

Royal Netherlands  
Meteorological Institute  
Ministry of Infrastructure  
and Water Management

**Interreg**  
Euregio Meuse-Rhine



# Noise modeling and attenuation relations in the EMR site



**E-TEST** Einstein Telescope  
EMR Site & Technology

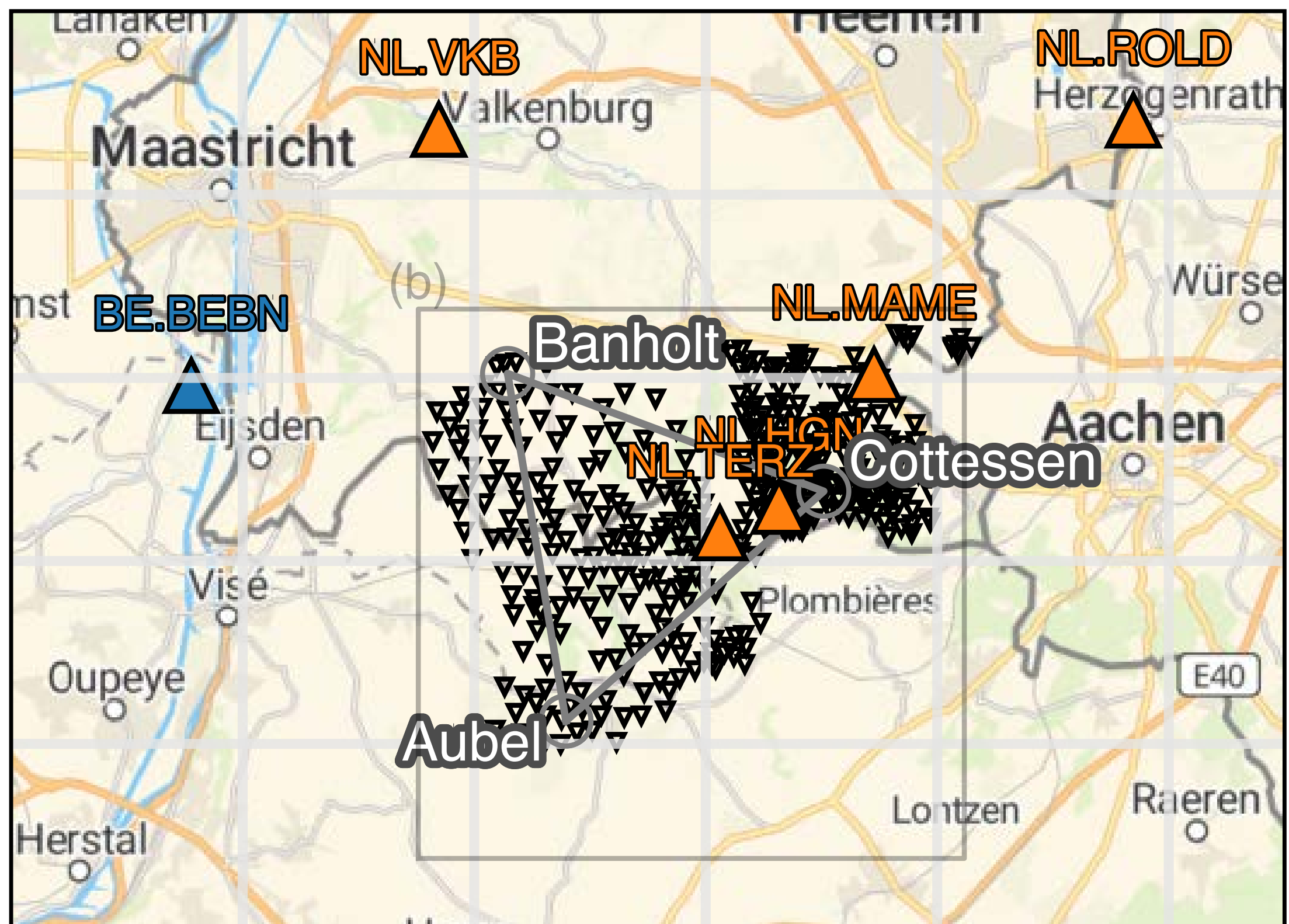






# A rich network of seismic sensors

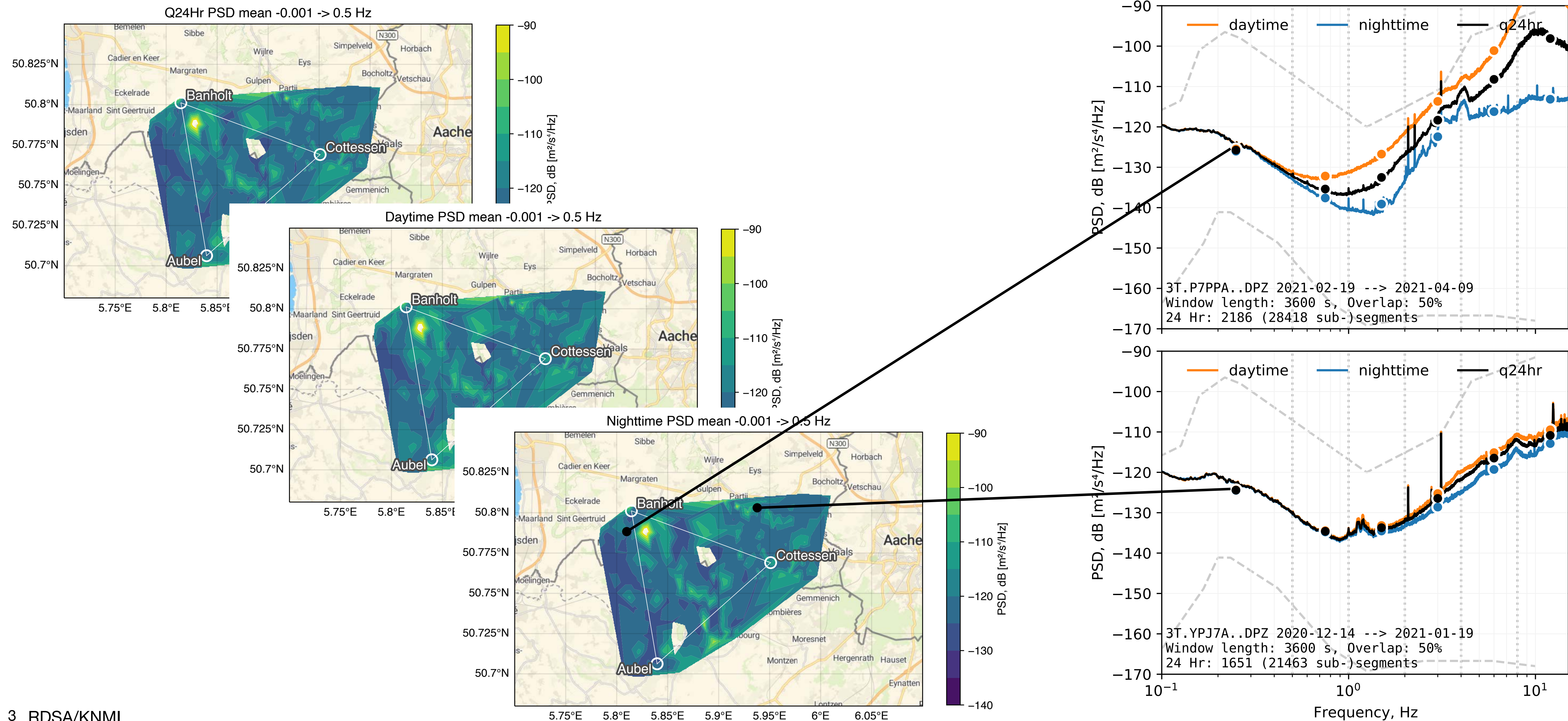
1. Seismic noise characterisation for the optimal location of the ET corner-points.
2. Imaging the subsurface to support geotechnical engineering efforts.
3. Extending the existing seismic network in the region: 15 new broadband seismic stations (surface) & 4 new broadband borehole seismic stations (250 m depth)







