Response to Reviewer 3 Comments (RC3):

This paper proposes a new chronostratigraphic approach that uses the oceanic ^{13}C Suess effect and spheroidal carbonaceous particles (SCP) to improve the age models of marine sediment archives that cover the last few hundred to thousand years and could then serve to extend instrumental records back in time.

Extending instrumental records back in time is an important goal since it is the only way to improve our understanding of decadal to multidecadal climate variability and how this variability is currently affected by climate change. Marine sediments are one key climate archive in this respect but uncertainties associated with traditional dating techniques of marine sediment cores (e.g. ^{10}Pb, ^{14}C) are too large (up to ±30-50 y) to actually build continuous times series from sediment and instrumental records.

The paper is clearly written and its topic deserves publication. However, a number of points should be improved, as detailed below, before it can be accepted for publication.

We appreciate the reviewer's thoughtful feedback and suggestions. We address the specific comments below.

Main comments

- My first major comment is that there is a relatively large uncertainty with respect to the date of the starting point of the decline in atmospheric $d^{13}C$ and with respect to the new core top age. But these uncertainties are both critical in the definition of the final revised age model. It is thus necessary to explore the impact of the uncertainty of these boundaries age on the final age model. This could be done by Monte Carlo or any other technique.

  Regarding the starting point of the decline in atmospheric d13C set at 1800, an error bar of ± 40 y seems reasonable given that the industrial revolution is dated between 1760 and 1840, depending on the authors. Note that this uncertainty does actually lead to an uncertainty in the definition of the core top age, which in turn is key in the definition of the new age model using the Bacon age-depth modeling software.

We thank the reviewer for this suggestion. We will explore the possibility of including a Monte Carlo (or similar) technique in the revised MS.

  In addition, l. 408, the authors discuss the possible impact of the changes in the subpolar gyre circulation over the 20thcentury and productivity decline in this region on the *G. bulloides* $d^{13}C$. They write "we suspect the uncertainty based on natural climate variability to be minor in our core top age estimate". In my opinion, in a scientific article, it is required to go one step further than "suspecting". One way to go would be to carry out a sensitivity study to various school cases.

This is correct, the magnitude of natural variability will affect our core top age estimate. We will highlight more strongly the potential sensitivity of this approach to high natural variability in the revised MS and explore the possibility of including a sensitivity study on various cases.

- My second major comment concerns the estimate of the "known ages" for depths 2.5 cm, 4 cm and 5.5 cm by reading the corresponding ages from the $d^{13}C_{SE\_50}$ curve (Fig. 4): doing so the authors assume that the sedimentation rate is constant between 0 and 7.5 cm, which leads to a constant sedimentation rate over the top 7.5 cm of the core by construction (as can be seen on Fig. 5b). This is a strong assumption which affects the final age model. It should be clearly described and its validity should be discussed.

The reviewer is correct. Our approach is based on, and assumes, constant sedimentation rates (and no bioturbation). We will include a more detailed discussion of this in the revised MS.

- A third important comment concerns the SCP profile : its resolution is too low to allow a verification of the age model obtained using the oceanic ^{13}C Suess effect. The published SCP profiles of Rose (2015) seem to indicate that the SCP concentration peaks between 1970 and 1990 in regions adjacent to the core site, which does not match the SCP profile in the studied core plotted vs the revised age model in Fig. 6. This should be discussed. Also, an additional figure in the supplementary material showing the studied core SCP profile superimposed on published SCP profiles of Rose (2015) would be useful.

We appreciate this suggestion. We will include an additional supplementary figure and include a comparison of our Gardar Drift Core SCP Concentrations vs the published SCP profiles of Rose (2015). As also suggested by Reviewer 1, we will de-emphasize the SCP profile.

- 8 is practically not discussed. What does the revised age model suggest in terms of the relative phasing between the Iceland-Scotland overflow vigor and the Atlantic Multidecadal Variability?

Since the focus of this MS was more on the methodological aspect, we avoided including a detailed discussion on the relative phasing between ISOW – AMV, and instead aimed to highlight the need for refining uncertainties of, and improving, marine based age models for significant comparisons. However, we can include more discussion on this in the revised MS, taking our preliminary results (and uncertainties) at face value.

- Concerning the assessment of the ΔR to be applied to the radiocarbon dates: why do not the authors extract it from the GLODAP data set? This should provide a nice alternative to the CALIB marine reservoir database. It would be interesting to compare the ΔR currently computed by the authors with the ΔR based on the GLODAP data set. This would provide another estimate of the uncertainty associated with ΔR.

We thank the reviewer for pointing this out. In the revised MS, we will include a comparison with reservoir ages extracted from GLODAP.

- The conditions of validity of the assumption of Transient Steady State should be discussed. For instance, this assumption does not hold in case of changes in ocean circulation.

We agree. This will be qualified in the revised MS.

- Line 349-350: the average sedimentation rate over 0-44 cm is not really meaningful since it is larger below 30 cm than over the 7.5-30 cm depth interval, and larger below 7.5 cm than above 7.5 cm (Fig. 5).

The reviewer is correct. Sedimentation rates for different depth intervals (e.g., 0-7.5cm and 7.5-30 cm) will also be included in the revised MS.

More minor comments:

- 4 and 5 must contain a typo because they don't yield an uncertainty of ± 38 y for the weighted mean of ΔR, contrarily to what is indicated in Table 2.

This will be clarified in the revised MS. Equations 4 and 5 are correct. However, as stated in Line 305, the reported uncertainty of ΔR is determined as the highest value of either the standard deviation of ΔR (Eq. 5) or the weighted uncertainty in mean of ΔR (Eq. 3). In this case, the uncertainty of ± 38 yr (highest of the two values) is based on Eq. 3.

- 88: "that uses" should be replaced by "that use"
- To ease the reading, l. 181 should read "In the North Atlantic, *inflata* calcifies between 200 and 400 m south of 57°N, and between 100 and 200 m north of 57°N".
- 185-189: an additional figure of the d^{13}C stack together with the average ^{13}C Suess effect change over 0-200 m would be useful in the supplementary material.
- 195: "even" seems unnecessary.
- 200: replace "found" by "computed" or "determined"
- 210: suppress "We show that,"
- 281: replace "would be" by "is"
- 301: replace "5 cm" by "5.5 cm"
- 378: replace "confirm" by "confirms"
- 7: the legend is too small
- 397-402: this is a repetition of what is written earlier in the article. Repetitions should be avoided.
- 412: replace "demonstrate" by "illustrate"
- 439: check the syntax.

We appreciate the reviewer for pointing out these. These will be corrected in the revised MS.