Southern New Mexico Ozone Modeling Study
Summary of Results: Tasks 1-3

University of North Carolina (UNC-IE)
Ramboll-Environ (RE)

November 30, 2015
SNMOS Background and Objectives

• The southern Doña Ana County region has the highest ozone levels of any area in New Mexico
  – The southern Doña Ana County area is within 95% of the federal standard for ozone
  – The New Mexico Air Quality Control Act requires the New Mexico Environment Department to develop a plan for reducing ozone levels in areas that are within 95% of the ozone standard

• The first step towards developing the plan is to understand the causes of high ozone in Doña Ana County

• SNMOS objectives:
  – Study the factors contributing to high ozone in Doña Ana County
  – Investigate future emissions scenarios that will produce attainment of the ozone standard
Overview of Approach

• SNMOS builds off of the Western Air Quality Study (WAQS)
  – WAQS 2011 modeling platform: WRF/SMOKE/CAMx
  – Adjustments to the meteorology and modeling domains to optimize for southern New Mexico

• Modeling 2011 New Mexico ozone season: May 1 – September 30

• Modeling Plan
  – Prepare base year emission inventories
  – Run WRF/SMOKE/CAMx for 2011 base year
    • Evaluate 2011 base year model against observations, refine model if needed
  – Prepare future year emission inventories, year TBD
  – Run SMOKE/CAMx for future year
    • Modeled Attainment Test
    • Emissions sensitivity/control runs
    • Source apportionment to diagnose causes of high ozone in Doña Ana County
  – Reporting
SNMOS Tasks

- **Task 1**: 2011 WRF 36/12/4 km with 4 km focus on Dona Ana/El Paso/Juarez and Work Plan
- **Task 2**: 2011 update Permian Basin O&G
- **Task 3**: 2011 update of Juarez and nearby Mexico EI, 2020 Mexico emissions update
- **Task 4**: SMOKE current 2011 NEI for 4 km domain
- **Task 5**: Gridded 2011 biogenic, fires, wind-blown dust, lightning emissions for 4 km domain
- **Task 6**: Develop 2011 4 km CAMx database and perform base case
- **Task 7**: 2011 MPE and sensitivity modeling for Dona Ana County
- **Task 8**: SMOKE current FY US EI and FY Mexico emissions update
- **Task 9**: FY 4 km CAMx simulation
- **Task 10**: FY ozone projections (MATS)
- **Task 11**: FY emissions sensitivity/controls
- **Task 12**: FY 4 km source apportionment run
- **Task 13**: Air Quality Technical Support Document (AQTSD)
Outline of Today’s Presentation

Task 1-3 Deliverables

2. PowerPoint presentation on Permian Basin oil and gas 2011 and future year emission update (Technical memorandum provides additional detail)
3. PowerPoint presentation on Mexico emissions to be used in 2011 base and future year modeling
Task 1: Weather Research Forecast (WRF) Meteorology Modeling
SNMOS 2011 WRF Sensitivity Results and Recommendations

Lead: University of North Carolina
Task 1 Objectives and Deliverables

- **Objective**
  - Simulate and evaluate WRF meteorology for modeling 2011 summer season ozone in Doña Ana County, New Mexico

- **Deliverables**
  - Prepare a work plan for the WRF modeling and other aspects of study. *(Completed 10/28/2015)*
  - Power Point Presentation of WRF Results/Recommendations *(Completed 11/30/2015)*

- **Tasks**
  - Coordinate with WRF modelers in New Mexico to find the best model configuration for simulating ozone in Doña Ana County. *(Completed 11/30/2015)*
  - Use the current version of WRF to simulate summer ozone season (mid-April - August) meteorology for the year 2011 *(Completed 11/1/2015)*
  - Modeling domains: 36-km CONUS, 12-km Western U.S., and 4-km Doña Ana/El Paso/Juarez *(Completed 10/28/2015)*
  - Convert WRF output to CAMx inputs using WRFCAMx for 12-km New Mexico/West Texas/Northern Mexico and the 4-km Doña Ana/El Paso/Juarez domains *(Completed 11/30/2015)*
  - Prepare documentation and model performance information for Task 13. *(Completed 11/30/2015)*
WRF Modeling Domains

SNMOS 36/12/4km WRF Domains
WRF Sensitivities

WRFv3.7.1 (latest WRF release)

1. **WRF_NAM_Kfmods** – NAM ICBCs and the modified Kain-Fritsch cumulus scheme.