# Spectral maps of seismic noise levels

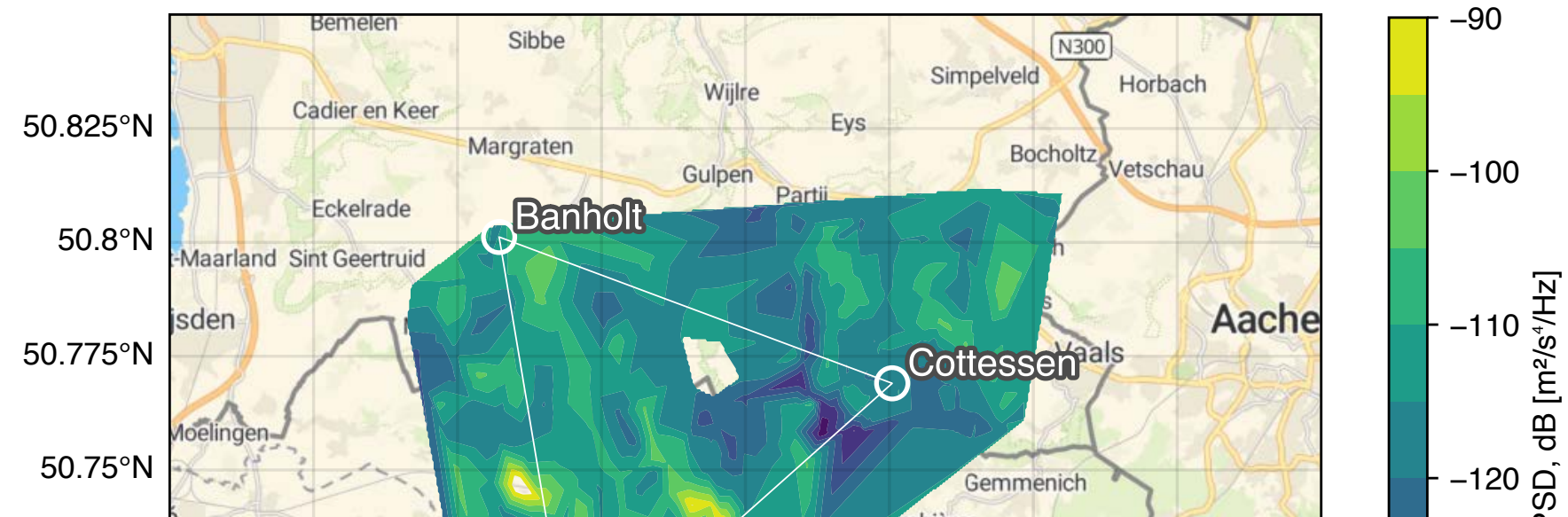




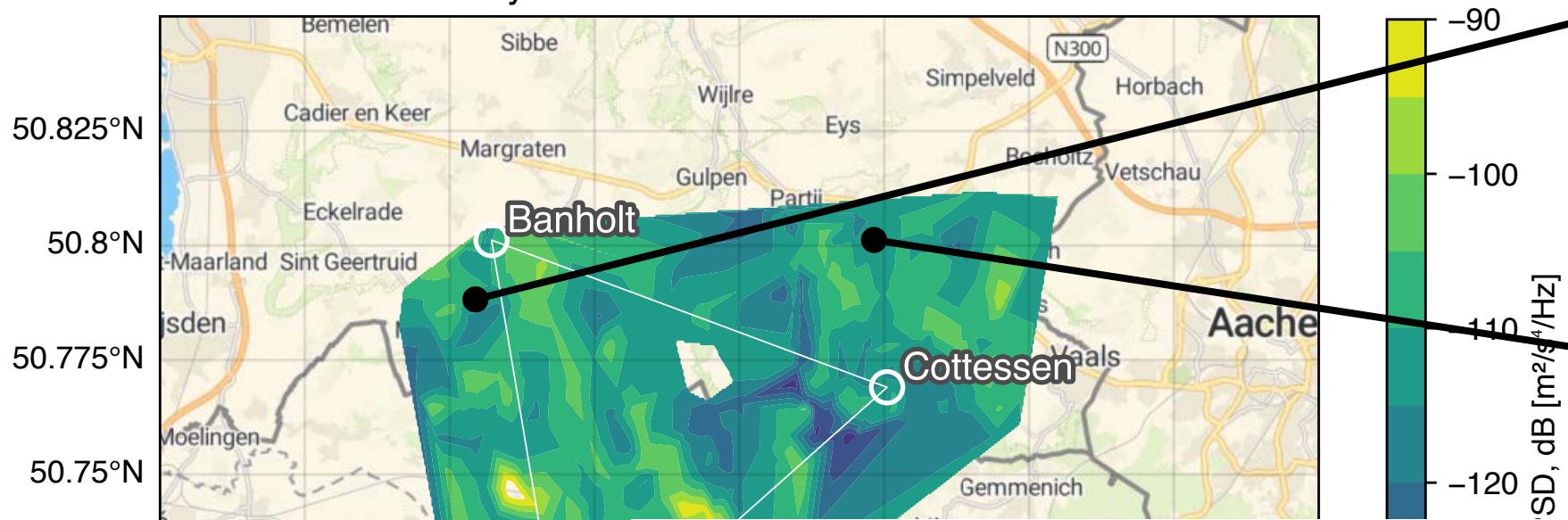


# Spectral maps of seismic noise levels

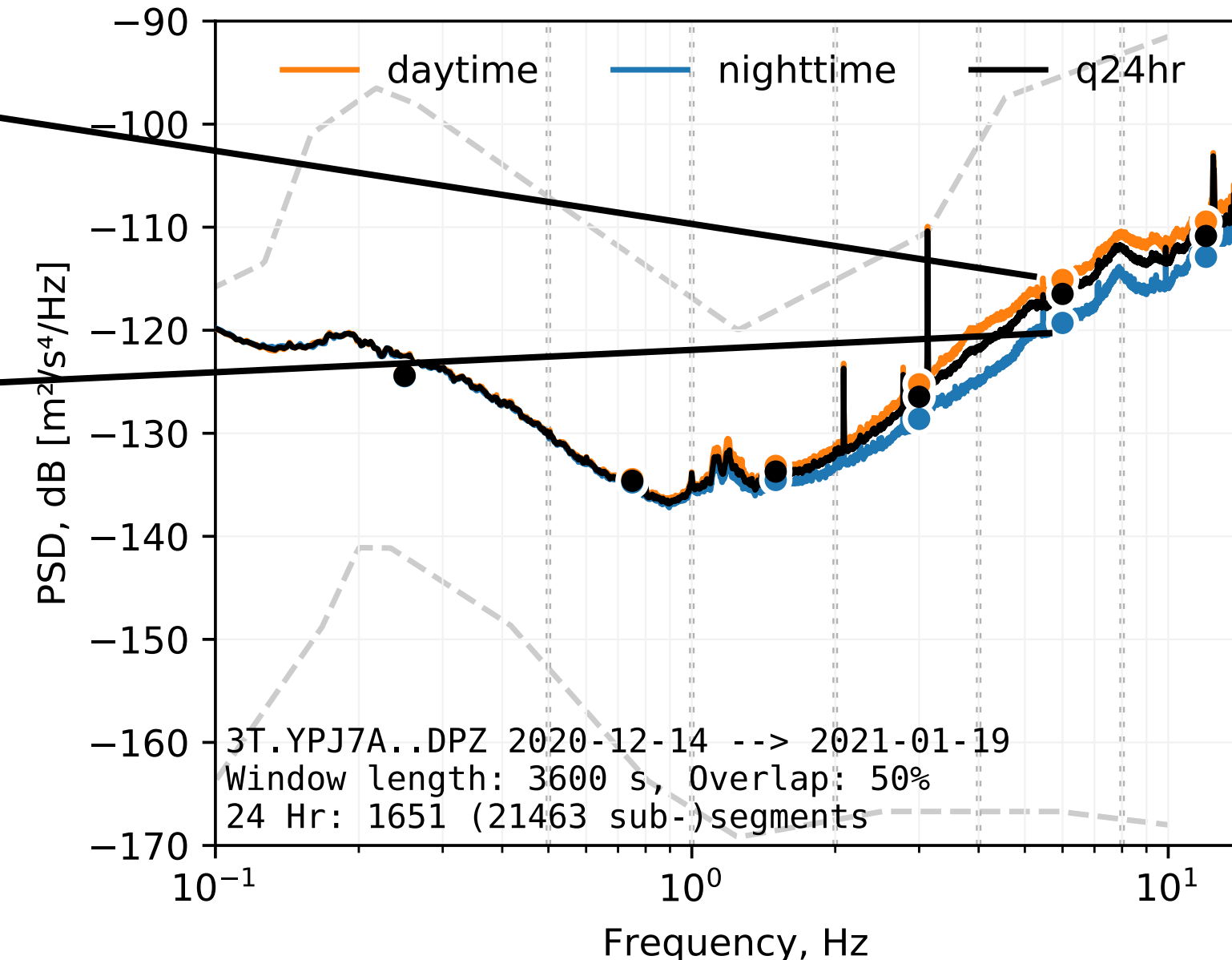
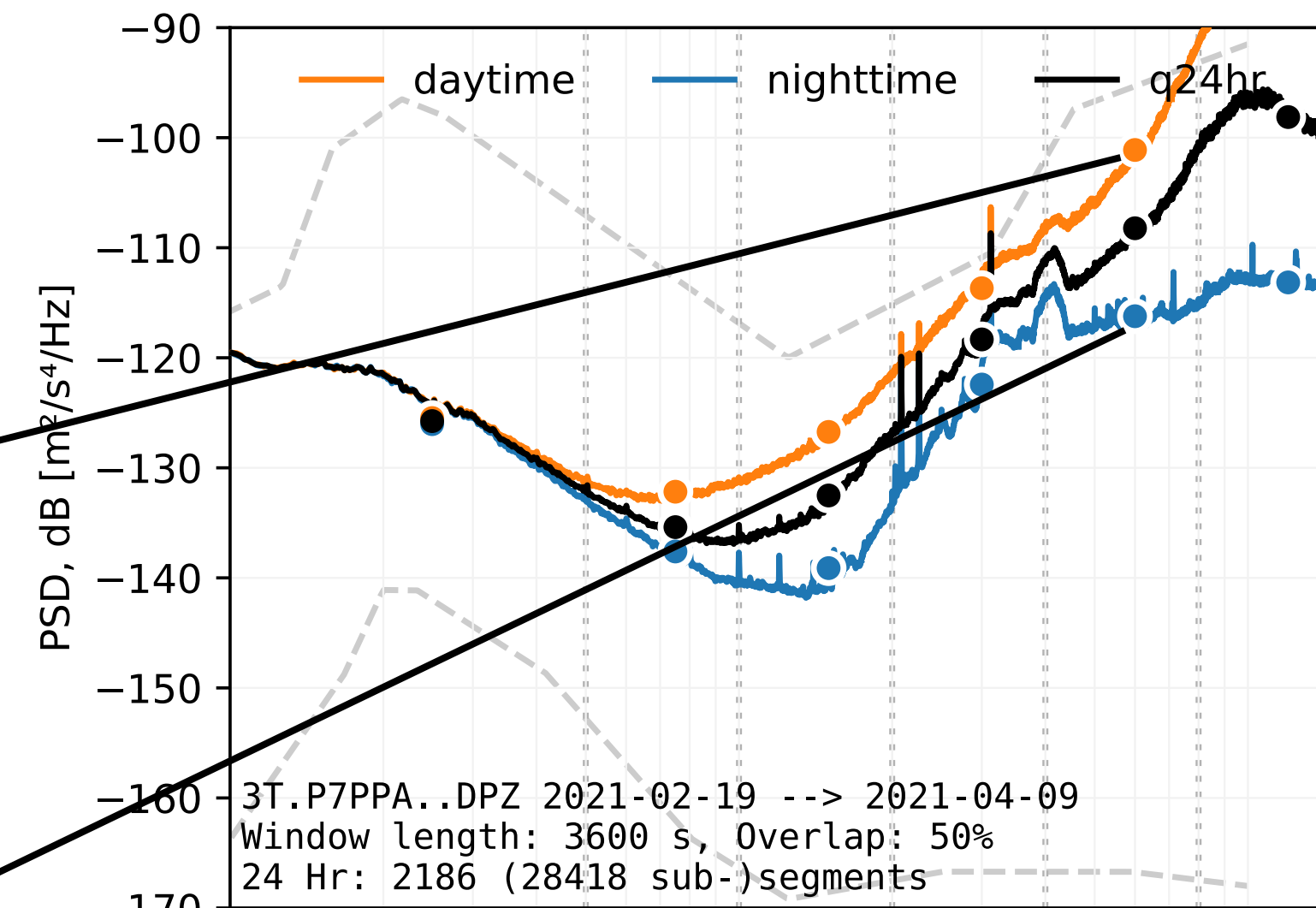
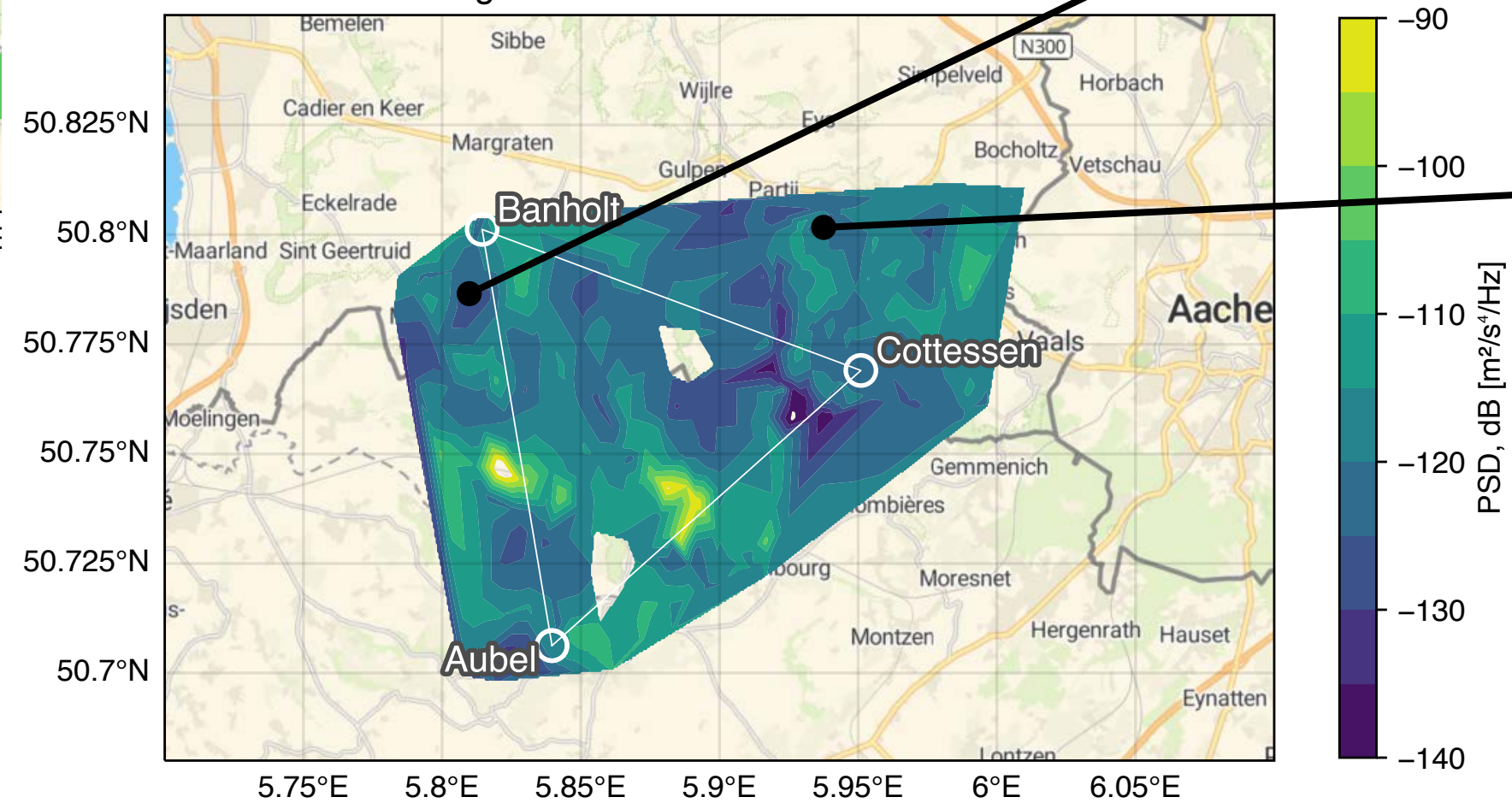
Q24Hr PSD mean 4.0 -> 8.0 Hz



