Activity 1: The glacial landscape at the snout of Sólheimajökull

This glacial landscape in Figure 1 shows several landforms associated with the melting of the ice as well as landforms of glacial deposition.

1. ***Either***, draw a sketch of this landscape on a separate sheet of paper and use the text boxes below to help you label the main features

   Or, on the photo, use the text boxes below to locate and label the main features

Large pro-glacial lagoon formed by the melting ice and trapped by deposited moraine

Thinning glacier covered with black sediment, some of which came from the eruption of Katla volcano in 1918

Till (moraine) deposited by the ice and revealed as the glacier has retreated

Icebergs in the lagoon formed by calving from the glacier snout

Deeply incised V-shaped river valley

Erratic boulder dumped by the ice

Bare rocky valley wall previously covered by ice and now subjected to freeze-thaw weathering

Figure 1

The glacial landscape at the snout of Sólheimajökull

Activity 2: Sediment roundness in till at Sólheimajökull

Glaciers act like giant conveyor belts transporting huge quantities of weathered and eroded sediment from the mountains to the lowland plains. Here the sediment – called till – is deposited to form landforms called moraines.

The small ridge-like lateral moraine in the photo (Figure 1) was formed at the edge of the glacier. It is located close to the valley side several hundred metres in front of the rapidly retreating glacial snout.

Till is typically very poorly sorted due to the lack of water transport. The sediment is usually very varied in its size and generally quite angular, due to the lack of attrition. To investigate the sediment further we can use the Power's Scale of Roundness (Figure 2) to assign each pebble to a roundness category, e.g. sub-rounded or very rounded.

Investigation: Is the sediment in glacial till angular?

2. (a) Use the Power's Scale of Roundness (Figure 2) to assess a selection of 30 pebbles in the photograph. Consider how to make your selection so that it is not bias! Complete the frequency table below. Total each column.

	Very angular	Angular	Sub-angular	Sub-rounded	Rounded	Well rounded
Number of pebbles						
TOTAL						

(b) Choose an appropriate diagram to represent the information. This could be a pie diagram (you will need to convert the figures into degrees), a divided bar chart, a radar diagram or a bar chart. Give your diagram a title, complete axes if appropriate and explain any colours or scale in a key.

(c) Describe and analyse your results.

(d) Write a brief conclusion focusing on the aim of the investigation.

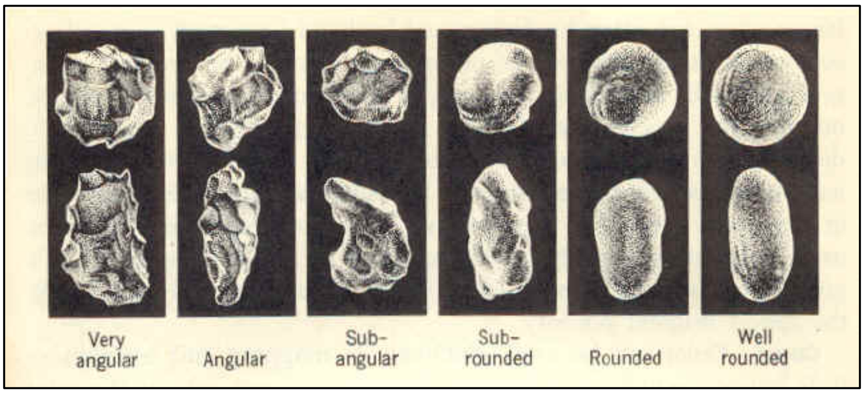
(e) Finally, write a brief evaluation considering the accuracy of your data collection and the reliability of your conclusion.

Figure 1

Part of the lateral moraine at Sólheimajökull

Figure 2

Power's Scale of Roundness



http://www.earthstudies.co.uk/Geography/Individual%20Research%20in%20Geography%20G3/Powers%20Scale%20of%20Roundness.html

Activity 3: The glacial system

Figure 1 shows the glacial system. In common with all systems it comprises inputs, transfers and outputs. Notice that the glacier has been divided into two zones:

- Accumulation zone – zone of net annual ***gain*** in the mass of the ice
- Ablation zone – zone of net annual ***loss*** in the mass of the ice
- Equilibrium line – this marks the level at which annual gain and loss are balanced

Several landforms of glacial deposition have been labelled on the diagram including the terminal moraine, which marks the furthest extent of ice advance.

