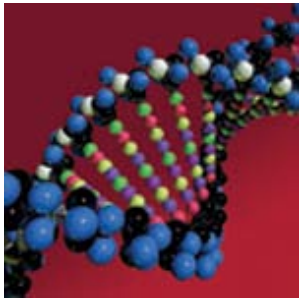
WestJumpAQMS Progress Report – Ozone and PM Source Apportionment Modeling and Final Report Outline



ENVIRON International Corporation
Alpine Geophysics, LLC
UNC Institute for the Environment

July 26, 2013

WESTERN REGIONAL AIR PARTNERSHIP

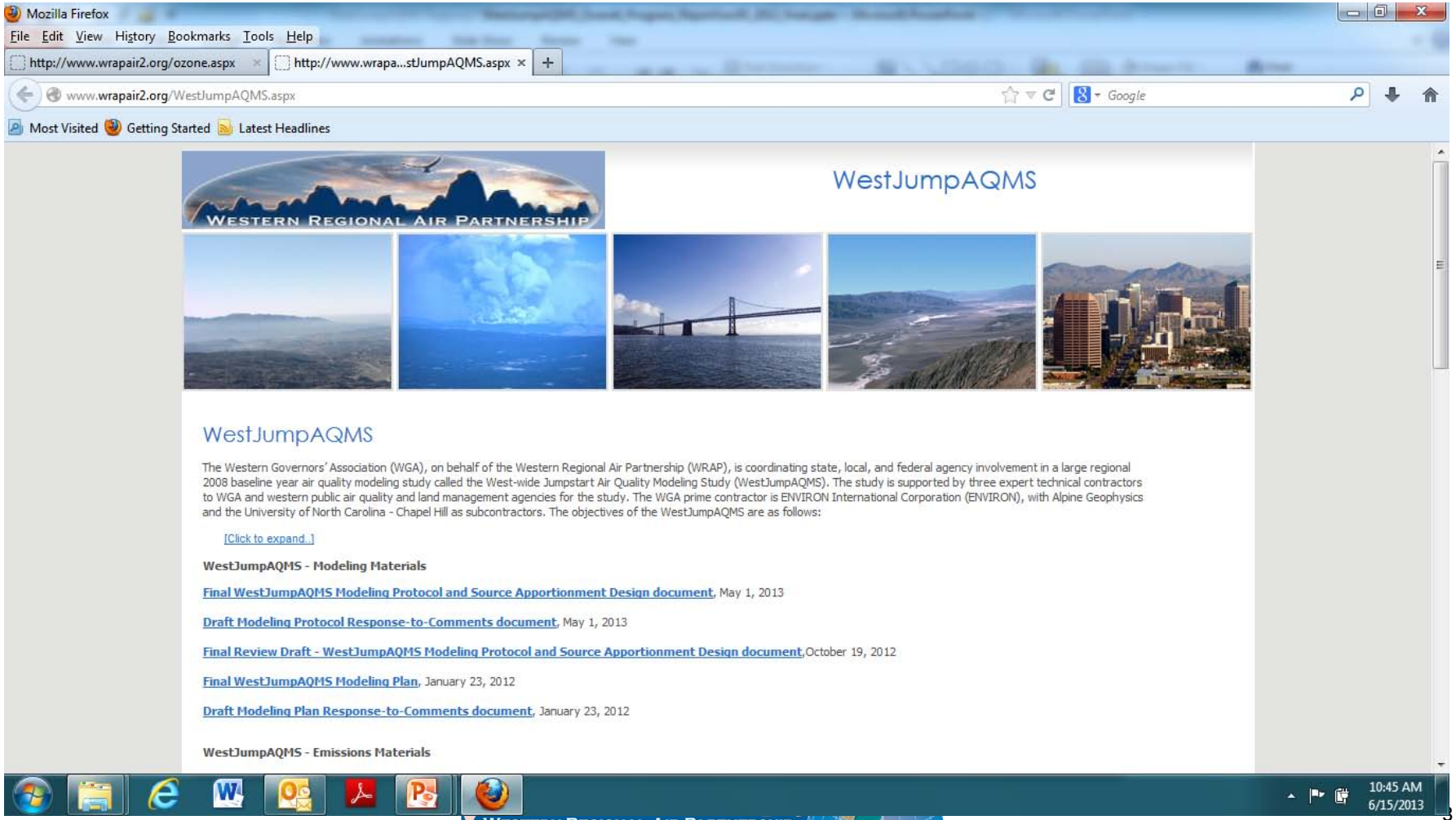
ENVIRON

Background

- Future Ozone standards could result in many areas in western U.S. being nonattainment
- Western Regional Air Partnership (WRAP) has initiated the West-wide Jump Start Air Quality Modeling Study (WestJumpAQMS) to:
  - Initiate next generation of regional technical analysis for ozone planning in the western U.S.
  - Continue work conducted at the WRAP Regional Modeling Center (RMC) and leverage recent air modeling studies
  - Provide a preliminary assessment of the role of ozone transport to elevated ozone concentrations across the West

Background

- Contracting team of ENVIRON, Alpine Geophysics and UNC IE
- WestJumpAQMS Website with products to date



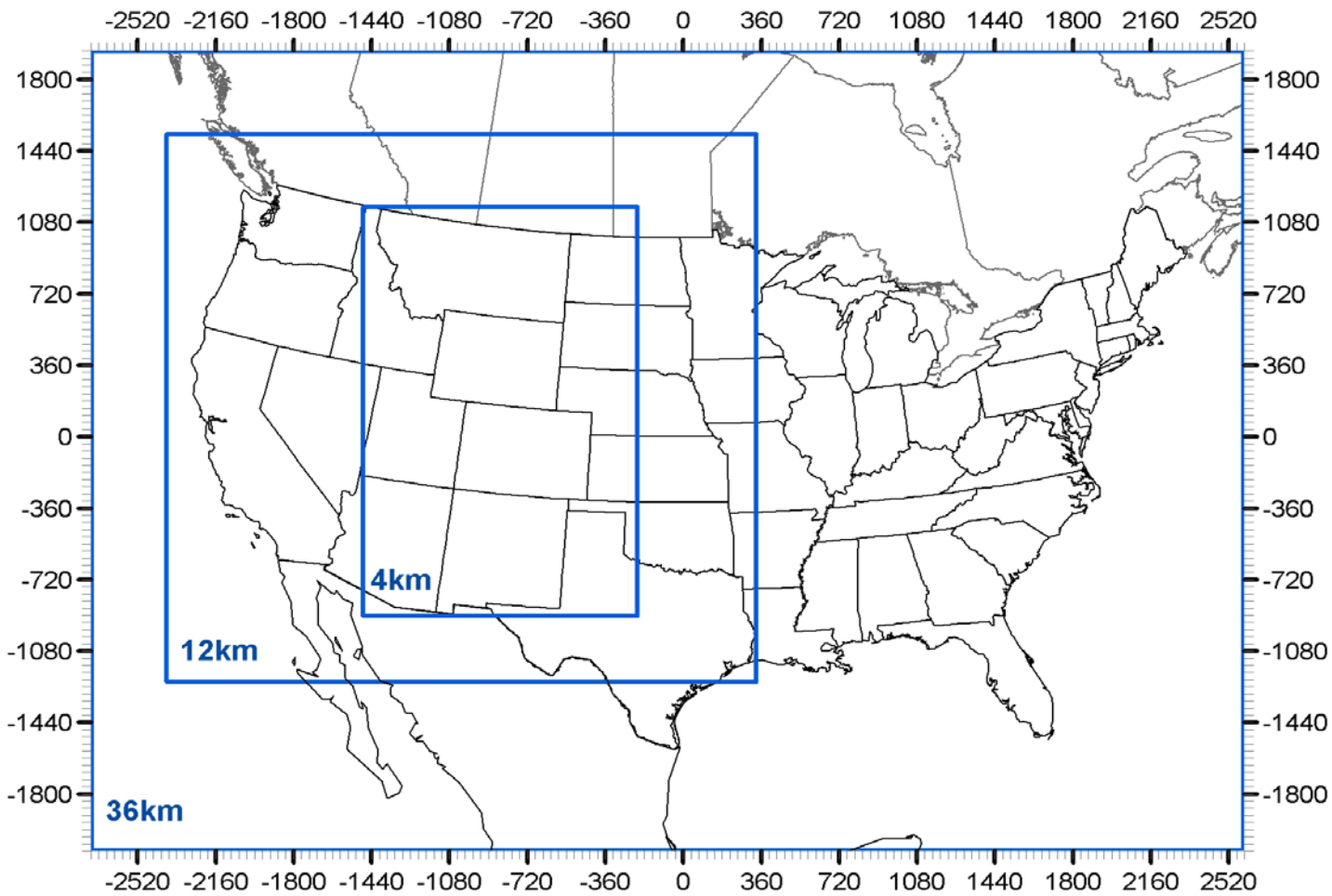
WestJumpAQMS Completed Tasks (today's topic)

- WRF Application/Evaluation
- 2008 Oil and Gas Emissions Update
- 16 Emissions Summary Memorandums
- SMOKE Emissions Modeling
- CAMx Model Input Development
- Calculate Basin-wide WRAP Phase III O&G EFs for use in 2011 NEI
- CAMx 2008 36/12 km Base Case
  - Model Performance Evaluation
- CAMx 2008 State-Specific Ozone Source Apportionment Modeling
  - Preliminary Results **and Refined Results**
- **CAMx 2008 State-Specific PM Source Apportionment Modeling**
- **MOZART vs. GEOS-Chem BCs**
- **Final Report Outline**
- **Next Steps**

WestJumpAQMS Ongoing Tasks

- CAMx 2008 Source-Category-Specific Ozone and PM Source Apportionment Modeling
- CMAQ 2008 Base Case Modeling
  - CMAQ and CAMx Model Performance Comparison
- CAMx 4 km Impact Assessment Domain (IAD) Inputs
  - Western Colorado Air Resource Management Modeling Study (West-CARMMS)
- Data Transfer to Three State Data Warehouse (3SDW)
  - Data lives on!
- Final Report and One more Webinar
  - Webinar in late August: Source category-specific ozone and PM source apportionment; final report; wrap up

36 km CONUS; 12 km WESTUS & 4 km IMWD processing domain



Modeling Domain

Summary of CAMx 2008 36/12 km Inputs

- WRF 2008 36/12 km Meteorology
- MOZART Global Model Boundary Conditions
- 2008 Base Case Emissions
  - WRAP Phase III 2008 Oil and Gas Emissions
    - 2008 NEI O&G outside of WRAP Basins
  - MEGAN Biogenic Emissions
  - Hourly CEM for Electrical Generating Units (EGUs)
  - 2008 National Emissions Inventory (NEIv2)
  - Fire INventory from NCAR (FINN) [Base08a&b]
  - DEASCO3 Fire Emissions (Base08c)

CAMx 2008 36/12 km Base Cases

- Base08a – FINN Fires -- May, Jun and Jul 2008
- Base08b – FINN Fires – 2008 36/12 km Annual
  - Correct double counting of SUIT O&G emissions (Southwest CO) from WRAP and 2008 NEI
- Base08c – DEASCO3 Fires (WF, Rx & Ag) – 2008 36/12 km Annual
  - Correct O&G county swapping
  - Model performance evaluation
    - ozone, $PM_{2.5}$ and speciated $PM_{2.5}$ (SO4, NO3, NH4, EC, OA, Soil and OPM2.5)
    - 36 km CONUS and 12 km WESTUS domains and by western state

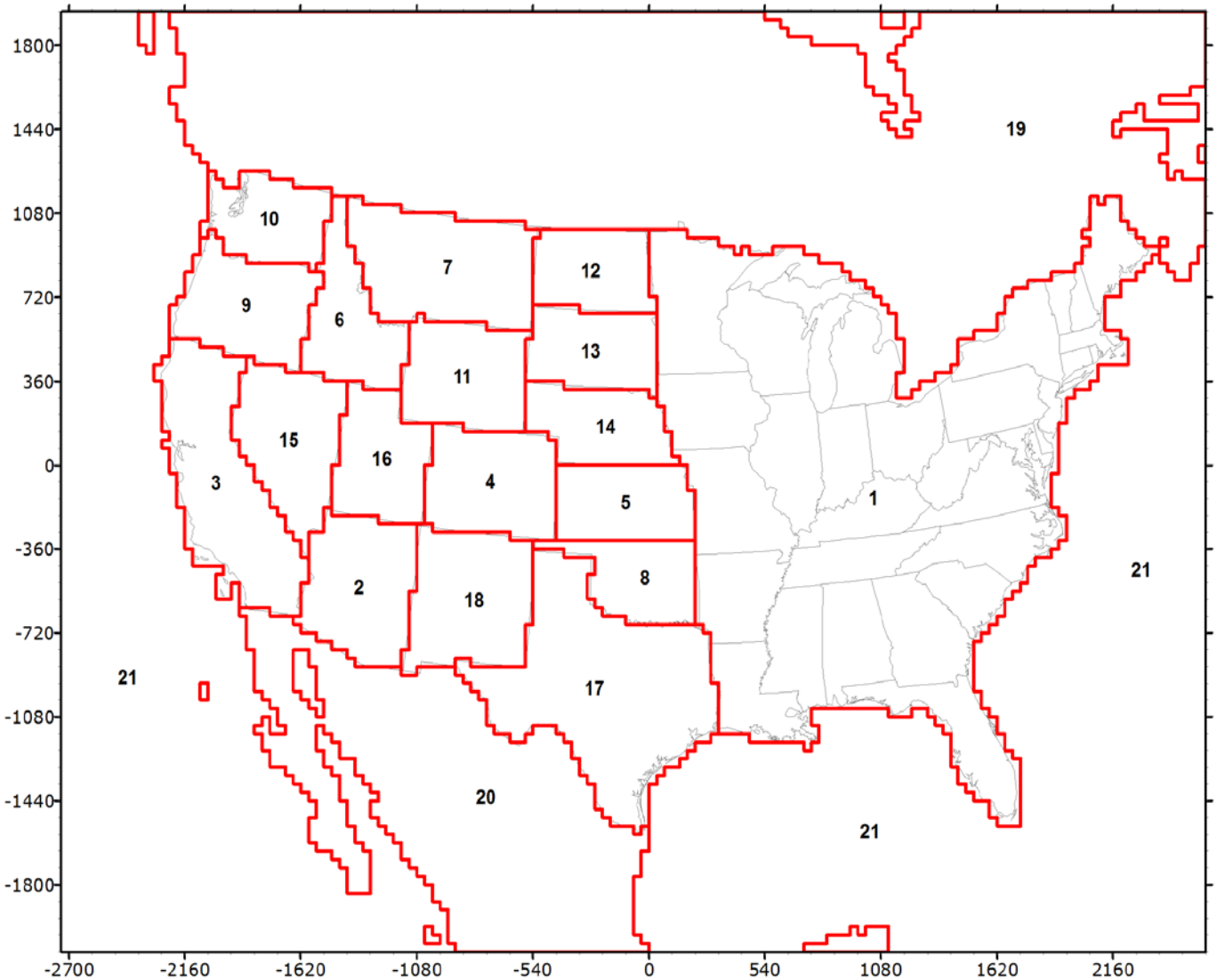
Summary Base08c CAMx PM Performance

- Daily maximum 8-hour ozone performance mostly good
  - Some overestimation bias, but within Performance Goals
- Operational difference in speciated PM species definitions in modeling vs. monitoring
  - For example, Other $PM_{2.5}$ (OPM2.5) overestimation
- In general fairly good model performance for $PM_{2.5}$, SO_4, NH_4 and EC
- NO3 underestimation in summer
  - Summer NO_3 concentrations very low, better NO_3 performance in winter when NO3 concentrations higher
- OA is underestimated, especially in summer
  - Missing emissions (SVOC) and Measurement uncertainties (SANDWICH)

Ozone and PM Source Apportionment Modeling

- 2008 Base Case emissions scenario
- State-Specific Source Apportionment
  - Source Regions: Western States
  - Source Categories: Natural (Biogenic, Lightning, Sea Salt and WBD), Fire (separately for WF, Rx, AG) and Anthropogenic
  - CSAPR-type transport analysis
    - Examine upwind state anthropogenic (Anthro+Rx+Ag) contribution to downwind state ozone and $PM_{2.5}$ Design Values (DV)
  - Spatial extent of state contributions to high ozone (1st and 4th Highest DMAX8) and $PM_{2.5}$ (8th Highest 24-Hour)
    - For example, maximum state ozone contribution to daily maximum 8-hour ozone ≥ 76, 70, 65, 60 and 0 ppb

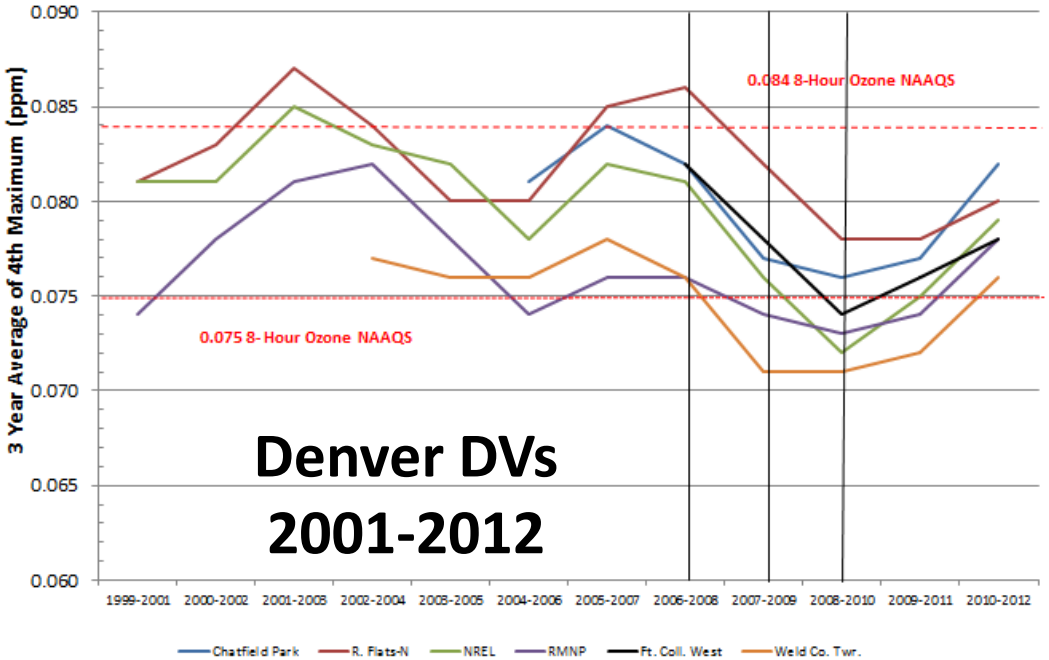
State-Specific Source Apportionment
21 Source Regions



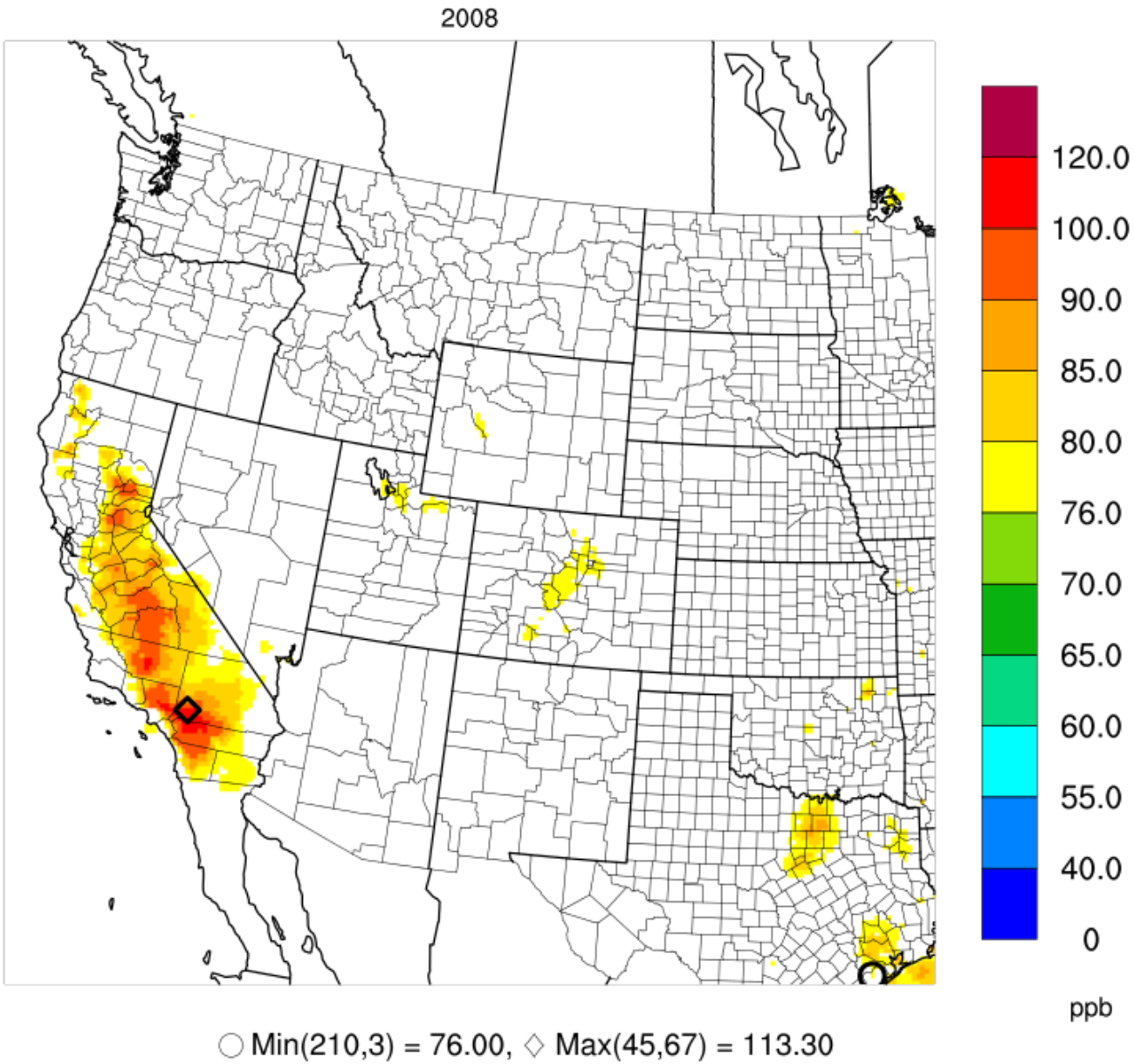
MATS Unmonitored Area Analysis (UAA)

