

Study on the Dynamic Changes of Vegetation Cover in Yan'an City based on Remote Sensing Data

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Abstract

Based on remote sensing data, we analyzed the spatial and temporal dynamic change characteristics of vegetation and meteorology in Yan'an City in the past 20 years, and explored the factors affecting the change of vegetation index. The results showed that the vegetation index of Yan'an City ranged from 0.54 to 0.75 from 2000 to 2019, and its spatial distribution showed the characteristics of high in the south and low in the north, which was consistent with the distribution of land use types in Yan'an City, and in the temporal distribution, it showed a significant upward trend, and the overall rate of increase was 0.095/(10a); during the period of 2000~2019, 79.83% of the areas of Yan'an City had an improved vegetation trend, and degraded areas accounted for 0.34% of Yan'an city. In summary, the vegetation index of Yan'an city showed an increasing trend.

Keywords

Yan'an City; Vegetation Index; Spatio-temporal Dynamic Change.

1. Introduction

Vegetation is an important medium for energy exchange, water cycle and carbon cycle on the earth's surface, and plays an important role in global energy balance and climate change [1-3]. Vegetation is also an indicator of regional ecosystem stability, with the role of climate improvement, soil and water fixation, and pollution reduction [4]. And the vegetation in arid areas is extremely sensitive to climate change and hydrothermal conditions, so exploring the process of regional vegetation change is of great significance in improving the ecological environment as well as the utilization of biological resources [5].

As one of the most fragile ecosystems in China, the Loess Plateau has suffered a substantial decline in vegetation cover in the early years due to over-cultivation of land, and problems such as soil erosion and land sanding have become increasingly prominent [6]. As a typical area of ecological fallowing on the Loess Plateau, Yan'an City is located in the south-central part of the Loess Plateau. Under the background of ecological fallowing, Yan'an City has experienced a great change in vegetation cover, but the ecological environment of Yan'an City is still fragile due to the influence of natural factors and human activities. Therefore, it is of great significance to explore the dynamic change pattern of vegetation cover in Yan'an City, as well as the relationship with precipitation and temperature, in order to guide the coordinated development of Yan'an City's socio-economic and ecological environment. This study takes Yan'an City as the study area and uses MODIS13 NDVI data as the basis to analyze the dynamic changes of vegetation index in Yan'an City from 2000 to 2019, so as to provide scientific reference for ecological environmental protection in the region.

2. Data Sources

MOD13A1 data is a level 3 product of MODIS data, which contains the normalized vegetation index (NDVI) on a global scale, with a spatial resolution of 500 m and a temporal resolution of 16 d. There are a total of 23 scenes of data per year, in which 001 represents the daily sequence of the maximum synthetic value of NDVI for 1~16 days. This data has undergone atmospheric processing such as water vapor, cloud, and aerosol to ensure the data quality, and has been widely used in the study of vegetation cover change. The MOD13A1 data selected for this study contains NDVI data from January to December from 2000 to 2019 (data for January 2000 are missing), and the data are obtained from the American Aviation Administration (<https://ladsweb.modaps.eosdis.nasa.gov/search/>), with the line number h26v05. Two periods of the monthly images, and the average of the two is taken as the vegetation index for the month.

3. Results and Analysis

3.1. Characteristics of Temporal Changes of Vegetation Index in Yan'an City from 2000 to 2019

The annual mean NDVI in Yan'an City ranged from 0.54 to 0.75 from 2000 to 2019, with an overall significant increasing trend and a growth rate of 0.095/(10a). Among them, in 2000~2012, the annual mean NDVI value in Yan'an City maintained a high upward trend with a growth rate of 0.135/(10a), while in 2012~2019, the annual mean NDVI value fluctuated and grew at a slower rate, with a very low value in 2015. The reason for this is that since 1999, Yan'an City began to implement the project of returning farmland to forests and grasslands, and human beings planted woodlands and grasslands on a large scale, which increased the vegetation cover in Yan'an City and led to a significant increase in NDVI from 2000 to 2012. However, after 2012, the government focused on protecting the vegetation from destruction, and the natural environmental factors had its dominant role in the growth of vegetation in Yan'an City, so the growth rate of its vegetation index slowed down.

