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Biogeosciences Discussions

Interactive comment on "Organic carbon sequestration and discharge from a deciduous forest catchment in Korea" *by* S. J. Kim et al.

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RE: "Organic carbon sequestration and discharge from a deciduous forest catchment in Korea", by S. J. Kim et al. (MS#: bg-2009-247)

Dear Anonymous Referee #1:

Thank you for the review of the above manuscript submitted to Biogeosciences. Referee's comments were fully taken into account in the revised manuscript as below. With this revision, we hope that this manuscript is acceptable for publication in Biogeosciences at this time. We attached the revised manuscript in supplement. Plaease note the supplement.

Best regards,

General Comments:

1. "This manuscript contains useful data set and valuable analysis on DOC dynamics in the deciduous forest catchment. However the many unclear descriptions and problems were found in the methods, results, discussions and others. See the details in below. One of the most critical problems for the whole manuscript is the usage of the unaccepted NEE values for the comparison. You should remove these analyses if the NEE paper still has not been accepted yet.";

Actions) Thank you for your critical review. Kwon et al.(2009) had been accepted in Biogeosciences Discussions. We corrected the reference to "Kwon, H., Kim, J., and Hong, J.: Influence of the Asian Monsoon on net ecosystem carbon exchange in two major plant functional types in Korea, Biogeosciences Discuss., 6, 10279-10309, 2009."

2. "The other critical points would be no description of the sampling method for "Hillslope runoff" which is an important end-member for your EMMA. The authors should revise the manuscripts intensively following the each comment listed below.";

Actions) When surface runoff occurred, Hillslope runoff samples were collected directly by 1L PVC bucket. We corrected the sentence to "Hillslope runoff samples were collected at SP1, SP2, and R1 by 1L PVC bucket during the storm events (i.e., E050626, E050701, and E050913)."

Specific comments

Study site

(1) Fig. 1. Indicate the location of the V-notch wier and the sampling location of spring water and hillslope runoff in the site map. Make the map of study site (located in the left and bottom in Fig. 1) larger than others.

Actions) V-notch weir already marked in the figure. Sampling points were described in

the manuscript. We corrected figure size. Please note the supplement file.

(2) Indicate the range of seasonality in air temperature (maximum and minimum with month).

Actions) We indicated the range the air temperature. The sentence was changed to "The (30-yr) normal annual air temperature at the site is 11.5°C (minimum: -5.2 °C in January, maximum: 23.4 °C in August; AFFIS); mean annual precipitation and runoff (from 1982 to 2004) are 1332 and 809 mm, respectively." Please note the supplement file.

(3) Describe more information for soil such as soil name (based on interantional clasiffication), carbon content, CN ratio, litter condition and so on.

Actions) Soil type is alfisols in the USDA soil classification systems. Average soil carbon content is 3.6%, CN ratio is 12.3. Litter distributed about 2 to 10cm depth (Chae, 2008). We added above information in the sentence as follow; "The soil texture is sandy loam, and soil type is alfisols in the USDA soil classification systems. Average soil carbon content and CN Ratio is 3.6% and 12.3, respectively (Chae, 2008). Soil depth is 0.4 to 0.8 m with a notable H horizon." Please note the supplement file.

(4) Condition of understory vegetation is also importnat to interprete your obserbation. Describe the general caracteritics of understory vegetation (species, coverage and so on).

Answer) Because this site occupied older hardwood tree, understory was not well developed. Biomass in understory vegetation occupies only 2% of whole vegetation in this study site. The canopy height in the study site is 18 to 20m (Lim et al., 2008). Therefore understory vegetation do not affects effectively the nutrition and water cycling.

Methods

(5) Does the automated throughfall collector mean the automated wet-only deposition

collector?

Answer) Yes. The automated throughfall collector collects only wet deposition. The throughfall means wet deposition usually. Because insects fall in the precipitation collector, we used automated throughfall collector to prohibit the contamination.

