

GEOS-Chem in GEOS:

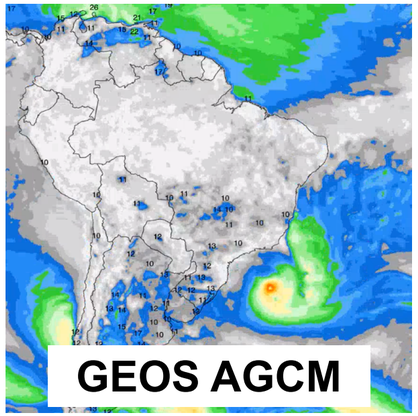
New developments and future outlook

Viral Shah (NASA GMAO & SSAI)

Emma Knowland, Christoph Keller, Pam Wales,
Obin Sturm, Kris Wargan, Brad Weir & Steven Pawson

GEOS-Chem is at the heart of GEOS-CF

GEOS-CF is GMAO's composition forecasting system,
built on the partnership between NASA GMAO and the GEOS-Chem community



+ GEOS-Chem

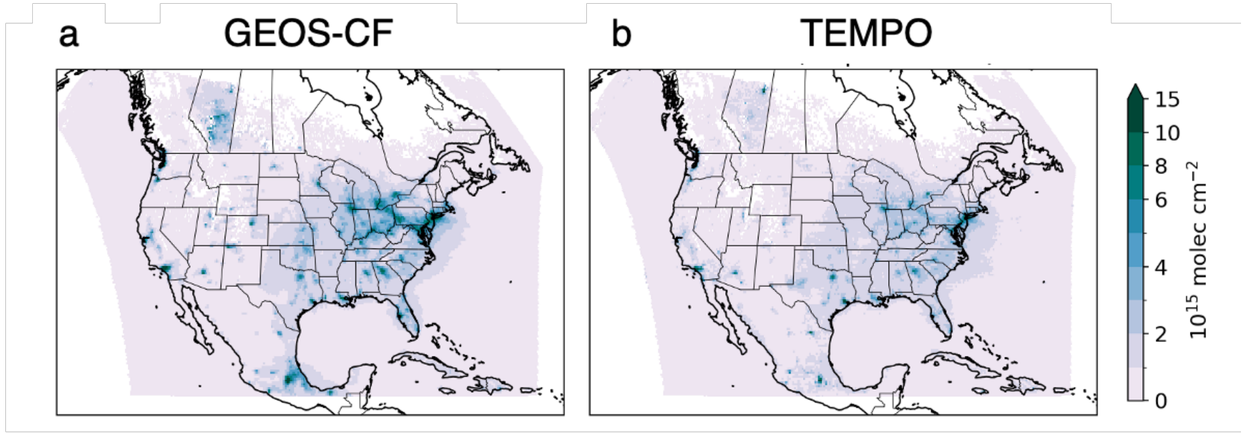
GEOS-CF

- Daily near real time estimates and 5-day forecasts since 2019
- Global coverage at c360 (~25 km) resolution
- Number of applications, including:
  - NASA mission support (TEMPO, TolNet, field campaigns)
  - Research
  - Air quality management and health impacts

