Exceptional Event Smoke Analyses Baton Rouge, September 14, 2017

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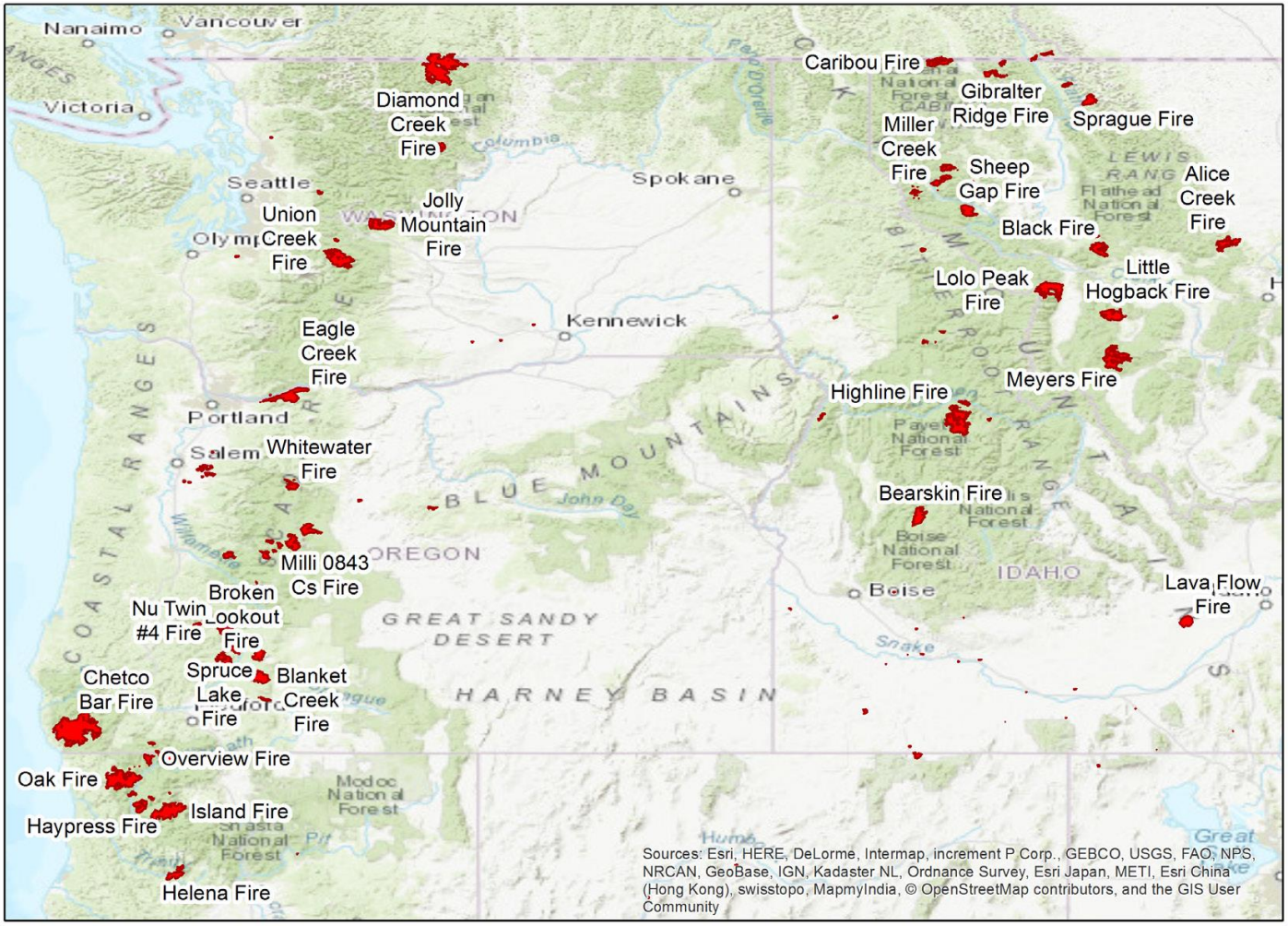
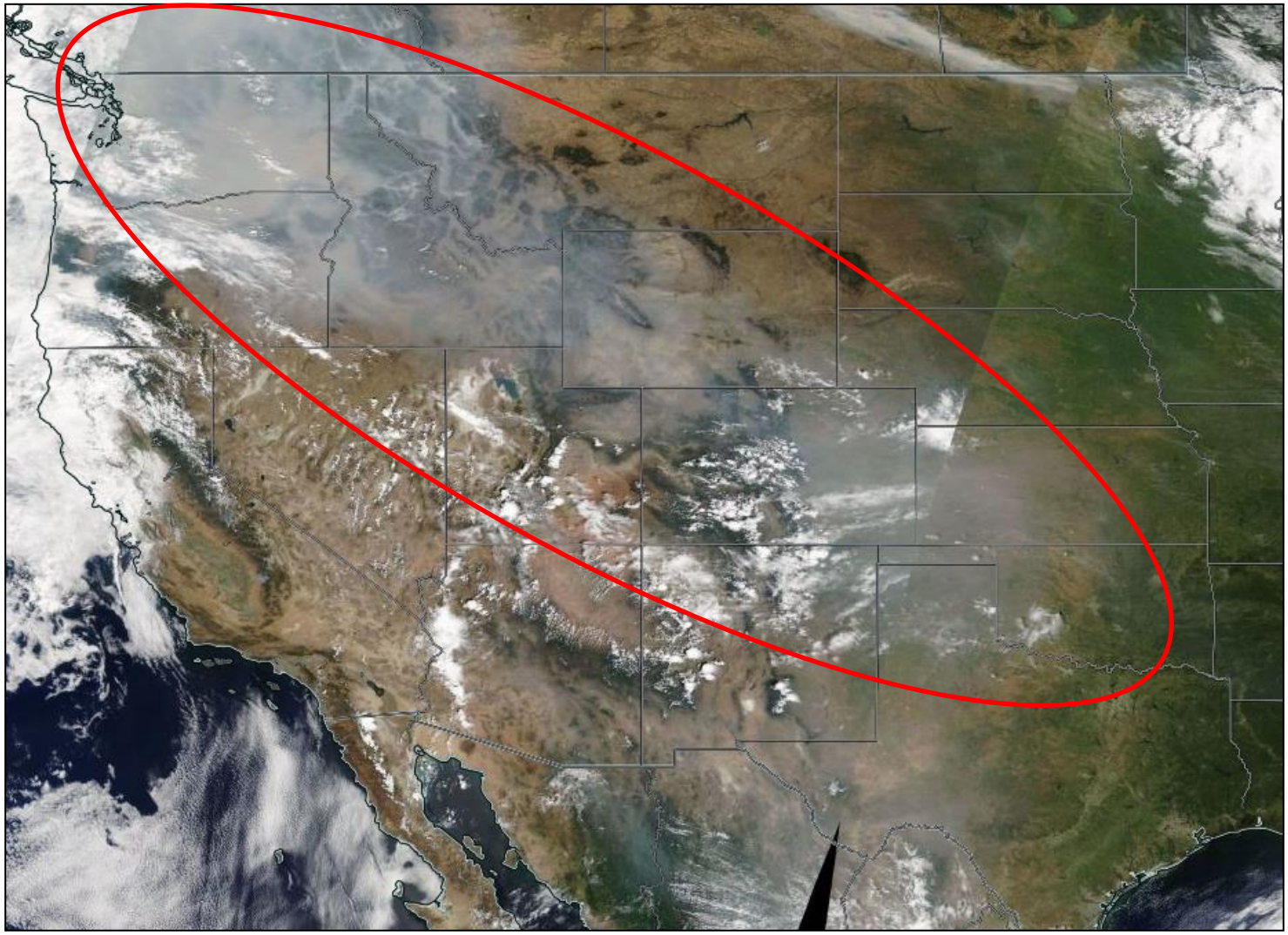
Innovative Environmental Solutions

September 2017 Northwest Wildfires



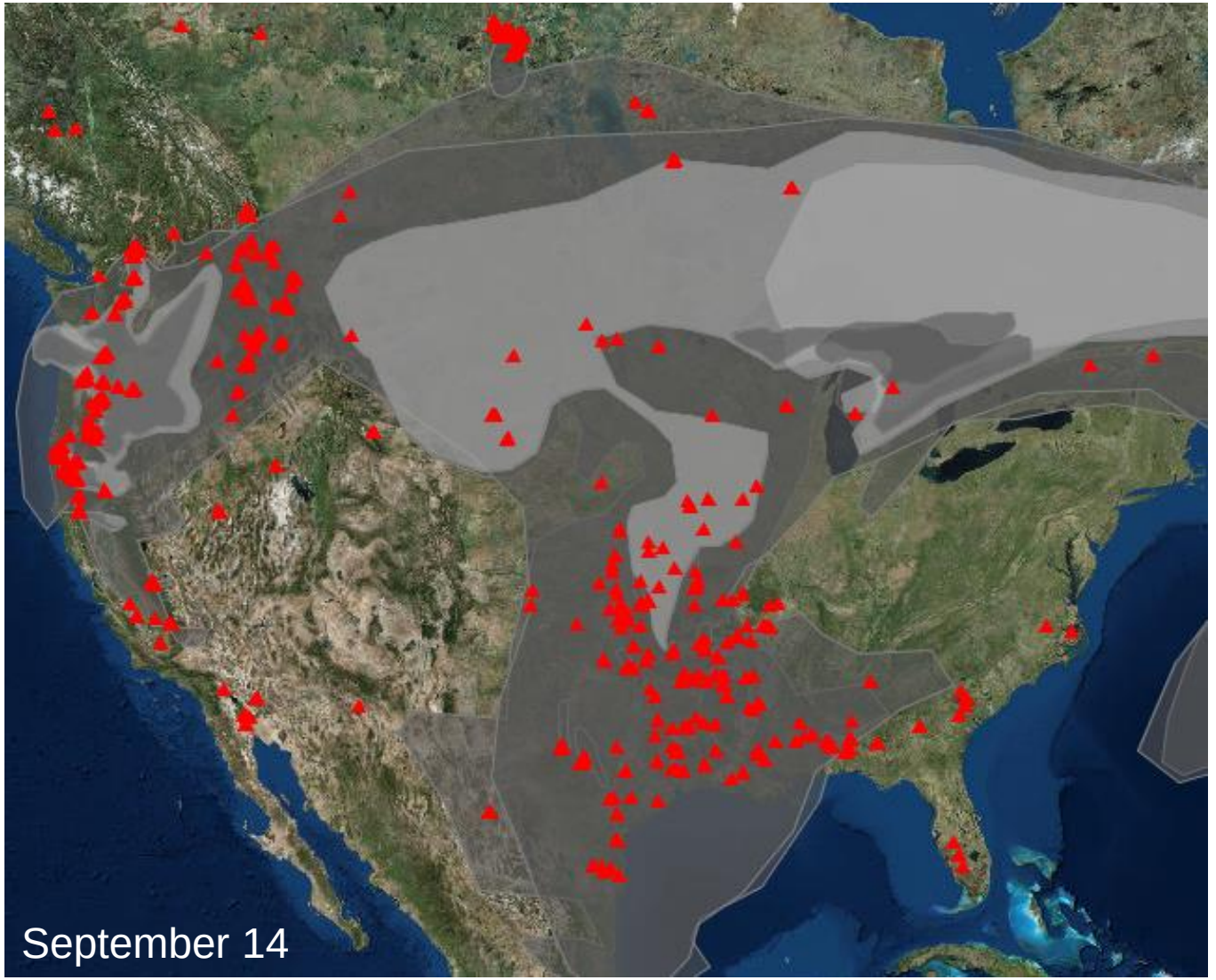
Wildfires active on September 14, 2017.
The names of fires greater than 10,000 acres are shown on the map.

