We sincerely thank the two reviewers for their valuable feedback, and we are especially grateful to the editor for his patience and efforts on our review paper. We have responded to the reviewers' comments point by point and outlined our modification plan to address the corresponding issues as requested.

This paper addresses a very interesting topic, promising a review of the long neglected field of agricultural VOC emissions. The best thing about this paper is that it present many citations, and highlights some of the complex issues associated with modeling such BVOC emissions. Unfortunately, I found the paper to be too qualitative and confusing to be considered a review, and believe that the changes needed to improve the paper are more than those possible with "major review". I am afraid that I cannot recommend publication.

Reply: We understand that the analysis in this paper is not as quantitative as expected. However we do not aim to present solely a quantitative assessment. The objective is rather to review existing data (which we show that is still scarce today for agricultural land uses) and to propose a theoretical approach to estimate BVOC emissions for agricultural land uses. The conclusion being that it is important to account for agricultural practices and to conduct more measurements in this area to have more data.

Major comments:

The paper is frequently confusing in what is presented, and the numbers presented are often not defined or useful. Some examples:

- *Table 1 presents "BVOC emissions", with units µg/m2(leaf)/h, but the units are for emission factors (EFs), not emissions. More seriously, the numbers are just numbers. There is no information on the environmental conditions under which these EFs were measured. I am guessing that these are not emission potentials (EPs) within either the earlier Guenther systems (ie at 30 deg. C, full sunlight) or the newer MEGAN EPs, so how can we use these numbers? What are they for?*

Reply: Table 1 presents emissions rather than emission factors, as mentioned in the table caption. This table is not for modelling purposes but rather to show the different measurements present in the literature today and the orders of magnitude of those emissions for the different crops and the different phenological stages. We could add a specific column in this table specifying briefly the environmental conditions for each experiment. About the conversion principle of the emission unit is explained in a footnote under the table. For example, VOC is measured in units as µg gdw^{-1} h^{-1}, acquiring the value of weight per m^2 of leaf from their papers or contacting their corresponding authors to get the corresponding values, then multiplying the values to get the unit we presented as µg/m²(leaf)/h. And papers that we converted the values already mentioned in detail in the footnote of the Table 1.
Also, the emission unit can be µg/m²(leaf)/h, as seen in Pihlatie et al., 2005, and Zhu et al., 2022.

Pihlatie, M., Ambus, P., Rinne, J., Pilegaard, K., and Vesala, T. (2005). Plant-mediated nitrous oxide emissions from beech (Fagus sylvatica) leaves. New Phytol. 168, 93–98. doi: 10.1111/j.1469-8137.2005.01542.x
Zhu C.F., Luo HD , Luo LC , Wang KY, Liao Y , Zhang S, Huang SS, Guo XM, Zhang L. Nitrogen and Biochar Addition Affected Plant Traits and Nitrous Oxide Emission From Cinnamomum camphora. Frontiers in Plant Science,13, 2022. 10.3389/fpls.2022.905537

Table 1 also has negative emissions for some species/periods. What are these? My first guess would be deposition, but then why aren't the species deposited at other stages? In any case, nothing is explained.

Reply: We appreciate your insight regarding the negative emissions. These reflect depositions that are also related to local conditions and BVOC atmospheric concentrations. We will provide a detailed explanation in Section 2 to clarify this point. Thank you for highlighting this area that could benefit from further clarification.

- *Tables 2, 4. Same points as with Table 1.*

Reply: We understand that the distinction between emissions and emission factors might have been unclear. Our intention was to present emissions in Tables 2 and 4, as we aimed to highlight the

significance of species-specific emission for arable crops, bare soil, and cover crops. We will ensure this distinction is made clearer in the revised manuscript. We also re-precise that the objective is to show orders of magnitude of different emissions related to different soils, crops, phenological stages, etc.

