

RUHR-UNIVERSITÄT BOCHUM

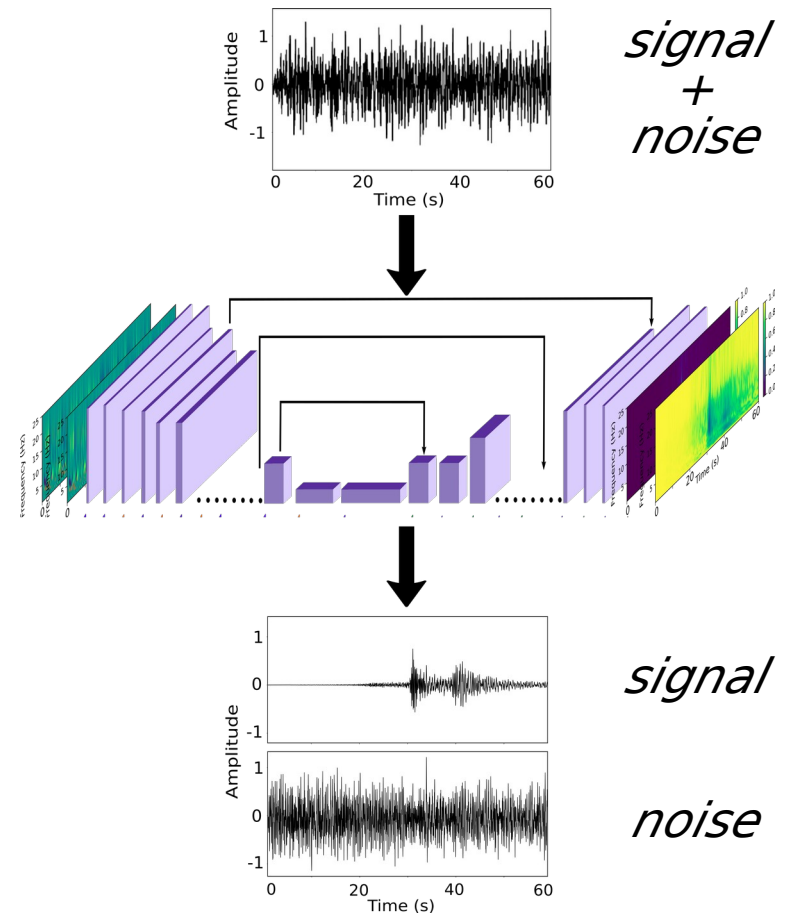
# HOW DOES A DENOISING AUTOENCODER IMPROVE EARTHQUAKE DETECTION AND THE ESTIMATION OF THEIR MAGNITUDE IN SEISMIC NETWORKS?

Janis Heuel, Meggy Roßbach, Wolfgang Friederich | EGU 2023 | NH 4.3 | April 26<sup>th</sup>, 2023

