Seismic and EM monitoring for DAPwell project

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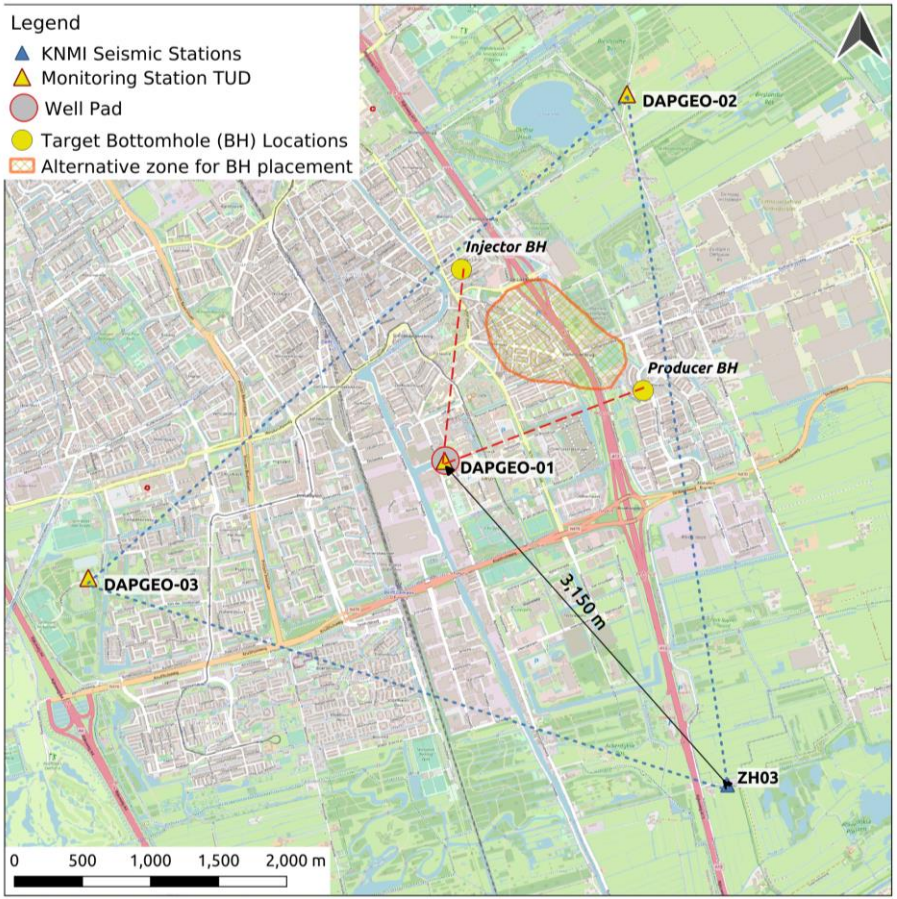
Aims of seismic and EM monitoring

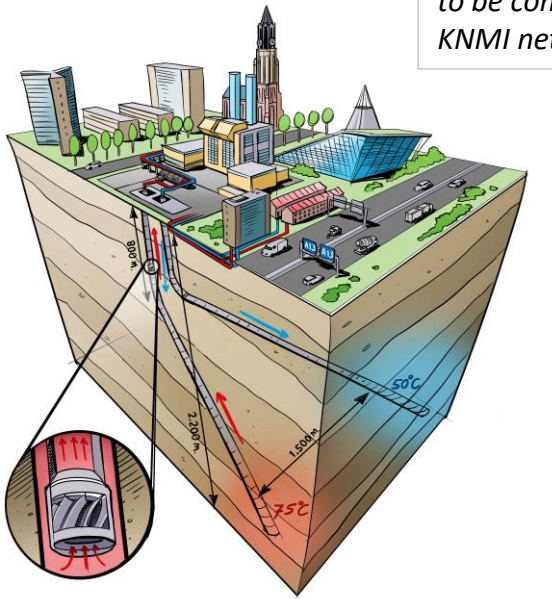
- **Passive monitoring for possible induced seismicity**
- **Passive monitoring for near-borehole micro-fracturing**
- **Active-source 3D seismic and Electromagnetic (EM) monitoring of geothermal production process, via surface-to-borehole configurations**
- **Seismic sensing in borehole via Distributed Acoustic Sensing (DAS)**
- **EM sensing in borehole via novel capacitive sensors**

