Response to the comment of Anonymous Referee #2

We appreciate the time and effort from Referee #2 for their extensive work to provide detailed comments and great suggestions on our paper. We address each comment below, where the reviewer's comments are shown in italics. The line numbers refer to the original document.

General comments

This study is interesting and has its own important value to supplement what has been done previously and giving new information about bark beetle infestation effect to BVOC emission from Norway spruce bark.

Thank you for the positive comments regarding the value of this study.

A lot of confusing information and weak Discussion is not helping to reveal this experiment value.

Thank you for pointing this out. We will work on revising and re-arranging the MS to avoid confusion and work on strengthening our Discussion – see detailed responses below.

Important part is also the new emerging volatiles, but these get so little attention or no attention in Discussion part.

Thank you for your input, we will elaborate more about this in the Discussion.

Discussion part is weak and needs more improving, more references and discussion that is connected with result and putting the results in bigger picture.

Thank you for your comment. We found difficulties in increasing our reference list for our Discussion section as there are only very few studies available to discuss with. We will expand and elaborate our Discussion to include a broader perspective and clarity to when we discuss and speculate around our own results to provide hypothesis to be tested and added on in follow-up studies. See detailed responses on the Discussion below.

I suggest leaving out the comparison with leaf emission; this does not give an extra value to the study. This has opposite effect: to diminish your efforts.

Thanks for the suggestion on leaving out the comparison with leaf emissions. We value the perspective you have given us and will consider leaving this part out in a revised manuscript.

Through MS: commas are there where they are not supposed to be and at the same time missing where they should be. I suggest to ask some native speaker to check English (my English is also not so good, but based on my experience I guess I understand when English needs improving).

Thank you for pointing this out, we will consider running our MS through a professional copy editor.

A lot of using %, this does not make the MS better. Try to find better alternative for this to describe results.

Thank you for this input, we appreciate the comment and will make changes to improve readability. We use % mainly to describe the increase/decrease in emission rate, the relative occurrence of each compound in all samples and the mass contribution of each compound in the samples. We will convert % to xx-fold increase/decrease in the first part. Using % is necessary for the latter two as we cannot quantify all of the detected compounds but we can compare the GCMS peak area to find the contribution of each compounds and compare the percentage within and between samples. We don't see a better way of displaying.

1) Title says: "...cause up to 700 times higher emission..." – but compared to what?

This is compared to the emission rates from healthy trees. Suggested title change for clarity: "Spruce bark beetle (*Ips typhgraphus*) infestation cause up to 700 times higher bark BVOC emission rates compared to healthy Norway spruce (*Picea abies*)"

2) L14 – drilled – used one style trough MS: drilled or boring; instead "entry holes and exit holes" use

"entry and exit holes", check whole MS

Corrected!

3) L15 – instead "healthy trees and infested trees" used "healthy and infested trees"; write out site

names in abstract

Corrected!

4) L21 – decreasing relationship – is it statistically true?

We test this by the 'goodness of fit' in terms of RMSE from which we found an exponentially decreasing relationship to best describe our data with the lowest error. Because of the few data points we did not further test this statistically and our intention is mainly to show the type of relationship in our data..

5) L28 – " This study...." This kind if sentence fits better to Conclusions

We agree and have removed this part of the Abstract.

6) L54 – "..SOA." – add reference

Reference inserted. (Kulmala et al., 2003)

7) L55-56 – better use "negative or a positive feedback loop..."

Corrected.

8) L57-58 – form a better sentence

Removed sentence, we regarded it as repetitive and must have been overlooked previously.

9) L63 – any references from last 10 years? If yes, add.

Yes, references added. (Celedon and Bohlmann, 2019; Krokene, 2015)

10) L10 - any references from last 10 years? If yes, add.

Assuming this refers to L70, no additional reference than (Everaerts et al., 1988) was found looking at the specific compounds mentioned. However, the references mentioned above was added after the section before "they have been shown to be toxic to spruce bark beetles".

11) Trough MS – I suggest to use Norway spruce instead of (just) spruce when related to your

experiment and xyz spruce when related to specific reference, if possible

Thanks for the suggestion. We understand the need of clarification and will change accordingly.

12) L78 - I guess it's not poorly understood, because every experiment gives valuable information, but

As this was also commented on by Reviewer #1, we agree and understand the poor choice on our wording. We changed the sentence to "There is still a lot to learn about the defense mechanism of Norway spruce, only a few studies have analyzed the induced BVOC emission….".

13) L81 – Connections with what? Some words missing?

We changed the sentence to clarify: ".. the connection **between** BVOC emission rate, number of bark beetle holes and time."

14) L82 – For me the bark emission comparison with needle emission is not giving this MS much more value. Needle emission and bark emission measurements from spruce should be standalone experiment.

