

RUHR-UNIVERSITÄT BOCHUM

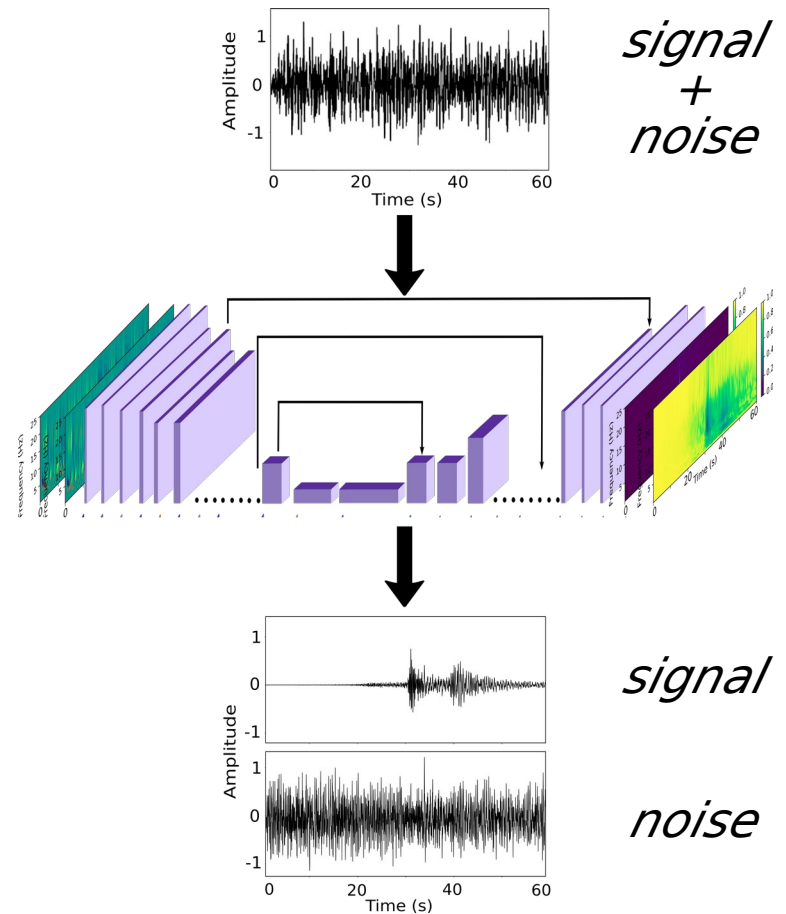
HOW DOES A DENOISING AUTOENCODER IMPROVE EARTHQUAKE DETECTION AND THE ESTIMATION OF THEIR MAGNITUDE IN SEISMIC NETWORKS?

Janis Heuel, Meggy Roßbach, Wolfgang Friederich | EGU 2023 | NH 4.3 | April 26th, 2023

