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Biogeosciences Discussions

Interactive comment on "Response of dissolved and particulate organic carbon and nitrogen in runoff to monsoon storm events in two watersheds of different tree species composition" *by* Mi-Hee Lee et al.

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see also attached file

General comments The manuscript presented very useful information on forms and flows of carbon and nitrogen in an upland fluvial system. The planning and coverage of sampling and parameters are good. The results will improve our understanding of material flows in terrestrial fluvial systems based on nature of tree types and water flows. The results deserve to be published but not in the present form. The basic problem is with the presentation and the way they dealt with scientific and technical issues. I

recommend encouraging the authors for submitting a revised version after they work on some of the issues mentioned and improve the presentation for clarity. Reply We appreciate your valuable comments and suggestions to improve our manuscript. We will revise our manuscript incorporating all your comments.

Specific Comments Title: manuscript is not really studying the 'response of carbon and nitrogen components IN RUNOFF to storm events' but addresses the influence of storms on carbon and nitrogen components in runoff. The appropriate title for the manuscript seems to be (from lines 32-33 on page 2): Influence of tree species and episodic discharges on the fluxes of dissolved and particulate carbon and nitrogen from two watersheds OR Changes in fluxes of dissolved and particulate carbon and nitrogen from two watersheds of different tree types during heavy discharge periods. Reply title will be changed accordingly to 'Changes in fluxes of dissolved and particulate carbon and nitrogen from two watersheds of different tree species during intense storm events'.

Page 3: Lines 4-5 – The sentence 'the annual air temperature ranges from 10-15oC with -6oC in January and 26oC in August' does not make sense to me. Reply Clarified as 'The average annual temperature of the Gangwon-province is 11oC with monthly average temperature ranging from -5oC in January to 24oC in August during from 1981 to 2010'.

Page 3: Line 7 –Is the 47% broadleaved forest 'the deciduous'? Here the comparison is between deciduous and mixed types and so appropriate type to be named than the description (broadleaved). Reply clarified as 'Korean mountainous forests are mostly composed of deciduous forests representing 47% of the total forested area (38% coniferous forest, 12% mixed deciduous and coniferous forest)'.

Page 3: Lines 12-14 – Are the slopes at two sampling points MC and MD oriented in different directions in the mixed watershed? If they are oriented in one direction then fluxes from the upper can definitely influence the other during floods. This question also pertains to slope comparisons between two watershed sampling points. Figure 1

and info on page 3 shows that deciduous sampling point is at a higher altitude than that in the mixed watershed. What if both the watersheds (and hence the sampling points) slope in the same direction? If yes, the flow from deciduous sampling point would influence the composition at MC and MD!! This is quite possible as the two watersheds are nearby. The authors should clarify on this issue of slopes and possible interference between sampling points. Reply The slope direction of the coniferous part of the mixed watershed is towards the MD plot. Lateral flow from coniferous part to MD can only influence deeper soil solution characteristics at MD as near surface flow was never observed. Data from Fig. 5 indicate significant quality differences of soil solutions between the MD and MC plots which suggest only a minor influence on soil solution chemistry at MD from lateral flows. Moreover, the quality parameters of soil solutions at the MD plot are similar to those of the DD plot, the latter being not influenced by lateral flows from coniferous sites. Thus, we believe that the components at the MC plot did not directly affect those at the MD plot.

Page 4: Line 5 – 'were collected after each storm event': maximal flows/fluxes must have occurred during the peak flow. When the maximal speeds subsided the original peak signals (of concentrations/fluxes) of the flood may have been lost!! This can be exemplified using the data in Table 2 for deciduous station. On July 8 (say first flood studied) DOC, DON, POC, PON values are higher than the following flood event on 14 July. Obviously, the first flood water carried more C & N than the second one since the first/fresh rain/flood can dissolve/scoop more of materials accumulated during the preceding dry or intervening periods in the soils. This was also noticed by the authors on Page 6 Line 15. Reply: We will clarify this: new text: 'During storm events in July 2013, throughfall, forest floor leachate and soil solution were collected after each storm event so that these samples represent cumulative water samples from corresponding compartments during the entire storm event".

Page 4: Line 5 – 'runoff samples were collected every 1 or 2 h in the weir' – were these also collected after the storm events (coinciding with throughfall, forest floor leachate

and soil solution sampling) or during the event or both? This information is crucial for making the right comparisons and assessing changes. Reply technical comment: can easily be clarified as 'Runoff samples were collected at the weir using automatic collectors before, during, and after each rain event at the two watershed, especially during event at intervals of 1 or 2 h during'.

