8-Hour Ozone Data Quality Objectives

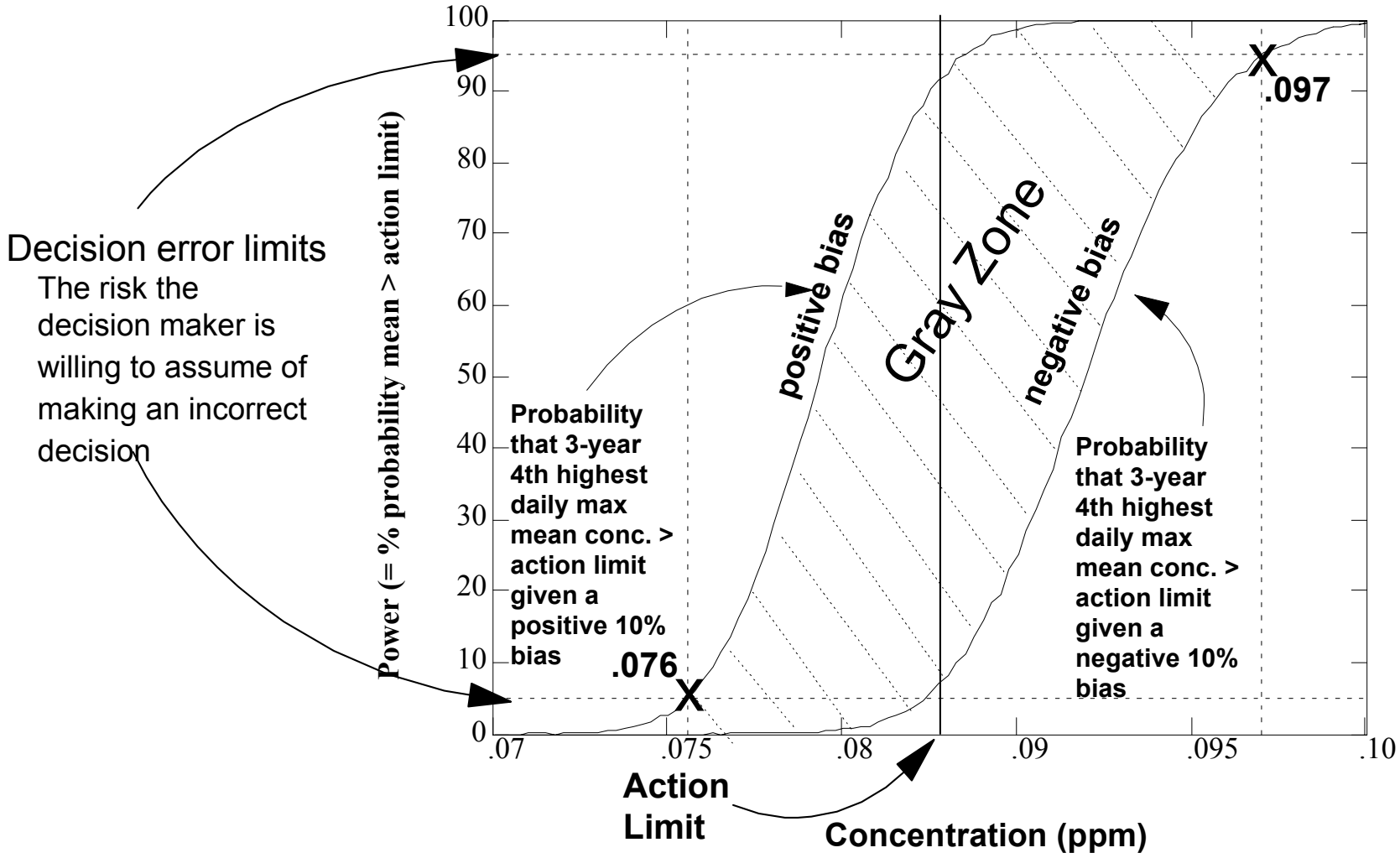
SAMWG

10/16/03

What are we here for & why now?

- What
  - Basic understanding of the DQO process
  - Agreement on proposed measurement quality objectives for precision and bias
- Why Now
  - Monitoring Strategy
    - Opportunity for review and revision of CFR (Nov. 03 draft for potential late 04 early 05 promulgation)
    - Did not rethink the QA requirements back in 97
    - DQO Endorsement –provides a rationale for the quality system requirements "Now we see why your asking us to do this"
  - Improved data quality
    - It's been awhile- the monitoring technology is better and the data quality is showing this. *("The +/- 20% calibration tolerance encourages sloppy practices by instrumentation technicians*" -Mims)

What is a performance curve?



Development of the 8-hour Ozone DQO

1. Aggregated 3 years (99-2001) of ozone data from ~1,125 sites
2. Reviewed data to identify the appropriate population distribution and population input parameters--Developed the ozone main simulation model
3. Reviewed measurement data quality indicators (precision, bias, completeness) and developed within-day module that adjusts the main simulation model
4. Calculate various decision performance curves depending on changes to input parameters

