VEGETATION COVER CHANGE AND ITS ATTRIBUTION IN CHINA FROM 2001 TO 2018

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Abstract: It is confirmed that China has been greening over the last two decades. Such greening and its driving factors are therefore significant for understanding the relationship between vegetation and environments. However, studies on vegetation changes and attribution analyses at the national scale are limited in China after 2000. In this study, fractional vegetation cover (FVC) data from Global Land Surface Satellite (GLASS) was used to detect vegetation change trends from 2001 to 2018, and the effects of CO_2, temperature, shortwave radiation, precipitation, and land cover change (LCC) on FVC changes were quantified using generalized linear models (GLM). The results showed that (1) FVC in China increased by 14% with a greening rate of approximately 0.0019/y r ($p < 0.01$). (2) On the whole, CO_2, climate-related factors, and LCC accounted for 88% of FVC changes in China. (3) CO_2 was the major driving factor for FVC changes, accounting for 31% of FVC changes in China. This study enriches the study of vegetation changes and its driving factors, and has an important significance for adjusting terrestrial ecosystem services.

Keywords: fractional vegetation cover; climate change; land cover change; vegetation change

Results :

FVC showed a clear increasing trend in China from 2001 to 2018. The regions with increased significantly trend in FVC accounted for 30.31%, and the regions with decreased significantly trend in FVC accounted for 3.38%. Increasing FVC was generally found in the Northeast Plain, Loess Plateau, and Yunnan-Guizhou Plateau, and decreasing FVC was generally found in the Middle-Lower Yangtze Plain (Figure 1a).

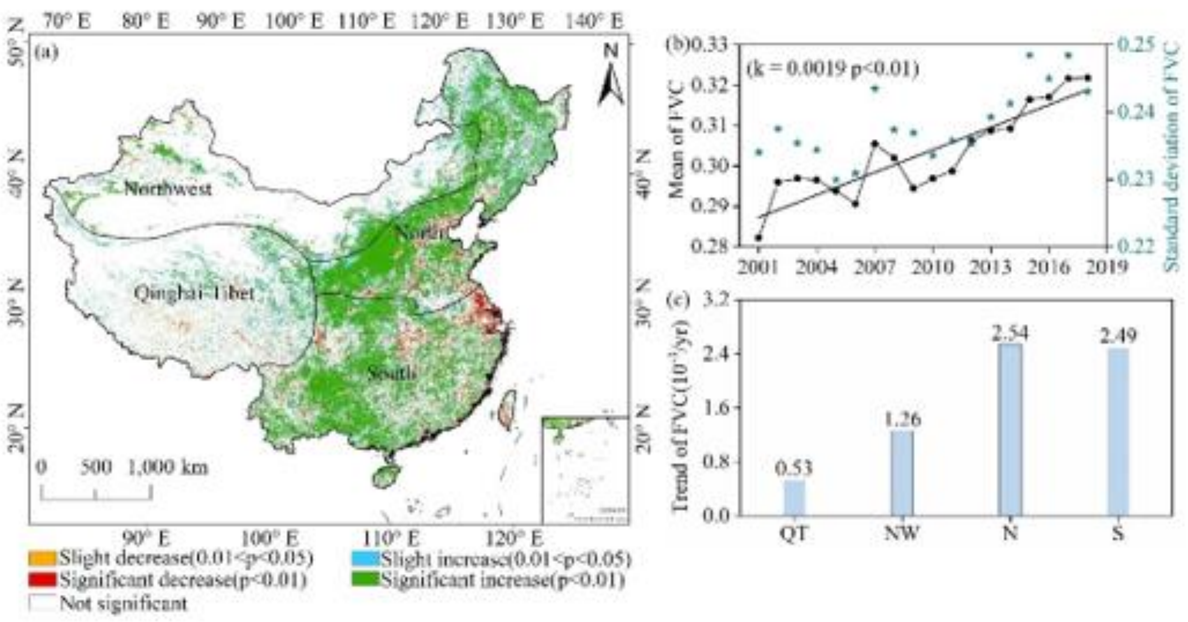

Figure 1. Spatiotemporal variation of the annual mean FVC. (a) the spatial distribution of the FVC change trend from 2001 to 2018; (b) the annual mean FVC and its trend from 2001 to 2018,