Page 6: line 3 – In the absence of clear definitions of Oi, Oe and Oa it is hard to understand the significance of percentages of these fractions, as also in relevant Figures. Reply definition and thickness of horizons will be given: new text: 'The total stock of organic horizons (Oi: slightly decomposed recognizable litter, Oe: moderately decomposed fragmented litter, Oa: highly decomposed humus material) was collected at each plot in a 20 $\times$ 20 cm frame with 10 replicates. The average thickness of Oi and Oe+Oa was 1.2 and 1.5 cm at the MC plot, 2.5 and 3 cm at the MD plot, and 2.3 and 2 cm at the DD plot, respectively'.

Page 6: Lines 17-21 – I am not convinced of the 'threshold value' since there are not enough data points to show a consistent increase in concentrations. Relatively higher concentrations in POC and PON are found (Fig 2d,e) RANDOMLY during discharges from _1 to 9 mm/h. Reply the reviewer is right, text will be changed accordingly to 'At discharges from $\sim$1 to 9 mm h-1, higher concentrations of POC and PON in runoff were found (Figure 2d,e). For example, The POC concentration in streamwater from the mixed watershed was as high as 10.7 mg C L-1 at the largest discharge of 9 mm h-1. At the deciduous watershed, POC concentration reached a maximum of 8.6 mg C L-1 already at 3 mm h-1 discharge during the first storm event (Figure 2d, Table 2).

Page 6: Lines 22-23 – DOC rise with increasing flood and fall with decreasing flood is convincing and is, indeed a good observation. Reply thank you for your comment; no reply needed.

Page 8: in the entire page of this discussion, the authors did not seem to have paid much attention to (a) nature of litter, (b) altitude and (c) substratum of the two water-

sheds. I understood that the deciduous watershed was at higher altitude with hard rock below 40 cm whereas that of mixed was at lower height laden with soils upto or below 50 cm. Presumably the hard rock might have occurred deeper in the mixed watershed. The nature off litter (seasonally fallen parts of the trees) would be relatively freshly fallen in the deciduous watershed that could easily be broken/decomposed by physical/microbial activities that could leach more DOC or dissolvable OM. This fresh DOM can be easily be flushed by flowing water. The hard substratum and high altitude facilitate flow of water at higher speeds (as it cannot seep deep) in the deciduous watershed than in the mixed watershed. The rapidly draining flood facilitates easy mixing of forest floor and soil solutions with surface runoff. Although logical in their statement of "i) In the deciduous litter layer the leaves are overlapping and are partly impermeable which may cause more surface near flow (lines 23-25)" this does support their observation that 'a larger proportion of the DOC in runoff results from forest floor leachates at the deciduous (lines 17-18)'. If the top layer is impermeable how would one explain high DOC in runoff to have come from mixing with forest floor leachates? It is also possible for high DOC formation at the surface itself as the fresher litter is weathered or decomposed on the floor of the deciduous watershed. Reply: We agree with the last statement and our argumentation in the discussion can be modified for more clarity. Your comments will be incorporated in more detailed discussion. New: 'The deciduous watershed is located at higher altitude suggesting more shallow soils than at the mixed watershed. This may explain the larger near surface flow paths at the deciduous watershed. Moreover, faster decomposition of the deciduous litter leaches relatively more DOM and both factors result in higher DOC export fluxes at the deciduous watershed than at the mixed watershed'.

Page 9: Lines 2-8 – higher DOC/DON ratio at deciduous basin is possible when organic matter with less or no nitrogen but rich in carbon is weathered and is leached. Nitrogen compounds are perhaps enriched in litter or particulates. However, Fig 2 depicts lower PON than DON, in general in both watersheds, implying that nitrogen might be remaining with the deposited litter in the watersheds! Reply we explained the larger

DOC/DON ratios at the deciduous watershed in lines 2-8. The mobilization of particulate organic matter is attributed to the erosion or river benches and no conclusion on N retention in litter is possible.

Page 9: Statements in lines 11-13 ('Substantial fluxes of NO3-N and the dominance of NO3-N over DON in runoff are likely due to a certain degree of N-saturation (N supply > N demand) of these forested watersheds (Aber et al., 1998; Compton et al., 2003)') and lines 20-21 ('Overall, it seems that a larger N uptake by the deciduous trees at the deciduous watershed could explain the differences in NO3-N fluxes') are arbitrary and not supported by any data. Reply: true, the conclusion is speculative and that is why it is formulated as a suggestion. However, other reasons for the higher NO3 fluxes at the coniferous site are not likely.

