# Regional Air Quality Impacts of Transported Smoke

March 18, 2015

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WESTAR Council

8th Annual EPA Region 10 Smoke Management Meeting
Boise, ID

WESTERN REGIONAL AIR PARTNERSHIP

WESTAR
Western States Air Resources Council

# Overview of WESTAR/WRAP

www.westar.org

www.wrapair2.org

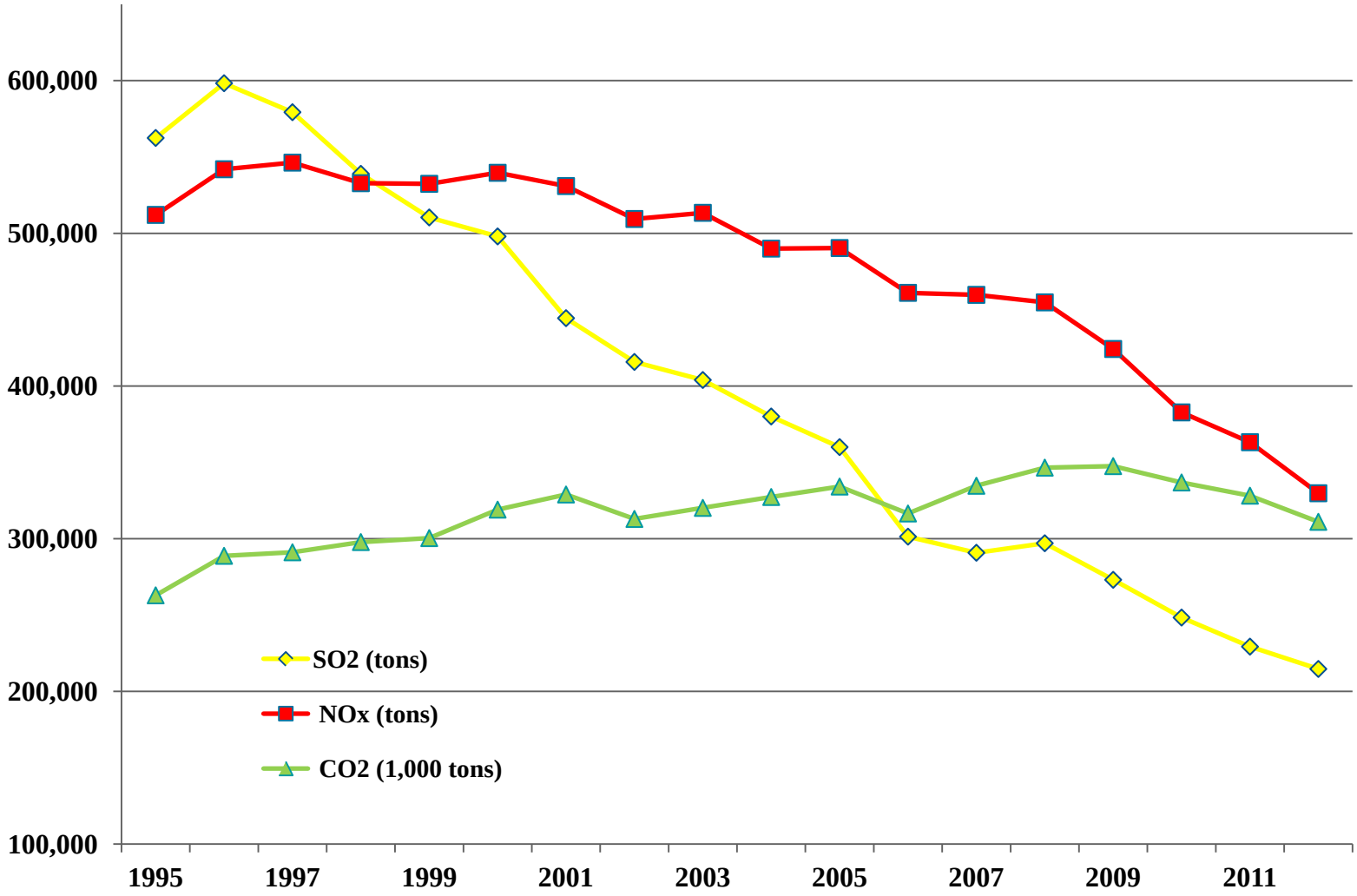
# Overview of WESTAR/WRAP (cont'd)

- Purpose
  - Service organization
  - Assist members in achieving their air quality management goals
- Approach
  - Training
  - Provide a forum for discussion
  - Inform policy-related discussions
  - (new) Provide technical support (esp. regional)

# WRAP current projects and priorities

- precursors to Ozone, Particulates, and Regional Haze - key western sources
  - Power plants
  - Mobile sources
  - Fire activity and effects
  - Biogenics (natural) emissions
  - Oil and gas exploration and production
  - All sources studied in comprehensive regional modeling analysis
    - West-wide Jumpstart Air Quality Modeling Study (WestJumpAQMS)

# Power Plant Emissions Trends – Western Interconnect




Data Source: EPA Clean Air Markets Division

# EPA national Ozone Standard

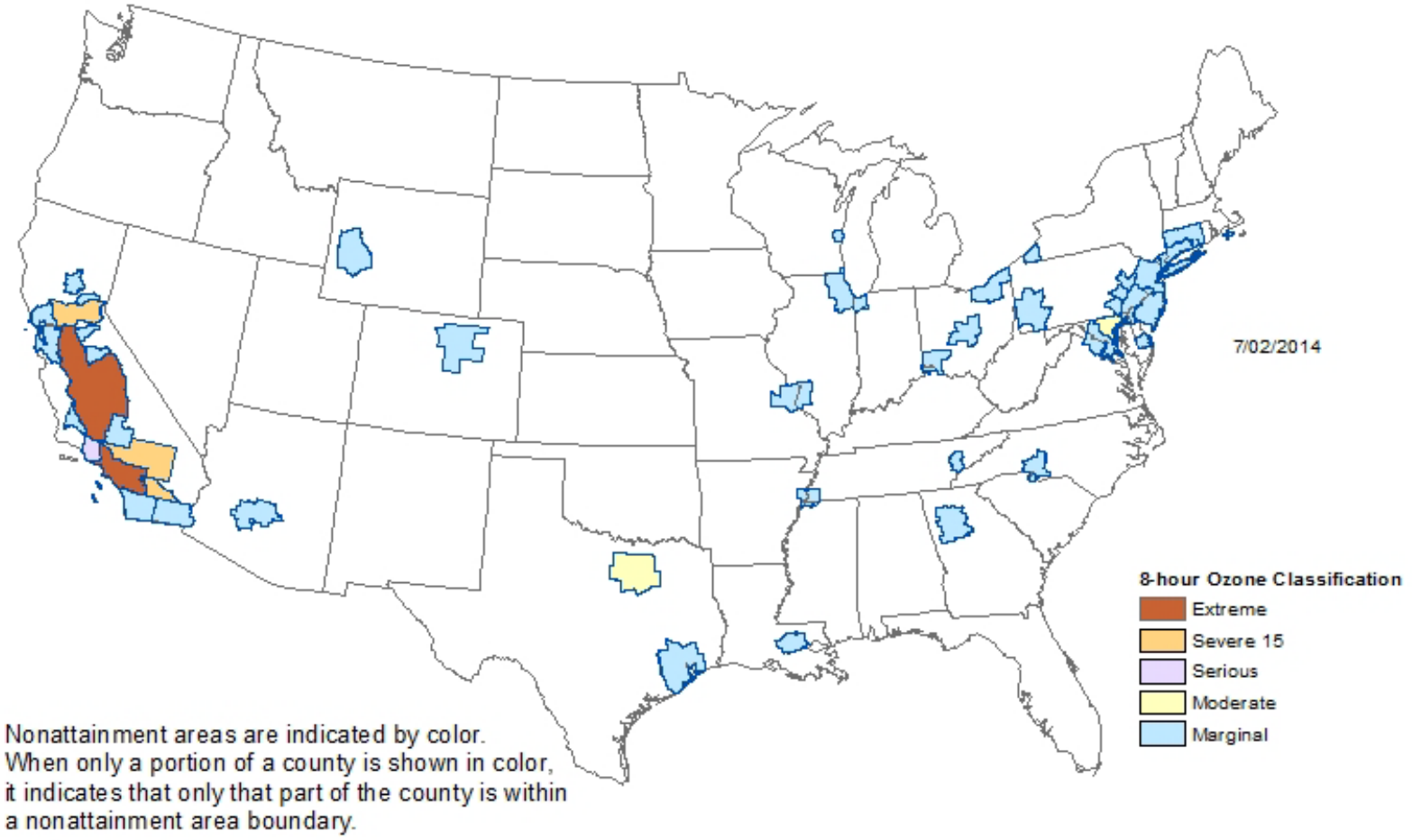
- Measured at ground station sites, highest 8-hour average each day
- 4th highest values each year are averaged over 3-year periods to determine compliance (e.g., 2007-09, 2008-10)
  - Statistic is called a “Design Value” for that site for that time period
- Current Ozone health standard level is 75 ppb
- EPA proposed a revised Ozone health standard in a range of 65 to 70 ppb
- EPA proposed a secondary Ozone standard for ecosystem protection at the same range
  - Proxy for a growing season / daylight hours-weighted cumulative metric

# What are (some of) the sources and control issues in the West related to new Ozone standard(s)?

- Urban and rural reactivity
- Transport and formation – how much / how important?
- Public lands with large biogenic emissions and fire activity
  - How to characterize for effects of drought and climate variation ?
- Federal and state mobile fuel and tailpipe controls
- Upstream Gas NSPS rules in place in 2015
  - Industry practices changing rapidly, e.g., green completions
- Point sources (dominated by EGUs for $SO_2$, $NO_x$ )
  - Significant $NO_x$ BART by ~2018
  - Less coal-fired electricity supply due to climate change rule?
  - 17+ million acres of public lands leased in last 5 years for O&G exploration and production

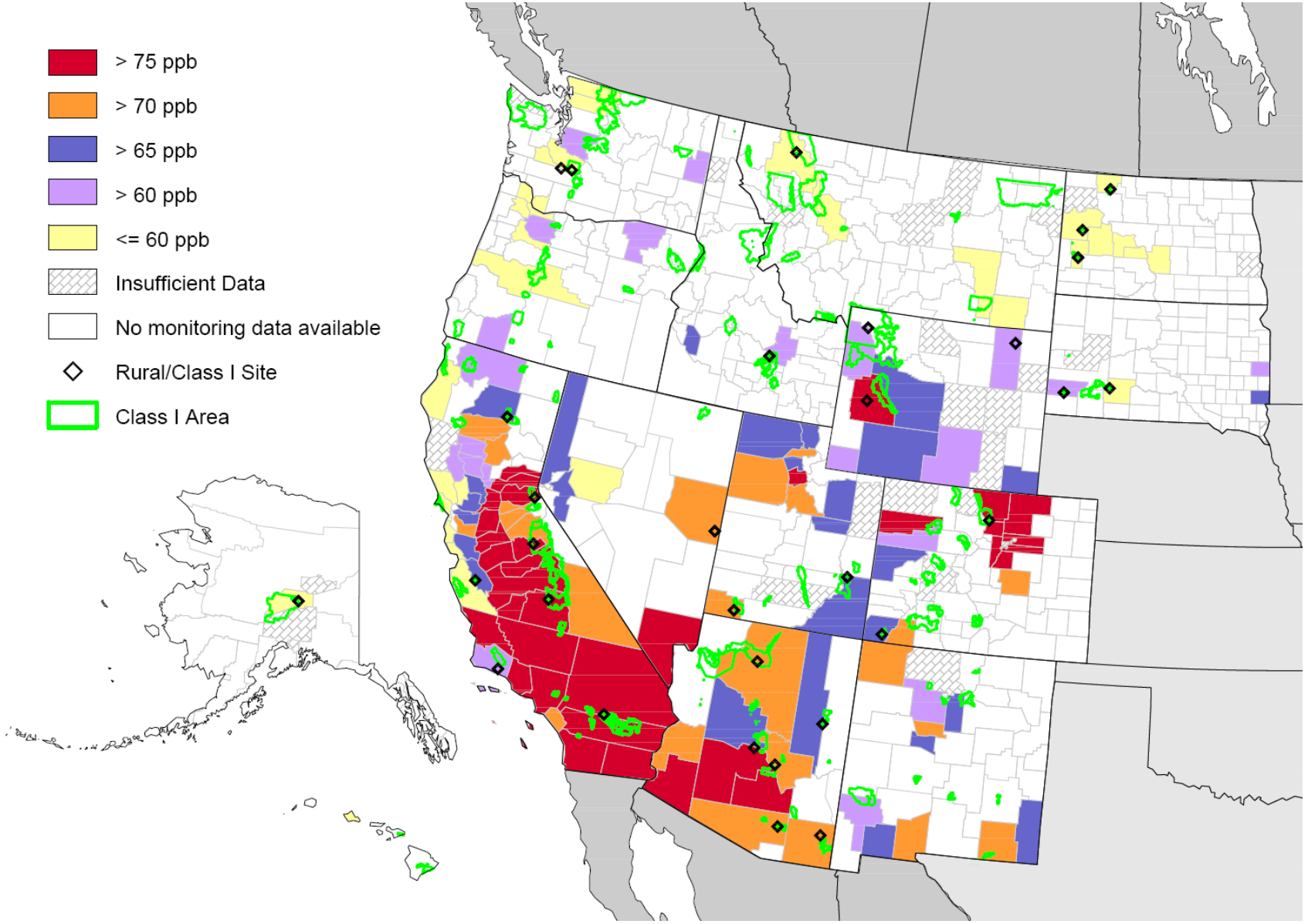
# Counties with Monitors Violating Primary 8-Hour Ground-Level Ozone Standard (0.075 ppb)

