Development of an Air Emission Inventory for the Western Arizona Sonora Border Air Quality Study (WASBAQS)
Part 1 – U.S. Emission Inventory

Presented by
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ENVIRON International Corporation

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June 2-5, 2008
Presentation Outline

• Introduction
• Inventory Scope
• Technical Approach
  – Stationary Point
  – Area Sources
  – Mobile Sources
    • On-road, Off-road
    – Fugitive Dust
      • Agricultural Dust
      • Road Dust
      • Windblown Dust
      • Construction
  – Agricultural Burning & Wildfires
• Emissions Modeling
Introduction

• Western Arizona – Sonora Border Air Quality Study
  – Cross-border risk assessment study conducted by ADEQ

• WASBAQS Goals & Objectives
  – Characterize air emissions along Arizona/Mexico border
  – Health risk assessment for Yuma, San Luis Rio Colorado & NE Baja California
  – Evaluate proposed control strategies within the WASBAQS domain

• Phased Approach to Achieve Objectives
  1. Air Quality Monitoring
  2. Emission Inventory Development
  3. Air Quality Modeling & Control Strategy Evaluation
  4. Human Health Risk Assessments
Emission Inventory Objectives & Approach

- Development of complete emission inventory CAPs & HAPs
  - Refinements based on local data sources and information
  - Conduct site visits
  - Focus on major sources (agricultural activities; fugitive dust; mobile sources)
  - Preparation for air quality modeling
  - Temporal, spatial allocation; speciation
- Review & recommend emissions and AQ modeling systems
  - Emissions Processing System, version 3 (EPS3)
  - Comprehensive Airquality Model w/ extensions (CAMx)
- Prepare emission inventory for AQ modeling
Inventory Scope

Geographic Domain

- Southern Yuma County, AZ
- Southeastern Imperial County, CA
- Northwestern Sonora, Mexico
- Northeastern Baja California, Mexico
Inventory Scope
Modeling Domains
Inventory Scope

• Pollutants
  – Criteria pollutants (CAPs)
    • NO$_x$, SO$_x$, VOC, CO, PM$_{10}$, PM$_{2.5}$, NH$_3$
  – Hazardous pollutants (HAPs)
    • 189 HAPs as listed in 1990 CAAA under Title III

• Source Categories
  – Stationary Point (≥ 10 tpy of relevant pollutant)
  – Stationary Area
  – Mobile (On-Road & Off-Road)
  – Fugitive Dust (agricultural, road, construction, windblown)
  – Fires (agricultural, wildfire & prescribed burning)

• Temporal Resolution
  • Calendar year 2005
  • Hourly for typical weekday & weekend day for each season
Speciation

- Based on EPA’s SPECIATE4 database
- VOC and PM-based speciation profiles
- Assumptions for missing profiles
- Estimated all applicable HAPS (189 HAPs defined in 1990 CAAA)
- Inventory summarized for selected HAPS

- 1,3-Butadiene
- Acetaldehyde
- Benzene
- Carbontetrachloride
- Chloroform
- Dichloromethane
- Ethylbenzene
- Formaldehyde
- m,p-Xylene
- o-Xylene

- Styrene
- Toluene
- Trichloroethene
- Vinylchloride
- Arsenic
- Cadmium
- Chromium
- Manganese
- Nickel
- Perchloroethylene
Stationary Point Sources

- 2005 emission estimates of NOx, VOC, CO, SOx, PM & total HAPs from ADEQ
- Major Stationary Points (> 10 tpy)
  - APS Yucca Power Plant – 150 MW natural gas-fueled turbines
  - Yuma Cogeneration Assoc. – 55 MW combine cycle gas turbines
  - Temporal profiles based on RPO “typical” modeling inventories
- Minor Points
  - light industry, MCAS, landfills, WWTP
  - Distributed movable sources – sand & gravel operations, concrete batch plants, etc.

