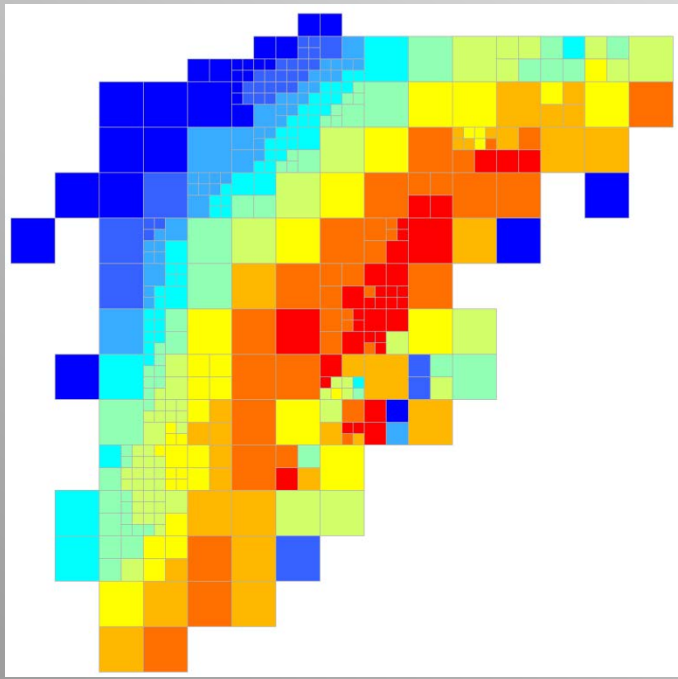


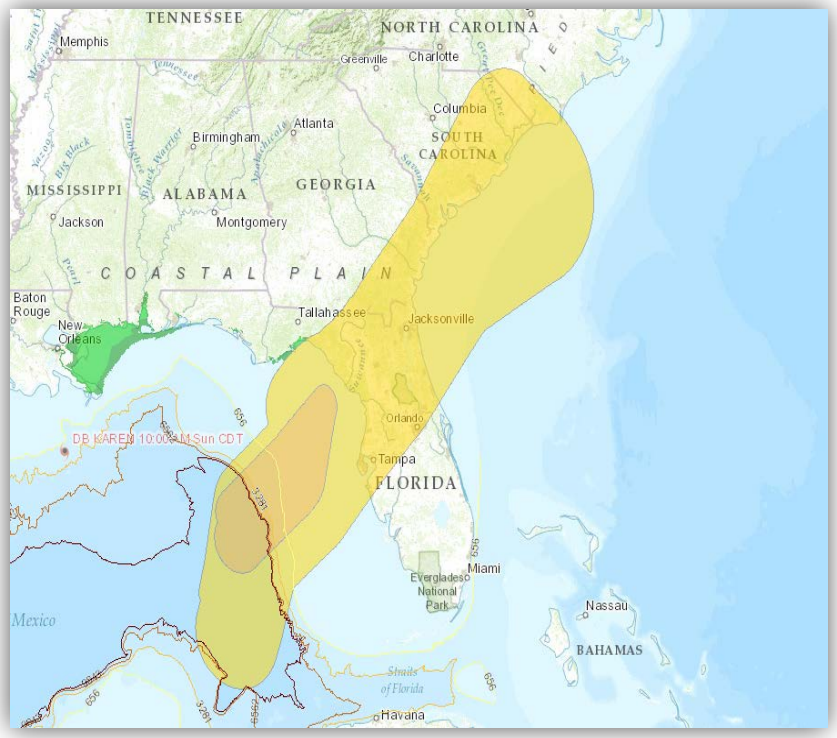
The Variable Grid Method (VGM)

A Novel Approach for Simultaneously Visualizing Spatial Data Trends and Uncertainty

