

Comments on MacDougall: “Estimated effect of the permafrost carbon feedback on the zero emissions commitment to climate change”

General:

The study assesses the effects of permafrost soil carbon emissions on expected changes in global temperature after the cessation of CO₂ emissions, called Zero Emissions Commitment (ZEC). Permafrost regions are the main potential carbon source due to warming and their long-term effects are not yet well understood. The study thus contributes to a very important topic. Methods are in most parts well described, but I think results and discussion should be expanded to better understand the findings of the study. And the findings are not so clear formulated either. I would suggest to expanding both sections.

A main conclusion, which is only little touched in the discussion and the introduction, but not in the conclusion, is that the structural uncertainty seems to be much more important than parameter uncertainty. But of course it is always a great effort to investigate these structural uncertainties, but perhaps necessary to capture the full range of uncertainties. The scenario uncertainty seems to be of minor importance, pointed out here, which I doubt, but maybe you could exercise a bit more on understanding this minor importance.

Methods:

Why is a separate pool needed to simulate permafrost carbon? Is there a second non permafrost-carbon pool in permafrost affected regions? I conclude that only permafrost soils have a passive pool in the UVic ESCM, right? And you tune the passive pool to match observed driven permafrost carbon estimates.

These and the following information are important to understand the permafrost carbon feedback effect and how you have contacted the model experiments. What are the assumptions for the non-permafrost experiment, which carbon amount do you assume? The non-permafrost carbon pool appears to be different in both experiment due to the existence resp. non-existence of cryoturbation. What are the differences in global soil carbon amount after emission cease? It seems to be important as you compare always to this time. Do you assume a vertical soil carbon distribution in regions which are not affected by permafrost?

Results and discussion:

Figure 3: Can you explain why ZEC (°C) declines after fossil fuel emission cease in both permafrost and no permafrost carbon case. Or does it decline until fossil fuel emission cease, but than I do not understand the caption, it states: “relative to the year emission cease” Secondly, is that really relative, it seems to be absolute values.

Figure 4,5 (b) no numbers are given in the result section

Comparing figure 4 and 5, we see carbon emissions of about an additional fourth of the total emissions in both cases, but only minor effects on the temperature change. Could you give a number of the mean temperature effect of both experiments without permafrost carbon when fossil fuel emissions cease. Now I have seen it in the supplement for the 1pctCO₂ experiment, but there you state that it is concentration driven experiment that does not result in changes in atmospheric CO₂ due to permafrost soil carbon changes. Please explain why it is different after fossil fuel emission cease. At least I didn't find it that easy to understand. What about the other carbon pools? It would be helpful if you could also show ocean carbon pools and vegetation carbon pools to better understand why permafrost soil carbon emissions do not lead to stronger warming.

Figure 6a Isn't it a relative change? And if we look at the trajectory of the permafrost carbon change seems only to decline even if higher vegetation growth due to the CO₂ fertilization effect and higher local temperatures could enhance soil carbon sequestration, no simulation shows this possibility. All show a release of soil carbon, could you explain this in the text please.

Figure 7 again relative temperature changes?

Page 11, line 221: Again, I couldn't follow why a higher emissions from permafrost carbon emissions do not lead to higher temperatures. How different is the atmospheric CO₂ concentration?

Some minor remarks:

Perhaps it will be easier to follow if you would distinguish more precisely between fossil fuel emissions and permafrost soil carbon emissions in the text.

Does temperature change means global mean temperature change?

The author often speaks of "we" which seems very strange with just one author.

Figure 6a and B1 have some label problems, double "ff" seems to be a problem