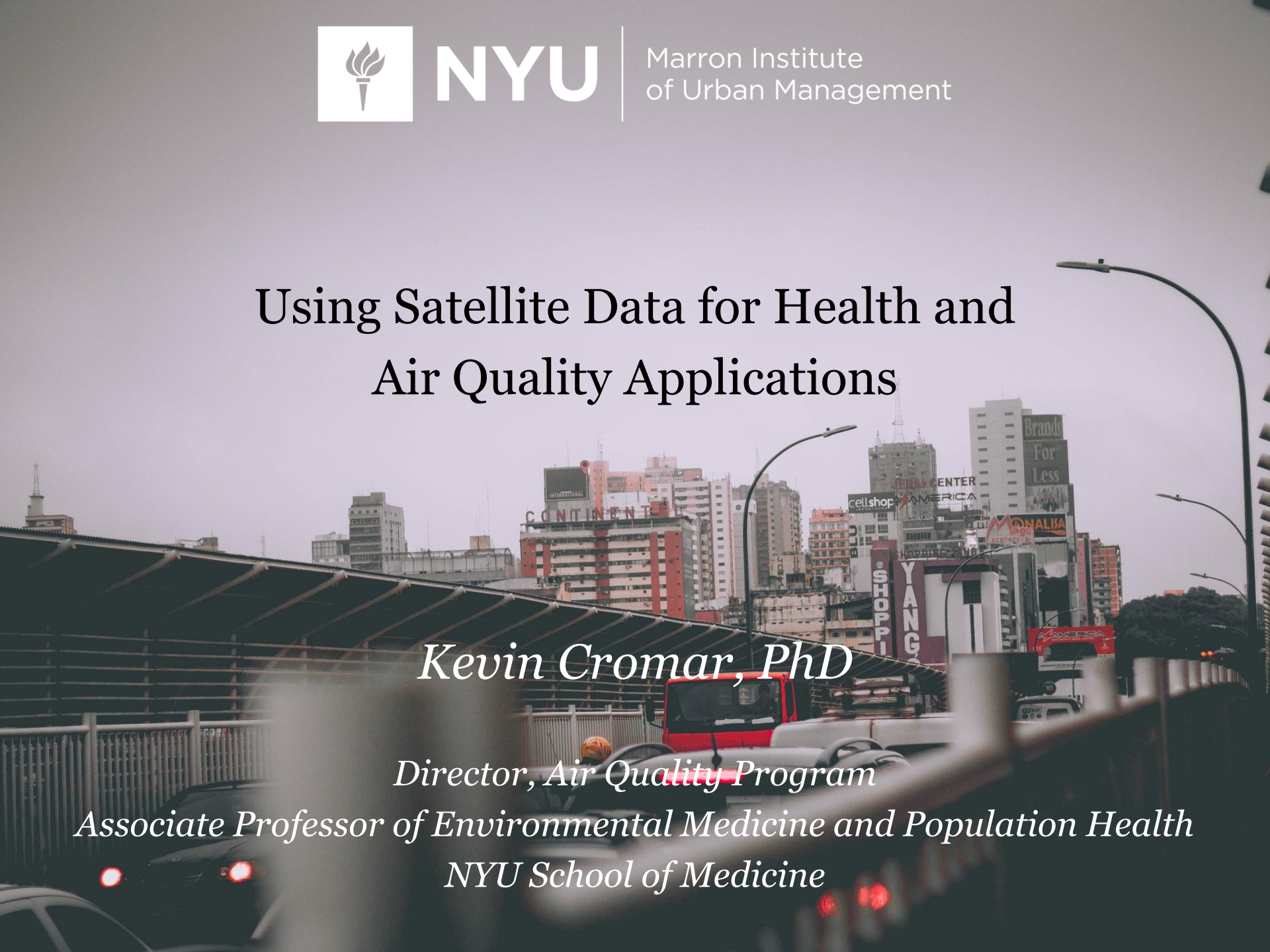


Using Satellite Data for Health and Air Quality Applications

Kevin Cromar, PhD

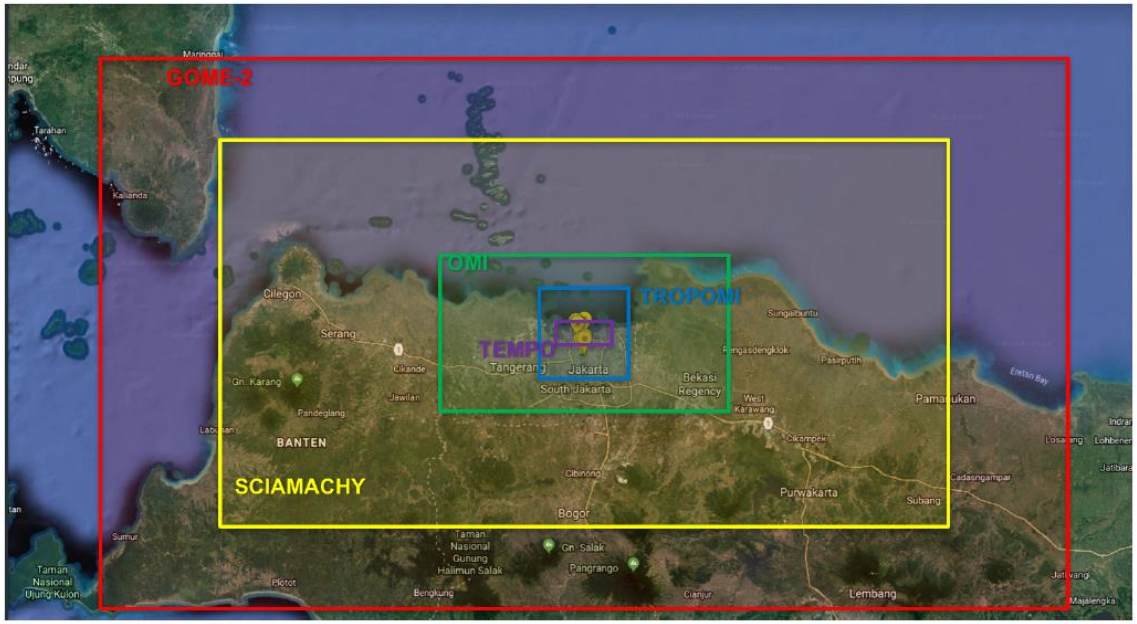
Director, Air Quality Program
Associate Professor of Environmental Medicine and Population Health
NYU School of Medicine

