

Status Report:

Regional Network Assessments

SAMWG Meeting
October 16-18, 2003
(by Mel Zeldin)

Background

- National Monitoring Strategy started in 2000.
- Network assessments one key component of Strategy
- National Assessment completed in 2001
- RO's tasked with conducting regional assessments
 - Originally targeted for end of 2002
 - Completion now early 2004

Background (Cont'd)

- RO's began process in 2001
- Various approaches taken
 - No guidance given
- Initially, “all over the map”
- Region meeting in Atlanta in Sep 2003
 - Better consistency than earlier indicated
 - Guidance product still needed for future assessments (also recommended by CASAC)

Overview

- Review of Region efforts to-date
- Take a look at some preliminary guidelines for future assessments

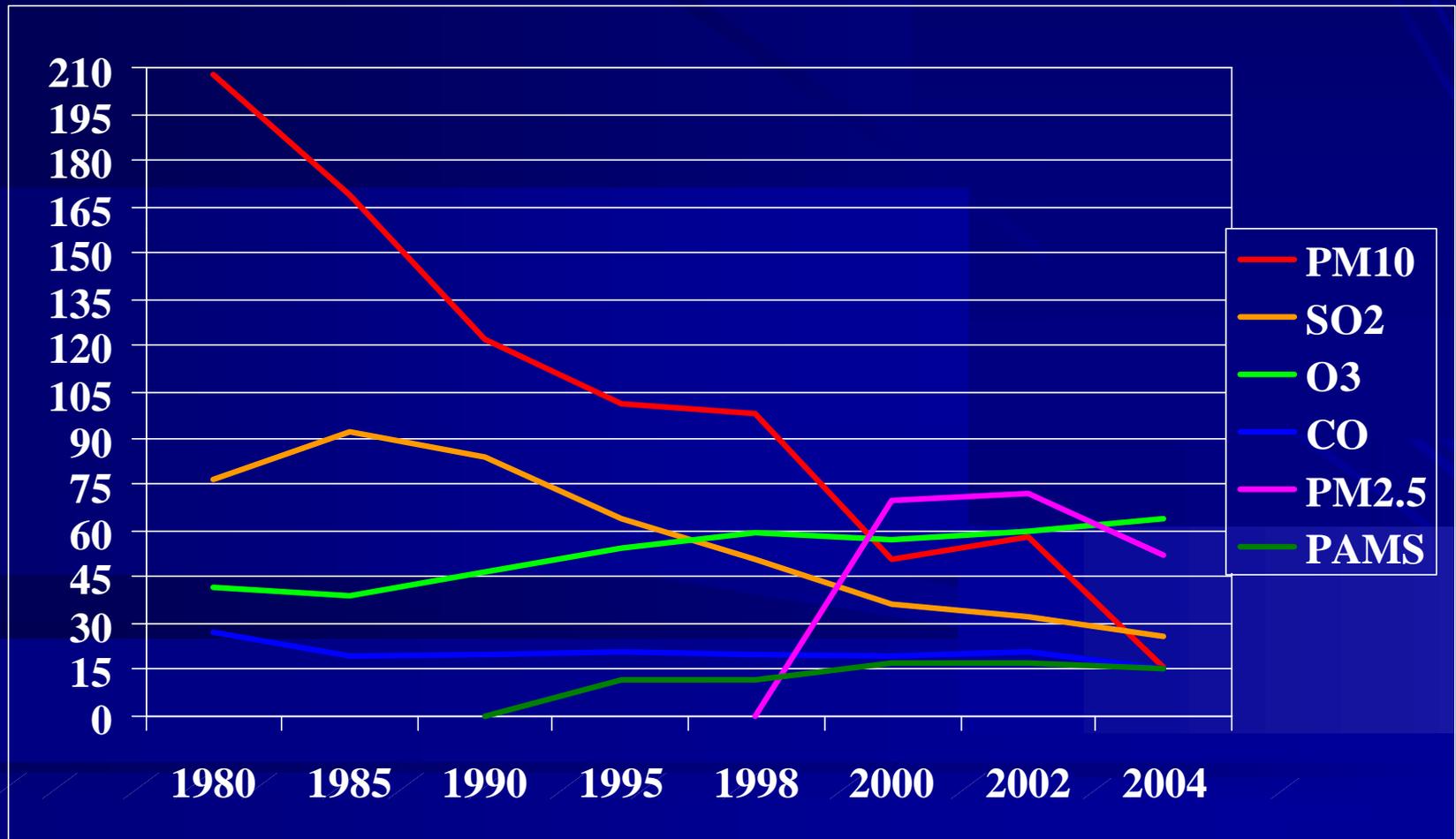
Region 1

- **Began the process of re-assessing the New England air monitoring networks with a meeting on 3/12/01**
 - **New England States and Tribes, NESCAUM, EPA**
- **Discussed concerns, issues and program needs with the major stake holders**
- **Agreed on a process for conducting the regional assessment**
 - **Each state/tribe began to review the existing networks to assess investment and disinvestment opportunities. These were submitted to the Region**

Region 1

- The Region reviewed the submissions/met with states and others
- A second regional meeting was held on January 28, 2003
 - Discussed the regional network and disinvestments
- The Region has been meeting with states/tribes individually to finalize their air monitoring proposals

Changes in the Number of New England Air Monitoring Sites 1980 to 2004



Region 1: Changes #1

■ *Ozone Program*

- Relocated several sites to improve coverage for mapping
- Added four tribal ozone sites
- Will add several special study sites next summer in support of NOAA's intensive study
- Based in part from the NESCAUM PAMS assessment contract with STI (1) revising the PAMS program by eliminating 3 sites, (2) adding NO_y at 6 sites, (3) reducing carbonyl measurements, (4) allowing RI to not operate one site in 2003, (5) adding low level CO and SO₂ at a few sites, (6) more to come

Region 1: Changes #2

■ *The PM Program*

- Adding 18 additional PM2.5 continuous monitors for mapping, eliminating 19 FRM sites, and relocating several FRM sites to improve coverage/reduce costs
- Adding 1 new PM2.5 speciation site and 9 Black Carbon sites
- Reducing at least 42 of the 58 SSI PM10 sites
- Modifying 23 PM2.5 FRM samplers to measure PM10 and locating them at PM2.5 to measure PMcoarse
- Tribal operation of 3 IMPROVE sites, 1 PM2.5 continuous monitor, and 1 carbon analyzer
- Added PM2.5 FRMs at 5 Canadian sites

Region 1: Changes #3

■ *The Other Criteria Pollutants*

- Striving to keep the critical long term trend sites in the Region
- SO₂ reducing at least 6 sites (note several sites will be in support of UNH's asthma study) One new tribal site
- CO reducing at least 6 sites (while still meeting SIP Maintenance Plan requirements) One new tribal site
- NO_x- no net change. MA is eliminating 2 sites and VT and ME are adding a site each. One new tribal site.
- Pb only 1 site in Boston, down from a high of 77 in the mid-eighties

Region 1: Changes #4

■ *The Air Toxics Program*

- Adding national trend sites in Boston, Providence and Underhill, VT. CT plans to establish a similar type of site in New Haven by relocating a PAMS GC
- Adding 9 new Black Carbon sites
- Most sites in New England are temporary and the number will fluctuate from year to year - 26 in 02, 19 in 03, and 24 planned in 04.
- Hg deposition sites will be reduced on the state side due to lack of funding. The tribes will be operating 2 sites

Region 1: Summary

- This redesign represents an investment in new monitoring at 77 sites in New England
- There is a reduction of less critical monitoring at 86 sites.
- Investment \$\$ > Disinvestment \$\$

Region 2: Approach

- Use OAQPS 5-parameter approach
- Look at trends and attainment status
- Review historical network changes
- Examine emerging needs
- Respond to community/health concerns
- Maintain dialog with S/L/Ts and public
- Build on national security experience

Region 2: Preliminary Findings

- Reduce CO monitoring in NY and NJ
- Reduce PM10 monitoring in PR
- Increase continuous PM2.5
- Shorten ozone season in upstate NY
- Other recommendations to follow

Region 3 - Approach

■ Nine-step process:

- Select appropriate “elements”
- Define decision criteria
- Gather data
- Index to common decision scale
- Quantify importance of decision criteria
- Create initial “decision set”
- Undergo iterative process
- Stakeholder involvement
- Final decision

Region 3 – Ozone Analysis

- 40 decision criteria initially selected
- 6 networks established to bound the evaluation
- Statistical metrics developed to evaluate adequacy of each network
- Used as starting point for S/L discussions

Region 3 – Six Network Designs

1. “Baseline:” 110 ozone monitors in 2001
2. “1 County:” Only 1 monitor per county (removes 33 monitors)
3. “All Stations:” Adds O₃ to all existing sites (adds 102 monitors)
4. “All Counties:” One monitor in each county (adds 165 monitors)

Region 3 – Six Network Designs

5. “Least Cost:” Removes monitors until information degradation occurs (removes 62 monitors)
6. “Best Krieking:” Least cost with added monitors to in worst information areas (removes 62 monitors, adds 4 back)

Each design also evaluates added costs or cost savings.

