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Constructing a New Catalogue of Greenland's Iceberg Calving Events through Seismic Data Analysis and Machine Learning

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The Greenland ice sheet, a critical component of the global climate system, has played a substantial role in rising sea level. Understanding the spatio-temporal changes in Greenland's ice mass loss resulting from iceberg calving is crucial for comprehending the impacts of climate change.

The mass loss related to calving icebergs can be estimated by combining mechanical simulation of iceberg calving and inversion of seismic data. Seismic signals are generated by the time-varying force produced during iceberg calving on marine-terminating glacier termini and known as glacial earthquakes.

However, differentiating these signals from tectonic events, anthropogenic noise, and other natural noise is challenging due to their complex frequency content (1-100s), multi-phase waveforms and low amplitude. To overcome this difficulty, we use a detection algorithm based on the Short-Time Average over Long-Time Average (STA/LTA) method and combine it with machine learning (Random Forests). Applying this methodology to continuous data offers the possibility to uncover smaller and previously undetected events. As a result, we present a comprehensive catalogue spanning several years and discuss its relevance and reliability. The generated catalogue allows us to develop new methods to better understand the spatio-temporal evolution of the ice-calving activity. Among these, we will initially focus on locating and inverting the force of the largest events, providing a basis for testing new machine learning approaches for the characterisation of the source. This includes extracting properties like the iceberg volume and shape from both large and smaller events, ultimately advancing our understanding of Greenland's ice mass loss dynamics.

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