Background Ozone and the Western U.S.

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WESTAR

November 2023

The WESTAR Region

- 15 Western States
- 24% of US population (2020 US Census)
- 50% of US landmass
- 573,284,316 acres of federally-owned lands➔93% of total federal lands in the US

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WRAP
Western Regional Air Partnership

Overview of WESTAR and WRAP

Purpose

- Service organizations
- Assist members to achieve their air quality management goals

WESTAR

- Training
- Provide a forum for discussion
- Inform policy-related discussions
- www.westar.org

WRAP (provides regional technical support)

- Virtual organization, not incorporated
- 70+ member agencies include 15 state air agencies: NPS, FWS, BLM, USFS, EPA, and interested tribes and local air agencies/districts in the WRAP region
- Board and technical committees have representatives across states, tribes, federal, and local agencies.

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WESTAR/WRAP and EPA

Funding	• States fund WESTAR/WRAP by setting aside EPA grant funding; these funds come to WESTAR/WRAP through an EPA grant • Some funding directly from states • Some funding from other federal agencies
Communications	• Sometimes…EPA communicates with states through MJOs • WESTAR/WRAP communicates with EPA through consensus-based membership letters and at fall and spring meetings
Technical Coordination	• Federal/State Technical Work Collaboration Group • Inventory Collaborative • Regional Haze • Exceptional Events
Training	• WESTAR/WRAP provides training courses to states with EPA funding

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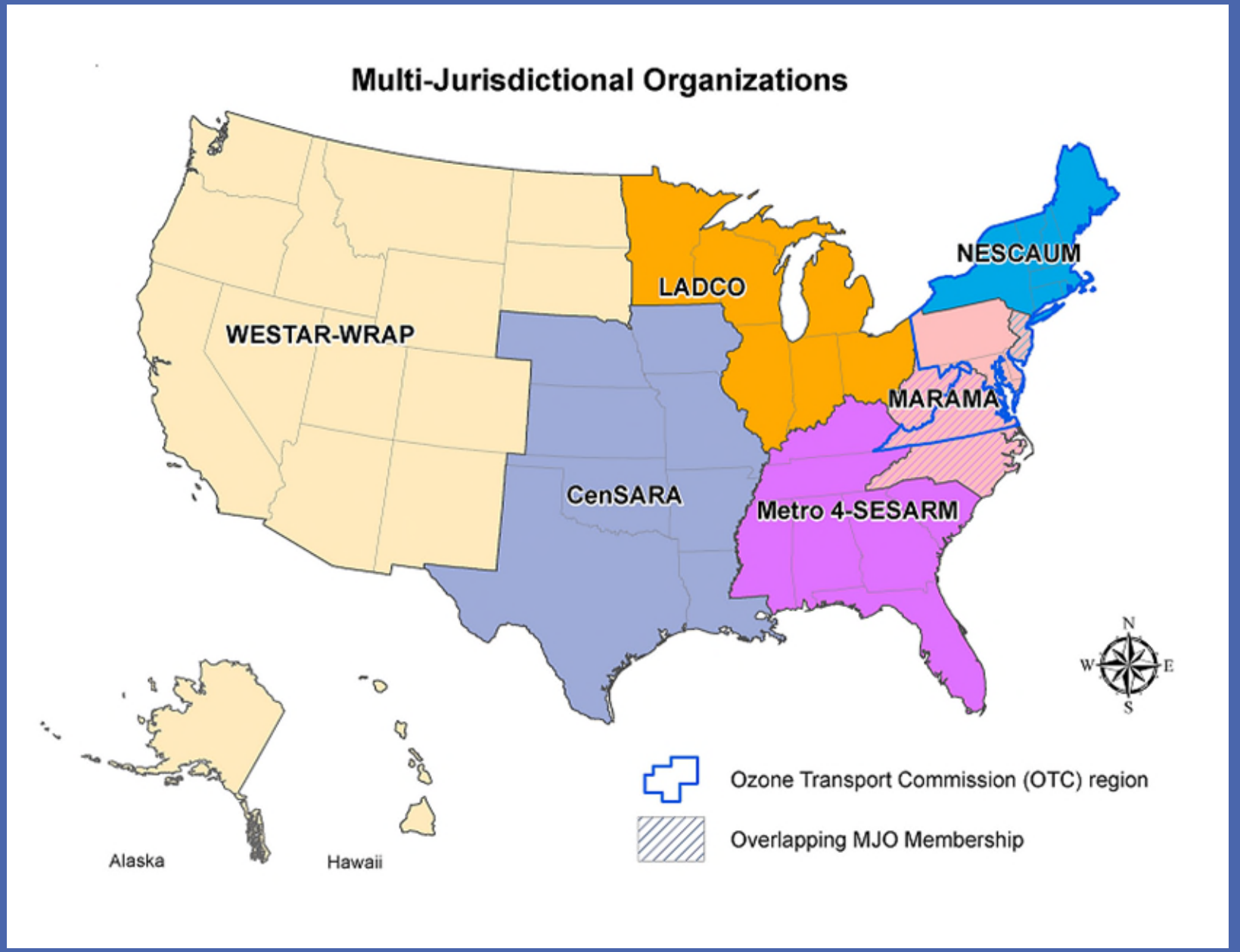

