Possible Tools and Analyses for the Upcoming Network Assessments

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Feedback from States

- Population
  - How has it changed over time?
  - Who is being served?
- PM_{10}
- $PM_{2.5}$
  - Continuous vs. FRM
- Documentation
- Emphasized analyses answering two general questions
  - Are there redundant sites?
  - Are there areas that are not well characterized?

How can the tools be used?

- Identify possible redundant sites
- Identify possible locations for new sites
- Provide information on population served
- Weight of evidence
- Validation of planned networks
- ***THEY ARE NOT PERSCRIPTIVE!!!***

What analyses/tools are there and for what pollutants?

- Site Information Tool (all pollutants)
- Population Animation (all pollutants)
- Correlation Matrix Analyses/Tool

  Area Served Analyses/Tool

  Removal Bias Analyses/Tool

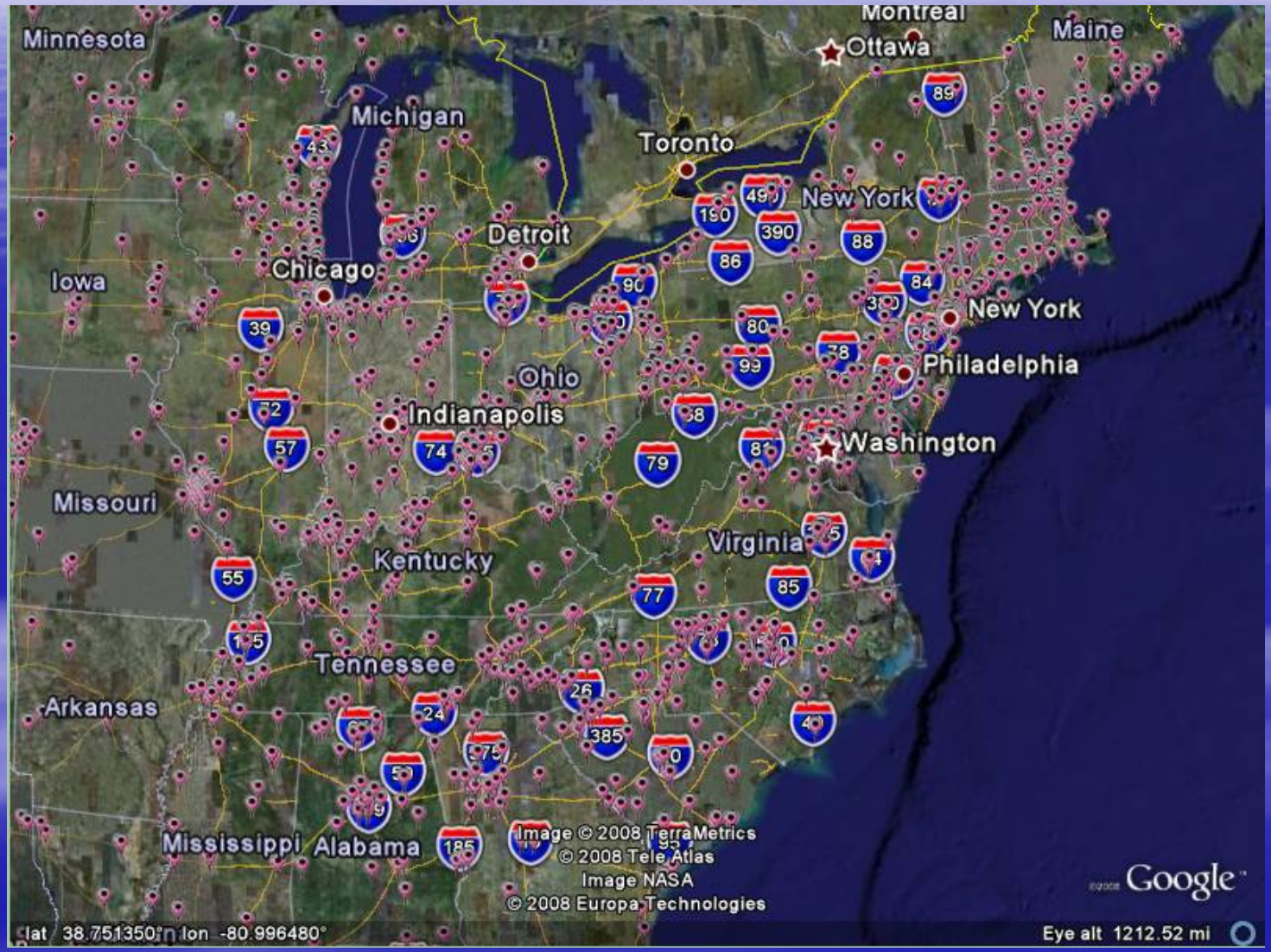
  New Sites Tool
  - Ozone, PM2.5 (FRM/FEM and Continuous), PM10 (under construction)
  - 2005 through 2008

Site Information Tool

- Created by David Mintz (AQAG) as part of the Air Explorer set of tools
- www.epa.gov/airexplorer
- Shows both active and inactive sites
- Provides pertinent site information

Site Information Tool

Ozone Sites across the Eastern Half of the United States



Google Earth is a nice tool that allows for the quick and easy viewing of the networks along with descriptive information for each site.