<table>
<thead>
<tr>
<th>Source</th>
<th>VOC</th>
<th>CO</th>
<th>NOx</th>
<th>SOx</th>
<th>PM10</th>
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<td><strong>172.1</strong></td>
<td><strong>512.2</strong></td>
<td><strong>25.7</strong></td>
<td><strong>118.3</strong></td>
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</table>
Area Sources

- Solvent utilization, fuel combustion, dry cleaners, RWC, open burning, structure fires, etc.
  - Estimation methodologies from EIIP guidance
  - US Census, Yuma City & County Agencies, ADEQ, ADOT
  - Per-capita emission factors

- Adjustments for seasonal population increases
  - Increased winter population (winter visitors, seasonal residents, i.e., “snowbirds”)

<table>
<thead>
<tr>
<th>Population</th>
<th>Spring</th>
<th>Summer</th>
<th>Autumn</th>
<th>Winter</th>
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<tr>
<td>Visitor Population</td>
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<td>213</td>
<td>20,869</td>
<td>53,719</td>
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<td>2005 Base Population</td>
<td>189,480</td>
<td>189,480</td>
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</tr>
</tbody>
</table>
Area Sources

- Gasoline distribution (Stage I & II refueling)
  - ADEQ survey of local gasoline distributors and gas stations
    - Throughput based on surveys (75% response rate)
    - Fuel sampling – RVP, sulfur content, seasonal variation based on sample averages by season & EIA sales data
    - Monthly & weekly sales data used for temporal allocation
    - Gas station locations geo-coded for spatial allocation
  - Emission factors from EIIP & MOBILE6
Area Sources

• Pesticide Application
  – Yuma Co. – 2005 Pesticide Use Reporting (PUR) database
    • Application type & amounts by crop, application methods, dates, locations
    • Locations provided by Township/Range/Section (TRS)
    • Arizona State TRS GIS layers used for spatial allocation
  – Imperial Co. – CA Department of Pesticide Regulation
    – Estimation methodology based on CARB method using VOC ‘emissions potential’
    – HAPs estimated from reported active ingredients; assumptions for inert ingredients

• US Army Yuma Proving Grounds
  – Emission estimates provided by US Army
    • Boilers, generators, industrial processes, woodworking, waste disposal, other miscellaneous sources
  – 2005 seasonal estimates of NOx, VOC, CO, SOx and total HAPs by SCC and location
Ammonia Sources

- Estimates based on WRAP RMC GIS NH3 Model
  - Developed as GIS-based modeling system
  - Applied domain-wide (US & Mexico)
  - Incorporates environmental parameters – soil pH, met data (winds, temperatures)
  - Source categories include:
    - Livestock, Fertilizers, Native Soils, Domestic Sources

- Incorporates county-level and local activity data
  - Livestock headcounts adjusted based on University of Arizona Agricultural Extension
  - Fertilizer usage based on county-level data from USDA & NASS
  - Activity data for soil emissions based on LULC; crop locations from pesticide database & TRS data
  - Monthly activity data for fertilizers; annual for livestock, domestic,

- Model estimates hourly emissions based on temporal variations of met data (not used in current application)
### Domain-wide Annual Ammonia Emissions

<table>
<thead>
<tr>
<th>Category</th>
<th>Yuma, AZ</th>
<th>Imperial, CA</th>
<th>Baja</th>
<th>Sonora</th>
<th>Total</th>
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<tbody>
<tr>
<td>Livestock</td>
<td>22</td>
<td>8</td>
<td>95</td>
<td>2</td>
<td>127</td>
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<tr>
<td>Fertilizers</td>
<td>1,563</td>
<td>289</td>
<td>5,928</td>
<td>677</td>
<td>8,458</td>
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<tr>
<td>Native Soils</td>
<td>550</td>
<td>315</td>
<td>56</td>
<td>202</td>
<td>1,122</td>
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<td>Domestic</td>
<td>78</td>
<td>10</td>
<td>5</td>
<td>30</td>
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<td><strong>Total</strong></td>
<td><strong>2,213</strong></td>
<td><strong>621</strong></td>
<td><strong>6,084</strong></td>
<td><strong>911</strong></td>
<td><strong>9,830</strong></td>
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<tr>
<td>Source Category</td>
<td>VOC</td>
<td>CO</td>
<td>NOx</td>
<td>SOx</td>
<td>PM10</td>
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<tr>
<td>Auto Body Refinishing</td>
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<td>0.0</td>
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<td>Construction</td>
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<td>Dry Cleaning</td>
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<td>Fuel Combustion</td>
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<td>Industrial Surface Coating</td>
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<td>Vehicle Fires</td>
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<td>1.4</td>
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<td>Structural Fires</td>
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<td>8.8</td>
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<td>Commercial Cooking</td>
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<td>Pesticides</td>
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<td>Yuma Proving Grounds</td>
<td>14.9</td>
<td>18.4</td>
<td>3.3</td>
<td>1.7</td>
<td>1.0</td>
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<td><strong>Total</strong></td>
<td><strong>2563.4</strong></td>
<td><strong>167.4</strong></td>
<td><strong>185.5</strong></td>
<td><strong>229.3</strong></td>
<td><strong>2599.2</strong></td>
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On-Road Mobile Sources

