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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 #2

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General comments The study aims at investigating the relationship between forage quality, methane emissions from livestock, and projected future emissions. The topic is interesting, relevant and timely. The authors have done a good job gathering data to show the variability of forage quality for key quality parameters, plant species and across world climates. And that in itself would be useful material to be published (e.g. Fig. 1 and 2, Table 1) in a specialized forage science journal. What I find less robust, is the use of statistical models derived with forage quality data, and the temperature under which the forage was sampled, to make (future) predictions of methane emissions by livestock. The analyses that would make this manuscript relevant for Biogeosciences are based on a few equations (derived from statistical analyses) which related methane

emissions to the quality of the feed. Temperature is an explanatory variable that was used by other authors (Hirotaka Kasuya and Junichi Takahashi – see Asian-Aust. J. Anim. Sci. Vol. 23, No. 5: 563 - 566) to explain the intake of NDF, whereas methane emissions are driven by the intake of NDF. I find the extrapolation of these equations too week to make global predictions of methane emissions. This sort of study, interesting and relevant, would be better substantiated using vegetation models that represent the physiological processes through which temperature would affect feed quality, and livestock models that would describe the effect of temperature on livestock (heat stress?) affecting the emission of methane. There are more weaknesses in the assumptions used for the study, which I describe below under specific comments. Unfortunately, I don't find this manuscript suitable for publication in Biogeosciences.

Specific comments L108: the authors used temperature at time of sampling, mean annual temperature (MAT) and monthly rainfall (MAR) over the past 10 years. The quality of the forage is associate to the current growing season, most like a seasonal and cumulative effect. So the use of an average long term (10 years) temperature of the temperature of the month of sampling seem inappropriate as predictors of feed quality.

L143-148: the use of equations developed for one experiment conducted in Japan, with a limited set of feedstuff (only 4 temperate climate species) to extrapolate global methane emissions seem largely inadequate for the purpose.

L192: I would have expected a species effect in the analyses of NDF. Under the same climate and soil there will be plants with largely different values of NDF, and other quality parameters simply because of genetic differences.

L232: the use of the selected statistical models derived from one single experiment, with future temperatures seem inappropriate to predict both future and actual methane emissions globally.

L247: I disagree with the authors. They don't describe here a climate feedback, but an

artifact of the use of statistical models and projected temperatures. The relationship between temperatures and plant quality parameters is largely known in ecology. That explains the differences between ecotypes across the globe. However, the authors extend these relationships to the calculation of methane emissions, and that seems incorrect. L264: the differences in NDF and CP across climate doesn't mean that ruminants are under nutritional stress. Livestock keepers manage different species and breed adapted to their climate across the globe. And therefore it is not correct to use one equation derived for Bos taurus dry cows in Japan to predict global emissions of ruminants.

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