Produced by David Mintz, AQAG

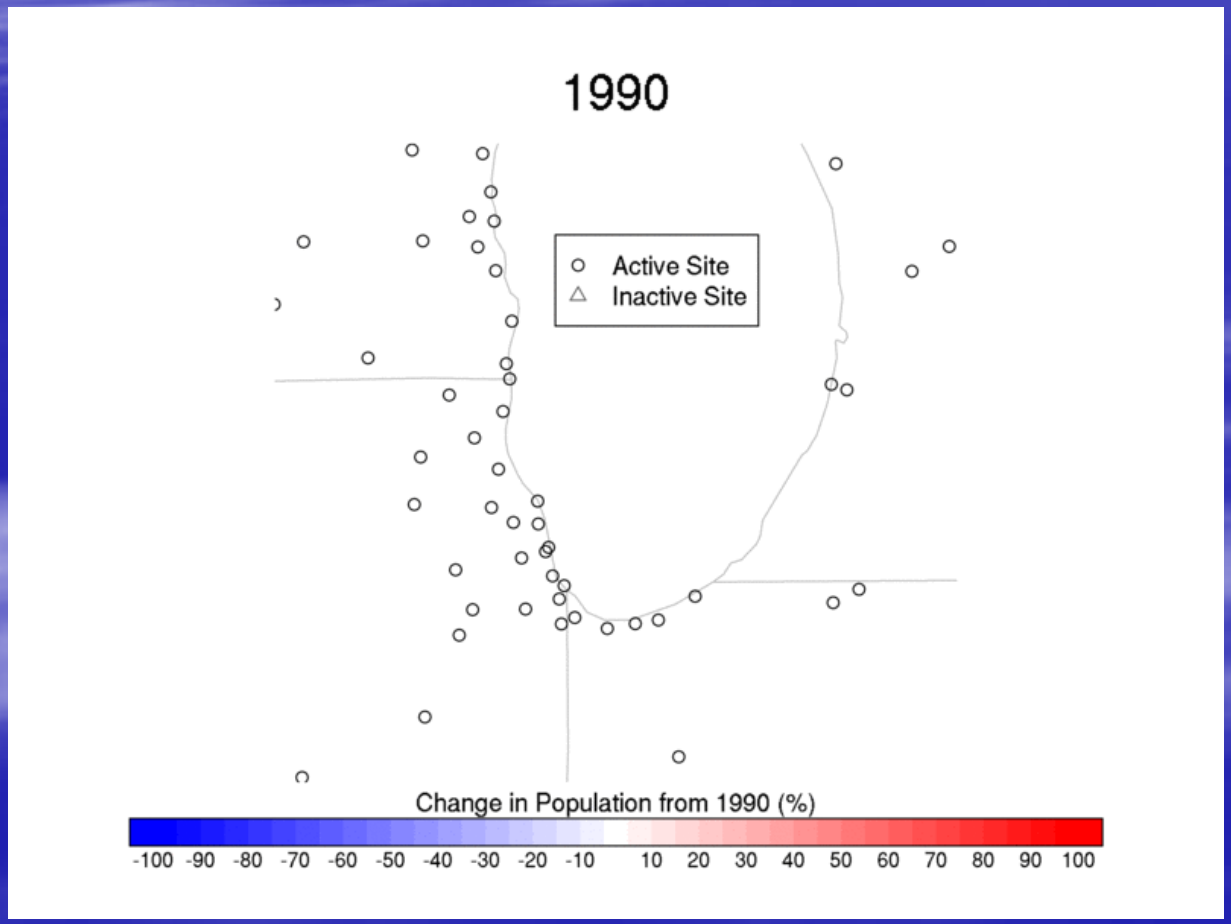
Population Animation

- Displays active and inactive sites from 1990 to 2008 along with an estimated population change from 1990
- Big caveat: very crude estimation of census tract populations
- Shows how the population has moved since 1990 in relation to the monitoring networks

Population Animation

"Where might there be a need for additional information?"
"Is current information being collected still relevant?"

Population Changes and Ozone Sites in the Lake Michigan Area



This animation shows the change in population using 1990 as a base and is intended to identify areas where population trends are increasing or decreasing.

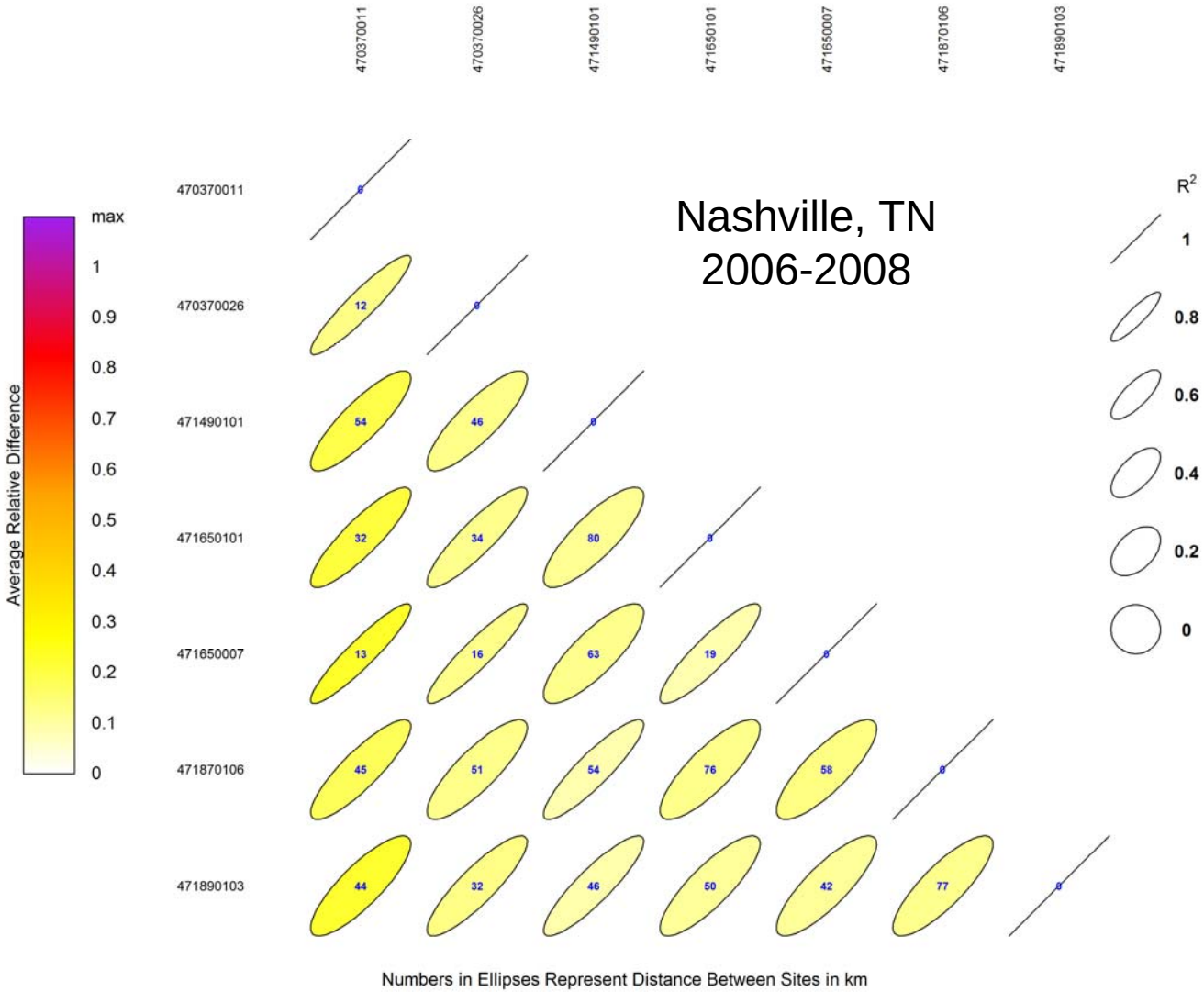
Sites active for the current year of the animation are displayed as circles while inactive or "historic" sites are shown as triangles.