- *Table 5. Are these emission factors for 30C, 1000 µmole/m2/h, or for MEGAN2 conditions, or something else?*

Reply: The details mentioned by Reviewer 1 have already been addressed in Lines 300-301: "EFs for crop BVOC are currently applying the same standard conditions as those used for tree species (Guenther et al., 2012)." In this review paper, EFs for wheat and rapeseed were derived from measurements in France using inverse MEGAN v2.1, along with field environmental data inputs. Since EFs' standard conditions follows the description in Guenther et al., 2006 [MEGAN v2.0] (Guenther et al., 2012) and "the factor γ is equal to unity under these standard conditions (Guenther et al., 2006) [e.g., as described for isoprene below]," we did not modify any of the default standard conditions in the model.

'The standard conditions for the MEGAN canopy-scale emission factors include a leaf area index, LAI, of 5 and a canopy with 80% mature, 10% growing and 10% old foliage; current environmental conditions including a solar angle (degrees from horizon to sun) of 60 degrees, a photosynthetic photon flux density (PPFD) transmission (ratio of PPFD at the top of the canopy to PPFD at the top of the atmosphere) of 0.6, air temperature=303 K, humidity=14 g kg−1 , wind speed=3 m s−1 and soil moisture=0.3 m3 m−3 ; average canopy environmental conditions of the past 24 to 240 h include leaf temperature=297 K and PPFD=200µmol m−2 s −1 for sun leaves and 50µmol m−2 s −1 for shade leaves.'

- *In Sect. 4.2.1, L296, it is stated that the standard conditions for EFs are 30C and 1000 µmole/m2/s, but MEGAN2 uses a much more complicated definition. I assume that Table 5 is for 30C, but as with other Tables, this is not explicit.*

Reply: 1. We understand that this is a bit ambiguous in the current writing of the paper, we will clarify and state clearly the conditions. For the standard conditions, we mentioned more details in the last response to Reviewer 1's comment above.
2. Yes, this is correct. All tables, except for Table 5, present emissions rather than emission factors. These emissions are not intended to be directly inputted into MEGAN or other models.

- *Sect 3, L131 "Studies show...."? This important section makes statements about BVOC emissions, but no citations are given. Which studies? Table 3 is referred to, but no citations appear there. (In the footnote to this table there is further forwarding to different sections later in the text, which makes the table awkward to read. It would be better with a Table row giving such information.)*

Reply: Thanks for this comment. We will add an appendix table to show the references used in this table.

- *The paper makes very little mention of the differences or issues surrounding leaf-scale versus canopy scale versus ecosystem scale emissions. Thus the sentence starting on L225 suddenly mentions that emissions may be reduced on an ecosystem scale, but no real explanation is given.*

Reply: We will revise the description to make the information from different scales clearer. Thank you for pointing out Line 225, we will add an explanation for the cited statement.

- *Section 4.1 "Numerical modeling of BVOC" is also confusing. On L266 they define EFs as the "abundance" of a type of of gas/pollutant, but one would normally define EFs in mass released per unit leaf-area or leaf-mass per unit of time. The cited "Cheremisinoff 2011" paper isn't in the reference list, and I would anyway have expected a Guenther-type reference here. On L271 the paper states that "a uniform plant type is applied", but where, by whom? On L272-274 I am not sure what the link is between the Pierce statement and the Guenther 2013 reference.*

Reply: Thanks. We understand the confusing and hard to follow of this section due to the multiple model approaches. In the revised version, we will (1) Redefine EFs: describe in detail the parameters we imported for get EFs from MEGAN v2.1. Such as what we answered to Reviewer 1 about the EF

standard conditions. And for the EFs acquired from others' studies that already calculated by them, we will mention their based model and hypothesis from their paper, such as in Havermann et al. (2022), where SEF was derived from the Guenther model but applied the 'electron transport dependencies in the JJv' to the 'modifiers for light and temperature. (2) Also, we will rewrite the paragraph by separating each model and stating how agricultural land uses are treated (or not) in each.