Location



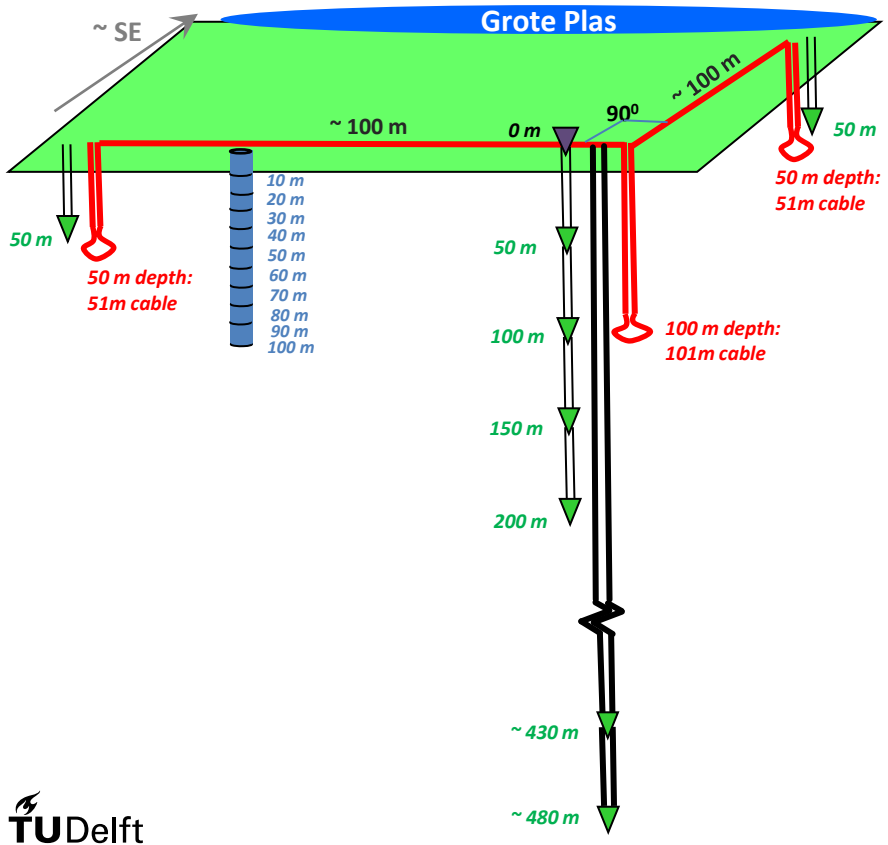
Purpose	Dedicated infrastructure
Seismic monitoring	**DAPGEO network**: DAPGEO-1, 2*, 3. **KNMI network**: ZH03.
DAS testing	DAPGEO-2
EM monitoring	DAPGEO-2

Geophones & accelerometers in DAPGEO-2 planned to be connected to KNMI network

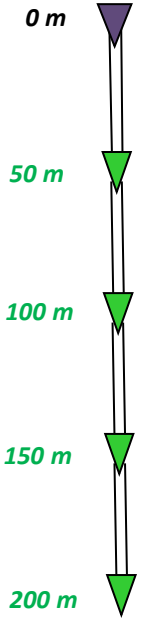


Borehole stations

DAPGEO-2 site:



All other sites:

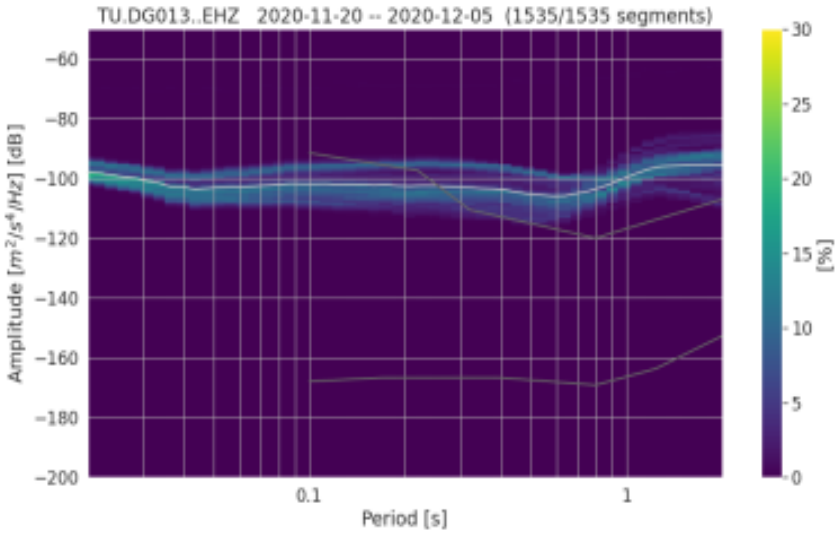


Legend:

- 3-c accelerometer (only in ZH03 and DAPGEO-2)
- 3-c geophone
- DAS: (at least one) straight and one helically wound fibre
- EM electrode

Seismic data quality

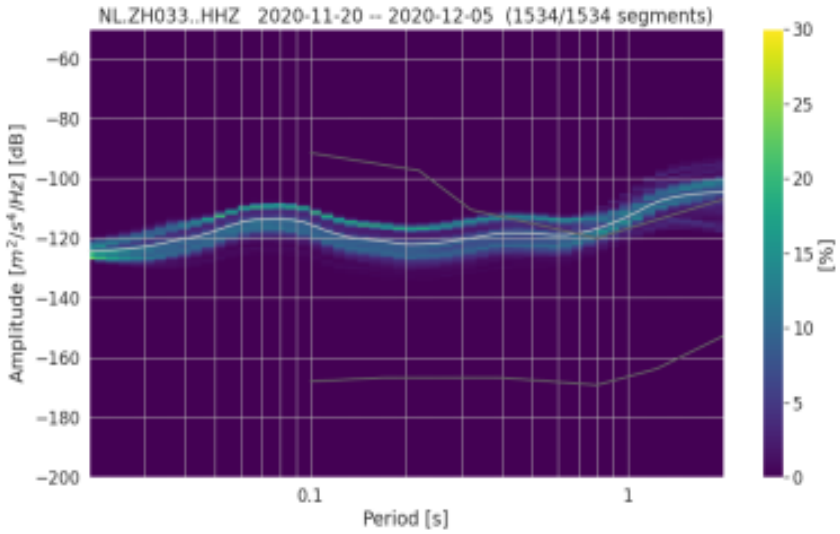
DAPGEO-1: 150 m, Z-component



DAPGEO-1 located in TUD Campus:

- Multiple noise sources
- Machinery operating 24 hrs/day

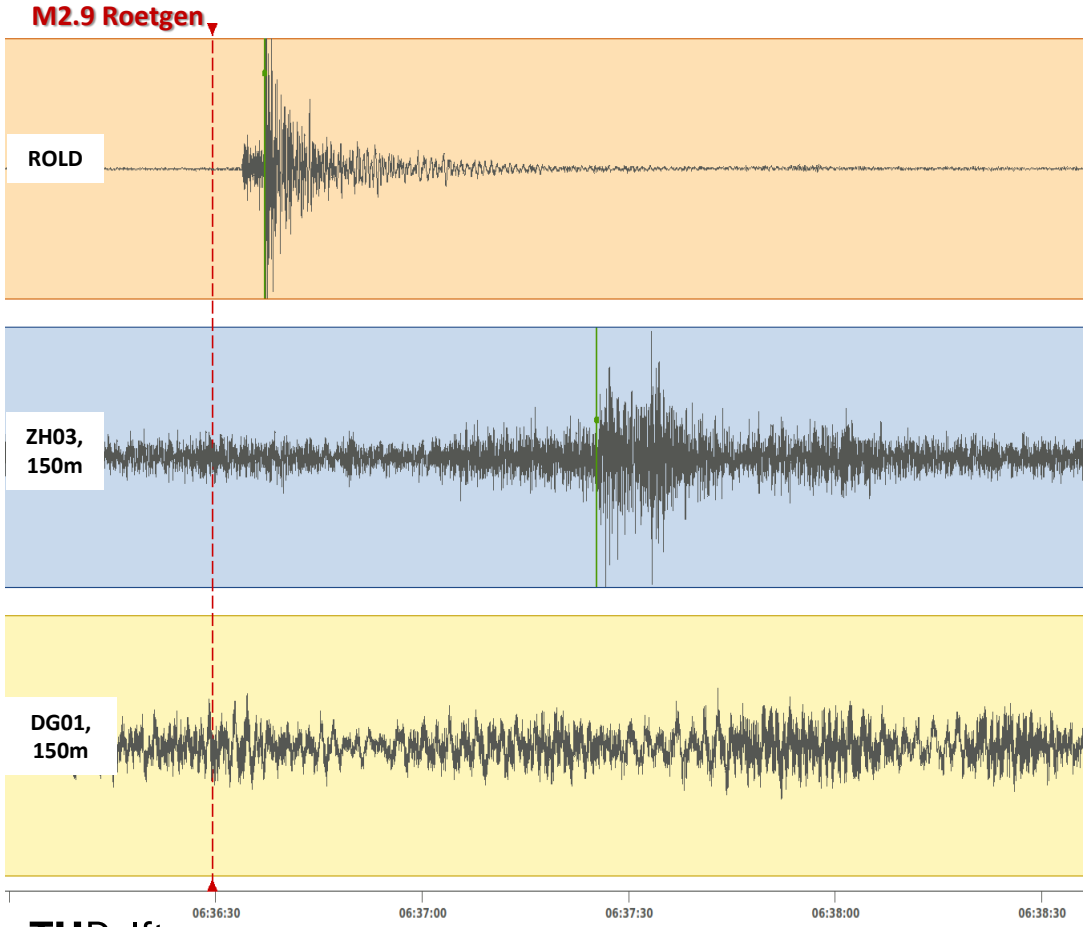
ZH03: 150 m, Z-component

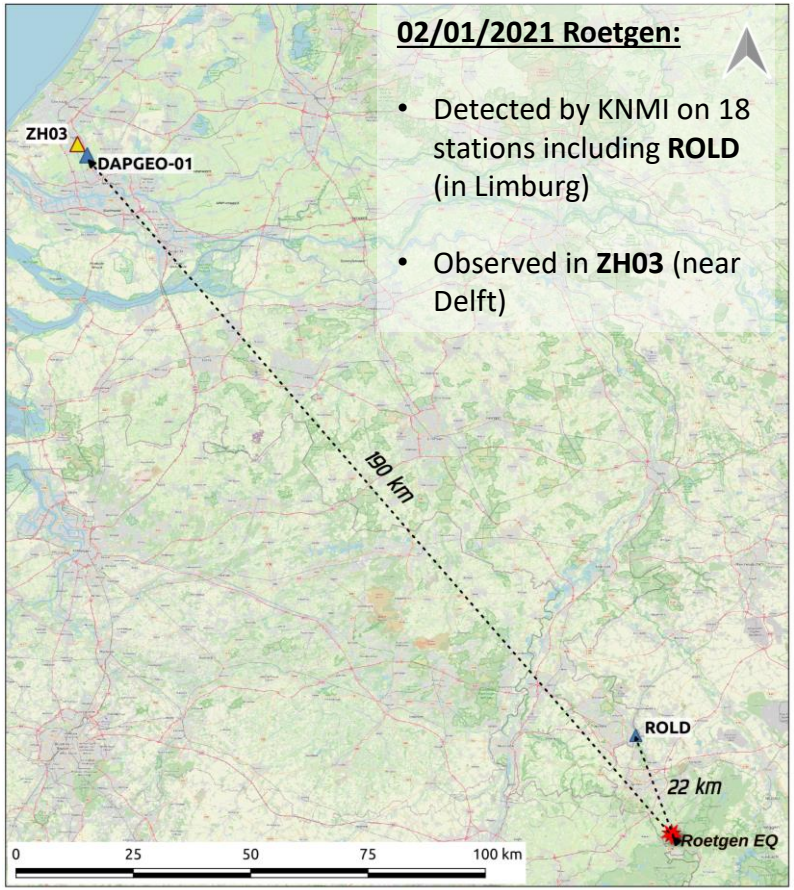


ZH03 located in rural area:

- Quiet environment
- Seasonal variation (farming activities)

