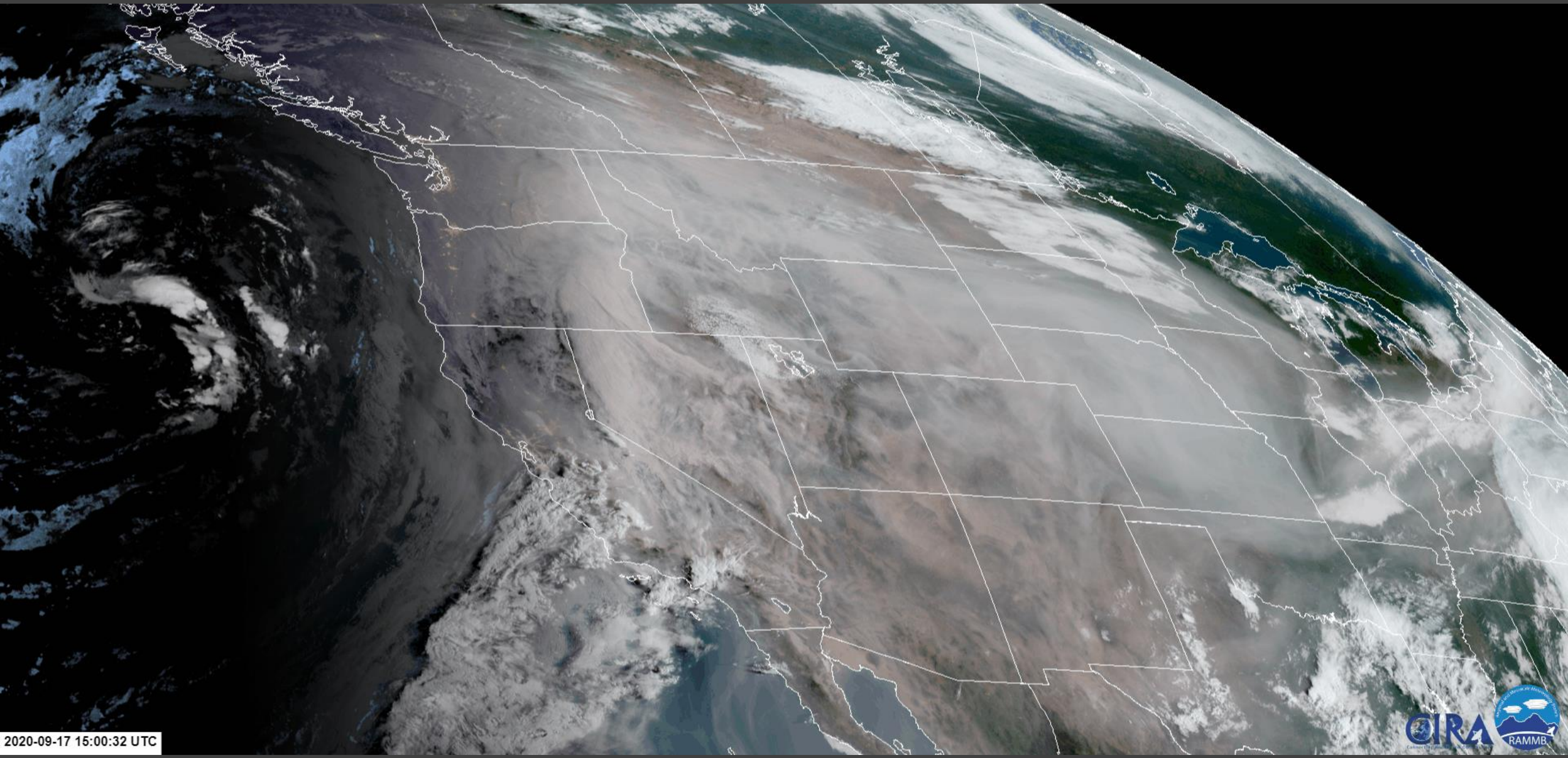
Wildfires and Air Quality

CHRISTINE WIEDINMYER
CIRES, UNIVERSITY OF COLORADO BOULDER

WENFU TANG
NATIONAL CENTER FOR ATMOSPHERIC RESEARCH

March 16, 2021

Christine Wiedinmyer, 21 October 2020, ~4pm MT


2020-09-17 15:00:32 UTC
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Biomass Burning contribution to surface $PM_{2.5}$

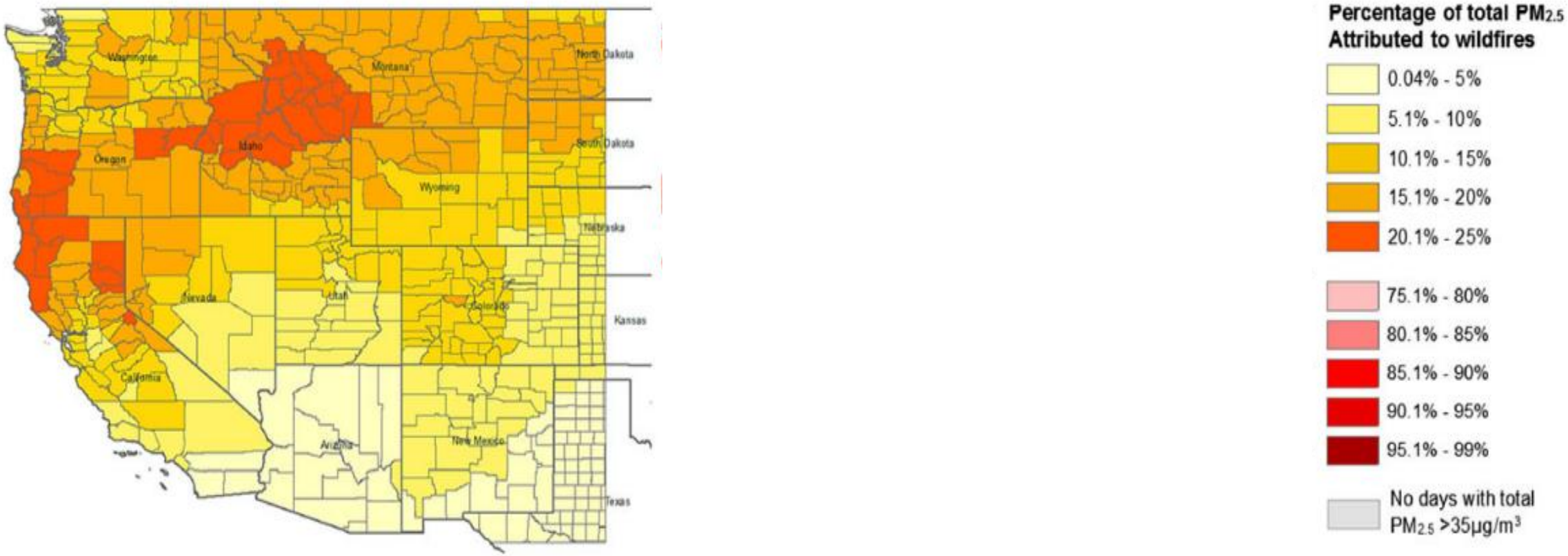

Fig. 1 Fraction of $PM_{2.5}$ attributable to wildfires by county during fire seasons (May-October) in the present day (2004–2009), on all days (left panel), and on the subset of days that had total $PM_{2.5} > 35$ µg/m^3 (The National Ambient Air Quality Standards (NAAQS) threshold; right panel)

