

Biogeosciences Discuss., referee comment RC2  
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## Comment on bg-2021-260

Anonymous Referee #2

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Referee comment on "Parameterization of the responses of subarctic European vegetation to key environmental variables for ozone risk assessment" by Stefanie Falk et al., Biogeosciences Discuss., <https://doi.org/10.5194/bg-2021-260-RC2>, 2021

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### General comments

This study has a novel motivation in studying the response of subarctic vegetation to ozone damage. It also raises potentially impactful takeaways based on the discussion and abstract, especially the potential underestimate in ozone risk. However, I found the current manuscript challenging to follow due to its organization and at times ambiguous or overstated language, so that it was difficult to identify and understand the supporting evidence or how to reproduce it. Along those lines, I would suggest using a more descriptive word or phrase than "bespoke" to distinguish your parameterization. Some equations appear to be described incorrectly in the text, and one of the main text figures is missing. Despite these issues that should be resolved, this paper investigates an interesting and potentially influential topic that I believe would be worthy of publication following major revisions.

### Specific comments

Lines 62-63 – Please include a citation for the sentence "A longer growing season is prolonging..." It is not immediately intuitive that a longer growing season would lead to increased ozone accumulation.

Lines 83-84 – Please include a citation for the concept that soil moisture deficits are most influential in decoupling concentration and uptake.

Starting at line 90, the remaining paragraphs in the introduction could be separated into a methods section. I find the introduction to be a bit longer than would be most effective for conveying this information. At this length, it would be helpful to at least break it into subsections with informative headers. In particular, the content of the paragraph in lines 115 – 134 is important for contextualizing the somewhat extensive discussion of meteorological parameters, but it seems unconnected with the adjacent paragraphs and could be better emphasized as part of the introduction or as an opening paragraph for the text in section 2 that leads to Figure 2.

Line 102 – The concept of critical loads is much older than 2016 (eg for nitrogen or sulfur soil acidification for example), so please include an earlier citation or specify that this is specific to ozone damage.

Please correct the text in line 105, “The CL is calculated by:” This doesn’t seem to be a correct descriptor for Equation 2, which calculates the exceedance rather than the CL itself.

In general, the meteorological description and analyses could be improved to better connect with the paper’s focus of vegetation damage from ozone pollution. For example, it is not clear how the paragraph in lines 196 – 201 relates back to your objective.

Section 3.2, line 237-238: Please include a citation for the sentence that begins: “As weather extremes...” The word “extremes” in this manuscript needs clearer description or contextualization, as the definition for this word may vary between climatological studies.

In the paragraph that starts at line 241, the meaning of the word “significant” is unclear and varies within the paragraph. My understanding is that it is implied that “significance” is generally taken to be +/-1 sigma (or ½ sigma for precipitation) for this analysis, but in this case it should be stated clearly early on in this section. Ideally it will pertain to a significance test. In addition, “more than 40% of the days were significantly warmer” indicates a different result than “a significant number of warmer days,” and it needs to be clarified what is significant about either scenario. The latter part of this paragraph reads as a list of results relative to the anomalies, and it would be helpful to tie back what is said here to the objective of this paper (e.g. “March 2018 had many unusually cold days” is possibly too vague and detached to merit inclusion without additional context).

Line 265 – Please cite Falk et al. 2021 (I believe this is the appropriate reference) for the sentence “The star indicates the reconstructed data in July.”

Section 4 – Please expand the description of the DO3SE model and consider including a description of its structure as relates to the rest of the section. At present, section 4.1 reads as a list of parameters, but the relationship to your stated objectives and the

common thread among this list is unclear. As a reader it is difficult to gauge whether the parameter adjustments described here are sufficiently comprehensive for the model's intended application. Based on the current content, I believe it could be helpful, for example, to describe early in the section what are the high-level inputs and which of the species need to be adjusted for temperature acclimation.

Line 289-291, sentence "We identified..." –  $f_T$  hasn't been defined yet. Also, please clarify that this is the limiting factor of stomatal conductance in perennial grassland in this model (rather than in general).

Line 304 – Again "extreme" is ambiguous here and seems to differ in definition from previous use (e.g., at line 237 it seems to relate to periodic events, while here it is describing a climate zone).

