

Unsupervised delineation of landfill geometries based on geophysical imaging results

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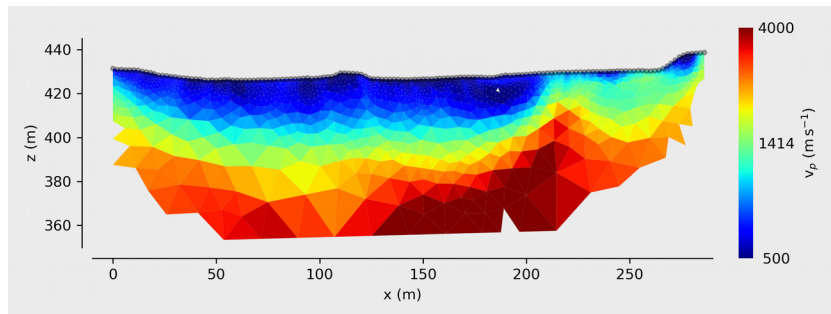
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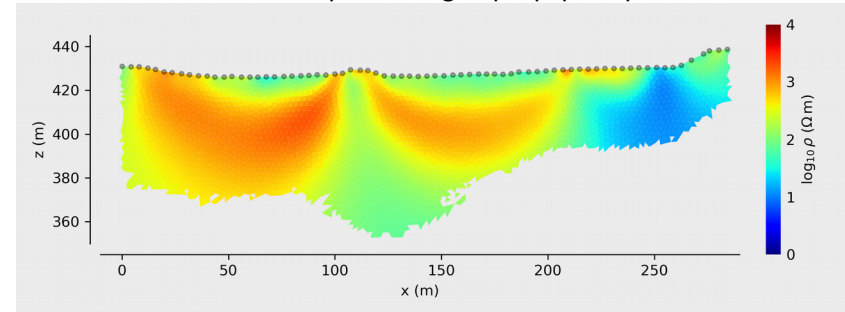
The motivation ...

- Geophysical imaging methods permit
 - the quasi-continuous collection of data
 - in a non-invasive and
 - cost-efficient manner

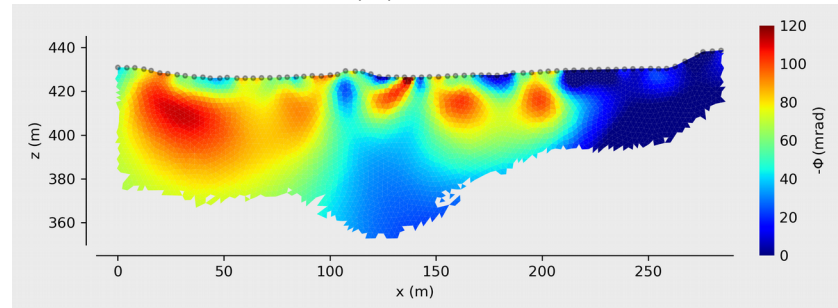
Seismic Refraction Tomography (SRT)



Electrical Resistivity Tomography (ERT)

