Ultrasound transmission measurements on core samples

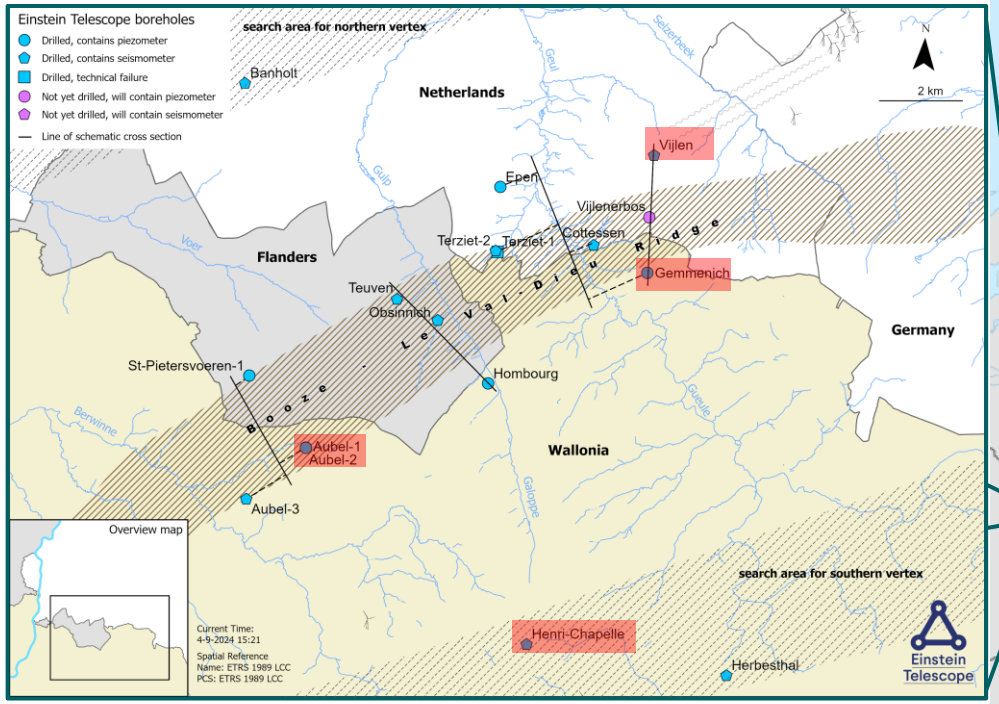
Marc S. Boxberg[1,2], Marius Waldvogel[3], Katrin Löer[2], Auke Barnhoorn[2], Florian M. Wagner[1]

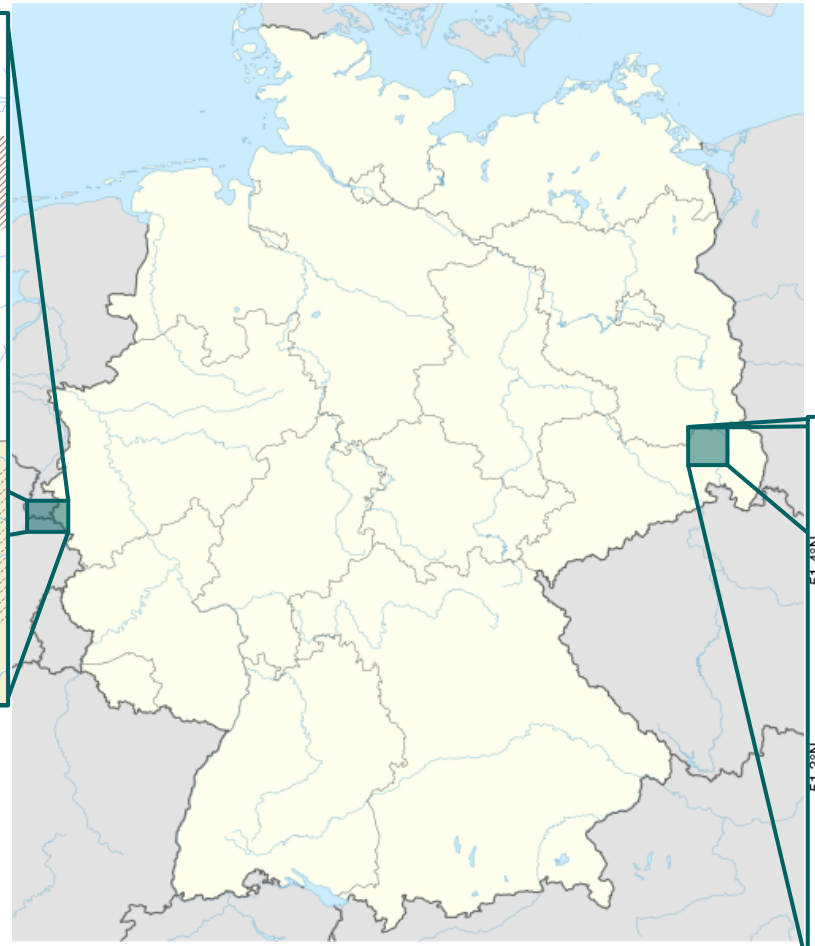
[1] Geophysical Imaging and Monitoring, RWTH Aachen University, Germany
[2] Applied Geophysics & Petrophysics, TU Delft, The Netherlands
[3] previously at Geological Institute, RWTH Aachen University, Germany

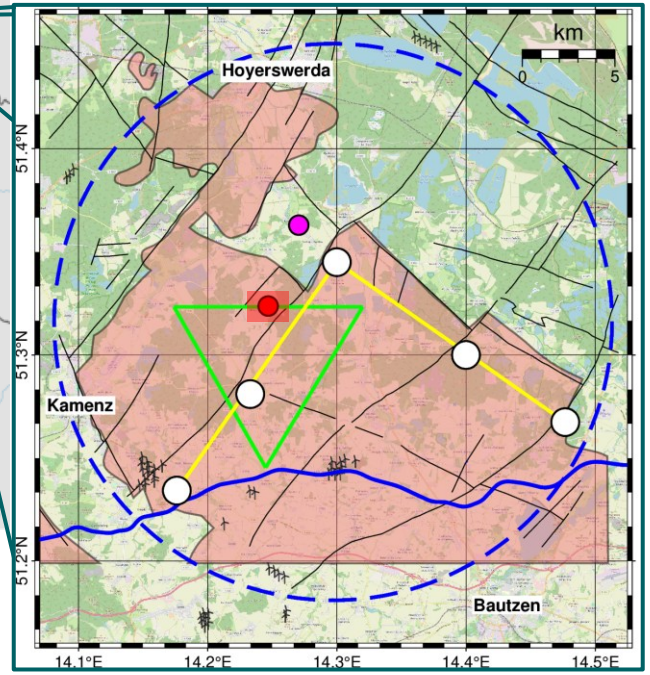
marc.boxberg@gim.rwth-aachen.de

XV ET Symposium | Bologna, Italy | 27 May 2025

34 Samples (45 plugs) from Euregio Meuse-Rhine and Lausatia







DZA01: 3 samples (5 plugs)

ETB05 (Aubel): 5 samples (8 plugs)
ETB08 (Gemmenich): 8 samples (8 plugs)
ETB09 (Vijlen): 8 samples (9 plugs)
ETB18 (Henri-Chapelle): 10 samples (15 plugs)