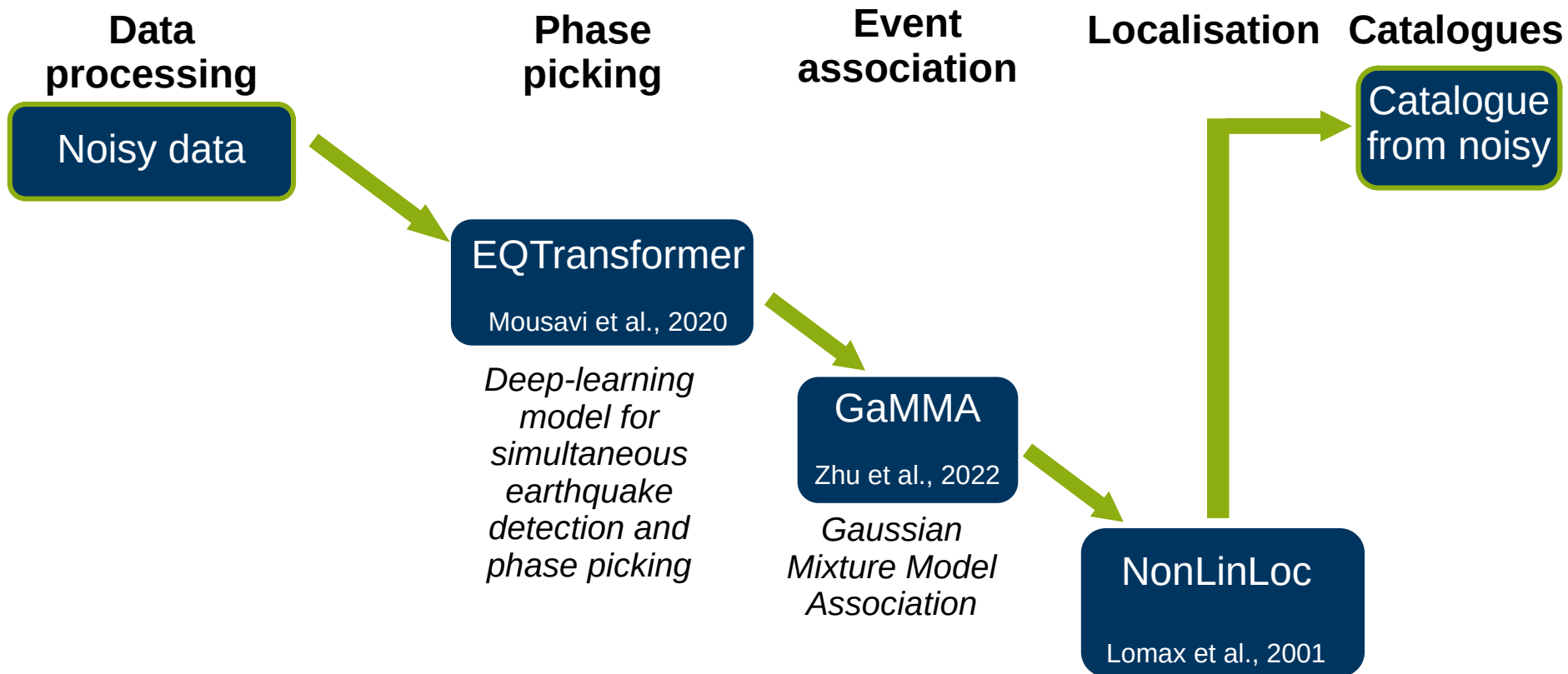


Motivation

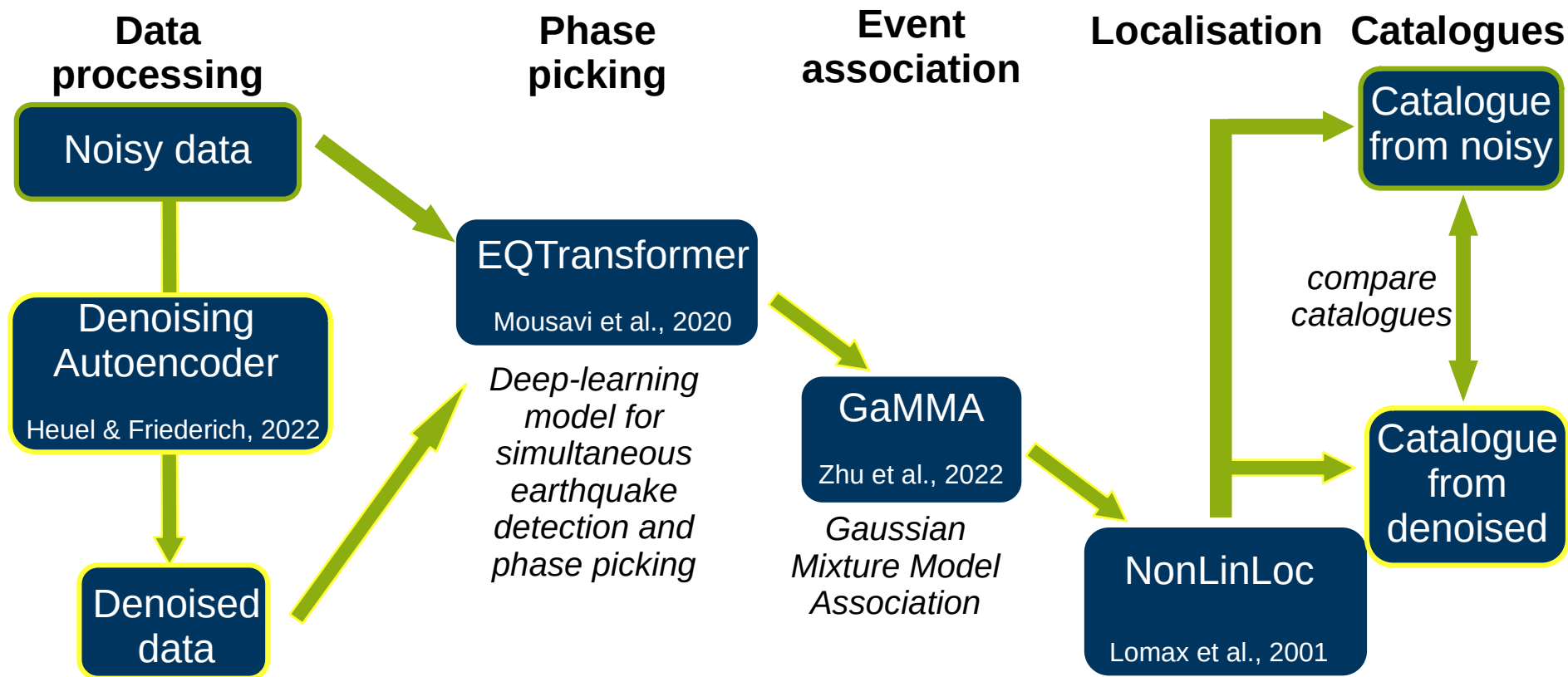
- Denoising Autoencoders are able to suppress seismic noise even when signal and noise share a common frequency band
- New seismic events can be detected in denoised data sets
- Like other filtering techniques, denoising autoencoders reduce the amplitude of the waveform
 - How does it affect the calculation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



