

# Dimensions, Uncertainties, and Impacts of Emissions in the Western U.S.

April 14, 2015

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WESTAR Council

EPA 2015 International Emission Inventory Conference  
"Air Quality Challenges: Tackling the Changing Face of Emissions"



# Topics

- Overview of the WESTAR/WRAP organization
- Key issues and areas of focus
- Selected results from projects and studies related to this Conference

# Overview of WESTAR and WRAP

- Purpose
  - Service organizations
  - Assist members in achieving their air quality management goals
- WESTAR
  - Training
  - Provide a forum for discussion
  - Inform policy-related discussions
  - [www.westar.org](http://www.westar.org)
- WRAP - provides technical support (esp. regional)
  - 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 representatives across states, tribes, federal, and local agencies
  - [www.wrapair2.org](http://www.wrapair2.org)



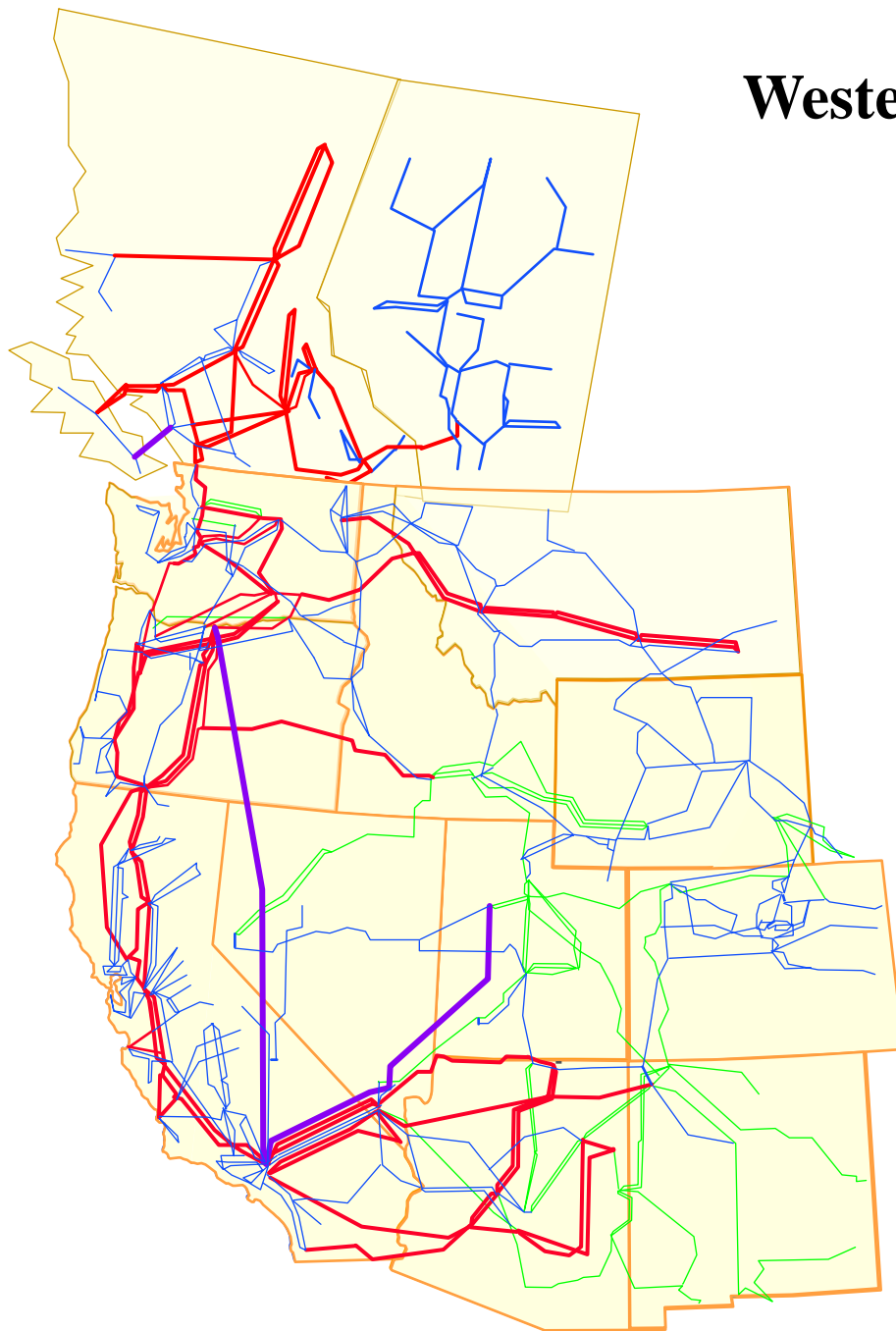


## WRAP current projects and priorities

- 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 analyses
    - West-wide Jumpstart Air Quality Modeling Study ([WestJumpAQMS](#))
    - Western Air Quality Data Warehouse ([WAQDW](#))

# Western Electrical Interconnect

## *WECC Existing Transmission System*



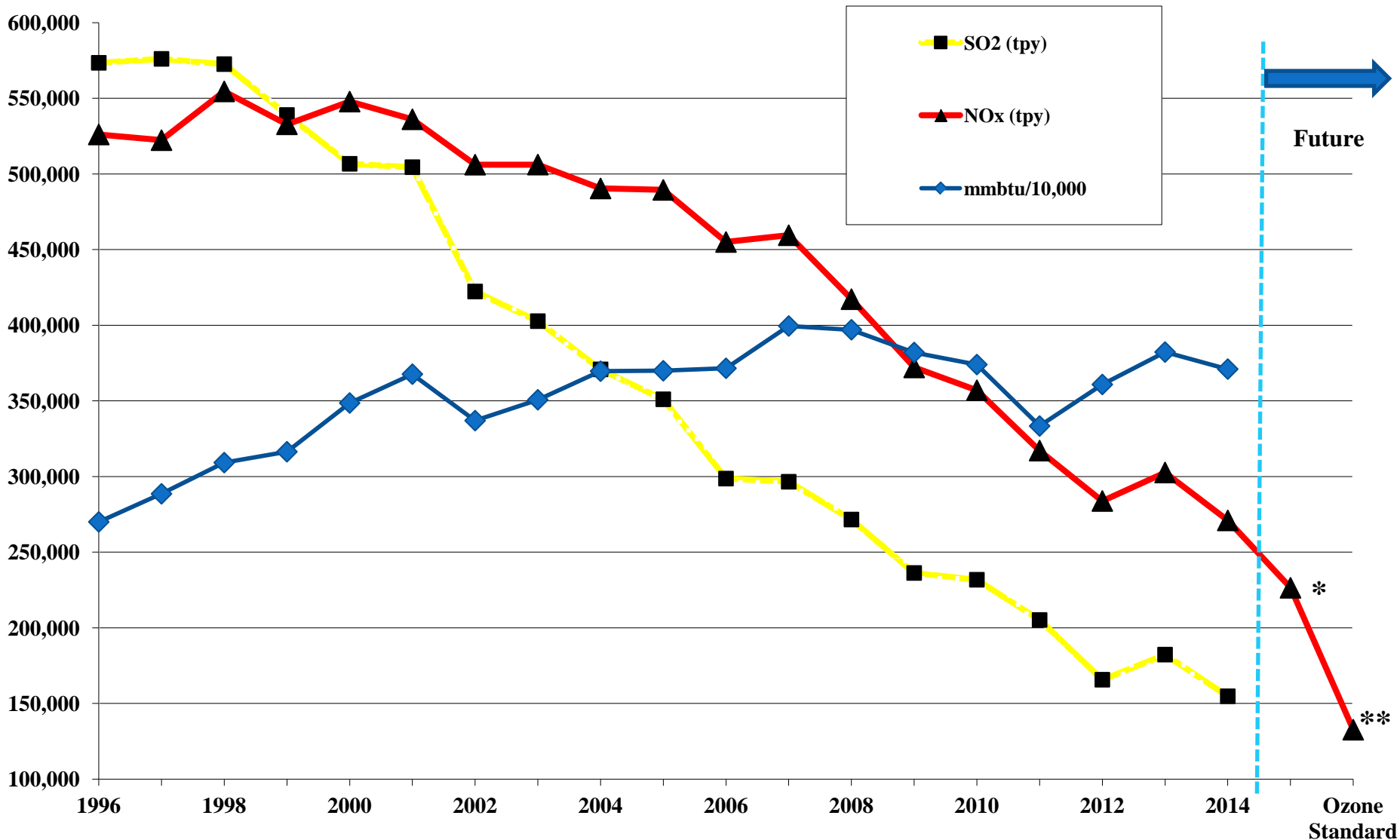
— 230 kV HVAC

— 345 kV HVAC

— 500 kV HVAC

—  $\pm 500$  kV HVDC

# Western Interconnect Fossil Fuel Power Plant Emissions



1996 through 2014 data from EPA data for fossil fuel-fired electrical generating units in the 11-state Western Interconnect

\* Additional NOx reductions estimate - BART controls from Regional Haze baseline planning

\*\* Further NOx reductions from applying maximum post-combustion controls to all remaining units