(Based on 2011-2013 Air Quality Data)



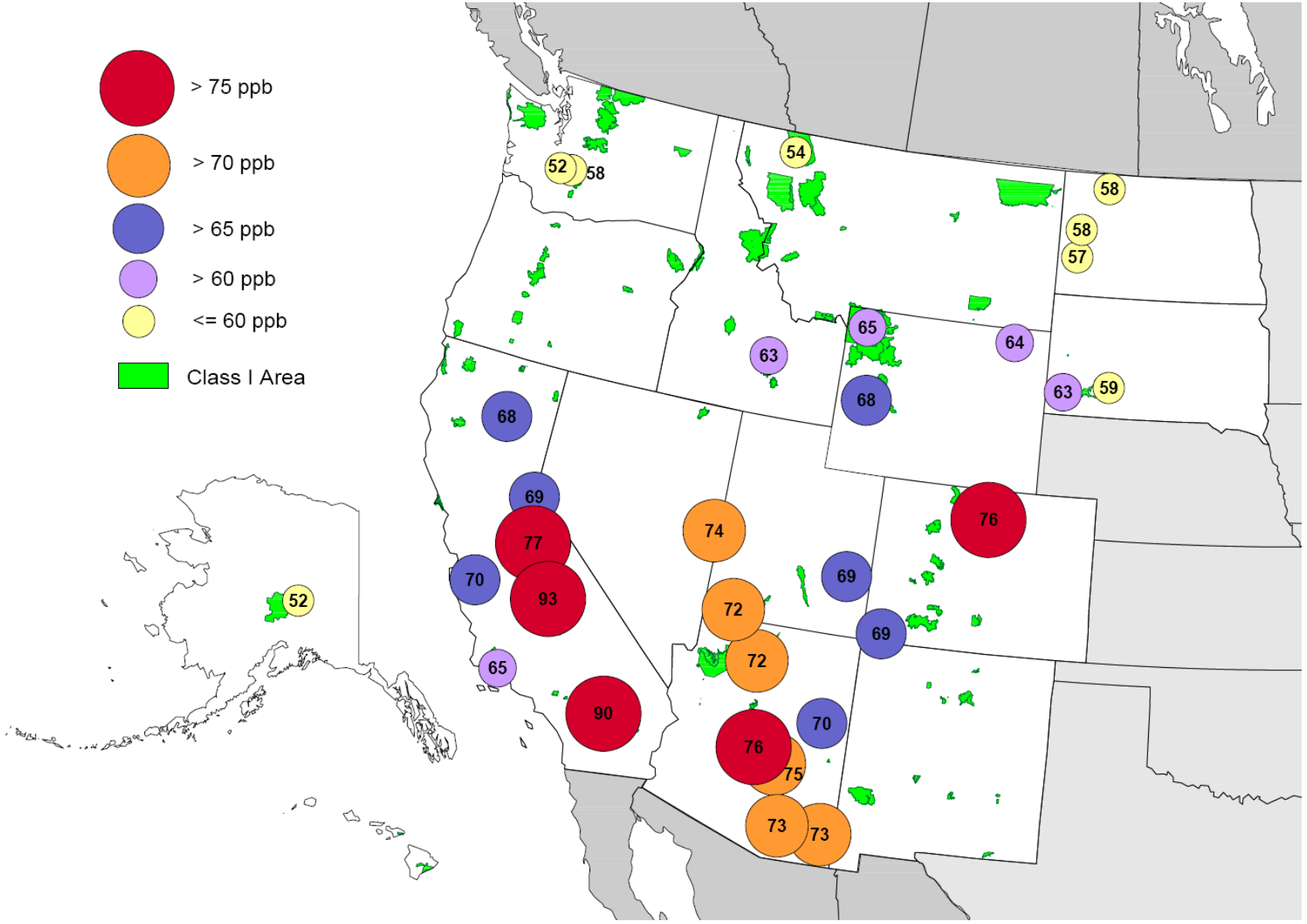

http://www.epa.gov/airquality/greenbook/map8hr_2008.html

# 3-year Average 4th Highest 8-Hour Ozone value by County 2011-2013



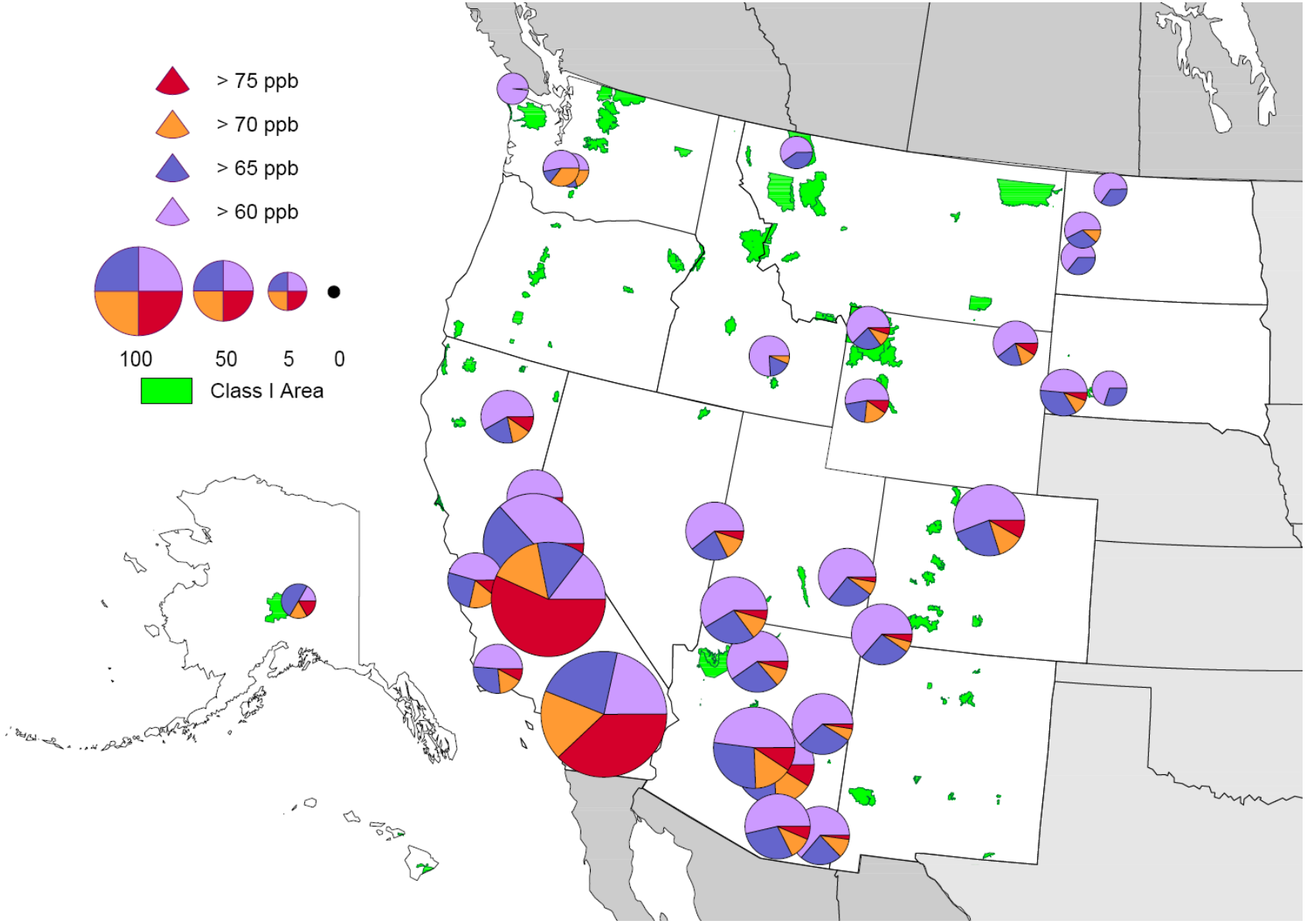

**AQS Federal Reference Method data from the monitoring site in each County with the highest Ozone values**

# 3-year Average 4th Highest 8-Hour Ozone value for Rural/Class I Sites 2011-2013



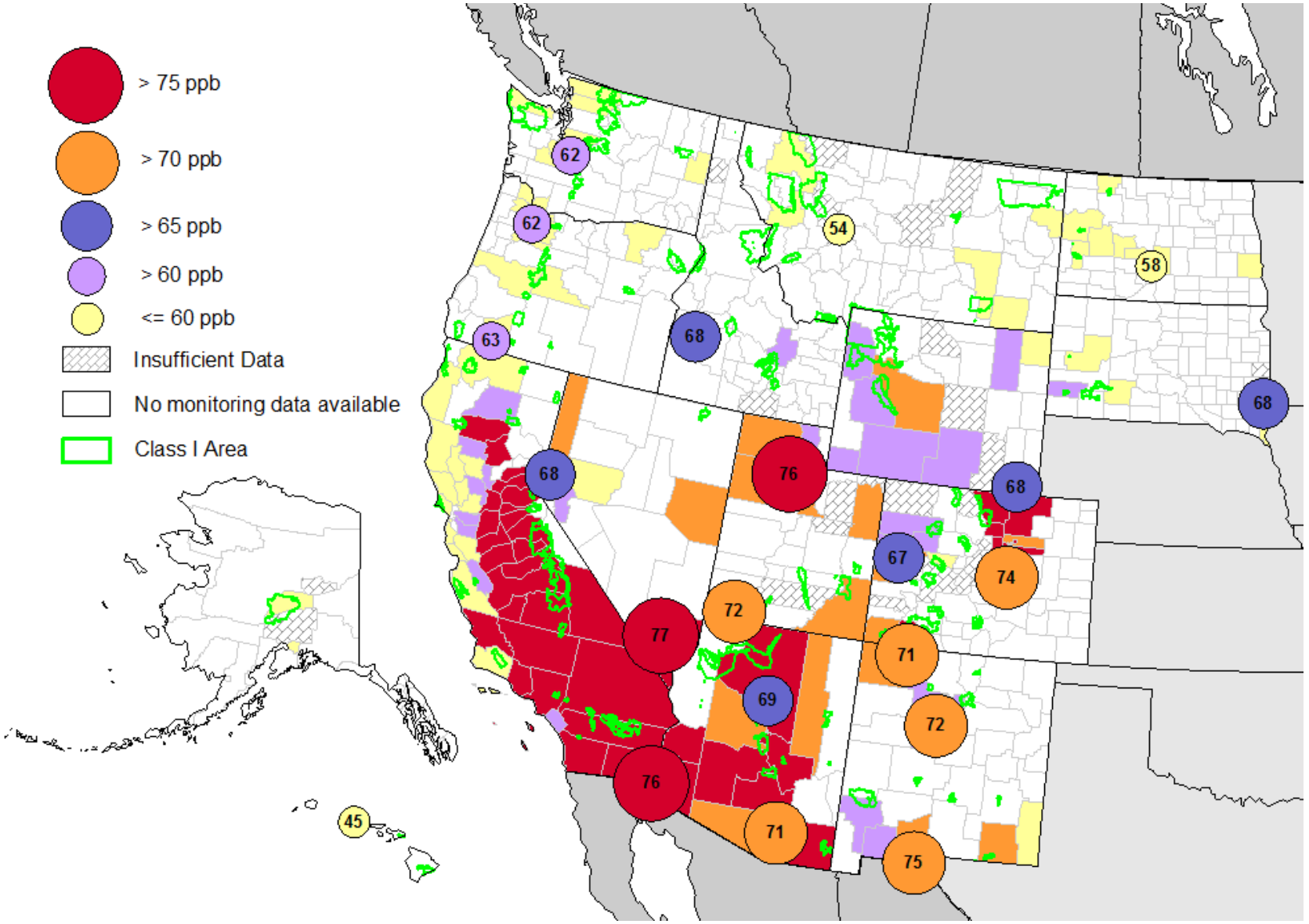

AQS Federal Reference Method data from rural or Class I area monitoring sites

# Average Annual Count of Days with 8-Hour Ozone Averages >60 ppb for Rural/Class I Monitoring Sites – 2004 through 2013




AQS Federal Reference Method data from rural or Class I area monitoring sites

# 3-year Average 4th Highest 8-Hour Ozone Design Value for Selected Urban Counties currently in Attainment – 2011 through 2013



