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Interactive comment on "BVOC emissions from English oak (*Quercus robur*) and European beech (*Fagus sylvatica*) along a latitudinal gradient" *by* Ylva Persson et al.

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We thank the editor and the reviewers for their ideas and suggestions to improve this paper. All of these have been carefully considered in order to improve the readability of this manuscript. Below follows a list of changes made according to each referee's suggestions.

Reviewer #1 We thank the reviewer for the thorough review of our manuscript and for the following suggested points of improvement.

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Point 1: I have a concern regarding to the very limited number of trees available.

We absolutely agree that the limited number of trees available is of concern, as it makes it difficult to statistically verify the results. Unfortunately, the IPG network only provides with two individuals per species and site. For this study, measurements were done on all trees that were available. Furthermore, it should be pointed out that they were done on adult and naturally growing trees instead of saplings grown outdoors or in greenhouses. In order to make the text clearer regarding the limited number of trees, an additional sentence in section 2.1 (p. 3, L25) has been added. The new sentence is marked in italics: "The IPG network was initiated in 1957 and performs long-term phenological observations on some of the most common European plant species across Europe. Each site is initially provided with up to two individuals per species."

Point 2: p. 2 L25: paragraph Isoprene has. . . should be re-written.

Thank you for your comment. We agree that the paragraph could be rewritten in order to improve the flow of the text. Our suggestion is to remove the sentence all together and add additional text to the previous line. The text (marked in italics) would then be the following: "Both trees are reported to be de novo emitters, lacking specialized anatomical structures for storing newly produced BVOCs (Holzke et al., 2006; Kleist et al., 2012; Steinbrecher et al., 2013).

Point 3: Materials and methods How the daily PAR had been calculated? This is very important.

Thank you for your comment! To make things a bit clearer, we did not use daily PAR in our measurements, but the PAR level was fixed within the chamber to 1000 μmol m-2 s-1 for all of the measured samples. The chamber is equipped with a 6400-02B LED light source which is software adjustable from 0 to 2000 μmol m-2 s-1. For the daily PAR which is mentioned on p. 8, L18, we used an external PAR sensor (LI-190SA) connected tothe same unit as the internal light source. An additional sentence was addedto section 2.2 (p. 4, L29): "In addition to BVOC measurements, net assimilation rates (A) and stomatal conductance (gs) were determined for each leaf using a portable photosynthesis system (LI-6400, LICOR, Lincoln, NE, USA), equipped with a led source leaf chamber (6400-02B) and an external quantum sensor (LI-190SA)."

Point 4: Why the assimilation rates are low? I could guess this is due to the fact that only leaves from lowest branches. It has been shown that assimilation rate and BVOC emission scale with the heights (see Niinemets et al. JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 115, G04029, 2010).

As the reviewer is pointing out, one of the reasons of low assimilation rates could be due to that measurements were only performed on the lowest positioned branches. Looking through some literature on similar PAR levels, English oak has been reported to have assimilation rates between 5-16 μmol CO2 m-2 s-1 for sunlit branches and 0-5 μmol CO2 m-2 s-1 for shaded branches (Morecroft and Roberts, 1999; Vallandres et al., 2002) and European beech between 5-6.5 μmol CO2 m-2 s-1 for sunlit branches and 0.5-4 μmol CO2 m-2 s-1 for shaded branches (Warren et al., 2007). Our study has assimilation rates between 2.6-7 μmol CO2 m-2 s-1 for oak and 2.6-8.9 μmol CO2 m-2 s-1 for beech. This would suggest that the assimilation rates for some trees in this study might be adapted to shade conditions, which would have an effect on the BVOC emissions as well. We already acknowledge in the discussion (p. 11, L5-10) that we know there is an effect of height, in particular for beech. A suggestion could be to add in an extra sentence together with references regarding the low assimilation rates for both oak and beech based on the discussion held here. The sentence for oak (marked in italics) was added into section 4.1 (p. 9, L20-25): "A low net assimilation rate of 2.5 μmol CO2 m-2 s-1 also indicated stress, which was less than half the rates found at the other sites, apart from one of the Grafrath trees. The assimilation rates of the tree in Ljubljana and Grafrath 1 correspond to the assimilation rates reported from shade adapted leaves, whilst the remaining rates are in range of sun adapted leaves (Morecroft and Roberts, 1999; Vallandres et al., 2002)." Morecroft, M.D. and Roberts,

J. M.: Photosynthesis and Stomatal Conductance of Mature Canopy Oak (Quercus robur) and Sycamore (Acer pseudoplatanus) Trees Throughout the Growing Season, Funct. Ecol., 13, 332–342, 1999. Valladares, F., Manuel, J., Aranda, I., Balaguer, L. and Dizengremel, P.: The greater seedling high-light tolerance of Quercus robur over Fagus sylvatica is linked to a greater physiological plasticity, Trees, 16, 395–403, 2002.

