Millimetre-wave Radar Monitoring of Snow in Scotland (MRaMSS)

Gray-Milne Travel Bursary Funding Report

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Project Summary

We are very pleased to report that our project, Millimetre-wave Radar Monitoring of Snow in Scotland (MRaMSS), was successfully conducted between 22nd and 24th March 2021. We would like to send our sincere thanks to the British Geophysical Association (BGA) for funding this fieldwork through their Gray-Milne Travel Bursary. Our primary objective, which was to deploy a ground-based 94 GHz radar and a Terrestrial Laser Scanner (TLS) in the Cairngorms, Scotland, to map snow covered terrain, was achieved (Figure 1). In addition, we were assisted by the Scottish Avalanche Information Service (SAIS) in the field and they helped gather data on snow conditions, as well as providing expert guidance on the snow-associated hazards present during our fieldwork. Some examples are shown below.

Figure 1 Deployment of the 94 GHz radar and TLS.

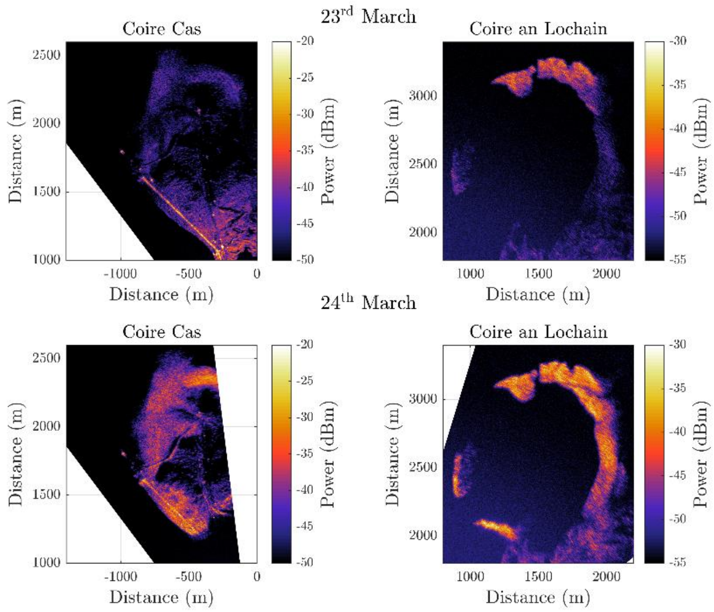

Figure 2 Radar backscatter changes over two corries.

Preliminary Results

We mapped the spring snowpack that covered the northern corries in the Cairngorms National Park in March 2021. In general, snow grain sizes were ~3 mm and homogenous across the region having gone through multiple freeze-thaw cycles. We observed an increased in radar backscatter (Figure 2) over the course of our study period which we believe was driven by lower temperatures on 24th March. Temperatures on 23rd March were above freezing, leading to minor surface melt that increased 94 GHz signal absorption. In contrast, radar backscatter increased when the snowpack was below freezing on 24th March (Figure 2). Additionally, the 94 GHz radar was able to detect locally enhanced calibrated radar backscatter values (σ^0) across the steep slopes of the eastern corrie (Figure 3). This was caused by wind-driven snow accumulation on the ridges of the corrie which led to surface activity in the same region, and so we hypothesize that increased snow surface roughness enhanced σ^0. Overall, this grant has enabled me to highlight the capabilities of millimetre-wave radar for snow surface mapping and has opened up new possibilities for future research.

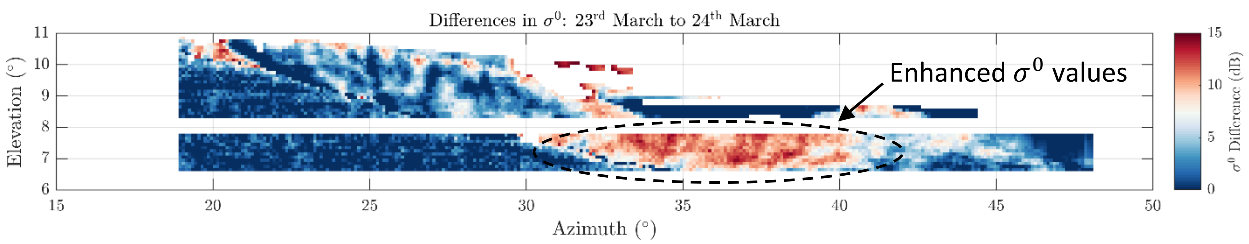

Figure 3 Localised increases in σ^0 caused by surface activity across the steep slopes of the eastern corrie.