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Rapid Monitoring of Mangrove Cover Changes Using Support Vector Machine Algorithm in Google Earth Engine Computing Platform Case Study: Qeshm Mangrove Forests

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Introduction

Mangrove forests are known as a unique ecosystem found along tidal shores that are bridges between sea and land. These forests are one of the most vulnerable ecosystems that are affected by natural disasters and climate change and human interventions such as pollution from offshore oil extraction, urbanization, deforestation due to human activities and crab and shrimp extraction. Accordingly, spatial and temporal monitoring of the mangrove ecosystem is essential. Mangrove forests in Iran, due to natural causes and human intervention, have caused adverse changes in the growth and development of mangroves. One way to study the spatial and temporal nature of these forests is to use satellite-based sensing techniques, as space-based technology makes it possible to collect information from landscapes. The processing and heavy volume of satellite data has led to the emergence of web-based processing systems. To this end, in recent years, the Google Earth Engine platform has been created with free access and faster processing of time series data used. The purpose of this study is to develop a method for monitoring mangrove forest changes in the northern cape of Qeshm Island over a 30-year period from 1986 to 2020 using a combination of support vector machine algorithm and Google Earth engine based on Landsat 5 and 8 series satellite data.

Material and Methods

In this study, to detect changes in the 30-year period and estimate the area of mangrove forests in the northern part of Qeshm Island, the Landsat Surface Reflectance images (LSR) in tidal mode for 1986, 2000 and 2020 were used in Google Earth Engine. In this regard, first the multi-season NDVI index was applied to the study courses and using the

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support vector machine (SVM) algorithm, the images were classified into 3 classes (mangrove, mud or tidal lands and sea) and then the maps were prepared using photographs. High resolution Google has been validated. Finally, in order to examine the rate of change in mangrove cover and other classes, the area of each class in ArcGIS was estimated.

Results

As can be seen in the error matrix table, the user accuracy of the mangrove class in every 3 years of study is more than 93.33%, which indicates the high accuracy of extracting the mangrove cover class from other lands by the SVM algorithm. The overall accuracy of the maps in the study years is 97.77, 91.11 and 93.33%, respectively. Also, the kappa coefficient of the maps is equal to 0.96, 0.86 and 0.90, respectively. The area of mangrove forests in 1986 increased from 5130.78 hectares to 5471.87 hectares in 2000, which indicates a rate of increase in mangrove area of about 6.23 percent. In 2020, the area of mangrove has reached about 5967.13 hectares, which is an increase of about 8.30% compared to the area of mangrove cover in 2000. Overall, the rate of change in mangrove land area has increased by about 14.02% over a 30-year period, from 1986 to 2020.

Discussion and conclusion

In this study, an attempt was made to quickly monitor the 30-year changes in the mangrove forests of Qeshm North Cape, using the SVM algorithm and the Google Earth engine system. The results showed that the area of mangrove forests increased by 6.23% from 1986 to 2000 and this amount of mangrove area increased by about 14.02% from 1986 to 2020. According to a previous study, the rate of increase in mangrove forests is the result of artificial afforestation by the natives of the region to keep this natural ecosystem alive. In general, it is concluded that rapid and continuous monitoring of mangrove forests requires a large amount of satellite data in different time series, which is provided by the creation and development of the computing platform Google Earth Engine by Google to process heavy and bulky satellite data in various dimensions.

Keywords: Mangrove Forest, Change Detection, Google Earth Engine, SVM Algorithm, Landsat, Qeshm Island.