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Recent Changes to Langjökull, Iceland: Integrating airborne LiDAR, skidoo-based GPS, Landsat imagery and airborne photography

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Three independent data sets are combined to produce a 30m-resolution digital elevation model (DEM) of Langjökull, Iceland's second largest icecap (∼950 km2) for 2007. The data are from: i) an airborne LiDAR survey; ii) skidoo-mounted GPS; and iii) Landsat ETM+ band 4. The technique of photoclinometry (which calculates slope angles and aspects from visible imagery) is applied to the Landsat data, which is then integrated to produce interpolated elevation data between the LiDAR flight lines and the GPS skidoo tracks. It is shown that photoclinometry is a satisfactory and robust technique for topographic interpolation (RMS error is ∼3.4m over a ∼3 km distance). A comparison of the 2007 DEM with an earlier 1997 DEM based on kriging of skidoo-based GPS data, suggests Langjökull has lost an area of 3.4 ± 2.5 km2 yr-1 over the decade. A comparison also shows it had an average annual mass balance of -1.10 ± 0.09 m yr-1 w.e., which compares favourably with mass balance estimates derived from stake and snow pit measurements and confirms previously published predictions that Langjökull will likely disappear within the next 200 years if current trends continue. Spatial patterns of elevation change show marked lowering towards the margins of several glaciers, including Hagafellsjökull Vestari, known to have surged prior to 1997. This is confirmed by comparison with a photogrammetrically-produced DEM of this glacier margin for 2001. Conversely, a rise in elevation around the margins of Hagafellsjökull Eystri reflects the 1998 surge of that glacier. An area of elevation rise in the accumulation area of Hagafellsjökull Vestari suggests this glacier is building up to another surge.