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WESTAR/WRAP and other MJOs

Coordination of training

Work with EPA to improve technical work

Coordination/consultation on technical work between regions

Sharing of knowledge, leadership efforts and initiatives

Joint workshops

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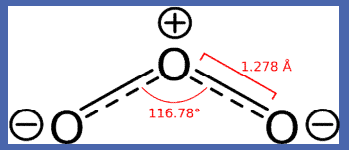
Ozone in the West: Why the West is Different

High ozone day in southern California



High ozone day in Gothic, Colorado

High ozone day in western U.S.

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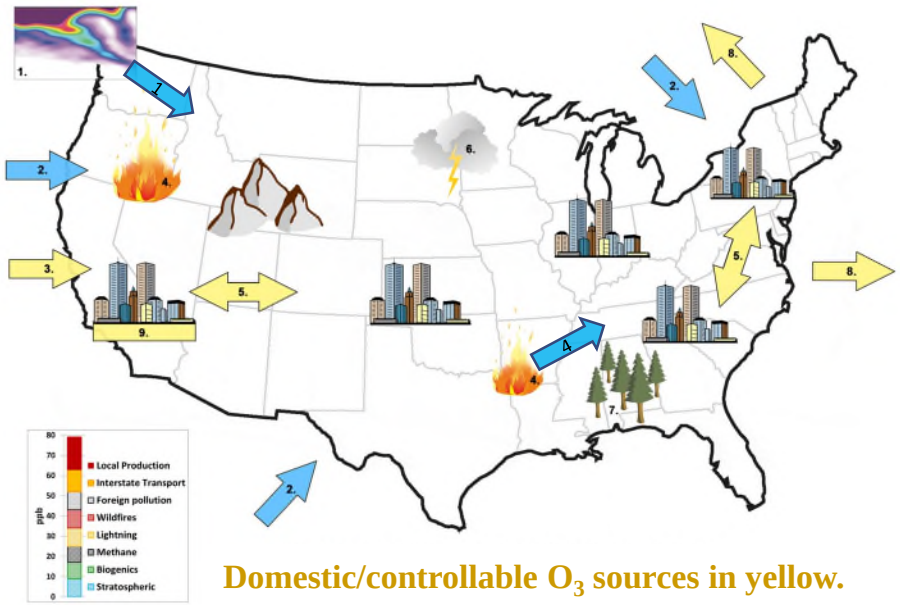
Sources of surface O_3



Domestic/controllable O_3 sources in yellow.

Foreign/non-controllable O_3 sources in blue.

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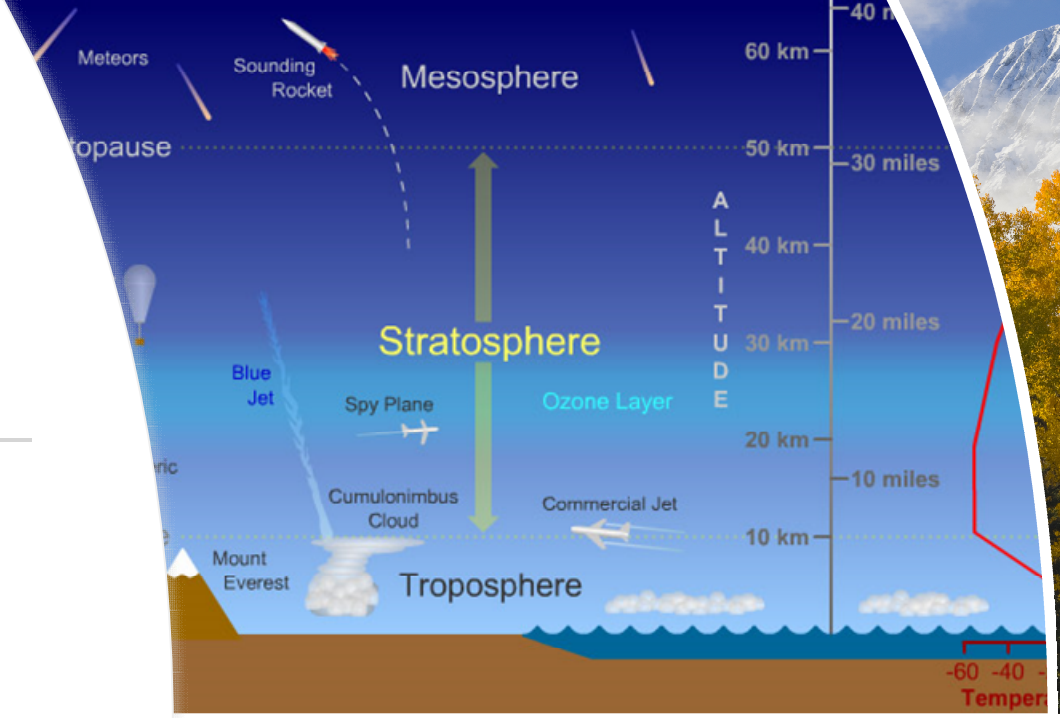
What is Background Ozone?