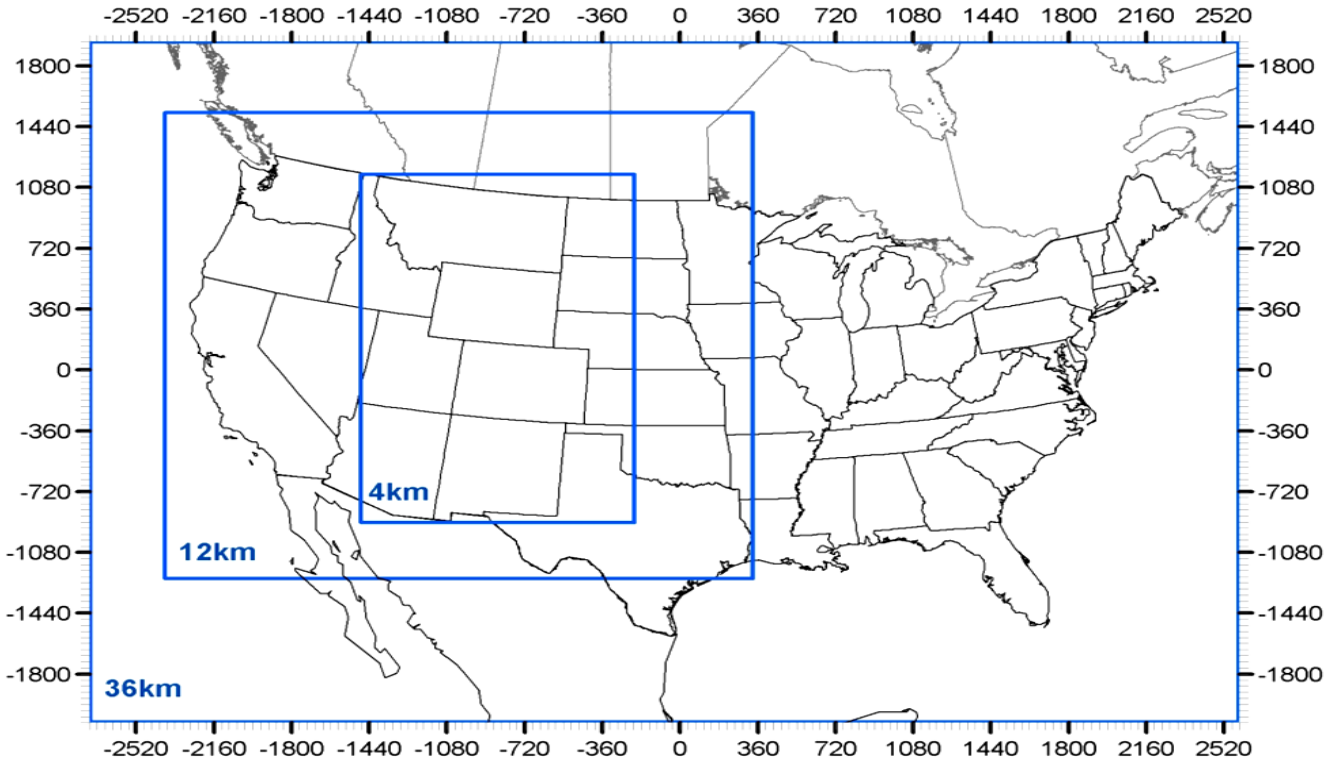

AQS Federal Reference Method data from the monitoring site in each County with the highest Ozone values

# West-Wide Jumpstart Air Quality Modeling Study

- Regional results provide data and context for state and federal planning
  - Uses most current transport and background studies
  - Meteorological and emissions modeling
    - Regionally consistent, High resolution, Comprehensive
  - Photochemical modeling
    - 2008 base case model performance evaluation with Ozone / PM source apportionment
  - Most up-to-date and complete characterization of Western U.S. air quality available

- Study completed September 2013
  - Emissions and Modeling data foundation of Western Data Warehouse
  - All materials at: http://www.wrapair2.org/WestJumpAQMS.aspx
  - Advances goal to provide a regional modeling framework

# WestJumpAQMS Area

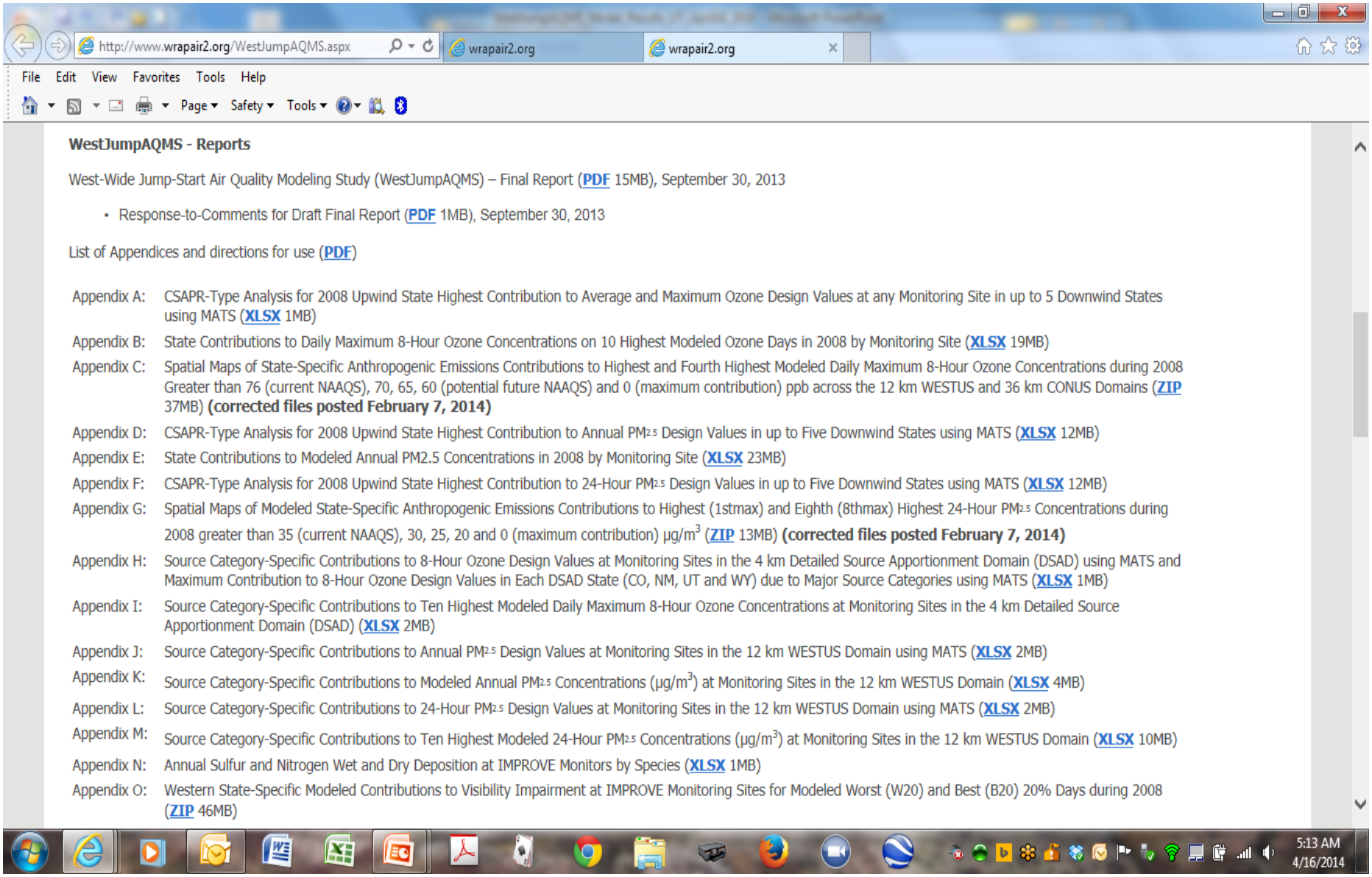



Modeling Domain

36km: 148 x 112 (-2736, -2088) to (2592, 1944)
12km*: 227 x 230 (-2388, -1236) to (336, 1542)
04km*: 317 x 515 (-1480, -904) to (-212, 1156)

* includes buffer cells

# Ozone, PM, Deposition, and Visibility Source Apportionment Resources from WestJumpAQMS




**WestJumpAQMS - Reports**

West-Wide Jump-Start Air Quality Modeling Study (WestJumpAQMS) – Final Report (PDF 15MB), September 30, 2013

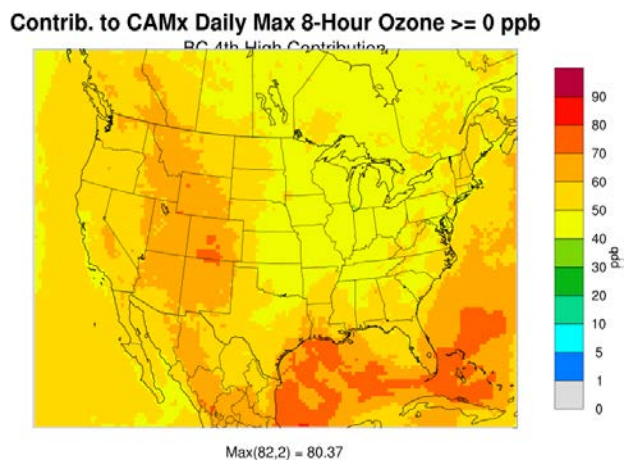
- Response-to-Comments for Draft Final Report (PDF 1MB), September 30, 2013

List of Appendices and directions for use (PDF)

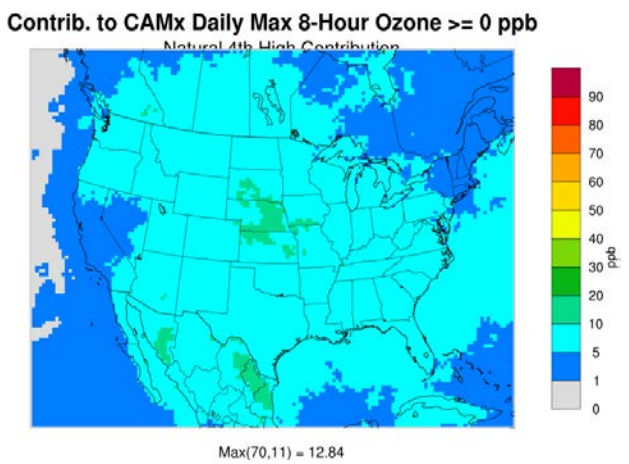
| | |
|---|---|
| Appendix A: | CSAPR-Type Analysis for 2008 Upwind State Highest Contribution to Average and Maximum Ozone Design Values at any Monitoring Site in up to 5 Downwind States using MATS (XLSX 1MB) |
| Appendix B: | State Contributions to Daily Maximum 8-Hour Ozone Concentrations on 10 Highest Modeled Ozone Days in 2008 by Monitoring Site (XLSX 19MB) |
| Appendix C: | Spatial Maps of State-Specific Anthropogenic Emissions Contributions to Highest and Fourth Highest Modeled Daily Maximum 8-Hour Ozone Concentrations during 2008 Greater than 76 (current NAAQS), 70, 65, 60 (potential future NAAQS) and 0 (maximum contribution) ppb across the 12 km WESTUS and 36 km CONUS Domains (ZIP 37MB) **(corrected files posted February 7, 2014)** |
| Appendix D: | CSAPR-Type Analysis for 2008 Upwind State Highest Contribution to Annual $PM_{2.5}$ Design Values in up to Five Downwind States using MATS (XLSX 12MB) |
| Appendix E: | State Contributions to Modeled Annual PM2.5 Concentrations in 2008 by Monitoring Site (XLSX 23MB) |
| Appendix F: | CSAPR-Type Analysis for 2008 Upwind State Highest Contribution to 24-Hour $PM_{2.5}$ Design Values in up to Five Downwind States using MATS (XLSX 12MB) |
| Appendix G: | Spatial Maps of Modeled State-Specific Anthropogenic Emissions Contributions to Highest (1stmax) and Eighth (8thmax) Highest 24-Hour $PM_{2.5}$ Concentrations during 2008 greater than 35 (current NAAQS), 30, 25, 20 and 0 (maximum contribution) $\mu g/m^3$ (ZIP 13MB) **(corrected files posted February 7, 2014)** |
| Appendix H: | Source Category-Specific Contributions to 8-Hour Ozone Design Values at Monitoring Sites in the 4 km Detailed Source Apportionment Domain (DSAD) using MATS and Maximum Contribution to 8-Hour Ozone Design Values in Each DSAD State (CO, NM, UT and WY) due to Major Source Categories using MATS (XLSX 1MB) |
| Appendix I: | Source Category-Specific Contributions to Ten Highest Modeled Daily Maximum 8-Hour Ozone Concentrations at Monitoring Sites in the 4 km Detailed Source Apportionment Domain (DSAD) (XLSX 2MB) |
| Appendix J: | Source Category-Specific Contributions to Annual $PM_{2.5}$ Design Values at Monitoring Sites in the 12 km WESTUS Domain using MATS (XLSX 2MB) |
| Appendix K: | Source Category-Specific Contributions to Modeled Annual $PM_{2.5}$ Concentrations ($\mu g/m^3$) at Monitoring Sites in the 12 km WESTUS Domain (XLSX 4MB) |
| Appendix L: | Source Category-Specific Contributions to 24-Hour $PM_{2.5}$ Design Values at Monitoring Sites in the 12 km WESTUS Domain using MATS (XLSX 2MB) |
| Appendix M: | Source Category-Specific Contributions to Ten Highest Modeled 24-Hour $PM_{2.5}$ Concentrations ($\mu g/m^3$) at Monitoring Sites in the 12 km WESTUS Domain (XLSX 10MB) |
| Appendix N: | Annual Sulfur and Nitrogen Wet and Dry Deposition at IMPROVE Monitors by Species (XLSX 1MB) |
| Appendix O: | Western State-Specific Modeled Contributions to Visibility Impairment at IMPROVE Monitoring Sites for Modeled Worst (W20) and Best (B20) 20% Days during 2008 (ZIP 46MB) |

