MARYLAND
DEPARTMENT OF THE ENVIRONMENT

Maryland's Approach to the 2010 Network Assessment and Plans for 2015

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MARAMA Air Monitoring Meeting

Charlottesville, VA

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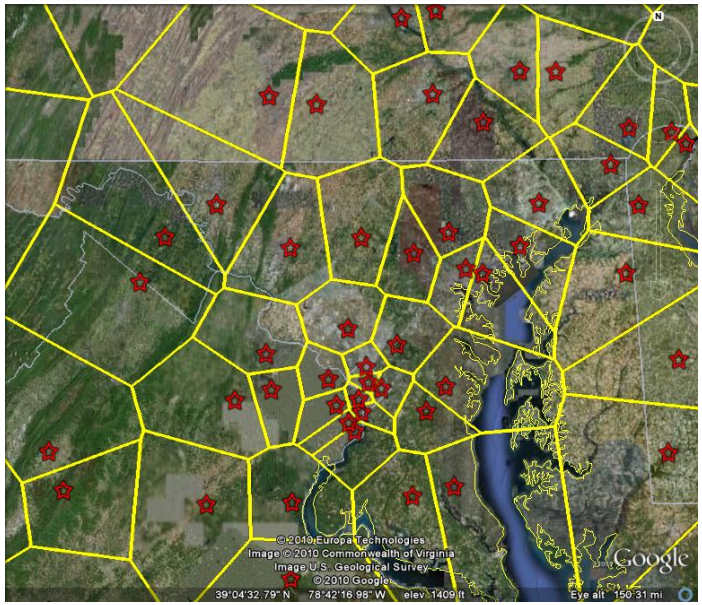
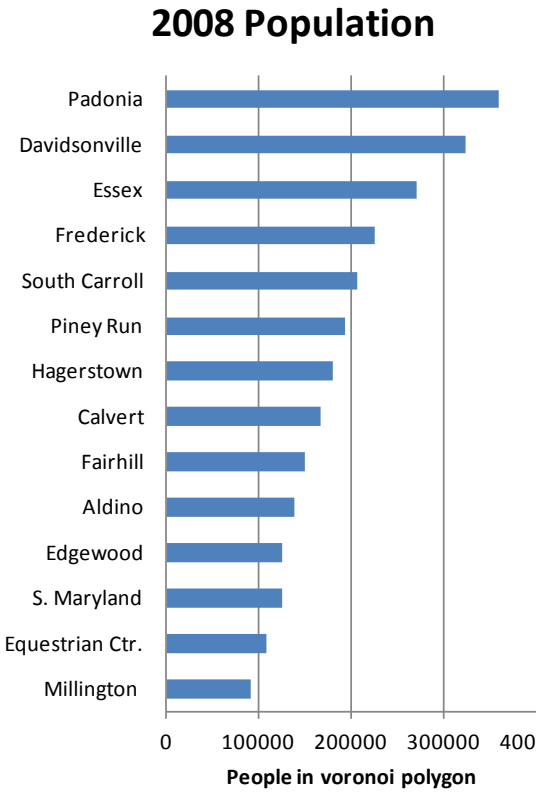
Overview

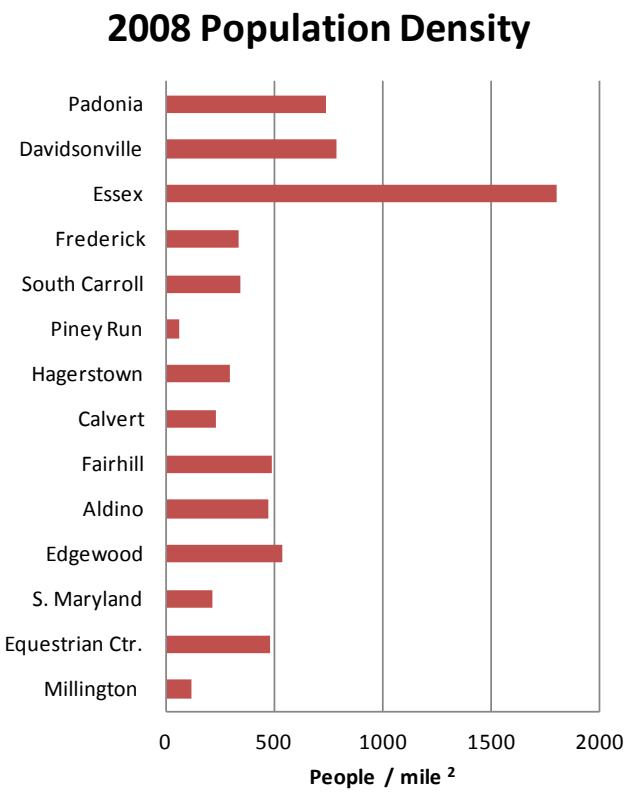
- Using EPA tools to apply to a decision matrix.
- Development of new tools for the 2015 assessment.
- Summary of approach for assessing how well sensitive populations are served by the network.
- New Technologies:
  - Marcellus Shale monitoring.
  - Near road and special purpose monitoring.
- Tips from Sonoma Tech.
- Census maps.
- Comments and suggestions for improvement are very welcome.

Population Served



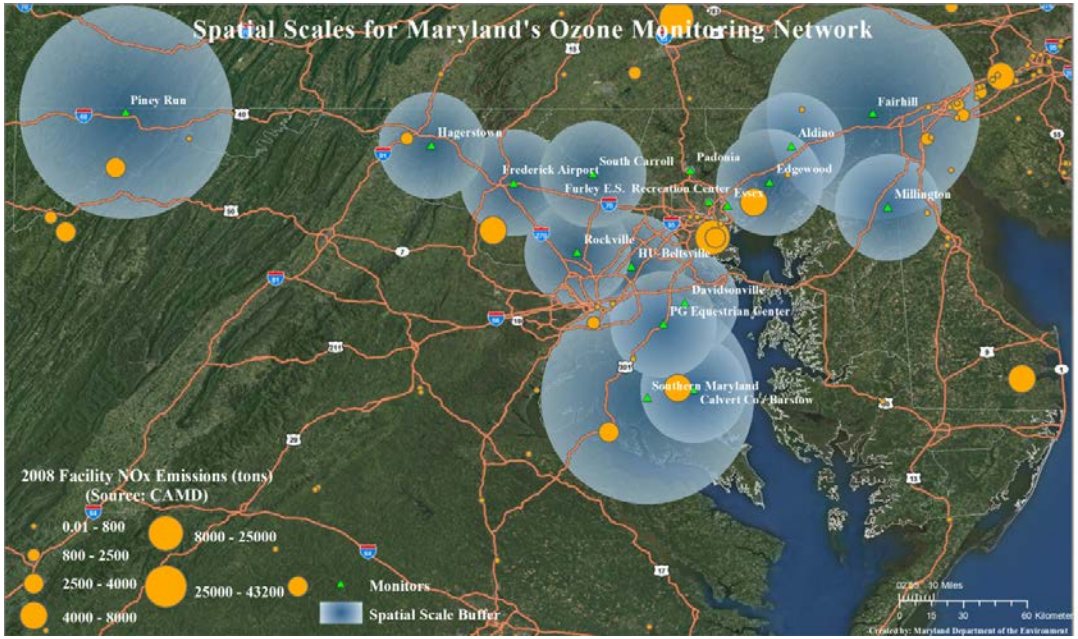
- For the 2010 Network Assessment EPA developed a tool using Thiesan/Voronoi polygons to provide information on the population served by a particular monitoring site.
- We used the population and the population density in our decision matrix to quantify the value of each site.





Another Way to Show Population Served

- We worked with a summer intern, UMD engineering student Hannah Shockley, developing an R script to determine population served from scales of representativeness and census tract data.



Part 58 Appendix D

Section 1.2 Spatial Scales (b)

Scale of representativeness	
Micro	several m - 100 m
Middle	100 m - 0.5 km
Neighborhood	0.5 km - 4 km
Urban	4 km - 50 km
Regional	50 km - 100 km

