Machine Learning applied to Greenland seismic signals

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Since the 2000s, global warming has been highlighted by many scientific proofs and the consequences start to be clearly identified. The acceleration of the Arctic's icecap melting is one of its major consequences and it generates more and more icebergs every year. This previously unseen situation leads us to understand quickly what are the mechanisms linked to the melting induced by polar glaciers dynamics. To answer that, Seismology is an excellent tool as it allows to describe sources from long distance and to create an exhaustive catalogue of events. In polar region, seismic activity was first detected in the 90s. Glaciers dynamics can be generated by different seismic sources type like basal slip, iceberg collision in the terminus, surface crevasse collapses and opening for instance. We focus on some of these events, mentioned as Glacial Earthquakes or Icequakes, which can generate seismic signal that can be recorded at distances of hundreds of km and are generally due to major iceberg calving (km scale). However, we must deal with more and more data to understand all these dynamics. Here we show how Machine Learning can help to classify seismic signals sources and build instrumental catalogues of ice-calving event in Greenland. We use these signals characteristics (amplitude, time, energy of the auto-correlation function, etc.) to create features for a machine learning algorithm. We choose to work with the Random Forest algorithm that we trained with the 1993-2013 catalogue of the GLISN network : it gathers a lot of important events that occurred in Greenland which were recorded by the regional stations. For the validation part of the algorithm, we confront Icequakes signals with Earthquakes signals and we assess the precision and the robustness of the algorithm for different training configuration. The new exhaustive catalogue will allow a better understanding of the chronology of ice-calving events over a long time period. Mechanical modelling will be performed to try to retrieve the physical properties of the sources of most of the event in the catalogue. The combined detection and characterization of those events might help to understand better the mechanism favouring Arctic icecap melting.

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