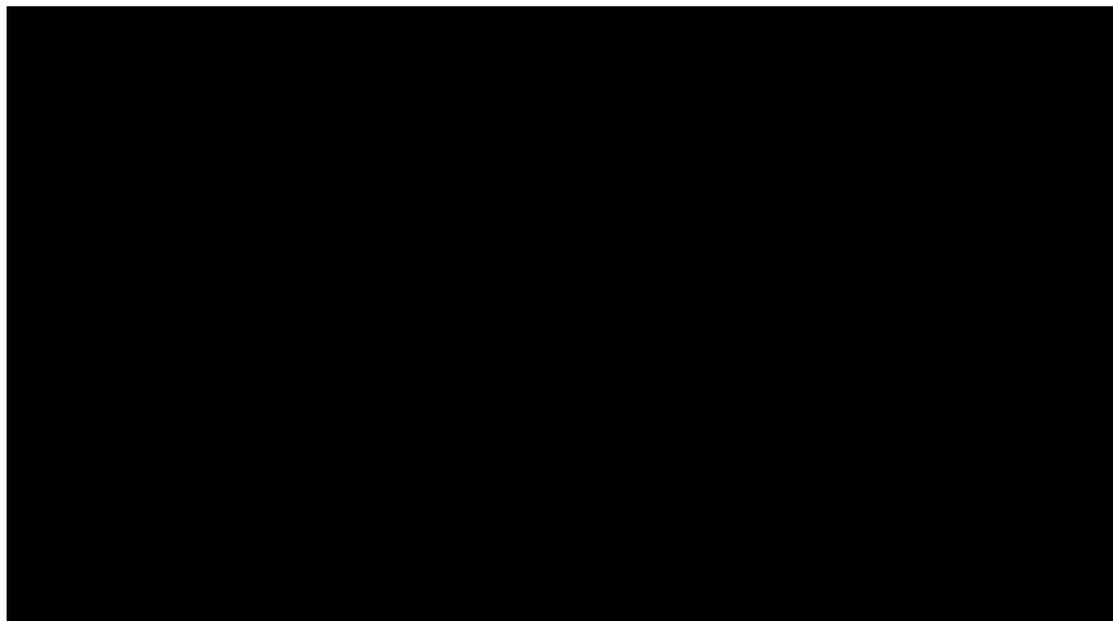




An Introduction to Air Quality Modeling



Shannon N. Koplitz

USEPA



Sustainability at the EPA

“The National Environmental Policy Act of 1969 **committed the United States to sustainability**, declaring it a national policy “to create and maintain conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic and other requirements of present and future generations.”

Sustainability is a priority interest for many organizations, and this is especially true at EPA. **Sustainability isn't part of our work – it's a guiding influence for *all* of our work.**”

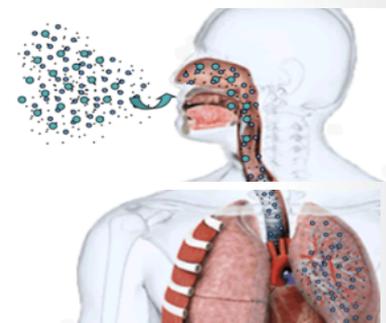
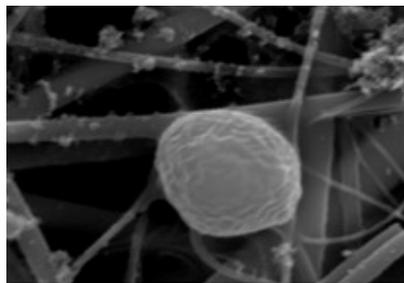
- www.epa.gov/sustainability



Air pollution presents a major challenge for sustainable development

Fine particulate matter (PM_{2.5}) and Ozone (O₃)