Daytime PSD mean 4.0 -> 8.0 Hz



Nighttime PSD mean 4.0 -> 8.0 Hz

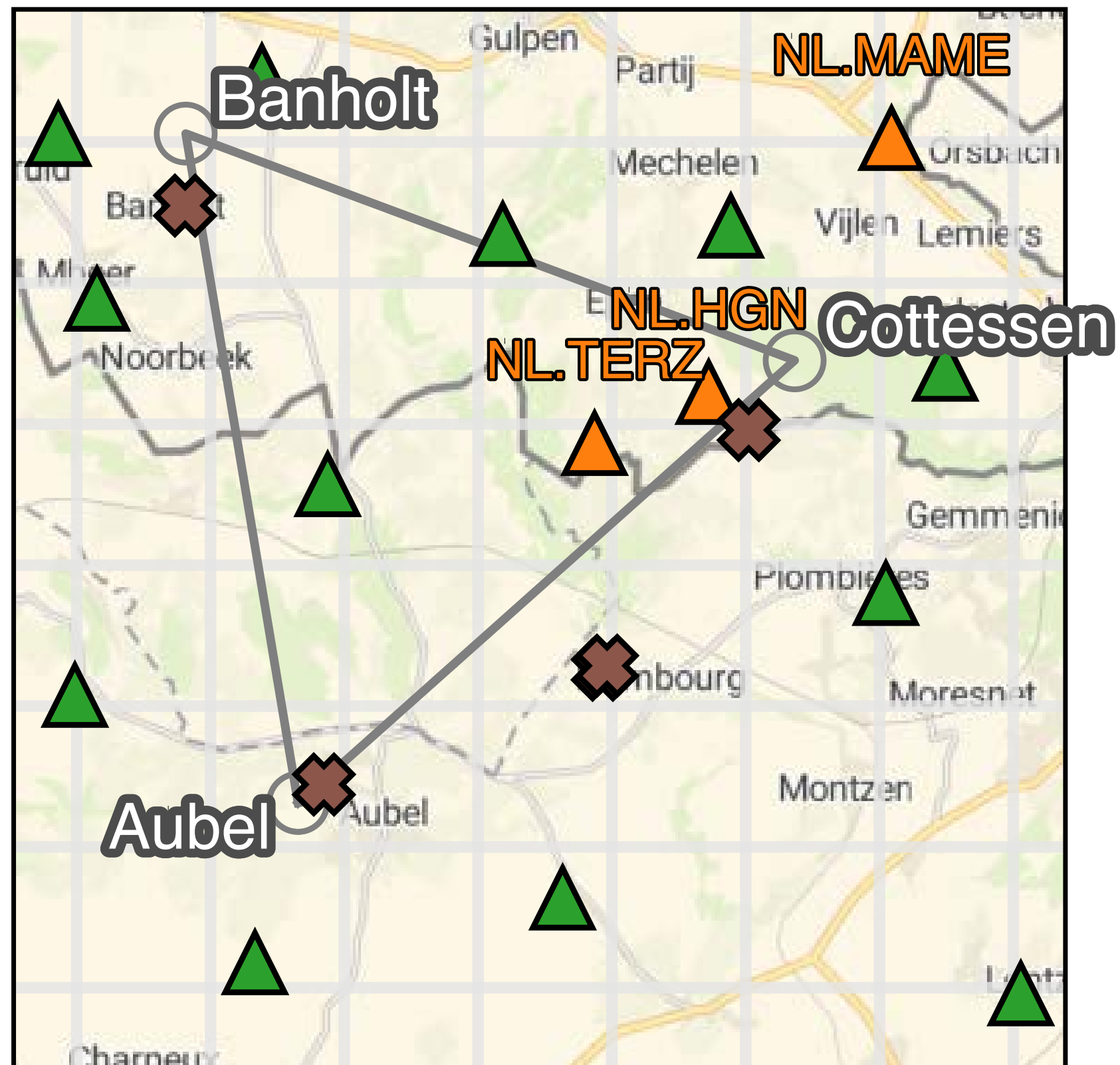






# Cottessen drilling and installation

- Drilling reached 250 m depth.
- Casing and cementing of the Cottessen borehole did not go as planned...
  - Glass fibre snapped after ~30 m
  - Casing leaked cement at ~170 m depth

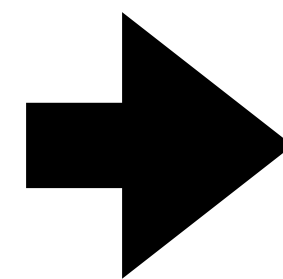
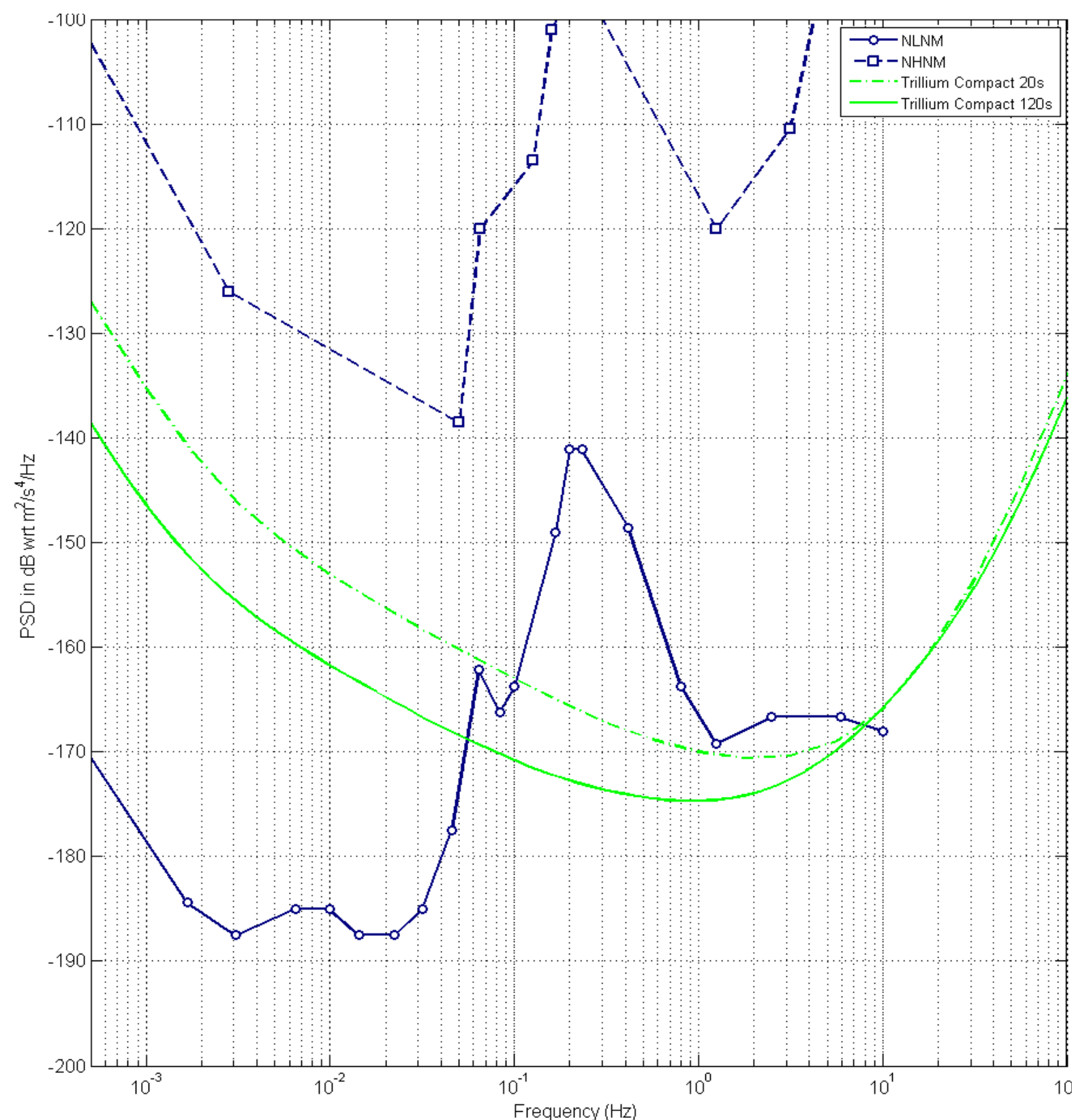




