



Air Pollution Forecasts using the NASA GEOS Model: A unified Tool from Local to Global Scales

K. Emma Knowland

USRA/GESTAR

NASA Global Modeling and Assimilation Office (GMAO)

In collaboration with:

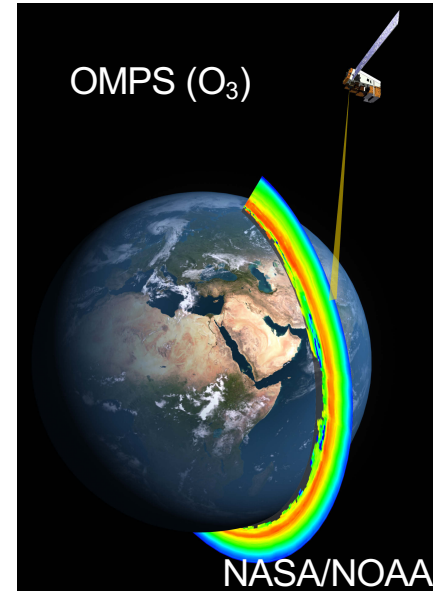
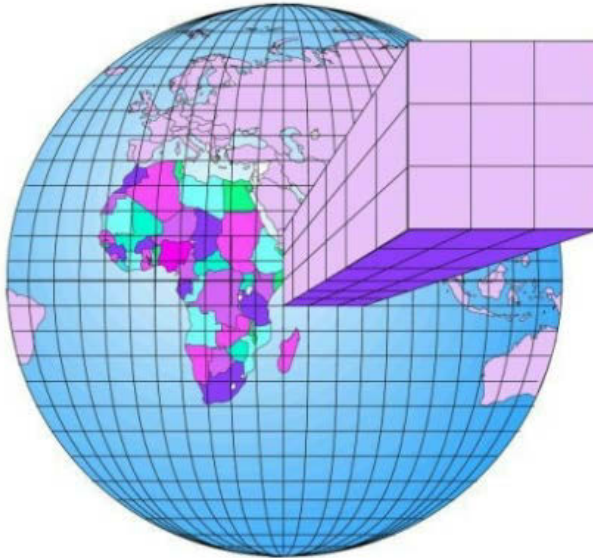
GMAO: Christoph Keller, Lesley Ott, Steven Pawson, Emily Saunders, Pamela Wales

Atmospheric Chemistry and Dynamics Lab: Bryan Duncan, Melanie Follette-Cook,
Junhua Liu, Julie Nicely



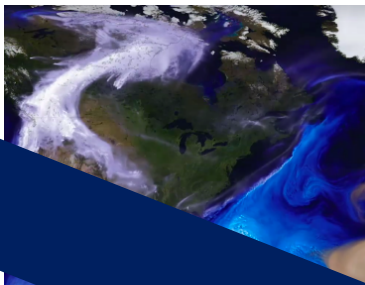
NASA GMAO global meteorology and chemistry products