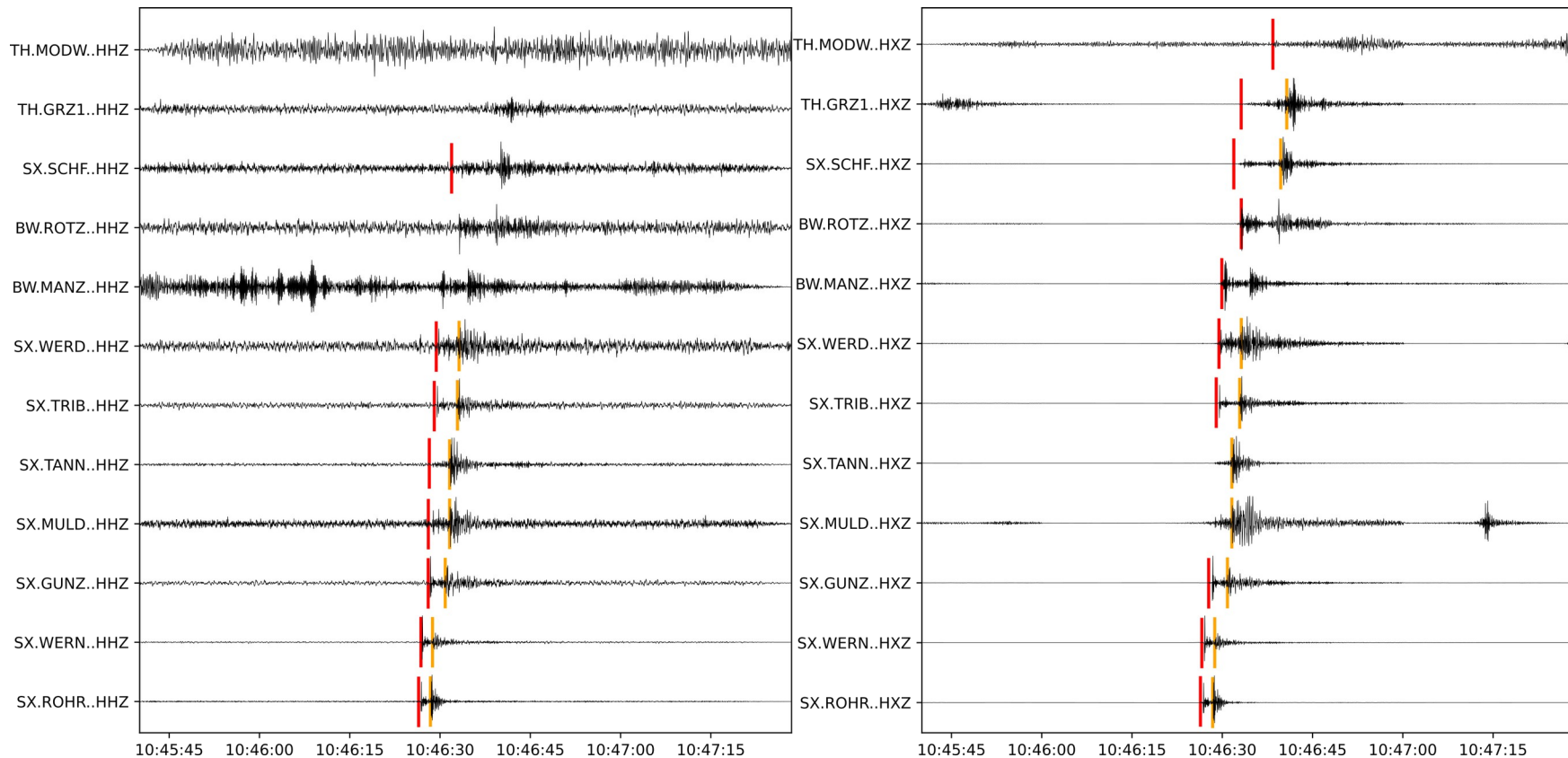
Catalogue building



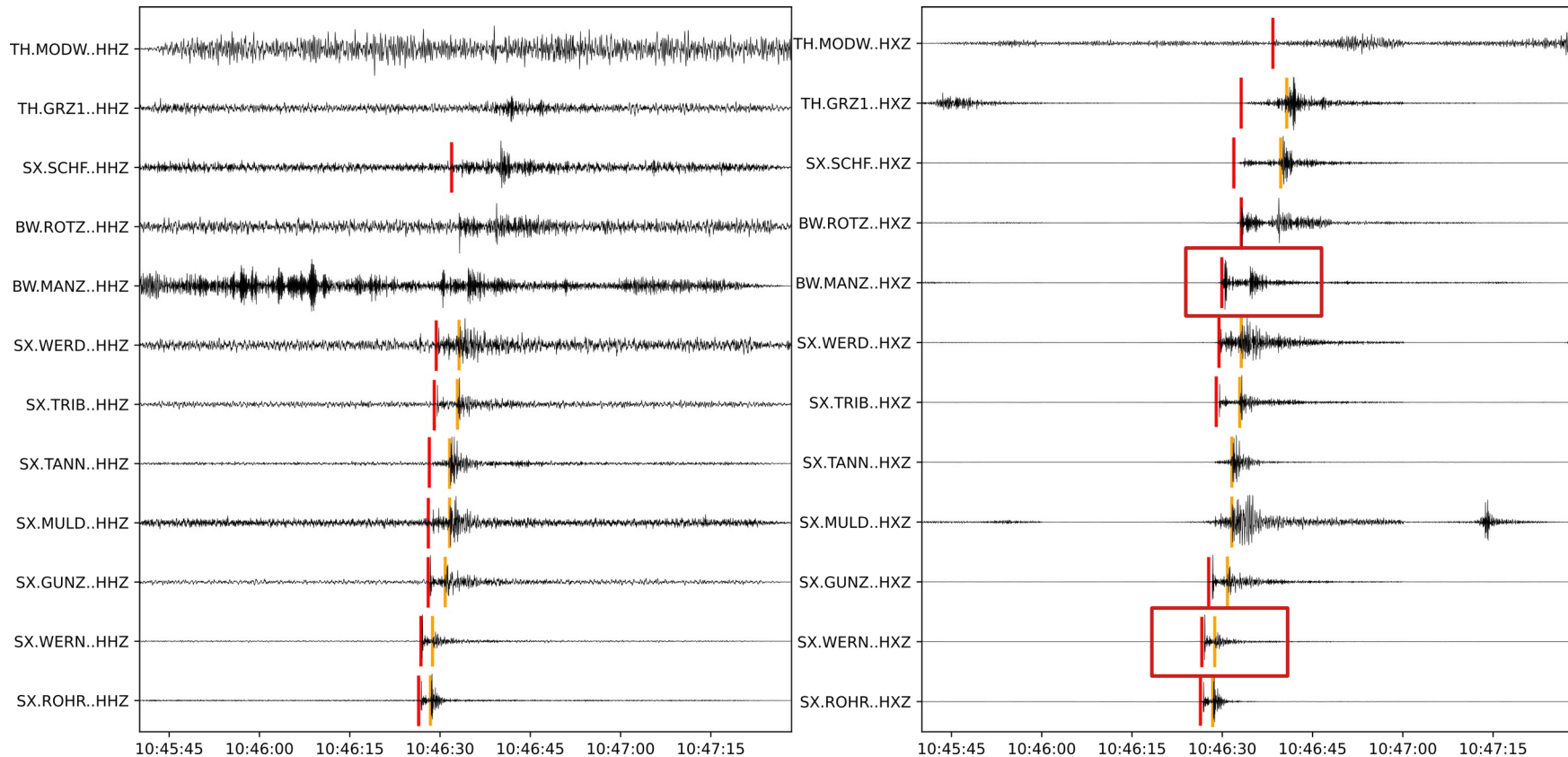
