Biogeosciences Discuss.,
https://doi.org/10.5194/bg-2017-413-RC1, 2017

Biogeosciences Discussions
Open Access
EGU

Interactive comment on "Uncovering biological soil crusts: Carbon content and structure of intact Arctic, Antarctic and alpine biological soil crusts" *by* Patrick Jung et al.

Anonymous Referee #1

Received and published: 30 October 2017

The manuscript entitled "Uncovering biological soil crusts: Carbon content and structure of intact Arctic, Antarctic and alpine biological soil crusts" brings a novel insight to the BSC structure. However, it seems to me that the manuscript was submitted in a rush. There are a lot of mistakes in punctuation and structure of the sentences. Furthermore, English correction is needed. Some sentences are not understandable and it is very hard to read the text. Not all references are listed. For example, Weber et al. 2016 is mentioned in the text, but not in the reference list.

Title.

You can trim the title simply into: Carbon content and structure of intact Arctic, Antarctic

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and alpine biological soil crusts

Introduction.

Page 1 Lines 25-26. The sentence is not well written. Please modify.

Page 1 Lines 29. Place a sentence connector. For example: Thus, plant cover is sparse as well as decomposition rates and biodiversity are generally low. Plant cover can be also moss and lichens which are sometimes very abundant. Here, you probably want to say vascular plant cover.

Page 1 Lines 29 - Page 2 Line 1. This sentence is too complex. It is better to divide it into two.

Page 2 Line 1. I don't think it is correct to write that instead of the vascular plants BSCs occur in polar and alpine regions. You can see vascular plants there and vice versa you can see BSCs in other types of environment.

Page 2 Line 2. The word "algae" is too complex because this term includes macro-, microalgae and cyanobacteria. Write something like eukaryotic microalgae.

Page 2 Line 3. You wrote that "cyanobacteria especially are important players within these intimate associations." However, the explanation why are they so important to compare to other organisms is very poor. For example, if you write about EPS, you can add that production of EPS promotes the stabilization of the soil surface, moisture retention, and protection against erosion.

Page 2 Line 13. Cryoturbation is a process, but not an environment. You can write: e.g., cryoturbated soils.

Page 2 Lines 8-9. It cannot be similar for green algae, because they have different functions to compare with cyanobacteria. Either write what is similar exactly or delete it.

Page 2 Lines 15-17. What's about other cyanobacteria contributing to C- and N- cy-

cling? Nostoc, for example.

Page 2 Lines 15-18. Provide references for 2d and 3d.

Page 2 Lines 20-21. Modify the sentence into: Therefore, a large proportion of important ecosystem services, such as erodibility (Belnap and Gillette, 1998; Bowker et al., 2008), soil formation (Rillig and Mummey 2006), soil moisture (Belnap, 2006) and C- and N- cycling (Shively et al., 2001; Tiedje 1988; Kowalchuk and Stephen 2001), are influenced by cyanobacterial communities.

Page 2 Line 24. Whose biomass?

Page 3 Line 1. I don't understand this sentence. Please clarify which carbon you mean here.

Methods.

Page 3 Line 27. and from 2 to 4 °C in July. Can you clarify in brackets what are frost days and what are ice days?

Page 3 Line 33. with a polar tundra climate in both?

Page 4 Line 2. "of" instead of "off"

Page 4 Lines 7-9. Either divide the sentence into several sentences or place the sentence connector.

Page 4 Line 19. Indicate the type of samples you collected: soil, soil crust or vegetated soil. How many samples did you collect.

Page 4 Lines 19-26. How did you choose the samples? Randomly?

Page 4 Line 27. It is not clear which part of BSC you chose. Surface or part below surface?

Page 5 Line 2. What type of chlorophyll?

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Page 5 Line 8. You should explain what is 530/30?

Page 5 Lines 10-11. How many centimetres?

Page 5 Lines 13-15. Either divide the sentence or place the sentence connector.

Page 5 Line 18. How the solution was prepared?

Page 5 Lines 22-23. Modify the sentence, it is hard to understand in the current state.

Page 5 Line 26. although they are BSC organisms.

Page 6 Line 1. and available online.

