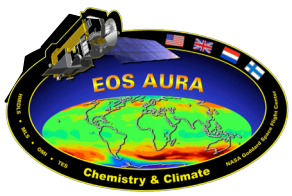


A Satellite-Based Global Health Air Quality Index (HAQI)*: Development and Assessment

Bryan Duncan[1] (PI), Lok Lamsal[1] (Co-I), & Kevin Cromar[2] (Co-I)

[1]NASA Goddard Space Flight Center, Greenbelt, MD

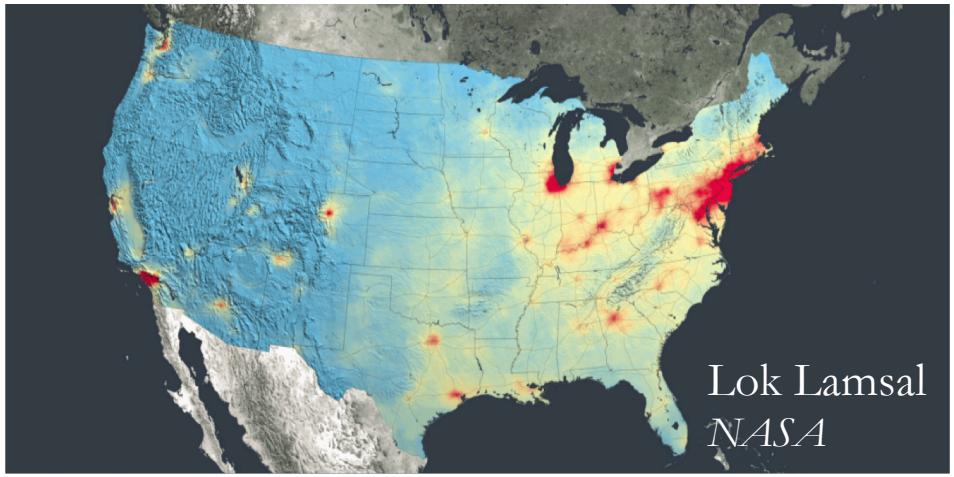
[2]NYU, NYC, NY

***Based on:** Cooper, M., R.V. Martin, A. van Donkelaar, L. Lamsal, M. Brauer, and J. Brook, A satellite-based multi-pollutant index of global air quality, Env. Sci. and Tech., 46, 8523-8524, 2012.

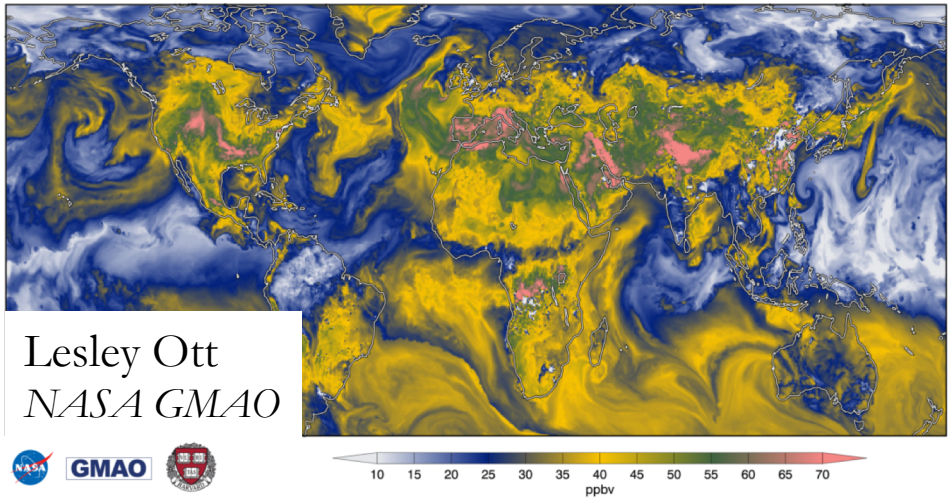
Advantages of Satellite Observations

→ The unique advantages of satellites is 1) global spatial coverage & 2) co-located observations of multiple pollutants.

