Local Earthquake Tomography

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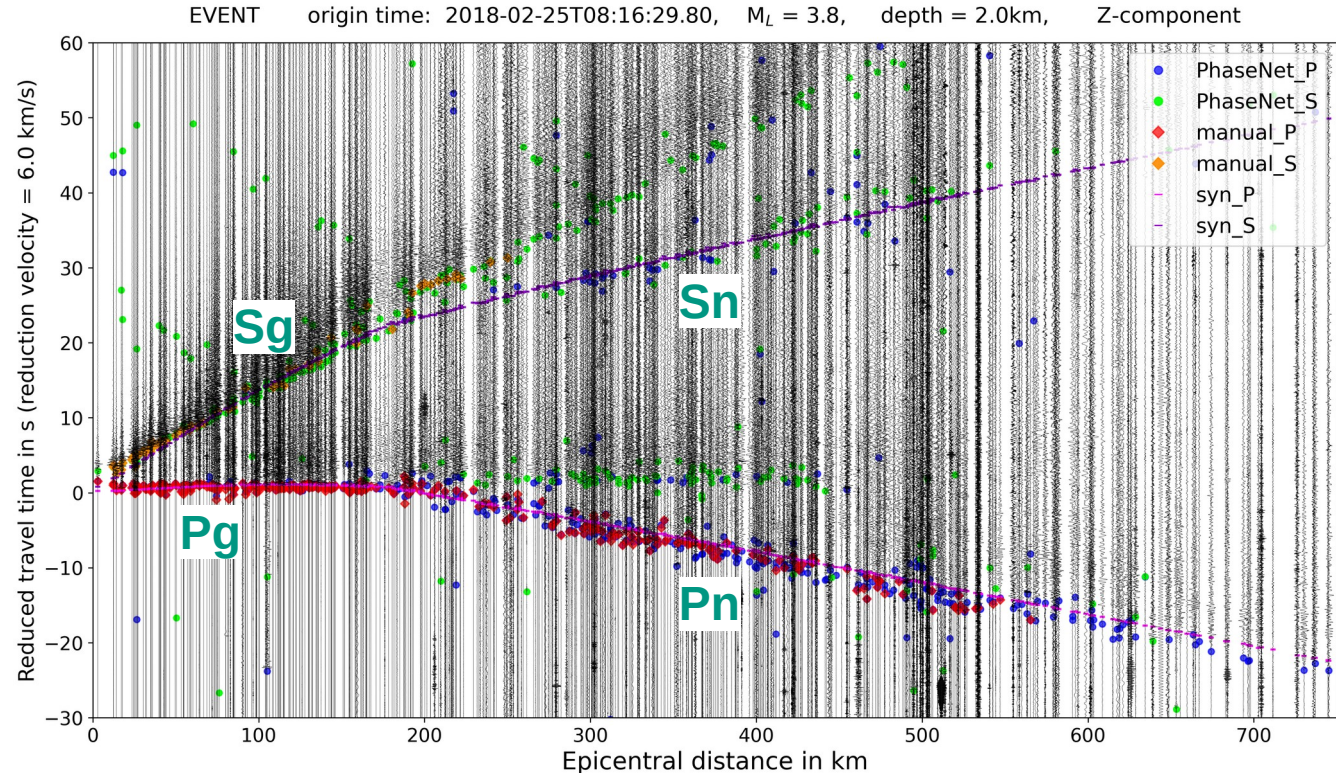
Goals:

- ✗ High resolution 3D P- & S-wave crustal velocity model for the Alpine region including crustal correction terms for the AASN

- ✗ Waveform data base with associated openly accessible arrival times for the AASN

