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The Variogram Basics: A visual introduction to one of the most useful geostatistical concepts

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Summary

The energy upstream has undergone nothing short of a revolution over the last 15 years. The exploitation of unconventional resources occurred alongside a rapid evolution in computing and data collection. Petroleum geoscientists working in the energy upstream have the challenge of making sense of and displaying trends in this data, which is often unstructured, poorly sampled, and disparate. One of the tools geoscientists can use to reveal meaningful spatial trends in data is geostatistical analysis.

The focus of the 2022 CSEG article 'The Variogram Basics: A visual introduction to one of the most useful geostatistical concepts' is to provide an understanding of some of the basic principles behind the semivariogram/variogram through words, basic examples, and images. This introductory explanation will build on key basic geological concepts such as 'Spatial continuity' and 'Geometric Anisotropy,' so that the reader can understand more complex statistical concepts such as 'Data Kriging,' which have real utility for upstream energy professionals.

This is all tied into real-world issues, as demonstrated in a recent paper, 'Spatial variability of tight oil well productivity and the impact of applying new completions technology and techniques' (Montgomery & O'Sullivan, 2017), which demonstrates how statistical techniques that don't take into account the overviewed concepts such as spatial continuity, can come to conclusions that vastly underestimate the importance of robust geoscience conducted on the reservoir scale, and strongly skew perceptions inside the energy upstream and the public at large.

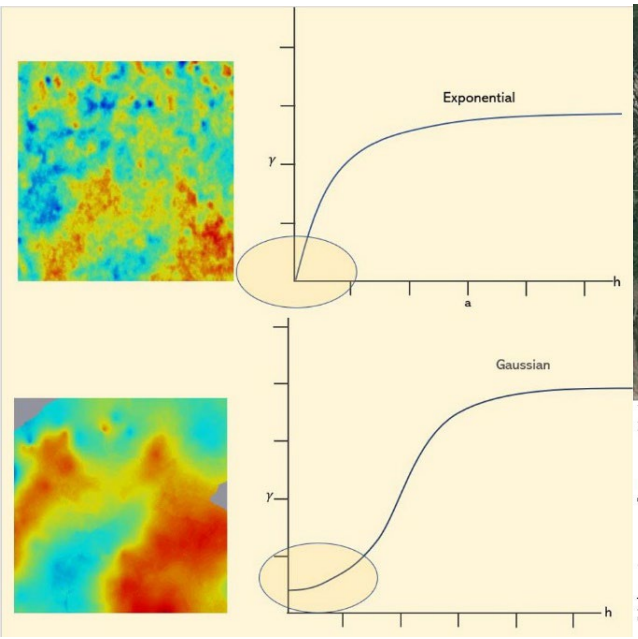

Figure 1 Comparison of data smoothness to Exponential and Gaussian data models.

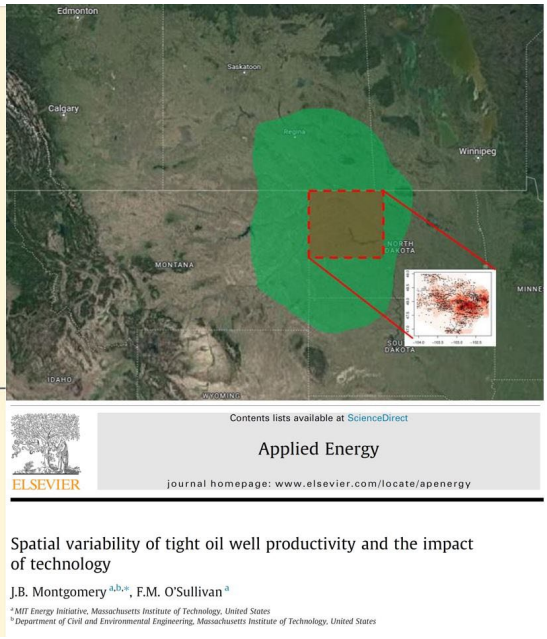

Figure 2 Map (EB) showing the area of study & results overlay for Montgomery and O'Sullivan,2017.