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Investigation of Changes in Snow Cover and Surface Temperature with the Topographic Component of Elevation Case Study: Urmia Lake Basin

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1-Introduction

Snow is a common global meteorological phenomenon that is recognized as one of the important components of the hydrological cycle and an environmental hazard. The characteristics of snow cover and the estimation of geophysical parameters of snow are of significant importance in water resources management (Asghari and Madirzadeh, 2019). Snow cover changes spatially and temporally during different seasons of the year. The reduction or expansion of snow cover in an environment shows the presence of changes in that environment and acts as an indicator of climate change (Singh et al., 2018). In the highlands, due to the roughness of the land and the presence of rough weather, there is a limitation in establishing meteorological stations. In this situation, remote sensing data have a high potential to provide spatial data suitable for describing spatial and temporal patterns of snow. Remote sensing is an effective technique to study snow properties at local and global levels; land surface temperature (LST) is a key parameter in planning, such as hydrology, meteorology, and agriculture (Meng et al., 2016). Currently, the data from meteorological stations are the most important decision-making reference in this case. However, in most cases, this information is not exactly related to the surface of the earth, and due to the relatively large distance from each other, the meteorological stations can determine the temperature of the entire region and the importance of extracting the surface temperature becomes apparent. Therefore, one of the important criteria for regional and regional planning, especially in agriculture, is determining the surface temperature (Afzan et al., 2013).

2-Methodology

The data set of the average resolution radiometer (Modis) with a spatial resolution of 500 m is very convenient for evaluating the snow cover of each catchment, which has 10000 km2 or larger area (Afifi et al., 2021). This research used terra satellite images to calculate snow and ground surface temperature. In this way, the mean annual average of 12 months

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of the studied years was calculated, and then the images were calculated for the earth's temperature. Then, daily snow precipitation was calculated for 12 months of the study, seasonally and annually. Finally, the images were transferred to the ArcMap environment for computing. In this research, for calculating the mean of 12 months of study (2000 - 2020), almost 7600 images were processed using coding within google heritage.

3-Results and Discussion

This study used MODIS sensor images to evaluate the ground surface temperature and snow cover level and investigate the relationship between these two components. ALOS satellite images are also used to show the topographic status of the area. The lowest temperature is related to January, with a maximum of 9 degrees and a minimum of -14 degrees, and the highest value of temperature, with a maximum of 48 degrees Celsius and a minimum of 24 degrees, is related to the months of July and August. Examination of the maps shows that in all months, the minimum temperature is related to high and mountainous areas, and the highest temperature is in low and flat areas, especially around Lake Urmia. Examination of seasonal average temperature maps shows that the highest temperature in the region in spring is 39 degrees, and the lowest is 8 degrees. Summer's maximum and minimum values are 47 and 23 degrees Celsius, respectively. The highest temperature in autumn is 24 degrees, and the lowest is -2 degrees. In winter, the maximum temperature is 17 degrees, and the minimum is -11 degrees. Mountainous areas have lower temperatures due to their altitude, but the central areas of the basin and around Lake Urmia have higher temperatures because these areas are low and flat. In spring and summer, around Urmia Lake, due to the presence of vegetation, has a relatively low temperature, but in autumn and winter, due to the drying of vegetation, these areas have the highest temperature. With the onset of snowfall in October, the area of snow cover in the region has increased and will reach its maximum in January. The area of snow cover in January is 44987 square kilometers. In this month, there is almost the whole area except the surface of Lake Urmia and around the snow lake. After January, Bahman, with an area of 41384, has the highest level of snow cover in the region. With the warming of the weather from the beginning of the year and the melting of snow, the area of snow cover decreases so that in April and May, the area of snow cover is small in area and only around the basin; The area of snow cover in April and May is 5888 and 1028 square kilometers, respectively. From June to September, the snow melted completely, and there was no snow in the area. In the studied years, in the altitude classes of 1431-1243%, the average annual snow cover was less than 10%, but in 2007, the snow cover in this altitude class increased and reached 17%. At altitudes of more than 3000 meters in all years, the amount of snow cover is more than 98% of the area. In fact, these tables show that the level of snow cover is directly related to height.

4-Conclusions

Snow is one of the important elements of barley that snow cover affects the energy balance of the surface of the earth through feedback and phase change. Because snow is highly reflective, it plays an important role in regulating the global climate. This study extracted the snow cover (Sc) area and land surface temperature (Lst) monthly, seasonally, and annually using Modis satellite products. The relationship between these two with different elevation classes in Urmia Lake was investigated. The results of monthly and seasonal temperature maps show that mountain and high-altitude regions have low temperatures due to high temperatures. However, the central area around Urmia lake, which covers the low and low regions, is more than 1500 m, but in the highlands, up to 3500 m in the same season, the temperature of more than 3500 m in the same season has reached 10c. The mean annual temperature showed that in the lowlands and areas, from 2000 m in all the studied years, the temperature ranged from 25 to 31 degrees, but at altitudes above 3500 m, the mean annual temperature of 7 – 13c.

Keywords: Modis sensor, snow cover level, ground surface temperature, topographic component of height, Urmia Lake catchment area.

5-References

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