

P&A – Striving for Consistency

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To understand the effects of data quality, we must first understand the intended use of the data

- ❖ consistent bias ok for trends analysis, not ok for determining attainment status
- ❖ level of imprecision tolerable for determining attainment of annual standards higher than that for determining attainment of daily standards
- ❖ decreasing imprecision ok for determining attainment of annual standards, not ok for trends analysis or daily standards (impacts to high percentiles)
- ❖ consistent site-specific biases ok for trends analysis but makes spatial analyses difficult (urban vs. rural, spatially interpolated maps, ...)

Traditionally, NAAQS comparisons have driven what was defined to be acceptable levels of data quality.

(Approx) Basics of Some Ambient Air Quality Standards

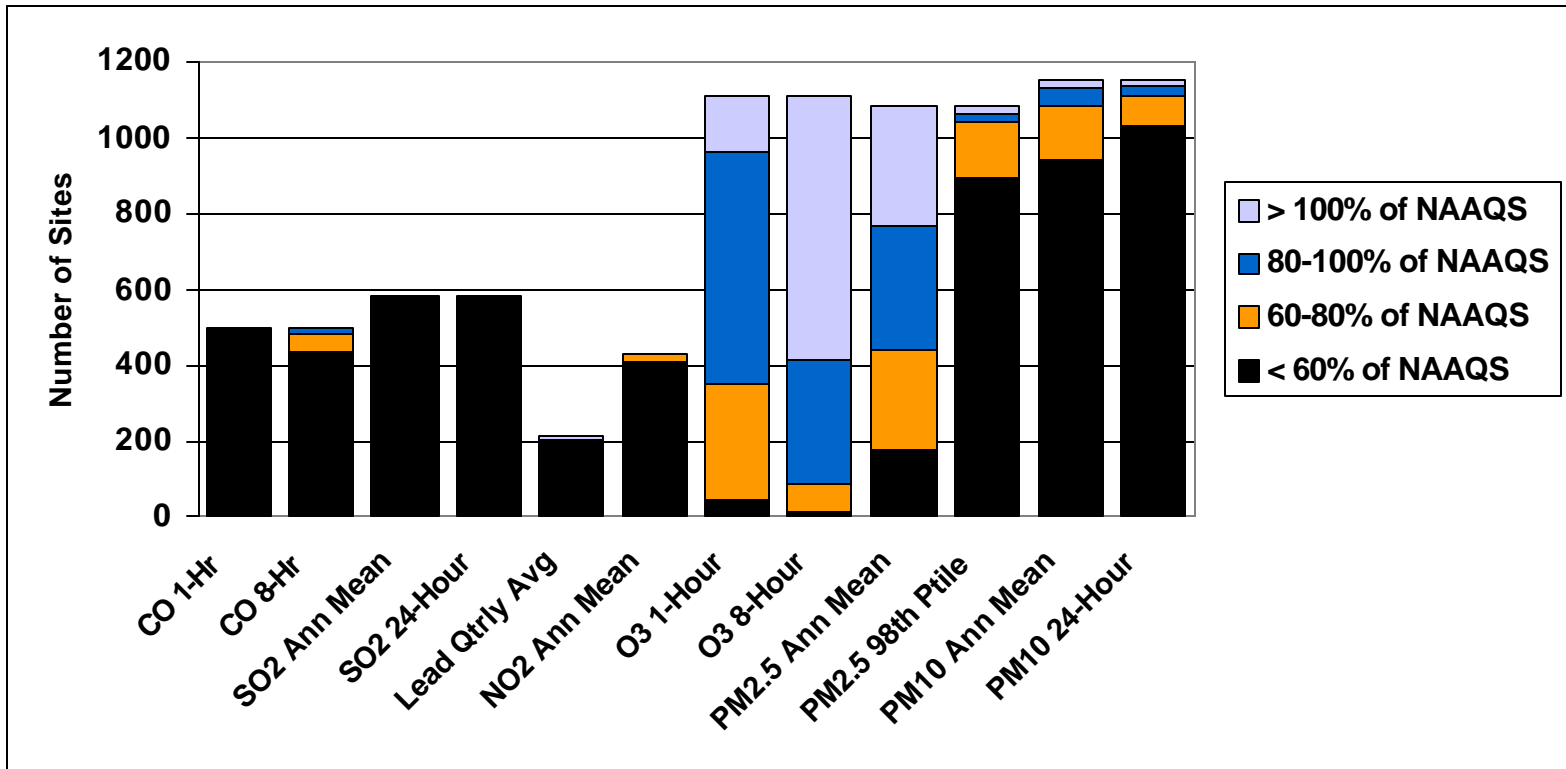
Pollutant	Averaging Time	Standard
CO	1-hour average	< 2 exceedences of 35 ppm per yr
	8-hour average	< 2 exceedences of 9 ppm per yr
SO ₂	1-hour average	Annual arithmetic mean < 0.03 ppm
	24-hour average	< 2 exceedences of 0.14 ppm per yr
	3-hour average	< 2 exceedences of 0.5 ppm per yr
Ozone	1-hour average	Expected # daily max 1 hr exceed 0.12 ppm < 2 times per year
	8-hour average	3-yr avg of annual 4 th highest daily max 8-hr < 0.08 ppm
NO ₂	1-hour average	Annual arithmetic mean < 0.053 ppm
PM _{2.5}	24-hour average	3-yr avg of annual averages < 15.0 ug/m ³
	24-hour average	3-yr avg of annual 98 th percentile < 65 ug/m ³