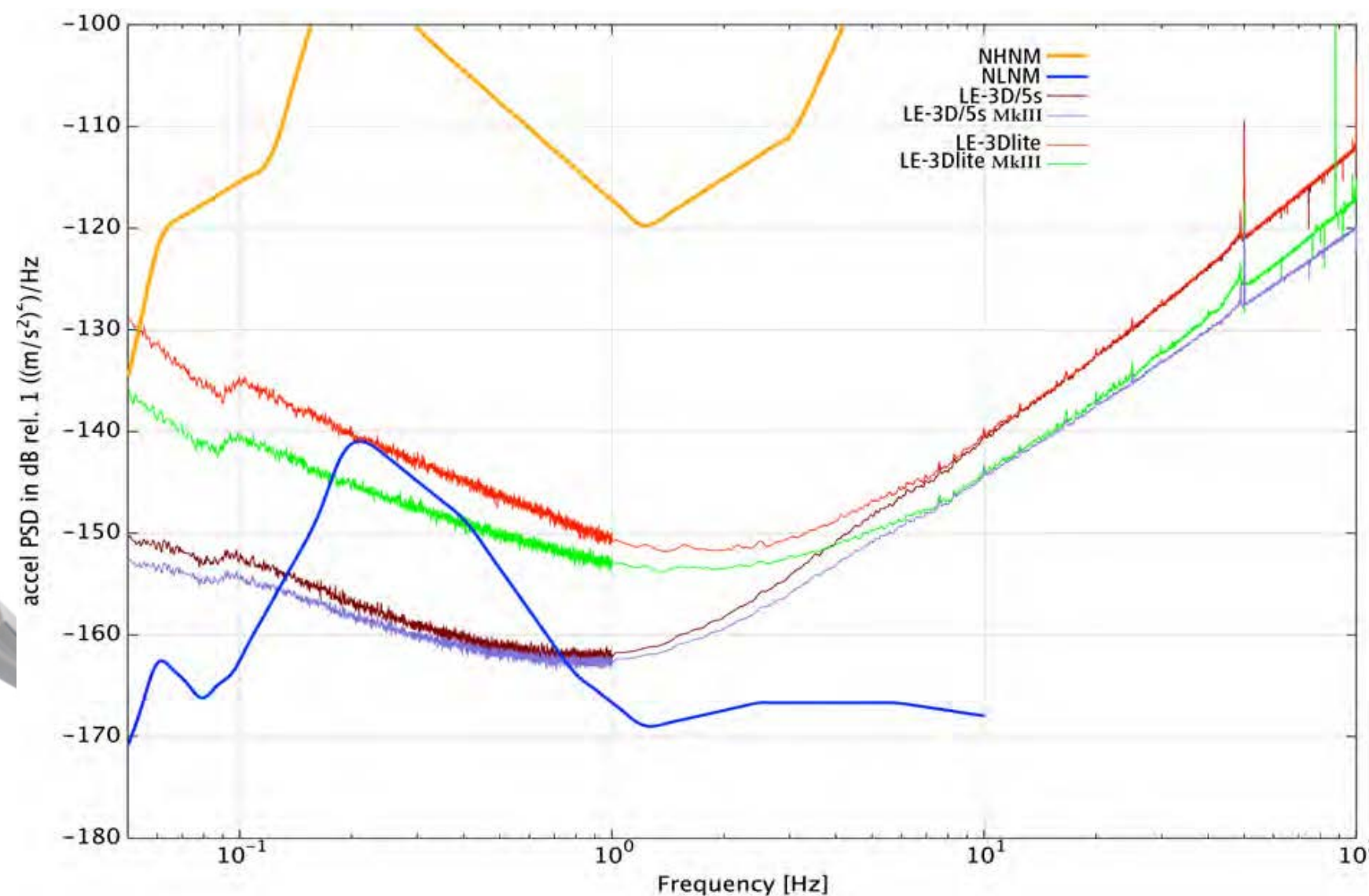


# Cottessen drilling and installation

- Drilling reached 250 m depth.
- Casing and cementing of the Cottessen borehole did not go as planned...
  - After drilling inside the casing to clear cement, usable diameter was less than 97 mm
  - Glass fibre had to be cemented inside the casing



**lennartz electronic**  
LE-3D/BH(s) MkIII



**Trillium CompactPH**





# Cottessen drilling and installation

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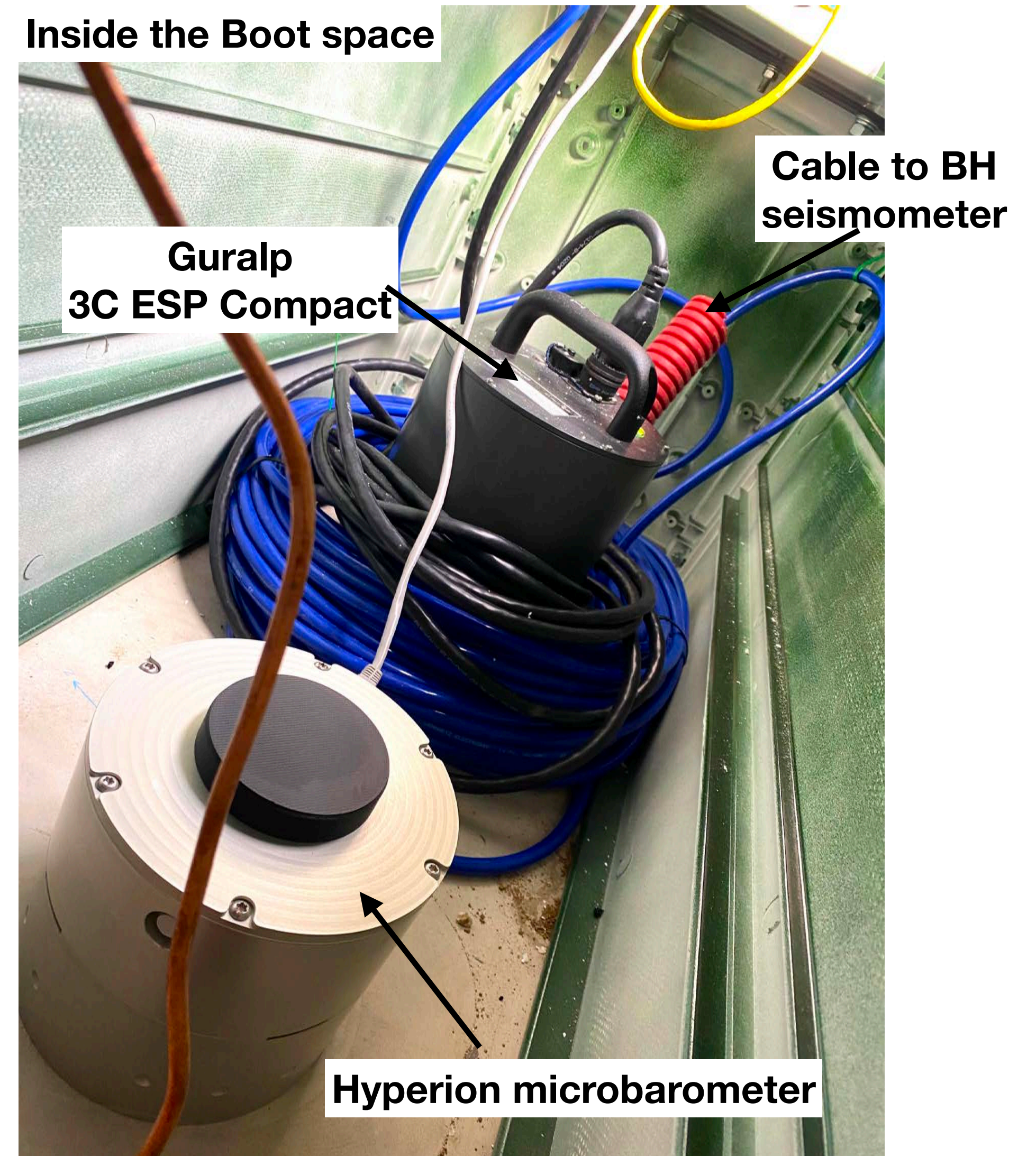
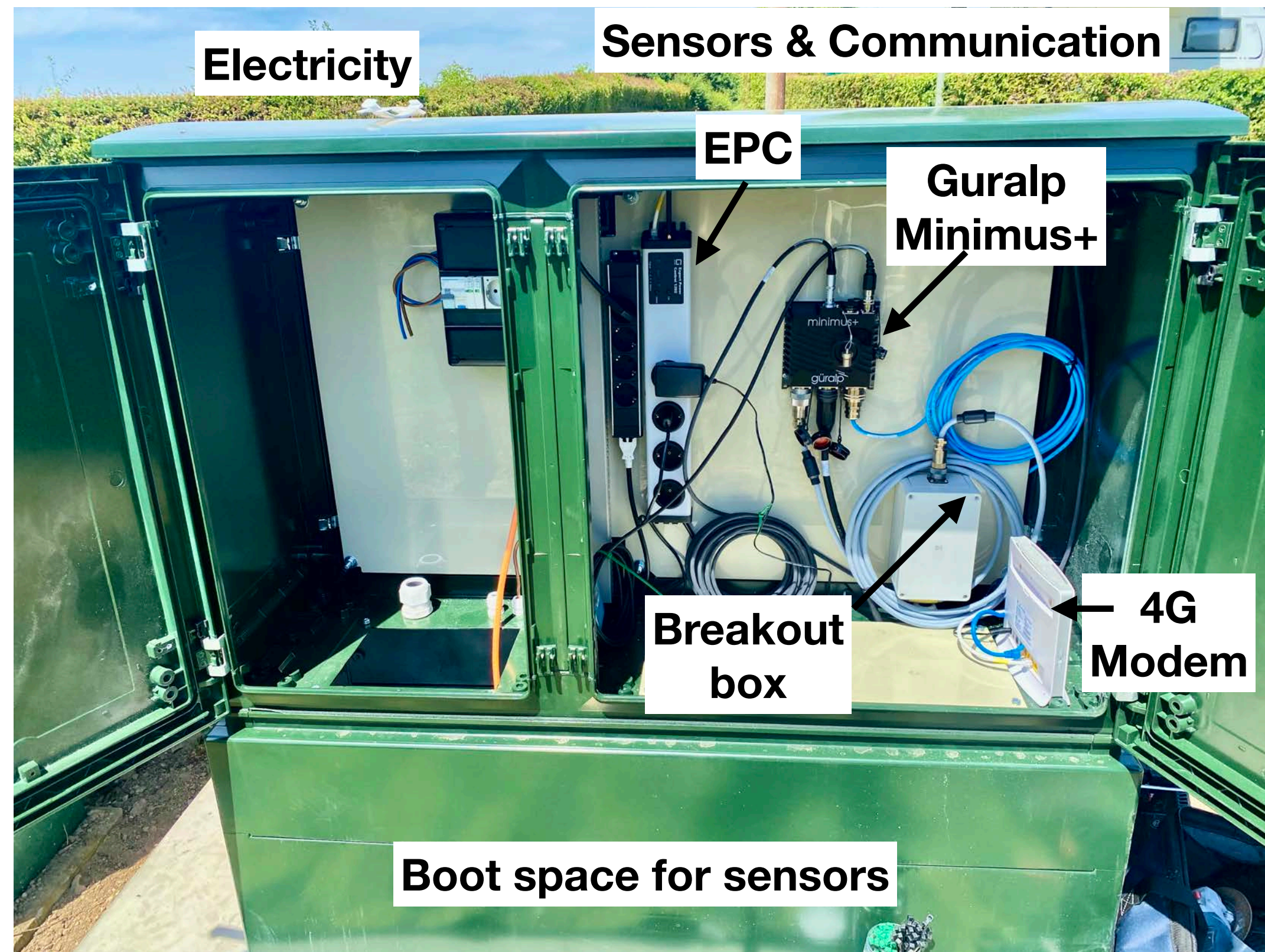






