Regional Groundwater modelling - Integration of geological structures into numerical models

Stefan Scheidler*[1], Birte Anders[1], Horst Dresmann[1], Peter Huggenberger[1]

[1] *University of Basel, Department of Environmental Sciences, Applied and Environmental Geology (AUG), Bernoullistrasse 32, 4056 Basel*

Introduction

The INTERREG VB project GRETA (near-surface geothermal resources in the territory of the Alpine Space), aims at unlocking the potential of Near-Surface Geothermal Energy (NSGE) in the Alpine Space through the exchange of best technical and regulatory practices, the identification of most suitable territories for these installations and the development of guidelines for the integration of NSGE into energy planning. Together with the project partners, the Office of Nature and Environment Chur, the Federal Office for Spatial Development ARE, the Gemeinde Davos and Geotest AG Davos, the AUG is working on a pilot study located in Davos (Canton Grisons, Switzerland) and its surroundings.

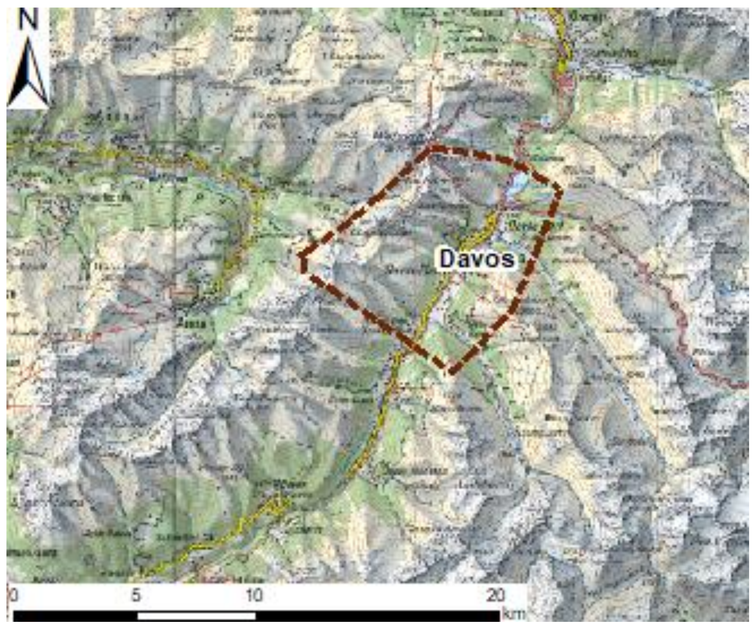

Figure 1. Case study area

Method

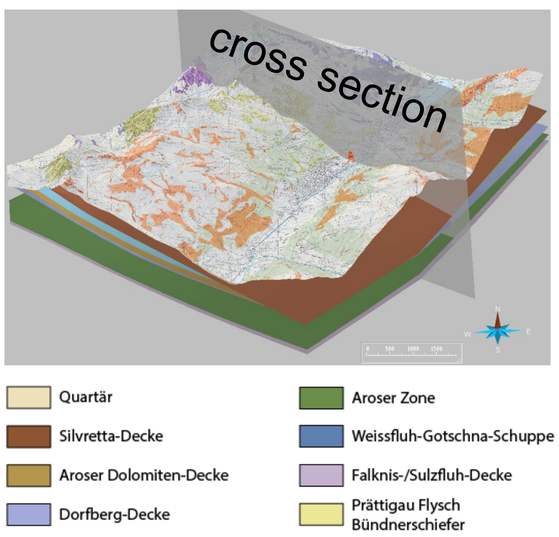

Figure 2. Geological model

In spite of low data availability regarding the hydraulic conditions of the subsurface the main challenge was to create a regional groundwater model which maps the large-scale circulation systems.

The basis for this was the integration of a 3D geological model (GOCAD®) into a numerical ground-water flow model (COMSOL®).

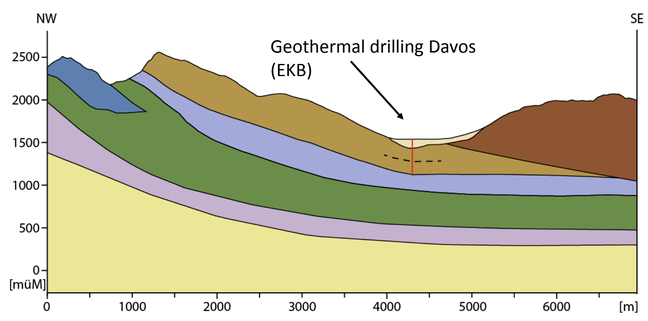

Figure 3. Cross section

Results

Regional groundwater flow is characterized by the topography driven groundwater circulation in the large-scale context.

