Biogeosciences Discuss., 11, C4276–C4279, 2014
www.biogeosciences-discuss.net/11/C4276/2014/

Biogeosciences
Discussions
Open Access

Interactive comment on "Inorganic carbon fluxes across the vadose zone of planted and unplanted soil mesocosms" *by* E. M. Thaysen et al.

Anonymous Referee #3

Received and published: 11 August 2014

Thaysen et al. performed a careful experiment of CO2 losses from the top and bottom of planted and unplanted experimental mesocosms. Whereas the results are largely confirmatory, many results, including the magnitude of the increase in dissolved organic carbon percolation after harvest, are of interest. The conclusions are at times overstated; for example, the last sentence of the abstract states that the cropland C balance will not change under elevated CO2 and temperature, yet the experiment only investigated mesocosms and not the many feedbacks that are known to exist in a cropping system under global change scenarios. I find that the manuscript is publishable after considering a number of revisions which, given the importance of properly placing results in context, may be considered major.

Specific comments: The atmospheric residence time of CO2 occurs at many different

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

scales from seconds to centuries or longer, but averages about 5 years as noted in a footnote. Footnotes are confusing, especially when the number 1 is in superscript after 'years', and would be better off incorporated into the text.

The flow in the introduction can be made more simple. The first paragraph discusses the global C cycle and atmospheric CO2, the second DIC, Rs and pCO2, the third DIC, the fourth pCO2, and the 5th diffusion. Note that pCO2 is the unifying concept for both DIC and Rs (at least its measurement as soil to atmosphere CO2 efflux). By discussing the importance of pCO2 first, the resulting fluxes follow. Such a reordering will also place paragraph 5, on the role of plants, in context; at the moment it is not well connected to the rest of the introduction section.

In paragraph 5, note also the important role of the flushing (advective transport) in the soil air space after rain. Many studies find an increase in Rs with rain, even in systems that are not water limited (e.g. Lee et al., 2002, http://onlinelibrary.wiley.com/doi/10.1046/j.1440-1703.2002.00498.x/full).

On page 4256 line 22, are mesocosms only useful for studying unsaturated soils but not saturated soils? Please clarify in the context of Thaysen et al. (2014).

On page 4257 line 25 it is stated that frequency and amount of irrigation were adjusted to serve the need of plants while maintaining downward leaching. Could you please clarify? Is this more or less rain than a barley crop in Denmark commonly receives? Is it typical for rain events of this magnitude to occur this frequently (in the case of Denmark I would assume that this is probably the case). At any rate, please quantify the amount of water that the plants actually received instead of in the context of plant nutrient delivery (which I note should also be justified in the introduction: is this an experiment on plant and fertilization impacts on Rs and DIC, and if so why?)

In section 2.2.2, did the transparent chamber impact the light environment in a meaningful way? In other words, was the magnitude of NEE decreased by a potential slight shading effect of the chambers?

BGD

11, C4276–C4279, 2014

In section 2.2.3, please clarify the meaning of ‘Cells were removed when their inside pressure had increased to 1013 hPa.’ What are ‘cells’ in this context?

How is equation 1, an expression of Fick’s Law, a simplified approach of Fierer et al.? Don’t most flux-gradient methods for determining soil CO_2 transport use a similar approach?

Why was Hydrus only used for mesocosms 4 and 5, and why are results for only mesocosm 5 presented? Likewise, in section 2.4, why are CO_2 budgets for only mesocosms 4 and 5 presented? Measurements exist to estimate CO_2 budgets for the other mesocosms as far as I’m aware, aren’t these reported on page 4275? I also note that it’s difficult for the reader to remember microcosms by their number rather than some abbreviation related to the treatment. The numbering scheme is arbitrary.

In equation 2, why are production from both soil microorganisms and plant roots multiplied by the plant root index? An explanation is given, but were other formulations tested? Might there be a plant root dependent and independent component of microbial respiration (i.e. S=gammas1 + (gammas2 + gammap)*RMI, where gammas1 is the root independent microbial contribution?)

In equation 5, how was r (root growth rate) simulated? Also, note that both dots and the multiplication sign are used in different equations. Please use the multiplication sign for accuracy and consistency.

On page 4266 how was GPP estimated using above and belowground vegetation biomass as proxies of autotrophic respiration is not estimated?

Please quantify ‘fairly stable’ on page 4267.

Section 4.1 is largely a collection of facts and is difficult to read; there is quite a bit to digest.

It is unclear to me how the authors reach the conclusion that increased atmospheric pCO_2 will not change the net C balance of croplands given the experimental treatment

BGD

11, C4276–C4279, 2014

of barley planted in mesocosms. Elevated CO_2 may increase plant growth, and root exudation and subsequent C losses may perfectly balance this enhanced C storage, or they may not. C storage in soil organic matter under different atmospheric pCO_2 treatments was not explored, so any statement with respect to cropland C balance is premature. See also statements on the last paragraph of page 4277: these also need to be changed to reflect the findings of the study.

Figure 7 is confusing. What do the numbers in the legend mean?

In Figure 8, can the large spikes resulting from irrigation and CO_2 displacement be validated using measurements?

Interactive comment on Biogeosciences Discuss., 11, 4251, 2014.

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper