

Interactive comment on “Circumpolar measurements of speciated mercury, ozone and carbon monoxide in the boundary layer of the Arctic Ocean” by J. Sommar et al.

Anonymous Referee #1

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The paper presents valuable measurements of gaseous mercury (Hgo), reactive gaseous mercury (RGM), particulate mercury (PHg), CO and O₃ in the marine boundary layer of the Arctic Ocean during a cruise in summer of 2005. The data are unique because they cover a large part of the Arctic Ocean for which data from only a few land based stations are available. The analysis of the data is comprehensive, apart from a few suggestions listed below. The paper is clearly written, although, it would profit at times from editing by a native English speaker. Therefore, I recommend the publication of the paper with minor modification suggested below:

Factual remarks:

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Page 20916, line 17: In fact the maximum Hg concentrations in the Southern Hemisphere reported by Slemr et al. (2008) occur in austral summer, not austral winter. Please correct.

Page 20916, line 21: The sweeping statement about ozone maximum in summer might be true for continental boundary layer and northern midlatitudes. However, in remote marine boundary with low NO_x concentrations ozone is photochemically destroyed, which might compensate for the summer maximum of the advected ozone. The statement should be confined to what is being reported for the Arctic stations which sample marine boundary layer.

In the section “Data Analysis” the authors mention the investigation of the 10 min averaged data for abnormally high and low concentrations. Thereafter, they are discussing only the high concentrations, mostly of CO, caused by the ship exhausts. But no specifications are being made in respect to “abnormally low” concentrations. Were there any “abnormally low” mercury concentrations screened out of the data, and if so what criteria were used for it? In view of the summer Antarctic mercury depletion episode described by Temme et al. (Environ. Sci. Technol. 37, 22-31, 2003) and depletion episodes in marine boundary layer reported recently by Brunke et al. (ACPD 9, 20979-21009, 2009) there might be nothing like “abnormally low” mercury concentrations, at least not in the marine boundary layer. Therefore, no “abnormally low” mercury concentrations should be deleted out of the data set.

In the section 3.1.2 the authors report the occurrence of the pollution plumes with elevated Hg and CO concentrations near to the Chukchi Peninsula. What was the Hg/CO (emission) ratio in these plumes? In this paragraph the authors also refer to Sect. 5 which does not exist.

In the section 3.2 the authors mention a diurnal variation of TGM concentrations during the crossing of the North Atlantic and they refer to Fig. 1, which does not provide any information about its timing, and to Fig. 2 with such a highly compressed time

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scale, that the timing of the maxima and minima cannot be found out either. An additional figure for this section of the cruise with an expanded time scale could solve this problem.

In the last paragraph of section 3.2.1 the authors conclude that the observed low RGM and PHg concentrations suggest “that the Arctic Ocean MBL during summer does not promote significant chemical conversion of Hg₀ . . .”. At the end of the same paragraph they mention the increased removal of RGM and PHg by frequently occurring fog and high relative humidity. In the latter case only a rapid chemical conversion would be able to sustain the observed RGM and PHg concentrations, which is at odds with the initial statement. Perhaps some insight could be gained from the statistics of the RGM and PHg concentrations binned according to the fog and fog-free episodes.

Page 20916, line 21: The sweeping statement about ozone maximum in summer might be true for continental boundary layer and northern midlatitudes. However, in remote marine boundary with low NO_x concentrations ozone is photochemically destroyed, which might compensate for the summer maximum of the advected ozone. The statement should be confined to what is being reported for the Arctic stations which sample marine boundary layer.

Editorial remarks:

As already mentioned, the paper would substantially profit from editing by a native English speaker. The following suggestions represent only a few examples where a more precise and pertinent wording could improve the readability:

Page 20916, line 26: In view of our limited knowledge about the origin of high levels of neurotoxic mercury in the Arctic ecosystems the wording “It has been elucidated” is too presumptuous.

Page 20917, line 15: The sentence starting with “We. . .” is neither grammatically correct nor understandable. “eligible candidate” - for what?

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Page 20918, line 22: The cleaning of the cartridges can regenerate them, but it cannot prevent their deactivation.

Page 20921, line 18: A reference to a refinery processing might improve the readability of the sentence starting with “Mercury in crude oil.”

Page 20926, line 3: When reading the sentence starting with “However, concerning the corresponding DGM data. . .” the reader tries vainly to find the DGM data in Table 3.

Table 3: As medians provide additional information about the distribution of the data, they should be added to this table. The authors should keep in mind that the statistical tests for difference of averages assume the normal distribution of the data. Added medians can help to justify the application of such tests.

Fig. 3: For convenience of the readers the figure should contain the TGM/Hgo concentrations as well.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 20913, 2009.

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