

Interactive comment on “Root biomass responses to elevated CO₂ limit soil C sequestration in managed grasslands” by W. M. A. Sillen and W. I. J. Dieleman

Anonymous Referee #2

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General Comments on “Root biomass responses to elevated CO₂ limit soil C sequestration in managed grasslands” by W. M. A. Sillen and W. I. J. Dieleman

The manuscript describes a meta-analysis exploring the interacting effects of elevated atmospheric CO₂, fertilization, and other management practices on the allocation of carbon to aboveground biomass, belowground biomass, the soil microbial community, and the soil carbon pool in grasslands. Overall, meta-analyses have great value in synthesizing the results of various studies and providing an important step toward scientific consensus on topics that have been extensively researched in a range of study sites and conditions. This paper provides interesting analysis results and does so us-

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ing appropriate and accepted methods. I recommend publication after some details and clarifications are addressed.

Specific Comments

Page 358, line 24: The current atmospheric CO₂ concentration is approximately 393 ppm, not 380 ppm, according to the most recent data from the National Oceanic and Atmospheric Administration in the USA. I would state something like “greater than 390 ppm” in the manuscript since these recent data are still considered to be preliminary by NOAA. See: <http://www.esrl.noaa.gov/gmd/ccgg/trends/>

Page 360, lines 3-5: This would be a good place to describe the study as a meta-analysis. While it is stated in the abstract, it seems appropriate for the introduction to briefly explain the approach that was used to explore the stated hypotheses, so that readers are not expecting an experimental paper. In addition, I agree with the comments of the other reviewer that the discussion of woody plants is distracting, and I think the following sentence is a weak justification for the focus on grasslands alone: “Because of these functional differences between grasslands and tree stands, and the management component involved in grasslands, we focused on elevated CO₂ effects in grasslands only.” I do think the reviews that address woody plants should be referenced but perhaps they would be a better fit in the discussion. The introduction can then keep a focus on the global potential of grasslands as carbon sinks, which justifies the meta-analysis strongly.

Overall, the introduction could provide a stronger context for the specific hypotheses explored by the meta-analysis, which are quite mechanistic. It would be useful to add a paragraph that reviews the literature on known interactions between elevated CO₂, microbial dynamics, and soil carbon. The stimulating effects of high CO₂ and N additions on plant productivity seem to be adequately addressed.

Page 361, line 5: Means were weighted by what criteria?

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Page 364, line 4: “. . .and partly refutes our 1st hypothesis.” It would be better to briefly restate the first hypothesis, rather than counting on the reader to recall the order in which the hypotheses were proposed. This also applies to the later references to “. . .our 4th hypothesis”.

Section 4.1 of the Discussion seems to repeat some information found in the previous paragraph. Can these sections be combined under the 4.1 heading?

Page 366, lines 17-19: “We found a striking similarity between soil C and microbial biomass responses (Figs. 1–2), and opposing trends between microbial biomass and soil C responses on the one hand, and root biomass responses to elevated CO₂ on the other hand (Figs. 1–2).” This sentence is difficult to figure out. Do you mean “We found a striking similarity between soil C and microbial biomass responses to elevated CO₂, but root biomass responses showed the opposite pattern.”?

Page 366, line 23: Elaborate on what you mean by “priming”.

Page 367, lines 6-7: “. . .possibly because of an increased cycling of C in the soil compartments” Be specific about the mechanisms you are proposing here. Increased cycling could be related to higher respiratory activity in roots or microbes, changes in root exudates, decreased lifespan of root tissues, or a combination of these factors.

Page 367, lines 9-10: “We suggest an important role for root biomass and dynamics and their response to nutrients under elevated CO₂ concentrations, based on our findings above.” An important role in what? This statement is vague.

Page 367, lines 26-27: “Moreover, respiration rates can be reduced when terrestrial systems are fertilized with large amounts of N. . .” Add a phrase explaining the mechanism.

Page 368, line 7: “N resp. C.” What does this mean?

Figures: I suggest the x-axes be elongated so that the values of the effects are easier to read along the x-axis scale.

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Figure 5: The figure legend of this graph contains a better summary of potential mechanisms and interactions than the discussion. See if you can integrate this figure into the Implications section to summarize the main findings of the study.

Figure 6 is not particularly illuminating, nor is it introduced in the results section. Omit?

Technical Comments

Page 360, line 19: “We constructed a database, consisting. . .” Eliminate the comma in this phrase.

Page 362, line 19: “. . .aboveground biomass responded equally strong to different fertilizer types” Change “equally strong” to “similarly”.

Page 365, line 11: “In addition, in the single factor fertilization treatment, aboveground biomass tended to respond stronger to NPK fertilizers. . .” Change “stronger” to “more strongly”.

Page 366, line 25: “. . .when purely N was added to grasslands” Change “purely” to “only”.

Interactive comment on Biogeosciences Discuss., 9, 357, 2012.

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