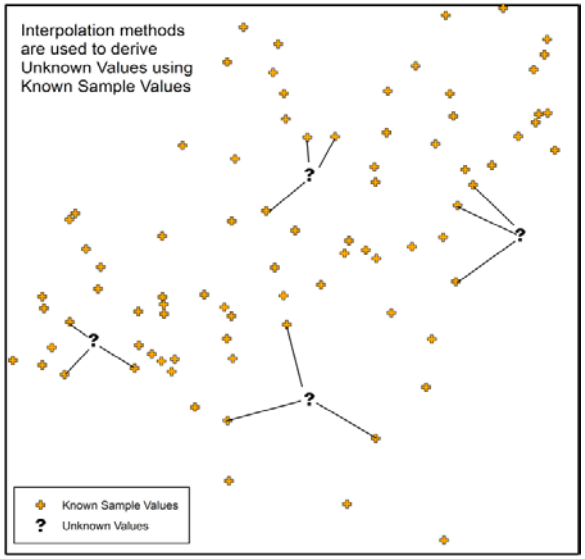
For more information, contact
techtransfer@netl.doe.gov

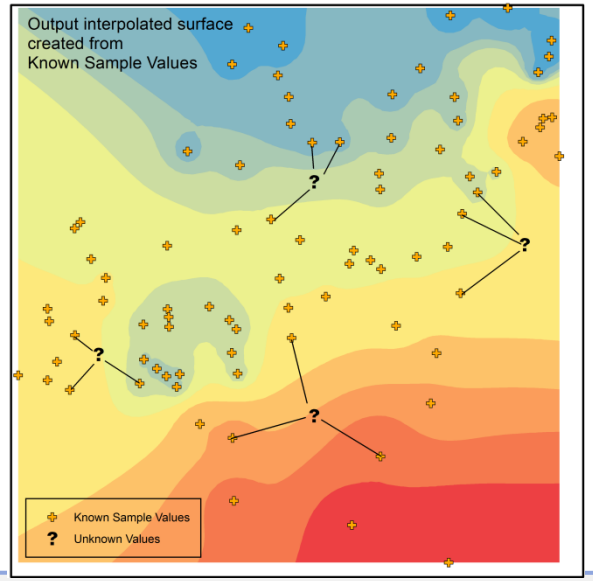
The Need

- There is an increase in the need for spatial data and corresponding products to help drive research, management, economic and policy decisions.
- Spatial data includes geospatial data, sampling grids, and data that can be associated with an area.
- Examples include census data, geological data, and sediment cores



The Need





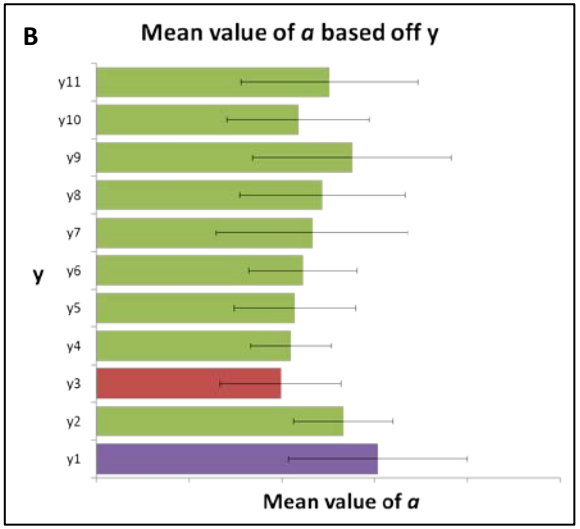
Spatial datasets are often interpolated to better represent continuous phenomena, such as:

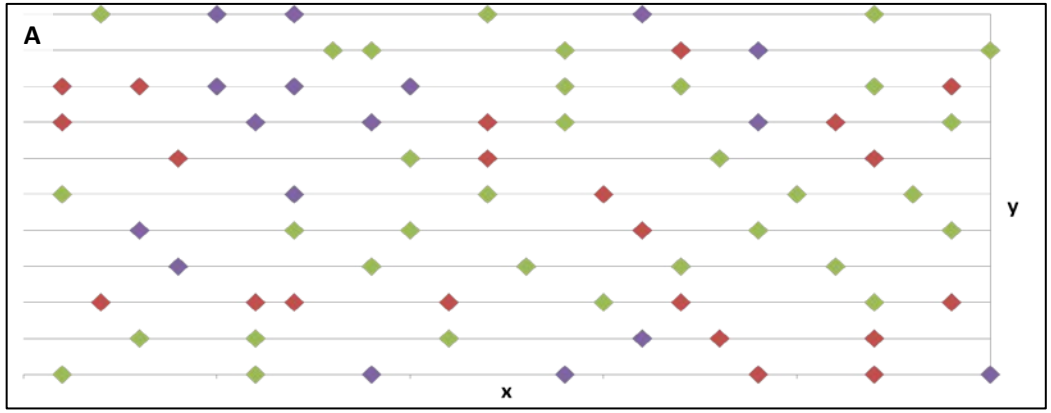
- **temperature**
- **depth**
- **groundwater or hydrocarbon distribution**
- **nutrient density**
- **ecological habitats**
- **wind speed**
- **population density, etc.**

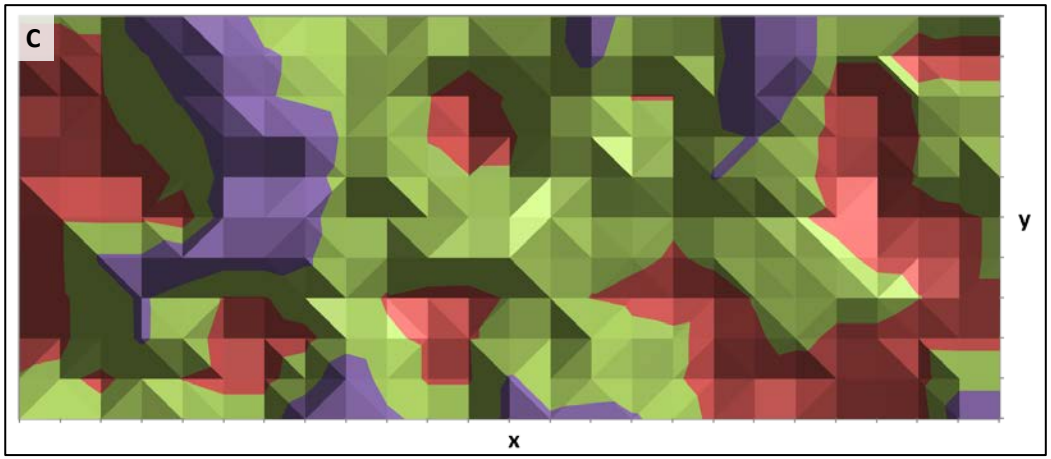
The Need

Many interpolated results are presented to an end user without any information about their uncertainty

Traditional methods of displaying data uncertainty aren't easily visualized as a surface







Example of a spatial dataset (A) where each point represents a value, *a*, which can be used to estimate the uncertainty of the data, such as standard error (B), and an example of an interpolated surface (C) created from the point values, *a*.

The Problem

Spatial data and corresponding products are often presented without effectively communicating any underlying uncertainty, which can led to:

- **false conclusions**
- **poor decisions**
- **poor quality of current and future research and products**

Image from the International Business Times and Dave Smith

Analysis errors

Human errors

Image from blogs.cetis.ac.uk

Image from Visual Mapper (visualmapper.blogspot.com)