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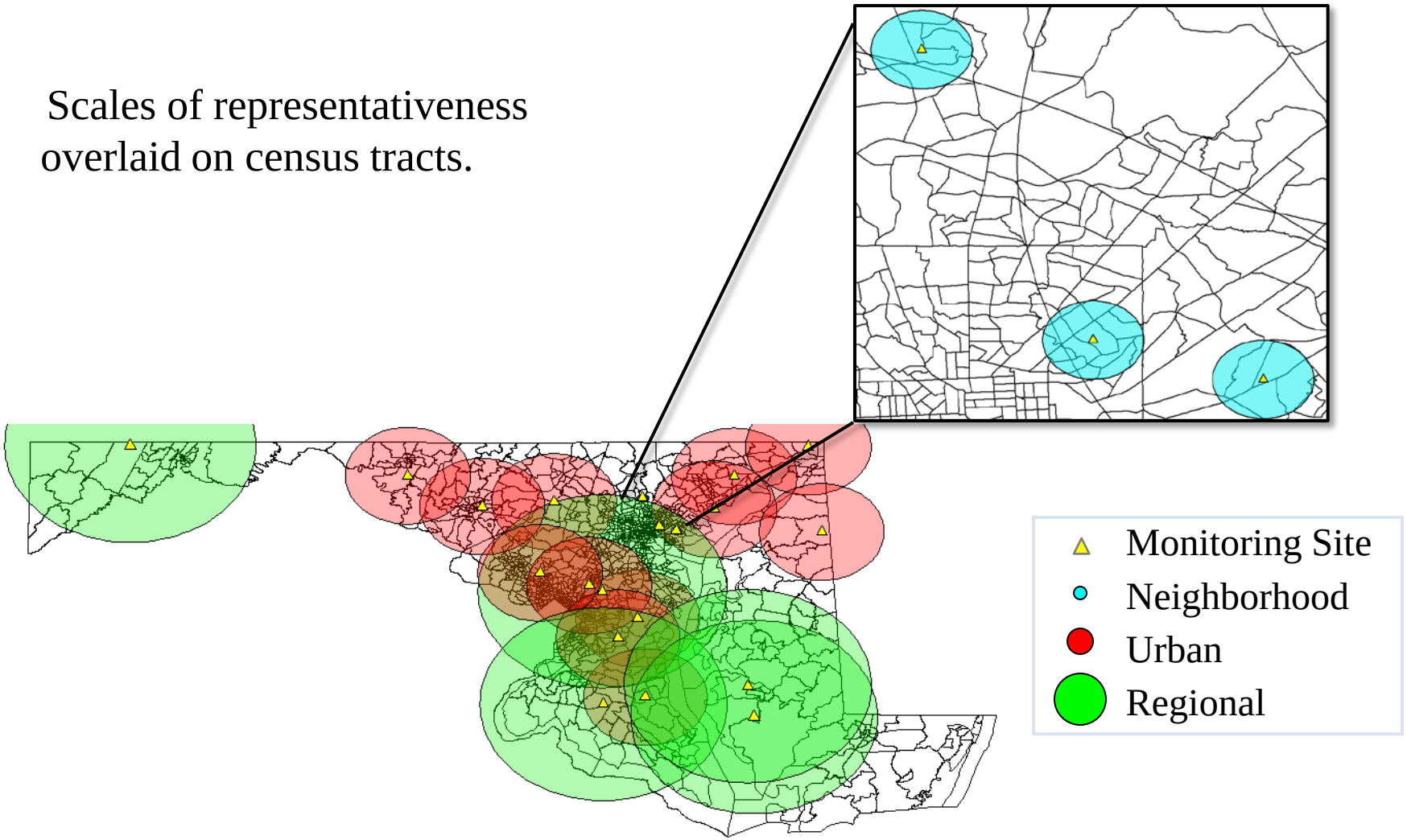
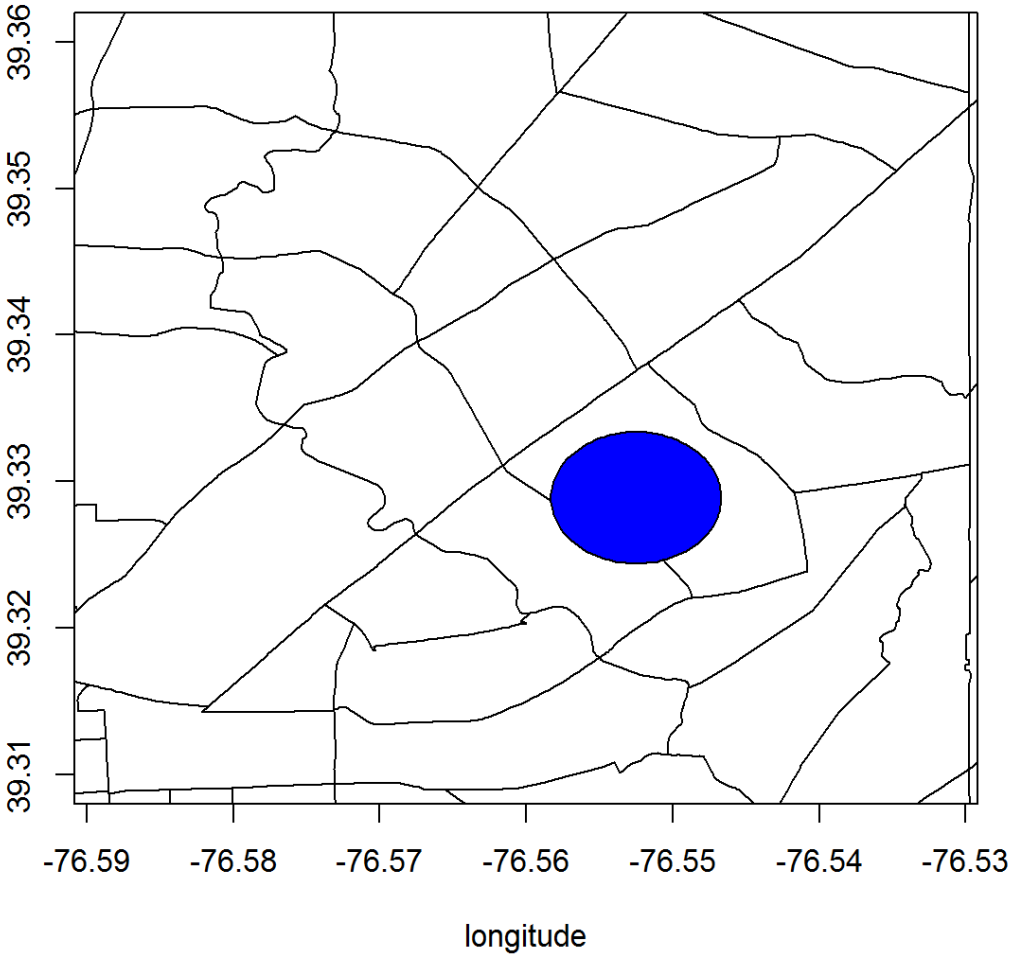
O_3 Monitoring Sites and Census Tracts

Scales of representativeness overlaid on census tracts.



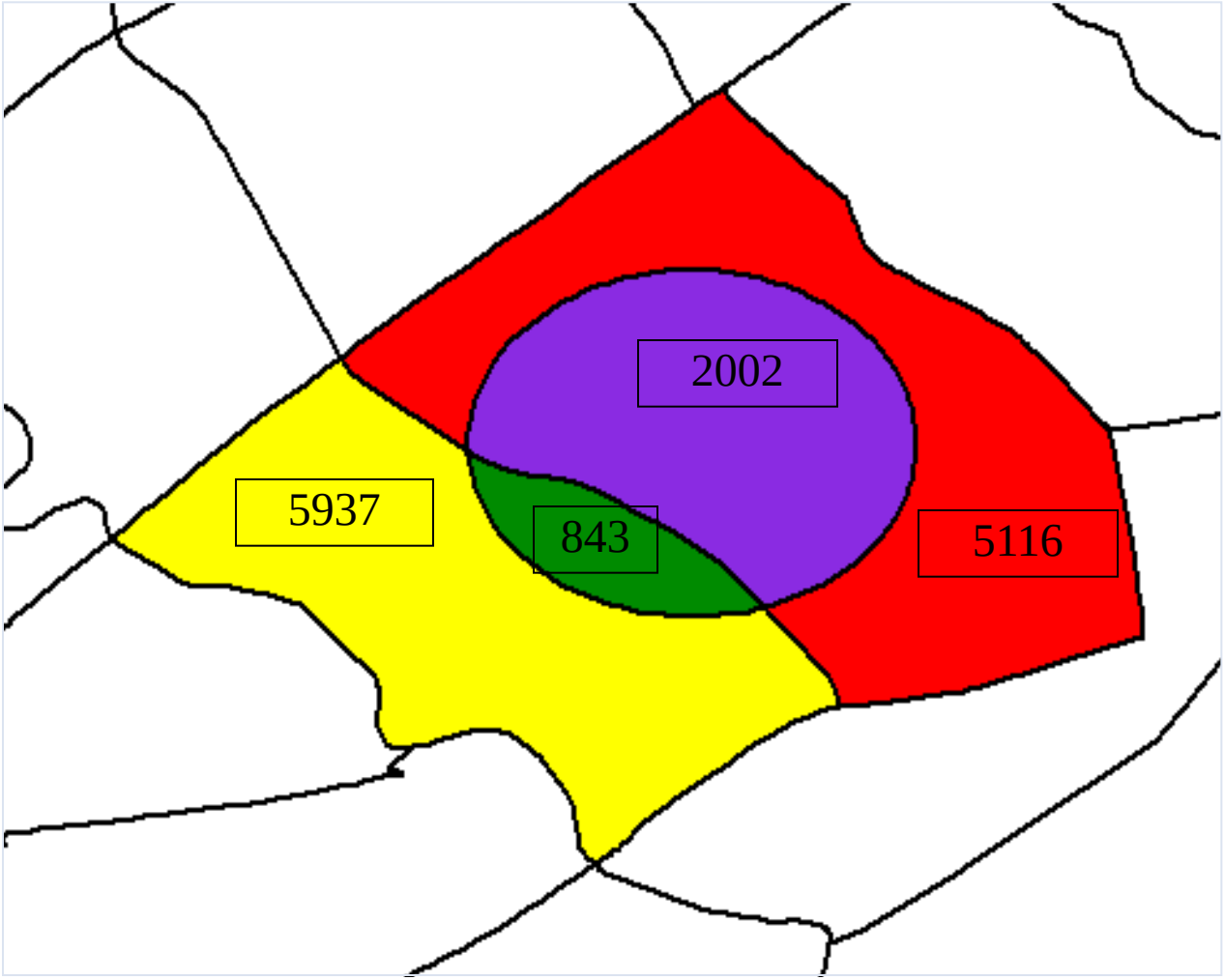
Credit: Hannah Shockley (UMD)