Northwest Wildfire Smoke



Terra MODIS imagery, September 7, 2017

NOAA Hazard Mapping System Smoke Plumes and Fire Detections



Outline

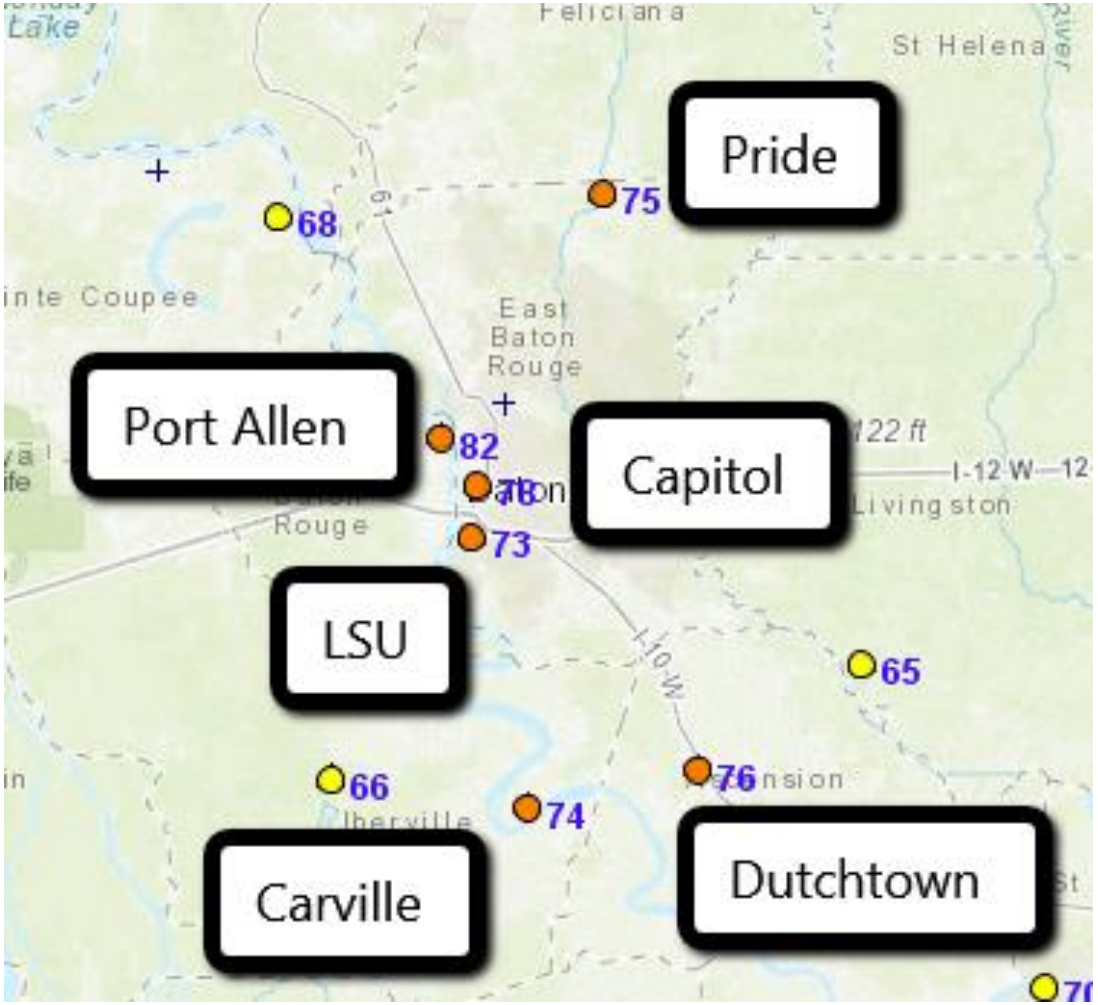
- Possibility and significance of smoke event on September 14, 2017 in Baton Rouge
- Summary of Tier 1 and 2 analysis results
- Conclusions

Wildfire Exceptional Events

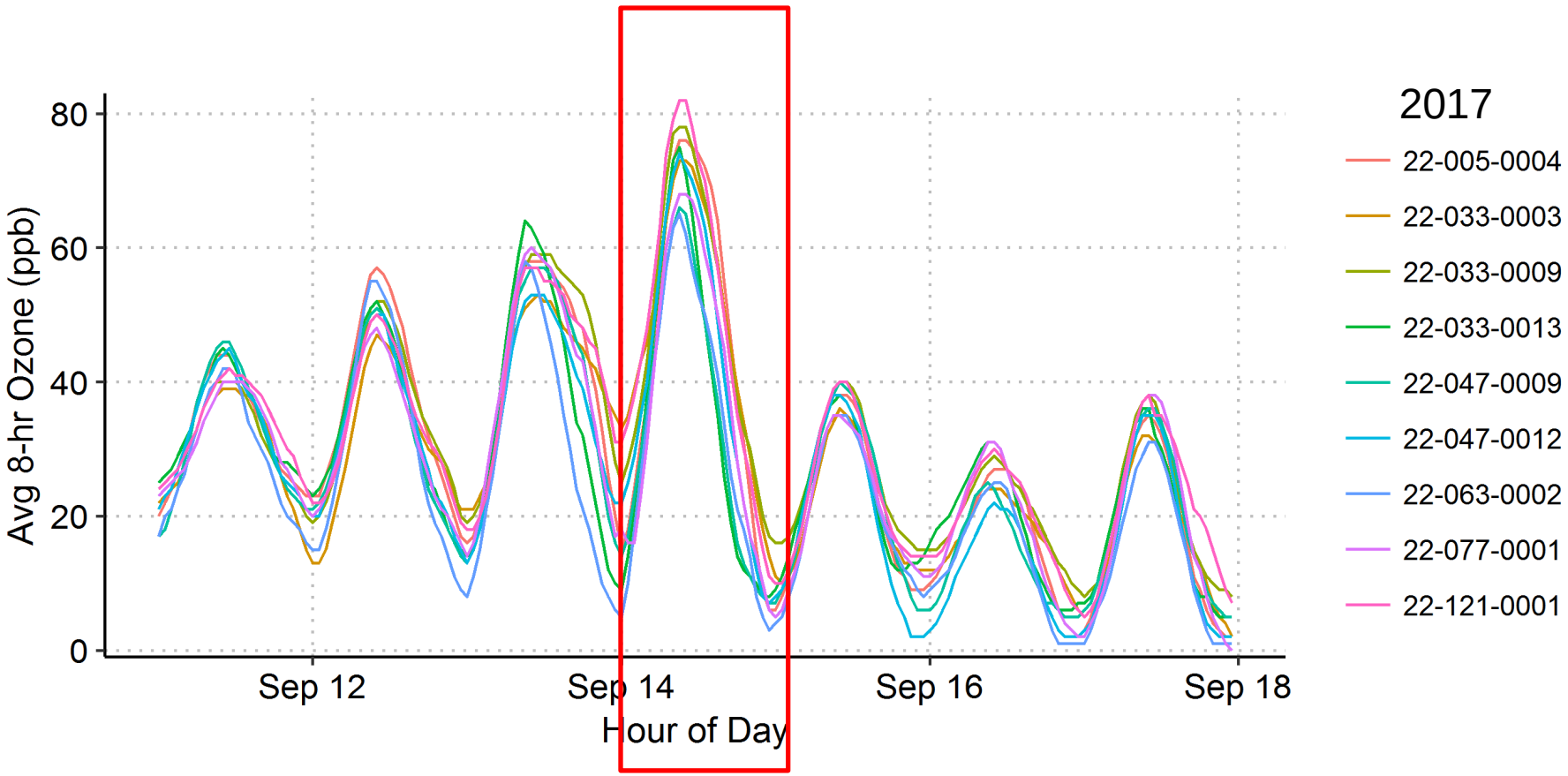
Exceptional Event Demonstrations must include 6 elements:

1. Narrative conceptual model of how the event emissions affected monitors;
2. Clear causal relationship between the event and exceedance at monitors;
3. Analysis comparing event-influenced concentrations to non-event data;
4. Event is not reasonably controllable and preventable;
5. Event caused by human activity unlikely to recur or natural event; and
6. Opportunity for public comment.

September 14, 2017 Exceedances



Week of exceedance



Ozone Design Value at Dutchtown, LA

	2015	2016	2017
First High	82	74	76
Second High	80	73	75
Third High	75	72	69
Fourth High	74	71	68
Fifth High	71	66	67
Design Value Including All Measurements		71	
Design Value Excluding September 14, 2017 Measurement		70	

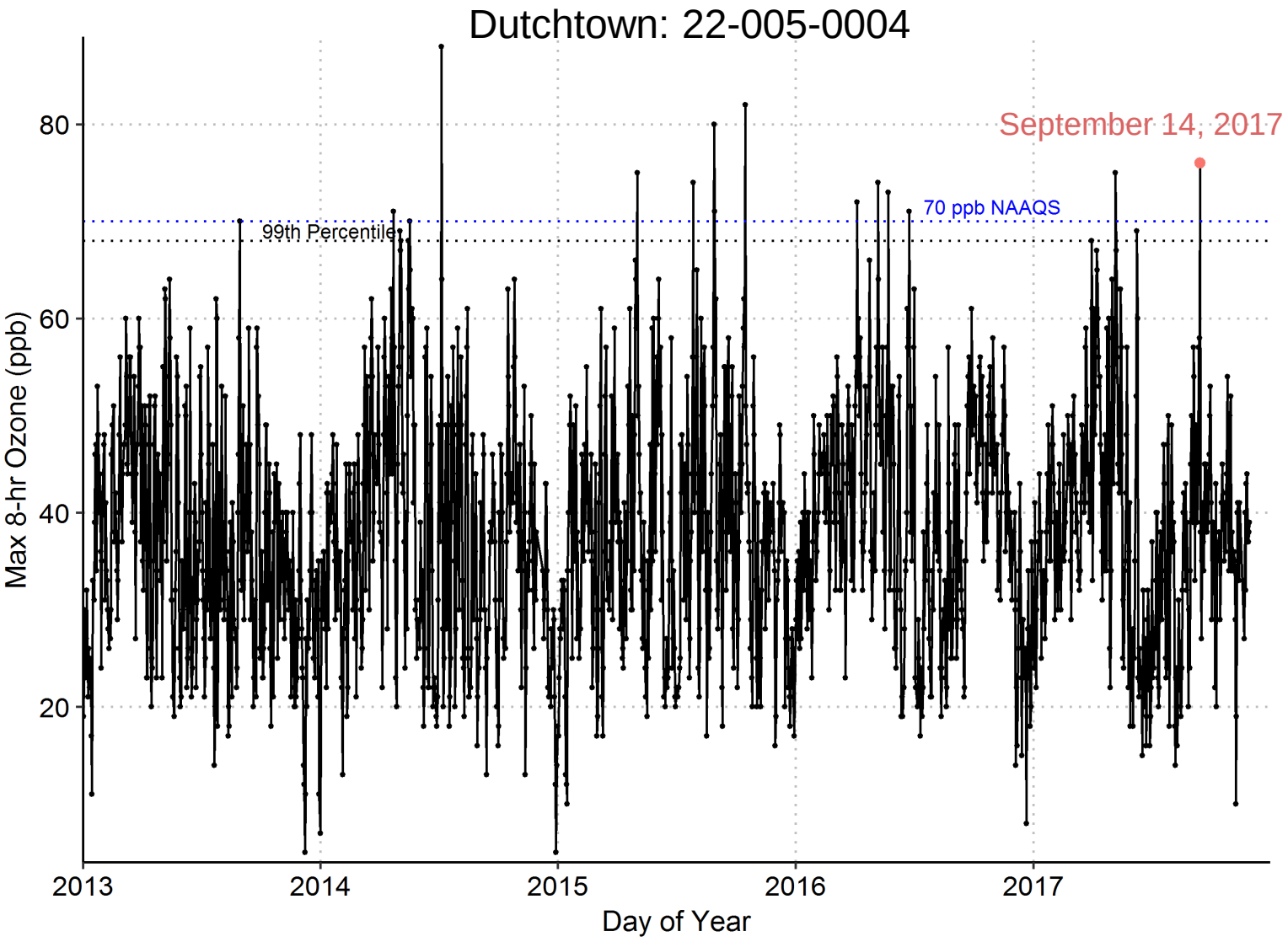
Sept 14, 2017

N/A means that the monitor did not meet the completeness criteria described in 40 CFR, part 50, Appendix U

Analyses

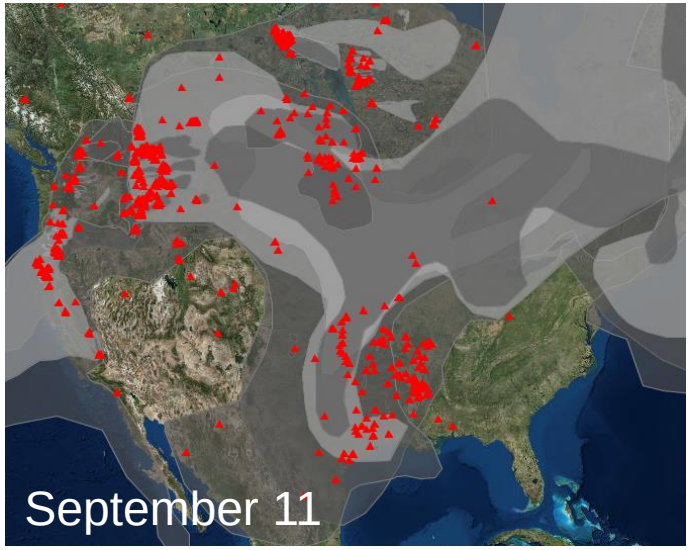
1. Provide historical context for ozone concentrations
2. Maps of ozone concentrations, fires, and smoke
3. Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) modeling
4. Maps of satellite measurements of NO_x, AOD, and CO
5. Compare diurnal patterns of NO_x, O_3 and VOC/NO_x during event and at other times
6. Assess measurements of VOC, CO, NO_x, and CO/NO_x ratios
7. Quantify total fire emissions and calculate emissions/distance ratio (Q/d)

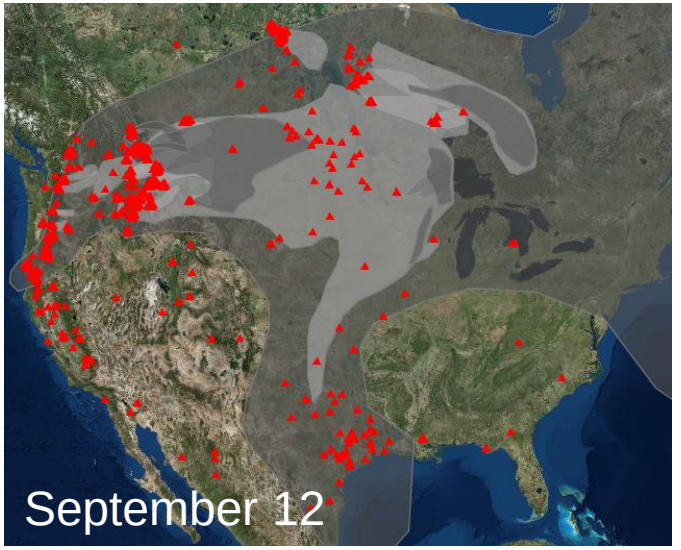
Historical Context: Past 5 Years

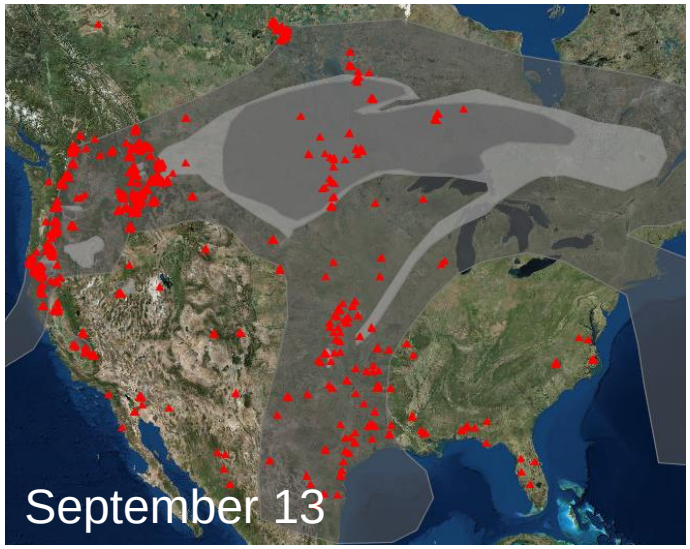


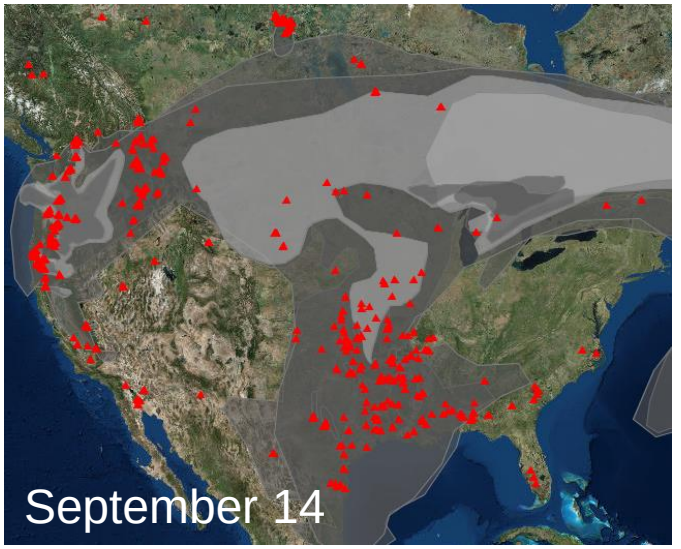
Daily Ozone AQI

NOAA Hazard Mapping System Smoke Plumes and Fire Detections

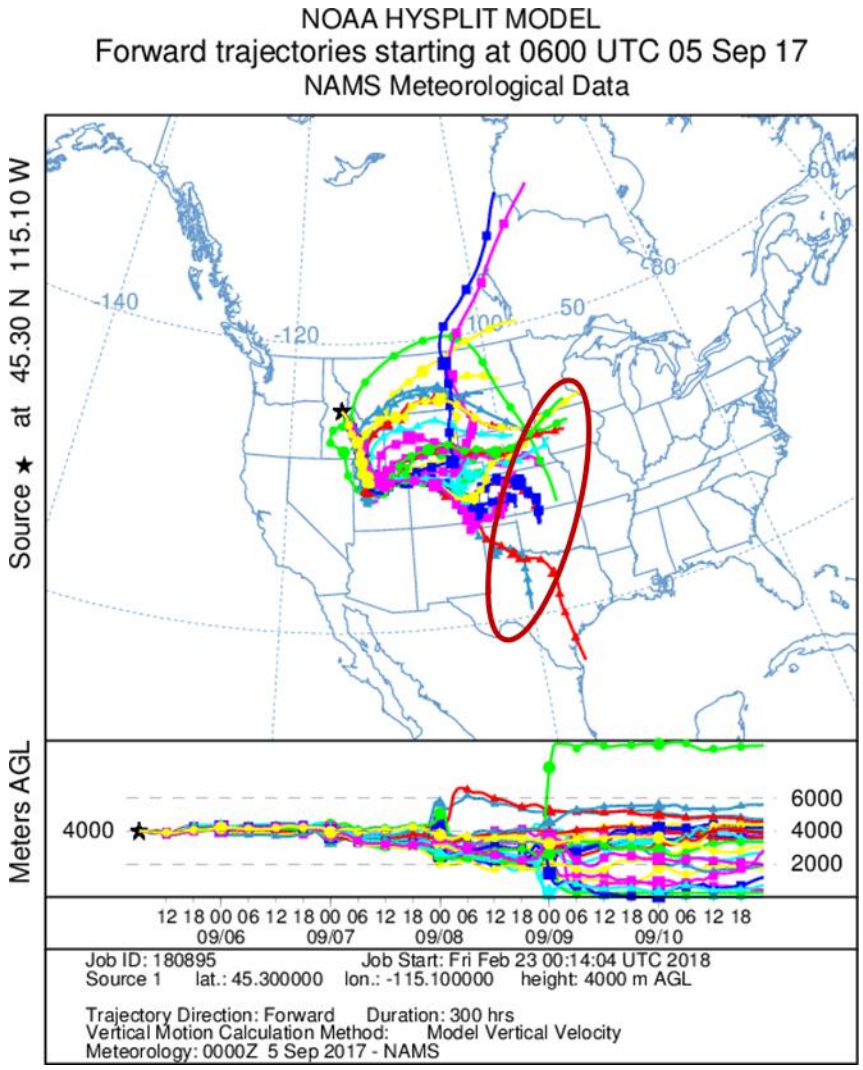


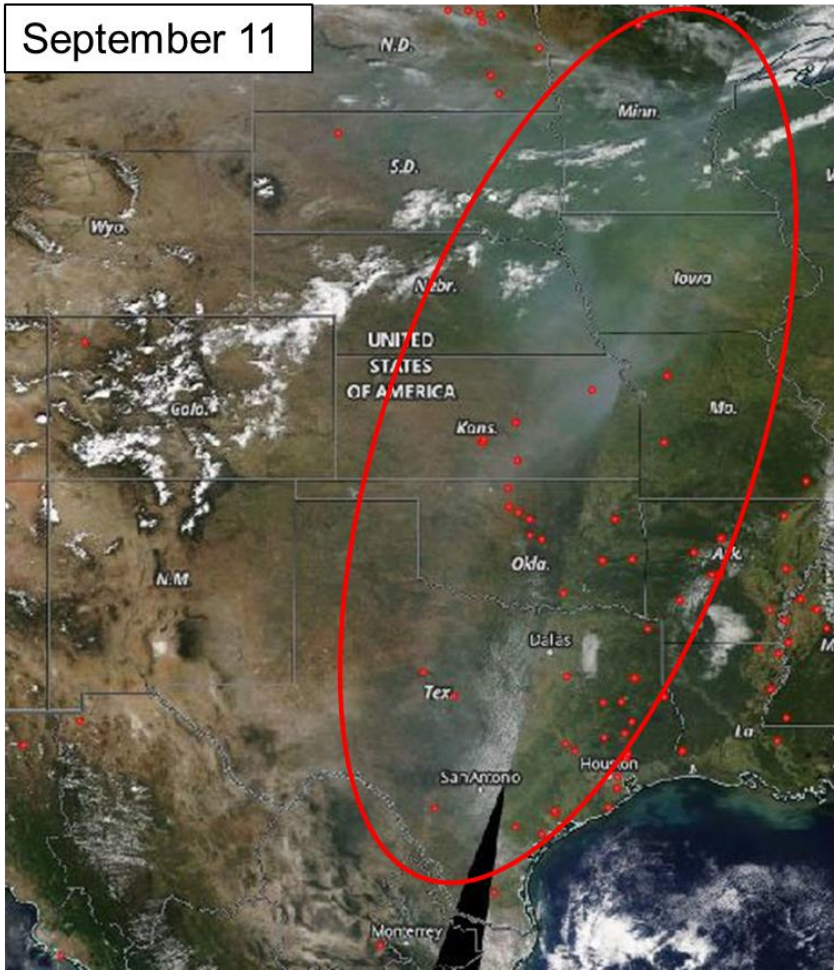






Long-Range Transport of Smoke from the Fires





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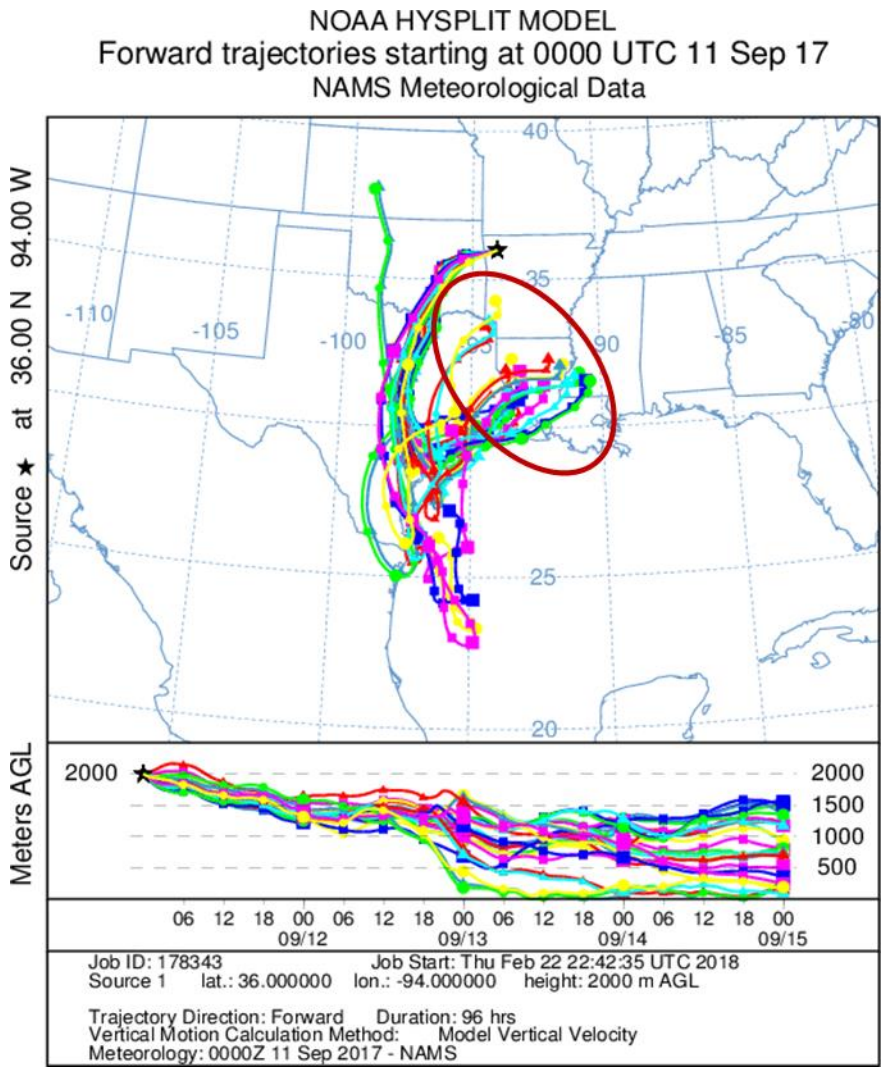
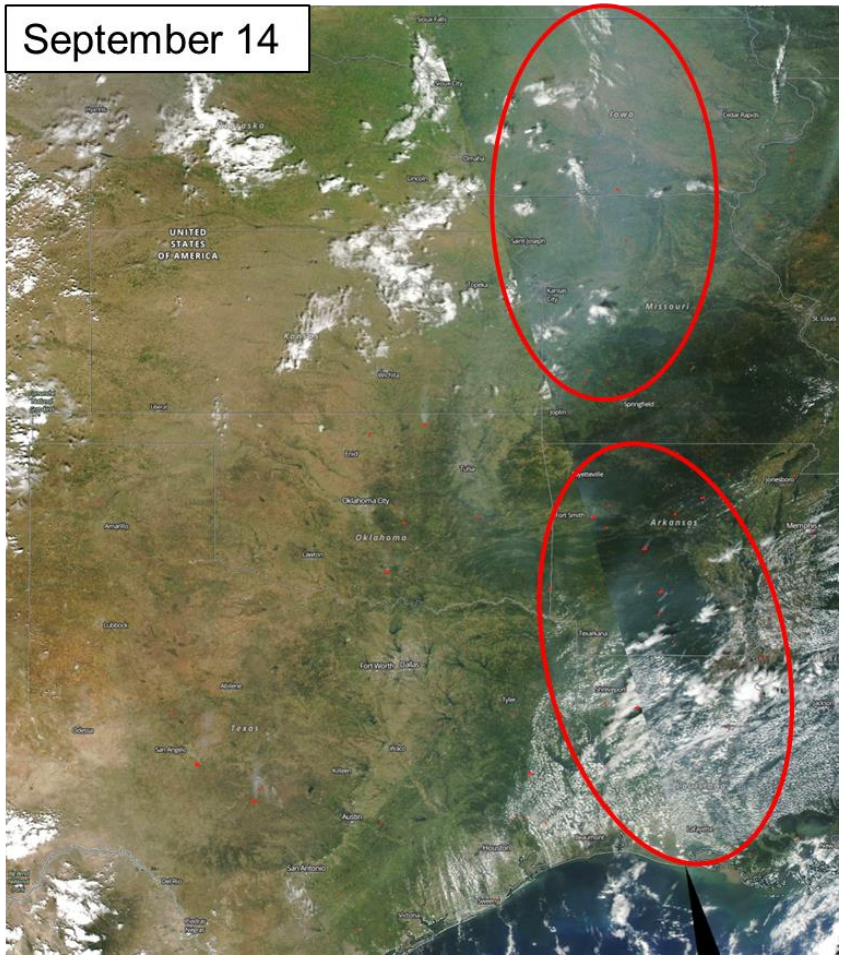
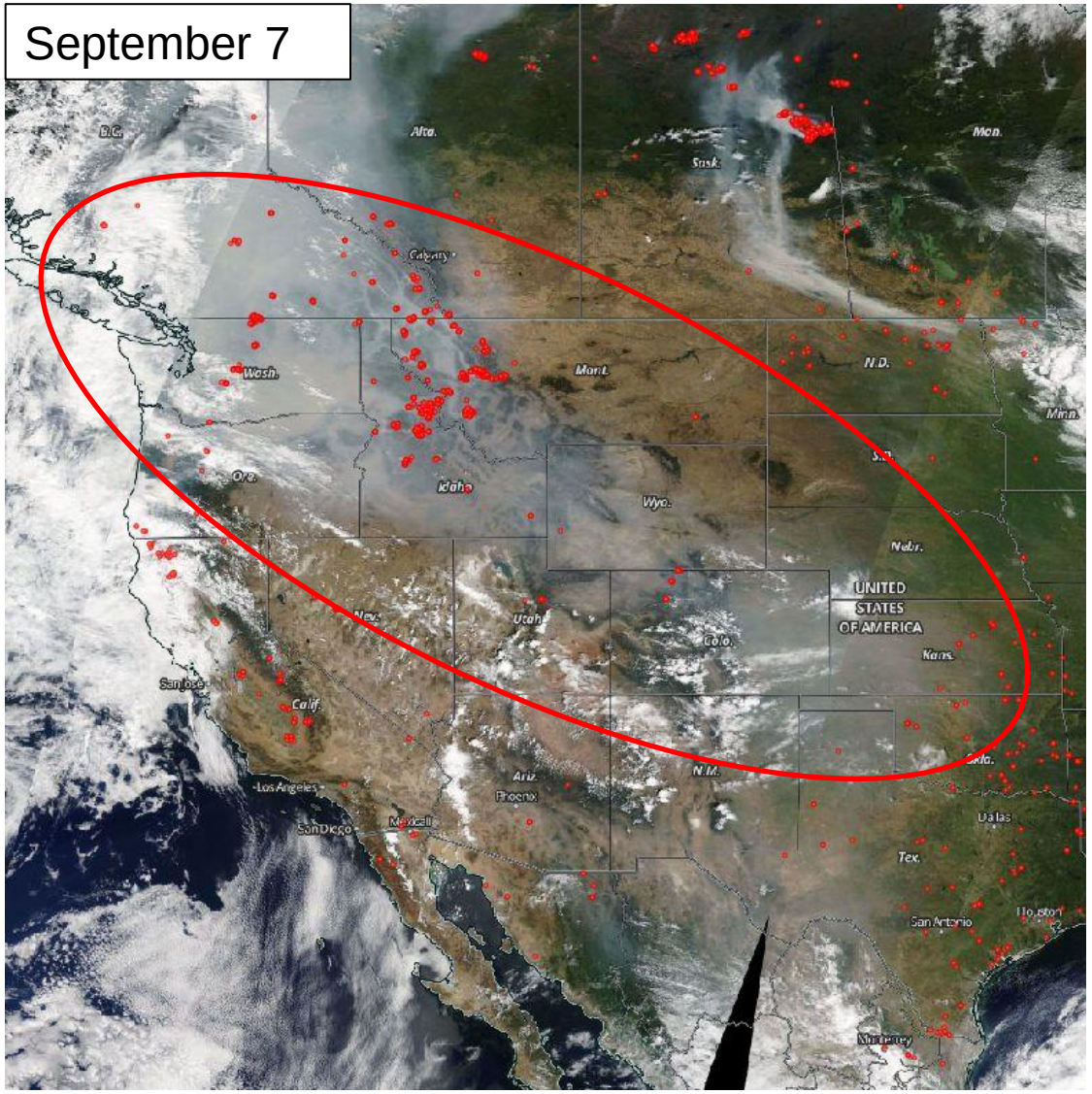