GEOS

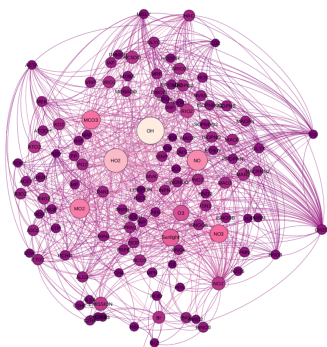


www.nasa.gov

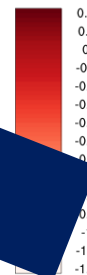
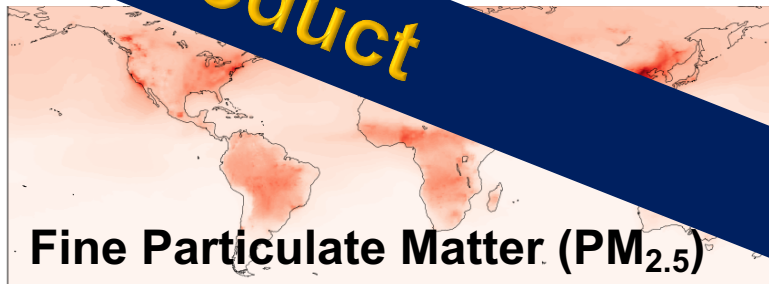
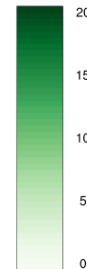
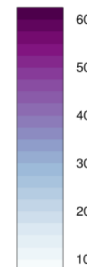
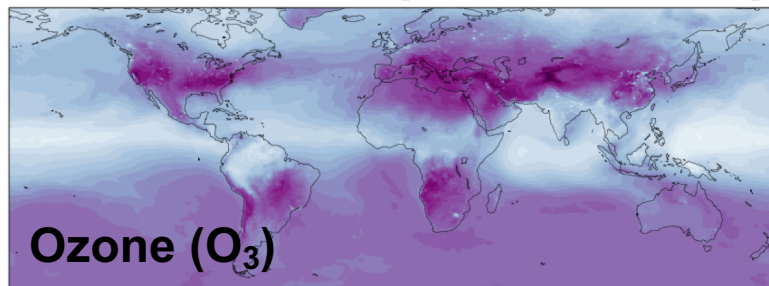
NASA's composition forecast (GEOS-CF)



GEOS N



GEOS - Chem



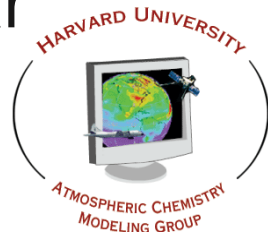
Research product

GEOS-Chem is a state-of-the science chemistry transport model

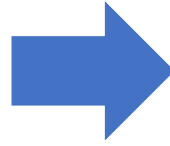
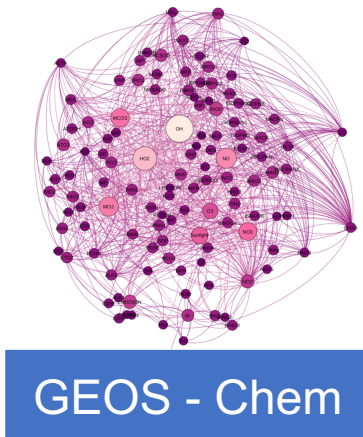
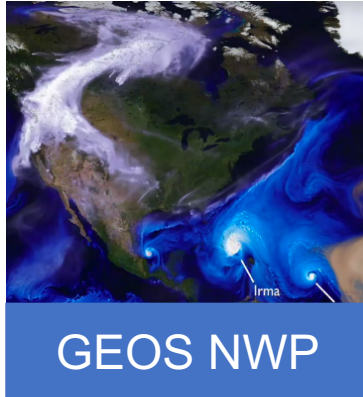
Tropospheric and Stratospheric full chemistry

- 250 reactive species, 725 reactions
- 100+ user/developer groups worldwide
- Updated version is released about every year