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

*Fire*



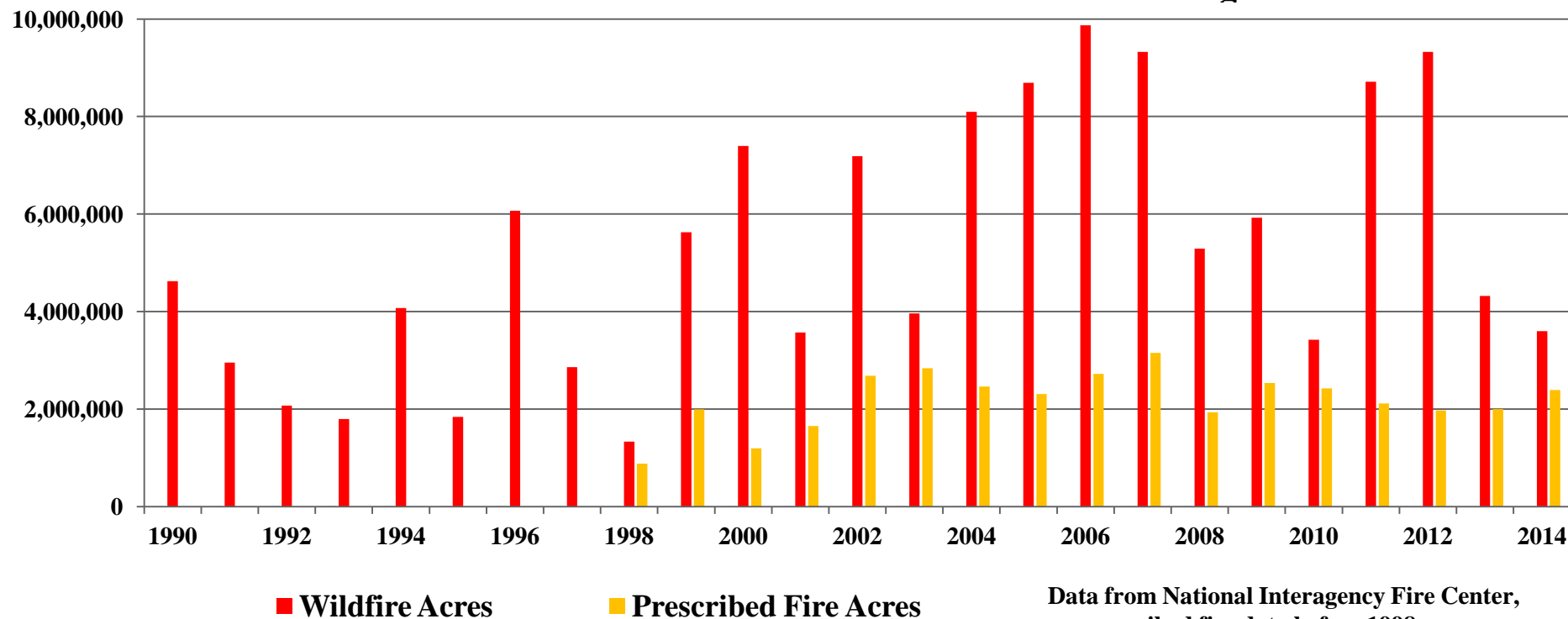
*The Big Picture*

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

**U.S. Wildfire and Prescribed Fires Acres Burned - 1990 through 2014**



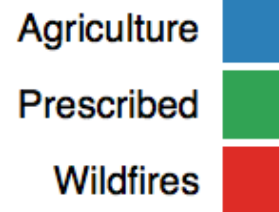
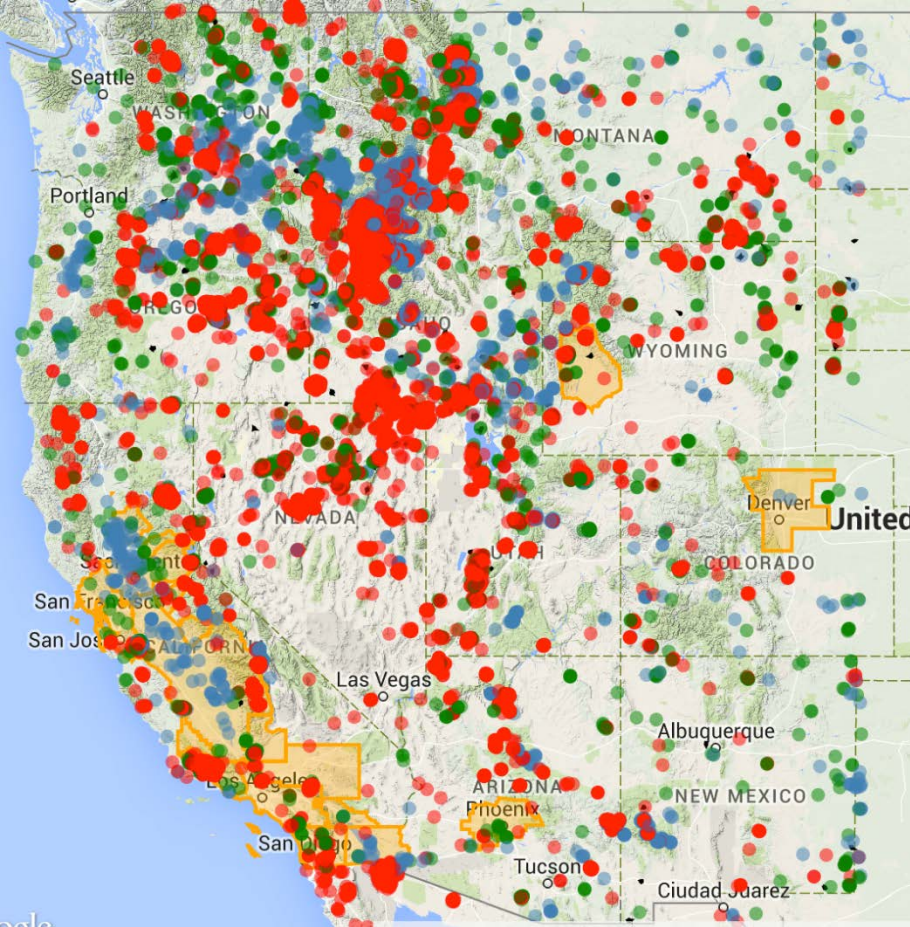


# 2007

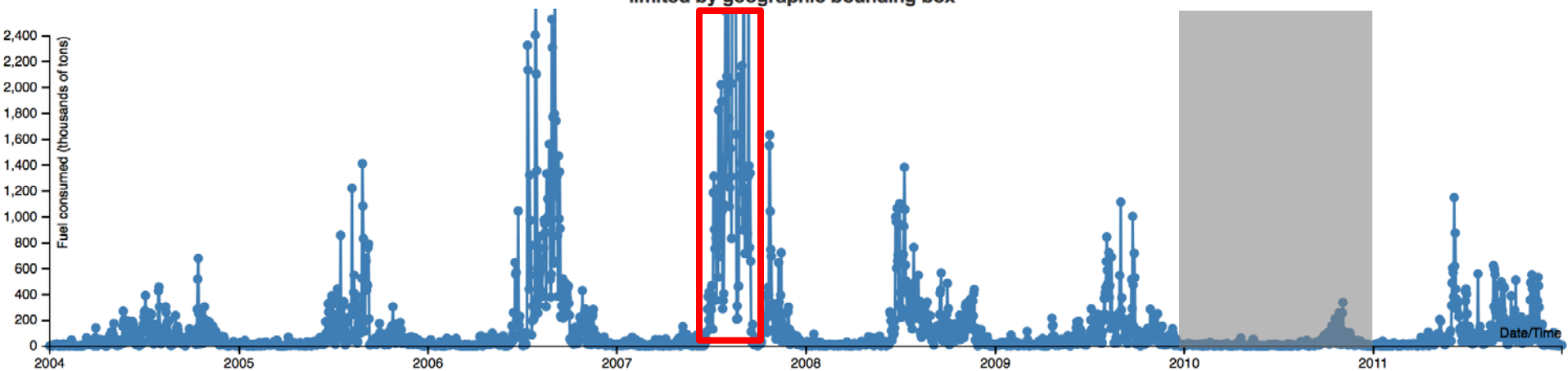
6/21 – 9/21

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



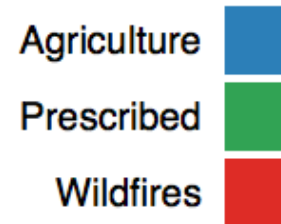
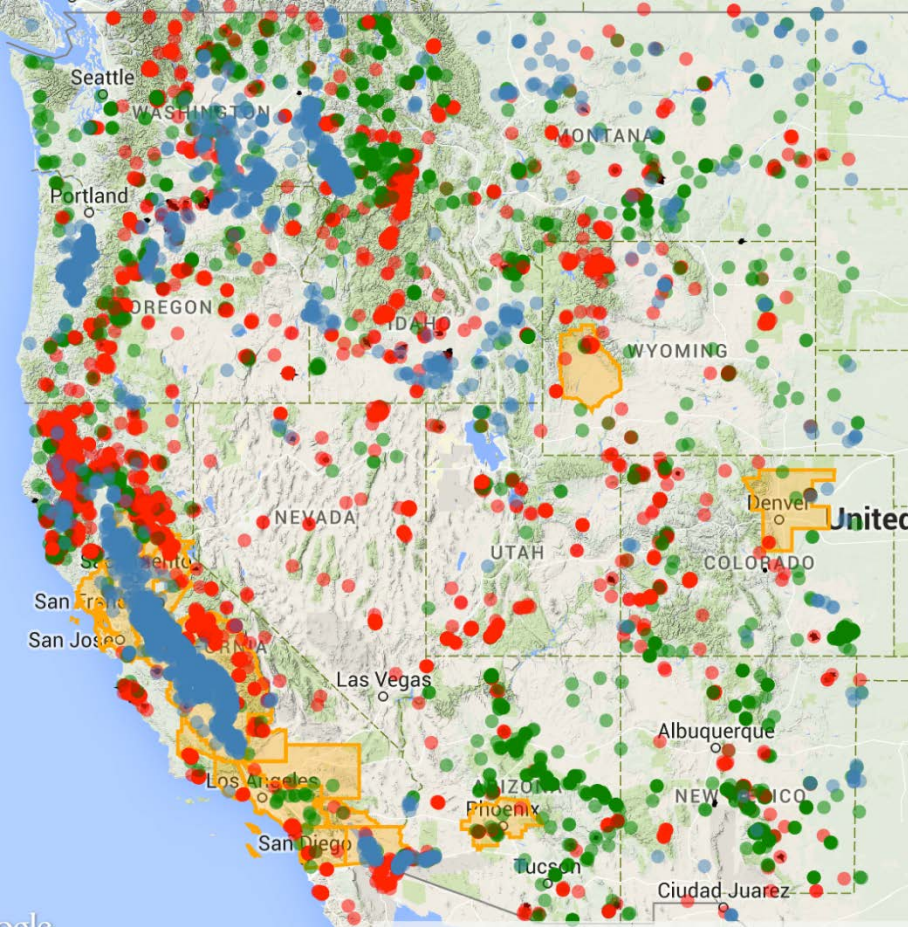


