

Interactive comment on “Effect of mid-term drought on *Quercus pubescens* BVOC emissions seasonality and their dependence to light and/or temperature” by Amélie Saunier et al.

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The authors would like to thank the Editor and the Reviewers for very careful and detailed review of our manuscript and providing of comments and suggestions to improve the quality of the manuscript.

RC1: The manuscript discusses the light and temperature dependencies of several BVOC emissions from a Mediterranean oak species. This manuscript fits in the scope of the journal presenting a BVOC emission study on a relatively little studied tree species. The authors go through the methods they have used thoroughly, and the results are presented in the text and figures clearly. The discussion on the results and conclusions could, however, be deeper and underline how this study increases the un-

C1

derstanding of BVOC emission dynamics. Though the manuscript is carefully written, some English language improvement would not be bad idea. My comments below are rather minor though their number is relatively high.

RC1: Line 13: You discuss many times about BVOC in singular form, though you actually mean plural BVOCs. Please check these throughout the text. AC: We did the modification in the manuscript.

RC1: Line 23: You claim that the three sampling campaigns cover the entire seasonal cycle. However, note that there are likely sub-seasonal periods, which are not covered by your measurements. For example, the highest natural drought at the site is likely in late summer, when you did not measure. Do you think that your results from these three measurement periods are representative enough to model *Q. pubescens* BVOC emissions year around? If so, why? Could you describe with a few words the physiological state of the oaks during each of the campaigns, e.g. if the new leaf emergence or leaf size growth occurred during the spring measurement period? AC: We think that our measurement periods are well representative of *Q. pubescens* BVOCs emissions because they took place during the principal phenological stages of leaves. There was no leaf emergence during our spring period sampling, it was the end of leaf growth. We also performed an experiment during leaf emergence (in April 2013), not presented in this study, but there were very slight BVOCs emissions. During summer, leaves still matured and autumn was featured by the beginning of leaf senescence. We added a short comment on this part in the manuscript (lines 105-106).

RC1: Line 24: Amplified drought impacted all studied BVOCs, but not necessarily all the minor compounds that the trees produce but you couldn't quantify. AC: Indeed, we added "studied" in this line.

RC1: Line 32: Please use throughout the text the unit formatting as advised in the journal instructions. AC: We did the modification in the manuscript.

RC1: Line 34: Please check the use of subscripts in the entire text. AC: We did the

C2

modification in the manuscript.

RC1: Line 35: You likely mean tropospheric ozone concentration. AC: Yes, we changed this in the manuscript (line 36).

RC1: Lines 72-74: In my mind, seven commas per a sentence is too much and makes the sentence hard to read. Please edit the sentence e.g.: However, there are still some misunderstandings at the level of emission mechanisms and consequently on model estimations for isoprene and, a fortiori, for highly volatile BVOCs under mild or severe water stress. In addition, you could open which misunderstandings you mean here. AC: We rewrote this sentence as suggested and we added some details on misunderstandings on isoprene emissions (lines 66-74).

RC1: Line 80-81: Please correct: 2 million ha. Note that the study by Keenan et al. (2009) considers only forests, and there are other remarkable sources as well. AC: We did the modification in the manuscript (line 84).

RC1: Line 86: The site may be free from direct human disturbance, but indirect disturbance through e.g. air pollution it certainly has experienced. AC: Indeed, we added "direct" in this sentence (line 90).

RC1: Line 93: The plots were 200-300 m² in size. How many trees were growing in the plots? Can you be sure that the trees at the amplified drought plot did not uptake water by their vast root system from the non-drought area? AC: In natural drought plot, there is 145 stems and in amplified drought plot, there is 95 stems. We cannot be sure that trees at the amplified drought did not uptake water in natural drought plot. Indeed, we do not know where the trees roots are located. But, on our site, there is a buffer zone for each plot (2 meters). So, we only followed trees located in the heart of both plots. And, also, we observed effect of amplified drought on BVOC emissions and physiology parameters. We think that it a negligible phenomenon.

RC1: Lines 96-97: I do not quite hit the idea of the latter part of the sentence: – corre-

C3

sponding for three years, to 2 months for natural treatment and 5 months for amplified treatment of drought period. Please rephrase. AC: We rephrased this sentence (lines 101-102).

RC1: Line 100: You had five trees per treatment, but how many enclosures there were per tree and per sampling campaign? Did you move enclosures from tree to tree during one sampling campaign? AC: During each field campaigns, the five trees of each plot were sampled. We used 2 enclosure systems concomitantly which allowed us to analyze one tree under amplified drought and one tree under natural drought. The analyses was performed during 1 or 2 days, depending on the weather. And, every 1 or 2 days, we moved enclosures from tree to tree. We added a sentence about that in the manuscript (lines 111-112).

