

Thank you for reviewing this article. We may not see things in the same way but the open discussion it yields has proven valuable.

(1) This manuscript as well as many other papers treats ^{14}C -measurement as something decisive and unquestionable in splitting aerosol carbon between fossil and modern carbon. While this potential generally exists, there are many pitfalls associated with drawing conclusions from its results. First, ^{14}C -measurement in source areas might be biased by the presence of specific ^{14}C -sources (not applicable here as sampling took place at a background site). Second, the broad source categories that can be derived with excessive uncertainties from ^{14}C and other macro tracer measurements are oversimplified for the purpose of meaningful source apportionment. There are many source categories listed for human activities which do not fit into the implications provided by the defined categories. Cooking, frying, tyre wear, biofuel components in fuel, etc. are just a few examples that may be falsely categorized into the simplified concept based on their ^{14}C -signature. When defining the basic aerosol classes and when interpreting the result, this issue should be addressed explicitly in order to avoid misunderstanding.

- (1) The first reason you mention is as you say not applicable for background sites. We are however painfully aware of the risks of hot ^{14}C sources being in a town where several institutions use ^{14}C labeled substances. We have routines and take precaution so these will not affect our measurements.

The sources used were chosen for several reasons, the major being they are the most common sources found. The major part was to determine the fossil and non-fossil contribution to the aerosol mass and also to be able to compare the results with the EMEP model. The EMEP model has also a separation between secondary and primary particles but the compounds used for apportion the primary particles are plenty and has in other studies been found to be a minor part.

Cooking and frying is probably a valid source in urban studies but have not been investigated at Vavihill. Tyre wear can also be valid in urban areas and presumably emit coarse particles which would have a hard time finding its way to our background station. The biofuel is more interesting. The Swedish car fleet however runs on a minor level (>5%) on bio fuels, but with time this source must be considered. Of these examples you mention I have only used biofuel (ethanol) in the MS, because of the urban nature of the other sources. All sources will, as you say, end up in the biogenic fraction. **The nature of OC_{bio} fraction as a combination of biogenic and other non-fossil sources has been explained in the MS (Sect 2.5).**

Finally it must be said that the ^{14}C method is not perfect but as a tracer compound the measurement error and the unambiguity of the source (remembering though the hot sources) and the quantification of the sources it is, to our opinion, by far the best source tracer compound. Its weakness is that it only can divide between fossil and modern carbon. But that part it does well, under the right circumstances. The uncertainties from the measurements are neglectable compared to the emission ratios used by other tracers.

(2) Similarly to earlier studies the representation of semi-volatile OCs has not been improved in the simplified concept of the manuscript. As a rule of thumb, gas phase OC is about 10 times more abundant than particulate OC, thus merely the change of temperature can drive vast amount of OC into the aerosol phase. These adsorbed species are not part of the sampling artifact as they are in equilibrium with the collected particles. They are also not SOA components by definition, since they still are as emitted. This should also affect both the OC_{ff}/EC_{ff} and OC_{bb}/EC_{bb} ratios in different

seasons. Whereas this fact is explicitly acknowledged in the manuscript (Page 13592 Line 29), a single value is used for each throughout the calculations. This results in very large calculated contribution of OC_{bio} in winter. Although the authors elaborate on the possible reasons for such a large contribution in Section 3.4.3, they forget to mention the most likely case that a large part of it should have been simply assigned to OC_{bb} as a result of the increased partitioning of SVOCs at low temperatures. I would suggest that at least two different ratios (OC_{ff}/EC_{ff} and OC_{bb}/EC_{bb}) should be used for the measurement data, one for winter and one for summer. Hopefully such seasonal ratios can be deduced from available literature. Accounting for this effect would significantly improve the reliability of the source apportionment.

- (2) The temperature effect is an important one and is also mentioned in sect. 3.4.2 and in 3.4.3 as well. It is in 3.4.3 this is mostly discussed just because of the biomass burning OC will under these circumstances influence the biogenic portion of OC (p 13591, l 12-21).

OC_{ff}/EC_{ff} ratio is not used in the data evaluation, merely stated that it is not stable over time so we agree with you on that point that a single value is not suitable.