- ✗ Precise earthquake event locations and associated uncertainties

EMSC Locations

Time period:
2015/01/01 - 2020/12/31
inter-event distance >5 km
events: 554
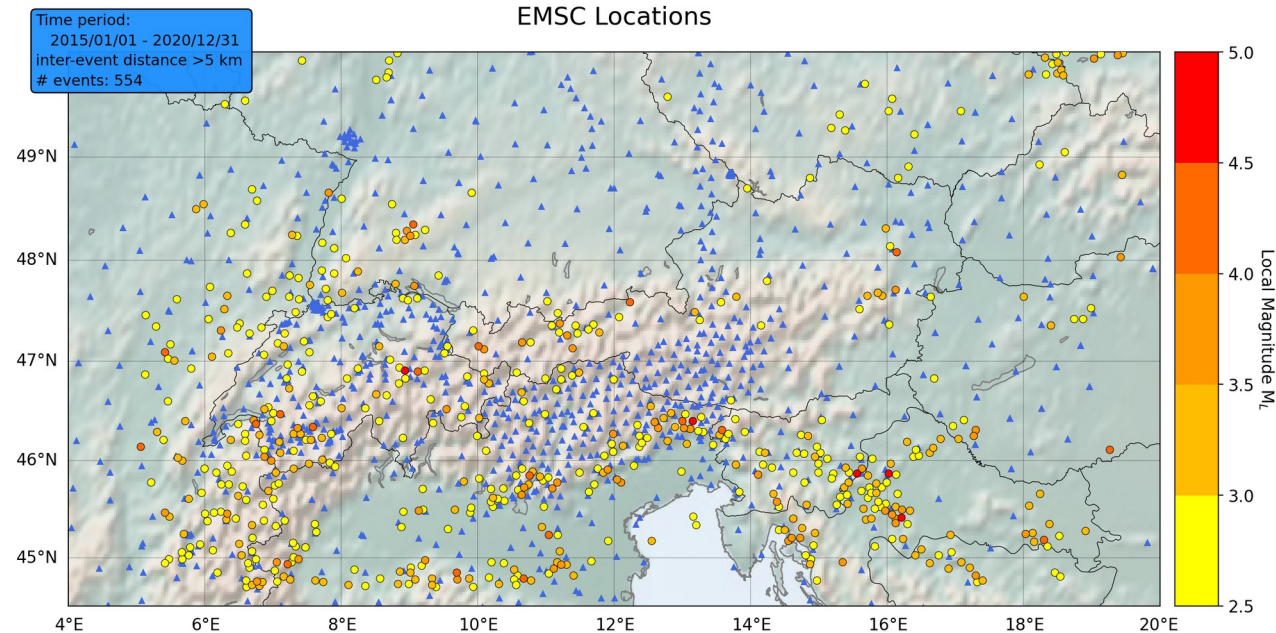
Methodology

- Determination of arrival times of crustal P- and S- phases with the deep-neural-network-based picking algorithm *PhaseNet* (*Zhu & Beroza, 2019*)
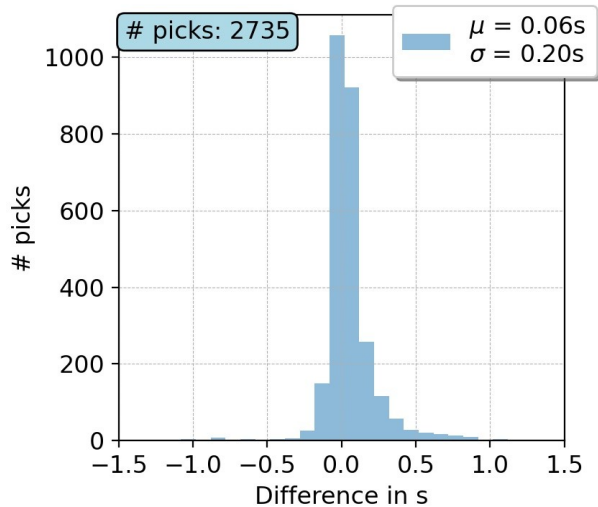
  - ➢ Pn-phase picked more consistently
    → additional distant picks
  - ➢ overcritical Pg often picked as S-phase & Sn often picked as P-phase