Zoom-in on Baltimore City Site



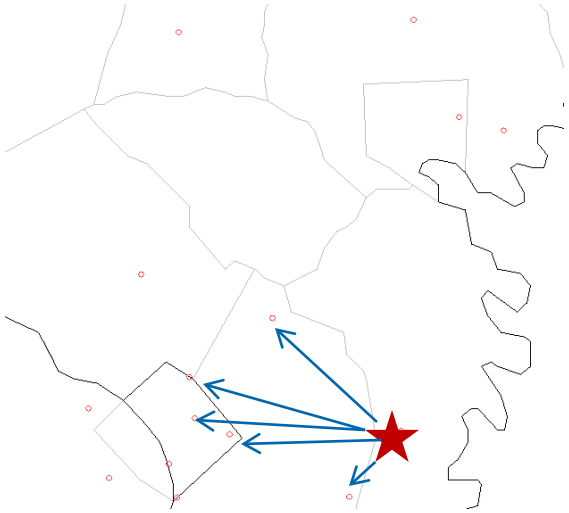
Credit: Hannah Shockley (UMD)

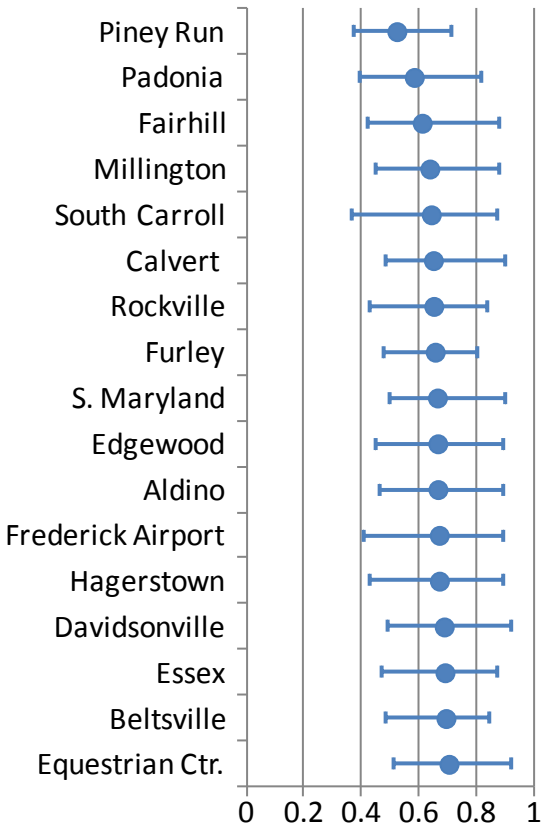
Population in Baltimore City Site

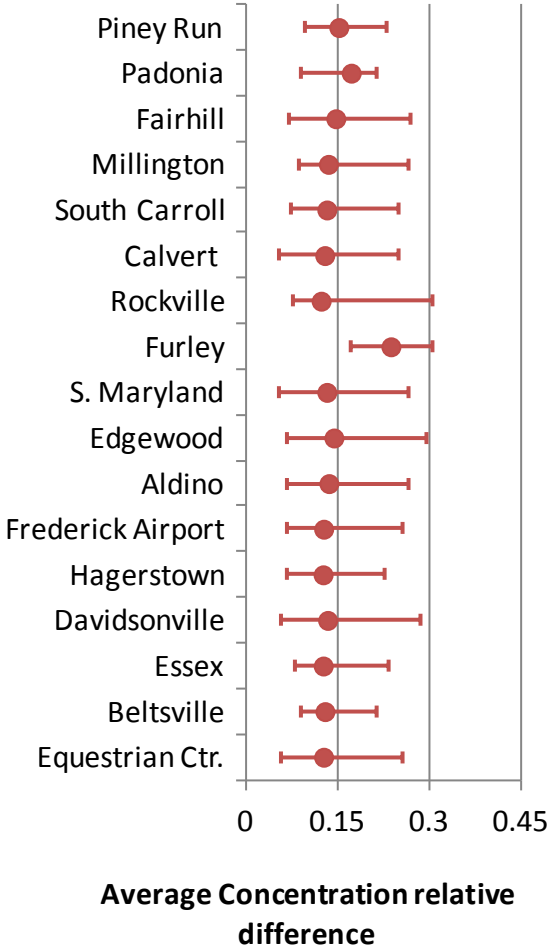


Credit: Hannah Shockley (UMD)

Cormat tool







- The cormat tool provided correlations and concentration relative differences for all site pairs.
- We averaged the correlations and relative differences among all site pairs. These averages were used in the decision matrix.
- We developed an R script to calculate the correlations and relative differences.

Decision Matrix

- A decision matrix was used to determine the relative value of each site in the ozone and PM2.5 network.
- The decision matrix ranks the sites according to a weighted score and a normalization process:
  - The score for each criterion was calculated with the following equation [Cavender, 2009]:

    Score = 100* weight * $(V_i - V_{min}) / (V_{max} - V_{min})$
    where V_i, V_{min} and V_{max} represent the value of the given criteria and the minimum and maximum values of criteria for all sites.

  - For correlation with other sites, the score is calculated differently so that smaller correlations receive more weight:

    Score = 100* weight * $(V_{max} - V_i) / (V_{max} - V_{min})$

[Cavender, 2009] - Cavender, K.A., Using a Decision Matrix to Combine Multiple Analyses into One Set of Recommendations, Presentation at EPA/OAQPS/AQAD, November 2, 2009.

Decision Matrix Criteria

- 2008 estimated population within Thiesan/Voronoi polygons associated with each site– important relative to the population oriented monitoring requirement but not highly weighted because of the reliability of the 2008 population estimates.
- 2008 population density within Thiesan/Voronoi polygons.
- The number of parameters measured at the site.
- The uniqueness of the concentrations measured at one site relative to other sites
  - The site-average squared correlation coefficient.
  - The site-average relative percent concentration difference.
- The site-specific 2008 design value (DV_{2008}) represented as a percentage of the NAAQS.

