Mapping glaciers using millimetre wave radar

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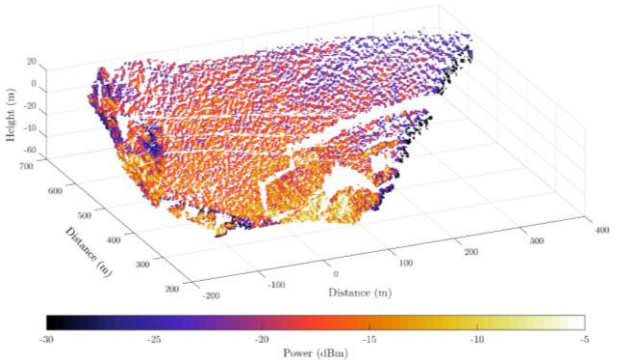
Abstract
Glaciers and ice sheets are losing mass at an accelerating rate, yet we still do not understand the processes controlling these changes. Improved observations hold the key to predicting the future state of the cryosphere. This work presents a 'proof-of-concept' study demonstrating the ability of millimetre wave radar to map glaciers at high resolution. This new data will underpin future deployments of the instrument in glaciated environments.

AVTIS2 Scanning at Rhône Glacier

AVTIS2 scanning Rhône Glacier.



Radar point cloud of glacier terminus.

Project Description
Millimetre wave radar offers a unique compromise between imaging resolution and penetration through atmospheric obscurants. In September 2019 we deployed the AVTIS2 millimetre wave radar at Rhône Glacier, Switzerland. Our aim was to quantify the backscatter characteristics of glacial ice at 94 GHz and generate Digital Elevation Models (DEMs) from the data. To our knowledge, this was the first time millimetre wave radar had been used to map a glacier. The development of this new technique will address the need for glacier observations at high spatial and temporal resolution in virtually all weather conditions. Further, this data will now be used to develop algorithms for terrain classification and improved DEM extraction.

Key Results
- We have successfully generated the first ever DEM of a glacier using millimetre wave radar.
- Normalised backscatter (σ^0) values have been calculated across Rhône Glacier by correcting for the illuminated area of the beam footprint.
- Preliminary results suggest that σ^0 values for glacial ice are larger than bare rock but lower than wet/dry snow.
- This 'proof-of-concept' study demonstrates the ability of millimetre wave radar to map glaciers at high resolution.
- AVTIS2 will next be deployed in Svalbard in 2021 to analyse the process of iceberg calving from marine-terminating glaciers.

Conference Presentation: https://meetingorganizer.copernicus.org/EGU2020/EGU2020-595.html
Blog post: http://williamharcourt.co.uk/2019/09/12/rhone-glacier-fieldwork/