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Biogeosciences Discussions

Interactive comment on "An inverse analysis reveals limitations of the soil-CO_2 profile method to calculate CO_2 production for well-structured soils" *by* B. Koehler et al.

Anonymous Referee #3

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General comment:

The manuscript provides an interesting contribution to the discussion about methodology to estimate soil CO2 sources at the plot scale. Some minor comments are given below. A more general issue is the fundamental possibility to simultaneously estimate diffusivity profiles and source profiles from the limited data available. As far as I understand, the time derivatives appearing in the appendix are not used in the inverse determination, which is indeed recommendable if profiles are only available at intervals of several weeks. Without this, however, the uncertainty of any effort to determine both the D profile and the source term profile from concentration profile measurements,

intuitively appears to be considerable. If the authors and/or editor should decide to follow the suggestion of Ref#1 to demonstrate the theoretical ability of the approach on synthetic data, it might be interesting to see whether measurements with a higher temporal resolution, which are available in many other studies, could be used to reduce uncertainty.

Specific comments:

1492-06: D has not yet been introduced at this point (the abstract doesn′t count as far as I am aware).

1492-09: The choice of the term "empirical" as a contrast to "inverse" is somewhat confusing. It tends to imply that you determined D empirically from your own data (a description that would also match your inverse determination technique). Maybe something like "literature" D would be better.

1498-05: Try to word the probe description in a way that avoids misunderstandings: Was it a type T thermocouple, is "T-probe" the model name given by the manufacturer, or your abbreviation for temperature probe?

1503-05: This description is not precise enough to be reproducable. E.g., on which grounds was the decision done whether a log or sqrt transform was aplied when the dataset was positively skewed? I guess the transform was only applied if the skewness afterwards was smaller than before? The same questions apply to the negatively skewed datasets.

1504-04: For measurements above the soil surface, the average CO2 concentration appears quite high; if this is due to poor turbulent exchange below the canopy, on the other hand, then the standard deviation is quite low. It might be helpful to discuss this in the context of daytime(s) of the measurements, presence or absence of green plants in the understorey, and presence or absence of an organic litter layer above of what was taken to be the soil surface. All these informations are either not given at all in

the manuscript, or difficult to find (some seem to be given in earlier publications cited, but this would only be sufficient if they were irrelevant for the results discussed in this manuscript).

1505-04: The RMSEs miss units (concentration).

1505-15: Is the value behind the +- the standard deviation (this applies to other places in the manuscript as well)? It doesn′t seem to match the variability shown in Fig. 6. If it is a confidence interval, the level needs to be specified. If it is simply the standard error, this should be mentioned.

1506-19: This statement may be true for your mathematical framework, but it does not (or at least, not to my intuition) match the physical truth of the underlying process. Consider a soil with positive production terms at all depths, a no-flux boundary at the bottom and a poorly permeable (e.g., moist clay) layer somewehere betwewn the production layers. If prodcution below that layer continues long enough, the gradient will become high enough such that it still contributes to the surface flux. If such conditions cannot be described by the mathematical framework, it needs to be discussed whether this is one of the reasons for the problems encountered.

1514-13: Replace (DeJong and Schappert, 1972, 1978) by (DeJong and Schappert, 1972, DeJong et al, 1978).

1523-Fig. 3: Why are the results of the two lowest levels given in another subfigure and another way? If scaling problems are the sole reason, consider a logarithmic depth scale. Why are deep sampling values missing "due to a high ground water level" near the end of a dry season?

1525-Fig. 5: If a figure contains only two different lines, they can easily, and should, be given in a way that is still easy to distinguish in black/white prints.

Interactive comment on Biogeosciences Discuss., 7, 1489, 2010.