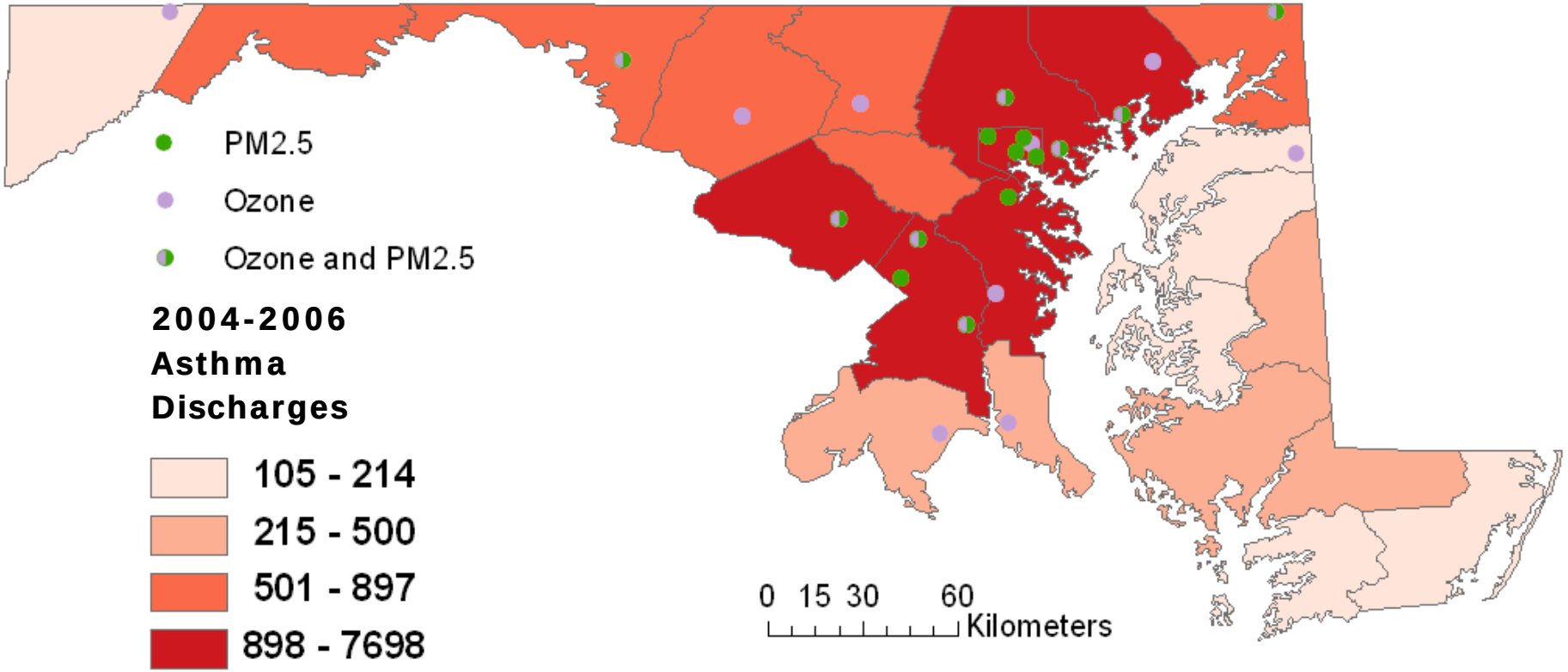
Scoring results for ozone

Site	2008 Design Values	Population 2008		Population density 2008		Number of parameters		Correlation with other sites		Relative concentration difference		Ozone DV %NAAQS		SCORE
		weight:	0.33	weight:	0.50	weight:	0.50	weight:	1.00	weight:	1.00	weight:	1.00	
		raw	points	raw	points	raw	points	raw	points	raw	points	raw	points	
Davidsonville	0.087	322819	8	784	7	2	4	0.69	9	0.14	9	1.160	83	121
Padonia	0.08	358215	10	759	7	3	7	0.59	67	0.18	43	1.067	54	187
Essex	0.085	270208	7	1804	17	12	39	0.70	8	0.13	3	1.133	75	148
Calvert	0.079	166991	3	225	2	1	0	0.66	30	0.13	5	1.053	50	89
S. Carroll	0.083	205345	4	340	3	1	0	0.65	34	0.14	8	1.107	67	116
Fairhill	0.09	150178	2	488	4	4	11	0.62	51	0.15	21	1.200	96	185
S. MD	0.082	125376	1	212	1	1	0	0.67	22	0.14	8	1.093	63	95
Frederick	0.082	224018	5	337	3	1	0	0.68	19	0.13	4	1.093	63	92
Piney Run	0.073	192030	4	64	0	13	43	0.53	100	0.16	25	0.973	25	197
Edgewood	0.091	125822	1	535	4	3	7	0.67	21	0.15	18	1.213	100	153
Aldino	0.089	137441	2	469	4	5	14	0.67	21	0.14	11	1.187	92	144
Millington	0.083	92039	0	117	1	4	11	0.64	37	0.14	10	1.107	67	125
Rockville	0.084	577350	18	2011	19	4	11	0.66	29	0.13	0	1.120	71	147
Beltsville	0.083	541105	17	1847	17	15	50	0.70	6	0.13	5	1.107	67	161
PG Equestrian Center	0.087	108724	1	479	4	3	7	0.71	0	0.13	4	1.160	83	99
Hagerstown	0.078	178897	3	290	2	3	7	0.68	18	0.13	3	1.040	46	80
Furley	0.067	988285	33	5305	50	1	0	0.66	26	0.24	100	0.893	0	209

Limitations

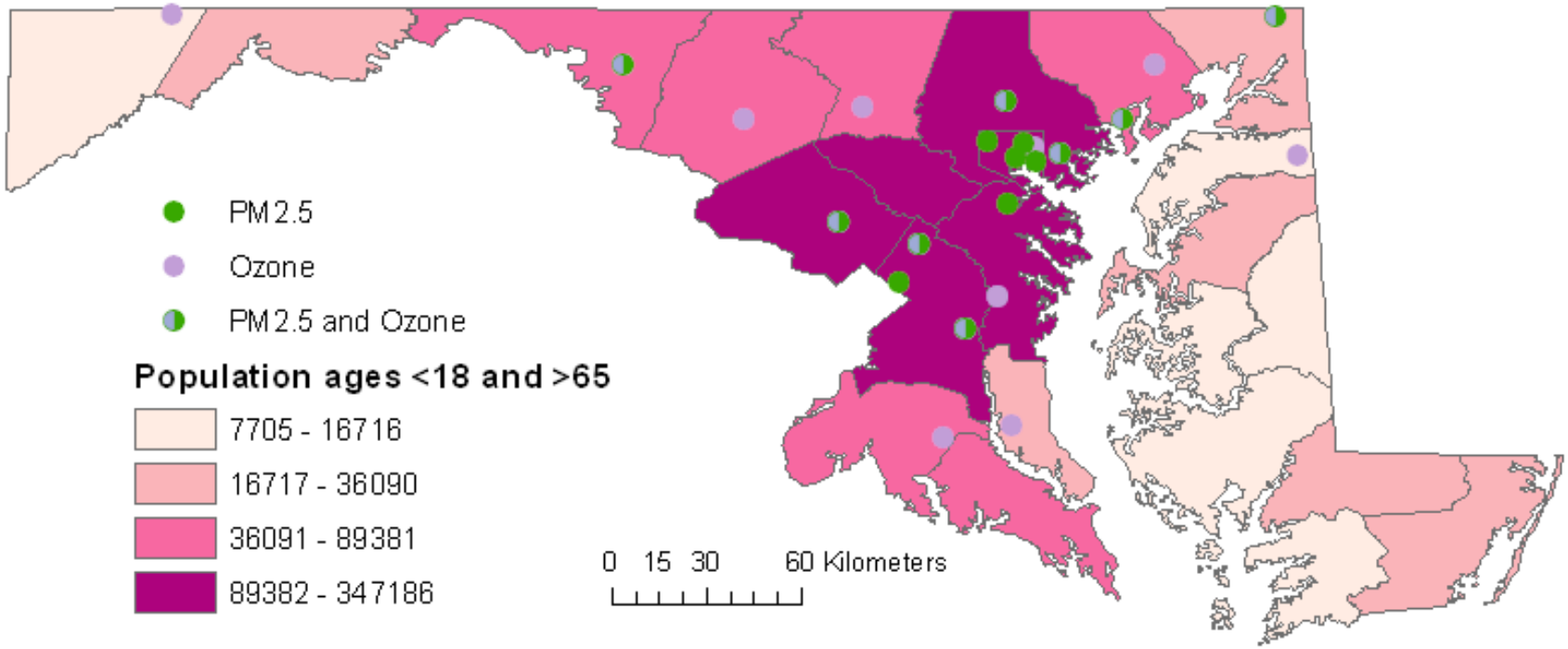
- The decision matrix does not help us determine if new sites are needed and where these sites should be located.
- Suggestions are very welcome.

Sensitive populations: Asthma Hospital Discharges



- Counties with the largest sensitive populations have monitors.
- More detailed sensitive population distributions are needed to fully assess whether monitors serve these populations.

Sensitive Populations: Children and the Elderly



- Another set of sensitive populations was defined as children (younger than 18) and the elderly (older than 65).
- Ozone and PM2.5 monitors are located in all of the counties with the largest sensitive population except Howard County.

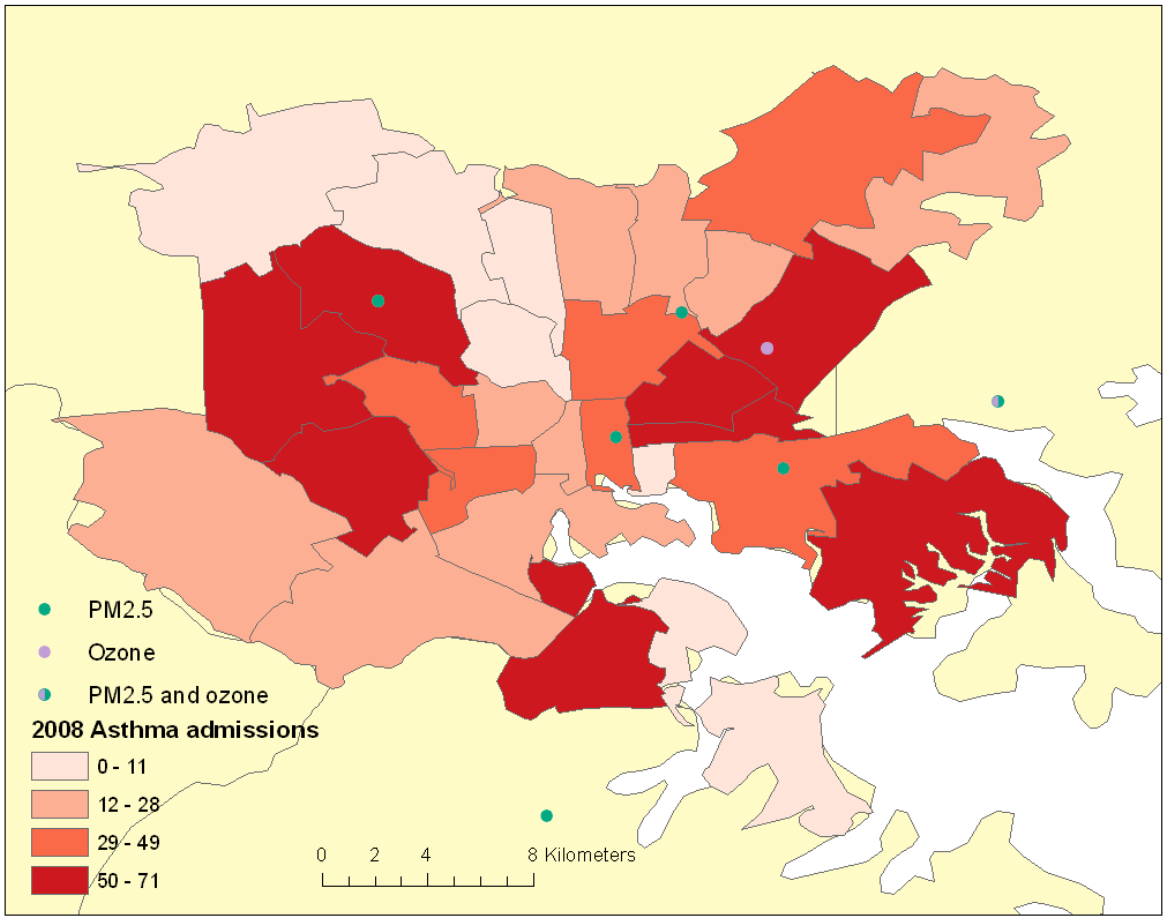
Sensitive Populations: Scales of Representativeness

COUNTY	SITE	PARAMETER	SCALE
Montgomery County	Rockville	Ozone	Urban
		PM2.5	Neighborhood
Prince George's County	HU-Beltsville	Ozone	Urban
		PM2.5	Urban
	PG Equestrian Center	Ozone	Urban
		PM2.5	Neighborhood
	Bladensburg	PM2.5	Neighborhood
Baltimore City	NE Police	PM2.5	Neighborhood
	NW Police	PM2.5	Neighborhood
	SE Police	PM2.5	Neighborhood
	Oldtown	PM2.5	Middle
	Furley	Ozone	Neighborhood
Baltimore County	Essex	Ozone	Neighborhood
		PM2.5	Neighborhood
	Padonia	Ozone	Neighborhood
		PM2.5	Neighborhood
Harford County	Aldino	Ozone	Urban
	Edgewood	Ozone	Urban
		PM2.5	Neighborhood
Anne Arundel	Glen Burnie	PM2.5	Neighborhood
	Davidsonville	Ozone	Urban

- Most counties have at least one urban scale monitor (4-50 km).
- Urban scale monitors cover most of the county and likely overlap Howard County which does not have a PM2.5 or ozone monitor.

