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Geoscientific Model Development Discussions

Interactive comment on "ORCHIDEE MICT-LEAK (r5459), a global model for the production, transport and transformation of dissolved organic carbon from Arctic permafrost regions, Part 1: Rationale, model description and simulation protocol" *by* Simon P. K. Bowring et al.

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Author Response to Interactive Comment by Anonymous Referee #2 on "ORCHIDEE MICT-LEAK(r5459), a global model for the production, transport and transformation of dissolved organic carbon from Arctic permafrost regions, Part 1: Rationale, model description and simulation protocol" by Simon P. K. Bowring et al.

Dear Anonymous Referee #2,

Thank you for taking the time to read and review our manuscript, and in doing so providing such diligent and constructive commentary for its improvement, which we hope we have been able to assimilate into its content to the greatest degree possible in our responses, which follow below.

Major Comments:

1. All abbreviations should be spelled out at their first usage in the Abstract as well as the main text. For instance, ORCHIDEE MICTLEAK should be spelled out in abstract as well as the main text, where this term is first mentioned. In addition, "IPSL", "DOC-C" and "MICT" are also not spelled out. Please check for all abbreviations throughout the manuscript and define them at the first usage.

1. We have included the full expansion of the acronyms identified by your review and included them in the main body of the text. In the abstract, we have included the full spelling of 'IPSL' (Institut Pierre Simon Laplace), to reflect the fact that this may not be a well-known institute, but have decided not to do the same for 'ORCHIDEE' in the abstract, as (i) this is a relatively well-known land surface model in the modelling community, such that it may not be necessary to unpack its letters in an abstract; (ii) this unpacking is extremely lengthy, and may not be sufficiently informative to justify its inclusion to the text body of an abstract. Thus the unpacking occurs in line 72 of the text. Finally, we cannot spell out "ORCHIDEE MICT-LEAK" since the second half of the compound name (LEAK) is itself not an acronym, and refers to a version of the ORCHIDEE model called ORCHILEAK -hence our reduction of the new branch name presented in this manuscript from ORCHIDEE MICT-LEAK to ORCHIDEE M-L. The rationale for the ORCHILEAK name is now included in the text (L. 81-82) with the text " where the suffix 'LEAK' holds no acronym, and refers to the 'leakage' of carbon from terrestrial to aquatic realms). " Further, in the abstract we try to clarify the point that the presented model results from the merge of two separate code versions with the following text: " The model, ORCHIDEE MICT-LEAK, which represents the merger of previously described ORCHIDEE versions -MICT and -LEAK, mechanistically represents..."

2. Line 46: "... as the permafrost line migrates poleward over time." is incorrect, because there is no line in permafrost zone. However, there is boundary between continuous and discontinuous permafrost zones, and this boundary is slowly moving poleward over time. Please correct the phrase with respect to this suggestion.

2. Thank you for spotting this conceptually misleading description in our text, and for providing some helpful pointers towards its resolution. The phrase has now been modified to "... as the boundary between discontinuous and continuous permafrost migrates poleward and toward the continental interior over time."

3. Please edit English grammar throughout the manuscript more carefully. For example, in line 70 "To this end" is not clear. In addition, in line 62 "metabolising" should be "metabolizing".

3. Thank you for finding this grammatical inconsistency in our text, which reflects the inputs of authors using differing standards for English spelling. The GMD English language guidelines stipulate that ""We accept all standard varieties of English in order to retain the author's voice. However, the variety should be consistent within each article". As such, we have chosen to homogenise the text for the UK variant. Thus 'metabolize' and its variants have now all been corrected to reflect this choice of English usage in the other text (e.g. lines 125-126), as have all other verbs that contain this ('-z') difference in spelling (e.g. 'mineralization' –> 'mineralisation', line 461) throughout the text. Further, "to this end" has been changed to "for this purpose".