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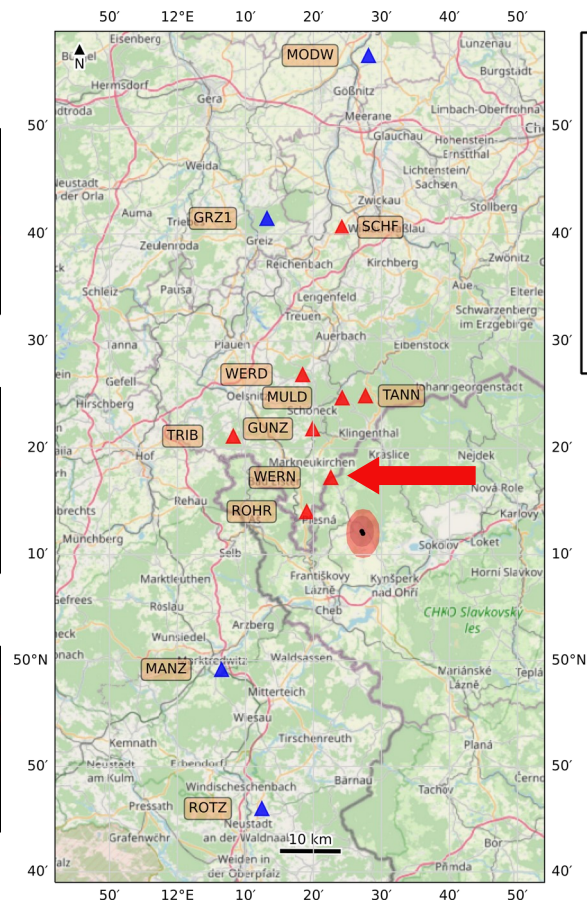
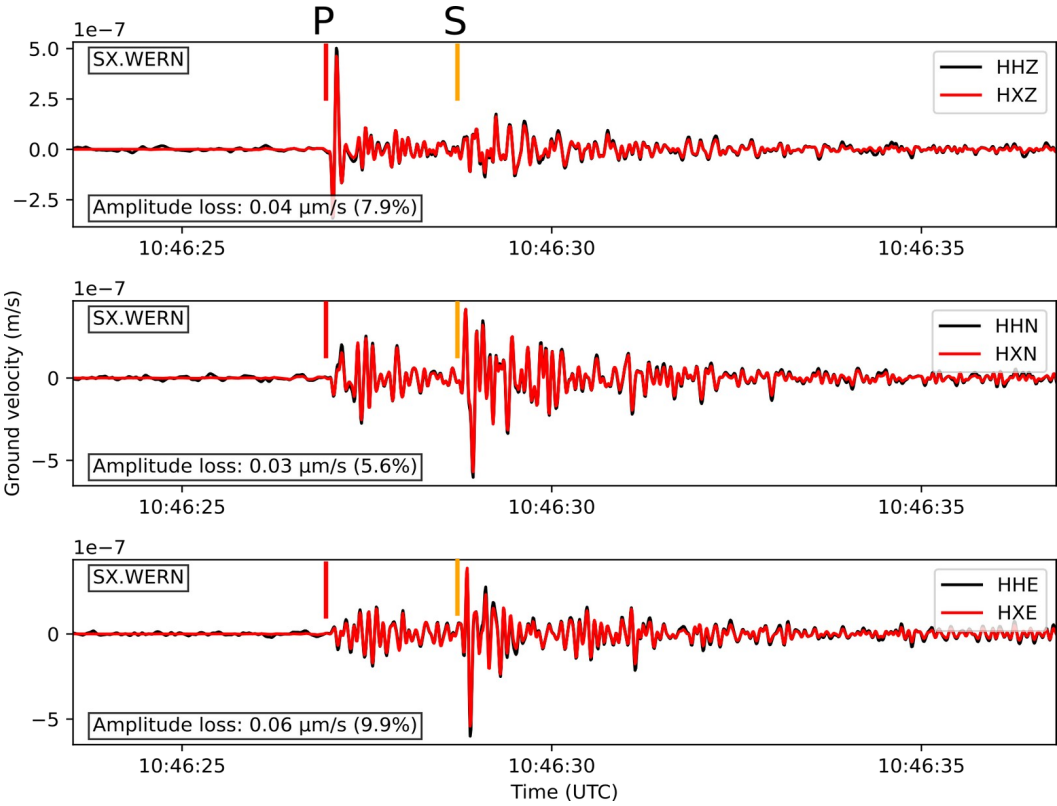
Examples Germany



