Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2018-125-RC2, 2018

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Assessing the impact of shipping emissions on air pollution in the Canadian Arctic and northern regions: current and future modelled scenarios" *by* Wanmin Gong et al.

Anonymous Referee #2

Received and published: 25 June 2018

This study uses a regional air quality forecast model (GEM-MACH) coupled with a new shipping emission dataset based on real-time vessel movement data for 2010 to assess the impacts of shipping on air pollutant concentrations and deposition in the Canadian Arctic. Projections based on business as usual and controlled emission scenarios are used to estimate possible future changes in shipping impacts on ambient pollutant levels. The study provides a useful regional perspective on shipping impacts on Arctic pollution, and includes a comprehensive model evaluation for the Canadian Arctic region. I recommend publication in ACP once the following comments have been addressed by the authors.

General Comments

1. Although the paper is generally well written and clear, parts of the paper are quite long, and could be written more concisely. In particular, I would encourage the authors to consider whether a summary figure and more concise discussion of the model evaluation against observations could be included, with the minute detail of seasonal vs daily vs hourly comparisons and the information in Table 4 could be moved to supplementary information. Specific aspects of these evaluations of particular relevance for shipping impacts could be summarised in the main text.

2. An important aspect of how shipping may impact ambient pollution concentrations in coastal regions is related to the dispersion of pollutant plumes emitted by ships. This is partly related to the vertical boundary layer structure and stability. If possible, and data is available, it would be helpful to include somewhere some assessment of the model vertical BL structure (temperature profile, BL depth), or at least add a comment based on past evaluation of the model.

Specific Comments:

Page 3, line 7: Is all of the Arctic pristine? Depending on time of year, "background" PM concentrations may be very different in different areas? This may have implications for the impacts of shipping. How does the Canadian Arctic compare with e.g. N Siberia in terms of background (non-shipping) PM and ozone?

Page 4, lines 3-4: It would be useful to know more about what was assumed regarding the "limited number of transits of north-west passage". Which sea ice and climate projection scenario are these most consistent with? Which criteria went into this assumption?

Section 4.1: Discussion of model evaluation against observations. It would be helpful to compare model performance with other model studies focussed on similar regions where possible. e.g. the POLMIP models compared with ARCTAS aircraft data near

surface over Canada? (Emmons et al., 2015). Other global modelling studies? For the comparison of SO2 agains observations (but also relevant for other species) -it would be helpful to know how the regional averages and poor model performance are skewed by certain sites. e.g. can the comparisons with the oil sands sites be separated to show how the model compares away from this source (and specifically near to it)?

Section 5: The impacts of shipping on ambient pollutant concentrations in future may be closely tied climate system changes - particularly changes in sea ice. It would be interesting to consider how the conditions that may make shipping more favourable (reduced sea ice) may also contribute to a change in the impact of the shipping emissions. While additional model simulations are probably outside the scope of this study, could the authors comment on how reduced sea ice might be expected to impact ozone and PM in the summertime Arctic in context of their results?

Figures 4,5,6,7: How representative are the regional average concentrations, and is there much spread? e.g. it would be helpful to know how variable the concentrations are that make up each average. Can some spread be plotted in shading? This is also relevant to discussion of model evaluation above.

Editorial corrections:

Page 3, line 3: “theses" should be “these”

References:

Emmons, L. K., et al., The POLARCAT Model Intercomparison Project (POLMIP): overview and evaluation with observations, Atmos. Chem. Phys., 15, 6721-6744, doi:10.5194/acp-15-6721-2015, 2015.

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2018-125, 2018.