Upcoming Satellite Products Will Enable a New Generation of Health Research

TROPOspheric Monitoring Instrument (TROPOMI)

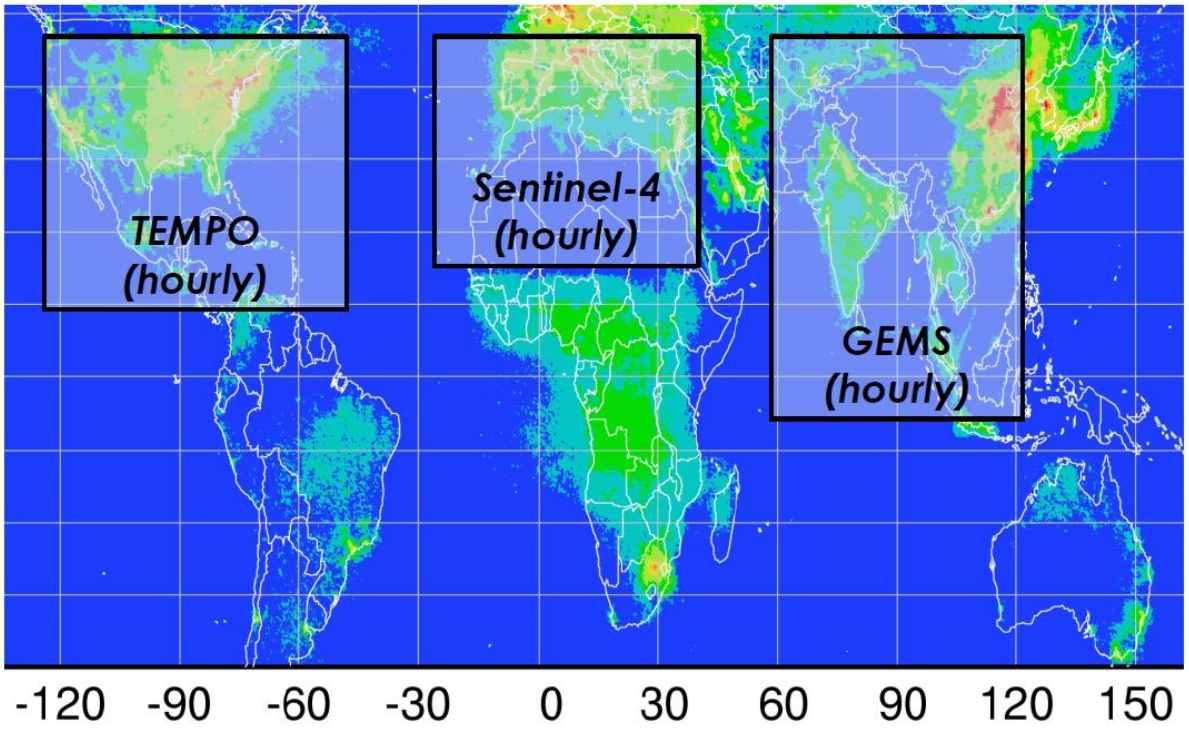
TROPOMI Highlights

- Launched on October 13 2017 by the European Space Agency
- Global Coverage
- Sub-urban spatial resolution (3.5 x 7 km^2)
- *1x/day*: NO_2, ozone (0-2 km vertical), aerosol, clouds, formaldehyde, glyoxal, SO_2, CO, methane



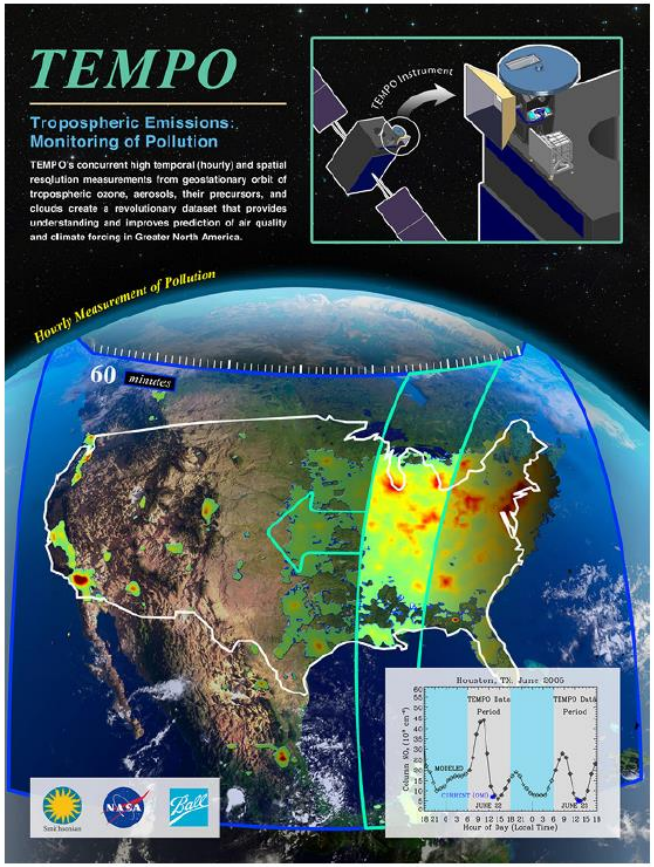
Global Pollution Monitoring Constellation (2020s)

- Improved emissions, at common confidence levels, over industrialized Northern Hemisphere
- Improved air quality forecasts and assimilation systems
- Improved assessment, e.g., observations to support United Nations Convention on Long Range Transboundary Air Pollution