3. (a) Can you suggest **one** additional input and **one** additional output not written on Figure 1?

(b) What is the evidence in the diagram that the glacier is retreating?

(c) Assuming that the glacier is retreating, what would you expect to be happening to the equilibrium line?

(d) Describe the location of the lateral moraine.

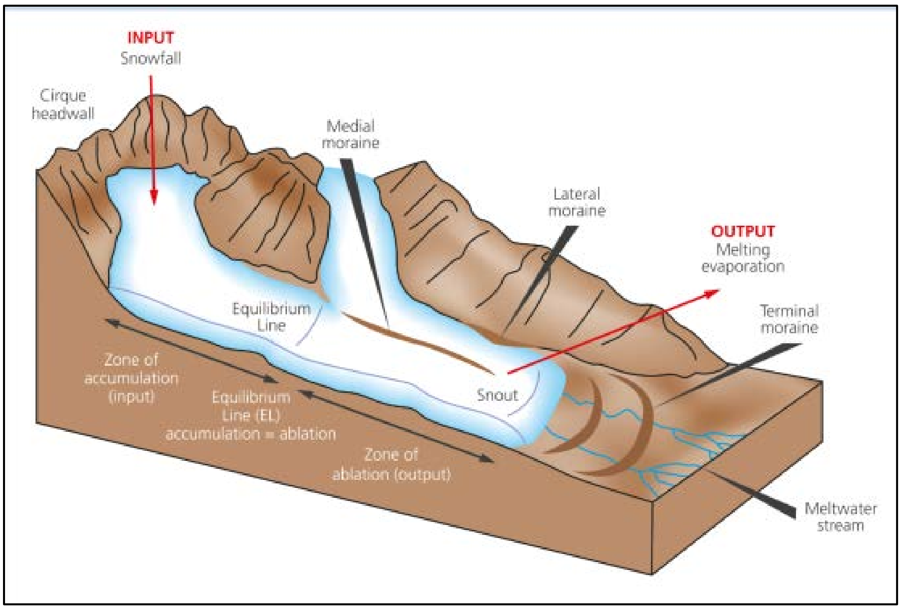
(e) What weathering process is likely to be responsible for the formation of the lateral moraine?

(f) On Figure 1, locate the medial moraine. Can you suggest how it has been formed?

(g) On Figure 1, locate and label the outwash plain.

Figure 1

The glacial system



Activity 4: *Sólheimajökull – the shrinking glacier?*

Sólheimajökull is one of the world's most studied and monitored glaciers. Photographic evidence is one of the best methods of assessing change in both area and volume of the ice. The two panoramic photos below (Figures 1 and 2) were taken from the same vantage point. They show the snout of the glacier in 1997 and 2008.

4. (a) Describe the changes in both the glacier and the glacial landscape.

The photograph below (Figure 3) is an oblique aerial photo showing Sólheimajökull in 2013. Notice that the glacier extends out like a tongue of ice from the Mýrdalsjökull ice cap. This type of glacier is called an outlet glacier. Figure 4 is a map of the area showing the position of the ice front in 2009.

(b) Locate and label the Mýrdalsjökull ice cap.

(c) On the glacier, locate and label the accumulation zone and the ablation zone.

(d) Draw a line to suggest where the equilibrium line might be and explain your decision.

(e) Describe the glacial landscape in front of the snout. Use the scale in Figure 4 to enable you to include some measurements.

(f) Use Figure 4 to help you locate and label Jokulhaus.

(g) Describe the changes that have taken place in the extent of the glacier between 2009 (Figure 4) and 2013 (Figure 3).

The final photo in this selection, Figure 5, is the most recent. Taken in 2015, it shows a huge difference compared to the previous photo taken in 2013.

