

Comment on amt-2022-131

Anonymous Referee #1

Referee comment on "SAGE III/ISS ozone and NO₂ validation using diurnal scaling factors" by Sarah A. Strode et al., Atmos. Meas. Tech. Discuss.,
<https://doi.org/10.5194/amt-2022-131-RC1>, 2022

Strode et al. developed in their study a global set of NO₂ and O₃ diurnal scaling factors accounting for the diurnal variability of NO₂ and O₃ concentrations in the atmosphere. The scaling factors were generated by using a 4D global atmospheric chemistry model, and are publicly available in dependence of solar zenith angle, latitude, and altitude. This work is relevant since the authors close a gap, which up to now do not allow an accurate comparison of different measurements (satellite vs satellite or satellite vs ground-based) of NO₂ and O₃ taken at different times of the day. The authors show, that the utilization of these scaling factors for comparisons (SAGE III/ISS, OSIRIS; MLS, OMPS and ACE-FTS) tremendously reduce the difference between the compared NO₂ and O₃ concentrations. Furthermore, Strode et al. could show that the interannual variability of NO₂ scaling factors is very likely to be correlated to the quasi-biennial oscillation (QBO). I recommend this paper to be published in Atmospheric Measurement Techniques, after the following minor points of criticism will have been addressed.

General remarks:

- Consistently use NO₂ and O₃ OR nitrogen oxide and ozone. I would recommend to firstly mention nitrogen oxide (NO₂) and ozone (O₃) and the switch to only NO₂ and O₃.
- For a better readability use consistent order of discussed trace gas in section 1, section 2.1.1, section 2.3 and figure 1. FIRST NO₂ and SECOND O₃.
- Change the order of instruments in section 2.1 to be consistent with the order of mention later in the manuscript: SAGE, OSIRIS, ACE-FTS, MLS, OMPS LP
- Please revise the reference section regarding missing doi or page numbers.

Specific remarks:

- Title: Capitalize "Using".

- Line 41 – 54: Please mention the order of magnitude for both the NO₂ and O₃ diurnal variation/photochemistry to get an idea of the difference of both species.
- Section 2: Underline difference between experimental data collection and simulation by using 2 sub-sections "2.1 Instruments and observation" and "2.2 Simulation and scaling factors" instead of 2.1-2.3. 2.2 can then be split up into "GEOS Model Simulation" and "Scaling Factor Calculation".
- Section 2.1: Better indicate whether the description regards O₃, NO₂ or both, especially for the used retrievals.
- Line 151 – 169: Is the dynamical tendency of NO₂ neglected in the analysis due to the dominance of the chemistry? This is not clear here.
- Line 188 – 191: For me the method is not clear here. Do you just take the best fitting data to compare model and observation and not the SZA=90° data? Is this admissible in this context? The "real" 90° value is unknown, isn't it? Please clarify.
- Line 221 – 230: Shift complete paragraph into the introduction or shorten it.
- Line 237: "the O₃ peak" instead of "the peak O₃".
- Line 248: Change the section title. The result part already starts in section 3 with the model validation. Maybe "Data evaluation".
- Section 4.1.2: define the parameter "sunrise scale diff" as used in the figures.
- Line 319: Change "SAGE III/ISS sunrise (SR) and sunset (SS) NO₂ and OSIRIS and ACE320 FTS observations" to "SAGE III/ISS sunrise (SR) and sunset (SS) and OSIRIS and ACE320 FTS NO₂ observations".
- Line 365 – 381: It would be helpful to note the difference in magnitude of the scale factors when comparing O₃ and NO₂.
- Figure 8: Colors of legend and data are not the same.
- Figure 9: Suggest to use a wider y-axis-range.
- Figure S4: Mention that the shown data is NO₂
- Figure S5: SZA=60 à SZA=60° (unit missing)

Please also note the supplement to this comment:

<https://amt.copernicus.org/preprints/amt-2022-131/amt-2022-131-RC1-supplement.pdf>