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Biogeosciences Discussions

Interactive comment on "Emission of monoterpenes from European beech (*Fagus sylvatica* L.) as a function of light and temperature" *by* T. Dindorf et al.

Anonymous Referee #3

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General Comments:

The paper focuses on an interesting detail related to VOC emission of plants: The emission of monoterpenes from Fagus sylvatica. The authors highlight the fact that Fagus is a monoterpene emitter with a broad range of emission potential. The experimental data presented are the results from a data set of two series of one twig. This kind of experimental set up strongly limits a generalisation of the findings as within tree variability and tree to tree variability is not quantified. The author's work on discussing achieved results is appreciated. However, a much more careful interpretation is often required particularly considering limitations of the experimental set up. Some very critical aspects have been identified in the paper, which the authors should address carefully by a deepened data evaluation, additional experiments as well as avoiding a

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speculative discussion. In the following some critical parts of the paper are detailed.

Specific Comments:

When measuring VOC in air samples the authors describe “that sabinene partially decomposed to p-cymene, a-phellandrene, b-phellandrene, a-terpinene, g-terpinene, terpinolene, and a-thujene during storage time of these cartridges. Thus a correction factor was applied to the relevant compounds.” As sabinene is the dominant compound emitted by Fagus, the instability of sabinene on the adsorbent during storage strongly impacts the accuracy of the calculated emission rates. Therefore, it is essential to explicitly report the uncertainty introduced by that process based on a sound error calculation considering that this error may be variable depending on storage time and perhaps also storage conditions. Results of corresponding experiments should be presented.

The authors observe a factor of three differences in the emission potential of the beech twig in the years 2002 and 2003. They state: “Consistent with the results of the enclosure measurements, ambient monoterpene concentrations (Ě.) ranged up to 1.8 ppb in June 2002 and up to 1.1 ppb in July/ August 2003. This result is indicative of the strong influence of beech trees on atmospheric gases in the vicinity of the tower site.” Based on the very small difference between the mixing ratios reported and further taking into account the variability of the ambinet air mixing ratios during the measurmetn periods which is not reported, there obviously is no indication that the shown difference in the source strength is reflected in observed ambient air monoterpene mixing ratios at this site.

The so called ‘midday depression’ in gas exchange is a well known feature reducing water loss due to high vapour pressure deficit between plant and the atmosphere by closing the stomata during high temeprature and light periods combind with reduced water availabilty in the soil. From data presented in Fig 7 a “midday depression of photosynthesis” is postulated. However, this statement can hardly been drawn from the data sets recorded with the twig enclosure system without presenting additional information. Critical are the temperature as well as PPFD values reported. They are measured on spot only. The variability of these values in the enclosure is not reported. Also some shading resulting from the enclosure mounting system may have impacted measured gas exchange (see Fig. 1). Leaves of the enclosed twig are (1) sun-lit leaves, (2) partially shaded as well as (3) totally shaded leaves. All leaf categories in the enclosure contribute differently to measured gas exchange rates during the day as well as during the season depending on the received light intensity. No data or model study is presented how different light angles impact gas exchange and monoterpene emission, respectively, from a twig using this experimental set up in the measurements.

Hysteresis - lower emission potentials in the morning compared to the afternoon or under “stress” upside down (observed only once) - of monoterpene emission may also be a result of the contribution of different portions of leaf classes (see above) to the measured gas exchange rates during the day. Whether the observed effect is a result of “down regulating Rubiso” is not proofed by facts and therefore this statment is very speculative. Further, sound experiments should proof this interesting feature "Hysteresis" possibly impacting monoterpene emission during the day before any discussion is raised.

According to the arguments present above the conclusion presented in the sentence “Since midday depression of monoterpene synthesis was observed only during high monoterpene production rates in 2002, we conclude that monoterpene emission was limited by substrate availability in this special case.” is not proofed by facts.

In the chapter “Variability of standard emission factors” some items need to be clarified. (1) It is stated that “the low standard emission factors calculatedĚ were confirmed by canopy scale flux measurements”. This statement per se is not valid without discussing such items as (i) the up/down-scaling problematic (twig to canopy and vica versa), (ii) the effects of within canopy/above canopy air chemistry and (iii) turbulent transport properties. Monoterpenes and particularly sabinene being twice as reactive

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as a-pinene in the daily mean (Neeb et al. 1997) are oxidised within minutes in ambient air and strongly impact canopy exchange rates of monoterpenes. (2) Discussed temperature and draught effects on the emission potential are of limited importance here as long as potential enclosure effects (see above) are not effectively ruled out and additional data presented, respectively (for instance predawn leaf water potential for showing that the plant actually suffers from draught). (3) Reported differences in light intensity when comparing 2002 and 2003 values might be an effect of not exactly placing the light senor at the same position in the following year rather than being an effect of increased biomass of surrounding twigs as discussed (see Fig 1).

Describing “Implications for the European budget of monoterpene emission” based on the results presented is very problematic as the presented implication are based on weak facts as discussed above. In this chapter different European scale emission scenarios are presented by changing a generally accepted mean emission factor for beech to a value which is not statistically sound. The set of presented graphs overemphasise the importance of this chapter. A table summarizing the results of the scenario studies would be appropriate.

The conclusions written reflect mostly current knowledge rather than presenting new insights in the problematic of temperature and light controlled monoterpene emission of ecosystems. Whether the reported increase of 14

Technical Corrections:

SI-units should be used for reporting emission rates (for instance μmol m-2 s-1).

References “in preparation” should not be cited.

The reference list should be carefully checked that plant names are correctly written and in italics.

p. 139 line 27: the reference “SCHNITZLER, J.-P., LEHNING, A., STEINBRECHER R. (1997): Seasonal pattern of isoprene sysnthase activity in Quercus robur leaves and

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its impact on modeling isoprene emission rates, Botanica Acta 110, 240-243" should be added.

p. 144, line 15: end of sentence: "Fig. 3" should be added.

p. 147, line 15: instead of "monoterpene concentrations" it should be "monoterpene mixing ratios" as ppb are reported.

p. 147, line 26: the phrase "pseudo correlation" is misleading here and the sentence need to be rephrased.

p. 154, lines 17 to 20: When comparing emission rates the same units should be used.

Appendix A: phi B in equation A3 should be explained.

Interactive comment on Biogeosciences Discussions, 2, 137, 2005.