Examples Germany



Examples Germany | SX.WERN



Magnitude noisy: 1.06
 Magnitude denoised: 0.39

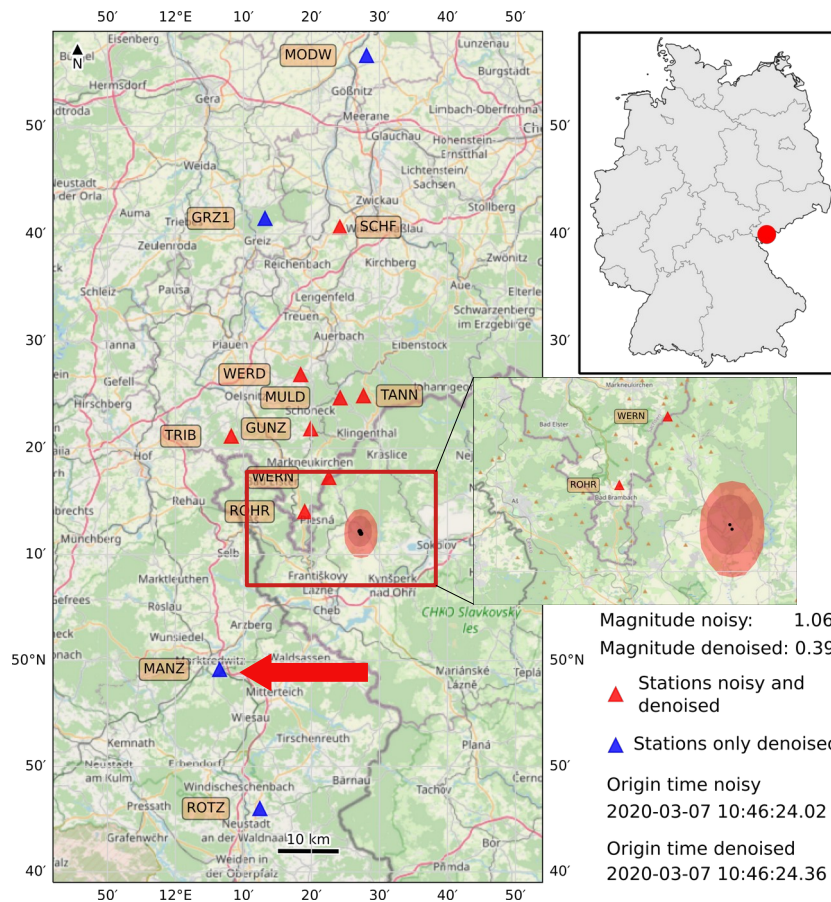
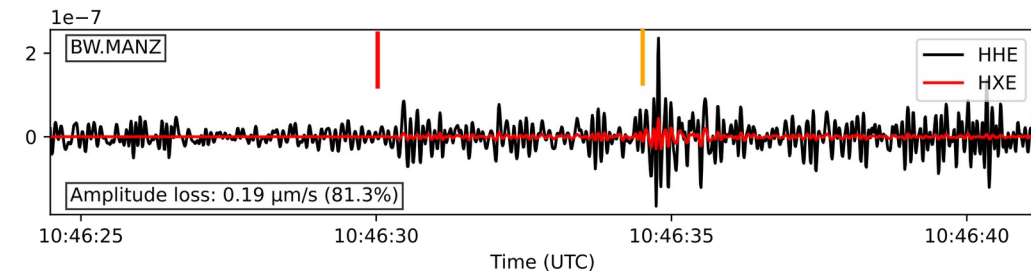
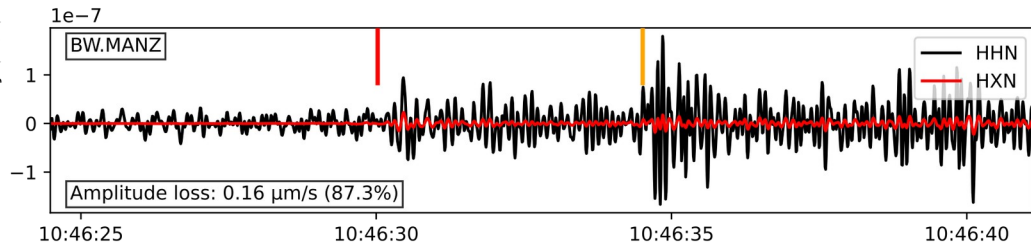
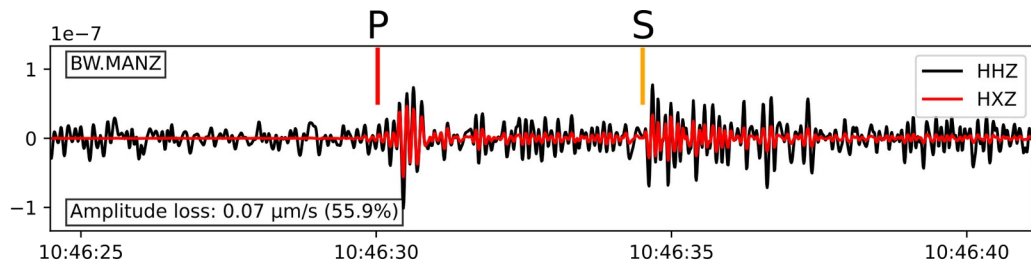
▲ Stations noisy and denoised
 ▲ Stations only denoised

