Monitoring Network Assessments Lessons Learned

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Air Quality Research and Innovative Solutions

Outline

- What is a network assessment?
- Questions that need to be answered
- Overview of a network assessment
- Lessons learned and examples

Sharing lessons learned from national-, regional-, and local-level network assessments

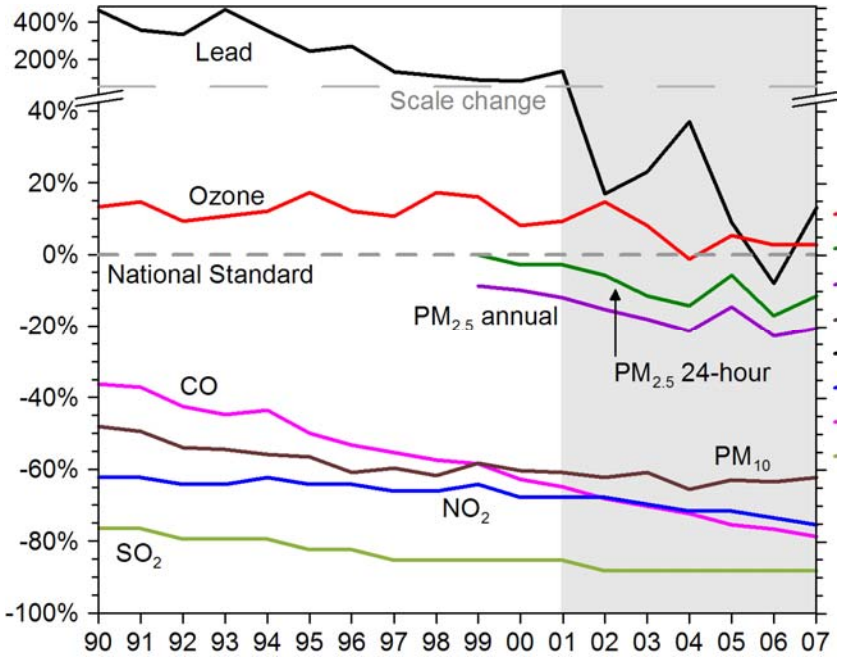
What Is a Network Assessment?

- Re-evaluation of the objectives and budget for air monitoring
- Evaluation of a network's effectiveness and efficiency relative to its objectives and costs
- Development of recommendations for network reconfiguration and improvement

EPA developed a guidance document that presents a technical approach, thought process, and methodologies: http://www.epa.gov/ttn/amtic/cpreldoc.html

Why Are Network Assessments Needed?

- Because
  - Air quality has changed
  - Populations and behaviors have changed
  - New air quality objectives have been established
  - Understanding of air quality issues and monitoring capabilities has improved
- EPA expects that a multi-level network assessment will be conducted every five years—the first is due in 2010



2007 EPA Status and Trends Report

Reconfiguring air monitoring networks to help meet the needs of current air quality research and issues will enhance their value to stakeholders, scientists, and the general public.

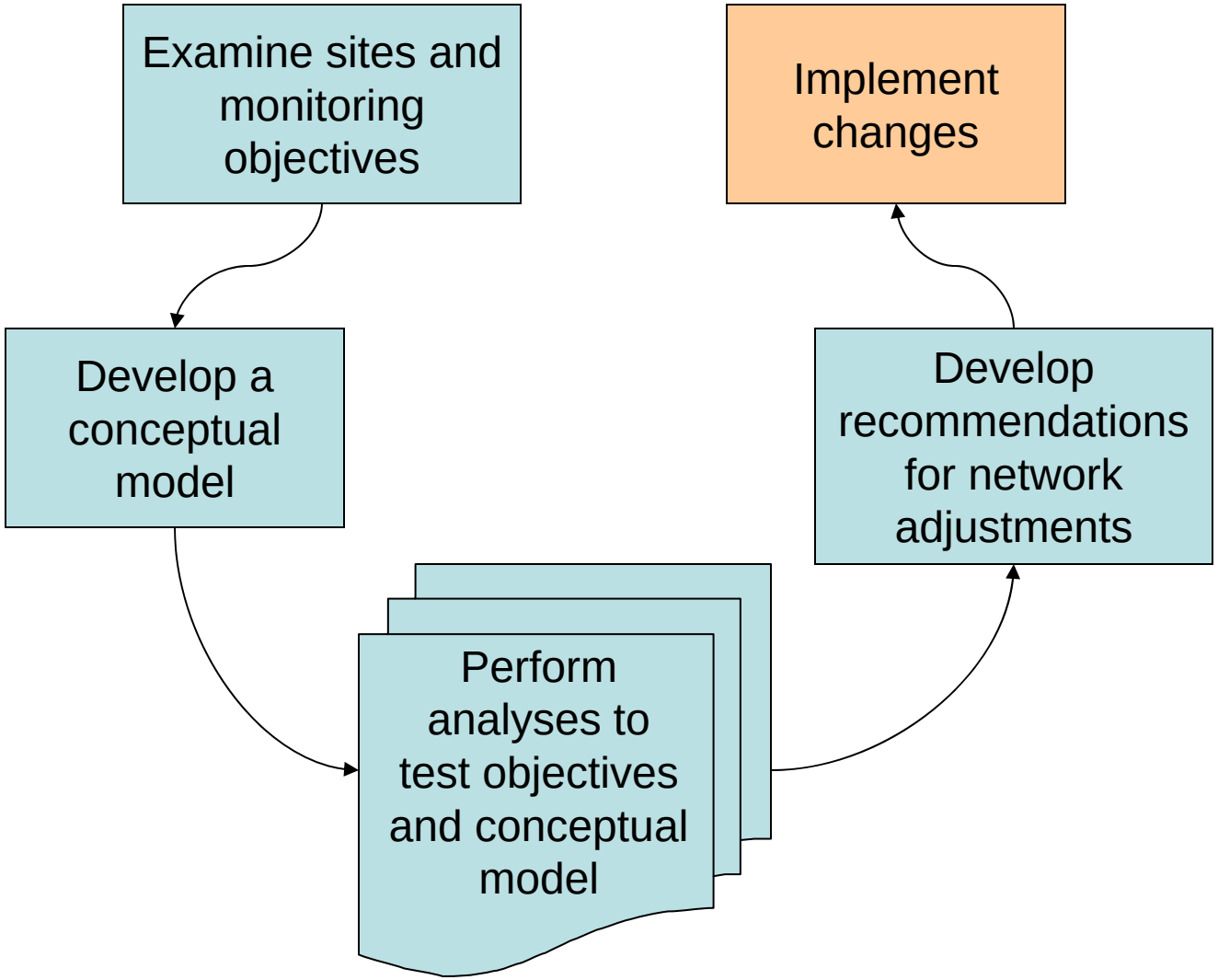
Specific Questions Agencies Need to Address

Are sites appropriately located to

- Determine the highest criteria pollutant concentrations expected to occur in the area covered by the network?
- Measure typical concentrations in areas of high population density?
- Determine the impact of significant sources or source categories on air quality?
- Determine general background concentration levels?
- Determine the extent of regional pollutant transport among populated areas and in support of secondary standards?
- Measure air pollution impacts on visibility, vegetation damage, or other welfare-based impacts?

