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Development of a facies model to identify hydraulic relevant variations in high permeable, glacifluvial sediments of the Munich Gravel Plain

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background

- In many big cities in the northern hemisphere, such as in Munich, the first groundwater aquifer is composed of glacifluvial sediments and shows high potential for near surface geothermal plants.
- In the urban area of Munich already exit more than 3.000 geothermal plants in the quaternary aquifer.
- The performance of the geothermal plants are heavily dependent on the pumping rate, which is manly influenced by the hydraulic permeability of the sediments.
- The hydrofacies concept shows strong links between hydraulic permeability and sedimentary deposition processes in glacifluvial systems (Huggenberger & Regli 2006, Heinz 2003).

Distribution of permeability values in Munich

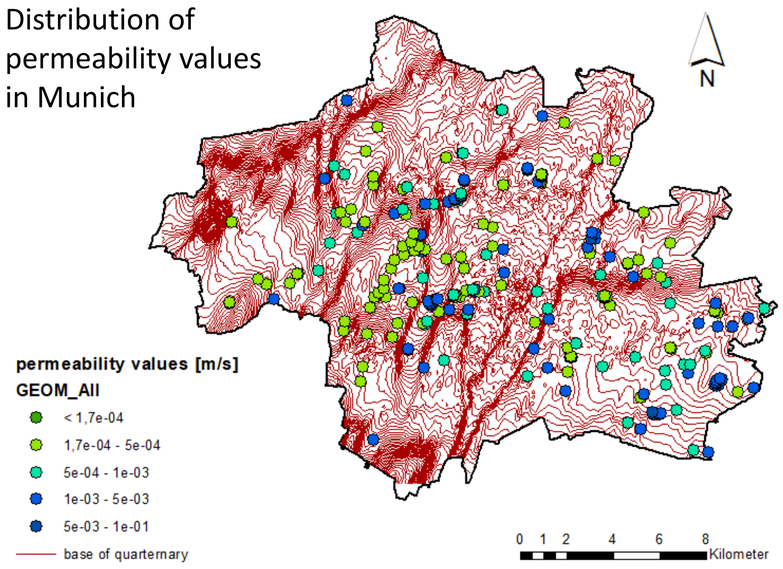

Figure 1: Distribution of permeability values of the quaternary sediments in the city of Munich. The range of the permeability values is 7,04 e-02 m/s. The permeability values resulted from pumping tests. Data from Zosseder (2014).

Research goals

- 1. Goal: Can we see **regional variations of structures and compositions of hydrofacies types** in the area of Munich?
- 2. Goal: How far **borehole data** are appropriated to **transfer in probabilities of hydrofacies types**?
- 3. Goal: Is it possible to **predict areas of high permeable sediments** with a stochastic **3D hydrofacies model**?

Methods

1. Goal:

- Method:
  - Field work in gravel pits in the area of Munich
  - Application of Ground penetrating radar (GPR) to delineate 3D structures of the hydrofacies

- Target parameters:
  - correlation lengths and composition of hydrofacies types

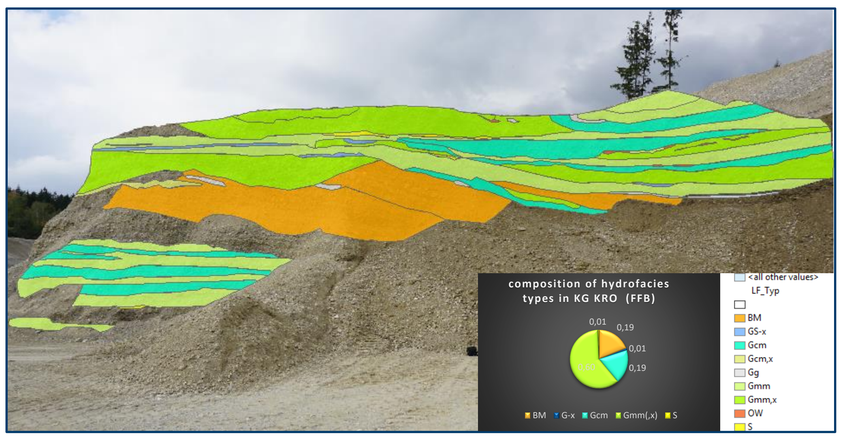

Figure 2: Hydrofacies types in a gravel pit in Fürstenfeldbruck in the west of Munich. The sections is parallel to the paleo flow direction.

2. *Goal:*

- Method:
  - Translate the borehole data in grain size distribution curves
  - Similarity analyses with known grain size distributions curves of hydrofacies types
  - Translate the borehole data in a hydrofacies types and compute a likelihood

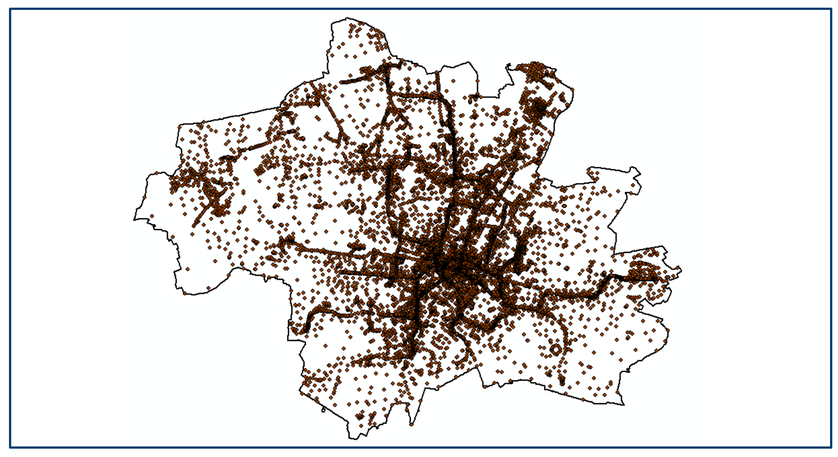

Figure 3: More than 20.000 borehole data can be used for facies modelling.

3. *Goal:*

- Method:
  - Create a hydrofacies model with Sequential Indicator Simulation (SIS) or Multiple Points Statistic (MPS) algorithms in SKUA (Paradigm).
  - The model will be validated with hydraulic permeability values from pumping tests and k_f-value-fields from groundwater models in Munich.

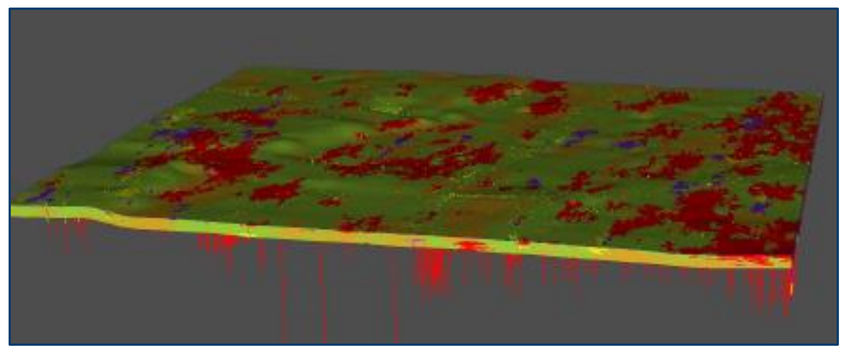

Figure 4: Hydrofacies model for the Maxvorstadt simulated with the SIS algorithm. The red cells symbolized gravels with high permeability (BM gravels), the green cells with medium permeability (Gmm, Gcm) and the purple cells represent cohesive soil (clay or silt).

References

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