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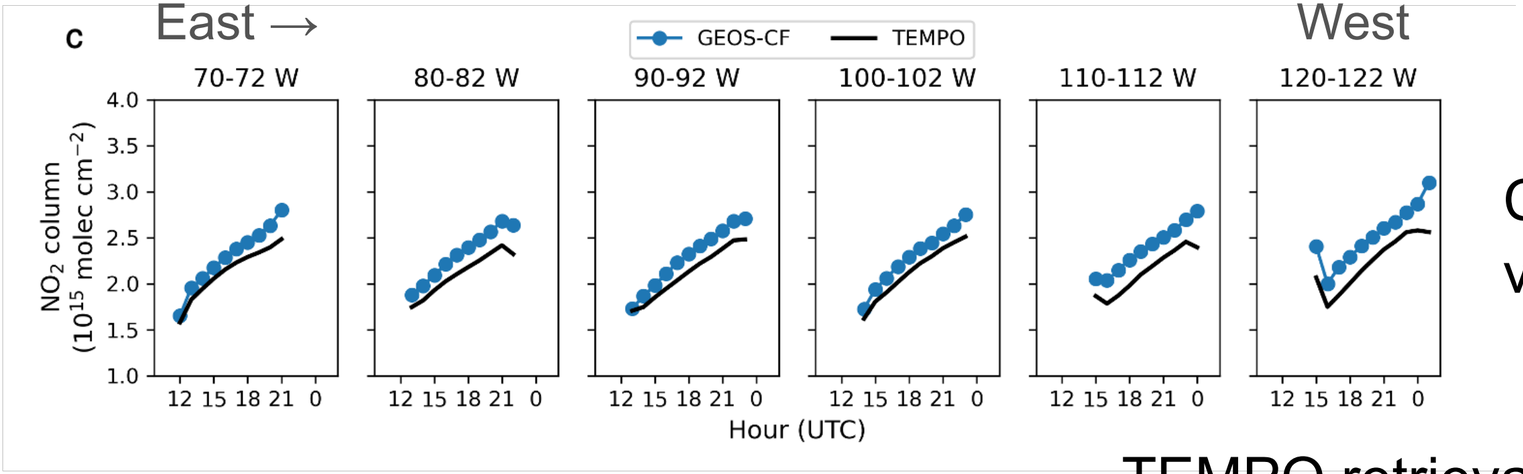
Validating TEMPO retrievals using GEOS-CF

Tropospheric NO_2 columns (April 2024)



High correlation;
GEOS-CF 30% higher

Stratospheric NO_2 columns (April 2024)
(diurnal variation)



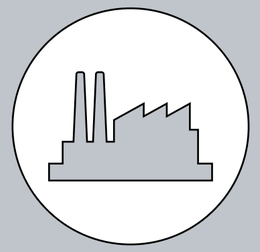
Consistent diurnal variation

TEMPO retrievals are “provisional”

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GEOS-CF-2 will be a major update to the system

Emissions



HTAP → CEDS

Updated fire emission factors

Redistributed lightning

Model components



GEOS Chem 14.0

GEOS-IT meteorology

GEOSgcm v10.23 with new model physics

GEOS convective tranport

Data assimilation



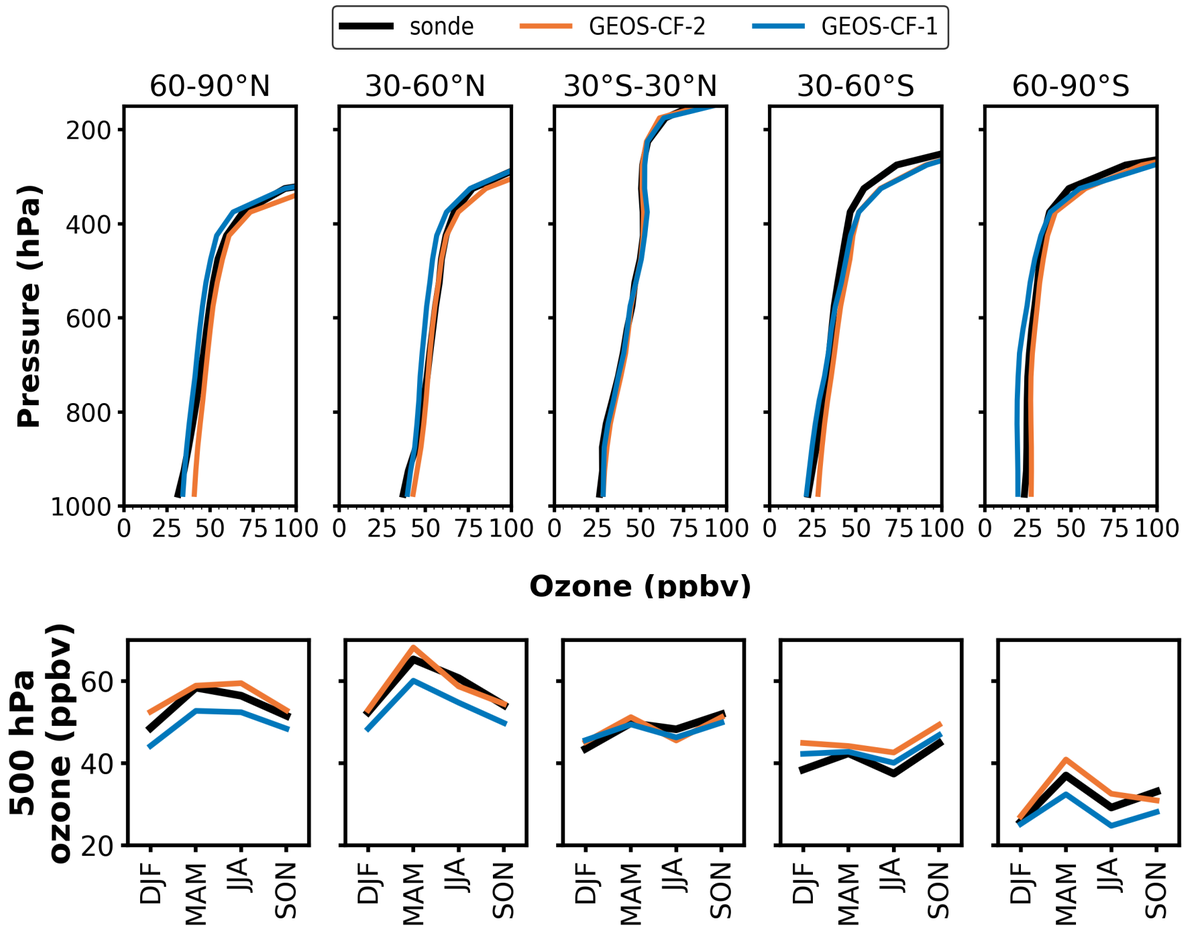
3D-Var assimilation of ozone, NO_2 and SO_2 satellite data

