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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Fossil and non-fossil sources of organic carbon (OC) and elemental carbon (EC) in Göteborg, Sweden" *by* S. Szidat et al.

S. Szidat et al.

Received and published: 2 December 2008

Comment 3/01: The paper also discusses error ranges, which are considerable. Unfortunately, the graphical presentation that the authors have chosen in figure 3 (additive bar) and 5 (pie chart) does not allow indicating those error ranges. I suggest using a format (e.g. single bars for individual fractions) that allows indicating the error bars.

Reply to comment 3/01: The uncertainty ranges of the final results are presented in detail in Tab. 6. As a consequence, they were omitted in Fig. 6 in order to present a clear overall picture of the results and provide a simple comparison with the Zurich data. Such a clear figure is by far not possible using single bars for individual fractions. Therefore, we cannot abandon the pie chart diagram. In order to meet the request of

the referee, however, single bar plots of the three campaign averages will be presented in addition to the already existing pie charts.

Comment 3/02: It would be useful to include a brief classification of typical WINSOC/WSOC compounds in the introduction, and then maybe refer to this at times in the discussion of results, like done only once in the manuscript on page 20, end of first paragraph.

Reply to comment 3/02: Typical compounds will be compiled in the introduction according to Pöschl, 2005.

Comment 3/03: Wood burning also emits SOA precursors, therefore the estimate of OCwood via OC/EC ratios (or levoglucosan/EC ratios) determined directly at the source might be somewhat skewed. It is possible that the contribution of SOA from biomass burning is negligible, but this issue should be mentioned and if possible a crude estimate should be given. A new paper in ACPD (Grieshop et al., Atmos. Chem. Phys. Discuss. 8, 15699 - 15737, 2008) finds that photochemical oxidation of biomass smoke produces substantial new OA in the matter of a few hours.

Reply to comment 3/03: The possible influence of SOA from wood burning (SOAwood) on OCwood and OCbio will be addressed in section 4.1. Nevertheless, the presence of OCbio remains significant for winter, as the upper estimate for SOAwood formation from Grieshop et al. (2008) (i.e. 100% of POAwood) is too high for the ambient conditions in our work, which appears to be maximum 60%. Furthermore, results of the last winter sample from Femman clearly indicate the occurrence biogenic SOA, as already was discussed in section 4.2 and explicitly recognized by Referee #2.

Comment 3/04: Wittmark et al., 2005 found that bioaerosols partially combust at temperatures comparable to or even higher than EC. This might be have an influence on f_M(EC), especially for the PM10 measurements.

Reply to comment 3/04: The possible influence on f_M(EC) will be addressed in section

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2.2 as follows. Wittmaack (2005) observed that bioaerosols may remain partially on the filter after pre-heating in air. This implies that the EC fraction in aerosol matter larger than PM1 may be overestimated due to these coarse WINSOC residues causing elevated f_M(EC) values. Due to the seasonal distribution of bioaerosols (Wittmaack, 2005), this artifact should be more important for summer than for winter.

Comment 3/05: Szidat et al., (2006) also separately analyze the water soluble EC fraction, which is likely polymerizable water soluble OC, and has a relatively high modern carbon fraction. This is not doe here. What impact could this have on the estimation of wood burning EC?

Reply to comment 3/05: Szidat et al. (2004a) (and not Szidat et al., 2006) describes the development of the technique of EC isolation for ^{14}C analysis. An important step towards this goal was the application of water extraction before the thermal treatment (see also our reply to Referee #1, Atmos. Chem. Phys. Discuss., 8, S7525-S7530, 2008). This step explicitly removes the polymerizable water-soluble OC fraction, which is mainly responsible for the charring artifact. We applied the procedure described in Szidat et al. (2004a) to the present work with the one exception that ^{14}C analyses were not done for the polymerizable water-soluble OC fraction, which is not necessary to gain further knowledge on wood-burning EC.

Comment 3/06: Abstract, last sentence: As long as it is not specified what those insights are, this sentence is better omitted.

Reply to comment 3/06: The sentence will be removed.

Comment 3/07: Page 3, line3-4: This sentence is not clear - the particulate character of the effects?

Reply to comment 3/07: See reply to Referee #2.

