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Interactive comment on "Towards understanding the variability in biospheric CO_2 fluxes: using FTIR spectrometry and a chemical transport model to investigate the sources and sinks of carbonyl sulfide and its link to CO_2" *by* Y. Wang et al.

Anonymous Referee #1

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This paper attempts to make progress in understanding the global budget of OCS and how vegetation uptake of OCS relates to gross primary production (GPP) and net CO2 flux. A set of flux and transport model runs is compared to OCS and CO2 observations in hope of providing a better constraint on model processes. The novel aspect of the paper is in using collocated ground-based FTIR tropospheric column OCS and CO2 data. OCS column data from 3 sites and CO2 from 2 are used to characterize seasonality at mid to high NH latitudes. HIPPO airborne in situ data are used to characterize latitude gradients in different seasons. Although the paper asserts that using

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OCS data can help understand biospheric processes in models, the findings and conclusions of the paper break little new ground: there are too many inconsistencies in the model-data comparisons and too many unconstrained elements in the OCS budget to critically evaluate the model representation of GPP and respiration processes for CO_2.

Although this and previous analyses provide some hope of eventually using the combined data to constrain processes, the findings here are not new or unique. The problem is not that the paper's methods are faulty or conclusions incorrect. It is that most of this has been done before and in some cases, better. The paper would be better suited for publication in ACP if it focused less on redundant comparison to models at a few sites, and used a more complete set of tropospheric column data, eg., all available NDAAC and TCCON, to diagnose OCS behavior that may not be illuminated by the previous works, e.g., the large inferred tropical ocean source.

More specifically, the sensitivity modeling with multiples of the Kettle et al., JGR, 2002 fluxes does very little to diagnose model processes. It has been shown repeatedly that the original Kettle fluxes (and updates) are not accurate in simulating several aspects of the atmospheric OCS observations. The sensitivity tests are not very useful since as the authors state (p. 26039) 'This scaling, while not realistic, . . .' and this has been done previously by Suntharalingam et al., 2008. Perhaps keep one of these simulations for historical context, but this material could be omitted or greatly reduced in emphasis.

The SiB modeling is essentially the same as Berry et al., 2013, who did a much better job of comparing seasonal/latitudinal/altitude dependences as well as diagnosing the process implications of the model-data comparisons. Again, focus on what new insights are provided in this analysis that haven't been shown before, in particular what the FTIR data have to say about the model across the full range of latitude. Relate this to use of the NDACC column OCS data by Kettle et al., ACP, 2002.

The comparisons with HIPPO, while valuable, need to be recognized as a single realization of the gradient from one flight transect. In addition, vertical gradients (which can

be large near source/sink regions) in HIPPO are convolved with latitude. As stated, the column data are less sensitive to these representation limitations. Focus on the column data to diagnose seasonal and latitudinal discrepancies and consistencies with SiB modeling, and use the HIPPO to substantiate. Perhaps this will lead to new insights.

Minor Points: The paper occasionally uses imprecise phrasing, loose language, and has misspellings, which should be cleaned up. A few examples are called out below, but overall it should be carefully copy edited.

P. 26027, line 8: mean -> means; lines 20-21: reads 'fluxes . . . are used.. and compared to measurements' but it is concentrations that are compared. Clean up.

P. 26029, line 11: source -> sources; line 14: more measurements of what, where? line 15: delete 'this'. Line 22: They -> This

P. 26031, line 18: cite personal communication properly.

P. 26032, line 14: the cited errors for tropospheric partial column seem unrealistically low. Explain better what they represent. Lines 18-23: are these the TCCON reported data (http://tccon.ornl.gov) or is this a separate retrieval performed by the authors? Explain please.

P. 26036, lines 13: ran -> run

P. 26040, line 1-5: increased/decreased, fluxes/mean values, lower/larger are mixed up. Re-compose.

P. 26041, line 21ff: previous simulations in Berry et al., 2013 used coupled fluxes of OCS and CO2. What is the point here?

P. 26043, lines 10ff: uptake is not on/off as characterized here. Relative rates differ at different times. Revisit discussion of this paragraph.

P. 26044, line 16: production -> uptake lines 19ff: 'rebound' is not standard usage;

rephrase.

P. 26045, lines 3-29: Discussion is speculative, qualitative, and conclusions unsupported. Tighten up.

P. 26046, lines 10-17: Column and HIPPO comparisons sound inconsistent. Clarify.

P. 26047, section 7: do it.

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