Western Air Quality Studies, Western Air Quality Data Warehouse and WRAP Regional Technical Center

February 4, 2015

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WESTAR Council

Washington State Department of Ecology, Air Quality Program
Western Air Quality Workshop
Lacey, WA

Topics

- Morning - Overview of the WESTAR/WRAP organization
  - Key issues and areas of focus
  - Western Regional Studies and Projects
    - Planning Applications for Regional Analysis, Exceptional Events, et cetera
    - Building the WRAP Regional Technical Center
    - Fire Impacts and Analysis Tools – hands-on activity
- Afternoon - WestJumpAQMS regional modeling study results:
  - Ozone and PM source apportionment
  - Nitrogen deposition

Overview of WESTAR/WRAP

www.westar.org

www.wrapair2.org

Overview of WESTAR/WRAP (cont'd)

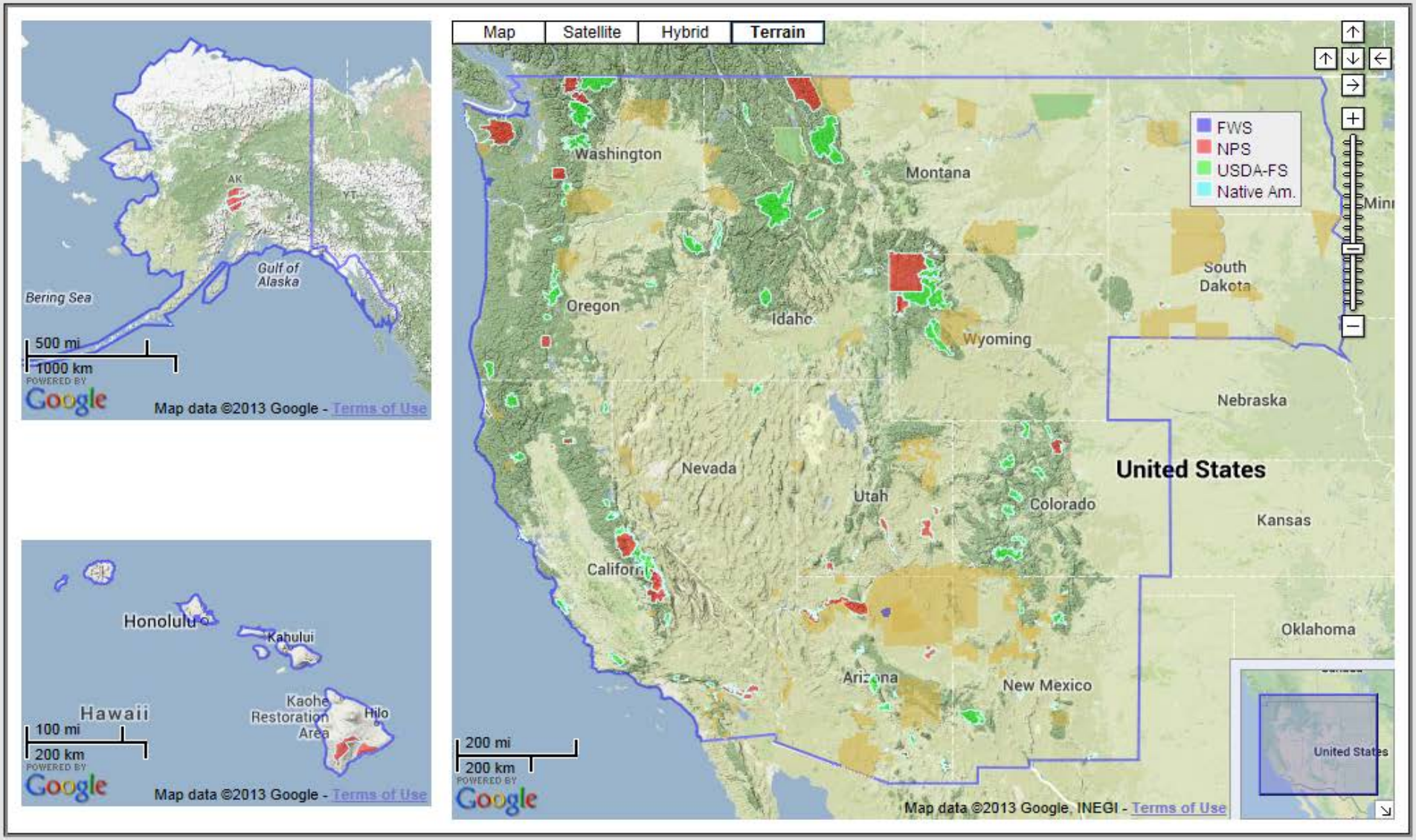
- Purpose
  - Service organization
  - Assist members in achieving their air quality management goals
- Approach
  - Training
  - Provide a forum for discussion
  - Inform policy-related discussions
  - (new) Provide technical support (esp. regional)

Overview of WESTAR/WRAP (cont'd)

WRAP = Western Regional Air Partnership

- www.wrapair2.org
- Same 15-state region as WESTAR
- Virtual organization, not incorporated
- 65 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 has State and Tribal co-chairs, with representatives across states, tribes, federal, and local agencies.
- Formed in 1997 to implement Grand Canyon Visibility Transport Commission recommendations
  - Led Regional Haze planning effort 1997-2009 for the West
  - 75 % of Class I areas in the WRAP region

About WESTAR/WRAP (cont'd)



- 15 states, federal land managers and EPA, tribes, and local air districts
- Regional analyses for Western sources and air quality impacts

Overview of WRAP

- Since 2010, WRAP working as regional technical center to support and coordinate Regional Analysis and Planning
- Develop and facilitate use of western air quality data:
  - Make improvements
  - Ensure consistency and comparability
  - Increase transparency and access
  - Track trends for better, reproducible analyses
  - Interconnected series of regional technical projects
  - Manage emissions and modeling studies

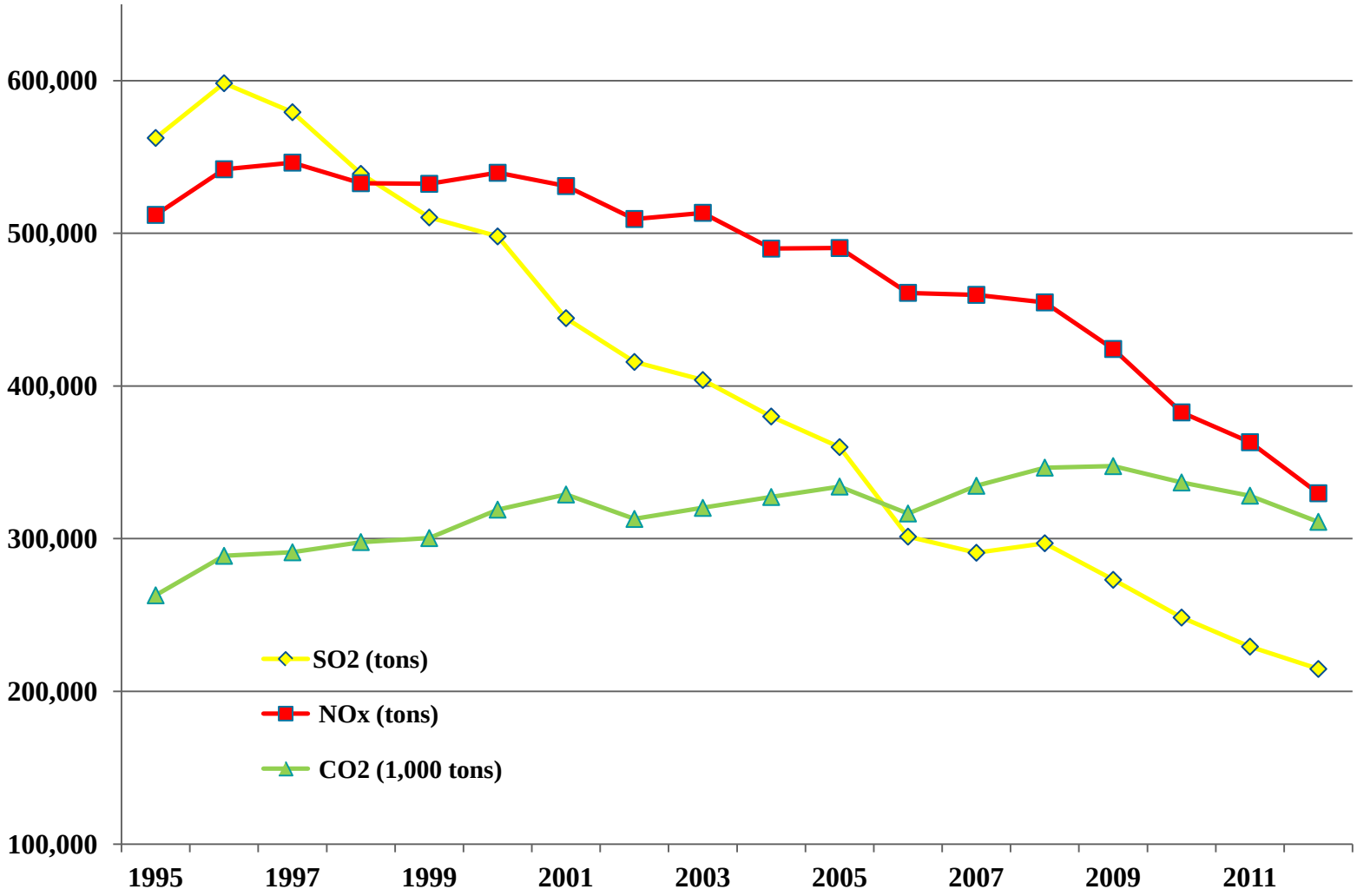
Key Issues and Areas of Focus

- NAAQS Implementation and Maintenance
  - Data for future infrastructure and transport SIPs
- Exceptional Events
  - Develop technical support data and analysis protocols
- Implementation of Regional Haze SIPs
  - Identify and execute technical work needed for 2018 plans
- Needs of sub-regional groups of states
  - Currently oil and gas, fire
  - Similar efforts in past – dust, BART, other topics

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

The Big Picture

Smoke/Fire & the Ozone and PM NAAQS, Regional Haze Rule

Fire

Technical Products for air quality planning & management as required by the Clean Air Act

Future emissions, efforts to avert emissions & health/visibility impacts, & adapt to a changing/varying climate

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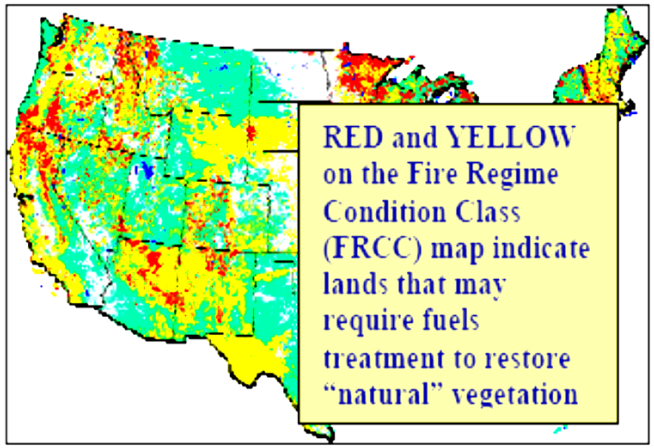
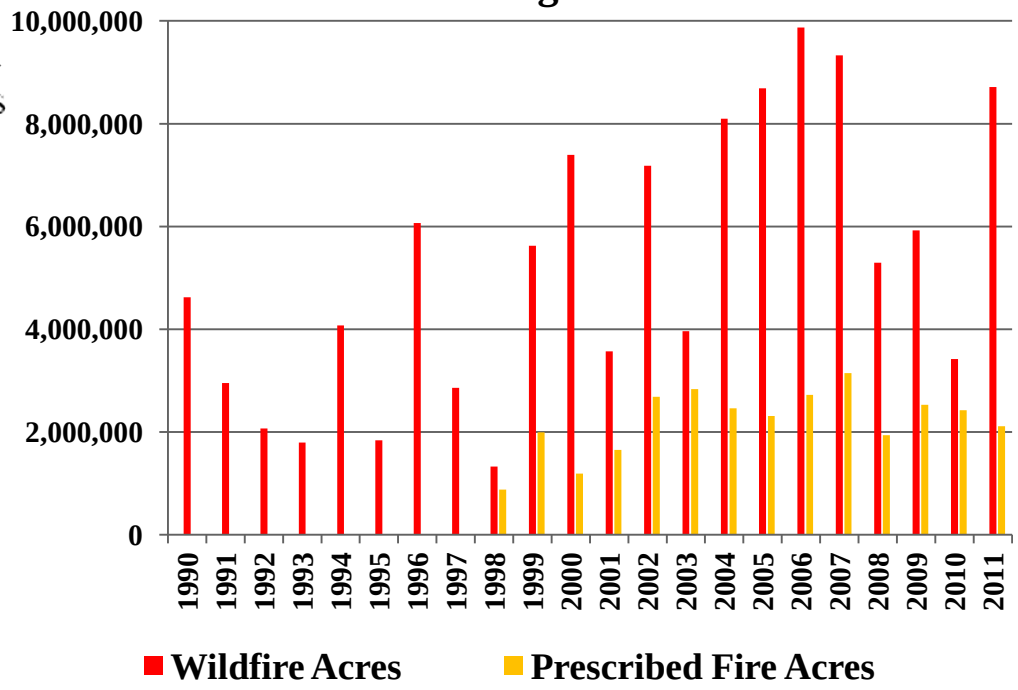
The quantity of forest fuels and composition of vegetation in the wildlands of the Western U. S. motivate the land managers to increase the application of prescribed fire to the landscape (from 650.000 acres in 2002 to a projection of up to 3.6 MM acres in 2018).



U.S. Wildfire and Prescribed Fires Acres Burned - 1990 through 2011



EPA national Ozone Standard

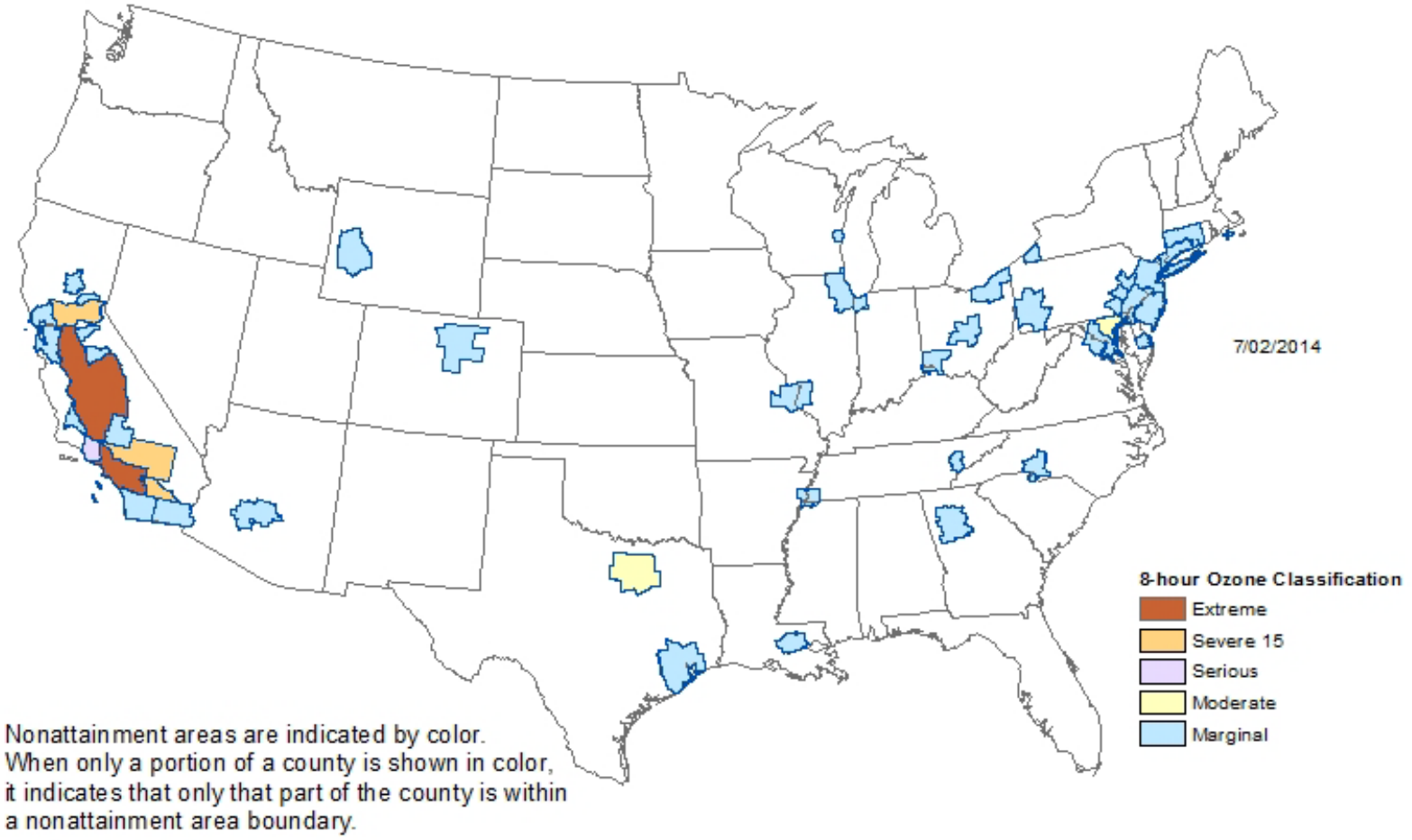
- Measured at ground station sites, highest 8-hour average each day
- 4th highest values each year are averaged over 3-year periods to determine compliance (e.g., 2007-09, 2008-10)
  - Statistic is called a “Design Value” for that site for that time period
- Current Ozone health standard level is 75 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

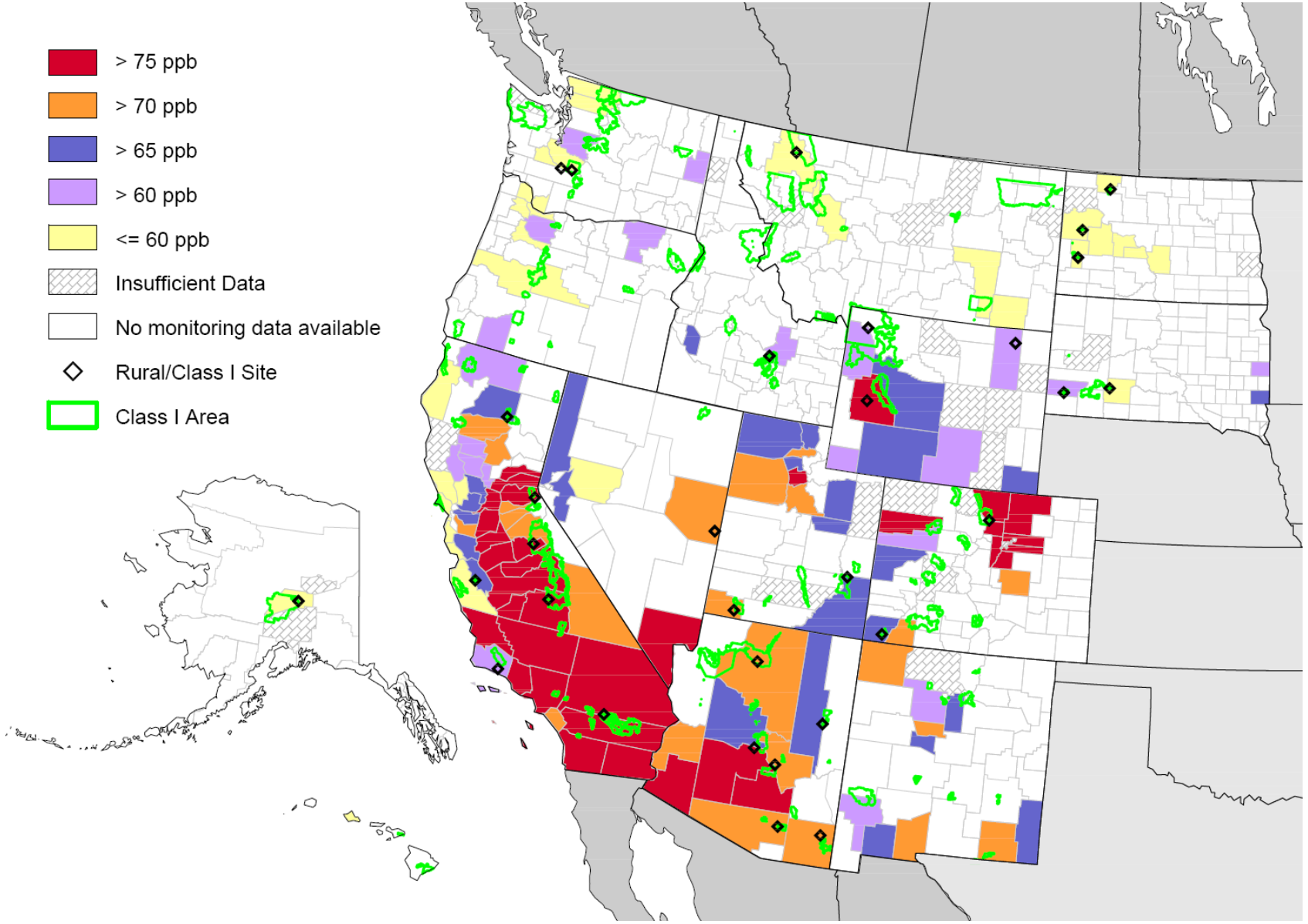
Counties with Monitors Violating Primary 8-Hour Ground-Level Ozone Standard (0.075 ppb)

(Based on 2011-2013 Air Quality Data)



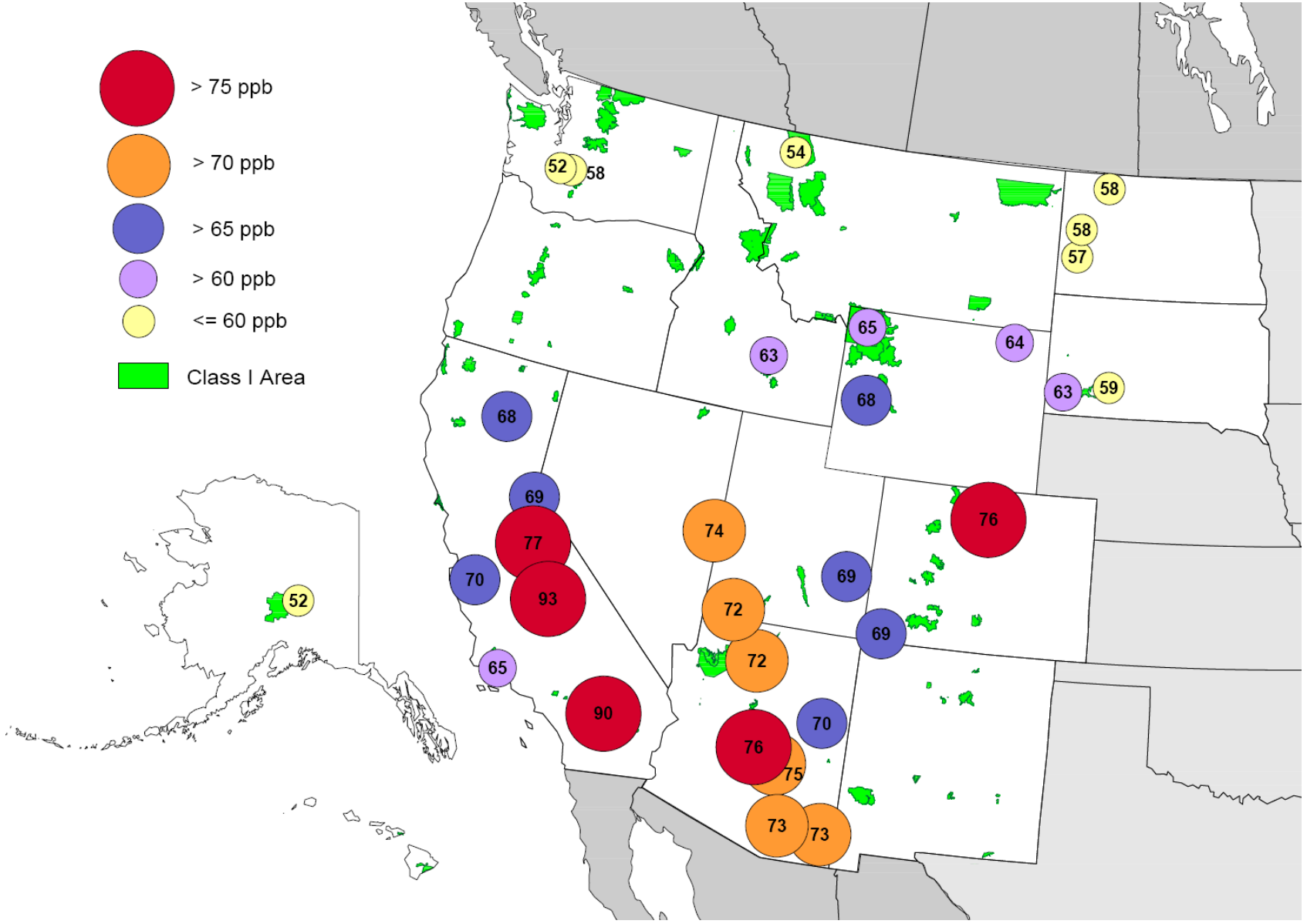
http://www.epa.gov/airquality/greenbook/map8hr_2008.html

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



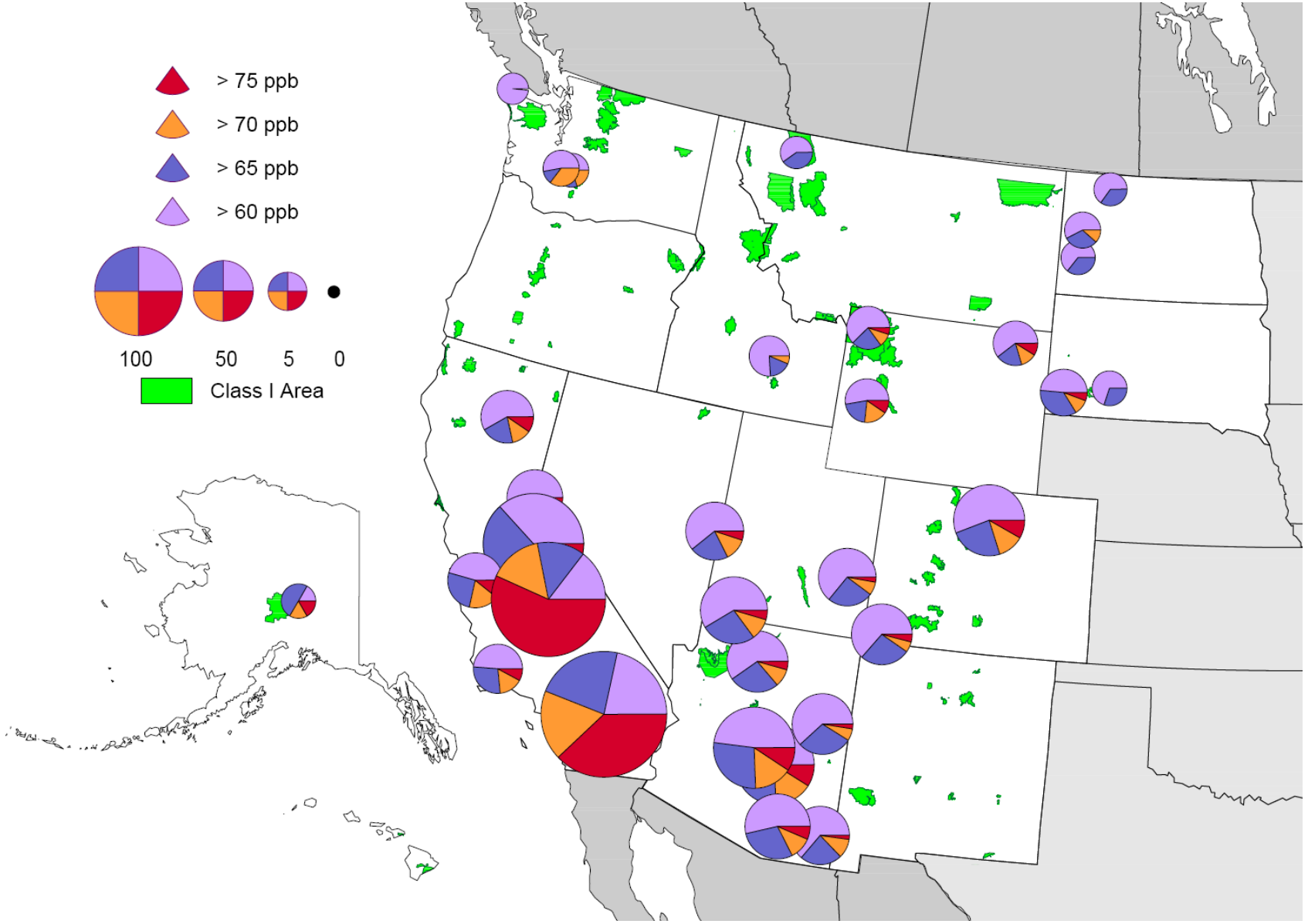
AQS Federal Reference Method data from the monitoring site in each County with the highest Ozone values

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



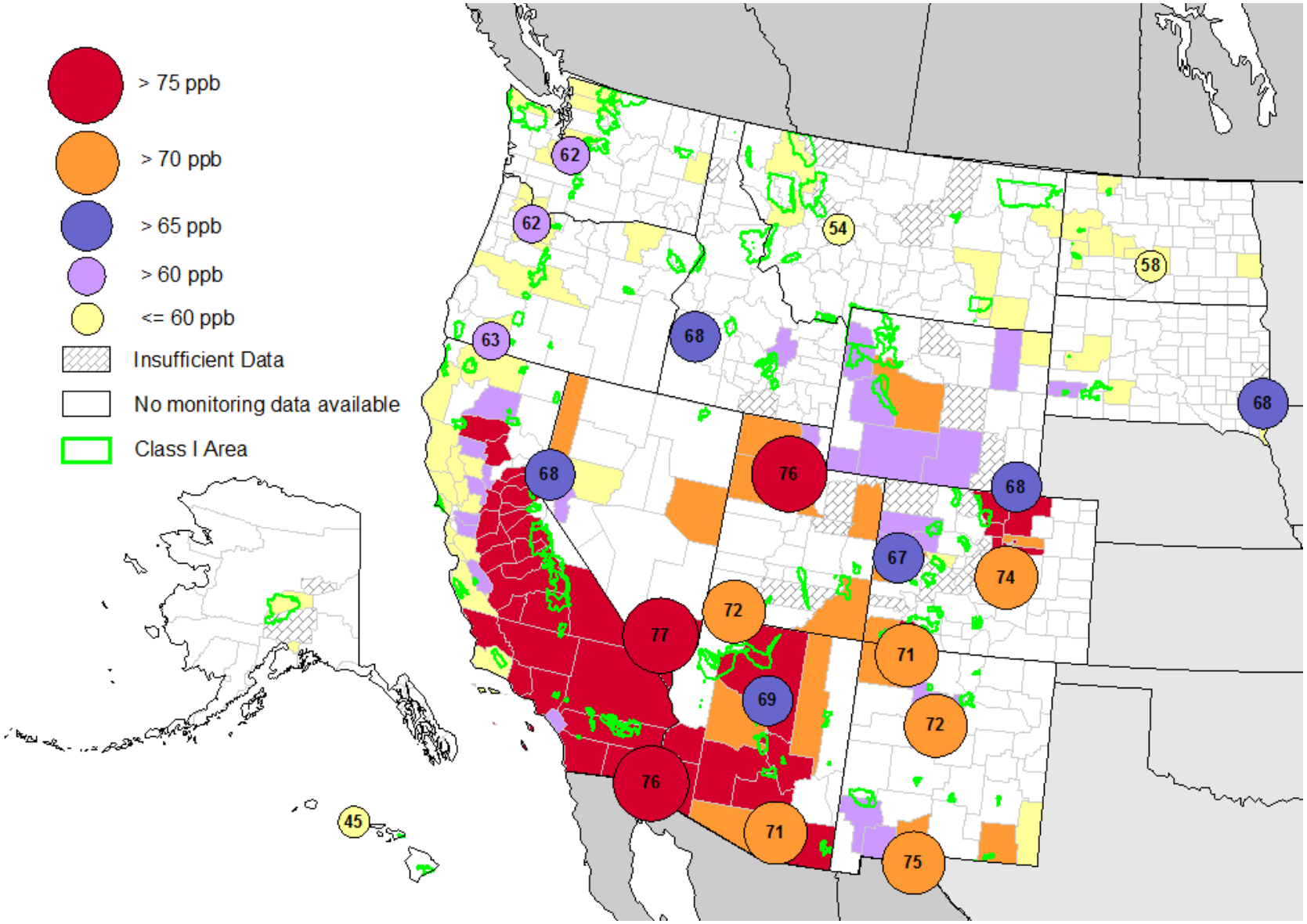
AQS Federal Reference Method data from rural or Class I area monitoring sites

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

Western Regional Studies and Projects

- Planning Applications for Regional Analysis, Exceptional Events, et cetera

Tracking and Managing Smoke

- Significant impacts to both local and regional air quality
  - Large summer wildfires
  - Prescribed and agricultural burns in spring and fall
- States, locals, and tribes manage both planned burns & wildfire impacts
  - FLM Joint Fire Science Program projects enable continuing operation of WRAP's Fire Emissions Tracking System (**http://www.wrapfets.org/**)
  - Used daily by western states, tribes, and federal agencies to track planned fire and manage smoke
  - FETS
    - Used by states and OAQPS to evaluate 2008 NEI
    - Fire activity and emissions data used by EPA contractor for 2011 NEI
    - Will be applied in 2014 NEI

Fire's Effects on Elevated Regional Ozone & PM

Deterministic & Empirical Assessment of Smoke's Contribution to Ozone (DEASCO$_3$) – completed Summer 2013

and leveraged companion study underway:

Prescribed and Other Fire Emissions: Particulate Matter Deterministic & Empirical Tagging & Assessment of Impacts on Levels (PMDETAIL)

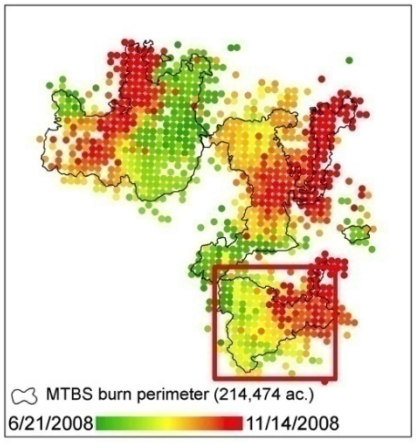
Funding for both from FLM Joint Fire Sciences Program

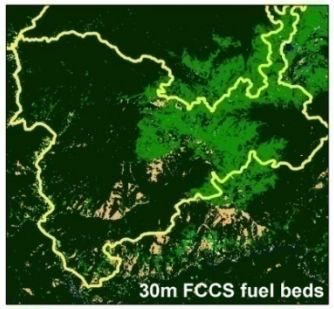
Both projects, analysis toolbox / data, and FETS access at: http://wraptools.org/

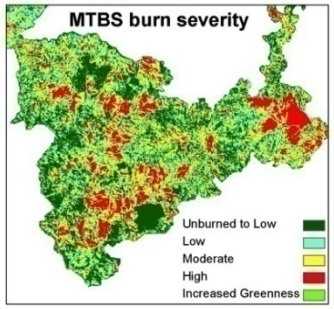
New proposal to be funded early 2015 by JFSP :
Contribution of Smoke Emissions to Secondary Organic Aerosols (SOA): Real-World Evaluation of Fire SOA Emissions Factors from Fires in a Data Management System (REFERS-DMS)

Smoke and Emissions Inventory Research

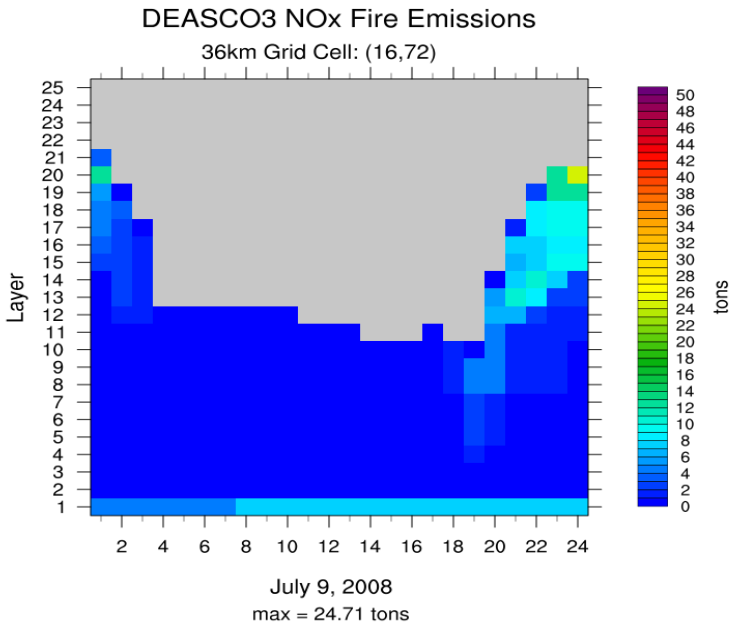
Source: [WRAP Fire Tools]



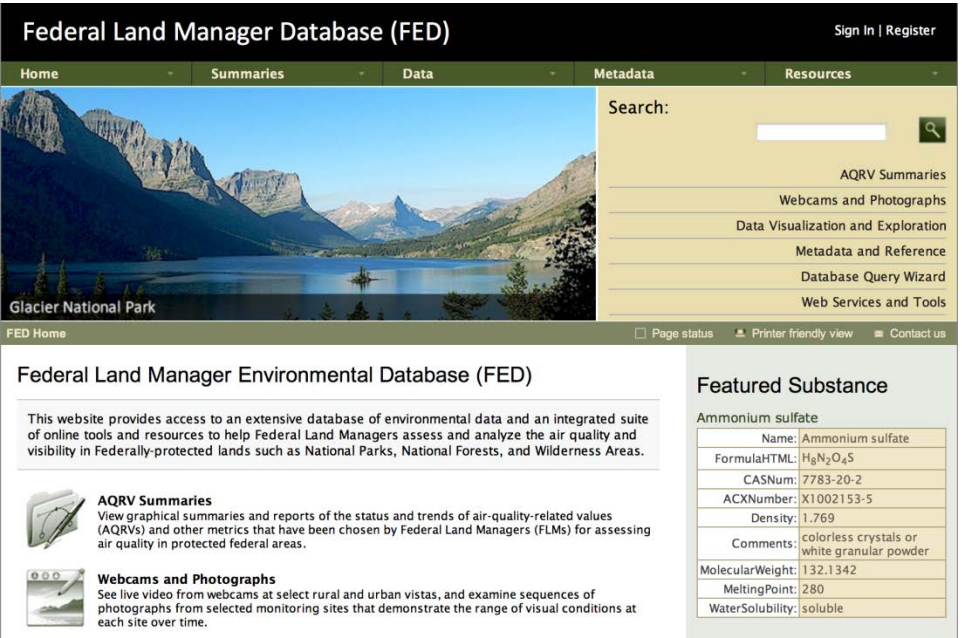




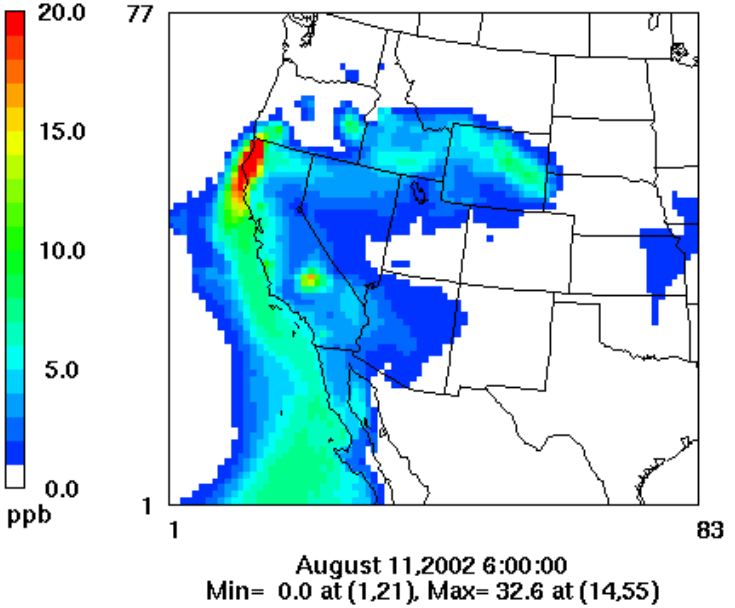
- Acres constrained by perimeter
- Daily growth & composite fuel loading
- Consumption scaled by severity