SO₂
NO_x



Respiratory and cardiovascular disease

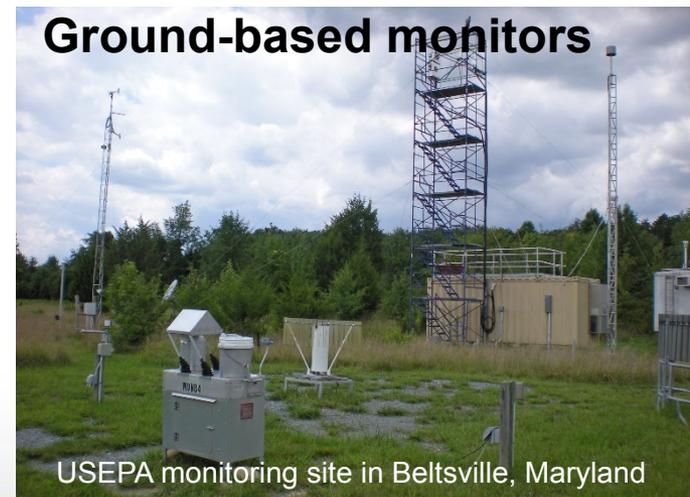
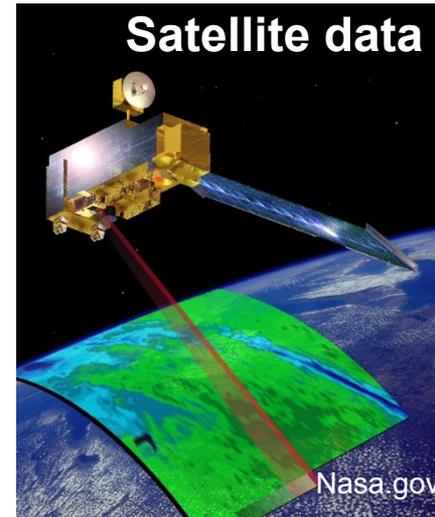
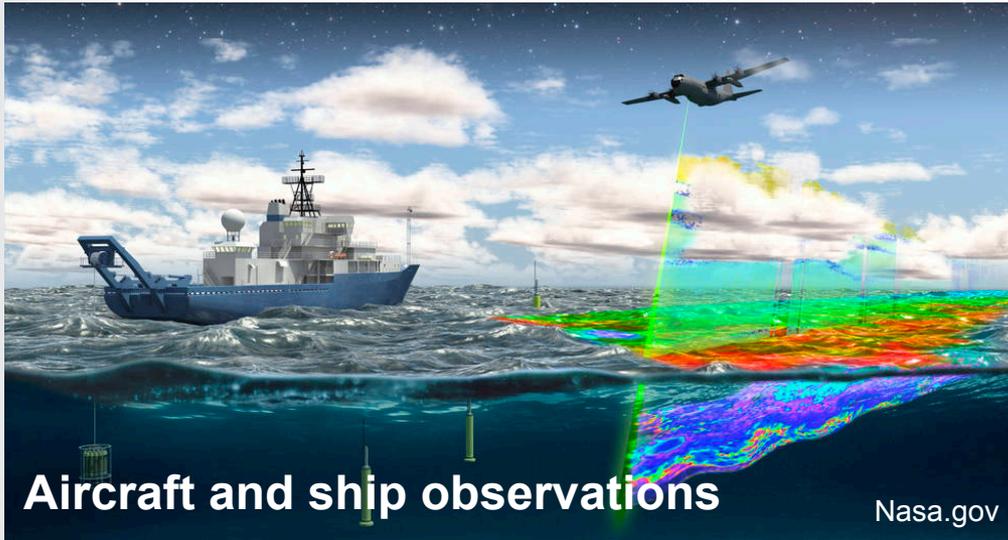
Plant damage



Many aspects of economic growth and development – energy use, transportation, land use changes, industrial productivity – lead to increased air pollution.



