

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

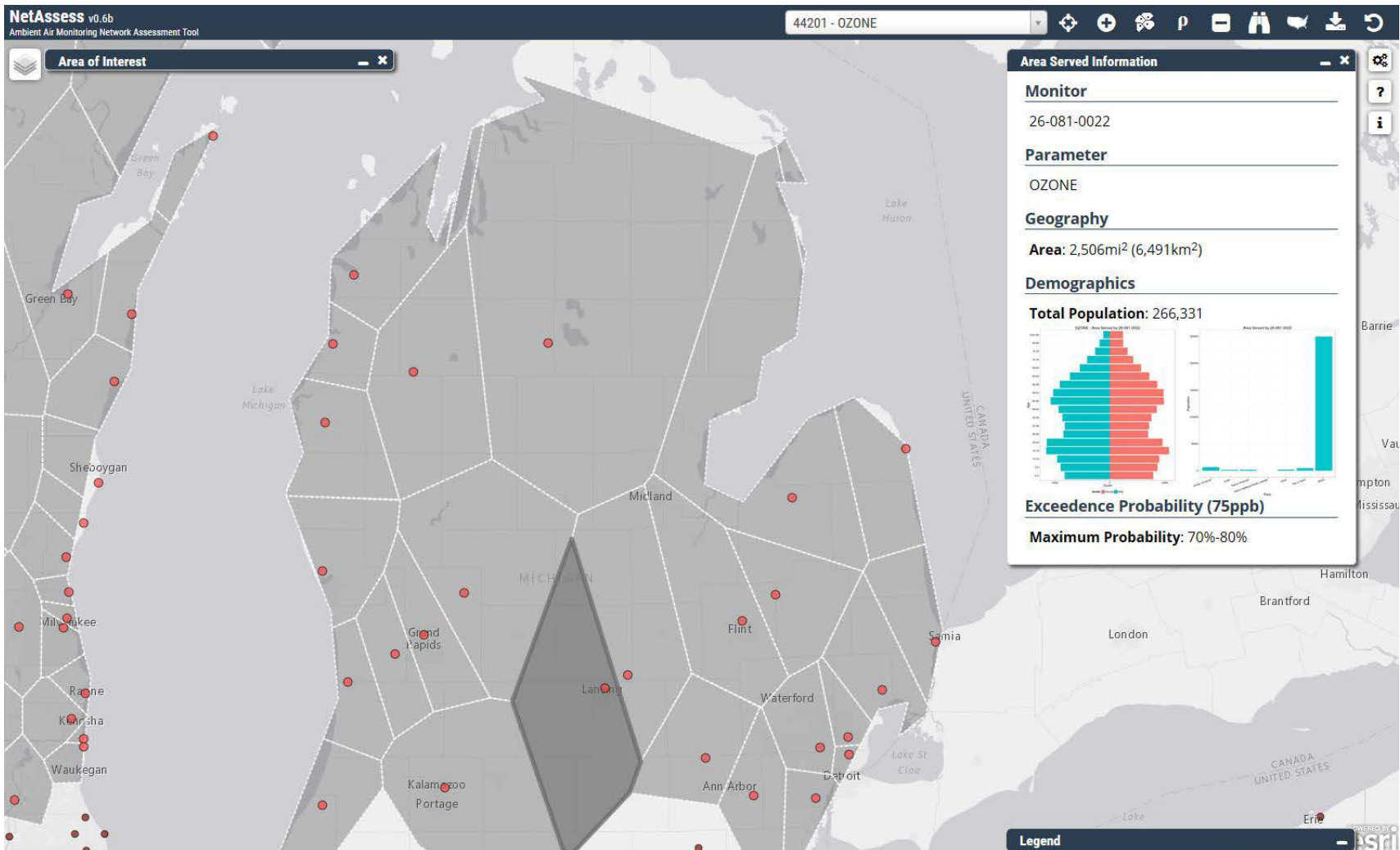
- A spatial analysis technique known as Voronoi or Thiessen polygons shows the area represented by a monitoring site.
- The shape and size of each polygon is dependent on the proximity of the nearest neighbors to a particular site.
- All points within a polygon are closer to the monitor in that polygon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





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.