MODIS Terra Satellite Images



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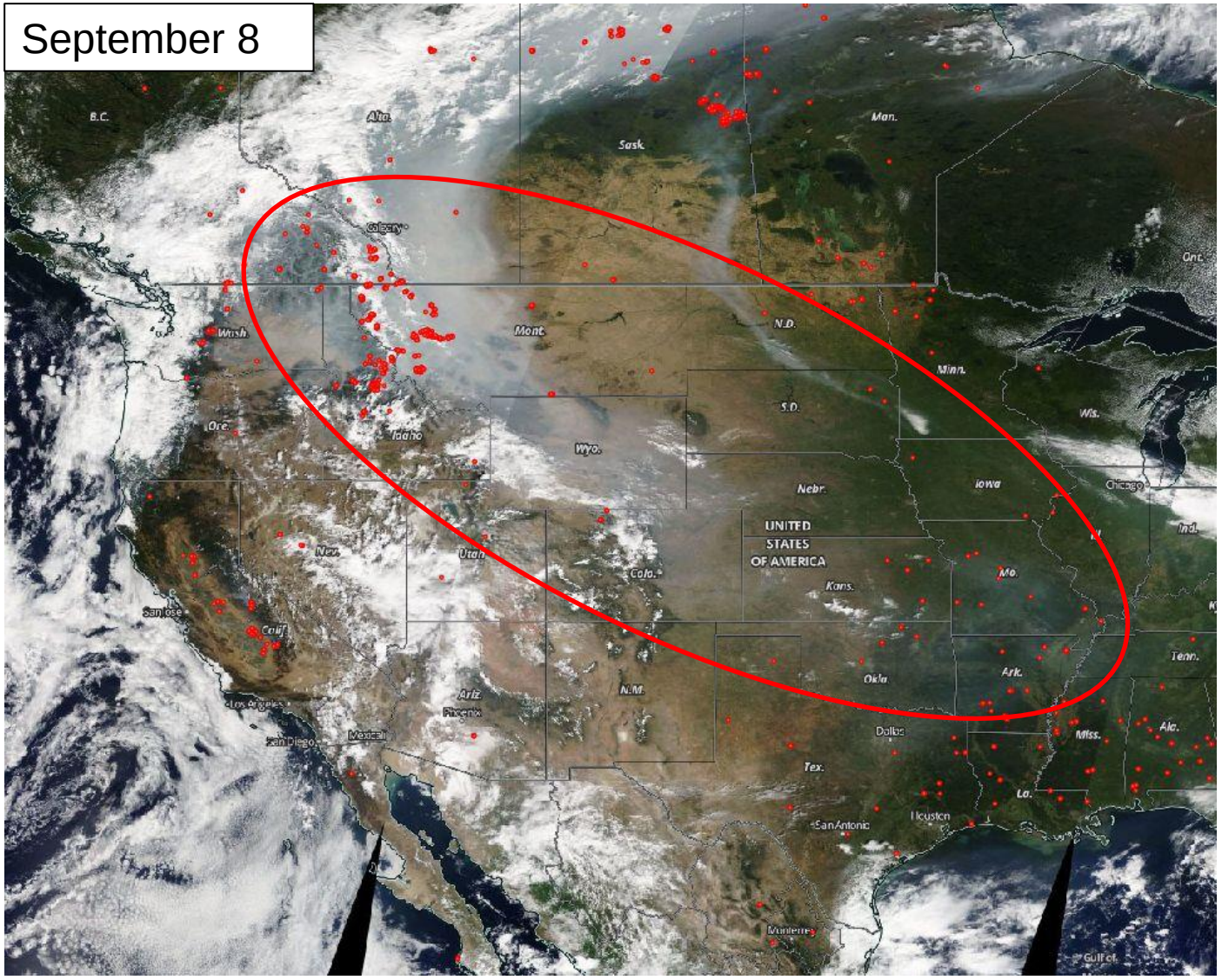

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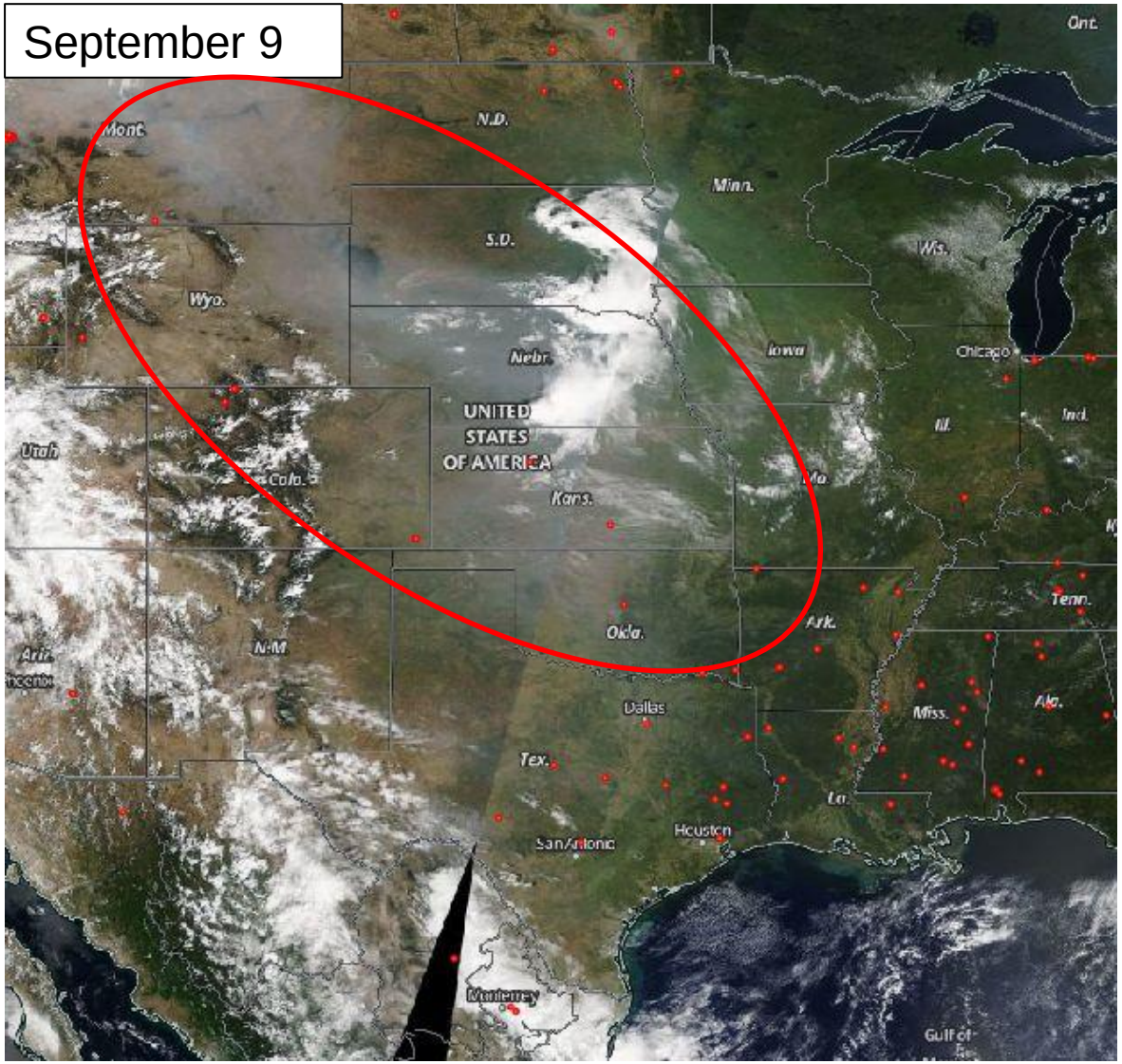
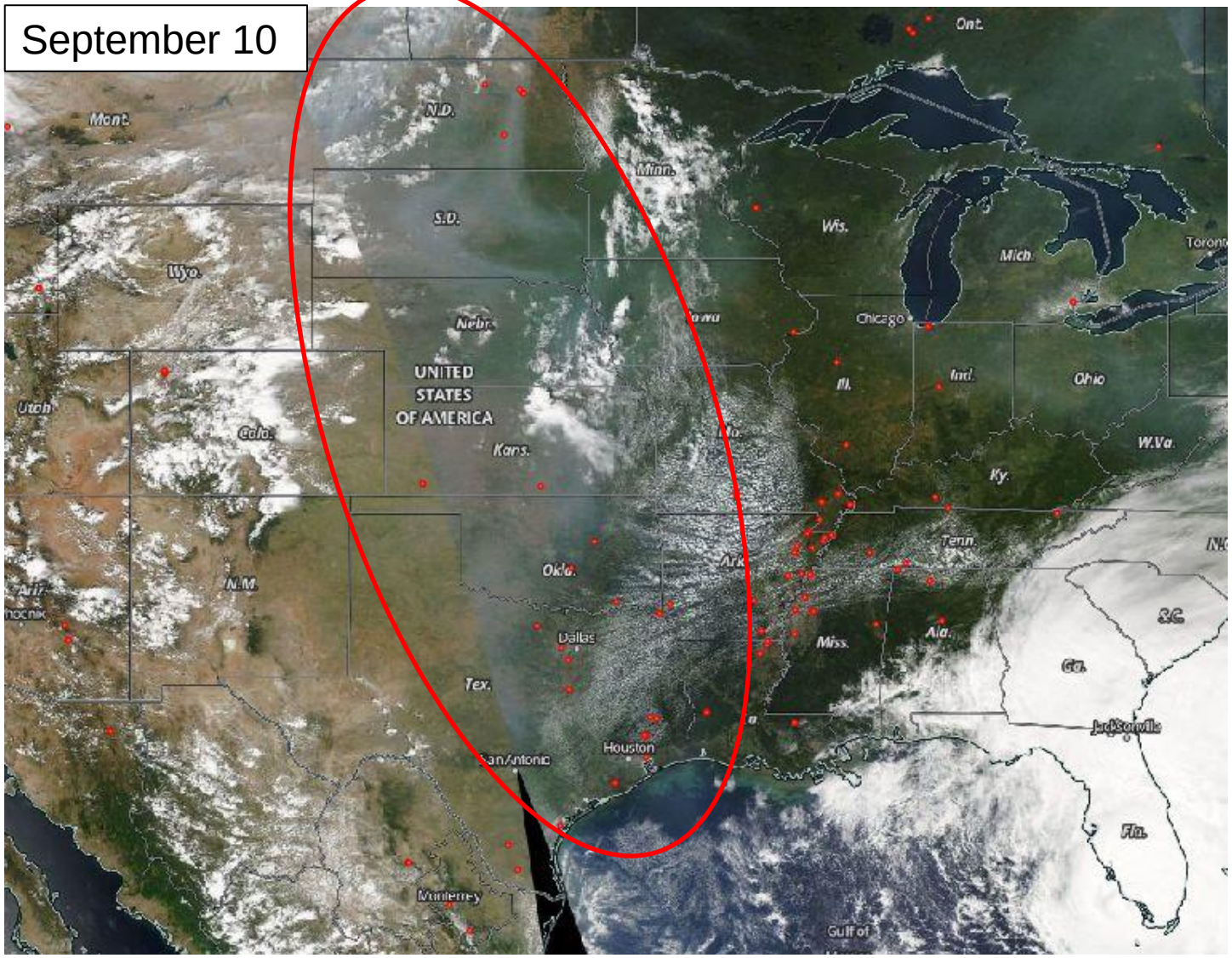


