

## **Application of Fuzzy-Object Based Image Analysis Approach for Identifying and Zoning Salt-Dust Storms of Urmia Lake Eastern Plain**

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### **Extended Abstract**

#### **Introduction**

All recent scientific evidences aware of this fact that the impact of global changes on environmental feature cannot be disavowed and lakes as one of the environmental members, may clearly reflect these changes. Nowadays, satellite and aerial images have an important role in environmental managements, risk assessments and sustainable development, which enable managers and spatial experts to evaluate changes and extract valuable information by using available image processing techniques. In this regard, the most important aspects are detection and analysis of coastline and lakes' changes. Reasons for the lakes' demise have been related to climate change and poor water resource management practices within the lakes' watershed. In this study, Urmia Lake has been chosen because of its unique condition which has been drying up over the past years. Urmia Lake is one of the most important environmental and natural resources in Iran, as well as the region of Azerbaijan, which is known as the residence of many different species. While, recently most of them have been vanished due to catastrophic changes of the lake. This lake is the second largest salt lake in the world and first saturated salt lake in the Middle East region which has been facing destructive threats in recent years. Lake Urmia has lost a devastating amount of water during these recent years.

#### **Materials and methods**

Object-based image analysis (OBIA) approach has applied to analyze digital imagery and research objective. OBIA based rule-set were developed to monitor the salt-zones in eastern plain of Urmia lake. OBIA is known as effective approach for image processing comparing to pixel based approaches. While

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pixel-based image analysis is based on the information in each pixel, object-based image analysis is based on information derived from a set of similar pixels called objects or image objects. In this study for evaluation salt regions changes of lake, Landsat (5, 7, 8) images (acquired from USGS earth explorer) and object-based fuzzy classification method between 2010 and 2016 have been used. Many scales, shape and compactness factors were tried to reach optimum scale for segmentations. Then, some object were chosen randomly as the training data for classification. The indices such as NDVI, SI (salinity index), and BI as well as operators like "AND" and "OR" membership functions were applied based on fuzzy classification.

### **Result and discussion**

The result of this study shows that 3,120 Km<sup>2</sup> of the lake's water area in 2010 were decreased to 887 Km<sup>2</sup> in 2014, but in 2016 by increasing in rainfall amount, water area of lake were increased to 2,475 Km<sup>2</sup>, which is equal to 79% of lake water body in 2010. This changes shows the impact of rainfall in lake condition. Result of classifications between 2010 and 2016 shows that salt regions has made great progress in its amount until 2014. Afterward, the result shows a gradual descending in salt region areas to 233 Km<sup>2</sup> in 2016 and other classes have same trend. While, water trend was positive and shows a great increase in water body amount. Throughout these years, low risk and high dangerous regions faced magnificent changes and other classes like dangerous region and potential regions trends show normal changes compared to water and high dangerous classes. The study showed that southern and southeast parts have seen most of the changes that those regions almost turned to high dangerous lands. While, half northern part of the Lake toward the southern half, as well as the south-north slope direction of lake have not faced many changes.

### **Conclusion**

In this study, object-based fuzzy classification methods and spectral indices have been used for classification. The results showed that object-based and spectral indices have better accuracy toward pixel-based methods. The reason of this high accuracy is the using of other auxiliary information like texture, color, shape and tone in object-oriented method, while, in pixel based methods, the only available information is DN (digital number) of pixel, which doesn't consists any information like shape and texture. Integration both object-based and spectral indices would present the best image classification result by increasing and improvements in spatial and spectral image resolution. All of these results indicate that environment is rapidly changing and affecting our living situation, and also the future is uncertain, vague and complex. Climate change is real and also is happening. There is no doubt that effects of climate

change would manipulate our social-economic situations, and over the time, the effects of this manipulation will be worse, that needs adaptation. But mankind can manage even the worse condition just by analyzing available data and trends. In current century, scenario-based foresight planning has shown its abilities and solutions to manage uncertain future by optimal scenarios. Spatial planners and managers can extract uncertain and vague factors which have leading roles in environmental changes (like temperature, precipitation, migration, social-economic, etc.) by these factors that may change the future of a region, city or national parks, planners can specify most important factors and based on those factors they would present plausible scenarios for the future. At last for managing and improving Urmia Lake situation by mentioned data and solutions, which discussed above, planners and managers can make and provide a better future for Urmia Lake and assist its sustainability.

**Keywords:** fuzzy object-oriented, Lake Urmia, Remote sensing, satellite image classification, dust storm