RC1: Line 103: To be precise, BVOC exchange between the tree and the atmosphere is a part of tree gas exchange. AC: We did the modification in the manuscript.

RC1: Line 104: How much biomass the enclosures enclosed? Please give some numbers (branch length, leaf area, leaf mass or equivalent). AC: We enclosed branches containing between 8 and 12 leaves which corresponded to 1.4g and 3.6g of dry matter. In terms of surface, we enclosed between 110 and 320 cm² of leaves. With these data, we calculated the relation between leaf mass and surface (LMA) and we found no significant difference between leaves from amplified and natural drought at any season. We added a sentence about that (lines 125-127).

RC1: Line 106: A PTFE air generator sounds like it would produce PTFE in the air. Please rephrase. AC: We rephrased this sentence (line 113).

RC1: Line 109: What do you mean by the excess of air humidity? Was the humidity inside the enclosure controlled (currently not stated in the text) and set to some range? If so, please make an addition in the text, as this is rather critical detail in the case of water-soluble compounds. AC: The humidity inside the enclosure was not controlled. However, we slightly removed some humidity from entering the chambers

C4

(before the air generator), especially in autumn to impede condensation of water vapor which would have disturb mass flow controller.

RC1: Line 116: Rather say: made of PTFE. AC: We did the modification in the manuscript (line 113).

RC1: Line 119: Is reference to chapter 2.2 correct or should it refer to 2.4 (BVOC analysis)? AC: Indeed, we did the modification in the manuscript (line 130).

RC1: Line 120: Please edit: gas exchange values. AC: We did the modification in the manuscript (line 131).

RC1: Line 125: Add s: parameters. Lyophilization is not familiar term to many readers of the journal, so say rather: –were lyophilized (freeze-dried) to assess the dry mass. AC: We did the modification in the manuscript (line 136).

RC1: Line 140-141: You say that formaldehyde calculation took into account the humidity dependence. What about the other humidity-dependent compounds? Could the clearly visible steps methanol and acetone fluxes in the late evenings of natural drought (fig.4 and S3) be humidity-related? Anyhow, there seems to be something else happening simultaneously: net photosynthesis rises to positive values just before midnight (fig. 1, autumn, natural drought). Something wrong with the measurements or calculation? AC: We only took into account the humidity dependency of formaldehyde because for this compound, this dependency was very problematic compared to the others compounds (Vlasenko et al. 2010). We do not think that the increase of methanol and acetone in late evening (in autumn) could come from the humidity because we analyzed a pair of trees at a time (one tree under natural drought and one tree under amplified drought). Moreover, the enclosure chambers were feed with the same inlet air (thus, with a similar humidity) and transpiration rate during the night was close to zero. If there was a humidity problem, with our set-up, we would have observed the same phenomenon on amplified drought and it was not the case. Moreover, it seems unlikely that there was a calculation problem because we always used

C5

the same calculation. It was probably a phenomenon linked to trees metabolisms but we cannot explain this yet.

RC1: Line 145: Why did you choose to express the emission rates as C (carbon)? AC: We chose to express the emission rates in carbon because in many studies of dealing with BVOC modelling, they used this unit (Guenther et al. 2012; Guenther 2013). Also, in global scale, it is more convenient to express BVOC emissions in carbon to evaluate their impact on global change.

RC1: Line 164-165: Please rephrase for example as follows: Afterwards, linear regression tests and slope tests (equal to 1) were also performed. AC: We did the modification in the manuscript (lines 178-179).

RC1: Line 168: Have you any data how dry the soil actually was? Any soil volumetric water content measurements or equivalent throughout the seasons? AC: We have predawn water potential only for the summer campaign which can give a good idea of water availability in soil. During this season, there is a significant difference between both plots (-0.61MPa for natural drought and -0.85MPa for amplified drought, $P < 0.05$). Moreover, we observed an effect of our treatments in physiology, especially on stomatal conductance.

RC1: Line 171: Please correct spelling: other season and stomatal closure (the latter one in some following lines as well). AC: We did the modification in the manuscript.

RC1: Line 177: I wonder if you have any tree growth data from the site ? In ceasing growth (height growth or lateral growth depending on timing) you might see drought effect earlier than in photosynthesis. The results are not discussed and compared to literature too much, so you could here e.g. refer to an earlier drought study (Damesin & Rambal 1995) conducted with the same species. AC: Indeed, we have some data on tree growth (in terms of leaf biomass and lateral growth) but with no change in 2013 and 2014 and significant reduction of growth in 2016 (data showed on other publication) that is the fifth year of amplified drought. Photosynthesis is typically, is the first parameter

C6

to be impacted by drought (Chaves et al. 2002). That is exactly what occurred in our study because we observed reduction of photosynthesis until 2012 (the first year of our experiment) whereas the first effect on growth appeared in 2016.

