

We would like to thank referee #1 for the comments and suggestions. We have answered all the questions and revised the texts. Thank you for the references. The answers are in blue color. The original comments from referee #1 is in black italic font.

Interactive comment on “Shipborne MAX-DOAS measurements for validation of TROPOMI NO2 products” by Ping Wang et al.

Anonymous Referee #1 Received and published: 9 January 2020

The manuscript describes the comparison between TROPOMI, TM5 model and MAXDOAS NO2 observations during 5 ship cruises over the Pacific Ocean. The paper is well written and can be published after addressing the following minor comments.

Specific comments P2 L41 There are a few recent paper on the validation of TROPOMI NO2 over land (some under discussion). Here some examples:

*Griffin, D., Zhao, X., McLinden, C. A., Boersma, F., Bourassa, A., Dammers, E., Degenstein, D., Eskes, H., Fehr, L., Fioletov, V., Hayden, K., Kharol, S. K., Li, S.M., Makar, P., Martin, R. V., Mihele, C., Mittermeier, R. L., Krotkov, N., Sneep, M., Lamsal, L. N., ter Linden, M., van Geffen, J., Veefkind, P., and Wolde, M.: High Resolution Mapping of Nitrogen Dioxide With TROPOMI: First Results and Validation Over the Canadian Oil Sands, *Geophysical Research Letters*, 46, 1049–1060, <https://doi.org/10.1029/2018GL081095>, 2019*

*Ialongo, I., Virta, H., Eskes, H., Hovila, J., and Douros, J.: Comparison of TROPOMI/Sentinel 5 Precursor NO2 observations with ground-based measurements in Helsinki, *Atmos. Meas. Tech. Discuss.*, <https://doi.org/10.5194/amt-2019-329>, accepted, 2019.*

*Zhao, X., Griffin, D., Fioletov, V., McLinden, C., Cede, A., Tiefengraber, M., Müller, M., Bogner, K., Strong, K., Boersma, F., Eskes, H., Davies, J., Ogyu, A., and Lee, S. C.: Assessment of the quality of TROPOMI high-spatial-resolution NO2 data products, *Atmos. Meas. Tech. Discuss.*, <https://doi.org/10.5194/amt-2019-416>, in review, 2019.*

Thank you for the references. The papers have been cited in the introduction.

‘Validation of TROPOMI satellite NO2 products has been done with ground-based measurements over land (e.g., Griffin et al., 2019; Ialongo et al., 2020; Zhao et al., 2019).’

P3 L74-76 So I understand you did not use the measurements of ship emissions? I was wondering why; could not be useful to get some of these data for the validation? If you are afraid the resolution of TROPOMI will not be able to detect that I think it’s still worth showing...

The measurements of air that are affected by the ship’s emissions are so local (within tens of meters from the smoke stack with a very limited area sampled) that they are in no way representative for the area sampled by the Tropomi pixel. Ships emissions on a well-travelled shipping route show up as a

collective signature but emissions from a single ship on a not well-travelled route disappear in the background.

Figure 2 (and all the others) Day fraction: could you use normal time of the day (not decimals)? It's a bit confusing...

We have changed the day fraction on x-axis to local time as suggested by referee #2.

P9 L267 Could you give these differences also as percentage? (In the abstracts as well)

We have given the percentage close to L267 and in the abstract, in lines 275-276, 310 in the revised manuscript.

L282 Could give a brief description of this interpolation method together with the reference? (it remains a bit unclear)

We shifted the TM5 simulated stratospheric NO₂ VCDs to the MAX-DOAS measurements in the morning and evening, but kept the shape of the NO₂ diurnal cycle in the TM5, then interpolated the NO₂ VCD at the TROPOMI overpass time from the shifted TM5 stratospheric NO₂ VCDs.

Figures 6, 10, 11: What quantity are the error bars? It should be mentioned in the caption

The error bars are the precision of the of TROPOMI tropospheric or stratospheric NO₂ VCDs. We have added the explanation in the captions. In Fig. 11, the horizontal error bar is the precision of MAX-DOAS NO₂ VCD; the vertical error bar is the precision of TROPOMI NO₂ VCD.