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Seismic waveform modeling for a structural model with the Greenland ice sheet

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We calculate regional synthetic seismograms for a realistic structure model beneath Greenland, including both surface topography and ice sheet thickness. In 2009, the multinational GreenLand Ice Sheet monitoring Network (GLISN) was initiated to monitor seismic events in and around the Greenland. Japan has been sending a field team to Greenland each year since 2011, to construct and maintain the GLISN stations especially on ice. However, the thick and heterogeneous Greenland ice sheet is considered to cause various kinds of distortion on seismic waveforms observed at these ice stations. We have been working for construction of a numerical technique, which can calculate accurate regional seismic wavefields with small computational requirements.

In this work, we calculate elastic wave propagation up to 2 Hz for four structural models of the Greenland ice sheet radiated from a seismic source with various depths and mechanisms. Our computations for a realistic ice sheet model, the near-surface seismic source produced a very characteristic wave train with the group velocity smaller than the S-wavespeed in the ice, which is considered as an icesheet guided S wave, developed by a superposition of post-critical reflections between the free surface and the ice bed. We named this wave "Le" on the analogy of the Lg wave, a crustally guided S wave ("e" comes from the German word "Eisdecke", meaning the ice sheet). Furthermore, computation for a deeper seismic source resulted in reinforcement of the crustal Sg-coda wave with a group velocity range of ˜3.1-2.6 km/s, which well explains the characteristic waveform observed on the Greenland ice sheet.

Keywords: Greenland ice sheet, Seismic waveform, Guided wave, Finite-difference method (FDM), GLISN project