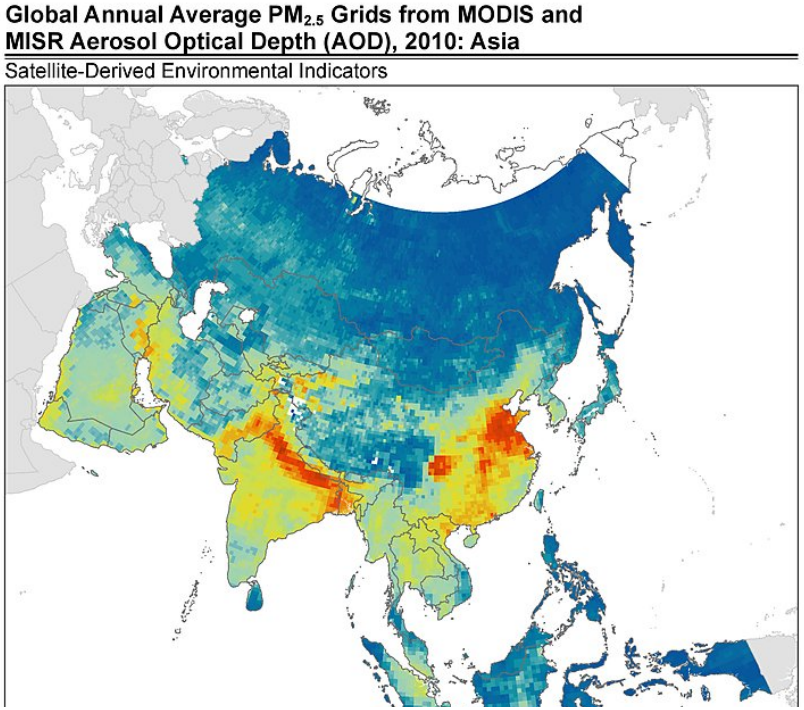
Aura/OMI NO_2



NASA GEOS-5 Model



Multi-Satellite: AOD → $PM_{2.5}$

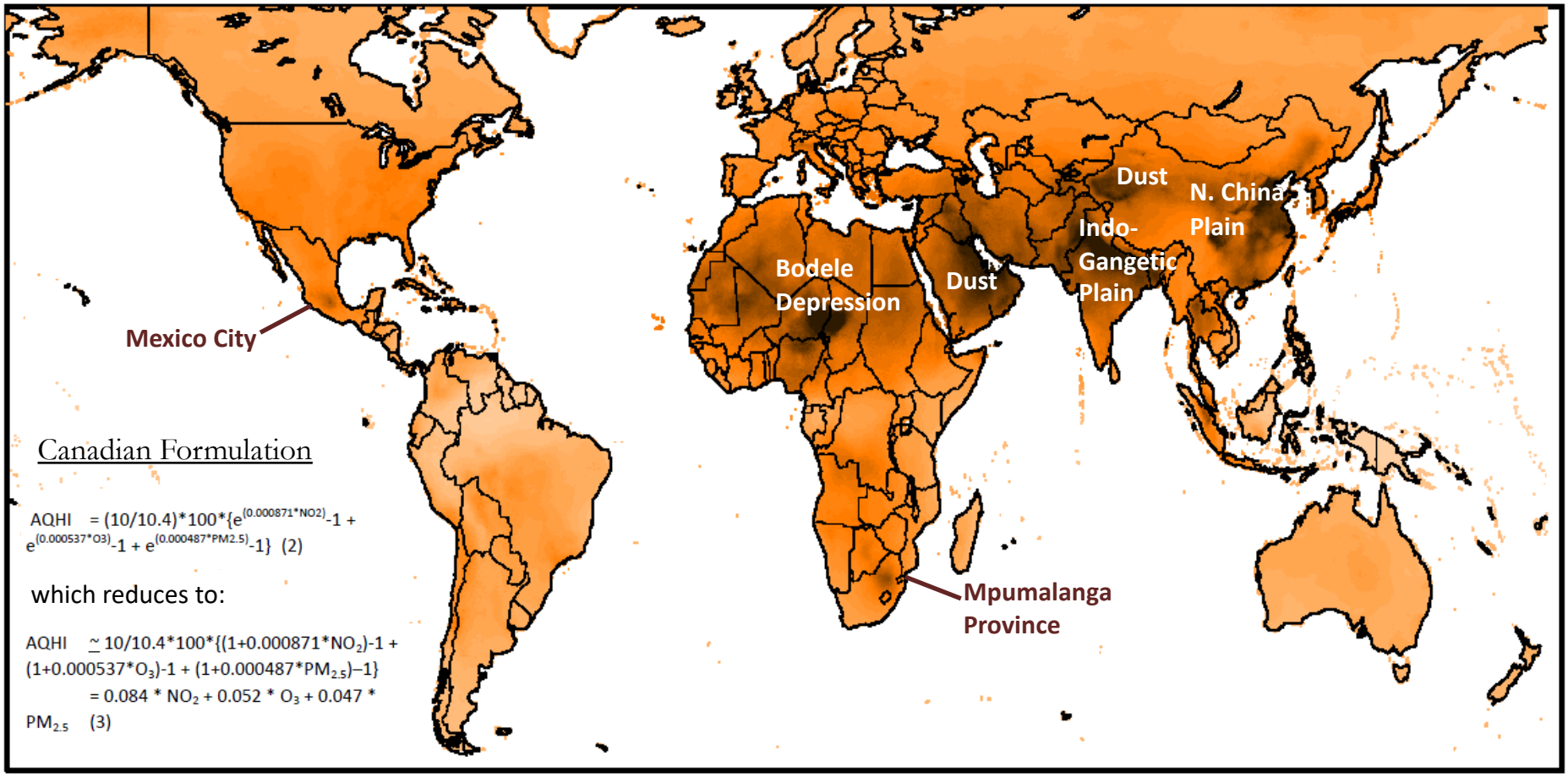


Aaron van Donkelaar & Randall Martin
Dalhousie University

Monthly/Annual HAQI for now with goal of Near-Real Time in future.

Formulation of Health Air Quality Index (HAQI)

Historical HAQI