# "Other Sources" Max Contrib. 4th High DMAX8 Ozone

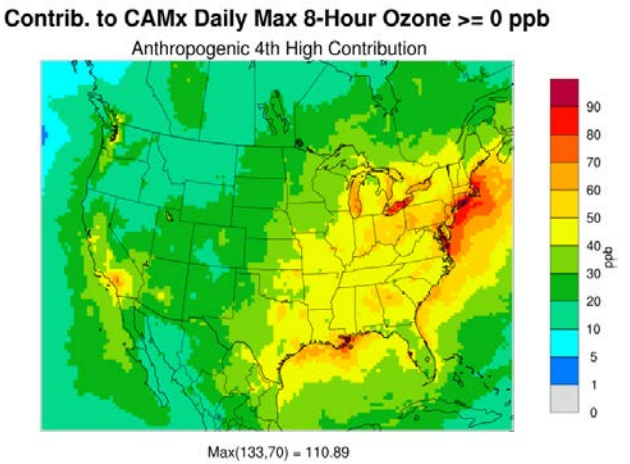
Boundary Conditions

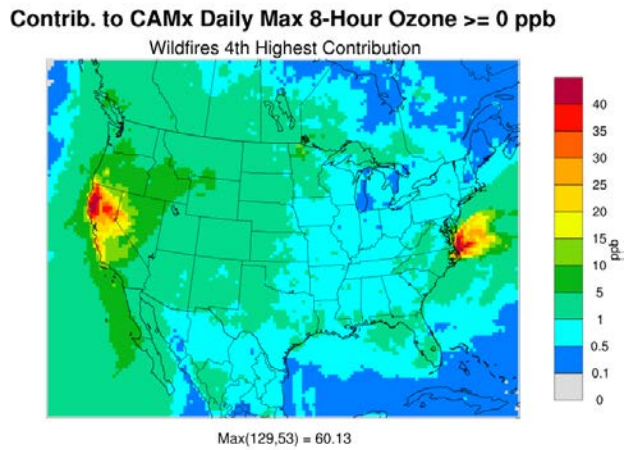



Natural

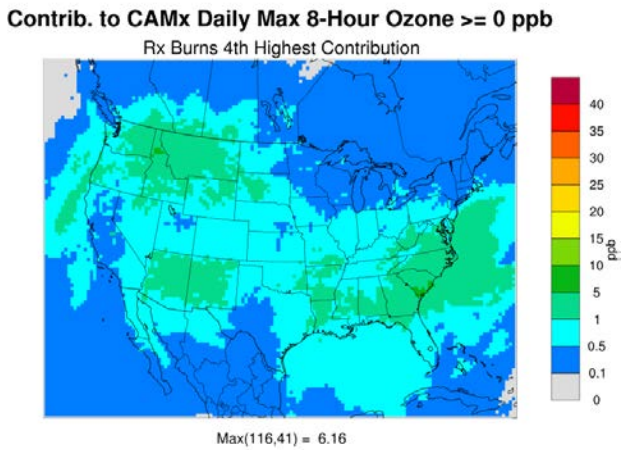



Anthropogenic

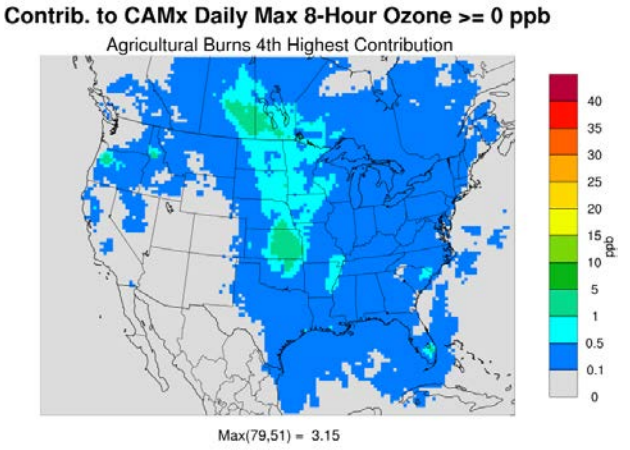


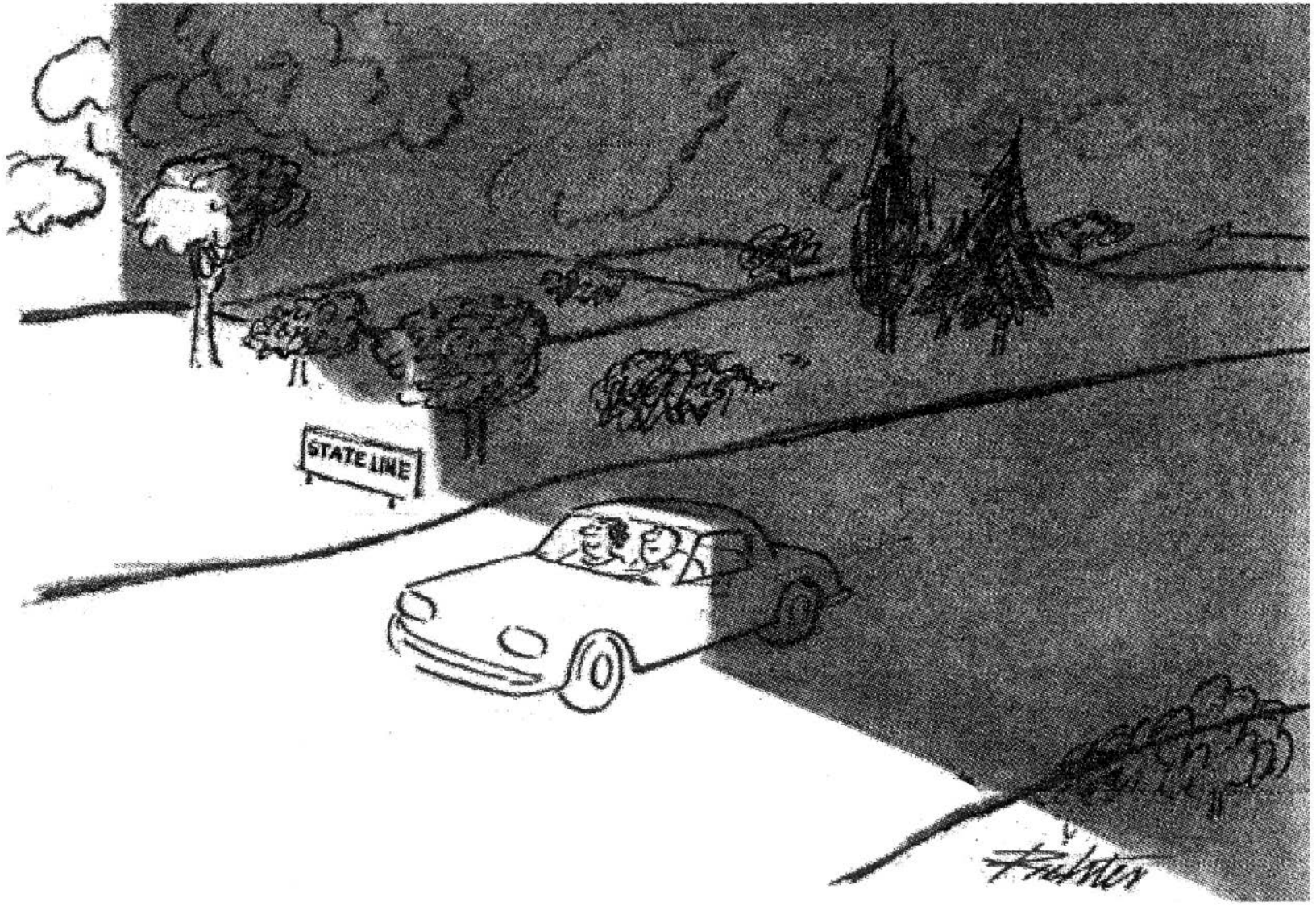

Wildfire




Prescribed Fire




Agricultural Fire

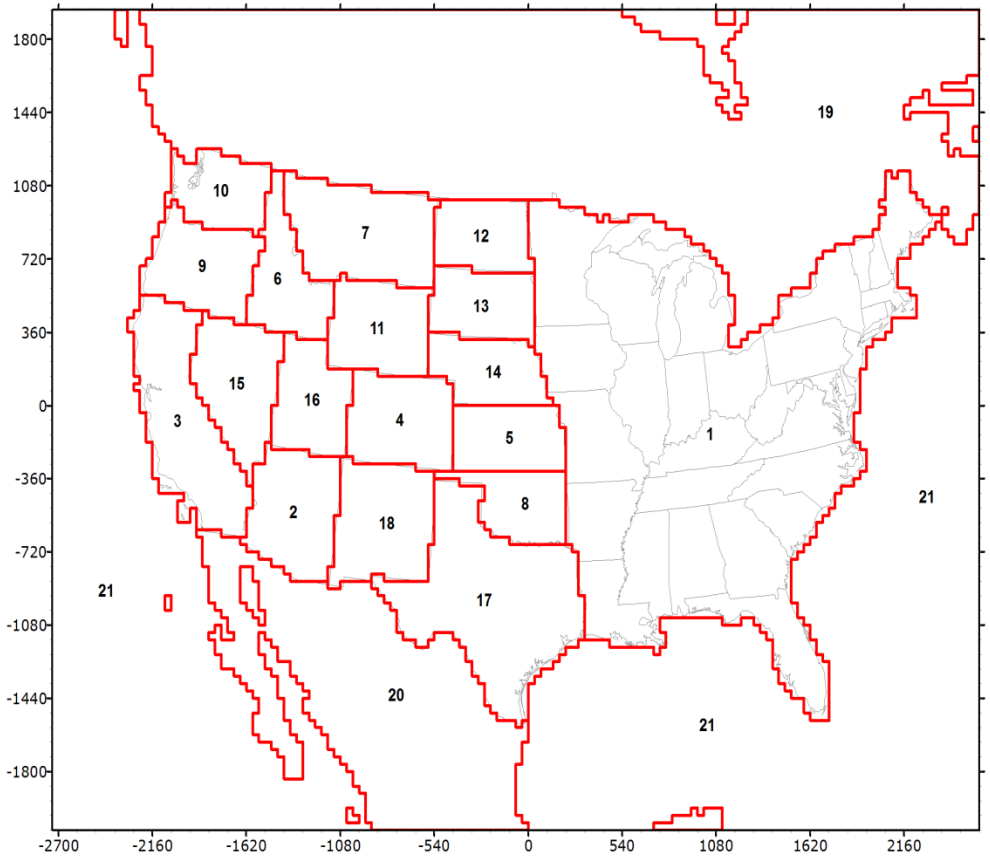



*"They have very strict anti-pollution laws in this state."*

# State-Specific Ozone Source Apportionment

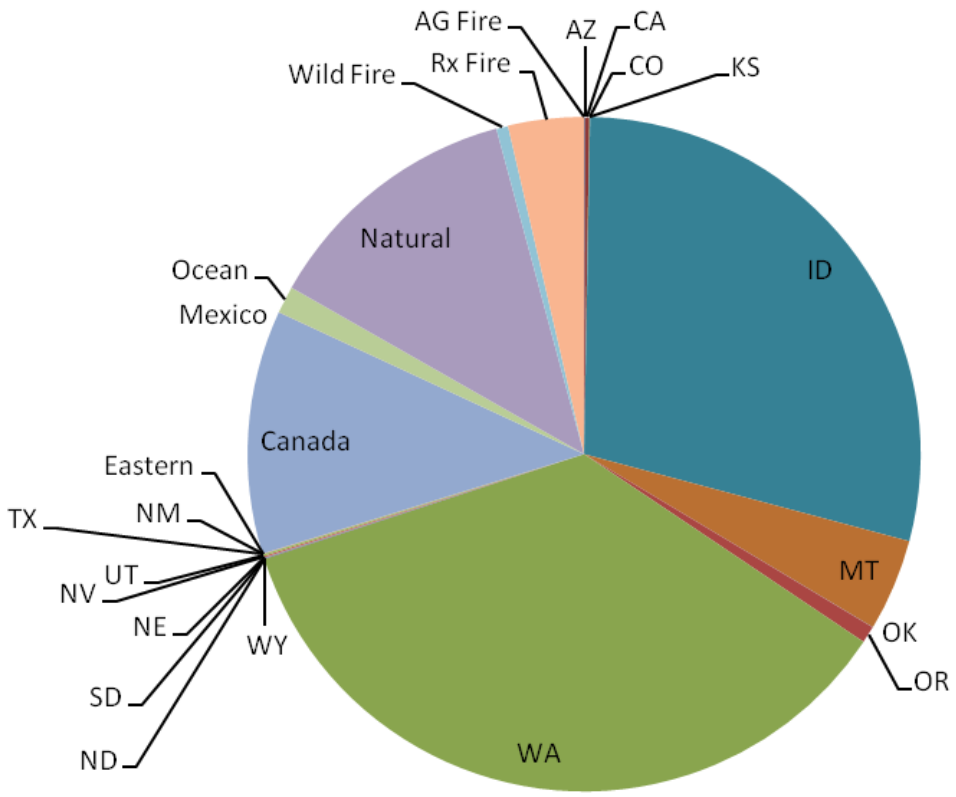
Purpose: Provide information on the role of ozone transport to exceedances of current and potential future ozone air standards in the western U.S.

