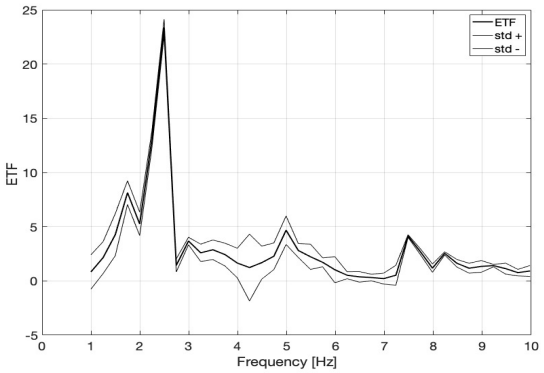
An approach to construct a Netherlands wide ground-motion amplification model

Janneke van Ginkel (j.a.van.ginkel@rug.nl), Elmer Ruigrok, Rien Herber, Jan Stafleu

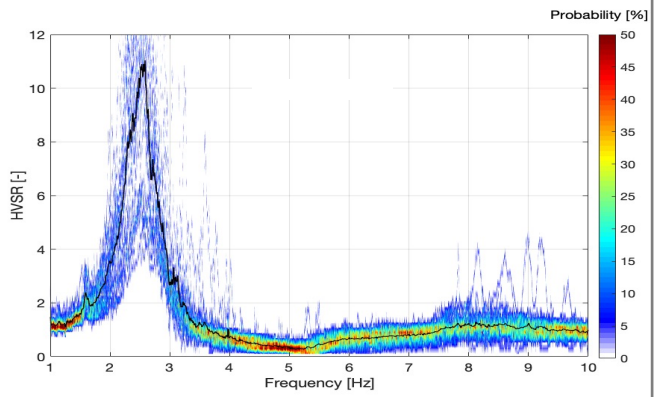
Royal Netherlands Meteorological Institute | university of groningen | Utrecht University | TNO innovation for life

Sharing is encouraged

Methods: Calculating amplification in frequency domain

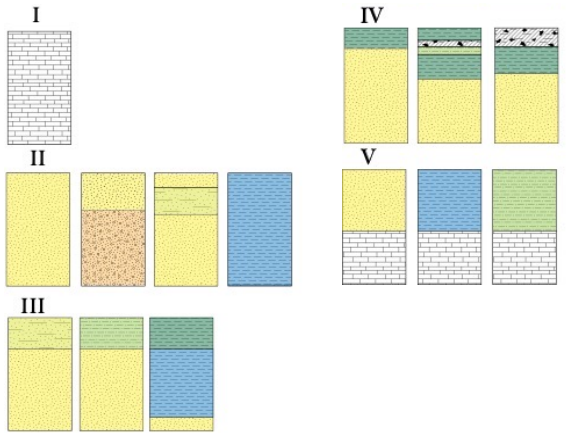


Earthquake transfer functions 200-0 m



Ambient seismic field horizontal-to-vertical spectral ratios

NL Sediment classification based on amplification level



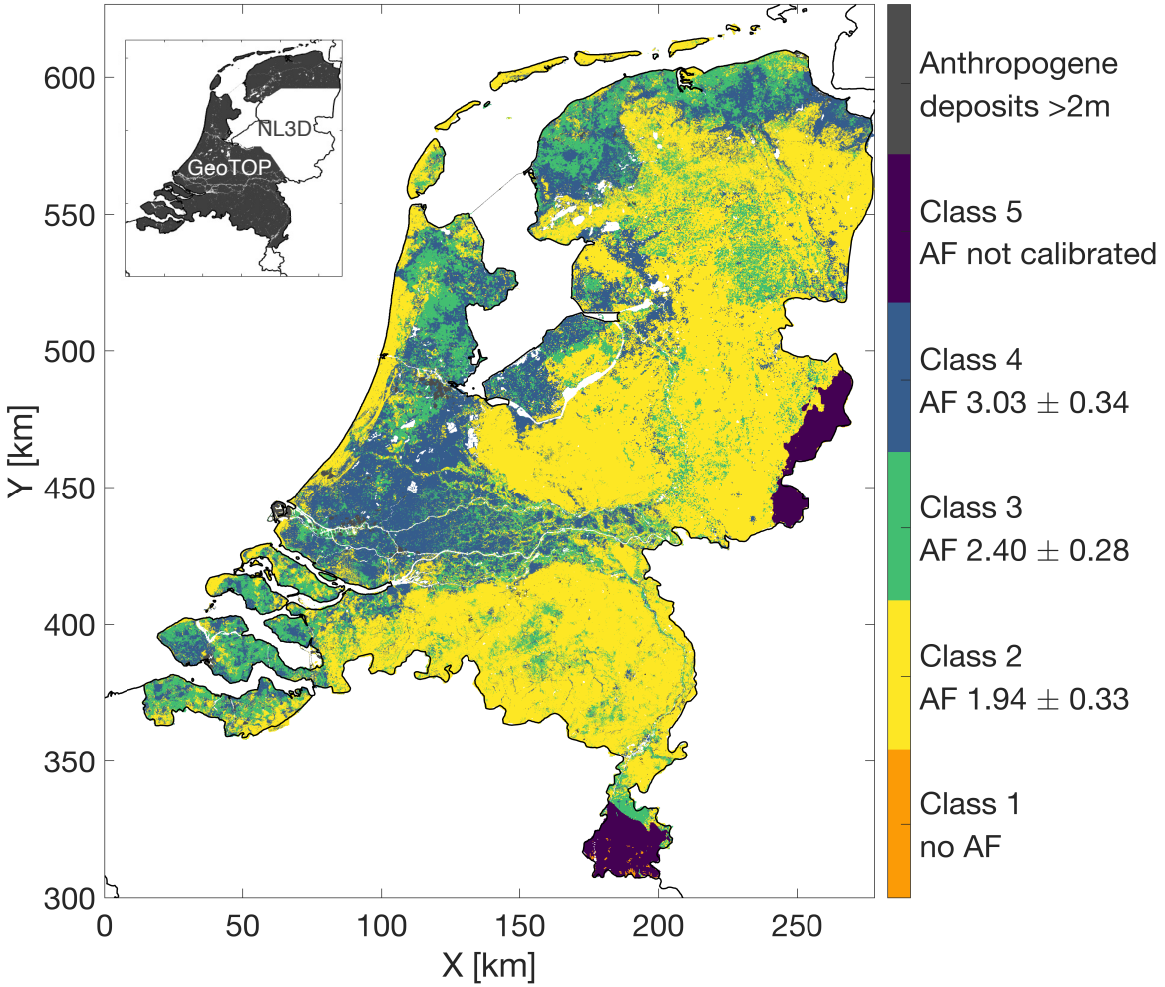
- Hard rock (chalk)
- Gravel / coarse sand
- Sand
- Sandy clay, loam, löss
- Argillaceous sand
- Clay (Holocene)
- Clay (Pleistocene)
- Peat

Classes based on:

- Shear wave velocity
- Velocity contrast
- Depth of the bedrock

For more details: van Ginkel et al., 2019, 2020 and 2021 (under review)

Aim: The Netherlands site response classification map



Based on GeoTOP, NL3D and DGM geological models, TNO, Geological survey of the Netherlands

Full presentation recorded: https://youtu.be/Qz3980KaizM and EGU website

An approach to construct a Netherlands wide ground-motion amplification model

EGU – April 2021

Janneke van Ginkel[1,2], Elmer Ruigrok[2,3], Rien Herber[1], Jan Stafleu[4]

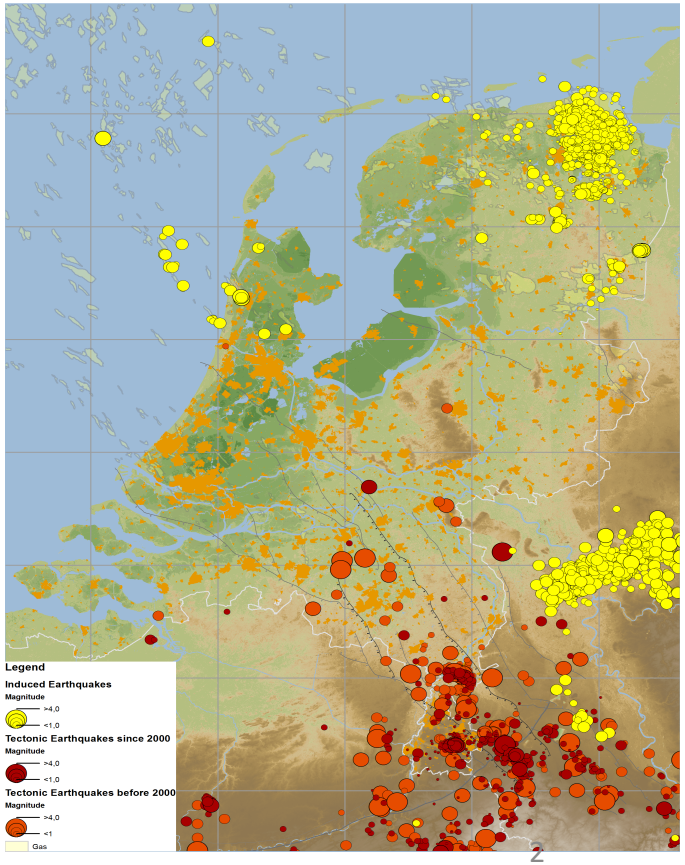
[1] University of Groningen, the Netherlands