- Link-based estimates in Yuma
  - Travel Demand Modeling by YMPO (TransCAD)
  - Data included VMT, link lengths, roadway classes, free-flow speeds, roadway capacities & total daily volumes
  - Transportation network provide in GIS format

- HPMS estimates outside transportation network region
  - 2005 HPMS VMT data from ADOT

- MOBILE6 applied with:
  - adjustments for specific fuel properties; vehicle registration data

<table>
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<tr>
<th>Roadway Type</th>
<th>TransCAD VMT (1000mi/day)</th>
<th>Yuma County-wide HPMS VMT (1000mi/day)</th>
<th>Non-YMPO VMT estimates</th>
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<td>Functional Code</td>
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<td>1,908</td>
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<td>Principal Arterial</td>
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<td>1,094</td>
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<tr>
<td>Minor Arterial</td>
<td>816</td>
<td>769</td>
<td>-</td>
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<tr>
<td>Collector</td>
<td>815</td>
<td>789</td>
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<tr>
<td>Local</td>
<td>430</td>
<td>664</td>
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<tr>
<td>Totals</td>
<td>4,316</td>
<td>5,223</td>
<td>Totals</td>
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YMPO Transportation Network
## On-Road Mobile Emissions

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<tr>
<th>Source</th>
<th>Exhaust VOC</th>
<th>Evap VOC</th>
<th>CO</th>
<th>NOx</th>
<th>PM10</th>
<th>PM2.5</th>
<th>SO2</th>
<th>NH3</th>
<th>Total HAPS</th>
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<td><strong>Wednesday</strong></td>
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<td></td>
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<tr>
<td>Transportation Network</td>
<td>4.301</td>
<td>3.483</td>
<td>101.16</td>
<td>15.060</td>
<td>0.305</td>
<td>0.216</td>
<td>0.222</td>
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<td>HPMS “donut”</td>
<td>0.972</td>
<td>0.776</td>
<td>21.5</td>
<td>2.908</td>
<td>0.077</td>
<td>0.056</td>
<td>0.063</td>
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<td><strong>Totals</strong></td>
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<td><strong>4.259</strong></td>
<td><strong>122.65</strong></td>
<td><strong>17.968</strong></td>
<td><strong>0.381</strong></td>
<td><strong>0.273</strong></td>
<td><strong>0.285</strong></td>
<td><strong>0.552</strong></td>
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<td>Transportation Network</td>
<td>3.295</td>
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<td>0.144</td>
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<tr>
<td>HPMS “donut”</td>
<td>0.863</td>
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<td>19.54</td>
<td>2.055</td>
<td>0.049</td>
<td>0.034</td>
<td>0.041</td>
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<td><strong>Totals</strong></td>
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<td><strong>0.186</strong></td>
<td><strong>0.500</strong></td>
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<tr>
<th>Season</th>
<th>VOC exhaust</th>
<th>VOC evap</th>
<th>CO</th>
<th>NOx</th>
<th>PM10</th>
<th>PM2.5</th>
<th>SO2</th>
<th>NH3</th>
<th>Total HAPS</th>
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<tbody>
<tr>
<td><strong>Wednesday</strong></td>
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<tr>
<td>Winter</td>
<td>7.130</td>
<td>4.617</td>
<td>172.94</td>
<td>22.539</td>
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<td>0.325</td>
<td>0.322</td>
<td>0.651</td>
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<td>Spring</td>
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<td>4.073</td>
<td>111.99</td>
<td>17.432</td>
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<td>0.267</td>
<td>0.324</td>
<td>0.527</td>
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<td>0.227</td>
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<td>4.048</td>
<td>110.90</td>
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<td>0.270</td>
<td>0.266</td>
<td>0.558</td>
<td>2.196</td>
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<tr>
<td><strong>Saturday</strong></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
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<td>Winter</td>
<td>5.583</td>
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<td>15.151</td>
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<td>0.198</td>
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<td>0.590</td>
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<td>Spring</td>
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<td>0.164</td>
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<td>Summer</td>
<td>3.272</td>
<td>3.883</td>
<td>82.20</td>
<td>9.622</td>
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<td>0.140</td>
<td>0.144</td>
<td>0.426</td>
<td>1.573</td>
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<td>Autumn</td>
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<td>93.26</td>
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<td>0.252</td>
<td>0.165</td>
<td>0.169</td>
<td>0.506</td>
<td>1.735</td>
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</table>
On-road Mobile Emissions by Vehicle Class

