West-wide Jumpstart Air Quality Modeling Study

Final Project Report and Modeling Results

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Funding from State of NM and National BLM Air Program

Oversight by western states, local air agencies, federal land managers, EPA regional and national offices
Introduction

• West-wide Jump-start Air Quality Modeling Study (WestJumpAQMS) was initiated in late 2010 to:
  – Develop the next generation of regional air quality modeling databases for ozone, PM$_{2.5}$, visibility and deposition planning in the western U.S.
  – Provide information on the role of interstate and international transport to ozone and PM$_{2.5}$ under current and potential future NAAQS
  – Assess contributions of major source categories (e.g., point, O&G, mobile, et cetera) to air quality in the West
  – Provide detailed information to the community
Overview of Approach

• 2008 Modeling Database
  – 36 km CONUS
  – 12 km WESTUS
  – 4 km IMWD

• WRF meteorological; CAMx photochemical; SMOKE emissions models

• 2008 WRAP Phase III O&G emissions

• 2008 NEI emissions

• Model Evaluation

• Sensitivity Tests

• State-Specific and Source Category-Specific Ozone and PM$_{2.5}$ Source Apportionment Modeling
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 website
WestJumpAQMS Progress Webinars

• June 20, 2013: 2008 Database Development
• July 26, 2013: State-Specific Source Apportionment
• August 29, 2013: Source Category-Specific Source Apportionment
• Interactive agenda from WestJumpAQMS Final Project Report meeting, Denver, CO – September 25, 2013

• Presentations and all project materials at: http://www.wrapair2.org/WestJumpAQMS.aspx
Ozone Attainment Test Software – Unmonitored Area Analysis with Design Value (2006-2010) ≥ 76 ppb
Ozone Attainment Test Software – Unmonitored Area Analysis with Design Value (2006-2010) $\geq 70$ ppb
Attainment Test Software – Unmonitored Area Analysis with Design Value (2006-2010) ≥ 65 ppb

Min(177,1) = 65.00, Max(45,67) = 113.30
Ozone Attainment Test Software – Unmonitored Area Analysis with Design Value (2006-2010) ≥ 60 ppb

Min(45,2) = 60.00, Max(45,67) = 113.30
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) NAAQS

• 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 NAAQS
  – 86 sites (63%) in California

• For 17 upwind western states examine 2008 contribution to DMAX8 ozone Design Value in downwind states
  – CSAPR used a 1% NAAQS significance threshold (≥0.76 ppb)

• This analysis is for 2008 and is not a regulatory analysis that would have to examine a future year
## UT CSAPR-Type Ozone Analysis for 76 & 65 ppb NAAQS
(from WestJumpAQMS Appendix A)

### Utah Ozone Contributions

<table>
<thead>
<tr>
<th></th>
<th>76 ppb</th>
<th>65 ppb</th>
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<tr>
<td>Downwind State Design Values</td>
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<tr>
<td></td>
<td>Avg 70.33</td>
<td>Max 73.00</td>
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<tr>
<td></td>
<td>Avg 64.00</td>
<td>Max 65.00</td>
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<td></td>
<td>Avg 68.67</td>
<td>Max 70.00</td>
</tr>
<tr>
<td></td>
<td>Avg 68.00</td>
<td>Max 68.00</td>
</tr>
</tbody>
</table>

### States' Contributions to Top 5 States Surrounding UTAH, where DV is at or above 76.0 ppb Threshold

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<thead>
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<th>State</th>
<th>Avg</th>
<th>Max</th>
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</thead>
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<tr>
<td>UT</td>
<td>82.00</td>
<td>86.00</td>
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<tr>
<td>WY</td>
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<td>70.00</td>
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<tr>
<td>WA</td>
<td>70.00</td>
<td>70.00</td>
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<tr>
<td>OR</td>
<td>65.00</td>
<td>65.00</td>
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<tr>
<td>CO</td>
<td>65.00</td>
<td>65.00</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>State</th>
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</thead>
<tbody>
<tr>
<td>UT</td>
<td>82.00</td>
<td>86.00</td>
</tr>
<tr>
<td>WY</td>
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<tr>
<td>WA</td>
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<tr>
<td>CA</td>
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<td>65.00</td>
</tr>
<tr>
<td>AZ</td>
<td>65.00</td>
<td>65.00</td>
</tr>
</tbody>
</table>
State Contributions to Modeled 10 Highest DMAX8 Ozone Days
(from WestJumpAQMS Appendix B)