Liu et al., *Climatic Change, 2016*

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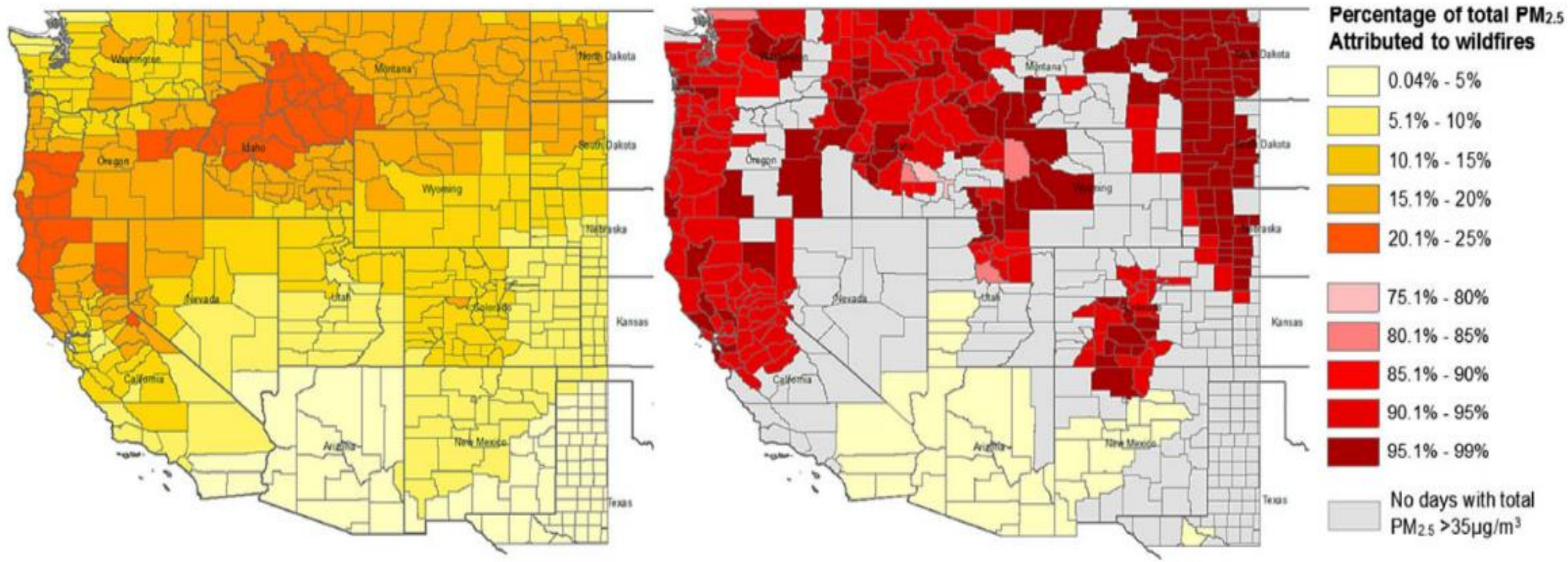

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Review

A Section 508–conformant HTML version of this article is available at http://dx.doi.org/10.1289/ehp.1409277.

Critical Review of Health Impacts of Wildfire Smoke Exposure

Colleen E. Reid,[1,2] Michael Brauer,[3] Fay H. Johnston,[4,5] Michael Jerrett,[1,6] John R. Balmes,[1,7] and Catherine T. Elliott[3,8]

VOLUME 124 | NUMBER 9 | September 2016 • Environmental Health Perspectives

Associations between wildfire smoke exposure and respiratory morbidity in general, and specifically for exacerbations of asthma and COPD

Suggested associations between wildfire smoke exposure with respiratory infections and all-cause mortality

Potential impacts on birth outcomes

Biomass Burning contribution to surface $PM_{2.5}$

Combined satellite observations and chemical-climate models

Globally:

339,000 (260,000 – 600,000) deaths per year from exposure to landscape fire smoke

