



Towards Chemical Forecasting with the GMAO's GEOS models

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Themes of GMAO's work

Weather Analysis and
Prediction

Seasonal-to-Decadal
Analysis and Prediction

Reanalysis

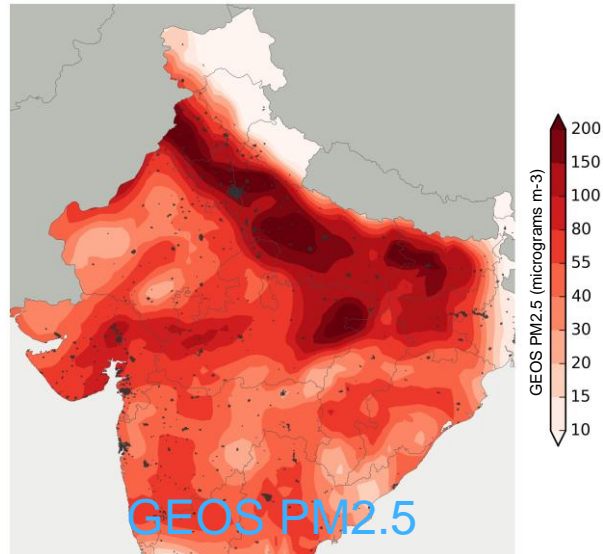
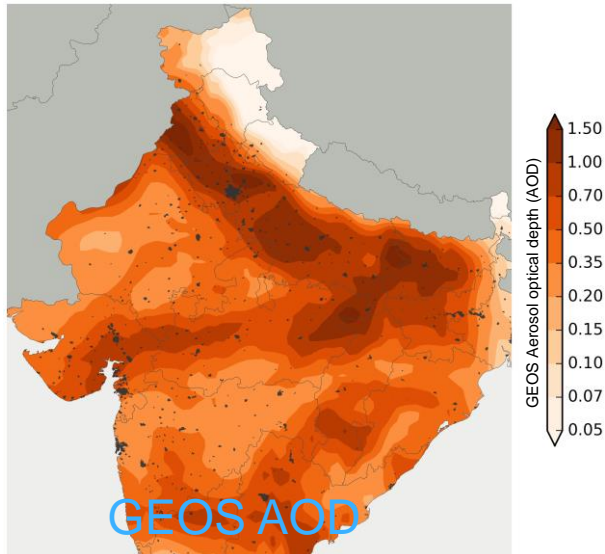
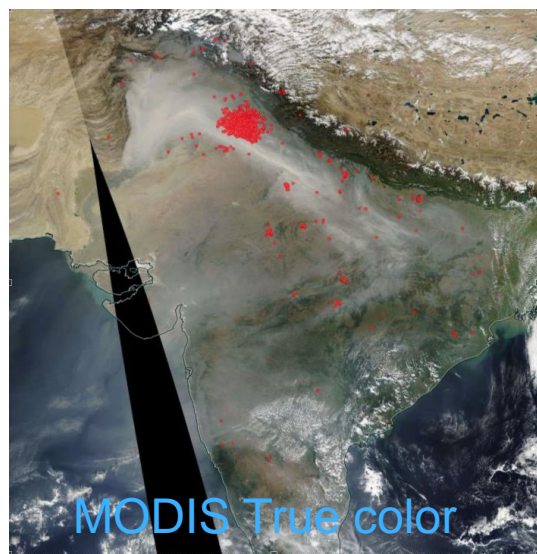
Global Mesoscale
Modeling

Observing System
Science

- These (non-orthogonal) themes span GMAO's main focus areas
- Strong emphasis on NASA's Earth Observations (use, support, planning)
- GEOS-5 research uses the same systems as used for product generation
- GEOS-5 is a modular system, encompassing many Earth System components

Taking Air Pollution to the Extreme

Agricultural Burning and the Air Over Northern India in 2016



The GEOS FP system captures the elevated pollution over India, shown for 08Z on November 6, 2016. This major pollution event caused extremely unhealthy air masses in New Delhi and the broad region in early November. With its computation of aerosol and pollutant emissions from fires detected by MODIS, the GEOS FP system provided realistic estimates of this surface pollution as well as strong evidence that the source was from agricultural burning practices that are prevalent at this time of year. The plots compare MODIS true-color imagery (left, showing fires as red dots) with GEOS estimates of AOD (middle) and PM2.5 (right).

Many steps in a collaboration between GMAO and Harvard

The GEOS-Chem CTM was based on using wind fields from the original GEOS meteorological analyses (Bey et al.)

Collaborative Harvard-GMAO implementation of “idealized” tagged CO tracers into GEOS model, in support of the Intex-NA field mission

Active collaboration over many years, focused on careful use of GEOS analyses (and forecasts) in GEOS-Chem CTM

NASA MAP funding (PI Jacob) led to development of the Grid-Independent GEOS-Chem modules: modular, flexible code base

Testing of GEOS-Chem modules in GEOS models, with a view towards adopting this mechanism in coupled chemistry-climate work (stratosphere!)