Line 305 – Is  $f_T = f_{temp}$ ? Please clarify.

Lines 306 – 307 – Please clarify which timeframes are being compared related to what is meant by "subject to climate change." In other words, are you comparing the 1990s to the 2000s? Or the 1990s + 2000s with implicit impacts of climate relative to the preindustrial era?

Please include a citation or support for the presumption stated in lines 316-317 that begins "Regarding the acclimation..."

Line 317-318 – Mention that this is PPFD 0.8 and 1.2 in parentheses after +/-20%? Where it is currently included (line 324) suggests to me that these configurations are specific to grassland.

Line 321 appears to substitute for  $f_{light}$  in Equation 4, not for as described in the text.

Line 331 – Is the low standard deviation mentioned specific to nighttime?

Line 331 – I find the conclusion that the standard deviations indicate "higher robustness to variability in growing conditions" to be too sweeping relative to the evidence presented. Variability in growing conditions could include many different drivers, but the impetus discussed seems specific to sunlight. However, narrowing this conclusion to sunlight would still require an additional sensitivity test beyond what is presented here, so that I suggest cutting this sentence.

Line 332 – “subarctic-PPFD0.8” is “best” relative to what? Please clarify.

Line 360 – Is there a citation or justification for the 1 nmol/m<sup>2</sup>/s flux threshold?

Figure 8 appears to be missing from the document.

Lines 367-372 – “leads to” seems strong, given that there are many variables changing with respect to the climatic parameterizations or growing season variability. Consider “is associated with” or something similar that does not imply causation.

Line 372 – Where is it shown that temperature acclimation relates to the amplification of drought effects?

Minor or technical comments

Lines 35-36 – Sentence that begins with “Tropospheric background...” seems misplaced, consider moving to finish this paragraph with a concluding, summary or transitional sentence.

Paragraph starting at lines 68 - If possible, please consider adding context for which of the species mentioned here are expected to proliferate under Arctic amplification.

Note at line 81 (also 134, 314) there is an errant space, and this formatting inconsistency recurs later in the document.

Figure 3 – please increase the width of the precipitation error bars for readability.

Figure 4 – This is a very effective illustration of the data in this plot – well done! One minor suggestion is to use a different plot background color or a colorbar that does not start with white to make it easier to see what are now the light yellow points.

Figure 5 – Please include a description of the 5d star in the caption for this figure.

Lines 267-269 – This is an important and interesting contribution. Please consider breaking up this sentence for readability, eg by first mentioning that fire-based enhancements to peak ozone apparently did not result in anomalous monthly mean ozone.

Line 298 – 302 – Consider reminding readers that MM is specific to the subarctic class? I found the text from “We construct cold...” to “...most efficient at cold temperatures” to be a bit confusing because the cold definition is compared with MM values, while the subarctic category is not. It would be helpful to make their definitions parallel or analogous to one another, contextualizing using the MM parameterization as necessary.

Lines 337-339 – I haven’t previously seen this method for identifying the start and end points of photosynthesis, and (noting that I’m not an ecologist) it seems elegant in concept and approach.

Sentence in lines 339-340: “This value will be used for all PFTs alike.” Please specify –  $A_{\text{end}}$ ? In this paragraph, please explain why it is acceptable to use the same  $A_{\text{end}}$  for all PFTs while  $A_{\text{start}}$  is specified with respect to the PFT.

Line 344 – “indicating” should be “indicate”

Line 352 – Two soil types seem to be described in this paragraph, but the sandy loam texture is only compared to one (unclear which one). Should “of this soil type” be “both of these soil types”?

Line 354-355 – Apologies if I missed it, but please clarify what leaf length you are using, given the observations are smaller than in the MM parameterization (this is specified for tree height later in the paragraph, so it seems odd this is not also described for leaf width.

Line 410 – I think “severer” should be “more severe.”

Line 456 – Consider expanding on the experimental data needed to verify these parameterizations.

Line 457 – do you mean the response to SWP, rather than SWP itself being negligible?  
Lines 484-486 – Please consider breaking this into two sentences for readability.