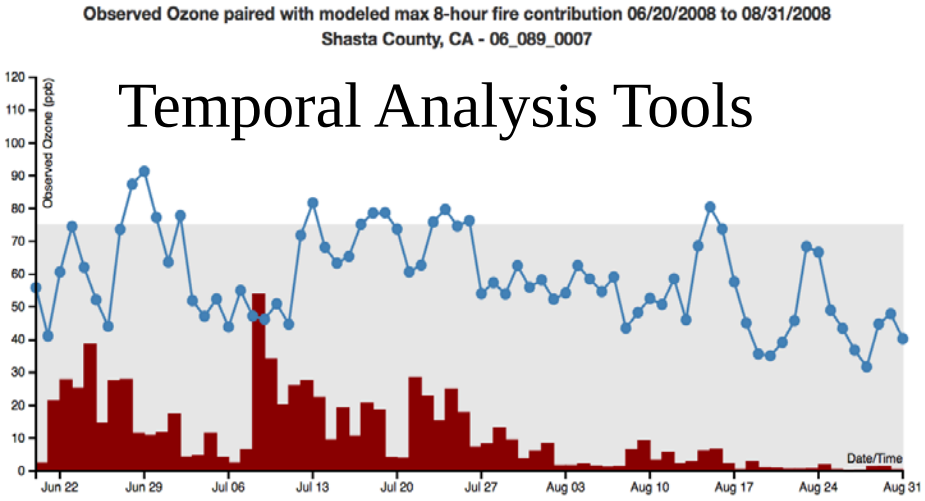
Smoke and Populations



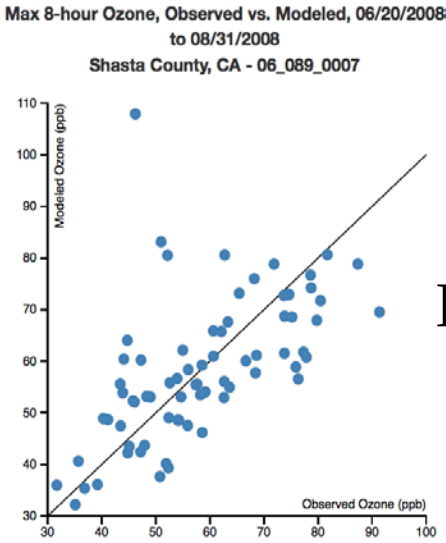
Fire and Smoke Model Evaluation



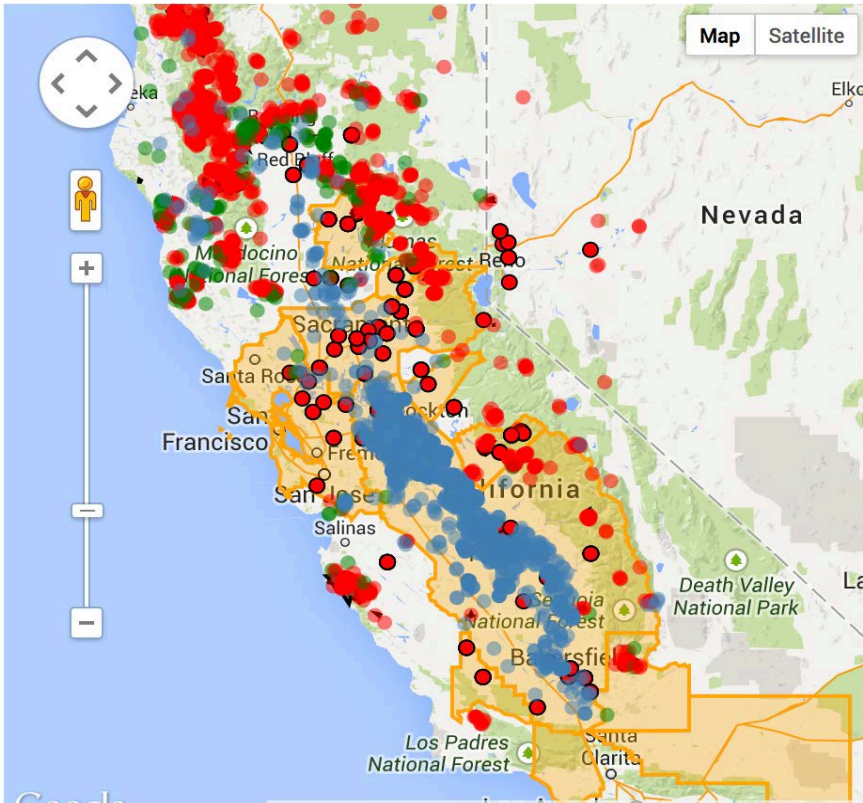
Temporal Analysis Tools

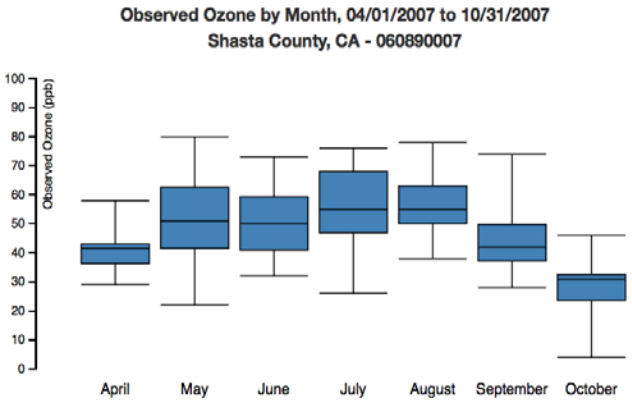


Model Evaluation



Fire Contributions to AQ Impacts





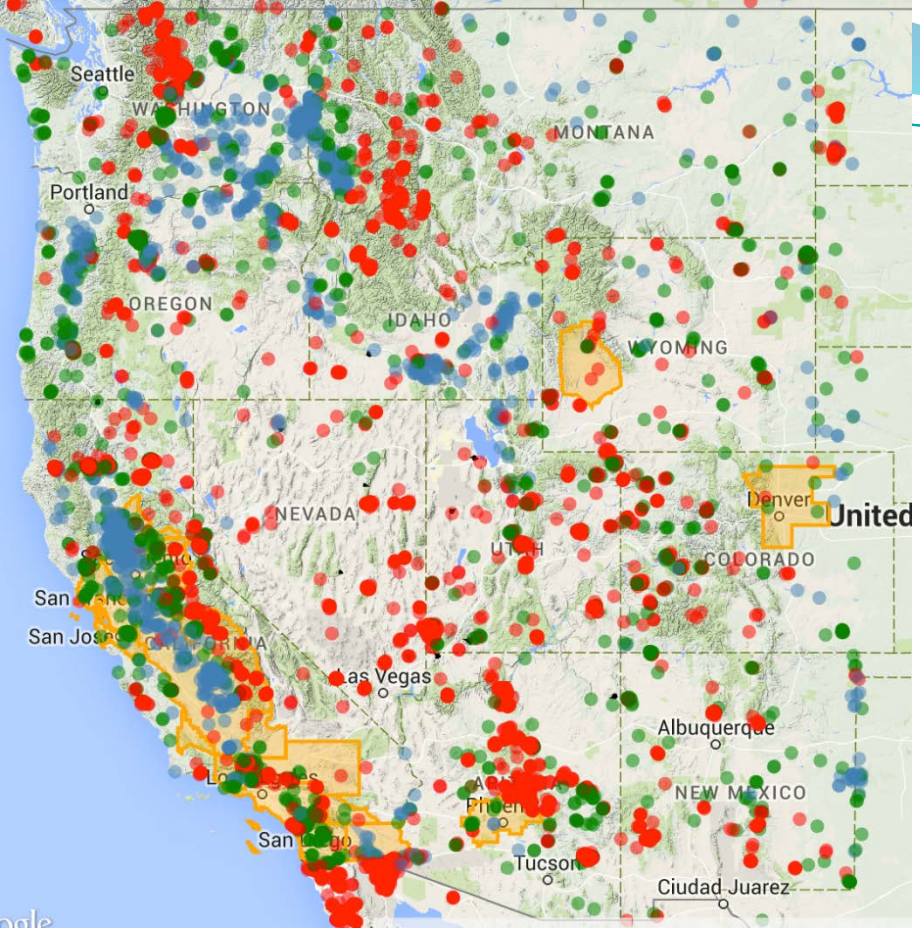
Inter-annual Observational Analysis

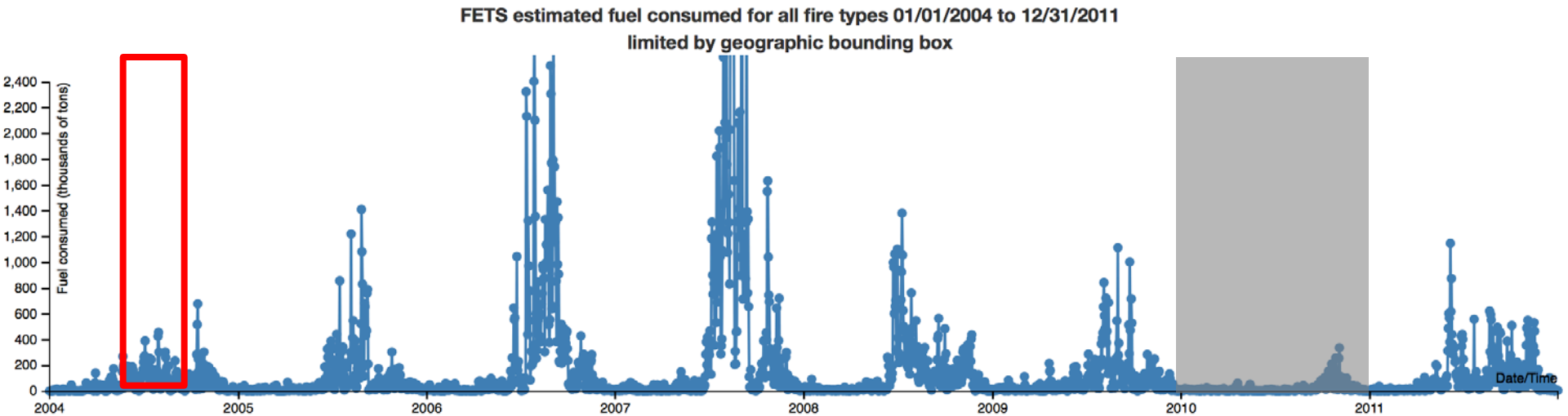
Source: [WRAP Fire Tools]

2004

6/21 – 9/21
Limited by bounding box

Source: WRAP Fire Tools

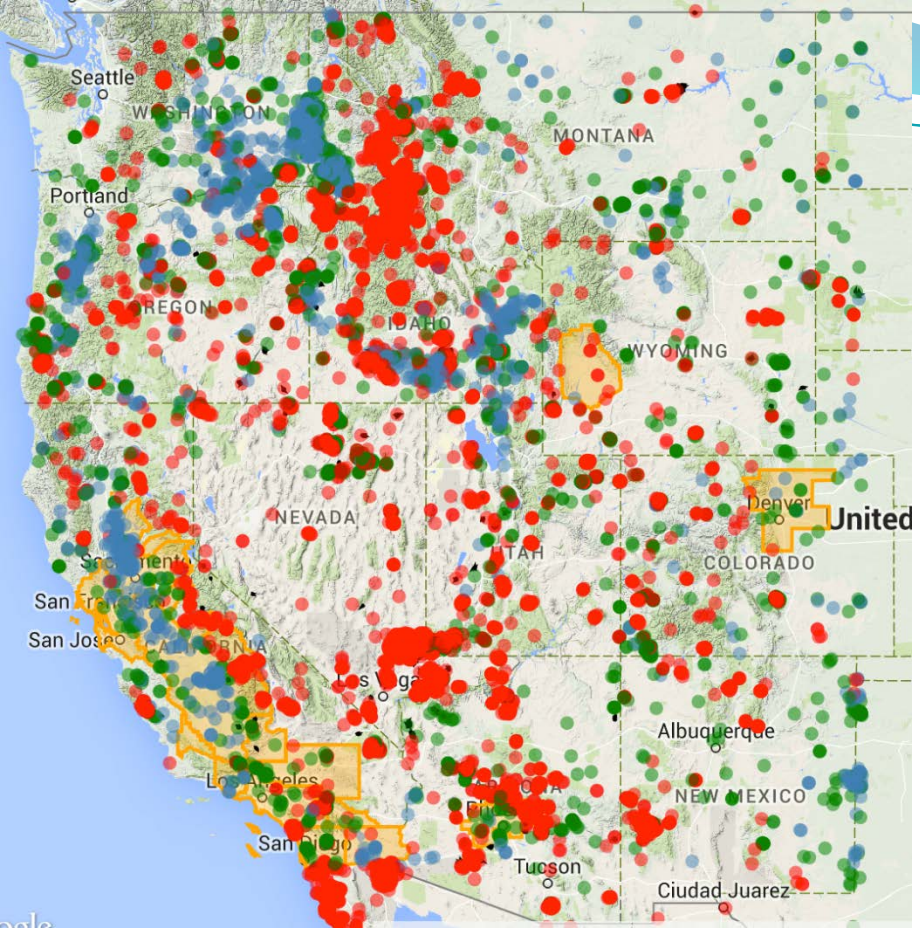




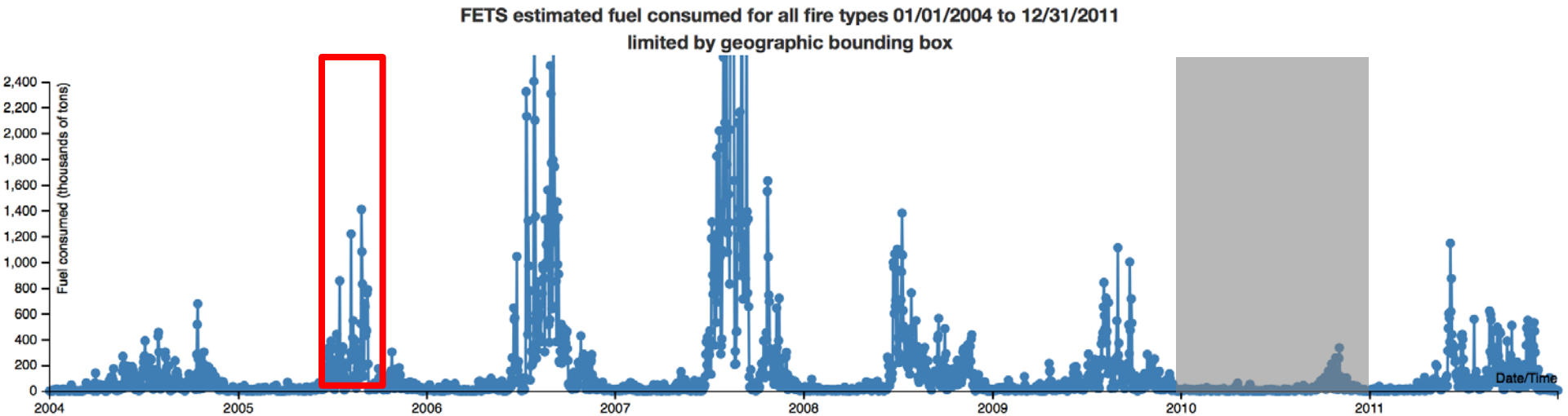
2005

6/21 – 9/21
Limited by bounding box

Source: WRAP Fire Tools



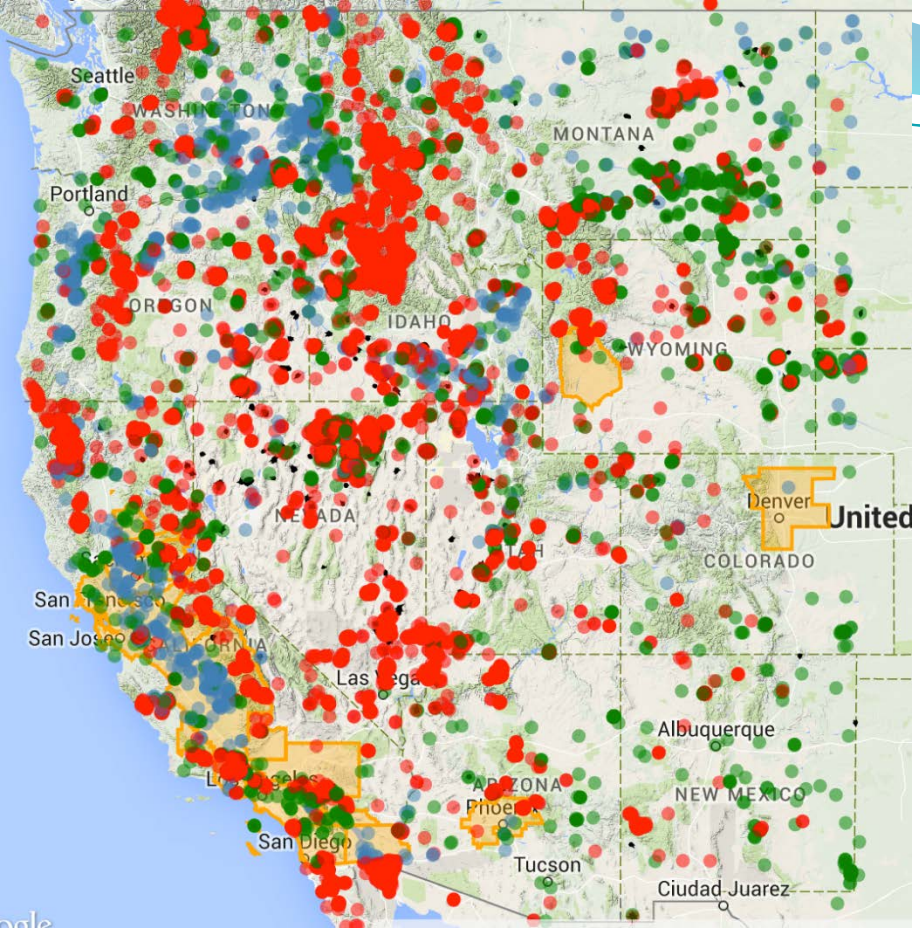
Agriculture
Prescribed
Wildfires



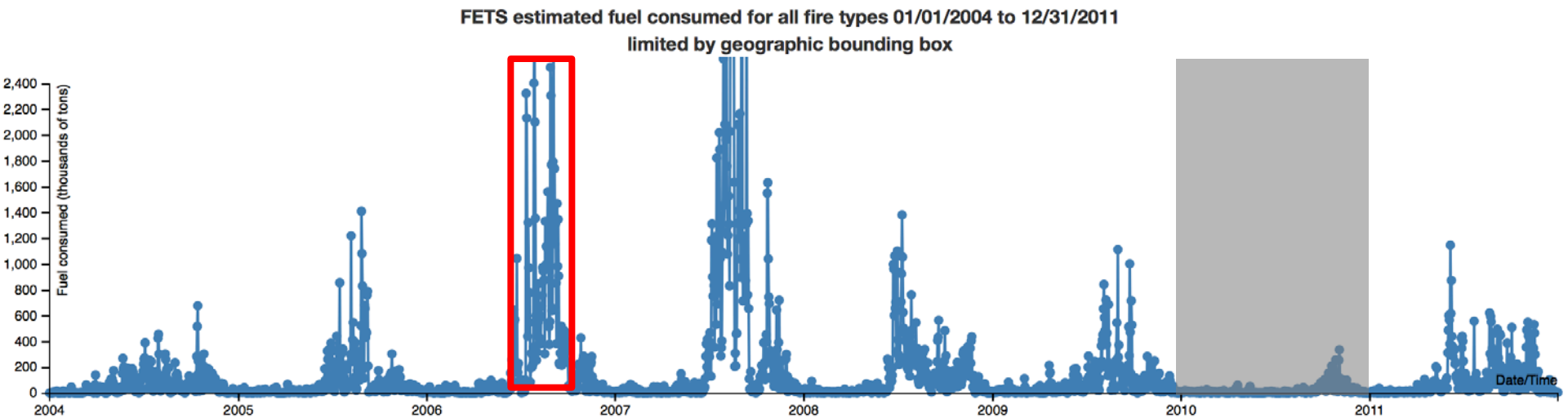
2006

6/21 – 9/21
Limited by bounding box

Source: WRAP Fire Tools



Agriculture
Prescribed
Wildfires



2007

6/21 – 9/21
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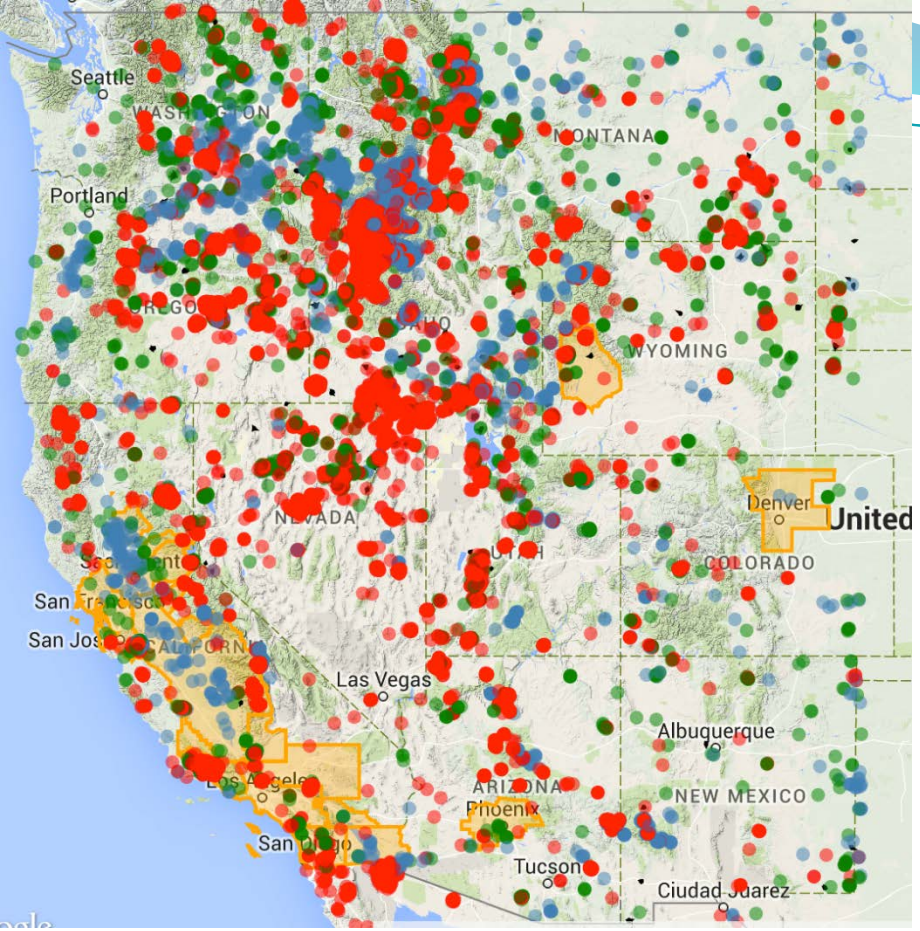
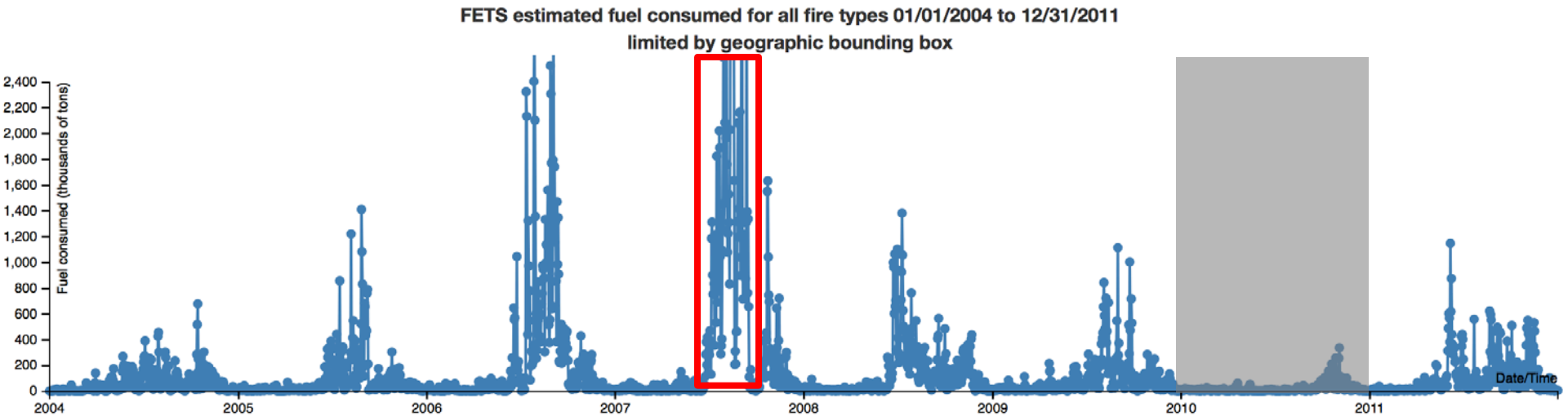
Source: WRAP Fire Tools



Agriculture
Prescribed
Wildfires



2008

6/21 – 9/21
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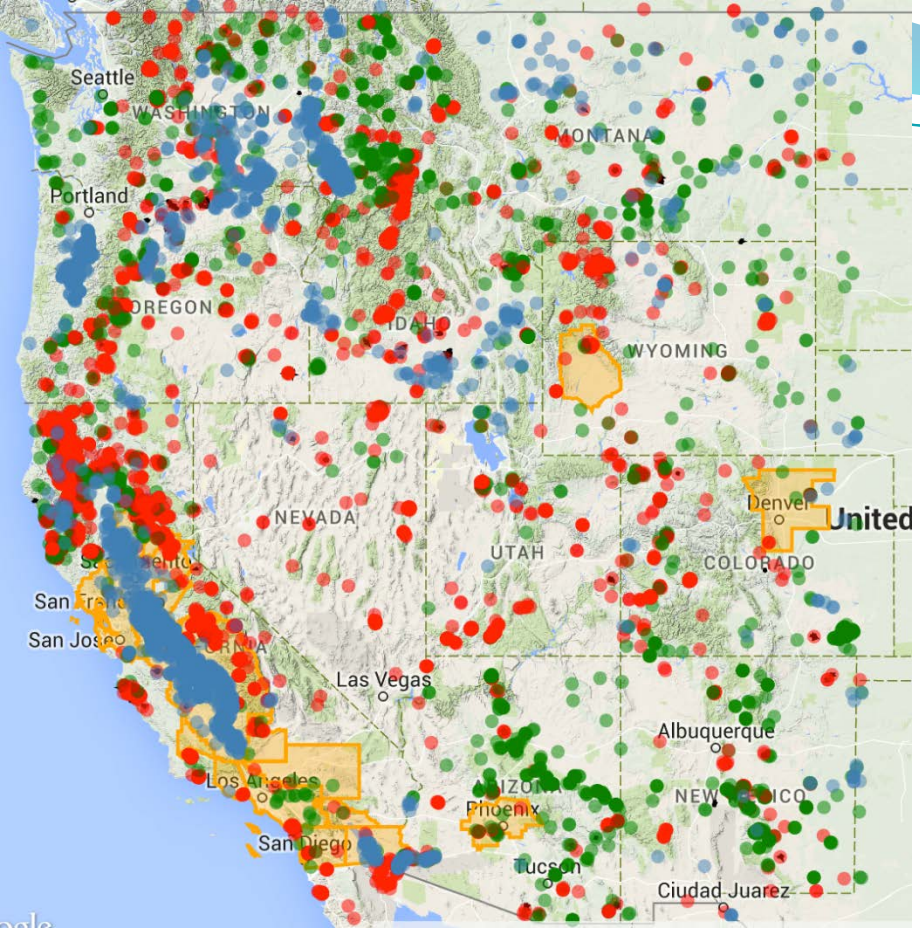
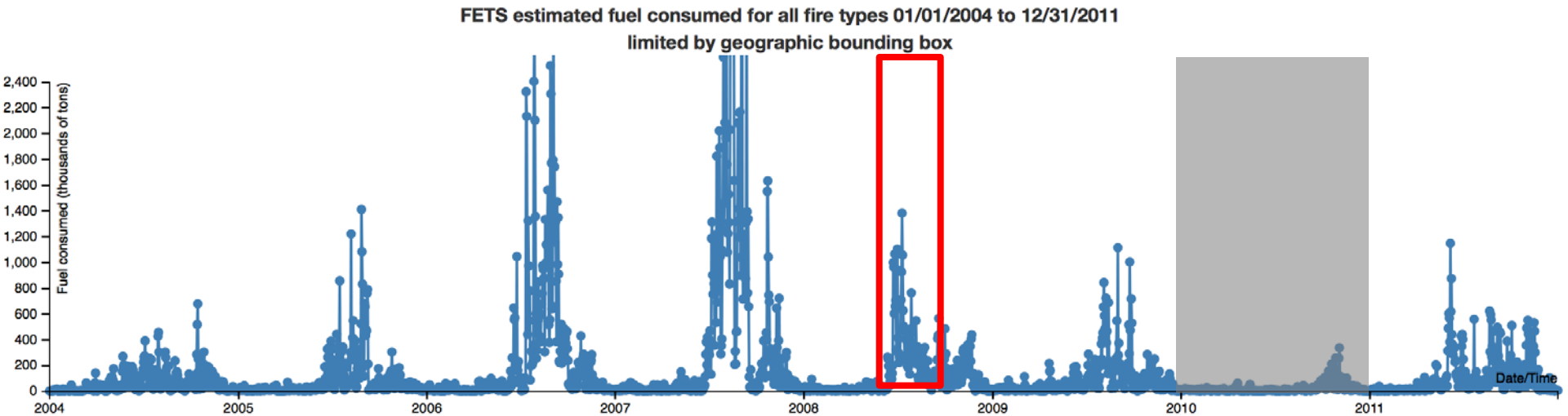
Source: WRAP Fire Tools



Agriculture
Prescribed
Wildfires



2009

6/21 – 9/21
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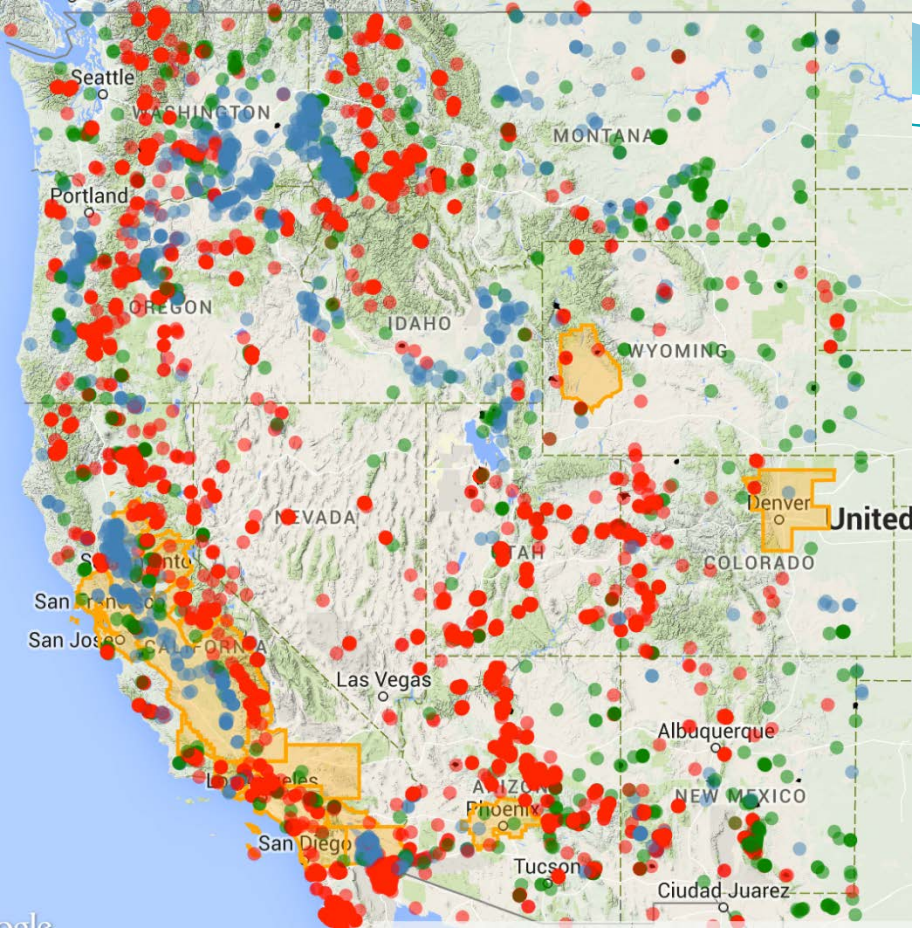
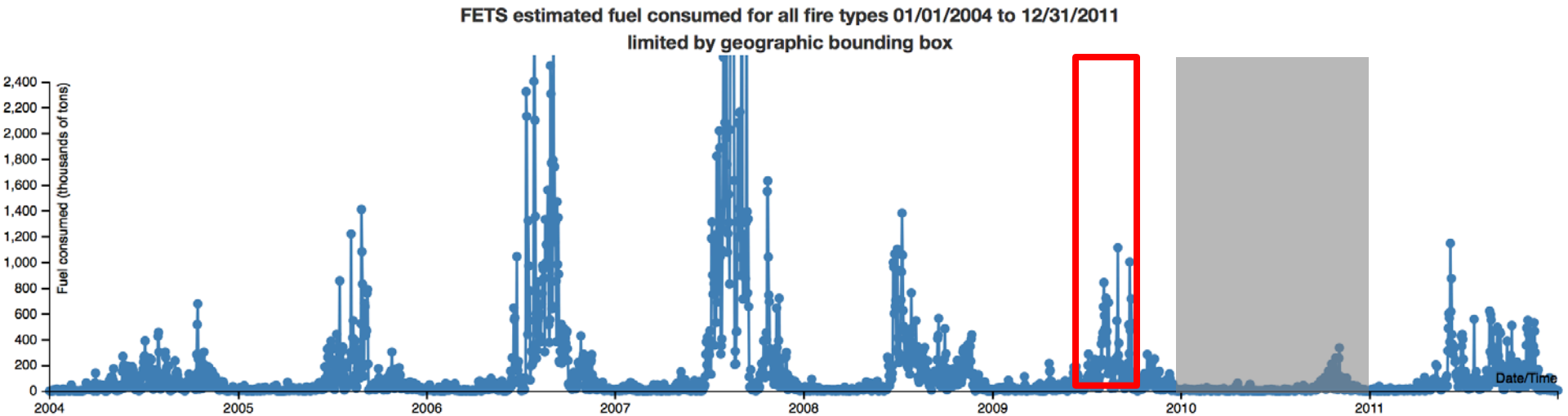
Source: WRAP Fire Tools



Agriculture
Prescribed
Wildfires



2011

6/21 – 9/21
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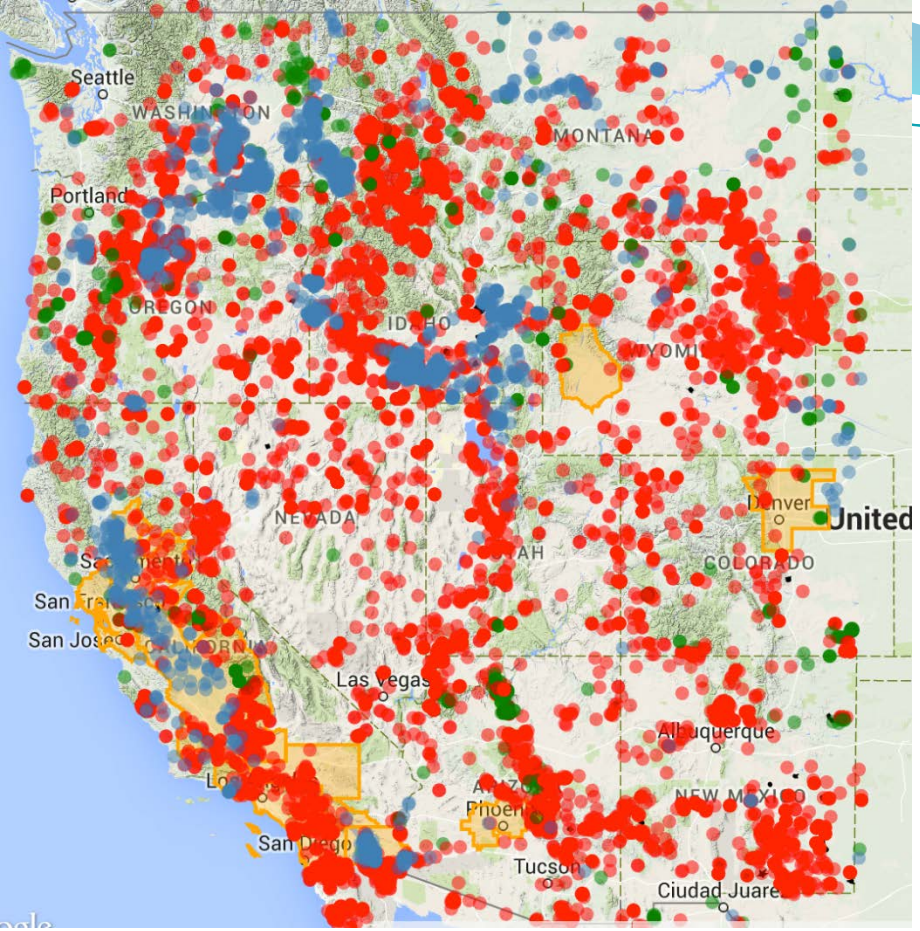
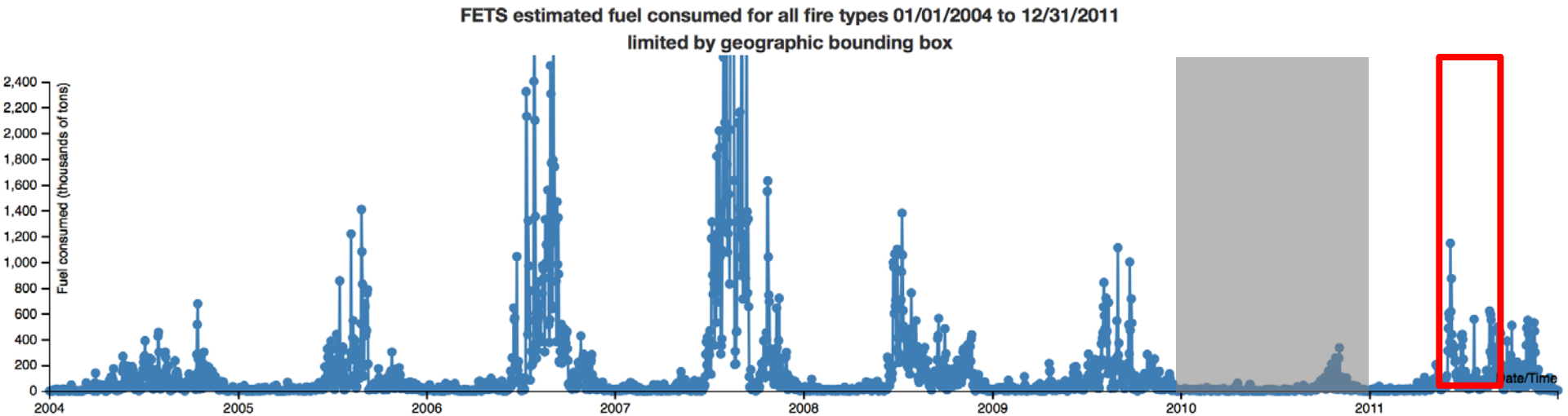
*Obtained additional small wildfire data for this inventory

Source: WRAP Fire Tools



Agriculture
Prescribed
Wildfires



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 smoke management regulations were complied with.

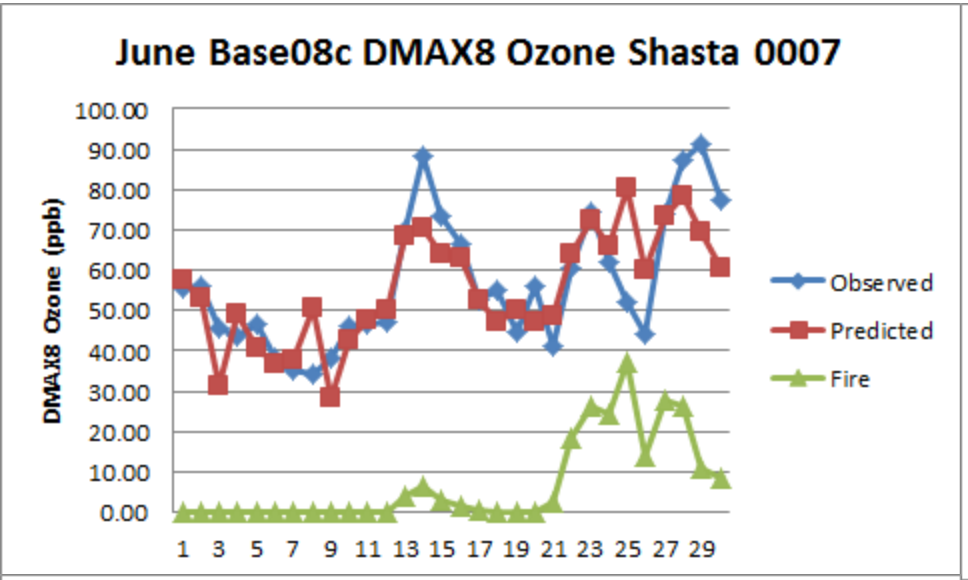
Review a Related Analysis

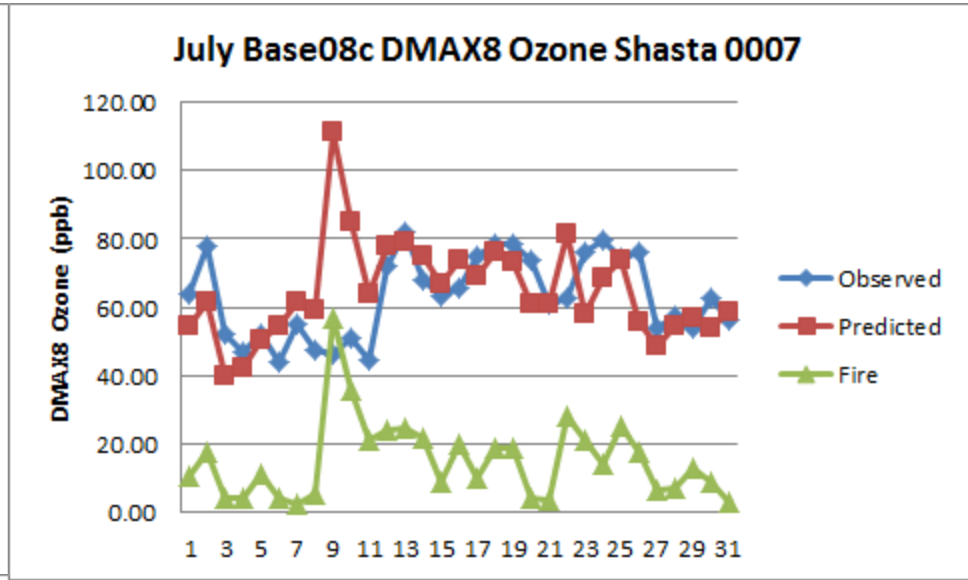
Title	Sections
Biscuit Wildfire	10
Chatfield, CO July 2004-2007	16
Chatfield, CO July 2008	12
Evans Road Wildfire (Pocosin NWR) / Peat burning	12
Fall burning in southern Louisiana, 2008	9
Flint Hills	8
McNally Wildfire	6
Missionary Ridge & Hayman Wildfires	7
Northern California Wildfires, 2008	17

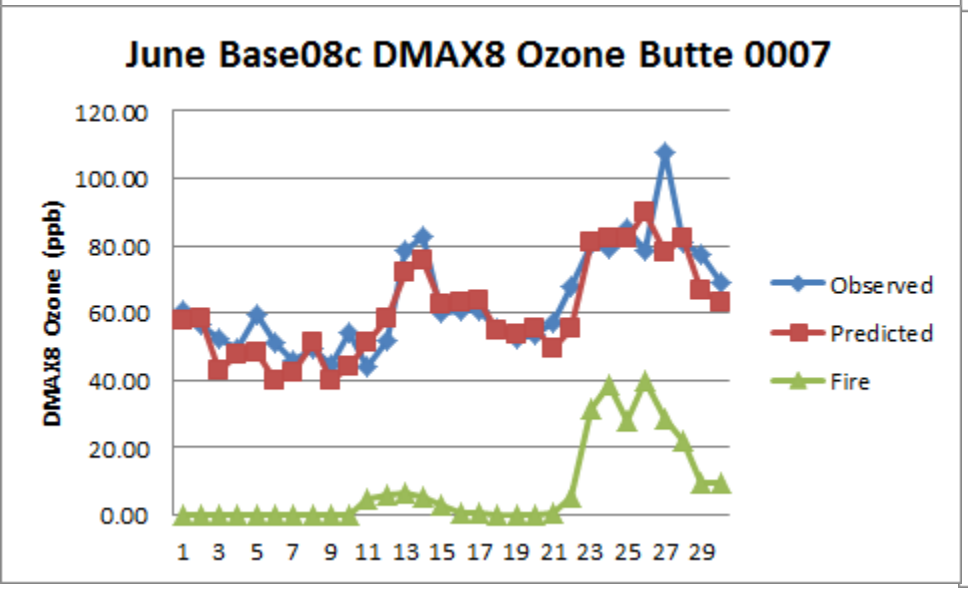
edit list

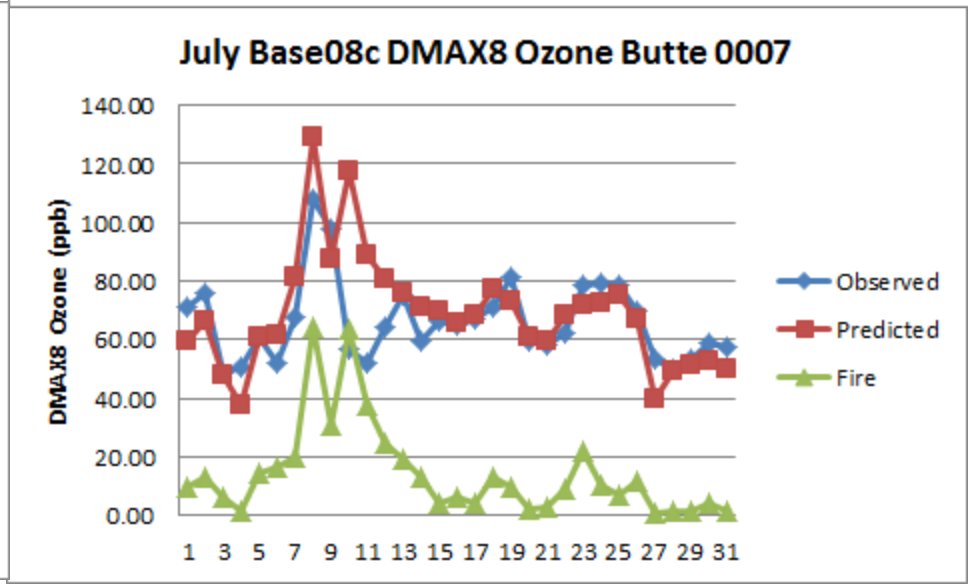
These are the current analyses associated with Exceptional Events Support. To review an

Northern California Wildfires June-July 2008

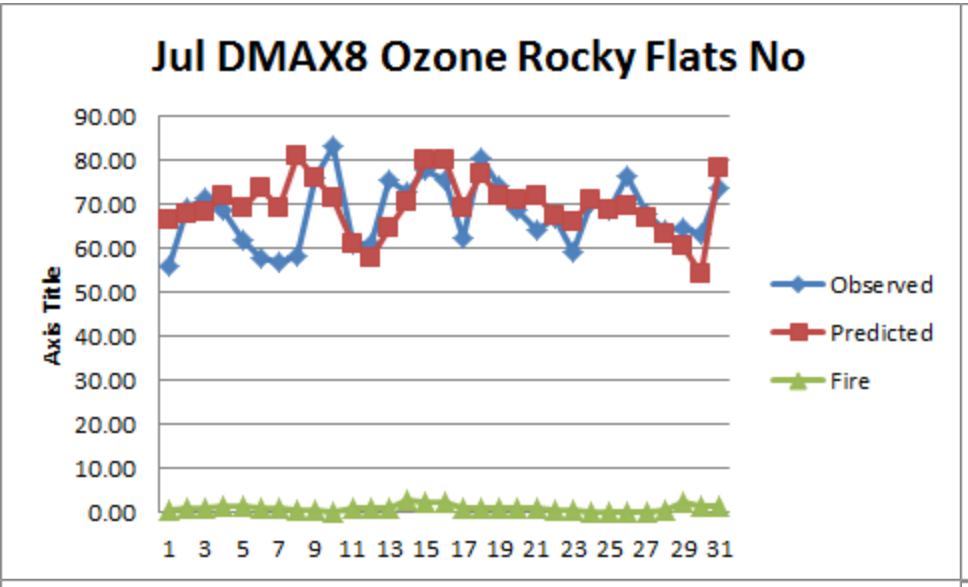


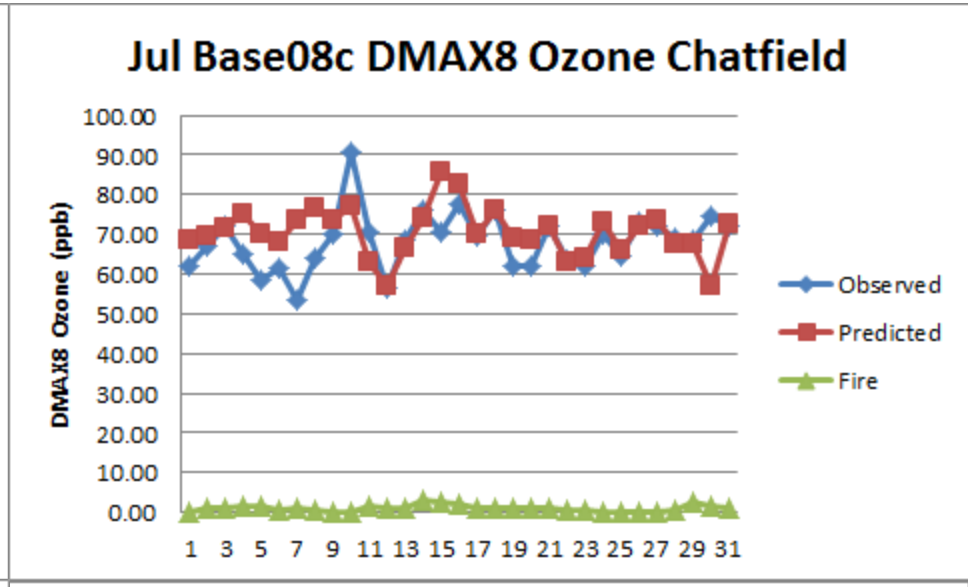


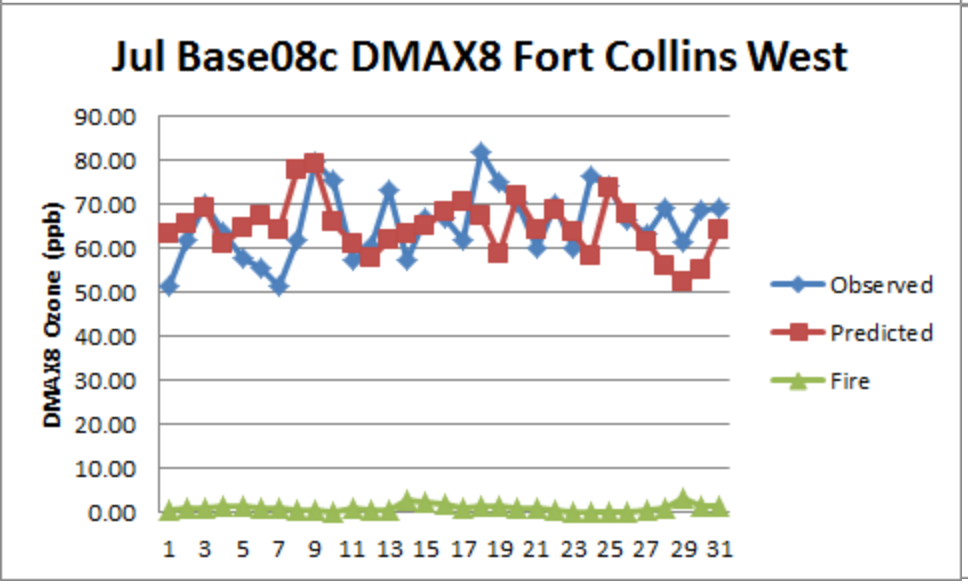


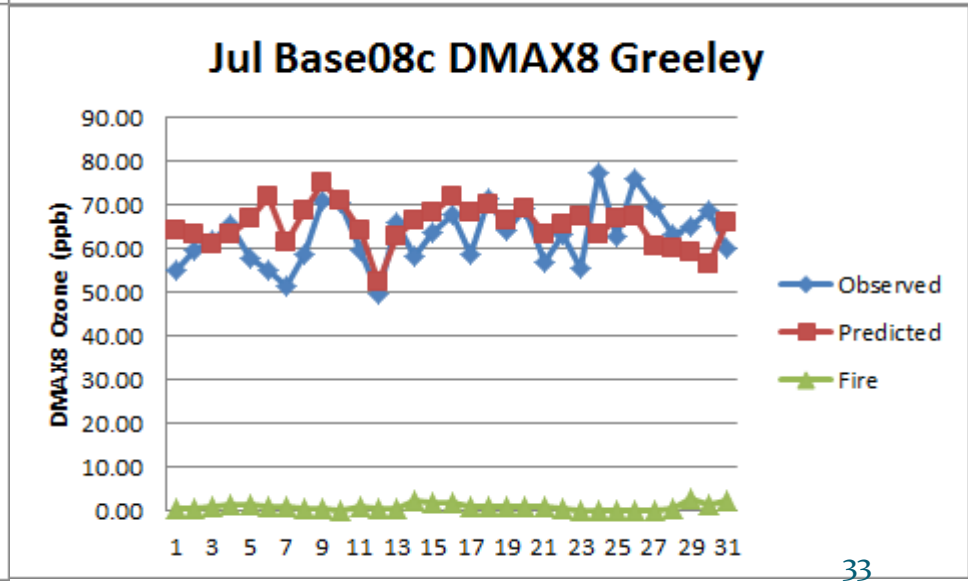


Denver Ozone Monitors July 2008









Regional Haze: Reasonable Progress Reports + July 2018 SIP

- WRAP produced a comprehensive, regionally-consistent technical report – completed Summer 2013
  - Regional, state, and Class I area reports http://www.wrapair2.org/reghaze.aspx
  - Monitoring and emissions data analyses as required by Regional Haze Rule
  - Western states will use as a common basis in preparing individual SIP revisions – adding status of state actions to implement controls
  - Progress report SIP revisions are due in the 2013-16 timeframe

- Regional Haze Planning
  - WRAP providing western 2008, 2011, and associated projections (as well as eventually 2014) emissions data
  - Modeling platform leveraged from WestJumpAQMS
  - States will use to evaluate changes in monitored visibility

- Regional technical support for July 2018 SIPs in WRAP Work Plan

3-State Air Quality Study - Objectives

- Combined effort of States of CO, WY, UT, and NPS, BLM, EPA, and USFS
- Facilitate more complete and consistent AQ Analysis for NEPA and other AQ decisions such as SIP planning
- Improve timeliness and collaboration
- Reduce duplication of AQ analysis resulting in lower costs
- Improvements include:
  - Six new monitoring sites
  - More region-specific modeled emissions
  - More current base case and better future case air quality modeling
  - A data warehouse to contain all this improved information and future data for access by agencies and those they approve to use it

Western Air Quality Data Warehouse

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The Western Air Quality Data Warehouse provides air quality data and analysis tools to support regulatory, research, and academic applications. Available datasets include emissions inventories, meteorological data, monitoring data, and air quality modeling platforms. Available modeling platforms support consistent photochemical grid modeling for National Environmental Policy Act projects and other modeling studies.

