LONG-TERM OBSERVATION OF CO_2 FLUX ABOVE A BROADLEAVED DECIDUOUS FOREST IN SAPPORO, NORTHERN JAPAN

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ABSTRACT

A long-term observation of CO_2 exchange was conducted above a broadleaved deciduous forest in Sapporo, northern Japan. The CO_2 exchange was measured using the eddy covariance method with closed-path gas analyzer and we obtained net ecosystem production (NEP). We estimated a carbon budget using a simple empirical model. In this model, ecosystem respiration (RE) and gross primary production (GPP) were parameterized by soil temperature and photosynthetically active radiation (PAR) respectively. The annual NEP derived from an equation "$NEP = GPP - RE$" ranged from 237 to 431 g C m^{-2} $year^{-1}$ for 4 years (2000 - 2003).

INTRODUCTION

Forestry and Forest Products Research Institute (FFPRI, Japan) established a CO_2 flux-monitoring network 'FFPRI-Flux Net' on 6 typical forests in Japan. The Sapporo site is characterized by northern cool temperate forest ecosystem. The monitoring of Sapporo site started in late 1999, and has been conducted for five years. In this study, we present seasonal and inter-annual variations of CO_2 exchange above the forest site and total annual NEP, RE, and GPP derived from an empirical parametric model.

SITES AND METHODS

The Sapporo observation site is located in the Hitsujigaoka Experimental Forest (42°59'N, 141°23'E, 180 m a.s.l.) of Hokkaido Research Center, FFPRI. The experimental forest is a secondary forest after forest fire occurred about 100 years ago. Dominant species of the forest canopy are Japanese white birch and Mizunara oak. The average canopy height is 20 m. In Sapporo, annual precipitation and mean temperature are approximately 1100 mm and 8.5 °C respectively. The snow-covered season is about from December to April and the snowfall is over 400 mm.

Fluxes above the forest were measured by the eddy covariance method using a 3-D sonic anemothermometer (DAT-600, KAIJO) and a closed-path Infrared gas analyzer (IRGA, Li-Cor Li-6262) at the height of 28.5 m. The CO_2 concentration profile was measured using IRGA in order to quantify CO_2 storage change below the eddy-flux level. Meteorological elements (air temperature, humidity, radiation balance, photosynthetically active radiation (PAR), soil temperature, and so on) were measured. The quality control procedures [*Ohtani et al*. 2005] were applied in process of flux calculation to check raw flux data.

RESULTS AND DISCUSSION

Seasonal and inter annual changes in RE, GPP and NEP are shown in Fig. 1. RE was estimated by an equation "$RE = a \cdot \exp(b \cdot Ts5)$" (*a* and *b*, constants; *Ts5*, soil temperature in the depth of 5 cm). The constants were determined by the relationships between nighttime net ecosystem exchange (NEE) and soil temperature with a friction velocity (U*) threshold of 0.4 m s^{-1}. The NEE was obtained by "$NEE = Fc + Fs$" (*Fc*, CO_2 flux; *Fs*, CO_2 storage changes below the eddy-flux level). The GPP was estimated by an equation "$GPP = Agmax \cdot PAR / ((Agmax/a) + PAR)$" (Agmax and a , constants). In May and October, GPP and

NEP of each year are different from another year because of difference of the beginning and the end of foliate season. Annual GPP, RE, NEP, and the temperature sensitivity of ecosystem respiration (Q10) were indicated in Table 1. RE and GPP were about 950 and 1300 g C m^{-2} $year^{-1}$ respectively. NEP derived from an equation "*NEP = GPP - RE*" ranged from 237 to 431 g C m^{-2} $year^{-1}$. The Q10 is largely different in each year. RE value influences the estimation of carbon budget in this model, so further consideration is necessary for RE estimation.

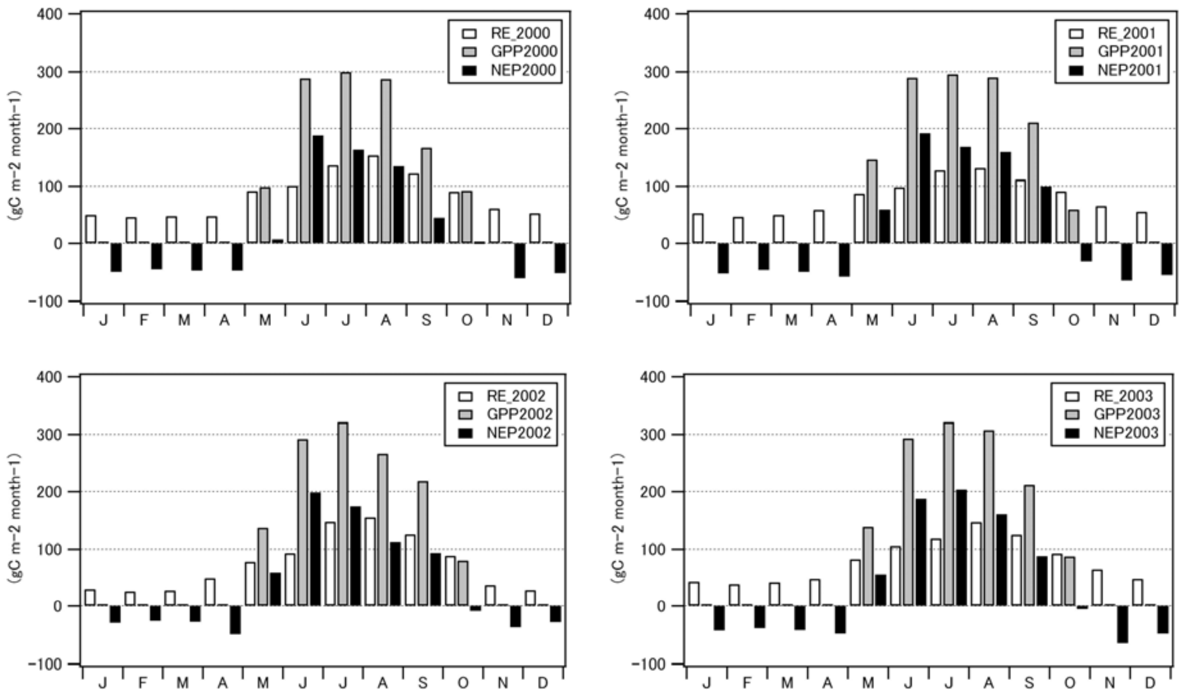

Fig. 1 Seasonal and inter annual changes in monthly mean ecosystem respiration (RE), gross primary production (GPP) and net ecosystem production (NEP)

Table 1. Annual GPP, RE, NEP (g C m^{-2} $year^{-1}$) and Q10 value (temperature sensitivity of respiration (nighttime NEE))

Year	GPP	RE	NEP	Q10
2000	1231	994	237	1.86
2001	1289	970	319	1.79
2002	1313	882	431	2.88
2003	1357	951	406	2.19

REFERENCE

Ohtani, Y., Mizoguchi, Y., Watanabe, T., Yasuda, Y. (accepted). Parameterization of NEP for Gap Filling in a Cool-temperate coniferous Forest in Fujiyoshida, *Japan, J. Agric. Meteorol.*