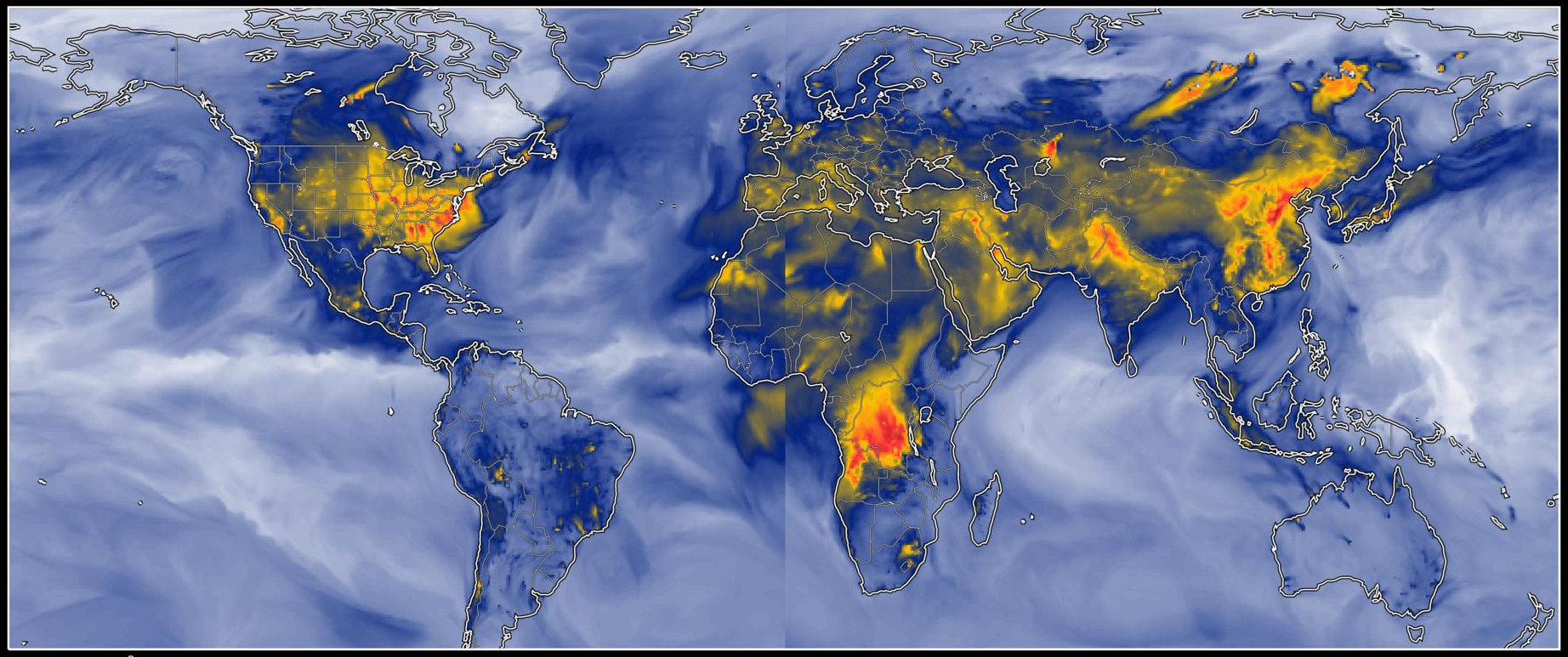


TEMPO: Tropospheric Emissions: Monitoring of Air Pollution

- Geostationary over North America
- High Temporal Resolution
  - 1 hr
- High Spatial Resolution
  - 2.2 x 4.7 km^2
- Spectral Range
  - 290-740 nm
- Data Products:
  - O_3, NO_2, $C_2H_2O_2$, aerosols, cloud parameters, & UVB radiation
- Expected Launch: 2021



Creating a Health-based Air Quality Index using Global Modeling Data



GEOS-CF 1/4°

GEOS-Chem v11-02

GMAO

Global Modeling and Assimilation Office
NASA Goddard Space Flight Center

0 5 10 15 20 25 30 35 40 45 50 55

Greater health risks

Atmospheric Chemistry Modeling Group
Harvard University

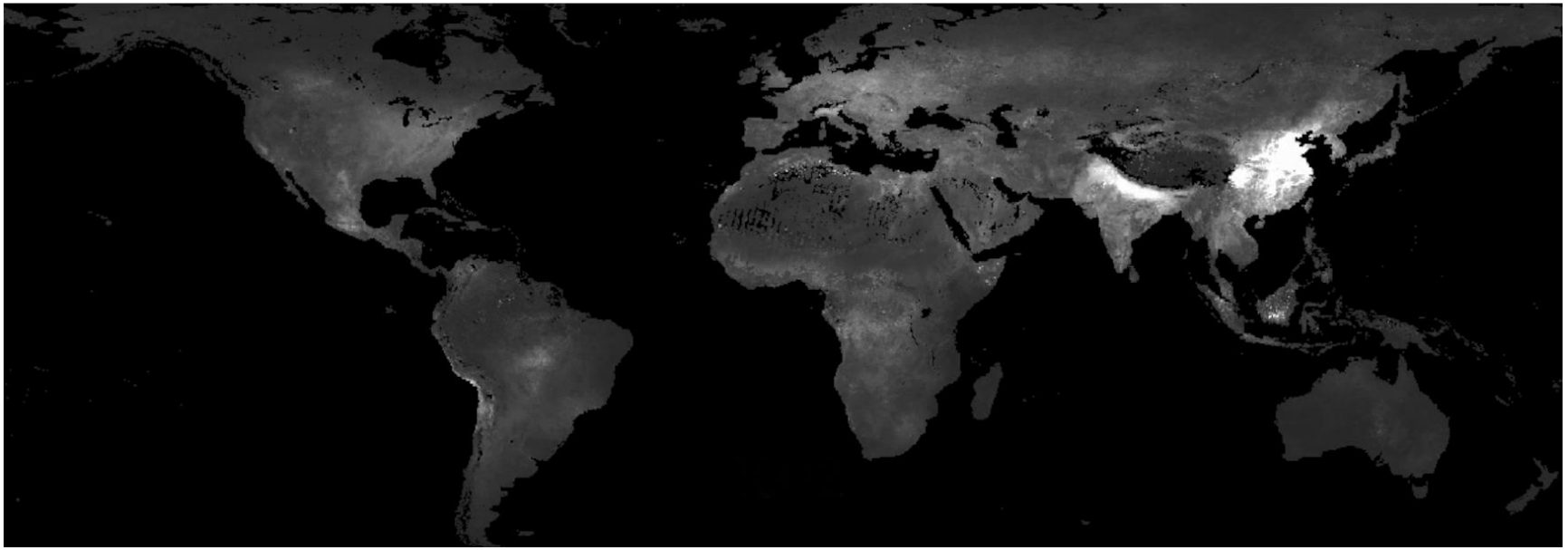
NYU Marron Institute of Urban Management