- Background Ozone is Ozone formed from natural sources plus anthropogenic international sources and global methane background. Natural sources include:
  - Transport of O_3 from the stratosphere
  - Biogenic VOC & NOx, wildfires, lightning

- U.S. Background Ozone (for regulatory purposes) can only be determined using chemical transport models or source apportionment modeling. EPA estimates background ozone for regulatory purposes.



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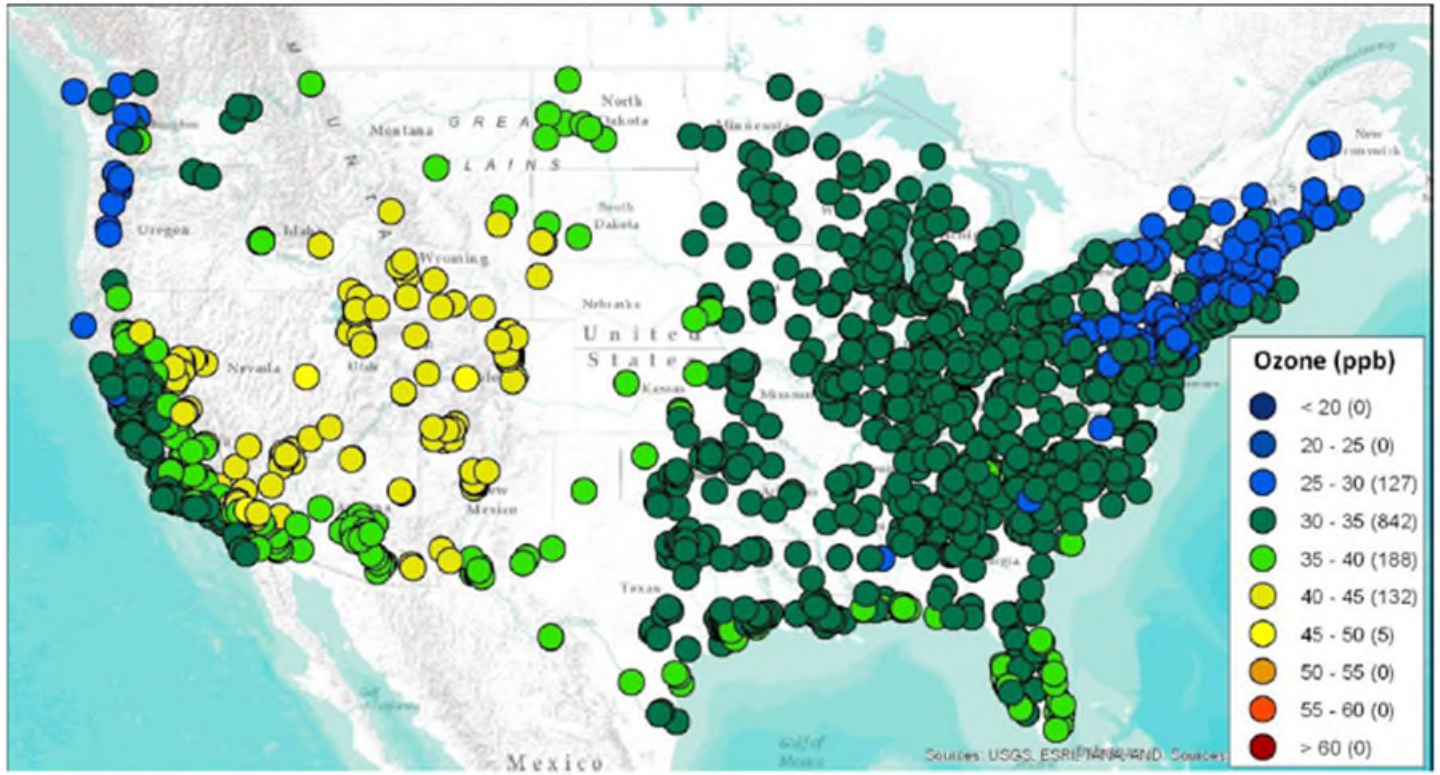
Background Ozone Estimates

- *CMAQ estimates of **<u>average</u>** background (USB) ozone at monitoring locations across the U.S. in 2007*



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O_3 Design Values at pairs of monitoring sites

For nearby locations, higher elevation sites show much higher O_3 design values, demonstrating how background ozone is more important at elevation.