Sensitive Populations: Baltimore City

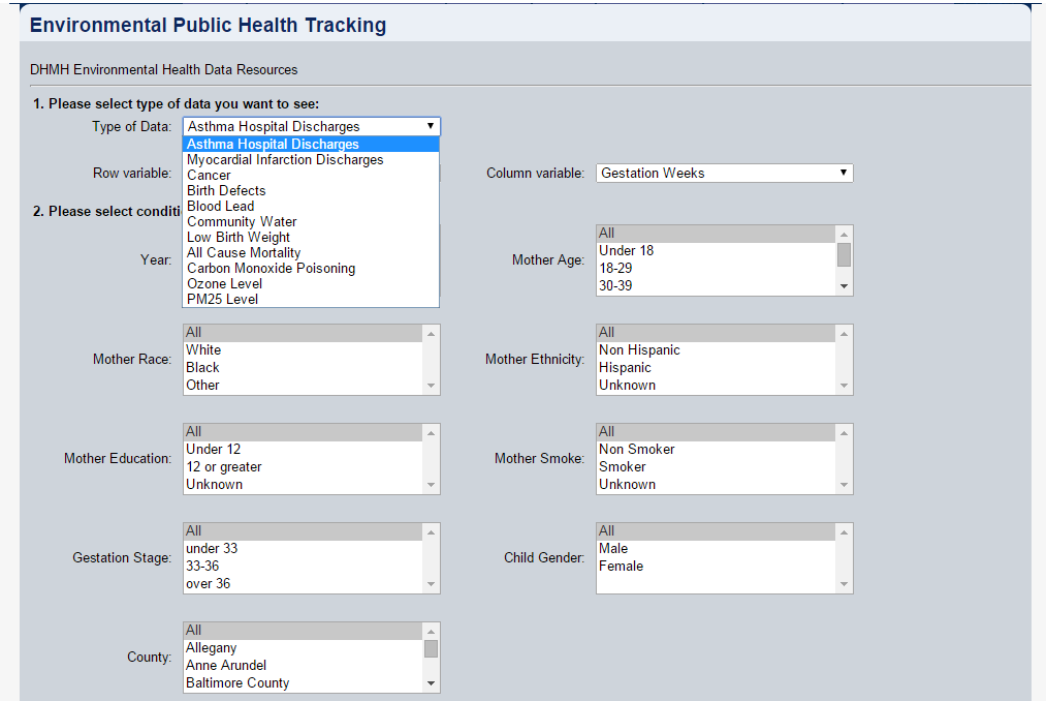
Child Asthma Admissions by Zip Code



- Some PM2.5 monitors are located within zip codes with large asthma hospitalizations.
- PM2.5 is well correlated throughout the city suggesting that distributions are similar throughout the city.

Sensitive Populations: New Data Sources

Tools from Maryland Department of Health and Mental Hygiene



- Data for asthma hospital discharges, low birth weight, blood lead, myocardial infarction discharges, cancer incidence.
  - http://eh.dhmh.md.gov/idehaweb/query.aspx
  - Most recent data for 2007-2009.
- Other state tracking - http://ephtracking.cdc.gov/showStateTracking.action
- National health tracking from CDC http://www.cdc.gov/nceh/tracking/about.htm

New Technologies

- Potential for Marcellus Shale development led to us exploring the applicability of new technologies for air monitoring and screening techniques.
  - Infrared cameras to detect methane/VOC leaks and accidental releases
  - Odor detectors (methyl mercaptan monitors) to detect leaks or seal failures.
  - These can provide for neighborhood scale warnings of malfunctions.
- Defiant Tech. recently loaned us a FROG-4000 that measures BTEX.
  - We will be evaluating this at our Essex site and possibly our I-95 near-road site and Piney Run.

New Technologies

- To evaluate background concentrations of methane and other gases before unconventional natural gas development begins we have installed new instruments at our Piney Run site.
  - Alpha 114 - Methane and TNMHC.
  - Synspec GC955-601 - benzene, toluene, ethyl benzene and xylenes

New Technologies: Near Road

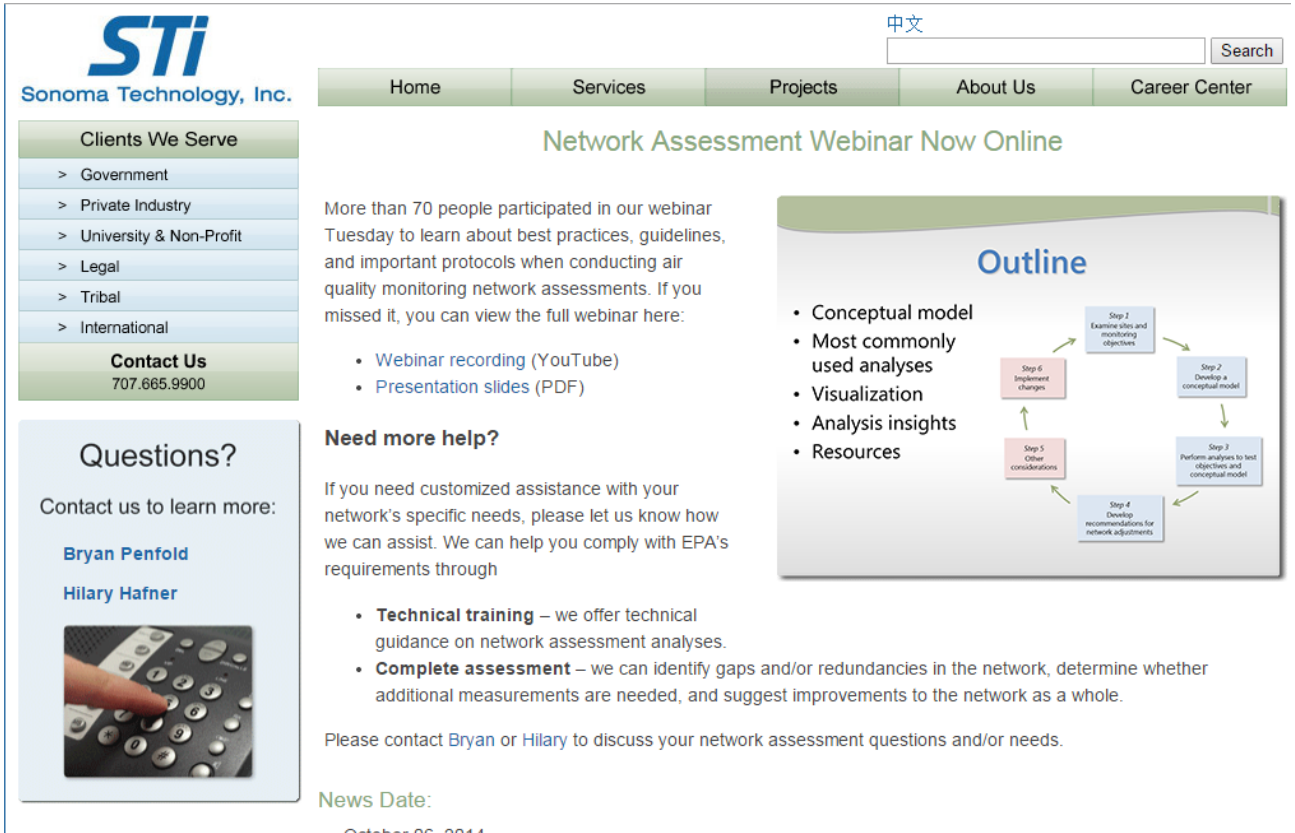
- The NO_2, CO, PM2.5 and air toxics sections will be updated to address our new near road monitoring stations.
- The new technology section will be updated to include:
  - Ultrafine particle monitors.
  - True NO_2 monitors: Photolytic, Cavity Ring Down, Cavity Attenuated Phase Shift.
  - Portable NO_2 monitors.

New Technologies: Special Purpose Monitors

- We recently submitted an over the target budget request for new staff to support special purpose monitoring.
- Next generation small sensors could be used to assess need for additional monitoring.
- Portable ozone monitors.
- Investigating small sensor technologies like the FROG-4000.
- Incorporation of new technologies will impact our budget.

Sonoma Tech. Resources

- Sonoma Tech. (STI) put together a webinar on Network Assessment best practices.
  - You can watch or view the slides here - http://www.sonomatech.com/project.cfm?uprojectid=1223
  - Highlights are presented in next few slides.