# 2008

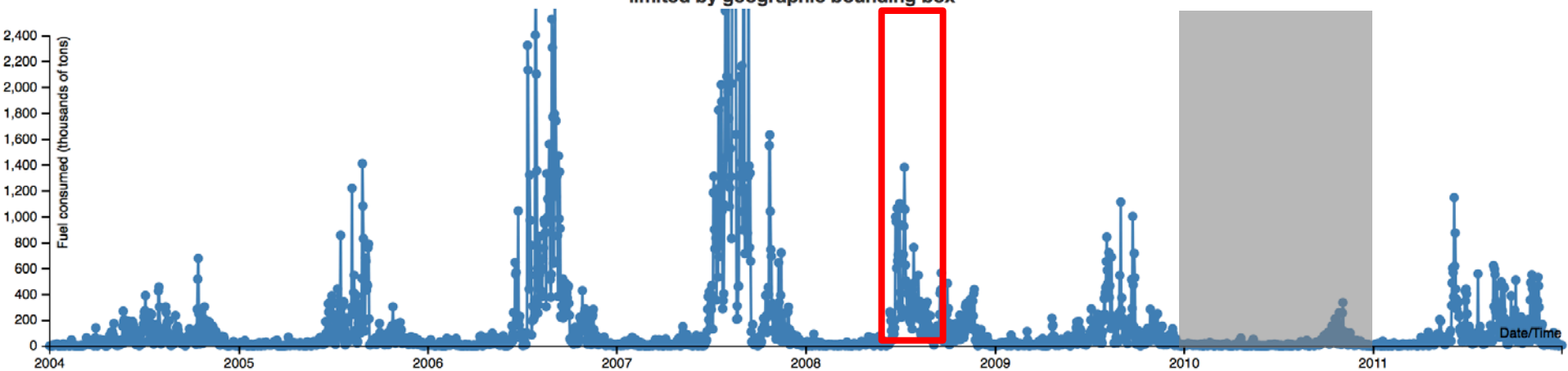
6/21 – 9/21

Limited by bounding box

Source: [WRAP Fire Tools](#)



FETS estimated fuel consumed for all fire types 01/01/2004 to 12/31/2011  
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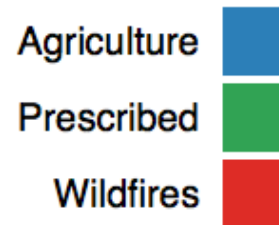
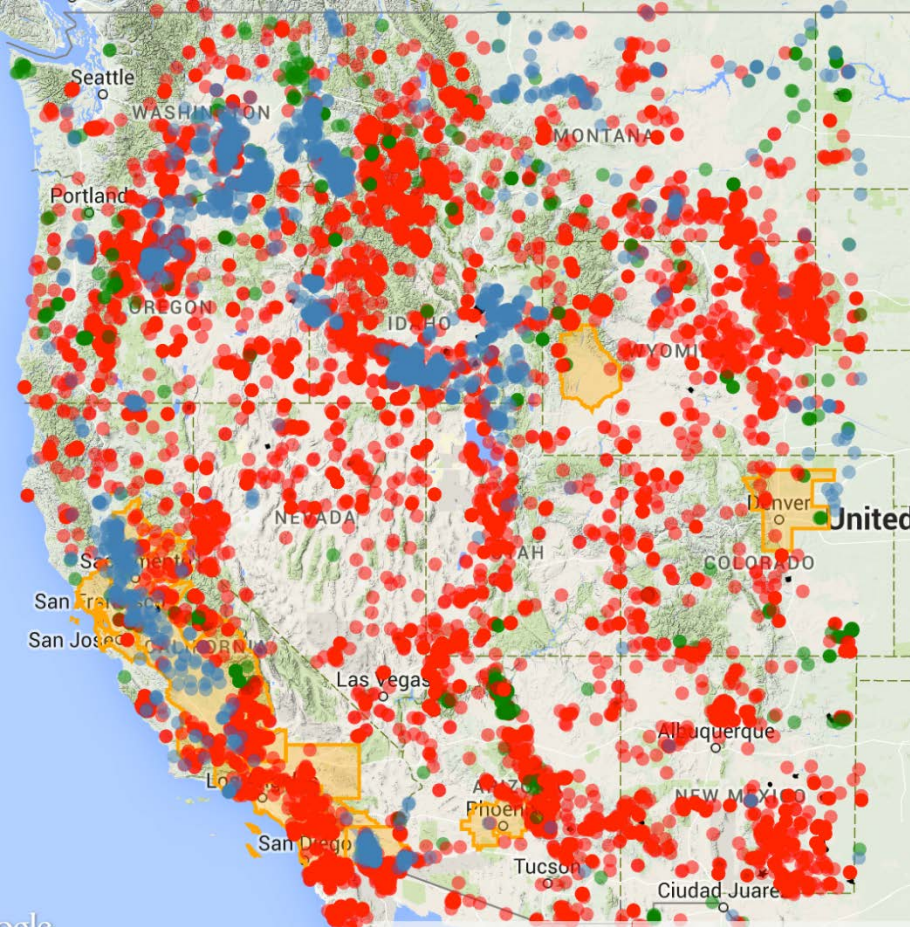
# 2011

6/21 – 9/21

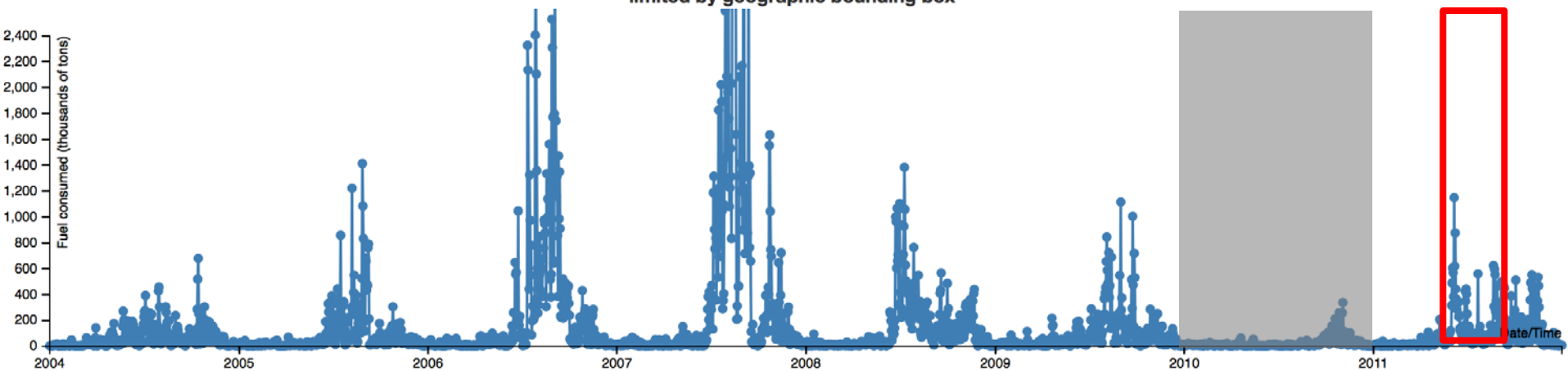
Limited by bounding box

\*Obtained additional  
small wildfire data  
for this inventory

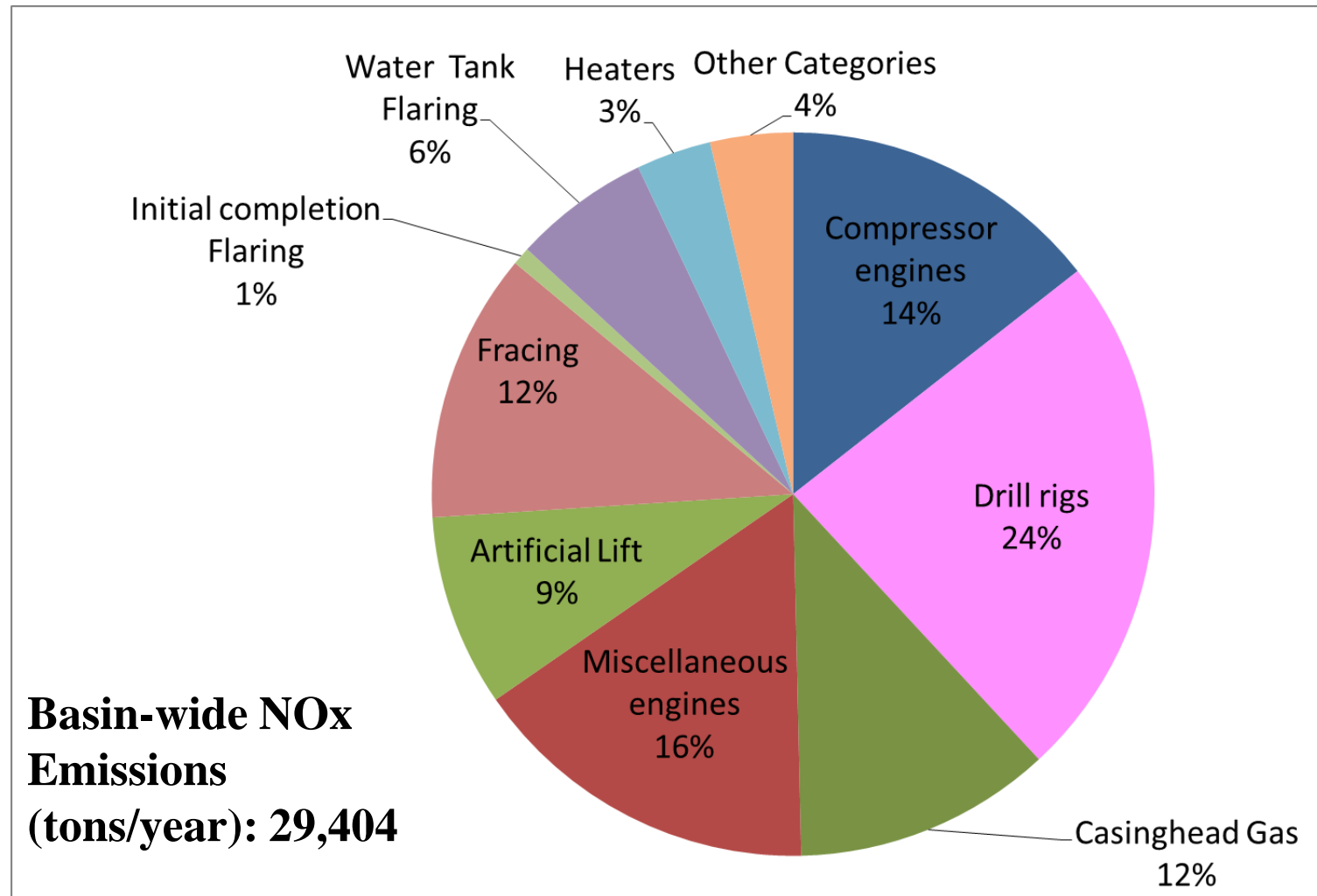
Source: [WRAP Fire Tools](#)



