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dbMISS project progress report:

Attenuation tomography in NRW

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Die Landesregierung Nordrhein-Westfalen

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Attenuation tomography

- Using selected 1665 local earthquakes recorded and processed by

GD (Geological survey of NRW) and RN (RuhrNet - Seismic Network of the Ruhr-University Bochum)

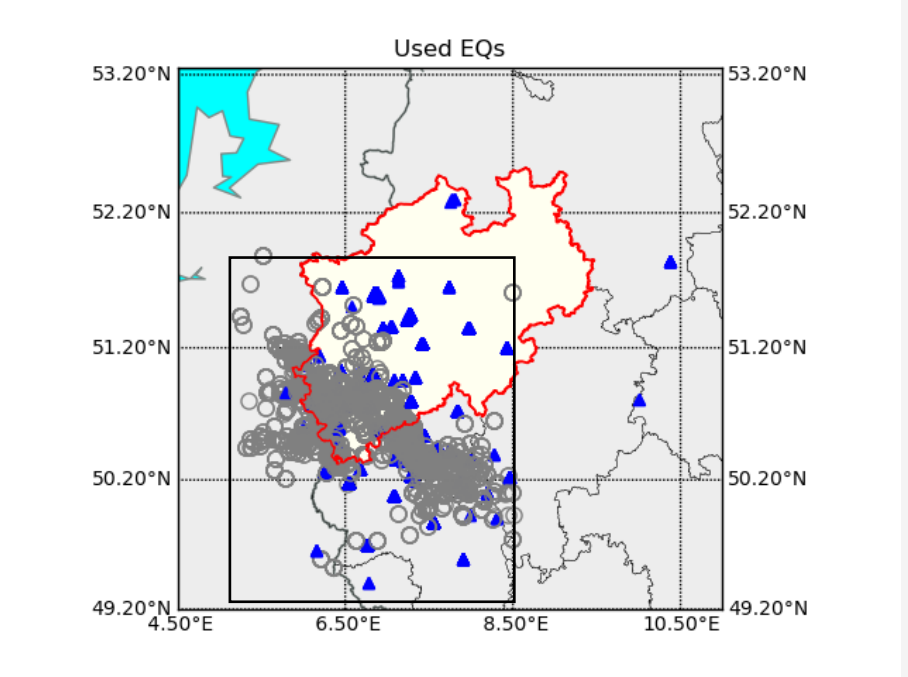
recorded in 101 stations,

Using **MuRAT-** Multi-Resolution seismic Attenuation Tomography

(De Siena, et al., 2014),

tomography model for:

Peakdelay, Q (using coda normalization method), Qc



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Current update:

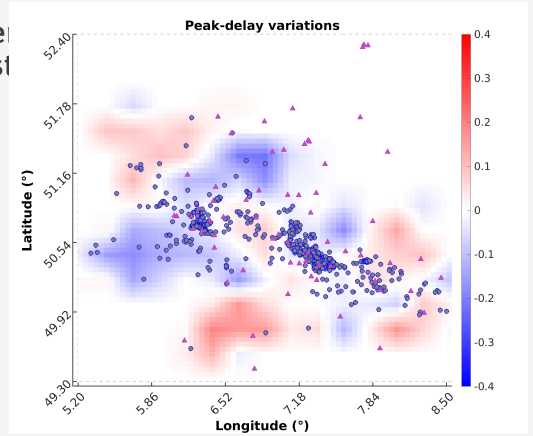
1- Testing consistancy of frequency dependent Q values:

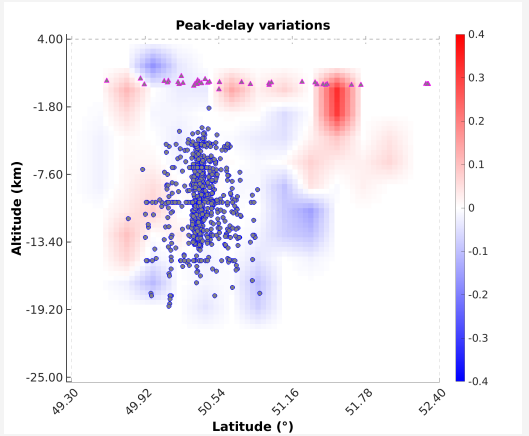
Using different components: 2D horizontal and 3D, and different input data selection, …

