Resistivity tomography, an underestimated tool for mapping fresh salt groundwater interface.

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ABSTRACT

Why does resistivity tomography (DC, EM) not always fulfill the (high) expectations?

For mapping the fresh and salt water interface subsurface resistivity is an important parameter because of the good contrast between sediment with salt and sediment with fresh water. Several methods can be used for measuring the earth resistivity, two methods are commonly used: Differential current systems with electrodes and EM methods which use the inductive coupling of EM fields.
All methods have their specific limitations and applications (exploration depth, resolution, noise) and the applicability depends on target depth, size, contrast and terrain conditions. At the same time, when a method is used, the configuration of the instrument itself is essential for obtaining good quality data. The data itself should be treated in the right way to generate useful inversions. And last but not least the inversion, which is a model of a resistivity distribution of the subsurface, suffers from equivalence. The problem of equivalence (one data set has more than one solution and the calculated (specific) resistivities are both influenced by water quality and lithology. Equivalence can be easily resolved with the combination of other methods.
In order to do a successful survey several essential aspects are important:

1) Terrain condition (topography, accessibility resistivity of the top layer, possible sources of noise.
2) Instrument choice, configuration and forward modeling of the expected target, checking for the best configuration.
3) Fieldwork, be well prepared for the unexpected……
4) Interpretation and verification with other methods.

This poster will show the do's and don'ts for obtaining a successful result.
This will be illustrated by several case studies. The examples include fresh water under the sea (measured along the beach and with an underwater cable), small lenses of fresh water in agricultural fields, and CVES measurements in coastal and dune areas of the Netherlands. Also the benefits of forward modeling for testing if the target is detectable are presented.

Example

Influence of topography of the seafloor on the inversion of underwater surveys

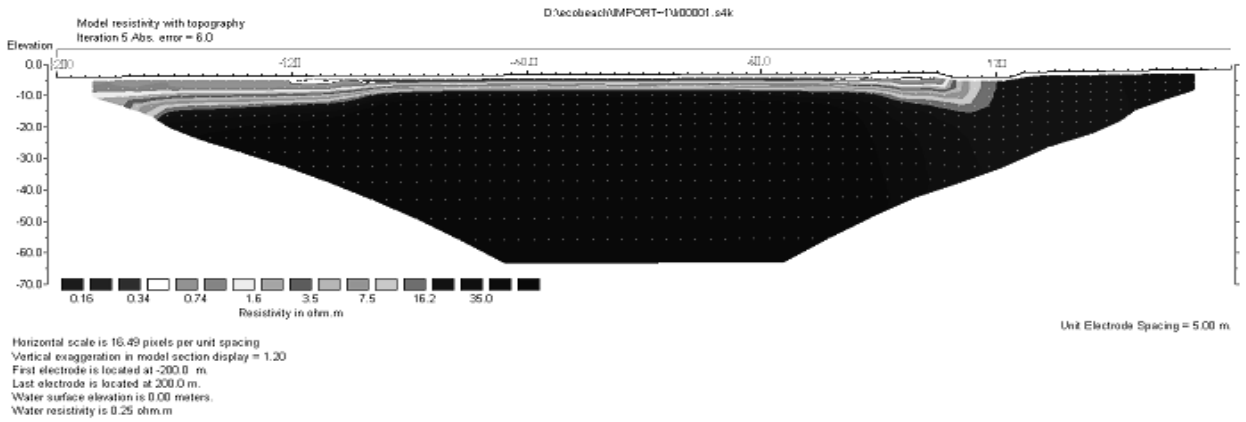

Figure 1a, CVES (Terrameter, ABEM lund), under water survey perpendicular Dutch coast, showing the influence of seafloor topography (on the right) on the inversion. (3-4 m salt water depth), light colors: sea water, dark colors: relative fresh groundwater, Wenner configuration, 64 electrodes, 5 m interval, fitting error 6%)

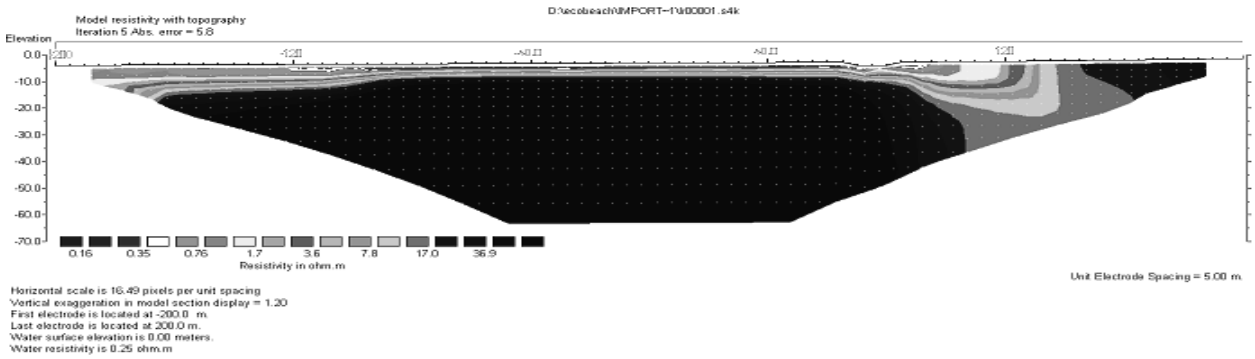

Figure 1b, the same CVES as in 1a, with slight change in seafloor topography, fitting error 5%.

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