**Highest** Modeled DMAX8 Day @ Desert View Elementary School in Sunland Park, NM

**Contributions to MDA8 Ozone [ppb]**

Site: NM_Dona Ana0021
Rank: 1 - 10 Aug, 2008
Total Ozone = 75.2 ppb
BC Ozone = 41.5 ppb (55.2%)
State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

4th Highest Modeled DMAX8 Day @ Desert View Elementary School in Sunland Park, NM

Contributions to MDA8 Ozone [ppb]

Site: NM_Dona Ana0021
Rank: 4 - 07 Aug, 2008
Total Ozone = 72.5 ppb
BC Ozone = 32.6 ppb (45.0%)

AZ (0.25 ppb, 0.35%)
CA (0.79 ppb, 1.09%)
CO (0.71 ppb, 0.98%)
KS (0.34 ppb, 0.47%)
ID (0.10 ppb, 0.14%)
MT (0.06 ppb, 0.09%)
OK (1.76 ppb, 2.43%)
OR (0.05 ppb, 0.07%)
WA (0.03 ppb, 0.04%)
WY (0.53 ppb, 0.73%)
ND (0.02 ppb, 0.03%)
SD (0.03 ppb, 0.04%)
NE (0.18 ppb, 0.25%)
NV (0.24 ppb, 0.33%)
UT (0.44 ppb, 0.60%)
TX (16.43 ppb, 22.67%)
NM (2.87 ppb, 3.97%)
Eastern (3.43 ppb, 4.73%)
Canada (0.05 ppb, 0.07%)
Mexico (2.26 ppb, 3.12%)
Ocean (0.58 ppb, 0.80%)
Natural (7.97 ppb, 10.99%)
Wild Fire (0.69 ppb, 0.92%)
Rx Fire (0.05 ppb, 0.07%)
AG Fire (0.02 ppb, 0.02%)
State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

10th Highest Modeled DMAX8 Day @ Desert View Elementary School in Sunland Park, NM

Contributions to MDA8 Ozone [ppb]

Site: NM_Dona Ana0021
Rank: 10 - 06 Aug, 2008
Total Ozone = 70.3 ppb
BC Ozone = 32.6 ppb (46.4%)

AZ (0.28 ppb, 0.40%)
CA (1.03 ppb, 1.47%)
CO (0.78 ppb, 1.11%)
KS (0.43 ppb, 0.61%)
ID (0.15 ppb, 0.21%)
MT (0.09 ppb, 0.13%)
OK (0.86 ppb, 1.22%)
OR (0.07 ppb, 0.10%)
WA (0.03 ppb, 0.05%)
WY (0.75 ppb, 1.07%)
ND (0.02 ppb, 0.03%)
NE (0.23 ppb, 0.33%)
NV (0.32 ppb, 0.46%)
UT (0.57 ppb, 0.81%)
TX (17.55 ppb, 24.96%)
NM (0.50 ppb, 0.71%)
Eastern (2.73 ppb, 3.89%)
Canada (0.05 ppb, 0.07%)
Mexico (2.40 ppb, 3.42%)
Ocean (0.23 ppb, 0.33%)
Natural (7.60 ppb, 10.80%)
Wild Fire (0.94 ppb, 0.03%)
State Contributions to Modeled 10 Highest DMAX8 Ozone Days
(from WestJumpAQMS Appendix B)

**Highest Modeled DMAX8 Day @ Double Eagle Elementary School, Albuquerque, NM**

**Contributions to MDA8 Ozone [ppb]**

- **Site:** NM_Bernalillo1012
- **Rank:** 1 - 02 May, 2008
- **Total Ozone = 78.5 ppb**
- **BC Ozone = 68.9 ppb (87.7%)**

