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Study of the relationship between land use and vegetation changes with the land surface temperature in Namin County

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Abstract

Background and Objective Rapid development of cities due to extensive changes in land use and land cover has had negative effects on global environmental quality. Land cover and land use changes, and the development of urban and agricultural regions and deforestation are changing the regional and local temperature regime. Knowing the land surface temperature degrees contribute significantly to a wide range of issues relating to the Earth science such as urban climate, global environmental changes, and the study of the interaction of human and the environment. The lack of sufficient meteorological stations to be aware of temperature values in regions lacking a station is considered as a major flaw in monitoring the land surface temperature. Due to the information limitations, collecting data especially to a large extent, is associated with many problems and obstacles, and the real-time access is difficult or impossible. Therefore, the need to use remote sensing technology with time conditions along with the feature of continuity and data collection in wide ranges can be very effective.
The purpose of this study is to investigate the land surface temperature of Namin county in a period of 28 years and to compare the obtained results with land use and vegetation changes.

Materials and Methods The data used in this study included Landsat 8 satellite image of the OLI sensor in order to extract land use map and TIRS sensor image to extract land surface temperature for the year 2015. Moreover, Landsat 5 satellite image of the TM sensor were used to extract land use map by using visible and infrared bands, and also to extract land surface temperature by using thermal bands for the year 1987. Images were taken in late spring and early summer due to the lack of high cloudy and snowy covers , as well as the high intensity of sunlight. The eCognition8.9 software was used for object-based classification.
Classification in five classes (dry and irrigated farming, rangeland, forest and residential) and six classes (dry and irrigated farming, rangeland, forest, residential and water bodies) were selected for the years 1987 and 2015 respectively. To assess the accuracy and comparison of the obtained maps, the error matrix, overall accuracy, and kappa statistics were used. Split-Window method was used to extract the land surface temperature of the study area. Finally, in order to analyze the relationship between land surface temperature with vegetation index, the correlation coefficients between land surface temperature and vegetation index were calculated based on land use types in the years 1987 and 2015.

Results and Discussion The highest land use area in the years 1987 and 2015 belongs to the rangeland use with 43781 and 34114 hectares respectively and the

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second land use area belongs to dry farming use with 23854 and 33277 hectares respectively. Moreover due to the lack of water use , the lowest land use area in 1987 belongs to residential use with 1301 hectares, while in 2015 with the construction of water structures, water use with an area of 86 hectares has the lowest land use area. The highest land use area increase was in the dry farming with 9423 hectares, which is a significant increase compared to 1987. The highest recorded temperature for Namin county in 1987 and 2015 was related to dry farming use (34°C and 27°C, respectively), indicating the concentration of heat in these regions. This type of land use has the highest temperature due to the factors such as the dryness of the products at this time and the harvest of the products. In 1987, dry farming use had the highest temperature (34°C), but in 2015 it experienced a decrease in temperature (27°C), despite the fact that it had the highest land surface temperature compared to other types of land uses in 2015. The reason can be attributed to the factor of harvesting crops. Due to the fact that the rainfed crops in the study area are mostly wheat, and at this time of the season, most of the wheat is ripe or harvested, so the transpiration of these products is insignificant. The lowest recorded temperatures in Namin county are related to the uses of water bodies (21°C), forest (21°C) and irrigated farming (22°C), respectively.

Since water has a high heat capacity, it has the greatest effect on reducing the temperature. In forest and irrigated farming land uses, due to the higher vegetation density, the land surface temperature has the lowest value (23°C and 24°C in 1987 and 21°C and 22°C in 2015 respectively) compared to the other land use types. Agricultural land use in this area has the lowest land surface temperature (24°C in 1987 and 21°C in 2015) after forest areas. Due to the fact that the crops cultivated in this area are plants such as potatoes and these plants have more water needs, therefore these plants have a high greenness value at June to early July, which has led to more transpiration in the area where they are cultivated than other areas, thus it has been very effective in keeping the land surface temperature cool. The rangeland use has had high land surface temperatures (27°C and 25°C, respectively) in the two study years, and there is little difference between the two years. According to the study season which was late June to early July, the high temperature of this land use type is due to the increase in the areas lacking canopy cover or areas having low or scattered vegetation. Due to the fact that in August, most of the leaves and brunches of the existing plants are dry and the transpiration is low, high temperatures are also recorded. The relationship between land surface temperature and vegetation index in rangeland use in the two study years had the highest correlation (0.91 in 1987 and 0.83 in 2015), while the correlation coefficient of the forest use was the lowest (0.46 in 1987 and 0.23 in 2015).

Conclusion Land use type and land use and vegetation changes have a significant effect on land surface temperature changes. However, areas without vegetation have a higher land surface temperature than the areas with vegetation. The results showed that there was no significant correlation between vegetation cover and land surface temperature, which is mainly due to sufficient vegetation. In general, the results showed that in most areas with lower temperatures, there is high density vegetation indicating an inverse relationship between vegetation index and land surface temperature.

Keywords Land use, Land surface temperature, Vegetation, Ardabil province analysis