40 CFR 58.10

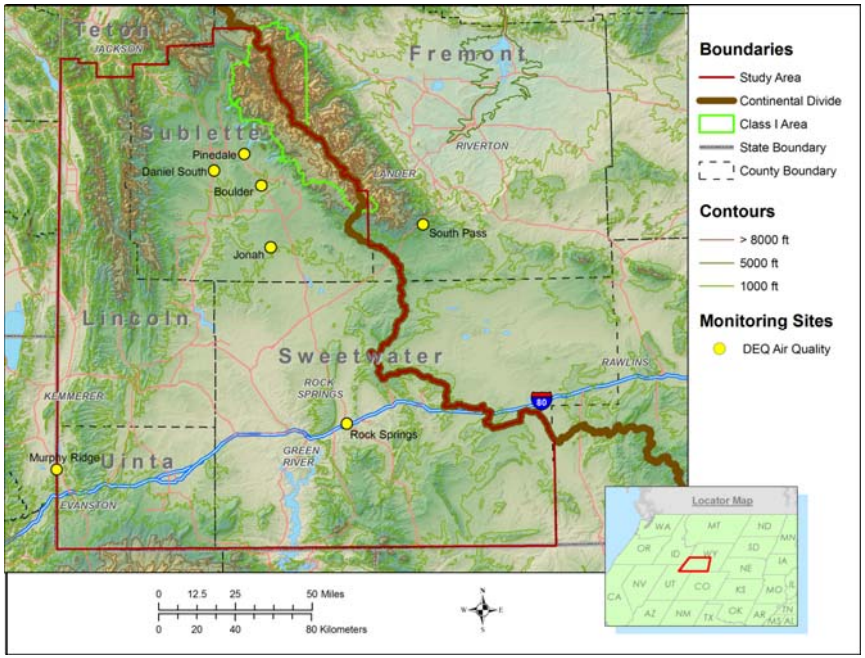
Overview of Assessment Approach



Overview of Assessment Approach

Examine sites and monitoring objectives and current state of regional air quality

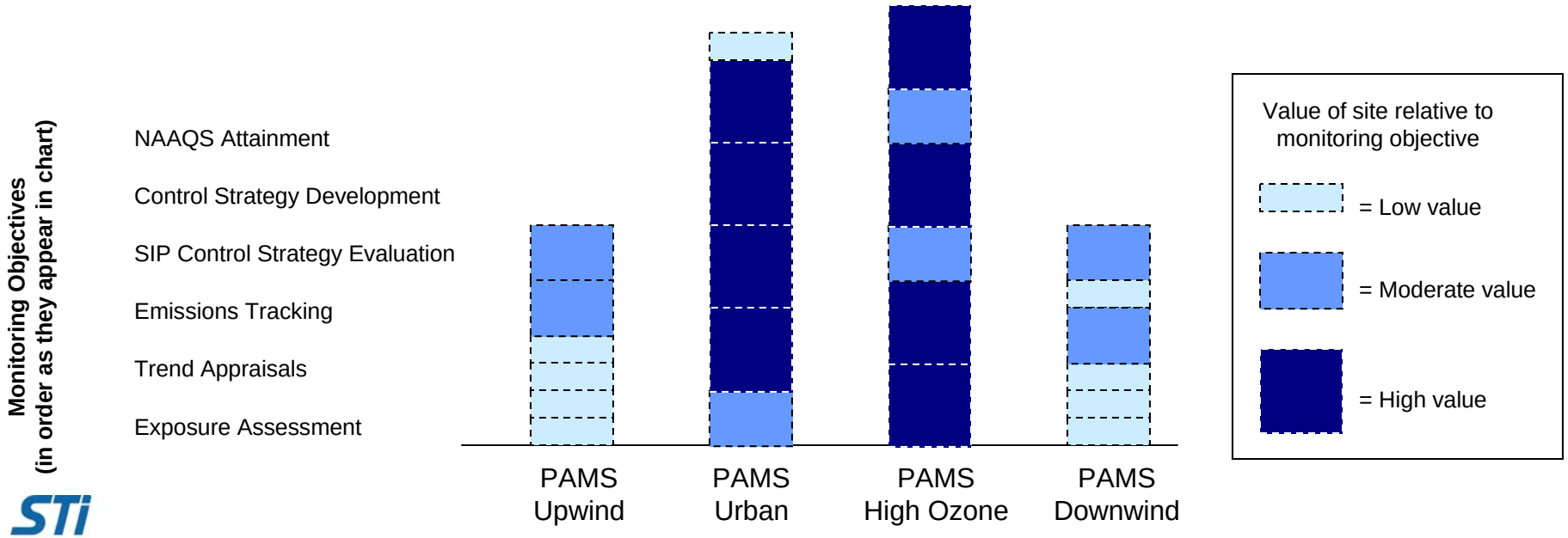
- Compile a network history
- Note each site's monitoring objective
- Determine whether sites meet established objectives
- Determine whether established objectives are still relevant



Overview of Assessment Approach

Develop a conceptual model; use your knowledge of the network to identify

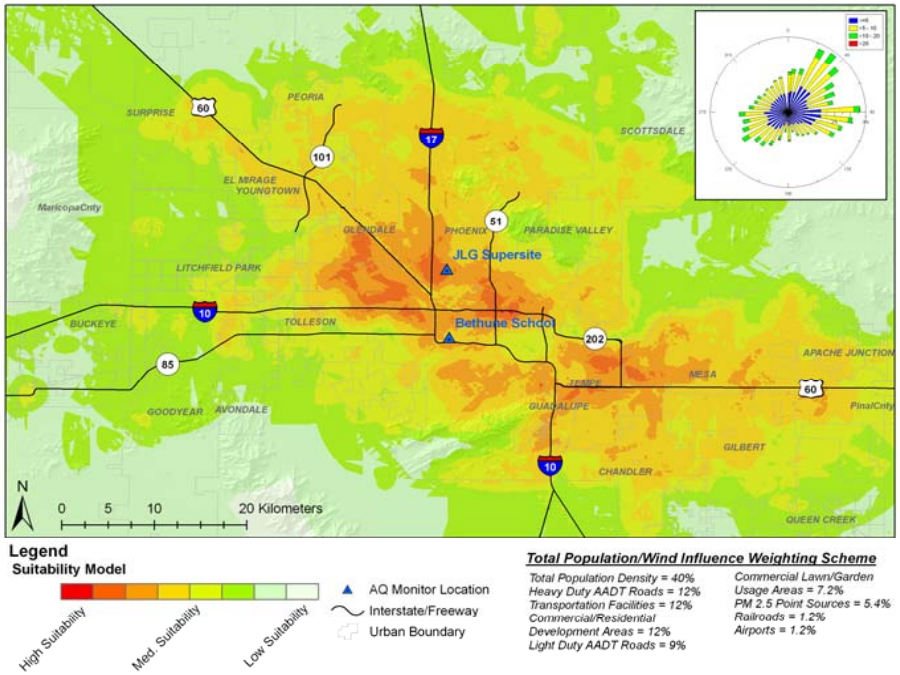
- Gaps in monitoring
- Sites that may no longer meet objectives
- Parts of the network that need investigation



Overview of Assessment Approach

Conduct data assessments starting with simple analyses and moving on to more complex and data-intensive analyses

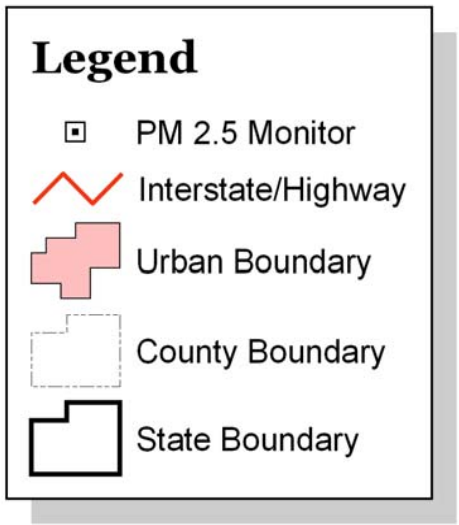
- Number of parameters monitored
- Trend impacts
- Measured concentrations
- Deviation from standards
- Monitor-to-monitor correlation
- Population change
- Population served
- Principal Component Analysis (PCA)
- Emission inventory comparison
- Removal bias
- Suitability analysis