2. **WRF_NAM_MSKF** - Same as Configuration 1 with the multi-scale (grid-aware) Kain-Fritsch (MSKF) cumulus scheme.

3. **WRF_ERA_MSKF** - Same as Configuration 2 but using the ECMWF ERA-Interim Reanalysis as the ICBC fields.

4. **WRF_ERA_MSKF_AN** - Same as Configuration 3 but based on prior experiences from the San Juan Hg study. Analysis nudging was not applied in domain 2 in the San Juan Hg study. This configuration will turn off analysis nudging for domain 2.
WRF Model Evaluation

• Evaluation focused on 4-km domain statistics (other domains available)
  – May-August 2011 Average statistics of bias and error for temperature, mixing ratio, wind speed and direction. (Simplified into a table)

• Evaluation during periods with high ozone and active monsoon (Table stats., precipitation, and windrose)
  – 06/02/2011 thru 06/06/2011
  – 06/20/2011 thru 06/24/2011
  – 08/02/2011 thru 08/05/2011
  – 08/19/2011 thru 08/22/2011
# 12-km Domain Average Statistics

## May-Aug 2011 Period Average

<table>
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<tr>
<th></th>
<th>Temperature (deg K)</th>
<th>Mixing Ratio (g/kg)</th>
<th>Wind Speed (m/s)</th>
<th>Wind Direction (degrees)</th>
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</table>

NAM – **warm bias** / dry MR bias / **underestimates wind speed**

ERA – **warm bias** / **wet MR bias** / underestimates wind speed

MSKF – warm bias / **sensitive to ICBC** / underestimates wind speed; **precipitation**
Overall warm bias but cool bias in late spring that is consistent between runs.
Mixing Ratio

Overall errors are consistent with error growing from late spring to summer.
Winds

May 2011
All Sites within 4-km

Southern New Mexico Ozone Modeling Study
Winds

August 2011
All Sites within 4-km

Southern New Mexico Ozone Modeling Study
Winds

May - August 2011
All Sites within 4-km

Southern New Mexico Ozone Modeling Study
<table>
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Precipitation
July 28th Ozone Episode

PRISM - OBS

ERA_MSKF

NAM_MSKF

PRISM - OBS

ERA_MSKF – No AN

NAM_KFmods
Precipitation
July 28th – No WRF Mask

PRISM - OBS

ERA_MSKF

NAM_MSKF

PRISM - OBS

ERA_MSKF – No AN

NAM_KFmods
Winds


KLRU 4-km

OBS

WRFERA_MSKF_04k --- KLRU --- 2011-07-25 to 2011-07-29 --- Obs

ERA-MSKF

WRFERA_MSKF_04k --- KLRU --- 2011-07-25 to 2011-07-29 --- Mod

ERA-MSKF – NO AN

WRFERA_MSKF_AN_04k --- KLRU --- 2011-07-25 to 2011-07-29 --- Mod

NAM-MSKF

WRFNAM_MSKF_04k --- KLRU --- 2011-07-25 to 2011-07-29 --- Mod

NAM-KFmods

WRFNAM_KFmods_04k --- KLRU --- 2011-07-25 to 2011-07-29 --- Mod

Southern New Mexico Ozone Modeling Study
# Las Cruces, NM (KLRU) 4-km Statistics

**06/02/2011 thru 06/06/2011**

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Winds

06/02/2011-06/06/2011

KLRU 4-km

OBS

ERA-MSKF

NAM-MSKF

ERA-MSKF – NO AN

NAM-KFmods

Southern New Mexico Ozone Modeling Study
Las Cruces, NM (KLRU) 4-km Statistics
06/20/2011 thru 06/24/2011

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Winds

06/20/2011-06/24/2011
KLRU 4-km

OBS

ERA-MSKF

NAM-MSKF

Frequency of counts by wind direction (%)
### Las Cruces, NM (KLRU) 4-km Statistics

**08/02/2011 thru 08/05/2011**

<table>
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Precipitation
August 3\textsuperscript{rd} Ozone Episode
Winds

08/02/2011-08/05/2011
KLRU 4-km

OBS

ERA-MSKF

NAM-MSKF

ERA-MSKF – NO AN

NAM-KFmods

Southern New Mexico Ozone Modeling Study
Las Cruces, NM (KLRU) 4-km Statistics
08/19/2011 thru 08/22/2011