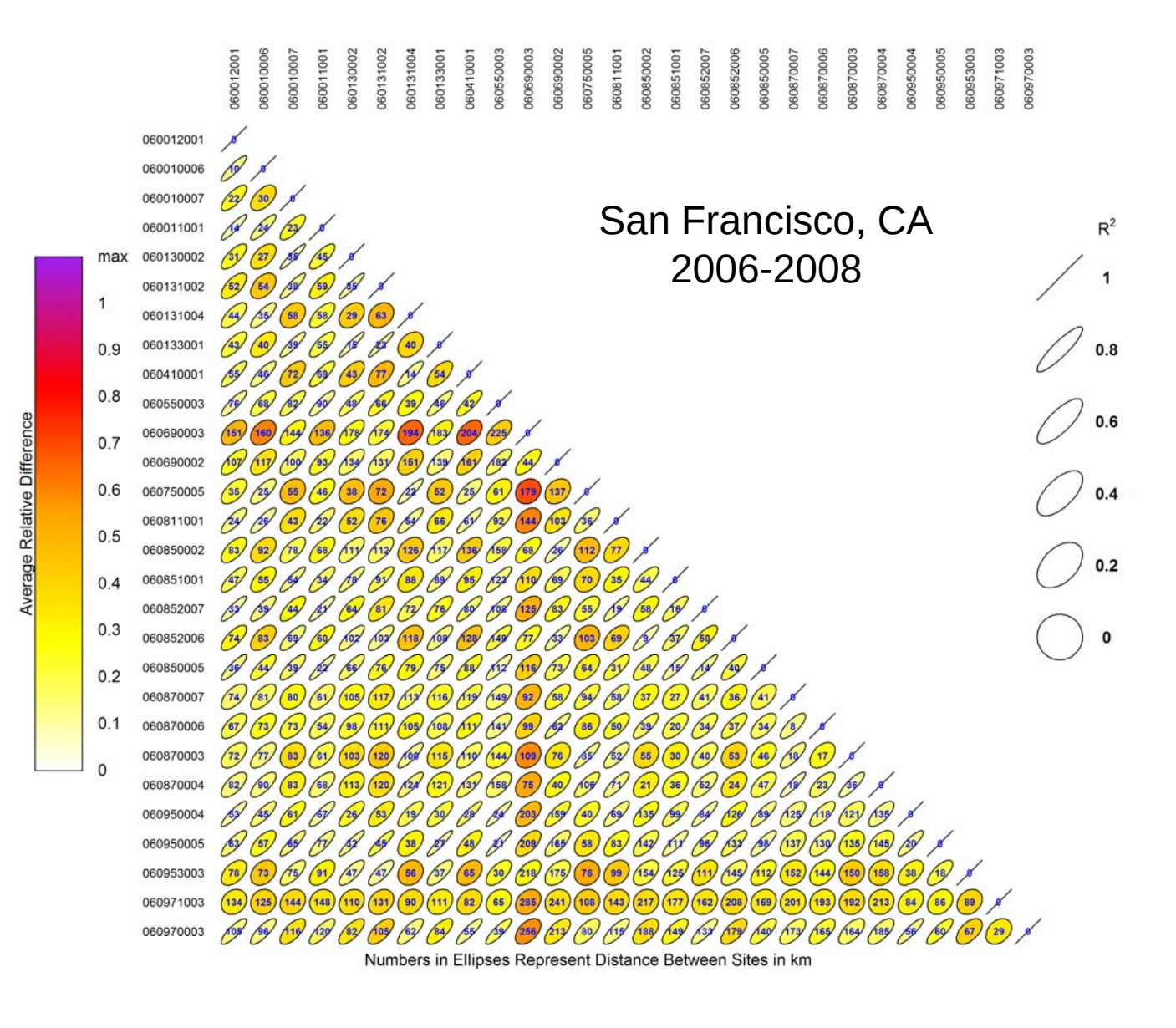
In this example, while the city of Chicago has seen little or no change in its population between 1990 and 2007, the areas surrounding Chicago continue to see a steady positive trend without seeing a change in the location of the existing sites in the ozone network to accommodate the increasing population in the suburbs.

This product will be available for Google Earth.