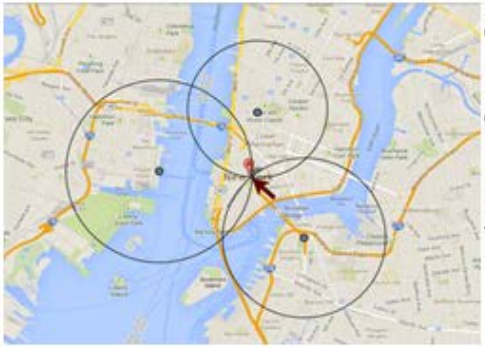
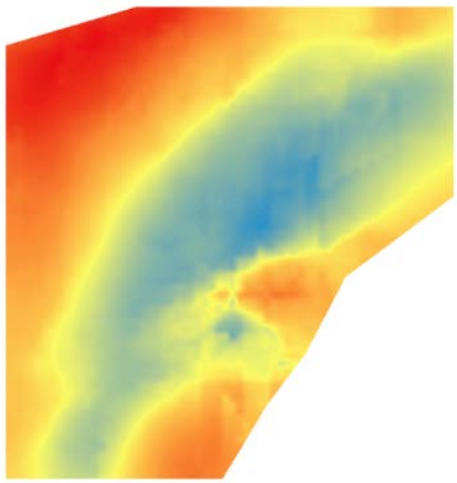


Image from blog.includesecurity.com

Locational errors

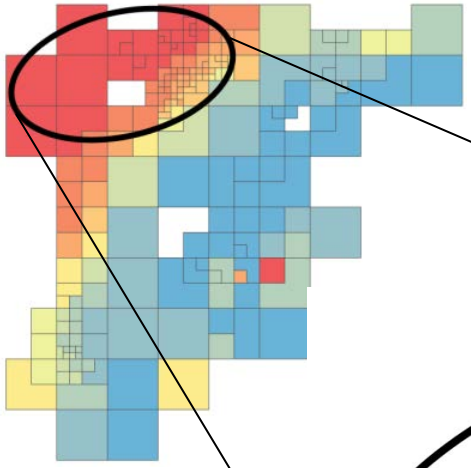
The Solution

- **The Variable Grid Method communicates both data and data uncertainties simultaneously in a single layer that represents the data (colors) and uncertainty (grid cell size)**

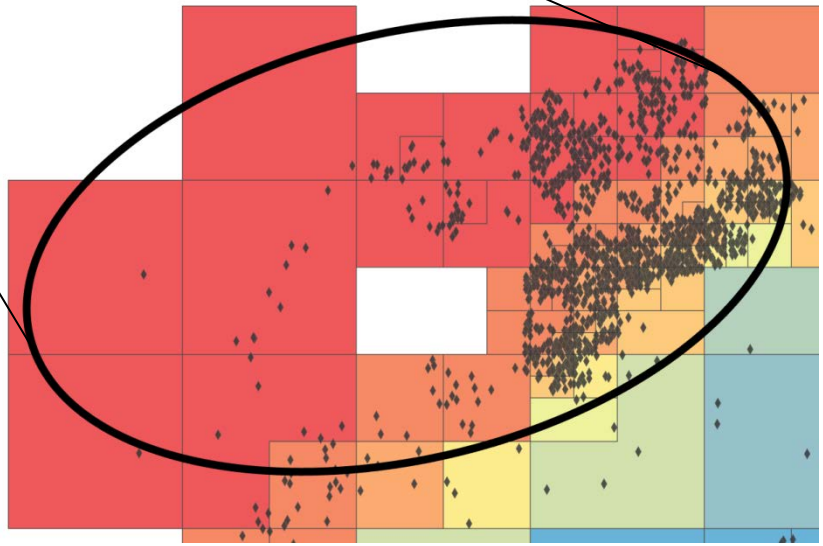


Traditional continuous interpolated raster

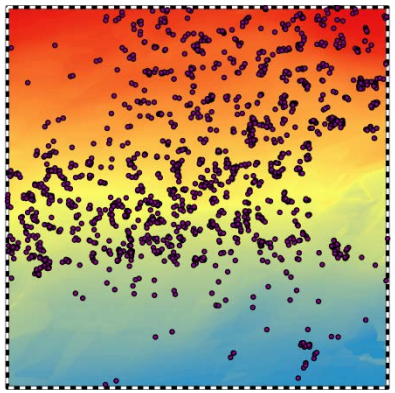
versus



A variable grid created using the same dataset used to create the traditional continuous interpolated raster seen on left

