E-TEST Einstein Telescope EMR Site & Technology

E-TEST

Einstein Telescope EMR Site & Technology

E-TEST Team

Timing 01.02.2020 – 31.xx.2023

10.03.22

Interreg Euregio Meuse-Rhine European Regional Development Fund

EUROPEAN UNION

E-TEST Einstein Telescope EMR Site & Technology

The Financiers

Interreg Euregio Meuse-Rhine

EUROPEAN UNION

Wallonie

VLAAMS-BRABANT

AGENTSCHAP INNOVEREN & ONDERNEMEN

Vlaanderen is ondernemen

provincie Limburg

provincie limburg

Ministerie van Economische Zaken en Klimaat

Ministerium für Wirtschaft, Innovation, Digitalisierung und Energie des Landes Nordrhein-Westfalen

The Partners

LIÈGE université

Fraunhofer ILT

RWTH AACHEN UNIVERSITY

UHASSELT

KU LEUVEN

Nikhef

UNIVERSITÄT BONN

NMWP. We enable innovation. Everywhere.

Koninklijk Nederlands Meteorologisch Instituut
Ministerie van Infrastructuur en Waterstaat

Maastricht University

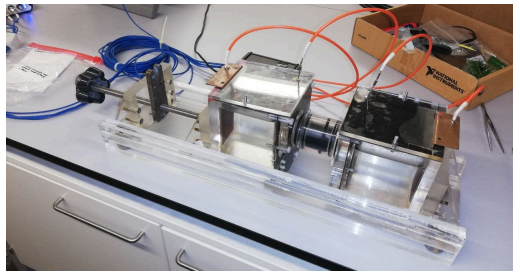
UCLouvain

E-TEST: where we stand

Deliverables

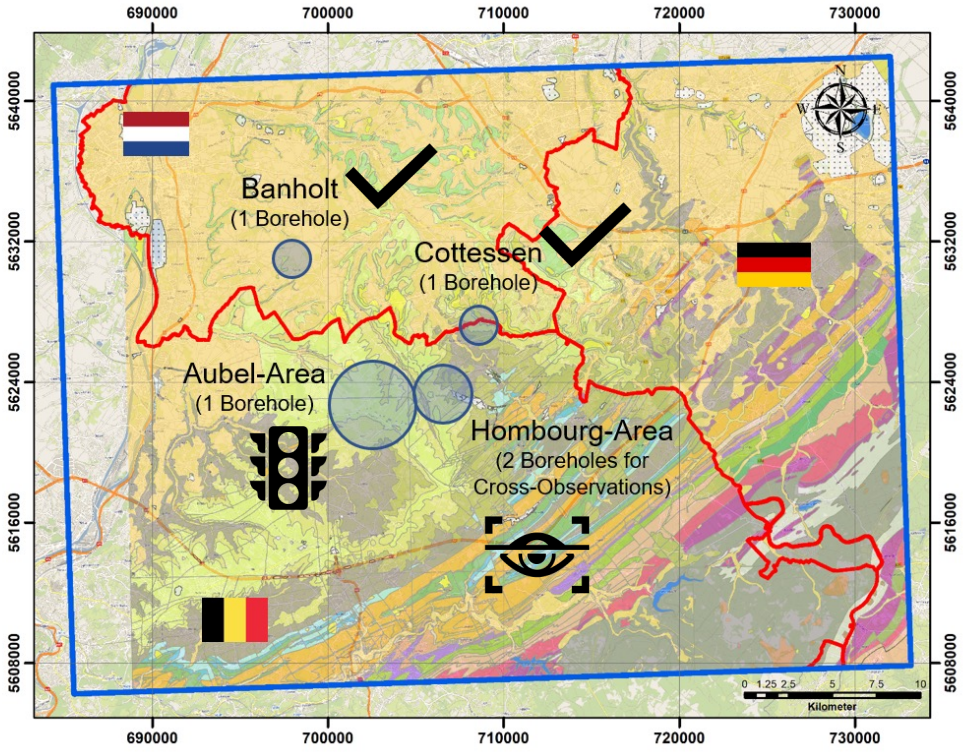
- Gathering information (ongoing)
  - Geology
  - Geophysical images
  - Geotechnical parameters
  - Hydrogeological parameters
  - Seismic noise
  - Seismology*
- Modelling (ongoing)
  - Geology
  - Seismic noise
  - Groundwater
  - Seismic hazard*
  - Positioning and costs

Latest updates : lot of field/lab work done

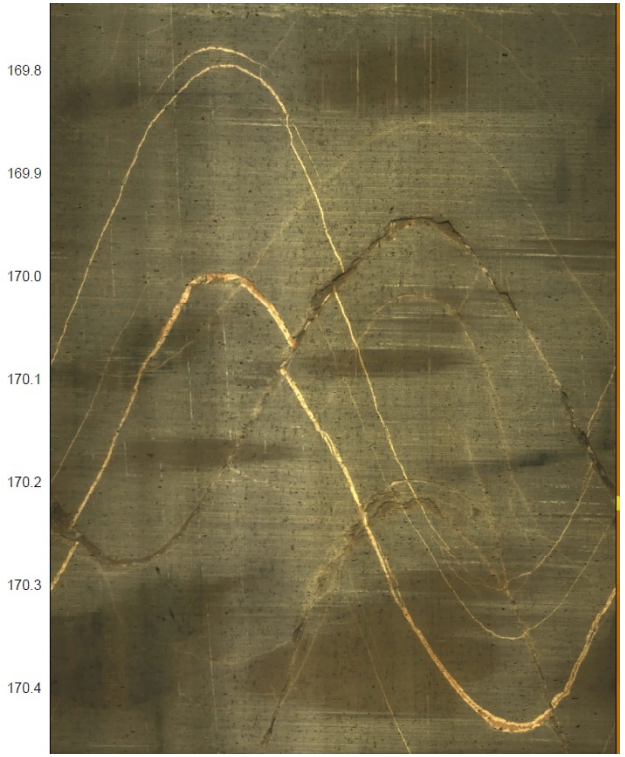


Key data: direct observation from 2/5 “deep” boreholes

- 1425 borehole descriptions have been collected for the study area (60 % less than 50 meters deep and 10 % of them reach depths greater than ~200 m but sparsely located in the surveyed area).
- Access to geology down to 250m
- Access to lab/in-situ hydraulic parameters
- Access to lab/in-situ geotechnical parameters on main geological formations
- Next steps: seismic noise monitoring

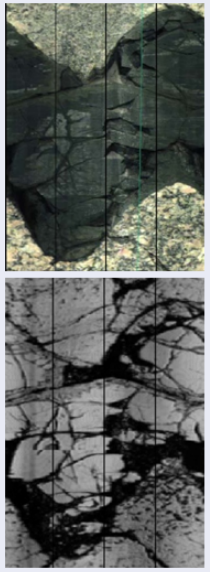


Key data from boreholes



Cottessen OPTV

Geophysical Borehole Investigations



- Optical Televiewer Scan
- Acoustic Televiewer Scan
- 3-Component Magnetometer Log
- Natural Gamma Log
- Spectral Gamma Log
- Full-Wave Velocity Log
- Inflow/Outflow measurements
- Formation Resistivity Log

