Biogeosciences Discussions

Biogeosciences Discuss., referee comment RC1
https://doi.org/10.5194/bg-2021-241-RC1, 2021
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Comment on bg-2021-241

Anonymous Referee #1

Referee comment on "Effects of climate change in European croplands and grasslands: productivity, greenhouse gas balance and soil carbon storage" by Marco Carozzi et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2021-241-RC1, 2021

General consideration:

This manuscript shows the impacts of climate change in the European cropland and grassland production systems towards year 2100. Specifically, by using two biogeochemical models, the work focuses at assessing changes in plant productivity and biogenic GHG (N2O, CH4, CO2) balance. The paper is well detailed and structured, the language is appropriate and is fluently flows. However, to my opinion, some very important weaknesses are presents:

- The novelty of the paper is quite low. Further modelling studies have been carried out at larger scale to assess changes in productivity and GHG emissions. The 2100 threshold is quite far and, even in the view of the EU policies mostly focused at nearest GHGs thresholds, the provided results risk to be very speculative and not very close-to-reality to provide suitable information for policymakers as suggested in line 74-75.
- Modelling works do need appropriate model parametrization such as climate variables, soil properties, vegetation parameters and management. Whereas climate and soil properties are clearly reported, several information in the other components are missing or shows very low confidence. For instance, for the management characteristics, I appreciate the effort of the authors to obtain all these information. However, some parameters need to be better explained and discussed. For instance, sowing dates and fertilization were imposed but, for sure, these cannot reflect all the possible variability observed in the whole EU. I understand the need to impose fixed parameters for running the model, however it is also necessary to indicate the results can be affected by uncertainties due to the application of these fixed parameters. My main concern is about crop parametrization. In line 175-176 authors indicate a crops parametrization based on those applied in previous/other works. However, no reference has been reported. Also, I was wondering how authors were able to retrieve and summarize all these crop/grassland information since modelling study are often carried out at single point/area, with different parametrization for the same crop over different areas, and do not report these data. This is also true especially for grasslands where, as the same authors says, very low information are presents. There is no explanation

about these parametrization (i.e. water efficiency, radiation use efficiency, maximum and minimum productivity, etc.) were found, from which studies, and how these parameters were summarized to find the most representative/suitable for each of the applied crops.

- My main concern is the point 3.1.1., model validation. Model validation should provide a confirmation about the model capability to represent the crop growth, development, and production in different environment. However, looking at picture 1a, does not seem that models are able to reproduce the correct behavior of each single crop. Putting all crops together may create an inthrinsic error and does not indicate if each single crop is well reproduced. For instance, looking at sugar beet or potato, I'm not able to see a proper correlation between modelled and observed crops. In order to provide a robust validation, each crop should be singularly validated and then reported, so as readers are able to see the model confidence and robustness at reproducing the crops. This is needed also to provide robust information about the expected changes due to climate change. Therefore, I suggest authors to provide single validation for each crop and then summarize them in scatterplot or table with the relative statistics. Concerning grasslands, results are very poor for all areas. For instance, for the sole Mediterranean data (L272) the overestimation of 55% do not allow to indicate these data as robust enough to be accepted. This overestimation led to unplausible results under future conditions, resulting not useful and misunderstandable for readers and policymakers. I understand the lack of data, however more recent and affordable information on productivity could be taken by remote sensing and new analysis may be done to provide more robust results. I understand the effort of the authors, but grasslands systems are very complex and sensitive to climate change, especially considering the dynamics involving water reduction and species changes. These results do not take in account changes in composition that, in turn, also affect productivity, neither provide robust statistics. Finally, as indicated for crops, at least model calibration/validation for single areas (if not for pasture composition) should be carried out, to make results more robust.

I appreciate the wide analysis done by authors; however, the above-described issues make the level of confidence of these results very low. Discussion section do not address this high level of uncertainty and only report the agreement in the impacts with other studies. This information is quite negligible if not accompanied by a strong model performance in the magnitude of the results. Simulated dynamics are found expected since driven by common algorithms (i.e., GDD for crop growth), but robust information about the expected change need to be provided. Whilst crop data may be improved, I'm quite concerned about pasture dynamics which need to be adequately addressed through a more consistent approach since, at this time they cannot be accepted as here proposed.