GET DATA

Access a wide variety of monitored, modeled, emissions, and met data.

USER FORUMS

DOCUMENT NEEDS REVIEW !

3SAQS WRF 2011 Meteorological Model Performance Evaluation

DOCUMENT NEEDS REVIEW !

CAMx Photochemical Grid Model Draft Model Performance Evaluation

DRAFT DOCUMENT AVAILABLE

3SAQS WRF

DATA & METADATA

- Data
- Studies
- Documents
- Literature

PROJECTS & PLANNING

- Projects
- Meetings
- News

TOOLS & RESOURCES

- Image Browser

Building the WRAP Regional Technical Center

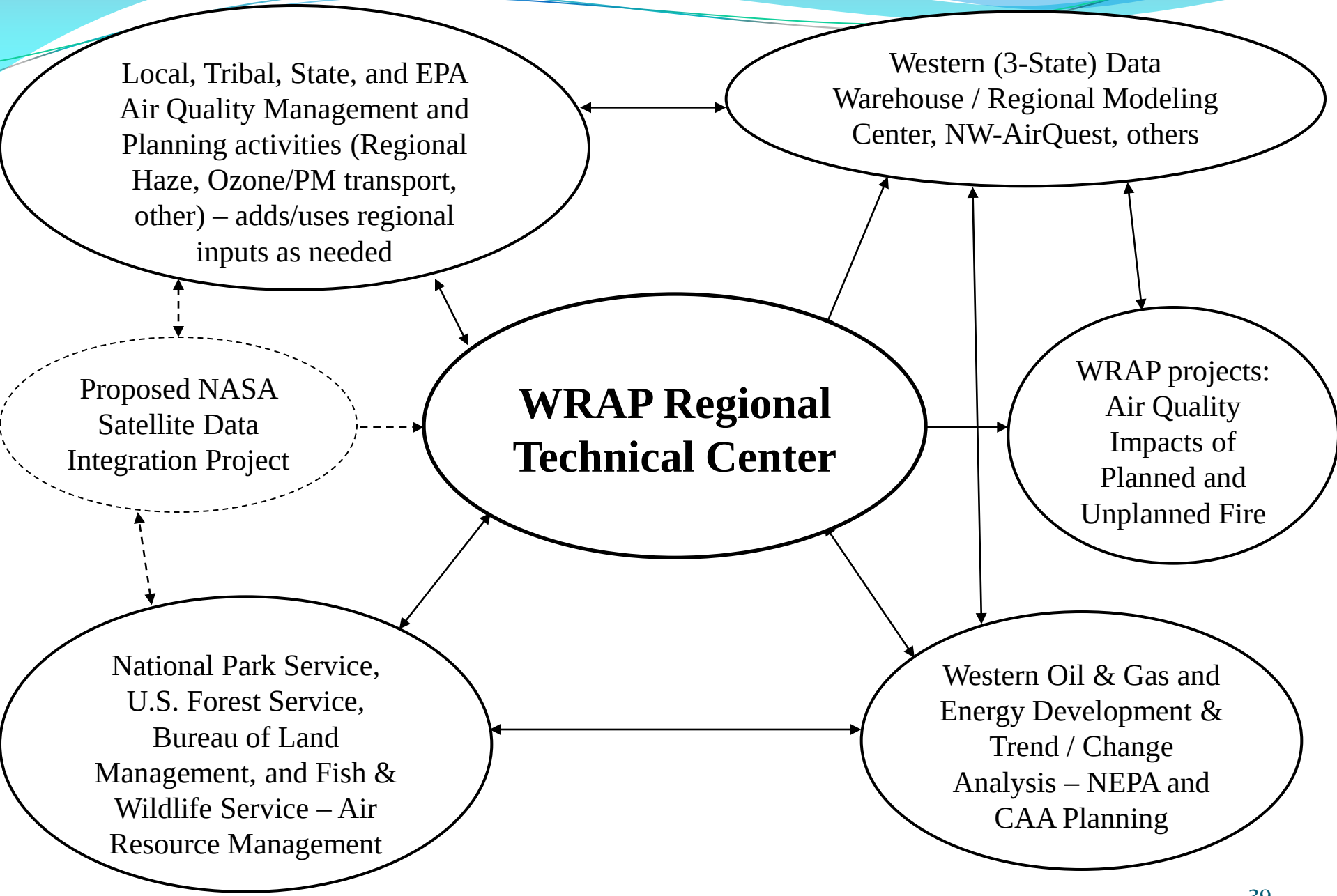
Attributes of the WRAP Regional Technical Center

Desirable Capabilities
Remote sensing/Satellite data,
Improved technical resolution for international transport,
Efficient regional data and decision support systems, et cetera

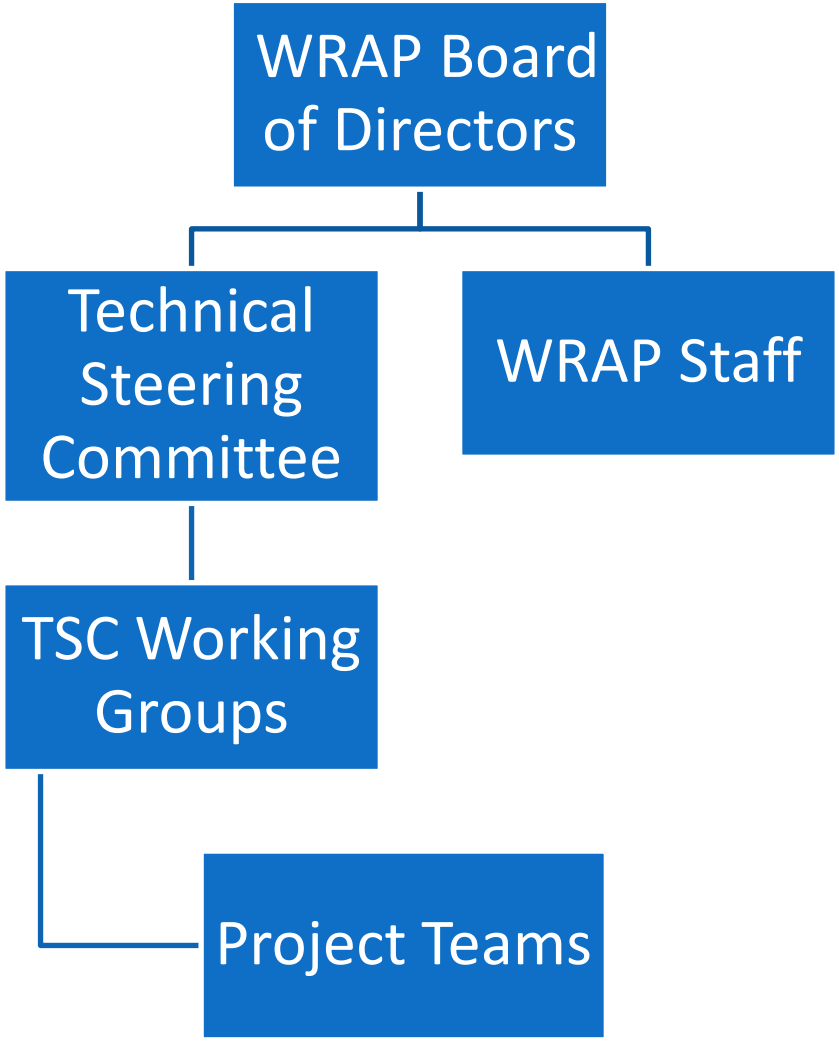
Necessary Regional Activities
Regional Haze Planning Support,
Tracking and Analysis of Controls, et cetera

Required Foundational Activities
(WRAP Regional Technical Center,
Tracking and Projection of Regional Emissions,
Preparation/delivery of ready-to-use Datasets, e.g., Monitoring, Meteorology, et cetera

WRAP members and relationship to regional technical activities



WRAP Work Plan - organizational structure



Opportunities for Western Data Warehouse and Applying Regional Modeling Results from Western Regional Technical Studies

- Leveraged studies address both regulatory planning needs and fill gaps where data are needed
  - Working for the users of the data
- Tracking key western source categories / source areas
  - Regionally consistent, comparable, transparent, and reproducible
- Modeling analyses of Ozone and PM background and transport on a routine basis and during elevated episodes
  - NEPA air quality studies
  - Background data for SIP planning
  - Impacts of fire on ozone and PM across West
- Better oil & gas, fire, biogenics emissions data
  - Improves assessment of natural vs. anthropogenic contributions

WRAP 2015-18 Integrated Work Plan – development, review , and adoption process

- All materials at: 2015-18 Integrated Work Plan
- Led by Technical Steering Committee
- Plan prepared during 2014
- High-level Work Plan for Board and agencies' decision makers
  - Keeping detailed documentation as Appendices
- Board review underway, planned adoption Spring 2015

WestJumpAQMS regional modeling study results:

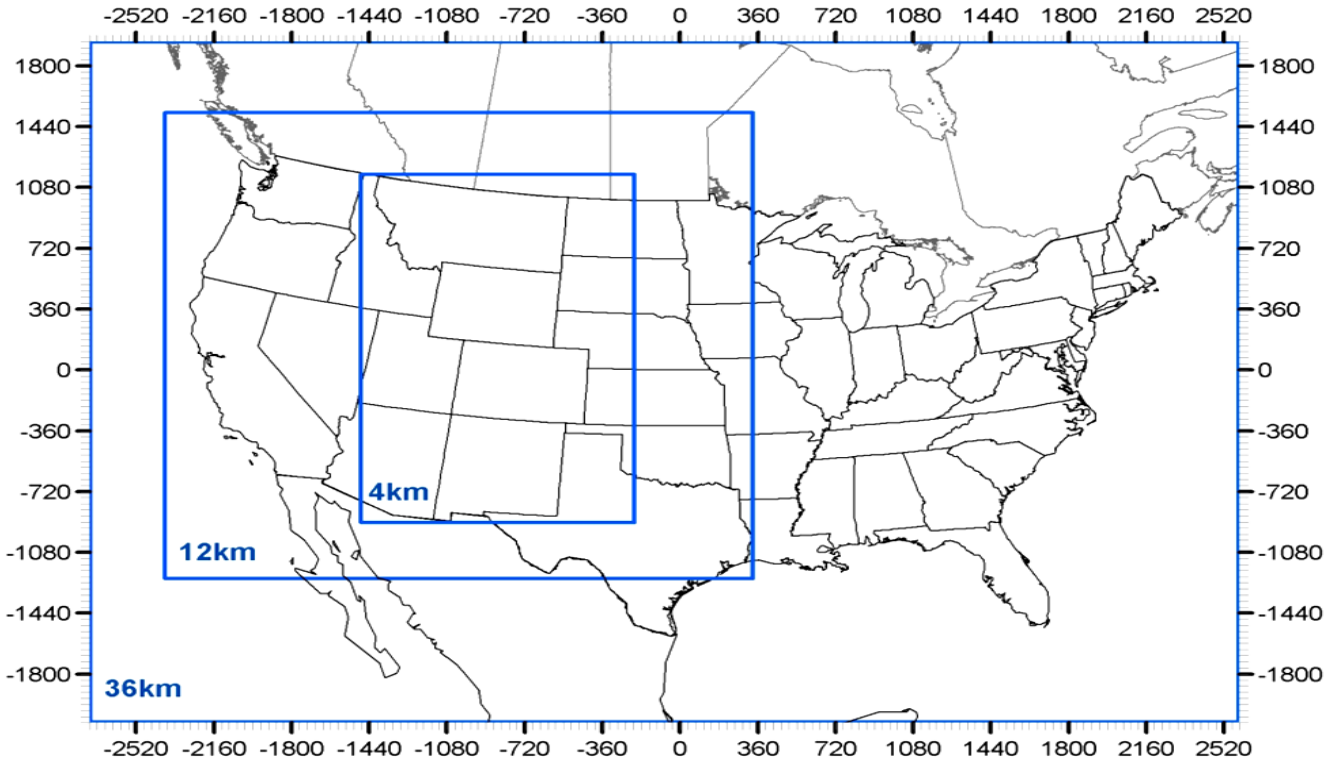
- Ozone and PM source apportionment
- Nitrogen Deposition

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

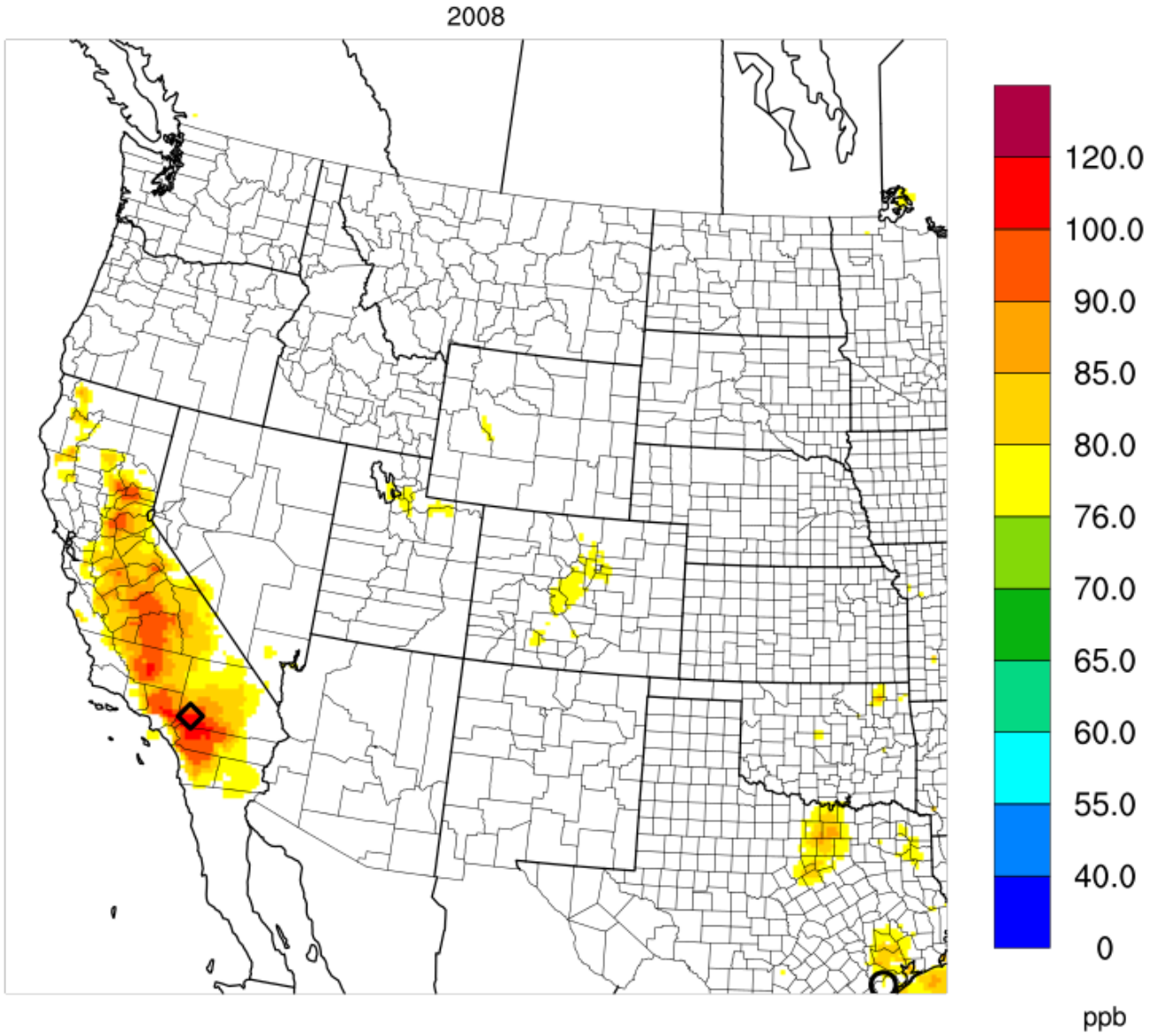


Modeling Domain

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)

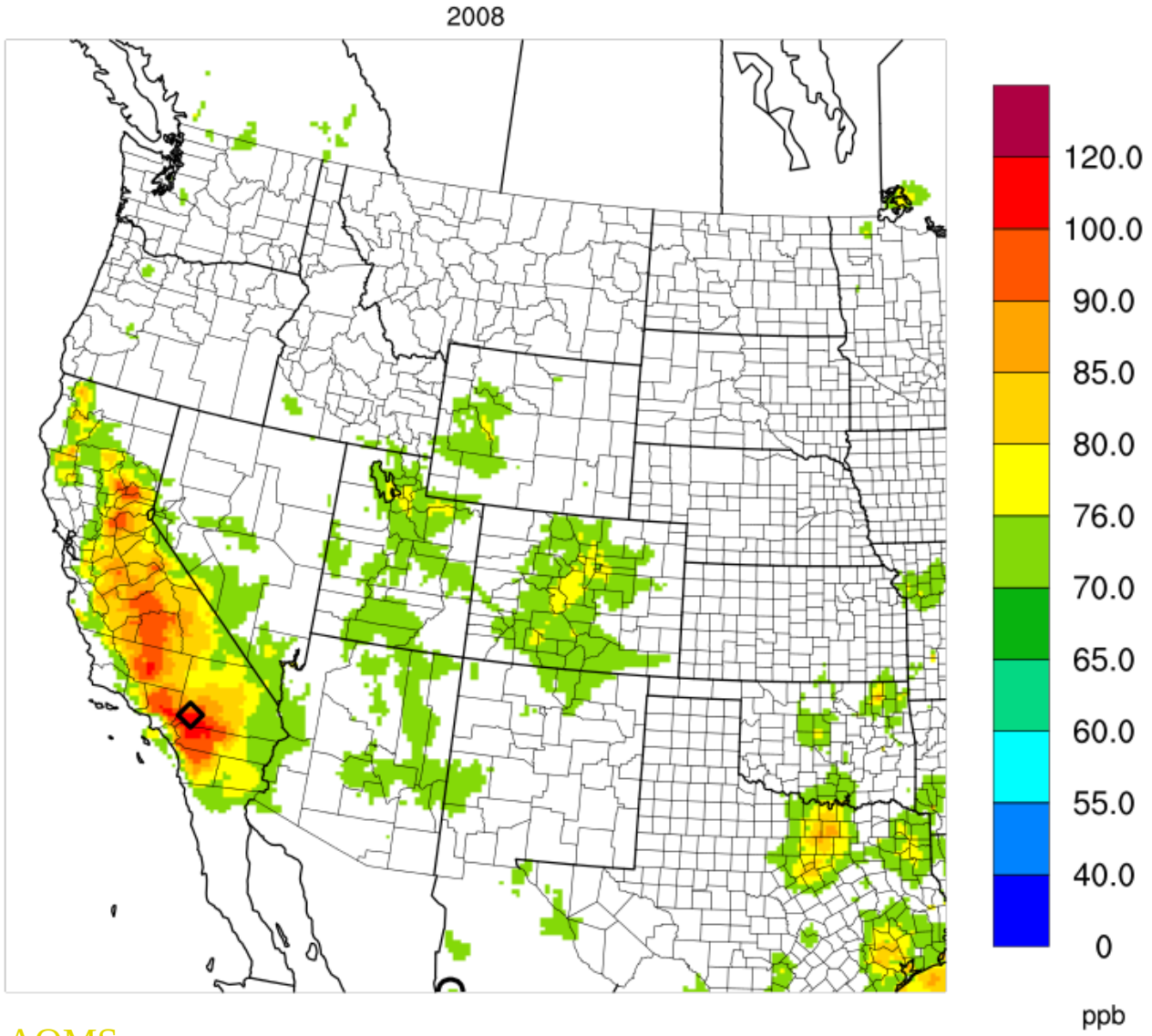
* includes buffer cells

Ozone Modeled Attainment Test Software – Unmonitored Area Analysis with Design Value (2006-2010) ≥ 76 ppb



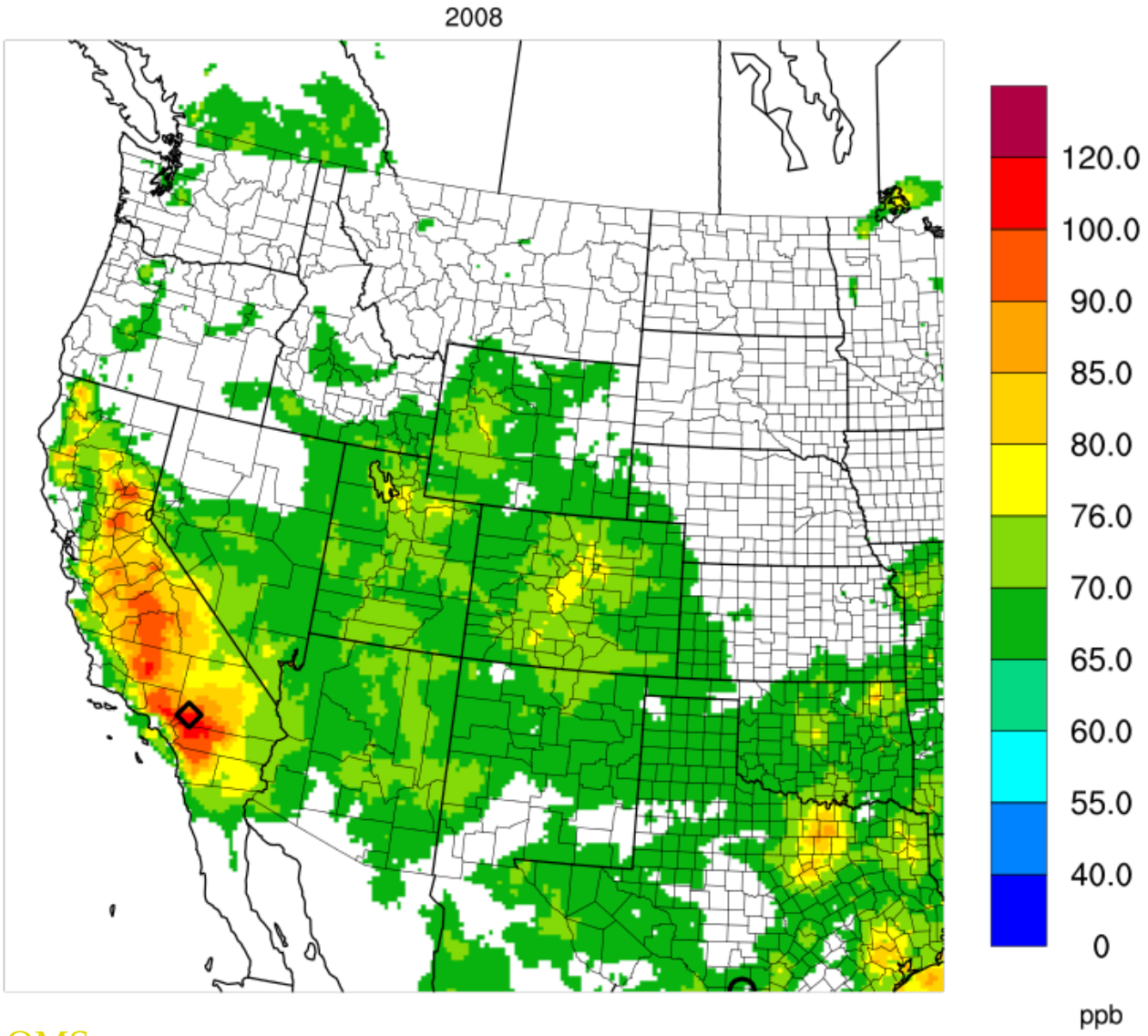
Source: WestJumpAQMS

Ozone Modeled Attainment Test Software – Unmonitored Area Analysis with Design Value (2006-2010) ≥ 70 ppb



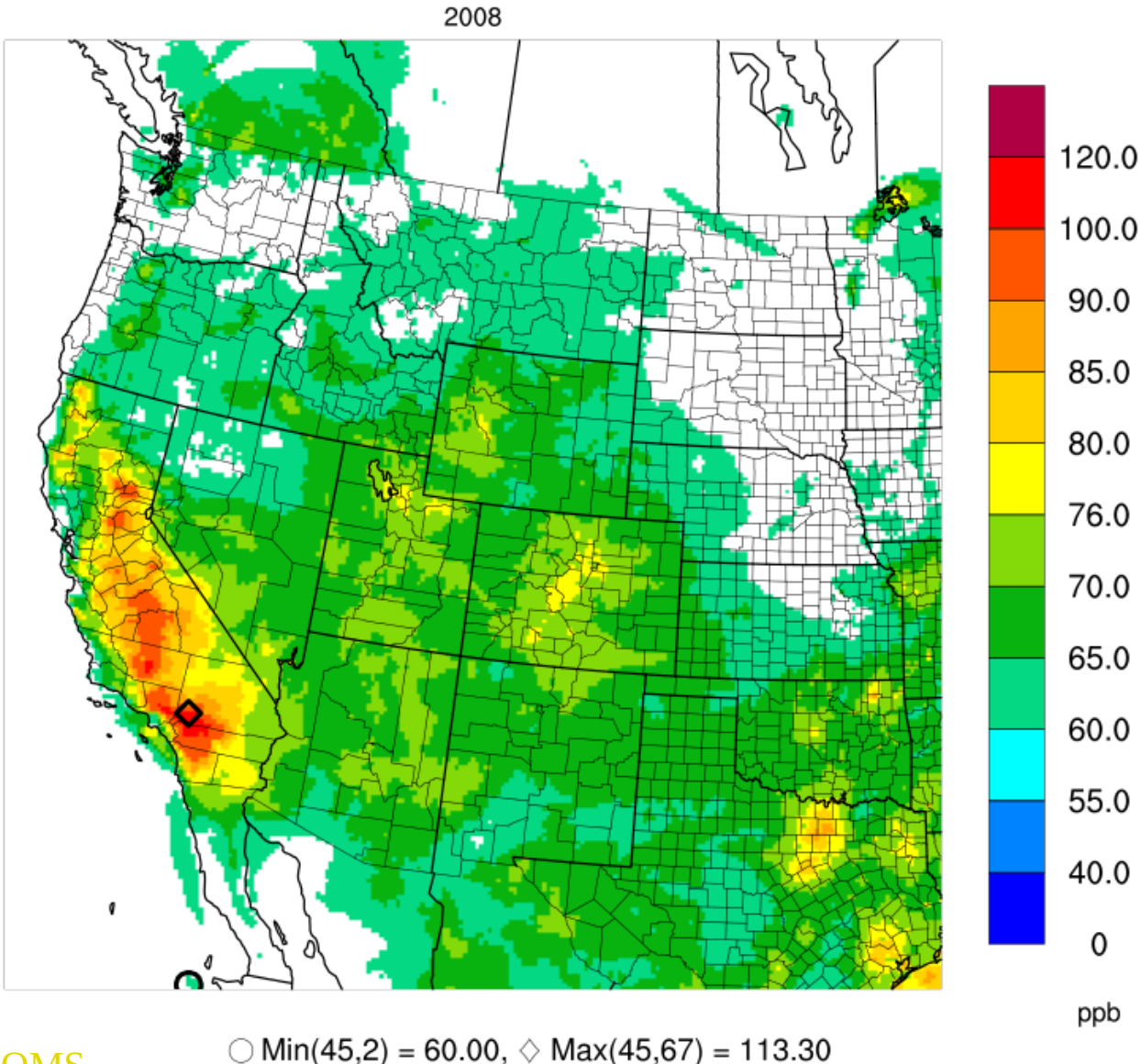
Source: WestJumpAQMS

Ozone Modeled Attainment Test Software – Unmonitored Area Analysis with Design Value (2006-2010) ≥ 65 ppb



Source: WestJumpAQMS

Ozone Modeled Attainment Test Software – Unmonitored Area Analysis with Design Value (2006-2010) ≥ 60 ppb



Source: WestJumpAQMS

WestJumpAQMS Products

- Final Report
  - 15 Electronic Appendices
  - Response-to-Comments
- Ammonia Emissions Recommendations Memo
- Modeling Protocol
  - Response-to-Comments
- WRF Application/Evaluation Report
  - Evaluation down to individual monitoring site
  - Response-to-Comments
- 16 Technical Memorandums on Emissions
  1. Point Sources
  2. Area + Non-Road
  3. On-Road Mobile

  4a-e. Oil and Gas (5 geographic areas)

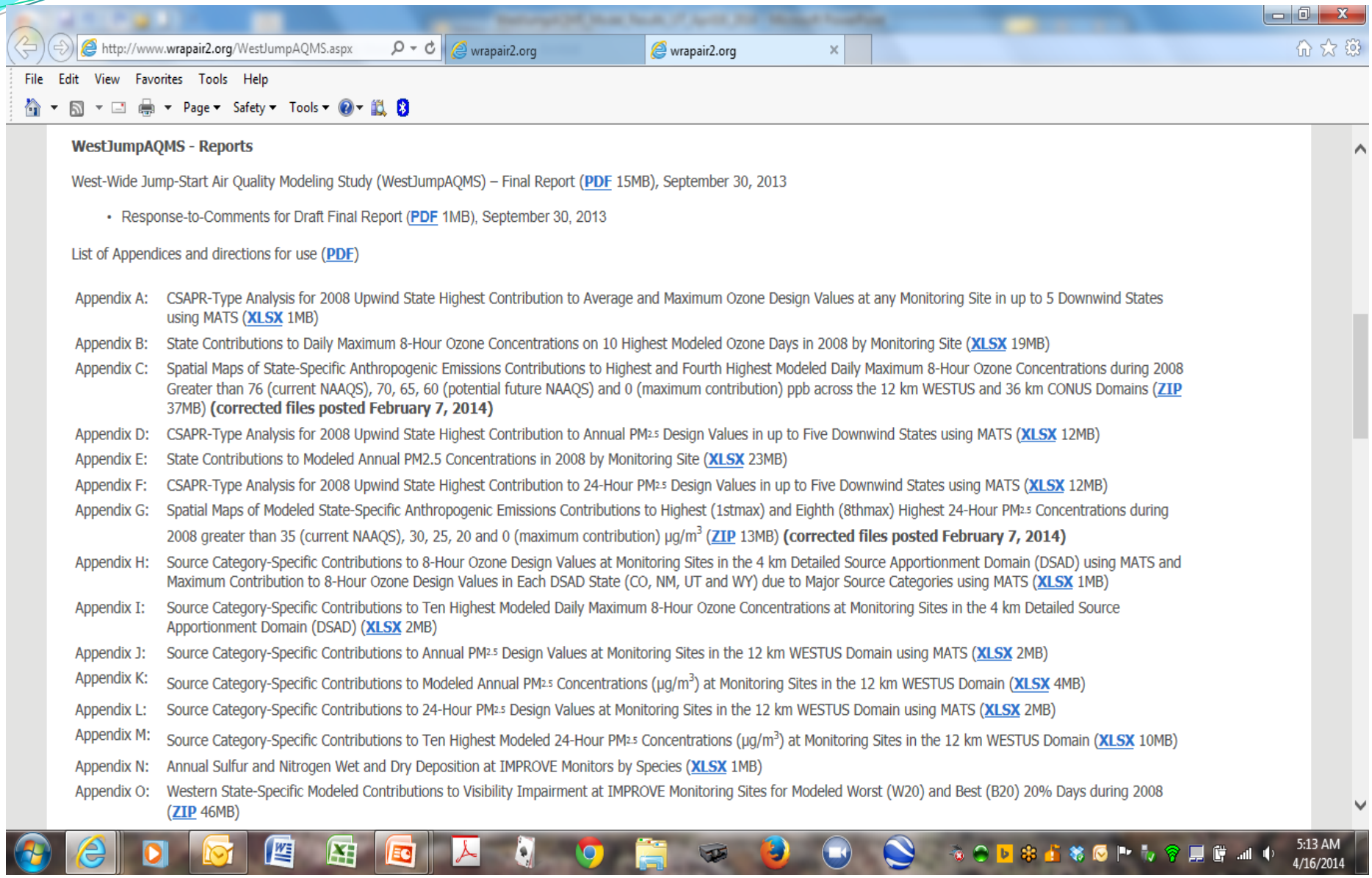
  5. Fire (WF, Rx & Ag)
  6. Fugitive Dust
  7. Off-Shore Shipping
  8. Ammonia
  9. Biogenic

  11 Mexico/Canada

  12. Sea Salt and Lightning
  13. Emissions Modeling Parameters

All information on WestJumpAQMS web page:
http://www.wrapair2.org/WestJumpAQMS.aspx

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



http://www.wrapair2.org/WestJumpAQMS.aspx

wrapair2.org

wrapair2.org

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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

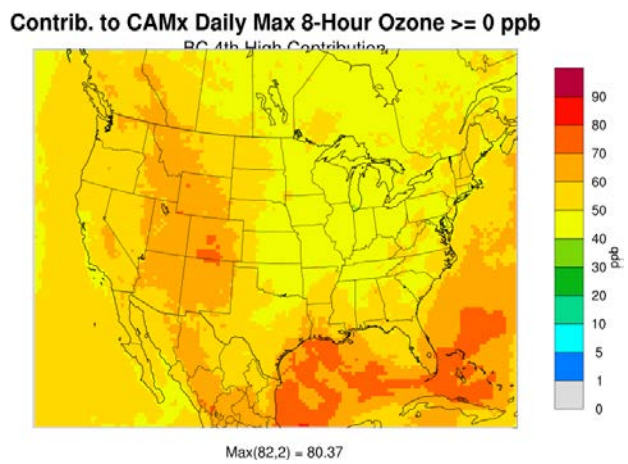
List of Appendices and directions for use (PDF)

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)

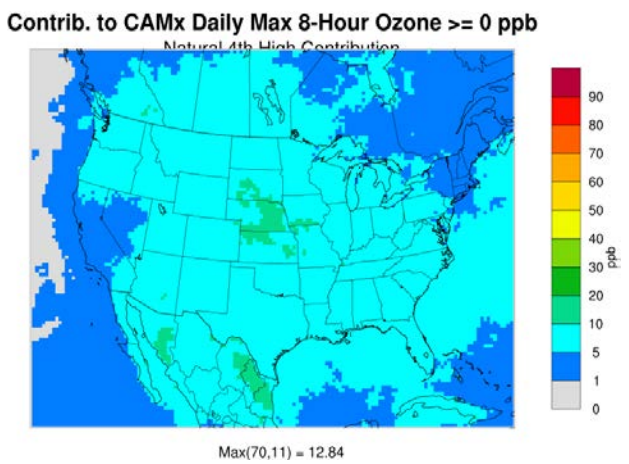
5:13 AM
4/16/2014

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

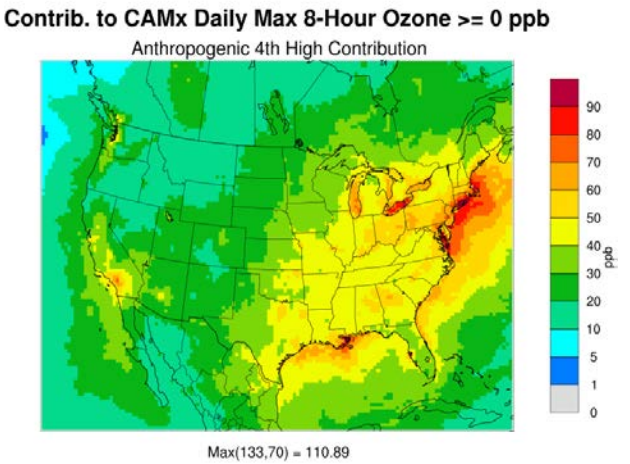
Boundary Conditions

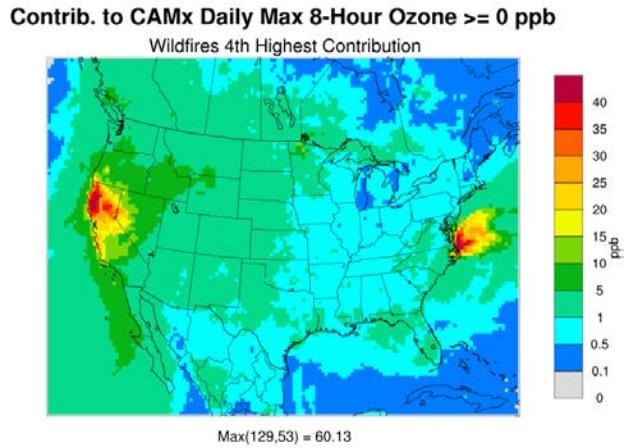


Natural

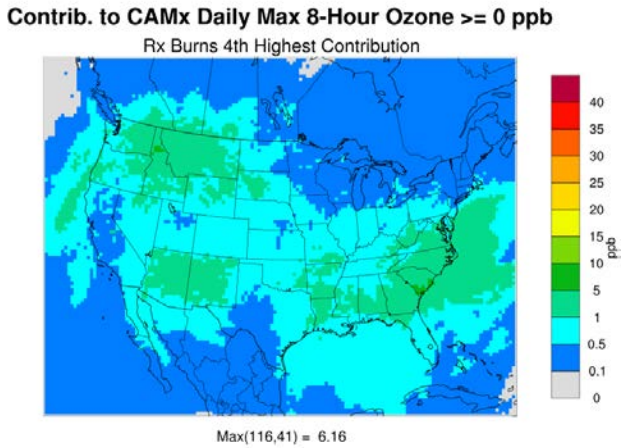


Anthropogenic

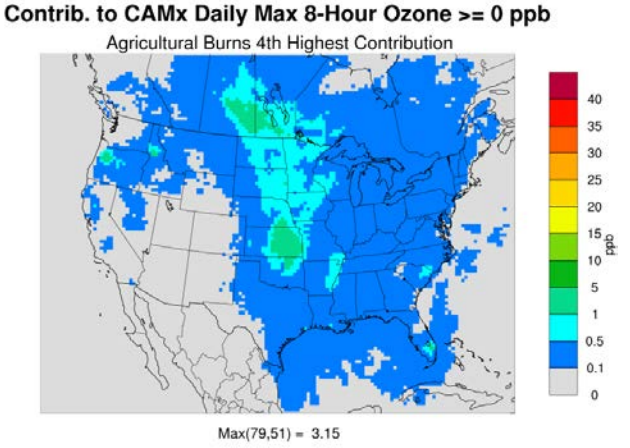




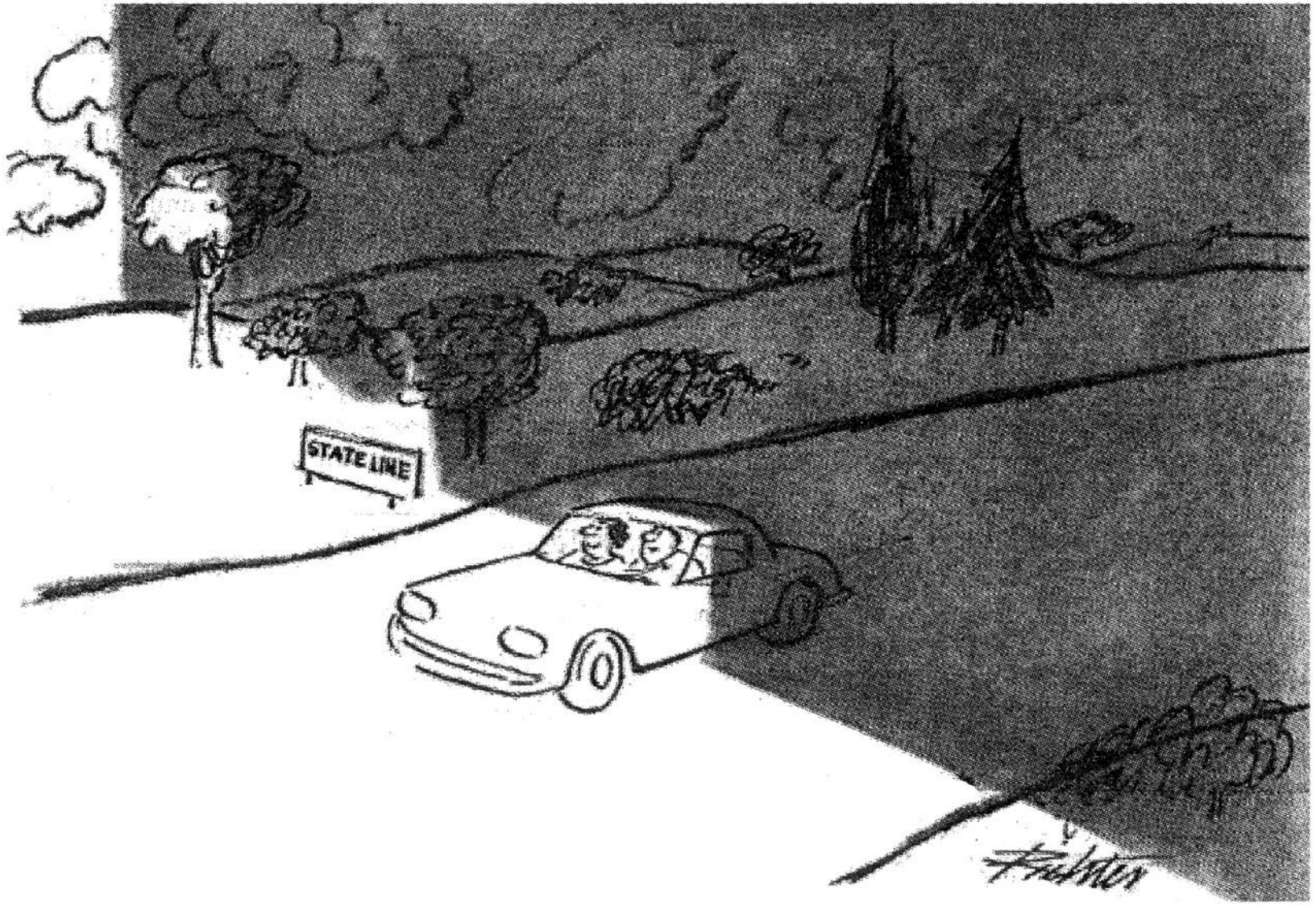
Wildfire



Prescribed Fire



Agricultural Fire



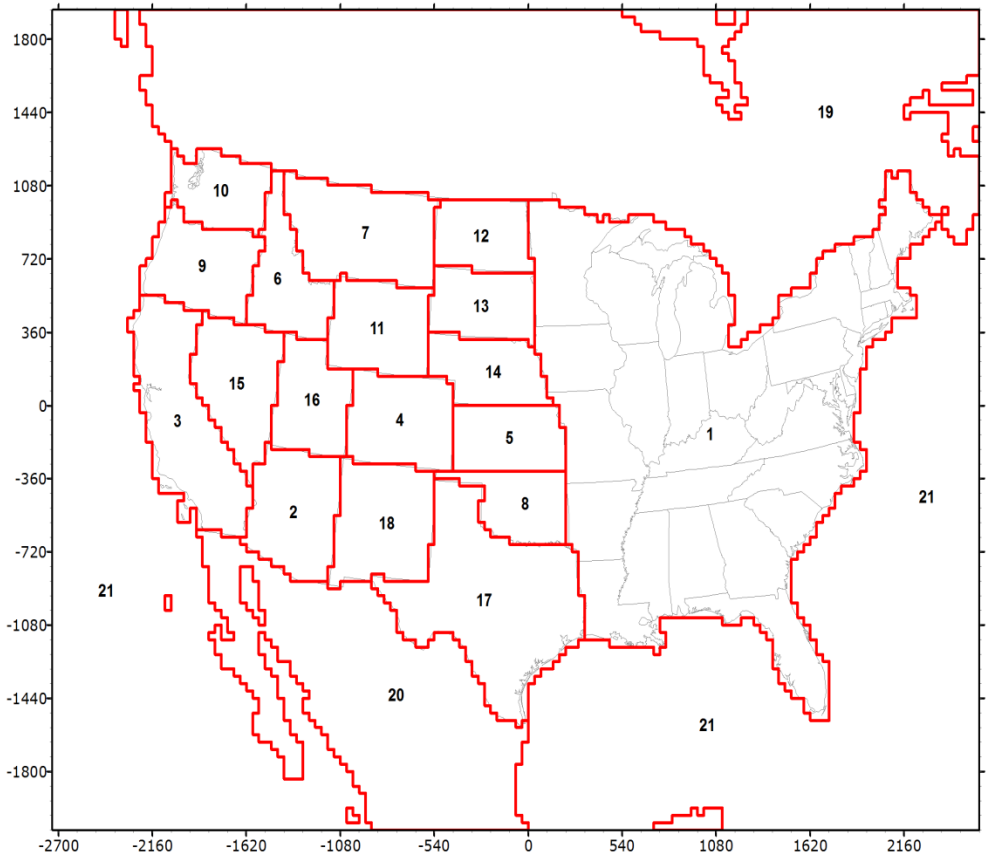
"They have very strict anti-pollution laws in this state."

