

# A method for mapping diurnal changes in subglacial hydrology using UAVs: characterisation of a Variable Pressure Axis at Skálafellsjökull, SE Iceland

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## Aim

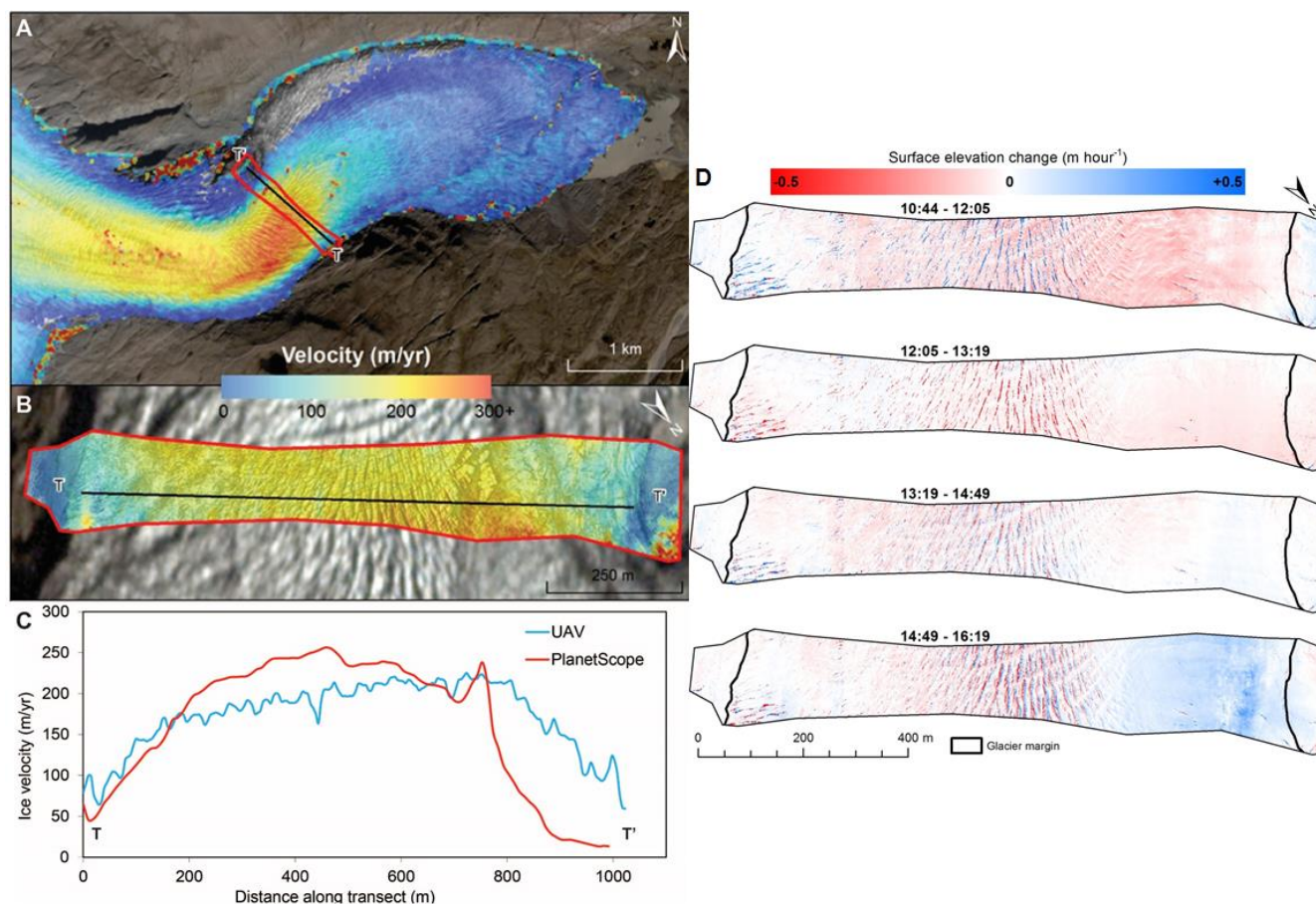
The project aimed to develop a method using Uncrewed Aerial Vehicles (UAVs) to monitor high-resolution changes in subglacial hydrology by repeat photogrammetric surveys of a glacier surface throughout a day. Changes in subglacial water pressure can manifest in surface uplift or subsidence, and associated changes in surface velocity. Repeat photogrammetry has the potential to measure these changes at very fine spatial (cm) and temporal (~hour) scales.

## Methods

A UAV was flown across a narrow section of Skálafellsjökull on a pre-programmed flight path five times during a day, capturing overlapping photographs. It was planned to also install RTK GNSS receivers on the ice to monitor surface velocity and elevation changes independently, but unfortunately the glacier was inaccessible due to recent marked surface lowering resulting in a steep cliff by the lateral margin.

## Findings

The UAV method produced a velocity field derived for a 6 hour period (Fig 1B) consistent with the mean velocity over a 1 year period (Fig 1A,C). Surface elevation changes were observed near the NW margin consistent with hydraulic jacking in response to increased surface meltwater production during the day (Fig 1D).



**Figure 1.** Satellite and UAV-derived surface velocity (A-C) and UAV-derived elevation change (D) across Skálafellsjökull over the course of a day.

## Value of BSG ECR grant

The BSG ECR grant was invaluable in providing a proof of concept for the UAV method for monitoring subglacial hydrology. Limitations in independent verification by on-ice GNSS may be overcome in future work using an RTK UAV. The findings have been used as the basis of two funding bids to extend the work in Greenland: (1) National Geographic Exploration Grant (\$17,526, unsuccessful); and (2) Royal Geographical Society Walters Kundert Fellowship (£10,000, unsuccessful). A further bid to NERC using the technique (alongside other analyses) is in development.