Correlation Matrix Analyses/Tool

- Site pair correlation and relative difference analysis
- Prepared analyses done by CBSA/CSA or county
- Tool can be run over a user defined area, pollutant and set of years


Nashville, TN
2006-2008
470370011
470370026
471490101
471650101
471650007
471870106
471890103
Average Relative Difference
max
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
R2
1
0.8
0.6
0.4
0.2
0
12
54 46
32 34 80
13 16 63 19
45 51 54 76 58
44 32 46 50 42 77
Numbers in Ellipses Represent Distance Between Sites in km

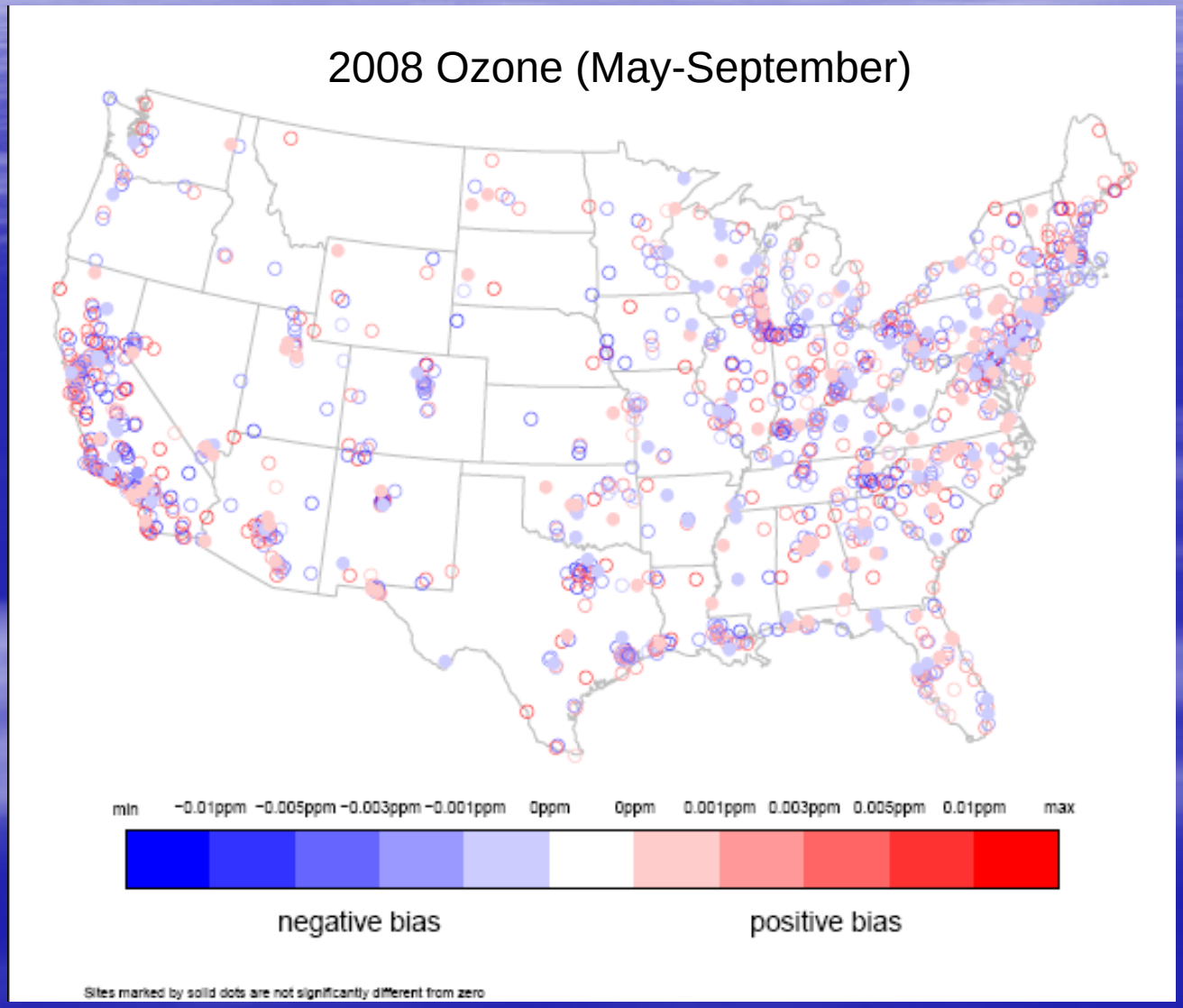

San Francisco, CA
2006-2008
Average Relative Difference
max
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
R2
1
0.8
0.6
0.4
0.2
0
Numbers in Ellipses Represent Distance Between Sites in km

Removal Bias Analyses/Tool

- Prepared analyses show the removal bias for each sie across 4 years of data
  - Main product is a Google Earth file; CSV and ARCGIS shape files will also be available
- Interactive tool can bee used for network verification where the user can take out multiple sites based on 2008 network
  - Will produce a Google Earth file as well as CSV and SHP files

Removal Bias Analyses/Tool

"Are there sites that could be discontinued or moved?"



Using a site's nearest neighbors, it is possible to determine whether or not a site usually measures higher or lower than its neighbors.