Comment 3/08: Page 3, line 5-9: These sentences do not necessarily describe the most important characteristics and effects of OC and EC and seem therefore a bit

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arbitrary. Moreover, "On the other hand" (line 7) suggests that OC does not have much impact on human health, whereas it is known to contain many toxins, allergens etc.

Reply to comment 3/08: To our opinion, the most important characteristics and effects are described shortly. The second sentence will be rephrased in order to omit the suggestion that OC may not have much impact on human health.

Comment 3/09: Page 3, line 9-13: These statements are essentially repeated in the next paragraph.

Reply to comment 3/09: This sentence will be removed and the following descriptions will be adapted accordingly in order to present a straightforward introduction.

Comment 3/10: Page 7, line 4-6: Do you have any indication that fine particles actually dominated during the measurement period, e.g., typical size distributions for this area etc.

Reply to comment 3/10: On the average, normalized PM2.5/PM10 ratios for Femman were 0.80 and 0.96 for TC and EC, respectively.

Comment 3/11: Page 7, line 20: was this preheating done in O_2 or air?

Reply to comment 3/11: It was done in air.

Comment 3/12: Page 8, line 3-4: This statement seems in contrast to the previous one (Page 7, line 20) that the pre-heating was done at 390C for 4 hours.

Reply to comment 3/12: The second description (Page 8, line 3-4) refers to the determination of OC and EC concentrations, whereas the first one (Page 7, line 20) represents the separation of EC for ^{14}C measurement. Both techniques differ from each other slightly. The determination of OC and EC concentrations aims at total recovery of both fractions accepting possible (small) impacts from the positive artifact. The separation of EC for ^{14}C measurement pursues mainly the complete isolation of EC from OC accepting certain losses of EC during this treatment (negative artifact). Unfortunately,

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it is not possible to meet both requirements with one method so that the usage of both methods was chosen as compromise. For more details, see our reply to Referee #1 (Atmos. Chem. Phys. Discuss., 8, S7525-S7530, 2008).

Comment 3/13: Page 10, last sentence, what is this "latter portion" referring to?

Reply to comment 3/13: It refers to the distinction of non-fossil WINSOC and WSOC into wood-burning and biogenic emissions. The sentence will be written more precisely.

Comment 3/14: Page 11 line 9: proximity to

Reply to comment 3/14: We will exchange the wrong preposition.

Comment 3/15: Page 14, line 7-8: Might this be an indication that fossil WSOC is largely secondary and therefore more regional in character?

Reply to comment 3/15: We will emphasize this observation as indicated.

Comment 3/16: Page 16, top: Please state explicitly how the state of combustion technology and nature of appliances affect levoglucosan levels.

Reply to comment 3/16: Recent results from Schmidl et al. (2008) will be used to underline that the production of levoglucosan is reduced for increasing burning temperatures.

Comment 3/17: Page 17, bottom: amount to

Reply to comment 3/17: We will insert the missing preposition.

Comment 3/18: Page 18, line 11: Replace "fossil impact" with "contribution of fossil sources" Next sentence: Shouldn't you better refer to Figure 3 here for the absolute levels? This figure indicates that on Feb 21, the ECwood fraction is about twice as high in Råö compared to Göteborg. Also, reword "nearly similar"

Reply to comment 3/18: We will consider this improvement.

Comment 3/19: Page 18, line 15, (Fig 5)

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Reply to comment 3/19: We will consider this rectification.

Comment 3/20: Page 19, line 2: similarities were

Reply to comment 3/20: We will consider this rectification.

Comment 3/21: Page 21, line 21: This statement is slightly misleading, as it seems to suggest that there was little wood burning in the urban environment, whereas later it is stated that EC wood is only slightly higher in the rural than in the urban environment. I guess what the authors mean is that high emissions of fossil EC decrease the relative contribution of biomass burning to EC (or TC?).

Reply to comment 3/21: Based on this referee comment, we now realize that the first statement of the conclusion was generally inaccurate. We will rewrite this section.

Comment 3/22: Figure 3, caption: I guess you mean vertical lines, not horizontal lines.

Reply to comment 3/22: We will consider this rectification.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 16255, 2008.

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