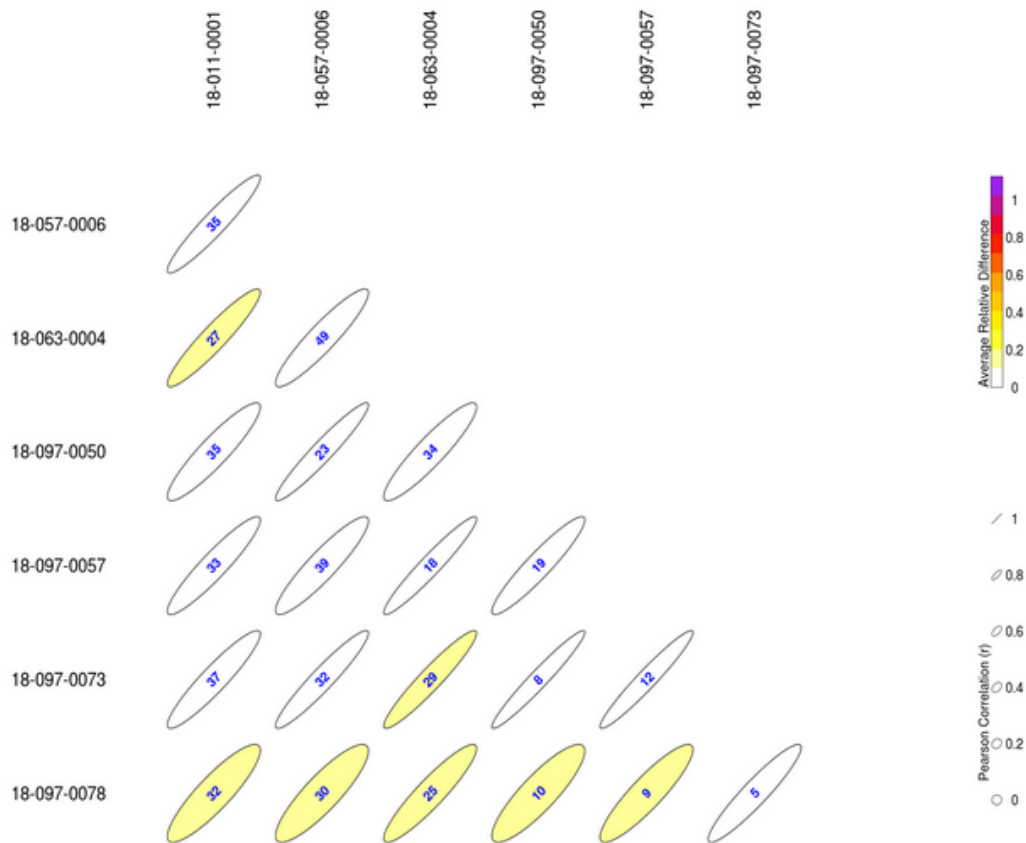
Analyses: Correlation Analysis (cont.)

- 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.)

Correlation Matrix

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



values in ellipse = distance in kilometers



Analyses: Removal Bias

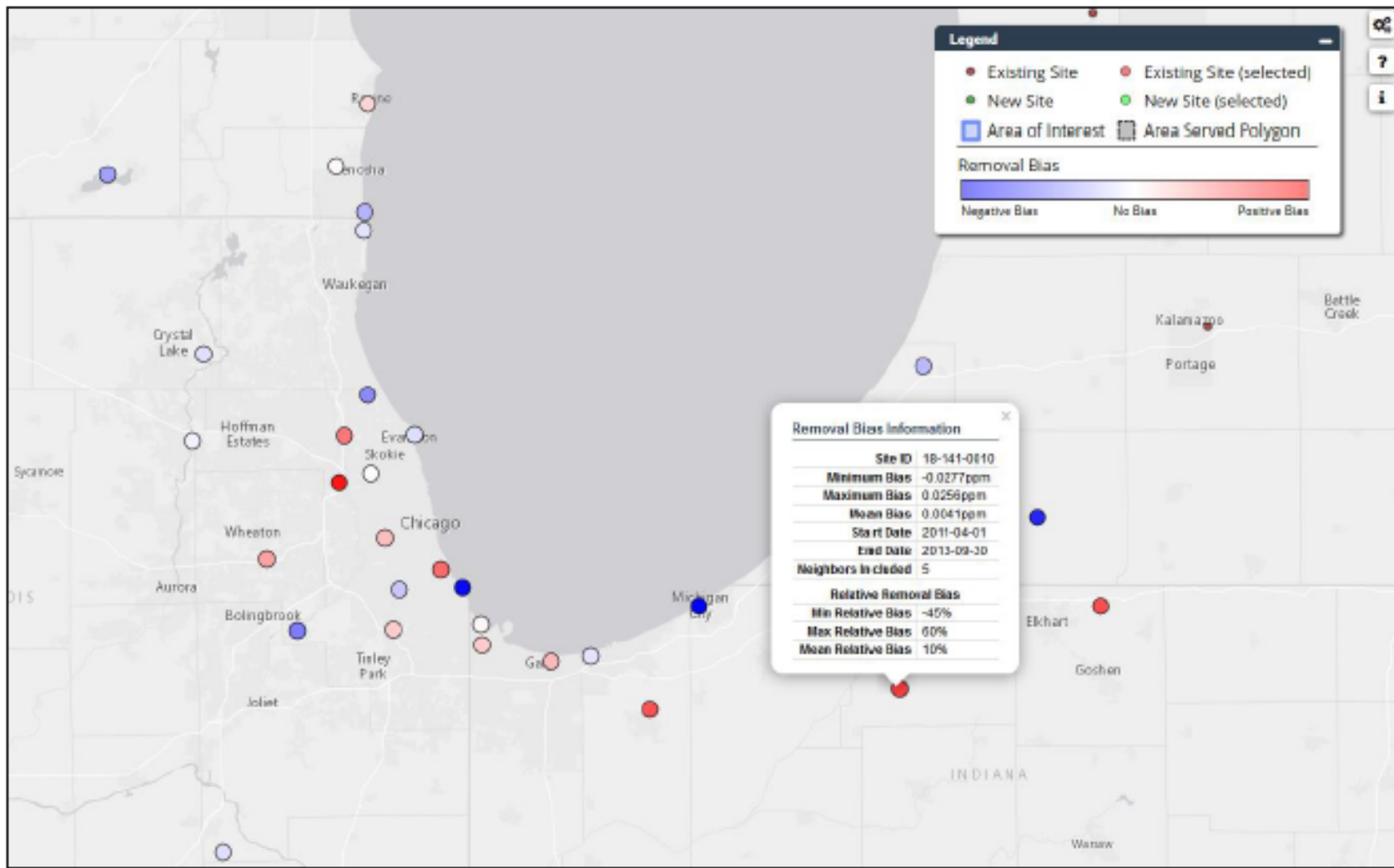
- The removal bias tool is meant to aid in determining redundant sites.
- The bias estimation uses the nearest neighbors to each site to estimate the concentration at the location of the site if the site had never existed.
- This is done using the Voronoi Neighborhood Averaging algorithm with inverse 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

