

## **Ten Years of Rolleston Glacier Measurements**

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The Rolleston Glacier loses enough water each year to fill an Olympic swimming pool 31 times. Put another way, an average of 0.7 m depth of water across the entire glacier has been lost each year for the last ten years. The last two years had the greatest loss with over 2.0 m. The greatest gains occurred in 2013 and 2015 when 0.7 m was added.

The Rolleston is a small glacier (0.1 km<sup>2</sup>) located near Arthur's Pass. The glacier can be accessed within 3 hours walk from the road, and measurements can be achieved within a day from Christchurch. The glacier is low angled, nestled in a south facing corner of a ridge with winter avalanches contributing to the glacier's snow. The glacier receives about 5 m of snow each year predominantly from westerly events.

Measurements are made twice a year. Once at the end of winter to find out how much snow has fallen, and once at the end of summer to determine how much melt has occurred.

End-of-winter measurements consist of snow depth observations in as many places as possible across the glacier. These depths are converted to a water equivalent based on measured snow density and then spatially interpolated to provide an all-of-glacier average.

End-of-summer measurements consist of determining how much of four plastic stakes (inserted into drilled vertical holes at the end of winter) are exposed by the melting snow and ice. This is combined with further snow probing of any remaining snow fields. The stake exposure depths are interpolated across the glacier based on an elevation relationship, and combined with the interpolated snow probe measurements to find the all-of-glacier average melt. The winter gain less the summer loss provides the annual change.

The Rolleston is one of two glaciers in New Zealand, and one of 200 in the world with annual mass measurements. For context, there are 3000 glaciers in New Zealand, and 200000 in the world.

The measurements are submitted to the World Glacier Monitoring Service where they are freely available.

The Rolleston Glacier's average mass loss of 0.7 m per year is a little less than the global average loss from monitored glaciers of 0.8 m per year.

This year is the 10<sup>th</sup> consecutive year of measurements of the Rolleston Glacier. The intention is to continue monitoring for at least thirty years so that the glacier will become a global reference glacier.