Weekday

Weekend
Off-Road Mobile Sources

• Off-road Mobile Source Categories
  – agricultural equipment
  – airport ground support
  – construction equipment
  – industrial and commercial equipment
  – residential and commercial lawn and garden equipment
  – recreational equipment (OHVs & ATVs)
  – locomotive

• NONROAD for Yuma; OFFROAD for Imperial
  – Fuel properties as from gasoline survey & sampling
  – Adjustments to default agricultural equipment data for Yuma Co. from 2006 NASS

<table>
<thead>
<tr>
<th>Equipment</th>
<th>NONROAD 2005 default</th>
<th>Revised population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combines</td>
<td>197</td>
<td>63</td>
</tr>
<tr>
<td>Balers</td>
<td>16.3</td>
<td>115</td>
</tr>
<tr>
<td>Tractor with &lt; 40hp</td>
<td>204</td>
<td>237</td>
</tr>
<tr>
<td>Tractor with hp between 40-99</td>
<td>332</td>
<td>799</td>
</tr>
<tr>
<td>Tractor with &gt; 100hp</td>
<td>447</td>
<td>539</td>
</tr>
</tbody>
</table>
Adjustments for OHVs & ATVs at Imperial Sand Dunes

- Imperial Sand Dunes Sheriff’s office provided activity statistics for ATVs & OHVs
- 90% of Imperial activity occurs at Imperial Sand Dunes; 25% of activity from Arizona

\[
AZ-ISD = 0.90\% \text{ of } IC_{catotal} \times 0.25 \\
IC_{total} = AZ-ISD + IC_{catotal} \\
Yuma = Yuma_{nonroadtotal} - AZ-ISD
\]

AZ-ISD = Arizona registered OHVs & ATVs operated only in Imperial Sand Dunes
IC_{catotal} = California registered OHVs & ATVs total in Imperial County from OFFROAD
IC_{total} = Total of all OHVs & ATVs operating anywhere in Imperial County
Yuma_{nonroadtotal} = Total population of OHVs and ATVs operating in Yuma County from NONROAD
Yuma = Estimated population of Arizona registered OHVs & ATVs operating only in Yuma Co.
# Off-Road Mobile Emissions