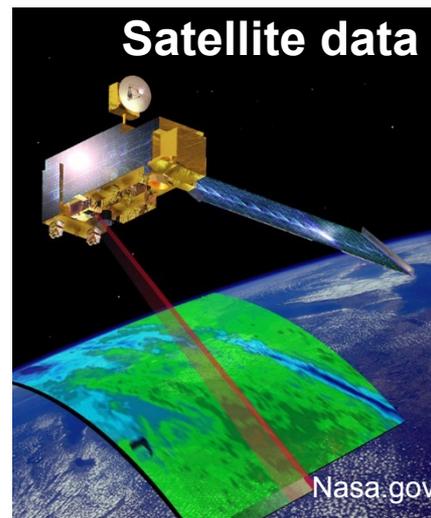
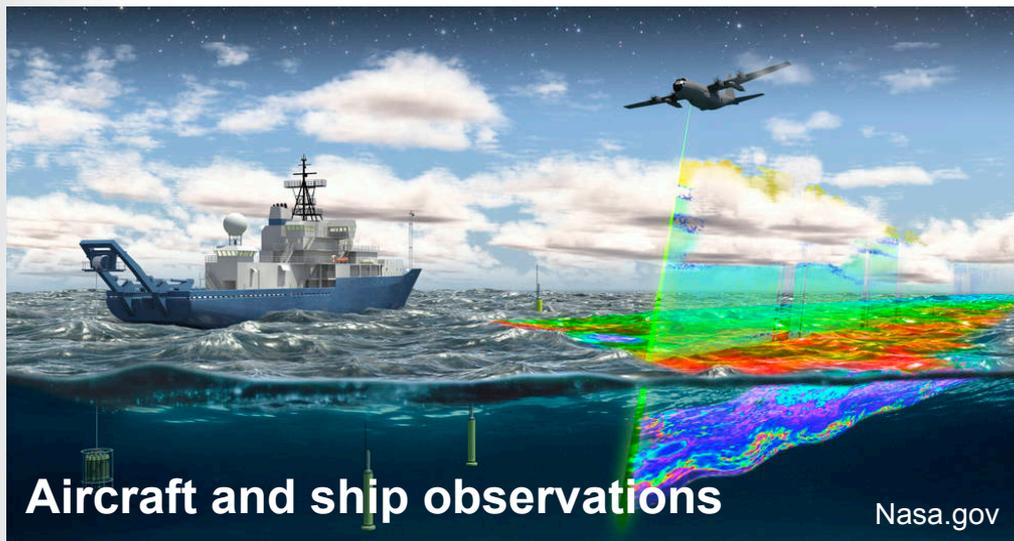
Direct observations of pollution are ideal for studying air quality



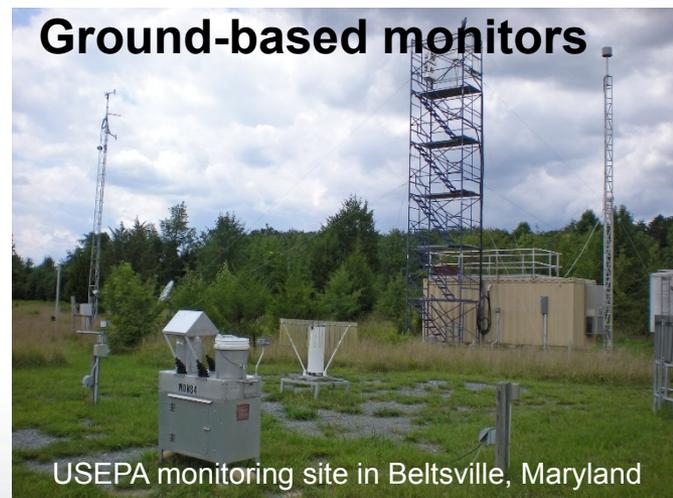
<https://www3.epa.gov/castnet/docs/CASTNET/AR2013-main.htm>



Direct observations of pollution are ideal for studying air quality



However, high quality observational data are limited in space and time.



