

GPR exercise

Angewandte Geophysik übung

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Task

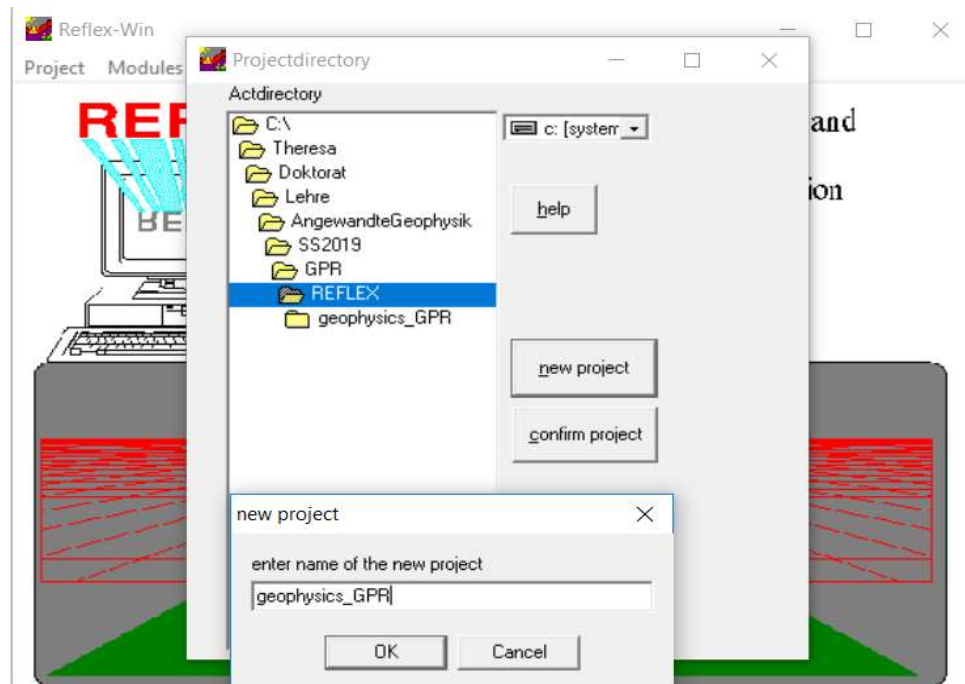
- 1. Exercise: understand what to expect from a GPR signal → build different models of the subsurface and calculate the synthetic response of these models, to get a feeling of different GPR responses and more experience for the interpretation of GPR data.
- 2. Exercise: measured GPR dataset collected at the field-scale in Stainach, contaminated site in Steiermark, 200 MHz antenna and 400, task: visualization, processing and interpretation of data
- 3. Exercise: In a last step you will have to calculate the synthetic response of this model and compare it with the measured data.

Task

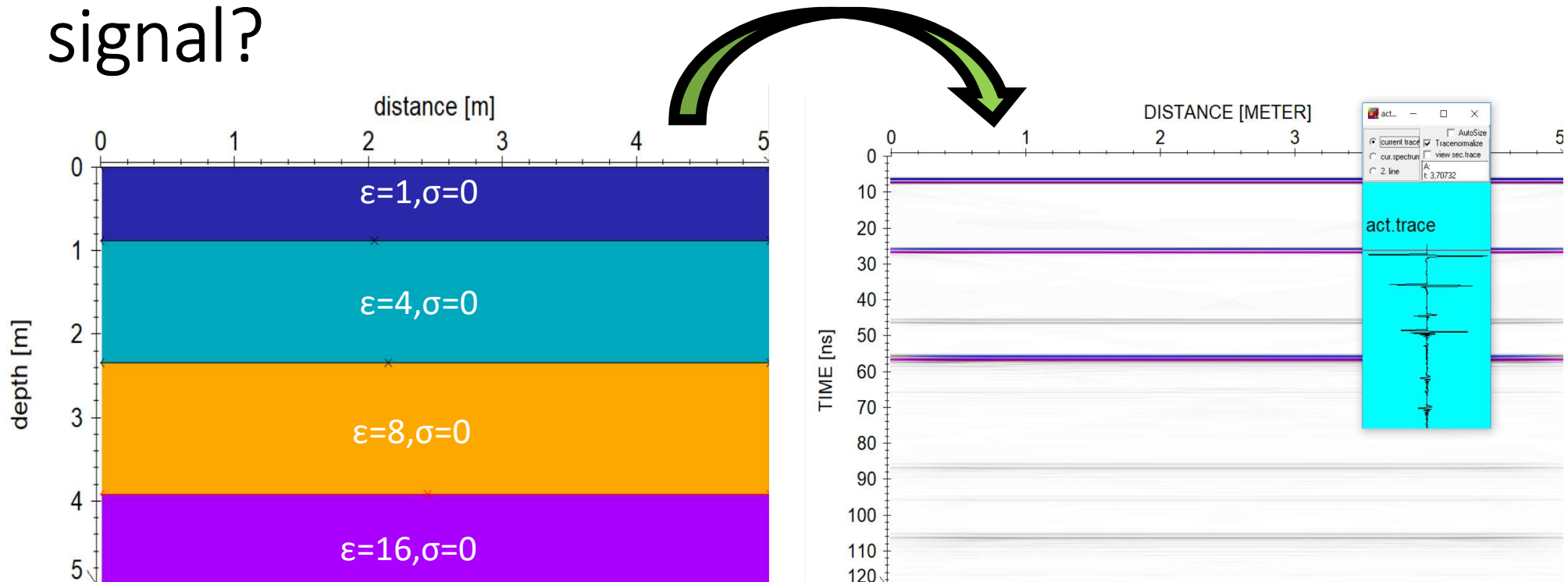
- Presentation of 3 minutes in groups of Exercise 1 (choose one model and the synthetic response) and Exercise 2 (one profile) at the 20th of May 2019
 - present your results
 - which challenges did you have?
 - discussion of results
 - Questions for the protocol
- Protocol in groups of Exercise 1,2 and 3 until the 27th of May 2019
 - no description of the software!
 - present your results and discuss them

