

Interactive comment on “Long term BVOC fluxes above mountain grassland” by I. Bamberger et al.

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We thank referee#2 for the detailed and helpful comments on the manuscript.

Comment No. 1: While I appreciate the effort involved in the flux measurements, the use of "Long-term" in the title implies a multi-year data set, which is not the case. The title should be changed to more accurately and appropriately represent the data set presented in the manuscript. A title such as "BVOC fluxes above mountain grasslands in 2008" or some variation thereof would be much more suitable.

Reply: we agree that the title implies a longer set of data and changed the title now to "BVOC Fluxes above Mountain Grassland"

Comment 2-19: P84, L5: "due to" should be replaced with "from".

*P84, L6-7: the following should be revised: "...over temperate mountain grassland
C393*

in Stubai Valley..." to either "...over a temperate mountain grassland..." or "... over temperate mountain grasslands..."

P84, L15-16: the following needs to be revised: "During the growth only methanol emissions were observed." During the growth of what? I think you are trying to say that during periods when the grasslands were growing, only methanol was observed - please revise the sentence so this is what it says.

P84, L20: "attain" is an inappropriate word choice and "attain to" is gramatically incorrect. Please revise with something more appropriate such as "are emitted" or "reach".

P84, L22: replace "these" with "the" as follows: "Up to 90% of the emissions..."

P85, L5: revise the following: "...is poorly determined as quantitative measurements are hard to obtain." to "...is poorly constrained as quantitative measurements are difficult to obtain."

P85, L8: "due to" should be replaced with "resulting from"

P85, L14: I don't think "status" is the appropriate word choice for what you are describing- please revise.

P86, L5: "for" should be replaced with "of"

P87, L2: the comma a semicolon as follows: "anemometer (R3IA, Gill Instruments, Lymington, UK);..."

P87, L3: "sucked" is not an appropriate word choice; please revise with something like "drawn"

P87, L5: The units in Figure 2 and the text are not consistent - convert all units to SI.

P87, L19: "home-build" should be "home-built" or something like the following. "...through a catalytic converter built in-house..." Also, it would be useful to include the operating temperature of the catalytic converter

P87, L27-28: should read as follows...rate of 2.82 s until 10 July, when..." There should not be a "the" after "until".

P88, L26: remove "exemplarily" - inappropriate word choice and not needed.

P88 and on: I would consider replacing "half-hourly" with "30 minutes" - in most places

it makes the text flow better and improves the overall readability.

P91, L7: replace "are" with "were" to read "...fluxes which were acquired at 20 Hz."

P91, L21: replace "less" with "fewer"

Reply: All suggested changes were done for pages 84 to 91.

Comment 20: P92, L2-3: revise the following: "Methanol was the only measured VOC that was emitted from the undisturbed growing grassland." to something such as: "Methanol was the only VOC measured by PTR-MS that was emitted from the undisturbed growing grassland." I think it is critical to make it clear that methanol was the only VOC you could measure the emission of using a PTR-MS. If you had other instruments deployed that could measure things like halocarbons, sulfur gases or other NMHCs, you might find that there were, in fact, other gases emitted from the undisturbed growing grasslands.

Reply: It was clarified: "Methanol was the only VOC measured by PTR-MS that was emitted from the grassland throughout the whole growing season."

Comment 21: P92, L5-7: revise the following: "The methanol fluxes we observed during the growing period were in the same range like the methanol fluxes detected by Brunner et al. (2007) over intensively managed grassland in central Switzerland." to read: "The methanol fluxes observed during the growing period were similar to those reported in Brunner et al. (2007) over intensively managed grassland in central Switzerland."

Reply: The discussion was extended. The sentence reads now: "The maximum of the averaged diurnal methanol flux during the growing period of the grass was $6.0 \text{ nmol m}^{-2}\text{s}^{-1}$ (observed around 13:30 CET). The observed maximum flux during the growing period is comparable to the $7.2 \text{ nmol m}^{-2}\text{s}^{-1}$ reported by Brunner et al. (2007) over an extensively managed grassland in central Switzerland."

