Biogeosciences Discuss., 10, C4744–C4747, 2013
www.biogeosciences-discuss.net/10/C4744/2013/

Biogeosciences
Discussions
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Interactive comment on "The impact of extreme summer drought on the short-term carbon coupling of photosynthesis to soil CO_2 efflux in a temperate grassland" *by* S. Burri et al.

Anonymous Referee #1

Received and published: 4 September 2013

General comments

This paper presents well conducted research on an important topic, that is the response of carbon allocation and carbon storage in grasslands to increased summer drought expected for the near future, using novel techniques (i.e. combined 13C-pulse labeling with online infrared laser isotope analysis of CO2 from soil respiration). Experiments were conducted in the growing seasons of 2010 and 2011 in a Swiss intensively managed lowland grassland ecosystem. Drought was implemented on three replicated plots in each of the two years by rainout shelters, equipped with a translucent screen, permeable also for UV-B radiation, for 8–12 weeks in each of the two years. 13C-label was applied at high dose (99.9 atom% 13C) with transparent chambers over a period of

90 min once on every plot (both on control and drought plots), a few weeks after installation of the rainout shelters. Soil CO2 efflux and its carbon isotopic composition were monitored online, whereas above- and belowground plant material was sampled at different times, starting with frequent sampling directly after labeling, and increasing the sampling intervals with time after labeling. The major finding was that, albeit drought reduced the total C uptake of the plants and also soil CO2 efflux, it increased the relative C allocation below ground, indicating that the plants were investing relatively more carbon into root growth than under non-drought conditions.

The paper is well written and the data presented are in principle of high quality. However, a few issues have to be straightened before the paper should finally be accepted. Among those is the fact that obviously a very high variability of belowground biomass was found between the different plots and sampling times (see Table 2, data for belowground biomass especially in 2010). This was mentioned briefly in the Results section (p. 11685, l. 17-18). However, this fact was not properly addressed in the discussion, especially its potential implications for the interpretation of the data. Was it, for example, due to an inappropriate sampling methodology? As this data, together with the 13C information, form the basis for the quantification of the belowground carbon allocation, it is important to clarify. More specific comments follow below.

Specific comments

p. 11674, l. 6: add "under field conditions", as e.g. Sanaullah et al. (2012) indeed looked at drought stress effects on carbon allocation, albeit under laboratory (microcosm) conditions (as correctly mentioned in the next sentence).

p. 11674, l. 25f.: The hypothesis could be more specific, i.e. don't just say that you expect a reduced coupling between above- and belowground carbon allocation under drought stress, but hypothesize in which way the allocation pattern might be altered.

p. 11675, l. 7: When was this original seed mixture applied?

p. 11675, l. 13: Had always the same plots been subjected to drought stress since 2005, i.e. the plots used for the experiments in this paper?

p. 11675, l. 14/15: Already mention here that you had six blocks, and give the size of the plots.

p. 11675, l. 23 + 25: Here it is not clear what "two of the three replicates" and "on one replicate" mean. If you have six blocks, you have six treatment replicates. If you refer to the three blocks that were equipped with soil sensors, the wording is misleading.

p. 11765, l. 22: Down to which depth were the soil samples taken?

p. 11678, l. 16-17: Don't refer the reader to a paper "in preparation". How should one get the information? If you can't cite a published or accepted paper, you have to describe it.

p. 11679, l. 19: How were the errors propagated?

p. 11679, l. 23: What was the error threshold before 13C labeling? Also 35‰

p. 11681, l. 13: Setting biomass to zero after cutting ignores the few cm of standing biomass after a cut. How large is the estimated offset?

p. 11684, l. 14f.: Make reference to Fig. 3 at an appropriate place also in this paragraph.

p. 11685, l. 9-16: The order of the two sentences should be reversed for the sake of a (chrono)logical order (first describe the observations within the shelter period, then after the removal of the shelter).

p. 11690, l. 27/pl. 11691, l. 1+2: This sentence should be better hyphenated with the previous sentence, as it appears a bit isolated.

Table 2: How can the linearly interpolated values for aboveground biomass be lower than the two endpoints of the reference period?

Table 2: How can belowground biomass decrease by 40 or even almost 60% in control and treatment plots within a period of nine days (between 21 and 30 July 2010)?

Technical corrections

p. 11673, l. 28: Replace "under solar radiation and temperature" with "at higher solar radiation and temperature.

p. 11675, l. 3: Replace "took place" with "were conducted".

p. 11678, l. 6: delete "took place"; "diameter" (singular)

p. 11679, l. 10: "tracer release with soil respiration"

p. 11682, l. 6 + 16: replace "after label stop" with "after labeling"

p. 11684, l. 23: replace "during which" with "when".

p. 11685, l. 6+8+13: replace "into the shelter period" with "after shelter installation"

p. 11685, l. 11: delete "2010 and 2011" (it's clear)

p. 11685, l. 16: replace "were recovered" with "was recovered"

Table 1: replace "Control" and "Treatment" with "ctrl" and "tmt" in the table, as the abbreviations are defined in the table header.

Table 2: Header: replace "at cuts" with "at the time of cutting" and write "interpolated values that were used".

Interactive comment on Biogeosciences Discuss., 10, 11671, 2013.