Many standards involve extreme observations and errors associated with extremes are different than errors in averages.

Some History of P&A Statistics

- The P&A developed in the early 80's centered on monitoring the uncertainty (precision or accuracy) of **individual measurements** at individual sites.
 - designed to look at range of expected concentrations, plus some extremes
 - assumed that the difference between “collocated” measurements increases with increasing concentrations, thus precision and accuracy are expressed as a ratio of the difference to the concentration
 - concluded if the variability is $\leq 10\%$, then approximately 95% of measured values are expected to be within 20% of the true value
- For PM_{2.5}, focus shifted to the **3-year average** of annual averages since this was the standard believed to be the more likely for sites to violate. Also at individual sites.
 - designed to look at errors in the 3-year average
 - also assumed the differences increase with increasing concentrations
 - concluded if the bias was kept between -10% and $+10\%$ and the coefficient of variation was kept $\leq 10\%$, then decision errors associated with the 3-year average were acceptable (like the 95% confidence above)

NAAQS Comparisons



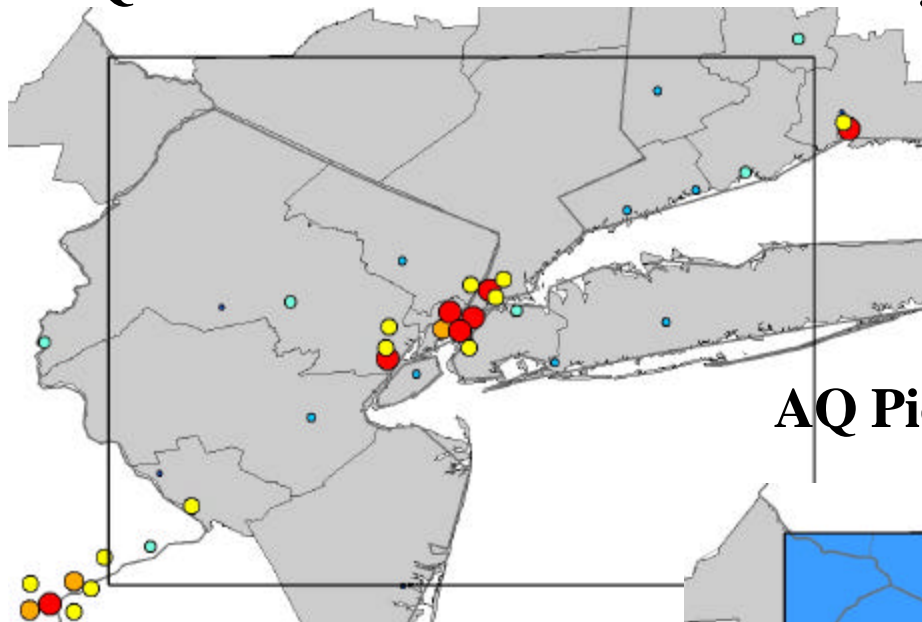
National Assessment results from 2001 (data from 98-00) available at:
<http://www.epa.gov/ttn/amtic/files/ambient/monitorstrat/natlanal.pdf>

Ramifications of concentrations below NAAQS?