Site location	Meters Above Sea Level	O_3 Design Value
Bend, OR	1135	59
Mt. Bachelor, OR	2763	75
Carbon, WY	2015	55
Centennial, WY	3178	66
Camp Dodge, NH	451	57
Mt. Washington NH	1914	67

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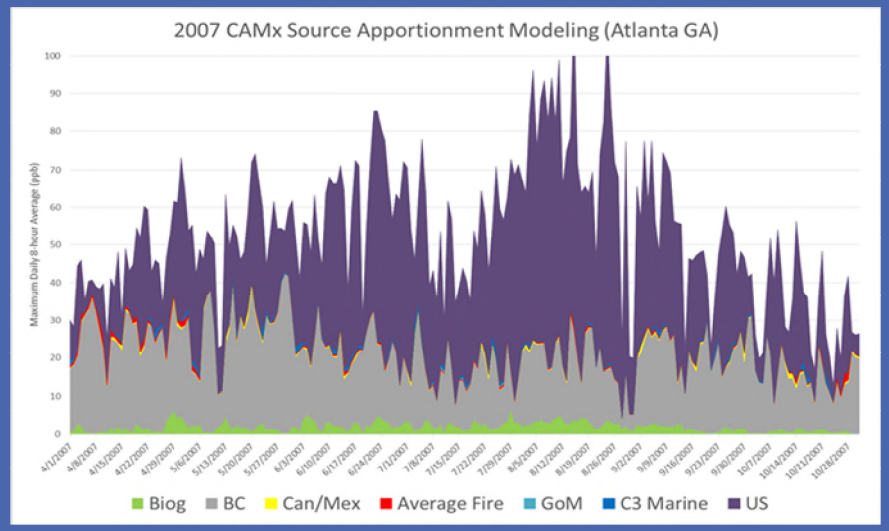
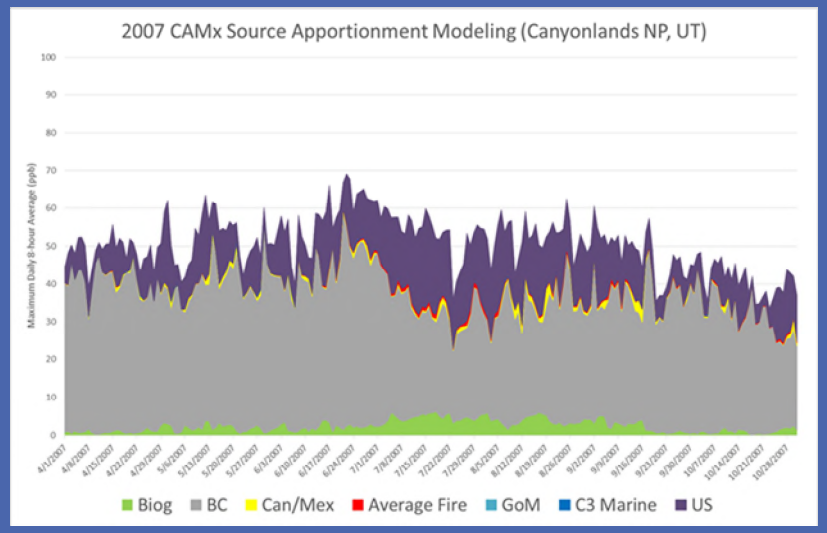
Comparing Ozone Source Contributions in the East and West