Sampling done together with Marius Waldvogel

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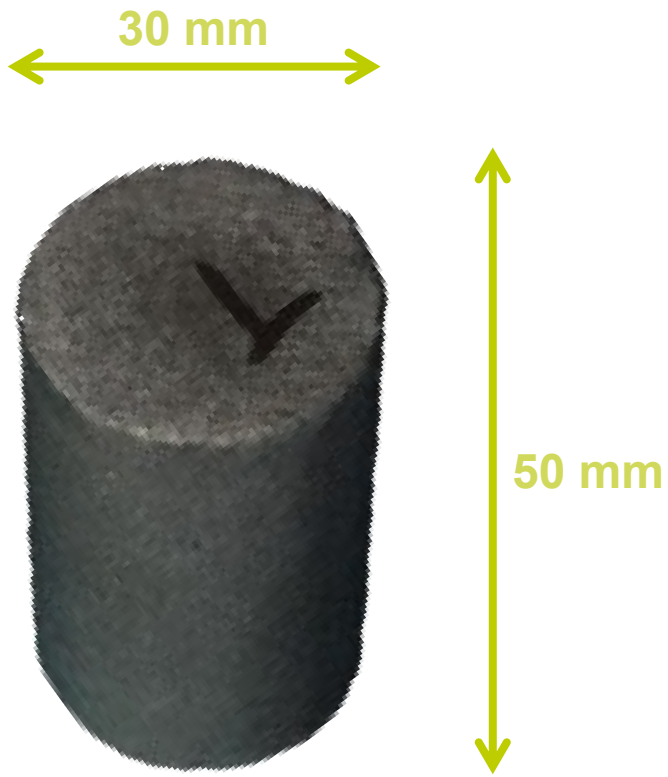
Sample processing

- Here: core from borehole ETB05 in Aubel (Belgium)

Sample processing

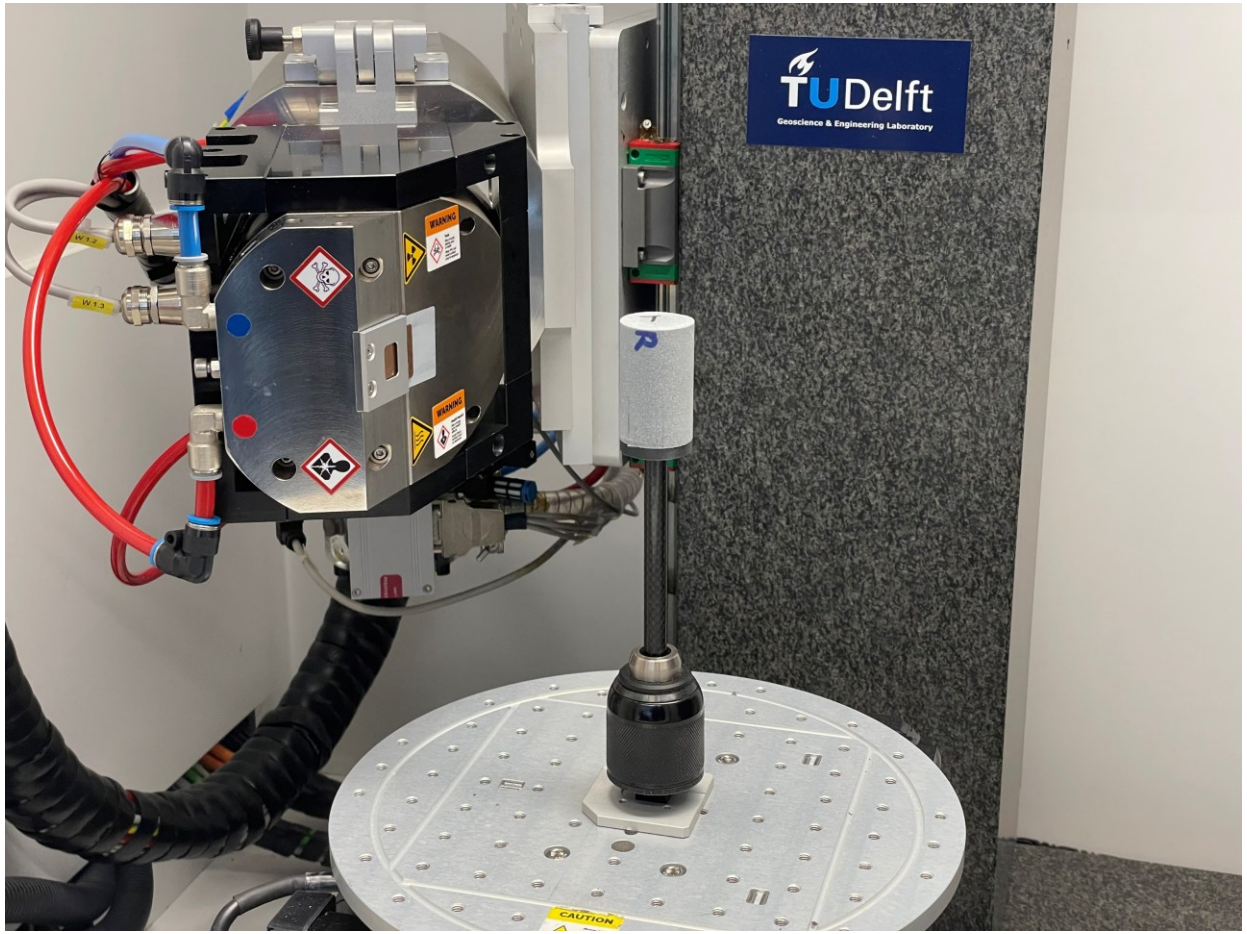
- Core from borehole ETB05 in Aubel (Belgium)
- Plugs drilled with 30 mm diameter in Aachen

Sample processing



CT-Scans for some samples that are not very homogeneous

CT-Scan



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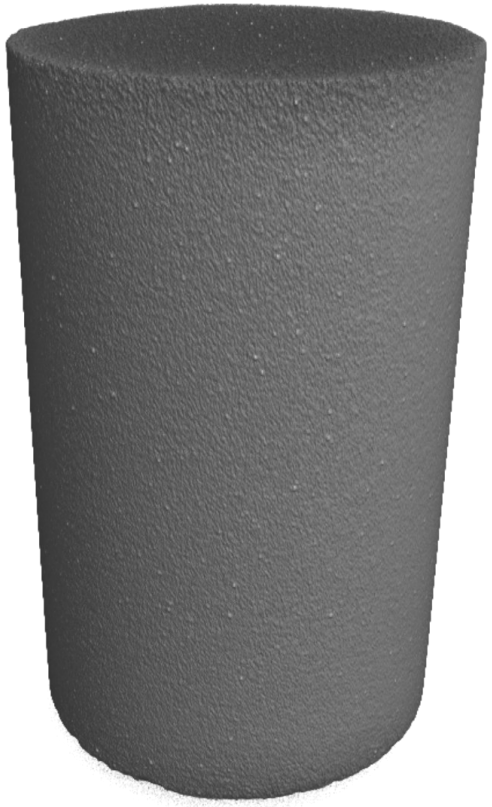
CT-Scans for some samples that are not very homogeneous