[2] Royal Netherlands Meteorological Institute, the Netherlands

[3] Utrecht University, the Netherlands

[4] TNO-Geological Survey of the Netherlands

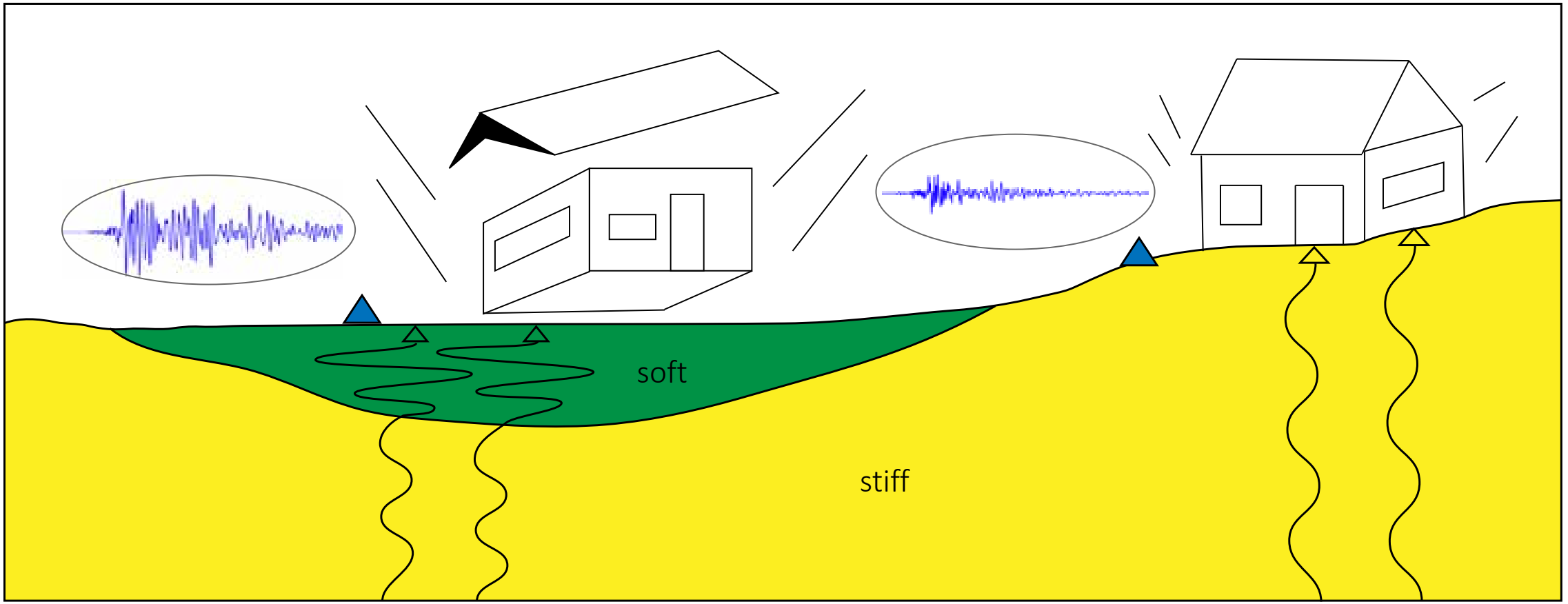
j.a.van.ginkel@rug.nl



Royal Netherlands Meteorological Institute

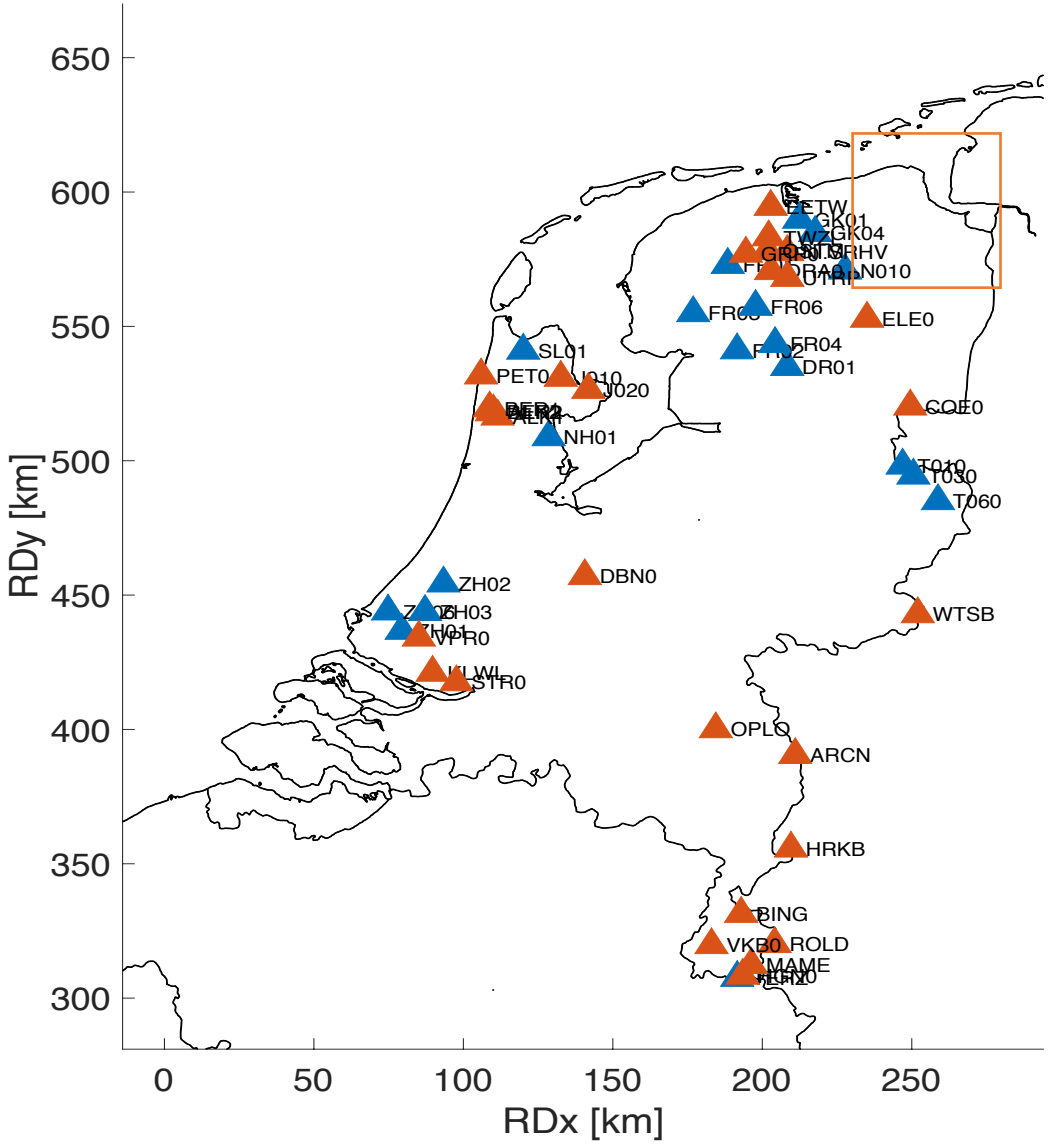
university of groningen

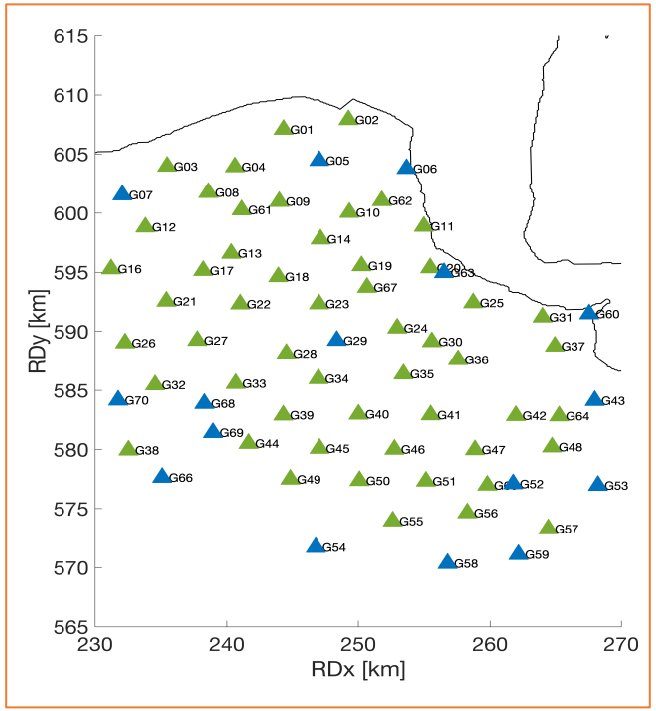
The Netherlands are covered with unconsolidated sediments, which are well known for their ability to **amplify seismic waves**

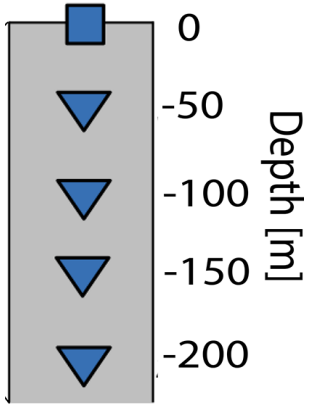


Madified after Ciaccio and Cultrera (2014)

