Seismological constraints on glacial processes

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Seismological observations of Earth structure provide valuable information about the shallow and deep properties of the Earth that influence glacier and ice-sheet behavior, and analysis of glaciogenic seismic sources contributes to understanding of the physical processes controlling glacier dynamics. Recent observations and modelling by multiple authors highlight the importance of interactions within the hydrosphere-cryosphere-solid Earth system. The elastic properties, temperature, and heat flux in the crust and lithosphere affect the state and strength of ice, exerting an important control on ice-sheet behavior. In turn, seasonal loading and unloading may affect the speed at which seismic waves propagate in the near-surface region. Within the ice, the presence and evolution of liquid-water aquifers can be mapped seismically; the effect of this water on ice dynamics remains largely unknown. Ice-ocean interactions at tidewater calving margins lead to glacial earthquakes, in which part of the seismologically observed signal is generated by the acceleration of gigaton-scale icebergs and part by the hydrodynamic response of fjord water. The ice loss alters the strain state in the glacier and may affect the hydrological system. I will discuss a variety of recent observations, and the ways in which seismology can complement other geophysical approaches in improving understanding of the hydrosphere-cryosphere-solid Earth system.