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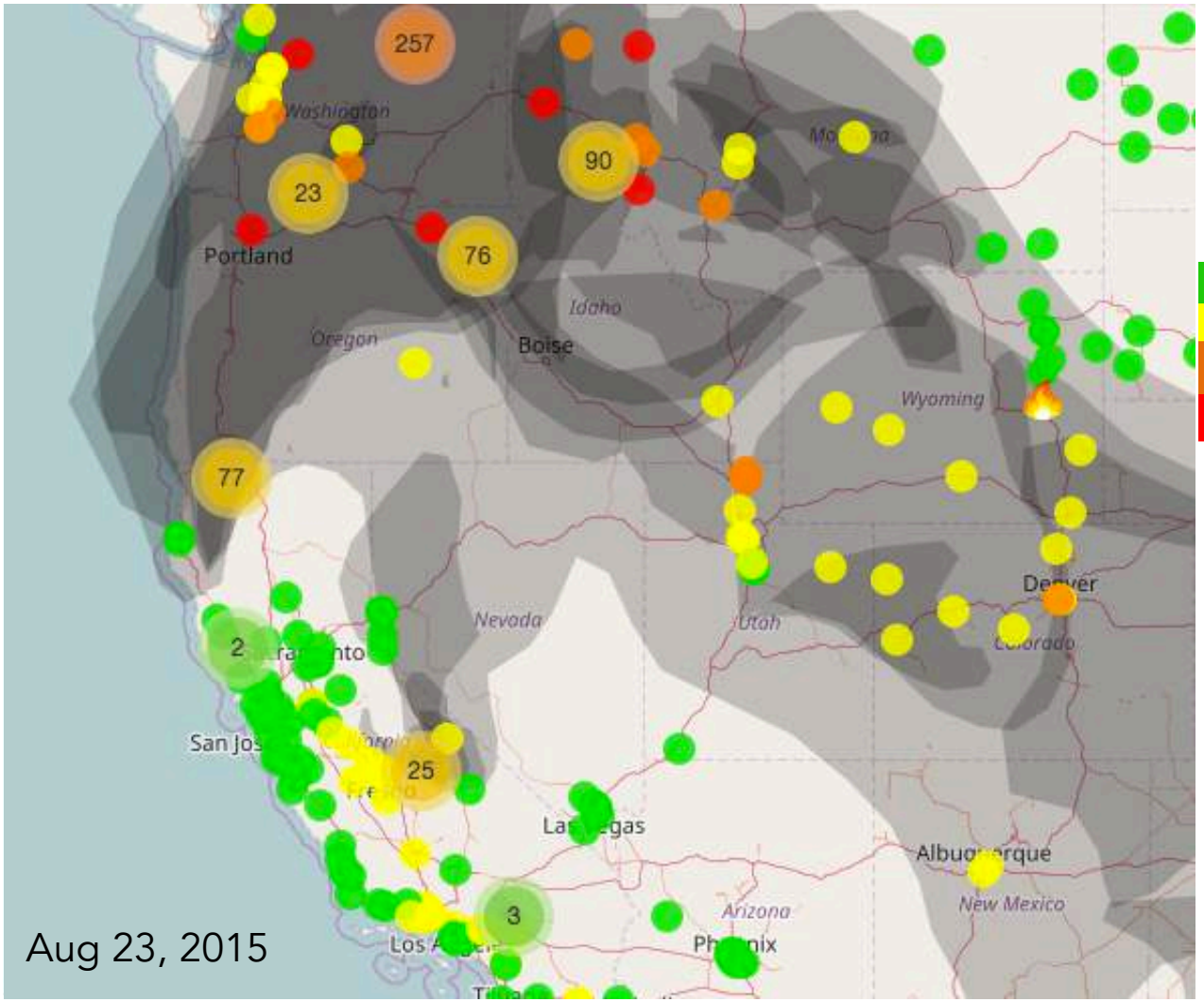
NCAR
NATIONAL CENTER FOR ATMOSPHERIC RESEARCH

Major fires, such as the record-breaking fires in 2015, produce smoke that can blanket the U.S. west.