GEOS-Chem



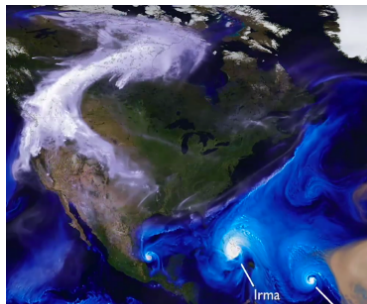
Daily composition forecast



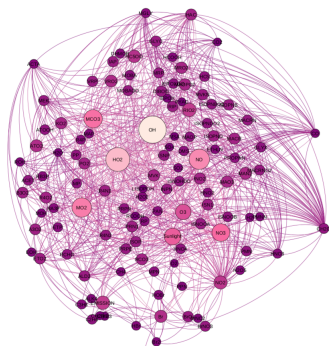
GEOS - CF

One **5-day forecast** per day

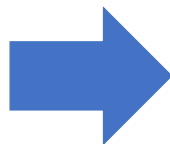
Daily composition forecast



GEOS NWP



GEOS - Chem

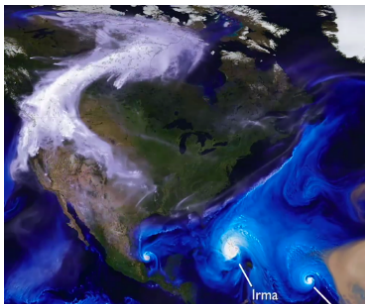


GEOS - CF

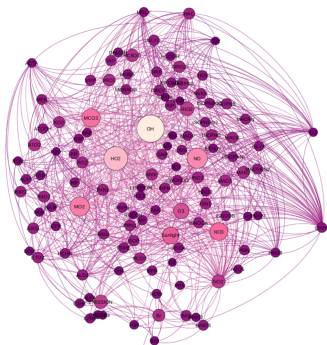
One **5-day forecast** per day

- 1-day “replay analysis”
- 5-day forecast

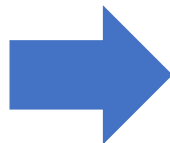
Daily composition forecast



GEOS NWP



GEOS - Chem

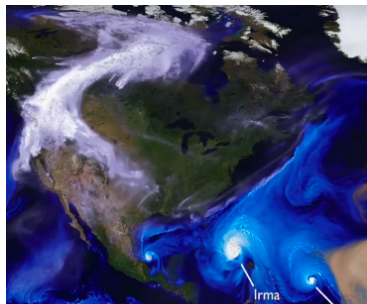


GEOS - CF

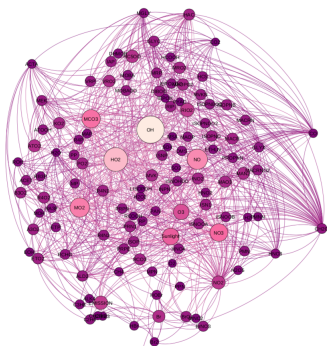
One **5-day forecast** per day

- 1-day analysis
- 5-day forecast
- c360 (0.25° , ~**25x25 km²**) resolution, 72 model layers

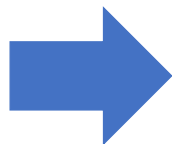
Daily composition forecast



GEOS NWP



GEOS - Chem

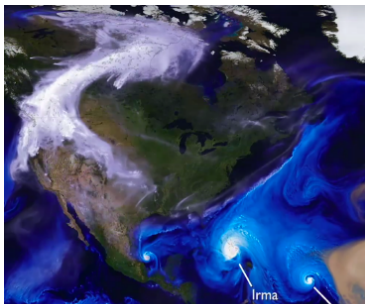


GEOS - CF

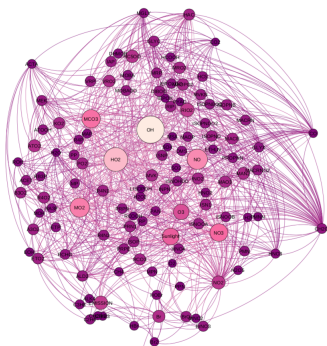
One **5-day forecast** per day

- 1-day analysis
- 5-day forecast
- c360 (0.25° , **$\sim 25 \times 25$ km²**) resolution, 72 model layers
- O₃, NO_x, VOCs, PM ...

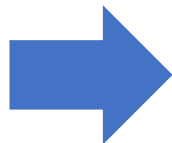
Daily composition forecast



GEOS NWP



GEOS - Chem

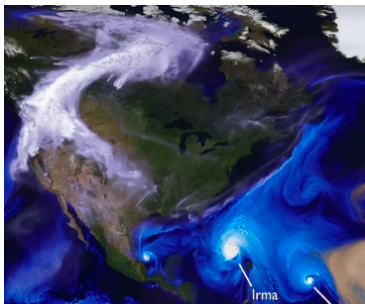


GEOS - CF

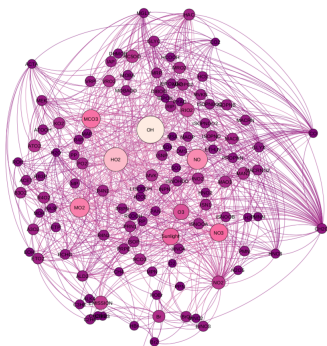
One **5-day forecast** per day

- 1-day analysis
- 5-day forecast
- c360 (0.25° , $\sim 25 \times 25 \text{ km}^2$)
- **15 minute** “surface”
- **1-hour** average and instantaneous 2D & 3D