EVENT   origin time: 2018-02-25T08:16:29.80, M_L = 3.8,   depth = 2.0km,   Z-component
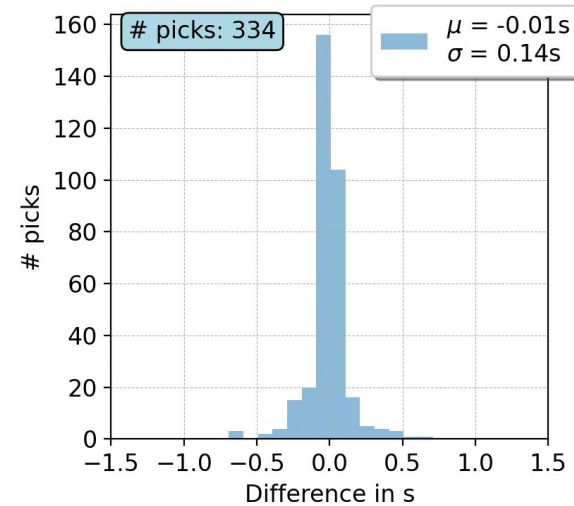
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Pick quality assessment

➢ PhaseNet's performance is almost as consistent with manual picks as these are within themselves

PhaseNet vs. human analyst

picks: 2735 $\mu = 0.06s$
$\sigma = 0.20s$

Two human analysts

picks: 334 $\mu = -0.01s$
$\sigma = 0.14s$

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Outlier removal

only direct Pg
(Δ = 0-130km)

min1D model

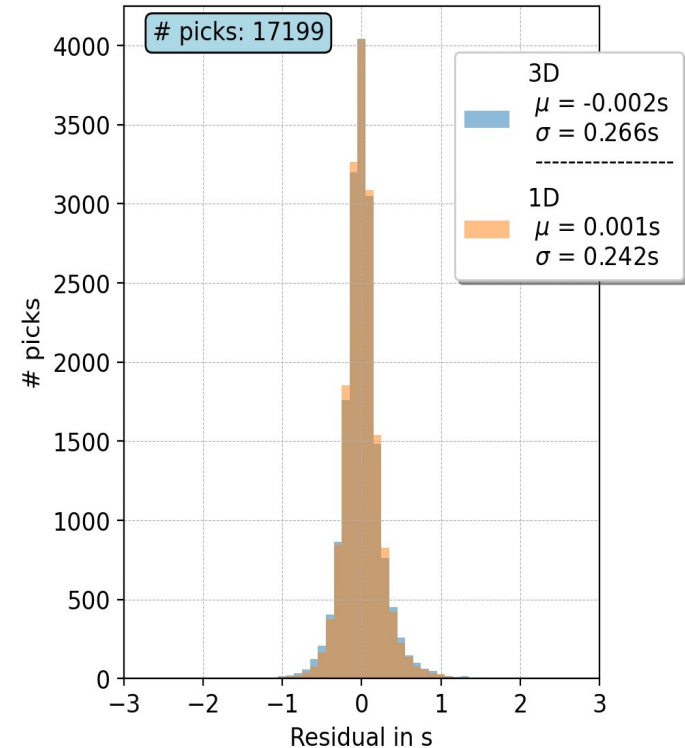- capturing average 1D velocity structure + station correction term

based on identical PhaseNet picks

coarse3D model

- capturing most prominent features of 3D velocity structure + station correction term