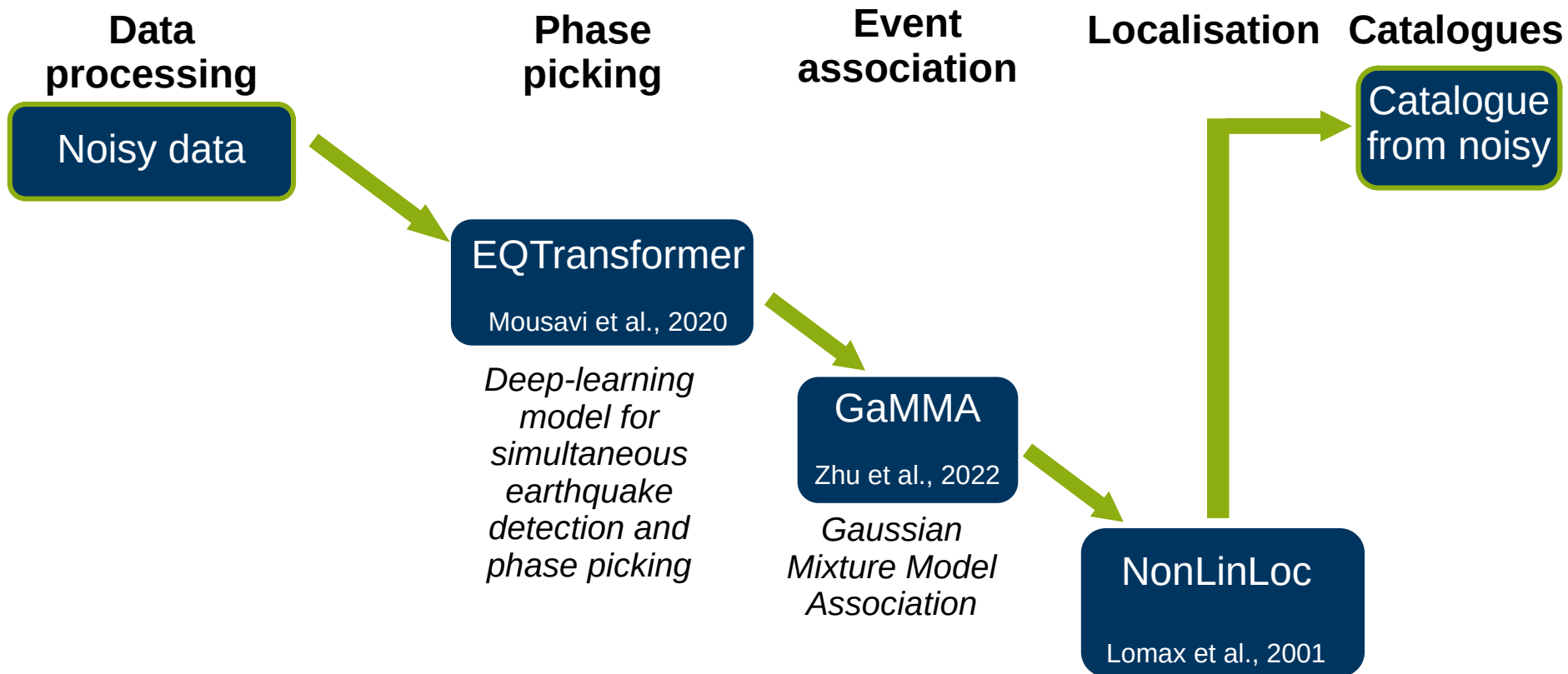


# Motivation

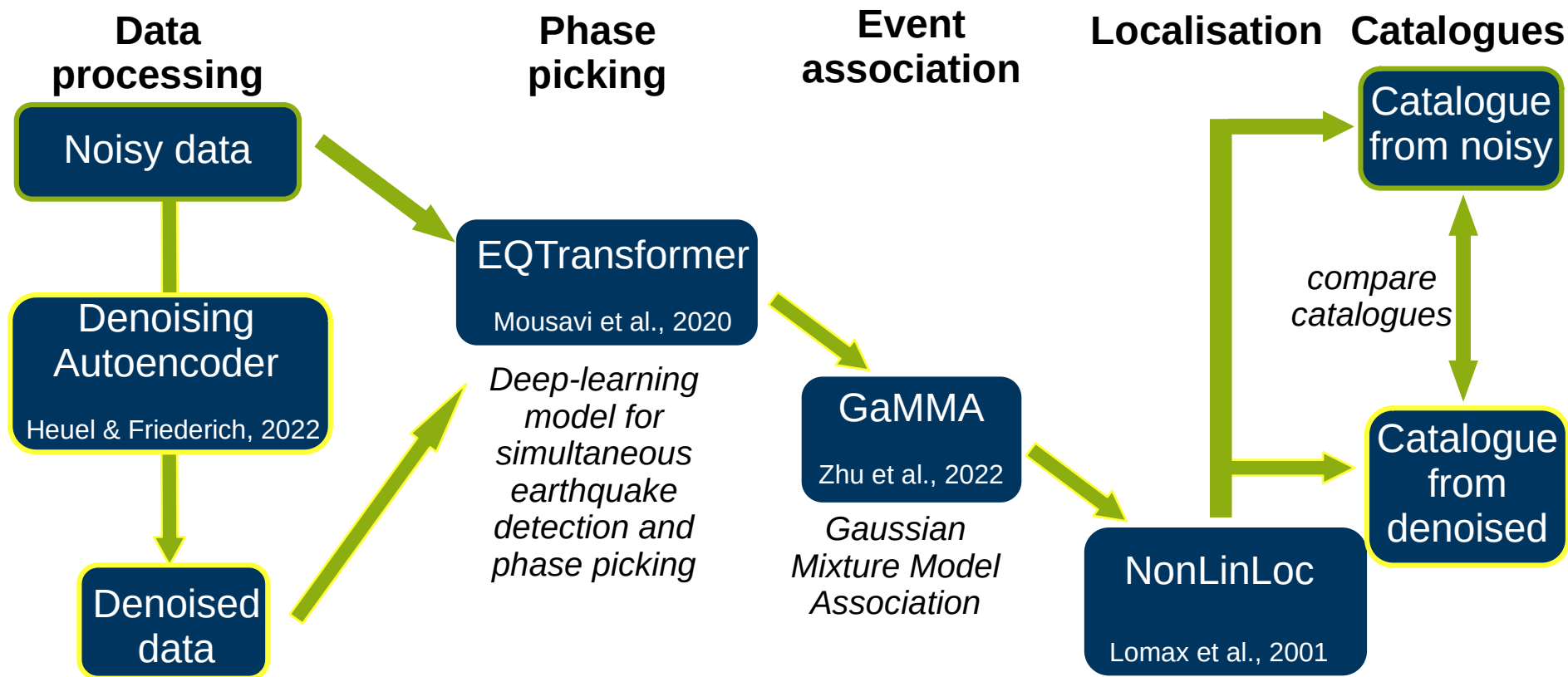
- Denoising Autoencoders are able to suppress seismic noise even when signal and noise share a common frequency band
- New seismic events can be detected in denoised data sets
- Like other filtering techniques, denoising autoencoders reduce the amplitude of the waveform
  - How does it affect the calculation of earthquake magnitude?



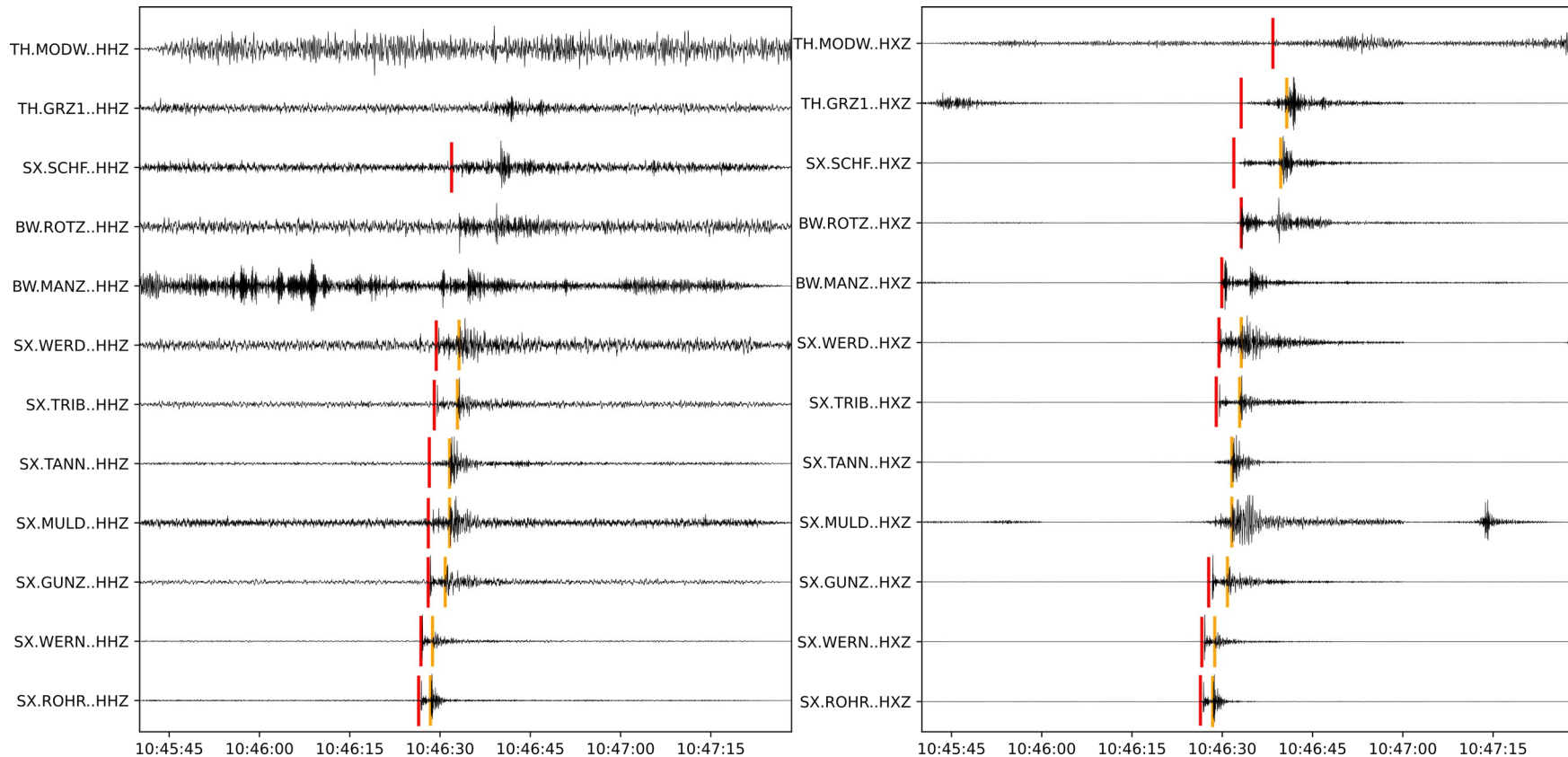
# Catalogue building



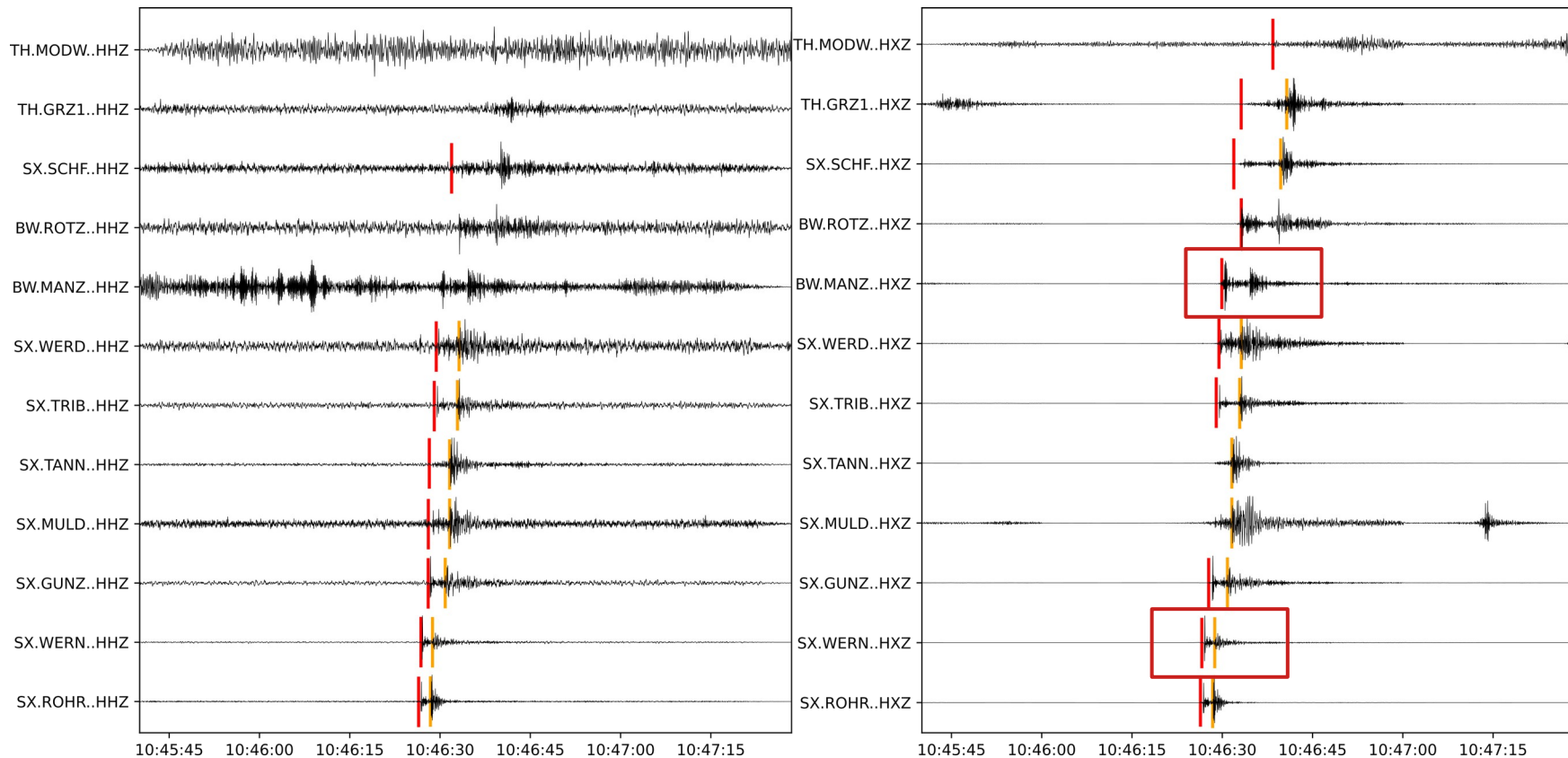
# Catalogue building



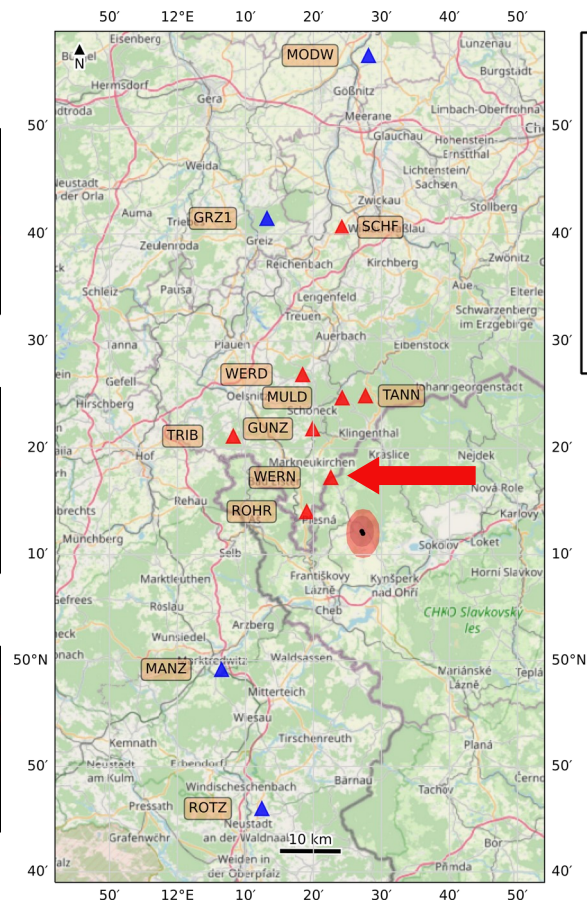
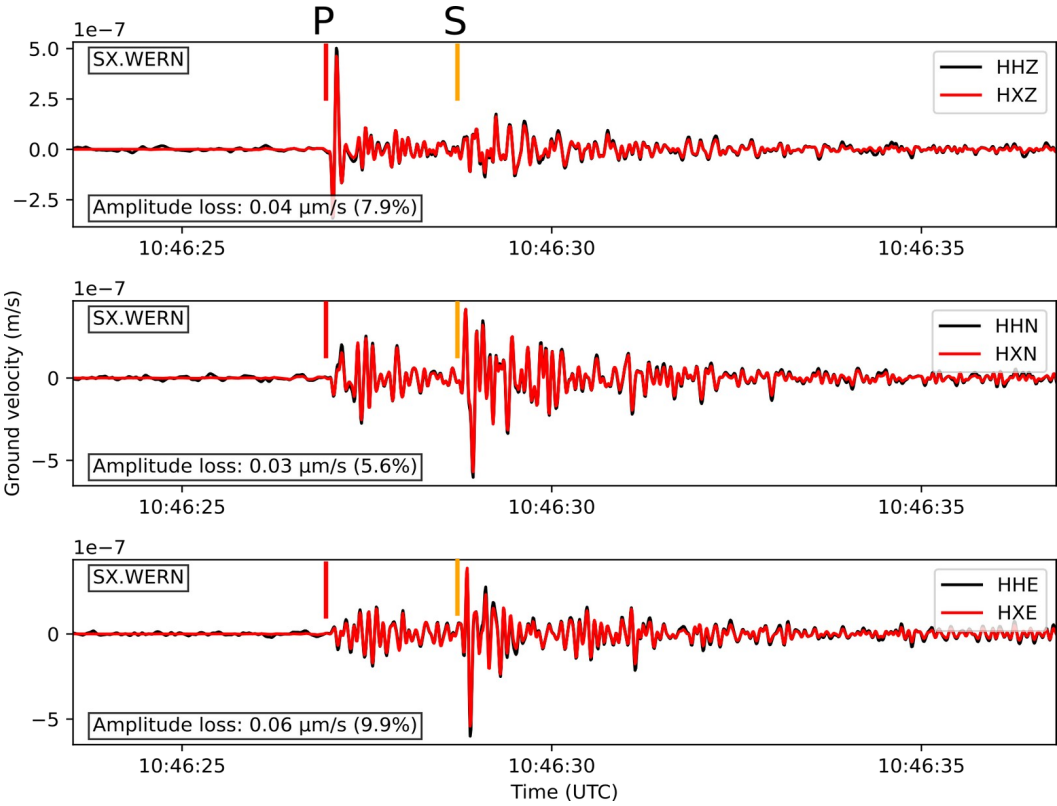
# Examples Germany



