

Response to Referees' Comments : bg-2017-157

Hydration status and diurnal trophic interactions shape microbial community function in desert biocrusts

Minsu Kim¹ and Dani Or¹

¹ Soil and Terrestrial Environmental Physics (STEP),
Department of Environmental Systems Sciences (USYS),
ETH Zürich, 8092 Zürich, Switzerland

We thank the reviewer for the constructive comments and suggestions for the manuscript. In the following we provide a point-by-point response to all comments.

The submitted manuscript by Kim and Or titled Hydration status and diurnal trophic interactions shape microbial community function in desert biocrusts builds a mechanistic model to look biological, physical and chemical process under different environmental conditions (e.g., temperature, light and hydrations status) and their interactions. In addition, each of these processes and conditions was simulated under different spatial (e.g., soil column) and temporal (e.g., diurnal cycles) resolutions. Overall the study has put a great deal of effort to create a detailed model that captures the high variability found within a biocrust system. It is also apparent that the authors were thoughtful in the specific metrics they chose to include, and why others, while relevant were omitted. However, with this detail it appears complicated for the reader when identifying what was tested where and how it pertained to the results. I suggest a general conceptual diagram that ties the different biotic and abiotic variables simulated and how they are each related to help guide the reader to understand what was done and why.

We thank the reviewer for the encouraging comments and the constructive suggestions to improve the manuscript. Following the suggestion, we will introduce a conceptual diagram of the current work for readers. A draft for the conceptual diagram is shown in Fig. 1 in this letter. The figure summarises the processes we consider in the model together with variables and parameters involved.

GENERAL COMMENTS:

The abstract does not adequately demonstrate the results and conclusions of the study. By stat-

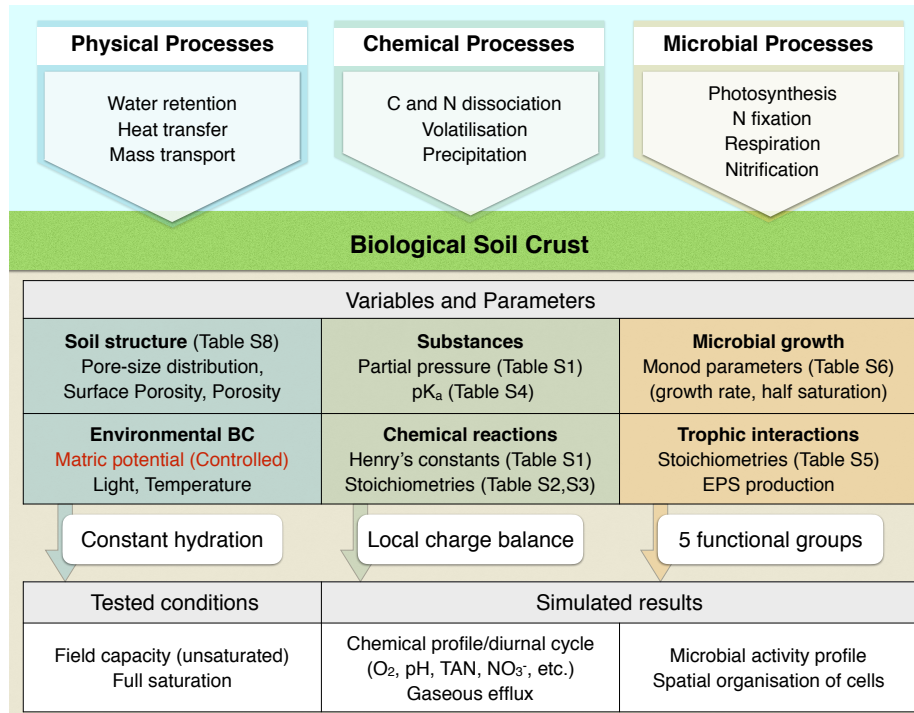


Figure 1: A conceptual diagram of the desert biocrust model (DBM) in this work.

ing “the model captures key features of observed microbial activity and distribution ...” and “new insights into the highly dynamic localized processes that shape biocrust functioning...” but don’t actually state what those features and functions are the reader is unable to grasp the main conclusions of the study and are left without much to work with.

We will revise and expand for clarity as suggested by the reviewer.