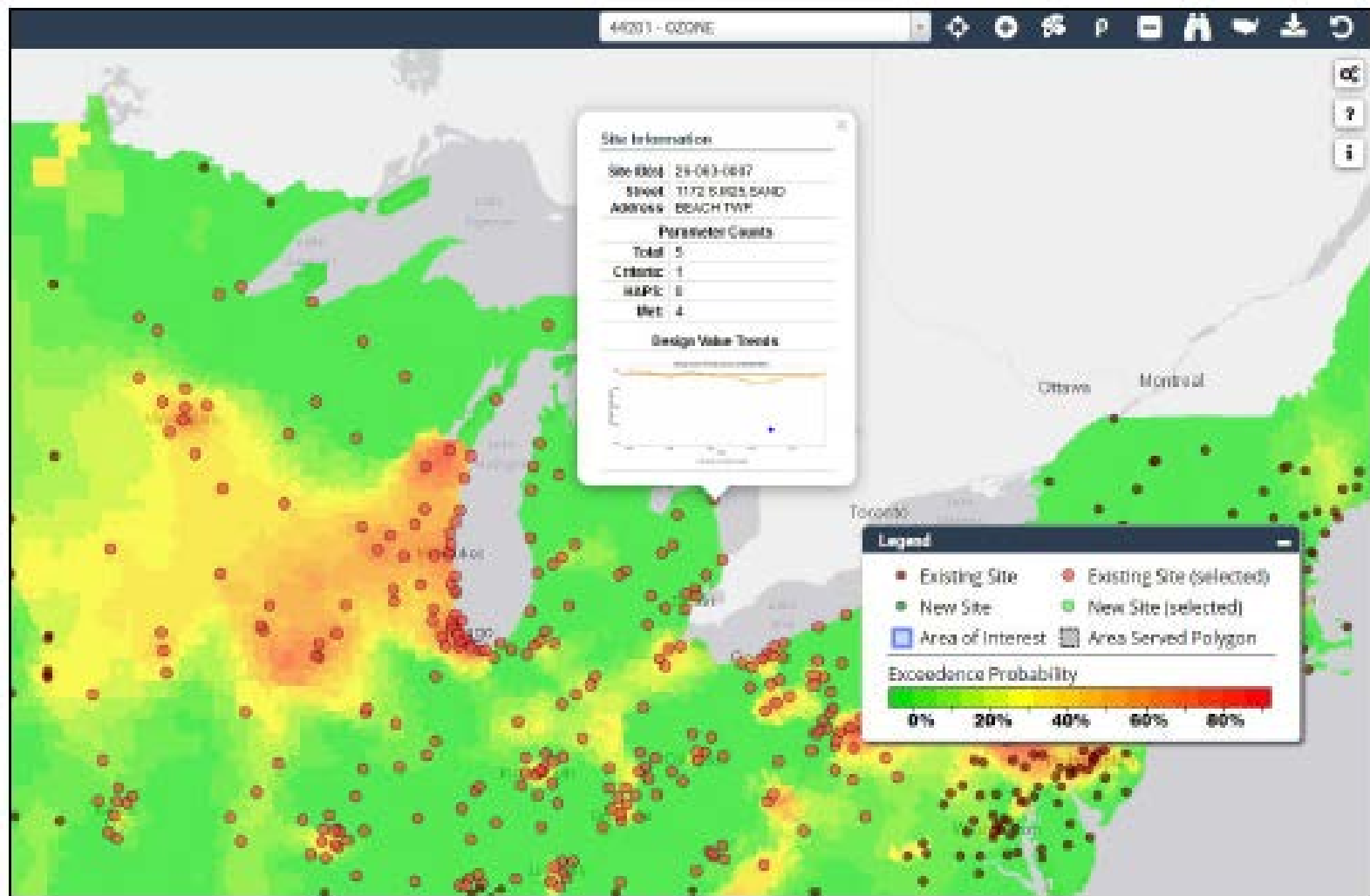
- These maps are intended to be used as a spatial comparison and not for probability estimates for a single geographic point or area.
- This information, along with demographic and emissions data, could be used in a weight of evidence approach for proposing new monitor locations.



