

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 #3

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The manuscript presents a very interesting study about the different physiology of two plant communities living in the same environment. The novelty of the study concerns both the species and the remote investigated ecosystem, that is a glacier forefield. The authors found an interesting within-ecosystem variability in CO₂ fluxes related to the C uptake capacity and the specific metabolism of the two species. I overall think these results could provide an interesting contribute to the CO₂ fluxes and the alpine ecology communities

Nevertheless, I think that the manuscript still need some work to improve the clarity of the main message, the grammar and the text readability. The main scope, i.e. the comparison of the two metabolisms is confused by too many details in both the introduction and materials and methods sections. In details, the introduction section lacks

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clarity, the reader can catch the story but the sentences and paragraphs are not well merged. The complex metabolism of the CAM species should be better introduced, to help the later reading of the results.

Specific points

- I think there is a bit of confusion about the role of source/sink strength of the two ecosystems: the role of sink or source of an ecosystem should be referred to a defined timespan. Here, NEE is measured only during the vegetative period, specifically four months. Lacking the off-season measurements the authors should be more specific about the terms sink and source and better discuss that it refers to the four months period, since for example on a annual basis also the grasses, which is a very weak sink on the summer period, could act as a source. For example at 10272/l.20 "the grassland acted mainly as a carbon sink with a total cumulated value of $-46.4 \pm 35.5 \text{ gCm}^{-2}$ " on which time span? The authors should specify that this value refers to a 4 months period otherwise one can think that this is an yearly cumulative.

-The abstract should be shortened, I suggest to introduce less details, the reading is not fluent and the last sentence (10273/l.1-4) could be removed.

-In the Methods section, even if simple in principle, the flux partitioning was not described. Moreover, I think that the use of a negative GPP in the figure 5 is unusual and confusing, since the authors then used a positive GPP cumulative (page 10286). I suggest to use a positive GPP also for figures

-In the Results section the separation of results from the 2012 and 2013 experiments is not completely clear e.g 10284/l27

Minor edits:

-10272/l.5-"In this study, using a comparative analysis of the C fluxes of two contrasting vegetation types, we intend to evaluate if the different physiologies of the main species have an effect on Ecosystem Respiration (Reco), Gross Primary Production (GPP),

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annual cumulated Net Ecosystem Exchange (NEE), and long-term carbon accumulation in soil." change with -"This study, uses a comparative analysis of the C fluxes of two contrasting vegetation types, to evaluate if the different physiologies of the main species have an effect on Ecosystem Respiration (Reco), Gross Primary Production (GPP), annual cumulated Net Ecosystem Exchange (NEE), and long-term carbon accumulation in soil."

-10273/l.7 -"The Alps are particularly vulnerable to climate change and it has been estimated that since 1850, glaciers in the Alps have lost half of their total extent" remove "it has been estimated"

-10273/l.9-13 some repetitions, these paragraphs should be shortened and more fluent

-10273/l.19-20 many passive forms can be converted into active ones such as: "To date there have been few studies that analysed the carbon budget in the glacier foreland and there is a large uncertainty about the role..." change with "To date few studies analysed the carbon budget in the glaciers foreland and a large uncertainty exists about the role"

-10276/l.23-27 reformulate this sentence. Plus, the description of plant communities could be more clear and concise

-10277/l.12-13 Also global radiation and wind speed are measured at both 0.1 and 2 m above the ground or the authors need to better specify the heights of the pyranometer and anemometer?

-10277/l.12 I think the authors mean "LI-8150" the multiplexer for LI-8100 not Li 8100-105. Moreover, I suggest to cite the instruments as generally the companies do, like Li 8100 -> LI-8100

-10278/l.10 in the previous paragraph the plots are defined as Festuca plot and Sempervivum plot, here change accordingly: "five Sempervivum plots..."

-10278/l.26 I would place this paragraph at line 7 before the detailed description of C4788

the measurements -10279/l.2 remove soil... in this case the CO₂ efflux is from the ecosystem not only the soil.

-10280/l.11-12-13 Not clear

-10282/l.4-10 this part is a bit redundant

-10282/l.13-15 "To verify the CAM behaviour in *S. montanum*, we investigated the carbon isotopic ratio ($\delta^{13}\text{C}$)" remove "To verify the CAM behaviour in *S. montanum*" and change with "We investigated the $\delta^{13}\text{C}$ " the $\delta^{13}\text{C}$ acronym was already introduced

-10282/l.16 it is not clear different among what. Reformulate: "The $\delta^{13}\text{C}$ in the above-ground biomass was significantly different between the two main species (Table 1) ($P \leq 0.001$) highlighting their different photosynthetic pathways"

-10282/l.22 "the DAILY average NEE".

-10284/l.1 "The most evident difference in response to PPFD of *Festuca* and *Sempervivum*" change with "The most evident difference in the light response curve between *Festuca* and *Sempervivum*"

-10284/l.2 remove "As a result"

-10284/l.15 difficult to catch the meaning of this sentence: "but eventually adapted to light until the closure of the opaque chambers"??

-10285/l.4 I would change "response to temperature" with "temperature sensitivity"

-10287/l.15 At the beginning of the discussion please recall some details e.g. "Robust differences in CO₂ fluxes between two vegetation types, a C3 (*Festuca*) and a CAM (*Sempervivum*) species"

-10290/l.14 "It has been shown that high GPP values are not always coupled with high rates of C accumulation in the ecosystem." in which study?