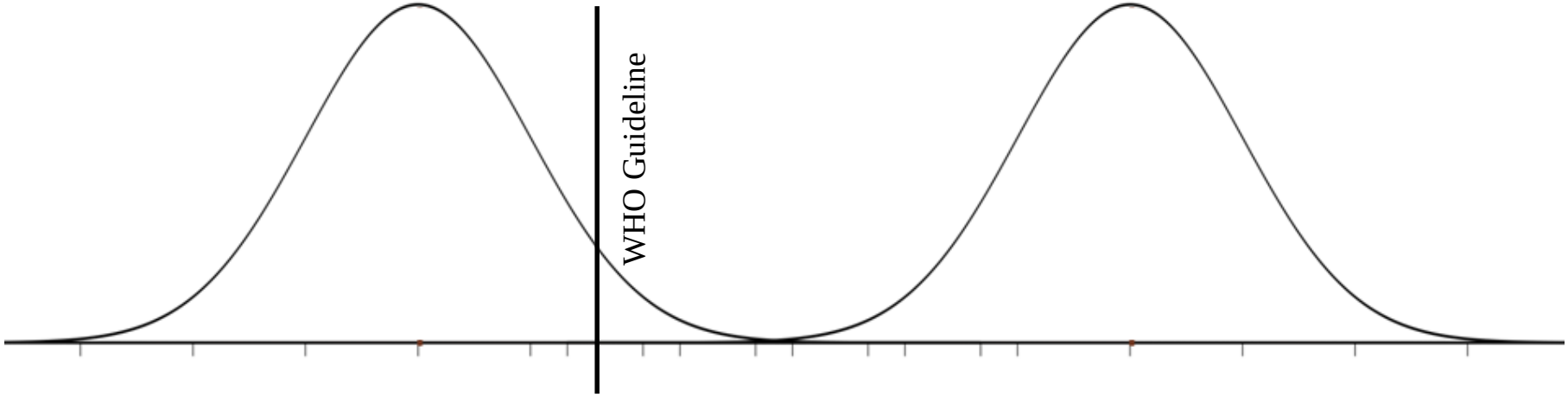
NASA's GEOS-CF System

Global air pollution model with forecasting capabilities:

- *The GEOS model/assimilation system (meteorology, transport, etc.)*
- *Aerosols from NASA's GOCART module*
- *Dynamic emissions modules*
- *The GEOS-CHEM chemical mechanism*
- *Many [NASA] observations of physical and chemical parameters (i.e., distribution of fires, vegetation, ocean color, etc.)*

Target date for routine production system is early 2019





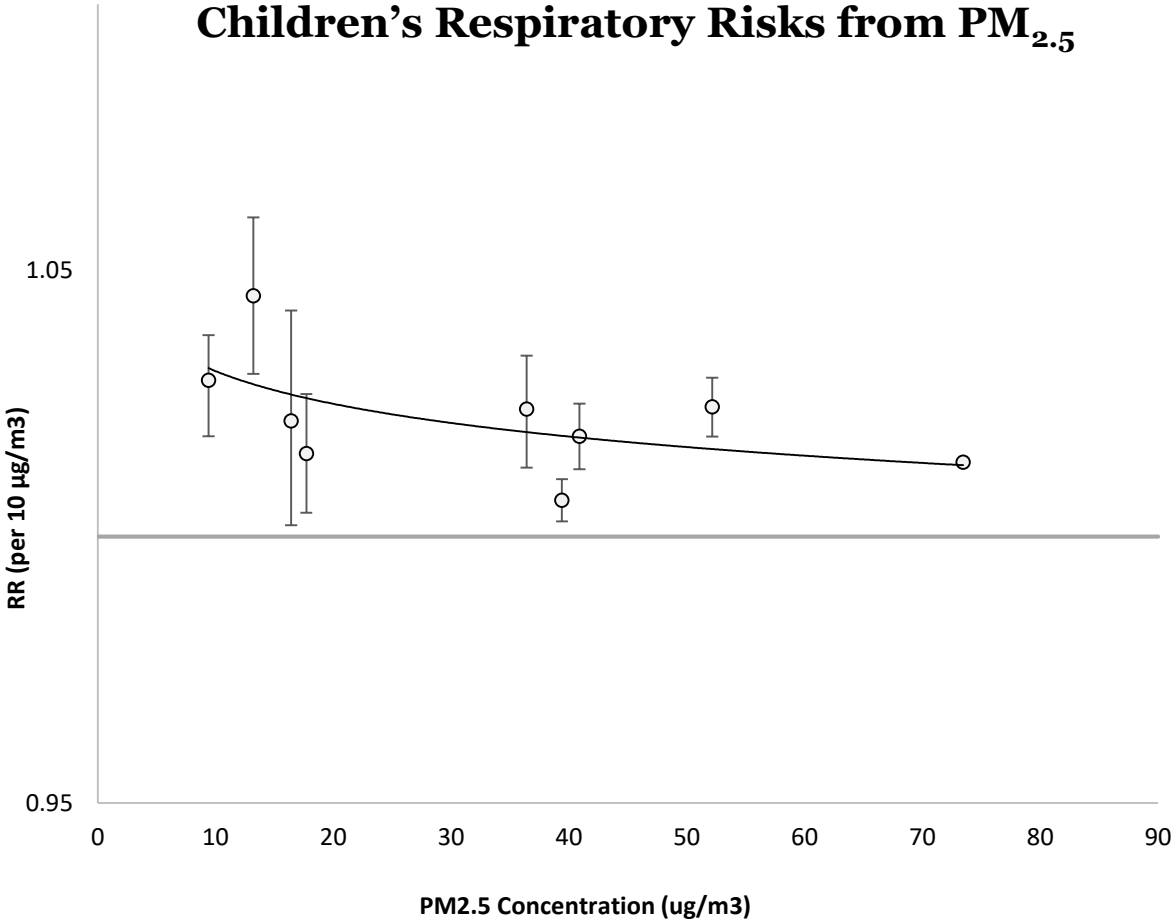
Good	Satisfactory	Moderate	Poor	Very Poor	Severe
0-50	51-100	101-200	201-300	301-400	>401