Population Input Parameters

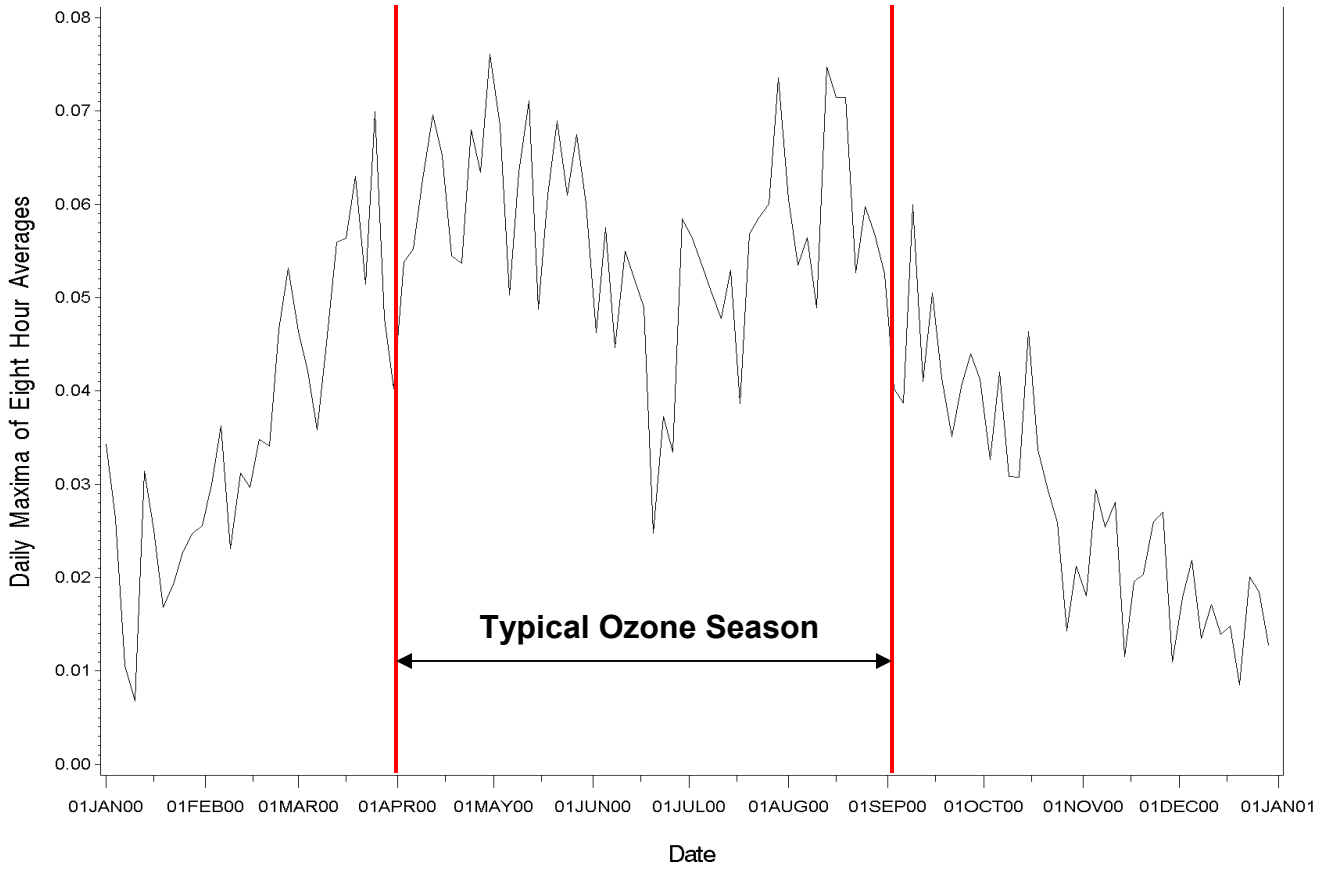
Seasonality Ratio- Ratio of high to low point on sine curve

Population CV - Variability of the population distribution

Autocorrelation – Similarity in concentration between successive days

Shift – The time at which ozone concentrations peak during the year

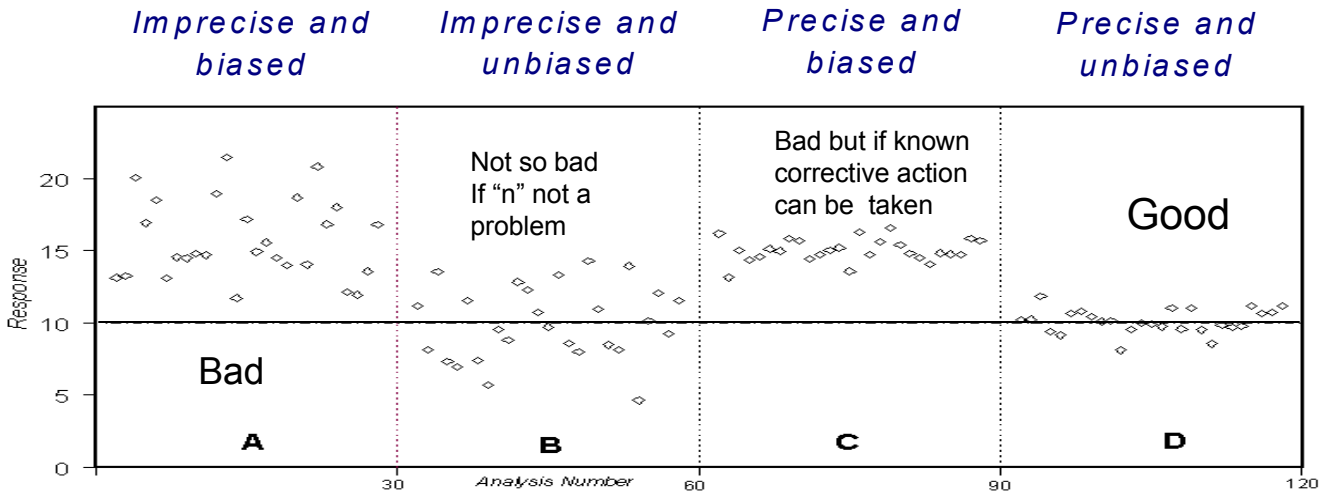
Typical time series of daily maximum 8-hour average ozone concentrations