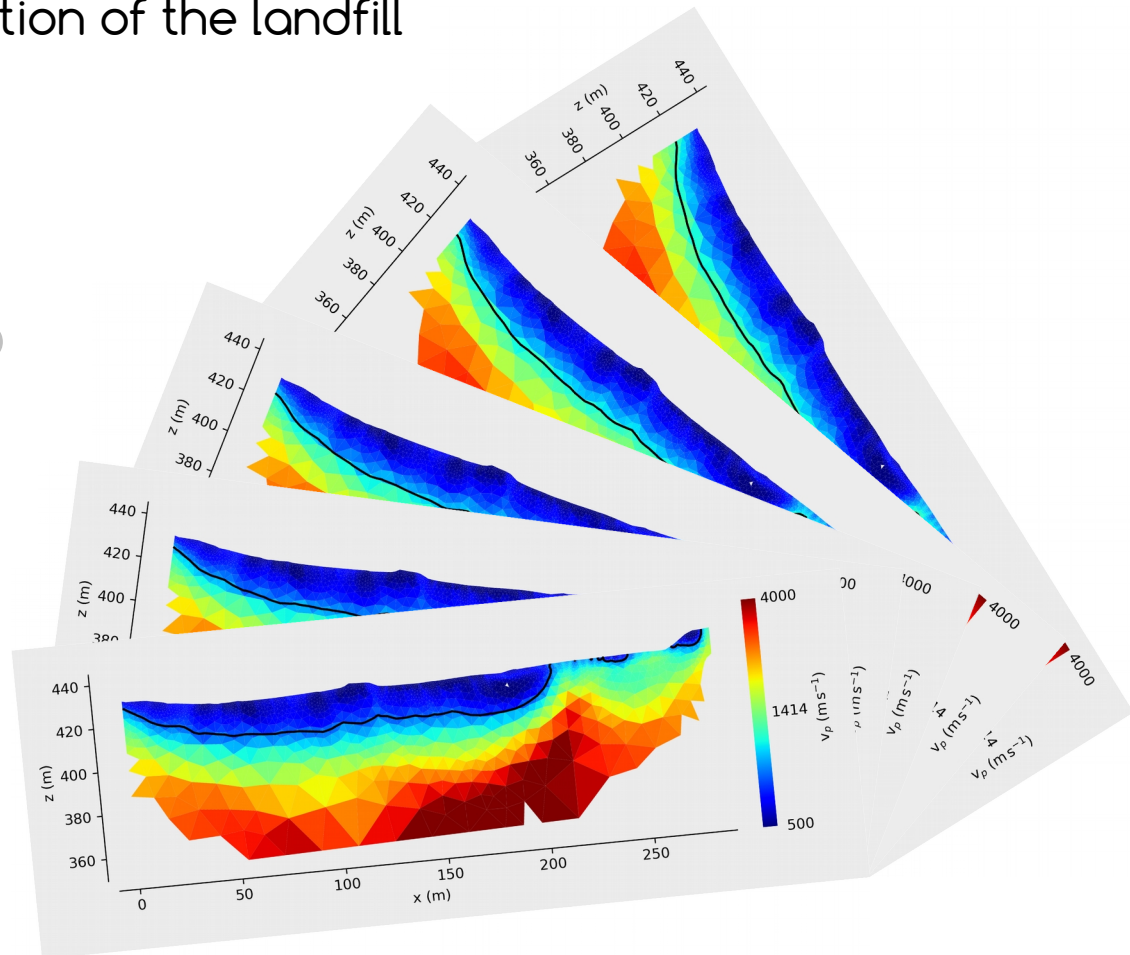


Induced Polarization (IP)



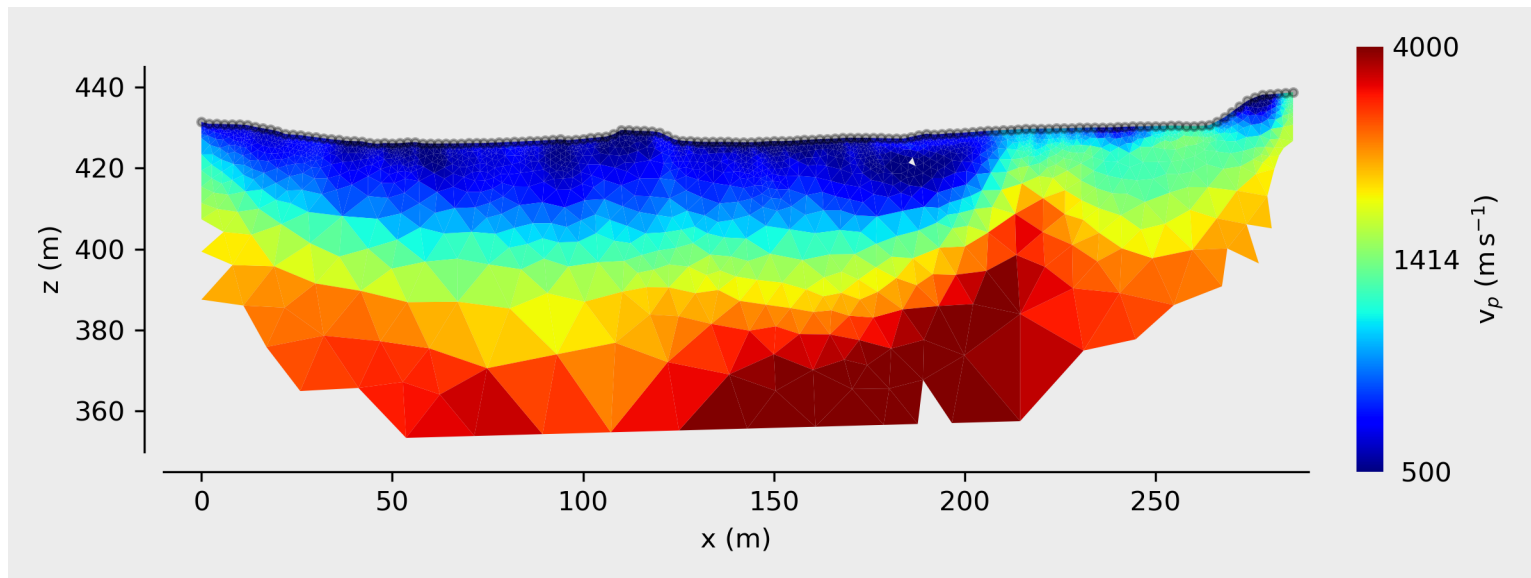
- However, subjective perception of imaging results might bias the interpretation
- Subsequent delineation of the landfill geometry affected