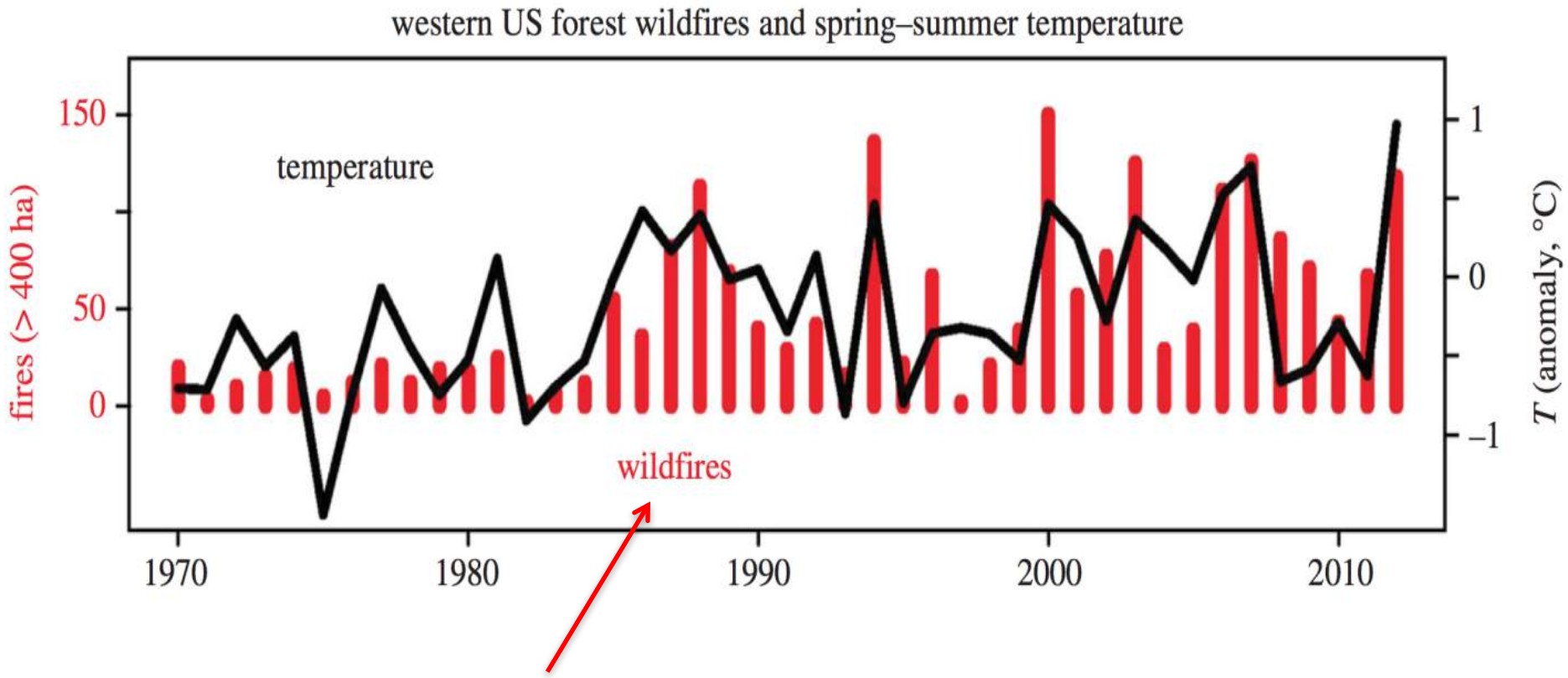


Grey is HMS Smoke Plume
Numbers are HMS Fires.
Colors are AQI: $PM_{2.5}$

- Good
- Moderate
- Unhealthy for Sensitive Groups
- Unhealthy

https://stevenjoelbrey.shinyapps.io/HMSExplorer/

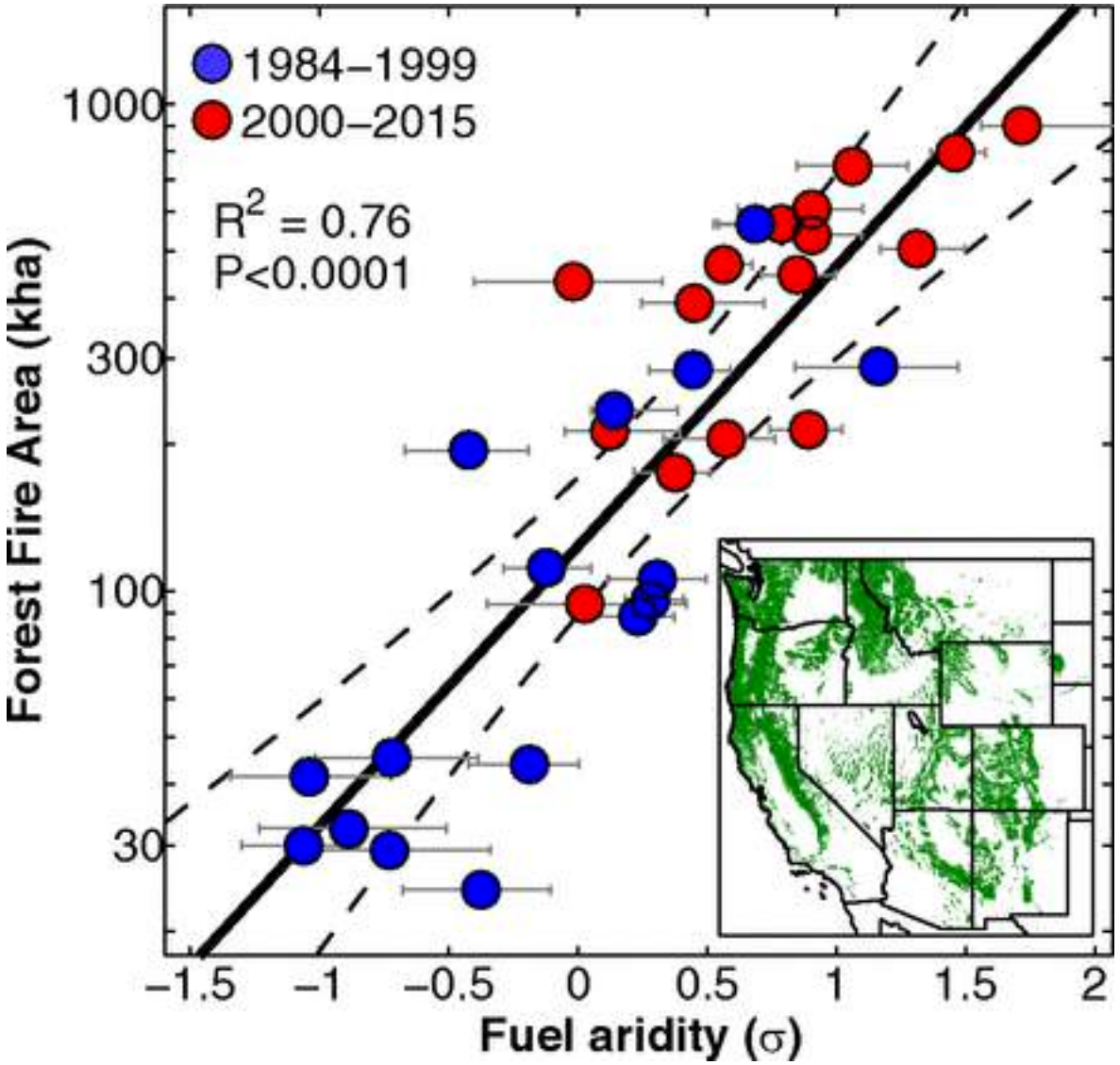
Big western wildfires are increasing in frequency.



These are large fires in the western U.S. – This trend is equivalent to 20 more additional large fires per decade.

Westerling [2016]

Changes to the climate are increasing fire-season aridity, fostering conditions favorable to fire.