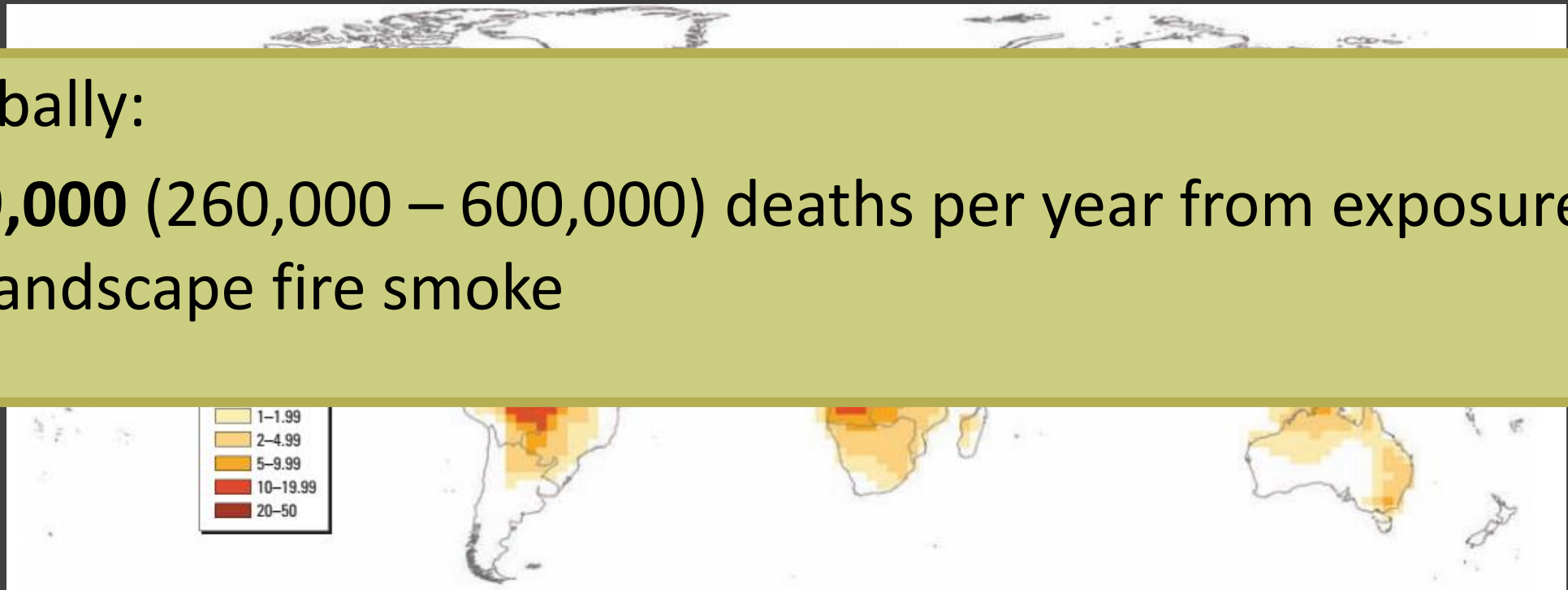


Figure 1. Estimated annual average (1997–2006) $PM_{2.5}$ concentrations from landscape fires, combining estimates from the GEOS-Chem model with the MODIS and MISR optimizations.

Johnston et al., *EHP*, 2012

Estimating emissions from open burning

$$\text{Emission}_i = f(ef_i, \text{Biomass Burned})$$

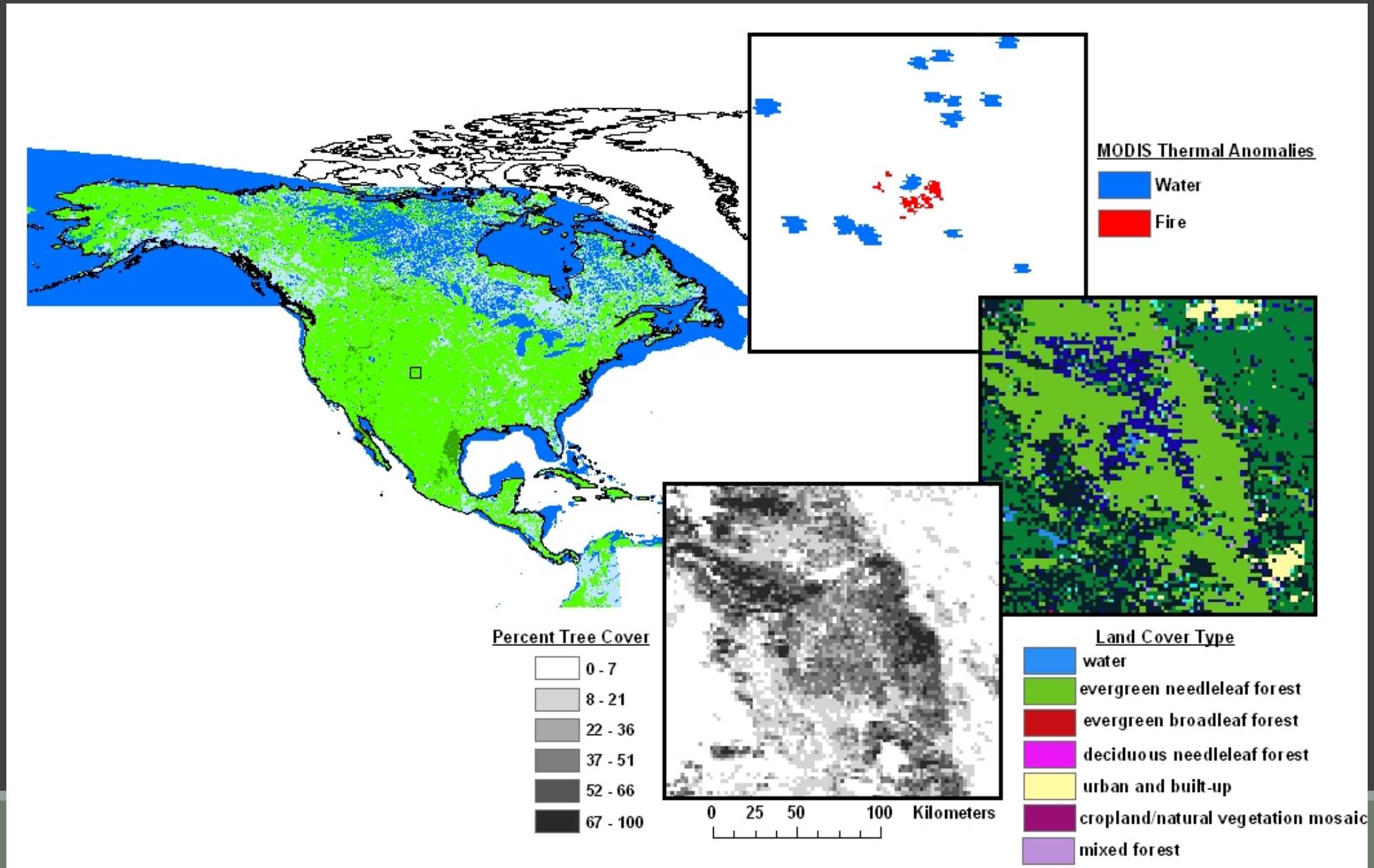
Emission Factor

- Vegetation
  - Type
  - Condition
- Fire
  - Intensity
  - Stage

Biomass Burned

- Vegetation
  - Type
  - Condition
  - Density
  - Loading
- Fire
  - Intensity
  - Duration

