점봉산 활엽수림의 순일차생산성 모의

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Validation of simulated annual Net Primary Production (NPP) in Mt. Jumbong hardwood forest based on applications of an ecological model to estimate carbon flux

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Ⅰ. Introduction

MODIS NPP/GPP algorithm provides a useful tool for monitoring seasonal variations of the global vegetation primary production. Numerous validation efforts for MODIS product have been conducted for diverse geographic regions and biome types by using eddy covariance measurement at flux tower sites. The aims of BigFoot model is to validate MODIS carbon flux product. BigFoot can connect the field data (flux tower measurement, forest inventory data etc.) with the remote sensing data (MODIS products). To use this carbon flux model, we accurately have to validate it using field data. So, we estimated the annual NPP by using the forest inventory and the annual treering data from Mt. Jumbong, and compared the simulated NPP with the dendrochronological NPP data.

Ⅱ. Study Area & Method

The study site is located in Gangseonri watershed in Mt. Jumbong. Vegetation of the site is a temperate hardwood forest and the overstory species are dominated by *Quercus mongolica, Acer pseudosieboldianum,* and *Carpinus cordata.*

Cho (1997) surveyed overstory species composition and DBH at the site, and Koh (1999) sampled treering cores of the dominant overstory species, which were utilized to estimate annual NPP from 1978 to 1997.

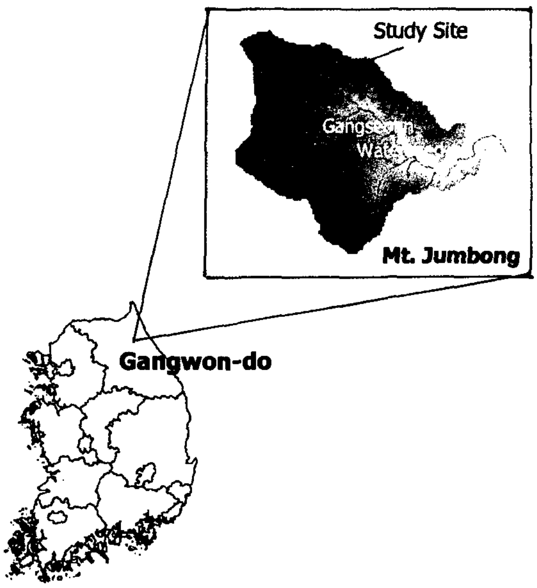

Fig. 1. Study area

First, we estimated actual NPP (=△biomass+aboveground detritus production+fine root production) from the annual treering growth and utilized allometric equations (Lim, 1998) to predict biomass increment from DBH. The equations are differentially applied for ring-porous wood and diffuse-porous wood, respectively. Then, we made year-by-year regressions between a yearly biomass increment and DBH to estimate growth of unmeasured trees. Aboveground detritus production was examined by using the leaf litter traps in 1995-1997. We assumed the ratio of leaf litter biomass to total biomass constant for the entire study period to estimate the leaf litter production before 1995. The ratio of fine root production to leaf litter production was given from the literature value (Landsberg, 1997).

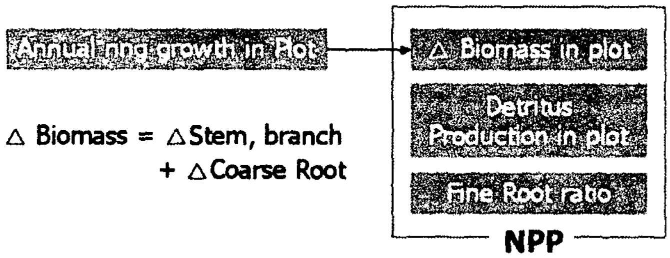

Fig. 2. The method of computing actual NPP

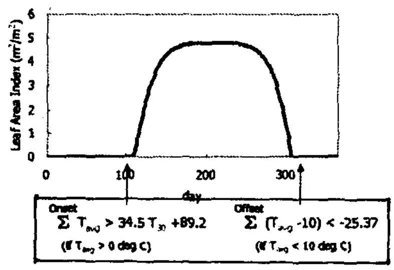

Fig. 3. Creation of onset, offset to estimate LAI of the past years

Second, we simulated NPP by using BigFoot model. It requires input of daily variation of leaf area index (LAI). Daily time series of LAI for 1978-1997 were prepared by using hypothetical curves with annual different leaf onset and offset dates as illustrated by Fig. 3. The dates were determined by using daily average temperatures. We assumed the fixed value of maximum LAI, 4.8 (the maximum LAI in 1997), for the study period. The model was calibrated by using field measured parameters from Mt. Jumbong as well as by using values suggested by White *et al.* (2000).

