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The use of repeat Terrestrial Laser Scanning to quantify jokulhlaup induced change caused by the 2010 Eyjafjallajökull eruption, Iceland

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In March 2010 precursory activity at Eyjafjallajökull suggested an imminent eruptive phase and the generation of potentially destructive melt induced outburst floods (jökulhlaups). Terrestrial Laser Scanning (TLS) using a 2 km range Riegl LMS Z620 system was carried out at locations previously modelled to be potential jökulhlaup pathways from a summit eruption. Sites were selected so that not only could flood induced topographic change be quantified, but used to reconstruct peak discharges and to form the basis of numerical flood models. A particular TLS focus was the Gígjökull Glacier basin in which an ice-contact lake existed, constrained by large latero-terminal moraines.

Repeat TLS was carried out post-eruption in July 2010 alongside sedimentological, morphological and dGPS measurements as part of a Natural Environment Research Council funded Urgency project in collaboration with the Icelandic Meteorological Office. Catastrophic jökulhlaups in April 2010 filled the Gígjökull basin with lahar type sediments and dramatically altered topography.

The repeat TLS surveys in the basin collected in excess of 150 million x,y,z, intensity R,G,B data to quantify the volumetric and morphological changes from the outburst floods. TLS point data have been aligned, merged, and surfaced to allow pre and post eruption differencing. The data reveal the extent of geomorphic change, in particular the modification of the Gígjökull basin outlet channel which has been significantly lowered, the erosive trimming of the lateral moraines, and the building of a large depositional fan of sediment in the upper half of the basin - the front of this fan corresponds to the former lake surface altitude. The new sediment surface is intensely kettled due to ice-melt out and is fluvially dissected; both clearly expressed in the TLS data.