- Default MATS calculates current year Design Value (DVC) using an average of three Design Values
  - Design Value (DV) is defined as the three year average of the fourth highest daily maximum 8-hour ozone (DMAX8)
  - MATS DVC defined as avg of 2006-8, 2007-9 & 2008-10 DVs

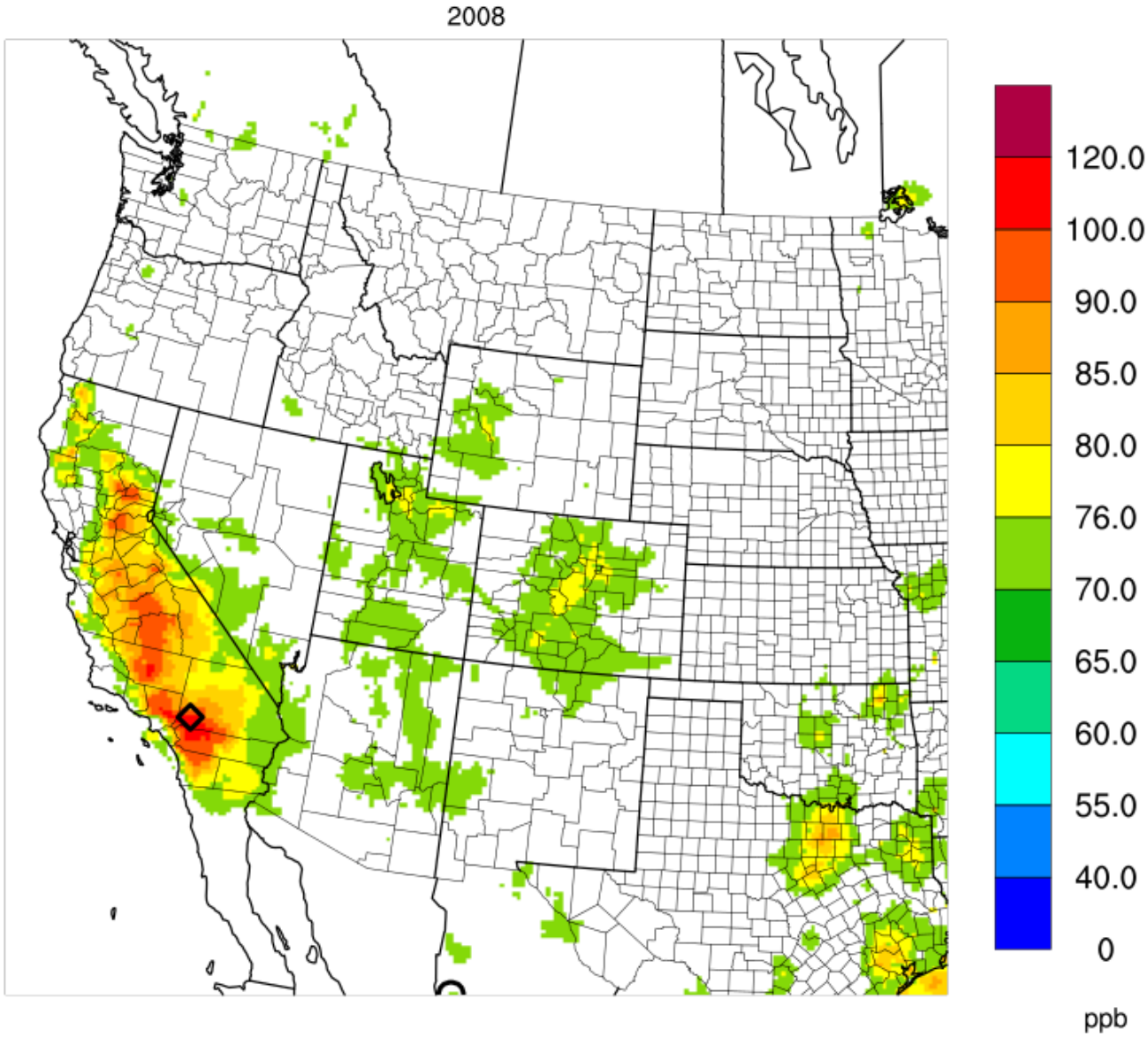
- MATS UAA interpolates DVCs across domain using observed DVCs at monitors and modeled concentration gradients
- Since low ozone in 2009, ozone has been increasing in west



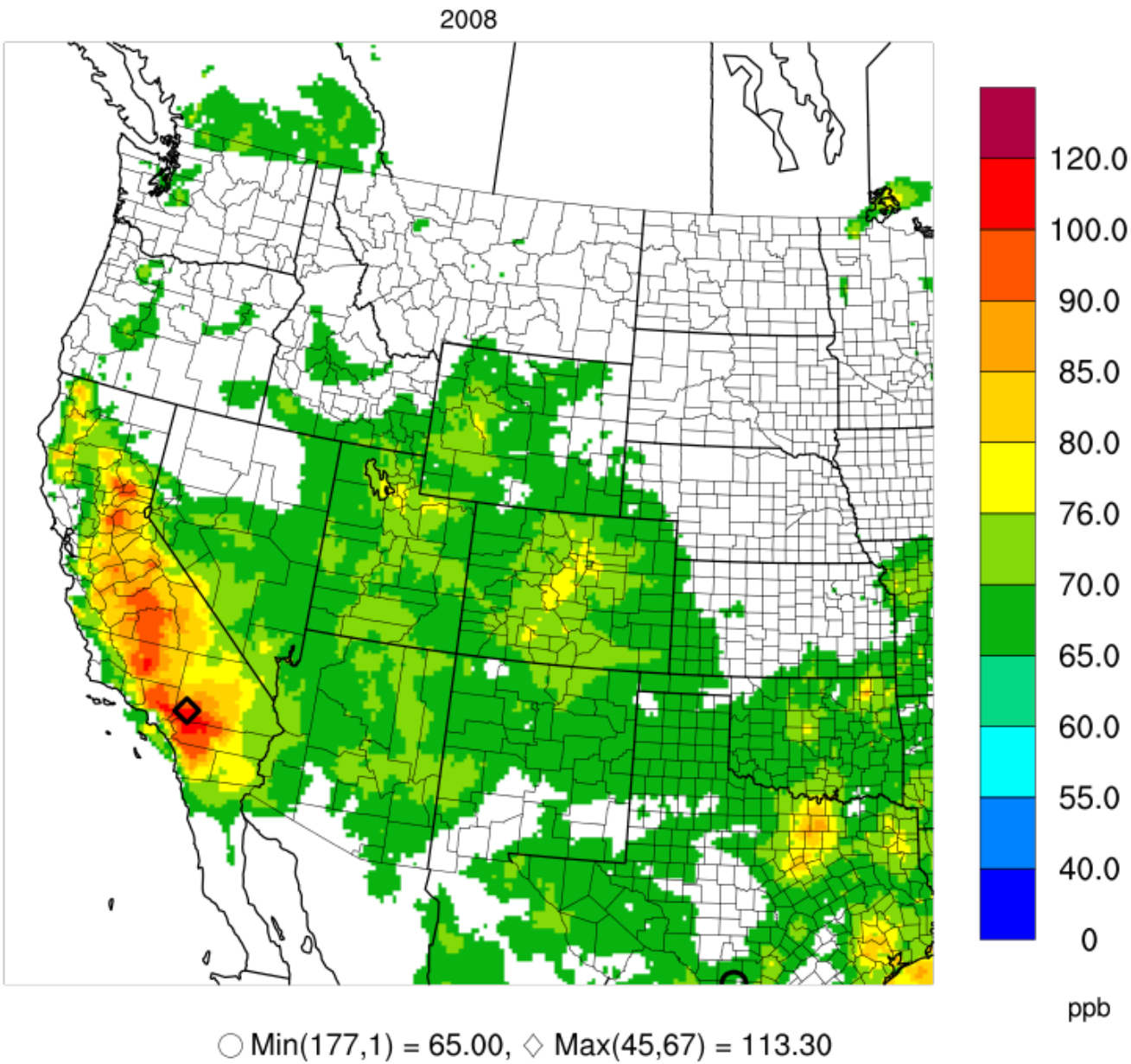
2006-2010 MATS UAA: Areas with DVC ≥ 76



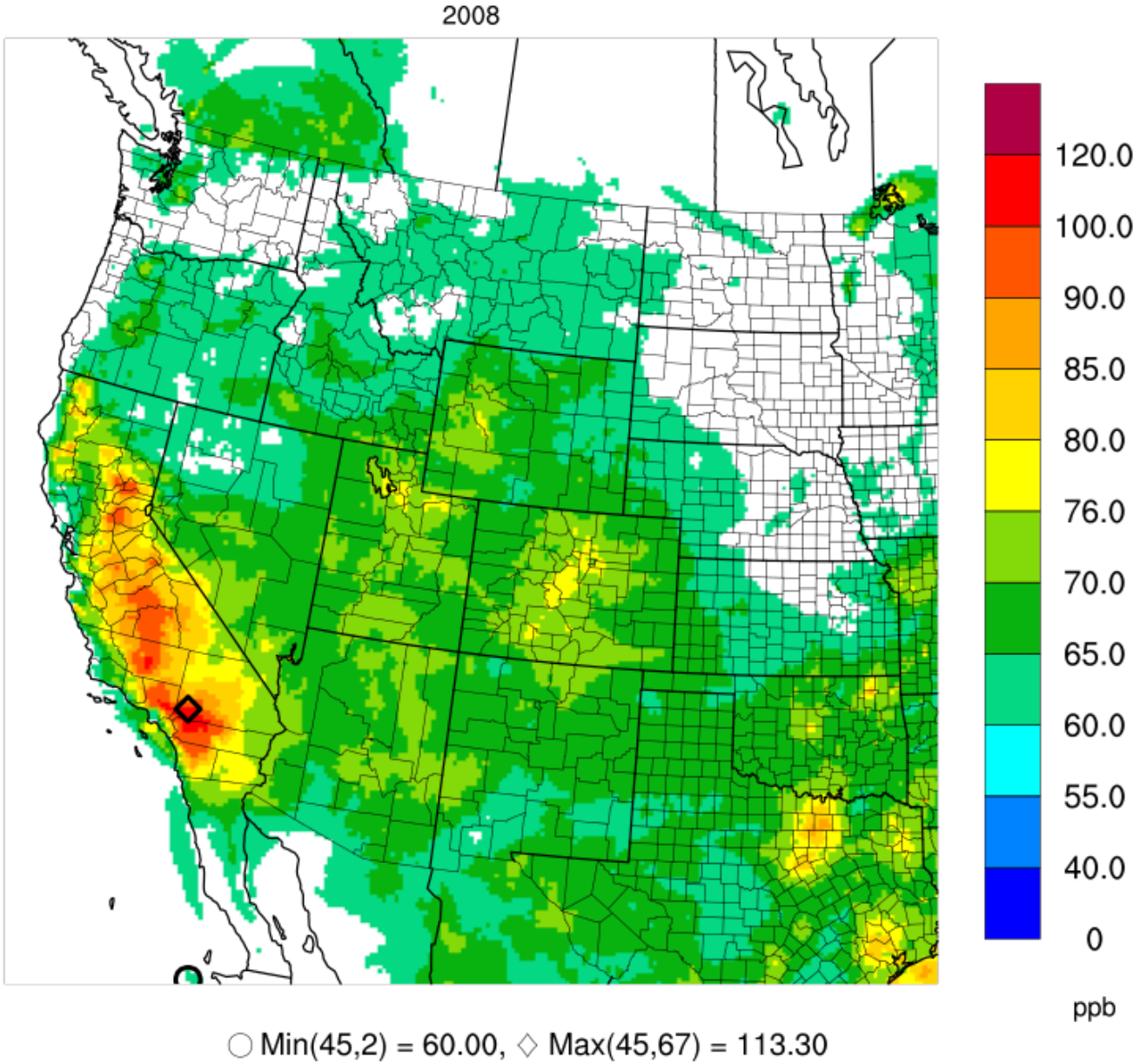
2006-2010 MATS UAA: Areas DVC ≥ 70 ppb



2006-2010 MATS UAA: Areas DVC ≥ 65 ppb



2006-2010 MATS UAA: Areas DVC ≥ 60 ppb



CSAPR-type Ozone Contribution Analysis

- State-Specific Anthropogenic (Anthro+Rx+Ag) contributions to 8-hour ozone Design Value (DVs)
- Model Attainment Test Software (MATS) to project current DVs without a selected state's contribution
  - Use relative change in model results to scale observed current year DV (DVC) in absence of a state's anthropogenic emissions
  - Difference is state's ozone contribution at each ozone monitoring site
- As in CSAPR, use two sets of DVCs
  - AvgDVC = Average of 2006-2008, 2007-2009 & 2008-2010 DVs
  - MaxDVC = Maximum of 2006-08, 2007-09 & 2008-10 DVs
- CSAPR used significant contribution threshold of 1% of the NAAQS

2008 36/12 km State-Specific Analysis

- Example CSAPR-type Analysis using current (March 2008) 0.075 ppm ozone NAAQS
  - Also looking at 70, 65 and 60 ppb potential future NAAQS
- 136 ozone monitors in 12 km WESTUS domain with AvgDVC exceeding NAAQS (76 ppb or higher) [86 sites (63%) in CA]
- For 17 upwind western states examine 2008 contribution to ozone Design Values at ozone monitoring sites in downwind states
- **This analysis is for 2008 and is not a regulatory analysis that would have to examine a future year**

2008 CSAPR-type Analysis for 0.075 ppm O_3 NAAQS

Number of sites with State contribution to DV ≥ 0.76 ppb

State	# Sites	Max O3 (ppb)
AZ	24	1.23
CA	18	16.65
CO	0	0.51
KS	4	8.95
ID	2	1.02
MT	0	0.18
OK	18	6.52
OR	25	1.13
WA	1	1.03

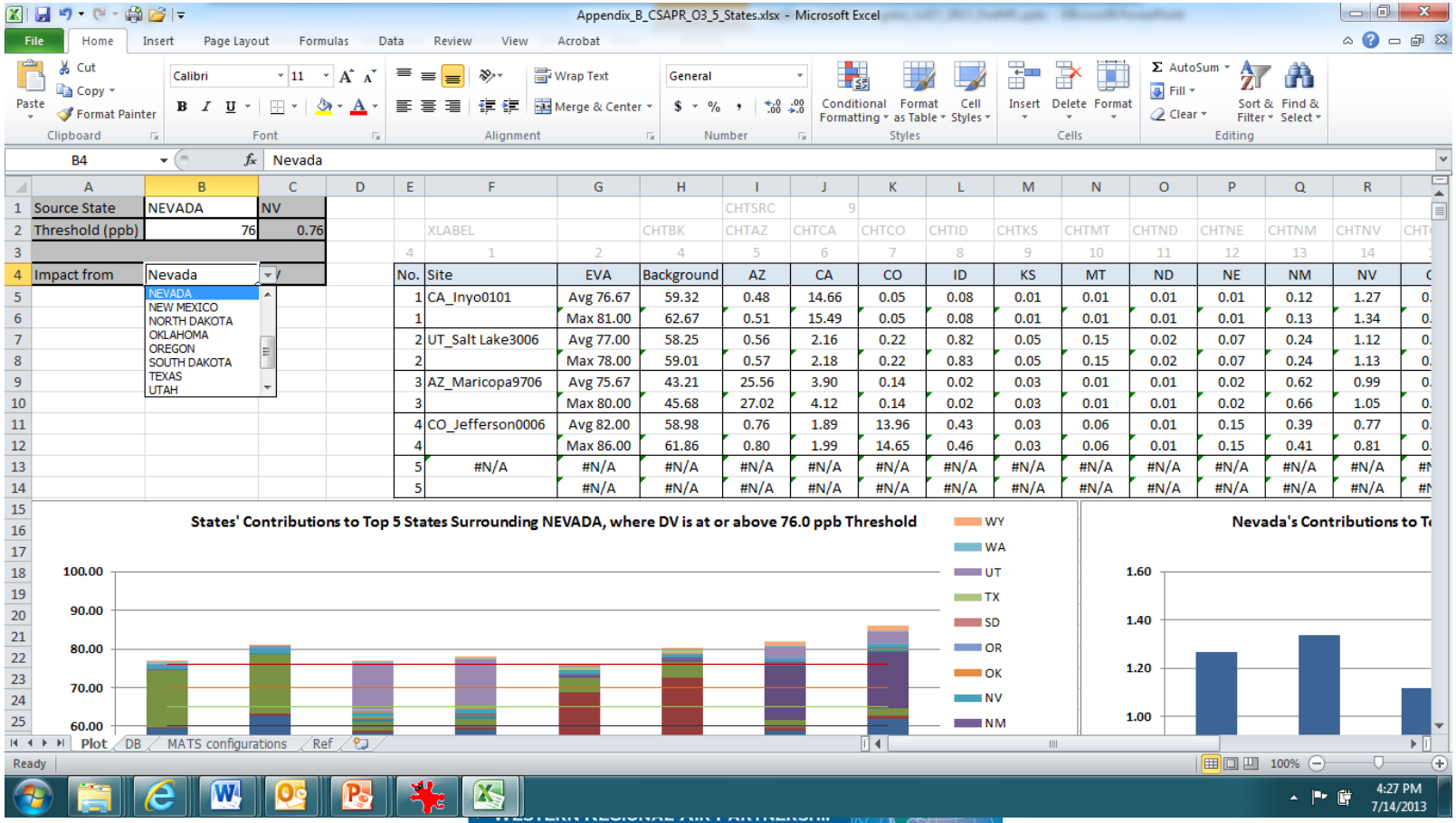
State	# Sites	Max O3 (ppb)
WY	5	1.53
ND	0	0.12
SD	0	0.13
NE	0	0.36
NV	20	1.28
UT	5	2.53
TX	6	10.17
NM	2	0.82

State-Specific CSAPR-Type Ozone Analysis

- Interactive Excel spread sheet to display upwind **"State"** contributions to DMAX8 ozone Design Values at maximum monitor in up to five downwind states (Appendix B in Final Report)
  - Can select an upwind **"State"** and level for the **"NAAQS"**
  - Spreadsheet will display AvgDV and MaxDV at maximum monitor in a downwind State and **"State"** contribution to the DV when:
    - MaxDV ≥ **"NAAQS"**
    - **"State"** contribution ≥ 0.01 x "NAAQS" (1% of the NAAQS)

State-Specific Ozone Contribution Spreadsheet

- Pivot Table controlled by Cells B1, B2 and B3
  - B1 = Upwind Source **"State"** for DVCs; B2 = **"NAAQS"**; B3 = Upwind Source **"State"** for DVC Contributions



Excel Spreadsheet Demonstration

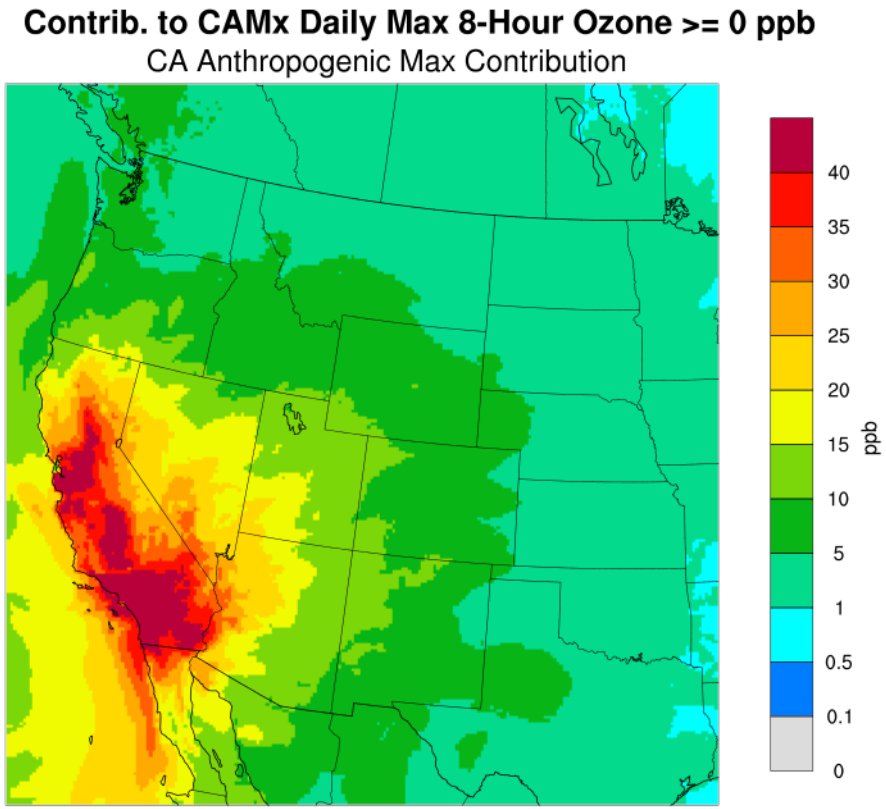
- Appendix B

State-Specific Ozone Foot Prints

- 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 DMAX8 ozone
  2. MATS UAA projection contribution to 8-hour ozone DVC
- Example results follow for 0 ppb threshold and three states: CA, CO and NM
  - All state results presented in June 20, 2013 conference call