Atlanta ozone source contributions



Canyonlands ozone source contributions



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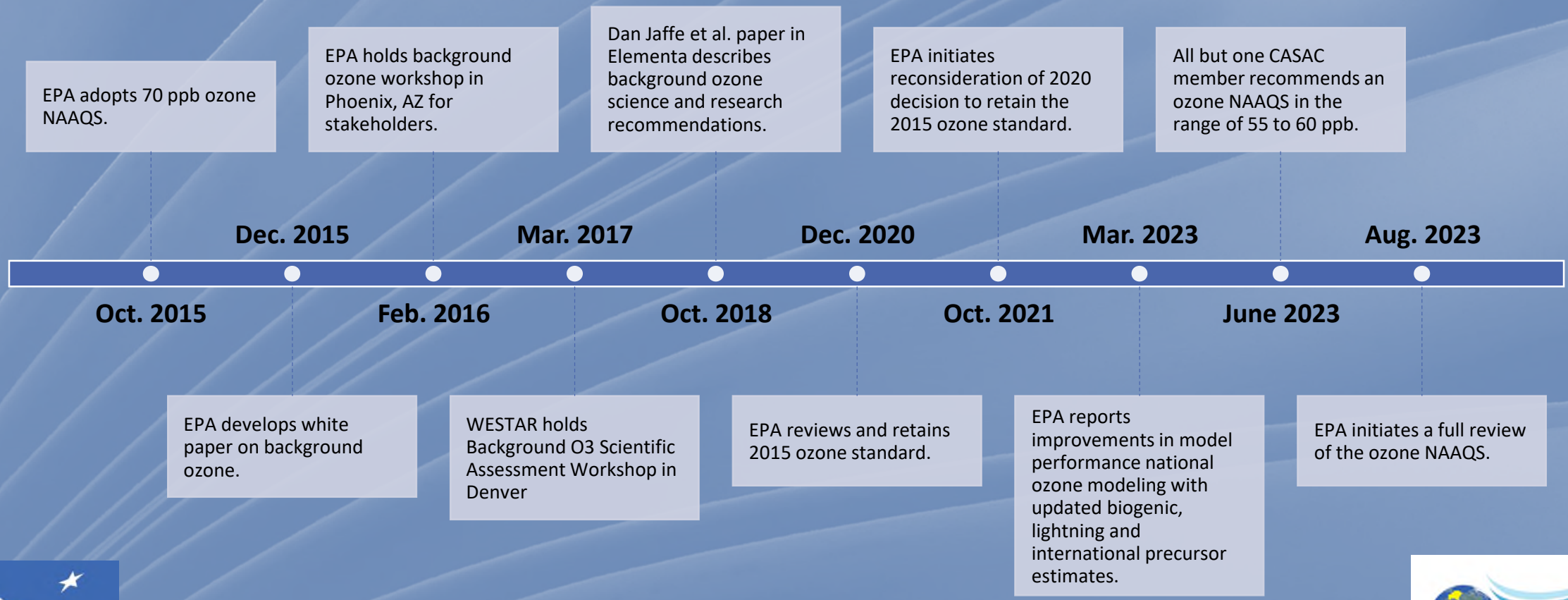
Milestones for the Ozone NAAQS and western ozone analysis



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Five Ozone Planning Needs under the Clean Air Act

1. Ozone NAAQS planning – requires photochemical modeling for SIP attainment demonstrations for nonattainment areas.
2. Ozone transport SIPs – photochemical source apportionment modeling can be used to quantify U.S. ozone transport between states and other jurisdictions.
3. Identification of Ozone exceptional events caused by stratospheric intrusion and wildfires – requires observations and data analysis, supplemented with global/regional scale photochemical models and regression models.
4. Identification of international transport of Ozone for §179B demonstrations - requires nested global and regional scale photochemical modeling to evaluate international transport of Ozone.
5. Identification of §182 Rural Transport Areas – combination of data analysis and photochemical modeling.

In the West under CAA, whom to do which ?

Alone or together ?