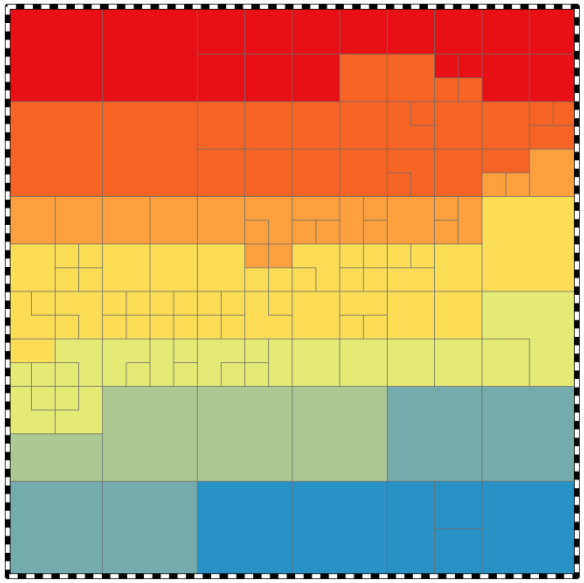


The Solution

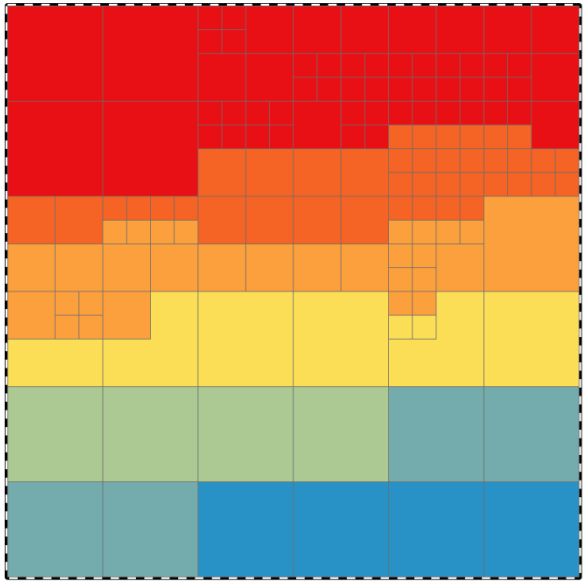


The VGM is a flexible method that allows for the communication of different data and uncertainty types, while still preserving the overall spatial trends and patterns