CT-Scan

mm

n: 20.022 Max: 41.694

CT-Scan



scan_000180

0.00 8191.88 16383.75 24575.62 32767.50 40959.38 49151.25

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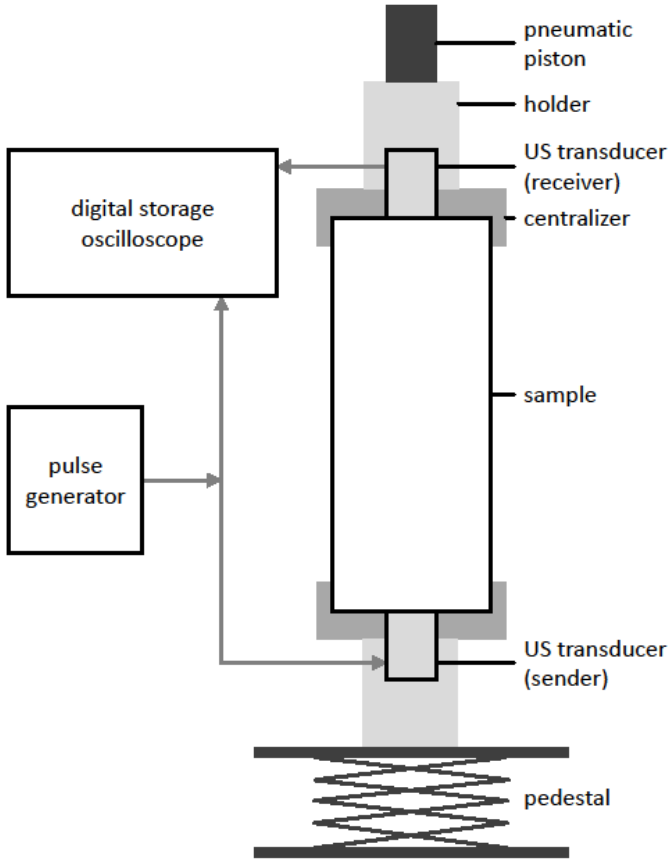
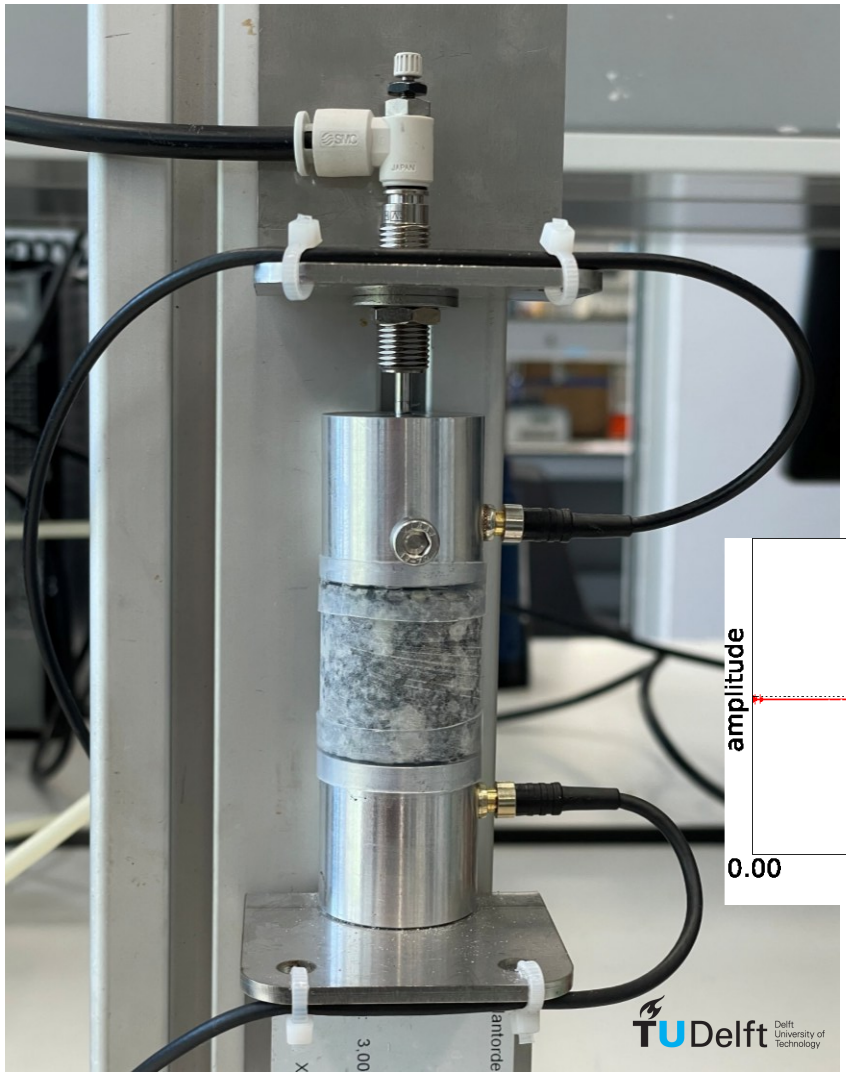
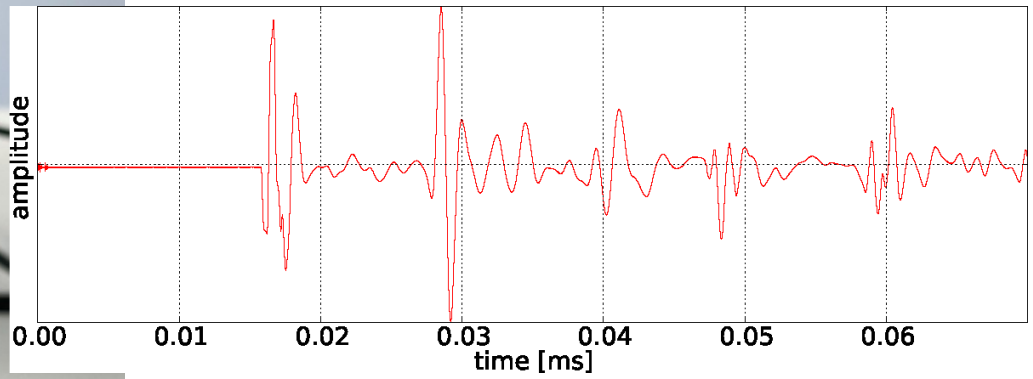
Ultrasound transmission measurements





Wave speeds?
Attenuation?