Constituent DA system developed by Brad Weir & Kris Wargan

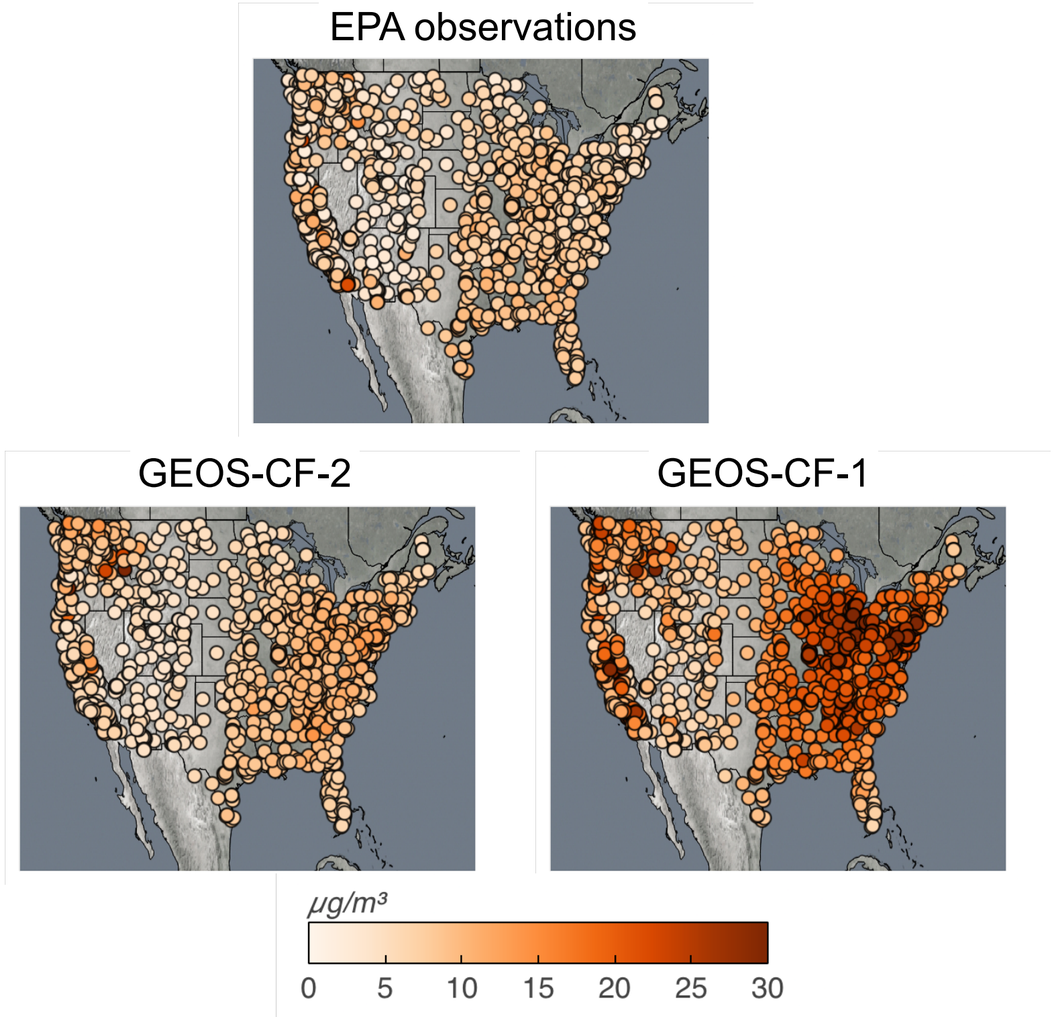
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Tropospheric ozone and $PM_{2.5}$ improve in GEOS-CF-2