- States/Locals
- Regional
- Federal

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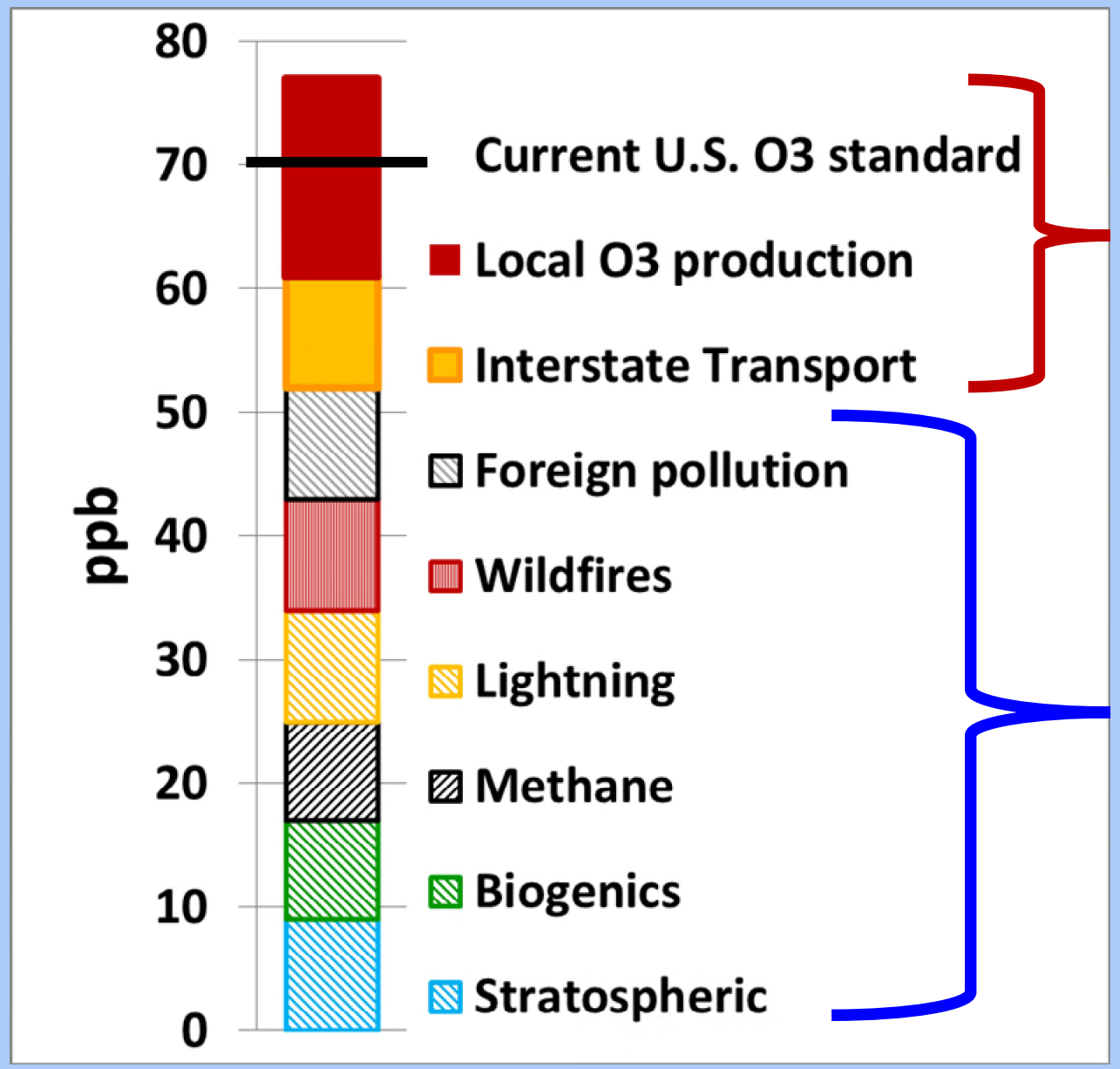
Why does background O_3 matter for NAAQS planning?



Controllable sources

- Consider U.S. emissions trends
- (further) by States if nonattainment
- by **EPA if allowed by CAA / litigation record / policy**

Background / uncontrollable sources

- rolling 3-year NAAQS compliance statistic
- States have to react to variability and magnitude

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Emissions sources – western U.S. air quality planning

	Source	Controllability	Trend	Variability
Anthropogenic	US Anthropogenic	Some emissions are controllable	Downward as sources are controlled	Relatively stable
		Some emissions will remain after all reasonable controls implemented	Could rise because of population increases	Relatively stable
	International Anthropogenic	Not controllable by state or federal regulations	Likely increasing due to increased development worldwide and rising population	Relatively stable
Natural	Fire, Dust, Sea Salt	Natural, not controllable	Increases due to climate change	Highly variable
	Volcanic	Natural, not controllable	Unpredictable	Highly variable
	Other Natural Sources	Not controllable	Potentially affected by climate change, e.g., changes in temperature	Relatively stable

Table Note: Shaded areas represent emissions that states cannot control.