Hydraulic Testing & Fracturing

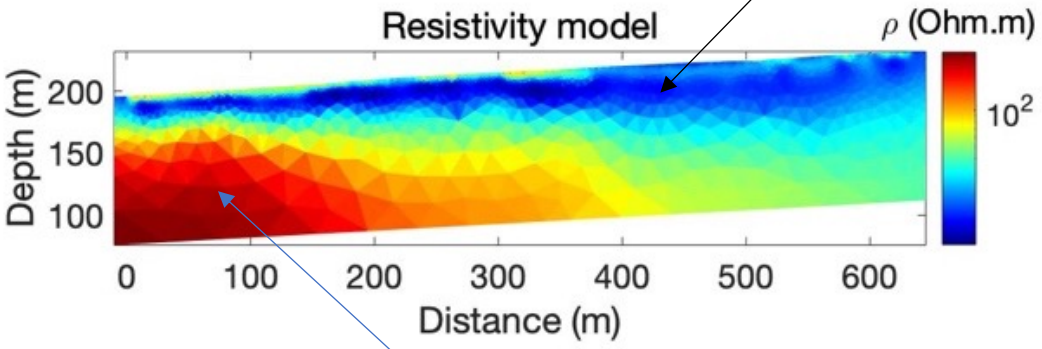
- Pump-/Slug-/Pulse-Tests (~ 5-10 tests/borehole)
- HF/HTPF-Tests + Impression-Packer-Tests (~ 5-10 tests/borehole in 3 boreholes)

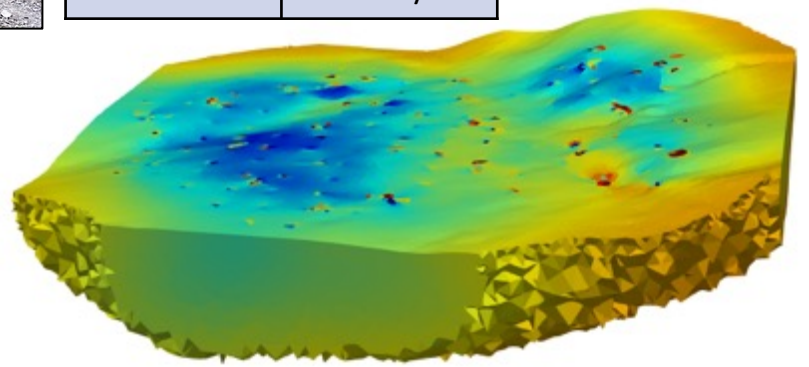
Laboratory Tests

- Uniaxial Compression Tests
- Triaxial Compression Tests
- Indirect Tensile Tests
- Shear Tests
- Cerchar-Test
- P-Wave Velocity Measurement
- …

Key data: geophysical “markers” of geological formations

Density	2.32 g/cm³
Porosity	18.7 %
E-Modul	23 GPa
UCS	104 MPa
BTS	9 MPa
P-Wave-V.	4309 m/s

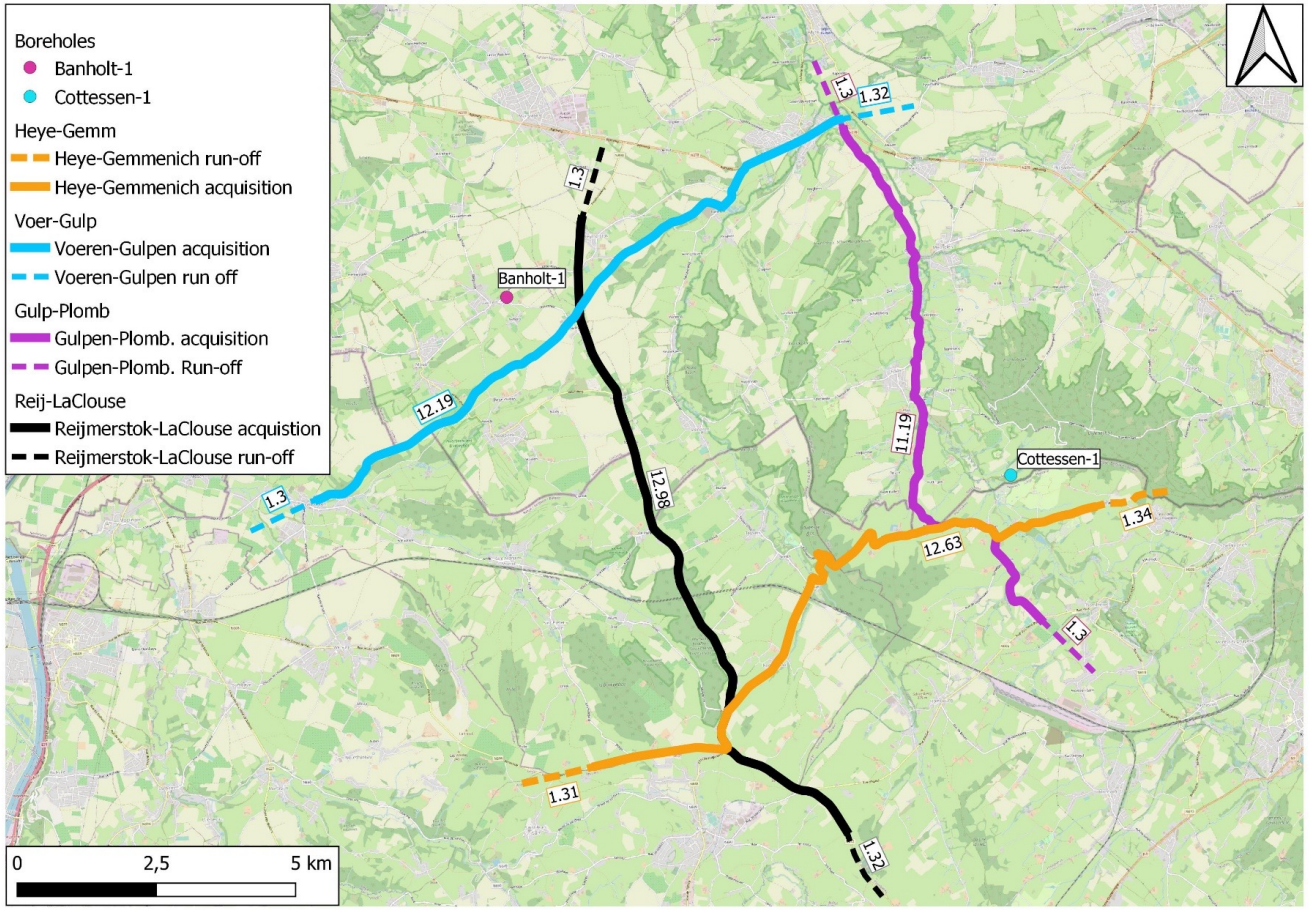




Density	2.64 g/cm³	UCS	119 MPa
Porosity	4.5 %	BTS	15 MPa
P-Wave-V.	5160 m/s	E-Modul	25 GPa

