I appreciate the authors' efforts in addressing several of the concerns I raised. But I still have some issues that remain unaddressed. I believe addressing these remaining issues will significantly enhance the clarity and scientific rigor of the manuscript.

Response: Thanks for your positive comments on our revision. We appreciate the comments and suggestions for further improvements. In this new version, we have reorganized the contents to make the manuscript more science-focused (dynamics of soil microbial biomass carbon pool and related carbon fluxes and their controls), replotted Figure 14 with more distinct color scheme, updated details clm4.5 output with the correct information, and double checked and updated labels of figures in the main text. Please see the details below.

1. Perhaps a more fitting title could be "CLM-Microbe Simulated Historical Dynamics of Terrestrial Carbon Cycling."

Response: Thanks for your comment. Since we have restructured the manuscript to be more science-focused on microbial dynamics during the historical period and analyzed its underlying reason, we have modified the title to "Modeling microbial carbon dynamics in global soils from 1901 to 2016" to be more appropriate. Please see the title section for details.

2. The current manuscript still presents numerous increasing/decreasing trends and numerical data regarding carbon fluxes and pools without effectively highlighting their most significant scientific findings. While it's challenging to fully integrate all the results, a clearer and more concise presentation of key findings is essential for an improved understanding of carbon cycling dynamics.

Response: Thanks for your comment. We have avoided presenting the trends of fluxes or pools one by one. Instead, we have focused on soil microbial carbon pools and fluxes, considering the crucial role of soil microbes in carbon cycling during historical dynamics across space. Furthermore, we investigated the mechanisms behind those trends or patterns, improving our understanding of carbon cycling dynamics. Please see L. 526-633 for details.

3. Interestingly, the Discussion section offers more scientific insights and is more engaging than the Results section. I recommend that the authors consider reorganizing their narrative to capitalize on this.

Response: Thanks for your suggestion. We have restructured discussion sections to focus on the scientific presentation of microbial carbon flux and pool dynamics during the historical period, analyzed the reasons behind those phenomena, and revealed the potential reasons for correlations of microbial carbon fluxes and pools with external environmental factors. Please see L. 526-559 and 561-633 for details.

4. It's important not to link simulation discrepancies to model differences when using different climate forcings for the two model simulations. If you only have access to CLM4.5 outputs with GSWP3v1, I strongly recommend running the CLM-Microbe model with GSWP3v1 as well to ensure a fair comparison. GSWP3v1 and CRUNCEP are significantly different, and it's crucial to eliminate the forcing difference before making any conclusions about model performance.

Response: Thanks for your comment. The GSWP3v1 and CRUNCEP are different, although they are both widely used to force community land models. We double-checked the validation data from the CLM4.5 output and noticed that we did use the model output with the CRUNCEP as driving forces; we should have updated the main text. In this new version, we have updated the main text about clm4.5 output; please see https://www.earthsystemgrid.org/dataset/ucar.cgd.ccsm4.clm45_clm50d001_1deg_CRUNCEPV7_hist.html and L. 247-255 for details.

We appreciate this comment that urged us to double-check and further correct the mistake in the main text.

5. The revised manuscript still lacks explanations for the results presented. For instance, in section 3.5, the authors discuss positive/negative correlations between GPP/NPP/VegC and MAT/MAP without delving into the underlying causes behind these findings.
Response: Thanks for pointing it out. We agree with the reviewer. In addition to the influence of environmental factors on biological processes, correlations are an essential part of our results; adding mechanisms behind those correlations can help make the manuscript more solid. This revision revealed the potential reasons for correlations of microbial carbon fluxes and pools with external environmental factors. Please see L. 596-633 for details.

6. Regarding color schemes, I appreciate the adjustments made in some figures. However, in Figure 14, the color scheme remains problematic as it doesn't effectively distinguish values.
Response: Thanks for pointing it out. We have replotted Figure 14 to make it distinct in color scheme and effectively convey information. Please see the updated Figure 14 for details.

Minor comments:
• Line 24: Please avoid using abbreviations here. Instead, write "soil temperature" and "soil moisture" explicitly.
Response: Thank you. We have replaced ST and SM with soil temperature and soil moisture, respectively. Please see L. 22 for details.

• Line 586: Figure S3 compares simulated and observed DOC, which is unrelated to the increase in GPP and NPP.
Response: Thank you for your comment. The comparison between simulated and observed DOC is part of our validation; please see L. 263-272 for details. We were expected to explain increases in GPP and NPP from the perspective of rising mean annual temperature and precipitation, as shown in Figure S4. We have replaced Figure S3 with Figure S4c; please see L. 544 for details. In addition, we have double-checked all figures labeled in the main text and updated them with the correct figure if they were mislabeled earlier. Thank you.