Estimating Emissions



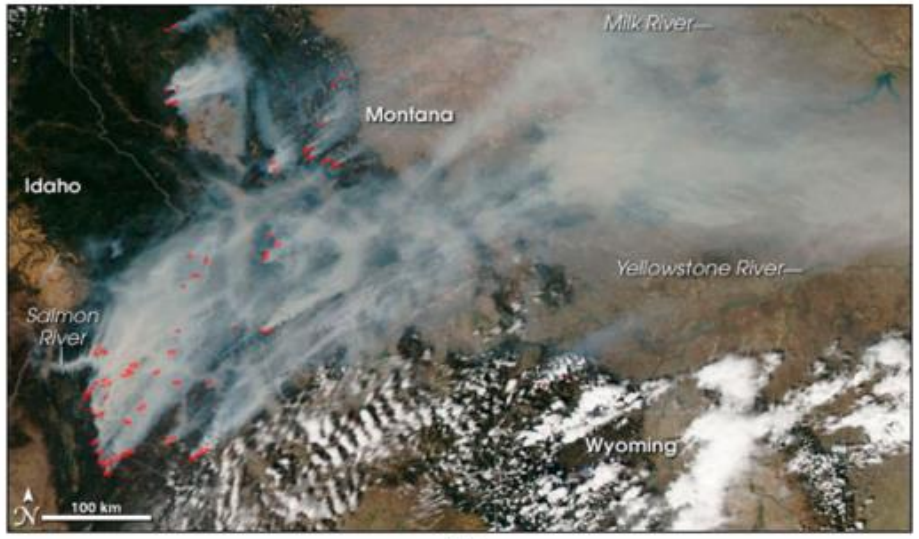
EMISSIONS

AIR
QUALITY

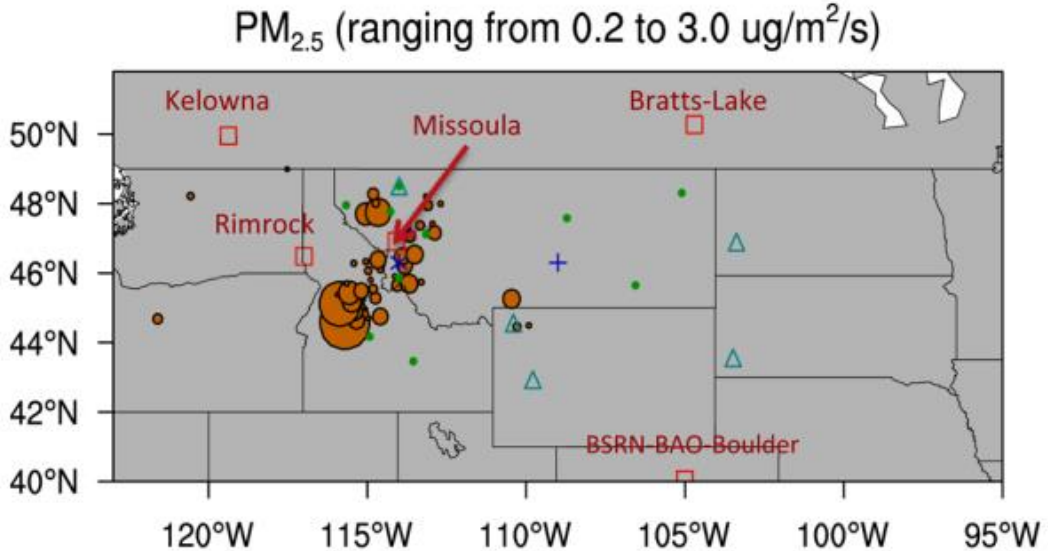
Feedbacks to regional meteorology and chemistry

High Resolution WRF-Chem with fire emissions

Simulate impact of fire emissions on boundary layer and chemistry



(a)



(b)

