Indian Journal of Geo Marine Sciences
Vol.46 (11), November 2017, pp. 2286-2289

Monitoring oscillations coastline of Dayyer city during the El Niño and La Niño using OIF utility index

Maryam Razmi [*], Hossein Mohammad Asgari, Ali Dadollahi Sohrab, Seyed Mohammad Jafar Nazemosadat[1] & Sayed Hossein Khazaei

College of Marine Natural Resources, Khorramshahr University of Marine Science and Technology, Khuzestan, Iran
[1]Water Engineering Department, College of Agriculture, Shiraz University, Shiraz, Iran

[Email: razmimaryam69@yahoo.com]

Received 17 August 2015 ; revised 02 November 2016

Present study focuses on assessing application of OIF index on Landsat images, TM, ETM$^+$ and OLI sensor for monitoring shoreline fluctuations in Dayyer city, and its relation between El Niño and La Niño with estimative sediment and erosion volume during the coast of this city in 1991, 2001 and 2014. Results of coastline oscillation investigation showed shifting coastline to sea side (Sedimentation) and inland (Erosion). Rate of sedimentation and erosion in Dayyer coastal from 1991 to 2001 are about 545964/9 and 248307/42 km^2 and from 2001 to 2014 about 981661/67, and 566883/7 km^2, respectively.

[Key words: Coastline, El Niño, La Niña, OIF, Sedimentation, Sobel]

Introduction

Coastline are the most important land features and they are always changing at short and long time period, these changes may be due to natural causes or human intermediary[1]. For optimal use of multi spectral data to assess the coastline, it is necessary to determine the best combination band. Selecting the best band by comparing visual images is difficult and time-consuming. Therefore, digital technique, the optimal index factor (OIF), can be used. This index is used for two purposes: A) determining the most suitable and for creating the best false color image (FCC), B) determine the most suitable band for digital classification[2]. Naeimi Nezam Abad et al. (2010) investigated shoreline and geomorphologic Landform changes in coast of Asalooye in a sixteen year period from 1990 to 2006. They used Landsat TM and IRS images. The results showed that changes in the coastal of Asalooye region, as destruction of sedimentary shapes, like deltas and flood plains and sedimentation as swamp[3].

Ghosh et al (2014) were used satellite images from Thematic Mapper (TM) and Enhanced Thematic Mapper (ETM) to quantify the spatio-temporal changes that took place in the coastal zone of Hatiya Island during the specified period. The modified normalized difference water index (MNDWI) algorithm was applied to TM (1989 and 2010) and ETM (2000) images to discriminate the land–water interface and the on-screen digitizing approach was used over the MNDWI images of 1989, 2000 and 2010 for coastline extraction. The results showed that erosion was severe in the northern and western parts of the island, whereas the southern and eastern parts of the island gained land through sedimentation[4].

Leili mirafzal (2000) studied Effect of El Nino in 1982-1983 (1362-1361) on Iran in terms of temperature and precipitation is noteworthy. So that the average temperature during this period is much lower than usual. The results show that significant anomalies (negative) temperature and (positive) rainfall occur simultaneously with the occurrence of El Nino and to clearly delay in minimum temperature and maximum annual precipitation, is seen. The delay in the annual maximum temperature is not clear enough. The contrast between winter monsoon flow sand flows south or south west to the El Nino phenomenon in this period causes in tense forms of is baric line on Iran. With the establishment of the summer monsoon during this period together with the effects of hypertension that occurrence of El Nino in the Pacific Ocean West has emerged

strengthened and handling monsoon from East to Iran takes place. Therefore summers in this period warming than summers in which El Nino is not over[5]. Present study is assessing application of OIF index in Landsat images and TM, ETM$^+$ and OLI sensors for monitoring shoreline fluctuations in Dayyer city, and find a relation between El Nino and La Nina and estimation rate of sediment and erosion in coast of Dayyer in 1991, 2001 and 2014.

