THE ROLE OF AVALANCHE DEPOSITION ON THE MASS BALANCE OF ROLLESTON GLACIER, ARTHUR'S PASS, NEW ZEALAND

Alison Spera[1], **Heather Purdie[2]** , Tim Kerr[3] , Wolfgang Rack[4]
[1] University of Canterbury
[2] University of Canterbury
[3] Rainfall New Zealand
[4] University of Canterbury

Avalanches can be an important source of nourishment for cirque mountain glaciers, supplementing their accumulation and delaying melt. However, their contribution to glacier mass balance is often overlooked.

Here we evaluate the effect of avalanche deposition on the Rolleston Glacier mass balance using an Energy Balance Model (EBM) coupled to a mass transport and deposition (MTD) routine. A 12-year climate record (2010 – 2022) was developed and used to drive the model, with temperature lapse rate and a precipitation factor used as tuning parameters. Annual (Bn) and winter balances (Bw) were compared for selected years (2010/11, 2012/13 and 2018/19) with and without the MTD component. Results showed that excluding gravitational processes under-estimated Bw by up to 2.29 m w.e, while activating the MTD yielded Bw estimates on average within 0.97 m w.e of observed measurements. The model replicated the observed spatial distribution of avalanche deposition reasonably well, and we determined that approximately 57% of the average winter balance could be attributed to avalanche deposition.

The EBM model was compared to cumulative mass balance measurements, showing a strong (R^2 = 0.9) relationship when coupled to the MTD, compared to a moderate (R^2 = 0.65) relationship when the MTD was not utilised. These results demonstrate that including a MTD routine has useful application to simulating more accurate mass balance estimates at alpine glaciers. Future work should include a comprehensive parameter optimisation and sensitivity analysis to further improve model performance.