**Contributors:**
- AZ (0.02 ppb, 0.02%)
- CA (0.17 ppb, 0.22%)
- CO (0.23 ppb, 0.30%)
- KS (0.01 ppb, 0.01%)
- ID (0.86 ppb, 1.10%)
- MT (0.26 ppb, 0.34%)
- OK (0.01 ppb, 0.01%)
- OR (0.58 ppb, 0.74%)
- WA (0.69 ppb, 0.87%)
- WY (0.43 ppb, 0.54%)
- ND (0.01 ppb, 0.01%)
- SD (0.00 ppb, 0.01%)
- NE (0.01 ppb, 0.01%)
- NV (0.09 ppb, 0.11%)
- UT (2.87 ppb, 3.65%)
- TX (0.02 ppb, 0.03%)
- NM (1.85 ppb, 2.35%)
- Eastern (0.04 ppb, 0.05%)
- Canada (0.10 ppb, 0.12%)
- Mexico (0.01 ppb, 0.01%)
- Ocean (0.10 ppb, 0.13%)
- Natural (1.28 ppb, 1.63%)
- Wild Fire (0.02 ppb, 0.00%)
- Rx Fire (0.03 ppb, 0.03%)
- AG Fire (0.00 ppb, 0.00%)

**Region:**
- Eastern
- Canada
- Mexico
- Ocean
- Natural
- Wild Fire
- Rx Fire
- AG Fire
State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

4th Highest Modeled DMAX8 Day @ Double Eagle Elementary School, Albuquerque, NM

Contributions to MDA8 Ozone [ppb]

Site: NM_Bernalillo1012
Rank: 4 - 12 Apr, 2008
Total Ozone = 72.9 ppb
BC Ozone = 63.7 ppb (87.3%)

Contributions:
- AZ (0.04 ppb, 0.06%)
- CA (0.21 ppb, 0.29%)
- CO (1.71 ppb, 2.35%)
- KS (0.00 ppb, 0.00%)
- ID (0.63 ppb, 0.87%)
- MT (0.44 ppb, 0.61%)
- OK (0.00 ppb, 0.00%)
- OR (0.38 ppb, 0.52%)
- WA (0.71 ppb, 0.98%)
- WY (1.18 ppb, 1.62%)
- ND (0.00 ppb, 0.00%)
- SD (0.00 ppb, 0.00%)
- NE (0.00 ppb, 0.01%)
- NV (0.12 ppb, 0.16%)
- UT (0.70 ppb, 0.95%)
- TX (0.00 ppb, 0.01%)
- NM (2.10 ppb, 2.88%)
- Eastern (0.00 ppb, 0.00%)
- Canada (0.17 ppb, 0.23%)
- Mexico (0.01 ppb, 0.01%)
- Ocean (0.08 ppb, 0.10%)
- Natural (0.71 ppb, 0.98%)
- Wild Fire (0.00 ppb, 0.0)
- Rx Fire (0.01 ppb, 0.01%)
- AG Fire (0.00 ppb, 0.00%)
State Contributions to Modeled 10 Highest DMAX8 Ozone Days
(from WestJumpAQMS Appendix B)

10th Highest Modeled DMAX8 Day @ Double Eagle Elementary School, Albuquerque, NM

Contributions to MDA8 Ozone [ppb]

Site: NM_Bernalillo1012
Rank: 10 - 02 Jul, 2008
Total Ozone = 71.3 ppb
BC Ozone = 47.9 ppb (67.2%)

AZ (0.46 ppb, 0.64%)
CA (0.68 ppb, 0.95%)
CO (4.31 ppb, 6.04%)
KS (0.02 ppb, 0.03%)
ID (0.10 ppb, 0.14%)
MT (0.15 ppb, 0.21%)
OK (0.02 ppb, 0.03%)
OR (0.07 ppb, 0.09%)
WA (0.09 ppb, 0.13%)
WY (1.05 ppb, 1.47%)
ND (0.00 ppb, 0.00%)
SD (0.01 ppb, 0.01%)
NE (0.03 ppb, 0.04%)
NV (0.76 ppb, 1.06%)
UT (2.68 ppb, 3.76%)
TX (0.10 ppb, 0.13%)
NM (9.59 ppb, 13.44%)
Eastern (0.00 ppb, 0.00%)
Canada (0.14 ppb, 0.20%)
Mexico (0.17 ppb, 0.24%)
Ocean (0.04 ppb, 0.06%)
Natural (2.64 ppb, 3.70%)
Wild Fire (0.33 ppb, 0.01%)
Rx Fire (0.01 ppb, 0.01%)
AG Fire (0.00 ppb, 0.00%)
State Contributions to Modeled 10 Highest DMAX8 Ozone Days (from WestJumpAQMS Appendix B)

