Study on Temporal and Spacial Characteristics of Jiangxi NPP Based on GLO-PEM Model

Li Zhou

Statistics School, Jiangxi University of Finance and Economics, Nanchang 330013 China

Abstract: Environmental Change, climate changing and land used changing will affect NPP in Jiangxi Province from 2000 to 2018 based on GLO-PEM model and meteorological data, the special distribution, change and influencing factors of vegetation NPP in Jiangxi Province were analyzed, according to Meteorological and Satellite Remote Sensing Monitoring, since 2000, the ecological quality of vegetation in Jiangxi has been continuously improved. In 2018, the vegetation coverage in Jiangxi province increased by 18.4% compared with 2000, the highest since 2000; the Vegetation Index (NDVI) was the second highest in nearly 20 years; and the NPP increased by 14.7%, the best since 2000. Based on GLO-PEM model, the following measures should be taken to maintain the superiority of ecological civilization construction in Jiangxi Province: (1) continue to increase the coverage of vegetation in Jiangxi Province; (2) improve the quality of forest vegetation and enhance the productivity of vegetation; (3) to promote green ecological agriculture and fruit industry, enhance the carbon sink function of agriculture and fruit industry, take measures to reduce the use of chemical fertilizers and pesticides, and reduce soil and water loss in farmland and orchards; (4) scientifically dealing with the impacts of extreme weather and climate events and meteorological disasters on the vegetation ecosystem.

Keywords: net primary productivity; Jiangxi province; spacial pattern

1. Introduction

Net Primary Productivity (NPP) were calculated by the method of pulsed corona discharge in 2001[1], a standard mixture method is proposed to evaluate the quantitative and qualitative parameters of the NPP, focusing on the terrestrial carbon cycle at home and abroad, which greatly promotes the study of vegetation NPP models. At present, there are a lot of studies on the temporal and special distribution of vegetation NPP at the national and regional scales in China, such as Xu Yuqing et al. [2]. Among them, there are many studies on forest ecosystem NPP using GLO-PEM model, such as Chen Lijun et al. [3], Yan Huimin et al. [4], Li Li et al. [5] used Casa model, C-FIX model and GLO-PEM model to evaluate and analyze the spatio-temporal distribution characteristics of NPP of forest vegetation in Karakax County in 2014. Gao Dongdong [6] studied the temporal and special variation of vegetation carbon flux in China from 1901 to 2005 by using seven Earth System Model of NPP, the relationship between NPP change and air temperature, precipitation and radiation was analyzed in combination with climate factors, and the inter-scale simulation of carbon cycle in terrestrial ecosystem was realized by coupling physiological-ecological process model with remote sensing model, NPP can reflect the special distribution and dynamic changes of carbon budget on regional and global scales, thus increasing the reliability of estimation of land vegetation NPP and Operability, 2000; [7] It is predicted that the global temperature will rise by 2 ℃ ~ 7 ℃ by the end of the 20th century, and the global precipitation pattern will change, and these changes are likely to change the carbon cycle of the ecosystem. Experiments that increase temperature and precipitation in the main promote plant growth and ecosystem carbon fluxes, with decreases in precipitation having the opposite effect, [8,9]. The relationship between vegetation NPP and climate in different areas simulated by different models is different [10-13]. The analysis of the relationship among NPP, climate temperature and precipitation in China in recent 30 years shows that NPP is positively affected by annual average temperature in most regions except southern Greater Khingan, and NPP is negatively affected by annual precipitation in qinghai-tibet Plateau and northeast China [10]. The forest carbon budget model (CBM-CFS3) was applied by Feng Yuan et al. [8] in different time scales, based on NPP and Net Ecosystem Productivity (NEP), the spatiotemporal dynamics of total forest ecosystem and net carbon sequest proportionn and oxygen release value in Xingshan County, Hubei Province from 2009 to 2030 were assessed, the value loss of carbon fixation and oxygen release services caused by heterotrophic as piproportionn was quantified. Since the 1980s, Jiangxi has implemented a large-scale project of mountains, rivers and lakes, and achieved good results; the construction of the Poyang Lake eco-economic zone in Jiangxi Province has been promoted as a national strategic regional development plan [14]. Therefore, in this paper, GLO-PEM model is used to simulate and analyze the special distribution pattern of NPP of vegetation in the case region, to provide a scientific basis for promoting the development of human society.