At the end of the introduction the authors state the organization of the manuscript. I think this is very useful and recommend expanding this further into a table that states the specific variables within the model and their different sub-variables. For instance, there could be a biological header and then the sub-headers could be the different main biological variables utilized. Then a chemical primary header and then perhaps an abiotic header with those variables underneath. Whatever format the authors choose, I think having a concise table of what is tested and what the general output would be could really help the reader. Additionally, by having this table the reader can refer to the equations presented in the text and see where they fit into the model in general. That said, if a robust conceptual model is included to better understand the interrelatedness of the variables this table could either strengthen the organization, or perhaps

duplicate it. I strongly feel a conceptual model would be useful, however defer to the authors if they want to present it in table form or some other visual, or both. The discussion does not follow a similar organization to the results. Having the uniquely different headers makes it difficult to return to where these findings (and discussions) were reported in the results. Where possible, I suggest having the results and discussion headers more closely follow one another.

We appreciate the detailed suggestions about the organisation of the manuscript. We will work on the manuscript together with the conceptual diagram (Fig. 1 in this letter, to be added in the revised manuscript) so it reads better in the revised manuscript.

MINOR COMMENTS:

- Pg 1 Ln 13: Remove “for” to read “... carbon covering over 70% of land...”
 - amended.
- Pg 1 Ln 17: An appropriate citation to be added: Rodriguez-Caballero, E., M. . Aguilar, Y. C. Castilla, S. Chamizo, and F. J. Aguilar. 2015. Swelling of biocrusts upon wetting induces changes in surface micro-topography. *Soil Biology and Biochemistry* 82:07111
 - The reference will be added.
- Pg 1 Ln 18: In addition to Chamizo et al. 2012, a newer citation to be added: Faist, A.M., Herrick, J.E., Belnap, J., Van Zee, J.W. and Barger, N.N., 2017. Biological soil crust and disturbance controls on surface hydrology in a semi arid ecosystem. *Ecosphere*, 8: e01691
 - We thank for introducing us a recent work! We will add the reference.
- Pg 2 Ln 13: In the later stages of succession the cyanobacteria are not necessarily “replaced” by other photoautotrophs as they remain in high abundance well into the late successional phases. I would remove this statement.
 - The sentence has been removed.
- Pg 2 Ln 28: The word “sketchy” does not feel appropriate for this context. Replace with something more universal such as “ ...sensitive ecosystem remain unclear.”
 - amended.

- Pg 2 Ln 28: The sentence starting with “Many field and laboratory studies...” does not make sense. Dont all studies rely on statistical analyses of the results to deduce impacts? Please reword or clarify.
 - We apologise for the unclear statement. We meant that there is a lack of mechanistic models of biocrusts. The sentence will be rewritten.
- Pg 13 Ln 14: I dont think “ingredients” is the best term to use. Perhaps “components”
 - amended.
- Pg 14 Ln 8-9: Because many of these cyanobacteria form sheaths that they can move up and down the soil column their abundance across a biocrust depth can vary depending on the light. Are you stating here that they decreased as you go down the column? I think a quick explanation how their movement across the soil column could warrant the projected organization would be helpful.
 - In the model, phototrophs were simply inoculated over the depth to follow light intensity with an exponentially decaying function. We note that this is only the initial condition and their distribution and abundance change during simulations following diurnal cycles until it reaches to a quasi-steady state.
- Pg 14 Ln 25: I would add occurred after denitrification.
 - amended.
- Pg 14: Ln 30: What do you mean by internal trophic interactions? Interspecies? Intraspecies? Within the community?
 - “internal trophic interactions” is rewritten as “trophic interactions within the biocrust community”.
- Pg 14 Ln 29 - Pg 15 Ln 6: These would probably fit better in the microbial methods section as opposed to the results section as they are descriptors of what you calculated rather than the actual findings of what you calculated.
 - We will move this part to the method section.
- Pg 15 Ln 13: state what figure number when say “green in figure” and the same recommendation goes for the rest of the text, when referring to a figure state the specific figure of reference.

- amended.
- Pg 16 Ln 1- 16: I really like the comparison of the simulated data with that of real world observations. However, the Garcia-Pichel and Belnap 1996 reference doesnt match the Garcia et al 1998 citation. Are these different studies? If so, I would site the Garcia-Pichel et al. 1998 in the text.
 - The citation in Fig. 7 was incorrect and the legend (not the text) will be corrected as Garcia-Pichel and Belnap (1996).
- Pg 16 Ln 11: Change from “quantitatively” to “quantitative”
 - amended.
- Pg 20 Ln 14: change “an hydrated” to “a hydrated”
 - amended.