State-Specific Ozone Source Apportionment

- Purpose: To provide information on the role of ozone transport to exceedances of the current and potential future ozone NAAQS in the western U.S.
- Approach: Analyze ozone apportionment several ways:
  1. Upwind state contribution to downwind state nonattainment using Cross State Air Pollution Rule (CSAPR-type) approach
     - Use EPA method for projecting ozone Design Values (RRFs)
  2. State contributions to modeled high ozone DMAX8 ozone at monitors in 12 km WESTUS domain
     - Spatial extent of modeled state contributions to 1stmax and 4thmax DMAX8 ozone greater than current and potential future NAAQS
     - Source category analysis (Natural, Fires & Anthropogenic)
  3. Detailed Source Category-Specific Source Apportionment
     - 6 key source categories across 4 states in intermountain West
     - 2-way nesting between model domains

State-Specific Ozone Source Apportionment

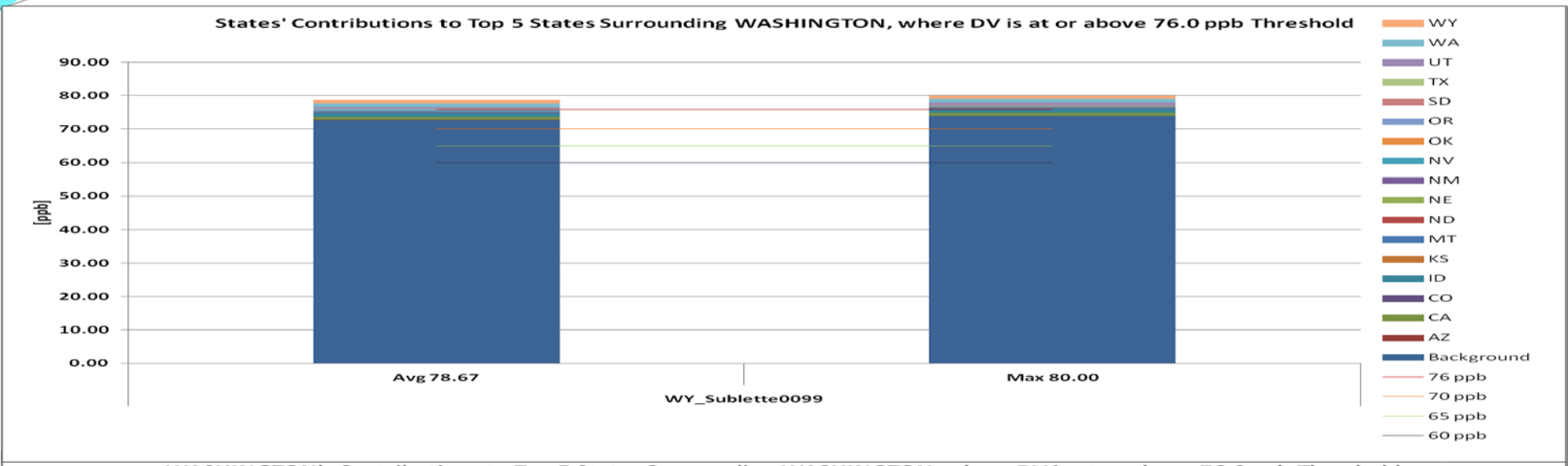
- 2008 36/12 km Base
- 17 Western States
  - Plus EasternUS, Can, Mex & Off-Shore
- 5 Source Categories
  - Natural (Biogenics+Lightning+WBDust+SeaSalt)
  - WF, Rx and Ag Fires
  - Anthropogenic
- 107 Source Groups (21 x 5 + 2)
  - 4 Extra Species for each Group
    - 428 additional species
    - Standard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

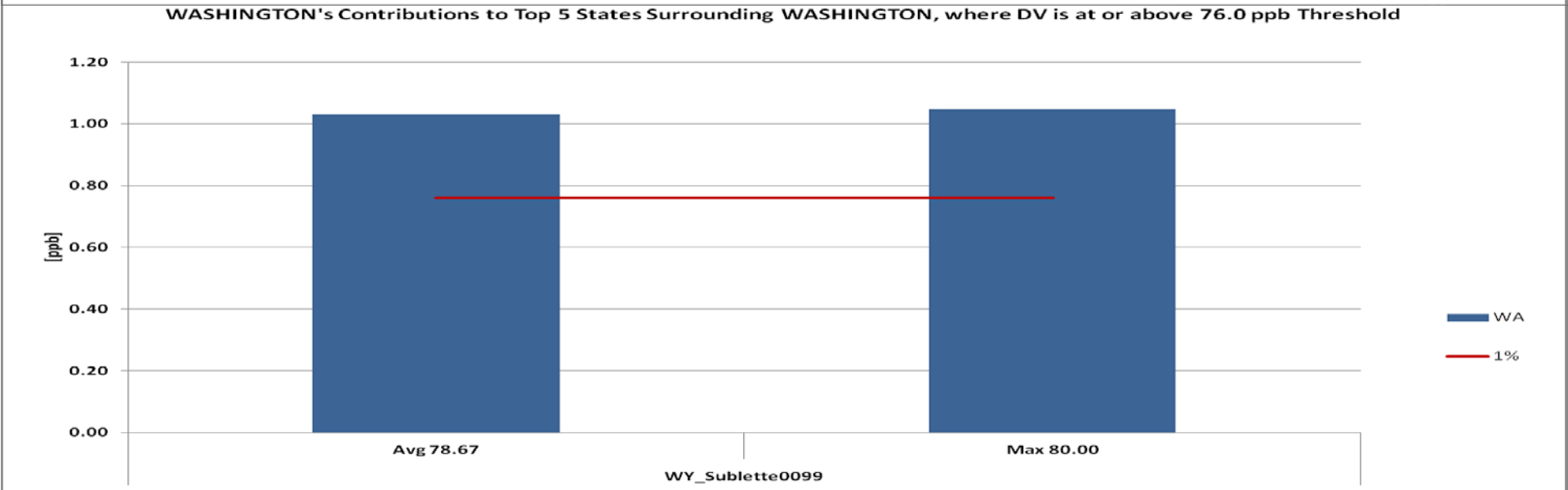


CSAPR-Type Analysis for current (76 ppb) and potential future (70 and 65 ppb) NAAQS levels

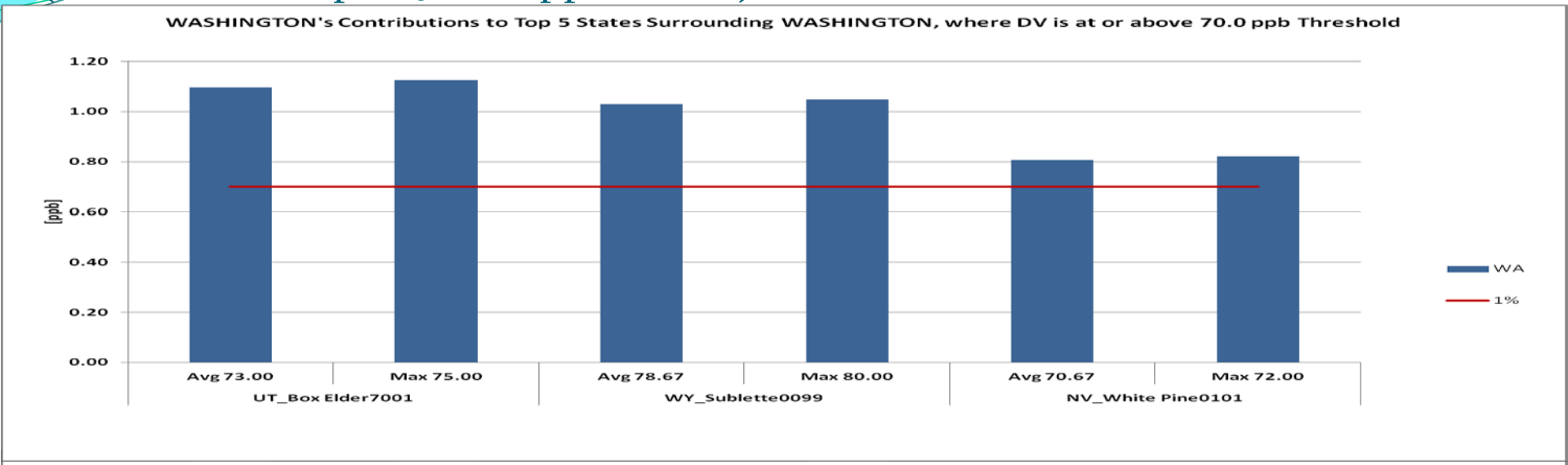
- CSAPR looked at contributions to:
  - Average Design Value = Average of DVs from 2006-2010
  - Max Design Values = Max DVs from 2006-2010
- 136 ozone monitors in 12 km WESTUS domain with Average Design Value exceeding 76 ppb NAAQS
  - 86 sites (63%) in California
- For 17 upwind western states examine 2008 contribution to DMAX8 ozone Design Value in downwind states
  - CSAPR used a 1% NAAQS significance threshold (≥0.76 ppb)
- This analysis is for 2008 and is not a regulatory analysis that would have to examine a future year

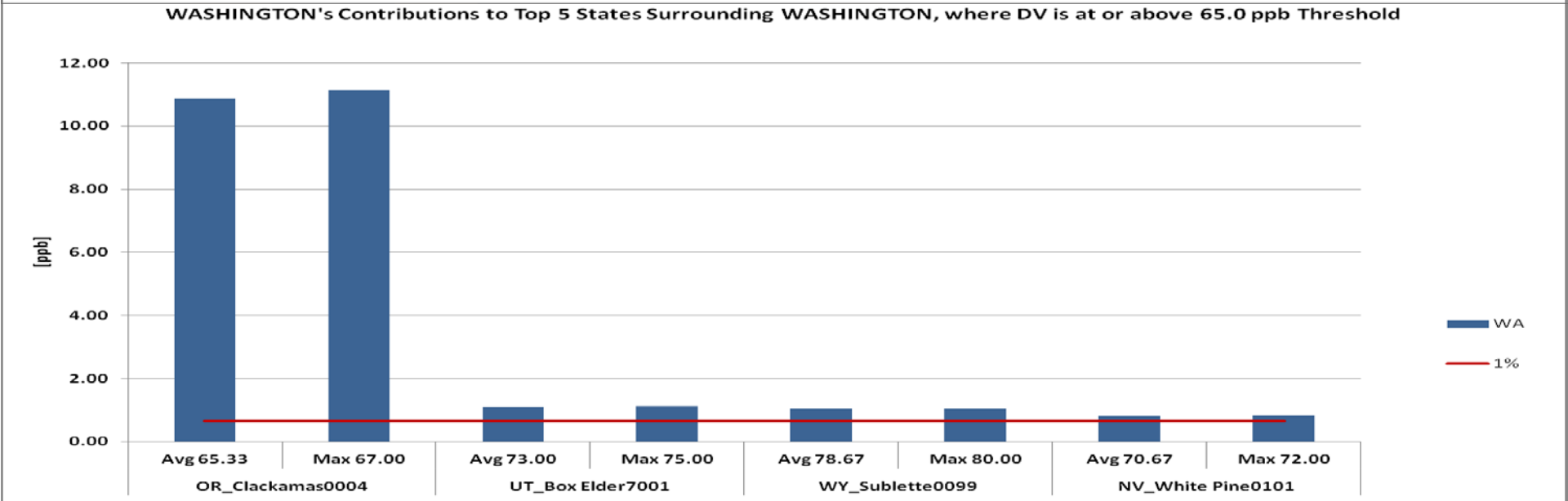
Washington CSAPR-Type Ozone Analysis for current 75 ppb NAAQS (from WestJumpAQMS Appendix A)



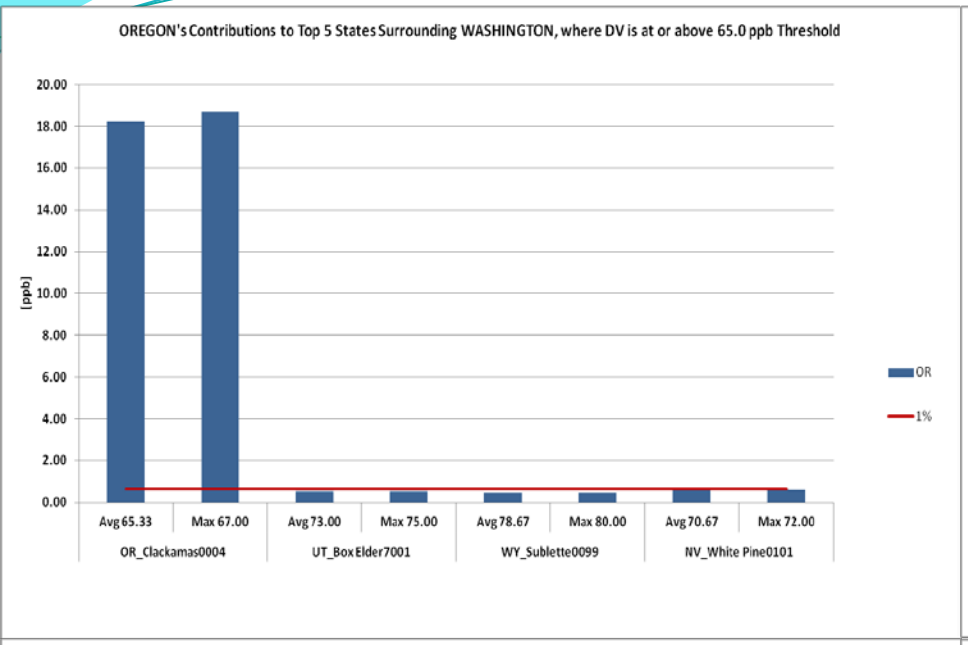


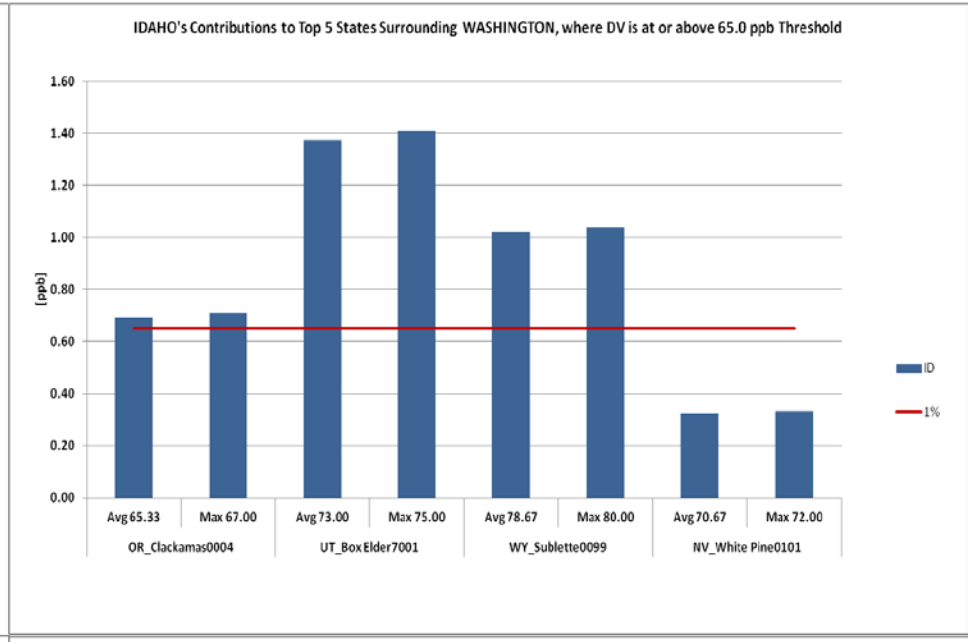
Washington CSAPR-Type Ozone Analysis for potential 70 and 65 ppb NAAQS (from WestJumpAQMS Appendix A)

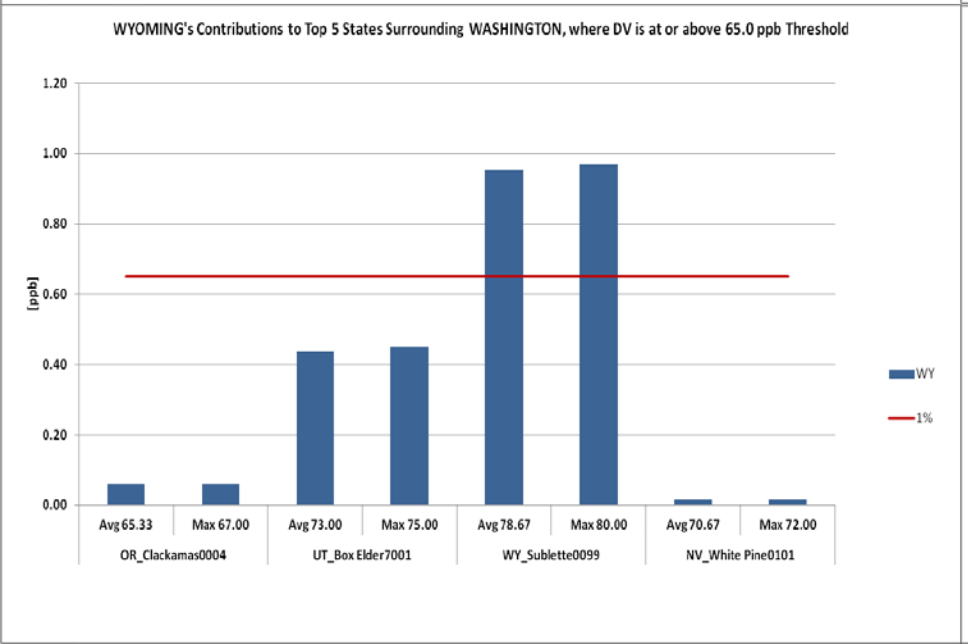


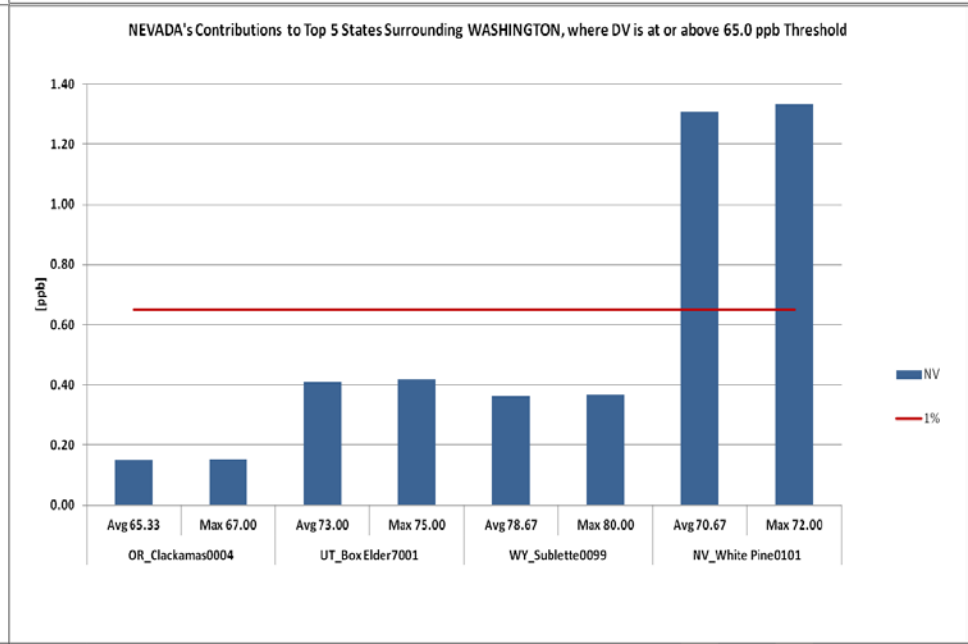


CSAPR-Type Ozone Contribution Analysis - "states near WA" at potential 65 ppb NAAQS (from WestJumpAQMS Appendix A)

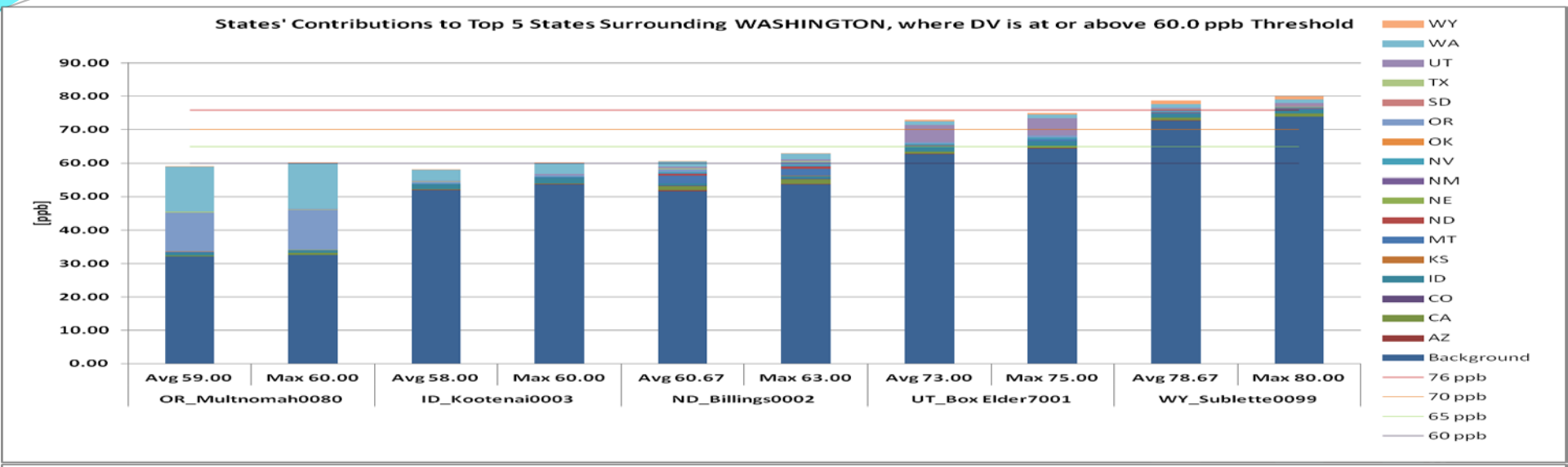


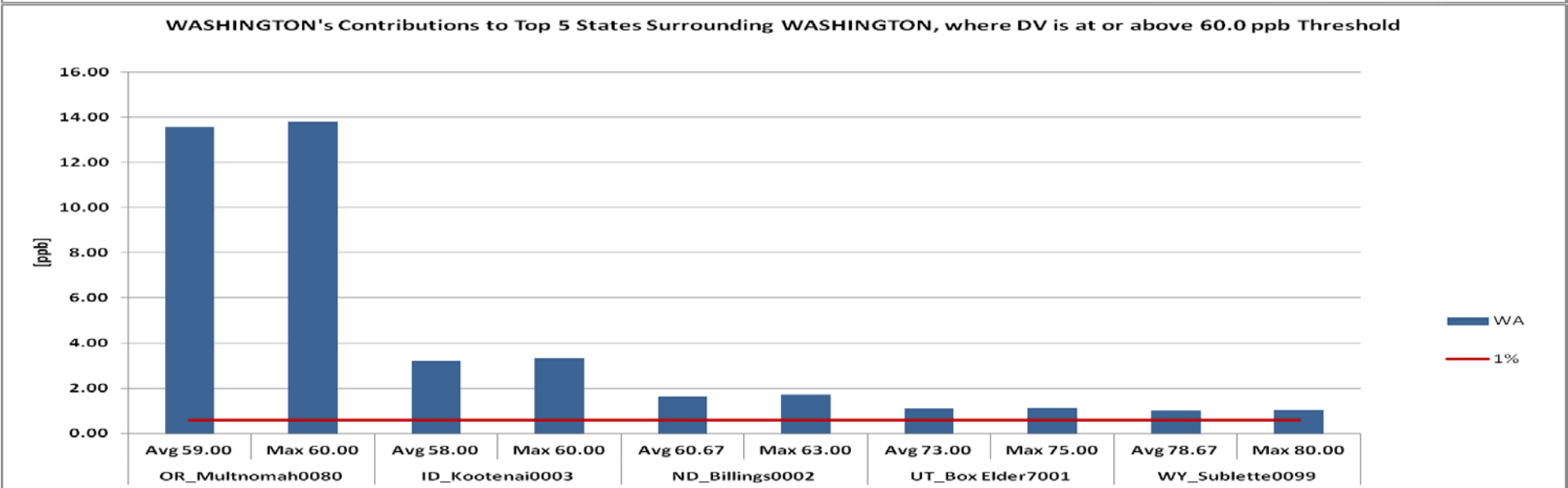






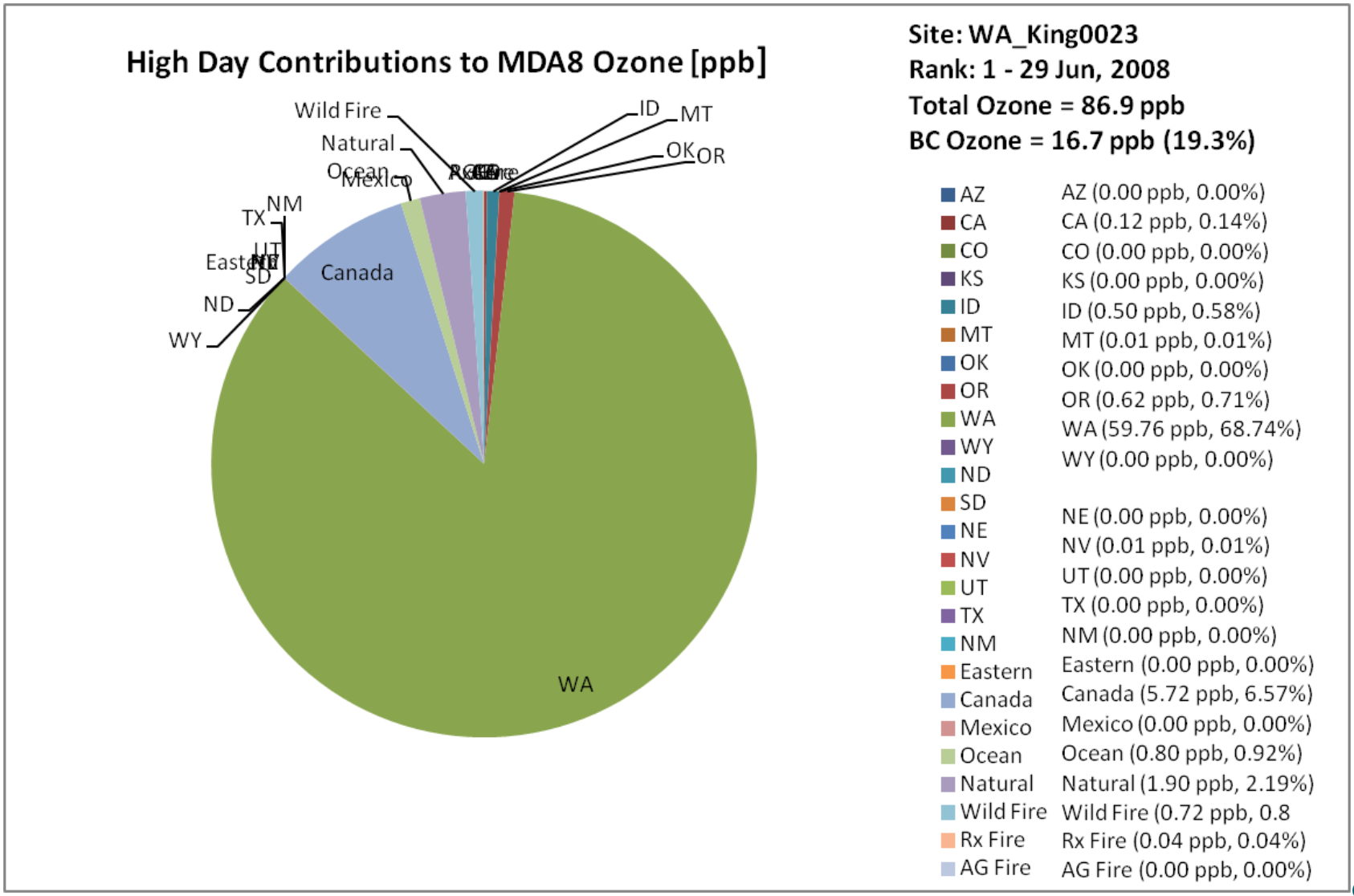
Washington CSAPR-Type Ozone Analysis for potential 60 ppb NAAQS (from WestJumpAQMS Appendix A)





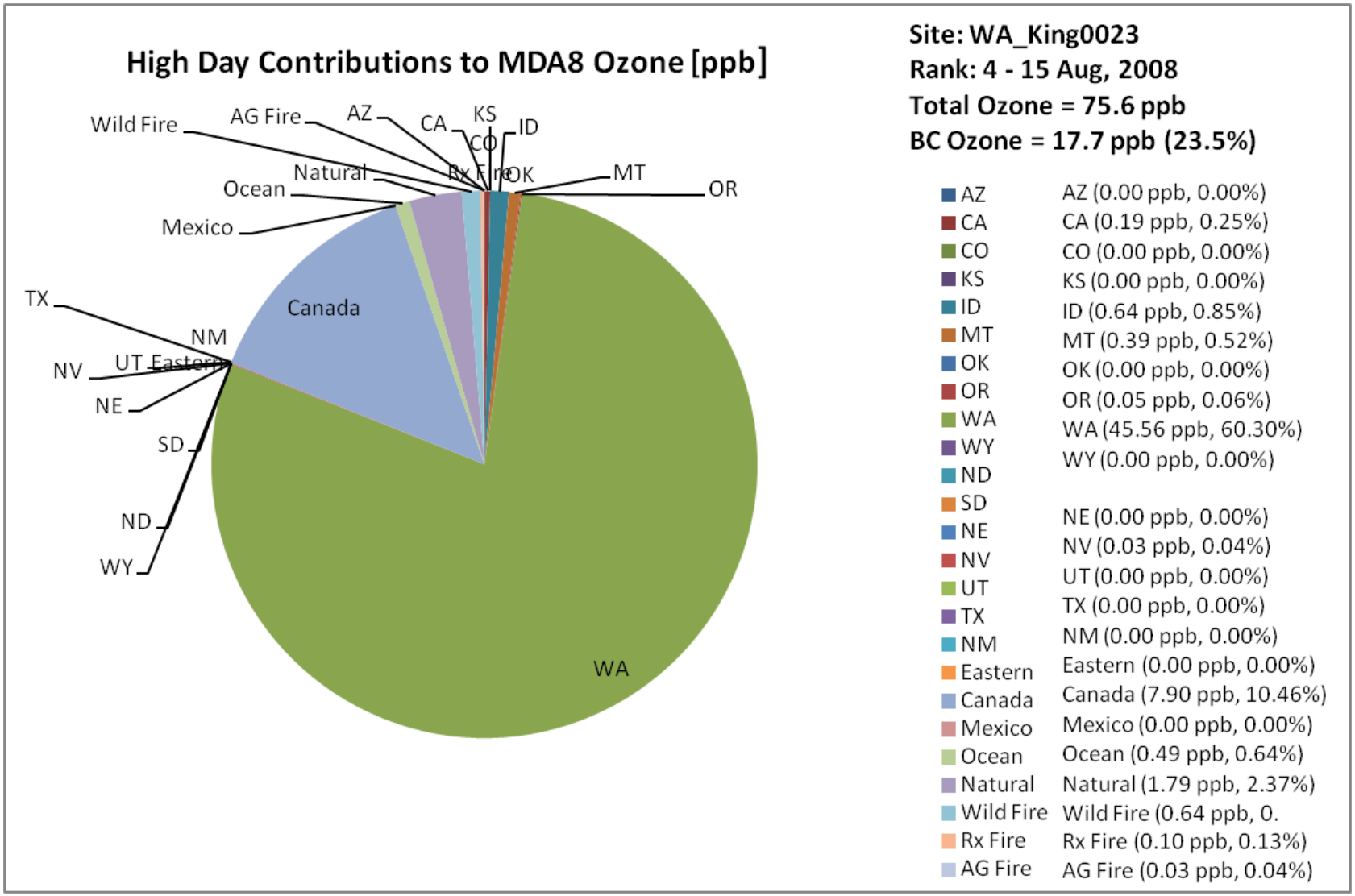
State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

Highest Modeled DMAX8 Day at Enumclaw site (53-033-0023)



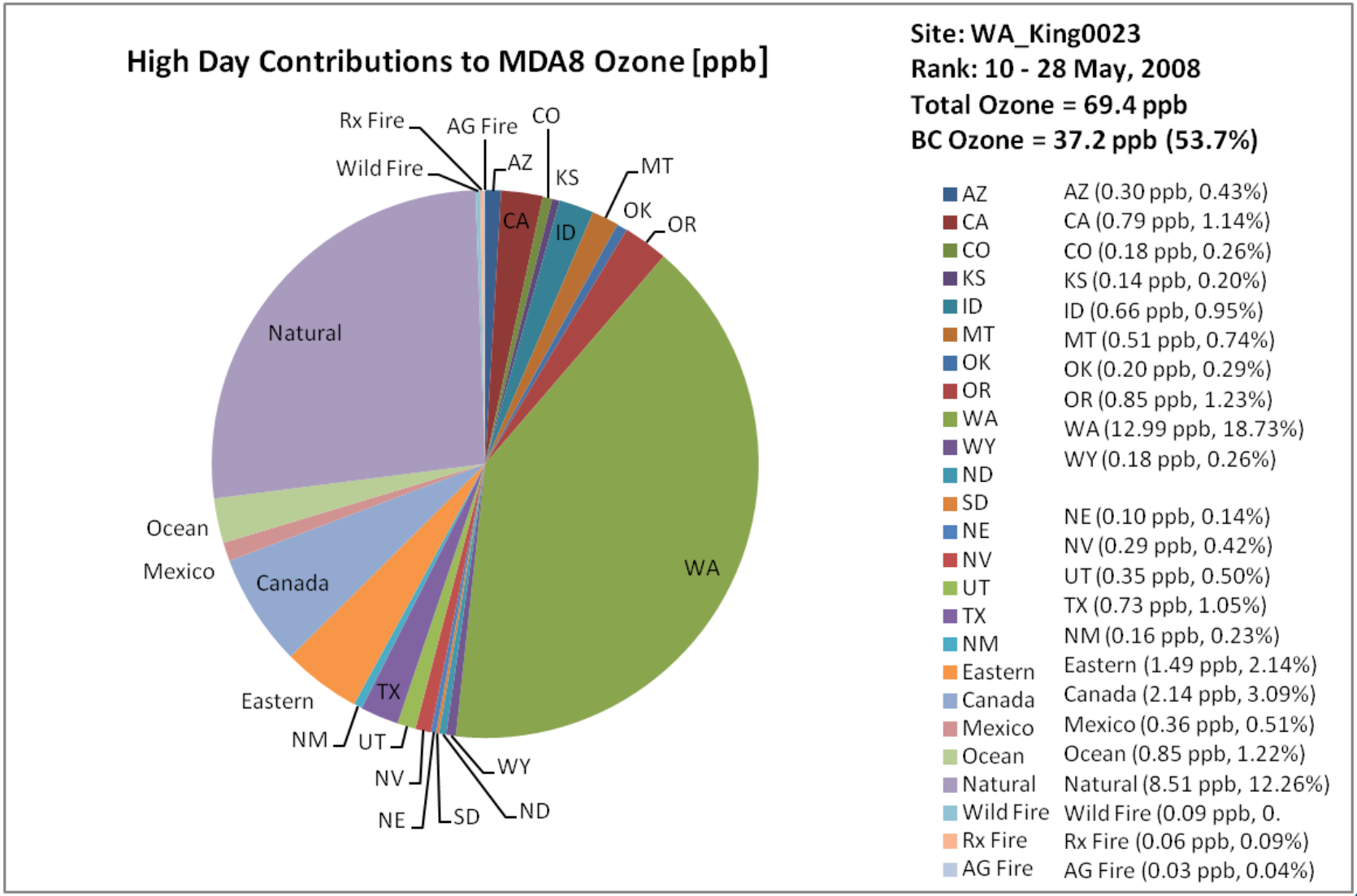
State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

4th Highest Modeled DMAX8 Day at Enumclaw site (53-033-0023)



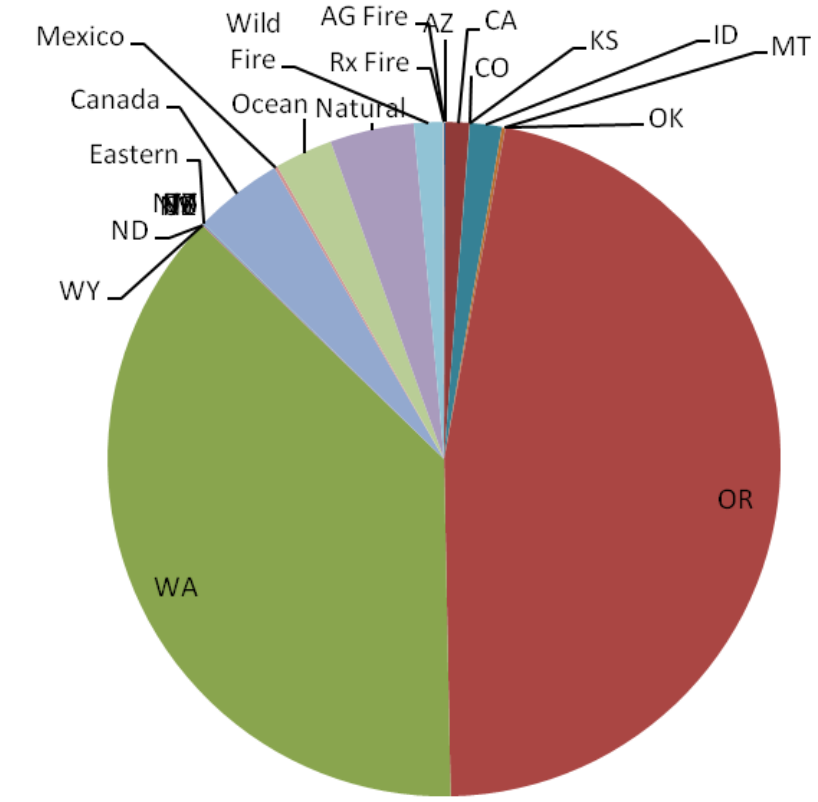
State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

10th Highest Modeled DMAX8 Day at Enumclaw site (53-033-0023)



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

Highest Modeled DMAX8 Day at Vancouver site (53-011-0011)

