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Biogeosciences Discussions

Interactive comment on "Predicting decadal trends and transient responses of radiocarbon storage and fluxes in a temperate forest soil" *by* C. A. Sierra et al.

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Offline, we received an additional review by Dr. Göran Ågren. The original text of his review is provided below and a response is presented subsequently.

1 Review by G. Ågren

The authors have an interesting and quite complete data set describing responses of soil organic matter to warming and nitrogen deposition. However, I do not

think the authors make the best use of their data. I would suggest reanalyzing the data with the GLUE technique (Generalised Likelihood Uncertainty Estimation, Beven, K.: A manifesto for the equifinality thesis, J. Hydrol., 320(1–2), 18–36, doi:10.1016/j.jhydrol.2005.07.007, 2006).

Using this technique avoids the arbitrariness in selecting which parameters to vary between treatments and takes also into account the uncertainty in the variables against which the model is evaluated. This technique is particular suitable for a system like this with many parameters and where most of the can be expected to be correlated. I realize that this means additional work but I think it should worth it as the outcome of the analysis will be so much more informative. However, the model is simple and GLUE is a straight-forward technique, so technically this should be an easy task. Given that I suggest a complete reanalysis I do not see any point in further detailed comments. The paper is well written.

Göran Ågren

2 Response to comments

The reviewer suggests a reanalysis of the data within the framework of the GLUE method. However, it is not clear from his report whether he suggests a complete parameter estimation using the entire dataset of observed values or simply an application of the GLUE method to find possible explanations for the results of the warming and nitrogen addition experiment.

We considered this suggestion carefully and came to the conclusion that the GLUE method can add only valuable information to the last part of the paper where we try to find explanations for the increase in radiocarbon two months after the start of the manipulations. For the first and main part of the manuscript, where we are interested in evaluating the performance of a previously proposed empirical model, the use of

GLUE would not contribute to meeting the objectives of the manuscript.

In the year 2000, some of the coauthors of this manuscript proposed a simple model of belowground carbon cycling based on field measurements of carbon fractions and turnover times. This model was not estimated from a parameter optimization procedure, or in other words, the authors were not interested in finding the best model and the parameter set that fits the data. Their reasoning was different; given a set of observations it is possible to propose an empirical model that describes the system. The idea behind the present manuscript therefore, is to evaluate the success of this empirical model in predicting observations made on this site over the subsequent decade. Because this objective is far from finding the best model or the set of models that best describe the observations, the philosophy of the GLUE method will not help in the comparison of this one model's predictions and observations. (We admit that it could in principle have provided a better initial model, but that was not our objective here).

We were also interested on exploring three alternative hypotheses that could explain the results from a manipulation experiment. The three hypotheses were clearly formulated and confronted with the data; again we were not interested in finding the best set of parameters that would explain the experimental data. Instead, we were interested in finding if the empirically derived model and those hypotheses would provide predictions close to the observations. In our opinion, GLUE cannot help much here either, because our objectives are clear and far from finding the best parameter set that would explain the experimental data.

In the last part of the manuscript however, we ran a set of arbitrary simulations to find what changes in parameters would actually explain the experimental data. For this part, we agree that the GLUE method could be useful because it would give us a hint on whether there is a set of behavioral models that would yield predictions within a range of acceptability.

We ran the model within the context of the GLUE method, setting prior ranges for the

decomposition rates based on the assumption that the manipulations can produce a multiplicative effect on decomposition rates from 0 to 5, or in other words, the manipulations would decrease or increase decomposition rates by a factor from 0 to 5. As a likelihood measure we used a triangular-shaped likelihood. We found that none of the simulations can actually pass the likelihood test, but the results suggest that the intermediate pool is the only one that can actually produce an increase in the radiocarbon signature due to the manipulations (Figure 1). This agrees well with our previous analysis and reinforces our conclusion that the experiment most likely caused a release of carbon from the intermediate pool.

An additional idea we were interested in testing in this analysis was whether a change in the size of the intermediate pool can actually explain the differences in radiocarbon observed two-months after the start of the manipulation experiment. We repeated the GLUE analysis including a parameter that controls a proportion of carbon that is transferred from the intermediate to the fast-cycling pool. We found in this case that the majority of the simulations passed the likelihood test (Figure 2), particularly for values > 0.04 for the transfer of carbon between the intermediate and the fast-cycling pool. (Dotty plots generated for this result are the new Figures 9 and 10 in the paper).

Interactive comment on Biogeosciences Discuss., 9, 2197, 2012.

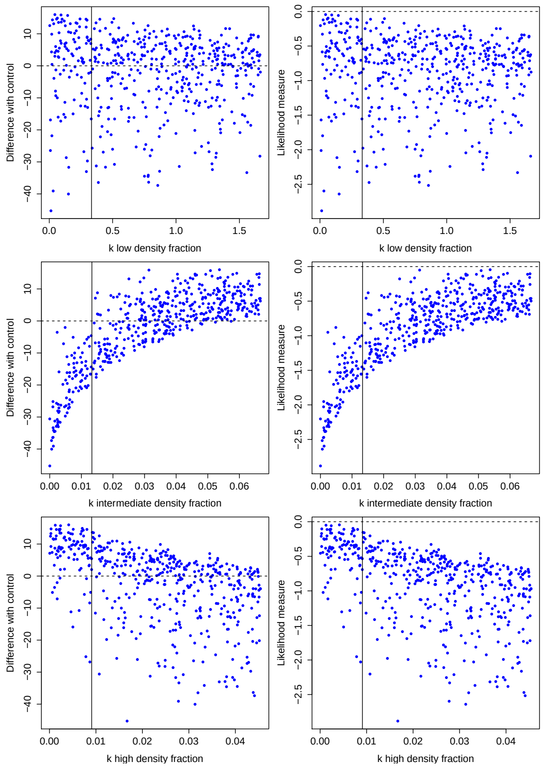

Fig. 1. Dotty plots generated by randomly modifying the values of the decomposition rates of the different fractions by a factor between 0 and 5. Additional details are provided in the manuscript.

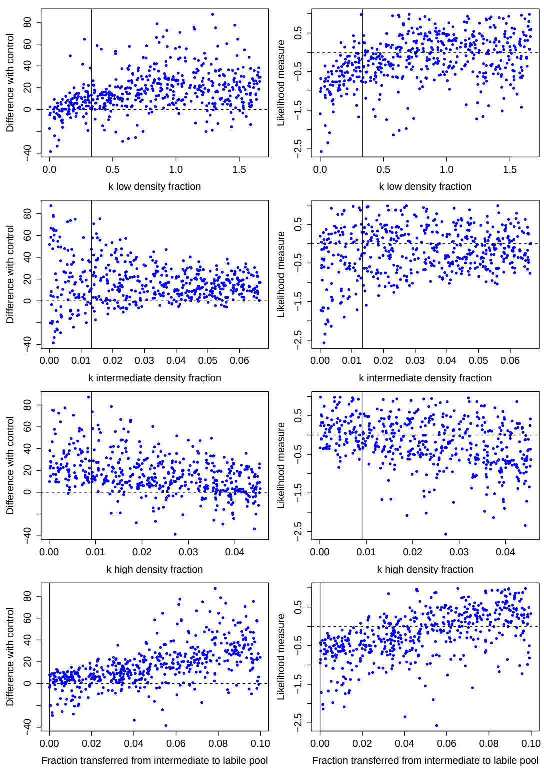

Fig. 2. Dotty plots generated by randomly modifying the values of the decomposition rates and the transfer from the intermediate pool to the labile pool. Additional details are provided in the manuscript.