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Investigating the Influence of Drought on Trend of Vegetation Changes in Arid and Semiarid Regions, Using Remote Sensing Technique: A Case Study of Hormozgan province)

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Extended Abstract

Introduction: As a hazardous complex climate condition, drought has affected many parts of the world, and in times when its duration is prolonged, its damage would be tremendous, affecting various sectors such as agriculture, environment, economic, social, etc. Due to the wide range of this phenomenon's effects on all ecosystems, especially in arid and semiarid regions, continuous monitoring of drought is particularly important. Vegetation and its products are among the most significant parameters affected by this destructive phenomenon. Observation of such harmful effects can be done using remote sensing science. In recent years, this science has played a significant role in managing and monitoring drought, vegetation, and their interactions by increasing sampling points, widening the coverage area, improving temporal resolution, lowering costs, and applying regular and higher spatial resolution. Considering the importance and necessity of this issue, this study set out to investigate and monitor drought indices (SPEI, SPI), vegetation index (NDVI), and these indices' interactions from 2000 to 2016 in Hormozgan province, Iran.

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Materials and Methods: To study meteorological drought and potential evapotranspiration, the required data concerning the monthly rainfall and temperature of 164 rain-gauge stations in the region were collected. Then, the homogeneity test was applied to all stations. Statistical deficiencies were reconstructed for the data, and finally, the annual SPI values were calculated using MATLAB software. Kriging geostatistics was used to map the SPI drought. Due to the availability of satellite images for 2000-2016, a drought map was prepared for this period. The NDVI index obtained from the Modis satellite images (MOD13A2) was also used to study the vegetation. Finally, to investigate the effects of meteorological drought and potential evapotranspiration on vegetation, the average NDVI and drought index was calculated for each year, and the severe effects of drought on vegetation were examined. Moreover, the correlation between vegetation and drought was studied through the Pearson correlation coefficient.

Results: According to the results of the study, the highest values of SPI and SPEI were found in the years 2009, 2014, 2012, and 2011, respectively. NDVI and annual rainfall's changing trend indicated that these indices' mean values were significant at 95 levels over the 17 years, showing an increasing trend. The trend of temperature, SPEI, and SPI changes was decreasing during this time interval. Also, the vegetation index peak was in accordance with the highest rainfall value in this time period. In other words, the highest rainfall occurred in 2005 in this region. The vegetation index showed the highest increase this year, suggesting that vegetation was affected by rainfall fluctuations in the region. Based on the results of the Pearson correlation coefficient between meteorological drought, evapotranspiration potential, NDVI vegetation index, precipitation parameter, and temperature at a 12-month time-scale, the highest correlation was reported between SPI index and precipitation, which was equal to 0.99, and the lowest correlation was found between temperature and SPEI, being 0.48. Moreover, this correlation coefficient analysis showed a high correlation between the meteorological drought index and NDVI vegetation index at 95% level in the study area. This correlation was reported as 0.792. The correlation between SPEI and NDVI was also reported as 0.797, indicating that with an increase in precipitation rate, the NDVI increased.

Discussion and Conclusion: It could be concluded that, depending on the prevailing conditions of the area, the extent, time, and type of rainfall affect the amount of vegetation. Therefore, studying and identifying vegetation in each area could lead to the discovery of each region's conditions and the vulnerability status of the area. Any reduction in the effects of drought on these fragile and sensitive ecosystems requires careful planning according to each region's conditions. Planners and relevant authorities should take appropriate measures to improve the irrigation system, reduce evaporation, enhance the crop system, mitigate the damages caused by drought, and get the ecosystem adapted to climate conditions. Moreover, this study used Modis images with a kilometer's pixel size. For a closer look at the vegetation index, satellite images with smaller pixel sizes, such as Landsat ones, could also be used to increase spatial accuracy. Finally, a more detailed study is recommended to investigate the effects of drought on vegetation in different land-uses.

Keywords: Hormozgan Province, NDVI, SPI, SPEI, Pearson Correlation Coefficient, Arid and Semi-Arid Lands.