

## ***Interactive comment on “Effects of a windthrow disturbance on the carbon balance of a broadleaf deciduous forest in Hokkaido, Japan” by K. Yamanoi et al.***

**K. Yamanoi et al.**

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Dear Dr. W. Eugster We appreciate your constructive comments and suggestions. We revised the manuscript on the basis of your opinion. We made the following statements about the major and minor comments. According to the editorial guidelines, the response is structured as follow sequence: (1) comments from referees / public, (2) author’s response, (3) author’s changes in manuscript. Thank you very much.

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Major points

C7290

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Comment 1: The terminology lack consistency in the manuscript, and information about the respirations.

Response: We are sorry for an inaccurate description. In the section 4.3 and Table 2, fluxes are measured by eddy covariance method. On the other hand, respirations ( $R_a$ ,  $R_h$ , and  $R_s$ ) are estimated biometrically from other measurements quoted from the references. Since ANPP is measured in this study with the estimations of SBM (Mizoguchi, et al., 2014b) and root biomass (Utsugi, et al., 2007), NPP is calculated from them. GPP, RE, and NEP are calculated biometrically by the formulas in Table 2.

Changes in manuscript: In the start of section 4.3, we explain the informations briefly to deduce the values in Table2. In the caption in Table 2, we give the details of the information for each component. Please verify alterations in the marked-up manuscript version.

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Comment 2: Jargon include the term of “carbon”

Response: We have used various kinds of terms related “carbon ...”. We unify the terms related with “carbon”. Since we use “carbon balance” in the title, we replace “carbon budget” with it. As you pointed out, the terms related with flux mostly look at CO<sub>2</sub> fluxes. We replace “carbon ...” implying flux by “CO<sub>2</sub> ...”. For example, we replace “carbon release” and “carbon uptake” with “CO<sub>2</sub> release” and “CO<sub>2</sub> uptake”, respectively. We also unify the terms had similar meanings like carbon pool, carbon storage, carbon stock, etc. As the reviewer indicated, any other carbon flux components (CH<sub>4</sub>, BVOC, , ) were ignored in this study. Those are little as against the whole carbon flux and mass; however, it have a significant effect on global warming. In most articles on flux measurement or biometrical study in forest ecosystem, those are ignored as a miner component without accurate descriptions.

C7291

Changes in manuscript: There are many places where the term with “carbon” and “CO2” were replaced in the manuscript. Please verify alterations in the marked-up manuscript version.

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Comment 3: Frequency and intensity of tropical cyclone in future

Response: As you pointed out, IPCC (2015) reported that the intense tropical cyclone activity would be low confidence in global scale. On the other hand, some reports have demonstrated increases of typhoon intensity in the western North Pacific (Tsuboki, 2015). An occasional strong typhoon even with low frequency would affect forest ecosystem.

Changes in manuscript: We revised this sentence with references as follows: “While IPCC (2013) reported the potential in future tropical cyclone frequency and intensity was low confidence, Tsuboki et al. (2015) demonstrated increases of typhoon intensity with global warming in the western North Pacific. An occasional large windthrow event may partly affect the interannual variation in the terrestrial carbon balance.”

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Comment 4: Dehumidification and calibration systems

Response: We added the system information for vertical profiling.

Changes in manuscript: “Sampling air from each height was dehumidified using the same air dryer, and was pushed into the IRGA at a flow rate of 1.8 L min<sup>-1</sup>.” and “The IRGA was calibrated automatically once a day.”

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Comment 5: Equation 5

Response: We added a reference for field method to measure NPP in forests. Clark et

C7292

al. (2001) expressed two approaches for calculating aboveground biomass increment. Approach 1 is based on tracking individual surviving trees. Approach 2 is based on measuring all trees in the stand at each census but also requires measurement of trees that died and recruited in a year. Revised equation reflects these approaches. Equation 5 is closely related to Fig.5. We divide Fig. 5(b) into two sub-figures. One is aboveground biomass increment of surviving and recruiting trees ( $\Delta y$ ). The other is stem and branch biomass of dead trees ( $L_d$ ).