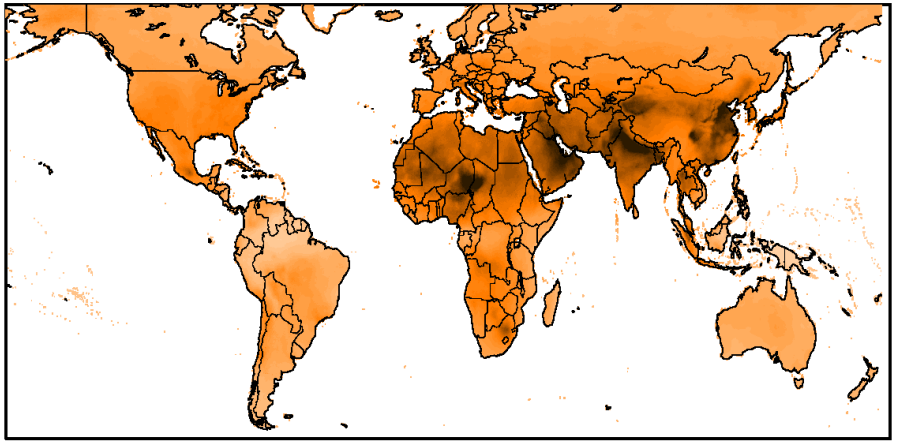
*Annual Mean & Based on Canadian HAQI formulation.

* $PM_{2.5}$, O_3, & NO_2 correlated with morbidity and mortality.

Formulation of Health Air Quality Index (HAQI)

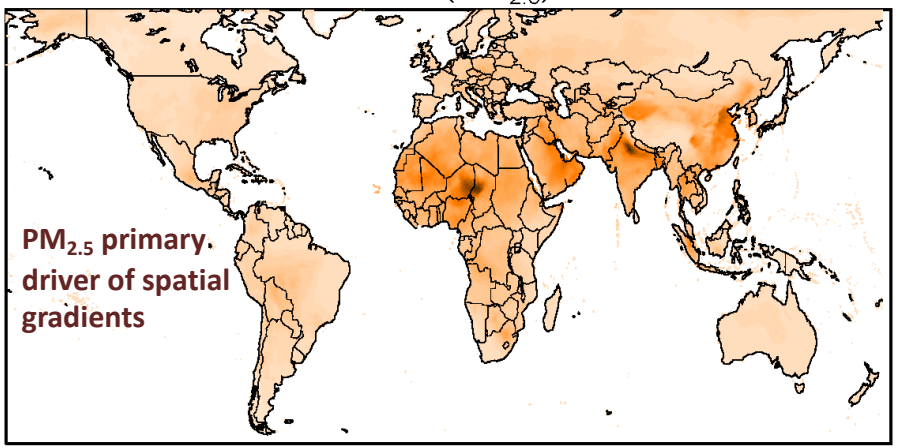
Breakdown of Individual Pollutant Contributions

AQHI ($PM_{2.5}$ + O_3 + NO_2)