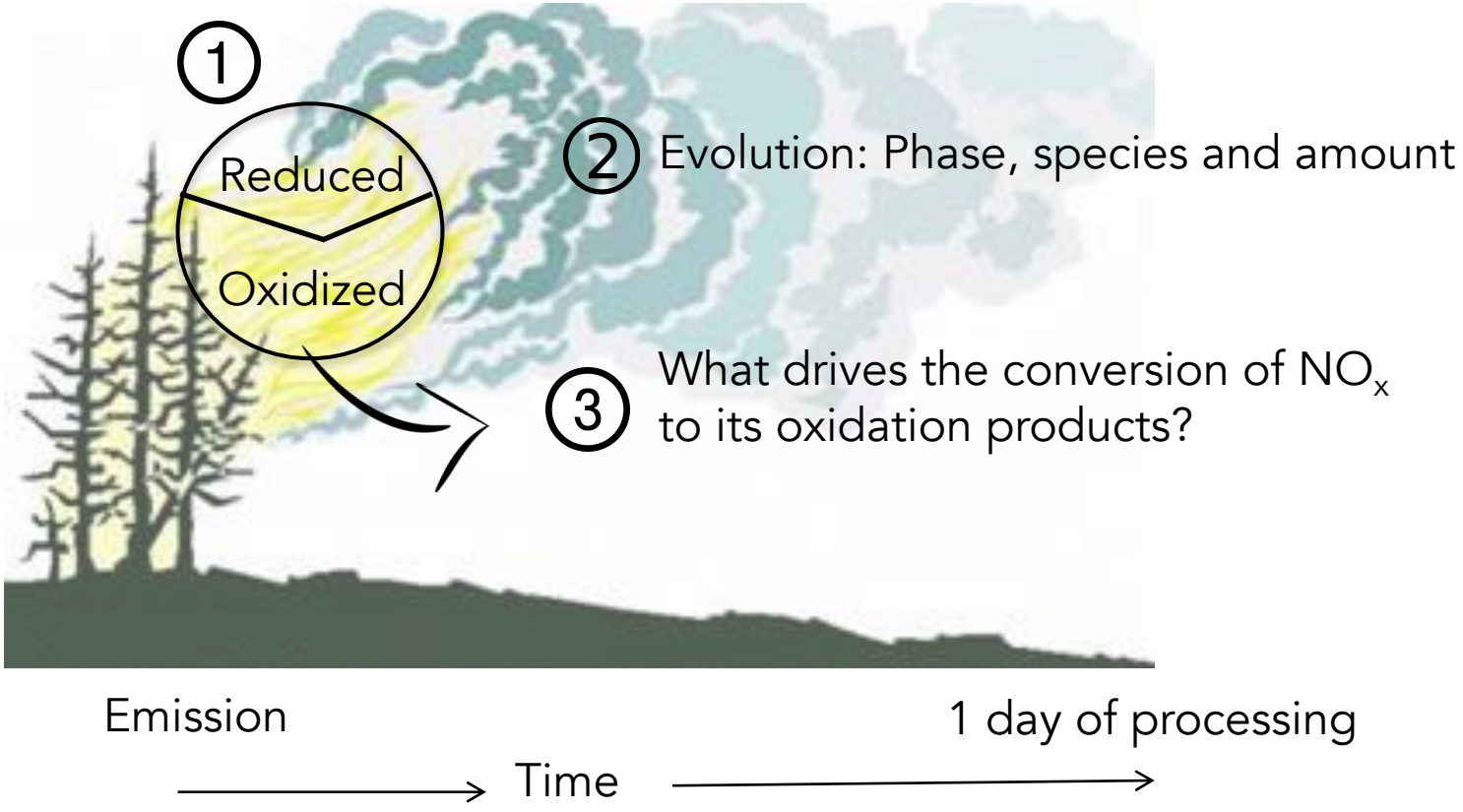
Abatzoglou et al. [2016]

8 fuel aridity metrics averaged over forested lands of the west

WE-CAN will focus on

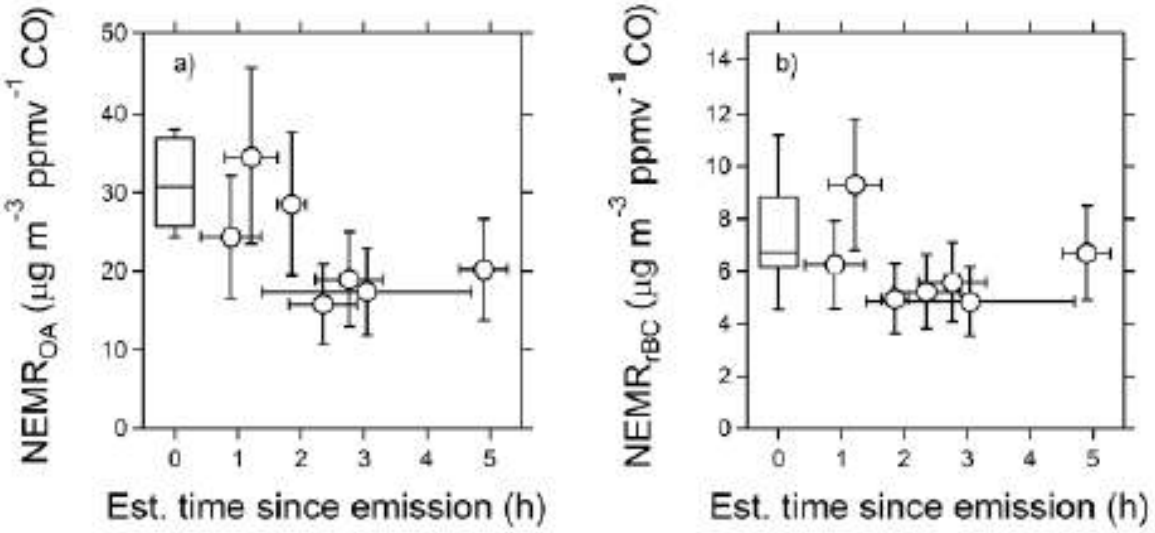
1) fixed nitrogen emissions and evolution
2) evolution of aerosol optical properties
3) cloud activation and chemistry in wildfire plumes
4) aerosol emissions composition and variability

Fixed Nitrogen: critical to free radicals & oxidant production, secondary pollutant formation/removal, light absorption, timescale and form of N deposition.



Payload
NO_X, NH_3, PANs, HNO_3, HONO, HNCO,
HCN, CH_3CN, aerosol composition and extensive VOCs

The identity of aerosol emissions and the understanding of their chemical and physical evolution in the near-field are not well constrained.

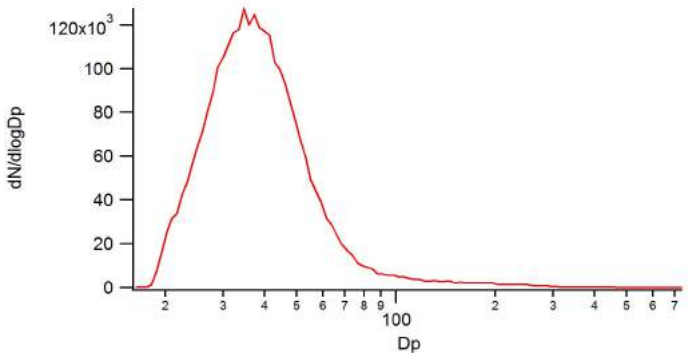


Results from prescribed fire during SCREAM campaign in SC (from May *et al.*, 2015)

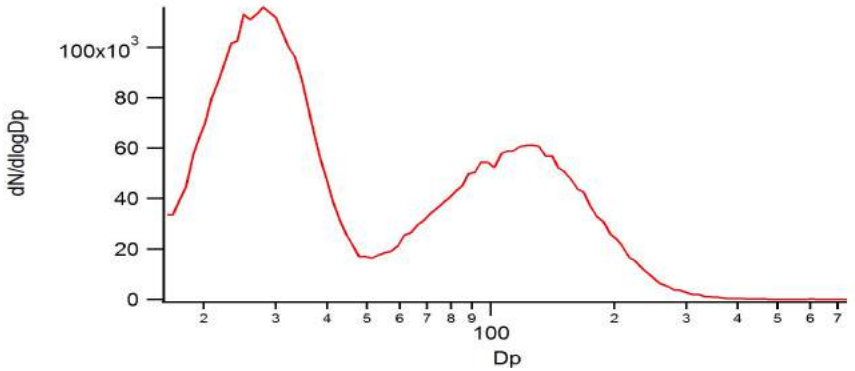
Characterizes aerosols at the source and in the near field with mass speciated measurements (organic vs. ionic species vs. black carbon) to determine source variability and the role of dilution and oxidation on aerosol evolution.