Event detection: Roetgen earthquake

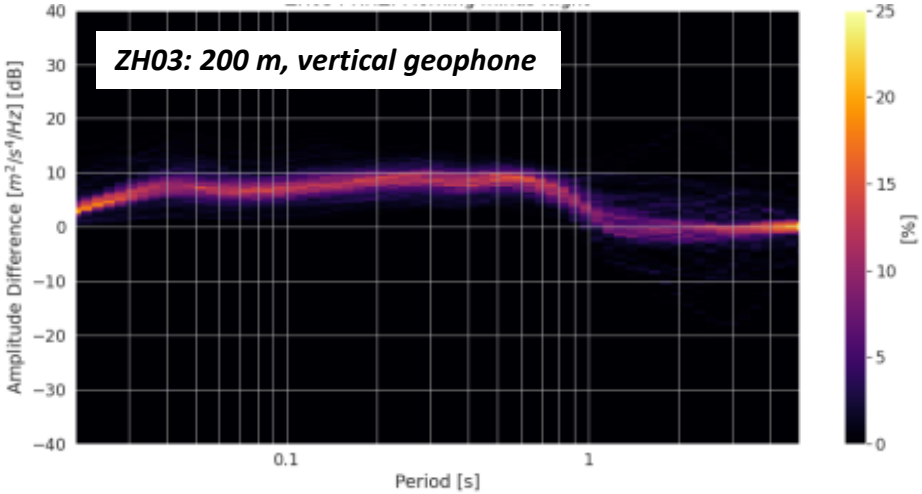




Characterization of ambient noise: effects traffic and wind

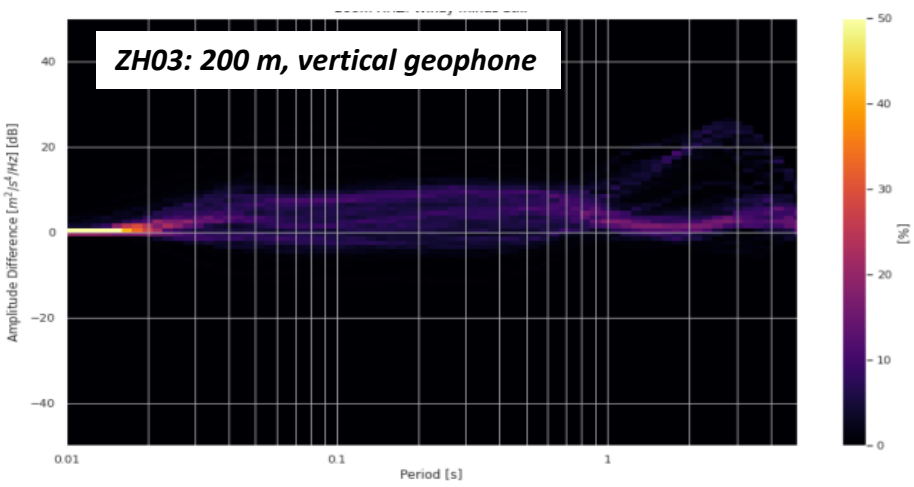
Difference rush and night hours

(~ 10 dB above 1 Hz)



(April-August 2020).