<table>
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Precipitation
August 21st Ozone Episode

PRISM - OBS

ERA_MSKF

NAM_MSKF

PRISM - OBS

ERA_MSKF – No AN

NAM_KFmods
Winds

08/19/2011-08/22/2011
KLRU 4-km

OBS

ERA-MSKF

ERA-MSKF – NO AN

NAM-KFmods

Southern New Mexico Ozone Modeling Study
Task 1: WRF MPE Summary

• Analysis nudging is needed in the 12km domain

• ERA vs NAM
  – ERA is generally wetter than NAM, better mixing ratio performance but positively biased overall
  – NAM performs better with temperature
  – ERA performs better with winds

• MSKF vs KF-mods
  – KF-mods is drier overall
  – MSKF has lower bias and error in mixing ratio
Task 1: SNMOS WRF Recommendations

• All WRF simulations able to simulate the predominant wind direction
• NAM-KFmods is too dry
  – select MSKF to improve dry bias
• ERA is wetter than NAM
• Recommend **NAM MSKF** because better to have a dry bias and improve temperature
  – Better to have a dry bias to allow more solar insolation for ozone production
Additional SNMOS WRF MPE Plots

- [http://ie.unc.edu/cempd/projects/data_viewer?project=SNMOS](http://ie.unc.edu/cempd/projects/data_viewer?project=SNMOS)
- Results > View the results from a single simulation
- MET > WRF
- Plot Types
  - AMET: Soccer, Spatial Surface, Summary, Timeseries, Windrose
  - NCL: Temperature-Pressure-Winds 2-d Spatial
  - PRISM: Precipitation 2-d Spatial
Additional SNMOS WRF MPE Plots
Task 2: Permian Basin Oil & Gas Inventory

Lead: Ramboll Environ
Task 2 Objectives and Deliverables

• Objective
  – Review available Permian Basin oil and gas inventories and recommend 2011 and future year inventories for the SNMOS

• Deliverables
  – Power Point Presentation on Permian Basin oil and gas 2011 and future year emission update (Completed 11/30/2015)
  – Memo on available Permian Basin oil and gas 2011 and future year emissions data (Completed 11/10/2015)
Outline

• Permian Basin emission inventory basis/background
• 2011 emission inventory summary
• Permian Basin forecast emission inventory basis/background
Inventory Basis/Methods

- **Basis:** 2011NEIv2-based Platform (2011v6.2)
- **2011 base year emissions from 2011 NEI**
  - Midstream (Point) sources: provided by state agencies
  - Well Site (Area) Sources:
    - New Mexico: estimated using EPA Oil and Gas Tool
    - Texas: provided by state agency
- **2017 and 2025 future year emissions forecasts**
  - O&G Activity Growth: AEO 2014
  - Control: Pertinent rulemakings
- **EPA O&G sector emissions only**
  - Confirmed O&G point source emissions include all O&G NAICS codes
Permian Basin Well Locations (circa 2014)

Source: Adapted from TCEQ Texas Oil and Gas Wells Map
http://www.tceq.state.tx.us/assets/public/implementation/barnett_shale/bs_images/txOilGasWells.png

Source: IHS Enerdeq Production Data
Permian Basin 2011 NOx Emissions

2011 NOx Emissions

• Totals (99,577 tpy)
  – 60% area sources (40% point sources)
  – 71% Texas (29% New Mexico)
Permian Basin 2011 NOx Emissions

2011 NOx Emissions

- Point Sources (40,302 tpy)
  - 59% Gas Plants
  - 39% Compressor Stations
  - 3% Other (tank batteries, etc.)
Permian Basin 2011 NOx Emissions

2011 NOx Emissions

- **Area Sources**
  (59,275 tpy)
  - 50% Compressor Engines
  - 26% Artificial Lift
  - 15% Heaters
  - 7% Drill Rigs
  - <3% All other categories combined
Permian Basin 2011 VOC Emissions

2011 VOC Emissions

- Totals (507,813 tpy)
  - 99% area sources (1% point sources)
  - 83% Texas (17% New Mexico)
  - combined

Permian Basin VOC Emissions

- TX area 82%
- NM area 17%
- TX point 1%
- NM point 0.4%
Permian Basin 2011 VOC Emissions

2011 VOC Emissions

- **Area Sources (498,889 tpy)**
  - 55% Oil Tanks
  - 18% Wellhead Venting
  - 5% Fugitives
  - 4% Pneumatic Devices
  - 4% Truck Loading
  - 4% Produced Water
  - <11% All other categories combined
## Permian Basin 2011 Inventory

