The authors would like to thank the two reviewers for their careful reading of the paper and their helpful comments. They have helped improve the quality and readability of the revised manuscript.

Response to Paul Quincey

Specific comments

The paper addresses four distinct techniques, which can be termed (as in Section 3.2): filter-based light transmission; photoacoustic light absorption; laser induced incandescence; and thermal optical analysis. It would be helpful if these terms were used consistently, and the measured quantity in each case was clearly distinguished, for example using terms such as Filter-based Black Carbon, Photoacoustic Black Carbon, Refractory Black Carbon, and Elemental Carbon respectively, for the soot-like metric. (It is understood that there is no standardized terminology, so these are suggestions.) If the first two techniques are seen as measuring only the light absorption coefficient, not Black Carbon, this needs to be explained – at the moment the Introduction (P2318 1st paragraph) implies that the paper is about measuring "Black Carbon".

> ***Corrected/Modified as suggested. Note that we are now careful to point out that neither the filter-based or photoacoustic techniques are recommended for deriving the mass concentration of BC. These measure optical properties directly and***

Abstract l.17 - It would be helpful if the SP2 instrument was described as a laser induced incandescence instrument.

> ***Modified as suggested***

P2320 l.27 – the scope should be clarified either in terms of techniques or measured quantities, as above.

> ***We have expanded this section by explicitly describing the techniques and measured quantities that were discussed.***

P2321 Section 2.1.1 – It would be helpful if the light transmission method was described as 2 distinct stages (both of which have their problems): (1) determining the absorption coefficient of the sampled air (with units m-1); and (2) converting this to a BC mass concentration using a mass extinction coefficient (which has units m2.g-1).

> ***As noted above, we specifically avoided the issue of converting an absorption coefficient to a mass concentration.***

It would also be helpful to point out that instruments such as the Aethalometer operate by measuring the small changes in the attenuation through the filter over the measurement period (not the absolute attenuation). This makes it more difficult to have

a simple Reference Material such as a filter with known attenuation, as an RM with stable attenuation does not give a direct test of the instrument's normal operation.

Excellent point that was overlooked in the article. This is now added in the section that discusses reference mat

P2324 Section 2.1.2 – As with 2.1.1, it would be helpful to point out that while PAS is superior to light transmission methods for determining the absorption coefficient, conversion to BC is again a separate matter.

As with the filter-based techniques, we don't discuss the use of the photoacoustic technique to derive BC.

P2326 l.4 – the heading "EC and OC" is being used to include Refractory Black Carbon, which is confusing.

This has been modified to include rBC.

Technical corrections

P2318 l.13 – replace "the whole of particles" with "whole particles".

Replaced with "The whole range of particles"

P2320 l.22 – italics are used both for controversial statements and for the Recommendations. This is confusing (unless all the Recommendations are controversial).

Controversial statements are now place in quotations.

P2324 l.8 – replace 2.12 with 2.1.2

Done

P2325 l.24 – replace Virkula with Virkkula

Done

P2328 l.20 – replace "only" with "even"

Done

P2331 l.17 – replace PyC with PC.

Done

P2333 l.8 – add “, previously the National Bureau of Standards,” after (NIST)

Done

P2335 l22 - Insert (4) before “cloud”

Done

P2337 l.7 – replace “don” with “do”

Done

P2345 l.15 – Replace “Fig. 1” with “Fig. 2”

Done

Response to Anonymous Referee #2

The MS summarizes discussions during a workshop and therefore is not a typical scientific paper. It is listed as “review” paper, but due to its origin it is not a typical review, either. I strongly recommend to expand the review aspects on the one hand by careful referencing, and to clearly differentiate between review and recommendations on the other.

> **The reviewer makes a valid point and we think that given that the title clearly states that this article contains recommendations, this aspect has been already sufficiently differentiated as recommended. The numbers of references are not uniform, as the reviewer has commented, particularly with respect to the photoacoustic and the TOA sections. These have been expanded and we will leave it to the reviewer to decide if we have adequately evened out the references in the various sections and addressed his/her concern.**

The recommendation in section 4.1.2 (the manufacturer of the SP2 instrument should provide well characterized fullerene soot to SP2 users; manufacturer should keep a database of results from instrument intercomparison studies) go far beyond the reach of both a review and a scientific paper.

> ***This recommendation has been changed to say that a centralized source is needed, without singling out the manufacturer, although this would be an obvious choice.***

The main weakness of some sections of the MS is the partial lack of references in the text. Some sections certainly have adequate references but others do not.

> **This has been rectified.**

Figure 1 seems to be new material, as no reference is given on p 2324. Near the end of the MS (p 2345) the text indicates that Figure 1 originates from Subramanian et al. 2006.

> **This is a typo. Figure 2 originates from Subramanian, 2006. Figure 1 is new material.**

Throughout the discussion of problems of the OC/EC split in thermal methods, valid points are summarized but without proper referencing. Many of the arguments can be found in earlier papers, e.g. the excellent discussion of the issues concerning thermal protocols one by Cavalli et al. 2010 (referenced in this MS), where proper references are given.

> **Yes, this has been rectified with many more explicit references**

The use of italics is confusing. In the introduction, the text states that “sections written in italics indicate material that might not reflect 100% agreement of the participants”. This is strange in itself – why include things that not all co-authors can agree to? Or do the co-authors agree, but not the workshop participants? These text sections should either be completely removed or reworded as open questions. This is even more important as the recommendations are also given in italics. Does this mean that not all co-authors agree to the recommendations?