# Examples Germany



# Examples Germany | SX.WERN



Magnitude noisy: 1.06  
 Magnitude denoised: 0.39

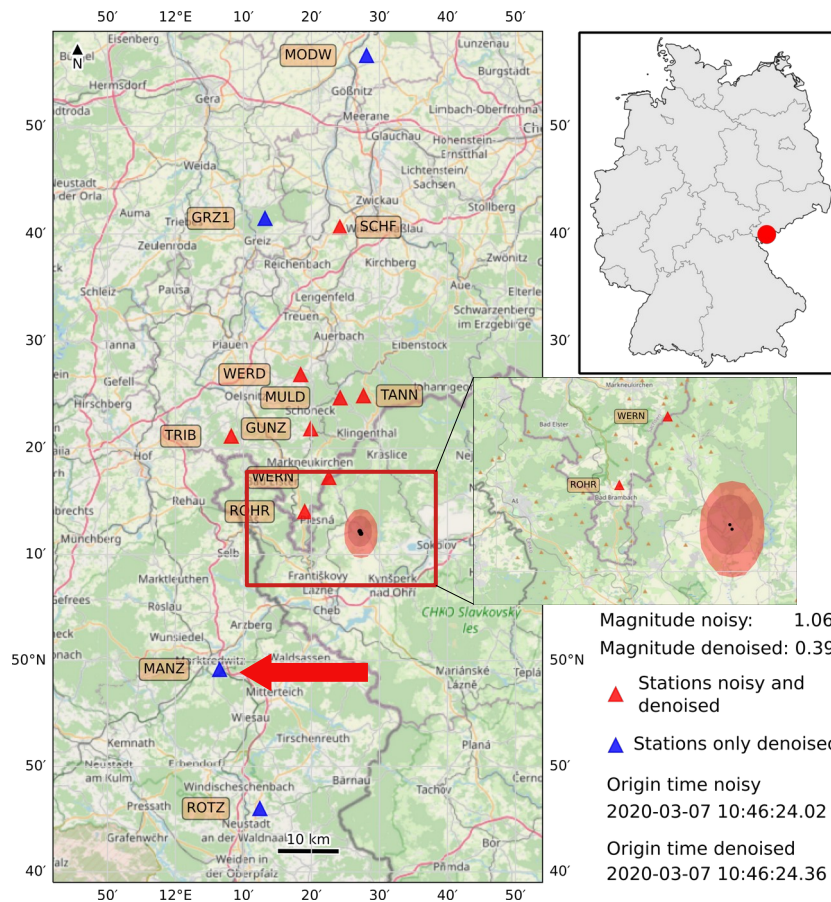
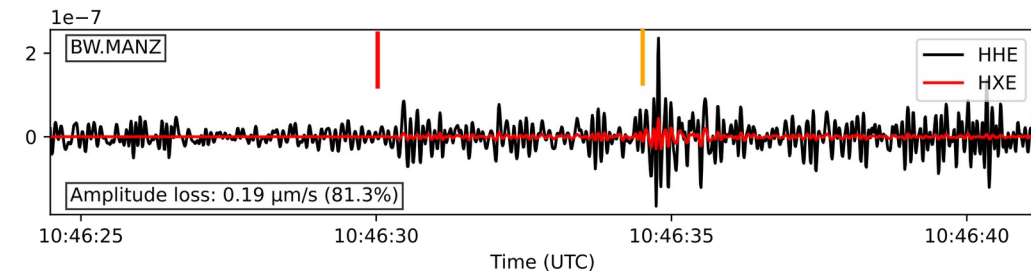
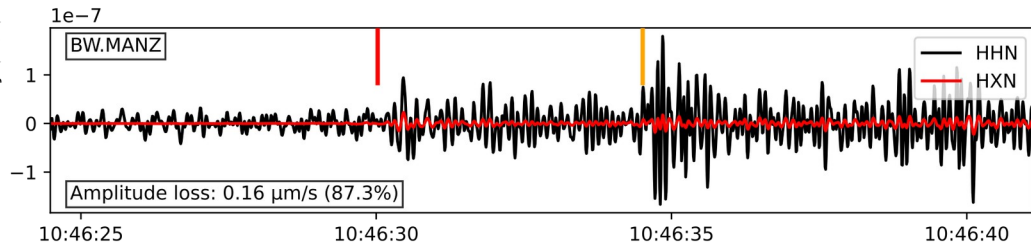
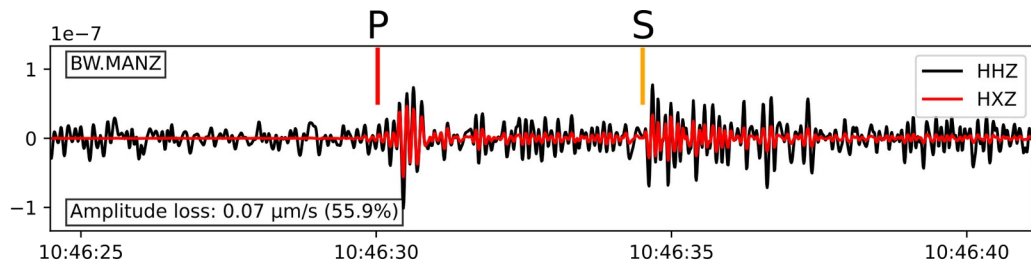
▲ Stations noisy and denoised  
 ▲ Stations only denoised