Netherlands and Groningen network continuously recording **local seismic events** and **ambient seismic field**







Borehole setup

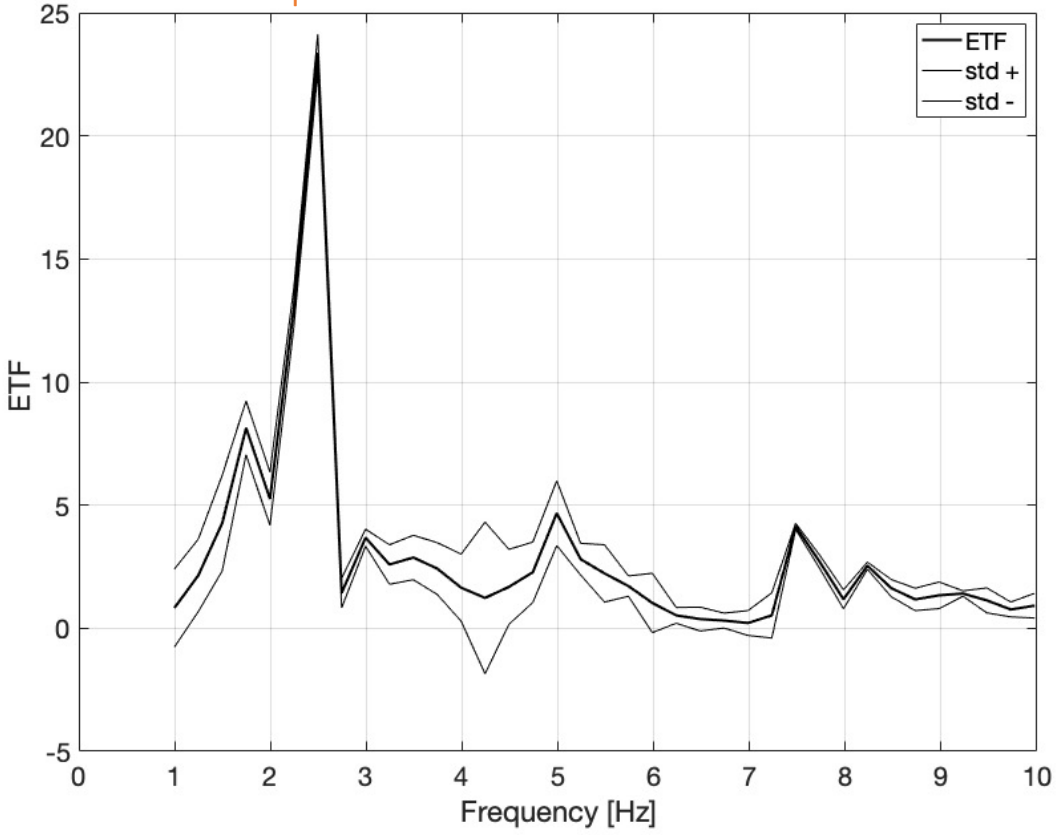
Borehole

Borehole with SCPT

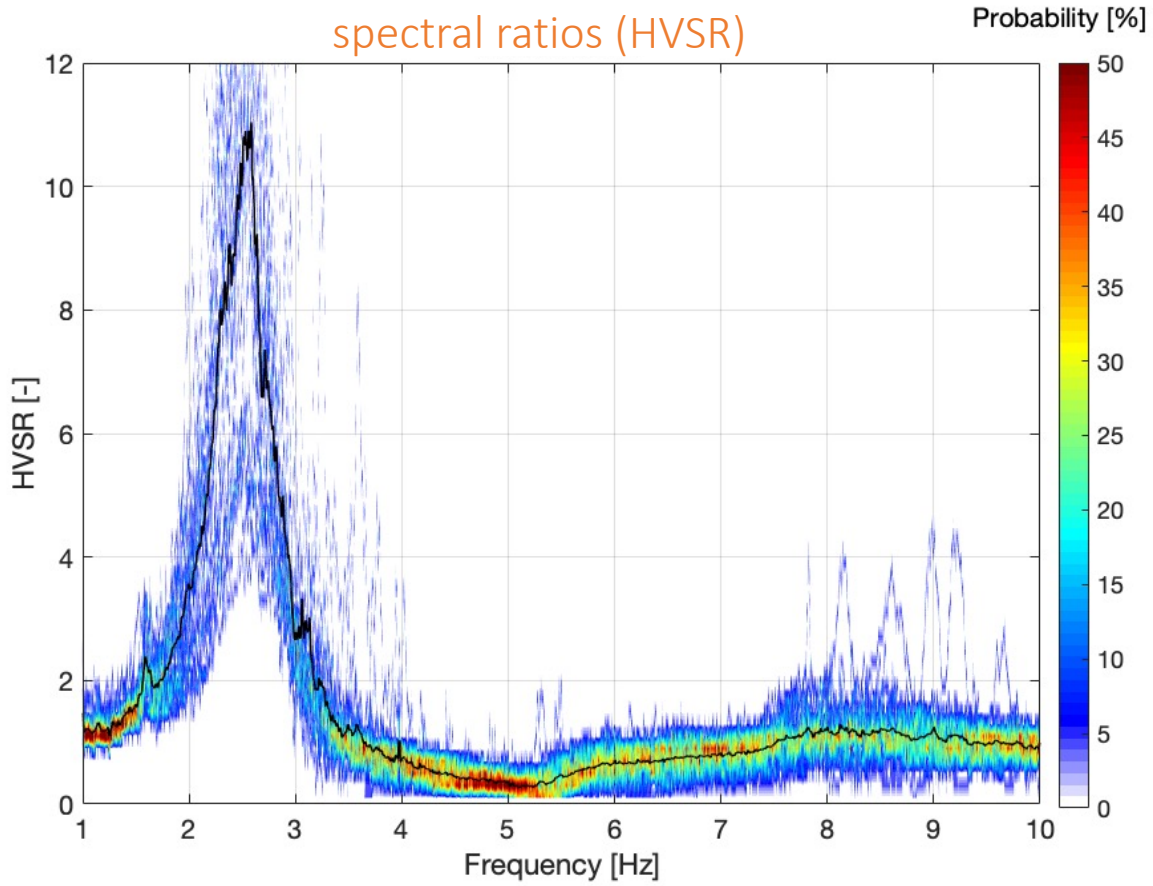
Surface accelerometer

Calculated **amplification in the frequency domain** [1-10 Hz], from local earthquakes and the ambient seismic field recorded in the boreholes.

Earthquake transfer functions 200-0 m

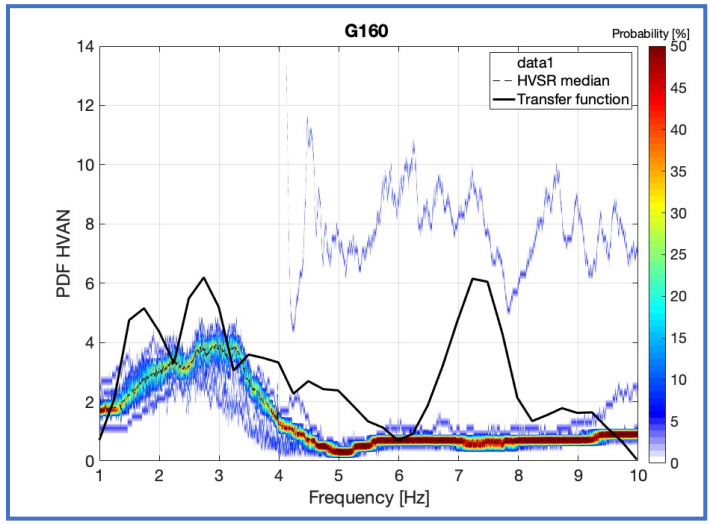


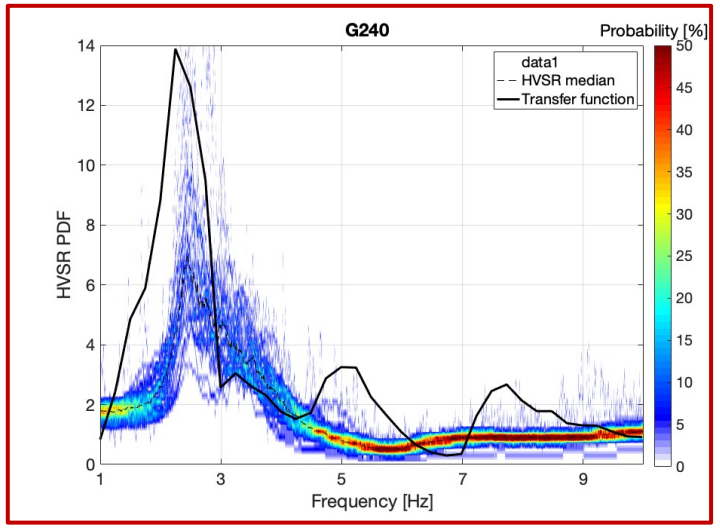
Ambient seismic field horizontal-to-vertical spectral ratios (HVSR)