<https://www3.epa.gov/castnet/docs/CASTNET/AR2013-main.htm>



Many places with severe air quality issues are not being monitored

USEPA PM monitoring sites



Source: USEPA AirData

PM pollution monitoring sites as of 2015

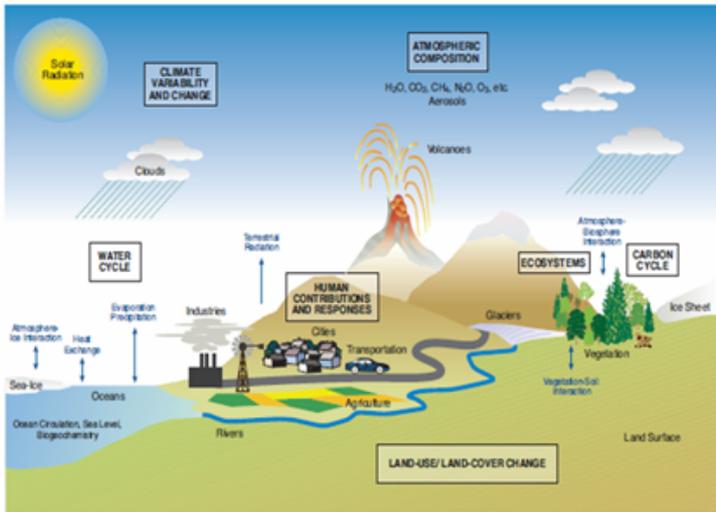
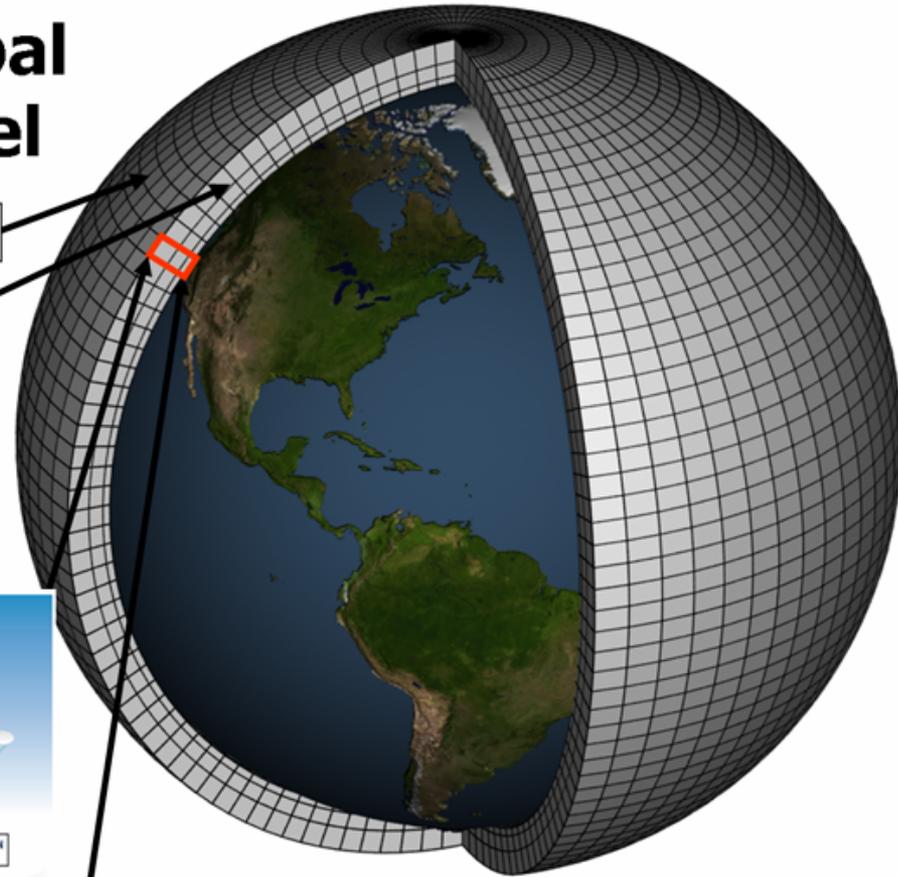


Precise air quality data is not available for much of the world, including large areas of the U.S.