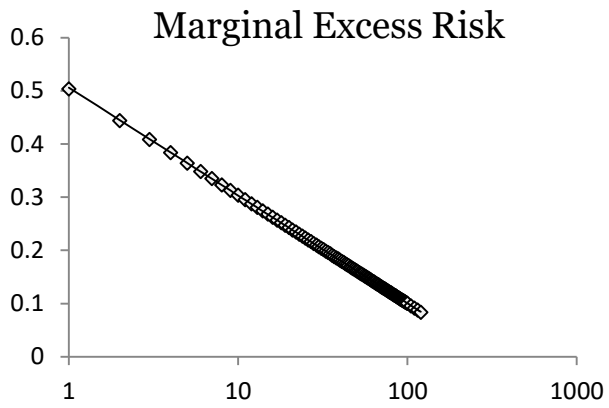
Initial search terms were run through the Ovid Medline, Embase, CINAHL, Wiley Cochrane, CENTRAL, and Web of Science. **Terms included air pollution terminology, specific respiratory outcomes and a list of countries** in order to capture any studies with data from developing nations.

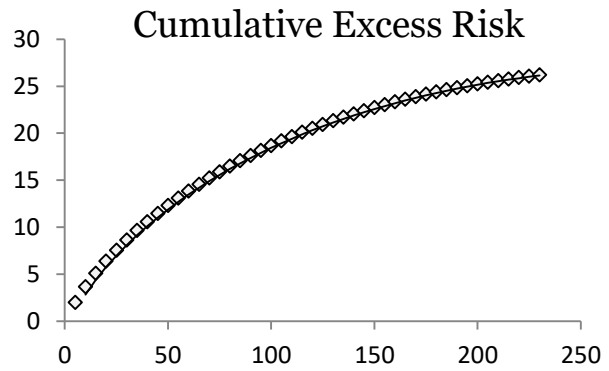
The resulting 5,868 results were screened using Covidence online software, restricting results to systematic reviews and meta-analyses. Title and abstract screening. Remaining articles were downloaded and a **full text screening was performed** to remove remaining mortality-only studies, as well as articles not reporting on one of the four focus pollutants ($PM_{2.5}$, O_3, NO_2, SO_2) or not providing relative risks by continuous pollutant concentration change.

32 systematic reviews and meta-analyses were extracted and from these, a total of **75 relevant studies were pulled and summarized** in a preliminary database.

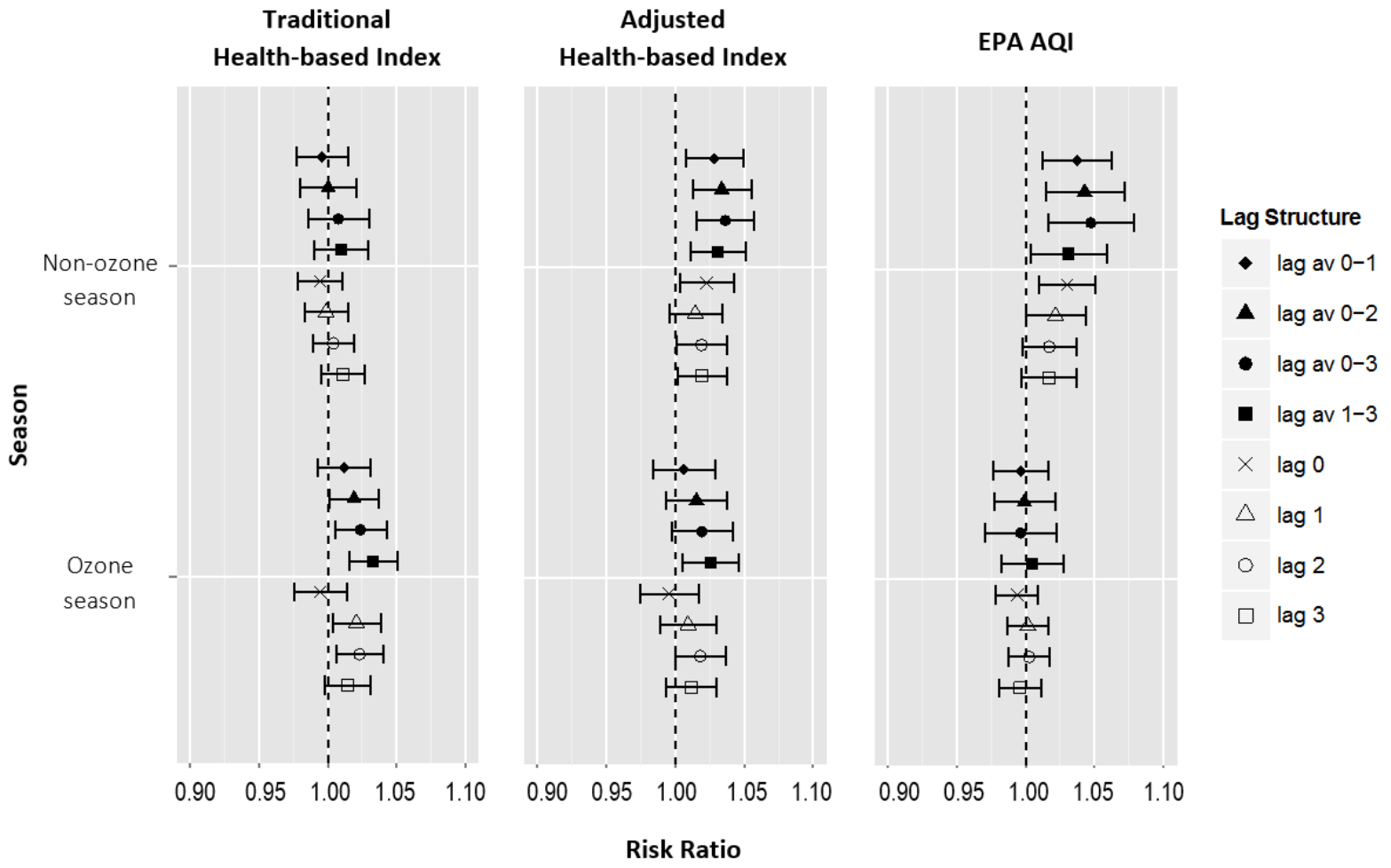
Children's Respiratory Risks from $PM_{2.5}$