**Highest Modeled DMAX8 Day in Carlsbad, NM**

**Contributions to MDA8 Ozone [ppb]**

<table>
<thead>
<tr>
<th>State</th>
<th>Contribution [ppb]</th>
<th>Contribution [%]</th>
</tr>
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<tbody>
<tr>
<td>AZ</td>
<td>0.16</td>
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<tr>
<td>CA</td>
<td>0.36</td>
<td>0.48%</td>
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<tr>
<td>CO</td>
<td>0.19</td>
<td>0.25%</td>
</tr>
<tr>
<td>KS</td>
<td>0.03</td>
<td>0.03%</td>
</tr>
<tr>
<td>ID</td>
<td>0.08</td>
<td>0.10%</td>
</tr>
<tr>
<td>MT</td>
<td>0.10</td>
<td>0.13%</td>
</tr>
<tr>
<td>OK</td>
<td>0.02</td>
<td>0.03%</td>
</tr>
<tr>
<td>OR</td>
<td>0.03</td>
<td>0.04%</td>
</tr>
<tr>
<td>WA</td>
<td>0.02</td>
<td>0.02%</td>
</tr>
<tr>
<td>WY</td>
<td>0.18</td>
<td>0.24%</td>
</tr>
<tr>
<td>ND</td>
<td>0.03</td>
<td>0.04%</td>
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<tr>
<td>NE</td>
<td>0.06</td>
<td>0.08%</td>
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<tr>
<td>NV</td>
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<td>0.11%</td>
</tr>
<tr>
<td>UT</td>
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<td>0.46%</td>
</tr>
<tr>
<td>TX</td>
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<tr>
<td>NM</td>
<td>1.69</td>
<td>2.25%</td>
</tr>
<tr>
<td>Eastern</td>
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<td>0.00%</td>
</tr>
<tr>
<td>Canada</td>
<td>0.06</td>
<td>0.08%</td>
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<tr>
<td>Mexico</td>
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<td>4.69%</td>
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<tr>
<td>Ocean</td>
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<td>0.06%</td>
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<tr>
<td>Natural</td>
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<td>0.29%</td>
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<tr>
<td>Wild Fire</td>
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<tr>
<td>Rx Fire</td>
<td>0.07</td>
<td>0.09%</td>
</tr>
<tr>
<td>AG Fire</td>
<td>0.03</td>
<td>0.04%</td>
</tr>
</tbody>
</table>

Site: NM_Eddy1005
Rank: 1 - 28 Feb, 2008
Total Ozone = 75.1 ppb
BC Ozone = 66.2 ppb (88.1%)
State Contributions to Modeled 10 Highest DMAX8 Ozone Days
(from WestJumpAQMS Appendix B)

4th Highest Modeled DMAX8 Day in Carlsbad, NM

Contributions to MDA8 Ozone [ppb]

Site: NM_Eddy1005
Rank: 4 - 11 Apr, 2008
Total Ozone = 68.9 ppb
BC Ozone = 63.6 ppb (92.4%)

- AZ (0.79 ppb, 1.15%)
- CA (0.09 ppb, 0.13%)
- CO (0.00 ppb, 0.01%)
- KS (0.00 ppb, 0.00%)
- ID (0.30 ppb, 0.44%)
- MT (0.00 ppb, 0.00%)
- OK (0.00 ppb, 0.00%)
- OR (0.61 ppb, 0.88%)
- WA (0.15 ppb, 0.22%)
- WY (0.01 ppb, 0.02%)
- ND (0.00 ppb, 0.00%)
- SD (0.00 ppb, 0.00%)
- NE (0.00 ppb, 0.00%)
- NV (0.13 ppb, 0.19%)
- UT (1.20 ppb, 1.75%)
- TX (0.00 ppb, 0.00%)
- NM (1.42 ppb, 2.06%)
- Eastern (0.00 ppb, 0.00%)
- Canada (0.01 ppb, 0.02%)
- Mexico (0.00 ppb, 0.00%)
- Ocean (0.06 ppb, 0.09%)
- Natural (0.45 ppb, 0.66%)
- Wild Fire (0.00 ppb, 0.0)
- Rx Fire (0.02 ppb, 0.02%)
- AG Fire (0.00 ppb, 0.00%)

Eastern Canada
Mexico
Ocean
Natural
Wild Fire
Rx Fire
AG Fire
State Contributions to Modeled 10 Highest DMAX8 Ozone Days
(from WestJumpAQMS Appendix B)

