

## ***Interactive comment on “Airborne emission measurements of SO<sub>2</sub>, NO<sub>x</sub> and particles from individual ships using sniffer technique” by J. Beecken et al.***

**J. Duyzer (Referee)**

jan.duyzer@tno.nl

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Airborne Emission Measurements of SO<sub>2</sub>, NO<sub>x</sub> and 1 Particles from Individual Ships using Sniffer Technique J. Beecken<sup>1</sup>, J. Mellqvist<sup>1</sup>, K. Salo<sup>1</sup>, J. Ekholm<sup>1</sup> and J.-P. Jalkanen<sup>2</sup>

General comments The paper by Beecken et al. (2013, AMT 187) is of sufficient quality and it should be published. - The paper reads well and the structure is quite clear and helpful - There are really interesting results here - Not much attention is paid to “ground truth”. If you look at literature there is a claim that 14% of S is not emitted as SO<sub>2</sub>. As

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far as I know this is only one result. Perhaps the uncertainty is larger because of other, unknown, processes in the plume or even in the stack. I know it is difficult but how confident can we be if this 14 % pops of with no clear explanation. - As far as I can tell the English is ok although there are a few places that need some attention. - The references to other literature are sometimes a bit easy (are in agreement..). We could do with some numbers here. Specific comments Abstract line 15 . The +/- signs read as if these are error bounds. Perhaps the can be describes as range. line 19. I suggest to be less bold and say that the fraction off ships observed complying with the IMO limits has increased. Rather than claiming that the sulphur emission has decreased. This would require a statistical proof that the sample is representative. Paper Perhaps the term submicron is more common than sub micrometer P4 line 5: the term flight modified. If important; please explain. P 4 line 17 The term VMR is not quite common. Perhaps ppb P5 line 8 the monitoring . delete the. P6 line 23 the Steam model P7 line 7 Density of soot is a difficult one. Large particles could be way below 1 etc. Adds to the uncertainty of the PM emission factor. Please caveat. P 8 is the difference in accuracy really significant in view of assumptions etc.

P 8 line 27 etc. I think this is only one reference and we should be careful to use the number of 14%. And it is strange that this would only be true with sniffer measurements. This suggest it is an artefact. Please discuss. P11 line 12. The overall distribution is 18% higher. ....That is a strange way of putting. Please describe as average or median. I also suggest to conclude by saying which fraction of the ships now have a S content according to IMO limits. How does the magnitude of the sample (or in fact both samples ie the old sample) relate to the total number. And is the distribution of ship types representative and comparable with the old sample. Please discuss. P 11 line 24. I don't think instantaneous is meant here. Please check English. Short term? P12 line 9 The half width of the distribution. ... That is not a common parameter I think. The mean diameter or geometrical standard deviation. And also looking at the number of bins: how significant is this change? Please show a graph or provide more detail. It is an interesting result showing that coagulation is important. Now it is rather vague.

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P12 line 17. Standard deviations are in the order of their averages. This could be ok and perhaps not so strange for lognormal like distributions. And what is the meaning of this statement? P 12 line 21 the conclusion based on the intercept is a bit fast. Perhaps some explanation P13 and general: PM is often understood as PM10. Perhaps it is better to specify. P12 line 27. Suction hopper dredgers are commercial as well I would think P13 line 12 Please provide some numbers rather than saying "in agreement" P13 line 17 match well with (rather than of) P14 line 30. I can imagine people may consider aircraft costly... Table 5 Why is this not converted into a graph?

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Interactive comment on Atmos. Meas. Tech. Discuss., 6, 10617, 2013.

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