How do overdeepenings affect glacial dynamics?

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Background & Rationale

Numerous interacting factors are responsible for the how and why a glacier flows the way it does, including for example, basal debris, meltwater and climate. Notably, little is known as to how the processes that contribute to glacier flow are affected by the presence of bedrock overdeepenings. Overdeepenings are potentially important because they give rise to particular phenomena that have significant capacity to affect glacial dynamics such as thrusting and supercooling and ponding of subglacial water, the latter of which has not been investigated significantly outside of the Antarctic and Greenland Ice Sheet. This is of importance due to smaller scale glaciers having a shorter response time to the effects of a changing environment.

This project will investigate identifying the characteristics of overdeepenings in Alpine glacier contexts and in particular how overdeepenings affect the hydrology and dynamics of Alpine valley glaciers on seasonal and annual timescales and whether adverse slopes are associated with ponding of subglacial water or the accretion of basal ice and subglacial till?

Fieldwork & Methodology

The aims of the first field season were to ground truth a bed inversion model of Findelen glacier, looking for signs of overdeepenings. In order to examine how glacial dynamics might interact with its topography at an overdeepening, 5 sets of UAV flights were recorded and 3D ortho-mosiac models were created using images captured from flight of the lower 2km of Findelen glacier in Switzerland over a period of 16 days (22/08/16 – 06/09/16). 9 Ground Control Points (GCPs) were used in order to accurately georeference the imagery.

By comparing models, it is hoped that feature tracking can be used to estimate glacial dynamics within this time period. Two further fieldworks are planned in order to obtain annual change from further flights (Summer) and to analyse the bed topography using GPR (Winter).

Figure 1. Example of GCP with DGPS to accurately georeference.
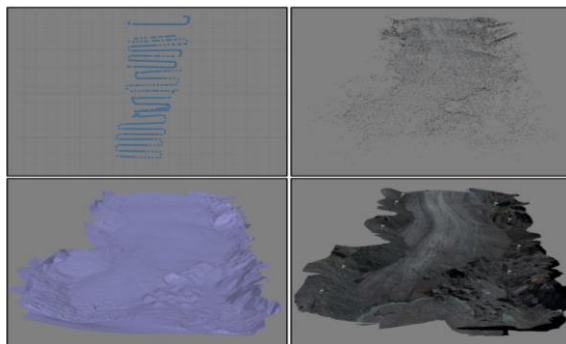
Figure 2. Steps of Agisoft ortho-model building: Clockwise from top left: Image locations, Sparse point cloud, Mesh, Tiled model with GCP markers.
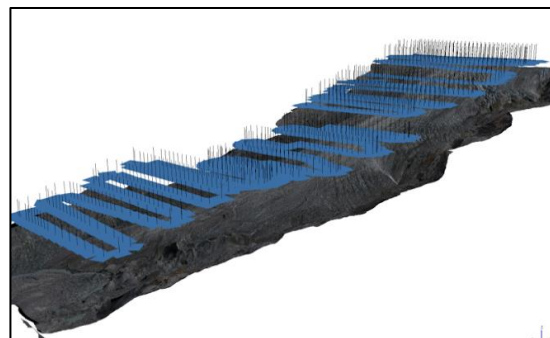
Figure 3. Tiled model image capture locations and extent (03/09/16).