We appreciate the new perspective that you bring on this and are willing to consider this part to be removed from the MS with the motivation you mention, needle emission and bark emission are in our case hard to compare as they are not measured at the same time. However, we still think it is important to compare emission rates from different parts of the tree to fully understand the whole tree dynamics. Our main reason for including this in our study was to highlight the importance of induced emission rates from infested bark, where the emission rates are so high that they greatly exceed those of leaf emissions, which normally is considered to be the dominant ones.

15) L84-90 – I suggest not to use we/our etc for this part (check also trough MS). For the reader would be helpful to find hypotheses easily when they are numbered 1,2,3 etc and hypotheses presented clearly and properly.

,Thanks for pointing this out, we will remove we/our throughout the text, and we agree that re-structuring the hypotheses for clarity is needed.

16) L87 –"…eventual death of the tree" – I assume you did not measure the tree until it's eventual death. How long does it take when the tree is dead or considered dead after bark beetle infestation?

We consider this a matter of definition. From our perspective, we consider the tree dead when the needles have shed off because of the disruption in the vascular system of the tree, which can happen at different time scales depending on the extent of the infestation. To achieve tree death, the beetles kill the cambium which is the part capable of emitting VOCs as a defense (Krokene, 2015), so when we measure close to 0 emissions or at least lower than the emission from healthy trees, we would consider this emissions from a dead tree. To answer your first assumption, we did not measure one specific tree until its death, but we did measure different trees at different stages where one was for certain considered dead after almost a year since infestation.

17) L89 – "total number of holes" – what do you mean in "total number of holes"? Entry+exit holes?

Yes, "total number of holes" is meant as entry+exit holes. For clarity we changed to: "rather than a high amount of holes".

18) L91 – You did not investigate blue stain fungi in this experiment – I suggest to use blue stain fungi

in discussion part.

We agree, the mention of blue stain fungi is removed in this sentence.

19) L92 – "tree individuals" – I suggest "two trees"

Agreed and corrected!

20) L99 – I suggest that in this sentence indicate table 1 for campaign dates

We have changed accordingly.

21) L96 –Based on this sentence I would expect that in a sub-study where more than one campaign

but it's written over time. For me it indicates more than one campaign.

The sub-study we refer to in this case is indeed more than one campaign. We followed two tree individuals from May to August, from before to after infestation. So the indication of it being more than one campaign is accurate. We will clarify this in the revision.

22) L101 – use one style: sub-study or additional campaign trough MS

Based on comment 21 above, we believe there to be a misunderstanding. The sub-study is the study in which we compare two trees with different health status over time before and after infestation. The additional campaign was a campaign carried out in Norunda on top of the campaigns in Hyltemossa, it was an additional campaign as we did not plan it but acted on the opportunity to travel there to measure more bark beetle infested trees. We will this keep the separate phrases as it refers to two different things, and will try to make it more explicit in the revision.

23) Figure 1 – how are the rules for figure legends, is there a dot or semicolon after Figure 1? What is

the rule for figure legend text - needs to be in bold? I like the map for showing, but describing b-ca is not common in figure legends also in text (like Fig.1b). If possible, change maps etc. starting

with abc and in figure legends also describing abc. Missing proper explanations what yellow

squares and circles mean. "The Figure..." –why is there Figure not figure? If possible, write out in

the legends which site had healthy and infested trees, and where was sub-study done.

The manuscript was conducted using the Copernicus_Word_template.docx in which the figure caption is in bold and has a semicolon after Figure number. We agree to change the orderof description to abc in the Figure caption, however we prefer to keep references like "Fig.1b" in text as it brings clarity to what is referred to in the text. We also appreciate that you noticed the lack of explanation in the figure caption, and the use of a capital F in "The Figure", this is not on purpose and will be added/changed accordingly.

24) L122 – "by visual examination" – meaning no entry holes?

Yes, in the visual examination there would be no entry holes, but we also looked at the general health of the tree. The tree could for example have been stressed due to forest machinery ripping up the roots, some other pests like aphids and adelgids. If we saw signs of this the tree was not selected. We will clarify this during the revision.

25) L123 – Indicate site name

Gustafsborg säteri AB is the company that owns and manages the forest, thank you for pointing out that this information is missing here and may cause confusion.

26) L120-125 – write out here which was here considered as sub-study

The sub-study is described below these lines in a new paragraph starting at L128. We will clarify that this is where the sub-study was conducted.

27) In Methods part, please consider clearly explaining healthy, infested and control, because later you

show also control measurements and use the same style trough MS.

We agree, it is currently inconsistent and it is now corrected in the MS. Control trees and healthy trees are the same and we already decided on using healthy trees only but obviously missed to change this through the MS.

28) L130 – check names and ALL NAMES in MS must be correct, many mistakes: alpha-pinene, αpinene, beta-pinene, β-pinene etc and other names written not well.

Thank you for highlighting this, we agree, consistency is important and this has been corrected for.

29) L130 – Typosan- company name?

