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Interactive comment on "Patterns of longer-term climate change effects on CO_2 efflux from biocrusted soils differ from those observed in the short-term" *by* Anthony Darrouzet-Nardi et al.

Anonymous Referee #1

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The study presented by Darrouzet-Nardi et al is an improvement of preliminary results obtained at shorter time span. They analyzed Net Co2 fluxes on soils covered by biocrust under different climate change treatments (warming, watering and a combination of both). They found that these treatments exert a significant effect on CO2 efflux, as consequence of biocrust loss and changes in composition, with important effects on drylands C balance. Overall the manuscript is interesting and well written however there are some points that I would like to discuss before I recomende it publication in Biogeoscience. To correctly contextualize these results, it could be necessary to compare temperature and watering effects with climatic predictions obtained by the different IPCC scenarios. Moreover, I would like to emphasize the potential effect OC

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and especially soil labile organic matter on soil respiration. Large effort has been made to explain the potential effect of roots respiration however I recommended talking about soil respiration (including roots, microbial, and other heterotrophs) and the relationship between soil C pools and rain or water pulses (see Lopez-Ballesteros et al., 2016). Watering may promote microbial and decomposition of dead biocrust organisms, with a depletion of labile OC in latter stages (by the cumulative effect of several water pulses, that did not occur in control plots. Moreover, the authors only analyze Net CO2 fluxes but they mention photosynthesis and respiration pulses within the result section (see line 184), I recommended changing it by Net CO2 fixation or release but not respiration and photosynthesis since there is no partition between these two fluxes. Maybe 9 years are not enough for the analysis of a natural (non-induced by the treatment) climatic trend. But I would like to see an exploratory analysis of current climate trend (at least during the study period). This could help to identify any trend in temperature or precipitation that could act in a synergistic manner with experimental treatments Methods section should be improved. There is a reference to a previous study with further details; however there are some key questions that should be explained in the docuemnt: i) I understand that there are a total of 20 plots (5 per treatment). Is it correct? ii) Were biocrust community composition, biomass and coverage of all plots comparable at the beginning of the experiment?. ii) "Water was added in 1.2 mm events manually with backpack sprayers and was applied 40 times from May 31-Sep 20, 2006 and 36 times from June 14-Sep 20 in 2007, with an average time between watering of 2.8 days (Table 1)" According to this sentence, water was added in 2006 and 2007. However as you explain watering was stopped in 2012. Even taken in to account that 2008-2009-2010-2011 were not included in this analysis, this information should be included as it is expected to affect NEE measurements at 2013 and 2014. Did you expect that this could have some effect on respiration patterns observed on 2013-2014. iii) Was the size effect of early warming, watering, and combined treatments on NSE calculated from the random forest models? It is not clear in the clear in the current form. Did you analyze significant differences between treatments?

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Some other suggestions Introduction could be better structured by: i) better description of biocrust communities, ii) Firstly describing the importance of drylands in global C fluxes in a context of climate change and then biocrust importance in these ecosystems. Doing this some sentences that are not clear could be better explained (see lines 44-48) Lines 54-58: did you considered the effect of water availability on both process? Positive and negative C fluxes are relative, I would recommend to use C gain and C losses or emissions Fig 2: It could be interesting to show a control plot as figure 2.b. moreover, natural rain pulses could help Fig 3: Are differences significant?

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