Region 3 – PM2.5 Analysis

- Same as for ozone except only 12 decision criteria were used
- 2. “1 County” – 46 monitors removed
- 3. “All Stations” – 128 monitors added
- 4. “All Counties” – 139 monitors added
- 5. “Least Cost” – 66 monitors removed
- 6. “Best Krieking” – removed 44, added 27

Region 3 - Considerations

- Needs S/L input
- Criteria/data modifications?
- Additional scenarios?
- Additional episodes?
- Extrapolation to other pollutants?

Region 4 - Approach

- Historical review of criteria pollutant networks since 1985
- Spatial Analyses
- Assessment of current reduction possibilities
- Ozone season analyses

Region 4 – Historical Review

- Ozone – continuing increase
- TSP – over 90% reduction
- PM10 – peaked in 1998, decreasing since
- Lead – decreased about 50%
- SO2 – decreased about 40%
- NO2 – peaked in 1994, reduced thru 1998, then increasing again

Region 4 – Spatial Analyses

- Extent and location of violations
- Population Exposure
 - Grid method
 - MSA method
 - County method
- Sensitivity of analyses
 - Bias
 - Results very sensitive to technique used

Region 4 – Initial Assessment

- Recommended 345 monitors for possible termination
- Interactions with states
- Suggested list:
 - 21% CO
 - 18% PM10
 - 9% NO2
 - 8% Lead
 - 6% SO2
 - None for ozone and PM2.5
- Most are single-pollutant sites

Region 4 – Ozone Season Analyses - Criteria

- In evaluating Ozone Monitoring Season length:
 - Include months with numerous hits
 - Exclude months with no hits
 - Further evaluate months with few hits & exceedences
- Determine the impact of boundary month exceedences on:
 - Regulatory Decision Making
 - AQI Reporting
- Include months needed to accomplish these monitoring objectives, with a margin of safety

Region 4 – Ozone Season Analyses - Results

STATE	CURRENT SEASON		REVISED PER GUIDANCE		REVISED PER R4 CRITERIA	
	BEGIN	END	BEGIN	END	BEGIN	END
Alabama	March	October	March	November	May	September
Florida	March	October	February	November	March	October
Georgia	March	October	March	November	May	September
Kentucky	March	October	March	November	May	September
Mississippi	March	October	March	November	May	September
North Carolina	April	October	March	November	May	September
South Carolina	April	October	March	November	May	September
Tennessee	March	October	March	November	May	September
Additional Monitoring Requirements:	(None)		(None)		Year-Round Operation of a small subset of O ₃ monitors (approx. 10% of the network or 2 per State)	

Region 4 - Conclusions

In addition to reducing monitors, shortening the ozone season by 3 months can save additional monitoring costs.

Region 5 – Approach for PM2.5

- Identify low value and high value PM2.5 monitoring sites
- Provide States with informational support for their own proposed network redesign
- Complement national network assessment by providing finer local-scale resolution

Region 5 – PM2.5 Evaluation Criteria

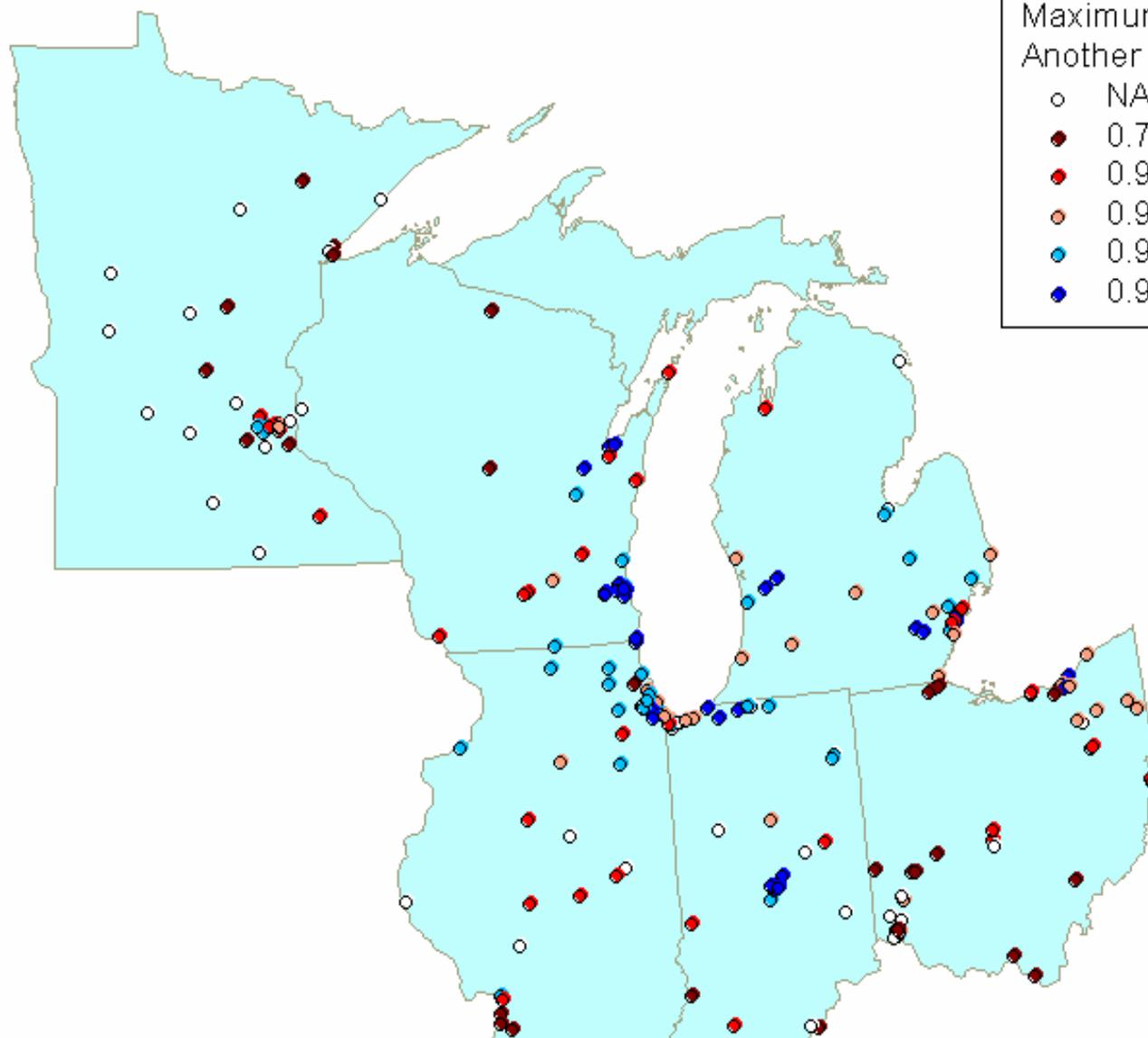
- **Evaluated PM2.5 monitors on the basis of four decision criteria:**
 - correlation
 - monitor density
 - mean concentration
 - population change
- The "least value" monitor would be one highly correlated to others ($R^2 \sim 0.95$), close to other sites, showing low means, and located in area of decreasing population



