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Biogeosciences Discussions

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

I. Bamberger et al.

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We thank referee#4 for the helpful and detailed comments on our manuscript.

Comment 1: P84-L10. The term independent is often used to describe the two methods. In my imagination, two methods are independent when measuring fluxes with different instruments and/or micrometeorological techniques, e.g. PTRMS vs GCMS. This is not the case when the same instrument is used and also some steps of the data processing are identical.
Reply: We agree that this can be misleading. We changed the wording to "Methanol fluxes obtained with the two independent flux calculation methods were highly correlated"

Comment 2: P86L11. For considerations on annual emission budget, it would

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be helpful to highlight the duration of these three growing periods which determine emissions.
Reply: we included the times for the growing periods in 2008 to the site description "In 2008 three growing periods (between two cutting events) lasted from April 10 to June 8, from June 15 to August 8, and from August 14 to September 28."

Comment 3: P86L20. Did you record precipitation events during the measuring period? If so, it should be mentioned.
Reply: We did record rain during the measurement period, we added the sentence "During the measurements from 22nd May 2008 until 31st October 2008 (163 days) at 71 days measurable rain was registered with a total precipitation of 428.8 mm."

Comment 4: P87L3. "Air was sucked..." is an inappropriate slang. I would rather say " Air was pulled", or similar.
Reply: we reworded the phrase: "Sample air was drawn from the inlet,..."

Comment 5: P87L22. From what I understand from the diagram, zero air was used to dilute calibration gases, and this zero air is humid because produced using a Zero Air Generator. Is that right? This should be better specified. Figure 2 is well designed, but the legend could be a little more explicative. It should be mentioned also if all measured masses were calibrated with the standards, or other analytical methods were used. Showing the sensitivity factors in a table could be appropriate.
Reply: We clarified: "The instrument's sensitivity was calibrated at ambient humidity once a week using a gas standard containing 11 VOCs in N2 (Apel Riemer Inc., USA). The flow of the gas standard was adjusted to 1 sccm, 2.5 sccm, 5 sccm and 7.5 sccm respectively, and diluted with 500 sccm scrubbed ambient air. The known calibration gas mixture was analyzed by the PTR-MS." Typical sensitivities obtained during our measurement are given in Table 1.
Figure 2: We improved the figure and extended the figure caption: "Schematical

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drawing of the PTR-MS inlet system and setup. During ambient air measurements outside air is drawn from the inlet line into the PTR-MS. For background measurements valve 2 is switched on and scrubbed ambient air obtained from a catalytic converter is guided to the instrument. For calibration measurements valve 1 is switched on to mix the selected gas standard flow (FC_1) with the scrubbed ambient air (FC_2 set to 500 ml)."

Comment 6: P88L1. Dwell time, is mentioned. Integration time is reported in Table 1. Please be consistent with the definition. What justify a higher integration time for Methanol? Maybe a minor transmission efficiency for PTRMS? Please motivate the use of 0.5 s.
Reply: We changed the integration time in Table 1 to "dwell time"
Justification of the higher dwell time for methanol:
We decided to use this rather long dwell time for methanol due to the somewhat reduced sensitivity (poorer mass transmission efficiency) and the higher background signal. Hoertnagl et al. (2010) demonstrated that the measured flux is not influenced very much by integration times in the range of 100ms up to 500ms. Therefore we are quite confident that 0.5s dwell time is justified for methanol.

Comment 7: P90 L8. "A significant background drift..." How is this significance evaluated? Please specify.
Reply: we changed the statement to: "removal of time periods with ..... (2) a background drift higher than the sum of the standard deviations of the two adjacent background measurements within an hour,..."

Comment 8: P90 L16. Is there any reference or other works in which the outlier removal is mentioned?
Reply: Yes there is:
D. Vickers and L. Mahrt, Quality Control and Flux Sampling Problems for Tower and Aircraft Data, Journal of Atmospheric and Oceanic Technology, 14, 512-526, 1997

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This is not in terms of disjunct measurements for which the definition of an outlier is more challenging especially for events like cutting where very high standard deviations in the data are expected.
During normal periods this outlier removal is not crucial to the flux data. However, it might act as a low pass filter during periods of cutting where high sudden changes happen. Therefore we changed the procedure. Outliers are not filtered anymore. The detailed procedure is described in section 3.3 quality control. This changed the fluxes for the cutting events. Therefore we provide revised versions for Figures 6, 7 and 8.

