Wildfire Smoke Transport Lessons from the Great Lakes Region

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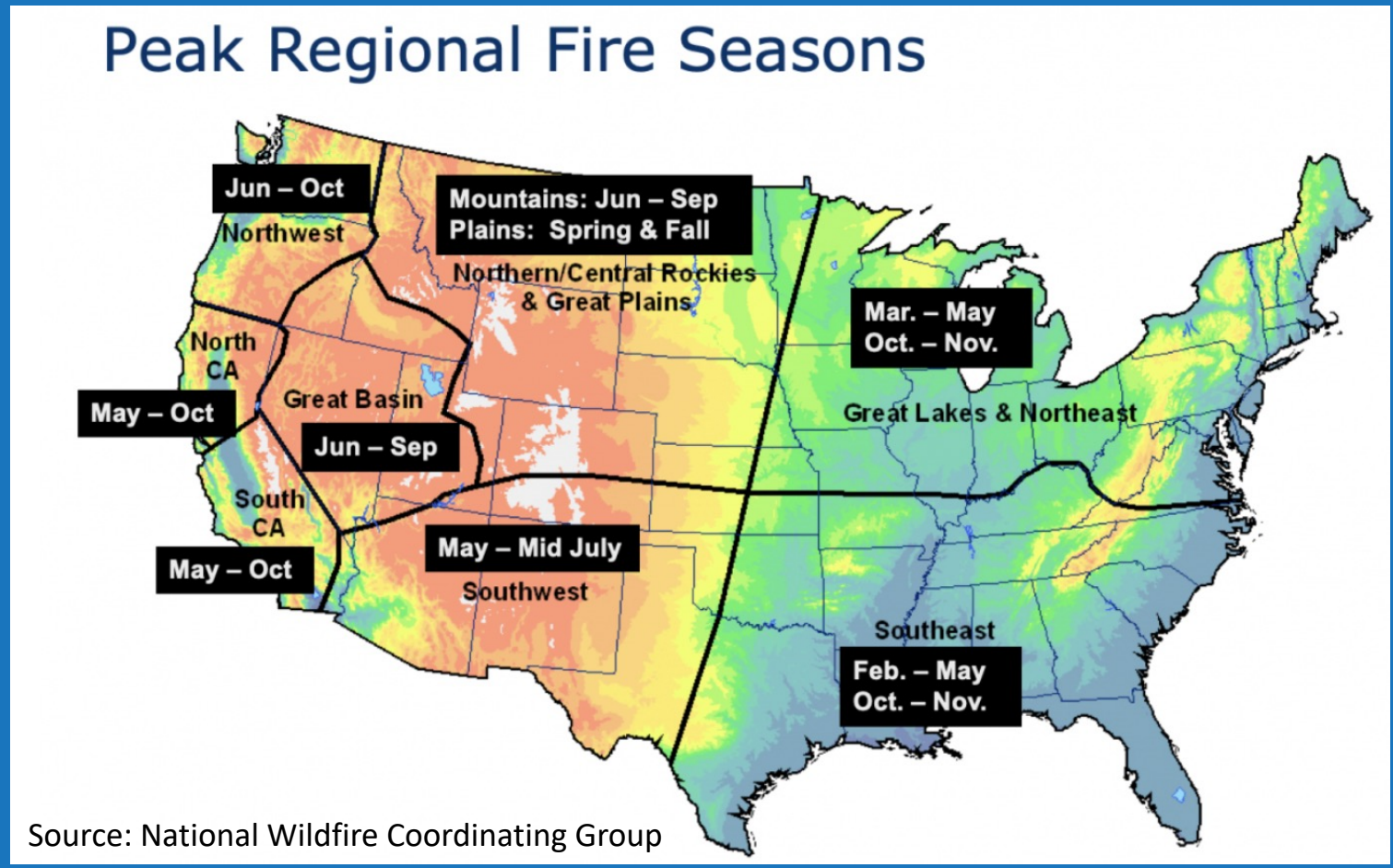
EPA/MJO Exceptional Events Wildfire and Prescribed Fire Smoke Workshop