(6) Page 10094 "2.2 Hydrological measurements". You mentioned that sampling and measurement of water level of groundwater was conducted at the SP1, SP2, R1 and R2 in this section. However, it seems that groundwater chemistry and water level at SP2 and R2 are not presented in the Result section (only for SP1 and R1). You should state them clearly.

Actions) Thank you for your comments. We collected the soil water samples SP2 and R2. We corrected the sentence "The SP1 site for the sampling of hillslope groundwater (HGW) was located in the upper slope of the catchment where the groundwater level changed noticeably. During the dry season, the saturated groundwater table did not appear in HGW, and the response to storm events was the same as that for the riparian groundwater. The R1 site for the sampling of riparian groundwater (RGW) was located in the riparian zone in the middle slope of the catchment." Please note the supplement file.

(7) Page 10095 Line 10. How did you collect "hillslope runoff sample"?

Answer) Please see in the General comments #2.

(8) Explain how you determined the values of A and B in Eq. (4).

Actions) The signal A and B means the measured precipitation, WFP, and stream discharge. We corrected the sentence to "We quantified the time lags among the precipitation, water-filled porosity, and stream discharge by calculating the cross correlation (CAB), which measures the persistence of two signals (A and B) during the measurement period and is defined as (Stull, 1988):" Please note the supplement file.

(9) Describe how you determine the Sy in Eq. (5).

Actions) Specific yield was calculated from water table fluctuation. And we added the sentence “Sy was calculated from water table fluctuation (Choi et al., 2007).” Please note the supplement file.

(10) You mentioned that groundwater was utilized as the end-members. In the results, Fig. 5 indicates the groundwater with different depth has different water quality. It is unclear which depth of groundwater was utilized as the end-member. You should describe them clearly in the method section.

Answer) As your comments, DOC concentrations in the shallow groundwater higher than deep groundwater. However, other six tracers were not showed the significant difference with groundwater depth each plots. Therefore, we use the all groundwater samples as tracers.

(11) Show the summary result of PCA for the EMMA analysis in either method or result section.

Actions) We added the result of PCA for EMMA as Table 2. Please note the supplement file.

(12) Table 3; Indicate the significant level for each correlation. I am wondering why the time lag between precipitation and WFP are larger than that between precipitation and stream discharge.

Actions) The numbers in the parentheses indicate cross correlation coefficients at $p < 0.01$ in Table 3. We added the significant level in the table caption. The time lag between precipitation and WFP are larger than that between precipitation and stream discharge means surface runoff rapidly discharge to stream. Because Table 2 added newly, Table 3 changed to Table 4 in the revised manuscript. Please note the supplement file.

(13) Page 10098 Line 25 to Page 10099 Line 9: In this paragraph, you describe the temporal change in the contribution of each component during each event. But many

of the data are not shown in Table 4 which indicate the values of mean (?) for each event.

Actions) We added the hydrograph separation results in Fig. 2. Please refer to changed figure, and please note the supplement file.

(14) Page 10101 Line 2-4. This statement is unclear to me because the DOC in groundwater (with possibly longer contact time) was lower than that in soil water (with shorter contact time) in Fig. 5.

Answer) As mentioned in the manuscript, DOC in soil water discharge rapidly to stream during summer monsoon. In this season, amount of water also transports DOC to groundwater from surface soil with longer contact time. Therefore DOC concentration in groundwater increases during summer. You can see increasing of DOC in groundwater in the Fig. 4. And part of infiltrated DOC adsorbs to soil surface and decay by microbial. Therefore, DOC in deep groundwater decreases with depth.

(15) Fig. 6(a). Separate early and late event for DOC like POC.

Actions) We separated early and late events for DOC efflux. Please note the supplement file.

(16) Fig 6(b). POC in early events should not be linear correlation (no export of POC when the discharge was lower than about 90 ton/10min).