(h) Attempt to label the following features and landforms on the photo:

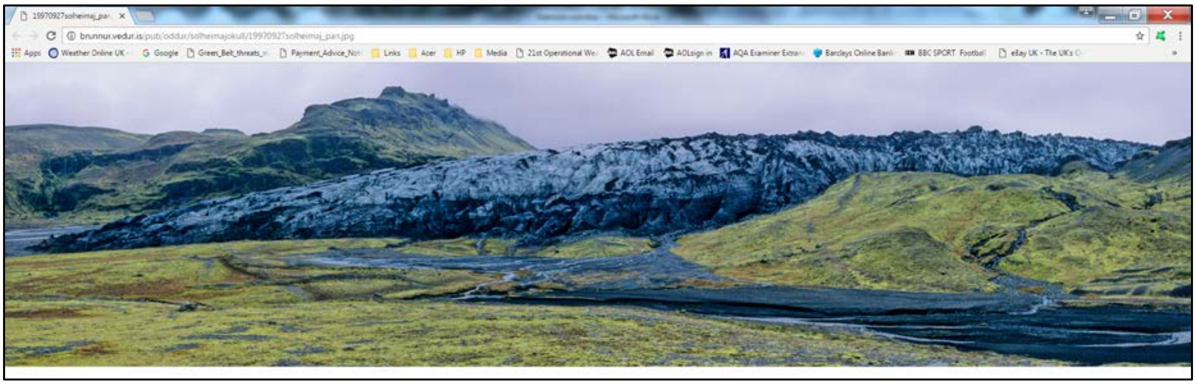
- Mýrdalsjökull ice cap
- Accumulation and ablation zones
- Equilibrium line
- Glacier snout
- Glacial lagoon and icebergs
- Isolated pools (kettle holes)
- Meltwater streams
- Till deposits
- Visitor car park

(i) Sólheimajökull glacier has become an extremely popular tourist attraction in recent years. Suggest the advantages and disadvantages of this surge in popularity.

(j) Conduct some internet research to see if you can update the photographic evidence presented here. Download recent photos and add annotated labels to describe the changes that have taken place.

Figure 1

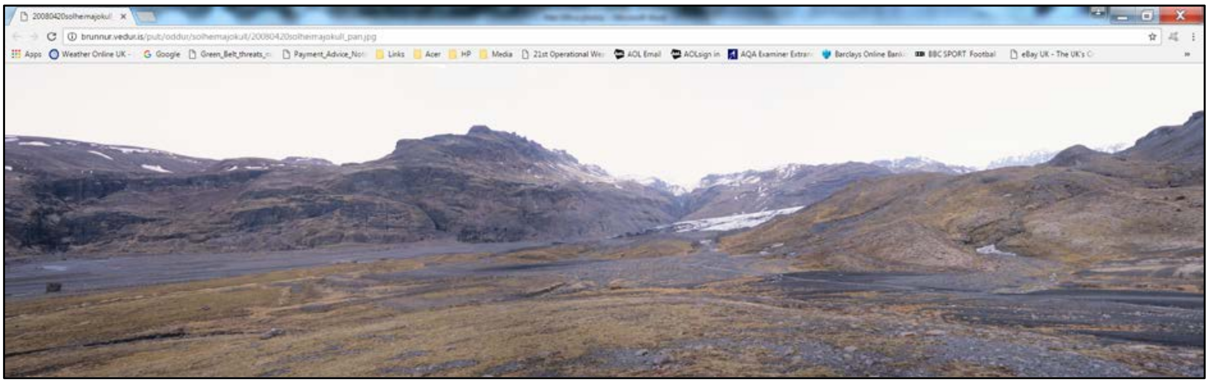
Panoramic photo of Sólheimajökull (1997)