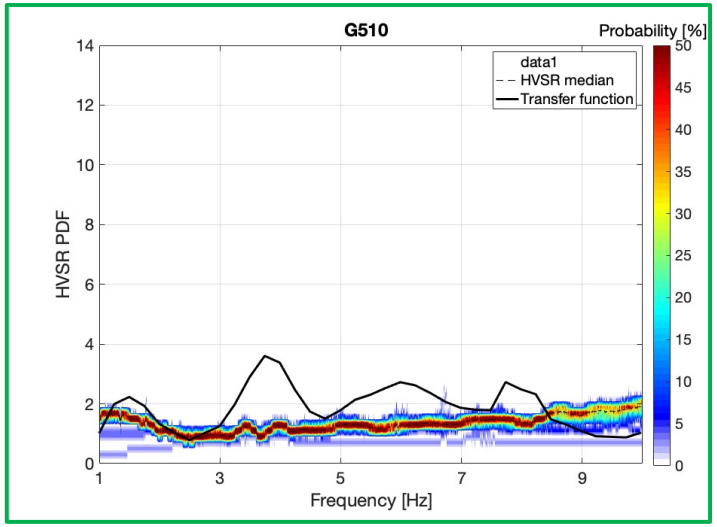


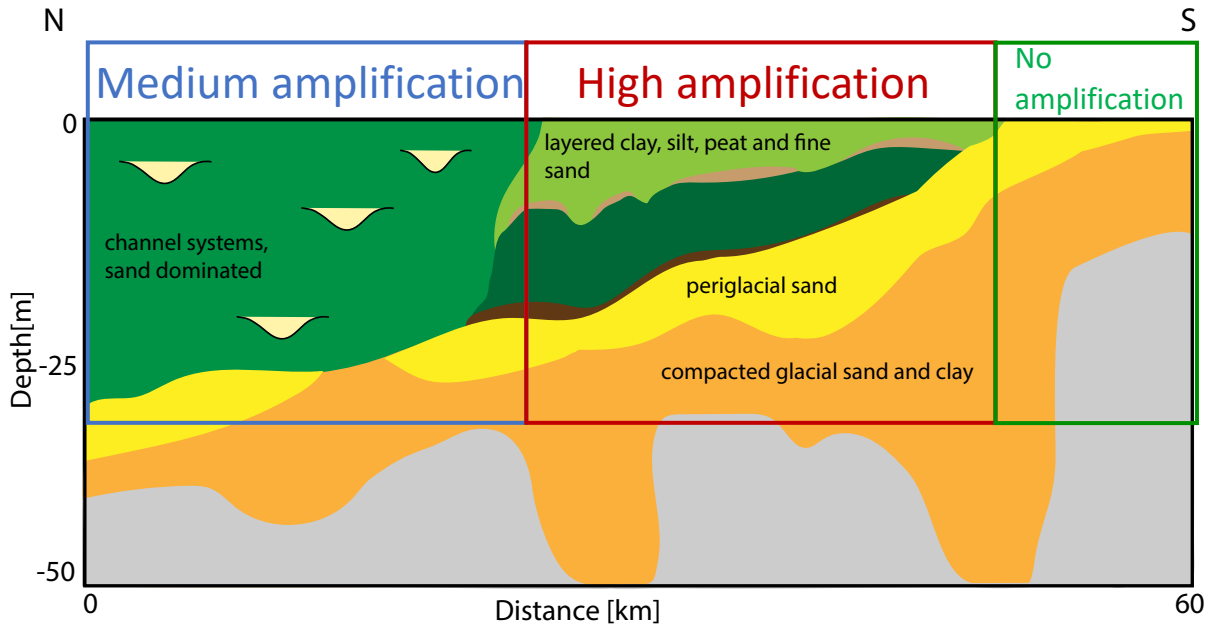
For more details: van Ginkel et al., 2019, 2020 and 2021 (under review)

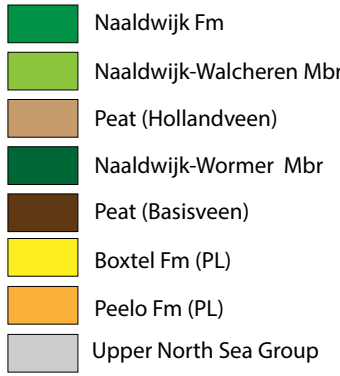
In **Groningen**, the relationship between **amplification and the shallow subsurface lithology** was established.

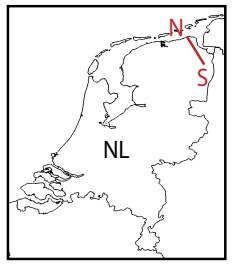






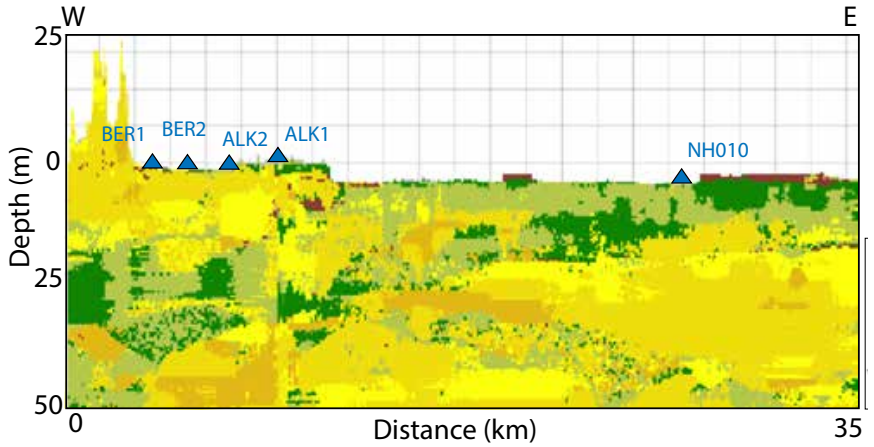




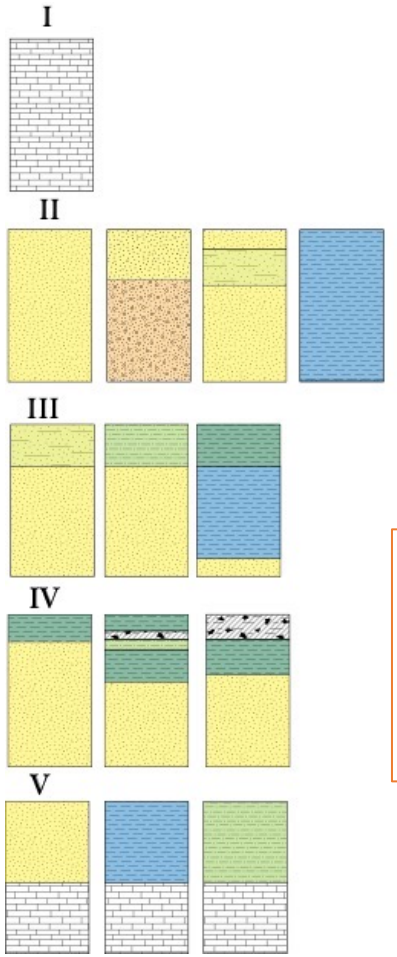


Van Ginkel et al., 2019, 2020

Based on shallow subsurface lithological models, a **Netherlands-wide sediment classification scheme** is constructed





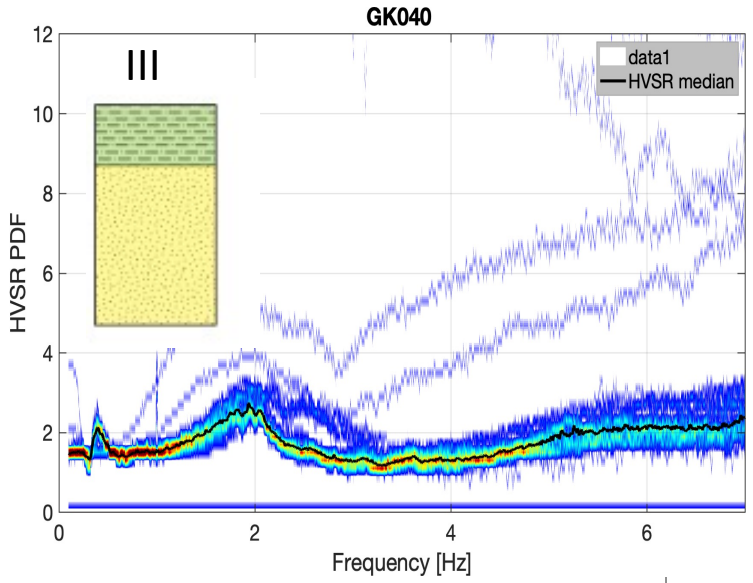


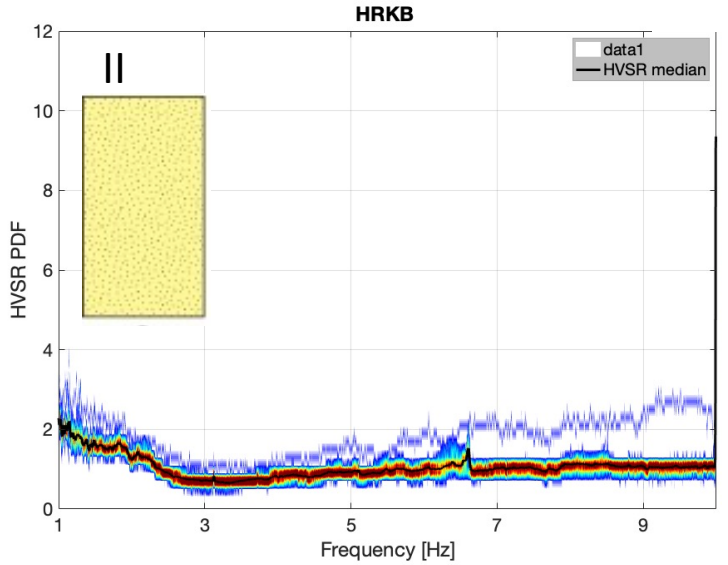
- GeoTOP voxel model: 100*100*1 m
- NL3D voxel model: 250*250*1 m