3.2. Dynamic Changes of NDVI in Yan'an City

Table 1. The area and proportion of different NDVI intervals in Yan'an City in 2000, 2010 and 2019

NDVI	2000		2019	
	Area/km ²	Proportion	Area /km ²	Proportion
< 0.3	1 685.2	4.55%	33.3	0.09%
0.3 - 0.4	9 888.9	26.70%	100.0	0.27%
0.4 - 0.5	8 077.8	21.81%	737.0	1.99%
0.5 - 0.6	4 400.0	11.88%	4 459.3	12.04%
0.6 - 0.7	3 877.8	10.47%	10 429.6	28.16%
0.7 - 0.8	6 155.6	16.62%	9 233.3	24.93%
0.8 - 1.0	3 322.2	8.97%	12 048.1	32.53%

The area and proportion of different NDVI intervals in each year were counted (Table 1). As can be seen from the chart, the vegetation index in Yan'an City showed an increasing trend, and compared with 2000, the area with NDVI value less than 0.5 was significantly reduced in 2010, and the vegetation index of the whole region of Yan'an City showed an improving trend. Compared with 2010, the vegetation index of Yan'an City in 2019 continued to maintain an increasing trend, and some areas with moderate vegetation cover were transformed into areas with high vegetation cover, but the areas with less than 0.3 increased, which were mainly distributed in the urban area of Yan'an City and urban-rural areas, mainly affected by urban

construction, and the land cover type was transformed from grassland and cropland to building land, which reduced the vegetation cover.

4. Conclusion

Based on the MODIS13 NDVI data products, the spatial and temporal distribution and dynamic change patterns of the vegetation index in Yan'an City from 2000 to 2019 were analyzed, and the following conclusions were obtained: the vegetation index in Yan'an City from 2000 to 2019 ranged from 0.54 to 0.75, and its spatial distribution was characterized by high in the south and low in the north. In the temporal distribution, it showed a significant upward trend, and its NDVI value increased from 0.54 in 2000 to 0.73 in 2019, with an overall increase rate of 0.095/(10a). The dynamics of NDVI in Yan'an City from 2000 to 2019 showed an overall increasing trend, in which 79.83% of the regional vegetation showed an improving trend, mainly distributed in the loess beams, mounts, and gullies areas in the north and east of Yan'an City. The degraded areas accounted for 0.34% of Yan'an city, mainly distributed in the urban area of Yan'an city and the suburbs of county-level cities, with point-like and strip-like distribution.

Acknowledgments

The authors gratefully acknowledge the financial support from Scientific Research Item of Shaanxi Provincial Land Engineering Built-up Group (DJNY2024-35) and Natural Science Basic Research Program of Shaanxi (2024JC-YBQN-0329).

References

- [1] Zhao Kuangchao, Zhu Yanhui, Duan Guohui, et al. Analysis of vegetation change characteristics in Xishuangbanna from 2001 to 2015 based on MOD13Q1 data[J]. *Journal of Ecology*, 2019, 38(4): 1083-1092.
- [2] MAO Dehua, WANG Zongming, LUO Ling, et al. NDVI change of vegetation and its correlation analysis with temperature and precipitation in Northeast China based on MODIS and AVHRR data sources[J]. *Remote Sensing Technology and Application*, 2012, 27(1): 77-85.
- [3] LIU Shao-hua, YAN Deng-hua, SHI Xiao-liang, et al. Interannual variation and correlation between vegetation NDVI and climate factors in China[J]. *Arid Zone Geography*, 2014, 37(3): 480-489.
- [4] HE Liheng, ZHOU Yinkang, YANG Qiang. Spatial and temporal variation and characterization of vegetation cover in Yan'an City, 2000-2013[J]. *Arid Zone Resources and Environment*, 2015, 29(11): 174-179.
- [5] LI Jianfei, LI Xiaobing, ZHOU Yi. Spatial and temporal variations of NDVI and its influencing factors during the growing season in Ulanqab City, 2000-2015[J]. *Arid Zone Research*, 2019, 36(5): 1 238-1 249. 1099-1107.
- [6] SUN Rui, CHEN Shaohui, SU Hongbo. Spatial and temporal changes in NDVI of vegetation of different land cover types on the Loess Plateau from 2000 to 2016[J]. *Progress in Geosciences*, 2019, 38(8): 1248-1258.