Seismic lines (structural information) upcoming

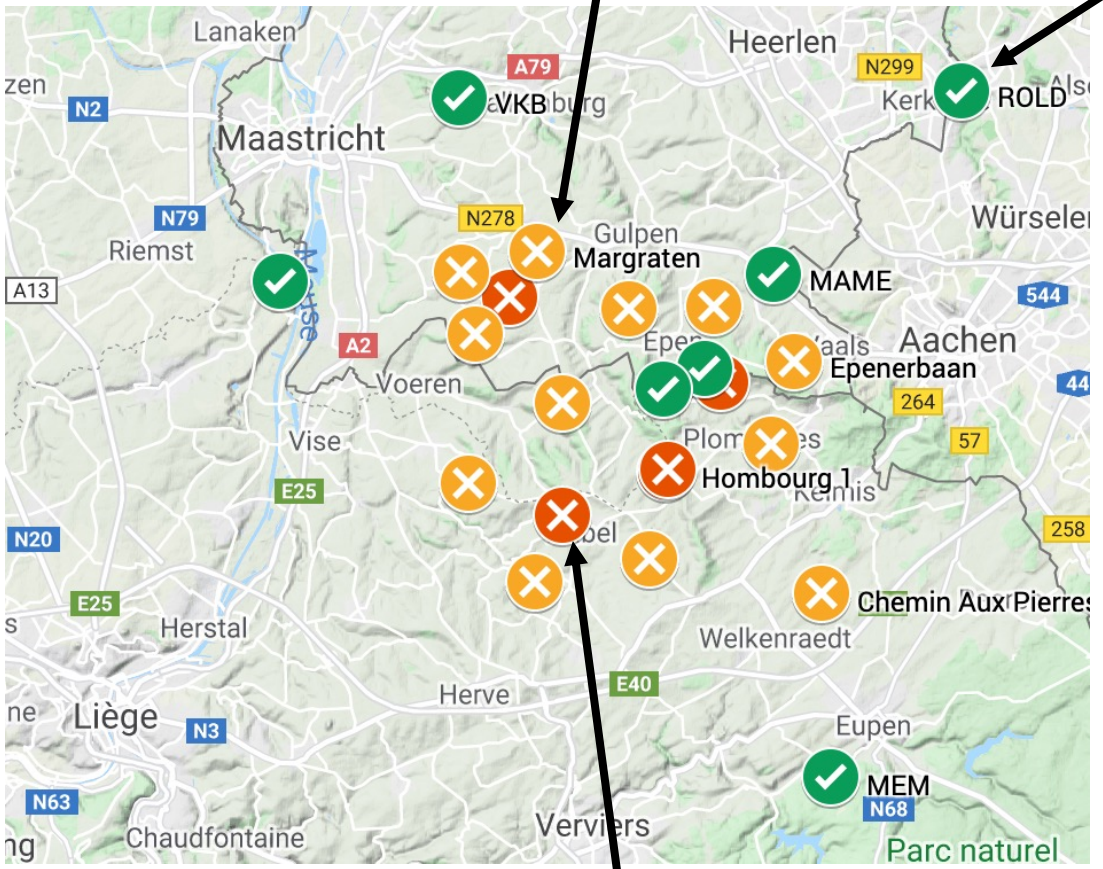
- To be updated on 7th march
- 1st Tender closed -> Unsuccessful
- 2nd Tender online since 19th Jan
- Environmental investigations finished in NL, ongoing in BE
- UXO desk study finished
- Contact with local authorities