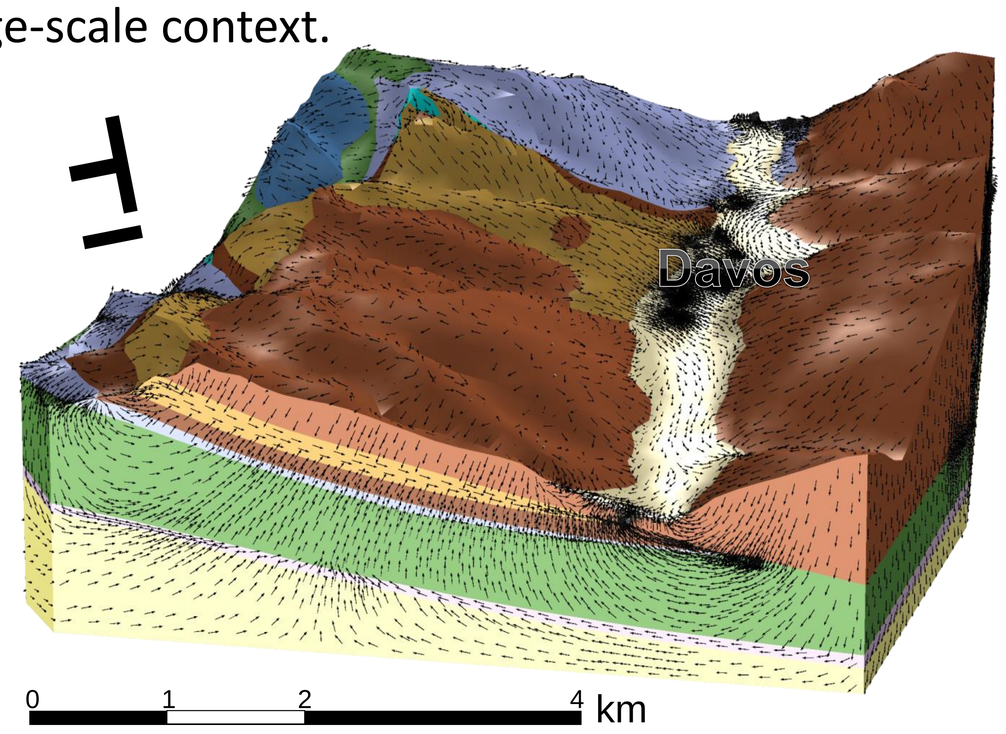

Figure 4. Result of regional groundwater modelling. The influence of the sequence of aquifer and aquitard geometries is visualized by the change of flow direction arrow

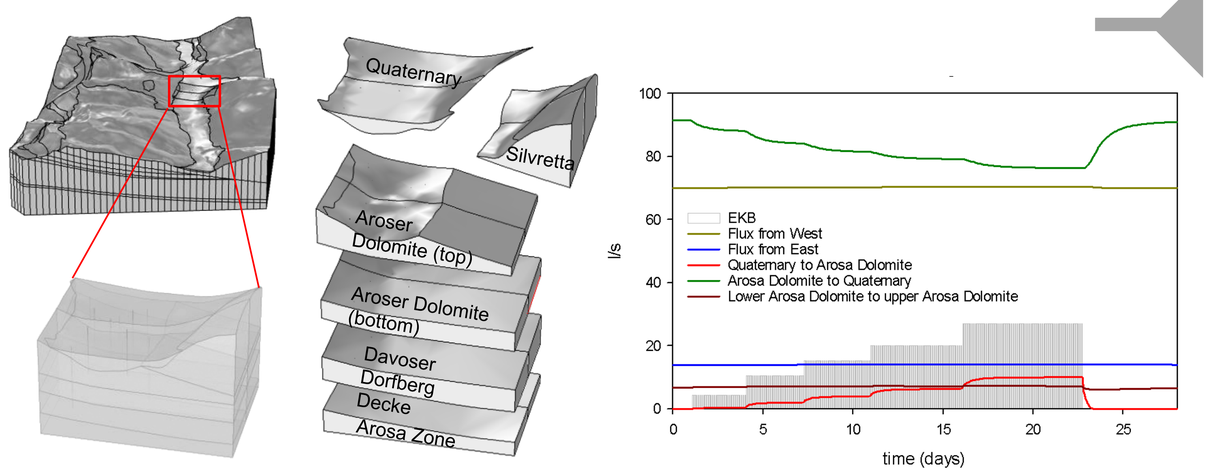

Figure 5. Box for the calculation of water flows for one calculated example

Conclusions

- The model is an expandable tool for groundwater management (shallow geothermal and regional circulation systems)
- Changes in the origin of water components of wells at large water withdrawals
- With (high) groundwater extraction, the direction of flow changes. Groundwater flows from the Quaternary to the Arosa Dolomites - but also from deeper areas
- Tool which allows under certain conditions the calculation of management scenarios

References:

1. Butscher C., Scheidler S., Farhadian H., Dresmann H., Huggenberger P. (2017) Swelling potential of clay-sulfate rocks in tunneling in complex geological settings and impact of hydraulic measures assessed by 3D groundwater modeling. Engineering Geology, DOI 10.1016/j.enggeo.2017.03.010

2. Scheidler S., Huggenberger P., Butscher C., Dresmann H. (2017) Tools to simulate changes in hydraulic flow systems in complex geologic settings affected by tunnel excavation. Bulletin of Engineering Geology and the Environment, DOI 10.1007/s10064-017-1113-5

Excerpt from the Proceedings of the 2018 COMSOL Conference in Lausanne