Changes in manuscript: “The aboveground net primary production (ANPP) in a year was calculated as follows (Clark et al., 2001):

$$\text{ANPP} = \Delta y + L_f + G = (\text{AGB}_{t2} - \text{AGB}_{t1}) + L_d + L_f + G, (5)$$

where  $\Delta y$  is the aboveground biomass increment of surviving and recruiting trees,  $L_f$  is litterfall from living trees,  $G$  is predation by herbivorous insects and was ignored in the present study, and  $L_d$  is the stem and branch biomass of dead trees produced in a year. AGB is the aboveground biomass of living trees, and subscripts imply times at the beginning ( $t_1$ ) and end ( $t_2$ ) of a year. The aboveground net biomass increment (ANBI) is defined as  $\text{AGB}_{t2} - \text{AGB}_{t1}$ .”

We revise the caption in Table 2 as follow:

“Interannual changes in (a) aboveground biomass of living trees (AGB), (b) aboveground biomass increment of surviving and recruiting trees ( $\Delta y$ ), and (c) stem and branch biomass of dead trees produced in a year ( $L_d$ ). The  $\Delta y$  of surviving trees from 2000 to 2004 include the recruiting trees.”

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Minor and technical / linguistic points

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Comment 10426/14: to net a carbon -> to a net carbon

C7293

Response: It is our careless mistake. We take the referee's comment.

Changes in manuscript: "to a net carbon"

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Comment 10426/15: light enrichment

Response: Following the referee's comment, we change the word.

Changes in manuscript: "Because of increased light intensity at the forest floor,"

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Comment 0427/17: continual

Response: Following the referee's comment, we choice "persistent."

Changes in manuscript: "impose persistent stresses on"

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Comment 10428/24: large numbers & short space

Response: We use "km<sup>2</sup>" for a unit of area. The typesetter put the short space in the manuscript. We want to follow the publishing house style. Revised manuscript contains the shot space as the separator for thousands.

Changes in manuscript: "2 720 km<sup>2</sup>" in this page. "7 500 km<sup>2</sup>" and "2 370 km<sup>2</sup>" in next page.

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Comment 10429/22: replace "from" with "since"

Response: Corrected

Changes in manuscript: "since the year 2000"

C7294

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Comment 10431/23: multisampling system

Response: Following the referee's comment, we change the word.

Changes in manuscript: "with a valve switching unit"

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Comment 10432/20: covariance

Response: We mistake the term. We replace "covariance" with "cross-correlation." In this case, the first peak of cross-correlation usually takes negative in daytime and positive in nighttime. We need only a lag time of the first peak. We rephrase this sentence.

Changes in manuscript: "was optimized for the first extremum of cross-correlation between the vertical wind velocity and the CO<sub>2</sub> concentration."

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Comment 10434/11: cut eight stands

Response: Corrected

Changes in manuscript: "Eight trees..."

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Comment: 10435: percentage by dry weight

Response: Corrected. We add it at the first appearance.

Changes in manuscript: "The carbon content of stems and branches was 48.9 % by dry weight for birch and oak,"

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C7295

Comment 10435/23: light transport

Response: Corrected

Changes in manuscript: "Beer's Law of light penetration was"

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Comment 10436/13: in CO<sub>2</sub> fluxes

Response: Corrected. Same phrase is corrected in the title of section 3.2.

Changes in manuscript: "3.1 Seasonal changes in CO<sub>2</sub> flux" and "3.2 Interannual changes in CO<sub>2</sub> flux".

