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Interactive comment on "Passive soil heating using an inexpensive infrared mirror design – a proof of concept" *by* C. Rasmussen et al.

Anonymous Referee #3

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The note "Passive soil heating using an inexpensive infrared mirror design – a proof of concept" by Rasmussen et al. describes a new innovative way of heating the soil surface and subsurface using infrared mirrors. The authors describe a step by step improvement of the experimental setup by adjusting mirror angles and the number of mirrors to increase soil temperature by simultaneously reducing artificial soil cooling. The setup was tested on 3 different soil types in Arizona at the Karsten Turfgrass Research Facility. It was convincingly shown that bare soil temperatures can be increased up to ∼7oC. The increase in temperature is however dampened by increased soil moisture and increased humidity. However, the presented experimental setup seems to be a good initiative to make future warming experiments easier to maintain and more cost effective. For a wider usage of mirrors as alternative to currently existing meth-

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ods across ecosystems, the system however needs to be tested on soils inhabited by plants to evaluate if the degrees of warming can actually be achieved under naturally occurring conditions.

Abstract - P428, L1-2: “climate warming” appears twice in one sentence, please be precise. - P428, L9: how do you know that it is suitable for low canopy vegetation as you only tested the mirrors on bare soil? Same in the discussion section p438. - P428, L9: what is several soils? State number of soils and the broad spectrum to give the reader an idea about the system you’re talking about. - P428 L13: it would be relevant that you also induced potential cooling and that you, despite the cooling, still found an overall heating effect of 4-6 degrees

Introduction: - P430, L2: your second experiment is in mesocosms, that’s not field conditions. Please add information.

Materials and Methods: - 61x61 cm is fairly small, especially when you want to justify that studying biogeochemical cycling in soil due to warming needs to be addressed. Please add the reason for this relatively small area. - P431 first paragraph: the explanation of location and climate overly detailed. Would a summary table for all studied sites be an option? - P431, L28: refer to Table1 and Fig 1. - Section “initial field trials”: how many plots did you measure? One control and one mirror treatment? Or more? Please add information. - Please add the same information for the replicated plots – was n=2, or 3 or?? It’s relevant for the statistics in any case. - P432, L27: you mention mirror treatments for the replicated plots. Though, you don’t show any results for this. Please either add results (if relevant) or, remove that you did the mirror tests here too. - P433, L4: what is LPSA? - P433, L12: what information gain did you get from the “volumetric heat capacity”? Anything useful to conclude from? Please add in discussion. - P433, L24: Why did you measure “surface soil temperature” at 1m height? Do you mean 1 cm? - P434, L6: - do you mean a one-sample t-test? And if so, would your H0 be that deltaT is different from 0? If so, why would you not do a two sample t-test where you have the control and mirror plots as sample population each? If I interpret

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this wrong, please clarify in the text. - P434, L8: “soil treatments” – do you mean soil types? Or did you treat the soils differently? - P434, L10: you used a simple one way t-test – same as above. Though, would you not expect soil type and water content to interact? In that case, an ANOVA would be more appropriate. Further, are the data normally distributed with equal variances to do a t-test? - What statistic software did you use?

Results: - P435, L15: please specify that the results you’re quickly presenting/concluding on here are from the replicated plot experiment – it’s a bit confusing otherwise. - P435, L21: is the 2300 a time, or a number of hourly readings? Didn’t you mention before that you conducted readings every 15min? - P435, L21: 64-67% of the measurement period resulted in soil warming. The remaining 46-43% - how much of this was deltaT=0 or cooling? - P436, LL12-14: you conclude that the mirrors were most effective under conditions – can you follow up on this point in the discussion and add what you think in which ecosystems these mirrors could actually be really helpful and where not (based on humidity and rain patterns) - P437, L7 onwards: would this be the paragraph to say something about volumetric heat capacity instead of mainly discussing water content? – you draw a big conclusion from about the effect of heat capacity, but I miss a bit of background for someone not familiar with the soils and measurements per se.

Discussion: Further possible points that would be valuable to address: - Plot size limitations? What would be the biggest plot being warmed with these mirrors without too big artefacts? - What would be a further step for improvement? - introducing vegetation as well? warming bare soil is a good first trial but vegetation will automatically keep moisture and higher humidity in the sub-canopy would occur, influencing the results towards cooling? Any assumptions from the trials? - Who would be interested in small plots? - can this be up-scaled to biologically/chemically relevant scales?

Figures and Tables Table1: - could you extend the table for the % of cooling – just to get an idea about the method - subscript b: “significant differences” – are these

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the differences between mirror treatments or different from deltaT=0? Figure2: add information that this information resulted from your trial experiment. Figure3: - add information that these results are from you replicated plot experiment. - Can panels c and d have the same y axis scale? - The precipitation bars coming from the tope are unconventional. Figure4: - Are all the plots necessary? It seems one of them would be enough to make your point. Rest can go into a supplement? Figures5 and 6: - Can you put this data in a small table instead? Or add to table 2.

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