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Biogeosciences
Discussions

Interactive comment on "Contribution of flowering trees to urban atmospheric biogenic volatile organic compound emissions" *by* R. Baghi et al.

R. Baghi et al.

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We thank referee 1 for the insightful comments. Below are our responses and corrections to the manuscript that we intend to make.

Referee 1 Comment: The authors derive normalized emission rates for the main BVOCs observed for conditions of Ts = 30oC. As experiments were carried out in spring (the season for the discussed trees to bloom) the ambient and also enclosure temperature were below this reference temperature for crabapple (see figure 4 of the manuscript). For horse chestnut (figure 6) 30oC were reached in the enclosure and the observed emission rates seem to level off at 28oC. The authors do not provide the respective figures for honey locust and hawthorn (actually no figure at all is provided for hawthorn). This reviewer doubts that the normalization can be performed the way

it was done by the authors and the approach needs to be further justified if followed in the final version of the paper. Many of the conclusions in this manuscript strongly depend on the choice of reference temperature for reporting normalized emission rates. For instance the comparison of modelled sum of monoterpenes from foliage emissions with floral emissions (figure 10) relies on correct emission rates as input for the model.

Author Response: We will add the requested figures for honey locust and hawthorn in the supplement. As the reviewer correctly noted, enclosure temperatures during the study of the crabapple tree did not reach 30°C. We believe that there is value in providing normalized emission rates, as those numbers are needed as inputs for modelling BVOC emissions and their effect on air quality. Most models are tailored towards using 30°C normalized Basal Emission Rates. We currently are not aware of a better way for presenting these data to the wider community. For most modelling purposes, springtime weather conditions will be reflecting temperatures that are well below 30°C. Given that we provide the BER and ïĄć-factors used for their determination, those conditions can be well simulated and relatively small statistical error margins with the information that is provided.

Referee 1 Comment: In their description of the sampling procedure the authors state that the sampling started no sooner than six hours after the enclosure was installed to allow stress induced emission caused by closure installation to subside. It seems questionable that six hours are a scientifically justified upper limit for stress-induced emissions to occur. This is further supported by the authors reporting methyl salicylate as one of the major emissions of horse chestnut. Methyl salicylate is a well-known stress-induced emission and it needs to be justified in detail why it is not considered to be indicative of stress in this case.

Author Response: During this study, most often an acclimation time of 24h was used. This time was shortened to six hours only in some occasional cases. Methyl salicylate was detected on seven out of twelve days of enclosure measurements on the horse chestnut tree, and we did not notice an obvious tendency of higher emissions at the

beginning of enclosure experiments. From the latter observation we do not suspect methyl salicylate being a stress induced emission in this case.

Referee 1 Comment: Give references for your statements that VOCs play an important role in e.g. formation of tropospheric ozone and SOA. Give references for statement that _90% of global terrestrial non-methane VOC emissions are biogenic.

Author Response: The following references will be added in the revised manuscript in support of this statement: (Andreae and Crutzen 1997), (Fuentes et al. 2000)

Referee 1 Comment: What is the expected effect of the trees investigated being 3-5 years old and potted?

Author Response: As far as we could tell the seasonal flower and foliage development of the potted plants was the same as for trees growing in the city. This experiment setup was for practical reasons to allow the study of several tree species at the same time in a safe and ambient condition environment. The investigated trees were relatively young but this is not thought to alter the representativeness of collected data. All trees were well acclimated to their planting pots and growing environment.

Referee 1 Comment: Provide more details on the experimental procedure: for instance with the reported flow of 25 l/min what is the residence time of air in the enclosure, respectively what is the associated exchange rate? Provide information on manufacturers of “respirator filter”, “cartridge with MnO2-coated screens”, “Velco strap”.

Author Response: The volume of the enclosure bag was between 50 - 60 l. At the 25 l/min purge flow this results in a turnover time of 2.0 - 2.5 min. The particle/charcoal “respiratory filter” was from Mersorb, Part no. 463532 (Mine Safety Appliances Company, Pittsburgh, PA). The MnO2-coated screens were from O.B.E. Corp. Fredericksburg, TX.

Referee 1 Comment: What concentrations of reference gas were achieved in the samples and why was a reference gas containing toluene chosen, when there is a chance

that toluene is also emitted from the trees?

Author Response: After feeding the reference gas standard into the bag purge gas flow resulting mixing ratios of the five compounds ranged from 2.2-11.4 ppbv. These compounds were chosen to cover a large range of volatility and to allow conducting recovery studies, to help the chromatogram analysis, and to allow for an internal standard calibration. There was no indication of toluene emissions in these experiments.

Referee 1 Comment: For the GC measurements: provide information on quality assurance such as limits of detection, accuracy etc.

Author Response: We had two independent quantification approaches. The FID signal was used for quantifying emissions using response factors that were derived from the sampling of a well-characterized C5–C16 hydrocarbon standard (Helmig et al. 2004). Secondly, the reference standard mixture injected in the purge flow was used to check the primary quantification method. The typical limit of detection of the cartridge collection-thermodesorption-GC-FID/MS system was 50 pptv at an accuracy of $\sim$10%.

Referee 1 Comment: With the lowest enclosure temperatures going down to below 5oC in the case of crabapple, the question arises, what was the lowest ambient and the lowest soil temperature during these measurements?

Author Response: The crabapple tree was the first tree to bloom in late April. Temperatures measured during the sampling on this tree were the lowest of the entire field campaign with a minimum temperature of 4°C at night. Soil temperature was not measured in this study. In general, enclosure temperatures were close to ambient temperature during night-time but exceeded ambient temperatures during day time under sunny conditions by $\sim$1-6oC.

Referee 1 Comment: Figures: It is unclear why for selected trees time series are presented (fig 3 for crabapple and fig 8 for honey locust) while corresponding figures are not provided for the other trees investigated. Such figures could be added to the

supplement. Furthermore all of these figures should include ambient temperature for comparison with enclosure temperature. Similarly, the plots of emission rate versus enclosure temperature are only provided for crabapple and horse chestnut and corresponding figures should be provided for all trees investigated.

Author Response: We will add the missing figures to the Supplement and will include ambient temperature in these figures.

Andreae, M.O. and P.J. Crutzen 1997. Atmospheric aerosols: Biogeochemical sources and role in atmospheric chemistry. Science. 276:1052-1058.

Fuentes, J.D., M. Lerdau, R. Atkinson, D. Baldocchi, J.W. Bottenheim, P. Ciccioli, B. Lamb, C. Geron, L. Gu, A. Guenther, T.D. Sharkey and W. Stockwell 2000. Biogenic hydrocarbons in the atmospheric boundary layer: A review. Bulletin of the American Meteorological Society. 81:1537-1575.

Helmig, D., T. Revermann and B. Hall 2004. Characterization of a pressurized C-5-C-16 hydrocarbon gas calibration standard for air analysis. Analytical Chemistry. 76:6528-6534.

Interactive comment on Biogeosciences Discuss., 9, 3145, 2012.