Many factors (size distribution, coating thickness, mixing state) impact the radiative forcing of biomass burning aerosol.

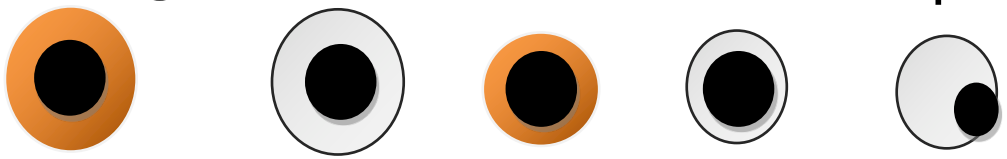
Size Distribution of BC



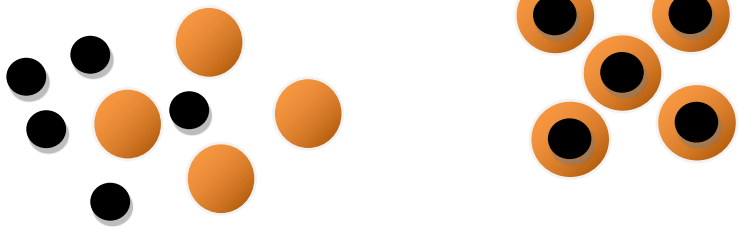
vs.



Coating Thickness or Absorption by Coating

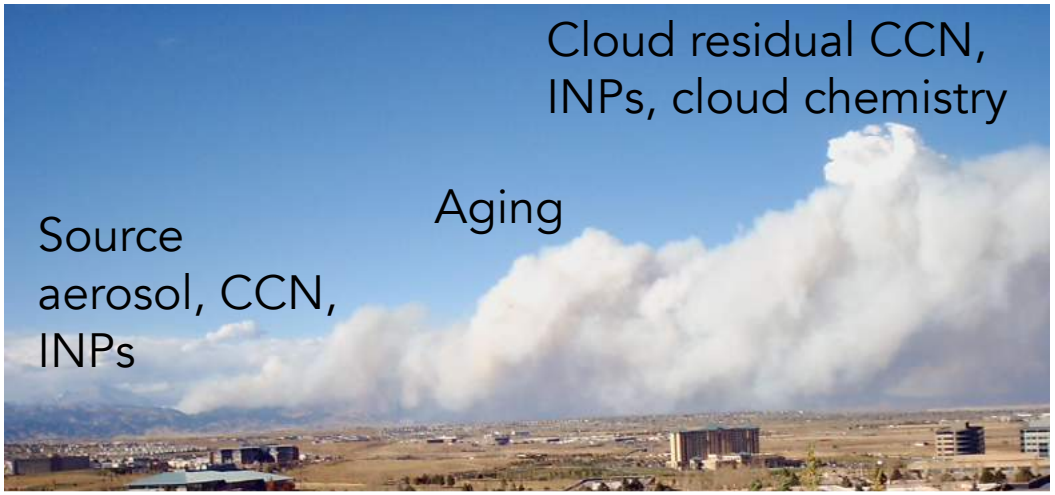


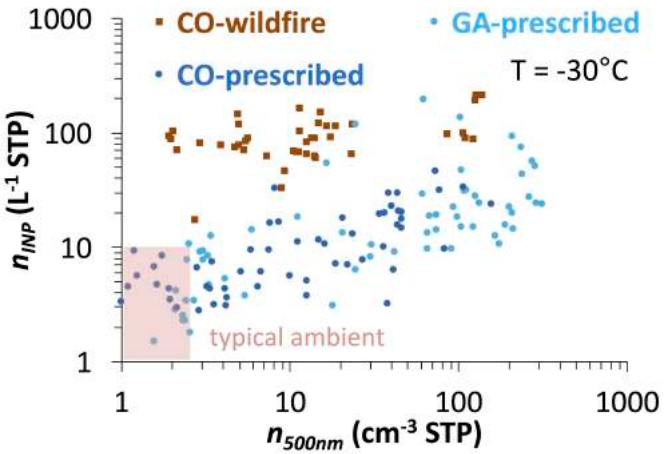
Mixing State



Payload allows determination of the contribution to absorption from brown carbon, lensing and black carbon via multiple approaches, and changes in optical properties can be related to chemical sources.

Influences of wildfire smoke on amending atmospheric ice nucleating particles is poorly understood.

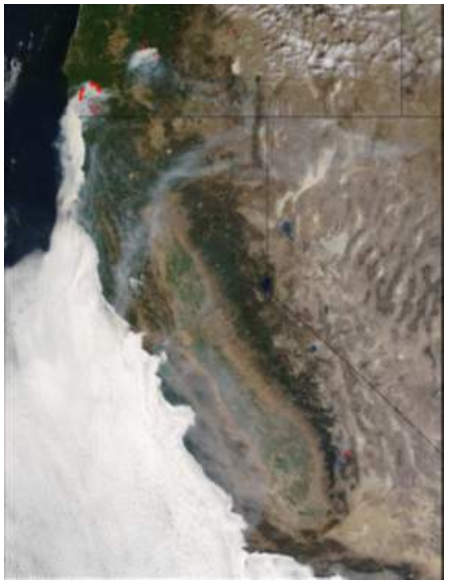




Instrumentation to observe cloud-active particles (CCN, INPs), microphysics in smoke- impacted clouds, and to collect cloud water for chemical analysis.