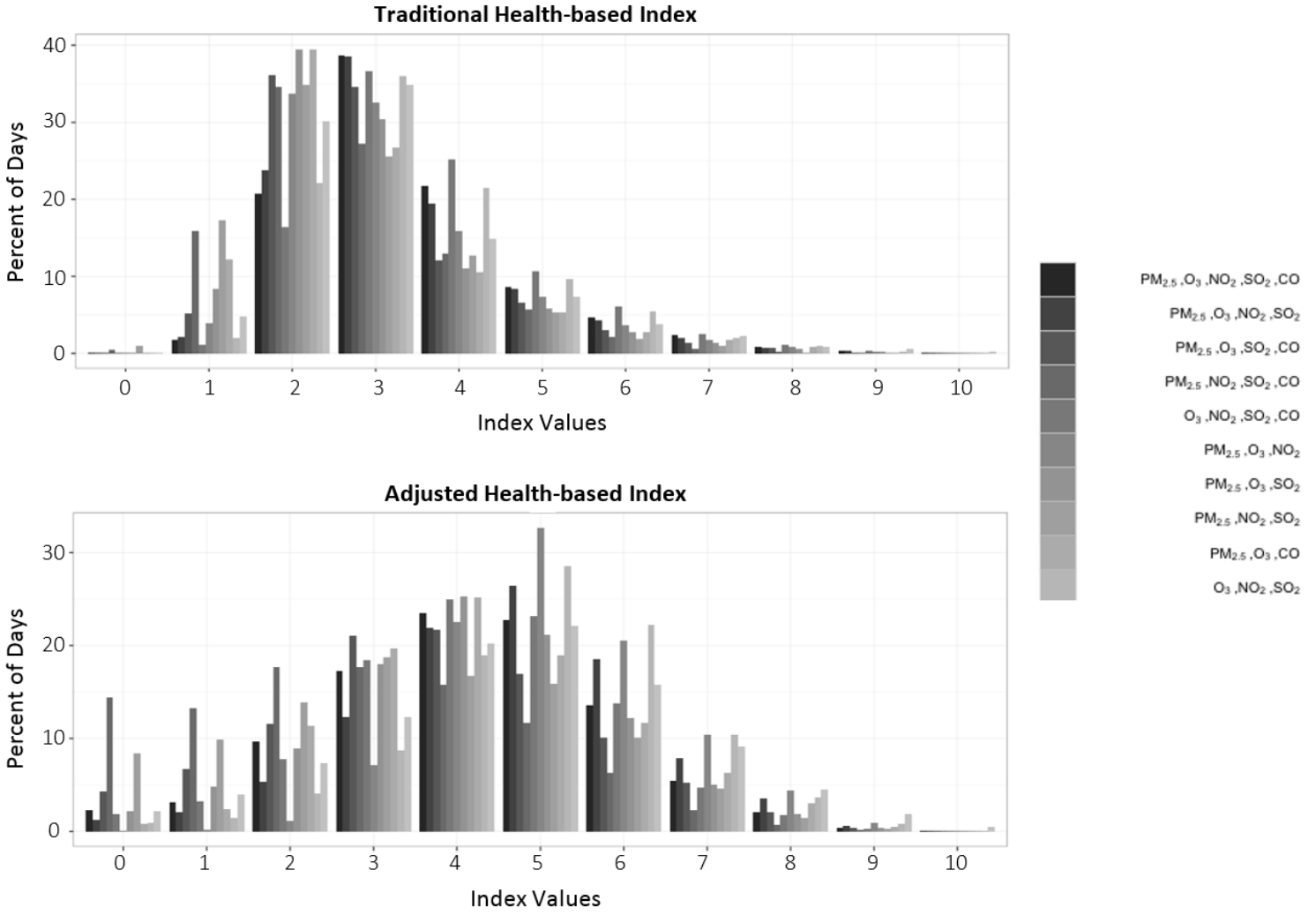




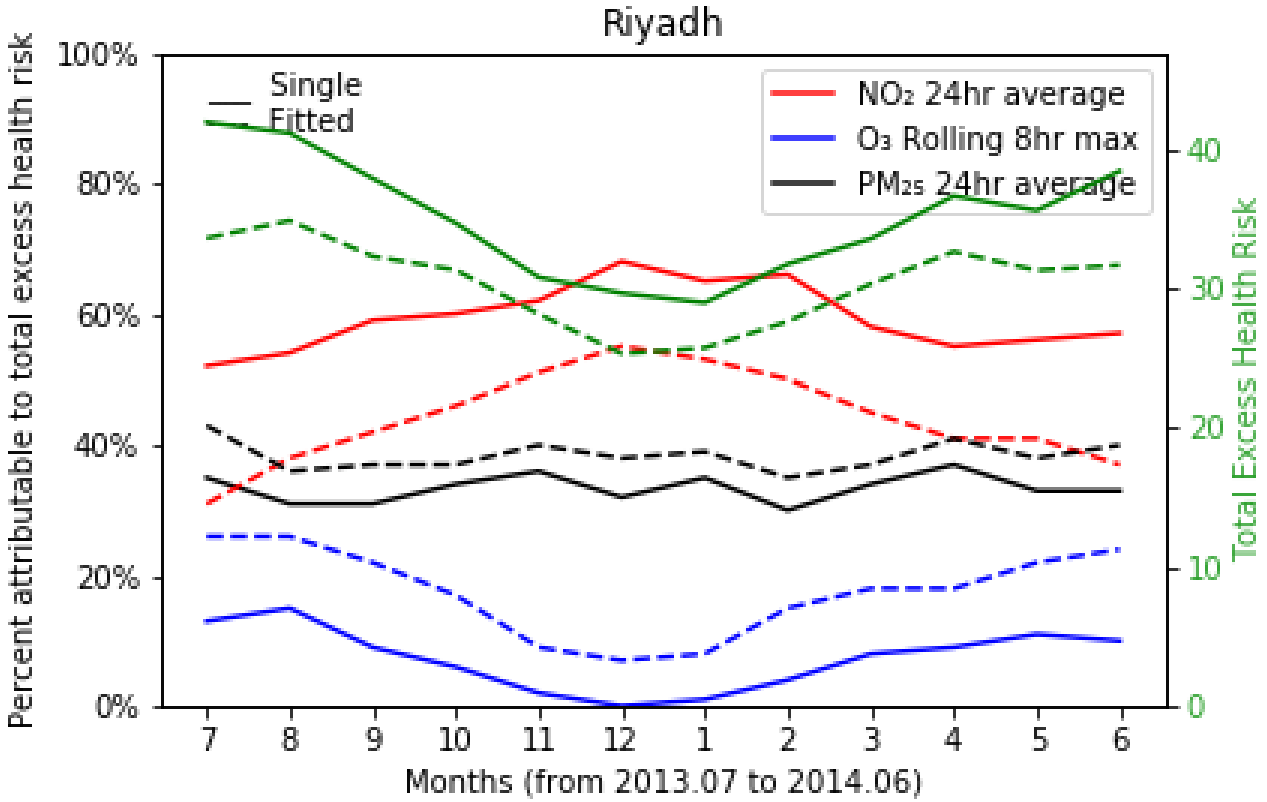
Verification using Population Health Data



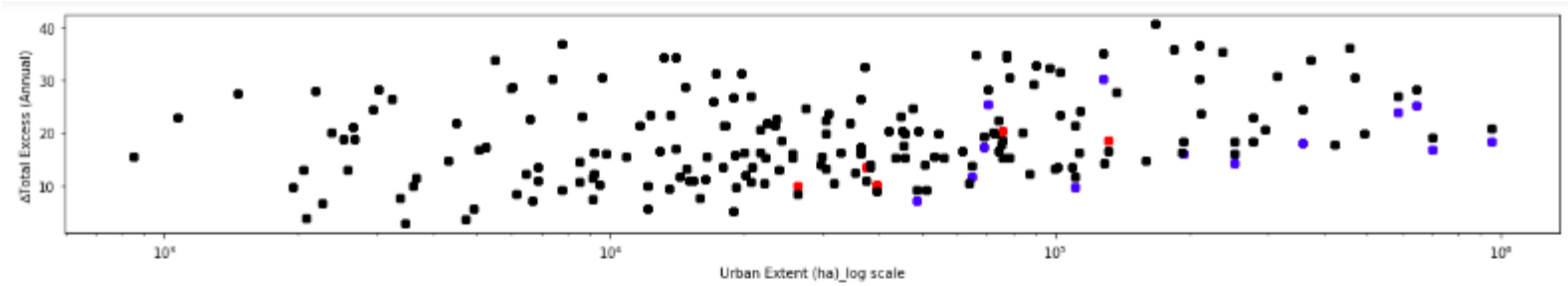