Measurement Input Parameters

- Precision – Repeatability of the measurement system
- Bias – Systematic deviation from the true value
- Completeness- acceptable data loss on a sampling day (6 hours) and annual basis (75%)
  - completeness values (75% and 95%) were used

10 is Truth



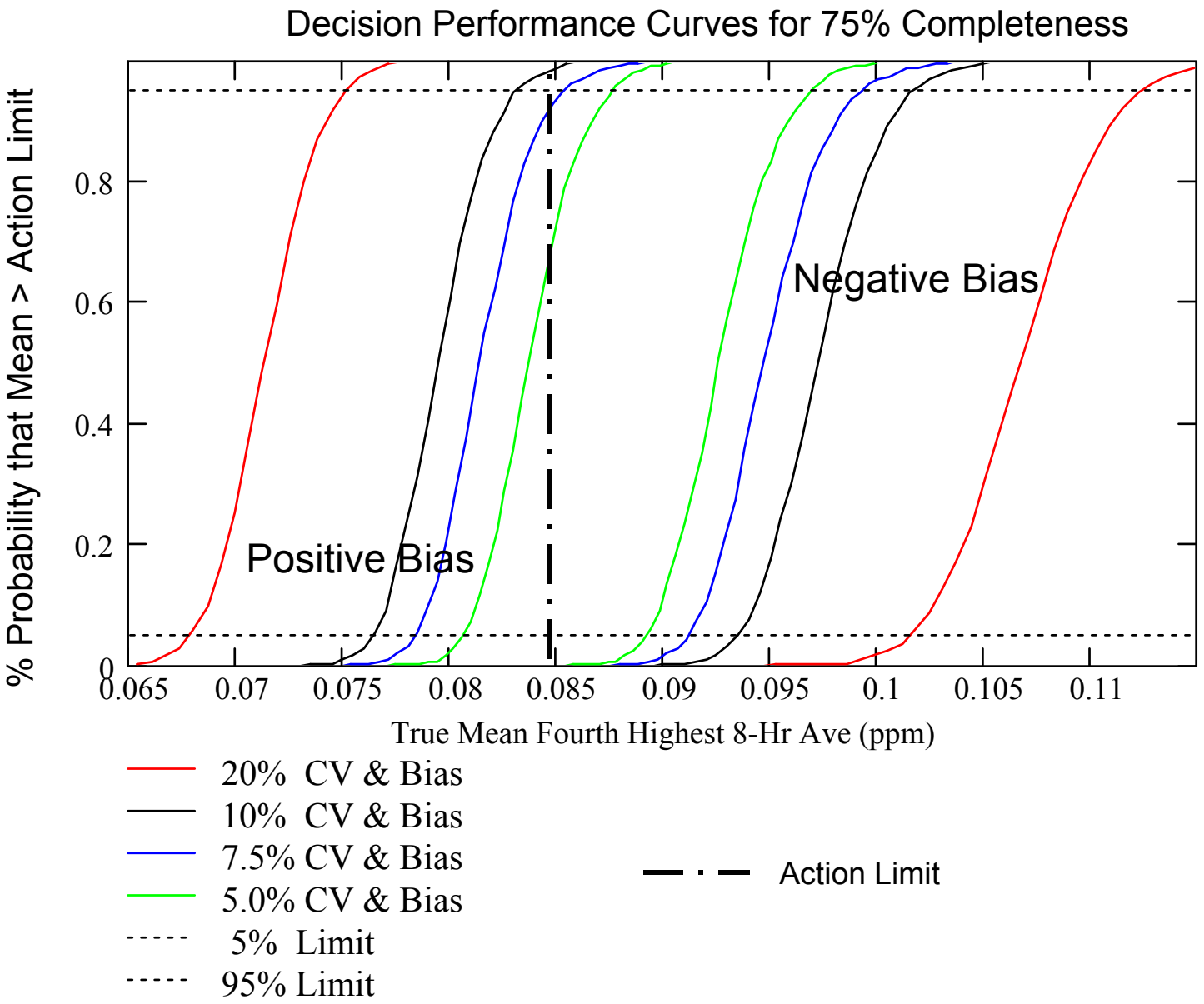
Selecting Input Parameters- Using the Conservative Approach