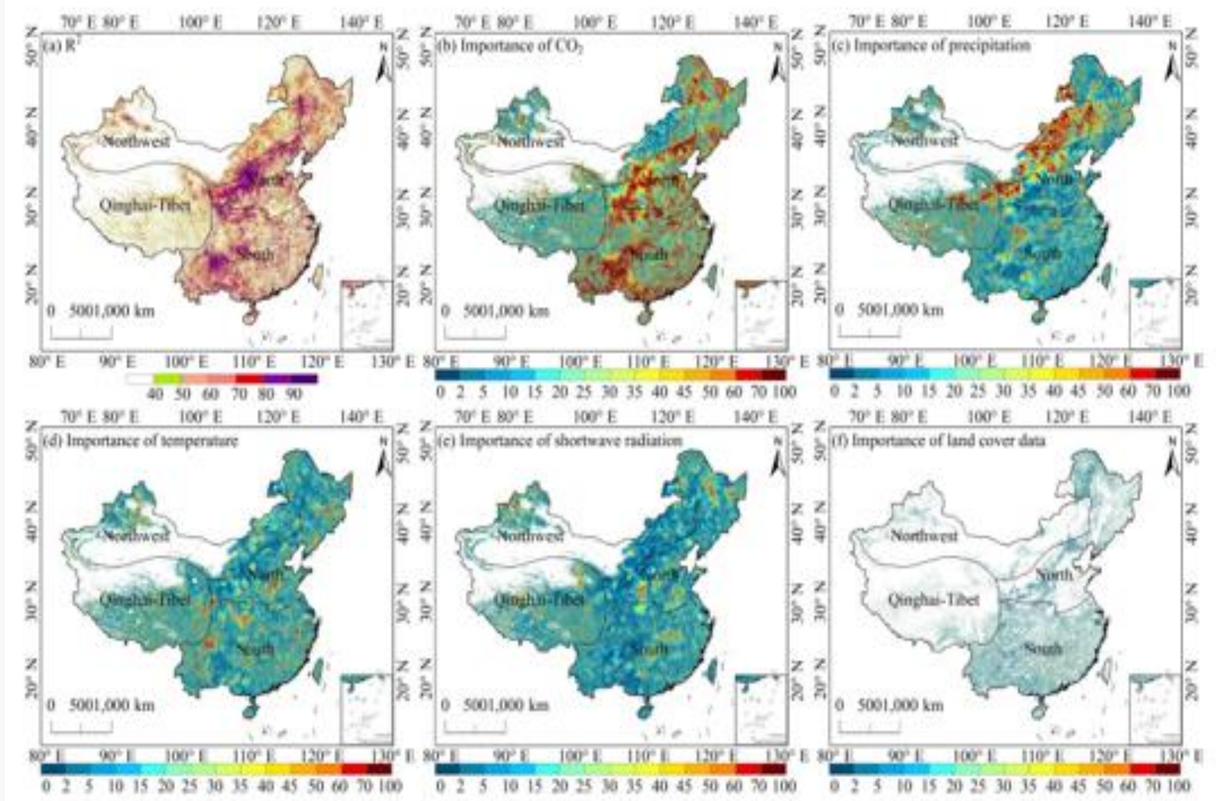

Figure 5. Spatial patterns of importance to FVC changes. (a) the spatial distribution of R^2; (b) importance of CO_2 to FVC changes; (c) the importance of precipitation to FVC changes; (d) the importance of temperature to FVC changes; (e) the importance of shortwave radiation to FVC changes; and (f) the importance of LCC to FVC changes.

The R^2 of the GLM model was higher in the east and lower in the west (figure 2a). At the country scale, increasing CO_2 was the major driving factor for FVC changes. At the regional scale, CO_2 was critical for FVC changes in southern and northern regions, especially in the Loess Plateau, and Yunnan-Guizhou Plateau. However, CO_2 had a small relatively importance in FVC changes in the eastern region of the Inner Mongolia Plateau (Figure 2b). Precipitation had a high importance in FVC changes in arid and semiarid areas, while it had a small importance in the southern region (Figure 2c). FVC changes in the Qinghai-Tibet region were mainly affected by temperature (Figure 2d), and shortwave radiation was critical for FVC changes in the Qinghai-Tibet region and northern region (Figure 2e). The importance of LCC was relatively low, and it was mainly concentrated in the west North China Plain, and southern region. In areas where forest, cropland and grassland were widely distributed, LCC has played a relatively important role (Figure 2f).

CO_2, climate-related factors, and LCC in sum accounted for 88% of FVC changes in China. The drivers explained 82%, 89%, 90%, and 89% of the FVC changes in the Qinghai-Tibet region, northwest region, northern region, and southern region, respectively.

Table 1. Importance of driving factors to FVC changes in four regions. Red shading denotes greater importance, and blue shading represents lower importance (Unit: %).

Drivers \ Regions	Qinghai-Tibet	Northwest	Northern	Southern	China
CO_2	23	24	38	40	31
Precipitation	24	36	21	15	24
Temperature	18	15	16	18	17
Shortwave radiation	16	13	14	12	14
Land cover	2	1	2	4	2
Sum	82	89	90	89	88

Conclusions : Vegetation status is an essential indicator in an ecosystem. Therefore, understanding the relationship between CO_2, climate change, LCC and FVC is critical for ecosystem conservation. Based on our research, vegetation growth in China continuously improved from 2001 to 2018, and increasing CO_2 was the major driving factor for FVC growth in China. In arid and semiarid areas, it is necessary to change the way of water use and adopt drip irrigation and other management measures to improve the vegetation growth. In addition, land cover change has affected the growth of vegetation to a certain extent. These findings are helpful for understanding the relationship between environmental factors and vegetation growth.