

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

February 5, 2015

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WRAP Air Quality Program Manager  
WESTAR Council

NW-AIRQUEST and Northwest Regional Modeling Consortium meetings  
Seattle, WA

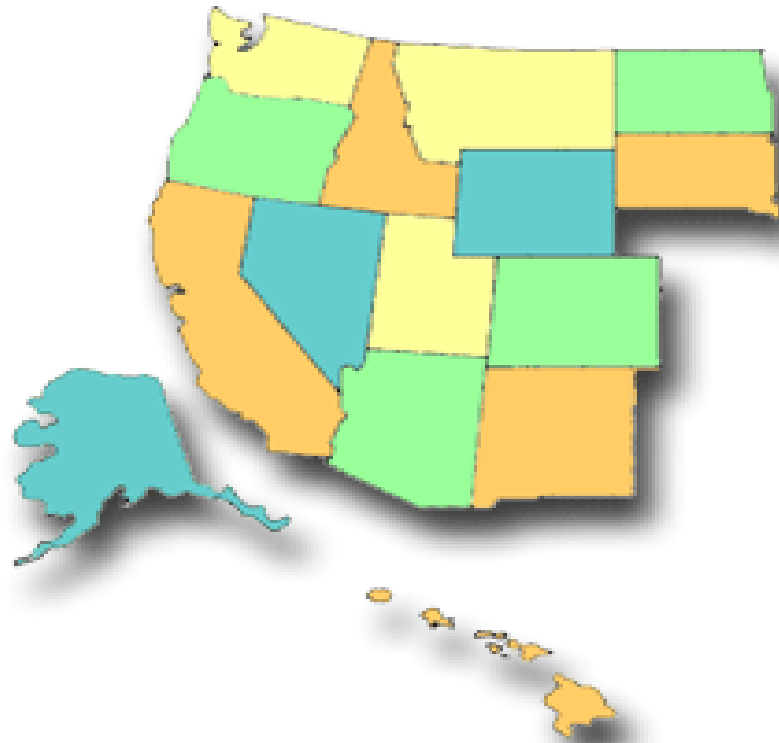


# Topics

## Western Regional Air Partnership

- *Update:* Work Plan
- *Technical Studies:*
  - WestJumpAQMS
  - WRAP Fire Tools
  - Western Regional Technical Center (Data Warehouse and Regional Modeling)

# Overview of WESTAR/WRAP



[www.westar.org](http://www.westar.org)

[www.wrapair2.org](http://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](http://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

# 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

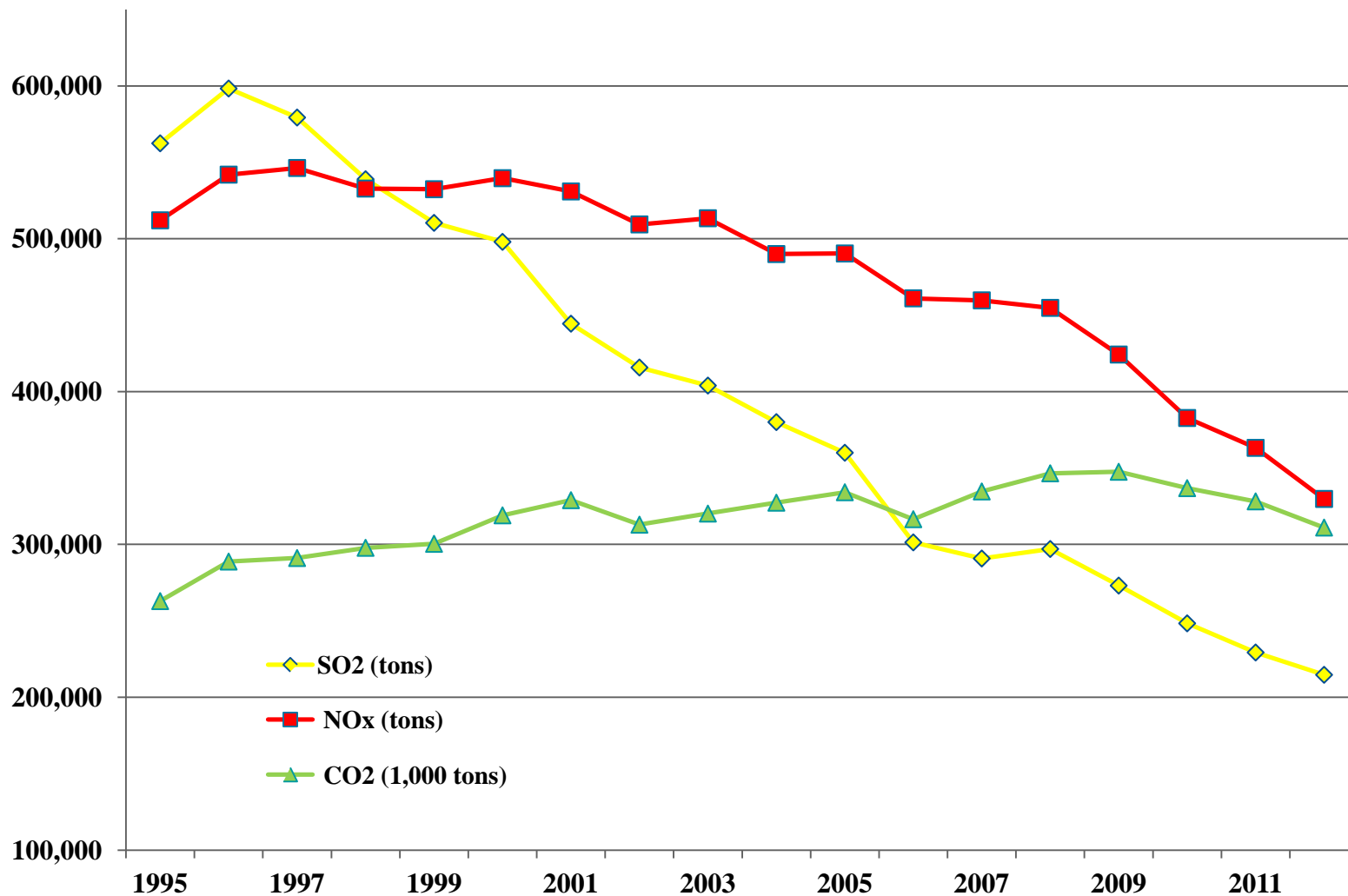


## WRAP current projects and priorities

- 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](#))

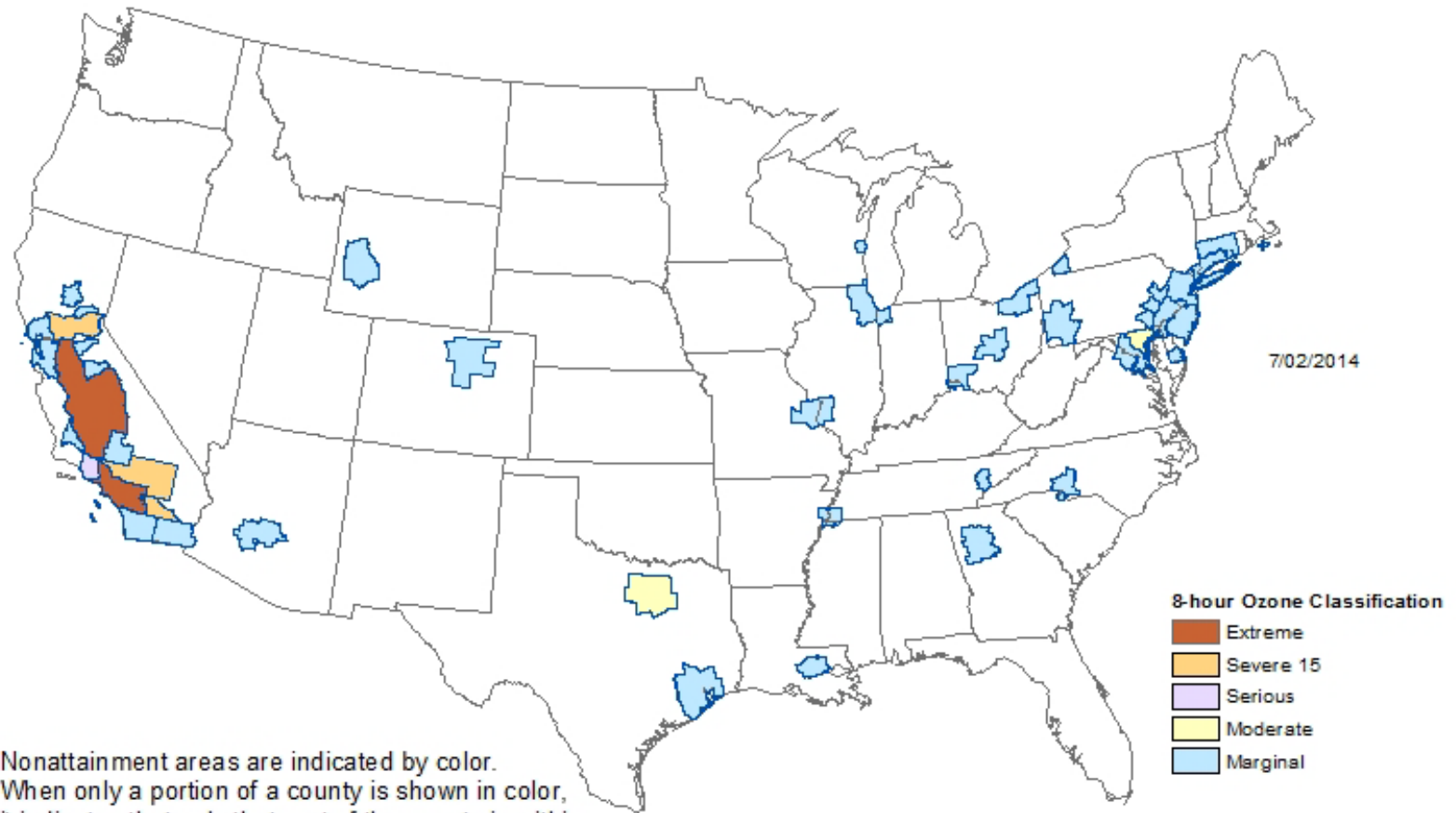


# Power Plant Emissions Trends – Western Interconnect



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

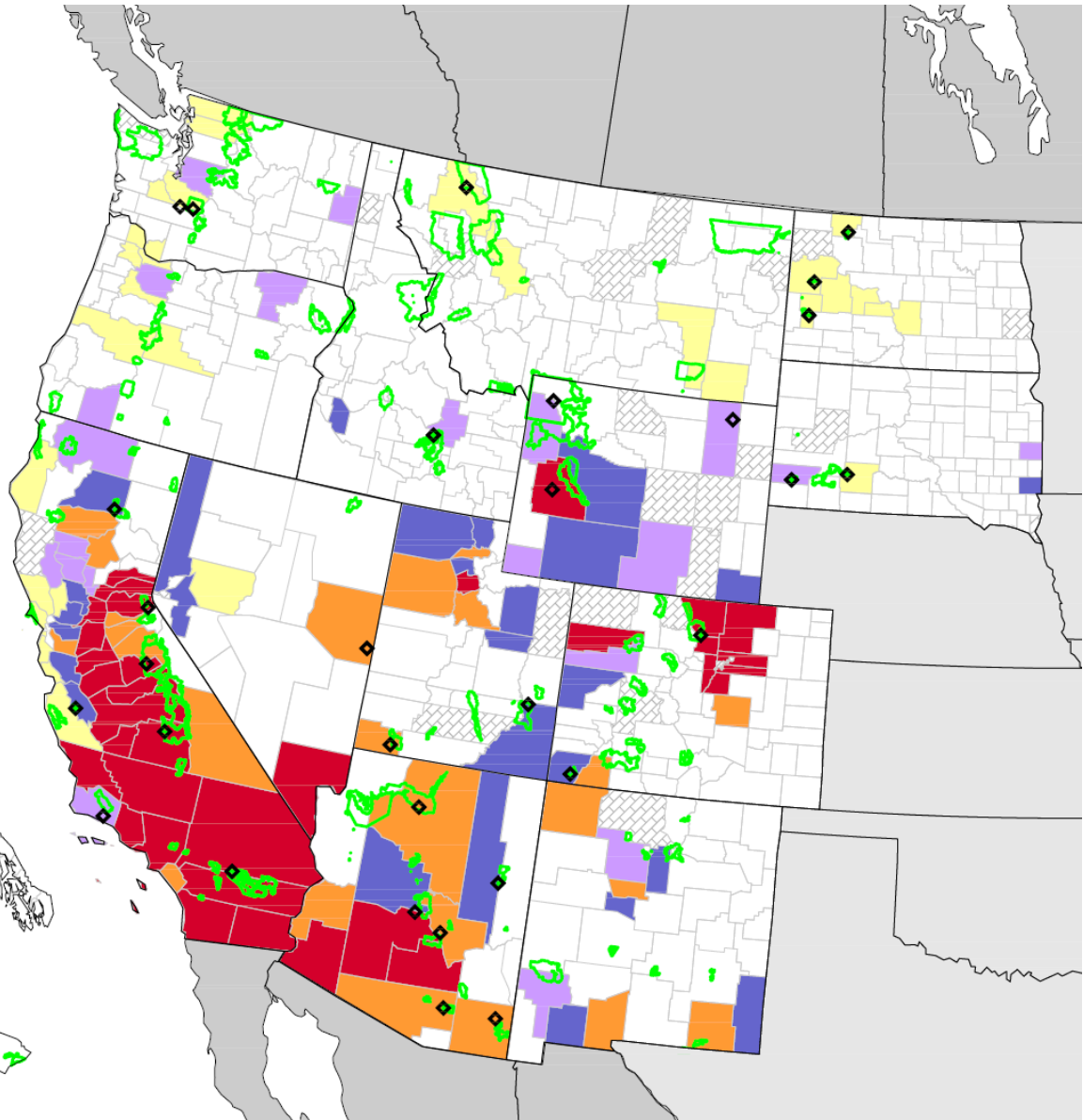
(Based on 2011-2013 Air Quality Data)



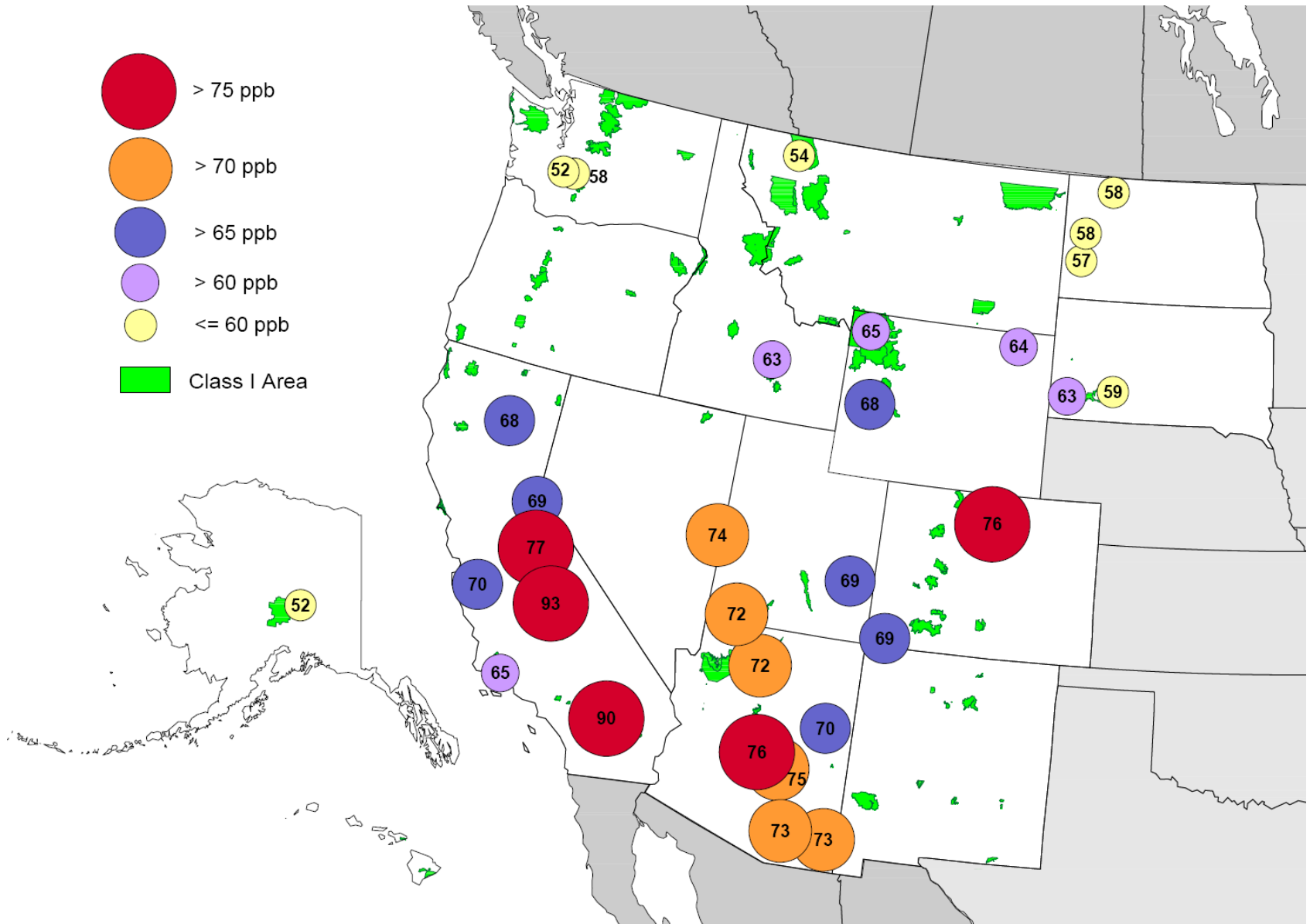
Nonattainment areas are indicated by color. When only a portion of a county is shown in color, it indicates that only that part of the county is within a nonattainment area boundary.

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

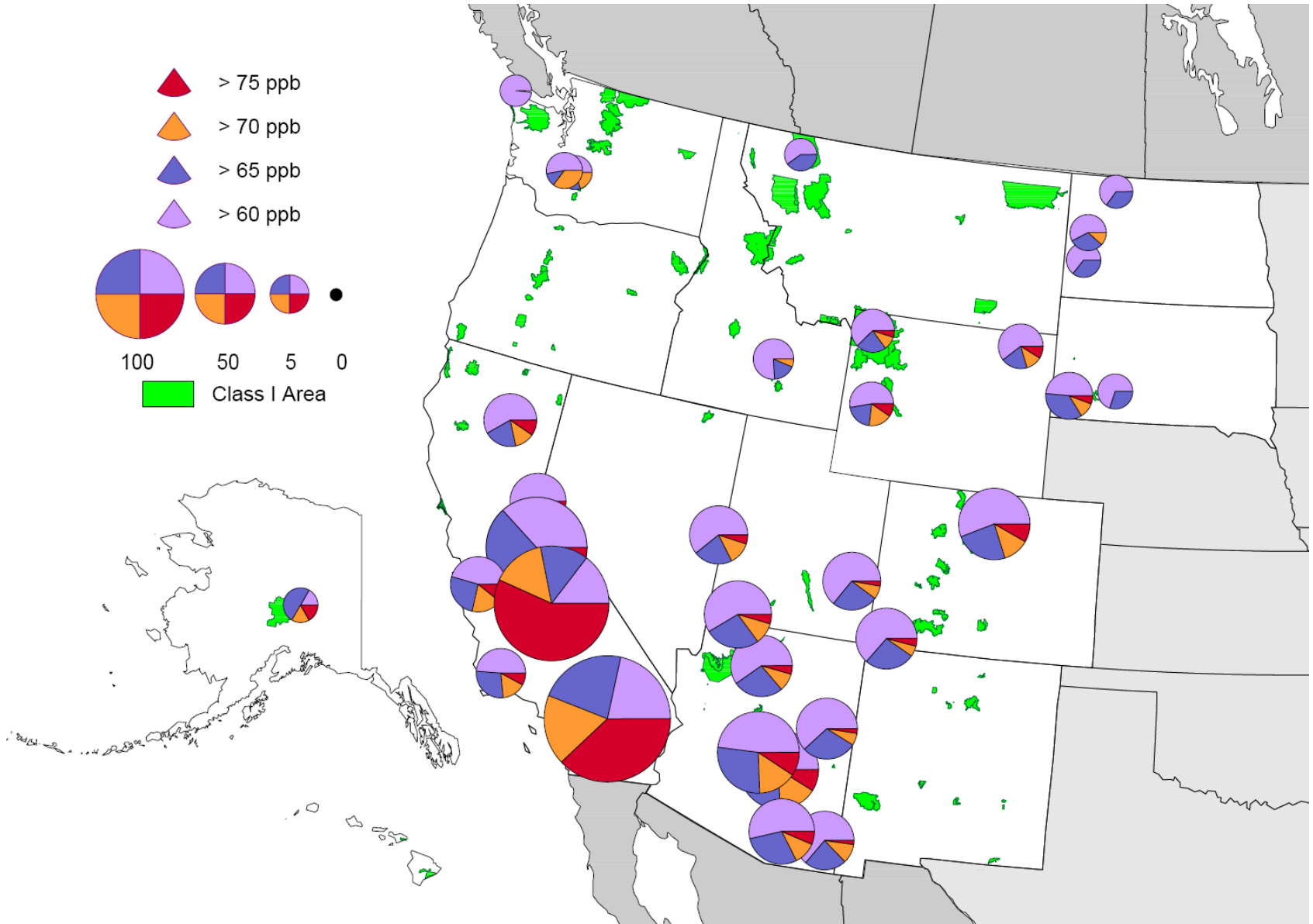
- > 75 ppb
- > 70 ppb
- > 65 ppb
- > 60 ppb
- <= 60 ppb
- Insufficient Data
- No monitoring data available
- Rural/Class I Site
- Class I Area



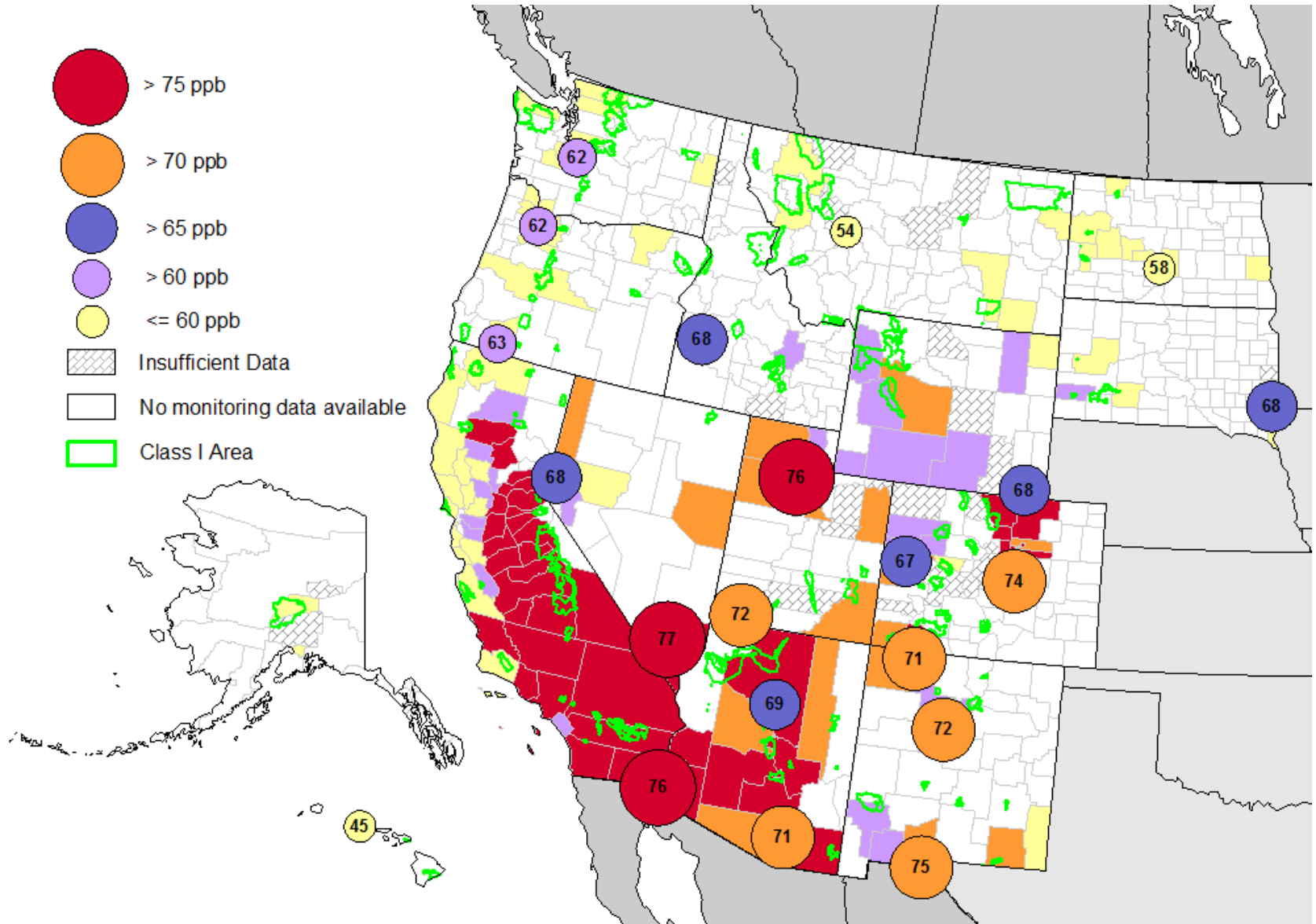
# 3-year Average 4<sup>th</sup> Highest 8-Hour Ozone value for Rural/Class I Sites 2011-2013



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



# 3-year Average 4<sup>th</sup> 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

# 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<sub>2</sub>, NO<sub>x</sub> )
  - Significant NO<sub>x</sub> 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



