Geographical planning of space quarterly journal

Journal Hopepage: www.gps.gu.ac.ir

Golestan University

Research Paper

Investigation of thermal and humidity anomalies between the present and Pleistocene and reconstruction of climatic conditions using geomorphic evidence A Case study the Northeastern heights of Binalood

Mahnaz Naemi Tabar [a*], Mohammadali Zanganeh Asadi[a]

[a] *Department of Geomorphology, Faculty of Geography and Environmental Sciences, Hakim Sabzevari University, Sabzevar, Iran*

A R T I C L E I N F O

A B S T R A C T

Pleistocene climatic changes are of special importance due to the time of their occurrence and their role in the formation of the current landscape of the planet. The current research aims to investigate the geomorphological evidence of Quaternary glaciers in the northeast of Binalud highlands. The border snow height was estimated by Wright and Porter's methods, including height ratio, cirque floor height, and cumulative area ratio. Based on the form of curve lines in the topographic maps, 55 circuses were identified in the northern, eastern, and western parts of the research area. The analysis of the estimated heights proves that the snow height of the permanent border in Porter and Wright's method is more consistent with reality than other methods due to the reflection of the effect of the roughness direction on the snow height of the border. The analysis of the findings shows that this region was under the rule of the glacial morphogenesis system during the cold periods. According to the correlation between the height and average annual temperature and the height and amount of annual precipitation, the thermal and humidity gradient was calculated. The findings of the research show that the snow line of the permanent border is located at an altitude of 2600 and 2100 meters with the Wright and Porter methods. According to this line and the drop in temperature to the value of 0.7 degrees for every 100 meters of height, the current temperature difference with the Pleistocene period was calculated to be 6.4 degrees Celsius. The results showed that the amount of annual precipitation in the Pleistocene period was 130 mm higher than today's average.

∗. Corresponding author (Email: mahnaznaemi@hsu.ac.ir)

Extended Abstract

Introduction

The evaluation of Quaternary climate changes has always been one of the most controversial and attractive topics that have attracted the attention of geomorphologists due to the reflection on morphogenic systems and forms created on the surface of the earth. In the Quaternary period, glacial and interglacial conditions occurred alternately and geomorphological evidence has left undeniable. By using this evidence, it is possible to determine the boundaries of snow and the limits of glacial expansion and to study the climatic changes of that period. This is possible since the external processes that change the shape of the earth have not been able to completely remove the remaining effects of the Quaternary glacial erosion.

Methodology

In estimating the snow height of the Quaternary boundary, the first step is to identify glacial cirques as the most important evidence of the glacial process. To track the circuses of the region, topographic maps of 1/50000, the layer of curve lines, and the digital height model have been used. Climatic data were obtained from rain gauge stations during a 20-year statistical period (1378-1398). To identify this evidence, the form of curve lines, the state of waterways, and the 30x30 digital elevation model were used. According to the purpose of the research and to achieve the desired results, the map of the circus shapes of the region, temperature, and precipitation data as the main variables of the region were analyzed and evaluated in the determination of snow borders. In the next step, 55 circuses were identified in the study area. According to the snow height of the boundary estimated by the Wright and Porter method (height ratio, cirque floor height, and cumulative area ratio), the past temperature of the stations was estimated and with the help of this temperature, the past precipitation was also reconstructed.

Determining the border snowline

Write method

In this method, the height of the snow line was 2600 meters. In other words, during the coldest period ruling the region, there was always snow at this height, or in other words, the average temperature on this line was equal to zero degrees Celsius.

Porter's method

Circus floor height method

To use the method of the height of the circus floor to find out the past border snow and the water and ice balance line in the study area, view or mode has been used.

Height ratio method

The snow line was obtained at an altitude of 2200 meters.

Cumulative area ratio method

First, the initial boundary snow is selected using the height ratio method. Then, the 100-meter lines of the specified glacier surface and the area between two consecutive curves (at a distance of 100 meters) are measured and used to create a cumulative curve that graphically displays the area of the glacier with the height distribution..

Results and discussion

In the studied area, 55 circuses with reasonable density were identified on the northern slopes.

Ice and water balance line

In the studied area, the water and ice balance line in Wright's method was 1900 meters, in Porter's method (circus floor height 2700 meters), (height ratios 2200 meters) and (cumulative area ratio 2800 meters) were obtained.

Current ambient temperature of the area

The current average temperature in the region ranges from 12°C in the highlands (northeast and southwest) to 3°C in the plains.

Reconstruction of ambient temperature conditions in the Quaternary

The results of the digital evaluation of the average annual temperature map in the past period show that in the northern and western highlands of the region, cold cells prevail more than any other place, and its value is the lowest, -3.5 degrees Celsius in the highlands. It varies up to the maximum of 6 degrees Celsius in the region.

Reconstruction of environmental precipitation conditions in the past

The amount of past precipitation in the zero-degree isoline is calculated to be 630 mm.

Current ambient rainfall in the region

The current rainfall map in the region shows that the minimum rainfall in the region is 281 mm and the maximum rainfall is 504 mm in the highest part of the region.

Comparison of current and past temperature conditions of the region (freezing anomaly)

Assuming an adiabatic drop in temperature during the cold season to the value of 0.7, it can be seen around altitudes above 2500 meters. This amount of drop was assumed because the adiabatic temperature drop is always higher in colder regions than in hot regions.

Comparison of current and past rainfall in the region (rainfall anomaly)

Rainfall in the past period was 1.98 times more than the current one. In other words, when the average annual temperature has decreased by 6 degrees Celsius compared to today, the average rainfall has increased twice..

Conclusion

The findings of the research show that the snow line of the permanent border is located at the height of 2600 and 2100 meters by Wright and Porter methods. Temperature and precipitation information indicates that the maximum and minimum temperature is 12 and 3 degrees Celsius and the maximum and minimum precipitation is 504 and 281 mm at present and in the last quarter, the maximum and minimum precipitation is 630 and 440 mm. And the maximum and minimum temperatures were 6 and -3 degrees Celsius, and by comparing the climatic conditions of the present time and the Pleistocene, we can conclude that the temperature difference is 0.7 degrees Celsius and the precipitation difference is 130 mm. A total of 55 circuses were identified, with the highest number of circuses located in the northern and western highlands. To reconstruct the water and ice balance line, considering the change of geomorphological processes in the region and the more dominant process, the best tool is to use wandering moraines and glacial valleys in the region. The balance line of water and ice in Wright's method was 1900 meters, in Porter's method (circus floor height 2700 meters), (height ratios 2200 meters) and (cumulative area ratio 2800 meters) were obtained.

Authors' Contribution
Authors contributed equally to the conceptualization and writing of the article. All of the authors approved thecontent of the manuscript and agreed on all aspects of the work declaration of competing interest none.

Conflict of Interest
Authors declared no conflict of interest.