# Cottessen drilling and installation

- Surface installation

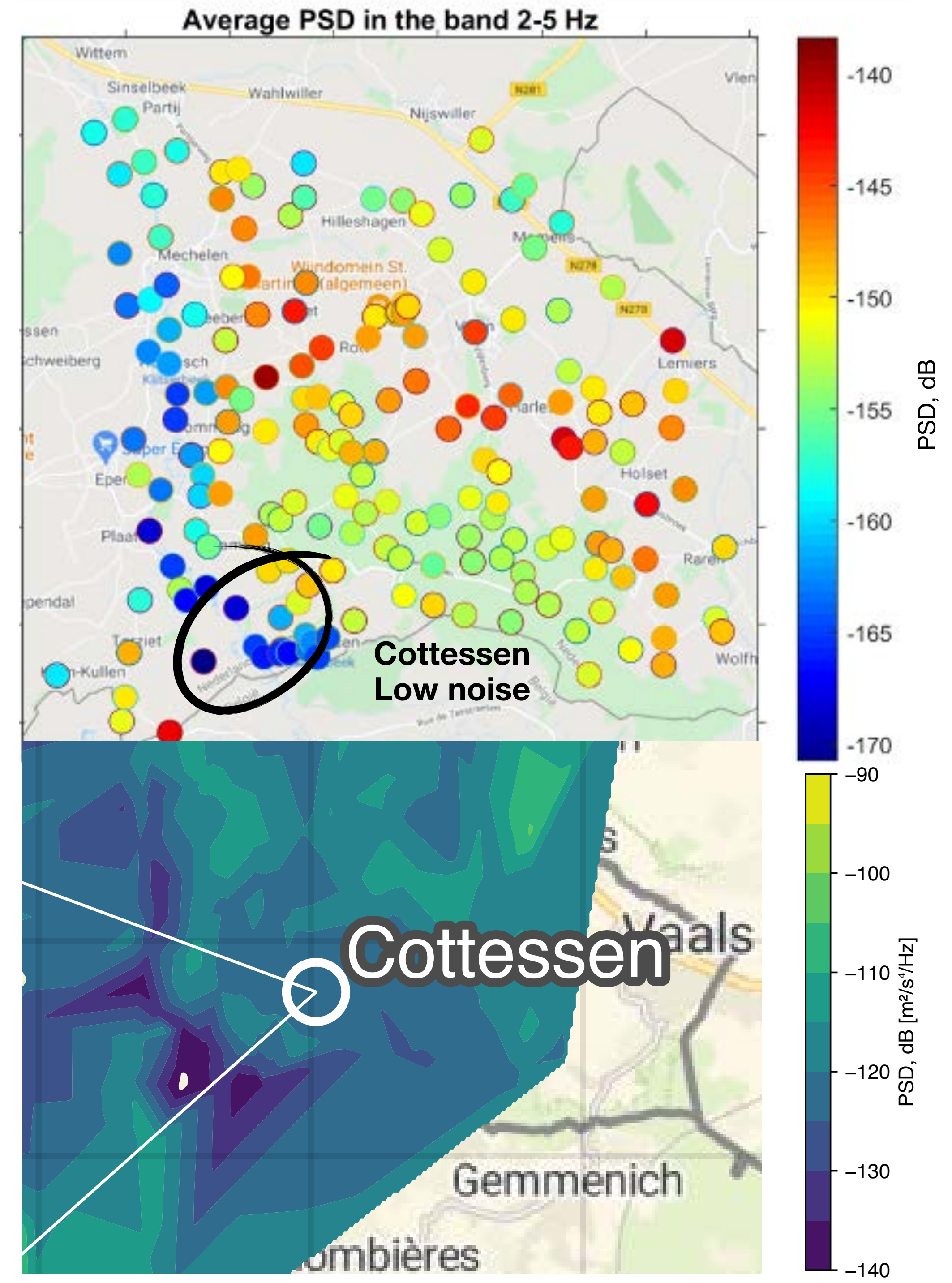
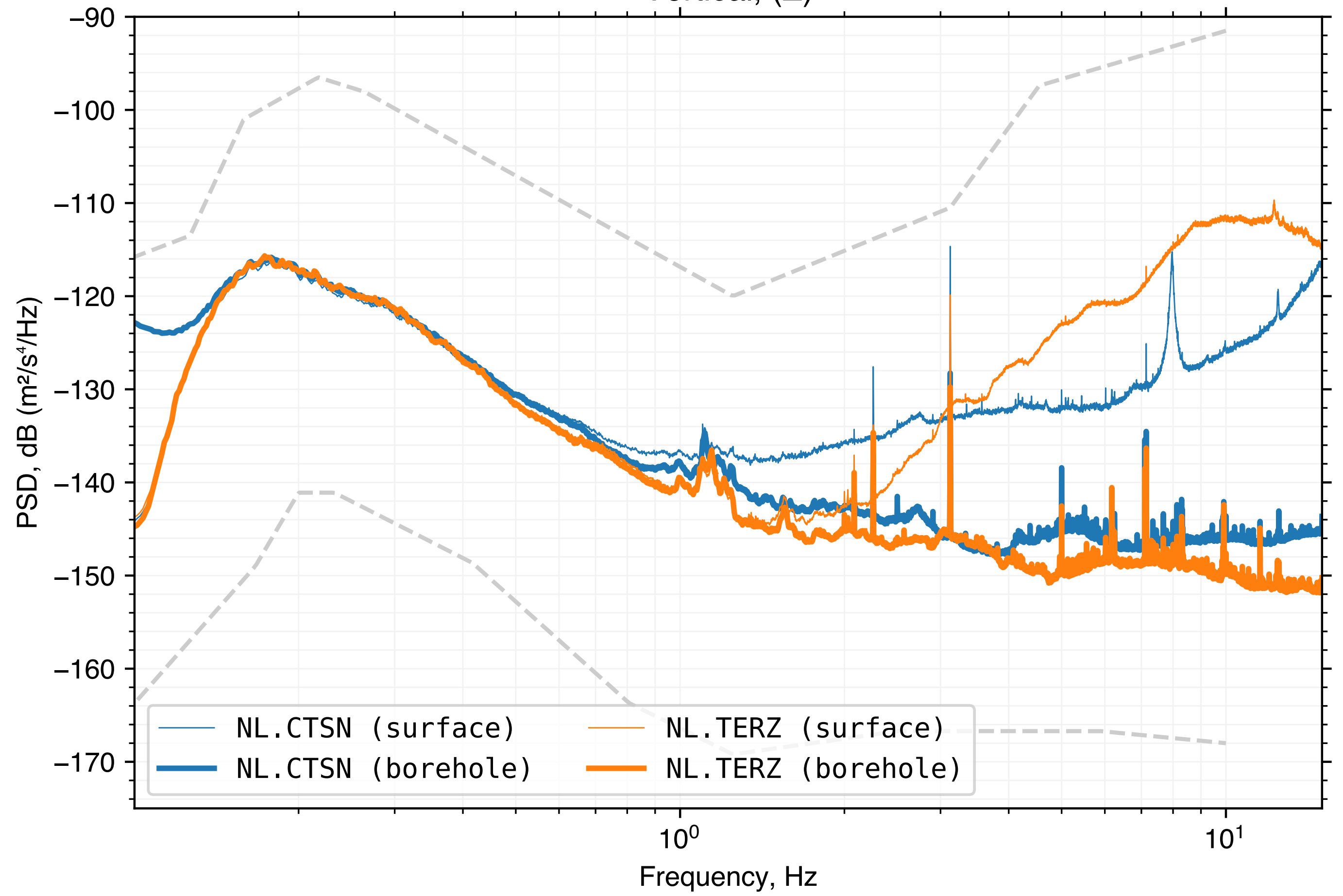






# Cottessen & Terziet comparison

2022-12-13 00:30:00 -> 2023-01-22 14:00:00  
Vertical, (Z)







# Banholt drilling and installation

- Drilling reached 250 m depth, but bottom 50 m were lost.
- Drill pipes were stuck in the borehole and remained behind as casing, cemented in place.
- Borehole is straight and dry months after.







Güralp 3ESPC

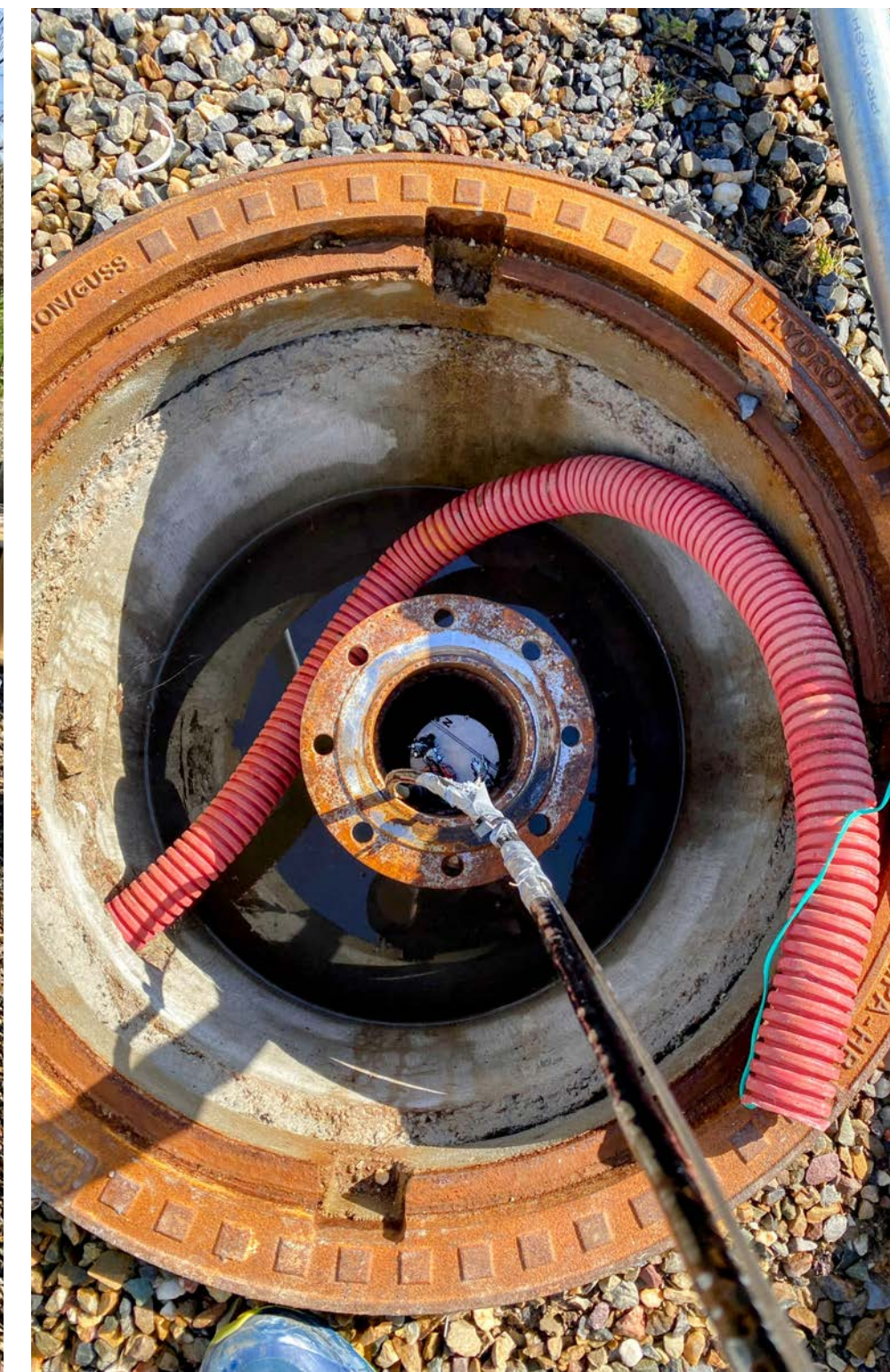
güralp

PORTABLE COMPACT WEAK MOTION SEISMOMETER

# Banholt drilling and installation

- BH Data cable is damaged and will be replaced under warranty by Nanometrics.
- A winch system was used for lowering and hoisting the payload.