**10th Highest** Modeled DMAX8 Day in Carlsbad, NM

### Contributions to MDA8 Ozone [ppb]

- **Site:** NM_Eddy1005
- **Rank:** 10 - 12 Aug, 2008
- **Total Ozone:** 66.0 ppb
- **BC Ozone:** 40.3 ppb (61.1%)

**Contributions to MDA8 Ozone [ppb]:**

- **AZ:** (0.65 ppb, 0.98%)
- **CA:** (1.32 ppb, 2.00%)
- **CO:** (1.90 ppb, 2.88%)
- **KS:** (0.54 ppb, 0.82%)
- **ID:** (0.07 ppb, 0.10%)
- **MT:** (0.04 ppb, 0.05%)
- **OK:** (0.85 ppb, 1.28%)
- **OR:** (0.02 ppb, 0.02%)
- **WA:** (0.01 ppb, 0.01%)
- **WY:** (0.59 ppb, 0.89%)
- **ND:** (0.01 ppb, 0.02%)
- **NE:** (0.14 ppb, 0.21%)
- **NV:** (0.41 ppb, 0.63%)
- **UT:** (0.73 ppb, 1.10%)
- **TX:** (5.10 ppb, 7.72%)
- **NM:** (4.64 ppb, 7.03%)
- **Eastern:** (0.49 ppb, 0.74%)
- **Canada:** (0.02 ppb, 0.04%)
- **Mexico:** (0.92 ppb, 1.40%)
- **Ocean:** (0.22 ppb, 0.34%)
- **Natural:** (6.86 ppb, 10.39%)
- **Wild Fire:** (0.15 ppb, 0.00%)
- **AG Fire:** (0.00 ppb, 0.01%)
- **Rx Fire:** (0.01 ppb, 0.01%)

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

**Highest** Modeled DMAX8 Day @ Navajo Lake, NM

**Contributions to MDA8 Ozone [ppb]**

| State | Natural Wild Fire Rx Fire AG Fire | AZ (0.01 ppb, 0.02%) | CA (0.01 ppb, 0.01%) | CO (0.61 ppb, 0.77%) | KS (0.00 ppb, 0.00%) | ID (0.06 ppb, 0.07%) | MT (0.03 ppb, 0.04%) | OK (0.00 ppb, 0.00%) | OR (0.36 ppb, 0.45%) | WA (0.56 ppb, 0.71%) | WY (0.01 ppb, 0.01%) | ND (0.01 ppb, 0.01%) | NE (0.00 ppb, 0.00%) | NV (0.32 ppb, 0.40%) | UT (1.78 ppb, 2.24%) | TX (0.00 ppb, 0.00%) | NM (2.00 ppb, 2.52%) | Eastern (0.01 ppb, 0.01%) | Canada (0.95 ppb, 1.20%) | Mexico (0.00 ppb, 0.00%) | Ocean (0.07 ppb, 0.08%) | Natural (2.66 ppb, 3.36%) | Wild Fire (0.10 ppb, 0.1) | Rx Fire (0.00 ppb, 0.00%) | AG Fire (0.00 ppb, 0.00%) |

Site: NM_San Juan0018
Rank: 1 - 13 Jun, 2008
Total Ozone = 79.3 ppb
BC Ozone = 69.8 ppb (88.0%)
State Contributions to Modeled 10 Highest DMAX8 Ozone Days
(from WestJumpAQMS Appendix B)

4th Highest Modeled DMAX8 Day @ Navajo Lake, NM

Contributions to MDA8 Ozone [ppb]

Site: NM_San Juan0018
Rank: 4 - 02 May, 2008
Total Ozone = 73.2 ppb
BC Ozone = 61.6 ppb (84.2%)
State Contributions to Modeled 10 Highest DMAX8 Ozone Days
(from WestJumpAQMS Appendix B)

10th Highest Modeled DMAX8 Day @ Navajo Lake, NM

Contributions to MDA8 Ozone [ppb]

Site: NM_San Juan0018
Rank: 10 - 10 Jul, 2008
Total Ozone = 71.4 ppb
BC Ozone = 48.3 ppb (67.6%)