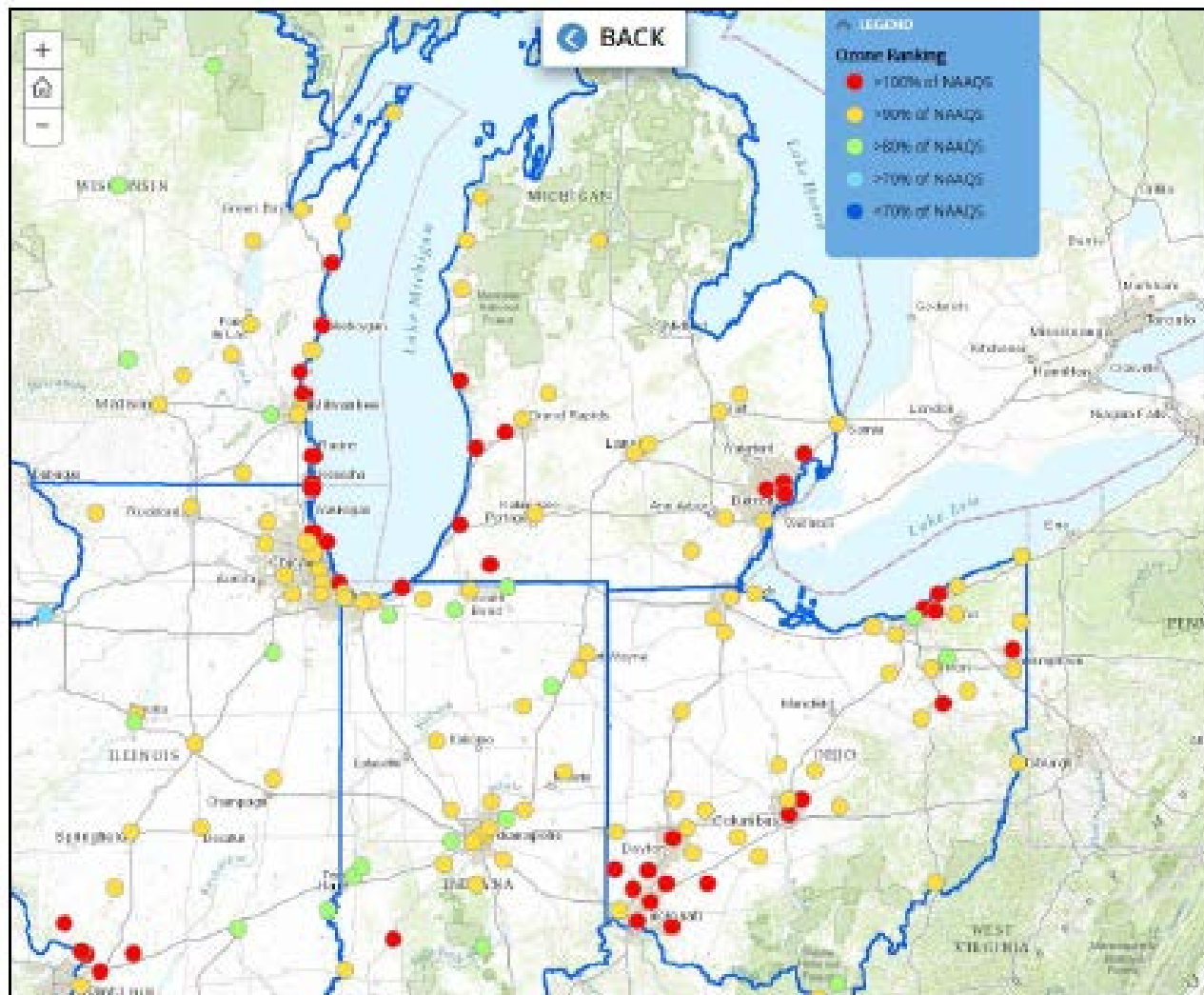
Analyses: Exceedances Probabilities (cont.)