### Criteria Pollutant Emissions Summary

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<td>28,935</td>
<td>7,036</td>
<td>16,699</td>
<td>5,136</td>
<td>935</td>
<td>920</td>
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<td>TX Total</td>
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<td>70,856</td>
<td>421,786</td>
<td>53,519</td>
<td>7,864</td>
<td>1,642</td>
<td>1,626</td>
</tr>
<tr>
<td>Grand Total</td>
<td></td>
<td>99,577</td>
<td>507,813</td>
<td>79,642</td>
<td>20,395</td>
<td>2,331</td>
<td>2,312</td>
</tr>
</tbody>
</table>
Permian Basin Forecast

Activity Growth

- O&G activity growth factors based on AEO 2014
- By O&G play growth factors (see figure)
- Southwest region growth factors outside of specified plays

Source: 2011v6.2 Modeling Platform TSD, excerpt from Figure 4-1
Permian Basin Forecast
Controls

• 2011NEIv2-based Platform O&G emission forecasts account for controls per the following regulations
  – New Source Performance Standards (NSPS) Subpart OOOO (area and point sources)
  – Reciprocating internal combustion engine (RICE) NSPS Subparts JJJJ and IIII and NESHAP Subpart ZZZZ (area and point sources)
  – Industrial/Commercial/Institutional Boilers and Process Heaters Maximum Achievable Control Technology (MACT) Rule (point sources)
  – Standards of Performance for Turbines 40 CFR Part 60 - Subpart KKKK (point sources)
  – Process Heaters NSPS (point sources)
Permian Basin Forecast Emissions

• Future year emissions will be summarized after the future year is determined
Task 3: Juarez and Mexico Border Inventory
Current and Future Years

Lead: University of North Carolina
Task 3 Objectives and Deliverables

• Objectives
  – Review available inventories and emissions input data for Juarez and Mexico border states
  – Recommend 2011 and future year inventories for the SNMOS

• Deliverables
  – Power Point Presentation on Mexico emissions to be used in 2011 base and future year modeling (Completed 11/30/2015)

• Tasks
  – Coordinate with NMED, EPA, and others as needed to gather the best-available current and future year inventories for Northern Mexico. (Completed 9/30/2015)
  – Develop deficient inventory components, as needed
  – Collect and process ancillary emissions data (spatial surrogates, temporal profile, chemical speciation) (Completed 11/1/2015)
Base and Future Year Mexico Inventories

- **US EPA 2011 Modeling Platforms**
  - **NEI 2011v1**
    - 1999 Mexico NEI (INEM) projection to 2012
    - Documentation: [EPA TSD](#); [ERG Inventory Conference Paper](#)
    - Projection years: 2018, 2025
  - **NEI 2011v2**
    - 2008 INEM inventory with corrections
    - Documentation: [ERG report to EPA](#)
    - Projection Years: 2018, 2025
Base Year Mexico Inventories
Mexico 2011 Inventory Analysis: NEIv1 vs NEIv2

Mexico Nonpoint NOX Emissions

- NEIv1 (MX2012)
- NEIv2 (MX2008)

TPY

Border States

States:
- Baja Calif Norte
- Sonora
- Chihuahua
- Coahuila
- Nuevo Leon
- Tamaulipas
- Aguascalientes
- Baja Calif Sur
- Campeche
- Chiapas
- Colima
- Distrito Federal
- Durango
- Guanajuato
- Guerrero
- Hidalgo
- Jalisco
- Mexico
- Michoacan
- Morelos
- Nayarit
- Oaxaca
- Puebla
- Queretaro
- Quintana Roo
- San Luis Potosi
- Sinaloa
- Tabasco
- Tlaxcala
- Veracruz
- Yucatan
- Zacatecas
Base Year Mexico Inventories

Mexico 2011 Inventory Analysis: NEIv1 vs NEIv2

Mexico Onroad Mobile NOX Emissions

TPY

Border States

Baja Calif Norte  Sonora  Chihuahua  Coahuila  Nuevo Leon  Tamaulipas

Aguascalientes  Baja Calif Sur  Campeche  Chiapas  Colima  Distrito Federal  Durango  Guanajuato  Guerrero  Hidalgo  Jalisco  Mexico  Michoacan  Morelos  Nayarit  Oaxaca  Puebla  Queretaro  Quintana Roo  San Luis Potosi  Sinaloa  Tabasco  Tlaxcala  Veracruz  Yucatan  Zacatecas

