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Discussions

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

Anonymous Referee #4

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This paper is interesting, but it needs to articulate better what problem it is trying to solve. There are many issues introduced by the kinds of simplifications presented here, and without clearly stating which research questions are within or beyond the scope of the analysis it is difficult to understand the extent to which the problems outweigh the advantages of the approach.

One issue I have with this paper is that it treats the concept of a single residence time as being meaningful in a transient sense. It is not, and none of the CMIP5 models treat it as such; instead they treat soil C as having a set of residence times, because they are all multi-pool models. This is an important distinction, and will lead to diverging results between the simple 1-pool model here versus the CMIP5 models. So I disagree with

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the dismissive treatment of this as an issue in section 2.1. Instead, you ought to ask how does this simplification affect your results?

A second issue is with the idea of a single global Q10 value. A problem with this is that it does not allow for the process of freezing to sharply reduce respiration rates in frozen soils. So by treating temperature dependence in this way you exclude the possibility of freeze/thaw processes from playing a role in the model. As a result, it is difficult to interpret the zonal-mean profiles in figure 7; is temperature sensitivity really less important in the high latitudes than mid latitudes, or is this an artifact of the simplifications you have chosen to make in your model? And why do you go all the way down to -30C in figure 5 while neglecting this obvious point that biological systems work qualitatively differently when they are frozen solid, whether your Q10 is 1.5 or 2.5?

Why does NPP in the driving model increase so abruptly around 1960 to drive the soil C in figure 3? Is that realistic with respect to what we know about the 20th century carbon cycle? What causes the change in sign of the slope in figure 4? Is it also NPP driven? Does the change in slope occur at different times for different parameter values?

I don't understand what we are supposed to learn from figure 5, if not that Tref matters as a parameter in this type of analysis, because it defines the relationship between k and Q10. So why don't you vary Tref in figures 6 and 7? Is there not uncertainty on this point?