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Integration of geophysical data into a three-dimensional geometrical model

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A 3-d subsurface GOCAD model has been developed for an industrial area near Wolfsburg (Lower Saxony, Germany) in a joint project of the GGA-Institute, the State Authority for Mining, Energy and Geology (LBEG), and Volkswagen AG who provided geological and geophysical data. The investigation area is 7.5 km x 10 km. Only Quaternary glacial and fluviatile sediments and the underlying Mesozoic (Lias mudstone, Early Jurassic) are considered. Hence the maximum depth of investigation amounts up to ca. 100 m. One aim of the project is to build up the model with geophysical data, besides the use of stratigraphic information from drillings. Seismic profiles, resistivity measurements with multi-electrodes arrays and gravity data are available from measuring campaigns. We have integrated these data in two different ways:

1. The interpreted seismic profiles are included as 3-d lines into the model. Common interpolation methods give weak results when 1-d borehole-data are processed together with 3-d lines. To circumvent this shortcoming we have applied a conditional sequential Gaussian simulation. Variogram analysis shows, that the seismic lines give significant better spatial information, compared to borehole data. The resulting surfaces therefore reflect the variability of the subsurface in a more realistic way.

2. The available potential-data have a spatial resolution which is mainly not sufficient for a direct integration into the subsurface model. However, these data are valuable, as they can be used for a validation. This is achieved by subsequent forward calculations based on the existing geometric model.

First results show that this approach is an efficient way to minimize uncertainties, especially regarding the lateral geometry of the glacial units.