Assessment of Urmia Lake Water Level Fluctuations and Increase in Salt Areas in the North West Iran

Mohammad Hossein Fathi*
PhD Candidate in Geomorphology, Mohaghegh Ardabil, University Ardabil, Iran
Aghil Madadi
Assistant Professor of Geomorphology, Mohaghegh Ardabili University, Ardabil, Iran
Ebrahim Beheshti
Ph.D. Candidate in Geomorphology, Mohaghegh Ardabili University, Ardabil, Iran
Nader Sarmasty
Ph.D. Candidate in Geomorphology, Mohaghegh Ardabili University, Ardabil, Iran

Received: 2 October 2013 Accepted: 4 December 2014

Extanded Abstract

Introduction

Urmia Lake in the northwestern corner of Iran is one of the largest permanent hyper saline lakes in the world and the largest lake in the Middle East. It is extended as much as 140 km from north to south and is as wide as 85 km east to west during high water periods. Qualitative and quantitative degradation of water resources is one of the major challenges in the way of sustainable development. The features and phenomena in the earth surface have been changed over time; the lakes as one of these features and due to a closed environment are not considered as an exception. Due to climatic changes such as reduced rainfall, increased temperature and also uncontrolled use of surface water resources in watershed areas, distinguished changes are exposed on the earth surface. Monitoring such changes should be considered as an important issue in the national and regional development and natural resource management. Monitoring the coastal areas and extraction of water at different intervals is currently regarded as an infrastructural research interest due to the significance of coastal zone management and dynamic nature of such sensitive ecological environments. Urmia lake is the twentieth largest lake of the world and at the same time one of the most unique and invaluable global water ecosystems. The lake surface area was estimated to have an area as large as 5620 km^2but since 1989 it has generally been declining and was estimated from satellite data to be only 2032 km^2 in August 2011. The decline is generally resulted from a combination of drought, increased water diversion for irrigated agriculture within the lake's watershed and also mismanagement.

* E-mail: geo.fathi@gmail.com Tell: +98 9355803041

The main insight of this study is to analyze Urmia water levels fluctuation and increase in salt area. This is to model the lake surface fluctuation regime by linking the observed data to satellite data in the northwest Iran.

Materials and Methods

Lake Urmia is an endorheic or terminal lake that is water leaves the lake only by evaporation. As is generally the case, this leads to a saltwater body and in the case of Lake Urmia salinity is quite high. The lake is bounded between 37°5′ -38°16′ latitudes and 45°01′ - 46° longitudes at 1275 m above sea level. Its surface area ranges from 4750 to 6100 km^2 and the average and greatest depths are 6 and 16 m, respectively. In order to study the fluctuations of the Urmia Lake surface area, multi temporal Land sat Images, ETM and TM, were used in a 23-year period, from 1989 to 2011. In the present study, the coastlines information was extracted for each year in two major steps using the ERADS and ArcGIS software. Firstly, geometric and radiometric corrections as well as different filters were applied on the selected images to make the spectral difference of the objects more clear. Secondly, supervised classification method has been used to extract the coastlines. To use the supervised classification, training data from the lake surface has been prepared for further process. The reflection values in these areas have been generalized to the entire lake surface using the software. Thus, the border between the lake and surrounding areas has been set precisely. Finally, through the algorithm for conversion of the two vectors, the coastline limits have been drawn for different years. ArcGIS application has been used for analysis of the images.

Results and Discussion

Satellite altimeter data measured the lake's level in 1989 to be at its highest level of any time in the past 30 years. This is in agreement with Hassanzadeh and others (2011) who mentioned water level of about 1278 m above sea level for the same time. Both the measures show a steady decline from that year on with the most recent satellite altimeter data indicating a drop of approximately 7.40 meters between 1989 and 2011. Because Lake Urmia is a terminal lake with no significant water outflow the only way water leaves the lake is by evaporation. Therefore, if the lake is declining, it is either by increased evaporation or a decrease in water coming into the system. The Zarrineh Rood River is the largest of the thirteen main rivers discharging into the Lake Urmia. The rivers are the source of majority of the Lake water budget. Additional input comes from rainfall directly over the lake, floodwater from the immediate watershed, and a very small fraction from groundwater flow.

Conclusion

The main objective of this study was to assess lake water levels fluctuation using satellite images and Geographic Information System (GIS). To achieve this goal, the satellite images of Landsat Multi-spectral images for the years 2011-1989, sensors of TM, ETM +, were used and processed along with field observations. Based on the results achieved during the 23-year-old, average height of the lake water level decreased 7.40 meter. Vast area of the lake surface turned into the arid soil and sediment salts in the last few decades. Most changes due to water loss, especially in the South East and the east coast of the lake is visible.

Keywords: coastline changes, salt area, satellite image, Urmia Lake, water level fluctuations.