The manuscript has been substantially revised by the authors, and I thank and acknowledge their work. Overall, the responses to the reviews are thorough and have led to a significant improvement in the manuscript. I'd like to follow up and clarify a few of the responses before the manuscript is published.

We thank the reviewer for her positive feedback on our manuscript. We would like to point out that during our last revision, we made some slights edits:

L79: we added "in Holocene samples"

L193: after a new literature research, we rephrased the sentence associated with the dust sources reaching Greenland during the YD. According to Han et al., 2018, the Saharan dust contribution did not contribute in a limited way, as previously written. The new sentence is: During the YD, dust deposited in continental Greenland was sourced from the Asian (Gobi and Taklamakan) and the Saharan desert, with the latter contributing with an average of 49% (12–73%) (Han et al., 2018).

L437: median background values for LFe during the Holocene was 0.51 ug L-1, while in the previous version 0.60 was reported.

Please find below our answers to the comments.

1) Fractional iron solubility

Thank you for clarifying the operational definitions of soluble iron. Given the clarification that LFe represents labile iron and FeICP represents total iron not structurally bound, it's possible to estimate fractional iron solubility (LFe/FeICP x100) and see how those values change across the transition along with the change in alkalinity. This is a relatively simple addition to the manuscript and will support the data interpretation.

We added an extra column in Table 1 showing median acidity values across all the analyzed bags. Please note that in this table, volcanic eruptions are included (see caption).

2) Drivers of iron solubility

The original suggestion was to consider processes/sources other than just dust alkalinity which could account for the change in iron solubility. I used cloud processing as an example of one of the many factors that control aerosol iron solubility, and which can explain the hyperbolic relationship observed between fractional iron solubility and total iron at that particular ice core site. The authors have included a section on cloud

processing. It seems a little out of place here without providing evidence to suggest that cloud processing plays a role. Apologies if this caused confusion. I wasn't necessarily expecting the authors to use this as an explanation for their data but to discuss the iron solubility (and fractional iron solubility) results in terms of other processes/sources. For example, dust in the core was measured on an Abakus particle sizer and thus the authors have particle size data which is another factor that controls iron solubility. Perhaps it would be more appropriate to add a short paragraph mentioning the other factors (such as changes in particle size, minerology, cloud processing, biomass burning, acidity etc) and then focus on acidity where there is good evidence. Here, it would be helpful to focus on making a stronger link between the changes in ice core acidity, dust alkalinity and dust source. Is the ice core acidity driven by changes in mineral dust alkalinity and dust source? What about changing dust sources over the last deglaciation transition? Apologies if I missed it, but I couldn't see where that comment had been addressed.

We agree with the reviewer that the previous discussion of cloud processing was not sufficiently clear. We have therefore removed that section and reformulated the paragraph. We now briefly introduce the main factors that can influence aerosol Fe solubility, before focusing on acidity changes. We added this paragraph at L315-327:

There can be different players influencing Fe solubility in atmospheric aerosol that can explain this geographical pattern. For example, changes in mineralogy associated with changes in dust sources, differences in particle size and differences in aerosol acidity. Regarding mineralogy and dust sources, Greenland is influenced by Asian and Saharan dust sources. During the YD, a higher fraction of Saharan source reached Greenland (average=49%) compared to the BA (average=18%) potentially changing the mineralogy and therefore iron solubility (Han et al., 2018). However, to prove this hypothesis, specific mineralogy analysis needs to be performed. Atmospheric aerosol size influences iron solubility, with smaller particles having a higher soluble iron fraction (Baker and Jickells, 2006). Based on evidence from other ice cores, particles size distribution decreases between the YD and the Early Holocene in Greenland (Ruth et al., 2003), and it increases in Antarctica (Delmonte et al., 2002). Therefore, particle size might have had a contribution to explaining why the fraction of soluble iron is higher during the Holocene in Greenland and during the Glacial in Antarctica. Another process that may have contributed significantly is the difference in atmospheric aerosol acidity between Greenland and Antarctica

3) Other sources of iron

Thanks for including mineral dust and volcanic iron sources in the introduction. It could be worth mentioning biomass burning which has recently emerged as having a relatively high iron solubility.

