Biogeosciences Discuss., 12, C6305–C6309, 2015
www.biogeosciences-discuss.net/12/C6305/2015/

Biogeosciences
Discussions
Open Access

Interactive comment on "Precipitation legacy effects on dryland ecosystem carbon fluxes: direction, magnitude and biogeochemical carryovers" *by* W. Shen et al.

W. Shen et al.

shenweij@scbg.ac.cn

Received and published: 8 October 2015

Dear Editor,

We are grateful for the opportunity to improve our manuscript. We have carefully studied the suggestions/comments by the reviewer, and incorporated them into this revised manuscript. A detailed list of the responses to the reviewers' comments is provided below and in the Supplement file. Hope that you will find this satisfactory.

Thank you again for considering our manuscript. I look forward to hearing from you.

Sincerely,

Weijun Shen, Ph.D. South China Botanical Garden, Chinese Academy of Sciences, Guangzhou 510650, China. E-mail: shenweij@scbg.ac.cn Tel: 86-20-37252950

Reply to Referee #2:

Comment #1: This manuscript uses a calibrated ecosystem model (PALS) to study precipitation legacy effects on a single calibrated site near Tucson, AZ. The authors designed a series of rainfall manipulation experiments and conducted the sensitivity analysis in the PALS model. Overall, the manuscript studied the legacy effect in an interesting way, but I find the current results/discussion are very premature. I have some serious doubt on the results part (see my following details). Another major issue of this manuscript is the lack of discussion on the probable mechanisms, which is very disappointing. I suggest major revision at most.

Re: Thanks to the reviewer for considering our approach interesting. We understand that the reviewer has doubts on the results. Some of the specific doubts raised by the reviewer are explained in the responses below. In addition, We revised the descriptions on the three mechanisms that we think are mainly responsible for the modeled legacy impacts (see lines 471-492). Hopefully these revisions would be helpful for the reviewer to assess our work.

Comment #2: I found the results in Fig 3 very suspicious. First, if the previous-period PPT change is 0% and the current-period PPT change is 0%, then your results of any legacy terms should be zero. But I simply find this is not the case. Furthermore, the results shows a positive legacy when there is a negative change in previous-period PPT (Fig.3a), i.e. the result here is saying if there is a decrease of rainfall in past, the current-period GEP will increase compared with no prior rainfall change. This is a striking result (also highly suspicious), and the authors failed to provide convincing explanations on that. The soil nitrogen argument (i.e. more N in soil becomes available during dry years) is really a stretch and with little support (Fig. 5 does not support this point at all, as it only shows the scenarios of increasing current rainfall). Still in Fig. 3,

the authors claimed “wet legacies imposed mostly negative impacts on current-period GEP” (Fig. 3a), which is simply not true from your figure.

Re: Yes, if there is no change in both the previous- and current-period PPT (i.e. under baseline PPT conditions), the legacy terms would be zero. That is how we defined and calculated the legacy effects. We therefore did not plot those zero data points in Fig. 3. To help the reviewer to better inspect the results in Fig. 3, we provide the figure below (see the attached figure behind this reply) with zero lines being added. Now you can see where the zero data point should be located. Then the question is why the connecting line between the -10% and +10% previous-period PPT change points does not cross the zero point (we think the reviewer expects the line should cross the zero point). The answer is that the carbon fluxes respond nonlinearly to previous-PPT changes as shown in the figure. Therefore the three data points (-10%, 0, and +10%) should not be on one line (or the line may or may not cross the zero point).

We have provided explanations for the positive dry legacy impacts on current-period GEP in the main text (see lines 484-489, 509-525) and the reply to another referee who had the same concern (Please see the Reply to Comment # 22 and # 30 from Referee #1) .

From the attached figure, you can see that the numbers for the wet legacies on GEP (Fig. 3a) are mostly negative in terms of the sign. But the effects are indeed very small in terms of the magnitude. We therefore replaced “mostly negative” will “little” in the main text (line 350; please also see the Reply to Comment #23 from Referee #1).

