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EXTENDED ABSTRACT

Investigation of Relationships between Landsat8 and Sentinel2 Sensors and Field Data on the Water Quality Parameters Estimation in Chalous River Estuary

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1. Introduction

Water quality monitoring through remote sensing involves establishing a reliable relationship between light reflectance (at specific wavelengths of bands) and water parameters collected in situ (Barrett et al, 2016). Estuaries can play an important role in changing the water quality of lakes, and according to studies, satellite images with high spatial resolution (better than 30m) have been used to study water quality. So, in Chalous River estuary has been selected due to its environmental importance in this research, and its qualitative parameters of salinity, temperature and pH have been studied. Also, to achieve these goals Sentinel2 and Landsat8 satellite images are used and the efficiency of these two satellites to determine the relationship between different physical and chemical parameters of water quality evaluated by comparing with the field measurements. Since Sentinel2 multispectral images comprise more bands compared to older multispectral images such as Landsat8, it is worthwhile to evaluate the possibility of evaluating water quality parameters using Sentinel2 multispectral data. In addition, the main mission of Sentinel2 satellite is continuous environmental monitoring, which if the significant relationship between satellite data and seawater quality parameters is proven, many concerns about environmental monitoring will be resolved and the lack of updated imagery data for monitoring changes in seawater quality will be addressed.

2. Methodology

2.1. Study area

Chalous sub-basin is located in the south of the Caspian Sea and is the fifth largest sub-basin of the Caspian Sea and its annual flow volume varies between 400 and 652.82 million cubic meters.

2.2. Field and experimental data

16 Stations along the river estuary on the coastline were selected for sampling at all points. The distance of the last sampling points from the estuary is one km from right, 600m from left and one km along the estuary. Sampling of the stations was done in December 2017 at the same time as the satellites passed and the images were used for the same date. In order to determine the desired parameters, sampling was performed in suitable Laboratory utensils under standard conditions and the values of temperature, salinity and pH were measured using a multi-function device on site.

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2.3. Remote sensing data

In order to investigate the water quality parameters, the multi spectral satellite images of the Landsat8- OLI and the Sentinel2 satellite were used. The process of satellite images was performed using ENVI 5.3 software. Satellite sensors can measure the amount of solar radiation reflected from the water surface in a wide range of wavelengths, which can be correlated with water quality parameters (Alparslan et al., 2009).

2.4. Statistical relationships

To determine the statistical models, 80% of sampling data were used as dependent variables and the reflectance data of different combinations of spectral bands of the processed images as independent variables. The models were generated through the stepwise linear regression technique with 80% of information generated in sampling and validation was performed through simple linear regression analysis with 20% of that information. The multiple correlation coefficients (R^2) were estimated in each combination in order to investigate the relationship between water quality parameters and remotely sensed data and the root mean square error (RMSE) were used to measure the accuracy of the models.

3. Results and discussion

3.1. Temperature

Among the regressions denoted in Table 3 for the Landsat8 satellite, the ratio of band 4 and 5 had the highest R^2 in the model development phase, and for the Sentinel2 satellite, the highest temperature correlation was for 4 to 11 band ratio. Given that the correlation coefficient in the validation stage for both equations was higher than the modeling stage, therefore, the obtained relationships have sufficient validity. The results showed that the best equation for Landsat8 yields R^2 of 0.55 with an error of 6% and for Sentinel2 the best equation has R^2 of 0.7 with an error of 3% (Fig. 1).

Fig. 1. Temperature distribution map using Sentinel2 image in Chalus river estuary

3.2. Salinity

According to the studies performed in the initial stage of model development, the ratio of band 1 to 7 of Landsat8 satellite and cube of band 3 of Sentinel2 satellite had the highest correlation with seawater salinity among other bands. However, by applying the obtained relationships on the validation parameters, the amount of R^2 was very low, so that the amount of R^2 for Landsat8 and Sentinel2 satellites was 0.0053 and 0.1706, respectively. Due to the decrease in R^2 in the validation phase, all variables were re-examined and band 12 was selected for Sentinel2 and the difference between bands 6 and 7 for Landsat8 (Fig. 2.)

Fig. 2. Salinity distribution map using Sentinel2 image in Chalus river estuary

3.3. pH

The equations obtained from the cube of band8 for the Sentinel2 satellite and the sum of the bands 1 and 7 for the Landsat8 satellite were selected. The error of estimating the pH for the Sentinel2 and Landsat8 satellites was 0.02 and 0.025, respectively, and the higher correlation coefficient for the equation was obtained from The Sentinel 2 satellite shows that it has performed better, but in this case the correlation coefficients and the error values for both satellites are very close to each other, and it also indicates a relatively good performance for the Landsat8 satellite.

4. Conclusions

Statistical models show significant relationship between measured water quality parameters in field and reflectance of satellite data. Remote sensing data provide a useful indicator for measuring the water quality parameters, and pollution problems can be identified quick and accurate with this method. The current study demonstrates that this method can be used for monitoring of large areas. Comparison of the two satellites shows that all the water quality parameters studied were more related to the reflectance values of the Sentinel2 satellite, and this could be because of the better spatial and spectral resolution of the Sentinel2 satellite.

5. References

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