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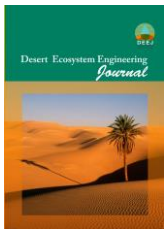

Assessing the vegetation trends in arid and semi-arid regions (Case study: Touran Protected Area)

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Introduction

Vegetation cover is an important indicator in the arid and semi-arid areas and plays an important role in balancing the ecosystems. Monitoring vegetation cover changes is of great importance because of vegetation effects on the environment. This monitoring provides detailed quantitative and qualitative information. It is therefore important to monitor dynamic changes in vegetation and to investigate the factors that are driving these changes in order to guide regional environmental management. Changes in vegetation could be tracked by satellite time-series data and trend analysis. Analysis of vegetation time series improves considerably our understanding of vegetation annual changes. Touran Biosphere Reserve accommodates three areas of Wildlife Refuge, National Park, and Protected Area. This reserve is the second largest biosphere reserve in the world. In terms of international categories, Touran is a special habitat of steppe grasslands in Central Asia and Desert-Saharas peculiar to West Asia. The aim of this research is to evaluate vegetation trend in Touran Protected Area using MODIS vegetation time series data from 2001 to 2015.

Materials and methods

The 16-day composite MODIS VI product with 250m spatial resolution from Terra (MOD13Q1) was downloaded from the Land Processes Distributed Active Archive Centre (LP DAAC) for the Touran protected the area and the years from 2001 to 2015. The MOD13Q1 product includes normalized difference vegetation index (NDVI), Enhanced Vegetation Index (EVI), infrared band, red band, and quality assessment (QA) information. Before the time series analysis, different vegetation indices (NDVI, EVI, TSAVI1, and PVI1) were created. Then, the vegetation indices were aggregated to monthly composites by applying the arithmetic max of each month and standardized anomalies (Z score) of the monthly vegetation indices data were calculated to remove the seasonality. Several studies using the more robust Theil-Sen trend analysis and Mann-Kendall tests were conducted to explore the trend analysis of vegetation using NDVI, EVI, TSAVI1, and PVI1. A field survey was

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conducted to select a suitable vegetation index.

Result

Accuracy assessment results showed the Kappa coefficient for the PVI1, TSAVI1, EVI, and NDVI indices to be 0.78971, 0.5674, 0.5288, and 0.4159, respectively. Field survey results showed that PVI1 is the best index in the study area. According to the results of the Theil-Sen slope analysis and the Mann-Kendall test, the trend was divided into 3 levels. Vegetation with Theil-Sen slope < 0 and Z values less than -1.96 has a significantly decreasing trend. Vegetation with Theil-Sen slope < 0 or Theil-Sen slope > 0, but with Z values ranging from -1.96 to 1.96 has no trend, and vegetation with Theil-Sen slope > 0 and Z > 1.96 has a significantly increasing trend. Results related to inter-annual trends show that vegetation degradation or decreasing trend occur in the northeast, east, and southeast, as well as the west and southwest region. Vegetation cover improves in central and southern of Touran protected area. Areas without a trend or stable regions are dispersed in the entire region. Vegetation cover improves in central and southern of Touran protected area. Areas without trend or stable regions are dispersed in the entire region. Results indicated that vegetation cover declines in 30% of Touran protected area, vegetation cover increases in 26% of study area but in 44% of Touran protected area no trend in vegetation cover was detected.

Discussion and Conclusion

Combining methods including the coefficient of variation, the Theil-Sen median trend analysis, and the Mann-Kendall test provide an effective way to investigate the characteristics of variations in vegetation. According to experts in this area, the overgrazing on rangelands of this area is one of the dangers that threaten the biosphere reserve. Overall, this study showed that the creation of distant-base vegetation indexes from the MODIS Time Series product could improve the evaluation of the long-term trend on a local scale. The method of this paper provides useful information for identifying vegetation changes in arid and semi-arid areas. For future studies, it is suggested studying the changes in vegetation trends in arid ecosystems in order to evaluate remote-sensing time-series images.

Keywords: MOD13Q1, Theil-sen, Time series, Trend analysis, Mann-Kendall, Vegetation Change.