

## ***Interactive comment on “Black carbon from ships: a review of the effects of ship speed, fuel quality and exhaust gas scrubbing” by D. A. Lack and J. J. Corbett***

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Received and published: 23 March 2012

General comments: In the topic of the paper three aspects for ship emitted black carbon is presented. In addition to these three aspects (ship speed, fuel quality and exhaust gas scrubbing) definitions and measurement of black carbon is widely discussed in the paper. Compared to the total length of text in the paper (24 text pages) 5 pages of discussion about methods feels quite a lot. Although maybe relevant for the issue authors should consider referring to other papers focusing purely on the definitions of black carbon and/or measurement methods (e.g. Slowick et al. AST 41,2007 DOI: 10.1080/02786820701197078) to shorten this section. In the references used to eval-

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uate the effect of fuel quality (table 3) on BC emissions, one reference (Petzold et al 2011) represent over 50% of the total number of points. As Petzold et al used only one single cylinder test engine with different fuels a significant bias to real world case can occur. This possibility to bias should be noted in the text. Authors have previously published data which show opposite trend in BC emissions as a function of fuel sulphur (e.g. Lack D., Corbett J.J. et al 2009 “Particulate emissions from commercial shipping: Chemical, physical and optical properties”) and now discard these results in chapter 4.2 by referring to data that is not yet publicly available for evaluation (Buffaloe et al). Author should consider if it is a scientific approach to discard published data based on unpublished data. Further it should be noted that nearly 50% (8/19) of the comparisons in the table 3, are to fuels which are not produced enough to be real alternative to HFO. I suggest that results are re-evaluated while discarding the biogenic fuels from the evaluation as they are not a true alternative to HFO.

Detailed comments: Introduction: As the share of global CO<sub>2</sub> emissions of shipping are mentioned (3.3%), it would be very informative for the reader to also obtain the contribution of shipping to global BC and SO<sub>2</sub> emissions. Further, it would be informative to the reader to get an estimate (e.g. in %) for the most significant BC sources of the BC deposited on the arctic – including shipping. Page 3513 line 7 and 11. Comparing the number of references in the two sentences “Each of these impurities is known...” (1 reference) and “There are some evidence...” (2 references) the phrasing should be vice versa: “There is some evidence that these impurities...(American bureau of shipping)” and “It is known that heavy metals catalyze...(Maricq 2007...)”. Authors should note that there are much more scientific articles reporting enhanced oxidation of soot due to metal additives (e.g. Jung et al Combustion and Flame 142 (2005) 276–288) and several commercial applications of metals catalyzing oxidation of soot exists. E.g. fuel borne catalysts in PSA group automobiles and products manufactured by . Innospec, Technol, SFA international, Conseal international. <http://www.meca.org/galleries/default-file/MECA%20Diesel%20White%20Paper%2012-07-07%20final.pdf> page 21 on fuel

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borne catalysts states “Fuel-borne catalysts are a colloidal dispersion of base metal oxides or organic compounds containing precious or base metal ions such as platinum, cerium or iron and are added to the diesel fuel prior to the combustion process.” and “The direct contact between catalyst particles and soot particles reduces the temperature required for ignition of trapped particulate matter that is collected together on the filter media.”

Chapter 3.1 line 15. “conditions away from stoichiometric combustion”. References supporting this claim should be provided as typically diesel engines operate with excess air conditions ( $\lambda > 1$ ) e.g. away from stoichiometric conditions. Chapter 6.2 line 4 on page 3531: “There is limited evidence that heavy metals catalyze the combustion...” Based on comments above on 3513 this sentence should also be revised.

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Interactive comment on Atmos. Chem. Phys. Discuss., 12, 3509, 2012.