Statistical and Geostatistical Services

Statistical Analyses

Based on the nature, distribution, and regulatory needs of environmental data, select and apply the most appropriate evaluation strategies and statistical procedures.

- Parametric or nonparametric analyses
- Comparison of multiple populations
- Analysis of trend for time series data
- Evaluation for detection, compliance, or corrective action monitoring
- Sample design and power analysis

Geostatistical Analyses

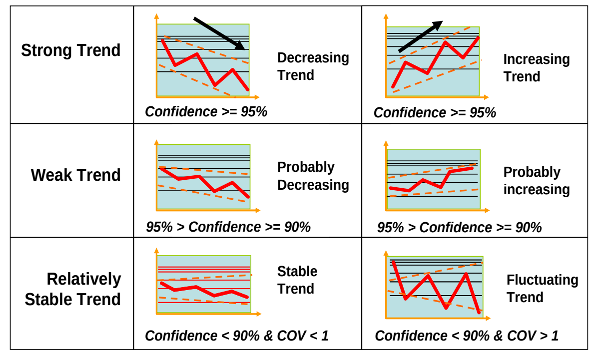
Analyze the spatial structure or correlation of environmental data to provide guidance for spatial mapping, uncertainty assessment, and sample design.

- Semivariogram modeling and kriging
- Performance evaluation for different interpolation methods in spatial mapping
- Assessment and reduction of the uncertainty in spatial mapping
- Sample design to locate hot spot or develop site-specific concentration criteria

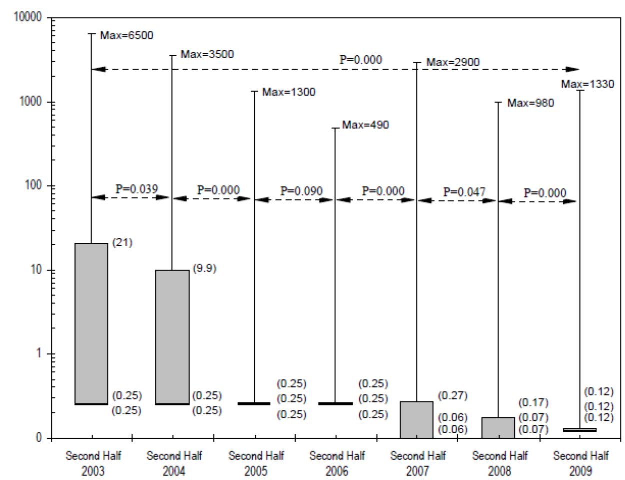
Monitoring Program Optimization

Optimize an existing monitoring network and its frequency of sampling to increase the efficiency and effectiveness of the monitoring program

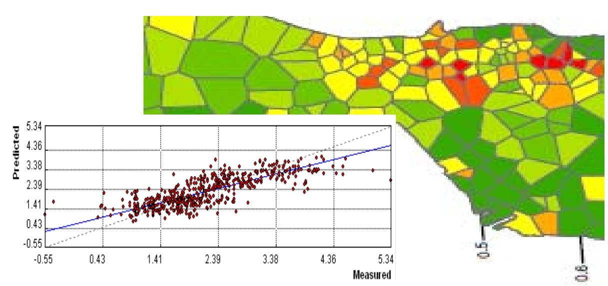
- Spatial and temporal analyses of historical monitoring data
- Redundancy reduction or augmentation of inadequate monitoring
- Developer of optimization methods for the *AFCEE MAROS* software



Classification of Concentration Trends



Box-Whisker Plot with Sign Test p-Value



Sediment PCBs by Thiessen Polygon

The AFCEE MAROS Software Start Page

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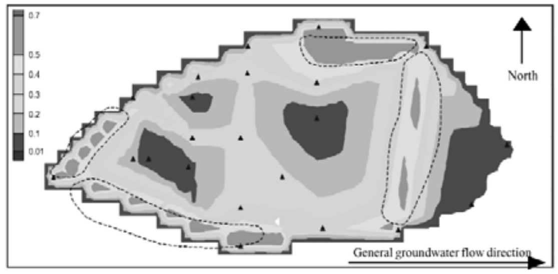
Monitoring Program Optimization

Statistical and Geostatistical Services

Introduction

AME's monitoring program optimization (MPO) quantitatively evaluates the technical value of monitoring wells at a site, and optimizes the monitoring well network for practical effectiveness. Significant and substantial benefits are achieved by monitoring program optimization, including cost savings, increased safety, and reduced site disruption. MPO optimizes both the number of monitoring wells and the frequency of sampling, so results are both immediate and long term.



Well Importance Map generated from the Delaunay Triangulation Analysis

The Challenge

Most monitoring wells are installed during the characterization phase of an environmental program when hydrogeologic understanding and plume delineation are incomplete. As site progress occurs, the vertical and lateral extent of contamination becomes delineated and remedial actions may be initiated. As a result, ineffective monitoring wells, which may have been beneficial in the early phases of the project but have become technically lower in value, are typically discovered.

Ineffective monitoring wells are typically characterized by low or non-detectable concentrations, stable or decreasing concentration trends, and other monitoring wells in close proximity. At many sites, low-value monitoring wells constitute over 20 percent of the total well network. Similarly, the frequency of sampling can be higher than is technically needed to adequately monitor site conditions. Inefficiencies in the monitoring well network and the frequency of sampling result in increased costs and increased worker safety risks. Specifically, increased costs result from unnecessary chemical analyses, the production of unwarranted waste, and excessive labor and materials. Ineffective monitoring programs also increase the potential risk exposure of workers in the field.

Our Solution

AME's MPO quantitatively evaluates the value of each monitoring well in a monitoring network as well as the adequacy of their frequency of sampling. Specifically, AME's MPO consists of three phases:

1) Site and historical evaluation – uses general statistics, concentration trends, and visual imagery to evaluate the stability of contaminant plumes, remediation performance, and conditions of the existing monitoring program.

2) Statistical assessment – uses the Delaunay method to define the relative importance of each monitoring well within the network and the Modified CES method to analyze the sampling schedules (these analyses have been supported by the U.S. EPA and other nationwide regulatory agencies). The monitoring program is optimized by removing the most redundant wells from the network and lowering the sampling frequency.

3) Comprehensive evaluation – results of the analyses are evaluated with respect to site regulatory and technical requirements to produce an optimized network with more appropriate sampling schedules.

The optimized program is technically equivalent to the existing program but smaller spatially and more efficient temporally. The resultant savings may be accrued throughout the life of the project. From decreased worker risk to lower costs, AME's MOP produces real benefits.

AME
Engineers and Earth Scientists

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