

Authors' Response

Reviewer #1 aims at the following points in his assessment:

1. What is the benefit of this manuscript compared to an existing text books on eddy covariance, such as that of Aubinet et al. (2012)?
2. Is the presentation of the eddy covariance technique perhaps over-simplified?
3. What if a soil scientist (or other non-specialist) reads this manuscript and believes this is sufficient to be able to conduct scientific-grade EC measurements?
4. The question remains however if the complex theory of turbulence measurements is perhaps presented in an over-simplified manner. From my perspective, the authors did a very good job in finding this balance. However, it could be worthwhile mentioning a few more aspects
 - (a) QA/QC
 - (b) Uncertainty quantification
 - (c) Flux corrections
5. plus 5 minor comments

We improved our manuscript as detailed below:

1. As the reviewer observed correctly, the first author was involved in two chapters of the Aubinet et al. (2012) book. To not offend readers who think differently about the development of the Aubinet et al. (2012) book we changed the wording (see lines 65–67).
2. This may be a personal feeling of the authors, but there are many colleagues who seem to have an interest in complicating things rather than simplifying it. As Einstein once noted: "Make everything as simple as possible, but not simpler" always leaves us with that threshold: when is something oversimplified. Our view is that if we get the right order of magnitude, the correct sign of the flux direction, then we are in business. We extended our text wherever the reviews indicate that we in fact have been overly simplifying things. See e.g. lines 280–284, lines 287–294, 328–330, 489–493.
3. This is a good question, but as replied above, if the order of magnitude is correct, the sign of the flux is correct, then it is purely a question of the scientific quality of the scientist how much quality and accuracy (in addition to precision) can be gained. The eddy covariance method by definition is quite robust, it is a noise-rejection method (since it works on covariances) and hence we are convinced that also soil scientists can obtain scientific-grade EC measurements.
4. We thank the reviewer that he finds we did a good job finding a balance between over-simplification and the complex theory of turbulence. We added Section 2.4 on uncertainty in flux estimates, including more references where to find additional information.
5. Minor comments: As explained in detail in our response to the reviewer in the discussion section, we were able to incorporate almost all suggestions. We also clarified the caption to Fig. 3 and explained why we use Fig. 3 and not the modeling assumptions by Huang et al. (2009). See Fig. 3 caption and lines 179–187.

Reviewer #2 aims at the following points in his assessment:

1. Is there a need for a paper of this type? [...] From my perspective this is more of an editorial decision
2. I miss a bit more on the constrains. I would find it useful to have a quantitative evaluation of, where the technic is applicable, or in other words; under which conditions would you expect to obtain useful results?
3. Also e.g. uptake of CH₄ in soils is not very likely to be detectable by standard EC techniques and can in my opinion not necessarily be considered superior to chambers. Some quantification on how to determine sensitivity limits in this context I would consider useful information in a paper like the present one.

4. Also, I think it could be appropriate to clearly point out, that though EC measurements are continuous, variations in the measured variables may reflect heterogeneity in the measured surface or changes in the footprint, rather than temporal variations in the observed parameters.
5. Paragraph 2.2.2 : could a drawing be helpful to support the text here?
6. P552 L1-5: it is unclear to me what is meant here, consider rephrasing. P553L25- Some discussion of the problem of obtaining good quality data during night might be appropriate here.
7. Paragraph 4.2.1., Though fascinating, EC techniques does not strike me as the best choice for manipulation experiments, which is why I find this part a bit lengthy. You could consider to shorten it or focus more on land-use or management techniques.
8. P559L21: Do we need the considerations on aircrafts here?
9. P561L8-15: likewise, isotopic EC flux measurements are certainly not for newcomers.

In response to this critique we were able to improve our manuscript as follows:

1. There may have been some confusion about what a review actually should be. We followed the suggestions by editorial board member J. Six and sharpened the synthesizing component of the paper (Section 5) which was not fully developed in the previous version.
2. We added a new Section 2.4 on Uncertainty in flux estimates to address this issue.
3. We agree, and we actually thought that we did not place a statement of EC being superior to chambers anywhere. We tried hard not to offend the seasoned chamber flux scientists, but as we see from this and other comments, we were not really 100% successful in making clear that eddy covariance cannot replace chamber flux measurements. We added explicit statements now in the Abstract (line 15) and in the main text (lines 33–34, 415–416, 599).
4. We now address this issue with new text in lines 489–493.
5. We added Figure 2 to support paragraph 2.2
6. We reworded and clarified
7. Originally we thought that we will shorten this paragraph and focus more on land-use or management techniques (see our reply in the discussion section), however, in the overall revision it turned out that only some less substantial modifications were possible. However, we put more emphasis on where soil scientists may still prefer chambers even if EC might be tempting. See lines 415–416.
8. We would definitely want to keep the aircraft aspect in, since this is an interest of many. We added a paragraph addressing the suggestion of reviewer #1 though, see lines 473–475.
9. of course we agree that isotopic flux measurements are not for newcomers, hence we only mentioned this under "Future directions and challenges". We have completely revised our synthesis aspect of the paper (Section 5) but kept the isotope aspect in.

We hope that with these modifications our manuscript can now be accepted for publication in SOIL.