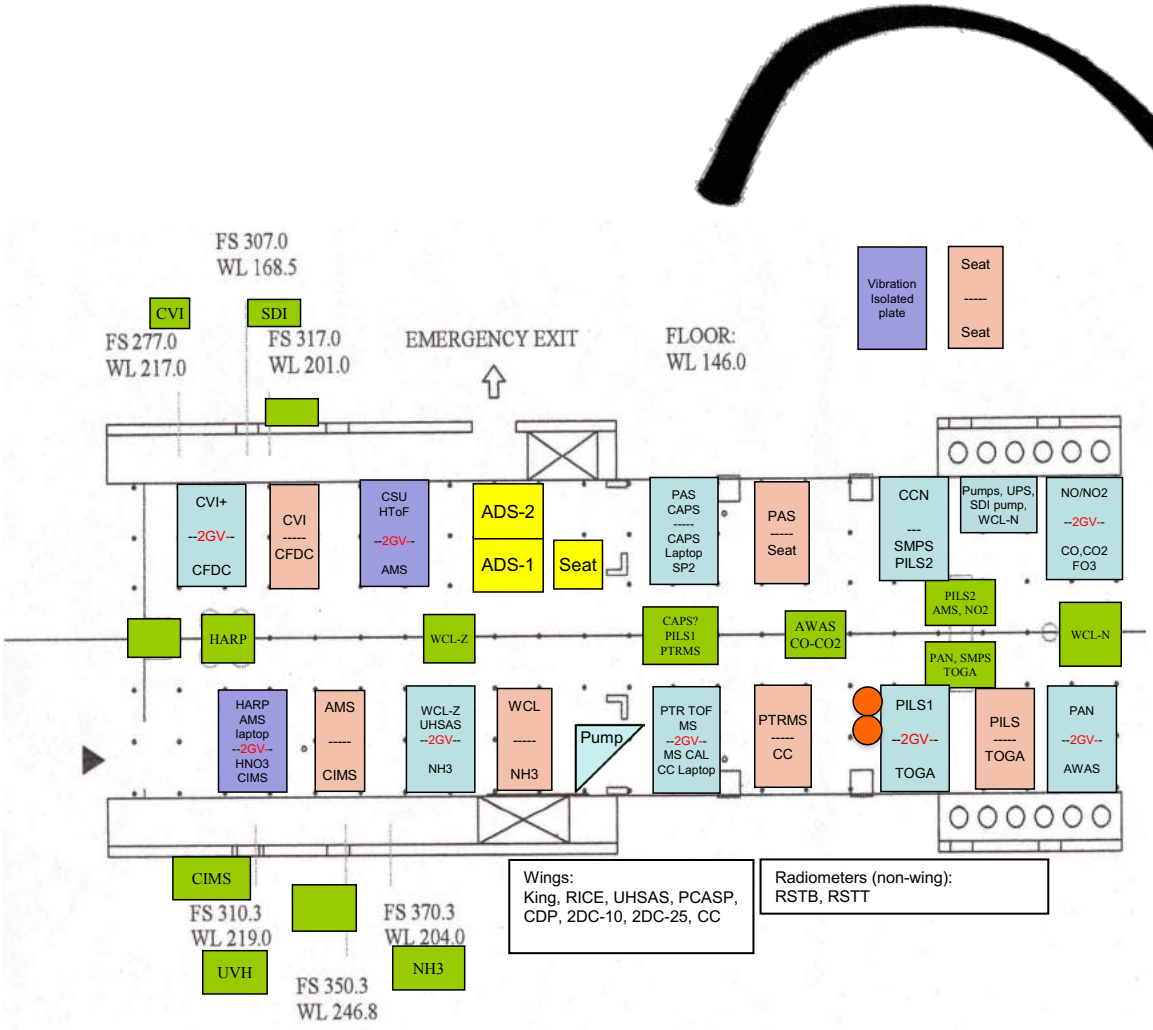
Clouds are important processors of gas and particle-phase species.

- Smoke often undergoes cloud processing during transport
- Field obs suggest greater BBSOA production than chamber studies
- Aqueous chemistry may increase (or decrease) total PM during aging
- Many hypotheses, but few measurements



Instrumentation to observe cloud-active particles (CCN, INPs), microphysics in smoke- impacted clouds, and to collect cloud water for chemical analysis.

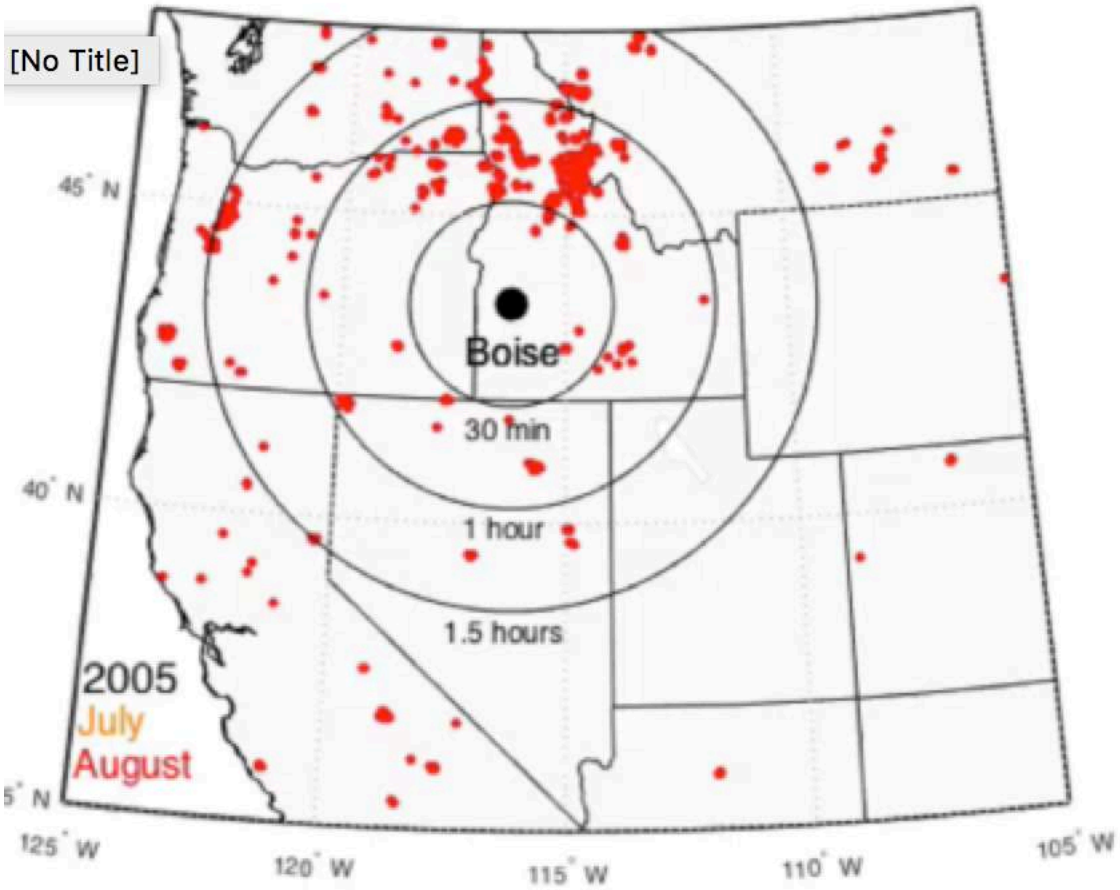
All that science will fill the NSF/NCAR C-130. We have great support at EOL to help us make it actually work.