Actions) We corrected the figure. Because annual DOC and POC flux was estimated every 2 h, the estimated values (0.04 and 0.05 t/ha/yr) were not changed. And, POC is discharged below 90 t/min. Please note the supplement file.

(17) Fig. 7, Page 10101 Line 16-19, Page 10101 Line 24-25. You cannot cite and utilize NEE data from the paper (Kwon et al. 2009) which are not accepted yet (under review). NEE values are often changed by various data correction and calculation methods during the review process. Use them only after the confirmation by acceptance in the peer-reviewed scientific journal.

Answer) Please, see General comments #1.

(18) Eq. (6). The description of the method for API and T should be located in the "Methods" section. Show the significant level for the correlation coefficient in Fig. 8.

Actions) The significant level was $p < 0.0001$. We added the significant level in the figure caption. The method for API and T moved in the Method section as "2.7 Analysis of antecedent precipitation index" Please note the supplement file.

Other minor change

Changed the Table number: We added PCA results as Table 2. Therefore Table numbers were changed.

Cited Fig. 2 in the Results section. We corrected "Fig. 2. Temporal variations in precipitation, mean value of water-filled porosity, groundwater level (GWL) at R1-G1, stream discharge, and relative contribution of hillslope runoff (HR), riparian groundwater (RGW), and hillslope groundwater (HGW) during the six storm events from June to October 2005." Therefore we cited Fig. 2 in the 3.1 and 3.2 section.

Corrected the Fig. 6 caption Fig. 6. Relationship between (a) the stream discharge and DOC, (b) stream discharge and POC, and (c) the estimation of the annual organic carbon efflux from the Gwangneung deciduous forest catchment. Early and late events indicate E050626, E050701, and E050709, E050824, E050913, E050930, respectively.

Cited new references We cited the two references as follow; AFFIS: Digital climate maps, http://nacl.epinet.co.kr, 2007. Chae, N.: Soil CO2 in a temperate forest ecosystem under monsoon climate in northeast Asia, Yonsei University Ph. D. Dissertation, Seoul, 2008.

Thank you.

Please also note the supplement to this comment:

http://www.biogeosciences-discuss.net/6/C3532/2009/bgd-6-C3532-2009-supplement.pdf

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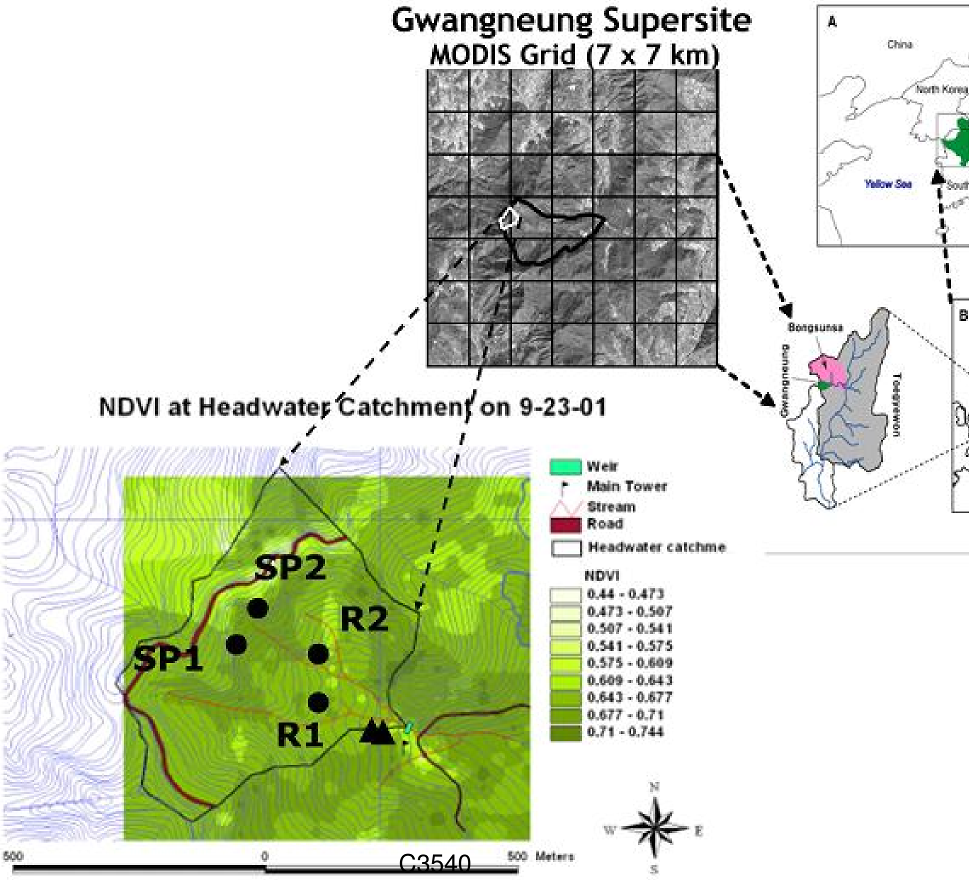
Interactive comment on Biogeosciences Discuss., 6, 10089, 2009.


