Revitalized Five-Year Regional Network Assessment

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Project Team for 2015 Region 5 Network Assessment

- Hamilton County Department of Environmental Services
- Illinois Environmental Protection Agency
- Indiana Department of Environmental Managements
- Lake Michigan Air Directors Consortium
- Michigan Department of Environmental Quality
- Minnesota Pollution Control Agency
- Ohio Environmental Protection Agency
- USEPA Region 5
- Wisconsin Department of Natural Resources
Goals of Five-Year Regional Network Assessment

- Determine whether networks still meet monitoring objectives.
- Determine whether new sites are needed.
- Determine whether existing sites are no longer needed.
- Determine whether new technologies are appropriate for incorporating into the network.
Current Region 5 Network

- Illinois, Indiana, Michigan, Minnesota, Ohio and Wisconsin
- 338 criteria pollutant monitoring sites
- Cost of over $20 million
Assessment Development Web Tools

- NetAssess - a complete rewrite of the analytical tools that EPA produced for the prior 5-year assessment.

- Data viewing application built on EPA’s Geoplatform as a Story Map
Analyses

- Area served - NetAssess
- Population served - NetAssess
- Correlation analysis - NetAssess
- Removal bias – NetAssess
- Exceedance probability - NetAssess
- Difference of DV from NAAQS – Geoplatform
- Unmonitored area analysis (in combination with gridded emission inventory analysis) - Geoplatform
Analyses (cont.)

- Design value ranking
- Length of record
- Number of parameters monitored
- Monitor shutdown criteria
- Overall ranking (excludes financial analysis)
- Financial
Analyses: Area and Population Served

- A spatial analysis technique known as Voronoi or Thiessen polygons shows the area represented by a monitoring site.
- The shape and size of each polygon is dependent on the proximity of the nearest neighbors to a particular site.
- All points within a polygon are closer to the monitor in that polygon than to any other monitor.
Analyses: Area and Population Served (cont.)

- Once the polygons are calculated, data from the 2010 decennial census are used to find the census tract centroids within each polygon.
- The population represented by the polygon is calculated by summing the populations of these census tracts.
Analyses: Area and Population Served (cont.)

NetAssess v9.4b
Ambient Air Monitoring Network Assessment Tool

44201 - OZONE

Area Served Information

Monitor
26-081-0022

Parameter
OZONE

Geography
Area: 2,506mi² (6,491km²)

Demographics
Total Population: 266,331

Exceedence Probability (75ppb)
Maximum Probability: 70%-80%
Analyses: Correlation Analysis

- The Correlation Matrix (CMT) tool calculates and displays the correlation, relative difference, and distance between pairs of sites within a selected set of sites.
- Within the NetAssess app, the CMT generates a graphical display and a downloadable CSV file which summarize the results for each selected site pair.
The CMT provides a means of determining possible redundant sites that could be removed.

Possible redundant sites would exhibit fairly high correlations consistently across all of their pairings and would have low average relative difference despite the distance.
Analyses: Correlation Analysis (cont.)

8-Hour Daily Max Ozone Correlation Matrix - All Valid Pairs

values in ellipse = distance in kilometers
Analyses: Removal Bias

- The removal bias tool is meant to aid in determining redundant sites.
- The bias estimation uses the nearest neighbors to each site to estimate the concentration at the location of the site if the site had never existed.
- This is done using the Voronoi Neighborhood Averaging algorithm with inverse distance squared weighting.
Analyses: Removal Bias (cont.)

The bias was calculated for each day at each site by taking the difference between the predicted value from the interpolation and the measured concentration.

A positive (negative) average bias would mean that if the site being examined was removed, the neighboring sites would indicate that the estimated concentration would be larger (smaller) than the measured concentration.
Analyses: Removal Bias (cont.)
Analyses: Exceedances Probabilities

- These maps are intended to be used as a spatial comparison and not for probability estimates for a single geographic point or area.
- This information, along with demographic and emissions data, could be used in a weight of evidence approach for proposing new monitor locations.
Analyses: Exceedances Probabilities (cont.)

- The surface probability maps were created by using EPA/CDC downscaler data.
- Downscaler data are daily estimates of ground level ozone and PM2.5 for every census tract in the continental US.
- These are statistical estimates from “fusing” photochemical modeling data and ambient monitoring data using Bayesian space-time methods.
Analyses: Exceedances Probabilities (cont.)
Analyses: Differences of DVs from NAAQS
Analyses: Gridded Emissions
Analyses: Other

➢ Length of record

➢ Number of parameters monitored
Rankings for Ozone and PM2.5

- Used population served, area served, number of parameters monitored, design value, number of years monitored, correlation with other sites and removal bias.