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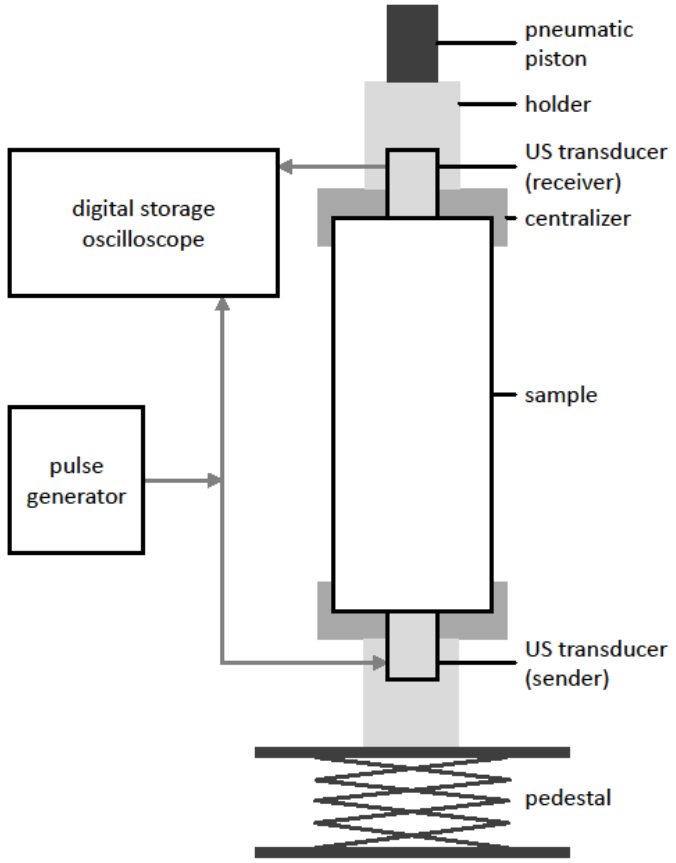
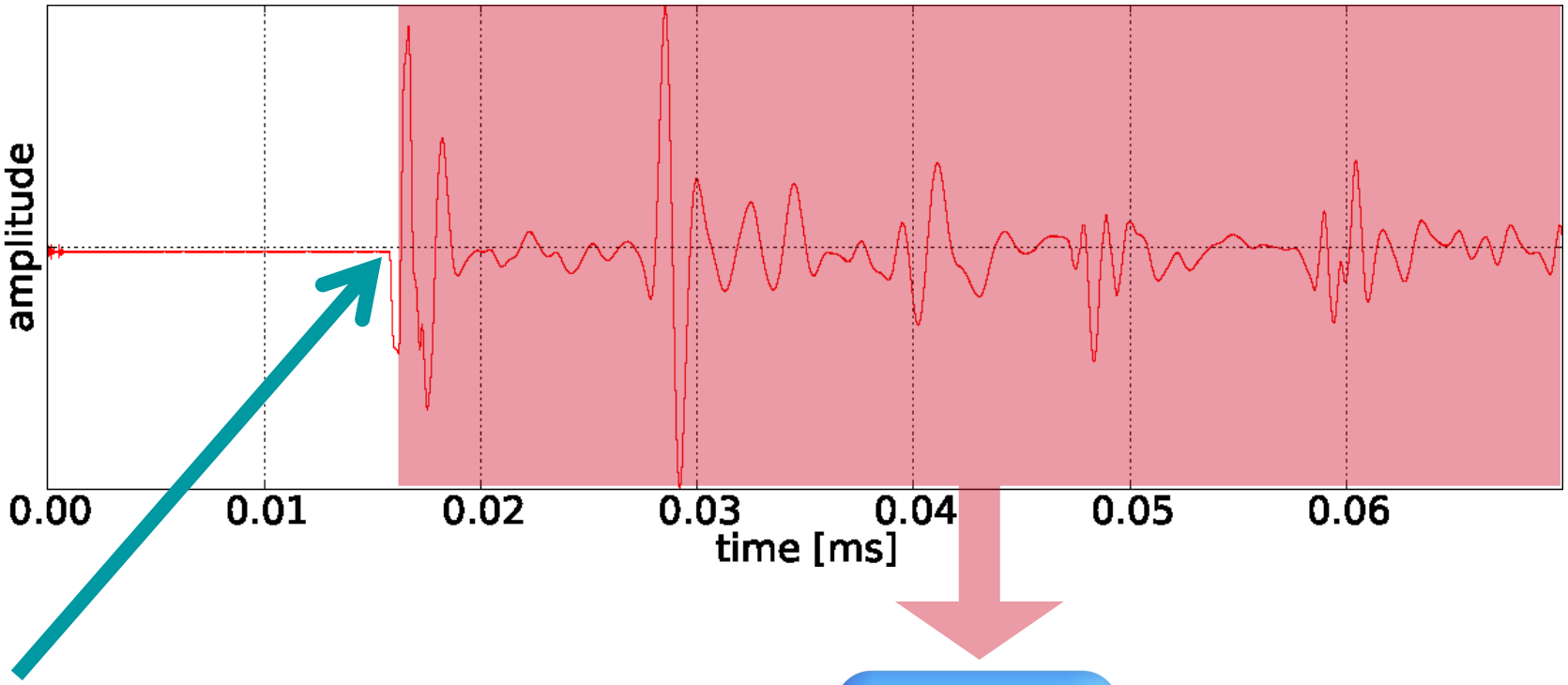
Ultrasound transmission measurements





- Determine first onset
- Calculate velocity from time of first onset and length of sample
- Done!

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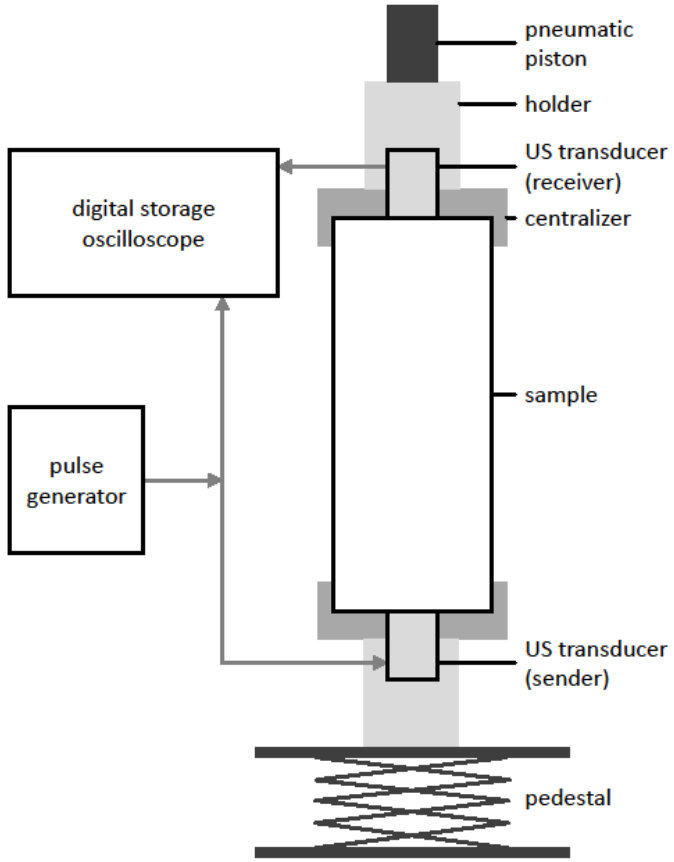
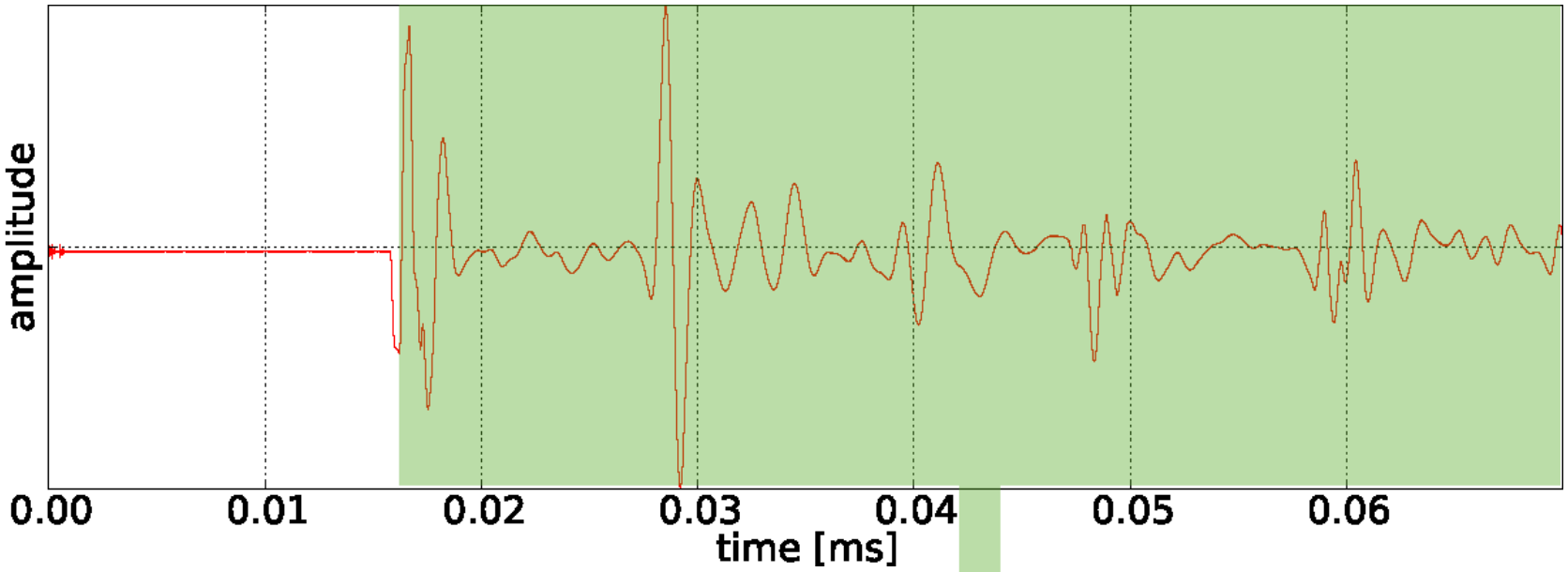
Ultrasound transmission measurements





Use all the information!
But: Measurements have to be reproducible!

