

Authors reply to the interactive comment on “Climate effects on the vitality of boreal forests at the treeline in different ecozones of Mongolia” of first referee U. Schickhoff (Referee)

Dear Udo,

thank you very much for the intensive work you have done by reviewing our manuscript. It is very helpful to receive valuable comments from an expert in bioscience and geography. Considering your comments will highly improve the precision and output of our research. Although we are in accordance with nearly all of your suggestions, we will answer to them one by one. We will mark and format your comments in italics to visually differentiate them from our replies.

In the reworking procedure, we will first correct your detailed proposals in the manuscript and then work on the comments of the 2nd referee. Doing it that way, some comments of the 2nd referee will already be solved, but in addition larger parts of the manuscript may be rearranged afterwards.

Ref.: In my view, the usage of the term 'ecozone' in the paper (in the title, throughout the text, in the figures) is not appropriate. The term 'ecozone' is associated with large-scale units (biomes) such as humid mid-latitudes, dry mid-latitudes etc. I believe it is confusing to use it for small-scale units as in this paper. The authors should apply a consistent, generally accepted terminology for habitats / vegetation formations along horizontal and altitudinal zonations (see below).

Rep.: You are right with the definition of the term “ecozones” and we will try to change the terms in the manuscript as you propose. At least we are focusing on the forest ecosystems, so we will change the term “ecozone” to “type of boreal forest” and the class “Total ecozone” to “Total ecosystem unit” throughout the entire manuscript.

Ref.: Without explicitly saying so the authors suggest that treeline positions (upper and lower treelines) are in accordance with present climatic conditions. This must not necessarily be the case. Most treelines are in a process of climate tracking, and lag behind climatic changes, in particular when those changes take place very fast. Human impact on treelines is only briefly touched in the paper. I would like to have stressed by the authors the influence of e.g. climate history, vegetation history and historical human impact, and to what extent these factors might influence the results of this study.

Rep.: OK, you are right. We inserted more information about treeline development and its ecology.

Ref.: The manuscript needs language editing in many lines, I suggest to involve a native speaker.

Rep.: Anyway, the English language needs always an improvement. The last version will be checked by a (nearly) native speaker. However, we count on the excellent English language editing, which may finally be done by Copernicus before publishing.

Specific remarks as follows:

- line 54: ...strongly varies in space and time... -done

- line 61-62: soil temperature, soil moisture and soil nutrients might also play a role

- We incorporated this fact with an additional sentence

- line 64-65: usage of the term 'ecozone' is confusing. Regarding altitudinal zonation I suggest to use the term 'zone' or 'belt' (alpine zone or alpine belt), regarding horizontal zonation I suggest to use the term 'habitat' or 'zone' or another term since the term 'ecozone' is associated

with large-scale units (biomes) such as humid mid-latitudes, dry mid-latitudes etc.

- We changed the sentence and will now consequently use the terms “zone” for horizontal and “belt” for altitudinal zonation
- *line 67: altitudinal zones are not biomes, but zones or belts* - changed
- *line 85: no comma after et al.*
 - not changed, because this kind of formatting is demanded by BIOGEOSCIENCE and automatically processed by CITAVI
- *line 103: either no comma before which or comma after Spot VGT)* - changed
- *line 105: see line 103* - changed
- *line 128-130: language editing* – The sentence is not necessary and completely deleted
- *line 144: trends of instead of trends for* - done
- *line 166: showed the NDVI to be well usable....* - done
- *line 167: tree biomass of Mongolian forests* - done
- *line 176: climatically restricted? I suggest to rewrite: ...'is delimited by a constellation of climatic threshold values'* - That is good, changed
- *line 177-178: reflect climate-ecological relationships and limitations* - changed
- *line 195: highly continental semi-humid* - changed
- *line 196: with little snowfall* - changed
- *line 205: ...are arranged in characteristic sequences along latitudinal and altitudinal gradients*
 - changed
- *line 206: obovata kursiv* - changed
- *line 207: selectively? Please rewrite this sentence* - changed to: .. locally as mountain taiga ..
- *line 211: intra-montane basins* - changed
- *line 217: the terms playas and takirs should be explained*
 - I preferred to delete the sentence, because this information is not really necessary
- *line 222: forest management* - changed
- *line 226/227: Please explain the increasing fire susceptibility*
 - explained by climate warming, permafrost retreat, and insect calamities
- *line 241: Fig. 2* - not changed, because directly naming the figure
- *line 244: language editing* - changed and hopefully better described
- *line 259: In the upper elevational zones?* - changed
- *line 265: tree species maps* - changed
- *line 268-270: Using this approach the authors should be aware of and should point out that this is a simplification since the plant species respond to inter-annual variations and extreme values; plant species do not respond to mean values*
 - We mentioned this problem following your words; however, in a next step of research it would be interesting to investigate if it possible to detect single extreme values in the data, which may play a significant rule for limiting tree distribution. But first it needs to establish the multi-

data analysis like shown here, before to go to deep into detailed analysis, while the accuracy of the base database does not fit the research problem.

- line 293-294: *language editing* - changed, sentence shortened

- line 298: *multiple comparisons* - changed

- line 306-308: *Alteration of treelines requires successful recruitment of tree species. The authors should be aware of the fact that bioclimatic requirements of seedlings and saplings might deviate to a considerable extent from those of adult trees*

- You are right. That this is true, we could see during our last fieldwork in Mongolia. We wanted to examine why there is such a bad rejuvenation for larch trees like observed 3 years ago. Now after three rainy and humid summers we found extensive succession and even larch seedlings inside the steppe. However, from the remote sensing point, we can only detect adult trees and forests, which must have had sufficient environmental conditions to survive for a longer period. At the end of this chapter method, we inserted a complete new paragraph, where we described the ecological problems of forest distribution, human impact, and the technical limits of the investigation presented here.

- line 332: *intermontane basins* - changed

- line 335: *language editing* - changed

- line 340-341: *language editing* - changed

- line 344: *language editing* - changed

- line 347-348: *language editing* - changed

- line 380: *blank space* - changed

- line 381: *forest distribution or forest stand distribution* - changed

- line 433ff: *Ulmus trees along water courses in the steppes should also be mentioned here*

Ulmus trees play a minor role in our investigation, because they occur at water-favored places near river and in the basins. Therefore their occurrence is less climate depend and also the basin region were excluded from treeline analysis. However, we inserted the Ulmus trees in the introduction to the Study area.

- line 447: *intramontane basins* - changed

- line 472-473: *language editing* - changed

- line 474: *2x thus* - changed

- line 474-475: *hygrophilous instead of water-demanding*

not changed because trees are not specific hygrophilous species

- line 478: *which additional factors?*

- We can only assume what the additional factor may be: permafrost, water from upper slope, ... The sentence was changed to the meaning that we can identify the position but not the specific ecological exception of extraordinary forest stands.

- line 479: *results instead of tendencies* - changed

- line 496: *language editing* - changed

- line 507: *Climatic change will lead: : .:* - changed

- line 509: *Forest dynamics* - changed

- line 510: modelled - changed
- Fig. 5: Map legend: there is no reference to the black line (not all of the readers are familiar with the borders of Mongolia) - changed
- Fig. 6: Legend: *Pinus sibirica* - changed