picks: 17199

3D
$\mu = -0.002s$
$\sigma = 0.266s$

1D
$\mu = 0.001s$
$\sigma = 0.242s$

picks

Residual in s

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Outlier removal

min1D model

- capturing average 1D velocity structure + station correction term

based on identical PhaseNet picks

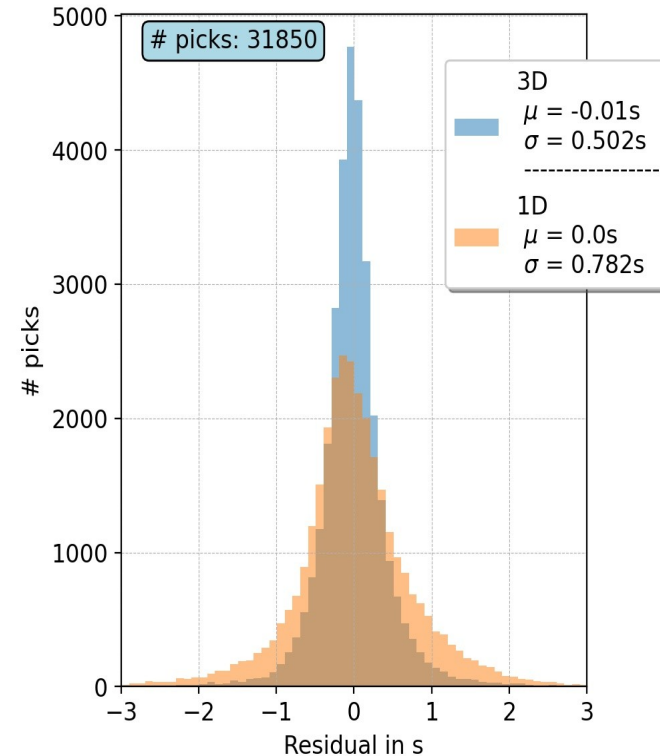## coarse3D model

- capturing most prominent features of 3D velocity structure + station correction term
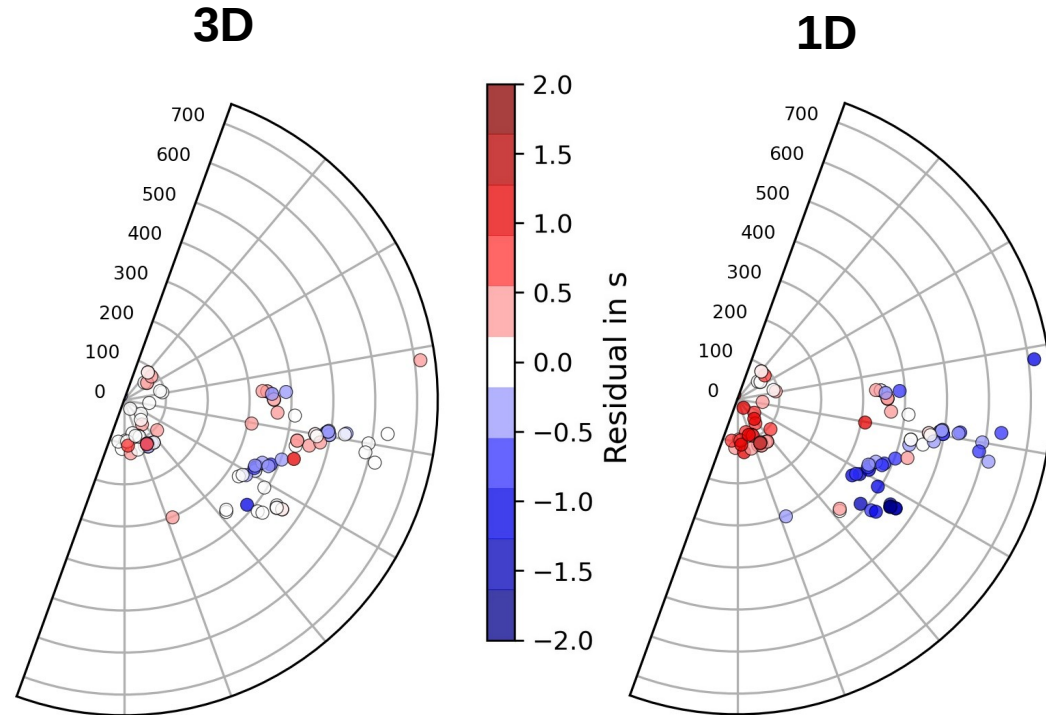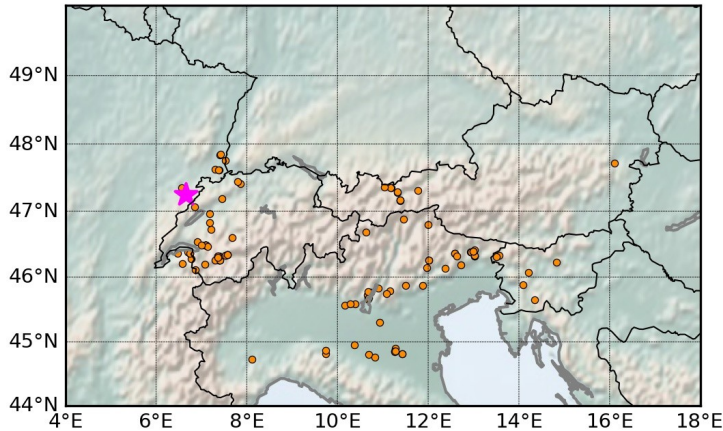
direct Pg & Pn
(Δ = 0-130km & 300-900km)

