



A New Conceptual Approach

Outline

- Goal
- Present Concept
- Problems
- New Concept
- Advantages
- Approach
- Network Design
- Example Application

Basic Goal

Produce a complete SPATIAL picture of air quality in a cost effective manner with acceptable uncertainty

Present Concept

- Air Quality Data (AQD) are truth (no uncertainty)
- **BUT:** Where there are no monitors there is no information

Problems With the Present Concept

- AQD "truth" is simply what a monitor recorded at a specific place and time. Its relevance and certainty depend on its use and instrument error.
- We use monitored AQD to represent unmonitored areas (i.e., 10 ft. from the monitor) WE ESTIMATE!
- To use AQD we must create a spatial picture (implicit interpolation) e.g.:
 - AQD are representative of the entire area of the county in which they are taken
 - AQD provide no information outside the county in which they are taken
- For a complete spatial picture monitors are needed everywhere (including counties that have monitors) -network optimization is meaningless
- Disincentive to monitor

New Concept

- Air Quality Concept:
 - Actual monitored or estimated (kriged) air quality are the same except for uncertainty
 - Define air quality as a estimated field of actual concentrations and their associated uncertainties
- Estimate Actual Concentration Field:
 - AQD are simply a sample of the "Actual" air quality
 - AQD are used as input to an interpolation model (kriging) to estimate the actual concentration field
 - Use area modeling to establish the best variogram for kriging
- Estimate uncertainty using area modeling

Advantages to New Concept

- The complete field of air quality is available for policy development, trends analysis, etc.
- The estimated concentration field is robust
 - Changes to an optimized network should not significantly affect the estimates
 - Lack of county monitors does not result in NO data
- Removes monitoring disincentive
- Provides a direct blueprint for developing optimal cost-effective networks

Approach:

- Constructing actual concentration field:
 - Produce a BENCHMARK concentration field from area modeling (modeling data must adequately characterize important features of the field)
 - Establish the best variogram model for the area using the benchmark data
 - Estimate, through kriging, the actual concentration field using:
 - The variogram model constructed from the benchmark data
 - All available monitored air quality values both within and outside the area





1999 Ozone Design Values: Kriged Contour Map



Approach (cont.):

- Constructing uncertainty field
 - Develop a subset of the benchmark (modeled) data from monitor locations only
 - Estimate the actual concentration field by kriging the benchmark data subset
 - Compare the full benchmark field with the estimated field from the benchmark subset
 - Construct a field of residuals (the uncertainty field)

BENCHMARK Data Set 4th High 8hr. Ozone: UAM-V Model Output 1996 Emissions Inventory 30 Days of 1995 Met



Constructing Data Subset (modeled values at monitor locations) from Benchmark UAM-V Modeling





Network Design

PREMISE: An optimum network is one that produces minimum uncertainty for acceptable resource demand.

GENERAL APPROACH:

- Develop a benchmark (modeled) concentration field
- Construct various data subsets from the benchmark data (i.e., network designs)
- Estimate (krig) a concentration field for each network design

Network Design (cont.)

- GENERAL APPROACH (cont.):
 - Compare each estimated field to the benchmark field
 - Choice the best design: establish point of diminishing returns
 - Example:
 - Existing Network Corr Coeff = .89
 - Add monitor: Albemarle county Corr Coeff = .90
 - Add Albemarle & Harrison county Corr Coeff = .91

Existing Network (Corr Coeff = 0.89)

MONRO

CRAIG

Add Albemarle (Corr Coeff = 0.90)

0.78



LYNCHBURG

APPOMA TIOX

PRINCE FOWA

Ratio of Kriged to Benchmark:

Black = Present Network; **Red = + Albemarle**; **Blue = + Harrison**

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Network Design (cont.)

Plan for Optimizing Present Network

- Develop appropriate benchmark data set (use existing modeled data if possible)
- Develop the best variogram model for kriging
- Develop optimization criteria
 - Comparison statistics: Correlation Coefficient; Maximum residual; Etc.
 - Resource demand
 - State preference
 - Etc.
- Compare Benchmark with estimated "present network" field : establish baseline stats.
- Optimize Network
 - Create potential new network
 - Examine uncertainty (residual) fields
 - Remove &/or add monitors
 - Compare new network with Baseline
 - Iterate to find optimal network

Application of New Approach

- Use of Interpolated AQ for Region III 8hr. Ozone Attainment Designations
 - PROCEDURE:
 - Estimate 1999 8hr. Ozone design value for all counties
 - Establish uncertainty field (benchmark kriged)
 - UAMV modeled 4th high 8 hr. average
 - 1996 base emissions
 - 30 days met 1995 several episodes
 - Weight estimate by uncertainty
 - The larger the residual the less weight the given to the estimate
 - Consider counties with monitors to be considerably more reliable than counties without (to reflect present EPA bias)