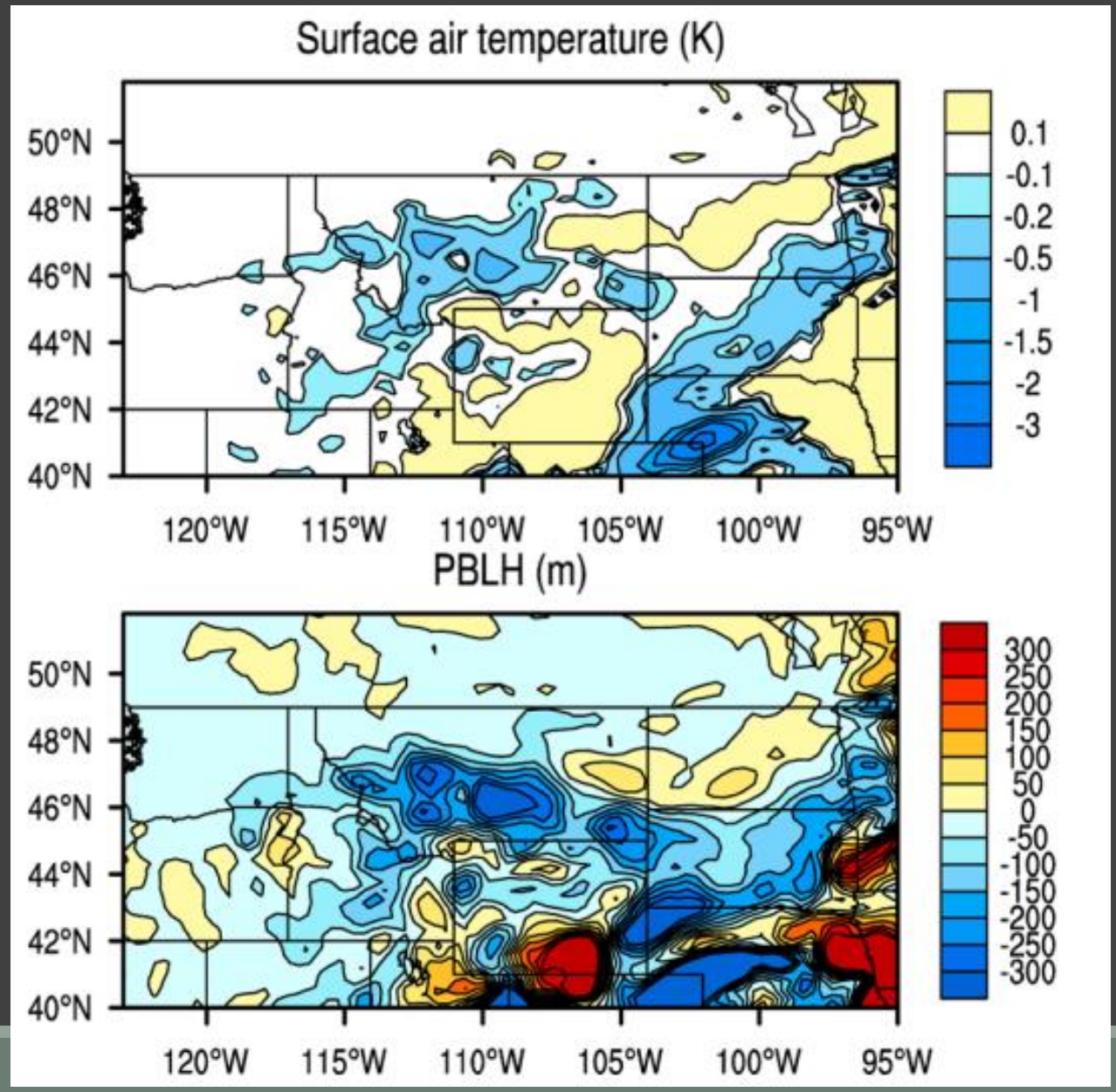
Jiang et al., *ES&T*, 2012

Feedbacks to regional meteorology and chemistry

Changes in PBL, surface air temperature, solar radiation

Feedback to chemistry

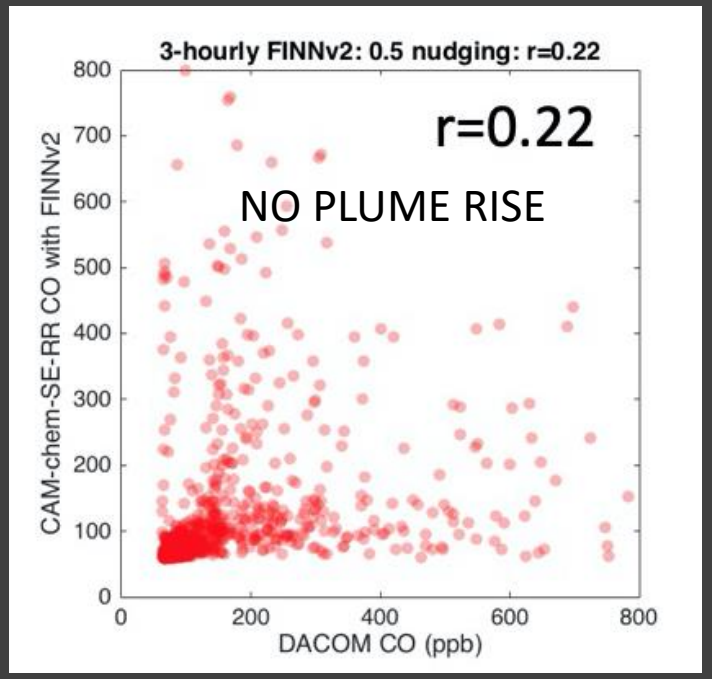
Changes in -15% to +60% in ozone concentrations

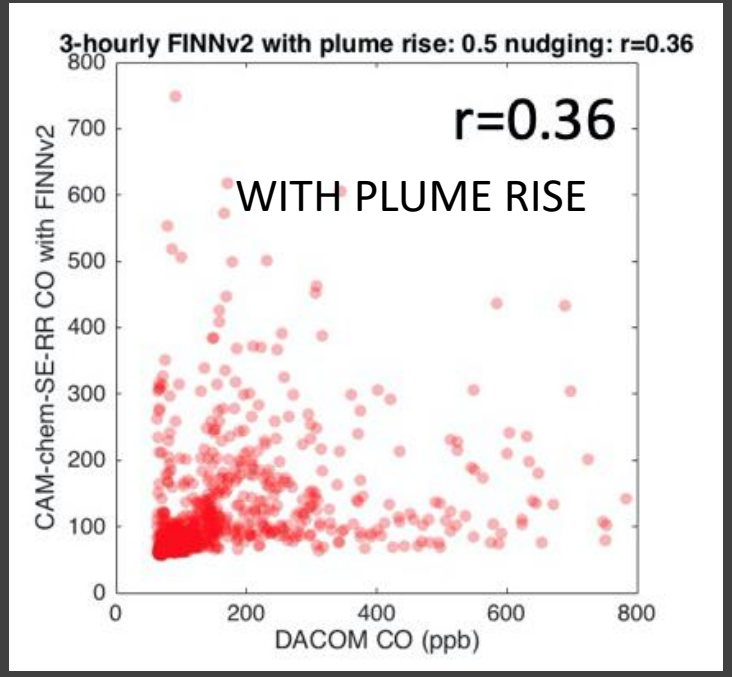


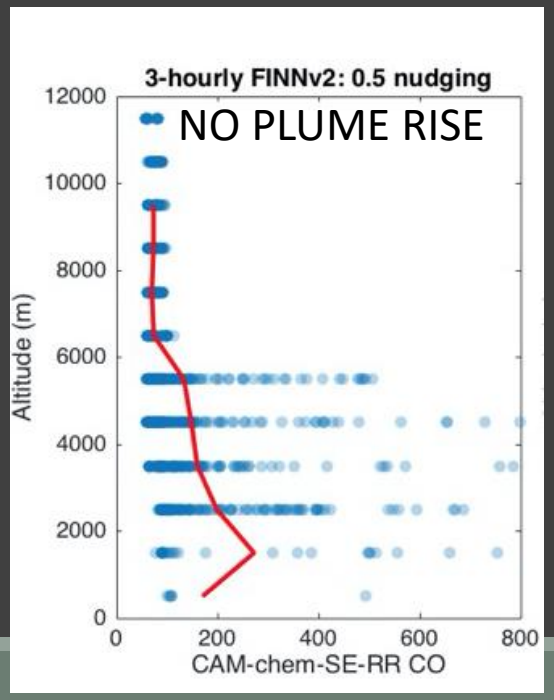
Jiang et al., *ES&T*, 2012

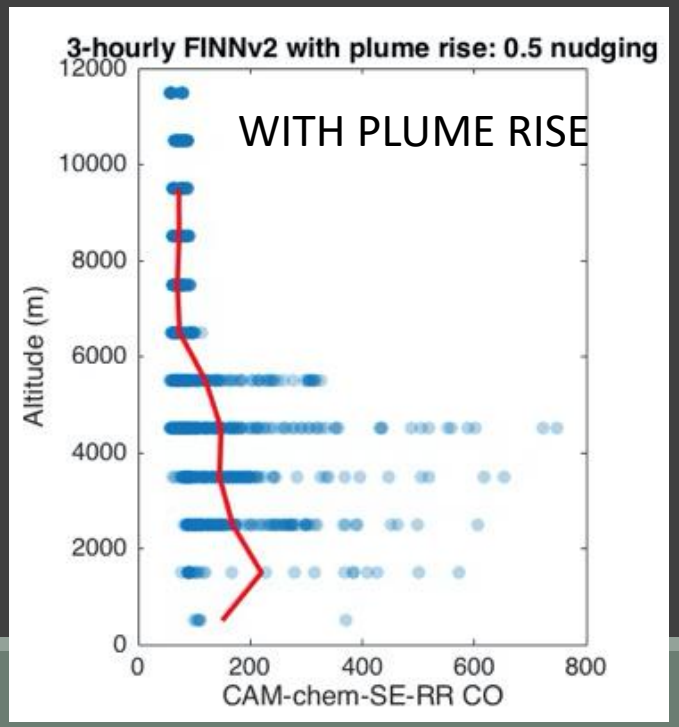
Vertical Distribution of Emissions *Important*