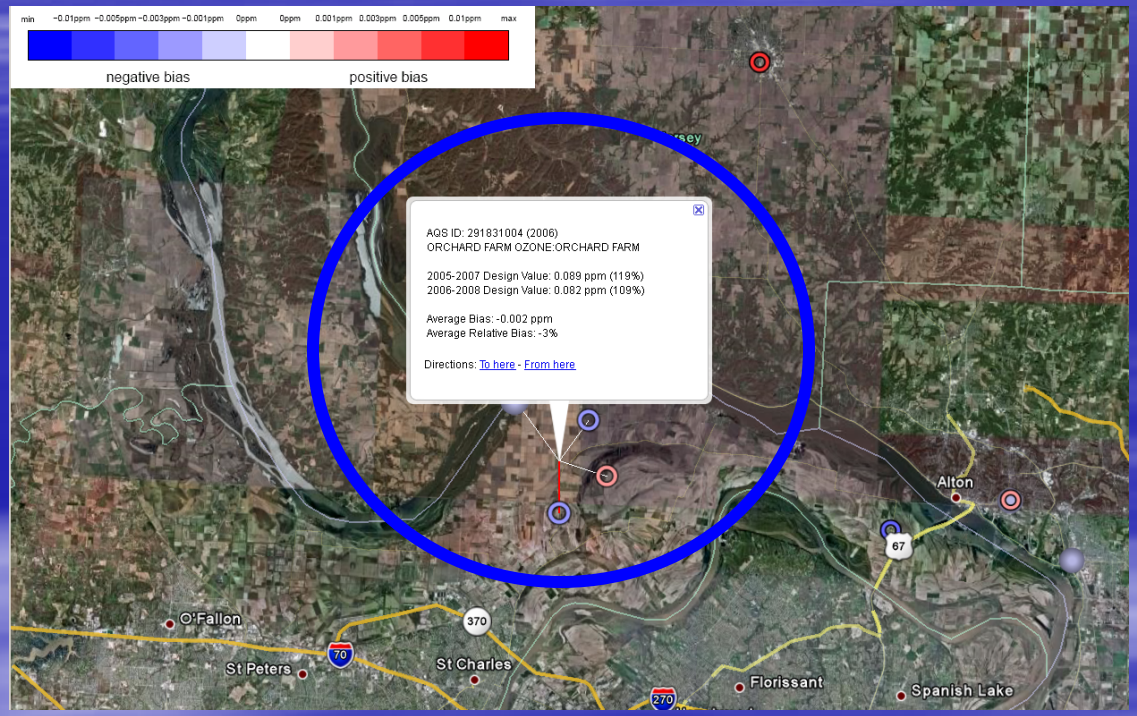
Red sites are locations where there is a positive bias or the sites' neighbors usually have a greater concentration.

Blue sites are locations where there is a negative bias or the sites' neighbors usually have a lower concentration.

Sites marked by a solid dot are not statistically different from their neighbors and could be considered as excess.

Removal Bias Analyses/Tool

"Are there sites that could be discontinued or moved?"



The Google Earth output provides the removal bias information for each of the four years analyzed as well as relevant design value information for the two overlapping 3-year periods.

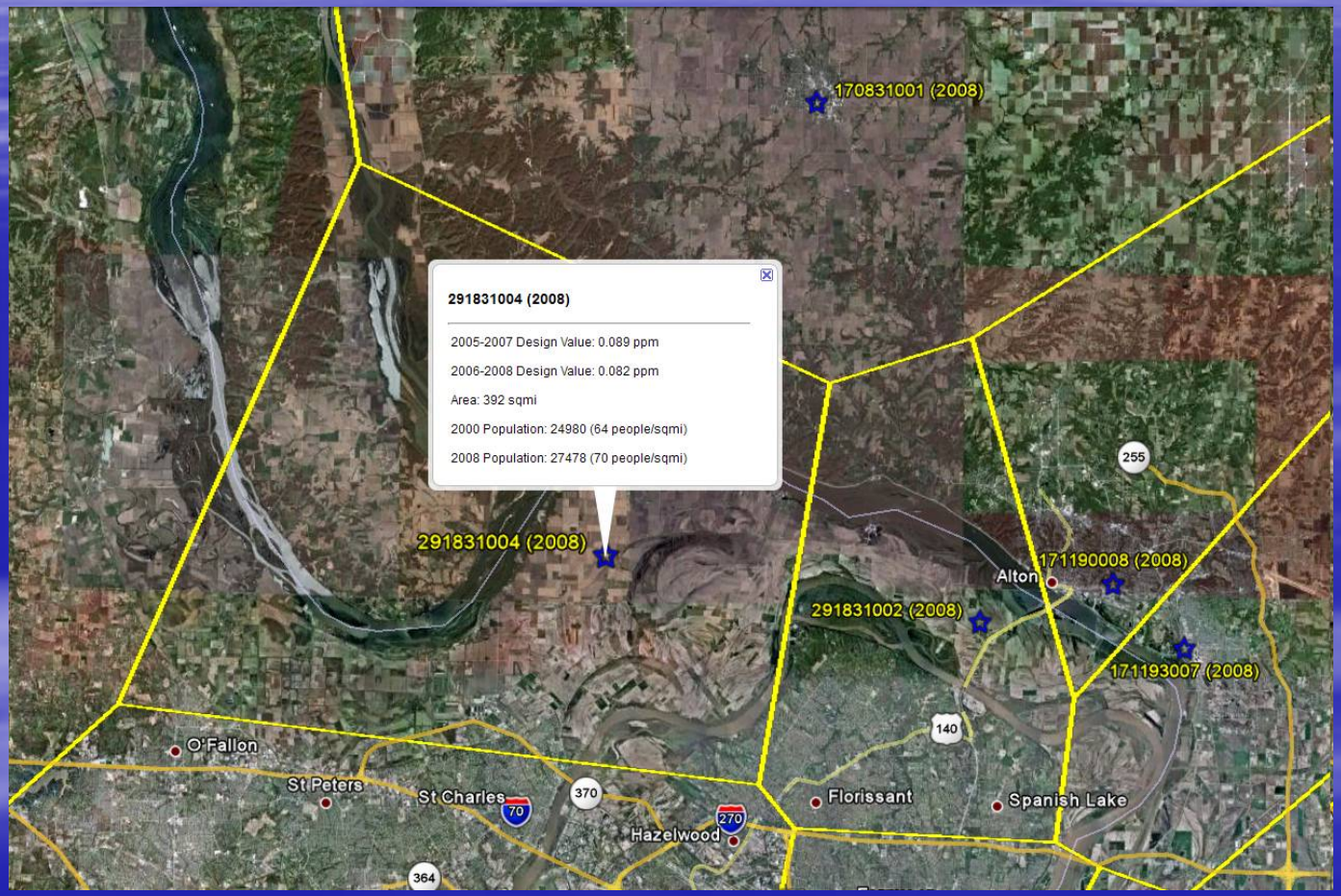
The highlighted site is near St. Louis, MO. Even though the site may consistently show a small bias in relation to its neighbors over time, there may be other circumstances which may preclude it from being considered for removal or relocation.

