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Monitoring of topographic changes in glacier ice and lava during the 2014-2015 Bárðarbunga unrest with airborne radar profiling

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The subsidence of the ice covered Bárðarbunga caldera, creation and evolution of ice cauldrons over the subglacial path of the lateral dyke, and the formation of a large lava to the north of the Vatnajökull glacier has called for repeated survey of the evolving ice and lava topography. For these measurements a system is used that was designed to monitor glacier surfaces, principally with the aim of detecting changes in subglacial geothermal activity, particularly at the ice-covered Katla and Grímsvötn calderas. The system is composed of ground clearance radar and a sub-meter differential GPS system aboard a Beech B200 Super King Air, two-engine survey aircraft. The system measures the aircraft position, elevation and air clearance four times a second, yielding surface elevation point readings at 15-20 m intervals. The absolute accuracy of the system is estimated 2-3 meters while the relative accuracy is 1-2 m along the profiles that are usually flown at an altitude of 80-120 m over the measured surface. During the ongoing unrest since August 2014, tasks that have been carried out using the aircraft profiling platform include: Survey of the: (i) shape, depth and volume of the subsidence bowl formed in the ice surface in the Bárðarbunga caldera since late August; (ii) shape, depth and volume of small cauldrons considered to have formed in minor, short-lived subglacial eruptions to the SE of the Bárðarbunga caldera and on three locations in the outlet glacier overlying the path of the dyke formed in the second part of August; (iii) evolution of three geothermal ice cauldrons located over the topographic rims of the Bárðarbunga caldera, (iv) mapping of the graben formed to the south of the volcanic fissure in Holuhraun, and (v) the topography of the new lava field. Many of the above tasks could possibly be carried out using satellite data, but the limited repeat rate, interfering cloud cover and short winter days, and timing of satellite overpasses restricts the amount of observations available. In contrast, use of the aircraft survey platform is much less restricted, allowing for rapid deployment as needed when weather conditions allow overflights.