- Preliminary simulations of the Williams Flats fire during FIREX-AQ
  - August 2019 over WA
- Comparing CO measurements from DC-8 to the model outputs



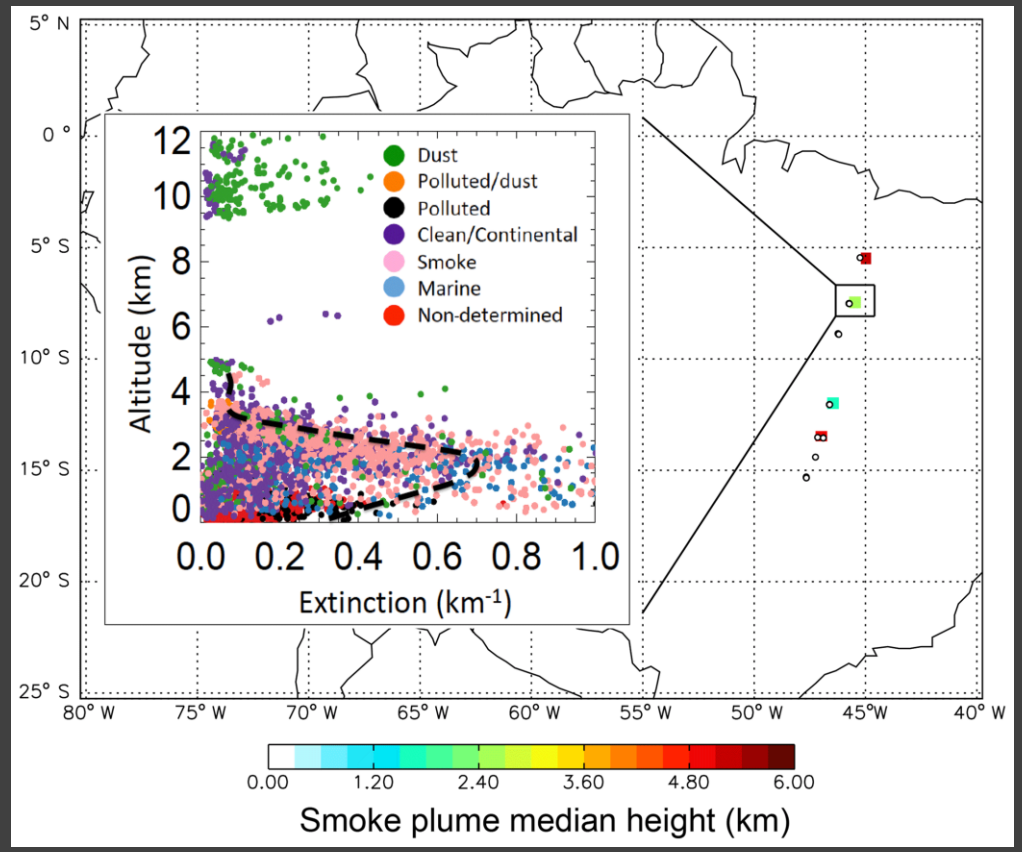


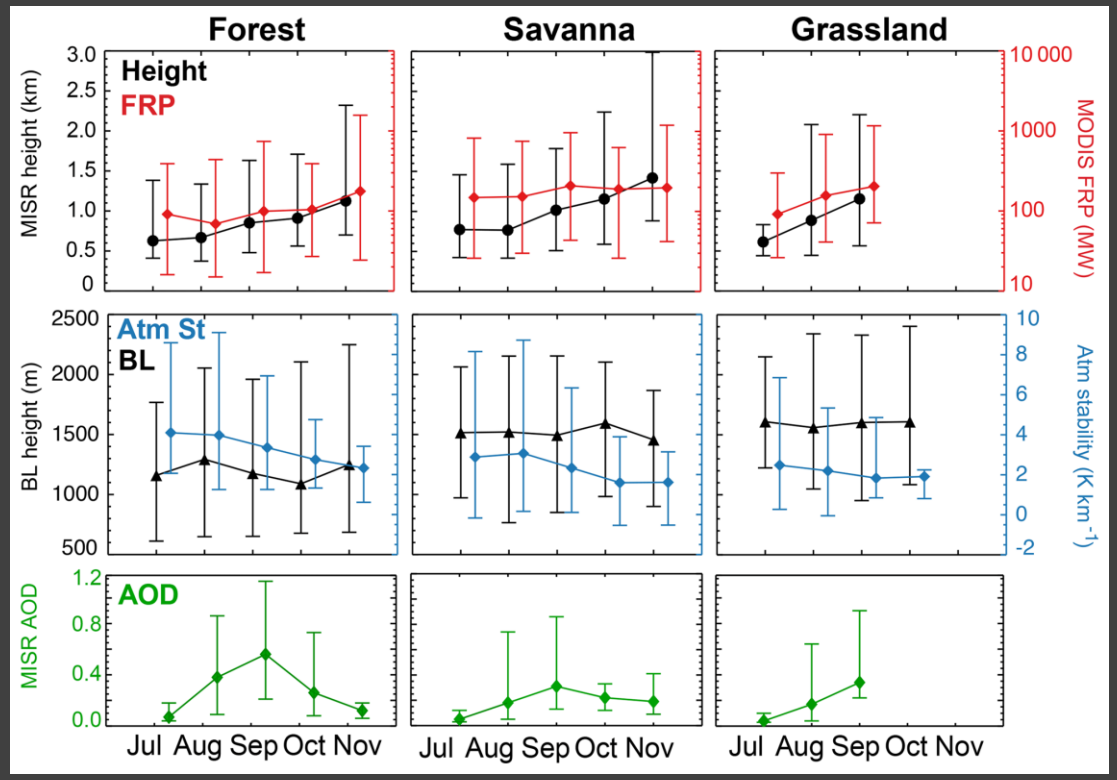




