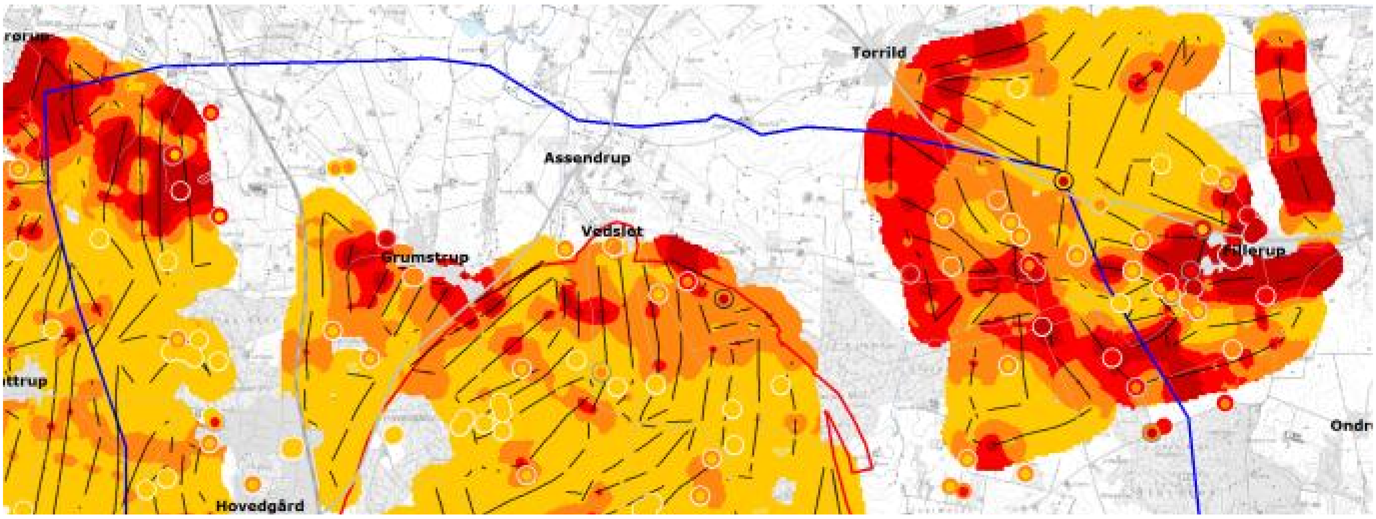

GEOSTATISTICAL ESTIMATION OF STRUCTURAL VULNERABILITY (SSV)

SSV is an efficient statistical method to combine geophysical inverted models with borehole information to optimise the resulting geological interpretation

After geophysical inversion of recently collected data, or re-interpretation of existing geophysical data, the interpreted models are often compared with information from boreholes. With the SSV inversion method information from boreholes are included in an optimized inversion of the geophysical data.

The SSV method

The SSV inversion method is designed to optimize the inversion of shallow subsurface geophysical data according to borehole information. In the inversion, lithological information from boreholes is combined with geophysical models, and the inversion optimizes on resulting translation function from resistivity to lithology.

The spatial distributed translation functions are then used to calculate the thickness of a given lithology, calculated from the inverted geophysical models.

The geophysical data input can consist of any 1D-inverted model from electrical or electromagnetic systems for example 1D-inversion of PACES, CVES or low moment airborne measurements like data from the SkyTEM-system. The geophysical models must be converted into GERDA-format, which is at database structured with all information like positioning, inverted parameters with calculated standard deviation.

Geological input consists of interpreted boreholes, converted to Jupiter-format, which is a standard Access database.

The SSV-modelling are often used to optimize interpretation of the natural protective clay layers in areas with interest of groundwater. Furthermore the SSV-method can be applied in the geological and hydrostratigrafic modelling, and hence help to understand the variation in resistivity versus lithology.

The modelling is built into the 1D-inversion code, AarhusInv and is integrated in the Aarhus Workbench software packages.

