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Interactive comment on "The impact of atmospheric CO_2 and N management on simulated yields and tissue C : N in the main wheat regions of Western Europe" *by* S. Olin et al.

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Thanks for the comments and corrections. Comments are included in this document within "" followed by answers with updated texts.

Specific questions and remarks.
1) "*Abstract suggests to me more of an evaluation paper. Title suggests an impacts study. I think the problem is with the abstract not saying much about the impact as advertised by the title.*"
That is correct, the title now reads:
"Modelling the response of yields and tissue C:N to changes in atmospheric CO2 and

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N management in the main wheat regions of Western Europe"

3) "*p. 9 first paragraph on Development Stage: my perception of the difference between DS and HU is subtle (possibly even non-existent) because HUs can have thresholds for DS transitions, as they do in AgroIBIS and CLMcrop as far as I know. So pls clarify or correct.*"
The reviewer is correct that this is not a general case, and it is now phrased more specific regarding the difference between the two implementations in LPJ-GUESS:
Compared to the HU implementation currently in the model, the use of DS facilitates a more detailed division of the growing period into the different crop phenological stages (Wang et al. 1998). Periods when the plant is more susceptible to heat and nitrogen stress can thus be represented in a more precise manner.

4) "*p. 10 line 19: you say "e.g." which means "for example" and I wonder whether this applies also to heat and cold stress or whether you really mean "i.e." which would limit the list to water and nitrogen. Pls clarify or correct.*"
The sentence was a bit vague and is now updated as follows:
When a plant experiences water or nutrient deficit during the vegetative phase, it starts to invest a relatively larger fraction of the assimilates into roots to overcome the stress (Keulen 1989).

8) "*Carbohydrate retranslocation: maybe should compare to the Drewniak et al. approach in the CLM, mentioned in one of her recent papers.*"
Thanks for this suggestion, which would indeed be interesting to include. However, after reading Drewniak et al 2013, Bilionis et al. 2014, Levis et al. 2012 and 2014 we could not find a detailed description of how the carbohydrate retranslocation is done in CLM. Perhaps the paper the reviewer mentions is as yet unpublished or we have overlooked the appropriate reference?

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11) "*p. 18 line 17: maybe I missed it; did you define pF earlier?*"
No, pF was not defined previous to that. We have now revised that sentence to read:
where Ψ_i is the actual pressure head (m) and θ_i is the actual volumetric water content ($m^3\,m^{-3}$).

12) "*p. 19 line 20: you say "were changed" and do you mean permanently or temporarily for this particular case?*"
The sentence is updated to the following:
Based on an initial calibration of the model using leaf phenology data from Trial I, the parameters a and b in the allocation function f_2 (Eq. 4) were changed from 0.88 and 0.09 to 0.8 and 0.2 respectively, for this application.

13) *"p. 19 line 24: change "data ... was" to "data ... were" and explain your choices of 100 vs later 200 kgN/ha/y and "applied on day 150 from the time of sowing.""*
We have updated and split the sentence to make it more clear:
To initialise (spin up) N and C pools in the model, climate data for the year 1979 were repeated for 500 years. In Groot et al. 1991, there is no information on management practices in previous years, so we decided to implement a moderate level of 100 $kg\,N\,ha^{-1}\,y^{-1}$ as a single application, 150 days after sowing for the spinup. The year before the trials started (1982 for Trials I, III and V and 1983 for Trials II, IV and VI) 200 $kg\,N\,ha^{-1}\,y^{-1}$ was applied, following Table 1 Groot et al. 1991.

14) "*p. 20 line 14: do you mean spring or winter cereals? Or both?*"
Updated for clarity as follows:
Also LPJ-GUESS does not model wheat and barley explicitly, but temperate cereals (Bondeau et al. 2007,Lindeskog et al. 2013) represented by wheat (spring and winter)

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in the model, therefore growth of cereals was simulated for all years.

15) "*p. 26 lines 1 and 7: so is the modeled in fact more accurate than the observed?*"
If the reviewer are referring to the modelled N application rates as compared to the input data used in this study, we would not say that they are more correct. But the modelled data reflects some of variation in the spatial patterns of N fertiliser applications that is not available in the input data.

16) "*p. 26 line 3: change "despite of" to "despite the" and in line 17 clarify "relative to C-only" or do I misunderstand?*"
The reviewer is correct, that was a bit unclear and is now corrected as follows:
As expected, optimised N management ($F_{opt(T,A)}$ and $F_{t,A}$) improved the fit of the model results to spatial variation in the data, but all the C–N enabled simulations except for max($F_{T,A}$) increased the agreement between the modelled and observed variance (Table 5), when compared to F_C.

7) "*eq. 6 is reminiscent of the CLM-CN allocation equations. If there's any connection, then pls add corresponding reference(s).*"
They stem from the same source, Penning de Vries 1998, see answere to 17 below.

17) "*CLMcrop now includes a representation of variable C:N. I think Oleson et al. (2013) mentions this and probably Drewniak et al. in a recent paper.*"
As far as I can interpret the implementation in Drewniak et al. (2013), the C:N of the various organs are dependent on the crops stage. N retranslocation is therefore the result of the crop entering a new stage, and thus not on its current status being dependent on auxiliary factors.
We have added the following to the discussion:

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CLM (Drewniak et al. 2013), e.g. includes N limitation for crops, and this model also simulates the retranslocation of N during the grainfilling period based on prescribed C : N of the plant organs pre- and post anthesis. The C allocation scheme implemented in CLM has the same origin (Penning de Vries 1989) as the one implemented here for LPJ-GUESS.

The suggestions regarding language and minor corrections to captions are included in the update but not answered here.

Interactive comment on Biogeosciences Discuss., 12, 1047, 2015.