Work Plan –  
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***

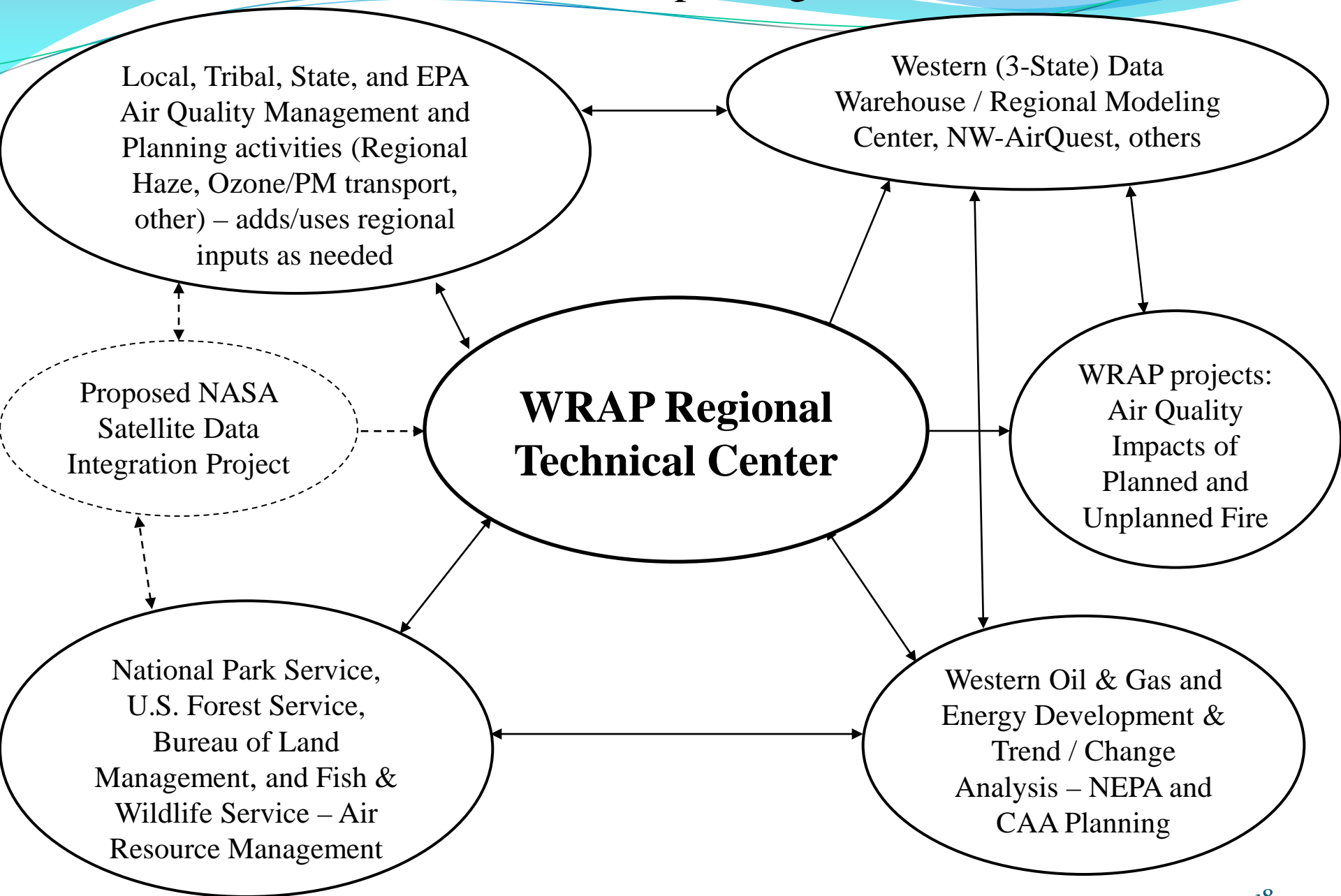
## **Necessary Regional Activities**

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

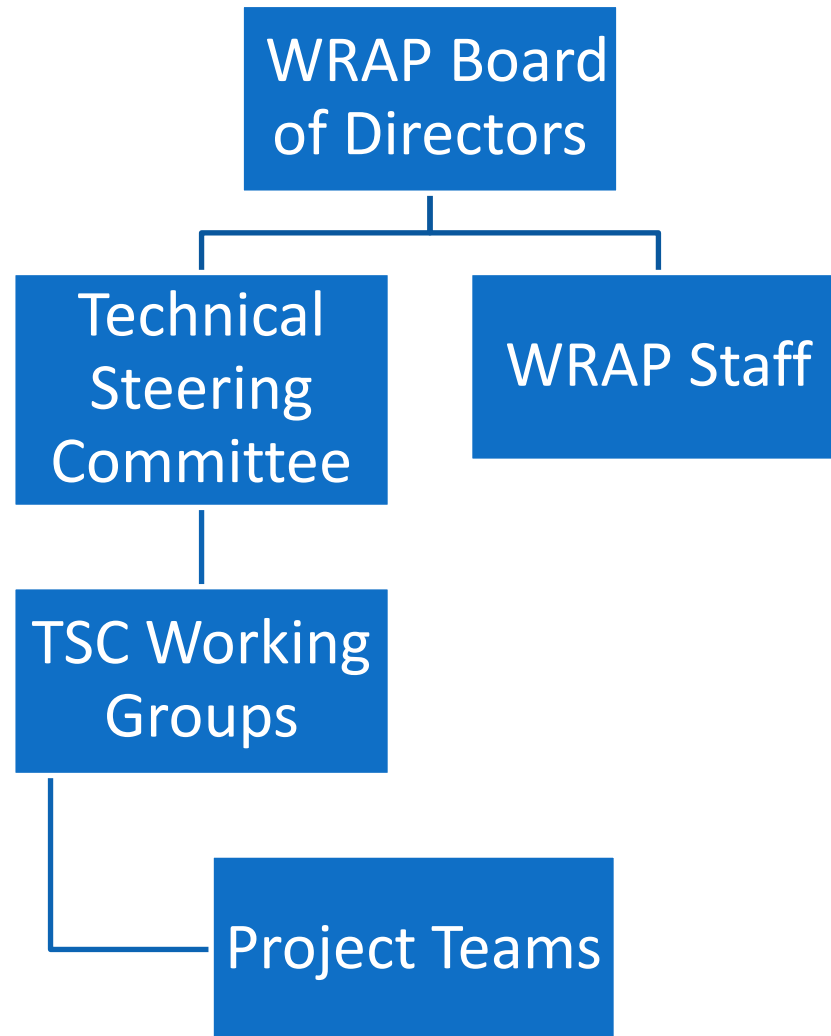
## **Required Foundational Activities**

***(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

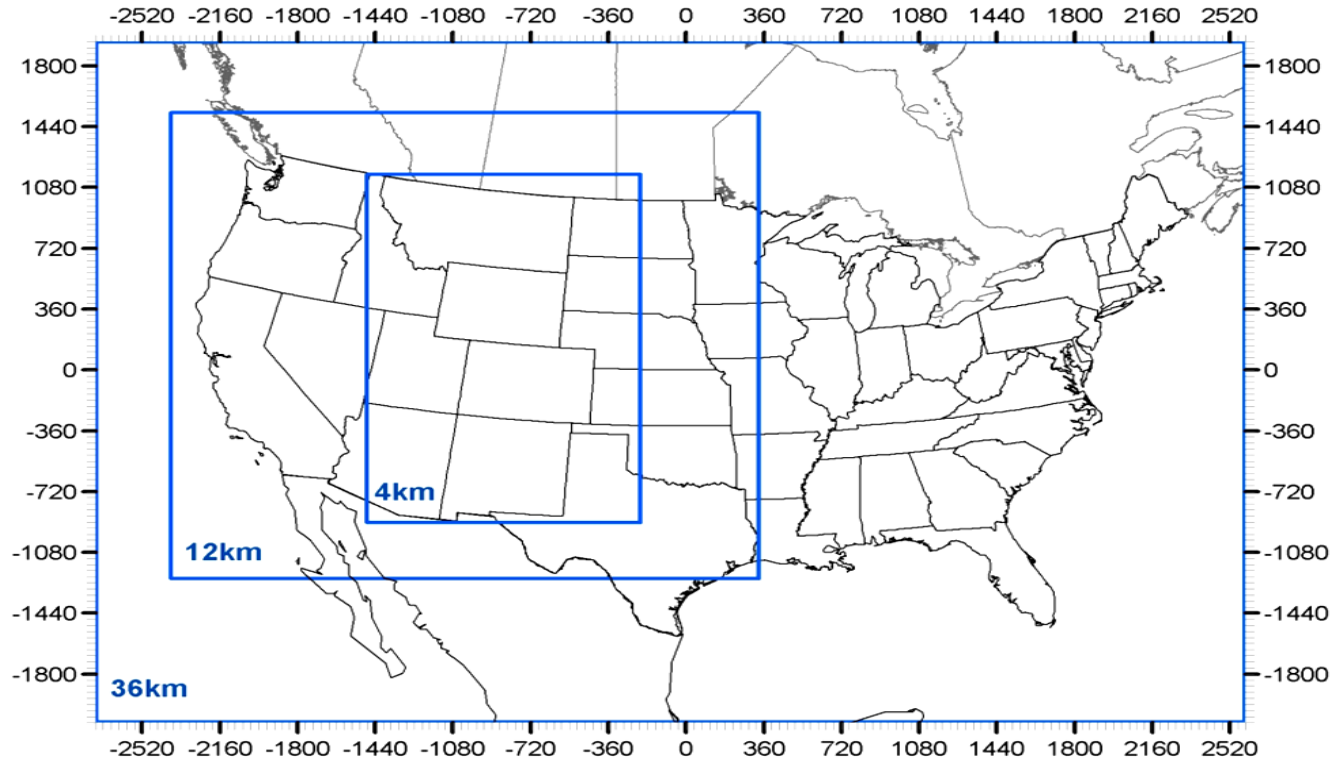


# WestJumpAQMS regional modeling study

## 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

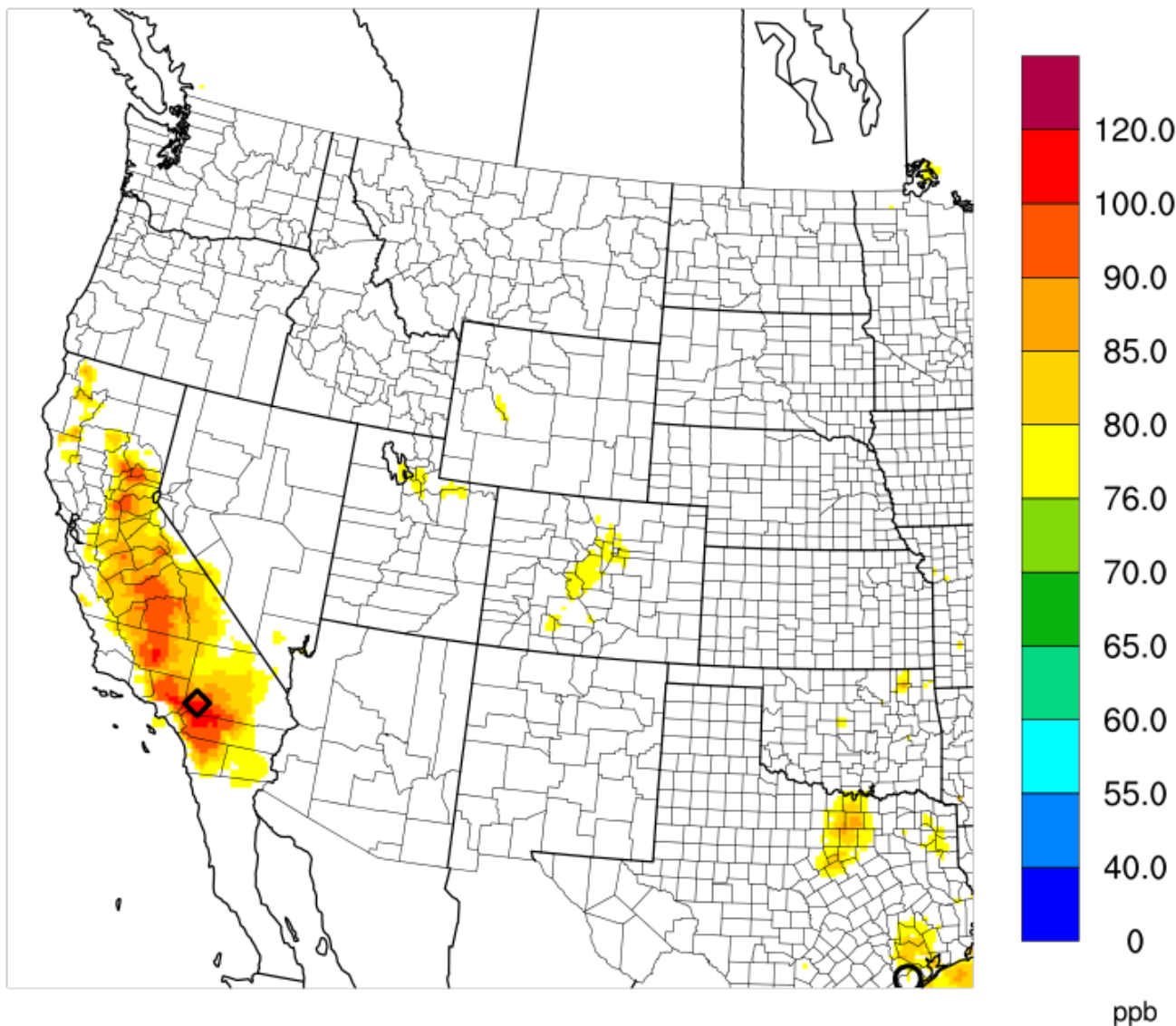
36km: 148 x 112 (-2736, -2088) to (2592, 1944)  
12km\*: 227 x 230 (-2388, -1236) to (336, 1542)  
04km\*: 317 x 515 (-1480, -904) to (-212, 1156)

\* includes buffer cells



# Ozone Modeled Attainment Test Software – Unmonitored Area Analysis with Design Value (2006-2010) $\geq 76$ ppb

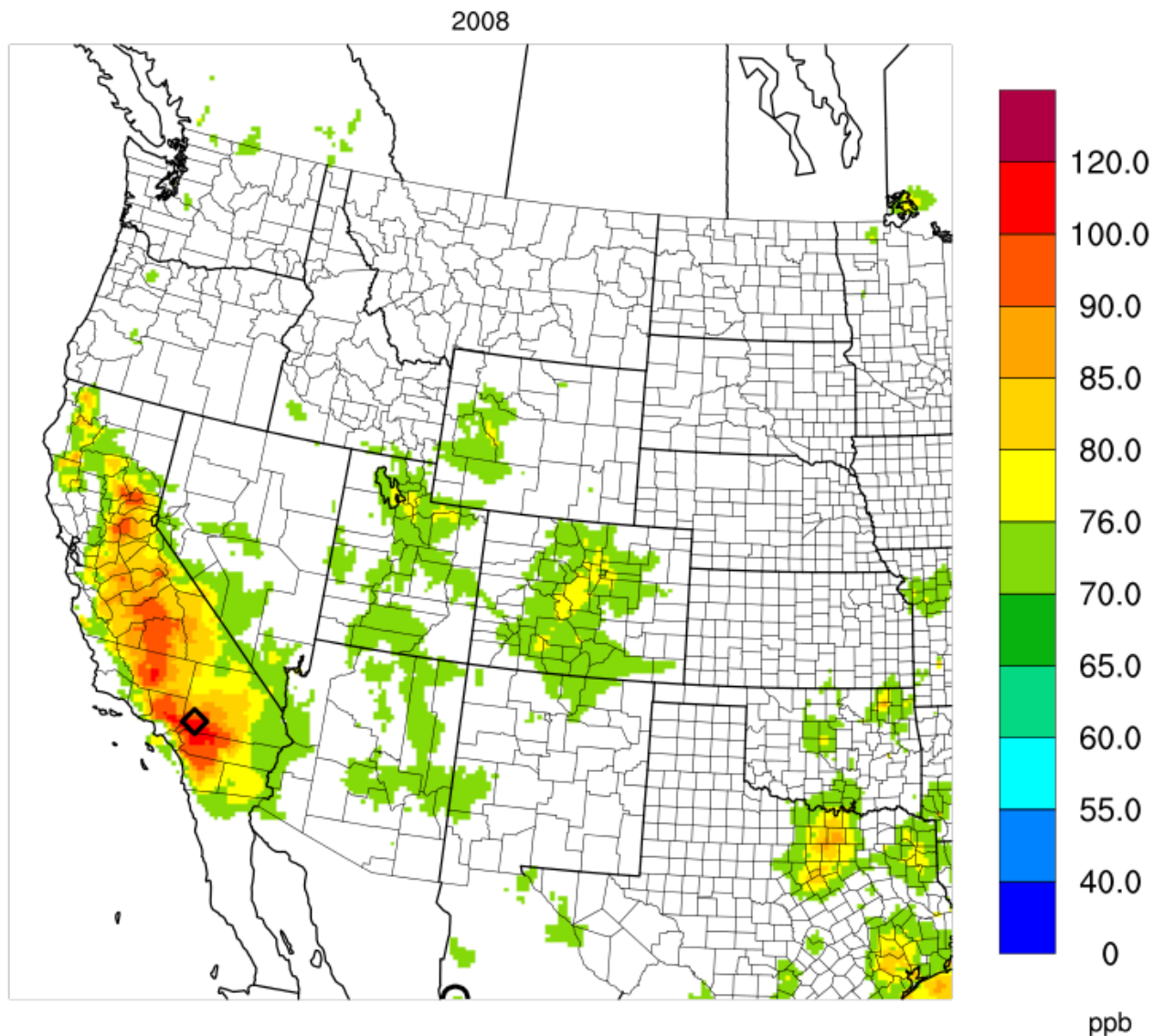
2008



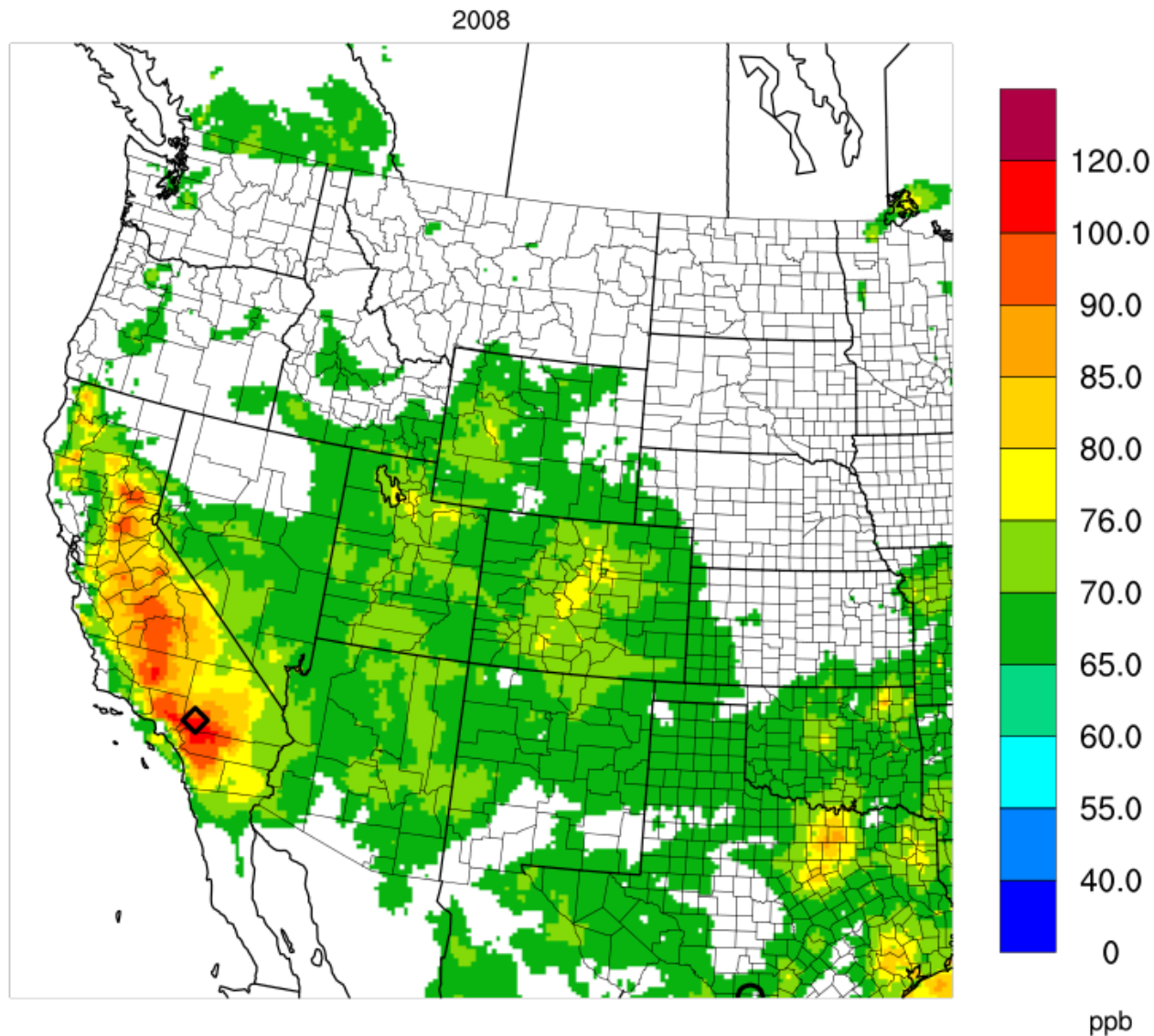
Source: [WestJumpAQMS](#)

○ Min(210,3) = 76.00, ◇ Max(45,67) = 113.30

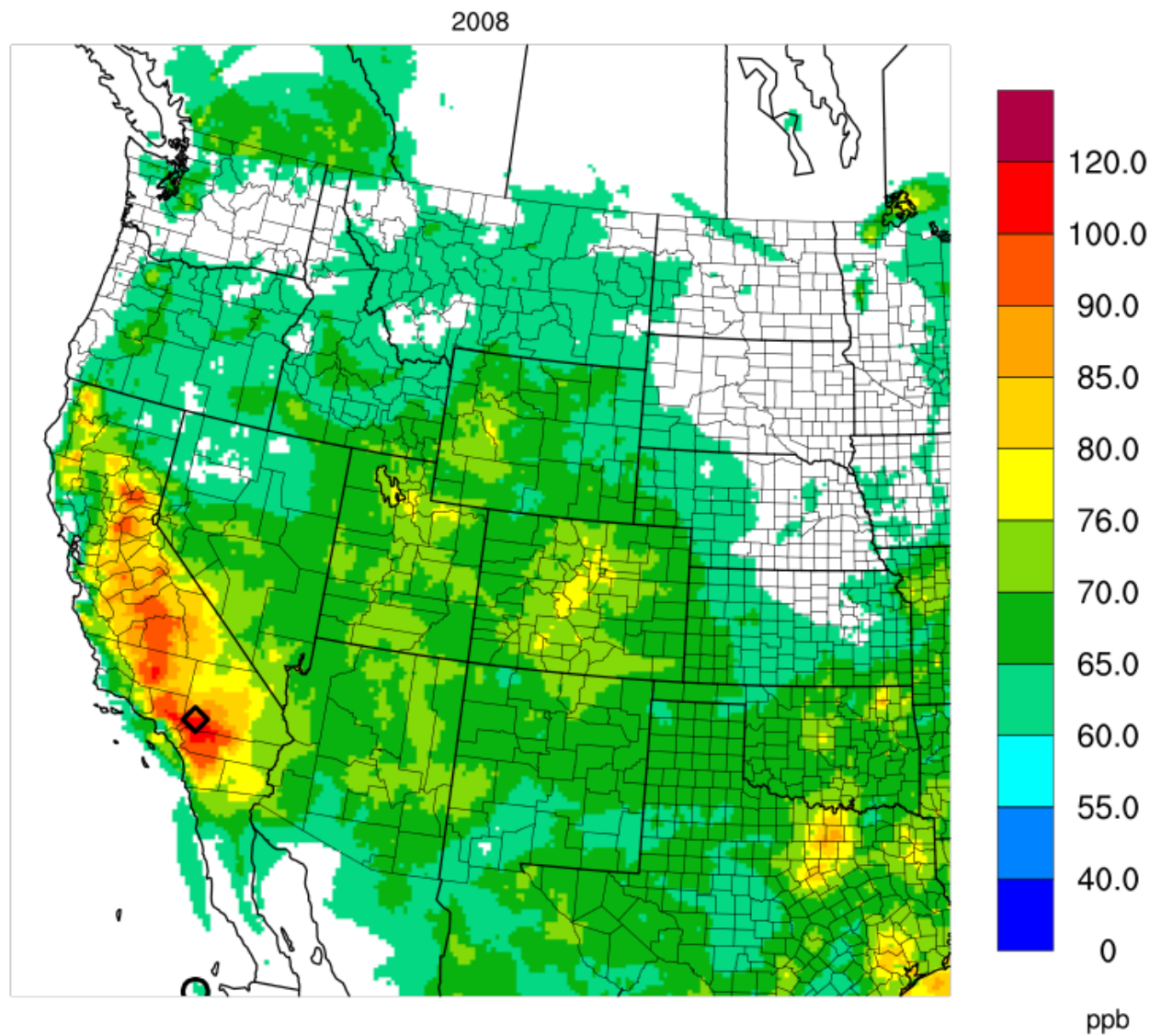
# Ozone Modeled Attainment Test Software – Unmonitored Area Analysis with Design Value (2006-2010) $\geq 70$ ppb



# Ozone Modeled Attainment Test Software – Unmonitored Area Analysis with Design Value (2006-2010) $\geq 65$ ppb



# Ozone Modeled Attainment Test Software – Unmonitored Area Analysis with Design Value (2006-2010) $\geq 60$ ppb



○ Min(45,2) = 60.00, ◇ Max(45,67) = 113.30

# 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>

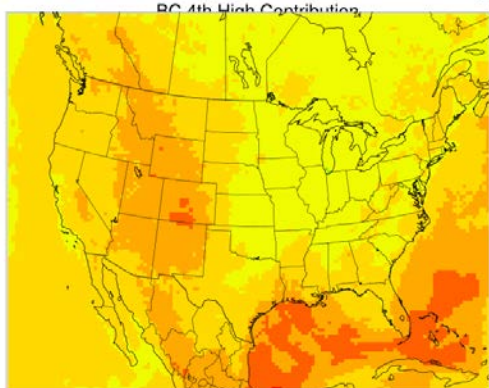
# “Other Sources” Max Contrib. 4<sup>th</sup> High DMAX8 Ozone

