Earthquakes induced by ice-mass loss: A case example for southern Greenland

Rebekka Steffen\textsuperscript{1}, Holger Steffen\textsuperscript{1}, Robert Weiss\textsuperscript{2,3}, Benoit Lecavalier\textsuperscript{4}, Glenn Milne\textsuperscript{5}, Sarah Woodroffe\textsuperscript{6}, and Ole Bennike\textsuperscript{7}

\textsuperscript{1}Geodetic Infrastructure, Lantmäteriet, Gävle, Sweden
\textsuperscript{2}Department of Geosciences, Virginia Tech, Blacksburg, Virginia, USA
\textsuperscript{3}Center for Coastal Studies, Virginia Tech, Blacksburg, Virginia, USA
\textsuperscript{4}Department of Physics and Physical Oceanography, Memorial University of Newfoundland, St. John’s, Newfoundland, Canada
\textsuperscript{5}Department of Earth and Environmental Sciences, University of Ottawa, Ottawa, Ontario, Canada
\textsuperscript{6}Department of Geography, Durham University, Durham, UK
\textsuperscript{7}Geological Survey of Denmark and Greenland, Copenhagen, Denmark

Due to their large mass, ice sheets induce significant stresses in the Earth’s crust. Stress release during deglaciation can trigger large-magnitude earthquakes, as indicated by surface faults in northern Europe. Thus, the current ice-mass loss in Greenland can be accompanied by earthquakes. Here, we will present an example of a possible large magnitude earthquake that occurred during the large melting period of the Greenland Ice Sheet in the early Holocene. The glacially induced stresses showed an instability occurring at 10,600 years ago. An offset in past sea level indicators falls within the same time frame, which gave us indications that the stresses have been released by an earthquake. The potential fault could have slipped up to 47 m, resulting in a large magnitude earthquake, if only one event occurred. The earthquake may have shifted relative sea level observations by several meters. In addition, as the potential fault is located offshore, the earthquake could have produced a tsunami in the North Atlantic Ocean with runup heights of up to 7.2 m in the British Isles and up to 7.8 m along Canadian coasts. Thus, ice-mass loss is strongly linked to the occurrence of earthquakes and even earthquakes-related tsunami. These scenarios due to a changing cryosphere can have effects for all countries bordering the North Atlantic Ocean and are in addition to the well-known sea-level rise.