Fact Sheet 2: Are Conditions Suitable for Geospatial Analysis?

This fact sheet is the second of four fact sheets developed by ITRC to accompany its guidance titled *Geospatial Analysis for Optimization at Environmental Sites* (GRO-1) (available at www.itrcweb.org/gro-1). This fact sheet introduces the value and use of geospatial analysis to support optimization activities to project managers, program or financial managers, and stakeholders. Specifically, this fact sheet describes the site conditions best suited to geospatial analysis.

Geospatial analysis examines relationships between the data and estimates values between and beyond the spatial and temporal locations of the existing data. When evaluating data and making decisions at environmental sites, project managers must consider information such as site history, site and area geology and hydrogeology, and data for other media. Geospatial analysis can provide an additional line of evidence under a multiple lines-of-evidence approach to decision making as described in the Data Requirements for Geospatial Analysis section.

While geospatial analysis can provide a deeper and more informative exploration of data, it is not appropriate for all circumstances. For example, when no spatial correlation is evident in the data, a geospatial analysis may not be needed or may be counterproductive compared to traditional statistical methods (see the ITRC 2013, groundwater statistics guidance, GSMC-1). The application of geospatial methods requires a thorough understanding of the CSM. In addition, data required for performing geospatial analysis vary depending on site-specific conditions.

The following questions address general guidelines for minimum data requirements for geospatial analysis, as well as potential misapplication of the geospatial methods:

What are the requirements of data sets for geospatial analysis?

The data and information needed for performing geospatial analysis include specific required elements and may vary depending on site-specific conditions. The minimum requirements for data sets for various geospatial analyses are different from, and usually more stringent than, those for other data analyses. For instance, accurate mapping generally requires more data than simple monitoring along a compliance boundary. It is thus critical to check the minimum requirements prior to choosing a geospatial analysis. If these requirements cannot be met, additional data or a revised method may be needed.

What are some potential misapplications of geospatial analysis?

Misapplication of geospatial methods can obscure or misrepresent site conditions. The Common Misapplications of Geospatial Analysis section provides examples of common misapplications and the recommended course of action to address the problem. The misapplication examples are organized by the aspect of a project to which they most appropriately apply, including: CSM, exploratory data analysis, model use, and model assumptions.

When geospatial methods are used, they must match the goals of the analysis and their assumptions should be evaluated for site-specific applicability. Also, consider the complexity of the site, robustness of the data set, and the project life cycle stage. An adequate CSM must be developed, in addition to assumption validations, an adequate data set, and an understanding of the tools to ensure that data interpretation is correct. Experienced, professional judgment is critical in using the models and understanding the assumptions. General considerations in using geospatial methods for optimization are included. Table 3, Organizing Geospatial Interpolation Methods, in the Categories of Geospatial Interpolation Methods section, also includes information that may be helpful in narrowing the list of appropriate methods for a specific site. This table includes information about data requirements, statistical assumptions, prediction uncertainty and some example methods.

Can geospatial analysis support optimization activities throughout each project life cycle stage?

If geospatial analysis is appropriate for optimization activities, then it can help to answer typical optimization questions for the applicable stage of the project life cycle. The following table summarizes the optimization questions for each stage of the project life cycle; some questions apply to more than one stage of the project life cycle.

Optimization questions in project life cycle stages

General Topic	Specific Question	Release Detection	Site Characterization	Remediation	Monitoring	Closure
Plume Detection and Estimation	Do various detected concentrations represent an actual plume?	X				
Trend Maps	Are there significantly different concentration trends in different parts of the site?	X				
	If there are changes occurring in the plume, what is the spatial distribution of the temporal concentration trends across the site?			X	X	X
Estimating Average Concentrations	What are the average concentrations for different chemicals, and how may they be changing over time as an indication of a release?	X				
	What is an estimate of the average concentration of a contaminant for any medium?		X	X		
Hot Spot Detection	Are there hot spots of interest at the site?	X				
	How can geospatial methods help with hot spot detection and delineation?		X			
Sample Spacing	What is appropriate sample spacing, considering spatial correlation?		X			
Interpolation	How can a representative interpolation (contour map) of results for any medium be prepared?		X			
Estimating Concentrations Based on Proxy Data	How can a large amount of inexpensive data be used to improve interpolation of other data?		X			

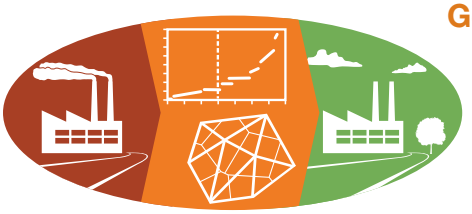
General Topic	Specific Question	Release Detection	Site Characterization	Remediation	Monitoring	Closure
Estimating Quantities	How can an estimate of quantities (for example, mass or volume of media) be developed?		X			
Background Estimation	How can background concentrations be estimated when working with spatially correlated data?		X			
Quantifying Uncertainty	How can geospatial methods help quantify uncertainty in the definition of a contaminated area needing further work, for any medium?		X			
Plume Change/ Attenuation Over Time	How are the plume intensity and boundaries changing over time?			X	X	
	How can the plume attenuation over time be verified?					X
Evaluating Remedial Success	Has the remediation met remedial goals?			X		
Remedial Action Optimization	How can the ongoing remedial action be optimized?			X		
Future Data Prediction/ Verification	Can geospatial methods support the prediction or verification of site conditions?			X		
Plume Intensity and Extent	What is the intensity and extent of the current plume?				X	
Monitoring Program Optimization	How can geospatial methods help optimize a monitoring program?				X	
	How can geospatial methods help to determine if the monitoring program is adequate for closure?					X

General Topic	Specific Question	Release Detection	Site Characterization	Remediation	Monitoring	Closure
Attainment of Closure Goals	How can the remaining plume intensity and extent be verified and the likelihood that all of the plume has met a specific closure goal or standard be assessed?					X

See Fact Sheet 3 for information about how geospatial analyses are typically applied or the Geospatial Analysis Support for Optimization Questions in the Project Life Cycle section for detailed discussion of specific stages of the project life cycle.

Reference

ITRC. 2013. "Groundwater Statistics and Monitoring Compliance, Statistical Tools for the Project Life Cycle." GSMC-1. Washington, D.C.: Interstate Technology & Regulatory Council. http://www.itrcweb.org/gsmc-1/



Geostatistics for Remediation Optimization (GRO) Team Contacts

Ning-Wu Chang • California Department of Toxic Substances Control
714-484-5485 • nchang@dtsc.ca.gov

Harold Templin • Indiana Department of Environmental Management
317-232-8711 • htemplin@idem.in.gov

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ITRC
50 F St. NW, Suite 350
Washington, DC 20001
itrcweb.org