Difference still (< 4m/s) and windy (> 8 m/s) hours (up to 5dB)



(April-August 2020)

Microseism in station ZH03

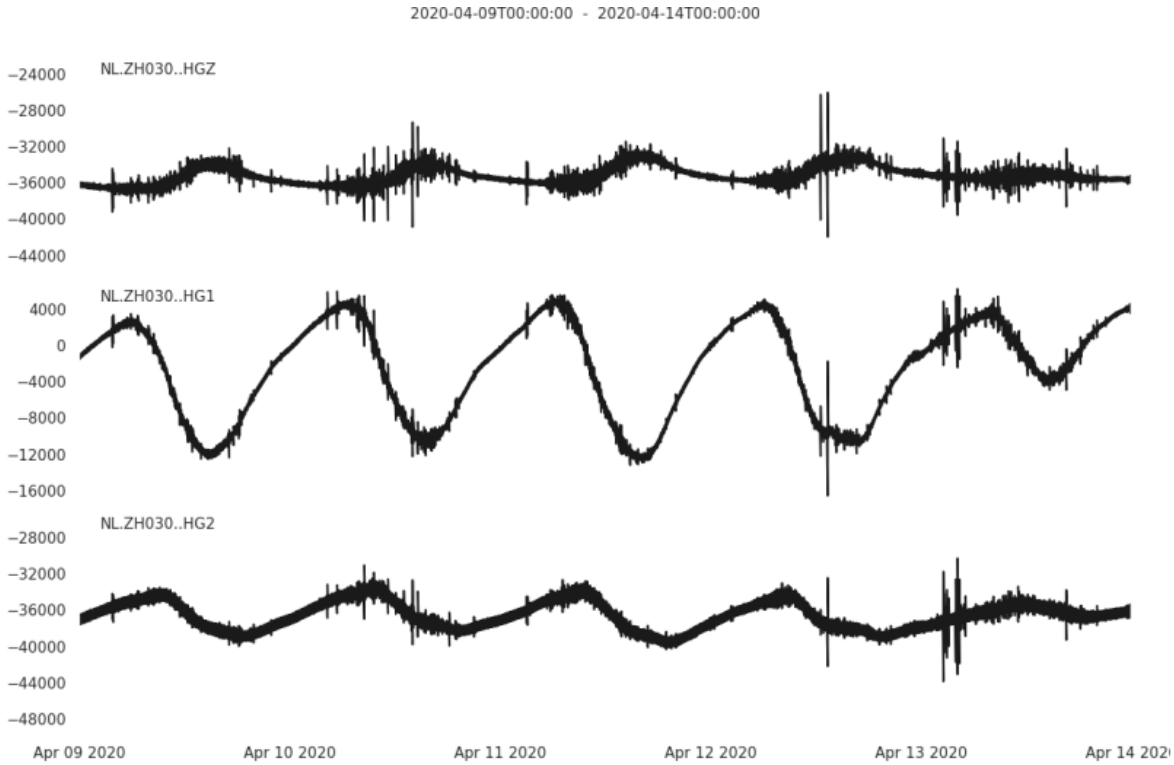
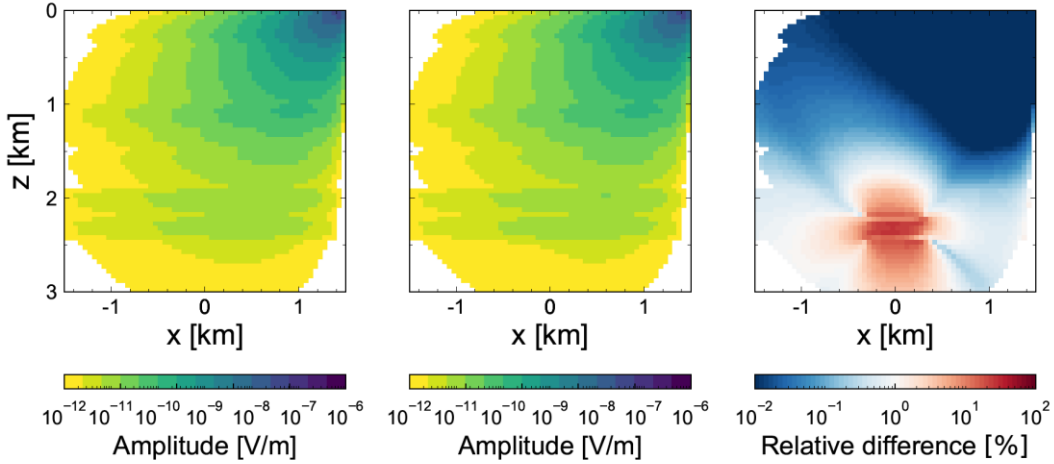