Tropospheric ozone profiles



$PM_{2.5}$



Results for 2022

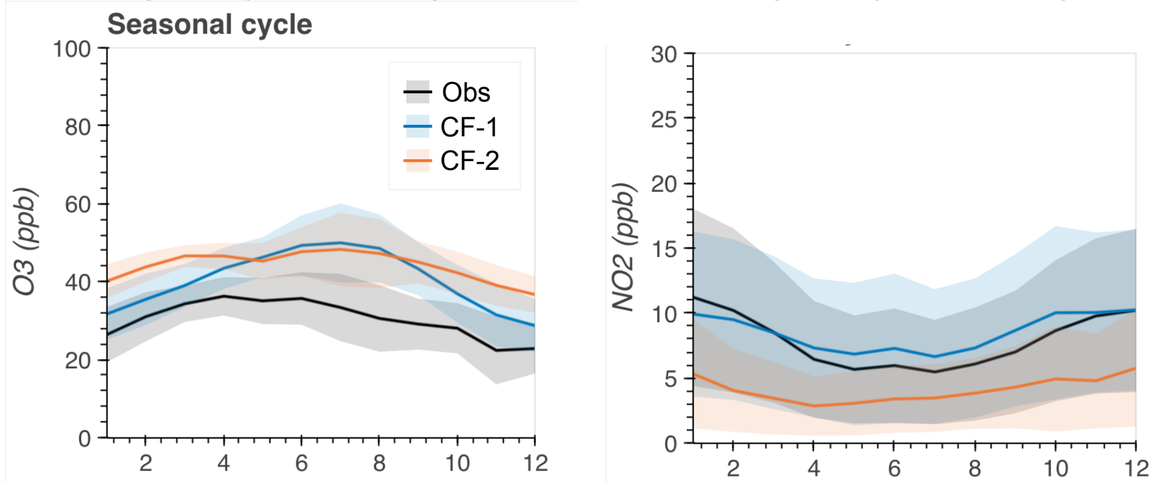
But surface ozone is still a problem

Seasonal cycle of surface ozone and NO_2 over the US

Ozone
(daily mean)

NO_2
(daily mean)