<table>
<thead>
<tr>
<th>Season</th>
<th>VOC</th>
<th>CO</th>
<th>NOx</th>
<th>PM10</th>
<th>PM2.5</th>
<th>SO2</th>
<th>NH3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weekday</td>
<td>2.025</td>
<td>26.053</td>
<td>2.684</td>
<td>0.264</td>
<td>0.244</td>
<td>0.046</td>
<td>0.002</td>
</tr>
<tr>
<td>Weekend</td>
<td>2.367</td>
<td>26.179</td>
<td>1.457</td>
<td>0.165</td>
<td>0.153</td>
<td>0.026</td>
<td>0.002</td>
</tr>
<tr>
<td>Spring</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weekday</td>
<td>1.969</td>
<td>25.234</td>
<td>2.66</td>
<td>0.258</td>
<td>0.24</td>
<td>0.047</td>
<td>0.002</td>
</tr>
<tr>
<td>Weekend</td>
<td>2.315</td>
<td>25.435</td>
<td>1.46</td>
<td>0.163</td>
<td>0.153</td>
<td>0.027</td>
<td>0.002</td>
</tr>
<tr>
<td>Summer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weekday</td>
<td>2.05</td>
<td>27.557</td>
<td>2.893</td>
<td>0.273</td>
<td>0.253</td>
<td>0.049</td>
<td>0.002</td>
</tr>
<tr>
<td>Weekend</td>
<td>2.248</td>
<td>27.653</td>
<td>1.588</td>
<td>0.16</td>
<td>0.149</td>
<td>0.028</td>
<td>0.002</td>
</tr>
<tr>
<td>Winter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weekday</td>
<td>1.026</td>
<td>10.382</td>
<td>1.766</td>
<td>0.158</td>
<td>0.146</td>
<td>0.03</td>
<td>0.001</td>
</tr>
<tr>
<td>Weekend</td>
<td>1.06</td>
<td>8.342</td>
<td>0.944</td>
<td>0.095</td>
<td>0.089</td>
<td>0.025</td>
<td>0.001</td>
</tr>
</tbody>
</table>
Off-Road Mobile Emissions

Winter

Class
- Logging Equipments
- Recreational Equipments
- Railway Maintenance Equipment
- Personal Watercraft/Recreational Equipments
- Lawn and Garden Equipments (Residential)
- Lawn and Garden Equipments (Commercial)
- Lawn and Garden Equipments
- Industrial Equipments
- Construction Equipments
- Commercial Equipment
- Agricultural Equipments
Off-Road Mobile Emissions

Summer

Class
- Logging Equipments
- Recreational Equipments
- Railway Maintenance Equipment
- Personal Watercraft /Recreational Equipments
- Lawn and Garden Equipments (Residential)
- Lawn and Garden Equipments (Commercial)
- Lawn and Garden Equipments
- Industrial Equipments
- Construction Equipments
- Commercial Equipment
- Agricultural Equipments
Fugitive Dust Sources

- **Agricultural Dust (harvesting & tilling)**
  - Activity data based on harvested acres by crop type from Ag Extension staff
  - Spatial allocation based on Yuma Pesticide database, CA Dept. Water Resources, TRS shapefiles

- **Agricultural Tilling**

\[ E_{\text{crop}} = (EF_{\text{till method}} \times P_{\text{till method-crop}}) \times A_{\text{crop}} \]

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>( E_{\text{crop}} )</td>
<td>PM10 emissions per crop</td>
<td></td>
</tr>
<tr>
<td>( EF_{\text{till method}} )</td>
<td>lbs/acre-pass for different till methods</td>
<td>Based on factors for 5 different till methods – data collected by UC Davis researchers in San Joaquin Valley. Mapping of the 5 basic till methods to multiple other till methods are found in CARB 2003a.</td>
</tr>
<tr>
<td>( A_{\text{crop}} )</td>
<td>Acres (harvested)</td>
<td>Crop acreage obtained from references: The University of Arizona 2006, Imperial County 2006.</td>
</tr>
<tr>
<td>( P_{\text{till method-crop}} )</td>
<td>Number of passes or tillings per year by till method and crop</td>
<td>Default values from ARB inventory methods (CARB 2003a) were used for this analysis.</td>
</tr>
</tbody>
</table>
Fugitive Dust Sources

- Agricultural Harvesting

\[ E_{crop} = EF_{crop} \times Acres_{crop} \]

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>( E_{crop} )</td>
<td>PM(_{10}) fugitive dust emissions</td>
<td></td>
</tr>
<tr>
<td>( EF_{crop} )</td>
<td>Variable factor by crop type (mass/area)</td>
<td>Factors for total fugitive dust emissions for total harvesting process measured by UC Davis for cotton, almonds, and wheat. A mapping of these 3 factors to over 200 different crop types, adjusting the numbers for different crops, is included in CARB 2003b.</td>
</tr>
<tr>
<td>( acres_{crop} )</td>
<td>Acres harvested for each crop.</td>
<td>Crop acreage obtained from references: The University of Arizona 2006, Imperial County 2006.</td>
</tr>
</tbody>
</table>
Road Dust Sources

