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Predicting laboratory earthquakes using machine learning

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The successful prediction of earthquakes is one of the holy grails in Earth Sciences. Traditional predictions use statistical information on recurrence intervals, but those predictions are not accurate enough. In a recent paper, a machine learning approach was proposed and applied to data of laboratory earthquakes. The machine learning algorithm utilizes continuous measurements of radiated energy through acoustic emissions and the authors were able to successfully predict the timing of laboratory earthquakes. Here, we reproduced their model which was applied to a gouge layer of glass beads and applied it to a data set obtained using a gouge layer of salt. In this salt experiment different load point velocities were set, leading to variable recurrence times. The machine learning technique we use is called random forest and uses the acoustic emissions during the interseismic period. The random forest model succeeds in making a relatively reliable prediction for both materials, also long before the earthquake. Apparently there is information in the data on the timing of the next earthquake throughout the experiment. For glass beads energy is gradually and increasingly released whereas for salt energy is only released during precursor activity, therefore the important features used in the prediction are different. We interpret the difference in results to be due to the different micromechanics of slip. The research shows that a machine learning approach can reveal the presence of information in the data on the timing of unstable slip events (earthquakes). Further research is needed to identify the responsible micromechanical processes which might be then be used to extrapolate to natural conditions.