- 2008 36/12 km Base
- 17 Western States
  - Plus Eastern US, Can, Mex & Off-Shore
- 5 Source Categories
  - Natural (Biogenics+Lightning+WBDust+SeaSalt)
  - WF, Rx and Ag Fires
  - Anthropogenic
- 107 Source Groups (21 x 5 + 2)
  - 4 Extra Species for each Group
    - 428 additional species
    - Standard Model = 70 species
    - Computationally Demanding



# State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

**Highest** Modeled DMAX8 Day at Spokane site (53-063-0021)

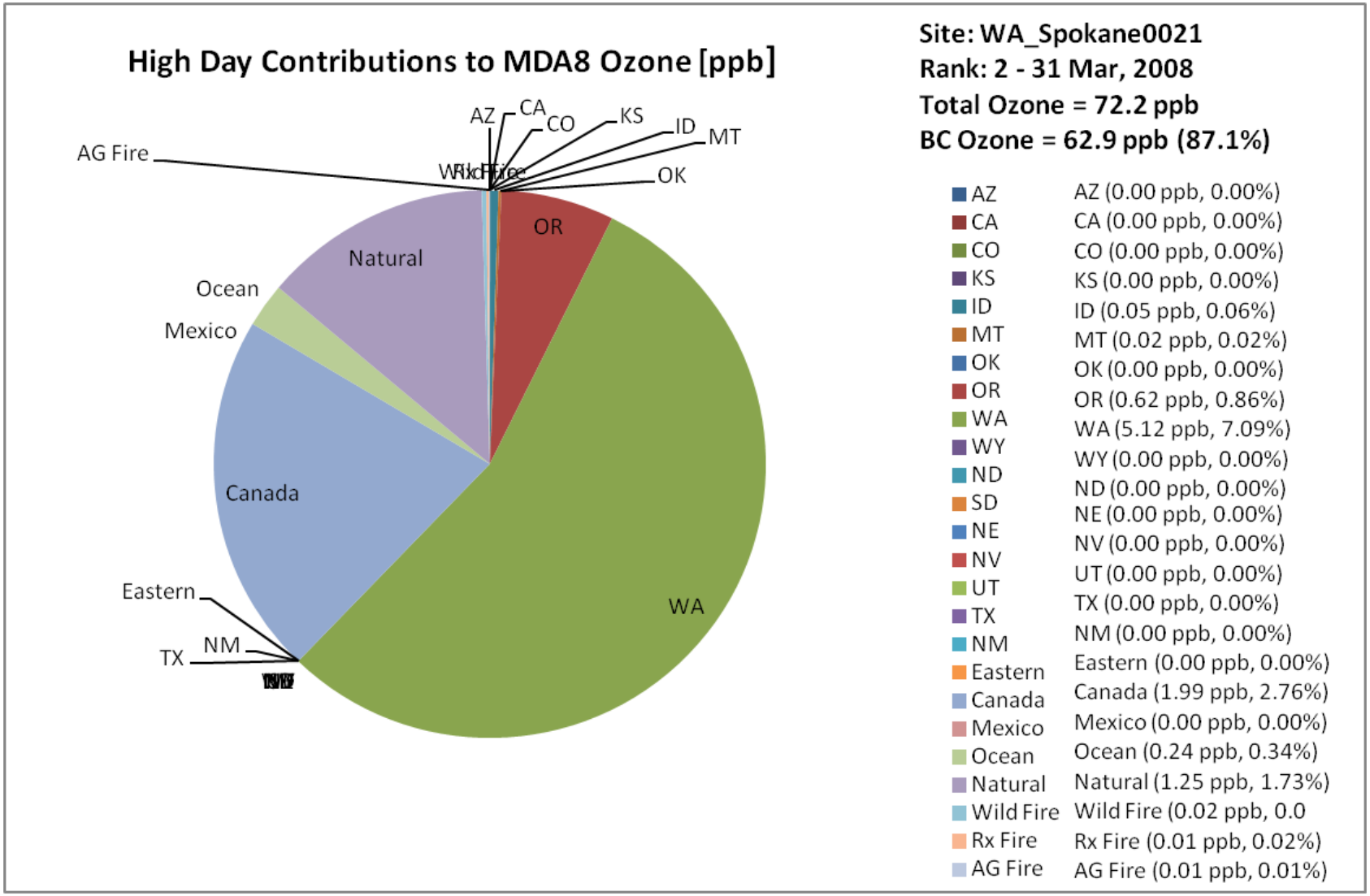



**Site: WA_Spokane0021**
**Rank: 1 - 02 May, 2008**
**Total Ozone = 73.3 ppb**
**BC Ozone = 59.3 ppb (80.8%)**

| | |
|---|---|
| AZ | AZ (0.01 ppb, 0.01%) |
| CA | CA (0.03 ppb, 0.04%) |
| CO | CO (0.00 ppb, 0.00%) |
| KS | KS (0.00 ppb, 0.00%) |
| ID | ID (4.06 ppb, 5.54%) |
| MT | MT (0.62 ppb, 0.85%) |
| OK | OK (0.00 ppb, 0.00%) |
| OR | OR (0.11 ppb, 0.16%) |
| WA | WA (5.00 ppb, 6.81%) |
| WY | WY (0.01 ppb, 0.01%) |
| ND | |
| SD | |
| NE | NE (0.00 ppb, 0.00%) |
| NV | NV (0.01 ppb, 0.01%) |
| UT | UT (0.01 ppb, 0.02%) |
| TX | TX (0.00 ppb, 0.00%) |
| NM | NM (0.00 ppb, 0.00%) |
| Eastern | Eastern (0.00 ppb, 0.00%) |
| Canada | Canada (1.65 ppb, 2.24%) |
| Mexico | Mexico (0.00 ppb, 0.00%) |
| Ocean | Ocean (0.18 ppb, 0.25%) |
| Natural | Natural (1.77 ppb, 2.41%) |
| Wild Fire | Wild Fire (0.08 ppb, 0.1 |
| Rx Fire | Rx Fire (0.51 ppb, 0.70%) |
| AG Fire | AG Fire (0.00 ppb, 0.00%) |

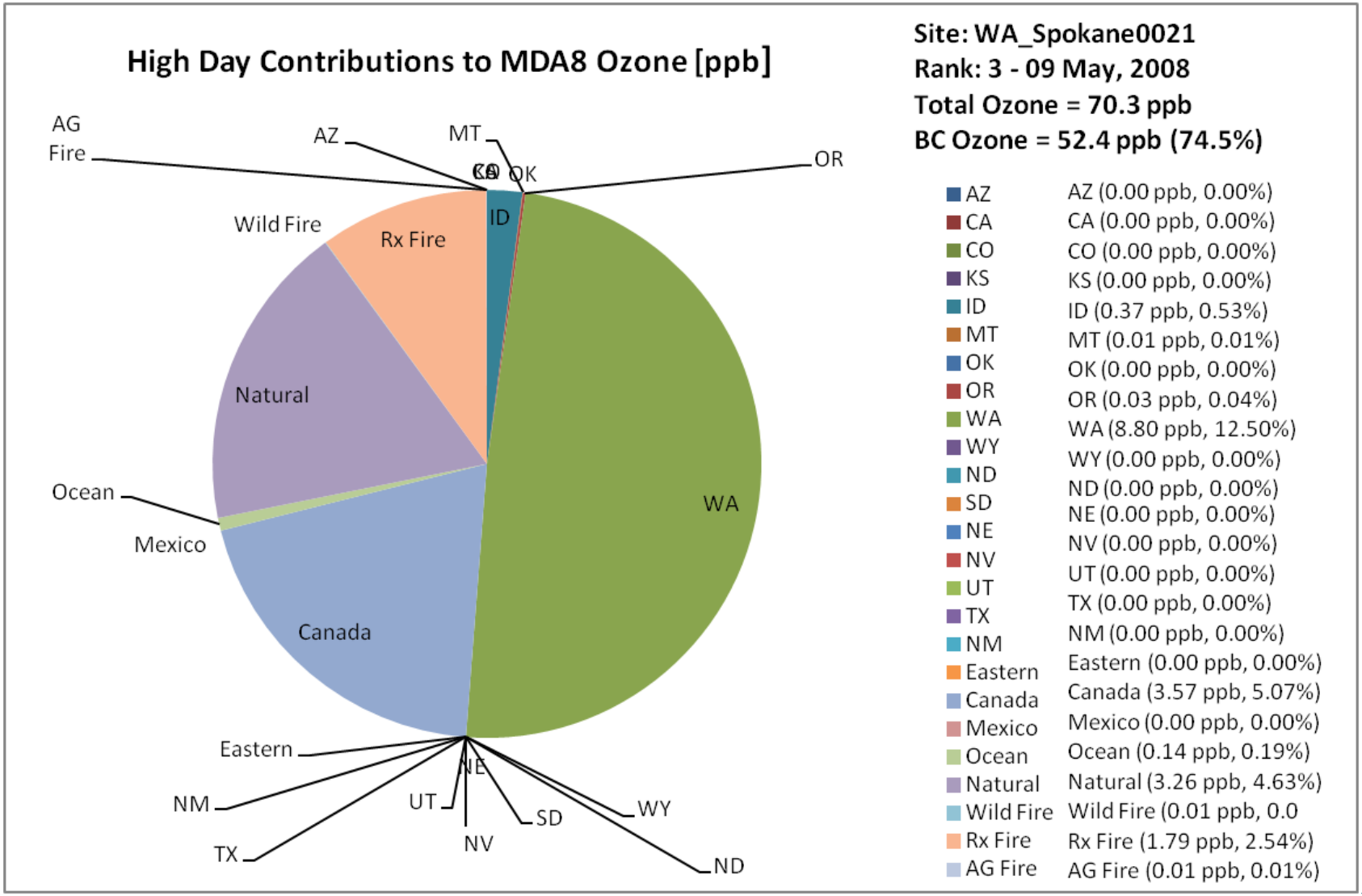
# State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

**2nd Highest** Modeled DMAX8 Day at Spokane site (53-063-0021)



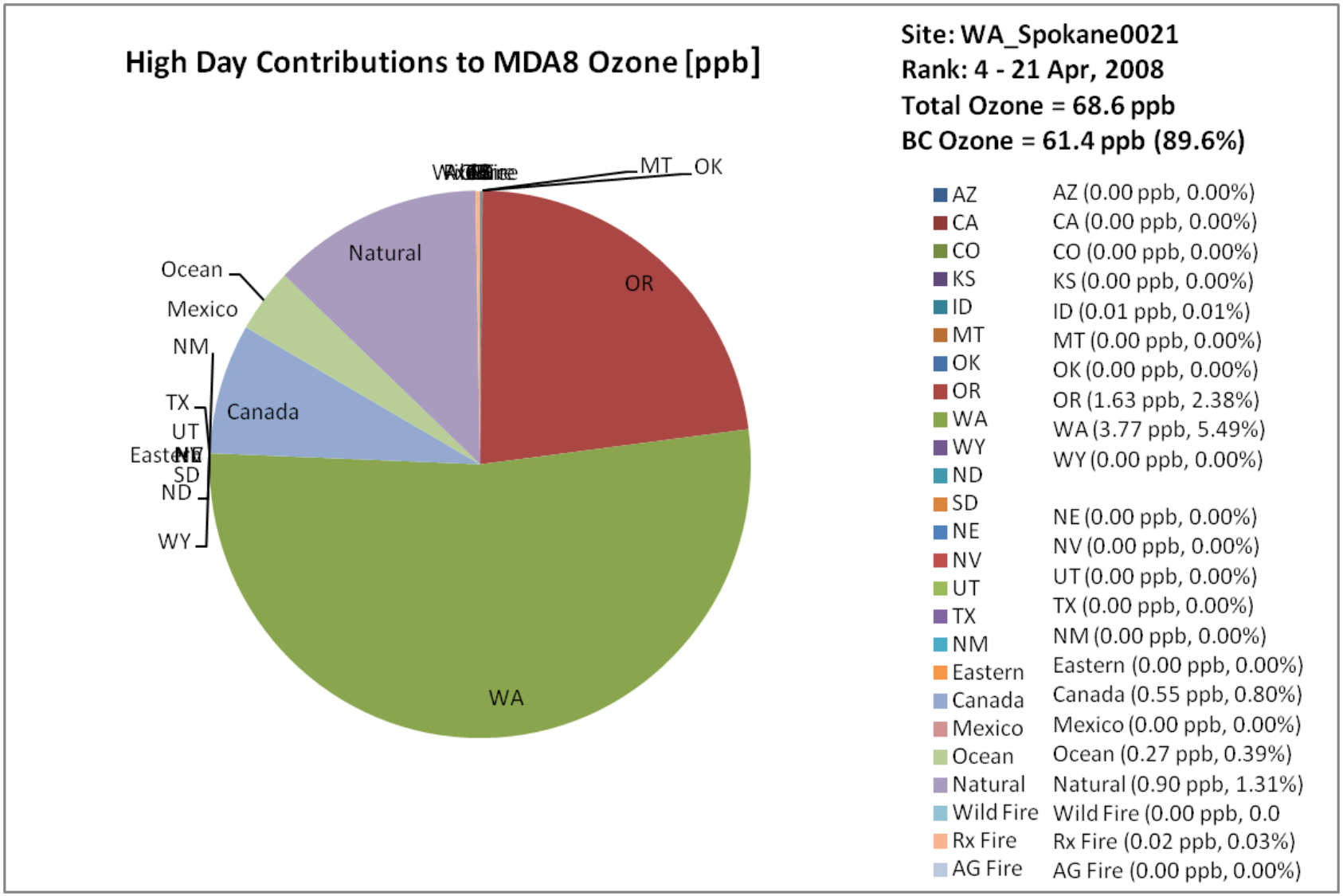
# State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

