Atmos. Chem. Phys. Discuss., 11, C8835–C8838, 2011
www.atmos-chem-phys-discuss.net/11/C8835/2011/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Extension of an assessment model of ship traffic exhaust emissions for particulate matter and carbon monoxide" *by* J.-P. Jalkanen et al.

Anonymous Referee #1

Received and published: 12 September 2011

LS, Please note that this review replaces my original review of ACPD-2011-471 submitted on 9/9/2011

Review acp-2011-471 Extension of an assessment model of ship traffic exhaust emissions for particulate matter and carbon monoxide J.-P. Jalkanen, L. Johansson, J. Kukkonen, A. Brink, J. Kalli, and T. Stipa

This paper describes an "upgrade" (STEAM2) of a previously published model STEAM by the same authors. Although it is apparent that for example the treatment of auxiliary engines is substantially better in STEAM2, the paper seems to loose itself in many detailed calculations but more complex is also less transparent and not by definition

better. The main criticism of this reviewer is that section 3.4 and 4 do not tackle this issue. Clearly the authors have good data for the Baltic sea. I would like to see a simple comparison table of Baltic sea emissions of NOX, SO2, PM, EC (if available) for EMEP total (can be effortlessly downloaded from www.CEIP.at); STEAM and the new STEAM 2. Are there significant variations and do these go beyond the uncertainty bounds resulting from the lack of exact fuel S contents? And if so why? are such changes explainable by the improvements of the STEAM2 model? There is no argument that AIS data allow better allocation of the ship routes but that is in a way independent of the STEAM2 model. In my mind these are the final and real interesting comparisons the paper should come to in the end to make it interesting for ACPD. Otherwise it is not about Atmospheric chemistry and physics but about model development for shipping alone – than I would recommend a more technical modeling journal. If the authors like they could split the Baltic in sections to highlight the geographical resolution compared to the previous model but for comparison reasons it is necessary to give also the value of the total Baltic Sea.

various detailed comments

Abstract L3 & p22132 L2; “a few meters” – I assume this should be a few tens of meters.. just the uncertainty of exactly where the transponder is on such a large ship will cause such an inaccuracy. Not that this matters for the usefulness of the method.

Introduction fist 2 sentences (“ top to down” etc.) is a confusing paragraph. Basically any calculation using activity data will be a bottom-up method but the scale on which it is accurate may differ widely. It may not tell you anything about the location of the emissions. These emissions are than e.g. down-scaled through a distribution over a ship route map but we have little idea if this distribution is realistic or biased. In general the introduction should be reorganized, the points presented are valid but the order in which they appear is jumping from one to another and back again. It starts with methods, than jumps to scarcity of PM data, not mentioning other pollutants which appear only a page later.

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p22132 L21-22 – OK but is this multi-engine set-up known for each ship?

p 22133 L5 the citation in this sentence is a bit strange, probably the sentence needs to be adjusted. Hulskotte 2010 and Cooper 2003 exactly determine the port emissions. So, the sentence could be something like: Although in port emissions have been determined before (H 2010; C 2003), these have been neglected in many previous etc. etc.

L12-16. Yes this is correct. But is it (one of) the main uncertainty? If we not even have accurate PM emissions should the distinction between BC and EC be the major cause of concern? Do you expect variations in engine load where in absolute terms BC will increase and EC will decrease? Both are strongly correlated – so given all the uncertainties I wonder if this is a crucial distinction at present or should be a "next step".

p22134 L17 : So, does HIS provide the previously mentioned multi-engine setups?

p22136 L 12: Indeed using the avg speed is not very accurate but can you indicate on which geographical scale level such deviations are significant? On the other hand it can be argued that the inertia of large ships is causing a certain time lag in actual speed versus power. In ship trial procedures minimal run lengths are between 2 and 3 nautical miles. Such distances are required in order to get accurate results for power-speed relations at constant speed. When speeds are changing larger distances will have to be considered since there is a time lag between power and speed depending on acceleration or deceleration. So on which scale levels the output of the STEAM and STEAM2 can be considered as accurate between certain boundaries?

p22144 & Fig. 3. Especially the relationship between EC and OC emission is not so easy to follow and check. The scale in fig 3. is good for looking at the SO4 but the line suggests that OC is decreasing with S content of the fuel while EC is increasing? Is that correct? if so any idea why?– maybe Fig3 should have a 2nd Y axis to show the OC and EC properly? From literature (Lack et al.,2009) it is suggested that S-content

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and EF-OC are strongly correlated which can easily be understood because cylinder feed lubricant oil is dosed in order to neutralize fuel-related acidity. Lubricant oil may be the most important source of OC. The relationships derived in STEAM2 seems to neglect such relationship?

Moreover, it is clear that you have to make a choice but in the literature quite some variation can be found in OC contents EC to S content – so somewhere the range has to be discussed. These 3 digits behind the decimal point suggest a very high accuracy and it is doubted if that is entirely correct. Furthermore the exact S% is often not known. . .it is know that it is less than x % (the max allowable limit value) but exactly how much can vary from ship to ship and this is unknown. This should come back in the discussion on p 22148 section 3.3. – it is good and correct that you compare with studies with exact known S% but it should be made explicit that in the next step (real world) you will not know this and replace it again by average values. . . what ranges does that create? relevant; irrelevant?

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 22129, 2011.