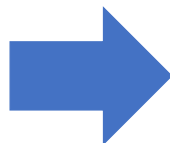
Daily composition forecast



GEOS NWP



GEOS - Chem



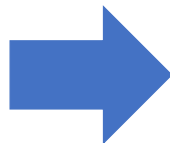
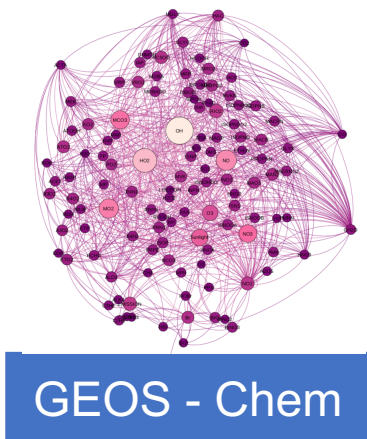
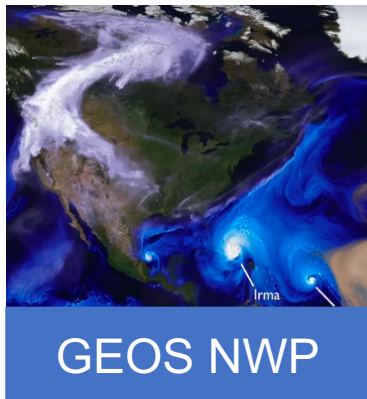
GEOS - CF

One **5-day forecast** per day

- 1-day analysis
- 5-day forecast
- c360 (0.25° , $\sim 25 \times 25 \text{ km}^2$)

➤ **1 January 2018 - NRT**

Chemistry is not cheap!



GEOS - CF

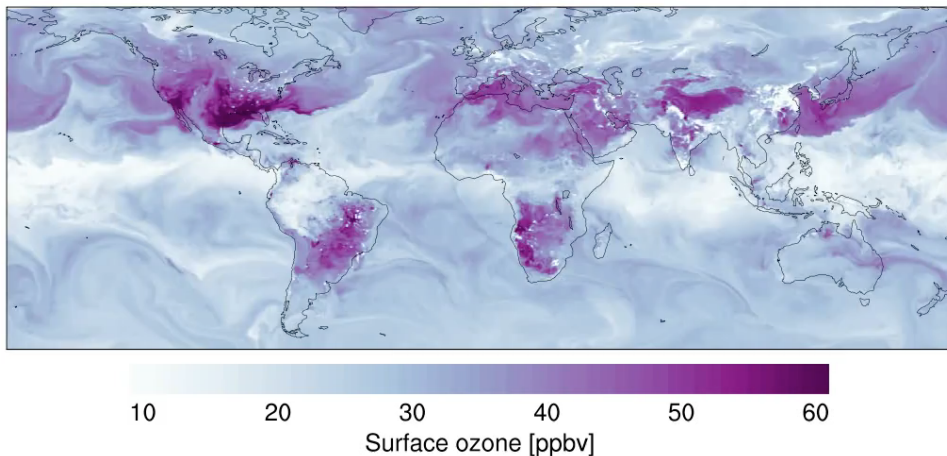
Run on **NASA's** Center for Climate Simulation
supercomputer

- using the computing power equivalent to **3500** personal computers.

