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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Quantifying black carbon from biomass burning by means of levoglucosan – a one year time series at the Arctic observatory Zeppelin" *by* K. E. Yttri et al.

Anonymous Referee #2

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Review: Quantifying black carbon from biomass burning by means of levoglucosan – a one year time series at the Arctic observatory Zeppelin K. E. Yttri, C. Lund Myhre, S. Eckhardt, M. Fiebig, C. Dye, D. Hirdman, J. Ström, Z. Klimont, and A. Stohl General comments: The manuscript by Yttri et al presents the results of a combined observational and modeled study of biomass burning impact (residential and ag/wildfire) on annual black carbon loadings at an established Arctic research station (Zeppelin). The observational methods include measurement of EC, EBC and levoglucosan on filters collected in 2008-9. Emission ratios of levoglucosan to EC combined with the atmospheric half-life of levoglucosan are used to estimate total EC from biomass burning.

These observational results are then compared to impacts calculated using FLEXPART modeled transport of BC emissions from mid and high latitude source regions. This is a very thorough source apportionment study which is timely and appreciably adds to the current discourse on the biomass vs fossil combustion contribution to Arctic BC. The conclusion that the half life of levoglucosan was longer than predicted using polluted plume conditions is also of high interest. In addition, the confirmation of the high impact of fossil sources to Arctic BC is very timely. There was only 1 major issue that I had with the methods of the paper – 2 field blanks for 73 filters measured by thermal optical analysis is insufficient. In addition there are other minor issues that should be addressed prior to publication. After the authors have addressed these issues, I would highly recommend publication. Specific comments: Abstract: line 10: this is a blanket statement for Europe – would it be better to be more specific? Ie. High density wood burning areas? Ln 14: how long were the elevated episodes? Ln 27-28: this is an overstatement that the model compared relatively well. The following statements just illustrate that the model fell within the large range provided by the ECbb and ECbb*. P31968 ln1: awkward phrase: "highly absorbing species black carbon" P31969 ln 4: need a ref for 20-30% BC P31970 ln 2: should be "confirmation of" Section 2: you need to clarify that the QA for the methods is included in one section – I had questions throughout that were then answered in section 3. P31972 ln 12: are these stable carbon or deuterated standards? Give molecular formula and source of standard. P31973 ln 17: delete obviously P31973 ln 22: give n for residential and wildfire/agricultural emission sources that were averaged to create the emission factors used here. P31973 ln 26-27: delete this sentence Equation 4: what is the r2 for this relationship between σ (sigma) and EC for Zeppelin? P31977 ln 10: I'm not familiar with this schedule – can you explain the 2+2+3? Ln 28: Is this the precision of the standards? The recovery is needed for the levoglucosan analysis during this particular study. P31978 ln10: This is a VERY low n for field blanks. Appropriate QAQC would be field blank analysis for 1 in 10 samples. You cannot get good statistical information from 2 field blanks. The authors really need to go back and analyze a couple more field

blanks to fill out this QAQC. This is a sticking point for the paper, but the importance of field blank analysis cannot be overstated. P31978 ln 24: are these comparison values for Zurich? Please include the city, country. P31983 ln10-15: this discussion becomes difficult to follow. Edit for clarity. P31986 ln 12-14: once the model for estimating half-life is shown to be inaccurate, it would seem to be more appropriate to report a range than to merely adjust the half-life until a "reasonable" percentage is obtained. In this case reasonable just means <100%, there needs to be better justification for choosing 4 days again. Ln 22-23: this sentence is awkward. Ln 28-3 (next page): this sentences need to be clarified and/or saved for the conclusion, as they are repeated later. This is an important clarification, so the authors should take care to word these sentences very clearly and carefully. Please edit. P31987 ln 25-26: add "annual" before Arctic EBC and delete "totally" Ln 27 -3 (next page): this is copied directly from the previous page. It is awkward and also should not be copied directly. Figure 1: need to include labels. At a minimum, the Arctic circle should be labeled. Figure 3: The source regions defined by FLEXPART for the annual sensitivity seems to be very dispersed. What does this tell us? Is FLEXPART not ideal for long-term averaging? Figure 5: the blue ECbb line cannot be seen at all. The figure needs to be adjusted with lighter color for the bars.

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