

Geosci. Model Dev. Discuss., referee comment RC1  
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## Comment on gmd-2022-176

Anonymous Referee #1

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Referee comment on "Modelling the role of livestock grazing in C and N cycling in grasslands with LPJmL5.0-grazing" by Jens Heinke et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2022-176-RC1>, 2022

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The authors developed a module simulating C and N dynamics of dairy cow grazing. The module accounts for the C:N ratios in grazed biomass, and its impacts on dry matter intake by cows and the C and N partitioning between milk, urine, feces, methane and respiration CO<sub>2</sub>. The module was established based on (mostly empirical) demand and supply equations for metabolizable and digestible energy and protein, empirical functions between characteristics of feeds, and data from feed database and literature. The module was then implemented in to a dynamic global vegetation model LPJmL to simulate the C and N dynamics of a grassland ecosystem under dairy cow grazing with different grazing density, including dynamics in vegetation, soil, and livestock as well as the ecosystem GHG emissions. The module is well constructed, the equations are justifiable, and the validations of the module and the model over four grassland sites are in general well conducted. The manuscript is well written and deserve a publication after revision. I have a few suggestions for consideration during the revision.

- Section 2 "Model description" is long and with many detail, which is necessary for a model description paper and is appreciated. But a schematic diagram linking all components of the module and the equations should be added to help readers get an overview of the module/model. In addition, a look-up table listing all abbreviations, variables and parameters used in the manuscript would be necessary.
- Given the fact that 1) this module only focus on dairy cow grazing over grassland, 2) the manuscript is mainly describing the module and the site application to infer the model's performance, and 3) cow grazing is one of the many herding systems in the world (actually not a dominantly widely spread one, especially over vast semi-arid rangeland), it is not needed and appropriate to conduct global simulations, which is not informative at all and out of the scope of this study. In fact, the authors did not pay much attention on the global results too.
- The title and the abstract should be revised to reflect the main point of this study. It is dairy cow grazing rather than livestock grazing.

Minor remarks:

L76: It is not there what is the wFA in Eq. 6 used for.

Fig. 7 unit for upper panel should be  $\text{kg(Protein) ha}^{-1} \text{ yr}^{-1}$ , while the figures could be deleted to make the manuscript more focused.