LADCO | LAKE MICHIGAN AIR DIRECTORS CONSORTIUM

Air Quality in the Great Lakes Region

- Summertime ozone near the lake shores and urban areas
  - Peaks in May and June
- Winter particulate ammonium nitrate and summer organic aerosols
- Transported fire smoke impacts the region from April to October



Source: National Wildfire Coordinating Group

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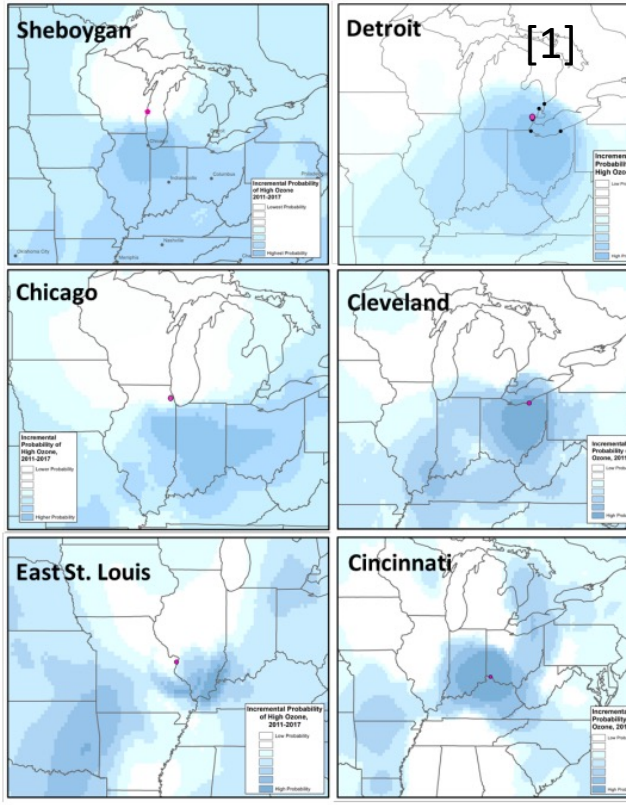
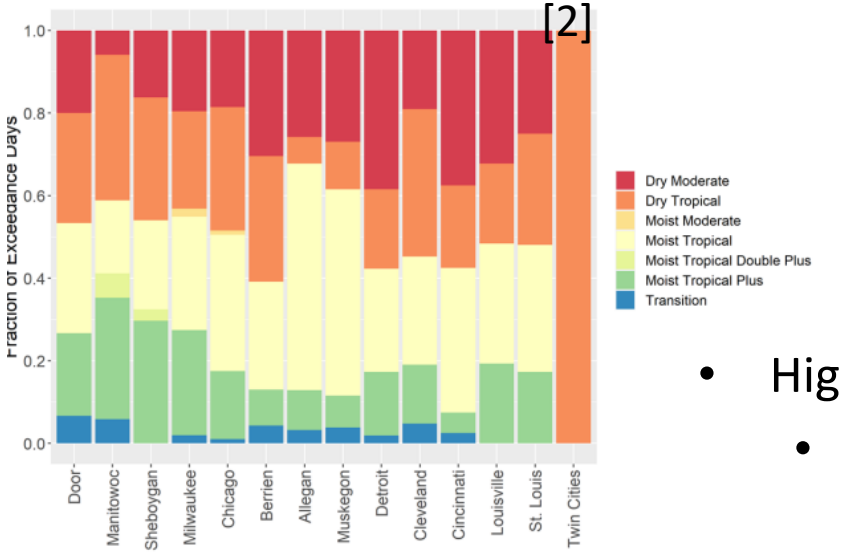
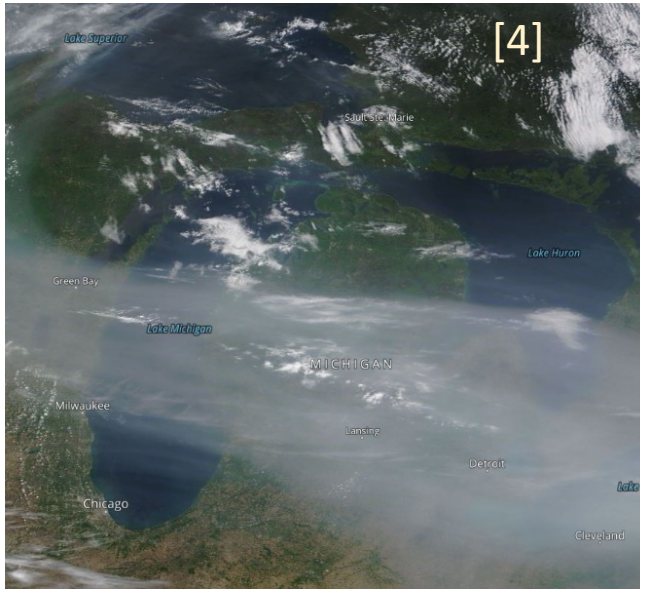
Ozone in the Great Lakes Region