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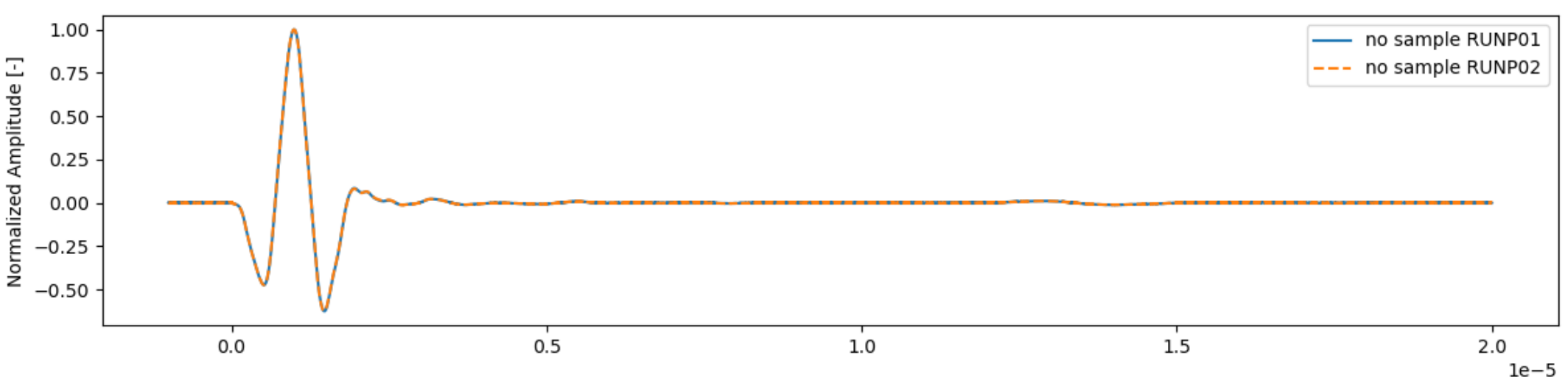
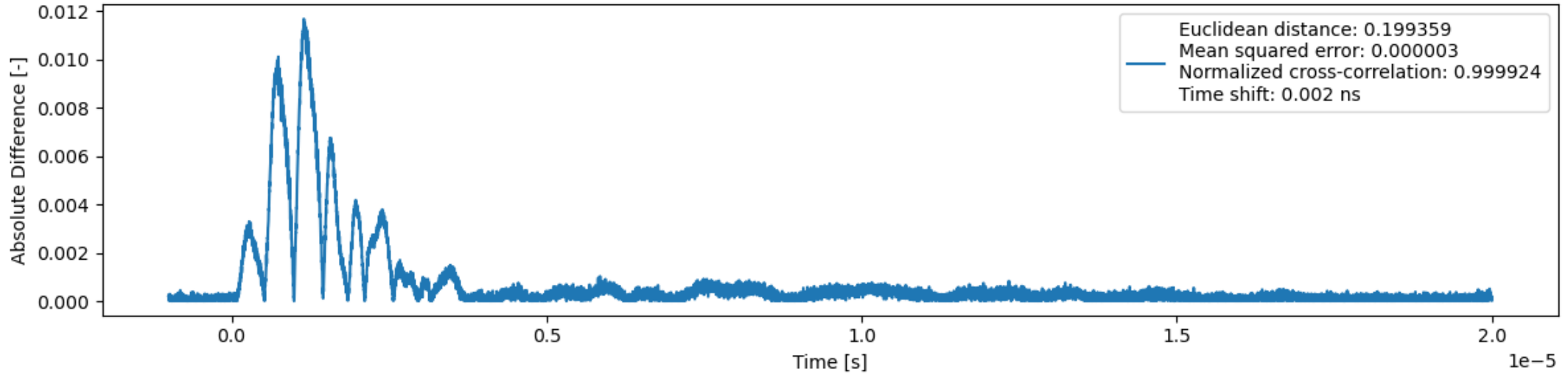
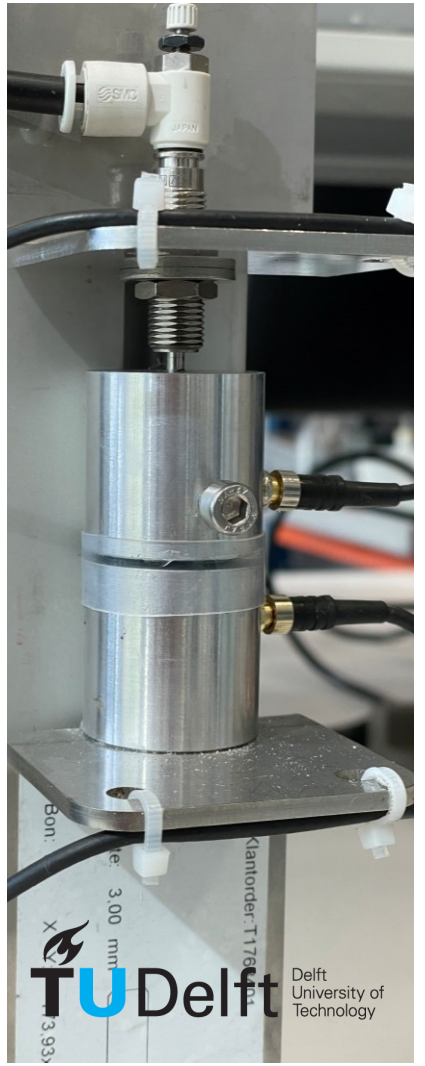
Reproducibility: Source wavelet for simulations = no sample







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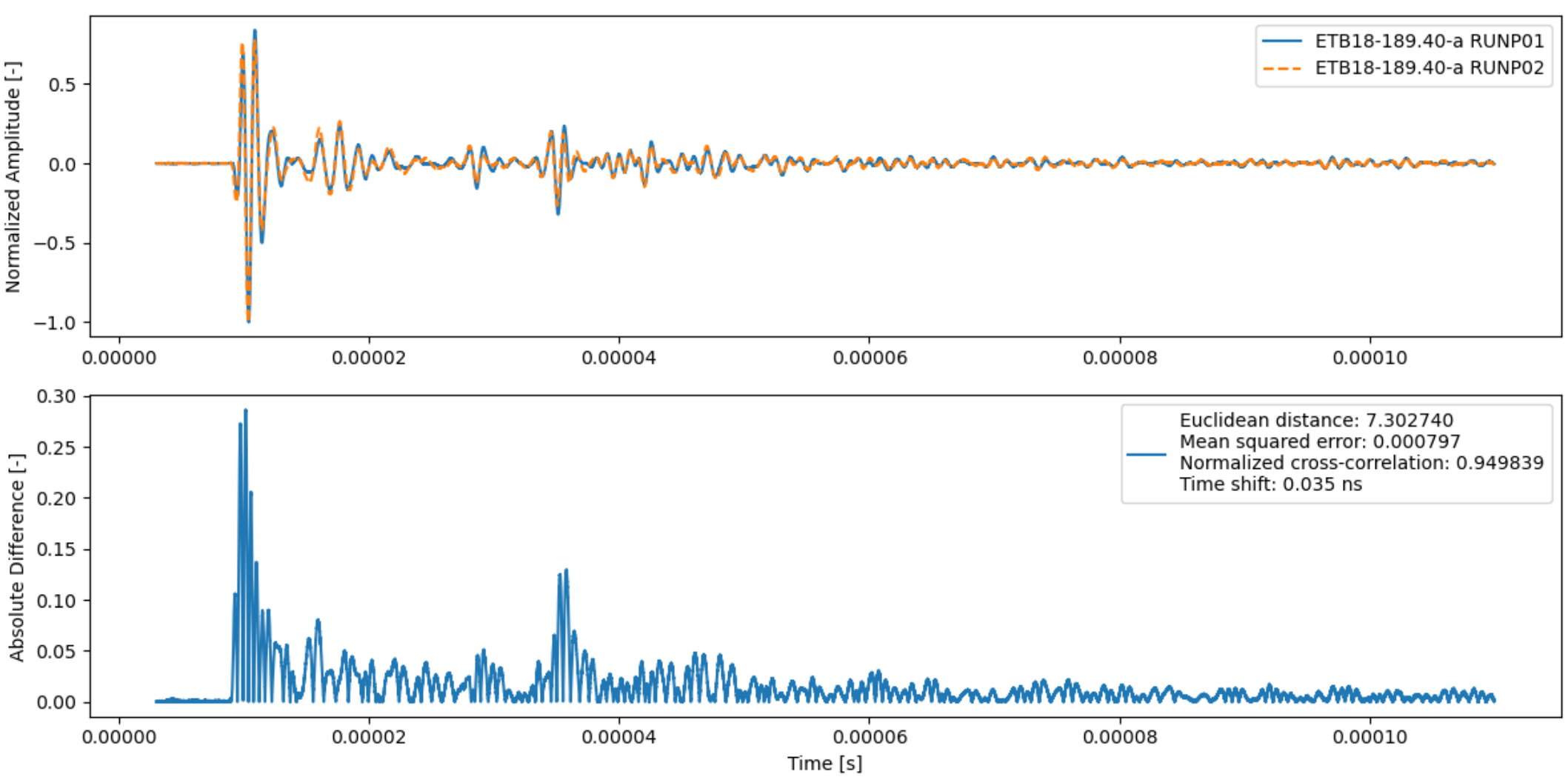
Reproducibility: #38, ETB18-189.40-a, Sandstone, Henri-Chapelle, BE