Which model to choose?

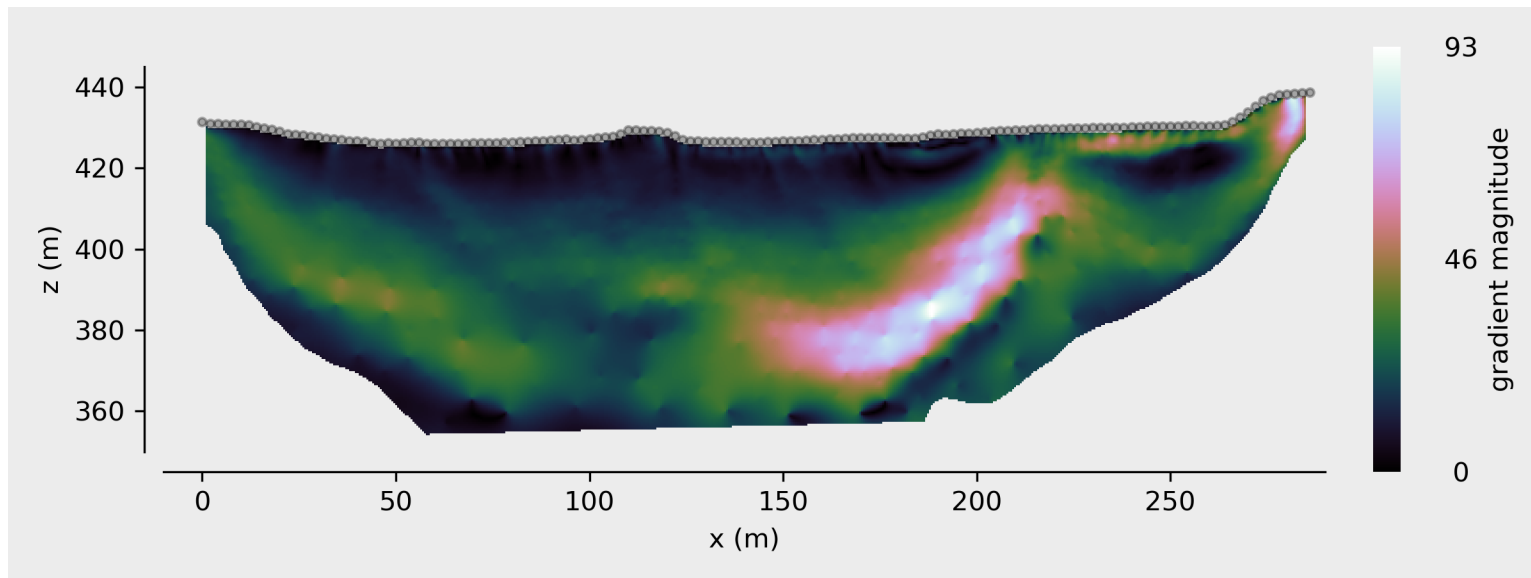


The approach ...

