Overview

This manuscript combines field scale EC data and satellite derived VIs to estimate the carbon flux over a local cropland in Europe. Several kinds of VIs are used to estimate NEE and GPP based on linear regression models. Their method is reasonably straightforward, and assumption is clearly stated. The results are well investigated from multiple aspects, which makes their conclusions more concrete. Their estimated values including uncertainties are fairly compared to previous works. The authors explain the strengths and weaknesses of their approach very well. Some figures and tables may be a little hard to read/follow to readers, though.

Thank you for the benevolent and constructive evaluation of our manuscript! In the following I will reply to the non-critical comments briefly and adequately to the more critical comments.

Followings are my minor comments and suggestions.

In the abstract, please clarify the size/location of the study field.

Total polder area is around 550ha and since 2005 around 272 ha are permanently inundated. The inundated open water area is around 10 ha.

L20: Please define "RMSE"

Sure! We will add a reference for the formula used as the "root mean square error" is sometimes defined differently.

L79: "limits"

Will be corrected. Thanks!

L86: Please define "NIR"

Sure! NIR = near infrared

L114: Please define "a.s.l."

a.s.l. = above sea level. We will just write it out.

L134: Data "were" measured…

Thanks! Will be corrected.

L141: For date expression, please be consistent ("5th March" or "23 August").

We will revise the manuscript accordingly.

L164: Please define "SCL".

SCL = "scene classification map". Will be added.

L198: There is no "section 0" in this manuscript.

Sorry about this mistake. This is obsolete.

L222: It will help to put the total NEE, GPP and Reco for each growing season in Fig.2 as you did for the climate parameters.

Yes, very nice idea. We will add this information to Fig. 2. Thanks!

L254: "apart from" Do you mean "except for"?

Yes, thanks. Will be revised.

L277-278: The VI observations are sparse compared to NEE/GPP, so it might be hard to tell "these VIs lag about 18 days behind the NEE signal for the senescence period of WR" from the Fig. 3. Please specify how you verify it.

True, VI observations are generally sparse. "about 18 days" is only an average across VIs based on the observation that given VI values had reached a plateau at the same time as of max. C uptake (= min NEE) and do not drop at the same time as NEE decreases, as another high VI value can be observed about 18 days later before the next VI value is much lower.

L308: Please define "lowess (should be LOWESS)".

We will change to "fitted line" as explained in the manual of the R-function used: chart.correlation of the R-package "PerformanceAnalytics".

L287-288: Why the signs of correlations are opposite of yours?

Signs are opposite because Baldocchi (2008) and Baldocchi et al., (2015) use the opposite sign for GPP as we do. Which sign to report final GPP values in does not follow a convention. Both can be used and the absolute correlation, which is the important information, does not depend on the sign.

L289: This sentence is hard to understand and seems not quite matching the results shown in Fig. 4.

Agreed. It should be along the lines: "NEE correlated highly significant (p<0.001) with all VIs except MNDWI which showed a lower level of statistical significance (p<0.01). GPP correlated highly significant (p<0.001) with all VIs except MNDWI (p<0.01) and NDSVI (p<0.05) which both showed a lower level of statistical significance.

L321 and L324: "nir"--> please define and change to "NIR".

We will change "nir" to "NIR". The definition will be given according to a previous comment by the reviewer (L86).

L322: "swir" --> please define and change to "SWIR".

We will change "swir" to "SWIR" and give the respective definition of "short-wave infrared".

L323: "amongst the highest" is not true. Do you mean "one of the highest"?

For me as a non-native English speaker the difference is very subtle here but I am happy to change to "one of the highest"!

L383: Please define "E". "RMSE" does NOT "increased" (but improved).

Yes, "increased" is wrong. Will be changed to "improved". "E" is defined in L183.

L405: It is not very clear that $R^2$-values are calculated between what parameters.

Agreed. We will change to "Jaszczak et al. (2018) found a $R^2$-value for the linear regression between NDVI and SAVI, respectively, and GPP of WW of 0.56 and 0.59 (p<0.0001).

L422: "τ" --> Do you mean "ρ"?

It is "τ" (Kendall tau rank correlation coefficient) as this is the correlation coefficient used in Wattenbach et al. (2010). We will add a comment noting the different coefficients used.

L434-439: These sentences are hard to understand. "overestimation" and "underestimation" with respect to what? Your estimated results?

Over- and underestimations relative to the measured values at the simulated sites used in the cited publication. We will add this information to the text.

L435: "204" and "217" are for cumulative C flux, right? Please mention that and specify the time period.

Correct. These values are annual sums. We will add this to the text.

L440: "85%" --> "85.66%".

Agreed. Will be changed.

L442: Please add ", respectively" after "(17.93%)".

Sure, will be added.

L443: "1.35 and 1.36" --> "1.36 and 1.35". "(Table 6)" --> "(Table 5)".

Yes, thanks for spotting this! Will be changed.

L451: Please add ", respectively" after "2021/2022,".

Sure, will do. Thanks!

L452-453: This sentence is a little hard to understand. I do not see how it is related to Table 3. Where the number "311 g C m$^{-2}$" come from?