2. Research Area and Methodology

2.1. Survey of the Study Region

Jiangxi Province is situated on south coast of Yangtze Plain, and its boundary is 113°34'E -- 118°28'E, 24°29'N -- 30°04'N, near the Tropic of Cancer, with abundant sunshine and warm climate, and the annual average temperature is about 20 ℃, spring is warm and rainy, summer is hot and warm, autumn is cool and dry, winter is cold and dry. The frost-free period lasts from 240 to 307 days. Due to the influence of monsoon and geomorphology, the annual precipitation in this area is uneven in space and time, averaging 1400~1800 mm per year. With complex natural conditions and various vegetation types, it is one of the origin centers of tropical and Subtropical Flora in Southeast Asia. The evergreen broad-leaved forest (EBLF) is the zonal vegetation and the climax community of plant community succession in Jiangxi Province. The distribution of plants in Jiangxi varies greatly from north to south, with a boundary of 27°00'N to 27°30'N, more tropical floristic elements in the south and many warm temperate floristic elements in the north. At the same time, because of the difference of altitude, the vegetation vertical band spectrum is formed. The main vegetation types are subtropical evergreen broad-leaved forest, artificial conifer forest, conifer Temperate broadleaf and mixed forest, deciduous broad-leaved forest and mixed evergreen and deciduous forest. Among the typical vegetation types, evergreen conifer forest accounts for 37% of Jiangxi province area and Shrub 30%, evergreen broad-leaved forest 5%, farmland 2%, grass land 1%. Territory east, south, west surrounded by mountains, rolling hills in the middle, the north of Poyang Lake and its plains.

2.2. Research Methodology

In this paper, GLO-PEM model is used to simulate global NPP data. GLO-PEM model includes the estimation of NDVI from AVHRR data. Since these algorithms have been verified by ground observation data, the model can be successfully used to evaluate the temporal and special patterns and changes of regional or global vegetation NPP, GLO-PEM is a light utilization efficiency model based on ecological mechanisms such as photosynthesis and autotrophic uptake. GLO-PEM is the first productivity efficiency model driven entirely by remote sensing models:

$$NPP=\sum t\times(S_t\times N_t)\times\varepsilon_g-R_a \quad (1)$$

NPP is the net primary productivity g/(m^2*a),St is the proportion of photo synthetically active photosynthetic radiationhttp://dict.youdao.com/w/eng/active_photosynthetic_radiation/javascript:void(0); absorbed by vegetation, and Nt is the proportion of photo synthetically active photosynthetic radiation absorbed by vegetation, I. E. FPAR, ε_g is the utilization efficiency of photo synthetically active photosynthetic radiation absorbed by vegetation, g / MJ, Ra indicates autotrophic absorption. Among them:

$$\varepsilon_g=f(T_a,D,CSI)\times\varepsilon_g^* \quad (2)$$

In the formula, T_a is air temperature, which is obtained by regression equation with NDVI. D is the difference of atmospheric water pressure (mb). CSI (Cumulative Surface Wetness Index) is the stress Index of soil moisture accumulation. ε_g* Is the maximum potential light utilization efficiency G / MJ, which is affected by photosynthesis and temperature.

$$R_a=0.53\times[w/(w+50)]\times e^{0.5}\times[(T_e-T_a)/25] \quad (3)$$

$$W=7166.1\times\rho_{min}^{-2.6}$$

In the formula, w is aboveground biomass Mg / hm^2, T_a is climatological average air temperature, ρ_{min} is the minimum value of visible light reflectivity.

With the support of Remote Sensing Software ERDAS IM AGINE, the vectorized administrative territorial entity image of Jiangxi Province and NPP image of each year were superimposed, and NPP data of Jiangxi Province from 2000 to 2018 were obtained by average s of mosaic, perceptual region and mask, each year Jiangxi Province Range NPP value of pixels. The average value of Jiangxi NPP is calculated by averaging the pixel value in the administrative territorial entity. The average value of 20-year NPP is calculated by calculating the average value of 20-year NPP of every pixel, and then calculating the multi-year average value of NPP in the whole province. Special modeling tool special Modeler was used for pixel-level classification statistics and linear regression. Based on the special visualization of NPP distribution in Jiangxi Province, the special distribution pattern of NPP in Jiangxi province was analyzed.

