

Interactive comment on “Identifying the sources driving observed PM_{2.5} variability over Halifax, Nova Scotia, during BORTAS-B” by M. D. Gibson et al.

M. D. Gibson et al.

mark.gibson@dal.ca

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Anonymous Referee #1

General comments: The paper presents the source attribution of observed PM_{2.5} concentrations over Halifax, Nova Scotia, using PMF receptor model. This study highlights the value of using air mass back trajectories coupled with local wind direction dependence to help identify the sources. The paper has been written well and the introduction, methodology, and results & discussions have been described well. Therefore the paper is considered as a good contribution to Atmospheric Chemistry and Physics.

C2637

Specific comments: 1.P4493, line

1: Please specify what kind of variability of total PM_{2.5} concentrations over Halifax, temporal or spatial variability?

Authors Response Firstly, thank you for taking the time to review the paper and for your very useful and insightful comments that we feel has greatly improved the paper.

Authors Response It is temporal variability coinciding with the aircraft and other ground based measurements at the Dalhousie Ground Station (DGS). I have add “temporal” to the title.

2.P4494, line 16: how samples collected at DGS were considered representative of Halifax? Multiple sampling sites could be more representative, especially for analyzing spatial variability of PM_{2.5} over Halifax.

Authors Response Many studies of past PM_{2.5} composition (including my own – unpublished) have shown that the bulk of PM_{2.5} in Halifax is due to long-range transport. The Environment Canada instruments in Halifax were not functioning during the BORTAS campaign. Hence the critical need for the PM_{2.5} measurements conducted by my group to support BORTAS. I have been involved with a large 50 site, seasonal, spatial study in 2009 in Halifax for Health Canada (we have only published results of the trace gases from this study so far) and the PM_{2.5} concentrations from this site are close to the median values seen in that study, therefore the site is representative of Halifax. The location of the site was driven by the need to collocate all of the other BORTAS related instruments, e.g. Aerodyne Aerosol Chemical Speciation Monitor, Lidar, PARIS FTIR, Sun Photometer, a second FTIR, size-resolved particle counters, ozone and SO₂. The BORTAS DGS was designed to have all of these measurements in one location. The site is not only representative of Halifax but was critical to the BORTAS ground station intercomparisons that will follow on from this paper. This paper presents the PM_{2.5} chemistry and major sources influencing PM_{2.5} composition during BORTAS. This is critical to understanding and explaining what the other ground based instruments were

C2638

observing. The data was also critical in validating the PM_{2.5} forecast models used to guide the BORTAS aircraft into smoke plumes over Halifax and upwind/downwind of Halifax.

3.P4495-4498: the description of lab analytical methods can be more summarized. Please provide more details on quality assurance of measurements if any has been done, such as precision analysis, blank correction, etc. Were there any blank or duplicate samples collected for quality assurance purposes?

Authors Response 10% of all samples were field duplicates and we also had lab blanks. All samples were blank corrected. We have now included this statement in the manuscript. There were no duplicate samples collected as there were no additional funds available to purchase further "very expensive" particulate-based samplers. The samplers used are Federal Equivalent Samplers with well-known precision and accuracy. New text "No duplicate filter samples were taken during the study. 10% of the nylon and Teflon filters were field blanks with an addition 5% acting as laboratory blanks. Blank subtraction was conducted on all filter samples where required."

4.P4499, line10: please indicate the location of Halifax international airport, such as the direction and distance to the DGS.

Authors Response (26.8 km distant at a heading of 012°). Now included in the manuscript

5.P4500, line 4-6: please specify the data sources (also resolution) used in HYSPLIT model. Please briefly explain why 2-day back trajectories were considered more appropriate for the analysis? Will there be any changes to the clusters if using a 1-, 3- or 4-day ensemble back trajectories?

Authors Response Hourly resolutions were used. The source of the data was the Global Data Assimilation System (GDAS) model accessed through the HYSPLIT online model. We also ran 10-day and 5-day trajectories. However, for ensemble plotting

C2639

of the multiple trajectories and for better visualization reasons we just used 2-day trajectories. We checked that the 2-day trajectories were explaining the same upwind source regions and they were. The 1-day trajectories can be seen on the existing plot, so no change there. We've added the resolution and data source to the manuscript.

6.P4507: please specify the analytical uncertainty of measurements that were used in PMF.

Authors Response 20%. Now mentioned in the manuscript.

7.P4507: please add a figure or table to show the source profiles for the 6 factors.

Authors Response A new figure (Figure 8 Source profiles for the seven PMF factors) has been created as requested and contains the 7 factor profiles. I included the sea salt profile for completeness as it clearly shows the Sea Salt chemical components, even though PMF could not apportion the Sea Salt mass.

8.P4510, line 9-17: this part belongs to methodology, not results. It would be more appropriate to be moved to under section 3 models.

Authors Response It has been moved to the methods section

Technical corrections: 1.P4502, line 13: In sentence ". . .found to have a high signal-to noise ratio were down-weighted. . .", high should be changed to low.

Authors Response This section has now been removed for the sake of brevity, so this change is no longer relevant.

Please also note the supplement to this comment:

<http://www.atmos-chem-phys-discuss.net/13/C2637/2013/acpd-13-C2637-2013-supplement.pdf>

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 4491, 2013.

C2640

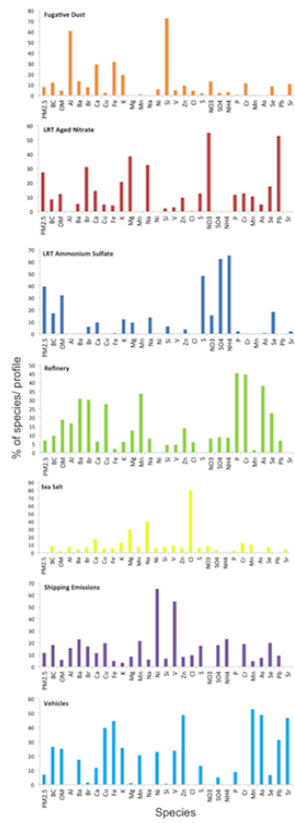


Fig. 1.

C2641