"311 g C m$^{-2}$" is the difference of NEE values of 2020/2021 and 2021/2022 respectively, after converting from t C ha$^{-1}$ to g C m$^{-2}$. We will change the sentence to "Further, estimation-

uncertainty is smaller than the difference of annual NEE values between the two WW growing periods 2020/2021 and 2021/2022, respectively, which was 311 g C m$^{-2}$ (Table 3)."

L467: Please add "," after "harvest".

Thanks, will do.

In sections 3.5.2 and 3.5.3, more detailed explanations of the models are needed such as the model simulation years (is there any inter-annual variability)? Readers might understand better if section 3.5.3 starts with explanation of Table 6, and then give comparisons with references.

Good point! To address this, we will add an additional sentence to section 2.7 introducing the reader to the comparison of our results to results of simulations studies by mechanistic crop models. In section 3.5.3 we will add the information of model simulation years and inter-annual variability from the simulation studies. Furthermore, we will be happy to start section 3.5.3 with explaining Table 6. This is exactly the comment which is needed from an independent reader to improve the readability of the manuscript. Thanks again!

Figure 1: It is a little too hard to understand what the percentage of "cumulative FP area" means. How was it calculated? It is not clear the definitions of "main field" and "area of interest".

We will write out FP as "foot print" area in the caption of Figure 1 and guide the reader to Appendix B, where the foot print modelling is explained. We will there add a sentence in which the cumulative foot print area is explained as the source are of the fluxes, and the isolines denote the cumulative contribution of that area to the flux signal over the measurement period. Further, we will remove "area of interest" as it is synonymously used for main field (Appendix B, L551) and occurs only once in the whole manuscript.

Figure 2 (The top panel): Please specify the duration of "flowering of WR". (the first 2 top panels): please explain the gray dots and black solid lines in the figure caption. Also, please differentiate the GPP and Reco by using different color or line type. I do not see the "urea spreading" in 2020/2021 listed in Table 1.

We will add a horizontal segment to show the length of WR flowering. We will obviously add an explanation of the gray dots and solid lines. Sorry for forgetting. We will adjust the line types of GPP and Reco to better differentiate between them. We will add a vertical line for the "urea spreading" in 2021!

Please give x-axis title as "Time" and do not use the numbers such as 5.3, 1.5, 1.7… which are hard to understand. You could show the dates (i.e. 05 Mar 2020) only for the start and end of the growing season or so. Also, it may be helpful for readers to put the x-tick values at the top of the figure, too.

Figure will be improved according to these comments.

Figure 3: Y-title for VIs should be "(-1)*VIs"? There is no explanation for blue dots. Again, the x-axis' thick name of "5.3, 1.6…" are hard to follow. Please give monthly tick marks and label them properly. Also, it would be easier for readers to compare the time series of

NEE/GPP and VIs if they have a common zero (horizontal) line. Please add legends for the vertical broken- and dotted- lines.

Good point to label the secondary y-axis with (-1)*VI. We will add the explanation for the blue dots and change the labeling of the x-axis. We deliberately have R optimize for the level of 0 of the two signals so the measured C values and the dots of the VIs align most closely. We will try out how it looks when fixing a common 0 line and if readability improves. We will add an explanation of the vertical broken- and dotted- lines. They denote sowing and harvest dates. Sorry for forgetting.

Figure 5: Please put an x-title and change the x-tick name format.

Yes, we will have an improved and uniform labelling of the x-axis throughout the figures!

Table 1: What is "ca."?

Ca. stands for "circa". We will revise to "approx."

Table 3: Please state the unit clearly.

All values are given in t C ha$^{-1}$ season$^{-1}$. We will clarify in the caption.

Table 4: Please explain what the bold and italic numbers indicate either in the caption or main text. Why are ρ-values not shown here (just wonder) as in Table 5? It could be better to make the line thicker between different growing periods (in Table 5, also).

Yes, we will explain bold and italic writing. Bold indicate best performing VIs within a group and italic indicate worst performing VIs within a group. We explain in the caption that all values are significant to the level of 0.001 except where indicated with '**'. Thus, we avoid printing '***' in each cell. That holds true for tables 4 and 5. We will improve readability by thickening the line between the groups.

Table 5: Please explain what the bold numbers indicate.

Bold indicate best performing measures within a group. We will explain this.

Table 6: the top of the 3$^{rd}$ column should be "NEE and GPP estimated [g C m-2]". You could add "*mean*" to Table 4 and 5 as well because it was mentioned in the main text. What does the "**" indicate? Again, please explain about the bolded numbers (it seems they are mentioned in the next, but not all of them are bolded).

Thanks for spotting the wrong labeling of column 3. Will be revised. We will add rows for mean values in table 4 and 5. '**' actually has no meaning and will be removed.

S1 The third paragraph: "Reco … but showed no response the grubbing events". Is this true? It seems the Reco increased between the first and second grubbing events. The last (fifth) paragraph, "GPP and Reco were both lower …": because the signs of GPP and Reco are opposite, "lower" is a little confusing. Could be better to say "smaller".

We will check in more detail on the response of Reco to grubbing events and revise accordingly. We will change "lower" to "smaller". Thanks.