- Methodology based on recently revised AP-42 (EPA, 2006)
- Paved Road Dust

\[ E = \left( k \times \left( \frac{s}{2} \right)^{0.65} \times \left( \frac{W}{3} \right)^{1.5} - C \right) \times \left( 1 - \frac{P}{4\times N} \right) \]

- Unpaved Road Dust

\[ E = \left[ \frac{k \times \left( \frac{s}{12} \right)^a \times \left( \frac{S}{30} \right)^d}{\left( \frac{M}{0.5} \right)^c} \right] - C \times \left( N - \frac{P}{N} \right) \]

\( E = \) particulate emission factor (g/VMT)
\( k = \) particle size multiplier (g/VMT)
\( s = \) road surface silt loading (g/m²); \( W = \) mean vehicle weight (tons)
\( C = \) emission factor for 1980's vehicle fleet exhaust, brake wear and tire wear.
\( P = \) number of days with at least 0.01 inch of precip.; \( N = \) number of days in the avg. period

- Silt loading & soil moisture from road dust sampling conducted by ERG
  - Paved – silt (5.5-28.9%); silt loading (0.13-22.5 g/m²)
  - Unpaved – silt (4.3-10.8%); soil moisture (0.2-0.8%)

- Paved VMT – as for on-road mobile
- Unpaved VMT – based on % of paved roads in Yuma PM Maintenance Plan (~2.67%)
Windblown Dust

- PM emissions estimates based on WRAP RMC WB Dust Model
  - Developed for regional applications, based on recent literature reviews, results of fields studies, erosion models
  - Estimates WB fugitive dust emissions from Barren, Shrub, Grass, and Ag lands (No forest or Urban lands)
  - Applied Domain-wide (US & Mexico)
  - Highly dependent on accurate, detailed LULC, soil characteristics & wind fields
  - Agricultural adjustments incorporated for Yuma & Imperial Counties
- Agricultural information from University of Arizona Ag Extension Office
  - Crop types, crop calendars
  - Spatially allocated using TRS and pesticide database
- LULC – from Shupe Geomapping & 2001 NALC
- Soil characteristics from SSURGO & STATSGO
- Meteorological data – surface wind fields interpolated from observed data, no precipitation
- Preliminary emission estimates
Fugitive Dust Sources

- **Construction Dust**
  - Residential activity from construction permits
  - Non-residential activity available for City of Somerton; Yuma activity based on interpolated data from Yuma Co. PM Maintenance Plan (ADEQ)
  - Road construction activity from ADOT, City of Yuma, City of Somerton, San Luis and Yuma Co.

### Annual WASBAQS US Domain-wide Fugitive Dust Emissions (tons/year)

<table>
<thead>
<tr>
<th>Category</th>
<th>PM10</th>
<th>PM2.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural Tilling</td>
<td>945</td>
<td>142</td>
</tr>
<tr>
<td>Agricultural Harvesting</td>
<td>195</td>
<td>29</td>
</tr>
<tr>
<td>Paved Road Dust</td>
<td>5,657</td>
<td>697</td>
</tr>
<tr>
<td>Unpaved Road Dust</td>
<td>11,863</td>
<td>1,183</td>
</tr>
<tr>
<td>Construction Dust</td>
<td>3,420</td>
<td>342</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>22,081</strong></td>
<td><strong>2,393</strong></td>
</tr>
</tbody>
</table>

### Annual WB Dust Emissions -- WASBAQS Domain (tpy)

<table>
<thead>
<tr>
<th>Region</th>
<th>PM10</th>
<th>PM2.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yuma, AZ</td>
<td>3,749</td>
<td>375</td>
</tr>
<tr>
<td>Imperial, CA</td>
<td>2,456</td>
<td>246</td>
</tr>
<tr>
<td>Sonora</td>
<td>643</td>
<td>64</td>
</tr>
<tr>
<td>Baja</td>
<td>793</td>
<td>79</td>
</tr>
<tr>
<td><strong>Domain Total</strong></td>
<td><strong>7,640</strong></td>
<td><strong>764</strong></td>
</tr>
</tbody>
</table>
Fire Sources

- Activity data for Yuma from:
  - personal communications w/ Forestry Division, Arizona State Land Department, Ag Extension staff;
  - Geo Spatial Multi Agency Coordination website
  - No prescribe fires within domain