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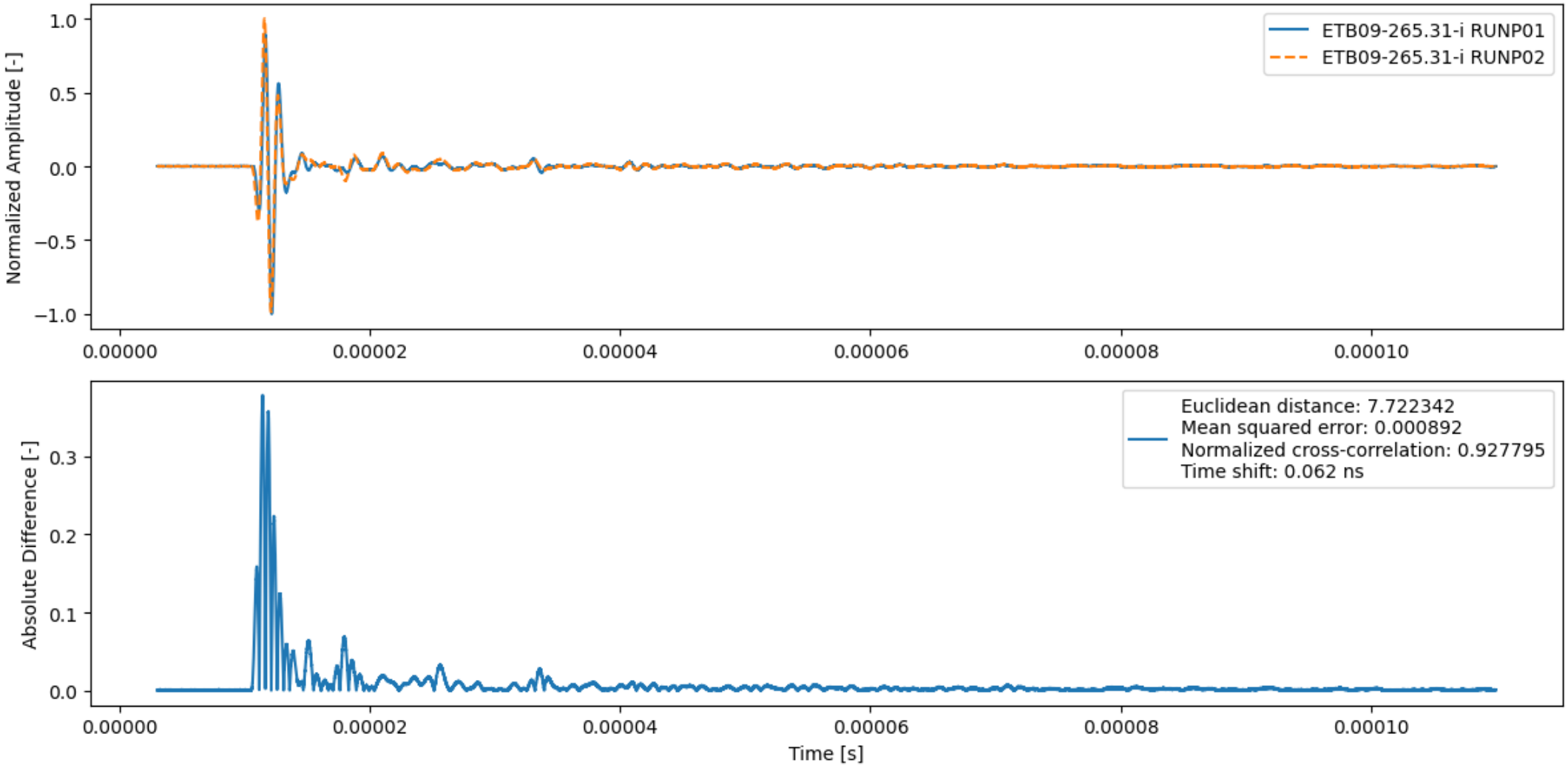
Reproducibility: #17, ETB09-265.31-i, Siltstone, Vijlen, NL



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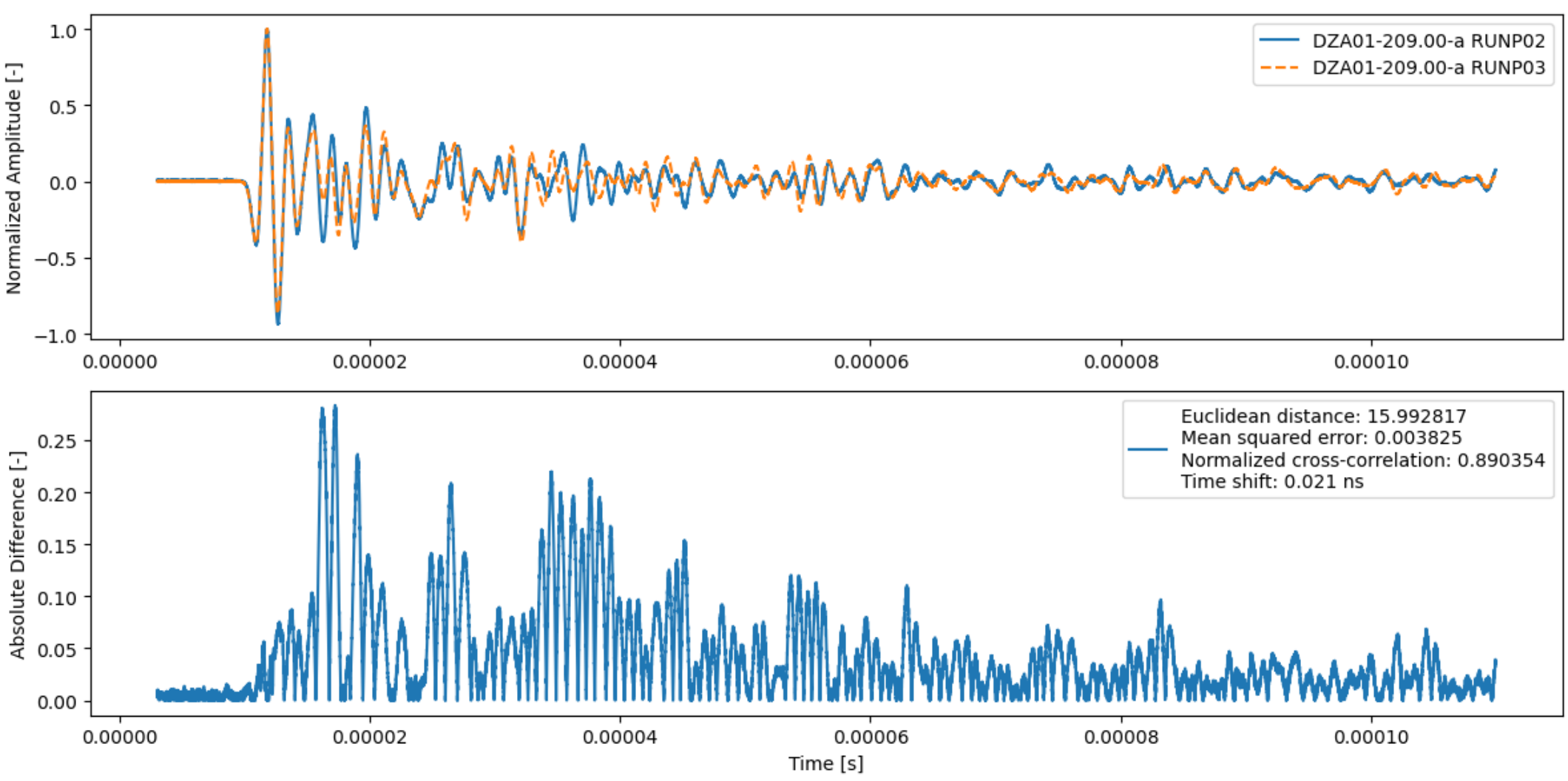
Reproducibility: #7, DZA01-209.00-a, Granodiorite, Cunnewitz, DE