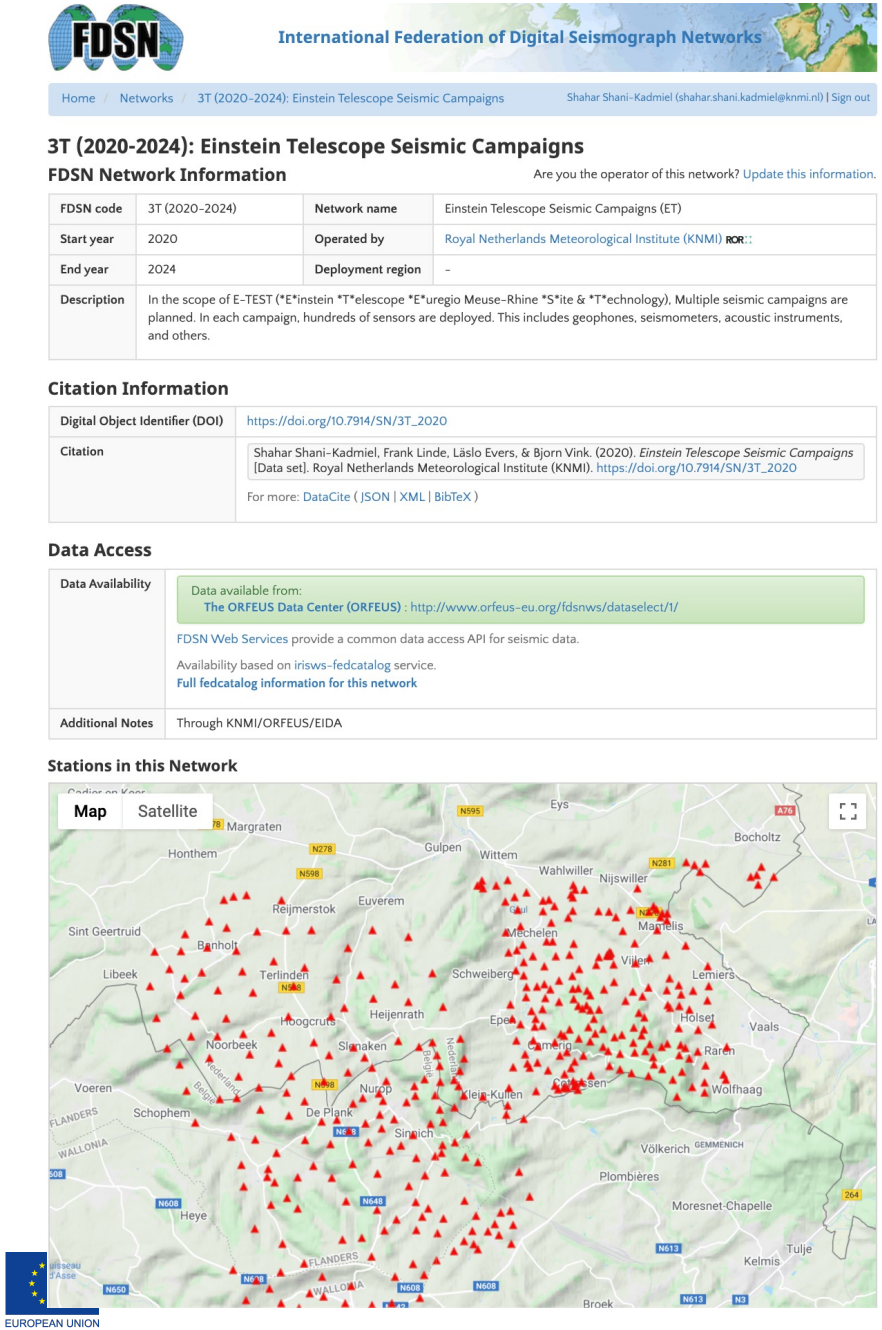
Seismic noise

Surface stations

Existing stations



Borehole & Surface stations



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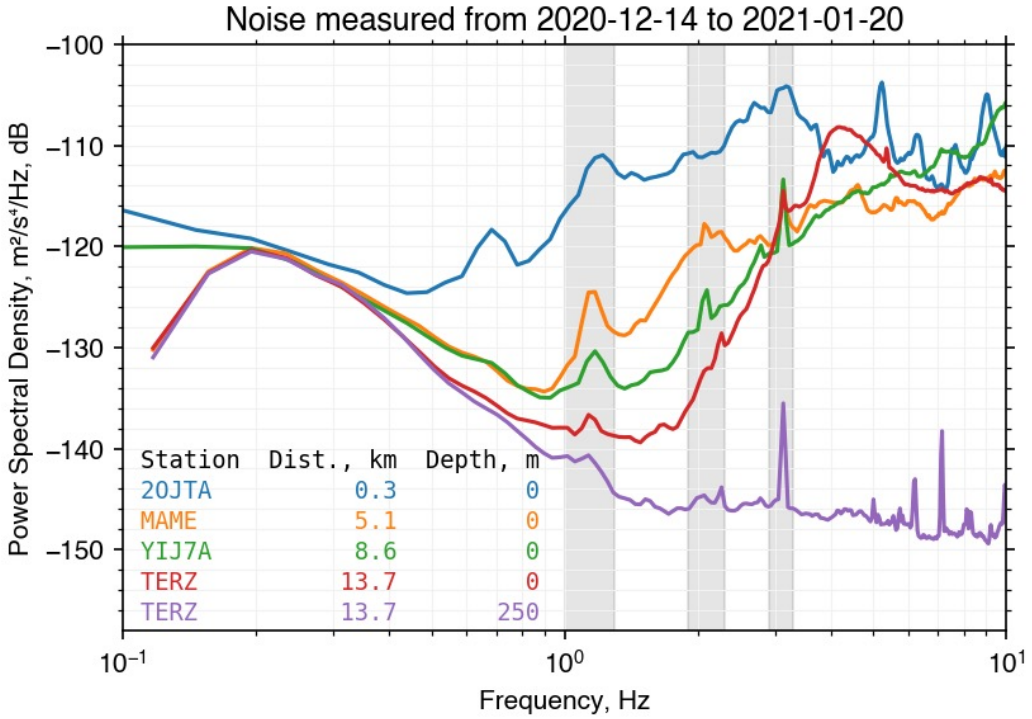
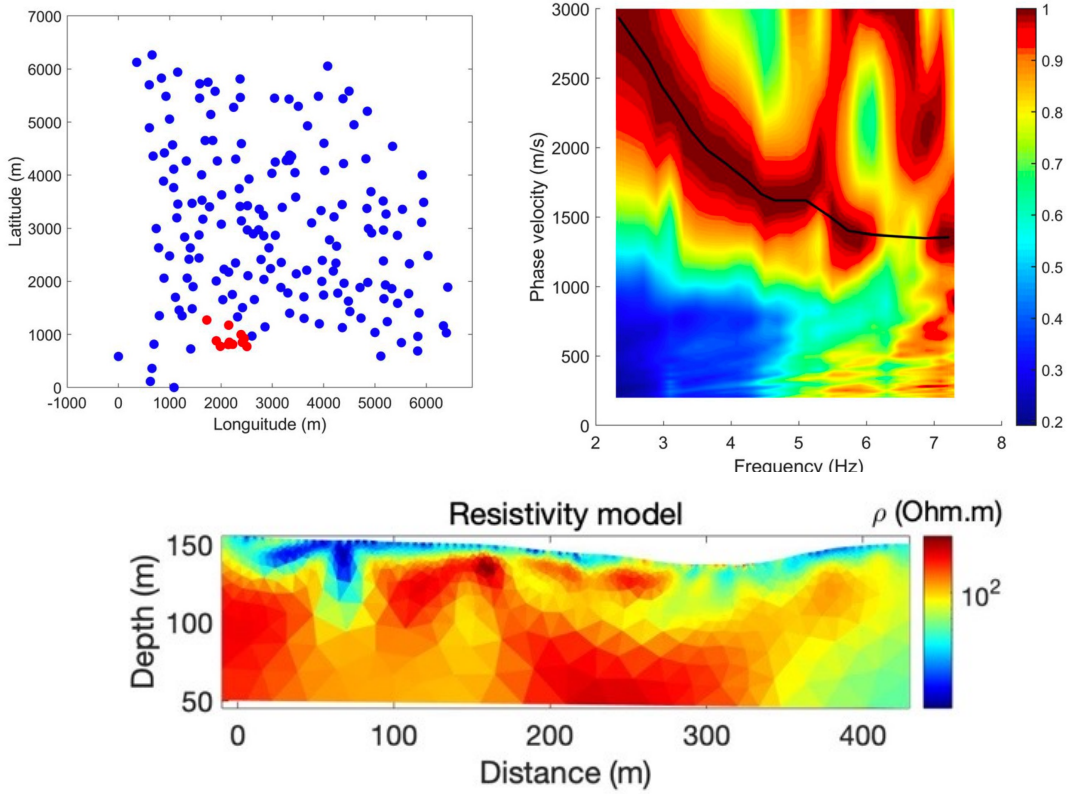
Noise behavior and imaging



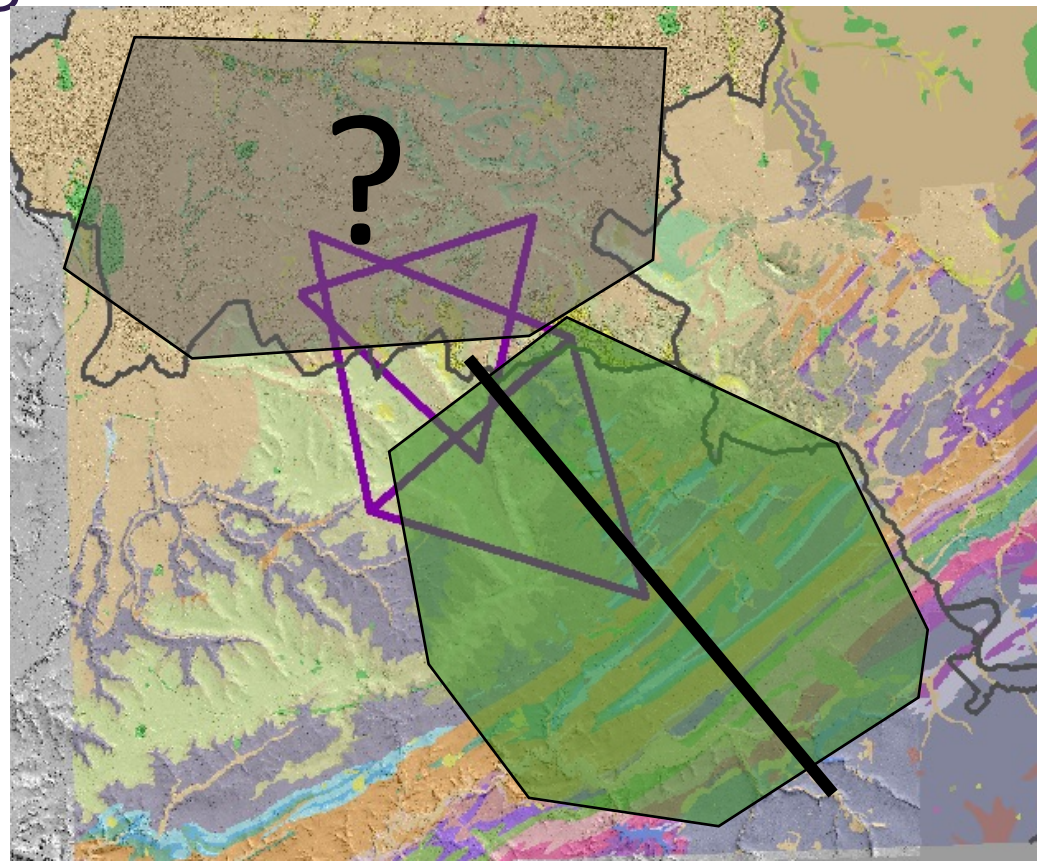
Towards a 3D subsurface image (Cottessen)

Seismic interferometry near Cottessen shows high phase velocities corresponding to hard rock near the surface