Origin time noisy  
 2020-03-07 10:46:24.02

Origin time denoised  
 2020-03-07 10:46:24.36

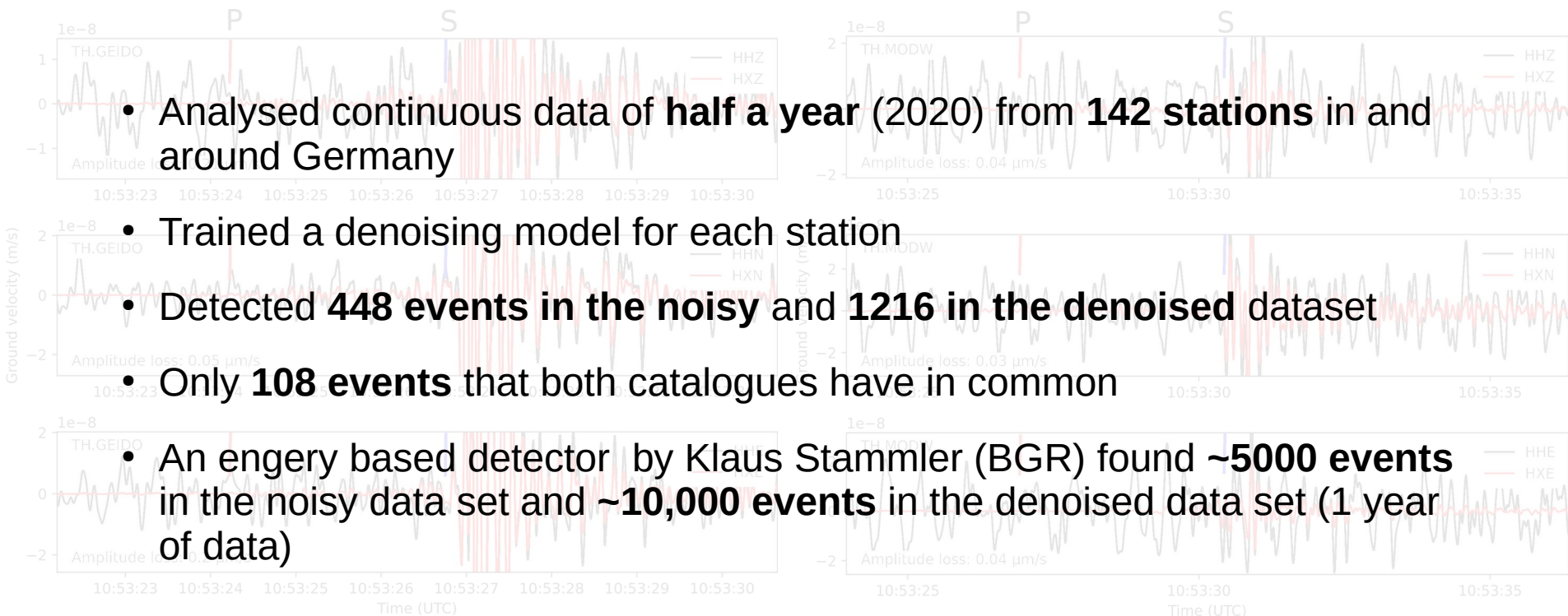


# Examples Germany | BW.MANZ

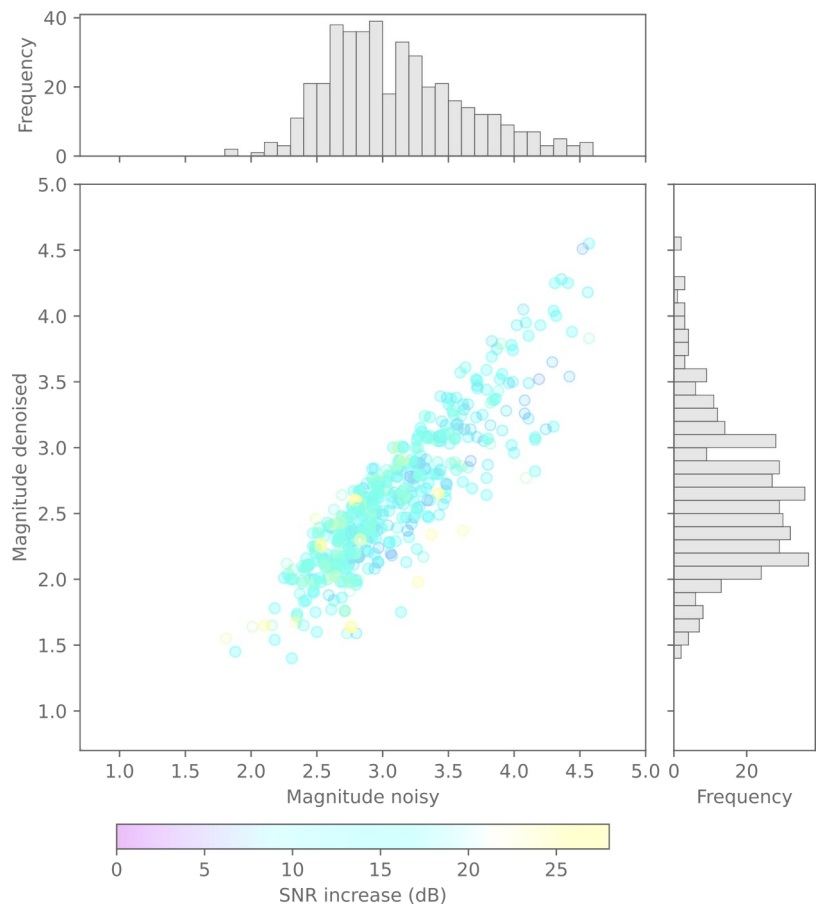
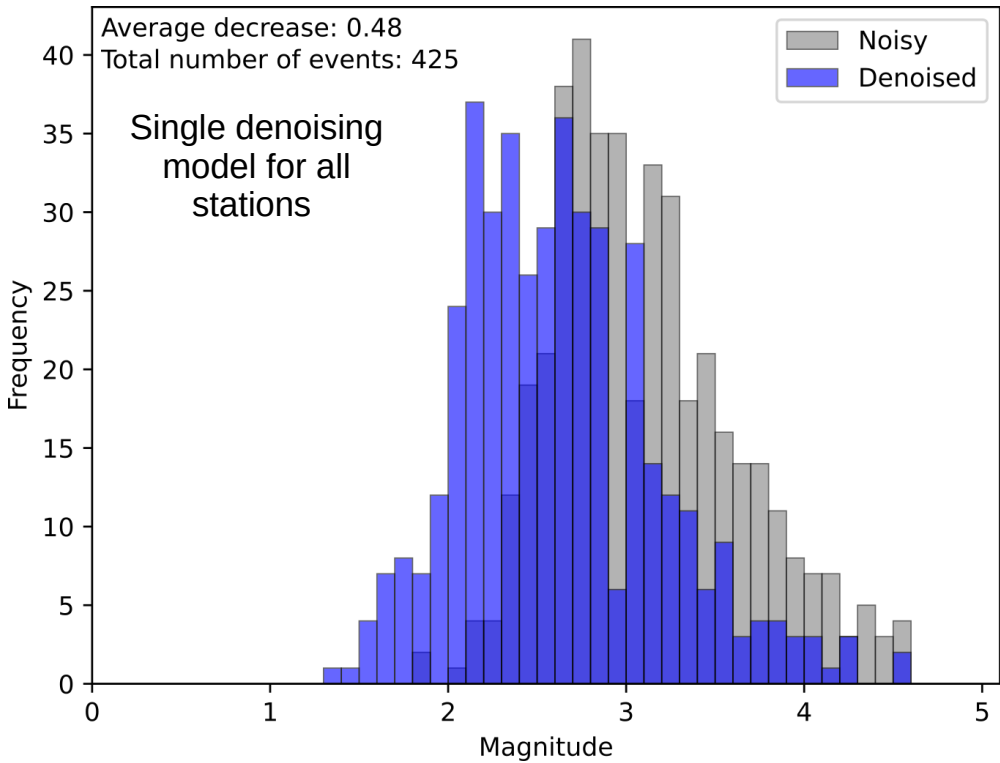




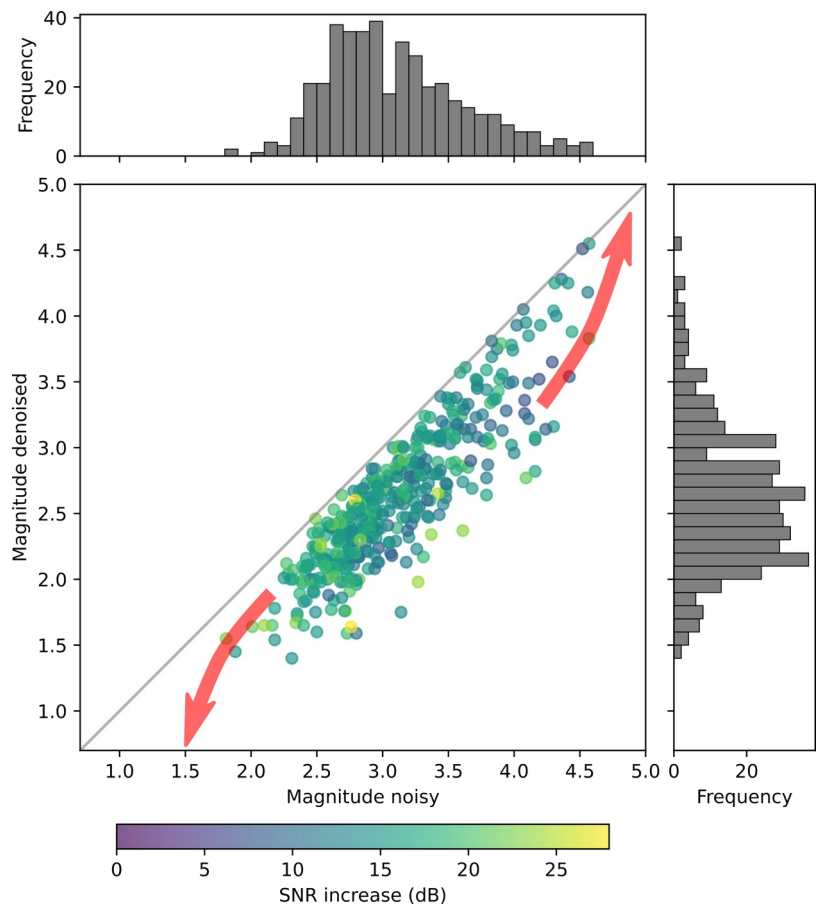
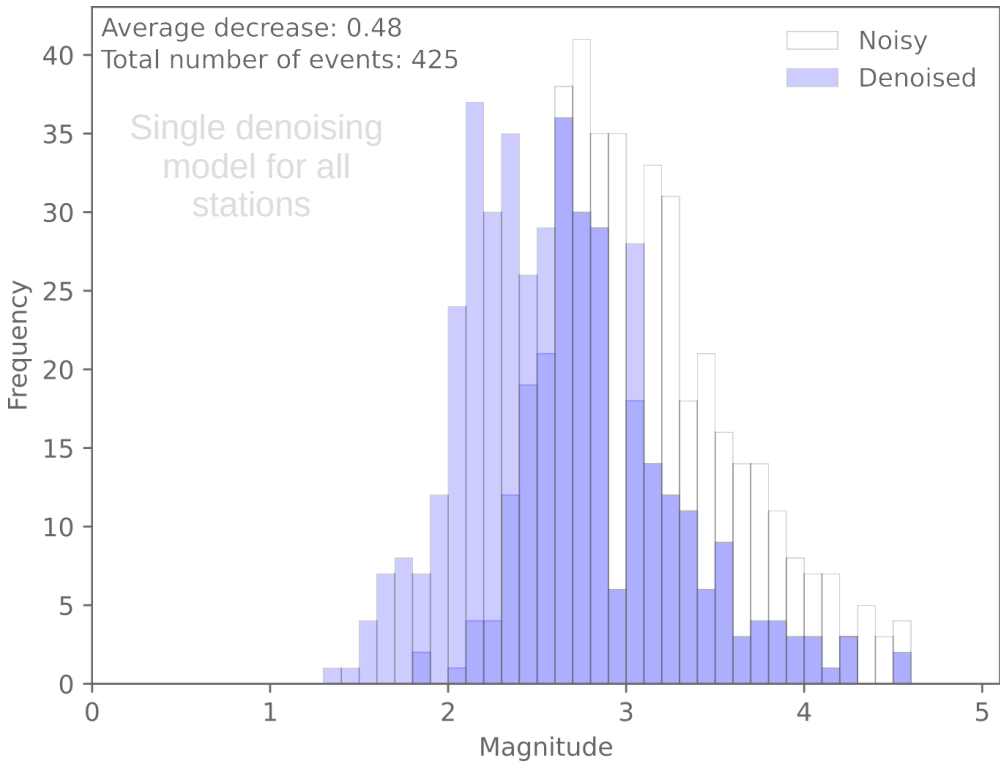
# Examples Germany



