HELMHOLTZ AI | ARTIFICIAL INTELLIGENCE COOPERATION UNIT

Which picker fits my data?

A quantitative evaluation of deep learning based seismic pickers

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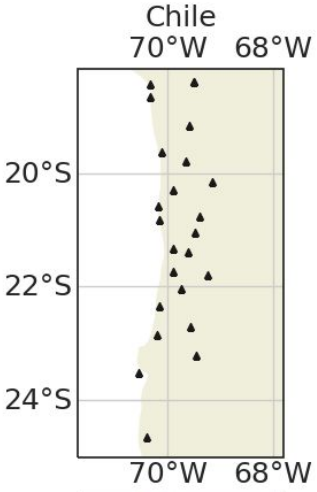
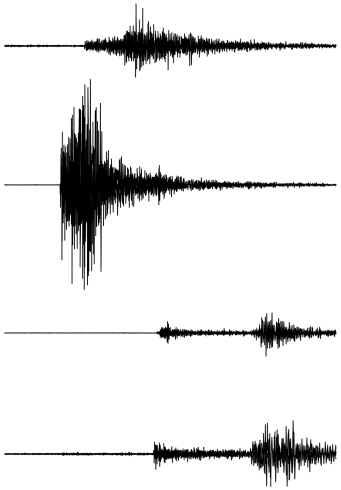
SeisBench
A toolbox for machine learning in seismology

Scenario: Generating picks for a catalog



Deployment



Waveforms

?

Picker

CX.PB01 - P - 05/03/2020 08:32:18.25
CX.PB01 - P - 05/03/2020 23:13:25.15
CX.PB03 - P - 05/04/2020 02:04:13.06
CX.PB03 - S - 05/03/2020 07:11:00.34
CX.PB04 - S - 05/03/2020 06:21:02.80
CX.PB05 - P - 05/03/2020 00:04:54.92
CX.PB05 - P - 05/03/2020 18:18:09.22
CX.PB09 - P - 05/03/2020 07:20:52.22
CX.PB09 - S - 05/04/2020 02:05:47.15
CX.PB10 - P - 05/03/2020 03:05:51.78
CX.PB10 - S - 05/03/2020 04:07:56.46
CX.PB11 - P - 05/03/2020 15:12:12.04
CX.PB13 - S - 05/03/2020 14:25:10.21
CX.PB14 - P - 05/03/2020 10:42:53.93
CX.PB14 - P - 05/04/2020 02:01:51.19

Phase arrivals

Which picker fits my data?

SeisBench

A toolbox for machine learning in seismology

- open-source, python toolbox for ML in seismology
- containing datasets, models, and training pipelines
- aimed at model developers and practitioners

SeisBench paper
https://doi.org/10.1785/0220210324

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Benchmark models

- **BasicPhaseAE** (Woollam et al., 2019)
- **CRED** - Convolutional Recurrent Earthquake Detector (Mousavi et al., 2019)
- **DPP** - DeepPhasePick (Soto & Schurr, 2021)
- **EQTranformer** (Mousavi et al., 2020)
- **GPD** - Generalized Phase Detection (Ross et al. 2018)
- **PhaseNet** (Zhu & Beroza, 2019)

Benchmark datasets

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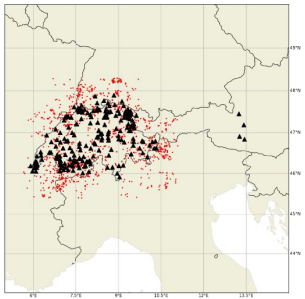
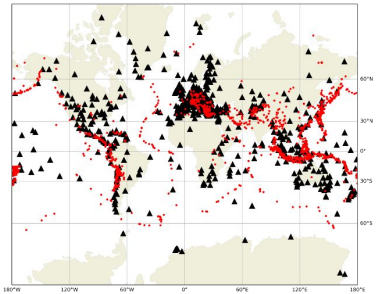
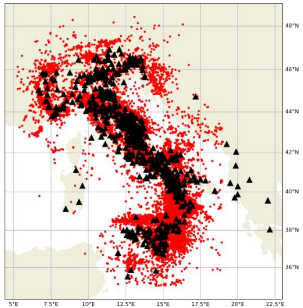
ETHZ