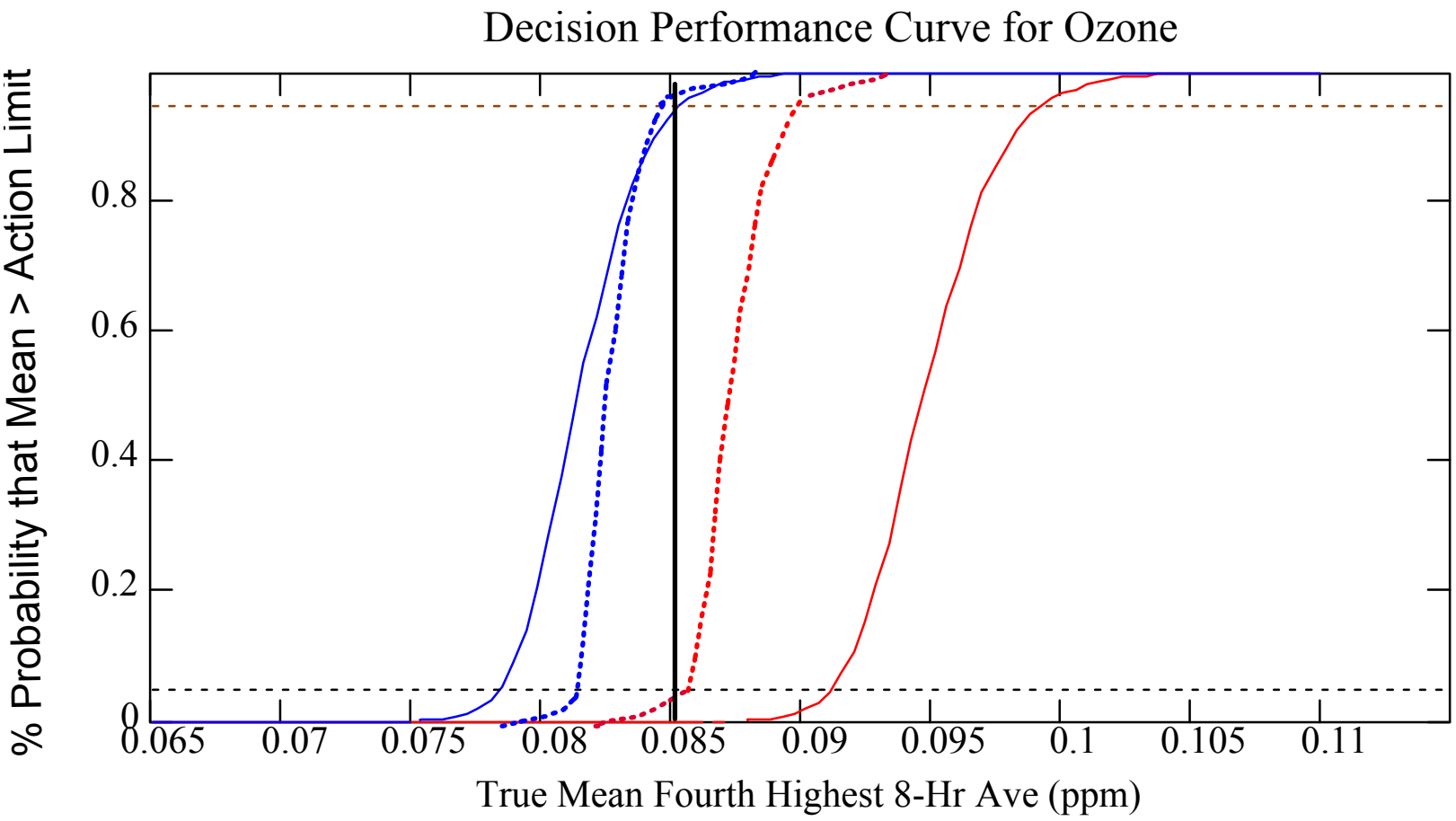
We selected input parameters that create the more extreme but realistic performance curves.

Percentiles of the Estimated Population and Measurement Parameters from the 3-Year Ozone Data Set

	Population Input Parameters				Measurement Parameters	
Percentile	**Ratio of High to Low Season**	**Population CV**	**Auto-Correlation**	**Expected date of peak ozone**	**Sampler Bias**	**Hourly Precision CV**
10	1.33	36% (43%)	0.17 (0.15)	7/27	1.23%	1.32%
20	1.49	34%	0.27	7/12	1.64%	1.69%
30	1.62	32%	0.34	7/6	1.98%	2.04%
40	1.76	30%	0.39	7/1	2.38%	2.38%
50	1.94	29%	0.44	6/27	2.72%	2.74%
60	2.14	27%	0.51	6/24	3.06%	3.10%
70	2.39	26%	0.55	6/20	3.51%	3.52%
80	2.79	25%	0.60	6/14	4.04%	4.00%
90	3.46 (3.5)	22%	0.67	6/3	5.00%	4.76%

For the performance curves the population input parameters were held constant, the measurement parameters are varied.


Decision Performance Curves for 75% Completeness
% Probability that Mean > Action Limit
0
0.2
0.4
0.6
0.8
0.065
0.07
0.075
0.08
0.085
0.09
0.095
0.1
0.105
0.11
True Mean Fourth Highest 8-Hr Ave (ppm)
Positive Bias
Negative Bias
20% CV & Bias
10% CV & Bias
7.5% CV & Bias
5.0% CV & Bias
5% Limit
95% Limit
Action Limit



Conservative Proposal
(.078-099 ppm)

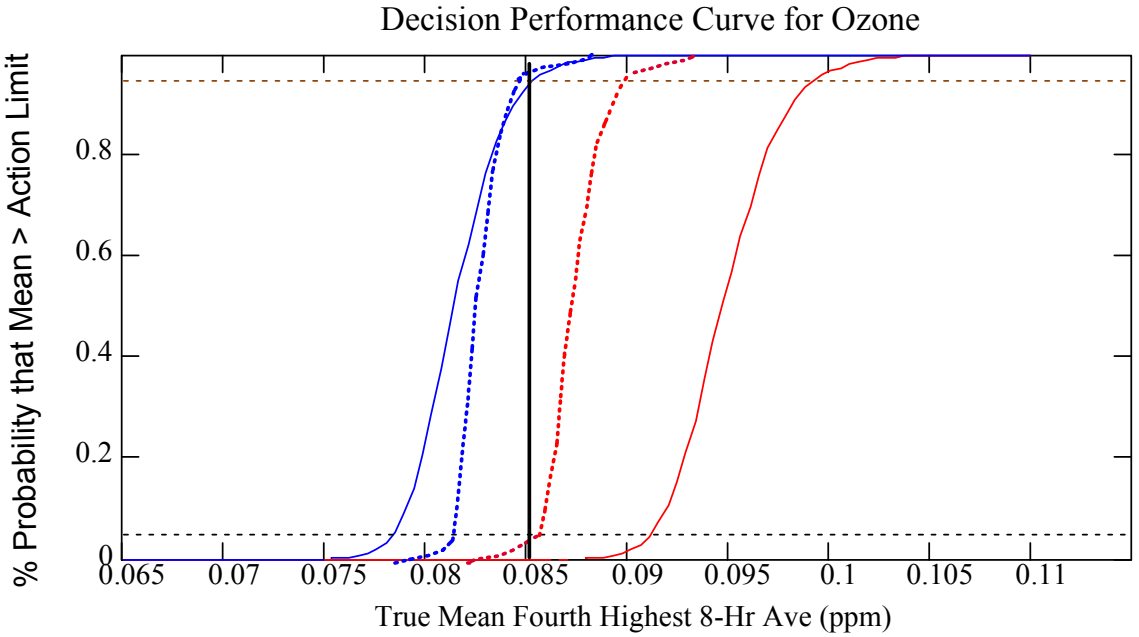
Bias 7.5
CV 7.5
Comp 75%
10/90 -Pop param.

