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Atmospheric Measurement Techniques Discussions

Interactive comment on "A new disjunct eddy-covariance system for BVOC flux measurements – validation on CO_2 and H_2O fluxes" *by* R. Baghi et al.

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We are grateful to the reviewer for the insightful comments which helped to improve the paper. Below are our responses to the comments and the corrections to the manuscript. The original Reviewer's Comments are reproduced in Italics under heading of **RC**. The Author Responses are under the headings of **AR**.

RC: *Page 4158, lines 4-5: "A new disjunct sampling system (called MEDEE) was developed and validated". The passive form seems awkward here, I would rather use active form, i.e. "We developed and validated a new disjunct sampling system called*

MEDEE". Page 4158, line 6 ": : :moving piston. It was designed: : :" Here it seems that "it" refers to the piston, even though I believe it should refer to the entire MEDEE system. The sentence should be rephrased. Page 4161, line 16: Reference "Karl et al., 2001" should be "Karl et al 2002".

AR: These corrections will be implemented in the revised version of the manuscript.

RC: *Page 4162, lines 19-21: "The complete turbulent flux of a scalar is described as the mean product of the vertical wind component w and the scalar concentration c" and Equation (1). Equation (1) comprises actually both the turbulent flux and the advective flux. Usually only the part consisting of fluctuations is called turbulent flux.*

AR: The decomposition of Eq 1 gives a sum of the turbulent part of the flux and the advective part of the flux. However, the advective term is in fact the result of a mass transport induced by buoyancy flux (Webb et al., 1980). In this sense this mean term can be considered as part of the turbulent flux. In order to avoid misleading the reader, the sentence will be rephrased.

RC: *Page 4163, lines 21-23: "It has been shown that as long as the time interval Delta t between two measurements is less than the integral time scale of the turbulence, the flux can be estimated with only a small increase in random error (Lenshow et al., 1994)". This sentence is only partially true. Equation (4) and this sentence cannot be applied to the same data set, as Eq (4) assumes that the subsequent samples are independent, i.e. sample interval is longer than the integral timescale. Furthermore, one obtains the same uncertainty with different sample intervals if sample number (and variance of w'c') is the same (see e.g. Rinne and Ammann, 2012).*

AR: We agree with the reviewer. The estimation of random error by Lenschow et al. (1994) applies when the sample interval is less or of the same order of the integral time scale. When the sample interval is longer than the integral time scale, samples are assumed statistically independent and Eq (4) is used. The question is to determine whether our sample interval is shorter or longer than the integral time scale, the estimations of which are very scarce in the literature. In Lohou et al. (2010), the mean of the integral length scale of w'q' is estimated to 4-5 m ($\pm$ 3 m standard deviation) in the surface layer above a western Africa wet savanna. From these values we can estimate that the integral time scale is below 10 s as long as the mean wind speed is higher than 0.5 m/s (i.e. most of the time). This implies that with a time interval of 11.5 s we can assume our samples statistically independent and use Eq (4) to estimate uncertainty. This discussion will be added to section 2.2 of the revised manuscript.

RC: *Page 4164, lines 19-21: "The blue arrow on the figure indicates the number of samples of the MEDEE system in the two field campaigns of the present study. The expected uncertainty is thus no larger than 8 %" and Page 4167, lines 17-19: "... 155 samples are analysed during half an hour, which would correspond to a low uncertainty (8 %) on the covariance estimate (see Fig. 1)". The line in Figure 1, which describes the Eq. (4), does not describe flux uncertainty divided by the magnitude of the flux, but uncertainty of the flux divided by standard deviation of w'c'.*

AR: The reviewer is right. Corrections will be added to specify that the term discussed here is the ratio of the flux uncertainty and the standard deviation of w'c'.

RC: *Page 4164, line 22: "Other sources of uncertainty for the DEC system are the sample carry-over". Sample carry-over causes also bias, not only increased uncertainty. The bias is quantified by Langford et al. (2009).*

AR: We agree with the fact that sample carry over causes bias and thank the reviewer for pointing at the study by Langford et al. (2009). During the realization of the MEDEE system, sample carry over was an important concern that conditioned the quality of the vacuum to achieve in the reservoirs. Using Langford et al. (2009) approach we estimated the bias for the day 165 to be 2.5 % ($\pm$2 % standard deviation) for CO2 fluxes and 2 % ($\pm$ 1 %standard deviation) for latent heat fluxes. This information will be added to manuscript in section 4.4.

RC: *Page 4175, lines 10-12: "The air temperature measured on the scaffolding tower*

was used for the conversion instead of leaf temperature because this latter was not available". Even larger source of error than the use of air rather than leaf temperature is the use of above-canopy PAR without canopy shadowing effects. The authors should comment on this as well.

AR: The use of above canopy PAR values to normalize the isoprene emission rates is a source of error because PAR is not uniformly distributed inside the canopy due to shadowing effects. In this case, using high (above canopy) PAR values might result in underestimated standard emission rates. However, this study was done in a Mediterranean area with high irradiance conditions. The forest canopy is relatively open and a fraction of radiation is still able to reach the ground. Guenther et al. (1993) showed that isoprene emissions are strongly dependent on PAR at low light levels but become saturated at approximately 50% of full sunlight. We have recalculated the standard isoprene emission rate with PAR values reduced by 30%. The result is a 2.5 % increase of the standard emission rate. In comparison, an underestimation of temperature by 0.5°C results in a 7% decrease of the standard emission rate. A short discussion on the use of above canopy PAR will be added to the revised manuscript in section 5.2.

RC: *Page 4175, lines 21-22: "The resulting emission rate was of 39.7 μg g^{-1} h^{-1}". I believe there are too many significant digits in this figure. The number of the significant digits should reflect the uncertainty of the figure.*

AR: The value is now rounded to 40 μg g^{-1} hr^{-1}.

References:

Guenther, A. B., Zimmerman, P. R., Harley, P. C., Monson, R. K., and Fall, R.: Isoprene and Monoterpene Emission Rate Variability: Model Evaluations and Sensitivity Analyses, J. Geophys. Res., 98, 12609–12617, 1993.

Langford B, Davison B, Nemitz E, Hewitt CN (2009) Mixing ratios and eddy covariance flux measurements of volatile organic compounds from an urban canopy (Manchester, UK). Atmos Chem Phys 9:1971–1987

Lohou, F, F. Saïd, M. Lothon, P. Durand, and D. Serça. Âń Impact of Boundary-Layer Processes on Near-Surface Turbulence Within the West African Monsoon Âż. Boundary-Layer Meteorology 136, n. 1 (2010): 1-23.

Rinne, J., Ammann, C., 2012. Disjunct Eddy Covariance Method. In: Aubinet, M., Vesala, T., Papale, D., (eds.): Eddy Covariance Handbook. Springer, ISBN 978-94-007-2350-4. pp 289-305.

Webb, E. K., Pearman, G. I., and Leuning, R.: Correction of flux measurements for density effects due to heat and water vapour transfer, Q. J. Roy. Meteor. Soc., 106, 85–100, 1980.

Interactive comment on Atmos. Meas. Tech. Discuss., 5, 4157, 2012.