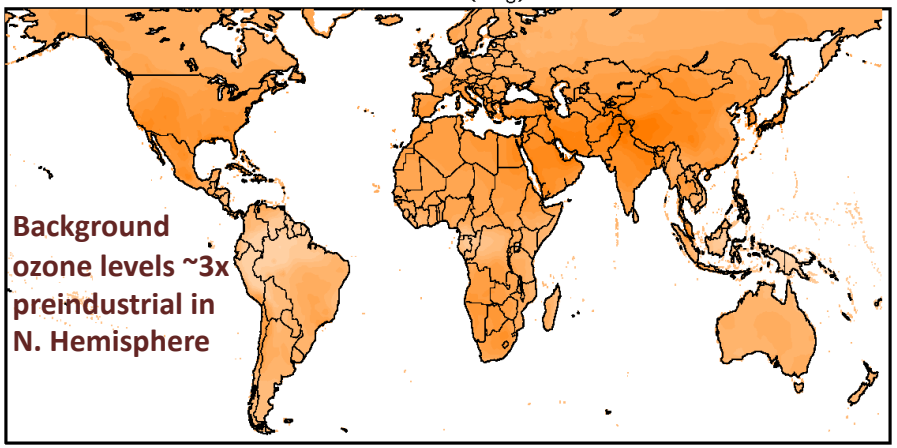
0.2 1.6 3.0 4.4 5.8

AQHI ($PM_{2.5}$)



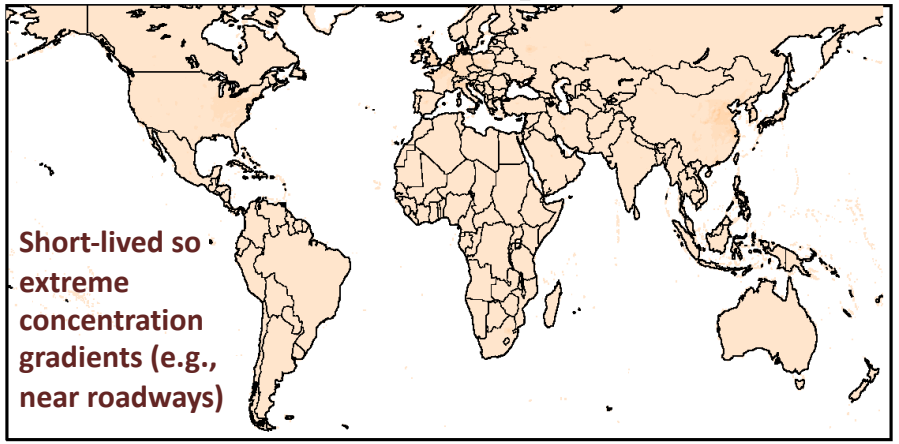
0.2 1.6 3.0 4.4 5.8

AQHI (O_3)



0.2 1.6 3.0 4.4 5.8

AQHI (NO_2)