The company name must have been missed, it is now corrected "(Typosan IPS, Plantskydd AB, Ljungbyhed, Sweden)

30) L132 – repeatedly: measurements dates are indicated where?

Dates indicated by Table 1, tree ID's are "S3S3" and "S3S2". This has now been indicated in MS.

31) L136 – indicate figure

Corrected

32) L137 – use one style trough MS 5°C to 22°C or 5° to 22°C

This has been corrected to the latter.

33) L138 – start with May and then with June

Agree, this has been corrected.

34) Figure 2 – in figure legends start describing with temperature as you have on the figure temp,

precip, campaign. Figure legend text in bold? I suggest writing out in a better way where data was

taken.

Figure caption has been corrected to follow the structure of the legend. The figure legend text is kept in regular to decrease the number of fonts used in the figure to one according to online instructions (https://www.biogeosciences.net/submission.html#templates). The description of data has been corrected.

35) L147 – pump company? I guess L/min is visually better than lpm. 0.6-0.9 L.

The pump box was custom made, but agree that the pump and flow controller information needs to be given here.. Corrections have been made accordingly. We decided to keep lpm as this is our preference. Changed liter to L.

Corrected.

Corrected, a space between number and unit is intended as described in online instructions.

Changed to metric system, 6.35 mm (1/4"). Corrected to PTFE-tubing, not lines.

Yes. For clarity "each sample" can be changed to "each VOC collection".

Yes, as indicated the sampling started at 8:00 in the morning. The chambers were placed onto the tree trunks prior to this to allow for flushing.

Info on swarming times can indeed be added asthis adds important information, thanks for pointing this out.. The swarming time had been used later to calculate how long the infestation has been ongoing, so we missed to explicitly mention it at this point.. Plot 3 is the name of Plot 3, the site is HTM which we can indicate for clarity. The date of the infestation start can be indicated more clearly in Table 1 where the date is already there (2019-06-04). We will add supplementary information to the swarming period time series to increase transparency on how accurately we were able to estimate the swarming date as we determined this from peaks during swarming periods taken from measurement stations located nearest to our measurement sites.

See answer to comment 41.

No, the entry/exit holes were not marked, so it is possible that "old" entry/exit holes where measured, but we still believe it to be the time since the infestation start that matters in our case, as well as the distinguishing between entry and exit holes.

Thank you for this input, we have corrected accordingly.

Corrected: "The number of holes visually counted inside the chamber area is listed in Table 1 along with an extrapolation of the number of holes that would represent per square meter bark area."

You are correct, in the Methods we do not mention "VOC filter" specifically but have only failed to be consistent in wording. In the Methods we named it hydrocarbon trap (L149). We will change this to VOC filter to keep the consistency. Added mention of the pocket pump as well as tree name. The text was revised to mention (b) in the beginning: "The experimental schematics (a) and field photo (b) indicating the tree trunk chamber mounted on a tree…".

Thanks for the clarification, tree name has been added, and corrections on the entry and exit holes. Photos were taken by the first author, something we must have missed out on referring to. Agree to change "drilled" to "bored" to keep the consistency.

The text is kept in bold as the template has figure text in bold. Name has been added as well as two columns indicating plot and site. S1S1 etc are the tree IDs. Type majority was changed to Hole type majority. As indicated in the answer to comment 41, one paragraph could potentially be added indicating the start of the swarming and/or the time passes since infestation start.

Thank you for the suggestion, this had been added.

The adsorbent tubes were bought packed with those two chemicals in a 2-bed configuration fromMarkes International as one product, so we prefer to give Markes International as reference.

The liters collected varied because of the sample time variation. Because of unforeseen events sampling was varying +/- 5 minutes with the goal of it being 30 minutes. This is however accounted for in the sample analysis which is based on the sample volume and not on the sample duration.

Clarification has been made "..from air entering the chamber once before the first sample and once after the last sample of the day to capture…"

BVOC sampling"

Thank you for the suggestion, we have changed accordingly.

54) L198 – "After sampling.." - does this sentence repeat the previous sentence? "During sampling period"?

Thanks for pointing out this can be misunderstood. To clarify, the sentence before refers to the air temperature inside the chamber which was measured during the sampling period, i.e. during active sampling. After sampling was done we measured the bark temperature as well. We have clarified stating that the temperature measured inside the chamber was air temperature.

55) L205 – He, which company He?; VOC or BVOC – use one style trough MS

(Air Liquide Gas AB, Sweden). Changed the MS to use BVOC throughout.

56) L210 – space between number and m/mm

Corrected.

57) L220 – Shimadzu… - country?

Japan, corrected.

58) 2.4 – ALL equations need numbers and indicated in the MS where necessary

Some confusion on this comment. All equations have numbers in parenthesis on the right hand side. However not for all cases is there an indication of the equation prior to the equation itself. This is something we can easily correct.