MODIS Aqua Satellite Images



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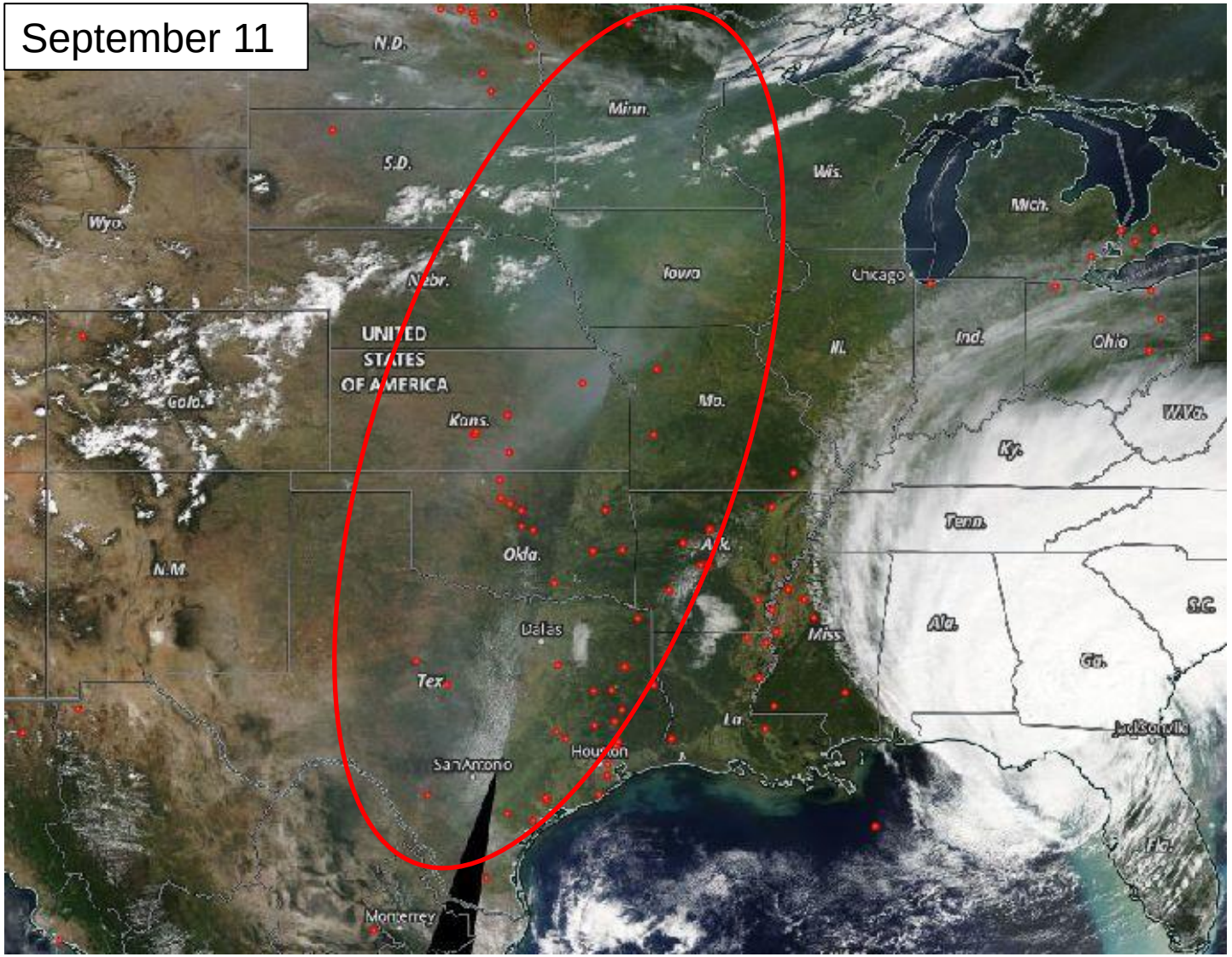

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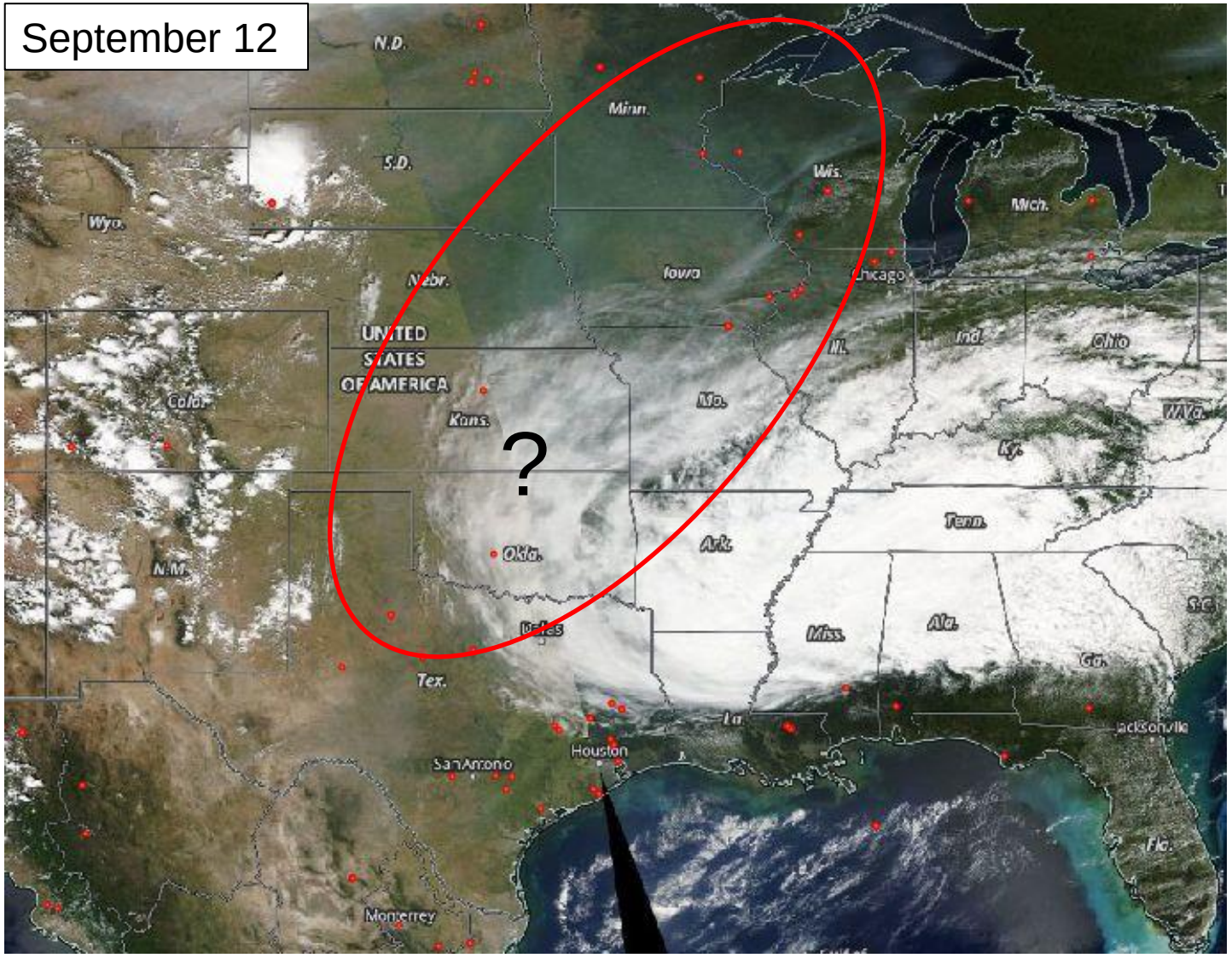

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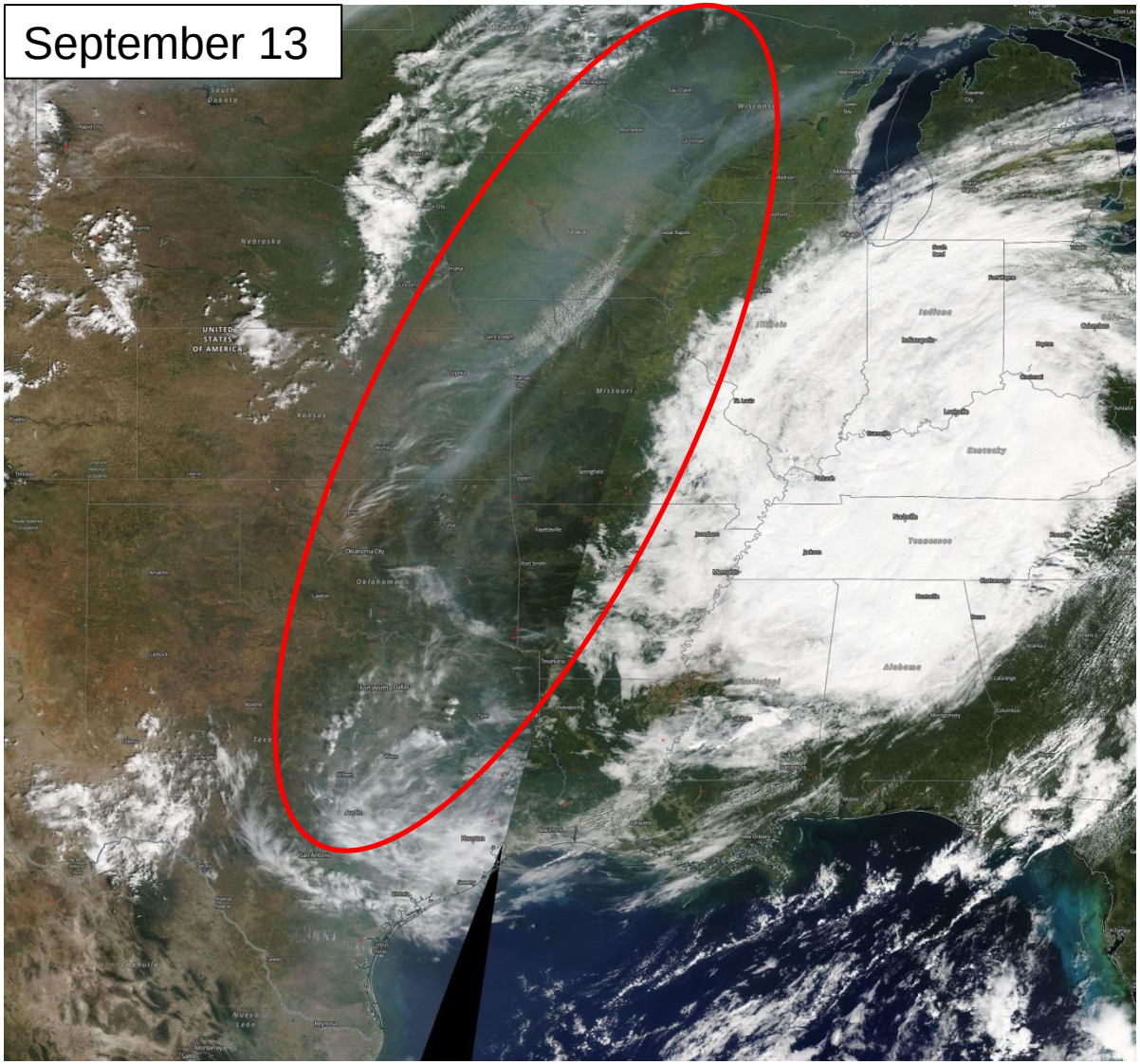

