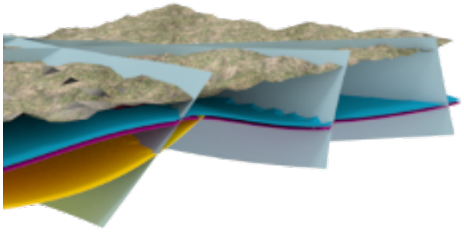
KIT GRACE Science School

Spatial Models for Categorical Data in Earth Sciences

Date: 23 - 25 September, 2020
Place: Building 20.40, Room 002, Jordan Lecture Hall **and as online course**
Time: 9.00 am - 5.00 pm
Lecturer: Prof. Florian Wellmann
Credits: 2



Content

Spatial statistics are highly relevant in all Environmental Science and is an important topic used to consistently model spatial variation of an event. Since information of natural phenomena is often collected by point sampling, geostatistical techniques are essential and required for filling gaps in data over the region of interest. Often, we use categorical spatial data for computationally modelling numerous environmental applications. The attribute representations are used as input for spatial functions whose outputs simulate earth-related phenomena, allowing in-depth analyses to support decision making in real-world problems. Promising approaches for dealing with categorical data and the proper understanding of uncertainties associated with the produced results will be discussed during the course.

This 3-day course will…

- introduce the fundamental concepts of categorical and geometric interpolations in geosciences;
- review established geostatistical approaches;
- present state-of-the-art geometric 3D geological modelling concepts;
- introduce a set of modern tools for considering uncertainties in spatial predictions of categorical data;
- describe concepts from information theory and the link to the analysis of uncertainties in these data sets; and
- discuss modelling and visualisation of uncertainties of categorical spatial data.

Program

Day 1 - Geostatistical and 3D geological models

The first day ensures a common basis for all participants. With a general introduction into the relevance of spatial categorical and geometric models, fundamentals from geostatistics, multipoint geostatistics to 3D geological models. The day will consist of three teaching units with practical examples across the Earth sciences.

Day 2 - Uncertainties and probabilistic spatial modelling methods

The second day will extend the discussion to uncertainties: as most information about the subsurface is either sparse or indirect, we always need to make assumptions about reasonable interpolation and extrapolation - and these assumptions lead to various forms of uncertainties in the resulting model realisations. In Day 2, we will explore the general underlying concepts of uncertainty in the spatial concept and discuss practical approaches to generate multiple geostatistical and geological model realisations as representations of uncertainty.

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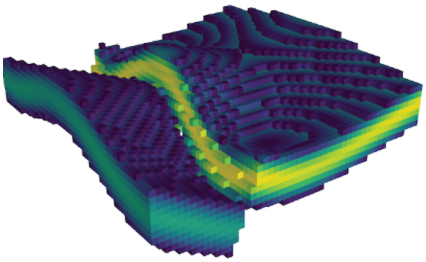

Day 3 - Spatial uncertainty analysis

The third day will explore data uncertainty and bring a new perspective on the topic using measures from information theory. It will cover fundamentals from information theory, multivariate entropy measures, boundaries estimation and spatial sampling design.

Hands-on tutorial

Throughout all three days, the theoretical aspects will be complemented with programming exercises. A focus will be on the implementation of simple models by students, as a way to transform concepts from geostatistics and geological modeling into numerical examples.
Language: Python, Jupyter
Evening: Discussion of possible collaboration and emerging aspects.

Lecturer

Florian Wellmann is Professor at RWTH Aachen University in Computational Geoscience and Reservoir Engineering. Florian does research in 3D Geomodelling, Geophysics, and Hydrogeology with a focus on novel modeling approaches, model optimization, joint Bayesian inversion, and Machine Learning.

Requirements

- Each participant should bring his/her own notebook for the hands-on exercises.
- Python should be installed beforehand.

Registration

Please register via online form.

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