Air Toxic Community Assessment Studies in Spokane Washington

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SPOKANE OBJECTIVES

1. Characterize community ambient air toxics concentrations and their spatial and seasonal patterns.
2. Determine base-line air toxics concentrations.
3. Estimate source apportionment for the study area.
4. Compare NATA and AIRPACT air toxics modeling results with measured data in Spokane.
5. Evaluate health risks to the community from exposure to air toxics.
SPOKANE FIXED SITE MEASUREMENTS

- VOCs (EPA “CORE SPECIES” PLUS OTHERS)
- CARBONYLS
- METALS IN PM$_{10}$
ANALYTICAL PROCEDURES

➢ TO-15 GC – FID & ECD

➢ TO–11A DNPH CARTRIDGE & HPLC

➢ IO–3.5 QUARTZ FILTER & ICPMS
NORTHWEST MAP
SPOKANE SITE MAP

Health District

School District

Orchard Center

Crown Z

Spokane
SPATIAL BEHAVIOR

BENZENE (PPBV)
SPATIAL BEHAVIOR

FORMALDEHYDE (PPBV)
SPATIAL BEHAVIOR

PCE (PPBV)
SPATIAL BEHAVIOR

MANGANESE (ng/m³)
SPATIAL BEHAVIOR

LEAD (ng/m$^3$)
SPATIAL BEHAVIOR

NICKEL (ng/m³)
TEMPORAL BEHAVIOR

BENZENE at CZ

PPBV

0.0 0.5 1.0 1.5 2.0

TEMPORAL BEHAVIOR

FORMALDEHYDE at 0°C

PPBV
TEMPORAL BEHAVIOR

TETRACHLOROETHYLENE at HD

PPBV

TEMPORAL BEHAVIOR

MANGANESE at CZ and SD

- CZ mn
- Sd mn

ng/m^3

TEMPORAL BEHAVIOR

NICKEL at CZ and SD

ng/m^3

CZ ni
SD ni
SPECIAL STUDIES

- Sonic anemometer
- Sample inlet
- Aerodynamic Particle Sizer (TSI 3320)
- GPS
- PAS2000CE
- PAS2000DC
- PTR-MS
AIRPACT Regional Air Quality Modeling System

IC/BC landuse terrain

landuse terrain

IC/BC emissions chem mech dry dep

MM5

CALMET

CALGRID

u, v formatted for each layer of CALMET

3D met field: u, v, w, T, BL variables

3D species field: O3, VOC, NOx, primary PM
BENZENE MODEL-MEASURED COMPARISON

Dec 6, 2005

24-hour model average

24-hour measured average
FORMALDEHYDE MODEL-MEASURED COMPARISON

Dec 24, 2005

24-hour measured average

24-hour model average

ppbv

Hour
SPOKANE SOURCE APPORTIONMENT
LEAD-BENZENE CORRELATIONS

<table>
<thead>
<tr>
<th>SITE</th>
<th>$R^2$</th>
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<tbody>
<tr>
<td>HD</td>
<td>0.67</td>
</tr>
<tr>
<td>SD</td>
<td>0.84</td>
</tr>
<tr>
<td>CZ</td>
<td>0.91</td>
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<tr>
<td>OC</td>
<td>0.76</td>
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</table>
SPOKANE SOURCE APPORTIONMENT

February, Pb 208 / Pb 206 vs Pb 207 / Pb 206 at Four Sites

CZ annual average
Spokane Crustal
Unlead gasoline (France)
SPOKANE SOURCE APPORTIONMENT

Model Results from random factor #4

- Mass of Species
- Percentage of Species

Mass of Species Apported to Factor

% of Species Apported to Factor

Time Series

Contributions (Average = 1)

Graphs showing the distribution and percentage of various species over time.
SPOKANE SOURCE APPORTIONMENT

[Graph showing model results from random factor #5, with mass of species and percentage of species plotted against different elements.]

[Graph showing time series of contributions with average = 1, showing fluctuations over time.]
SPOKANE SOURCE APPORTIONMENT
## SUMMARY

### AMBIENT VOC CONCENTRATIONS

<table>
<thead>
<tr>
<th>Substance</th>
<th>Spokane (ppbv)</th>
<th>Seattle (ppbv)</th>
<th>Pilot Cities (ppbv)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BENZENE</td>
<td>0.24</td>
<td>0.18</td>
<td>0.53</td>
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<tr>
<td>1,3-BUTADIENE</td>
<td>0.05</td>
<td>0.03</td>
<td>0.05</td>
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<tr>
<td>CARBONTET</td>
<td>0.11</td>
<td>0.10</td>
<td>0.10</td>
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<tr>
<td>CHLOROFORM</td>
<td>0.01</td>
<td>0.05</td>
<td>0.04</td>
</tr>
<tr>
<td>PCE</td>
<td>0.04</td>
<td>0.03</td>
<td>0.04</td>
</tr>
<tr>
<td>TCE</td>
<td>0.02</td>
<td>0.03</td>
<td>0.06</td>
</tr>
<tr>
<td>FORMALD</td>
<td>2.0</td>
<td>1.1</td>
<td>3.3</td>
</tr>
<tr>
<td>ACETALD</td>
<td>1.4</td>
<td>0.8</td>
<td>1.1</td>
</tr>
</tbody>
</table>
## SUMMARY

### AMBIENT METALS CONCENTRATIONS

<table>
<thead>
<tr>
<th>(ng/m^3)</th>
<th>Spokane</th>
<th>Seattle</th>
<th>Pilot Cities</th>
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</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>0.9</td>
<td>1.0</td>
<td>1.9</td>
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<tr>
<td>Cadmium</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Chromium</td>
<td>4.8 (1.0)</td>
<td>1.3</td>
<td>1.0</td>
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<td>Lead</td>
<td>4.9</td>
<td>4.4</td>
<td>10</td>
</tr>
<tr>
<td>Manganese</td>
<td>19</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Nickel</td>
<td>5.6 (2.1)</td>
<td>3.1</td>
<td>4.0</td>
</tr>
</tbody>
</table>
SUMMARY

- Ambient concentrations
- Spatial and temporal behavior
- Special studies
  - Mobile Van Sampling
- Source apportionment
  - lead isotopes
  - PMF