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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.

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We would like to thank the anonymous referee #1 for a thorough review and the constructive comments to the manuscript. The answers to the comments come here below in chronological order, the pages and line numbers refer to the AMTD paper:

1. P. 3934: The sulphur content was added to the abstract at place where MGO is mentioned 2. P. 3938, l. 17 – 3939, l. 12: The initial plume dilution rate corresponding to the plume age of $\sim$ 1s is typically 10-40 (von Glasow et al., 2003; Chosson et al., 2008). During this the plume temperature drops to temperature close to the ambient

one. The primary dilution rates and temperatures reached after the dilution are thus realistic for the ambient conditions.

3. P 3946, l.25-25: We can expect that some part of the sulphate and H2SO4 is not captured by our instruments. However, we do not expect to capture less than 10% which would be needed to explain the S deficiency.

4. P. 3948: We would expect that most of the condensation takes place first after the exhaust dilution in the dilutor and the sampling line. This has been shown in our earlier study (Moldanová et al., 2009). The time for condensation growth would then be mostly the same under both engine load conditions. We would rather speculate that higher amounts of sulphate formed at high engine load (Figure 6) could result in nucleation of large number of volatile particles while a lower sulphate formation at low engine load led to less nucleation and the condensable material in the exhaust could instead contribute to the growth of the ultrafine particles into the accumulation mode, which is higher in the low engine load exhaust. This would mean that the increase in accumulation-mode particles is not a result of higher soot formation at low engine load conditions, something what is actually supported by results of the EC analysis (Figure 7).The total bars in Figure 3 were deleted.

5. P. 2949, dominance of particles in range $\sim$10 nm. Size 10 nm is well above the detection limit of the EEPS instrument. Similar shape of size distribution can be observed e.g. in Petzold et al. (2011), especially for their measurements at low loads and by Jonsson et al on a 4-stroke MSD engine (personal communication). The sampling conditions have a strong influence on observed particle number concentration. This was tested during the campaign and is now discussed in the text. In most of the published studies it is difficult to find accurate data on dilution conditions, especially since the dilution is typically performed in several steps with different temperatures of the dilution air which all have effect on the results.

6. P. 3954, l. 26-29: Size distributions were changed to number size distributions.

7. The exhaust was in all cases sampled relatively close to the engine and the low sulphate emissions can be because of the plume is very young. However, this is likely to be also the case in many test bench and some of the on board studies where much higher sulphate to SO2 ratios still were observed (Petzold et al., 2010, Ristimaki et al., 2010). The large effect of the exhaust dilution conditions on observed particle number concentration is recognised, however, when online particle instruments with a need of high dilution are used, both the dilution technique, dilution ratio and temperature change of the sample varies largely between the studies. It is therefore important to compare the on board measurements with measurements in plumes.

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