# Magnitude distribution Greece

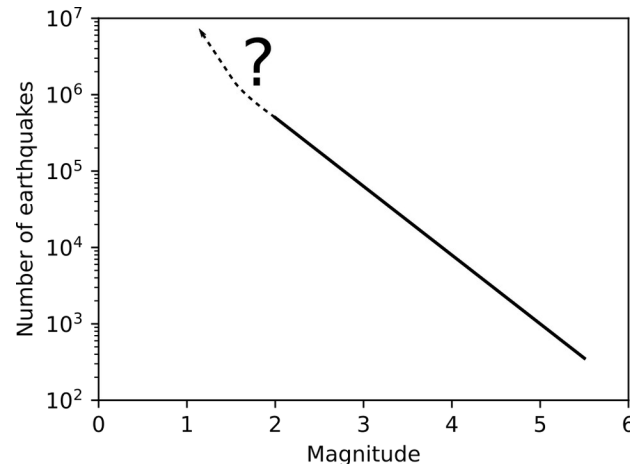


# Magnitude distribution Greece



# Conclusions / Open issues

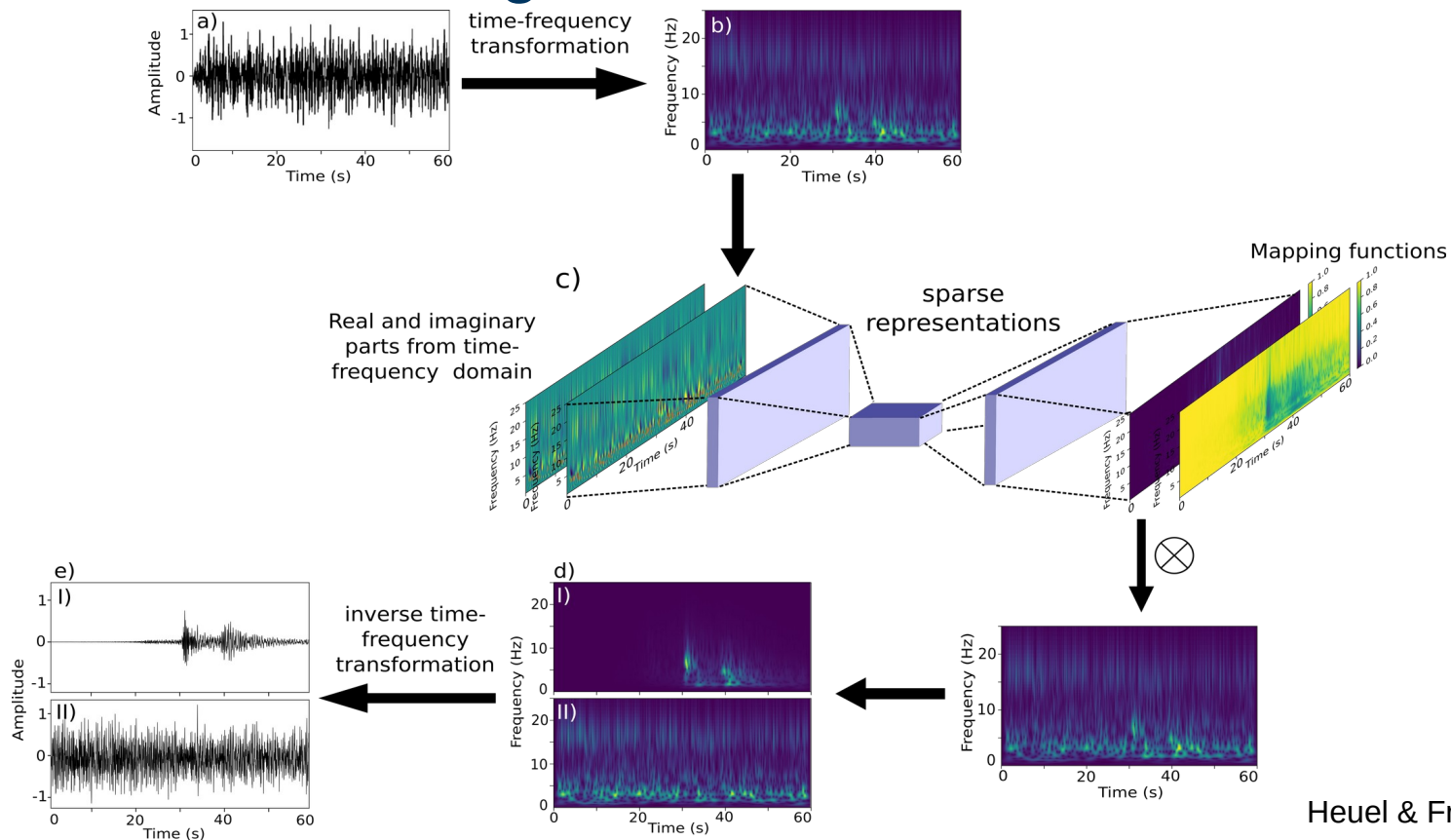
- Using denoised data leads to a massive increase of detections
- For events with a large magnitude, the autoencoder reduces the amplitude only slightly
- For events with small magnitude, the effect on amplitude is much greater
- What is the effect on the Gutenberg-Richter relation?
- How to deal with denoised data in the future, especially when creating earthquake catalogues?



Further questions? [Janis.Heuel@rub.de](mailto:Janis.Heuel@rub.de)

