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# *Interactive comment on* "Impacts of soil moisture on de-novo monoterpene emissions from European beech, Holm oak, Scots pine, and Norway spruce" *by* C. Wu et al.

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General comments

This is the presentation of a very interesting experiment and I am very thankful to the authors that they approached the laborious task to determine the relationship between drought stress and monoterpene emissions. Overall, I am confident that this work will be eagerly taken up by model developers to improve their approaches. Nevertheless, I would like to suggest some potential improvements, i.e. the presentation of more results, the consideration of relative water content as a proxy for stress, and the incorporation of some more (partly very recent) literature to enrich the discussion. One



of the aspects I would like to suggest considering is the modification of the Niinemets approach presented in Morfopolous et al. (Morfopoulos et al., 2013, Morfopoulos et al., 2014). This concept has been theoretically explored by Grote et al. (Grote et al., 2014) - among other things with regard to drought stress! They find that 1) the concept allows for an increase of emissions with mild drought stress and 2) an exponential decrease of emission can be represented considering observed drought effects on photosynthesis. The presented data very nicely support this theoretical model analysis.

Some more specific comments

Abstract:

- I would be more careful with the word 'explainable'. From the exceptions in the measurements it could be deduced that other reasons might also be important (see below)

- Some words about the photosynthesis measurements would be appreciated. Especially because I think that the delayed increase of emission after rewetting could be linked to the response of photosynthesis which also is somewhat delayed. So in fact, this finding hint to a close relation between photosynthesis and emission that should be better considered in models.

Introduction

- P12990L2: Yes, one of them is soil moisture. However, it would be nice to mention a few others such as seasonality (leaf phenology), CO2 and/or ozone.

- In the overview about drought stress findings in the literature, the authors might like to consider the review done by Possell and Loreto (Possell & Loreto, 2013).

Methods

- The authors seem to have determined pool emissions as well as de-novo emissions of monoterpenes. However, the paper doesn't present a quantitative differentiation of the two. Is it possible to give a species-specific ratio of the two fractions? I would like

to ask the same thing for standard emission factors.

- Progressing drought stress increased leaf temperature by 'additional' 2-3 oC (P12996L10). Unfortunately this not presented in a graph. Nevertheless, I would be interested in the dynamic of this increase in relation to stomata conductance (or a proxy to this such as relative transpiration rate or photosynthesis).

- It says in the paper that soil samples are taken from the pots to determine Mdry (P12996L18). Is this done for each pot individually or have the soil samples been pooled? Do you think that the sample was of the same density than the average soil density in the pots? This is important to judge the obvious problems with the determination of soil water content.

- Overall, I would recommend using relative water content as drought stress proxy – alone or in addition to absolute soil water. It is much more common in modelling approaches and more easily to transfer. In principle, soil water potential would also be an option but the necessary data to derive this on the regional or global scale are not available. There should also be a solution to find a correction method for the 'negative values' of water content.

Results

- Define 'green leaf volatiles' before using the expression (P12997L21)

- P12997L25ff: This is unclear. What are 'constant patterns' or 'emission correlations that are correlated with . . .'. Consider Rephrasing.

- Why has it to be noted that acyclic ocimenes were not found (P12998L17ff)? I guess it has something to do with stress responses but the explanation is unclear.

- I would appreciate if figures like Fig. 3 would be presented also for pine and holm oak.

- It is not clear to me, where the variations of emissions at high water content (Fig. 4)



are coming from.

- Is it possible to present the emission factors for the sum of monoterpenes – possibly differentiated by pool- and de-novo- emissions? In the text only some relative amounts for the compounds used in the analysis are given. This could be better presented in a table which would be beneficial for the text which is quite complicated.

Discussion

- It would be very interesting, if temperature dependence of emission increase (P13004) could be quantified. In any case, it should be discussed that other reasons for the increase are at least possible. I am particularly thinking on the excess electron flux that is coming from the light reaction of photosynthesis and is not channeled into assimilation any more when CO2 supply is limiting. This electron supply could eventually trigger emission production (see Grote et al. 2014).

- P13004L17ff: Please note that this chapter discusses mild drought stress impacts. I gather that the conclusion for modeling is to describe leaf temperature more mechanistically and consider cooling by transpiration. The decreasing impact on emission should be discussed in the chapter of severe drought stress.

- Regarding the impact of soil moisture (P13006L18ff), it might be good to include the data of Acosta-Navarro et al. (Acosta Navarro et al., 2014), whose estimates of the drought impact are a bit higher than those mentioned.

- Generally, the chapter 4.2 (state of the art regarding models) would benefit from citing the recent reviews of the topic by Monson et al. (Monson et al., 2012) and Grote et al. (Grote et al., 2013).

- As stated at page 13007, the relative soil moisture is indeed a common index term to describe drought. The authors demonstrate that they could easily calculate this value, which I again recommend to do. The different possibilities of introducing drought stress into emission models by using this relative water content have been investigated by

Grote et al. (Grote et al., 2009) and further explored by Grote et al. (Grote et al., 2010).

- At P13008L23ff the time lag between re-watering and MTemission recovery is discussed. I would like to mention that also photosynthesis is recovering and that these findings support the idea that photosynthesis and emissions are directly linked (as stated in the Niinemets model). The use of epsilon however, might indeed not be appropriate if use alone as has been demonstrated for all light-dependent isoprenoid emissions by Grote et al. (Grote et al., 2014). Given the information above, the chapter 4.3 might need a revision that could include a considerable shortening, particularly regarding the end.

Conclusion

- Please consider the new findings (best of our knowledge. . .) also in the conclusions.

- P13011L23: replace 'will' by 'might' or similar

- P13011L26: as far as I recall Kleist et al. advocate a less intense increase of emission with heat rather than a suppression of MT production.

Figures

- Harmonize colors between Figs. 3 and 4

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