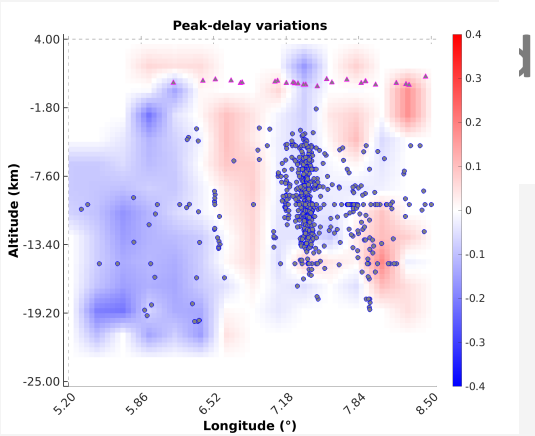
2- Analyzing the local earthquake catalog FloodRisk Seismic Network (FloodRisk) operated by Ruhr University Bochum (Rische et. al. 2022)

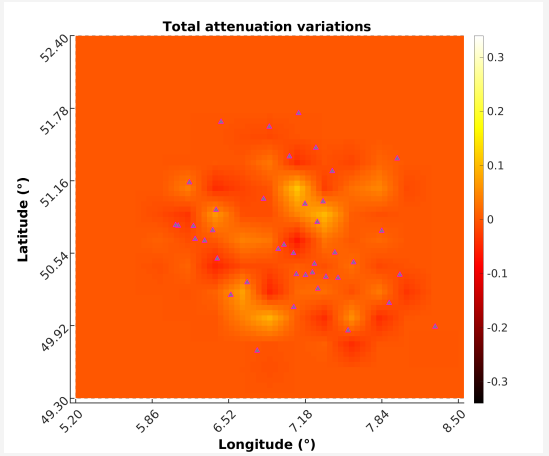
3- Preparing for the publication

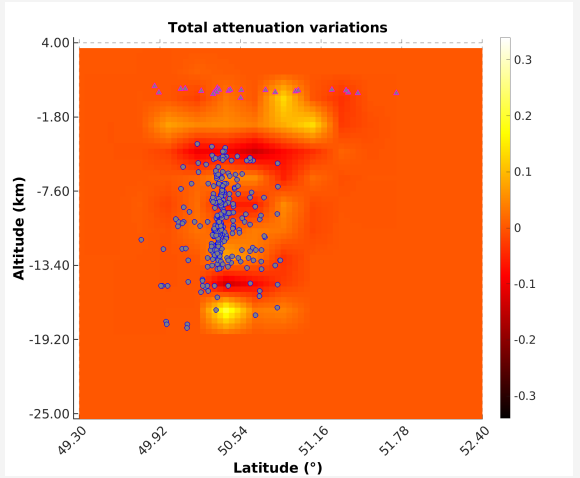
18 Hz

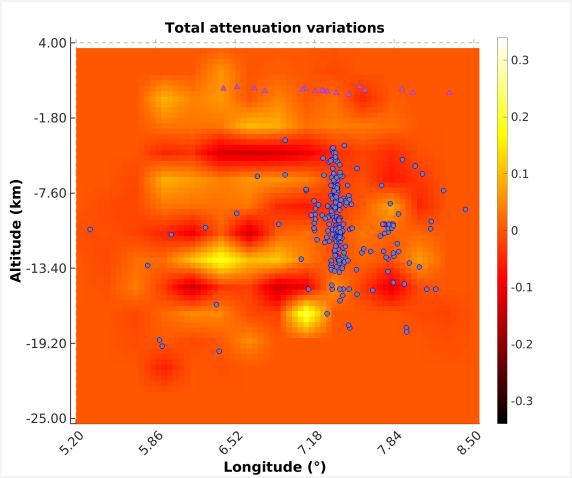












The Average frequency dependent formula for Q using s waves coda:

3D: Q = 37.6 f^ (0.79)

2D: Q = 38.5 f^ (0.73)

Other studies in the region:

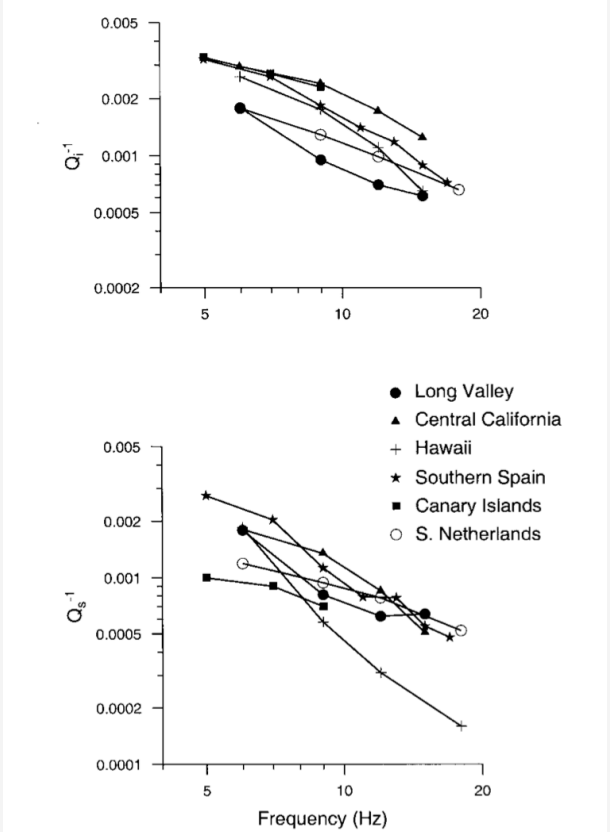


Figure 8. Comparison of Q_i^{-1} and Q_s^{-1} versus frequency for different regions: Long Valley, Central California, Hawaii (Mayeda et al., 1992), Southern Spain (Akinci et al., 1995), Canary Islands (Canas et al., 1998), Colombia (Ugalde et al., 2002) and Southern part of The Netherlands (present study).

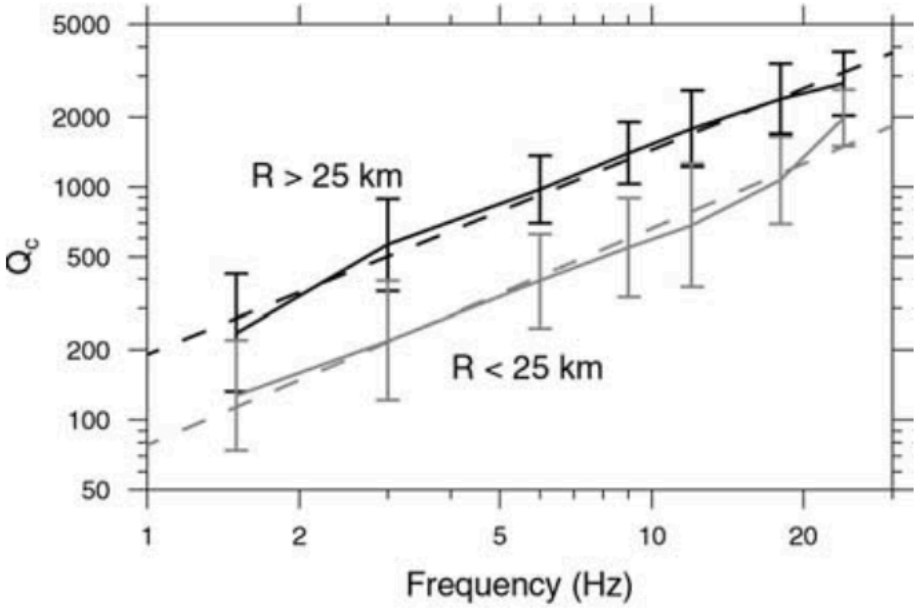


Figure 3. Coda Q_c models for the southern part of the Netherlands, estimation following Aki and Chouet (1975). The black lines represent epicentral distances larger than 25 km, grey lines distances shorter than 25 km. The solid line is the data, the dashed line the linear regression to obtain Q_0 and n. The vertical bars represent the error bars. The length of the bars represent the standard deviation of the value of Q_c of that particular frequency band.