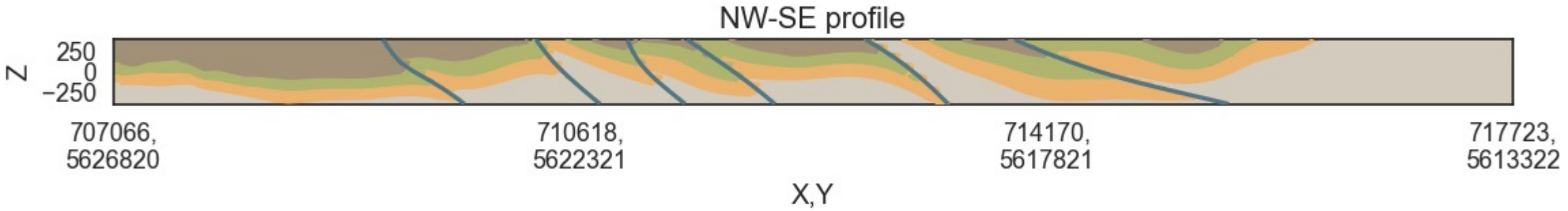
3D Cross-Border Open Geological Model

- North-East Belgium covered
- South Limburg poorly explored
- Significant improvement of model expected with inclusion of active/passive seismic data, ongoing geophysical exploration (ERT by ULiege) and borehole data

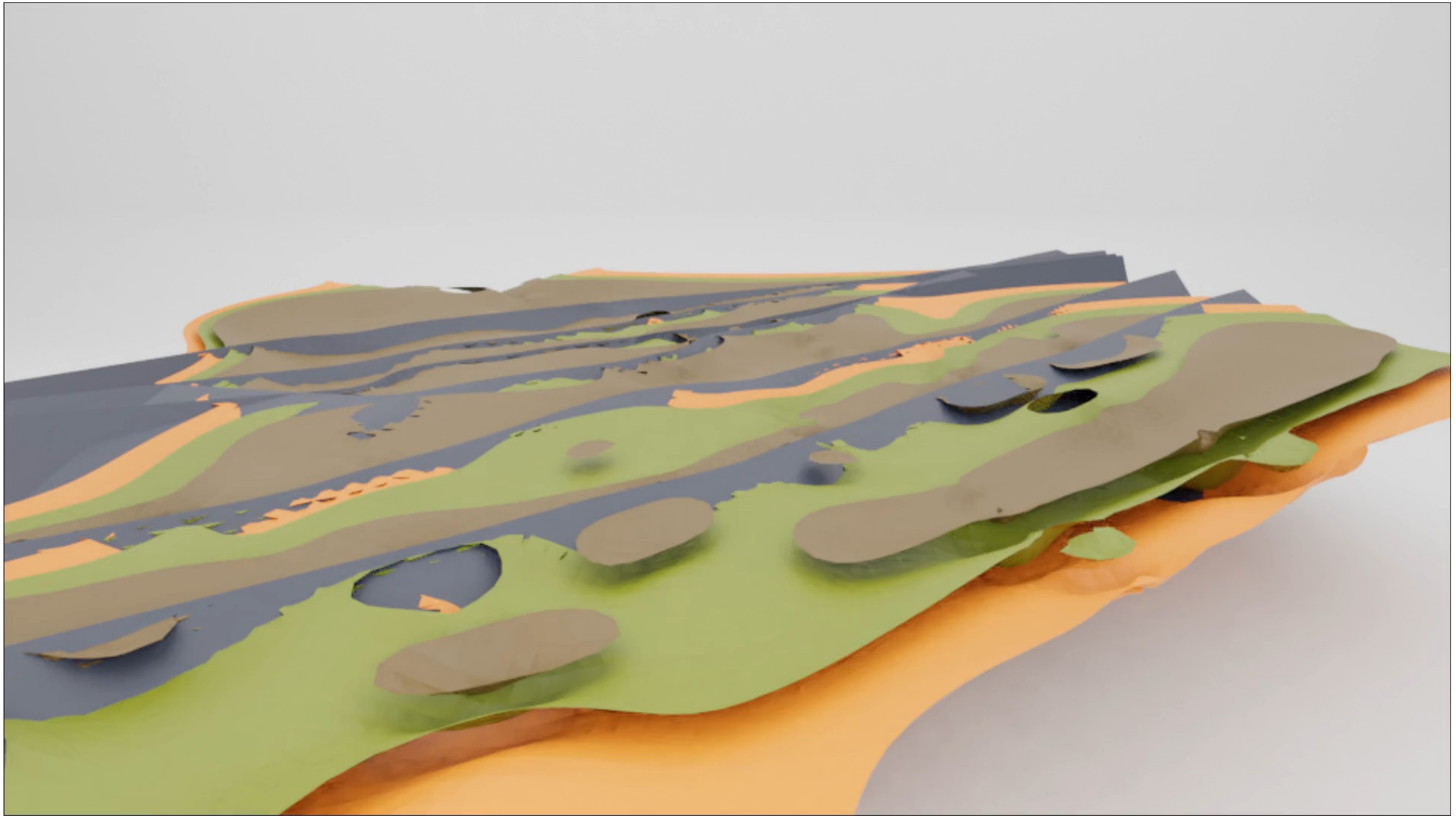


Upcoming:

- Ongoing improvement of model
- Quantification of uncertainties of model input
- Animation of geological uncertainty and AR/VR for ET Conference in Walloon Region (March 22)

