Review of egusphere-2023-3032 (referee comment)

General comments

Zhu et al. investigated the terrestrial GPP estimation using COS within a two-leaf modelling framework. COS flux data were used to calibrate the ecosystem model parameters and to optimize GPP simulations among different ecosystems within the Monte Carlo-based methodology base on the coupling of COS modeling and the BEPS model. The approach is with novelty, and brings new method and knowledge to the field of carbon cycle and also improves the estimation of GPP. In general, the work presented in the manuscript is interesting and worthy of publication. However, there are a few issues the authors should address before publication. The figures, tables and citations are not carefully maintained. The storyline is sometimes hard to follow.

Specific comments

COS fluxes measurements are used to assimilate and improve the BEPS model and GPP estimate. COS itself is also a trace gas in the atmosphere, and the authors are suggested to summarize the measurements of COS mole fractions and relevant modelling studies.

The manuscript is related to another manuscript, Zhu et al, (2023 under review). Authors are advised to cite the previous one and discuss relevance to the current manuscript, e.g. the model approach.

The discussion part is suggested to include a discussion of advantage and disadvantage of the model work.

Technical corrections and Typing errors
Line 1: The title "two-leaf" could be two-leaf without "".
Line 5: change to the affiliation only without currently at. If the co-author is currently only at this affiliation, please indicate with a superscript.
Line 18: 'two-leaf' to two-leaf, and elsewhere.
Line 19: "through the fusion of COS data" to "through the data assimilation of COS flux measurements".
Line 27: GPP should be one keyword. Model-data fusion is not accurate, use data assimilation.
Line 55: "not only the model variables like GPP are expected to be optimized" to "not only the model variables like GPP are expected to be improved".

Line 57: "through assimilating the COS data" to "through assimilating the COS flux measurements".
Line 58: here more related papers should be cited, e.g. Zhu et al., 2023.
Line 65: "LSM" to "a LSM".
Line 72-75: it is too vague to read. Please rewrite what you are going to do in details.
Line 90: "two-leaf" to two-leaf.
Line 95: the model description is not clear enough. Suggest move details to the main text from appendix A1.
Table 1: Is there missing data in a whole year? How do you deal with the missing data?
Section 2.3.1: how do you select the satellite LAI data to best match the field measurements?
Line 129: define ERA5.
Section 2.4: Is it the optimization approach? If so, please rename the section title to show the method explicitly.
Line 159: please refer to literatures.
Line 164: define "behavioral and non-behavioral simulations".
Line 207: "influence GPP modeling but have minimal impacts on COS modeling." To "influence GPP simulations but have minimal impacts on COS simulations."
Figure 1: the parameters need to be explained in the figure caption.
Line 220: Here the text refers to Fig. 2?
Figure 2: there are many subplots in the figure, maybe make it bigger.
Figure 2: explain the parameters and PI in the figure caption.
Line 281: here you refer to Fig. 3? Also Line 287-288.
Table 3: define reduction in percentage.
Figure 3: the order of numbering is something wrong. IT-Soy should be (d).
Figure 3: it is confusing that some panels have x-axis labeled as year, while others are labeled as Day of year. Please make it in consistency.
Line 334: refer to Fig. 4.
Line 341: refer to Fig. 4d.
Figure 4: IT-Soy should be (d).
Table 2 and Table 4: why is RMSE reduction of COS range width is much larger than that of GPP?
Figure 5 and Figure C1: move Figure C1 to main text. Or combine Figure 5 and Figure C1.
Line 390: "Knauer et al., 2020" is not in the Reference.
Line 394: "Ma et al., 2022" is not in the Reference. check reference if all of them are properly cited in the main text.
Line 420: remove "To provide deeper insights into these interactions and highlight significantly correlated parameter combinations, we generated

Fig. 6."

Line 421: "This figure …" To "Figure 6 …"

Figure 6: It is not easy to interpret the information from 3D view. Please try cross-section.

Line 436: define PI before using it.

Line 456: provide citation or the text you refer to.

Line 474: "show a significant range of variation", provide an estimate of the range.

Line 482: "COS modeling" to "COS simulation".

Reference:

Zhu, H., Wu, M., Jiang, F., Vossbeck, M., Kaminski, T., Xing, X., Wang, J., Ju, W., and Chen, J. M.: Assimilation of Carbonyl Sulfide (COS) fluxes within the adjoint-based data assimilation system–Nanjing University Carbon Assimilation System (NUCAS v1.0), EGUsphere [preprint], https://doi.org/10.5194/egusphere-2023-1955, 2023.