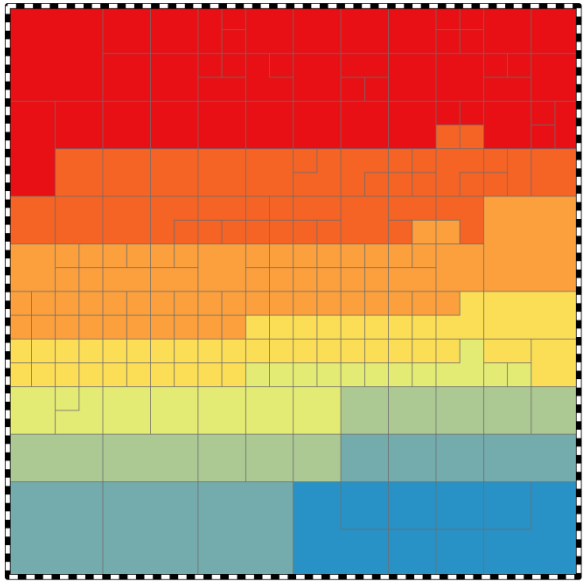
Point Density



Sample Variance



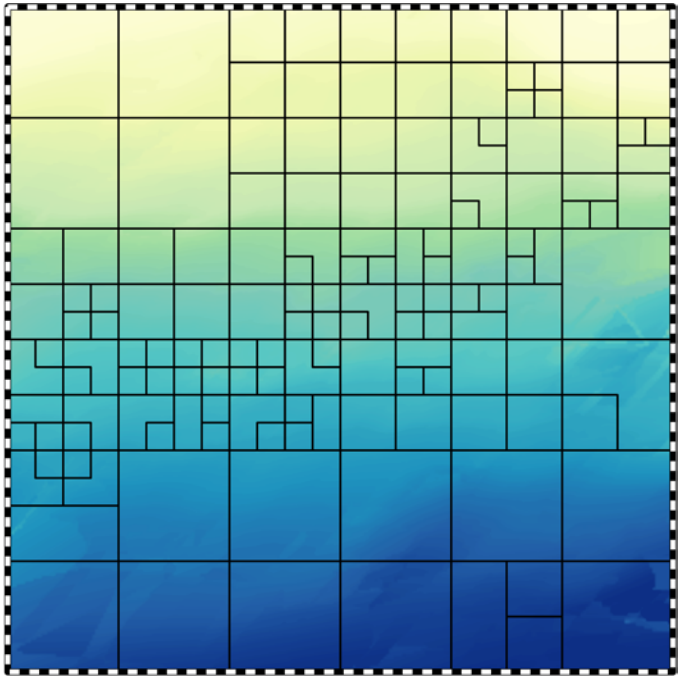
Kriging Standard Error



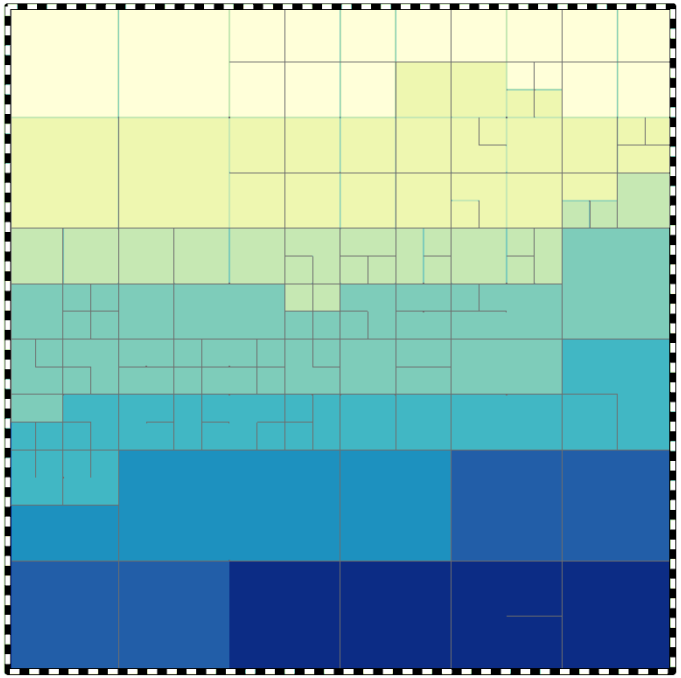
The Solution

The VGM can represent uncertainty as either an overlay on top of the original interpolated layer (A), or it can be associated with the data values to present a more abstract view of the data and its uncertainties (B)

