

Interactive comment on “Net ecosystem production in a Little Ice Age moraine: the role of plant functional traits” by E. Varolo et al.

Anonymous Referee #1

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The introduction overall sets the scene for the research quite well. Yet, in its current stage, I miss a little bit of a narrative. Often, facts are following each other without a clear connection of the sentences. Take for example the section in lines 20–28 on p.10274. The message is very complex and hidden in the summation of facts. In a very condensed space, plant–soil interactions and functional traits are introduced, as well as the concept of scale dependency. The paragraph ends with a statement on small–scale difference being more important than broad–scale differences, yet I wonder what that refers to: functional traits, the physical environment, the C sink capacity, or all. Further, I think the citation to Reichstein needs some more context.

The manuscript is rather interesting, and I think it would make an interesting contribution, especially in the light of colonization of harsh environmental like glacial forefields.

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That said, I have some worries which deal with the concept of the CAM metabolism and the temporal separation of photosynthesis and CO₂ fluxes, which cascades to the conclusions (difference in light constraints between C₃ and CAM plants). I have the feeling the authors are mixing fluxes and photosynthesis. In C₃ metabolisms these are related, but in CAM they are temporally separated. Perhaps the authors can fix this ambiguity in their manuscript.

Method and assumptions: The first and second paragraph describing the methodology of the NEE measurements seem a bit ambiguous. NEE was measured using a LiCor with eight chambers, equally divided over transparent and opaque chambers. A bit later it is described that the S and F plots are replicated five times, making ten plots in total. Apart from the fact that NEE dark and NEE light are measured at different times, which I can see is difficult to avoid, I also interpret that there is a temporal distribution in the measurements in NEE of the replicates within and/or between the plant types. Perhaps I misunderstood the set-up; did you use more gas analysers? In case not, how did you correct for potential changes in time (climate, PAR, etc.) between sets of measurements. More information is needed! On that note, I wonder how the 2012 was treated to serve to compare the daily courses of NEE in S and F plots, as stated in the first sentence of the ‘data analysis’ chapter.

Flux calculations: linear regression was used to calculate fluxes. Did you check if the evolution of carbon dioxide in the chambers followed a linear pattern? See Kutzbach, L., Schneider, J., Sachs, T., Giebels, M., van den Hoven, H.N., Shurpali, N.J., Martikainen, P.J., Alm, J. & Wilmking, M. (2007) CO₂ flux determination by closed-chamber methods can be seriously biased by inappropriate application of linear regression. *Biogeosciences*, 4, 1005–1025.

Light response curves: I have the feeling we are facing a conceptual complication here (underpinned by the authors statement that CAM photosynthesis is performed at night [10281 / 6]). In CAM metabolism, essentially carbon dioxide fluxes and photosynthesis are temporally separated. CO₂ uptake takes place in the night and is stored during

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as malate. During the day malate is decarboxylated after which it is subject to photosynthesis. NEE would as such also not depend that much on light, but on the vacuole storage capacity.

Novelty of the study Generally, I feel the questions asked are rather interesting. I wonder however how correct the statement is about the apparent absence of studies dealing with flux measurements from within-ecosystem plant communities(two studies immediately pop into my mind: Ward et al. (2015) Vegetation exerts a greater control on litter decomposition than climate warming in peatlands. *Ecology*, 96, 113–123. Ward et al. (2013) Warming effects on greenhouse gas fluxes in peatlands are modulated by vegetation composition. *Ecology Letters*, 16, 1285–1293). Certainly the question regarding the differences between ecophysiological pathways, and if ecophysiological processes are subject to different environmental variables, is interesting. It however comes a bit out of the blue, and I feel in the introduction the authors should put more focus on the comparison of the C3 and CAM vegetation. How do these communities differ, and as such why is it important to know if they respond differently to environmental change?

10273 / 10 See Bardgett et al. (2007; Heterotrophic microbial communities use ancient carbon following glacial retreat. *Biology Letters*, 3, 487–490) for a mechanistic explanation on soil/substrate formation after glacial retreat.

10272 / 22–23 There are two things I think the authors need to be more careful with. First, the used reference discusses the use of Eddy covariance techniques, not how to assess carbon budgets. Second, an important part of the carbon budget, especially in these dynamic ecosystems, comes from DOC and DIC and should be taken into consideration. [this is basically addressed one sentence later].

10273 / 10–13 The way of referencing would suggest that the Laine paper deals with plants with different photosynthetic pathways (C3, C4, CAM). Their study has been performed in peatlands, with only C3 plants; indeed they used different plant growth forms.

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10276 / 23–26 I guess this is better: ... a pioneer grassland community, dominated by, is present, and covers about 35% of the surface area.

10279 / 11–12 what was the volume of the soil samples? It is a little strange to say that the soil samples were separated from the root; better: Course roots(> 2mm) were separated from the soil.

10280 / 6 so, the time unit is dropped in your NECB calculation? Why do you not simply call it the ecosystem carbon content?

10282 / 17–19 repetition of what is shown in Table 1. Should it not be noted that that the isotopic signature of the S biomass does not show full CAM metabolism? Many CAM plants can function in a C3 mode when water is available. Do you know how this is for *Sempervivum*? In Table 1 caption, what sense does it make to indicate what the significance code means when the numbers are presented in the table?

10282 / 20–21 I do not understand what the authors mean with 'spatial variability was similar for all plots belonging to the same vegetation'? How was this tested? There seems to be quite some variance between the plots, especially for *Festuca*! In Table 2, do positive NEE values indicate net loss of C (as in Fig. 2)?

10283 / 14–15 vs. 22–23 How do these two sentences relate? First NEE dark fluxes show similar trend, then they are different! If you intend to say that the trends are different between NEE dark and light measurements, to me that is a rather open door! Perhaps I miss the intention of the last paragraph.

10287 / 15–16 This is a one-sentence paragraph.

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