More Typical Curve
(.080 - .090 ppm)

Bias 3.5
CV 3.5
Comp 95%
70/30- Pop. Param

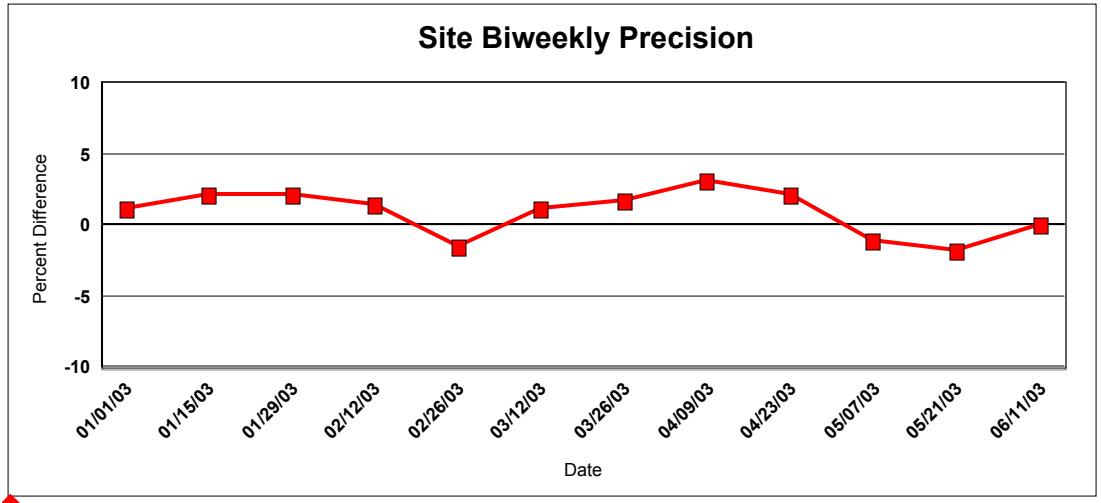
DQOs Summary

- Initial planning- can be used to help understand data quality impacts on:
  - The level of the standard
  - The form of the standard
  - Optimize network designs (number of sites, sampling frequency etc.)
- Ongoing monitoring implementation
  - Provides an excellent assessment tool for achievement of data quality
  - Provides a way to focus on quality system improvements as well as site specific improvements