High-Resolution Global Simulation

GEOS - CF

2017-10-01 00:30 UTC

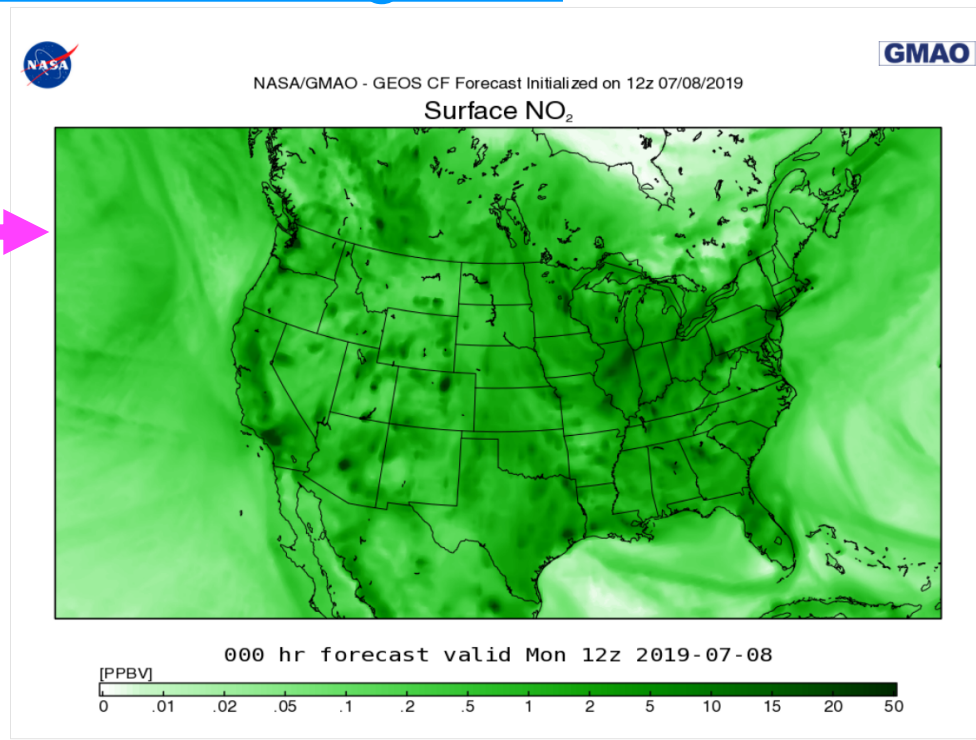
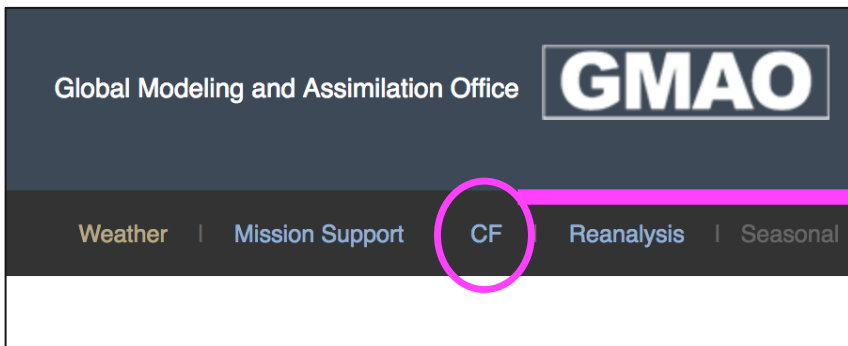


25 km x 25 km (16 miles)

- **Highest** horizontal resolution of a global atmospheric composition forecast
- **10 x higher** than conventional global atmospheric chemistry simulations.