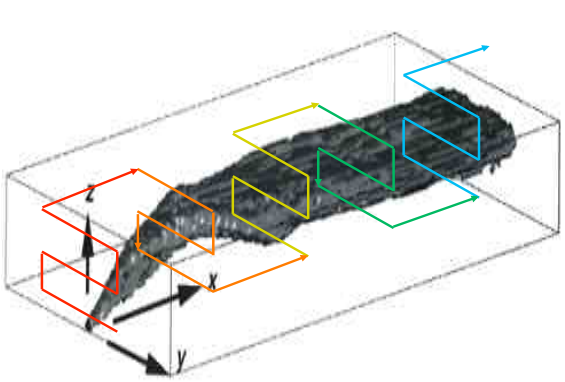
Fire activity within ~1-2 hour flight of Boise should allow sampling wildfires between late July and early September.

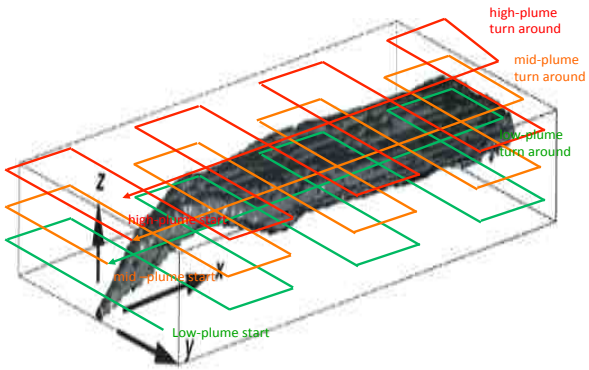
Fires that are identified by HMS analysts as fires warranting air quality forecasting in July and August.

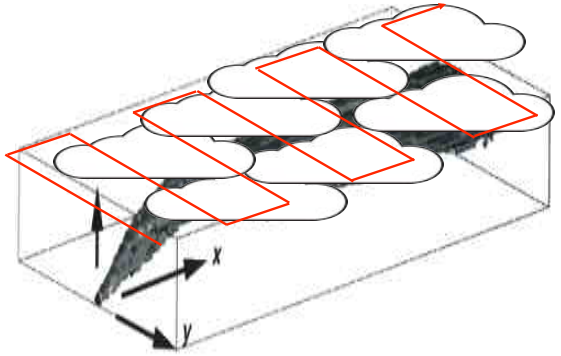
These are the major smoke producing wildfires.



Flights will sample fire emissions and smoke plumes in a pseudo-lagrangian fashion, & target smoke-cloud mixtures.



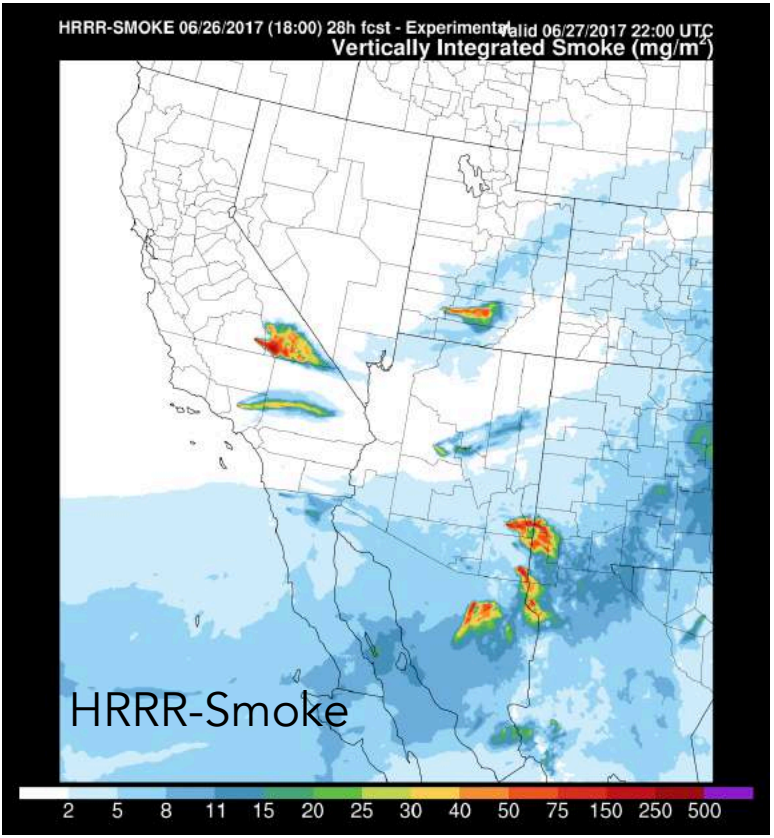


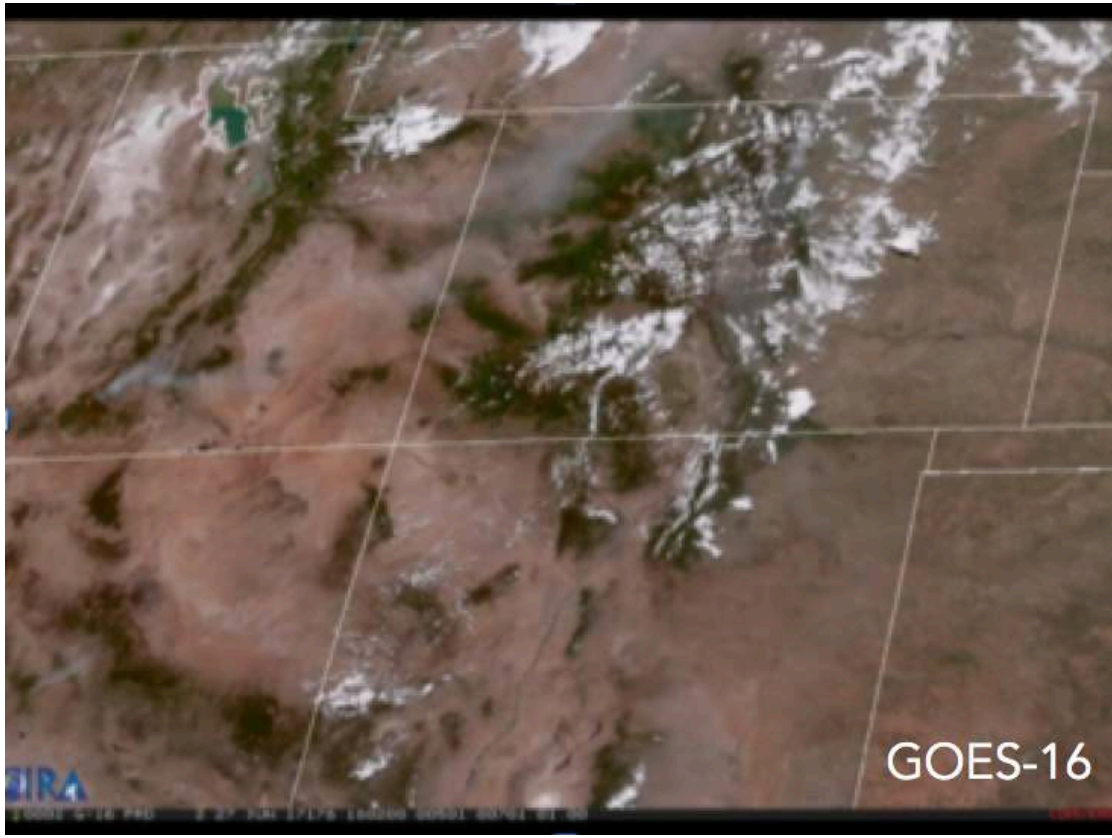


- 2/3 of flight hours
- Very fresh smoke
- Test both patterns, pick one, and repeat

- 1/3 of flight hours
- Likely aged smoke

We expect to leverage a range of forecasting (and now-casting tools), including models and satellite products.





