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Biogeosciences Discussions

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

Anonymous Referee #1

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Summary. Authors implement simple yet effective model of microbial biomass dynamics, that improves NPP/NEE seasonal cycle simulation by modified TEM (MIC-TEM) model for several observation sites in Arctic. They also apply the modified mode to simulating the trends of the soil carbon storage under climate change. The study is valuable and manuscript is reasonably well written, so it can be accepted after implementing suggested revisions.

General comments.

1. It appears that the transient simulations for 20th and 21st century runs are starting from non-equilibrium state, initialized from observations. That introduces artificial dis-

turbance likely to affect conclusions on ecosystem carbon storage trends. Additional tests with well equilibrated initial state are needed to clarify the potential problem.

2. Model description contains several deficiencies and omissions, that need to be corrected (see detailed comments).

3. Model parameters are not presented, a table of the model parameters should be added

4. References in a manuscript and the supplement should be formatted according to Biogeoscience journal format

Detailed comments.

Line 140 (L140) Abbreviation DOC is used, so it should be introduced here rather than at Line 155

L150 "microbial biomass death (DEATH) and enzyme production (EPROD) are modeled as constant fraction of microbial biomass". According to Eq. 6, DEATH appears as a process rate, so it cannot be a fraction of MIC, it can be proportional to MIC. To avoid confusion, authors need to rewrite the Eq. 6 in terms of monthly increments (delta MIC), not as process rates (dMIC/dt).

L152 Formally, if Eq. 6 is right, in Eq. 7 DEATH should appear as a multiple of MIC and a process rate constant, the rate constant (units: sec-1) is missing, the rdeath is a ratio, assumed non-dimensional. Same problem with Eq. 8. Authors should explain what is in fact meaning of DEATH and EPROD, is it a process rate (as appears in Eq. 6) or (monthly) increment due to the conversion from one (organic matter) pool to another?

L157 "MICtoSOC is carbon input" – suggest to write "MICtoSOC is carbon input ratio"

L170 KmðÍŠăðÍŚźðÍŠIJðÍŠÍðÍŚŠ not explained.

L189 The source of MODIS NPP (version, MODIS product name and parameter) are not mentioned.

L225-236 Using non-equilibrium initial SOC taken from observations cannot be recommended for transient simulations, even for a model like TEM, that doesn't have very slow soil carbon pools. Accordingly, additional tests should be made with equilibrated initial SOC set by long enough spinup run (200-300 years) to the equilibrium.

L436-L720 References should be formatted according to Biogeoscience format.

Supplementary material:

Formatting of references should be fixed to same style as paper (also check initials vs full name)

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