http://brunnur.vedur.is/pub/oddur/solheimajokull/19970927solheimaj_pan.jpg

Figure 2

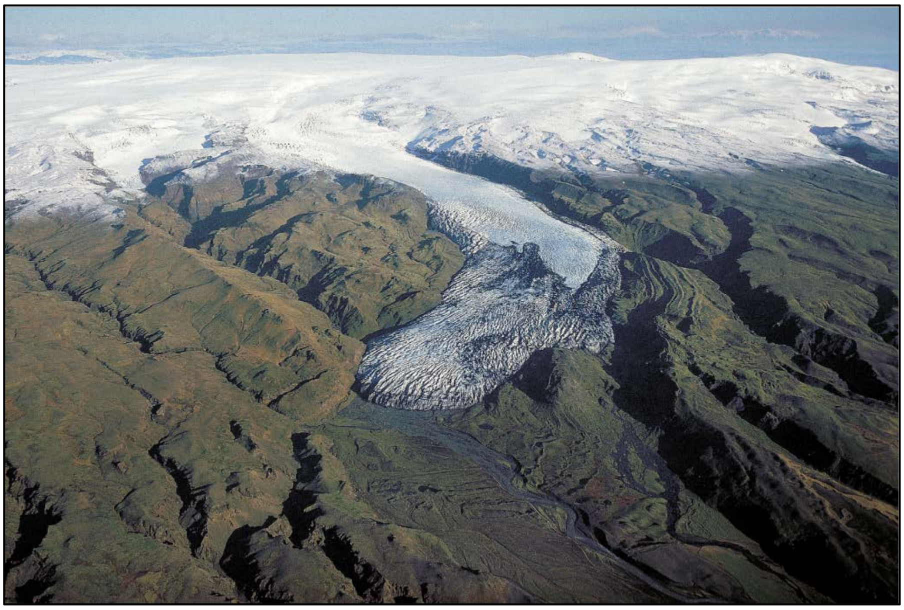
Panoramic photo of Sólheimajökull (2008)



http://brunnur.vedur.is/pub/oddur/solheimajokull/20080420solheimajokull_pan.jpgc

Figure 3

Oblique aerial photo of Sólheimajökull (2013)



http://brunnur.vedur.is/pub/oddur/solheimajokull/7615m_solheimajok.jpg

Figure 4

Topographical map of Sólheimajökull (2009)

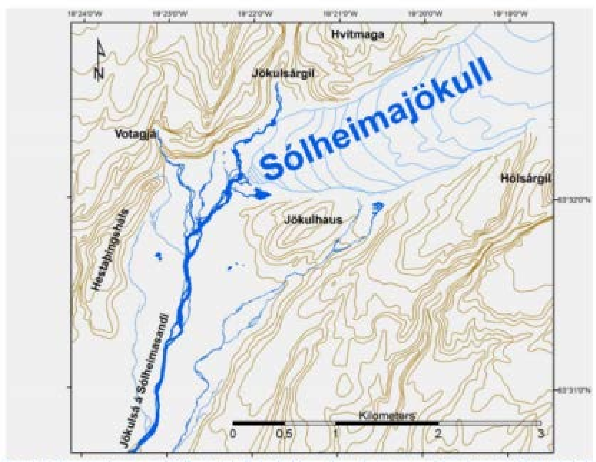
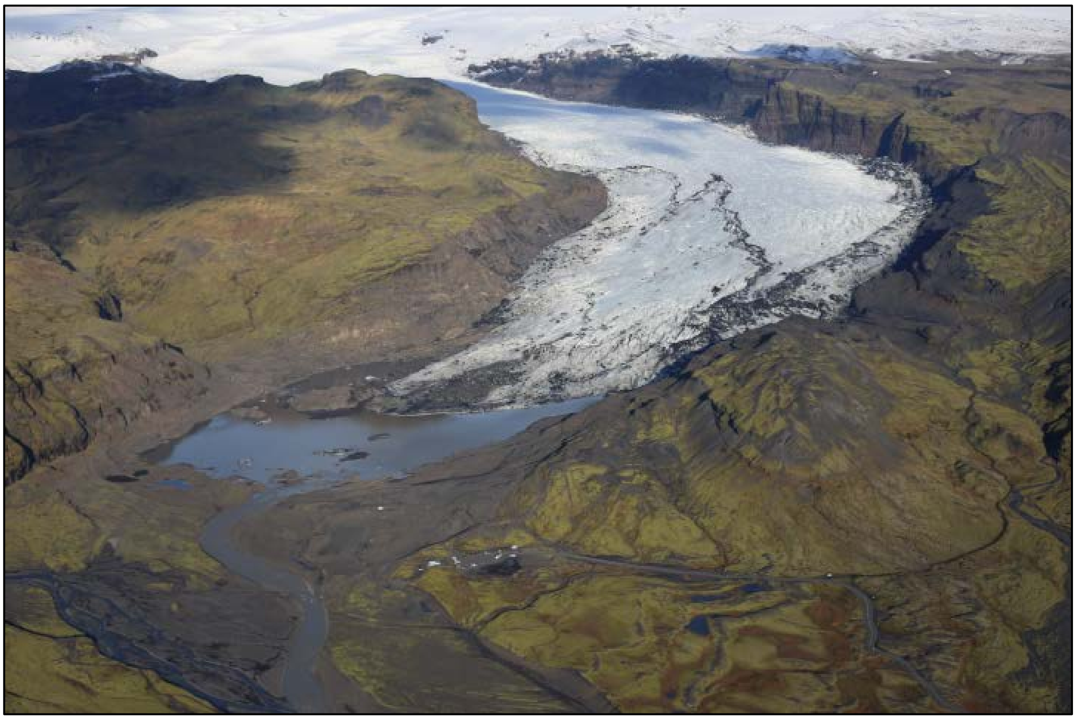