**3rd Highest** Modeled DMAX8 Day at Spokane site (53-063-0021)



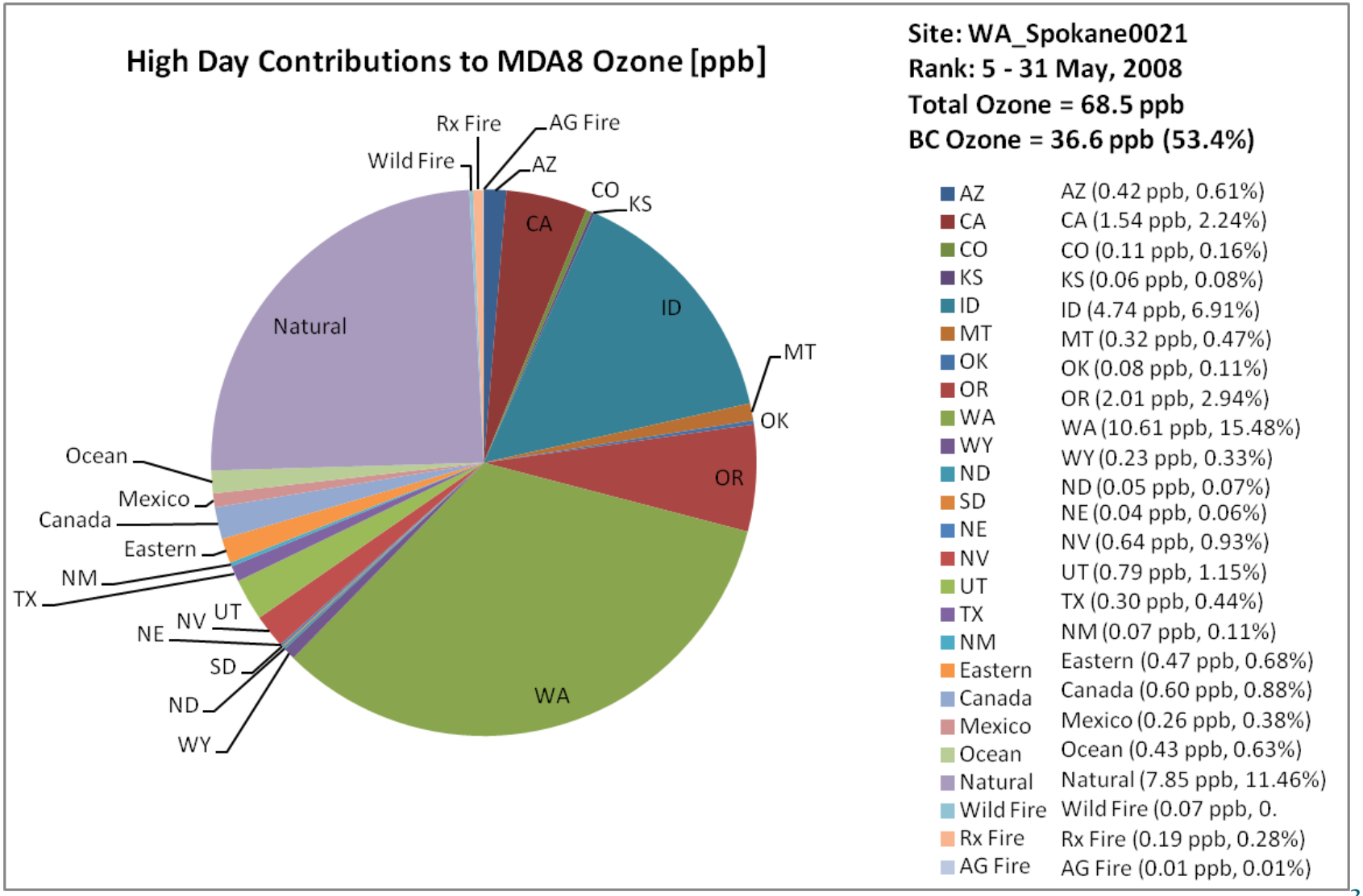
# State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

**4th Highest** Modeled DMAX8 Day at Spokane site (53-063-0021)



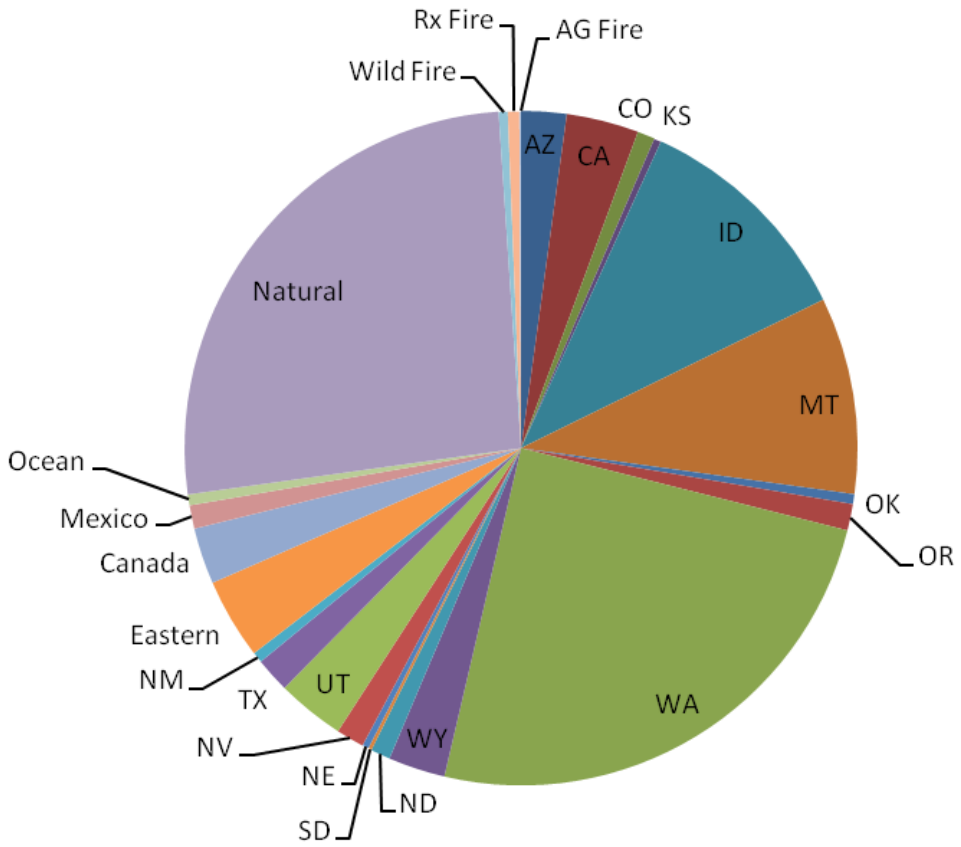
# State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

**5th Highest** Modeled DMAX8 Day at Spokane site (53-063-0021)



# State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

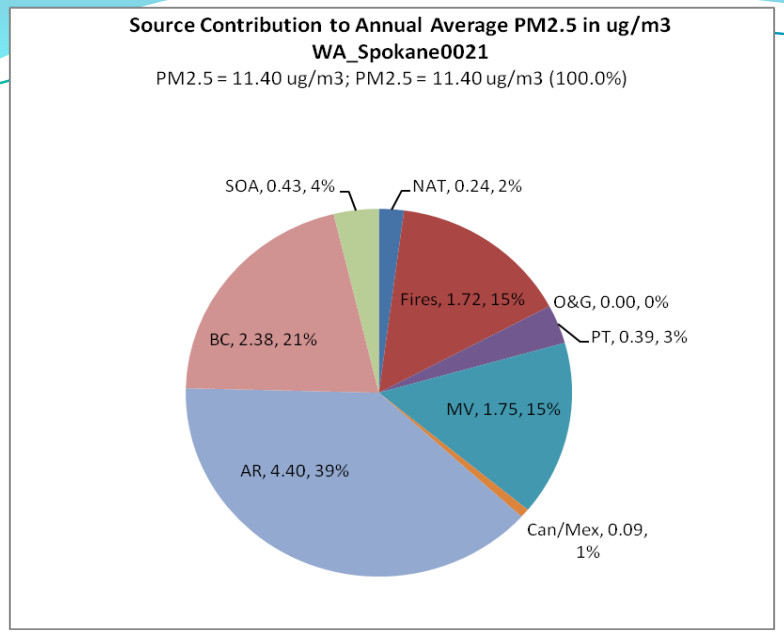
**10th Highest** Modeled DMAX8 Day at Spokane site (53-063-0021)




**Site: WA_Spokane0021**
**Rank: 10 - 28 May, 2008**
**Total Ozone = 63.3 ppb**
**BC Ozone = 37.7 ppb (59.6%)**

| | |
|---|---|
| AZ | AZ (0.55 ppb, 0.88%) |
| CA | CA (0.89 ppb, 1.40%) |
| CO | CO (0.21 ppb, 0.34%) |
| KS | KS (0.09 ppb, 0.14%) |
| ID | ID (2.79 ppb, 4.41%) |
| MT | MT (2.42 ppb, 3.82%) |
| OK | OK (0.12 ppb, 0.19%) |
| OR | OR (0.32 ppb, 0.51%) |
| WA | WA (6.32 ppb, 9.99%) |
| WY | WY (0.70 ppb, 1.10%) |
| ND | |
| SD | |
| NE | NE (0.08 ppb, 0.12%) |
| NV | NV (0.34 ppb, 0.54%) |
| UT | UT (0.83 ppb, 1.32%) |
| TX | TX (0.43 ppb, 0.68%) |
| NM | NM (0.13 ppb, 0.21%) |
| Eastern | Eastern (0.99 ppb, 1.56%) |
| Canada | Canada (0.69 ppb, 1.09%) |
| Mexico | Mexico (0.29 ppb, 0.46%) |
| Ocean | Ocean (0.13 ppb, 0.21%) |
| Natural | Natural (6.68 ppb, 10.55%) |
| Wild Fire | Wild Fire (0.11 ppb, 0. |
| Rx Fire | Rx Fire (0.14 ppb, 0.22%) |
| AG Fire | AG Fire (0.02 ppb, 0.03%) |

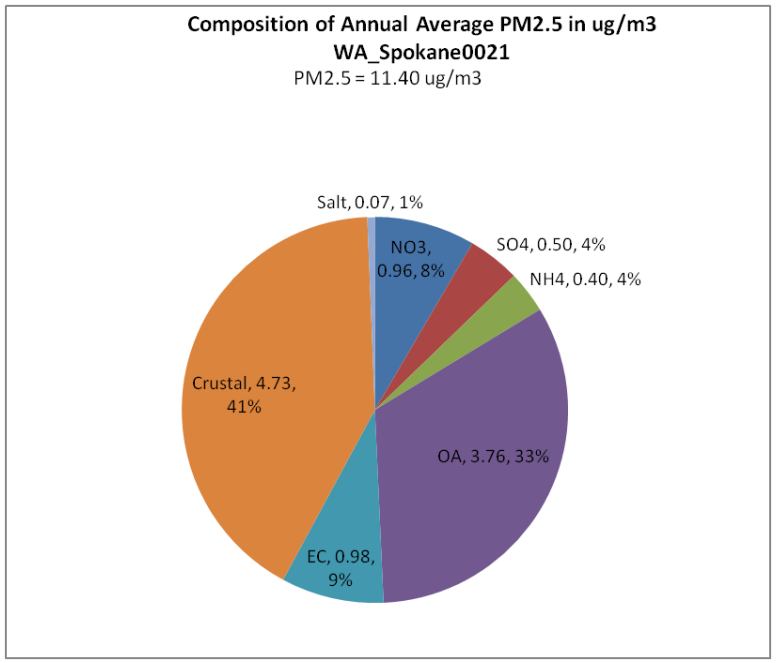
# Annual Average $PM_{2.5}$ (µg/m³) Spokane site