The sentence for beech was added to section 4.1 (p. 10, L5-10): "In this study, the average net assimilation rates for Ljubljana and Grafrath were between 4.62-8.93 μmol CO2 m-2 s-1, whilst Taastrup had the lowest rate of 2.56 μmol CO2 m-2 s-1. The values for Ljubljana and Grafrath are in the same range as assimilation rate for sunlit leaves measured earlier, whilst values from Taastrup are more similar to the assimilation rate for shaded leaves (Warren et al., 2007)." Warren, C. R., Matyssek, R. and Tausz, M.: Internal conductance to CO2 transfer of adult Fagus sylvatica: Variation between sun and shade leaves and due to free-air ozone fumigation, Environ. Exp. Bot., 59, 130–138, 2007.

Point 5: Other problem is the stress induce on the leaves which could increase BVOC emission.

Thank you for pointing this out. The reviewer is absolutely right regarding the risk of stress induced on the leaves as they are handled and measured, leading to a potential increase in BVOC emissions. We cannot deny that as we are inserting the leaf into the chamber and providing it with climatic conditions which are usually a little bit different from what the ambient conditions are at that time, that we do influence the emission patterns from that particular leaf. We have however tested the stress induce beforehand with the help of a PTR-MS. We found out that one hour of acclimation to the chamber conditions was sufficient for the emissions to return to a stable level.

Reviewer #2 We thank the reviewer for the thorough review of our manuscript and for the following suggested improvements. The following describes the view we have on the four points raised.

Point 1: The authors compare BVOC emissions from populations of same genetic structure but at different climatic locations. Generally speaking, then comparisons of such data set would often include a test of significance. Would a test of significance be appropriate in this particular case? Thank you for the comment! We have performed significance tests on the data, both between sites using a one-way ANOVA followed by a Tukey's test, and within sites where two clones were available using a paired t-test. However, we have to acknowledge that the wrong t-test has been performed. Instead of a paired t-test, which studies the significance from dependent samples, a two-sample t-test, studying the significance of independent samples, should have been used. The results of the different significance tests are however not contradicting the similarities between clones from the same site ($P>0.05$), but we will in the revised manuscript correct the paired t-test to a two-sample t-test (p. 6, L15 and figure caption for Fig. 7).

Point 2: Fig. 1 is a bit difficult to read. It would be better if the country borders were drawn on top of the coloured grids.

Thank you for the comment. We will redraw the map, adding in country borders for the revised manuscript.

Point 3: Could some of the figures be more efficiently presented in a table. Figures like Fig 2,3,7 appear to be highly related to Table 3. If this is possible, then would it make the results more quantitative and at the same time save space.

We agree with the reviewer that the figures could be represented in a table instead. Fig. 7 for example showing the boxplots of the standardized emission patterns of oak and beech at the different sites are already covered in Table 3. We assume that the reviewer is referring to Figs 3 and 4 regarding assimilation rates, stomatal conductance and WUE for oak and beech and these could be added into the table as well. We therefore suggest that Figs 3, 4 and 7 and the text referring to these figures is removed from the manuscript and that Table 3 is rewritten, adding in stomatal conductance and WUE to the table.

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Point 4: It is unclear to me, why the BVOC component Sabinene is not measured at some of the trees in Taastrup and Grafrath 1 (e.g. Fig 9). Is there a particular reason to this. Secondly, is findings in relation to the BVOC component Sabinene an important finding that suggest that large variations are found at the individual tree level? Thus suggesting that BVOCs from several trees must be measured before conclusions can be drawn?

As the reviewer correctly points out, the component sabinene was not detected in all the samples of the beech trees in Taastrup, Grafrath 1 and one sample in Grafrath 2. By inspecting the data, we have seen that the samples without Sabinene for Grafrath 1 and 2 were all taken in the morning before 9:00. The samples without Sabinene for Taastrup were from measurements performed on leaves that had started to turn yellow. From the data that we present here, we can add in two additional sentences (marked in italics) at p. 8, L5: "In the few samples where sabinene was not detected, limonene was the main emitted compound. In Grafrath, these samples were taken usually before 9:00 in the morning. For the tree in Taastrup, the samples without sabinene were from leaves which were more yellow in colour than the other leaves."

On behalf of all authors,

Ylva van Meeningen

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