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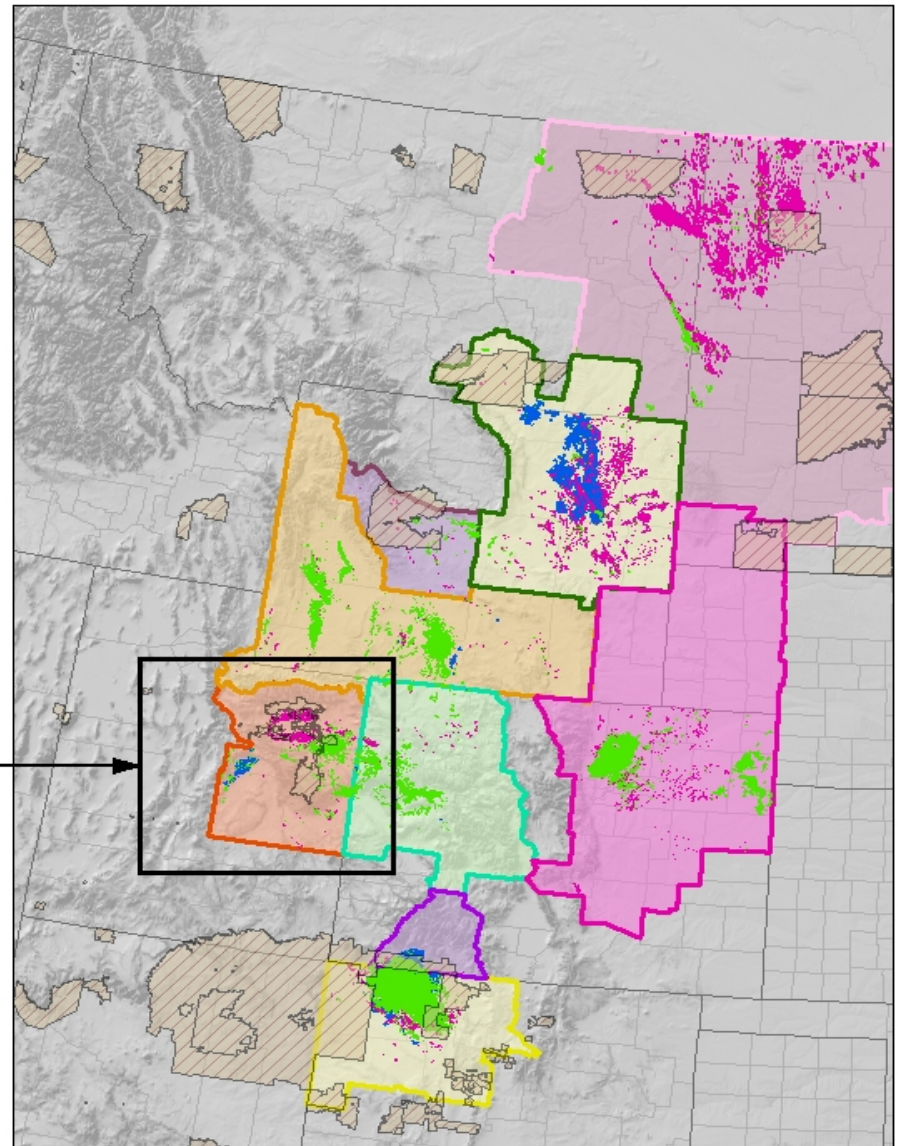
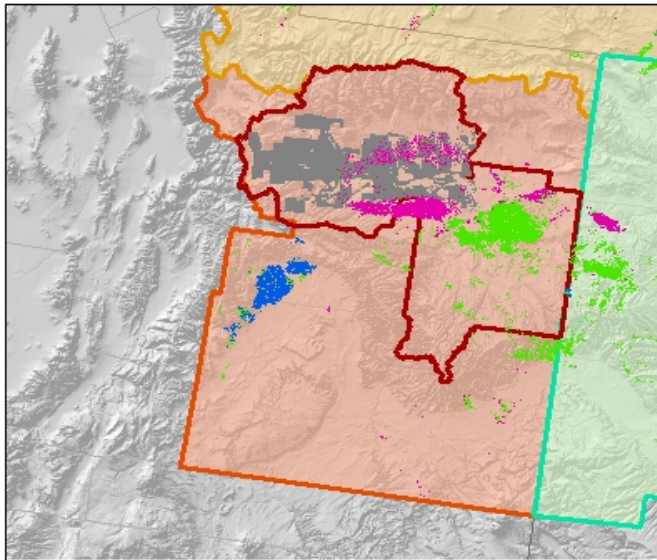
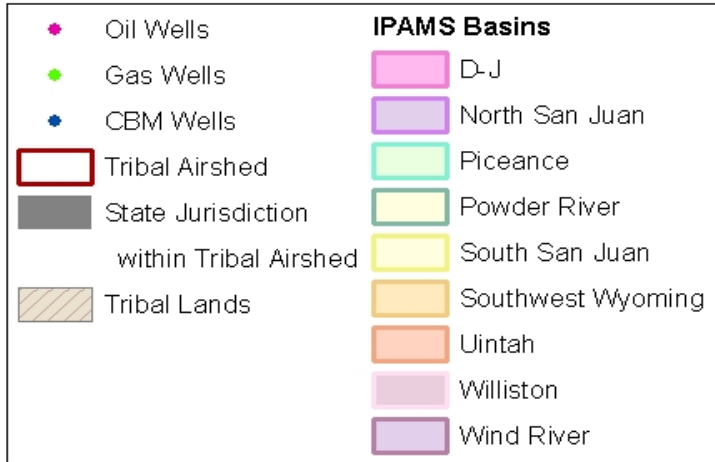


