Utilizing Google Earth Engine to Retrieve the Devon Ice Cap's Equilibrium Line Altitude

Zhou, Kevin (School: Troy High School)
Liu, Peizhi (School: Troy High School)

Glaciers have exhibited increased melting rates due to rising global temperatures resulting from climate change. To track the effects of climate change on glacial mass balance, the equilibrium line altitude (ELA), the height at which snow accumulation equals snow ablation (mass loss), is commonly used. However, determining a glacier's ELA via prior methods has been cumbersome due to limited satellite imagery and large amounts of data processing. Google Earth Engine (GEE) bypasses these issues, granting users free access to petabytes of regularly updated, pre-processed satellite imagery without tedious data download. We propose utilizing GEE as a novel approach to determine a glacier's ELA and extent of melt, observing the Devon Ice Cap from 2015-2018 as a case study. We used satellite data from various satellites (Sentinel-1, Landsat 8, etc.) and GEE's built-in classification algorithm functions to cluster the ice cap into regions of differing melt levels. By doing this, we were able to obtain the Devon Ice Cap's ELA values each year, which were consistent with past in-situ measurements. Using the melt clusters to generate accumulation and ablation zones, we were then able to estimate the extent of glacial melt of the ice cap as a percentage. Currently, satellites like Sentinel-1 only being operational for a few years limits our ability to establish long-term trends. However, as more data is accrued over time, GEE's efficacy in tracking glacial change will only grow, making our methodology essential to properly monitor the effects of climate change on Earth.