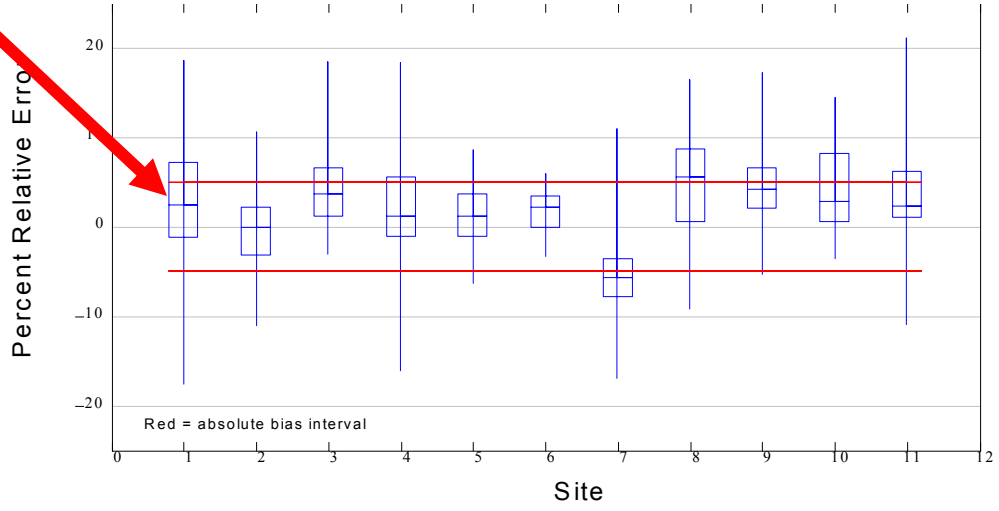


Steps to Data Assessment

1) Site level
   a) Individual value
   b) Trend



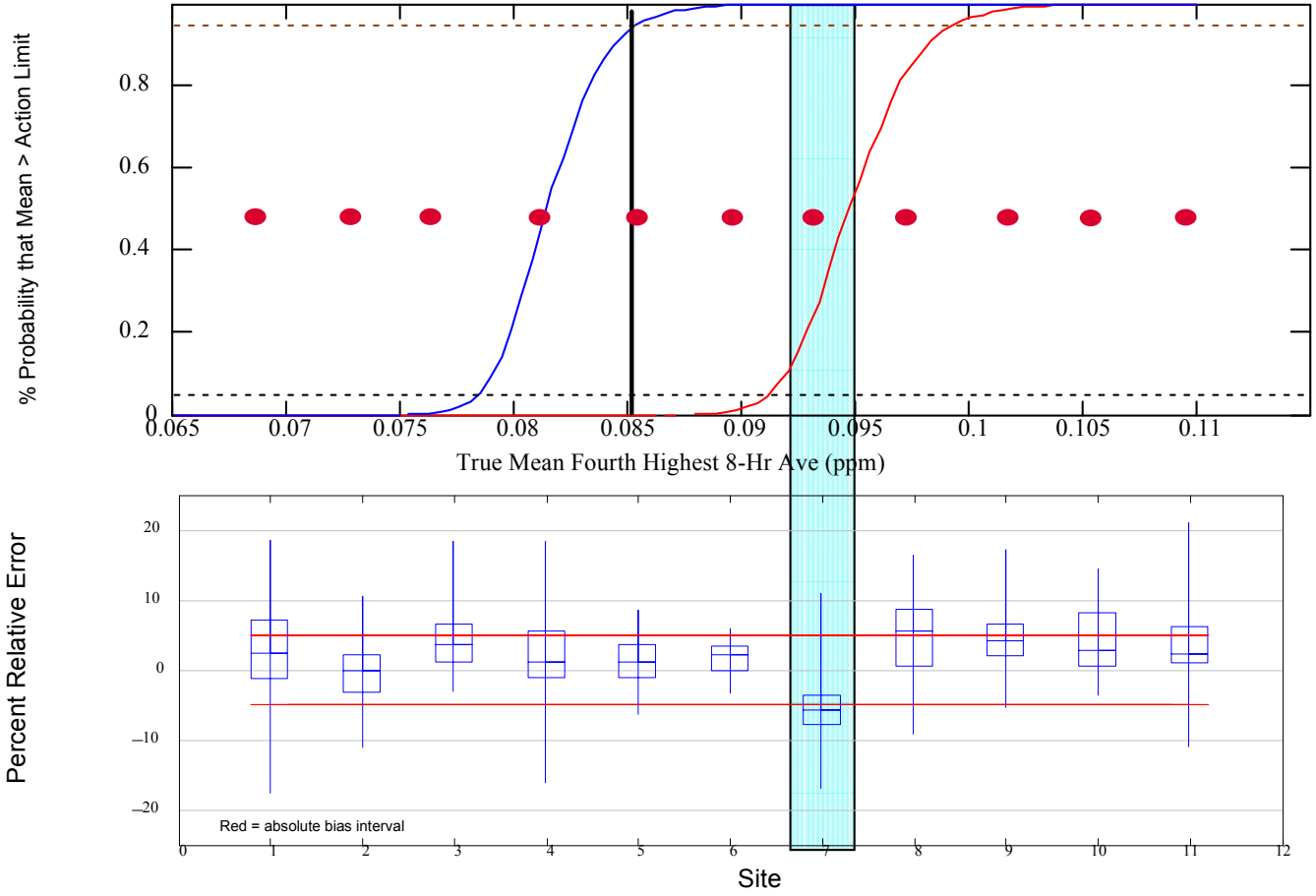
2) Site/Reporting Organization
   a) Yearly
   b) 3 year



3) Assessments related to the DQOs

Ozone CY 99-01 Data Quality Objective Parameters

State	Rep. Org	Siteid	Ave Conc. ppm	Season Ratio	Pop CV (%)	Autocor.	Complete.	Bias CL	Precision CL	99-01 Gray Zones	Gray Zone Within DQO
AK	15	20200018	0.066	1.33	25	0.27	0.90	2.7	7	(.078 - .093)	Yes
AK	15	20200044	0.074	1.37	23	0.34	0.94	-0.4	4.5	(.0789- .090)	Yes
AK	15	20900010	0.076	1.62	33	0.60	0.83	4.2	3.7	(.081 - .089)	Yes
AK	15	21100004	0.080	1.76	23	0.25	0.89	2.6	6.2	(.078 - .093)	Yes
AK	15	21700014	0.084	2.14	21	0.34	0.85	1.4	3.2	(.0789- .090)	Yes
AK	15	21700008	0.089	1.67	34	0.52	0.88	1.7	2.5	(.081 - .089)	Yes
AK	15	22900003	0.092	2.39	36	0.34	0.76	-5.6	4.7	(.078 - .093)	No
AK	15	21100005	0.096	2.19	22	0.25	0.89	4.6	6.3	(.0789- .090)	Yes
AK	15	21700007	0.101	1.24	32	0.34	0.85	4.8	5.2	(.081 - .089)	Yes
AK	15	21700022	0.104	2.22	12	0.52	0.88	4	4.4	(.078 - .093)	Yes
AK	15	22900004	0.108	3.46	33	0.34	0.76	3.7	5.8	(.0789- .090)	Yes



DQOs Summary

- Are not used to invalidate data
  - Precision and bias QC checks can fail the MQOs without invalidation
- Identifies the probability of decision errors not the fact that these errors have occurred.
- Proposed
  - 5% decision error rate
  - 7% precision and bias MQO
  - 75% Completeness

Performance Curve Gray Zones

Measurement Input Parameters				Gray Zone (ppm)	
Daily Completeness	Minimum Hours per day	Hourly Measurement Precision (CV)	Measurement bias	Lower end point	Upper end point
95%	18	7.5%	7.5%	0.077	0.095
		10%	5%	0.078	0.093
			10%	0.075	0.098
			20%	0.069	0.110
		15%	5%	0.078	0.092
			10%	0.074	0.097
			20%	0.068	0.110
		20%	5%	0.076	0.091
			10%	0.073	0.096
			20%	0.066	0.108
75%	18	7.5	7.5	0.078	0.099
		10%	5%	0.080	0.096
			10%	0.076	0.102
			20%	0.070	0.114
		15%	5%	0.079	0.096
			10%	0.075	0.101
			20%	0.069	0.114
		20%	5%	0.078	0.095
			10%	0.074	0.100
			20%	0.068	0.112