Comment 22: P92, paragraph beginning on L8: In general, I feel that the point

C395

the authors are making about methanol being the "only VOC with a measurable flux" should be toned down quite a bit. As stated previously, this was the only compound that the author's measured using a PTR-MS - it is most certainly very unlikely that this is the only VOC with a measurable flux at all. Ultimately, I believe this is an important paper and the author's results provide key insight to VOC emissions over managed grasslands. Therefore, dismissing the fact that other VOCs are not emitted during undisturbed growing undermines the overall importance of assessing growing, cutting and drying emissions. This is particularly important because of the scale of agricultural processes worldwide and the fact that currently, we do not have a handle on if these emissions are truly important or not because of the overall limited number of studies. Main point - please articulate clearly that methanol was the only VOC with a measurable flux that you observed with your PTR-MS measurements; do not dismiss the fact that a more comprehensive suite of measurements could show that other VOCs have a measurable flux during undisturbed growth periods!

Reply: We added: "Methanol was the only VOC measured by PTR-MS that was emitted from the grassland throughout the whole growing season." and "Due to the sequential detection of each mass only a limited set of 15 compounds was measured. Other methods could complement the range of compounds that are measured to determine alkene and halogenated VOC fluxes."

Comment 23: P93, L9-24: Please revise this paragraph, confusing as written.

Reply: revised version of the text: "The fluxes of methanol showed a distinct diurnal cycle with highest emissions around noon (Fig. 8). Methanol is produced during plant growth (Fall and Benson, 1996) and amongst other factors, stomatal conductance controls its emission (Niinemets et al., 2004). The opening of the stomata largely follows the diurnal course of radiation at this measurement site (Wohlfahrt et al., 2009) and as expected the methanol emission follows the diurnal pattern of the global radiation (Fig. 9 upper left panel). For the diurnal cycle of methanol flux in June the emission increased until it reached a maximum of $9.7 \text{ nmol m}^{-2}\text{s}^{-1}$ around noon;

C396

afterwards it decreased slowly to zero in the evening. Despite the clear local source, no distinct diurnal cycle for the methanol volume mixing ratio (4-7 ppbv) was visible. This was caused by the long lifetime of methanol, in combination with an efficient mixing of the atmosphere during daytime."

Comment 24: P94, L10: It is stated that "No significant monoterpene fluxes from grasslands were detected." Define "significant" for the reader and it would be useful to put this value into context.

Reply: We revised the sentence: "There was no indication for monoterpene emissions. The monoterpene fluxes from the grassland were close to zero and calculated emissions were always below $0.6 \text{ nmol m}^{-2}\text{s}^{-1}$. This is several times lower than average daytime emissions from forest ecosystems e.g., from a mixed deciduous forest (Spirig et al., 2005).

Comment 25: P94, L16: "norway spruce" should be "Norway Spruce"

Reply: changed as suggested

Comment 26: P94, L16-17: revise "Coniferous forest is known to emit monoterpenes." to something like "Coniferous forests emit large quantities of monoterpenes." or "Coniferous forests are large emitters of monoterpenes."

Reply: the suggested changes are implemented, the sentence reads now "Coniferous trees emit large quantities of monoterpenes" *Comment 27: P100, Table 1: It would be useful to identify the other "possible compounds" for the masses listed.* Reply: In the revised version of Table 1 "possible compounds" are identified for every mass and the typical sensitivities for the compounds are shown (when applicable).

Comment 28: P101, Table 2: Please revise the caption text, in addition to more clearly explaining the point and usefulness of information in the text. If it's just to show the number of 30 minute cycles, I'm not sure this really needs to be a table, it would be

C397

more straightforward to just state the values in the text.

Reply: The table clearly shows that there are enough data points for the statistics of the diurnal cycles. Its caption was changed: "Minimal and maximal amount of half-hours used to calculate the hourly flux medians for diurnal patterns (Fig. 8) in June and October after applying the quality control on m/z 33 and m/z 137 (partitioned to nighttime and daytime according to median radiation). Each hourly flux median was calculated from at least 18 half-hours."

Comment 29: P103, Figure 2: As stated previously, please use SI units consistently throughout the text.

Reply: the unit was changed to SI units.

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C398