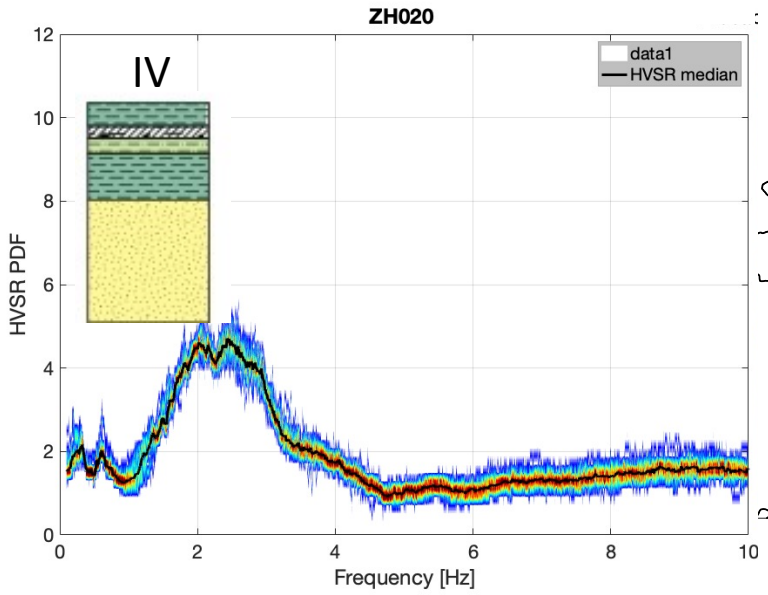
- Shear wave velocity
- Velocity contrast
- Depth of the bedrock

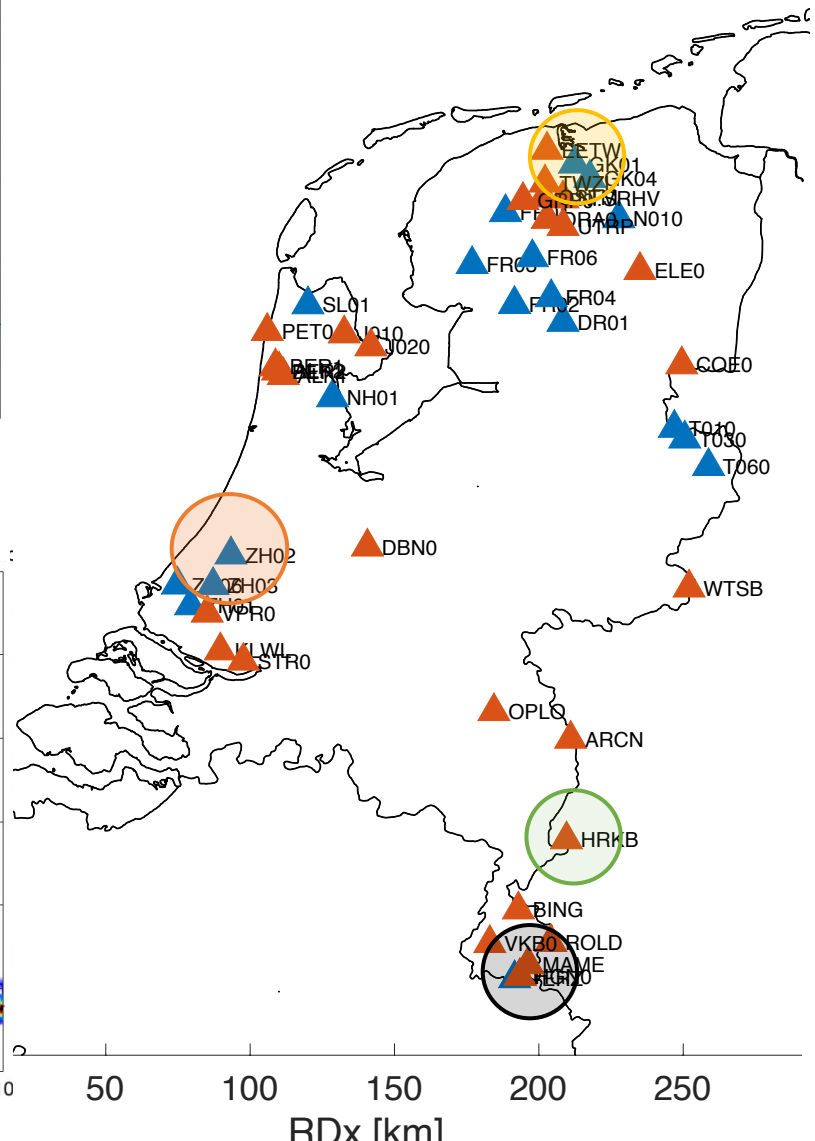
Based on GeoTOP and NL3D geological models, TNO, Geological survey of the Netherlands

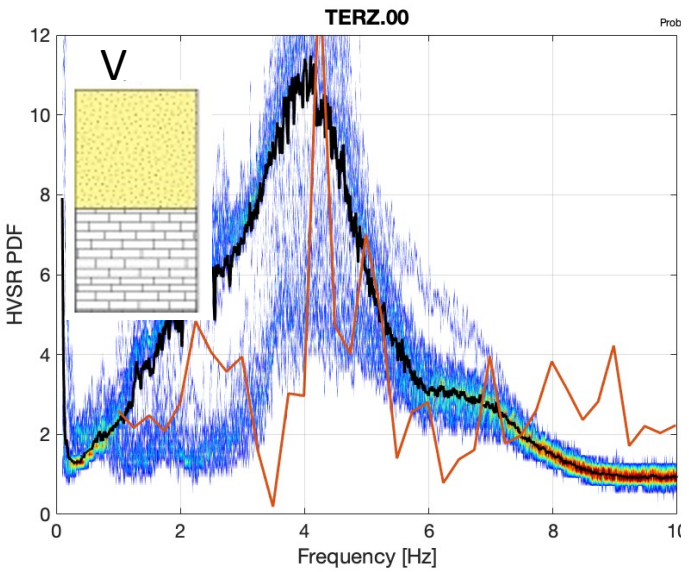
Some examples of the match between the sediment classification and HVSR curve characteristics