NEIv1 (MX2012)  NEIv2 (MX2008)
Base Year Mexico Inventories

Mexico 2011 Inventory Analysis: NEIv1 vs NEIv2

Mexico Nonpoint VOC Emissions

- NEIv1 (MX2012)
- NEIv2 (MX2008)

Border States

TPY

- Baja Calif Norte
- Sonora
- Chihuahua
- Coahuila
- Nuevo Leon
- Tamaulipas
- Aguascalientes
- Baja Calif Sur
- Campeche
- Chiapas
- Colima
- Distrito Federal
- Durango
- Guanajuato
- Guerrero
- Hidalgo
- Jalisco
- Mexico
- Michoacan
- Morelos
- Nayarit
- Oaxaca
- Puebla
- Queretaro
- Quintana Roo
- San Luis Potosi
- Sinaloa
- Tabasco
- Tlaxcala
- Veracruz
- Yucatan
- Zacatecas
Base Year Mexico Inventories

Mexico 2011 Inventory Analysis: NEIv1 vs NEIv2

Mexico Onroad Mobile VOC Emissions

- NEIv1 (MX2012)
- NEIv2 (MX2008)

Border States

TPY

- 500,000
- 450,000
- 400,000
- 350,000
- 300,000
- 250,000
- 200,000
- 150,000
- 100,000
- 50,000

States:
- Baja Calif Norte
- Sonora
- Chihuahua
- Coahuila
- Nuevo Leon
- Tamaulipas
- Aguascalientes
- Baja Calif Sur
- Campeche
- Chiapas
- Colima
- Distrito Federal
- Durango
- Guanajuato
- Guerrero
- Hidalgo
- Jalisco
- Mexico
- Michoacan
- Morelos
- Nayarit
- Oaxaca
- Puebla
- Queretaro
- Quintana Roo
- San Luis Potosi
- Sinaloa
- Tabasco
- Tlaxcala
- Veracruz
- Yucatan
- Zacatecas
Base Year Mexico Inventories

Mexico 2011 Inventory Analysis: NEIv1 vs NEIv2

Mexico Point VOC Emissions

<table>
<thead>
<tr>
<th>Border States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tpy</td>
</tr>
<tr>
<td>---------------</td>
</tr>
<tr>
<td>70,000</td>
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<tr>
<td>60,000</td>
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<td>50,000</td>
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<td>40,000</td>
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<tr>
<td>30,000</td>
</tr>
<tr>
<td>20,000</td>
</tr>
<tr>
<td>10,000</td>
</tr>
</tbody>
</table>

- Baja Calif Norte
- Sonora
- Chihuahua
- Coahuila
- Nuevo Leon
- Tamaulipas
- Aguascalientes
- Baja Calif Sur
- Campeche
- Chiapas
- Colima
- Distrito Federal
- Durango
- Guanajuato
- Guerrero
- Hidalgo
- Jalisco
- Mexico
- Michoacan
- Morelos
- Nayarit
- Oaxaca
- Puebla
- Queretaro
- Quintana Roo
- San Luis Potosi
- Sinaloa
- Tabasco
- Tlaxcala
- Veracruz
- Yucatan
- Zacatecas

Southern New Mexico Ozone Modeling Study
Base and Future Year Mexico Emissions

- On September 30 SNMOS conference call decision made in coordination with NMED to use NEI2011v2 Mexico inventories
- **NEI2011v2**: Mexico 2008, 2018, and 2025 inventories
  - Based on work by SEMARNAT published in early 2014 (Inventario Nacional de Emisiones de México)
  - Eastern Research Group (ERG) reviewed and improved the inventory for EPA in late 2014
  - Documentation: [ERG Report](#)
- **Natural**
  - Fires from WRAP PMDETAIL Phase II
  - Biogenics from MEGAN 2.10
  - Windblown Dust from WRAP WBD model
Southern New Mexico Ozone Modeling Study