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Comment 10441: a mixture of mass given in kg C and in g C

Response: As you pointed out, there are two units of mass in the manuscript. One is the "stock" (kg C m<sup>-2</sup>), and the other is the flux or the change of mass in a year (g C m<sup>-2</sup> yr<sup>-1</sup>). Furthermore, others (e.g. kg C m<sup>-2</sup> yr<sup>-1</sup>) appeared in the manuscript. In biometrical study, "kg C" was generally used. On the other hand, "g C" was generally used in flux study. Because they differ more than four digits, especially in monthly values of fluxes, we venture to use two unit of mass. We classify units as follows:

kg C m<sup>-2</sup>: carbon stock (AGB, ABM, soil carbon),

g C m<sup>-2</sup> yr<sup>-1</sup>: CO<sub>2</sub> flux (GPP, Re, NEP, Ra, Rh, Rs, ) , biomass change ( $\Delta y$ , Ld, ANBI, SBM, ),

g C m<sup>-2</sup> day<sup>-1</sup>: monthly mean fluxes of GPP, Re, and NEP.

Changes in manuscript: We change "kg C m<sup>-2</sup> yr<sup>-1</sup>" into "g C m<sup>-2</sup> yr<sup>-1</sup>" (P14L17,18,19,26, and P18L23 in the marked-up manuscript version).

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C7296

Comment 10441/12: "times greater than"

Response: It is confusing to readers. We revise the sentences.

Changes in manuscript: "The annual Re increased from 978 g C m<sup>-2</sup> yr<sup>-1</sup> before the disturbance to 1359 g C m<sup>-2</sup> yr<sup>-1</sup> in 2006. The 380 g C m<sup>-2</sup> yr<sup>-1</sup> increase in the annual Re was 2.1 times as large as the decomposition rate of CWD."

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Comment 10443/16–17: the word "axis"

Response: Corrected in the main body and Fig.10

Changes in manuscript: We change "axis" into "margin" (P19 L21,22,24,26, and the caption in Fig. 10) in the marked-up manuscript version.

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Comment 10443/28: add "is"

Response: Corrected

Changes in manuscript: "by Mkhabela et al. (2009), is unknown."

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Comment 10444/4–6: this phrase seems completely unrelated to your discussion.

Response: We delete this sentence with references from the manuscript

Changes in manuscript: We delete "The net carbon . . . Kira and Shidei (1967)" and two references (Kira and Shidei, 1967; Luysaert et al., 2008).

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Comment 10444/27–10445/1: light enrichment

Response: We use the same expression in abstract.

C7297

Changes in manuscript: "Because of increased light intensity at the forest floor . . ."

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Comment Table 1: add the units

Response: We move the units from footnotes to the header line.

Changes in manuscript: "Carbon stock (kg C m<sup>-2</sup>)"

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Comment Table 2: add the units to the caption (move it from the footnotes to the caption)

Response: We move the units from footnotes to the header line. The caption of Table 2 was changed in connection with the major comment 1.

Changes in manuscript: Please verify alterations in the marked-up manuscript version.

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Comment Figure 4: also here in my view the y-axis title should say CO<sub>2</sub> flux, not Carbon flux.

Response: The y-axis title is corrected

Changes in manuscript: "CO<sub>2</sub> flux"

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Comment Figure 7: "The data in this figure are quoted from. . ."

Response: It is not necessary here. We delete this sentence.

Changes in manuscript: Deleted

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C7298

Comment Figure 8: photosynthesis

Response: Change the term to "photosynthetically"

Changes in manuscript: "photosynthetically active radiation (PAR)"

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Independent efforts by authors (Number of page in the marked-up manuscript version)

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Changes in manuscript (P6L2): "... in the carbon balance under the natural revegetation process ..."

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Changes in manuscript (P14L6–7 & L16–18): We revise the sentences related with Eq(5).

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Changes in manuscript (references): We add Sakata et al. (2008) and Tsuboki et al. (2015)

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Changes in manuscript (J. Forest Res. in reference): The typesetter inserts "–Jpn." But Journal of Forest Research is currently in print by Springer. It is not Japanese journal. We delete it.

Please also note the supplement to this comment:

<http://www.biogeosciences-discuss.net/12/C7290/2015/bgd-12-C7290-2015-supplement.pdf>

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