Preliminary results with plume rise parameterization improves model performance

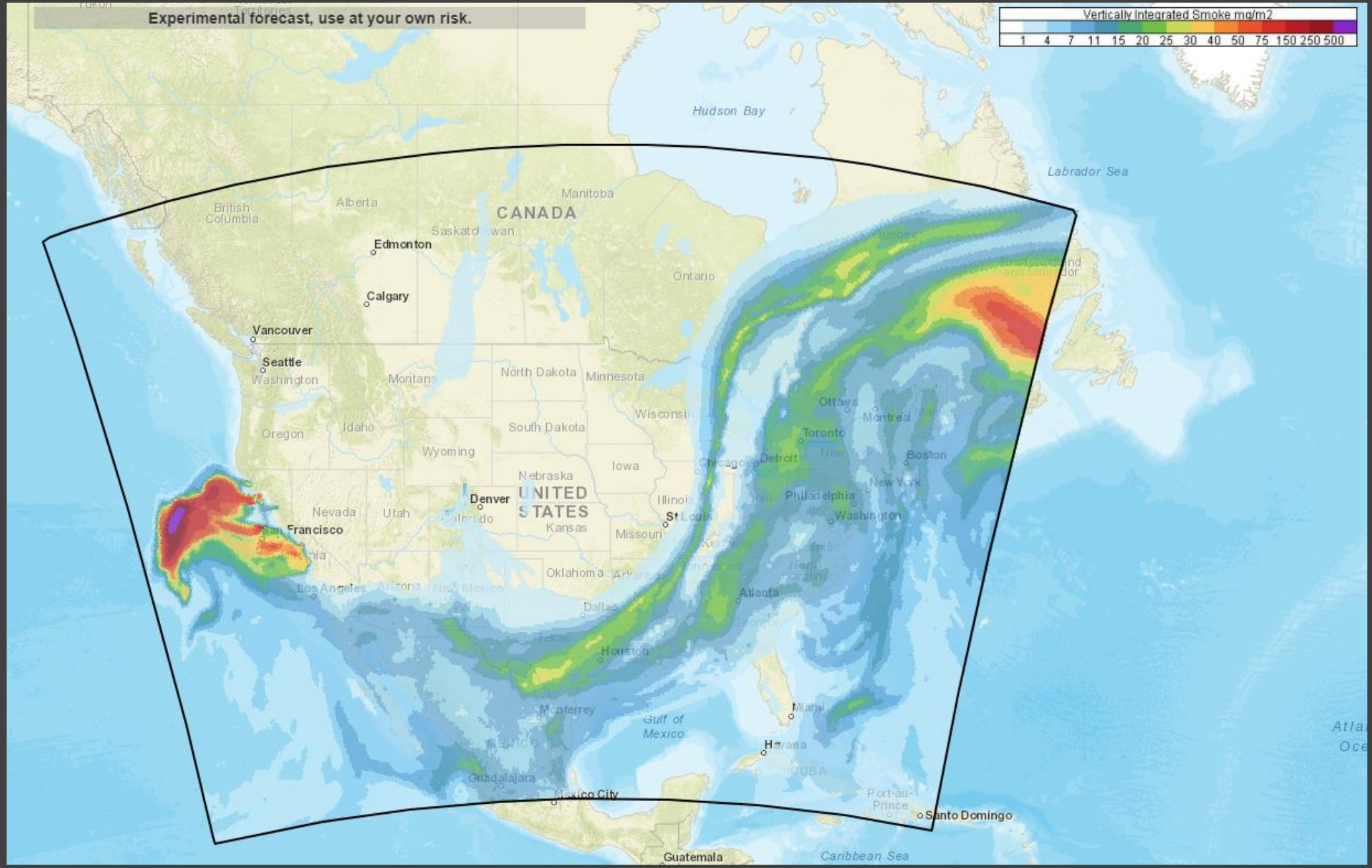
Current data applied for plume rise estimates





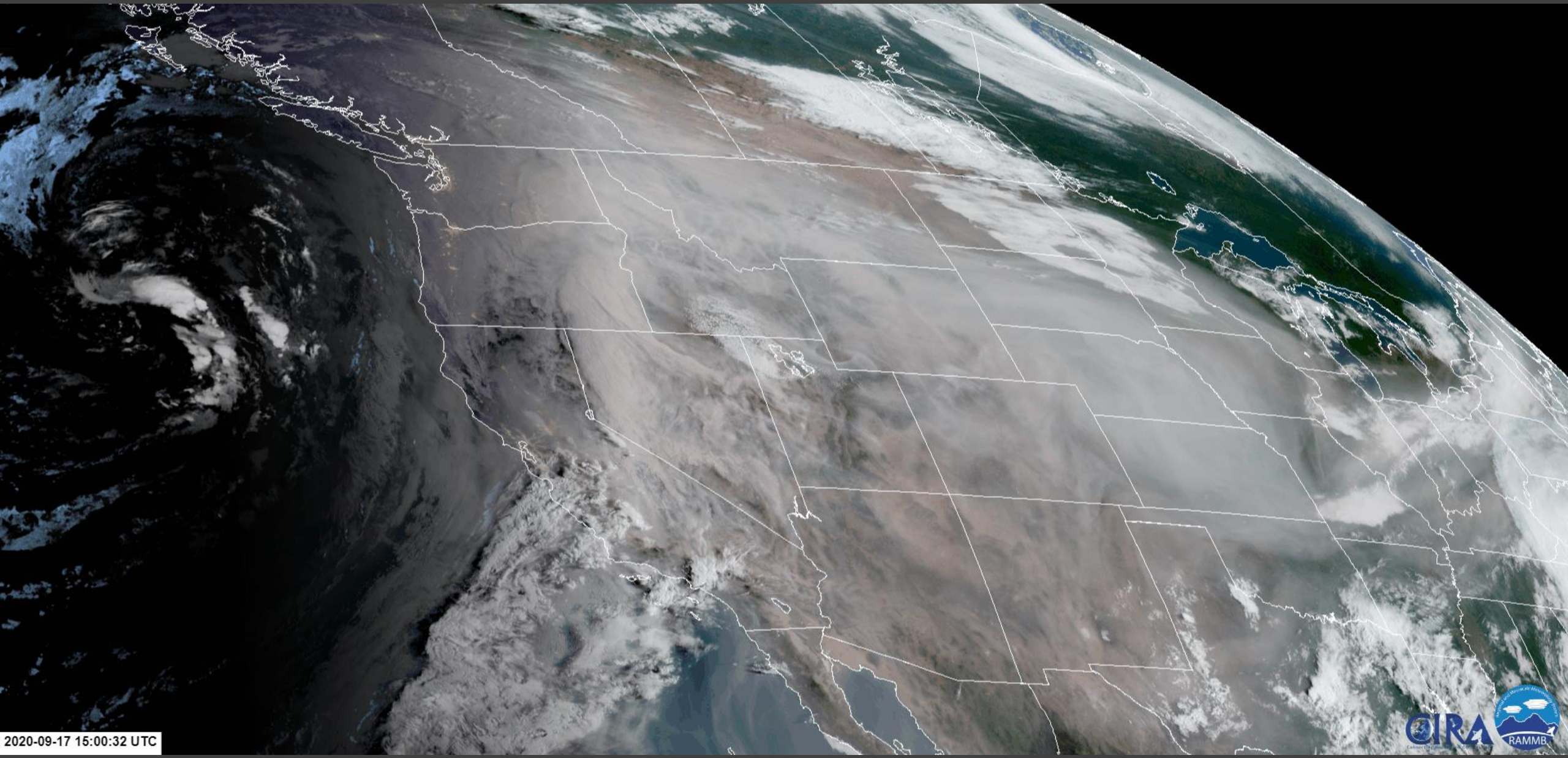
Biomass-burning smoke heights over the Amazon observed from space
Laura Gonzalez-Alonso et al., 2019