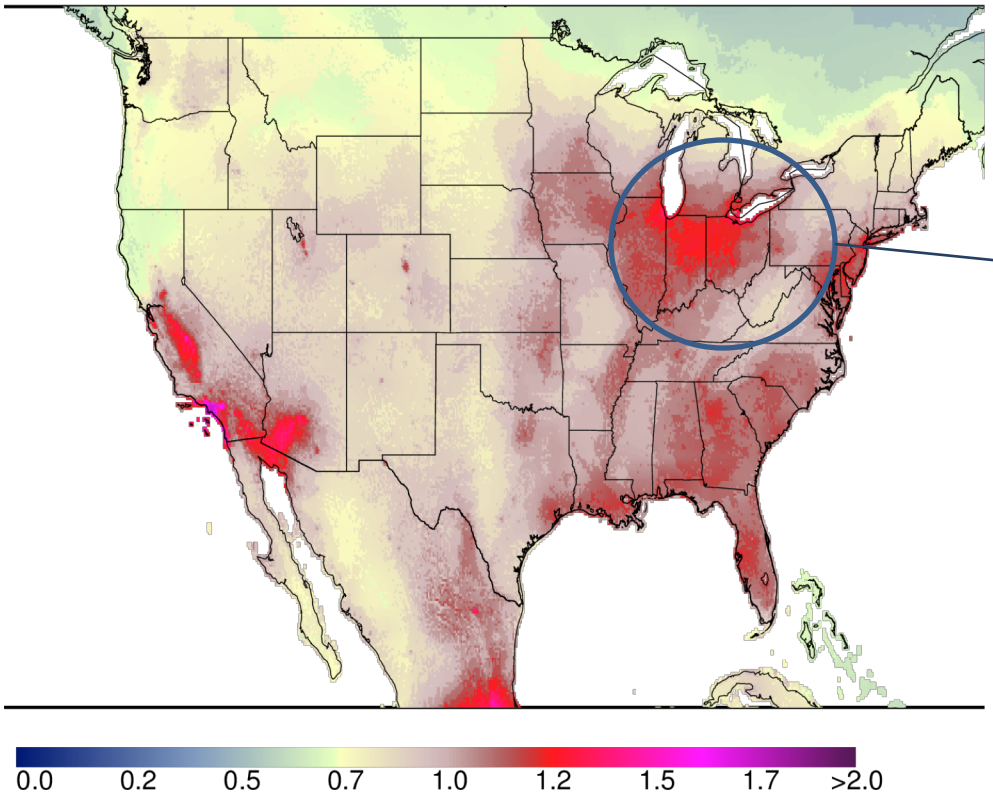
0.2 1.6 3.0 4.4 5.8

** Day-to-day HAQI variations may tell a different story than an annual mean.

Exploring Alternate Formulations of the HAQI

- Different formulations have varying sensitivities to inputs.
  Which formulation to use? Are they valid for diverse regions?

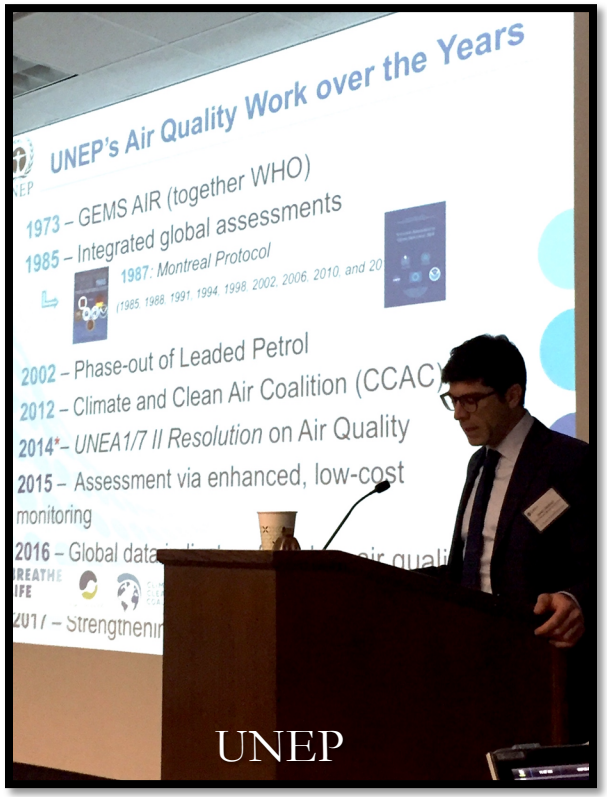
- We need help inferring monthly PM from AOD!
  Only have annual now.

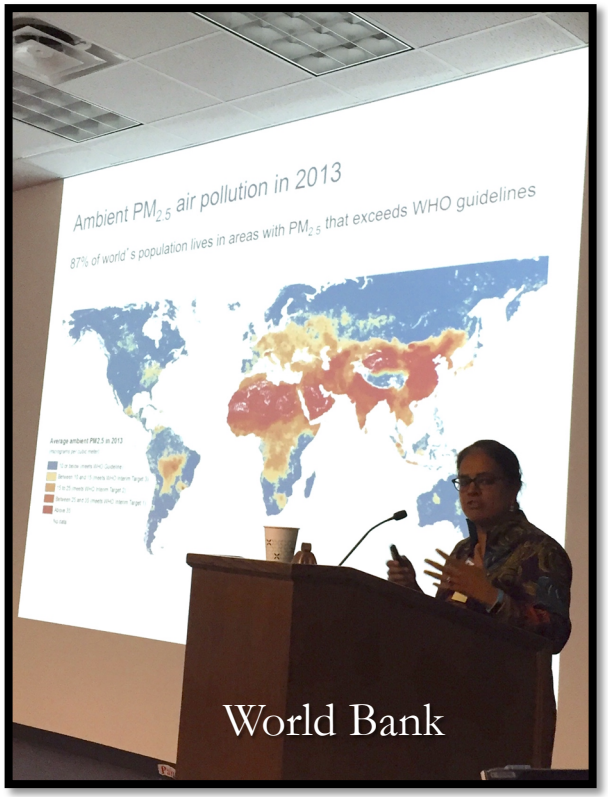


e.g., Is this real?

NASA Goddard Air Quality & Health Showcase (Nov. 17th, 2016)

Goal: Create opportunities to form collaborations with NASA in environmental health applications.





NASA Goddard Air Quality & Health Showcase (Nov. 17th, 2016)

An Idea Emerges!