RC1: Line 186-187: Reduced and increased emissions compared to what? And what is the reference for? In the discussion about isoprene emission dynamics during drought, you may also refer to Bruggemann & Schnitzler (2002), who have studied isoprene emissions of *Q. pubescens* saplings. AC: This experiment was conducted since 2012. In this paper, we only presented the results from the end of the second year to the beginning of the third year. In the first year, an increase of isoprene emissions was observed (data unpublished yet) whereas, we observed a decrease after 2-3 years of amplified drought. We added also a sentence on Bruggemann and Schnitzler's work (line 202).

RC1: Line 193: You write here and in many other cases as well, that a compound responds to something. This reflects very much the modelling point of view. However, the plant responds to the changes in its environment, and that we see as a change in the plant volatile emissions. I would like to see in the discussion more of this plant-point-of-view: what does the plant do so that we see these kind of fluxes. AC: We added some part on plant-point of view throughout the discussion.

RC1: Line 196-199: You write: "the daily cycle between natural and amplified drought was very different for each season." If I look at the fig. 2 about isoprene emissions, I don't see very different daily cycles. Please clarify what you mean. Moreover, you write: "were not the only parameters driving isoprene emissions." Please tell which other parameters you think were affecting at that time of the year. AC: Accordingly to the reviewer's comment, we change this sentence since indeed our description was confused. We should have written the daily cycle between natural and amplified drought was different. What was different but the intensity of isoprene emissions between amplified and natural drought. We suggest that plant likely needed to produce more isoprene with the aim to protect the photosystems apparatus in new leaves. We

C7

added this point in the manuscript (lines 217-218).

RC1: Line 200: You discuss about MACR+MVK+ISOPOOH basically as a compound. Have you any data if all these three compounds really are present in the fluxes all the time or if one of them dominates the measured flux and thus masks the variations in the others? AC: We did not have data on these compounds separately. We only detected the ion 73 corresponding on the three compounds. Thus, we cannot say if one of these compounds dominated flux.

RC1: Line 213: Turn the sign: <. AC: In this line, it is the good sign. It was just for specifying that the slope was not significantly different to 1. Maybe, it is confusing and we can remove this indication.

RC1: Line 221: Please check spelling: phenomena. AC: We did the modification in the manuscript (line 239).

RC1: Line 227: Please change to leaf elongation. AC: We did the modification in the manuscript (line 248).

RC1: Line 230: You write that methanol emissions respond only to temperature in nighttime. Have you taken into account that in nighttime light intensity is basically zero if no artificial light is available and stays constant over the night? Moreover, in nighttime light intensity range is far smaller than in daytime, and this will be reflected in your modelling results. AC: We measured light during the night and used these data for modelling. The data on light during nighttime was close to zero and temperature was roughly constant. Thus, we attributed emissions of methanol during the nighttime to a temperature-driven response as already demonstrated by Smiatek and Steinbrecher (2006). We made some figures in the new version of the supplementary files, summarizing light and temperature conditions during our experiment.

RC1: Line 254-255: Would this sentence need a reference? AC: These results were not published yet. Thus, we added personal communication from A.C. Génard-

C8

Zielinski, line 282).

RC1: Line 261: Please change phenomenon to phenomena. AC: We did the modification in the manuscript (line 289).

RC1: Line 263: Please check spelling: the calculation of ecophysiological parameters. AC: We did the modification in the manuscript (line 291).

RC1: Line 278: Please check spelling: vapour. AC: We did the modification in the manuscript (305).

RC1: Line 327-328: Here and in some other cases as well the italics of scientific names have been replaced with cryptic markings. Please check the reference list. AC: We did the modification in the manuscript.

RC1: Table 1 caption: Please remove the abbreviation ER and add the explanations for ND and AD. AC: We did the modification in the manuscript.

RC1: Figure 1: Please remove “ND: natural drought; AD: aggravated drought” as the information is in the figure. The various vertical scales make it hard to compare the seasons, so please consider unifying the scales. And please remove A from the lower right panel. AC: We did the modification in the manuscript.

RC1: Figure 2-4 captions: Edit the last sentences: – emissions are presented –. AC: We did the modification in the manuscript.

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C9

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Please also note the supplement to this comment:

<http://www.atmos-chem-phys-discuss.net/acp-2016-836/acp-2016-836-AC1-supplement.pdf>

Interactive comment on *Atmos. Chem. Phys. Discuss.*, doi:10.5194/acp-2016-836, 2016.