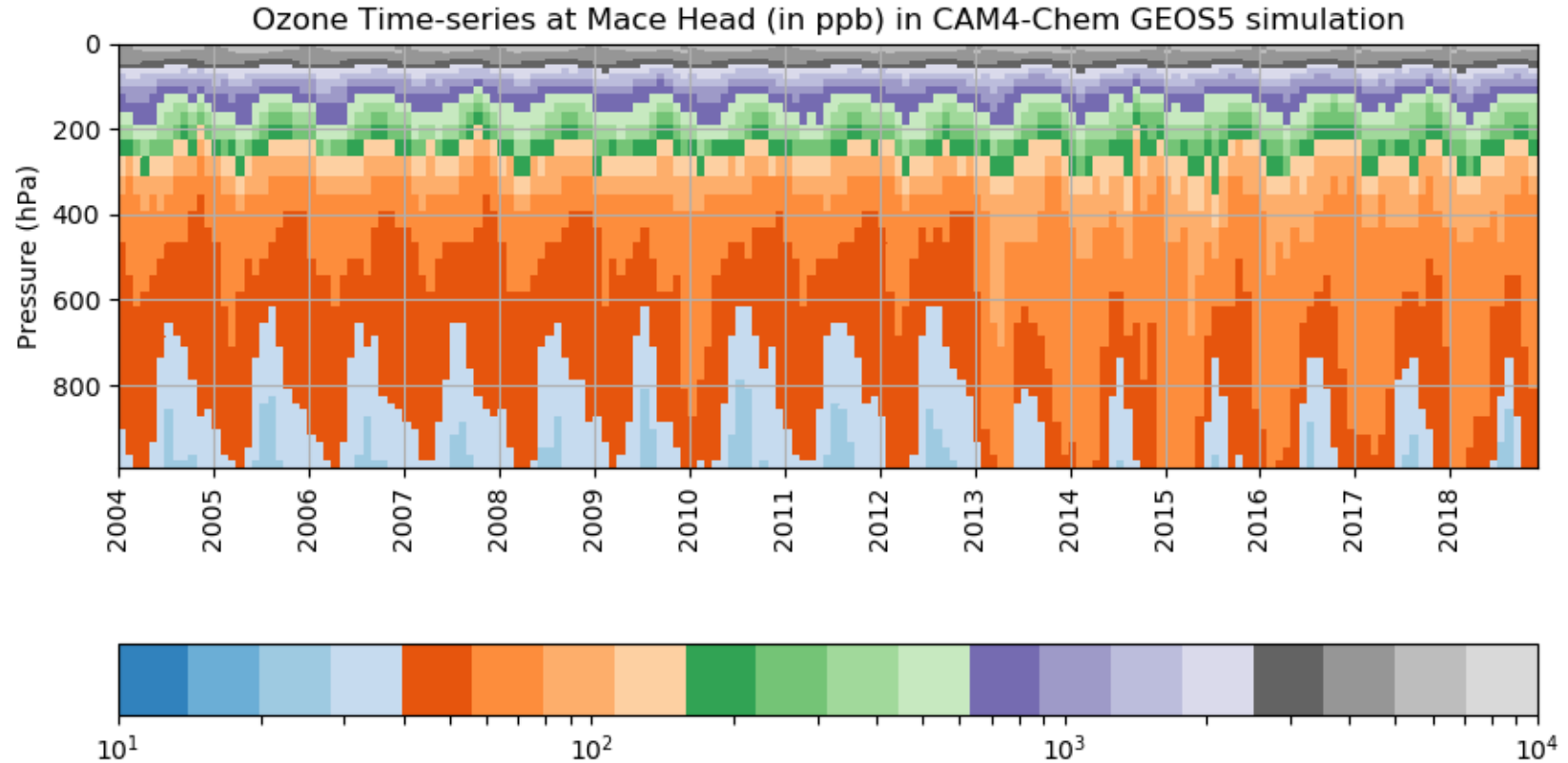
# 2010 ozone production potential of the Northern Hemisphere



- Implement tagging in MUSICA
  
- Further work with CESM 1.2.2
- Transient run: 2000-2018
- Emissions: CAMS-global, CAMS-ship
  - Ships tagged by ocean basin and ECAs
- Surface methane: CAMS analysis
- Specified Dynamics: GEOS5? MERRA-II? Other?
  
- Current status: test runs (no tagging)

# Test runs (no tagging)





- TOAST is implemented in CAM4-chem (CESM 1.2.2)
  - NO<sub>x</sub> and VOC contributions to tropospheric ozone (and more)
  
- Implementation of TOAST in MUSICA is planned
  
- Ongoing work with CESM 1.2.2 in support of HTAP
  - Attribution of trends in surface ozone
  
- Overestimation of background ozone in winter-spring with specified dynamics
  - Too much vertical mixing?
  - Suggestions welcome!