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Atmospheric Measurement Techniques Discussions

Interactive comment on "Physical and chemical characterisation of PM emissions from two ships operating in European Emission Control Areas" *by* J. Moldanová et al.

Anonymous Referee #1

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My general impression of the article is very good and suitable for publication in Atmospheric Measurement Techniques. The article is long and detailed but does not contain unnecessary information. I have read this article as a potential user of the results of this study and the results are indeed very useful for compiling emission inventories for instance. I do have some remarks on specific sections and furthermore some general remarks and comments. I will start with the section-specific comments and conclude with some general remarks.

Pg 3933, lines 24-25: Consider rephrasing to "no large differences between HFO and MGO fuels were found"

Pg 3934, line 1: Consider adding "(0.1% FSC)" after MGO

Pg 3938, line 17 – pg 3939 line 12: Users of the PM and PN measurement results will need to know if the followed sampling procedure (e.g. dilution rates used) yields samples that are representative for a stabilized plume. Some commenting on Table 1 in this sense would therefore be welcome.

Pg 3946, lines 25-26: Do you expect that all PM-bound sulphates and sulphuric acid aerosols formed in the early stages of the plume aging are captured in the sampling procedure?

Pg 3948, Figure 3: Consider deleting the "Total" bars; Comparing the S1..-full and S1..-low results suggests that S1..-low has had more time to coagulate (resulting in more accumulation mode, less nucleation mode). Could that be an explanation for the difference?

Pg 3949, Figure 4 shows a very important result of this study in my opinion. The figure suggests that the majority of the total particle count for HFO is of size around 10 nm, so very small (and also close to the lower boundary for detection). This somewhat different from other observations that report little contribution from nanoparticles. I do miss an interpretation and discussion of this figure (perhaps in relation to sampling conditions or plume aging?). Please be aware that an emission factor of 1e17 #/kg fuel is fairly high; line 16: Is 300 degrees Celsius enough to evaporate all sulphuric acid? lines 14-22: Is it possible to mention the FSCs and engine types investigated by other authors? lines 22-24: This discussion is also rather brief. The interpretation of the results for PN would be greatly facilitated if you could elaborate a bit on how the used dilution rate and sampling temperature might differ from earlier studies and what effect this might have. But I realize that this might be difficult at this stage.

Pg 3954, lines 26-29: Please mention that you are discussing <u>number</u> size distributions.

Pg 3956, lines 6-7: Please consider mentioning the term “fuel cenospheres” in reference the large spherical particles observed.

Pg 3960, lines 19-21: In reference to the difference in EC and BC emissions: Could a reflecting OC coating have been formed around the EC particles?

For a general remark I would like to readdress the issue of cooling and diluting in the online PN sampling. If I consider the observed low volatility for PN (with apparently little sulphuric acid?), the dominance of extremely fine particles in the PSD (with probably a strong on-going coagulation and heterogeneous condensation during sampling?), the low conversion of fuel-contained sulphur to SO4 (which is generally about 5% in other studies), one might reason that the sampling took place at a rather early stage. Other researchers might have allowed the exhaust gas particles more time to condense and coagulate, or have sampled the actual aged plume, resulting in a more stable PSD, larger particles, a higher volatility and a higher conversion of fuel sulphur. The investigated engines are relatively small and all 4-stroke and differ from the larger typical slow speed 2-stroke “work horse” ship engines in the sense that exhaust gasses have a lot less time to convert, and this might influence the results in a similar direction as well. Some discussion on this matter would be very helpful when interpreting the results of this study. But I do realize that this might be outside the scope of this article.

Interactive comment on Atmos. Meas. Tech. Discuss., 6, 3931, 2013.