- AZ (0.20 ppb, 0.28%)
- CA (0.32 ppb, 0.44%)
- CO (3.87 ppb, 5.41%)
- KS (0.11 ppb, 0.15%)
- ID (0.43 ppb, 0.60%)
- MT (0.03 ppb, 0.05%)
- OK (0.01 ppb, 0.02%)
- OR (0.11 ppb, 0.16%)
- WA (0.03 ppb, 0.04%)
- WY (0.94 ppb, 1.31%)
- ND (0.00 ppb, 0.00%)
- SD (0.02 ppb, 0.02%)
- NE (0.14 ppb, 0.19%)
- NV (0.11 ppb, 0.16%)
- UT (1.49 ppb, 2.09%)
- TX (0.49 ppb, 0.69%)
- NM (11.31 ppb, 15.84%)

- Eastern (0.01 ppb, 0.01%)
- Canada (0.00 ppb, 0.01%)
- Mexico (0.49 ppb, 0.68%)
- Ocean (0.06 ppb, 0.09%)
- Natural (2.61 ppb, 3.65%)
- Wild Fire (0.33 ppb, 0)
- Rx Fire (0.00 ppb, 0.00%)
- AG Fire (0.00 ppb, 0.00%)
Spatial Distribution of State Ozone Contributions

• Spatial distribution of state’s ozone contribution to DMAX8 ozone concentrations greater than or equal to:
  – 76 ppb (current NAAQS)
  – 70 ppb; 65 ppb and 60 ppb (potential future NAAQS)
  – 0 ppb (highest contribution in year)

• Two types of metrics:
  1. Maximum modeled contribution to Highest and 4th Highest DMAX8 ozone (from WestJumpAQMS Appendix C)
  2. Attainment Test Unmonitored Areas projection contribution to 8-hour ozone design value

• Examples for Colorado next:
  – Maximum contribution to highest DMAX8 ever and design value
  – Maximum contribution to 4th high DMAX8 for 76 and 65 ppb
2008 Colorado 8-Hour Ozone Contribution

Highest Modeled Contribution

Attainment Test Design Value Contribution

Contrib. to CAMx Daily Max 8-Hour Ozone >= 0 ppb
CO Anthropogenic Max Contribution

Max(144,110) = 29.18

CO

Min(3,1) = 0.00, Max(142,107) = 17.60
Colorado Max Contribution to 4th High DMAX8 Ozone

DMAX8 Ozone $\geq 76$ ppb

DMAX8 Ozone $\geq 65$ ppb

Contribution to CAMx Daily Max 8-Hour Ozone $\geq 76$ ppb
CO Anthropogenic 4th Highest Contribution

Max(142,109) = 24.25

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

Max(142,109) = 24.25
“Other Sources” Max Contrib. 4th High DMAX8 Ozone

Boundary Conditions

Natural

Anthropogenic

Wildfire

Prescribed Fire

Agricultural Fire
Northern California Wildfires June-July 2008
Denver Ozone Monitors July 2008

Jul DMAX8 Ozone Rocky Flats No

Jul Base08c DMAX8 Ozone Chatfield

Jul Base08c DMAX8 Fort Collins West

Jul Base08c DMAX8 Greeley
Detailed Source Category-Specific Source Apportionment

• Six Source Categories:
  – Natural (Biogenic, Lightning, Sea Salt & WBD)
  – Fires (WF, Rx, & Ag)
  – Upstream Oil and Gas (O&G)
  – Point Sources (EGU & Non-EGU)
  – Mobile Sources (on-road, non-road & CMV)
  – Remainder (Area/Non-Point)

• Ozone Apportionment
  – May-Aug 2008
  – 36/12/4 km Domains
  – 4 States (CO, NM, UT & WY)
Ozone Source Category-Specific Source Apportionment

↔ 4 km Detailed Source Apportionment Domain
36/12/4 km Two-Way Grid Nesting
(Results in Appendix I on WestJumpAQMS webpage)
Summary of WestJumpAQMS 2008 Modeling Results for New Mexico

- Shown earlier
  - Examples of Upwind Ozone Contribution to highest, 4th highest, and 10th highest modeled days at 4 monitor sites measuring 70 ppb or higher (shown earlier, from Appendix B)

- Next
  - New Mexico’s Ozone Contribution to Downwind States (from Appendix A)
  - Spatial distribution of total modeled daily 8-hour maximum ozone contribution and Colorado examples of contribution at 65 ppb NAAQS
  - Detailed 2008 Highest Modeled Contribution to Ozone (from Appendix I)
New Mexico’s Ozone Contribution to Downwind States
(from WestJumpAQMS Appendix A)

• A significant contribution for this analysis is 1% of the standard or contributions > 0.76 ppb, addressing the current Ozone NAAQS