This would include violating the NAAQS as this site does for both 2005-2007 and 2006-2008.

Area Served Analyses/Tool

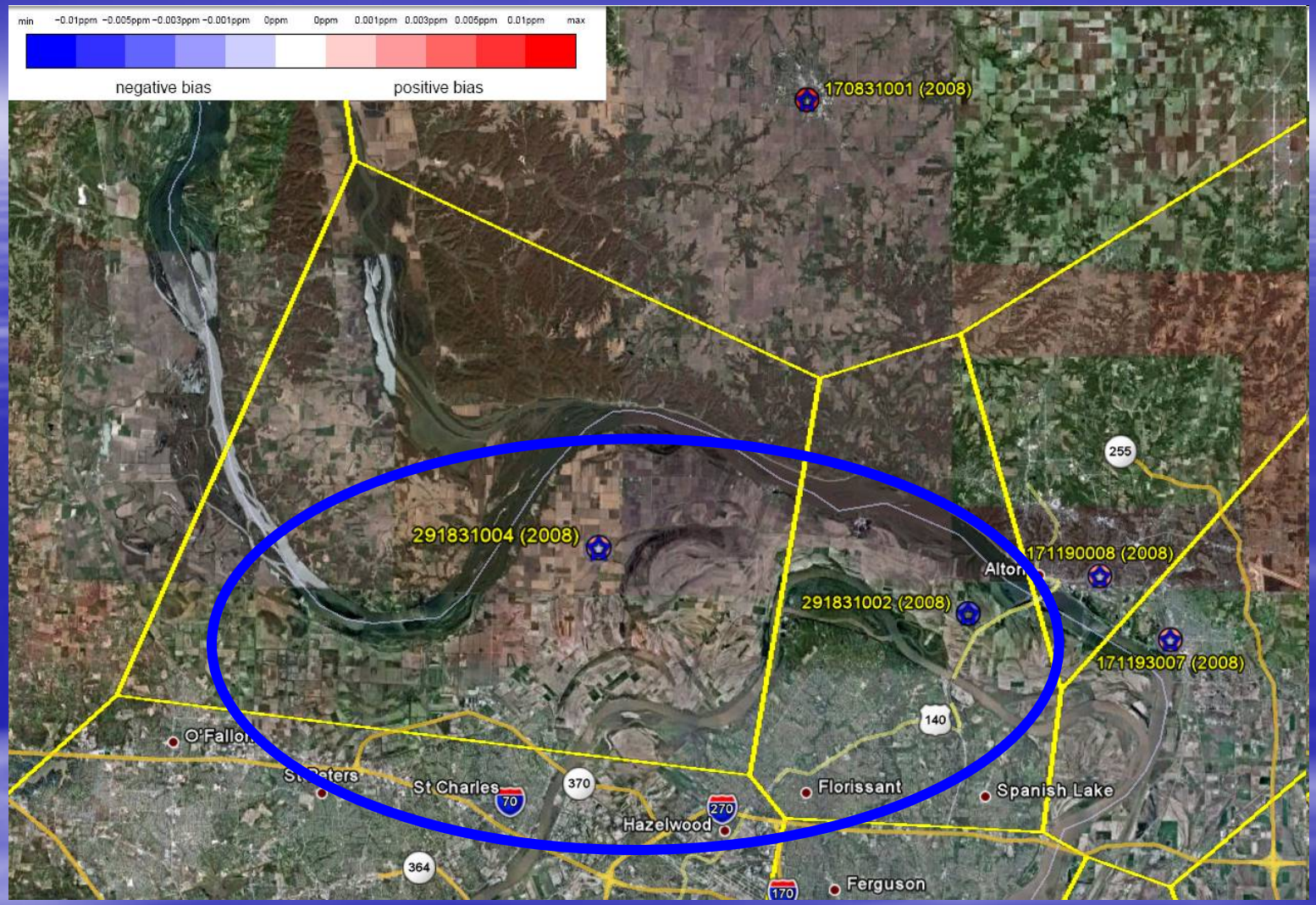
- Prepare analyses show the area served by each monitor based on Voronoi polygons
- Tool allows for user input and shows area served for existing sites as well as possible new sites

Area Served Analyses/Tool



This map shows the Voronoi polygons for ozone sites near St. Louis, MO. Each polygon shows the area represented by an ozone monitor marked by a "star" on the map.

Depending on the year, clicking on the site in Google Earth provides the design value, the size of the area the monitor represents as well as the population represented from both 2000 and an up to date estimate.