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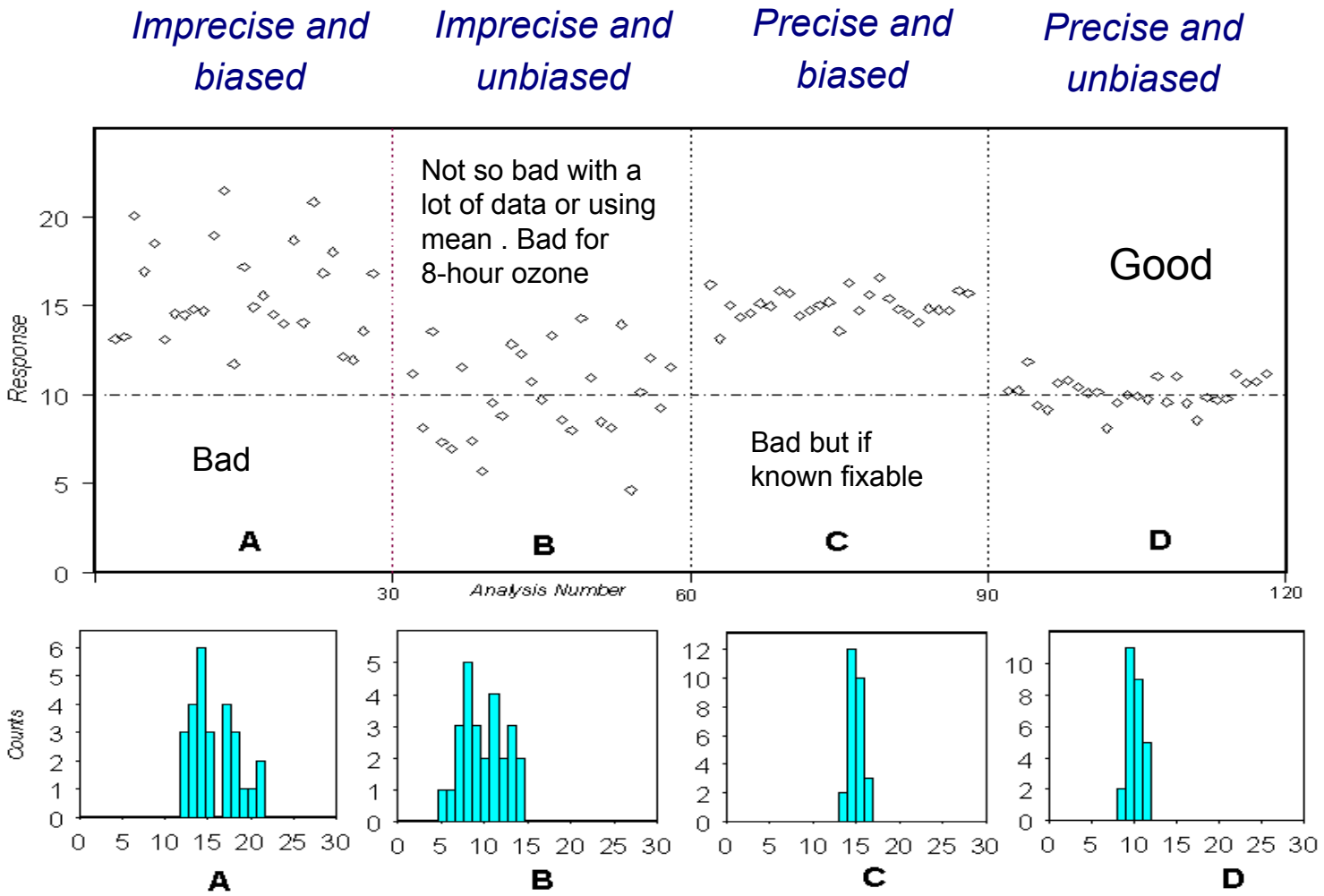
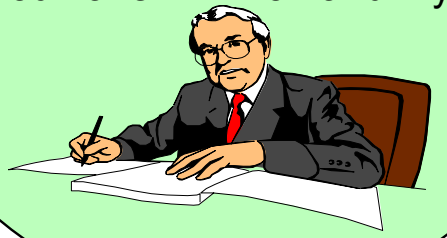
Relationship Between Bias and Imprecision on Data Quality



Why do we need DQO's?

Decision Maker

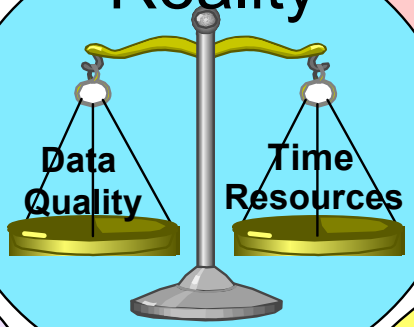
I want the right answer!
You have 1 million and 1 year



