General comments

"Response of microbial decomposition to spin-up explains CMIP5 soil carbon range until 2100" could be interesting to readers in Geoscientific Model Development. This paper clarified how to differ initial global SOC stocks among ESMs in CMIP5 experiment and the initial condition considerably governed future global soil stock behaviors even under the extreme climate change scenario in ESMs. Although the results and messages of this manuscript are very simple, I think that this study can still contribute to the further improvement in ESM due to seriously lack of constrains of initial global SOC as in this study.

I agree the overall comments given by Referee 1. Additionally, there are two major questions and some individual comments on here.

I thought the key finding in this study is that the soil decomposition processes is more dominant process to determine the initial global SOC stocks of current ESMs than C input onto soil from photosynthesis production. So, I recommended this finding should be emphasized more by additional analysis. For example, instead of just comparing between two linear regression analyses (Fig.3&4), can you analyze the relative importance of these two explanatory variables to total SOC?

We appreciate this comment and initially thought it was a very good suggestion. When we looked more closely at our results we noted that the relationship between SOCin and the pools is not significant ($R^2 = 0.01$, $p = 0.766$). We therefore suggest that any comparison between the relative importance of the two variables is likely based on non-significant relationships and could be very misleading. We therefore suggest that SOCin cannot be considered as an explanatory variable for SOC.

In fact, we are not sure the actual earth system getting the equilibrium in the global SOC stock even at industrial era. In addition, SOC accumulation and soil genesis need millennial time scale in situ. So, we can also choice the non-equilibrated state for global SOC stock in simulation. It means that we can get initial states of global SOC stock to be reaching the reference global SOC stock (HWSD) in spin-up procedure before getting the equilibrium (although this method is not used for C, N, O.). If GPP are well constrained by observations, this might seem not to be too worse option. Do you have any recommendation about whether getting the equilibrium of global SOC or not in spin-up procedure?

This is a very interesting suggestion with which we fully agree. Actually, due to the very long time needed by soil pools to equilibrate, we cannot be sure that they have been able to fully equilibrate in the pre-industrial times since, for example, the last ice age.

Also, HWSD represents the current state of the soil carbon pools and we could go further by selecting only model runs that are within this range for the representative period. We have done so with a reduced complexity model (Exbrayat et al., 2014). One issue is that it would potentially require multiple realisations of the computationally expensive Earth System model. However, this problem can be partially circumnavigated by using reduced complexity or statistical models to emulate the behaviour of the more complex model.

We will add few sentences about this issue in our revised manuscript.

Individual comments

P3488L8-9 If you have any literatures using such an explanation, please cite here.

We do not have a reference to support this statement. We just suggest that checking whether some models are not at equilibrium is the first obvious step in this investigation of the reasons why simulated SOC pools vary that much between models.

P3488L29- P3489L2 I don't think these statements are meaningful. During the historical periods, it is likely that all models without N cycling scheme are parameterized under N limitation conditions. Therefore, the comparison between them doesn't give any information in this context.

We are not clear with this comment from the reviewer. The logic is that models with an active N cycle should have lower pools than the others because N actively reduces NPP and SOC_{in} in these models. However, here we find that it has more to do with these models having a faster SOC turnover rate.

P3488L26- P3489L8 You should mention the differences in the variation between SOCin and decay constant among ESMs. Especially in SOCin, are there any comparable values in previous literatures?

Yes – we agree and will add that piece of information in the revised manuscript.

P3489L9-18 Are there any relationships between SOC residence time and (mean?) decay constant "k" in each ESM or between SOC residence time and the number of components in each ESM? This is the important information how to adjust decay constant of ESMs?

According to our results, SOC residence time is not affected by the number of pools represented in the model and we will add this piece of information in the revised manuscript.

Fig. 1&2 Please re-size the aspect ratio to be 1:1 (X axis: Y axis) of all figures.

Fig. 3&4 Please line up these two figures.

All figures There are too large significant digits in regression results.

We will improve the figures following these guidelines.