Inga Moeck
GeoForschungsZentrum Potsdam
Section Geothermics - Potsdam - Germany
@mail: moeck@gfz-potsdam.de

Guido Blöcher
GeoForschungsZentrum Potsdam
Section Geothermics - Potsdam - Germany
@mail: bloech@gfz-potsdam.de

External drift kriging:

A method to interpolate data of different accuracy degrees

Objectives

3D geological model building for geothermal exploration

Production of deep thermal water needs cost saving exploration strategies

Use of pre-existing data to calculate 3D structural models of the reservoir

Data base: 15 deep wells and 6 seismic sections
Data characteristics: wells were drilled between 1964 and 1990
seismic was done between 1968 and 1976

Motivation: Development of a workflow that calculates most suitably with data of different age and sources

Setting

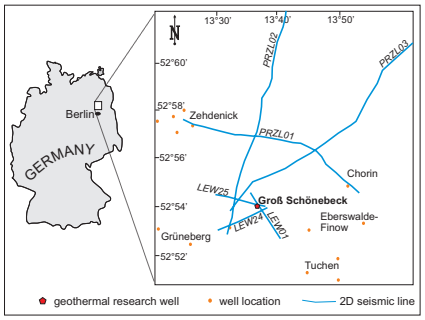


Figure 1. Location of the pre-existing 2D seismic sections and deep wells. The data were generated for gas exploration in East Germany.

Geological Model

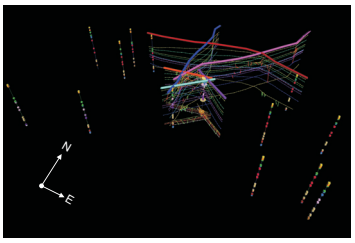


Figure 2. Input data of wells and seismic sections

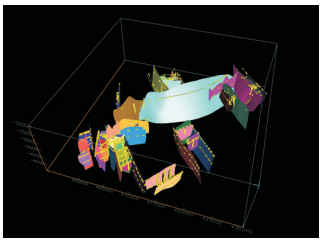


Figure 3. The fault model: Interpolation of grid nodes by inverse distance weighted average and minimum tension

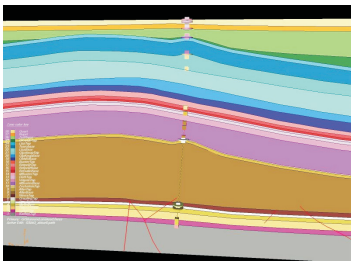


Figure 4. The stratigraphic model: Interpolation of grid nodes by inverse distance weighted average and minimum tension

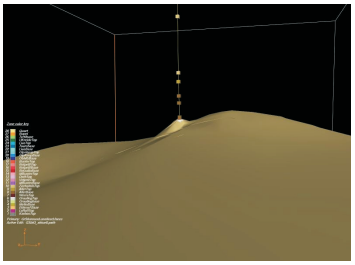


Figure 5. Bumps and dents: The result of non-statistical interpolation algorithms, in that well and seismic data have the same weights and are independed from distance and direction

Refinement by External Drift Kriging

Z-value results from a drift and an additional Random function

$$Z(u) = m(u) + R(u)$$

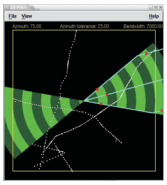
The drift function is given by

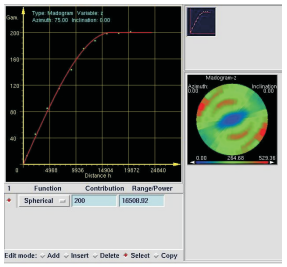
$$m(u) = a + bZ_2(u)$$

Where a and b are weight constants (determined by the variogram) and Z_2 is the external drift given by the secondary variable (seismic)

KED estimate (ordinary kriging)

$$Z^*(u_0) = \sum_{\alpha=1}^{n} \omega_\alpha Z(u_\alpha)$$

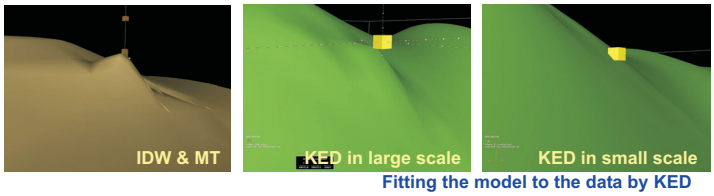




Variogram: Madogram
Search direction: 75°
Search Tolerance: 25°
Bandwidth: 7000 m
Lags: 10
Lag Tolerance: 1129.2 m
Lag distance: 2258.4 m

Resùme

Multiple source data show oftenly discontinuities in time and space with respect to accuracy



Fitting the model to the data by KED

If one source gives the general trend (seismic data) and another source supplies hard data (well data) than KED is the best estimator

With respect to modelling efficiency a pre-analysis of input data is recommended before applying KED refinement

This project is funded by the German Federal Ministry of environment and reactor safety

Workflow

3D geological modelling of multiple source data