Material and Methods

Study area is Dayyer city in Bushehr province at northern Persian Gulf (from $27^{\circ}50'N\ 49^{\circ}47'E$ to$20^{\circ}28'N\ 51^{\circ}50'E$) (fig.1). The climate in Dayyer varies from arid to humid. Annual mean of rainfall is 215 mm and temperature variation from 22 to 47° C [6]. The annual evaporation is 200–400 mm. Pre dominant wind directions in the province are W→E and NW→SE.

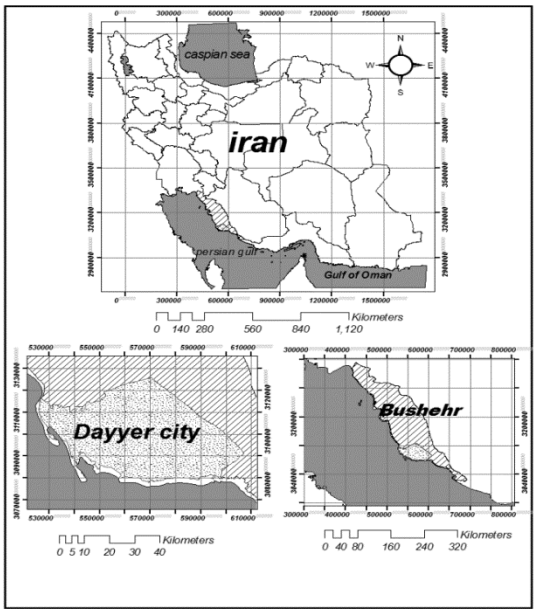

Fig.1. Location of the study area

According to NOAA, El Nino accrued in 1991 and La Nina accrued in 2001 and 2014, Landsat images selected in relation with El Nino and La Nina events.

In this study, used the satellite images of three time steps for Determination the changes during the Dayyer coastline: (a) Landsat Thematic Mapper (TM) (November 1991), (b) Enhanced Thematic Mapper (ETM) (January 2001), (c) Operational Land Imager (OLI) acquired in November 2014[7].

By comparing the coastline in terms of El Nino and La Nina events, amount of erosion and sedimentation estimated during the coastline.

OIF index is a basis of total variance and correlation between different bands. To find changes in the coastline, first specified bands with lowest correlation to each other, the clarity between sea and land boundary detected using the OIF index. We can extract the appropriate bands[8]. So, using the OIF index calculated as follows,

$$OIF = \frac{\sum_{K=1}^{3} S_K}{\sum_{J=1}^{3} Abs\,(r_j)} \quad (1)$$

S_k is standard deviation of k band, r_j is correlation coefficient between the two bands. Following equation determined three bands to obtain colored image.

$$OIF = \frac{Std\,(b_i)+Std\,(b_j)+Std\,(b_k)}{|cor\,(b_i,b_j)|+|cor\,(b_j,b_k)|+|cor\,(b_i,b_k)|} \quad (2)$$

Whatever OIF index value be higher, the correlation between bands is less and more information obtained from combination of three bands and border of land and sea is better shown.

After determination of three bands using OIF index, Sobel filter was used to detect sea and land border. Sobel relationship is as follows:

$$sobel_{out} = \sqrt{X^2 + Y^2} \quad (3)$$
$$X = (BV_3 + 2BV_6 + BV_9) - (BV_1 + 2BV_4 + BV_7)$$
$$Y = (BV_1 + 2BV_2 + BV_3) - (BV_7 + 2BV_8 + BV_9)$$

Result

In this study, using the Landsat images and El Nino and La Nina dates. For determination sea and land borders, OIF index used to selection the best bands (fig. 2) and performed Sobel edge detection filter (fig. 3).