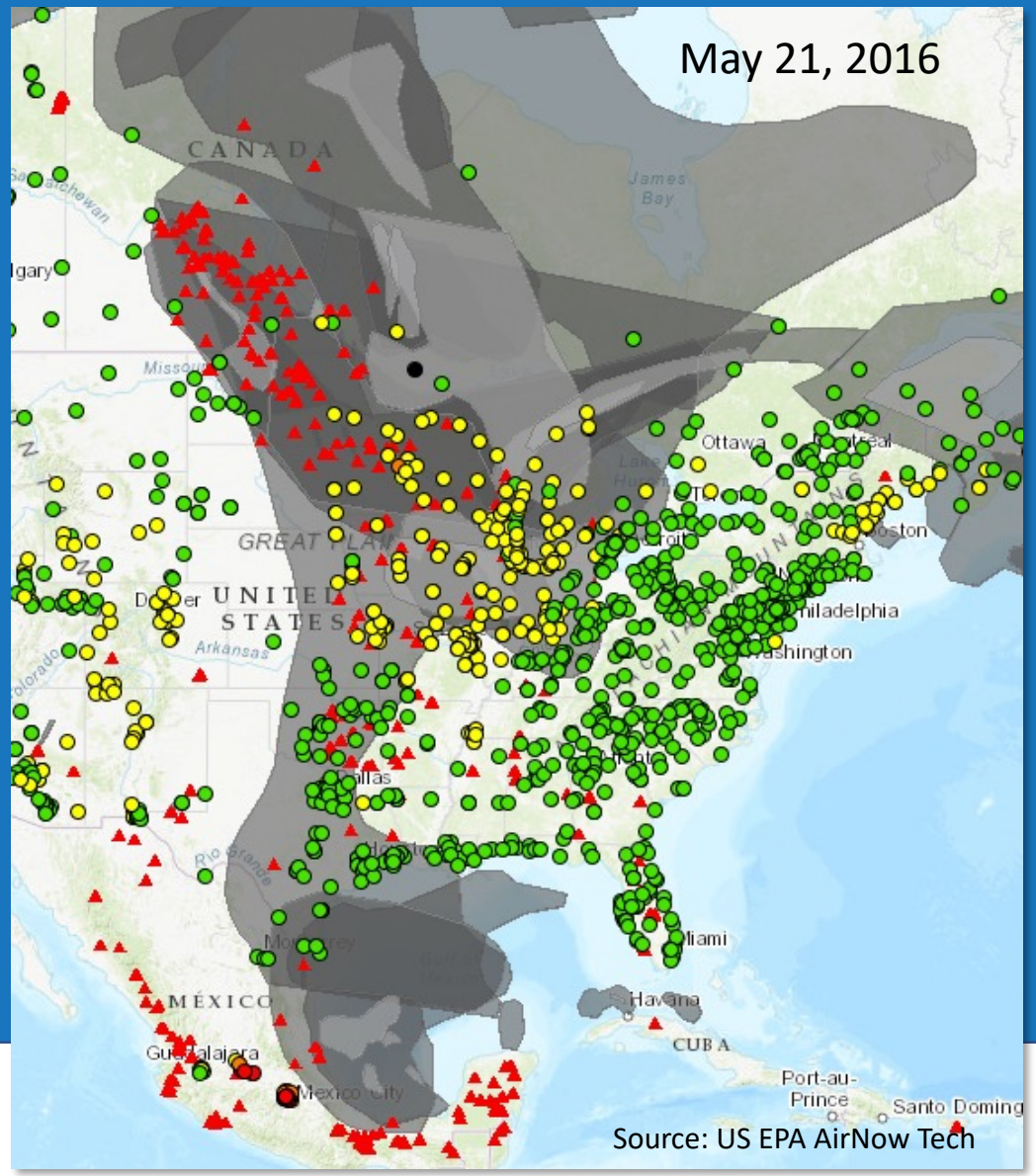
- High ozone days are most associated with:
  - South and southwesterly air masses per incremental trajectory probabilities [1]
  - Low humidity (dry moderate) or southerly flow (dry or moist tropical) per spatial synoptic classifications [2]
- Lake breezes bring transported ozone over the lake to onshore receptors; seen by the fair-weather cumulous cloud fronts in imagery [3]
- …and smoke from near and afar is often present during high ozone events [4]
  - It's common to have smoke in the column through most of June and July