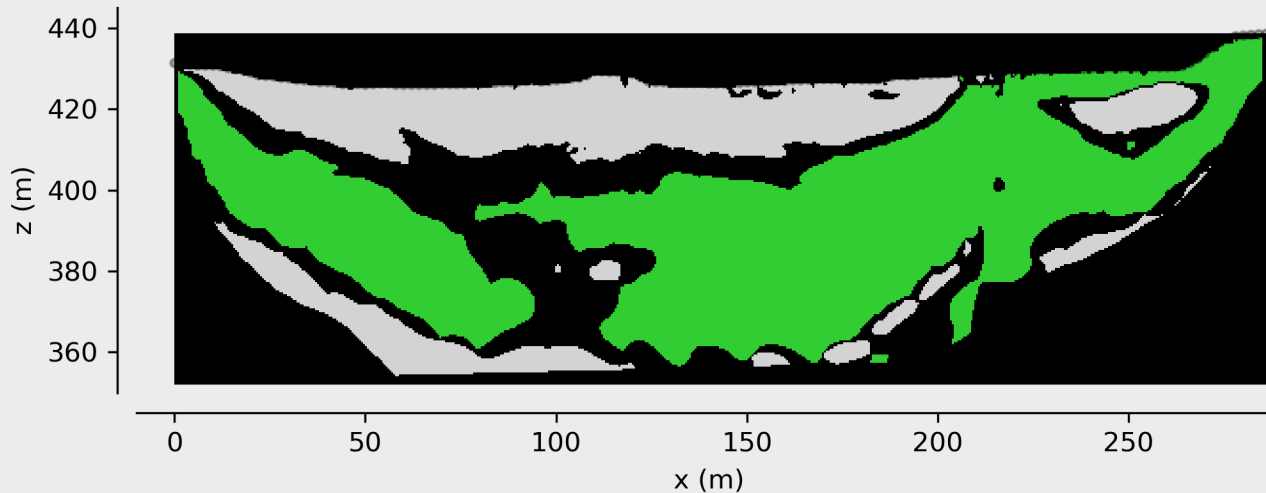
- Invert seismic refraction data collected at the landfill with pyGIMLi (Rücker et al., 2017)
- Apply an unsupervised method on seismic velocity models to automatically assess the landfill geometry



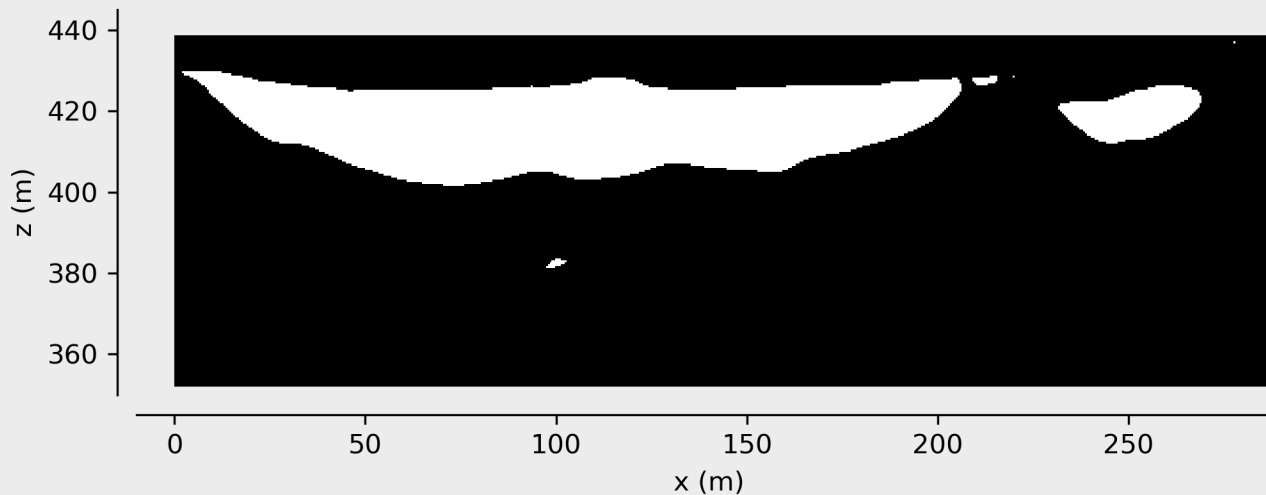
- Compute velocity gradient in x and z direction and plot the magnitude of the gradient vector for each pixel