U.S. Environmental Protection Agency
Region 5 - Air and Radiation

08/17/01, Air Monitoring Section

Region 5 PM_{2.5} Monitor Correlations





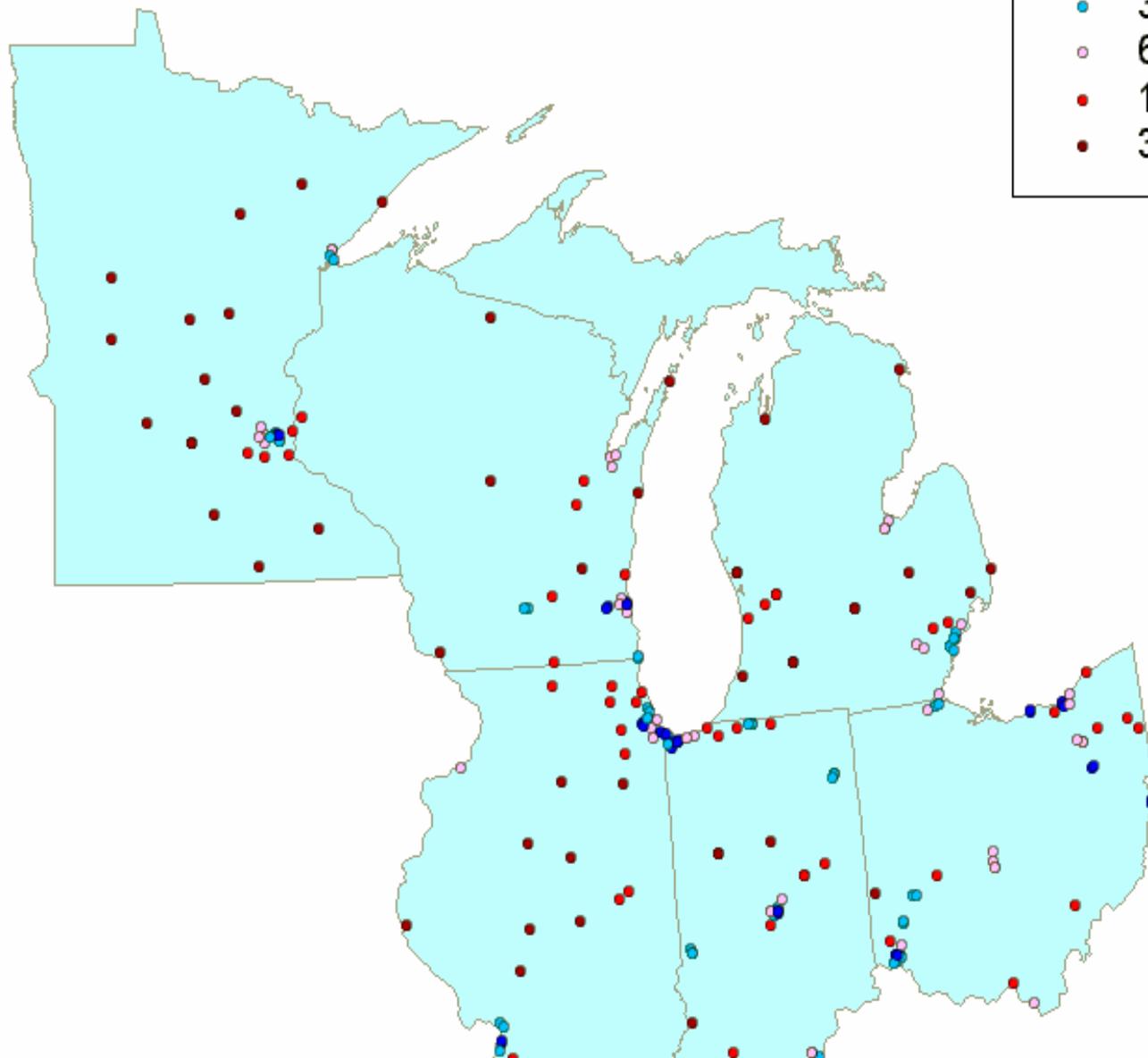
U.S. Environmental Protection Agency
Region 5 - Air and Radiation

08/09/01, Air Monitoring Section

Region 5 PM2.5 Monitor Density

Distance to Nearest
Monitor, km

- 0.9 - 3.3
- 3.5 - 6.3
- 6.4 - 12.2
- 13 - 34.2
- 34.5 - 190





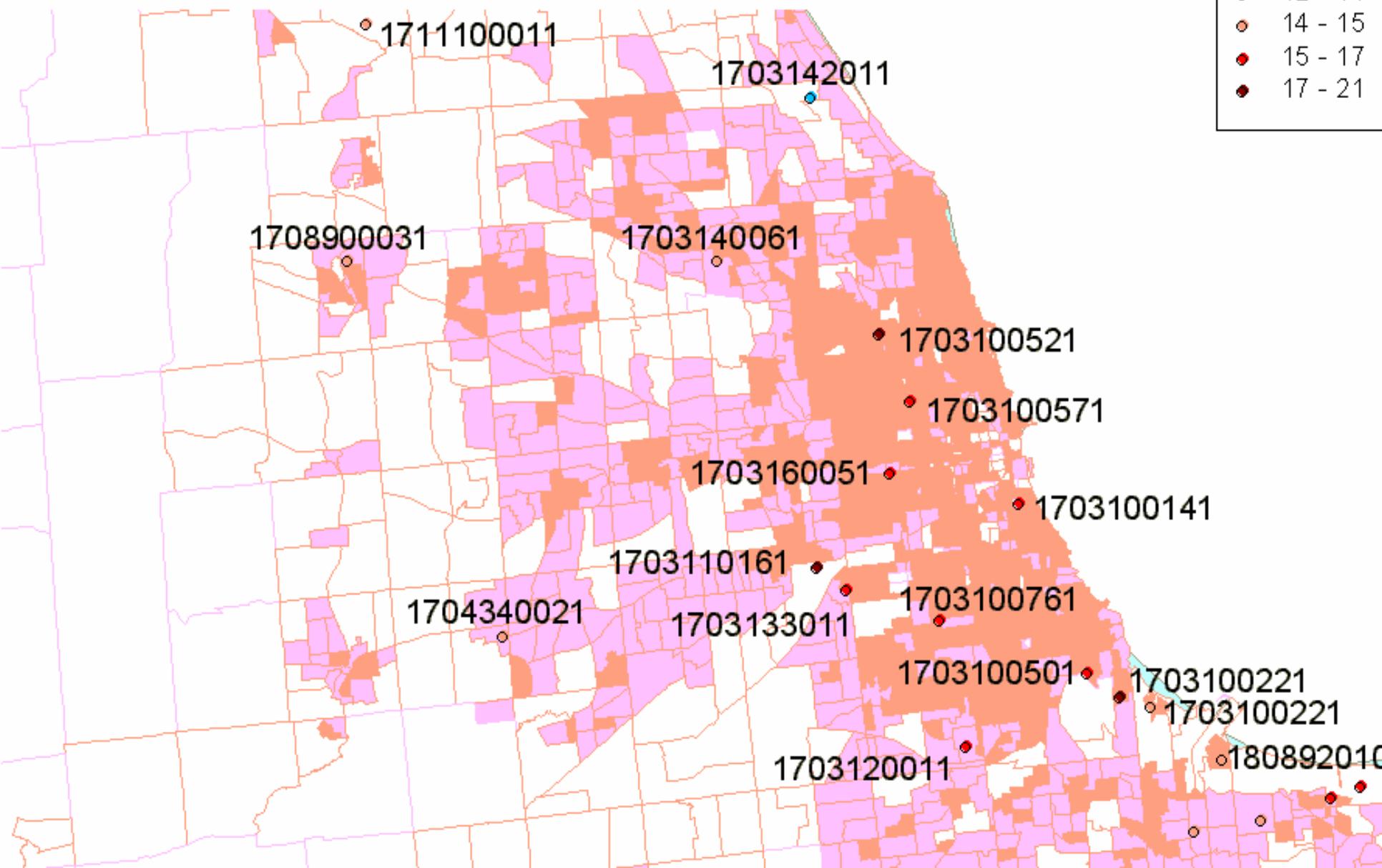
U.S. Environmental Protection Agency
Region 5 - Air and Radiation