Where to find GEOS-CF

Output available at fluid.nccs.nasa.gov/cf



Composition Forecast Maps

FIELDS

CO Sfc

NO2 Sfc

O3 Sfc

PM2.5 Sfc

SO2 Sfc

REGIONS

United States

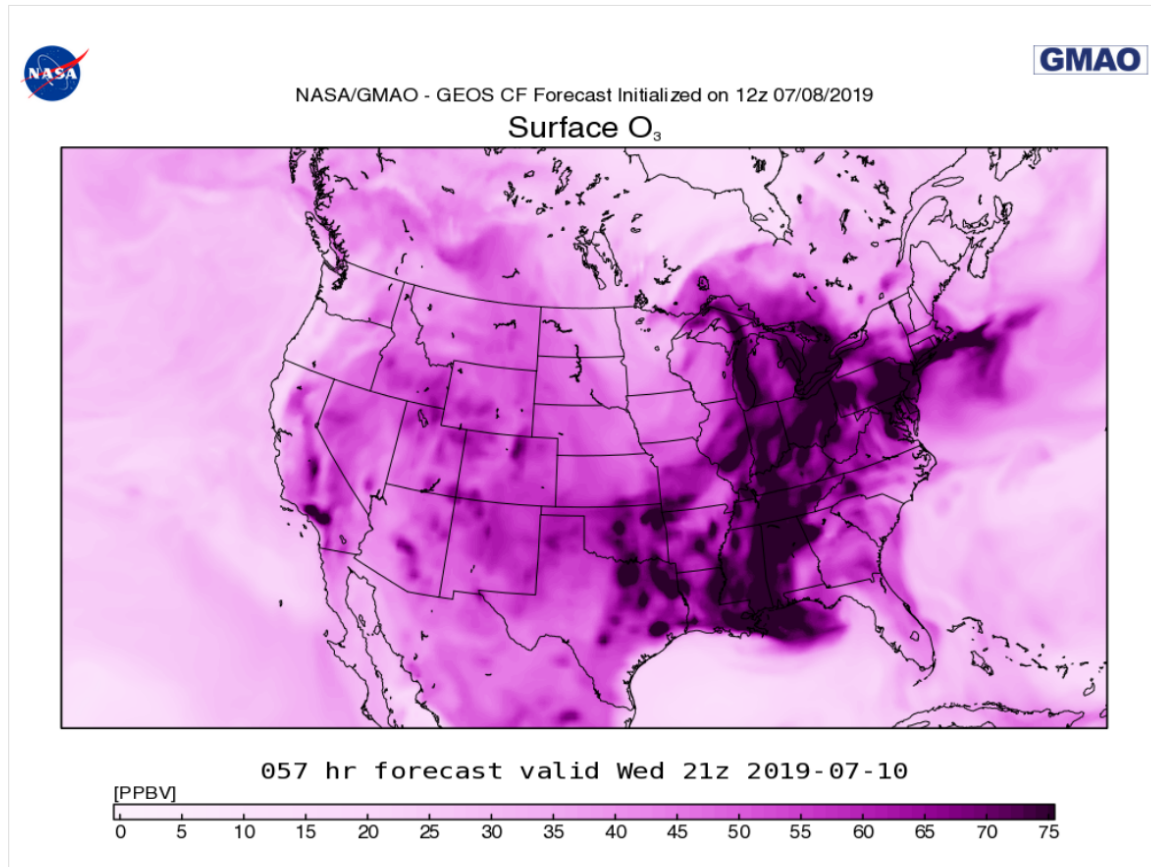
FORECAST INITIAL TIME

08Jul2019 12z

FORECAST LEAD HOUR

057h 10Jul2019 21z

Model
forecast O_3



ANIMATE

DOWNLOAD MOVIE

NATIONAL

Los Angeles

WORLD

Select a Station