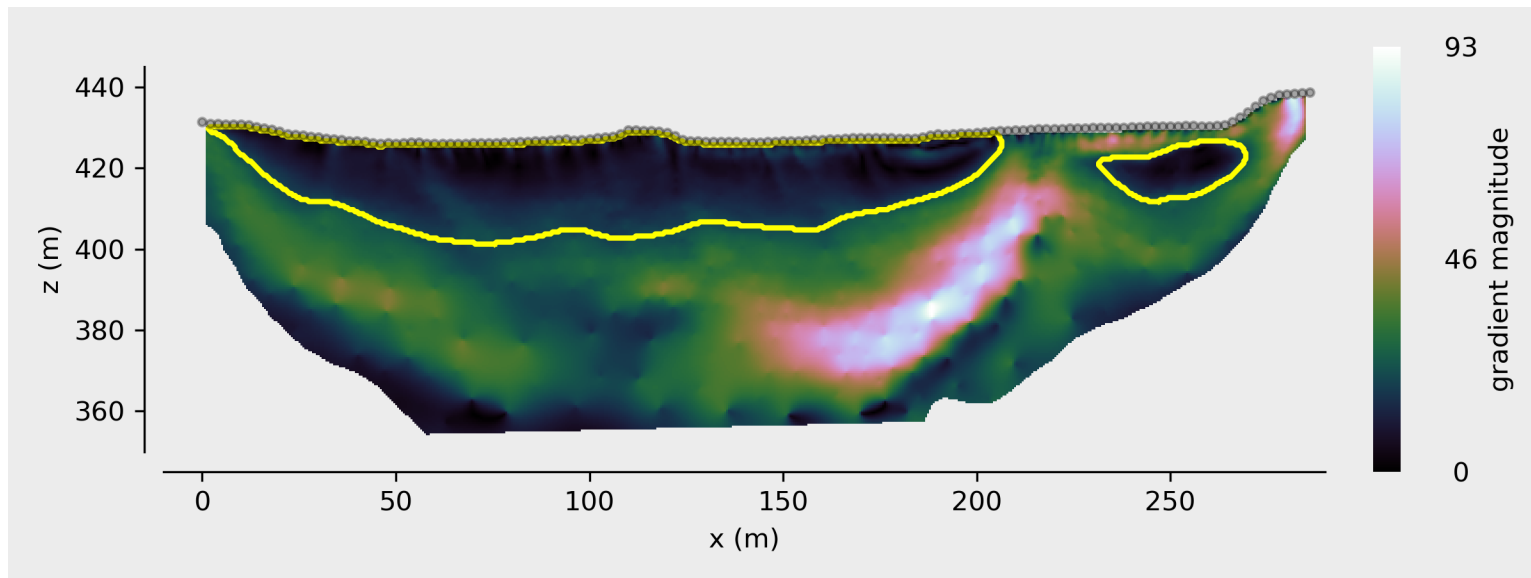
- Divide the gradient magnitude values based on the median value into three groups
- Assign distinct marker values to these groups



- Use a random walk algorithm to segment the subsurface based on the defined zones

