

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

Anonymous Referee #2

Received and published: 16 January 2020

The manuscript “Shipborne MAX-DOAS measurements for validation of TROPOMI NO₂ products” presents results of NO₂ MAX-DOAS measurements from several ship cruises in the Atlantic and Pacific Ocean which are used to validate the NO₂ measurements of the new TROPOMI instrument and NO₂ simulations of the TM5-MP model. They found a good agreement between the three datasets. In general the manuscript is well structured and fits in the scope of AMT. Before publication, the following comments should be considered:

General comments:

- Where are the data from the cruise SO201712 shown? Are they only used in Fig. 1? If the data are not used for validation, they should not be shown in this

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manuscript.

- discussion of the results of previous studies, for example:
 - P2, L41: What are the results of the validation measurements over land? Please cite some papers.
 - P2, L45: What are the results from the previous studies of the comparison between shipborne and satellite measurements?
 - Sect. 4.5: comparison with previous studies is missing
- The aerosol data are described in Sect. 2.1.3. Is there a relationship between aerosol load and differences between the satellite and MAX-DOAS measurements?

Specific comments:

- throughout the manuscript: slant/vertical column → slant/vertical column density.
- throughout the manuscript: “R.V.” → “RV”
- P3, L67: absolute or relative wind speed and wind direction?
- P3, L73: “The ships were quite stable measurement platform,”: Is this really true? For all cruises, pitch and roll angles in a range of $\pm 1^\circ$ sounds for me a little bit unrealistic, especially for the cruise SO201712.
- P3, L79-81: Please move the part of the aerosols to Sect. 2.1.3
- P4, L89-97: The whole set-up of the instrument remains unclear to me. Did the instrument really point to the backward? Are the 200° clockwise or counter-clockwise? Why are measurements to the back of the ship used? I would assume that these measurements are mostly contaminated by the ship plume.

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- P4, L99: What is about the ship movement within one minute? How large is the error which is introduced in the elevation angle?
- P4, L102-103: Maybe it would be good to move this sentence to the description of the position of the instrument.
- P4, L120: Please add also the coordinates in °E.
- P4, L118: Why is an AOT of 0.05 chosen for days without aerosol measurements?
- P5, L129: What are detailed results? Please add some further information.
- P7, L187: What means “later”? Please add an reference.
- P8, L237: Please add a tick in Fig. 3 at 70°? Than it is easier to see.
- P9, L270-272: Can these results be presented in a small table?
- P9, L273-276: The TROPOMI results are unexpected as the section is about MAX-DOAS and TM5-MP. Change title of the section or put the paragraph somewhere else in the manuscript.
- P10, L288: What is with the first days (28 Jan. - 2 Feb.) of the cruise?
- Figure 2: Please use a normal time axis (such as local time), because day fraction is hard to understand. Please add “strat.” to y-label and add the coordinates of mean ship position form the 5 Feb. 2019 in the caption.
- Figure 3: Please use a normal time axis (such as local time). Please add “tropo..” to y-label and add the coordinates of mean ship position form the 24 June 2019 in the caption.
- Figure 4: Please use a normal time axis (such as local time).

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- Figure 5: Please add a unit to the offset in the figure caption.
- Figure 6: Please adjust the y-label to the label of the other figures. Please use the day of month for the x-axis.
- Figure 7: Please add a unit to the offset in the figure caption. TROPOMI is an acronym. Please use capital letters.
- Figure 8: Please add a unit to the offset in the figure caption. Please change y-label (see Fig. 7).
- Figure 9: What means “MAX-DOAS TM5 interpolated”? In L 309 it is written “...MAX-DOAS and TROPOMI stratospheric NO₂...”.
- Figure 10: Please add “MAX-DOAS” to the legend. Please adjust y-label (Trop. NO₂ VCD) and use day of month for x-axis.
- Figure 11: TROPOMI is an acronym. Please use capital letters in the y-label.
- Table 1: The official cruise names are written with a slash in the name such as SO268/1. Please adjust throughout the manuscript.

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