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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Surveillance of SO_2 and NO_2 from ship emissions by MAX-DOAS measurements and implication to compliance of fuel sulfur content" *by* Yuli Cheng et al.

Anonymous Referee #2

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The paper presented by Cheng et al. has reported the shore-based MAX-DOAS measurements of ship emitted SO2 and NO2 under three different conditions in China's ship emission control area (ECA), i.e. ship docked at berth, navigation in the inland waterway and inbound/outbound in the deep water port. Although the detection of SO2 and NO2 by MAX-DOAS has been developed for many years, the employments for ship emission surveillance are an interesting application of the MAX-DOAS technique. I think the manuscript fits to the scope of ACP, especially for this special issue. I recommend publication after the authors addressed the following comments.

Major concerns:

The authors use the SO2 and NO2 DSCDs measured at different elevations for the evaluation of ship emissions. However, the vertical distribution of background SO2 and NO2 are quite different. It is not clear that how do the authors separate the ship emissions of SO2 and NO2 signal from the background? This information has to be supplemented in section 2.

The sectioning of section 2 is not very logical. I suggest the authors follow the order of "instrument", "spectral retrieval" and "ship emissions identification".

In section 2.3, the SO2 and NO2 DSCDs are retrieved at different spectral ranges. How do the authors compensate the effect of wavelength dependency? If it is not considered in the retrieval, an error analysis is required.

Sect. 3.1, In the 2D scanning, the authors used the reference spectrum measured at azimuth angle of 10, however, it can be seen from Fig. 2(b) that this direction are still pointing to the berth. How to confirm the impacts of ship emission in the reference spectrum has been excluded? Alternatively, how to evaluate the uncertainties on the absolute value of DSCDs due to this?

Both in Sect. 3.1 and 3.3, the authors used the mathematic method to the slowly change of DSCDs in temporal pattern. I think the author should introduce something more about why this method can be used here? And the basic principle? In line 340, how to prove that the baseline represents the diurnal variations of DSCDs mostly due to the change of light path caused by solar zenith angle and the background emissions?

The authors have mentioned that it is difficult to distinguish the single ship plume. How do the authors derive the emissions from different vessels (Figure 11)? How the data are filtered? What is the error?

Minor comments:

What is the typical error of the measurements? Please put the error bars on figure 6, 10 and 11.

Figure 11 is very busy. It is difficult to see the differences between each species. Maybe the authors can separate it into 2 to 3 subplots. More detailed caption is required.

Technical corrections:

Line 17, “berth” to “berths”

Line 105, “instruments” to “instrument”, “observe” to “observes”

Line 111, “less trace gas absorptions”

Line 112, what is the slope column concentration? It should be the slant column density.

Line 122, “impacted by”

Line 174, “unqualified NO2 and SO2 DSCDs” to “unsatisfied spectral fitting”, and “fitting results” to “DSCDs results”.

Table 1 title, “operative” to “operation”; in the line of “Yantian”, “Smaller” with unnecessary capital letter.

Table 2, whether the O4 absorption was included in the SO2 fitting range? What’s meaning of symbol “–” standing for here?

Line 191, “multiple berth” to “multiple berths”

Line 226, “the residual after background subtraction”

Line 247, “boxes serving”?

Line 268, “around 5 mâĂćs-1 on March 9”

Line 277, “impacting” to “influencing”

Line 292 and 293, “meters” can be shorten as “m”

Line 300, there are two dots in the end of the sentence. Please delete one.

Fig. 11, I suggest to also indicate the inbound and outbound status of the vessels to easily exam the relationship with slope.

Line 371, SO2-to-NO2 > SO2/NO2, also in the rest of the manuscript.

Line 381, IV or IX ?

Line 405, where is the 2-D DSCDs map at Yantian in manuscript?

Line 390 and 410, what the ratios of SO2/NO2 of inbound vessels and tugboat? Lower than 1.3 or 1.5? Please keep the consistency of description.

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