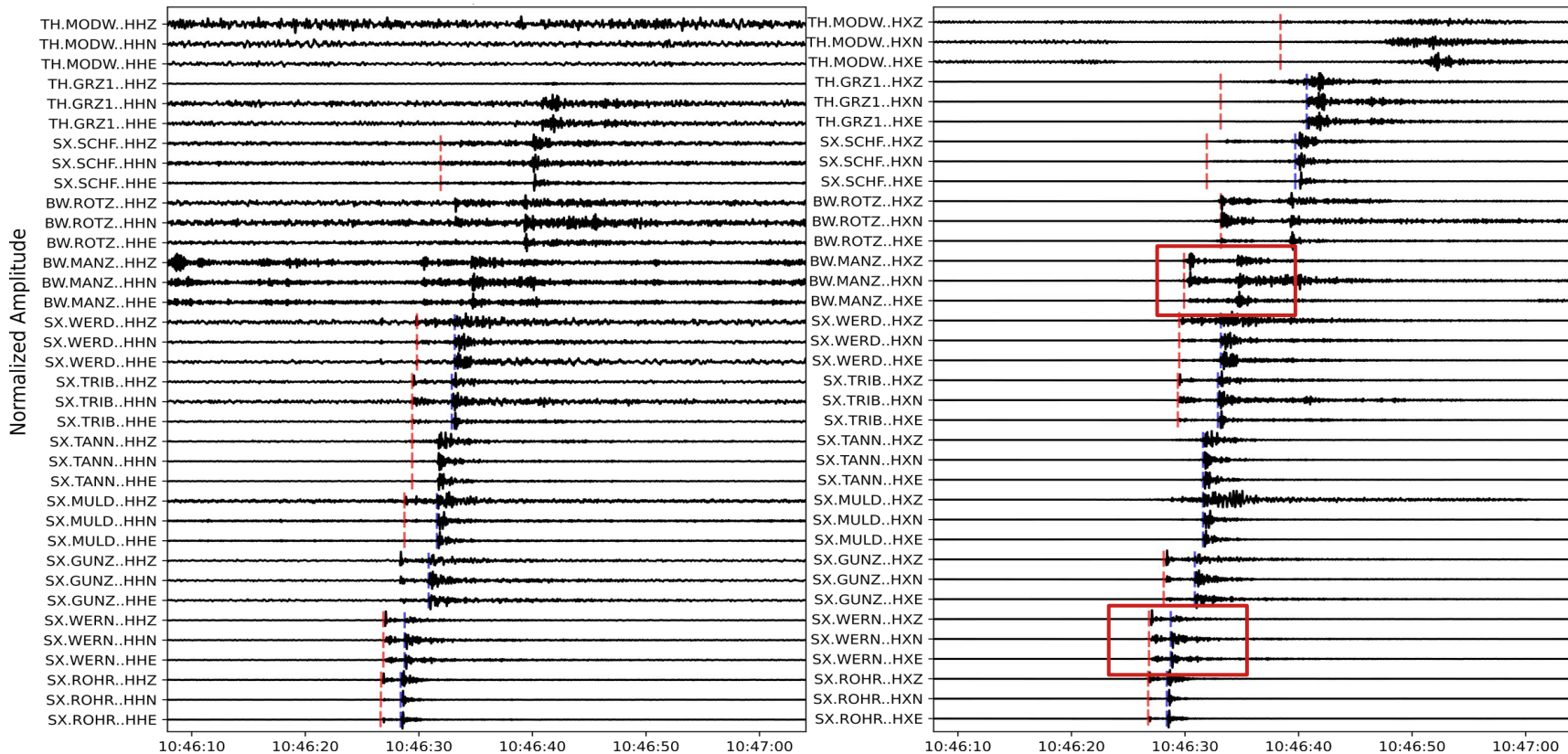
Code available at <https://github.com/JanisHe>

# How does the denoising work?

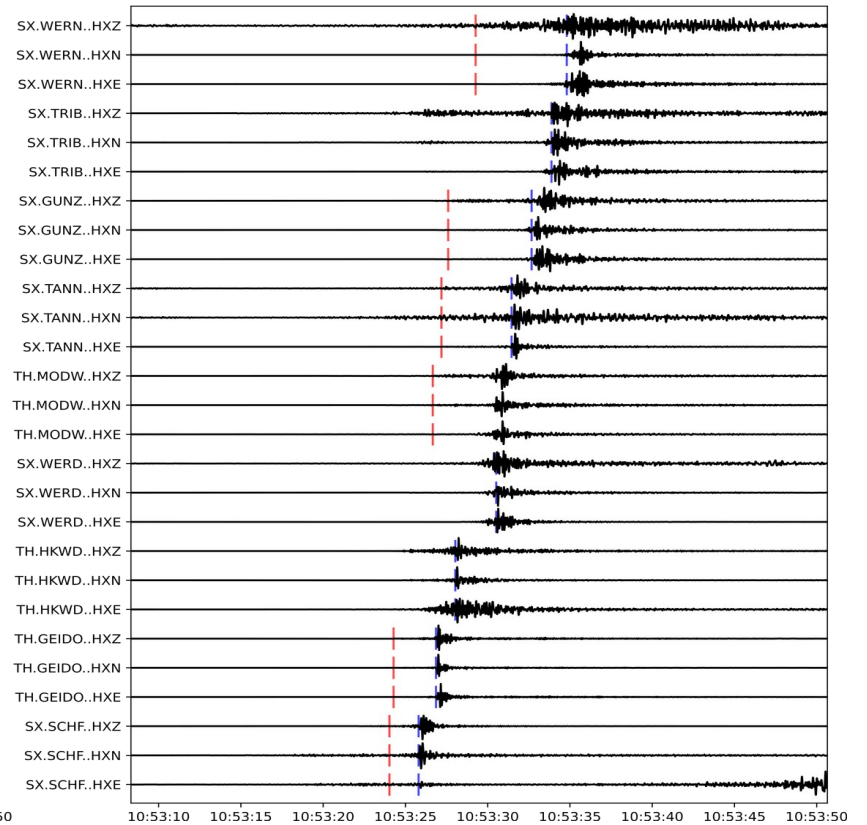
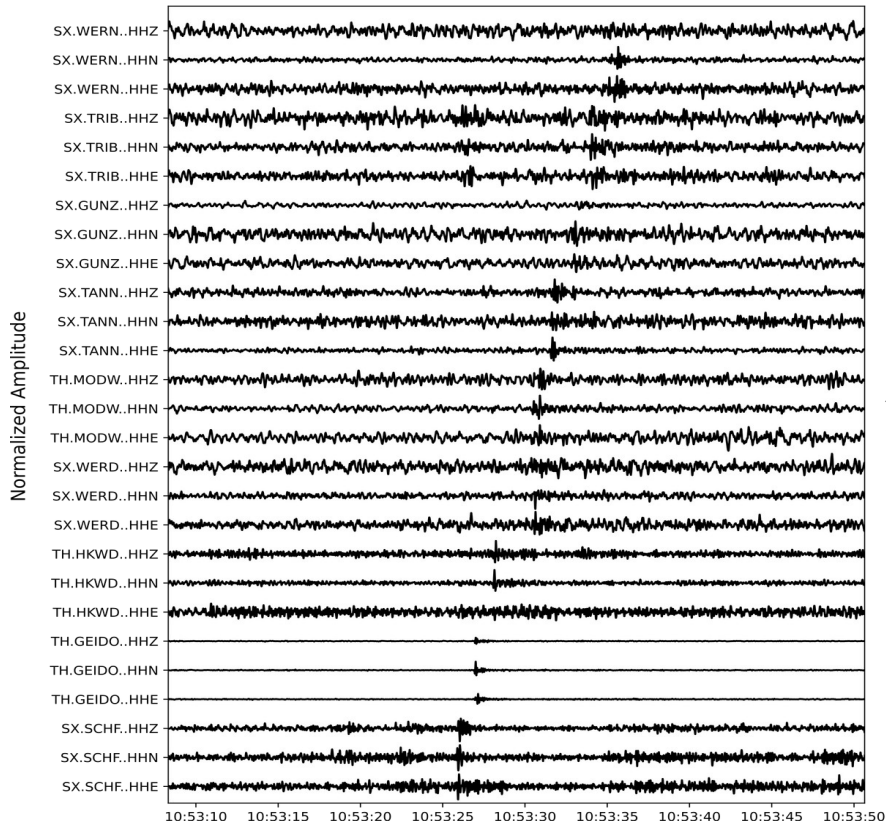


