Introduction to the theory and practice of geostatistical modelling with the PluriGaussian and Multiple-Point Statistics techniques

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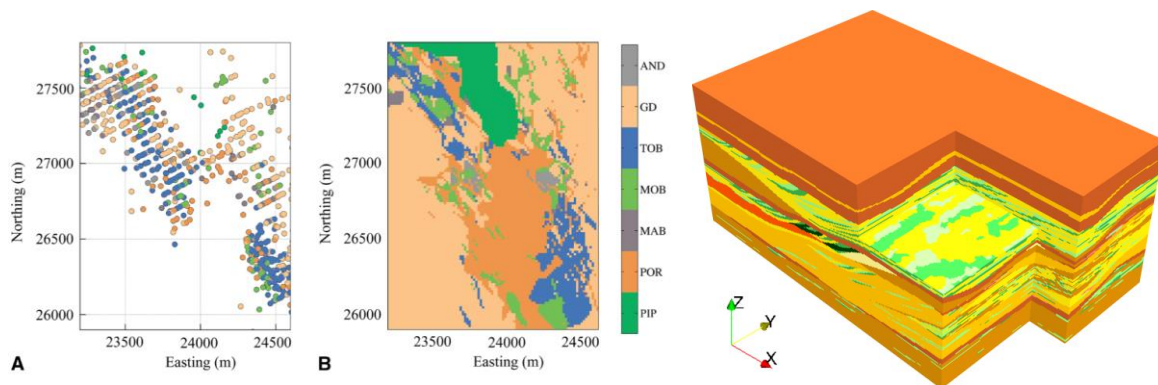
June 17th to 20th 2019

Registration form online : https://bit.ly/2DcXroH

Location: University of Neuchâtel

The aim of this course is to introduce two advanced geostatistical modeling techniques: the PluriGaussian and the Multiple-Point Statistics approaches.

These techniques can be applied to model geological heterogeneity and in particular the spatial distribution of categorical variables such as rock types or lithofacies. They are used for example in the field of hydrogeology, mining extraction, geotechnical characterization or hydrocarbon reservoirs, but they can also be employed in any field where categorical variables are important such as for example the mapping of plant or ecosystem types in biology, the simulation of soil types, land use, or hydroclimatic patterns.

During the course, participants will learn the fundamental aspects underlying the PluriGaussian and Multiple-Point Statistics approaches and will have the opportunity to apply them in practice through a series of tutorials and hands on.

Schedule

The course will start every morning at 9 am and end around 5 pm every day.

Day 1.

Morning. General introduction

- Brief introduction: schedule of the course, overview of the types of geostatistical models for geological heterogeneity, presentation of the participants (P. Renard)
- Introduction to the Pluri-Gaussian technique (N. Madani)

Afternoon theory: Fundamentals of two-point Geostatistics (N. Madani)

- Principles of two-point Geostatistics for facies modeling
- Deterministic geo-domains modeling (hacking probabilistic approaches)

Afternoon laboratory exercises:

- Indicator kriging and Sequential Indicator Simulation practice (MATLAB code and Ar2gems)

Day 2.

Morning theory. Introduction of PluriGaussian Simulation (N. Madani)

- Introduction to Truncated Gaussian Simulation
- Pluri-Gaussian Simulation (Definition of flag, thresholds and variogram analysis)

Morning laboratory exercises:

- Examples of geo-domains modeling with forbidden contacts from a siliciclastic platform (MATLAB code)

Afternoon theory: Dealing with heterogeneity in PluriGaussian simulation (N. Madani)

- Vertical proportion curve (is it really helpful?)
- Non-stationary modeling by IRF-k
- Examples of more complicated flag definitions (hierarchical model based on evolution of geological domains)

Afternoon laboratory exercises:

- Modeling of heterogeneity considering the predefined interpretive block model (MATLAB code)
- Enhanced practice for hierarchical Pluri-Gaussian modeling

Day 3.

Morning theory: Introduction to MPS (P. Renard)

- General principle and philosophy of MPS
- Concept of training image
- Basic algorithm and variants

Morning laboratory exercises:

- First simple application of DeeSse for a stationary case (in Ar2gems)
- Comparison with Sequential Indicator Simulation

Afternoon theory: From stationary to non-stationary simulations (J. Straubhaar)

- Understanding DeeSse parameters in a categorical case
- Requirements of a training image / how to get it and what should be its properties
- Dealing with non-stationarity in the simulation grid

Afternoon laboratory exercises:

- How to generate a Training Image and a trend of orientation to control the simulation
- A simple practical case study: the Areuse delta (in Ar2gems)

Day 4.

Morning theory: modeling with elementary training images (P. Renard)

- Elementary training images and invariances
- Parameterization of the structure

Morning laboratory exercises:

- Construction of elementary training images
- Use of invariant distances
- Modeling a fluvio-glacial aquifer from borehole data (in Ar2gems)

Afternoon theory: multivariate simulations (J. Straubhaar)

- Multivariate MPS and gap-filling
- Tests on synthetic applications
- Multivariate, multitemporal satellite image gap-filling

Afternoon laboratory exercises:
- How to deal with non-stationarity when using analog data?
- Use of secondary attributes
- Time-series simulation using the Direct Sampling technique (in python)