Technical Comments Page 3: Lines 11 and 21 – Are the latitude and longitude positions accurate to the decimals mentioned? Reply technical comment: can easily be clarified. The positions of watershed at the weir will be corrected as 38°12′24.8ËİN, 128°11′9.1ËİE for the mixed watershed in Seohwa and 38°15′5.6ËİN, 128°7′10.9ËİE for the deciduous watershed in Haean.

Page 3: Line 30: Does 'throughfall' refer to precipitation or rainwater? Reply The sentence will be written as 'Throughfall collectors (n=5) under the canopy were equipped with filters to prevent large particles from entering'.

Page 4: Line 13 – define Oi, Oe and Oa. Reply As mentioned earlier, the definitions of Oi, Oe and Oa will be added in Page 4: line 13

Page 4: Lines 26-27 – 'The storm events during monsoon season were identified from the start to the end of precipitation with more than a day interval between each storm event'. The storm events should be identified based on meteorological observations of wind and rainfall. However, one should keep in mind that the present study is made in summer monsoon. During monsoon season the rainfall may not be continuous on all days but with intermittent gaps (breaks) or spells of rain. I guess the authors are

referring to these spells, or at the most the episodic rainfall events (which are normal during summer monsoon) of variable duration as 'storms'. This requires authors clarification for what they meant by 'storm'. This point, however, was rightly stated by the authors on page 8 line 4 – 'four heavy rainfall events of the monsoon season at both watersheds' but not elsewhere in the manuscript. Reply As you suggested, the rainfall characteristic during monsoon will be referred as 'During monsoon season the rainfall was not continuous on all days but with intermittent gaps of rain, thus the most lasting rainfall events were identified as storm events with more than a day interval between each storm event' . The term 'rainfall' will be used to explain 'storms' in the method part of this manuscript.

Page 5: Lines 4 and 8 – (i) unmatched DOC and POC cutoff limits! (ii) 0.7 micron cutoff limit for POC is quite on higher side since most of the fine sized particulate materials are lost through the filter paper. Reply We do not agree that the fraction from 0.45 to 0.7 micron represents most of the fine sized material. DOM is commonly defined as organic matter in water samples smaller than 0.45μm (Thurman, 1985). Previous studies have often used a 0.7 μm pore size of glass filter for POM fraction for technical aspects in the analysis (Bauer and Bianchi 2011, Mostofa et al. 2013). Consequently, DOC and POC cutoff limits are unmatched as you pointed. However, prior tests (Doyle 2013) showed that materials between 0.45 and 0.7 μm comprised a minor fraction in total organic matter. We will make a comment on that in the methods section -Thurman, E. M. (1985). Organic geochemistry of natural waters. Nordrecht, The Netherlands: Martinus Nijhoff/Junk Publisher. -Bauer, J.E., and Bianchi, T.S. (2011). 5.02âĂŤdissolved organic carbon cycling and transformation. Treatise on estuarine and coastal science, 5, 7-67. -Mostofa, K.M., Liu, C.Q., Minakata, D., Wu, F., Vione, D., Mottaleb, M.A., ... and Sakugawa, H. (2013). Photoinduced and Microbial Degradation of Dissolved Organic Matter in Natural Waters. In Photobiogeochemistry of Organic Matter. Springer Berlin Heidelberg, 273-364 -Doyle, C. B. (2013). Contribution of bacterial cells to the fluorescence spectra of natural organic matter in freshwaters, University of North Carolina, master thesis.

Page 5: Line 6 – was nitrite in water analysed? It should be included in mineral-N. Reply Nitrite was not measured because it was negligible in soil solutions and runoff from test measuremenst.

Fig 2 – what are FPOC/FPON in Fig. 2f? Reply technical comment: can easily be clarified. Will be changed to POC/PON.

Fig. 3. Upper panel in the left column – DON and PON should be corrected to DOC and POC. Reply technical comment: figure will be corrected. Will be corrected to DOC and POC.

Figures 5 & 6: Alphabets (a, b: : :.) need to be explained in more detail. For instance what does it mean by ab or abcd. In the captions it is mentioned "Different alphabet letters indicate the significant difference between groups". I could not understand what is the difference and what are the groups mentioned. Reply technical comment: can easily be clarified. The meaning of alphabets will be explained in detail as 'Statistically significant differences betweeb sample types (runoff, throughfall, forest floor leachates, soil solution) are indicated by different letters in the box plots, significance level of $P < 0.05$'.

Fig. 6 – DTN is dissolved total nitrogen? Reply technical comment: can easily be clarified. Changed to total dissolved nitrogen (TDN) in the manuscript

Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/bg-2016-92/bg-2016-92-AC3-supplement.pdf

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