- The surface probability maps were created by using EPA/CDC downscaler data.
- Downscaler data are daily estimates of ground level ozone and PM_{2.5} 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.

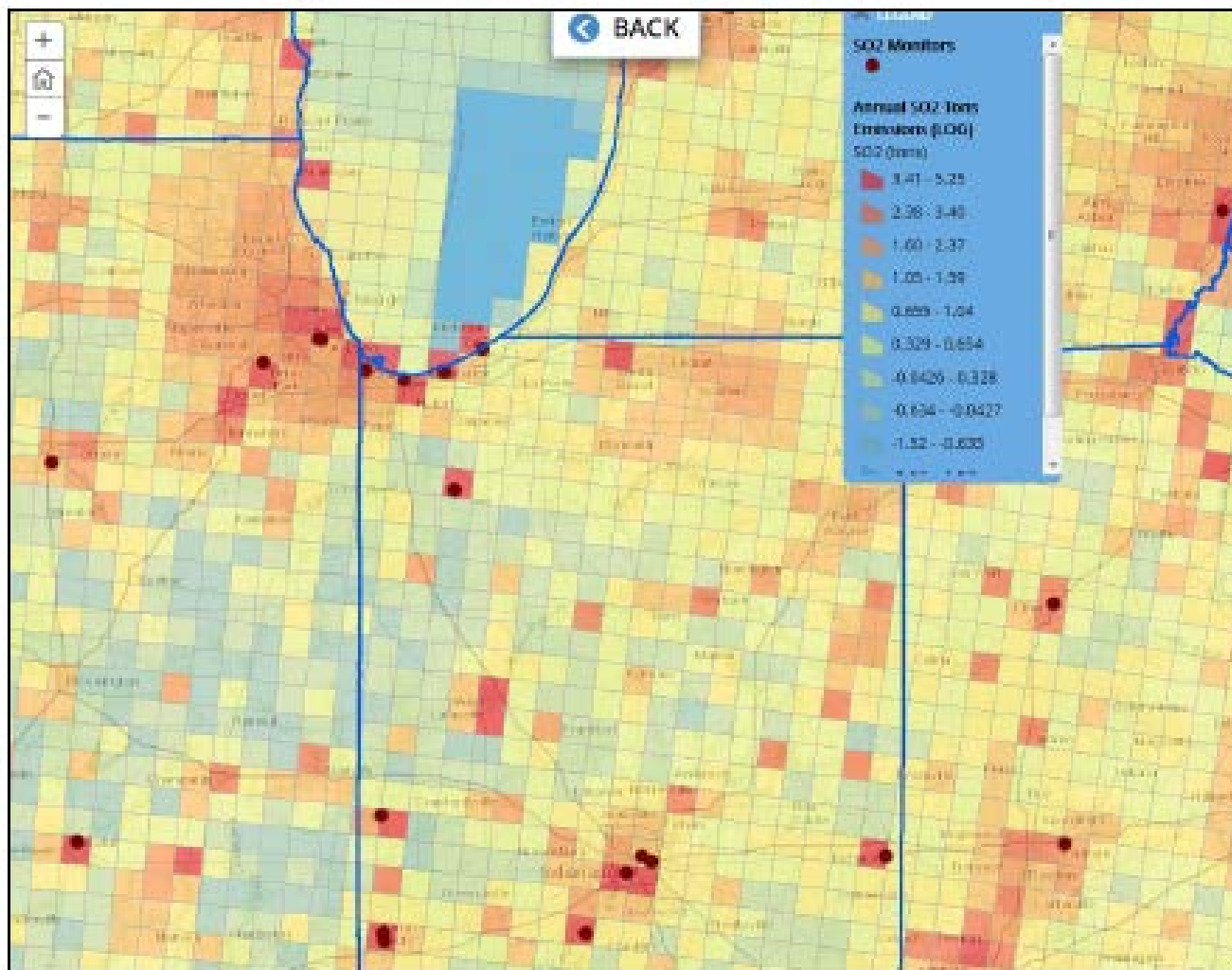
Analyses: Exceedances Probabilities (cont.)



