Biogeosciences Discuss.,
https://doi.org/10.5194/bg-2017-157-RC1, 2017


Biogeosciences Discussions
Open Access
EGU



# *Interactive comment on* "Hydration Status and Diurnal Trophic Interactions Shape Microbial Community Function in Desert Biocrusts" *by* Minsu Kim and Dani Or

**Anonymous Referee #1**

Received and published: 20 July 2017

In their manuscript, Kim and Or introduce a mechanistic biocrust model, which describes the functioning of biocrust communities with a special emphasis on carbon and nitrogen cycling within these systems. This is a highly relevant topic and the authors made large efforts to include many factors relevant in biocrusts. The results look logic and reasonable and will be relevant for many aspects of biocrust research. Nevertheless, there are some aspects of biocrust functioning, as e.g. leaching of nutrients, erosion processes and more complex N cycling mechanisms, which were not considered in the model and which at least should be mentioned/discussed in the discussion section. More detailed information on this is given below. Detailed comments: Page 2, line 10 ff.: "The settlement of photoautotrophic organisms is followed by other pho-



Printer-friendly version

Discussion paper

totrophic, heterotrophic and chemoautotrophic microorganisms". Here, the publication by Pepe-Ranney et al. may be considered, where settlement of non-cyanobacterial diazotrophic bacteria prior to cyanobacteria is described. C Pepe-Ranney, C Koechli, R Potrafka, C Andam, E Eggleston (2016) Non-cyanobacterial diazotrophs mediate dinitrogen fixation in biological soil crusts during early crust formation. The ISME journal 10 (2), 287-298. Page 2, line 26 ff.: Here, you should consider introducing the work of Porada and co-authors, where lichens and mosses as important biocrust compounds have been modelled, e.g.: Porada, P., Weber, B., Elbert, W., Pöschl, U. & Kleidon, A. (2013) Estimating global carbon uptake by lichens and bryophytes with a process-based model. Biogeosciences 10: 6989-7033. Porada, P., Weber, B., Elbert, W., Pöschl, U. & Kleidon, A. (2014) Estimating impacts of lichens and bryophytes on global biogeochemical cycles. Global Biochemical Cycles 28: 71-85. Porada, P., Lenton, T.M., Pohl, A., Weber, B., Mander, L., Donnadieu, Y., Beer, C., Pöschl, U., Kleidon, A. (2016) Strong weathering and climate effects of early lichens and bryophytes in the Late Ordovician. Nature Communications 7: 12113. Porada, P., Pöschl, U., Kleidon, A., Beer, C., Weber, B. (2017) Estimating global nitrous oxide emissions by lichens and bryophytes with a process-based productivity model. Biogeosciences 14: 1593-1602 Page 2, line 15 ff. and Fig. 1: The uppermost millimeters of a biocrust clearly differ from the rest, as e.g. the soil texture is finer etc.. It seems to me that this has not been considered, but on the other hand, the uppermost millimeter or two are shown in a different color. What does the different color imply? Please clarify! Page 5, line 18 ff.: Gas diffusion is most probably affected by finer soil at the surface and by extracellular polysaccharides (EPS). This at least needs to be discussed in a proper way as a potential source of error. Page 7, equation R3: The minus in CO32- needs to be written in superscript Page 8, line 15: As I understand from the later text, diazotrophic photoautotrophs, i.e. cyanobacteria capable of fixing atmospheric nitrogen are forming the first group. This has to be made clear. Page 14, line 21 ff.: The oxygen profile shows no major variation with depth or time of the day. I am quite sure that this does not reflect natural conditions in biocrusts under unsaturated water conditions, but that higher

oxygen contents occur in the uppermost millimeters of a biocrust during daytime. As stated above, multiple scientific results have shown that 1. Soil texture of biocrusts is much finer in the uppermost layer, and 2. There is a dense layer of EPS in the uppermost millimeters, both causing a constrained exchange of gases with the atmosphere. This definitely has to be discussed in an appropriate manner and should be improved in a follow-up version of the model. Page 14, line 24 ff.: It is hard to recognize a diurnal cycle in the nitrate profile in Fig. 4, as stated by the authors. This has to be clarified. It also does not become clear, why a nitrate accumulation below 4-5 mm should be caused by inhibited denitrification. One normally would expect this inhibition to take place at shallower depth, also due to the occurrence of oxygen. Please clarify! Page 15, line 7 ff.: Some things are striking in the distribution of organism groups along the profile and need explanations. First, there are only very few denitrifiers present and they occur at only ∼2-3 mm depth. This looks strange, as one would expect more of them occurring at larger depth. Second, there is a pronounced organism gap at ∼4-6 mm depth. Can you please give explanations for these features. Page 15, line 32 ff.: Although the simulation has been made for fully saturated water conditions, which indeed only rarely occur within biocrusts under natural conditions, I still expect it to more closely reflect the actual distribution and activity patterns in biocrusts with a dense surface especially contraining the gaseous surface exchange.

Minor issues: Page 1, Line 9: assemblies instead of assembly Page 1, Line 12: remove “the” Page 1, Line 18: remove comma Page 1, Line 20: include “the” -> protects the soil surface Page 3, line 22: Matrix potential instead of matric potential Page 12, line 13 ff.: This sentence is incomplete and needs to be corrected Page 12, line 26 ff.: Formatting of this sentence has to be corrected with regard to brackets. Errors like that occur also in other parts of the manuscript and need to be corrected. There are many, many more of these minor language issues. Thus, the manuscript needs to be thoroughly checked and corrected by a native speaker.

Interactive comment on Biogeosciences Discuss., https://doi.org/10.5194/bg-2017-157, 2017.