Meeting leads to UNICEF – NASA – NYU Partnership

UNICEF: Mark Anthony, Nick Rees, and Toby Wicks

NYU: Kevin Cromar

NASA: Steven Pawson (GMAO), Bryan Duncan

→ UNICEF wants AQ alert system to warn guardians of children with respiratory diseases (e.g., asthma)

- **GMAO: augmenting their existing forecasts of PM, CO, & SO_2 to include O_3 & NO_2.**
- **UNICEF: Developing telephone app, website, etc. for distributing alerts.**
- **NYU: Developing HAQI formulations for specific childhood respiratory illnesses.**
- **NASA: Historical HAQI (context for forecasts) & validating forecasted HAQI.**

Follow-up Meeting at UNICEF HQ, NYC (Jan. 23rd, 2017)

***UNICEF*: Toby Wicks + graphic designers/web developers**

***NYU*: Kevin Cromar**

***NASA*: Bryan Duncan**

UNICEF wants August rollout!
Publicity Gala!

→Refined plan of action.

NYU funding/deploying ~150 low-cost AQ monitors to be placed at UNICEF country HQs. Will use in multiple ways, including validating HAQI.

→ <u>As an aside</u>: Several UNICEF personnel expressed interest in using other NASA satellite datasets for a variety of applications.

NASA GMAO GEOS-5 Forecast Model

Example

Red dots = detected fires

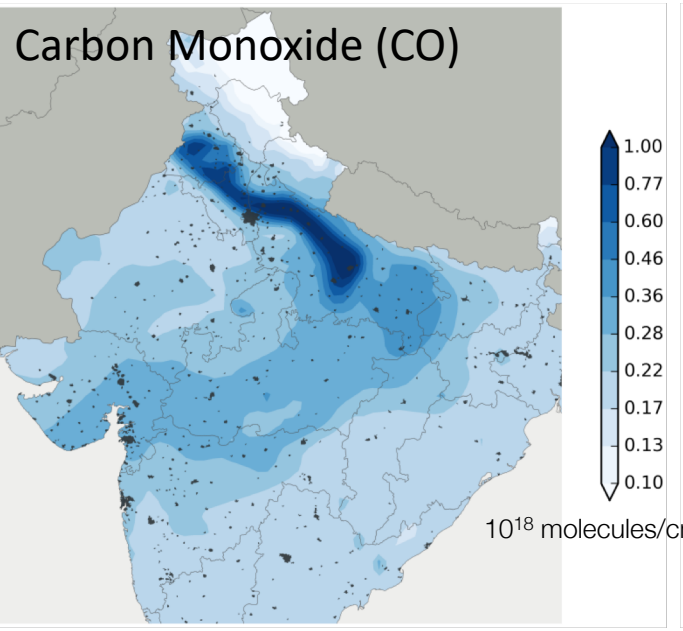
Excessive Exposure =
Seasonal Agricultural Burning
+ Air Pollution +
Air Stagnation

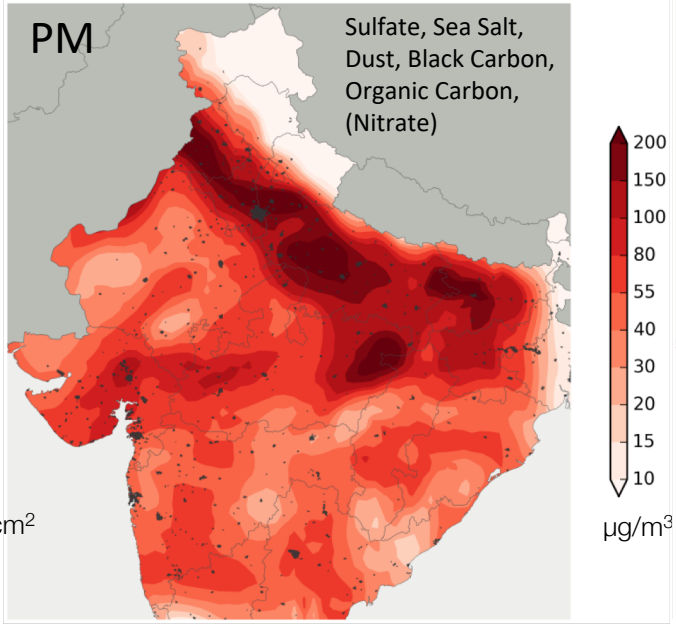
Provided by Anton Darmenov (NASA GMAO)