Analyses: Differences of DVs from NAAQS



Analyses: Gridded Emissions





Analyses: Other

- Length of record
- Number of parameters monitored



Rankings for Ozone and PM2.5

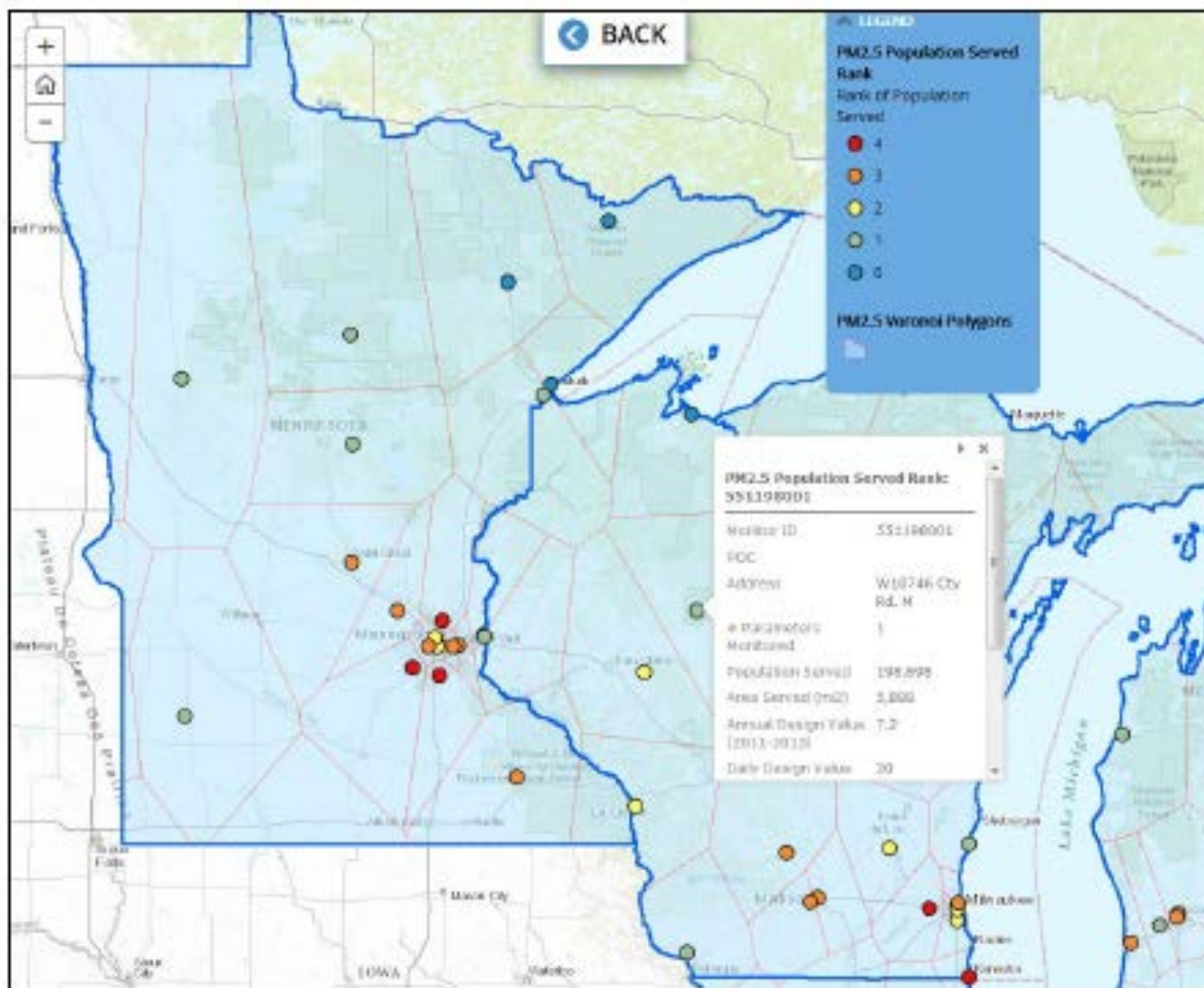
- Used population served, area served, number of parameters monitored, design value, number of years monitored, correlation with other sites and removal bias.
- Absolute values for each of the criteria were converted to ranks from 0 to 4 (quintiles), with 0 the lowest rank and 4 the highest rank and then averaged for an overall ranking