A



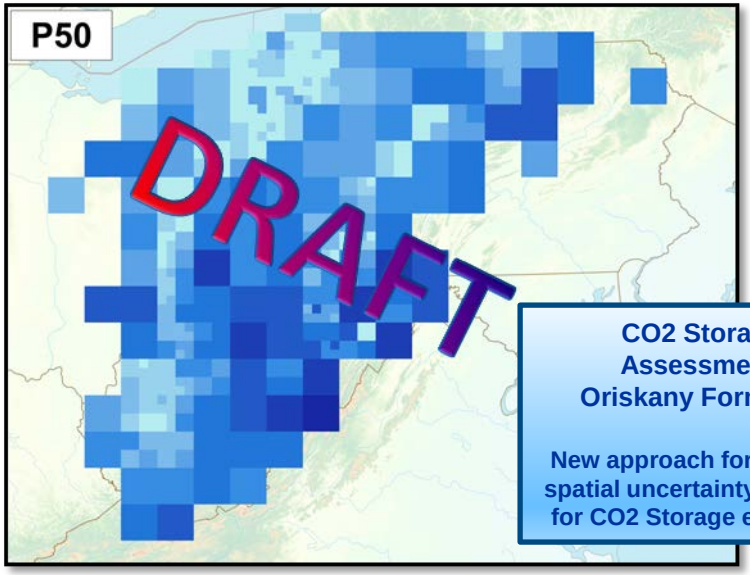
B



The Applications

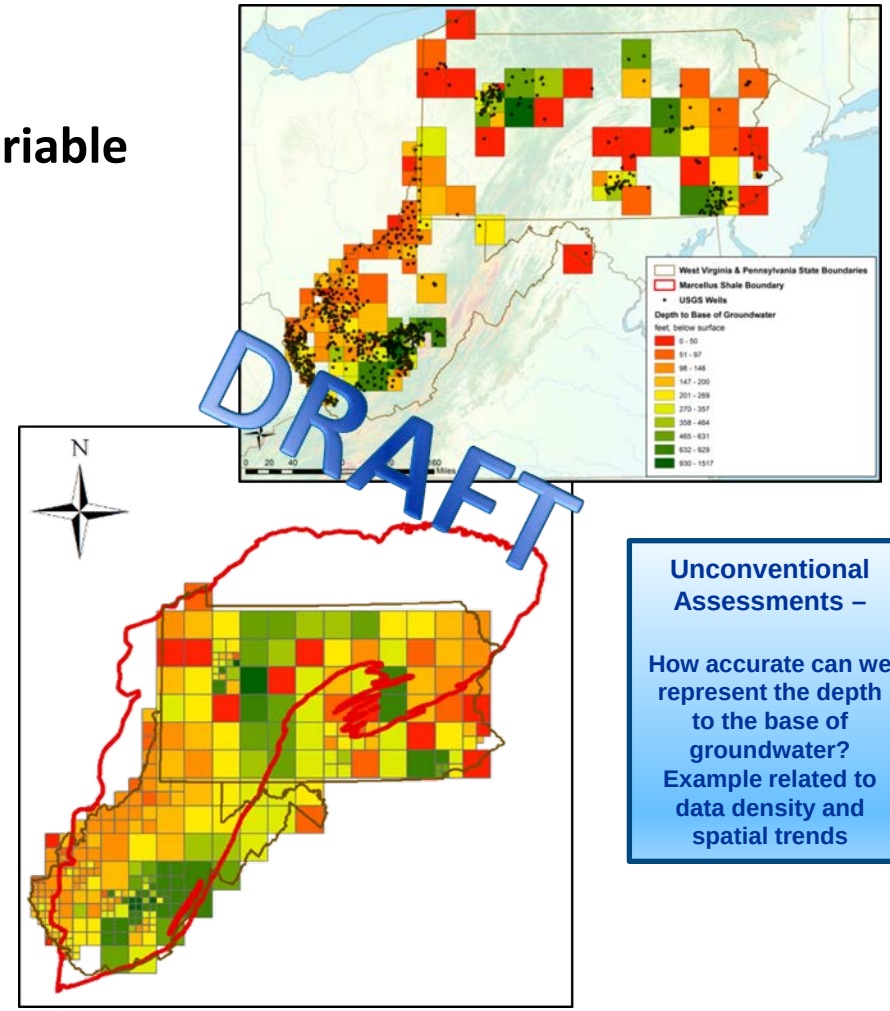
VGM can be used to address a range of questions related to:

- Resource evaluation
- Assessing potential impacts
- Understanding trends in the data variable
- Calculating project feasibility
- Identifying knowledge gaps
- Etc.



CO2 Storage Assessment, Oriskany Formation

New approach for defining spatial uncertainty & trends for CO2 Storage estimates



Unconventional Assessments –

How accurate can we represent the depth to the base of groundwater? Example related to data density and spatial trends

Partnership Opportunity

This technology is available for licensing and/or further collaborative research from the U.S. Department of Energy's National Energy Technology Laboratory.

For more information, contact techtransfer@netl.doe.gov