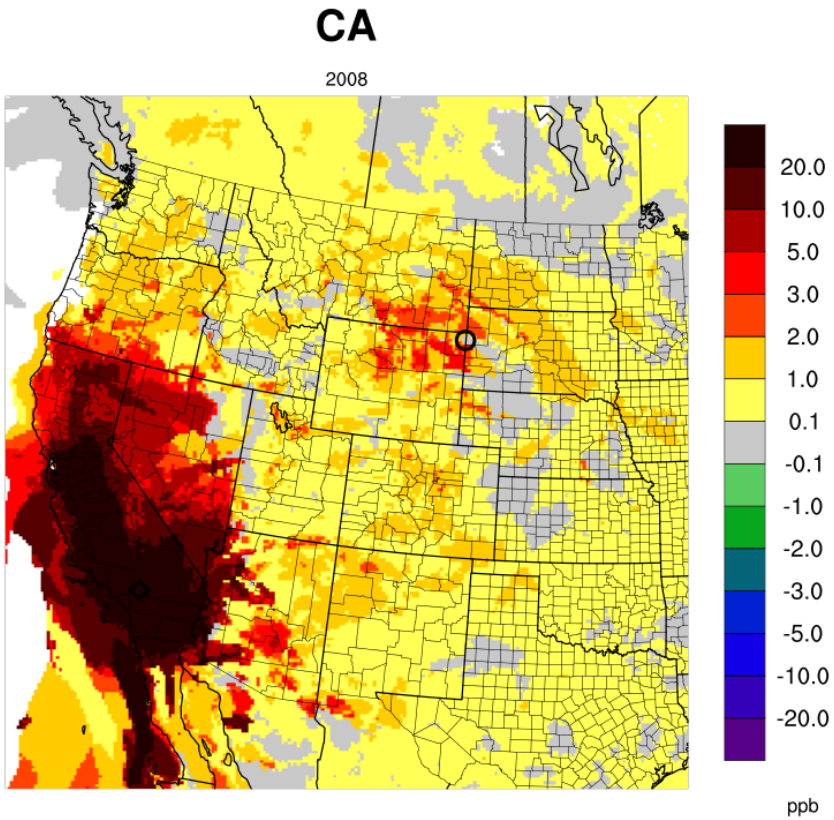
2008 California 8-Hour Ozone Contribution

Highest Modeled Contribution



Max(40,69) = 95.85

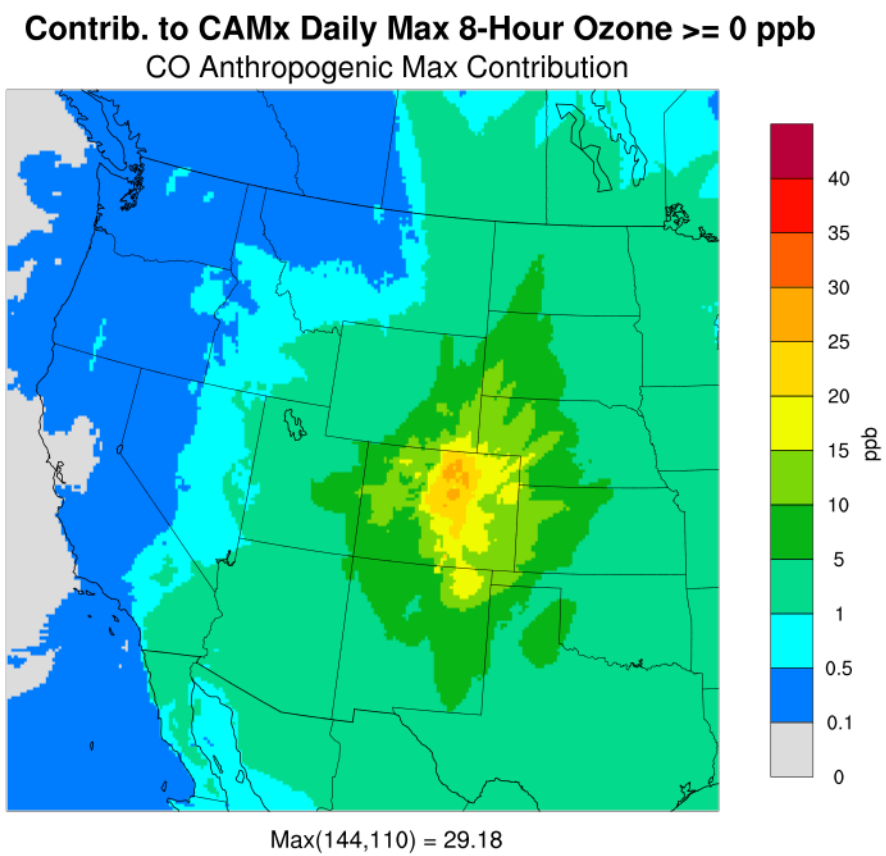
MATS DVC Contribution



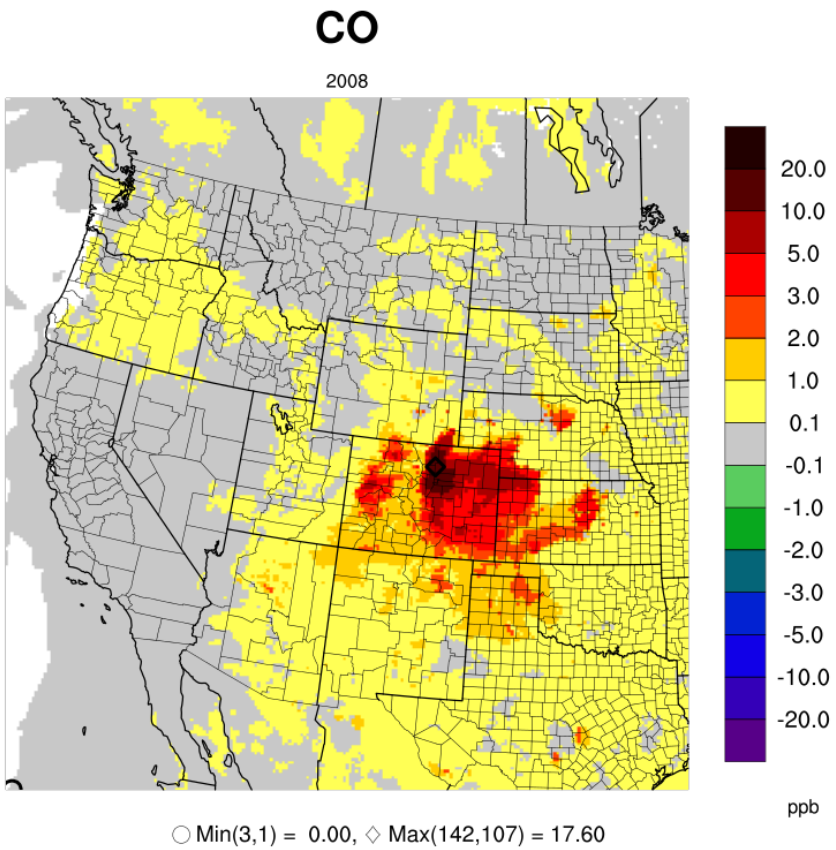
○ Min(152,148) = 0.00, ◇ Max(45,66) = 63.20

2008 Colorado 8-Hour Ozone Contribution

Highest Modeled Contribution

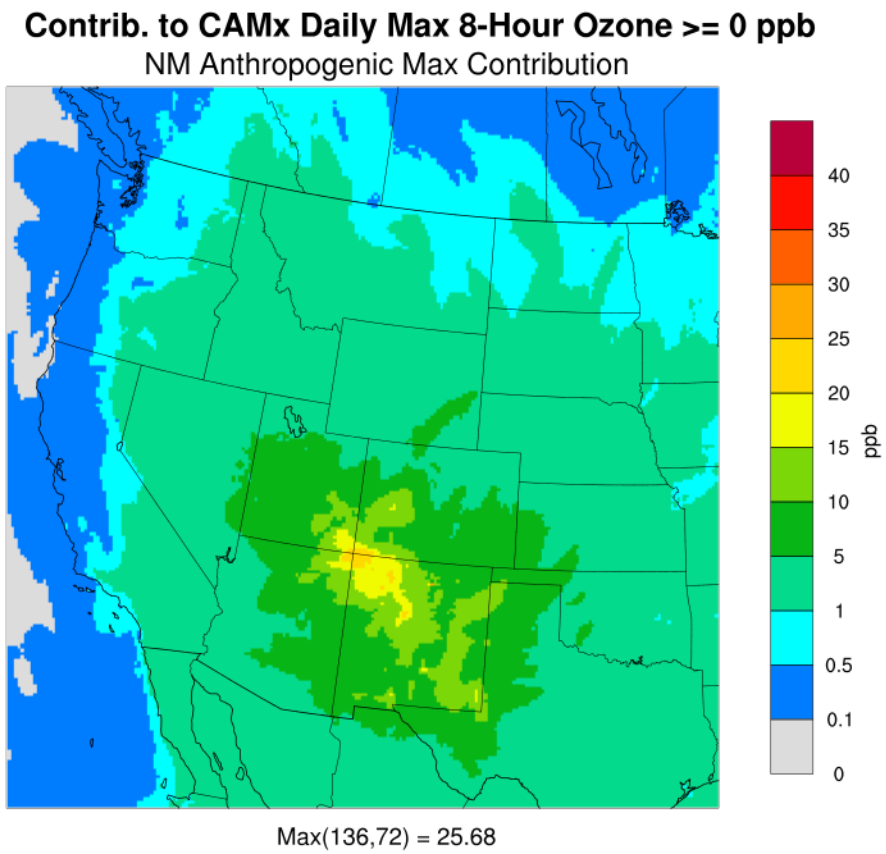


MATS DVC Contribution

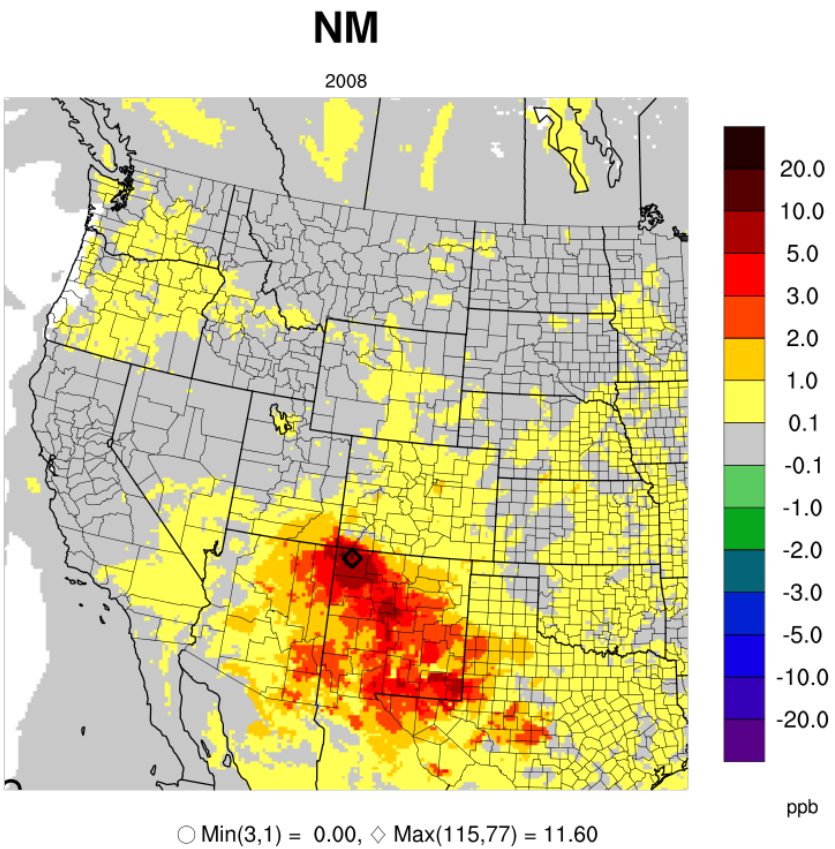


2008 New Mexico 8-Hour Ozone Contribution

Highest Modeled Contribution



MATS DVC Contribution



Maximum and Fourth Highest Contributions to DMAX8 Ozone by Major Source Category

- Boundary Conditions (BC) for CONUS Domain
  - Background, International Transport and Stratospheric Ozone
- Natural Emissions (Nat)
  - Biogenic, Lightning, Sea Salt and WBD
- Wild Fires (WF)
  - Special Case (Exceptional Events)
- Anthropogenic Emissions (Anth)
  - U.S., Can and Mexico Anthropogenic plus Rx and Ag Fires
- For total DMAX8 ozone ≥ 0, 60, 65, 70 and 76 ppb
- Examples follow:
  - 4th Highest DMAX8 Ozone Contribution to Total Ozone ≥ 0 and 76 ppb
  - 8th Highest 24-hr $PM_{2.5}$ to Total $PM_{2.5}$ ≥ 0 and 35 $\mu g/m^3$

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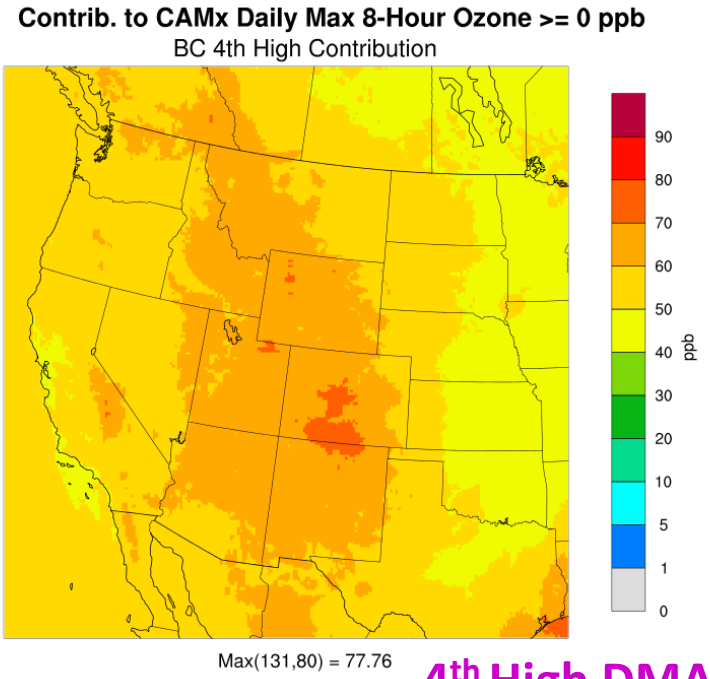
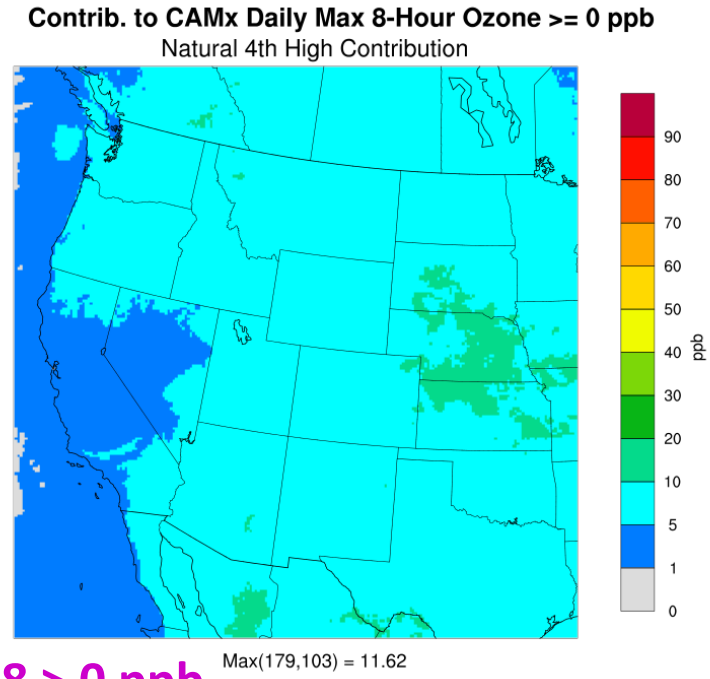
4th High DMAX8 > 0 ppb

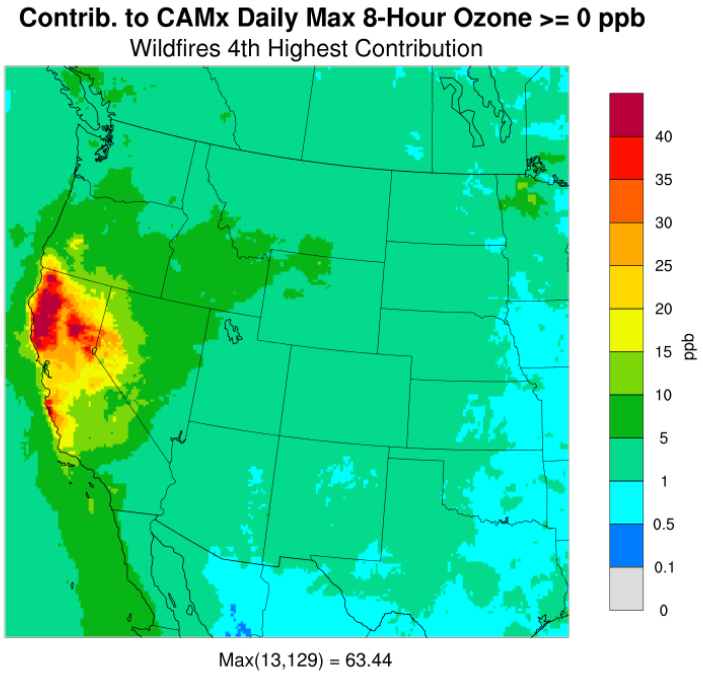
BC



Nat



WF



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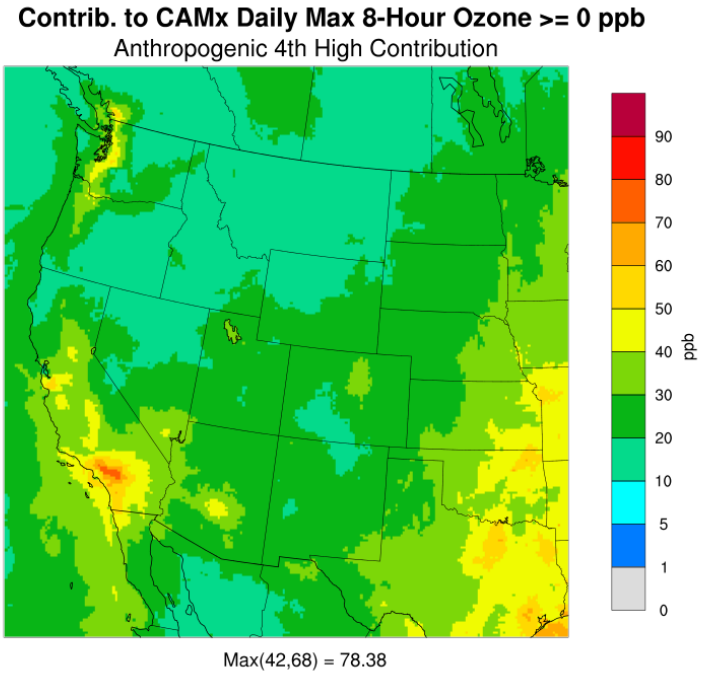
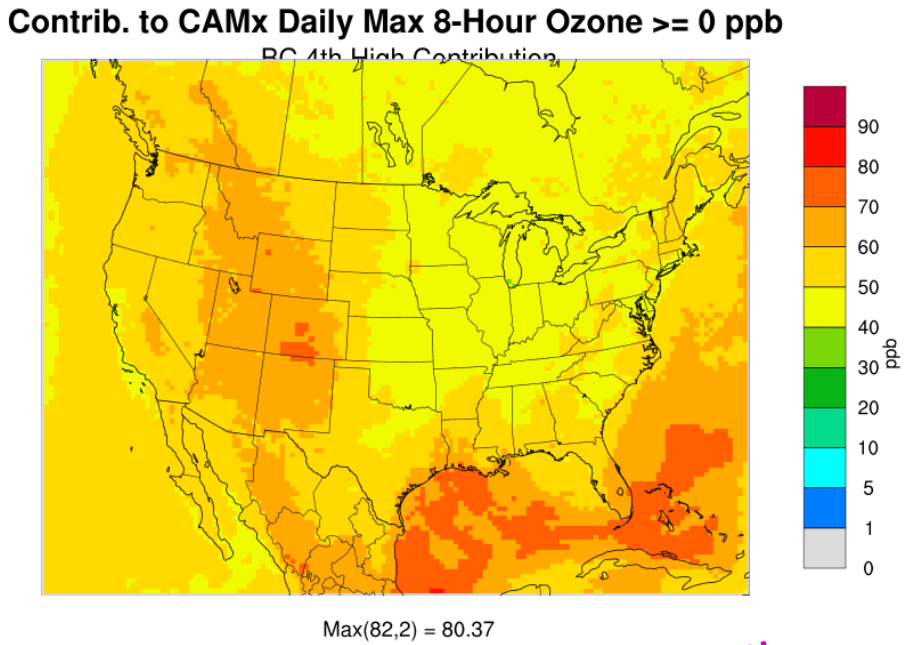
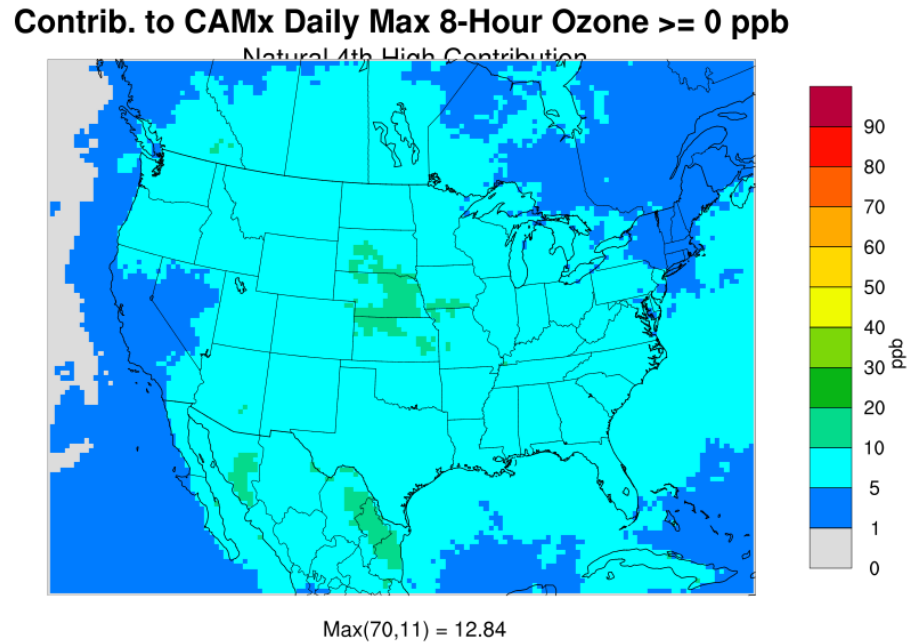
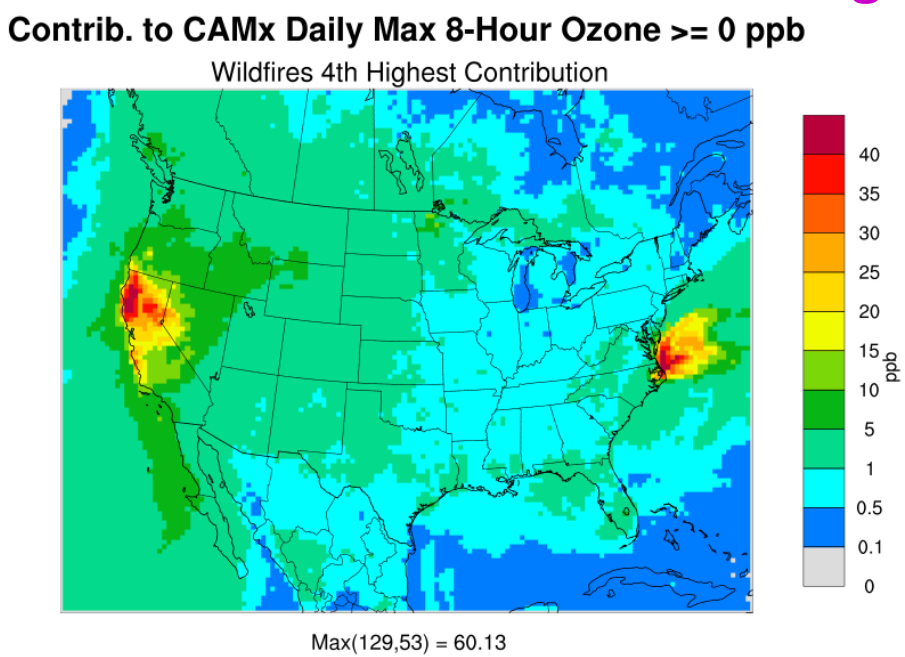
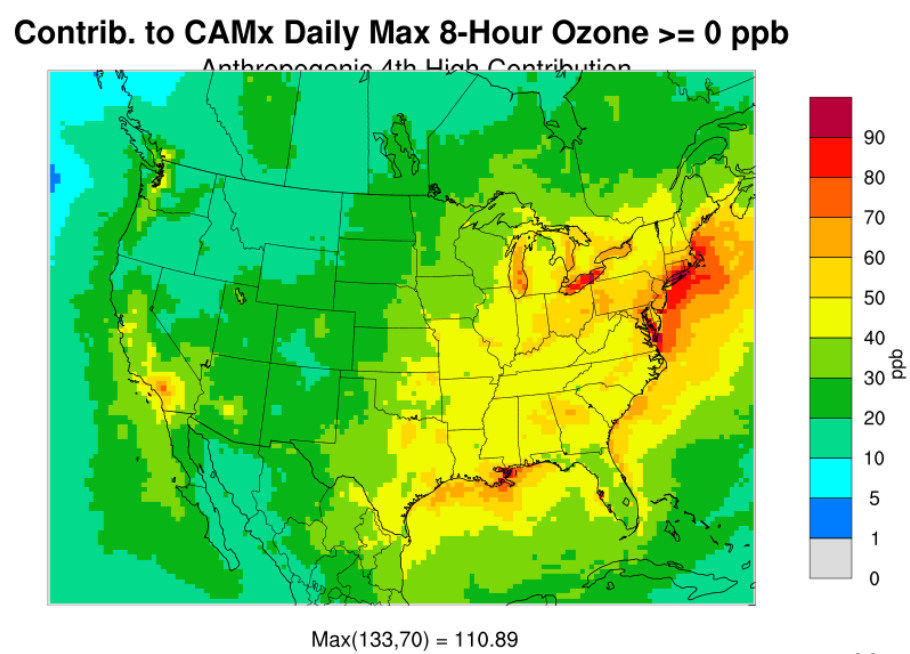


