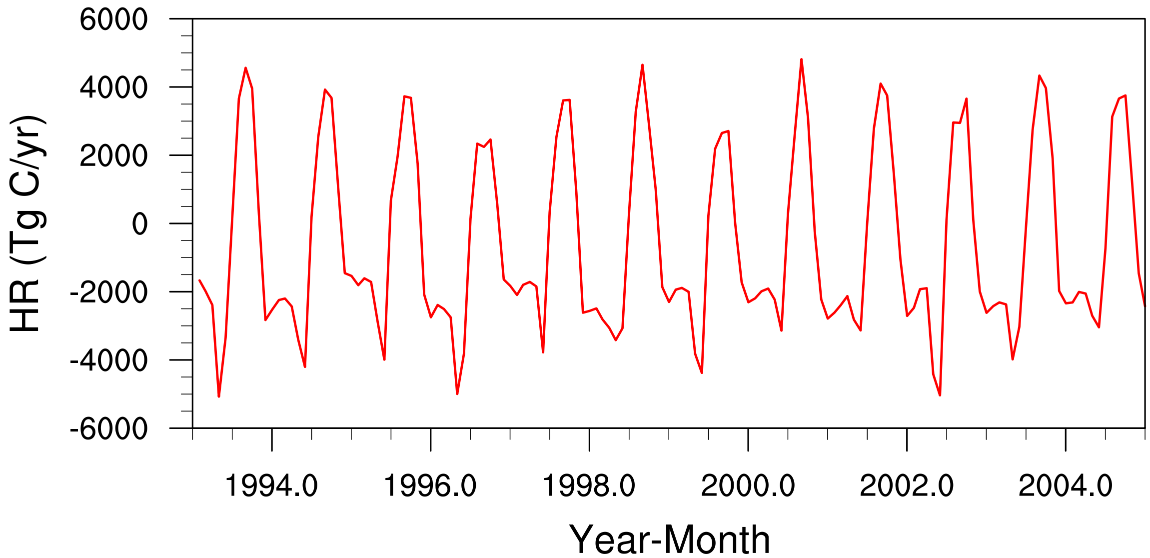
We thank review #1 for the helpful critical comments and suggestions. Below, we respond in detail to the comments and suggestions (our responses are in red).

Comments on "Seasonal and inter-annual variability in wetland methane emissions simulated by CLM4Me' and CAM-chem and comparisons to observations of concentrations" submitted by L. Meng et al. to Biogeosciences. General comments This manuscript described results of global terrestrial CH4 emission from wetlands simulated by CLM4Me's models and atmospheric CH4 concentration simulated by CAM-chem. The authors compared these results with previous model estimates and observational data. Modeling CH4 emission is undoubtedly an important task for understanding and predicting the Earth system, and fits the scope of journal.

The authors present plenty of materials showing seasonal and interannual variability in their simulated CH4 emissions and atmospheric concentrations. Moreover, they made comparison with TransCom-CH4 and WETCHIMP data, and conducted several model experiments. The manuscript seems well prepared but I would like to recommend several modifications. First, it is unclear and somewhat confusing why the authors used two model versions: i.e., CLM4 (CN) and CLM 4.5 (BGC). If the latter is the latest (e.g., incorporating an updated scheme) one, I think using the CLM4.5 (BGC) is sufficient. If you persist in using the two versions, I recommend presenting more descriptions for the different schemes. At present, I could not understand from the manuscript why (i.e., by which process and factor) the two versions of CLM provided different results. Second, several figures can be removed or merged; the present manuscript contains as much as 20 figures. For example, data in Figure 19 seem to have been presented in Figure 18. Third, more importantly, it is unclear for me what is the advancement of this study compared with previous studies. The only message of this study seems that uncertainties remain in your model estimation. Please clarify progress and derive more insightful implications from your simulation results. In conclusion, the manuscript is not acceptable in the present form and requires at least major revision. In addition, the manuscript has several issues (see below) that should be addressed.

Response: The main concern that Reviewer #1 has is the difference in methane emissions between the two versions of CLM. In order to provide more detailed information on the changes in carbon and nitrogen models from CLM4.0 to CLM4.5, we added section 3.2.3. Here is what we added in section 3.2.3:

The large difference in spatial distribution of methane emissions between CN_a (CLM4.0) and BGC (CLM4.5) experiment is due to the change in soil biogeochemistry and soil C and N models from CLM4.0 to CLM4.5. Koven et al. (2013) conduct a detailed analysis of the effect of such changes on C dynamics in the CLM model. Here we briefly describe the changes that most affect high latitudes C dynamics, where the differences are the largest. The carbon cycle is linked to the Nitrogen (N) cycle because N availability in soils will affect vegetation growth. In the CLM4.0, available mineral N experiences a first-order decay with a time constant of two days that is not subject to environmental limitations. In high latitudes, the long winters will allow most mineral N to decay and only a limited amount of N is available for vegetative growth during the short *growing season. Therefore, CLM4.0 estimates a low productivity and produces low heterotrophic respiration (HR) that is available for conversion to methane production (in CLM4Me, methane production is a function of heterotrophic respiration). In CLM4.5, the dependence of N losses on T and soil moisture and seasonality of N fixation are introduced so that the unrealistic N limitation in CLM4.0 can be reduced. Thus, CLM4.5 allows for more N to be used for vegetation growth and produces higher soil C, higher HR, and thus higher methane fluxes. As shown in Appendix A, HR in CLM4.5 is much higher than that in CLM4.0, particularly in northern hemisphere summer seasons when most of CH_4 is produced. Please note that annual CH4 emissions from northern latitudes are not affected by winter season HR because CH4 is not produced in winter seasons due to below-freezing temperatures. There are other changes made to the Carbon and Nitrogen model in CLM. Please refer to Koven et al. (2013) for details.*



In this diagram, we used the units Tg C/yr so that readers can compare it with methane emissions (Tg CH4/yr) on Fig.5.