AERONET

Select a Station

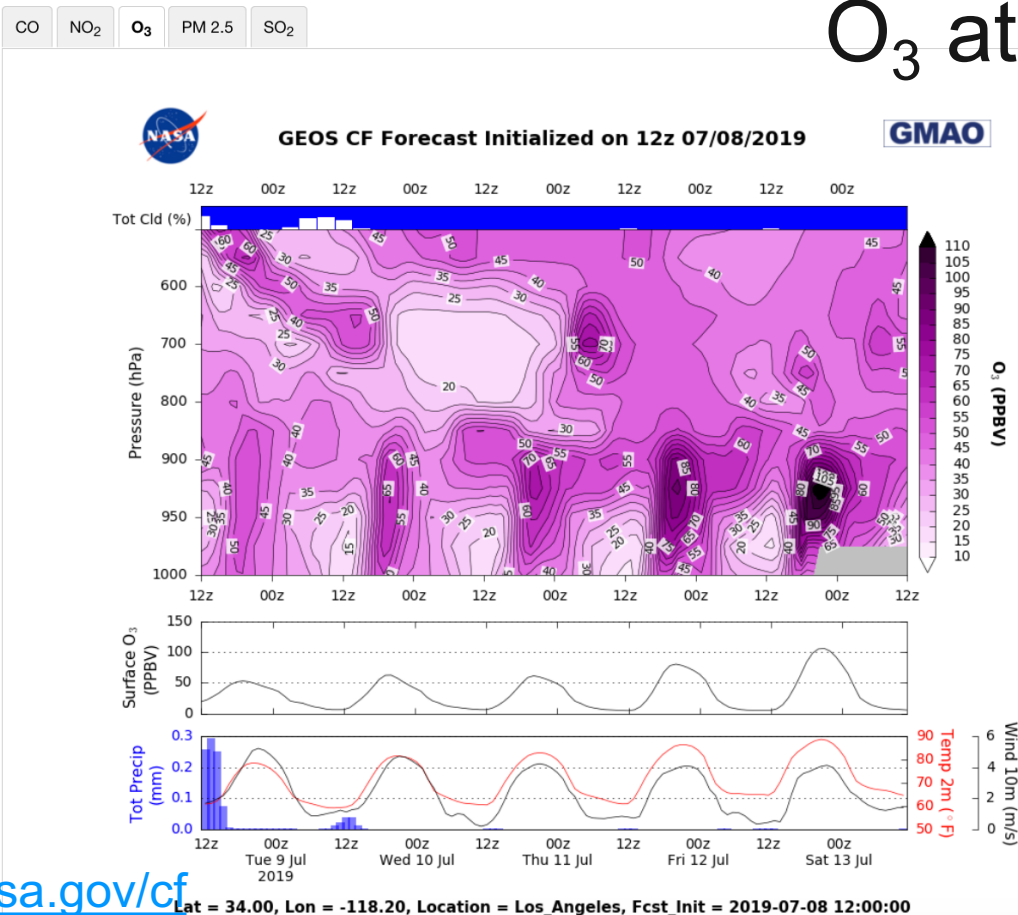
MEGACITIES

Los Angeles

ACTIVE CAMPAIGNS

Select a Station

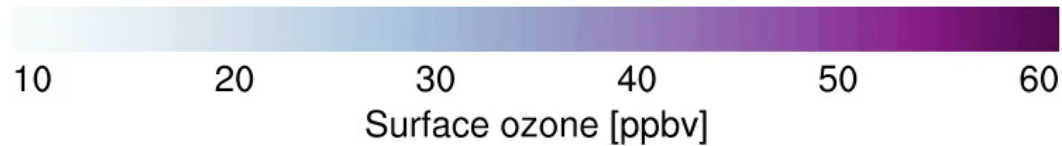
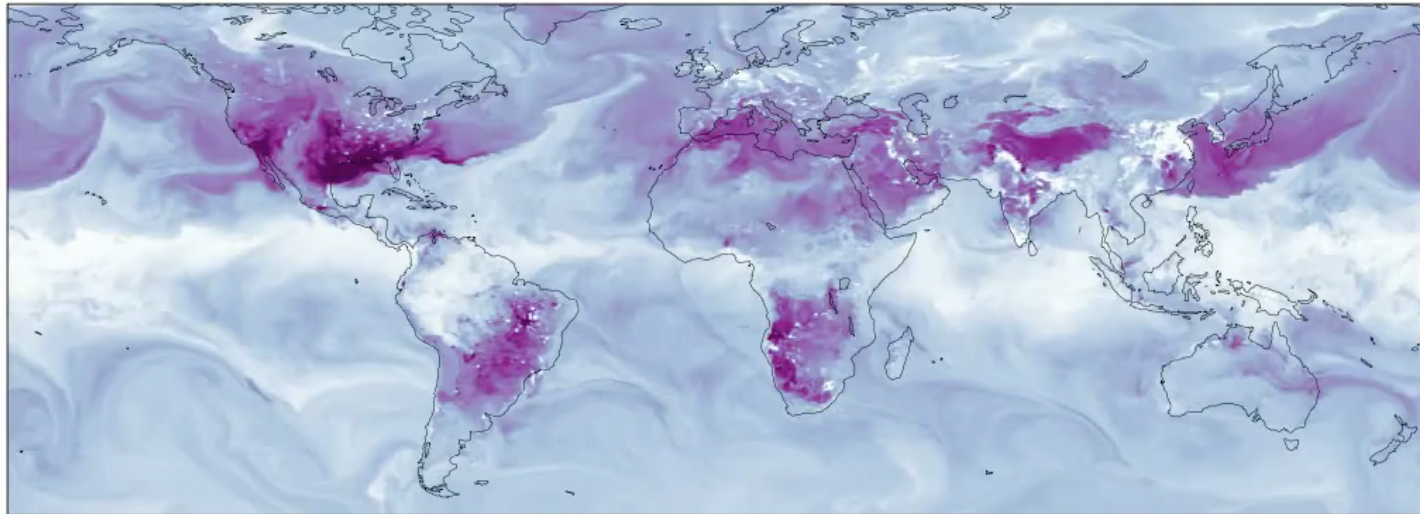
GMAO GEOS CF Datagrams

O₃ at Los Angeles (34.00, -118.20)Model forecast
O₃ at LAVertical O₃Surface O₃

Meteorology

Thank you!

2017-10-01 00:30 UTC



<https://fluid.nccs.nasa.gov/cf>