## Reply to report 1 from Referee2

**General comments**

Concerning the content and the structure, the manuscript is improved, its structure is more concise and objectives are more comprehensive now. The connection between soil organic carbon stocks and the components of the carbon budget is now clearer to see. The authors addressed my previous comments and e.g. added an improved justification of the study area for applying the presented approach.

However, there are still minor points to improve. Some sections are still very lengthy, e.g. the first part of the discussion is too descriptive and repeats the findings from the previous section instead of placing them in the wider research context. E.g., the finding that the number of image acquisitions leads to reduced accuracy, but specific sensors increase the accuracy, needs to be discussed more clearly. What are the limitations and also steps forward to improve the approach? Shall users focus on careful image pre-processing (cloud filtering) or sensor selection, what advices could you give based on your findings?

Further, the abstract lacks the most important research findings.
Unfortunately, the manuscript still needs to be linguistically revised. It is not so much the spelling mistakes, but often sentence structure and transitions as well as few grammatical errors that make it difficult to read. Please check the references and short citations in the next, as they are numerous redundant brackets and inconsistent formatting!

We thank Referee2 for his constructive and detailed comments that improved the readability of the paper and teh presentation of the findings. We modified the paper according to his recommendations. The first section of the discussion (section 4.1) was enhanced with a better discussion of the results and a clearer transition between the findings and limitations. Discussion on the impact of remote sensing data was also enhanced by adding the recommendations on selection of complementary remote sensing sources and the . The abstract was modified and more insights about the results, discussion and recomendations were added. The paper was revised. The citations formatting was corrected. At the final stage of publishing, we will also recheck with the publishing editor if incompatible formatting is still present.

Point-by-point answers on the specific points are provided below.

**Specific comments**

**Abstract Lines 15ff**

What are the main findings here? You rather describe what was done but I am missing an interpretation/discussion of what we can learn from the findings. Please add some insights from the discussion (on data comparison, the difference between pixel- and field scale and the impact of remote sensing images). How are your results, e.g. the accuracy values, the bias or the affected percentage of

uncertainty, to be evaluated? Are the values high, surprising, low - what is new? What are the ways forward?

The abstract has been updated to better highlight the main findings quantiativly and summarise the elements of the discussion.

**Line 25 – "soil organic carbon (SOC) storage has the potential to remove 0.6 to 9.3 Gt CO2 yr-1"**

At which scale – global, Europe-wide or regional? Please specify.

It is at the global scale. We specified it in the text.

**Line 34ff – "..shows the importance"**

The equation rather shows the linkage between those components and, as a consequences, it is important to quantify them in order to better understand the effect of changing farming practices on the carbon budget. Please rephrase that accordingly and provide more information on the overall objective of the quantification.

Agree, modified to "shows the linkage". The corresponding paragraph has also been enhanced.

**Discussion**
**Section 4.1** Instead of an almost 1-page descriptive text about the results from other studies, a figure or table with an overview of the selected studies their results in R$_2$, RMSE, site characteristics etc. compared against the metrics of this study would be useful here.

In addition, please highlight more clearly what we can learn from that. You write that performances "are close to or better than existing state-of-the-art evaluations" but what does that mean? How high is the agreement or the improvement? Does that mean with **less input** variables you can yield better results? Please provide more information on what we can learn from the experiment!

In the submission after first review process, the section "4.1" was added following the request from the previous review. In the current submission, we have rewritten this section based on the additionnal recommendations of the reviewer. We added the scores for the AgriCarbon-EO in the text of this section, and added conclusions and recommendations. We didn't add a table to this section. Because there is a high diversity in the conditions of each study making it difficult to add to a concise table that takes into account the conditions (resolution, reference, area of application…) and results (stats for each variable), knowing that not all variables are covered by each of the studies. The paragraphe is now mentions:

A Comparison with previous iterative retrieval with the SAFYE-CO2 model that is included in AgriCarbon-EO, showing that the assimilation scheme doesn't degrade (enahnces in some cases) retrieval values. Comparison with other studies on NEE and GPP showing that it is possible to have similar to better results considering lesser inputs and constrains. A comparison for Reco pointing the

need for a better soil module in AgriCarbon=-EO. A comparison for biomass and yield. A summary of the conclusions and the need for more comparative studies in the future.

