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Global observations of an up to 9 day long, recurring, monochromatic seismic source near 10.9 mHz associated with tsunamigenic landslides in a Northeast Greenland fjord

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We report the discovery of an unprecedented, monochromatic low-frequency seismic source arising from the fjords of North-East Greenland. Following a landslide and tsunami event in Dickson fjord on 16 September 2023, the seismic waves were detected by broad-band seismometers worldwide. Here we focus on a detailed analysis of the long-period seismic signal, while a reconstruction of the dynamics of the landslide is presented by Svennevig et al. in session NH3.5.

Both frequency and phase velocity of the waves are consistent with fundamental mode Rayleigh- and Love-waves. However, the decay rate of these waves is much slower than predicted for freely propagating surface waves so that we infer a long-lasting and slowly decaying source process. Although the 16 September 2023 event was by far the largest, analysis of historical seismic data has revealed five other previously undetected events, all with a fundamental frequency between

10.85 and 11.02 mHz. The signal of the largest two events initially decayed with a quality factor, *Q* close to Q=500, which increased to Q=3000 within the first 10 hours and could thus be detected for up to nine days. The smaller four events had a slow decay-rate (Q>1000) for their entire duration. In comparison, the global average attenuation of Rayleigh waves at these frequencies is Q=117 for PREM, thus precluding a single, impulsive source for these signals.

Gleaning archives of optical and SAR satellite images reveals that at least four out of six events could be associated with landslides in Dickson fjord, the two others remain unresolved. However, such rapid transient events cannot explain the long duration of the radiated seismic waves. Our modelling of the largest event shows that a transversal seiche in Dickson fjord, excited by a landslide induced tsunami, can account for both the monochromatic low frequency signal as well as its seismic signal amplitude and radiation pattern. However, the seiche modelling results in Q values lower than 250 and hence the seiche needs to be continuously driven for the entire duration of the observed seismic signal. Thus, a full understanding of the source process that produces the monochromatic signal remains enigmatic.

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