Forecasting Team:
Russ Schumacher, Ravan Ahmadov, Sher Schranz,
Arlindo da Silva, Karla Longo

https://rapidrefresh.noaa.gov/hrrr/HRRRsmoke/
http://rammb.cira.colostate.edu/ramsdis/online/loop_of_the_day/

WE-CAN will also have a very strong educational focus.

> 12 graduate students across 5 public universities

Development of a graduate airborne observations course

Undergraduate Research

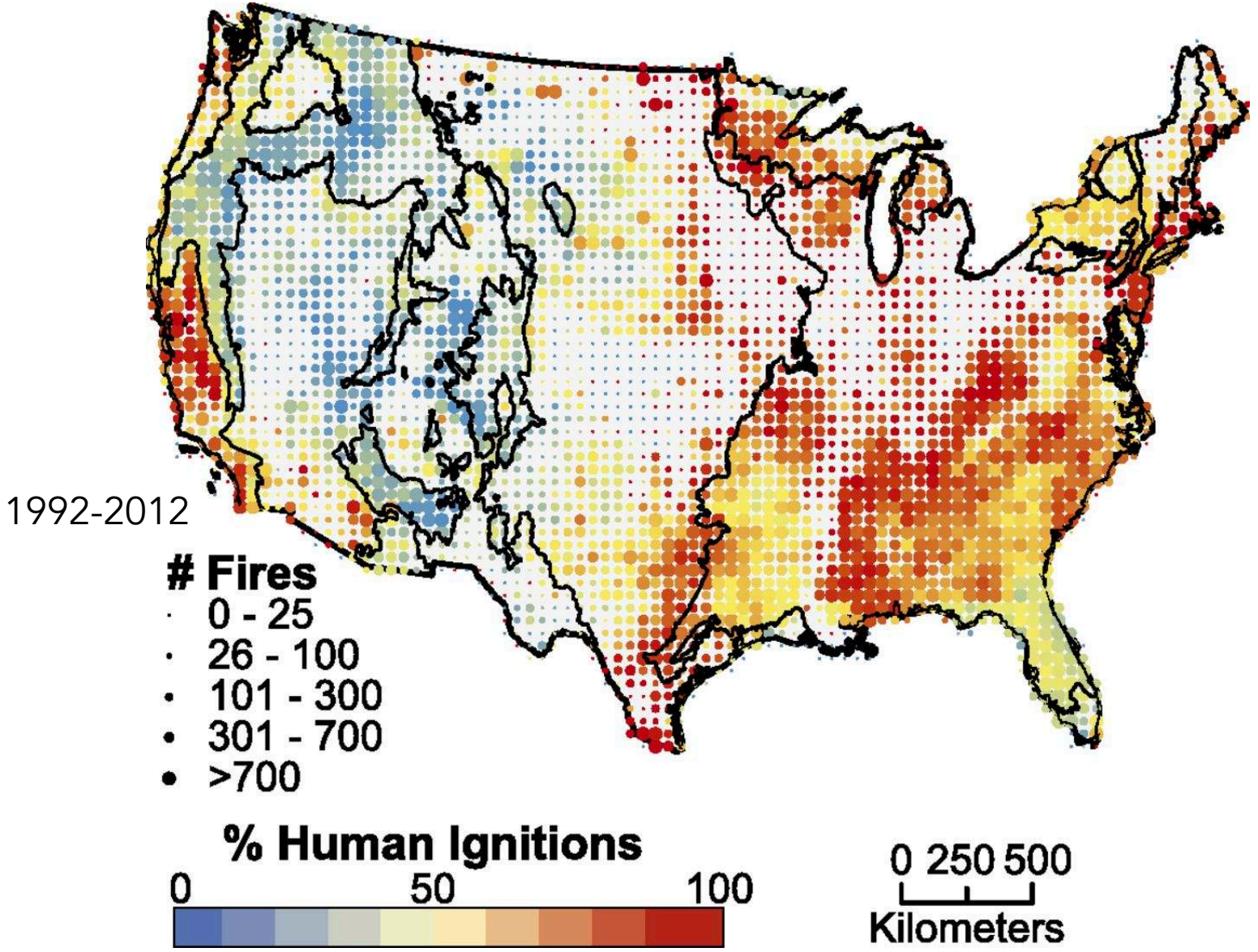
Outreach to undergraduate women across 8 universities in 2 regions.

WE WANT to COLLABORATE.
Just reach out, and WE CAN.