**Line 548ff**: **"The same approaches may be penalized when applied to areas with high spatial variability, such as the hilly countryside in southwestern France"**
How about your approach applied to an area with low spatial variability? Please provide information on the scalability of your approach to other regions!

We don't see an issue with the application of the approach to a lower spatial variability. Generally, the challenges arise in high spatial variability. Other impacts may arise in other regions, like for example a greater presence of clouds. These are discussed in the relevant discussion sections of the manuscript. Considering the genericity of the input data in AgriCarbon-EO, large-scale and multi-site testing of the chain will provide more insights into the robustness of the approach across regions and ecosystems. In this sense the comments by the reviewer are valuable, but certainly, this is beyond the scope of this paper where we presented and validated the approach at a regional scale.

**Technical corrections (please check again! This is just a selection)**

- Line 26: remove ")"

  Done.

- Line 28: remove " )" and redundant spaces and brackets in the references

  Done.

- Line 30: remove brackets in the references

  Done.

- Line 46: insert space in "theregional"

  Done.

- Line 47: change references into readable format

  The reference to the studies were added.

- Line 47ff: insert hyphenation and commas where needed

  Done.

- Line 58/59: remove brackets in reference

Modified, we will also recheck during the publishing phase with the publishing editor for all requirements.

- Line 561ff: wrong sentence structure! please change to "our approach will benefit from

  Improvements..."

  The corresponding paragraph was modified.
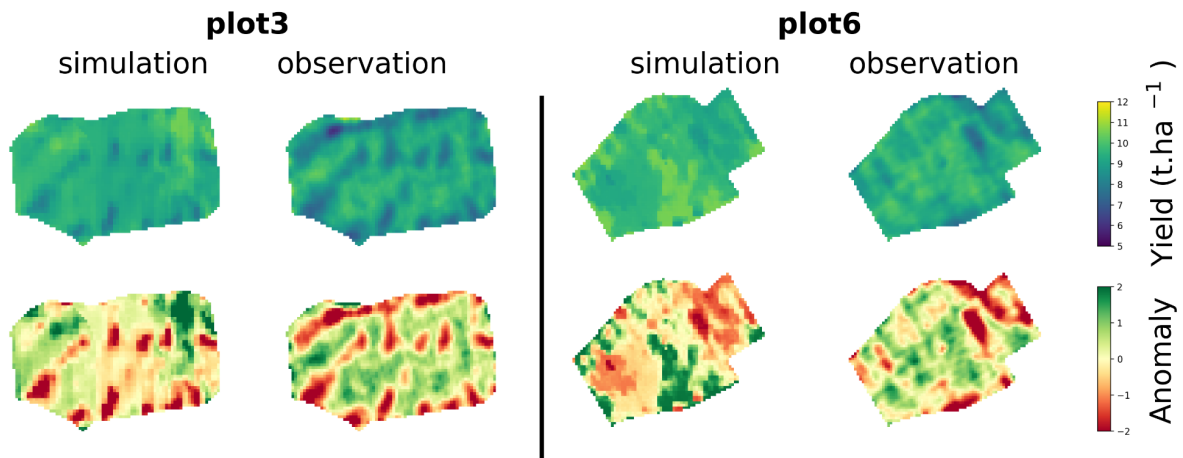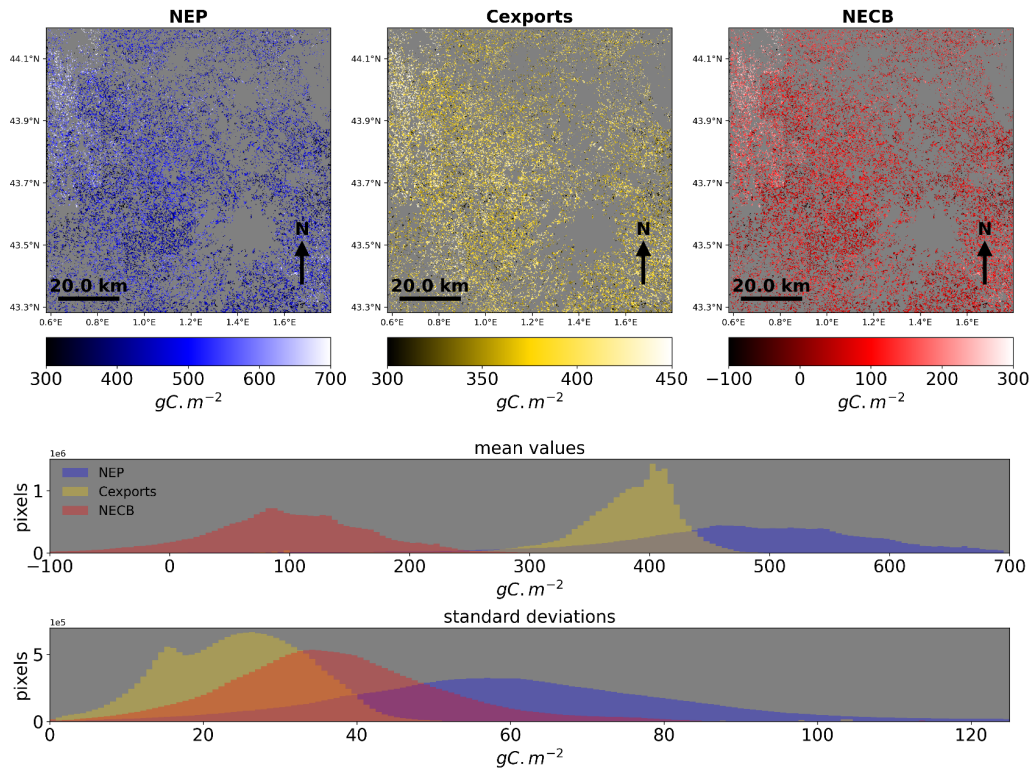
- Figure 5: typo in the axis labels

