Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2017-407-RC1, 2017

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Canopy uptake dominates nighttime carbonyl sulfide fluxes in a boreal forest" *by* Linda M. J. et al.

Anonymous Referee #1

Received and published: 15 June 2017

In this study, the authors profiled COS and CO2 concentrations at 5 heights for 5 months in 2015 for evaluating storage fluxes and understanding the processes of gas exchange, concomitantly with eddy covariance and radon measurements over and in the canopy for assessing the vertical fluxes. Special attention is paid to the nighttime uptake of COS and to the apportionment of this sink within the ecosystem. I share the conclusions of this paper which is well written and deserves to be published, but more detailed information is required in an area of major importance to the study, i.e. the role of plants in the nighttime uptake of COS which, in this manuscript, is only assessed indirectly (i.e., Plant flux = Total flux – Soil flux) because the authors make very little use of their short-term COS profile measurements. If trees are a larger sink of COS than soils during the night, there should be some sign of COS drawdown at canopy level

especially if the 8 m canopy layer is decoupled from the air close to the ground as discussed in chapter 5.2. I look forward seeing new plots showing isolines of the average COS concentration distributions within the canopy as a function of height (including the 125 m reference level) and time of day for the summer and autumn months (see my comment about Fig. 2 below). I hope that this analysis will not end up showing that there are no clear vertical changes in COS between .5 and 125 m height during the night.

Methods

The authors used a multi-position Valco valve to switch frequently (10 times per hour) between the sample tubing from the different profile heights. It would be useful to know the flow rates through the sampling lines (are they flushed permanently or not?) and through the QCLS sampling cell which internal volume could be reminded. Did you use data from the last xx seconds of each cycle or the 3 min records? Did you notice memory effects from previous samples? I would highly recommend the authors to show in a new figure a typical 1h cycle recorded in the late night (stable atmospheric conditions favoring COS and CO2 stratification) and in the afternoon (vertical mixing, no vertical gradient).

Figures

Fig. 1 provides a nice illustration of the radon-tracer method but the times of sunrise and sunset are missing. I guess that a significant portion of daytime Rn measurements is used to calculate the linear regressions shown in the lower panels from which the nighttime fluxes of COS and CO2 are derived. This appears inconsistent to me. 8 m data extrapolated from other levels using an exponential fit isn't it? I also suggest adding the diurnal variations of hourly values of storage fluxes and friction velocity during 12-13 July 2015.

Fig. 2 shows the mean diurnal variations in fluxes based on all available data with friction velocities > to 0.3 m/s (a quite high threshold to separate stable from turbulent

atmospheric conditions). Such a presentation is inadequate because daylight duration from early July to late October exhibits large variations at 61°N as stated page 3 line 15. I don't think it is necessary to generate monthly averages of hourly fluxes, averaged values for summer and autumn months would be adequate.

Abstract

Page 1 line 18: the total nighttime COS fluxes over the whole measurement period were. . .

Page 1 line 21: . . .suggesting that the main sink of COS is not located at the ground. May be the new analysis of vertical profiles will demonstrate that the main sink of COS is not located at the ground.

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