https://www.ladco.org/public-issues/ozone/ozone-science/

Clear and Causal Evidence of Smoke Influence

Exceptional?

- Smoke is often present in the column from mid-April to September
- Typical ozone conducive conditions are associated with continental air masses



Events?

- Downwind receptors subject to transport conditions (>~250km) are impacted by many different upwind sources

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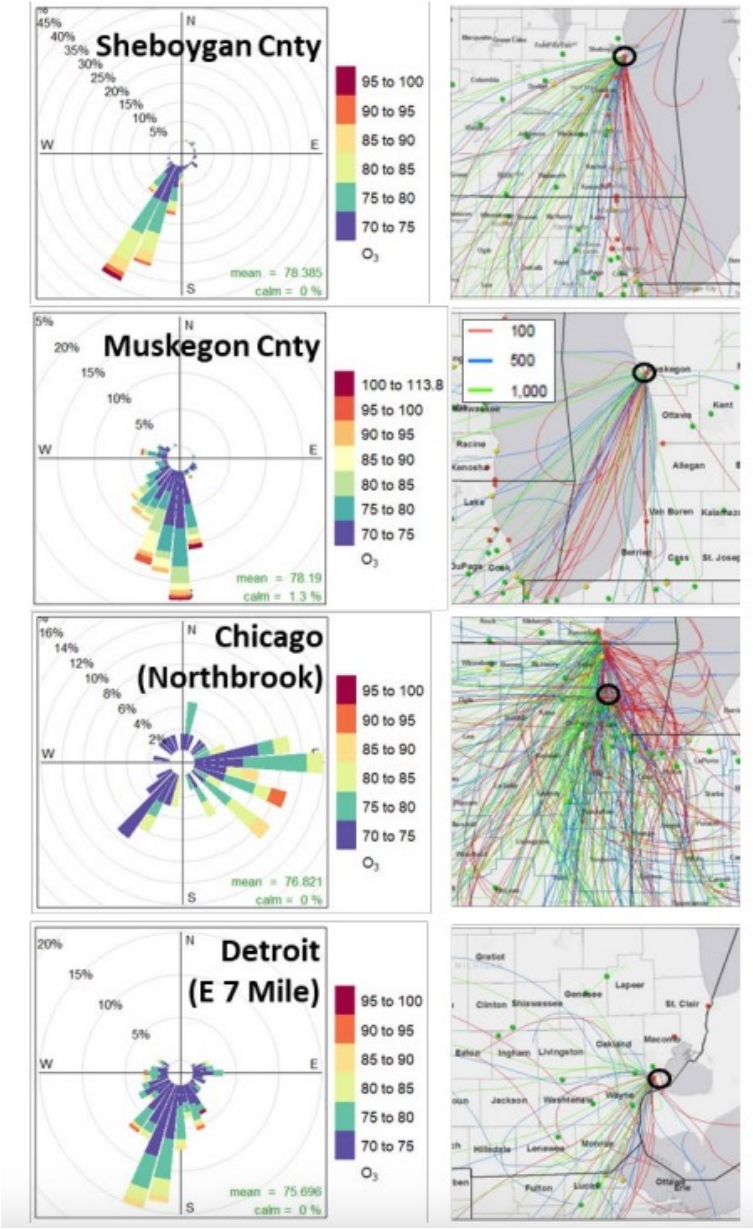
Great Lakes Region Lessons for Ozone EE Concurrence

