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Biogeosciences Discussions

Interactive comment on "Quality or decomposer efficiency – which is most important in the temperature response of litter decomposition? A modelling study using the GLUE methodology" *by* J. Å. M. Wetterstedt and G. I. Ågren

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We appreciate the comments from Carlos Sierra, which indicated some points where our manuscript has not been clear.

General comment We have to admit of not being GLUE experts either but have appreciated its ease of use and rather easily interpretable results. To account for Sierra's comments as well those of Reviewer 3 (anonymous) we suggest rewriting and expanding the last paragraph of the Introduction as follows:

We have chosen to use the GLUE (Generalised Likelihood Uncertainty Estimation, Beven, 2006) framework for model calibration and evaluation. GLUE can be used as a modelling protocol and is well suited to give uncertainty estimations in model output. It also provides criteria for complete model rejection, i.e. the model structure needs to be changed if the model fails to predict empirical data well enough.

The main reason for choosing GLUE as opposed to a formal Bayesian approach was because it allowed us more freedom in specifying a likelihood function. The measurements are known to contain equipment-related errors, there is biological variation within the replicates, the Q-model is non-linear, and the ever present model structural error makes the identification of a formal error model to be used in a formal Bayesian approach problematic. Moreover, our main purpose is not to establish the value of the parameters to the best precision possible, but rather to explore qualitative effects of the parameters and the model. Using GLUE, it is often the case that quite different parameter sets give more or less equal good fits (equifinality). Within the framework it is easy and straightforward to use those sets in ensemble modeling. Even though the likelihood function is subjectively chosen it is easy to understand and communicate to a wider audience. The likelihood function is of lesser importance as long as it will help us find parameters that make the model predict measurements well. See also the discussion of the use of the GLUE methodology versus other formal Bayesian approaches (Mantovan & Todini, 2006; Beven et al., 2008).

New references Beven, K.J., Smith, P.J., and Freer, J.E.: So just why would a modeller choose to be incoherent? J. Hydrol. 354, 15-32, 2008. Mantovan, P. and Todini, E.: Hydrological forecasting uncertainty assessment: Incoherence of the GLUE methodology, J. Hydrol. 330, 368-381, 2006.

Specific comments 1 and 2.

Once one has arrived to equation (11) in B&Å (1999) we think it is possible to relax the assumptions leading up to this equation and allow a wider range of q. Note that ïĄĎG0

is the activation energy for each step in the decomposition process and therefore what should be used. We have, however, to be clearer on this point and would rewrite the first part of the second paragraph of Section 2.1 as follows:

In the Q-model the growth rate (u) of the decomposers depends on carbon quality (q) and temperature (T) as well as the base rate parameter (u0). The temperature response of the growth rate couples temperature and quality through an Arrhenius function with activation energy ïĄĎG0giving

where R is the gas constant (Bosatta and Ågren, 1999), although we will for convenience allow q > 1 in contrast to the restriction 0 <q <1 in the original derivation. Decomposer efficiency (e) is set to be either temperature independent (fixed) or allowed to vary with temperature (flexible). In the latter case no specific temperature function has been assumed; the intention is instead to investigate the existence of a temperature dependence. Transfer of carbon . . .

Comment 3.

We will clarify the use of versions of the Q-model by rewriting the last paragraph of Section 2.1as: Four versions of the model were run with combinations of one or two initial qualities combined with fixed or flexible decomposer efficiencies. When using two initial qualities, one quality was chosen as the best one found when using only one quality and the other one was set to lower value estimated to give a reasonable difference; the sensitivity to this choice was also tested. The initial amount of carbon was partitioned equally between the two qualities. When estimating parameters within GLUE we have used the approximate version of Model III as defined in Bosatta and Ågren (2003). The best parameter set has then been used in the exact solution to calculate quality distributions.

Technical comments 1. Included in previous comment.

2. Corrected, we forgot that all readers are not fluent in Swedish.

3. Figures are cited in order. Figs 1 &2 are cited twice already in Section 2.2.

4. Corrected, thanks.

Interactive comment on Biogeosciences Discuss., 7, 8699, 2010.