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Interactive comment on “Isoprene emissions from a tundra ecosystem” by M. J. Potosnak et al.

Anonymous Referee #2

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The manuscript “Isoprene emissions from a tundra ecosystem” reports results from several short field campaigns conducted in Alaska. We have very limited understanding on VOC emissions from arctic ecosystems, so this manuscript is a welcomed addition to the current body of knowledge. It is also timely and relevant, because climate change in the Arctic areas could have a significant impact on isoprene emissions from these areas.

General comments

I enjoyed reading the Introduction, which very clearly set the work into larger context. However, there is a little problem with the logic in the section ‘Previous research on global change factors and deciduous shrub species’. You – correctly – tell about the documented increase in *Betula nana*, but since *B. nana* does not emit isoprene, which this manuscript is about, I don’t see the point. This section gave me an impression

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that the measurements here would be on *B. nana*. Finally, on page 13359 I can find that the leaf-level measurements were made on *Salix pulchra*. Is it possible to shift the text in the section 'Previous research on global change factors and deciduous shrub species' towards isoprene-emitters and in addition to specifically address *Salix*? Why did the study focus particularly on this species? Is it an important species in the Arctic global change context? In the Methods, you should again and earlier tell what species is measured.

In the chamber and EC measurements, you have obviously measured emissions from other species than *S. pulchra* as well. As I point out later on, you should add vegetation descriptions for both of these measurements. If the percent cover for *S. pulchra* was 1.6% as you write on page 13371, I assume the 98% was not just bare soil? (By the way, on page 13374, you state that the cover was <1%.) On page 13372, you hint that actually there was no *S. pulchra* at all in the dynamic chambers, but only *Sphagnum* mosses. On page 13374, you finally say that 'We ascribe the emissions observed from the static chambers to sedge species'. The reader is quite confused when this information is not presented earlier.

Weather conditions in the Arctic vary a lot and are often shifting from conditions allowing for isoprene synthesis to no isoprene synthesis. Therefore, reliable data collection should take place over long time periods. Here, data were collected in 3 short field campaigns during the peak season. In 2005 there was 2 full days of measurement data, in 2010 one week, and 2011 2-4 days depending on the method. These datasets represent only a snapshot of ecosystem functioning. As the authors state 'Because of the short nature of both datasets, we cannot determine if this difference represents experimental error or a true difference'. The authors also write that 'no conclusions can be drawn from these two short datasets', but still the results are discussed at length. Do you consider that this data is solid enough to allow estimation of ecosystem emission factors and to drive an atmospheric chemistry model to determine their impact on Arctic photochemistry?

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It is not clear whether the leaf-level measurements were made on intact or detached leaves. In general, making isoprene emission measurements on excised leaves does not make sense to me, because isoprene emission is linked to photosynthesis. Could you please explain why this method was chosen? The comparison of measurements on intact and excised leaves mentioned on page 13359 is unclear. On line 15, what does ‘...at times up to 2 h’ mean? Line 17, what emission rates? If this is isoprene, it would not take much space to show the mean and standard error for the two groups.

To me the temperature of 25C for leaf-level measurements sounds high, and based on the figs 3 and 4, the max. temperature was about 22 degrees during the eddy flux measurements. Same applies for the stepped temperatures; the range 20-32.5C sounds high. Why did you select these temperatures and not ambient temperature?

If I understood correctly, leaves taken from greenhouses and control plots were measured under similar conditions, and then the isoprene emission per leaf area from the leaves collected from the greenhouse were 3 times higher than the emissions from the controls. What was the difference per leaf mass? Did the greenhouses affect the leaf structure? What did the greenhouses do to the soil water content? If there was a difference, how would you expect this to affect isoprene emissions? What was the CO2 concentration inside the greenhouses relative ambient and how would you expect this to affect the emissions?

Specific comments:

page 13353 line 5: ‘Once BVOCs...’ Start a new paragraph here.

line 22: To have a more complete list, you could add a reference to Ekberg et al. 2011 (Boreal Environment Research Ekberg et al. 2011), Holst et al. (Atmospheric Chemistry and Physics 10, 1617-1634, 2010) and Faubert et al. 2012 (Plant and Soil 352: 199-215).

page 13355 line 9 onwards: Please specify that the ozone destruction mentioned here

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is tropospheric/ground-level ozone, not to confuse with ozone depletion in the stratosphere. You should also correct the source of halogens. Helmig et al. (2007) refer to other papers and write “. . .halogens originating from within the sea ice zone.”

page 13358 line 3: To my knowledge the hydrocarbon trap does not remove ozone. Was ozone removed from the incoming air?

line 13 onwards: The isoprene analysis part could be easier to understand if you clearly describe the two methods used in separate sections. Now it is a bit confusing and it appears as if some issues are explained twice.

page 13361 line 13: Were the measurements done in situ or using detached leaves, which were measured somewhere else? How many plants per experimental plot were measured and how many leaves per plant?

line 16: The description of statistical analyses is inadequate. You mention a post hoc test you have used, but it must have been preceded by something else.

page 13363 line 24: Why canopy type grass if the vegetation was shrubs?

page 13364 line 7: Was *S. pulchra* the only plant species present in the footprint area? If not, please add to the manuscript a description of the vegetation.

line 12 onwards: Please describe the vegetation composition in the chamber bases. Was the same vegetation community measured by dynamic and static chambers?

line 15: What was the chamber made of? Was it transparent or dark? How many individual chamber bases were measured?

line 20: Do I understand correctly that one cartridge collection took 4-5 minutes? What did the cartridges contain and how were they analyzed?

page 13365 line 1: What do you mean by leak rates and could you please describe the procedure to determine it in more detail? How did you measure isoprene decay in the chamber? Leak and decay are two different things - which is it you think takes place

during your measurements?

line 12 onwards: The dynamic chamber measurements are not explained in enough detail. Was the chamber flushed first or was the measurement started right away after enclosure? Were ozone and hydrocarbons filtered from these chambers? How was isoprene analyzed?

line 14: Chamber height or volume?

page 13367 line 19: Replace 'experiments' with 'treatments'.

line 26: show standard errors for the two groups, please.

line 27: Replace ' $p = 0.0000035$ ' with ' $p < 0.001$ '. Show in parentheses where this P-value is derived from. What analysis? Was it a single measurement or repeated measurements? I assume that $n=4$ – also show that if that is correct. Redo the stats, if you have an incorrect n .

page 13370 line 28: What model do you refer to?

page 13372 line 10: I think you should be careful with conclusions based on measurements done with different techniques.

Fig. 2: You could mention in the figure legend the species measured. Do the 'individual sets of measurements' mean individual leaves?

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