Schematic for Global Atmospheric Model

Horizontal Grid (Latitude-Longitude)

Vertical Grid (Height or Pressure)

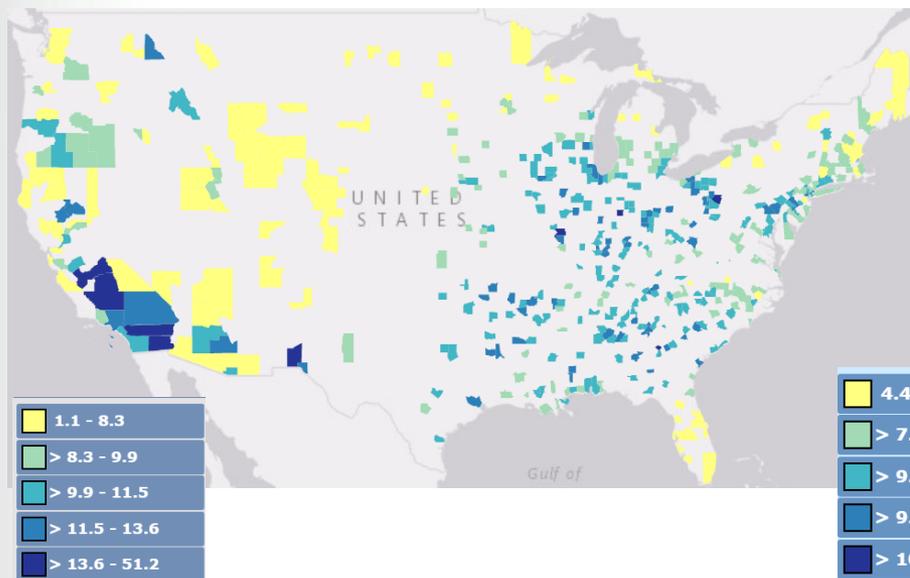


$$\text{Concentration} = \text{Emissions} + \text{Transport} + \text{Chemistry}$$

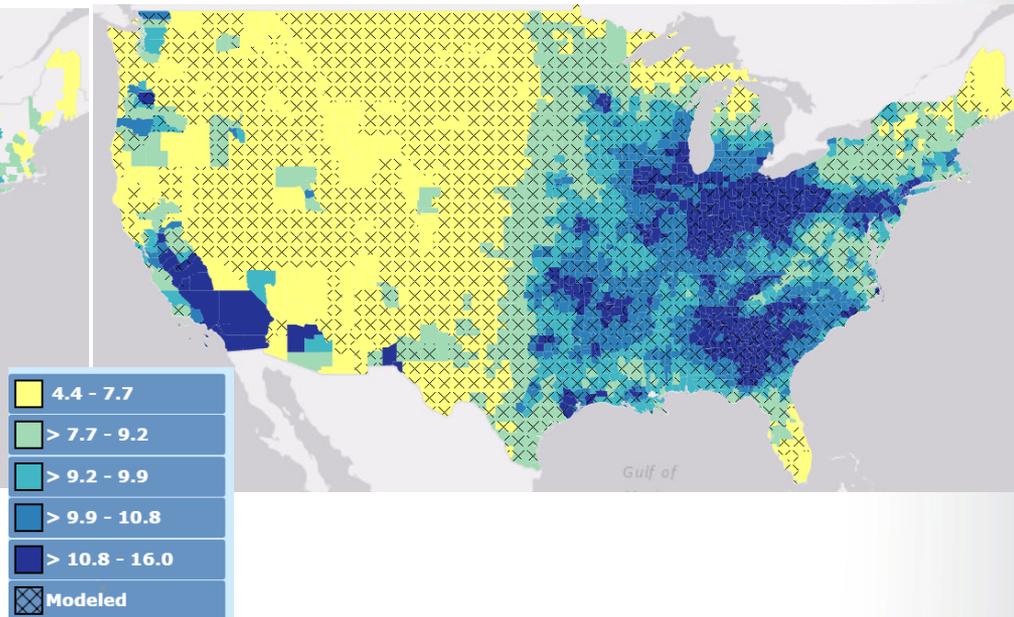


Atmospheric models are data synthesis platforms

Observed PM pollution from sites



Observed + modeled with CMAQ



(Created using <https://ephtracking.cdc.gov/DataExplorer/>)