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

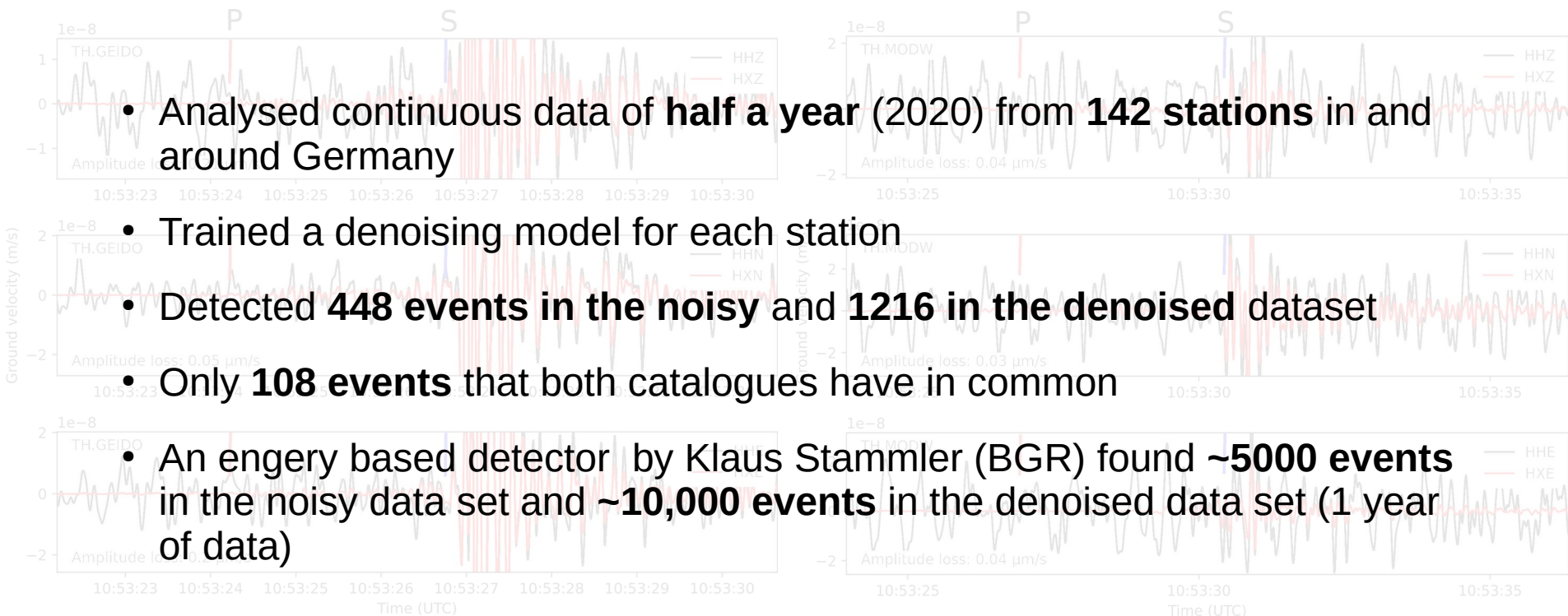
Origin time denoised
 2020-03-07 10:46:24.36



