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EXTENDED ABSTRACT

The evaluation of the impact of the anthropogenic factors on Lake Urmia crisis using Remote Sensing and GIS

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Lake Urmia, satellite data, spatial analysis, anthropogenic factors.

1. Introduction

Lake Urmia is considered as one of the country's most important aquatic habitats and has experienced significant changes in recent years due to various factors, such as the climate changes (Abbaspour et al., 2012), anthropogenic activities (Zeinoddini et al., 2009) and the lack of a comprehensive management approach (Garousi et al., 2013) in the Lake Basin. Hence, the evaluation of changes in its different characteristics during decades is of great importance. In this study, changes in key parameters such as sea surface temperature, saline features and vegetation are studied using satellite imagery, remote sensing and fieldwork. The main purpose of this study is to conduct a supervised monitoring in order to evaluate Lake Urmia crisis in regard to human-involved factors such as the effects of the agriculture sector and the construction of the causeway bridge. Providing a comprehensive spatial database to determine the impact of each parameter on the Lake Urmia crisis is another objective of this study.

2. Methodology

Satellite imagery and use of modern methods based on remote sensing technology provide means of interpreting and monitoring environmental conditions, without the cost, difficulties or time consuming nature of fieldwork. Also, they have provided useful tools for the study of dynamic phenomena (Mehrian et al., 2016). Therefore, they have been taken into consideration for spatial studies in recent years. The groundwork for this study is the use of Landsat and MODIS satellite images. ENVI 5.1 and ArcGIS 10.3 software programs are used to perform correction and calibration of images and to apply analysis on them, respectively.

2.1. Study of vegetation and water area changes

The MODIS satellite product MYD13A3 is employed in Lake Urmia basin during the July 2005 to 2015 period in order to study vegetation. A false-color technique is used to separate vegetation cover in the region, after the selection of the product and the isolation of the lake's watershed. Also, this study evaluates the shoreline and water area changes of Lake Urmia in the period 1995 to 2016. For this purpose, Iso-cluster unsupervised classification is applied to the images to determine the variation of the region's surface reflection. Moreover, supervised classification is conducted by comparing the analyzed images with aerial photos and field survey.

2.2. Study of causeway bridge construction impacts

2.2.1. Study of saline features

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In this study, Iso-cluster unsupervised classification is applied to the images to determine the variation of the region's surface reflection, and then the supervised classification is implemented by conducting field visits. To this end, the sampling of saline features around the lake is performed using GPS Garmin 62.

2.2.2. Study of changes in sea surface temperature

MODIS satellite product MOD11A2 is used to investigate the lake temperature variations. Thus, the mean sea surface temperature of Lake Urmia is separately studied in the warm season (August) and cold season (January) of the year. Additionally, the temperature changes of the lake are assessed separately for both northern and southern halves. Images obtained from Landsat 5, 7, and 8 are used for this purpose. Also, ENVI and ArcGIS software programs are used to obtain radiance and water body temperature of Lake Urmia, respectively.

3. Results and discussion

3.1. Study of vegetation and water area changes

The time frame of the present study is from 2005 to 2015, and the study area is the lake water body and its basin. The trend of vegetation changes in the watershed of the lake is displayed in Fig. 1(a) for 2005 to 2015. Also, in order to evaluate the shoreline of Lake Urmia, changes are studied from 1995 to 2016, which is visualized as shpfile in Fig. 1(b).

