

Shoreline Changes and Glacier Retreats Under Climate Change Conditions in Svalbard Using Remote Sensing and GIS Technique

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Date: 2023/04/07

Abstract

In recent decades, climate change has become one of the most global concerns, and rapid climate change is one of the biggest threats to the Poles. Among the most dramatic evidence of Earth's climate changes are mountain glacier retreat and disappearance. Therefore, the main objective of this study is to investigate landform behavior in Kaffiøyra, Svalbard under the impact of climate change. The study utilized remote sensing and GIS techniques to quantify shoreline changes, glacier retreats, and tundra area changes for almost 40 years, which are significant indicators of the impacts of climate change. Landsat images were used to extract the boundaries between land and sea (shoreline), land and glaciers, and land and tundra from 1985 until 2022. After that Digital Shoreline Analysis System (DSAS module) and GIS technique were used to quantify the rate of shoreline change and the change of glaciers and tundra area. The shoreline change results indicate that there are two sorts of shorelines: the shoreline in zone 1, 3, and 5 is relatively stable, with linear regression rates (LRR) ranging from -2 m/yr to +3 m/yr, whereas the shoreline in zone 2 and 4 is significantly eroded, with the LRR ranging from -65 m/yr to +10 m/yr. The study also calculated the area change of seven glaciers and three tundras. Aavatsmark, Elise, and Andreas glaciers, which have the most area, have lost 63.1%, 35.1%, and 54.6% of their area in 37 years, respectively. The tundra extraction results are only 20/37 years, due to the effect of various factors such as image noise, scan line error, and difficulties in defining the boundary between the tundra and land. The area change of tundra trend to increase but not significantly, less than 10%. In summary, the integration between remote sensing and GIS technique has been well-determined and pointed out the behavior of shoreline change rate, glacier, and tundra area change. The glacier's shoreline (zone 2, and 4) experiences the most severe erosion. The area of seven glaciers decreased, with the two largest glaciers losing more than 50 % area. The tundra area is increased but not significantly. The study's

findings be able to use as evidence for proving the impact of climate change on the landform of Svalbard.

Keywords: climate change, Landsat images, shoreline changes, glacier retreats, tundra, Svalbard