08/06/01, Air Monitoring Section

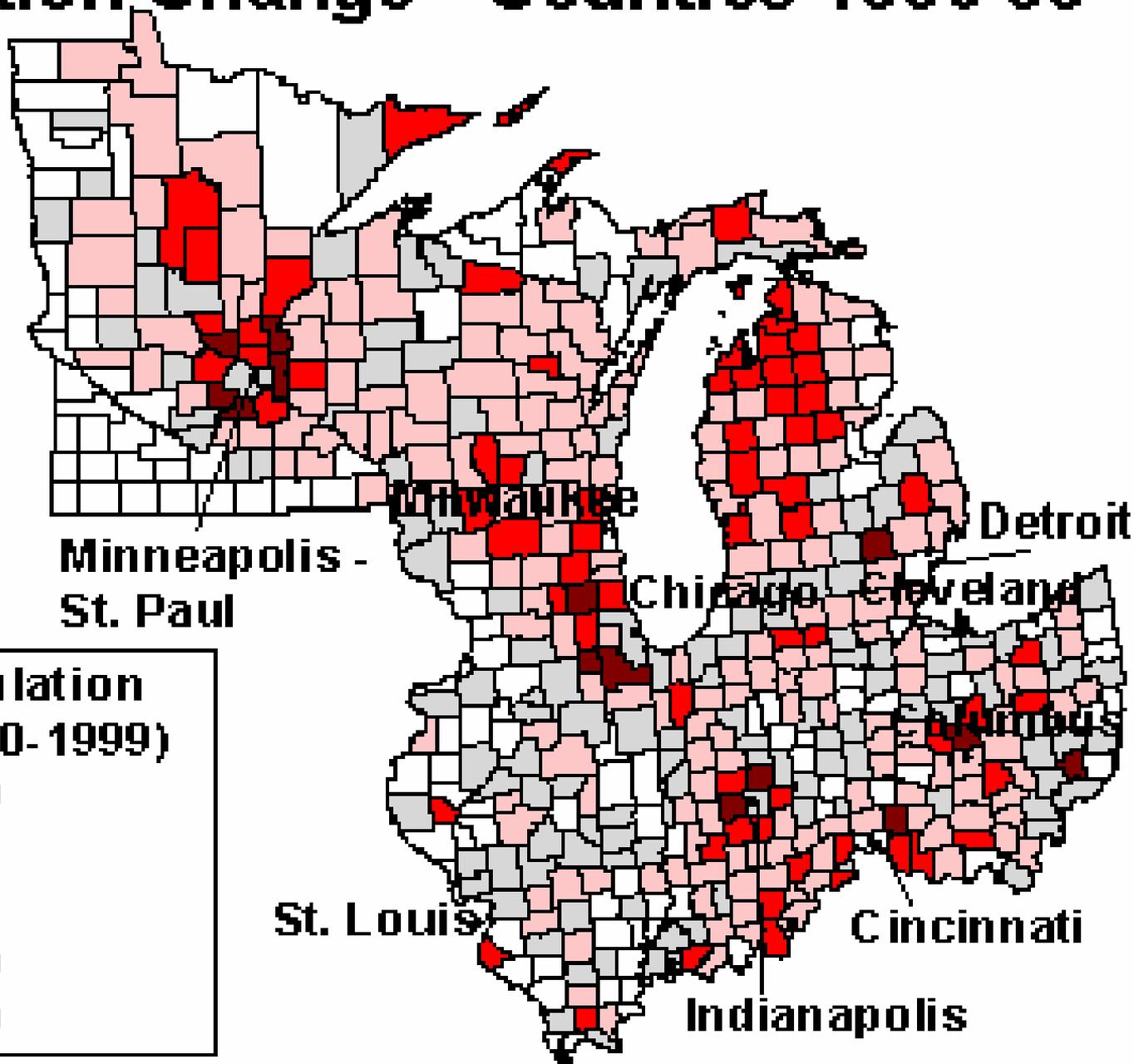
PM2.5 Mean, Chicago, IL

Mean PM2.5
Quintiles (ug)

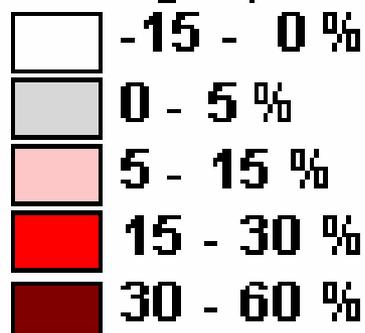
- 7 - 12
- 12 - 14
- 14 - 15
- 15 - 17
- 17 - 21



Population Change - Counties 1990-99



County Population Change (1990-1999)



Region 5 – Approach for Ozone

■ Correlation Analysis

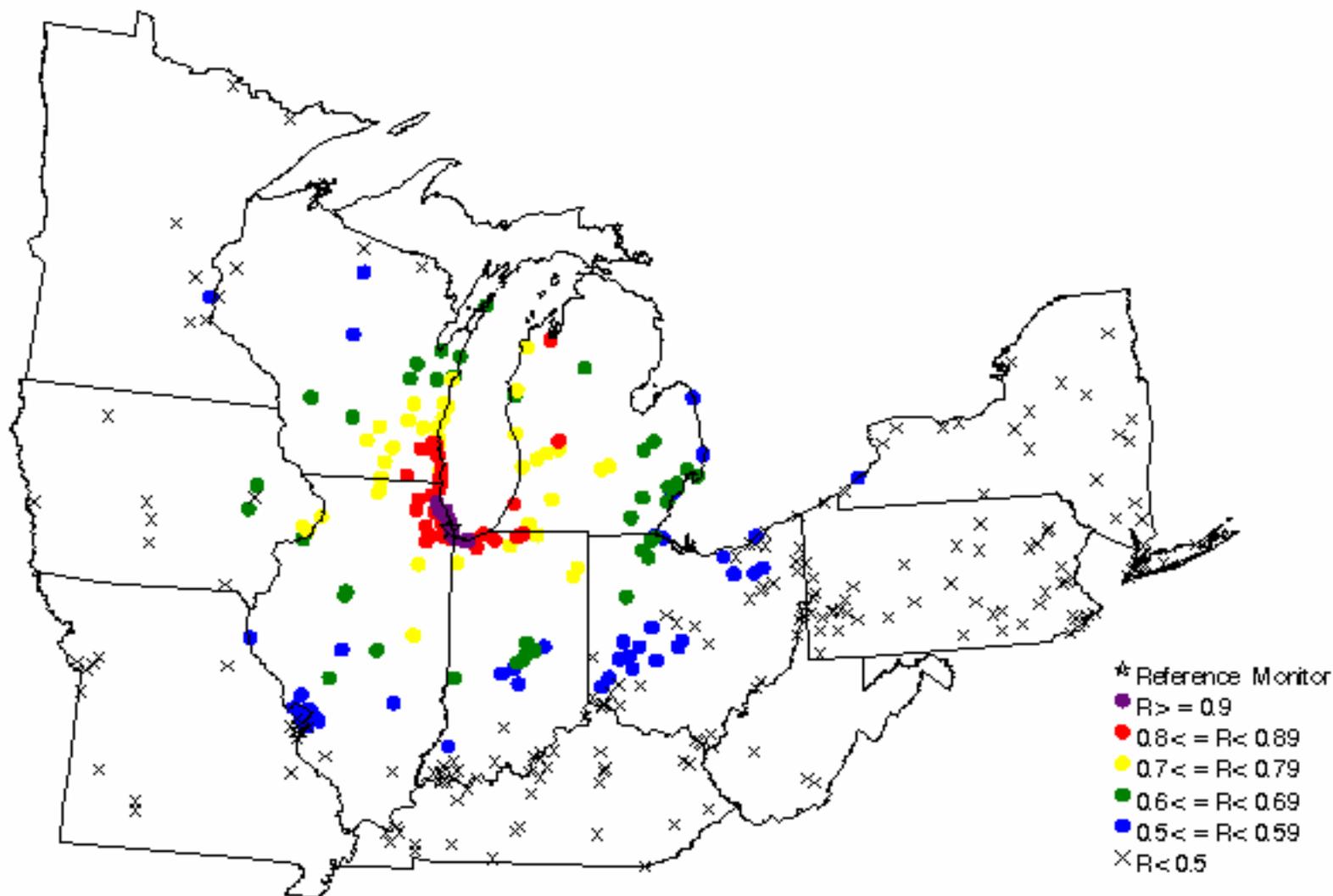
- Determine "redundant" monitoring sites
- Preserve "unique" sites
- Data
 - 1996-2000 8 hour daily maximum ozone concentration
 - IL, IN, OH, MI, MN, WI, IA, MO, KY, WV, PA, NY

■ Positive Matrix Factorization (PMF)

- Group monitors by spatial factors
 - Examine areas with similar ozone concentrations