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Distance dependent residuals at single station

- no clear trend for 3D residuals
- two clusters for 1D residuals

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Backazimuth dependent residuals at single station

- no clear trend for 3D residuals
- two clusters for 1D residuals

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Conclusions

direct Pg & Pn
(Δ = 0-130km & 300-900km)
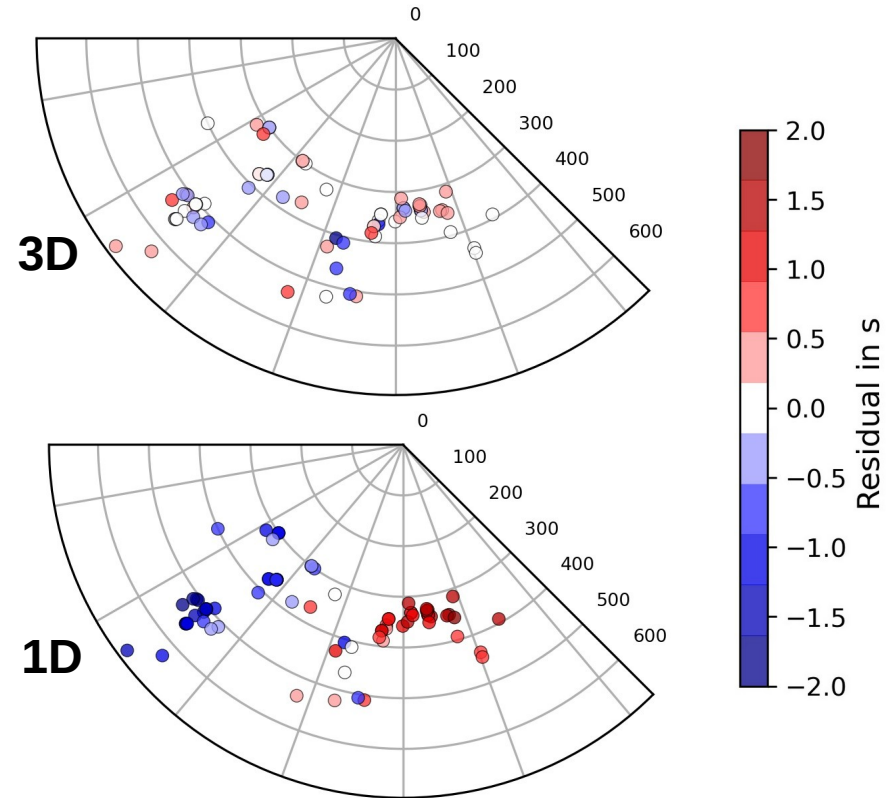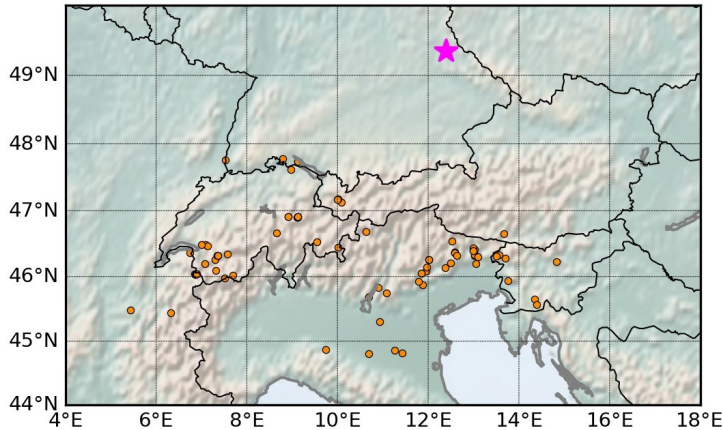
- **minimum 1D** model not representative anymore for large heterogeneous regions

- **coarse 3D** model yields significantly better synthetic travel times and is more suited to

  - remove outliers

  - avoid wrongly discarding valid picks

  - associate phases to picks in triplication zone of Pg, Pn & PmP