SAND2007-6013C

Coordinated Panel Session

Sampling Strategies for Characterization and Clearance

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Accounting for Spatial Variability in Sampling Design

Spatial Design Considerations

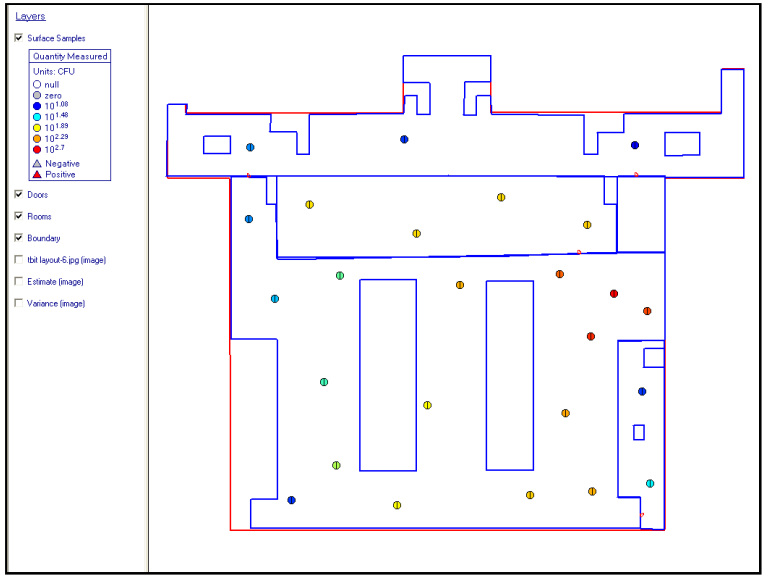
- **Statistical design methods only indirectly account for spatial variability on a very coarse scale.**

- **Geostatistical techniques developed for the mineral/oil/gas industries have been used successfully in the environmental arena to address the spatial distribution of contaminants**

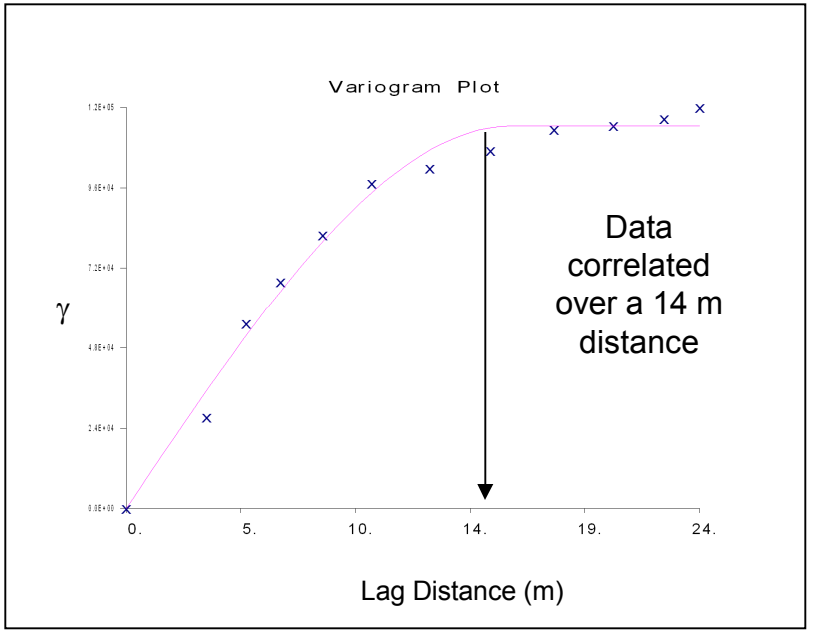
- **Coupled with optimization routines, these techniques offer a potential to decrease the number of samples needed to characterize or clear an area compared to traditional statistical methods**

