NETL’s Variable Grid Method

A Tool for Simultaneous Visualization and Assessment of Spatial Trends and Uncertainty

Kelly Rose and Jennifer Bauer

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Communicating Environmental Risk
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Increasing use of spatial data and their products to drive research, management, economic and policy decisions

- The term *spatial data* can be applied to various datasets, including:
  - Geospatial data, or data that can be associated with a discrete location,
  - Data that can be associated with an area,
  - Distance measurements in a sample,
  - Sampling grids, etc.
Using the ‘U’ word

Spatial data, spatial data products, and analyses are littered with *uncertainty*, that can come from various sources.

Failing to effectively communicate the underlying *uncertainty* can lead to *false conclusions* and *poor decisions* as well as *affect the quality* of current and future research and products.
Example: 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.

However, many spatial datasets, spatial data products, and analysis results, such as those from interpolations, are presented without any information about their uncertainty.
Difficulties Visualizing Uncertainty

Traditional methods of displaying 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 or standard deviation (B), and an example of an interpolated surface (C) created from the point values in A.
Imagine that you are presented with the results of a study to help identify potential sites for a CO₂ storage reservoir

- The data presented shows estimated CO₂ storage capacity (in MT) for the area of interest
- You’ve been told that the chosen site(s) should have a high storage potential (> 16 MT)
Let’s now take a look at the details that were not included and see if they might alter your decision...

Traditional continuous interpolated raster provided as part of a final product or result (left) and the same raster overlaid with the data points used to create the interpolation (right).
Role of Uncertainty in Decisions

This example demonstrates the importance of including information about the **uncertainty** to help shed light on the **quality** and **quantity** of data used to better inform decisions utilizing these data.

**How do we make sure the underlying uncertainty in our data, analyses, and final products are appropriately and effectively communicated?**
NETL’s Variable Grid Method (VGM)

The VGM was designed to address these issues by communicating the data and it’s uncertainties simultaneously in a single layer that represents the data (colors) and uncertainty (grid cell size).

Traditional continuous interpolated raster (upper left) and a variable grid (bottom left and right) created using the same dataset.
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*.
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).
Applications of the VGM at NETL

CO₂ Storage Assessment
*Oriskany Formation*
New approach for defining spatial uncertainty & trends for CO₂ Storage estimates

Unconventional Resource Risk Assessments
Estimating the depth to the base of groundwater to evaluate risks of groundwater contamination

NETL VGM approach can be used to address questions such as:
- Resources evaluation
- Impact assessments
- Understanding trends in the data
- Calculating Project Feasibility
- Identifying Knowledge Gaps

CO₂ Storage Potential
Artesian & Aquifer南阳
- 126–160
- 69–120
- 30–60
- 15–30
- 0–15
- 0

Legend
- Depth from Surface, feet
- 111–150
- 75–110
- 60–75
- 0–60
- 0

https://edx.netl.doe.gov/
Next Steps: Automation and Accessibility

Developing a Python-based Toolbox and Toolbar as a Add-in to Esri’s ArcGIS software to automate Variable Grid creation
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Useful Links:


VGM Technology Video: [http://youtu.be/9vLa1HM1IKY](http://youtu.be/9vLa1HM1IKY)

Energy Data Exchange: [http://edx.netl.doe.gov](http://edx.netl.doe.gov)

Notes
A U.S. provisional patent application was filed February 12, 2014 (61/938,862)

Come to the VGM Demo
Tuesday, October 5, 2014
2:40-4:40 pm
Room 618