Biogeosciences Discuss., 12, C7787–C7790, 2015
www.biogeosciences-discuss.net/12/C7787/2015/

Biogeosciences Discussions

Interactive comment on "A new mechanistic framework to predict OCS fluxes from soils" *by* J. Ogée et al.

Anonymous Referee #1

Received and published: 19 November 2015

This is a salient and timely contribution to our understanding of COS ecosystem exchange. Methods to use COS measurements are presently being developed to understand biosphere carbon uptake on ecosystem and continental scales. Uncertainty in estimates of global photosynthetic carbon assimilation are large; studies incorporating COS observations suggest that this uncertainty can be reduced (e.g. Hilton et al., Tellus B, 2015). While it has been demonstrated that plant foliar uptake is the largest terrestrial sink for COS, soil-atmosphere interactions can confound what would otherwise be a straightforward proxy for gross primary production. To my knowledge, this paper is the first thorough effort to represent soil COS exchange mechanistically, therefore predictively.

The careful treatment of Henry's Law relationship to temperature, effective diffusivity

of COS, and catalyzed COS uptake processes are much needed additions to the COS soil modeling arsenal.

General Comments: It's not clear why advective fluxes can be dispensed with, but mechanical dispersion is still important. One of the first stated assumptions is one of equilibrium. If advective fluxes are neglible after an hour, how are mechanical dispersion fluxes still important after 2 hours?

For some of the important components of the soil fluxes described here, equations were based off of one or two studies. The important and as of yet unexplained process of aerobic soil COS production was discarded though there is plenty of evidence for it. There are several studies with empirical evidence of exponential COS production in dry soils, increasing with temperature rather than Eh. Liu et al., 2010, and Whelan et al., 2015 demonstrated this in incubation studies, and Maseyk et al., 2014 found exponential COS production during a field study in aerobic agricultural soils. This model could be improved by taking into account this process, even if its drivers are not entirely known.

The overall model being presented needs more detail to reproduce. There are some missing connections that could be easily remedied with, perhaps, a supplement with all of the variable/constants defined and a tree of equations.

Specific comments

15695 The tortuosity discussion would be aided by having the equations in a table.

15696 It is unclear how the variables introduced here relate to the later discussion, particularly equation 17. It's clear that diffusivity and tortuosity are included in the analysis in Section 3.1, but this section and the actual equation given need to be better linked.

15700 18-23 The exercise to show that COS membrane diffusion and CO2 competition is negligible is left for the reader. It would be helpful to do the calculation or, in the case

of membrane diffusion, quote the numbers used as well as the citation.

15701 5-15 I had to read this a couple of times to figure it out. The Protoschill-Krebs work was based on extracts of CA from pea shoots, which is also β-CA. Burnell et al. 1988 is the only work that looked at temperature and β-CA. Sun et al. 2015 used Km directly from Protoschill-Krebs and then calculated kcat using the Protoschill-Krebs data set. The Sun et al. work is the only work to report kcatÂň and Km for OCS and β-CA. And now this study is reporting a relationship based on the empirical temperature-response data from the Burnell study. The paragraph makes it sound like Protoschill-Krebs might be a theoretical work or examines a different family of CA. Some minor re-phrasing would make everything clear.

15703 2 There is field data (Maseyk et al, 2014) that also reports production above $\sim$25 C for drier soils.

15703 12-14 It is unclear that the availability of sulfate will affect either the uptake or production of COS.

15705 Section 2.7. Only some of the variables defined in the preceding equations have actual numbers assigned to them. For example, the moving water and air fields (ql and qa)– how are they calculated for this incubation data?

15713 21-29 If the turbulent mixing would increase dispersion, could there be a data set that was collected without turbulent mixing? In other words, should the dispersive fluxes always be included? It would be good to include a further justification of why they were neglected here.

15714 paragraph starting at line 20 This paragraph makes it sound like lab data cannot be extrapolated to the field, answering the question in the title of section 4.2. Perhaps moving this paragraph up to the top of the section, then describing previous work in that context would work better. It reads now like a discussion of previous lab-based modeling efforts, but ends by dismissing this work as problematic.

Technical corrections

15692 17-18 introduces Ksw but then 15693 line 4 starts a discussion about Ksl

15692 25 the Henry's law equation is difficult to parse and might benefit from formatting as an Equation rather than a line of text.

15694 Not sure why some units have "m2 soil" and some others are just "m2. If this is a fine distinction, it needs to be explained a little further.

15695 17, Is Camindu Deepagoda the full name of the researcher? In the Bibliography, it suggests the first name begins with T.

15697 Equation 6a, hl does not appear to be defined.

15700 17 I'm not sure what co-limination means. Co-limitation is meant here?

15701 20 The text and Figure 2b suggest that you're using the equation from Rowlett et al., 2002. Is there a reason to plot the equation twice? Or is it a slightly different equation in the figure?

15703 10 "oxydants".

15704 10 z units are probably meters.

15704 Eq. 16a is z12 supposed to be (z1)2? Or is this another variable?

15710 12 do you mean Equation 16b?

15710 14 "asymetric"

15714 21 and 15715 5 there are two parenthetical comments with ". . .".

15715 21 "mistmatch".

Interactive comment on Biogeosciences Discuss., 12, 15687, 2015.