Minor Comments:

1. Lines 50-51: "... , the majority as dissolved organic carbon (DOC)." is not clear. Please cite some references supporting the statement. For instance, in the headwater of the Lena River basin, Suzuki et al. (2006)showed that DOC was a dominant form of riverine organic carbon transport becauseinorganic carbon and particulate organic carbon (POC) transport would be negligible on the basis of their observation data. Suzuki, K. et al. (2006), Nordic Hydrology, 37(3), 303-312, doi:10.2166/nh.2006.015.

Thank you for pointing out this unqualified statement. We have included the citation suggested in review.

2. Line 116-117: Please consider citing Suzuki et al. (2006).

This has been included in the text (now line 128).

3. Line 133-134: "... , and DOC concentration are affected at watershed scale by parent material and ground ice condition (O'Donnell et al., 2016)." The statement is incomplete, because DOC concentration is also affected by active layer depth as the frozen ground table limits water infiltration into deeper soil layers, as shown by Suzuki et al. (2006).

Thank you for finding this error in conceptualisation. Indeed, we agree with the reviewer that this is a critical determinant of DOC conentrations, and have altered the text to reflect this with "DOC concentrations are affected at watershed scale by parent material, ground ice content (O'Donnell et al., 2016) and active layer depth (Suzuki et al., 2006). "

4. Line 169: "... and greater evapotranspiration (Zhang et al., 2009)." Please consider adding the study by Suzuki et al. (2018), wherein they have shown increasing evapotranspiration from the entire Arctic circumpolar Tundra due to summer warming. Suzuki, K. et al. (2018), Remote Sensing, 10(3), 402, doi:https://doi.org/10.3390/rs10030402. Thank you for alerting us this additional citation that further strengthens the assertions made in this portion of the text (now line 187).

5. Line 373: " ..., non-conservative canopy DOC production rate of 9.2*10-4 g DOC-C per gram ..." is not clear. Please rewrite more clearly.

Indeed, on reflection, this sentence is not particularly straightforward and has been adapted to make what has been calculated clearer to the reader. It now reads " From this we obtain a constant tree canopy DOC production rate of 9.2*10-4 g DOC-C per

gram of leaf biomass per day (Eq. 1). This is the same for all PFTs except those representing crops, for which this value equals 0, reflecting how at a very general level, crops are small and tend no to be characterised by high organic acid loss rates from leaves due to e.g. aphids, due to human control." (now lines 394-399).

6. Line 388: "3.5 Hydrological mobilisation of soil DOC" should be "3.5 Hydrological mobilization of soil DOC".

This has now been included (see Major Comments Response (3)).

7. Line 396: "... (see sections 'soil flooding' and 'floodplain representation')." Please add the specific section numbers.

Here we realise that the section headings had changed since this part was written, and we had since merged the segments discussing floodplain representation. This is now reflected in the text body (line 424) which now reads: "(see section 2.8, 'Representation of floodplain hydrology and their DOC budget')."

8. Lines 520-522: Please consider citing Suzuki et al. (2006), because they observed very large DOC transport from a headwater basin of the Lena River basin.

Thank you for your suggestion. This has now been included.

9. Line 654: "... , such as the photochemical breakdown of riverine OC, ...". Here, OC is not clear. Please define this and add explanation.

Thank you, this has been corrected to "dissolved organic carbon" (now line 691).

10. For equations (1)-(6): within the equations, variables are in italics but variables in the main text are in normal font. Please modify these for consistency.

Indeed, we had not noticed this inconsistency in the text, which has now been edited accordingly throughout.

12. In Figure 1, letters (a)-(m) are too small to read. Please enlarge the letters.

(note, no 11. in the original review document). The font size for the letter subheadings has been increased from 8 point to 12 point in Figure 1.

13. In the caption of Figure 1, line 1254, "(d) Hydrological mobilisation of soil DOC" should be "(d) Hydrological mobilization of soil DOC"

This remains as was (see choice of English in Major Comments (3)).

14. In the caption of Figure 2, line 1277 "Blue dashed boxes" should be "Blue colored boxes".

This change has been included in the document.

Please also note the supplement to this comment:
https://www.geosci-model-dev-discuss.net/gmd-2018-320/gmd-2018-320-AC2-supplement.pdf

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