Ecosystem NPP of Typical Steppe in Xilinhot Based on the Improved CASA Model

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Key words: Net Primary Production (NPP), short grassland ecosystem, the improved CASA Model

Introduction Net primary production (NPP) is a key component of the terrestrial carbon cycle, and it is defined as the rate at which an ecosystem accumulates energy or biomass, excluding the energy it uses for the process of respiration. The CASA (Carnegie-Ames-Stanford Approach) model is a typical and extensive model of ecosystem NPP based on light use efficiency (Potter et al., 1993), but the classic CASA model has some weaknesses, such as the estimation of maximum light use efficiency (ε_{max}), impact to NPP from vegetation classification accuracy, and parameter calculation of the soil water model. Thus, this study used the improved CASA model (Zhu et al., 2006) to simulate NPP.

Materials and methods Xilinhot, Inner Mongolia was selected as the study region because it represents the most typical temperate steppe in north China. 1991, 2000 and 2005 TM/ETM images for the research region were attained by false color composition, mosaic, geometric rectification, and resampling of gray values, followed by transformation into Albers projection in ERDAS software. The spatial resolution of three images was 30m×30m. Following image processing, NPP ($gC \cdot m^{-2}$) was computed as the amount of photosynthetically active radiation absorbed by green vegetation (APAR) ($MJ \cdot m^{-2}$) multiplied by the actual light use efficiency (ε) ($gC \cdot MJ^{-1}$) by which the radiation is converted to plant biomass increment:

$$NPP(x, t) = APAR(x, t) \times \varepsilon(x, t) \qquad (1)$$

where x is a pixel in a remote sensing image, and t is the period that NPP is cumulated, such as a month. The technology flow chart for APAR and ε are provided by Zhu et al. (2006). In addition, thirty-two samples in the study area were selected to test the result of CASA. The error was evaluated by linear regression model in SPSS, and was found to be acceptable ($R^2 = 0.375$, $p < 0.05$).

Results and discussion NPP was found to be in good condition in 1991. In 2000, in the southern and southeastern part of Xilinhot there was a small quantity of good vegetation, while in the mid-western and northwestern region there was poor vegetation mostly distributed in large areas. In 2005, there were sparse, scattered areas of good vegetation while poor conditions occupied the main part of central and northwestern Xilinhot, although the area was smaller than that in 2000 (Figure 1).

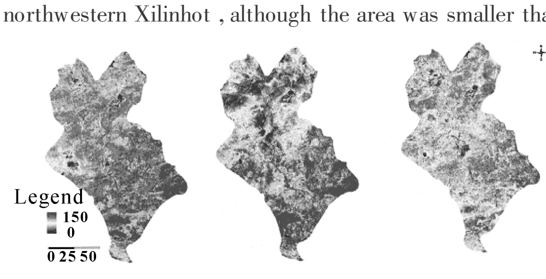

Figure 1 *NPP of Xinlinhot in 1991, 2000, 2005.*

Summary and conclusions This study used the improved CASA model to simulate regional NPP in the short grassland (typical steppe) region of Xilinhot. Image analysis and NPP calculation showed that the ecosystem has been in poor condition over the past decade. Continued degradation will continue unless grazing activities are changed. Remote sensing techniques are effective tools for detecting changes in the regional ecological conditions.

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