Glacial retreat in the Turgen mountains, Mongolia

Based on fieldwork carried out in 1910 and 2010

Royal Geographical Society with IBG

www.rgs.org

Read the original research report: http://onlinelibrary.wiley.com/doi/10.1111/j.1475-4959.2012.00486.x/full

How should you measure glacial retreat?

Two similar studies of glacial retreat in the Turgen region drew surprisingly different conclusions. Both used Geographical Information Systems (GIS) and the disparity is expected to be due to varying GIS techniques.

We found that the Turgen glacier has lost 19% of its surface area since 1970

A study of the Turgen region in 2007

Actually, we found that the glacier's surface area has decreased by 35%

A similar study published in 2008

Compiling evidence

For a more accurate measure of glacial retreat, a 2010 research project sought to compile multiple sources of data. This included the addition of primary data, as well a repeat photography for an extended timeline of evidence.

Repeat photography

As part of an expedition in 1910, the Turgen glacier was photographed. Researchers returned in 2010 to take photos of the same glacier, from the same angle. This primary data allows direct visual comparisons to be made

Satellite imagery

Recent technological advancements mean that we view the glacier from above, in its entirety. Satellite imagery from 1992 and 2010 was used. This secondary data provides accurate short-term evidence

Topographic maps

A topographic map from 1910 provides secondary evidence of the overall shape and size of the glacier. Russian maps from 1970 provide further historical evidence where satellite imagery is not available

Timeline of evidence for glacial retreat

A range of primary and secondary data sources allow results to be validated. The 1910 expedition extends previous records of the Turgen mountains by 40 years.

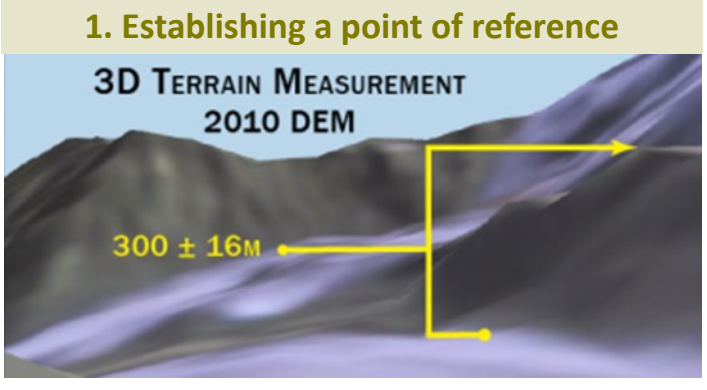
- **1910** — Topographic maps; Repeat photography
- **1950** — Aerial photos
- **1970** — Topographic maps
- **1992** — Satellite imagery
- **2010** — Satellite imagery; Repeat photography

Repeat photography

1910 photograph, taken by Douglas Carruthers and Morgan Phillips Price is held in front of the glacier as it is today. This reveals glacial down-wasting

Pixel analysis of down-wasting

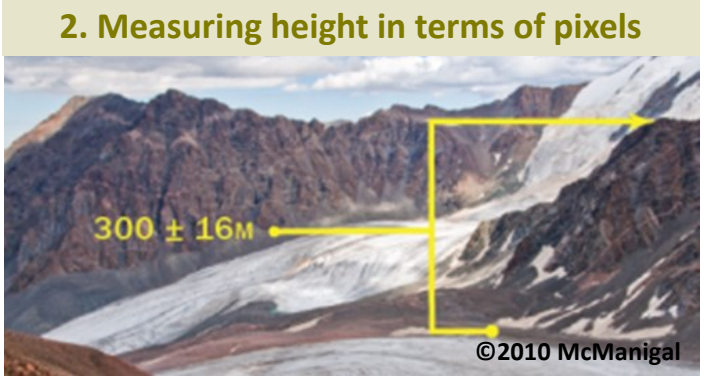
1. Establishing a point of reference



- **3D imagery of the landscape was collected in 2010 at the same angle as the photos**
- **This is used to calculate the distance between the glacier's surface and the ridge:**

  Distance = 300 metres, accurate to ±16m

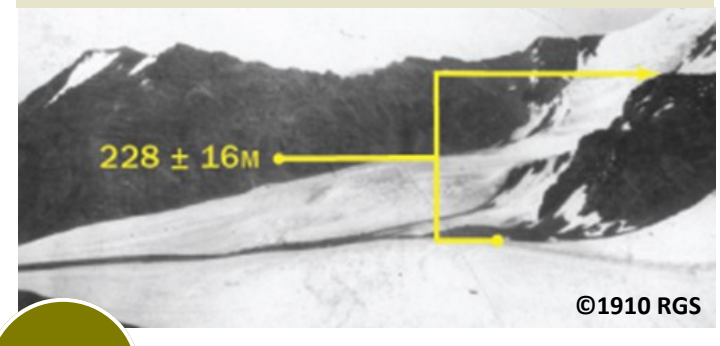
2. Measuring height in terms of pixels



- **Repeat photos taken in 2010**
- **Height measurement is converted from metres into pixels:**

  300 metres in the 3D imagery
  = 262 pixels in the photograph

3. Comparing height across photos



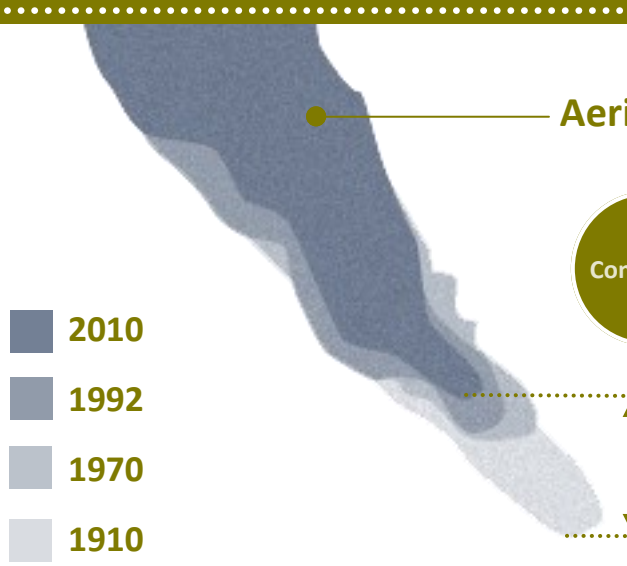
- **Original photos taken in 1910**
- **Height is measured in terms of pixels:**

  199 pixels = 228 metres
- **1910-2010 height difference is calculated:**

  228m (1910) - 300m (2010) = -72m

Conclusion *The glacier down-wasted by 72 metres between 1910 and 2010, to an accuracy of ±16m*

Analysing glacial retreat



Aerial view of the Turgen glacier (1910-2010)

Conclusion *The glacier retreated by around 600 metres between 1910 and 2010*