After a day spent surveying the upper slopes of Brown Glacier, Martin Truffer (leading) and Shavawn Donoghue of the Heard Island glaciology team make their way down the crevassed lower slopes towards Brown Lagoon. In 1947 the glacier extended to the surf line, terminating in a 20 m high ice cliff. By 1986 it had retreated out of the 55 m deep lagoon onto the foreground rock. Three years previously, the ice surface in this area was 11 m higher than when this photo was taken, and the glacier ended 60 m further down slope. Doug Thost

Glacial retreat heralds changing Antarctic climate

Research has shown that Brown Glacier on subantarctic Heard Island is retreating rapidly. It suggests that local climatic conditions are continuing to change rather than stabilise.

Measurement of the basic physical characteristics of Brown Glacier commenced in November 2000, and the Heard Island glaciology team – from the Australian Antarctic Division, the Antarctic Climate and Ecosystems Cooperative Research Centre, the University of Tasmania and the University of Alaska – repeated these measurements during the 2003–04 Antarctic season, to see what changes had occurred.

The results showed that compared with 1950 (the earliest record from which physical boundaries of the glacier can be defined), the glacier has lost 38% of its volume and retreated 1.17 km at an average rate of 21 m per year. The retreat is attributed to an increase in average annual temperatures of about one degree Celsius. While this may sound trivial, a one-degree change is a significant temperature increase when considered as a yearly average.

Since 2000, Brown Glacier has retreated 60 m. However, the greatest changes were noted using Global Positioning System surveying techniques to measure the ice surface elevation. The lower slopes of the glacier have lost as much as 11 m in thickness, while higher up (where it is colder and changes were expected to be minor), the surface has dropped by up to four metres. This translates to a loss of about 8 million cubic metres of ice a year, compared with the 50-year average of 3 million cubic metres a year.

Brown Glacier has been changing for the last 50 years and the changes appear to be ongoing at an accelerated rate. It implies that climatic conditions are continuing to change, rather than stabilise. To understand these changes the glaciology team installed markers to measure the glacier's mass balance – the amount of ice that accumulates and melts on the glacier – over the summer, and over the next few seasons. Three weather stations were temporarily installed at different altitudes to monitor the glacier's immediate response to temperature. Ice samples were collected from deep within crevasses to help determine the amount of annual ice accumulation – still the biggest unknown.

Because Heard Island is difficult to get to, and scientists can't always be there to measure how much ice is melting, the glaciology team aim to predict melt rates based on data from a remotely operating weather station near the glacier, combined with energy balance models. The field measurements made this summer will enable fine-tuning of the equations that are used to make these calculations.

Other glaciers on the island are also displaying marked changes with time. A comparison of the ice front of Stephenson Glacier (which terminates in a 113 m deep lagoon) using a high resolution satellite image taken in January 2003, showed a retreat of nearly 200 m; a dramatic change for just a one-year period.

The majority of glaciers are retreating worldwide and Heard Island fills a gap in an otherwise vast expanse of ocean by providing a point where change in the climate of the Southern Ocean can be monitored. The lonely outpost of Heard Island is like a sentry, providing advanced warning. And while the loss of glaciers on Heard Island would make a trivial contribution to world sea level rise, it heralds the progression of climate change south, towards the ice-covered Antarctic continent.

● **Doug Thost**

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