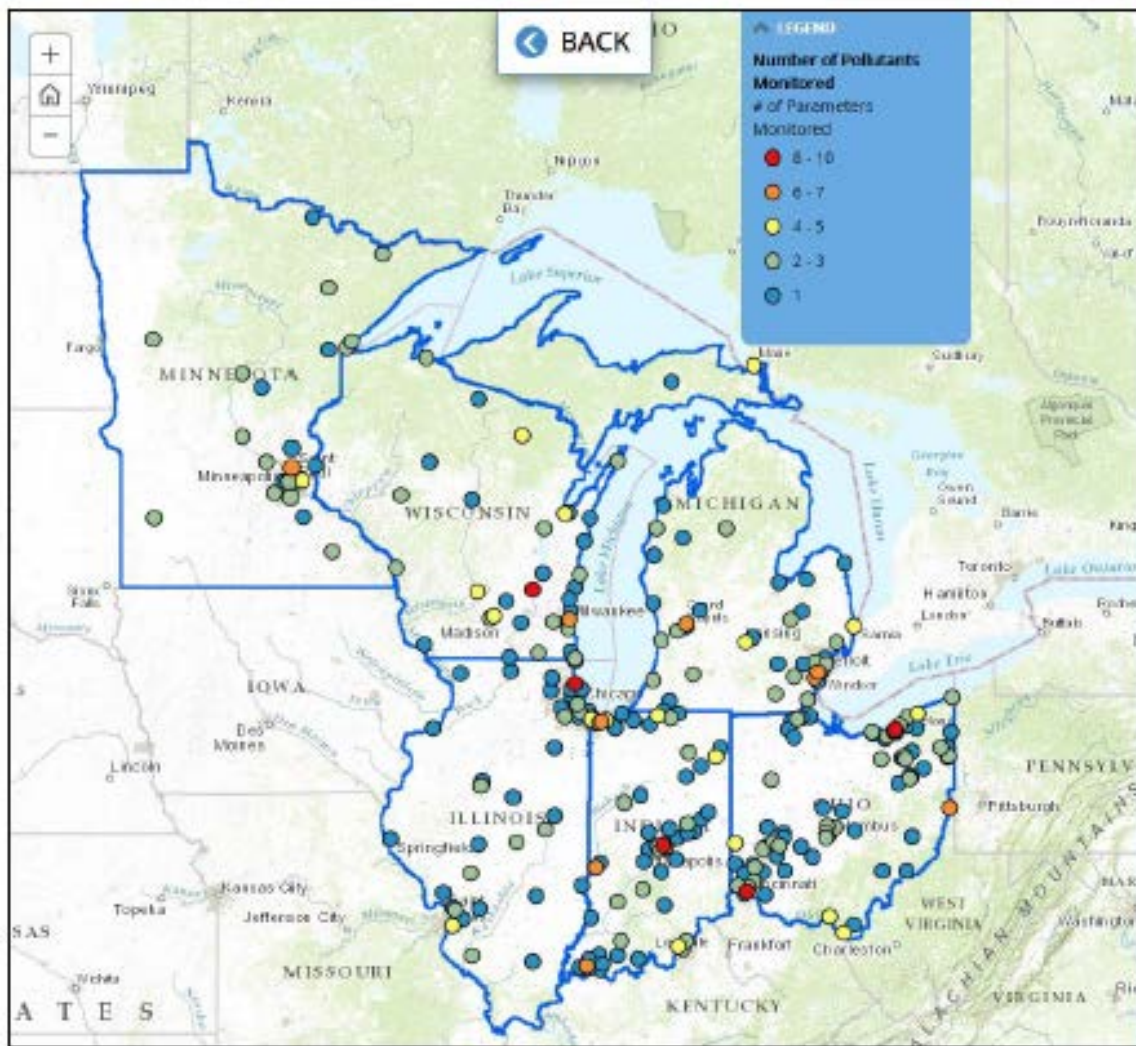
Rankings for Ozone and PM2.5 (cont.)