Verification using Index Value Distributions



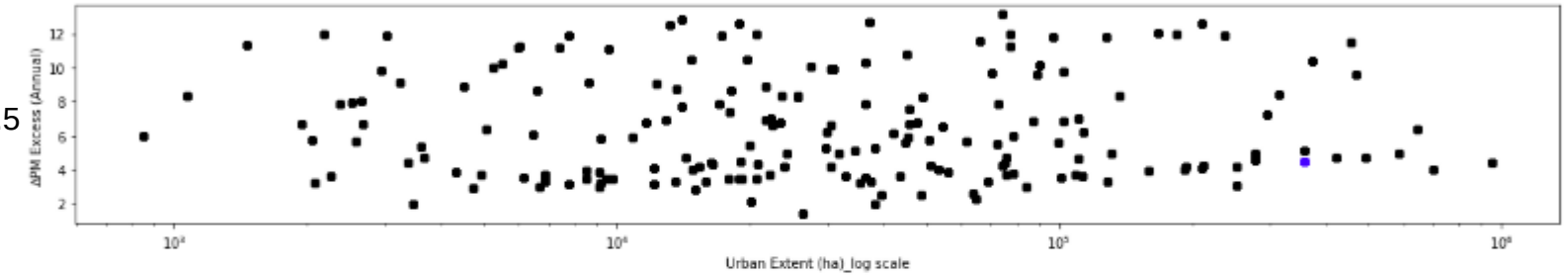
Urban Extent & City-Level Pollution Estimates



