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Application of Machine Learning techniques for detection of earthquake events in Jalisco (Western Mexico).

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1. Introduction.

For assessing performance at RESJAL (Jalisco's Seismic Network) we applied machine learning (ML) based methodologies in western Mexico, where the Rivera, Cocos and North American plates interaction constitute a very active seismic zone.

2. Data & Methodology.

We used *SeisBench* (Woollam et al., 2021) to apply the *EQTransformer* (Mousavi et al., 2020) for phase classification and event detection (Fig.1) and *GaMMA* (W. Zhu et al., 2021) for events association, earthquake location and origin time estimates.

Three component and 100 sps data (from May, 2022), was obtained from a shared local/regional network (Fig.2) with broadband and short period instruments from RESJAL, RESCO and SSN monitoring institutions.

3. Results.

Within a 5s window and minimum of 5 picks, *EQT + GaMMA* (Fig.3) can easily recover a large number (~71%) of events reported in SSN's catalog, which we consider our "ground truth" and benchmark. Almost all *RESJAL* events (~93%) were recovered and a considerable amount of new events were detected (~110).

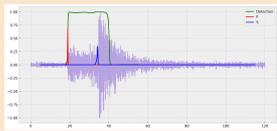


Fig. 1. Event detection in a local waveform given by EQT.

Pre-trained models and ML association tools achieve great performance on the early task of earthquake detection for Western Mexico.

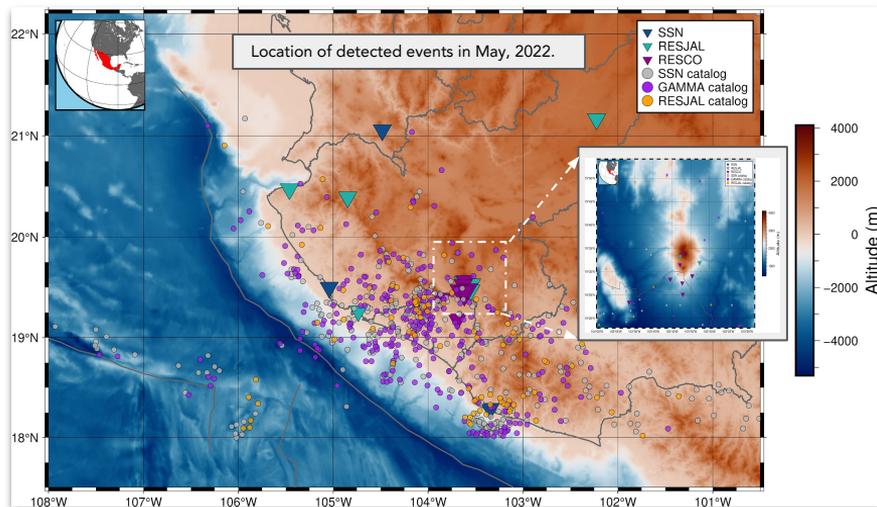


Fig. 2. (top) location comparison for earthquake events and (bottom) distribution by lat and lon for each catalog.

More results.

A minimum of 5 picks is chosen for association. The assignments can be used to visualize the stations that recorded the associated earthquake (Fig 3.)

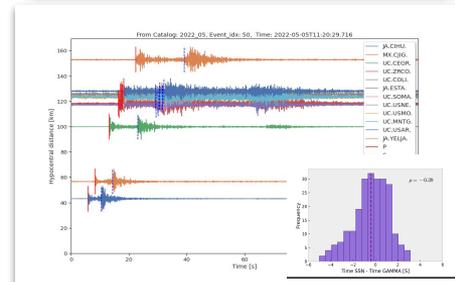


Fig. 3. Association result as given by *GaMMA* and (bottom right) distribution of time residuals for catalog comparison.

4. Discussion & Conclusions.

Although RESJAL is a growing local seismic network who has support from a national network (SSN) and another neighbour (local) monitoring effort (RESCO), it has been detecting too few events (fig.4). *GaMMA+EQT* have outperformed the classical approach using the same data (although the current real-time monitoring system can be much better configured to avoid *fake* events). ML-based real-time monitoring tools need to be implemented next.

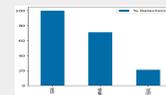


Fig. 4. % of detected events when compared to SSN.

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