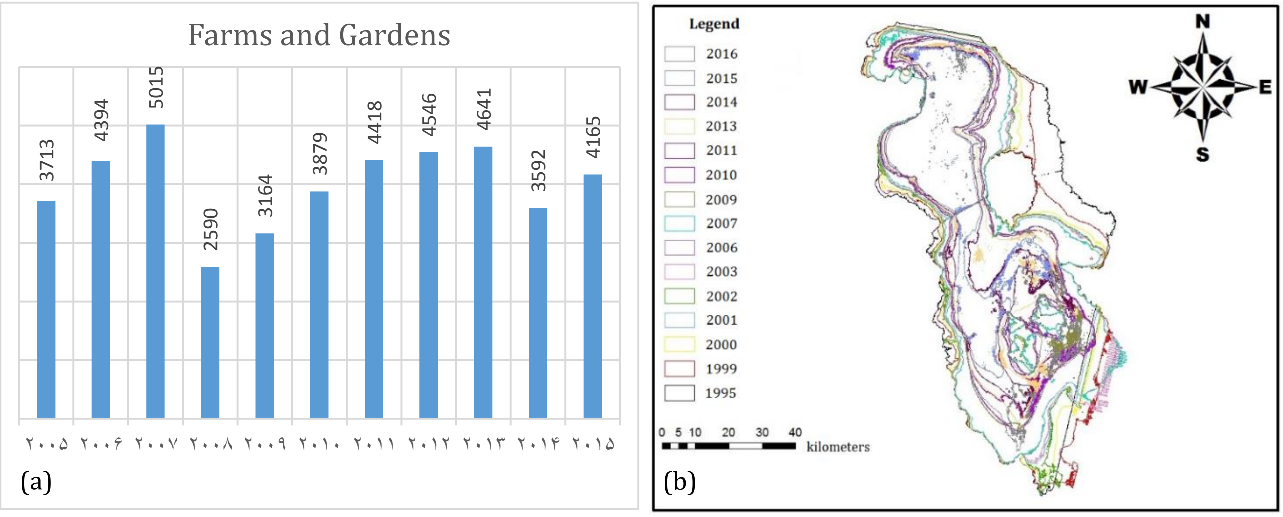

Fig. 1. (a) The trend of vegetation changes in Lake Urmia basin from 2005 to 2015 (km[2]), (b) Changes in the shoreline of Lake Urmia from 1995 to 2016

3.2. Study of saline features

The extent of the saline features is visualized in Fig. 2 for the years 1999 and 2016. It is observed that the trend of changes is incremental during the study period. Another point to be noted in the images is the extremely large extent of saline features in 2016, which even exceeded the recorded area of the lake in 1995. Quantitatively, saline features increased by 104.129 km^2 to cover an area of 2470.469 km^2 from 1999 to 2016.

3.3. Study of changes in sea surface temperature

The study of mean water temperature indicates that in the most recent years, the temperature of the northern waters are higher than those of the southern part in warm season during the analysis period from 1999 to 2015; however, the water temperature in the southern part is generally about 0.2 °C more than the northern part in the whole study period.

4. Conclusions

The results highlight an alarming surface water decrease during the analysis period. Furthermore, saline features has been increased dramatically due to vegetation growth and relative decrease in precipitation. Also, the temperature of the lake water surface experienced relative increase whether in warm or cold seasons, during the study period.

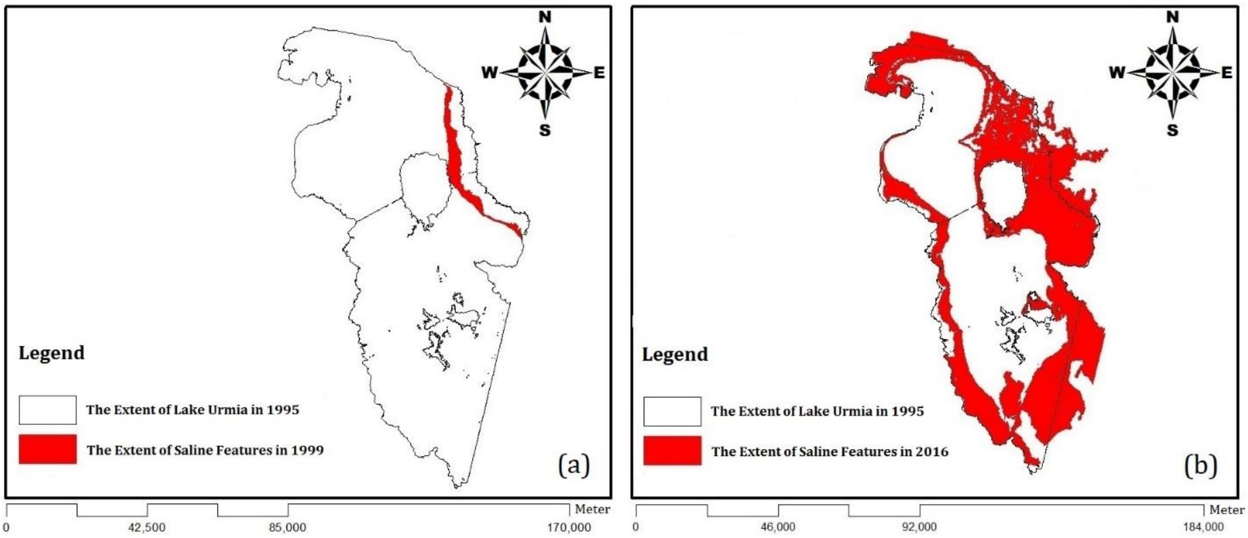

Fig. 2. Saline features map of Lake Urmia in (a) 1999, (b) 2016

5. References

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