Machine Learning aids rapid assessment of aftershocks: Application to the 2022-2023 Peace River earthquake sequence, Alberta, Canada

Jinji Li*, Jes´us Rojas-Parra, Rebecca O. Salvage, David W. Eaton, Kristopher A. Innanen, Yu Jeffrey Gu, and Wenhan Sun
li.jinji@ucalgary.ca

ABSTRACT

The integration of machine learning (ML) models has ignited a paradigm shift in seismic analysis, fostering enhanced efficiency in capturing patterns of seismic activity with reduced need for time-consuming user interaction. Here, we investigate automated event detection and extraction of seismic phases using two widely used ML models, EQTransformer and PhaseNet. We applied both models to four weeks of continuous recordings of aftershocks using a temporary array following the November 30, 2022 M_L 5.6 earthquake near Peace River, Alberta, Canada. Both tools identified >1000 events over the recording period. The aftershocks are located in close proximity and depth to the M_L 5.6 mainshock, as well as to disposal operations that were ongoing at the time. Although there are some differences in the temporal and spatial evolution of the detected events by each model, both sets of detections reveal similar patterns of the aftershock distribution that were not identified by the regional network. Our results highlight the advantages of using ML models for rapid detection and assessment of seismicity following felt events, which is important for assessing hazard potential and risk in near real time.

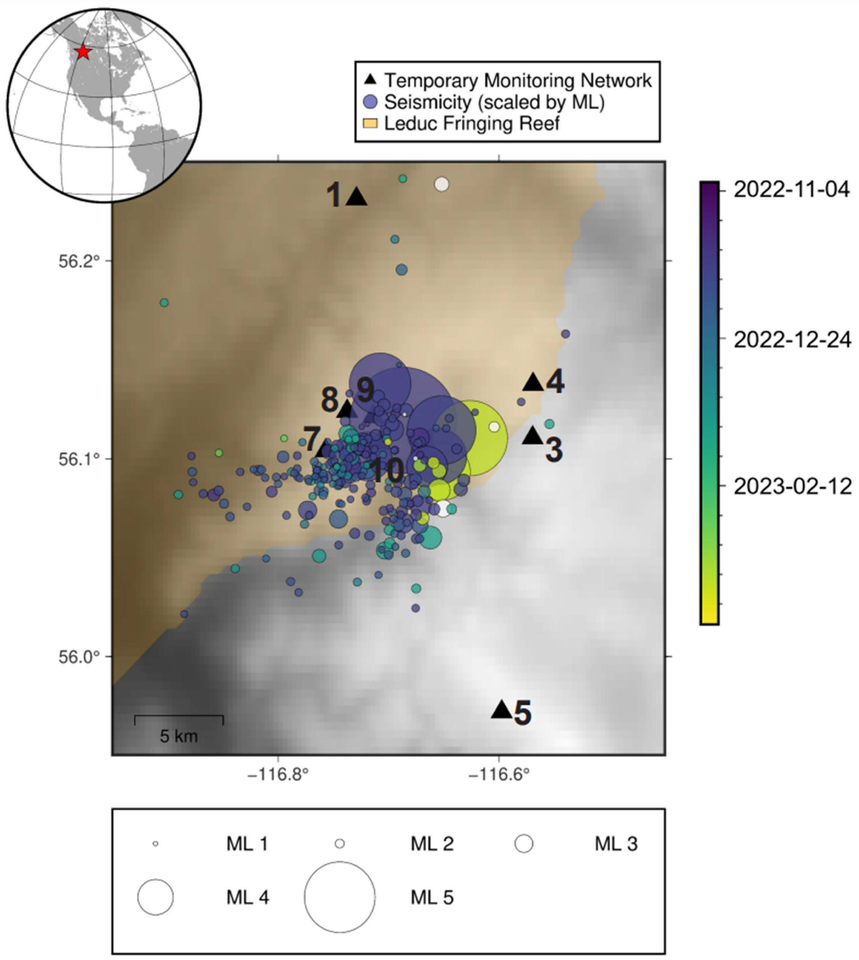

Figure 1. Site location and station deployment.