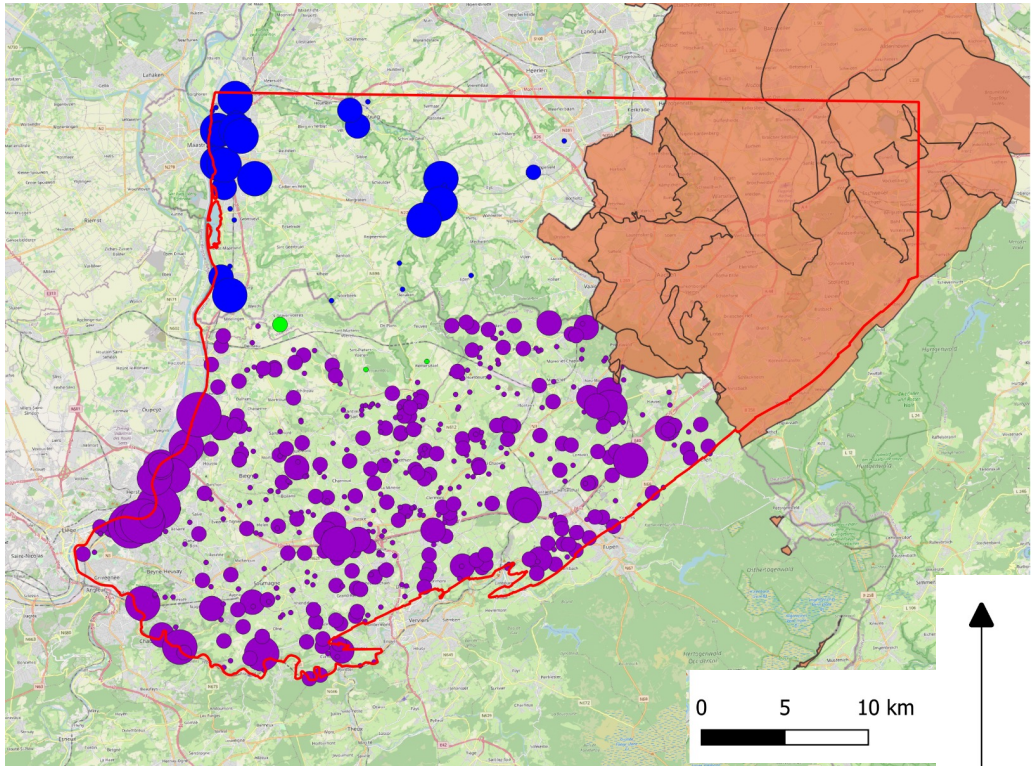


3D Cross-Border Open Geological Model

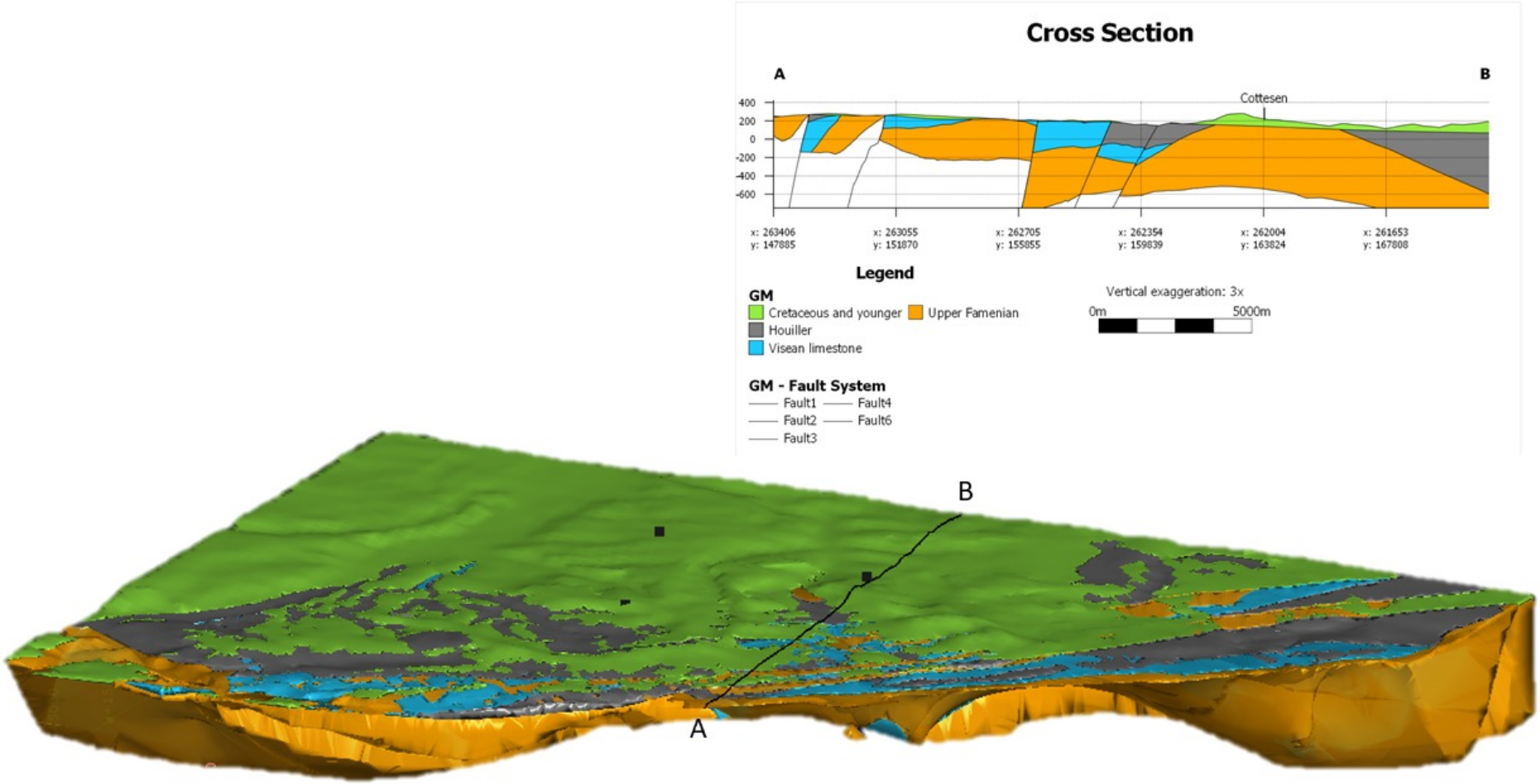


Groundwater model in the EMR region

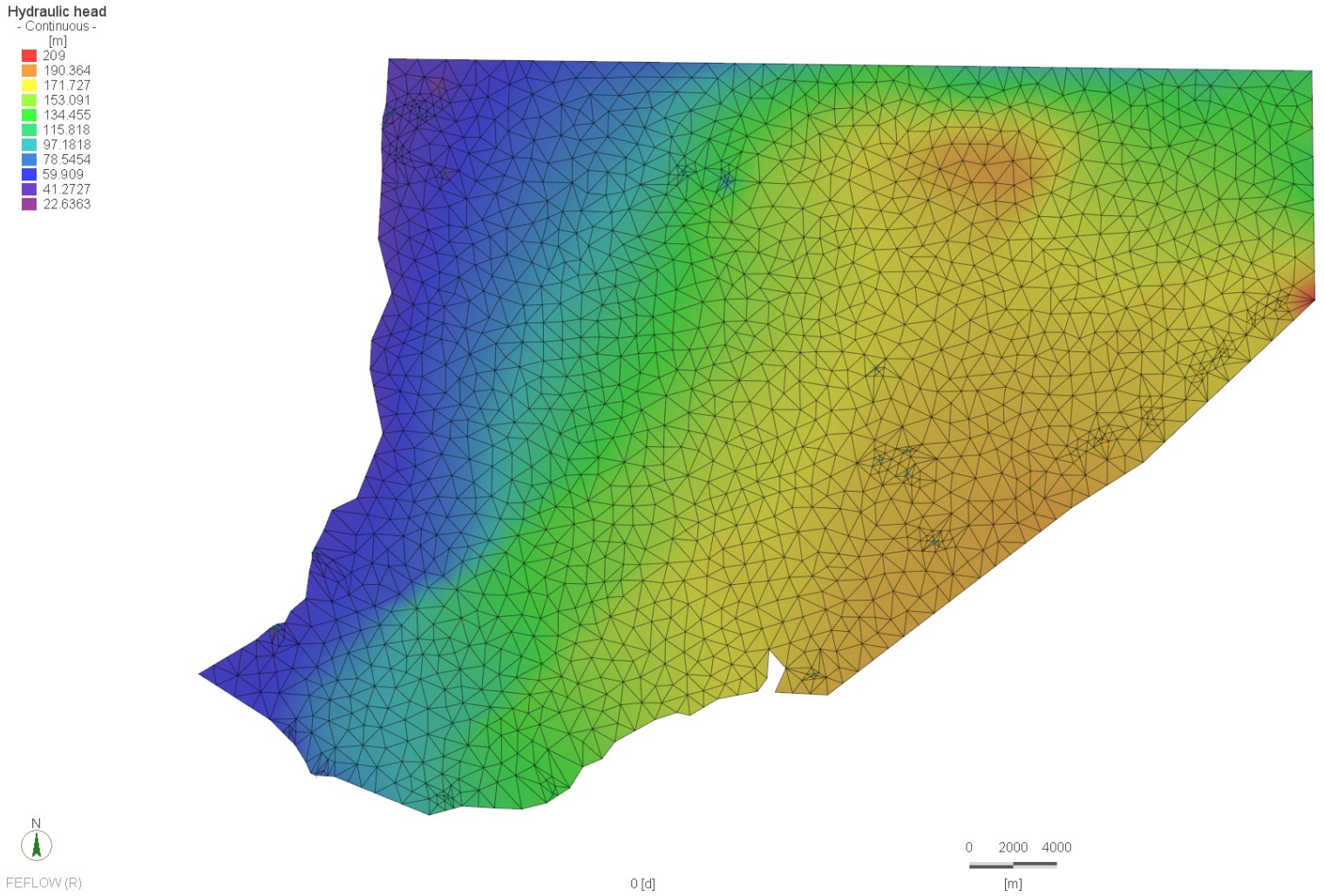
- **At least 1370 groundwater extracting wells**
  - Most of them extract water in shallow aquifers
- **28 200 000 m^3 of water extracted in 2018**
  - 25 pumping wells with a mean annual pumping rate of 809 000 m^3 per year account for 95 % of the water extracted in Wallonia, Flanders and the Netherlands
  - German extraction of groundwater is subtracted from the recharge

