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***Interactive comment on* “On measurements of aerosol–gas composition of the atmosphere during two expeditions in 2013 along Northern Sea Route” by S. M. Sakerin et al.**

Anonymous Referee #2

Received and published: 22 July 2015

The manuscript Sakerin et al. reports results of physical and chemical aerosol observations during two summer cruise campaigns in water basins of the Arctic and Far East seas. The observations provide a valuable insight into aerosol properties in two poorly observed regions of the world. The AOD observations are especially interesting as they provide a measure of summer background Arctic AOD across a large area of the Russian Arctic in the absence of fire and volcanic influences. The manuscript is mostly well written, however some sections require improvement. I recommend the manuscript for publication in Atmospheric Chemistry and Physics once the following corrections have been addressed.

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Corrections

Interpretation of the results in the context of previous studies is required in sections 5 and 6. What do the authors conclude are the sources of the aerosol enrichment in section 5.1? The enrichment factors should be discussed in context of previous work in this region or in the context of observations in other regions. What new scientific insights have been gained from the results presented in sections 5 and 6.

The introduction is at times confusing and should be re-written. It is not suitable for publication in its current form. Paragraph 2 is not clear.

Section 4.1 Paragraph 11. How do your results compare with BC observations in summer at Ny-Alesund (Eleftheriadis et al., 2009), Barrow and Kevo (Dutkiewicz et al., 2014)? It would be interesting to compare the BC in the outflow from the Kola Peninsula and with BC observations at Kevo in Finland. The BC observations in this study are unique; please provide an improved discussion of how they compare with other BC observations in the Arctic summer.

Section 4.3 Paragraph 11. The last sentence of this paragraph requires further discussion. Please address the following points.

- 1) Is this result specific to the time-period of the observations? In summer removal processes in Northern Hemisphere mid-latitudes are more efficient than in winter.
- 2) Is this result specific to the surface? Pollution sources from the hot continental landmass at lower latitudes are lifted on potential temperature surfaces. This might explain why the observations do not show any increase in the outflow. Do the AOD observations support the author's conclusion in the last sentence?
- 3) The observations took place during a time of low fire emissions. Does this statement hold if fire emissions had been large during this time?

Minor comments

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Section 1 Paragraph 1. Define what you mean by “beginning development of the Arctic basin”.

Section 1 Paragraph 3. Re-phrase “own aerosol”. Do you mean that local aerosol sources are small?

Section 1 Paragraph 4. Why the focus on methane emissions here? It doesn't seem to be relevant to the paper?

Section 3.1 Paragraph 7. Why is the strongest difference in fine AOD noteworthy?

Section 4.1 Paragraph 3. Why were the highest values observed near the Kola Peninsula?

Section 4.1 Paragraph 3. To me it looks like the enhancement was a factor of 3 (60/20) and not 6?

Section 4.1 Paragraph 6. Do you mean “fraction” rather than “content”?

Section 4.1 Paragraph 7. The Kola Peninsula is not labelled on fig 5. Remind the reader which line you are referring to.

Section 4.1 Paragraph 8. Why are low temperatures important? It is the ice-covered surface that matters for the local aerosol source.

Section 4.1 Paragraph 11. Why are the values so high in the Kopeikin et al. [2010] study? 1998 was a huge year for fires throughout northern hemisphere boreal region's.

Section 4.2 Paragraph 10. Could you make a second analysis where you remove observations above a threshold wind-speed value to remove the local influence of wind speed? Maybe add a second line to Fig 8 to show this.

Section 4.3 Paragraph 2 (page line 10). Remind the reader which panels you are referring to.

Section 4.3 Paragraph 5. Have previous authors developed such models? How does

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your estimate compare to those estimates? Why is your estimate different?

Section 5.1 Paragraph 9. What do conclude are the sources of the observed aerosol enrichment? High K enrichment and low nss-so4 would suggest fires to me. Please provide an interpretation of your results.

Section 5.2 Please provide an interpretation of your results.

Section 5.4 Paragraph 3. The order of magnitude comment is true for ions but not for GI. GI is more like a factor of 2.5-4 lower. Are the studies that you compare to also during the summer?

Section 5.4 Paragraph 4. How do your results compare with previous work? Put your observations in the context of other regions?

Section 6.1 Paragraph 5. Why was the SO₄²⁻ enrichment smaller over Sea of Japan than the Bering Seas?

Section 6.2 Paragraph 6. Put these results in context of other regions? Are these enrichments particularly high or low?

Section 6.4 Paragraph 4. Provide some interpretation of the results?

Spellcheck the document

Figure 3. Make these panels line up and increase font sizes

Figure 13. "Latitudinal" is spelled incorrectly.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 16775, 2015.

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