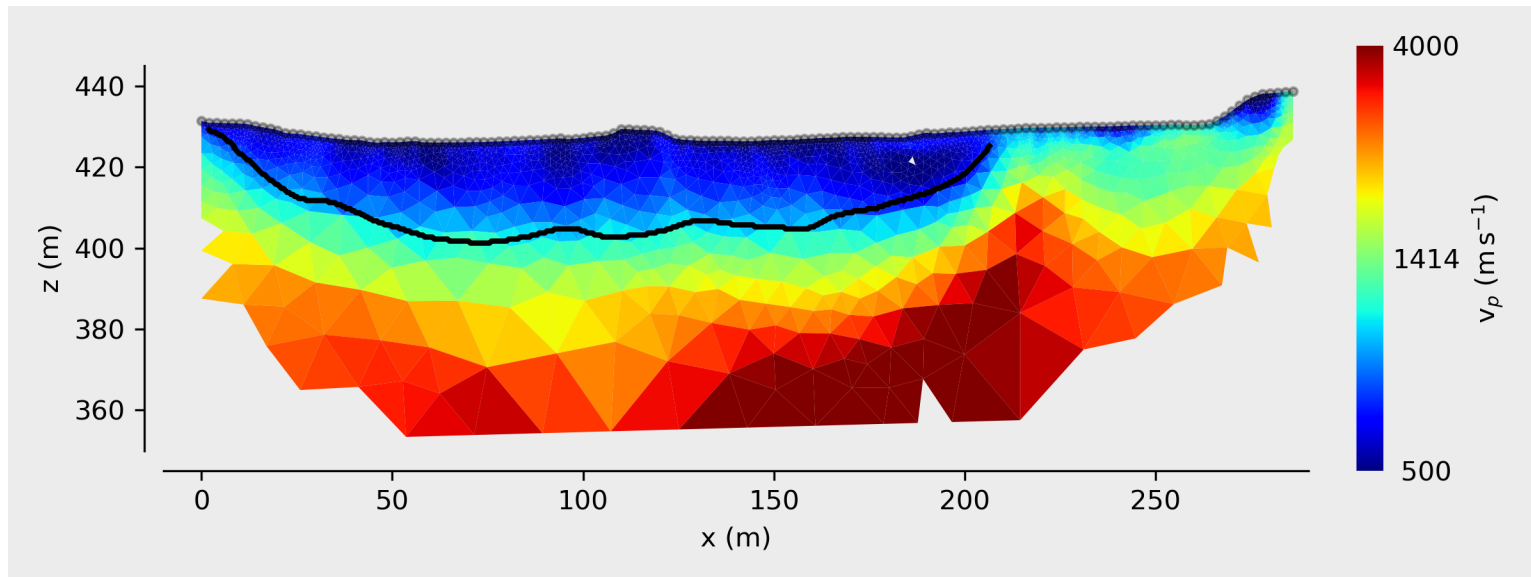


- Based on the gradient magnitude our method identified two subsurface regions presumably corresponding to the landfill body