  Corrected.

Figure 6A: Please use different colour scaling for the different maps, as the spatial differences in the middle plot are not visible at all.

Modified. Each variable has it's own colour scaling and colour bar which matches the main color in the histogram.

**Reply to Report2 from Referee3**


We would like to  thank the Reviewer for their constructive comments that contributed to improving our manuscript. We updated the figures and the text as requested. Furthermore, we also provide point-by-point answers to the raised comments.

Specifically:

Table 2: How was the range of priors defined? Were they empirically adopted?

The baseline for the determination of the priors was based on the previous implementation of SAFYE-CO2, namely in **Pique et al. (2020a)**. In fact, the BASALT - Bayesian approach - in AgriCarbon-EO requires statistical distributions for the priors in contrast to initial values and range in the iterative retrievals implemented in **Pique et al. (2020a)**. Consequently, we added a mean and standard deviation to the minimum-maximum of the range of the parameters. The value of the standard deviation for the priors is based on a sensibility analysis. The minimum and maximum values are based on physical limits. The priors are generated based on a Gaussian distribution that respects the conditions for the mean and standard deviation and constrained to the minimum and maximum values. The fixed parameters for the wheat crops were not modified from the baseline in this study.

Line 26: The ")" should be removed.
Done.
Table 5: "R2, 2" should be in superscript.
Modified.
Figure 4: There are no y-tick values.
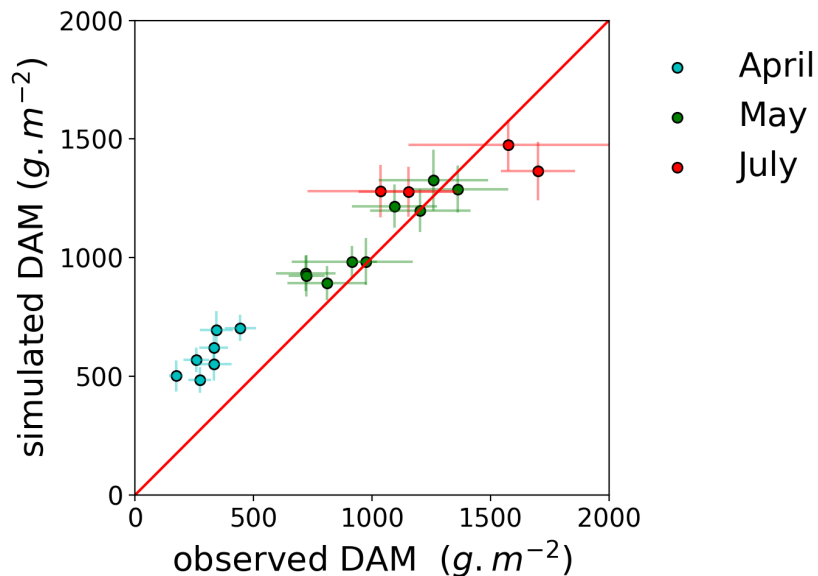The figure has been corrected as presented below.



Figure 7: The numbers/digits in the wind rose plot should be enlarged or removed, as they are currently too small for readers.
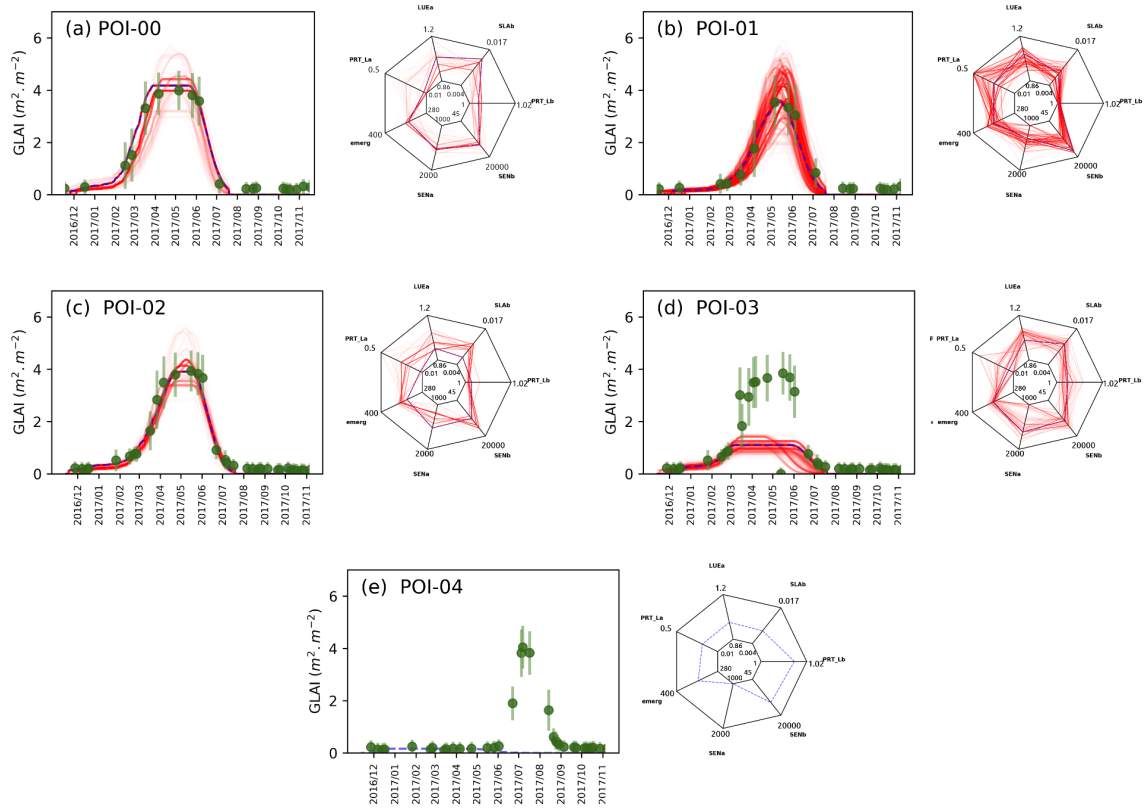
Figure 9: There is an incomplete display of text on the images; "images" needs attention.