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Atmospheric Chemistry and Physics Discussions

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

Anonymous Referee #2

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GENERAL REMARKS

The review by Lack and Corbett on the current knowledge on black carbon (BC) emissions from ships makes an essential contribution to the actual discussion of climate impacts expected from opening northern waterways for commercial shipping. The authors review the current literature systematically, separating effects of engine load, fuel quality, and BC removal technologies on BC emissions. Measurement methods used during the various field studies are assessed in terms of comparability of reported data. Based on the method assessment and the dependence of BC emissions on various parameters, the authors formulate implications for regulations.

The review includes all relevant literature and gives a unified presentation of experimental data which justifies conclusions on the effects of engine load or cruise speed, respectively, and fuels sulphur content on BC emissions. The presentation of the material is clear and scientifically sound. The manuscript is within the scope of ACP and deserves publication after consideration of minor changes which are discussed in the following.

SPECIFIC COMMENTS

1. Section 2.2: Petzold et al. (2010) showed in their paper that for the performed test rig studies BC_{Filter} and BC_{FSN} are highly correlated while the difference between BC_{Filter} and BC_{TOA} is anti-correlated to the ratio of organic carbon (OC) to BC_{TOA} (named EC in this study). They suggested a potential cross-sensitivity of BC_{TOA} determination to the organic fraction of the carbonaceous aerosol. Erroneously high BC_{TOA} values may be caused by pyrolytic conversion of OC to BC_{TOA} during the thermal analysis step particularly for samples with a high OC fraction of total carbon. This interpretation is supported by a method intercomparison study (Schmid et al., 2001). On the other hand, close agreement is found between BC_{Filter} and BC_{TOA} for an aerosol with low organic content, see e.g. Petzold et al. (2011). This finding offers a potential reason for the observed discrepancy. Furthermore, the authors refer to this explanation in Section 4.1 (page 3526, line 14ff) without giving details in Section 2.2.

2. Section 3.1: Eq. (1) is introduced as calculating fuel consumption per nautical mile of travelling. In its current version this equation reports fuel consumption per hour of operation. Please correct the equations or adjust the text accordingly.

3. Section 3.3: The expression "speed $\propto$ engine load^3" is misleading. I suggest introducing it as "cruising speed proportional to engine load to the power of 3 (speed $\propto$ engine load^3)". This avoids confusion.

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MINOR EDITS

Page 3517, line 15: translated into BC
Page 3520, line 3: some studies show a direct relationship
Page 3521, line 23-24: delete "..."
Page 3523, line 13: combining safe speed/IDN data and the rated speed data
Page 3528, line 9: BC from ship exhaust
Page 3532, line 16: each ship's load distribution

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