

Interactive comment on “Refractory black carbon mass concentrations in snow and ice: method evaluation and inter-comparison with elemental carbon measurement” by S. Lim et al.

Anonymous Referee #2

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This paper addresses an important topic in atmospheric and climate science. Models and laboratory studies indicate that BC in snow and ice can have a significant impact on snow melt rates and radiative forcing. Field studies aimed at verifying these studies in the natural environment face significant challenges due to extremely high uncertainties in the techniques currently available for direct measurements of BC concentration in snow and ice. The authors present a very detailed discussion of their comparison of BC concentration retrieved from snow samples using a SP2 (Single particle soot photometer) and Sunset Labs EC/OC protocol. As this study focuses on using SP2 to measure BC in snow and ice and compares this method to the Sunset Labs EC/OC

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method, the title of the paper should be changed to clarify that the measurement methods evaluated are the SP2 and Sunset Labs EC/OC protocol.

One major concern I have is that analysis of known lab standards of BC in water (aquadag) were not conducted using both methods. The Aquadag standards used to evaluate aerosolization efficiency should also be measured with the sunset labs EC/OC instrument following the same protocol as used for samples. A plot showing this comparison would be good too. This would provide a nice baseline comparison between the two methods for ideal standards not subject to artifacts caused by OC and dust. The primary artifacts affecting analysis of the standards are size distribution (already characterized by the authors) and filtration efficiency, which the authors evaluated for the field samples. Analyzing lab standards in the same way would add insight into how much of a role the other artifacts play in over or under-estimating EC or rBC.

Minor comments Page 3551, line 3 The statement that BC is the second most important component of global warming is a bit strong and the uncertainties surrounding BC's role in climate change are pretty high. I would replace “is” with “may be”. The high uncertainty surrounding BC and climate change is one reason studies like this one are important. Page 3552, line 22 Run on sentence beginning with “Appropriate treatment...” Page 3553, line 6 Run on sentence beginning with “These differences appear despite...” Suggested re-write “These differences appear despite good precision of individual laboratory analyses and are mainly attributed to organics that pyrolyze during thermal analysis.” Page 3555 line 11, “incandescence while emitting visible radiation”. The definition of incandescence is to emit light. Did the authors intend to say the incandescence was in the visible spectrum? Is there a specific wavelength or range of the spectrum that should be specified here? Page 3555 line 16, where did the rBC density of 1.8 g cm⁻³ come from. Reference please. Page 3555 line 17, Please provide a published reference for the SP2 toolkit, or indicate if you will be describing this tool kit further in the paper or in SI. Page 3556 line 7, Starting this paragraph with the same phrase as the previous paragraph is confusing. Are both paragraphs referring to the

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same calibration method? If the second calibration is specific to rBC, what was the first calibration for? Was any comparison between SP2 and Sunset Lab EC/OC analysis done using the aquadag standards? It would be interesting to see how comparisons between the two methods using an idealized standard as well as the field samples. Page 3561 line 10 and 11, in discussing why HULIS would have a negligible impact on particle aerosolization, use of consistent units would be helpful; use either mg L⁻¹ or ppbC. Page 3561 line 13 space between be and negligible. Page 3562, line 1 “Since concentrations of EC and OC are low in snow and ice.” Please give references for statement and a range of what the authors consider to be “low”. Why is decarbonation necessary when EC/OC concentrations are low? Although the detailed description is in the SI, a brief statement explaining why this needs to be done would be helpful. When referencing SI, provide section number or page number. Page 3572, line 10- 13, more recent studies have shown that filtration efficiency through quartz fiber filters can be 30% or less (Torres et al., 2013 Aerosol Sci & Tech; Hadley et al., 2008 Env. Sci & Tech) Page 3573, line 25 “The rBC concentrations ranged between ~35 and 70 ug L⁻¹, and remained constant at around 5 %.” This is a confusing sentence that at first seems contradictory. This can be clarified by rewriting this sentence as well as the previous one as “Different samples with rBC concentrations ranging from 35 to 70 ug L⁻¹ were each measured at regular intervals over 15 minute. The reported concentrations remained constant (standard deviation <5%) over each measurement period.”

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