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Basic processing and further measurements

- Geometry (Length, Diameter)
- Geometric Density
- Matrix Density (Gas Pycnometer)
- Porosity
- P-wave arrivals (and some S-wave arrivals)
- P-wave velocity (and some S-wave velocities)
- Dynamic shear and bulk modulus

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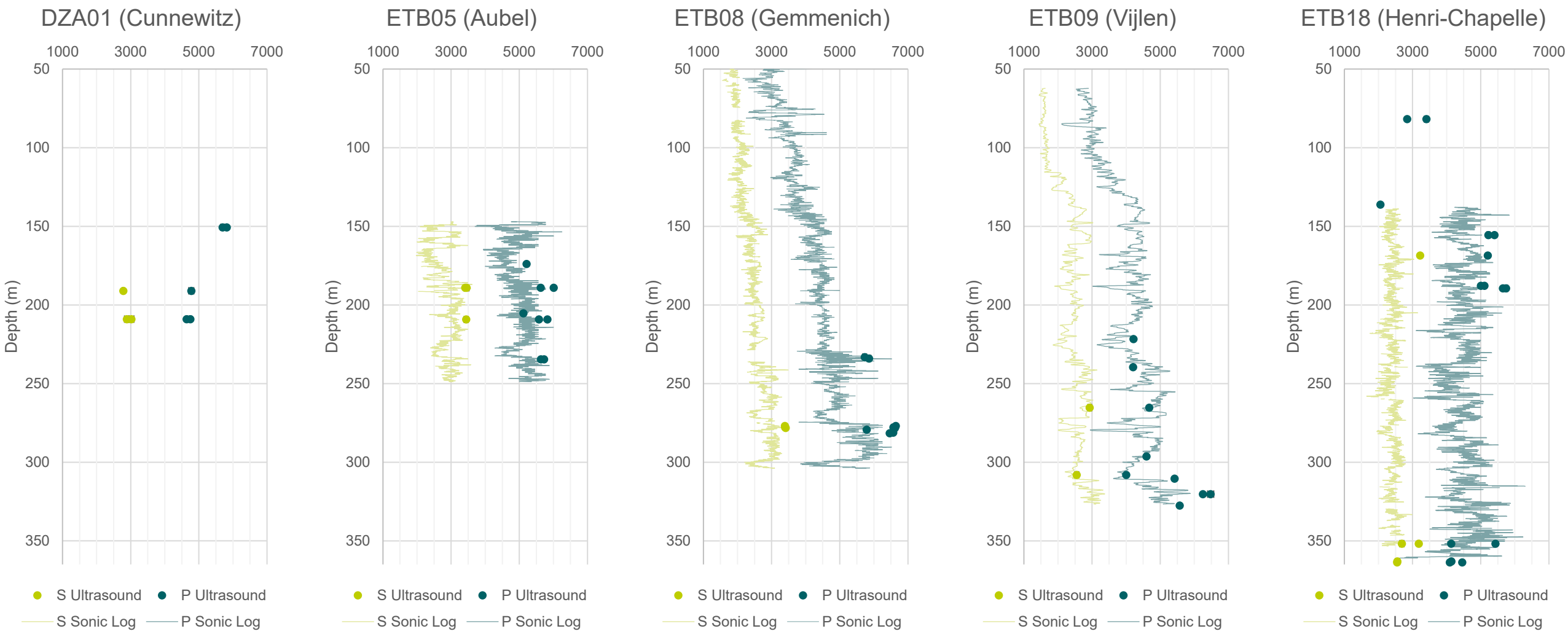
Velocities using a correlation picker (will be starting values for the inversion)



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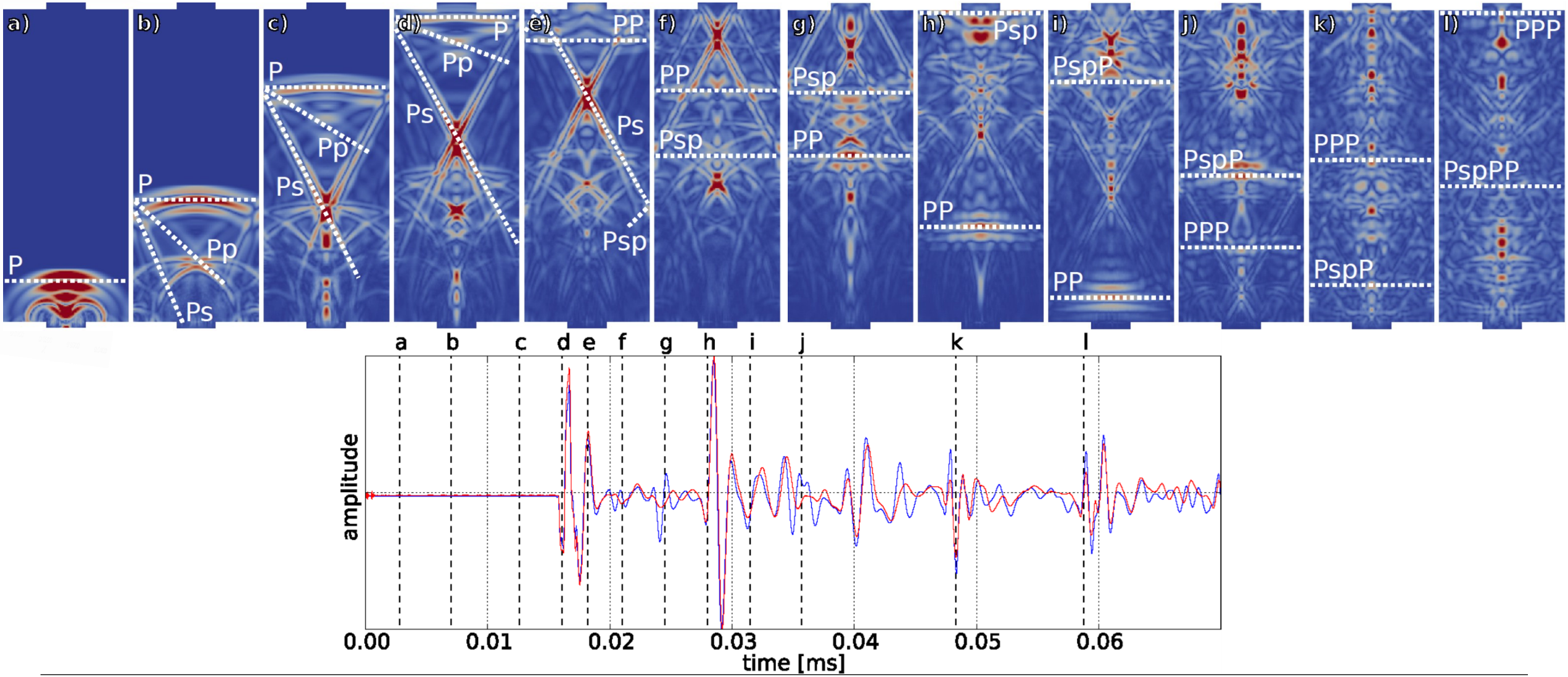
Simulations / Full Waveform Inversion (FWI)

