

Biogeosciences Discuss., author comment AC1
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Reply on CC1

Vasileios Myrgiotis et al.

Author comment on "The carbon budget of the managed grasslands of Great Britain – informed by earth observations" by Vasileios Myrgiotis et al., Biogeosciences Discuss., <https://doi.org/10.5194/bg-2021-144-AC1>, 2021

Reply on general comments:

We would like to thank the reviewer for their comments. We understand that our methodology section (as is) does not describe how data and modelling were used in a clear manner; and this concern is shared among the three reviewers.

We will revise the methodology section by adding new text, by including flow charts of how data are used and by describing how the DALEC-Grass model works in more detail. We will also add a section in materials and methods that clarifies the C accounting terminology and what every related abbreviation refers to. We will also ensure that the reader is always reminded the sign convention i.e. that "-" before an NEE/NBE value shows a C sink and "+" a C source . In this context, three new figures that we propose to include in the revised manuscript are attached here (figures.zip). Moreover, we will expand the text on limitations and possible solutions and discuss some options such as the this reviewer's suggestion on coupling (or incorporating) soil water models with DALEC-Grass.

Replies on specific comments:

Comment : The same was for manure. Where did Manure come from and how Cardamom accounted for Manure (C/and N) ? EDINA database? (see L368)

Reply : Manure production is estimated on the basis of simulated grazed biomass. 32% of the simulated grazed biomass is converted to manure and added to the litter pool. As it is impossible to infer the type/age/weight of animals grazing a field using satellite imagery this conversion factor is an average for dairy/beef cattle and sheep based on UK and northwest european data. We will clarify this part in the revised document and provide references for the conversion factors for the grazed biomass. Conversion factors (shown as % of grazed biomass) are presented in the attached DALEC-Grass schematic.

Comment (L 134ff) : "At each time step the algorithm reads the vegetation reduction information and decides whether to simulate the corresponding ..." this is not quite clear and I wonder of a flowchart will help? What is the time step? Do you mean management practices coming from Edina AgCenesus . If yes please refer to section 2.1.5

Reply : We understand that this part is not clear. The process of deciding whether a

vegetation reduction value (vegetation reduction is model input driver) will be simulated as grazing, cutting or not simulated at all is described in Myrgiotis et al (2021). Inferring management and predicting sub-field scale C dynamics in UK grasslands using biogeochemical modelling and satellite-derived leaf area data. *Agricultural and Forest Meteorology*, 307, 108466. <https://doi.org/10.1016/j.agrformet.2021.108466>. We will expand the model-description text to explain the way this is done.

Comment (L212ff) : "To assess the effectiveness of the LAI assimilation process we quantify the level of fit between MDF-predicted and EO-based time-series using ..." Until now I did not get that Cardamom estimates LAI (see L 141 and L241) put is used this as an input. Seems I have missed a point. Can authors please clarify. (eg in a scheme?)

Reply : We understand that the lack of clear description of the use of data in the materials and methods section has caused problems. We believe that new text and figures will help the readers understand better what the model-data fusion (MDF) framework does and how DALEC-Grass is used as part of the framework. The framework is used to implement the model and provide the predictions for the presented variables we, therefore, refer to "MDF-predictions" and not "model-predictions" to reflect this fact.

Comment (L235 and L 331ff) : RCR is equal to the size of the MDF-predicted 95% confidence interval divided by the corresponding..." please help the reader to get the number in the right way. eg RCR is $42 \pm 9\%$ for LAI, means the uncertainty of LAI is 43% so very high? Or very low? With respect to which best value?

Reply : The relative confidence range (RCR) presents the uncertainty around the MDF-predicted variables (e.g. LAI) as a %. It shows how wide the 95% confidence intervals (i.e. 2 standard deviations, assuming normality) are relative to the mean value. The cartogram shows the distribution of RCR across Great Britain and the violin plots the distribution of RCR grouped according to whether grazing or cutting was the main removal method (i.e. most biomass was removed via grazing or via cutting). The assimilated LAI data come from processing Sentinel-2-based images (20m resolution) and have an uncertainty attached to them. This means that every 400m² of a field has an uncertainty that is attributed to "instrument error" (remote sensor). This uncertainty is not always examined in the relevant literature but studies suggest a value 15%; the standard deviation around each LAI data point per 400m² is 15% of the value which converted to RCR is 30%. We use a field-mean LAI for each simulated field which means that uncertainty is amplified when we calculate a field-average LAI. Taking this fact into account and considering that MDF predictions incorporate model parametric uncertainty a mean LAI RCR = ~40-50% is proportional to the observational uncertainty. This is not discussed in sufficient detail in the manuscript and we will revise accordingly.

Comment on suggested references to include. **Reply** : These are interesting and very relevant studies that we will include as references in the revised manuscript.

Please also note the supplement to this comment:

<https://bg.copernicus.org/preprints/bg-2021-144/bg-2021-144-AC1-supplement.zip>