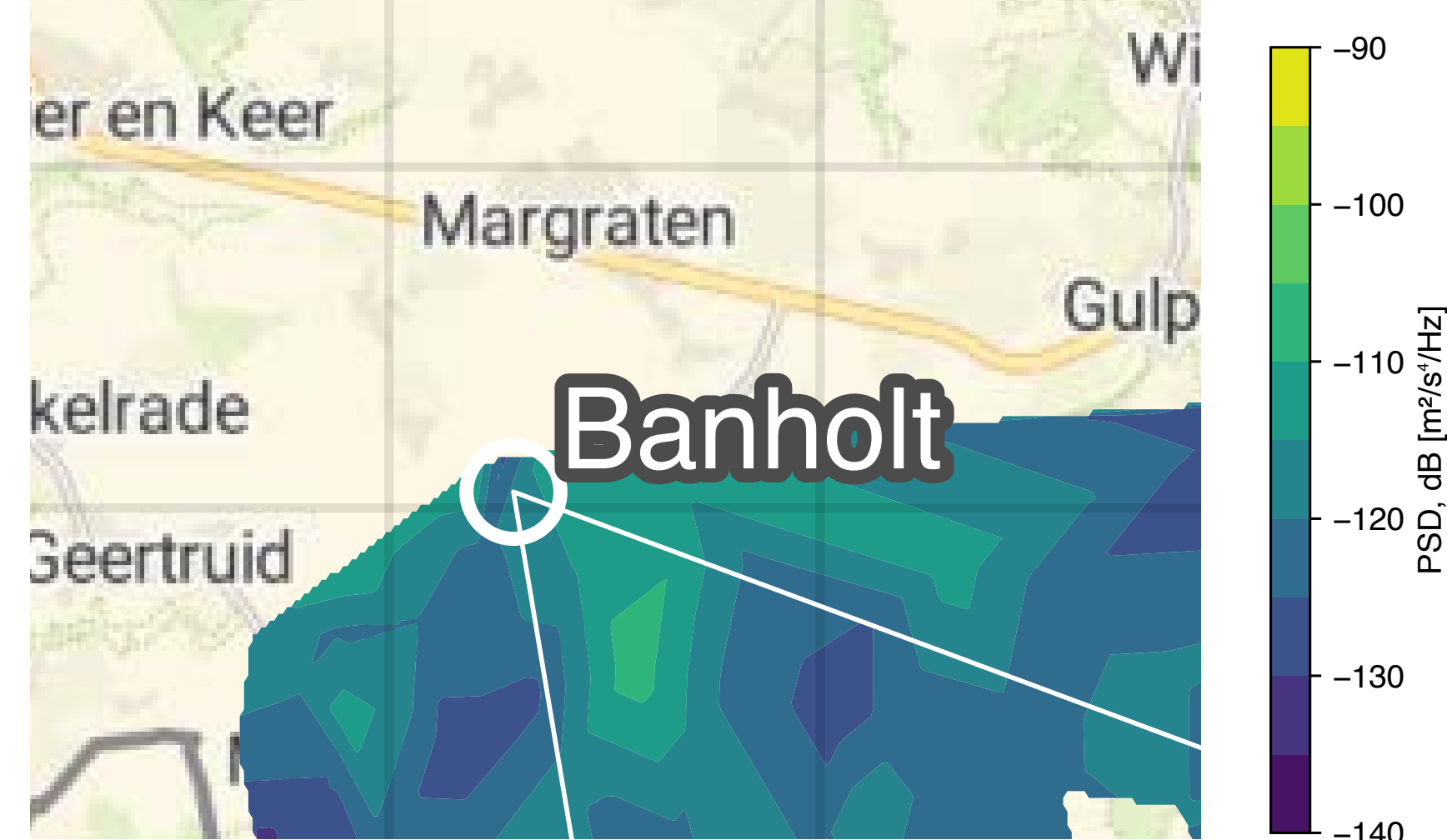
Trillium  
CompactPH



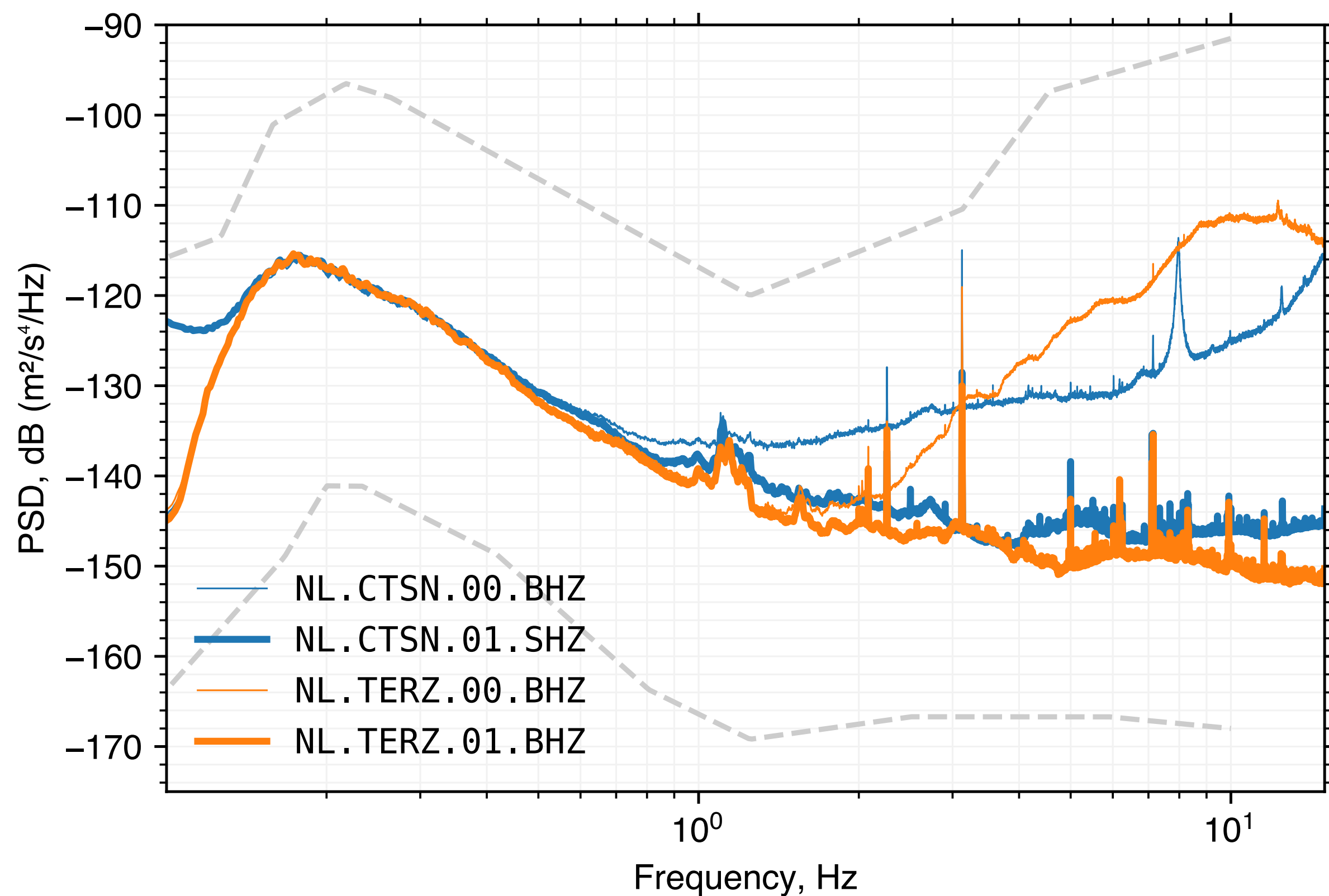




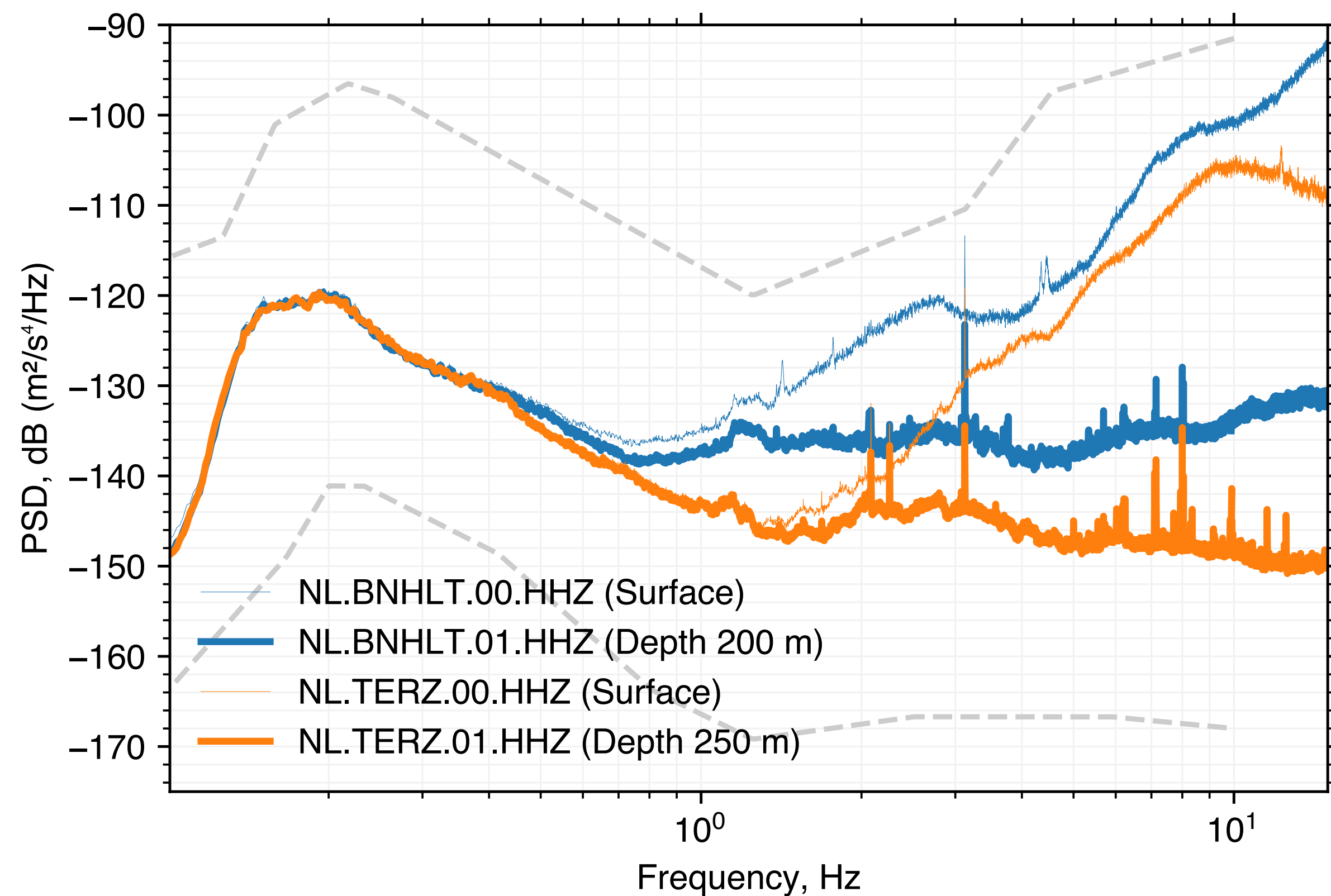