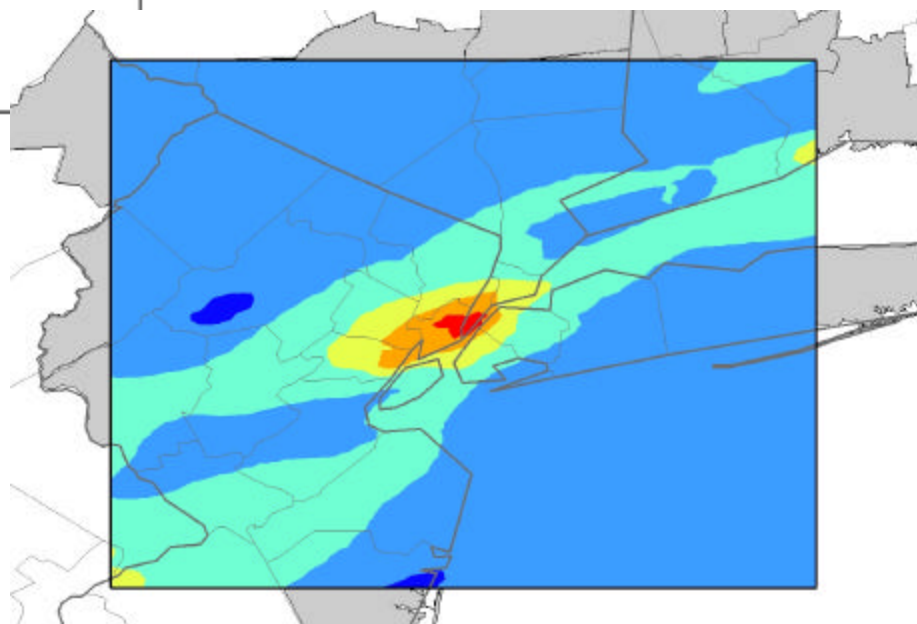
- In the National Monitoring Strategy, networks where levels of AQ are below standards are to shrink; monitoring focuses shifting to support other data needs
 - linkages to health studies
 - source apportionment
 - emission inventory evaluation
 - air quality simulation model evaluation
 - verification of impacts of control strategies
- Also in Strategy, there is call for mapping of air quality concentrations. This new data use emphasizes information from a group of sites instead of individual sites.
 - using multiple sites takes the “pressure” off individual sites, just like the annual average takes the pressure off individual hours or days
 - also can provide non-traditional ways of evaluating quality of data
 - for some examples...

See <http://www.epa.gov/ttn/amtic/files/ambient/monitorstrat> for more details about the monitoring strategy.