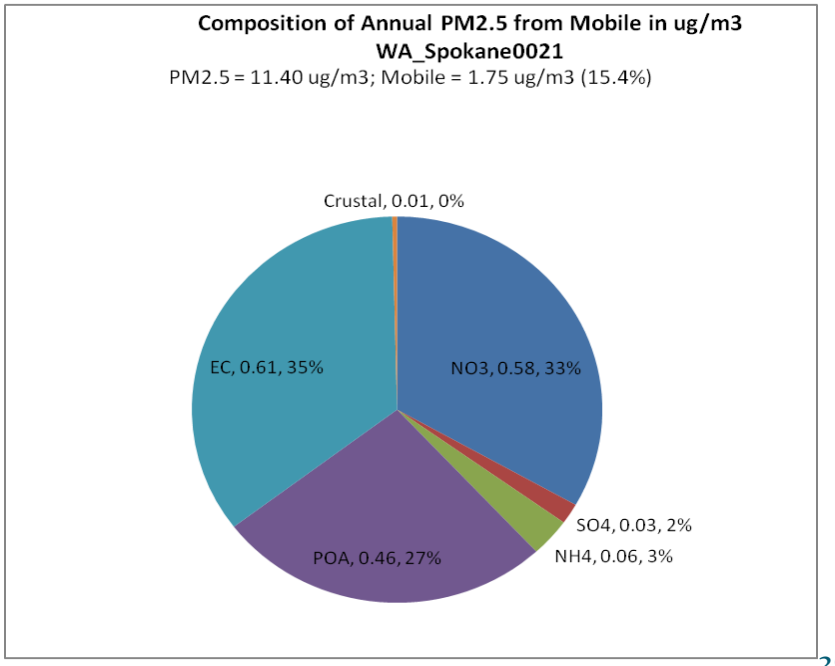



**Sources**

**Composition**

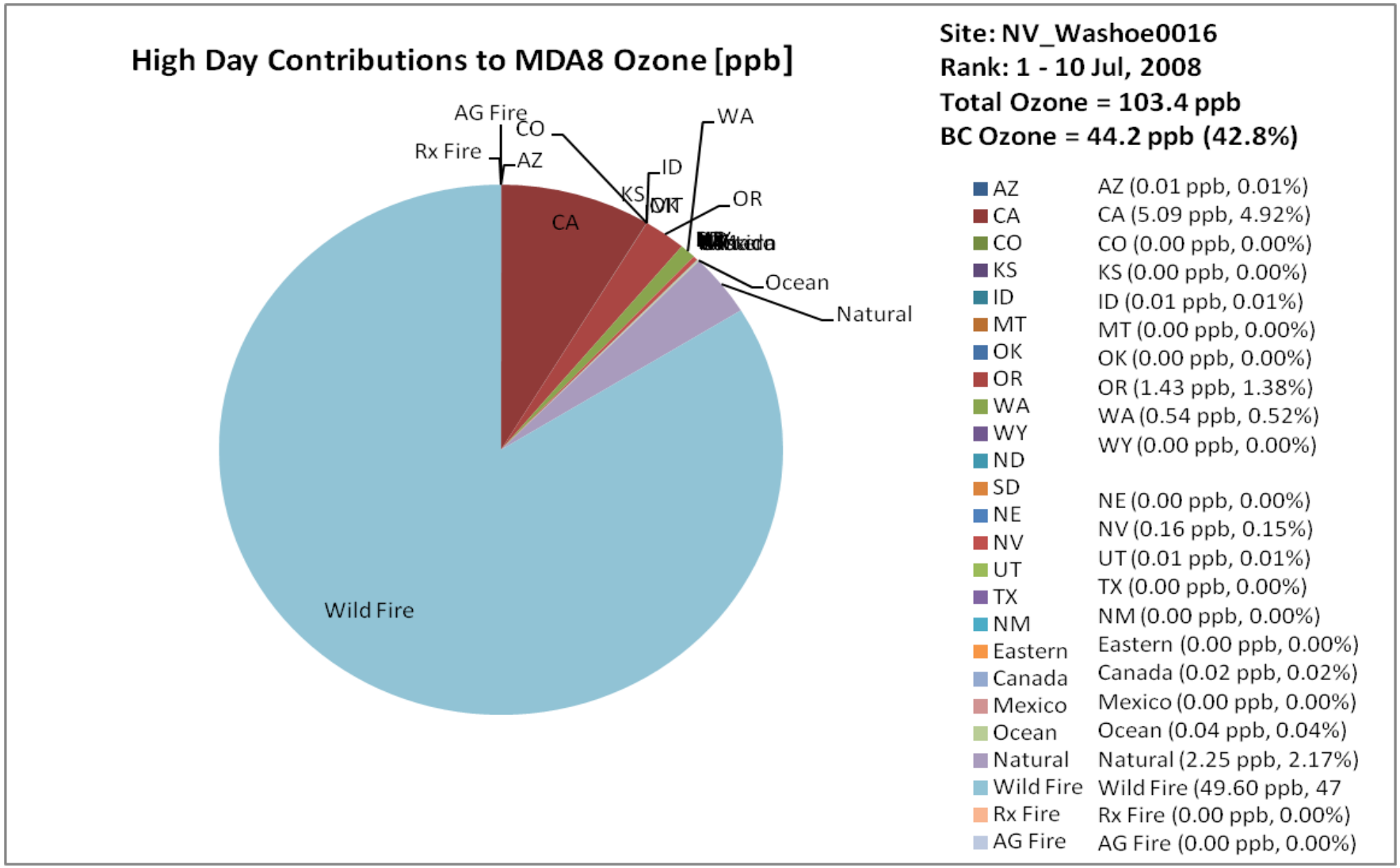
**Source category Composition example**



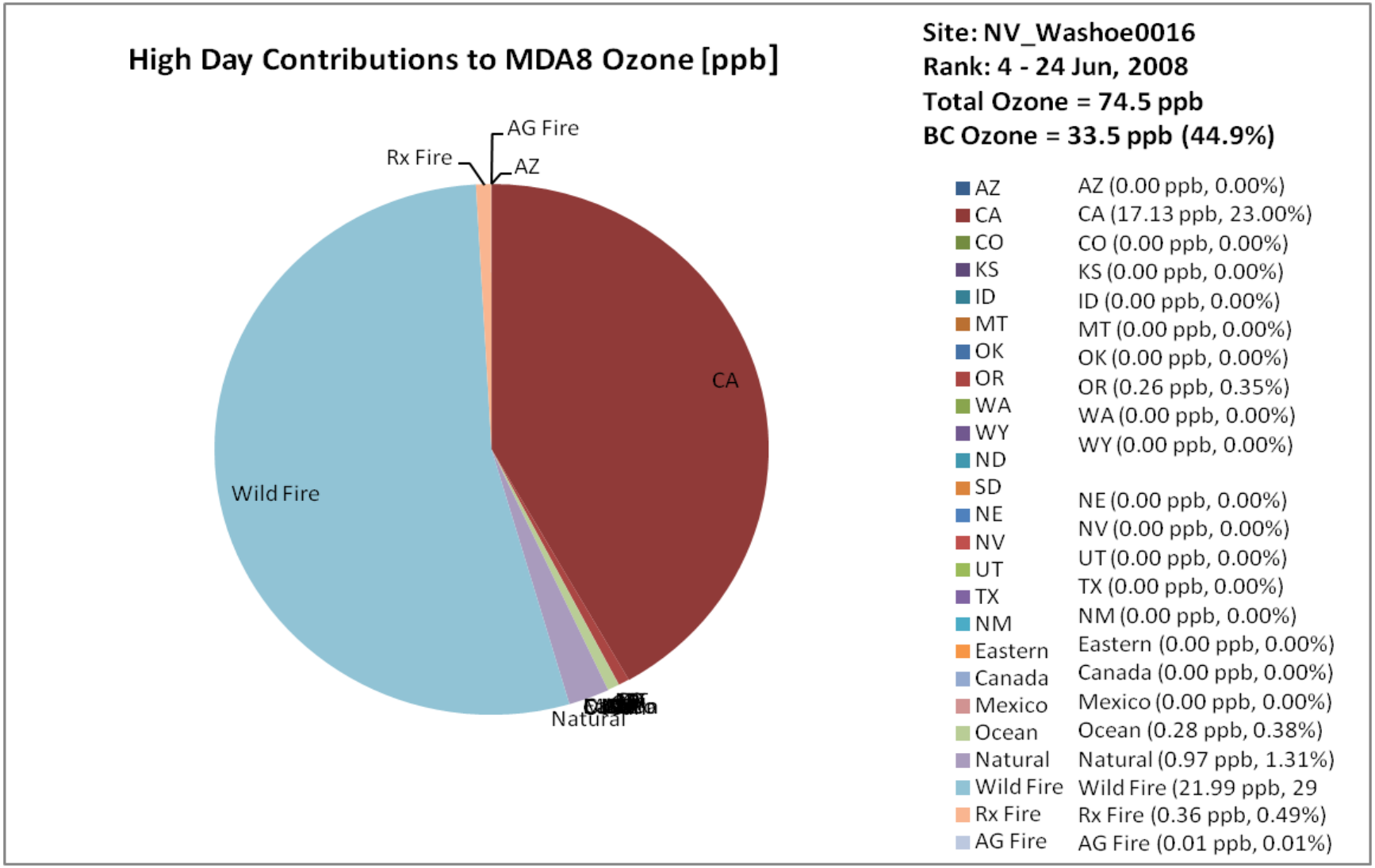
# State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

**Highest** Modeled DMAX8 Day at "Reno3" on State Street, Reno



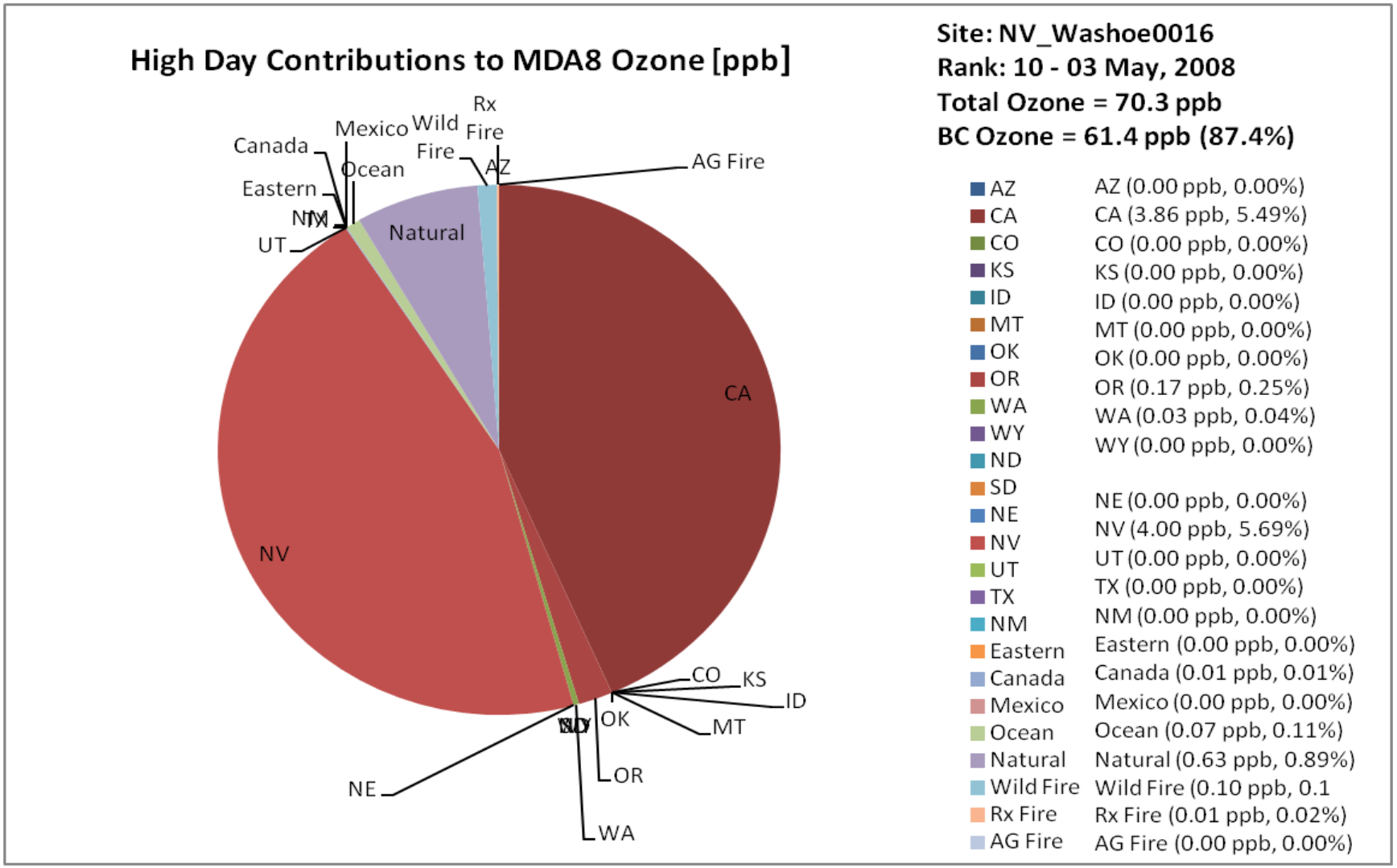
# State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

