Royal Holloway Geography for Schools Lecture Series

Quantifying glacier change in the Patagonia Andes

Aim: To use satellite imagery to quantify length change of the Viedma Glacier

In this activity you are provided with .kmz shapefiles that trace the outline of the lower section of the Viedma Glacier from 1986 to 2019. The date and source of the imagery is shown in the Table below.

Date	*Satellite mission*	*Date*	*Satellite mission*
9th December 1986	Landsat	21st January 2015	Landsat
12th March 2001	Landsat	18th October 2016	Sentinel
20th February 2011	Landsat	7th March 2019	Sentinel

Two additional shapefiles are provided – a line tracing moraine crests, and a polygon shapefile tracing the outline of moraine deposits, which indicate the former ice margin of the Viedma Glacier. Based on evidence from across Patagonia, for this exercise we will assume a latest date of 1860 for the Viedma Glacier occupying this moraine position. Using these shapefiles students can calculate the distance of recession from 1860 to 1986; 1986 to 2001; 2001 to 2011; 2011 to 2015; 2015 to 2016; and 2016 to 2019.

The .kmz files can be added to either Google Earth Pro or Arc GIS so that students can determine the distance Viedma Glacier has receded over time.

Google Earth:
Click a shapefile file in File explorer to open the shapefile in Google Earth. They will initially be saved in your Temporary Places. Repeat for each shapefile.

ArcGIS:
In ArcGIS use the Conversion Tool 'KML to Layer', which works with .kmz extensions also. Simply choose the shapefile you wish to add to the map and select a folder location to save the output file. Repeat for each shapefile.

<u>Measure glacier recession</u>
In Google Earth use the ruler tool to measure the distance between each successive glacier outline. In ArcGIS Pro use the Measure Distance tool under the Measure tools on the Map tab.

You should be able to see a glacier snout position on the south side of the moraine in the lake. Use this as the point from where to measure back to the snout to 1986. Then measure from the 1986 snout to 2001 and repeat until you have all the measurements.

<u>Quantify retreat rate</u>

To calculate retreat rate in metres per year (m/a) for each of the time intervals –

Distance (m) / Number of years between images.