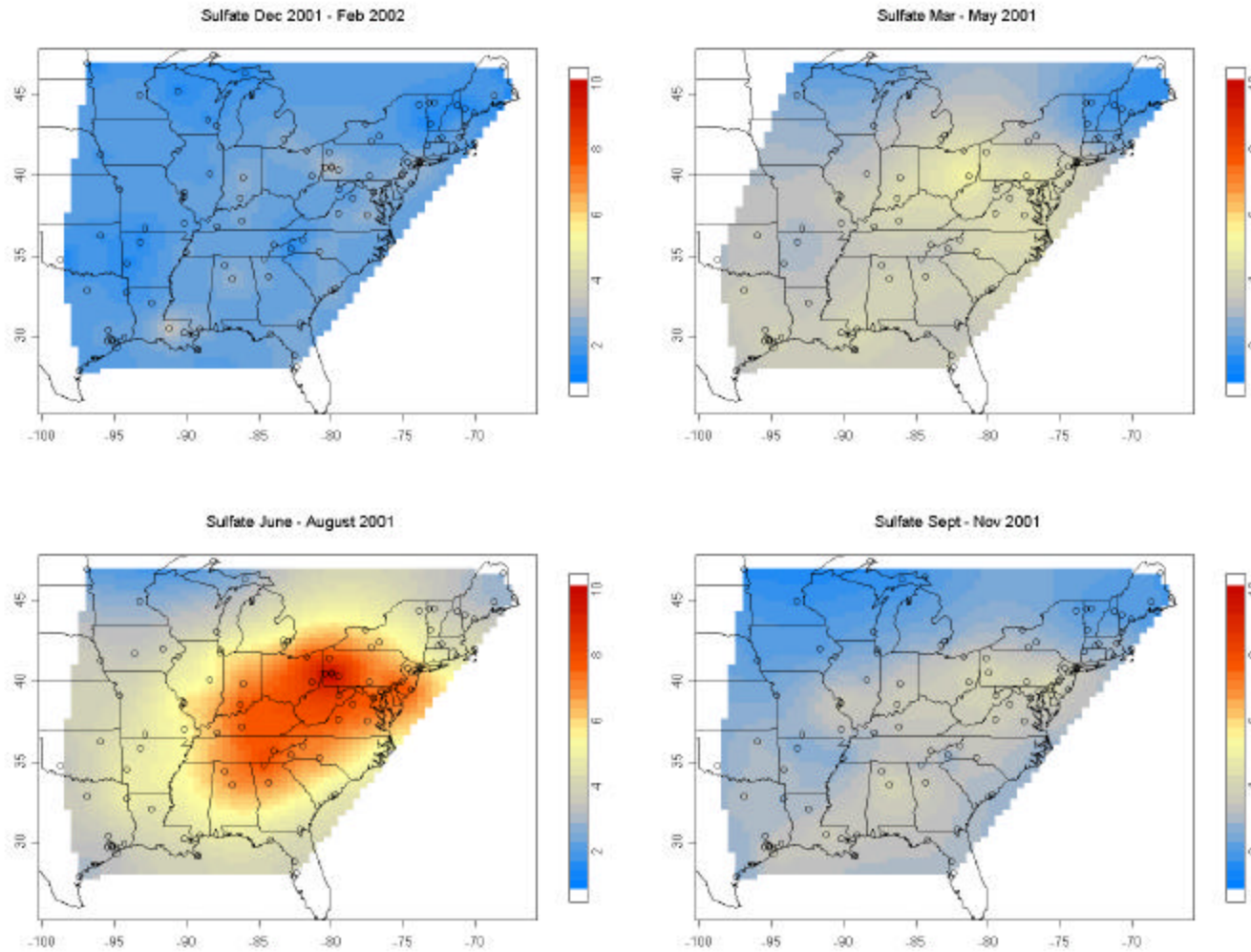
AQ Picture Based Just on Monitoring Data

