Glacier Seismology (Walter)

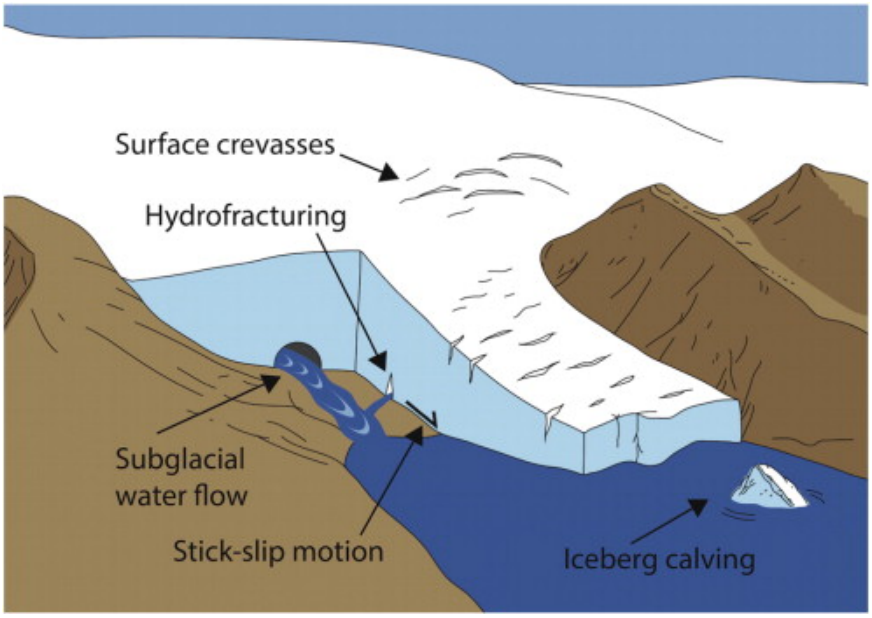

Figure 1: Cartoon of seismogenic processes in glacial environments. Reproduced from Larose et al. (2015).

Glacier seismology is a young but rapidly evolving discipline. With the advent of robust, cheaper and more portable seismic instrumentation it is now possible to install sensors near and on glacial ice. The seismic wave field is rich at a spectrum between hundreds of seconds and hundreds of Hertz and provides insights into various ice dynamic processes (Figure 1), which are difficult or impossible to study with conventional techniques. The recently published **review article by Podolskiy and Walter (2016)** presents an overview about glacier seismology.

ETH's Glacier Seismology Group conducts research in several disciplines. Microseismic sources near glacier beds are an important emphasis. In certain cases, these sources are manifestations of sudden ice sliding episodes, often referred to as stick-slip motion. The glacier seismology group investigates stick-slip "icequakes" (Figure 2) to clarify their role in overall glacier motion. Although not all glacial deployments of seismometers have revealed the presence of stick-slip icequakes, there exists evidence for them in Antarctica, Greenland and various mountain glaciers around the world. Investigating the subglacial environment of glaciers and ice sheets also involves the

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Links

Glaciology at WSL
Our group at the Swiss Federal Institute for Forest, Snow and Landscape Research **WSL**.

Open Bachelor- and Master Theses
Student theses open in our group.

Glaciological Seminars
A series of talks given by international experts.

Work-In-Progress Talks
A series of internal, technical talks (Fachgespräche).

Glacier Monitoring in Switzerland (GLAMOS)
The Swiss glacier monitoring network.

hydraulic drainage system. In this context, seismological measurements of water tremor have been a valuable analysis tool.