evf@atmos.colostate.edu

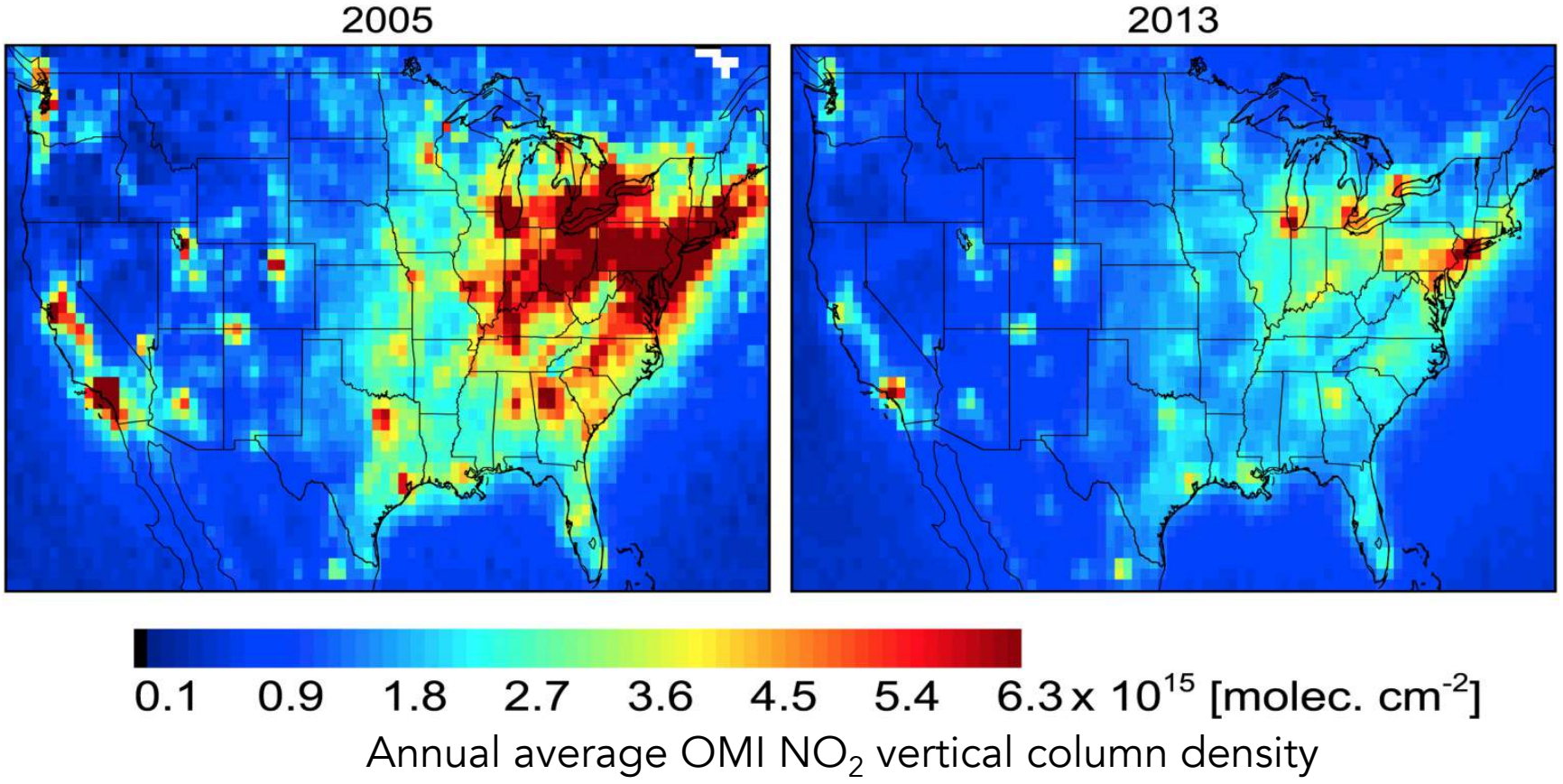
Extra Stuff

Humans are driving some of the increase, but our influence is not the same everywhere.



Balch et al. [2017]

The relative importance of fires as a source of both O_3 precursors and $PM_{2.5}$ will likely grow.



Lamsal et al. [2015]

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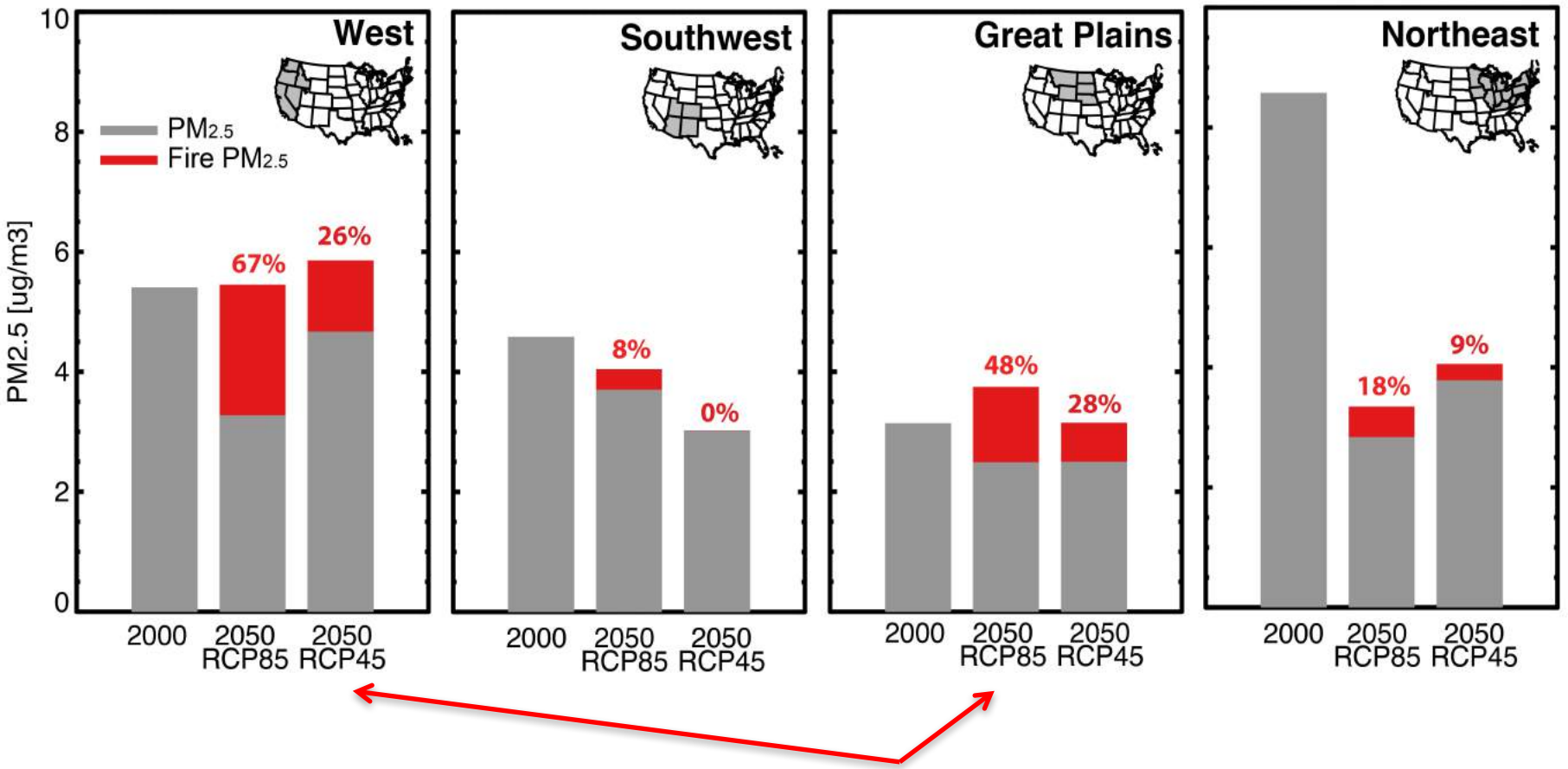

Climate-driven increases in fire $PM_{2.5}$ could offset anticipated reductions in anthropogenic emissions.

Val Martin et al. [2015]