Ozone episodes associated with northerly flow are exceptional

And…

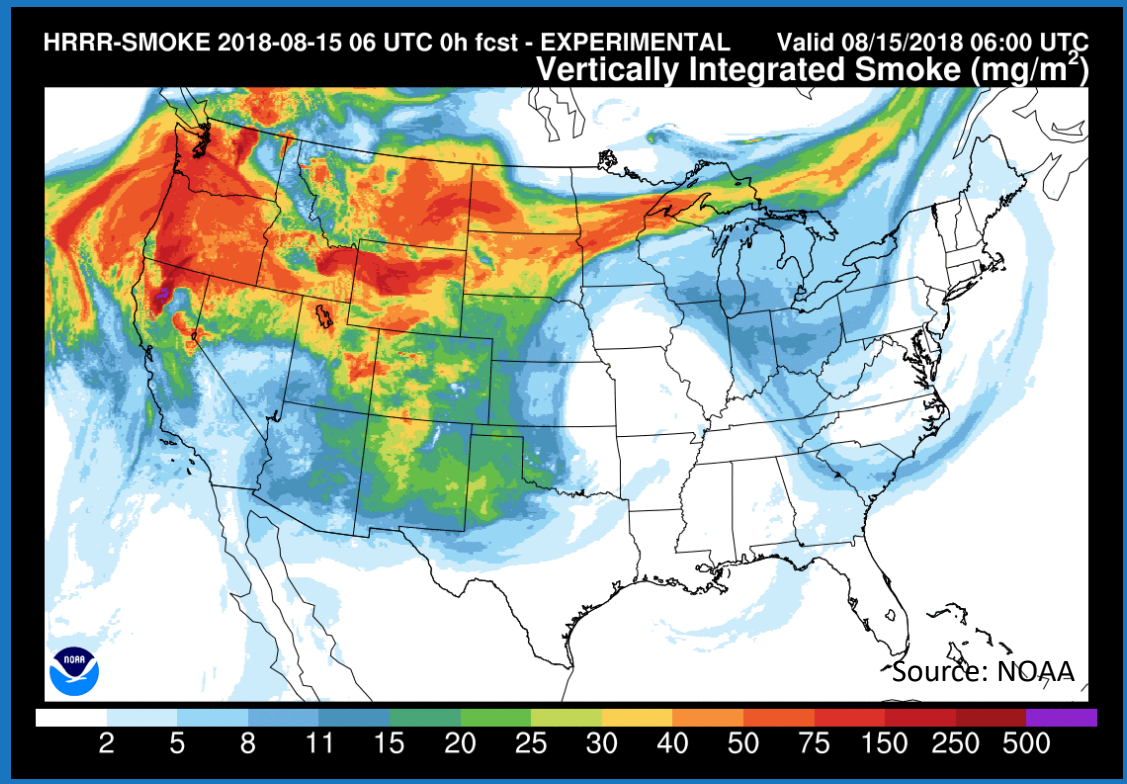
- Smoke in the column
- Intersecting forward and backward trajectories
- Surface chemical tracers of smoke: BC, K^+, $PM_{2.5}$/CO
- Vertical mixing indicators: LIDAR, ceilometers, soundings