Reflexw

- a popular geophysical near surface processing and interpretation software from Sandmeier



1. Exercise: What do we expect from a GPR signal?

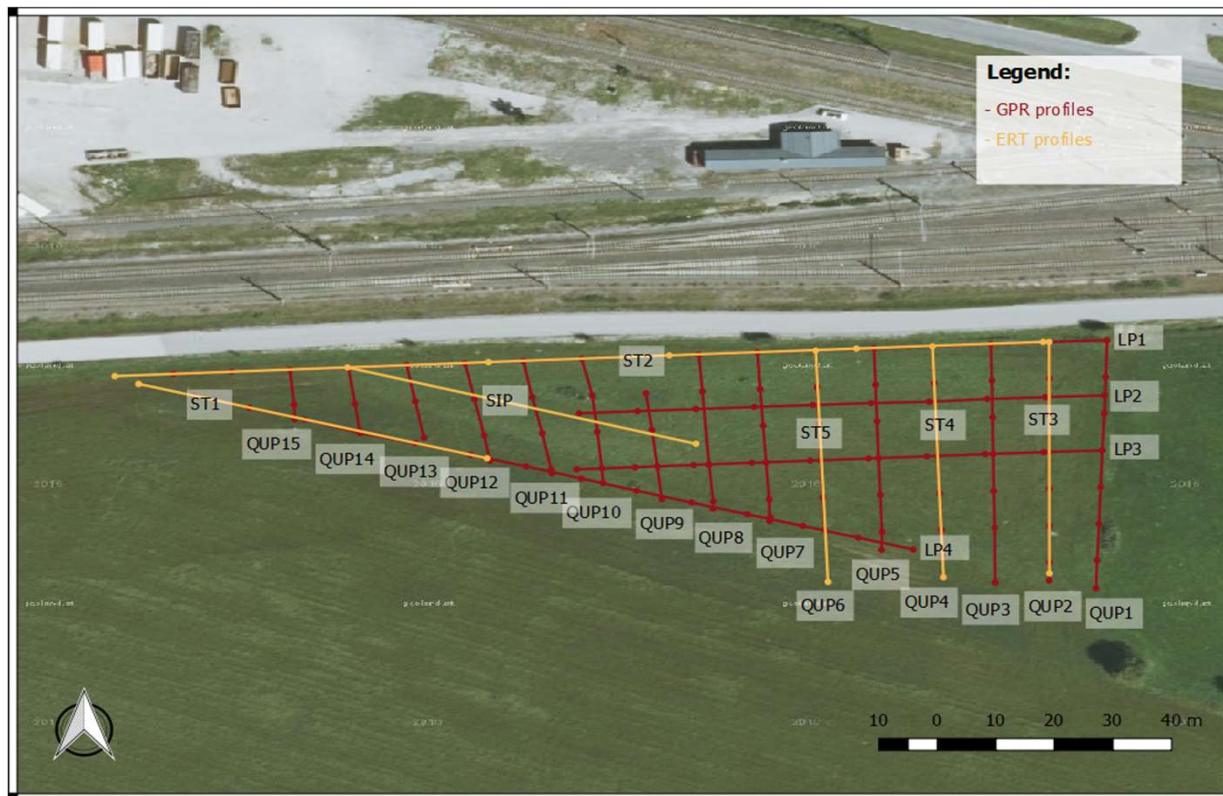


Goal of this exercise is to calculate the response of different models:

- Varying the electrical properties (ϵ, σ), varying the geometry of the interfaces
- Adding objects into the subsurface (for example a pipe or a cave)
- Testing different antenna frequencies

2. Exercise: Visualization, processing and interpretation of measured GPR data

- GPR data collected in Stainach, in 2017

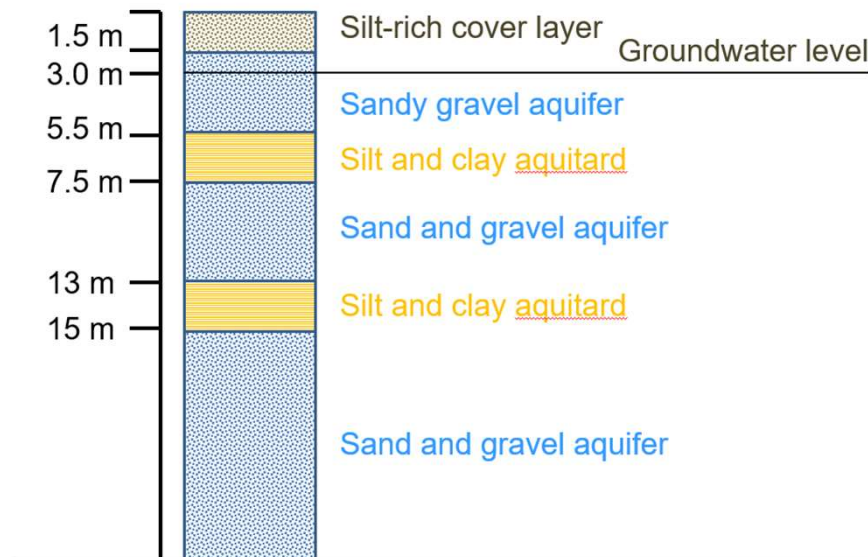


Focus on profiles LP1 and ST1 collected with 200 and 400 Mhz antennas

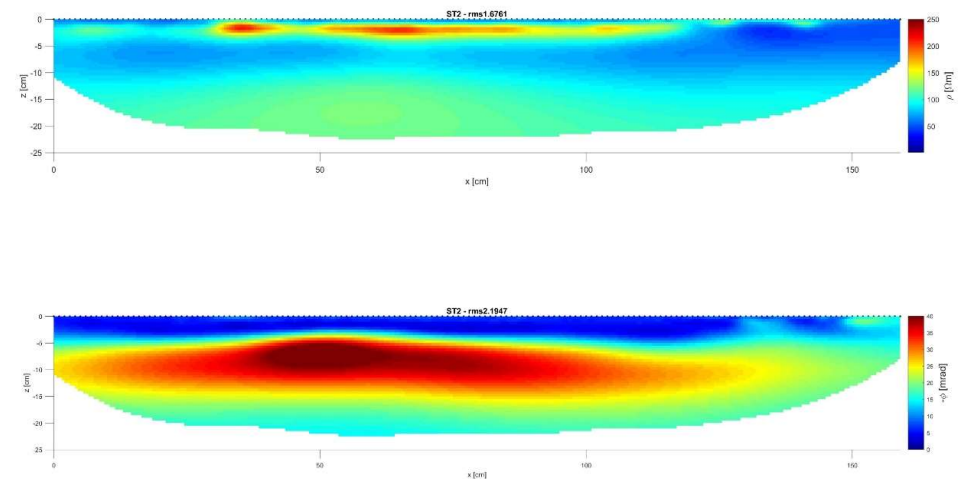
2. Exercise: Visualization, processing and interpretation of measured GPR data

- Additional information about the study area

Geology Stainach



Goelectrical information



2. Exercise: Visualization, processing and interpretation of measured GPR data

- Processing steps:
 - plot the raw data
 - edit the geometry (marker interpolation, flipping files)
 - process the data (dewow, time zero correction, time varying gain, bandpass filter, clutter reduction)
 - interpretation of the data (picking interfaces, building a 2D-model)