Goutbeek, F. H., B. Dost, and T. Van Eck.
"Intrinsic absorption and scattering attenuation in the southern part of the Netherlands." *Journal of seismology* 8 (2004): 11-23.

- Belgium 1-32 Hz, Q0= (17-30); n=1-1.6

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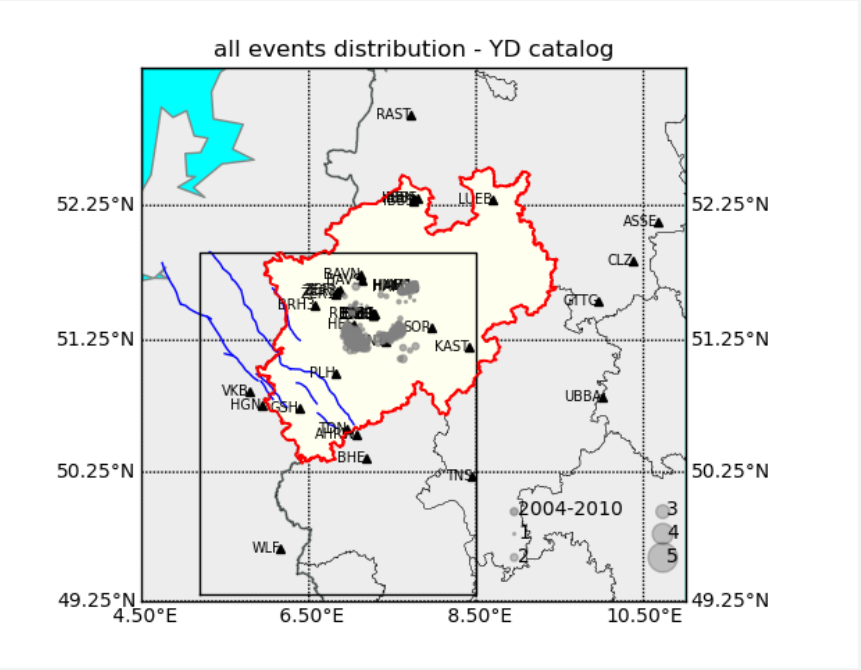
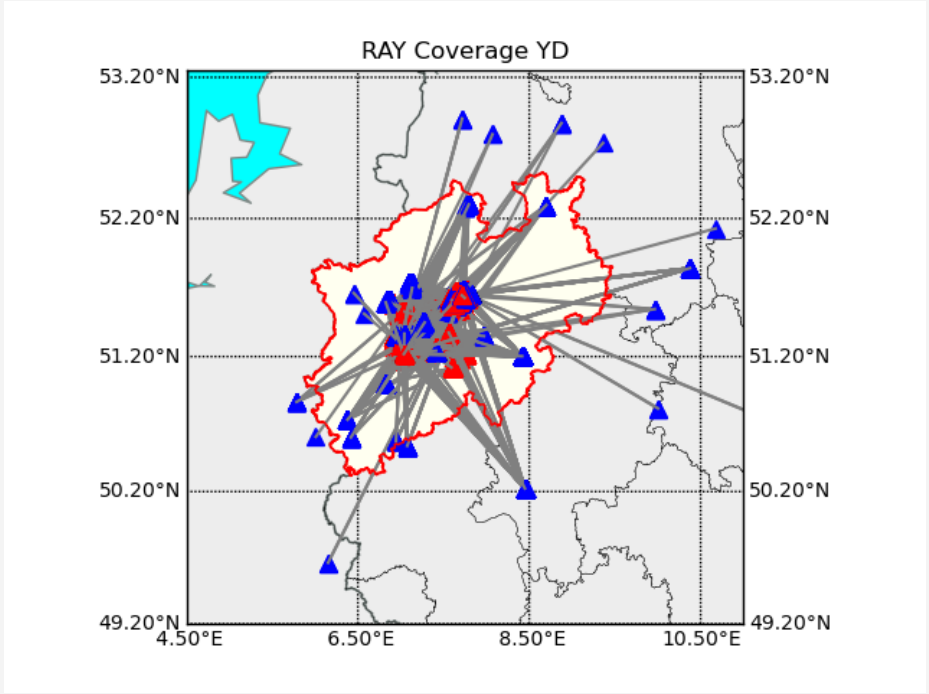
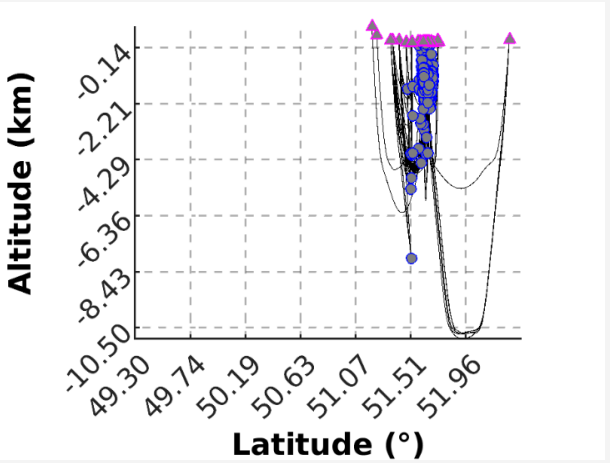
Adding a local dense data: FloodRisk Seismic Network data:



2553 EQ and 566 QB



Increasing the area?



shallow depth

Although the YD catalog data improves coverage in part of our study region, combining the two databases and interpreting the results presents challenges.

Peakdelay values test

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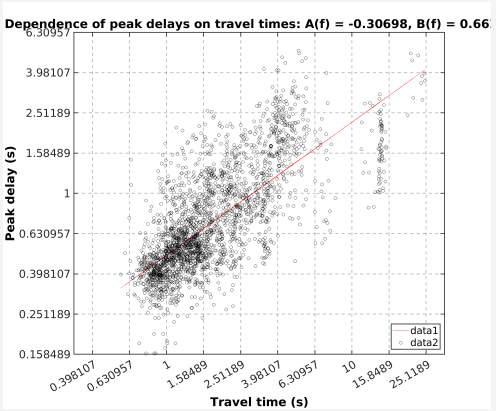
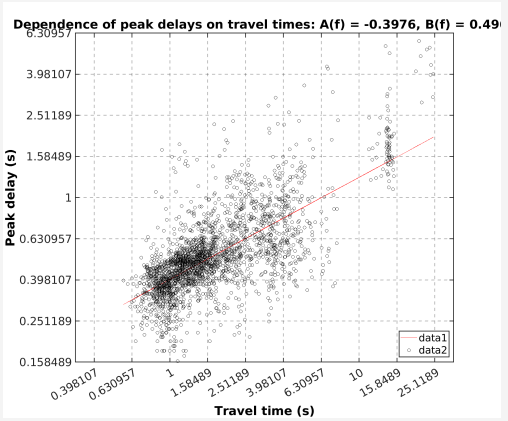
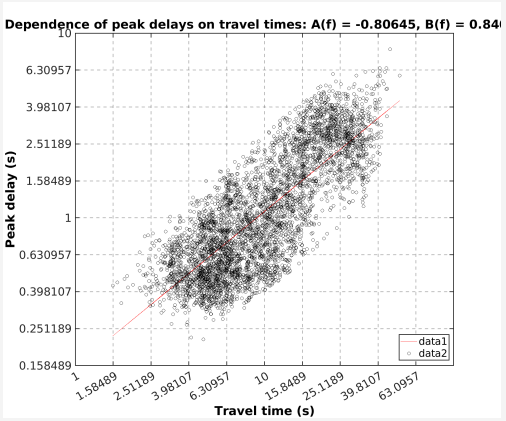
