

Anonymous Referee#2

General comments:

After the first revision the paper has been significantly improved in terms of clearness and a more honest interpretation of the still debatable results was given. Particularly, despite the evident limitation in the depth-age model for the DV99.1 core, now it seems more reasonable. The decadal interpretation of the results seems the right choice because of the lack of annual resolution and the uncertainties in the depth-age model.

However, there are still some points that require more precise explanations and, particularly the SP2 calibration procedure and data analyses description, still need some efforts and clarifications.

In the following some comments:

- Figure 2: Please add the Katmai EC marker in the DV99.1 age plot (even if uncertain). The long term
 - It was not possible to analyze ionic species: Why? During the melting no discrete samples were taken? The instruments were not available?
 - The only EC measurement available is the one done with the hand held device? Was the core in good conditions below the 38 m? How accurate are those measurement?
 - Figure S10: there is a cross in the period 1840-1850, is it an outlier? If yes how was it defined?
 - Figure S13: rBC and elemental carbon concentrations needs correction factors in order to be directly compared. In the caption and in the y-axis you wrote «rBC or Elemental carbon», please report specifically for which Greenland ice core was measured rBC and/or elemental carbon (if some of them were analyzed not with an SP2 you shouldn't call the resulting concentration with «rBC»). Therefore, the same correction has to be done in Figure 5 of the main text.
 - Line 46/47: please consider adding the utilization of the CEATC nebulizer as a possible source of losses on real BC particles during the analyses.
 - Line 81: add the word «concentration» after «rBC»
 - Line 100: please add that the crumble firn part was not preserved at the time of the drilling.
 - Line 124: what does it mean was «essentially» the same? Did all of them use an SP2? Did they use different nebulizers?
 - Line 186/187 and Figure S7: it is known that melting and refreezing cycles tend to reduce the Delta18O oscillations in snow/ice; so how can you confidently speculate that 40-45% of snow was annually removed considering that both wind and melting affects the DV99.1 site?
 - Change the scale of the Figure S6b in order to make the D18O oscillations more evident (the same in Figure S7).
- In order to understand if the CETAC system contributed in hiding the increase of the rBC concentration in the last century due to the increase of the particles dimensions caused by coagulation during melting and refreezing cycles, it would be very important (and the results shown in this paper absolutely need this) to compare the mass size distribution of BC particles in

the real sample in a period with very low melting features and in one with very high volumetric percentage of icy melt features.

- Line 268: In the decade 1780-1990? Please correct these dates.
- Line 289: I would rather use more general terms saying «wet deposition of BC containing particles» (not only the hydrophilic part of them).
- Line 470: underestimation of 20-40% without considering the 25% of efficiency of the CETAC system?

SP2 Calibration

- How did you analyze the data? Did you write your own code for analyzing the SP2 raw data? Or did you use any prepared toolkit?
- You used the «Ebony MIS, EB6-4 K» material for SP2 calibration, what is that? Is there any reference paper about it? How the particles mass was measured? Cite the work that has characterized it, e.g. for its «effective density» (as Gysel Martin did for Aquadag and Fullerene, the most used calibration materials, in «Effective density of Aquadag and fullerene soot black carbon reference materials used for SP2 calibration»). Moreover, using the CETAC system with its typical cutoff in the nebulization efficiency it is important that the peak of the mass size distribution of the calibration material is in the window of the highest nebulization efficiency, otherwise you cannot trust the absolute concentration values.
- Please be more precise in explaining the calibration procedure of the SP2. What is the «Response»? Did you get the SP2 internally calibrated from DMT and well aligned before using it?
- Did you perform the SP2 alignment and the laser's beam shape check prior to the analyses? Was the laser beam into the TEM₀₀ mode as reported by the instrument manual?
- You said that «the CETAC efficiency was typically 25%». What does it mean? The nebulization efficiency? Does it mean that only the 25% of the sample was nebulized and carried in the SP2? Therefore the measured rBC concentration could be 25% of the actual value?
- Could you provide the number concentration to mass concentration ratio (from the SP2) for the standards and for a part of the real sample? This is very important if you are not referring to a paper describing in details the new calibration material that you used (in terms of size distribution measured for instance with an SMPS).
- Why do you call the calibration «External»?
- Do you sonicate the standard solutions before each calibration? Do you keep a standard solution with a very high concentration and then dilute it every day for making the low concentration ones? And how do you know that the CETAC system was not the responsible for the decrease in the calibration slope? Were the most recent sections of the core analyzed before or after the decrease in sensitivity?

Typing errors:

- Please refer to «rBC» only when reporting the mass concentration measurements done with the SP2 (e.g. remove the «r» before «rBC particles» in line 300, before showing the TEM image in the supplementary material, in the caption of the Figure S2...). Be more specific in the caption of

the Figure S2: explain what the aggregates shown are, maybe graphite or soot. Insert a space before (ppb) in the caption of this figure.

- Write the dates in a coherent way in the figures «S3».
- Please add the «melting speed» in the supplementary material.
- Page 7, line 199: remove the comma.
- Line 142 spelling error: «potential»