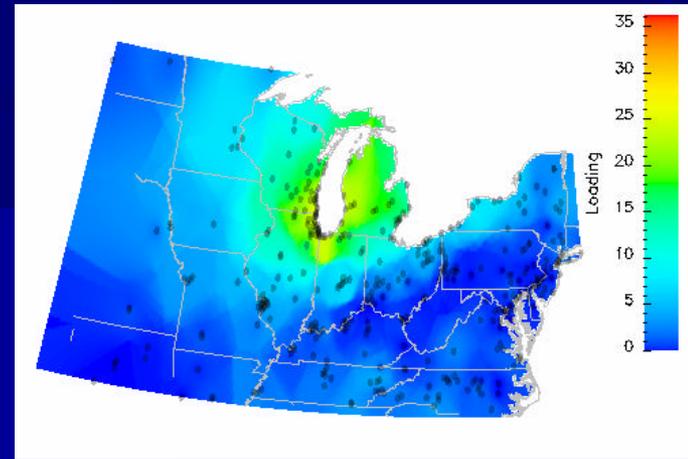
Ozone Correlation Map for a Monitor in METROPOLITAN CHICAGO

Site ID= 170310064442011

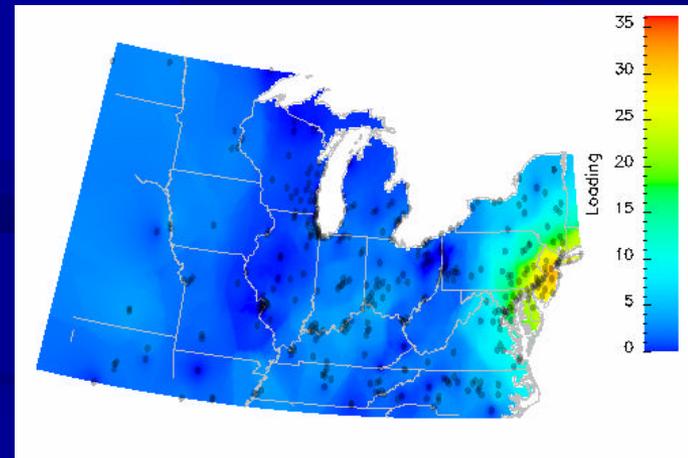


Region 5 – PMF Analysis

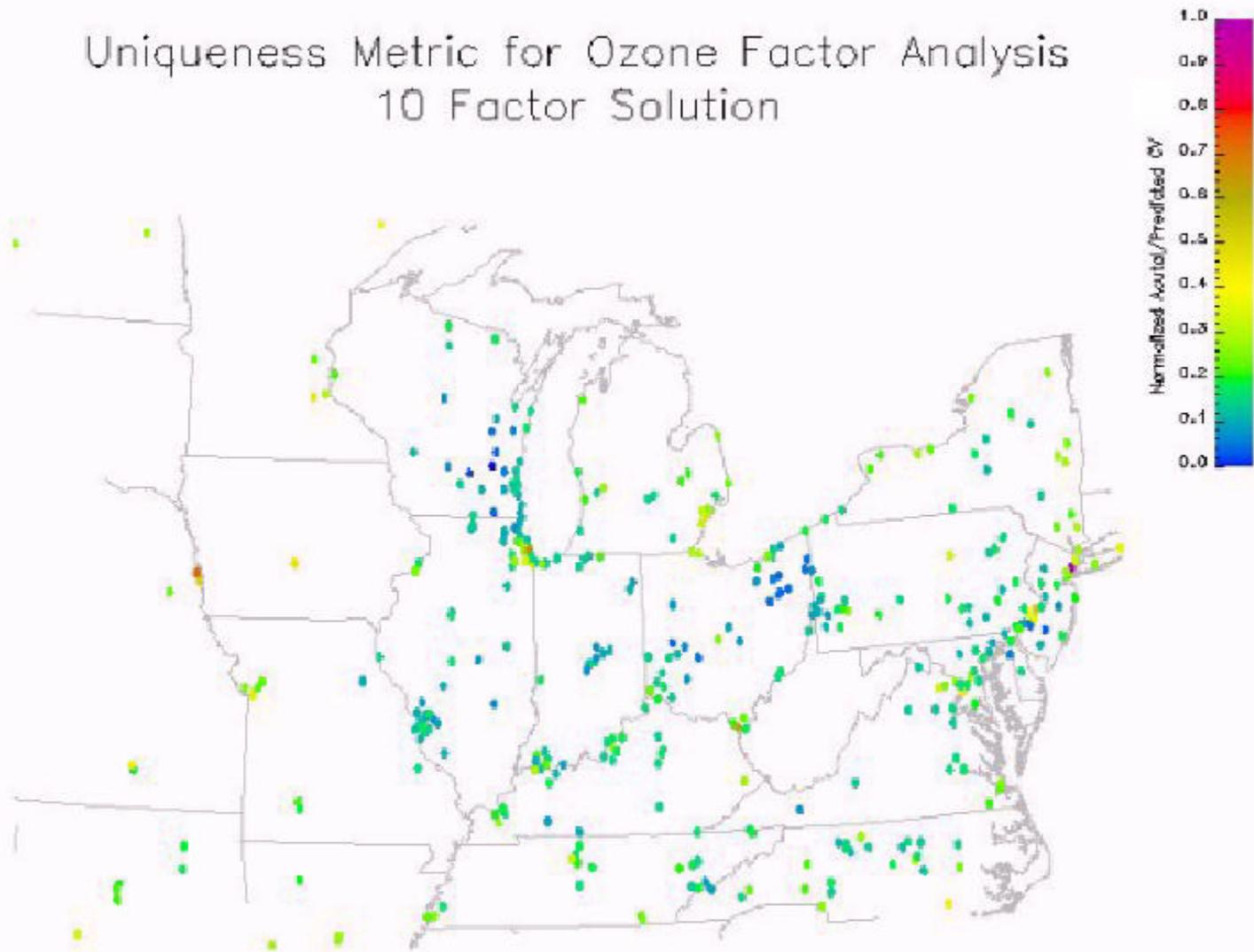
Lake Michigan Factor



East Coast Factor



Uniqueness Metric for Ozone Factor Analysis 10 Factor Solution



Region 5 - Considerations

■ "Bottom-Up" Network Assessment

– Create networks "from scratch"

– States established set of criteria

■ Public Information

Public health/NAAQS

■ Strategy development

Trends/strategy evaluation

■ Multi-pollutant sites

Population-oriented sites

■ Over/under-monitoring

Low concentrations

■ Regional/local scale

Population growth

– Analyses used to aid in decision process

Region 5 - Status

- Phase I: "Fine pruning" by States **COMPLETE**
- Phase II: Thorough assessment of networks resulting in initial revisions **COMPLETE**
- Phase III: Review by technical and regulatory staffs at both Regional and State level to see if data needs met **COMPLETE**
- Phase IV: Approval of proposed networks by State Air Directors **IN PROGRESS (4 of 6 States have OK'd)**
- Phase V: Outreach to public to explain changes **IN PLANNING STAGES**

Region 5 - Summary

- Technical assessments provided objective evidence
- Regional approach
- Implement changes in networks over period of up to five years
- Coordinate with federal/state policy staff
- Overall: 24% reduction in criteria pollutant networks