Comment #3: Based on the results in Fig 3-5, I have serious doubt about the scientific robustness of this work. Besides the points raised above, the authors neglected the rich literatures on the dryland ecohydrology that discusses the intra-seasonal rainfall effects (e.g. rainfall frequency, intensity) on ecosystems. Please search literatures by Rodriguez-Iturbe, Porporato, Albertson, etc and incorporate them in your manuscript. It has to be recognized that the proposed rainfall change in this manuscript is only

changing the rainfall intensity (i.e. simply multiplying a ratio to all the rainfall events) but does not change any rainfall frequency or seasonality. This is fine as your approach has been largely used elsewhere, but recognizing its limitation is necessary.

Re: It is true that many studies have been done to understand the PPT legacy impacts on ecosystem properties at seasonal and event scales. We have mentioned these in several places of the Introduction section (e.g. lines 62-66, lines 95-105). That is why we focused our simulation analysis on the interannual and interdecadal scales.

Comment #4: The manuscript in general is very hard to follow esp. in the results and discussion section. The authors defined “legacy” term only for NEP, and you should add “legacy terms for other variable of interest follow the same definition”.

Re: We revised the discussion section especially with respect to the mechanisms that explain the modelled legacy behaviors (lines 474-490). Hopefully these revisions would be helpful for the reviewer to have an easier understanding of our work. We only provided one equation as an example for calculating the legacy effects for NEP. The calculations for other variables (e.g. GEP, NEP, Biomass) are exactly the same as for NEP. It is therefore redundant to provide all such equations with the same form.

Interactive comment on Biogeosciences Discuss., 12, 9613, 2015.

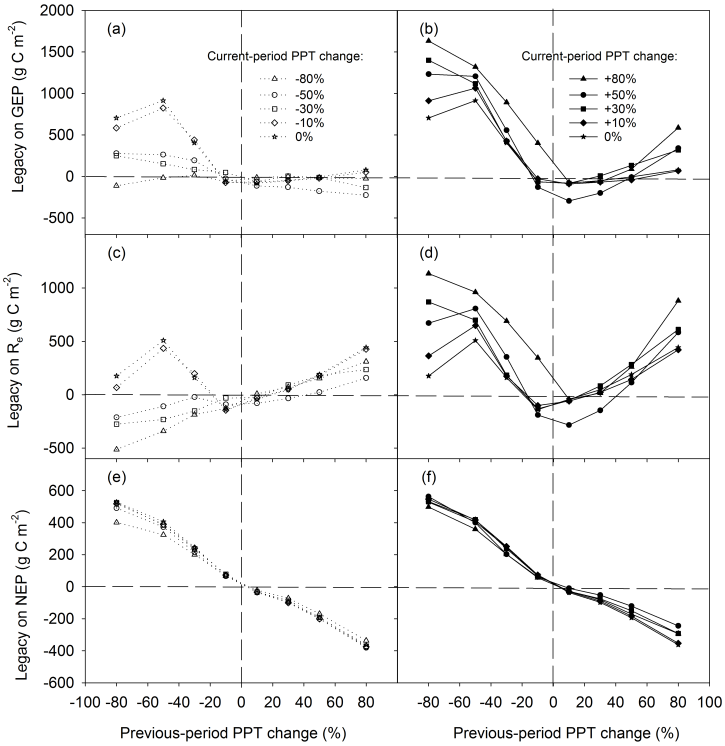
(a)
(b)
(c)
(d)
(e)
(f)
Current-period PPT change:
-80%
-50%
-30%
-10%
0%
+80%
+50%
+30%
+10%
Legacy on GEP (g C m-2)
Legacy on Re (g C m-2)
Legacy on NEP (g C m-2)
Previous-period PPT change (%)
Previous-period PPT change (%)

Fig. 1.