2. Exercise: Visualization, processing and interpretation of measured GPR data

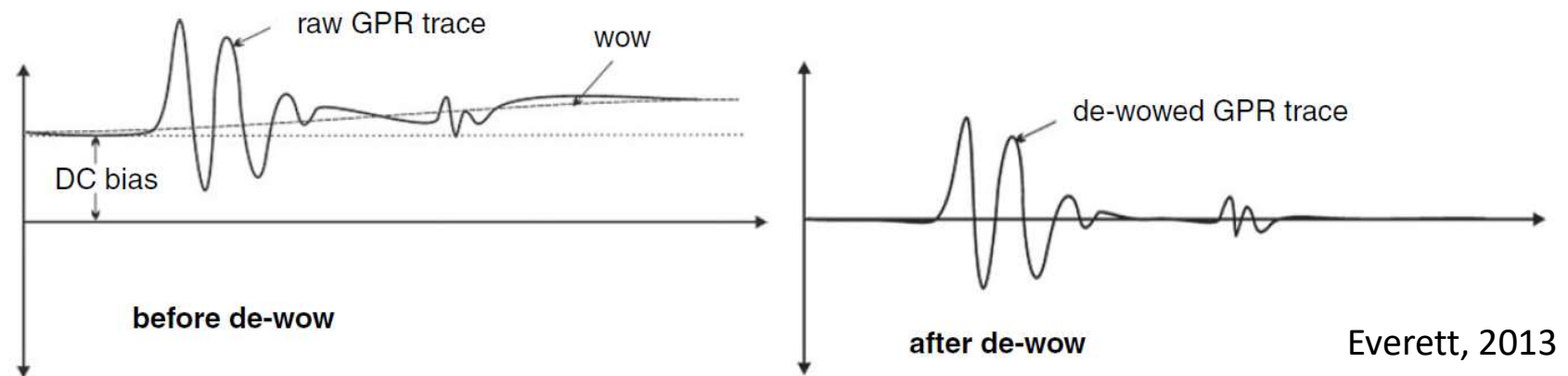
- **Editing the geometry**



- Acquisition of GPR data along profiles based on fixed time base
- For correlation to the distance
→ equally spaced markers

2. Exercise: Visualization, processing and interpretation of measured GPR data

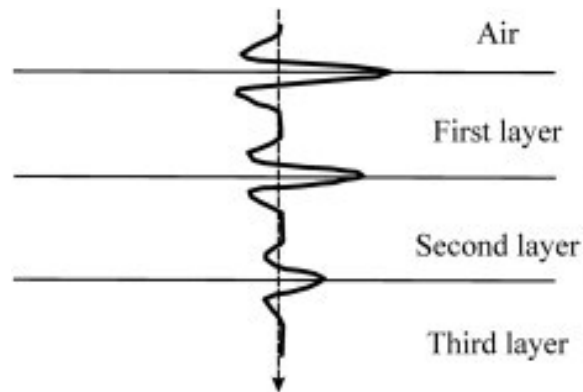
- Dewow



- Wow: slow variation of the baseline amplitude caused by low frequency components contained in the spectrum of the transmitted electric field
- Dewow: removing low frequency range

