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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Characterization of trace gas emissions at an intermediate port" *by* Aldona Wiacek et al.

Anonymous Referee #1

Received and published: 14 March 2018

General Comments:

This is a very nicely written paper, detailing some interesting and novel work, and I thank the authors for their work and insight. The unique application of the OP-FTIR using the specific geography of Halifax Harbour and the direct identification of several features of ship plumes, as well as a discussion of the spatial impact of emissions from a medium-sized port in the Atlantic Canadian coastal environment, make this an important contribution to the scientific literature. The paper discusses a) the high-frequency detail of the field observations, b) the relevance of the observed trace gas perturbations due to ship emissions in relation to other major trace gas emitters in this coastal urban environment, and c) the broader global context of this issue, making it quite a thorough read. The paper identifies the impacts of both large ships (including pas-

senger, Container, Bulk Carrier, Cargo, Ro-Ro, Tankers, Navy) as well as – uniquely – small pleasure craft, on trace gas concentrations, and highlights the importance of further investigation into the impact of marine emissions in this region. The analysis and discussion is thorough, although as detailed below I would like to see quantitative correlations to support the discussion points. Qualitative time series correlation is compelling when it appears to makes sense, but for robust take-away messages more quantitative analysis should be considered. I have made a few minor suggestions throughout to improve the clarity, and I support the publication of this work in ACP.

Specific Comments:

Abstract

Why do passenger ships contribute 0.5% to emissions in off-season? (when there are no cruise ships between November and April)

Introduction

Scope of Introduction is appropriate and well-researched.

p3 lines 8,9,10 seem to contain a contradiction with respect to whether SOx is projected to increase or decrease: please clarify.

P7 lines 22-27: Are these two sentences relevant? The mention of LRT seems to pull focus from the point of the paper, but are you setting up for the suggestion that the Gibson LRT number includes what should rightfully be included in the shipping component? If so, I did not find a continuation of the discussion later in the paper. Either way, these two sentences detract from the well-made points of this paper and I would remove them.

Fig. 1: Whereas your paper is situated in an international context, I suggest making your "widest shot" an image of Canada, rather than the Maritime Provinces.

Results and Discussion

p14 line 13 – it is too bad the SO2 signature showed interference and could not be reported, this would be an interesting measurement given the recent SECA regulations. Do you have any reliable data?

I appreciate the discussion of what was not reported.

P14 line 31 – This sentence is confusing . . . does it suggest that plant respiration of CO2 would cause an enhancement of CO2? Regardless, I'm not sure a comment regarding plant respiration is relevant here. Would a citation for your previous work (p15 line2) help to clarify?

P15, line 22 – there are what appear to be anti-correlated variations in CO and NO2 at about 03:40 through to 07:00, when winds are directly from the north and NNE (Figure 6a). To what is this attributed, if not to the Bulk Carrier and Oil Tanker north of the OP-FTIR path? Quantitative correlations would be very helpful in understanding the relationships between constituents, and the times at which they cease to be correlated or anti-correlated, especially when attributing their causes (lines 22-25). Did you perform any correlations between the data series (during specific times of interest)?

P15, line 31 – This is a broad statement that may be considered speculative. I suggest ". . .wind was north / north-east MAY HAVE BEEN (or WAS LIKELY) CAUSED by 1) the Ro-Ro . . .."(author should replace "was caused" by one of the capitalized phrases).

P17 line 8 – did you calculate correlations between constituents for specific time frames, or is this statement based on eyeballing the time series'? Quantitative relationships between constituents for case studies where ship plumes were clearly observed would be a useful addition to your analysis.

P17 line 24 – quantitative correlations to support this statement could be added.

Figs. 9&11 – suggest to represent the wind speed and direction with a vector as you have done in Fig. 6.

Fig 11 – the agreement between the FTIR and the NAPS measurements is compelling,

and the discrepancies interesting. I agree that it warrants further investigation, especially considering the NAPS site is long-running and more analysis could be done on historical data where meteorological conditions indicate that the influence of ship emissions could be fairly wide-spread, as they are on January 30. This could further highlight the influence of ship plumes on the population of the port city, without embarking on a new field study.

P21 lines 29-31 – I would say that I do not agree that, by sight, the spikes occur mostly in the late afternoon and early evenings. It does stand to reason that pleasure craft may be more active later in the day, at least on weekdays. However, on two (Jul 14, Aug 16) of the three days (Jul 13, 14, Aug 16) where you have full days of data, the CO spikes appear to begin around 6am and persist until midnight. Do the earlier spikes follow the same pattern of enhancements/depletions?

P23 line 19, what accounts for the 0.5% in winter, as there are no cruise ships between Nov and April?

Technical Comments

P7 line 18 - ". . .to contribute between <10% (Hingston 2005) and $\sim$30% (Phinney et al., 2006) OF AMBIENT CONCENTRATIONS in Halifax . . ." (author should add the capitalized phrase if that is the correct interpretation; otherwise clarify)

P9 line 5 – add space between "corner" and "array"?

P9 line 5 – the word "if" should be "is".

P. 20 line 24 – take out "In summary, "

Fig 8 – add date to caption (suggest after "(time index 10)")

Fig. 10 – it is difficult to understand which paths are attributable to which ships. Suggest to add a black connector from the description/time to the coloured path, or add a legend.

Fig 12 / p22 line 14 – The events at 20:00 are mentioned; do you mean 19:51? Whereas the analysis in this section refers to events happening on the order of minutes, the text should be corrected to read “19:51”.

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