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Interactive Comment

Interactive comment on "Eddy covariance for quantifying trace gas fluxes from soils" *by* W. Eugster and L. Merbold

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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

As a response how we will be able to improve our manuscript or where we are of different opinion we think that:

1. As the reviewer observed correctly, the first author was involved in two chapters of the Aubinet et al. (2012) book. We still feel that the Aubinet et al. (2012) book is an extension of previous work, which starts with the forest as the standard system (Chapter 1). For soil scientists we believe that the material can be presented in a simpler way by directly addressing bare-soil and low-statured vegetation ecosystems. In any case it is always recommended that somebody getting interested in a specific technique thanks to having read a paper will then take the time to read a full book with 449 pages. So as a short reply the benefit for the soil science reader would be to have the essential information on roughly 10% of the pages covered by Aubinet et al. (2012).

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,

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then we are in business. Note that we do not specifically address CO_2 (for which more elaborate protocols exist), but general gas flux measurements via eddy covariance. We will of course extend our text whereever the reviews indicate that we in fact have been overly simplifying things.

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-simplifcation and the complex theory of turbulence. We can add more specific statements (with references to the respective chapters in Aubinet et al. 2012) for QA/QC, uncertainty quantification, and flux corrections.

5. Minor comments: We can revise our manuscript accordingly. The only problem we have is with the statement "Other fluxes, such as those of latent heat or CO2, usually do not exhibit a linear decrease with height" (with a reference to Huang et al. 2009). The Huang et al. (2009) paper is a large eddy simulation study which makes quite some brave assumptions for the vertical CO_2 profile during daytime, namely that a huge step change exists between the low concentrations in the atmospheric boundary layer and the atmosphere above the atmospheric boundary layer. This contradicts experimental evidence (see Fig. 1). As an example from own measurements we present vertical CO_2 concentration profiles over the Swiss Plateau, up to 1800 m a.g.l. (that is, roughly 400–2200 m a.s.l.). The atmospheric boundary layer (ABL) height can extend up to 1500 m a.g.l., but its height is only seen with H_2O concentration (for H_2O Huang et al. 2009 use a realistic assumption – free atmosphere air is mostly clearly dryer than ABL

air), in O_3, and in the virtual potential temperature (Siegrist 2001 wrote her Ph.D. thesis on such vertical concentration and flux profiles). Please note in Fig. 1 that the diel variations in CO_2 concentration are **not** a step-change across the ABL height, but are the near-surface CO_2 concentrations in the lowest ca. 300 m above ground level, where nocturnal accumulation of heavy air (stable stratification) takes place.
Thus, to address this critique we will modify the text, more clearly specify whay there are no such step changes in the vertial CO_2 profile under real-world conditions, and more clearly address the different nature of vertical flux profiles during the night (our graph best relates to nocturnal conditions), and during the day with convective mixing.

References

Aubinet, M., T. Vesala, and D. Papale (eds.) (2012) *Eddy Covariance – A Practical Guide to Measurement and Data Analysis*. Dordrecht Heidelberg London New York: Springer. 449 pp.

Eugster, W. and F. C. Siegrist (2000) The Influence of Nocturnal CO_2 Advection on CO_2 Flux Measurements. *Basic Appl. Ecol.* **1** (2), 177–188.

Huang, J., X. Lee, and E. G. Patton (2009) Dissimilarity of scalar transport in the convective boundary layer in inhomogeneous landscapes. *Boundary-Layer Meteorol.* **130**, 327–345.

Siegrist, F. C. (2001) *Determination of Energy and Trace Gas Fluxes on a Regional Scale: Combination of Local Surface Flux Measurements and Vertical Flux Profiles Throughout the Atmospheric Boundary Layer in Complex Terrain (Swiss Seeland Region)*. Ph. D. thesis, University of Bern, Institute of Geography, University of Bern, Geographical Institute, Hallerstrasse 12, CH–3012 Bern, Switzerland. Vol. G67 of Geographica Bernensia, 113 pp.

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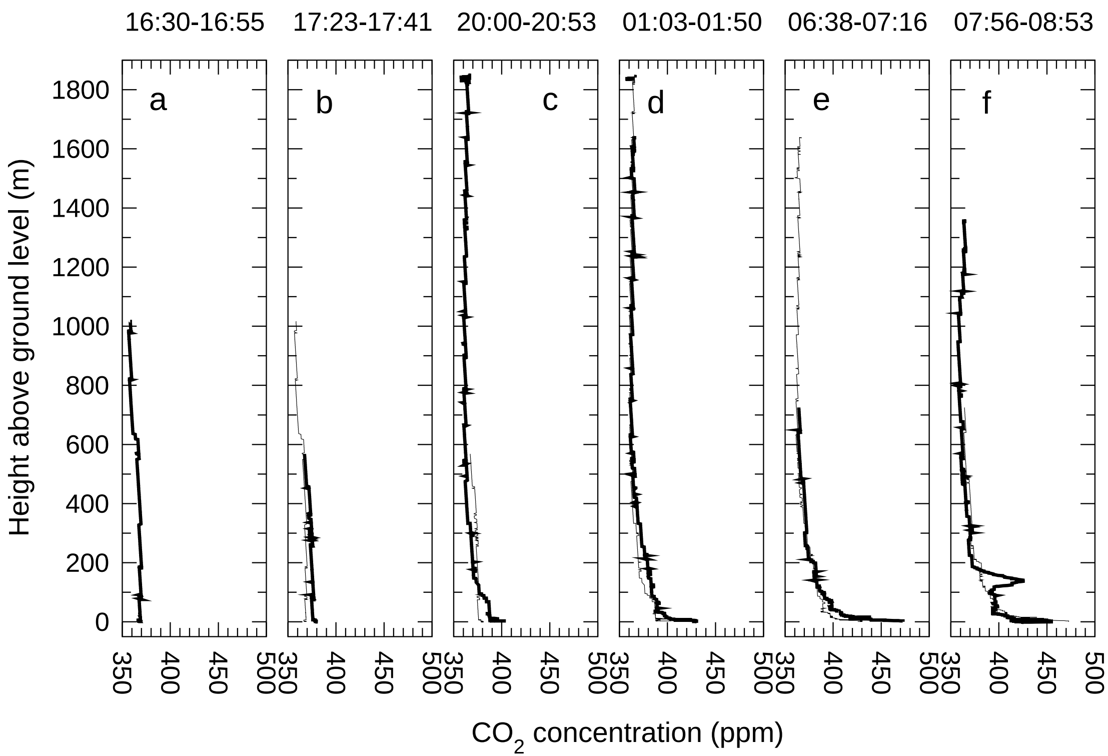

Fig. 1. Vertical CO2 profiles across the atmospheric boundary layer and above (up to 1800 m a.g.l.) over the Swiss Plateau, corrected for pressure artefacts after a publication by Eugster & Siegrist (2000).

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