Tunsbergdalsbreen Expedition 2011

Figure 1: Location map of Tunsbergdalsbreen

Figure 2: Newcastle University students Rob Barker (left) & Alex Smith (right).

Tunsbergdalsbreen, in southern Norway (figure 1), is the longest outlet glacier (18km long) of the Jostedalsbreen ice cap; the largest icecap in mainland Europe. In August 2011, two Newcastle University students (figure 2), in conjunction with Brathay Exploration Group (BEG), travelled to Norway with the aim of surveying the lower section of the glacier. Tunsbergdalsbreen was first surveyed by Nottingham University and BEG in the late 1950's and early 1960's. Annual expeditions to Tunsbergdalsbreen recommenced in 2009 involving Newcastle University, BEG, the Field Studies Council and the Norsk Bremuseum. The results attained from these more recent expeditions allows comparison to the original results, and enables analysis of how the glacier has changed in the intervening 50 years.

Figure 3: The team makes the regional press

The aims of the 2011 expedition were:

1.To locate the glacier snout by taking the slope distance and bearing to the snout from previously marked locations using Leica laser locator binoculars.

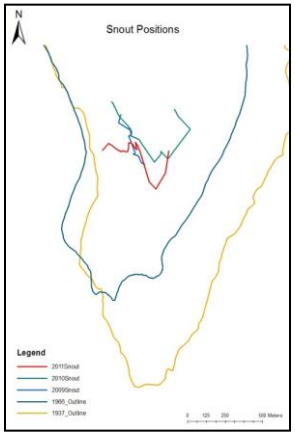
2.To calculate ice volume changes between 2009, 2010 and 2011 by walking transects across the glacier with a Differential GPS unit, and creating a 3D digital map.

3.To measure ice velocity by noting down the GPS co-ordinates of painted stones laid out in 2009 and 2010, as well as laying out 2011 stones.

Figure 4: In order to minimise the risks of working in a dynamic ice environment a 3-day glacier course was undertaken on Nigardsbreen, another outlet glacier of Jostedalsbreen, to learn how to safely negotiate the glacier and perform crevasse rescues.

In addition to the survey work, a day hike was undertaken to Roykjedalen, where the expeditions in the 1950's and 60's had set up camp. This allowed a panoramic photograph to be retaken (figure 9), and the environmental impact of these earlier expeditions was reduced by removing their rubbish, which had been hidden under rocks. Interesting finds included 50 year old tubes of Coleman's Mustard and tins of milk powder, as well as a pair of trousers and a complete crampon! The rubbish was put into helicopter bags to be collected at a later date. The efforts even made the regional newspaper (figure 3).

Figure 5 – Snout positions



Results

Figure 5 shows the snout positions of Tunsbergdalsbreen. A strong pattern of retreat is apparent, although a slight advance can be seen in 2011 (red), compared to 2010 (green). This most recent advance may be attributed to seasonal ice calving variations.

Figure 6 shows a digital elevation model composed from the co-ordinate and height data derived from the Differential GPS readings. These readings were taken every second whilst walking the transects (inset top right of figure 2) resulting in over 40,000 readings being taken.

Figure 6 – 2011 Digital Elevation Model

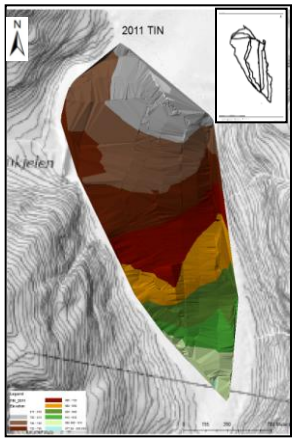


Figure 7– Ice volume change 2010-11

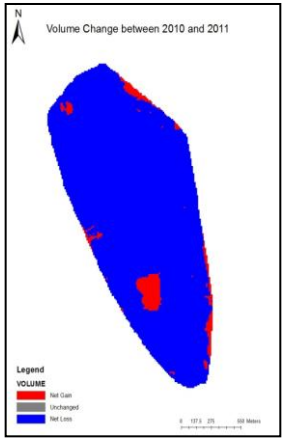
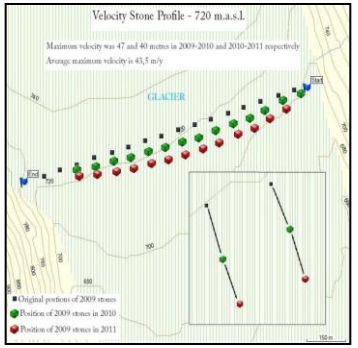


Figure 7 shows the volume change over the lower section of the glacier between 2010 and 2011, created by merging the 2010 and 2011 digital elevation models. It is clear to see that ice decreased in volume across the lower section of the glacier, with increases in just a couple of areas.

Figure 8 shows the location of the 2009 velocity stones as they were found in 2010 and a year later in 2011. This shows that the glacier is moving fastest in the middle, at an average maximum velocity of 43.5 metres per year.

Figure 8 – Velocity Stones



Surveying in 1959

Surveying in 2011

Figure 9: Panoramic photograph of Tunsbergdalsbreen taken from Roykjedalan, 13th August 2011, with 1959 photo for comparison (inset).

Conclusions

Tunsbergdalsbreen has experienced the same general trend of retreat and decrease in volume as many other European glaciers, although it has undergone a slight advance in snout position over the past year. The ice has, on average, a maximum velocity of 43.5m/y, although more than two years worth of velocity readings are required to gain a more accurate representation. Continued annual studies are required to assess whether these findings are consistent, and to further analyse the dynamicity of Tunsbergdalsbreen.

Written by Robert Barker and Alexander Smith

Civil Engineering and Geosciences · Newcastle University · FSC · Norsk Bremuseum & Ulltveit-Moe senter for klimaviten · Brathay Exploration Group · Royal Geographical Society with IBG