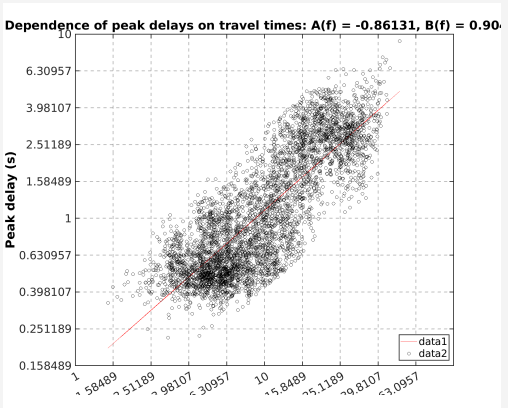
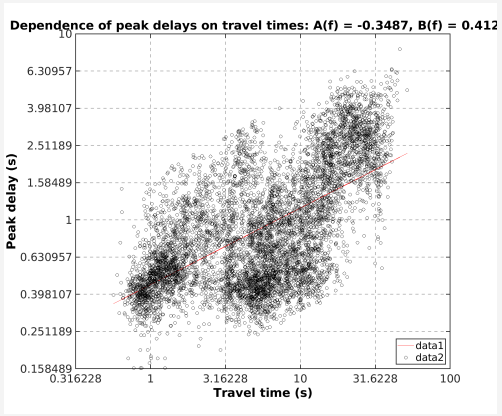
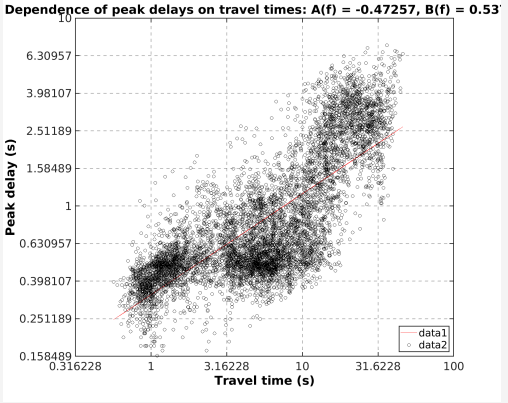
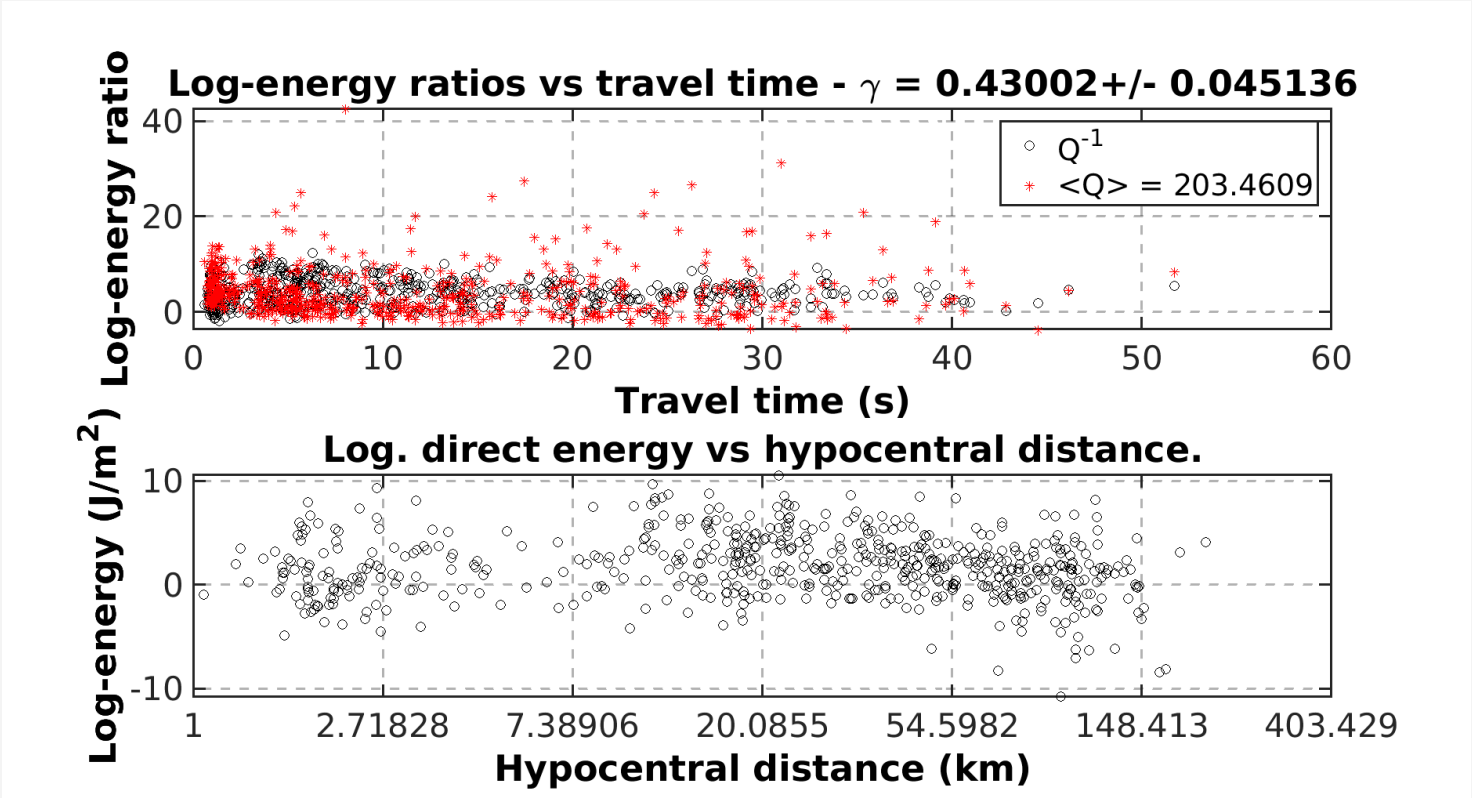
	6 Hz	12 Hz	summary of results:
YD catalog			inside small box: f: 18, 25 Q=27. f^ (0.66) region: f:3, 6, 9, 12 Q=24. f^ (0.9)
GD + RN Catalog			f:3, 6, 12, 18 Q = 37.6 f^ (0.79)
YD +GD + RN Catalog			f:3, 6, 9, 12 Q=56. f^ 0.99