59) L225 – in equation the A is normal, but in describing text it is A (italic)

Corrected

60) L243 – For me you have three ways to describe 1) 100 days before/after; 2) majority entry and /or exit holes; 3) early and late season. And all these three are used trough MS. I suggest to explain this well in this paragraph and use one style trough MS and also on figures and figure legend text.

We agree and have changed to keep it consistent.

61) L256 - Q in italic?

Corrected

62) L258 – F in italic?

Corrected

63) L262 – F and Q in italic?

Corrected

64) 269 –Eq 4 – where, which one?

See line 250 right hand side.

65) L270 – Eq 5 – where, which one?

See line 264 right hand side.

66) L270 – I suggest explaining in Methods part: does constitutive mean healthy or control tree emission. And what is considered as control, because later on the figures you have a control.

Control trees are the same as healthy trees, we have changed to use healthy only. Constitutive emissions mean emissions from healthy, unstressed trees as constitutive emissions are what is emitted constantly. But we will add a clarification.

67) L274 – 3 m

Corrected

68) L275 – North, East? north? east? - Look trough MS that weather arc are correctly. I suggest that weather arcs info goes in BVOC collecting paragraph.

Corrected.

69) L276 – I'm not so fond of comparing bark emission with leaf emission. This should be extra study to compare with more measurements campaigns. For me this comparison does not give an extra value to this study (overall). For me the core of the study is bark emissions from infested and healthy trees and then finding important results to discuss on Discussion part and with SOA and climate change and modelling (MEGAN etc).

See reply under the general comments. While we agree that the focus here is on the bark emissions, we also want to make a point that under infestation the emissions from bark are way larger than emissions from leaves – which normally are dominating the overall emissions from a tree.

70) L282 – outliers from which sites/area? I suggest moving this paragraph closer to BVOC sampling paragraph. "Photography"->"photos"

Clarification/corrections has been made.

71) 2.5 Statistical studies – Needs a lot improving. In here also clarify which measurements, from what area/sites, what about constitutive etc, what about sub-study? Look my comment before. P in italic (p)? Same with F and Q. Clearly write out what did you compare and with what statistical test and which program did you use for it.

Thanks for this comment as it seems this paragraph was confusing and may have been misleading. However, the requested information is listed. All measurements were included in the statistics, from all sites and plots. Clarifications has been made accordingly: Using a Kruskal-Wallis test (MATLAB R2021a, The MathWorks, Inc., MA, US) with a level of significance set to $p < 0.05$ we compared the following scenarios: 1) emission rates between the healthy tree plots, plot 1, 2 and 3 in HTM, 2) the difference in emission rates from healthy trees and infested trees, from all plots and sites, 3) the difference in emission rates from the two infested trees in the sub-study and 4) the difference between $Q10$ and $F0$ for healthy and infested trees.

We decided to only perform a Kruskal-Wallis test because of our small sample set. Our data was also not normally distributed which further limited our choice in statistics to perform. We decided that in order to test our hypothesis, we simply needed to know if there was a significant difference between the groups or not which we could find our using the Kruskal-Wallis test for our different scenarios.

72) Should there be dot in each main/second headline, like 3. Results/ 3.1. zyx ?

According to the online template (referred to above) there is no dot.

73) 3.1. – Revise the tile if clarifying "constitutive" in previous MS parts

This will be considered as stated above.

74) L294 – constitutive=healthy? Is it temperature-standardized or temperature standardized? Use one style.

This has been corrected to use temperature standardized throughout MS.

75) L296 – indicate the results in table X if they are written out in table.

Thank you for highlighting this, they are written in the table and this had now been indicated.

76) L301 - The numbers here and on the figure are not well trackable/comparable and at the same time quickly understood on the figure. If I read the sentence and look at the same time on the figure, cannot distinguish quickly what is what and figure is hard to read for a reader who does not read the results part about this figure.

The numbers on the second sentence at L301 is referring to the range of the emission rates at each plot (1-3) as visualized by the boxplot (Fig. 5), the medians are referring to the medians as visualized by the boxplot. The figure is describing all the emission rates measured throughout the season for the healthy trees at the different plots, the point of the boxplot is to show that there is no significant difference in emission rates between the plots, which we think is clear from this figure.

77) L303 – p-value? p>0.3. Make changes through MS.

Corrected.

78) L304 – which sites in what area?

Correction – mistake in MS, sites = plots at the same site in HTM.

79) Add on Figure 5 HTM, so the reader can understand what area without reading figure-describing text. In describing text, indicate statistical test. What n means? What black circles mean?

Thank you for the suggestion. A clarification on the parts of the box plot will be added in the figure caption.

80) L311 – infested trees in which area?

We indicate all infested trees in all areas, but this will also be clarified.

81) L312 – drill or bored? "The season…" – you were describing it before in Methods part, in here use one style to indicate, but not repeating the same as in Methods. Look my comment before.

See answer to comment before.

82) L314 – I suggest to add total emission also to Table 1.