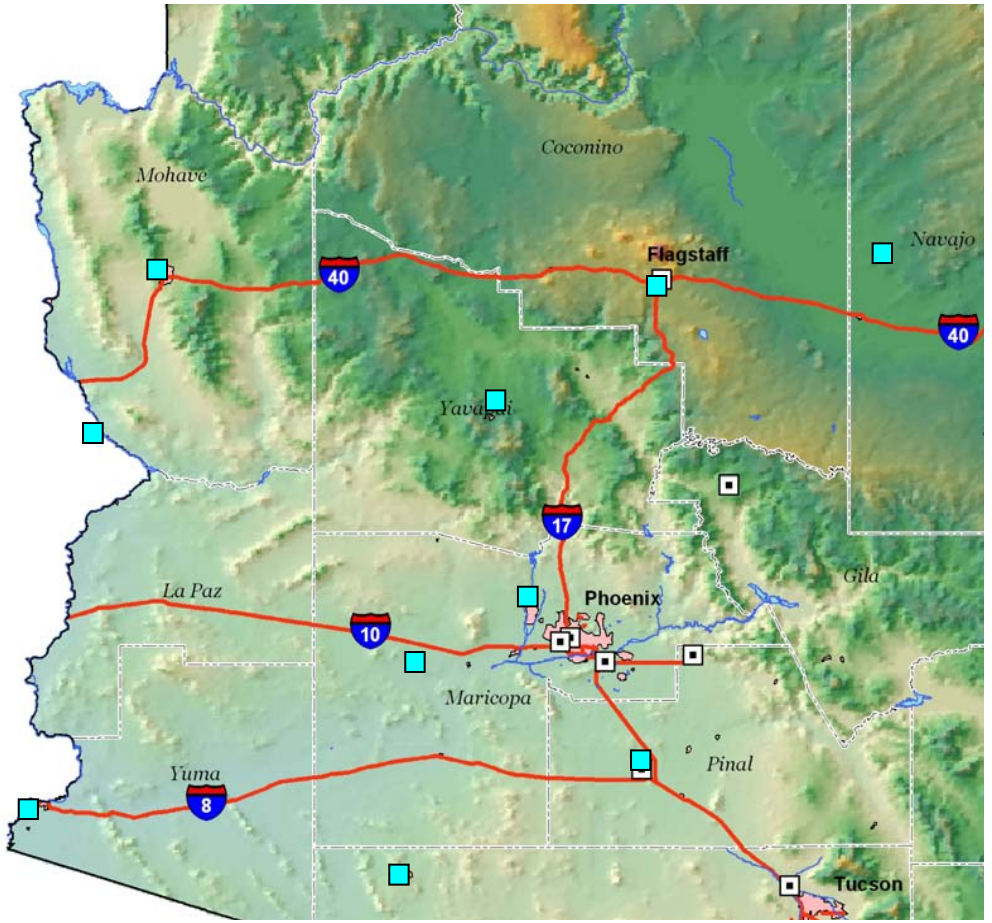


Overview of Assessment Approach

- Recommend adjustments to the network
- Implement adjustments

Suggested additional $PM_{2.5}$ FRM sites

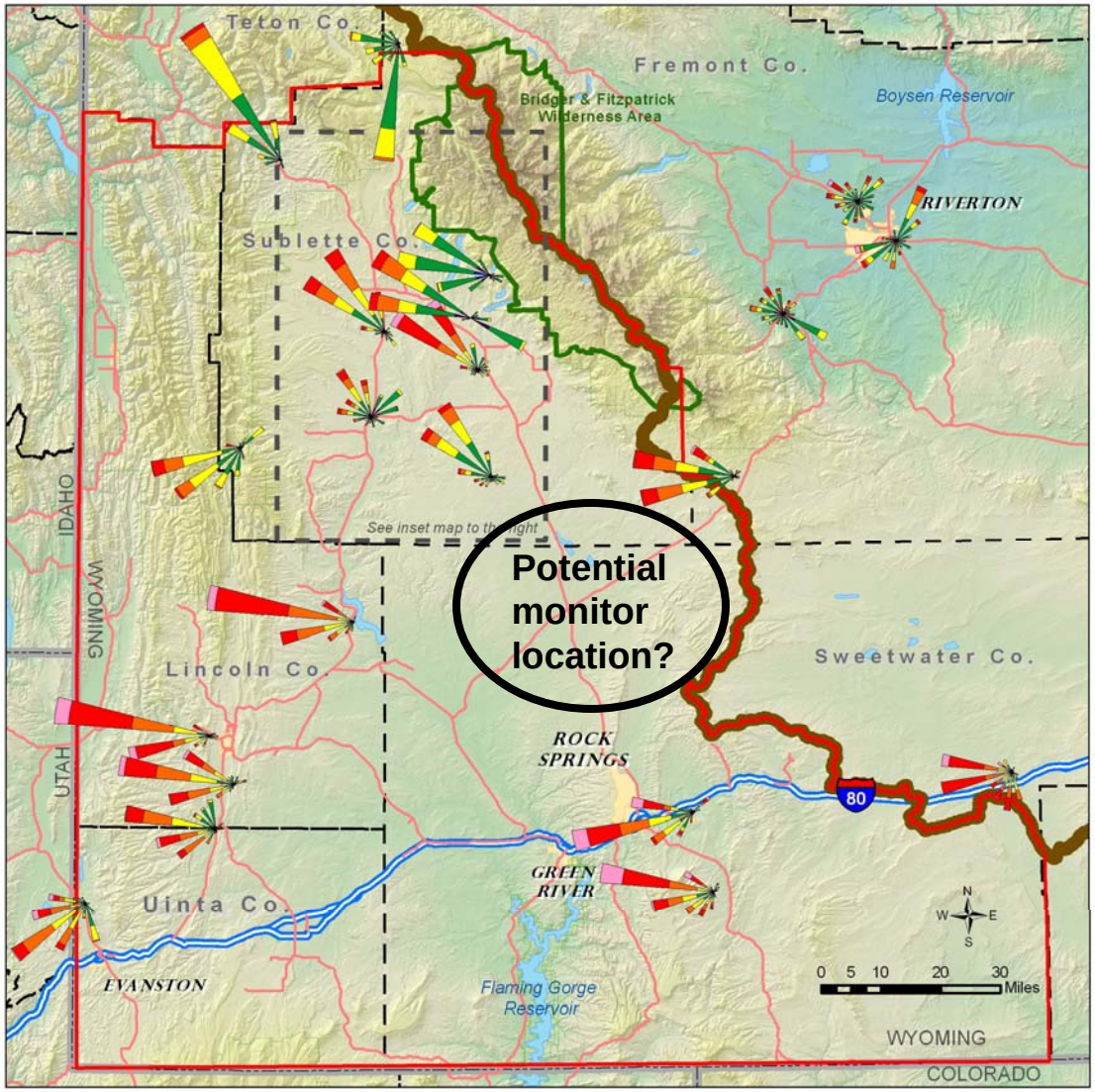




Lessons Learned
Trust Your Instincts

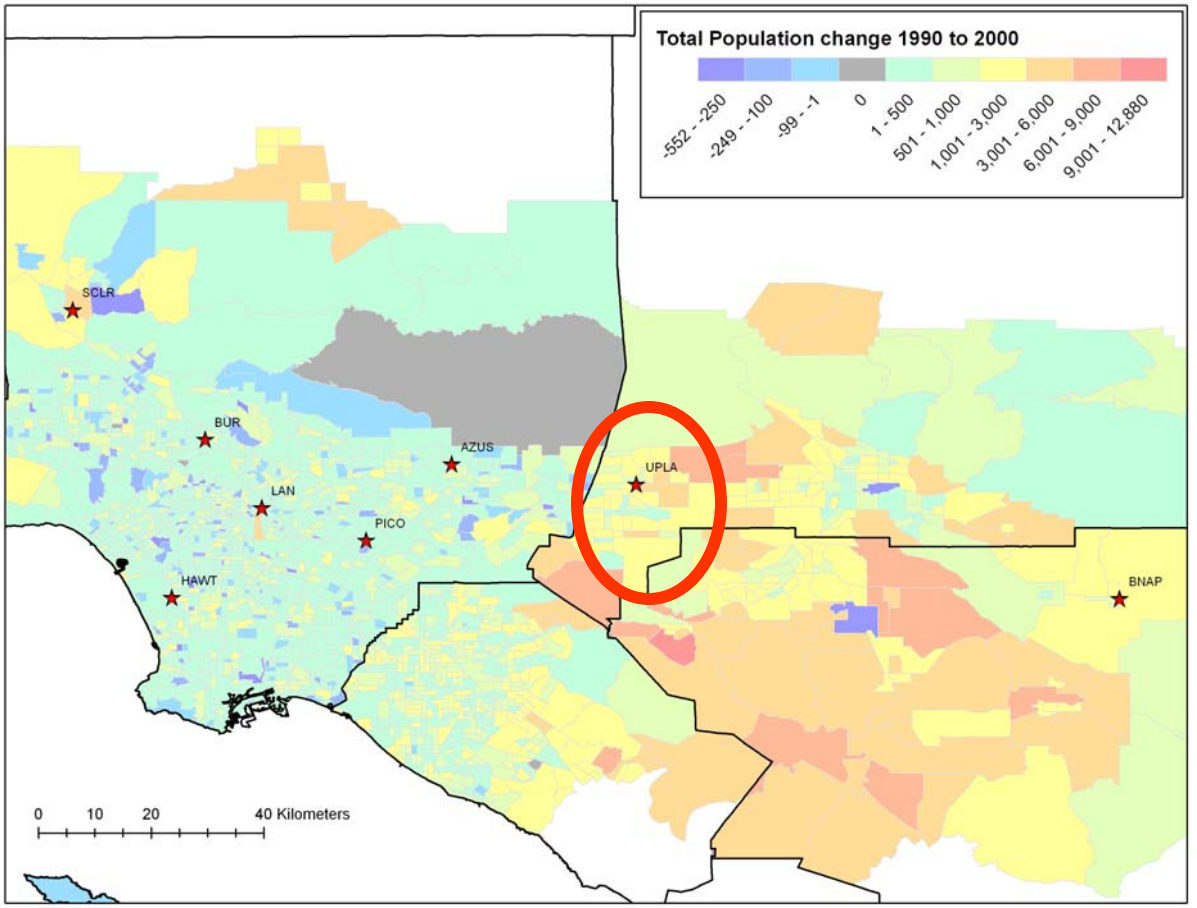
"We feel there is a hole in the ozone and meteorological monitoring coverage downwind of the high emissions area."