- *The text is very qualitative, e.g. on L71 we read "emitted at relatively low rates", on L89 we have a "considerably higher emission rate". On L146 we read that "toluene is abundant in soil", but are there substantial emissions, also in comparison to e.g. road traffic emissions? Very much of the important section 3 is qualitative, making it difficult to know if emissions are really potentially important, or simply something somebody measured, somewhere. Similarly, on L237 we read that "a large amount of acetone..." is possible, but large compared to what?*

Reply: We will rewrite this paragraph by giving the numbers for each cited reference to make this section become more comparable.

- *L279-281 states that MEGAN2.1 has 19 VOC compounds for 15 plant categories; are these 285 EFs supported by measurements? How many are?! I would have hoped that a "review" of such BVOC emissions, and with Alex Guenther as coauthor, would have provided more background to such issues.*

Reply: 'MEGAN2.1 has 19 VOC from 15 plant categories' mentioned in Guenther et al 2012. The 19*15 = 285 EFs and can be found in the mentioned paper. We agree that it is good to have a critical view on the different models cited. We will try to dig in these EFs in a revised version of the manuscript. In any case, this review paper focuses solely on agricultural land; we do not provide information for other landscapes.

In Section 4.2.2 I missed a discussion of the very real uncertainties associated with the specification of agricultural events: dates of sowing, emergence, growth, and fertilizer application. I know this is mentioned in the last paragraph, but the wording is rather vague. Is there any realistic hope of using satellite data to specify phenology and agricultural practices for European and/or global scale modeling? What would be needed to make progress in this field?

Reply: In Section 4.2.2, we discussed the limitations of agricultural management-related data in lines 337 to 344. We did not suggest that 'there is no realistic hope of using satellite or statistical data.' On the contrary, we strongly encourage Reviewer 1 and other readers to consider using these data for larger-scale modeling. Here I attached some references about satellite images can (and are actually used) to estimate some agricultural practices. For example:

Dodin, M.; Smith, H.D.; Levavasseur, F.; Hadjar, D.; Houot, S.; Vaudour, E. Potential of Sentinel-2 Satellite Images for Monitoring Green Waste Compost and Manure Amendments in Temperate Cropland. *Remote Sens.* 2021, *13*, 1616. https://doi.org/10.3390/rs13091616

Veloso, Amanda, Stéphane Mermoz, Alexandre Bouvet, Thuy Le Toan, Milena Planells, Jean-François Dejoux, et Eric Ceschia. 2017. « Understanding the temporal behavior of crops using Sentinel-1 and Sentinel-2-like data for agricultural applications ». Remote Sensing of Environment 199 (septembre):415-26. https://doi.org/10.1016/j.rse.2017.07.015.

Wijmer, T., Al Bitar, A., Arnaud, L., Fieuzal, R., and Ceschia, E.: AgriCarbon-EO: v1.0.1: Large Scale and High Resolution Simulation of Carbon Fluxes by Assimilation of Sentinel-2 and Landsat-8 Reflectances using a Bayesian approach, EGUsphere [preprint], https://doi.org/10.5194/egusphere-2023-48, 2023

And it is still ongoing research, and other methods are also possible like national databases such as :

Levavasseur, F., P. Martin, C. Bouty, A. Barbottin, V. Bretagnolle, O. Thérond, O. Scheurer, et N. Piskiewicz. 2016. « RPG Explorer: A new tool to ease the analysis of agricultural landscape dynamics with the Land Parcel Identification System ». Computers and Electronics in Agriculture 127 (septembre):541-52. https://doi.org/10.1016/j.compag.2016.07.015.

However, as a review paper, we also have the responsibility to highlight potential challenges for future use, so that scientists in related fields can address and improve upon them. Considering that other audiences may share the same concerns as Reviewer 1, we can consult with agronomists and incorporate their current solutions into the corresponding section for a more detailed discussion.

