

Dear Dr. A. Hildebrandt

We greatly appreciate your review and constructive comments. Below are our responses to your specific comments. Please see also the revised manuscript.

Sincerely,

Hidenari Iwasaki

On behalf of the co-authors.

Specific comments

1: Page 6088, line 13: For the understandability of the abstract it would probably be better, if no variable names were used (because there is not space to define them).

Response

We changed “the relative gas diffusivity (D_p/D_0)” to “the gas diffusivity in soil” to be understood without defining D_p/D_0 .

2: Page 6088, line 16-19: I think this statement is too strong, compared to the presented evidence in the paper. The paper shows that certain topographic features are conducive to water collection and resulting increased soil moisture, compared to the surrounding areas. In these moist areas trees suffered. It is not shown, if or how the size of these moist areas changes with precipitation. The expected expansion of forest degradation should therefore be formulated more like a possible implication, not a necessary one.

Response

Unfortunately we could not estimate how prevalent the senescence area was. Therefore we changed the composition. However, as shown in Fig. 6, we recognized that this was not a small area feature.

3: Page 6089, line 13 For readers, who are less familiar with the area, it would be nice to have a literature reference after your statement that “water stress is a major limiting factor to tree growth”.

Response

We added a literature reference.

4: Page 6090, lines 14-19 This sentence is rather long and difficult to follow through. Could you split it up in two? Also, I think the placement of the reference (Epron et al., 1999) is a little un-lucky. Your statement is in present tense, suggesting that it is a fact that the emission of CO₂ to the atmosphere was increased in Yakutsk in 2007. You support this statement with a reference (Epron et al., 1999). However, the reference concerns an ecosystem in France (where indeed CO₂ emissions were increased in dry soils). It would be necessary to distinguish the motivation (the observation of increased CO₂ efflux in correlation with lower soil moisture in a beech forest in France) from your hypothesis (that this might also have been the case in the larch forest in Yakutsk in 2007).

Response

We spited it in three sentences.

“Higher amounts of precipitation must mitigate the water stress of the trees and decrease the number of forest fires, which is considered to be beneficial to the carbon cycle. However in summer of 2007, even though in the growing season, yellowing and browning leaves of larch trees were recognized in an undisturbed forest near Yakutsk city and these larch trees withered in 2008. Senescence of the trees also emits CO₂ to atmosphere in the process of decomposition.”

We do not mean that it is a fact that the emission of CO₂ to the atmosphere was increased in Yakutsk in 2007. This reference (Epron et al., 1999) means the emission of CO₂ to atmosphere in the process of decomposition.

5: Page 6090 site description It would be interesting to state here, how prevalent was the browning of larch trees in this area? On the picture it looks like this was an occasional feature?

Response

As mentioned above, we think it was not occasional feature as shown in Fig. 6.

6: Page 6090, line 10 I find it unusual that such an old, undisturbed forest (160 years) would have no age structure (i.e. all trees having the same age). Could you explain more about why this is the case? Could you indicate, how this age was obtained, and why all the trees are of the same age? I tried to find more information on this in the reference (Lopez et al., 2007) you give to support this fact, but also there, the age is simply stated, without reference to when and how this was measured, or if this

is a valid assumption based on independent information. Could you explore? Also, erase the “C” after “Lopez”.

Response

The tree age is averaged value, so this value doesn't mean that all the trees are of the same age. Nikolaev *et al.* (2009) reported that tree age of larch trees in the same forest was more than 200 years as a result of tree-ring chronology. Therefore we think this value “160 years old on average” is relevant.

We erased the “C” after “Lopez”.

7: Page 6090, line 23 "core samples were saturated by capillarity" I do not understand this sentence well. I have not encountered this description before, and also an online search did not help further. Maybe use an equivalent expression?

Response

We changed the composition.

8: Page 6090, line 26 From the context I understand that each soil sample was classified?

If yes, maybe say "Each soil sample" or "All soil samples" here.

Response

Yes. It was replaced to “All soil samples” and we changed the composition.

9: Page 6091, line 1 "Soil water retention curves were developed for each soil type using... “ Is it correct that you measured soil water retention for one soil sample per soil type (i.e. 3 of roughly 40 samples)? If this was the case, did you apply a certain rule to select the sample of your choice? Do you expect some variation of the soil parameters within your specified soil classes? Could you explore somewhat more on these points? How was the spatial distribution of the soil classes along your transect? Was there a relation between soil class and location (sill versus slope)? I am asking this, because you use the derived parameter (b – one value for each soil classification) to compute the ratio D_p/D_o and compare the values between slope and sill. Could you add a comment on how your derived b-values relate to the b-values for the same soils published in the literature?

Response

We found three textures in the studied forest. Three textures were found randomly on the line transect, there was no clear relation between soil texture and location. Therefore we decided to measure soil water retention for each soil texture, regardless of location.

We add the comment on the b-values.

10: Page 6091, line 5 Maybe consider renaming this heading into "Derived Variables" since "Calculations" is rather general.

Response

It was renamed.

11: Page 6093, line 4 I would split up the sentence between "content" and "which" Also, I think that the second part of the sentence needs to be formulated more carefully, as in replace "which had a destructive" with "which seemed to have a destructive". This is, because the conclusions are drawn based on indirect measurements and hence are not entirely certain.

Response

We changed the sentence as below.

“The low D_p/D_0 at YBL sampling sites was tied to their elevated soil water content. And their high soil water condition seemed to have a destructive effect to larch trees, as exemplified by larch trees in YBL zones in 2007 (Fig. 6a) which did not flush in 2008 (Fig. 6b).”

12: Page 6034, line 24 - Page 6094, line 2 I do understand why you draw this conclusion, but I think it needs some more support. For example, is it certain that such an event could not have taken place within the last 160 years? Is there no chance that the trees will recover, if conditions are favourable during the following years? Could you tell us more, why you think that no such event could have taken place before?

Response

From the precipitation data, this event did not occurred at least within the last 26 years. In this study we found the possibility that two consecutive years of high precipitation may have destructive effect to larch trees. This forest is estimated as 160 age in literature and we did not find many dead trees before this study. Therefore we think this event is assumed to be one in at least 160 years.

13: Page 6094, line 26 I think this conclusion needs to be formulated more carefully. There is no research on how far this feature can spread around the taiga. Your own research indicates that it is tied to particular micro-topography; hence only certain areas are potentially affected. Thus, concluding, "forest decline must spread and affect the global carbon cycle" is still far fetched.

Response

We changed the composition.

14: Page 6095, line 9 "caused by an elevated soil moisture" - erase "an"

Response

It was erased.

15: Page 6095, line 11 "These results implied the possibility that climate" maybe reword to "These results imply that climate change"

Response

It was reworded.

16: Page 6102, Figure 2(a) I think the x - coordinate should be "log (s)".

Response

Figure 4(a) shows logarithmically-plotted WRCs. The x – coordinate is volumetric water content (θ), not degree of saturation (s).

References

Epron, D., Farque, L., Lucot, E. and Badot, P.M.: Soil CO₂ efflux in a beech forest: the contribution of root respiration. *Ann. For. Sci.*, 56, 289-295, 1999.

Nikolaev, A.N., Fedorov, P.P., Desyatkin, A.R.: Influence of climate and soil hydrothermal regime on radial growth of *Larix cajanderi* and *Pinus sylvestris* in central Yakutia, Russia. *Scand. J. for. res.*, 24, 217-226, 2009.