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Semi-supervised seismic event detection using Siamese Networks

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Detecting seismic events and their precursors is vital to understand and assess risks in areas of seismic instability. Most recent detection methods are based on supervised learning, where machine learning models are first trained using a labelled dataset, before being deployed. However, seismic sensors are often difficult to install and maintain, and large-scale events are few and far between. Furthermore, labelling collected data requires a great deal of time and effort from seismologists. Noise can vastly increase the difficulty of this task and labels can be highly subjective. Labelled data used for training machine learning models depends on the monitoring setup and geological characteristics of the terrain where the sensors are installed. For example, a dataset of events recorded in the Alps will likely not be representative of events that could be seen in less mountainous regions, meaning that transferability of proposed networks is vital. The Rest and Be Thankful in Scotland is a remote hillside prone to weather-induced seismic events which can cause disruption to the road infrastructure in the valley below, after rockfalls and landslides due to quakes. In this paper we propose a semi-supervised method of clustering these different types of events. Grouping data into categories of both known and unknown event types can reduce the time needed by experts to create labelled datasets via the use of Siamese networks and further understand the dynamics of the slope. We validate results against the BGS earthquake database from within a 50km radius, as well as human induced rockfalls. Grouping across around 100 days of data has detected a possible 10 earthquakes, 82 rockfalls, and 137 micro-quakes.