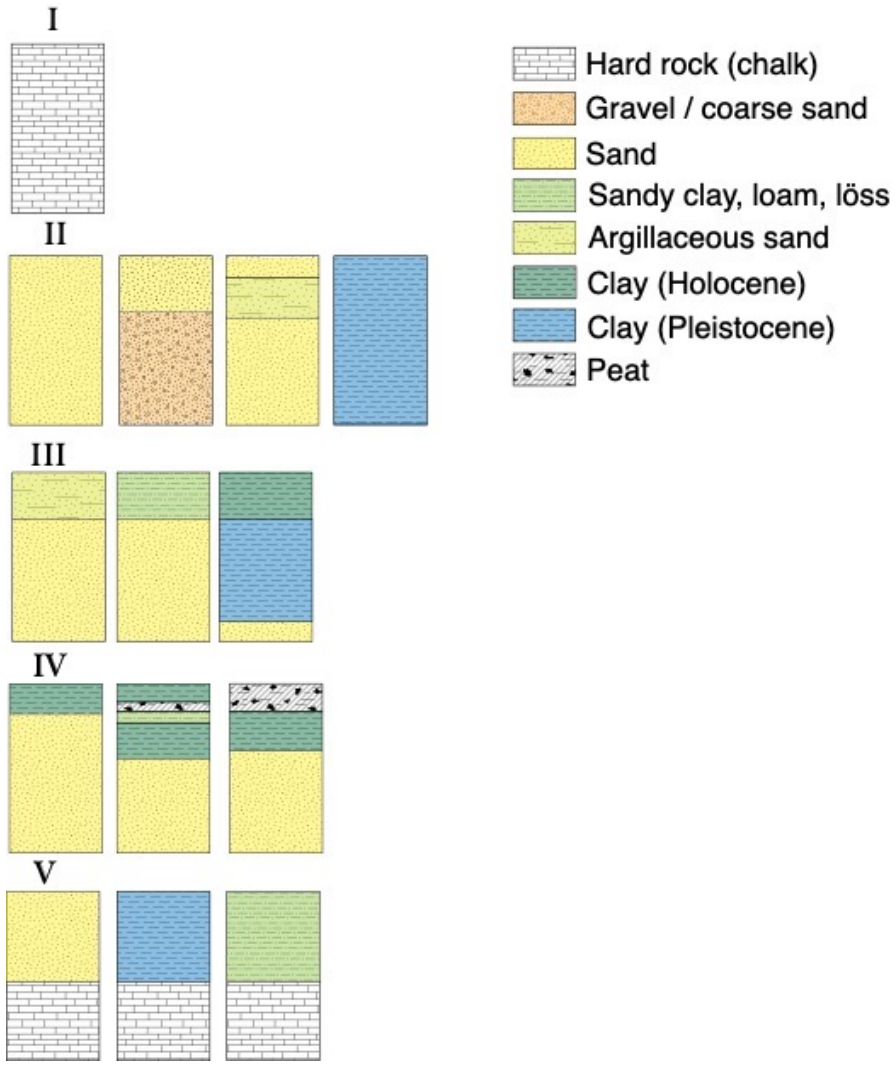


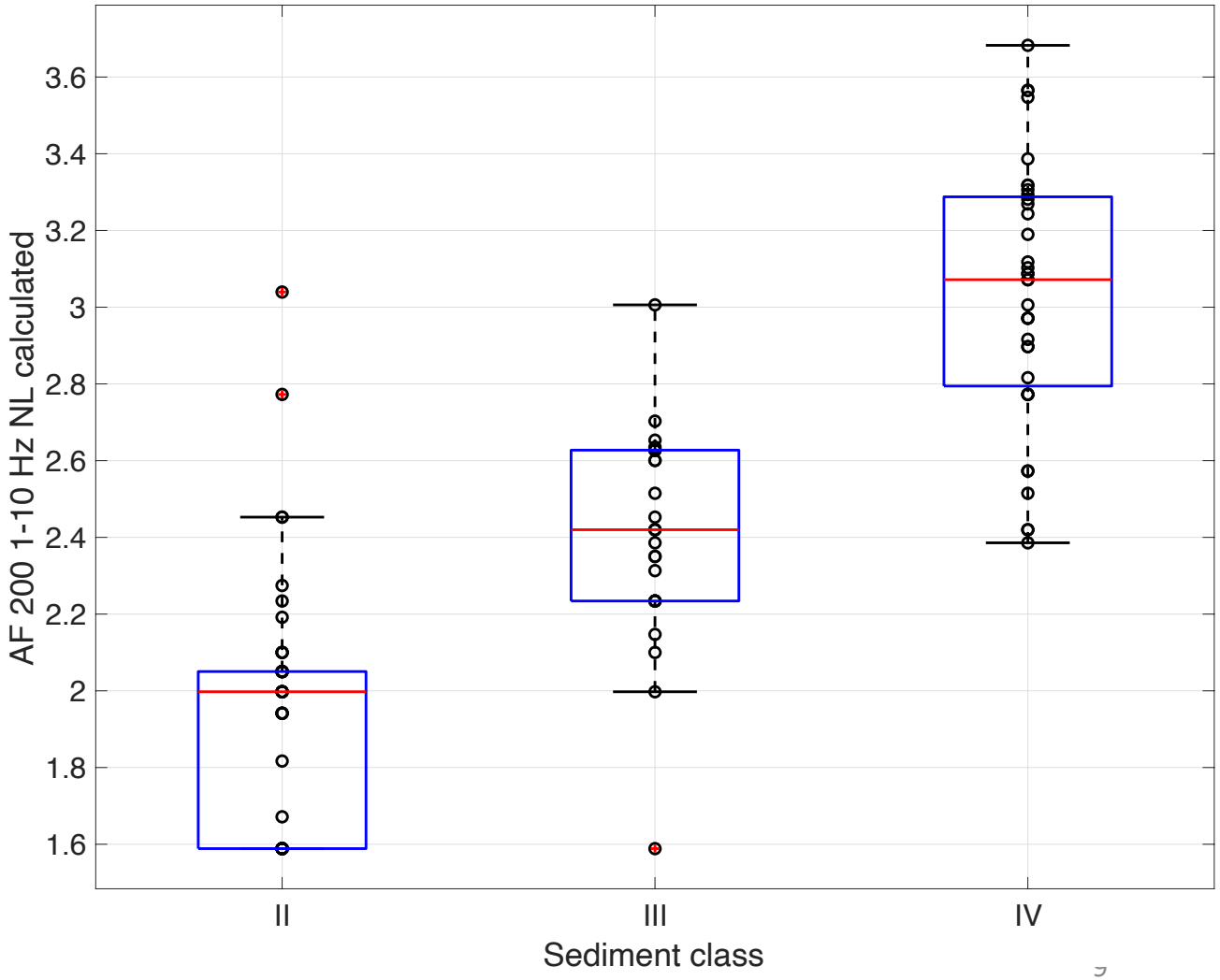




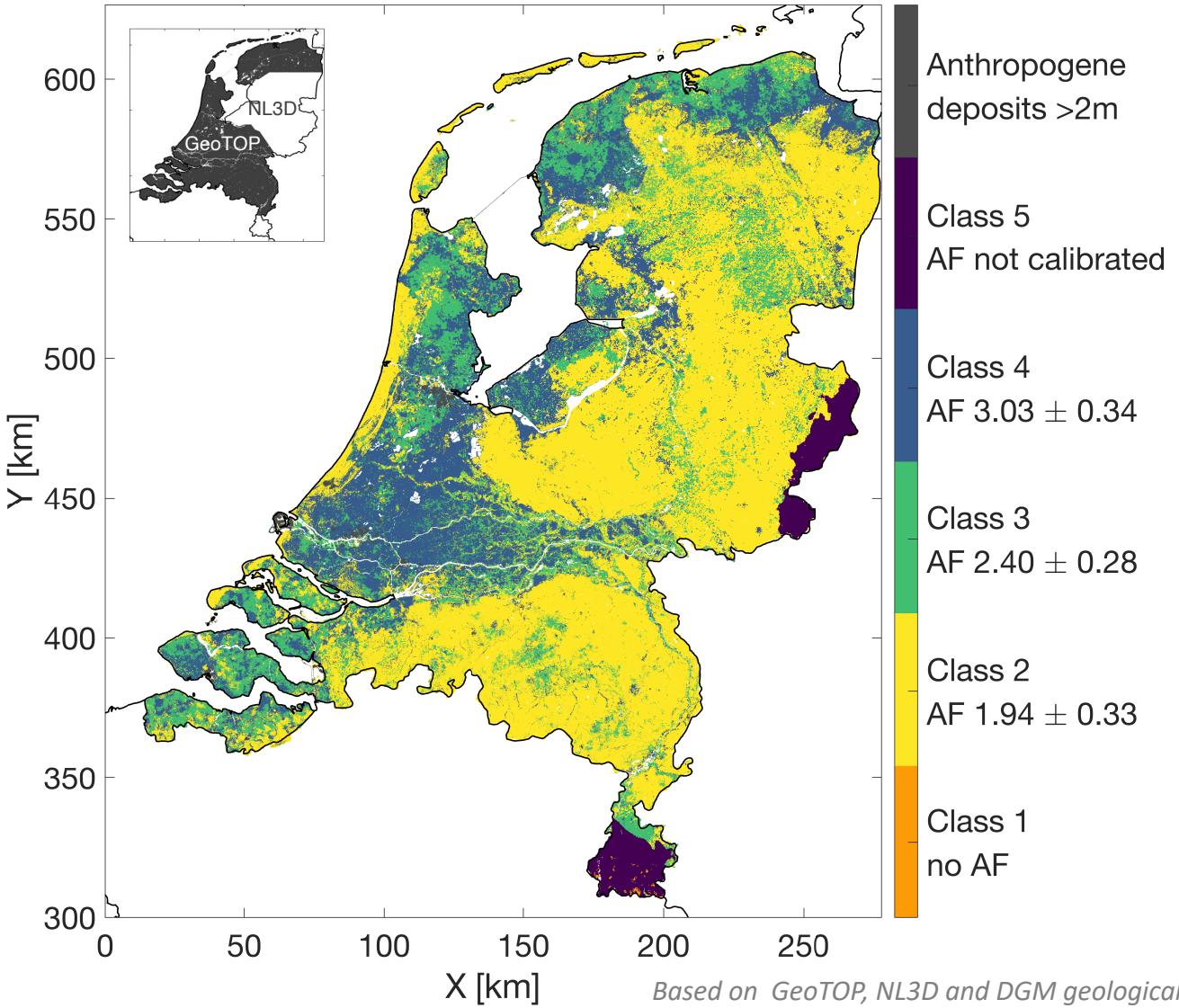


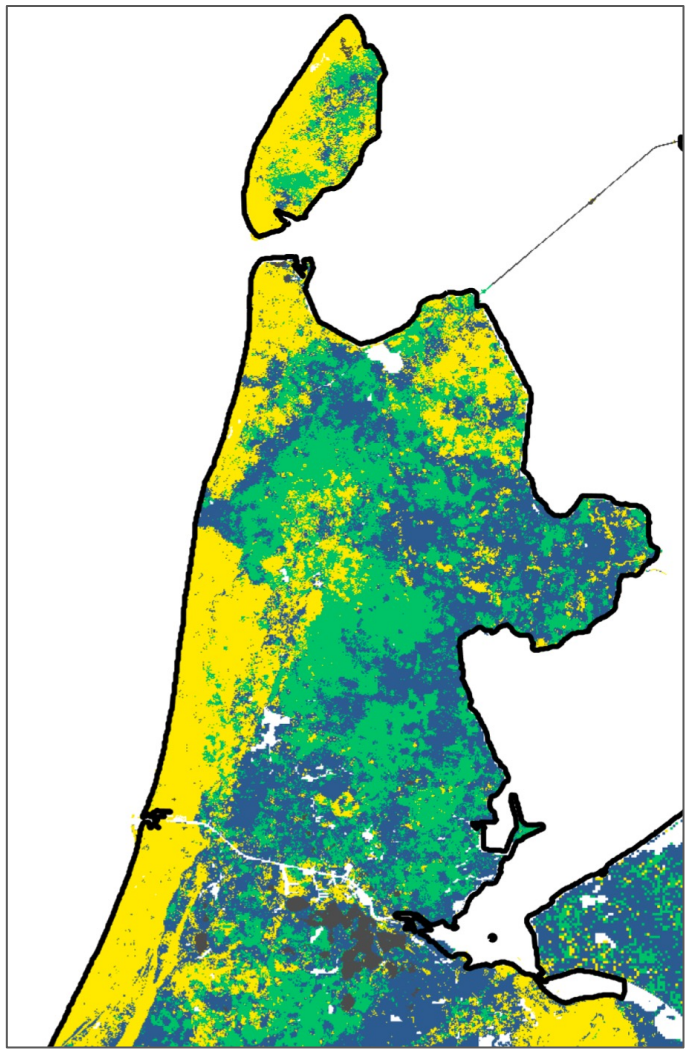
The **HVSR peak amplitudes** from each seismometer in NL are converted for an **amplification factor (AF)** for class II-IV.