- Wildland fire incidents by date, location and acres burned

- Agricultural burning in Yuma limited to wheat stubble (~40% total wheat acreage burned in June & July)

- Spatial allocation for agricultural burning based on TRS pesticide database and TRS shapefiles

- Imperial Co activity data from the Air Pollution District of Imperial County

- Emission estimation methodology based on WRAP Phase III/IV Fire Inventory
## Fire Sources

### Annual WASBAQS US Domain-wide Burning Emissions (tons/year)

<table>
<thead>
<tr>
<th>Category</th>
<th>VOC</th>
<th>CO</th>
<th>NOx</th>
<th>SOx</th>
<th>PM10</th>
<th>PM2.5</th>
<th>NH3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural Burning</td>
<td>80.8</td>
<td>985.6</td>
<td>34.4</td>
<td>6.4</td>
<td>86.7</td>
<td>82.3</td>
<td>19.3</td>
</tr>
<tr>
<td>Wildland Fires</td>
<td>11.8</td>
<td>10.1</td>
<td>5.4</td>
<td>1.5</td>
<td>24.4</td>
<td>20.9</td>
<td>1.1</td>
</tr>
<tr>
<td>Total</td>
<td>92.6</td>
<td>995.7</td>
<td>39.8</td>
<td>7.9</td>
<td>111.1</td>
<td>103.2</td>
<td>20.4</td>
</tr>
</tbody>
</table>
HAP Emissions Summary

2005 Annual Total HAPs (lbs/yr)

- On-Road Mobile: 42%
- Off-Road Mobile: 17%
- Area: 16%
- Pesticides: 7%
- Stationary Point: 5%
- Ag Burning: 6%
- Ag Dust: 1%
- Road Dust: 1%
- Construction Dust: 2%
- WB Dust: 3%

Environ
HAP Emissions Summary

2005 Annual Estimates

Contributions By Source Category for US Domain

Source
- Off-road equipment
- On-road
- Windblown dust
- Road dust
- Point
- Pesticides
- Locomotives
- Construction dust
- Area
- Agricultural dust
- Agricultural Burning
Emissions Modeling

• Emission Processing System, Version 3 (EPS3)

• EPS3 application
  – Chemical speciation: Emission estimates of criteria pollutants (VOC) speciated for the CB05 chemical mechanism; HAPs based on SPECIATE4.
  – Temporal allocation: Annual, or seasonal, emission estimates are resolved hourly for air quality modeling. Based on locally obtained data and information; EPA default temporal profiles by pollutant & SCC.
  – Spatial allocation: Regional or county level emission estimates spatially resolved to the modeling grid cells for air quality modeling. Spatial allocation based on locally obtained data and information, US Census, transportation networks, LULC.
Emissions Modeling

- Nested grid modeling domains:
  - 4.0 km coarse grid domain
  - 0.5 km nested grid domains

- LULC data
  - ETM (4-km domain)
  - IKONOS aerial photos (urban domains)
  - Developed by Shupe Geomapping under contact to ADEQ
Landuse/Landcover Data
4-km WASBAQS Modeling Domain
Landuse/Landcover Data

0.5-km Yuma Modeling Domain

LULC Description

- Unclassified
- Urban Tree
- Urban Turf
- Urban Marginal Green
- Agriculture
- Orchards
- Marginal Agriculture (new growth, etc)
- Fallow Ag
- Riparian Veg
- Riparian Veg, Burned
- Riparian Area, Bare
- Desert (undisturbed)
- Desert, Sandy
- Not Used
- Residential/Urban Bare
- Disturbed Ground
- Paved Roads and Parking Lots
- Paved/Non-Paved, Confused
- Canal Banks
- Buildings
- Water
- Shadows
- Dirt Sport/Ball Fields
Acknowledgements

• ENVIRON International
  – John Grant
  – Amnon Bar-Ilan
  – Raji Parikh
  – Stella Shepard
  – Matt Russell
  – Alison Pollack

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  – Marty Wolf
  – Paula Fields

• ADEQ
  – Randy Sedlacek
  – Dan Catlin
  – Peter Hyde
  – Phil DeNee