Potential gap in the network for measuring downwind ozone concentrations confirmed using suitability analyses



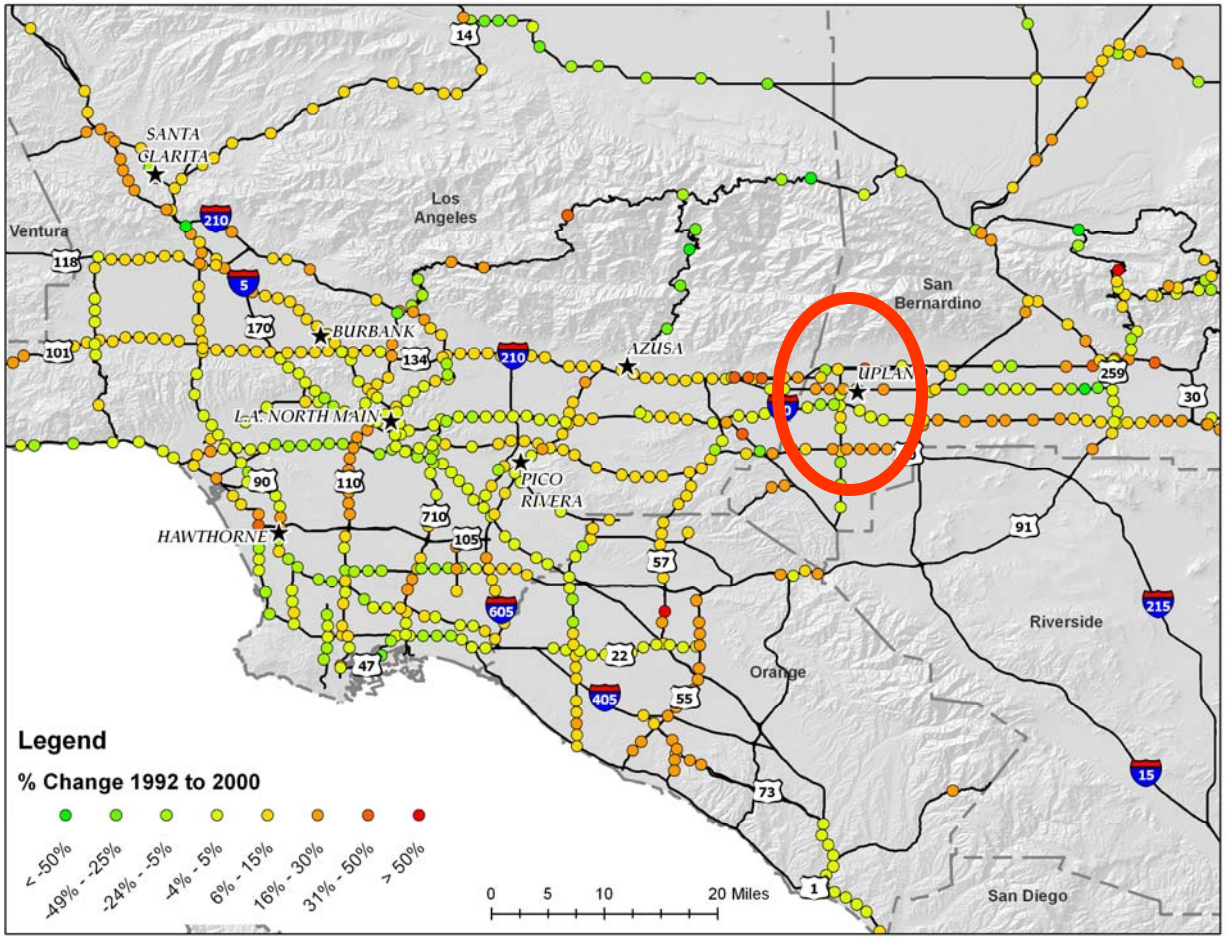
Lessons Learned
Urban Encroachment is Widespread

- Pollutant concentrations at an historically downwind site east of Los Angeles became increasingly similar to near-urban sites.
- Population is increasing near the site (1990-2000).



Lessons Learned
Urban Encroachment is Widespread

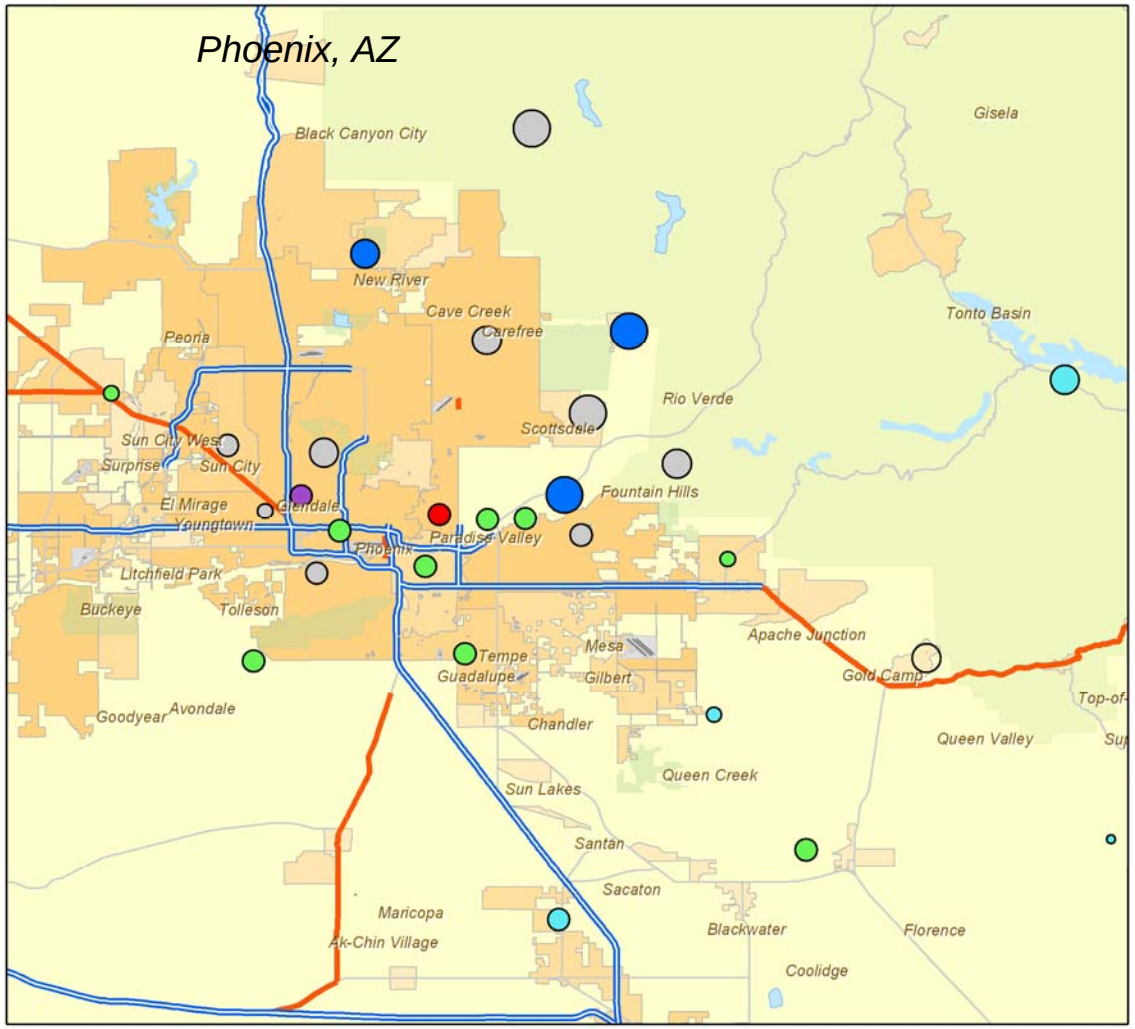
Vehicle traffic has also increased nearby.