3. Analysis on Temporal and Spacial characteristics of Jiangxi NPP

Since 2000, the construction of ecological civilization in Jiangxi Province has made gratifying achievements. Through the analysis of Satellite Remote Sensing Monitoring, it is found that the vegetation coverage and quality of other areas have been improved continuously, especially in the east and south of Jiangxi Province.

3.1. Analysis on Special Distribution of NDVI in Jiangxi Province in 2018

According to the monitoring and analysis of satellite data from 2000 to 2018, the vegetation coverage of Jiangxi Province in 2018 is the percentage, unit of the vertical projection area of the above-ground part of the vegetation, the annual average vegetation coverage is the average of 12 months vegetation coverage. Compared with 2000, the vegetation coverage in Jiangxi province has increased by 18.4%, and the trend rate is 0.4 ~ 0.6(% / year) in some areas (figure 1)

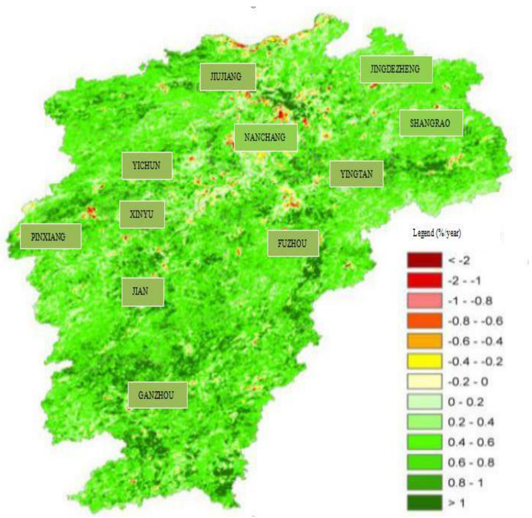

Figure 1. 2000-2018 trend rate of vegetation coverage in Jiangxi Province (% / year)

The Normalized Difference Vegetation Index (NDVI), that was synthesized from 16 days satellite datum from 2000 to 2018, is the best indicator of vegetation growth and vegetation coverage. As an effective index for monitoring vegetation and eco-environment change by satellite remote sensing, it can reflect the luxuriant degree of vegetation on the surface and objectively reflect the vegetation ecological situation in Jiangxi Province. Products, we calculated the largest NDVI in Jiangxi over the years. In 2018, the yearly maximum NDVI in most areas of Jiangxi province was between 0.65 and 0.75, and the vegetation ecology was good. The annual maximum NDVI of Jiuling Mountains, Luoxiao Mountains, Yushan, Wuyishan and Huaiyu mountains natural reserves is greater than 0.85, which is 12% higher than the average of Jiangxi Province, at the same time, it also shows that the protection measures and effects of the government to the nature reserve are very remarkable. The overall "greenness" of the right graph is significantly higher than that of the left one, which indicates that the maximum vegetation index of Jiangxi Province in 2018 is significantly higher than that of 2000.

From the annual average maximum NDVI change map of Jiangxi Province (figure 2), it can be seen that since 2000, the vegetation growth of Jiangxi Province has shown a trend of continuous improvement, especially since 2011, the maximum NDVI values of each year are higher than the average values of previous years. The maximum NDVI in 2015 was 0.77, the highest in nearly 20 years. In 2018, 0.76 was the second-highest level in nearly 20 years, up about 3 percent from the previous year's average. This is mainly due to better water and heat conditions in 2015 and the periodic peak of the vegetation index, in 2018, vegetation production was restrained in the peak season due to the continuous lack of rain in spring and summer and the high temperature and drought (from March to August, the precipitation in Jiangxi province was 1.8% less and the temperature was 1.4 ℃ higher), the peak vegetation index is on the low side.

Figure 2. 2000 ~ 2018 largest annual NDVI change map of Jiangxi Province

The analysis of the special distribution of NDVI change trend rate in Jiangxi Province from 2000 to 2018 shows that the NDVI change trend rate in most areas of Jiangxi province is greater than zero in the past 20 years. This indicates that the vegetation coverage and the quality of vegetation in most areas of Jiangxi Province are improved simultaneously.