Thank you for the suggestion, we will add a row with total emissions to Table 1.

83) L315 – "..µg m-2 h-1 . MTs…" check space. " MTs…" indicate for table 2.

Corrected.

84) L319 – 42% or 42 %? Use one style thorough MS.

See replies above.

85) L322 – Which trees: name? Which area? Name? BVOC or VOC?

See replies above. All trees are indicated to be from all sites but this will be clarified.

86) L323 – healthy from which area?

From all healthy trees, only measured at site HTM, which will be clarified.

87) L328 – infested tree: I suggest to use infested bark samples, bark emissions, infested tree bark etc through MS, one style through MS.

We have considered your suggestion but will continue to use the phrase "infested tree". Bark beetles attack the bark, but the entire tree is substantially and most often lethally affected by the infestation.

88) 329 – "isoprene, (n = 17) compared " check the mistake. Infested trees in which area?

Typo corrected. Infested trees from all sites.

89) L331 – indicate table

Corrected

90) L337 – Which areas/sites? P value – how come 0.00???? "The median…" - Consider writing this sentence according to this what is shown on figure or change figure according to the sentence. I advise to start with healthy and then infested (early, late). I suggest to use less "respectively" through MS, not so easy to follow.

All sites. P-value is a typo, corrected to 0.001. The median is shown in Figure 6 as the line in the boxplot. We will change the text to start with the healthy trees, and then continue with infested trees – thanks for pointing this out.. Thank you for the suggestion on finding an alternative to "respectively", we will change this.

91) Figure 6 - please add also HTM or NOR on the figure. Which tree? Again use one style for early/late season, exit/entry. "The emission rate.." sentence doesn't belong to figure describing text. Pvalue?? Standardized to temperature – indicate equation in XX part. Explain yellow and blue.

Statistical test used?

See earlier replies. "The emission rate…" sentence is corrected. Indication of Eq added.

92) L349 – healthy trees and infested. Which sites/area???

All plots and sites.

93) L315 – I suggest rounding the numbers to proper value in table, visually better. Overall, it's kind of disturbing using so much % through MS.

Your suggestion has been noted and the numbers will be rounded. See reply to general comments regarding %.

94) Check VOC names trough MS.

See earlier reply.

95) L287 – Again, using % and even so big numbers….do you use 22678 or 22 678? Which area, which site trees? Which trees?

See earlier replies regarding %. We will change to 22,678 throughout MS for consistency.

96) L374 – when it's the first time indicating Appendix, write out Appendix, otherwise what Table A1 means? trans, trans-alloocimene - > maybe (4E,6E)-alloocimene better?

Thank you for the suggestion. This has been corrected.

97) L375 – gamma-terpinene or γ-terpinene? "in infested…"- revise end of the sentence, double Repeat

This has been changed throughout MS, γ-terpinene is used. The sentence has been revised.

98) Table 2 – paragraph spacing. Which tree? Which area? STDEV is only for groups, not for each compound. Explain MT, SQT. What about decrease (-65%), not explained, only increase. Again numbers: 22678 or 22 678? Check all the names in table, all the names need to be used correctly trough MS (tables, figures, etc). If possible add total emission.

All trees, all plots, all sites. STDEV will be added for each compound. Other suggestions have been checked and corrected.

99) 386 –Which area? Which trees? Number 13000?

All sites and all infested trees. We noticed a large misinformation in the text, number 13000 refers to the highest temperature standardized emission rate measured from one single tree which can be seen in Figure 7. This is however not the seasonal average for all trees as it seems in the text. This has been revised to indicate the range in seasonal average for the individual trees, which ranged from 500 to 13000 as indicated by Figure 7. Thanks for spotting this!

100) L390 - "…daily average standardized emission.." – check

This is what we intended, the daily average temperature-standardized emission for clarity.

101) L391 – "The average number of holes per square meter bark area found in this study was based on the values in Table 1." Revise or delete.

If it does not bring any clarify to the following text we will delete it.

This is not the sub-study, this part is comparing the emission rates as only standardized to temperature with the emission rates when also standardized to bark beetle holes. This was done to exclude any difference in the results simply due to the variation in number of holes (20 holes might indicate higher emission rates than 10 holes). We will clarify this in the revision, thanks for pointing out.

103) L400 – "The TS emission…" – I guess this sentence is to long for explanation, I suggest to divided

in two parts and describing clearly. I guess this kind of description goes to Methods part in

Statistics.

We will move or add a section on this in the Methods part. But we do think it is necessary to keep where it is also as the continuation of the MS is based on this.

104) Figure 7 – Which trees? What area? S3S2, S3S3, etc meaning? Early/late, 100 days before/after.

"The emission rates…" and "This is evident…" sentences do not belong to figure describing text.

All infested trees in all sites and plots. S3S2 etc is the individual tree ID, will be clarified or changed to "tree 1" etc. Corrections have been made accordingly.

105) 3.2 – Did you to statistics to evaluate influence of time?