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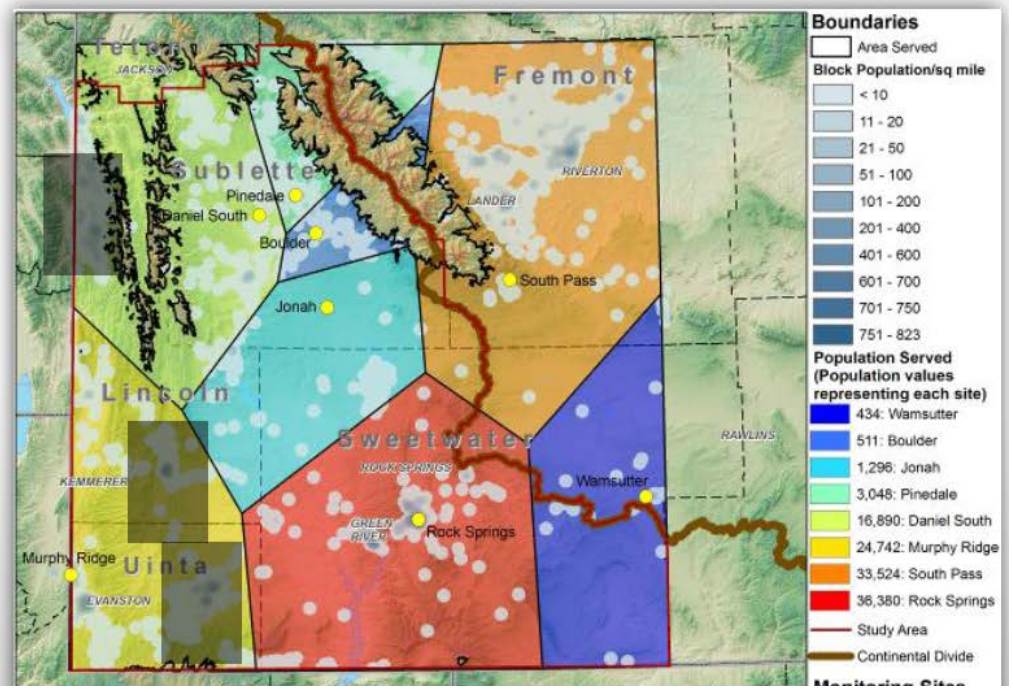
Monitoring Gaps

Population Served

The dark gray areas on the map may be impacted by industrial source emissions, are underrepresented in the network, and are relatively densely populated.

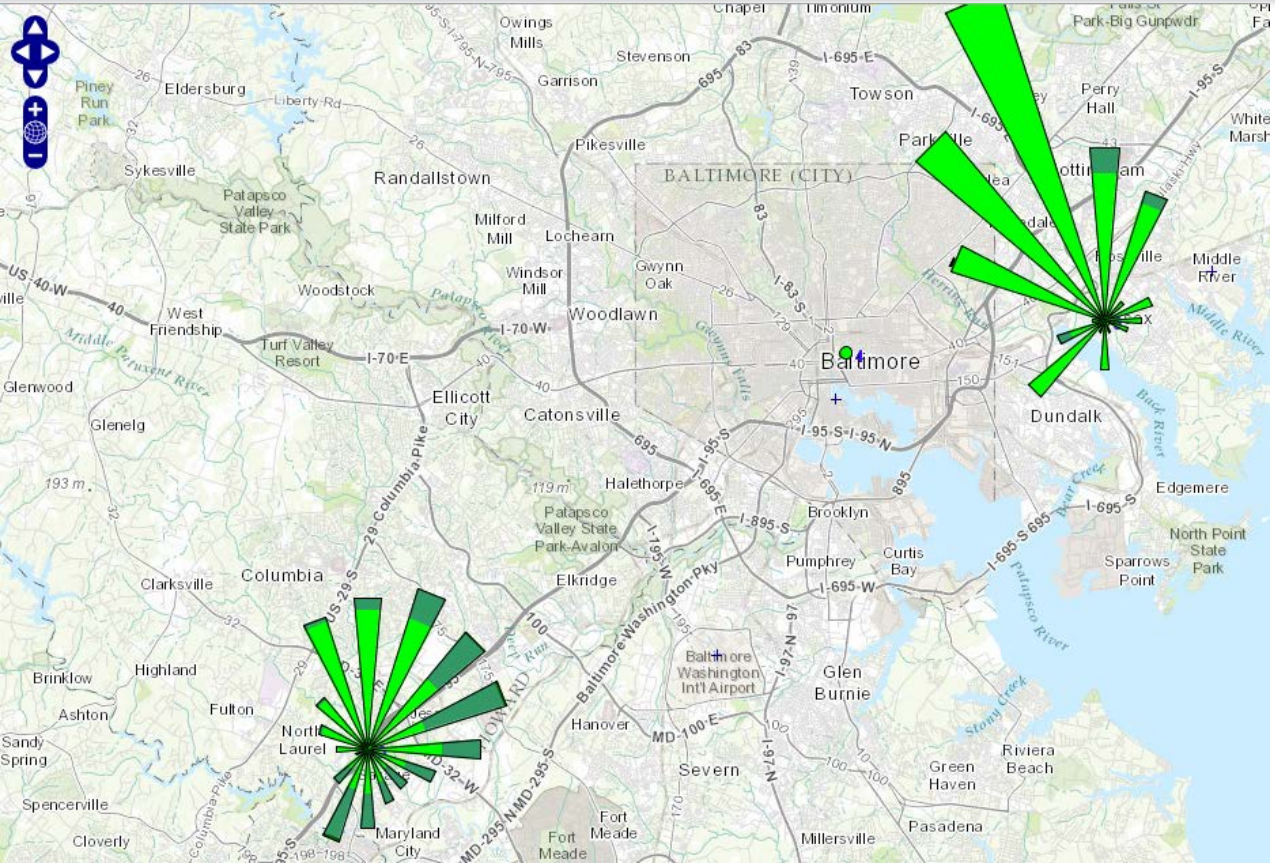
Example from Wyoming network assessment



- Thiesan polygons were used to show populations served by monitors.
- Census block populations were added to the map to examine monitoring gaps.

Slide source: STI and Wyoming.

AirNowTech



- AirNowTech lets you create wind and pollution roses.
- These maps can be combined with population data to investigate monitoring gaps.

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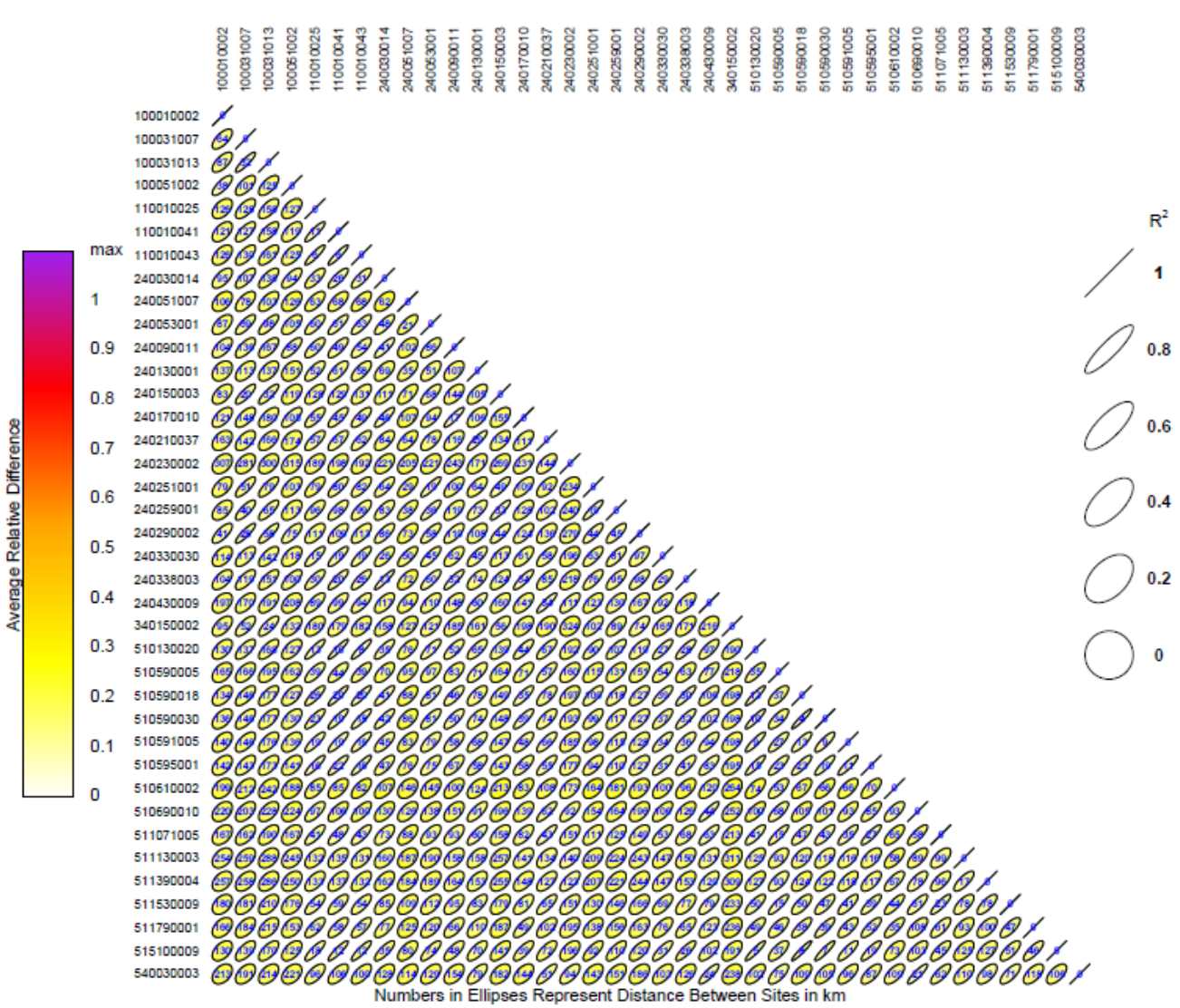
Correlation Tool Used in 2010



We used the tool as part of our decision matrix.