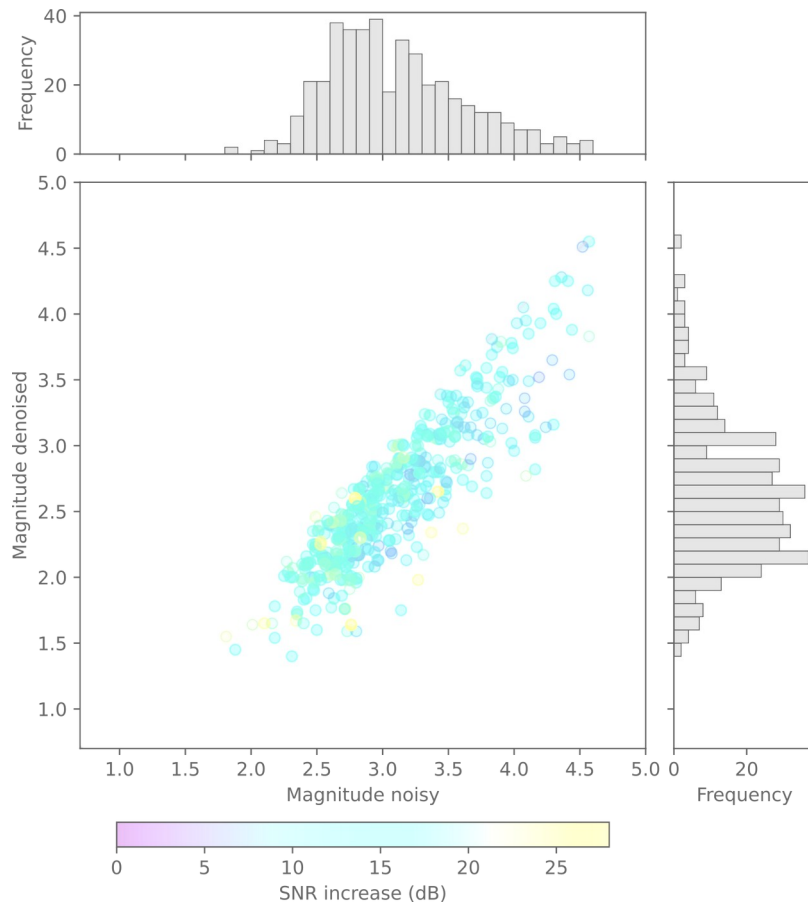
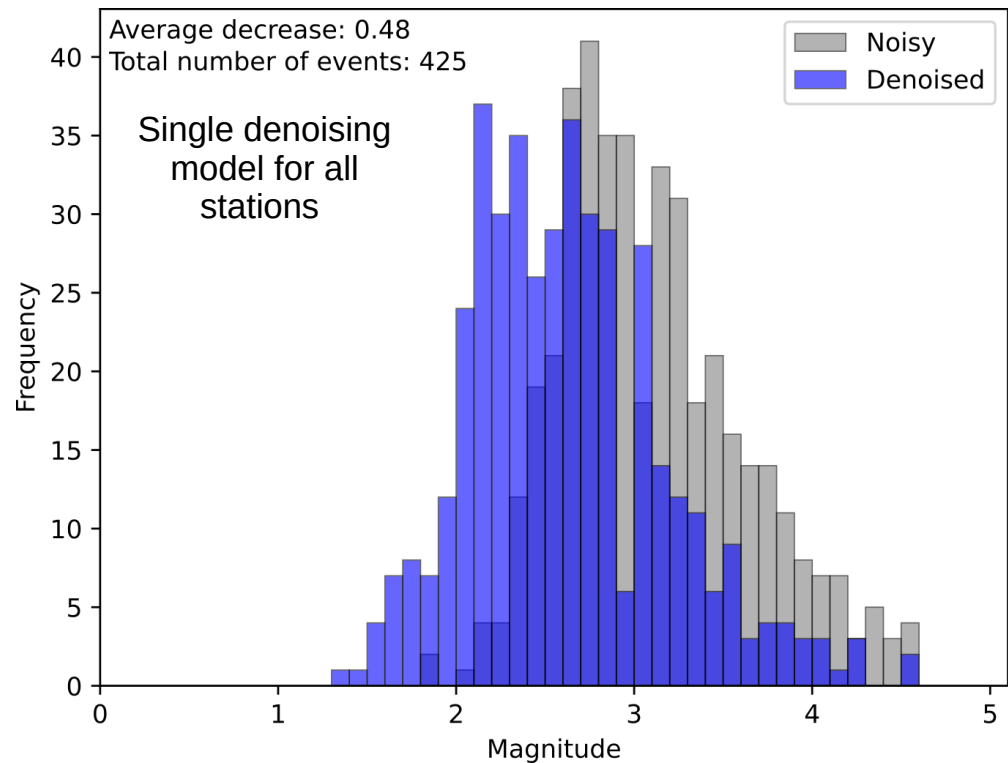
Examples Germany | BW.MANZ