Figure 6. Topographic map of Sólheimajökull. Light blue colour show extent of the glacier in 2009. Made by extracting data from IS 50 V2 into ArcMap.

http://skemman.is/stream/get/1946/7407/19823/1/Bjarki_Friis_master_thesis_ready_for_printing_V3.pdf

Figure 5

Oblique aerial photo of Sólheimajökull (2015)



http://brunnur.vedur.is/pub/oddur/solheimajokull/IMG_9522.JPG_solheimajokull.JPG

Activity 5: Glacier processes

When studying a glacier, it is hard to imagine that movement is taking place. This is because it is happening extremely slowly. Yet, as the earlier photos clearly demonstrate, the entire glacier is retreating quite rapidly as ablation exceeds accumulation.

Despite the overall shrinking of the ice, there is still forward motion of ice within the glacier through the processes of basal slip and internal deformation (Figure 1). This forward motion is in response to gravity and mass.

- ***Basal slip*** – the sliding of a cohesive mass of ice over the bedrock, lubricated by meltwater
- ***Internal deformation*** – the plastic-like deformation or slippage of individual grains of ice in relation to each other

5. (a) Study Figure 1. Use simple sketches to describe the processes of basal slip and internal deformation.

Basal slip	Internal deformation

(b) Study Figure 2 which also shows the operation of these two processes. Locate the two processes on the diagram. Notice that two purple lines have been drawn to show the relative movement profile with depth for each process. Suggest why there are differences in the two purple line profiles.

(c) Suggest why on Figure 2 there is no 'plastic flow' (essentially internal deformation) close to the surface of the ice.

(d) Look at Figure 3. It shows how the processes of abrasion and plucking can erode the bedrock beneath a glacier. Describe how each of the two processes operates. Use simple diagrams to support your answer.

Abrasion	Plucking

(e) In the field, what evidence would you look for to suggest that these processes have been active in the past?

