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Array Analysis of Seismic Tremor from Different Sources, Vatnajökull Glacier, Iceland

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The volcanic systems, including the central volcanoes Bárðarbunga and Grimsvötn in South-East Iceland lie beneath the Vatnajökull glacier and are covered by up to 700 m of ice. This affects the monitoring of the volcanic systems as it complicates a close-to-the-source installation and is the source of strong propagation effects. Monitoring efforts with a single station network include the location of earthquakes which becomes a difficult task when it comes to tremor. We aim to not only locate but also to characterize the source of tremor. We installed three arrays (antennas), each consisting of seven broadband instruments, to the northwest, west and southwest of Vatnajökull glacier (Urðarháls, Jökulheimar and Laki) to improve tremor locations. Another difficulty is that tremor can originate from hydro-thermal systems, the glacier itself or flowing water.
Since the beginning of the installation we observed tremor pulses from a small flood (jökulhaup) in the Skaftá river and one at Þórðarhyrna – one of the volcanoes south of Grimsvötn. In August 2014 an effusive eruption started in Holuhraun north of Vatnajökull glacier. Magma is fed from Bárðarbunga and has caused eruptive and flood tremor since the onset of the (still ongoing) eruption. We apply a beamforming method to locate and compare tremor from different sources. Each tremor is analyzed in terms of their frequency content, amplitude, duration, wavefield and spatial and temporal locations in order to classify magmatic- and non-magmatic tremor origins.