Development of an Air Emission Inventory for the Western Arizona Sonora Border Air Quality Study (WASBAQS) Part 2 – Mexico Emission Inventory

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Presentation Overview

• Inventory scope
• Methodology and data collection
  – Point sources
  – Area sources
  – On-road motor vehicles
  – Nonroad mobile sources
• Conclusion
Inventory Scope

- Pollutants and sources types as discussed in Part 1 presentation
- Inventory Domain
  - NW portion of municipality of San Luis Río Colorado (SLRC), Sonora
    - Municipality population of 157,076 (90% in domain)
    - Includes urban area
  - NE portion of municipality of Mexicali, Baja California
    - Municipality population of 855,962 (9% in domain)
    - Agricultural ejido (communes); does not include urban area
Map from Gopi
Point Sources – Definition

- Classified as federal or state jurisdiction
  - Federal – 11 industrial sectors or location
  - State – not federal jurisdiction

- Submit emissions data by Annual Operating Certificate (Cédula de Operación Annual – COA)

- No point sources (> 10 tons or more) identified in the 1999 Mexico NEI

- SLRC Municipal Office of Economic Development and Tourism identified 32 maquiladoras
Point Sources – Methodology

• **32 maquiladoras**
  – 12 textile or clothing manufacturers
  – 20 clustered in Industrial Parque east of town
  – None in Mexicali portion of domain

• **SLRC identified most significant 15 sources in Industrial Parque**

• **SLRC mailed out point source surveys to significant sources**

• **Follow-up by CESUES students**
Point Sources – Survey Results

• **8 responses**
  – 1 facility not operating in 2005
  – Fuel combustion – stack test data (4)
  – Paint usage (4); VOC content (1)

• **Reconciliation**
  – Diesel and LPG quantities subtracted from area source fuel combustion
  – Employment counts subtracted from industrial surface coating

• **Stack Parameters (except coordinates)**

• **Operating Schedules**
## Point Sources – Results (tpy)

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<tr>
<th>Facility</th>
<th>NO\textsubscript{x}</th>
<th>SO\textsubscript{2}</th>
<th>VOC</th>
<th>CO</th>
<th>PM\textsubscript{10}</th>
<th>PM\textsubscript{2.5}</th>
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<tr>
<td>Acero Ameri-mex</td>
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<td>0.0</td>
<td>3.2</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Demda Mexico (Daewoo)</td>
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<td>0.0</td>
<td>7.8</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
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<tr>
<td>G.P.I. Mexicana</td>
<td>0.1</td>
<td>&lt;0.1</td>
<td>0.0</td>
<td>0.3</td>
<td>0.0</td>
<td>0.0</td>
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<tr>
<td>Mecox Resources</td>
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<td>0.0</td>
<td>5.5</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
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<tr>
<td>Phoenix Textiles</td>
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<td>0.0</td>
<td>0.0</td>
<td>10.4</td>
<td>0.0</td>
<td>0.0</td>
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<tr>
<td>SANA Internacional</td>
<td>4.2</td>
<td>12.5</td>
<td>0.0</td>
<td>27.5</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
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<tr>
<td>TSE de Mexico</td>
<td>2.7</td>
<td>0.0</td>
<td>16.4</td>
<td>82.1</td>
<td>0.0</td>
<td>0.0</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>26.7</strong></td>
<td><strong>12.5</strong></td>
<td><strong>32.9</strong></td>
<td><strong>120.3</strong></td>
<td><strong>&lt;0.1</strong></td>
<td><strong>&lt;0.1</strong></td>
</tr>
</tbody>
</table>
Area Sources – Definition

• Area source list based upon previous inventories
  – ADEQ Ambos Nogales
  – ADEQ Douglas/Agua Prieta
  – Mexico National Emissions Inventory

• Some General Groups
  – Solvents
  – Agricultural
  – Paved and unpaved road dust
  – Other
Area Sources – Solvents

- **Mexico-specific emission factors from MNEI**
  - Architectural surface coating
  - Industrial surface coating
  - Autobody refinishing
  - Graphic arts

- **Adjustment of consumer solvents**
  - Aftermarket automotive adjustment factor of 0.116
  - Household cleaning products adjustment factor of 0.25

- **Dry cleaning**
  - Interviews with 2 out of 5 dry cleaners, including largest one

- **PEMEX gasoline stations**
  - Gasoline quantities not provided, but station locations identified
Area Sources – Agricultural Sources

• **SAGARPA**
  – Contacts with SLRC only, unable to contact Mexicali

• **Tilling and Harvesting**
  – SAGARPA crop calendar
  – ARB emission factors and acre-passes

• **Pesticide Application**
  – Typical application quantities from SAGARPA cost production estimates

• **Agricultural Burning**
  – Limited to wheat fields
  – Occasionally government subsidies to not burn
13 of the 156 Class I areas are in the WRAP states and tribal areas.
Area Sources – Paved/Unpaved Road Dust

- **Sampling conducted in Yuma and SLRC**
  - 10 paved samples each
  - 10 unpaved samples each
  - Per AP-42 Appendix C.1 and C.2