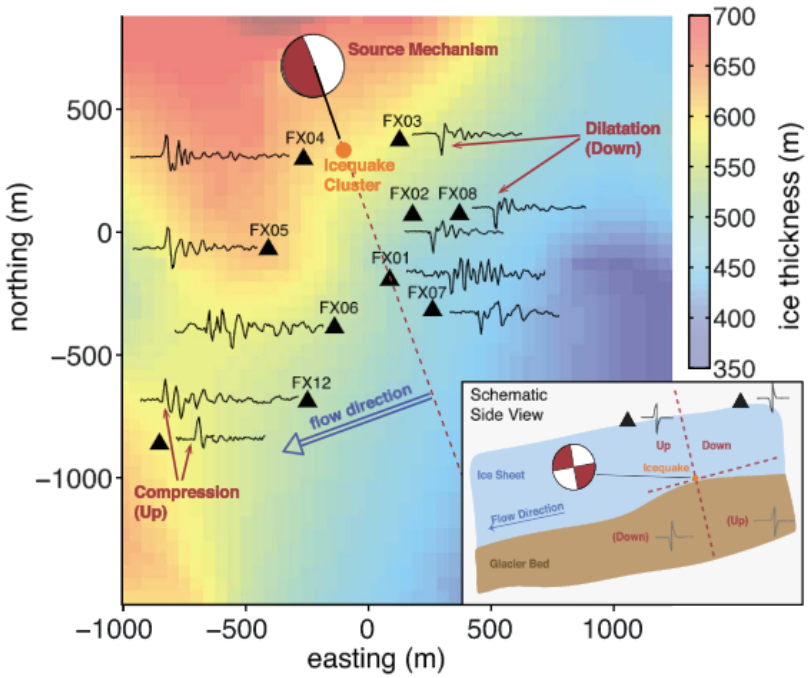

Figure 2: Seismic network (triangles) installed during summer 2011 on the Greenland ice sheet. Ice thickness is color coded in the background. Stick-slip seismograms at different stations, ice flow direction and seismic focal mechanism of one event are shown. Reproduced from Roeoesli et al. (2016).

Perhaps the most prominent subject of glacier seismology is that of iceberg calving. Seismologically speaking, the detachment of icebergs is a very "loud" process (Figure 3). At high frequencies (>1 Hz), iceberg calving can be detected and studied with regional seismometer networks at distances of up to 100 km. However, the largest iceberg calving events in Greenland and Antarctica also constitute large seismic events called "glacial earthquakes" (Nettles and Ekström, 2010). These events generate low frequency seismic waves (below 0.1 Hz) and can be detected at 1000's of km distances. Calving seismology offers the possibility to monitor iceberg production remotely at an unrivaled temporal resolution. It has also elucidated processes, which play key roles in hazardous unstable mountain glaciers (see project tab).

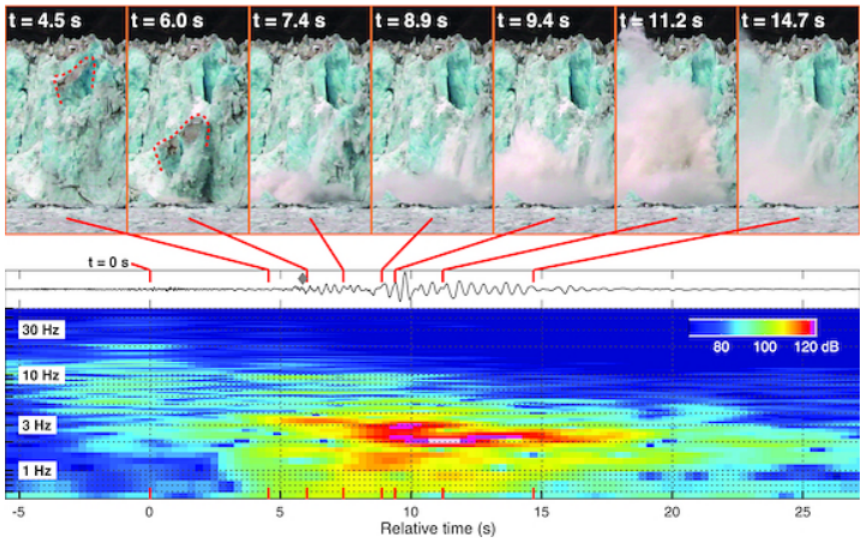

Figure 3: Synchronized video footage and concurrent seismological measurements of an iceberg calving event at Yatseh Glacier, Alaska. Note that the calving cliff is approximately 50 m high. Reproduced from Bartholomaus et al. (2012).

References

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