– ozone: 14%

– PM2.5: 18%

– PM10: 36%

– Lead: 48%

CO: 25%

SO2: 33%

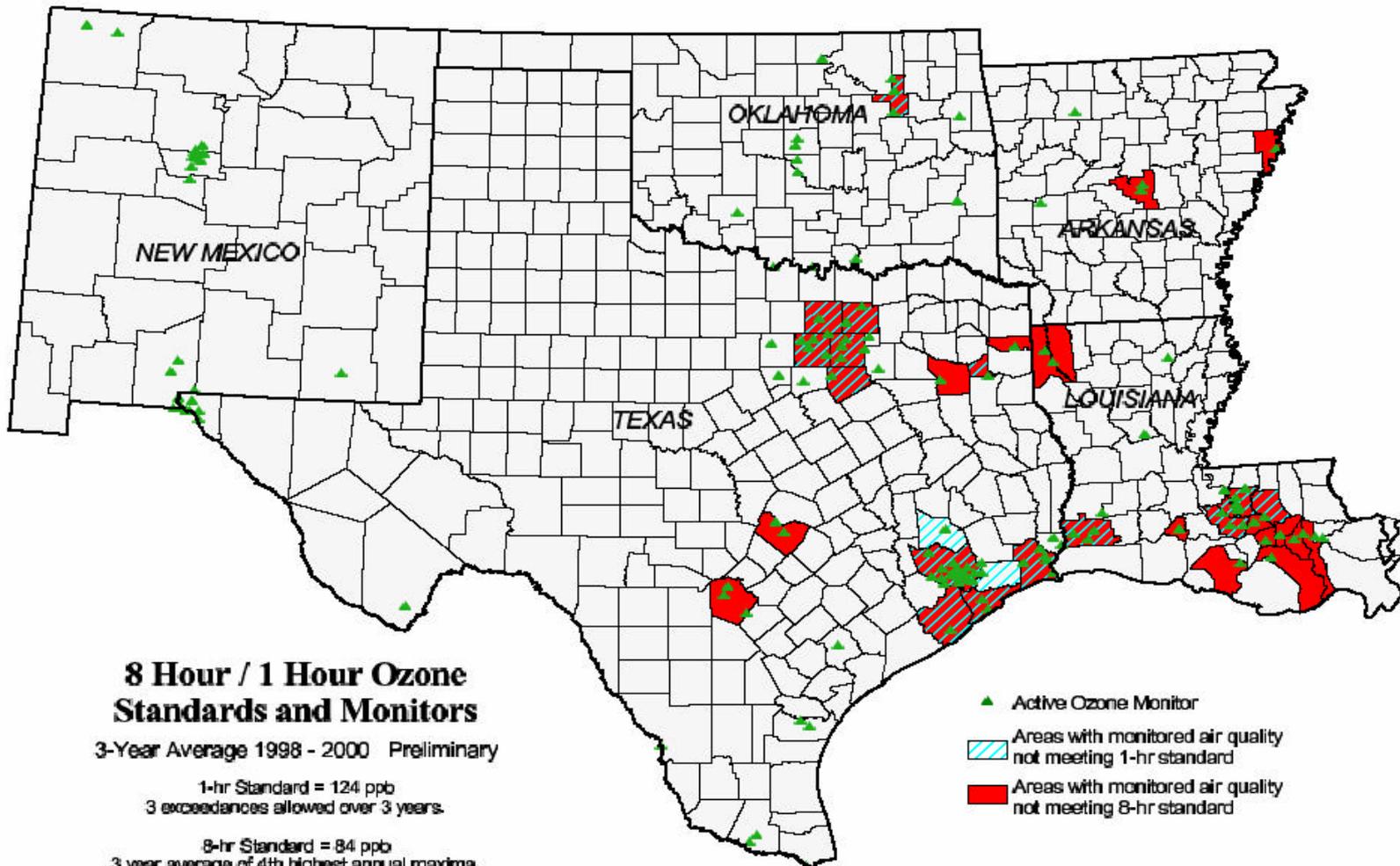
NO2: 14%

Region 6 - Approach

- Detailed analyses were conducted:
 - long term data back to the mid 1980's
 - trends not only in exceedance days but also close call days (for both 1-hour and 8-hour)
 - trends in site by site design values
 - long term met. data trends including temp., ws, wd, precip.
 - GIS maps
- Correlation analyses determined to be inappropriate for large diverse region

Region 6 - Approach

- The state and local programs developed detailed network assessments, going beyond the usual annual network review.
- In many cases air monitors were identified for deactivation.
- The network assessments were reviewed by EPA Region 6 staff and comments provided.



8 Hour / 1 Hour Ozone Standards and Monitors

3-Year Average 1998 - 2000 Preliminary

1-hr Standard = 124 ppb
3 exceedances allowed over 3 years.

8-hr Standard = 84 ppb
3 year average of 4th highest annual maxima.

Source: US EPA AIRS Database

-  Active Ozone Monitor
-  Areas with monitored air quality not meeting 1-hr standard
-  Areas with monitored air quality not meeting 8-hr standard

100 0 100 200 Miles



The areas shown above are recognized by EPA Region 6 as of April 2, 2001.



EPA Region 6
GIS Support Team
Dallas, Texas
4/2/01



Region 6 – State Recommendations

- Arkansas operates 21 PM-2.5 sites. Two sites have been recommended for deactivation.
- Several TEOM continuous PM-2.5 monitors are operated, with one being added.
- Only two PM-10 sites are operated.
- There are no lead monitors in Arkansas.

Region 6

– State Recommendations

■ Louisiana operates

- 28 ozone sites
- 12 NO₂ sites
- 6 SO₂ sites
- 3 CO sites
- 6 PM-10 sites (proposed -2)
- 22 PM-2.5 FRM sites (proposed -2)
- 6 continuous PM-2.5 (proposed +3)
- One lead site

Region 6 – State Recommendations

■ New Mexico

- 8 PM2.5 FRM (relocate 1)
- 6 PM2.5 continuous (no change)
- 15 PM10 FRM (discontinue 1; relocate 2)
- 6 PM10 continuous (no change)
- 8 active SO₂ (discontinue 2; relocate 2)
- 9 NO₂ (discontinue 2; reevaluate 1)
- 13 Ozone (discontinue 2, reevaluate 1)
- 3 CO (no change)

Region 6 – State Recommendations

■ Oklahoma

- Discontinue 2 PM_{2.5} FRM sites
- Discontinue 3 CO sites
- Discontinue 1 SO₂ site
- Discontinue 3 NO_x sites
- No changes to other pollutants

Region 6 – State Recommendations

■ Texas

- Ozone – added 2 sites
- CO – discontinue 1 site
- SO₂ – add 2 sites
- NO_y – add 1 site
- PM_{2.5} – discontinue 33 sites
- PM₁₀ – discontinue 14 sites; add 1 site
- Lead – discontinue 9 sites

(Note: recommendations subject to EPA approval)

Region 7



Region 8 - Approach

■ Description of Region

- Area
- Topography
- Population
- Climate

■ Description of Monitoring Network

■ Discussion of Funding/Budgetary Setting

Region 8 - Approach

- Statistical applications (ozone and PM2.5)
 - Paired site correlations
 - Ranked high-to-low
 - Scatterplots
 - Comparisons to NAAQS
- Consideration for major source impacts
- Identification of potential network changes
- Identification of future assessment tools

Region 8 - Status

- Information given to States
 - Awaiting input back from States
 - Awaiting new regs before implementing
- Consider as extension of annual network review process

Region 9 - Approach

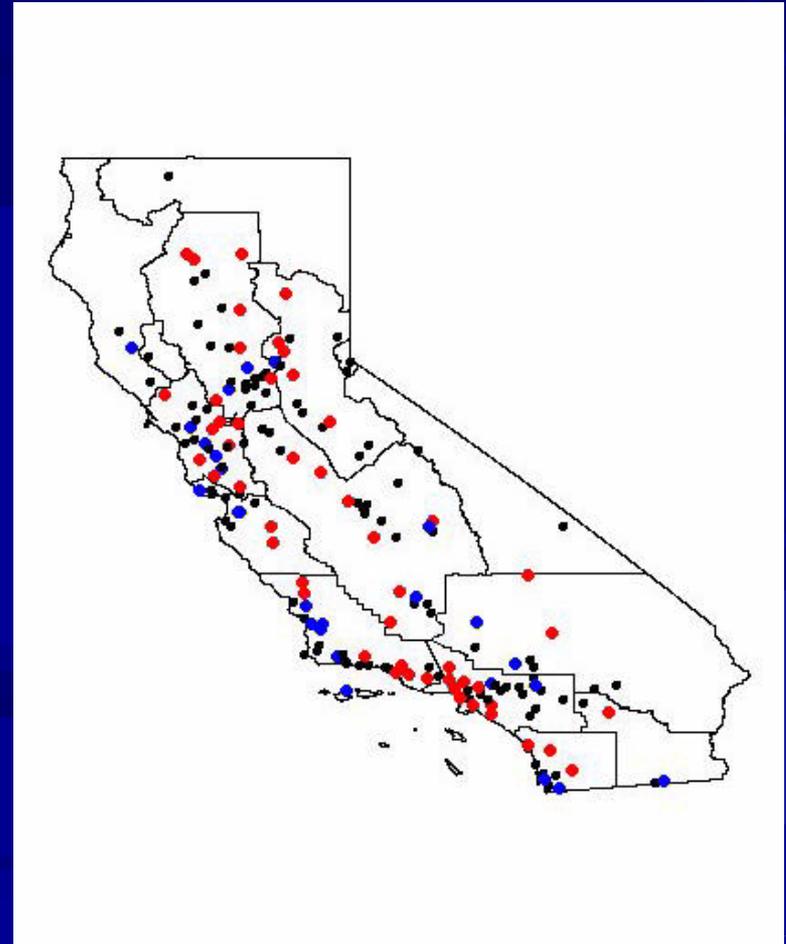
- Regional Workshops held in early 2002 to gain State & local agency input
- Prioritized pollutants: Ozone, PM2.5, PM10
- Applied the National assessment measures regionally:
 - California – by air basin
 - Arizona, Nevada – by county
 - Hawaii – by island