Figure 14: Effect of diurnal tides recorded by surface accelerometer Etna-2.

EM monitoring in DAPwell

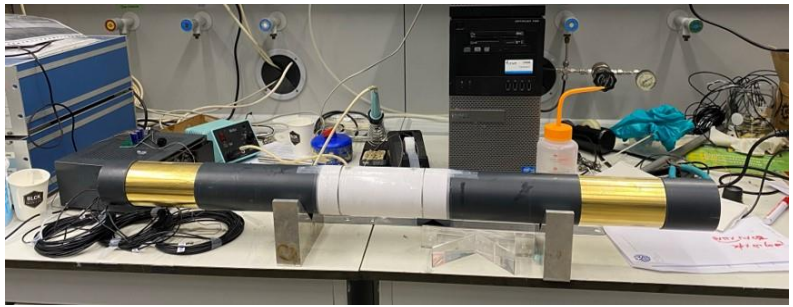


(courtesy of Mahmoud Eltayieb, unpublished)

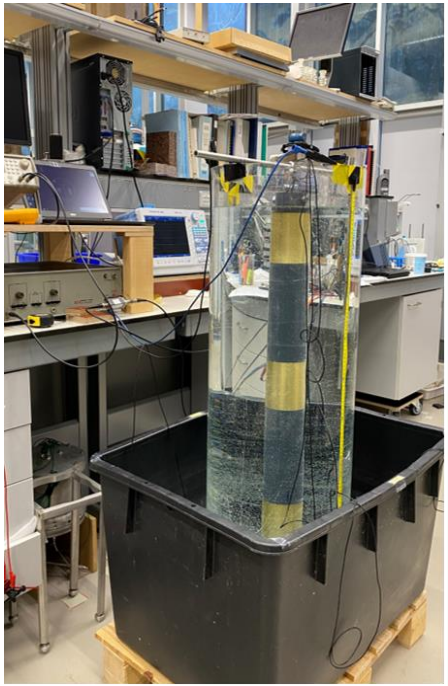
Time-lapse z-component electric field for base (left) and monitor state (middle), and difference (right) where cold front advanced 300m from injection well

- Evaluate potential of surface-borehole CSEM monitoring to detect cold front propagation.
- Modelling study using DAPwell configuration.
- Design and development of novel borehole EM sensors, data processing and inversion methods.

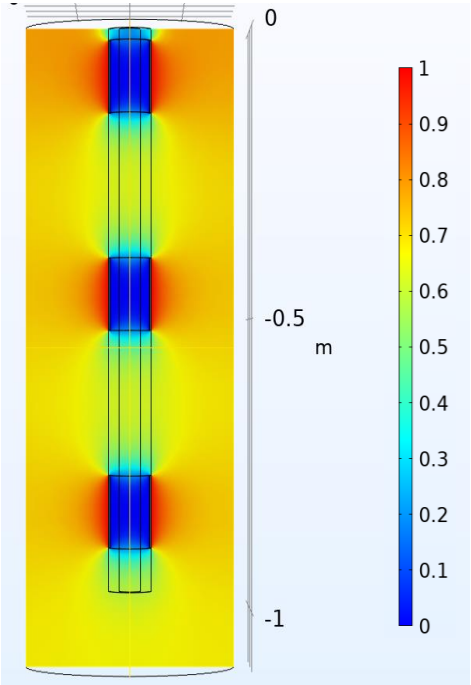
Fabrication, Numerical Modelling & Lab Testing of novel capacitive EM sensors