4th High DMAX8 > 0





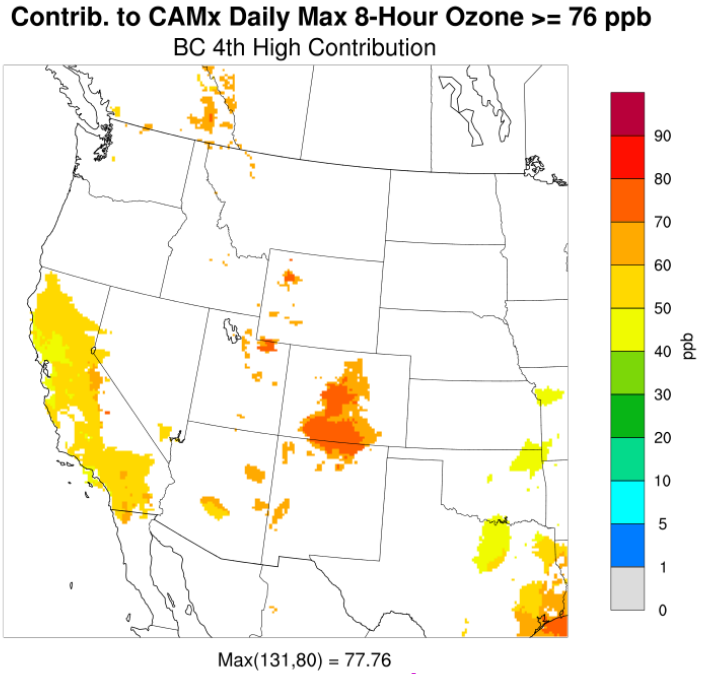




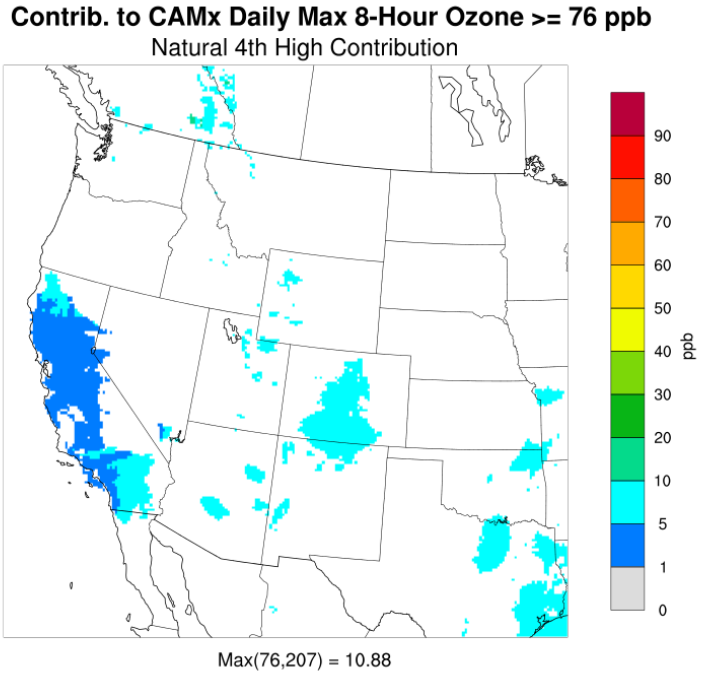
RON

4th Highest DMAX8 Ozone > 76 ppb

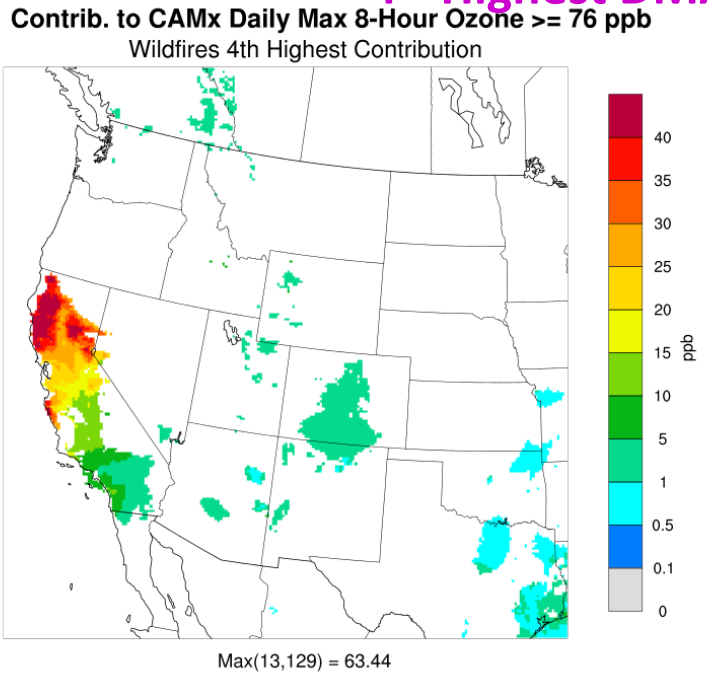
BC



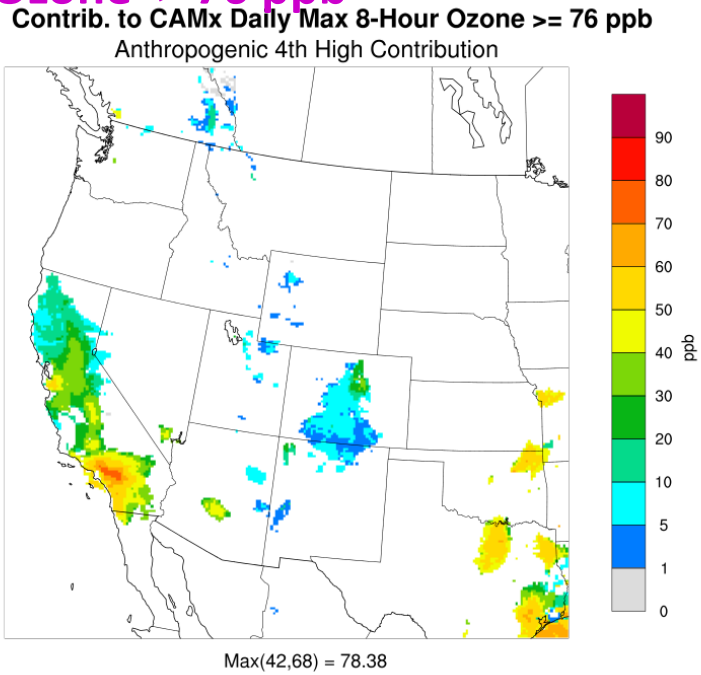
Nat



WF



Anth

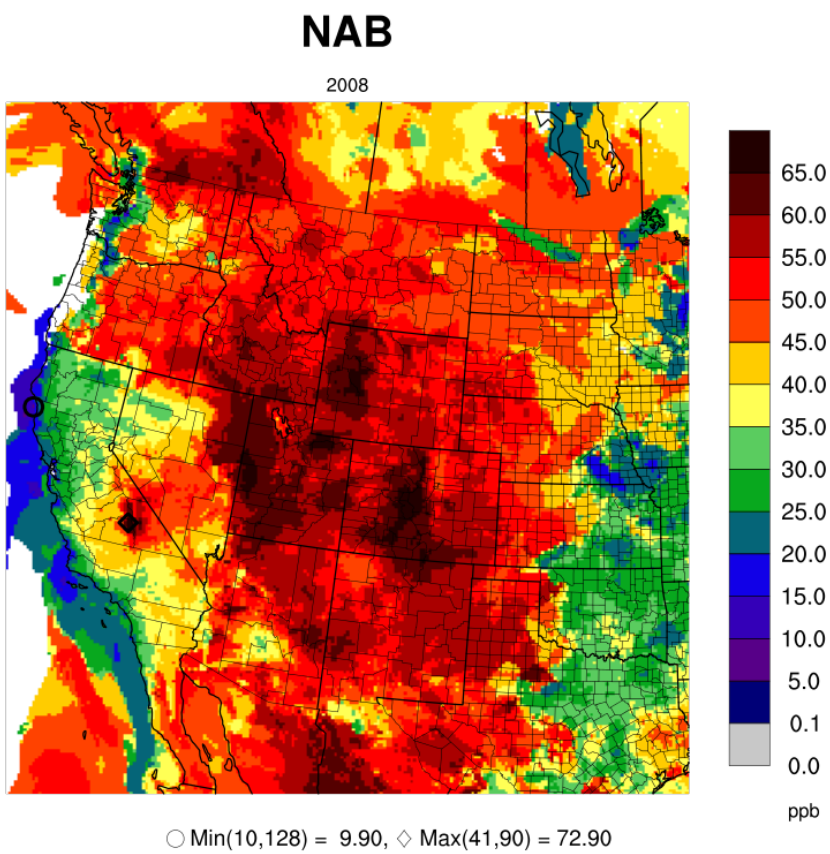


North American Background (NAB) Ozone

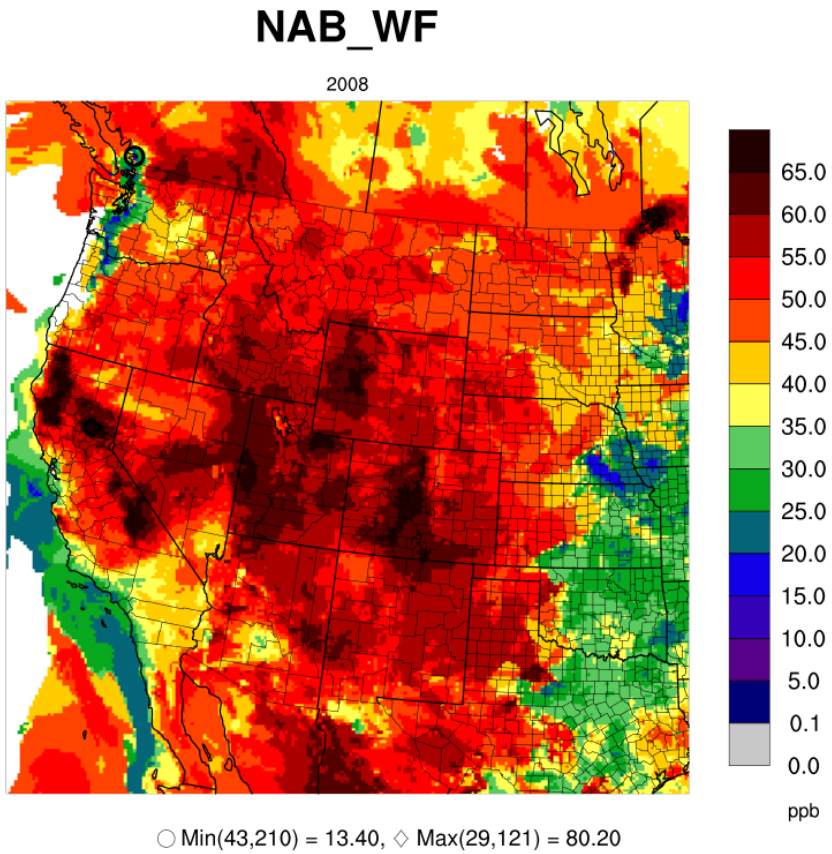
- Ozone concentrations in absence of North American anthropogenic emissions
  - Previously called Policy Relevant Background (PRB)
- Provides "floor" of achievable ozone concentrations in North America by elimination of controllable emissions
  - U.S., Mex and Can Anthropogenic plus Rx and Ag fires
- NAB defined two ways:
  - BCs plus Natural Emissions (Biogenic, Lightning, Sea Salt & WBD)
  - BCs plus Natural Emissions plus Wild Fires (WF)
    - Although some WF are natural, the Exceptional Event policy can eliminate them from ozone compliance considerations
- NAB Calculate using Modeled results and DVC projections by MATS
  - Projected DVs without anthropogenic emissions (w/ and w/0 WFs)
  - Highest and fourth highest DMAX8 ozone

NAB DMAX8 Ozone DVs using MATS (RRFs)

NAB w/o WF

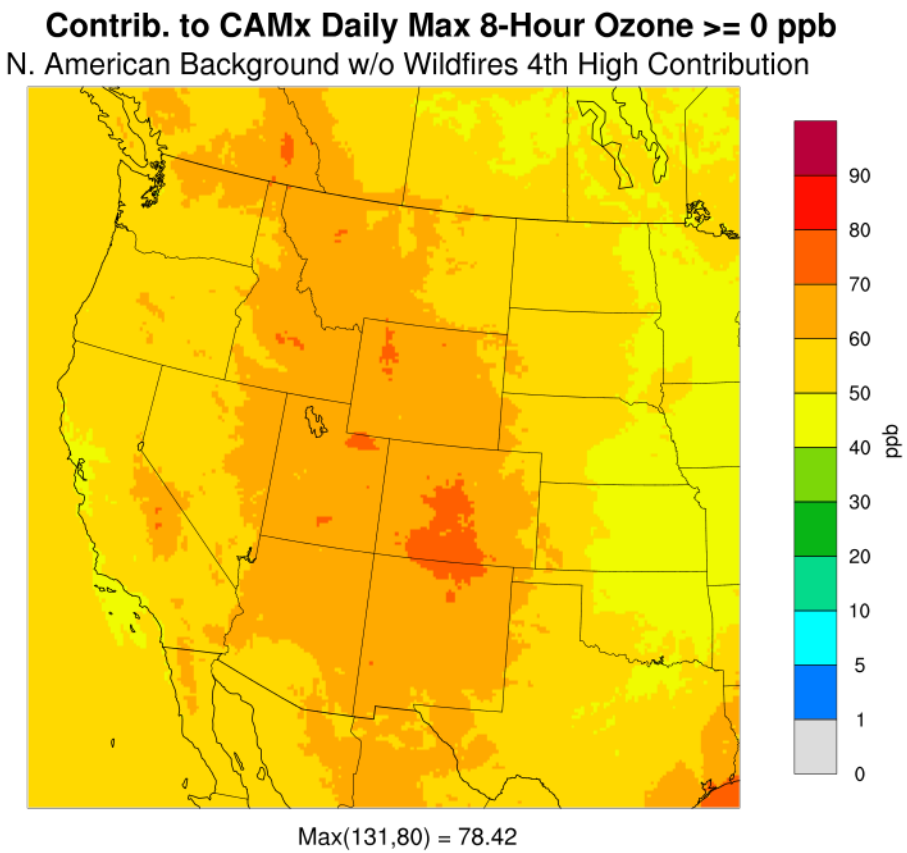


NAB w/ WF

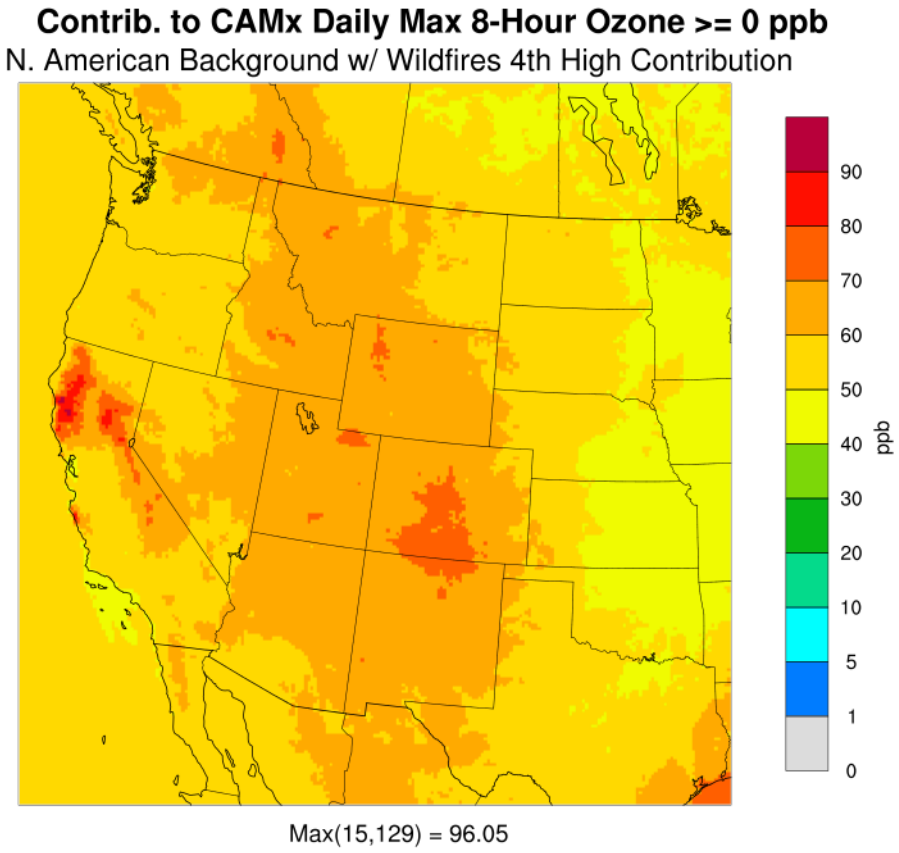


NAB 4th Highest DMAX8 Contribution (Absolute)