Region 9 - Approach

- Each area network (air basin, county, or island) was analyzed using each of the five metrics
- The results were then aggregated to obtain the final index value used for ranking the monitors

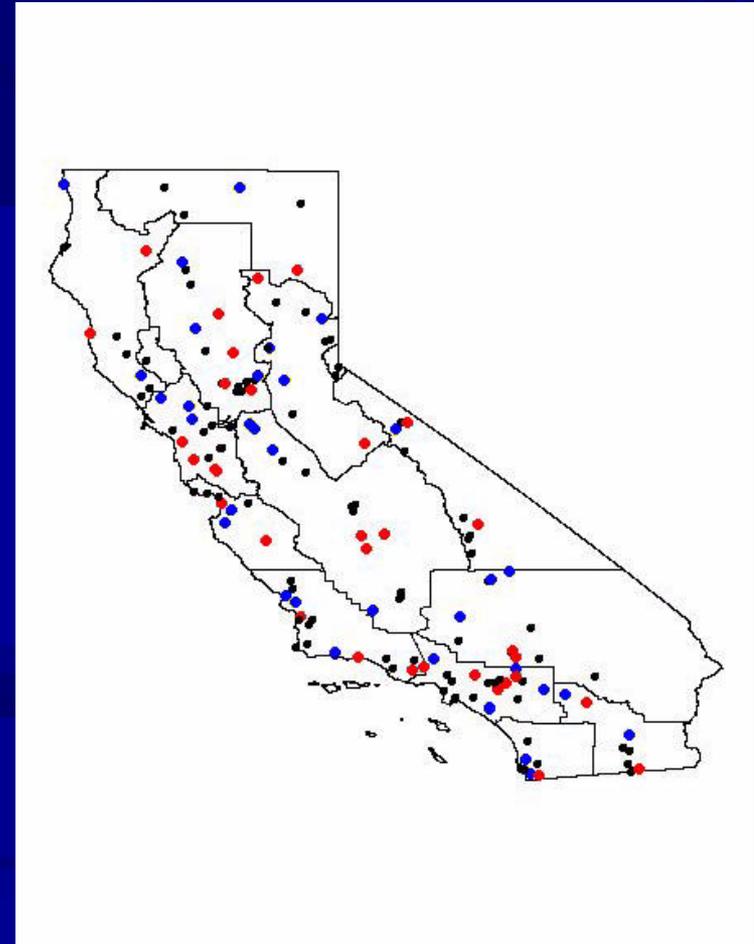
Region 9 - Results

- Ozone – Equal Wt.
- High Value (≥ 75 th percentile) – Red
- Median (26 – 74th percentile) – Black
- Low Value (≤ 25 th percentile) - Blue



Region 9 - Results

- PM10 – Equal Wt.
- High Value (≥ 75 th percentile) – Red
- Median (26 – 74th percentile) – Black
- Low Value (≤ 25 th percentile) - Blue



Region 9 – Results for PM10

CA Air Basin	Retained	Shutdown	% change
Bay Area	17	4	19
Great Basin	5	5	50
Lake County	1	0	0
Lake Tahoe	2	0	0
Mojave Desert	8	6	43
Mtn Counties	13	6	46
N Cent. Coast	10	2	20

Region 9 – Results for PM10

CA Air Basin	Retained	Shutdown	% change
North Coast	5	6	54
NE Plateau	2	3	60
Sacramento	19	12	39
Salton Sea	6	3	33
San Diego	10	1	9
SJV	22	11	33
S Cent. Coast	24	5	17
South Coast	26	11	30

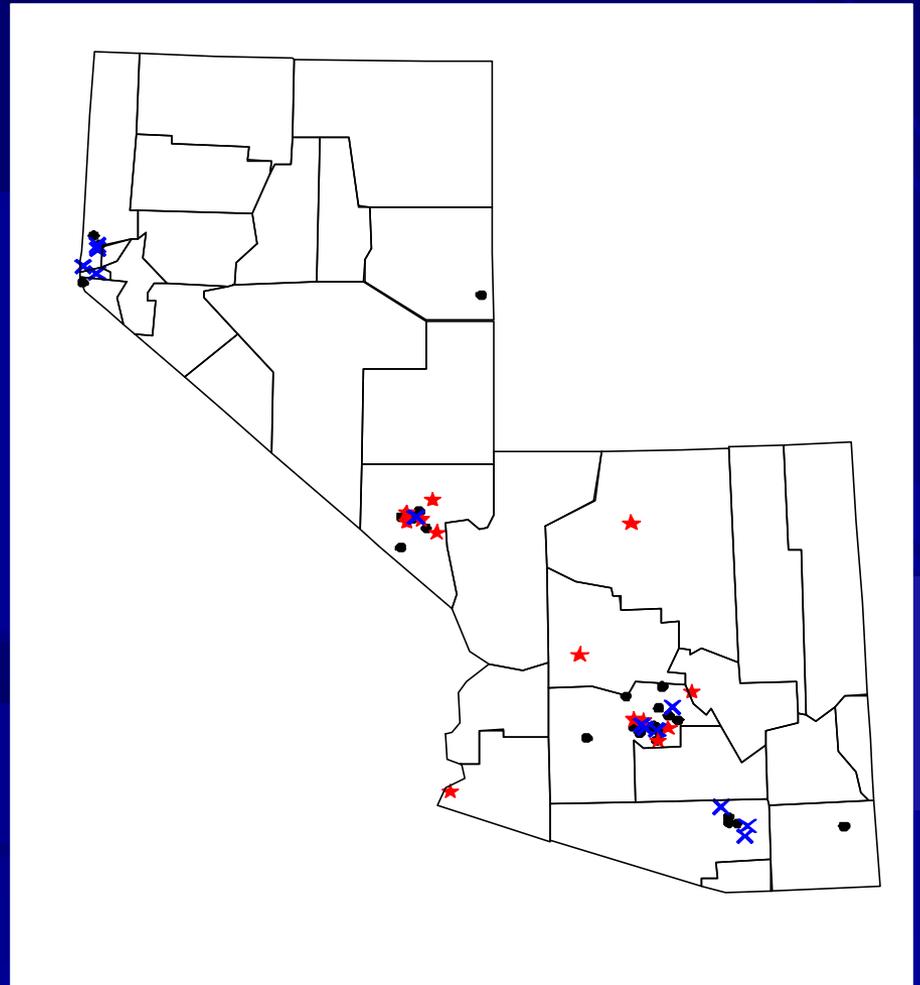
Region 9 - Results

Ozone – Equal Wt.