# Example Oil & Gas Study: Williston Basin 2011 Baseline Results NOx Emissions By Source Category

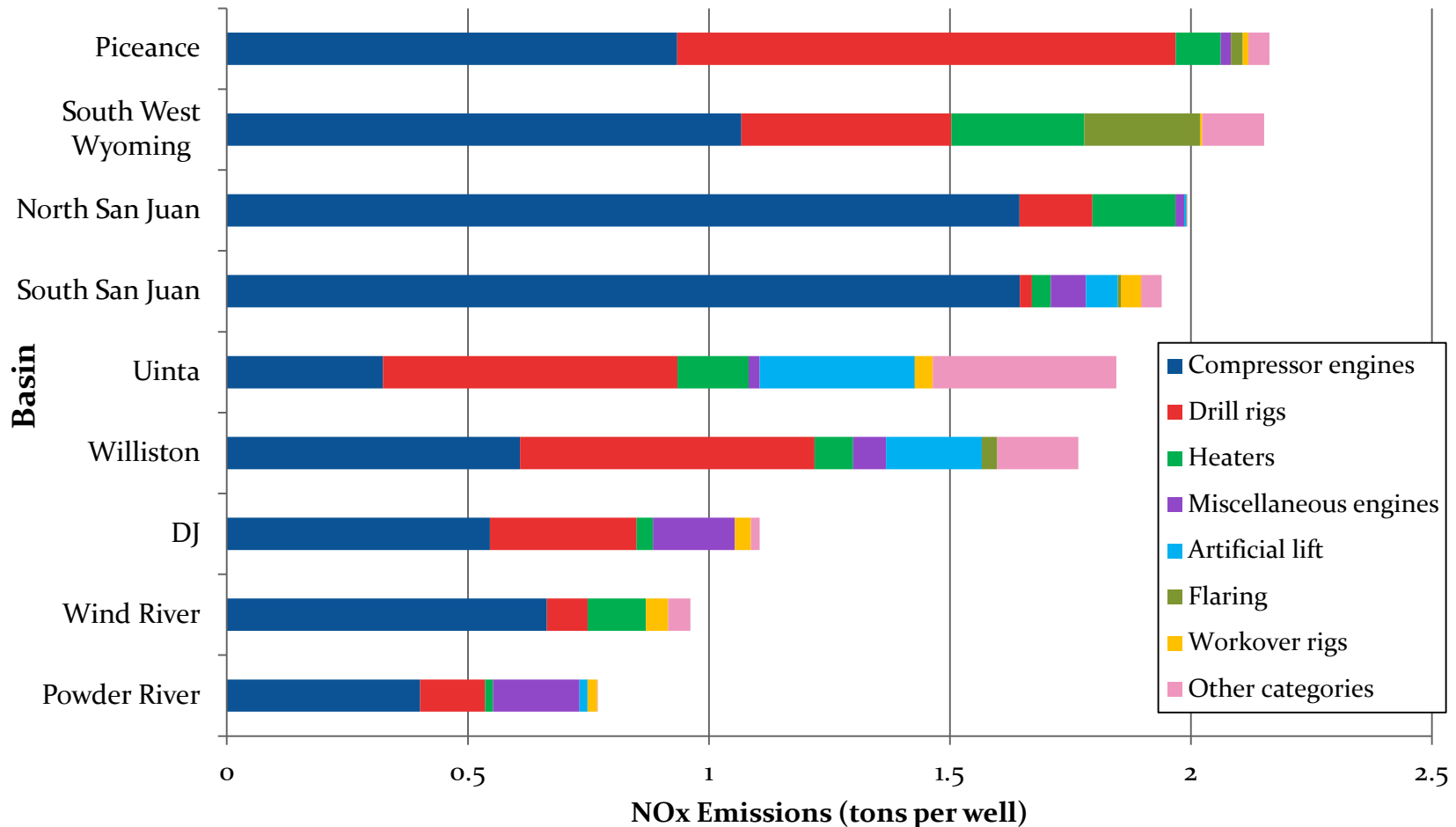




# Geographic Extent

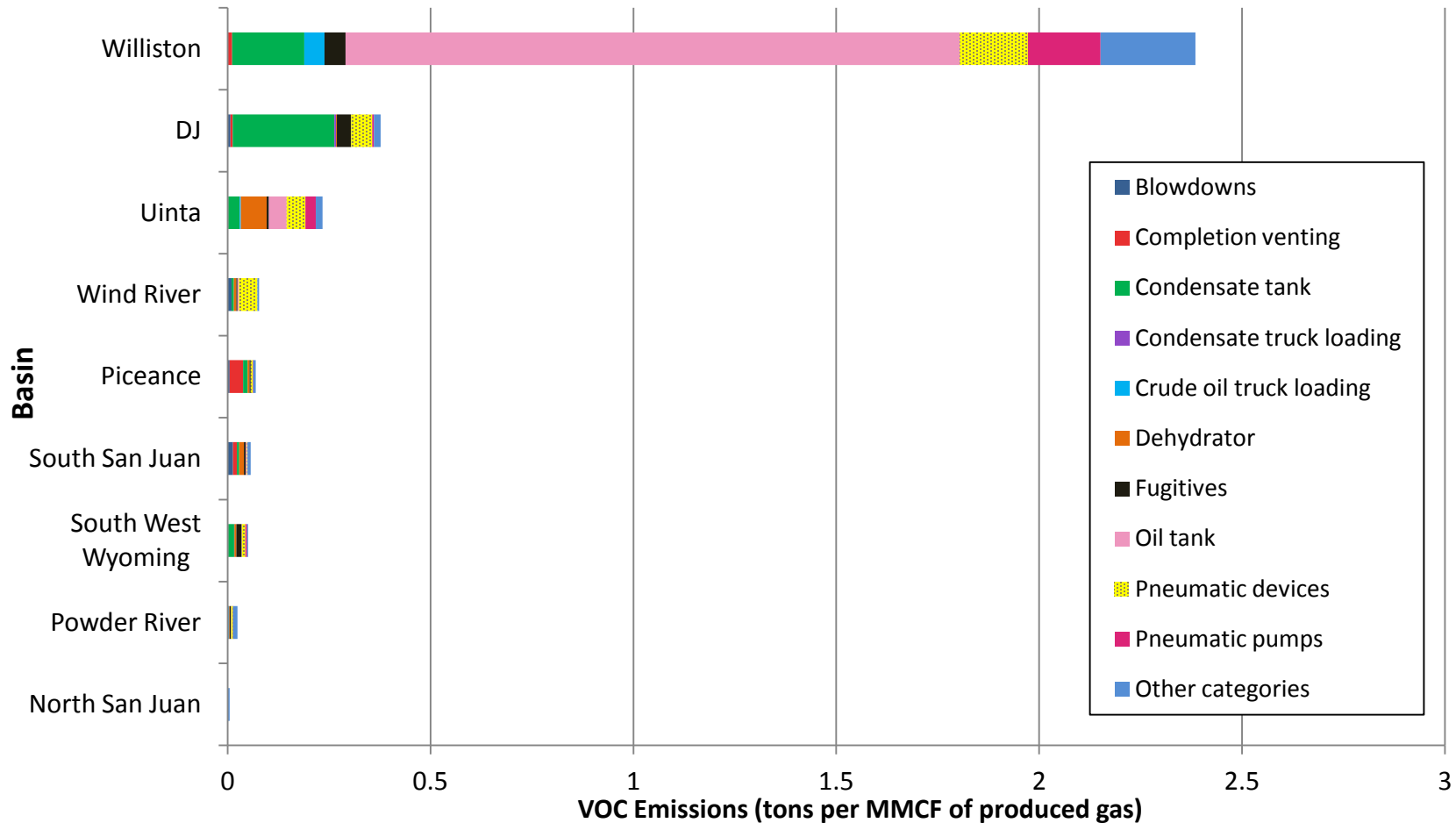


# Cross-Basin – Per-Well NO<sub>x</sub> Emissions



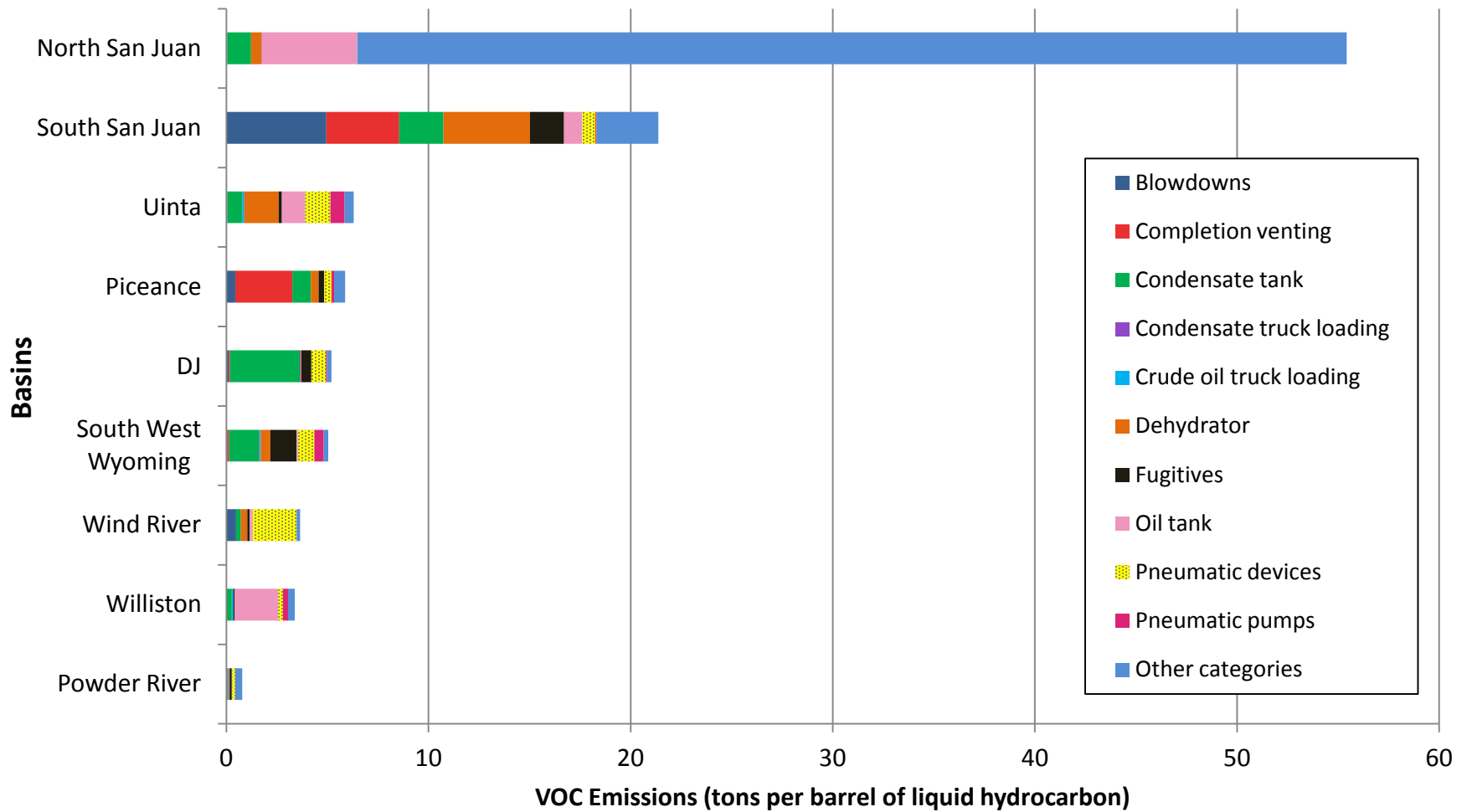
**Per well NO<sub>x</sub> emissions relatively consistent across basins – differences mainly due to usage of compression and centralized vs. wellhead compression**