NAB w/o WF

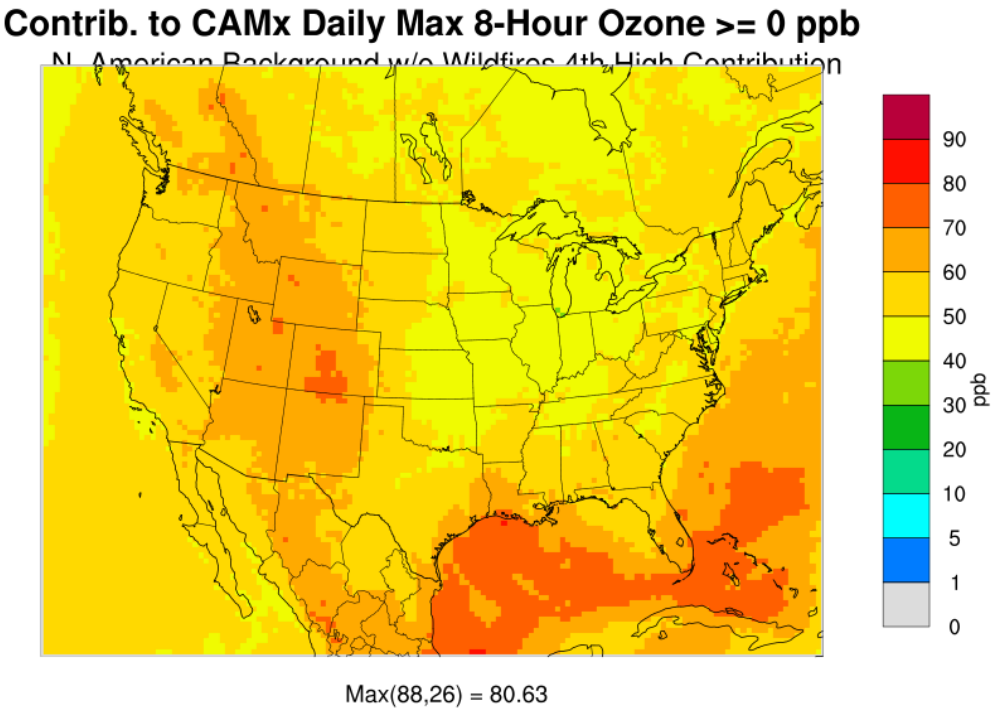


NAB w/ WF

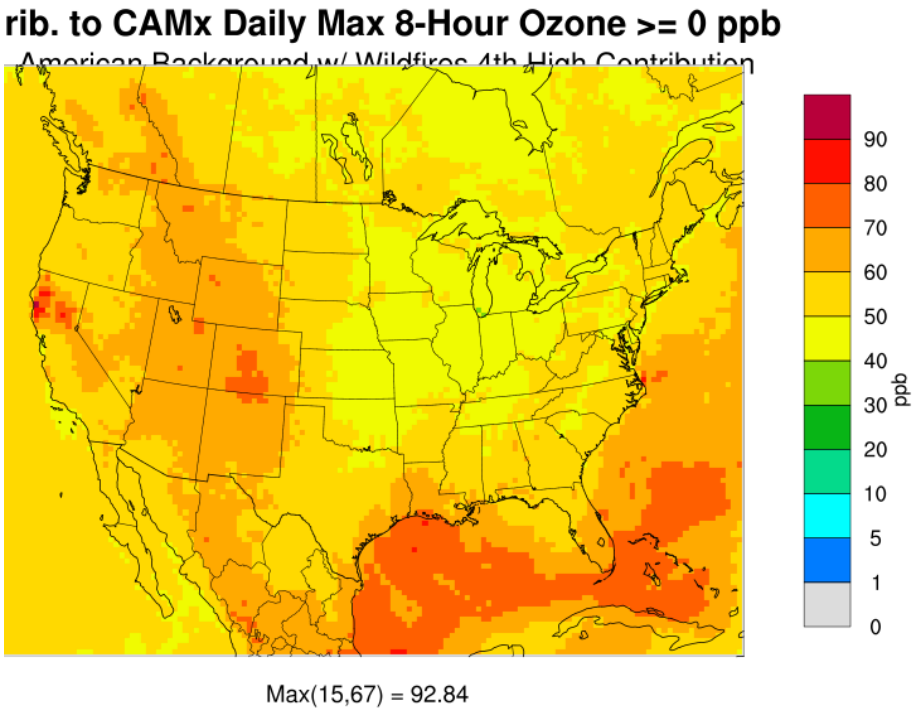


NAB 4th Highest DMAX8 Contribution (Absolute)

NAB w/o WF



NAB w/ WF

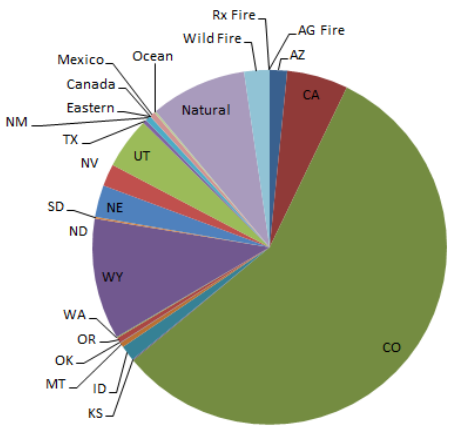


10 Highest Modeled DMAX8 Ozone Contributions at all Monitoring sites in WESTUS

- Pie and bar charts of state and other contributions at monitoring sites for 10 highest modeled DMAX8 ozone days
  - Highest modeled ozone days are used in Design Value projections
  - Show a examples for four highest days at Denver CO – RFNO monitor on next slide
  - Interactive Excel spreadsheet can be used by users to drill down into all monitoring sites

Denver Rocky Flats North (RFNO)

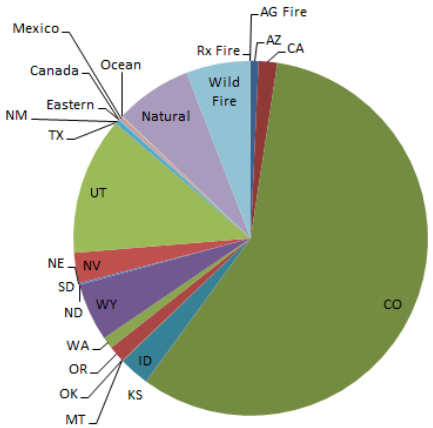
Contributions to MDA8 Ozone [ppb]



Site: CO_Jefferson0006
Rank: 1 - 08 Jul, 2008
Total Ozone = 80.6 ppb
BC Ozone = 52.0 ppb (64.5%)

AZ	AZ (0.45 ppb, 0.56%)
CA	CA (1.60 ppb, 1.98%)
CO	CO (16.27 ppb, 20.19%)
KS	KS (0.03 ppb, 0.03%)
ID	ID (0.40 ppb, 0.50%)
MT	MT (0.12 ppb, 0.15%)
OK	OK (0.01 ppb, 0.01%)
OR	OR (0.14 ppb, 0.17%)
WA	WA (0.03 ppb, 0.03%)
WY	WY (3.16 ppb, 3.92%)
ND	ND (0.00 ppb, 0.00%)
SD	NE (0.83 ppb, 1.03%)
NE	NV (0.58 ppb, 0.72%)
NV	UT (1.34 ppb, 1.67%)
UT	TX (0.10 ppb, 0.12%)
TX	NM (0.14 ppb, 0.18%)
NM	Eastern (0.00 ppb, 0.00%)
Eastern	Canada (0.00 ppb, 0.00%)
Canada	Mexico (0.14 ppb, 0.17%)
Mexico	Ocean (0.05 ppb, 0.06%)
Ocean	Natural (2.51 ppb, 3.12%)
Natural	Wild Fire (0.66 ppb, 0.8
Wild Fire	Rx Fire (0.00 ppb, 0.00%)
Rx Fire	AG Fire (0.00 ppb, 0.00%)
AG Fire	

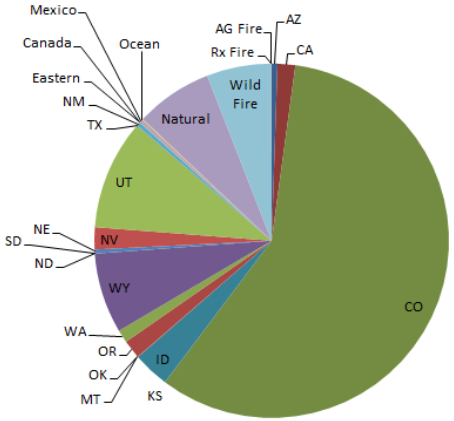
Contributions to MDA8 Ozone [ppb]



Site: CO_Jefferson0006
Rank: 2 - 15 Jul, 2008
Total Ozone = 80.1 ppb
BC Ozone = 40.7 ppb (50.8%)

AZ	AZ (0.28 ppb, 0.35%)
CA	CA (0.67 ppb, 0.84%)
CO	CO (22.69 ppb, 28.34%)
KS	KS (0.01 ppb, 0.01%)
ID	ID (1.10 ppb, 1.37%)
MT	MT (0.02 ppb, 0.02%)
OK	OK (0.00 ppb, 0.00%)
OR	OR (0.60 ppb, 0.75%)
WA	WA (0.42 ppb, 0.53%)
WY	WY (2.08 ppb, 2.60%)
ND	ND (0.00 ppb, 0.00%)
SD	NE (0.06 ppb, 0.08%)
NE	NV (1.08 ppb, 1.35%)
NV	UT (4.93 ppb, 6.15%)
UT	TX (0.02 ppb, 0.02%)
TX	NM (0.15 ppb, 0.19%)
NM	Eastern (0.00 ppb, 0.00%)
Eastern	Canada (0.05 ppb, 0.07%)
Canada	Mexico (0.10 ppb, 0.12%)
Mexico	Ocean (0.04 ppb, 0.05%)
Ocean	Natural (2.76 ppb, 3.45%)
Natural	Wild Fire (2.31 ppb, 2.8
Wild Fire	Rx Fire (0.00 ppb, 0.00%)
Rx Fire	AG Fire (0.00 ppb, 0.00%)
AG Fire	

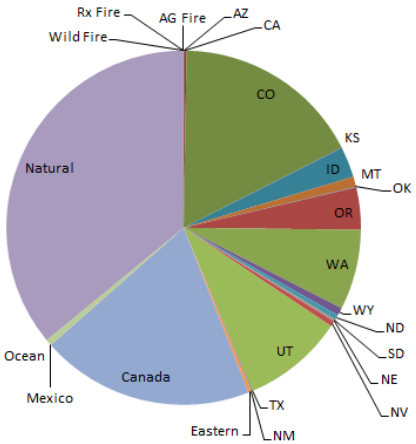
Contributions to MDA8 Ozone [ppb]



Site: CO_Jefferson0006
Rank: 3 - 16 Jul, 2008
Total Ozone = 79.9 ppb
BC Ozone = 42.1 ppb (52.7%)

AZ	AZ (0.20 ppb, 0.25%)
CA	CA (0.61 ppb, 0.76%)
CO	CO (21.94 ppb, 27.47%)
KS	KS (0.00 ppb, 0.00%)
ID	ID (1.25 ppb, 1.57%)
MT	MT (0.01 ppb, 0.02%)
OK	OK (0.00 ppb, 0.00%)
OR	OR (0.64 ppb, 0.81%)
WA	WA (0.44 ppb, 0.55%)
WY	WY (2.76 ppb, 3.46%)
ND	ND (0.00 ppb, 0.00%)
SD	NE (0.14 ppb, 0.17%)
NE	NV (0.76 ppb, 0.95%)
NV	UT (3.79 ppb, 4.75%)
UT	TX (0.02 ppb, 0.02%)
TX	NM (0.11 ppb, 0.14%)
NM	Eastern (0.00 ppb, 0.00%)
Eastern	Canada (0.06 ppb, 0.07%)
Canada	Mexico (0.08 ppb, 0.10%)
Mexico	Ocean (0.03 ppb, 0.04%)
Ocean	Natural (2.65 ppb, 3.32%)
Natural	Wild Fire (2.23 ppb, 2.7
Wild Fire	Rx Fire (0.00 ppb, 0.00%)
Rx Fire	AG Fire (0.00 ppb, 0.00%)
AG Fire	

Contributions to MDA8 Ozone [ppb]

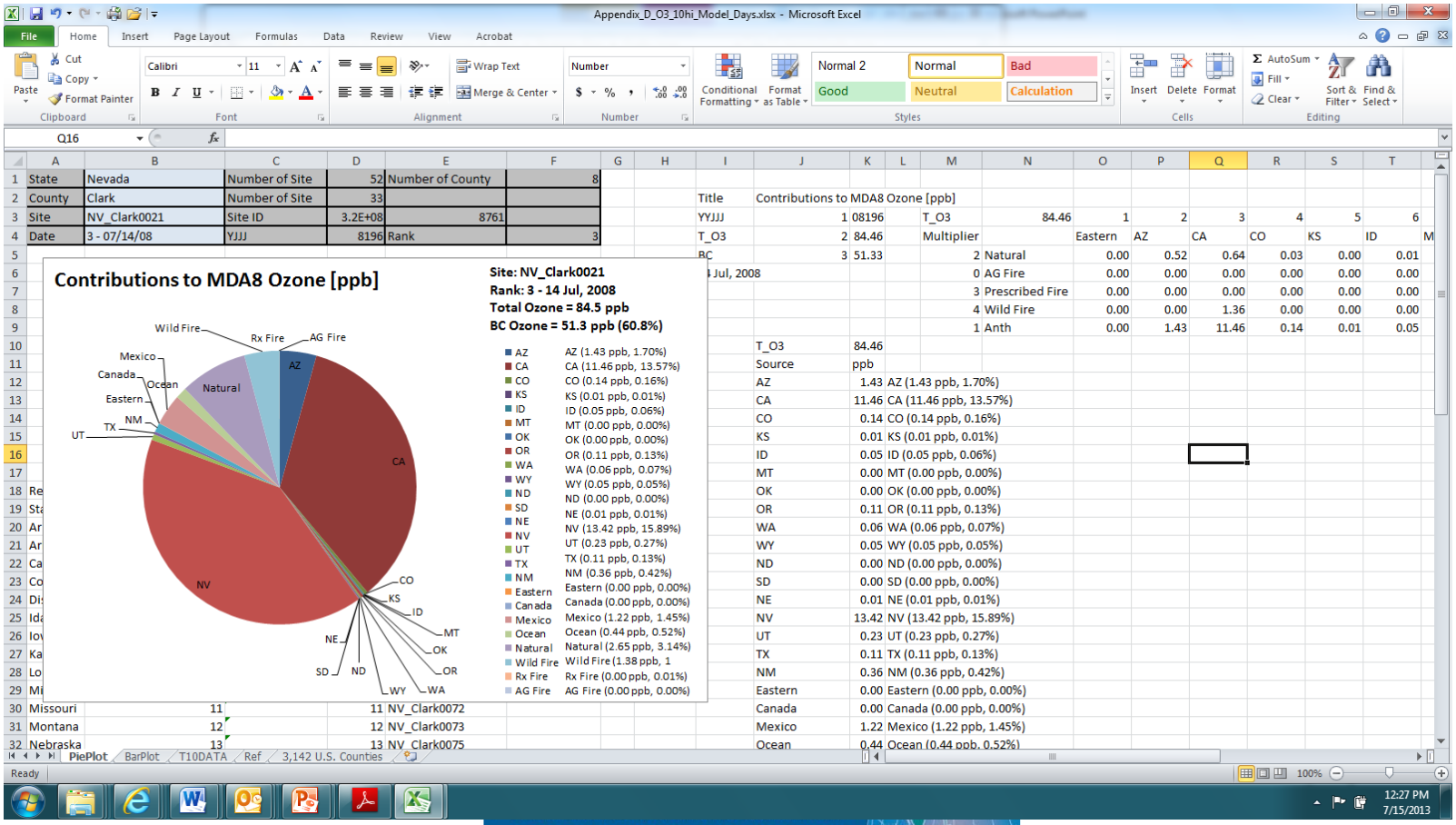


Site: CO_Jefferson0006
Rank: 4 - 13 Jun, 2008
Total Ozone = 79.7 ppb
BC Ozone = 64.5 ppb (80.9%)

AZ	AZ (0.01 ppb, 0.01%)
CA	CA (0.04 ppb, 0.05%)
CO	CO (2.62 ppb, 3.29%)
KS	KS (0.01 ppb, 0.01%)
ID	ID (0.42 ppb, 0.53%)
MT	MT (0.14 ppb, 0.18%)
OK	OK (0.01 ppb, 0.01%)
OR	OR (0.58 ppb, 0.73%)
WA	WA (1.11 ppb, 1.39%)
WY	WY (0.11 ppb, 0.14%)
ND	ND (0.07 ppb, 0.09%)
SD	NE (0.01 ppb, 0.02%)
NE	NV (0.07 ppb, 0.09%)
NV	UT (1.41 ppb, 1.77%)
UT	TX (0.01 ppb, 0.02%)
TX	NM (0.00 ppb, 0.00%)
NM	Eastern (0.04 ppb, 0.05%)
Eastern	Canada (2.95 ppb, 3.70%)
Canada	Mexico (0.00 ppb, 0.00%)
Mexico	Ocean (0.09 ppb, 0.11%)
Ocean	Natural (5.46 ppb, 6.85%)
Natural	Wild Fire (0.00 ppb, 0.0
Wild Fire	Rx Fire (0.00 ppb, 0.00%)
Rx Fire	AG Fire (0.00 ppb, 0.00%)
AG Fire	

Excel Spreadsheet with 10 Highest Modeled Ozone Days at Each Monitoring Site in WESTUS

- B1 = State; B2 = County; B3 = Monitor; B4 = Select on of top ten modeled ozone days at this monitoring site



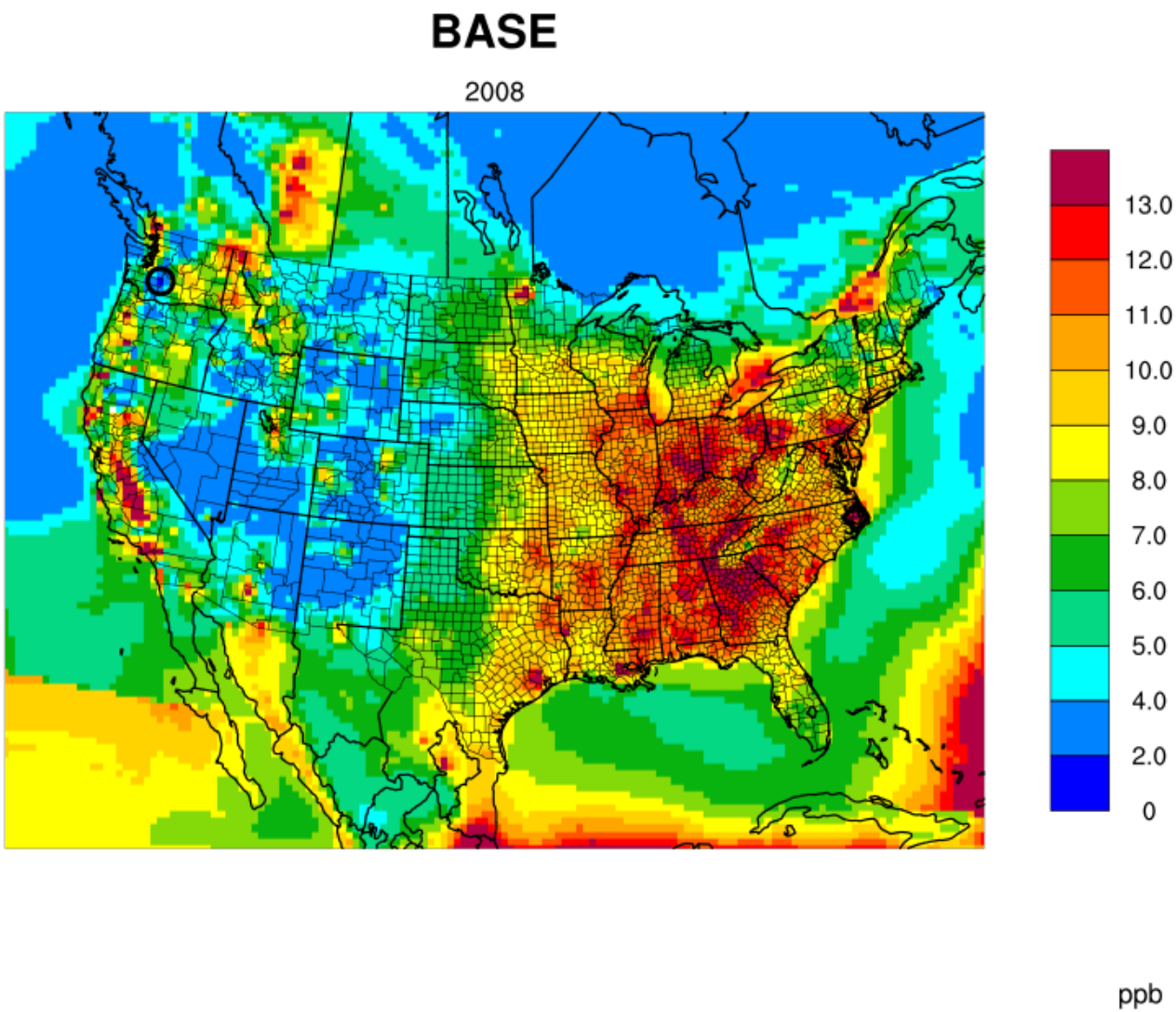
10 High Spread Sheet Demonstration

- Appendix D

CSAPR-Type State Analysis for $PM_{2.5}$

- CAMx 2008 base case 36 km state-specific PSAT source apportionment run
  - Same source regions and category as used for ozone
- State-specific Anthropogenic and Rx + Ag fires emissions tracked for:
  - SO4, NO3, NH4, PEC, POC and OPM2.5
    - Note that NH4 is traced back to state NH3 emissions not associated with state SO2 and NOx emissions through SO4 and NO3
  - State-specific SOA contributions not tracked
- 24-Hour $PM_{2.5}$ NAAQS = 35 $\mu g/m^3$
- Annual $PM_{2.5}$ NAAQS = 12 ug/m_3

2006-2010 MATS UAA Annual $PM_{2.5}$ DVCs



2008 States with Maximum Annual $PM_{2.5}$ DV Cont. ≥ 1% of NAAQS when DVC ≥ NAAQS

State	Cont.	Site (State/County)	DVC
CA	0.24	AZ Santa Cruz	12.88
ID	2.56	MT Lincoln	12.52
KS	0.18	IA Muscatine	12.98
NE	0.15	IA Muscatine	12.98
NM	0.12	AZ Santa Cruz	12.88
ND	0.15	IA Muscatine	12.98
OK	0.19	AR Pulaski	12.21
OR	0.38	MT Lincoln	12.52
TX	0.52	AR Pulaski	12.21
WA	1.65	MT Lincoln	12.52

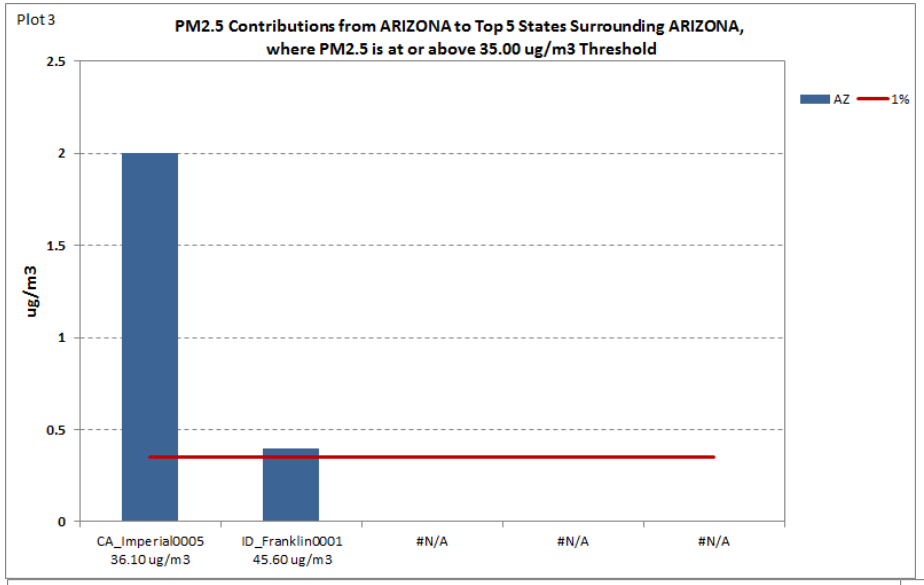
- 295 $PM_{2.5}$ FRM monitoring sites in western U.S. 12 km domain (west of ~Mississippi) with sufficient observations to calculate 2006-2010 annual $PM_{2.5}$ DVCs
  - 40 had DVCs above the 12 μg/m^3 NAAQS (Dec 2012)
    - Mainly CA but also AZ, IA, MO, MT and TX
  - 16 had DVCs above the 15 μg/m^3 old NAAQS
    - All in CA

