Biogeosciences Discuss.,
doi:10.5194/bg-2016-389-RC1, 2016

Biogeosciences Discussions

Interactive comment on "Forage quality declines with rising temperatures, with implications for livestock production and methane emissions" *by* Mark A. Lee et al.

Anonymous Referee #1

Received and published: 25 October 2016

General Comments

The authors present a meta-analysis of forage studies in order to ascertain any impacts of growing conditions on methane production by livestock. Overall I think this study is a valuable contribution by highlighting a positive feedback between temperature increases and methane production by livestock. The clear and succinct project raises many important questions for global methane contributions and feedbacks under future climate scenarios, but could be improved by some additional considerations and clarifications. I did not find that the analysis of Nitrogen addition to add much value as part of the results section, and because of the limited data on this part of the study (and lack of a significant impact for the species with the most data) is to preliminary

an analysis for inclusion. In addition, clarification and discussion if these results are indicative of changes within a species or between species (and relative contributions of each) is needed as this is considerable factor in the assumptions for their model. Furthermore, projections related to RCP 2.6 and 8.5 and increased methane should be developed further than currently presented to clarify the relationship to livestock assumptions in these models and present the spatial variability between regions of the world in more detail. Finally, additional clarification of other assumptions and limitations to this study are needed to generate discussion and thoughts about taking these coarse projections further. Grassland communities are complicated and although the authors show a response to general long term temperature to forage nutritive value, interannual and geographic variability (plus management) are additional important factors. More detailed comments on specifics sections of the manuscript follow.

Specific Comments

Line 42, if 48% of the biomass is grass, would be good to know what composes the other 52%. This is a big deal for methane production and would help with conclusions and discussion points.

Line 51, consider talking about tundra regions here as well since you base your results on this climate type. Since these are harsh climate do they behave like arid regions (stressful) or temperate regions (cooler, so greater nutritive value)?

Line 84, you need to talk about the size of the database here and not just percentages. It is important to know the distribution and number of species across climate types, the amount of data that your fertilizer model is based off of, etc. It is hard to determine if the results you have are from within species variability or across species variability. The two lead to different conclusions and are an important to discussing changes in methane production from cattle in the same locations (are we assuming a change in forage species?).

Line 91, a brief discussion of whether harvested time impacts DM and other variables

and then later on, account for this in the analyses (i.e. on line 109 it is reported that a sample was taken at -5 degrees C).

Line 143, is this for all temperature and rainfall values? Both the month of collection and mean annual values?

Line 167, RCP 2.6 and RCP 8.5 incorporate projections in the amount of livestock as a part of determining changes to radiative forcing. Be explicit here that you are restraining your analysis to just the projected temperature changes as determined by RCP 2.6 and then 8.5, not any changes related to projections in number of livestock in the scenarios or any assumptions about where, feed type, etc.

Line 201, consider splitting the relationship between C3 and C4 plants here as you do in the model later on. Looks like a different response but hard to tell.

Line 203, please revise the table caption to better reflect the four models presented. The comparison to the results section and why the numbers of sites differ, plus the two models for NDF and CP are not clear.

Line 223, please clarify the figure explanation, it is hard to determine where the two scenarios come from in your temperature model for each size of livestock. Also consider some clarification in the methods section where you present equations for these (line 150).

Line 223, I find the nitrogen addition discussion distracting and not needed for the main part of this paper. I think you could make a great point focusing on temperature and save discussion of nitrogen addition to the discussion. It complicates the methods section (data collection) and this is a small part of your database (8%), plus you find a temperature impact for the main species in your data, but not a nitrogen effect (making this a more complicated question).

Line 235, I like the analyses but the figures presented could be more informative. In this case these figures mainly represent areas with larger projected temperature change.

Consider some alternative presentation, such as presenting the % change by continent, or other factor. A table or figure that presents changes by geographic location for different sizes of cattle would give much more information than currently presented in the text and figure. You could even consider ramifications of increased numbers of livestock in addition to the temperature impacts (as referred to in the discussion but not presented in the results).

Line 253, talk here a bit more about the assumptions in the model you have created (data sources, species variability vs community variability, forage type, etc.). Again, I think this is a valuable study and addition, just need to explain what additional information is needed to go beyond the "coarse projections."

Line 300, what is the magnitude difference of increased methane in housed cattle vs. the increase of methane from grass at warmer temperatures. Can you say your overall projection may increase?

Line 331, I liked the discussion overall, and think you cover a lot of good points about the conclusions of the study. Two additional factors to consider are the unknowns of the impact of increased C02 on NDF and CP for grass species (especially C3), how would this impact your conclusions. And secondly, consider a discussion about grazing pressure (which I know you excluded) changing community composition and species response, and those impacts to CD and NDF.

Technical corrections

Line 117, units wrong on elevation (not likely km).

Interactive comment on Biogeosciences Discuss., doi:10.5194/bg-2016-389, 2016.