



Extraction of Snow-covered Area of Sabalan Mountain Using Landsat Satellite Images by Object-oriented Classification Method

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1-Introduction

One of the most important water sources in mountainous areas is snow cover, which significantly affects the amount of runoff on the ground. Moreover, seasonal snow cover influences biotic components and water quality in rivers. Snow cover is one of the most important sources of fresh water and affects the hydrological system of different altitudes in mountainous areas. Climate change has a major impact on the diversity of snow cover, thereby having adverse effects on snowmelt runoff and glacier mass balance. Remote sensing, due to its advantages, can control large areas with high spatial and temporal resolution. This technology provides the ability to quantitatively measure the physical properties of snow and water in remote and inaccessible areas where ground surveying may be expensive and dangerous. Therefore, it can be said that in basins with no accurate information on snow cover, this technology can be used to extract snow cover.

2-Methodology

The study area is Sabalan Mountain located in Ardabil province and its surroundings. In this study, Landsat 8 satellite images for 2020 and Landsat 5 images for 2000 were used for February due to the presence of sufficient snow to extract the snow-covered area. It was tried to select images with minimal errors. The images were mosaicked after ensuring the absence of common errors and atmospheric correction using the FLAASH model in ENVI5.3 software, then a part of the image was cut based on the research. In the eCognition software, the images were classified into three classes of water, soil, and snow using NDSI and $NDSI_{NW}$, then the classification result was transferred to ArcGIS software and the snow cover area was calculated. The NDSI was proposed based on the normalization of the green band difference and SWIR1 on MODIS images. NDSI and MNDWI are among the most widely used indices for implementing SCG maps.

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3-Results and Discussion

In this research, in order to obtain a snow cover map and its area, an object-oriented classification and NDSI and NDSI_{NW} have been used. The snow-covered areas extracted using the object-oriented method for the years 2000 and 2020 were calculated as 2500 and 1954 square kilometers, respectively. The values of 2557 and 1937 square kilometers were extracted as snow-covered area by applying NDSI_{NW} and 2610 and 2577 square kilometers were extracted by applying NDSI. The NDSI shows a larger snow and ice cover than it exists because it considers water as snow (Commission Error). Therefore, it is not suitable for distinguishing water from snow or extracting snow-covered area in areas where water exists. In contrast, the NDSI_{NW} is able to extract snow cover in areas with aquatic terrains because it uses near-infrared and middle-infrared bands and the difference between them in snow reflection to remove water-covered area. The classification maps were validated using samples taken from the satellite images and for both 2000 and 2020 images, overall accuracy coefficient and the kappa coefficient of the classification were estimated 0.99 and 99%, respectively.

4-Conclusions

In the present study, the object-oriented classification method was applied for detecting and extracting the snow-covered area based on the combination of optical bands on the Landsat 8 and Landsat 5 images of Sabalan region in Ardabil province. Then, the normalized difference snow index (NDSI) and the normalized difference snow index with no water information (NDSI_{NW}) were applied and the results of them were compared to identify the snow cover using the accurate object-oriented classification method. According to the results of the object-oriented classification map and the applied indices, it was found that both indices were able to extract snow cover compared to the object-oriented method in cold and winter area. However, the NDSI index had some error in extracting the snow-covered area due to not limiting aquatic terrains and water-covered areas and considering them same as the snow-covered areas, especially in areas where the presence of water is significant. Therefore, in areas with little or no water, it can be a very good index for extracting the snow-covered area.

Keywords: Object Oriented Classification, Snow-covered Area, NDSI and NDSI_{NW} Spectral Indicators, Sabalan Mountain.

5-References

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