2. Exercise: Visualization, processing and interpretation of measured GPR data

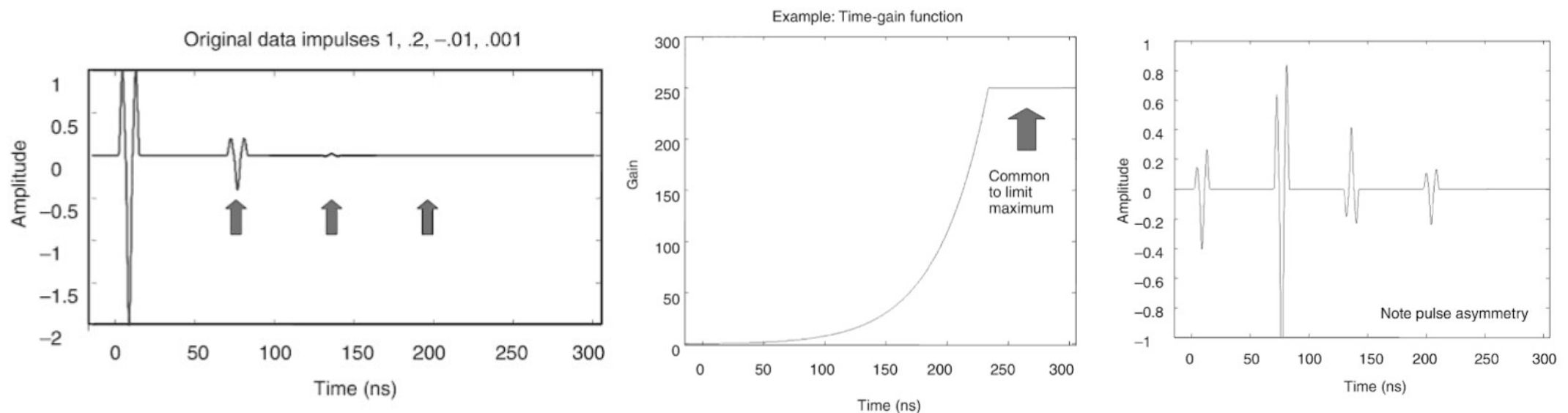
- **Time Zero Correction:**



- Thermal drift, electronic instability, irregularities in the cables can cause jumps in the air/ground wavelet first arrival time
→ effect on position of the ground interface in the section
- Therefore adjustment of traces to a common temporal datum

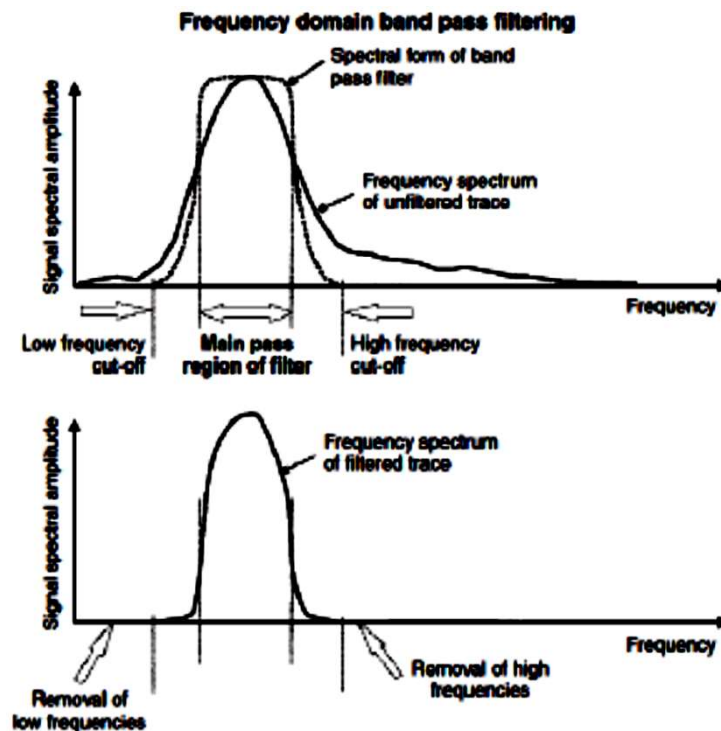
2. Exercise: Visualization, processing and interpretation of measured GPR data

- **Gain correction:** gain function compensates for spherical spreading losses and exponential ohmic dissipation of the wave amplitude
- During measurements – automatic gain function, for data comparison – removing gain and applying the same gain function for all profiles



2. Exercise: Visualization, processing and interpretation of measured GPR data

- **Bandpass filter**



- GPR antenna receives a distribution of different frequencies

- To adjust for drift and noise → high and low pass filter
→ Bandpass filter

2. Exercise: Visualization, processing and interpretation of measured GPR data

- **Clutter reduction:**
- Clutter: GPR system noise, ground bounce, soil roughness scattering, reflection signals from external anomalies
- Filter: average trace removal (background removal)

