Scanning Antarctic glaciers

In 2004 a Maptek™ I-Site™ 4400 laser scanner was used to map the position of an Antarctic glacier. The project was investigating the possibility of using terrestrial laser scanners to monitor long-term glacier movement, as part of research conducted by the University of Otago.

In 2004 Dr Sean Fitzsimons from the University of Otago, New Zealand, was looking into the mechanisms of several Antarctic glaciers. Scanning was carried out by Measurement Solutions of NZ and all results were generated using Maptek™ I-Site Studio™ software.

Similar glacial measurements have been collected in the past using terrestrial photogrammetry, or by monitoring a small number of discrete reference points adjoining the glacial apron.

Two of Dr Fitzsimons' research sites had been monitored using these methods. It was hoped to compare this data, proving the reliability of the technique, and also provide immediate comparison with past movements for both glaciers.

The research sites are in the McMurdo Dry Valleys, Victoria Land. Most research in this area is supported from New Zealand's Scott Base, or USA headquarters, McMurdo Station.

Travel to these distant sites is primarily by helicopter, with local travel on foot. The compact size and ease of deployment of the Maptek™ I-Site™ 4400 scanner was well suited to this challenging environment.

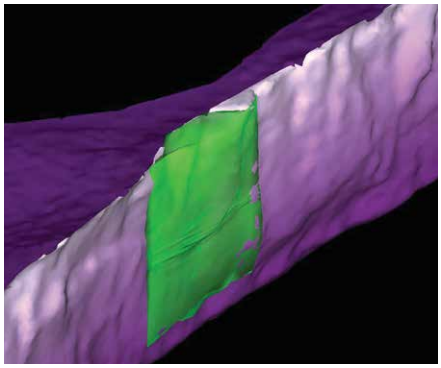
The Upper Victoria Glacier in the Victoria Valley was the site of the first scan. In the 1980s, Trevor Chinn of the then NZ Ministry of Works undertook research here using a Wild photo-theodolite.

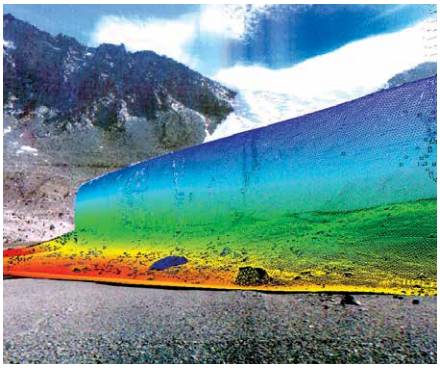
One of his survey control points was located by Dr Fitzsimons and Shelly MacDonnell in 2003, and was used in this project to provide a common reference system.

Highlights

- I-Site used to monitor long-term glacier movement
- Compact size of scanner and ease of deployment are well suited to this environment

The I-Site 4400 laser scanner was used to record and map the position of an Antarctic glacier, as well as investigate the possibility of monitoring long-term glacier movement using terrestrial laser scanners.





The ease of use in capturing reliable, accurate data with modern laser scanning methods has contributed to the feasibility of long-term research projects.

Accurate geo-referencing means that data can be easily validated against both historical and more recent data records.

A second point used for the 1980s projects can be linked indirectly via the 2003 research. Eight scans were recorded in around 3 hours, covering approximately 1km of the 35 metre high glacier face.

The second site, the Suess Glacier, is in Taylor Valley. This was the first of the Dry Valleys to be discovered by accident in the early 1900s when members of Captain R F Scott's party became lost. After walking down the valley past Suess Glacier, they retraced their steps to the head of the valley and continued on their way. Today, the same area is serviced by Bell 212 helicopters.

At this site 2 existing control points were able to be used, one of which is known to have been used by Chinn, while the second is presumed to have been. A total of five scans was recorded in around 2.5 hours to cover approximately 500 metres of the glacier face and surrounding terrain.

The I-Site 4400 scanner provides a motorised survey telescope which enables accurate and easy backsighting for alignment, as well as automated scan data geo-location when existing survey control is used.

At both sites, scanner locations were selected to provide coverage along the ice cliff. Each station was fixed by survey for later combining of adjoining scans.

The original intention was to collect a dataset during the summer season, with a proposal to revisit the sites in 2005/06 or 2006/07 for a comparative survey.

However, on the third day in the Victoria Valley, a significant icefall from the glacier provided an opportunity to measure the volume of ice which fell.

On a small scale this would simulate the expected situation on follow-up visits. The area of the fall was re-scanned from approximately the same location as previously, providing a record of the event.

A tense 30 minutes followed while the scanner was set up and orientated, and the scan was carried out with the sound of cracking ice directly above.

Modelling of the surveyed laser scan data was completed entirely in I-Site Studio. Individual scans were modelled to preserve overhanging areas common in the ice structures, and a pair of fusion surfaces was created with triangle sizes of 0.5 and 1 metre.

The resulting two surfaces covered the total 1500 metres of glacier face, composed of data from 13 different scans. The volume of ice which slipped was calculated to be 1475 cubic metres.

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