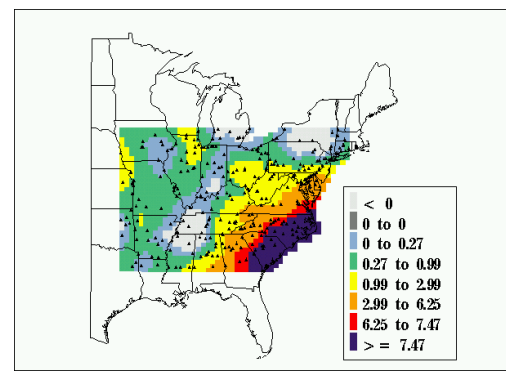
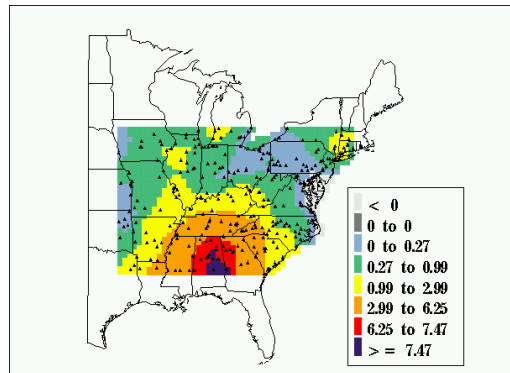
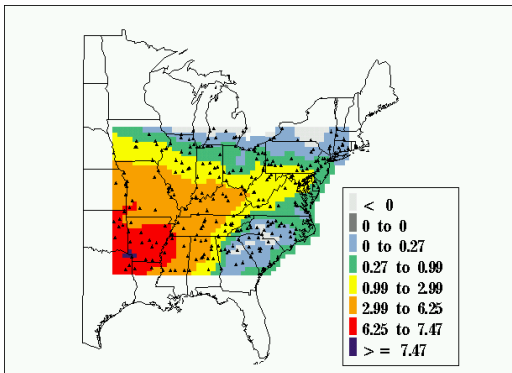
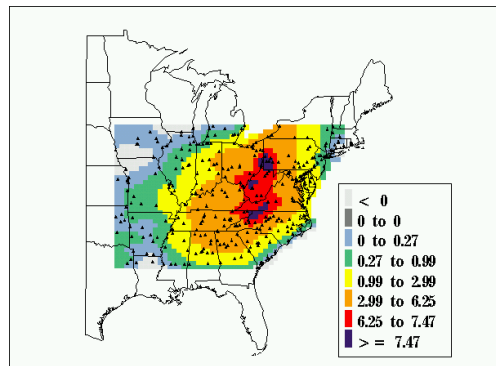
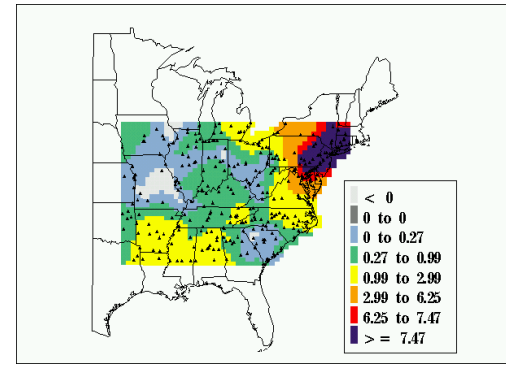
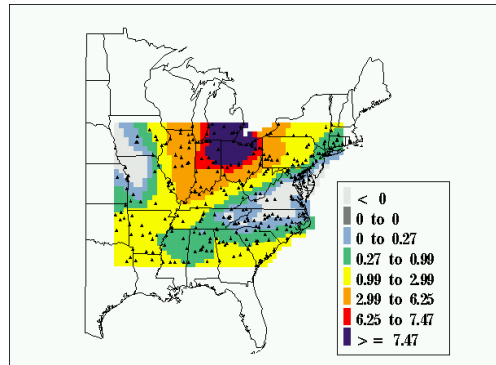
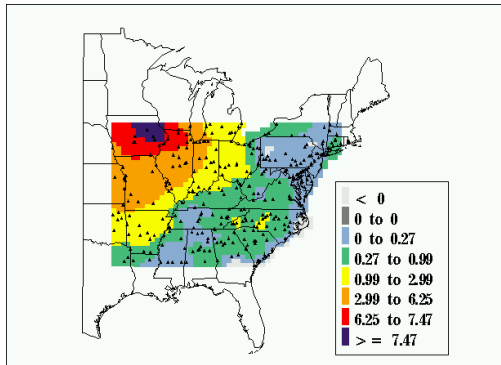


