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Interactive comment on "Plant-driven variation in decomposition rates improves projections of global litter stock distribution" *by* V. Brovkin et al.

Anonymous Referee #2

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General comments

This is an interesting study of an important subject, and it improves the way litter decomposition rates are described in global vegetation models. However, the different model scenarios could be more clearly described and better linked to the part of text explaining the new parameterization. I suggest the manuscript to be accepted for publication in Biogeosciences after revision. Please find my more detailed comments on parts of the manuscript that need clarification below.

Specific comments

Line 25, page 8819, Could you add more information on how lignin concentrations were measured? Also, be more specific about the data used, all readers may not be familiar

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with the database. Are the k values based on litterbag studies? How many years of data (how many years of decomposition in the field) is included when calculating the k values? For how long is litter considered to be litter and when it becomes soils C in the LPJ model? Are decomposition rates similar for sites with the same MAT, but different seasonal cycle?

Line 27, page 8819: "After correction for environmental conditions (temperature), both lignin and nitrogen were highly significantly ($P < 0.001$) related to k (Fig. 1). What does this mean? Can you be more specific of how the statistics were actually done?

Lines 1-2., page 8820: Figure 1. Does not show the relation of lignin and N concentrations to decomposition rates as stated here, but a plot of predicted vs. measured values. Can you please include a figure showing the relationship of k with lignin and N. Also, clarify Figure 1: What are the observed values (are they from the ARTDECO database? What is n?). Could you also add statistics on the goodness of the model fit/ model performance? Qualitatively if looks to be close to the 1:1 line, but could you please add a quantitative measure. Also, could you clarify in the Figure caption that it is about the leaf litters?

Line 10, page 8820: Why is the k determined at a reference temperature of 10 °C? Later on page 8823, in the beginning of part 2.3, it becomes clear that this is how decomposition rate was determined in the original formulation of the model (0.3 yr-1 for the reference temperature of 10 °C for all sources of litter). For a reader not familiar with the model, it would be helpful to clarify here, how decomposition was modeled with the earlier model version, and what are the improvements/changes made here. It would be then easier to follow the different modeling scenarios. Could you be more specific about how decomposition depended on temperature and moisture in the original model and in your model simulations? Based on the footnotes of Table 1. I would understand that moisture had an effect on decomposition rates in the original model, but it seems it is not taken into account in the new parameterization for leaf litter decomposition rates. What are the grounds for omitting the effect of moisture on leaf litter decomposition,

but including it for coarse woody litter? Later on page 8826, on line 19 it also reads that "W, WK and WKQ simulations excluded the modulation by soil moisture on litter decomposition", which seem contradictory to equation 2.

Line 15, page 8820, It is not explained what is meant by reference litter site in Equation 1. Reference T is 10 °C, but is there also a reference litter type relative to which the decomposition of other litters (average of each PFT) is determined? It is not clear. Can you also be more specific on how the parameters a and b were obtained? It would be useful to include a table representing the lignin and N concentrations (%) averaged per PFT, and also show variation between and within PFTs. In the discussion you talk about k varying within PFTs. It would be nice to see in a table how big this variation between species is compared to the variation between different PFTs? Line 17, page 8820 it reads "Arithmetic means of litter chemistry per PFT and overall averages across the ART-DECO database were applied". Is it these "arithmetic means of litter chemistry per PFT" that were used to obtain parameters a and b? Or were the parameters obtained for different species and then averaged per PFTs? I'm not sure if I understand the meaning of the rest of the sentence " and overall averages across the ART-DECO database were applied." What were the overall averages of lignin and N% used for? Later on page 8826, line 9 it reads: "The W simulation uses k values averaged from the trait databases. . .", so I would understand that the overall averages are used for the W simulation, but this information could have been given earlier, to better link the new parameterization to the simulations made.

Page 8822, what is reference k value in equation 2?

Page 8823-8825, I think it is not clear what the CTL simulation represents. On line 10, page 8824 it reads that it represents the original LPJ parameterization. On page 8825, line 3, and in Figure 5. woody litter is compared between CTL and WKQ simulations, but CTL was supposed not to differentiate between woody litter and leaf litter.

Figures and Tables:

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Table 1. Why are only the Q10 values of coarse woody litter presented? Are there differences between plant functional types in the Q10 values of different leaf litters? Are the Q10 values in the table also calculated at a reference temperature of 10 °C? In the table caption it reads: "In the CTL simulation, decomposition rates for the leaf and woody litter at 10 °C were set uniformly to 0.3 yr-1. The sensitivity to temperature and soil moisture was defined following parameterizations by Lloyd and Taylor (1994) and Foley (1995), respectively." You should show the temperature sensitivity parameters also here, either in Table 1., or by adding a curve to the Figure 3 showing decomposition rates vs. MAT, so that the reader could see what is the difference compared to the earlier parameterization.

Fig 2. Could you add that the data (observed values) is from the FET dataset? You could also add the number of observations and a goodness of fit.

Technical comments

Fig. 5. Name of the third PFT in the figure is written as TeN, should be TeNE

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