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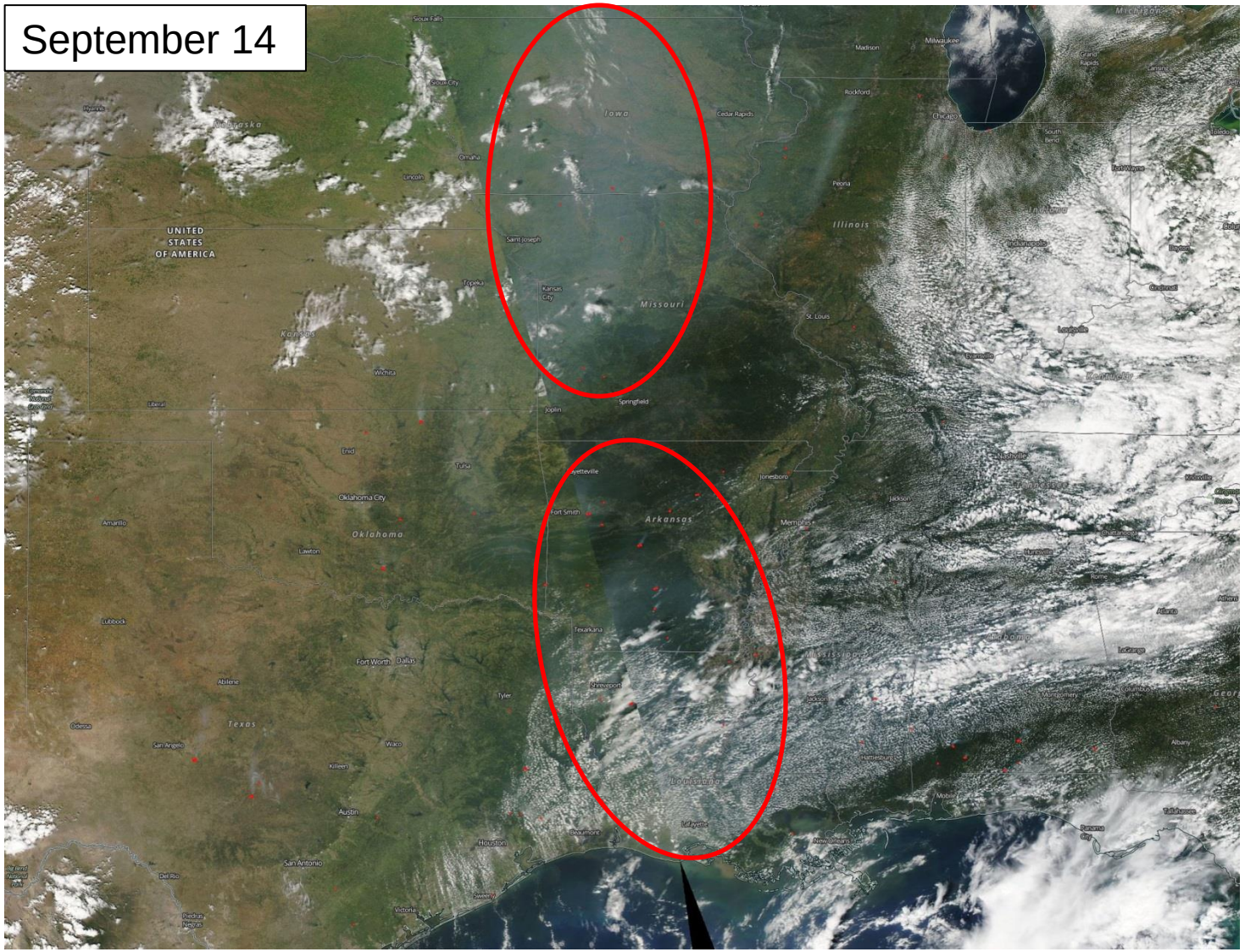
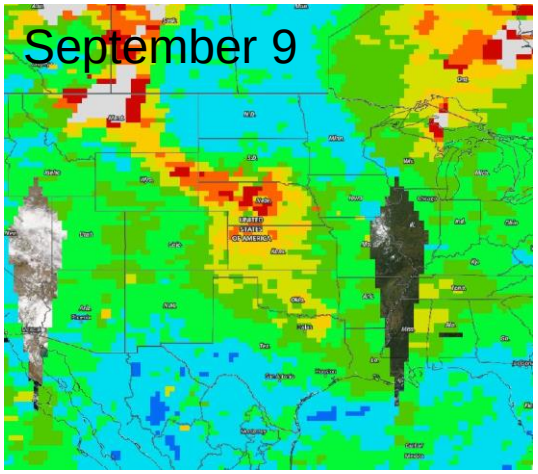
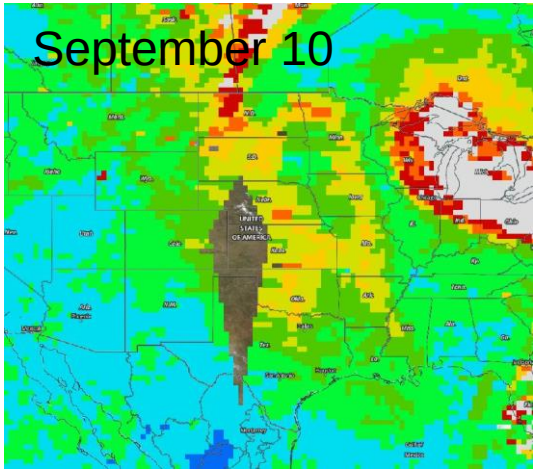
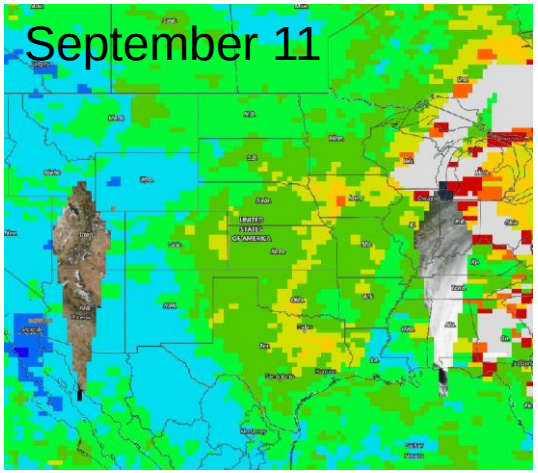
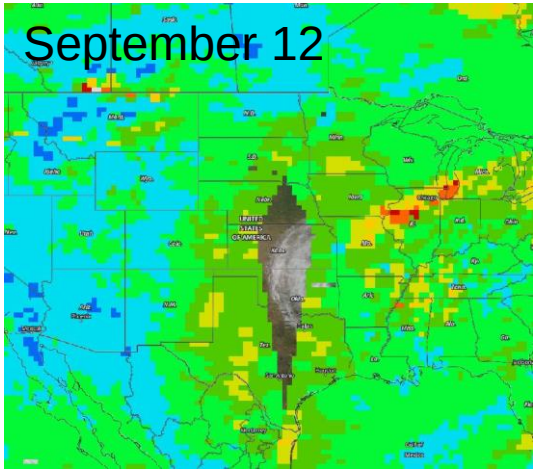


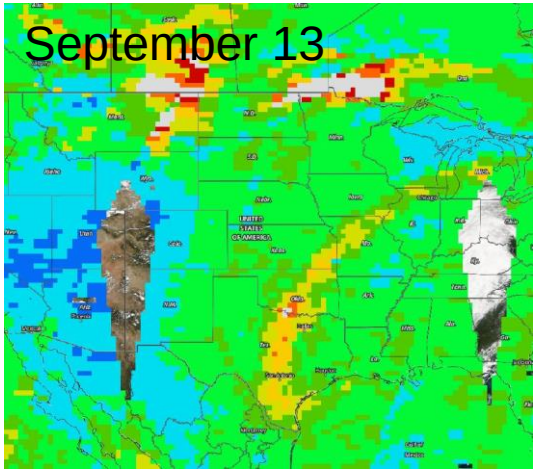
Satellite Maps of MODIS CO

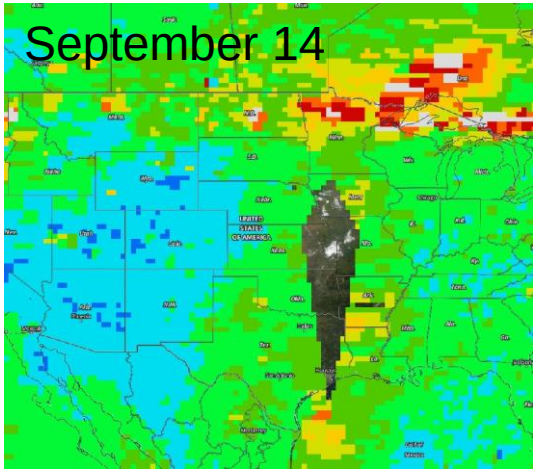










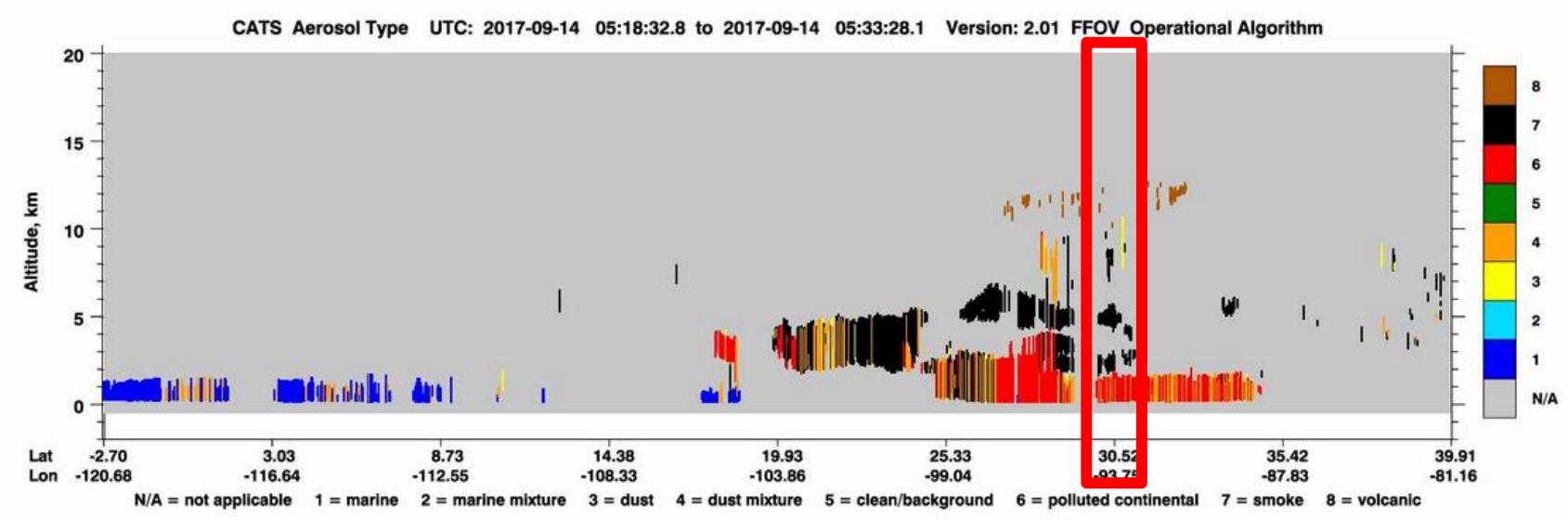


AIRS Carbon Monoxide (CO) Total Column (Day/Night)
NASA Worldview

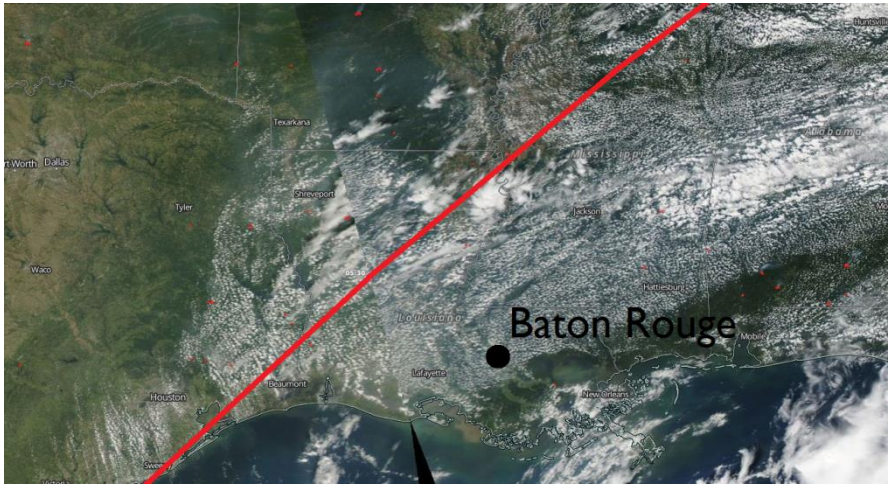
Additional Supporting Evidence for Transport to Louisiana

