Examining the 2006 Hourly VOC Emission Inventory

TexAQS II Principal Findings / Data Analysis Workshop

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Background

- TexAQS 2000 measurements showed ~10-100 fold underestimation in Houston point source VOC EI

- Point source EIs from 2000-2004 did not respond to this finding – in fact, slight decrease in total reported VOC from 2000 → 2004

- TCEQ HRVOC process flow monitoring (flares, cooling towers) implemented Jan. 2006 (some enhanced fugitives monitoring started earlier)

- TCEQ Hourly Inventory (8/15 – 9/15/2006) is thus the first EI in Houston to incorporate this monitoring on a broad scale… **What does this inventory tell us about reported VOCs in the HRVOC monitoring era?**
Method

- Compared 2006 Hourly EI against the TCEQ 2004 Ozone Season Daily EI (OSD EI)
  - For accounts (plants) common to both Hourly and OSD, compared only where matching process units and emission points (i.e. FINs and EPNs)
  - Summed Hourly EI emissions across entire period (lb/32 days)
  - For comparison, calculated same rate for OSD

- Focused on comparison of aggregated 32-day Hourly emission rates vs OSD rates, rather than analyzing hourly variation
The Hourly Emission Inventory

- **141 Accounts (plants) selected from 24 counties**
  - HGB, Beaumont, Corpus Christi / Victoria, and elsewhere within TXAQS II study area
  - 247 total species reported, including VOCs, nonreactives, CO, NOx, and SO₂

- Plants typically reported emissions for process units that had some amount of monitoring data available

- Hourly variation greater than that seen in 2005 “pilot” hourly EI
The HGB VOC Hourly EI

- 79 accts, 405 paths (process units * emission point combinations) – less than 2% of paths in OSD EI

- Emissions from these paths encompass 16% of OSD EI (17% in Harris County)
<table>
<thead>
<tr>
<th>Group</th>
<th>hourlyEI_lb_32days</th>
<th>osd_lb_32days</th>
<th>HourlyEI_OSDEI_ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 County</td>
<td>4,780,019</td>
<td>2,506,625</td>
<td>1.91</td>
</tr>
<tr>
<td>HGB 8 County</td>
<td>2,238,403</td>
<td>1,225,840</td>
<td>1.83</td>
</tr>
<tr>
<td>Harris County</td>
<td>1,165,652</td>
<td>676,541</td>
<td>1.72</td>
</tr>
</tbody>
</table>
8-County HGB Hourly EI vs OSD EI
Total Emissions per Compound
(N=165 cpds)

\[ y = 1.9662x + 2031.6 \]
\[ R^2 = 0.862 \]
Harris County Hourly EI vs OSD EI
Total Emissions per Compound
(N=143 cpds)

\[ y = 1.9822x + 731.79 \]
\[ R^2 = 0.7241 \]
Total VOC, Hourly vs OSD Inventories
118 Facilities in entire 24-County Hourly Inventory domain

\[ y = 0.7455x + 12.336 \]

\[ R^2 = 0.0445 \]
Total VOC, Hourly vs OSD Inventories
79 Facilities in 8-County HGB Area

\[ y = 1.9352x - 0.8472 \]

\[ R^2 = 0.5341 \]
Total VOC, Hourly vs OSD Inventories
49 Harris County Facilities

\[ y = 1.8212x - 0.6779 \]

\[ R^2 = 0.637 \]
### Total Ethene/Propene Point Source Emissions by Inventory and Geog. Region

<table>
<thead>
<tr>
<th></th>
<th>HGB 8-county</th>
<th></th>
<th></th>
<th>Harris county</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OSD</td>
<td>Hourly</td>
<td>Hourly:OSD Ratio</td>
<td>OSD</td>
<td>Hourly</td>
<td>Hourly:OSD Ratio</td>
</tr>
<tr>
<td>Ethene</td>
<td>105,134</td>
<td>219,995</td>
<td>2.1</td>
<td>73,084</td>
<td>111,171</td>
<td>1.5</td>
</tr>
<tr>
<td>Propene</td>
<td>95,165</td>
<td>183,044</td>
<td>1.9</td>
<td>68,281</td>
<td>128,004</td>
<td>1.9</td>
</tr>
</tbody>
</table>
Total Ethene Emissions by Account -- 8-County HGB Area

\[ y = 1.1303x + 2352.5 \]

\[ R^2 = 0.2413 \]
Total Ethene Emissions by Account -- Harris County

y = 0.7544x + 2334.8
$R^2 = 0.2626$
Emissions by Process Unit Type
Hourly vs OSD Inventories

- **Propylene**
- **Ethylene**
- **Butenes**
- _1_3__Butadiene

**Process Unit Types**
- Cooling Towers
- Flares
- Equipment Leak Fugitives
- Unknown source type

**Lb per 32 days**
- Hourly EI
- OSD EI
Cooling Tower - Propylene

\[ y = 0.4439x + 47.473 \]

\[ R^2 = 0.1659 \]
Cooling Tower - Ethylene

$y = -0.0189x + 39.694$

$R^2 = 0.0066$
Flare - Propylene

\[ y = 0.6003x + 1282.3 \]

\[ R^2 = 0.1281 \]
Flare - Ethylene

\[ y = 0.364x + 1335.2 \]

\[ R^2 = 0.0087 \]
Unknown source type - Propylene

\[ y = 1.2609x + 665.51 \]

\[ R^2 = 0.1919 \]
Unknown source type - Ethylene

$y = 1.7954x + 646.06$

$R^2 = 0.1727$
Uncertainties

• One month EI may not be representative of a year or an ozone season

• Only about 1/6 of HGB VOC EI is represented here

• About ~10% of the process units were undefined (this to be fixed soon)

• Some inconsistencies in matching-up of Hourly paths and OSD paths
  – Some paths in one EI had large emissions, whereas corresponding path had zero emissions
  – In some cases paths in Hourly EI were not present in OSD
Conclusions / Next Steps

- Substantial increase in HRVOC, VOC emissions in HGB Hourly Inventory versus equivalent OSD EI
  - 70-80% increase in Total VOC
  - 90% increase in propylene
  - 50-110% increase in ethylene

- Flares were dominant process/point type behind the large increases
  - Cooling towers showed decreases

- Differences (Hourly vs OSD) in emissions of the individual species correlated well with the change in total emissions

- Changes in process unit and account emissions correlated poorly with changes in emissions totals
Acknowledgments/Contact Info

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  – Vincent Meiller
  – Marvin Jones
  – Ron Thomas

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