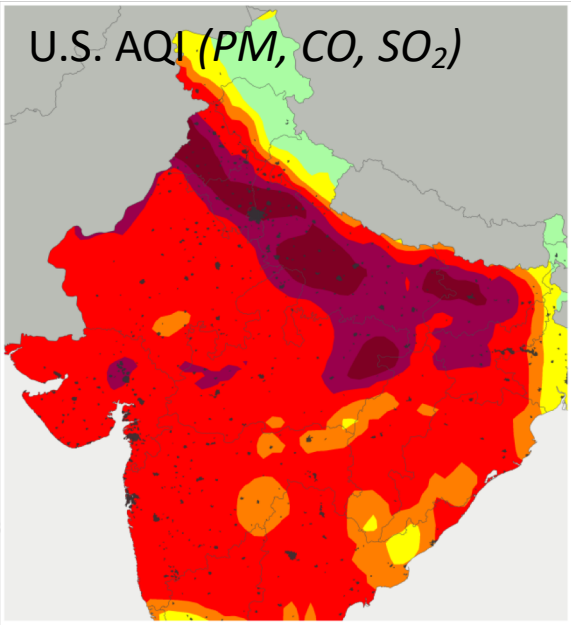
November 02, 2016

Forecast model output:
~12x12 km^2

now: Carbon Monoxide (CO), $PM_{2.5}$ (speciated) & Sulfur Dioxide (SO_2)
future: Ozone (O_3), Nitrogen Dioxide (NO_2)

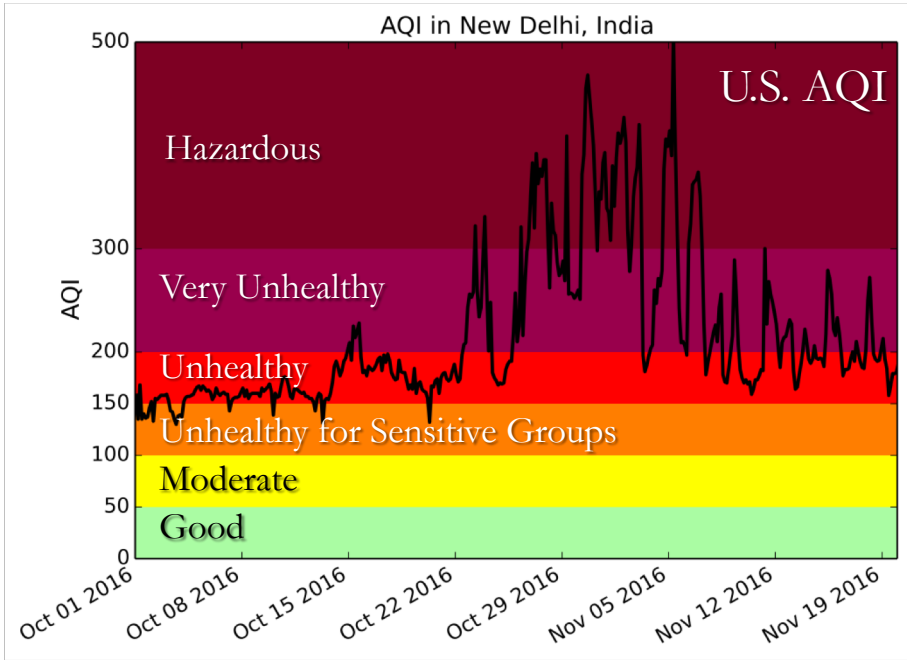




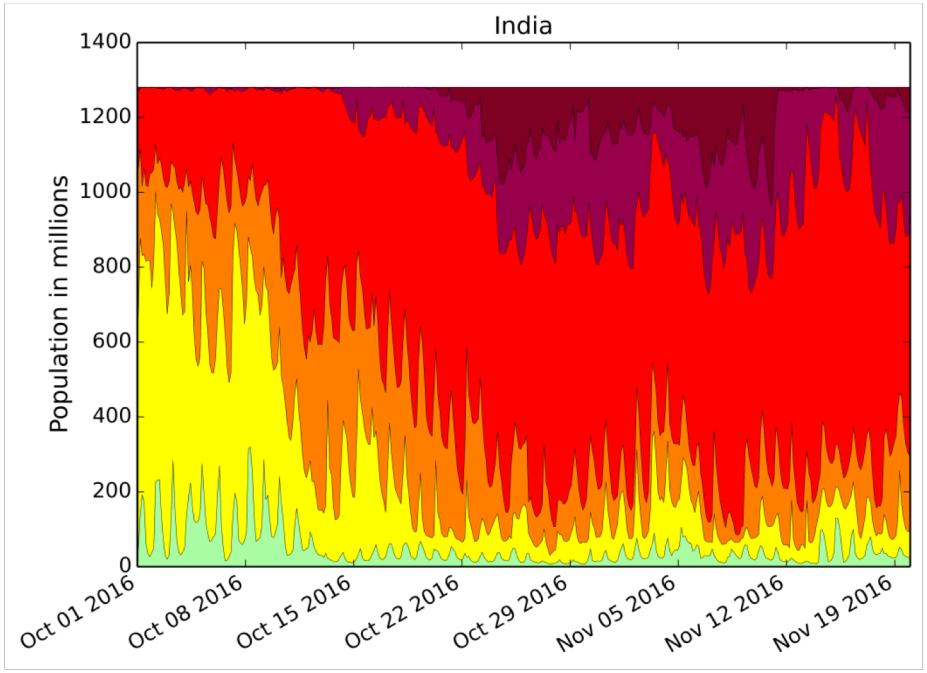


NASA GMAO GEOS-5 Forecast Model

Exposure in New Delhi



Population Exposure in India



Other Stuff

SatSummit (Jan. 31st, 2017 in DC): Lightning talk, entitled
"Satellite Data for Health & Air Quality Applications"

Upcoming American Thoracic Society Workshop (May 20th, 2017 in DC):
Co-organizer with Kevin Cromar (NYU)
"Air Pollution Monitoring for Health Research and Patient Care"
Goal: Bring together a range of experts to discuss ways to collect air pollution data from personal monitors to satellites.

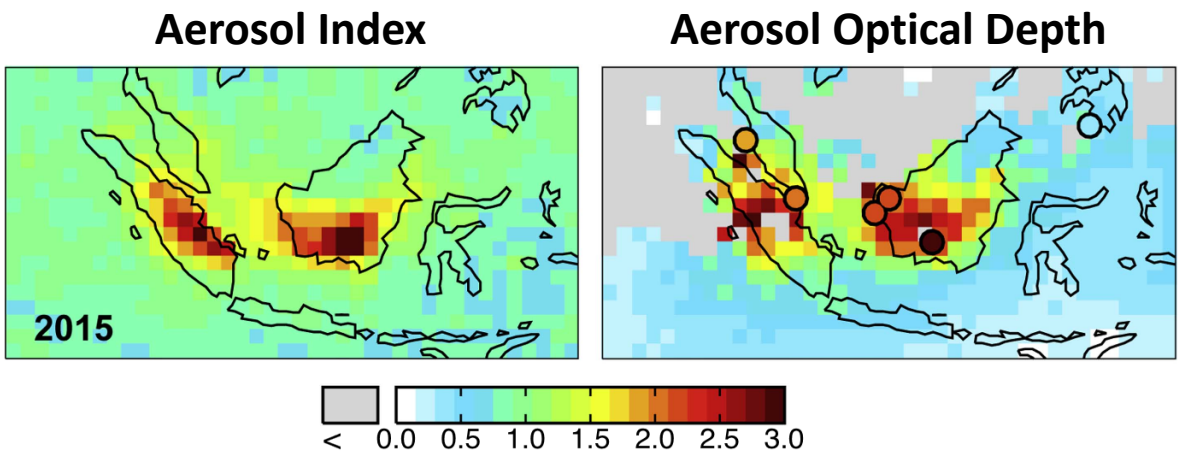
Aura Satellite Senior Review Proposal (due March 3rd):
In the last few years, Aura data (NO_2, AI, UV, HCHO) used for health applications.

Application: Mitigation Strategy Development

- ~100,000 Excess Deaths
- Used satellite data for short and long-term mitigation strategy development

Public health impacts of the severe haze in Equatorial Asia in September–October 2015: demonstration of a new framework for informing fire management strategies to reduce downwind smoke exposure

Shannon N Koplitz[1,9], Loretta J Mickley[2], Miriam E Marlier[3], Jonathan J Buonocore[4], Patrick S Kim[1], Tianjia Liu[5], Melissa P Sulprizio[2], Ruth S DeFries[3], Daniel J Jacob[1,2], Joel Schwartz[6], Montira Pongsiri[7] and Samuel S Myers[6,8]



Koplitz, S. N., et al., Public health impacts of the severe haze in Equatorial Asia in September-October 2015: Demonstration of a new framework for informing fire management strategies to reduce downwind smoke exposure, Environ. Res. Lett., doi: 10.1088/17489326/11/9/094023, 2016.