Figure 1

Processes of glacier movement

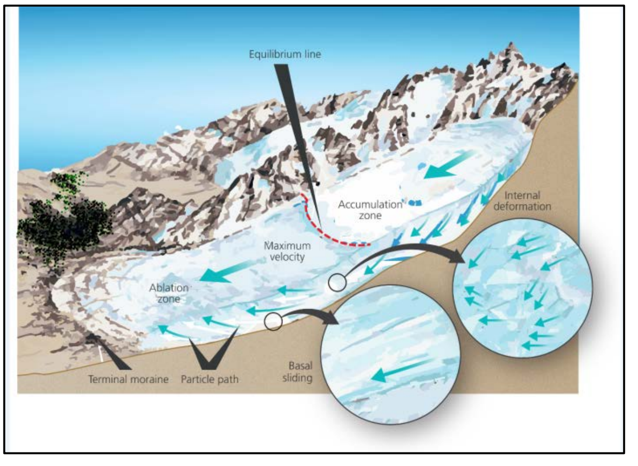


Figure 2

Movement characteristics of basal slip and internal deformation

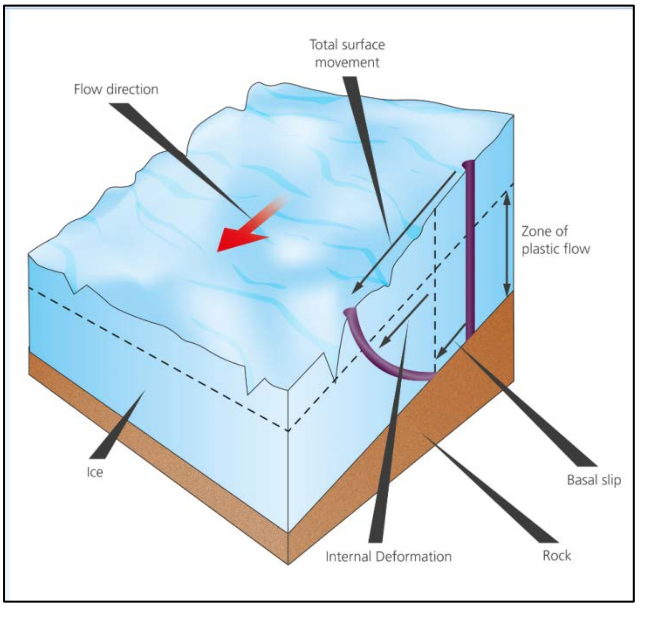
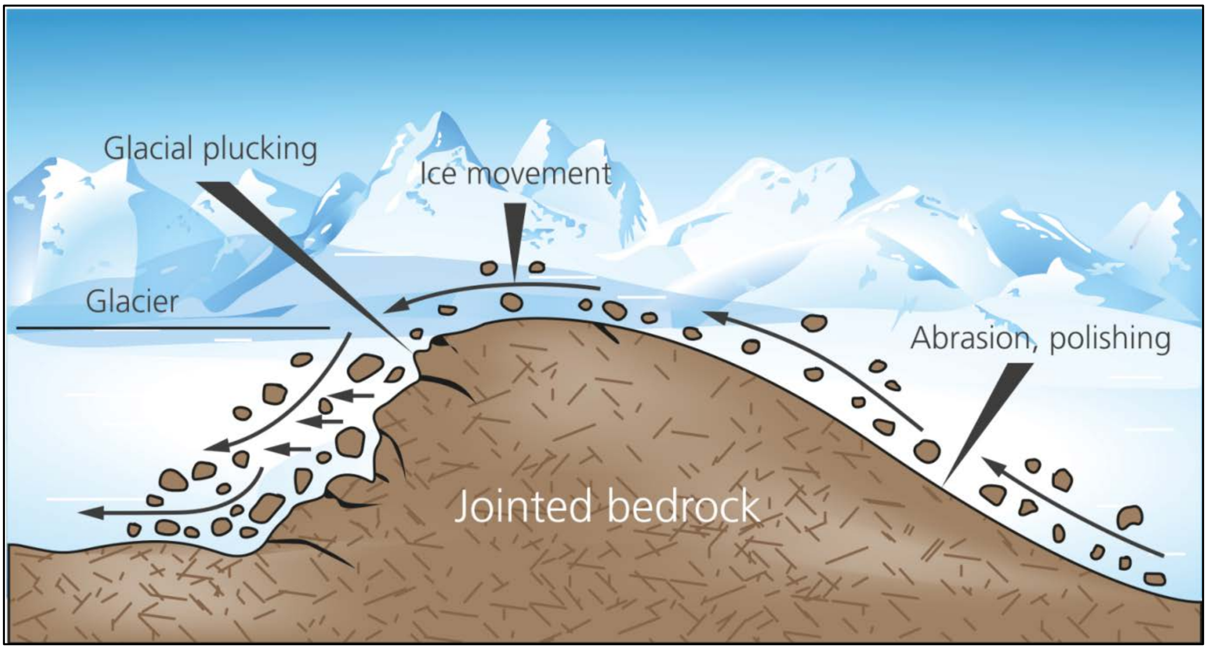