https://acp.copernicus.org/articles/19/1685/2019/



https://hwp-viz.gsd.esrl.noaa.gov/smoke/index.html

Forecast – Sept. 28, 2020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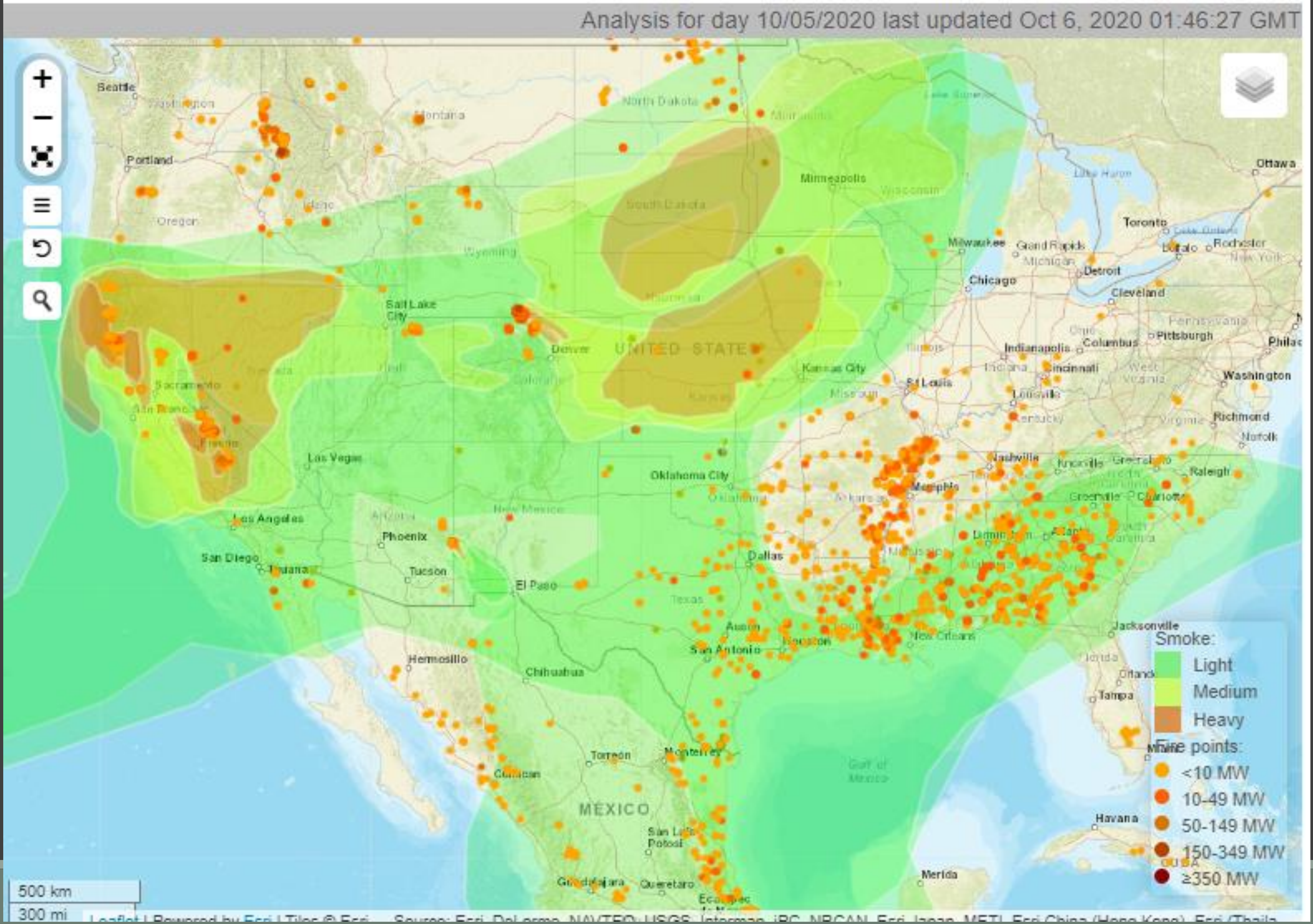
Analysis for day 10/05/2020 last updated Oct 6, 2020 01:46:27 GMT
Smoke:
Light
Medium
Heavy
Fire points:
<10 MW
10-49 MW
50-149 MW
150-349 MW
≥350 MW
500 km
300 mi
Seattle
Portland
Salt Lake City
Denver
UNITED STATES
Las Vegas
Los Angeles
San Diego
Phoenix
Tucson
El Paso
Oklahoma City
Dallas
Austin
San Antonio
Houston
New Orleans
Kansas City
St Louis
Minneapolis
Chicago
Milwaukee
Detroit
Cleveland
Toronto
Ottawa
Pittsburgh
Columbus
Indianapolis
Cincinnati
Louisville
Nashville
Memphis
Washington
Richmond
Norfolk
Raleigh
Jacksonville
Tampa
Havana
Merida
Hermosillo
Chihuahua
Torreon
MEXICO
Monterrey
Guadalajara
Queretaro

Prediction of AQ and Health impacts from wildfires

- Vertical Distribution of Plumes
  - Improve model predictions
  - Better interpret satellite observations