

Comments about paper “An improved process-oriented hydro-biogeochemical model for simulating dynamic fluxes of methane and nitrous oxide in alpine ecosystems with seasonally frozen soils” Submitted by Zhang et al. to Biogeosciences

General remarks

This paper presents measurements and modelling of evolution of soil temperature, soil moisture, methane and nitrous oxide emissions in cold altitude wetlands, alpine meadows and forest. The used CNMM-DNDC model has been adapted by the authors to simulate the freeze-thaw cycles of the area. It is a matter for Biogeosciences but the authors have to improve seriously the paper before publication.

Primarily, they have to complete their bibliographic list and more discuss their results considering other published models. CNMM-DNDC incorporates the core biogeochemical processes of DNDC into the hydrological framework of CNMM (Catchment Nutrient Management Model). These coupling attempts, like present adaptation to freeze-thaw cycles are interesting efforts. My doubts concern the use without discussion of the DNDC corpus published near 30 years ago, when other models have showed more recently their interest in modelling the ecological functioning of microorganisms, using a smaller number of well-defined kinetic parameters and avoiding badly defined parameters of flow fractionation. Conversely, the decomposition part of DNDC uses a lot of these parameters and is for me largely over parameterized. Consequently, its prediction must be discussed, not only by the results of the usual statistic tests, comparing measurements and predictions (It is well known that any complex signal can be adjusted by any model using a great number of parameter e.g. in Fourier transforms), but also in terms of microbial functioning.

Also the article needs to be improved by more explanations about the CNMM part. Some surprising choices must be better justified in the text, like why to predict temperature in all the profile for two systems when moisture is described in the 3 systems but only in the surface layer. The particular remarks below must be taken into account.

Particular remarks

L37 Is this 1st sentence a little banal?

L 60-62 the listed biogeochemical models is not exhaustive and limited to relatively old models sometimes subjected to critics (over parameterization, functional role of microorganisms...), e.g. the model MOMOS is ignored, please complete the list in such a way to better situate your work in the literature data.

2.1 paragraphs: the original paper on DNDC includes a sub model for denitrification but not for methane emission; please clarify this part. The only denitrification submodel includes 17

parameters which must be combined to the numerous parameters regulating various splitting's in the DNDC core! By two points you can adjust a right line, but also a parabola, then more and more sophisticated functions by increasing the number of parameters, and the fittings will be already OK when evaluated by the statistic laws. All the models will predict the two points. You must discuss about the number of parameters in the paper (Ockham razor)

L111-112 OK for hydro-geochemical but there is a doubt for biogeochemical, please discuss more deeply your choices considering all the literature data. The same for biogeochemistry in line 112; in contrast, paragraph 2 of 2.1.1 explain a particular interest of CNMM-DNDC

Eq5: It looks like a sum, not a weighted average? Should j be defined in L148?

Eq.6: product or geometric mean?

L148-151: is there references data for the values of C and k for each constituent j ?

L168: reference for this opaque chamber method? Is not a risk of perturbation by elimination of solar radiation?

L189-190: could the layer description be clarified?

Table1: Could the legend remember the meaning of IA, NSI and R2? I suppose P is the probability of rejection, but for what test? Are the P columns necessary since P is always <0.001 ?

Fig.1: legend in 1a is not very clear, perhaps write "observed" in red color; the same for other Figs

L210: ZIR does not appear in table 1

L216: The range values does not correspond to that of Table 1, please clarify

L218: where is Fig S2? (the same for all S figures, I suppose supplementary not visible for me)

Improve coherencies in Figs or more explain your choices: Fig 1 shows soil temperature for two systems at all soil layers; in contrast, Fig.2 shows moisture in the 3 systems but only in the 0-6 cm layer

Fig3: format date of x axis not very clear

L223: is the term "Water movement" exaggerated when you speak only of the surface water?

Fig.6:y axis legend not clear

L293-294: should you present succinctly this concept of the CH₄ balloon in material and methods?

L351: define TP

Principal criteria

Scientific significance:

Does the manuscript represent a substantial contribution to scientific progress within the scope of Biogeosciences (substantive new concepts, ideas, methods, or data)?

yes

Scientific quality:

Are the scientific approach and applied methods valid? yes

Are the results discussed in an appropriate and balanced way (consideration of related work, including appropriate references)? No

Presentation quality:

Are the scientific results and conclusions presented in a clear, concise, and well-structured way (number and quality of figures/tables, appropriate use of English language)? No

Access review (quick report), peer review, and interactive public discussion (BGD)

Manuscripts submitted to BG at first undergo a rapid access review (initial manuscript evaluation), which is not meant to be a full scientific review but to identify and sort out manuscripts with obvious major deficiencies in view of the above principal evaluation criteria.

Manuscripts rated 4 (poor) in any of the principal criteria are normally rejected without further review and discussion. Manuscripts rated 1–3 (excellent–fair) in all criteria are normally published on the Biogeosciences Discussions (BGD) website, the discussion forum of BG, where they are subject to full peer review and interactive public discussion.

In the full review and interactive discussion, the referees and other interested members of the scientific community are asked to take into account all of the following aspects:

1. Does the paper address relevant scientific questions within the scope of BG? Yes
2. Does the paper present novel concepts, ideas, tools, or data? New data
3. Are substantial conclusions reached? No
4. Are the scientific methods and assumptions valid and clearly outlined? Incomplete (see my remarks)
5. Are the results sufficient to support the interpretations and conclusions? yes
6. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? No
7. Do the authors give proper credit to related work and clearly indicate their own new/original contribution? Yes
8. Does the title clearly reflect the contents of the paper? yes
9. Does the abstract provide a concise and complete summary? no

10. Is the overall presentation well structured and clear? No, see my remarks above
11. Is the language fluent and precise? yes
12. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? No, see my remarks
13. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? yes
14. Are the number and quality of references appropriate? No
15. Is the amount and quality of supplementary material appropriate?

Peer-review completion (BG)

At the end of the interactive public discussion, the authors may make their final response and submit a revised manuscript. Based on the referee comments, other relevant comments, and the authors' response in the public discussion, the revised manuscript is re-evaluated and rated by the associate editor. If rated **excellent** or **good** in all of the principal criteria and specific aspects listed above, it will normally be accepted for publication in BG. Additional advice from the referees in the evaluation and rating of the revised manuscript will be requested by the associate editor if the public discussion in BGD is not sufficiently conclusive.

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