See answer to comment 4.

106) L413 – Which site/area? Indicate table/figure.

This was a general statement, but will be changed to avoid confusion.

107) L415 – Where is 3.2.3? I suggest to put function to Statistics part and indicating on the figure

describing text where to find it.

Thanks for spotting the wrong reference to 3.2.3. We will move the exp function to the methods/statistics section, and refer to it in the text here; thanks for this suggestion that will make the text more readable.

108) L420 – use one style trough MS: 8b and 8d or 8b,d etc.

We agree and will change this to ensure consistency.

109) L421 – I guess "slightly" is not correct to use here. "..depending…" revise, double repeat.

This has been revised.

110) L425 – How long does it take from infestation to total damage/death to the tree? Maybe

something to discuss in Discussion and some info for introduction part?

See reply above (comment 16).

111) L428/429 – indicate figure. Again constitutive/healthy emission? Area?

Corrected.

112) L432 – "The tree measured.."- did it have a name SxSx? What area?

Corrected.

Corrected.

Revised and corrected.

115) Figure 8 – VOC names!!! Which trees? What area? "..days passed since..". Correclty put abcd to figure describing text, (a) is in a wrong place and (d). Blue is for what? Did you include yellow marked tree also in the fitting? Revise sentence for clearer understanding. What test is used here? In Methods part there is no indication about measurements after 300 days.

See previous comments. We would like to argue that the use of abcd before the intended figure part is not wrong but rather a matter of preference. As intended in the figure caption "All trees are included in the exponential fitted curve", also the yellow one. It is simply marked to show that it had lower emission rates compared to the other trees. No test is used due to low sample number here, and in Methods part there is indeed no specific indication of the measurements after 300 days since infestation had started, however, it was assumed from our part that it was obviously included in the measurements > 100 days since infestation has started. This will be clarified, and we thank the reviewer for spotting this inconsistency

Corrected.

Corrected.

Corrected.

See reply before.

Corrected

121) Figure 9 – check names. Which area. Change the order top of the figure: first are entry holes and then exit holes. Relationship p value? Which test was used? Which trees? Again (a), (b), etc to correct order. All or total BVOC. The "2" on the x-scale title is to big. "High…" sentences does not belong to figure describing. Again: exit/entry, late/early, 100 days before/after. "There is a disctinion.." – revise.

See previous replies for Figure 8. The "2" on the x-scale title is the same font size as the other text, but will be changed to a smaller font.

122) 3.4 - sub-study?

This is indeed the section where the results from the sub-study are presented. This will be indicated more clearly.

123) L466 – Revise sentence "At plot 3…" and indicate figure. On another way L466-L469 is describing what you said before, I suggest revise this sentence. Which area?

This will be revised.

124) L470- P in italic.

Corrected.

125) L471 - Control trees – what does the control trees mean in MS? Control - not at all infested during campaign or beginning of campaign not infested and later experiencing bark beetle infestation? Indicate figure 8 correctly.

See previous replies. Control trees = healthy trees, which were healthy all the time. Indication corrected.

126) L473 –Which other trees? Other trees in plot 3 or somewhere else? Indicate a tableX?

Other trees in plot 3. There is no table to indicate as we decided to only present this as the figure for better visualization.

127) L576 –" a difference.." indicate table if possible

Corrected. See reply above.

128) L477 – check names; I suggest to remove 800 ug or use another number for comparing.

Corrected and agreed regarding the 800 ug, seemed a bit random as it was.

129) L479 - check names

Corrected.

130) L480 – indicate figure, I suggest that p<0,03. Delete "and close to zero", check names

Thanks for the suggestion. Corrected.

131) L483 – p italic

Corrected.

132) L484 – indicate figure

Corrected.

133) L485-495 – Again less % or even when presenting choose important results, because this part is interesting. I suggest this part to discuss in Discussion part. Check names. "..by mass" – what mass?

See reply in general comments. Mass is the compound mass found in the sample, the %-age refers to the fraction of the respective compound regarding the total emitted mass. The results were narrowed down to what we thought were the most important compounds found, but a more elaborated list of

compounds found is shown in the appendix (Fig A1). We will clarify this point and explicitly refer to this figure in the revision, thanks for pointing this out. The ongoing infestation is discussed in 4.1.1., but we will make this more clear. Thanks for pointing this out.

134) Figure 10 - Months names ith capital letter. On the figure, where is asterix-what does it indicate? Can't be seen. Check names! All figure plot need to have month names. Describing text what trees, what area. Why no SE? Add tick marks on the figure, other figures have. Remove the outer box from top of the figure, where are indicated control, S3 and S2 and add some space between them for clearer separation. Start with control in describing text, then healthy or infested etc. Add year in describing text. "For", I guess "from". In this figure, there is important info, but this does not come forward clearly because of figure negative sides. Maybe another alternative?