Boundary Conditions

Natural

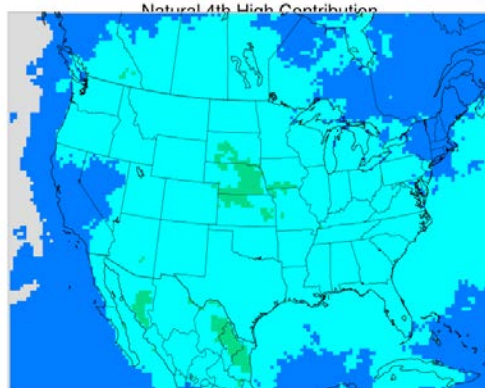
Anthropogenic

Contrib. to CAMx Daily Max 8-Hour Ozone  $\geq$  0 ppb



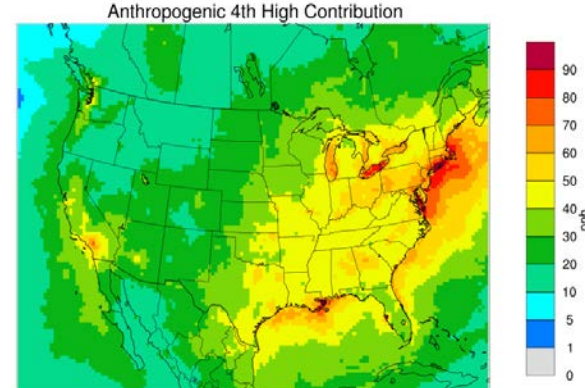
Max(82,2) = 80.37

Contrib. to CAMx Daily Max 8-Hour Ozone  $\geq$  0 ppb



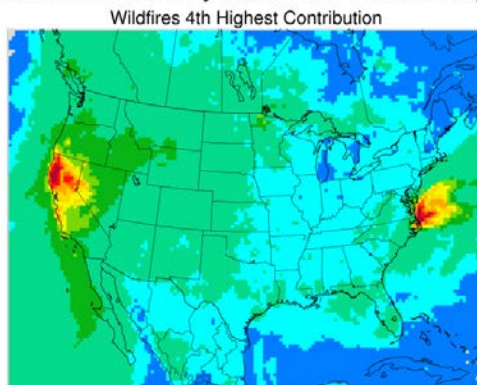
Max(70,11) = 12.84

Contrib. to CAMx Daily Max 8-Hour Ozone  $\geq$  0 ppb



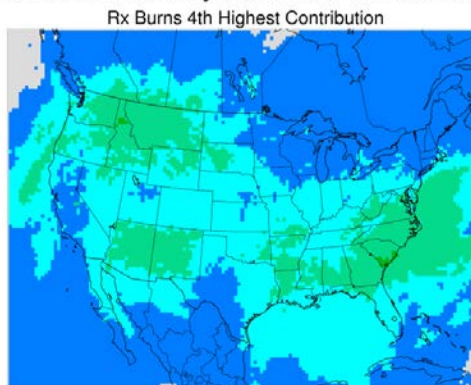
Max(133,70) = 110.89

Contrib. to CAMx Daily Max 8-Hour Ozone  $\geq$  0 ppb



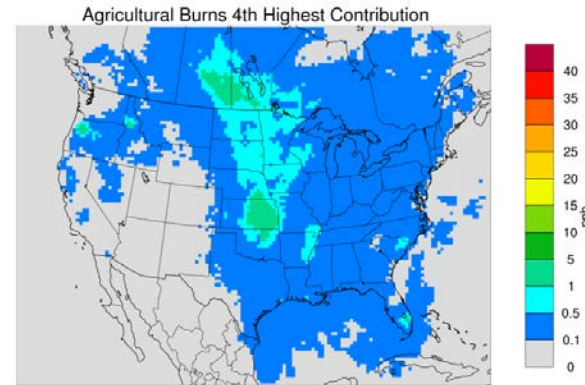
Max(129,53) = 60.13

Contrib. to CAMx Daily Max 8-Hour Ozone  $\geq$  0 ppb



Max(116,41) = 6.16

Contrib. to CAMx Daily Max 8-Hour Ozone  $\geq$  0 ppb

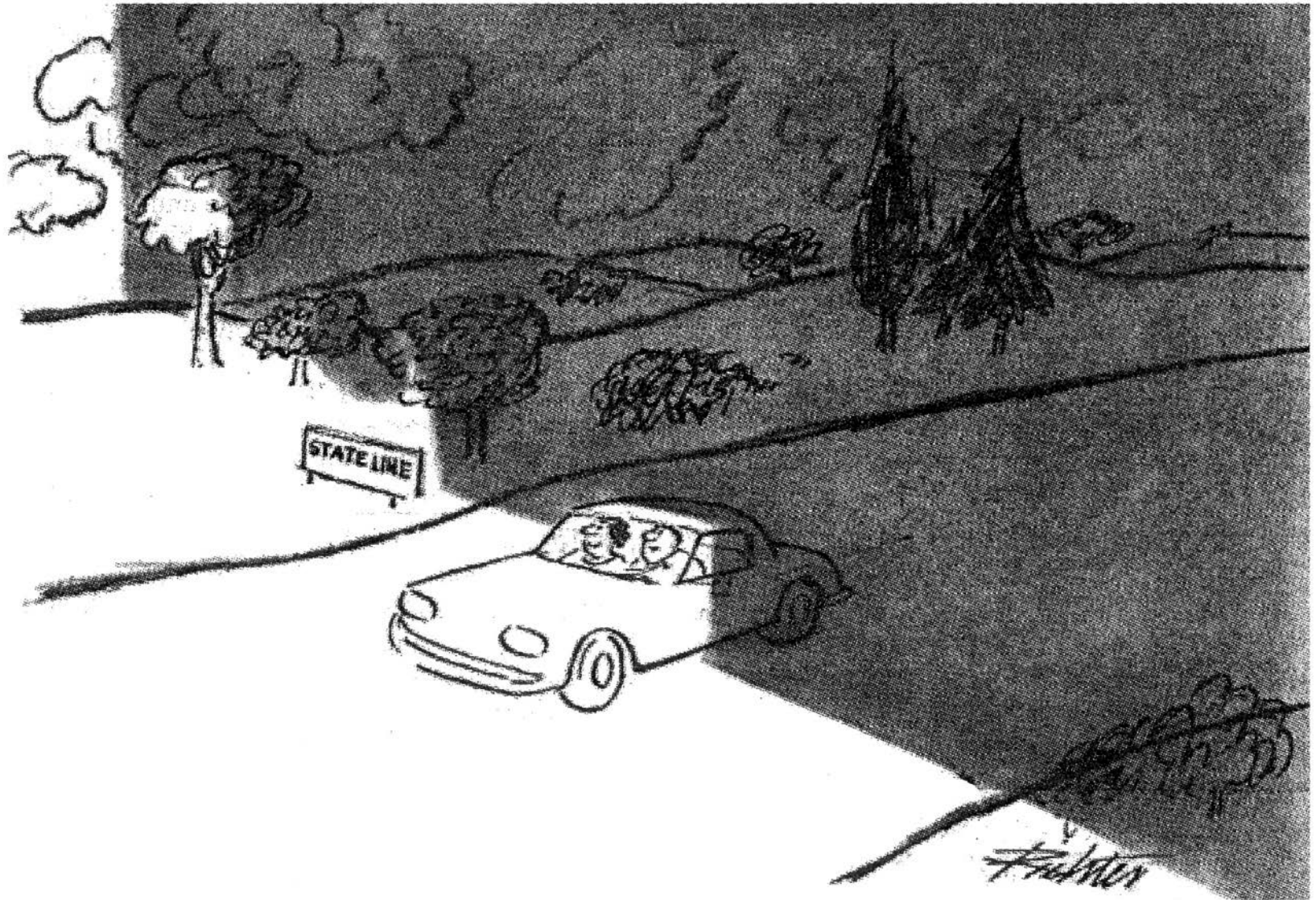


Max(79,51) = 3.15

Wildfire

Prescribed Fire

Agricultural Fire



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

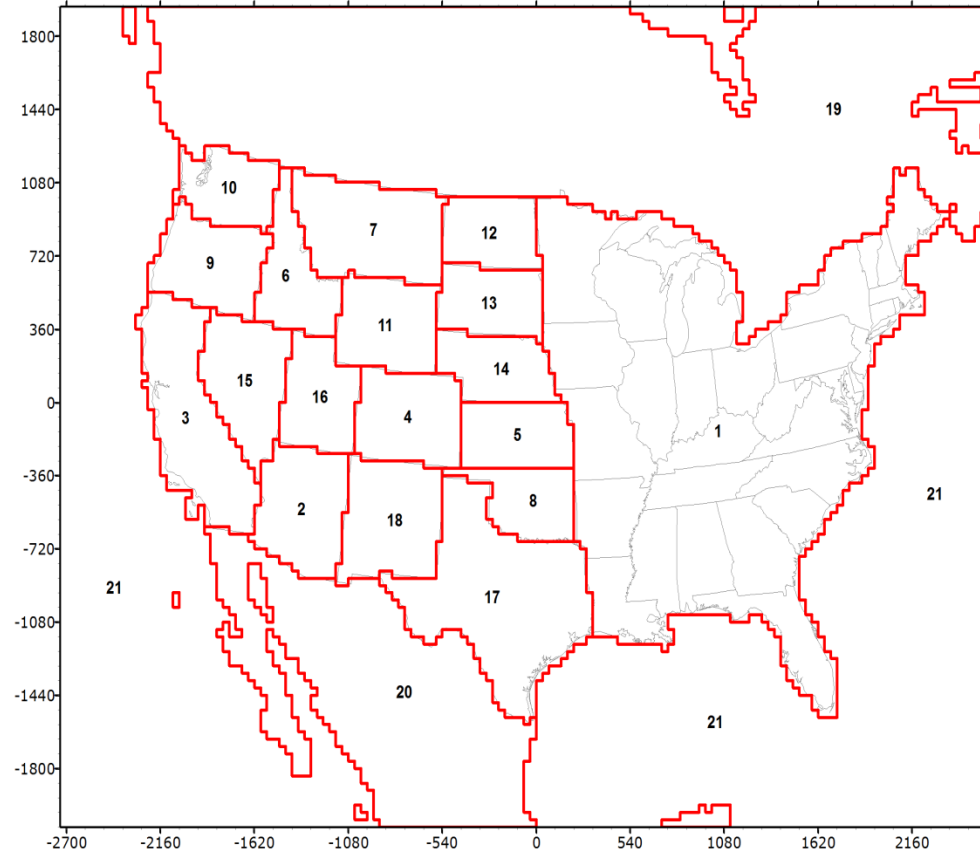
# State-Specific Ozone Source Apportionment

- 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

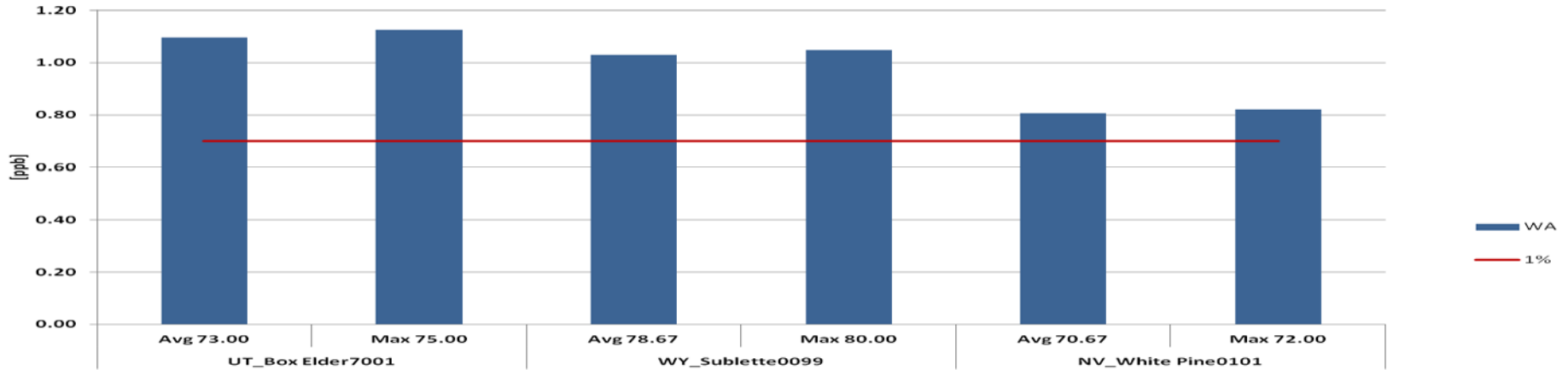


# CSAPR-Type Analysis for current (76 ppb) and potential future (70 and 65 ppb) NAAQS levels

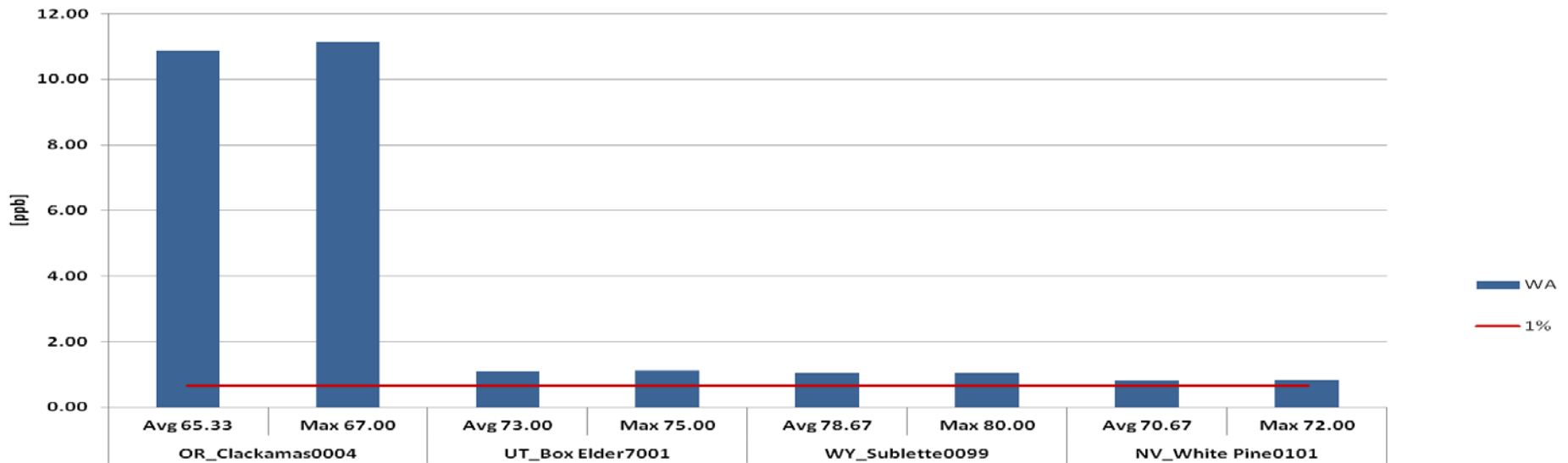
- CSAPR looked at contributions to:
  - Average Design Value = Average of DVs from 2006-2010
  - Max Design Values = Max DVs from 2006-2010
- 136 ozone monitors in 12 km WESTUS domain with Average Design Value exceeding 76 ppb NAAQS
  - 86 sites (63%) in California
- For 17 upwind western states examine 2008 contribution to DMAX8 ozone Design Value in downwind states
  - CSAPR used a 1% NAAQS significance threshold ( $\geq 0.76$  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 potential 70 and 65 ppb NAAQS (from WestJumpAQMS Appendix A)

WASHINGTON's Contributions to Top 5 States Surrounding WASHINGTON, where DV is at or above 70.0 ppb Threshold

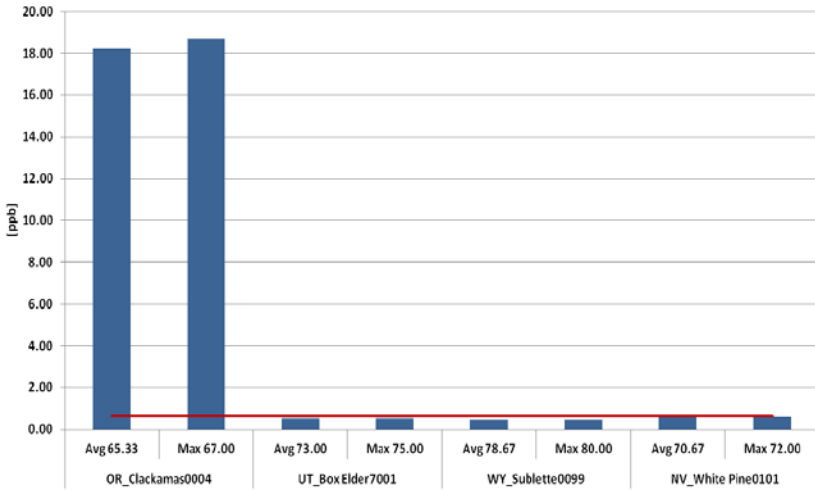


WASHINGTON's Contributions to Top 5 States Surrounding WASHINGTON, where DV is at or above 65.0 ppb Threshold

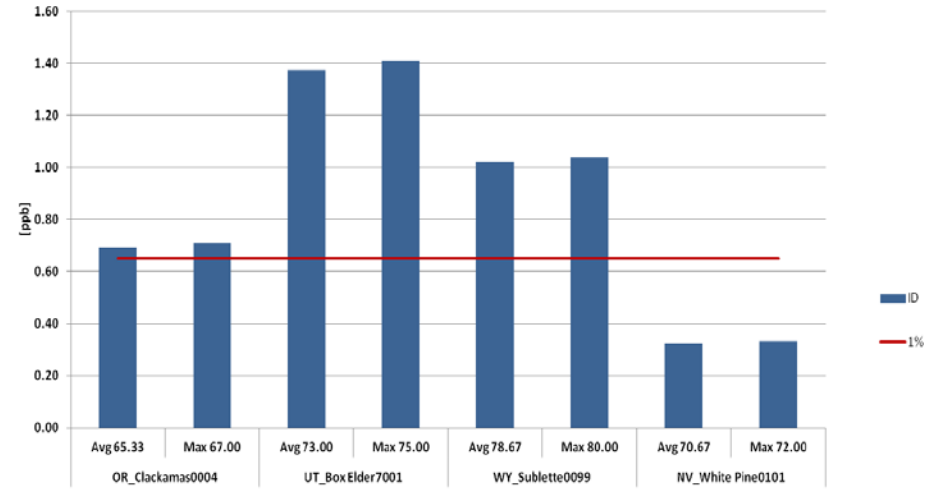


# CSAPR-Type Ozone Contribution Analysis - "states near WA" at potential 65 ppb NAAQS (from WestJumpAQMS Appendix A)

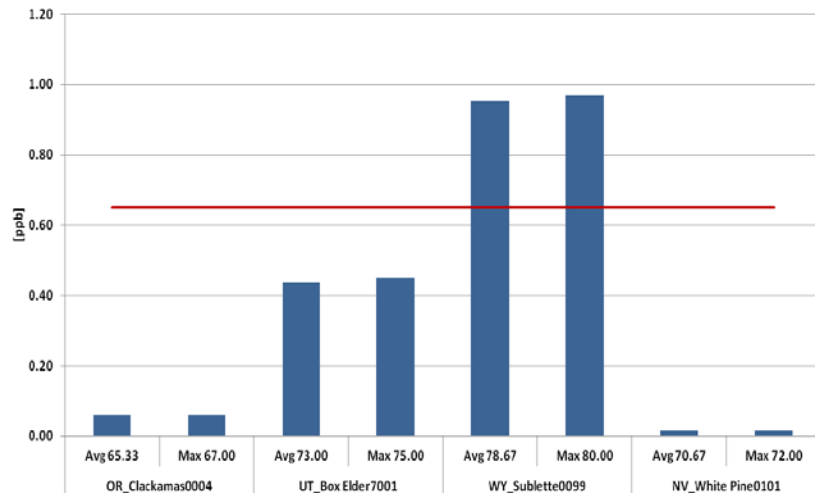
OREGON's Contributions to Top 5 States Surrounding WASHINGTON, where DV is at or above 65.0 ppb Threshold



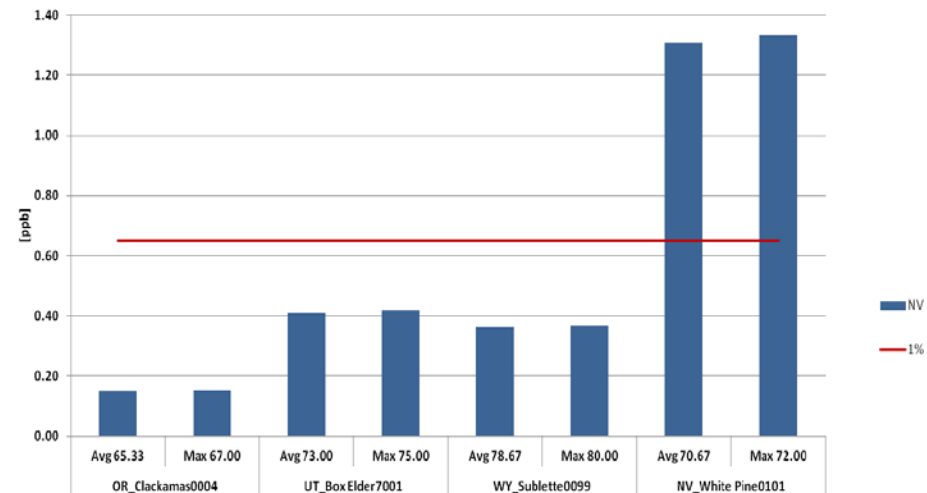
IDAHO's Contributions to Top 5 States Surrounding WASHINGTON, where DV is at or above 65.0 ppb Threshold



WYOMING's Contributions to Top 5 States Surrounding WASHINGTON, where DV is at or above 65.0 ppb Threshold

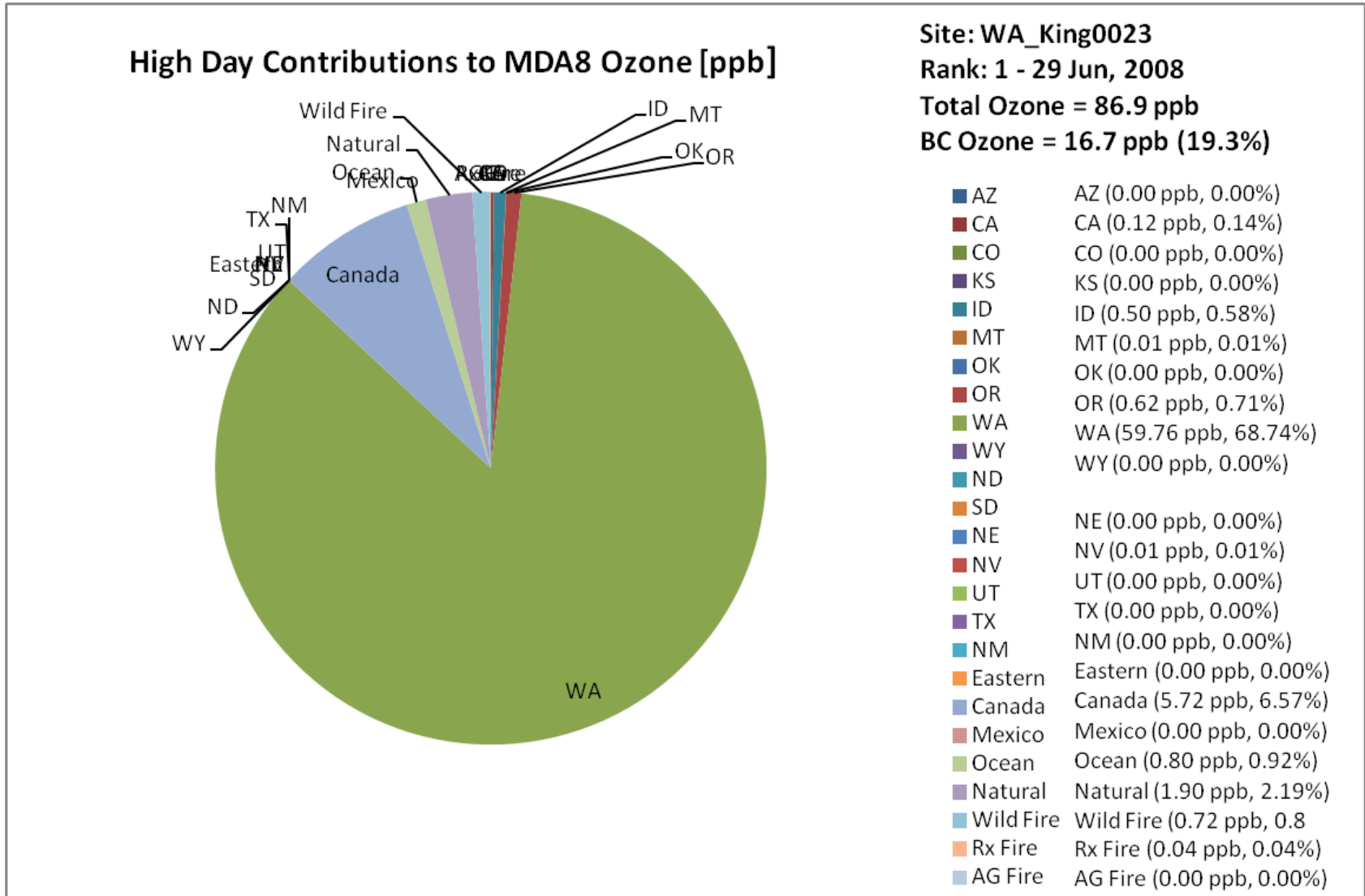


NEVADA's Contributions to Top 5 States Surrounding WASHINGTON, where DV is at or above 65.0 ppb Threshold



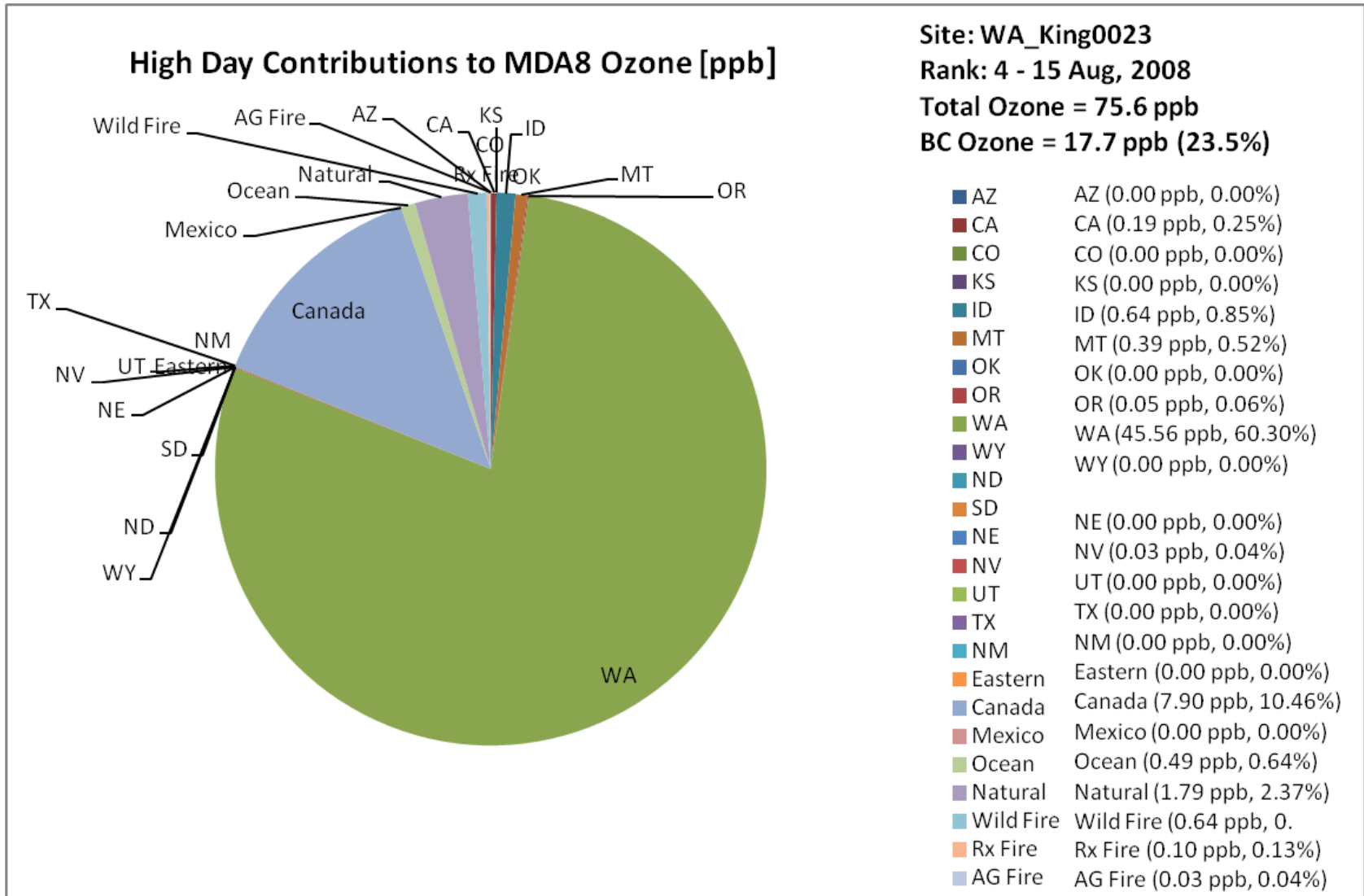
# State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

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



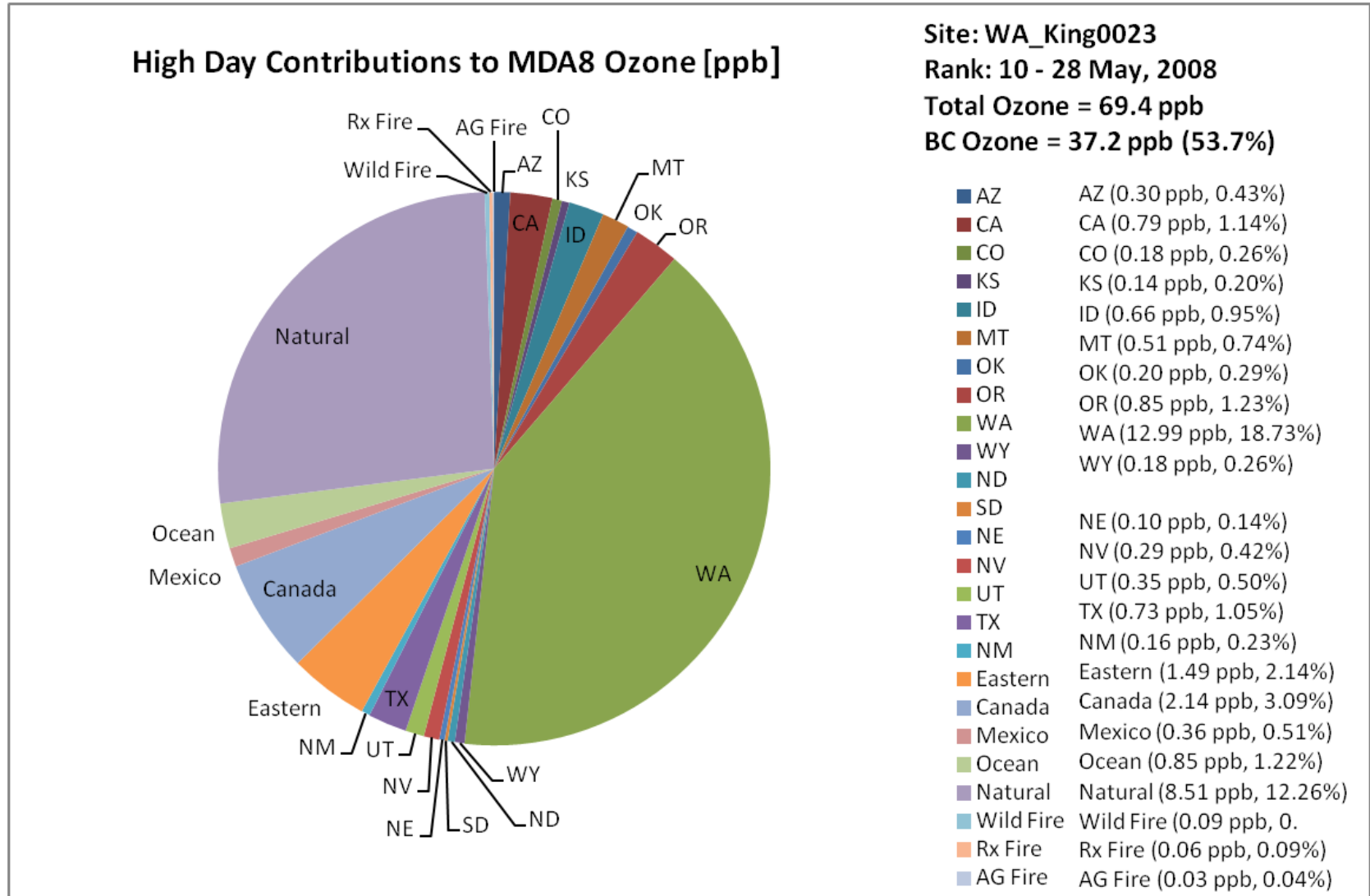
# State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