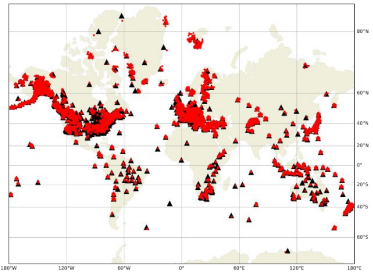
GEOFON



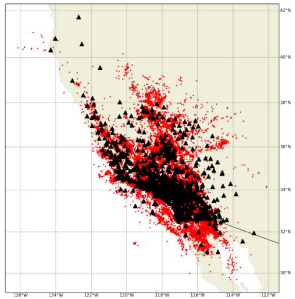
INSTANCE



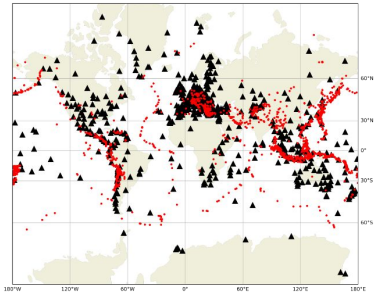
LENDB



SCEDC



STEAD



Further:

- NEIC
- Iquique

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Task 1: Event detection

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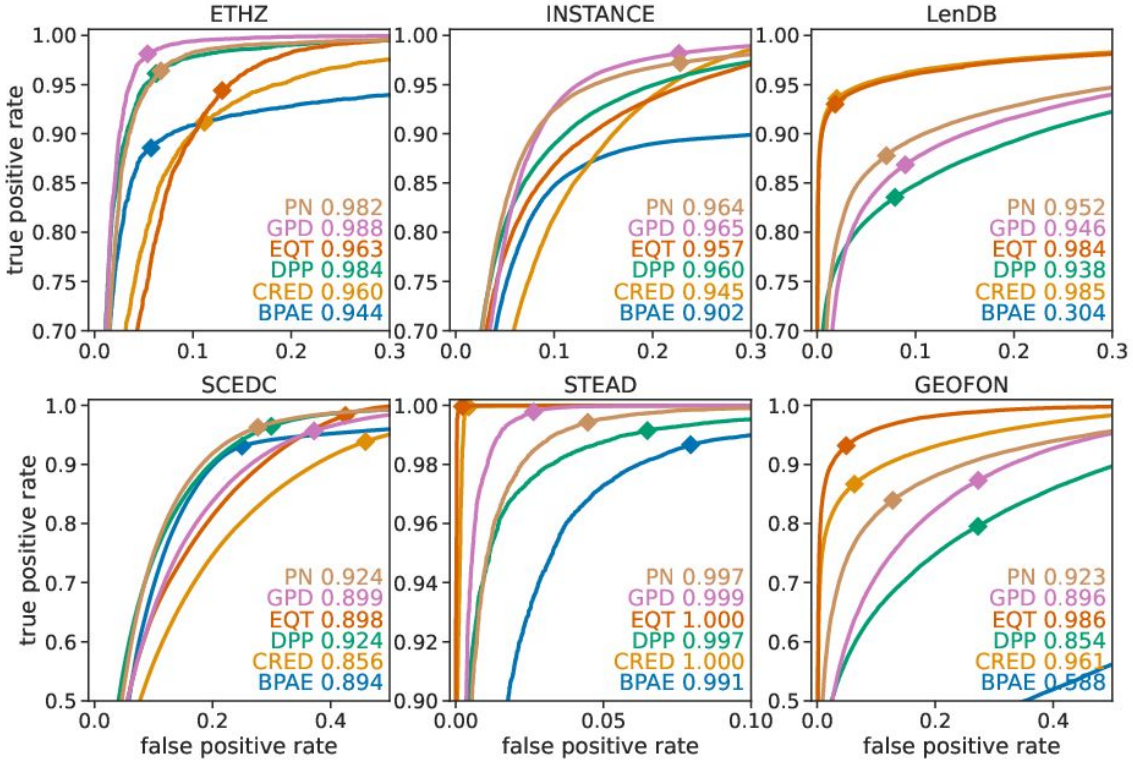