# Vertical attenuation



## Cottessen vs. Terziet



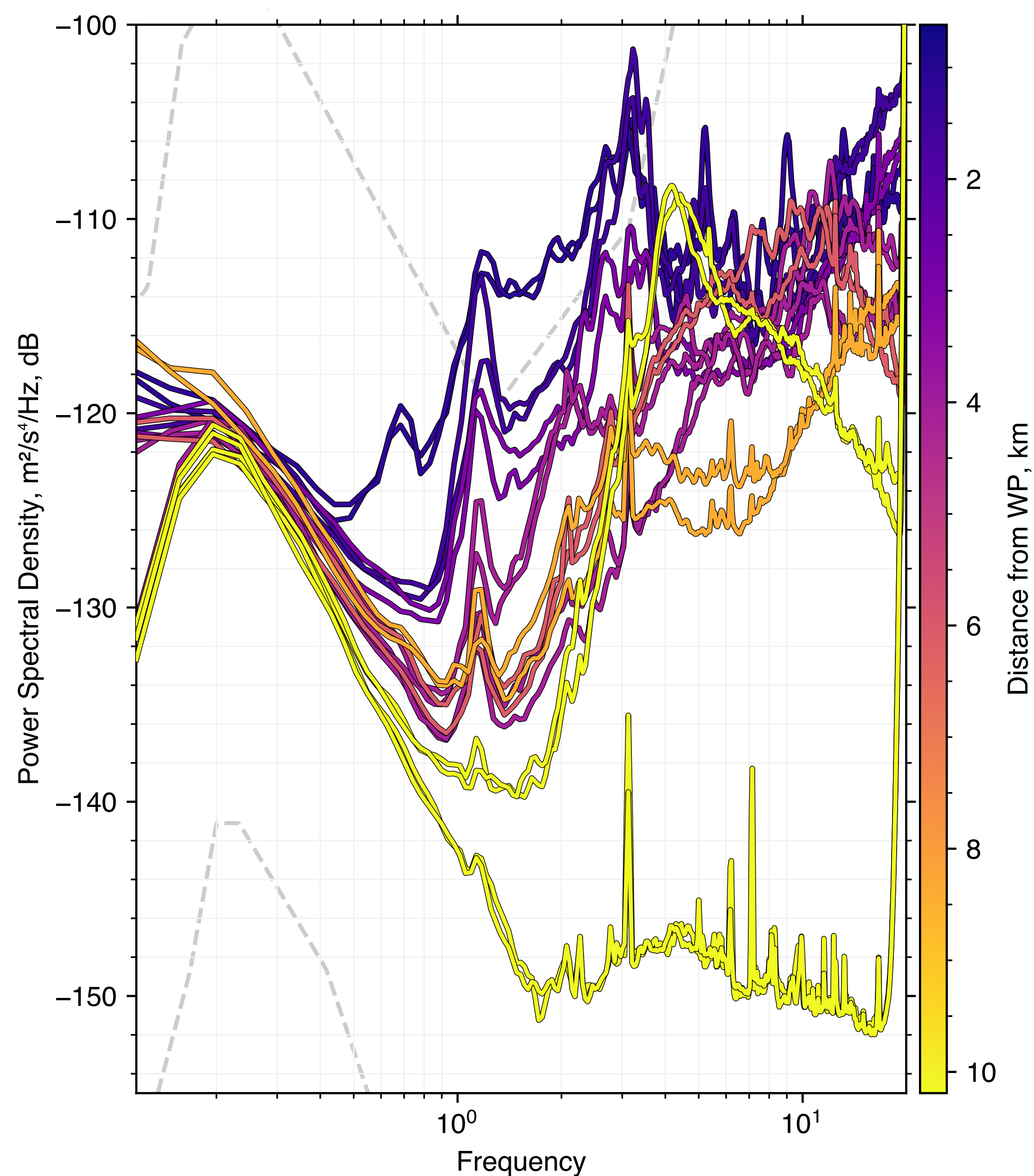
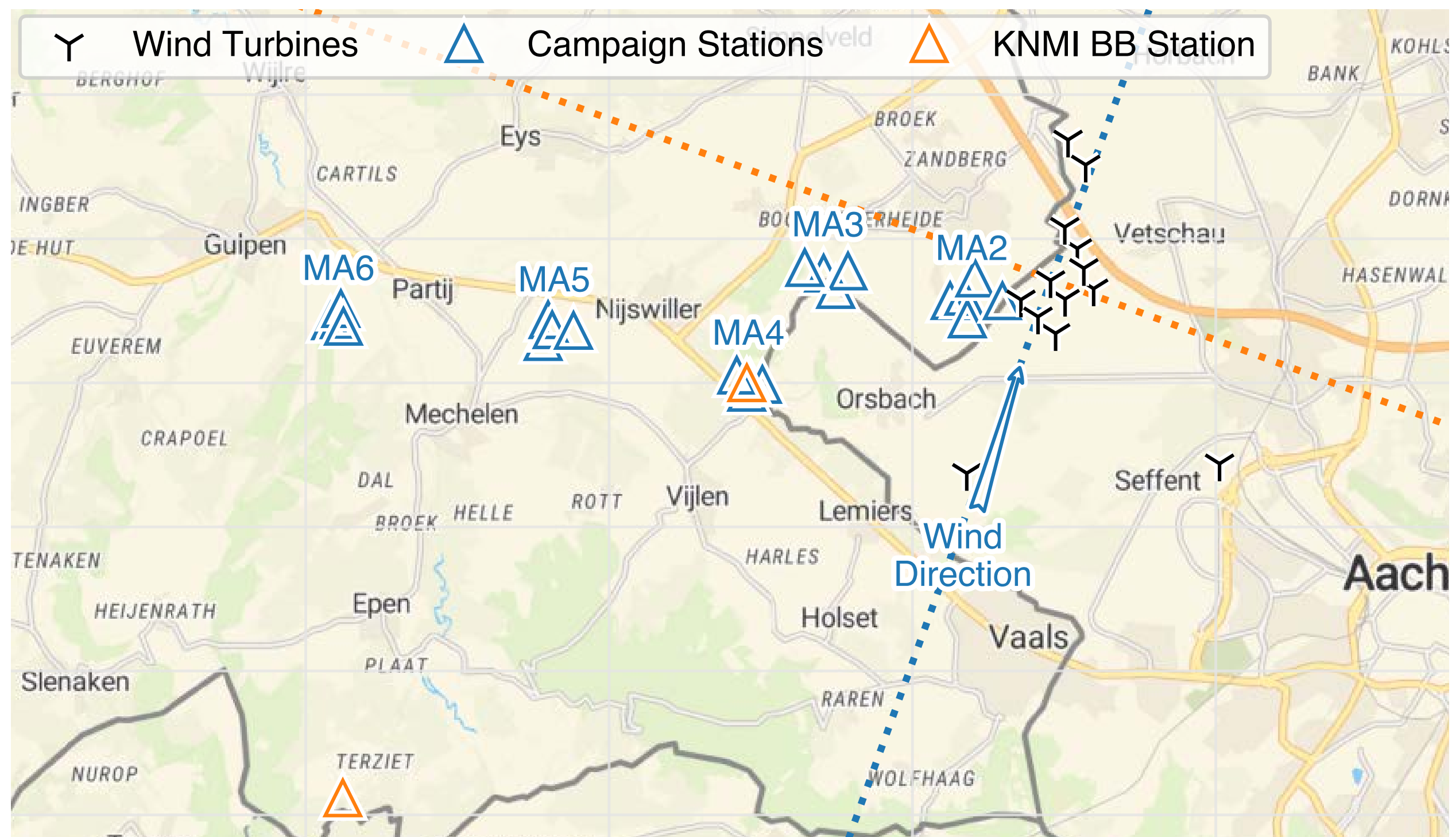
## Banholt vs. Terziet