We take it from the reviewer's comments, that we were not clear enough on describing the innovation in this paper. The advancement of this study is that it suggests both anthropogenic and wetland methane emissions have significant contributions to seasonal and inter-annual variations in atmospheric CH4 concentration. It also points out that not only the methane module itself, but the underlying carbon model can drive uncertainty in both the seasonal and interannual variability. We have modified the abstract and conclusion portion to reflect both points so that both proportional contributions and uncertainties are emphasized in this manuscript.

We also removed Figure 19 from the original manuscript.

Specific comments Page 2163 Line 20 Chen and Prinn (2006) is not found in the reference list

Response: added in the reference list. Thanks,

Page 2064 Line 17 “adde” should be “added”
Response: corrected.

Page 2166 Line 13 Add “(” before “Fung”
Response: corrected.

Page 2168 Line 4 Clarify the spatial resolution of CLM4Me’s simulations. Is it the same as that of CAM-chem? The NCEP/NCAR reanalysis has the spatial resolution of T62, which is different from that of the CAM-chem.
Response: the spatial resolution for both CLM4Me’ and CAM-chem is 1.8X2.5 degree.

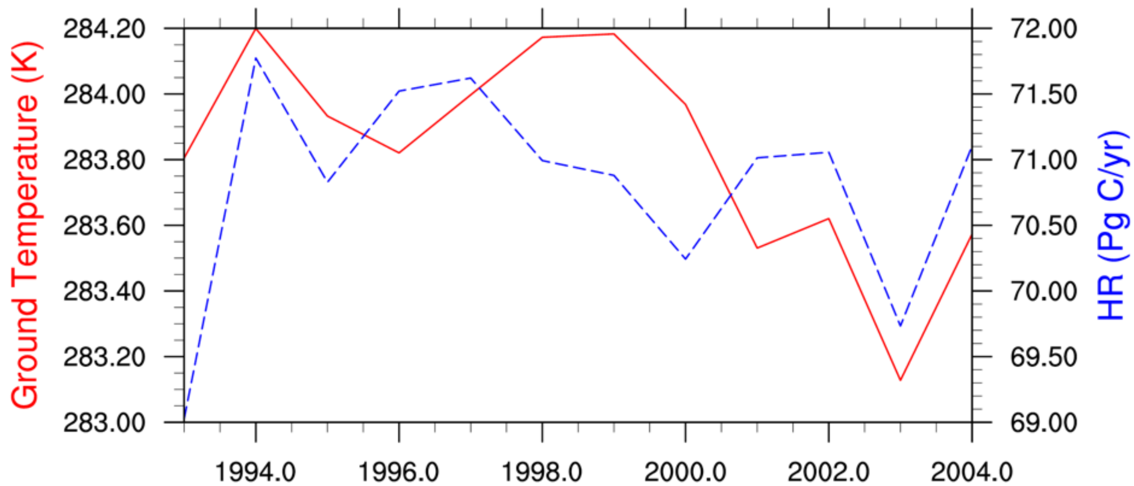
Page 2170 Line 24 From the statement here, it seems that you calculated relative contributions to total RMS instead of absolute RMS for each component. Please check.
Response: Thanks for catching this. We have modified the captions for Figs 8 and 9 to clearly indicate the proportional contribution of total RMS from each source.

Page 2172 Line 25 Do you mean “on the right” instead of “on the left”? Latitudinal figures are given on the right of Figure 6.
Response: corrected.

Page 2175 Line 7 In Figure 8, high seasonality caused by rice paddy in North America seems to occur in central Canada. Is it reasonable?
Response: We think it is reasonable. Please note that we are talking about atmospheric CH_4 concentration. Methane emissions from surface may be transported to nearby regions through large-scale atmospheric circulations. So surface emissions may have remote impacts on atmospheric concentrations.

Page 2180 Line 13 Why HR increased dramatically in from 1993 to 1994 in the CN_a case?

Response: The statement here was mainly from Fig. 20 which showed increase in HR from 1993 to 1994. In fact, a 12-month smoothing was applied to Fig. 20. The following figures show annual mean HR and ground temperatures. From the figures below, it suggests that HR increase from 1993 to 1994 was possibly due to the increase in ground temperatures. The correlation between annual mean temperature and HR for the period of 1993-2004 is 0.4.



The above figure shows the annual mean ground temperatures and HR from 1993-2004.

Page 2181 Line 1 Most of statements in Conclusions are just a repeat of results. Please focus on conclusive statements and implications in this section.

Response: We have modified conclusions to demonstrate more implications. Thanks,

Page 12 Figure 12 Please clarify correspondence between numbers in the figure and site names (e.g., in Table 2).

Response: We have added station # to Table 2 and corresponded the station # to the numbers on Figs 12 and 13. The captions of Figs 12 and 13 have also changed to reflect this.