Investigating the water level and volume variations of Lake Urmia using satellite images and satellite altimetry

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Extended abstract

Introduction

We live in a world where water has always been considered as one of the major issues. Currently, many people in developing countries are deprived of sufficient water to meet their basic needs. Lake Urmia is located between the longitudes45 to 46 ° East and latitudes 37 ° to 38.5 North. The lake is located in Zone 38 of theUniversal Transverse Mercator System (UTM). Lake Urmia is the largest inland lake in Iran and the second largest saltwater lake in the world. The desiccation or drying upcrisis of Lake Urmia with an area of about half a million hectares consideringits consequences has led to actions and plans by organizations, agencies and even people which still continues and has become a national issue. Investigating the changes in the water level and the volume of lakes in order to protect them, has acquired a special place among the countries both in national and regional levels during the recent years. Generally, there are two methods forthe collection of information from the objects and phenomena on the surface of the earth:one island methods (land access) and the other is remote sensing methods.

Materials & Methods

In this regard,due to the importance of the issue, exploitation of satellite images and satellite altimetry observationsto study the water level and volume variations of Lake Urmia is the reason for the present research. In this research, Landsat satellite imagery in a 40 year period from 1976 to 2016 was used. Lake Urmia is located in 2 frames in some of these images and in 3 frames in some, and using them, the coastline map and the area of the Lake and its changes were obtained. To do this, ENVI software was used to perform the processing steps required to extract thecoastline changes, and ArcGIS software to perform cartography for the obtained outputs.After selecting the appropriate technique for implementation in order to analyze the extraction of the coastline changes, the steps can be expressed as the following:Selecting educational samples on the images, applying neural network classification method, evaluatingclassification accuracy, extracting coastline changes.

Results & Discussion

After the classification is donewith the desired algorithm and the classification accuracy is verified, thedata output

is divided into two main water and non-water applications. And then, as the boundary between the land and water is determined, the coastline can be extracted.In this research, three indexes of error matrix, overall classification accuracy and Kappa coefficient were used to assess the accuracy of the classification.It should be noted that in the selection of the water areas, three deep, medium depth and shallow water sections were taken into consideration and the choice of these areas in the infrared band which is particularly for the distinction between water and non-water was used.And finally, the accuracy of the classificationswas evaluated. Also, using Envisat and Saral altimeter satellite data,both of which have two passes over Lake Urmia, we obtained the water level of the lake in 2002-2015. For this purpose, we first processed the data,using the BRAT software, and obtained the balance level by applying the corrections related to the measurements of the satellite range and elevation in the MATLAB software. Now, using the amount of the lake surface area and its level in different years, we obtained calculated the volume changes and finally, the obtained resultswere compared with the results drawn from the land data which corresponded to the answers. In this research, the information of the area including runoffs flowing into Lake Urmia, we have also studied runoff flowing into the Lake Urmia region, surface and groundwaterwithdrawal, climate changes, changes in groundwater levels, investigation the volume changes in groundwater aquifersand...were studied as well.

Conclusion

The results indicate that the area of Lake Urmiahas decreased from 5366 square kilometers in 1976 to 633 square kilometers in 2015, about one-eighth, and then with an increase has reached to 2383 square kilometersin 2016. The level of the lake water has decreased by 4 meters from 2002 to 2015 and has increased by 0.5 meters in 2016. The volume of water in Lake Urmia has decreased by 9.7 billion cubic meters from 2002 to 2015 and 1.2 billion cubic meters were added to it in the following year. The results also show that the largest reduction in the volume of the lake water has occurred in 2007-2012. The water inflow into the lake in 2014-15 comparing to 1995-96 has beenapproximately one fifth and has decreased to 700million cubic meters from 3,500 million cubic meters,And in fact the inflow water has decreased 2800 million cubic meters while, the groundwater withdrawal has increased by 360 million cubic meters in this period, which indicates an imbalance in the amount of inflow water and groundwater withdrawal. According to the results obtained, the main reason for reduction of the lake water is the withdrawal of surface and ground water. Therefore, avoiding uncontrolled water withdrawal, shutting down the unauthorized wells, opening the floodgates of dams as needed, to avoid the construction of other dams in the basin of the LakeUrmia, dredging of the rivers leading to the lake, as well as the reforming the agricultural methods and types of products are essential.

Keywords: Lake Urmia, Evaluation of Water Area and Volume, Satellite Imagery, Satellite Altimetry.