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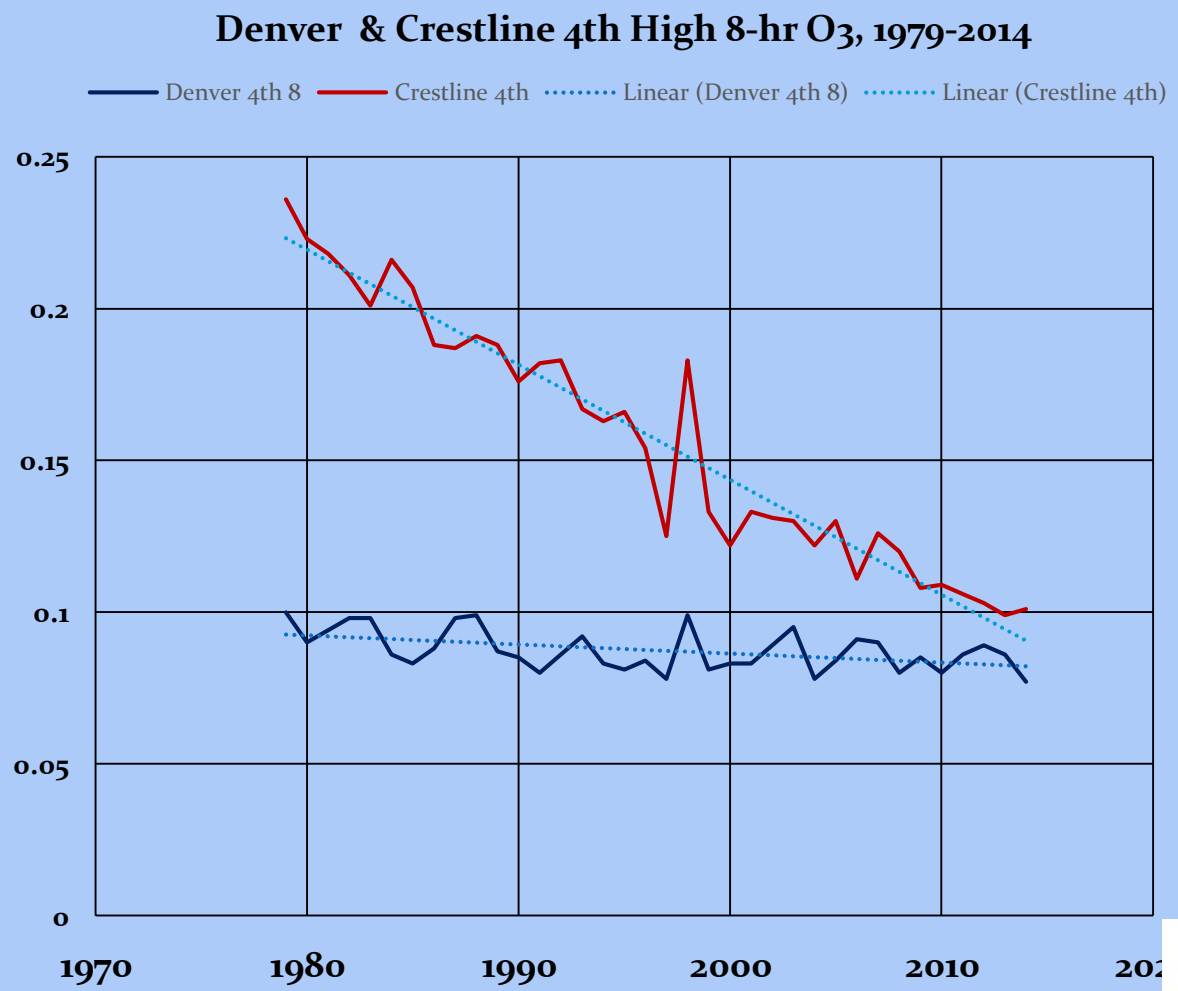
O3 trends at high elevation sites in Western U.S.

Need to understand roles of:

- International and interstate transport
- Wildfires
- Stratospheric O3
- Population growth
- Oil and gas development
- Seasonal variation