Task 3: Onset time determination - P waves

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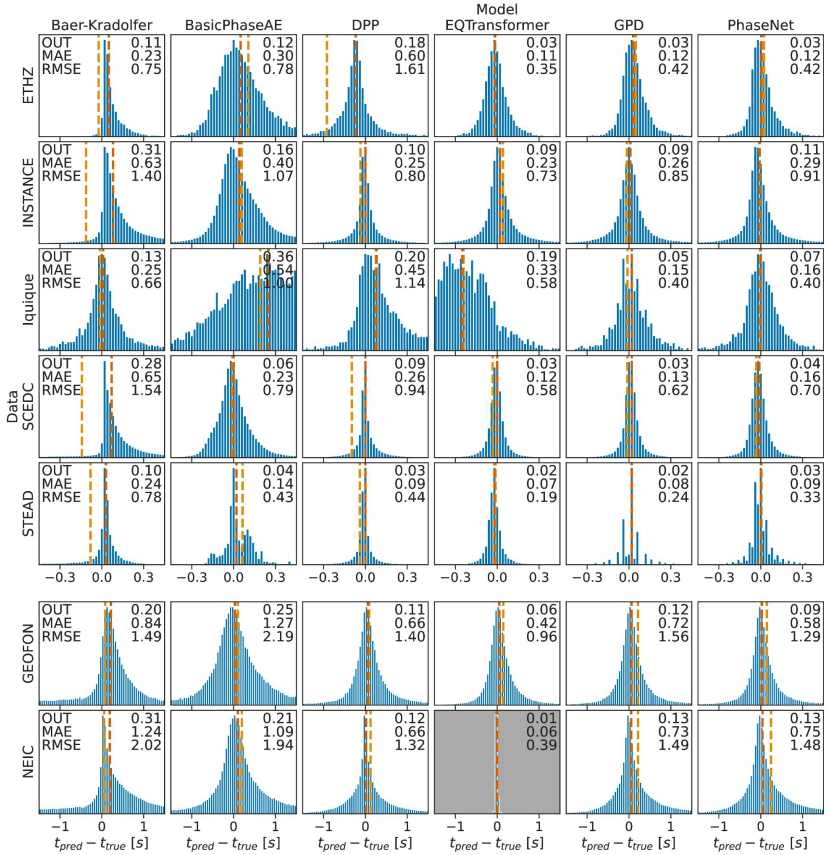
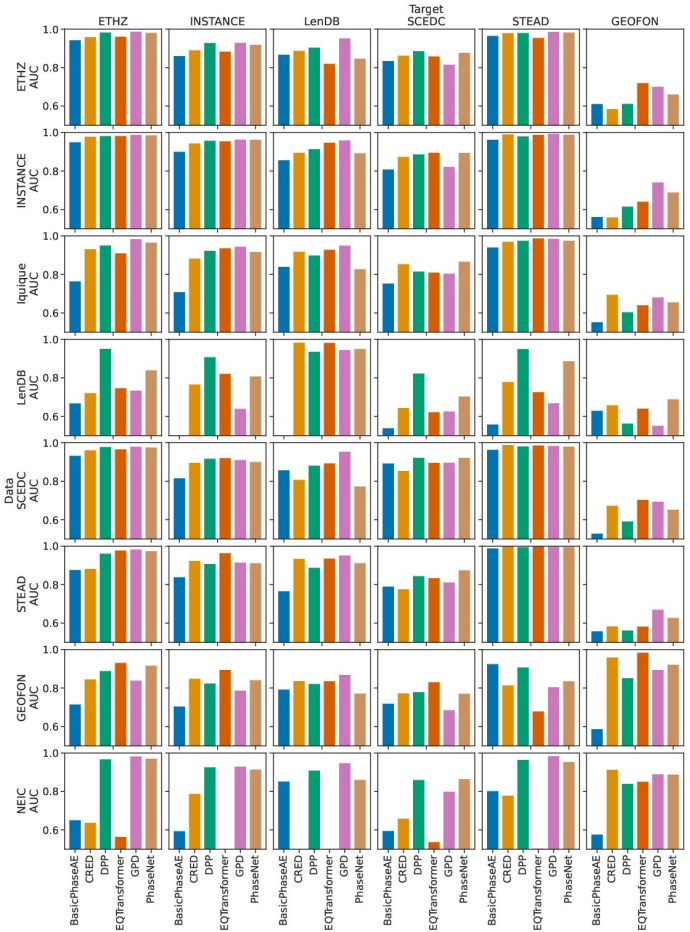


How to choose a picker if there is no training data

Detection
(cross domain)



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Conclusion

- We conducted a large scale benchmark of seismic pickers with SeisBench.
- Overall, GPD, PhaseNet and EQTransformer showed the best performance.
- Models transfer well within the same distance range, but badly across distance ranges.

SeisBench paper
https://doi.org/10.1785/0220210324

Benchmark paper
https://doi.org/10.1029/2021jb023499