Page 6 Lines 1-3. Use the past tense as you started to use in Method section.

Page 6 Lines 6-7. Correct the sentence. It is not well written.

Page 6 Line 6. You have already used the word voxel in previous sentences (F.ex.: Page 6, Line 2). You should put explanation of abbreviation at first time you use this word.

Page 6 Line 7. Take care of the tenses you use throughout the text. If you use past then use it everywhere in the methods.

Page 6 Line 11. How do you visually estimate it? Sometimes you cannot see small microalgal or cyanobacterial cells by eyes.

Page 6 Lines 11-13. Again, the sentence is not well written. Modify it.

Page 6 Line 23. Normally distributed data or data with normal distribution.

Results.

Check the tenses you use here. It should be either past or present tense.

Page 6 Lines 28-29. Check punctuation throughout the manuscript including these two lines.

Page 6 Line 30. Since you write about EPS here, maybe it would be useful to indicate it (for example with arrow) in the Figure 1.

Page 7 Lines 1-2. Divide the sentence into two.

Page 7 Line 3. You write that Nostoc is found on top. I see on the figure 3 that white triangles are in the upper layer but not on the top. Also from the figure it is very hard to understand where exactly the surface of BSC is. Maybe you can show that. Also on the figure 3 you indicate Nostoc. However I don't understand the way you decided that it is these cyanobacteria. Especially Fig 3b.

Page 7 Lines 7-8. Delete this sentence. You have already mentioned it.

Page 7 Lines 11-12. Correct the sentence. For example: The highest values range between 25 and 40 mg C cm-3 in all soil crust samples.

Page 7 Lines 18-19. Divide the sentence into two sentences.

Page 7 Line 20. The sentence is too complex and it is hard to read.

Page 7 Line 22. Here you talk about bryophytes but I don't see bryophytes in the Fig. 6 where you show who is responsible for total organic C.

Page 7 Lines 23-24. I don't understand the sentence. Cyanobacteria occupy 7-23% of BSC in general? Or BSC organisms?

Page 7 Line 25. accounted instead of differ

Discussion:

The discussion can be trimmed. Some information is not so important for this manuscript. For example, the paragraph (Page 8 Lines 25 – Page 9 Line 11) is too long and could be trimmed. I also feel that discussion is mostly focused on the results obtained from Hochtor. Maybe you should also discuss a bit more arctic and Antarctic BSCs.

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Page 7 Line 27. You applied CLSM, to measure what?! Add in this sentence.

Page 7 Line 30. Which is instead of this is.

Page 8 Line 1. You have already mentioned in the beginning of the discussion that you used CLSM for the first time. No need to repeat it again.

Page 8 Lines 9-13. This sentence is too long. It is hard to read.

Page 8 Lines 19-20. Was it detected somewhere else or only in Hochtor? This sentence is confusing. Was it found in your study? Or it was found only in Budel et al., 2014 and Peer et al., 2013?

Page 8 Lines 22-24. Write something like this: Interestingly, Büdel et al., (2014) showed that within the microbiome of BSC from Hochtor, cyanobacteria contributed only 1.6 % to the total bacterial diversity, whereas we show that cyanobacteria occupy 20 % of space within the crust.

Page 8 Line 24. Can you write a sentence with a small conclusion coming out of this finding.

Page 8 Lines 26-27. Which literature exactly? Put references.

Page 8 Lines 27-28. You write that light regime could be a responsible factor for the differences in the crusts thickness. However, in this sentences you point that light conditions are similar for all studied srusts.

Page 8 Lines 29-30. Reference?

Page 8 Line 34. Therefore

Page 9 Line 13. cyanolichen, chlorolichen and bryophyte crusts

Page 9 Line 16. Better not to use a colon. Rather start a new sentence.

Page 9 Lines 21-24. Reference?

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Figure 2. I don't see the point to show Fig 2a and 2c. It is clear from the text that the green algae don't have phycobillins.

Figure 5. Can you present Depth scale in mm. It would be easier for the reader. The legend of the figure is too long. I see this text already in the results.

Figure 6. The same here. The legend is too long and should be trimmed. Inorganic carbon instead of anorganic.

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