Percent change in vehicle activity—annual average daily traffic—between 1992 and 2000

Lessons Learned
Graphical Displays Are Essential

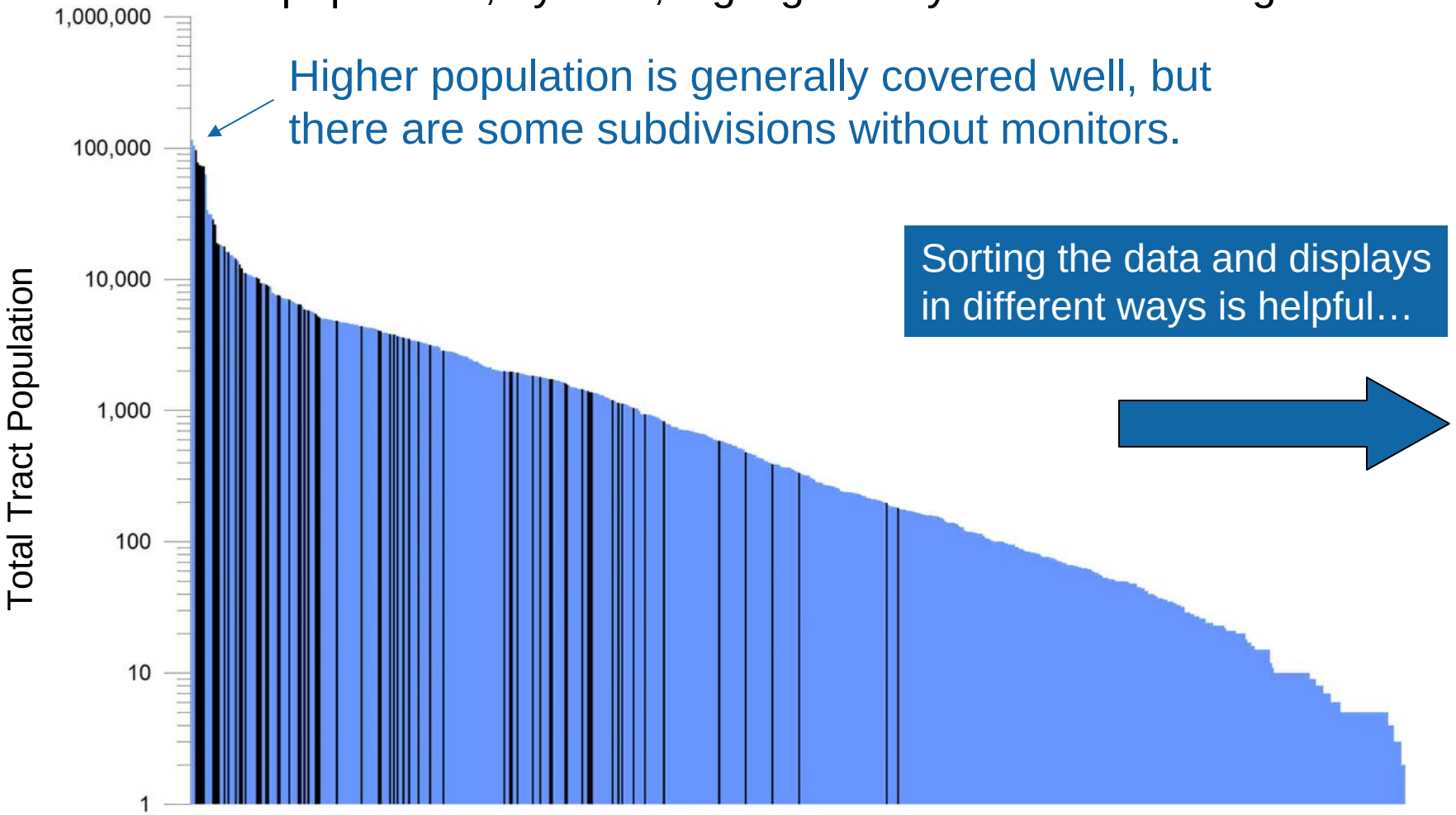
Graphical display of information, which is commonly placed in a table, aids analysts in the network assessment thought process.