3.2. Spacial Distribution of Jiangxi NPP on Account of GLO-PEM Model

Based on 2000-2018 Mod is NDVI and monthly meteorological data, GLO-PEM model was used to calculate the net primary production (NPP) of each month in Jiangxi Province since 2000. NPP is the accumulation of organic matter in a unit region and a unit time by CHLOROPLASTIDA, generally, the dry matter content per square meter ($g \cdot C/m^2$) can reflect the growth of plants and the quality of terrestrial ecosystem. Value. As figure 3 shown, the vegetation of Jiangxi Province in 2018 was significantly higher than that in 2000. The net carbon dioxide absorbed by vegetation increased obviously, and the vegetation productivity of Jiangxi Province increased obviously. Figure 4 also shows that NPP in Jiangxi Province has been increasing gradually since 2000, with an average annual increase of 6.8 $g \cdot C/m^2$. In 2018, NPP in Jiangxi Province was the highest since 2000, with an increase of 14.7% compared with 2000. This is inseparable from our province's efforts in ntity

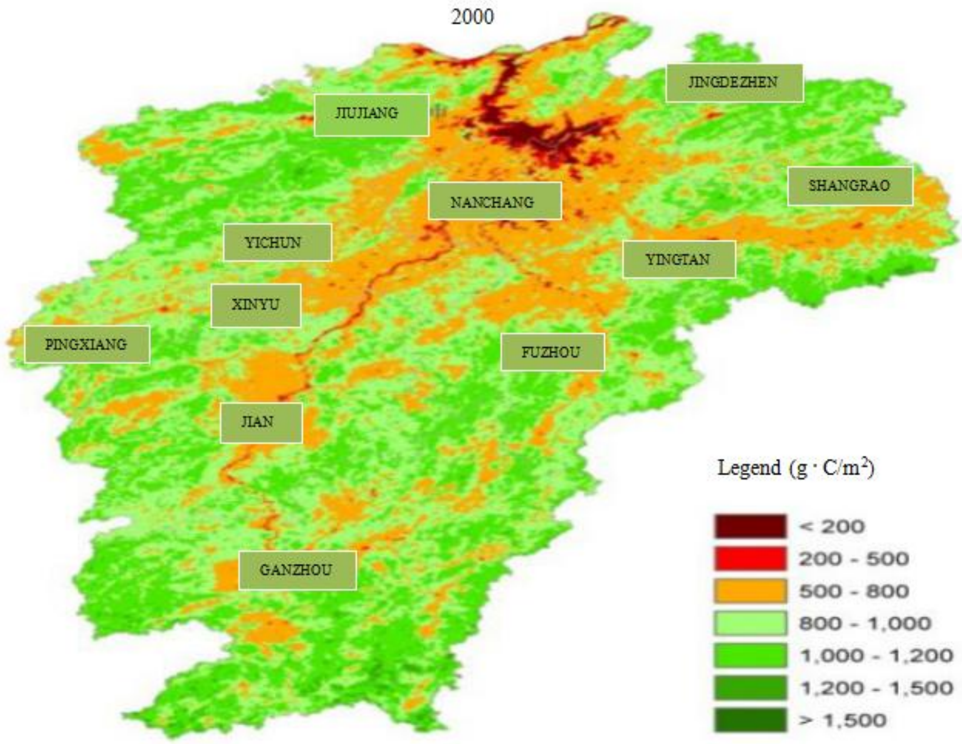

Figure 3. NPP special distribution maps of Jiangxi Province in 2000 ~2018

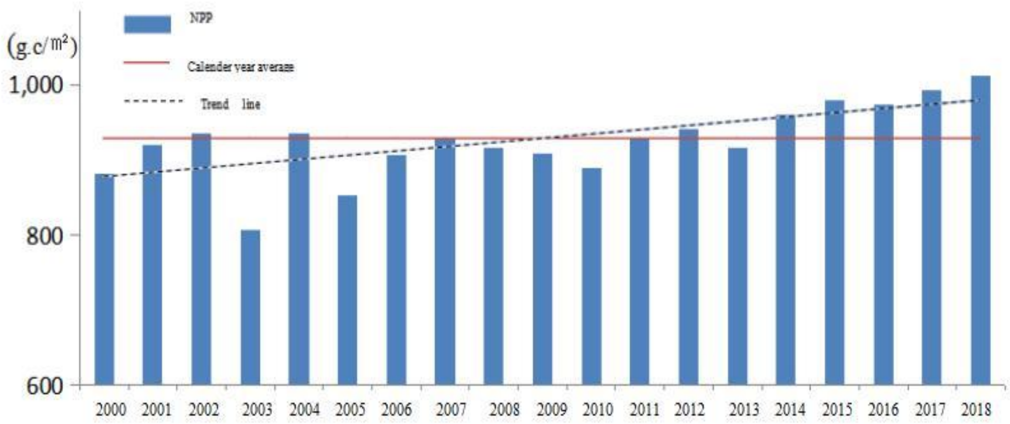

Figure 4. 2000 ~ 2018 NPP in Jiangxi Province

3.3. Analysis of Ecological Improvement of Vegetation in Different Districts of Jiangxi Province

Since 2000, the vegetation ecological quality of 11 Cities divided into districts in Jiangxi Province has been improved in different degrees. Ji'an, Ganzhou and Fuzhou, Jiangxi ranked among the top three cities in terms of vegetation improvement (figure 5). In Nanchang, the provincial capital, the degree of vegetation improvement is lower than that of other cities, due to factors such as faster urban development, but nearly 80% of the vegetation has also been improved compared to 2000.

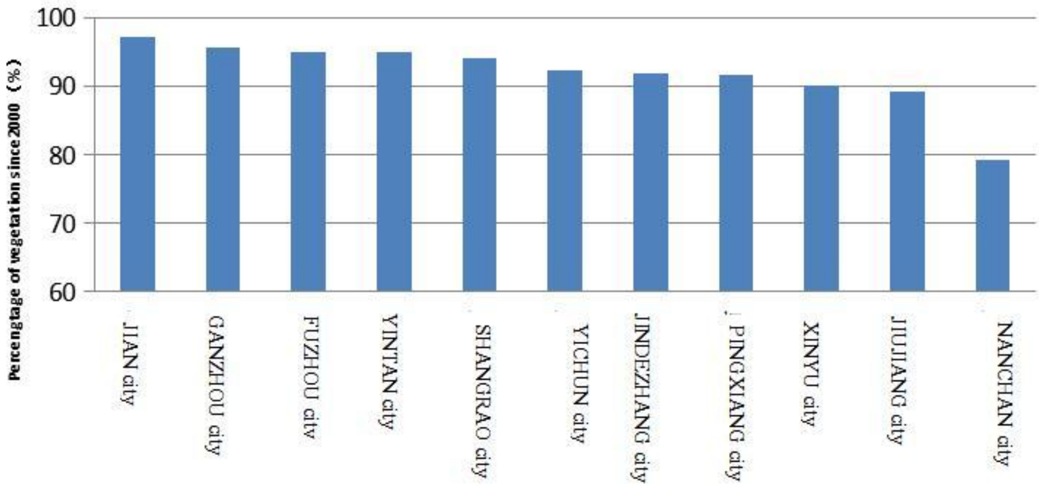

Figure 5. Proportion of vegetation ecological improvement in 11 cities divided into districts in Jiangxi Province since 2000