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Geostatistical estimation of structural vulnerability (SSV):

- Combined inversion of geophysical models and borehole informations.
- Optimized interpretation of the natural protective clay layers.
- Additional input to geological- and hydrostratigrafic mapping

Relevant applications

In areas where both geophysical- and borehole data are present, the SSV-modelling can be applied for different purposes such as:

- Optimize interpretation of the natural protective clay layers above aquifers.
- Additional information to the hydrostratigraphic models for example with information on varying resistivity within similar lithological layers.

Case example

I order to map the vulnerability an intensive geophysical survey has been carried out around the village Hovedgaard, using the galvanic electrical PACES method providing a detailed spatial extent of the resistivity in the upper 30 m.

The 1D-LCI-inverted models and existing boreholes data are joined together in an optimized SSV-modelling with the purpose to map the natural vulnerability in the area with great interest in groundwater. The thickness of clay layers is taken from the description of the boreholes and is included in the SSV inversion.

After an iterative process the optimized translation function from resistivity to clay layers are found, and is migrated to the inverted 1D-models for to inversion of the PACES-data.

Figure 1, to the left shows a close-up on the result, where the background is the resulting clay thickness based on the inversion of the PACES data. The inner circle shows the input clay thickness from the borehole and the middle circle shows the resulting output clay thickness in the same borehole. The standard deviation of input-output thickness is shown with the grey scaled outer circle.

Figure 2 shows the resulting geophysical clay thickness in the survey area in the upper 5 m. The thickness is based on the geophysical models, using the resulting translation function. This geophysical clay thickness will be an important input data for identifying areas that have to be protected from for example percolating substances.

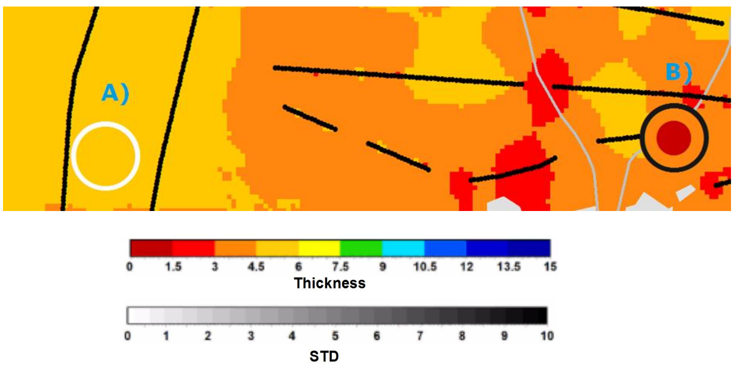

Figure 1: Illustration of boreholes where good correlation is shown at A), and bad correlation is shown at B).

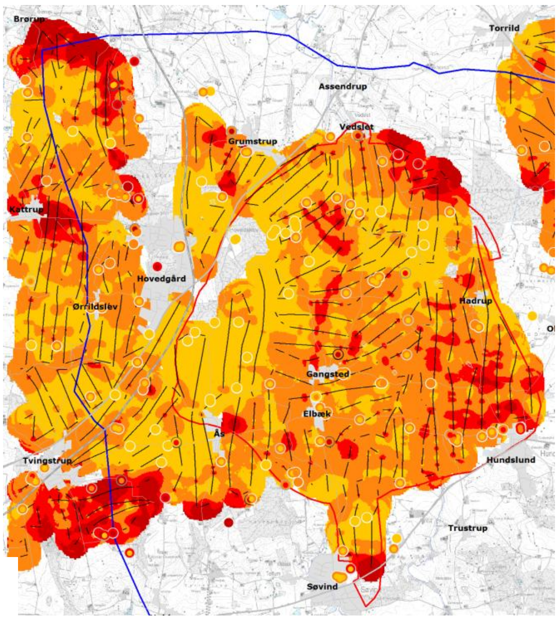

Figure 2: Calculated resulting geophysical clay thickness based on SSV modelling of borehole data and PACES data