

Interactive comment on “Disentangling residence time and temperature sensitivity of microbial decomposition in a global soil carbon model” by J.-F. Exbrayat et al.

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Received and published: 22 April 2014

We would like to thank Dr. Xia for their interest and positive comments about our work. We provide a brief answer here and we will incorporate these aspects in a more detailed way in the revised manuscript.

First, we agree that differences in the absolute values of f_T are smaller when T_s is below 15°C as shown in the reviewer's own Figure 1. However, relative differences are comparable between f_T with different values of Q_{10} for T_s greater or lower than 15°C as shown in our Figure 5. This explains the approximately two-fold range in zonal SOC at equilibrium found in both the warmest and coldest regions (Figure 6a).

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As SOC input and soil physical states are the same in all model versions, we can attribute it to the response of decomposition to the spin-up procedure: a low (high) value of Q_{10} involves a low (high) decay rate in warm regions, and the build-up of large (small) SOC stocks; and a low (high) value of Q_{10} involves a high (low) decay rate in cold regions, and the build-up of small (large) SOC stocks. Regions with temperatures closer to 15°C are less sensitive to the choice of Q_{10} during spin-up. Overall, there is a zonal compensation that explains the apparent lack of sensitivity of global SOC to Q_{10} in our Figure 1a notably. Of course, we could have increased the sensitivity of equilibrium SOC stocks to Q_{10} by choosing a reference temperature that would have not led different f_T to cross within the spectrum of prescribed T_s .

Second, we also agree that as long as temperatures remain similar to pre-industrial conditions, the sensitivity of the model to the choice of Q_{10} is low. Conversely, when a strong warming is imposed the highest Q_{10} leads to the strongest depletion (or smallest accumulation) of global and regional SOC, while k influences the magnitude of the changes. Still, the magnitude of the change is very dependent upon the value of k .

In summary, we agree with Dr. Xia and will implement the required revisions to clarify the main message in the revised manuscript.

Interactive comment on Biogeosciences Discuss., 11, 4995, 2014.

C1203