Heuel & Friederich, 2022

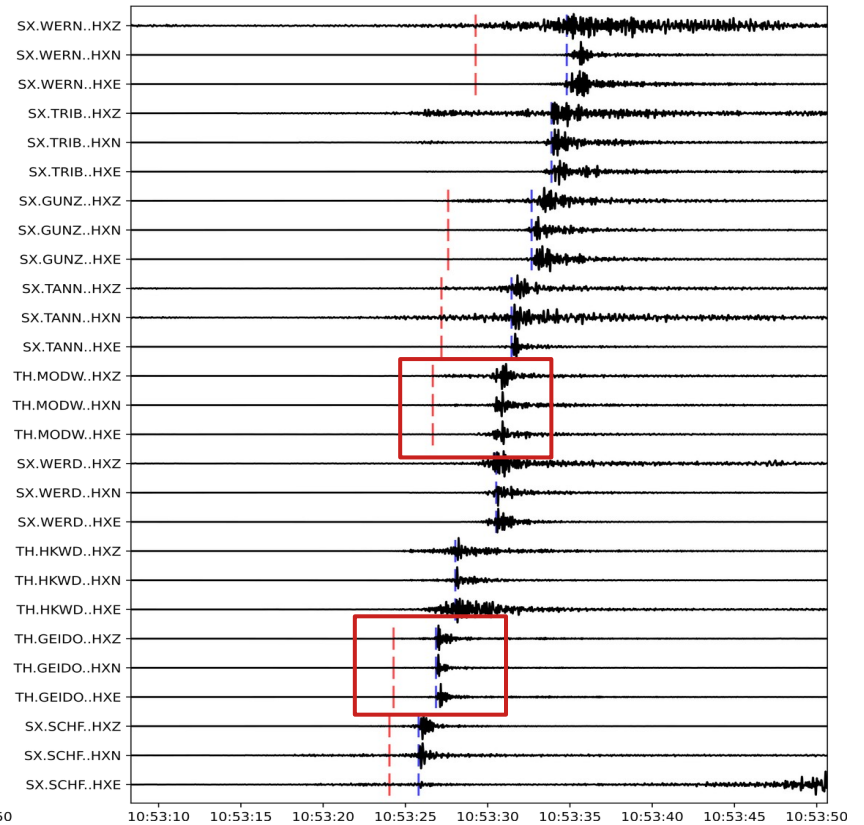
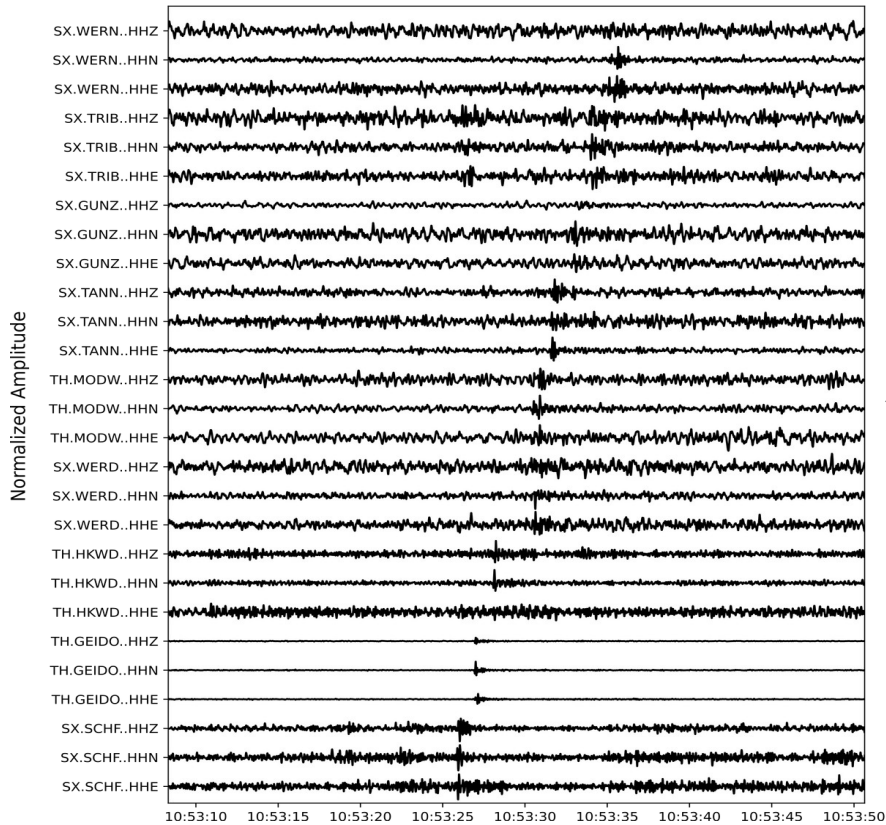
# Examples Germany



# Examples GRSN

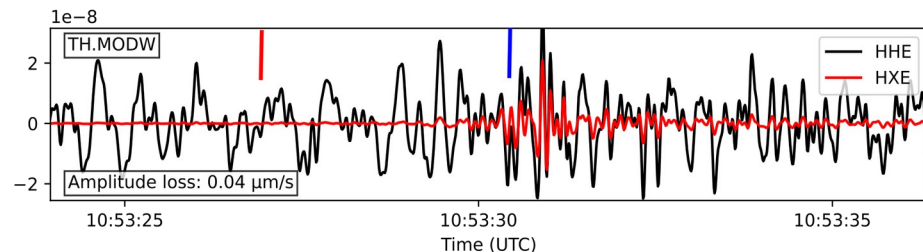
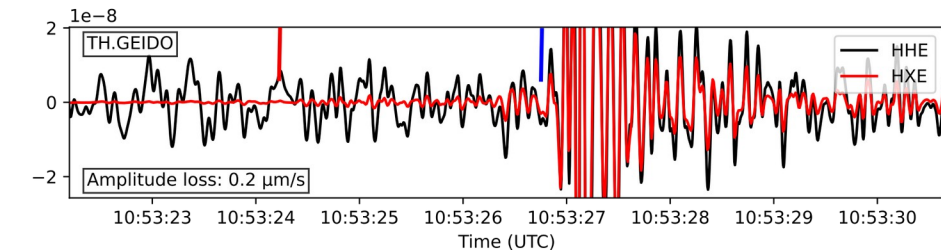
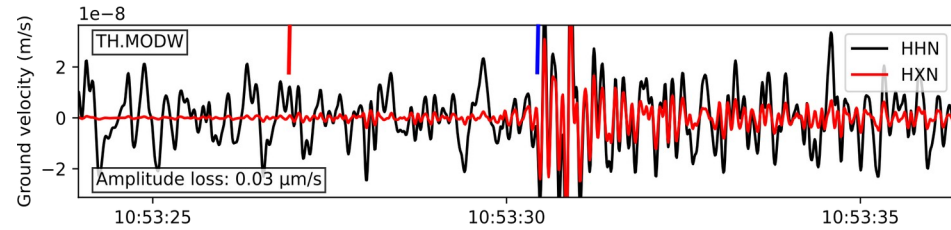
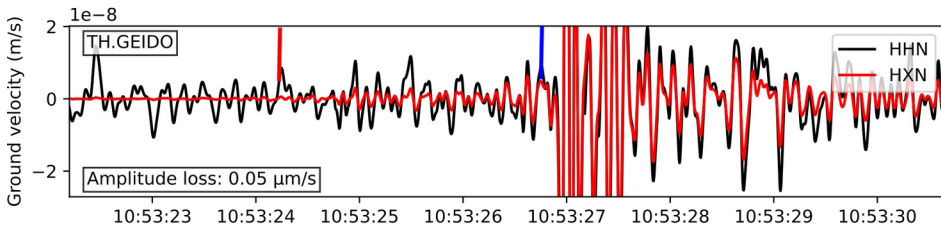
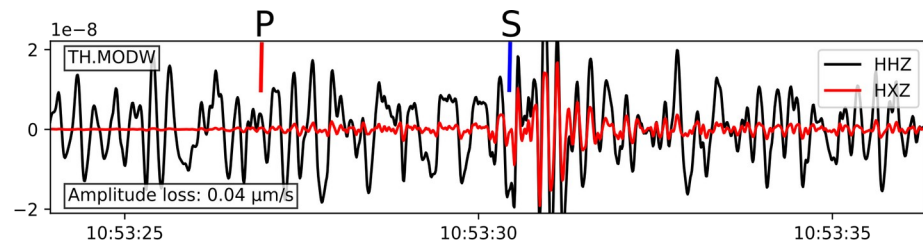
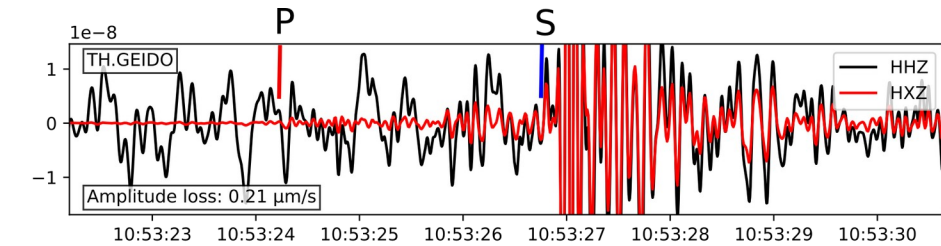


# Examples GRSN





# Examples GRSN



# Appendix

