

***Interactive comment on* “The CO₂ exchange of biological soil crusts in a semiarid grass-shrubland at the northern transition zone of the Negev desert, Israel” by B. Wilske et al.**

Anonymous Referee #1

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This paper represents a lot of work and certainly addresses an area where more information would be valuable but I would have difficulty recommending it for publication at present for several reasons.

First, the actual measurement system is curious in that any particular sample is measured against one of the so-called controls. It is difficult to see how this does anything except introduce errors. The gas exchange of a sample can be measured on its own and then one gets the net CO₂ exchange for that sample. Instantaneously measuring it against another sample simply introduces a subtraction error from that sample. I cannot find a justification for this methodology in the paper.

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Second, it would be better if the authors could stick with one set of units. I find instantaneous rates in $\mu\text{mol m}^{-2} \text{s}^{-1}$, and also per 15 h and per 24 h. It would be much easier to follow if the actual measurements in daily cycles were in $\mu\text{mol m}^{-2} \text{s}^{-1}$ and then the actual net uptake or loss can be calculated on longer time spans, per day would be obvious, why 15 h I am not sure. In the section on flux triggering the units $\mu\text{mol m}^{-2} \text{s}^{-1}$ per 100 $\mu\text{mol m}^{-2} \text{s}^{-1}$ PAR are used and I do not understand this at all. Why not simply quote actual maximal rates. Better units would make the paper much easier to follow. There are obvious difficulties in extrapolating from point measurements to daily and seasonal net exchanges and the authors are aware of this. However, why not summarise the problems and how it was done at one place and not mention it several times.

Terminology The use of the words emission and deposition (in particular) is curious. Deposition is incorrect and should be replaced by uptake, and emission by loss. The abbreviation LTER for the research site is also confusing. As far as I can see it is not an LTER (see LTER pages on web) so perhaps LTR might be better. The phrase soil-dwelling BSC seems unnecessary, is there any other type? The format for time 00:00 to 15:00 means from midnight to 3 pm, but I am not sure this is what is meant in the paper. If it is a 15 hour period it should simply be written as 15h. Section 3.2, Flux triggering sounds great but is really incorrect, fluxes are always present but sometimes with a value of zero or below detection level. Flux dependency is better, perhaps. To put it another way, fluxes are not triggered by light, if the light is removed then one gets loss rather than uptake.

The long sections on the effects of water should be rewritten so that they are much shorter and more clearly state what was found. Fig 4, the regressions and symbol description should be put into the captions. Why no line for 15o and why no R² when they turn up elsewhere. The figure is a little confusing as well, are these light response curves or? Fig. 5, The R² in this graph are very low for many lines, if below 0.5 then the line is best left out as it has little value in predicting results. Fig, 6, this can be left

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out, it is a presentation of correlations that can be put into the text. I suspect it could be better presented and I am not sure what the correlation with frequency means. It is not possible to write about annual patterns because the investigation only occupied part of a year. If the authors want to address annual patterns in the results then perhaps the section right at the end of the discussion should be brought forward in order to better justify the concept. The space allocated to these topics in the results and discussion are somewhat long. This does not detract from the results which do look good. In the discussion it is odd to me that efflux is discussed first when perhaps either the daily cycles or the net carbon gains might be a more interesting start. To me, the discussion could be better organised and much more directed, also briefer. Overall, I personally found the paper hard to follow because of the curious terminology, the lack of clear focus in some sections and the mixture of units. I really suggest that it be rewritten carefully separating the instantaneous results from the calculations of net CO₂ exchange.

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