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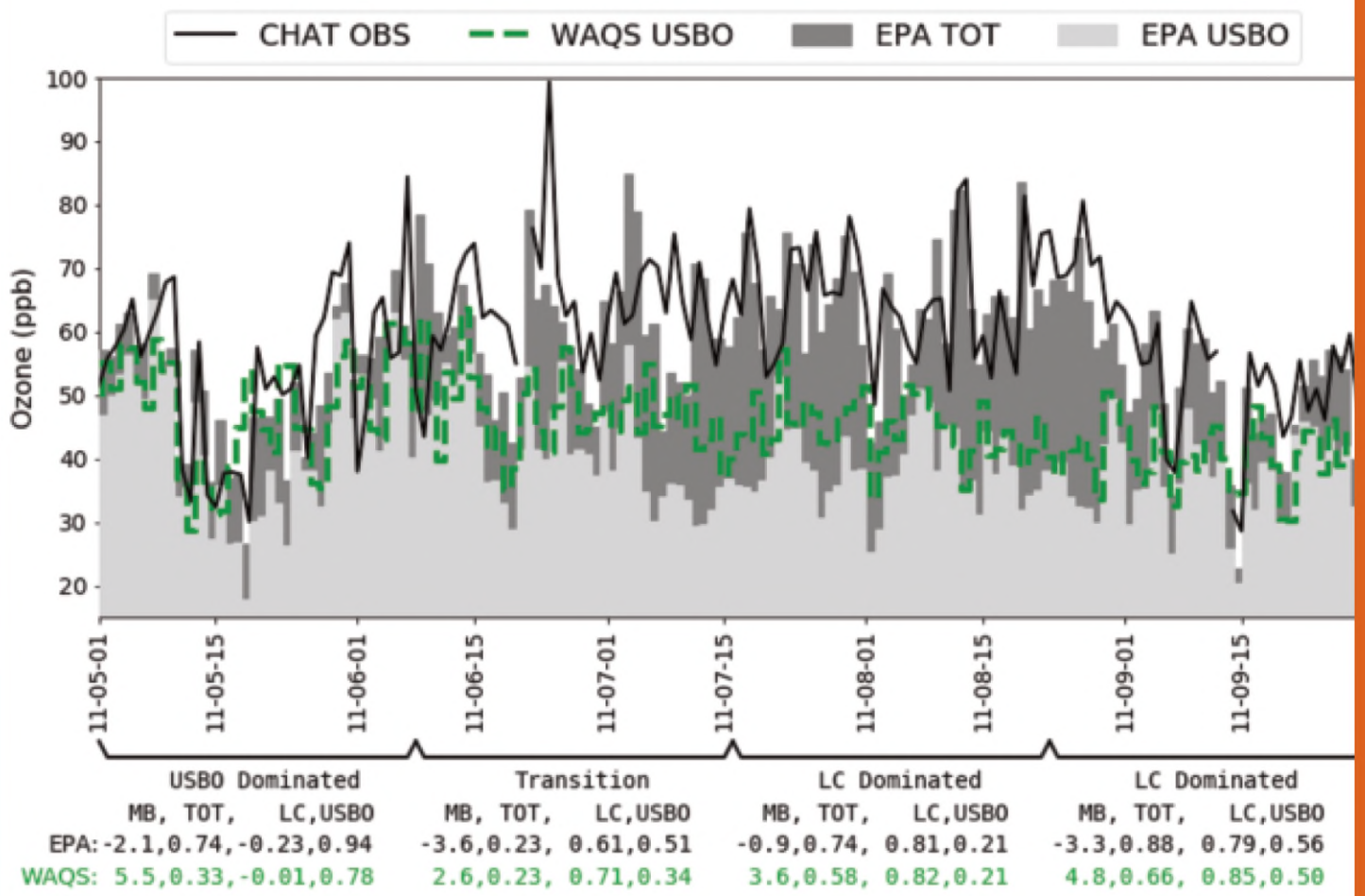

Figure 3. Observed and modeled MDA8 O with USB O from EPA model and WAQS for Chatfield. Observed O_3 (black lines), EPA model MDA8 O_3 (top of dark grey), EPA model USB O_3 (top of light grey), and WAQS USB O_3 (dashed green lines). For four simulation segments, the values below the axis give (for both models) the mean bias (MB), correlation (r) of total prediction with observations (TOT), correlation of local contribution (LC) with observations, and correlation of USB O_3 contribution with observations (USBO). DOI: https://doi.org/10.1525/elementa.309.f6

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Strategies for Improving the State of the Science for modeling O3 in the western U.S.

- More monitoring data to improve characterization of background O_3 and to evaluate the accuracy of model-based estimates of USB:
  - More measurements to improve characterization of vertical O_3 profiles.
  - Network of O_3 LIDAR vertical profiles (NASA TOLNET pilot study)
  - More ground based O_3 and precursor measurements in rural areas.
- Perform comprehensive model evaluation studies using new monitoring data to assess contributions to background O_3.
  - Do global models accurately estimate BC inflow?
  - Do regional models accurately simulate natural sources of O_3 from wildfires and biogenic precursors?
  - Do regional models accurately simulate vertical mixing of O_3?
  - ***Need improved projections of future emissions for uncontrollable sources as well as trends in global O3***.
- Increase state/federal & planner/researcher collaborations to improve modeling and data analysis for O3 transport, wildfires, and stratospheric intrusion.

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February 12, 2018 Western Governors' Association letter to EPA Asst. Admin. Bill Wehrum - Ozone

- Uncontrollable events and conditions such as wildfire, lightning, biogenic emissions, stratospheric ozone intrusion, and transported ozone from international and interstate sources result in elevated levels of background ozone. Western Governors have significant concerns about the lack of CAA tools available to account for ozone exceedances resulting from factors outside state control.

- The West needs additional and ongoing research on background, interstate and international ozone. This research should be transparent, comprehensive and coordinated with state air quality agencies and regional organizations. With this new information, EPA should reconsider the one percent threshold for significant contribution for interstate ozone transport obligations.

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Current WESTAR collaboration to improve Ozone Analysis

- National Inventory Collaborative for 2022 Model Platform Development
- Working with NASA Tiger Team to improve boundary conditions for photochemical modeling
- TEMPO Early Adopters—how can new satellite data help us to understand ozone formation and background ozone?
- New NAAQS for ozone could bring more focus and resources to background ozone analysis

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