# 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**

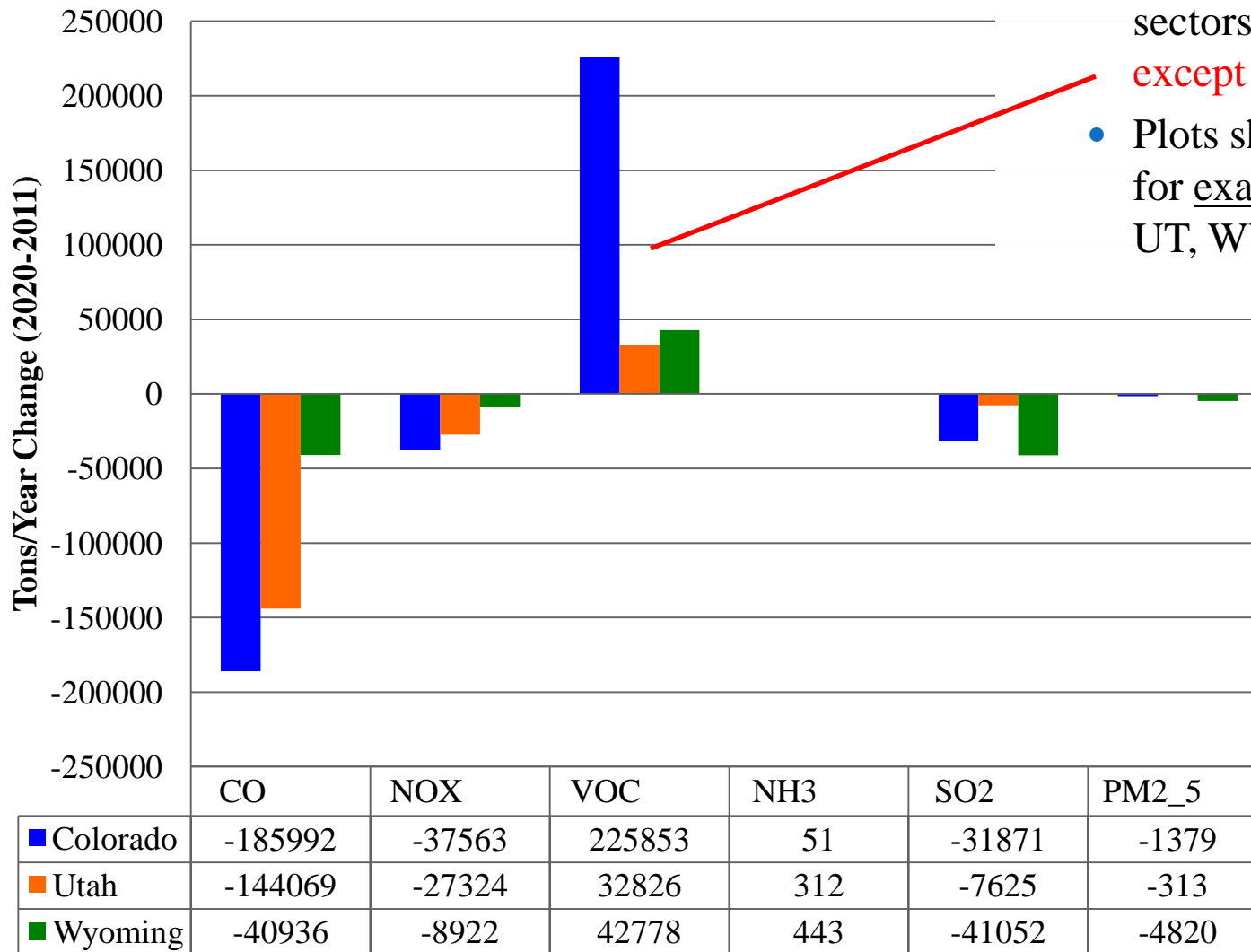


# Oil & Gas Projections - Methodology

- No standardized methodology for conducting projections
  - Each inventory study has used different approaches (EPA methods, Resource Management Plans, NEPA air quality projects, Western States Air Quality Modeling Study regional inventories)
- WRAP O&G inventories have used a three-step approach:
  1. Activity scaling factors
  2. “Uncontrolled” projections
  3. State and federal regulatory control requirements
- Activity scaling requires input from operators on planned activities, and/or analyzes trends, and/or relies on industry studies
- State and federal regulatory control requirements complex and continuing to evolve
  - National rules focused on new sources

# Trends in projected emissions - example


## State Total Inventory Change: 2020-2011



- Mostly decreases for all sectors/pollutants/states **except O&G VOCs**
- Plots show differences for example states (CO, UT, WY)

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

- 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 Clean Power Plan?
  - 17+ million acres of public lands leased in last 5 years for O&G exploration and production



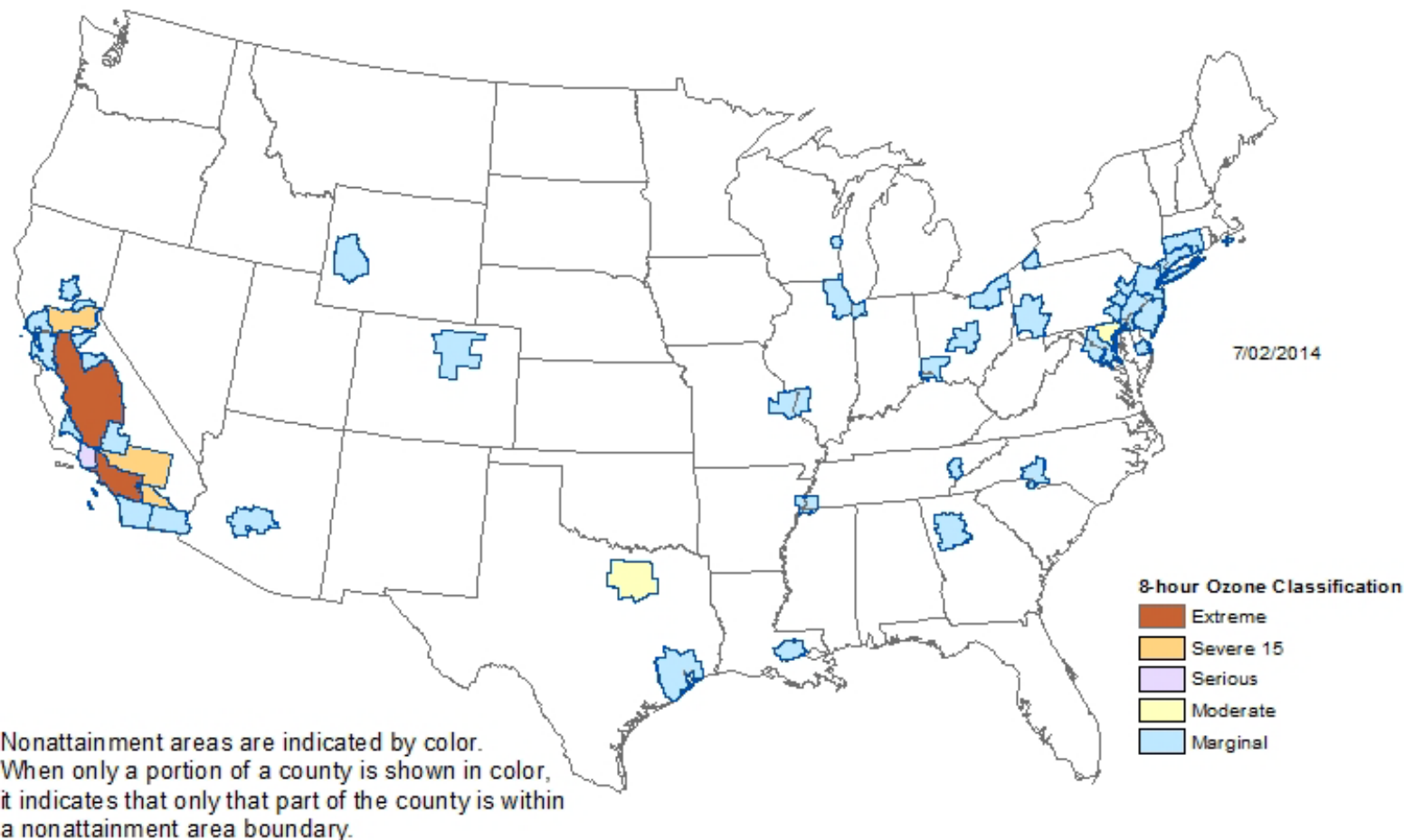
Numerous sources within and outside the U.S. will continue to contribute to air quality impacts across the West

Some are further controllable

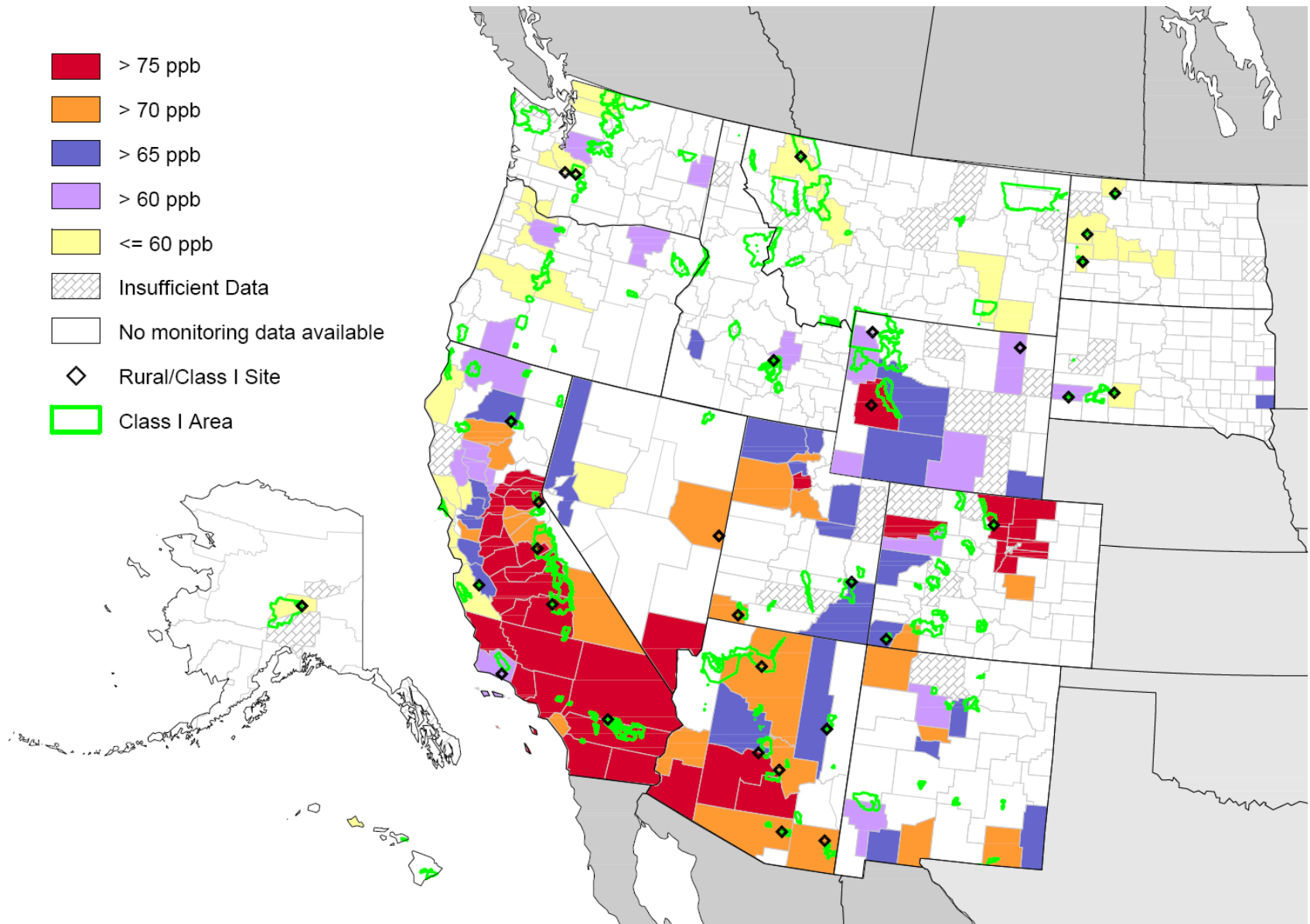
Others are less controllable, quasi-natural, and/or less well-understood - these may grow and/or vary significantly within the CAA planning timeframes

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

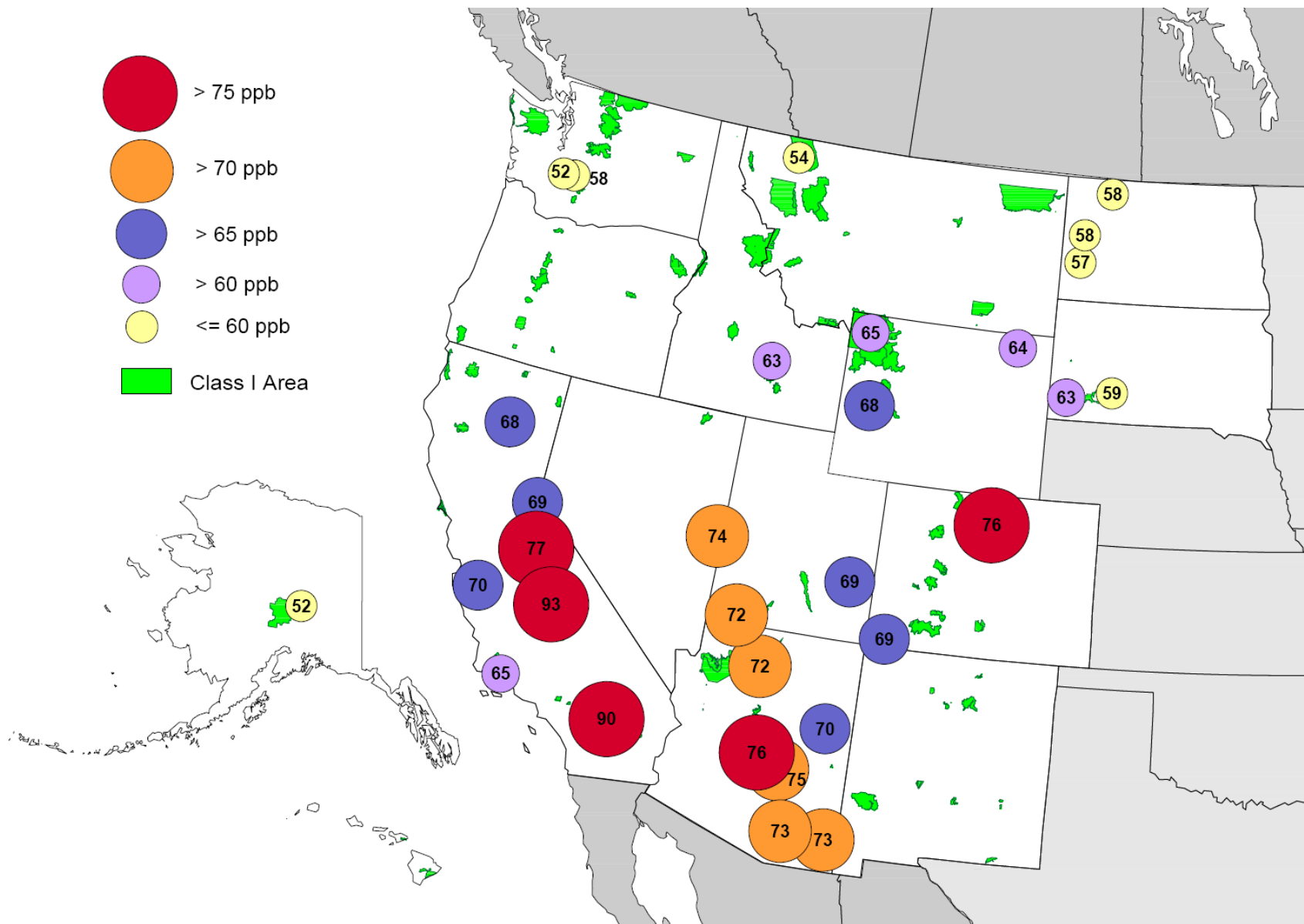
(Based on 2011-2013 Air Quality Data)



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

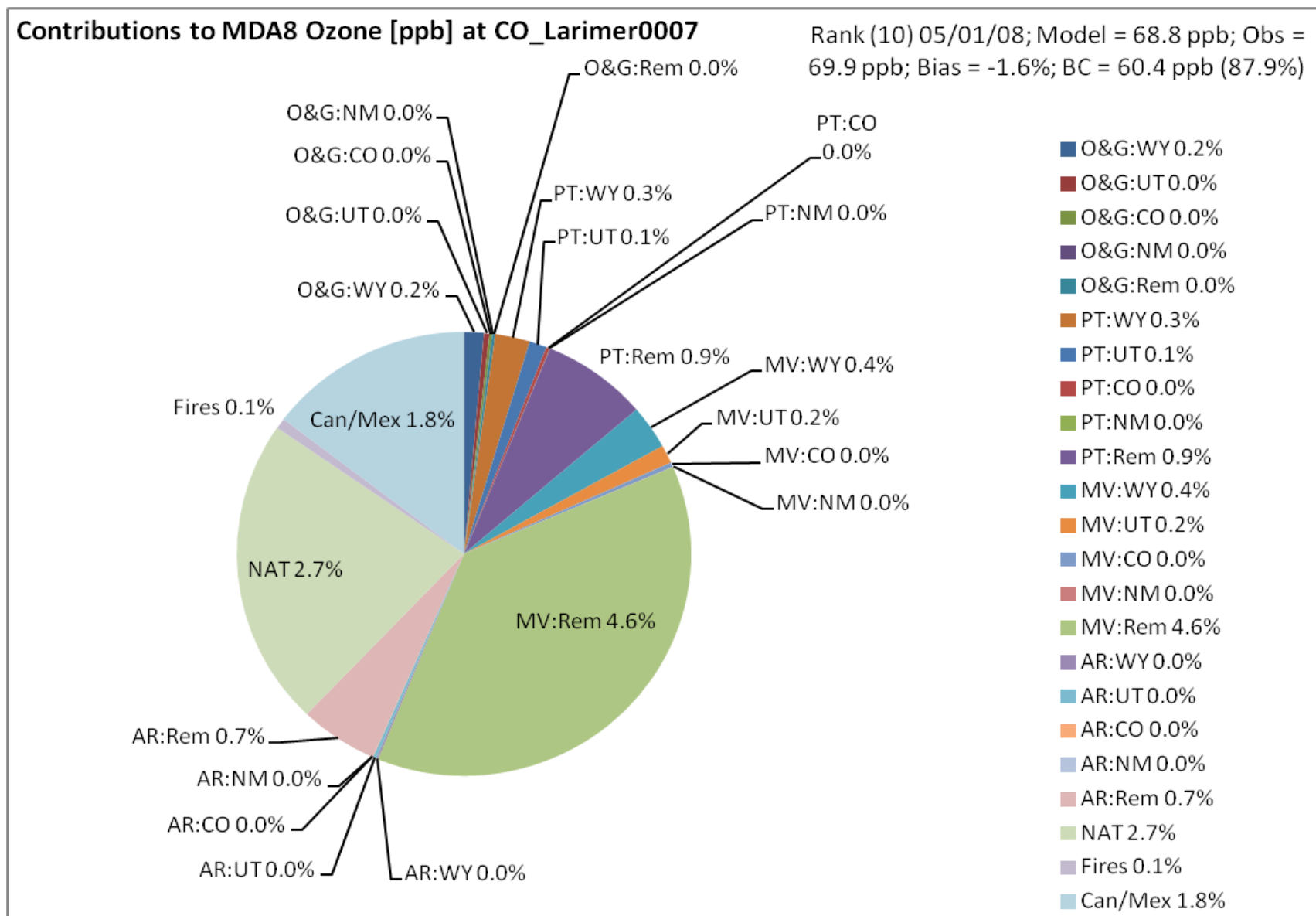


# 3-year Average 4<sup>th</sup> Highest 8-Hour Ozone value for Rural/Class I Sites 2011-2013





# Contributions to Ozone at Rocky Mountain National Park



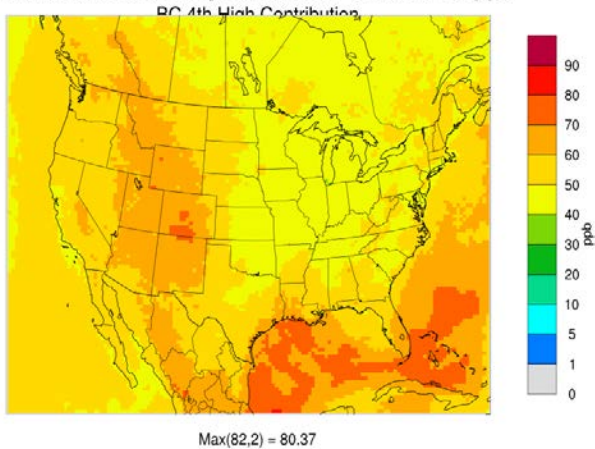
# “Other Sources” Max Contrib. 4<sup>th</sup> High DMAX8 Ozone