Monitor values and objectives

Lessons Learned
Graphical Displays Are Essential

Total population, by tract, highlighted by monitor coverage



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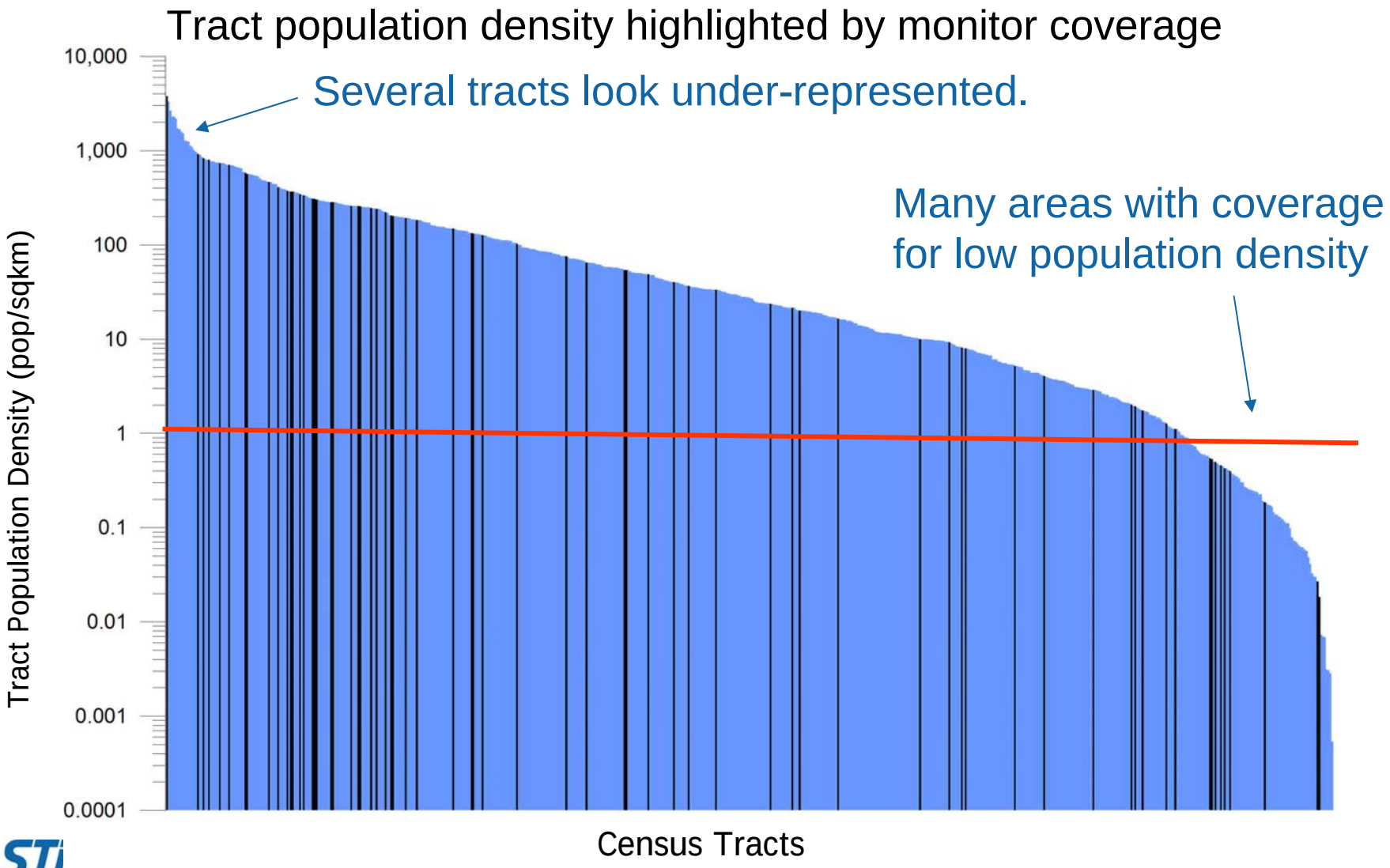
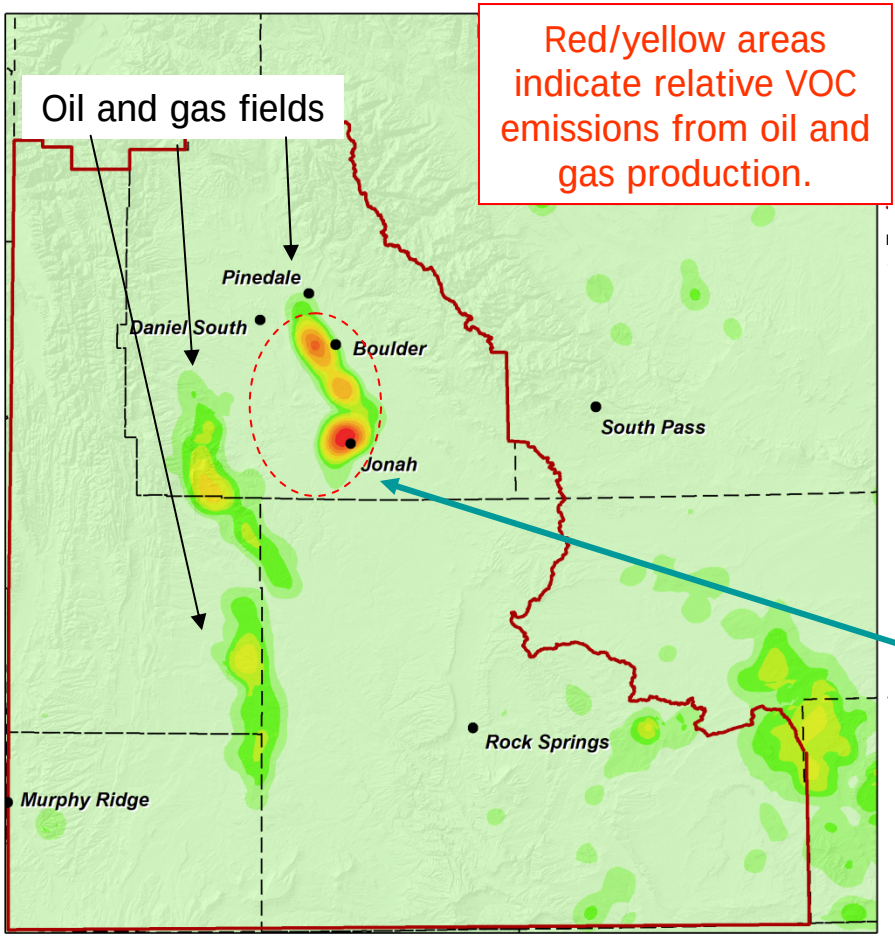
Lessons Learned
Graphical Displays Are Essential



Lessons Learned
Emissions Changes Affect Some Sites

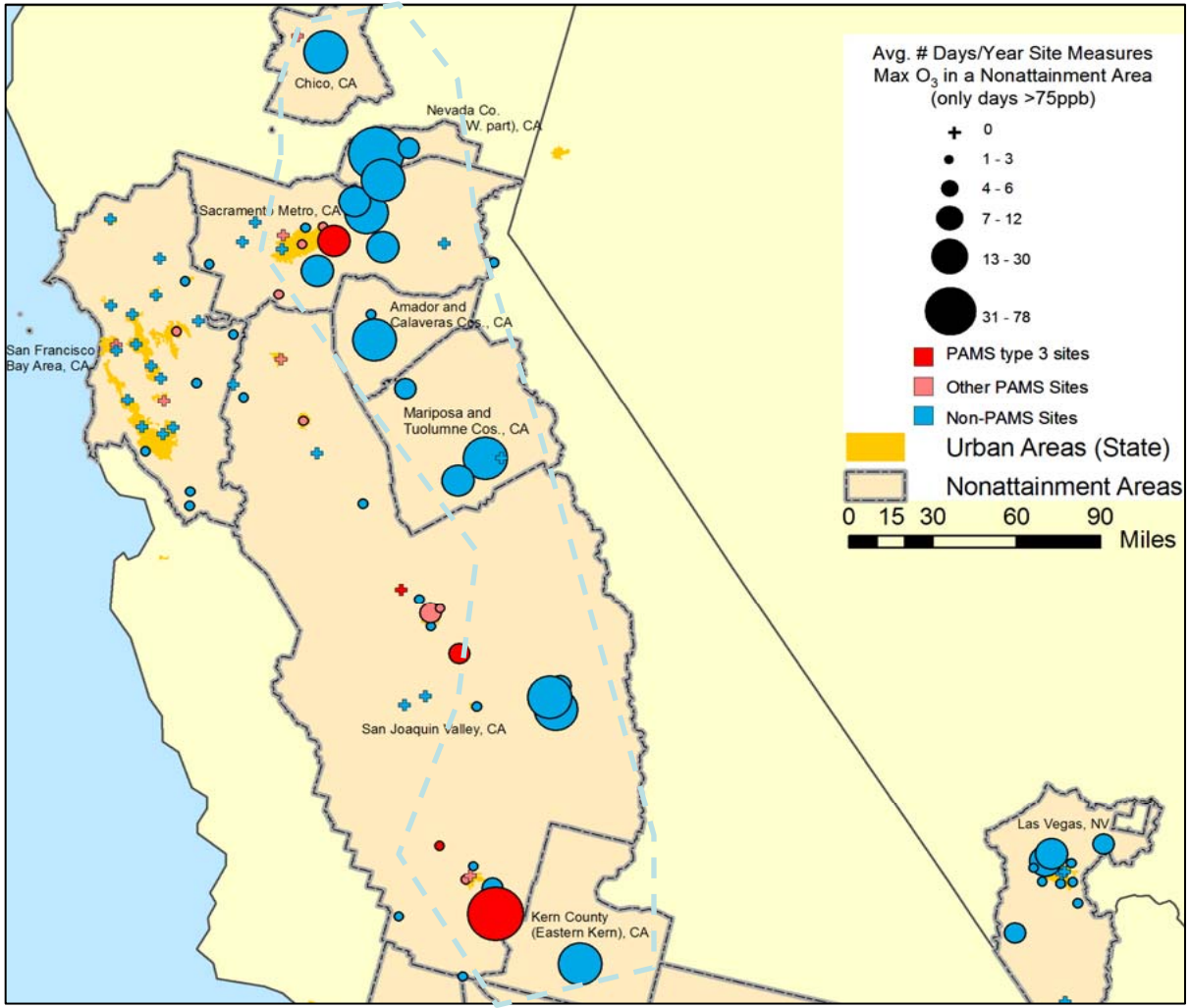


Areas of High VOC Emissions

The Jonah site was originally located to measure downwind ozone concentrations; it is now located in an area of high precursor emissions due to emissions-source encroachment.

