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Original Article

Simulation of Net Primary Productivity in Mongolia Using CASA Model, During 2000-2004

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Abstract

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Vegetation net primary productivity (NPP) is always used as an indicator of carbon cycling in terrestrial ecosystems at landscape and regional scales. Based on the CASA model, we analyzed the spatiotemporal pattern of growing season NPP from 2000 to 2004 using MODIS/NDVI and its relationship with precipitation. The result shows that the annual NPP in Mongolia has a tendency to slightly decrease from 61.13 in 2000 to 60 gC/m^2/yr in 2004, with an annual mean decrement of -0.259 gC/m^2/yr. However, annual and inter-annual NPP trends showed spatial and temporal heterogeneity. NPP in forest and grassland has decreased with an average annual decrement of -1.03 (r^2=0.262) and -0.49 (r^2=0.324), meanwhile NPP in desert steppe and desert has increased with the annual average increment of 0.4327 (r^2=0.322) and 0.2401 (r^2=0.283), respectively. The correlation coefficient showed that mean growing season NPP in grassland and desert steppe were closely correlated with precipitation than forest and desert.

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Introduction

Vegetation net primary productivity (NPP) plays important role in global carbon balance. NPP is generally defined as the difference between the total carbon uptake from the air through photosynthesis (GPP) and the carbon loss back to the atmosphere due to respiration by living plants (Ra) and is therefore the net carbon flux from the atmosphere into green plants per unit time. Its alteration greatly affects global carbon balance and climate change (Nemani *et al*., 2002, 2003; Schimel *et al*., 2000). Therefore, study on NPP and its response to global change are one of the key focuses for ecologists.

Mongolia is located at the junction of Siberian taiga and central Asia desert, where ecotones are formed forest-grassland-desert because of the climatic shift from humid condition in northern part to arid conditions in southern part. Therefore its ecotones are ecologically fragile and sensitive to environmental changes (Peters, 2002). NPP is regulated by many environmental factors such as precipitation, temperature, solar radiation, soil nutrient availability. Among these, water stress is the most critical limiting factor determining the efficiency of plant radiation utilization and vegetation productivity in Mongolia because of the low precipitation and high evapotranspiration (Munkhtsetseg *et al*., 2007; Li *et al*., 2008; Nakano *et al*., 2008). A number of model has been developed to investigate the magnitude and geographical distribution of NPP at the global scale, such as CASA (Potter *et al*., 1993; Field *et al*., 1995), TEM (Raich *et al*., 1991;