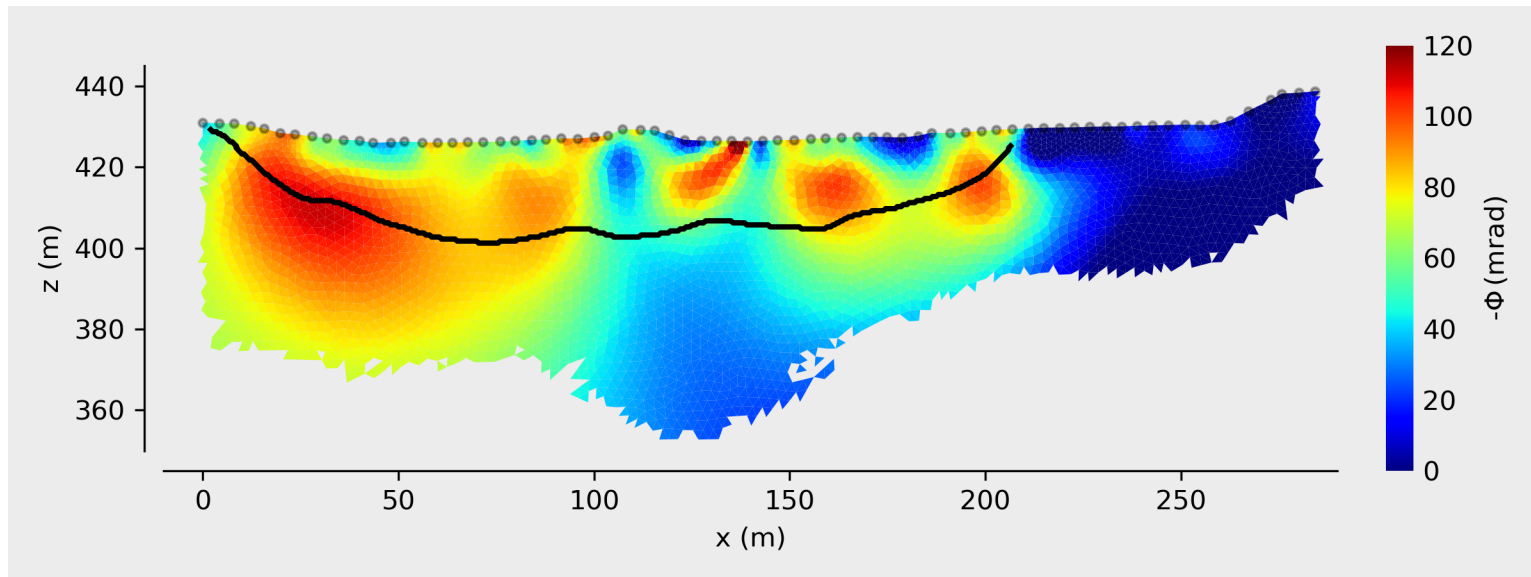


- Use the geometry of the segmented polygons to deduce information regarding the geometry of the landfill base

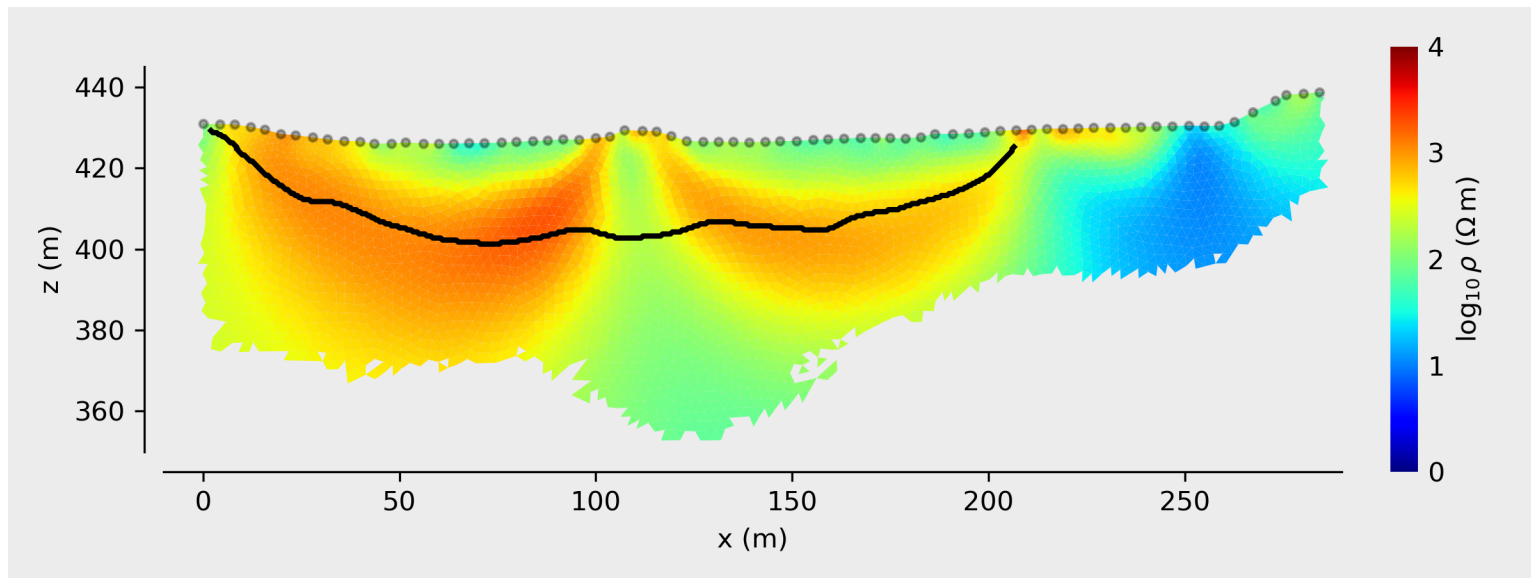
→ Verification?