Base and Future Year Mexico Inventories
Mexico Inventory Analysis: 2008 vs 2025

NEI2011v2 NOx Emissions: Mexico Border States

<table>
<thead>
<tr>
<th>State</th>
<th>Area</th>
<th>Mobile</th>
<th>Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baja Norte 08</td>
<td>21,493</td>
<td>46,346</td>
<td>13,521</td>
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<td>Baja Norte 25</td>
<td>29,616</td>
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<td>34,934</td>
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<td>Sonora 08</td>
<td>23,438</td>
<td>14,338</td>
<td>14,689</td>
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<td>Sonora 25</td>
<td>29,047</td>
<td>7,568</td>
<td>19,810</td>
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<tr>
<td>Chihuahua 08</td>
<td>55,087</td>
<td>21,893</td>
<td>12,138</td>
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<tr>
<td>Chihuahua 25</td>
<td>60,814</td>
<td>10,121</td>
<td>13,619</td>
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<tr>
<td>Coahuila 08</td>
<td>16,370</td>
<td>94,558</td>
<td>174,978</td>
</tr>
<tr>
<td>Coahuila 25</td>
<td>21,127</td>
<td>41,640</td>
<td>222,978</td>
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<tr>
<td>Nuevo Leon 08</td>
<td>25,018</td>
<td>68,375</td>
<td>38,330</td>
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<tr>
<td>Nuevo Leon 25</td>
<td>31,755</td>
<td>31,026</td>
<td>59,774</td>
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<td>Tamaulipas 08</td>
<td>47,906</td>
<td>17,073</td>
<td>33,404</td>
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<td>Tamaulipas 25</td>
<td>56,222</td>
<td>7,876</td>
<td>44,183</td>
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Base and Future Year Mexico Inventories
Mexico Inventory Analysis: 2008 vs 2025

NEI2011v2 VOC Emissions: Mexico Border States

<table>
<thead>
<tr>
<th>State</th>
<th>2008</th>
<th>2025</th>
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<tbody>
<tr>
<td>Baja Norte</td>
<td>60,078</td>
<td>81,036</td>
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<tr>
<td>Sonora</td>
<td>58,422</td>
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<td>Chihuahua</td>
<td>97,197</td>
<td>120,858</td>
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<tr>
<td>Coahuila</td>
<td>49,052</td>
<td>62,857</td>
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<tr>
<td>Nuevo Leon</td>
<td>85,480</td>
<td>112,230</td>
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<td>Tamaulipas</td>
<td>70,068</td>
<td>87,327</td>
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<td><strong>Total</strong></td>
<td>507,212</td>
<td>641,865</td>
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<th>Source</th>
<th>2008</th>
<th>2025</th>
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<td>Area</td>
<td>60,078</td>
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<td>44,654</td>
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<tr>
<td>Point</td>
<td>12,886</td>
<td>20,655</td>
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</table>

Southern New Mexico Ozone Modeling Study
Base and Future Year Mexico Inventories
Mexico Inventory Analysis: 2008 vs 2025

NEI2011v2 PM2.5 Emissions: Mexico Border States

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Baja Norte</td>
<td>4,370</td>
<td>5,141</td>
<td>7,156</td>
<td>7,976</td>
<td>15,590</td>
<td>16,752</td>
<td>5,518</td>
<td>5,941</td>
<td>5,877</td>
<td>7,264</td>
<td>14,136</td>
<td>15,250</td>
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<tr>
<td>Sonora</td>
<td>338</td>
<td>485</td>
<td>136</td>
<td>186</td>
<td>223</td>
<td>278</td>
<td>320</td>
<td>380</td>
<td>499</td>
<td>627</td>
<td>173</td>
<td>212</td>
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<tr>
<td>Chihuahua</td>
<td>2,025</td>
<td>5,235</td>
<td>5,636</td>
<td>6,408</td>
<td>2,925</td>
<td>2,988</td>
<td>17,822</td>
<td>24,425</td>
<td>7,756</td>
<td>12,000</td>
<td>6,785</td>
<td>9,276</td>
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</table>

Legend:
- **Area**
- **Mobile**
- **Point**
Base and Future Year Mexico Inventories

Mexico Inventory Analysis: NOx Emissions

2008 NOx Emissions

- Ag
- Nonpoint
- Nonroad
- Onroad
- EGU Point
- NonEGU Point
- Fires
- Biogenic

Southern New Mexico Ozone Modeling Study
Base and Future Year Mexico Inventories

Mexico Inventory Analysis: NOx Emissions

2025 NOx Emissions

Southern New Mexico Ozone Modeling Study
Base and Future Year Mexico Inventories

Mexico Inventory Analysis: 2008 vs 2025 NOx

Trends Analysis

- Change from 2008 → 2025
- Border States
  - +11%: Baja N.
  - -0.1%: Coahuila
  - -4%: Chihuahua
  - -6%: Nuevo Leon
  - +8%: Tamaulipas
- Increases in Nonpoint, Nonroad, and EGU Point
- Decreases in Onroad NOx: 54% decrease from diesel vehicles, 50% decrease from gasoline vehicles
Base and Future Year Mexico Inventories