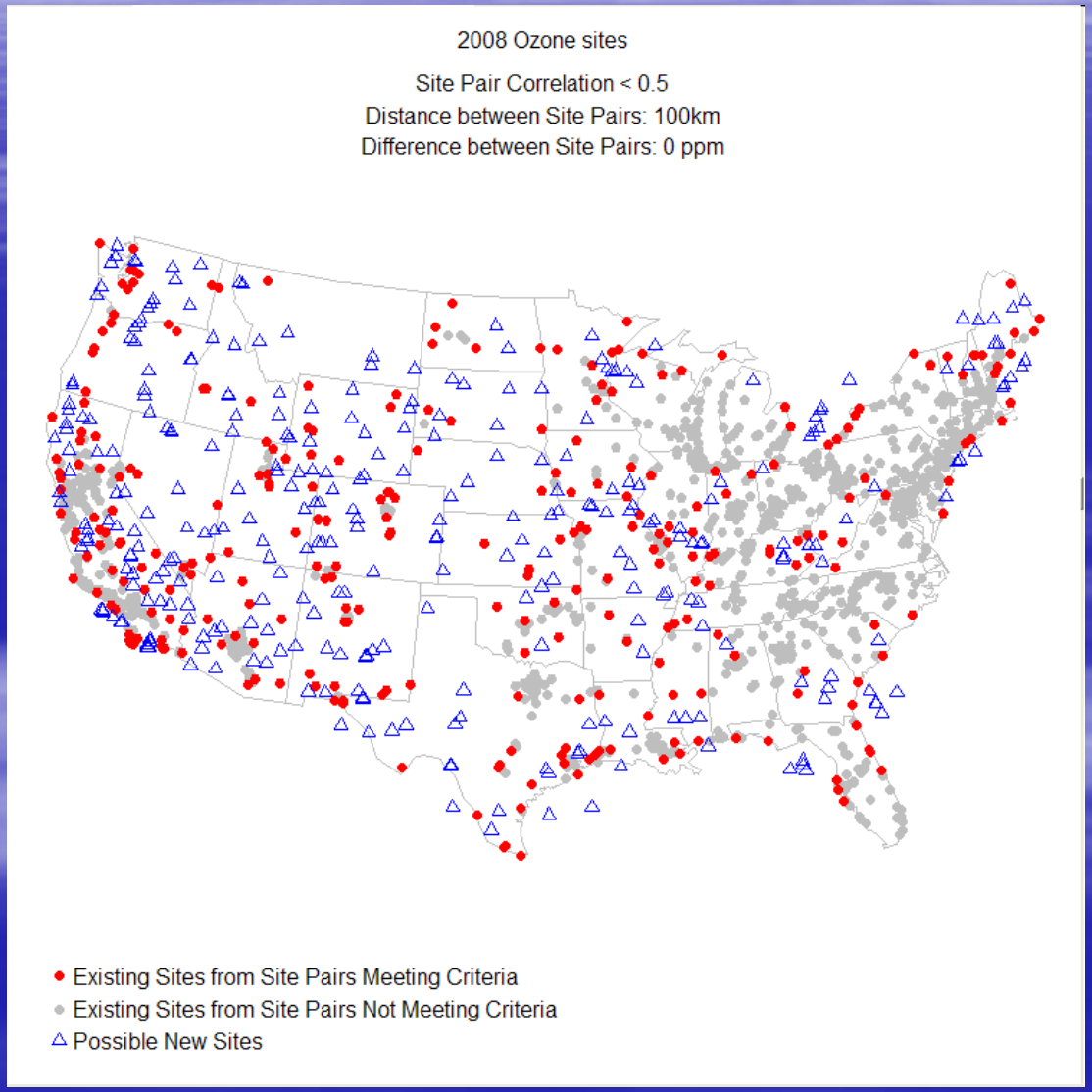
Using more than one tool or analysis in combination with others may provide better overall information regarding the utility of a site. With the St. Louis example, when overlaying the Voronoi polygons, the neighbor to the east of the monitor that was not different from its neighbors has the same design value and represents more people. One possibility could be to combine the two monitors to represent a single area.

New Sites Tool

- Tool looks at nearest neighboring pairs of sites
  - Correlations, distance and gradient (difference)
- Pairs of sites that meet use input have a “new” sites placed half way between them

Examples of Possible Analyses

"Where might there be a need for additional information?"



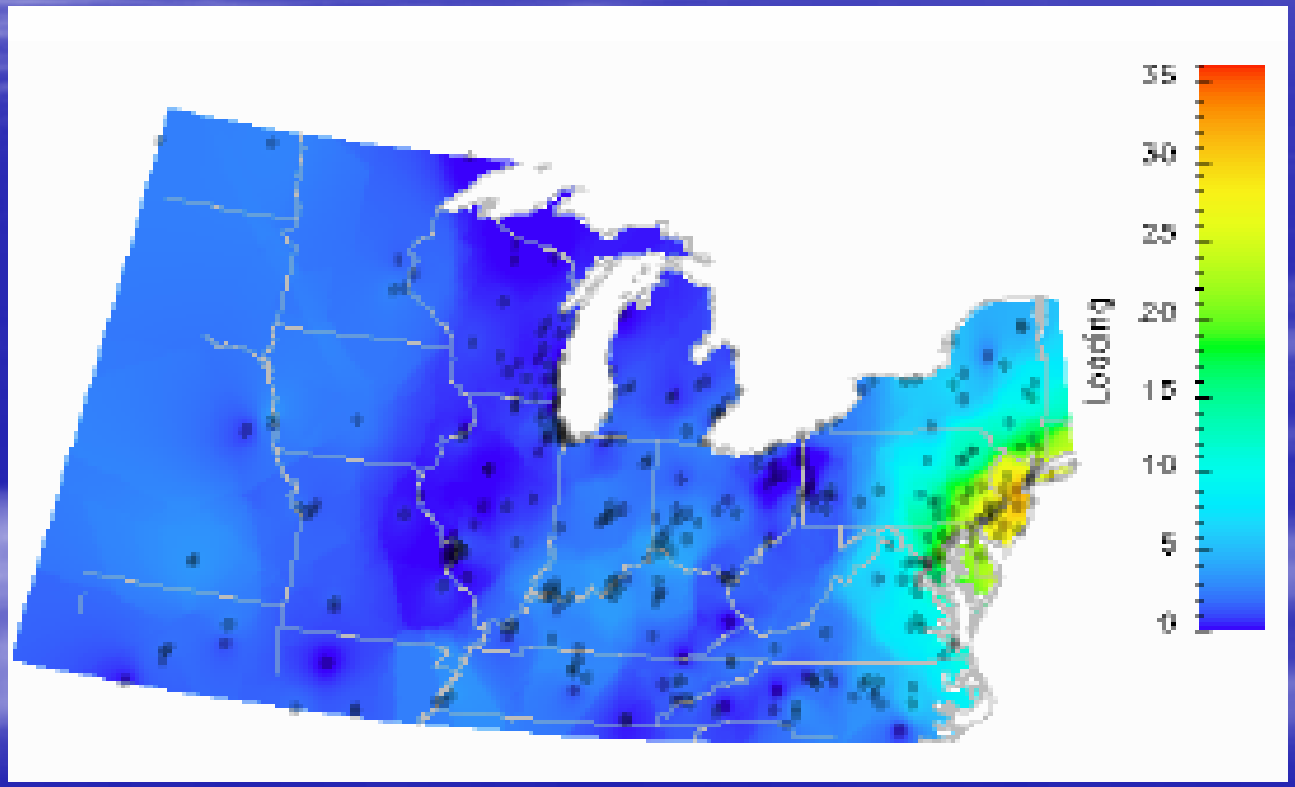
Using the nearest Voronoi neighbors and applying some criteria to the site pairs such as examining the gradient, distance and correlation between them, a possible new site was placed half way between two sites that met above criteria.