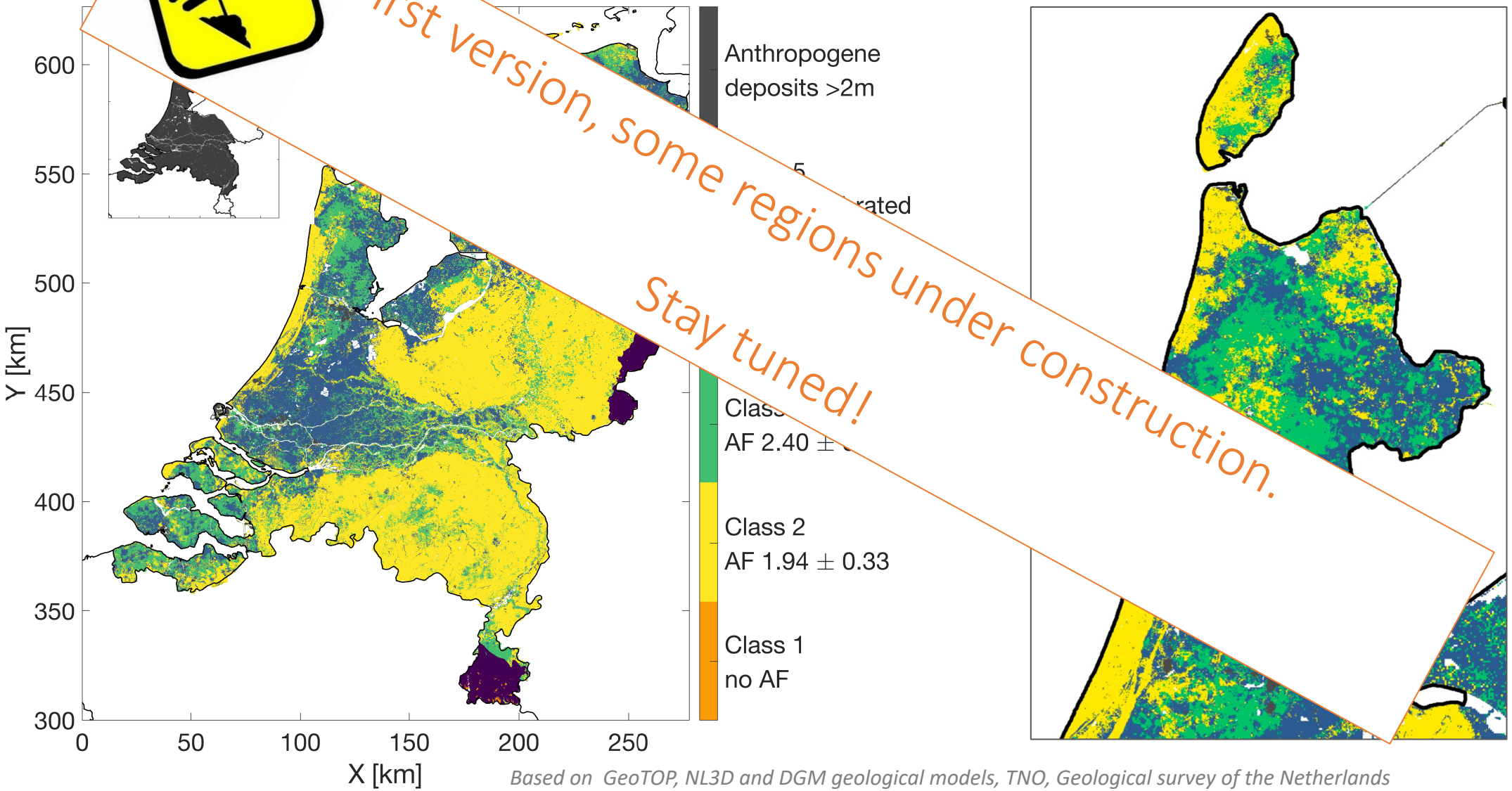
Amplification classes map for NL based on geological models GeoTOP and NL3D.





Based on GeoTOP, NL3D and DGM geological models, TNO, Geological survey of the Netherlands

Amplific[illegible]n classes map for NL based on geological model[illegible] and NL3D.



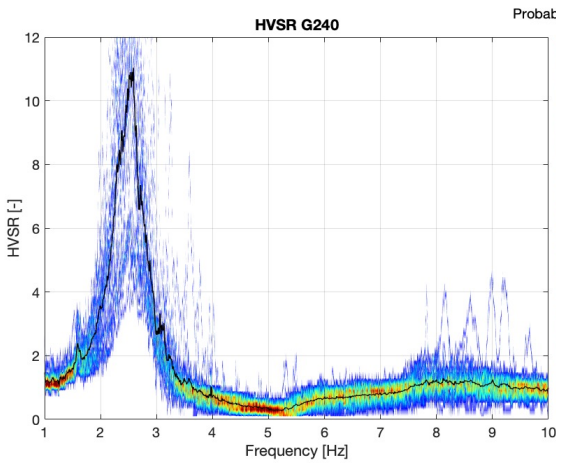
First version, some regions under construction.

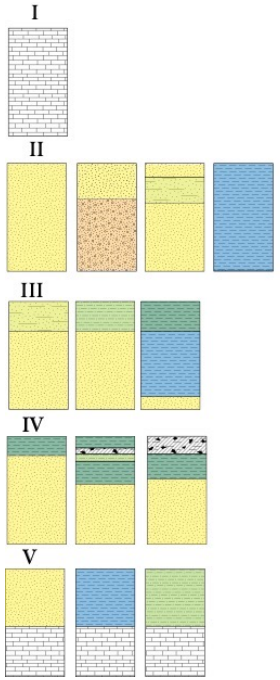
Stay tuned!

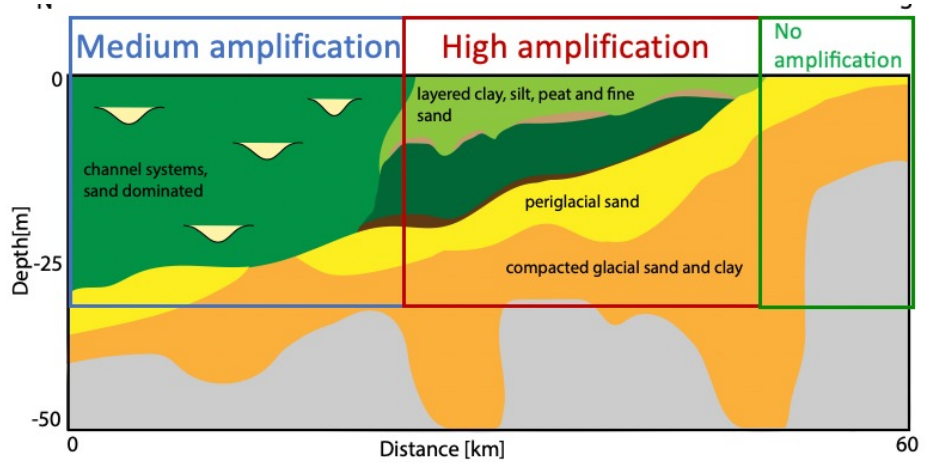
Based on GeoTOP, NL3D and DGM geological models, TNO, Geological survey of the Netherlands

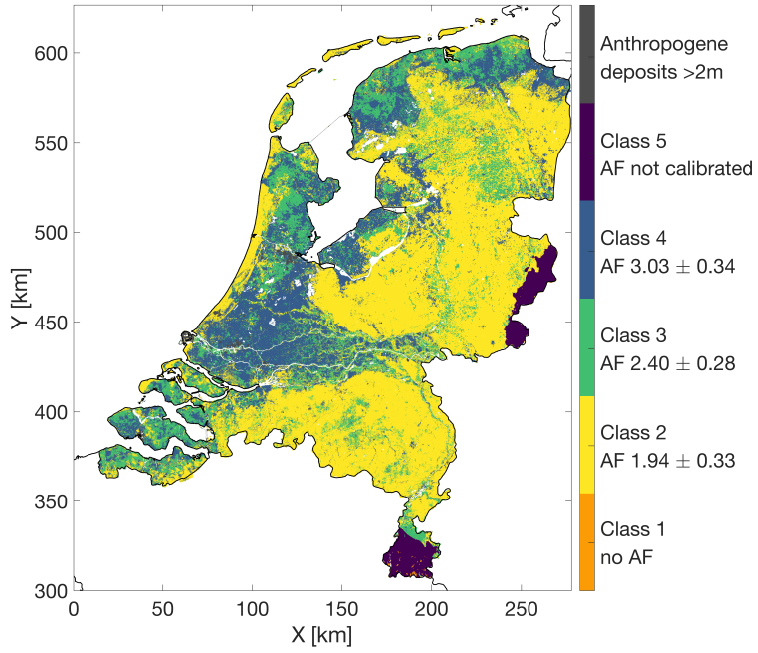
Summary and Outlook

- Calculate amplification in frequency domain
- Link to shallow subsurface lithology
- Defined sediment classification scheme
- Geological models TNO translated into NL classes map

