Use of passive sampling methods to understand sources of mercury to high elevation sites in the Western United States

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Methods

- Box sampler-concentration
- Surrogate surface-dry deposition
- A 3-times correction factor
- Multiple-resistance model
- $\alpha=\beta=2$, $\alpha=\beta=10$, no canopy resistance
- Hybrid Single Particle Lagrangian Integrated Trajectory

- Probability function, $P_{i,k} = \frac{N_{i,k}}{M_{i,k}}$
Different materials and exposure times

polysulfone membranes, ICE 450
polyethersulfone membrane, Mustang S
Correlations

Overall

\[ y = 0.38 x + 0.95 \]
\[ r^2 = 0.43 \]
\[ p < 0.01, n=109 \]

High elevation

\[ y = 0.16 x + 2.0 \]
\[ r^2 = 0.14 \]

Low elevation

\[ y = 0.45 x + 0.41 \]
\[ r^2 = 0.46 \]

Monthly "ICE450"

Bi-weekly "ICE450"

Bi-weekly "Mustang"

AGPK

BSIP

CCRS

CGSP

CHALK

GBNP

AGPK outlier
Spatial and temporal variation
Modeled and measured results

thorn shrubs sites
Probability function domain
Source regions

- **AGPK**
  - LA and MBL boxes-high elevation
  - LA, Las Vegas, MBL, and San Joaquin Valley low elevation.

- **PEAV**
  - SF all elevations
  - LA less points
Asian long range transport
Summary

- Hg amount collected on Mustang S is comparable to that on ICE 450.
- Hg dry deposition was higher at high elevation sites than at low elevation sites.
- Dry deposition uncertainties are still high and different GOM species were observed.
- Regional and long range transport sources affect Hg level at high elevation sites in the Western US.
The Influence of a Local Coal-Fired Power Plant on Ambient Mercury Concentrations

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SITE MAP
INSTRUMENTS

- Tekran® 2537/1130/1135
- Trace gases instruments (CO, ozone, SO₂)
- Scanning mobility particle sizer
  - differential mobility analyzer
  - ⁸⁵Kr aerosol neutralizer
  - Condensation particle counter
- PM$_{2.5}$: tapered element oscillating microbalance (TEOM)
- Two-wavelength aethalometer
A weighted factorization problem with non-negativity constraints using known experimental uncertainties as input data thereby allowing individual treatment (scaling) of matrix elements.
**Ambient Air Hg Concentration Downwind Influences**

Significantly higher before than after the CFPP closure
PMF RESULTS

(1) O₃-rich

(2) Traffic

(3) Gas phase oxidation

(4) Wood combustion

(5) Nucleation

(6) CFPP
CFPP CONTRIBUTION

(a) GEM

(b) GOM

(c) PBM
CONDITIONAL PROBABILITY FUNCTION

black line: before the CFPP closure
red line: after the CFPP closure
# Reactive Hg Partitioning Coefficient

\[
K_p = \frac{\text{PBM/PM}_{2.5}}{\text{GOM}}
\]

<table>
<thead>
<tr>
<th>Time period</th>
<th>slope</th>
<th>intercept</th>
<th>(r^2)</th>
<th>(K_p) (m³/µg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>-1300 ± 120</td>
<td>5.0 ± 0.4</td>
<td>0.11, p&lt; 0.01</td>
<td>1.1 ± 4.0</td>
</tr>
<tr>
<td>12/7/2007-4/24/2008</td>
<td>-1400 ± 330</td>
<td>5.7 ± 1.2</td>
<td>0.09, p&lt; 0.01</td>
<td>0.5 ± 0.5</td>
</tr>
<tr>
<td>12/7/2008-4/24/2009</td>
<td>-3500 ± 260</td>
<td>13 ± 1.0</td>
<td>0.35, p&lt; 0.01</td>
<td>1.5 ± 6.7</td>
</tr>
<tr>
<td>4/25/2008-12/6/2008</td>
<td>-1100 ± 280</td>
<td>4.3 ± 1.0</td>
<td>0.06, p&lt; 0.01</td>
<td>1.2 ± 1.3</td>
</tr>
<tr>
<td>4/25/2009-12/6/2009</td>
<td>-2000 ± 490</td>
<td>7.4 ± 1.7</td>
<td>0.07, p&lt; 0.01</td>
<td>1.2 ± 4.0</td>
</tr>
</tbody>
</table>

Partitioning coefficient significantly changed after the CFPP closure
Why? What is the explanation? Maybe add a box below that explains?
Thomas M. Holsen - tholsen, 04-06-2014
SUMMARY

- A significant reduction of three Hg concentrations after the CFPP closure
- PMF results indicate a low contribution of three Hg forms for the CFPP factor after shutdown
- CPF results also show the low contribution from the CFPP location after shutdown
- A significant change of reactive Hg gas-particle partitioning coefficient
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- New York State Department of Environmental Conservation
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QUESTIONS??