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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.

**Anonymous Referee #1**

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The Olin et al. manuscript describes the implementation and evaluation of plant N dynamics in a crop sub-model within the LPJ-GUESS DVM. A key strength of the manuscript is the evaluation across multiple spatial scales using both field trials and regional yield data. They use field experiments (nitrogen addition and CO2 enrichment) to explore the patterns of dynamics within a growing season, including the timing and magnitude of vegetation and grain production. However, global models are not designed to perfectly simulate field plot scale dynamics, rather, as the authors appropriately acknowledge, they are designed for regional-to-global studies. Therefore, a regional scale evaluation using broad-scale yield data across Western Europe was used to confirm that reasonable site-level comparison do not produce unrealistic re-



gional scale predictions.

Overall, the description of the model was clear.

The key scientific finding from the paper that helps other modeling groups is that specifying nitrogen addition rates is more important than timing for modeling yields. This helps focus attention on the need to build datasets describing N addition rates.

While figure 2 does show the productivity results for different N treatments, the manuscript could be improved by more explicitly addressing whether the model is appropriately sensitive to N addition or whether it is too N limited or not N limited enough. What processes in the model control the sensitivity to N addition?

Other areas for improvement:

The introduction leaves out any discussion about N20 emissions from croplands. N2O emissions are relevant to the goals of the manuscript because getting the N uptake correct is an important step to modeling the N that is available for N20 production.

More description about how the model handles the labile C pool would be helpful. Is there a max size of the labile C pool? What happens when the labile C pool become unrealistically large? Similarly, is there a labile N pool or is N allocation directly linked to N uptake from the soil?

Equation 11: Why is the nitrogen availability a function of projected leaf coverage by the plant?

Please provide a more thorough description of LAIn on page 1059 line 15. How does it differ from LAI?

It seems that the authors did not have data at the FACE site on the total magnitude of N addition, timing of individual N additions, and magnitude of individual N additions. To overcome this lack of data, they simulated an ensemble of magnitudes and timings and used the combination that produced yields that best fit the observations. One limitation

to this approach is that it assumes that the rest of the model structure and parameters are correct. To address this assumption, it would be helpful to show the sensitivity to N addition from the ensemble of magnitudes and timing. Is the range large, therefore fitting the model to the yield data is critical, or is the range small, therefore choosing the magnitude and timing of N addition is not absolutely critical? The authors could also be clearer about whether the total magnitude of N addition over the growing season is known but just the timing and magnitude of individual additions are unknown

Page 1080 Line 16: How does this study show the crop model is applicable under climate change? The response to climate is not described or evaluated.

Table 1 – the three columns under N app need more explanation. Are there three different treatments applied to three different plots or three different times within the year?

Table A.3. The column NUTS2 needs to be defined so that a reader just looking at the table can understand.

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