Boundary Conditions

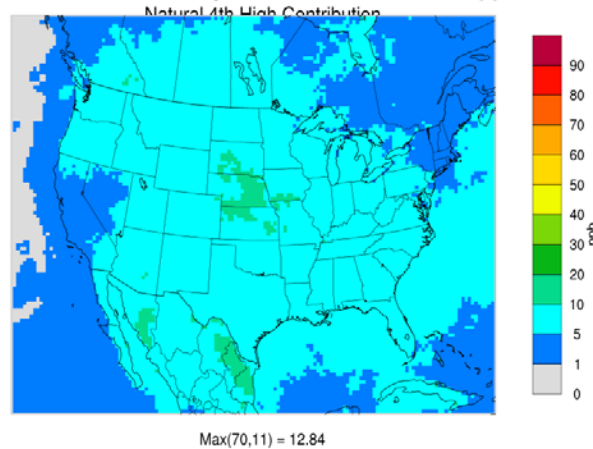
Natural

Anthropogenic

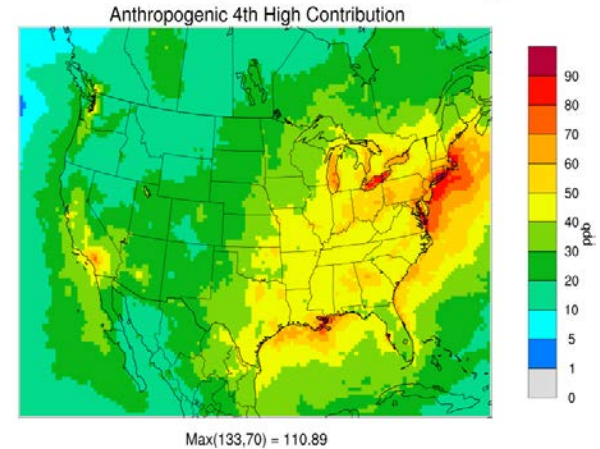
Contrib. to CAMx Daily Max 8-Hour Ozone  $\geq 0$  ppb



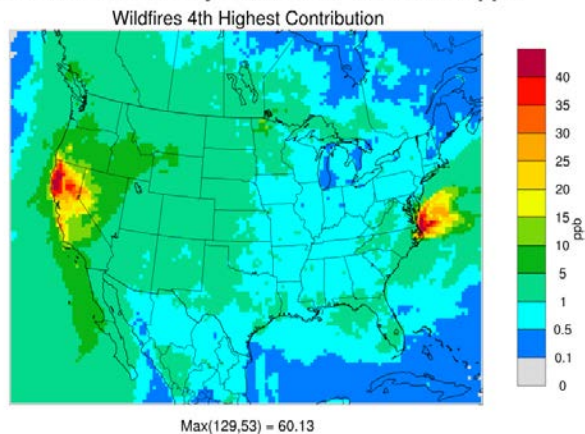
Contrib. to CAMx Daily Max 8-Hour Ozone  $\geq 0$  ppb



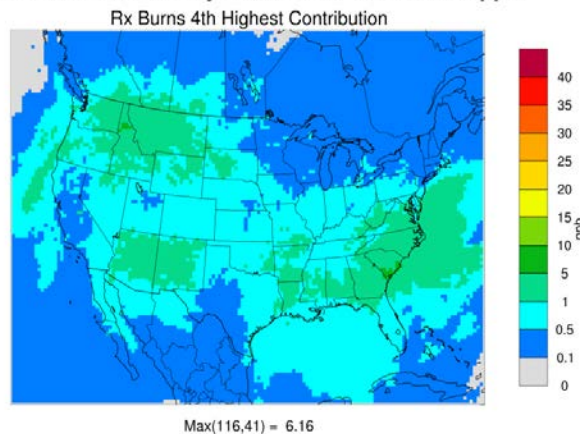
Contrib. to CAMx Daily Max 8-Hour Ozone  $\geq 0$  ppb



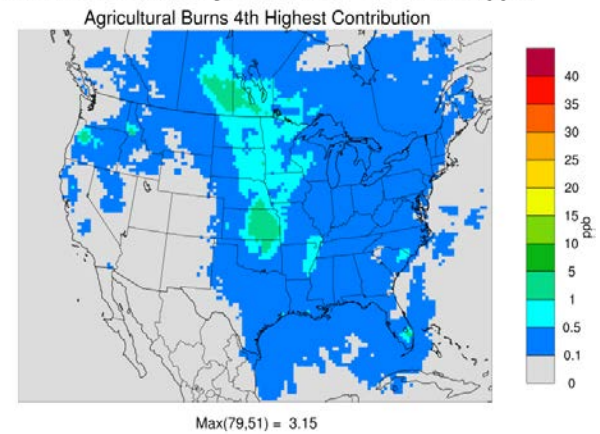
Contrib. to CAMx Daily Max 8-Hour Ozone  $\geq 0$  ppb



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



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



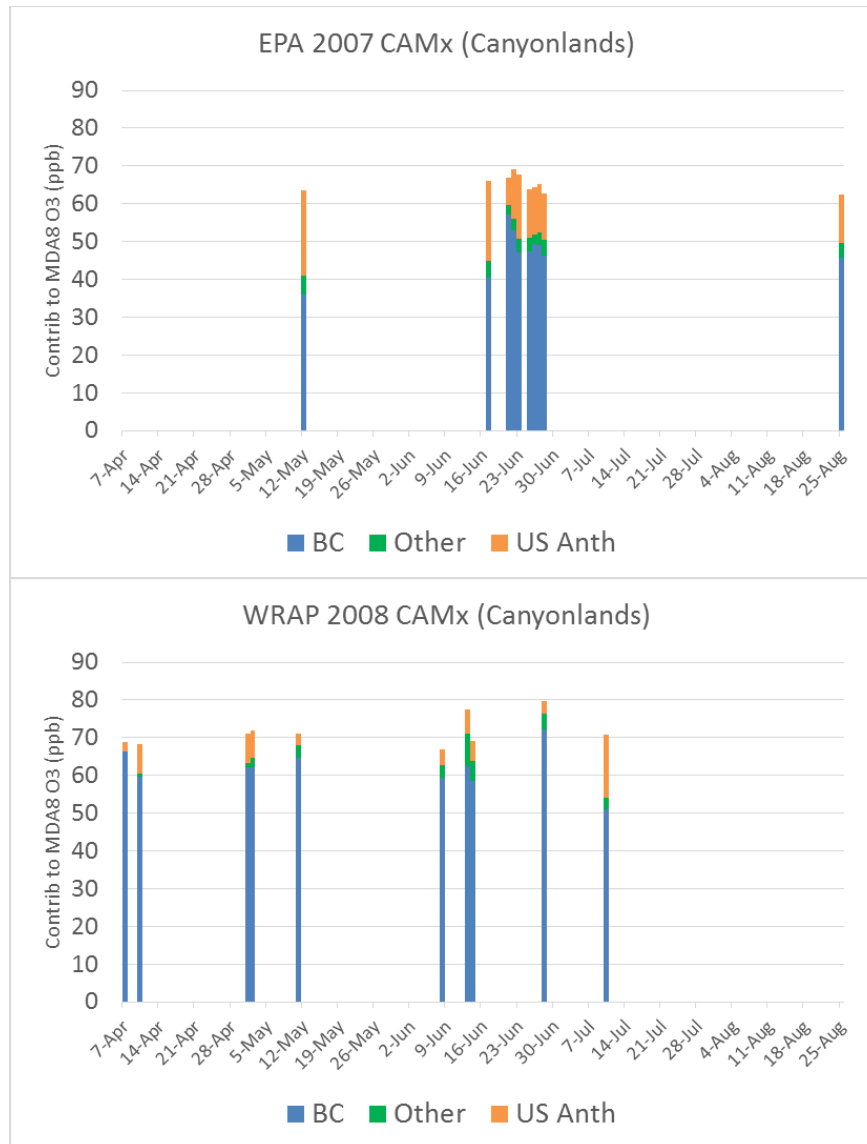
Wildfire

Prescribed Fire

Agricultural Fire

# Uncertainty in model estimates of U.S. Background

CAMx simulations for 2007 and 2008 at Canyonlands National Park – Eastern UT



EPA 2007 CAMx model:  
BC contributions of 36-57 ppb;  
still substantial U.S.  
anthropogenic contribution to O<sub>3</sub>.

WRAP 2008 CAMx model:  
BC contributions of 50-72 ppb,  
much larger than OAQPS  
modeling.

Same methodology - reasons for  
modeled differences are not fully  
understood

## Meetings and Workshops

San Joaquin Valley Unified Air Pollution Control District – *Transboundary Ozone Pollution Conference* – March 31-April 2, Tenaya Lodge, Yosemite National Park

EPA *Emission Inventory Conference* – April 13-16, San Diego

WRAP-EPA *Modeling Air Quality from the Global to Local Scale* Workshop – May 11-15, Boulder, CO

Thanks –

Tom Moore, WRAP Air Quality Program Manager  
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Western Regional Air Partnership | [www.wrapair2.org](http://www.wrapair2.org)