The EC_{bb}/OC_{bb} used is not a single value. As described in sect 2.6 the ratio varies with burning condition, fuel etc. To account for this a range is used for both EC_{bb}/OC_{bb} and levoglucosan/OC_{bb} ratios (table 2). There is however the same ranges for summer and winter. These two ranges could perhaps be improved by dividing them by seasons, however, the data used in this, and several other, studies are based on laboratory studies. A similar idea was considered as the MS was prepared, ambient data for levoglucosan, OC and EC from ambient biomass burning was examined. This is however hard to find. One study is used in the MS (Zdráhal et al., 2002) which is from the dry season in the amazon and the lev/OC was in range of the laboratory studies. The EC_{bb}/OC_{bb} ratio is however lower than almost all the measurement points in the other studies. This was taken into account when the most probable value was determined. A study of winter condition levoglucosan, OC and EC is Yttri et al. (2009) where the levoglucosan/OC_{bb} (if all OC is from biomass burning which is assumed at this local) is 0.07, thus just below the range used. The EC_{bb}/OC_{bb} ratio is 0.27, which is within the range. The lack of any distinction between the two season make the use of season differentiated ratios hazardous and would introduce more unknown uncertainties into the result. **Therefore the use of the same ranges for the two seasons is still used in the revised MS.**

(3) The Introduction of the manuscript is very poorly written: reading it, it gives the false illusion that this is more or less the first study of this kind, which is not true. References are randomly selected: sometimes very basic papers are cited, in the same paragraph a 2010 paper is quoted. (e.g bomb effect – 2010, Suess effect - 1955). There are quite a number of incorrect or at least clumsy statements, (e.g. ‘EC consists of: : graphitelike structures’, ‘EC: : lead to a warmer climate’. It is stated that ‘(the 14C) method is complicated with the: : dilution of atmospheric modern carbon by fossil carbon emitted from combustion of fossil fuels’: this is not a complication, this fact makes possible the use of 14C technique in dating

- (3) It is hard to see your first point. In the introduction it is stated that “These measurements were combined to provide the first full-year source apportionment of the carbonaceous aerosol in Sweden” which is true. Probably the first in northern Europe. However, looking at a wider geographical context, it is not unique. Earlier 9 other papers are cited which have used similar source apportionment method to quantify biomass combustion as well as other sources of carbonaceous particles. The method itself is thus not unique. **To further clarify this, the second sentence of the last paragraph of the introduction has been changed and references**

added.

The reference you are referring to must be Levin and Hesshaimer 2000 (not 2010). It was chosen since it presents data for the whole bomb pulse until almost normal (1850's value) atmospheric $^{14}\text{C}/^{12}\text{C}$ levels were reached. **You are right that it is not ideal and is exchanged with Rafter and Fergusson (1957).** It is the first, to our knowledge, where the bomb pulse is examined but since it was published in 1957 it did not know the full scale of the peak. However you use the plural form of reference indicating that more references are selected at random. It can humbly be said that not all papers covering the area of organic aerosol have been read in the process of this paper. But the references used are selected since they contained valuable information for the article. If you have more suggestions for additional or replaceable references please advise.

Clumsy statements: EC do consist of graphite-like structures, however it is not graphite. We are talking about highly polyaromatic compound (similar to graphite sheets) but with varying degree of impurities and flaws compared to their organized relative, graphite. See e.g. the very nice article by Johannes Schmid (Schmid et al., 2011) where diesel soot had a clear graphite peak in the raman spectra but also a big peak showing the defects in the structure.

EC can, due to its' ability to absorb visible light heat the atmosphere (Menon et al., 2002). **The part regarding the climate alteration has been changed to EC's ability to heat the atmosphere.**

“method is complicated...”: What is meant is the non-constant $F^{14}\text{C}$ value of atmospheric CO_2 . These changes make the “reference values” used for the sources (especially biomass burning and to a minor extent biogenic) uncertain. If the Suess and bomb effect wasn't there all modern sources would have $F^{14}\text{C}$ values very close to 1. **It has been clarified that the complication refers to the atmospheric CO_2 which in turn affect contemporary carbonaceous particle sources.**

Finally, when dating using ^{14}C we do not use mixtures of fossil and modern carbon but the inherent half-life of the radioactive carbon isotope found in the dated material.

References

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