Biogeosciences Discuss.,
https://doi.org/10.5194/bg-2018-265-RC2, 2018

Biogeosciences Discussions

Interactive comment on "On the role of soil water retention characteristic on aerobic microbial respiration" *by* Teamrat A. Ghezzehei et al.

Anonymous Referee #2

Received and published: 11 July 2018

General comments

The contribution by Ghezzehei and co-authors presents a model describing the responses of microbial respiration to changes in soil water. The proposed approach follows the work by Skopp et al. (1990; cited in the Discussion paper) and defines a set of limiting functions that affect respiration: one for oxygen availability, one for aqueous diffusivity, and one for matric potential effects (microbial activity limitation). The latter function represents an improvement over the original model by Skopp et al., but it is analogous to some other recent papers (see details below). These limiting functions are then combined in a factor that rescales the first order decay constant regulating carbon release from a single pool of organic carbon. This model is then parameterized using measured respiration-soil water relations for a number of soils. This topic

is timely given the uncertainties in modelling respiration-soil water relations, and suitable for Biogeosciences; however, I have some concerns regarding the novelty of the proposed approach, I found the model description at times confusing, and there are several inconsistencies and language/presentation issues.

Specific comments

As acknowledged by the authors, the use of combined gas and aqueous diffusion limiting functions to predict respiration-soil water relations had been proposed by Skopp et al. (1990) and used in many occasions later. The matric potential-dependent function capturing reductions in microbial activity is a more novel addition, but similar functions have been recently proposed and used to capture respiration-soil water trends observed in laboratory studies (Yan et al. 2016; Manzoni et al. 2016). It might also be worth looking at other recent papers (some not available at the time this contribution was submitted) using a comparable approach, though with equations derived in different ways (Tang and Riley, 2013; Yan et al. 2018; Moyano et al. 2018). Considering these previous papers, some statements in the Discussion and Conclusions section seem to overstate the novelty of this contribution (P18, L4-5; P19, L9).

The model description is not always clear and there are several inconsistencies in the way parameters are defined. For example, in Eq. 10, the aqueous diffusivity D_W does not have the dimensions of a diffusivity (Lˆ2/T), but is non-dimensional. The symbol C_A in the same equation is not used elsewhere. In Eq. 11-13, which are used to fit the data, C_A does not appear, so 'accessibility' does not play a role, unless C_0 is interpreted as the 'accessible' organic carbon (but that is defined as 'initial active carbon'). Moreover, the units in Eq. 11-12 do not match up: with K defined as in Eq. 12, the exponent in Eq. 11 is not non-dimensional, but has the same units of C_0. Towards the end of the manuscript, a "curve lambda" is mentioned (P19, L3), but lambda is only used as a parameter before. Overall, these issues make the reading and interpretation of results difficult.

Some choices of the soil moisture characteristic curves appear arbitrary. How were unimodal vs. bimodal curves selected? At the dry end of the soil moisture characteristic curves in Fig. 4, for example, there appear to be a sharp decrease in water content – possibly a sign that a bimodal curve could work better? I would suggest selecting curves using a more objective criterion based on goodness of fit and robustness (e.g., AIC).

Minor comments

- Please check the whole text for grammar mistakes and inconsistent formatting of citations (e.g., author names in capital, erroneous use of brackets); some of these issues are highlighted below P1, L17: “comparing” P1, L22: “Yuste” P3, L6: “nitrification rate... correlates” P6, L1: if alpha refers to matric potential at maximum drainage, I am not sure I understand why D_0 (a function of alpha) refers to the modal rather than maximum pore throat diameter P6, L9: “top axis of the figure” – which figure? I would refer to the figure number P6, L15: “unimodal” P6, L16: extra full stop? This sentence appears incomplete P7, L12: check use of brackets - “Chowdhury et al. (2011b)” P7, L16: “Watson” P8, L4: this sentence appears incomplete P11, L17: “important to note” P14, L8: but in Figure 5, k_a,min=0.8 as well P15, L4: what does “explained in its entirety” mean? Based on which performance metric? P15, L17: “soils that were...” P16: to avoid having incubation duration as a confounding factor, only the first data points from the Arnold et al. (2015) study could be used P16, L21: more than inter-sample differences, the data from Miller et al. (2005) show strong Birch effect (Birch 1958) – longer dry periods trigger larger respiration pulses. This effect, which is widespread, cannot be captured by the proposed model P17, L15: delete “in the” P17-18: the structure of the Discussion and Conclusion section is a bit strange, with two introductory paragraphs and a single numbered subsection P26, last line of the caption: “diameter” Figure 2: check if labels (B) and (C) are correctly placed; the caption is not consistent with the figure and does not explain what panel (d) shows P30, caption: no explanation of the difference between top and bottom panel is provided Figure 6: check panel

labels – now only (W), (I), and (D) appear as labels Figure 7: not clear what is the difference between red and black curves Figure A3: “bulk density” Figure A4: what are the numbers in brackets? Is the number of significant digits reasonable?

References

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