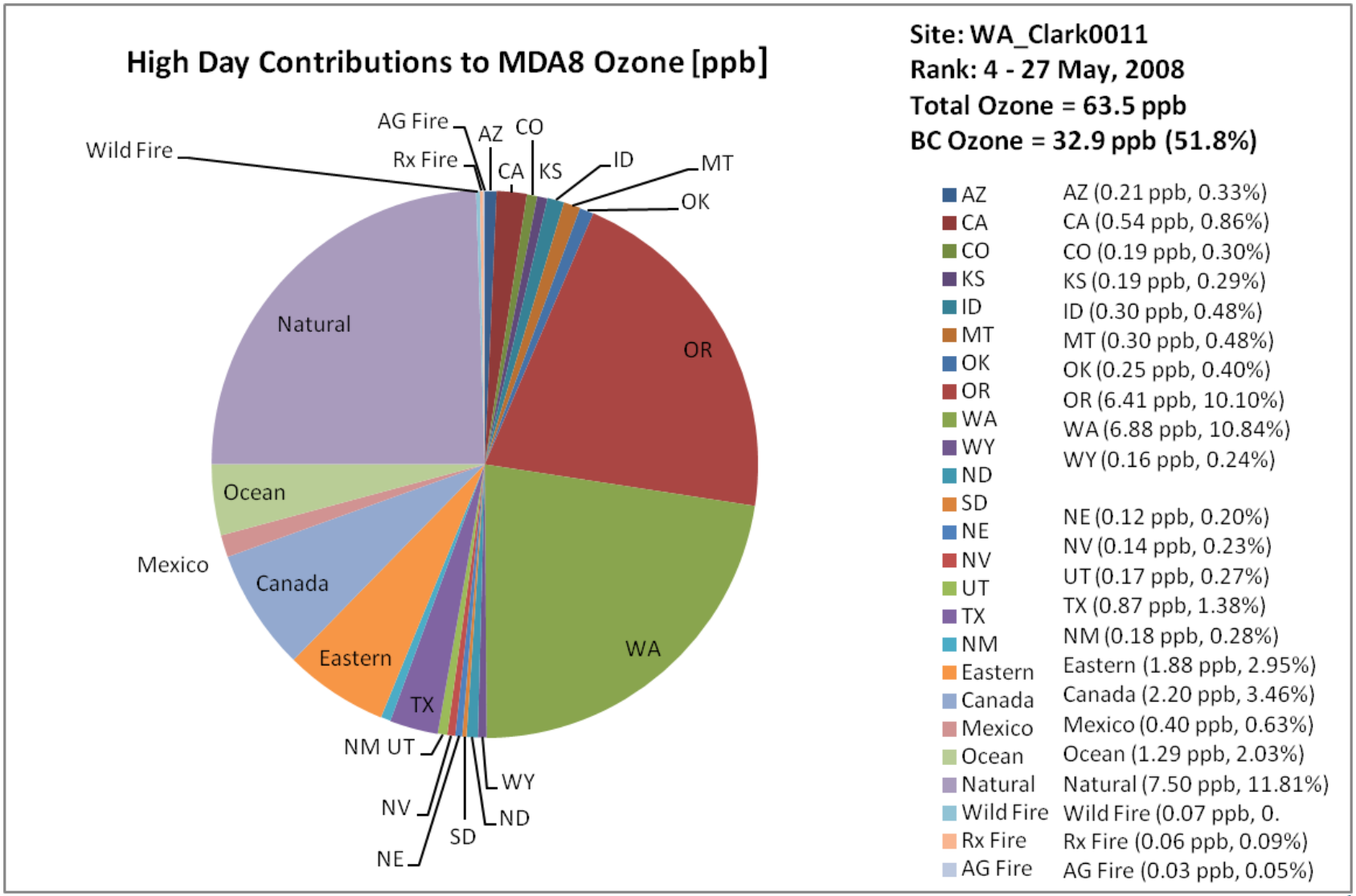


Site: WA_Clark0011
Rank: 1 - 06 Aug, 2008
Total Ozone = 66.7 ppb
BC Ozone = 24.1 ppb (36.2%)

AZ	AZ (0.03 ppb, 0.04%)
CA	CA (0.49 ppb, 0.73%)
CO	CO (0.00 ppb, 0.01%)
KS	KS (0.00 ppb, 0.00%)
ID	ID (0.65 ppb, 0.97%)
MT	MT (0.07 ppb, 0.11%)
OK	OK (0.00 ppb, 0.00%)
OR	OR (19.91 ppb, 29.85%)
WA	WA (15.98 ppb, 23.96%)
WY	WY (0.00 ppb, 0.00%)
ND	
SD	
NE	NE (0.00 ppb, 0.00%)
NV	NV (0.01 ppb, 0.01%)
UT	UT (0.00 ppb, 0.00%)
TX	TX (0.02 ppb, 0.03%)
NM	NM (0.02 ppb, 0.02%)
Eastern	Eastern (0.00 ppb, 0.00%)
Canada	Canada (1.81 ppb, 2.72%)
Mexico	Mexico (0.07 ppb, 0.10%)
Ocean	Ocean (1.18 ppb, 1.77%)
Natural	Natural (1.72 ppb, 2.57%)
Wild Fire	Wild Fire (0.59 ppb, 0.8
Rx Fire	Rx Fire (0.01 ppb, 0.02%)
AG Fire	AG Fire (0.01 ppb, 0.01%)

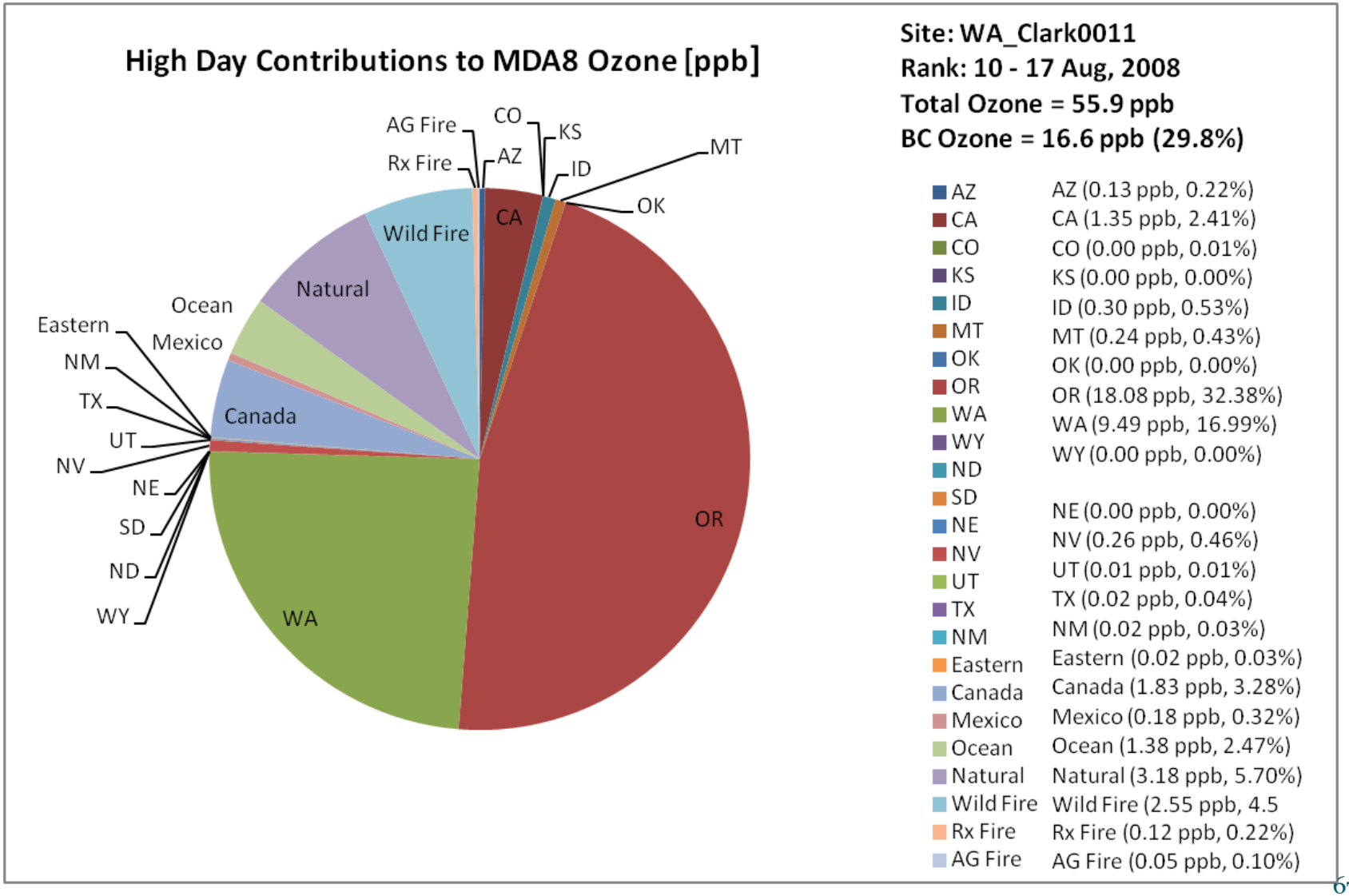
State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

4th Highest Modeled DMAX8 Day at Vancouver site (53-011-0011)



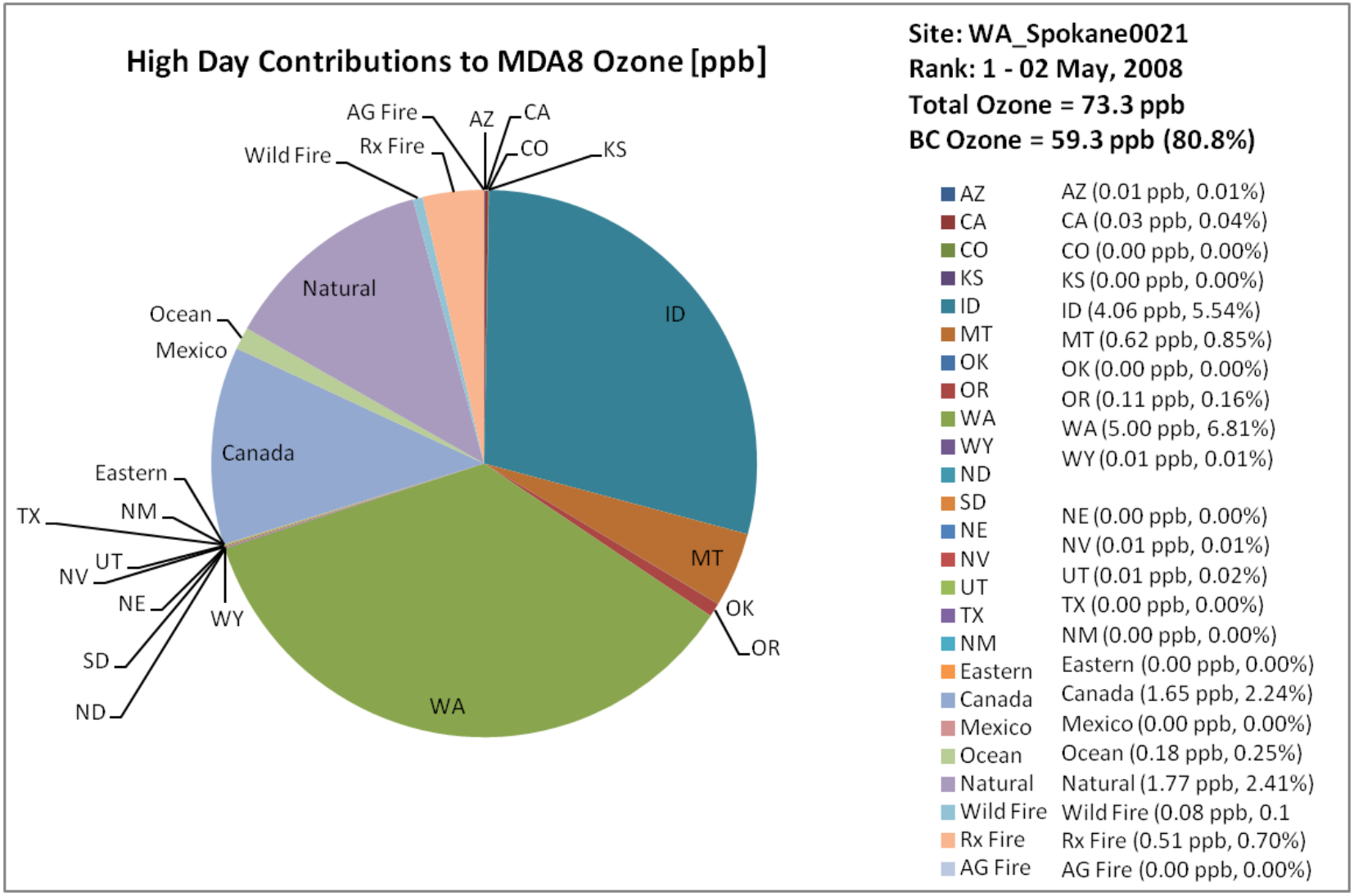
State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

10th Highest Modeled DMAX8 Day at Vancouver site (53-011-0011)



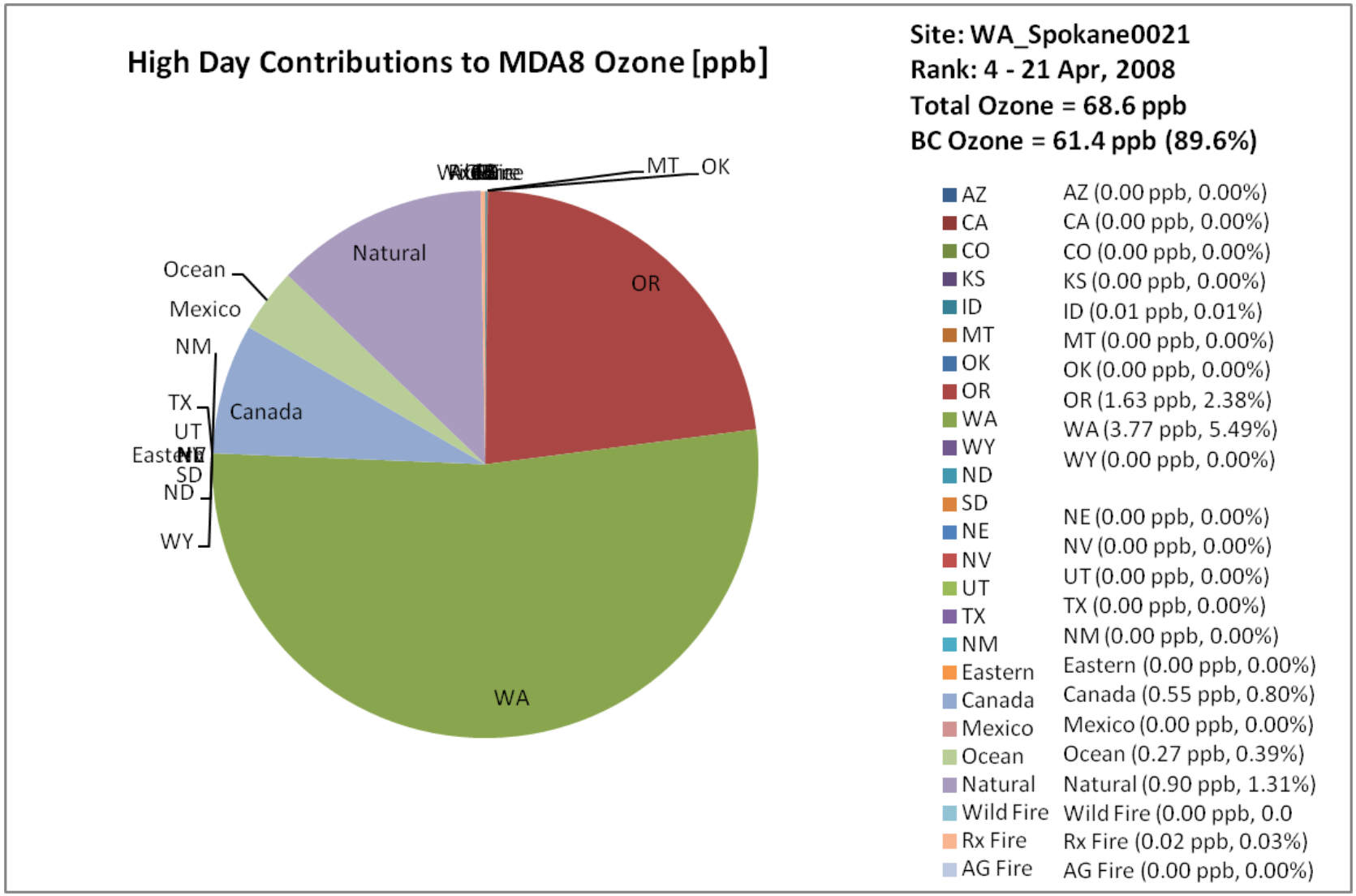
State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

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



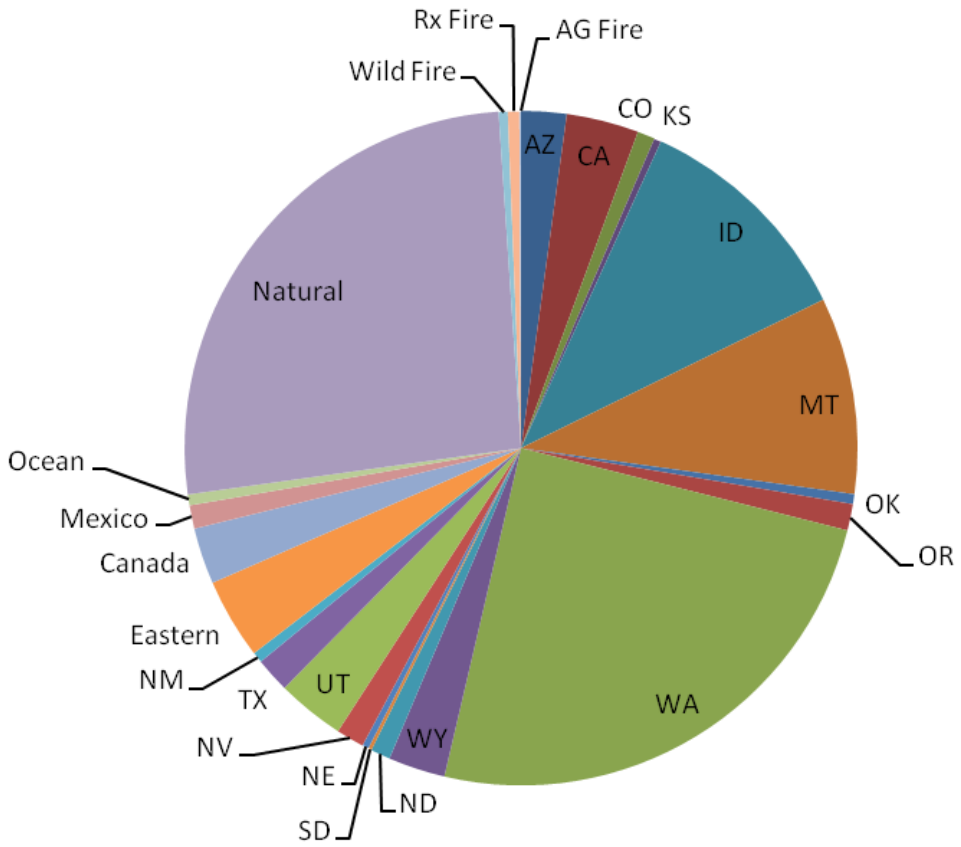
State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

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



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

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%)

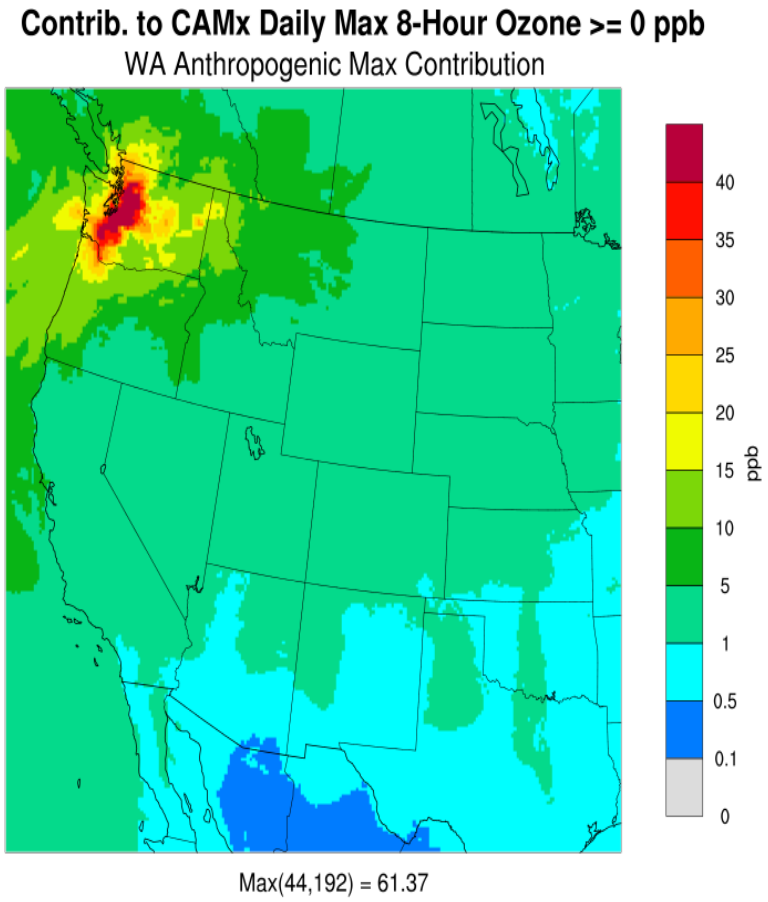
Spatial Distribution of State Ozone Contributions

- Spatial distribution of state's ozone contribution to DMAX8 ozone concentrations greater than or equal to:
  - 76 ppb (current NAAQS)
  - 70 ppb; 65 ppb and 60 ppb (potential future NAAQS)
  - 0 ppb (highest contribution in year)
- Two types of metrics:
  1. Maximum modeled contribution to Highest and 4th Highest DMAX8 ozone (from WestJumpAQMS Appendix C)
  2. Attainment Test Unmonitored Areas projection contribution to 8-hour ozone design value (not shown in this presentation)
- Examples for Washington next:
  - Maximum contribution to highest DMAX8 ever and at 76 ppb (current NAAQS)
  - Maximum contribution to 4th high DMAX8 for 76, 70, 65, and 60 ppb

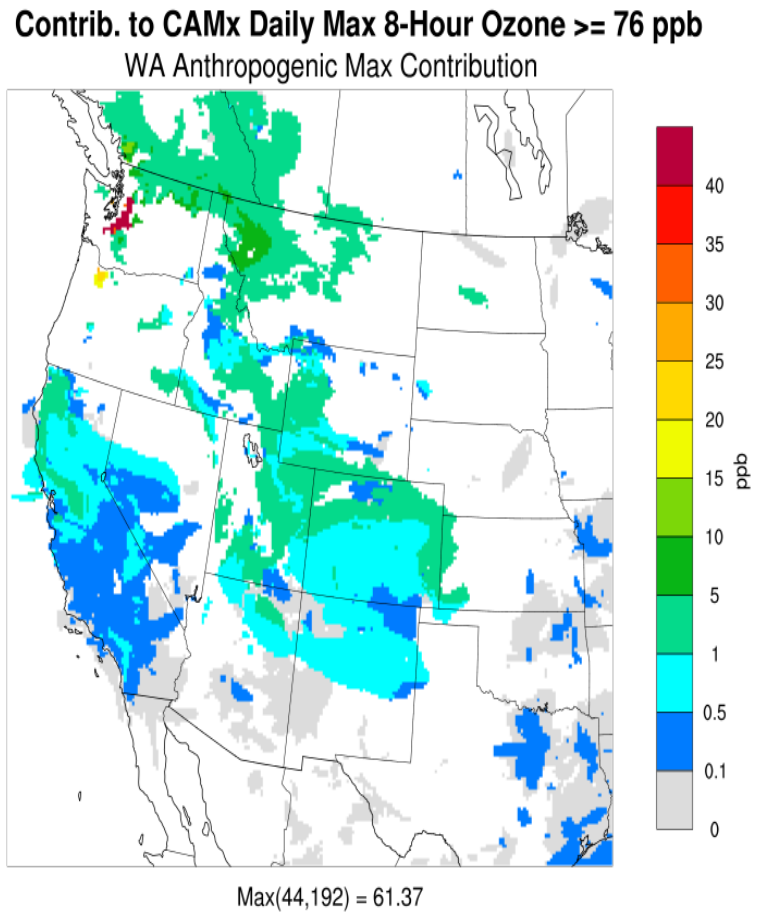
2008 Washington 8-Hour Ozone Contribution

from WestJumpAQMS Appendix C

Highest Modeled Contribution

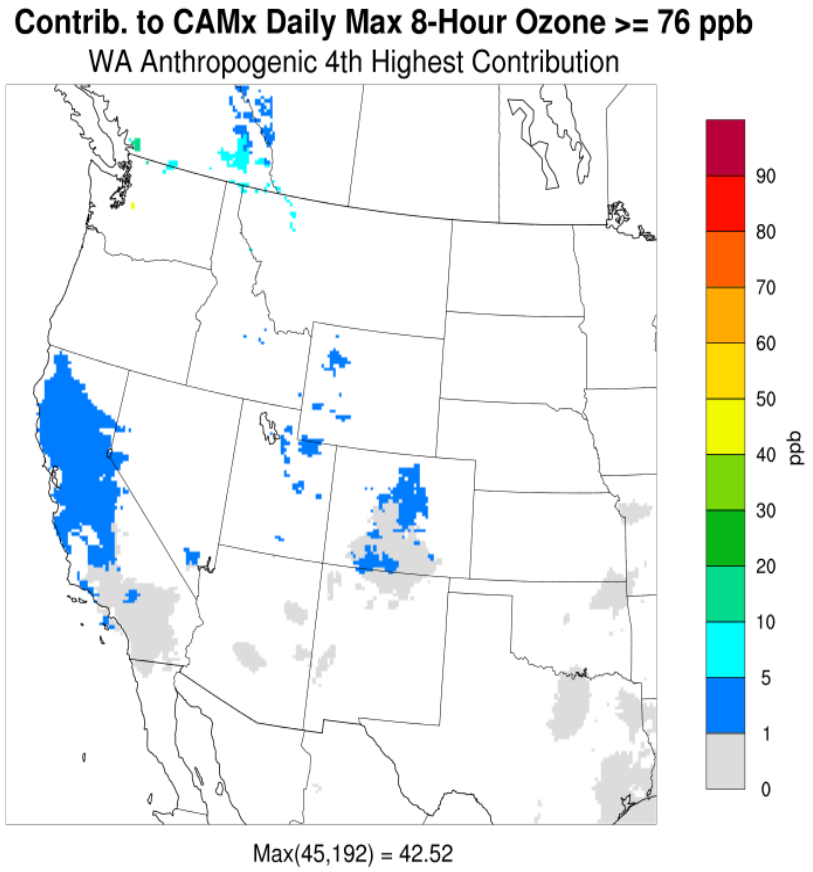


Modeled DMAX8 Ozone ≥ 76 ppb

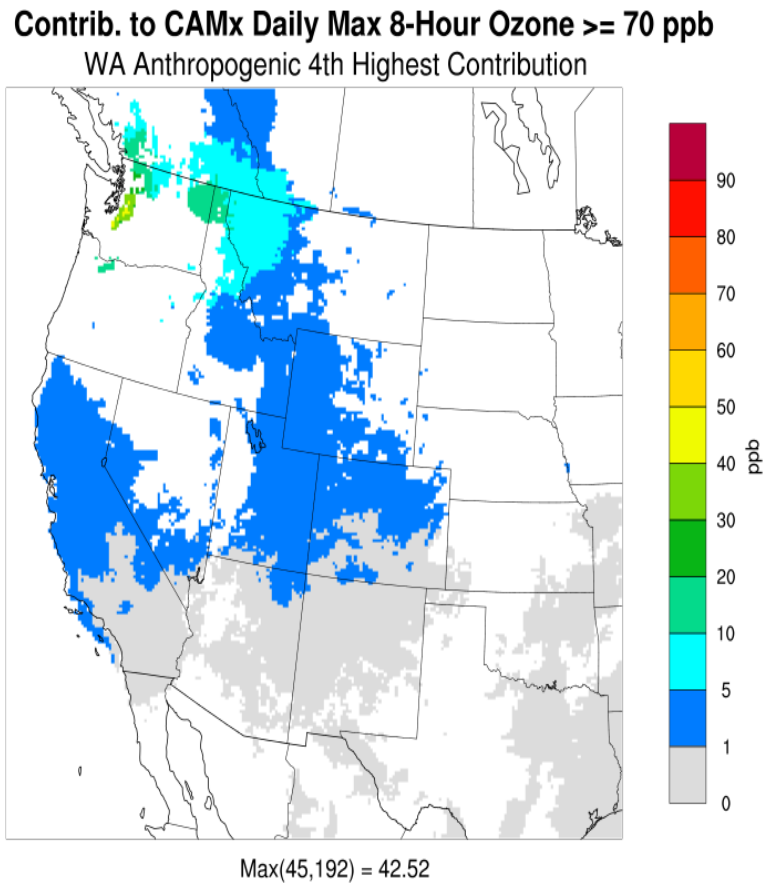


2008 Washington Contribution to 4th High DMAX8 Ozone
from WestJumpAQMS Appendix C

4th Highest DMAX8 Ozone ≥ 76 ppb

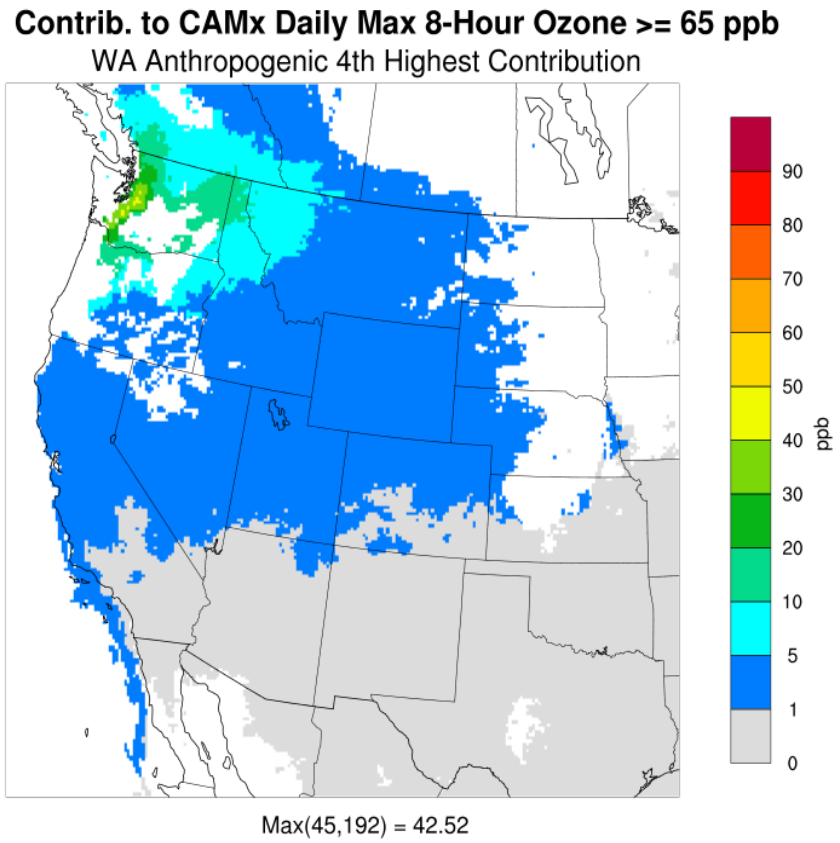


4th Highest DMAX8 Ozone ≥ 70 ppb

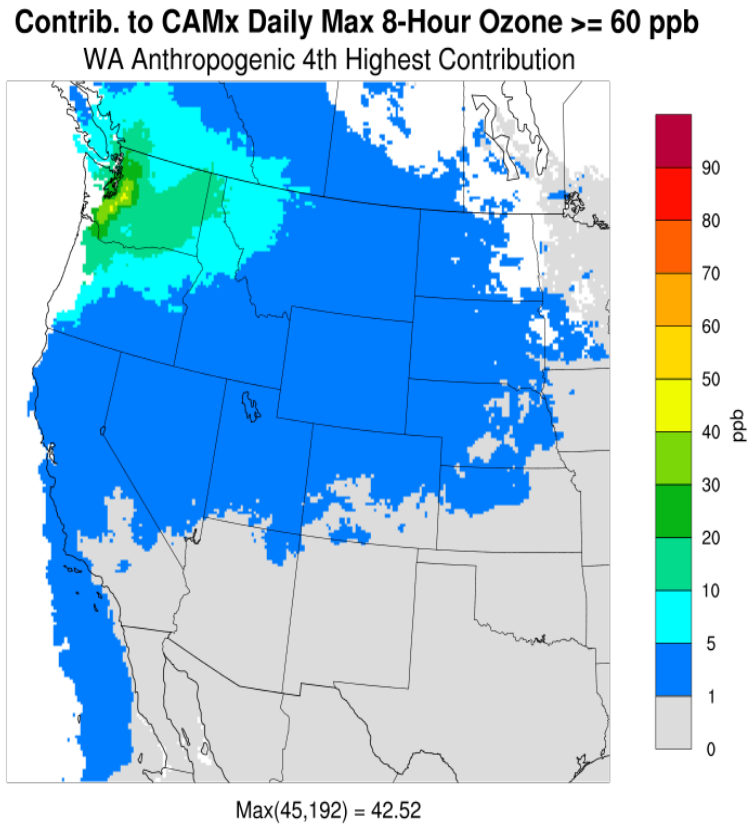


2008 Washington Contribution to 4th High DMAX8 Ozone
from WestJumpAQMS Appendix C

4th Highest MAX8 Ozone ≥ 65ppb

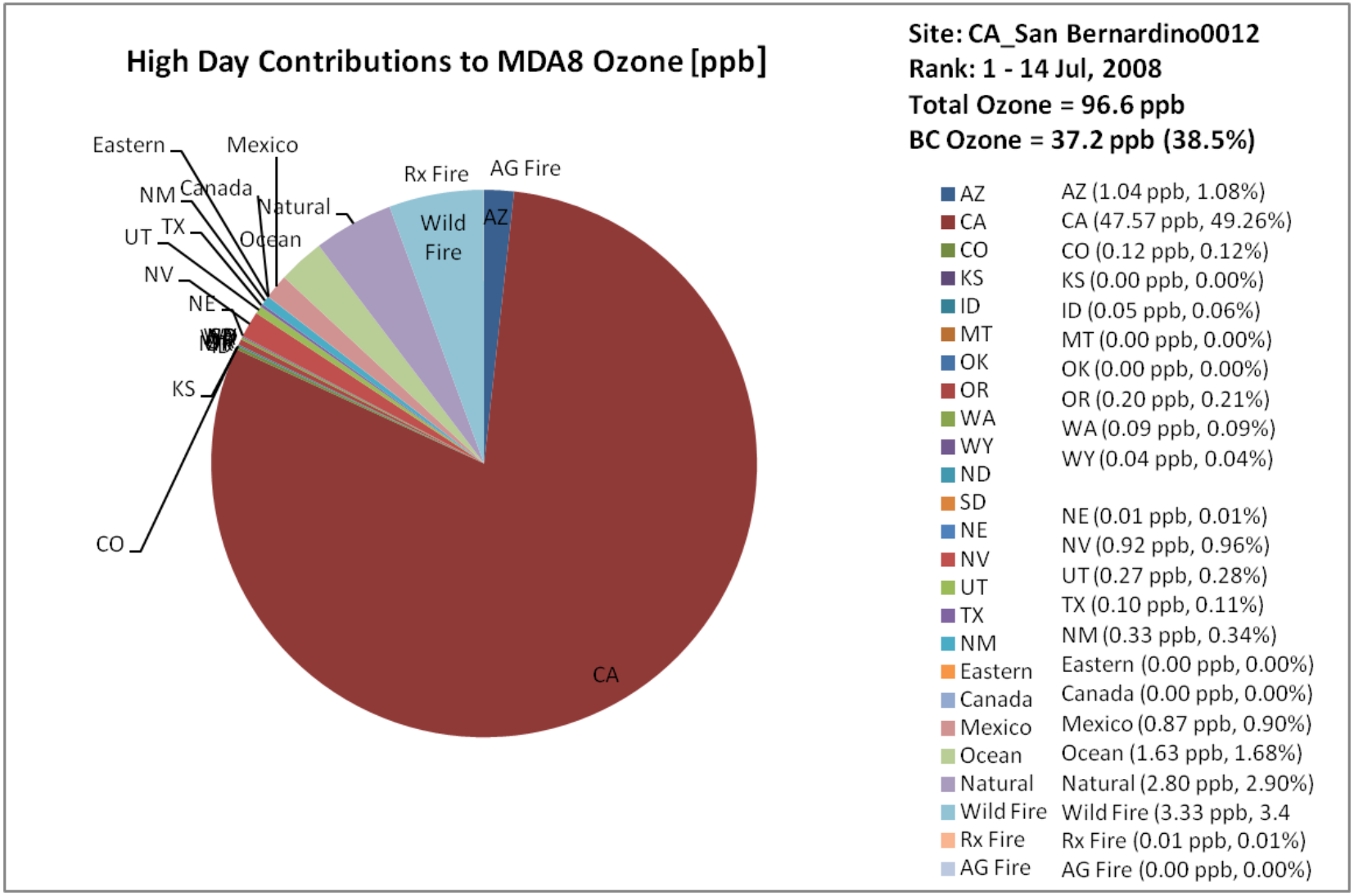


4th Highest DMAX8 Ozone ≥ 60 ppb



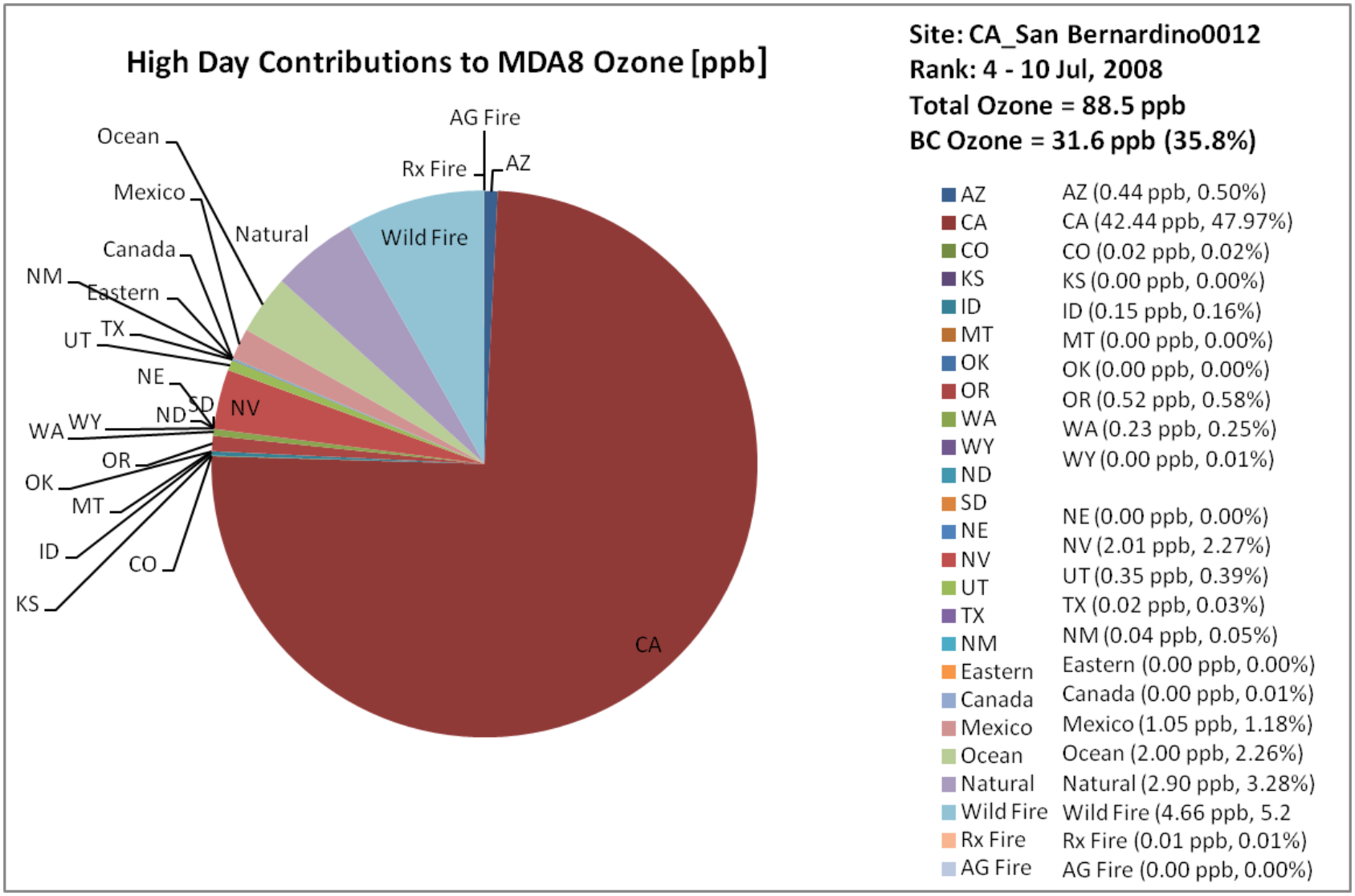
State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

Highest Modeled DMAX8 Day at Phelan



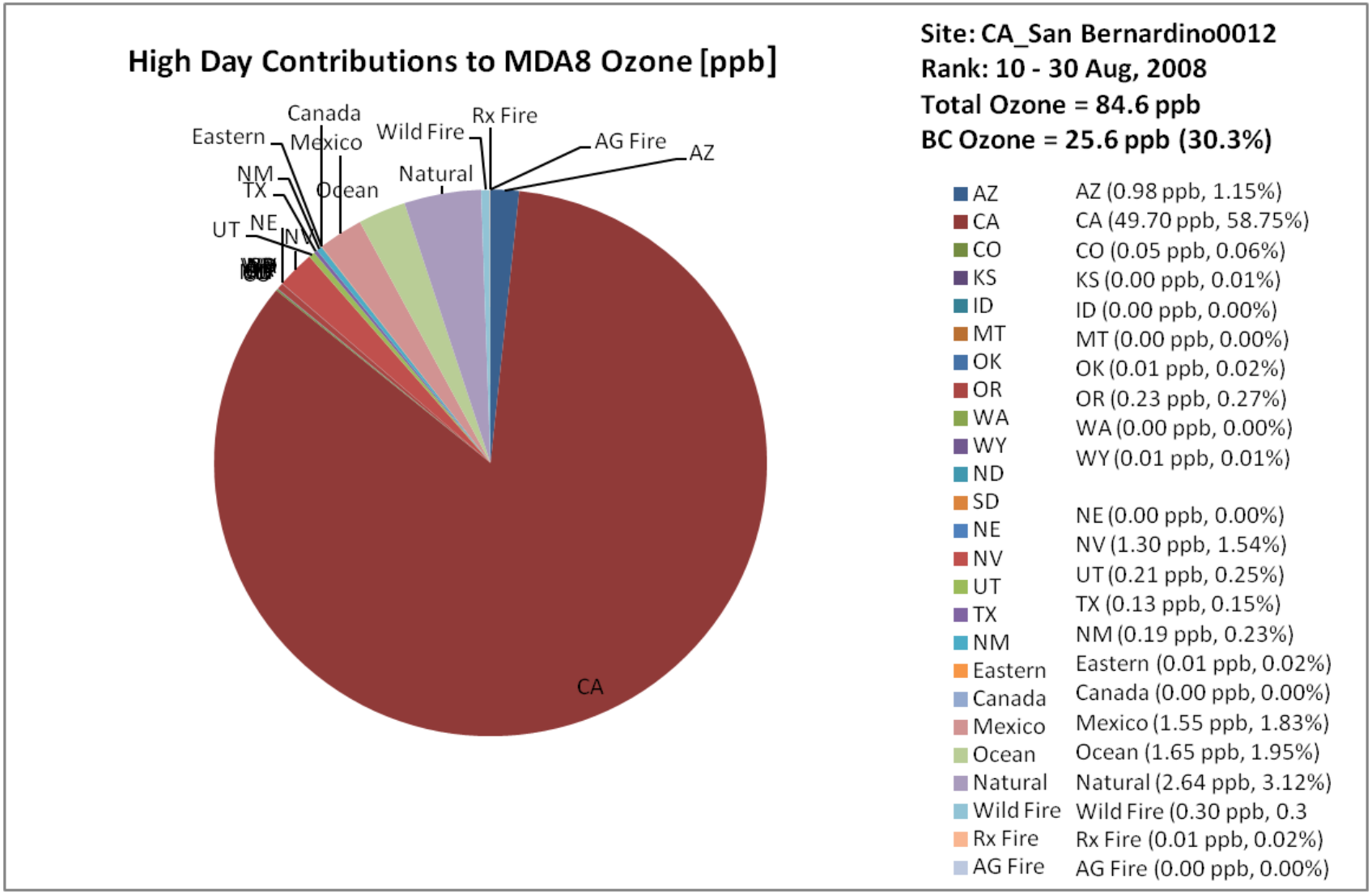
State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