Finally, we compared the simulated NPP with the dendrochronolgical NPP estimation. As well, we conducted correlation analysis between the two NPP datasets (SPSS 12.0 software) to identify climatic variables controlling annual NPP variations.

Ⅲ. Results

Annual mean and standard deviation of the dendrochronological NPP were 413.67 gC/m^2/yr and 39.51 gC/m^2/yr, respectively (Fig. 4). Whereas, simulated NPP showed 414.62 gC/m^2/yr and 24.09 gC/m^2/yr, respectively. Both NPP datasets resulted in similar interannual variations, except for years 1989-1991 (fig.5). The root mean square error (RMSE) was 40.07 gC/m^2/yr.

The large errors for years 1989~1991 seems to be related with abnormally high cloudiness during the period, which reduced treering growth more than the model simulated. RMSE was

29.62 $gC/m^2/yr$ except the large error dataset (Fig. 6).

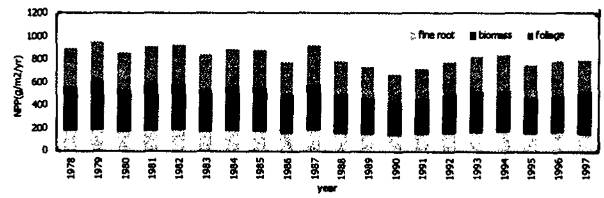

Fig. 4. Variation of Yearly NPP from 1989 to 1997 in Mt. Jumbong hardwood forest.

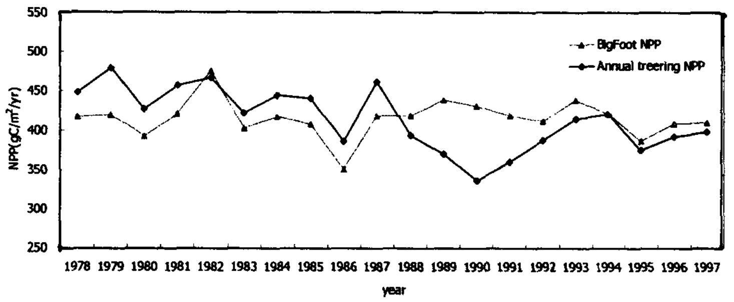

Fig.5. Comparison of dendrochronological NPP & BigFoot model NPP

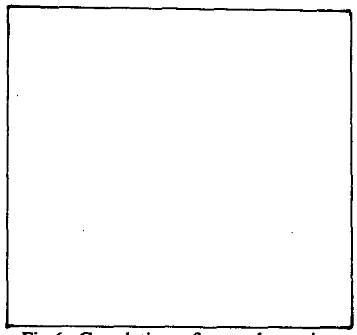

Fig.6. Correlation of annual treering NPP and BigFoot NPP. (Except large error data, 1989-1991)

Correlation analysis resulted that the dendrochronological NPP was positively correlated with July Vapor Pressure Deficit (VPD) but negatively correlated with July~September cloud abundance at a significance level of 0.05 (Table 1). On the other hand, the simulated NPP was strongly positively correlated with February temperature and July precipitation at a significance level of 0.01. Especially, the simulated NPP was positively correlated with July VPD in 0.05 significance level, and it was the same as the results of the dendrochronological NPP. The dendrochronological NPP was sensitive to a cloud abundance but BigFoot NPP was not so.

Table 1. Correlation analysis of climate factor and annual NPP (dendrochronological NPP, BigFoot NPP)

		pre10	pre11	pre12	cur1	cur2	cur3	cur4	cur5	cur6	cur7	cur8	cur9	2term	3term
Temp	Treering NPP												-		
	Simulated NPP	-				+									
Prcp	Treering NPP					-		+							
	Simulated NPP										+				
VPD	Treering NPP														
	Simulated NPP											+	+		
Cloud	Treering NPP														
	Simulated NPP														

■ 0.01 significance level ▩ 0.05 significance level 0.1 significance level

- Treering NPP = dendrochronological NPP
- Simulated NPP = BigFoot NPP

- pre10 : October in the preceding year
- cur1 : January in the current year
- 2term : from April to June
- 3term : from July to September

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