- Meteorological Maps
- Additional HYSPLIT Trajectories
- MODIS Aerosol Optical Depth Measurements
- Cloud-Aerosol Transport System (CATS) aerosol profiles

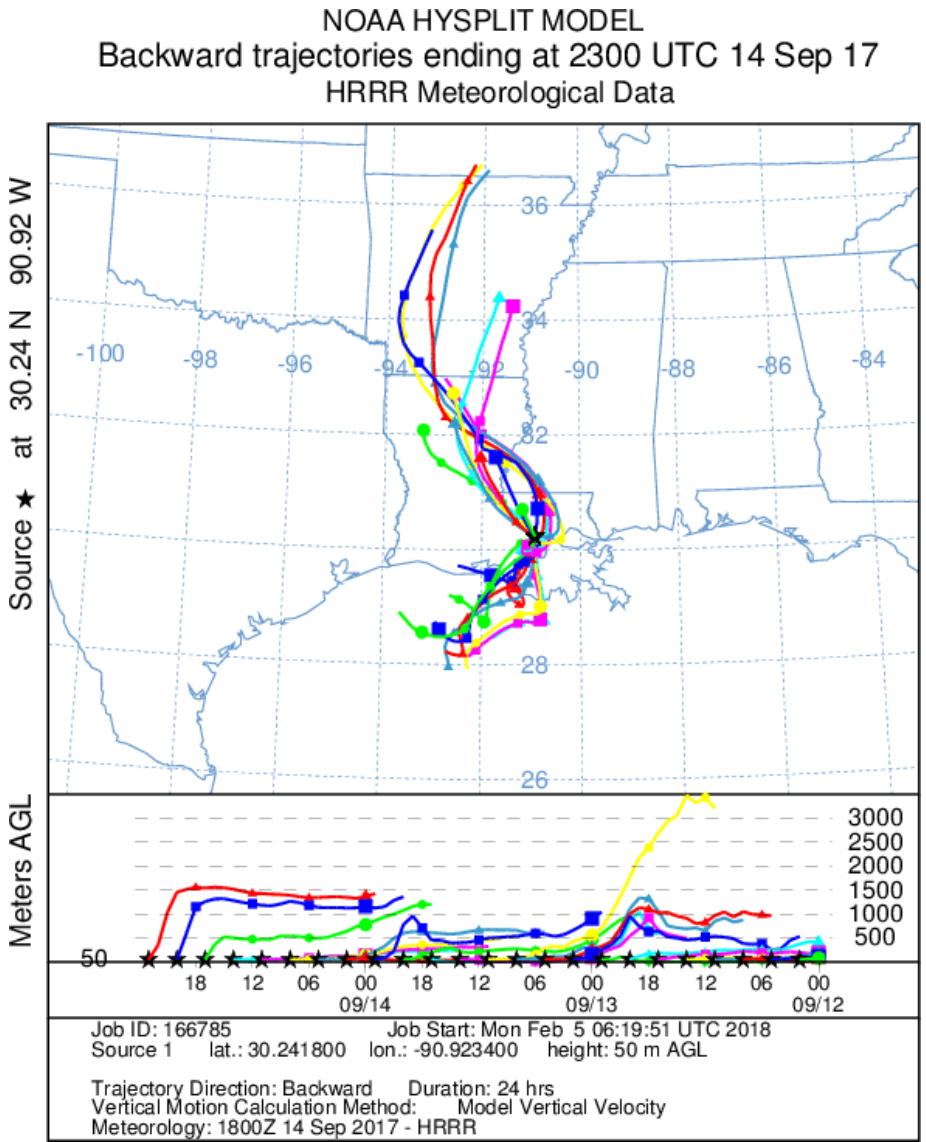
Satellite Profile of CATS AOD



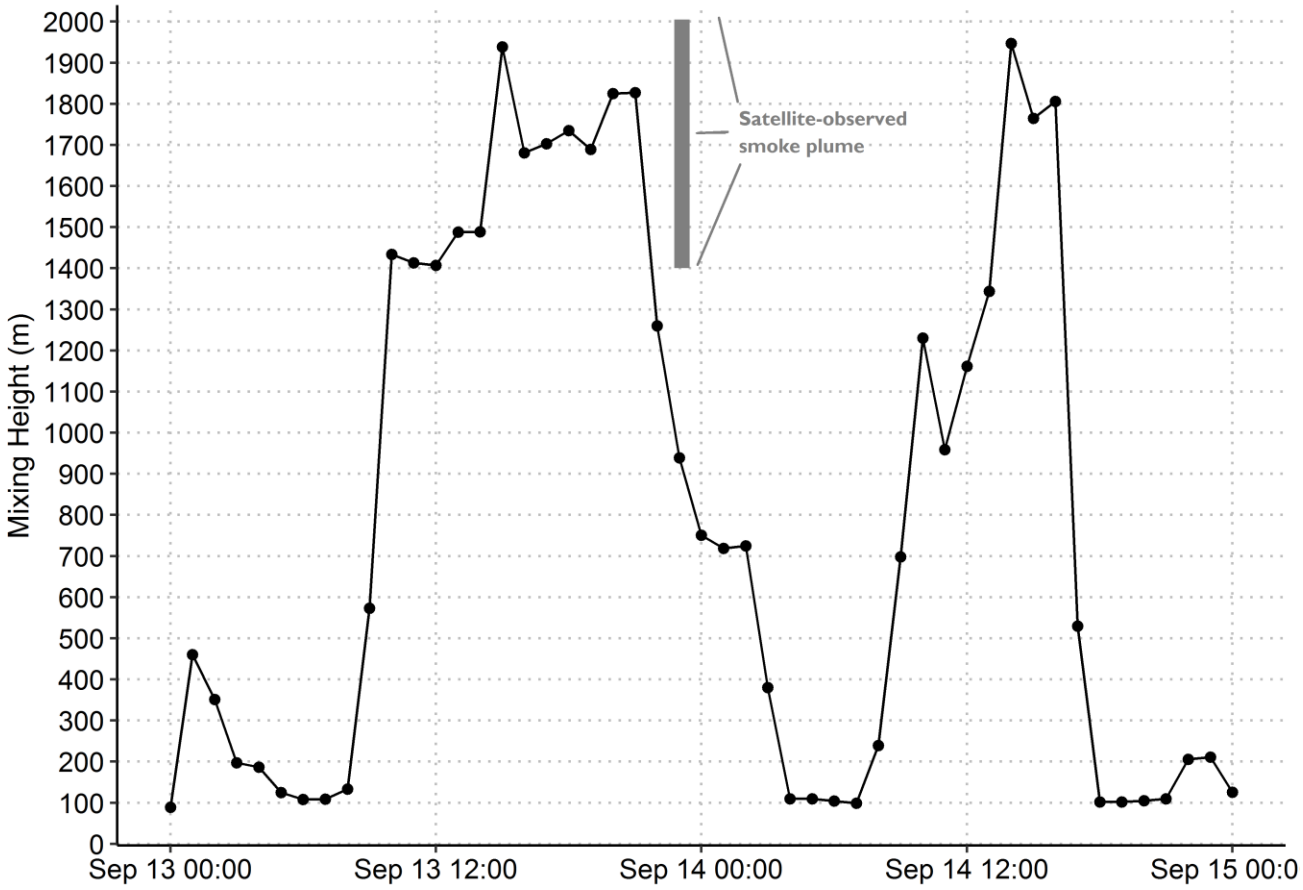
ISS Path over Louisiana



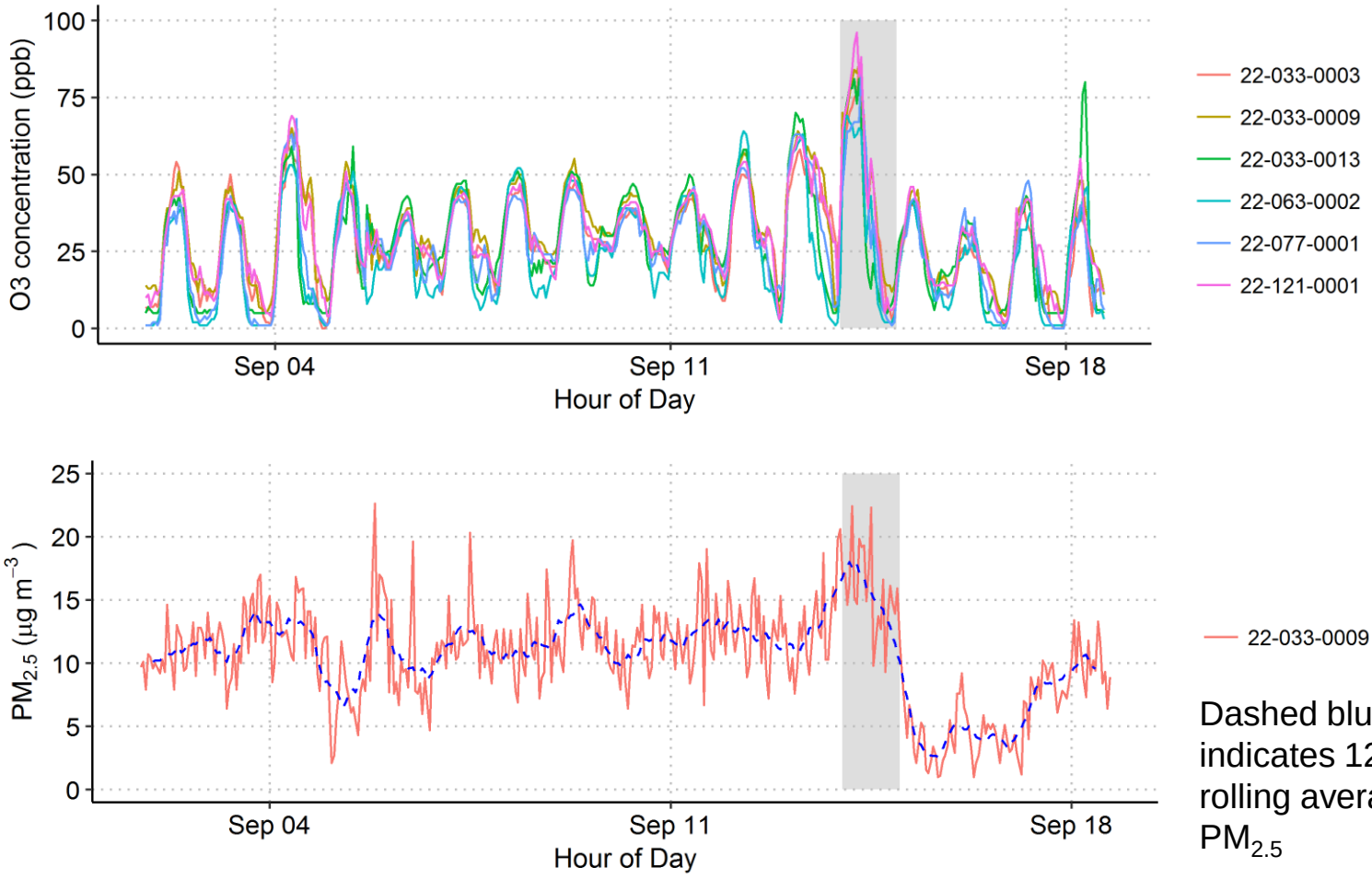
HYSPLIT Trajectories transport to the surface at Baton Rouge