AQ Picture Using Spatial Model

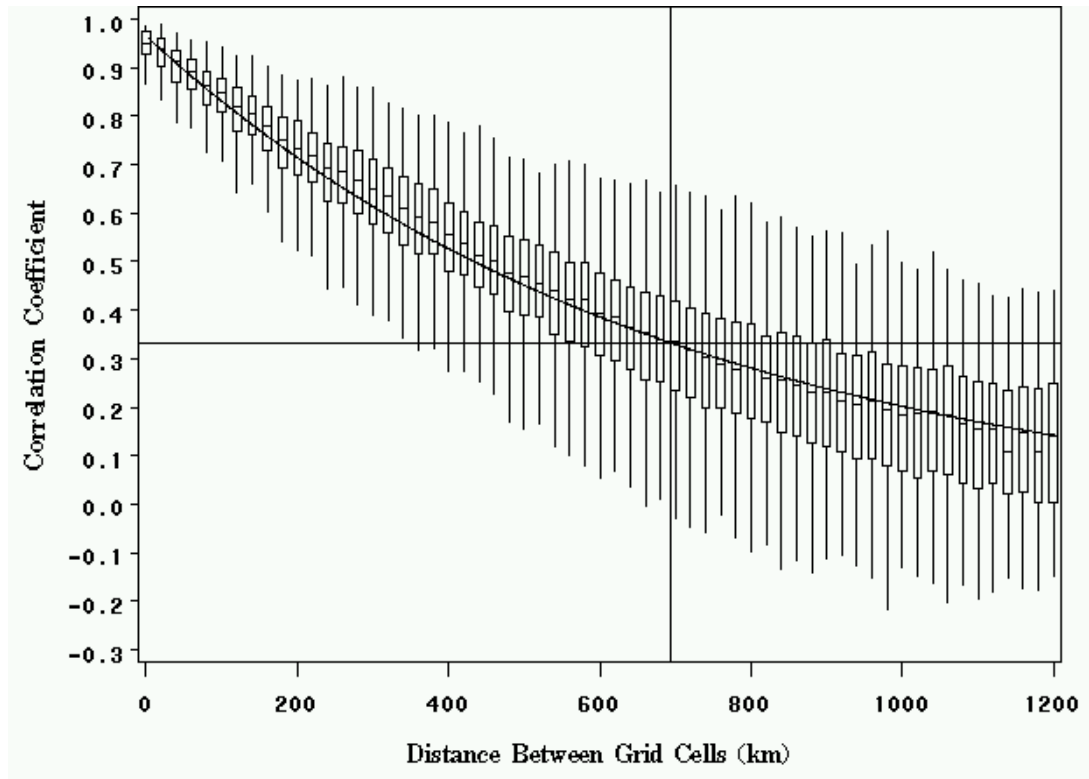


Seasonal Variation in Sulfate Concentrations





“Building Blocks” for 2000 PM_{2.5}, using Factor Analysis



Correlation coefficient between grid cells for 2000 PM_{2.5}.

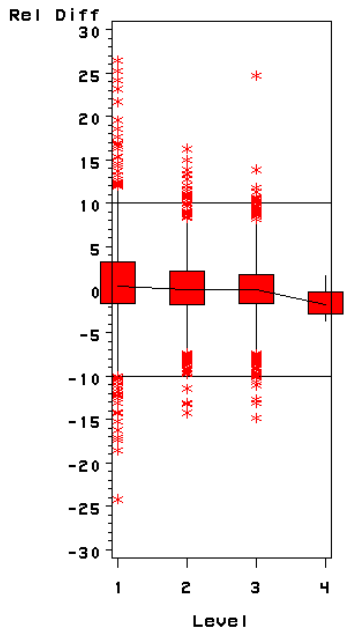
Next Steps

- With changing monitoring focuses, need to
 - Clearly define data uses.
 - Revisit acceptable levels of data quality.
 - Revisit statistics (P&A) used to evaluate/summarize that quality.
- Strive for consistency in this process
 - Data quality indicators are used in the DQO process; examples include repeatability of an instrument, systematic deviation from truth, amount of data available. Must be sure to implement a way to measure those data quality indicators.
 - Also need to summarize the data collected to evaluate the data quality in a manner that is consistent with what was used in the DQO process.
 - For simplicity and consistency, helpful to use the same data quality indicators across pollutants.
 - For simplicity and consistency, helpful to use the same statistics to summarize the data quality.

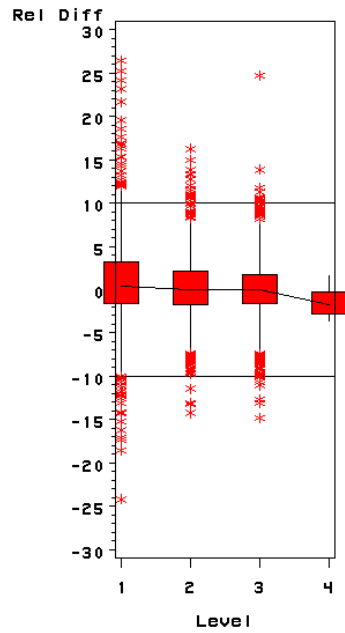
These Consistency Points may seem obvious,
but they are ever elusive!