Gwangneung Supersite
MODIS Grid (7 x 7 km)
NDVI at Headwater Catchment on 9-23-01
SP1
SP2
R1
R2
Weir
Main Tower
Stream
Road
Headwater catchme
NDVI
0.44 - 0.473
0.473 - 0.507
0.507 - 0.541
0.541 - 0.575
0.575 - 0.609
0.609 - 0.643
0.643 - 0.677
0.677 - 0.71
0.71 - 0.744
500
0
500 Meters
N
W
E
S
A
China
North Korea
Yellow Sea
South
B
Bongsunsa
Gwangneung
Toegyewon

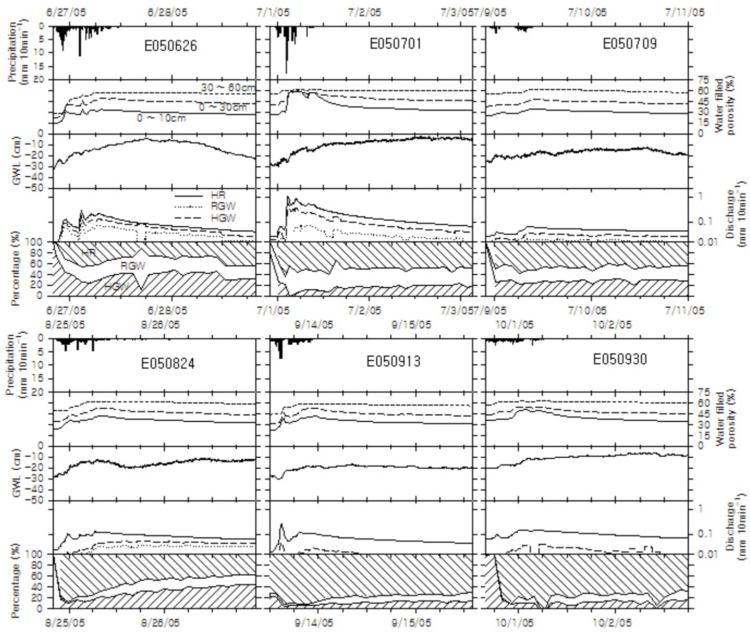

E050626
E050701
E050709
E050824
E050913
E050930
30 ~ 60cm
0 ~ 30cm
0 ~ 10cm
HR
RGW
HGW
Precipitation (mm 10min⁻¹)
Water filled porosity (%)
GWL (cm)
Discharge (mm 10min⁻¹)
Percentage (%)
6/27/05
6/28/05
7/1/05
7/2/05
7/3/05
7/9/05
7/10/05
7/11/05
8/25/05
8/26/05
9/14/05
9/15/05
10/1/05
10/2/05

Fig. 2.