## 4<sup>th</sup> Highest Modeled DMAX8 Day at Enumclaw site (53-033-0023)



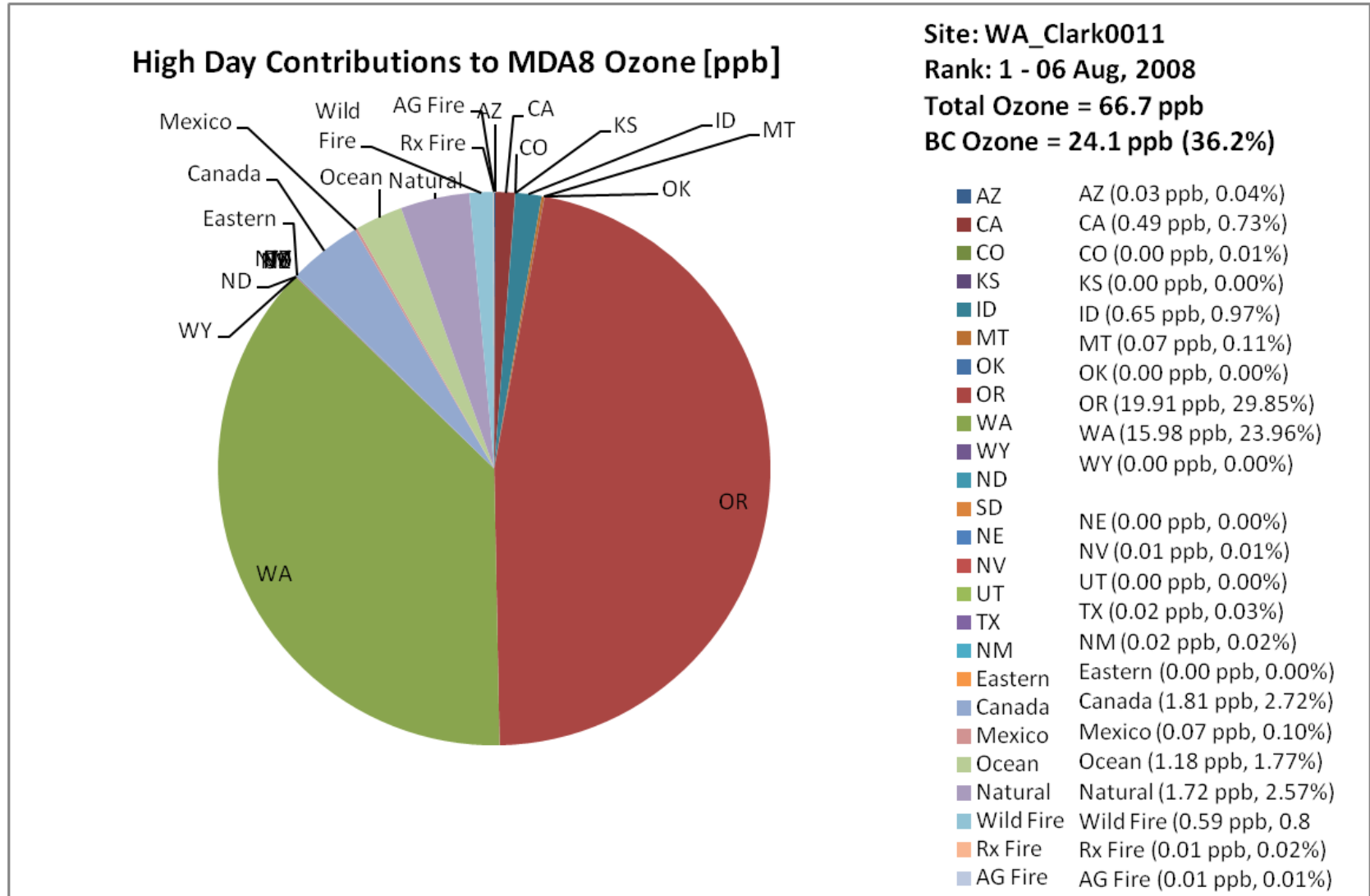
# State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

## 10<sup>th</sup> Highest Modeled DMAX8 Day at Enumclaw site (53-033-0023)



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

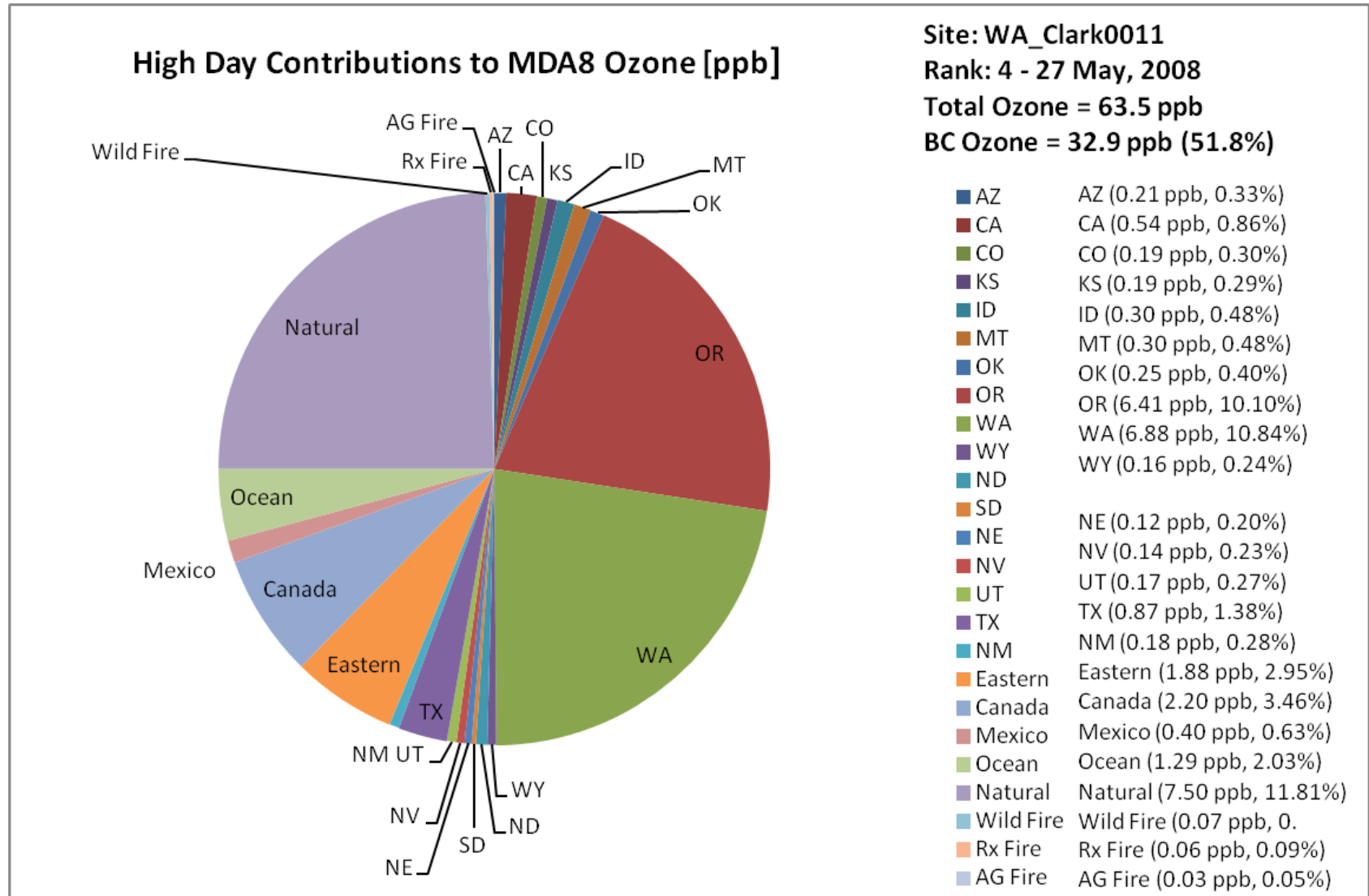
**Highest Modeled DMAX8 Day at Vancouver site (53-011-0011)**





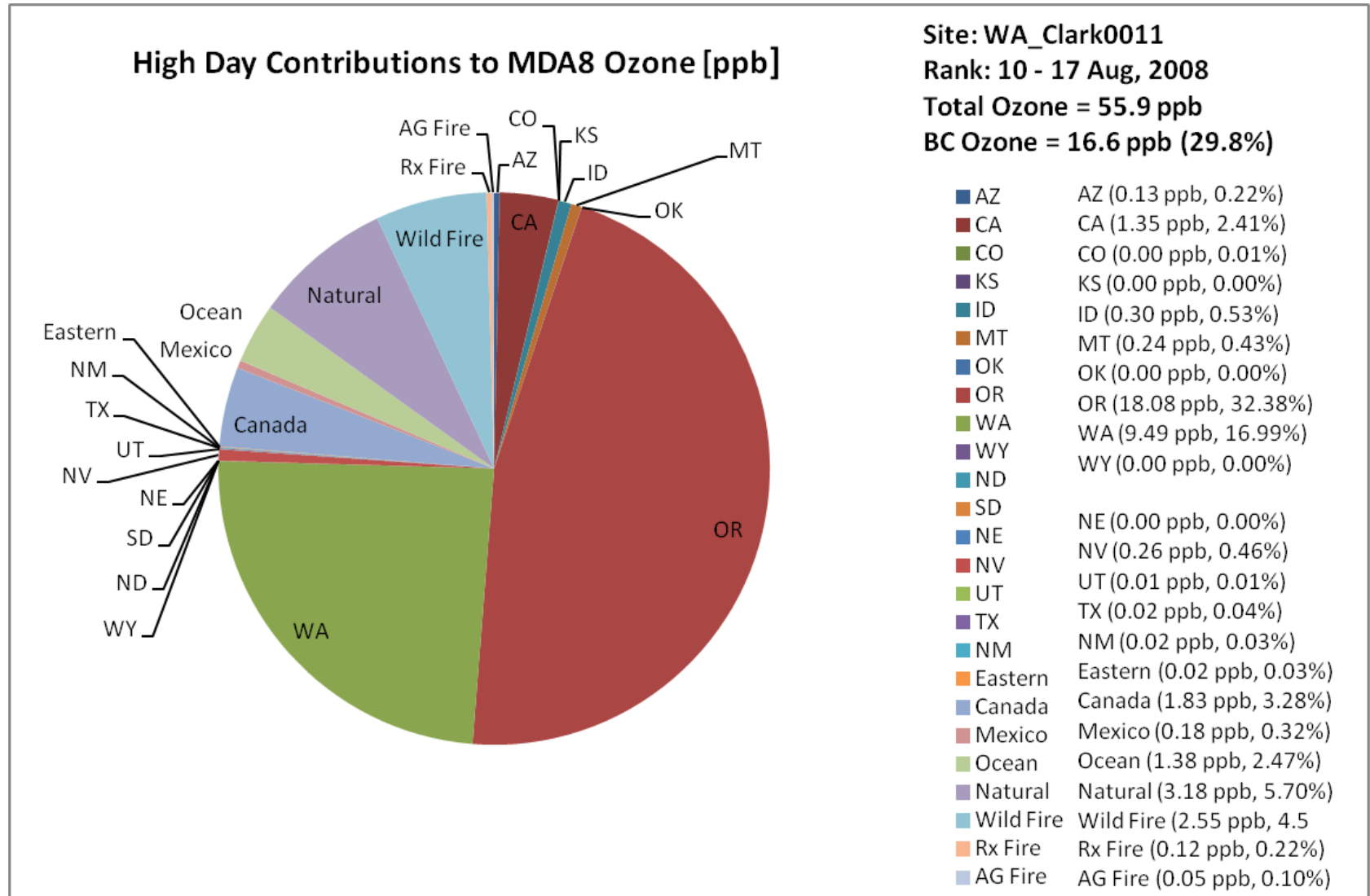
# State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

**4<sup>th</sup> Highest Modeled DMAX8 Day at Vancouver site (53-011-0011)**



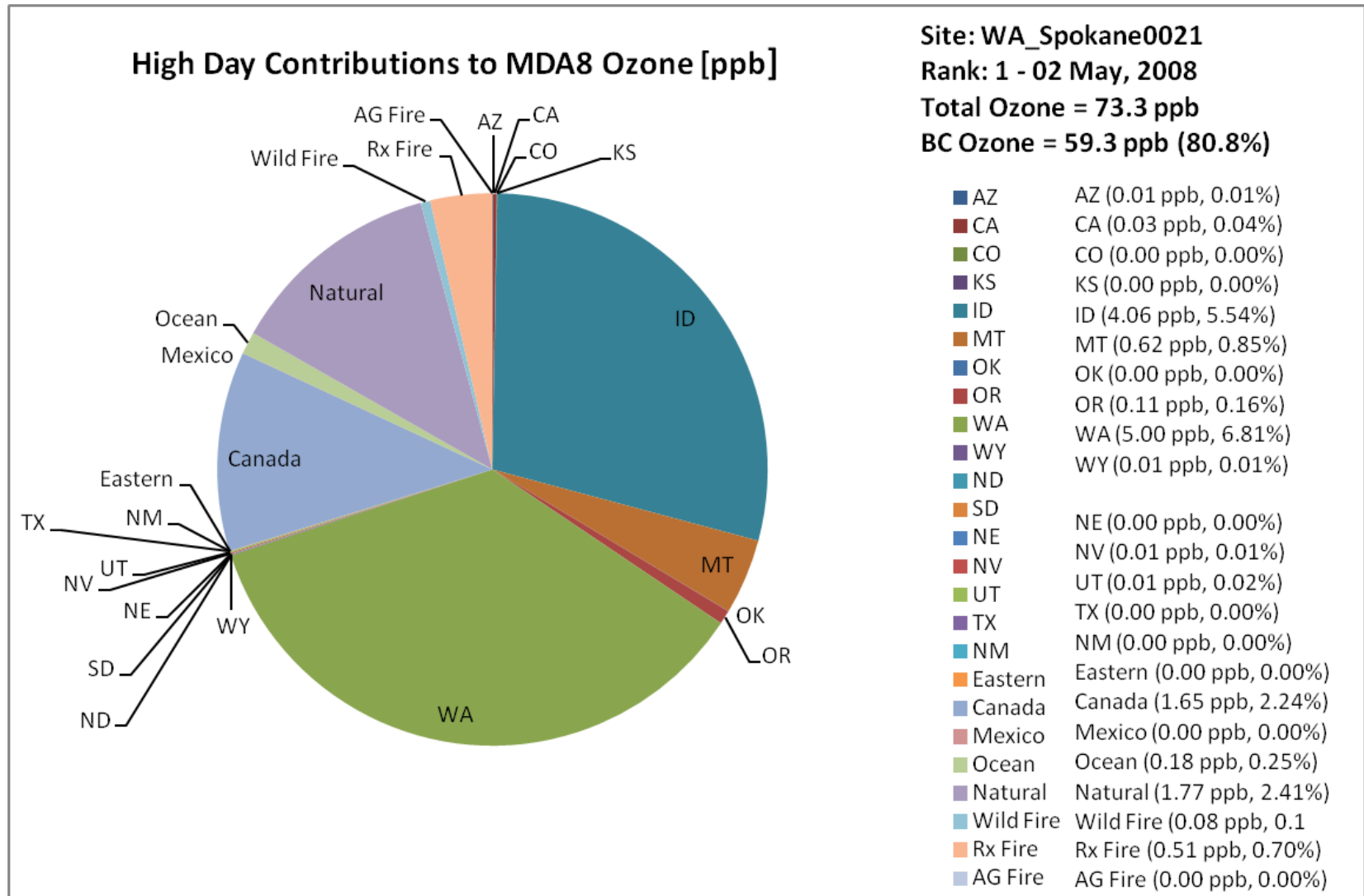
# State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

## 10<sup>th</sup> Highest Modeled DMAX8 Day at Vancouver site (53-011-0011)



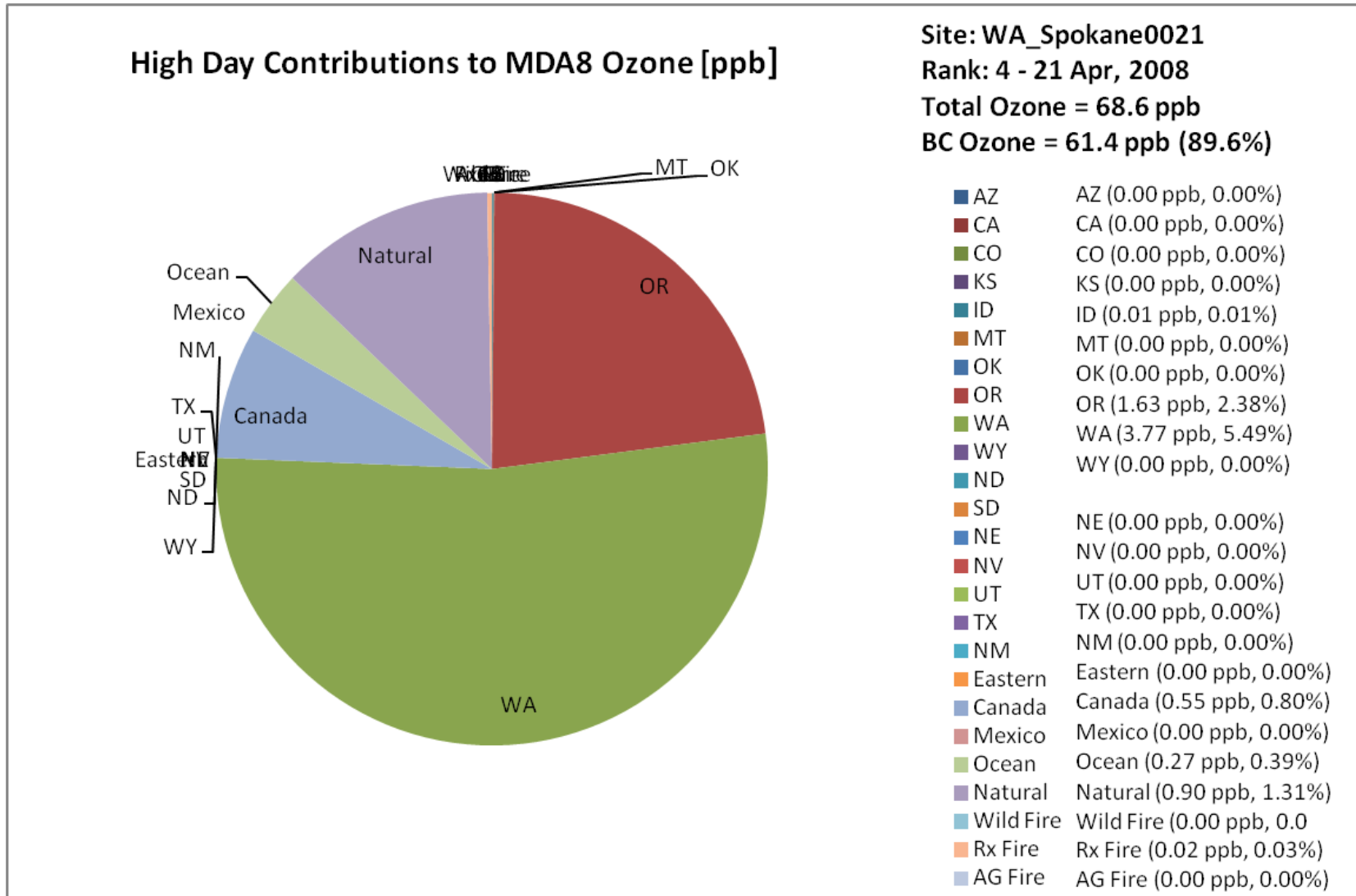
# State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

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



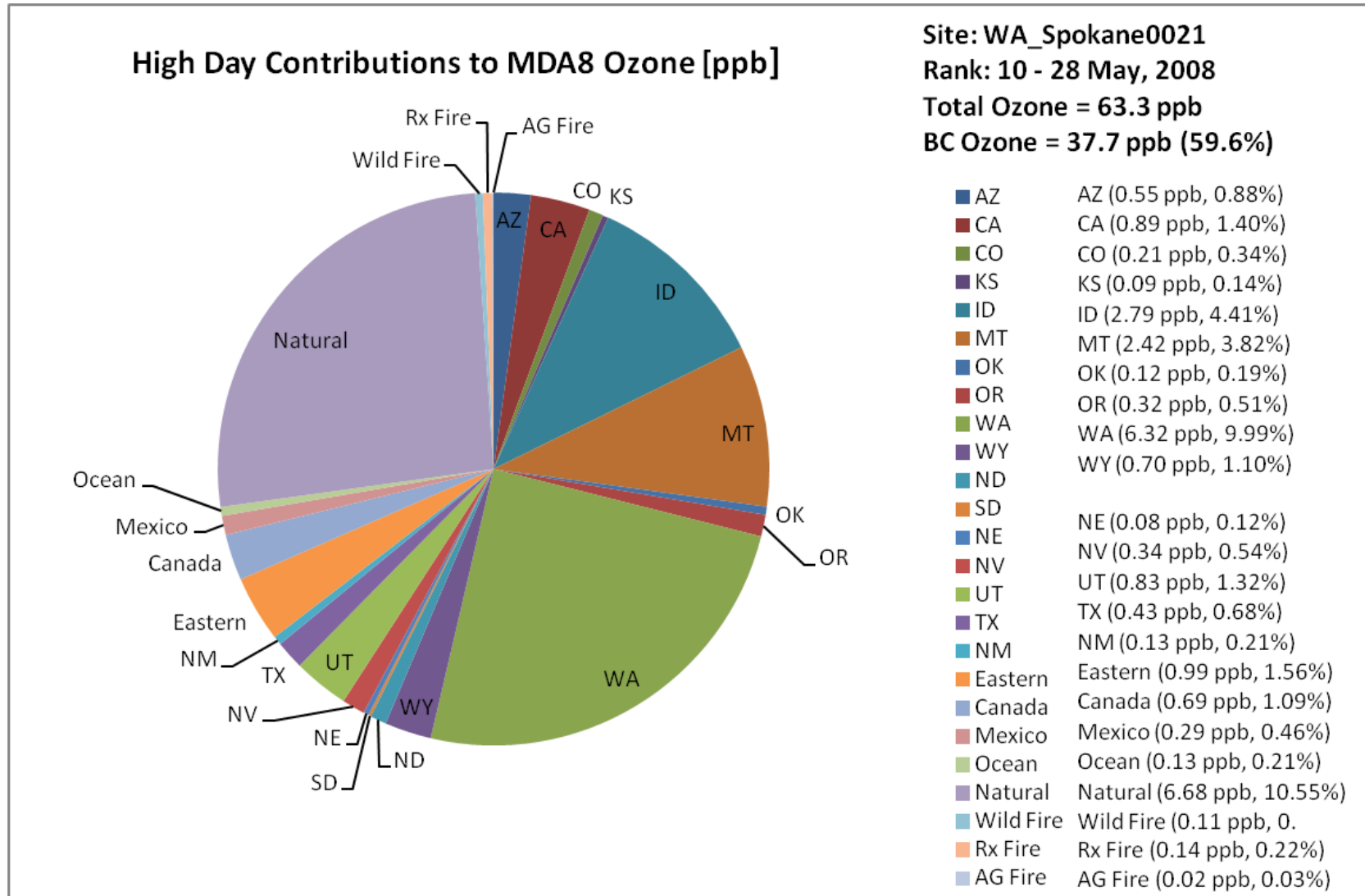
# State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

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



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

## 10<sup>th</sup> Highest Modeled DMAX8 Day at Spokane site (53-063-0021)

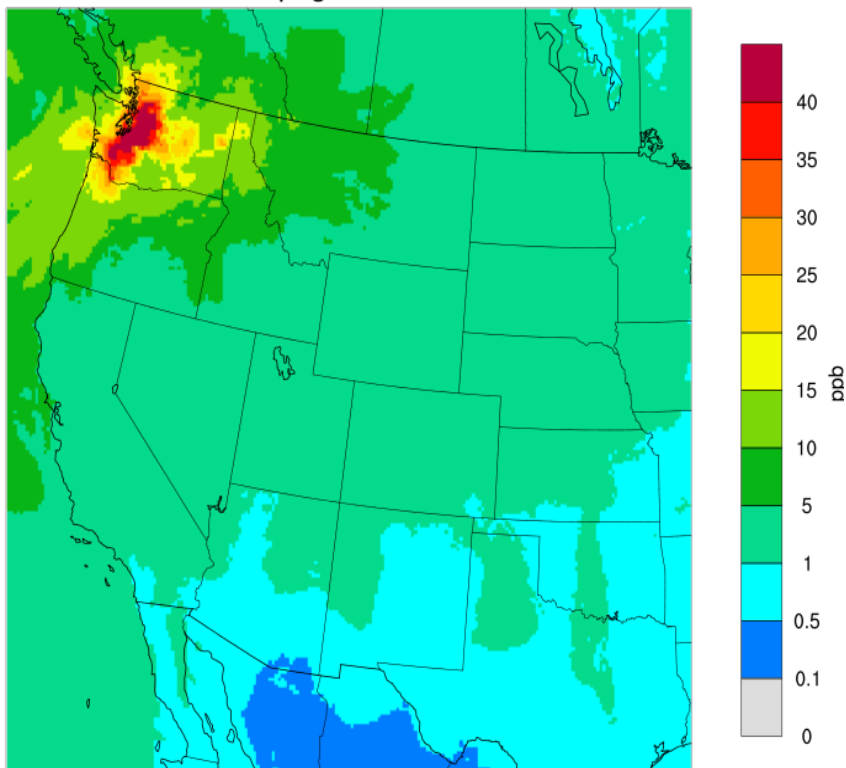


# 2008 Washington 8-Hour Ozone Contribution

from WestJumpAQMS Appendix C

## Highest Modeled Contribution

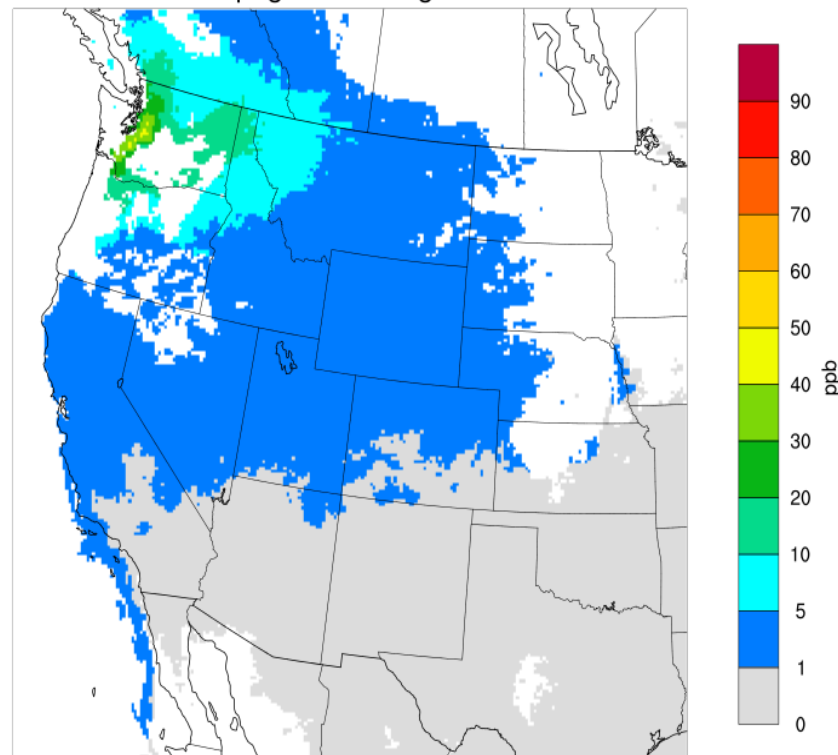
Contrib. to CAMx Daily Max 8-Hour Ozone  $\geq 0$  ppb  
WA Anthropogenic Max Contribution



