Author's reply to anonymous referee #1

Reply for the revision process of the manuscript untitled "Are BVOC exchanges in agricultural ecosystems overestimated? Insights from fluxes measured in a maize field over a whole growing season" published on ACPD.

First of all, we would like to thank the referee for her/his comments and suggestions which contribute to improve the quality of this manuscript. We answered all general and specific comments point-by-point as thoroughly as possible and adapted the manuscript accordingly.

Technical comments consisted of spelling mistakes and minor phrase structure, so they did not request a detailed author's reply. Consequently, we did not include them in this document. They will of course be taken into full consideration during the manuscript revision, and the text will be corrected accordingly.

The reply document is formatted as follows:

Comment n°X where X is a number is the comment number;

PX LY corresponds to the line Y in the page X; Sec. X corresponds to the section X;

Referee comment;

Author's reply;

Author's changes in the manuscript. Original text and revised text are detailed.

Page and line indexes after each comment number, in the author's reply and after the mention "original text" refer to the discussion manuscript published in ACPD.

Page and line indexes after the mention "revised text" refer to the revised manuscript to be sent to the editor.

References used to answer the referee comments were listed in "Author's reply references". As all these references were present in the discussion paper, no additional reference will be included in the revised paper following the referee #1 comments.

General comment

The focus of this paper is to investigate BVOC exchange on a maize field via comprehensive in situ measurements so as to examine previous results and BVOC emission models. The major conclusions from the authors were that BVOC exchange fluxes in the maize field was lower considerably than those measured in other crops. As a result, a BVOC emission model created from standard emission factors seemed to overestimate BVOC emission fluxes and hence such the model should treat BVOC emissions case by case in different crops field. The authors further recommended to incorporate their SEF obtained from this field study in BVOC emission modeling. The evidence from their field study was strong and their arguments in the presentation were also reasonable. I recommend acceptance for publication in ACP after clarifying following questions.

The authors are very grateful to the referee for her/his positive comment. We adapted the manuscript following her/his questions and suggestions to make it clearer.

Specific comments

<u>Comment n°1</u> (P3 Sec. 2.1.2; P5 Sec. 2.3)

I would suggest authors to give the expression of BVOC flux equation which should be the product of measured concentration and 'vertical velocity'. I would assume that '3D sonic anemometer' measures turbulent fluctuations of vertical wind, not vertical wind itself?

The 3D sonic anemometer measures the wind velocity at high frequency in 3 non parallel directions. So it gives measurements of the vertical wind speed component at high frequency; those measurements are also called instantaneous vertical wind speed w. w is then separated into two terms:

$$w = \bar{w} + w'$$

Where $\bar{w}$ corresponds to the mean vertical component of the wind speed, computed by averaging w over each half-hour, and w' corresponds to the fluctuations of the vertical wind speed component around this mean.

As this is well-known information, we will not detail this expression. However, to make the text clearer, we will explicitly write that the BVOC fluxes were calculated from the covariance between the BVOC concentration and the vertical component of the wind speed, both being measured at high frequency.

Original text (P3 L13-14): *The BVOC fluxes were computed every half-hour from high frequency vertical wind speed and BVOC concentration measurements using the disjunct eddy covariance by mass scanning (DEC-MS) technique.*

Revised text (P3 L14-15): *The BVOC fluxes were computed every half-hour using the disjunct eddy covariance by mass scanning (DEC-MS) technique, i.e. from the covariance between the vertical component of the wind speed and the BVOC mixing ratio, both variables being measured at high frequency.*

<u>Comment n°2</u> (P11 L16)

Given the huge differences in normalized BVOC exchange rates among studies, we conclude [...] by normalizing T and PPFD'. Can BVOC exchange rate be normalized by solar zenith?

We used PPFD for normalisation as this is done by other authors measuring in the field (e.g. Park et al., 2014). But indeed, standard conditions defined by the up-scaling models are rather defined for particular solar zenith angle and PPFD transmission ratio (Guenther et al., 2006). We prefer to keep PPFD as the normalizing factor because we think that use of solar angle may bring uncertainties. Indeed, in Graus et al., 2013 and Das et al., 2003 articles, we did not find information about the solar angle and the PPFD transmission ratio. And we did not find enough information in those articles to estimate these values with accuracy. Consequently, we prefer keeping the normalisation by PPFD, since it is based on data given by the authors themselves, in order to rely on known values when comparing data.

<u>Comment n°3</u> (P6 L9)

'According to a lower u_* threshold'. What is 'lower u_* threshold'?

The friction velocity, represented by the symbol "u_*", provides insights about the importance of turbulent processes on the site. Flux data measured by the eddy covariance technique are only valid when tracers are carried from the atmosphere to the ecosystem through turbulent exchange processes. Consequently, flux data are not representative anymore of the actual exchange between the ecosystem and the atmosphere when the turbulence is not important enough. Practically, we use u_* measurements to determine whether the turbulence is sufficient so that fluxes measured by the eddy covariance technique are valid. The value of u_* above which the turbulence is sufficient is then called the 'lower u_* threshold'.

Following your question, we will clarify in the section about friction velocity that flux data which were measured at u_* values below a certain threshold must theorically be discarded for non-soluble compounds.

Original text (P6 L9-10): *It should be noted that we did not filter BVOC fluxes according to a lower u_* threshold or to stationarity. Indeed, u_* can actually control soluble BVOC fluxes (*Aubinet et al., 2012*;Laffineur et al., 2012).*

Revised text (P6 L10-13): *It should be noted that we did not filter BVOC fluxes below a certain u_* threshold or according to stationarity. Theoretically, for non-soluble compounds, when measuring fluxes by the EC technique, flux data which were measured at u_* values below a certain threshold must be discarded (Aubinet et al., 2012). However, we did not apply this specific filtering criterion because u_* can actually control soluble BVOC fluxes (Aubinet et al., 2012;Laffineur et al., 2012).*

Comment n°4 (P10 L14 and P11)

'The methanol and acetaldehyde fluxes measured at our site were of the same order of magnitude for bare soil as for fully developed vegetation '; 'the soil was an important BVOC source and sink'. What is net flux of BVOC over bare soil?

The second sentence is not present in P11. We guess you refered to P13 L9? Using the eddy covariance technique, what we actually measure is the net flux between the ecosystem and the atmosphere. But we observed that for some compounds like methanol, most net fluxes were positive when the soil was bare. This means that for most data, there were net methanol emissions from the ecosystem to the atmosphere. From this we concluded that there were methanol sources in the ecosystem. On the opposite, for other compounds, such as acetic acid, most net fluxes were negative when the soil was bare, meaning that for most data there were net acetic acid uptakes from the atmosphere to the ecosystem. Then we concluded that there were acetic acid sinks in the ecosystem.

When we wrote 'the soil was an important BVOC source and sink', we intended to indicate that the soil was a source for some BVOC compounds while it was a sink for other BVOC compounds. The use of the terms "source" and "sink" without mentioning that they refered to different compounds was however probably confusing. In order to avoid any further confusion, we will complete this sentence.

Orignal text (P13 L9): *the soil was an important BVOC source and sink*.

Revised text (P14 L25-26): *the soil was an important methanol and acetaldehyde source, and an important acetic acid sink*.

Author's reply references

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