**4th Highest** Modeled DMAX8 Day at "Reno3" on State Street, Reno



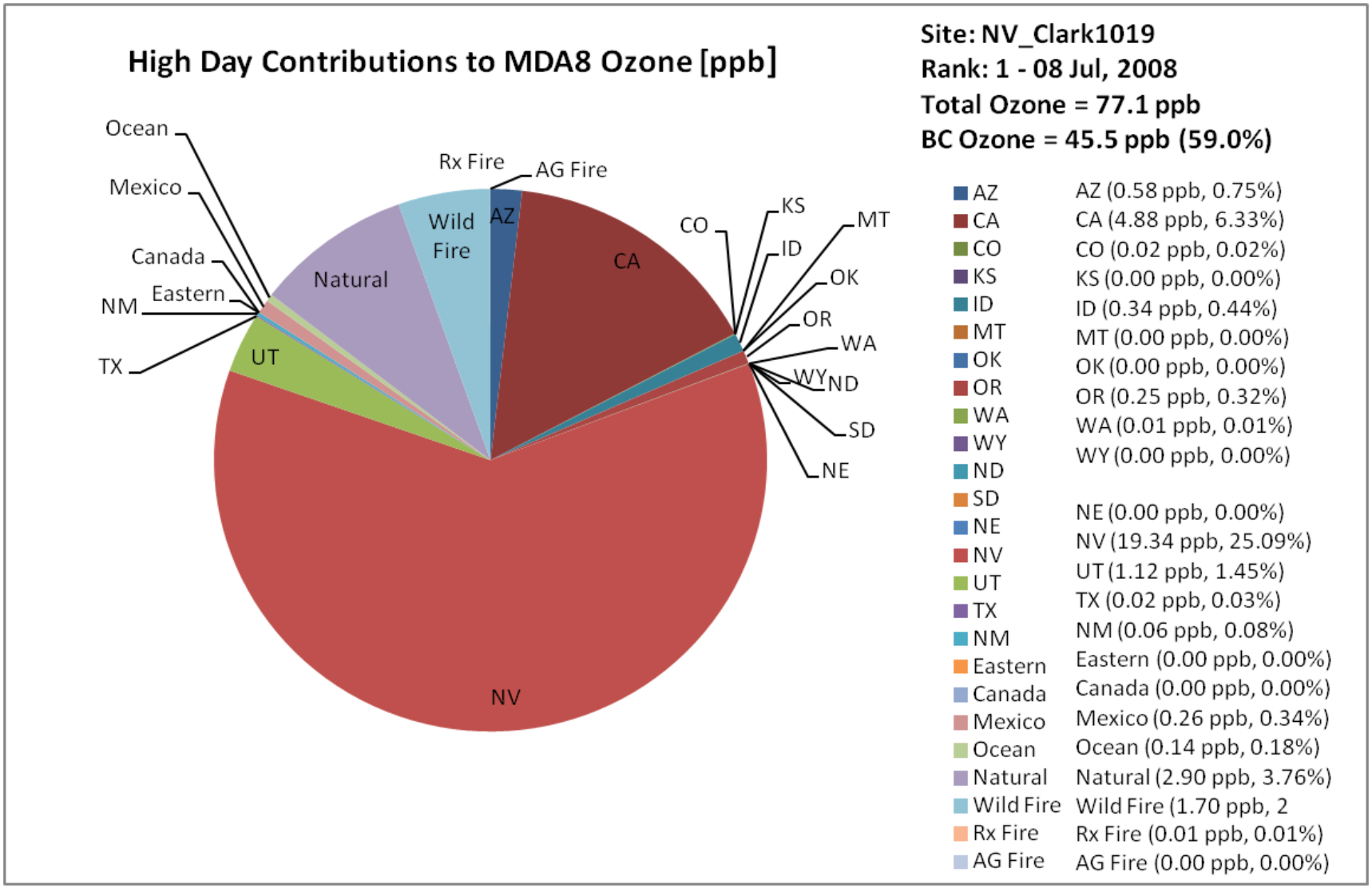
# State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

**10th Highest** Modeled DMAX8 Day at "Reno3" on State Street, Reno



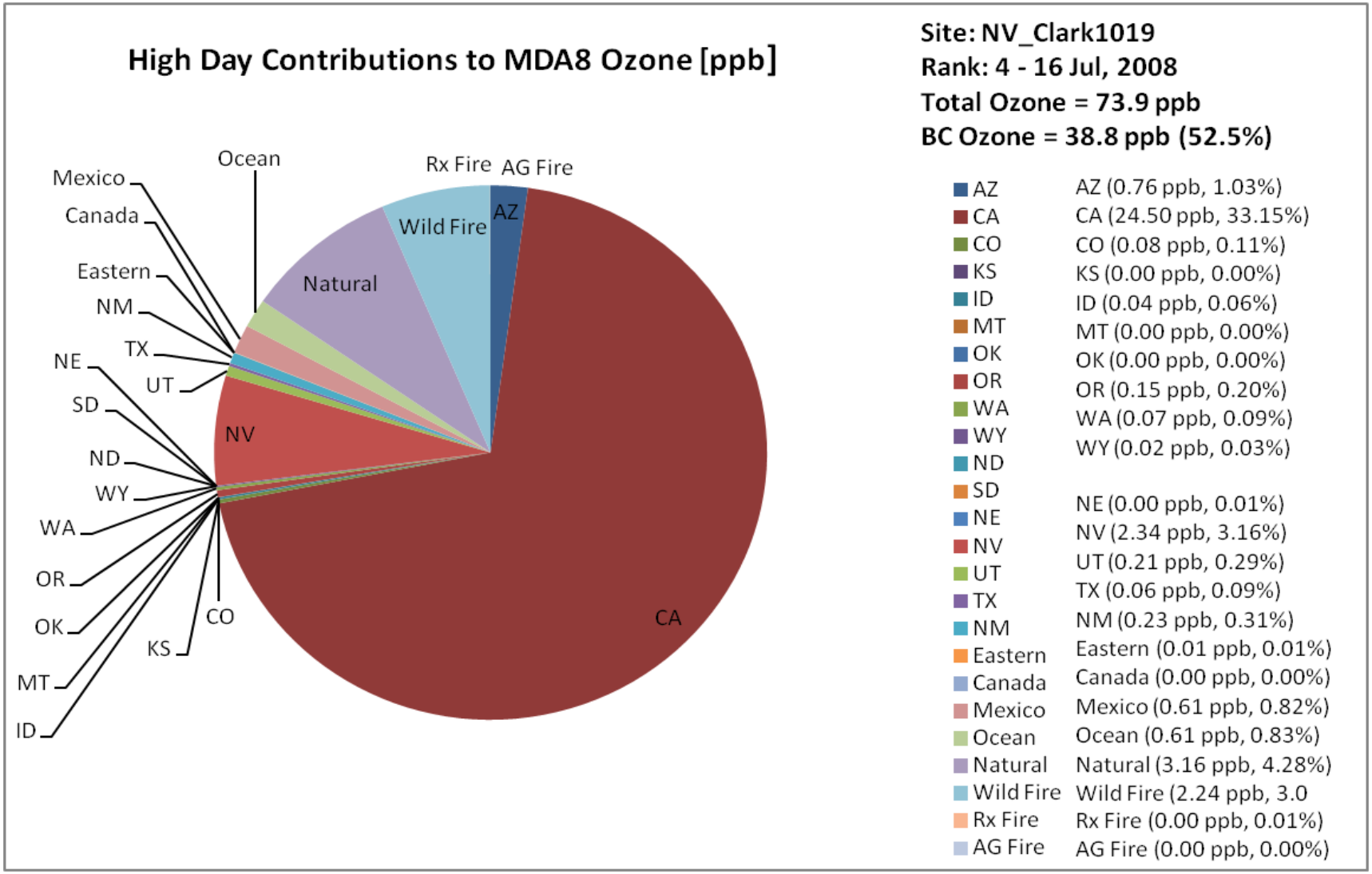
# State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

**Highest** Modeled DMAX8 Day at Jean background site on SR 161, southwest of Las Vegas



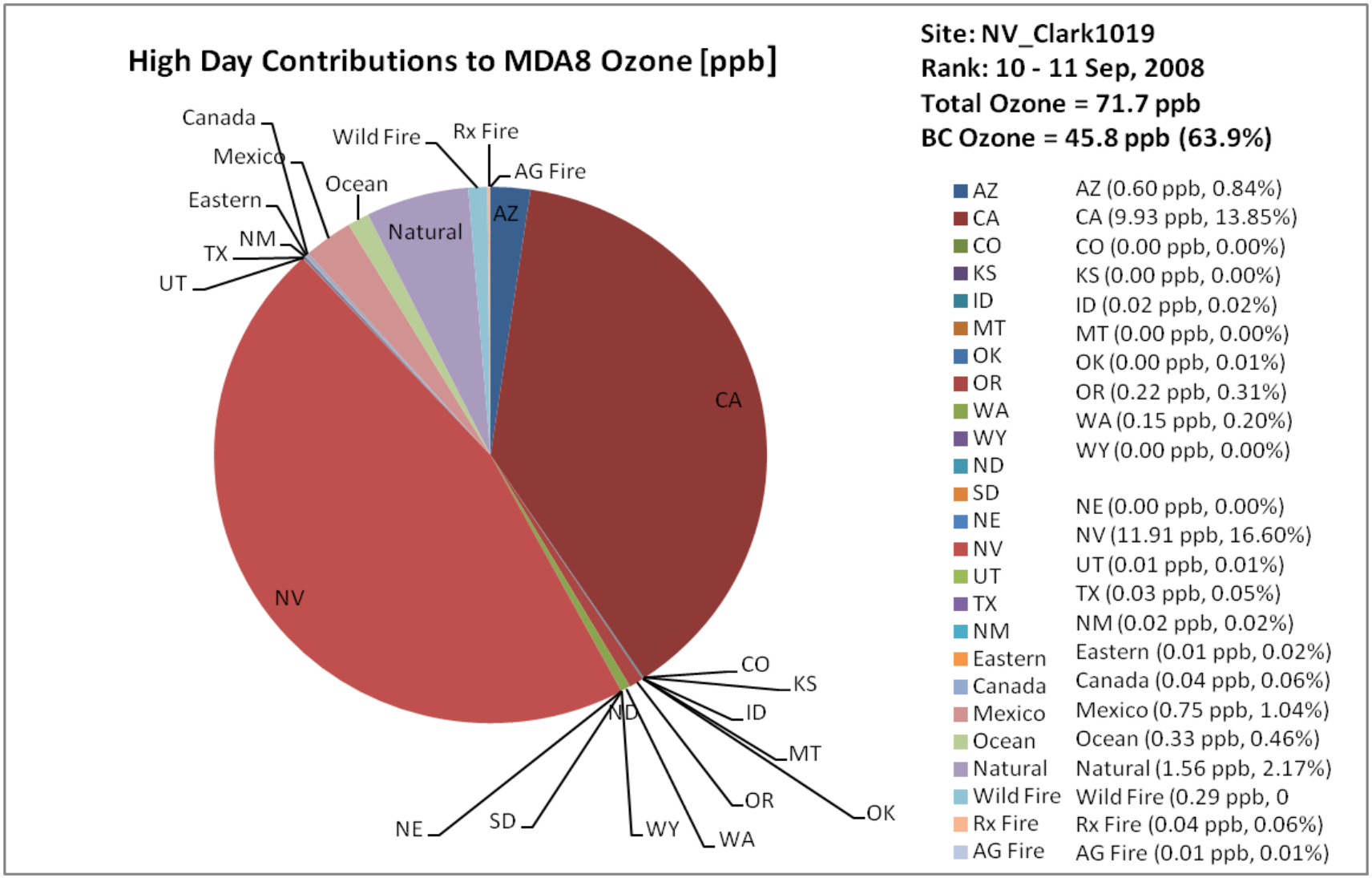
# State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

**4th Highest** Modeled DMAX8 Day at Jean background site on SR 161, southwest of Las Vegas



# State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

**10th Highest** Modeled DMAX8 Day at Jean background site on SR 161, southwest of Las Vegas



# Exceptional Events Support

Source: WRAP Fire Tools

The following case studies are related to the Exceptional Events Support analysis type. To begin click on one of the case studies to review it, or select **Start a New Analysis** to begin creating your own study.

The purpose of this analysis tool is to assist with understanding whether fire might have contributed to an ozone exceedance; and assist with knowing what kind of information might be helpful to a state for preparing an Exceptional Event demonstration package(s) for air quality excursions affected by fire and smoke. The effects of wildland fire on ozone are complex, and meeting the exceptional events requirement is difficult for most if not all fire occurrences. This is, in part, because wildland fires occur at the same time of high ozone caused by anthropogenic emissions. Thus, separating the contribution of wildland fire from anthropogenic emissions is challenging: the but-for test. Yet, EPA requires this for their concurrence. Using the combination of observed ozone and CMAX model output, this tool examines selected cases—planned, unplanned, and combinations of the two—fires contribution to ozone impacts.

## Exceptional Events Support Overview

A State Exceptional Event demonstration package must provide evidence that:

**A.** The event affects air quality, is not reasonably controllable or preventable, and is an event caused by human activity that is unlikely to recur at a particular location or a natural event;
**B.** There is a clear causal relationship between the measurement under consideration and the event that is claimed to have affected the air quality in the area;
**C.** The event is associated with a measured concentration in excess of normal historical fluctuations, including background; and
**D.** There would have been no exceedance or violation but for the event.

States are responsible for demonstrating to EPA that unplanned fires or certain planned fires were responsible for an exceedance of the ozone standard at a particular monitoring site or group of sites. In attempting to make this demonstration, a state may request certain information from land managers. This might include: the smoke emissions; particulate monitoring particular to the fire or photographs; the timing of the burn along with how it was distributed through the day in terms of combustion and smoldering; and to what extent

## Review a Related Analysis

| Title | Sections |
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| Biscuit Wildfire | 10 |
| Chatfield, CO July 2004-2007 | 16 |
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| Evans Road Wildfire (Pocosin NWR) / Peat burning | 12 |
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| Northern California Wildfires, 2008 | 17 |

edit list

These are the current analyses associated with Exceptional Events Support. To review an

Thanks –

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