Running a prototype chemical forecasting system in research mode, with a view towards making an official product on the 6-12 month timeframe

Surface Ozone from GEOS model with GEOS-Chem

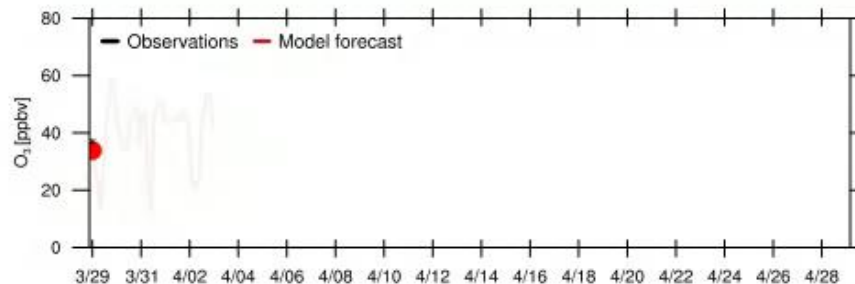
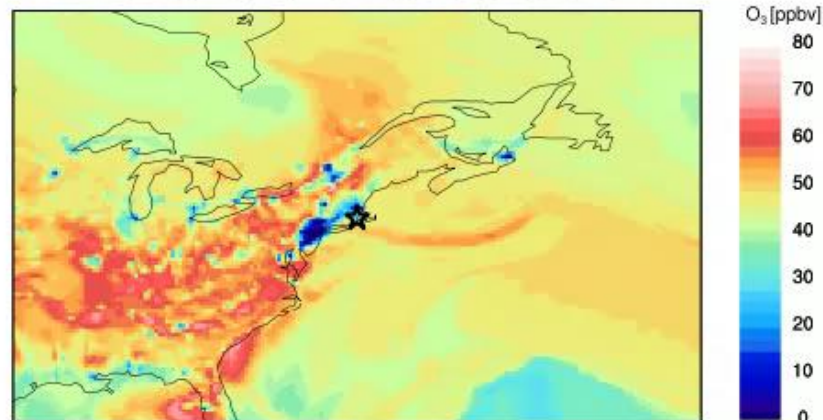
c360L72 configuration
of GEOS system
(~25km or 0.25 degree)

Meteorology “replayed”
to GEOS-FP (c720L72)