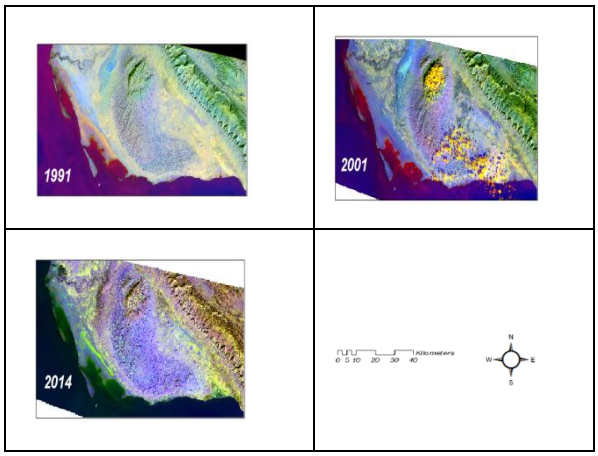

Fig. 2.False colored composite with highest value of OIF index

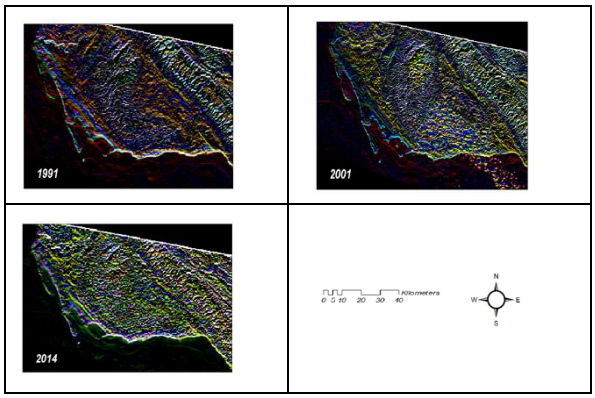

Fig.3. Apply Sobel edge detection filters on Landsat images

Results of coastline oscillation investigation showed shifting coastline to sea side (Sedimentation) and inland (Erosion). El Niño/ Southern Oscillation are a global event that results in anomalous circulation patterns in the Pacific Ocean[9]. The effects of El Nino and La Nina have been considered as the major variables in weather changes in the Middle East[10]. Coastal erosion is a problem at many coastal sites caused by natural effects as well as human activities. By comparing the 1991 and 2001 Coastline, amount of sedimentation and erosion in the Dayyer coastal are about 545964/9 and 248307/42 km^2 and from 2001 to 2014 are about 981661/67, and 566883/7 km^2, respectively (fig. 4).