- *Section 5.1 (L357) starts "MEGAN was applied as a base model (Eq. 5.1) to estimate BVOC emissions from agricultural herbaceous crops...", but MEGAN isn't applied here. Further, if I understood right Table 5 gives emission factors using the older 30 deg C definition of emission factors, whereas MEGAN requires much more complex conditions.*

Reply: 1. MEGAN v2.1 (Guenther et al., 2012) includes a PFT15 function specifically for crops.
2. The emission factor (EF) and canopy model for light and radiation distribution will be modified. In lines 358-359, a portion of the sentence was omitted, specifically the phrase 'the canopy model for LAI depth distribution.' As a result, only two citations related to crop-specific growth formats were left in that section.
3. We appreciate your perspective regarding the '30°C' statement. In line 301, we aimed to clarify that our approach involves inverting MEGAN, considering all relevant meteorological and environmental inputs. We will revise this section to ensure that the process and reasoning are fully transparent and accurately presented.

- *Section 5.1 continues (L358) to say "we modified EFs to crop/grass species-dependent values", but no details are given of the resulting EFs. This is all very confusing!*

Reply: We propose to use MEGAN as a base model. EFs will acquire by applying the environmental measurements, include air temperature (for leaf temperature), relative humidity, air pressure, PPFD, soil moisture, wind speed, and LAI, then inverse model version 2.1 to get the best EF to match the net fluxes from measurement.

- *Section 5.3 was also wordy but vague; which information here can be used, and/or what is needed before we can use such information.*

Reply: Thank you. We will separate this paragraph into two sections: 1. recommended practices that should be accounted in future models and for which there are some existing measurements in the literature (e.g. different type of organic fertilization applied (Abis et al., 2020, 2021; Haider et al., 2022)).
2. Few hypotheses concerning agricultural practices that could have an impact on BVOC emissions and should be further investigated, e.g. tillage, irrigation.

- *Section 6, Conclusions states the paper presents "a table of emissions during different phenological stages", and that they "provide a list of crop-specific emission factors for dominant BVOCs", but as noted above the numbers provided are confusing and probably not useful.*

Reply: Thank you. This will be clarified as stated above in response to your specific comment. We will also mention this statement as potential research points for further agricultural VOC measurement approaches.

- *Data availability: these days data should be provided in SI, or via zenodo I think. Available from the authors on request is always dependent on the availability of the authors.*

Reply: Thank you for this comment. We did not expect the reviewer to interpret this statement in this way. It is easy to arrange data from a research paper because all data are measured by the authors or their team. However, as a review paper, we have data from other groups, which means we have the right to use it but must respect their work. Therefore, we state here that the data is available from the authors upon request.

Smaller points:
The English needs a thorough revision. There are many cases where cases don't match (leaf versus leaves for example), and some cases where the sentences don't make sense (e.g. L82-84). Other examples: L86 - I guess you mean emergence and not emergency? ; L109: what does "besides the fate of VOCs" mean here? ; L140: "and promote new compounds show" isn't English; L150: Does "a positive response" mean increased emission rate? ; L166 delete "to" from "to organic waste"
Table 1: it would be useful for non-agriculturalists to give the approximate time-periods of the different stages.

Reply: We appreciate your observation and agree that this is an important point. We will make the necessary revisions to improve clarity. We will seek help from a native English speaker to review the language.

L96. The paper states that "The soil continues emitting BVOCs during plant growth and ripening, but emission rates from this period have not been reported so far to our knowledge." So, how do you know that BVOCs are still emitted?

Reply: We mentioned that soil continues to emit VOCs even when plants are present in the field because: 1. Microbial activity, soil moisture, and particle absorption are primary contributors to soil VOC emissions (e.g., Tang et al., 2019), which depend on soil properties and the amount of soil organic matter. Plants, particularly their residues and root systems, can increase soil organic matter content to some extent.

