

bg-2020-437: Isoprene and monoterpene emissions from alder, aspen and spruce short rotation forest plantations in the UK

Response to Anonymous Referee #2

General comments

The paper is aimed at describing how different planted trees affect air quality in Great Britain. VOC emission rates were measured in two years 2018 and 2019. The amount of samples taken was limited considering quite large variability of BVOC emissions. The goal is not reached, but this is a good start to evaluate air quality impacts of planted forests, which is an important topic now when forests are being planted for carbon sequestration purposes.

The paper is well written, uncertainties of the measurements are evaluated, earlier literature is well cited and the overall presentation is well structured and clear. The C1 paper is suitable for publication in Biogeosciences after minor revisions.

Response: We thank Anonymous Referee #2 for the time spent reading our manuscript and the positive comments and suggestion we received to improve it. Below we respond to each review comment individually (in blue font), indicating changes made to the revised manuscript.

Specific comments

The paper is aimed at evaluating VOC emissions impact on air quality, i.e. ozone and aerosol formation, but the measurements include only isoprene, monoterpenes and oxygenated monoterpenes. Sesquiterpenes (SQT) could have been measured at the same time and their secondary organic aerosol (SOA) formation potential is much greater than that of monoterpenes. It is really pity that the SQTs are excluded from the study, they would certainly have had an impact and SQT emission rate data is overall very sparse. In addition to air quality impacts, VOC emissions have also climate impacts, other than C sequestration. SOA formed from the reactions of the VOCs impact the climate by scattering and absorbing radiation. This is beyond the scope of the current manuscript but highlights the importance of knowing also SQT emission rates.

Response: We thank the reviewer for highlighting these important points and we appreciate the impact that sesquiterpenes may have on air quality. We did not actively exclude sesquiterpenes from this study, it was just not possible to include them in this first assessment. Given this is just a first look assessment of the impacts of BVOC from bioenergy forests it is our hope that this work will be extended in the future to include the much needed sesquiterpene data that is significantly lacking in the databases of BVOC emission potentials for a range of short-rotation forest species relevant to UK bioenergy.

Measurements: -It is very good that the collars were placed already previous year. This certainly reduced emissions from cut roots etc.

Response: We appreciate the positive comment with respect to this aspect of the methodology.

-Usually Teflon films are used as chamber materials in VOC emission measurements. Why did you choose acrylic chambers? Did you test the suitability of acrylic chambers before the measurements that VOCs are not retained on the surfaces or for memory effects?

Response: Although we did not specifically test the surface effects of VOCs on the chamber materials we note that polymethyl methacrylate, commonly known as acrylic, plexiglass and Perspex glass has previously been used for the construction of chambers in both a full (Ghirardo et al., 2012; Potosnak et al., 2013; Spielmann et al., 2017) or partial capacity (Ghirardo et al., 2011) for BVOC emission measurements. In some cases the acrylic chamber has been coated in an inert Teflon film to prevent the losses of BVOC to reduce the absorption and adsorption of BVOCs to the chamber walls (Aalto et al., 2015). We appreciate acrylic may be less inert than Teflon and therefore BVOC emissions could be subject to interference from adsorption/desorption processes. We used a dynamic system in our study and equilibrated with flow through for up to 30 minutes before sampling to reduce the potential effects of chamber material interferences as shown in a previous study by Stewart-Jones & Poppy (2006).

All VOC emissions have pronounced diurnal variation with maximum emission during the afternoon and minimum at night, mostly driven by temperature and light. Therefore, it is important to say if you use measured emission rates or standardized emission potentials.

Throughout the text, please be accurate what you mean. For example, in Figure 1 and 3 captions it says emissions, but are they measured rates or standardized potentials?

Response: We have now clarified each instance of the term emissions throughout the manuscript as to whether it refers to measured or standardized emissions.

I agree with the authors that measurements on canopy scale would be very useful, but the measurements of the larger VOCs would be even more important.

Response: We thank the reviewer for highlighting this important point. We believe both these points are important and the following additional statement has been added to emphasise this in lines 599-603.

“...Norway spruce has also been found to be significant emitters of sesquiterpenes (Hakola et al., 2017). Given the dominance of Sitka spruce plantations in the UK (and Ireland), the potential for variation within this species, and the limited literature data on BVOC emissions, we suggest further measurements are needed at the branch and canopy level to fully assess the terpenoid species composition and their subsequent impact on air quality.”

References

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