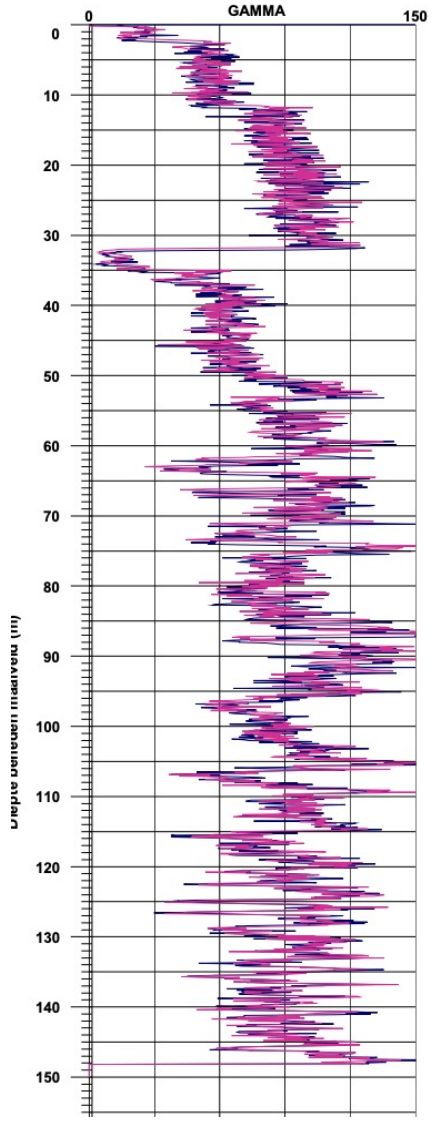


Conceptual model : update based on latest data



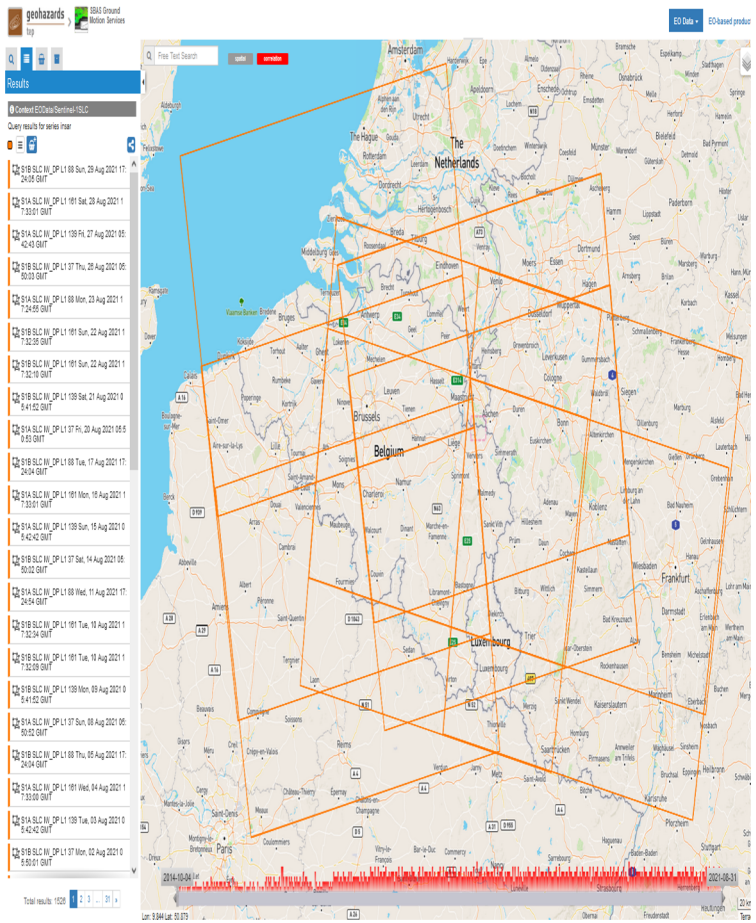
New simulations based on the outcomes of Cottessen drillings

