

## ***Interactive comment on “Biogenic isoprenoid emissions under drought stress: Different responses for isoprene and terpenes” by Boris Bonn et al.***

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First of all, thanks to the reviewer for the valuable comments made. We will address the individual issues step by step as listed in the review:

### **Response to general comments:**

Indeed the studies used were digitalized by extracting the datasets from the individual publications as far as we could access it either personally or by web. It's a very good

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idea to put all data into a datasheet for the community to use it henceforth. This will be done as suggested as an extra supplementary dataset.

It's correct that most of the datasets were obtained from Europe, as a lot of studies on drought effects were conducted especially in the Mediterranean and the project is focused on this area. However, looking for other studies with sufficient parameter measurements available for comparison were difficult to find. Potentially further information were obtained by the experimentalists but were not accessible within the article or supplementary datasets. An inclusion of further studies is welcome anytime. As suggested the different studies will be classified by area of investigation (Mediterranean, temperate) in the overview Table 2, where it is supposed to fit best. But one of the outcomes was actually that the plant response curves for individual species were physically i.e. molecular property based, but not species dependent. The plant species behavior was reflected in the selection of the different intensities of processes and may be adapted in this way to the local environmental conditions such as typical wetness, temperature and oxidation strength. However, we do not have sufficient data to clearly prove this hypothesis in a statistically significant way.

The term 'biological growth curve' is based on a variety of fit curves to match best with observations. The fitting equation was derived from 'biological growth' behavior, i.e. stresses to occur similar to the growth process. Those are supposed to be linked directly to processes involved in the plant status and establishing a metabolic balance. While some compounds such as isoprene may be less hindered by the stomata closure, its emission may be an appropriate adaption measure of the plant to different conditions (e.g. energy fluxes). We will consider your comments by adding an explanatory sentence at the introduction of the fitting curve term in L. 150.

Regarding section 2.3, i.e. the fitting curves and the named driving forces: We do

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not have sufficient understanding of and information about the detailed physiological processes acting during production, emission and stress response in total. This is supposed to be gained in further experiments in the community. Thus, the present manuscript is only focused on figuring out the plant response to drought stress for different compound classes. A review covering all the named aspects would probably be very extensive and fill a book, which would be nice to have. The controlling factor of emissions can be added as follows: "Isoprene is known to be emitted close to production (Guenther et al., 1995; 2006; 2012) and is therefore controlled by the production process itself as well as by diffusion gradients between plant and atmosphere. The larger sized monoterpenes at least partially require passage through the stomata, as their size does not necessarily permit diffusion directly through the plants cuticula (Sharkey et al., 1991). Therefore monoterpene emissions are controlled by the stomata opening to a larger extent than isoprene and less by the production. Parts of the produced terpenes may be stored if not emitted for later usage. This is even more evident for sesquiterpenes with 50

Thanks for naming the issue of 'forest' air. This will be corrected to 'ambient' air, since the plant nursery is not placed in the forest but at the campus site. Figure S1 is added to the supplementary material, since it demonstrates a large variety of the behavior of different VOCs and no lumping of functional groups seems possible. It is not part of the paper, but to support following the analysis pathway. There is a tendency of an overall link predominantly by emission. Ozone and OH reactivity values were calculated based on reactivities as listed in Table S1 and the individual emission rates. Thus, no further measurements like nitrogen oxides etc was needed. Temperature measurements have been taken from the nearby German weather service station named in L. 172f and temperature will be added to this paragraph. The BVOC measurements have been described in L. 176ff and methods have been referred to. While a further discussion would cause the manuscript to increase notably the measurements are used here to demonstrate only the behaviour of the plants emission reactivity at declining water status in addition to the match with other observations with

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respect to water availability and terpene emission rates.

#### **Response to specific comments:**

L. 16: OK.

L. 19: Correct. "On the contrary. . ." will be changed to "On the contrary to declining soil water availability. . ."

L. 26: Correct. To prevent any misunderstanding the term "and methane (CH<sub>4</sub>)" will be deleted.

L. 137: It should have stated as "last" or "final barrier" before being released to the ambient. The 'e' will be deleted.

L. 189: Correct. "emissions of any vertical mixing" will be changed to "effects of any vertical mixing".

L. 191: Correct. It is tens not tenths and the second part of the sentence ". . .and the area of emission can be easily traced back within the next kilometers in distance (unpublished data)" will be deleted.

L. 230: Done.

L. 263/331. Thanks. This will be done to prevent misunderstanding and misuse.

L. 293: True. This will be included in L. 292 as "SQT and diterpene (DT) (. . .)".

L. 310: Thanks.

L. 344: We stated "tendency" as this was found in the Rombach study (Rombach, 2018) and aimed not to generalize in total. We will put the references next to tendency to indicate that this is based on a limited amount of data, to be investigated further.

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The comment on the DOI is absolutely correct and the DOI will be removed from the thesis reference!

Fig. 5: The figure caption will be improved. Total monoterpene emission fluxes are plotted on the left, the corresponding of sesquiterpenes on the right. The individual emission fluxes will make the figure more complex but will be added in different colors. To display all 89 compounds identified would overload the plot. However we will include the dataset in the supplementary dataset to be uploaded for everyone interested in this study.

Figs. 6 and 7: These results are gained by applying the derived parameterisation for isoprene and monoterpene emission rates for a) European beech (*Fagus sylvatica*, lower plots) and for all species present in the Black Forest according to their basal emission rate. This will be clarified in the caption adding "...using the parameterisations of Guenther et al. (2012) and the SWA or SWC dependency derived in this study." In Fig. 6.

Fig. 7: Will be done by adding a shaded box for the time of enforced drought. We will ask for language editing.

Thanks a lot for the detailed suggestions made!

### References:

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Sharkey, T.D., Holland, E.A., and Mooney, H.A. (1991). Trace gas emissions by plants. Academic Press, London, UK.

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