2008 States with Maximum 24-Hour $PM_{2.5}$ DV Contribution ≥ 1% of NAAQS when DVC ≥ NAAQS

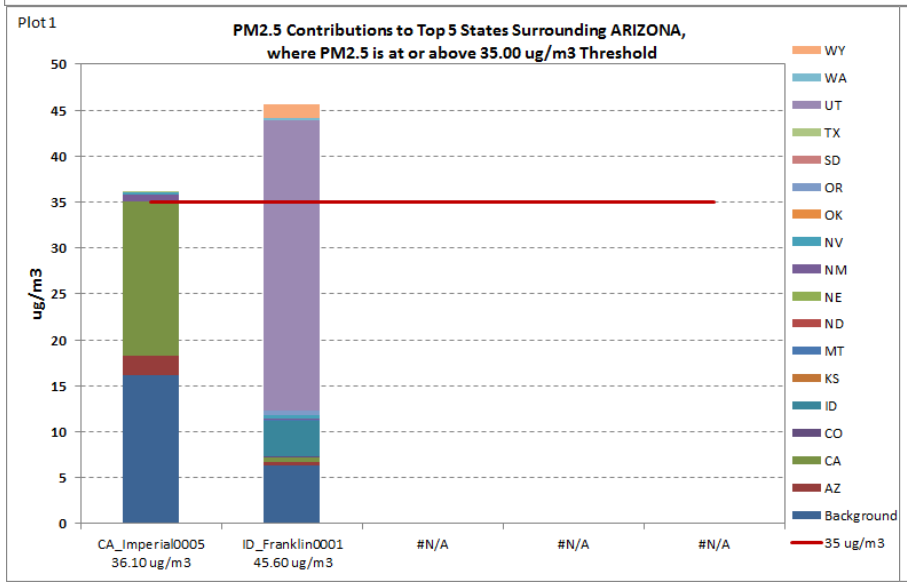
State	Contribution	Site (State/County)	DVC
AZ	2.0	CA Imperial	36.1
CA	3.0	OR Klamath	46.0
ID	3.8	UT Cache	39.5
KS	1.2	IA Muscatine	36.4
NE	0.8	IA Muscatine	36.4
NV	0.6	UT Utah	44.8
NM	0.7	CA Imperial	36.1
OK	0.4	IA Muscatine	36.4
OR	2.3	WA Yakima	37.2
TX	0.4	IA Muscatine	36.1
UT	31.6	ID Franklin	45.6
WY	1.5	ID Franklin	45.6

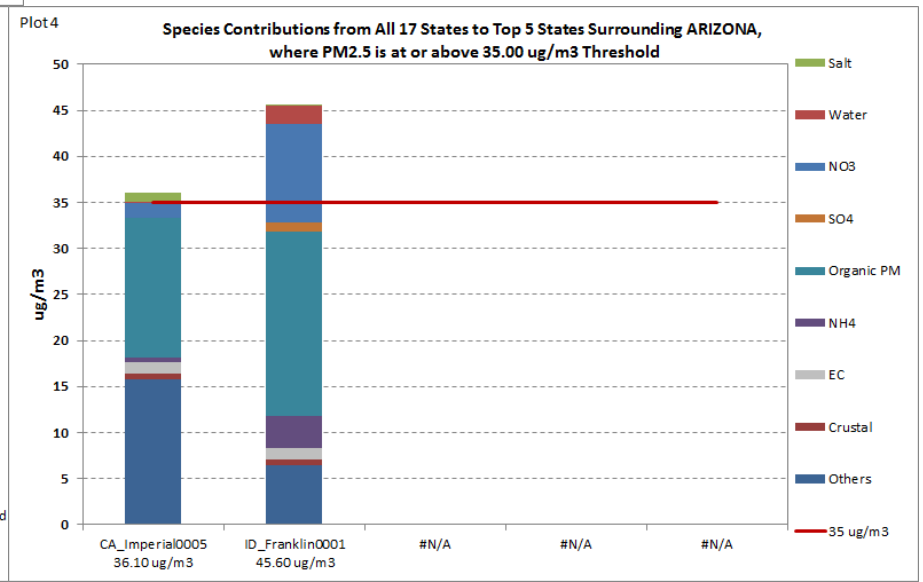
- 300 FRM sites in western U.S. with 24-hour PM2.5 DVCs
  - 53 have 2008 DVCs above the NAAQS
  - Many in CA but also IA, ID, OR, UT and WA

2008 Arizona 24-Hour $PM_{2.5}$ Contributions

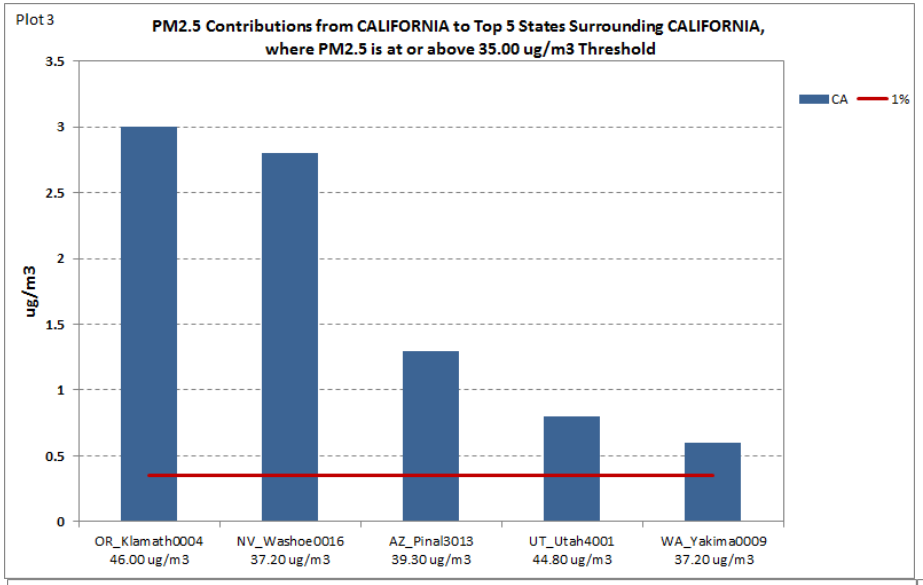


- AZ has 2.0 and 0.4 µg/m^3 contributions to DVCs above the NAAQS in CA and ID

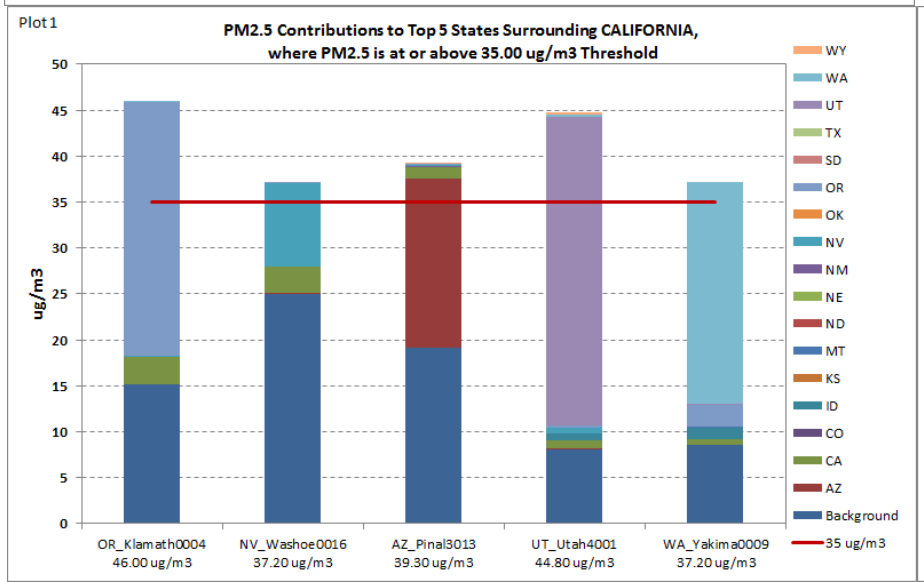


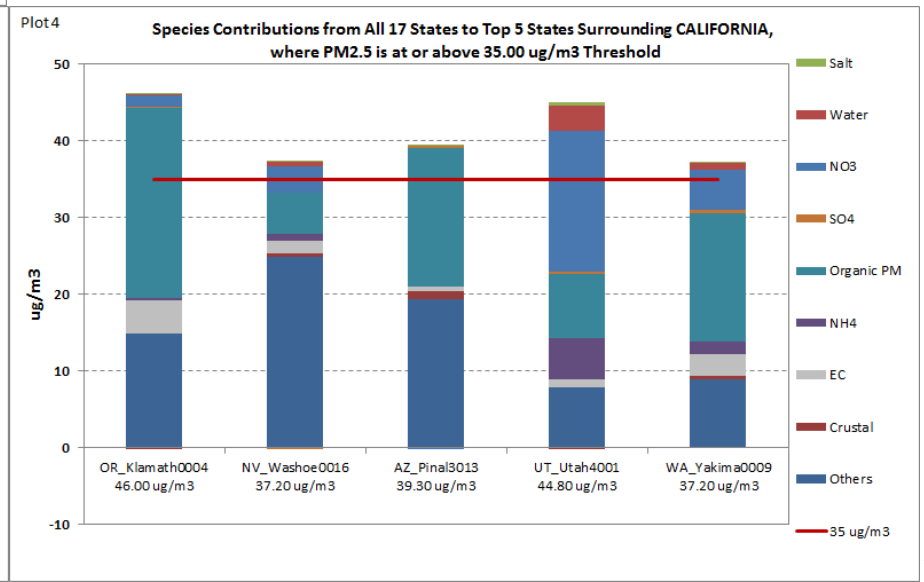


2008 California 24-Hour $PM_{2.5}$ Contributions

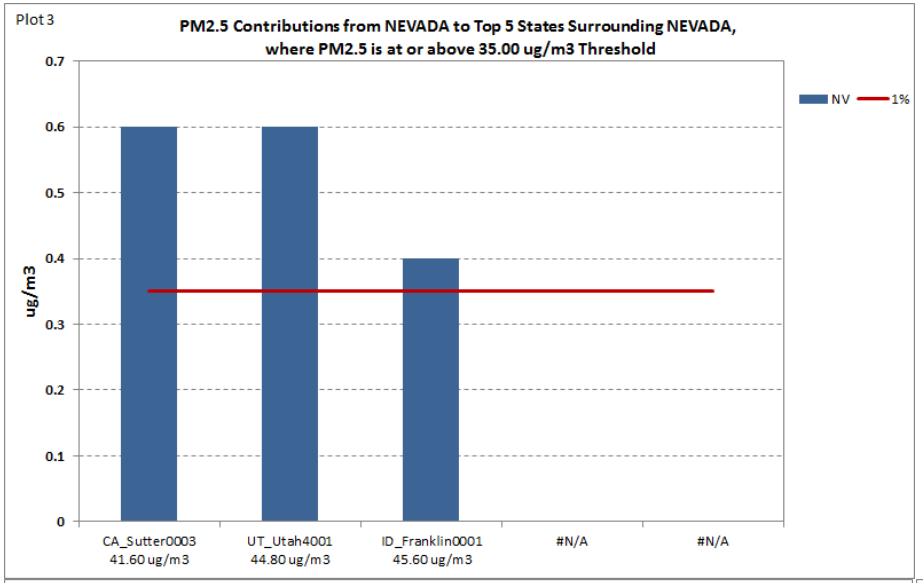


- CA has 3.0, 2.8, 1.3, 0.8 and 0.6 µg/m^3 contribution to DVCs above the NAAQS in OR, NV, AZ, UT and WA

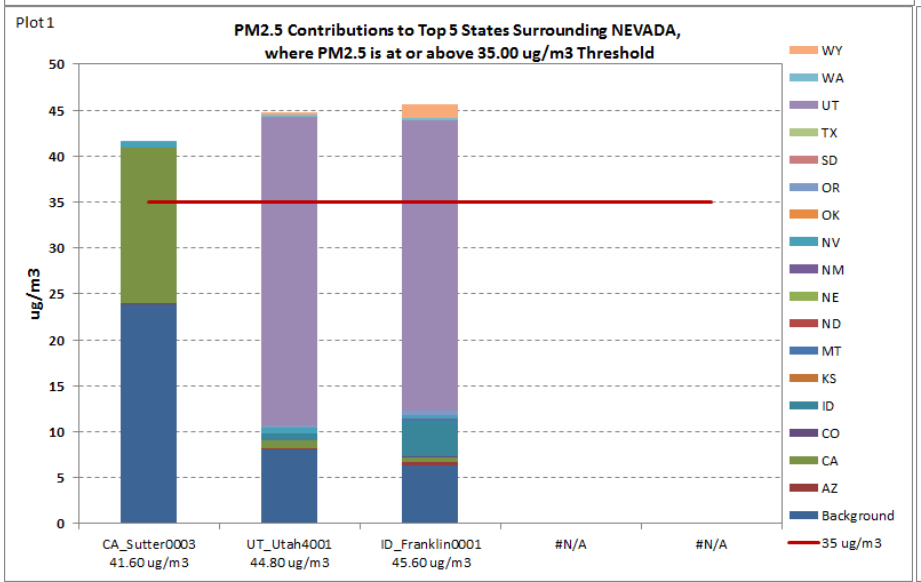


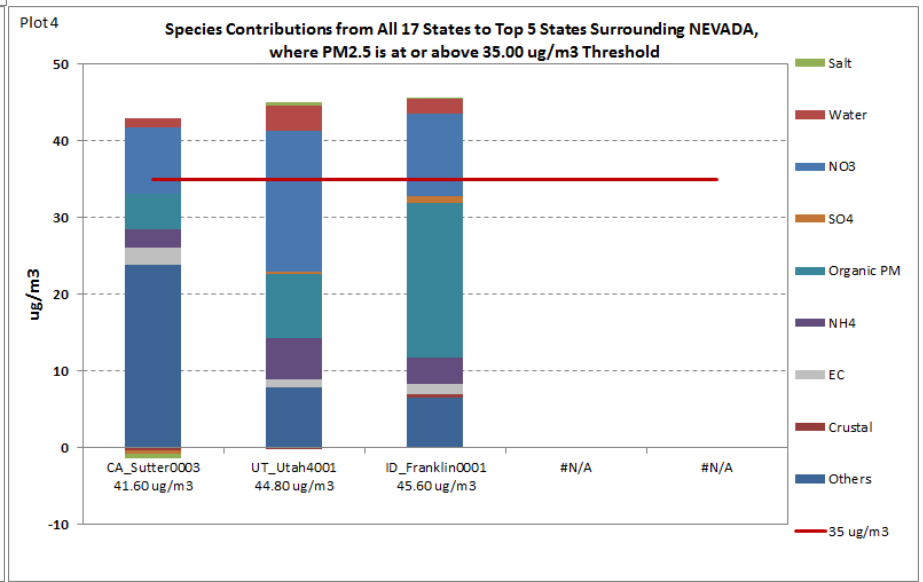


2008 Nevada 24-Hour $PM_{2.5}$ Contributions



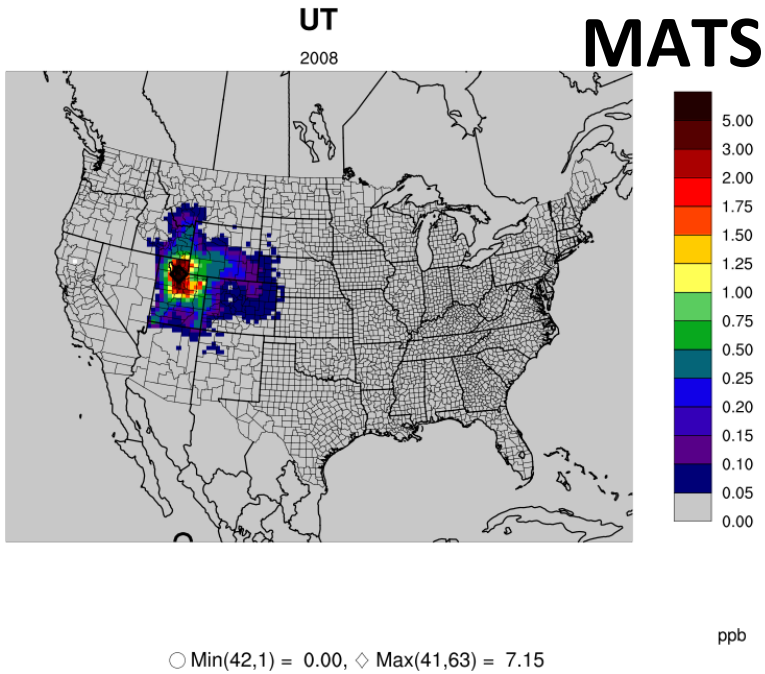
- NV has 0.6, 0.6 and 0.4 µg/m^3 contribution to DVCs above the NAAQS in CA, UT and ID

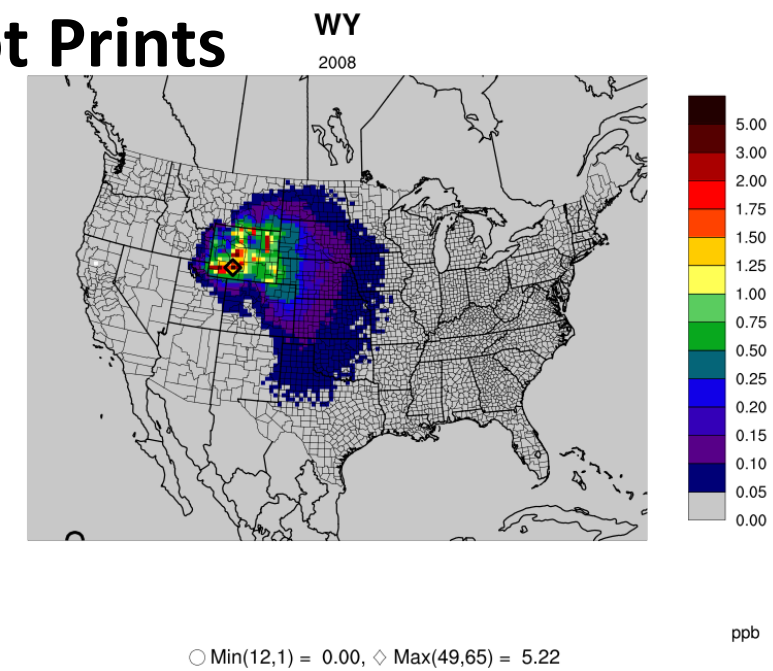


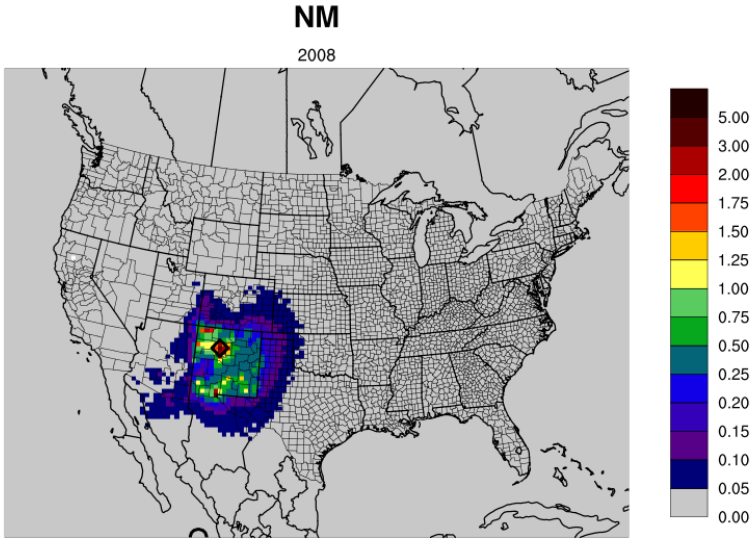


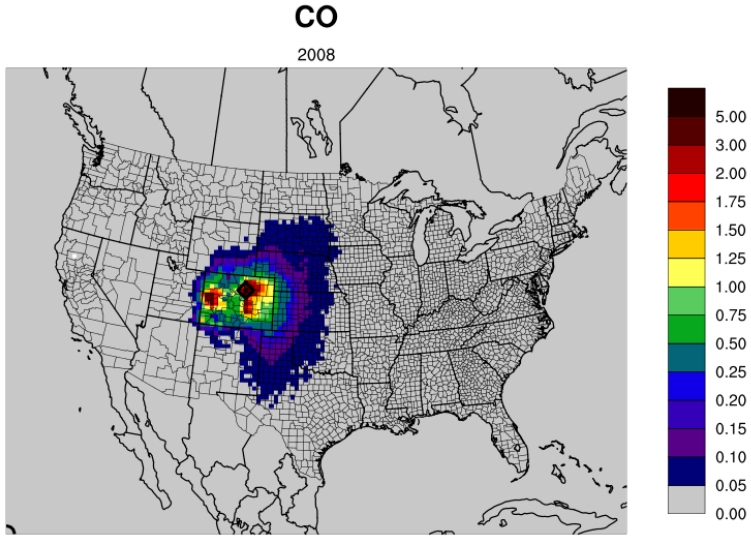
Example Annual $PM_{2.5}$ MATS State Foot Prints