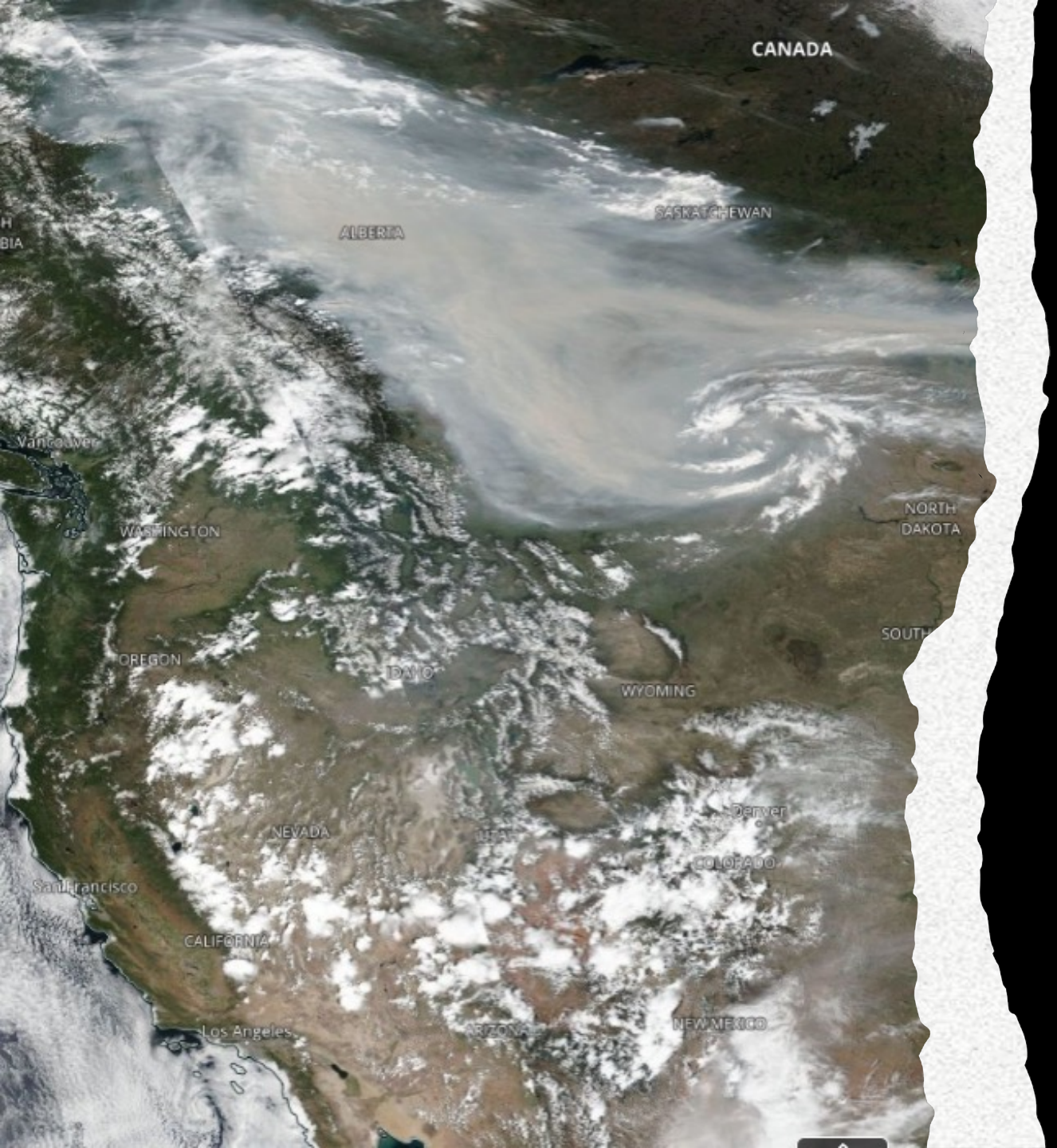


Ozone pollution roses for hours > 70 ppb for 2017-2021

Support for Future EE Demonstrations: Data

- Need co-located met, total $PM_{2.5,}$ CO, and a measurement of vertical mixing at all controlling O_3 monitors
  - Controlling $PM_{2.5}$ monitors will need met, CO, and vertical mixing; O_3 could be nice too
- Archived hi-res model forecasts and reanalysis data should be used to obtain spatially and chemically complete analysis products
- Create operational, archived machine learning or smoke-indicator products to identify potential smoke influence





Support for Future EE Demonstrations: Process

- Automate and operationalize AQS data flagging
- Develop online analysis products for EE demos (see WRAP EE Tool)
- Define an unambiguous, turnkey demonstration process
  - EEs should not divert resources from NAAQS attainment planning @ state air agencies
  - States with limited resources should not be penalized by an onerous EE demo development process

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Questions for the Community

- Considering the strengths and limitations of commonly available data, what is a practical monitoring regime to satisfy EE demonstration development?
- Could any smoke influence be regulatory significant, even if the influence happens during typical pollution conditions? What would be the implications for planning?
- Ozone and $PM_{2.5}$ NAAQS, and regional haze all need to account for the influence of wildfire smoke. Envision consistent “smoke-impact” metrics that could be applicable to all regulatory programs. What might they look like?