

Interactive comment on “The amount and timing of precipitation control the magnitude, seasonality and sources (^{14}C) of ecosystem respiration in a polar semi-desert, NW Greenland” by M. Lupascu et al.

Anonymous Referee #2

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The article by M. Lupascu et al. considers the control of the amount and timing of precipitation on the magnitude and seasonality of C-14 sources at a semi-desert site in NW Greenland. Although the premise of small precipitation events leading to the release of C-14 is an interesting conclusion, I think the article could do with a better statistical analysis, more figures showing the driving environmental parameters, and quite a lot less clutter as the paper tends to bog down in obvious remarks. For example, the author mentions in general that snowfall and rainfall drive soil water content, which is incredibly obvious. More such general statements abound in the

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paper, and should be removed to reduce the amount of reading needed to get to the point. The main point of this paper is the release of old carbon during small rainfall events. Focus on that, and remove all the trivial information and speculation. I also noticed that the discussion mentions many things as ‘likely’ without giving more evidence than a citation. Don’t confuse likely with possible!

I, therefore, suggest a major revision that cuts down the amount of unnecessary information in this paper, with a stronger focus on the core message of precipitation and old carbon release.

Main remarks:

page 2465, you measure Reco and soil concentrations in the middle of the day, when soil temperatures are arguably the highest. How can this represent daily mean Reco?

page 2465, line 23-25: How many replicates of these stainless steel gas wells were installed per treatment? Is there a possibility that the variability within a plot is greater, or just as great, as within plots and treatments?

page 2470, line 5-6: why aren’t these episodic cold snaps displayed in Figure 1? Or better still, add a separate figure that shows precipitation, soil water content, active layer depth and temperature, so the environmental drivers can be better understood by the reader.

page 2470, line 11: why is there an error estimate of ± 0 percent? This does not make sense and can’t be true. Were there no replicates made? How significant is your comparison between treatments then?

page 2470, line 12-13: When looking at table 3, I don’t see significant differences between the different treatments. It’s only obvious that they’re all higher than the control, but otherwise there’s too much variance. The \pm percentage values being mentioned here do not correspond to the variation I see in the table.

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page 2474, line 22-24: isn't this just because the active layer is shallow, and profiles deeper in the ground are still frozen? The reader can't check this, because no active layer measurements are shown! Please provide them!

page 2477, line 21-24: this means that you can't say that these water pulses are a control on old carbon release. What is described here, is that C-14 is released by these water pulses, but this may just be C-14 that was already built up. There is no proof that these water pulses increase e.g. the respiration of old carbon from the soil. Perhaps it's just a modulating effect. This should be much more stressed in this article.

page 2478, line 3-5: closing a chamber for 24 hours is incredibly long! What is the effect of this on the C-14 that's being measured? Aren't you introducing artificial heating, which leads to more respiration, possible with a different C-14 signature?

page 2478, line 13-14: likely because of water pooling on the permafrost table? was the water table measured? Don't guess! Show! Otherwise, it's 'possible'. Not 'likely'.

page 2479, line 1: this study does not show anything about the stability of old carbon! It just shows that old carbon is released in different quantities following rainfall. That's a variation, but no proof is presented that this leads to more release of old C. Additional rainfall events may release lower amounts of CO₂, but the magnitude of Reco fluxes was not measured together with the C-14 measurements, so this is unknown.

page 2491, table 3: does the n.a mean that there were no replicates being done that summer? How can you compare in between treatments if the variation within a treatment isn't known?

page 2494, figure 2, middle panel: at some depths measurements are missing for some treatments. Nonetheless, the concentrations at depth are connected by a straight line, making them seem comparable to other depths, while they are not due to the missing data!

Some additional remarks:

page 2461, line 3: ice-free Arctic: do you mean the high Arctic? And I assume

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just the terrestrial part? This is not clear.

page 2461, line 20: please cite the new IPCC report.

page 2463, you say the site is located near Thule Air Force Base. This could mean that a lot of disturbance has taken place in the vicinity. How certain are you that the site is undisturbed? If not, how does that affect your measurements?

page 2464, line 4: why denionized water? Thule is a coastal site, and the precipitation is not going to resemble deionized water. Besides, nutrients such as DOC are not necessarily removed through simple deionization. This could still lead to a fertilisation effect.

page 2464, line 23-24: saying that a trend is significant when it exceeds 1 standard deviation is not statistics. One large outlier in your data could falsely represent a trend. Please use pearson-r correlations with associated p-values to indicate the significance of the trend.

page 2465, line 22: I assume the data from the arrhenius relationship is only used to estimate seasonal budgets, and are not shown in Figure 1?

page 2465, line 27: these wells remained in the ground. Were they not damaged or disformed due to freeze-thaw actions?

page 2468, line 6-7: f_{air} could be explained a lot better. Currently it's not clear what's meant by it.

page 2468, line 13-14: why do you only look at trends including the last ten years? Why not a trend per decade? Or even better: plot the data in a graph, so the reader can actually see that there is a trend. At the moment, these trends can be completely dominated by a couple of years of high precipitation in recent years, which is not necessarily a guarantee that this is something ongoing and consistent.

page 2469, line 8-11: this is incredibly obvious! of course soil water content is driven by precipitation patterns and irrigation. Why mention this at all? One sentence saying that your irrigation didn't influence irrigation patterns is all that's of relevance in this paragraph.

page 2470, line 6-7: it's not surprising that SWC is negatively correlated with Reco.

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A higher soil water content reduces the amount of pore space filled with air, thus less oxidic environments, and less respiration can occur.

page 2471, line 15: again, this is obvious. Of course vegetated areas will have younger C, as plants put fresh carbon into the soil.

page 2473, line 10: not just irrigation, but warming itself also raises Reco. Actually, all treatments raise Reco by approximately the same level! Why is that?

page 2473, line 16: again, it would be good to show more environmental parameters, so the reader can see for themselves that temperatures decrease following rainfall.

page 2473, line 19: does your soil water content show that it was drought stress? Don't guess, show it!

page 2474, line 1-6: this is again very obvious, as it has long been known that respiration is driven by temperature. This is general knowledge.

page 2475, line 1-2: again, isn't this just to do with the development of an active layer? The soil has to thaw first before processes can start.

page 2475, line 5: why would CO₂ production be stimulated by small precipitation events?

page 2476, line 18: is this likely or are you guessing?

page 2478, line 23-26: so in other words, the contribution of old C is low.

page 2491, table 2: please show the temperature and precipitation also in a graph, so the trend can be visualised.

page 2491, figure 1: like said before, it would help to have some environmental parameters plotted in the same graph to show the temporal variation of those in relation to the numbers presented here

some spelling improvements:

page 2460, line 16: 'extend' should be 'extent'

page 2462, line 19: 'microorganism' should be 'microorganisms'

page 2464, line 4: 'through the end' should be 'through to the end'

page 2465, line 26: please change "allowed and remained" into 'allowed for it and these remained'

page 2466, line 14: 'that in' should be 'that of'

page 2467, line 22: 'graphite is measured with accelerator' should be 'graphite was measured with the use of accelerator'

page 2470, line 9-10: 'relative to control' should be 'relative to the control'

page 2476, line 23: 'periods is not' should be 'periods are not'

page 2477, line 4: 'described described' should be 'described'

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