Max(44,192) = 61.37

## Modeled DMAX8 Ozone $\geq 65$ ppb

Contrib. to CAMx Daily Max 8-Hour Ozone  $\geq 65$  ppb  
WA Anthropogenic 4th Highest Contribution



Max(45,192) = 42.52

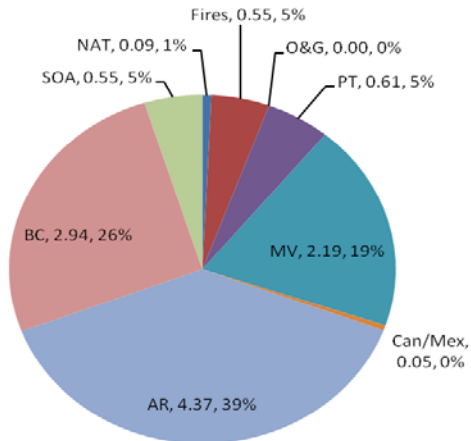
# Annual Average PM<sub>2.5</sub> (µg/m<sup>3</sup>) Vancouver 4<sup>th</sup> Plain Blvd. site

Sources

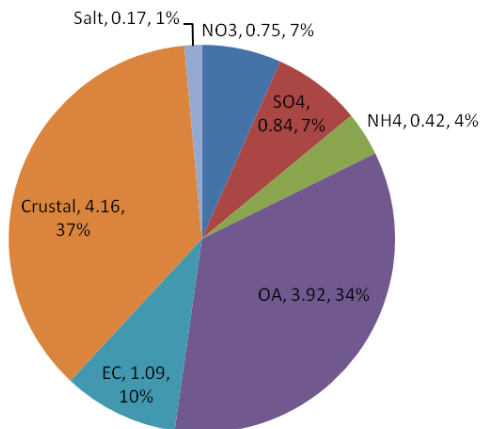
Composition

Source category  
Composition example

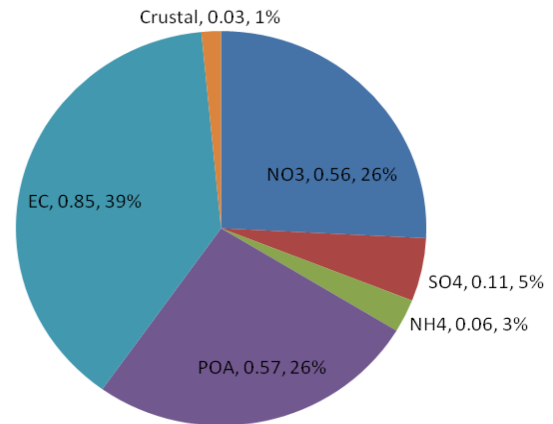
Source Contribution to Annual Average PM<sub>2.5</sub> in ug/m<sup>3</sup>  
WA\_Clark0013  
PM2.5 = 11.34 ug/m<sup>3</sup>; PM2.5 = 11.34 ug/m<sup>3</sup> (100.0%)



Composition of Annual Average PM<sub>2.5</sub> in ug/m<sup>3</sup>  
WA\_Clark0013  
PM2.5 = 11.34 ug/m<sup>3</sup>



Composition of Annual PM<sub>2.5</sub> from Mobile in ug/m<sup>3</sup>  
WA\_Clark0013  
PM2.5 = 11.34 ug/m<sup>3</sup>; Mobile = 2.19 ug/m<sup>3</sup> (19.3%)





# 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



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

*Fire*



## The Big Picture

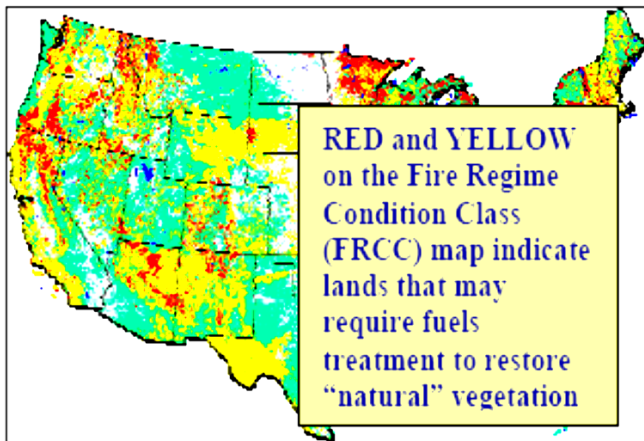
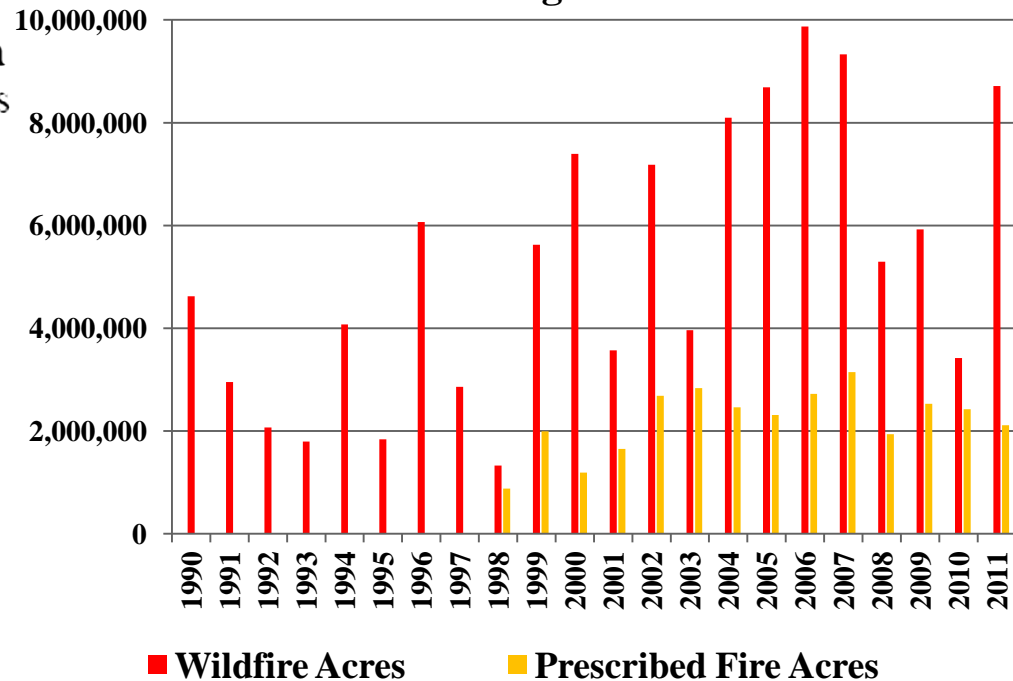
Technical Products for air quality planning & management as required by the Clean Air Act



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

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



## Fire's Effects on Elevated Regional Ozone & PM

**Deterministic & Empirical Assessment of Smoke's Contribution to Ozone (DEASCO<sub>3</sub>) – 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**

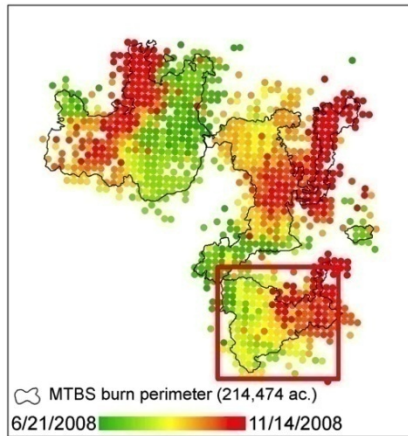
**Both projects, analysis toolbox / data, and FETS access at:  
<http://wraptools.org/>**

*New proposal to be funded early 2015 by JFSP :*

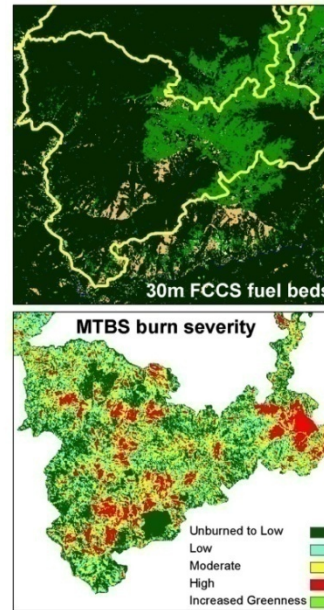
**Contribution of Smoke Emissions to Secondary Organic Aerosols (SOA): Real-World Evaluation of Fire SOA Emissions Factors from Fires in a Data Management System (REFERS-DMS)**

# Smoke and Emissions Inventory Research

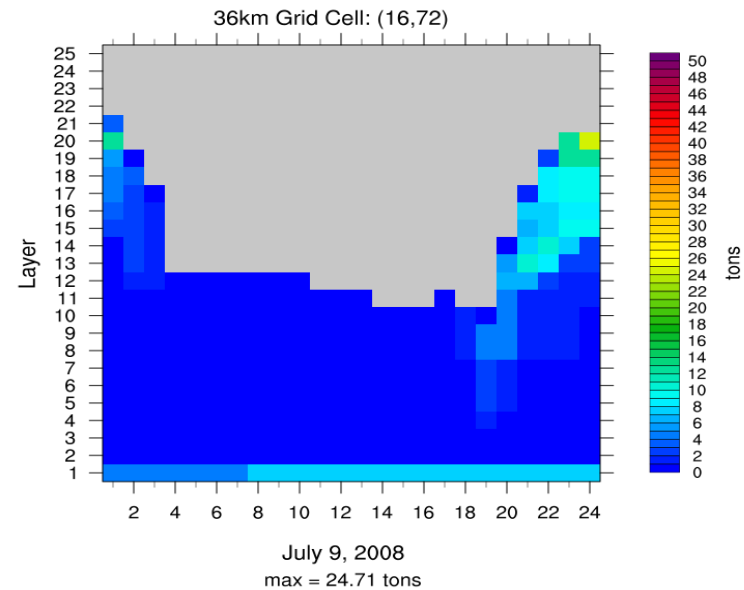
Source: [WRAP Fire Tools](#)



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



## DEASCO3 NOx Fire Emissions



# Smoke and Populations

Federal Land Manager Database (FED) Sign In | Register

Home | Summaries | Data | Metadata | Resources

Search:

[AQRV Summaries](#)  
[Webcams and Photographs](#)  
[Data Visualization and Exploration](#)  
[Metadata and Reference](#)  
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Glacier National Park

FED Home Page status | Printer friendly view | Contact us

Federal Land Manager Environmental Database (FED)

This website provides access to an extensive database of environmental data and an integrated suite of online tools and resources to help Federal Land Managers assess and analyze the air quality and visibility in Federally-protected lands such as National Parks, National Forests, and Wilderness Areas.

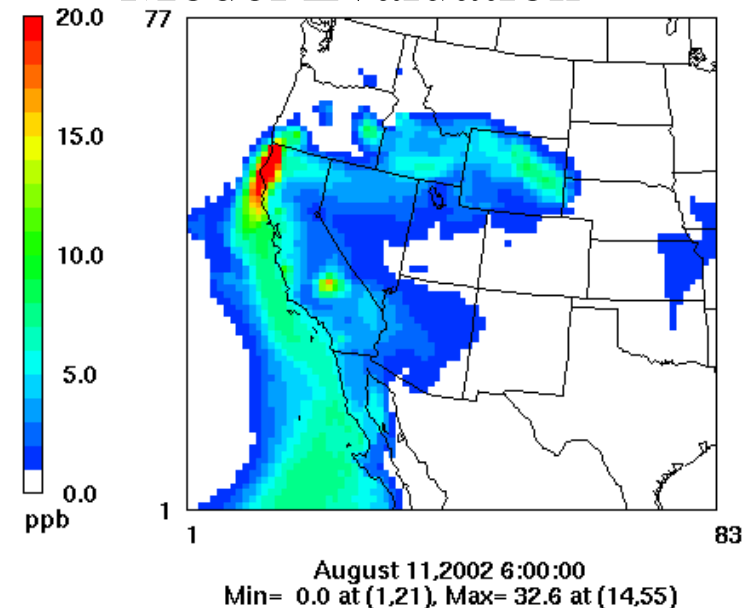
**AQRV Summaries**  
View graphical summaries and reports of the status and trends of air-quality-related values (AQRVs) and other metrics that have been chosen by Federal Land Managers (FLMs) for assessing air quality in protected federal areas.

**Webcams and Photographs**  
See live video from webcams at select rural and urban vistas, and examine sequences of photographs from selected monitoring sites that demonstrate the range of visual conditions at each site over time.

**Featured Substance**  
Ammonium sulfate

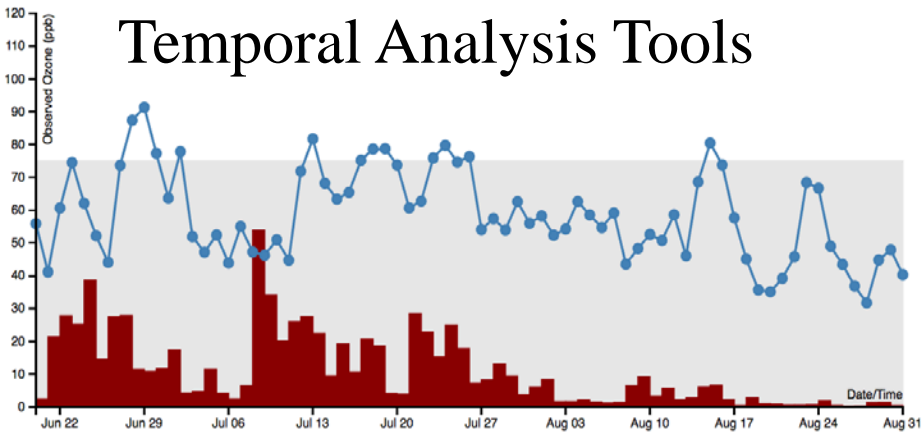
Name:	Ammonium sulfate
FormulaHTML:	H <sub>4</sub> N <sub>2</sub> O <sub>6</sub> S
CASNum:	7783-20-2
ACXNumber:	X1002153-5
Density:	1.769
Comments:	colorless crystals or white granular powder
MolecularWeight:	132.1342
MeltingPoint:	280
WaterSolubility:	soluble

# Fire and Smoke Model Evaluation

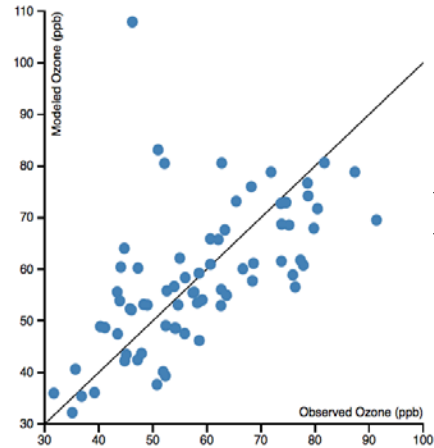


Observed Ozone paired with modeled max 8-hour fire contribution 06/20/2008 to 08/31/2008  
Shasta County, CA - 06\_089\_0007

# Temporal Analysis Tools

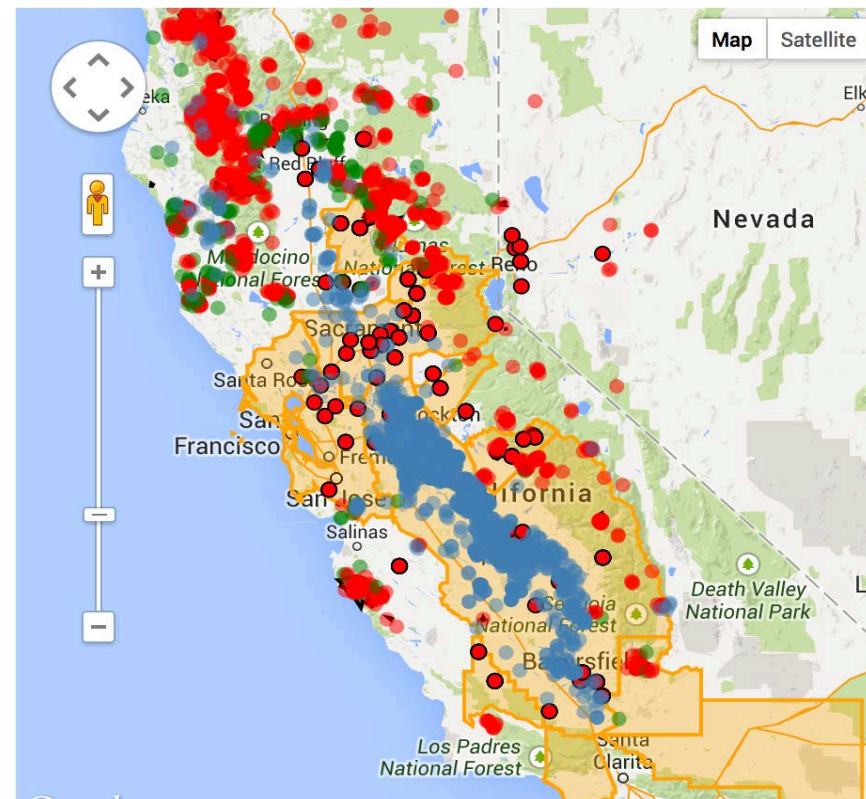


Max 8-hour Ozone, Observed vs. Modeled, 06/20/2008 to 08/31/2008  
Shasta County, CA - 06\_089\_0007

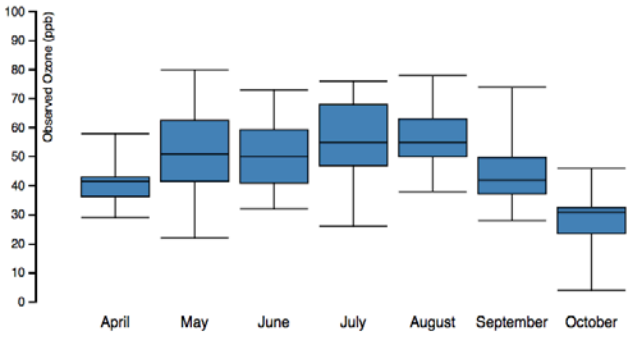


# Model Evaluation

# Fire Contributions to AQ Impacts



Observed Ozone by Month, 04/01/2007 to 10/31/2007  
Shasta County, CA - 060890007



# Inter-annual Observational Analysis

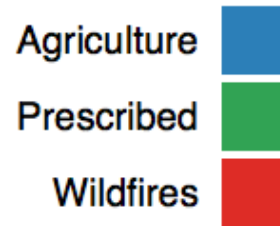
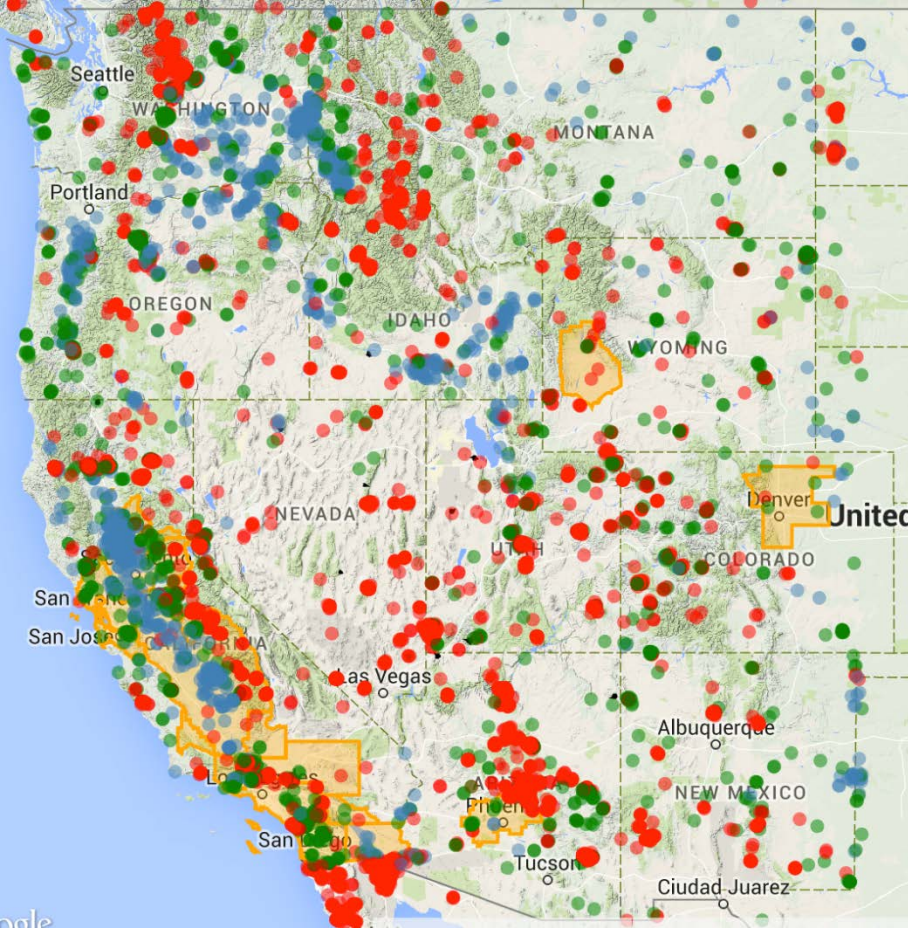
Source: [WRAP Fire Tools](#)

# 2004

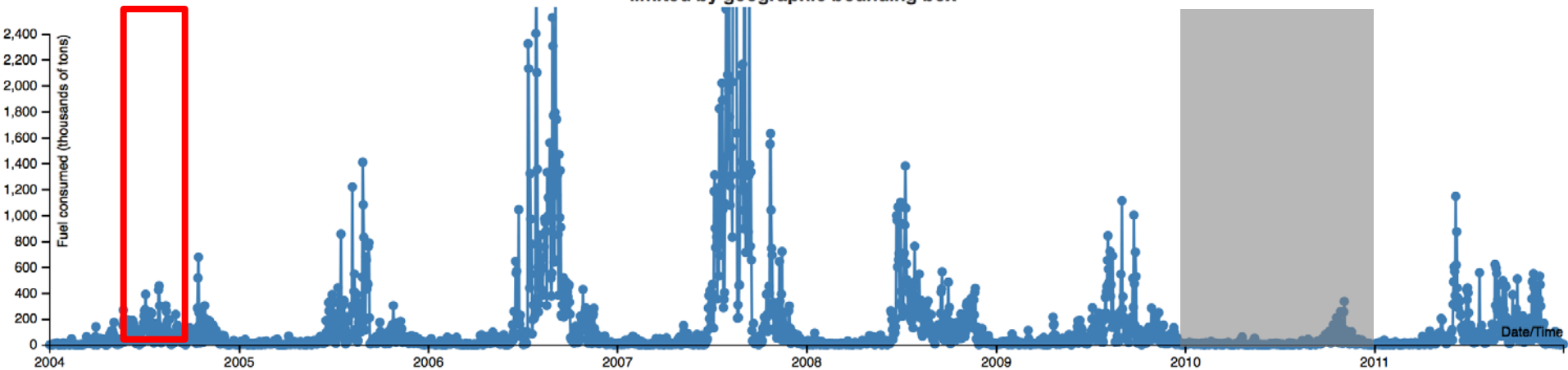
6/21 – 9/21

Limited by bounding box

Source: [WRAP Fire Tools](#)



FETS estimated fuel consumed for all fire types 01/01/2004 to 12/31/2011  
limited by geographic bounding box

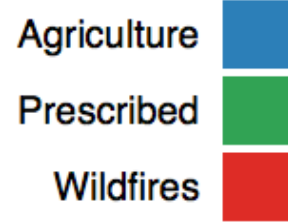
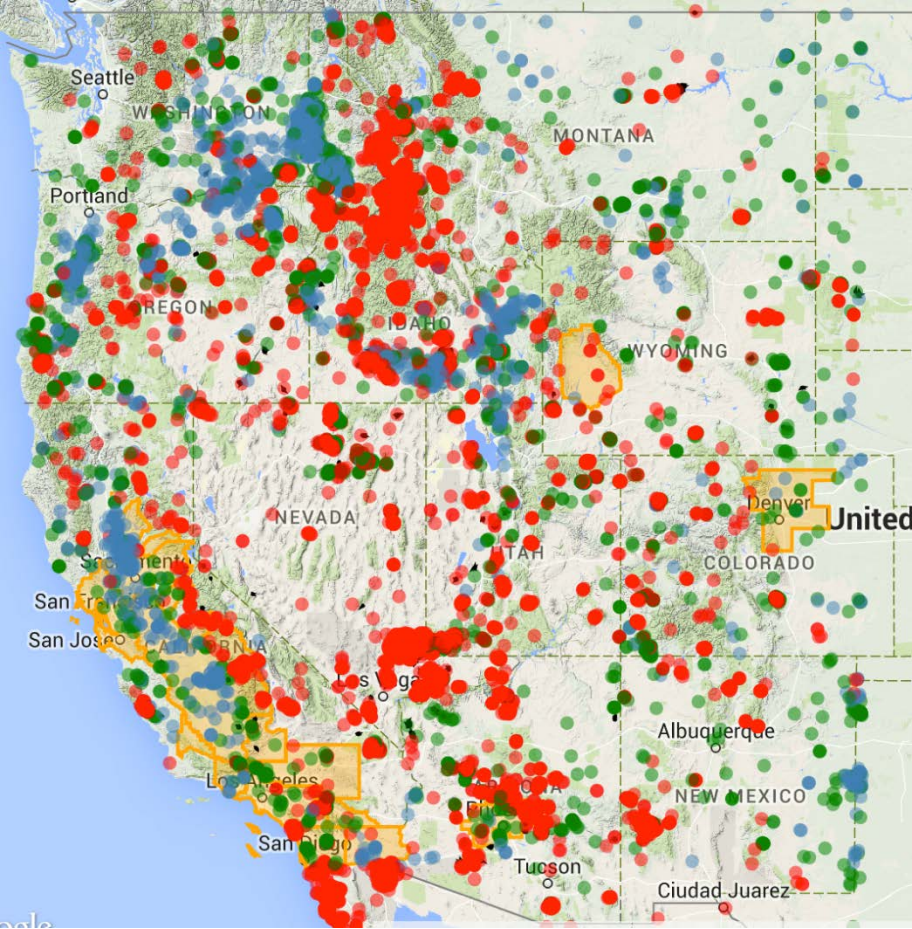


# 2005

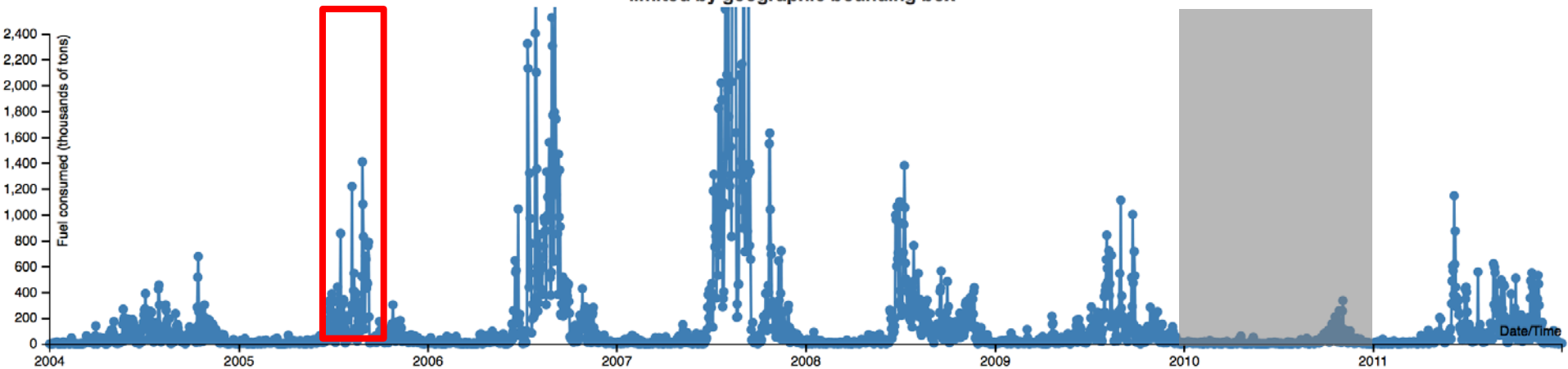
6/21 – 9/21

Limited by bounding box

Source: [WRAP Fire Tools](#)



FETS estimated fuel consumed for all fire types 01/01/2004 to 12/31/2011  
limited by geographic bounding box