Vertical Mixing: Ceilometer



Hourly Ozone and $PM_{2.5}$



Dashed blue line indicates 12-hour rolling average $PM_{2.5}$

Additional Supporting Evidence of Surface Impacts

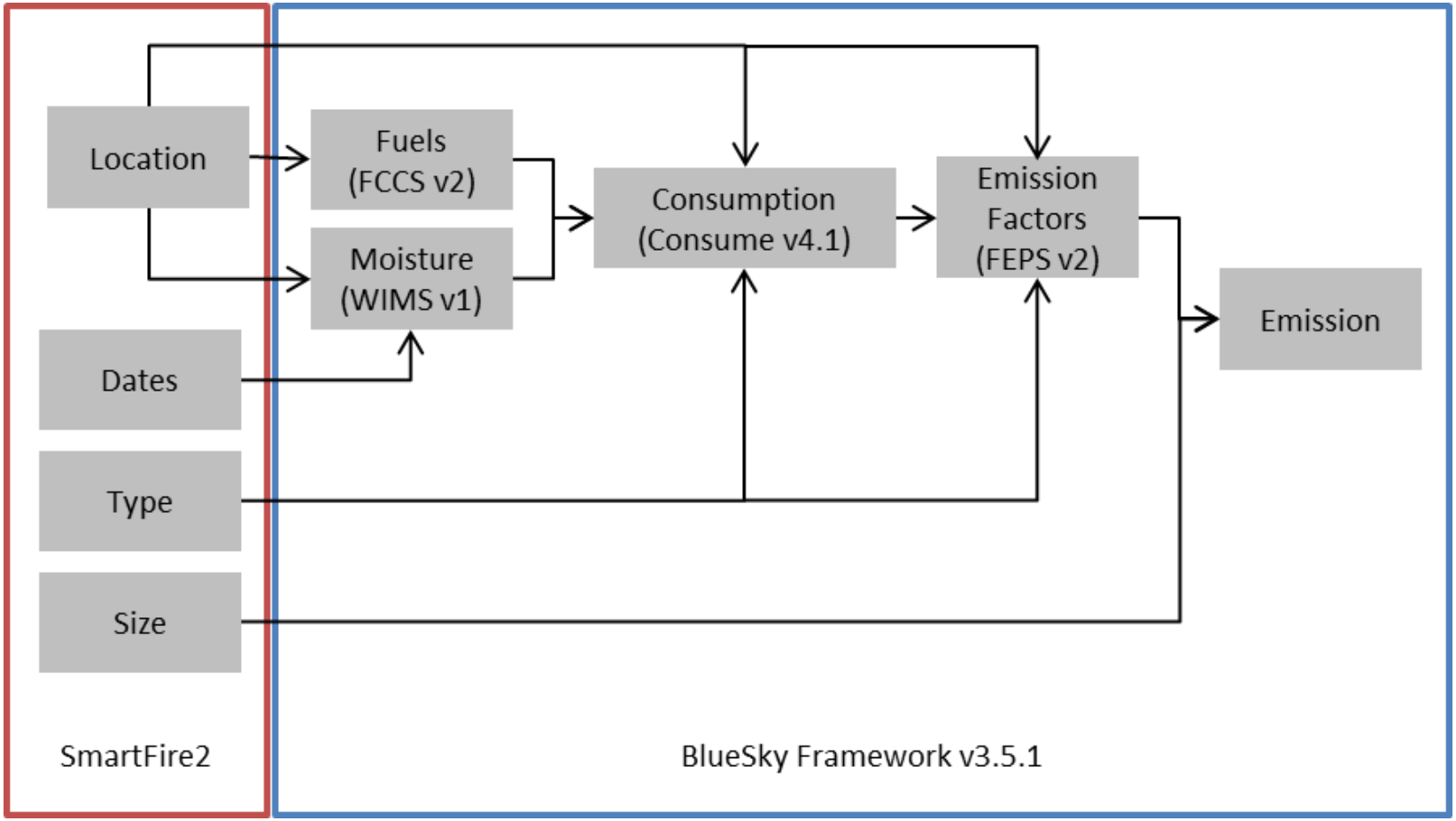
- Radiosonde vertical mixing data
- Comparison of hourly ozone/$PM_{2.5}$ variations
- Speciated VOC measurements
- BlueSky Gateway coarse resolution CMAQ model output

Tier 2: Emissions over Distance (Q/d) Analysis

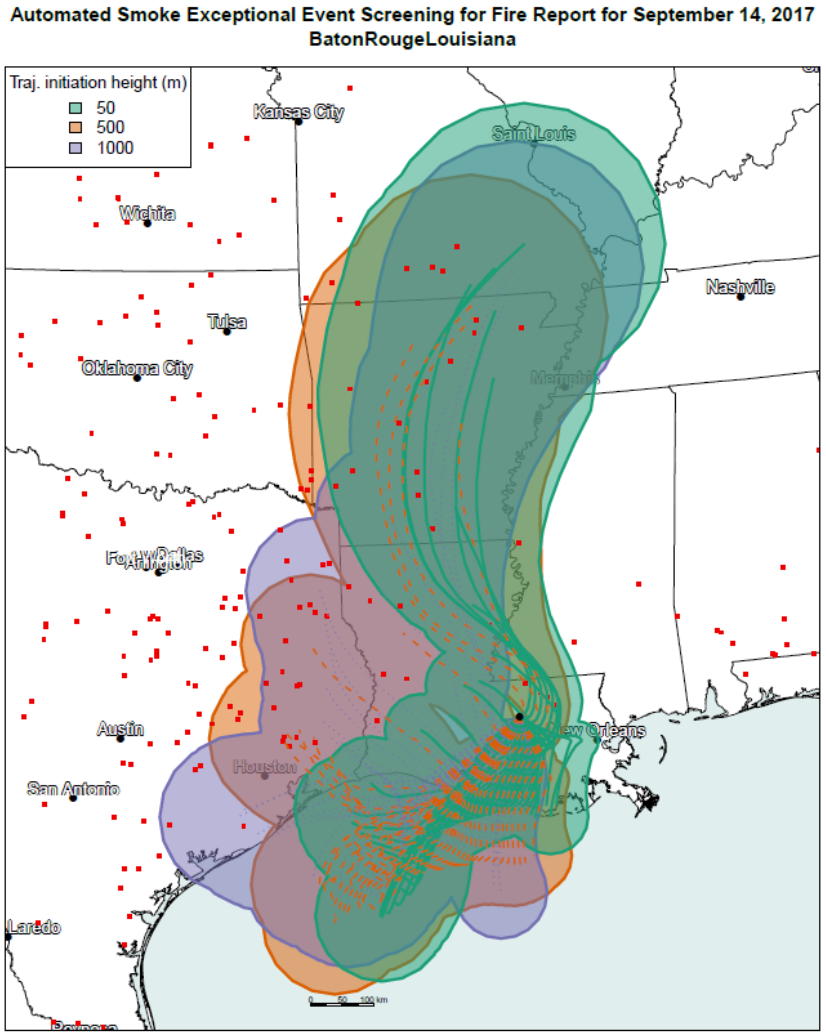
- Provides an indication of local fires likely to have impacted ozone concentrations

- Assesses the total quantity of emissions of NO_x and reactive VOCs from wildfires, and the distance of those fires from the site

SmartFire2 / BlueSky Gate Fire Emissions Processing



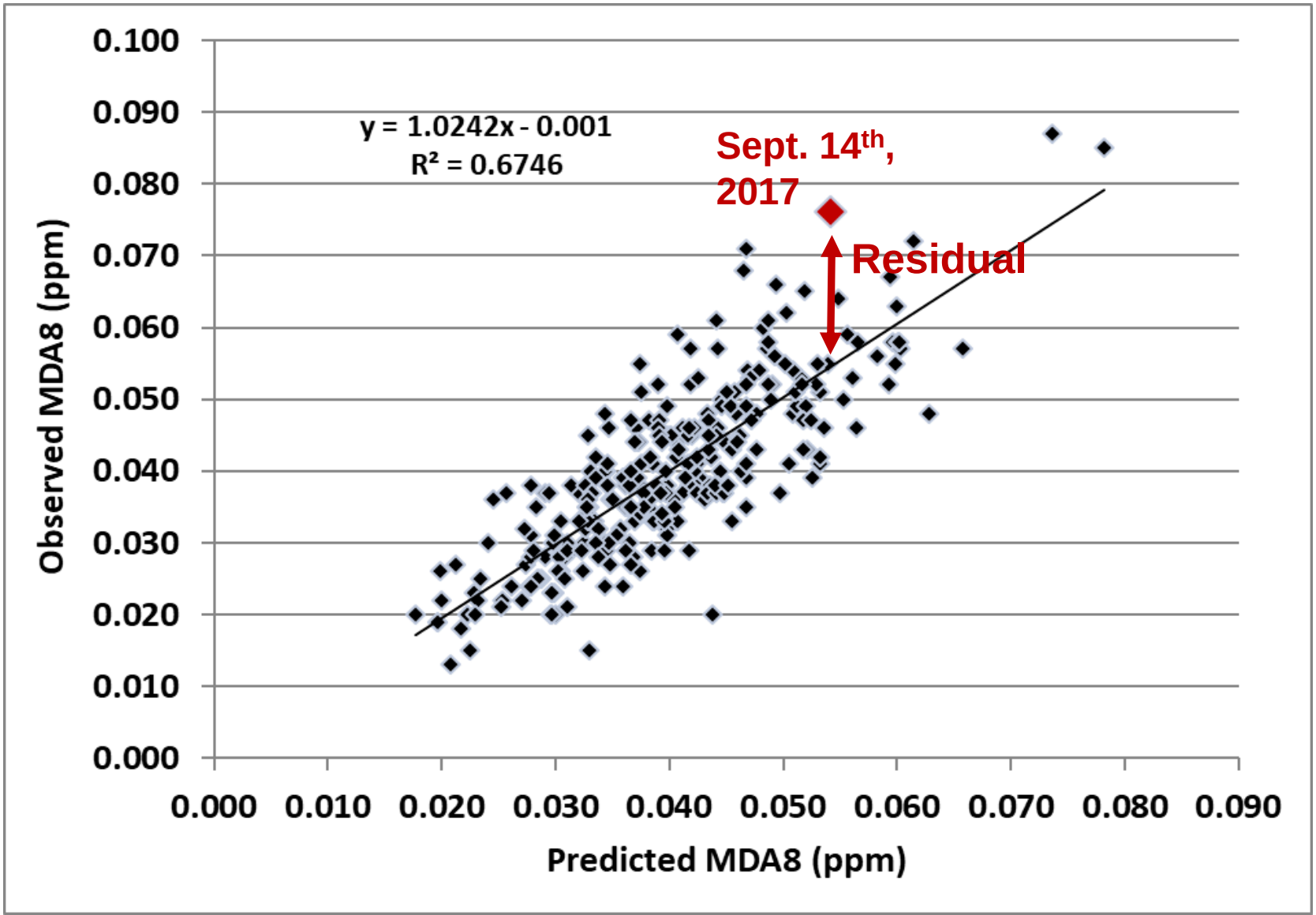
Fire emissions and Q/d



Largest Q/d for individual fire: 0.79 (satellite-detected prescribed fire)

Aggregate Q/d from 36 fires: 5.36

GAM Tier 3 Analysis (Dr. Dan Jaffe)



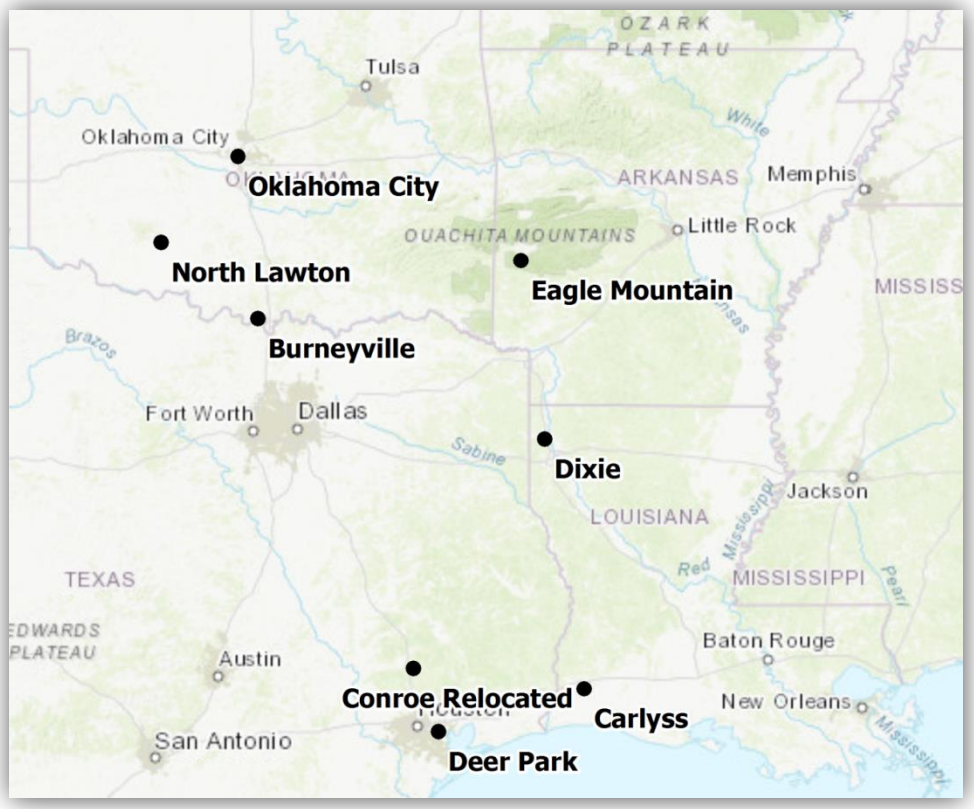
GAM results, all sites

	Port Allen	Dutchtown	LSU	Capitol
Slope	1.025	1.026	1.027	1.022
R^2	0.660	0.661	0.680	0.734
97.5th percentile (ppm)	0.014	0.016	0.014	0.012
Sept 14th res. (ppm)	0.028	0.023	0.022	0.022
Sept 14th MDA8 (ppm)	0.082	0.076	0.073	0.078
Min fire contrib (ppm)	0.014	0.007	0.008	0.010
No fire MDA8 (ppm)	0.068	0.069	0.065	0.068

The model residual is the best estimate for any "unusual" contributions, but the EPA sets a very high bar for using this. The EPA guidance on statistical models indicates that only the difference between the residual and the 97.5th percentile of all residuals can be considered as an estimate of the fire contribution – or the minimum fire contribution (per the EPA guidance doc). For Sept. 14th, subtracting this minimum, puts the "nofire" MDA8 below 0.07 ppm for all sites.

Additional Analyses

- Additional trajectories
- Upwind sites



Summary

- Smoke present over Louisiana
  - Satellite data
  - Trajectory analysis
- Smoke mixed to surface
  - CATS aerosol vertical profiles and types
  - Trajectories
  - Surface measurements of O_3 and $PM_{2.5}$
- Smoke associated with elevation in ozone
  - Meteorological regression analysis

Lessons Learned for Agencies

- Consider smoke impacts over long distances (1,500+ miles)
- Satellite data provides strong evidence for transport and potentially vertical mixing
- VOC & NO_x impacts may not be present
- Assess smoke impacts at upwind sites
- Don’t forget to “check the boxes”

Contact Us

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