

***Interactive comment on* “Constraining the relationships between aerosol height, aerosol optical depth and total column trace gas measurements using remote sensing and models” by Shuo Wang et al.**

Anonymous Referee #2

Received and published: 20 April 2020

Review of Wang et al.:

I will keep this short and to the point. I think the basic idea of trying to investigate the relationship between trace gas/aerosol plume height and the pollutant loading is good. But having read the manuscript few times, I do not believe the authors have approached the problem with the right tools. My opinion/review is mostly from the observational perspective and I don't know much about the plume models.

1) Why use the total column values of NO₂ and CO, when the authors themselves

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show how, depending on the region, aerosols can be lifted to different heights. What do we actually scientifically gain by looking at the total column only? It is not a surprise that when episodes of strong pollution occur (e.g. fires, biomass burning), the total column values will increase and depending on the thermodynamical conditions (e.g. strength of convection) the lofting will occur. I understand that the vertically resolved observations of NO₂ are not available, but altitude-resolved CO retrievals are available from a number of sensors, MOPITT, AIRS, IASI etc. I also wonder why the authors don't use aerosol layer heights from CALIPSO (possibly combined with OMI)? Wouldn't that be the most accurate account of plume heights?

2) The lifetimes of CO and NO₂ are very different. CO has much more homogenized distribution in the atmosphere, especially as the altitude increases due to transport processes etc. So can the authors disentangle this background signal from the one that is associated with the biomass burning plumes for CO, especially over those regions that already have strong background variability in industrial+traffic pollution?

3) There is virtually no description of how different satellite data products are quality controlled, analysed etc. The devil is in the details. What quality flags are used? How are cloudy/non-cloudy cases handled? Is there a consistency in such cases across all datasets? How is the sampling affected by the quality control?

Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2019-1017>, 2020.

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