WAVEFORM APPEARANCE

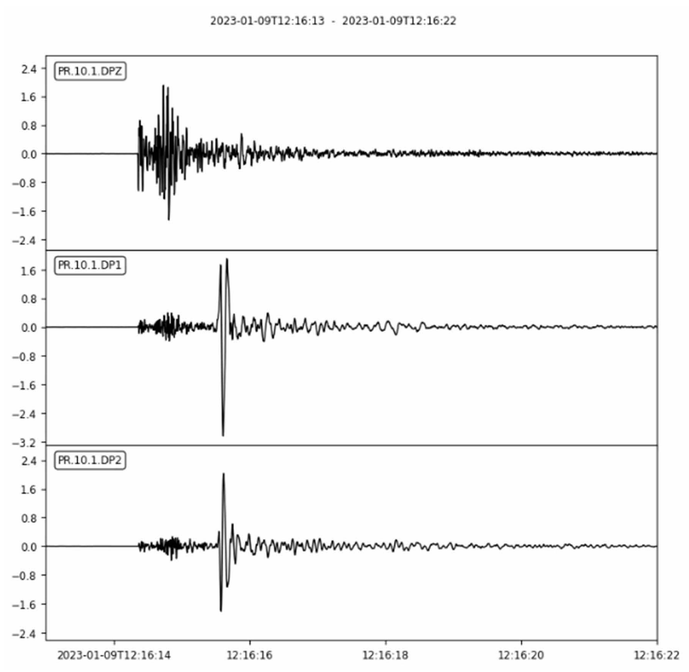

Figure 2. Waveform recorded by station 10 on Jan 9, 2023.

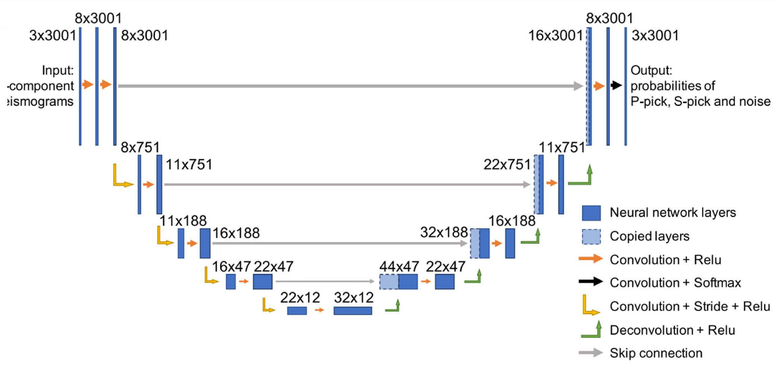

Figure 3. PhaseNet structure (Zhu et al., 2019).

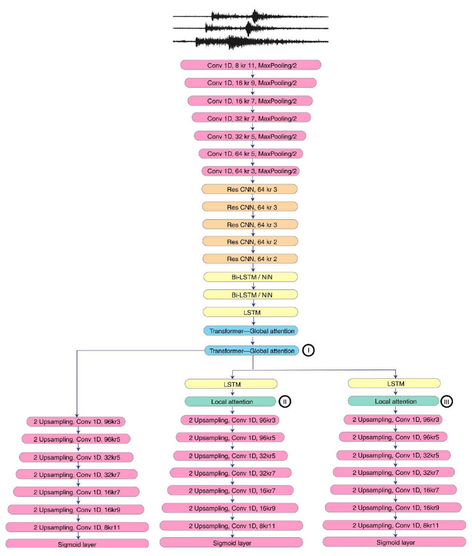

Figure 4. EQTransformer structure (Mousavi et al., 2020).

