



EGUsphere, referee comment RC1
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Comment on egusphere-2022-1309

Anonymous Referee #1

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-RC1>, 2022

Yang et al. used aircraft observations from the Korea-United States Air Quality (KORUS-AQ) campaign to get detailed insights into the diurnal variability and vertical distribution of tropospheric NO₂. With this knowledge, Chemical Transport Model (CTM) simulations were optimized regarding mainly the oxidant chemistry. Furthermore, the authors analyzed the diurnal variability of the air mass factor (AMF), which is crucial when retrieving NO₂ vertical column densities from the recently launched Geostationary Environment Monitoring Spectrometer (GEMS). This work is relevant since for the GEMS measurement campaign, a detailed knowledge about the AMF in this region is required and until now not known. The authors show, that their optimization of the CTM simulation within the GEOS-Chem model, significantly reduces the bias between observation and model. Nevertheless, especially in the planetary boundary layer (PBL), the model still does not reflect completely the observations. However, the AMF variability can be mostly captured by the GEOS-Chem model. There are only significant deviations in the morning due to incorrect timing of mixed layer growth. I recommend this paper to be published in Atmospheric Measurement Techniques, after the following minor points of criticism will have been addressed.

General remarks:

It is hard to follow the description of the figures. Especially for Fig. 4 and 5, I would suggest a denotation with a/b/c/d and a clear reference when discussing trends and/or comparing data.

The calculation of errors and their sources are in many cases not clear. Please clarify for the whole manuscript.

Specific remarks:

Line 103: ...which leads us to evaluation... --> ...which leads us to **the** evaluation...

Line 123: ..., A high-Resolution... --> **a High-Resolution**

Line 132: Introduce here the abbreviation of the version **v13.3.4** and not in Line 145

Line 167: The sentence "The NO_3^- photolysis... $\times j_{\text{HNO}_3}$." is not clear.

- EF **relative** to j_{HNO_3} mostly means a ratio and not a multiplication
- please rephrase

Line 178: what does it mean "very high"? In comparison to what?

Line 205: Is this 50 % increase just an empirical estimation? Why this exact value?

Line 219: Is z_t constant or date dependent?
The index of z_t must not to be in italics.

Line 259 and 261: How are the relative differences of the profiles calculated? At one given altitude? Or overall the PBL?

Line 277: What is the accuracy of the measurement? Is it possible to show error bars or at least give an accuracy?

Line 332ff: Is the described behavior only taken from literature (Chong/Crawford) or is it taken from the new data? Where is this time resolution shown? Figure 5 only shows the given 3 timeslots

Line 353: mention, that the model values are given in parentheses in Table 1.

Line 373f: please rephrase the sentence.

Line 364f: what are the values given in parentheses? Mean+StdDev?

Line 372: Which errors do you mean? The RRMSE from above?