Not enough ozone titration

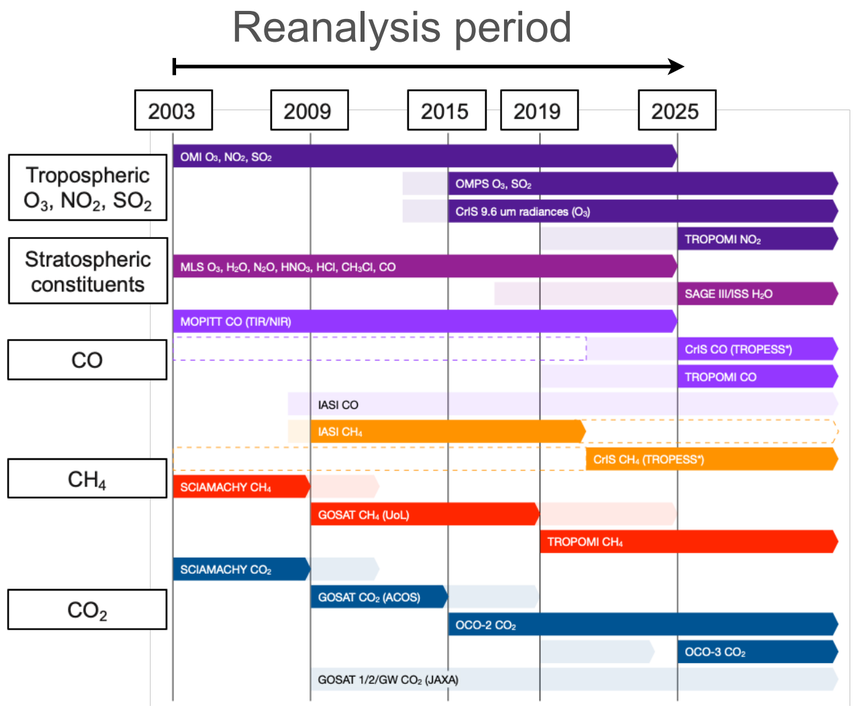


Too little NO_2

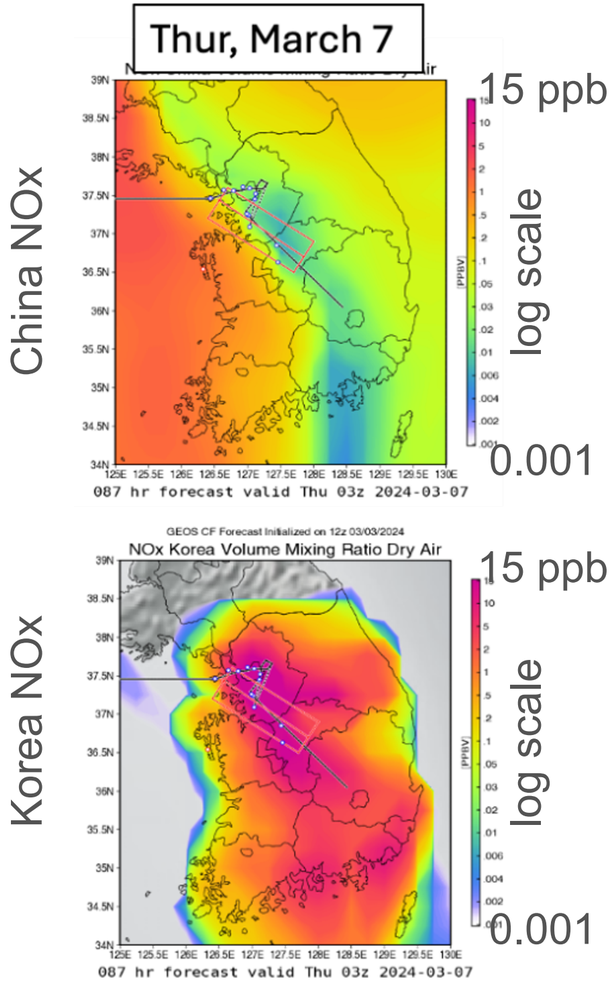
Results for 2022

Developments in the pipeline

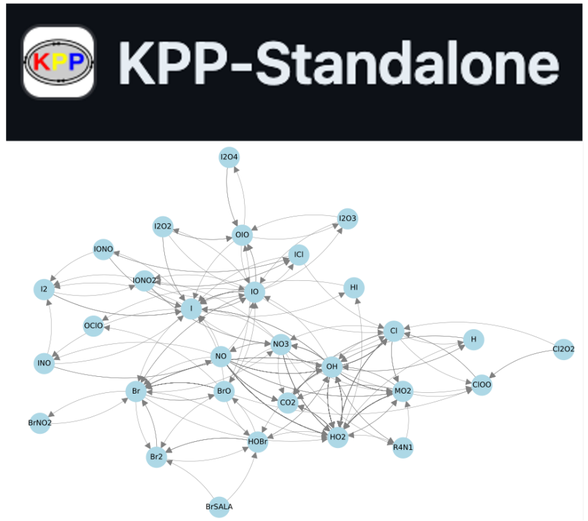
GEOS Composition Reanalysis (led by Kris Wargan)



Capability for tagging tracers (Pam Wales)



A standalone KPP tool (Obin Sturm)



Check out Obin's talk on Wed morn

Future outlook

GEOS-CF developments on the horizon:

- Higher vertical resolution and stretched grids
- Transition to data assimilation with JEDI
- Coupling with GEOS aerosols
- Improved benchmarking

GEOS-CF is a product of the GEOS-Chem community and is available for use in your research