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Analysis of seismogenic rumblings from Helheim Glacier, South East Greenland

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Seismogenic rumblings from the large Greenland outlet glacier Helheim Glacier have a characteristic frequency content, distinctively different from both tectonic earthquakes and the background noise. The glacier emits energy containing both high- and low-frequency waves with typical event duration between 15 and 30 minutes. Teleseismically detected glacial earthquakes from Helheim Glacier are preceded by these long-duration rumblings, but the rumblings are far more abundant than the large seismic events. We identify the rumblings using a frequency-domain detector tuned to a low noise BB station ISOG located approximately 100 km from the glacier. The detector monitors the energy content in a high- and a low-frequency band using a sliding window. Data from other BB seismographs in the region, including a temporary station in the town of Tasiilaq, are included in further analysis of the signals. The rumblings are strongly associated with glacier activity. Rumblings precede all observed teleseismically detected glacial earthquakes at Helheim Glacier for 2007 and 2008 where the analysis has been carried out. Furthermore, calving events in 2008 observed at a time lapse camera near the glacier front also coincide in time with detected rumblings. Several rumblings are detected every day and the coincidence of glacial earthquakes and calving events could be spurious. However, the occurrence of the rumblings shows a strong seasonal variation similar to the one previously observed for glacial earthquakes. The rumbling season peaks in mid-September when the melt season ends. The study of glacial rumblings can provide a valuable supplement to in-situ glaciological observation methods for studying and monitoring the dynamics of large outlet glaciers.