Royal Holloway Geography for Schools Lecture Series

Quantifying glacier change in the Patagonia Andes

In this lecture we explore how satellite remote sensing has been used to quantify glacier recession in response to climate heating. Remote sensing can be defined as the practice of deriving information about the Earth's land and water surfaces with images acquired from an overhead perspective, using electromagnetic radiation reflected or emitted by the Earth's surface. As such, satellite remote sensing has been an essential tool for monitoring glacier response to climate change because it allows scientists to monitor glaciers in remote mountainous regions and at the global scale.

The talk begins with key findings of the latest Intergovernmental Panel on Climate Change (IPCC) report demonstrating how we know climate heating caused by greenhouse gas emissions since the Industrial Revolution have led to warming unprecedented in over at least the last 2,000 years. We then explore what satellites have observed over recent decades by looking at a time series (spanning 1986 to 2019) of satellite images of the Viedma Glacier in Patagonia. The Viedma Glacier is one of the largest outlet glaciers of the Southern Patagonia Icefield, the largest mid-latitude ice body in the Southern Hemisphere. It is these kinds of mountain glaciers that are predicted to be the largest source of sea level rise in forthcoming decades before larger meltwater volumes are released from the Greenland and Antarctic ice-sheets. The talk shows how digitised shapefiles from the Viedma Glacier (see accompanying activity) can be used to calculate rates of recession from 1986 to 2019, showing an acceleration in retreat over recent decades. We will also see how the most recent moraine landforms in front of the Viedma Glacier can be used to extend the record likely back to at least 1860 (and the Industrial Revolution).

We end by looking at recent studies using more advanced satellite data that can quantify glacier elevation and therefore rates of thinning and mass loss, in response to climate heating. One recent global study for example has calculated a mass loss acceleration of 48 ± 16 gigatonnes per year per decade from mountain glaciers during 2000-2019, leading to accelerated sea level rise. Glaciers will continue to recede and contribute to sea level rise in forthcoming decades, however a rapid electrification of global economies can limit the worst predicted impacts of sea level rise.