We added a sentence at L45-46

4) Volcanic iron

The key point is to highlight that volcanic ash is more soluble than mineral dust and undergoes different atmospheric processes that enhance its solubility. Alex Mattin has written a review on this topic titled "Volcanic ash impacts on marine primary productivity: A review" that is currently in press. I have provided the proofs of the article along with this review and hope it will help strengthen the explanation of the mechanisms that enhance iron solubility across the volcanic horizons. The handling editor has said it is possible to cite a paper accepted and in press.

We thank the reviewer for this suggestion. We included a paragraph related to atmospheric processing at L412-417:

Atmospheric processing can enhance Fe solubility as acidic plume gases such as sulfuric and hydrofluoric acid can react with ash surfaces, dissolve Fe-bearing phases and promote the formation of soluble surface iron salts. Therefore, the amount of soluble volcanic Fe depends not only on its total abundance, but also on plume gas composition, atmospheric processing history and the mineralogical host phase of Fe, with surface salts and silicate-hosted Fe being generally more readily leachable than refractory oxide phases (Mattin et al., 2026).

Specific comments

L65 "require HF-based microwave-assisted digestion for complete dissolution (Gaspari et al., 2006)." There are a few methods to measure total iron content. Suggest keeping the method more general e.g. "strong acid digestion" rather than limiting to just "HF-based microwave-assisted."

Done

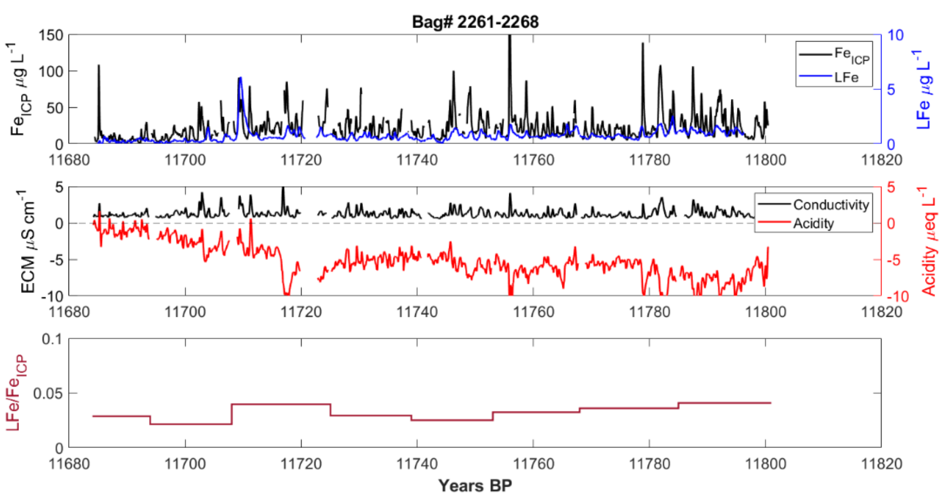
Figures of merit. Section 2.2.1 reported the LoD. I couldn't find any reference to blank concentrations, accuracy or reproducibility values for the samples analysed in this study. Please include.

We added at L144-146: *Accuracy, evaluated using a 0.5 ng g-1 standard solution, was 96%. Reproducibility, evaluated by performing five replicate measurements of a 0.5 ng g-1 standard solution was 8% RSD.*

For each calibration, the Milli-Q signal was used to define the zero-absorbance baseline. Calibration standards and samples were then quantified relative to this baseline. Consequently, the blank does not correspond to a separately measured concentration value, but to the zero point of the calibration curve, which was subsequently used to monitor instrumental drift.

Figure 3 ECM and acidity y-axis is small compared to Fe. Apologies, there was a typo in the original comment which should say Figure 3 not Figure 2.

We modified the scale to show better changes in acidity, which before it was not so clear due to the [-10:10] chosen scale. We hope to have properly understood the reviewer's comment.



Key point "Limited increase in dissolved iron during the Younger Dryas (+29%) compared to the Early Holocene". Suggest changing "dissolved iron" to "labile iron concentration".

Done. We also changed the first key point substituting dissolved iron with labile iron.

Mattin, A., Winton, H., Barker, S., and Hoffmann, L.: Volcanic ash impacts on marine primary productivity: a review, Bulletin of the Volcanological Society of Japan, 71, 2026.