Mexico Inventory Analysis: VOC Emissions

2008 VOC Emissions

- Ag
- Nonpoint
- Nonroad
- Onroad
- EGU Point
- NonEGU Point
- Fires
- Biogenic

Southern New Mexico Ozone Modeling Study
Base and Future Year Mexico Inventories

Mexico Inventory Analysis: VOC Emissions

2025 VOC Emissions

- Ag
- Nonpoint
- Nonroad
- Onroad
- EGU Point
- NonEGU Point
- Fires
- Biogenic

Southern New Mexico Ozone Modeling Study
**Base and Future Year Mexico Inventories**

**Mexico Inventory Analysis: 2008 vs 2025 VOC**

**Trends Analysis**
- **Change from 2008 → 2025**
- **Border States**
  - +5%: Baja N.
  - -5%: Coahuila
  - +2%: Chihuahua
  - -0.3%: Nuevo Leon
  - +2%: Tamaulipas
- **Increases in Nonpoint, NonEGU, and EGU Point**
- **Decreases in Onroad**
Base Year Mexico Inventories
Doña Ana and Surrounding Counties 2011 NOx EI

NEI2011v2 NOx Emissions: Dona Ana and Surrounding Areas

- POINT
- MOBILE
- AREA
Base Year Mexico Inventories
Doña Ana and Surrounding Counties 2011 VOC EI

NEI2011v2 VOC Emissions: Doña Ana and Surrounding Areas

- **TPY**
  - NEI2011v2 VOC Emissions

- **Areas**:
  - Dona Ana Co, NM
  - Luna Co, NM
  - Otero Co, NM
  - Sierra Co, NM
  - El Paso Co, TX
  - Agua Prieta, SO
  - Naco, SO
  - Nogales, SO
  - Santa Cruz, SO
  - Aduana, CH
  - Ascension, CH
  - Buenaventura, CH
  - Casas Grandes, CH
  - Janos, CH
  - Juarez, CH
  - Nuevo Casas Grandes, CH

- **Categories**:
  - **POINT**
  - **MOBILE**
  - **AREA**
Task 3 Summary

• SNMOS will use 2008-based SEMARNAT/ERG inventory from the NEI2011v2 modeling platform
  – Future Year options include 2018 and 2025
  – Analyses in the above slides for 2025
Additional SNMOS Emissions Plots

- [http://ie.unc.edu/cempd/projects/data_viewer?project=SNMOS](http://ie.unc.edu/cempd/projects/data_viewer?project=SNMOS)
- Results > View the results from a single simulation
- EMIS > SMOKE > DonaAna_base11b
- Plot Types
  - 2d Tile Plots
  - Ex. 12-km and 4km July total US nonroad mobile total Organic Gas (TOG) emissions
Next Steps

Tasks to be Completed by February 29, 2016

- **Task 1**: 2011 WRF 36/12/4 km with 4 km focus on Dona Ana/El Paso/Juarez and Work Plan (Completed)
- **Task 2**: 2011 update Permian Basin O&G (Completed)
- **Task 3**: 2011 update of Juarez and nearby Mexico EI, 2020 Mexico emissions update (Completed)
- **Task 4**: SMOKE current 2011 NEI for 4 km domain (2/29/16)
- **Task 5**: Gridded 2011 biogenic, fires, wind-blown dust, lightning emissions for 4 km domain (2/29/16)
- **Task 6**: Develop 2011 4 km CAMx database and perform base case (2/29/16)
- **Task 7**: 2011 MPE and sensitivity modeling for Dona Ana County (4/30/16)
- **Task 8**: SMOKE current FY US EI and FY Mexico emissions update (4/30/16)
- **Task 9**: FY 4 km CAMx simulation (5/31/16)
- **Task 10**: FY ozone projections (MATS) (5/31/16)
- **Task 11**: FY emissions sensitivity/controls (8/15/16)
- **Task 12**: FY 4 km source apportionment run (9/15/16)
- **Task 13**: Air Quality Technical Support Document (11/18/16)