Spatial Variability

- **Geostatistics accounts for spatial variability**



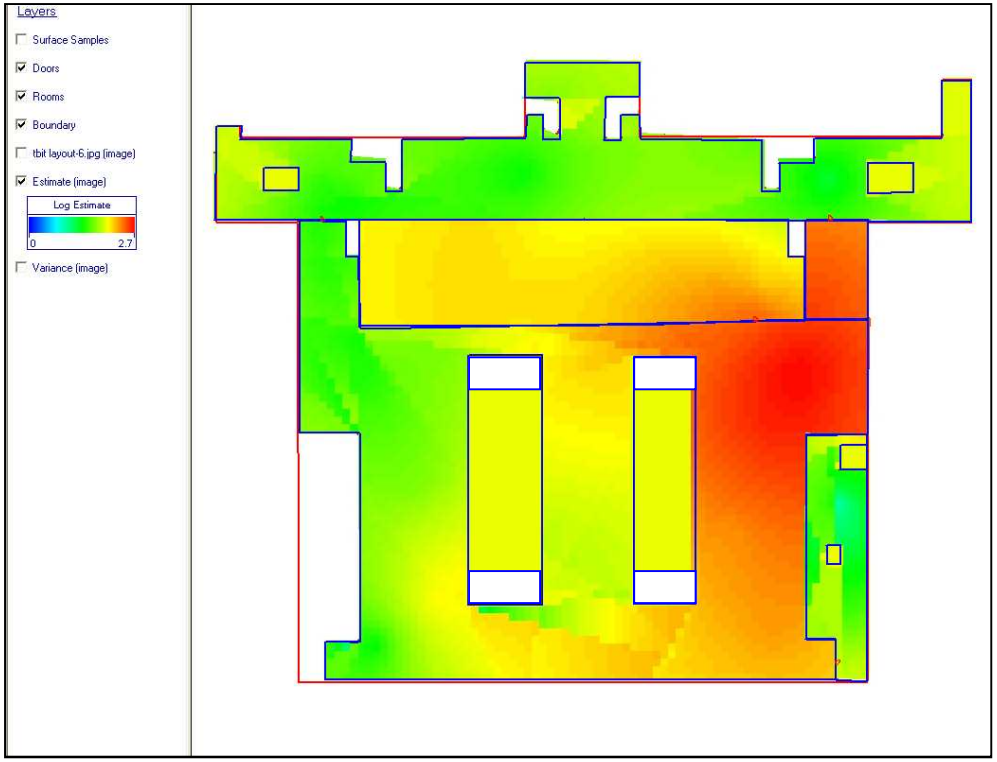
Sample locations, color-coded for concentration



Data fitted to a variogram model, which describes the spatial variability

Mapping Contamination

- Geostatistics provides mapping capability
  - Concentration map
  - Uncertainty map
- This approach is well suited to an adaptive sampling procedure
  - multiple rounds of sampling, with each round based on reducing uncertainty in knowledge of the contaminant distribution
- This approach may reduce the number of samples and therefore the time necessary to reopen the facility



Sampling Design Summary

- Preplanning can save time if an event occurs
- Conceptual model development is important
- Classification of sampling zones helps make sampling design decisions in a timely manner
- Sampling design methods exist, such as:
  - Targeted sampling
  - Probability-based statistical design methods (that provide confidence estimates)
  - Combined targeted and probability-based approaches
  - Geostatistical methods that account for spatial variability, and are well suited to adaptive sampling
- Emphasis is on providing the decision makers with defensible data to make decisions and to reduce sampling time in order to reopen the facility

Conclusions

- **Preplanning for air sampling (instruments, strategies, analytical types, etc.) can enhance remediation efficiency**
  - **Where will you get the samplers, pumps, etc.?**
  - **Who will do the analyses?**
  - **How many samplers will be needed?**
  - **How would the ventilation spread the contaminant and how best to sample the ducts and facility exhausts?**
- **Air sampling can improve decontamination efforts and provide support for confident decisions**
- **For just about any terrorist scenario imagined, air sampling will be critical during and after remediation, with its main goal to help ensure the safety of workers and public**

Decision Support Tools

- **Two decision support tools exist that can aid the sampling design, data management, and mapping processes**
  - **Visual Sample Plan (VSP) from Pacific Northwest National Laboratory**
  - **Building Restoration Operations Optimization Model (BROOM) from Sandia National Laboratories**

VSP
Visual Sample Plan

BROOM

Visual Sample Plan

A DQO-Based Statistical Sampling Design and Analysis Toolkit

- How Many Samples Required?
- Where Samples Located?
- Decision Confidence Achieved?