4th Highest Modeled DMAX8 Day at Phelan



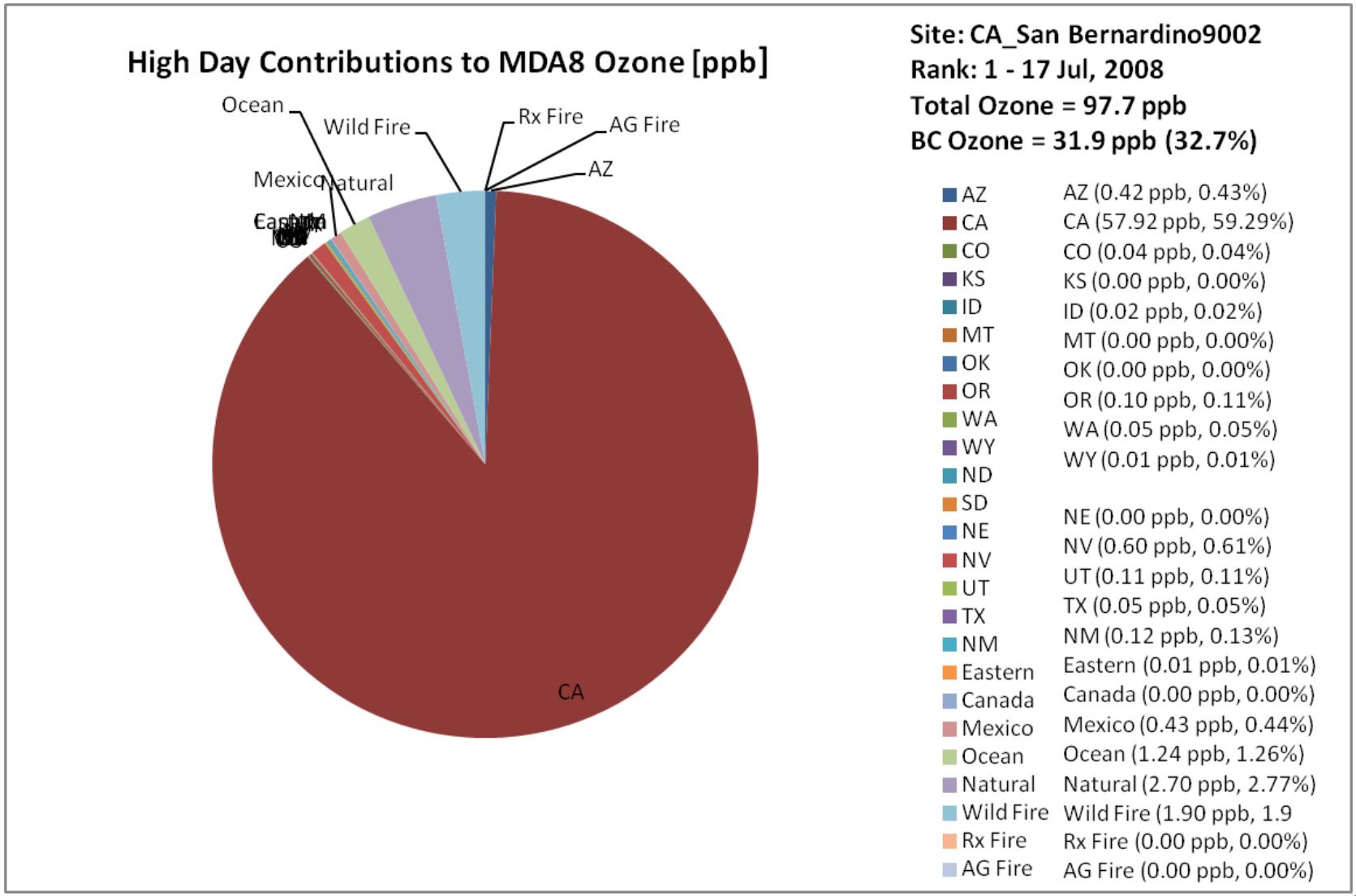
State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

10th Highest Modeled DMAX8 Day at Phelan



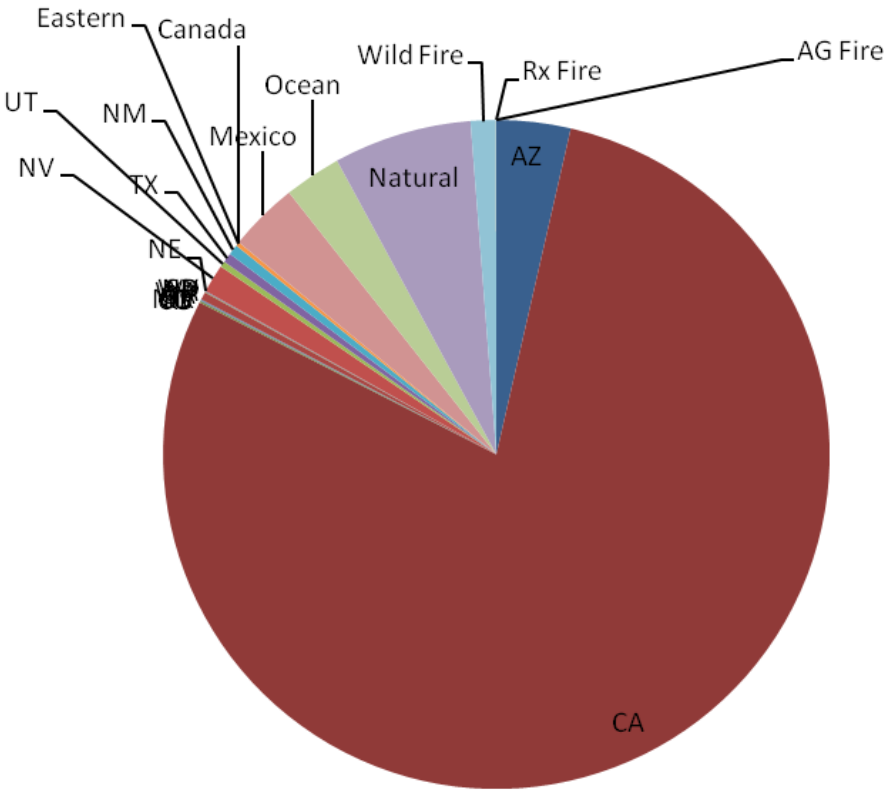
State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

Highest Modeled DMAX8 Day at Joshua Tree National Monument



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

4th Highest Modeled DMAX8 Day at Joshua Tree National Monument

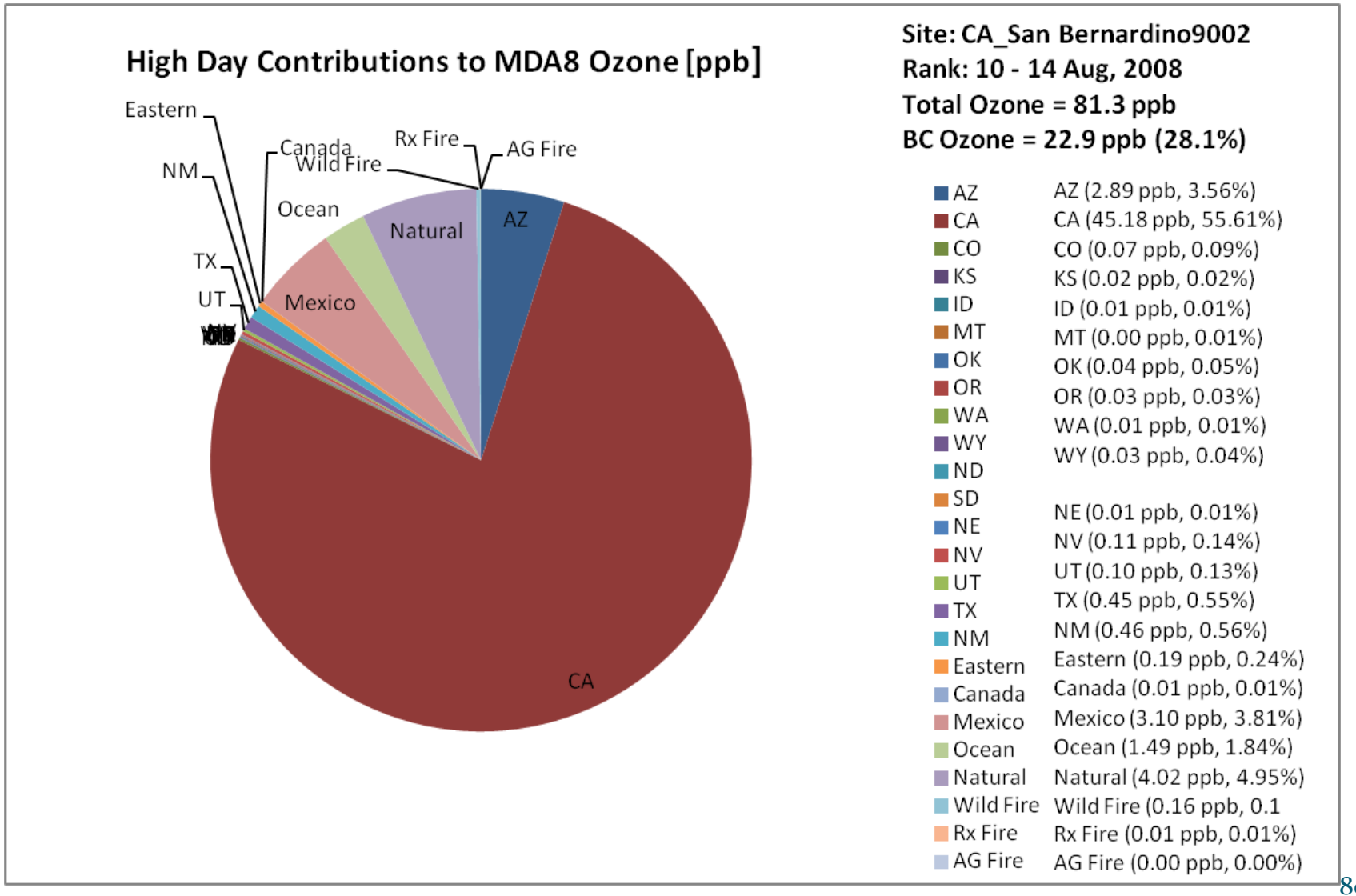


Site: CA_San Bernardino9002
Rank: 4 - 15 Aug, 2008
Total Ozone = 85.8 ppb
BC Ozone = 26.1 ppb (30.4%)

AZ	AZ (2.14 ppb, 2.49%)
CA	CA (47.16 ppb, 54.94%)
CO	CO (0.05 ppb, 0.05%)
KS	KS (0.01 ppb, 0.01%)
ID	ID (0.01 ppb, 0.02%)
MT	MT (0.00 ppb, 0.00%)
OK	OK (0.02 ppb, 0.03%)
OR	OR (0.23 ppb, 0.26%)
WA	WA (0.02 ppb, 0.02%)
WY	WY (0.02 ppb, 0.02%)
ND	
SD	
NE	NE (0.01 ppb, 0.01%)
NV	NV (0.82 ppb, 0.95%)
UT	UT (0.17 ppb, 0.20%)
TX	TX (0.27 ppb, 0.32%)
NM	NM (0.30 ppb, 0.35%)
Eastern	Eastern (0.12 ppb, 0.14%)
Canada	Canada (0.00 ppb, 0.00%)
Mexico	Mexico (2.01 ppb, 2.34%)
Ocean	Ocean (1.64 ppb, 1.92%)
Natural	Natural (3.99 ppb, 4.65%)
Wild Fire	Wild Fire (0.73 ppb, 0.8
Rx Fire	Rx Fire (0.01 ppb, 0.01%)
AG Fire	AG Fire (0.00 ppb, 0.00%)

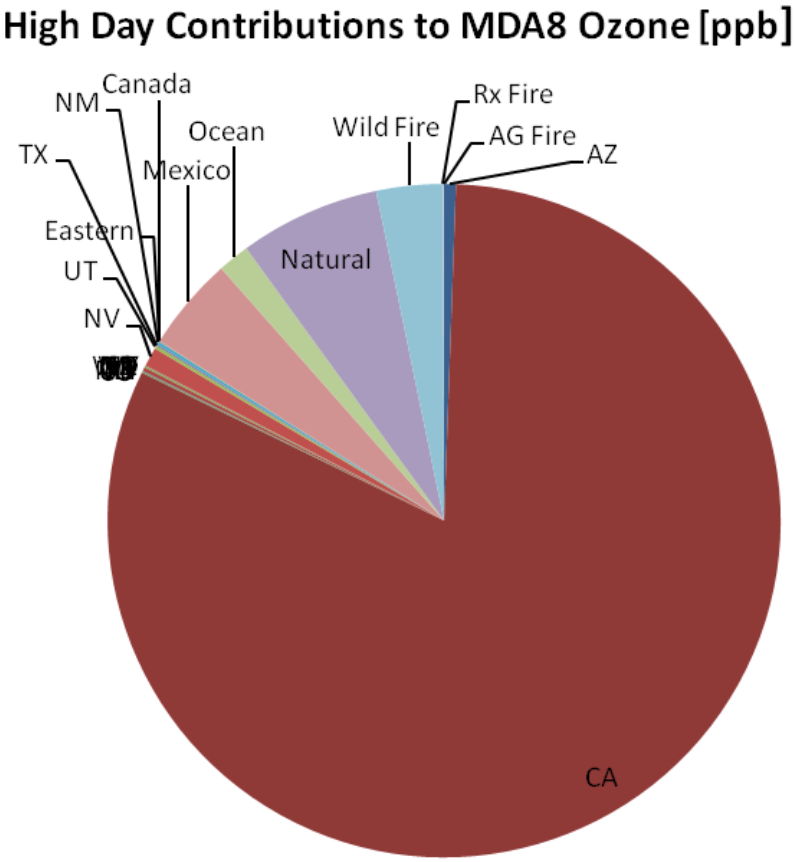
State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

10th Highest Modeled DMAX8 Day at Joshua Tree National Monument



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

Highest Modeled DMAX8 Day at 1029 Belcher St., Calexico

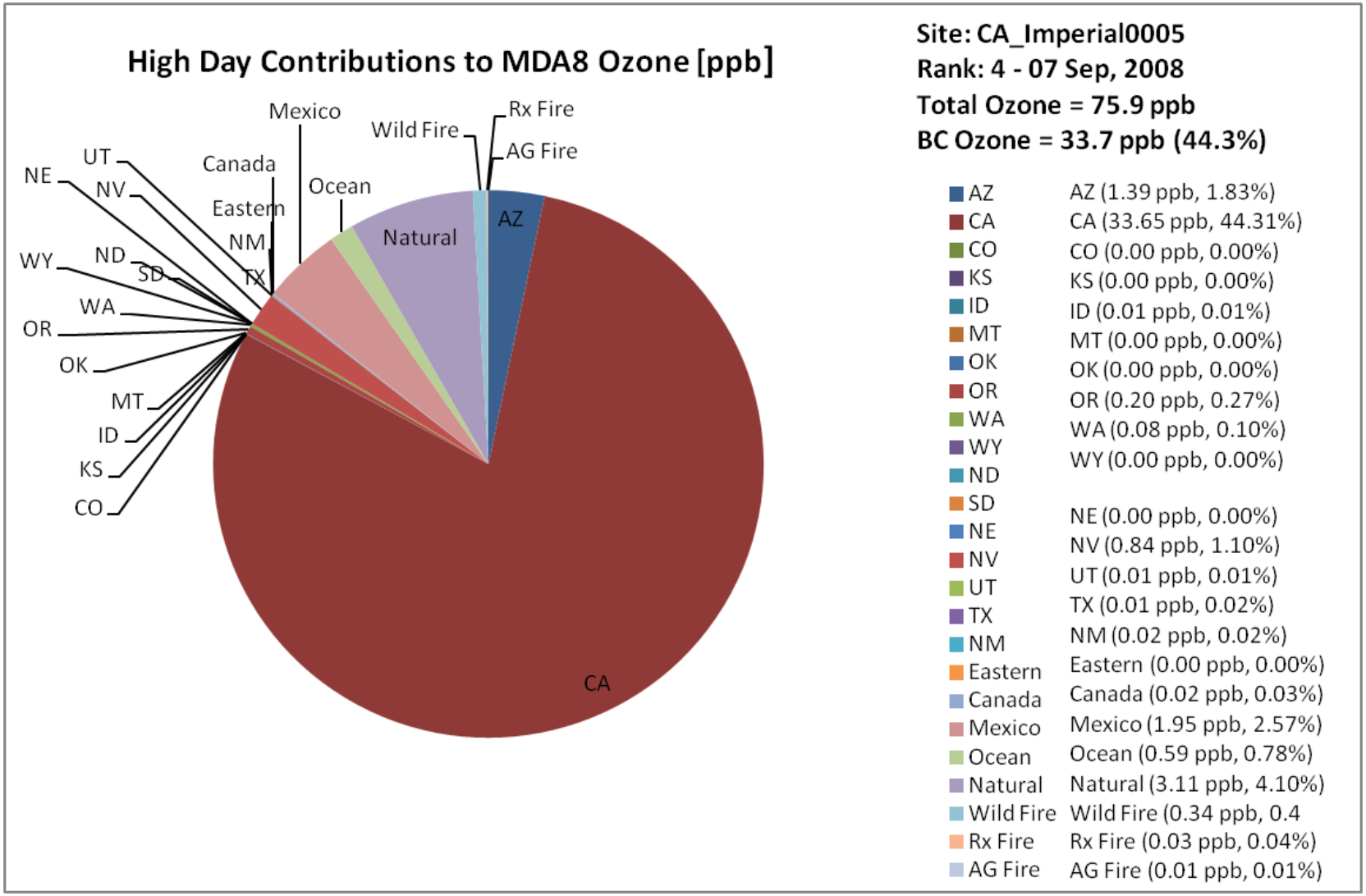


Site: CA_Imperial0005
Rank: 1 - 18 Jul, 2008
Total Ozone = 87.8 ppb
BC Ozone = 35.1 ppb (40.0%)

AZ	AZ (0.30 ppb, 0.34%)
CA	CA (43.01 ppb, 49.01%)
CO	CO (0.03 ppb, 0.03%)
KS	KS (0.00 ppb, 0.00%)
ID	ID (0.02 ppb, 0.02%)
MT	MT (0.00 ppb, 0.00%)
OK	OK (0.00 ppb, 0.00%)
OR	OR (0.10 ppb, 0.11%)
WA	WA (0.04 ppb, 0.05%)
WY	WY (0.01 ppb, 0.01%)
ND	
SD	
NE	NE (0.00 ppb, 0.00%)
NV	NV (0.48 ppb, 0.55%)
UT	UT (0.08 ppb, 0.09%)
TX	TX (0.04 ppb, 0.04%)
NM	NM (0.09 ppb, 0.10%)
Eastern	Eastern (0.01 ppb, 0.01%)
Canada	Canada (0.00 ppb, 0.00%)
Mexico	Mexico (2.38 ppb, 2.72%)
Ocean	Ocean (0.80 ppb, 0.91%)
Natural	Natural (3.56 ppb, 4.06%)
Wild Fire	Wild Fire (1.68 ppb, 1.9
Rx Fire	Rx Fire (0.00 ppb, 0.00%)
AG Fire	AG Fire (0.02 ppb, 0.03%)

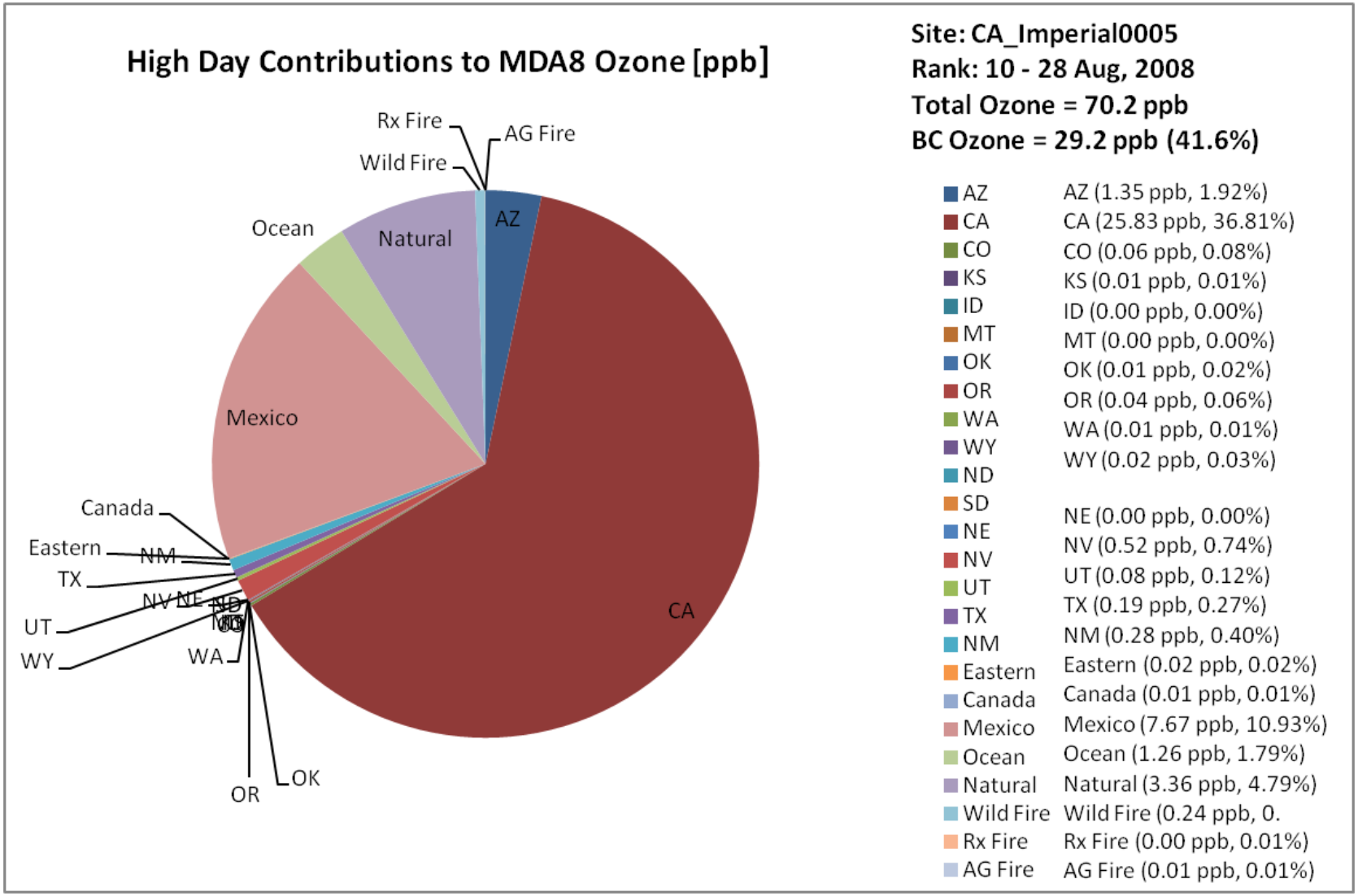
State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

4th Highest Modeled DMAX8 Day at 1029 Belcher St., Calexico



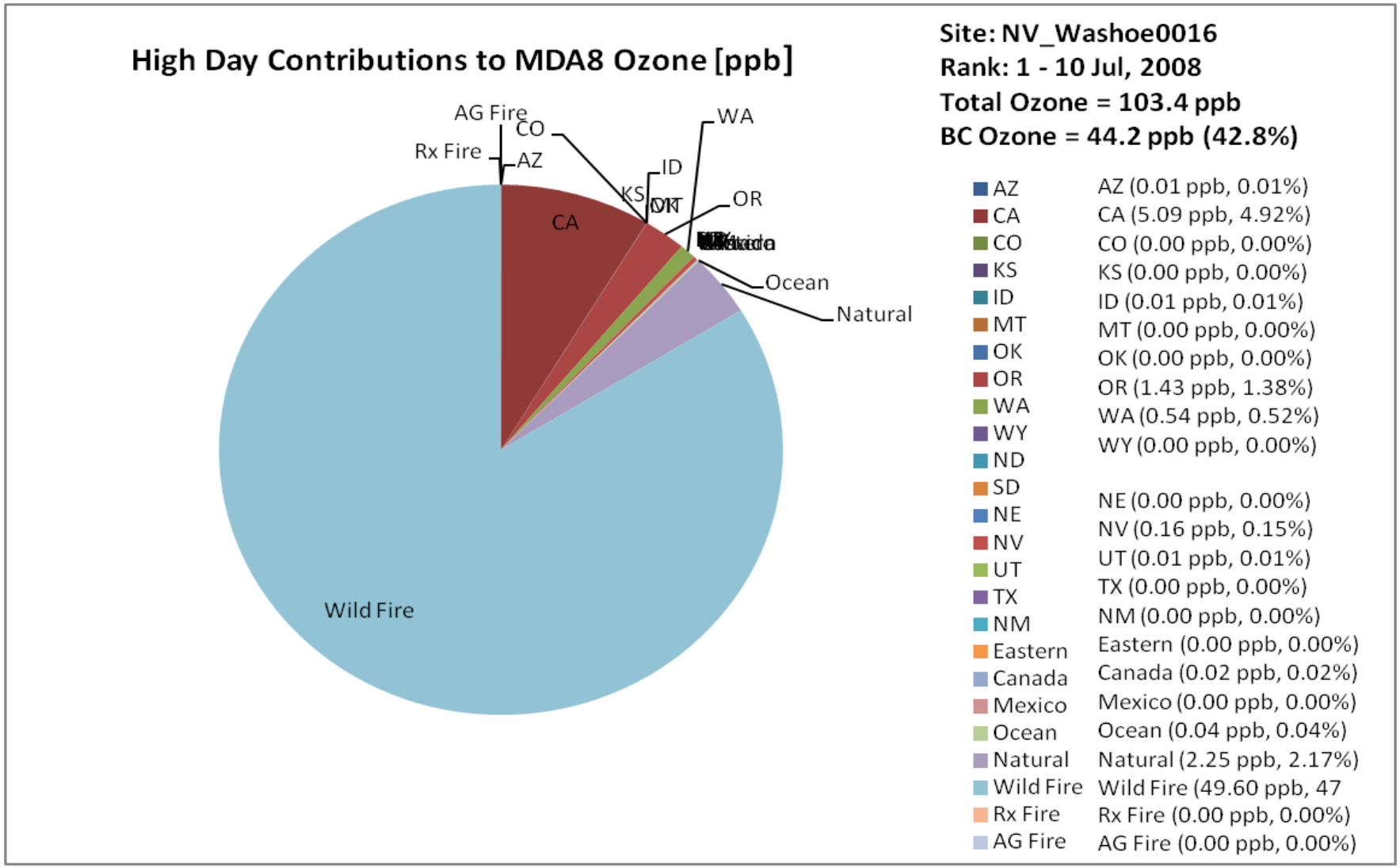
State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

10th Highest Modeled DMAX8 Day at 1029 Belcher St., Calexico



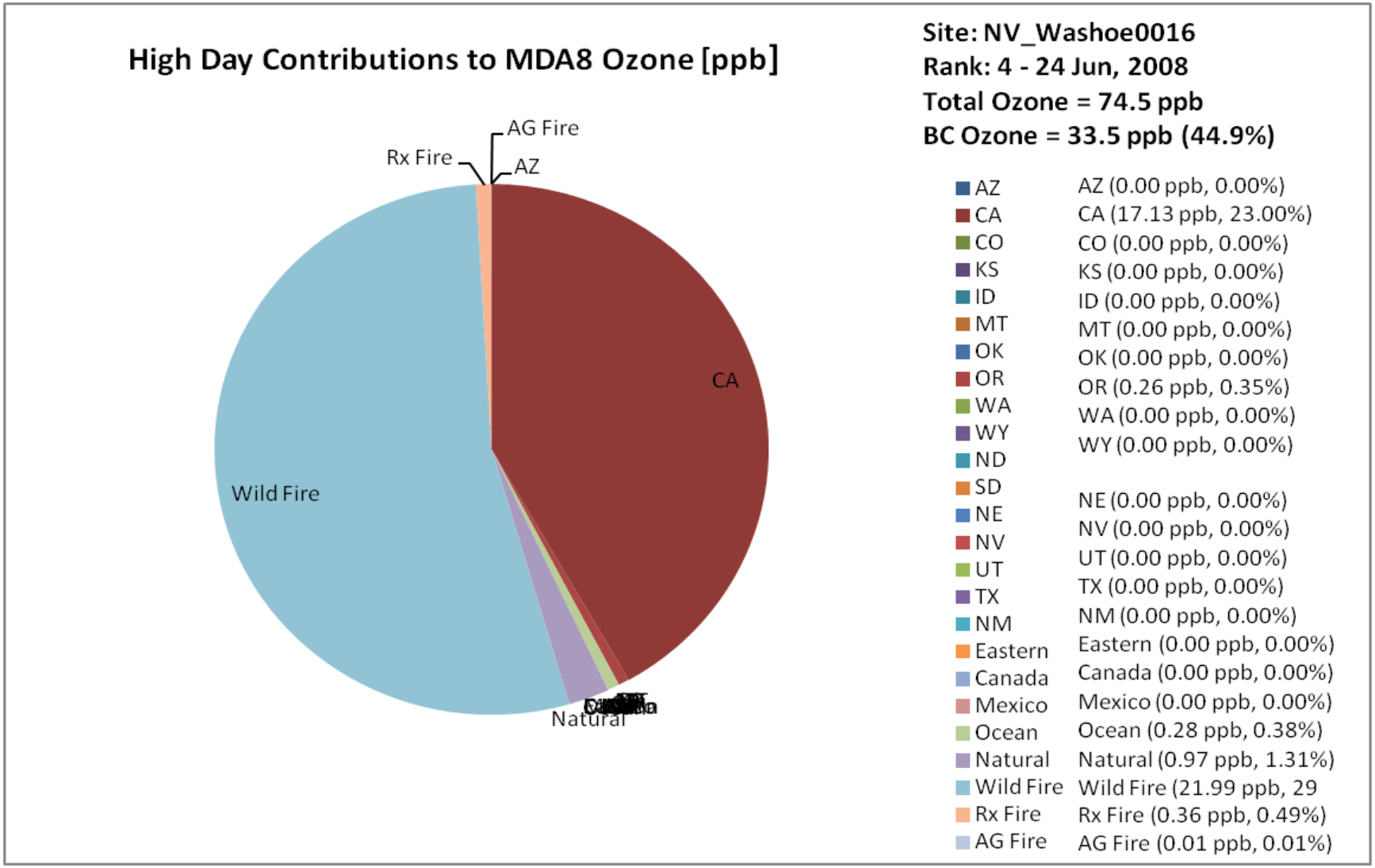
State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

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



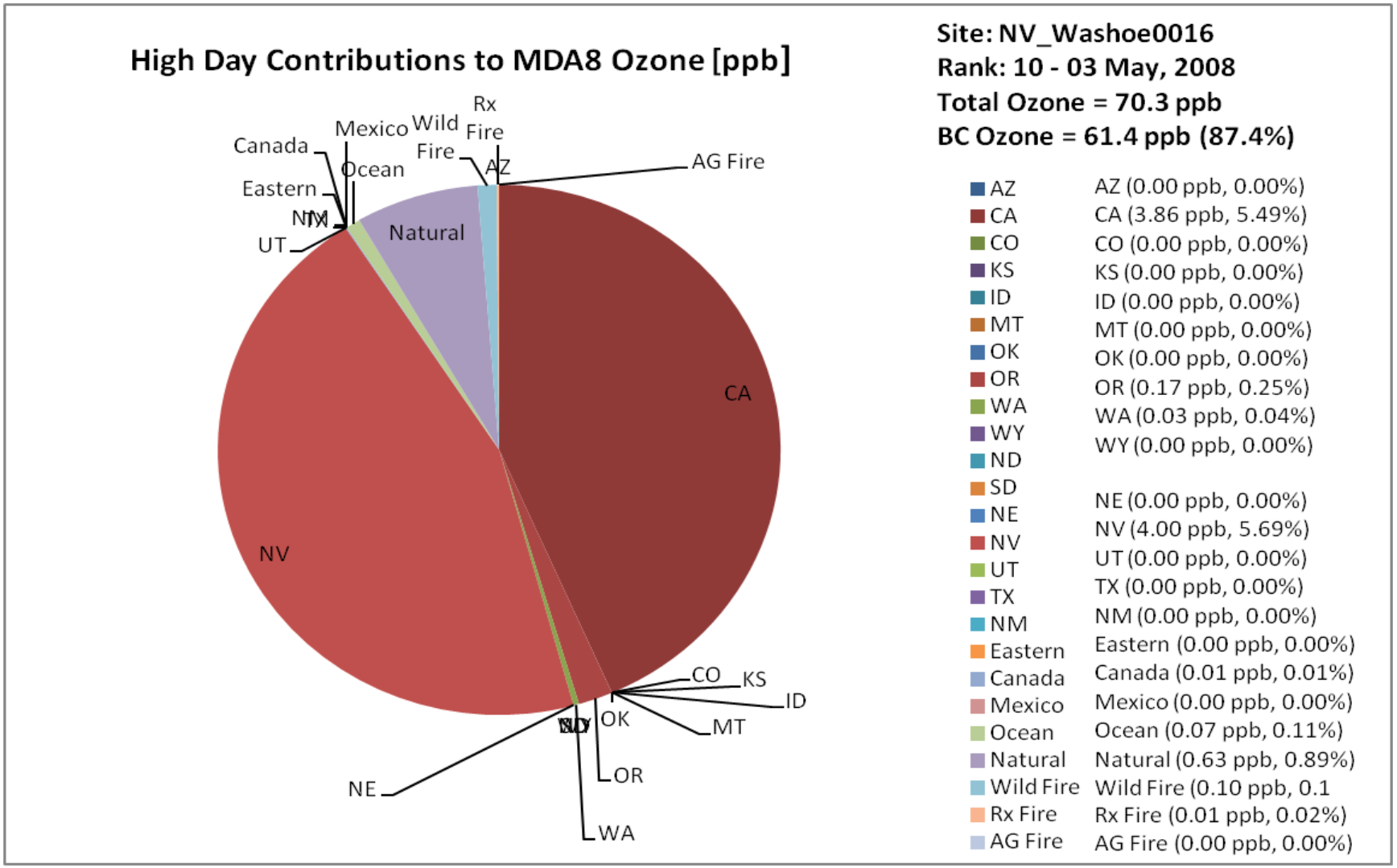
State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

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



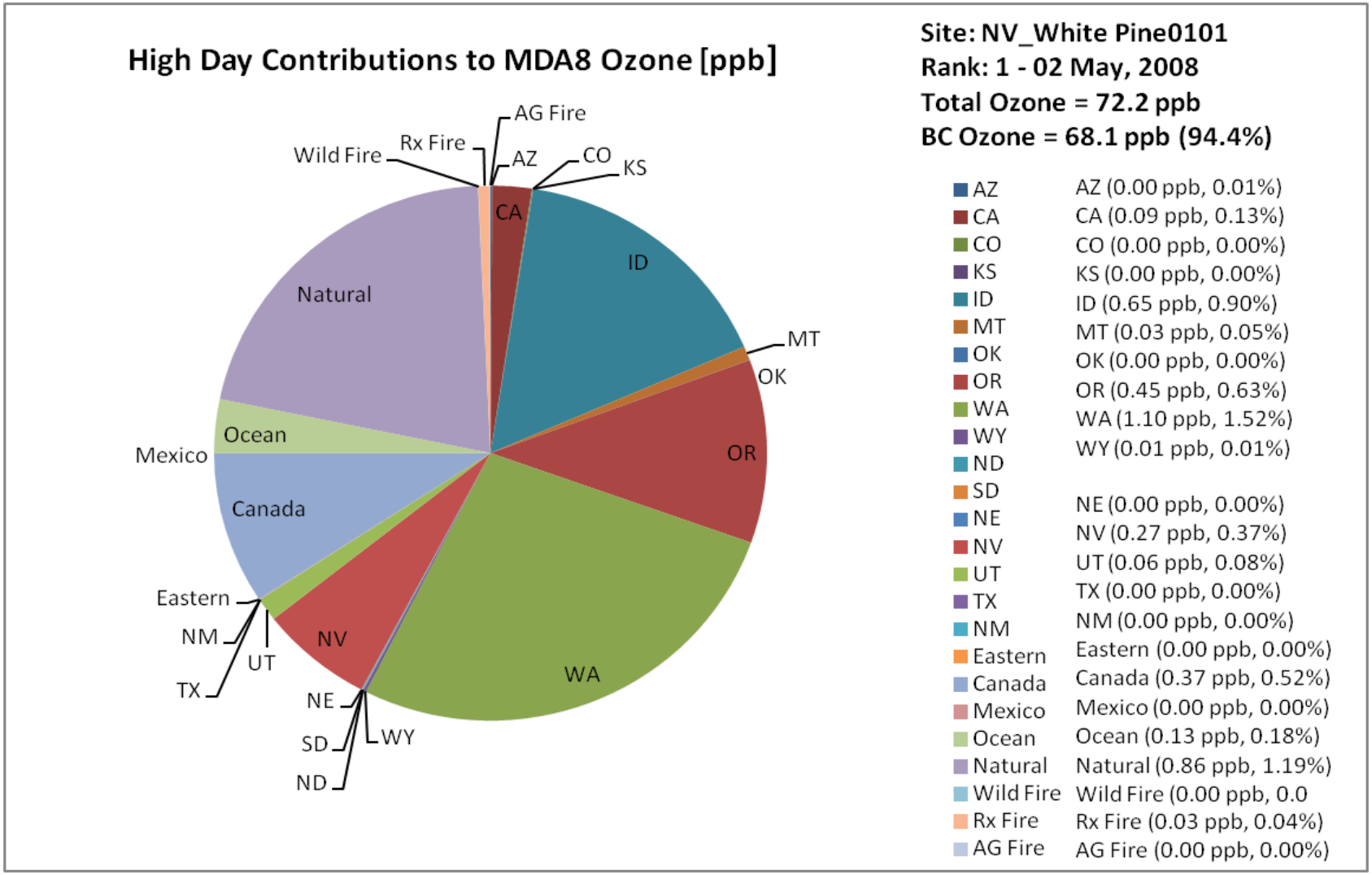
State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

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



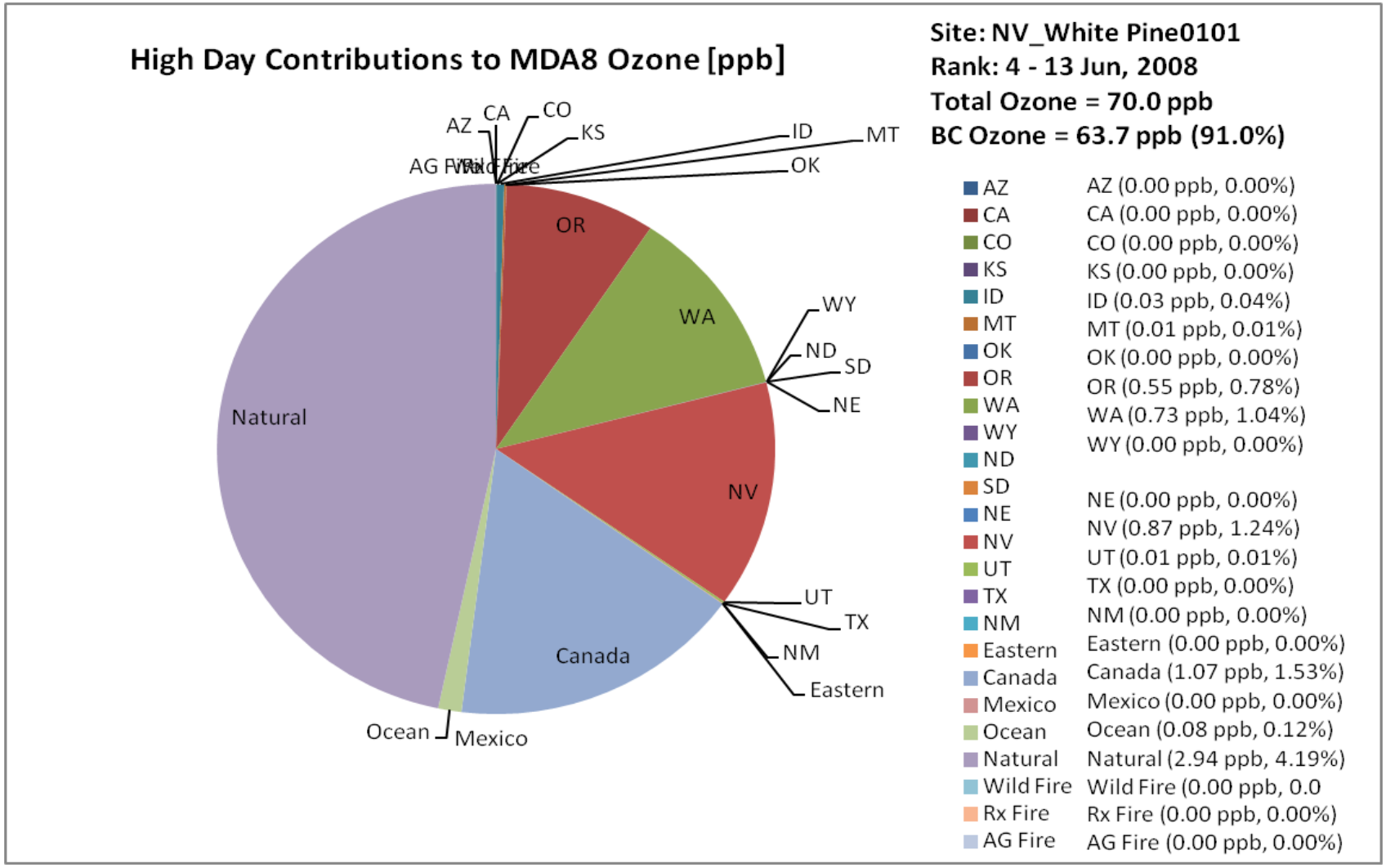
State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

Highest Modeled DMAX8 Day at Great Basin NP, White Pine County



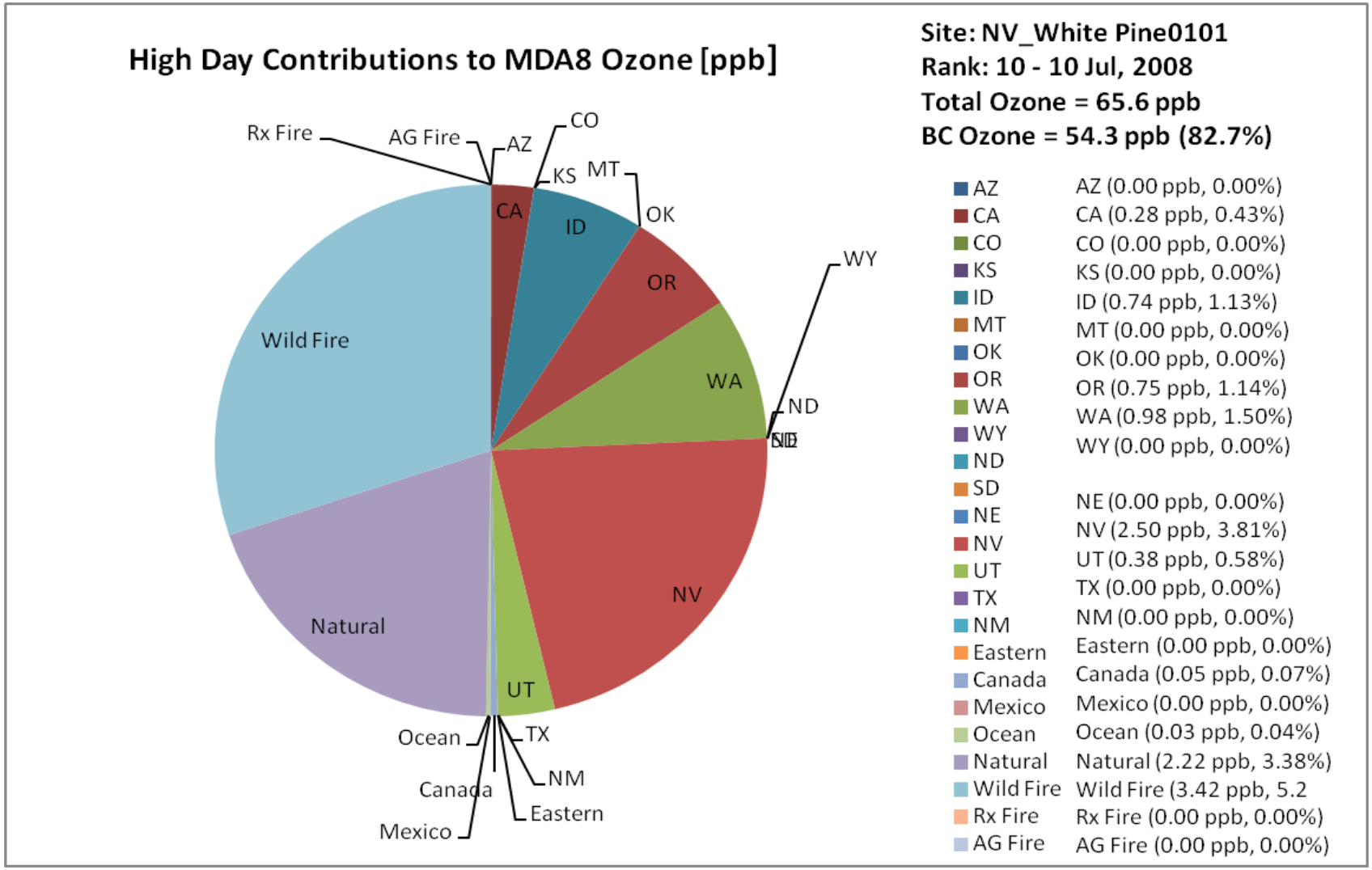
State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