3 Hz



It is evident from this plot that the slope of the energy ratio differs between the two databases, indicating possible varying attenuation mechanism or data quality.

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Possible reasons for inconsistencies at shorter hypocentral distances (<10 km) compared to larger distances include:

- Different attenuation mechanism, at shorter distance seismic energy may be dominated by scattering rather than intrinsic attenuation.

- Energy might be redistributed among different wave modes and frequencies but overall energy level remains relatively constant.

-Near source effects, such as source radiation pattern, local heterogeneities that impact the seismic energy distribution.

- Environmental noise might introduce biases or uncertainties effect that affect the observed log energy ratio at short distances.

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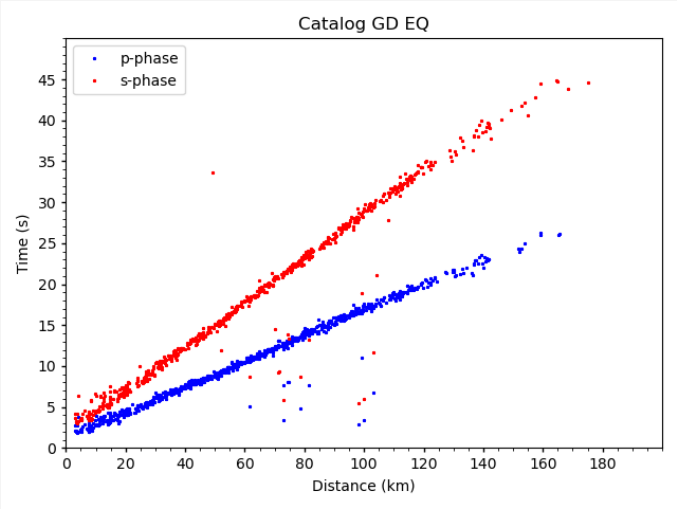
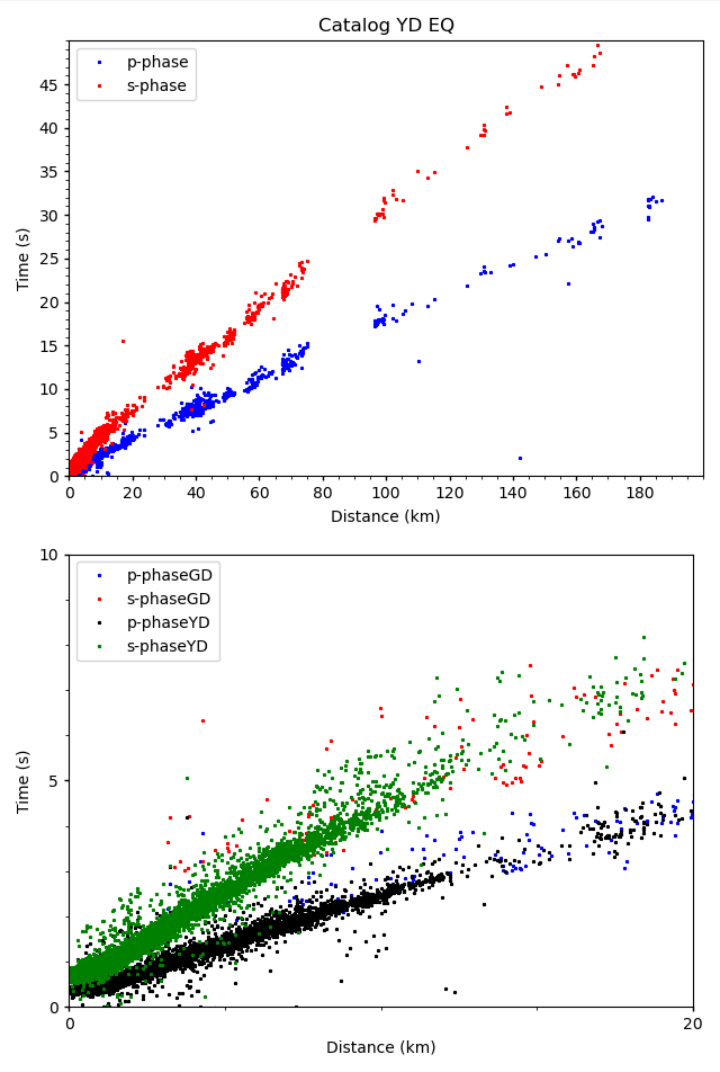
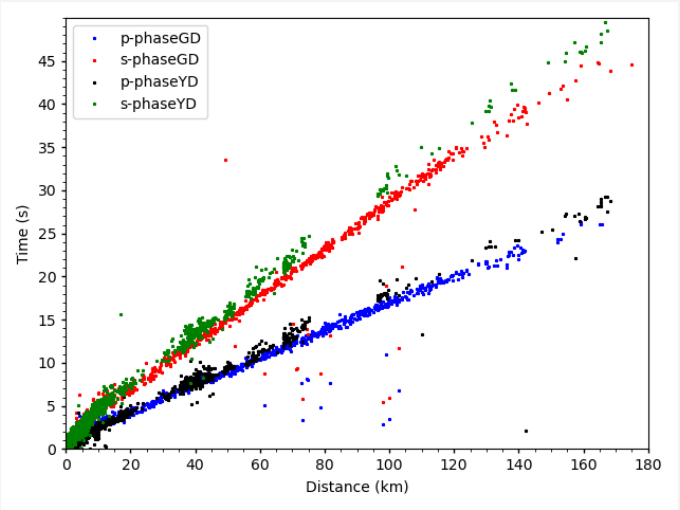
Plot showing P- and S- phase arrival data in two data bases.







1-2 second error in S- phase arrivals at shorter distances could cause problem in the processing.

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other remarks

- The data from our temporary network is collected. 06/2024: 01/2025

- The network is still operating.

- Using an automatic event detection algorithm (Heimann S (2017) Lassie, a friendly earthquake detector), some detections of weak or regional events are declared but they need to be revised to verify any earthquake.

- The detectability of events reported in YD catalog (ML > 1.5) are checked and only 3 of the events were visible on stations of the temporary network.