• At the current Ozone NAAQS level of 75 ppb, New Mexico significantly contributes to downwind nonattainment in surrounding States, AZ and TX

• If the Ozone NAAQS were lowered below 70 ppb or lower, then New Mexico would start to be a significant contributor to downwind exceedances, again in TX and AZ

• This analysis is for 2008 and is not a regulatory analysis that would have to examine a future year. A future year analysis, as is done for CSPAR, would be required in a Transport SIP.
States' Contributions to Top 5 States Surrounding New Mexico, where DV is at or above 76.0 ppb Threshold

- TX_El Paso0029: Avg 73.67, Max 77.00
- AZ_Maricopa0019: Avg 74.67, Max 78.00
- CO_Douglas0004: Avg 78.33, Max 82.00

Background levels:
- 76 ppb
- 70 ppb
- 65 ppb
- 60 ppb
New Mexico's Contributions to Top 5 States Surrounding New Mexico, where DV is at or above 76.0 ppb Threshold

<table>
<thead>
<tr>
<th>State</th>
<th>Avg</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>TX_El Paso0029</td>
<td>73.67</td>
<td>77.00</td>
</tr>
<tr>
<td>AZ_Maricopa0019</td>
<td>74.67</td>
<td>78.00</td>
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<tr>
<td>CO_Douglas0004</td>
<td>78.33</td>
<td>82.00</td>
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</tbody>
</table>

NM contribution: 1%
States' Contributions to Top 5 States Surrounding New Mexico, where DV is at or above 70.0 ppb Threshold

<table>
<thead>
<tr>
<th>State</th>
<th>Avg 73.67</th>
<th>Max 77.00</th>
<th>Avg 74.67</th>
<th>Max 78.00</th>
<th>Avg 78.33</th>
<th>Max 82.00</th>
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<tr>
<td>TX_El Paso</td>
<td>73.67</td>
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<td>74.67</td>
<td>78.00</td>
<td>78.33</td>
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<tr>
<td>AZ_Maricopa</td>
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<td>CO_Douglas</td>
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<td>CO_Douglas0004</td>
<td>78.33</td>
<td>82.00</td>
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</tbody>
</table>

New Mexico contributes to the top 5 states surrounding New Mexico with an average of 73.67 ppb, a maximum of 77.00 ppb, and 1% of New Mexico's contributions being at or above the 70.0 ppb threshold.
New Mexico’s Ozone Contribution to Downwind States, cont.
(from WestJumpAQMS Appendix A)

• If the Ozone NAAQS were lowered to 65 ppb then New Mexico would start to be a significant contributor (> 0.65 ppb) to downwind exceedances especially in Montezuma County CO, Maricopa County AZ, and El Paso County, TX

• If the Ozone NAAQS were lowered to 60 ppb then New Mexico would continue to be a significant contributor (> 0.60 ppb) to downwind exceedances in Montezuma County CO, Maricopa County AZ, and El Paso County, TX

• This analysis is for 2008 and is not a regulatory analysis that would have to examine a future year. A future year analysis, as is done for CSPAR, would be required in a Transport SIP.
States' Contributions to Top 5 States Surrounding New Mexico, where DV is at or above
65.0 ppb Threshold

- TX_El Paso0029: Avg 73.67, Max 77.00
- AZ_Maricopa0019: Avg 74.67, Max 78.00
- CO_Douglas0004: Avg 78.33, Max 82.00

Background levels:
- TX: 60 ppb
- UT: 70 ppb
- NV: 65 ppb
- NM: 76 ppb
- WA: 70 ppb
- WY: 77 ppb
- SD: 65 ppb
- OR: 60 ppb
- OK: 70 ppb
- NV: 65 ppb
- NM: 76 ppb
- NE: 60 ppb
- MT: 65 ppb
- KS: 70 ppb
- ID: 65 ppb
- CO: 76 ppb
- CA: 70 ppb
- AZ: 70 ppb
- Background: 60 ppb
New Mexico's Contributions to Top 5 States Surrounding New Mexico, where DV is at or above 65.0 ppb Threshold

TX_El Paso0029: Avg 73.67, Max 77.00
AZ_Maricopa0019: Avg 74.67, Max 78.00
CO_Douglas0004: Avg 78.33, Max 82.00

NM 1%
States' Contributions to Top 5 States Surrounding New Mexico, where DV is at or above 60.0 ppb Threshold

