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Interactive Comment

Interactive comment on "Soil atmosphere exchange of Carbonyl Sulfide (COS) regulated by diffusivity depending on water-filled pore space" *by* H. Van Diest and J. Kesselmeier

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Interactive answer on Referee #1

1) It is obvious that the deposition velocities measured by Kesselmeier et al. (1999) are an order of magnitude (4 times) smaller than the Vd measured in this study. We may take into account three potential explanations.

(a) Kesselmeier et al. (1999) measured the uptake rates at a fixed soil WC by measuring at a relative humidity of 90%. Our data was obtained by drying out the soil from his maximum soil WC to 0% of soil WC with a varying soil WC at around 40%.

(b) The difference in achieving the data implies also that our data was taken at the

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moment the soil was already adapted to the cuvette´s environment during a long-term measurement. The data of Kesselmeier et al. was achieved during a short-term measurement where the soil had less time to adapt to the cuvette environment.

(c) The third reason, which may be the most important one, could be the developmental stage of the soil, i.e. development of soil quality over time. We assume that the soil microbiological community has changed over the years because of different crops and the use of different fertilizers, which can both influence the microbiological growth in the soil. Such a development represents a general problem for determination of trace gas exchange. Determining the microbial activity in terms of carbonic anhydrace activity may lead to a solution or at least a gradual reduction of this problem. If we find a positive relationship between CA activity and gas exchanges, it will be of great help to predict the soil uptake on a regional and global scale in future. At the moment we are developing a method for CA activity determination in soil samples. We will discuss these items in the new version of the paper.

2) The older data set as obtained by Kesselmeier et al (1999) will be added to figure 1 and the magnitudes of exchange will be discussed.

3) "All investigated soils acted as a significant sink for COS". Yes, the referee is right. Our data shows only the importance of certain parameters to predict the COS deposition velocity. Therefore we will delete the word "significant" in the new text. However, our data will help to predict the sink strength of the soil in the future, because emission of COS was never observed during our measurements.

4) This study can not deliver an estimation of sink strength. This would be a limited interpretation. We can only state that all soil types in this investigation were acting as sinks. Thus, taking into account that most of soils will act as sinks for COS plus the recent reports about the strong sink strength of vegetation by Sandoval et al. (2005), we rather consider an underestimation of known an unknown sources to be responsible for an unbalanced COS budget.

BGD

4, S2079–S2082, 2007

5) Earlier models (Kettle et al., 2002) were only based on the measurements of one soil type and interpolated on a global scale. Our measurements should guide to a more realistic approach on the COS uptake by soils on a global scale. This study was useful in order to parameterize the COS uptake by soils and to underline the dominant role of diffusivity depending on the bulk density (linear relationship) and the WFPS. It is difficult to determine the exact COS uptake in the field but this could give a better idea about estimating the sink strength of soils on a regional and global scale. We will implement these points in the new discussion.

6) We will delete this sentence. There is no other significance of the narrowness, it was only personal impression.

7) Soil samples were obtained from the top 5 cm of the soil from multiple grabs (up to 10 grabs in the same field) in order to eliminate variability within a single location on the site. The data is representative for that site. We tried to use the same method to collect all soil samples. But we cannot exclude the variability over time.

8) The experiments were carried out at an ambient concentration (cref) of approximately 1100 ppt to ensure measurable uptake rates at low activities (i.e. at dry and wet conditions). Since Kesselmeier et al. (1999) demonstrated that a positive linear correlation exists between COS uptake and the ambient concentration up to these ranges, we compared all soil data by calculating the deposition velocity (Vd). Furthermore, the measurements for the German arable soil were carried out with 200g of soil. In this manner, it was possible to compare our findings directly with those of Kesselmeier et al. (1999). All further measurements were performed with only 80g of soil per cuvette. This could be related to other soil masses according to Kesselmeier et al. (1999) who found a linear correlation of COS exchange and soil mass up to 200g per cuvette, but shifted to a saturation-like exchange behaviour with increasing soil masses between 200 and 400g of soil.

9) The new figure 1 will contain the older data set additionally (see also remarks 2)

10) Another row with general site description will be added to Table 1: Site description: German soil: sandy/low loess content; Chinese soil: sandy arable/boreal; Finnish soil: arable/moraine origin/boreal; Siberian soil: sandy podzolic/boreal forest.

11) We will use the term "uptake rates" (because emission was never detected) throughout the text.

12) We took the average temperature of the area to meet the optimal soil conditions.

13) Fig.3 has no German soil in it. The German soil was also measured at a temperature of 10°C as mentioned on page 8: "Vds at 10°C were near zero mm s-1 at all soil WCs" and therefore not shown in Figs. 1 and 2a. We will add an explanation in the figure caption.

Interactive comment on Biogeosciences Discuss., 4, 3701, 2007.