Lessons Learned

High Ozone Locations Have Changed



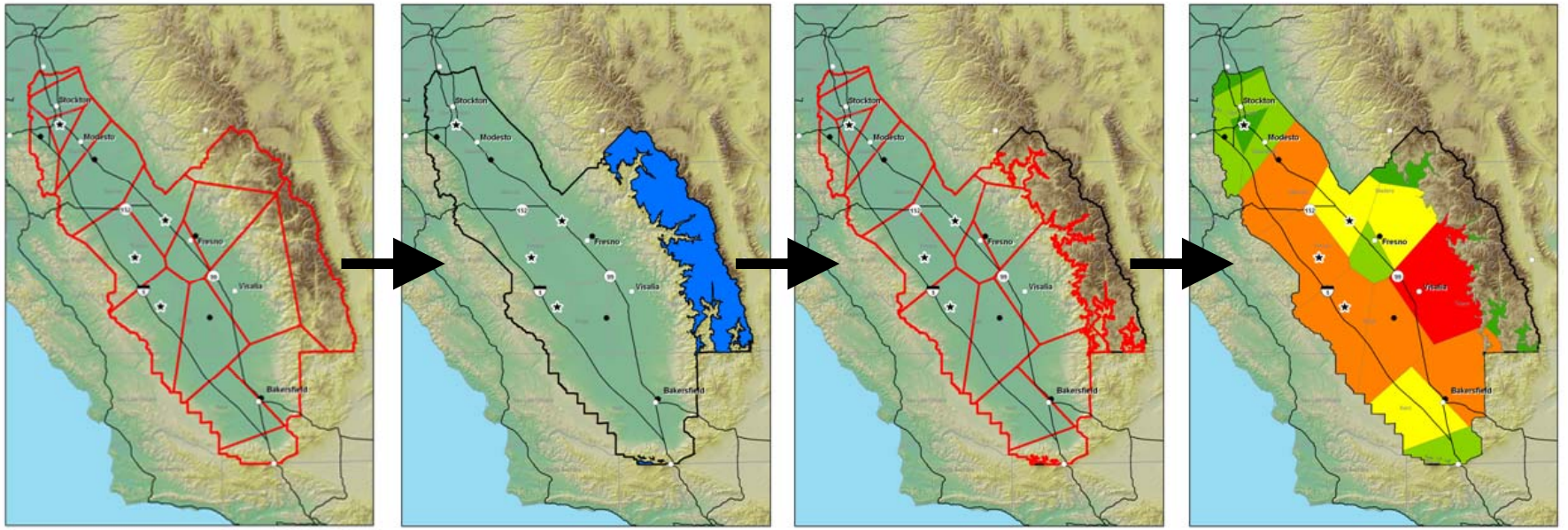
In central California, maximum ozone concentrations have shifted to the eastern side of the San Joaquin Valley.

Lessons Learned

Not All Analyses Are Easily Interpreted

Area served

For areas with complex topography, elevation needs to be taken into account.



Thiessen polygons developed for each monitoring network

Identify elevations above 6,000 feet

New polygons without areas where elevation is above 6,000 ft

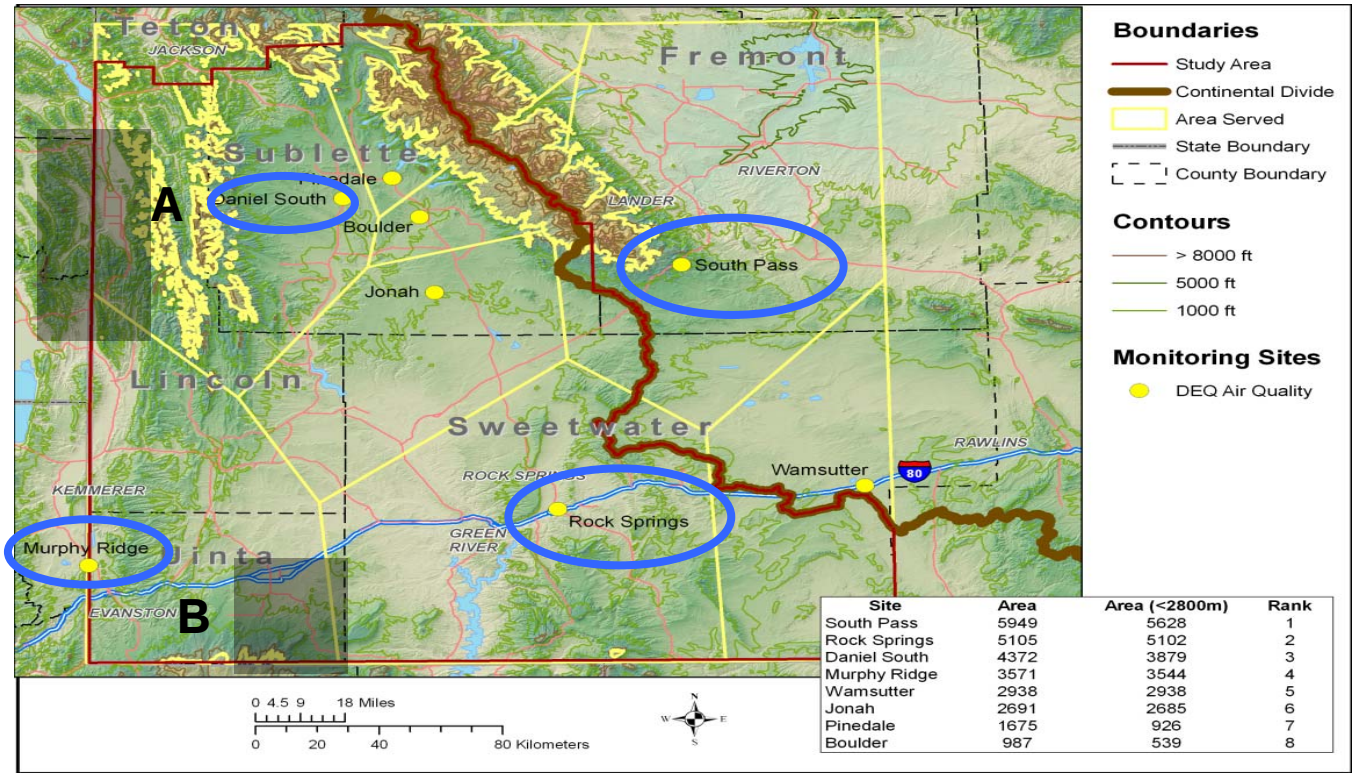
Area Served analysis (area values of each site polygon)

Lessons Learned

Not All Analyses Are Easily Interpreted

Area served

For regions with small topographical variations, the Area Served analysis works very well; however, in areas with complex topography, the Area Served analysis may produce misleading results.



Site	Area	Area (<2800m)	Rank
South Pass	5949	5628	1
Rock Springs	5105	5102	2
Daniel South	4372	3879	3
Murphy Ridge	3571	3544	4
Wamsutter	2938	2938	5
Jonah	2691	2685	6
Pinedale	1675	926	7
Boulder	987	539	8

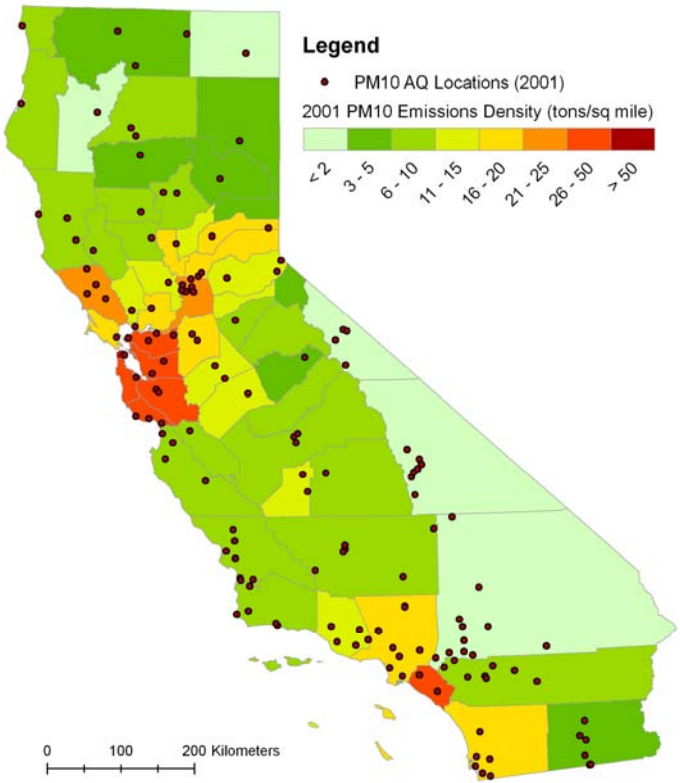
(A,B) Major geographic barriers (mountains) bound the spatial coverage at Daniel South and Murphy Ridge monitoring sites. Regions indicated by dark gray boxes are likely not represented by these monitoring sites.