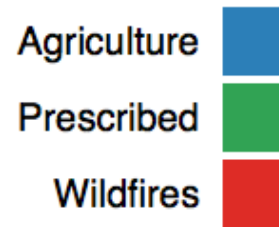
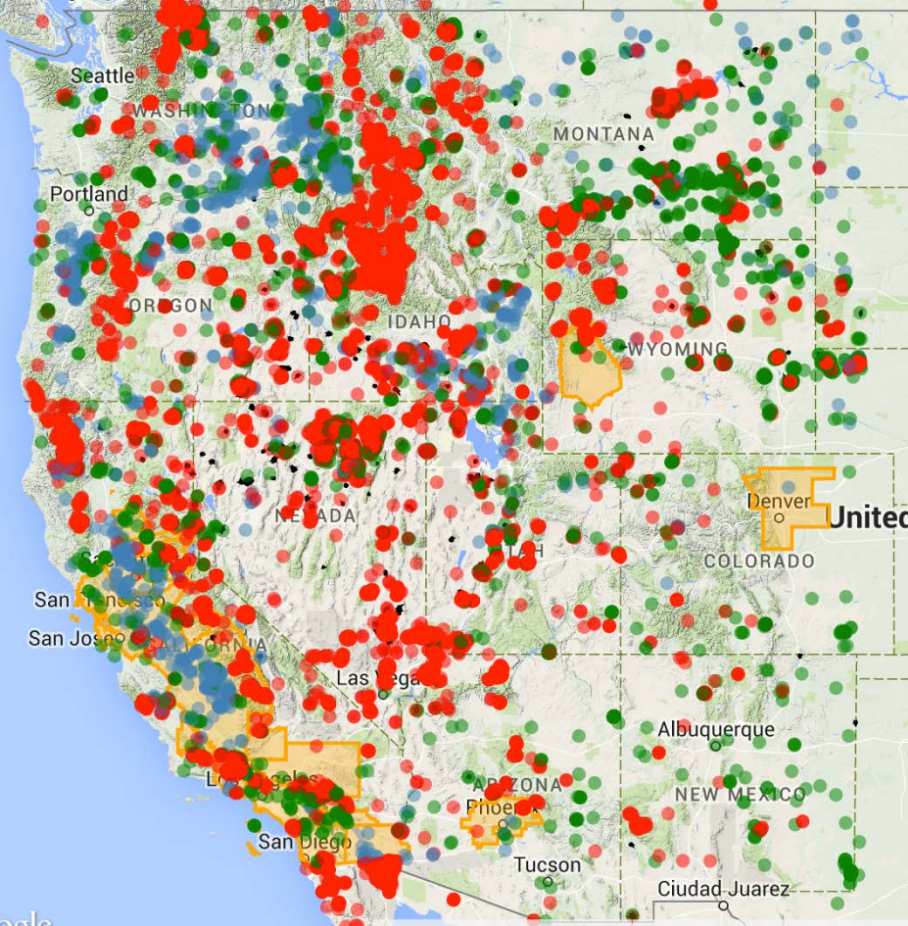


# 2006

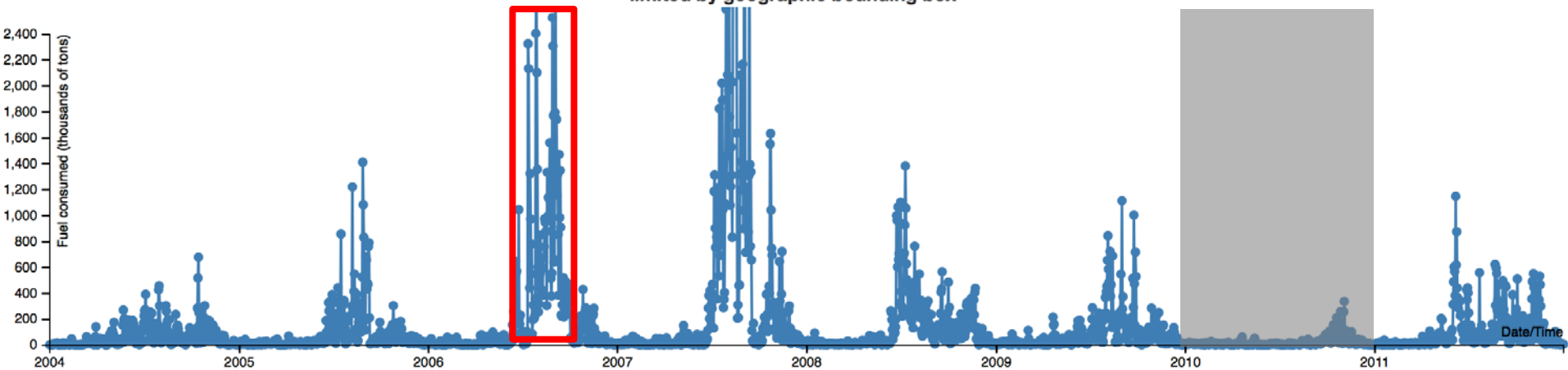
6/21 – 9/21

Limited by bounding box

Source: [WRAP Fire Tools](#)



FETS estimated fuel consumed for all fire types 01/01/2004 to 12/31/2011  
limited by geographic bounding box



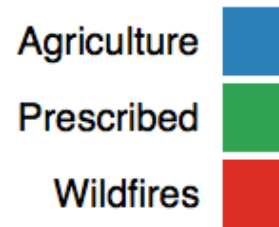
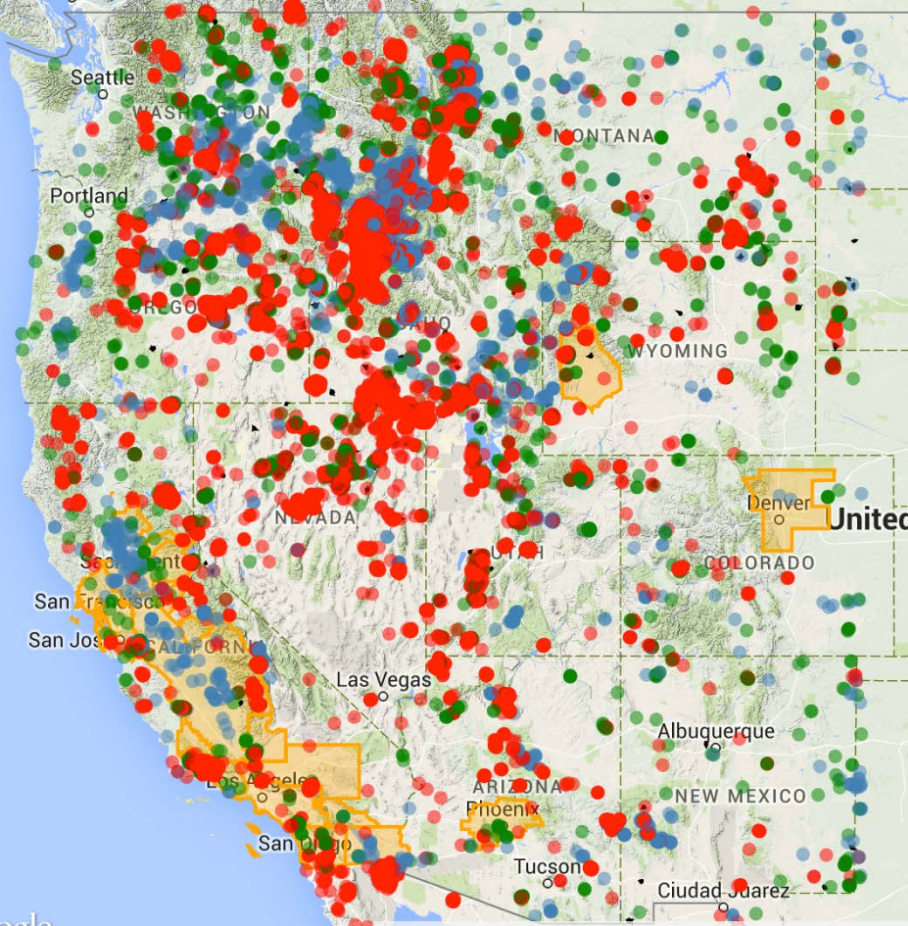


# 2007

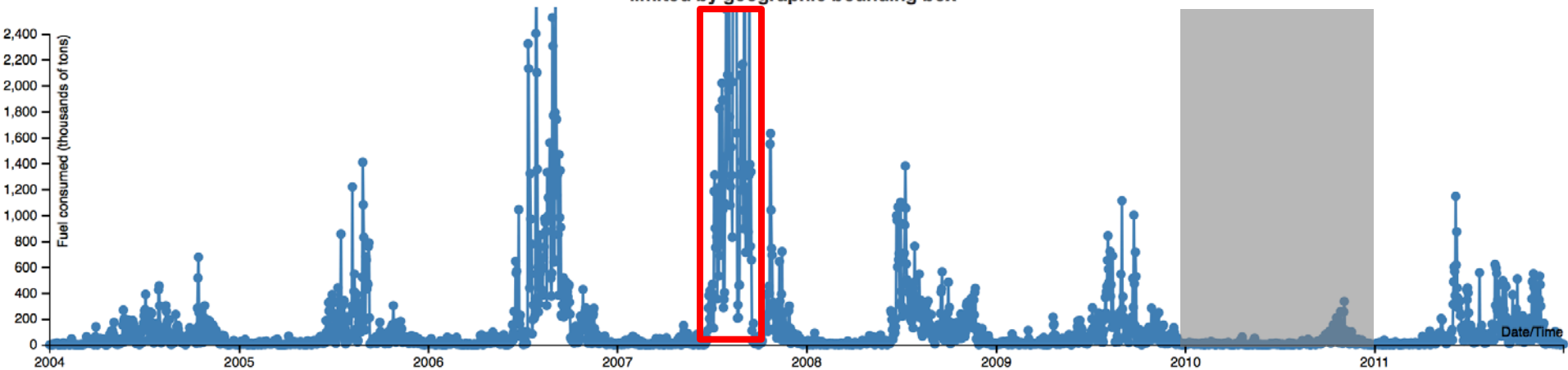
6/21 – 9/21

Limited by bounding box

Source: [WRAP Fire Tools](#)



FETS estimated fuel consumed for all fire types 01/01/2004 to 12/31/2011  
limited by geographic bounding box

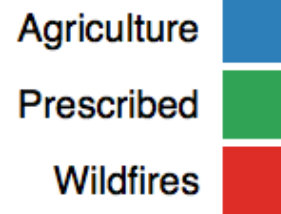
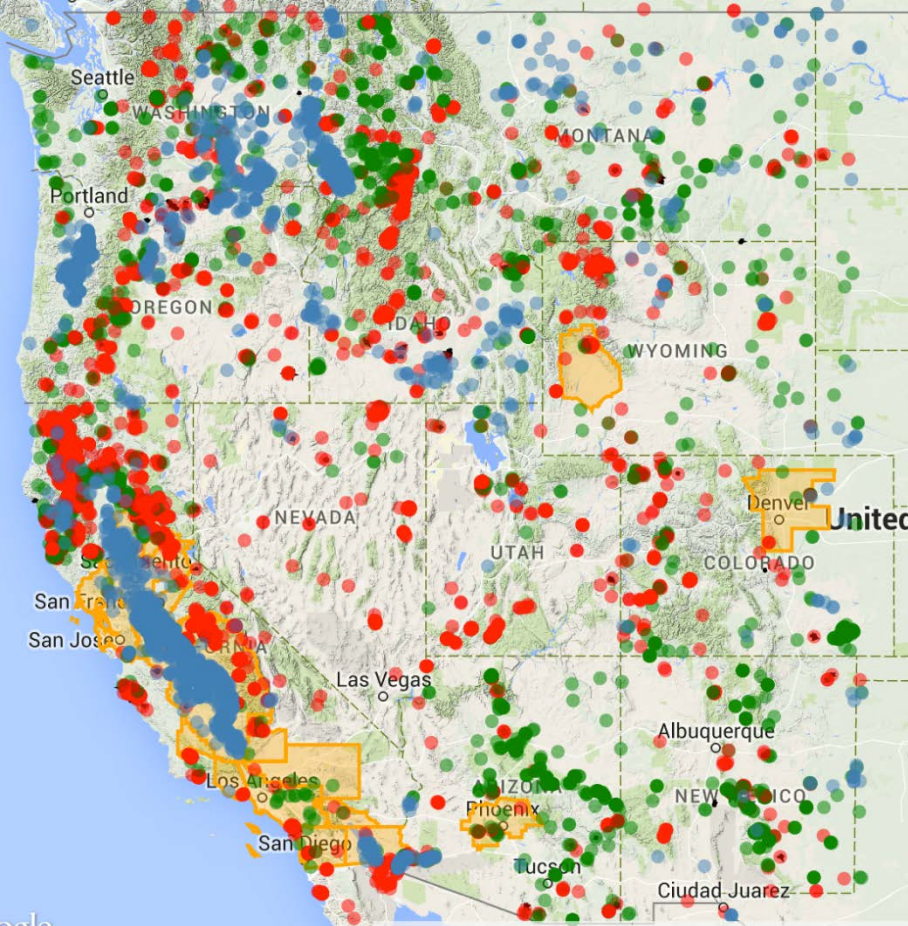


# 2008

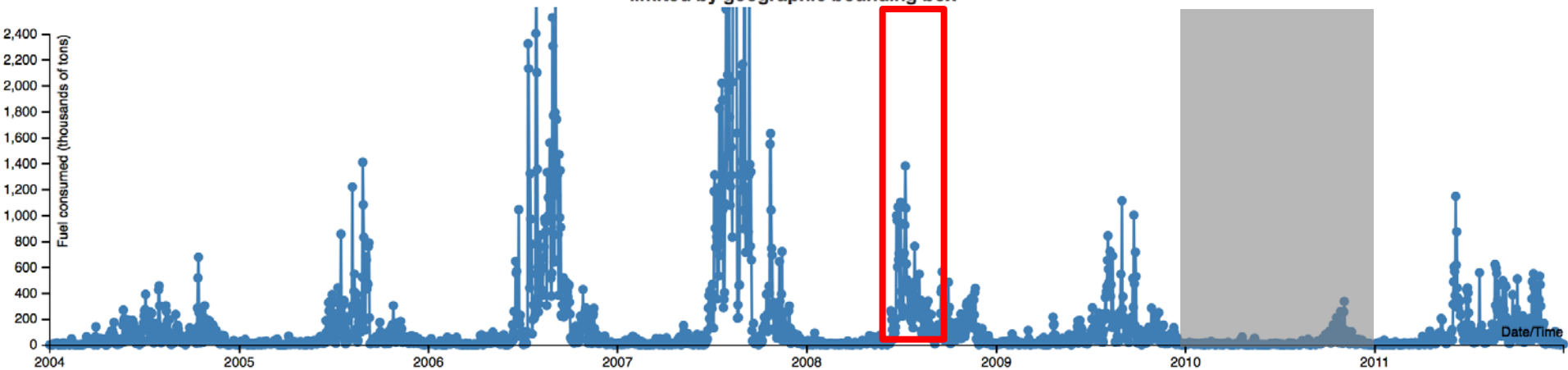
6/21 – 9/21

Limited by bounding box

Source: [WRAP Fire Tools](#)



FETS estimated fuel consumed for all fire types 01/01/2004 to 12/31/2011  
limited by geographic bounding box

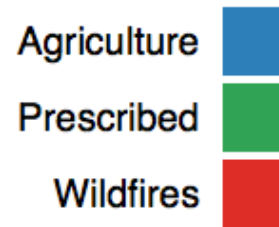
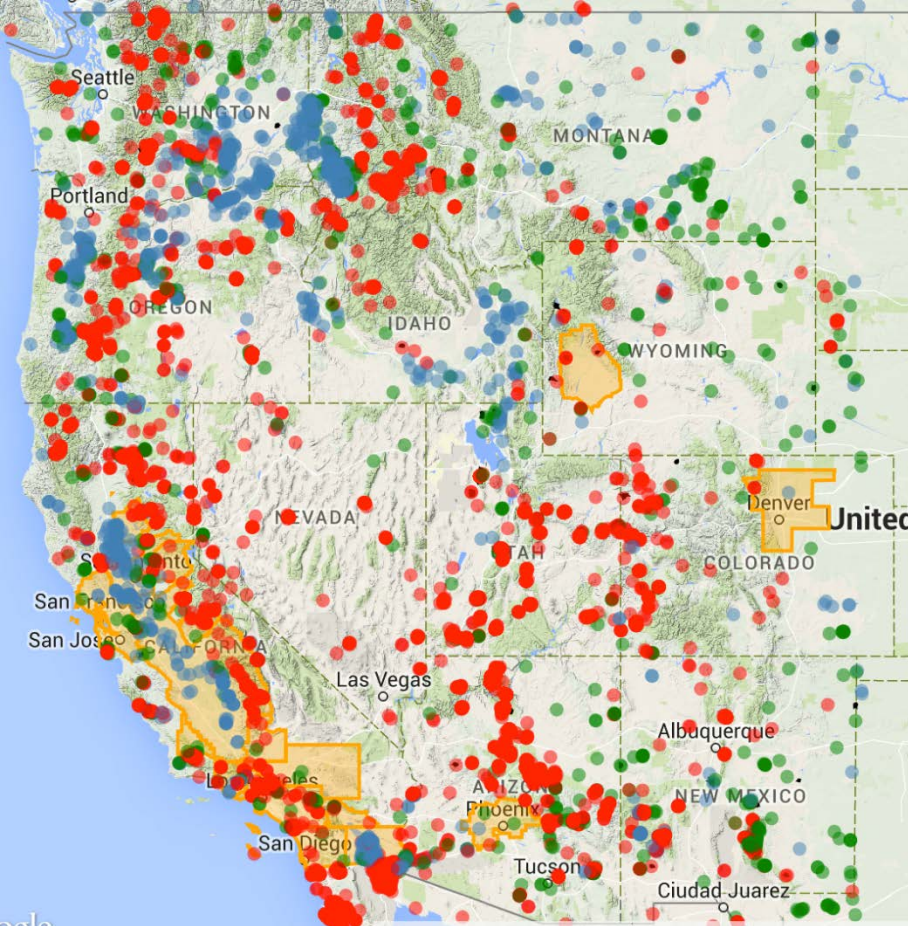


# 2009

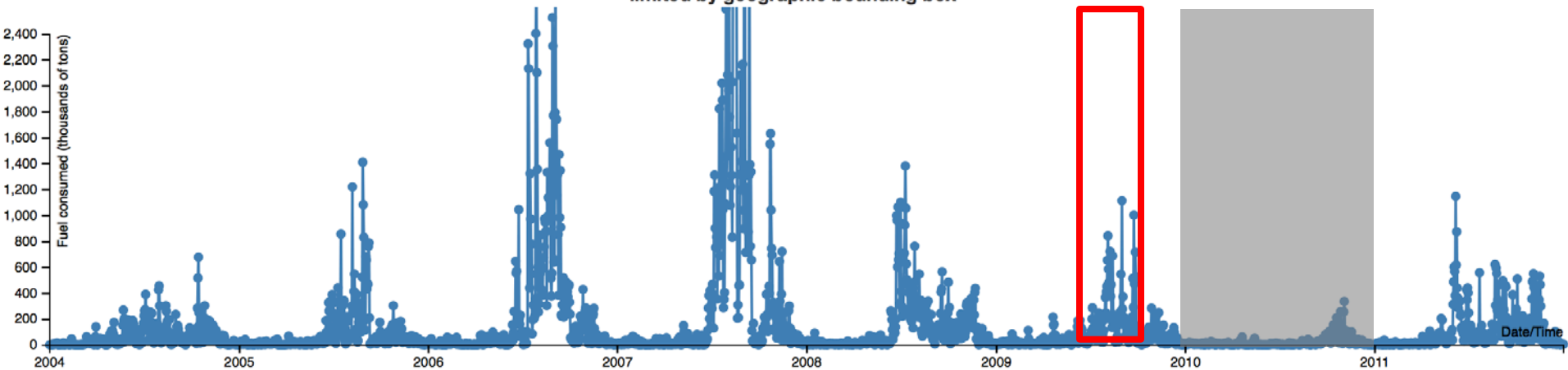
6/21 – 9/21

Limited by bounding box

Source: [WRAP Fire Tools](#)



FETS estimated fuel consumed for all fire types 01/01/2004 to 12/31/2011  
limited by geographic bounding box



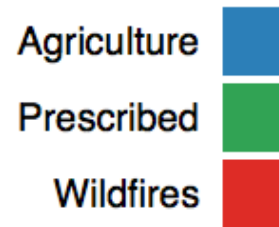
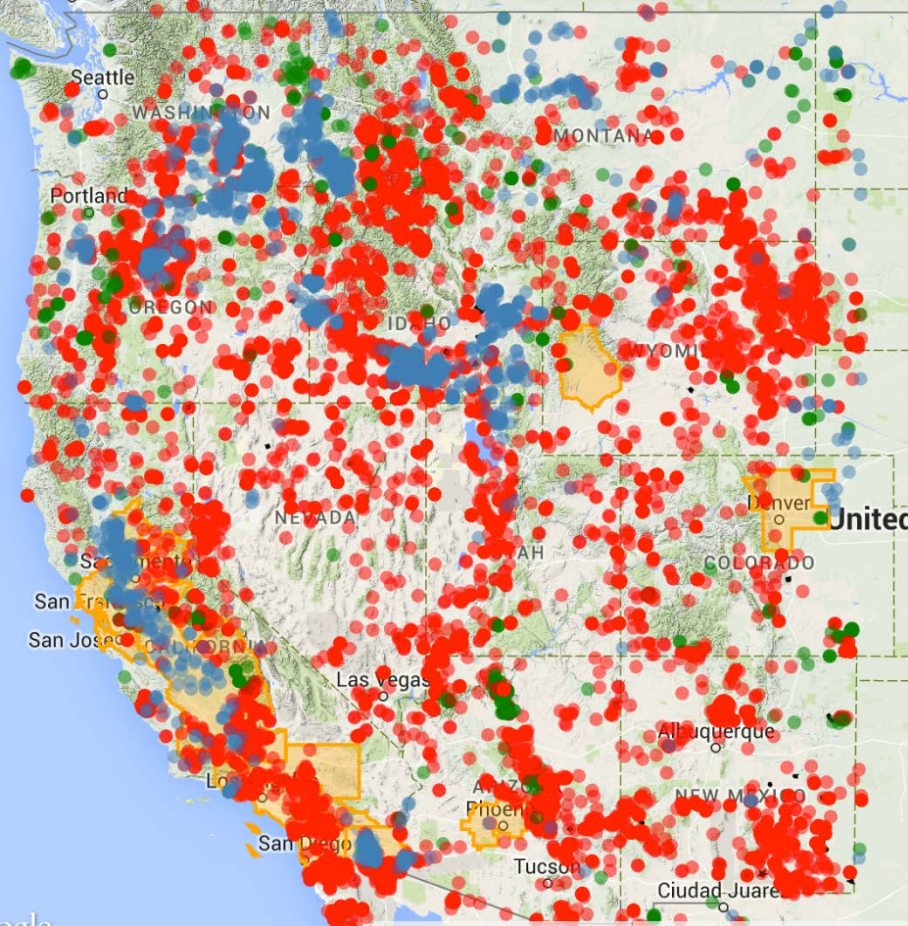
# 2011

6/21 – 9/21

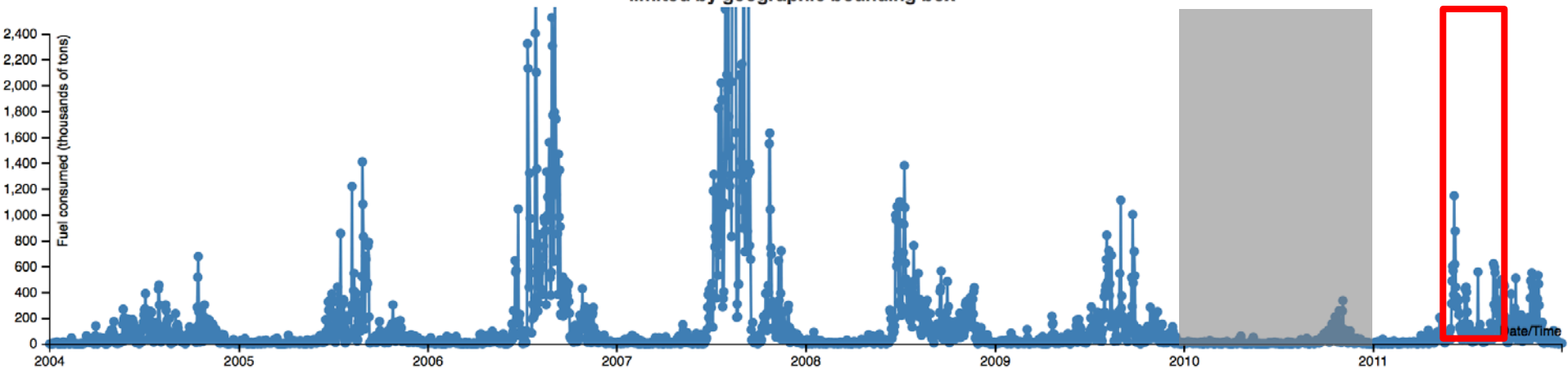
Limited by bounding box

\*Obtained additional  
small wildfire data  
for this inventory

Source: [WRAP Fire Tools](#)



FETS estimated fuel consumed for all fire types 01/01/2004 to 12/31/2011  
limited by geographic bounding box



# 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
<a href="#">Biscuit Wildfire</a>	10
<a href="#">Chatfield, CO July 2004-2007</a>	16
<a href="#">Chatfield, CO July 2008</a>	12
<a href="#">Evans Road Wildfire (Pocosin NWR) / Peat burning</a>	12
<a href="#">Fall burning in southern Louisiana, 2008</a>	9
<a href="#">Flint Hills</a>	8
<a href="#">McNally Wildfire</a>	6
<a href="#">Missionary Ridge &amp; Hayman Wildfires</a>	7
<a href="#">Northern California Wildfires, 2008</a>	17

[edit list](#)

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

## 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



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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

Forum	Topics	Posts	Last Post
<b>Forum Discussions</b>			
<b>Announcements</b> Information about new releases and fixes. Moderators: Administrators	0	0	No Posts
<b>Requests</b> Post requests you might have in this forum. Moderators: Administrators	0	0	No Posts

### DOCUMENT NEEDS REVIEW !

3SAQS WRF 2011  
Meteorological Model  
Performance Evaluation



### DOCUMENT NEEDS REVIEW !

CAMx Photochemical Grid CAMx  
Model Draft Model Performance  
Evaluation

### DRAFT DOCUMENT AVAILABLE

3SAOS WRF



### DATA & METADATA

- [Data](#)
- [Studies](#)
- [Documents](#)
- [Literature](#)

### PROJECTS & PLANNING

- [Projects](#)
- [Meetings](#)
- [News](#)

### TOOLS & RESOURCES

- [Image Browser](#)





Thanks –

Tom Moore, WRAP Air Quality Program Manager  
Western States Air Resources Council (WESTAR)

e: [tmoore@westar.org](mailto:tmoore@westar.org) | o: 970.491.8837

Western Regional Air Partnership | [www.wrapair2.org](http://www.wrapair2.org)