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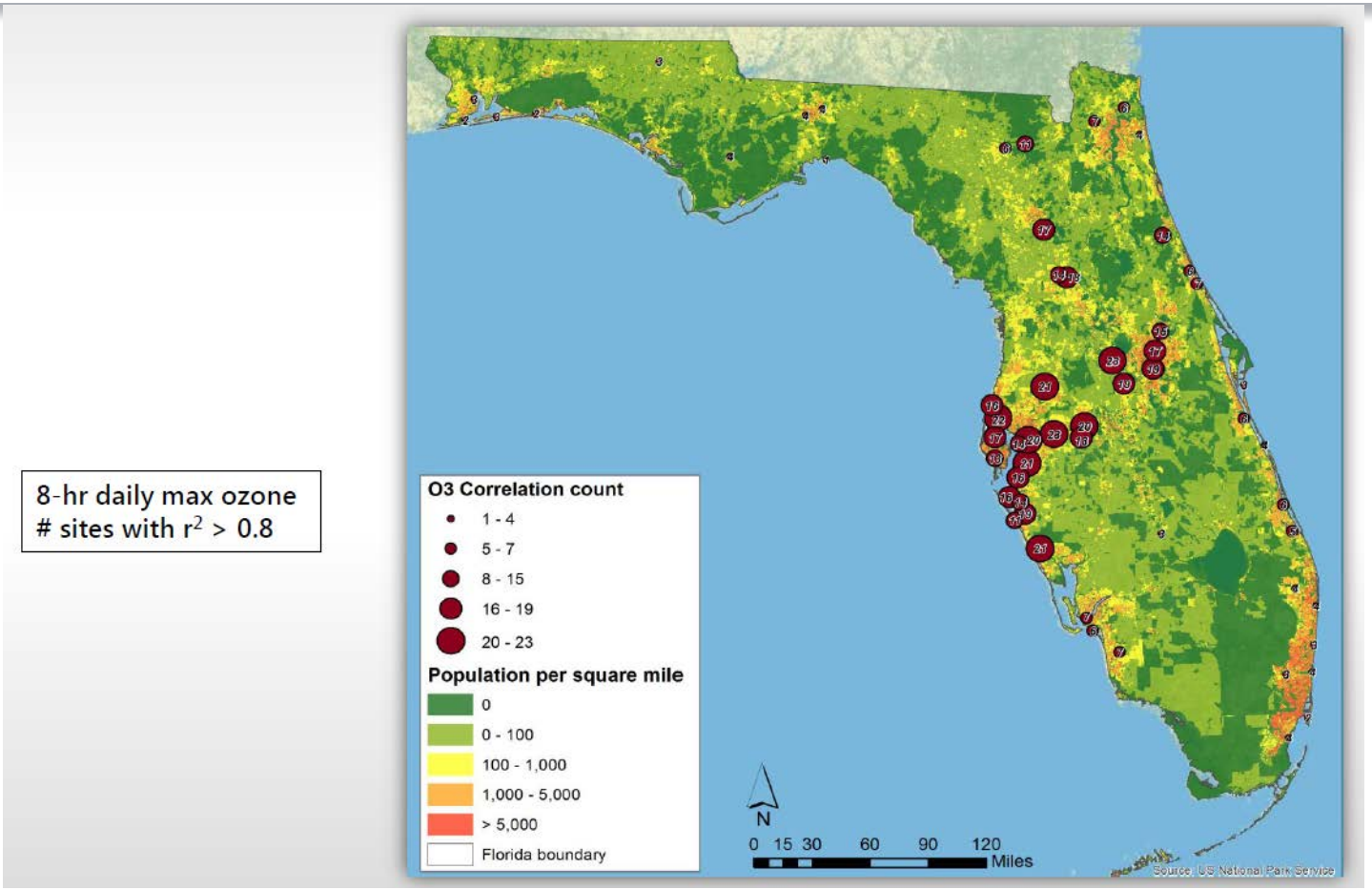
Correlation Analysis



- STI shared a nice example of mapping the correlation, making it a little easier to visualize.
- In this case they found that monitors in central Florida were highly correlated and may be redundant.

Slide source: STI

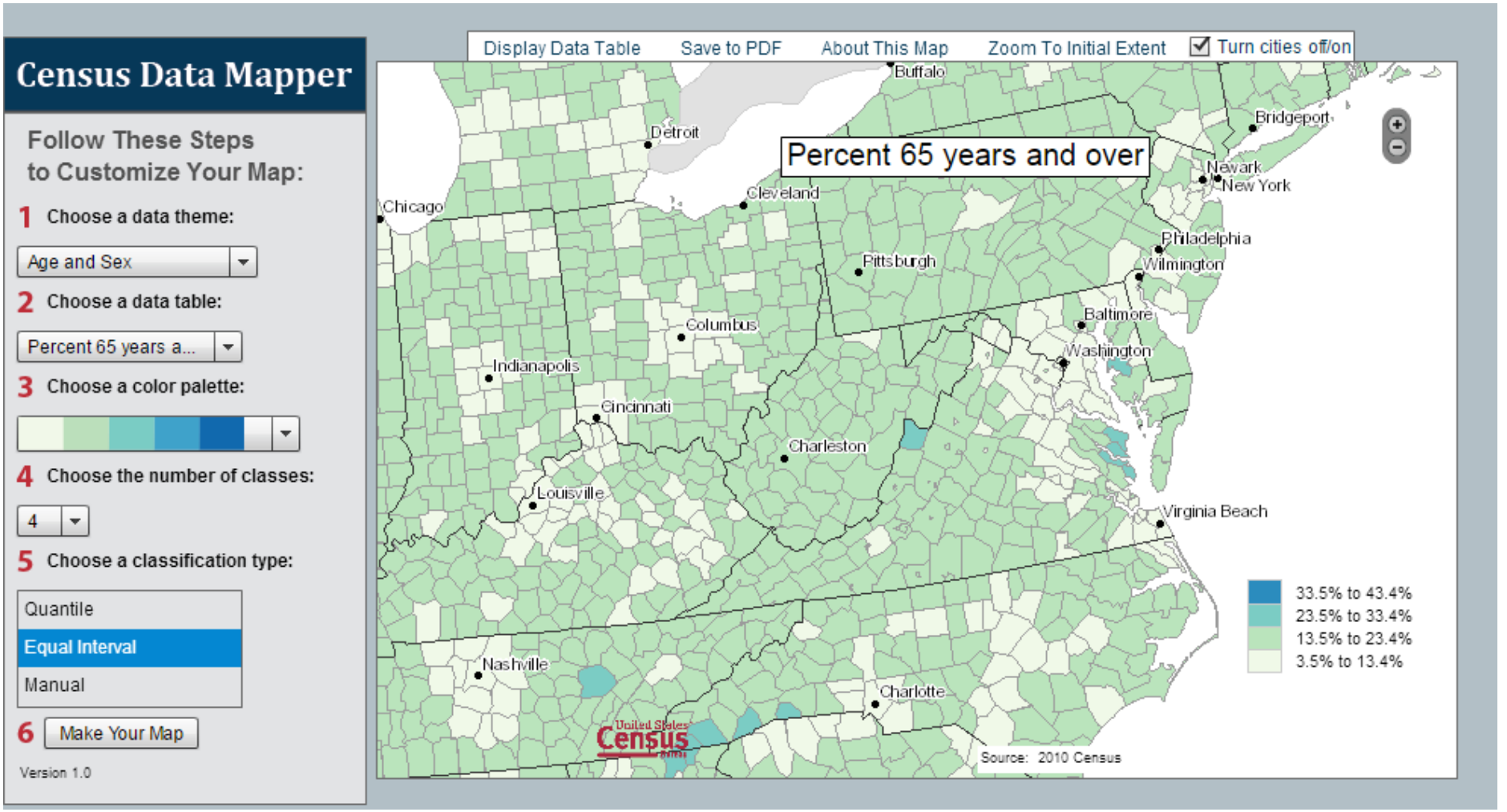
Analysis Insights from STI

- Consider sites in and outside of your “control”.
- Use careful wording – if working with multiple stakeholders and public, can’t promise new monitors or monitor removal.
- Build a stronger case through consensus among analyses.
- Consider budget realities when thinking about change.

Additional Resources

- National Ambient Air Monitoring Conference presentations
  - http://www.epa.gov/ttn/amtic/2014present.html
- AirNowTech
  - www.airnowtech.org
- EPA Guidance
  - http://www.epa.gov/ttn/amtic/network-assessment.html
- Census Data
  - www.census.gov
  - http://www.census.gov/geography/interactive-maps.html
  - Data visualization gallery - http://www.census.gov/dataviz/

Census Demographics



http://tigerweb.geo.census.gov/datamapper/map.html

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County population Growth 2012-2013

County Population Growth Between 2012 and 2013 and the Primary Source of Population Change

Between 2012 and 2013, migration was the primary driver of change in the high growth counties, particularly in counties in gas- and oil-rich areas in or around the Great Plains.