4th Highest Modeled DMAX8 Day Great Basin NP, White Pine County



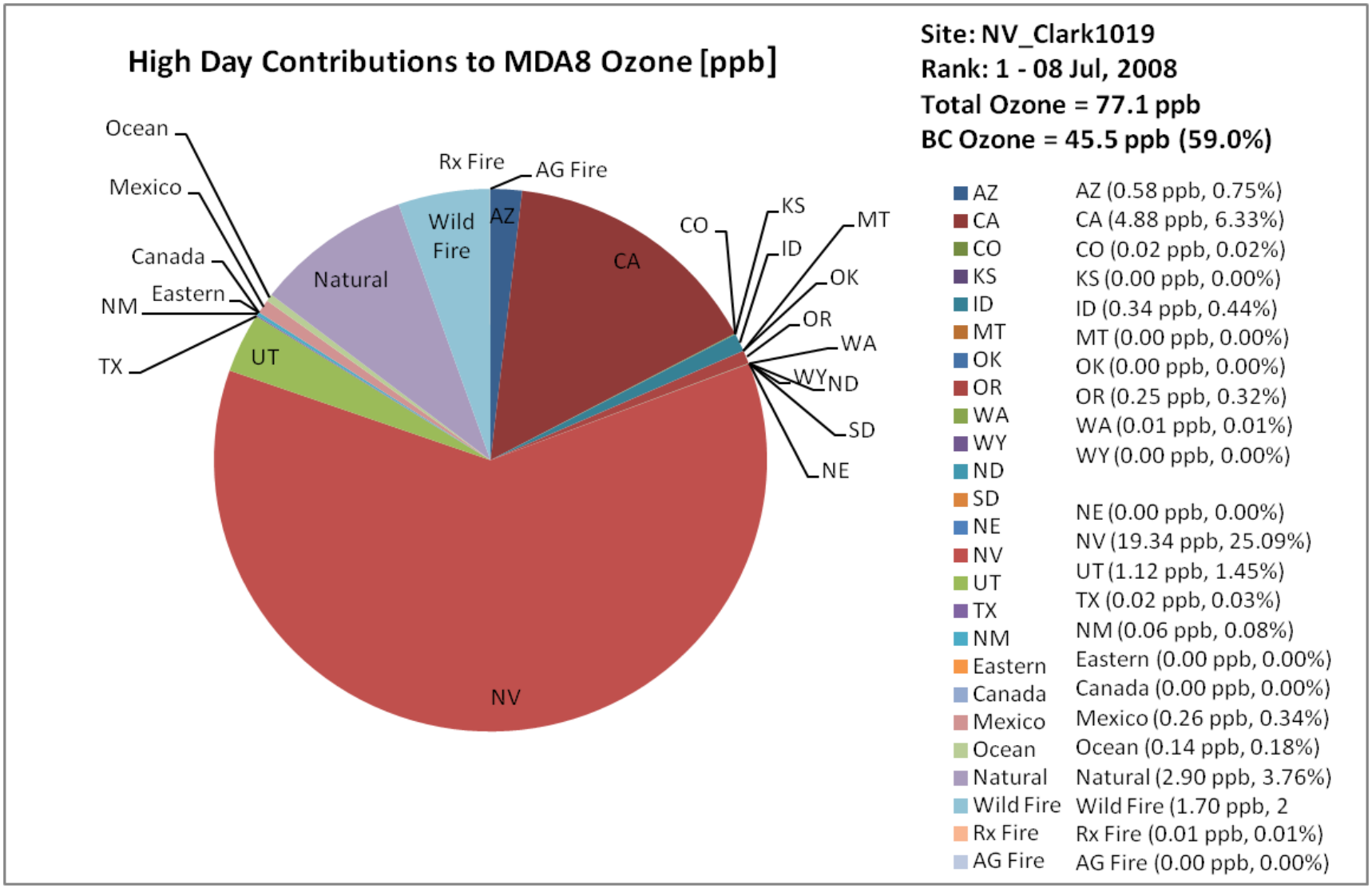
State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

10th Highest Modeled DMAX8 Day Great Basin NP, White Pine County



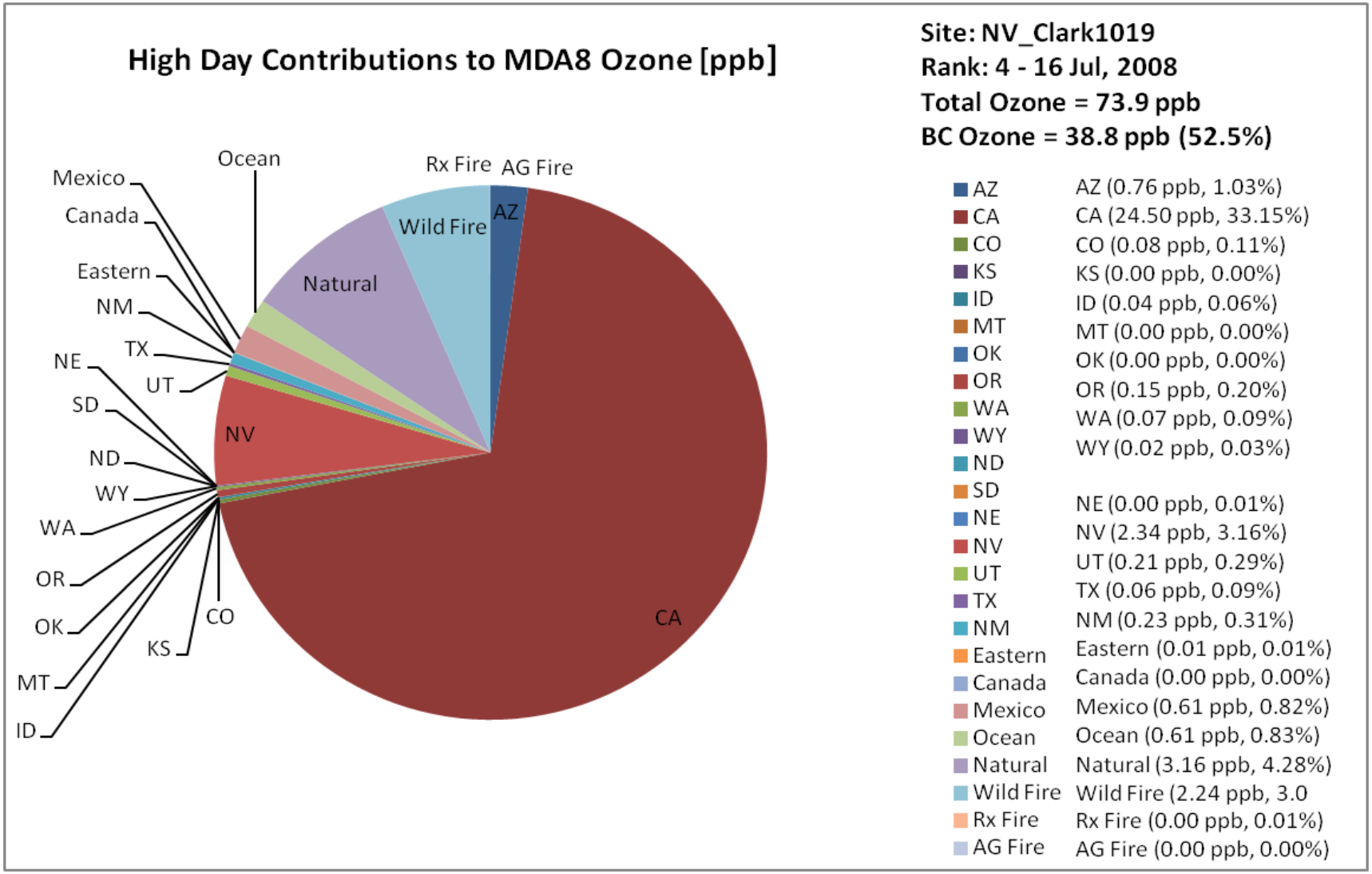
State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

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



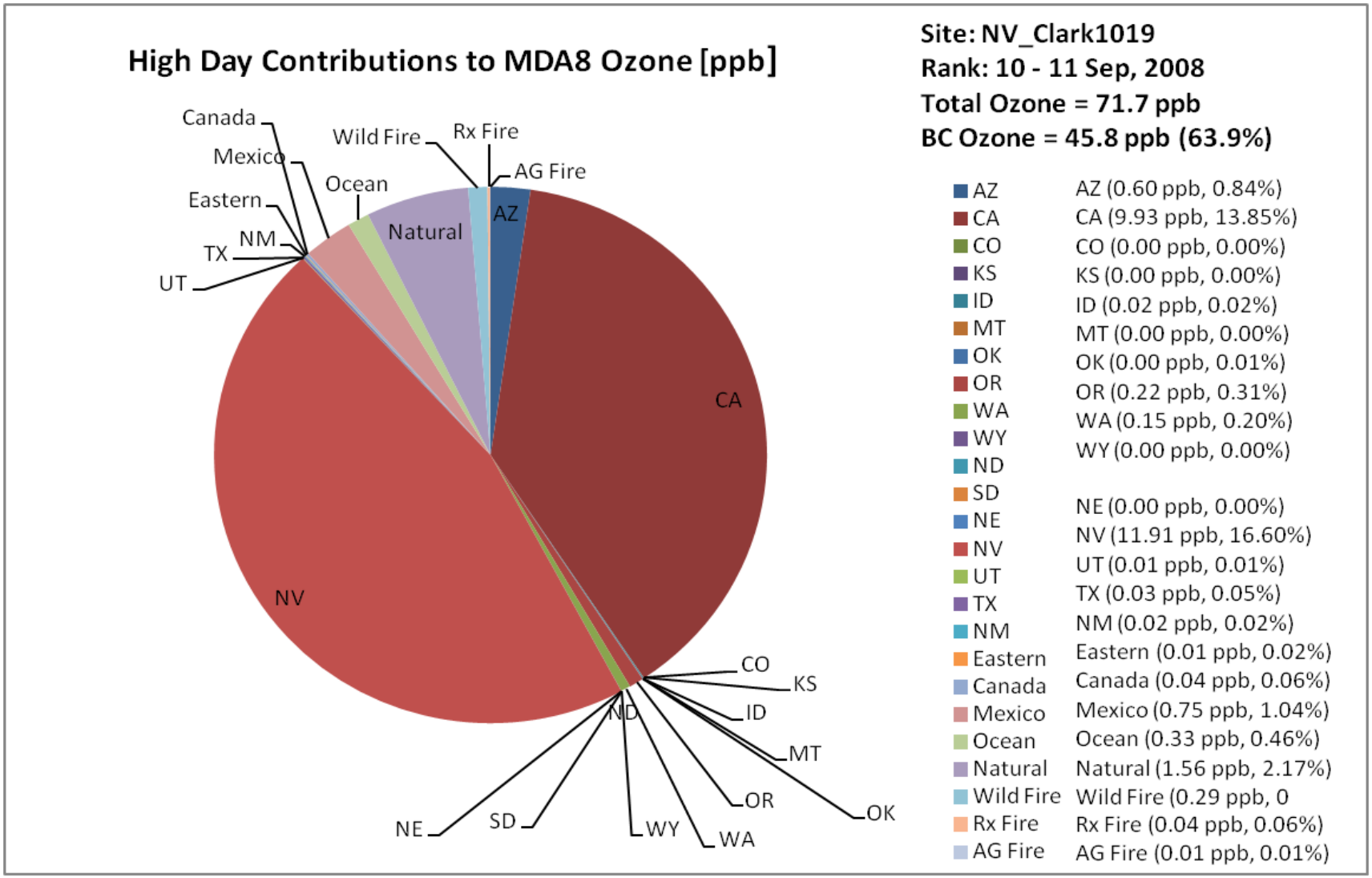
State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

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

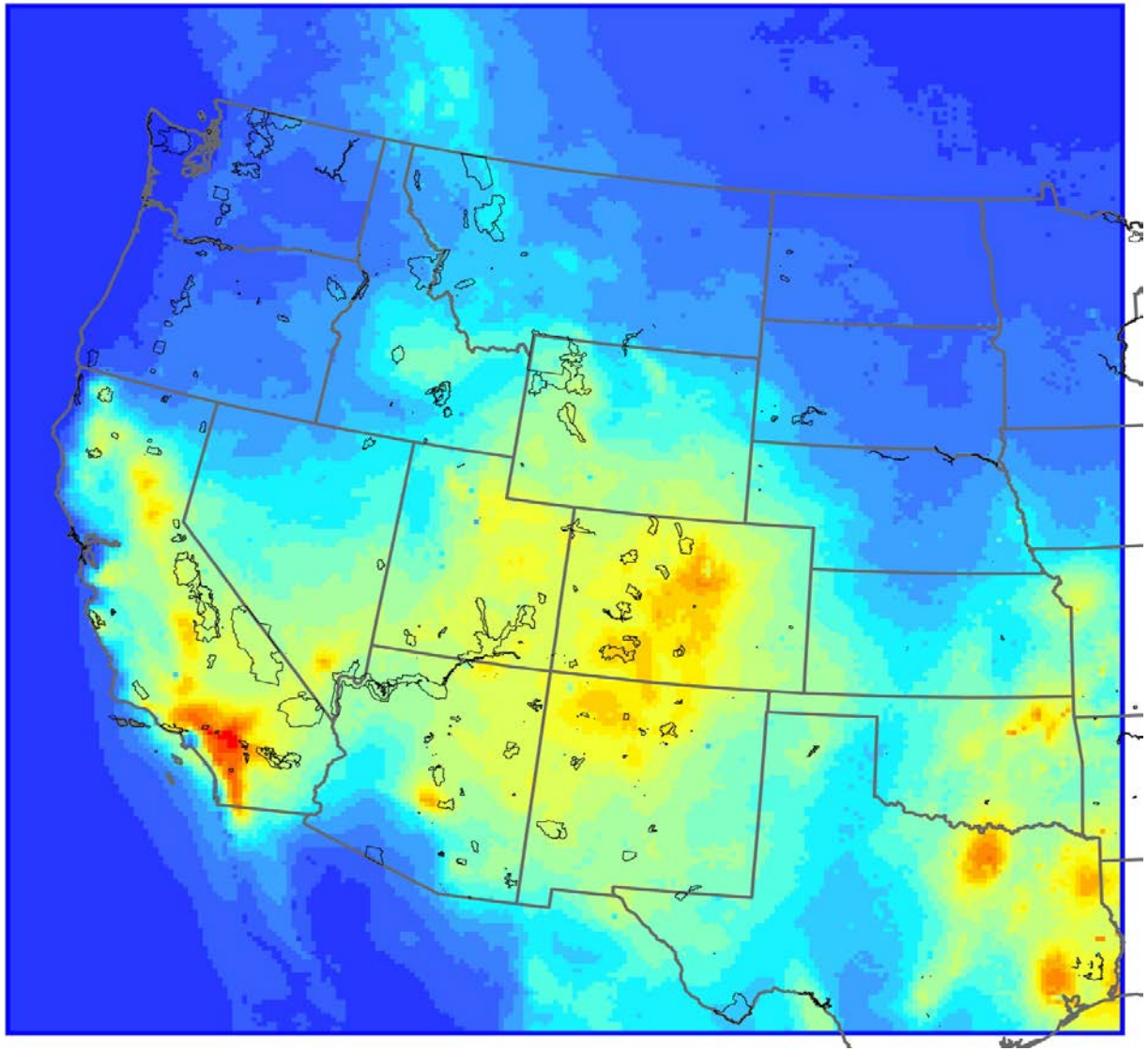


State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

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



WestJumpAQMS Maximum Ozone Season W126 (ppm-hrs)

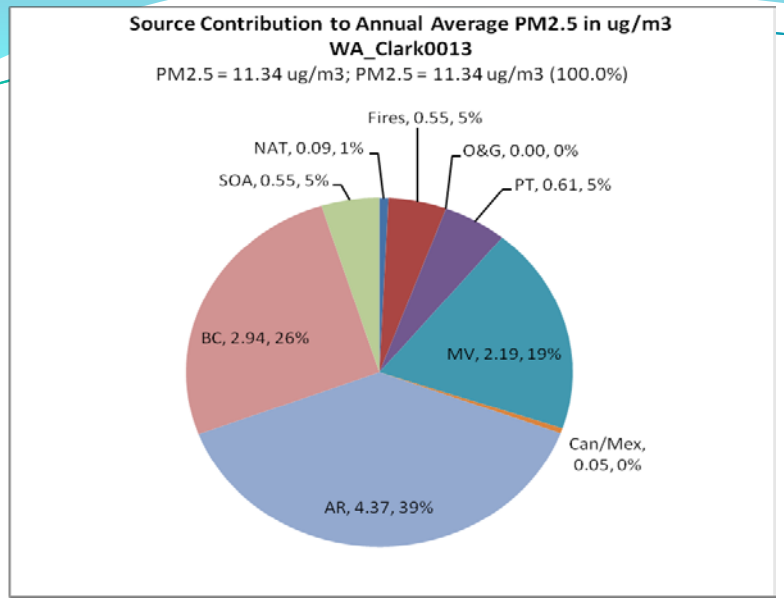


Max W126 (ppm-hrs)

BC_w126

- 0.0
- 0.1 - 3.0
- 3.1 - 5.0
- 5.1 - 7.0
- 7.1 - 9.0
- 9.1 - 10.5
- 10.6 - 12.0
- 12.1 - 13.5
- 13.6 - 15.0
- 15.1 - 17.0
- 17.1 - 19.0
- 19.1 - 21.0
- 21.1 - 23.0
- 23.1 - 25.0
- 25.1 - 27.0
- 27.1 - 30.0
- 30.1 - 35.0
- 35.1 - 40.0
- 40.1 - 45.0
- 45.1 - 50.0

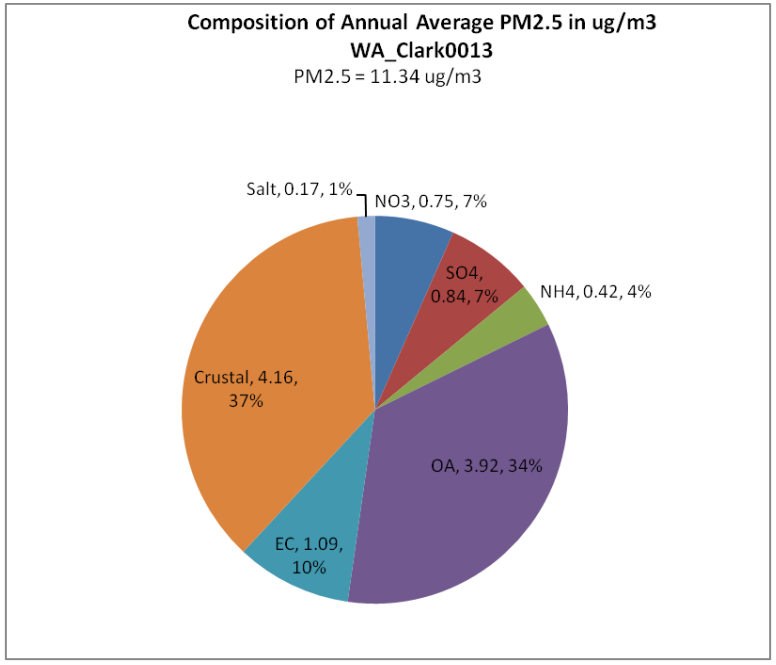
Annual Average $PM_{2.5}$ (µg/m³) Vancouver 4th Plain Blvd. site

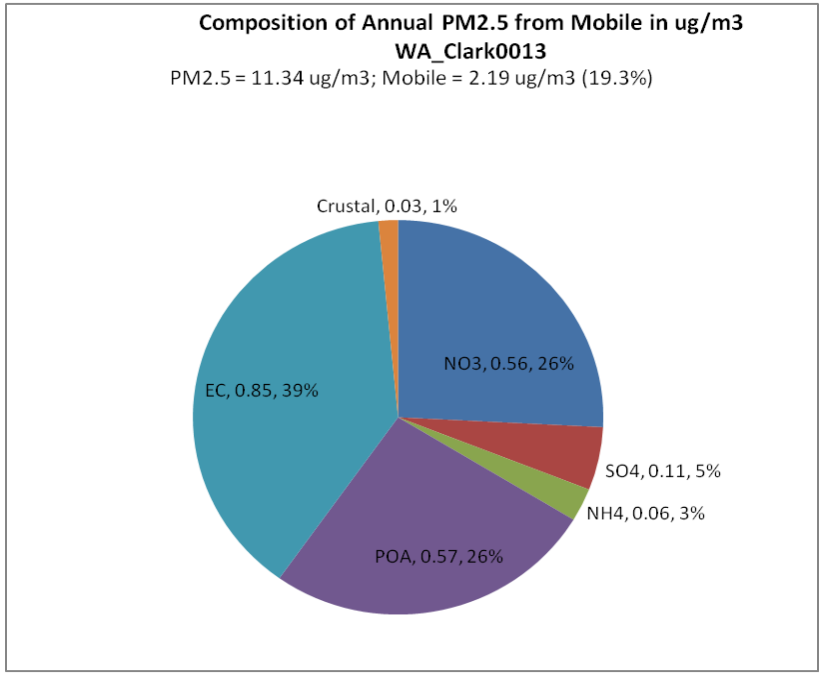


Sources

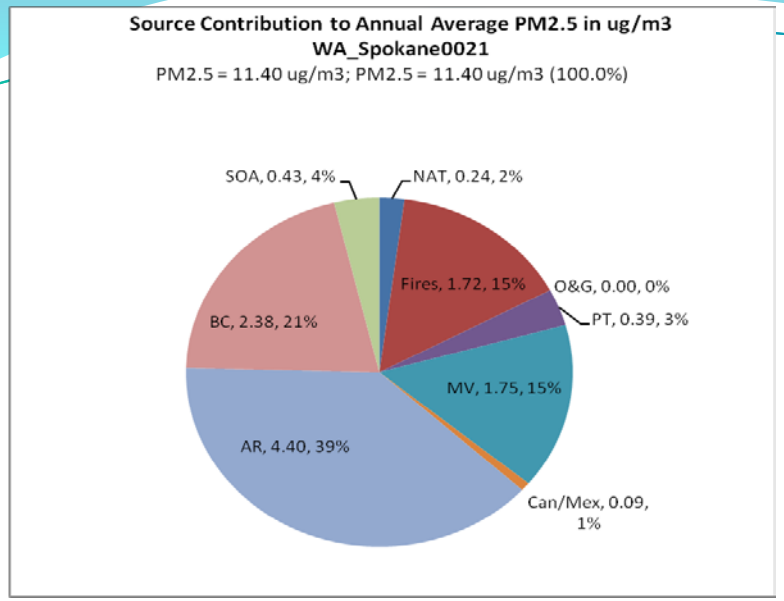
Composition

Source category Composition example





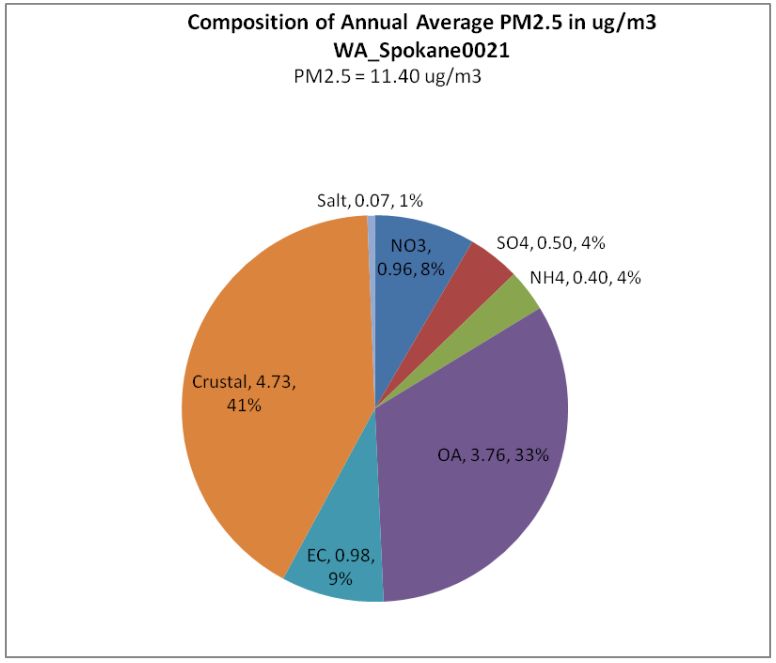
Annual Average $PM_{2.5}$ (µg/m³) Spokane site

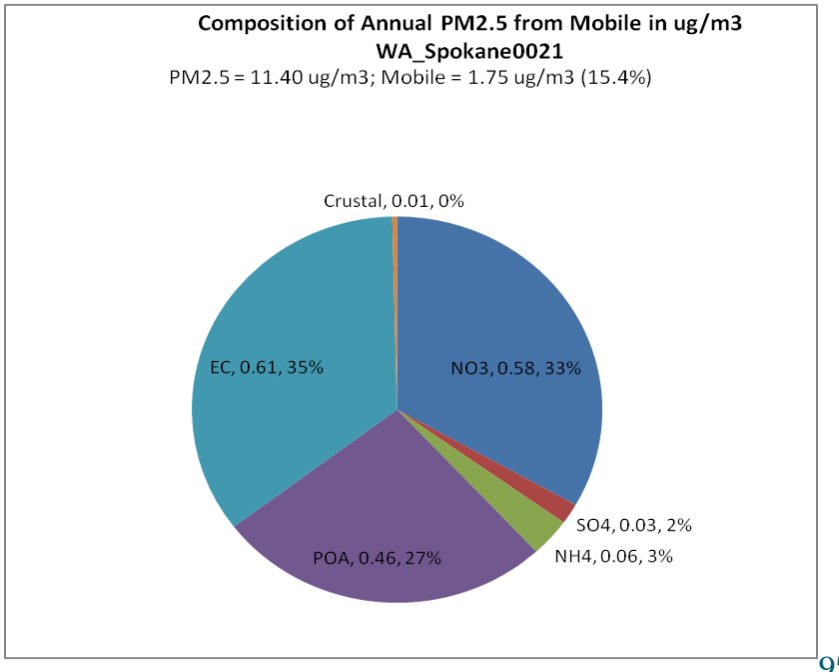


Sources

Composition

Source category Composition example





WestJumpAQMS Benefited From

- WRAP Regional Modeling Center (2002 Platform)
- Four Corners Air Quality Task Force (2005 Platform)
- Continental Divide-Creston EIS (2005/2006 Platform)
  - NEPA O&G EIS using PGM for far-field AQ/AQRV
- Denver Ozone SIP Modeling and Follow-On
- 2008 National Emissions Inventory (2008 NEIv2.0)
  - Cornerstone to 2008 emissions
- WRAP Phase III O&G Emissions Study
  - Projected to 2008 plus add Permian Basin
- WESTAR-funded MEGAN Biogenic Emissions Enhancement Study
- DEASCO$_3$ 2008 Fire Emissions

Benefited from WestJumpAQMS

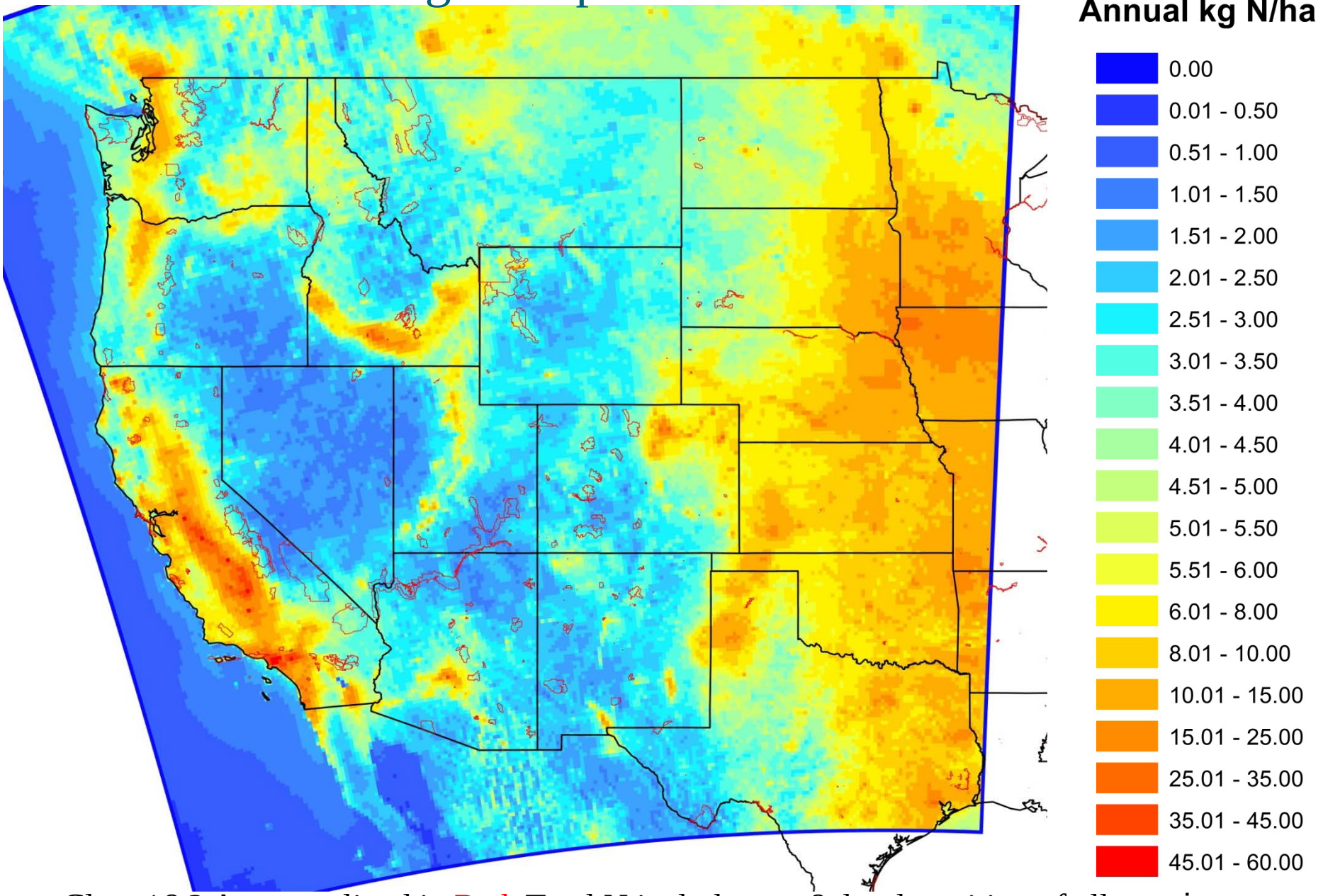
- Colorado Air Resource Management Study (CARMMS)
  - 2008 4 km Modeling Platform
- Deterministic & Empirical Assessment of Smoke's Contribution to Ozone (DEASCO$_3$)
  - 2008 36/12 km Modeling Platform
- PMDETAIL -- Smoke contributions to PM
  - 2011 36/12 km Modeling Platform
- Western Air Quality Data Warehouse (WAQDW) and Three-State Air Quality Study (3SAQS)
  - 2008, 2011, 2014 36/12/4 km Modeling Platform; database for DW
- Additional Follow-On Studies
  - NPS, BLM, states, locals, etc.

Nitrogen Deposition

Summary of WestJumpAQMS 2008 Modeling Results - Nitrogen Deposition Analysis

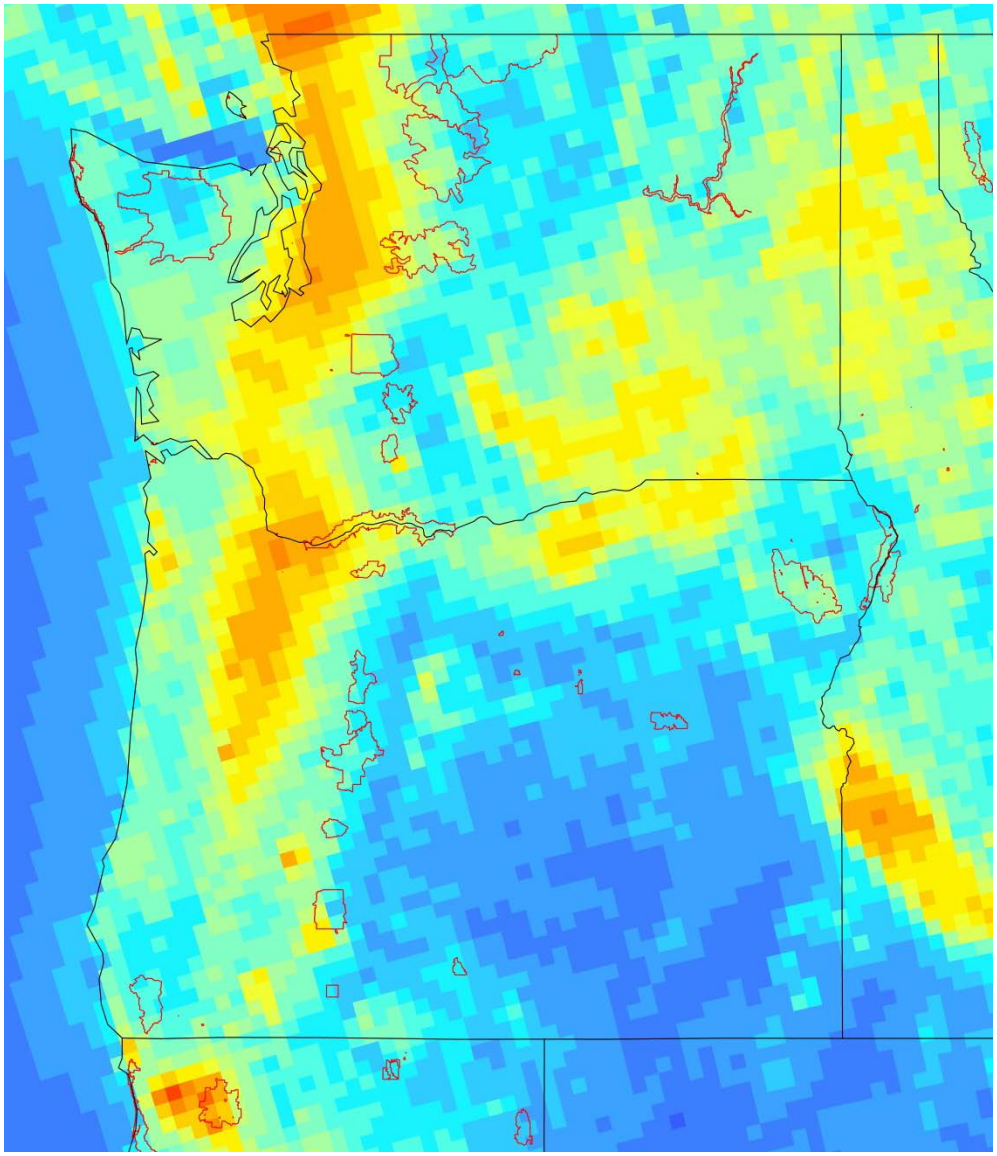
- Thanks to Tammy M. Thompson, CIRA, and Michael G. Barna, NPS for modeling results and slides

Modeled Total Nitrogen Deposition



Class 1&2 Areas outlined in Red. Total N includes wet&dry deposition of all species.

Modeled Total Nitrogen Deposition



Annual kg N/ha

- 0.00
- 0.01 - 0.50
- 0.51 - 1.00
- 1.01 - 1.50
- 1.51 - 2.00
- 2.01 - 2.50
- 2.51 - 3.00
- 3.01 - 3.50
- 3.51 - 4.00
- 4.01 - 4.50
- 4.51 - 5.00
- 5.01 - 5.50
- 5.51 - 6.00
- 6.01 - 8.00
- 8.01 - 10.00
- 10.01 - 15.00
- 15.01 - 25.00
- 25.01 - 35.00
- 35.01 - 45.00
- 45.01 - 60.00

Class 1&2 Areas outlined in Red. Total N includes wet&dry deposition of all species.

Total Modeled Nitrogen Deposition includes:

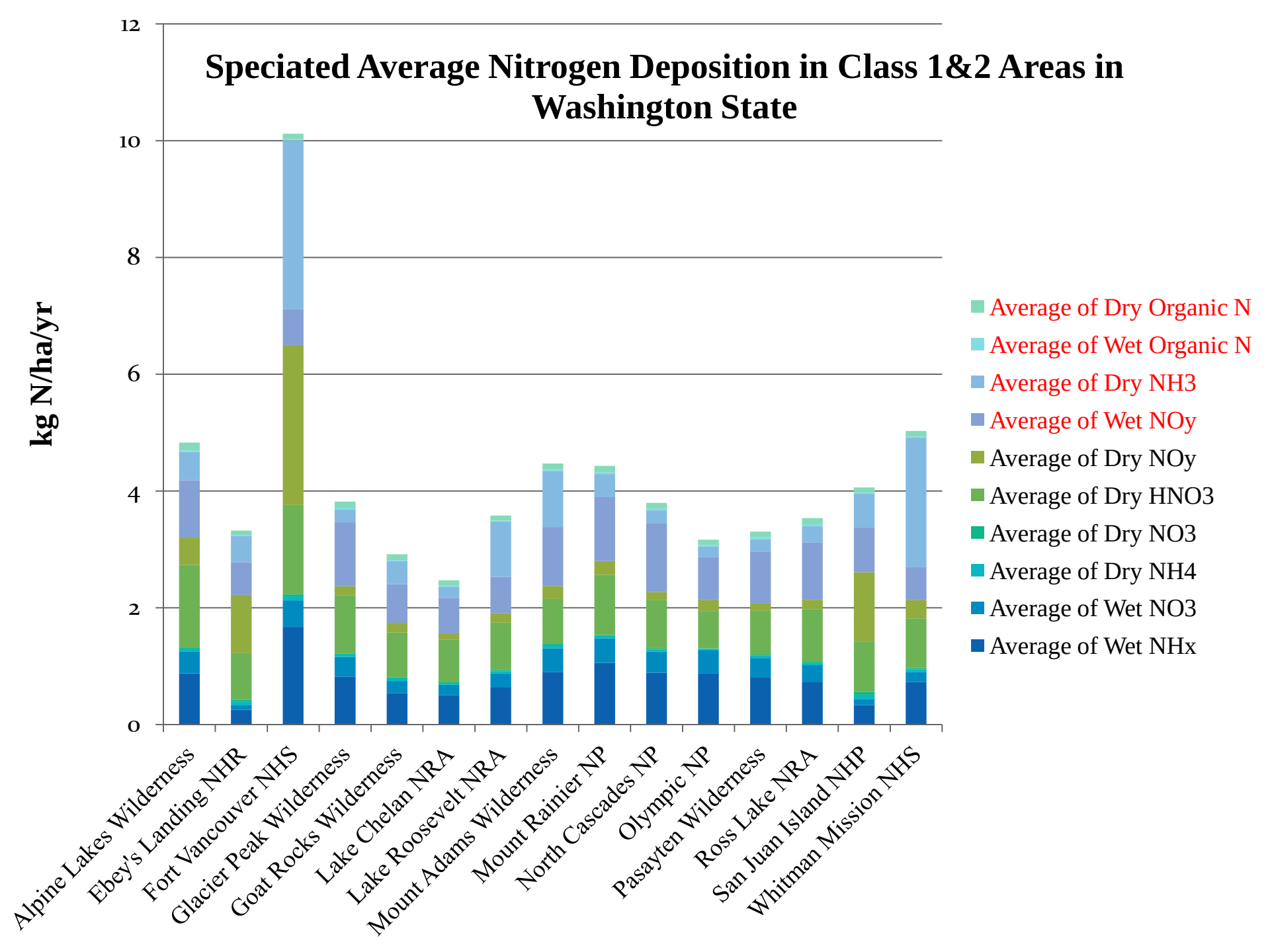
- Organic Nitrogen Species: PAN, RNO_3 (model chemistry includes organic N formed from biogenic VOCs)
- Dry Deposition Other Oxidized Nitrogen: NO, NO_2, N_2O_5, HONO, HO_2NO_2
- Dry Deposition Ammonia (NH_3)
- Wet Deposition Other Oxidized Nitrogen: NO, NO_2, N_2O_5, HONO, HO_2NO_2
- Dry Deposition of Nitric Acid (HNO_3)
- Particulate Nitrate (NO_3^-): Wet and dry
- Particulate Ammonium (NH_4^+): Wet and dry

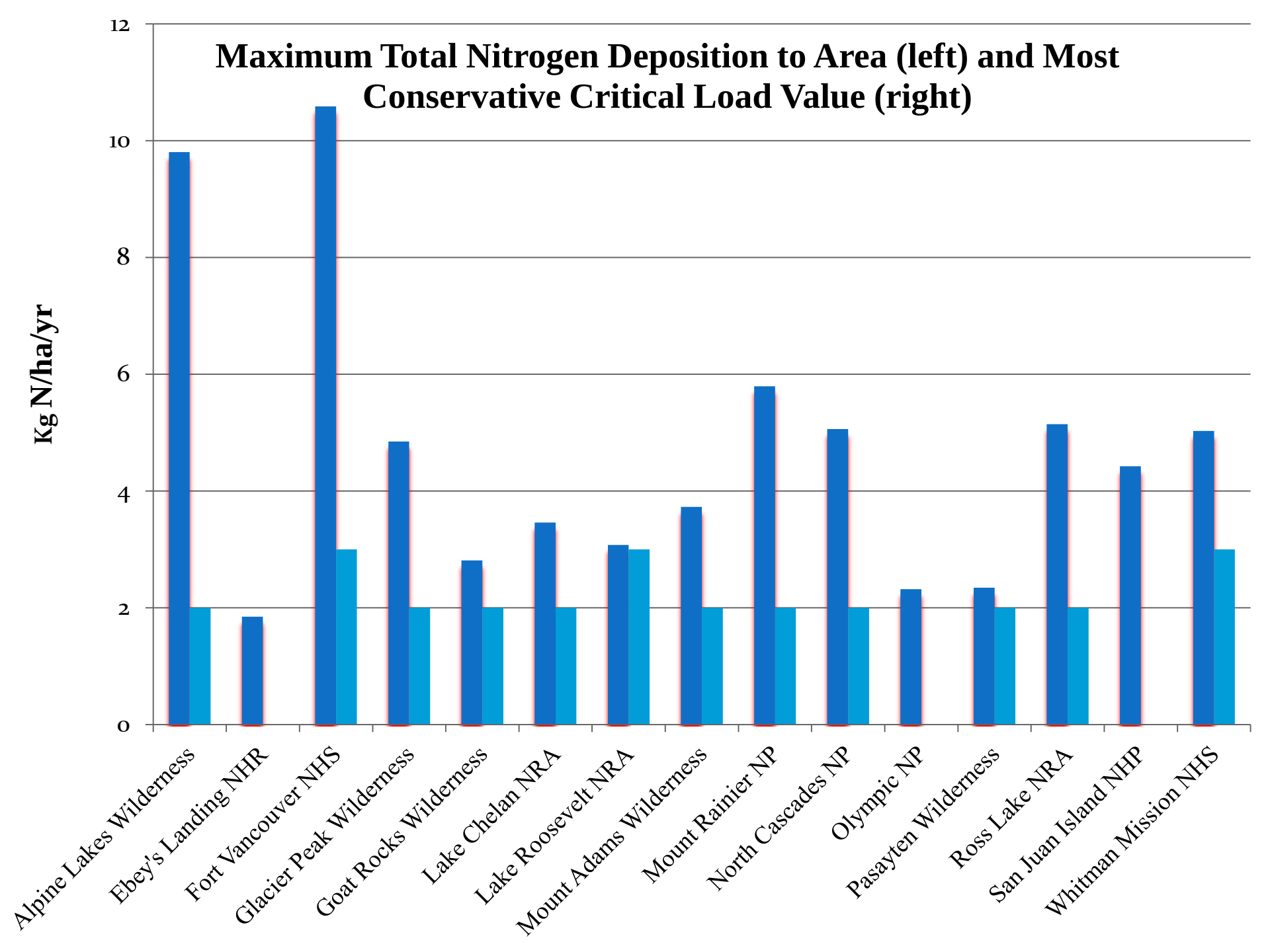
Total Measured Nitrogen Deposition Includes:

- Organic Nitrogen Species: PAN, RNO_3 (model chemistry includes organic N formed from biogenic VOCs)
- Dry Deposition Other Oxidized Nitrogen: NO, NO_2, N_2O_5, HONO, HO_2NO_2
- Dry Deposition Ammonia (NH_3)
- Wet Deposition Other Oxidized Nitrogen: NO, NO_2, N_2O_5, HONO, HO_2NO_2
- Dry Deposition of Nitric Acid (HNO_3)
- Particulate Nitrate (NO_3^-): Wet and dry
- Particulate Ammonium (NH_4^+): Wet and dry