See replies for other figure comments. Months have been capitalized. The asterix might be confusing, it is there to indicate that the trees were not infested in May. We will find an alternative. Month names will be moved as axis labels on the right to avoid repetition in the plot. SE is not included as the average is an average over the day, 3 measurements. This can of course be added if necessary but we did not think it would add any value other than cluttering the figure. We have added more space between labels in order to increase the readability and clearity of the figure which we think is also supported by the legend box that we have applied constantly throughout the figures in this MS. The control (changed to healthy) is shown in green, S3S3 is orange and S3S2 is blue in the figure. We hope the figure is more clear now. Revised caption text is inserted below where bold letters indicate changes:

"Figure 10: The average **temperature** standardized **BVOC** emission rates for all compounds **from Norway spruce at plot 3 in Hyltemossa: healhty trees (green), infested spruce with ID S3S2 (blue) and infested spruce with ID S3S3 (orange). Measurements were taken in 2019 during** May (a-b), June (c-d), July (e-f) and August (g-h). The graphs are horizontally separated for visibility due to large differences in scale. The **healthy** trees are included in all graphs but the emission rates are not visible on the same scale as the infested trees in June (c-d) or July (e-f). The bark beetle infestation had not started in May (a-b), however, the spruce S3S2 was already subjected to stress from late bark beetle attacks previous season before the bark beetle infestation started again in June (c-d), leading to higher emission rates in May."

135) L506 – F in italic? Q in italic? Look through MS

Corrected

136) L507 – which area?

All sites and plots.

137) L508 – indicate a table

Thanks for pointing out this was not clear enough. The reference for this is also Table A2, and we will make sure that Table A2 will be indicated here as well.

138) L510-511 – double repeat

Revised.

Changed to 34,900 µg m-2 h-1.

See replies on general comments; but we will reduce those high %-ages and refer to x-fold increase instead.

This is meant to be the Q10 coefficient. Corrected.

Corrected.

See replies to general comments. The short paragraph on the comparison with leaf-scale emissions in our view adds valuable information and helps to assess the importance of the induced emissions as normally only leaf-emissions are considered as for healthy trees these are dominant.

Corrected.

We will revise this sentence as "**Emission rates from the bark of the infested trees were at least about 55 times higher than the total MT emission rate from both leaves and bark of a healthy tree.**"

Revised.

Thank you for your input. Tables and figures will be clearly indicated. Names have been checked. Sites will be clarified. The number of references used in our Discussion is low because of the low number of relevant studies to compare with. We decided to deliberately use only studies where a comparison will be relevant between Norway spruce bark BVOC emissions and stresses, particularly insect stress from the European spruce bark beetle. As the number of comparable studies remains low, we determined to keep our discussion very open as we thought it to be hard to draw any firm conclusions from our findings due to the limited dataset.

The relationship we are referring to would be a correlation, either positive or negative. The reference Zhang-Turpeinen et al., 2021 found a positive correlation with isoprene emission and lichen cover. We did, as Ghimire, asses the lichen cover visually from our bark photos. But you are correct that this is not included in Methods, this must have been missed and will be included around L170 where we describe looking at bark photos for checking the hole types. Ghimire tested the correlation using the Spearman's correlation analysis, which we did not do, we only assessed this visually by comparing the images with the emission rates of isoprene – where there were no clear indication of anything, there would be high isoprene emissions and no lichen cover at all, which made us determine not to move forward with that. It is included in the discussion only because we thought it interesting that there would be isoprene emitted from bark with no clear explanation why.

149) L591 – healthy and infested trees – what previous findings? References? Some examples for

describing? Indicate figure.

The previous findings referred to is the previously mentioned references – however this will be further elaborated in the revision.

150) L591 – repeating of the results. I suggest to put these number into comparison with some

references if possible or to discuss about emissions. I suggest not to use "we".

Thanks for pointing this out. This part will be revised or removed. We will revise all first person terms throughout the ms..

151) L549 - And so what it is higher at the beginning? Connect the higher emission with atmospheric

processes, add references. What is different in the beginning? Indicate your figure/table if proper.

We will add some more discussion to why this is interesting. There are more entry holes in the beginning and the spruce defense is more active, as time passes the vitality of the spruce decrease as does the emission rates. We will elaborate this in the revision of the discussion.

152) L583 – 605: all compared to one reference.

Yes, this is indeed all compared to one reference as this is, to our knowledge, the one recent study comparable to ours, in which the measured the bark emission rates from Norway spruce from healthy trees and infested trees. There are of course some other studies where they look at fungal inoculation and European spruce bark beetles on Norway spruce, however this is more targeted towards chemistry and they measure the absolute concentration of BVOCs using a different method, not calculating emission rates (Mageroy et al., 2020; Zhao et al., 2010, 2011). As mentioned previously we wanted to mainly compare our results to similar studies (bark bvoc emissions from Norway spruce trees infested by European spruce bark beetles and measured with chamber systems -> emission rates). However, our results will be discussed more widely but this was not our first intention. We will follow the recommendation by the reviewer and elaborate the discussion to include this.