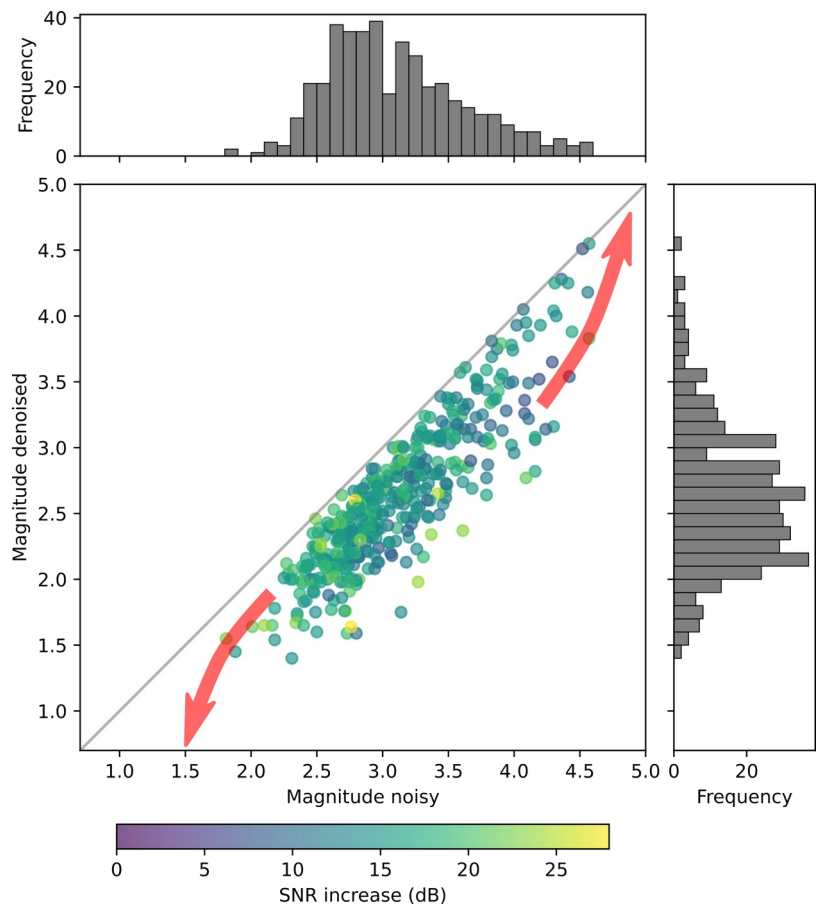
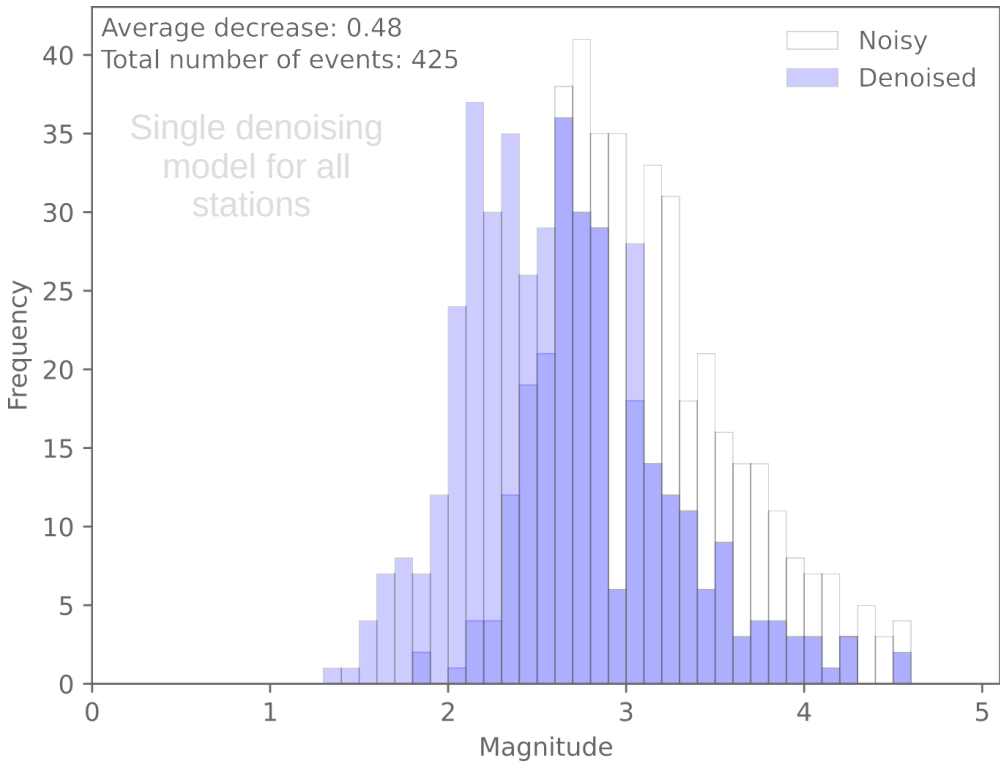
Examples Germany



Magnitude distribution Greece

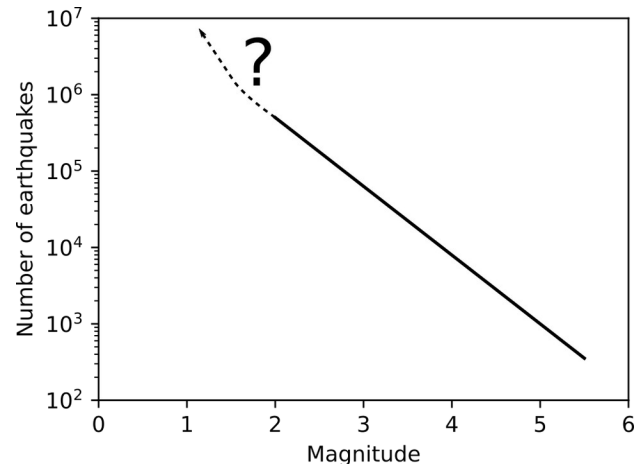


Magnitude distribution Greece



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

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