Casting epoxy over electrode foil

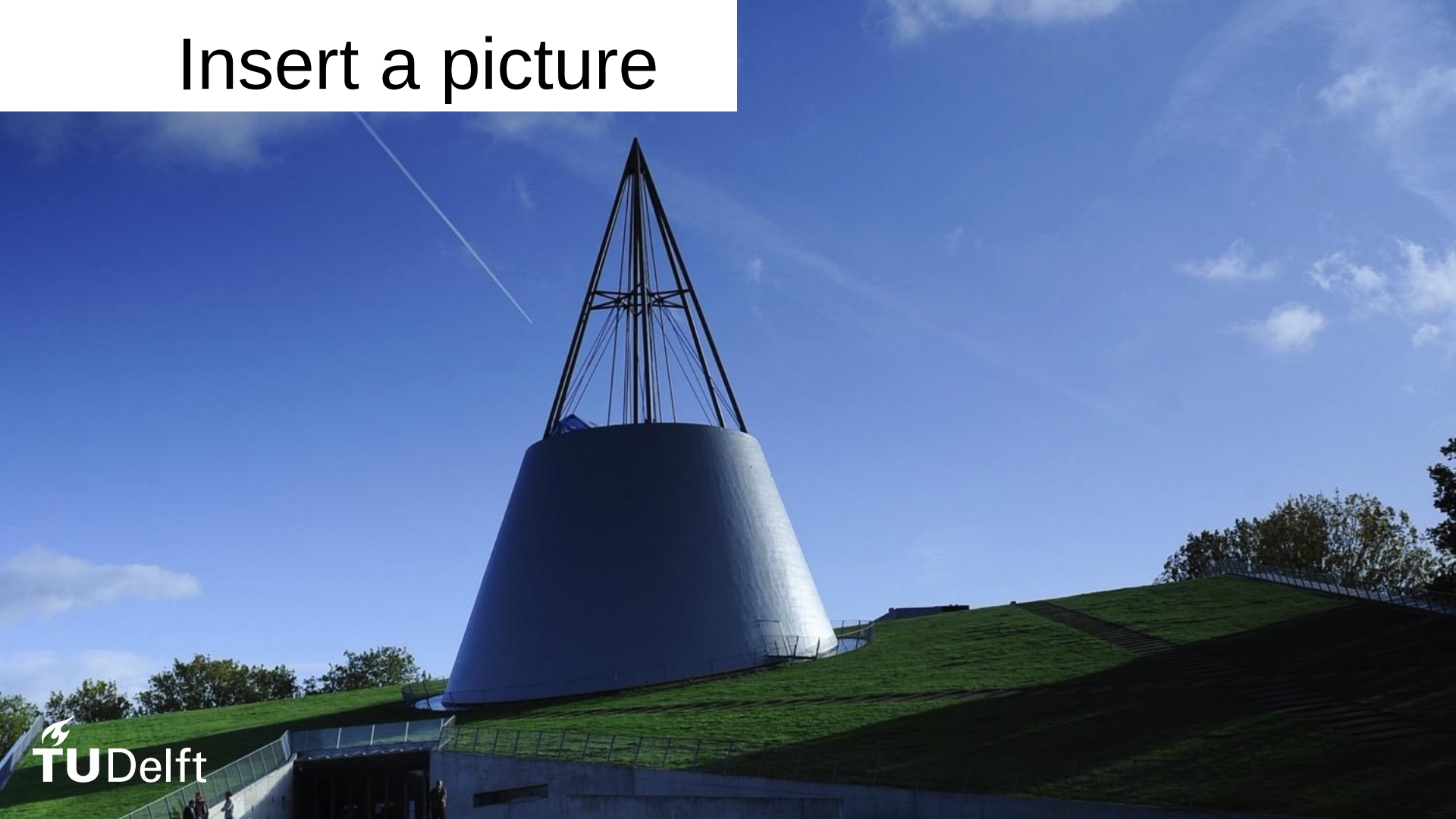


Water tank tests



Electric potential distribution

Insert a picture



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