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# Semi-Automated workflow for glacier monitoring using Google earth engine

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**Abstract**

Glaciers are a major source of fresh water and very sensitive to climate change. The temporal change detection and their delineation of a glacier are time consuming task. Most of the studies are focused only on the selected glaciers. The present study is an attempt to develop a workflow using Google Earth Engine (GEE) that will select and classify glaciers with minimal human intervention. This program requires location of desired glacier in longitude and latitude which will select automatically images from the Landsat archives. This program can be applied to any glacier in the world. As a sample study area, Klinaklini glacier in Canada is selected which is a debris free glacier. The NDSI (Normalized Difference Snow Index) method is used for debris free glacier delineation, which uses green (G) and shortwave infrared (SWIR) bands. For accuracy assessment, Randolph glacier inventory version 6 has been used as reference data. After running the program, it computed the temporal changes in the targeted glacier; mapped the glaciers and their outlines; carried out minimum, maximum, average elevation and slope analysis. The results show not only good agreement with the reference data but also improvement in spatial data analysis. The results below (Fig. 1) shows the area change of the Klinaklini glacier from year 1990 to 2017 using images from Landsat TM, ETM+ and OLI. The glacier outlines (Fig. 2) are also displayed over the false color image composite. The program developed using Google Earth Engine can expedite the glacier delineation and classification tasks which can be essential for computing long term glacier changes using the datasets available in Google Earth Engine.

***Keywords:*** Google Earth Engine, Debris free Glacier, NDSI, Temporal Change

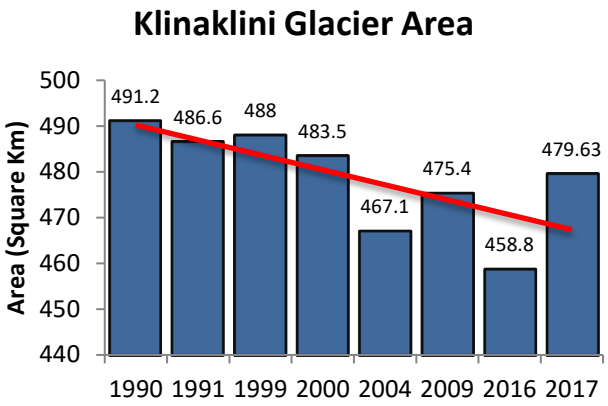


Figure 1: Klinaklini glacier area changes from 1990 to 2017

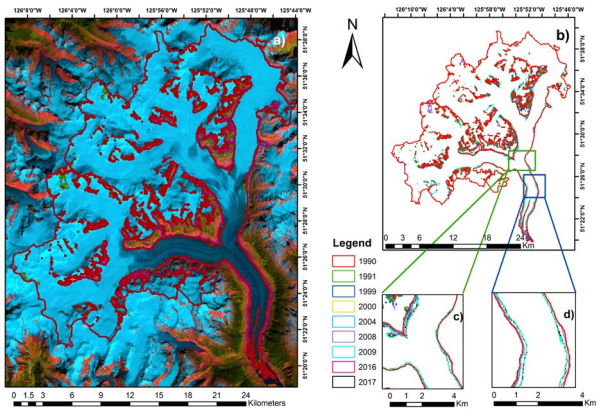


Figure 2: All outlines of Klinaklini glacier Canada

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