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Interactive comment on "Global uptake of carbonyl sulfide (COS) by terrestrial vegetation: Estimates corrected by deposition velocities normalized to the uptake of carbon dioxide (CO_2)" *by* L. Sandoval-Soto et al.

L. Sandoval-Soto et al.

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We are grateful to the referee #2 for the well taken comments. We will make use of them to improve our manuscript.

Our answers to all comments:

- General comments - Balance of losses and sources

The referee is mentioning an important point. If we are right in proposing higher estimates for the COS sink strength of the terrestrial vegetation, the numbers for the global sources must be corrected too. This would mean that COS sources must be investigated again in order to check their validity. It is beyond our capabilities to state such

errors, but we seem to have substantial gaps in our knowledge of the COS production and consumption. This is good point to be mentioned in the concluding remarks.

- Specific comments

– On the estimate of Vd

Yes, the uptake rates were definitely affected by the total loss in the plant cuvette. As the enclosed branch is consuming COS, the actual concentrations within the plant cuvette was significantly lowered. As already pointed out in our answer to referee #1 the losses of COS ranged between 20 and 40 % during all experiments over the years. Nevertheless, as the uptake rates are linearly correlated to the actual concentrations we considered these concentration changes and normalized all exchange rates to the atmospheric concentration of 600 ppt COS, but based on the actual concentration of the reference cuvette (incoming concentration) which turned out to exhibit a more stable baseline. As we used the incoming air for all calculations of the COS uptake, we also took the mixing ratios of the incoming air to calculate Vd. As the plant cuvette (outgoing air) contained around 20-40 % lower COS values, our estimation results in an underestimation of Vd for COS. Thus, the final number for the global uptake might be underestimated by roughly 20-40%. We will mention this point in a revised version. See also Referee #1.

– leaf area determination

Leaf contours were copied onto paper in order not to destroy the leaves. The area was measured by a calibrated scanner system (ScanJET IICX with DeskSCAN II; both Hewlett-Packard, USA), and SIZE 1.10 (Müller, Germany).

– corrections of respiration fluxes

We did not perform any corrections of respiration fluxes for the observed net exchange with an enclosed branch. Autotrophic respiration of such a branch is small as compared to the net assimilation of CO2. We agree that this error exists, but in accordance

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with the referee we regard it as small. A correction, however, is necessary in case of upscaling by using the data of global Net Primary Productivity (NPP). Here we propose to use Gross Primary Productivity (GPP) in order to take into account the assimilation of CO2 which is released again by stem, roots and soils for example. This way we correct for the loss of carbon by all heterotrophic respiration processes. See also answer to referee #1.

– inter-species variations; C3 and C4 plants

This is a very interesting comment made by the referee. If C4 plants exhibit higher COS uptake rates we would also expect higher CO2 uptake rates. Hence, the ratios of the deposition velocities should be comparable. It is a question how much carbonic anhydrase is active and to what extent other carboxylating enzymes contribute. We need more experiments to answer this question. However, we would like to mention a manuscript submitted to PHYTON (Yonemura, S., Sandoval-Soto, L., Kesselmeier, J., Kuhn, U., Von Hobe, M., Yakir, D., and Kawashima, S. Uptake of carbonyl sulfide (COS) and emission of dimethyl sulfide (DMS) by plants), where the C4/C3 differences are discussed in more detail. We will mention this discussion in the revised manuscript.

– Technical comments to clarify the text

– Abstract

We will rewrite the text in order to improve the text and to match the referee comments. The referee was completely right in understanding what we wanted to express. We assume indeed that a simple scaling of NPP to derive COS loss to vegetation will result in an underestimation of the sink. Furthermore, because the influence of CO2 respiration in leaf-based measurements is small a global COS uptake by vegetation is more accurately estimated from scaling GPP which is taking into account the gross uptake rate of CO2 and thus reflecting the more accurate basis for global estimation.

– Delineating conclusion from observations

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Many thanks for this comments, we will reformulate: As a respiration activity was still detectable we conclude that stomata did not completely close in the dark which would explain a low but detectable COS exchange which is still based on an enzymatic consumption. On the other hand we do not exclude fluctuations by analytical uncertainties caused by the non-simultaneous COS sampling at the sample and reference cuvette due to switching of the automated system from one cuvette to the other.

– Citation to relate branch respiration to the complete autotrophic respiration

According to our experience with enclosed branches the respiration does not play a significant role under light conditions. We will go through the literature to find a reference.

– Inclusion of the Xu et al paper in table 4

We agree. We also include the Kjellstrom (1998) estimate. See answers to referee #1.

– last chapter of discussion

This part of discussion will be improved in order to point out that the COS sink strength can be better estimated on a GPP basis.

References

Kjellstrom, E.: A three-dimensional global model study of carbonyl sulfide in the troposphere and the lower stratosphere." Journal of Atmospheric Chemistry 29(2), 151-177, 1998.

Xu, X., Bingemer, H.G., and Schmid. U.: The flux of carbonyl sulfide and carbon disulfide between the atmosphere and a spruce forest. Atmospheric Chemistry and Physics 2, 171-181, 2002

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