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Reawakening of the Öræfajökull volcano in Iceland: deformation signals of stress triggers and intrusive activity

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Öræfajökull is an ice-capped volcano in southern Iceland, located outside the main belt of active volcanoes that follow the Eurasian - North American plate boundary. Öræfajökull is Iceland's tallest volcano and has erupted twice in historic times: in 1362, a large (∼10 cubic kilometers of tephra) silicic explosive eruption; and a smaller eruption in 1727. In the past few years Öræfajökull has shown increased signs of unrest, most notably increased seismicity, but also changes in geothermal systems, river chemistry, and crustal deformation (see Jónsdóttir et al., this meeting). In the year 2017 seismic unrest increased substantially and a ∼1 km wide ice cauldron formed in the centre of the caldera. GPS and InSAR (SENTINEL-1 and TERRASAR-X) measurements at Öræfajökull show a small deformation signal indicating that an intrusion entered the volcano, consistent with seismicity and changes in geothermal output. The GPS observations are mostly based on campaign measurements in 1996, 2003, 2005, and 2017, with addition of continuous measurements in recent years. Here, we explore a range of deformation models that can explain the observed data, ranging from the simple models (single sphere, sill, dyke), to more complex ones. A key for extracting the small deformation signal we observe is to account for glacio-isostatic adjustment (GIA) in the area, as Öræfajökull lies at the edge of Europe's largest glacier, Vatnajökull. The GIA affects both the horizontal and vertical components of the deformation field, and is time-dependant because of rheology and time-varying melting rates of Vatnajökull. Furthermore, the regional GIA signal creates east-west extensional strain across Öræfajökull, and we address how the GIA-induced strain may affect magma pathways in and under the Öræfajökull volcano, in addition to strain changes caused by the 2014-2015 Bárðarbunga rifting episode and magma accumulation at Grímsvötn volcano.