Figure 3

Processes of abrasion and plucking



Activity 6: Glacier fluctuations (1931-2010)

Figure 1 shows the advance (in blue) and retreat (in red) of Sólheimajökull 1931-2010. By 2010, the glacier had retreated some 1,300m since measurements first started in 1931.

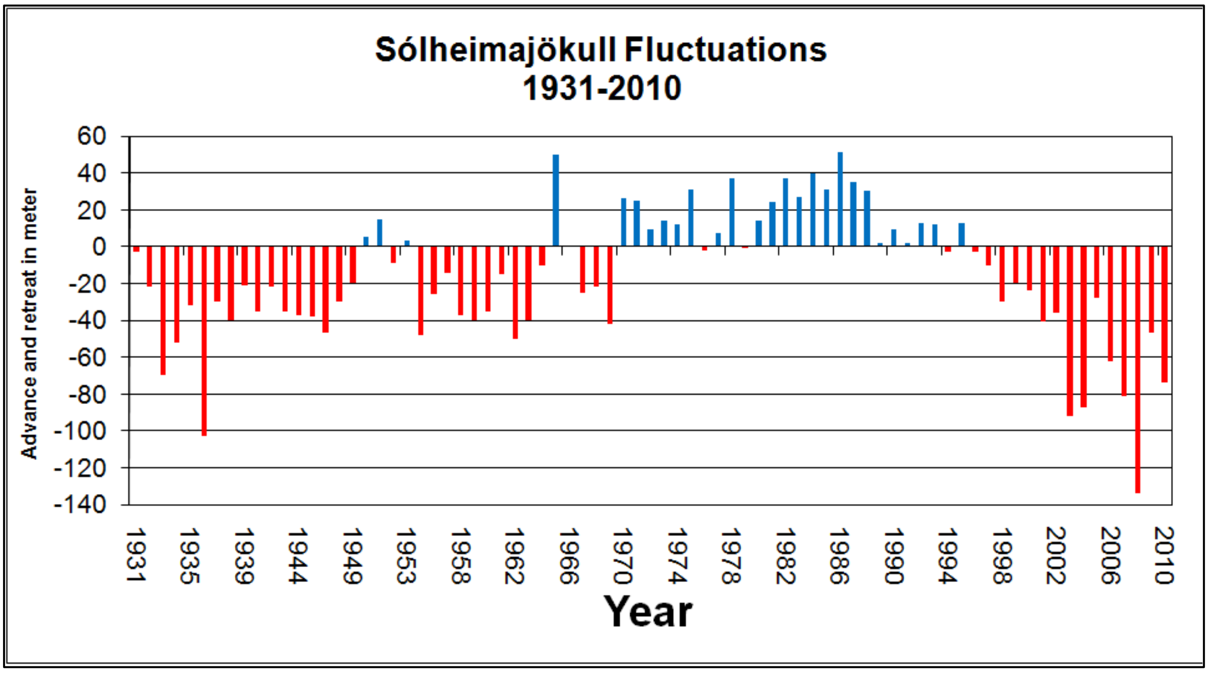
6. (a) Describe the pattern of advance and retreat 1931-2010.

(b) Do you think this graph provides strong evidence of the effect of recent global warming?

(c) In the period 1995-2015 the glacier retreated by nearly 900m. Use data in Figure 1 to approximate the total retreat in the period 2011-2015.

Figure 1

Sólheimajökull fluctuations (1931-2010)



Red = retreat

Blue = advance

http://skemman.is/stream/get/1946/7407/19823/1/Bjarki_Friis_master_thesis_ready_for_printing_V3.pdf