Comment 9: P92 L1. The site characteristics should be reported in the M&M section, unless strictly coupled to the discussion, which is not the case in this paragraph.
Reply: We think it is necessary to mention at this point that there was sufficient rainfall and the grass wasn't under drought stress: "During this period the average air temperature was 16.0°C, the total rainfall was 85 mm and the grass wasn't suffering from drought stress."

Comment 10: P92L 5-7. More discussion is needed here. Which order of magnitude are we talking about? Has the experimental site of Brunner et al. the same characteristics?
Reply: We extended the discussion:
"The maximum of the averaged diurnal methanol flux during the growing period of the grass was 6.0 nmol $m^{-2}s^{-1}$ (observed around 13:30 CET). The observed maximum flux during the growing period is comparable to the 7.2 nmol $m^{-2}s^{-1}$ reported by Brunner et al. (2007) over an extensively managed grassland in central Switzerland. However, our findings are almost two times higher than the 3.4 nmol $m^{-2}s^{-1}$ which were recorded at an intensively managed grassland during the same study, which was cut and fertilized four times a year and covered with a lower diversity of graminoids and forbs than our field site. The extensively managed grassland in Switzerland consisted

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of a higher diversity of species and its treatment - three cuts a year and no fertilization - was similar to the treatment of our field site (three cuts and one fertilization). "

Comment 11: P92 L25-30. Please rephrase this entire paragraph, the message is clear but the English for need some revisions.
Reply: The paragraph was rephrased: "In contrast to the usual wind patterns in Stubai valley (demonstrated for June in Fig. 9 (lower left panel)) the dominating wind directions in the period from August 11 until August 13 were cross-valley or valley-outwards. The meadows which are located in the patch for the corresponding wind directions were not cut yet and therefore VOC emissions were lower and CO2 fluxes were dominated by uptake during this time period."

Comment 12: P93 L 12. The range reported (7-9 ppb) is higher than what can be observed in figure 8.
Reply: the range was corrected to (4-7 ppbv)

Comment 13: P94 L 5-7. This paragraph should be rephrased.
Maybe out of the scope of the paper, but a more detailed analysis of dependence of methanol fluxes from light and temperature could be performed. You recorded meteorological parameters which could be used in models of emission based on light and the effect of light + temperature (e.g. Guenther et al. 1995, 2007, Tingey et al. 1992). Observing the regressions between measured and modeled fluxes using the two different algorithms could help to understand which of the two algorithms better predict methanol emission. This could help the modeling community to estimate regional and global emissions of this important compound. Basal emission factors could be also calculated using the above mentioned models.
Reply: the paragraph was rephrased: "The reduced methanol emissions in October can be explained by the lower global radiation and lower temperatures compared to June (Harley et al., 2007; compare Fig. 9 upper left and upper right panels)."

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We first wanted to include a discussion about driving factors of methanol emissions. During the preparation of the manuscript we realized that this is beyond the scope of the present manuscript. We are currently preparing a manuscript (Hörtnagl et al., 2010) which will focus on that important issue.

Comment 14: Table 1. Some more information on the possible compounds could be provided, e.g. acetone (m/z 59), isoprene (m/z 69). In this table, averaged sensitivity factors could be added.
Reply: the information on possible compounds and sensitivities is added in Table 1.

Comment 15: Table 2. This table is not very clear, and maybe not necessary. You could mention the % of the half hours which did not fulfill the quality test in the M&M section.
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."
Further, the % of the half-hours which did not fulfill the quality test has been added in chapter 3.3 (quality control).

Comment 16: Figure 2. More explanation in the figure legend could be helpful.
Reply: We added information to the figure caption: "Schematical drawing of the PTR-MS inlet system and setup. During ambient air measurements outside air is drawn from the inlet line into the PTR-MS. For background measurements valve 2 is switched on and scrubbed ambient air obtained from a catalytic converter is guided to the instrument. For calibration measurements valve 1 is switched on to mix the

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selected gas standard flow (FC_1) with the scrubbed ambient air (FC_2 set to 500 ml)."

Interactive comment on Biogeosciences Discuss., 7, 83, 2010.