- 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



Rankings: Number of Parameters



Rankings: Correlation





Rankings: General Tendancies

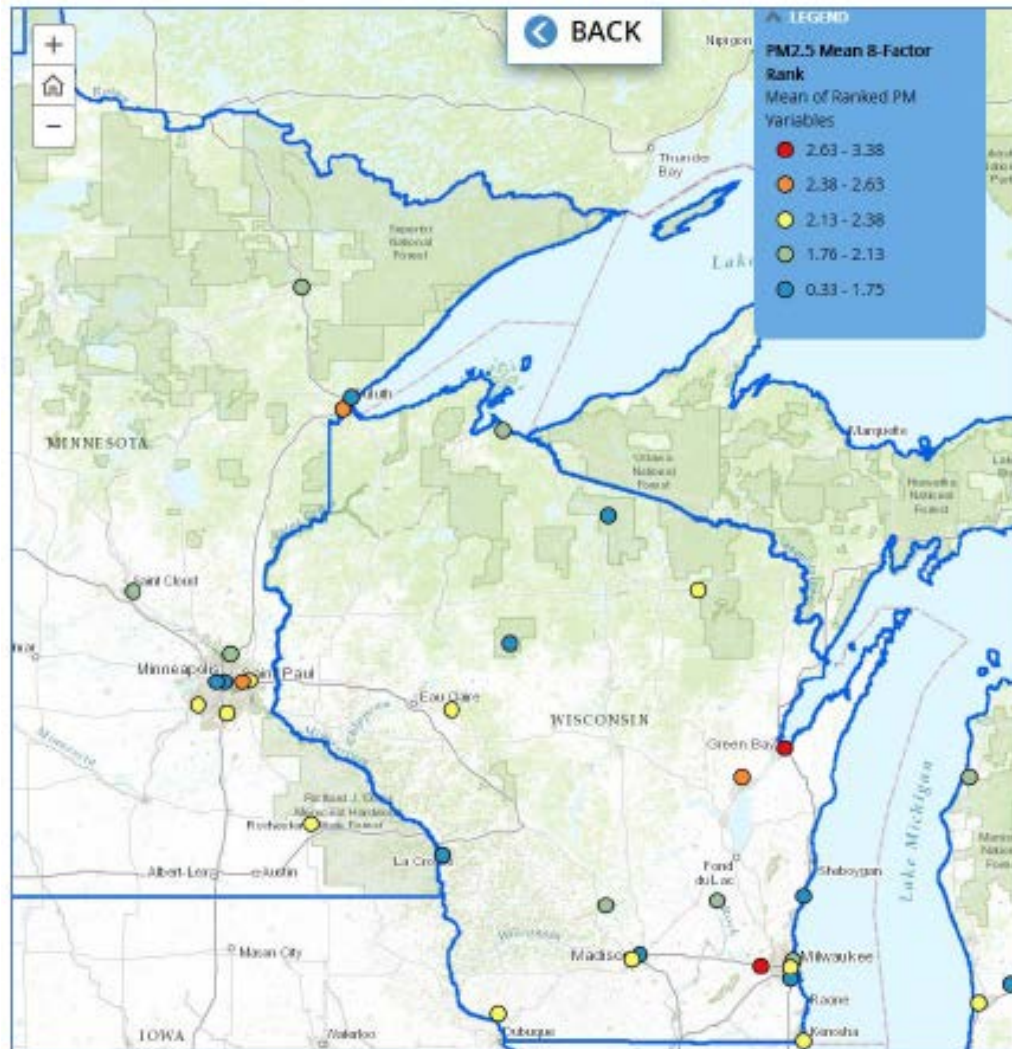
- Scores for area served, which ranks monitors higher for greater areas, will naturally tend to value rural monitors most highly, because the rural network is sparse and each monitor is intended to represent a large geographic area.
- Scores for population served tend to value urban monitors more highly, because they are sited in areas of greatest population density.



Rankings: General Tendencies (cont.)

- Rural monitors in general tend to be undervalued in this analysis because they also tend to be lower concentration monitors.


Rankings: Overall



Analyses: Monitor Shutdown Criteria

Site	CBSA	Latitude	Longitude	2013 PM2.5 Annual Design Value	2013PM2.5 24-hour Design Value
260050003	Allegan, MI	42.77	-86.15	8.3	22
260170014	Bay City, MI	43.57	-83.89	7.6	20
260490021	Flint, MI	43.04	-83.67	8	20
261010922	Manistee, MI	44.31	-86.24	6.7	18
261130001	Cadillac, MI	44.31	-84.89	5.9	17
271377001	Virginia, MN	47.52	-92.54	6.1	16
271377550	Duluth, MN	46.82	-92.09	5.7	18
271453052	St. Cloud, MN	45.55	-94.13	7.9	22
550030010	Ashland, WI	46.60	-90.66	5.1	17
550410007	Forest County, WI	45.56	-88.81	5.1	19

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

Objective	Subobjective	Analysis
Provide data to public in timely manner	Public reporting, assuring adequate geographic and population coverage	Spatial analyses: Area served, population served, removal bias, correlation analysis
Support compliance with NAAQS	Attainment analysis	Concentration-based analyses: Design value ranking, deviation from design values, unmonitored area analysis
Support control strategy development	Characterize regional concentrations, track progress	Spatial analyses (above), length of record ranking, inventory analysis
Support air pollution research		Emission inventory analysis, number of parameters analysis



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.

Questions or Comments?