Extra slides

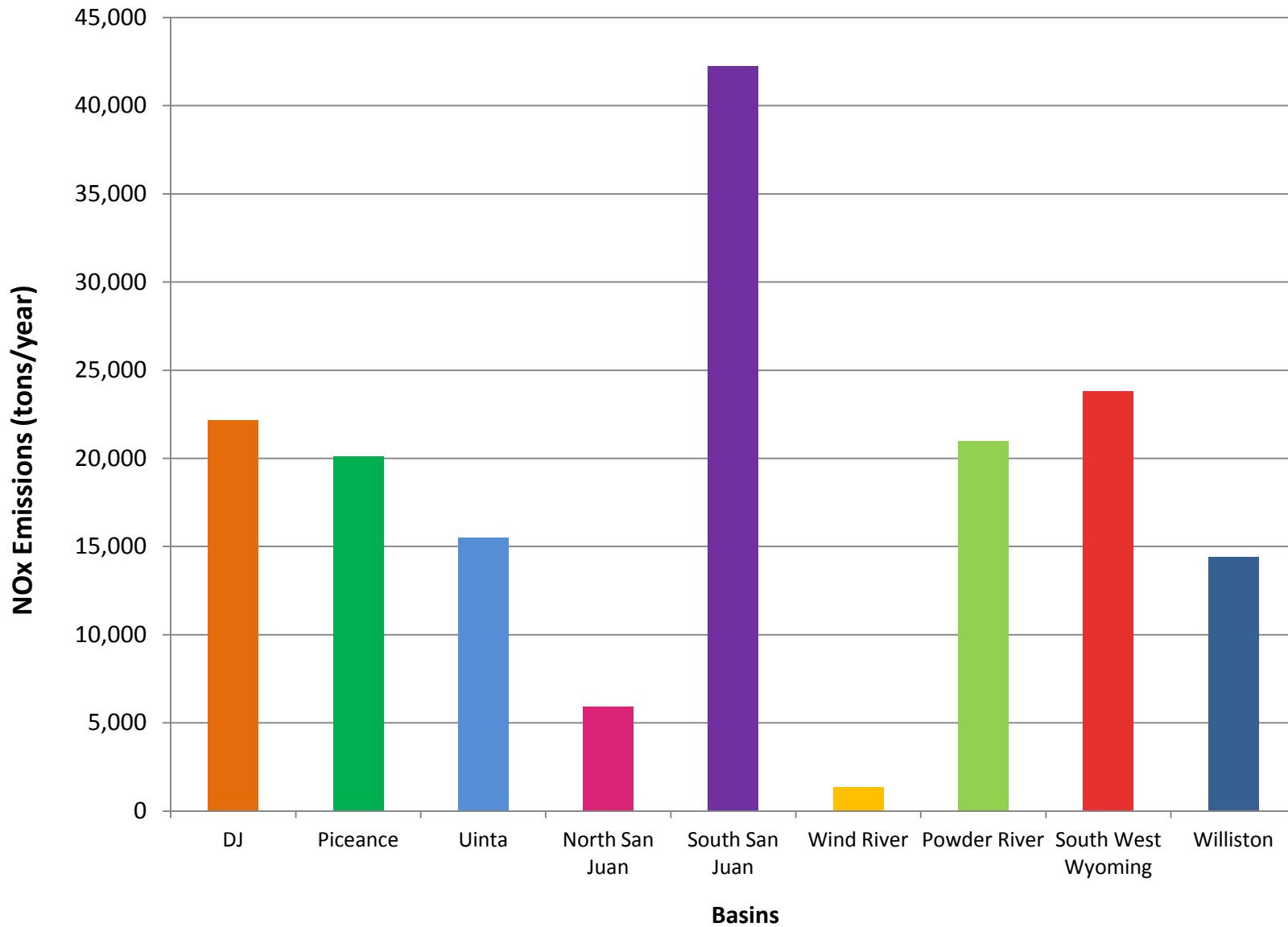


# Oil & Gas

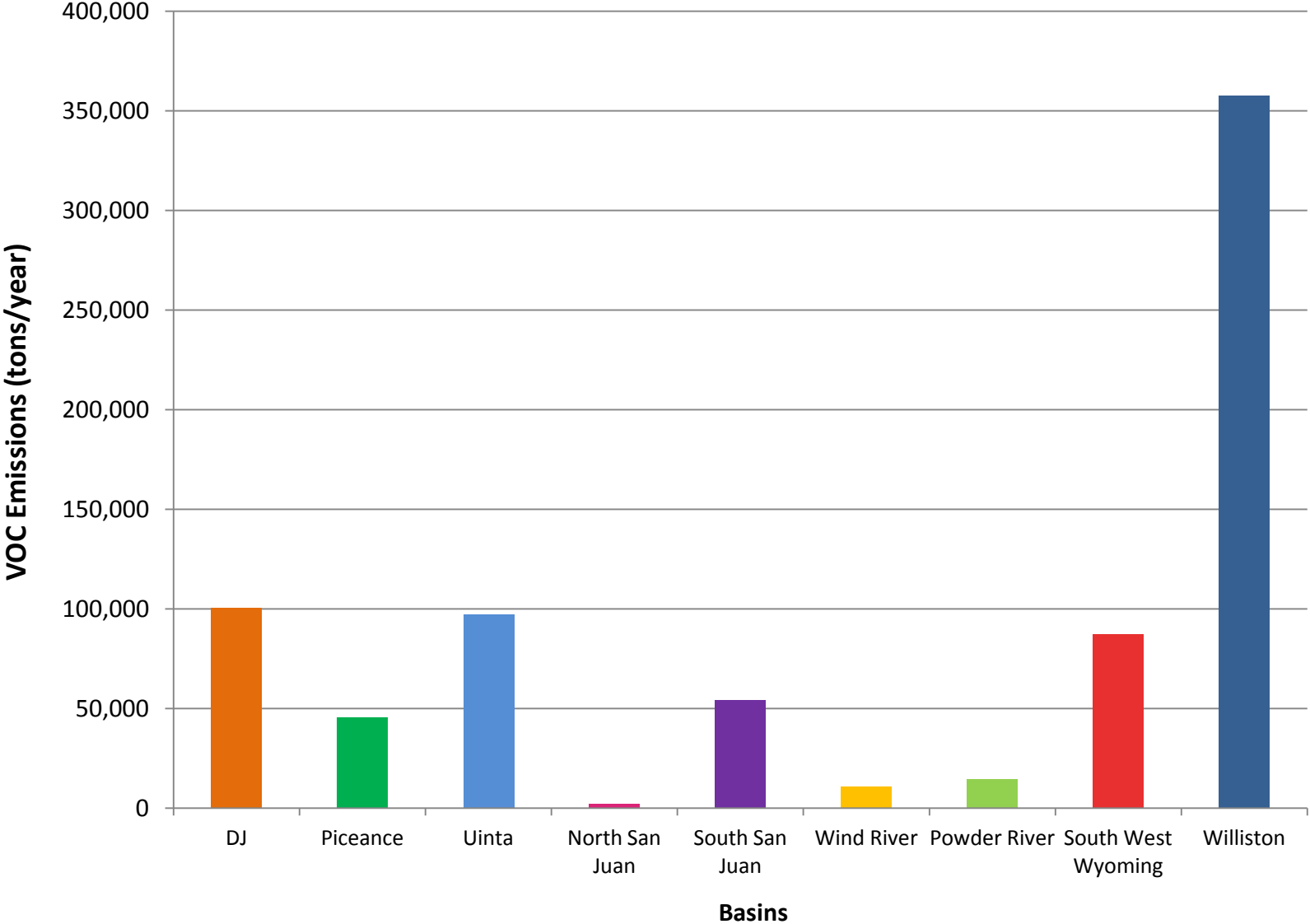
## Oil & Gas: Emissions Inventories and Control Analysis

- 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

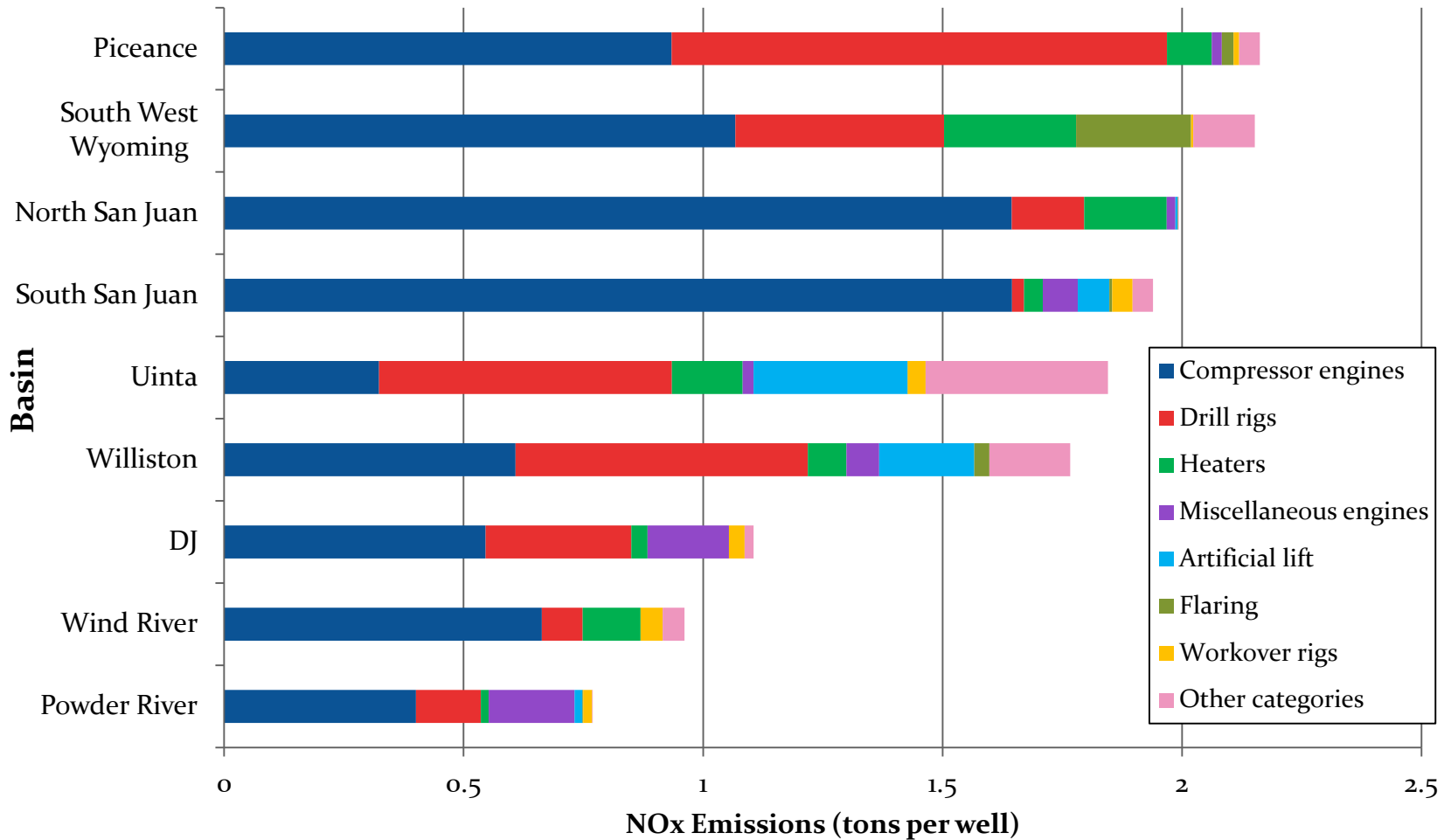
# Cross-Basin – NO<sub>x</sub> Emissions



# Cross-Basin – VOC Emissions

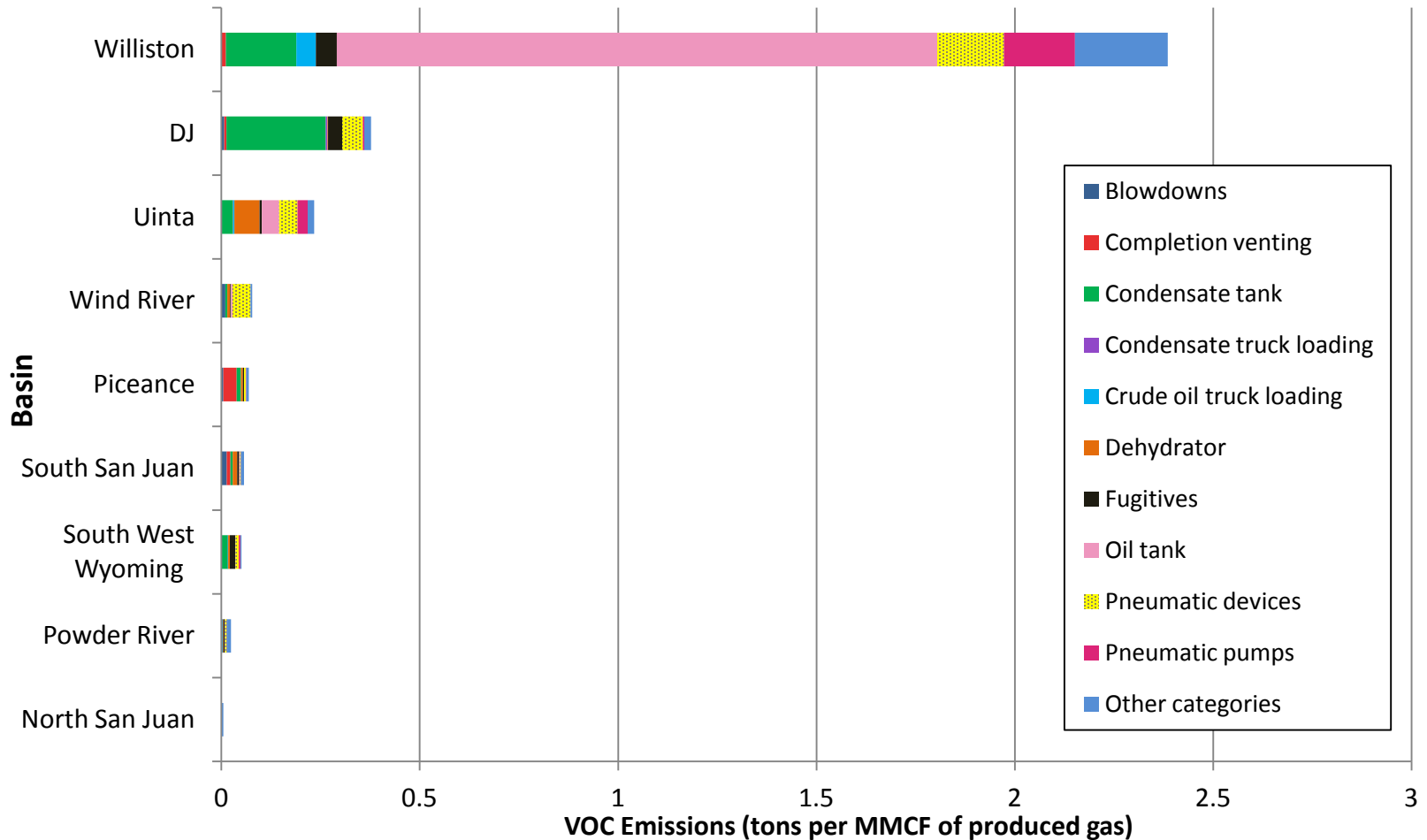


# Cross-Basin – Per-Well NOx Emissions



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

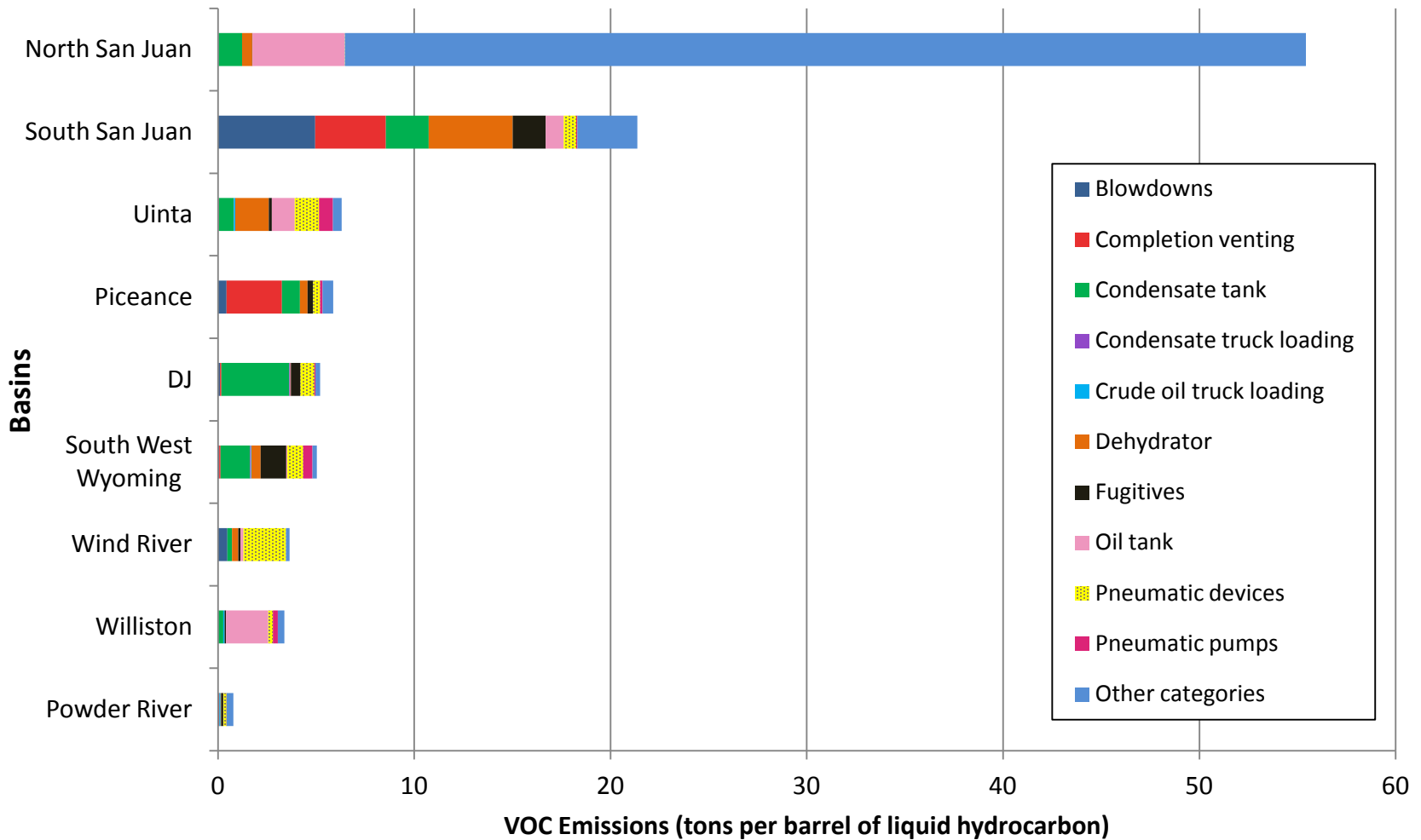
# Cross-Basin – Per-Unit-Gas-Production VOC Emissions



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

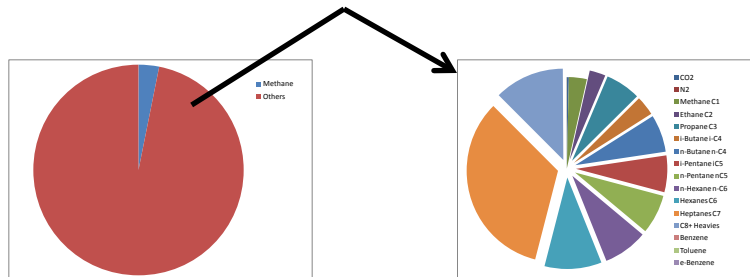


- Poorly performing and “non-average” sources could have significantly higher emissions than estimated in inventories
- Analogous to “smoking vehicles” in mobile source inventories
- Statistical sampling/monitoring of sources needed to develop methods to represent this in inventories
- See for example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



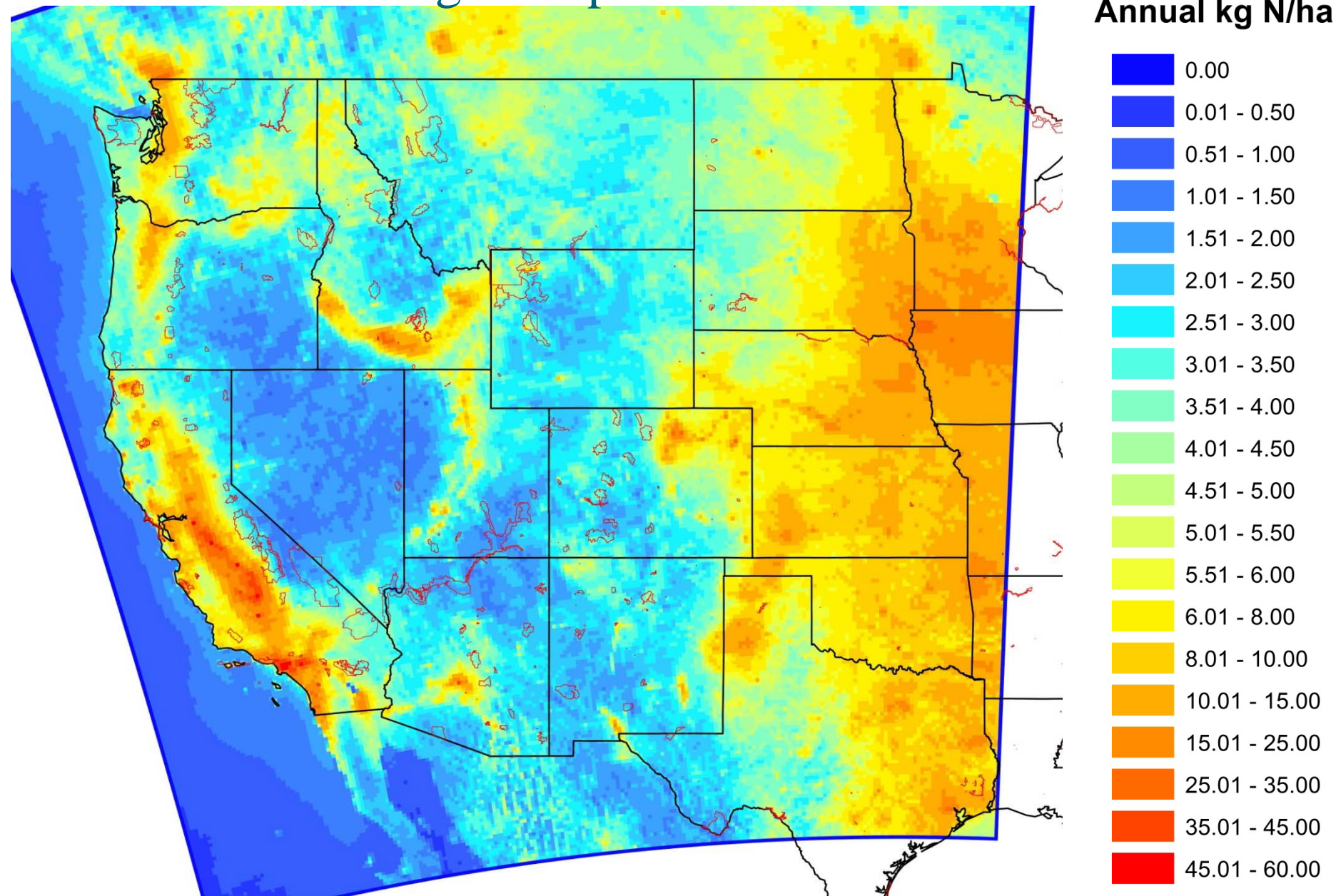
# Nitrogen Deposition



## Summary of WestJumpAQMS 2008 Modeling Results - Nitrogen Deposition Analysis

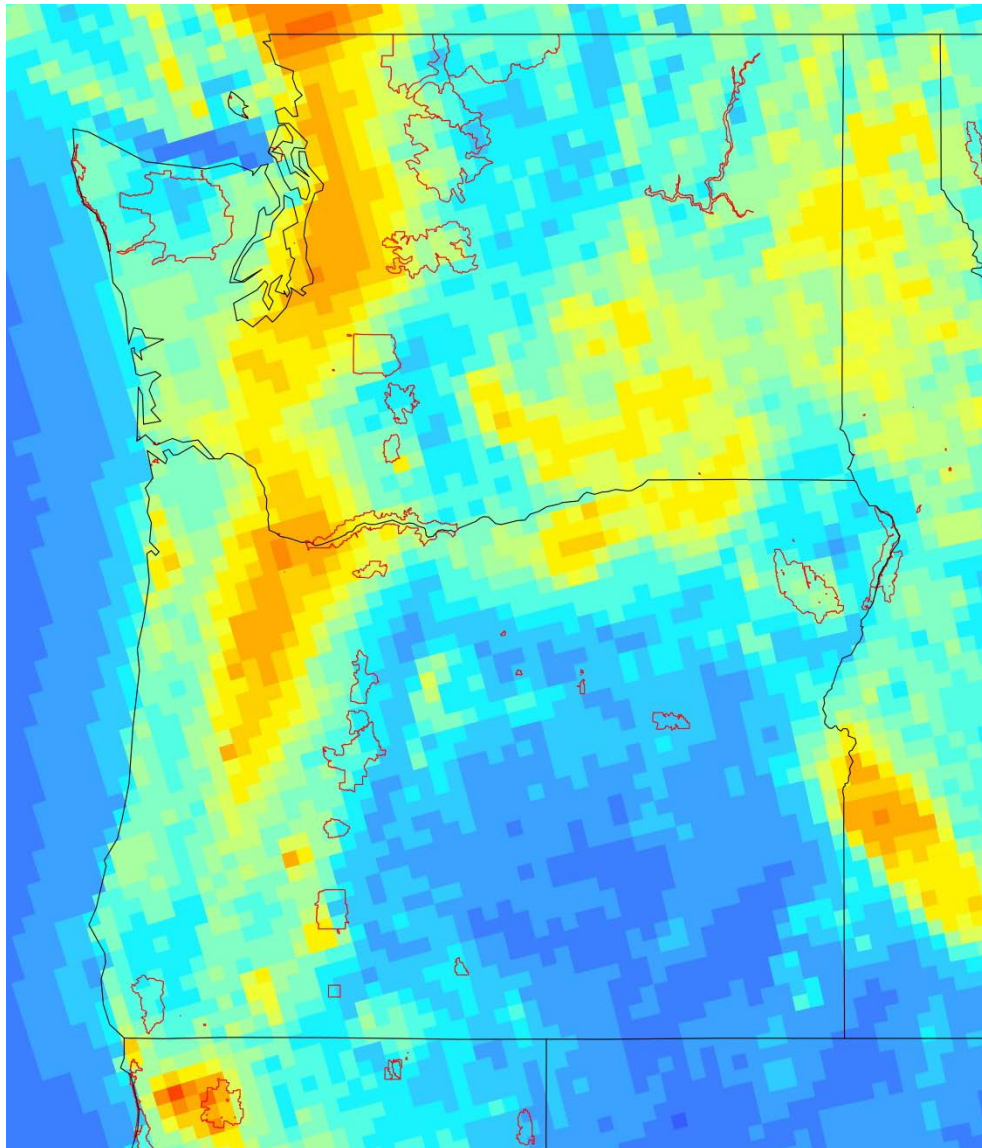
- Thanks to Tammy M. Thompson, CIRA, and Michael G. Barna, NPS for modeling results and slides

# Modeled Total Nitrogen Deposition

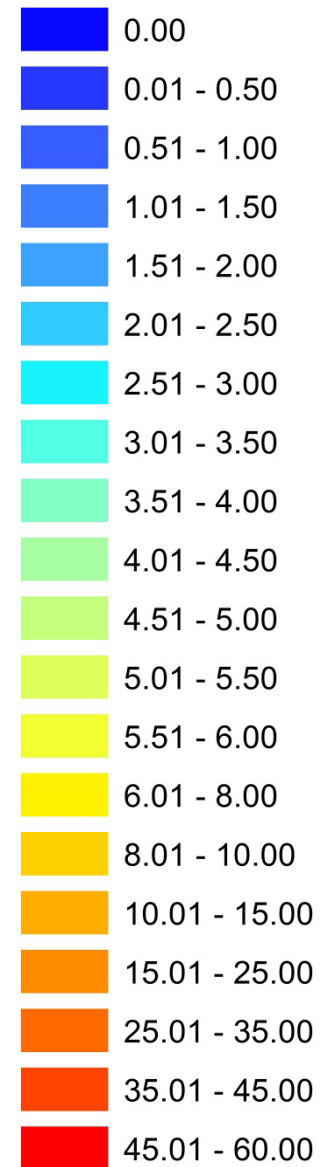


Class 1&2 Areas outlined in Red. Total N includes wet&dry deposition of all species.