Within Building Modules

- Import Maps and Floorplans
- 3-D Setup of Rooms/Buildings
- Many Possible Sampling Design Approaches
- Realistic Furniture/Shelving Overlays
- Surface Type Stratification (carpets, vinyl, wallboard, etc)

>5000 Users Worldwide

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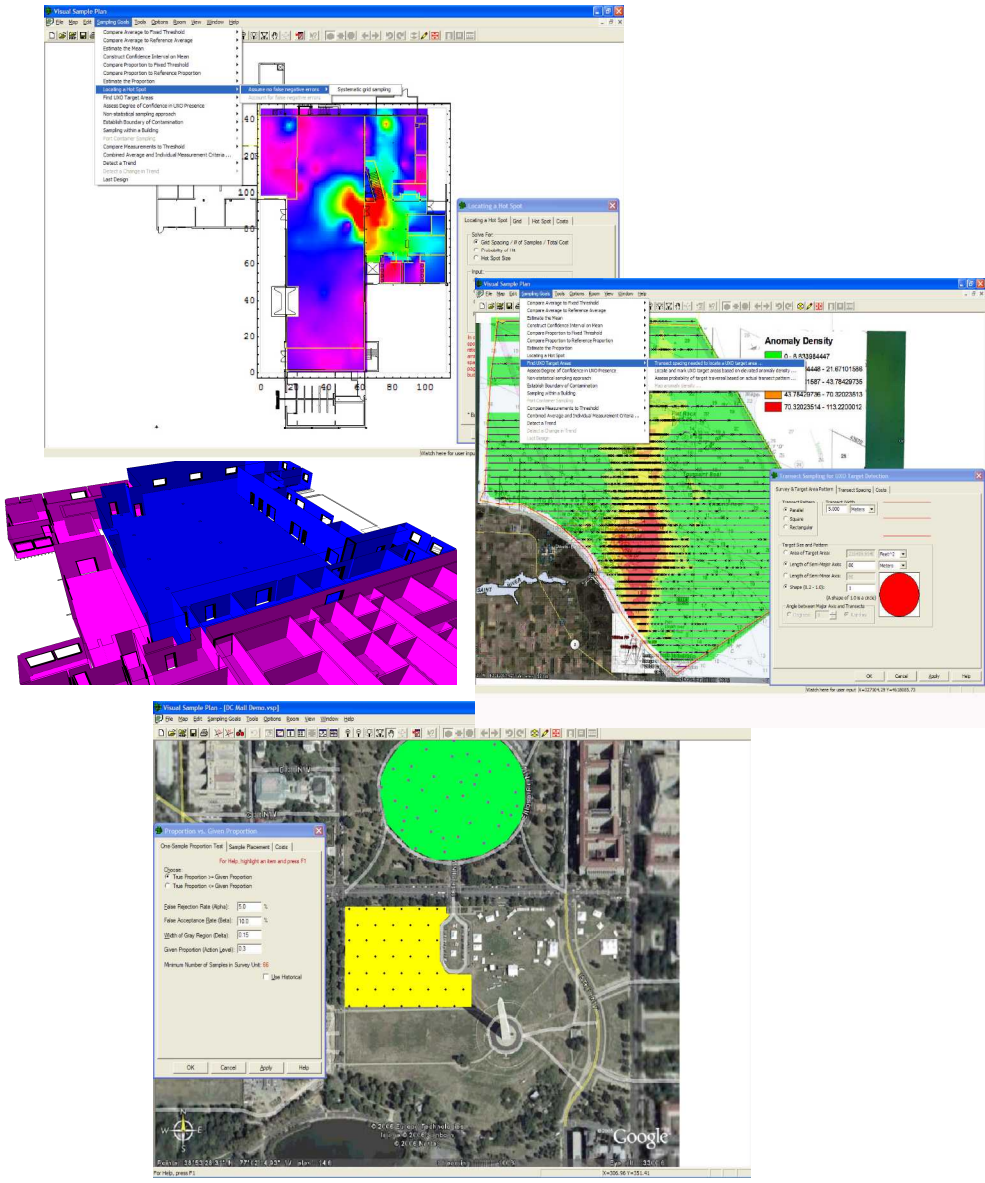
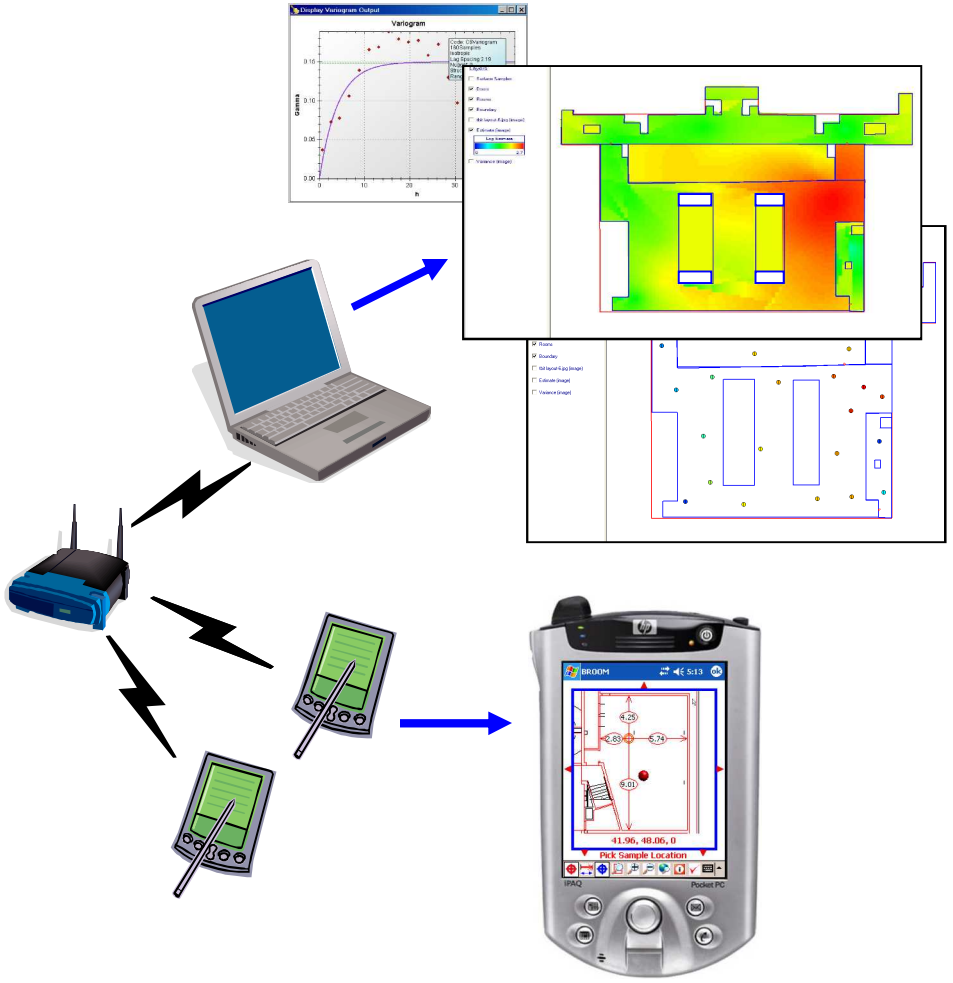


Building Restoration Operations Optimization Model - BROOM

- A decision support tool to collect, manage, and analyze sample data
  - Secure SQL database
  - GIS mapping
  - Geostatistical analysis tools
  - Uncertainty analysis
  - Interfaces with VSP for statistical sampling design
- Data collection
  - Hand-held wireless PDAs with barcode readers and laser rangefinders
  - Paperless data transfer
  - Secure transmission of data
  - Chain of custody



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Summary

- Preplanning is important
- Strategic sampling improves confidence, reduces time and cost associated with remediation, protects workers, and ensures public confidence
- Tools and methods are currently available to develop optimal sampling strategies and support confident decisions

Please visit the poster session, where a poster showcasing sampling design, as well as the VSP and BROOM software tools, are on display