There are obviously more "new" sites than would be expected to be put into service. This analysis simply highlights areas where a new site ***MAY*** be placed to possibly provide additional information. Additional analyses and priorities from the States may show that the suggested sites are not necessary.

If Time Permits

"Are there sites that could be discontinued or moved?"

Typical factor from PMF Analysis from Region 5 2001 Network Assessment



PMF is not just a tool for source apportionment analyses. It is a generalized multivariate technique that can be used to characterize any data which covary.

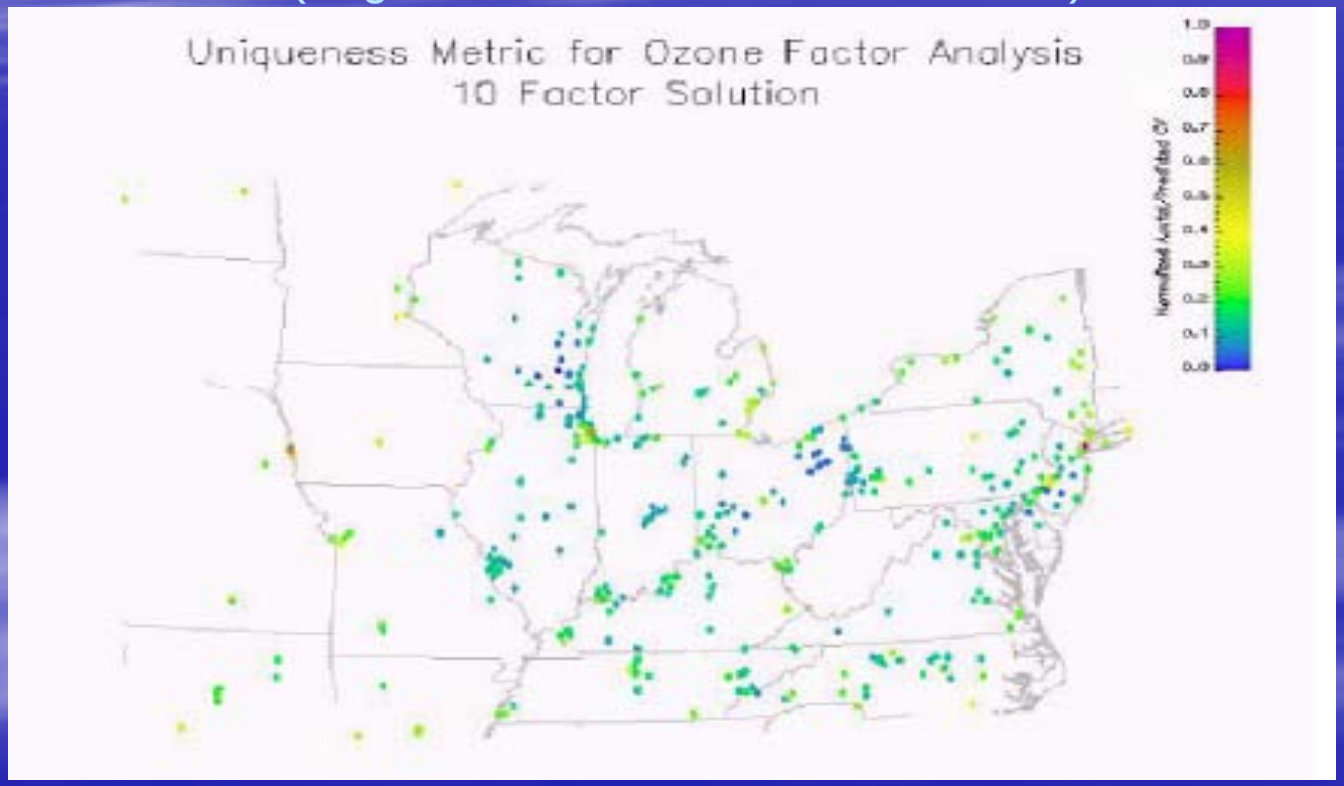
In this case, an analysis was done looking at ozone data from Region 5 with the plot showing one of the "factors". The results of the analysis grouped the ozone sites shown on the map into different spatial factors. This one represents the Northeast US. There were also factors representing other geographical regions such the Lake Michigan area, the central Midwest (southern IL, IN, OH), North Carolina, and the south central US.

Rizzo, MJ; Scheff, PA; Assessing ozone networks using positive matrix factorization; **ENVIRONMENTAL PROGRESS; Vol 23** Issue **2;** Pages: **110-119; JUL 2004**

If Time Permits

"Are there sites that could be discontinued or moved?"

Uniqueness Metric Describing How Well PMF Fit the Ozone Data
(Region 5 Network Assessment 2001)



PMF provided a prediction of the ozone concentrations at each site included in the analysis. A uniqueness metric was constructed to characterize PMF's ozone predictions.

Sites colored near the bottom part of the scale (blue to green) were predicted very well and considered candidates for either removal or relocation. Sites colored near the upper end of the scale were seen as being more unique and, therefore, less likely to be moved.

Analyses and Tools Roll Out

- Working with Ambient Air Monitoring Group to provide a download site via AMTIC
- Need to finish some analyses for continuous PM and add PM_{10} to everything
- May need to make some minor changes to interactive tools
- Need to provide complete documentation as possible addendum to 2007 "AMBIENT AIR MONITORING NETWORK ASSESSMENT GUIDANCE" including interpretation of results