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基于地形校正的植被净初级生产力遥感模拟及分析

Simulation by remote sensing and analysis of net primary productivity of vegetation based on topographical correction

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中文摘要:

植被净初级生产力（NPP）模拟研究对碳平衡监测及深入理解碳循环具有重要意义。高空间分辨率、短重访周期的遥感数据和地形校正成为精准模拟山区植被NPP研究的必然选择。在利用DEM数据对太阳总辐射和气温进行地形校正的基础上，估算了研究区植被吸收光合有效辐射因子、温度胁迫因子、水分胁迫因子和典型植被类型的最大光能利用率，构建了改进的CASABTC估算模型，利用HJ-1CCD数据模拟了2009年大别山区植被的NPP，并探讨了其时空变化特征。结果表明：1）由该文模拟值与MOD17A3的精度验证结果分析，基于地形校正的CASABTC模型和HJ-1数据适合精确模拟山区植被的NPP；研究区NPP在冬季比在春、秋、夏季受地形起伏的影响大。2）该文模拟的年NPP平均值为413.7 g/(m2 • a)比MOD17A3平均值偏小4.9%，在空间分布上前者更加详细，地表特征更明显。3）研究区2009年NPP模拟值范围为0～1143.6 g/(m2 • a)，研究区总面积66.1%的NPP值在200～600 g/(m2 • a)之间；年总NPP为9.891×106t，约占全国年总NPP的3.2‰，整体上呈现高、低值区交错分布的不规则特点。4）月NPP值随季节而变化，所有植被类型的NPP季节变化曲线都呈典型的单峰分布，且不同植被类型NPP的季节变化幅度有差别。月NPP值的季节变化与气温、太阳总辐射及NDVI的季节变化基本吻合，而降水量年内分配不均与NPP无相关性特点。5）各植被类型的月NPP和总NPP随海拔高度上升而逐渐变大，对于后者当海拔高度上升至1100 m时达到最大值，继续上升，其保持在600 g/m2左右不变。该研究可为后续基于HJ-1数据的山区植被NPP模拟提供参考。

英文摘要:

Abstract: The study on simulation of the net primary productivity (NPP) was significant in monitoring carbon balance and understanding deeply the global carbon cycle. Remote sensing image data of a high spatial resolution and short revisit cycle and topographical correction should inevitably be the choice for accurately simulating mountain net primary productivity. On the base of topographical correction for the total solar radiation and the air temperature by DEM data using geographic information system (GIS) technology, hotosynthetically active radiation absorption, the temperature stress factors, the moisture stress factor and the max light use efficiency of typical vegetation types were estimated in this paper. Then an improved Carnegie Ames Stanford Approach model was built and used with HJ-1 data to simulate the net primary productivity of the Dabie Mountain region in 2009, and the temporal and spatial variation characteristics of the net primary productivity were discussed. The results showed that: 1) By analyzing the accuracy of test results between the simulated NPP in this paper and MOD17A3 product value, a conclusion should be drawn that the CASABTC model and HJ-1 remote sensing image data were suitable for accurately simulating the net primary productivity of mountain vegetation. The net primary productivity in the study region in winter more than in spring, autumn, summer was affected by topographic relief.2) The annual average of simulated NPP in this paper was about 413.7 gC/(m2 • a) and smaller than that of MOD17A3 4.9%. More details on the spatial distribution and surface features of the former were more obvious than the latter. 3) The average of simulated NPP in study region in 2009 was from 0 to 1143.6 gC/(m2 • a), and the range of NPP in 66.1% of the total area was from 200 to 600 gC/(m2 • a). Total NPP in the study region was 9.891×106 tC and constituted approximately three thousandth of total NPP throughout the country. On the whole, the spatial distribution of annual net primary productivity was irregularly staggered by high and low net primary productivity.4) Monthly NPP value varies with the season. The seasonal change of net primary productivity of all vegetation types manifested typical unimodal distribution curves and their range of the seasonal change differed from each other. The seasonal change of monthly NPP was in agreement with that of the temperature, the solar total radiation and normalized differential vegetation index (NDVI). However, the uneven distribution of precipitation was not related to the net primary productivity.5) Monthly NPP for all vegetation types and total NPP increased gradually with increasing altitude. For the former, according to the change in size, their order was: evergreen broad leaf forest, deciduous broad leaf forest, mixed broadleaf conifer forest, deciduous needle leaf forest, evergreen needle leaf forest, shrublands, crops vegetation and grasslands, but the latter peaked as the altitude ascended to 1100 meters and remained constant around 600 gC/m2 when altitude went on. This study could provide the reference to further the net primary productivity simulation of mountain vegetation based on HJ-1 remote sensing image data and topographical correction.

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