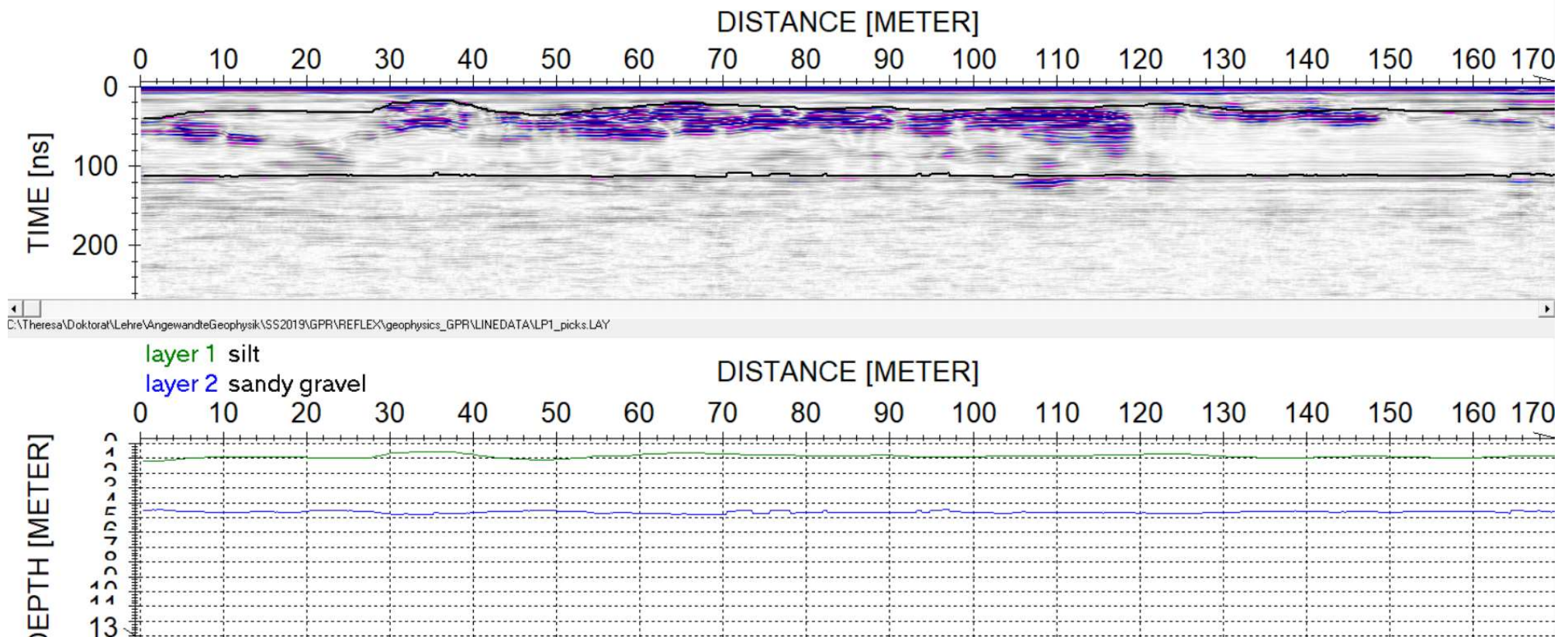
→ Warning: processing can introduce artifacts in the data and lead to wrong interpretations

2. Exercise: Visualization, processing and interpretation of measured GPR data

- **Interpretation of the data** (picking interfaces, building a 2D-model)
- First of all:
 - check the information available for the site: lithological information from boreholes, other geophysical data (ERT/IP)
 - What do you know about the local physical properties? High/low conductivity? High/low dielectric permittivity? Is the ground dry or saturated (permittivity)?
 - What is the operating frequency and the wavelet pulse width? What do you think about the resolution and penetration depth?

2. Exercise: Visualization, processing and interpretation of measured GPR data

- Interpretation of the data (picking interfaces, building a 2D-model)



2. Exercise: Visualization, processing and interpretation of measured GPR data

- Interpretation of the data (picking interfaces, building a 2D-model)
- Regarding your measured data:
 - Are you able to pick interfaces? What were the challenges? If you compare 200 Mhz and 400 Mhz, what are your observations?
 - When is the latest useful signal you measure? Why can't you see anything after the latest signal? Attenuation? Strong reflector?
 - Is there a reverse in polarity of the wavelet signal? What does that tell you about ϵ_1 and ϵ_2 for an interface?
 - Do you notice any hyperbolic features? If yes/no, what does it indicate?
 - We expect tar oil within the subsurface. What are the electrical properties for oil? What did you learn from the processing of the ERT and IP data? You can find attached the result of the ERT and IP data from the same profile measured in 2017 together with GPR. Where would you expect oil within the subsurface? Can you see any change in the reflection amplitude within the radargram?

3. Exercise: Comparison of measured data and synthetic data

- How reliable is your interpretation? Where do you expect the oil within the radar section? For validation, you can calculate the synthetic response of your layer model and compare it with the measured data. How comparable are they? What is your conclusion?

