



EGUsphere, referee comment RC2
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Comment on egusphere-2022-1309

Anonymous Referee #2

Referee comment on "Tropospheric NO₂ vertical profiles over South Korea and their relation to oxidant chemistry: implications for geostationary satellite retrievals and the observation of NO₂ diurnal variation from space" by Laura Hyesung Yang et al., EGU sphere, <https://doi.org/10.5194/egusphere-2022-1309-RC2>, 2023

This manuscript investigates the effect of the diurnal variability of NO₂ vertical structure on the air mass factor. It is a nice albeit brief investigation into this topic. I recommend publication after minor revisions.

The lone major suggestion is to add-on to Figure 5 to better show the diurnal variability of NO₂ at various altitudes. It's hard to tell whether GEOS-Chem is getting the diurnal patterns correctly. I do think this is a critical missing piece of the manuscript because it would more clearly demonstrate whether NO₂ vertical mixing in GEOS-Chem needs to be further improved (in future work). I expand on this further in my comments below.

The Introduction also needs several minor adjustments, but otherwise the manuscript is in good shape.

Line 22. Modify "high-density" to different phrase. Maybe "hourly high-spatial resolution"

Line 22. I recommend merging sentence #2 of this paragraph into the current sentence #4 of this paragraph. The current sentence #2 is a bit out of place, and should belong in a sentence mentioning the study motivation. Similar to the sentence in Line 50.

Line 32. Mention "SMA" somewhere in this sentence.

Line 41. Never heard of NO_x referred to as radicals, but I suppose an argument could be made. Instead I recommend modifying "Nitrogen oxide radicals" to "Nitrogen oxides"

Line 48. Modify "starting to provide" to "providing"

Line 61. Modify "GEMS is the first geostationary instrument" to "GEMS is the first geostationary instrument measuring trace gases, such as NO₂."

Line 62. Modify "from which the stratospheric portion is removed" to "from which the stratospheric portion is removed to estimate the tropospheric SCD"

Line 69. Modify "observed" to "observe"

Line 78 - 80. Remove the sentence "These diurnal variations...". It is confusing and out of context in my opinion. Penn and Holloway investigated a less polluted area in the US, and should not be compared to Seoul in this context. Subsequently modify "this issue" in Line 81 "the diurnal patterns of NO₂"

Line 205. It would be appropriate to add one more sentence here describing what the previous literature found. Are global CO emissions too low? Is the lifetime of CO too short? Or is the reason for the underestimate still not known?

Figure 5 (or a new figure). It would be very interesting to create a pseudo diurnal plot from this information. For example on the x axis would be time of day, and y-axis would be number density. Both the observations and GEOS-Chem would be plotted on the same panel. And then have 4 or 6 panels with the diurnal patterns at 4 or 6 different altitudes (surface+three different heights or surface+five different heights). Currently I cannot tell how well GEOS-Chem is reproducing the diurnal pattern at each altitude (only the absolute values).

Line 348. To complete this paragraph, it'd be best to mention how this will affect the VCD in a final sentence. Since VCD and AMF are inversely correlated, a 14% AMF increase will decrease the VCD 14% more in the afternoon than at mid-day, assuming an identical slant column at both hours.

Line 384. Modify "it would be rare to find a 7×8 km² GEMS pixel without clouds" to "it would be likely that a 7×8 km² GEMS pixel would have some amount of clouds"