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Determination of soil loss conditions and spatio changes of Hoz-e-Sultan playa based on Albedo index

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Summary

In this study, the albedo and pca index , which is defined as the ratio of solar electromagnetic radiation reflected from the soil and plant surface to incoming radiation, is based on two images of Landsat 5 and 8 satellites taken on 16-06-1991 LandsatTM and 08-06-2016 Landsat 8 OLI-TIRS satellite was used. The results showed that the albedo index in 1991 with a maximum of 0.72 reached 0.85 in 2016, which indicates an increase in albedo, soil loss, increased salinity and reduced vegetation. The albedo index in 1991 and 2016 showed that the Playa Center has values greater than 0.42, which occupies about 15% and 10% of the study area, respectively. Which has decreased from the very high albedo area in the center of Playa from 1991 (9.1%) to 2016 (3.5%), the main reason being the excessive increase of salt extraction from salt mines in this playa. The decrease in the area of albedo with very low values in the margin of Playa, in 1991 and the addition of this area to the range of medium and high albedo in 2016, indicates soil loss, salinity, reduced vegetation and desertification in the study area. The results of the pca index showed changes in the area of the playa during 26 years, with a decrease of 10.09 square kilometers.

Theory / Method / Workflow

1.Datasets

In the present study, three Landsat 5, and 8 satellites imagery dating back to 1991, and 2016 in the 26-year period were used to determine the changes in Hoz-e-Sultan playa. The characteristics of these images, along with the meteorological information related to the synoptic station of Qom at the moment of taking images by sensors.

2.Overall workflow

Equation (1) was corrected to convert the digital values of the image to thermal radiation values (Nelson, 2002).

$$L_{\lambda} = Gain \times DN + Bias = \left(\frac{L_{\max} - L_{\min}}{255}\right) \times DN + Bias \quad (1)$$

Surface albedo is defined by correcting the amount of high atmospheric albedo (αtop) for the effects of atmospheric passage (Nelson, 2002) Equation (2).

$$\alpha = \frac{\alpha_{toa} - \alpha_{path\_radiance}}{\tau_{sw}^{2}} \quad (2)$$

(3) pca : Principal component analysis

3. Sampling in the study area

Results, Observations, Conclusions

Soil loss leads to the destruction of land cover with vegetation capacity and increased spatial variation of soil spectral properties, Because the top layer of soil is lost and the bottom layers of the soil are exposed. This is one of the key environmental issues that affects vital aspects such

as food security, reduced production, conservation of natural resources, biodiversity loss, global climate change and environmental hazards, especially dust. To study and identify these conditions, remote sensing has been used as a starting point to control the increase in salinity and desertification. In this regard, there are many early warning signs and symbols based on remote sensing, Among these, we can mention the albedo index. Due to the increase in fluctuations and a significant decrease in the surface of the Hoz-e-Sultan playa in parallel with the rapid development of the desert salt marshes in its periphery, which has become one of the most important and controversial environmental challenges in the country over the past decade, its devastating and long-term consequences In this basin has produced. . In this regard, by taking 20 samples, 10 samples were randomly selected from the playa border in two time periods, which with increasing the albedo index, the pca values also increase, indicating the high correlation between these two indices in determining the amount of spatial and temporal changes in the playa. With increasing fluctuations and a significant decrease in moisture of Playa chlorides from 1991 to 2016 due to increased evaporation and reduced water inflow, especially from the eastern part of the basin and lower groundwater levels, these minerals crystallized due to lost soil and salinity. As a result, vegetation has decreased and the amount of albedo has increased, and in a way, with the increase of salt exploitation from the mines, its density in the central part of Playa has decreased, so the area of albedo has been greatly reduced in 2016. Accordingly, the area of Playa has decreased and its border has retreated, especially in the eastern part. This issue, due to the increasing trend over two time periods, indicates the reasons for the change in the ecological system of the region, which is one of the main factors damaging it.

Novel/Additive Information

In this research, for the first time, the albedo index has been used for environmental changes in Hoz-e-Sultan playa.

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