

## ***Interactive comment on “Microstructure and hydraulic properties of biological soil crusts on sand dunes: a comparison between arid and temperate climates” by T. Fischer et al.***

### **Anonymous Referee #1**

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#### General:

The paper presents about some key physical and hydraulic properties of BSCs from two different sites. Such differences are expected, which is reported here. However, several such hydrological studies have been reported in the literature (see review by Belnap 2006 in Hydrological Processes titled ‘The potential roles of biological soil crusts in dryland hydrologic cycles’). More comprehensive analysis of micro-structure has also been reported by many workers. The authors have to underpin the importance of this study (what is novel here?) with the literature. Having said that, the paper can be substantially improved by incorporating major problems I found, which are given

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#### here:

Title: This is misleading/vague and it should be changed to something like: ‘Comparison microstructure and hydraulic properties of sand dune Biological Soil Crusts from arid and temperate climates’ (just an example only).

Introduction: It is rather vague and confusing. It is missing key literature. For example Belnap (2006) has given a comprehensive review on the problems investigated in this study. Another example is on microstructure studies by Menon et al (2011, J. Hydrology) using X-ray tomography. There is no detailed account on why this study was necessary and key idea of selecting these two sites? What is novel here has to be pointed out.

Methods: Many concerns here-

1. Sampling was done different times (in Nizzana in 2009 and, Lieberose in 2010 and 2011). Any particular reasons? For sampling performed in 2010 and 2011, how do we make sure that conditions in the field are not changed?
2. Slope of these sampling sites not given. Looking at the images presented, it is really different. This is important factor for interpreting your results. Sites should be compared based on this.
3. Prevailing weather conditions at the time of sampling? What is the prevailing wind direction? Any particular weather events occurred prior to the sampling?
4. Why east-facing dune was selected for one site and north-facing slope for the other site? This is very critical in crust development. Inconsistency in sampling/method would lead to misinterpretation of the data.
5. Some sentences are repeated for each site (e.g. the samples were cut into.... measurements).
6. Replications are very few (at times only one!) as given in section 2.1 and this is one

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of my major concerns and considering the heterogeneity of BSCs, two replicates are absolutely not enough. It is not clear what these replicated samples were used for! I see variable number of replicates is used in each test (section 2.1, 2.2 and 2.3). Please make it clear in the manuscript.

7. What was the average thickness of the crusts at different positions of the slope at these sites?

8. Why uncrusted areas were sampled/ not taken as control in each study site? Possibly you could explain difference you observed with this data. Again refer back to the issues raised by Belnap (2006) in doing hydrological observations.

9. It is not clear where the micro-infiltration was done (field or lab?) and how it was possible to do this test on a fragile surface? Could you elaborate on this? In my experience, it was very difficult to do without breaking it.

10. Statistical analysis. I am not familiar with some of the tests you have used here (Tukeys HSD, Shapiro-Wilk test etc). For the benefit majority of the readers, it would be nice to elaborate why these tests are used and what for. Some references may be provided as well.

11. Micro-structure images are interesting and I wonder why you have not reported porosity from this data? Also insert a scale bar in those figures showing SEM images

12. Hot water extractable carbon (to measure EPS) would have helped to interpret some results

13. What was the rationale for measuring chlorophyll and plotting along with WHC data on figure 9?

I recommend inserting a table for comparing site characteristics than given in the text format.

Discussion: missing key literature here (see reported studies in Belnap 2006 review on

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the effect of slope, climate factors etc). I would focus the discussion on catena to start with and provide summary of key differences between two sites afterwards (again a table would help!). These two sites are too different (including crusts biodiversity) and without measurements on non-crusted controls at each location, I am not sure that a comparison of hydrological characteristics of these two sites giving us any valuable conclusions on the role of BSCs on hydraulic parameters.

The paper can be accepted with major revision/possibly with additional data (more replicates!) on hydrology at two sites but with similar slope and orientation.

Good luck!

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