ENVIRON







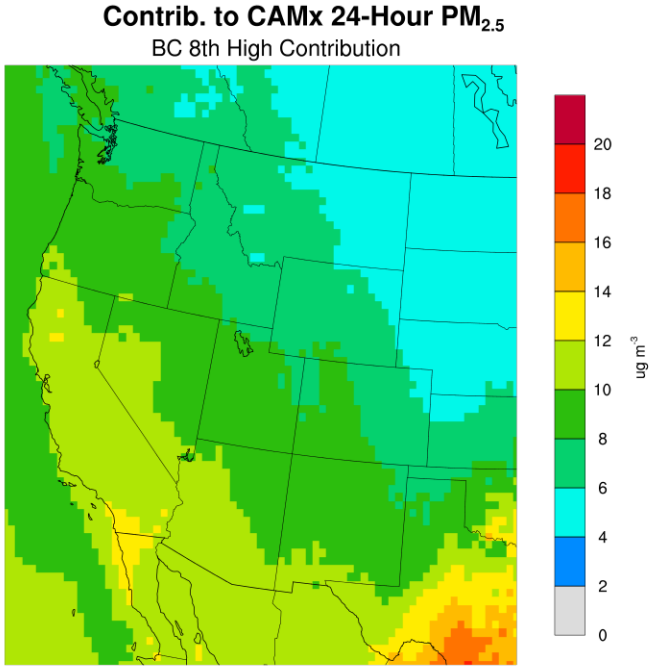


REGIONAL AIR PARTNERSH

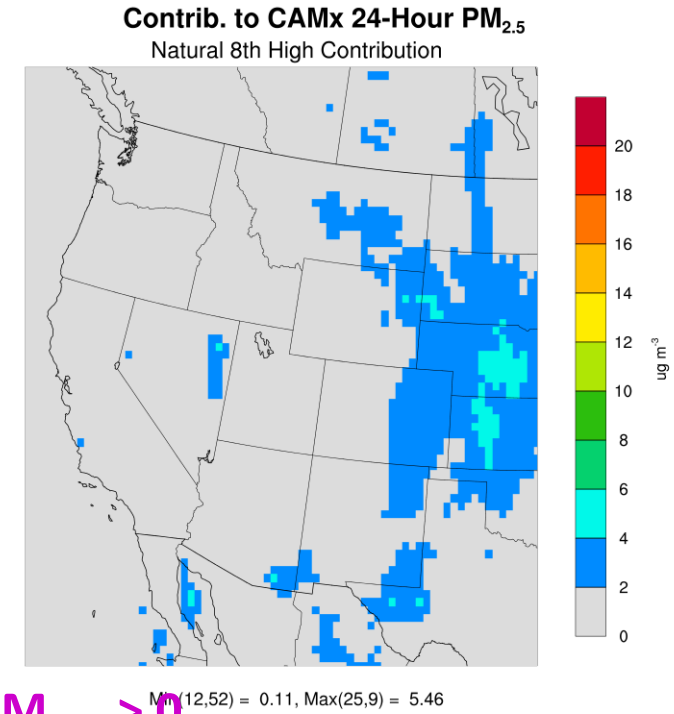
IRON

8th Hi 24-Hour $PM_{2.5}$ > 0

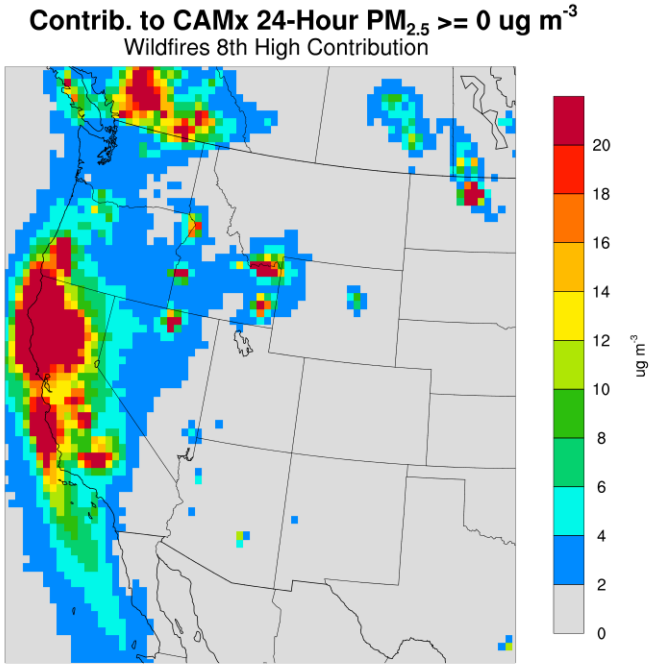
BC



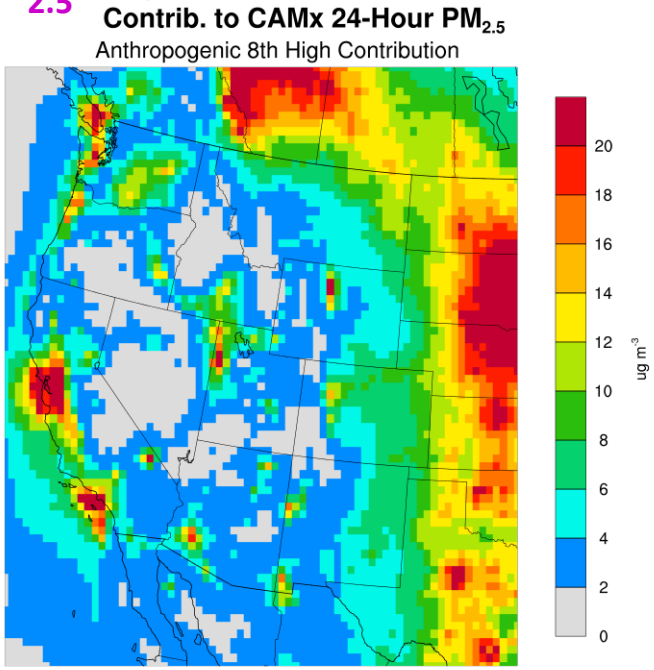
Nat



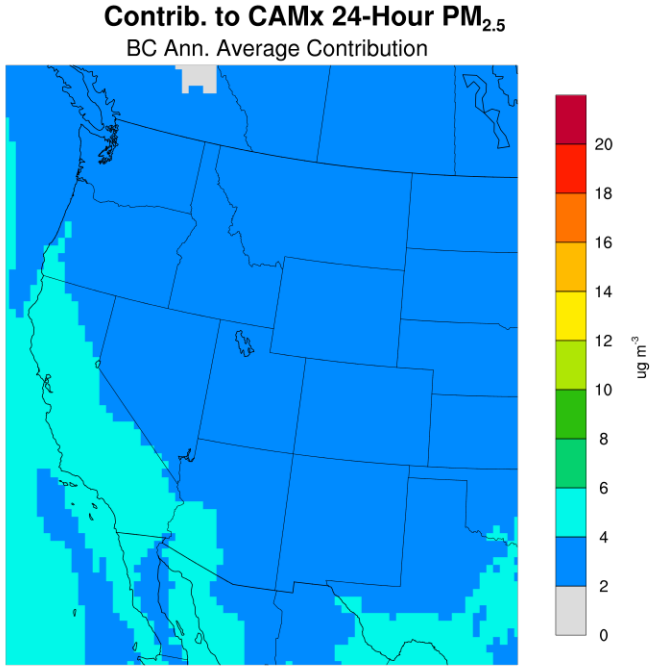
WF



Anth

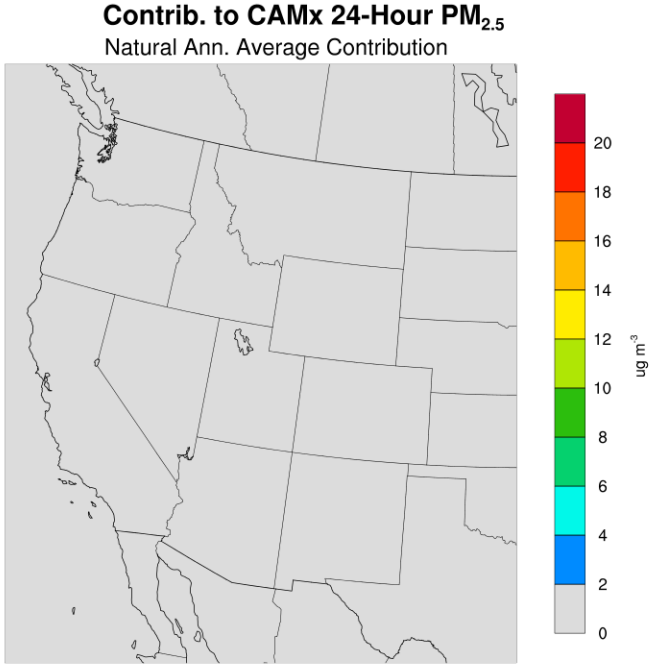


BC



Min(29,76) = 1.86, Max(10,39) = 5.06

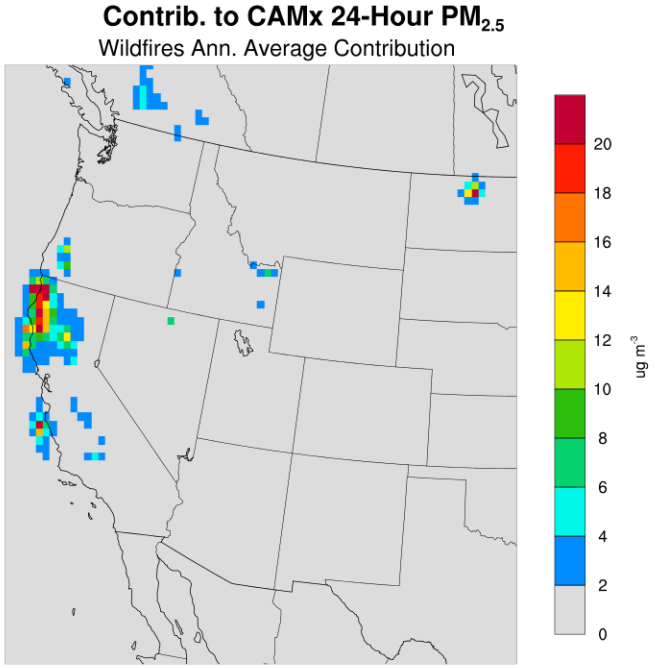
Nat



Min(13,76) = 0.03, Max(54,9) = 1.30

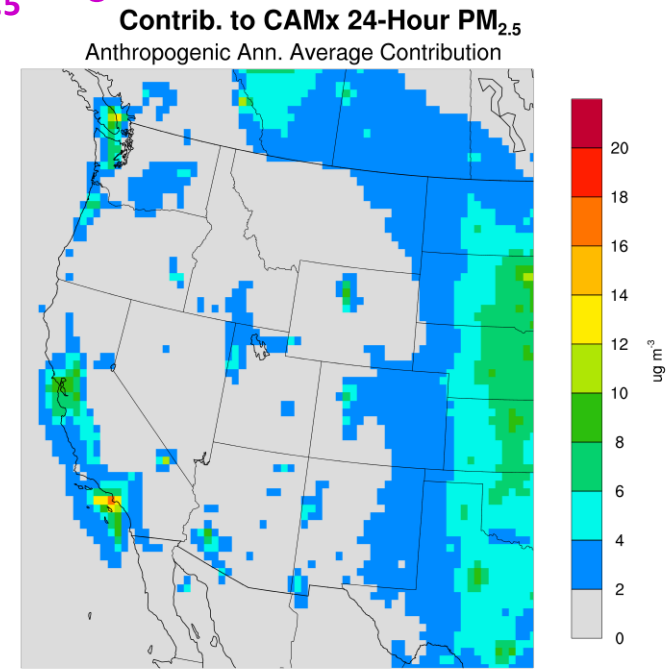
Annual $PM_{2.5}$ > 0

WF



Min(35,2) = 0.02, Max(6,48) = 55.90

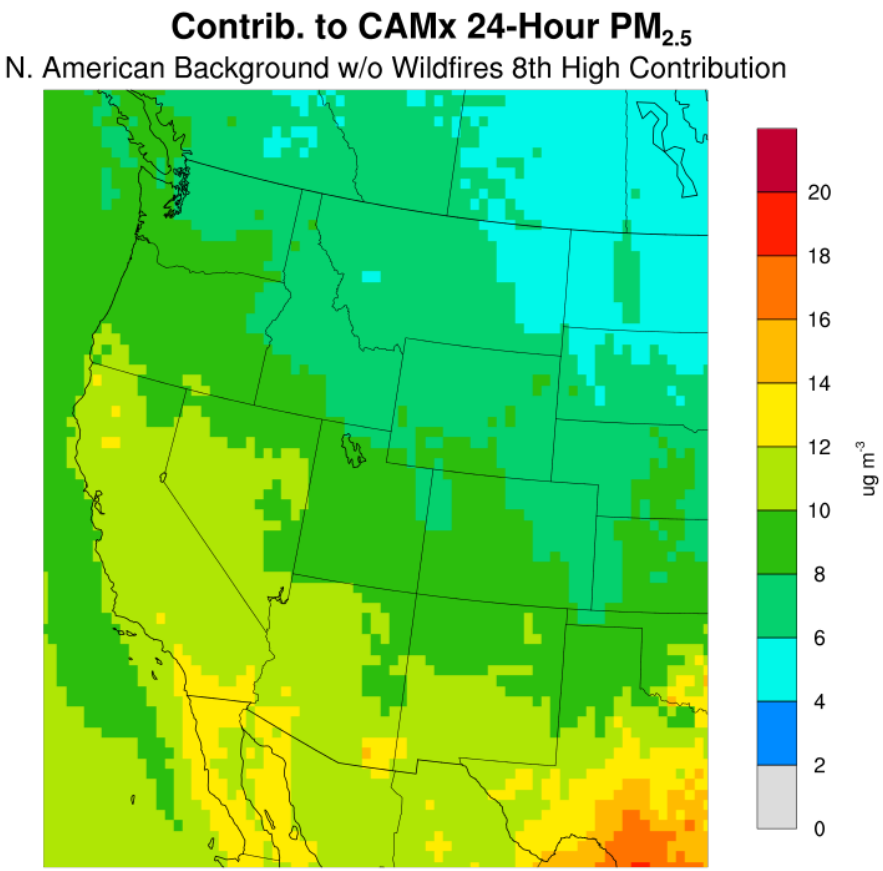
Anth



Min(1,76) = 0.11, Max(14,22) = 16.24

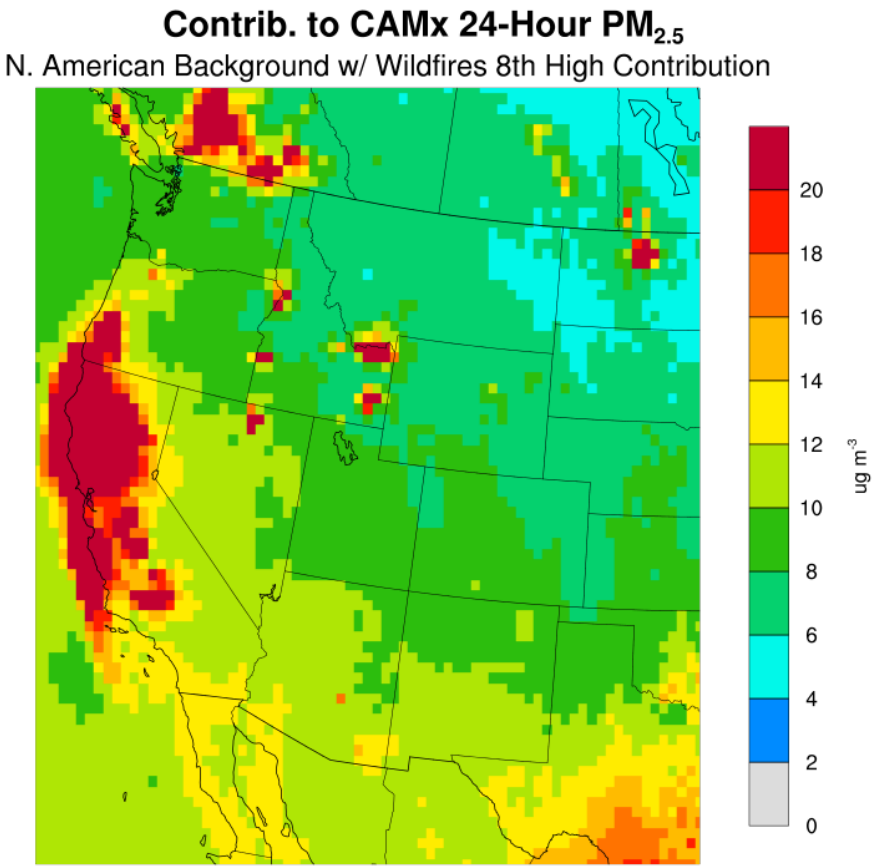
North American Background 8th High 24-Hour $PM_{2.5}$

w/o Wildfires



Min(63,74) = 4.77, Max(68,1) = 18.62

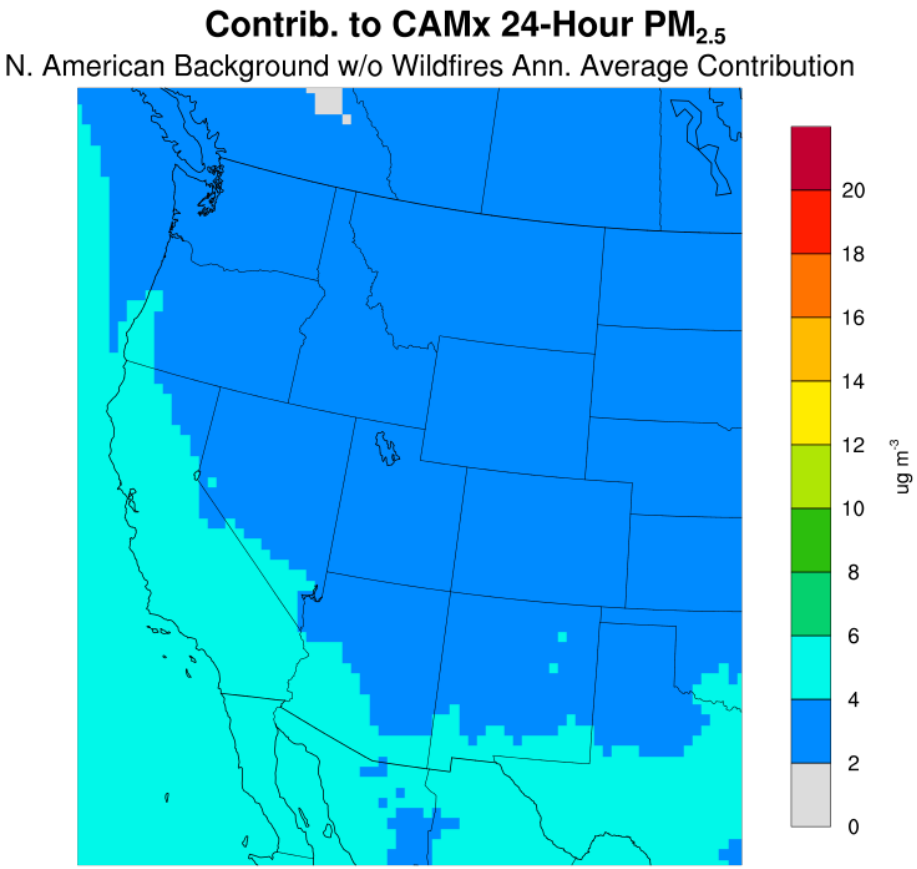
w/ Wildfires



Min(63,74) = 5.11, Max(6,48) = 563.34

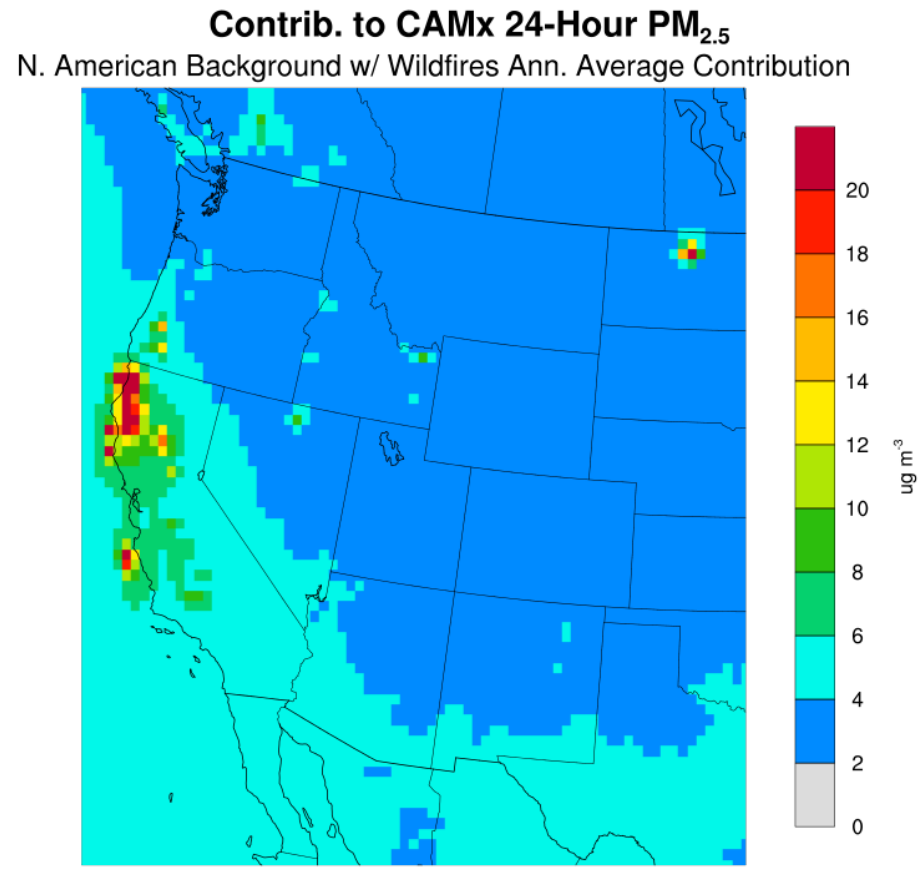
North American Background Annual $PM_{2.5}$

