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Extending Icelandic volcanological network operations into the ice caps

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Many of Iceland‘s most active volcanoes are located under glaciers, with limited access for monitoring equipment. In the warming climate however, a few rock outcrops (nunataks) have emerged from the ice permitting some access improvement, but to properly monitor seismic signals from volcanoes deep inside the ice caps, instruments placed in the ice itself are needed. Continuous, real-time operation of monitoring equipment in harsh climate, heavy snow accumulation and icing conditions on a glacier is a considerable challenge.

The FP7 project FUTUREVOLC, which focusses on Icelandic volcanoes, aims for the development of a multiparametric volcano monitoring and early warning system. One of the new developments in the project involves strengthening the existing real-time seismic monitoring and analysis systems by extending the permanent network into the Vatnajökull ice cap. The goal is to improve detection and location of seismic signals, such as microseismicity, LP events, ice-quakes and continuous tremor due to volcanic eruptions at the volcanoes under the ice cap. Real-time processing and discrimination of these signals could give early warnings of an imminent eruption. At subglacial volcanoes however, other processes, such as subglacial floods (jökulhlaup) and subglacial hydrothermal systems – boiling due to sudden drainage –also generate continuous tremor and can therefore lead to false eruption alarms. To minimise the number of false alarms, the network and processing will need to discriminate between the different tremor sources by determining their characteristics and track the temporal evolution and location of the source. For this purpose broad-band instruments will be placed on nunataks as well as in the ice and two short-period arrays will be located at the margin of Vatnajökull, close to subglacial flood paths from the Skaftár ice cauldrons. To record ice movements associated with the jökulhlaups, GPS receivers will be placed on outlet glaciers during subglacial flooding events.

The glacier broadband seismometers are being developed by Güralp Systems Ltd. They will be able to operate in tilted position and maintain clock accuracy during extended periods of burial in the ice. To minimize their traveling with the moving ice, they will be located close to the ice divide on the glacier.