work in progress …

Simulation Teaser



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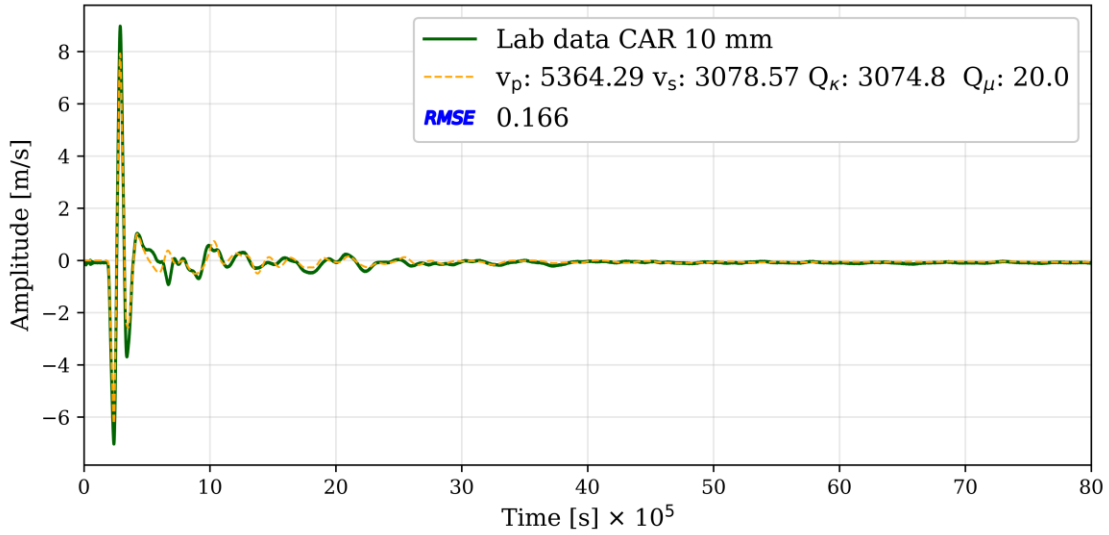
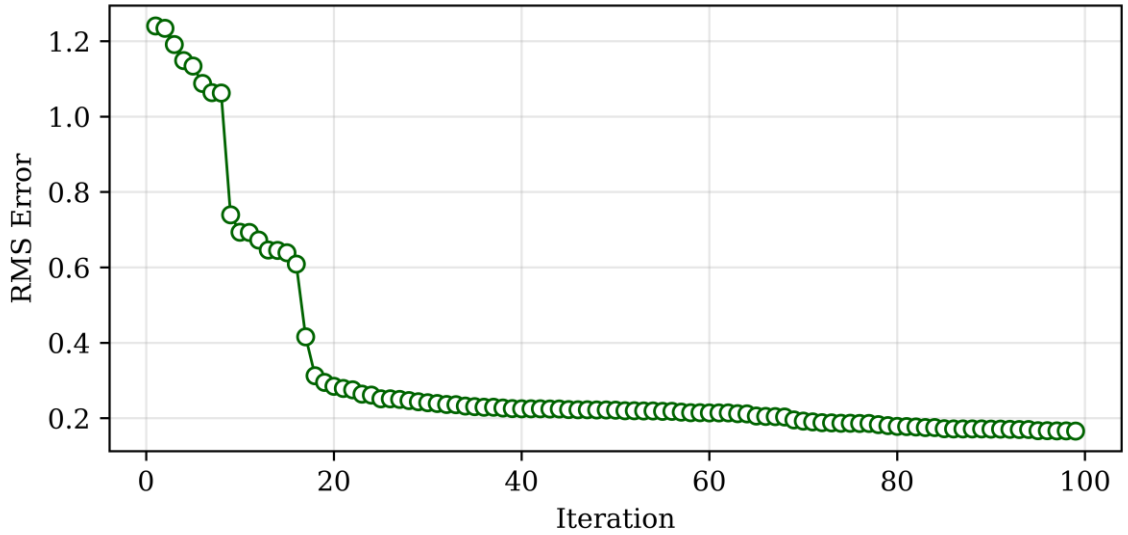
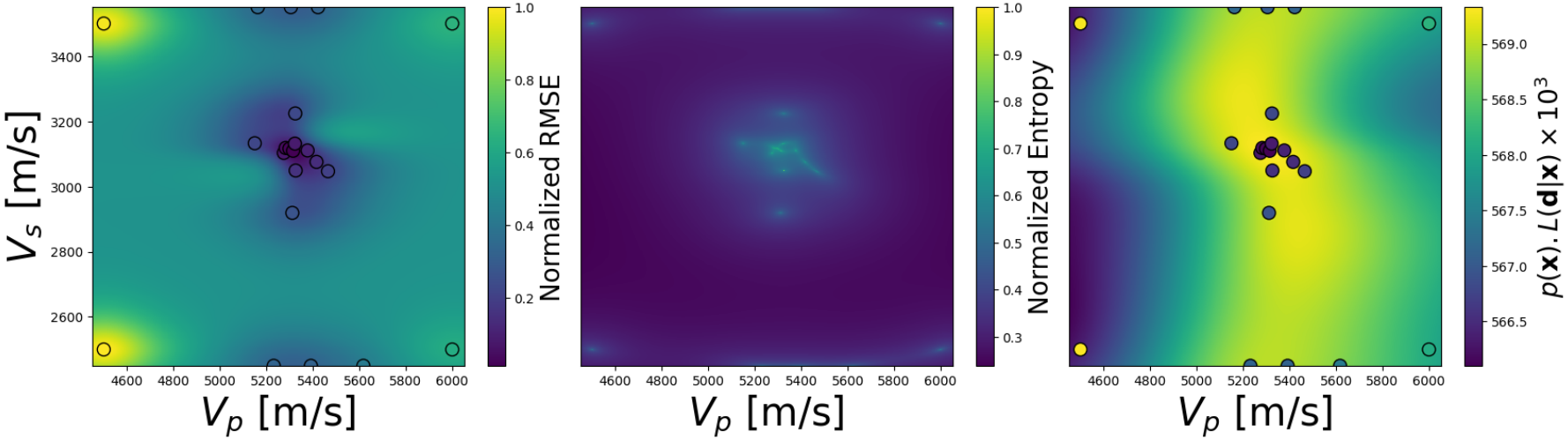
Inversion Teaser







- Inversion of velocities and attenuation using a Gaussian Process Emulator

M.Sc. Thesis Ghozy El Fatih (2024)

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Thank you
for your attention

Dr. rer. nat. Marc S. Boxberg

Geophysical Imaging and Monitoring
https://gim.rwth-aachen.de

marc.boxberg@gim.rwth-aachen.de