

Interactive comment on “Ground-based validation of the Copernicus Sentinel-5p TROPOMI NO₂ measurements with the NDACC ZSL-DOAS, MAX-DOAS and Pandonia global networks” by Tijn Verhoelst et al.

Anonymous Referee #2

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The manuscript titled “Ground-based validation of the Copernicus Sentinel-5p TROPOMI NO₂ measurements with the NDACC ZSL-DOAS, MAX-DOAS and Pandonia global networks” provides a comprehensive validation information of Total, Tropospheric, and stratospheric TROPOMI NO₂ data based on three types of the ground based remote sensing data. The manuscript contains the scientific information, which is thought to contribute to the community of this field for sure. The paper is well written and easy to follow. However, there are a few things that need to be addressed and discussed to enhance the quality of the paper.

C1

Specific comments: Lines 150-155: (1) Please address the accuracy of the stratospheric NO₂ column retrieved from the ZSL-DOAS. (2) Temporal resolution of the ZSL-DOAS data and differences of measurement time between the ZSL-DOAS and TROPOMI needs to be discussed. (3) Spatial coverage of the ZSL-DOAS data need also to be specified.

Line 184: Please specify how large footprint which tropospheric NO₂ are averaged over. It can be a specific area size or a range of the area sizes. It will help the readers quantitatively understand the horizontal representativeness of the stratospheric NO₂ column from the ZSL-DOAS.

Line 189: “A small negative bias”: I recommend not to use “bias” unless ZSL DOAS accuracy is proven to be much higher than that of TROPOMI or space borne UV hyperspectral sensors.

Lines 211-220: The manuscript addresses that there is an issue of 10% overestimation of the PGN NO₂ data at high altitude stations due to using cross sections at a single temperature. Please consider removing the Section 3.4 since of the PGN NO₂ data at high altitude stations is not accurate enough for validating stratospheric NO₂ from TROPOMI as the authors also mention it.

Figure 7: Y Axis: (1) Why using SAT-GND? All other figures use “TROPOMI”. For consistency, please consider using something like “TROPOMI-ZSLDOAS” or anything better. (2) Please enlarge the figure and explain what the colors represent in the caption?

Section 4.1 and 4.3: (1) Authors need to address quantitative differences of tropospheric NO₂ columns retrieved from various MAX-DOAS instruments and their algorithms. (2) Errors and accuracy of the retrieved tropospheric NO₂ column needs to be both quantitatively and qualitatively addressed before discussing comparison results in Section 4.3.

C2

Lines: 264-280: (1) Please address major factors that cause the difference between tropospheric NO₂ column data obtained from MAX-DOAS and TROPOMI. (2) Please discuss the possible reason for larger discrepancy at more polluted sites. I personally think one of the things that authors need to do is to compare aerosol properties and aerosol extinction profiles used to retrieve tropospheric NO₂ column between MAX-DOAS and TROPOMI.

Section 5 Total column validation: Is there any problem associated with cross section at a single temp.? Please clarify it since there is the issue at Section 3.

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