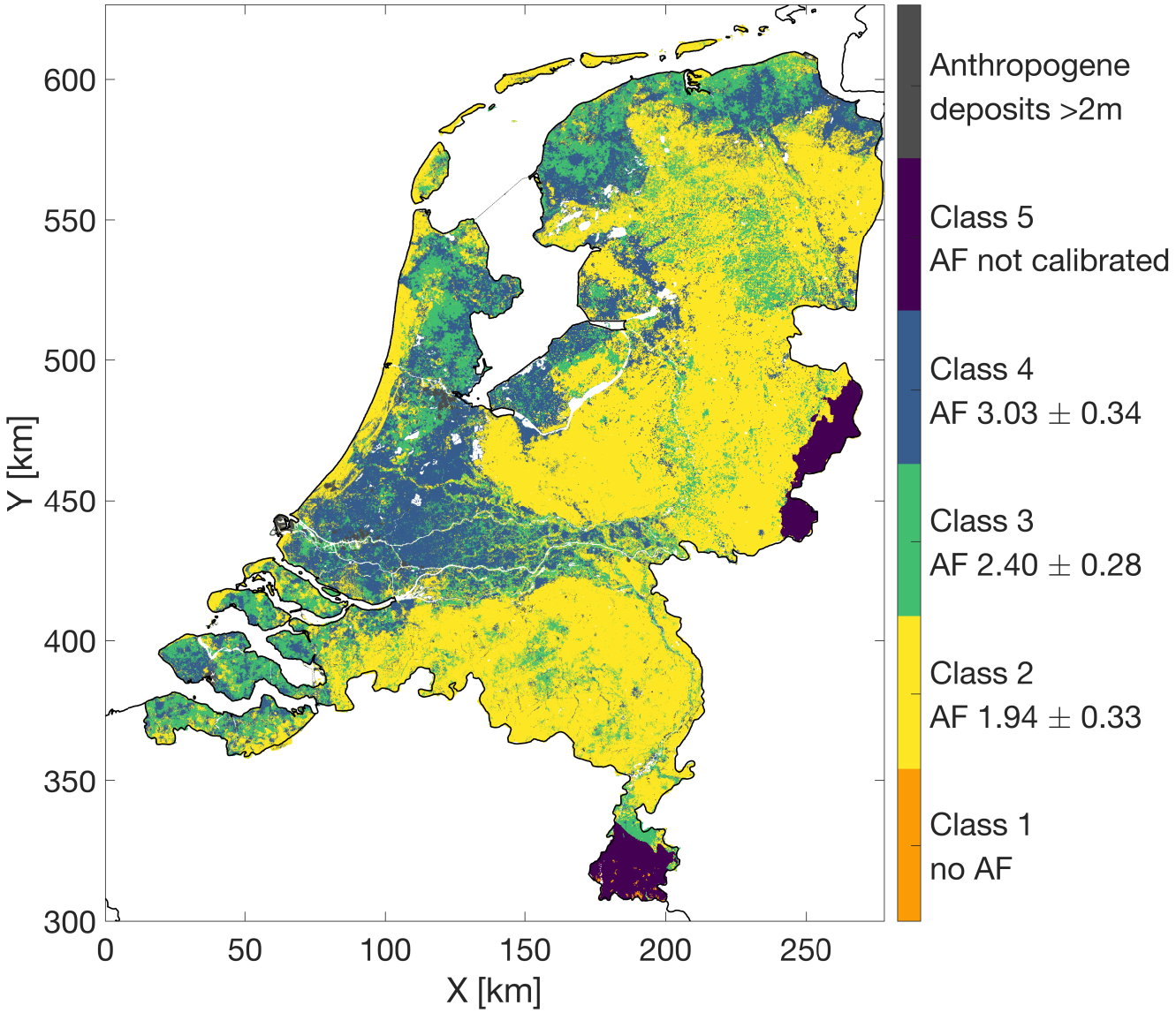








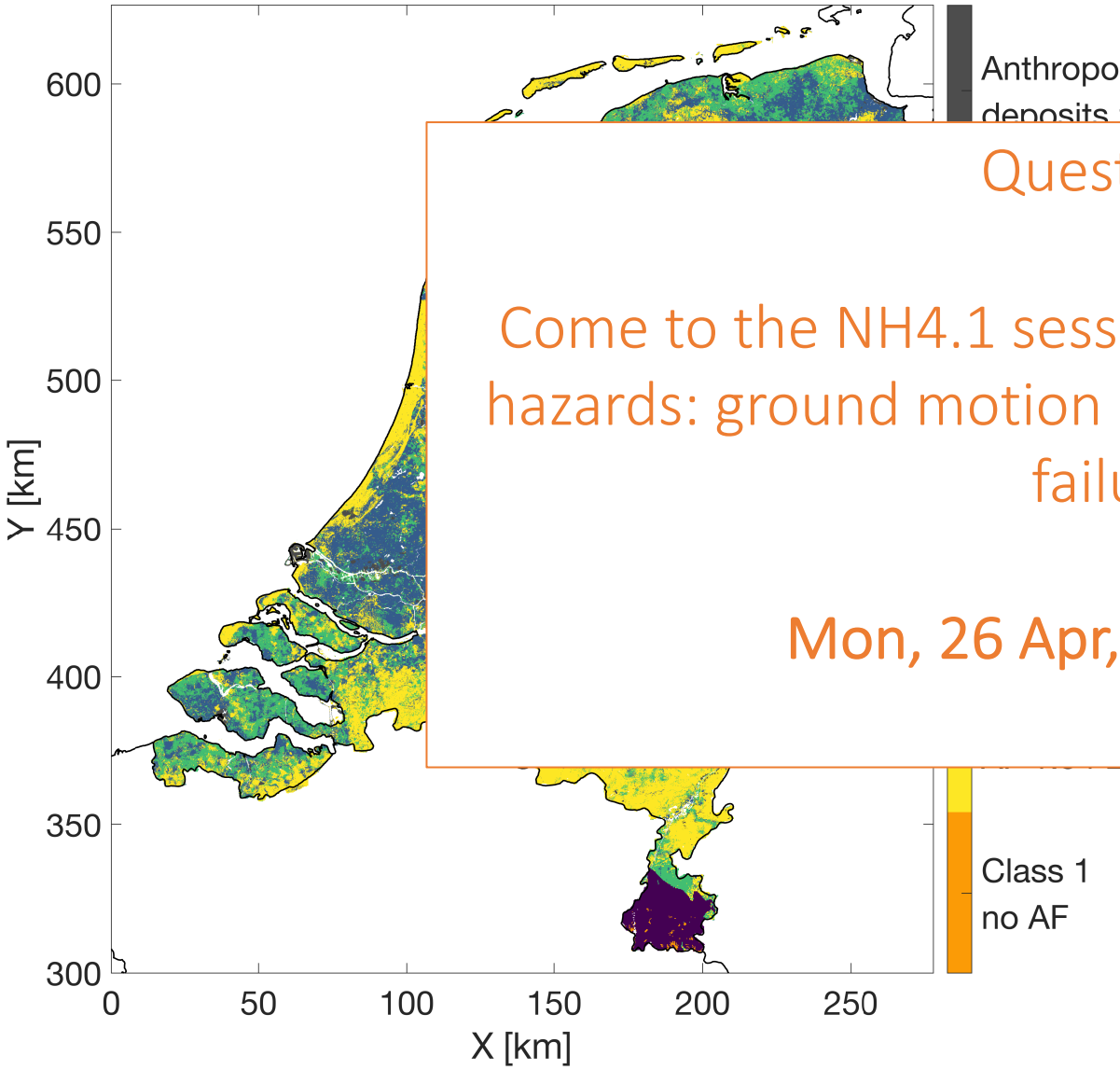
Summary and **Outlook** - How to use this map?



- ✓ For seismic hazard assessment, this map can act as first indicator for regional site response for frequencies of 1-10 Hz
- ✓ Based on Groningen empirical relationships we defined the amplification factor (AF) for the top 200m for each class .
- ✓ Therefore shallow hard rock settings are not calibrated
- ➢ Check with more data (SCPT)

Janneke van Ginkel: j.a.van.ginkel@rug.nl

Summary and **Outlook** - How to use this map?



Questions?

Come to the NH4.1 session: Earthquake-induced hazards: ground motion amplification and ground failures

Mon, 26 Apr, 13:30–17:00

- ✓ For seismic hazard assessment, this map can act as first indicator for
  onse for
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  gen empirical
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