One five-day forecast
produced each day

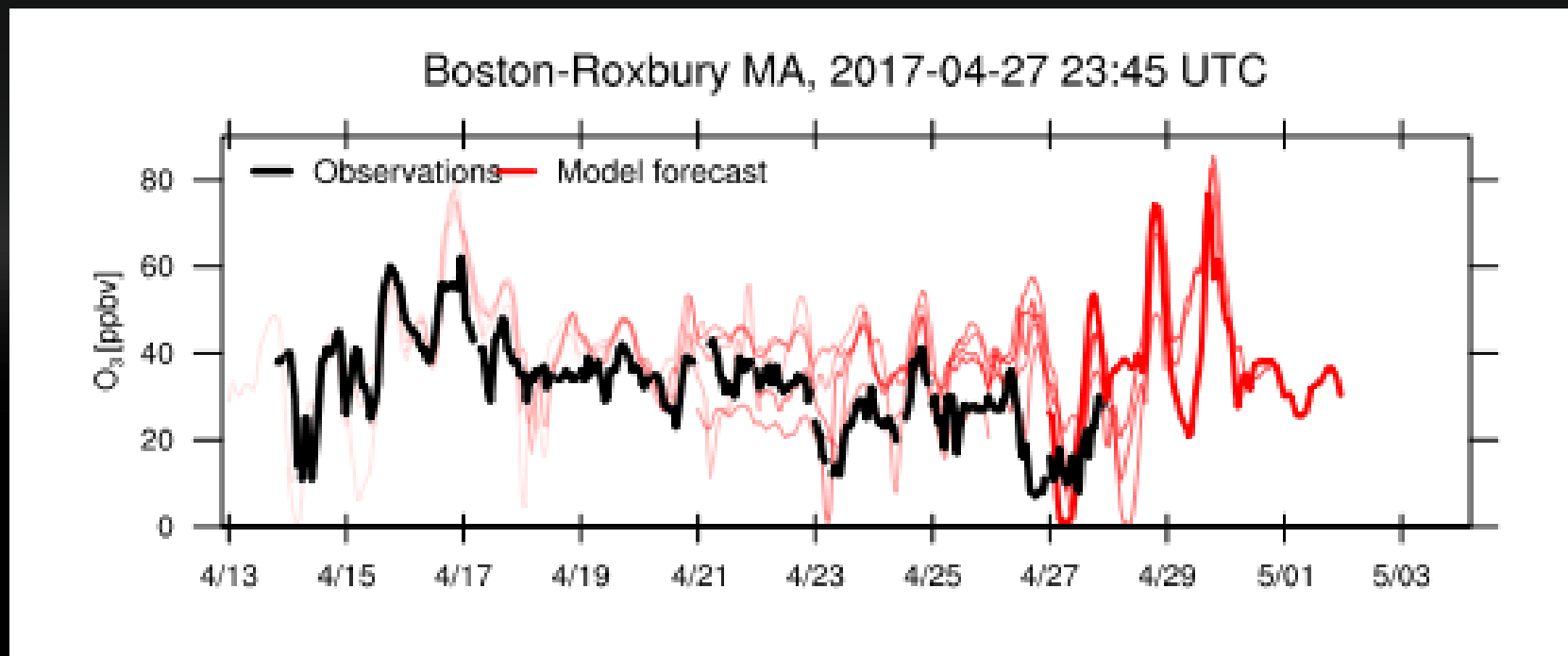
Completed by about
9AM EST

Providence RI, 2017-03-29 00:00 UTC

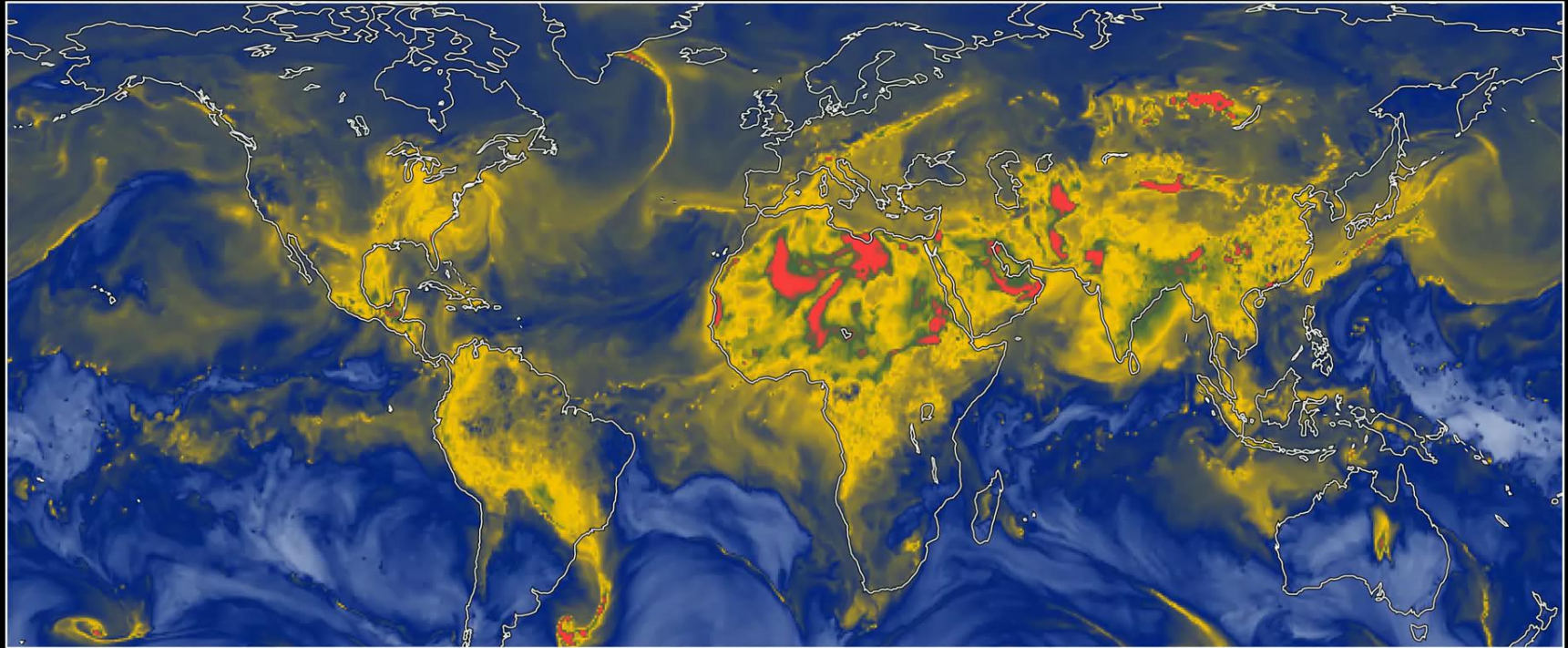


Providence, RI: Obs (black) forecast (red)

Surface Ozone observations (black) and forecasts (red) Boston, MA



Air Quality Health Index



GEOS-5 1/4°

GEOS-Chem v11-02



GMAO

Global Modeling and Assimilation Office
NASA Goddard Space Flight Center



Atmospheric Chemistry Modeling Group
Harvard University

Summary

A global chemical forecasting system, with ~25-km resolution, is being run each day using the GEOS-Chem modules in the GEOS model

This prototype system may go into production mode on the 6-12 month timeframe, depending on performance and resource availability

Plan to provide data access to interested parties, once some logistics are sorted out

Future enhancements may include “chemical assimilation” and development of faster chemical mechanisms

**An exciting new product that builds on capabilities of both the
GEOS-Chem community and the GMAO!**