Technical Manager

I'll use the very best equipment for the best precision and accuracy

Reality

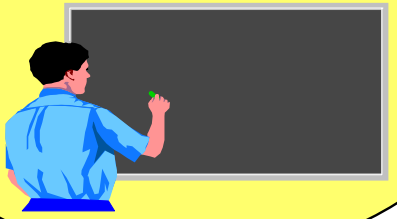


QA Manager

I'll try to ensure that the precision and bias are near zero

Statistician

Give me all the samples you can.
I don't want to make any assumptions



DQO Process Promotes Communication/Collaboration

Problem
Decision
Error Tolerance
Resources
Time

Methods
Expertise
Logistics
Implementation

DQOs
Quality system development
Measurement quality

Uncertainties
Statistical sample design
Achievable error limits

DQOs

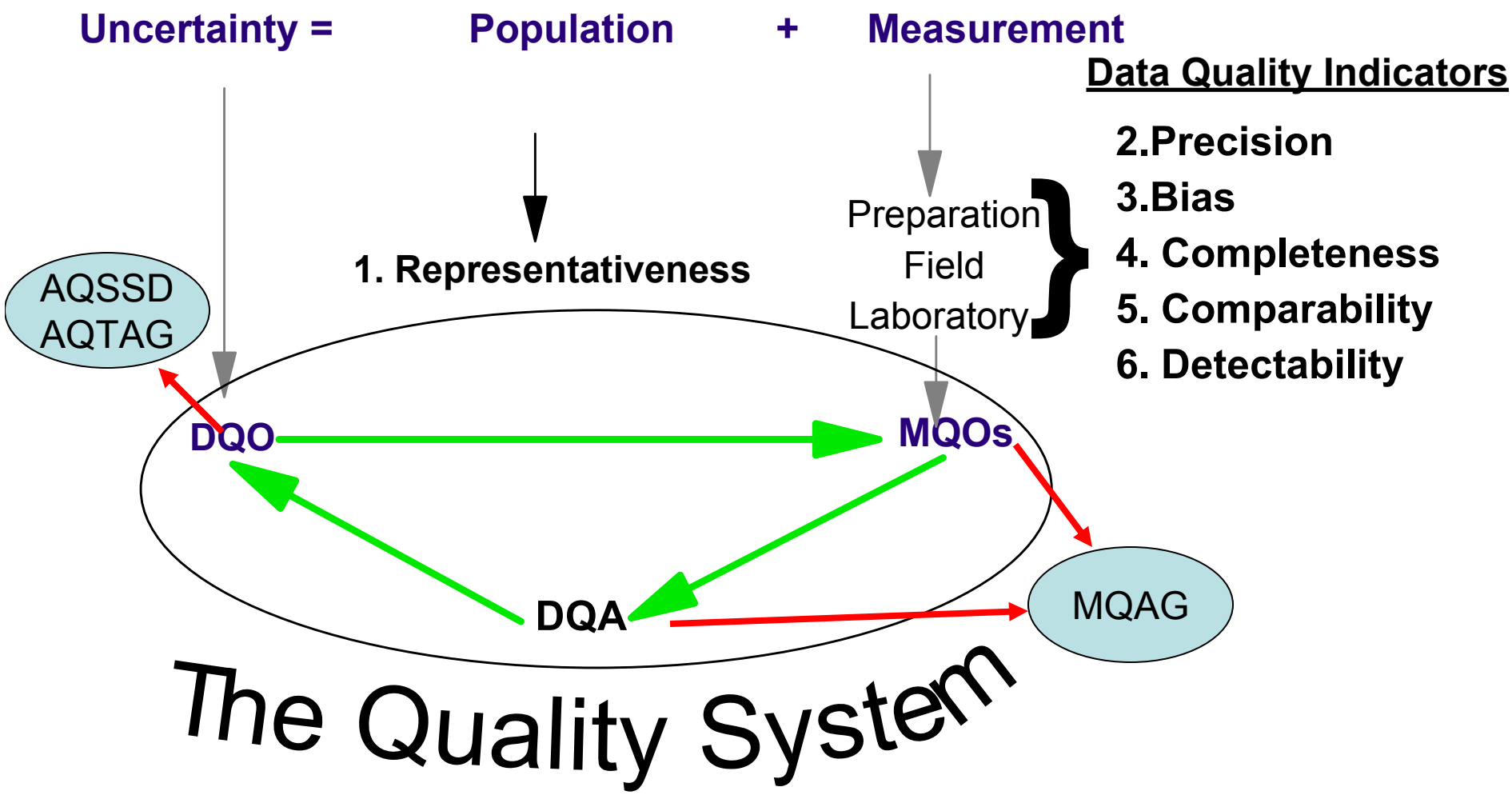
A process for ensuring that environmental data will be adequate for their intended use

Problem

Resource Effective Data Collection Design

- State the Problem
- Identify the Decision
- Identify Inputs to decision
- Define the Boundaries
- Develop the Decision Rule
- Specify Tolerable limits to Decision Error
- Optimize the design

Understanding and Controlling Uncertainty in Order to Minimize Decision Errors



OZONE OPERATIONAL CRITERIA TABLE

Criteria	Acceptable Range	Frequency
Shelter Temperature		
Temperature range	*20 to 30° C* or Instrument must be operated per manufacturers specifications **(see note D Below)**	Daily (hourly valu
Temperature control	# 2°C SD over 24 hours	Daily
Accuracy		
Single analyzer	None **(See note C)**	25 % of sites
Annual accuracy	95% Confidence Interval# ± 20%	*quarterly (all sites ye*
Compressed Gases		
Zero air	Free of any substance that might react with ozone	
Calibration		
Multipoint calibration (at least 5 points)	Linearity error <5%	Upon receipt, adjustr or 1/year if cont. zero/s 1/ 6 months if man zero/span
Precision		
Reporting organization	*95 % Confidence Interval # ± 15 %*	*1/3 months*
Performance Evaluation		
Federal audits	Mean absolute difference # 15%	*1/year at selected s*
State audits	State requirements **(see note E below)**	1/year