In the introduction we make the use of quotations more clear (we have changed from italics to help differentiate better). What we say is “A number of issues related to measurement techniques, interpretation of the results, calibration methodology, etc. are under continuing discussion. So that there is no presumption that all of the material presented here meets with the complete acceptance of those who are co-authoring this article, sections that are “written in quotations indicate material that might not reflect 100% agreement of the participants.” While the reviewer considers this odd, it reflects the nature of the problem and helps the reader understand the open issues that still require consensus.

Minor points

p 2324, lines 24/25: “light absorbing particles convert the absorbed photons to heat and raise the temperature of the surrounding environment” should be reworded. Photons cannot really be “converted” to heat – their energy is absorbed and increases the internal energy of the particles, which of course means an increase in particle temperature.

Reworded as recommended.

p 2325, line 1: change “magnitude of this wave” to “amplitude of this wave”

Corrected as recommended

p 2325, line 8: insert “at the ground” between “solar radiance” and “is at its maximum”. The sentence “532 nm, the wavelength where the solar radiance is at its maximum” implies that the maximum of the solar radiance indeed is at 532 nm. Actually the maximum of the extraterrestrial solar radiation is below 500 nm. http://rredc.nrel.gov/solar/spectra/am0/

Corrected as recommended

p 2325, line 12: add reference

Reference add (Lewis et al., 2008)

p 2327, line 2: add reference and specific materials used

Reference add (Schwarz et al., 2006)

p 2327, second and fourth calibration issues: there seems to be a contradiction between these two issues?

The fourth calibration issue has been removed as it is somewhat redundant since calibration issue number two already covers this point with an example. There can be up to a factor of two between different calibration materials but this has been largely resolved through mutual agreement of the SP2 users community

p 2328, line 11, reference to book by Seager and Slabaugh: page numbers would be helpful in references to books

This reference has been replaced with Seinfeld and Pandis, 1998 and page numbers added.

p 2329, line 6: add reference for the enthalpies of sublimation

These are now referenced

p 2329, line 17 ff: give reference for the semi-continuous Sunset Analyzer

This is now referenced

p 2330, line 19: the Sunset lab instruments always inject a calibration amount of CH4 at the end of each analysis cycle

This information has now been added.

p 2331, paragraph starting line 12: add references discussing the effect of removal of WSOC by washing procedures

This is now referenced (Piazzalunga et al., 2011)

p 2332, lines 20/21: “a single RM cannot be used for both calibration and validation of results in the same measurement procedure”: please give reason

The new text now reads “The uses of RM may include the calibration of a measurement system, assessment of a measurement procedure, assigning values to other materials, and quality control; however, a single RM should not be used for both calibration and validation of results in the same measurement procedure. Calibration RMs, for example, are typically used to establish scaling constants and determine the linearity of the various components of a measurement system whereas validation RMs are needed

to test the complete measurement system, preferably with material that represents the natural environment."

p 2335, line 14. "used to exercise a sensor in an instrument": please clarify what is meant by "exercise"

This is common terminology synonymous with "Test" or "work out".

p 2337, line 5: "significant variability, compared to the photoacoustic reference materials": please quantify

Added "up to 30%"

p 2337, Boulder Light Absorbing Carbon experiment: please provide reference, or, if this is not yet available, at least names and contact info of PIs

Added names of the PIs and emails.

p 2339, line 25: change "Kirschstetter" to "Kirchstetter"

Corrected

p 2340, line 1: add reference for the CAST soot generator

Added link to the web site

p 2340, line 9: add reference to the Palas GFG spark discharge aerosol generator

Added Roth et al., 2004

p 2349, paragraph starting line 14: has this "tailored material" been tested? If yes, add reference. If no, please declare that is has not.

Yes and this is discussed in the reference already provided, i.e. Popovicheva et al., 2011)

p 2350, line 2: "the tailored soot : : : can be placed directly in the oven of a TOA instrument, on a clean quartz substrate, thereby avoiding issues associated with contaminated filters" – how can this be done so that a transmission (or reflection) measurement is still possible?

The quartz "boat" is transparent, allowing the laser to transmit through the sample or to reflect from the sample in the same manner it would if the sample was on a filter punch.

p 2343, line 24, figure 5: this figure seems to have been taken from Laborde et al. 2012a - has permission been obtained for reproduction?

These permissions have been requested (for Fig. 2 also).

p 2346, last par: the discussion of the influence of carbonate carbon comes quite late in the MS, and should not be relegated to a recommendation section. Jankowski et al. 2008 not only mention CC interference, they provide a method to quantify CC. The MS states here that the question of CC has not been assessed.

Agreed. This whole paragraph has been moved into section 2 where the TOA technique is discussed.

p 2347, last par: give references also here for the “community of SP2 users” and the “similar group who use filter based instruments”

References have been added.

p 2348, lines 4ff: “strong need for a working group” – there is already a working group located at CEN

Text now reads “There is a strong need for a working group to be formed, similar to the group within CEN, that will bring these researchers together to select or develop the SRMs that will help resolve these problems.”

text: check spelling of “Virkkula” – there are several versions of this name

Corrected