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Micro seismic event detection based on neural networks in the Groningen area, The Netherlands

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Over the past decades, the Groningen gas field has been increasingly faced by induced earthquakes resulting from gas production. The seismic monitoring network at Groningen has been densified in order to acquire more accurate information regarding the onset and origin of seismic events, resulting in increasing amounts of seismic data. Although traditional automated event detection techniques generally are successful in detecting events from continuous data, its detection success is challenged in cases of lower signal-to-noise ratios and often limited availability of seismologists. Besides the recent expansion of the Groningen seismic network, additional new seismic networks have been deployed at several geothermal and CO_2 storage fields. The data stream coming from these networks has sparked specific interest in neural networks for automated classification and interpretation.

Here we explore the feasibility of neural networks in classifying the occurrence of seismic events. For this purpose a three-layered feedforward neural network was trained using public data related to a seismic event in the Groningen gas field obtained from the Royal Netherlands Meteorological Institute (KNMI) data portal. The first arrival times that were determined by KNMI for a subset of the station data were used to determine the arrival times for the other station data. Different derivatives, using different frequency sub-band and STA/LTA settings, were used as input. Based on these data, the network's parameters were then optimized to predict arrival times accurately. Although this study is still ongoing, we anticipate our approach can significantly increase the performance as compared to detection methods usually applied to the Groningen gas field. This will clear the way for future real-time micro seismic event classification.