A Story Map app

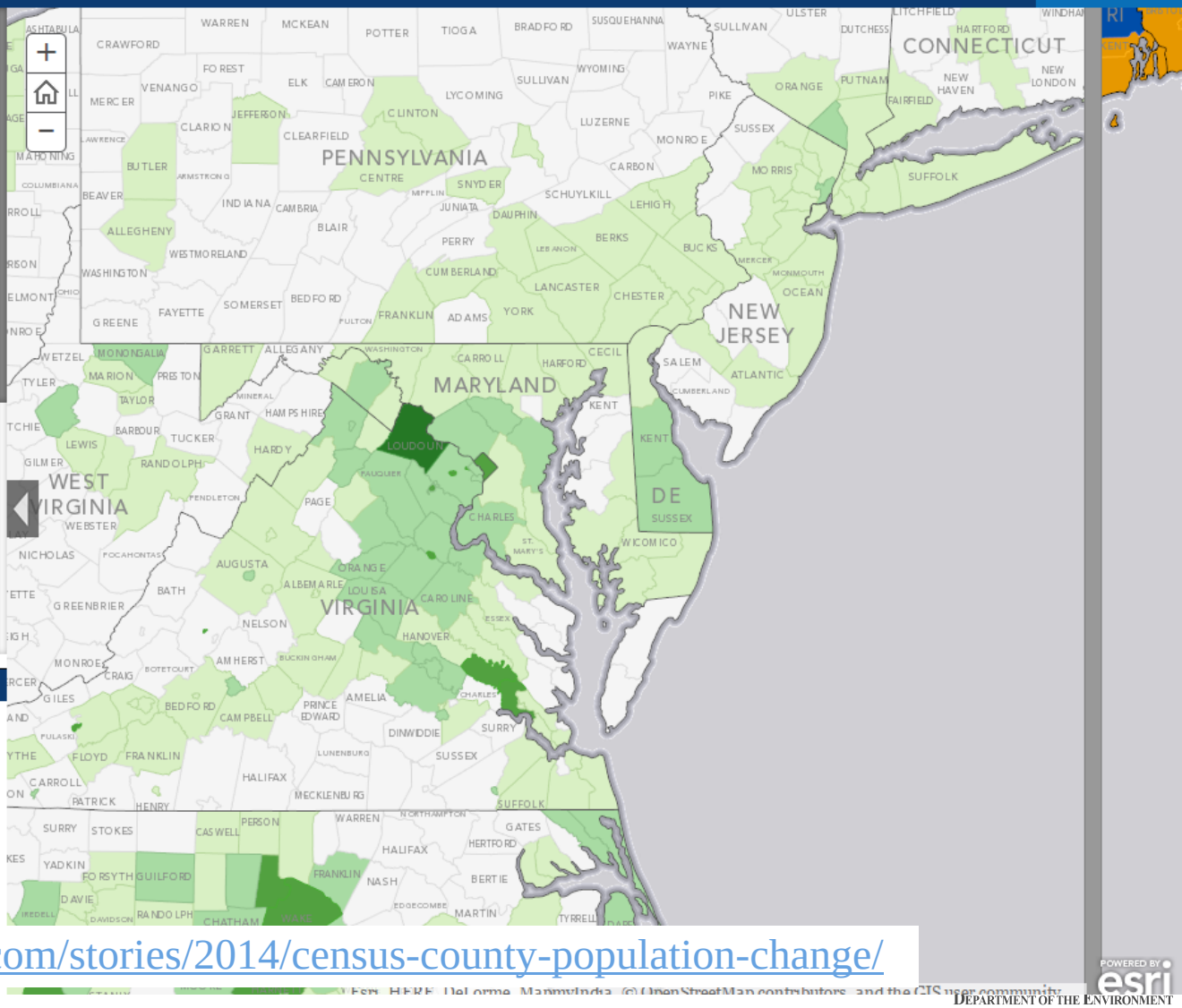
United States Census Bureau

Moving the slider will allow you to switch between seeing percent change and the primary source of growth in counties that are gaining population.

These maps show the percent growth in population for all counties in the U.S. **(left map)** and the component that contributed the most to growth within the county **(right map)**. Both maps are based on the most recent set of county population estimates released by the Census Bureau.

Clicking on the percent growth map will provide a pop-up box containing the county name, the county's 2013 population, percent population change from 2012 to 2013, as well as the change in the components of the estimates from 2012 to 2013. The components of estimates change are natural increase (both births and deaths) and migration (both net domestic and net international migration).

Clicking on the component of growth map will provide a pop-up box indicating which



Legend

Percent growth

- 3.0 or more
- 2.0 to 2.9
- 1.0 to 1.9
- Up to 0.9
- No growth

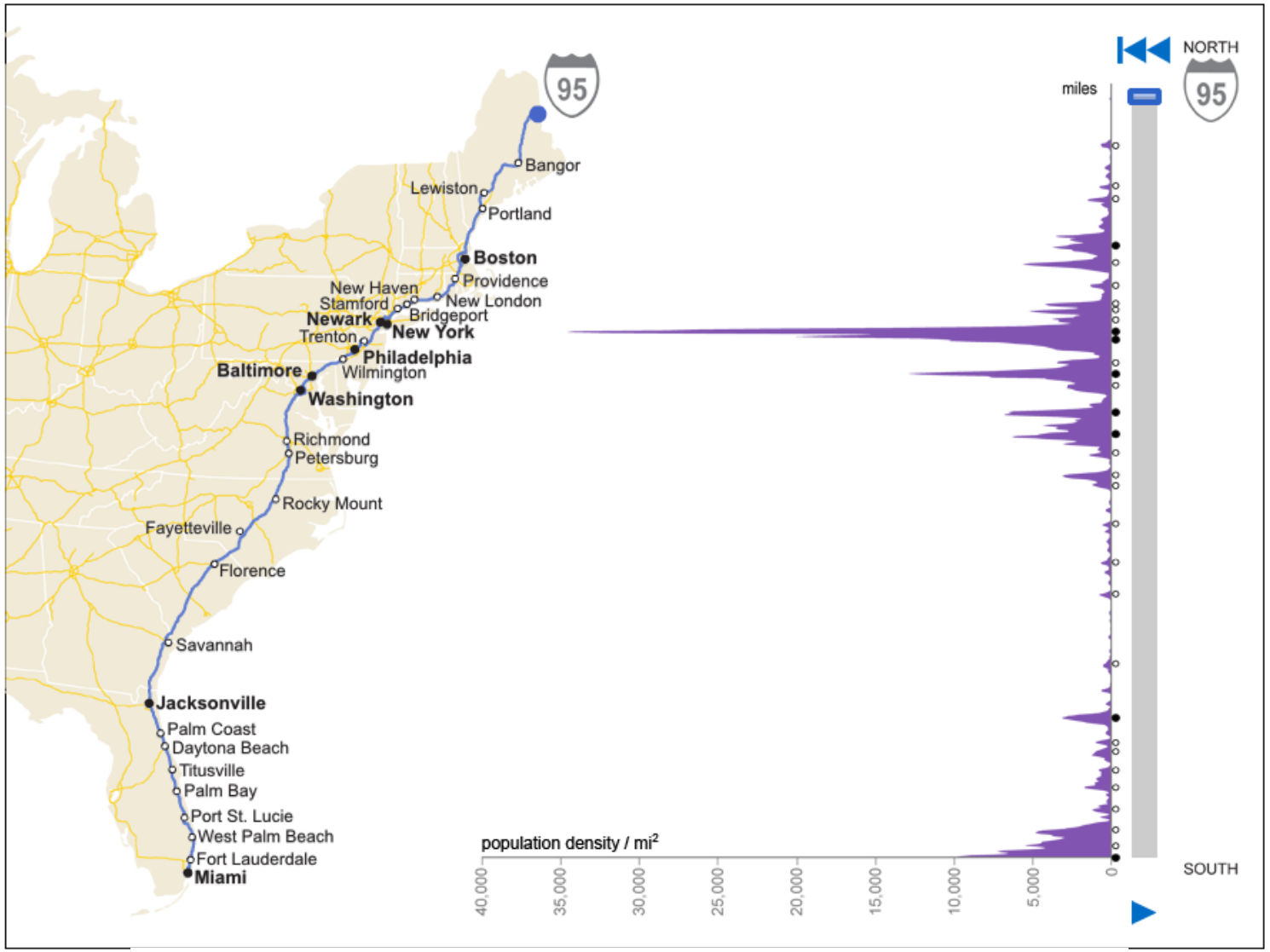
Primary source

- Natural increase
- Net migration
- Equal
- No growth or no primary source

http://storymaps.esri.com/stories/2014/census-county-population-change/

Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

I-95 Population Density Profile 2010



Population density within five miles of I-95.

http://www.census.gov/dataviz/visualizations/012/

Discussion Questions

- What are other state's plans for the 2015 Network Assessment?
- What tools or approaches did others find useful for the 2010 Network Assessment?
- Do others plan many changes to their approach?
- Can MARAMA host a web page of useful Network Assessment links for all to use?
- Any other comments/suggestions?

Suggestions and comments are very welcome!

Contact : Jennifer Hains

Air and Radiation Management Administration

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