TRAINING DATASET

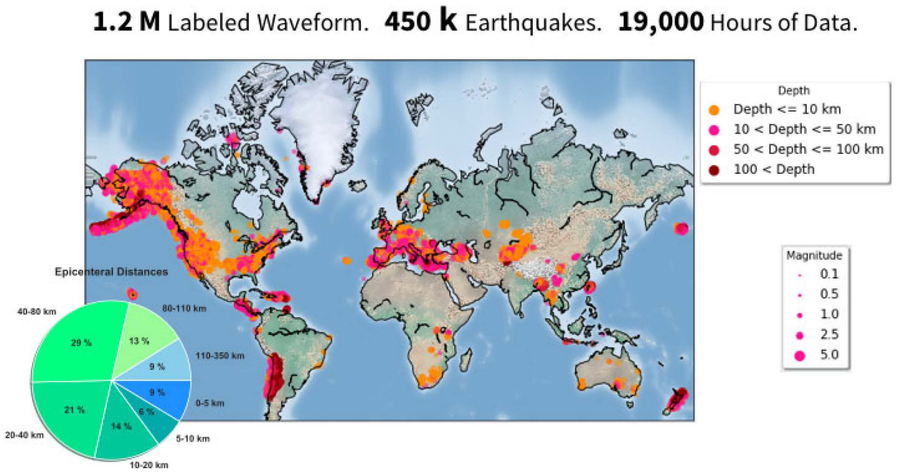

Figure 5. STEAD dataset (Mousavi et al., 2019).

RESULTS

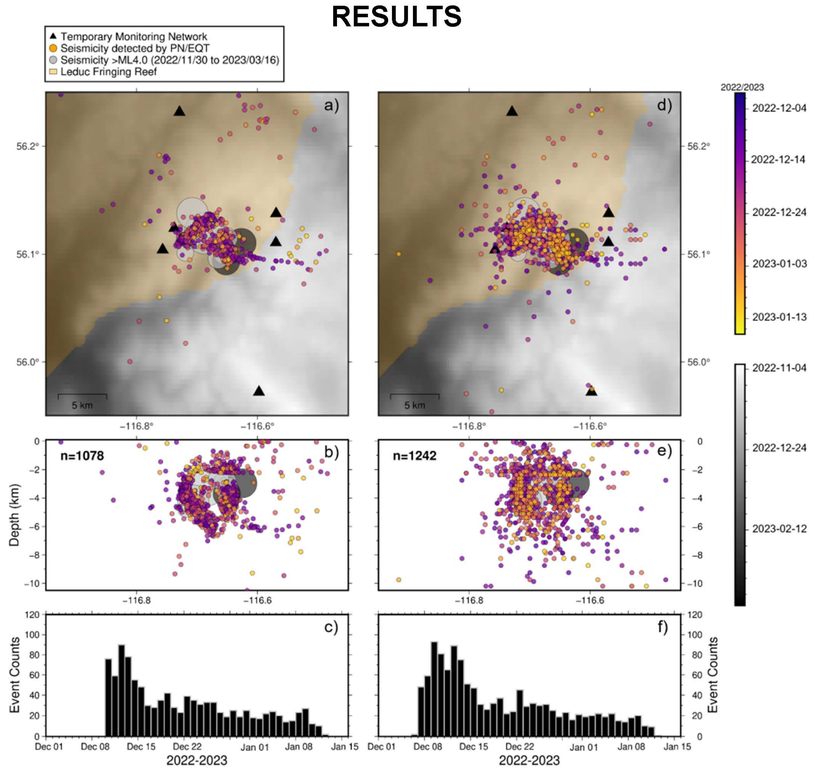

Figure 6. Seismicity associated with the Peace River earthquake sequence for the period December 7, 2022 to January 13, 2023. The left panel contains results from PhaseNet, and the right panel contains the results from EQTransformer.

ACKNOWLEDGEMENTS

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