2. Agricultural soil measurements provide insights under specific conditions, such as during a heatwave with wheat in the field, as observed by Schade et al., 2004 (https://doi.org/10.1016/j.atmosenv.2004.08.017). We can add these references in the corresponding section and clearly state the specific conditions and influencing factors.

L141. The last sentence is so vague ("Variations of BVOC..") as to be meaningless.

Reply: Thanks for the comment. We will revise accordingly.

L217-220. This is a bit vague and unclear. If drought reduces BVOC emissions, wouldn't one get less secondary organic aerosol, not more?

Reply: In line 213 - 216, we already started to talk about increase effects rather than reduce effects. The chemistry behind SOA formation is complex and less emissions does not necessarily imply less SOA formation (Bonn et al., 2019; Wang et al., 2023).

Wang, Ruipeng, Wenjiao Duan, Shuiyuan Cheng, et Xiaoqi Wang. 2023. Nonlinear and lagged effects of VOCs on SOA and O3 and multi-model validated control strategy for VOC sources ». Science of The Total Environment 887 (08):164113. https://doi.org/10.1016/j.scitotenv.2023.164113.

L223. The text here and around relies a lot on Bonn et al., 2019, but that paper only dealt with trees. Also, many monoterpene emissions are not under stomatal control, being rather stored in pools within the leaf (e.g. Niinemets et al., 2004, Guenther et al - many papers).

Reply: Bonn et al., 2019 was cited in the paragraph discussing how stressed VOCs contribute to particle formation L217-220. We did not cite this paper in the section that discusses the types of VOCs emitted by crops during drought. However, we will clarify this distinction for the readers and add references specific to that.

L247. The statement "Cover crops are planted a few months between two main crops" is likely true in France, but do all countries have two main crops, with a few months between them? In general, this paper has little consideration of climatological differences between even parts of Europe, let alone the globe.

Reply: We will narrow and state the regional information in our title and material section.

About cover crop, *'is likely true in France, but do all countries have two main crops*', see reference: e.g. Fendrich et al., 2023.

Arthur Nicolaus Fendrich, Francis Matthews, Elise Van Eynde, Marco Carozzi, Zheyuan Li, Raphael d'Andrimont, Emanuele Lugato, Philippe Martin, Philippe Ciais, Panos Panagos. From regional to parcel scale: A high-resolution map of cover crops across Europe combining satellite data with statistical surveys, Science of The Total Environment, 873, 2023, 162300, https://doi.org/10.1016/j.scitotenv.2023.162300.

Although cover crop is applied in short period, and normally during winter time, but as an approach of management practice with less focusing, we believe it worthy and should be mentioned in our review paper. In the revised version, we will only focuses (as stated in the reply before as well) on Europe and North American conditions.

L262: Usually the "and" can be dropped between chemistry and transport models.

L263. Give MEGAN a proper reference.

L288 states "To our knowledge" about MEGAN and LPJ-GUESS, but you have the lead author of MEGAN on the author list. I am sure Alex Guenther knows. And it would not take much effort to ask the LPJ developers about the EFs being discussed.

L323: What is "airflow" emitted?

Reply: Thanks for the comment. We will revise accordingly.

L371: why are natural environments relevant here. Agricultural land us far from natural.

Reply: The wording here is confusing this will be clarified.

L365 on, Section 5.2. Is WFPS a good indicator of soil moisture? Soils with the same WFPS can have very different soil water pressure values.

Reply: WFPS is a mixed variable informing about soil water content but also O_2 availability in the soil. We believe it is a good driver for microbial activity.

L395-397 - this text is unclear. Re-word.

General: why are italics used for words such as "dry weight" in Table 6, and in units throughout the text, e.g., for g, kg, m or h? Also, g and kg and VOC should not be italic.

Reply: Thanks for the comment. We will revise accordingly.