Models help us “fill in the blanks” in data-poor regions.



Modeling platforms serve many functions

1. Informing the development and enforcement of air quality regulation
2. Forecasting upcoming pollution events
3. Advancing our scientific understanding of how the world works
4. Many others!



An example: estimating health impacts from fire pollution in Indonesia

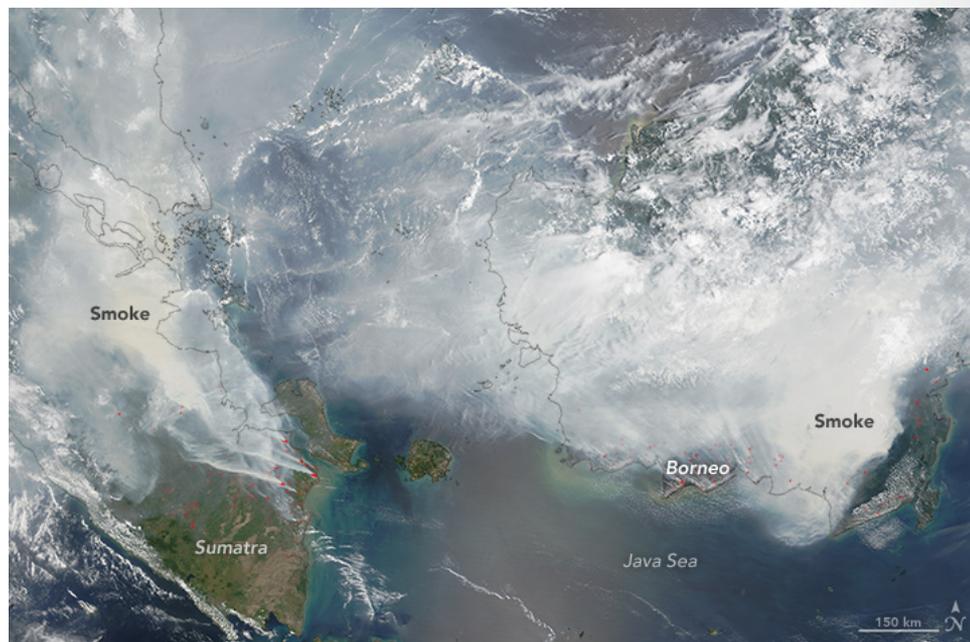


Drainage canals in Kalimantan

Burning timber concession



Smoke during September-October 2015



(NASA image by Jeff Schmaltz, LANCE/EOSDIS Rapid Response.)

Using a modeling approach, scientists at Harvard University and Columbia University estimated over 100,000 premature deaths due to the severe fire-related haze in 2015.



Current project: Understanding wildfire pollution in the U.S.

California 2013



Photo: Dan Bartletti, Los Angeles Times (accessed from www.soperwheeler.com)

Tennessee 2016



Photo: Saul Young/New Sentinel

Colorado 2012



Photo: @PatrickSandusky (accessed from www.businessinsider.com)