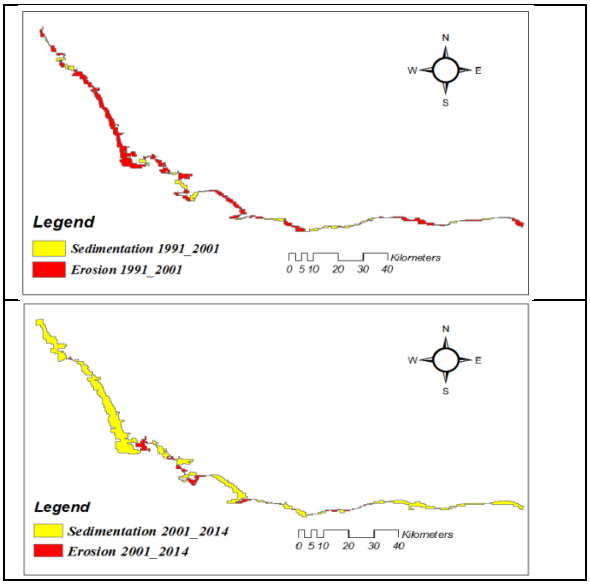

Fig. 4. Dayyer coastline change in El Niño and La Niño

Discussion

The El Niño-southern oscillation (ENSO) exerts a profound influence on global weather and climate patterns[11]. Coastal areas are sensitive lands that are located on two sides by sea and land ecology. Coastal areas as functional are as faced natural and human disturbances such as sea level rise, coastal erosion and sedimentation and excessive exploitation of resources. The clear relationship observed between El Nino and coastal erosion in short to intermediate time frames, but severe storms had a big impact on coastal erosion. However, long term trends and seismic events also contributed to form of land where it meets the sea. By decreasing rainfall, amount of sediment that entered to sea from the land to be reduced, which followed the coastline are encounter with the erosion. Studies of coastal erosion are important for informing government agencies on development of coastal areas, disaster relief, and predicting future 'Erosional Hotspots'. If we know that most erosion occurs during severe storms, and that El Nino events bring climatic changes that affect coastal erosion, then we can be better prepared for all possibilities.

Conclusion

In Dayyer coastline rate of erosion estimated more than Sedimentation from 1991 to 2001. In 2001, when occurrence La Nina, with the increases rainfall interactive rate of the sediment entering the sea to be more than a result rate of increases sedimentation on the coast. According to NOAA, El Niño phenomenon reported in 1991, in this year had a low precipitation; low erosion in the land. Also decreased rate of sediment entering these a La Nina phenomenon reported in 2001, this year hadhigh precipitation; high erosion in the land and rate of sediment entering these a is more.

Acknowledgements

The research was supported by Khorramshahr University of Marine and Science Technology. This article is extracted from the master's thesis.

References

1. Cracknell, A. P, Remote Sensingtechniques in estuaries and coastal zones – anupdate, *International Journal of Remote Sensing*, 19(1999), 485-496.
2. Sarmasti, N., Fathi, M. H., Ayase, F., Beigi Pourmotlagh, F., Soozandepour, F, Application of techniques utility index factor (OIF) Landsat 7 ETM^+ data in the assessment salt shells of Kashan, *Second International Conference on Environmental Risk*, KharazmiUniversity,2013.
3. Naeimi Nezam Abad, A., Ghohroudi Tali, M., Servati, M, Monitor of the changes the coastline and Landform geomorphologic Persian Gulf, using the techniques of remote sensing and GIS (Case

study: coastal area Asalooye), *Journal of Geographical Space*, 30(2010), 3561.

4. Ghosh, M. K., Kumar, L., Roy, Ch., Monitoring The Coastline Change Of Hatiya Island In Bangladesh Using Remote Sensing Techniques, *ISPRS Journal of Photogrammetry and Remote Sensing*, 8(2014), 137–144.
5. Mirafzal, leili. Effect ofEl Nino 1982-83onthe weather in Iran. *Earth and Space Physics Journal*. 2(2000), 85-96.
6. Ahmadi, A.,Ramesht, M. H., Derafshi, K, Assessment of shoreline changes using remote sensing and GIS techniques, case study coast port city Dayyer, Persian Gulf, *Journal of Geography and Environmental Planning*, 3(2014), 63–74.
7. USGS. Landsat Missions Timeline <http://landsat.usgs.gov/about_mission_history.php> (Accessed 24.09.14).2013.
8. Jensen, J. R., introductory digital image processing: a remote sensing prospective, 2ndEnd, Prentice-Hall, *Englewood Cliffs*, NJ, 2008.
9. Richmond, R. H. The Effects of the El Niño/Southern Oscillation on the Dispersal of Corals and other Marine Organisms. *Elsevier Oceanography Series*.52 (1999), 127–140.
10. Hamedani Azmoodehfar, M. Azarmsa, A. Assessment the Effect of ENSO on Weather Temperature Changes Using Fuzzy Analysis (Case Study: Chabahar). APCBEE Procedia. *4th International Conference on Environmental Science and Development- ICESD 2013*. 5(2013), 508–513.
11. Ghayoor, H, A. khosravi, M, Impact of El Niño/Southern Oscillation (ENSO) on the summer and Autumnal Precipitation Anomalies in South East of Iran. *Journal of Geographical Research*, 62(2001), 141-174.