In mean time, assess P&A relative to what currently in CFR

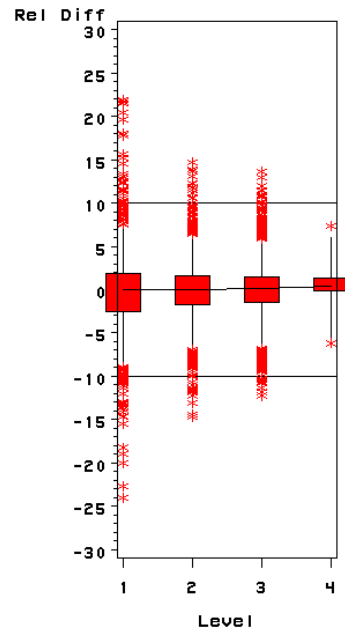
CO Relative Accuracy



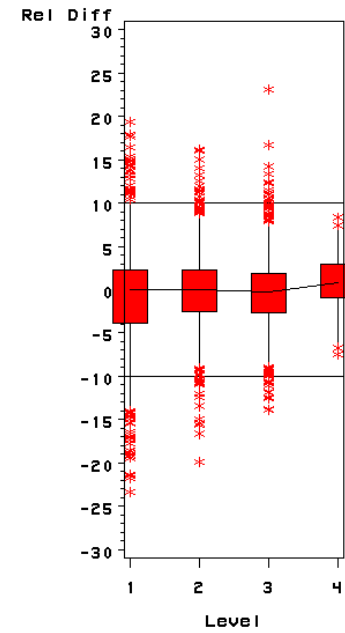
NO2 Relative Accuracy



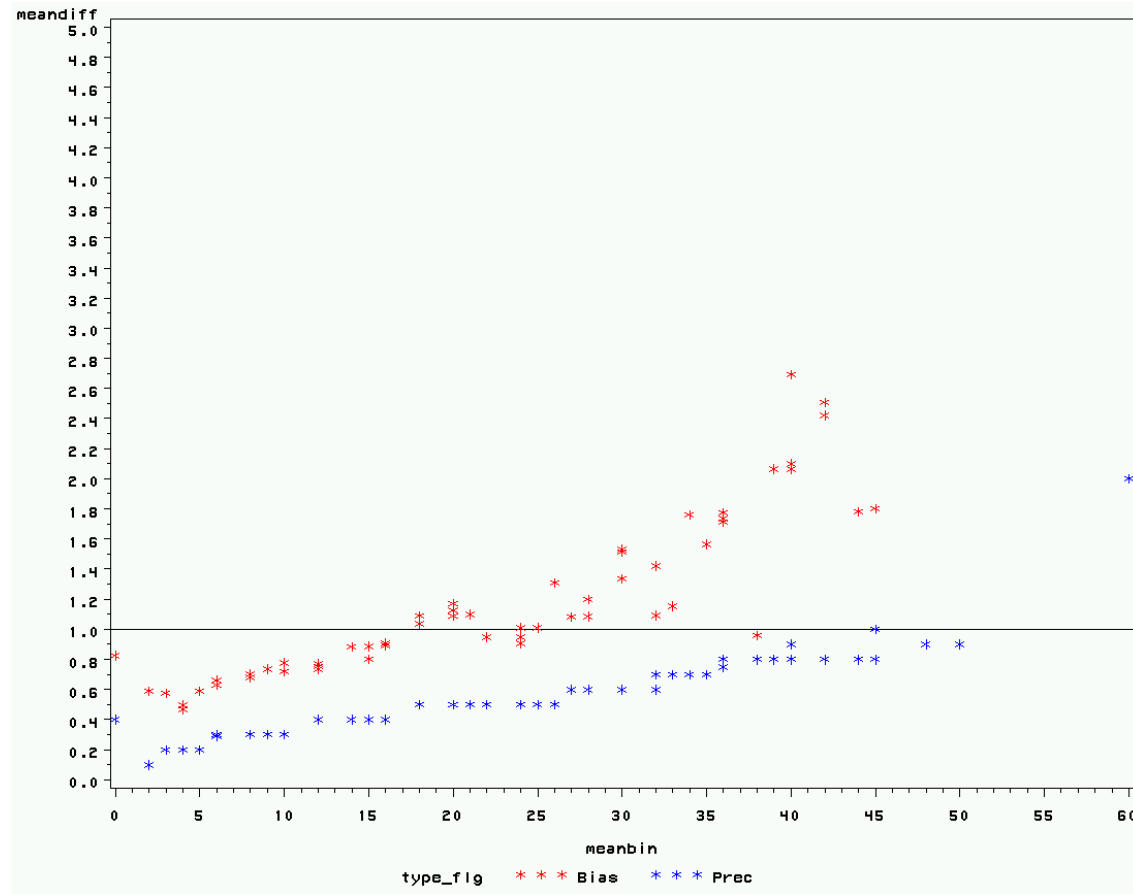
O3 Relative Accuracy



SO2 Relative Accuracy



PM2.5 Differences Relative to Concentrations



Note: 21% of bias pairs < 6 ug/m3 and 20% of precision pairs < 6 ug/m3.