

Interactive comment on “Microbial decomposition processes and vulnerable Arctic soil organic carbon in the 21st century” by Junrong Zha and Qianlai Zhuang

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Received and published: 9 August 2018

We thank the Associate Editor and two referees for their providing constructive comments to this manuscript. Below we detail how we have revised the manuscript following their suggestions.

General comments. L 76. (here and hereinafter in the text) - "Most models treated soil decomposition as a first-order decay process, i.e., CO₂ respiration is directly proportional to soil organic carbon." The region chosen for modeling is very large. There are ecosystems with very different reserves of SOC on this territory. In reality, there can be no direct dependence of respiration CO₂ from SOC. The main and most active

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processes associated with the transformation of organic carbon and emissions occur mainly in the upper horizons of soils. The authors try to take into account the carbon stocks at different depths of 30, 100 and 300 cm, and according to the model - the more carbon stocks the more it accumulates. However, northern high latitude ecosystems are often represented by wetlands with large organic carbon stocks in the form of peat deposits. While most of them have low productivity, in contrast to boreal forests, where the stock of soil carbon is much lower. Is this taken into account when modeling?

Response: Thanks. The pixels in our model were not split into uplands and peatlands ecosystems. All the carbon pools represent the total amount of carbon for each pixel on a per unit area basis. Similarly, the inventory or observation-based estimates of SOC from Tarnocai et al. (2009) also covers both uplands and lowlands / wetlands across the landscape without explicitly differentiating these land types.

In the abstract, there is no mention of the improved model (only TEM), therefore it is not clear on which model the values of sink or source of carbon were obtained.

Response: Thanks. In this revision, we clarified that the results are simulated from new model, which is MIC-TEM.

Some of model parameters are not presented, a table of the model parameters should be added for example how litterfall is calculated.

Response: Thanks. In this revision, we moved the table from supplementary materials to main text, as Table 1.

It is not clear what territory is taken for modeling - in the name and abstract of article are talking about the Arctic ecosystems, in the Fig. 3 and Fig.S5 represent the territory of the exciting 45°N, in the text 45°N or 60°N - which territory was being investigated?

Response: Thanks. In this revision, we stated that our study region is north 45°N above.

C2

In fact, a period of 200 years (20th century and 21st century) is simulated, which SOC value was taken as the initial value. A value characteristic of 2000 yr or what? When modeling the 20th century, which parameters of the model were taken as input?

Response: The transient simulations for the 20th century were initialized with equilibrated state after spin-up. The initial state variables include vegetation carbon, soil carbon, vegetation nitrogen, soil organic carbon, and the total soil inorganic nitrogen that are obtained after equilibrium, which typically takes several hundred years in TEM (See Qu et al., 2018).

Qu, Y., Maksyutov, S., and Zhuang, Q. Technical Note: An efficient method for accelerating the spin-up process for process-based biogeochemistry models, *Biogeosciences*, 15, 3967–3973, 2018 <https://doi.org/10.5194/bg-15-3967-2018>

The source of MODIS NPP (version, MODIS product name and parameter) are not mentioned. It is also not clear how values of NPP were obtained by model TEM and MIC-TEM.

Response: In this revision, we added the following to main text “The MODIS NPP data was developed by the MOD17 MODIS project. The product name is Net Primary Production Yearly L4 Global 1 km. The critical parameter used in MOD17 algorithm is conversion efficiency parameter α . More information about the MODIS NPP product could be found on https://neo.sci.gsfc.nasa.gov/view.php?datasetId=MOD17A2_M_PSN”.

Please also note the supplement to this comment:

<https://www.biogeosciences-discuss.net/bg-2018-241/bg-2018-241-AC2-supplement.pdf>

Interactive comment on *Biogeosciences Discuss.*, <https://doi.org/10.5194/bg-2018-241>, 2018.