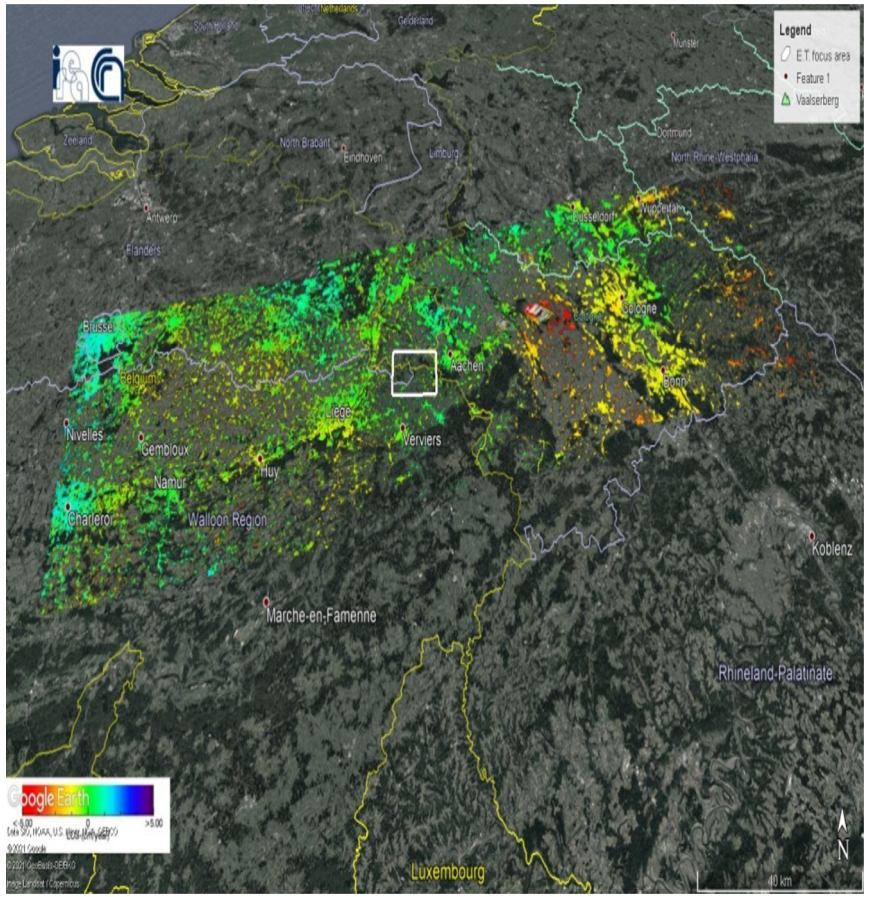


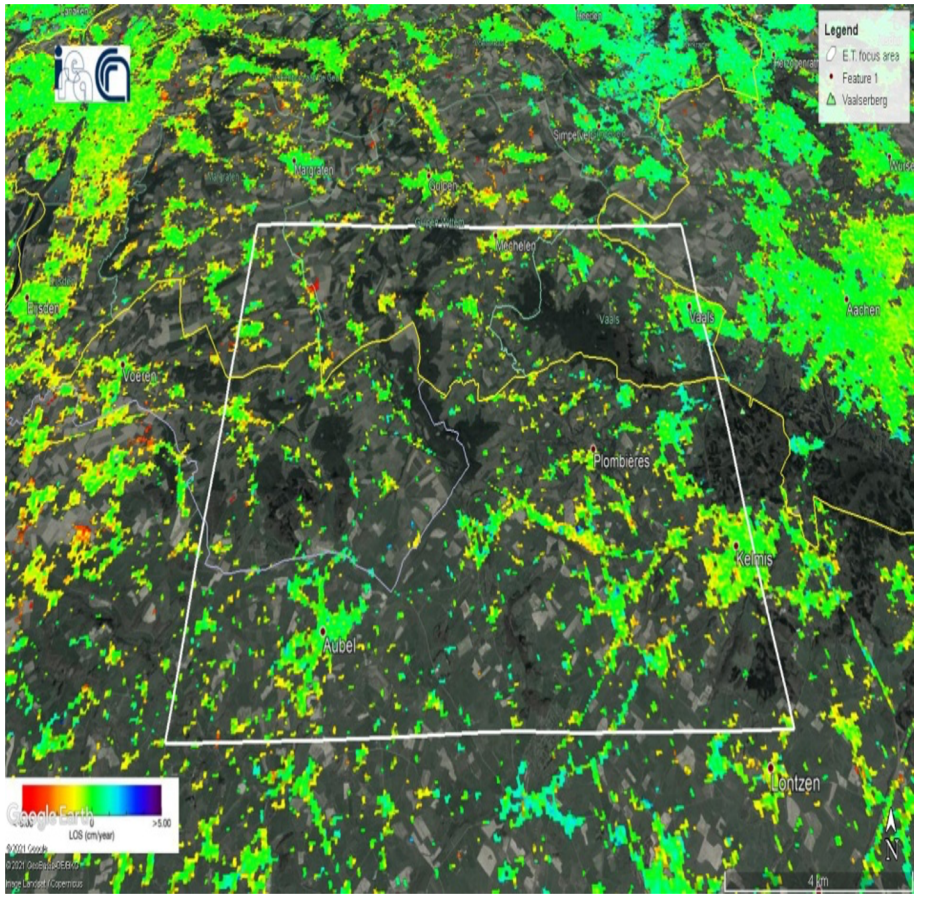


Preliminary Analysis from CSL/ULlege project (Hans-Balder Havenith and Romy Schloegel) + TU DElft

- InSAR processing with the TEP Geohazards platform with P-SBAS (Parallel Small BAseline Subset) developed by CNR-Irea







Ascending track #88 between 2020/12/26 & 2021/07/24 (35 images; coherence threshold: 0.4)

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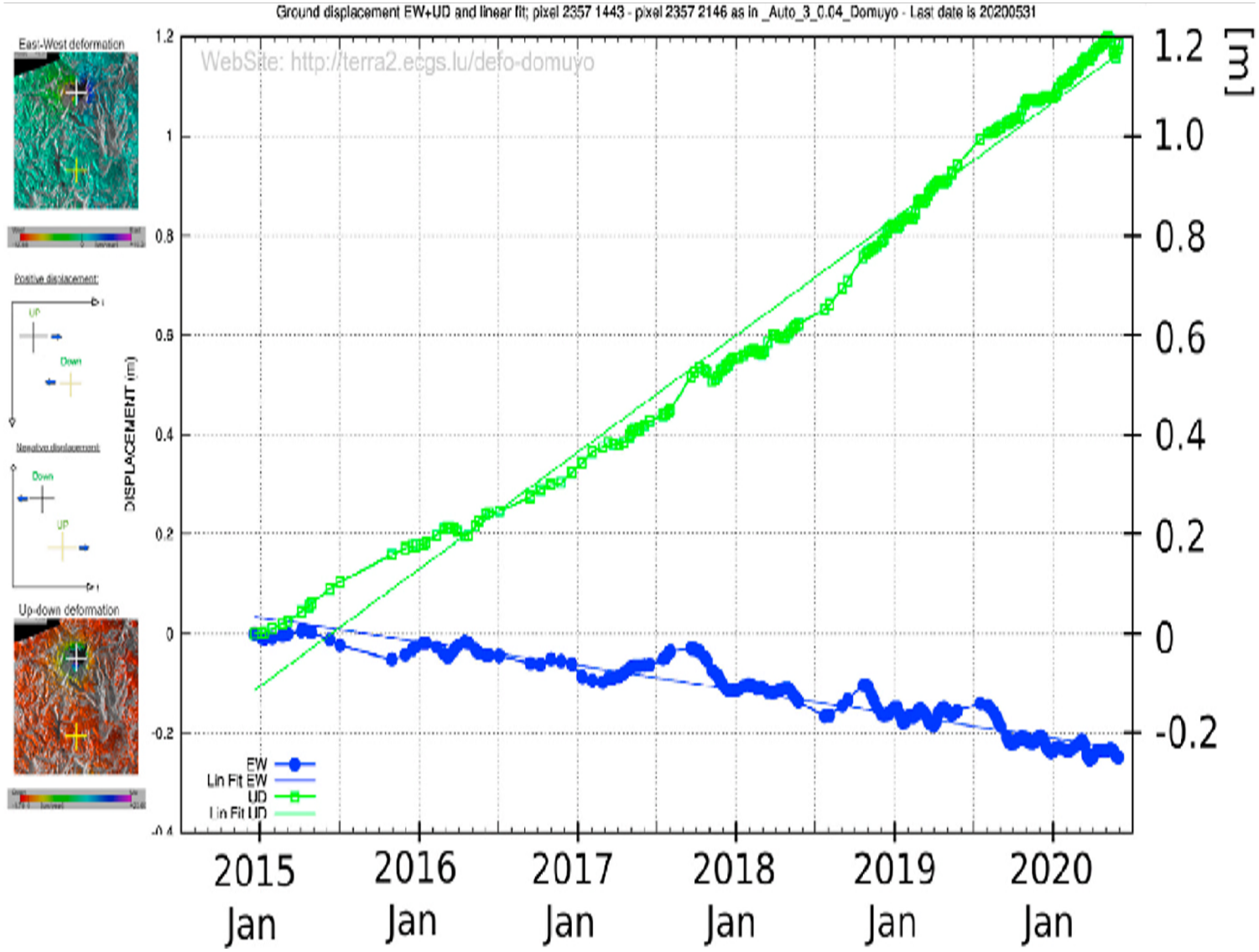
Next steps



Installation of corner reflectors (and integrated GNSS) for continuous monitoring and InSAR measurements validation

Integrated Geodetic Reference Stations DBFT reflector (Ndls) >

khardt et *al.*, 2021

CSL Design

Use of **C**SL **I**nSAR **S**uite and **M**ultitemporal **S**mall **BA**seline **S**ubsets [Samsonov and d'Oreye, 2012] in comparison with MT-InSAR from Coherent Scatterers (CS) at TUDelft to retrieve ground displacement in various directions

What we will probably deliver with E-TEST

- Quantification of geo-parameters (from rock strength to geophysical proxys at various scales)
- Quantify the subsurface uncertainty and reduction of it (geo-model)
- Measurements of seismic noise at depths in the EMR area
- Groundwater flow model and ET impact
- Define where we should focus on to further de-risk the area

Forecast