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Biogeosciences Discussions

Interactive comment on "Partitioning of catchment water budget and its implications for ecosystem carbon exchange" *by* D. Lee et al.

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Reply to Editor's Comments

This study attempts to relate watershed-scale net primary productivity to transpiration. Isotope measurements are used to partition the total evapotranspiration into transpiration and evaporation. Long-time series of precipitation and discharge data for the Han River watershed are used for this analysis. The estimation of the various hydrological components is carefully done. The results of water use efficiency are certainly useful for assessing the carbon cycle at the watershed level. However, I have the following questions:

Comments:

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Interactive Discussion

Discussion Paper

The NPP values of 250-300 gC/m2/y shown in Figure 5 are surprisingly small, unless much of the watershed is devoid of vegetation. The values are extracted from a M.Sc. thesis by Kim (2006), perhaps using tree ring data. (1) I wonder if this is biomass increment rather than NPP. Biomass increment is often 1/3 to 1/4 of NPP. (2) How was the watershed-averaged NPP obtained with tree ring data? Even with this low NPP, (3) I am also surprised to see that WUE values obtained from this study are even larger than those from other studies. (4) Are those WUE values reported in the other studies obtained on the basis of transpiration or ET?

Reply:

(1) The M. Sc. thesis of Kim has been recently accepted for publication in Ecological Research. The data reported by Kim et al. (in press) is the 'wood biomass production (WBP)' calculated using DBH measurements and biometric equations rather than NPP, as pointed out by the editor. Although NPP was not derived from WBP data in the paper, theoretical and empirical relationships have been suggested to estimate NPP from total (below and above ground) wood production data (e.g., Jenkins et al., 2001) and therefore the data may serve as a reliable productivity measure. The main reason to show Fig. 5 was to examine the relationship between transpiration and productivity, thereby estimating possible variability of WUE. Without having long-term WUE data by independent methods (i.e., micrometeorological), the cited 'WBP' data are the only long-term estimate that can be used to infer water-carbon relationship. We revised Fig. 5 and the associated text by changing 'NPP' into 'WBP' and adding relevant explanations (from page 23 line 12 to page 24 line 2).

<Reference>

Jenkins, J.C., Birdsey, R.A., Pan, Y. (2001) Biomass and NPP estimation for the Mid-Atlantic region (USA) using plot-level forest inventory data. Ecol Appl 11:1174–1193.

Kim, Y., Kang, S., Lim, J.-H., Lee, D. and Kim, J., in press, Inter-annual and inter-plot variations of wood biomass production as related to biotic and abiotic characteristics

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at a deciduous forest in complex terrain, Korea. Ecol. Res.

(2) Currently, no productivity data are available at watershed scale in Korea. The WBP data reported by Kim et al. (in press) were measured from 10 plots in the Gwangneung watershed (area of ∼2 km2) with the size of each plot being 20m X 20m. The total number of measured tree specimen encompassed 259 from 17 species. We considered that the data can be representative in terms of carbon uptake characteristic of the forests in the watershed. We added the above explanation in the revised manuscript (from page 23 line 12 to line 17)

(3) Based on the tower ET and GPP data, the annual average WUE for the Gwangneung forest was estimated to be 2.9 ∼ 3.4 g C/kg H2O from 2006 to 2008 (Kang et al., 2009; Kwon et al., in press) which are greater than those reported by other studies. The seasonal variation of WUE in Gwangneung forest indicated remarkable increase in early and late growing periods (April, May and October) which are typically dry seasons in Korea. During April and May, GPP increased at a much greater extent than ET thereby increasing WUE (up to ∼5 g C/kg H2O). During October, ET decreases at greater extent than GPP and WUE increased accordingly. This decoupled response between GPP and ET with growing stages is not observed in Kuglitsch et al. (2008) and Yu et al. (2008) studies, and considered to be one of the main causes of the higher WUE in Gwangneung forest. Although the implications of this finding merit further discussion, we will have more specific reports on WUE in Korean forests with in-depth discussions on biophysical and eco-physiological processes that support higher WUE. Following the editor's comment, we have added the above explanation in the revised manuscript (from page 24 line 21 to page 25 line 8)

<References>

Kang, M., Park, S., Kwon, H., Choi, H.T., Choi, Y.-J., and Kim, J.: Evapotranspiration from a deciduous forest in a complex terrain and a heterogeneous farmland under monsoon climate. Asia-Pacific Journal of Atmospheric Sciences, 45(2), 175-191, 2009.

Kuglitsch, F. G. et al.: Characterisation of ecosystem water-use efficiency of European forests from eddy covariance measurements, Biogeosciences Discuss., 5, 4481–4519, 2008.

Kwon, H., Kim, J., Lim, J.-H., and Hong, J.: Interannual variability of net ecosystem carbon exchange in two major ecosystems in Korea, Biogeosciences (in press)

Yu, G., Song, X., Wang, Q., Liu, Y., Guan, D., Yan, J., Sun, X., Zhang, L., and Wen, X.: Water-use efficiency of forest ecosystems in eastern China and its relations to climatic variables, New Phytologist, 177, 927-937, 2008.

(4) The WUE values from the cited reports were calculated based on GPP divided by ET after accounting for intercepted evaporation in Kuglitsch et al. (2008), while the intercepted evaporation was not separated in Yu et al. (2008) and the Gwangneung data. To avoid confusion, we indicated the types of WUE based on the calculation method such as GPP/T and GPP/ET. (from page 24 line 9 to line 20)

Comments:

It is plausible that NPP is related to transpiration as both are controlled by the stomatal conductance. However, NPP is only part of the carbon cycle, and heterotrophic respiration is not directly related to transpiration. It is therefore not justified to say "The proposed relations provide a simple and practical way to assess the distribution and strength of carbon sink." In Abstract. It should be made clear that transpiration estimation from watershed water budgets and isotope measurements provides useful information for the carbon cycle but not complete information.

Reply:

It is the GPP, not NPP or NEE, that can be constrained by the inter-dependency between water and carbon exchanges and independent measurement of transpiration (or ET). The 'WBP' data in Fig. 5 were used as an alternative to GPP since long-term GPP data for corresponding period are not available. To avoid confusion, we changed

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‘carbon sink’ into ‘GPP’ in the text. (page 2 line 6∼7, line 17, line 20; page 5 line 4; page 27 line 19)

Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/6/C4759/2010/bgd-6-C4759-2010-supplement.pdf

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Interactive comment on Biogeosciences Discuss., 6, 11401, 2009.