- Absolute values for each of the criteria were converted to ranks from 0 to 4 (quintiles), with 0 the lowest rank and 4 the highest rank and then averaged for an overall ranking.
Rankings for Ozone and PM2.5 (cont.)

- The 7 ranks were then averaged for an overall ranking.

- Each criteria ranking as well as the overall rank is plotted on a separate map.
Rankings: Population Served

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Rankings: Number of Parameters
Rankings: Correlation
Rankings: General Tendancies

- Scores for area served, which ranks monitors higher for greater areas, will naturally tend to value rural monitors most highly, because the rural network is sparse and each monitor is intended to represent a large geographic area.

- Scores for population served tend to value urban monitors more highly, because they are sited in areas of greatest population density.
Rural monitors in general tend to be undervalued in this analysis because they also tend to be lower concentration monitors.
Rankings: Overall

[Map showing air quality rankings for a region, including various cities and geographic locations.]
Analyses: Monitor Shutdown Criteria

<table>
<thead>
<tr>
<th>Site</th>
<th>CBSA</th>
<th>Latitude</th>
<th>Longitude</th>
<th>2013 PM2.5 Annual Design Value</th>
<th>2013 PM2.5 24-hour Design Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>260050003</td>
<td>Allegan, MI</td>
<td>42.77</td>
<td>-86.15</td>
<td>8.3</td>
<td>22</td>
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<tr>
<td>260170014</td>
<td>Bay City, MI</td>
<td>43.57</td>
<td>-83.89</td>
<td>7.6</td>
<td>20</td>
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<tr>
<td>260490021</td>
<td>Flint, MI</td>
<td>43.04</td>
<td>-83.67</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>261010922</td>
<td>Manistee, MI</td>
<td>44.31</td>
<td>-86.24</td>
<td>6.7</td>
<td>18</td>
</tr>
<tr>
<td>261130001</td>
<td>Cadillac, MI</td>
<td>44.31</td>
<td>-84.89</td>
<td>5.9</td>
<td>17</td>
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<tr>
<td>271377001</td>
<td>Virginia, MN</td>
<td>47.52</td>
<td>-92.54</td>
<td>6.1</td>
<td>16</td>
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<tr>
<td>271377550</td>
<td>Duluth, MN</td>
<td>46.82</td>
<td>-92.09</td>
<td>5.7</td>
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<td>271453052</td>
<td>St. Cloud, MN</td>
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<td>-94.13</td>
<td>7.9</td>
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<td>550030010</td>
<td>Ashland, WI</td>
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<td>5.1</td>
<td>17</td>
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<td>550410007</td>
<td>Forest County, WI</td>
<td>45.56</td>
<td>-88.81</td>
<td>5.1</td>
<td>19</td>
</tr>
</tbody>
</table>

The Ashland, WI, site (550030010) is the only ozone monitor eligible for shutdown.
## Crosscheck Between Monitoring Objectives (40 CFR 58.10, App. D) and Data Analyses

<table>
<thead>
<tr>
<th>Objective</th>
<th>Subobjective</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide data to public in timely manner</td>
<td>Public reporting, assuring adequate geographic and population coverage</td>
<td>Spatial analyses: Area served, population served, removal bias, correlation analysis</td>
</tr>
<tr>
<td>Support compliance with NAAQS</td>
<td>Attainment analysis</td>
<td>Concentration-based analyses: Design value ranking, deviation from design values, unmonitored area analysis</td>
</tr>
<tr>
<td>Support control strategy development</td>
<td>Characterize regional concentrations, track progress</td>
<td>Spatial analyses (above), length of record ranking, inventory analysis</td>
</tr>
<tr>
<td>Support air pollution research</td>
<td></td>
<td>Emission inventory analysis, number of parameters analysis</td>
</tr>
</tbody>
</table>
Benefits of Using Web Tools for Regional Network Assessment

- Increased usability of raw data
- Increased usability of results of the individual analyses
- Ability to zoom to an area of interest for ease of viewability
- Ability to focus on individual monitors and to bring up specific data for that monitor (monitor ID and location, design value, 10-year trends, demographics, rankings, etc.)
- Access to additional layers including nonattainment areas, metropolitan statistical areas, gridded emissions, analysis results, monitor rankings, and a link to environmental justice data.

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Questions or Comments?