

## ***Interactive comment on “Modeling anaerobic soil organic carbon decomposition in Arctic polygon tundra: insights into soil geochemical influences on carbon mineralization” by Jianqiu Zheng et al.***

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The manuscript proposes a new model to study organic matter decomposition under anaerobic conditions from arctic soil with a focus on implementing the effects of temperature and pH. The research direction is of a great importance and the authors attempt to formulate such effects on carbon decomposition from arctic is also interesting. However I believe the representation of the manuscript could be significantly improved. My major concern is that the current form of presenting the manuscript is not self-standing and a lot of refers has been done to authors previous publications that makes it difficult to follow and evaluate the content efficiently. Similarly, model description is not com-

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plete and no clear hierarchy of the model development and formulation is provided. I understand that the main model has been developed previously but this should not lead to a discontinuous representation that will be non-informative for audience with different background. I strongly suggest improving the model representation and at minimum including a clear schematic with explicit steps that should be taken in formulating such model. Other comments: - Introduction was well-written and provided important and necessary information. However I would still encourage authors to try shortening it that would be focused on the main message of the paper. - While authors acknowledge the key role of hydrolysis to convert SOM (particulate organic matter) to DOC, they have simply ignored this step and no discussion is provided on how the step 1 (Figure 2, conversion of SOM to DOC) is modelled and if hydrolysis is taken into account in the current model. - How the model deals with large discharge rate of DOC that is common in permafrost soil due to lateral flow? - More explanation on how fermentation step is formulated in the model would be helpful. - Q10 values are represented as soil layer combinations. Was there no effect of soil layer? Or there is a correlation with soil depth? More explanation would be helpful. - More explanation on how parameterization has been done and how it has been used in the current model would be nice. - In schematic Figure 2, it is shown that conversion of SOM to DOC produces CO<sub>2</sub>? What is the process for this production? Is it general? - Representation of Table 1 should be improved. Is table 1 and Table S4 representing different system? Please be clear in the captions of the Tables. - In the text, it is mentioned that "The maximal production of CO<sub>2</sub> is about 2/3 of the initial carbon." Where this number came from? - What "process rich carbon decomposition model" mean? - In Figure 8, could you also show the data at 8C which other data points are normalized with? Is only two data points enough to make a conclusion? How do you illustrate huge variations in observation data? What are the actual values for CO<sub>2</sub> and CH<sub>4</sub> production rates at 8C? is it for observations? Is absolute data are comparable? Where is the Shaded area mentioned in the caption? - In Figure 3, notations for Figure 3a are not clear. For example LCP-C1-0? - In general, I found it difficult to follow the model results in the form that are represented in Figures

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3, 6 and 7, 9. Is there a simpler way of showing the model results that one could extract the trends?

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