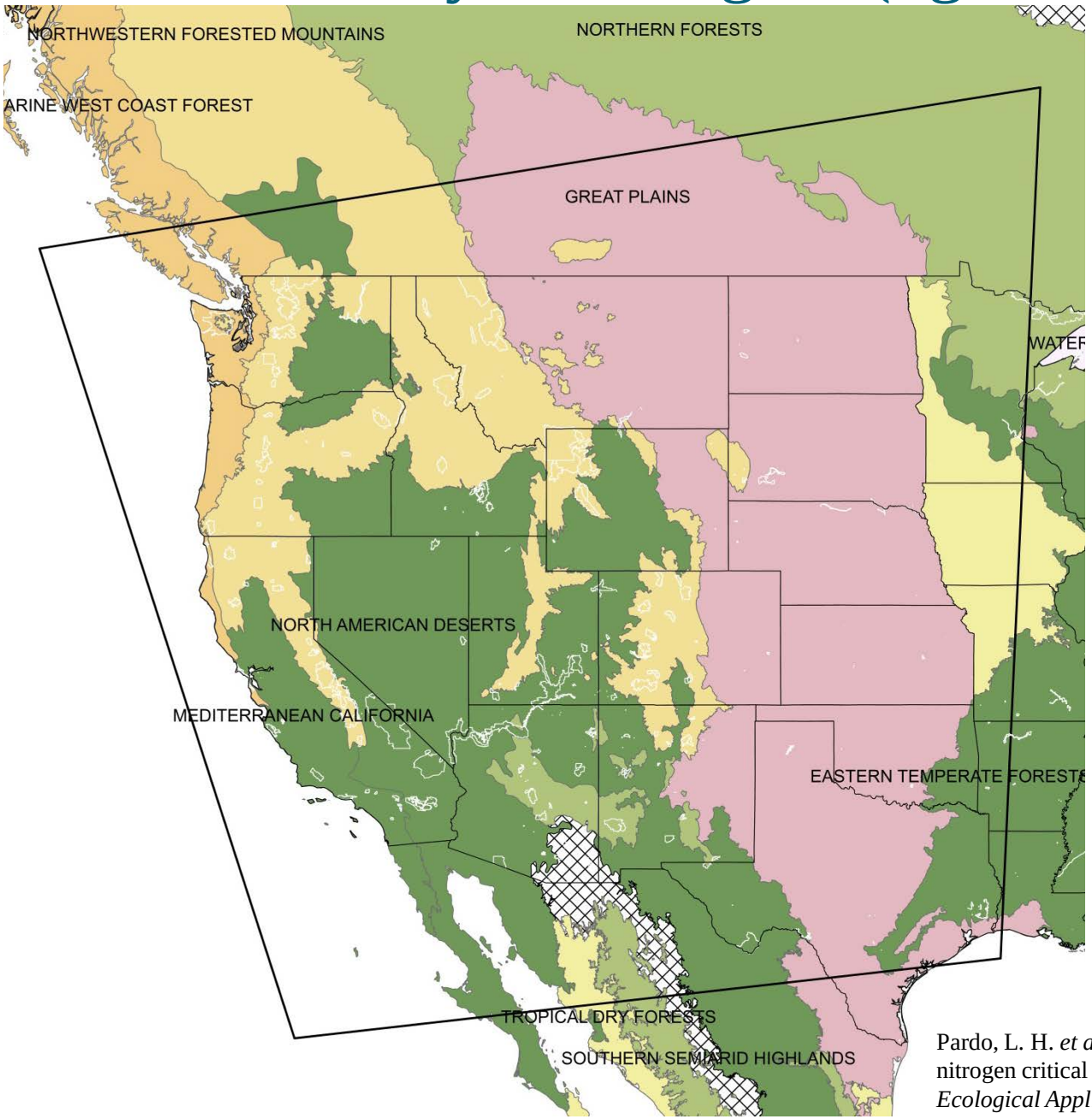
Nitrogen deposition measurement data are incomplete

- Chemical Transport Models (e.g., CAMx) capture the bulk of total Nitrogen Deposition (although CAMx is missing reduced organic nitrogen and includes limited oxidized organic nitrogen – both expected to be small)
- Many Critical Load values are estimated using measurement data, some with scaling factors to account for “missing” N, others incorporate modeling data, still others leave data as is with caveats
- Efforts to close this gap continue, including the creation, in 2010, and subsequent expansion of the Ammonia Monitoring Network (AMoN)


Speciated Average Nitrogen Deposition in Class 1&2 Areas in Washington State
kg N/ha/yr
0
2
4
6
8
10
12
Alpine Lakes Wilderness
Ebey's Landing NHR
Fort Vancouver NHS
Glacier Peak Wilderness
Goat Rocks Wilderness
Lake Chelan NRA
Lake Roosevelt NRA
Mount Adams Wilderness
Mount Rainier NP
North Cascades NP
Olympic NP
Pasayten Wilderness
Ross Lake NRA
San Juan Island NHP
Whitman Mission NHS
Average of Dry Organic N
Average of Wet Organic N
Average of Dry NH3
Average of Wet NOy
Average of Dry NOy
Average of Dry HNO3
Average of Dry NO3
Average of Dry NH4
Average of Wet NO3
Average of Wet NHx


Maximum Total Nitrogen Deposition to Area (left) and Most Conservative Critical Load Value (right)
Kg N/ha/yr
12
10
8
6
4
2
0
Alpine Lakes Wilderness
Ebey's Landing NHR
Fort Vancouver NHS
Glacier Peak Wilderness
Goat Rocks Wilderness
Lake Chelan NRA
Lake Roosevelt NRA
Mount Adams Wilderness
Mount Rainier NP
North Cascades NP
Olympic NP
Pasayten Wilderness
Ross Lake NRA
San Juan Island NHP
Whitman Mission NHS

Critical Load by Eco-Region (kg N/ha)

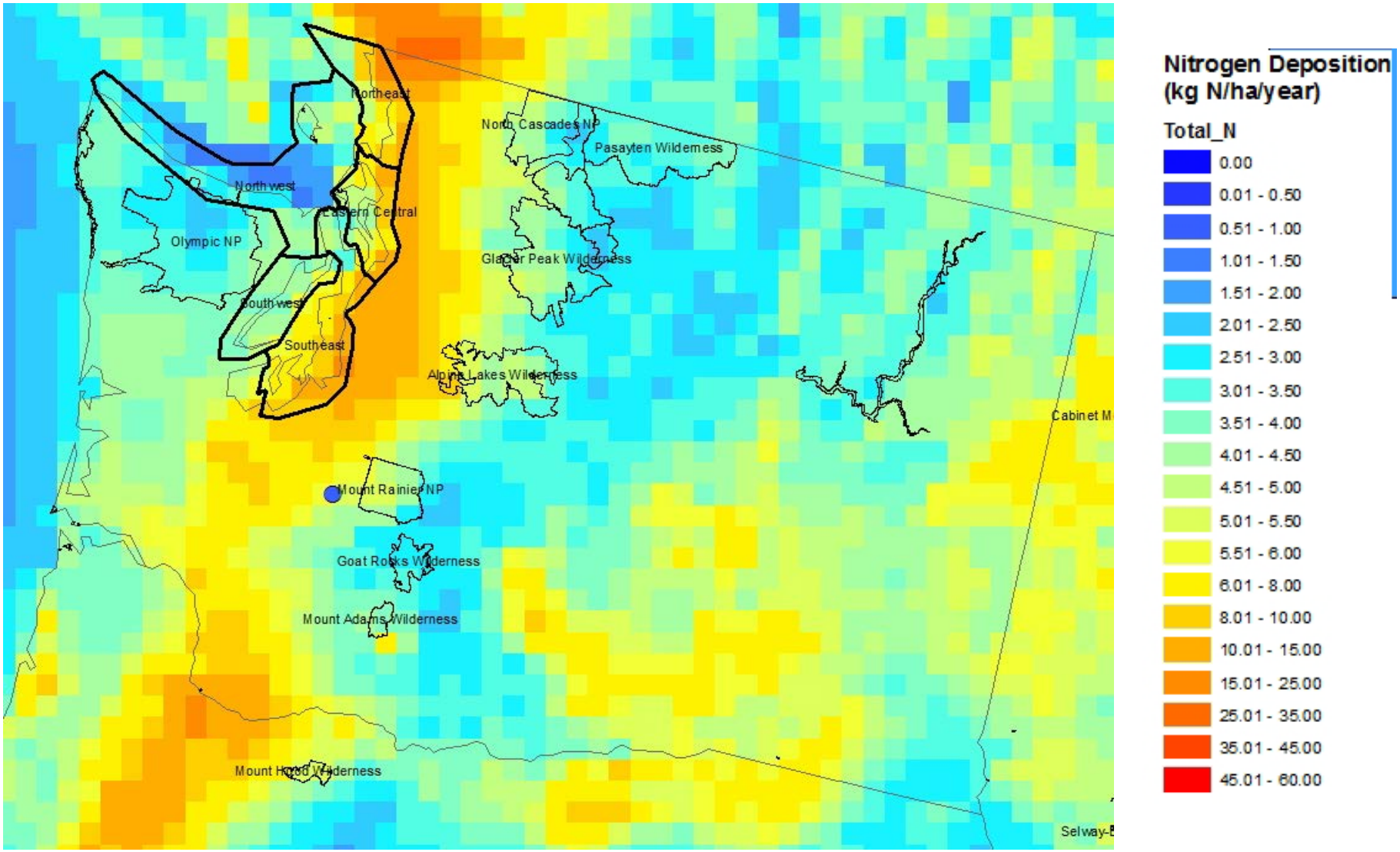


CL_Lichens

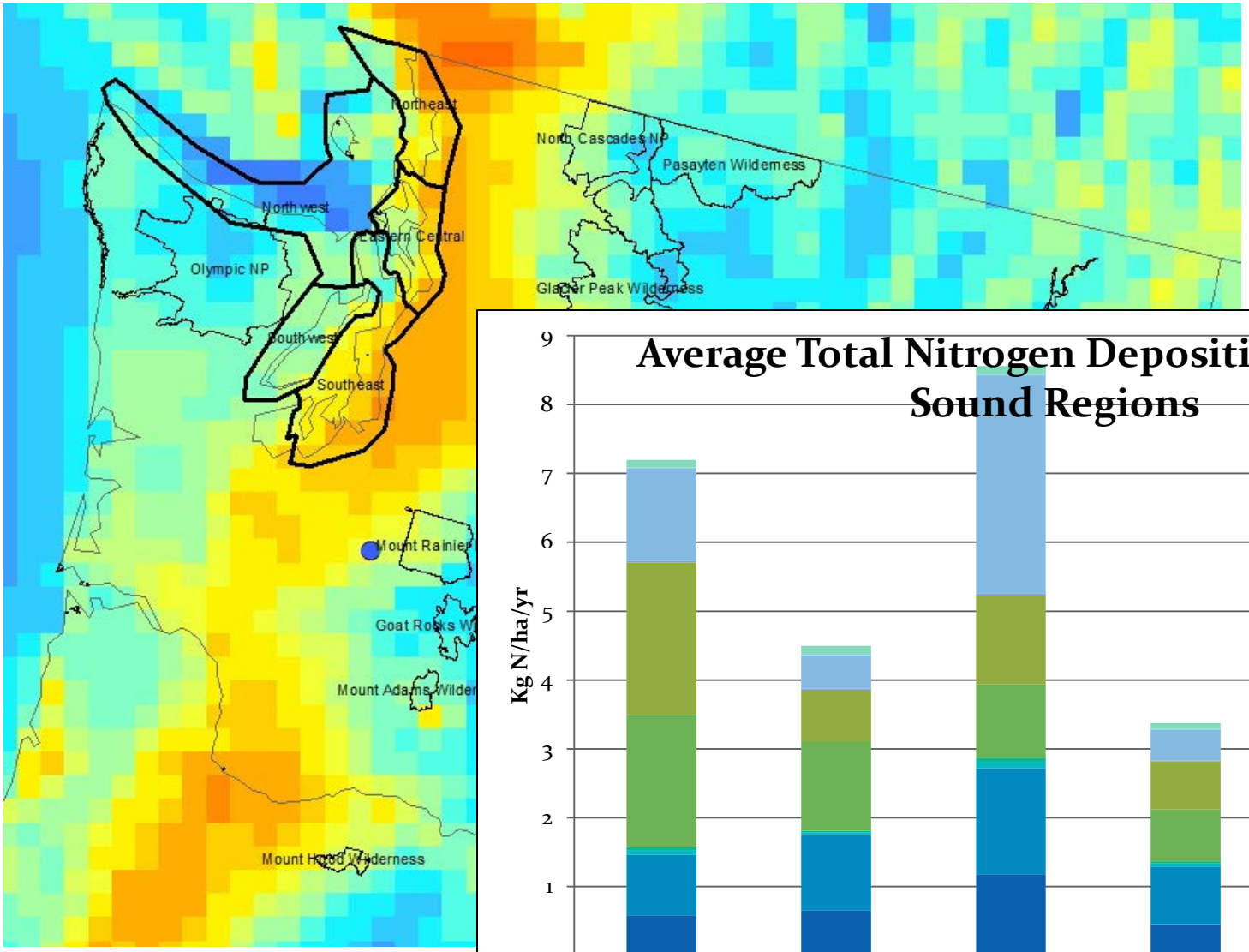
- -999
- 1
- 2
- 2.5
- 2.7
- 3
- 4
- 5
- 10

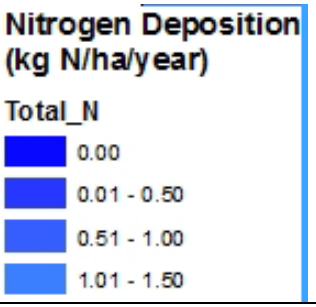
Pardo, L. H. *et al.* Effects of nitrogen deposition and empirical nitrogen critical loads for ecoregions of the United States. *Ecological Applications* **21,** 3049–3082 (2011).

Puget Sound Modeled Nitrogen Deposition



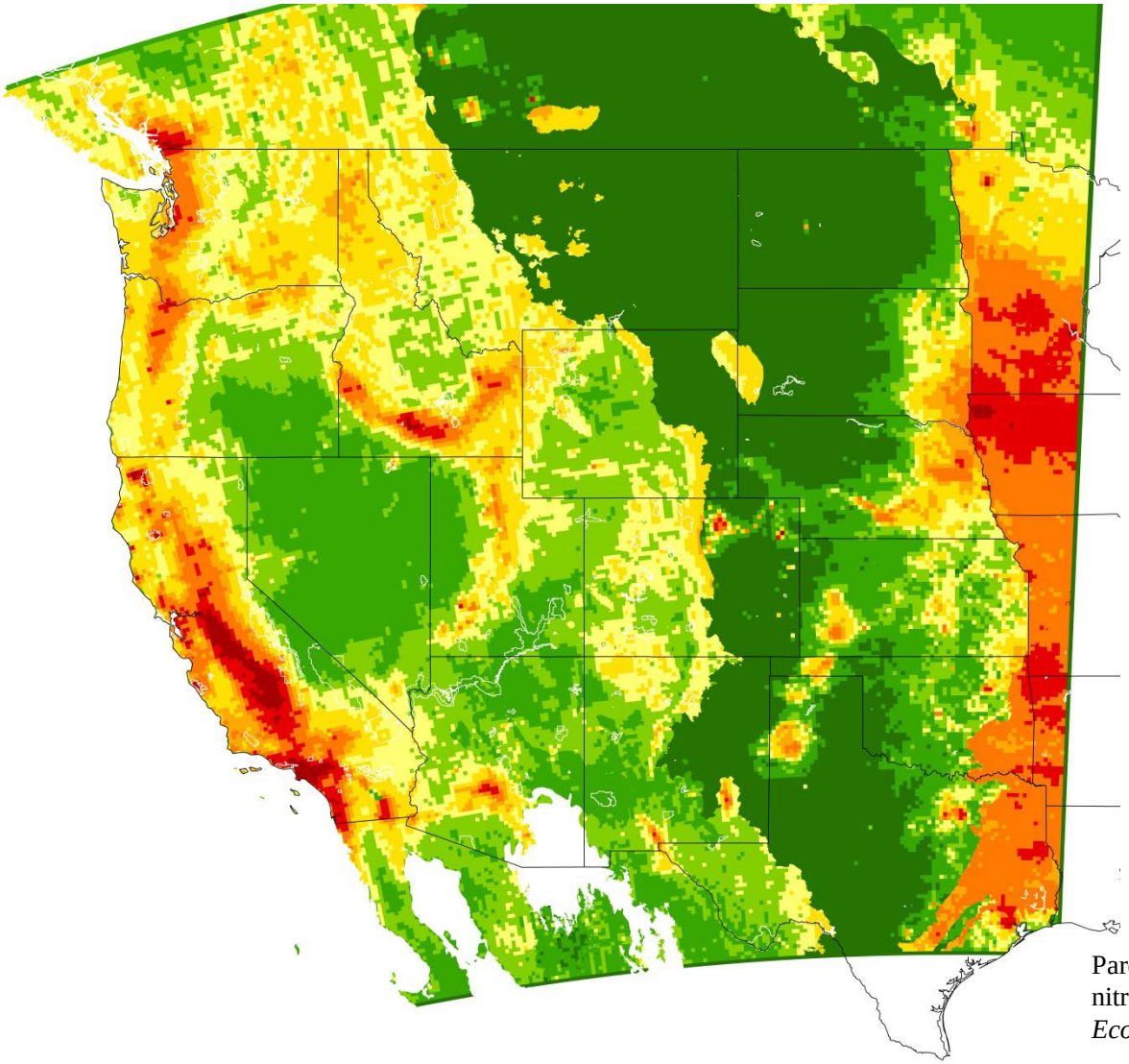
Puget Sound Modeled Nitrogen Deposition





Nitrogen Deposition Excess

Total Modeled Nitrogen Wet&Dry Deposition (all species) - Critical Load



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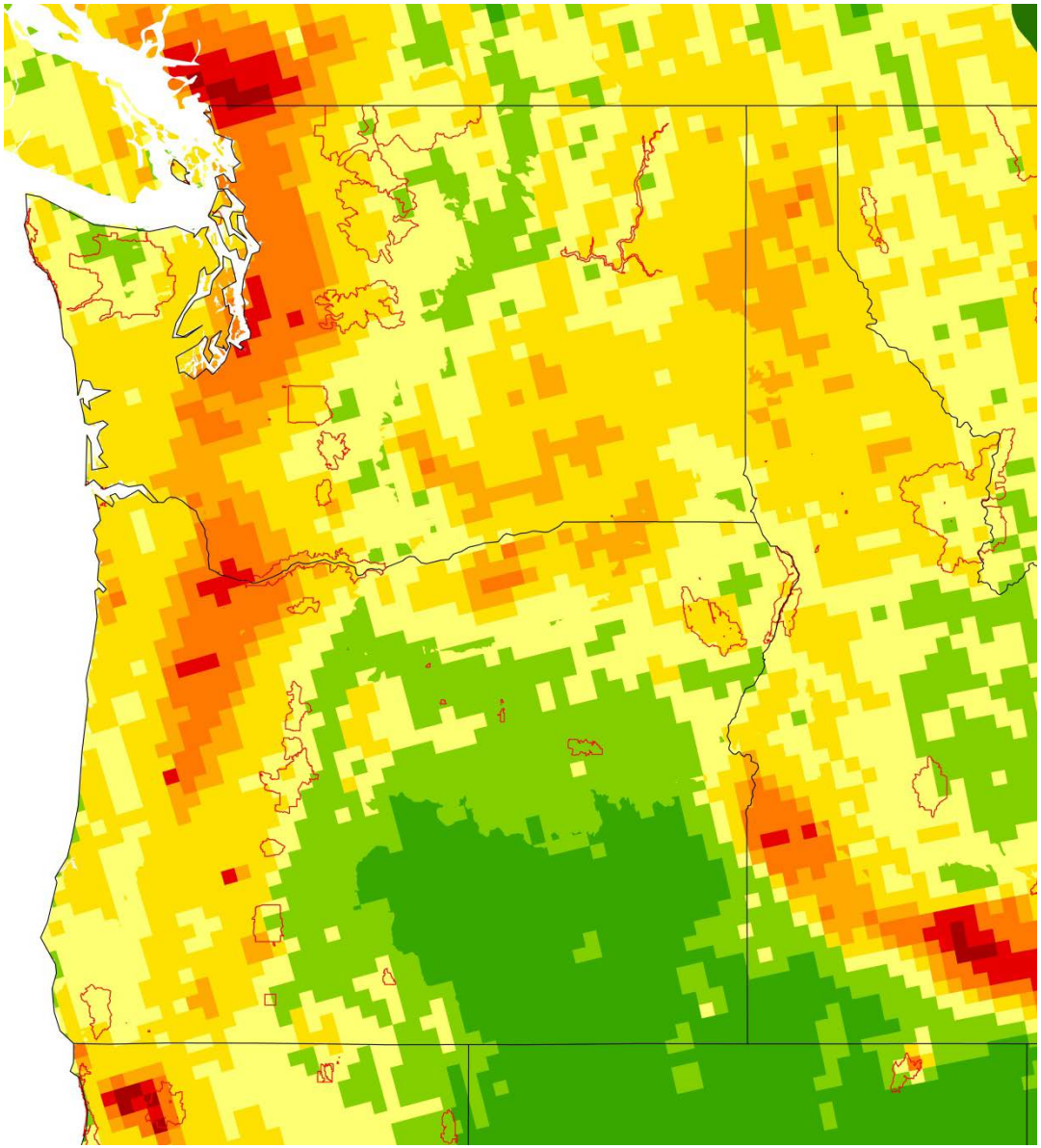

Annual Excess kg N/ha

Excess_1

- -10.0 - -3.0
- -2.9 - -1.0
- -0.9 - 0.0
- 0.1 - 0.0
- 0.1 - 1.0
- 1.1 - 3.0
- 3.1 - 5.0
- 5.1 - 10.0
- 10.1 - 20.0
- 20.1 - 60.0

Pardo, L. H. *et al.* Effects of nitrogen deposition and empirical nitrogen critical loads for ecoregions of the United States. *Ecological Applications* **21,** 3049–3082 (2011).

Thanks –

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Western States Air Resources Council (WESTAR)

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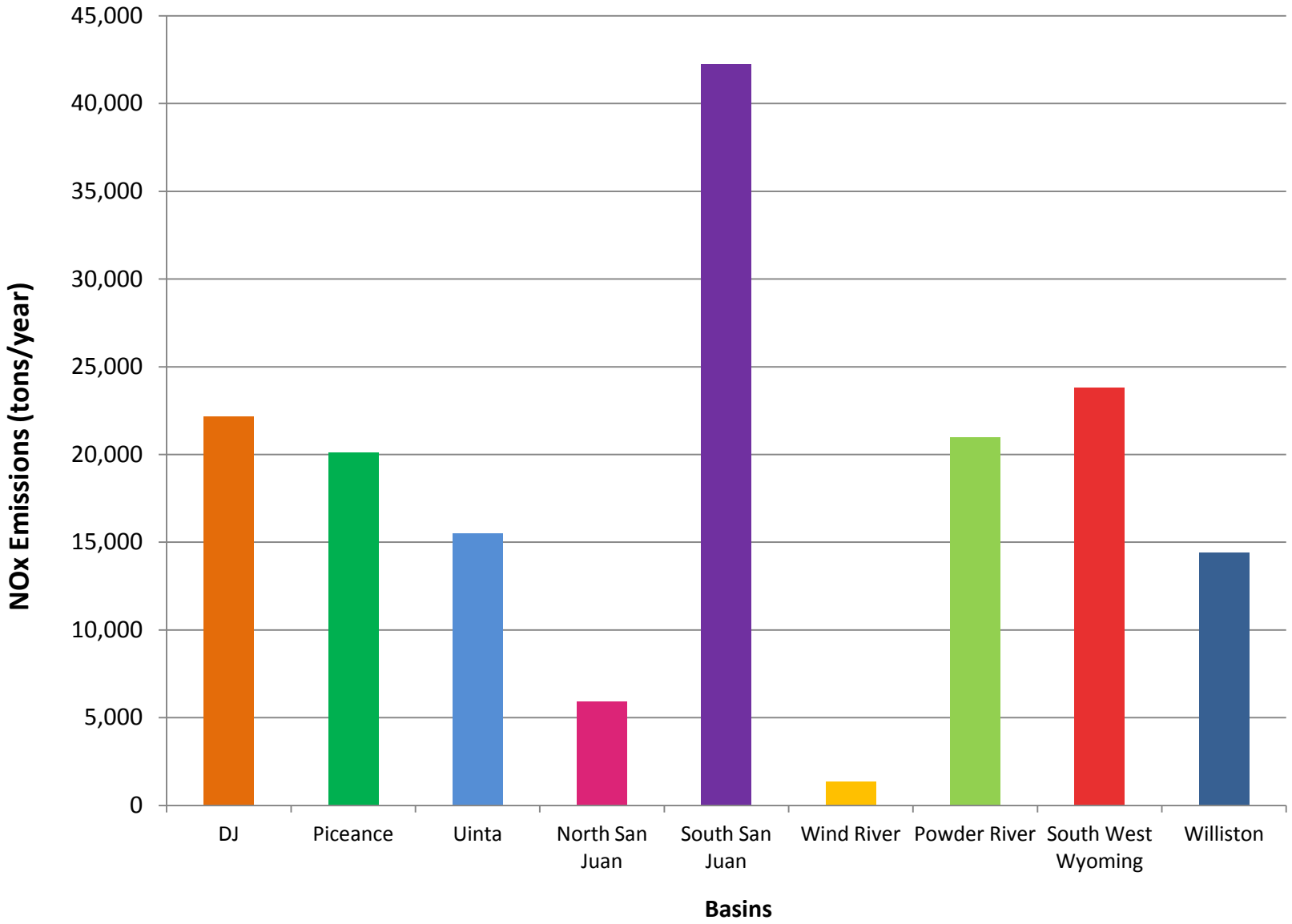
Western Regional Air Partnership | www.wrapair2.org

Oil & Gas

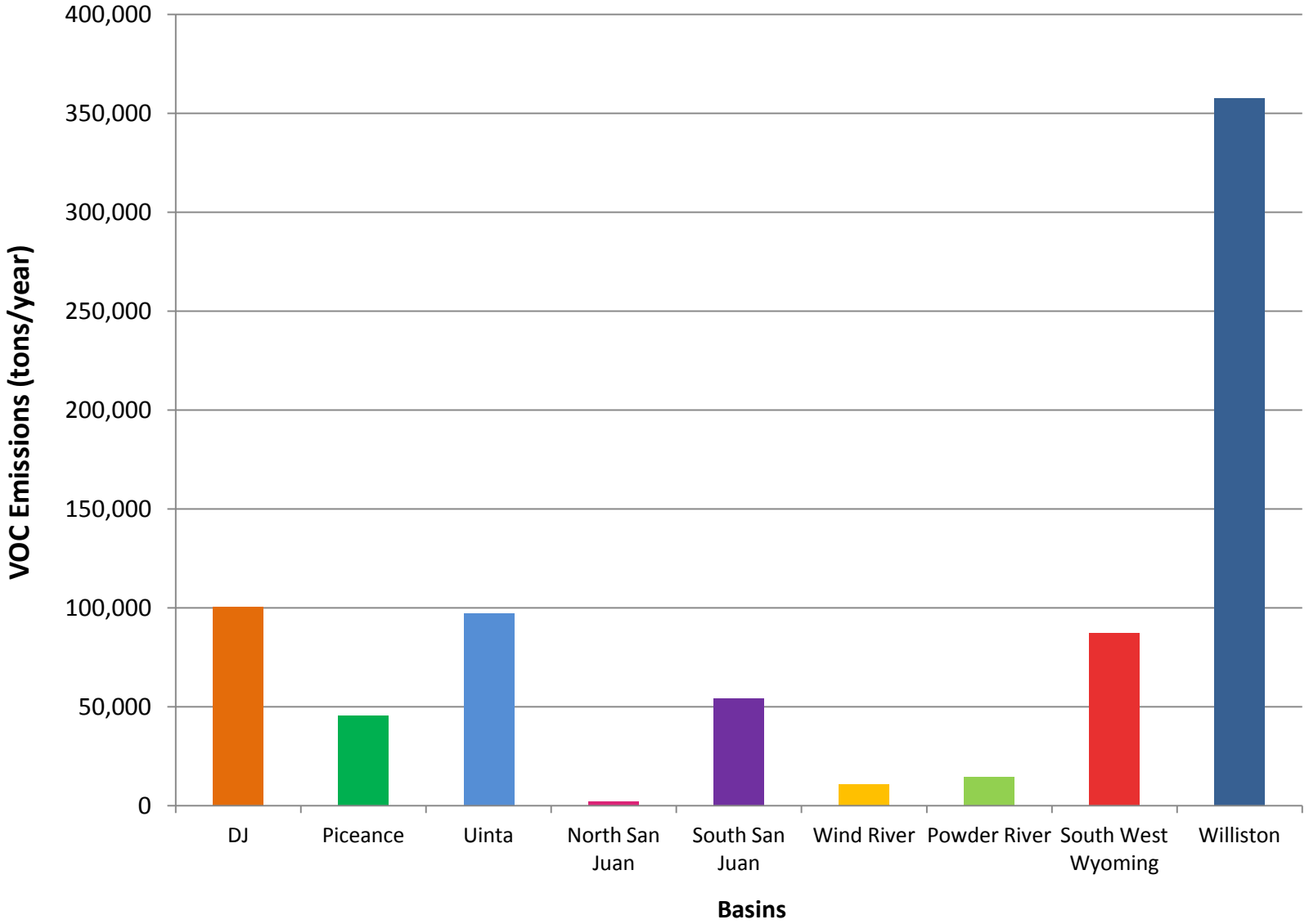
Oil & Gas: Emissions Inventories and Control Analysis

- Key source for Ozone / PM standards, & Regional Haze
- Exploration and production activity continue to increase
- Data in use current OAQPS national & western modeling work
  - Significant funding and involvement by industry
  - Open review and discussion process with all interested stakeholders
- Linkages
  - WestJumpAQMS
  - 3-State Air Quality Study
  - O&G EI project funded by BLM MT-Dakotas office
    - 2011 base & projection years' EI for Williston & Montana Great Plains Basins

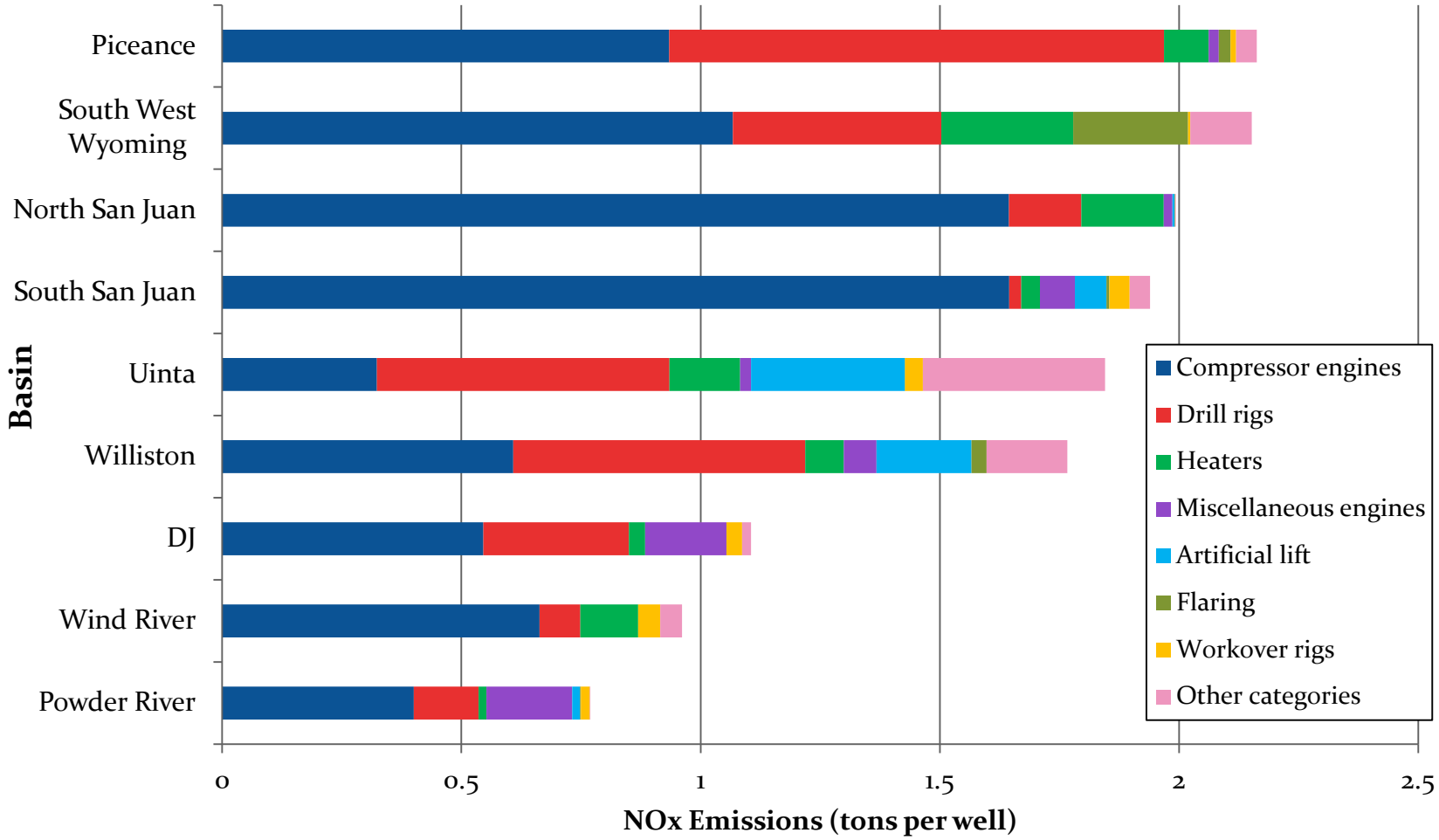
Cross-Basin – NOx Emissions



Cross-Basin – VOC Emissions

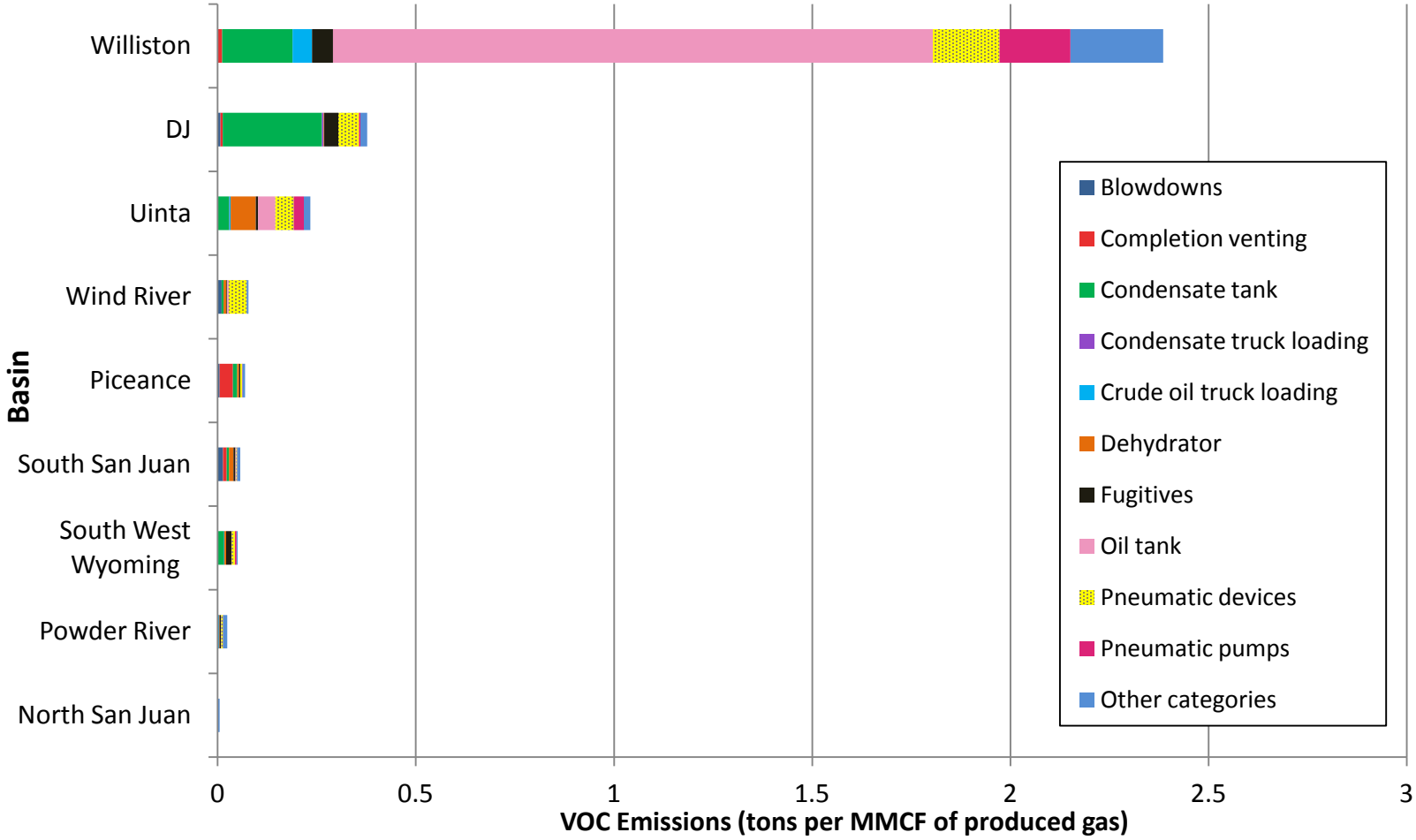


Cross-Basin – Per-Well NOx Emissions



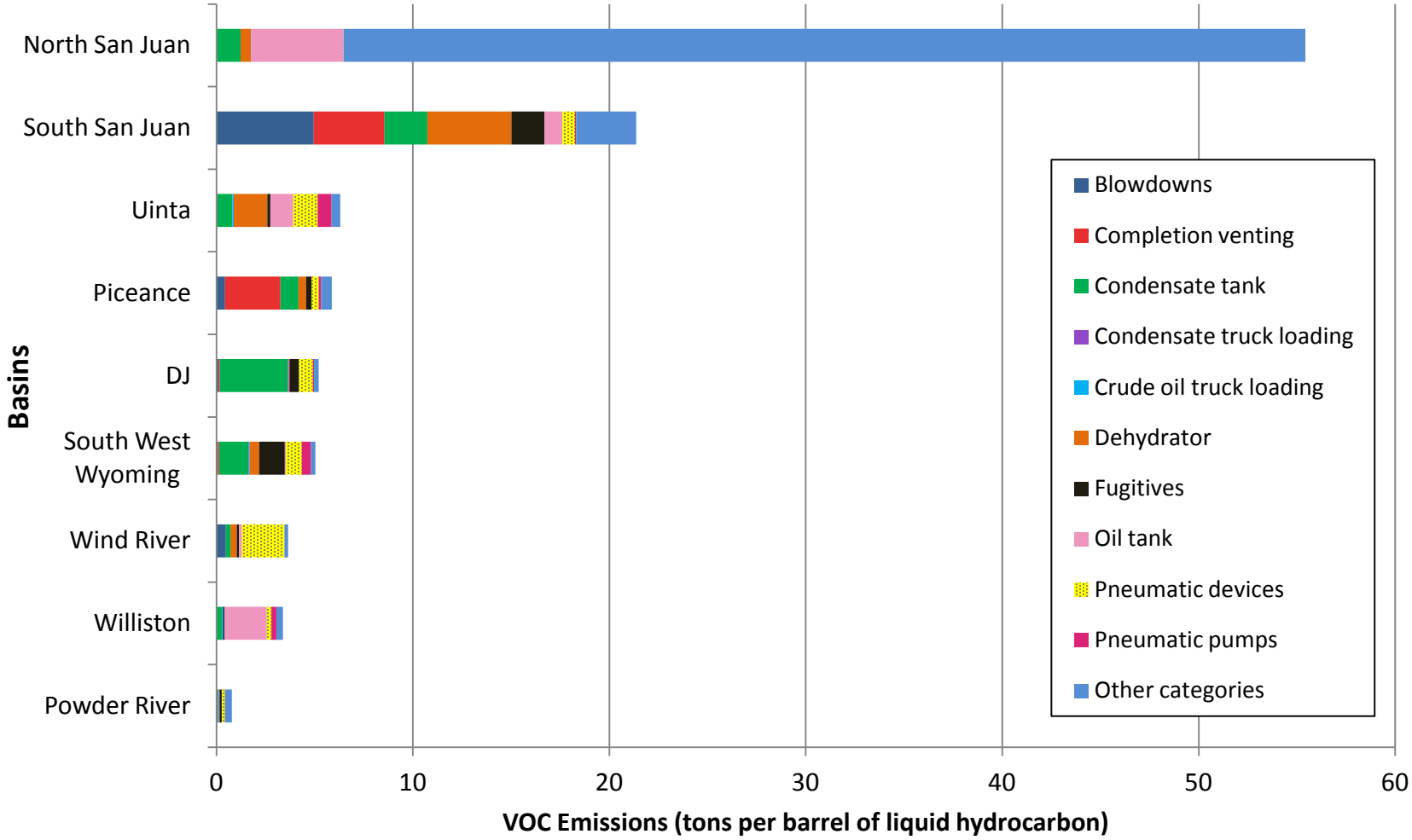
Per well NOx emissions relatively consistent across basins – differences mainly due to usage of compression and centralized vs. wellhead compression

Cross-Basin – Per-Unit-Gas-Production VOC Emissions



Per unit gas production VOC emissions vary widely across basins – differences due to levels of liquid hydrocarbon production (oil and condensate) and VOC content of produced gas

Cross-Basin – Per-Unit-Liquid-Production VOC Emissions



Per unit gas production VOC emissions vary widely across basins – differences due to levels of liquid hydrocarbon production (oil and condensate) and VOC content of produced gas

Issues – Missing Categories

Produced water (evaporation) ponds

- **Emission factors uncertain and highly dependent on composition, production type**
- **Seasonal/diurnal variations**
- **See for example Utah State University work to characterize emissions in Uinta Basin**

Issues – Missing Categories

Field gathering pipelines

- Lack of data on extent of pipeline infrastructure within fields
- Pipeline companies historically not part of the inventory process

Issues – Missing Categories

Midstream sources

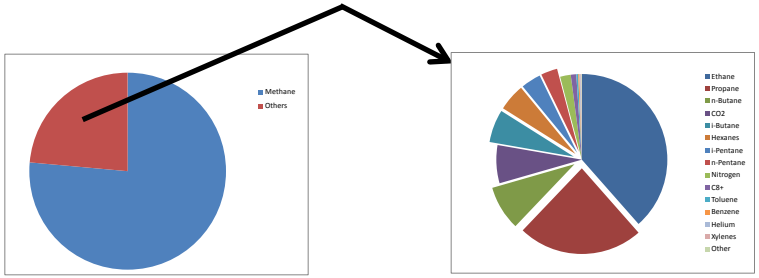
- Midstream sources not always captured in inventories – state reporting thresholds
- Midstream sources on tribal lands
- Midstream companies historically not part of the inventory process

Issues / New Concepts – Non-routine events, Skewness

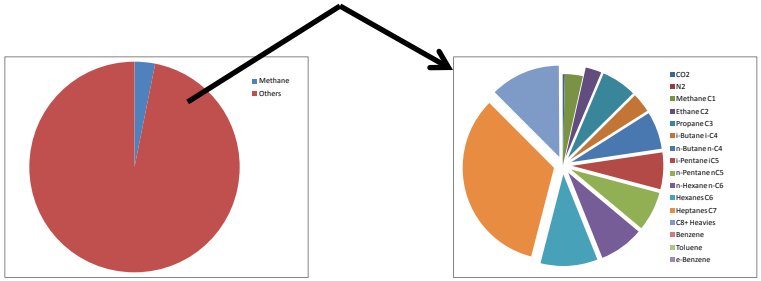
- Pipeline blowdowns
- Spills/upsets
- Maintenance activities

- Poorly performing and “non-average” sources could have significantly higher emissions than estimated in inventories
- Analogous to “smoking vehicles” in mobile source inventories
- Statistical sampling/monitoring of sources needed to develop methods to represent this in inventories
- See for example NOAA monitoring in Uinta Basin and CDPHE capture efficiency adjustments

Issues and New Concepts – Gas Compositions



Conventional Gas
(Vented/Fugitive Sources)



Flash Gas
(Condensate and Oil Tanks)

- **Gas compositions in Phase III use a basin-average approach**
- **Variability within a basin by production type (field to field)**
- **Variability within the production/gathering system**
- **More data needed – field or formation level approach for basins?**

Issues and New Concepts – Factors and Uncertainty

New factor data

- **Fugitive emissions**
- **Venting from well completions**
- **Water tanks / evap ponds**

Uncertainty

- **Uncertainties not quantitatively estimated in most inventories**
- **Large data sets needed to estimate uncertainty**
- **Helpful in identifying poorly-characterized sources, and estimating uncertainty in AQ modeling**