Mercury Monitoring in Precipitation Across the Midwest/Great Lakes Region

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Goal of this Presentation....

- A short introduction to the Mercury Deposition Network.
- A description what we know about the deposition of mercury and trends.
- A few research plans.
**Bioaccumulation of methyl mercury**

- **Dry Deposition**
- **Wet Deposition**
- **Geologic Sources** (soil, rock, base flow etc.)
- **Through Fall** (wet+dry)
- **Litter Fall**

**Methylation**
- Bacterial action (water and sediment)
- Zooplankton
- Small fish
- Predatory fish

**Me-Mercury Concentration**

**Water Body/pore water**

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**What is the Mercury Deposition Network?**

- **A Cooperative Research Program**
  - Part of National Atmospheric Deposition Network
  - 115 sites
  - Federal, State, Local and Tribal Governments members, private organizations
  - Measuring wet deposition of mercury

- **Our Charge:**
  - to determine if trends exist in wet deposition of mercury over time
MDN Wet Deposition Monitoring Sites

What the Data Show....
Annual Average Mercury Concentrations

Yearly Average Mercury Concentration
Trends In Concentration & Deposition

Trend Methods

- Seasonal Kendall Test for Trends
- Seasonal Kendall Slope Estimator
- Regional Kendall Test for Trends

- From the “Mann Kendall” as extended by van Belle and Hughes, 1984
- non-parametric, normality not assumed
- allows for seasonality and multiple stations
- allows for missing data

- Examines differences over time
  - Difference (obs1 – obs2) > 0, then =+1
  - < 0, then =-1
  - = 0, then = 0
**Seasonal Kendall Example**

3 Up = +3  
1 down = -1  
1 no change = 0  
SUM = +2

<table>
<thead>
<tr>
<th>3 Up</th>
<th>1 down</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>+4</td>
<td>-0</td>
<td>+4</td>
</tr>
<tr>
<td>+2</td>
<td></td>
<td>+6</td>
</tr>
</tbody>
</table>

Positive Trend

**Conditions For Trend Tests**

- At least 75% valid observations for 5 or more years
  - 1996 through 2008 (68 sites)
- Run seasonally
- No “Trace” events
Significant Changes in Concentration
(all valid observations, 1996 through 2008)
Independent Confirmation of Same

Decreases
Conc.
Prec.
Increases

Significant Changes in Precipitation
(all valid observations, 1996 through 2008)

Decreases
Conc.
Prec.
Increases
Significant Changes in Wet Deposition
(all valid observations, 1996 through 2008)

Decreases
Increases

Regional Trends
(all valid observations, 1996 through 2008)

Decreases
Increases

Upper MW
Dep: 
Prec: 
Conc: 

East MW
Dep: 
Prec: 
Conc: 

Lower MW
Dep: 
Prec: 
Conc: 

Southwest
Dep: 
Prec: 
Conc: 

Northeast
Dep: 
Prec: 
Conc: 

Southeast
Dep: 
Prec: 
Conc: 

Dep: Decreases
Conc: Increases
Prec: Increases
Rates of Changes in Concentration
(slope, percent/year)

Decreases

Increases

Michigan 48 (Upper Peninsula) Concentration Trend
(with LOESS red, trend blue)
Dry Deposition

Future Directions: Measurements for Dry Deposition

- A New NADP Network

- Measure:
  - wet deposition flux (MDN),
  - Hg species (Tekran system)
  - meteorology and land cover variables

- Immediate priority: areas with strong impact from local and regional Hg sources

- Estimate Dry Deposition
Candidate 2008 NADP Atmospheric Hg Network Sites

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