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Geoscientific
Model Development
Discussions

Interactive comment on "Calibration of the Crop model in the Community Land Model" *by* X. Zeng et al.

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Main comments:

This paper describes the use a well-established calibration method to adjust 6 parameters of the crop model recently implemented within the Community Land Model. There is nothing innovative, but it is quite interesting to see how a method much used in the climate community can be applied for biological processes. The methodology is well described. Nevertheless, I am asking for major revisions because I see at least two main points that are problematic enough:

1) The calibrated parameters impact the growth of soybean, but one of the variables used to tune them, the maximal NEE, is significantly impacted by the previous maize

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crop through the incorporated residues that lead to a high soil respiration (see e.g. Law et al. 2002 in AFM). Therefore it is not correct to calibrate a model simulating continuous soybean, as the NEE of continuous soybean should be less negative (smaller ecosystem respiration) during the growing season than the NEE of soybean following maize (larger ecosystem respiration), the one used as observation. If the model cannot simulate crop rotation, then the authors should eliminate NEE. This would result in even less observations for relatively a lot of parameters to estimate. I wonder if their number cannot be reduced, and if the authors have tested their independence. Besides, all the calibrated parameters relate to the C/N ratio, but by looking at Fig. 2, the reader might ask why other parameters related to the allocations to different plant parts are not adjusted, as leaves and grains are largely underestimated while the stem is overestimated.

2) Sus et al. (Biogeosciences Discuss., 9, 11139–11176, 2012) found that: "The Bondville data also show that reported sowing of the 2002 soybean crop is clearly delayed due to abnormal precipitation in April–June, which is well reproduced by the MODIS-based model value." This clearly indicates that the Bondville sowing dates are available, and they should be used, especially for the abnormal year 2002.

I am asking for redoing the exercise by: 1) removing observations that reflect a situation not simulated by the model (NEE), 2) "possibly" calibrating parameters that allow the simulation to better fit such an important variable as LAI, and if not possible, discuss this point, 3) using the reported Bondville sowing dates.

Besides the point about sowing dates, the Sus et al. paper "A data assimilation framework for constraining upscaled cropland carbon flux seasonality and biometry with MODIS" is certainly worthwhile reading.

Detailed comments:

From the abstract it looks like that the calibration is done for wheat, maize, and soybean. Then the 1st section speaks about maize and soybean at two sites, then only

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Bondville data are used, and only for soybean. This should be clear from the beginning.

p. 381: l. 3-5: soil nitrogen seems to be the only limiting resource considered. What about water? Does it mean that these crops are always irrigated? This must be clarified. In fact it is said below (p. 385 l. 20) that irrigation is uncertain, and Mead is a rain-fed site. (Only later we understand that the Mead site is not used, so what is the point to tell that?)

p. 381, Equations 1 & 2: it could be useful to precise that leafcn, fleafcn, stemcn, and fstemcn are fixed parameters for each crop type, without that the reader needs to look at the Drewniak et al. paper.

p.384: "Although from the literature we have minimum and maximum estimates for some variables, some parameters do not have observed ranges, as they were optimized for use in CLM based on performance.": unclear. Is the word "variables" just another word for "parameters", or do the authors mean variables like e.g. "leaf carbon mass" that can be used for parameters calibration?

Table 1: It should be specified that these parameters vary across crop types. At this time of reading, the reader still imagines that the calibration will be done for several crops.

p.387 l. 8-17: Not all variables of the equations are explained, and not all equations do have a number.

p. 388, l.11-12: "We generate artificial observations by using the default parameter values and then perturb the parameters". How many perturbations and which level of perturbation (20%, 50% ???)

l.20. LEAFC, TLAI, etc, should be defined at some point, even if they appear to be self-explaining. For example, what is the difference between LAI and TLAI?

Figs 1-2-3: Please specify the location and the crop.

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Figs 2-3: The units are missing. Choose a similar scaling for GPP and NEE. p.389 l. 16-17: The calibrated model outputs are indeed much better, nevertheless the TLAI remains really underestimated. Why is that not discussed?

p.389 l. 28: “the yearly planting date at global scale is not available”. I do not see the point of looking for yearly planting date at the global scale. I find it quite strange that, when getting flux data from the AmeriFlux data over crop sites, you cannot get such critical information like the sowing date. As we see, sowing dates drive seasonality! Indeed, after investigation, I found that such data are available and already used (see Sus et al., 2012). Beside the sowing date problem in 2002, specific events that have affected NEE that year are described in “Dobermann et al. 2006. Comment on ‘Carbon budget of mature no-till ecosystem in North Central Region of the United States’. AFM.”, and in the response to the comment.

p. 390 l. 2-5: “The uncertainty levels represented by the size of the boxes in Fig. 1 indicate the 50 % spread of the parameter values around the median. We note that the distribution seems to be relatively symmetric, and in general, the relative uncertainty seems to be about the same.” What is the point to mention that here?

p. 390 l. 19-20: “Thus, the model can over- or underestimate the planting date, which, if significant, could influence the growth cycle and resulting carbon fluxes”. This is misleading, as the model does not estimate the planting date, but uses a constant prescribed one. The authors use sometimes “sowing date” and sometimes “planting date”, which leads to confusion.

p. 390 l. 22-24: “Crop rotation can modify below-ground carbon and nitrogen cycling that would have an impact on crop productivity through nutrient availability. “ This is a very important point, as discussed above. Maize-soybean rotations impact a lot on NEE: the larger biomass of maize residues entering the soil might lead to a large soil respiration next year (see discussion in Bondeau et al., 2007), which reduces the carbon sink during the soybean season.

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