Texas 2017



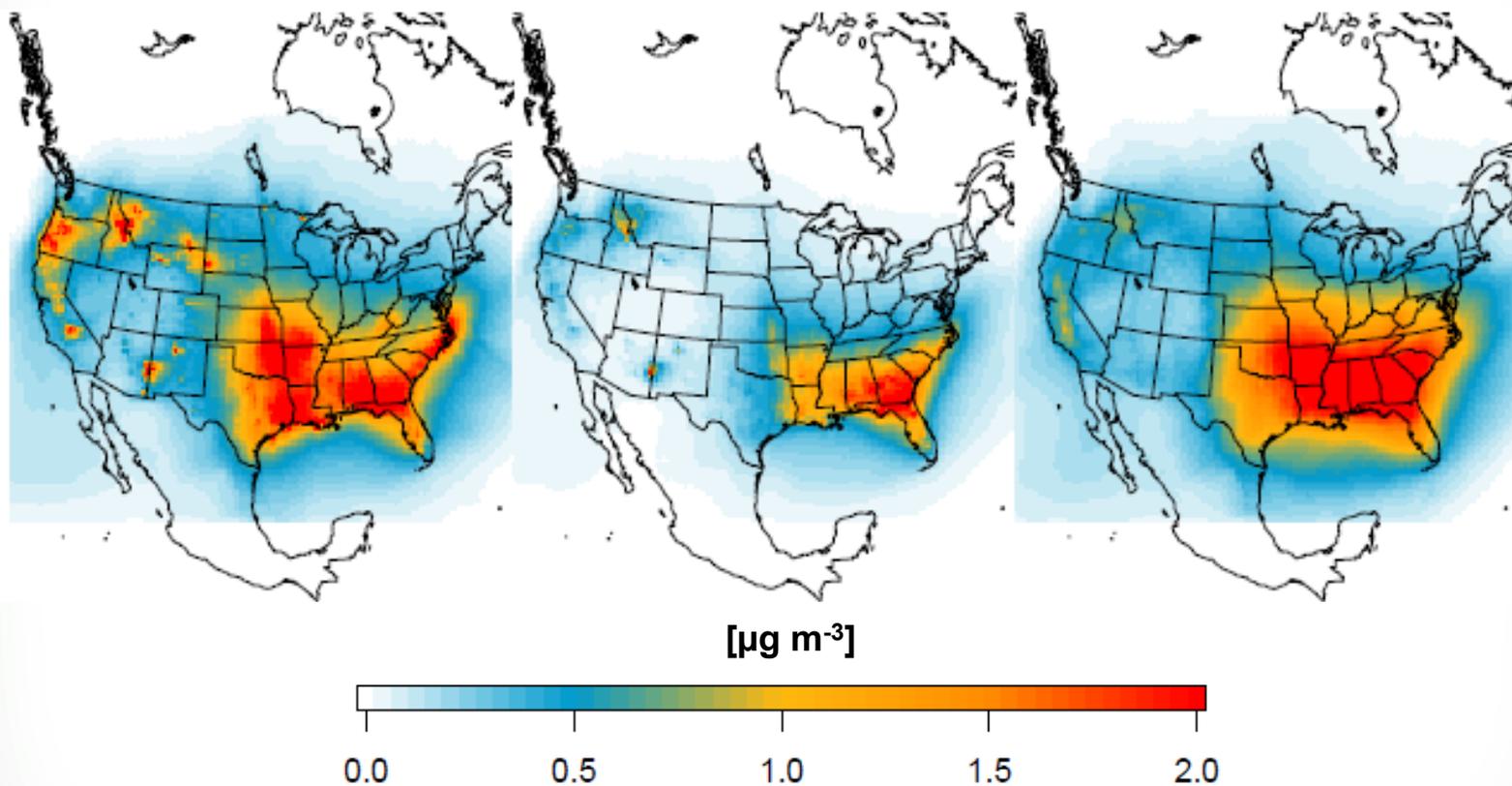
Photo: Hoover Volunteer Fire Department (accessed from CNN.com)

How well do we represent the complex landscape of fire pollution in the U.S. with current modeling approaches?



Fire activity is difficult to capture in models

Modeled fire pollution in 2011 using three commonly used fire datasets



What we learn from these comparisons will help refine our ability to address current and future impacts of fire pollution on human and environmental health.