<table>
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<th>State</th>
<th>Avg</th>
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<th>AZ_Maricopa0019</th>
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<td>Background</td>
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</table>

[ppb] Background Contributions:
- 76 ppb
- 70 ppb
- 65 ppb
- 60 ppb
New Mexico's Contributions to Top 5 States Surrounding New Mexico, where DV is at or above 60.0 ppb Threshold

- TX_El Paso0029: Avg 73.67, Max 77.00
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NM

1%
Spatial Distribution of the Maximum Modeled 2008 Anthropogenic contribution at a 65 ppb level for the Ozone NAAQS (from WestJumpAQMS Appendix C)

- If the Ozone NAAQS is lowered to 65 ppb then New Mexico and portions of a number of other western states would be modeled as nonattainment areas.
Example Spatial Distribution of the Maximum Modeled 2008 Colorado Anthropogenic contribution at a 65 ppb level for the Ozone NAAQS (from WestJumpAQMS Appendix C)

• From previous slides Colorado would have a significant contribution (> 0.65 ppb) to non-attainment at the San Juan County monitor in northwestern New Mexico, as well as monitors in Oklahoma, Texas, and Kansas.
Detailed 2008 Highest Modeled Contribution to Ozone at Navajo Lake, NM
(from WestJumpAQMS Appendix I)

Contributions to MDA8 Ozone [ppb] at NM_San Juan0018
Rank (1) 06/13/08; Model = 79.8 ppb; Obs = 77.6 ppb; Bias = +2.9%; BC = 69.0 ppb (86.4%)
Detailed 2008 4th Highest Modeled Contribution to Ozone at Navajo Lake, NM
(from WestJumpAQMS Appendix I)

Contributions to MDA8 Ozone [ppb] at NM_San Juan0018
Rank (4) 05/02/08; Model = 71.2 ppb; Obs = 61.6 ppb; Bias = +15.5%; BC = 59.7 ppb (83.8%)
Detailed 2008 10th Highest Modeled Contribution to Ozone at Navajo Lake, NM (from WestJumpAQMS Appendix I)

Contributions to MDA8 Ozone [ppb] at NM_San Juan0018
Rank (10) 07/04/08; Model = 68.9 ppb; Obs = 64.5 ppb; Bias = +6.9%; BC = 46.4 ppb (67.3%)
PM and Visibility Source Apportionment Resources from WestJumpAQMS

• Appendices A through I address Ozone

• Appendix J: Source Category-Specific Contributions to Annual PM$_{2.5}$ Design Values at Monitoring Sites in the 12 km WESTUS Domain using MATS (XLSX 2MB)

• Appendix K: Source Category-Specific Contributions to Modeled Annual PM$_{2.5}$ Concentrations ($\mu$g/m$^3$) at Monitoring Sites in the 12 km WESTUS Domain (XLSX 4MB)

• Appendix L: Source Category-Specific Contributions to 24-Hour PM$_{2.5}$ Design Values at Monitoring Sites in the 12 km WESTUS Domain using MATS (XLSX 2MB)

• Appendix M: Source Category-Specific Contributions to Ten Highest Modeled 24-Hour PM$_{2.5}$ Concentrations ($\mu$g/m$^3$) at Monitoring Sites in the 12 km WESTUS Domain (XLSX 10MB)

• Appendix N: Annual Sulfur and Nitrogen Wet and Dry Deposition at IMPROVE Monitors by Species (XLSX 1MB)

• Appendix O: Western State-Specific Modeled Contributions to Visibility Impairment at IMPROVE Monitoring Sites for Modeled Worst (W20) and Best (B20) 20% Days during 2008 (ZIP 46MB)
WestJumpAQMS Benefited From

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

• Colorado Air Resource Management Study (CARMMS)
  – 2008 4 km Modeling Platform

• Deterministic & Empirical Assessment of Smoke’s Contribution to Ozone (DEASCO$_3$)
  – 2008 36/12 km Modeling Platform

• PMDETAIL -- Smoke contributions to PM

• Three-State Data Warehouse (3SDW) and Three-State Air Quality Study (3SAQS)
  – 2008 36/12/4 km Modeling Platform; Test database for 3SDW

• Additional Follow-On Studies
  – NPS, BLM, etc.
Thanks –

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

e: tmoore@westar.org | o: 970.491.8837

Western Regional Air Partnership | www.wrapair2.org