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论文

俄罗斯布里亚特共和国植被*NPP*对气候变化的时空响应

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摘要:

以遥感和气象数据为主要数据源,运用改进后的CASA模型,估算了俄罗斯布里亚特共和国2000—2008年的植被*NPP*,并验证了模型的精度,分析了该地区植被*NPP*的时空变化规律及其与气候因子的相互关系。研究结果表明:时间上,植被*NPP*年际上呈现为在波动中上升,月份上表现为先升后降的趋势;空间上,植被*NPP*随经度的增加而增大,随纬度的增加而减小,由西南到东北逐渐递增的趋势;不同植被类型的*NPP*也不同,从大到小依此为:草地与沼泽林>森林>森林与草原>稀树草原>高山植被。其变化主要受气温和降水量变化的作用。改进后的CASA模型运用于布里亚特共和国植被*NPP估算的精度较高。该研究对中国北方植被NPP*估算和生态跨境研究具有借鉴意义。

关键词: CASA模型 植被*NPP* 气候因子 布里亚特共和国

Temporal and Spatial Response of Vegetation Net Primary Productivity to Climate Change in Buryatiya Republic, Russia

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Abstract:

As a critical index for monitoring the terrestrial ecosystem responding to climate change, net primary productivity(*NPP*) is widely used to reflect the productivity of vegetation community under natural conditions. Little work has been carried out on vegetation *NPP* in Buryatiya Republic of Russia in China. As Baikal Lake is located in Buryatiya, it would affect the vegetation growth in this area through changing the atmospheric circulation. Moreover, Buryatiya borders on Northern China. It would be of great importance for natural resource security and ecological value evaluation in Northern China to examine the vegetation growth there. In order to fully understand temporal and spatial variations in vegetation *NPP* and its response to climate change, satellite images of Moderate-resolution Imaging Spectroradiometer (MODIS) NDVI products in conjunction with ground-based observations of climatology were jointly used to estimate the vegetation *NPP* in Buyatiya Republic during the period 2000-2008. Meanwhile, observed values of vegetation *NPP* and MODIS *NPP* products were jointly utilized to verify simulations of vegetation *NPP* in this area. Data of MODIS NDVI and MODIS *NPP* were obtained from the United States Geological Survey (USGS), and the ground observations of climatology were gained from the United States National Centers for Environmental Prediction (NCEP). In addition, observations of vegetation *NPP* were obtained in August 2008 and September 2009 in Buryatiya. In particular, the Carnegie Ames Stanford Approach (CASA) was improved by simplifying its parameters so as to be suitable for large-scale estimation of vegetation *NPP*. Bio-temperature instead of monthly average temperature was applied to the sub-model of soil water content. Subsequently, the reliability of the model was tested with the observed vegetation *NPP*. Variation in vegetation *NPP* and its relationship with climatic factors were analyzed in detail. Results showed that: 1) The modified CASA model can be used to estimate vegetation *NPP* in Buryatiya Republic, and the accuracy of the model was generally high with a correlation coefficient of 0.91 ($P<0.01$). 2) The vegetation average annual *NPP* was 542.45 gC • m^{-2} • a^{-1} and the total *NPP* was estimated as 1.91×10^{14} gC • a^{-1}. Vegetation *NPP* exhibited an increasing trend at a rate of roughly 0.39 gC • m^{-2} • a^{-1} from 2000 to 2008. As for monthly variation, vegetation *NPP* increased significantly from April to July, decreased rapidly from August to November, and maintained steady from December to March of the next year. Its monthly increasing rate was found to be approximately 9.93 gC • m^{-2} • $month^{-1}$. Vegetation *NPP* revealed fluctuation change in different regions with effect of terrain and human factors. However, it raised with increasing longitude and decreased with raising latitude. The *NPP* value of different vegetations embodied trend with meadow and swamp>forest>forest and steppe>steppe>high mountainous vegetation. 3) Temperature and precipitation were found to be the primary factors limiting vegetation

NPP over this area. In short, this study results can be taken as reference for vegetation *NPP* estimation in Northern China or cross-border ecological research.

Keywords: CASA Model vegetation *NPP* climatic factor Buryatiya Republic

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