153) L599 - time...what about temperatures, weather conditions? And what time, measuring time

during day (morning, lunch time, evening) or campaign times (certain dates).

Temperatures should not be an issue as they also used standardized temperatures in their study, and using monthly means for their results. The values are comparable in the manuscript as well.

154) L600 – "study…" indicate figure

Corrected.

155) L601 – Ghimire – which holes in this reference?

All holes supposedly, they did not specify entry or exit holes from inside their chamber area.

156) L602 – "this allowed…" then what is done before? References? What stage to what stage?

We could not find a single study measuring a spruce before infestation and following it through infestation, thus relation the emission rates to the stages of infestation. What has been done before is to measure healthy trees, travel to another site at another time to find bark beetle infested trees, and so on. There are also older studies on the very beginning stages and emissions from entry holes for about 2 weeks, this is mention later in discussion (L632) but we will re-structure and mention this here as well.

157) L604 – "This finding.." – what finding exactly? Why it is important in bigger picture?

Corrected – not referring to a specific finding, rather the design of the study.

158) L605 – "We could see…"- is it really a trend or rather something normal to be expected when

more time passes since infestation.

We expected an exponential decrease, we might have used the word "trend" falsely here. The sentence will be revised to "The results strongly indicates a decreasing exponential relationship with time since infestation for the total BVOCs and the selected compounds, supported by the goodness of fit which provided an RMSE with low error. ". As we did not find comparable studies for this part of our results we will elaborate further in our discussion to include this information and suggest follow up studies on this.

159) L608 – check space

Corrected.

160) L609 – references, more to discuss with few sentences?

This is a statement that the trend we saw in our data is only related to the start of the infestation, not taking into account the time of the season and in what swarming period the infestation started, while for e.g. leaf emissions seasonality and phenology is known to be important. But we agree that if it might be of interest there could be some added discussion on the potential influence of the swarming periods and time in season. However, finding data for this to discuss around might be difficult as there are only very few studies available, and this rather would be speculation

161) L611 – indicate figure

Corrected.

162) L612 – which total holes, majority of entry or exit holes? Or entry+exit? To discuss what could be

the possibilities for no pattern. Any references where this kind of pattern occurs?

Yes, total number of holes refers to all holes, entry+exit. We did not see any pattern in emission rates and the entry+exit holes until we separated them. This is discussed further in this section. We have not seen any studies done comparing number/type of holes and emission rates. We first expected a

positive correlation between increasing number of holes and higher emission rates, but as mentioned we did not see that pattern. Also to further stress this, we did not have a generous amount of data on the infested trees, which made it hard to make any conclusions, but will be suggested for further studies.

163) L614 – indicate figure

Corrected.

164) L616-617 – references. Too long sentence, I suggest to make into two sentences. Double repeat.

Will add reference on the entry holes appearing at the start of an infestation. Will revise sentence.

165) L618 –VOC`

Corrected.

166) L619 – which individual tree, which area?

Will be corrected.

167) L620-629 – References.

This is a discussion around our results only. As we did not find any comparable studies we decided only to focus this part around our own results as speculations and forming of hypotheses which can be tested in follow-up studies. We will clarify this and we will elaborate this more with the reference we found looking at BVOC emissions from entry holes of Norway spruce (Birgersson and Bergström, 1989).

168) L624 – All trees – what area?

All trees in the study. All sites, all plots.

169) L628 – any reference to support your results and conclusion?

See reply above (comment 167).

170) L631 – indicate table/figure if proper

Table will be indicated.

171) L630-639 – add references and something to discuss more than these two references

This is the one reference we found looking specifically at BVOCs emitted from entry holes on Norway spruce.

172) L635 – oxygenated monoterpenes?

Yes, corrected.

173) L639 – any references to add?

We will try to find one.

174) L640 – 4.1.1.- Only 3 references per this part?

See replies above regarding low amount of references.

175) L682 – what other 16 BVOCs? Revise, no need to add BVOC names exactly.

Will revise this, the 16 other BVOCs if from the referred study (Lee et al., 2006), but it should be "compared to 13 other BVOCs" as alpha-humulene, longifolene and beta-caryophyllene was already mentioned and the study compared in total 16 BVOCs. Thanks for pointing this out.

176) L700- "As the…" double repeat.

Corrected.

177) 684 and 690 – both sentences are a repeat. " This could.." and "This change.."

Revised.

178) L685 – Myrcene sentence goes rather to Results part.

Correct, we will move it to the result section.

179) 4.2 – again % and numbers. Now here Ips typographnus – why not bark beetle as trough MS?

Only 5-6 references per this part?

See previous replies. Will change to bark beetle for consistency.

180) Table A1 – Names: numbers; MT, SQT explanation – check comment for table 1.

Will be corrected per previous replies.

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