# Modeled Total Nitrogen Deposition



## Annual kg N/ha



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<sub>3</sub> (model chemistry includes organic N formed from biogenic VOCs)
- Dry Deposition Other Oxidized Nitrogen: NO, NO<sub>2</sub>, N<sub>2</sub>O<sub>5</sub>, HONO, HO<sub>2</sub>NO<sub>2</sub>
- Dry Deposition Ammonia (NH<sub>3</sub>)
- Wet Deposition Other Oxidized Nitrogen: NO, NO<sub>2</sub>, N<sub>2</sub>O<sub>5</sub>, HONO, HO<sub>2</sub>NO<sub>2</sub>
- Dry Deposition of Nitric Acid (HNO<sub>3</sub>)
- Particulate Nitrate (NO<sub>3</sub><sup>-</sup>): Wet and dry
- Particulate Ammonium (NH<sub>4</sub><sup>+</sup>): Wet and dry

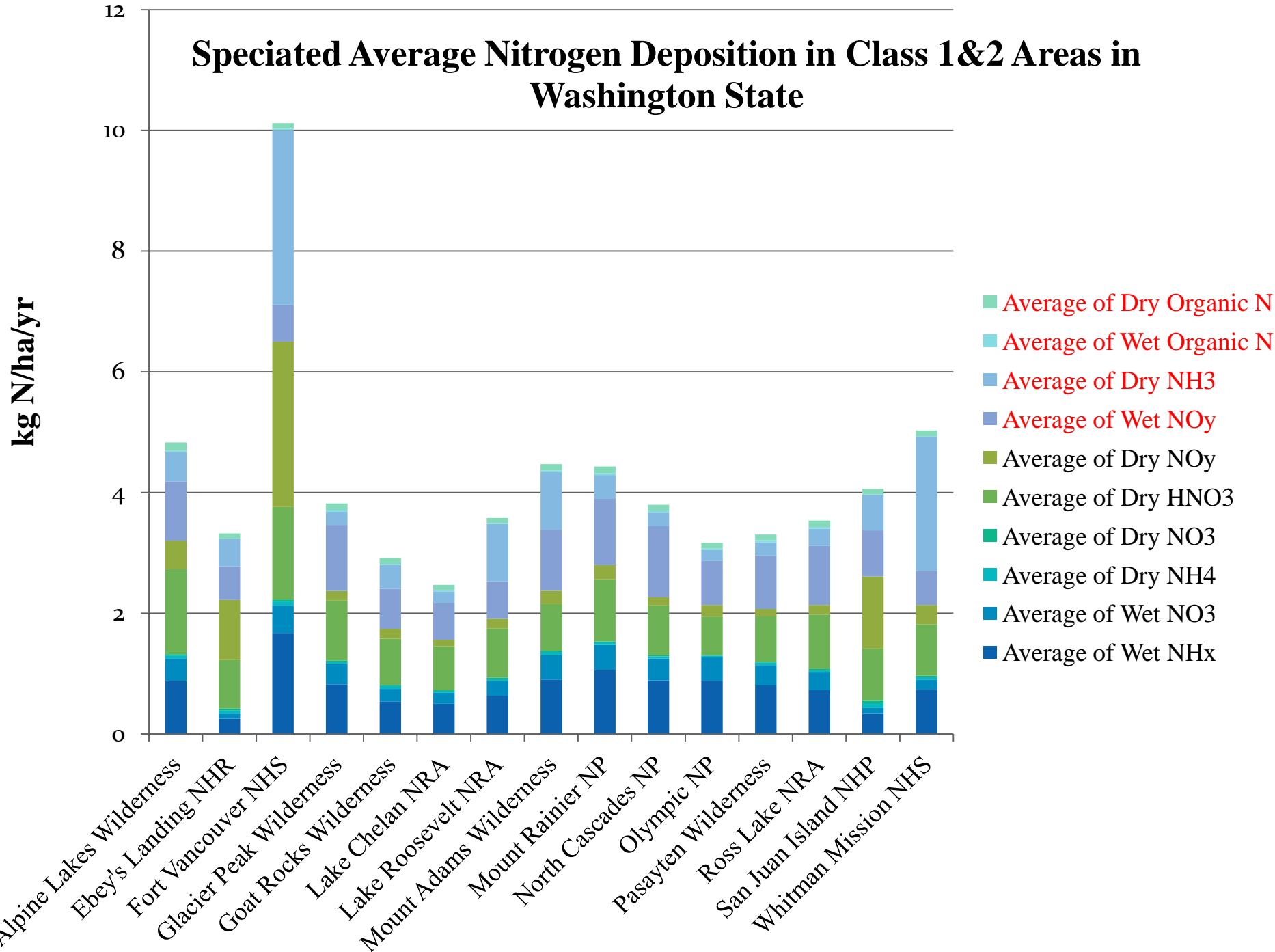
## Total Measured Nitrogen Deposition Includes:

- Organic Nitrogen Species: PAN, RNO<sub>3</sub> (model chemistry includes organic N formed from biogenic VOCs)
- Dry Deposition Other Oxidized Nitrogen: NO, NO<sub>2</sub>, N<sub>2</sub>O<sub>5</sub>, HONO, HO<sub>2</sub>NO<sub>2</sub>
- Dry Deposition Ammonia (NH<sub>3</sub>)
- Wet Deposition Other Oxidized Nitrogen: NO, NO<sub>2</sub>, N<sub>2</sub>O<sub>5</sub>, HONO, HO<sub>2</sub>NO<sub>2</sub>
- Dry Deposition of Nitric Acid (HNO<sub>3</sub>)
- Particulate Nitrate (NO<sub>3</sub><sup>-</sup>): Wet and dry
- Particulate Ammonium (NH<sub>4</sub><sup>+</sup>): Wet and dry

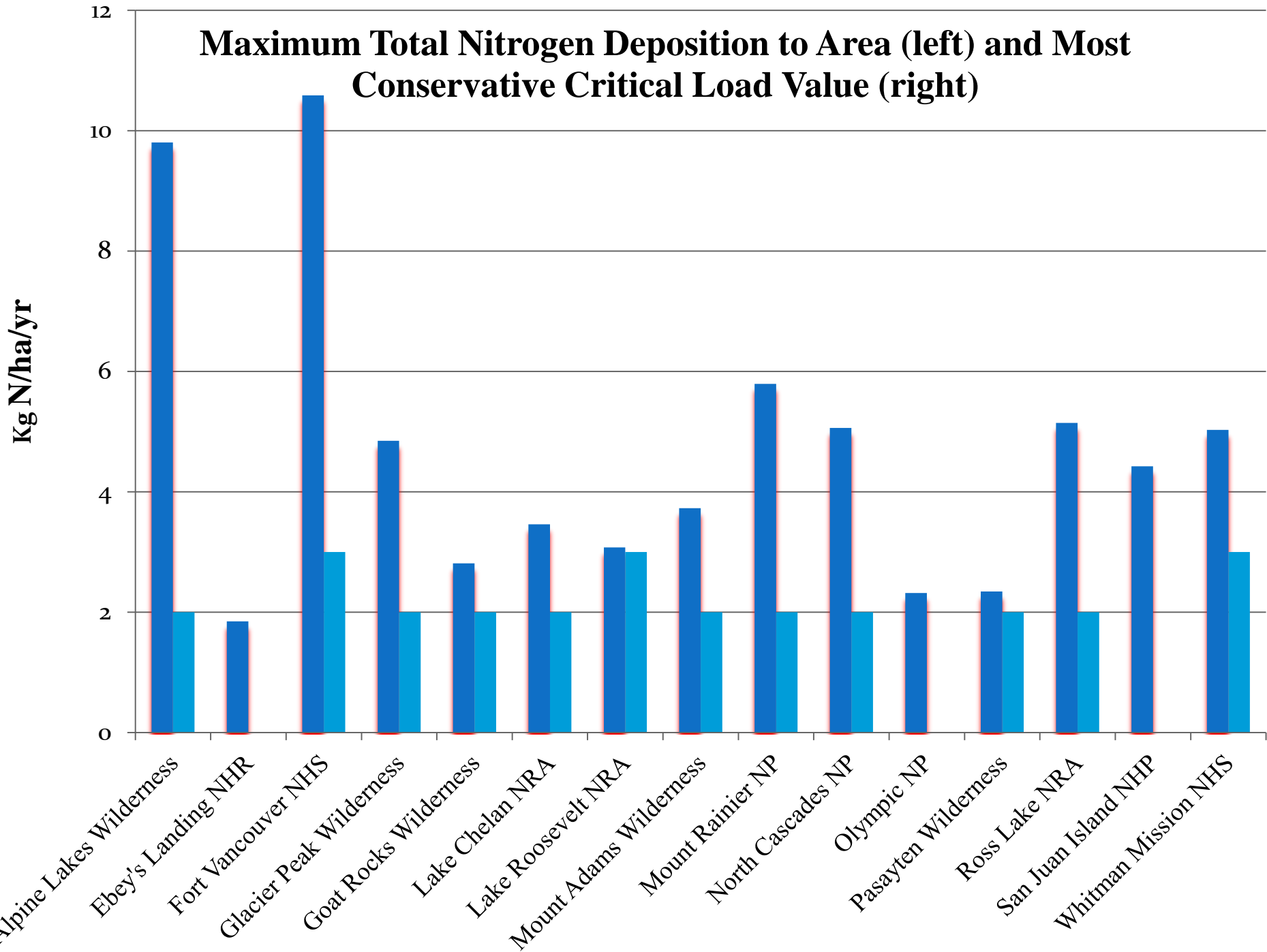
# Nitrogen deposition measurement data are incomplete

- 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

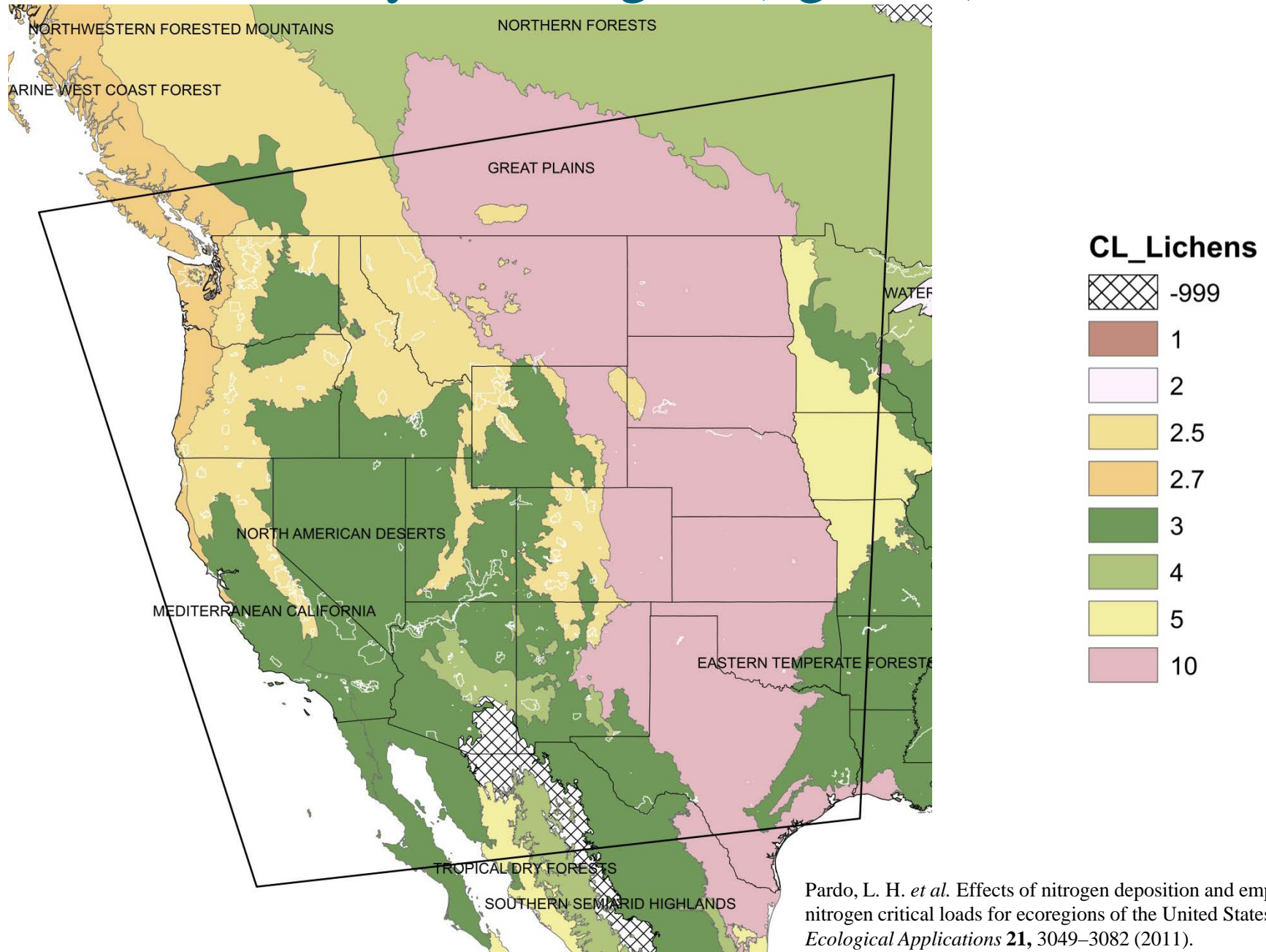


# Maximum Total Nitrogen Deposition to Area (left) and Most Conservative Critical Load Value (right)



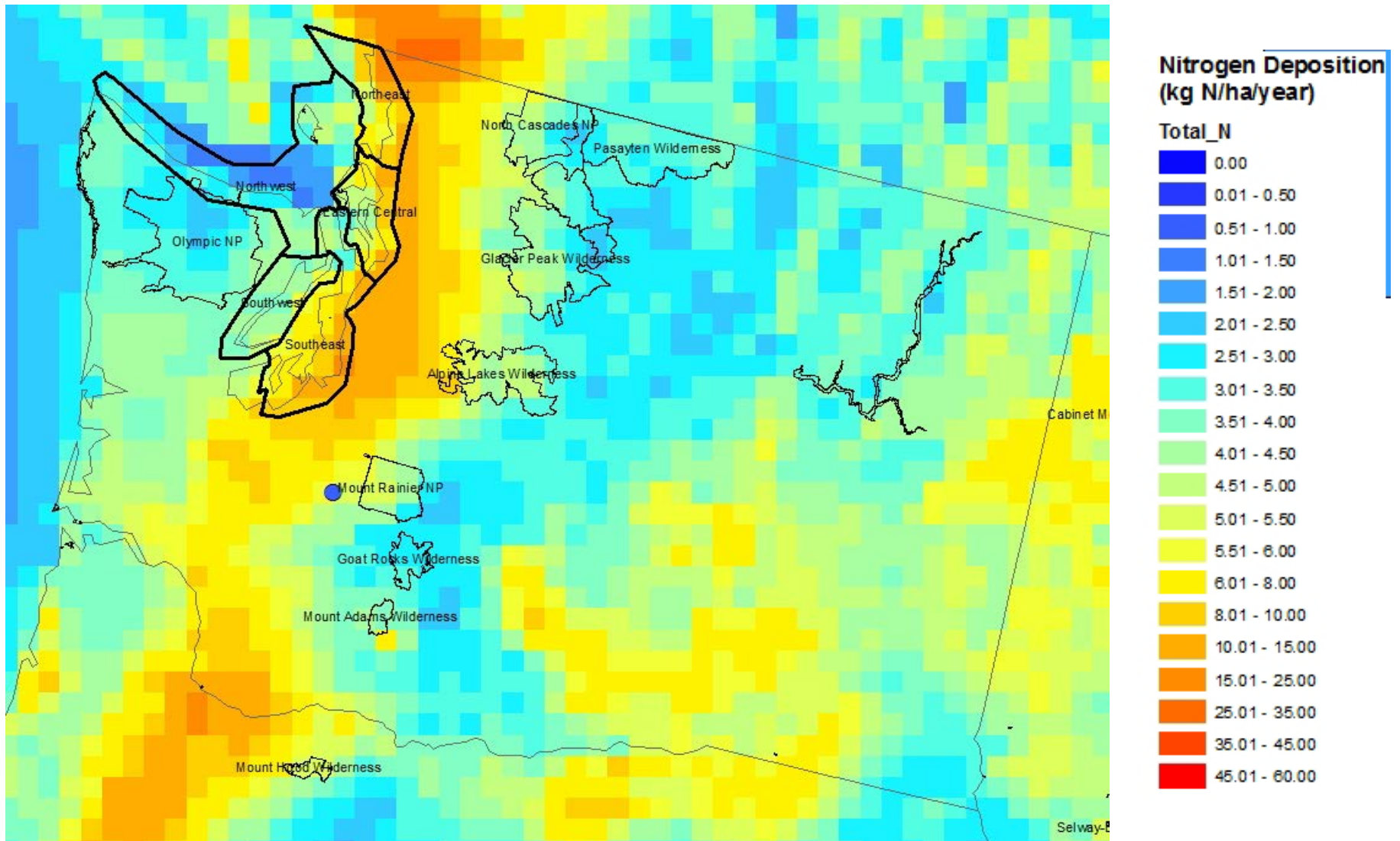


# Critical Load by Eco-Region (kg N/ha)

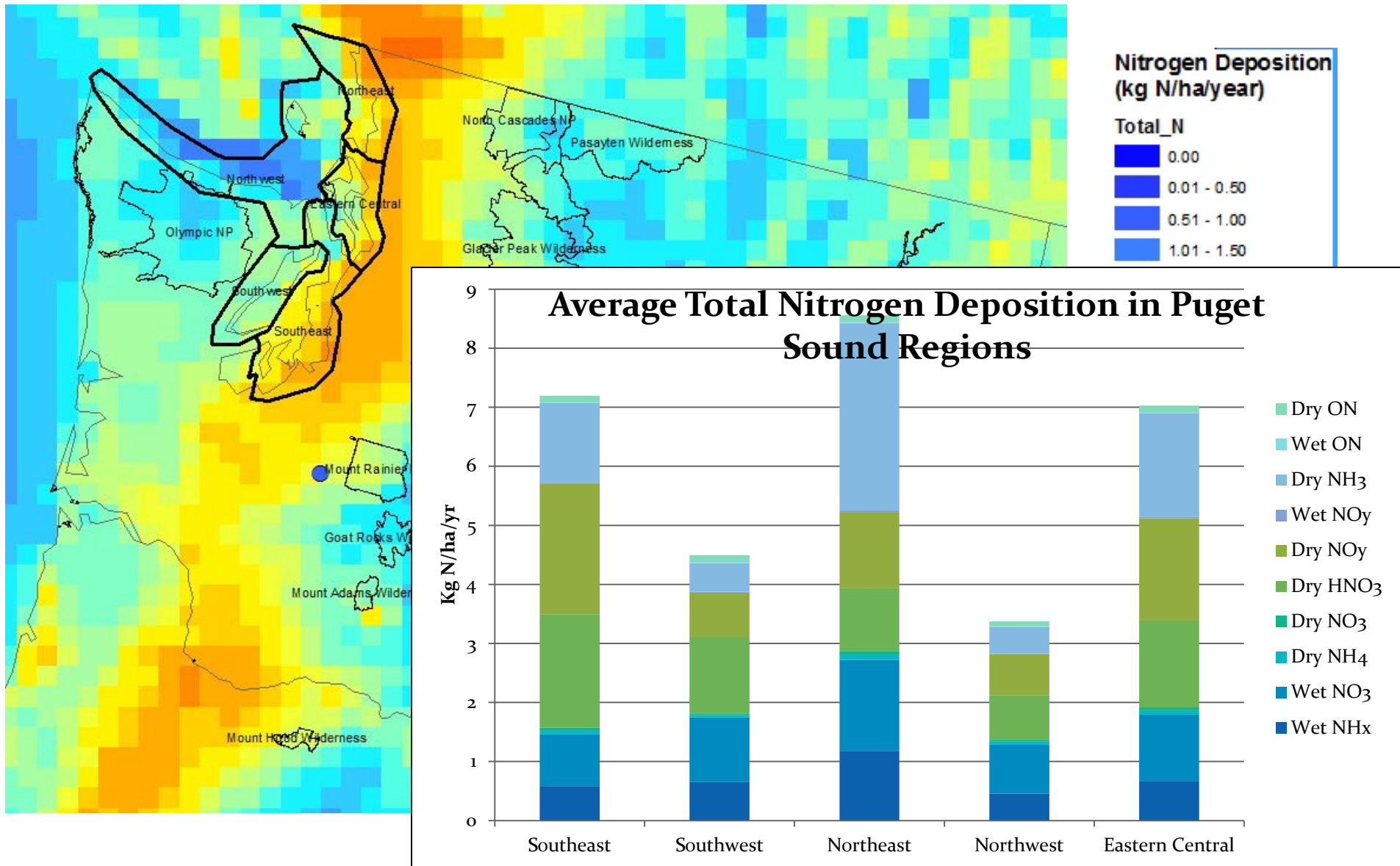


Pardo, L. H. *et al.* Effects of nitrogen deposition and empirical nitrogen critical loads for ecoregions of the United States. *Ecological Applications* **21**, 3049–3082 (2011).

# Puget Sound Modeled Nitrogen Deposition

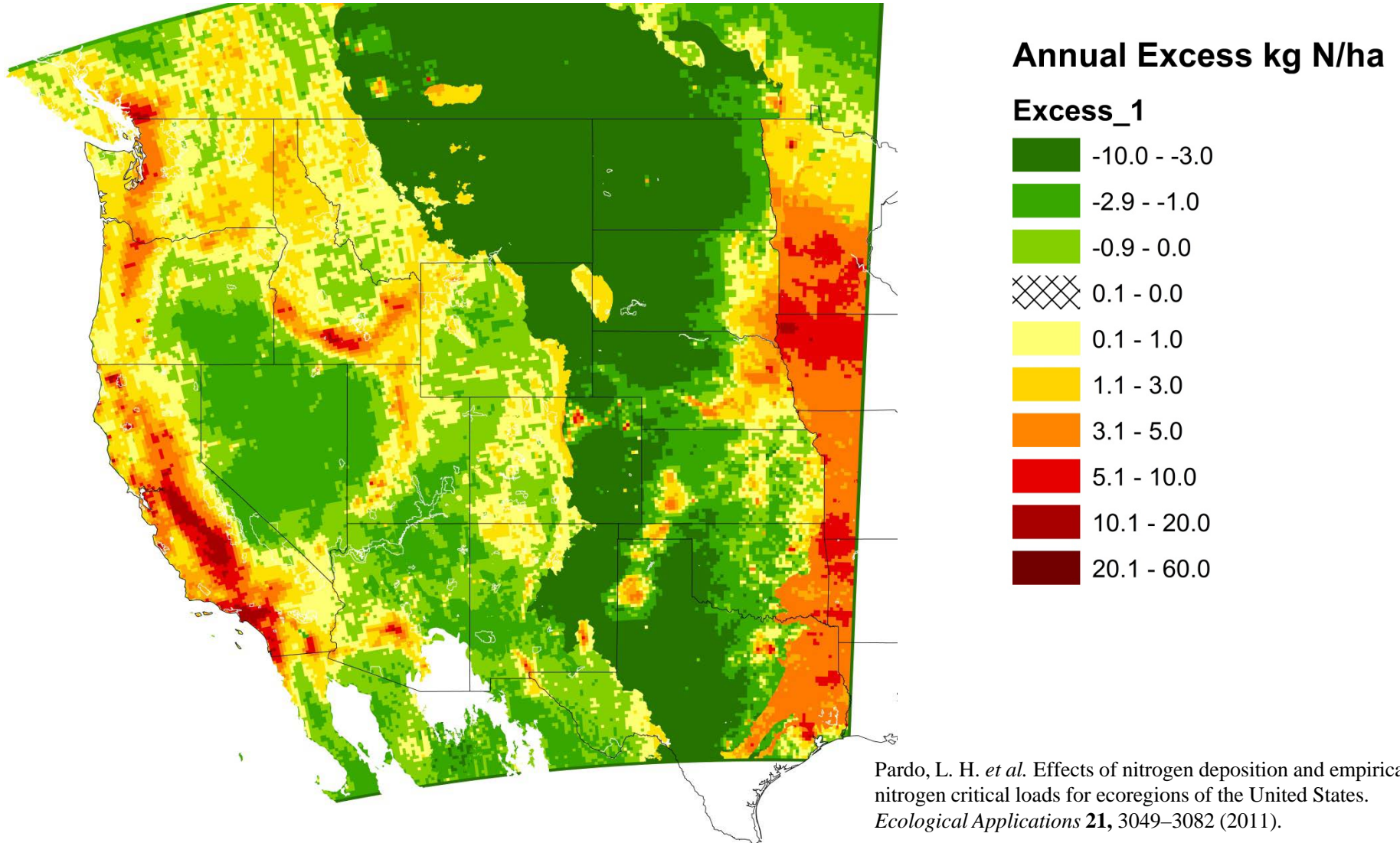


# Puget Sound Modeled Nitrogen Deposition



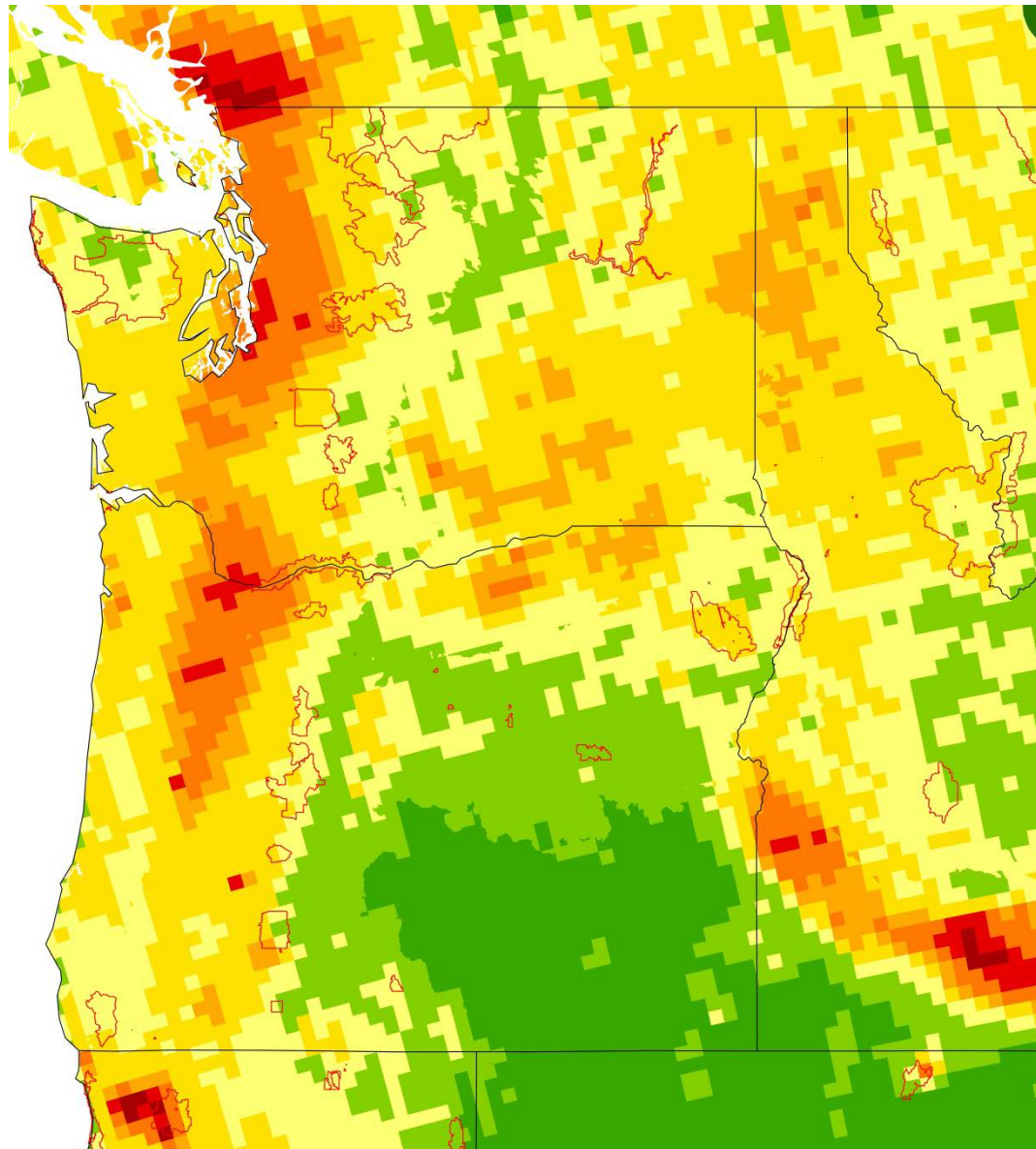
# Nitrogen Deposition Excess

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



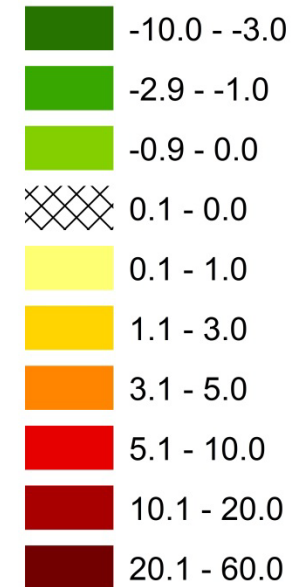
# Nitrogen Deposition Excess

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



**Annual Excess kg N/ha**

**Excess\_1**



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).