# Horizontal attenuation



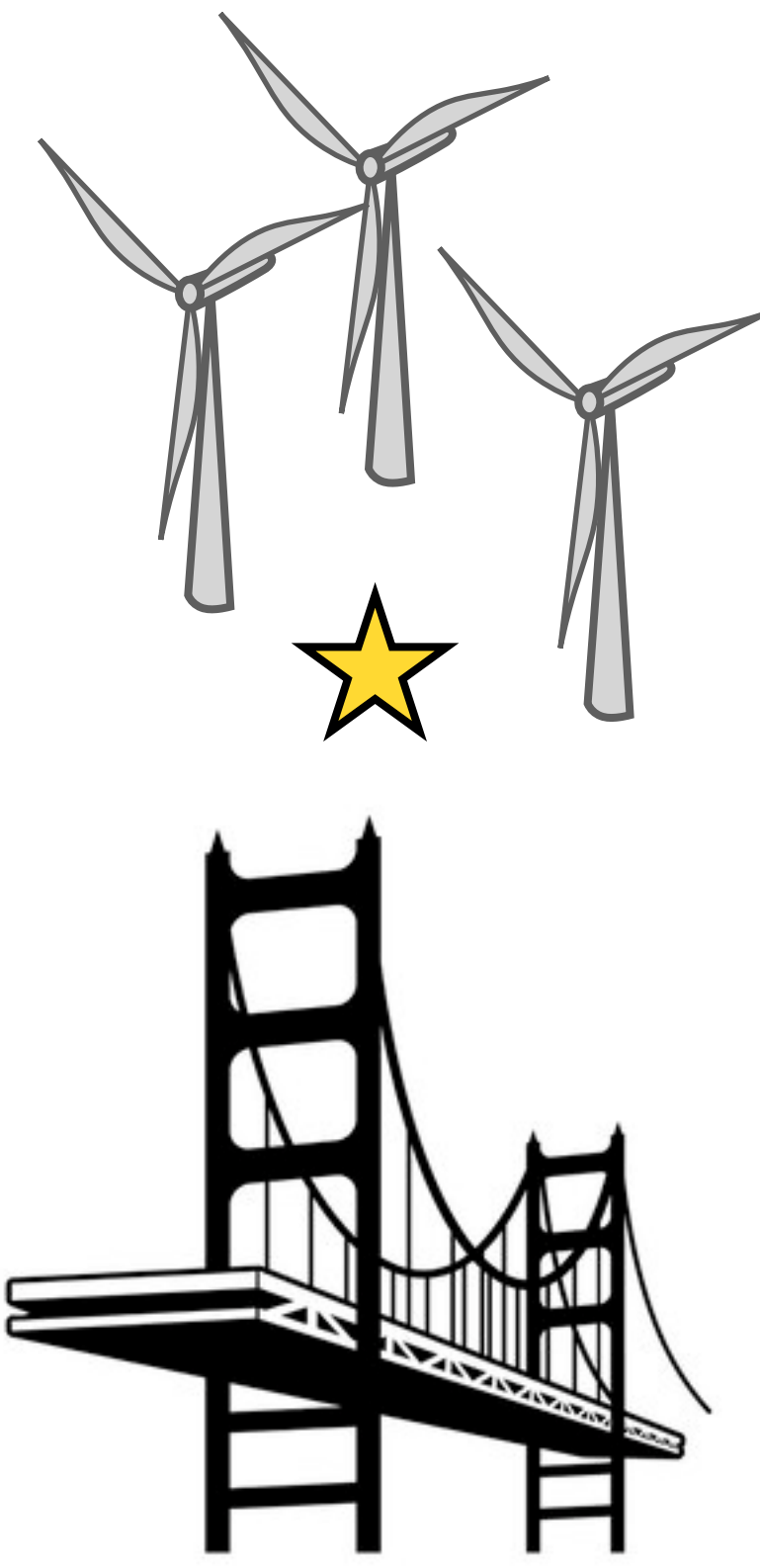


# Future ambitions:

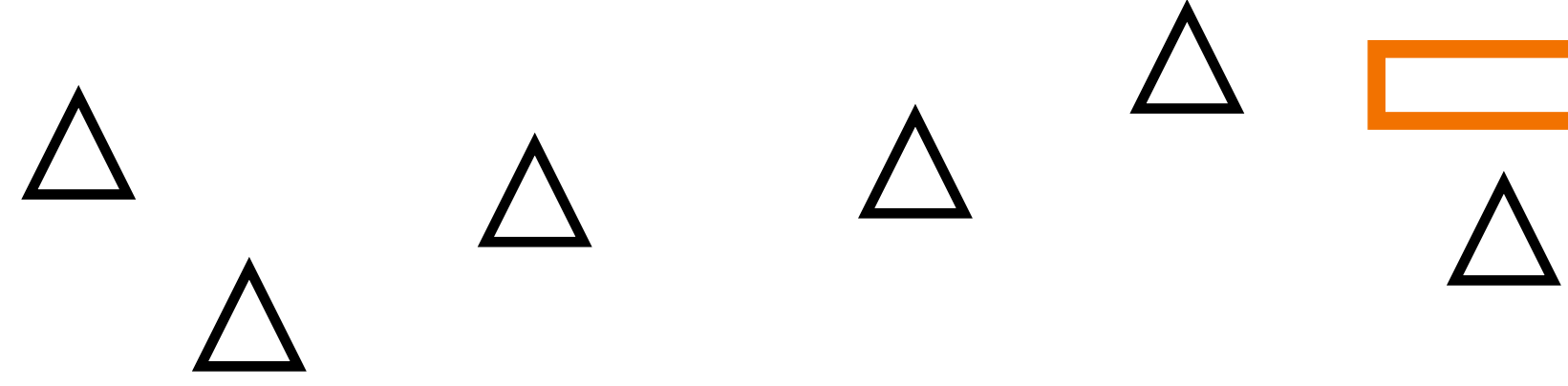


# Attenuation relation - observations and models

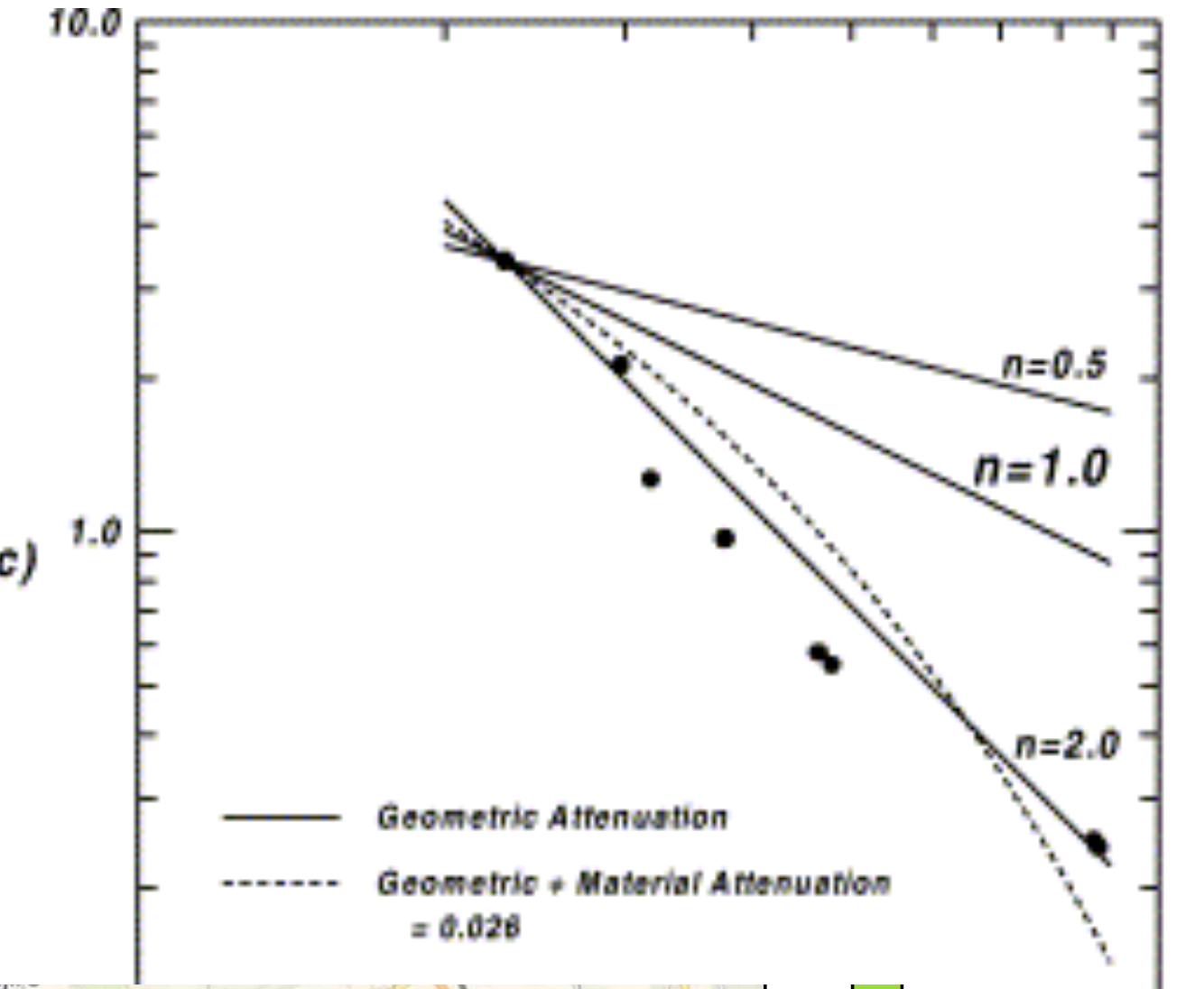
Sources



Receivers



Attenuation eq.

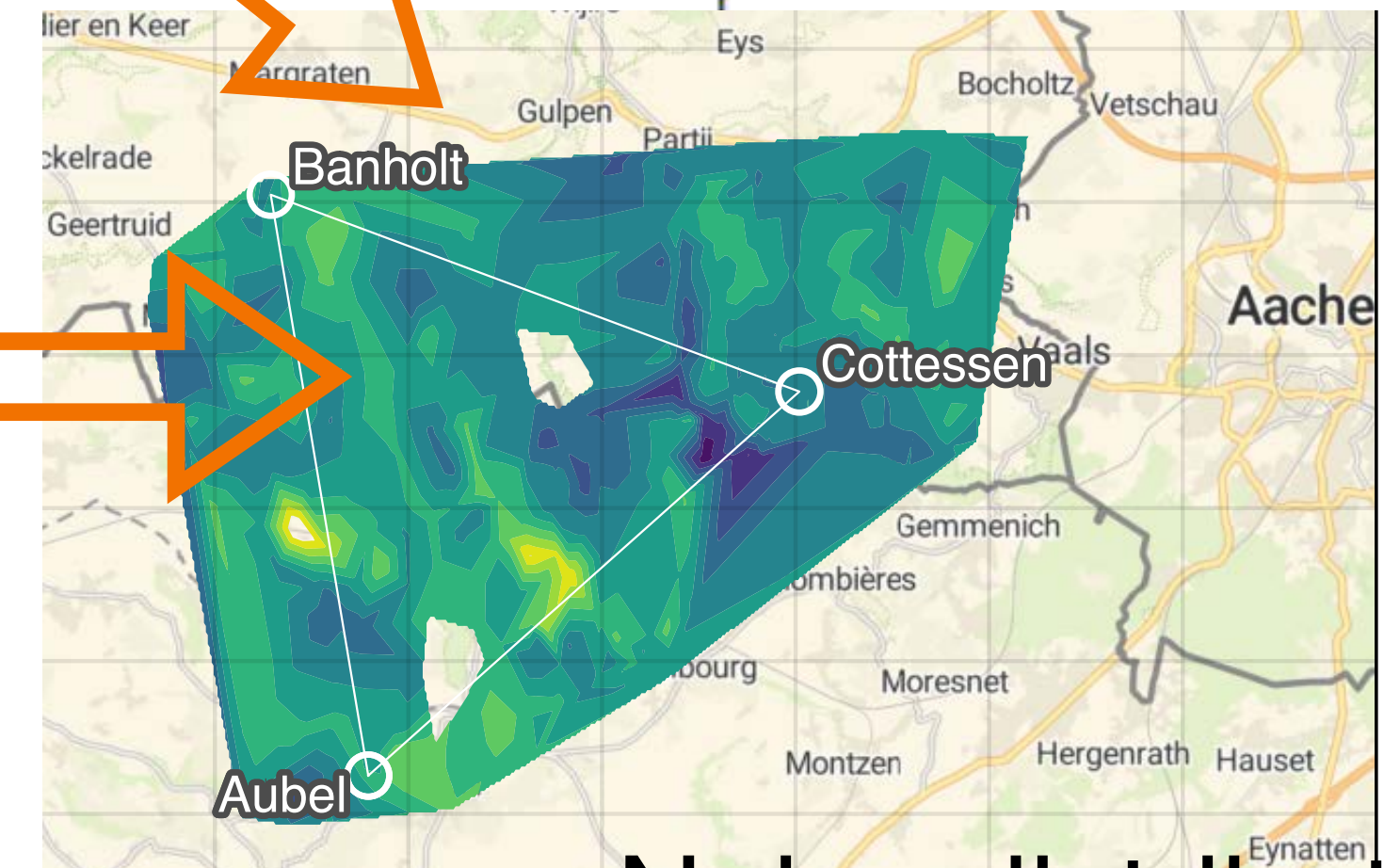
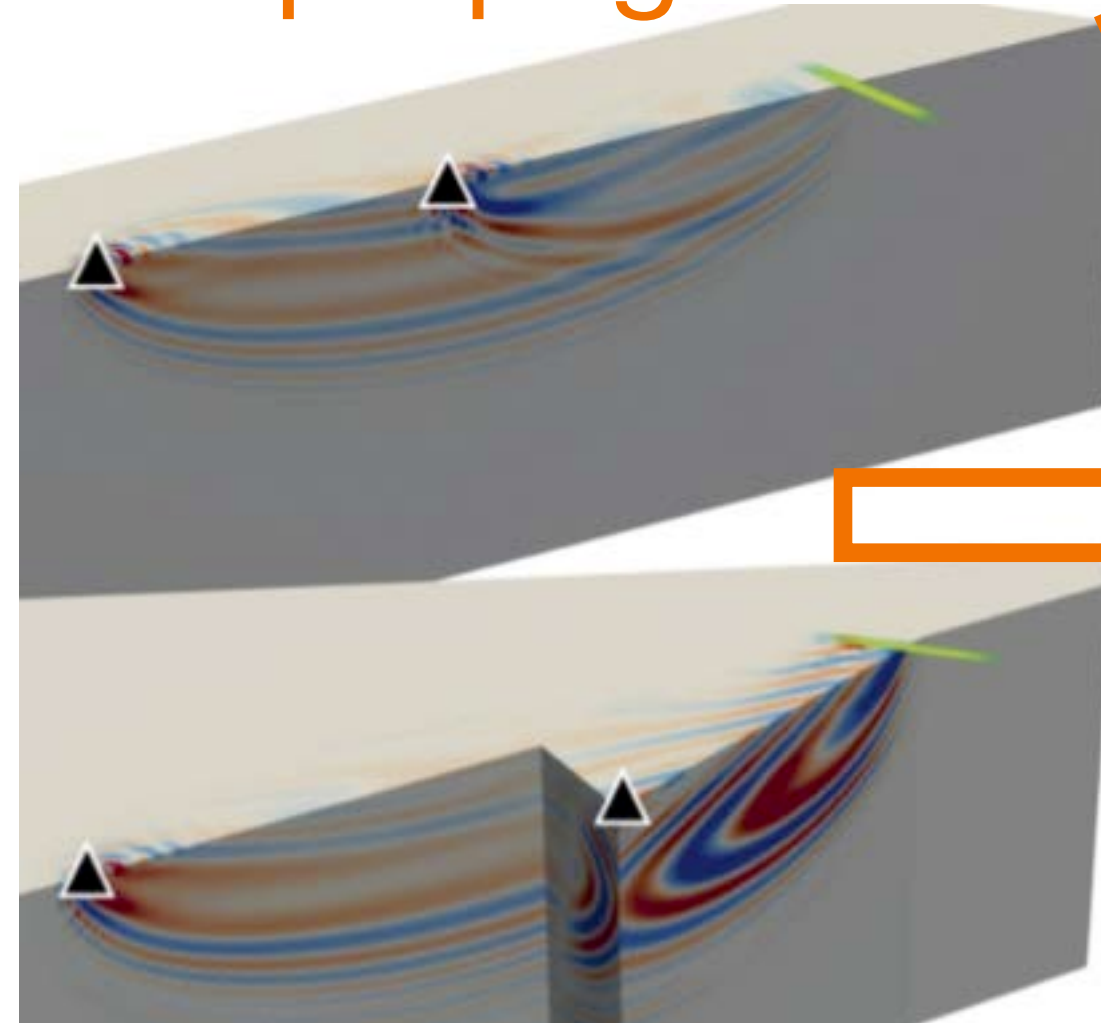


Wave propagation in a heterogeneous Earth

Numerical wave propagators



SPECFEM3D



Noise distribution maps