Atmos. Chem. Phys. Discuss.,
doi:10.5194/acp-2016-1005-RC1, 2017


Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "Carbonaceous aerosol source apportionment using the aethalometer model – Evaluation by radiocarbon and levoglucosan analysis at a rural background site in southern Sweden" *by* Johan Martinsson et al.

**Anonymous Referee #1**

Received and published: 19 January 2017

Martinsson et al. present analysis of a year long dataset of carbonaceous aerosols at a rural background site. Long-term source apportionment studies of carbonaceous aerosols are rare, and in addition the authors propose a new modification to the 'aethalometer model' that they suggest can apportion biogenic sources in addition to wood burning and fossil fuel from aethalometer data. However, while the source apportionment results are promising for wood burning and biogenic carbon, there is a clear shortcoming in its ability to apportion carbon from fossil fuel. The authors are upfront with this issue and have tried alternative methods to improve the source apportionment model, but these did not offer any improvements. I would have liked to see more dis-



cussion on why the proposed aethalometer model over-estimated fossil fuel carbon, apart from the blaming the poor correlation between fossil fuel aerosol light absorption and carbon mass concentration. Why do the authors think there was such a poor fit?

Overall, the paper is well written and structured with a wide range of relevant references and I would recommend it for publication after consideration to the comments below.

Comments:

1. Page 11, line 15-20: While I would agree that the in Fig 3d, the BCFF diurnal trend is bimodal like traffic emissions (though with a peak at night?) I am not sure I agree that the diurnal trend in BCFF for winter especially (Fig 3c), is similar to NOx (Fig 3g). The diurnal trends in NOx in winter are more what would be expected for traffic emissions, and are dissimilar to that observed for BCFF. The flat diurnal trend in BCFF for winter instead to me suggests that the model did not apportion the FF fraction correctly.

2. Page 11, line 25: If NOx is being oxidized in transport to the site, then shouldn't the CMFF and NOx show the highest correlation during winter when there is less photochemistry compared to the other seasons? Why is there such a better correlation in spring compared to the other seasons?

3. Page 12, lines 1-3: I find it surprising that the CMwb was better correlated with NOx than CMFF. You explain this by stating that both NOx and CMwb have a seasonal dependence, but why would NOx and CMwb have the same seasonal dependence? Have you examined the correlation between CMwb and NOx to see if there is a change for the seasons?

4. Page 12, line 17. In Fig S6, why there is a very large spike in the concentration of levoglucosan in late March that is not observed in AAE (fig 2)? This sharp spike in levoglucosan suggests a biomass burning event, and I would have thought you would observe a corresponding increase in AAE if wood burning aerosols have a high AAE? Investigating the cause of the spike may help guide the choice of AAE for wood burning

at the site.

5. Section 3.5: did you use annual means for your comparison of the aethalometer and radiocarbon and levoglucosan apportionment? Did you see any changes in agreement between the two methods for the seasons, e.g. was there better agreement in summer or winter?

6. Page13, line 15: In the aethalometer model, to calculate C1 and C2 only winter data was used as it was assumed that there would be negligible CMbio. However, the results from the radiocarbon and levoglucosan model suggest that biogenic carbon was not negligible during winter. I think that you should therefore include some discussion on how the presence of biogenic carbon in winter affected the source apportionment by the aethaolometer model.

7. Page 13, line 31: Why did you fix CMbio to -0.103 ug m-3 and not zero as you expect no CMBIO in winter?

8. Section 3.6: My understanding is that in the proposed aethalometer model, the influence of biogenic carbon needs to be minimized in order to calculate C1 and C2. In addition to only using winter data, could you not also select data for the calculation by wind direction? My reading of this section is that there are geographically distinct areas around the sampling site, and that filtering by wind direction you could further decrease in the biogenic influence (e.g. removing data when the wind is from a forested area or from the NE?) in the data.

9. Page 14, line 19-20: Why would SW air masses have high NOx but not be associated with carbonaceous aerosols, when traffic emissions are a significant source of both?

---

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-1005, 2016.