

Interactive comment on “Mountain birch – potentially large source of sesquiterpenes into high latitude atmosphere” by S. Haapanala et al.

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The authors wish to thank Anonymous Referee #1 for taking the time to review the manuscript and the valuable comments and suggestions to improve it. We have answered each of the comments below. Whenever the referee is cited, the text has been written inside quotation marks.

“First: From the presentation of data it isn’t clear how many diurnal cycles they have measured. Instead of Figure 1 (and 3) I recommend to design new figures showing subsequent emission rates over several days for each tree, including night time (even under midsummer light) measurements to demonstrate the light dependent emission of C10 and C15 terpenes. In addition, these figures should show the light and temperature profiles (cuvette vs. ambient), and the CO₂ fluxes (even when this measure is

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only a rough proxy of net CO₂ assimilation rates, which should be measured normally).
“

The current Figure 1 shows all the measurements of tree #1 in 2006 with the supporting data mentioned. The measurements taken from trees #2 and #3 do not include any full diurnal cycles. The measurement data from tree #4 in 2007 is practically shown in Figure 4. The amount of data is given in Table 1 and added also in the text on the corrected version of the MS.

“I do not agree with the way the authors calculate emission potentials (or standard emission factors). As correctly mentioned, emissions of mountain birch are light-dependent as in other tree species with no storage structures within their leaf tissue. For that reason it makes no sense to normalize emissions only according to the temperature dependency (which I would like to see as a figure; also for light!) and a modification of the G97 algorithm combining emission from storage pools and active light-dependent emission. NOT everything what can be calculated makes scientifically sense, even when the data fit better. That’s more related to an insufficient data set rather than the process of terpene biosynthesis itself. Indeed. I see the problem of the authors with the light dependency of emission: Due to the measuring period in midsummer and the northern latitude there was almost no darkness. For that reason a real light-dependency measurement (not taking data throughout the day) is essential to generate the empirical constant alpha (necessary in the light term of the Guenther 97 algorithm). The same is in principle true for the temperature dependency of the emission. Here the authors have used diurnal occurring variations in temperature to plot (a figure I missed in the paper) emission vs. temperature for the estimation of the empirical constant beta (in the temperature term of G97). Since the light-dependent emission capacity (due to their underlying processes, e.g. circadian regulation (particularly important in northern Sweden in summer), accumulation of metabolic intermediates, etc...) is not stable over the day (as e.g. shown for isoprene in Wiberley et al. PC&E 2009) the use of temperature/emission relationships at different times a day generate

an inherent error which cannot be avoided when diurnal emission data are used for the determination of temperature (as well as light) dependencies. For the above mentioned reasons the authors should carefully re-analyze their data set and redraw Table 1 and the figures clearly showing the reader the diurnal variation of C10 and C15 emissions under a northern climate for the 4 trees they have studied. “

The authors agree that from plant physiological point of view the temperature dependent model is not applicable to birch emissions. Even in the original manuscript the temperature and light dependent emission algorithm was used, along with the more traditional monoterpene emission algorithm. We do this as a lot of modeling work for global emissions inventories is still conducted using simple models, which sometimes apply only one emission algorithm. This parameterization, even though it is not theoretically as sound as the de novo algorithm, is capable of approximating the emissions reasonably well. The scope of this work has been to quantify the atmospheric emissions rather than test plant physiological models.

“In addition, I would like to see the data in SI units (n(p)mol and second NOT in ng and hour). Since the molecular weights of mono- and sesquiterpenes are so different, this expression is misleading in particular in Fig. 2 where the authors show the emission pattern. “

The authors prefer using the well-established units for easy comparison with existing literature in surface-atmosphere gas exchange, although this is not fully compatible with SI units. In addition, emission models accept their inputs in mass rather than molar units and emission inventories are one of the most important applications of emission potentials. Where possible, we have included both mass and molar units in the corrected MS.

“I would also recommend that the authors redraw this figure in a way that the variation in emission pattern (+SD) between the trees becomes visible.”

Figure 2 was replaced with a new figure showing only the share of the most abundant

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compounds emitted by tree #4.

“Generally, all figures, are not appropriate to become reproduced: How should a reader be able to read the legends given in the present form (Who is able to read the legend in Figure 4)? I would like to recommend that the authors should use a graphic program (instead of Excel) and draw the figure in good quality. In addition, I would like to ask the authors to work out the figure legends correctly. E.g, in the graphs of Figure 1, the labeling is not appropriate, no ticks are given, the subplots are not named from a, b, c. . .etc.), color and symbol code should be described in the legend not in the graph itself.. In the legends (e.g. Figs. 3 and 4): How many replicates they used, what do the error bars represent (SE or SD)? In general I have the feeling that the graphs and legends were prepared in great hurry.”

All figures and figure captions are now revised according to these suggestions.

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