w/o Wildfires



Min(28,76) = 1.90, Max(56,1) = 5.31

w/ Wildfires



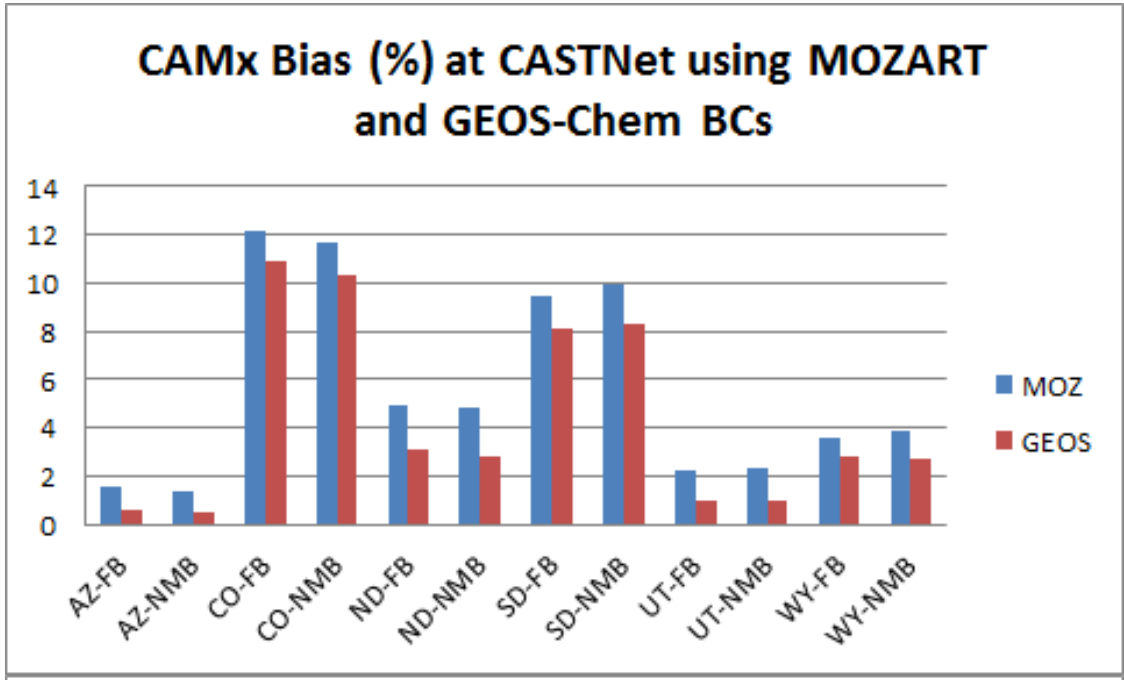
Min(30,76) = 2.18, Max(6,48) = 60.65

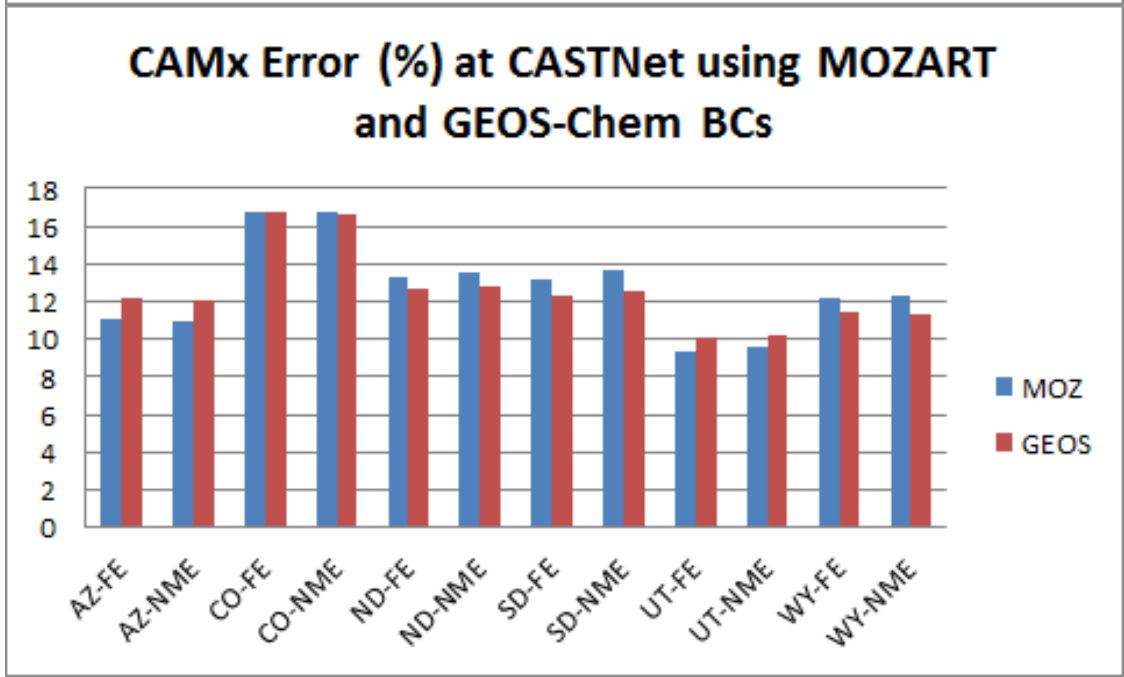
WestJumpAQMS BC Sensitivity Analysis

- CAMx 2008 36 km CONUS sensitivity simulation using two different sets of BCs basednon Global Chemistry Model (GCM() output:
  1. 2008 MOZART
  2. 2008 GEOS-Chem
- Compare ozone model performance at AQS and CASTNet monitoring sites
- Use CAMx Reactive Tracer (RTRAC) probing tool to track contributions of three types of ozone BCs:
  - Clearly stratospheric (~9,000 to ~20,000 m AGL)
  - Mostly tropospheric (0 to ~6,000 m AGL)
  - Potentially mixed (~6,000 to ~9,000 m AGL)

DMAX8 Ozone Performance CASTNet

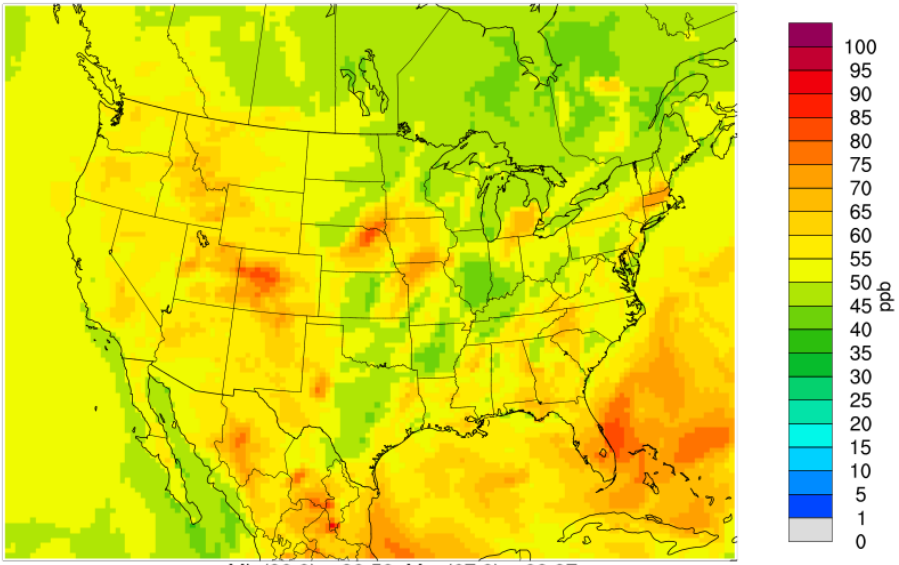
- CAMx/GEOS has lower bias than CAMx/MOZ in all states
- CAMx/GEOS has lower error than CAMx/MOZ in all states except AZ & UT
- CAMx generally has overestimation tendency using both BCs
  - Exception is CA with a -14% bias
- CAMx achieves Ozone Performance Goals using both GCM BCs





April Max Ozone Contrib. from BCs

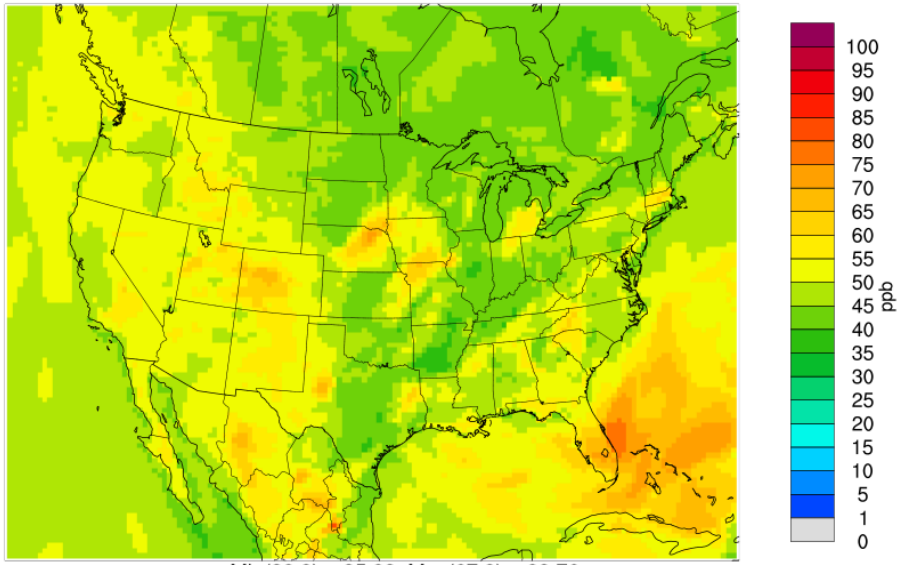
MOZART: All



Min(39,8) = 39.59, Max(67,8) = 93.37

April Max Ozone Contrib. from BCs

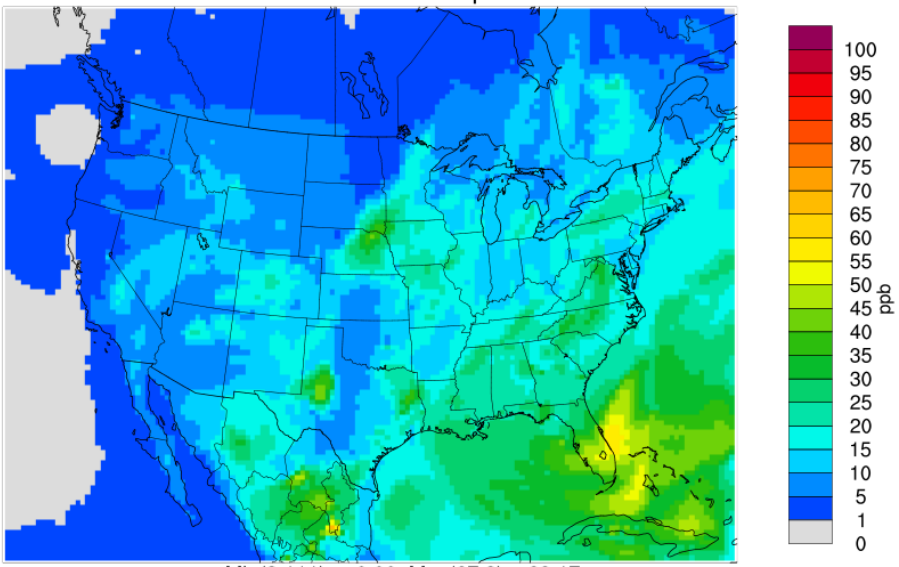
GEOS-CHEM: All



Min(39,8) = 35.93, Max(67,8) = 83.76

April Max Ozone Contrib. from BCs

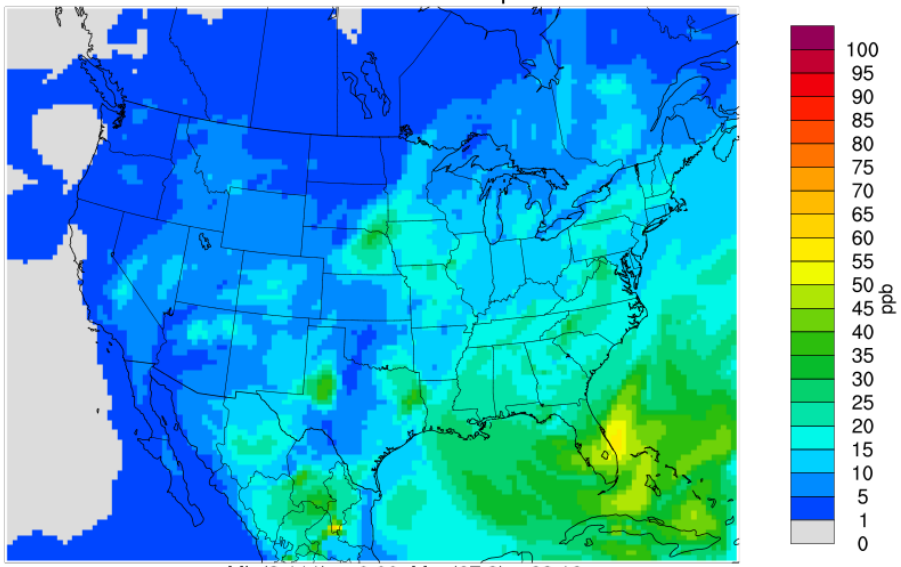
MOZART: Stratospheric



Min(3,111) = 0.00, Max(67,8) = 69.17

April Max Ozone Contrib. from BCs

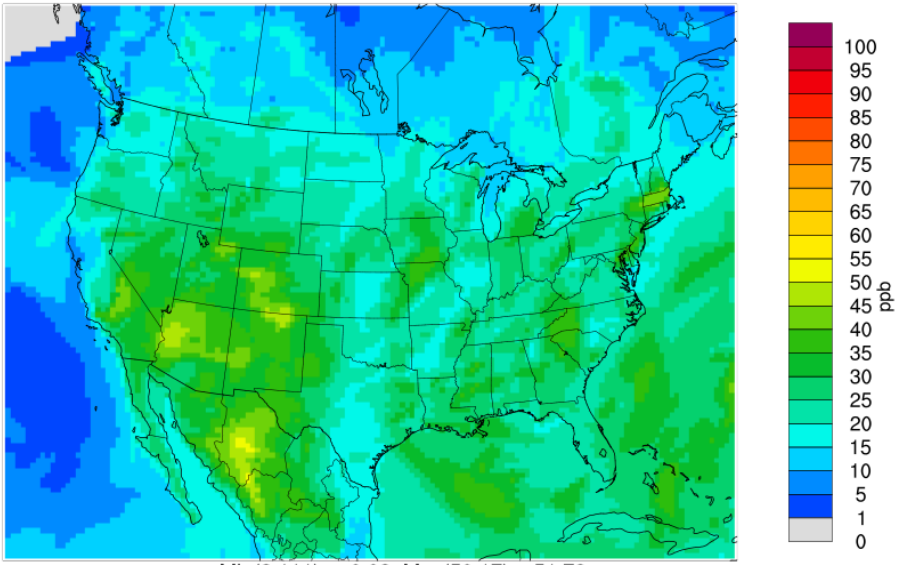
GEOS-CHEM: Stratospheric



Min(3,111) = 0.00, Max(67,8) = 62.16

April Max Ozone Contrib. from BCs

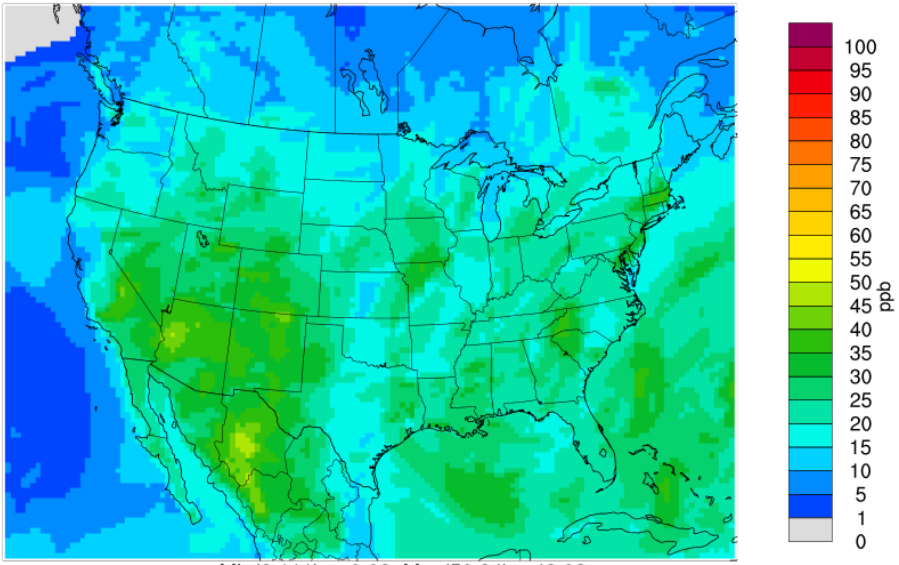
MOZART: In-Between



Min(2,111) = 0.08, Max(50,17) = 51.79

April Max Ozone Contrib. from BCs

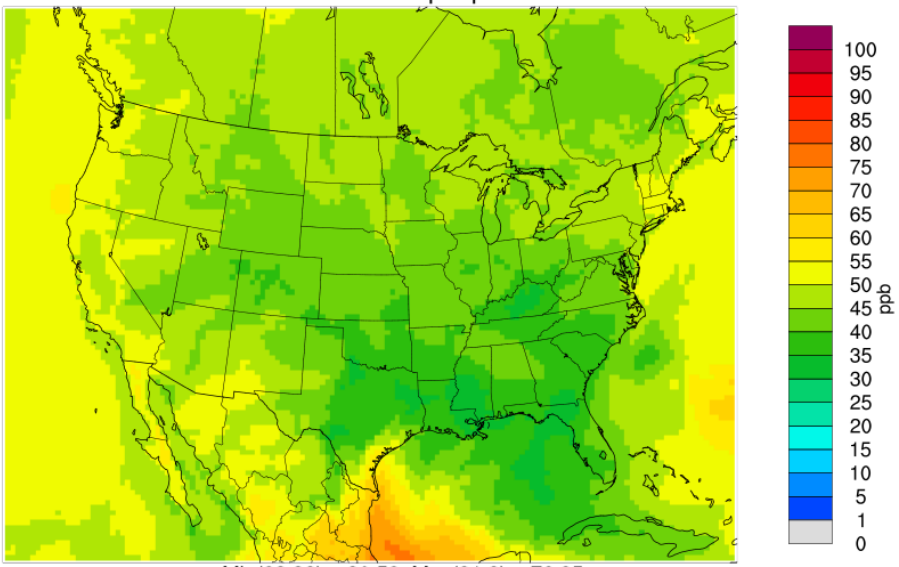
GEOS-CHEM: In-Between



Min(2,111) = 0.08, Max(50,24) = 49.02

April Max Ozone Contrib. from BCs

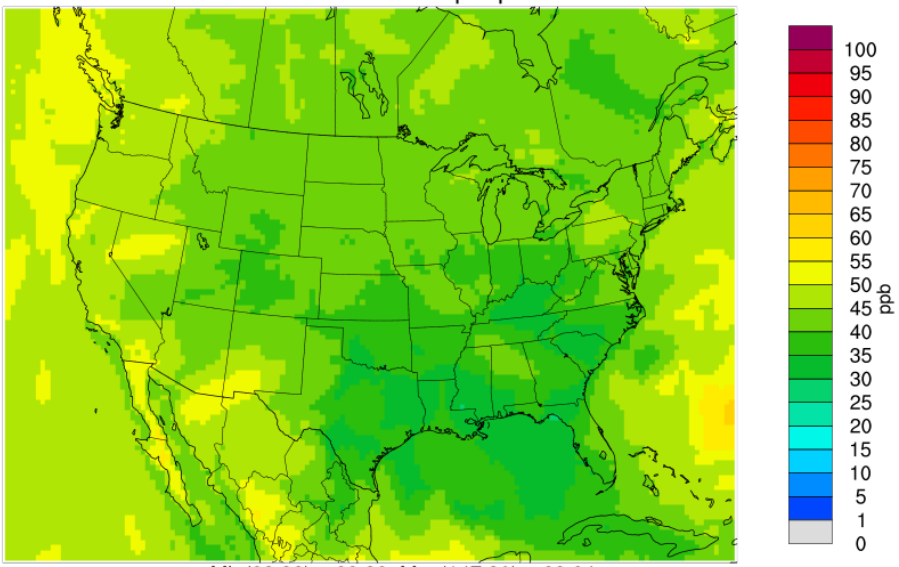
MOZART: Tropospheric



Min(93,32) = 30.59, Max(81,2) = 76.85

April Max Ozone Contrib. from BCs

GEOS-CHEM: Tropospheric



Min(93,32) = 29.39, Max(147,30) = 62.64

GCM BC Sensitivity Findings

- Similar CAMx ozone model performance using MOZART & GEOS-Chem BCs
  - Both exhibit overestimation bias and GEOS-Chem BCs generally produce lower ozone so produces better CAMx ozone performance
- Ozone BCs are a major source of ozone in the rural western U.S.
  - At Gothic, RTCMC estimates 50% to 95% of DMAX8 ozone is from BCs
    - Note RTCMC bias toward overstating ozone BC contribution
- MOZART BCs have higher ozone BC contributions in spring when Asian transport and stratospheric ozone intrusions occur
- GEOS-Chem BCs have higher ozone BC contributions in summer when monsoon convection brings stratospheric ozone to ground
- Can't conclude one GCM better than other for BCs
  - Need to understand cause for CAMx ozone overestimation first
- More details at: http://www.wrapair2.org/pdf/Morris_MOZART-GEOS_WestJumpAQMS_Jul10_2013_Draft1.pdf

WestJumpAQMS Final Report Outline

1. INTRODUCTION
2. METEOROLOGICAL MODELING
3. 2008 BASE CASE EMISSIONS
4. 2008 BASE CASE MODELING
5. 2008 STATE-SPECIFIC OZONE SOURCE APPORTIONMENT MODELING
6. 2008 STATE-SPECIFIC PARTICULATE SOURCE APPORTIONMENT MODELING
7. 2008 SOURCE CATEGORY-SPECIFIC SOURCE APPORTIONMENT
8. LESSONS LEARNED
9. REFERENCES

- Electronic Appendices

WestJumpAQMS Next Steps

- State-Specific PSAT Visibility Analysis
- Complete Source Category-Specific Ozone and PM Apportionment Modeling
  - Natural Emissions (Biogenic, Lightning, Sea Salt and WBD)
  - Oil and Gas (Upstream)
  - Fires (WF, Rx and Ag)
  - Other Point Sources
  - Mobile Sources (On-Road, Non-Road and CMV)
  - Remainder (Area, Ammonia, Dust, etc.)
- Final Report and Final Webinar in Late August
- Transfer Databases and Results to 3SDW