- **Yuma**
  - Collection by ERG

- **SLRC**
  - Collection by Mexicali subcontractor
  - Analysis by Tijuana laboratory
Area Sources – Paved/Unpaved Road Dust

Results

• **Paved**
  - SLRC – silt (0.78-3.80%); silt loading (0.09-0.65 g/m²)
  - Yuma – silt (5.5-28.9%); silt loading (0.13-225 g/m²)

• **Unpaved**
  - SLRC – silt (0.34-1.85%); moisture (0.03-0.57%)
  - Yuma – silt (4.3-10.8%); moisture (0.2-0.8%)

• **Emission Factors (average)**
  - SLRC paved – 0.004 lbs/VMT
  - Yuma paved – 0.059 lbs/VMT
  - SLRC unpaved – 0.134 lbs/VMT
  - Yuma unpaved – 1.125 lbs/VMT

• **Yuma emission factors – order of magnitude higher**
• **SLRC dust – “sandy”, entrained plumes barely visible**
Area Sources – Other Sources

- **Charbroiling/Street Vendors**
  - Interviews at main charbroiling facility and smaller ones
  - Minimal number of street vendors

- **Border Crossings**
  - SLRC and Andrade (NE tip of Mexicali)
  - Hourly vehicle counts and wait times from Customs and Border Protection
  - Emission factors from MOBILE6-Mexico
Area Sources – Other Sources

• Brick Kilns
  – Two neighborhoods in SLRC and one in Algodones (NE tip of Mexicali)
  – Regulated in SLRC with burn schedules coordinated by city and brick kiln associations
  – Temporary kilns
  – Various fuels
  – Fuel and brick/burn quantities estimated through interviews
Area Sources – Results

- **Significant Sources**
  - Agricultural burning – Mexicali (CO, NOx, PM2.5)
  - Unpaved and paved road dust (PM10)
  - Agricultural tilling and harvest – Mexicali (PM10)
  - Brick kilns (CO, PM2.5, HAPs)
  - Solvents (VOC)
  - Industrial residual combustion (SO2)
On-Road Motor Vehicles – Methodology

• **VKT Estimates**
  – Travel demand model (TDM)
    ‣ Detailed for SLRC urban area
    ‣ Coarse for SLRC non-urban area and Mexicali portion of domain
  – Link-level
  – Methodology explained in 2003 conference paper (see Wolf, Fields, and González-Ayala)

• **Emission Factors**
  – MOBILE6-Mexico
  – Link-level for a specific link-level congested speed
Detail of loaded roadway network for urban SLRC
On-Road Motor Vehicles – Results

- **Significant Sources**
  - Heavy-duty diesel vehicles (NOx, SO2, PM10, and PM2.5)
  - Light-duty gas vehicles and trucks (VOC, CO, and HAPs)

- **Mexicali emissions > SLRC emissions**
  - SLRC more population and vehicle trips, but more concentrated activity
  - Mexicali trip origins and destinations more disperse
  - TDM performs best in urban areas; more uncertainty in rural areas
Nonroad Mobile Sources – Definition

• **Construction and agricultural nonroad equipment**
  – Estimated using NONROAD-Mexico

• **Other nonroad equipment**
  – Thought to be less significant; not in NONROAD-Mexico – not estimated

• **Railroads and commercial marine vessels**
  – Not present in domain – not estimated

• **SLRC airport**
  – Very infrequent general aviation – not estimated
Non-Road Mobile Sources – Results

• Mexicali > SLRC (~ 1.6-2.2 times)
• Mexicali
  – Predominantly agricultural equipment (69-79%)
• SLRC
  – Predominantly construction equipment (75-84%)
SLRC and Mexicali NOx Emissions

- SLRC Point: 0.7%
- SLRC Area: 6.7%
- SLRC On-Road: 14.4%
- SLRC Nonroad: 13.7%
- Mexicali Area: 15.3%
- Mexicali On-road: 26.2%
- Mexicali Nonroad: 23.0%
SLRC and Mexicali CO Emissions

- **SLRC Area**: 7.0%
- **SLRC On-Road**: 13.1%
- **SLRC Nonroad**: 1.0%
- **Mexicali Area**: 53.1%
- **Mexicali On-road**: 23.2%
- **Mexicali Nonroad**: 2.1%
- **SLRC Point**: 0.5%
- **SLRC Nonroad**: 1.0%
- **SLRC On-Road**: 13.1%
**SLRC and Mexicali Total HAPs**

- **SLRC Area**: 39.5%
- **Mexicali Area**: 32.2%
- **Mexicali On-road**: 14.7%
- **Mexicali Nonroad**: 2.9%
- **SLRC On-Road**: 8.9%
- **SLRC Nonroad**: 1.3%
- **SLRC Point**: 0.4%
Conclusions

• First-ever inventory for SLRC and rural Mexicali
• Local data supplemented with interpolation of national/state data
• More rigorous data collection needed (e.g., interviews, brick kiln fuel use, etc.)
• Need to confirm assumptions (e.g., industrial residual, Mexicali rural, etc.)
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