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Atmospheric Measurement Techniques Discussions

Interactive comment on "Characterizing black carbon in rain and ice cores using coupled tangential flow filtration and transmission electron microscopy" *by* A. Ellis et al.

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Response to:

Interactive comment on "Characterizing black carbon in rain and ice cores using coupled tangential flow filtration and transmission electron microscopy" by A. Ellis et al. K. Pohl (Referee)

We thank the referee for their constructive comments.

Referee comments are bolded, and the authors' response is below.

1. **GC-1: With both an approximated black carbon concentration and ice core age, can a general deposition of BC onto the ice be estimated? This may not be in the scope of this work, and the authors did stress that this study was a qualitative first application of the method, but a deposition could provide some useful insight.**

Bisiaux et al. (2012) measured the flux of BC deposition to the same site, Law Dome, East Antarctica using a single particle soot photometer (SP2, Droplet Measurement Technologies, USA). This was referenced briefly in section 3.2, but the following has been added to Section 2.4 for clarity:

"The flux of BC deposition at the same sampling site in Law Dome, East Antarctica has been quantified using an SP2 (Bisiaux et al., 2012)."

2. **GC-2: What affect would BC aging and compaction from the weight of overlying ice have on the size of the BC aggregates characterized? I wonder if the smaller size of the BC aggregates in the ice compared to rain is due to transport and deposition processes, or if it is the results of post-deposition processes within the ice core.**

Post-deposition processes cannot be ruled out, but are unlikely, as volume equivalent diameters measured in Bisiaux et al. (2012) are closely matched to measurements of atmospheric BC in the remote Southern Ocean (Schwarz et al., 2010). The following has been added to Section 3.3 for clarity:

"While post-deposition processes within the glacier cannot be ruled out, volume equivalent diameters of BC particles found in the ice (Bisiaux et al., 2012) are similar to those determined over the remote Southern Ocean by the HIPPO project (Schwarz et al., 2010). Snow densification and ice metamorphosis are more likely to aggregate BC particles into crystal junctions. If this were significant, larger particles would be expected rather than smaller ones. The differences between the BC found in rain and Antarctic ice likely reflect the loss of large aggregates during long-distance transport to

Antarctica."

3. **Page 2061**(assumed to mean 6021)**, line 18-19: how does the selected filter pore size affect (or not affect) the retention of salts and minerals?**

A 50 kD (10 nm) pore size was selected for the hollow fiber filter. Any soluble species or particulates smaller than 10 nm would be removed from the solution during filtration, including dissolved salts. We have clarified this in the manuscript to read:

"50 kD pore size mPES Hollow Fiber Filters (HFF, Spectrum Laboratories, California) with 20 cm2 membrane surface area, gamma irradiated for sterility, were used to concentrate samples. The 50 kD (10 nm) pore size was selected to retain as many particles as possible while minimizing filtration time. Any soluble species or particulates smaller than 10 nm are removed from the solution during filtration, including dissolved salts."

4. **Page 6022, line 24: Which stable isotopes were measured to date this ice core?**

The DSS0506 ice core was dated using the oxygen isotope record (δ18O). We have added this to the manuscript for clarity, which now reads:

"The ice was dated by matching the dissolved ion chemistry and water stable isotope records (δ18O) to the main DSS ice core record to produce a depth age scale for DSS0506."

5. **Page 6024, line 29: What temperature were the drops left to evaporate at?**

The sample was left to dry on the TEM grids at room temperature, 22° C. We have added this to the manuscript for clarity, which now reads:

"The TEM grid was held elevated off the laboratory bench surface by a SPI stainless steel tweezers in the TRACE module clean air hood at room temperature (22° C) while the sample was evaporating down."

6. **Page 6020, line 25: I suggest making the clean water set-up a separate paragraph to make the flow of this section easier to read.**

We agree, and Section 2.1 has been reorganized into three paragraphs.

7. **Page 2061**(assumed to mean 6021)**, line 13: Define/spell out PSL in the header of this section. The acronym is spelled out in the following sentence, which seems out of order.**

Page 6021, line 13, "PSL particles" has been changed to "Polystyrene latex particles" and the acronym is defined in the following sentence.

8. **Page 6022, line 3: When beginning a sentence, spell out acronyms. In this sentence, SEM begins the sentence, but elsewhere acronyms are spelled out if they are at the front of a sentence. This is just for consistency and ease of reading. This is repeated again with BC on page 6027, line 21.**

Both instances have been corrected, and are now spelled out at the beginning of their respective sentences.

9. **Page 6023, line 4-5: This sentence seems to be repeated from above.**

We agree that there is a repeat with page 6023, line 4-5 and page 6022, line 22-23. This sentence has been removed.

10. **Page 6023, line 24: "Difference" should be "different"**

This has been corrected in the revised manuscript.

11. **Page 2042**(assumed to mean 6024)**, line 16: misspelled "elevate"**

This has been corrected in the revised manuscript.

References:

Bisiaux, M. M., Edwards, R., McConnell, J. R., Curran, M. A. J., Van Ommen, T. D., Smith, A. M., Neumann, T. A., Pasteris, D. R., Penner, J. E., and Taylor, K.: Changes in

black carbon deposition to Antarctica from two high-resolution ice core records, 1850–2000 AD, Atmos. Chem. Phys., 12, 4107-4115, 2012. Schwarz, J. P., Spackman, J. R., Gao, R. S., Watts, L. A., Stier, P., Schulz, M., Davis, S. M., Wofsy, S. C., and Fahey, D. W.: Global-scale black carbon profiles observed in the remote atmosphere and compared to models, Geophysical Research Letters, 37, 2010.

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 6015, 2015.