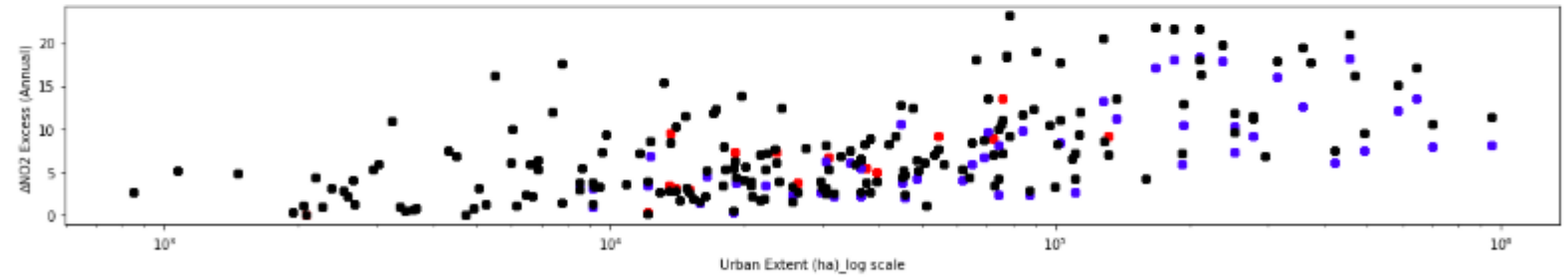
Total



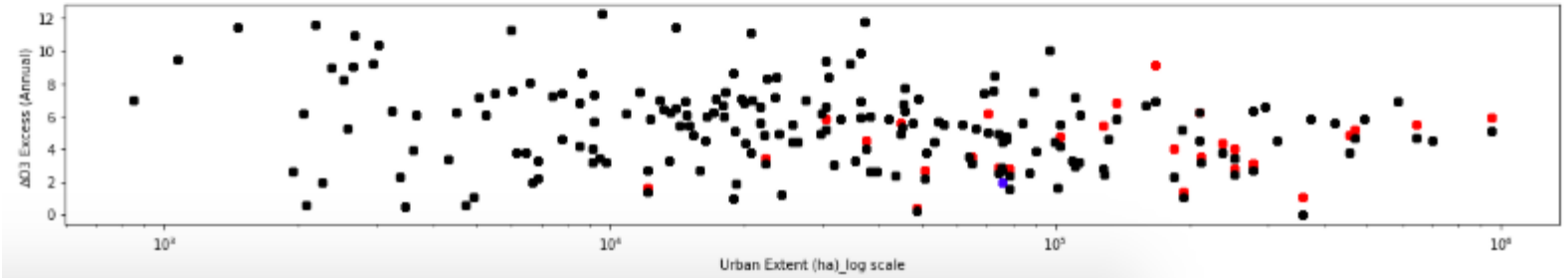
$PM_{2.5}$

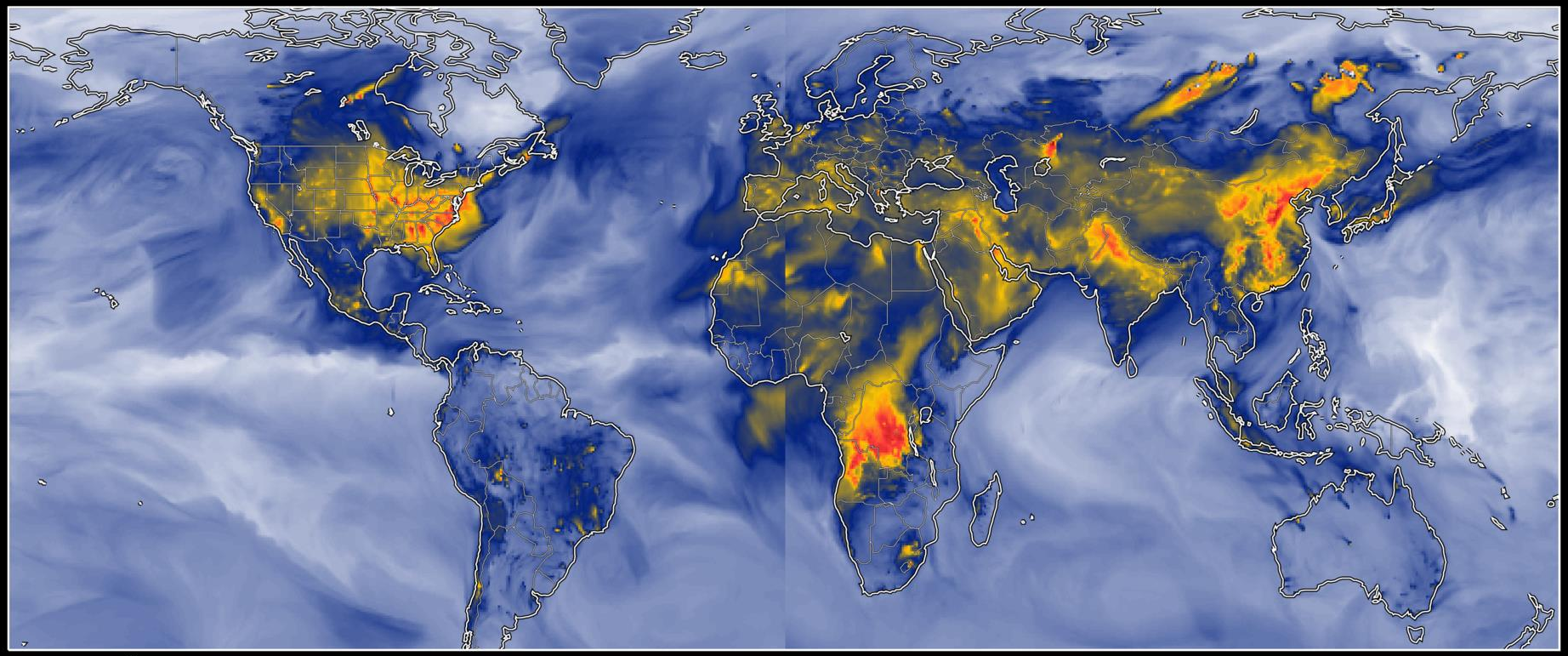


NO_2



O_3





GEOS-CF 1/4°

GEOS-Chem v11-02

GMAO

Global Modeling and Assimilation Office
NASA Goddard Space Flight Center

0 5 10 15 20 25 30 35 40 45 50 55

Greater health risks

Atmospheric Chemistry Modeling Group
Harvard University

NYU Marron Institute of Urban Management

Summary of Main Points

- Upcoming satellite data products (e.g., TEMPO, MAIA) will enable a new generation of air pollution health research due to improved spatial, and more importantly, temporal resolution
- Global models (e.g., GEOS-CF) are now able to provide forecasted and real-time pollution estimates at the city-level enabling global risk communication
- Urban extents need to be accounted for when estimating city-level air pollution for health purposes