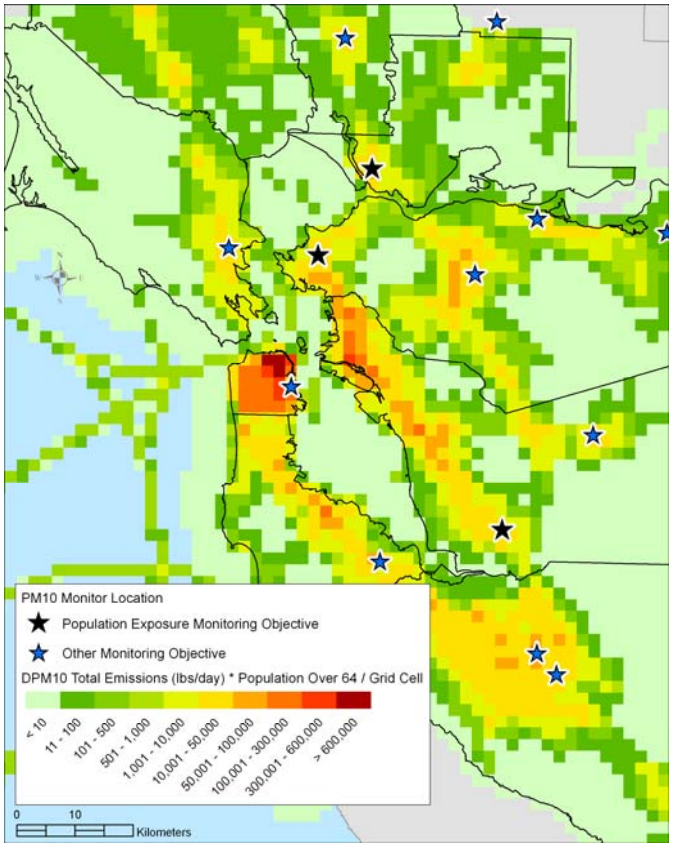
Lessons Learned
Analyses Vary in Their Usefulness

Emission inventory comparison

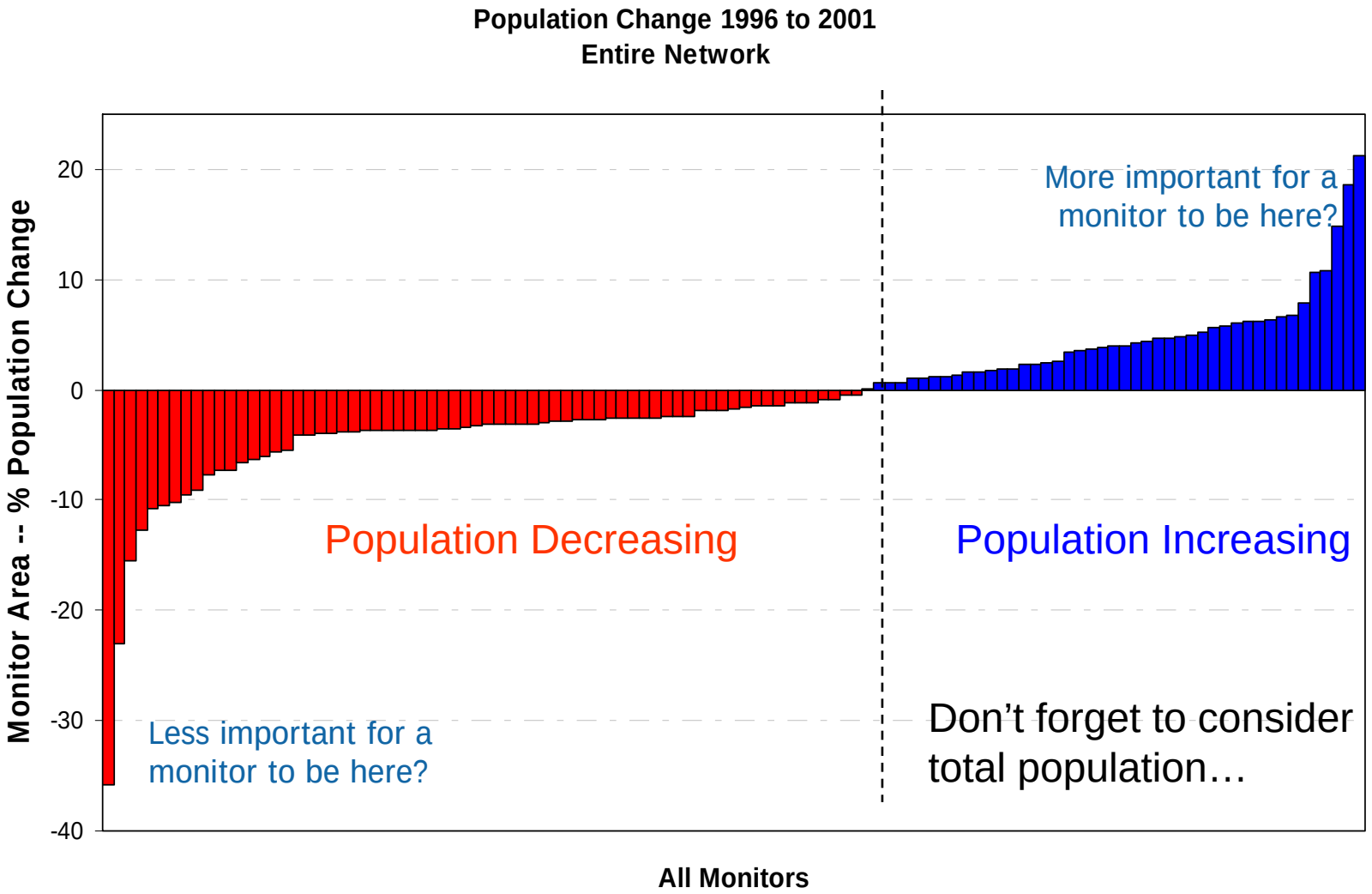
Typically, emission inventories are generated at the county level. County-level emission inventories

- Are suitable for analysis of large networks spanning numerous counties
- Do not have adequate spatial resolution for regional or local-level networks





Lessons Learned
Some Questions Need Policymaker Input



Lessons Learned
Common Findings

- Air quality sites with hourly data should have collocated meteorological data.
- Data quality should be reviewed frequently rather than waiting until a network assessment is made.
- Comprehensive (annual) data analyses should be performed (and made public).
- Instrument detection limits and sensitivity likely need to be improved in older networks.
- Rather than moving a site, changing its monitoring objectives to reflect the new reality of nearby emissions, population, etc., should be considered.
- Most networks have at least one well-instrumented site that provides data for multiple pollutants over a long trend period.

Lessons Learned
Overall

- **Start with a conceptual model** – use your knowledge of the network and trust your instincts, then apply analyses to convince yourself that you are right or wrong.
- **No one analysis stands alone.**
- **Each analysis builds on the previous analysis** – in some cases, the most basic analyses may reveal that more sophisticated analyses are needed to address a specific question.
- **Not all analyses discussed in the guidance document are relevant to all** areas and sizes of monitoring networks.
- **An assessment is not as sophisticated** as an analysis of the data (it is really a screening-level assessment).

Resources

Data Sources

- **EPA AirData** web page offers you access to yearly summaries of U.S. air pollution data extracted from EPA's air pollution databases. Data types include emissions and ambient monitoring.
- **EPA AIRNow-Tech** web page offers you access to AIRNow observational data.
  - Navigator tool is a customizable, air quality GIS tool that allows you to display site information with multiple geographic, pollutant, and meteorological features.
  - Data tool allows you to create personalized site lists, access predefined queries, and download AIRNow observational data.

Resources

Tools

- **Geographic Information Systems (GIS)** allow users to manage, analyze, and display geographic information.
  - GIS software is available for purchase from ESRI, MapInfo, AutoDesk, etc.
  - Simple displays can be made using GoogleEarth or Google Maps.
- **Statistical software and database packages** allow you to organize, manipulate, create, analyze, and display data. These packages include Microsoft Excel, Microsoft Access, Grapher, SAS, SYSTAT, etc.

Resources

Useful resources for network assessment

- EPA AirData
  http://www.epa.gov/air/data
- EPA AIRNow-Tech
  http://www.airnowtech.org
- Geographic information systems (GIS)
  http://www.esri.com
  http://www.mapinfo.com
  http://usa.autodesk.com
- Statistical software, database packages
  http://www.systat.com
  http://www.goldensoftware.com/products/grapher/graph.shtml
  http://www.sas.com/software