High Value (≥ 75 th percentile) – Red

Median (26 – 74th percentile) – Black

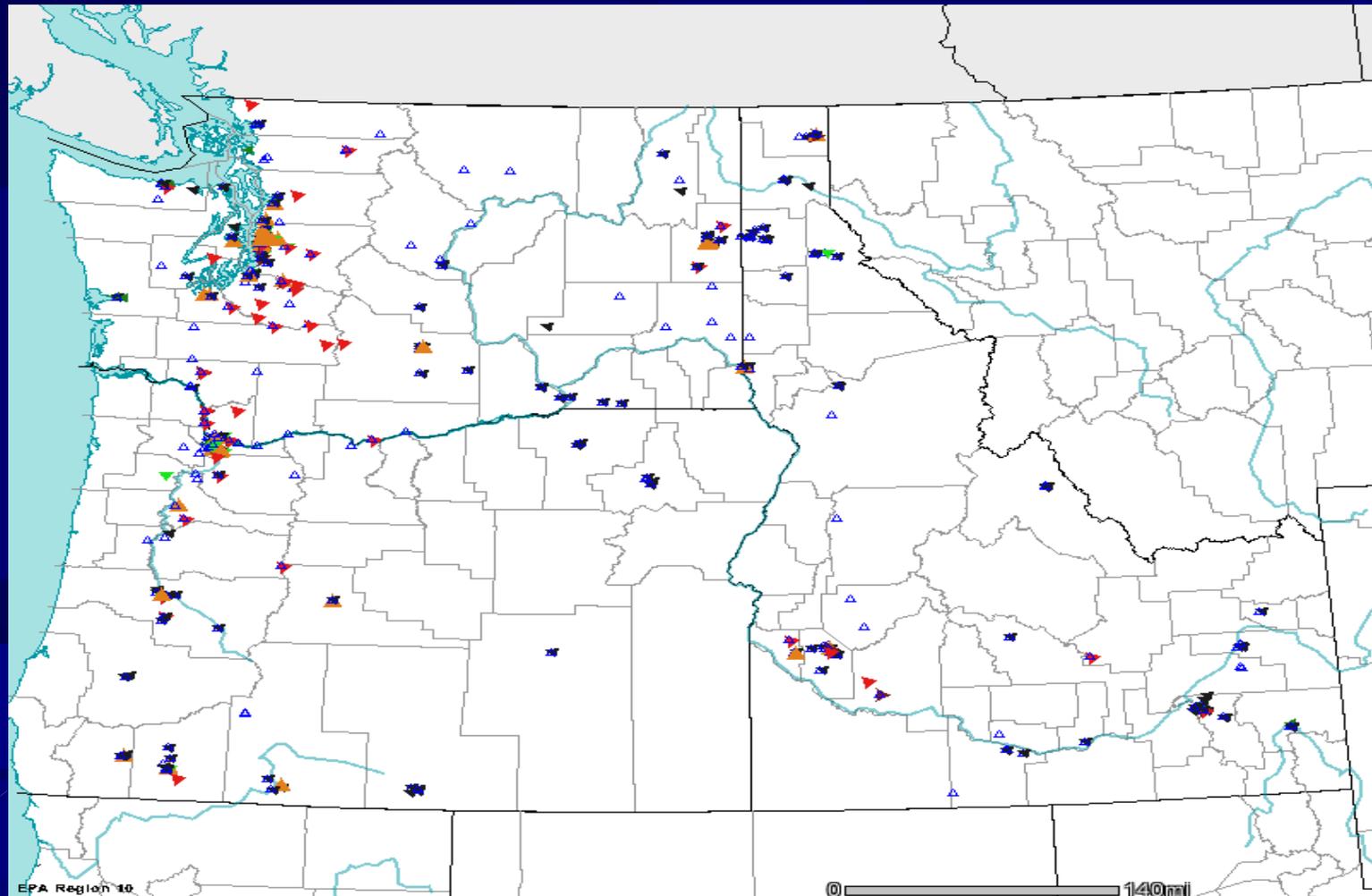
Low Value (≤ 25 th percentile) – Blue



Region 9 - Status

- Awaiting feedback from S/L's

Region 10 – Approach (Description of Existing Network)



Region 10 - Approach

- Eliminate PM10 and PM2.5 FRMs reporting less than 80% of the NAAQS except as required by population or in non-attainment areas.
- Eliminate redundant monitoring sites with correlation coefficient $r > 0.85$.
- Identify one site in each state which would meet the objectives of an NCORE Level 2 site.

Region 10 - Approach

- Identify all remaining NAMS and SLAMS sites which meet the objectives of NCCORE Level 3.
- Identify cost saving which will be achieved in 2004 due to network reductions, and how these savings would be used to conduct new work consistent with NCCORE objectives.

Region 10 - Results

- Substantial reduction in the number of PM2.5 and PM10 FRMs in WA, OR and ID
- Significant increase in the number of continuous PM2.5 monitors for all R10 states.
- Redundant monitoring sites have been eliminated.

Region 10 - Results

Washington

Monitor Type	<u>2002</u>	<u>2003</u>	<u>2004</u>
PM2.5 FRM	29	22	15
PM2.5 Continuous	27	35	35
PM10 FRM	24	21	14
PM10 Continuous	17	17	17
Ozone	14	14	14
CO	14	10	10
SO2	1	1	1
NO2	3	2	2

Region 10 - Results

Oregon

Monitor Type	<u>2002</u>	<u>2003</u>	<u>2004</u>
PM2.5 FRM	27	22	15
PM2.5 Continuous	15	16	21
PM10 FRM	19	18	18
PM10 Continuous	10	10	10
Ozone	7	7	7
CO	12	11	11
SO2	0	0	0
NO2	1	1	1

Region 10 - Results

Alaska

Monitor Type	<u>2002</u>	<u>2003</u>	<u>2004</u>
PM2.5 FRM	10	7	6
PM2.5 Continuous	0	0	4
PM10 FRM	8	8	7
PM10 Continuous	5	7	7
Ozone	0	0	0
CO	7	7	7
SO2	0	0	0
NO2	0	0	0

Region 10 - Results

Idaho

Monitor Type	<u>2002</u>	<u>2003</u>	<u>2004</u>
PM2.5 FRM	12	7	7
PM2.5 Continuous	17	17	19
PM10 FRM	15	4	3
PM10 Continuous	6	6	6
Ozone	2	2	2
CO	2	2	2
SO2	3	2	2
NO2	0	0	0

Region 10 – Upcoming Work

- R10 is planning a workshop to review and evaluate available models which the states/local air agencies could use to optimize their air monitoring networks.

Models would include:

- Dispersion models (CMAQ)
- Receptor models (CMB, PMF, and UNMIX)
- Geostatistical models (Kriegering)

Evaluation of RO Efforts

- Most RO's invested considerable effort
- Most RO's engaged S/L's
- Some focused on statistical approaches
- Some focused on other factors
- Some have begun implementing changes
- Some are awaiting implementation
- Most are meeting the intent of the assessment process

Assessment Guidelines

- Needed to maintain national consistency, yet allow for regional differences
- Preliminary guidelines proposed
- Would be effective for next round of assessments

Preliminary Assessment Guidelines: Step 1 - Description

- Background – boilerplate (updated as necessary for each subsequent assessment)
 - Topography
 - Climate
 - Population and trends
 - General air quality
 - Attainment/non-attainment areas

Preliminary Guidelines: Step 2 – Network History

- Cover at least the previous 10 years
- Include:
 - Number of monitors by pollutant over time
 - Can include details by each site:
 - Site location
 - Pollutants measured
 - Years of operation
- Each successive 5-yr assessment appends to previous list

Preliminary Guidelines:

Step 3 – Statistical Analyses

- Some statistical analysis should be conducted
- Can vary from simple to complex, according to needs of each Region
- Simplest analyses should include:
 - Site-by-site comparison to NAAQS (over past 5 to 10 years) with most interest in:
 - Sites 20-40% below NAAQS and not trending upward
 - Sites more than 40% below the NAAQS

Preliminary Guidelines:

Step 3 – Statistical Analyses

- site-to-site linear or multiple linear regression
 - Find sites with highest correlations (e.g., $r > 0.85$) as estimated from adjacent site(s)
 - Predictability can be used to create “pseudo” sites for sites to be discontinued, yet utilized in ongoing spatial analyses. Historical data therefore beneficial. (May need periodic sampling to re-validate relationships)
 - Use appropriate parameter (e.g., daily max)

Preliminary Guidelines: Step 4 – Situational Analyses

- Complements statistical analyses
- Looks at rationale and other factors, e.g.:
 - Value of long-term trends
 - Closeness to NAAQS
 - Population changes (+ and -)
 - Maintenance plan and SIP requirements
 - Special circumstances
 - Sparseness of existing network
 - Identified needs of scientific/health communities

Preliminary Guidelines: Step 5 – Suggested Changes

- Based on RO analyses, compile list of suggested site/pollutant changes
- Conduct workshop(s) with S/L/T's
 - Share results of analyses
 - Go over suggested network changes
 - Seek input from S/L/T's
 - They may have other considerations, e.g., political, for accepting/not accepting suggested changes

Preliminary Guidelines: Step 6 – Interactive Discussions

- S/L/T's provide RO's with their list of recommended network changes
 - Need justification from S/L/T's for each change from original “suggested” list
 - RO's review submittals
 - May need one-on-one discussions to reach final recommendations
 - RO's accept or reject changes

Preliminary Guidelines: Step 7 – Final Recommendations

- Compile list of all proposed network changes
- Include justification statement for each change
- Include timelines to implement
- In future, forward all NCore Level 2 site changes to OAQPS for approval

The End – at last !!!

The haze will disappear and
all will become clearer....

A Scheffe Production
In Cooperation with
RO Dreamworks