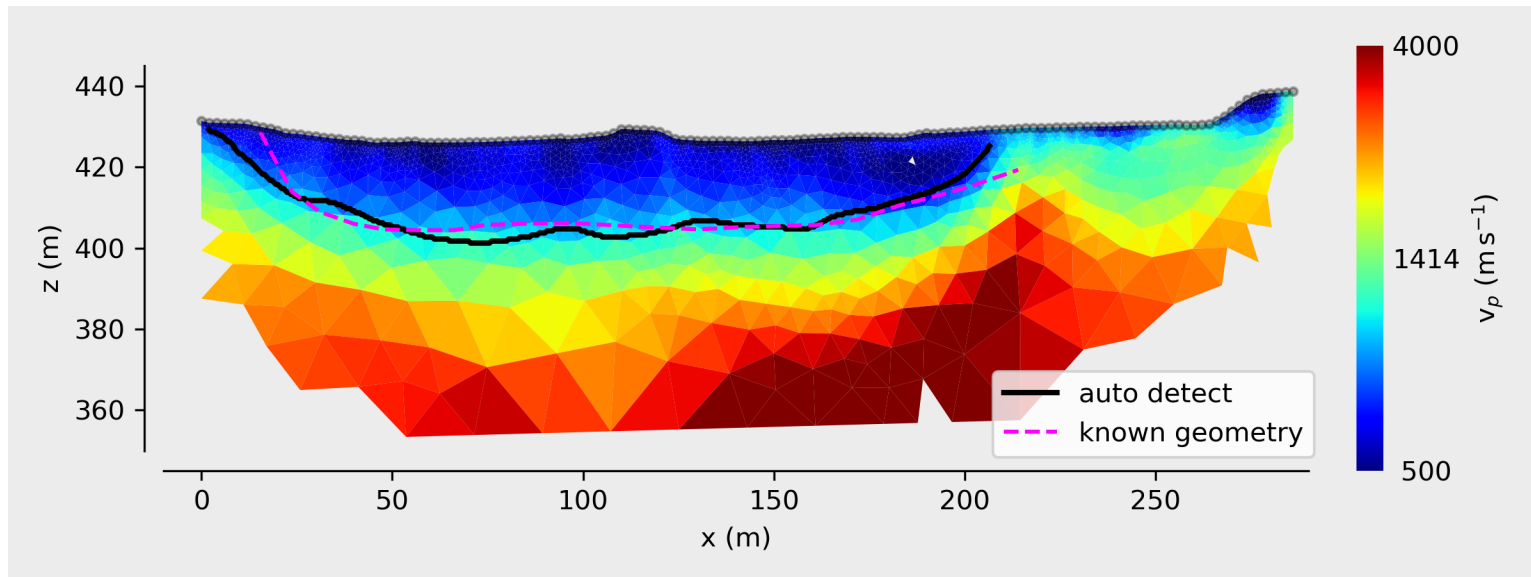
- Flores Orozco et al. (2020) showed
 - that the IP is less affected by leachate, and thus
 - is more sensitive to the landfill geometry than the ERT
- Observed IP anomalies are consistent with the delineated landfill body



- The ERT is widely-used method for waste characterization in landfill investigations; yet, the method is less sensitive to the landfill geometry (e.g. Nguyen et al., 2018).
- Accordingly, the ERT image is of limited use for the verification of the automatically delineated landfill geometry



- Officially reported landfill base manually delineated based on the seismic velocity model and direct information regarding the landfill geometry
- The automatic interface detection resolved accurately for the known geometry of the landfill



The conclusion ...

- We used geophysical methods to investigate the geometry of a landfill
- We developed a method to automatically delineate the base of the landfill
- We could verify the automatically delineated landfill base with existing information and other geophysical methods

- Incorporate the obtained structural information in the inversion of other geophysical data sets
- Apply our method on data collected at different landfills
- Extend our method to permit the assessment of other relevant parameters, e.g. the waste composition, in frame of joint inversion applications

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Mapping biogeochemically active zones in landfills with induced polarization imaging: The Heferlbach landfill

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4TH INTERNATIONAL SYMPOSIUM ON ENHANCED LANDFILL MINING - MANAGING PAST LANDFILLS FOR FUTURE SITE DEVELOPMENT: A REVIEW OF THE CONTRIBUTION OF GEOPHYSICAL METHODS

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Research paper

pyGIMLi: An open-source library for modelling and inversion in geophysics

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