4. Conclusion

In this paper, GLO-PEM model is used to analyze the special distribution of NPP in Jiangxi region. In order to maintain the superiority of the ecological civilization construction of our province, it is suggested that the important thought of "Green Water and Green Mountains is Jinshan District Silverhill" should be included in the report of the 19th National Congress of the CPC and the newly revised Party Constitution.

1. Continue to increase the vegetation coverage of Jiangxi Province. On the one hand, efforts will be intensified in a forestation, returning farmland to forests and grasslands, and greening mining areas. On the other hand, efforts will be made to strengthen urban ecological construction and planning, increase the coverage of urban vegetation, restore urban natural wetlands and optimize urban water systems, building a "sponge city";

2. Improve the quality of forest vegetation and enhance the productivity of vegetation. Further strengthen the protection of natural forests, expand the scope of protection of non-commercial forests, improve the structure of artificial forests, in order to improve the quality of forest vegetation and enhance forest productivity;

3. Promote green ecological agriculture and fruit industry, enhance the carbon sink function of agriculture and fruit industry, take measures to reduce the use of chemical fertilizers and pesticides, reduce soil and water loss in farmland and orchards;

4. Scientific response to the impact of extreme weather and climate events and meteorological disasters on the vegetation ecosystem. Monitoring and early warning of meteorological disasters such as drought, waterlogging, freezing and high temperature, as well as forest fire danger levels will be strengthened, and ecological rain enhancement opeproportionns will be carried out in a timely manner to enhance the resilience of vegetation ecosystems to disasters.

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